QT OPTOELECTRONICS

1995-96

OPTOELECTRONIC PRODUCT DATA BOOK

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1995/96

QT

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Optoelectronic Product Data Book 1995/96

610 North Mary Avenue
Sunnyvale, California 94086

QT
OPTOELECTRONICS

ALL SPECIFICATIONS SUBJECT TO CHANGE

Printed in USA

About QT Optoelectronics

Experience

For the last twenty five years—first as Monsanto, then General Instrument and then Quality Technologies Corporation—we have been a leading manufacturer of optoelectronic products. As a result of this experience and our leadership in developing III-V materials technology, we have contributed many firsts to the field of optoelectronics—in LED Lamps, Displays, Optocouplers and Infrared Components.

New Company Name

We have changed our name from Quality Technologies Corporation (QTC) to QT Optoelectronics. This new name reflects the fact that optoelectronics is our only business. When it comes to companies dedicated exclusively to optoelectronics, no one in the World has a bigger, broader line.

Reliable Products

At our manufacturing plant extensive reliability testing (see pg. 5) and advanced manufacturing techniques ensure the highest standards of production. We are committed to the concept of providing state-of-the-art dependable products at competitive prices.

Broad Product Range

We offer high performance optoelectronic devices in five major categories; optocouplers, I/R components, displays, lamps, and light bars and bargraph arrays. This data book contains detailed specifications on our complete line of optoelectronic products.

Product Availability

A worldwide network of stocking distributors assures immediate availability of most standard products. QT Optoelectronics authorized distributors are located worldwide. In addition, QT Optoelectronics Direct Sales Offices in the United States and International Sales Offices serving major world markets, provide a complete range of all QT Optoelectronics products. See "HOW TO ORDER" in the following section.

Efficient Service

If you have a question or a problem, just pick up the phone and call the nearest QT Optoelectronics Technical Representative. These highly qualified sales engineers can offer assistance in design and product selection. The lists on section 7 will enable you to locate one in your area.

In addition, our staff of factory product engineers can provide information, discuss specific problems and offer applications assistance. The answer to your question is only a phone call away.

You can depend on QT Optoelectronics.

About This Data Book

This data book describes in detail our complete line of optoelectronic products. For your convenience, the catalog is divided into five major product groups—optocouplers, I/R components, displays, lamps, and light bars and bargraph arrays.

A selection guide will be found at the beginning of each product section. This provides brief basic information on the product line to assist you in selecting the device best suited to your requirements.

Full specification sheets are located within each section.

For fast reference, an alphanumeric listing appears on page 19 which lists all products individually with the appropriate data sheet page number. An alphanumeric listing also appears at the beginning of each product section.

Application notes provide useful technical information to assist you in selecting and testing optoelectronic devices.

DATA SHEET CLASSIFICATIONS

CLASSIFICATION	PRODUCT STAGE	DISCLAIMERS
Preview DATA SHEET	Formative or Design	This document contains the design specifications for product under development. Specifications may be changed in any manner without notice.
Advance Information DATA SHEET	Sampling or Pre-Production	This is advance information, and specifications are subject to change without notice.
Preliminary DATA SHEET	First Production	Supplementary data may be published at a later date.

How to Order

All QT Optoelectronics products may be ordered through any of the International Sales Offices and Direct Sales Offices listed on the back cover. For immediate delivery of QT Optoelectronics products, contact any of the stocking distributors located in your area. See section 7.

Warranties

Seller warrants all items against defects in material and workmanship under normal use and service for a period of one (1) year from the date of shipment; provided, however, that Seller's liability under said warranty shall be limited, at Seller's option, to crediting Buyer's account or replacing or repairing items or parts thereof which Seller's inspection shall have disclosed to its satisfaction to have been defective in the form in which it was shipped by Seller, prior to its use in further manufacture or assembly. This warranty shall not apply to items or parts thereof that have been (a) subjected to misuse, neglect, accident, damage in transit, abuse or unusual hazard; (b) repaired, altered or modified by anyone other than Seller; or (c) used in violation of instructions furnished by Seller. All requests for return of items must receive the written authorization of Seller.

Seller's warranties extend to the Buyer and to no other person or entity.

Seller's warranties as hereinabove set forth shall not be enlarged, diminished or affected by, and no obligation or liability shall arise or grow out of, Seller's rendering of technical advice or service in connection with Buyer's order of the goods furnished hereunder.

THE FOREGOING ARE IN LIEU OF ALL WARRANTIES, EXPRESS, IMPLIED, OR STATUTORY, INCLUDING, BUT NOT LIMITED TO, ANY IMPLIED WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE AND ANY OTHER WARRANTY OBLIGATION ON THE PART OF THE SELLER.

QT Optoelectronics Reliability

At QT Optoelectronics, product dependability is assured through an active program which includes:

New Product Qualification

All new products evolve through an orderly design-to-manufacture flow. At each stage reliability engineering is present to ensure that the defined reliability requirements are met.

The reliability plan is implemented in the development stage where actual testing begins. Stress tests are performed to show potential problem areas and the reliability of the new product is compared directly with that of a previously qualified product of a similar generic type.

During limited production, where components must meet defined reliability goals, samples from a minimum of three lots are taken for extensive testing. These samples must meet or exceed defined goals in order for the product to be considered qualified and transferred to the reliability monitoring program.

Quality Control

Quality control is a vital function at QT Optoelectronics. To minimize variations in the product and to maintain quality and hence reliability, the following in-process control activities are routinely performed:

- Incoming inspection of all piece parts and raw materials.
- Die-attach process control gate.
- Wire-bond control gate.
- Encapsulation control gate.
- 100% final testing.
- Equipment monitors.
- Final Q.A. gate of all lots.
- Finished goods stores monitor.
- Frequent process line audits for conformance to specification.

Monitor Program

To ensure that qualified products continue to meet reliability targets, a monitor program tests generic device families on a periodic basis and provides information for the reliability data bank.

Reliability monitoring consists of the following tests.*

- High Temperature Operating Life
  T_A=70°C or Higher Temperature
  Time=1000 hours minimum
  I_F=max. rated
- High Temperature Storage
  T_A=150°C or specified
  Time=1000 hours
- Low Temperature Storage
  T_A=−55°C or specified
  Time=1000 hours
- 85/85 No Bias
  T_A=85°C
  RH=85%
  Time=1000 hours
- HTRB
  T_A=100°C or specified
  Voltage=80% max. rated
  Time=1000 hours
- Thermal Shock per MIL-STD-883C, Method 1011
  T_A=0°C to 100°C (Air to Air)
  No. of cycles=30
- Temperature Cycle per MIL-STD-883C, Method 1010
  T_A=per device based on storage temperature (Air to Air)
  No. of cycles=50
- Pressure Pot pressure=15 PSI
  Time=96 hours
  T_A=121°C±1°C
- 85/85 and Pressure Pot tests are not required per MIL-STD-883C for Hermetic Products.
- Solder Heat Tests (visible products only) per MIL-STD-883C Method 2003.3
  T_A=260°C±5°C
  Duration 10 sec.

Reliability Test Facilities

The Kuala Lumpur (Malaysia) test facility is equipped with:

- Automated Testing.
- Life test equipment—High and Low Temperature.
- Temperature/humidity chambers.
- High Temperature ovens.
- T/S and T/C equipment.

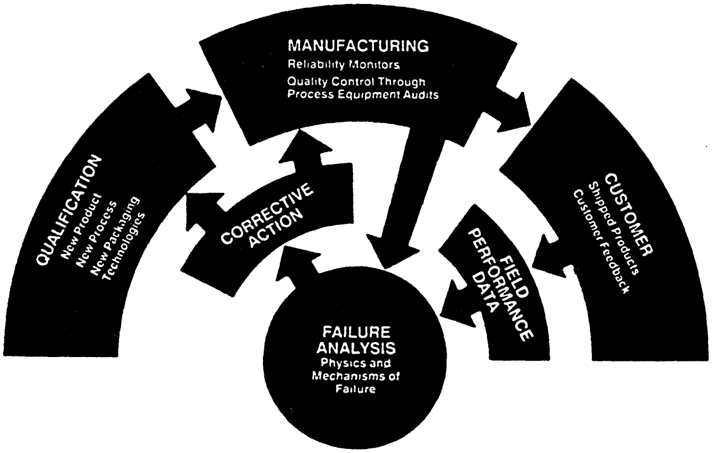
In addition, the failure analysis lab facilities have the following capabilities:

- Electrical testing and verification.
- Pin-to-pin measurements.
- Package dissection and cross-sectioning.
- Chemical etching.
- Optical photomicroscopy.
- Micromanipulators.
- Access to scanning electron microscope with X-ray spectrometry.
- Access to Augur analysis.

Failure Analysis and Qualitative Reliability

When a reliability failure does occur, a detailed analysis is performed to provide data for corrective action, as well as guidelines for the design of future new products.

This on-going activity and the resulting feedback and action are illustrated in the accompanying diagram.



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*Not all tests apply to all products.

OPTOPLANAR™
QT OPTOELECTRONICS' PROCESS TECHNOLOGY

QT OPTOELECTRONICS has developed a new high voltage optocoupler packaging technology which the company has termed OPTOPLANAR™. The name derives from the coplanarity which is a primary feature of the new technology, i.e., placing the emitter, detector and, in some cases, the driver, on the same plane. This does away with leadframe folding or flipping, operations which are both difficult to control and a potential source of problems.

Benefits of the OPTOPLANAR™ process include:

- Increased coupling efficiency
- Higher tolerance to changes in die position
- Less dependence on size of sensitive area on detector
- Reduction in assembly-related CTR variations
- Enhanced reliability
- Improved performance consistency

The improvements in features and performance represented by the new technology are so marked that QT OPTOELECTRONICS plans to implement the OPTOPLANAR™ process across its entire optocoupler product line.

FORMER PHILIPS OPTOCOUPLER PRODUCTS

In addition to the optocouplers listed in sections 1 and 2, QT Optoelectronics also supplies the optocouplers formerly manufactured by Philips Semiconductor. The following part numbers are available. All devices are available with UL and VDE approval. Please contact your nearest QT Optoelectronics sales representative for more details.

4N29
4N30
4N31
4N38
CNG35
CNG36
CNG40
CNG82
CNG83
CNW11AV-1
CNW11AV-2
CNW11AV-3
CNW82
CNW83
CNW84
CNW85
CNW135
CNW136
CNW137
CNW138
CNW139
CNW2601
CNW2611
CNW4502
CNX35U
CNX36U
CNX38U
CNX39U
CNX48U
CNX62A
CNX71A
CNX72A
CNX82A
CNX83A
CNY17F-4
CNY17G-1
CNY17G-2
CNY17G-3
CNY17G-4
CNY17GF-1
CNY17GF-2
CNY17GF-3
CNY17GF-4
H11B255
H11D4
H11G3
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OPTOCOUPLERS

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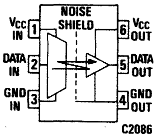
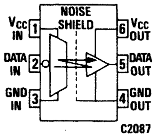
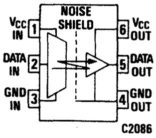
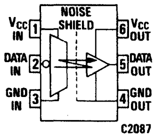
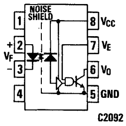
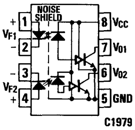
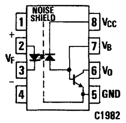
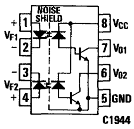
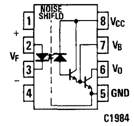
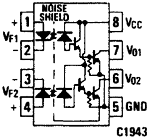
OPTOCOUPLERS HIGH SPEED

FAN-IN/FAN-OUT AND CTR AT 0-70°C; ALL WITHSTAND TEST VOLTAGES ARE 2500 VAC RMS 1 MIN.

EQUIVALENT CIRCUIT	PART NUMBER	INPUT	OUTPUT	V_{CCI}/V_{CCO} OR BV_{CEO}	FAN-IN/FAN-OUT OR CTR MIN. @ I_F=mA	DATA RATE (NRZ) TYP.	CMR TYP.	PAGE	COMMENT
	74**OL**6000	Logic 1 LSTTL Load	Logic 10 TTL Loads Totem Pole	5 V/5 V	0.4 mA/16 mA	15 Mbit/s	15 kV/µs	1-57	Buffer
	74**OL**6001	Logic 1 LSTTL Load	Logic 10 TTL Loads Totem Pole	5 V/5 V	0.4 mA/16 mA	15 Mbit/s	15 kV/µs	1-57	Inverter
	74**OL**6010	Logic 1 LSTTL Load	Logic 10 TTL Loads Open Coll.	5 V/5-15 V	0.4 mA/16 mA	8 Mbit/s	15 kV/µs	1-57	Buffer
	74**OL**6011	Logic 1 LSTTL Load	Logic 10 TTL Loads Open Coll.	5 V/5-15 V	0.4 mA/16 mA	8 Mbit/s	15 kV/µs	1-57	Inverter
	6N137 HCPL-2601 HCPL-2611	LED	Logic 8 TTL Loads Open Coll.	–/5V	5 mA/13 mA Recommended I_F=6.3 mA	10 Mbit/s	10 kV/µs	1-45 1-45 1-45	
	HCPL-2630 HCPL-2631	Dual LED	Dual Logic 8 TTL Loads Open Coll.	–/5V	5 mA/13 mA Recommended I_F=6.3 mA	10 Mbit/s	10 kV/µs	1-101 1-101	
	HCPL-4502	LED	Transistor	to 30 V	14% @ 8 mA 17% @ 16 mA	1 Mbit/s	10 kV/µs	1-39	Guaranteed Switch Times **0-70°C**
	6N136[1]	LED	Transistor	to 15 V	15% @ 16 mA	1 Mbit/s	10 kV/µs	1-39	Recommended I_F is 20% Above Rated I_F
	HCPL-2503	LED	Transistor	to 30 V	9% @ 16 mA	1 Mbit/s	10 kV/µs	1-39	
	6N135	LED	Transistor	to 15 V	5% @ 16 mA	1 Mbit/s	10 kV/µs	1-39	
	HCPL-2531	Dual LED	Dual Transistor	to 30 V	15% @ 16 mA	1 Mbit/s	10 kV/µs	1-95	Recommended I_F is 20% Above Rated I_F
	HCPL-2530	Dual LED	Dual Transistor	to 30 V	5% @ 16 mA	1 Mbit/s	10 kV/µs	1-95	

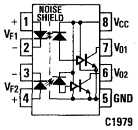
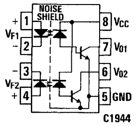
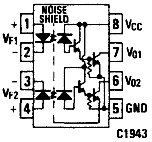
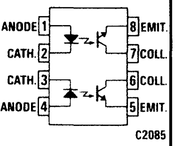
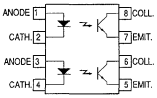
OPTOCOUPLERS HIGH SPEED

FAN-IN/FAN-OUT AND CTR AT 0-70°C; ALL WITHSTAND TEST VOLTAGES ARE 2500 VAC RMS 1 MIN. (Cont'd)

EQUIVALENT CIRCUIT	PART NUMBER	INPUT	OUTPUT	V_{CCI}/V_{CCO} OR BV_{CEO}	FAN-IN/FAN-OUT OR CTR MIN. @ I_F=mA	DATA RATE (NRZ) TYP.	CMR TYP.	PAGE	COMMENT
	6N139	LED	Darlington	to 18 V	400% @ 0.5 mA 500% @ 1.6 mA	100 kbit/s	10 kV/µs	1-51	Low $V_{CE(SAT)}$ of 0.4 V Recommended I_F is 20% Above Rated I_F
	6N138	LED	Darlington	to 7 V	300% @ 1.6 mA	100 kbit/s	10 kV/µs	1-51	
	HCPL-2731	LED	Darlington	to 18 V	400% @ 0.5 mA 500% @ 1.6 mA	100 kbit/s	10 kV/µs	1-107	Recommended I_F is 20% Above Rated I_F
	HCPL-2730	LED	Darlington	to 7 V	300% @ 1.6 mA	100 kbit/s	10 kV/µs	1-107	

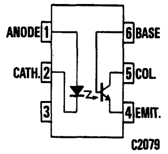
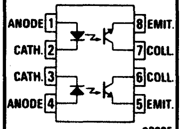
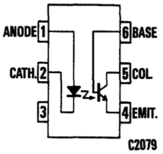
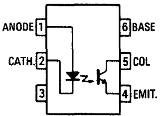
OPTOCOUPLERS DUALS

ALL WITHSTAND TEST VOLTAGE 2500 VAC RMS 1 MIN.

EQUIVALENT CIRCUIT	PART NUMBER	OUTPUT	V_{CC} OR BV_{CEO}	$CTR_{CE(SAT)}$ MIN. @ I_F=mA or F_I/F_O	DATA RATE (NRZ) TYP.	CMR TYP.	PAGE	COMMENT
	HCPL-2630 HCPL-2631	Logic	5 V	5 mA/13 mA	10 Mbit/s	10 kV/µs	1-101 1-101	See Also High-Speed
	HCPL-2530	Transistor	to 30 V	5% @ 16 mA	1 Mbit/s	10 kV/µs	1-95	See Also High-Speed
	HCPL-2531	Transistor	to 30 V	15% @ 16 mA	1 Mbit/s	10 kV/µs	1-95	
	HCPL-2730	Split Darlington	to 7 V	300% @ 1.6 mA	100 kbit/s	10 kV/µs	1-107	
	HCPL-2731	Split Darlington	to 18 V	400% @ 0.5 mA 500% @ 1.6 mA	100 kbit/s	10 kV/µs	1-107	
	MCT62 MCT61 MCT6	Transistor	30 V	12.5% @ 16 mA 12.5% @ 16 mA 12.5% @ 16 mA	15 kbit/s 10 kbit/s 1 kbit/s		1-173 1-173 1-173	$CTR_{CE(MIN)}$=100, 5 mA/5 V $CTR_{CE(MIN)}$=50, 5 mA/5 V Low Cost
	MCT9001	Transistor	30 V	50% @ 5 mA			1-177	

OPTOCOUPLERS TRANSISTOR-OUTPUT LOW SPEED

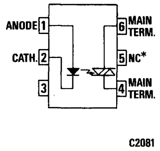
LISTED BY INCREASING I_F AND DECREASING $CTR_{CE(SAT)}$

EQUIVALENT CIRCUIT	PART NUMBER	$CTR_{CE(SAT)}$ MIN. @ I_F =	mA	CTR_{CE} MIN. @ $V_{CE} \geq 5$ V @ I_F =	mA	CTR_{CB} MIN. = mA	BV_{CEO} MIN. VOLT.	CMR TYP.	WITHSTAND TEST VOLTAGE	PAGE
 C2079	MCT5211	75%	1.0	110%	1	0.25%	30	5 KV/μS	7500 VAC PEAK	1-167
	MCT5211	100%	1.6	150%	1.6	0.3 %	30	5 KV/μS	7500 VAC PEAK	1-167
	MCT5210	60%	3.0	70%	3.0	0.2 %	30	5 kV/μs	7500 VAC PEAK	1-167
	MCT210	50%	3.2	150%	10	—	30	—	7500 VAC PEAK	1-135
	MCT5201	120%	5.0	TYP 300%	5.0	0.28%	30	5 kV/μs	7500 VAC PEAK	1-159
 C2085	(MCT6)	See Duals							2500 VAC RMS	
 C2079	MCT5200	75%	10	TYP 200%	10	0.2%	30	5 kV/μs	7500 VAC PEAK	1-159
	MCT2200	25%	10	20%	10	—	30	—	7500 VAC PEAK	1-141
	MCT2201	25%	10	100%	10	—	30	—	7500 VAC PEAK	1-141
	MCT2202	25%	10	63-125%	10	—	30	—	7500 VAC PEAK	1-141
	CNY17-1	25%	10	40-80%	10	—	70	—	7500 VAC PEAK	1-67
	CNY17-2	25%	10	63-125%	10	—	70	—	7500 VAC PEAK	1-67
	CNY17-3	25%	10	100-200%	10	—	70	—	7500 VAC PEAK	1-67
	CNY17-4	25%	10	160-320%	10	—	70	—	7500 VAC PEAK	1-67
	MCT270	20%	10	50%	10	—	30	—	7500 VAC PEAK	1-145
	4N35	20%	10	^{3}40%	10	—	30	—	7500 VAC PEAK	1-33
	4N36	20%	10	^{3}40%	10	—	30	—	7500 VAC PEAK	1-33
	4N37	20%	10	^{3}40%	10	—	30	—	7500 VAC PEAK	1-33
	H11A1	5%	10	50%	10	—	30	—	7500 VAC PEAK	1-79
	H11AA1, 2, 3, 4 See AC-Input								7500 VAC PEAK	1-83
	H11D1^2	5%	10	20%	10	—	300	—	7500 VAC PEAK	1-87
	H11D2^2	5%	10	20%	10	—	300	—	7500 VAC PEAK	1-87
	H11D^2	5%	10	20%	10	—	200	—	7500 VAC PEAK	1-87
	MCT2	12.5%	16	20%	10	—	30	—	7500 VAC PEAK	1-123
	MCT2E	12.5%	16	20%	10	—	30	—	7500 VAC PEAK	1-129
	MCT271	12.5%	16	45-90%	10	—	30	—	7500 VAC PEAK	1-149
	4N25	4%	50	20%	10	—	30	—	7500 VAC PEAK	1-23
	4N26	4%	50	20%	10	—	30	—	7500 VAC PEAK	1-23
	4N27	4%	50	10%	10	—	30	—	7500 VAC PEAK	1-23
	4N28	4%	50	10%	10	—	30	—	7500 VAC PEAK	1-23
 C2079A	CNY17F-1	25%	10	40-80%	10	—	70	—	7500 VAC PEAK	1-73
	CNY17F-2	25%	10	63-125%	10	—	70	—	7500 VAC PEAK	1-73
	CNY17F-3	25%	10	100-200%	10	—	70	—	7500 VAC PEAK	1-73
	MOC8111	25%	10	40%	10	—	70	—	7500 VAC PEAK	1-187
	MOC8112	25%	10	63%	10	—	70	—	7500 VAC PEAK	1-187
	MOC8113	25%	10	100%	10	—	70	—	7500 VAC PEAK	1-187

[1] Guaranteed Switching Times Over 0-70°C [2] High Volt [3] At $T_A = -55$ to $+100°C$

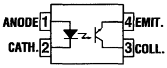
[4] To order VDE device, add .300 suffix to part number [5] VDE qualification pending, Call QT.

OPTOCOUPLERS NON-ZERO-CROSS TRIACS

EQUIVALENT CIRCUIT	PART NUMBER	I_{FT} MAX.	V_{DRM} MIN.	WITHSTAND TEST VOLTAGE	PAGE
	MCP3022	10 mA	400 V	7500 VAC PEAK	1-119
	MCP3021	15 mA	400 V		1-119
	MCP3020	30 mA	400 V		1-119
	MCP3011	10 mA	250 V		1-113
	MCP3010	15 mA	250 V		1-113
	MCP3009	30 mA	250 V		1-113

[1] To Order VDE Device, Add .300 Suffix To Part Number

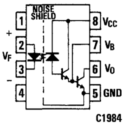
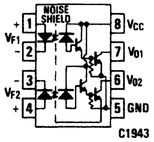
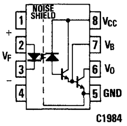
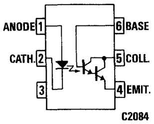
OPTOCOUPLERS TRANSISTOR OUTPUT TO-18 PACKAGE

EQUIVALENT CIRCUIT	PART NUMBER	$CTR_{CE(SAT)}$ MIN. @ I_F =	mA	CTR_{CE} MIN. @ V_{CE} = 10V @ I_F =	mA	BV_{CEO} MIN. VOLT.	WITHSTAND TEST VOLTAGE	PAGE
	MCT4	5%	10	15%	10	30	1000 VDC	1-153
	MCT4	4%	50	—	—	30		1-153
	MCT4R[5]	5%	10	15%	10	30		1-157
	MCT4R[5]	4%	50	—	—	30		1-157

[5] Tested to MIL-STD-883 Class B

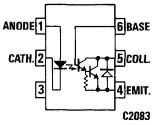
OPTOCOUPLERS DARLINGTON-OUTPUT

LISTED BY INCREASING I_F AND DECREASING $CTR_{CE(SAT)}$ MIN.

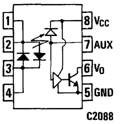
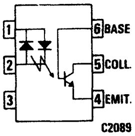
EQUIVALENT CIRCUIT	PART NUMBER	$CTR_{CE(SAT)}$ MIN. @ I_F=	mA	$V_{CE(SAT)}$	CTR_{CE} MIN. @ I_F=	mA	BV_{CEO} MIN. VOLT.	CMR TYP.	WITHSTAND TEST VOLTAGE	PAGE	COMMENTS
	6N139	400%	**0.5**	0.4 V	—	—	18	10 kV/µs	2500 VAC RMS	1-51	Hi-Speed
	HCPL-2731	400%	**0.5**	0.4 V	See: Duals			10 kV/µs	2500 VAC RMS	1-107	Hi-Speed
	6N138	300%	**1.6**	0.4 V			7	10 kV/µs	2500 VAC RMS	1-51	Hi-Speed
	4N33	25%	**8.0**	1.0 V	500%	10	30	—	2500 VAC RMS	1-29	
	4N32	25%	**8.0**	1.0 V	500%	10	30	—	2500 VAC RMS	1-29	

OPTOCOUPLERS DARLINGTON-OUTPUT

LISTED BY INCREASING I_F AND DECREASING $CTR_{CE(SAT)}$ MIN. (Cont'd)

EQUIVALENT CIRCUIT	PART NUMBER	$CTR_{CE(SAT)}$ MIN. @ I_F=	mA	$V_{CE(SAT)}$	CTR_{CE} MIN. @ I_F=	mA	BV_{CEO} MIN. VOLT.	CMR TYP.	WITHSTAND TEST VOLTAGE	PAGE	COMMENTS
	H11G1	1000%	**10**	1.0 V	500%	1.0	100	—	7500 VAC RMS	1-91	H11G1 Hi-Volt
	H11G2	1000%	**10**	1.0 V	500%	1.0	80	—	7500 VAC RMS	1-91	H11G2 Hi-Volt

OPTOCOUPLERS AC-INPUT LINE MONITORS

	MID400	Logic 10 TTL Loads	5 V	4 mA RMS/16 mA **0-70°C**		1-181
	H11AA1 H11AA2 H11AA3 H11AA4	Transistor	30 V	10 mA/0.5 mA	20% 10% 50% 100%	1-83 1-83 1-83 1-83

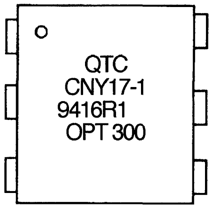
UL APPROVED OPTOCOUPLERS

UL LISTING - YELLOW CARD

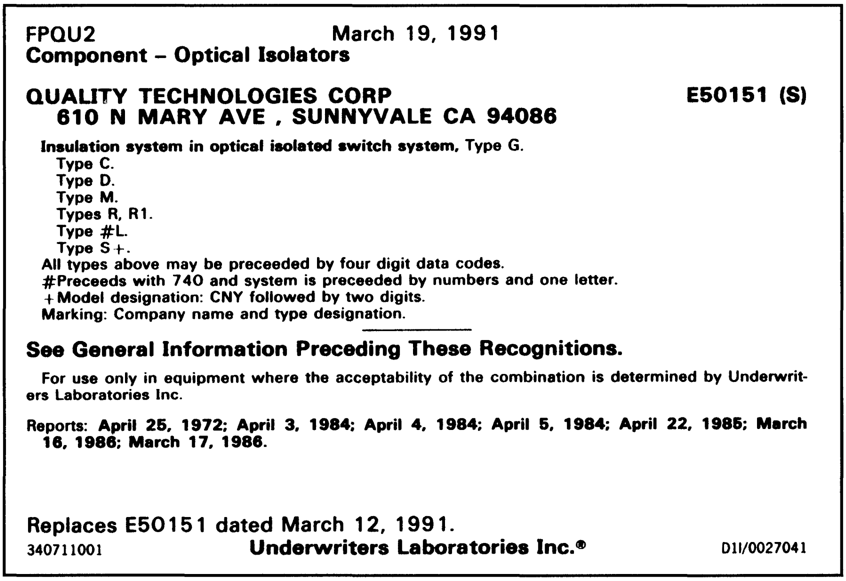
A UL yellow card may either specify the optocoupler manufacturer's own device part number or a package code. Optocouplers are listed as a package code consisting of a single capital letter.

GENERAL

All optocouplers are always UL approved prior to introduction to the marketplace. Devices which are approved by VDE are marked "OPT 300".



UL "YELLOW CARD"



FPQU2 March 19, 1991
Component – Optical Isolators

QUALITY TECHNOLOGIES CORP **E50151 (S)**
610 N MARY AVE , SUNNYVALE CA 94086

Insulation system in optical isolated switch system, Type G.
Type C.
Type D.
Type M.
Types R, R1.
Type #L.
Type S+.
All types above may be preceeded by four digit data codes.
#Preceeds with 740 and system is preceeded by numbers and one letter.
+Model designation: CNY followed by two digits.
Marking: Company name and type designation.

See General Information Preceding These Recognitions.

For use only in equipment where the acceptability of the combination is determined by Underwriters Laboratories Inc.

Reports: **April 25, 1972; April 3, 1984; April 4, 1984; April 5, 1984; April 22, 1985; March 16, 1986; March 17, 1986.**

Replaces E50151 dated March 12, 1991.
340711001 **Underwriters Laboratories Inc.®** D1I/0027041

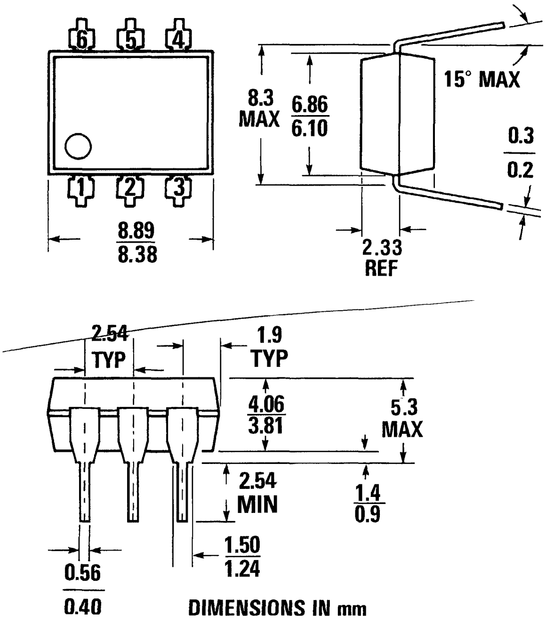
UL CODE CONVERSION TO QT PART NUMBER

*PACKAGE CODE	RATING	QT DEVICE PART NUMBER
D	2.5 kVAC RMS, 1 min.	6NXXX, MID400, HCPL-2XXX, HCPL-4XXX
G	2.5 kVAC RMS, 1 min.	4NXX, H11GX, MCT52XX, MCT2, MCT2X, MCT2XX, MCT6, MCT6X
L	2.5 kVAC RMS, 1 min.	Optologic 74**OL**6000, 74**OL**6001, 74**OL**6010, 74**OL**6011
R_1	5.3 kVAC RMS, 5 sec.	CNY17-X, CNY17F-X, H11AX, H11DX, MCT22XX, MCP3XXX
R_1 (with OPT 300)	5.3 kVAC RMS, 5 sec.	CNY17-X.300, CNY17F-X.300, H11A1.300, H11DX.300, MCT22XX.300, MCP302X.300

*Package codes E,F,K and N are approved under UL file #E90700. Call QTC for more information.

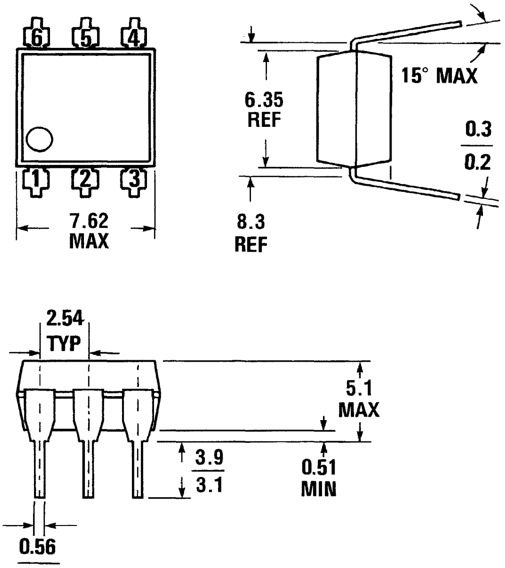
VDE APPROVED HIGH-VOLTAGE OPTOCOUPLERS

PACKAGE DIMENSIONS



DIMENSIONS IN mm
PACKAGE CODE K

ST1603A



DIMENSIONS IN mm
PACKAGE CODE E

ST1603-02

VDE APPROVED OPTOCOUPLERS

Quality Technologies' optocouplers can be supplied with approval to VDE component standard 0884/08.87.

Approved parts are denoted by an "OPT 300" marking on the device, and package code R1. When ordering VDE approved parts, add a ".300" suffix to the part number.

VDE RATINGS*

Ambient operating temperature range	−55°C to +100°C
Storage temperature range	−55°C to +150°C
Climatic test class	55/100/21
Isolation voltage (1 minute)	5300 VAC RMS
Nominal operating voltage for isolation group C acc. to VDE DIN 0110B	500 VAC/600 VDC
Isolation creepage path	8.0 mm minimum
Isolation clearance/air path	8.0 mm minimum
Internal distance through insulation	0.5 mm minimum
Package tracking resistance index	CTI 175

*Per approval certificate 76852

ELECTRICAL MAXIMUM RATINGS AND CHARACTERISTICS

See standard product data sheet specifications.

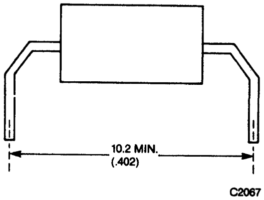
OPTION W

The VDE 0884/08.87 calls for a minimum 8.0 mm creepage distance between any point on the input terminals to any point on the output terminals of an optocoupler.

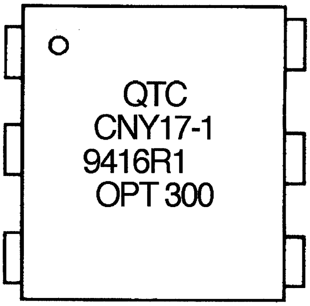
This also applies to the creepage distance over the PCB. The equipment designer may choose to break up that creepage path by stamping a slot in the PCB under the optocoupler or using leadbend Option W.

When ordering a VDE-approved optocoupler with 10 mm leadbend, add the suffix W as in MCT2200.300W. The W will not show on the optocoupler marking, but will be on the shipping tube label.

By making this option available, QTC does not assume any responsibility or liability for meeting 8.0 mm creepage distance in customer applications.



Option W Dimensions



Marking Example

CSA APPROVED COUPLERS

CSA LISTING

The Canadian Standards Association has approved Quality Technologies for Component Acceptance for all optocouplers.

The listing reference number is 82858.

The package codes for all product types is the same as those for the UL listing. (See table page 9)

GENERAL

All Quality Technologies optocouplers are included in the component acceptance listing.

OPTO PLUS

DESCRIPTION

OPTO PLUS 2 reliability conditioning is offered for any Quality Technologies optocoupler with transistor or darlington output. This special conditioning is designed to reduce the infant mortality failures in optocouplers.

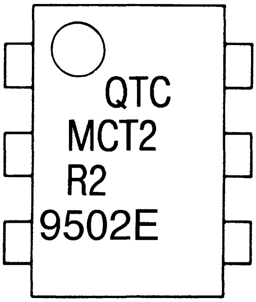
ORDER INFORMATION

To order an optocoupler with OPTO PLUS 2 add R2 to part number, i.e., MCT61R2.

RELIABILITY CONDITIONING

The following flow outlines the 100% pre-conditioning testing.

TEST PERFORMED	CONDITION
Stabilization Bake	MIL-STD-883C Method 1008.1 Condition C. 150°C, 24 hours.
Temperature Cycle	MIL-STD-883C Method 1010.2 Condition B. 5 Cycles −55°C to 125°C, 30 min. at extremes
Burn-in PLUS 2—48 hrs. $\left(\begin{smallmatrix}+8\\-0\end{smallmatrix}\right)$	MIL-STD-883C Method 1015.2 Condition C. T_A=70°C I_F=10 mA V_{CE}=10 V
Hot Track Testing	T_A=100°C Functional Test
Final Test	T_A=25°C Electrical test per specification
Outgoing Q.A.	0.065% AQL

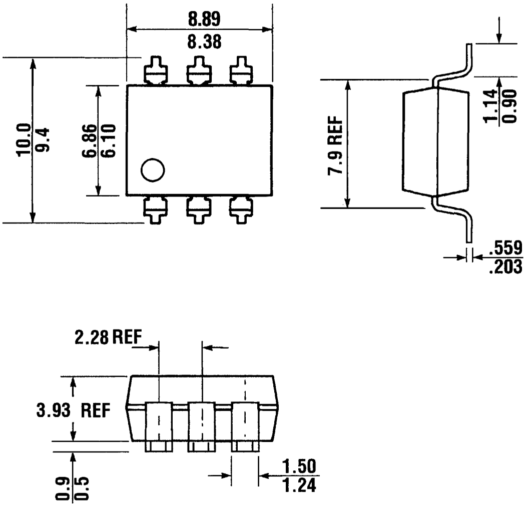


C2093

Example of Opto Plus 2 marking

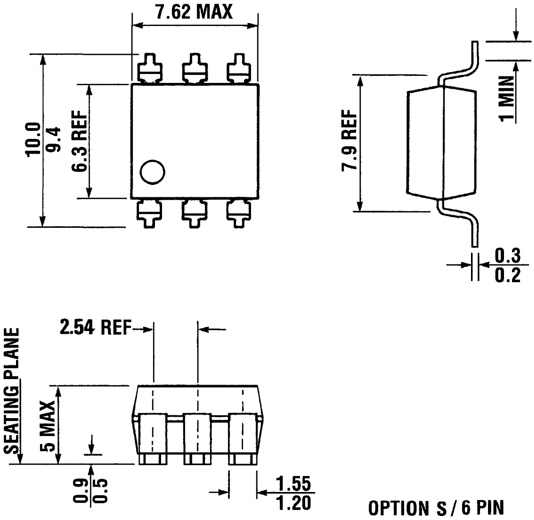
SURFACE MOUNT OPTIONS

PACKAGE DIMENSIONS



OPTION S /6 PIN
PACKAGE CODE K

ST4001



OPTION S / 6 PIN

PACKAGE CODE E

ST4002

FEATURES

OPTION S

- Surface Mount Options available for all Quality Technologies 6 pin dual in-line optocouplers.
- Industry Standard lead co-planarity — within 0.1 mm/.004 inch.
- Compatible with vapor phase reflow soldering — withstands standard 215°C/30 second process.
- Electrical specifications unchanged - see applicable device data sheets.
- Uncompromised isolation performance.
- UL approved - File E90700.

ORDER INFORMATION

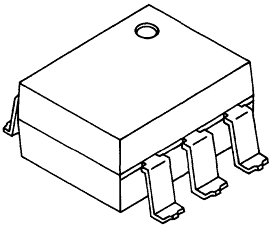
Option S is available for all 6-pin optocouplers in plastic packages.

To order the surface mount option, just add a .S suffix to the part number, for example:

740L6000.S	OPTOLOGIC
H11G2.S	High Voltage Transistor Output
CNY17F-1.S	Single Transistor Output
MCT2.S	Single Transistor Output

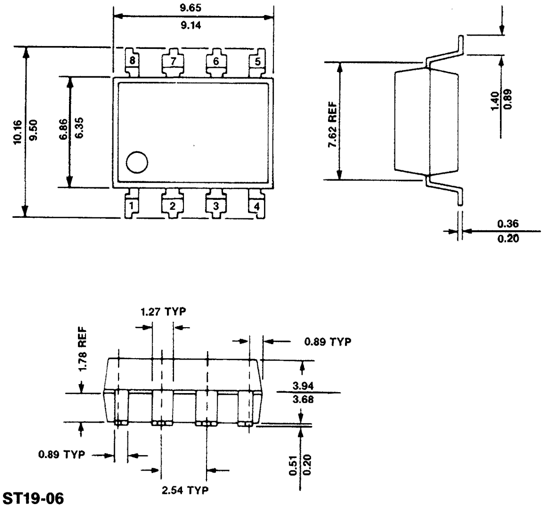
OPTION S

- Formed leads for JEDEC MS-013 surface mount specification compatibility.



SURFACE MOUNT OPTIONS

PACKAGE DIMENSIONS



ST19-06

DIMENSIONS IN mm

Option 200 / 8-Pin
PACKAGE CODE D

ORDERING INFORMATION

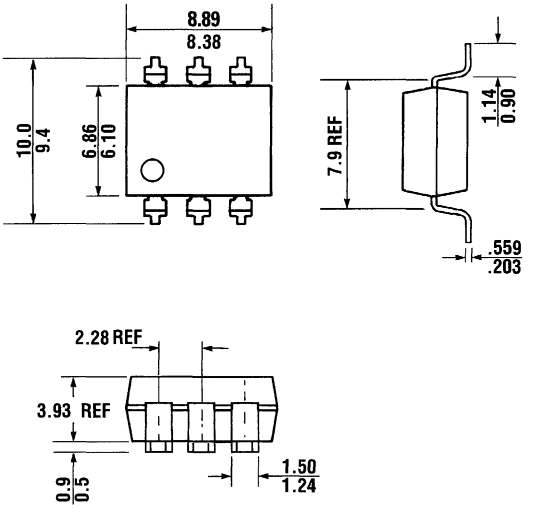
- Option 200 is available for all 8-pin optocouplers in dual in-line packages.
- To order the surface mount option, just add a .200 suffix to the part number, for example:

6N139.200	High-Gain Split-Darlington Output
MCT6.200	Dual transistor output
HCPL-2631.200	Dual logic output
MID400.200	AC Monitor Logic Output

6-PIN SURFACE MOUNT

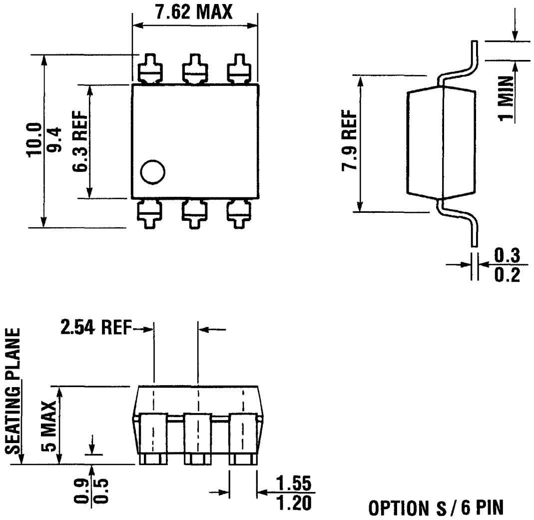
TAPE AND REEL

PACKAGE DIMENSIONS (OPTION S)



OPTION S /6 PIN
PACKAGE CODE K

ST4001



OPTION S / 6 PIN

PACKAGE CODE E

ST4002

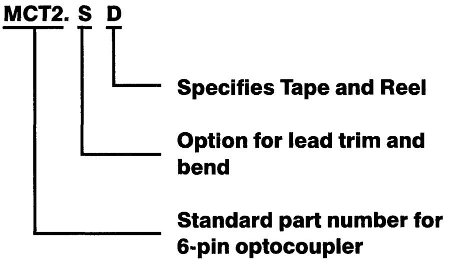
FEATURES

- Taping of Surface-Mount optocouplers for compatibility with automatic placement equipment
- Packaging in full compliance with EIA Standard 481-A—Option S
- Efficient packaging, static-inhibiting materials, industry compatible tape
- Bar coding label for optimum inventory control

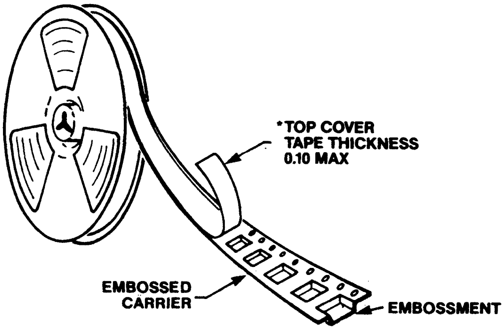
ORDERING INFORMATION

To order 6-pin package on Tape and Reel, include appropriate standard device part number, option, and suffix code to specify Tape and Reel. Standard quantity per reel is 1000 parts.

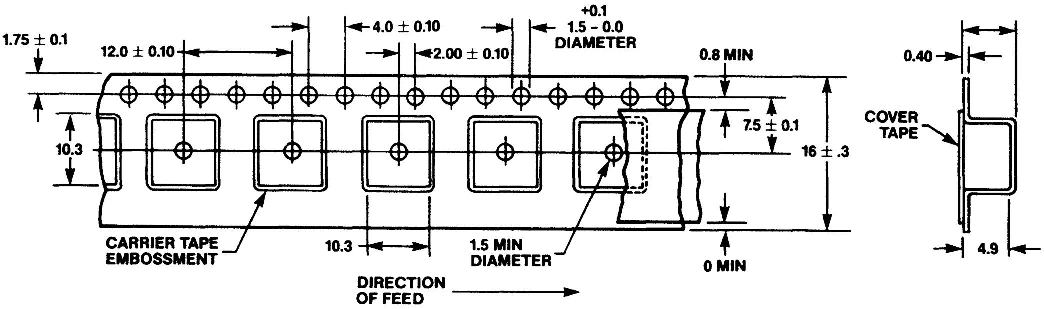
For example:



PACKAGE DIMENSIONS (OPTION S)



ST20-03



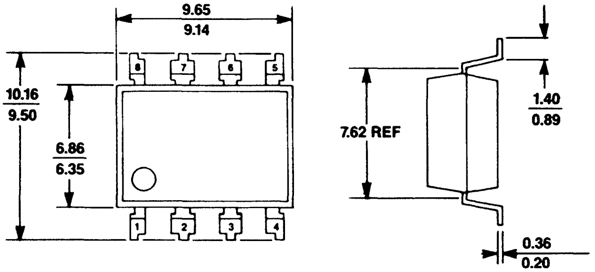
ALL DIMENSIONS ARE IN mm.
ALL DIMENSIONS AND TOLERANCES PER E.I.A. STANDARD 481-A.

ST21-04

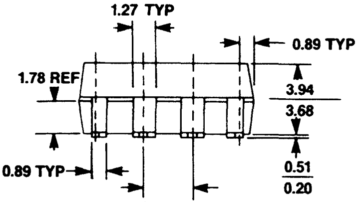
8-PIN SURFACE MOUNT

TAPE AND REEL

PACKAGE DIMENSIONS (OPTION 200)

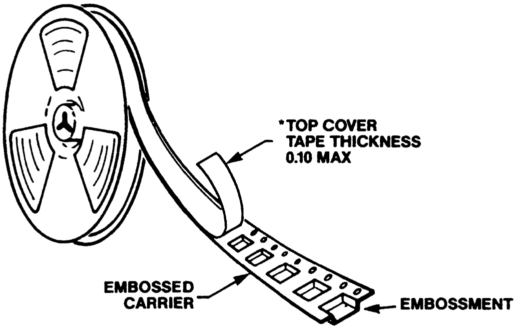


ST21-01



ST21-02

PACKAGE CODE D



ST21-03

FEATURES

- Taping of Surface-Mount optocouplers for compatibility with automatic placement equipment
- Packaging in full compliance with EIA Standard 481-A—200
- Efficient packaging, static-inhibiting materials, industry compatible tape
- Bar coding label for optimum inventory control

ORDERING INFORMATION

To order 8-pin package on Tape and Reel, include appropriate standard device part number, option, and suffix code to specify Tape and Reel. Standard quantity per reel is 1000 parts.

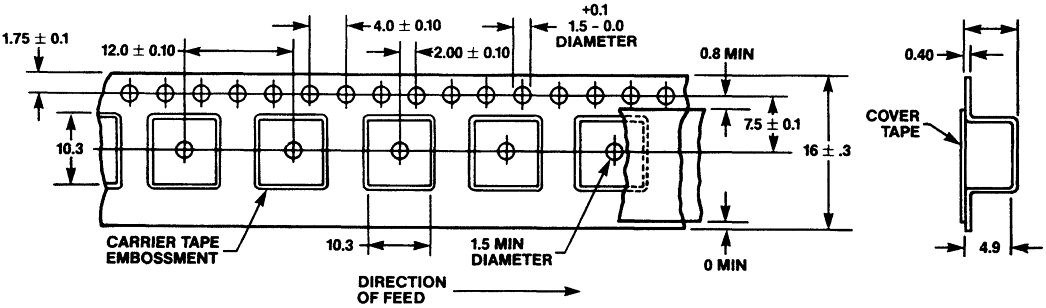
For example:

MCT9001.200 D

Specifies Tape and Reel

Option for lead trim and bend

Standard part number for 8-pin optocoupler



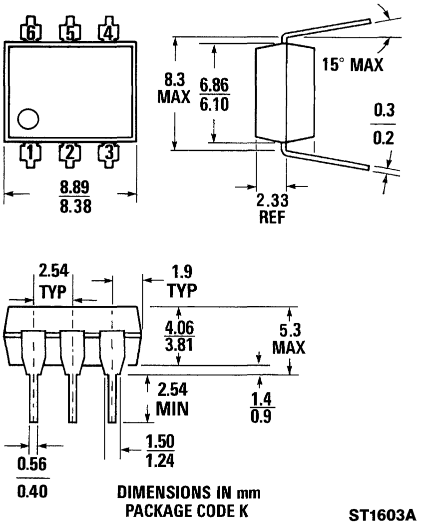
ALL DIMENSIONS ARE IN mm.
ALL DIMENSIONS AND TOLERANCES PER E.I.A. STANDARD 481-A.

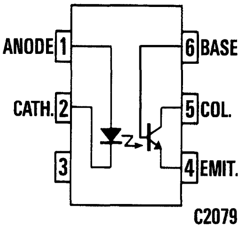
ST21-04

PHOTOTRANSISTOR OPTOCOUPLERS

4N25 4N27
4N26 4N28

PACKAGE DIMENSIONS





Equivalent Circuit

DESCRIPTION

The 4N25, 4N26, 4N27, and 4N28 series of optocouplers have an NPN silicon planar phototransistor optically coupled to a gallium arsenide diode.

FEATURES & APPLICATIONS

- AC line/digital logic isolator
- Digital logic/digital logic isolator
- Telephone/telegraph line receiver
- Twisted pair line receiver
- High frequency power supply feedback control
- Relay contact monitor
- Power supply monitor
- Small package size and low cost
- Excellent frequency response
- UL recognized—File E90700

ABSOLUTE MAXIMUM RATINGS

TOTAL PACKAGE

*Storage temperature	−55°C to 150°C
*Operating temperature at junction	−55°C to 100°C
*Lead temperature (soldering, 10 sec)	260°C
*Total package power dissipation at 25°C ambient (LED plus detector)	250 mW
*Derate linearly from 25°C	3.3 mW/°C

INPUT DIODE

*Forward DC current continuous	80 mA
*Reverse voltage	3.0 V
*Peak forward current (300 μs, 2% duty cycle)	3.0 A
*Power dissipation at 25°C ambient	150 mW
*Derate linearly from 25°C	2.0 mW/°C

OUTPUT TRANSISTOR

*Collector emitter voltage (BV_{CEO})	30 V
*Collector base voltage (BV_{CBO})	70 V
*Emitter collector voltage (BV_{ECO})	7 V
*Power dissipation at 25°C ambient	150 mW
*Derate linearly from 25°C	2.0 mW/°C

*Indicates JEDEC Registered Data.

ELECTRO-OPTICAL CHARACTERISTICS

(25°C Free Air Temperature Unless Otherwise Specified)

INDIVIDUAL COMPONENT CHARACTERISTICS

CHARACTERISTICS	SYMBOL	MIN.	TYP.	GUAR. MAX.	UNITS	TEST CONDITIONS
INPUT DIODE						
*Forward voltage	V_F		1.20	1.50	V	$I_F=10$ mA
Capacitance	C		150		pF	$V_F=0$ V, f=1 MHz
*Reverse leakage current			.05	100	μA	$V_R=3.0$ V, $R_L=1.0$ MΩ
DETECTOR						
DC forward current gain	h_{FE}		250			$V_{CE}=5$ V, $I_C=500$ μA
*Collector to emitter breakdown voltage	BV_{CEO}	30	65		V	$I_C=1.0$ mA, $I_B=0$
*Collector to base breakdown voltage	BV_{CBO}	70	165		V	$I_C=100$ μA, $I_E=0$
*Emitter to collector breakdown voltage	BV_{ECO}	7	14		V	$I_E=100$ μA, $I_B=0$
*Collector to emitter leakage current (4N25, 4N26, 4N27)	I_{CEO}		3.5	50	nA	$V_{CE}=10$ V Base Open
*Collector to emitter leakage current (4N28)				100	nA	
*Collector to base leakage current	I_{CBO}		0.1	20	nA	$V_{CB}=10$ V Emitter Open

TRANSFER CHARACTERISTICS

DC CHARACTERISTICS	SYMBOL	MIN.	TYP.	GUAR. MAX.	UNITS	TEST CONDITIONS
*Collector output current (a)						
(4N25, 4N26)	I_C	2.0	5.0	—	mA	$V_{CE}=10$ V, $I_F=10$ mA, $I_B=0$
(4N27, 4N28)		1.0	3.0	—		
*Collector-emitter saturation	$V_{CE(SAT)}$		0.2	0.5	V	$I_C=2.0$ mA, $I_F=50$ mA

TRANSFER CHARACTERISTICS

AC CHARACTERISTICS	SYMBOL	TYP.	UNITS	TEST CONDITIONS
Non-saturated Collector				
Delay time	t_d	0.5	μs	$R_L=100$ Ω, $I_C=2$ mA, $V_{CC}=10$ V
Rise time	t_r	2.5	μs	(Fig. 10 and 11)
Fall time	t_f	2.6	μs	
Non-saturated Collector				
Delay time	t_d	2.0	μs	$R_L=1$kΩ, I_C 2 mA, $V_{CC}=10$ V
Rise time	t_r	15	μs	(Fig. 10 and 11)
Fall time	t_f	15	μs	

*Indicates JEDEC Registered Data.

(a) Pulse Test: Pulse Width=300 μs, Duty Cycle ≤2.0%

(b) For this test LED pins 1 and 2 are common and Phototransistor pins 4, 5 and 6 are common.

(c) If adjusted to yield $I_C=2$ mA and $i_c=0.7$ mA RMS; Bandwidth referenced to 10 kHz.

ELECTRO-OPTICAL CHARACTERISTICS

(25°C Free Air Temperature Unless Otherwise Specified) (Cont'd)

TRANSFER CHARACTERISTICS (Cont'd)

AC CHARACTERISTICS	SYMBOL	MIN.	TYP.	GUAR. MAX.	UNITS	TEST CONDITIONS
Saturated t_{on} (from 5 V to 0.8 V)	t_{on} (SAT)		5		μs	R_L=2kΩ, I_F=15 mA, V_{CC}=5 V
t_{off} (from SAT to 2.0 V)	t_{off} (SAT)		25		μs	R_B=Open (Fig. 10)
Saturated t_{on} (from 5 V to 0.8 V)	t_{on} (SAT)		5		μs	R_L=2kΩ, I_F=20 mA, V_{CC}=5 V
t_{off} (from SAT to 2.0 V)	t_{off} (SAT)		18		μs	R_B=100kΩ (Fig. 10)
Non-saturated Base—Collector photo diode Rise time	t_r		175		ns	R_L=1kΩ, V_{CB}=10 V
Fall time	t_f		175		ns	
Isolation voltage (b) (4N25, 4N26, 4N27, 4N28)	V_{ISO}	5300	—	—	V	$I_{I\text{-}O} \leq 1$ μA RMS, t=1 minute
*(4N26, 4N27)		1500	—	—	V	Peak
*(4N28)		500	—	—	V	Peak
Isolation resistance (b)			10^{11}		Ω	V=500 VDC
Isolation capacitance (b)			1.3		pF	V=0, f=1.0 MHz
Bandwidth (c) (also see note 2)	B_W		300		kHz	I_C=2.0 mA, R_L=100 Ω (Fig. 12)

*Indicates JEDEC Registered Data.

(a) Pulse Test: Pulse Width=300 μs, Duty Cycle ≤2.0%

(b) For this test LED pins 1 and 2 are common and Phototransistor pins 4, 5 and 6 are common.

(c) If adjusted to yield I_C=2 mA and i_c=0.7 mA RMS; Bandwidth referenced to 10 kHz.

TYPICAL ELECTRO-OPTICAL CHARACTERISTIC CURVES

(25°C Free Air Temperature Unless Otherwise Specified)

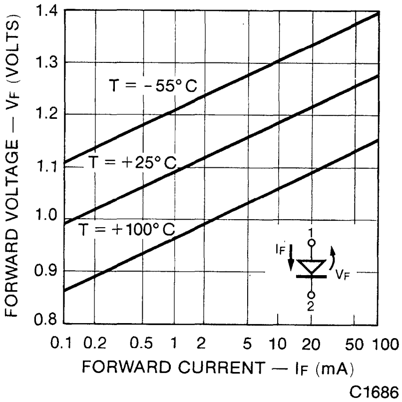


Fig. 1. Forward Voltage vs. Current

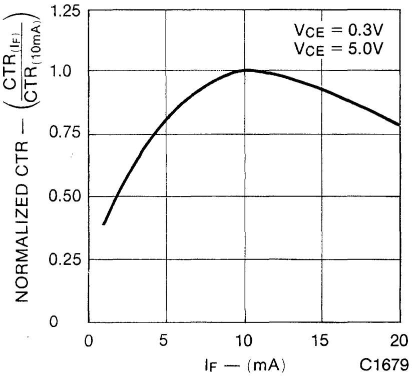


Fig. 2. Normalized CTR vs. Forward Current

TYPICAL ELECTRO-OPTICAL CHARACTERISTIC CURVES

(25°C Free Air Temperature Unless Otherwise Specified) (Cont'd)

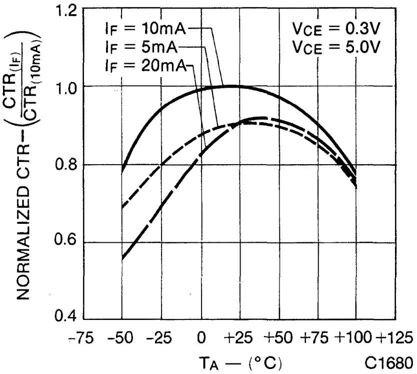


Fig. 3. Normalized CTR vs. Temperature

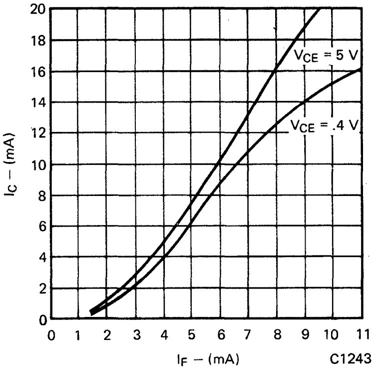


Fig. 4. Collector Current vs. Forward Current

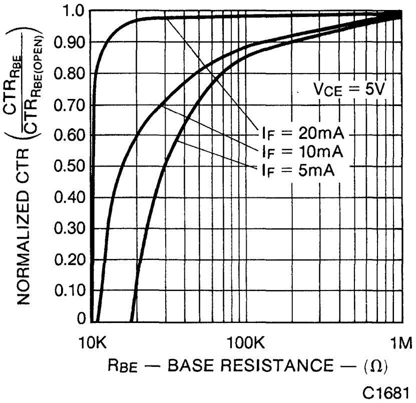


Fig. 5. CTR vs. RBE (Unsaturated)

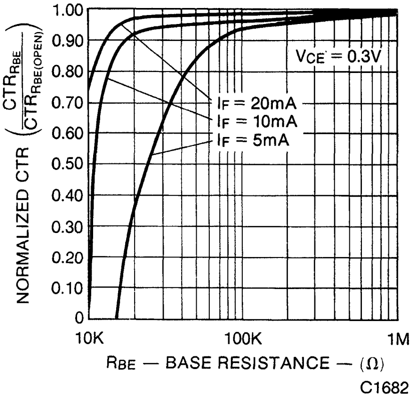


Fig. 6. CTR vs. RBE (Saturated)

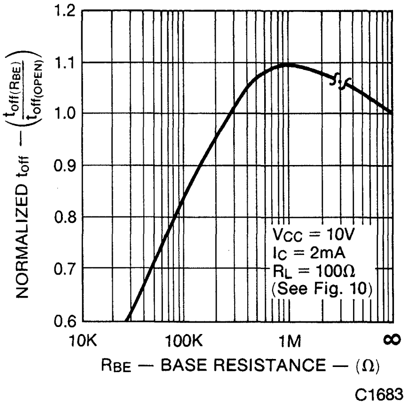


Fig. 7. Normalized T_{OFF} vs. RBE

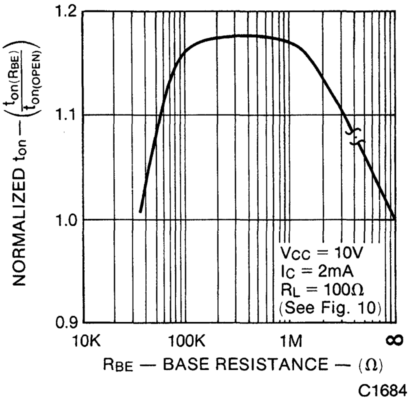


Fig. 8. Normalized T_{ON} vs. RBE

TYPICAL ELECTRO-OPTICAL CHARACTERISTIC CURVES

(25°C Free Air Temperature Unless Otherwise Specified) (Cont'd)

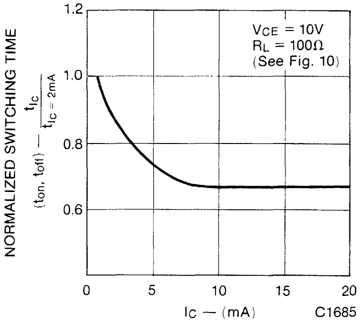


Fig. 9. Switching Time vs. IC

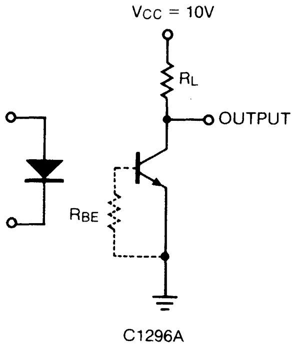


Fig. 10. Switching Time Test Circuit

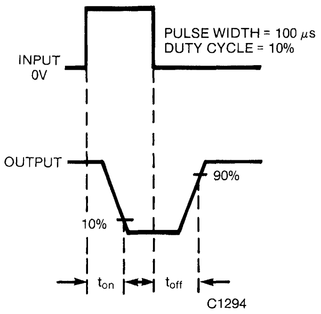


Fig. 11. Switching Time Waveforms

OPERATING SCHEMATICS

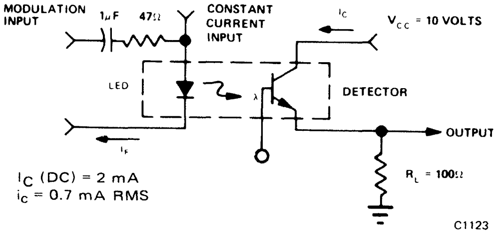


Fig. 12. Modulation Circuit Used to Obtain Output vs. Frequency Plot

NOTES

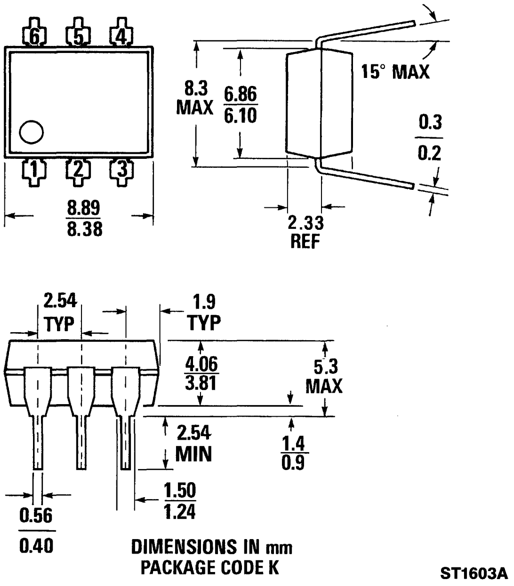
1. The current transfer ratio (I_C/I_F) is the ratio of the detector collector current to the LED input current with V_{CE} at 10 volts.
2. The frequency at which i_c is 3dB down from the 10 kHz value.
3. Rise time (t_r) is the time required for the collector current to increase from 10% of its final value to 90%.
   Fall time (t_f) is the time required for the collector current to decrease from 90% of its initial value to 10%.

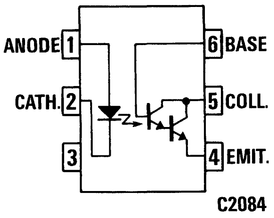
QT OPTOELECTRONICS

PHOTODARLINGTON OPTOCOUPLERS

4N32 4N33

PACKAGE DIMENSIONS





Equivalent Circuit

DESCRIPTION

The 4N32 and 4N33 have a gallium arsenide infrared emitter optically coupled to a silicon planar photodarlington.

FEATURES & APPLICATIONS

- High isolation resistance—$10^{11}\Omega$
- High dielectric strength, input to output 5300 V RMS—1 minute
- Low coupling capacitance—1.0 pF
- Convenient package—plastic dual-in-line
- Long lifetime, solid state reliability
- Low weight—0.4 grams
- UL recognized—File E90700

ABSOLUTE MAXIMUM RATINGS (T_A=25°C Unless Otherwise Specified)

TOTAL PACKAGE

*Storage temperature	−55°C to 150°C
*Operating temperature at junction	−55°C to 100°C
*Lead soldering time @ 260°C	10 seconds
*Total power dissipation at 25°C ambient	250 mW
*Derate linearly from 25°C	3.3 mW/°C

INPUT DIODE

*Power dissipation @ 25°C ambient	150 mW
*Derate linearly from 55°C	2 mW/°C
*Continuous forward current	80 mA
Reverse current	10 mA
*Peak forward current (300 μsec, 2% duty cycle)	3.0 A

OUTPUT TRANSISTOR

*Power dissipation @ 25°C ambient	150 mW
*Derate linearly from 25°C	2.0 mW/°C
*Collector-emitter breakdown voltage (BV_{CEO})	30 V
*Collector-base breakdown voltage (BV_{CBO})	50 V
Emitter-base breakdown voltage (BV_{EBO})	8.0 V
*Emitter-collector breakdown voltage (BV_{ECO})	5 V

*Indicated JEDEC Registered data.

PHOTODARLINGTON OPTOCOUPLERS

ELECTRO-OPTICAL CHARACTERISTICS (25°C Unless Otherwise Specified)

INDIVIDUAL COMPONENT CHARACTERISTICS

CHARACTERISTIC	SYMBOL	MIN.	TYP.	MAX.	UNIT	TEST CONDITION
DIODE (T_A=25°C unless otherwise noted) *Reverse leakage current	I_R		0.05	100	μA	V_R=3.0 V
*Forward voltage	V_F		1.2	1.5	Volts	I_F=10 mA
Capacitance	C		150		pF	V_F=0 V, f=1.0 MHz
DETECTOR (T_A=25°C and I_F=0 unless otherwise noted) *Collector-emitter dark current	I_{CEO}			100	nA	V_{CE}=10 V, base open
*Collector-base breakdown voltage	BV_{CBO}	30			Volts	I_C=100 μA, I_E=0
*Collector-emitter breakdown voltage	BV_{CEO}	30			Volts	I_C=100 μA, I_B=0
*Emitter-collector breakdown voltage	BV_{ECO}	5.0			Volts	I_E=100 μA, I_B=0
DC current gain	h_{FE}		5000			V_{CE}=5.0 V, I_C=500 μA

TRANSFER CHARACTERISTICS

DC CHARACTERISTICS	SYMBOL	MIN.	TYP.	MAX.	UNIT	TEST CONDITION
(T_A=25°C unless otherwise noted) *Collector output current (Note 1) 4N32, 4N33	I_C	50			mA	V_{CE}=10 V, I_F=10 mA, I_B=0
*Collector-emitter saturation voltage (1) 4N32, 4N33	$V_{CE(SAT)}$			1.0	Volts	I_C=2.0 mA, I_F=8.0 mA

TRANSFER CHARACTERISTICS

AC CHARACTERISTICS	SYMBOL	MIN.	TYP.	MAX.	UNIT	TEST CONDITION
(Fig. 6 and 7) Turn-on time	t_{ON}		0.6	5.0	μs	I_C=50 mA, I_F=200 mA, V_{CC}=10 V
Turn-off time 4N32, 4N33	t_{OFF}		45	100	μs	V_{CC}=10 V
Bandwidth (3)			30		kHz	

ISOLATION CHARACTERISTICS

CHARACTERISTICS	SYMBOL	MIN.	TYP.	MAX.	UNIT	TEST CONDITION
Isolation capacitance (Note 2)			0.8		pF	V=0, f=1.0 MHz
Isolation voltage (Note 2) 4N32, 4N33	V_{ISO}	5300	—	—	V	$I_{I-O} \leq 1$ μA V RMS, t=1 minute
*(4N32)		2500	—	—	V	VDC
*(4N33)		1500	—	—	V	VDC
Isolation resistance (Note 2)	R_{ISO}		10^{11}		Ohms	V=500 VDC

*Indicates JEDEC Registered Data.

(1) Pulse test: pulse width=300 μs, duty cycle ≤ 2.0%

(2) For this test LED pins 1 and 2 are common and phototransistor pins 4, 5 and 6 are common.

(3) I_F adjusted to I_C=2.0 mA and ic=0.7 mA RMS.

(4) t_d and t_r are inversely proportional to the amplitude of I_F; t_s and t_f are not significantly affected by I_F.

TYPICAL ELECTRO-OPTICAL CHARACTERISTIC CURVES

(25°C Free Air Temperature Unless Otherwise Specified)

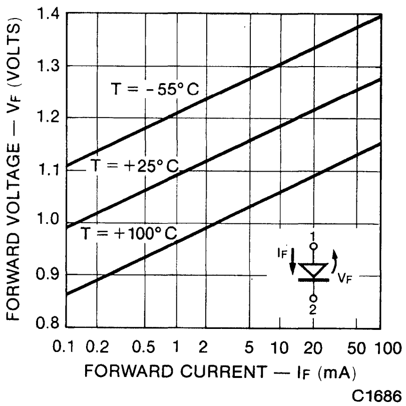


Fig. 1. Forward Voltage vs. Forward Current

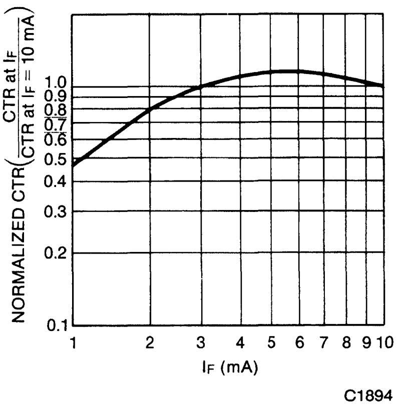


Fig. 2. Normalized CTR vs. I_F

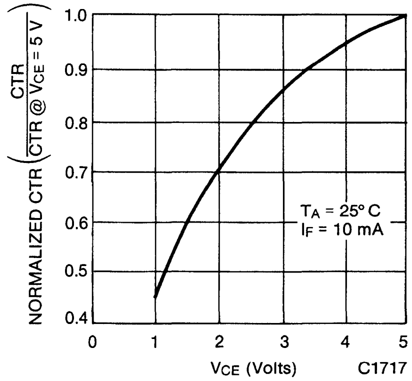


Fig. 3. Normalized CTR vs.– V_{CE}

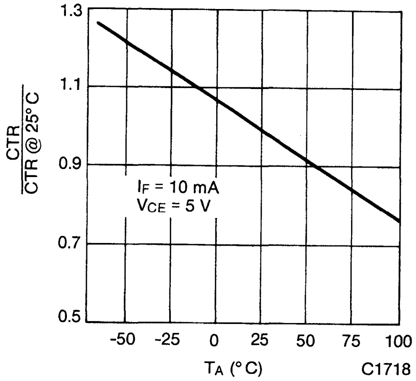


Fig. 4. Normalized CTR vs. Temperature

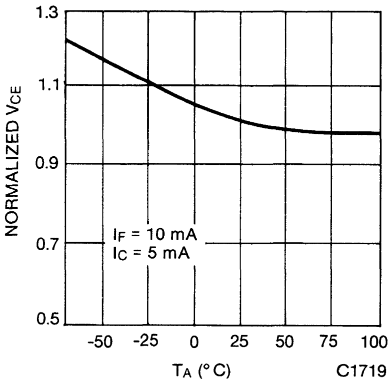


Fig. 5. Normalized $V_{CE(SAT)}$ vs. Temperature

TYPICAL ELECTRO-OPTICAL CHARACTERISTIC CURVES

(25°C Free Air Temperature Unless Otherwise Specified) (Cont'd)

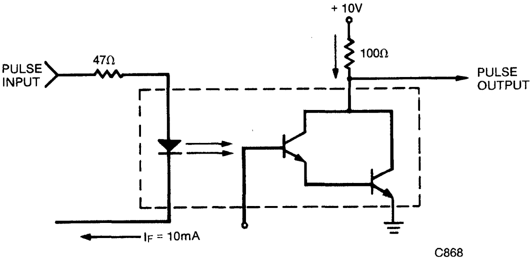


Fig. 6. Test Circuit

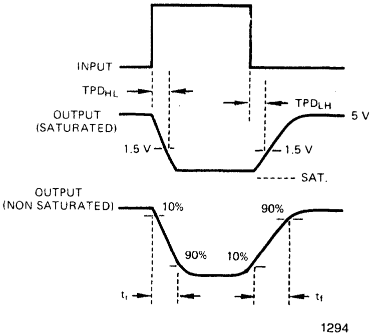


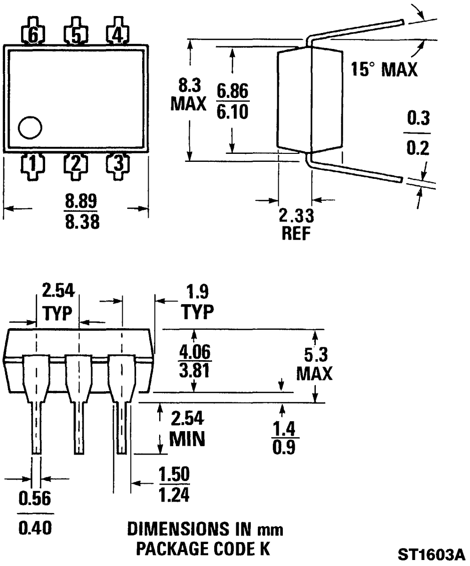
Fig. 7. Switching Waveforms

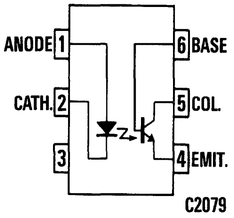
NOTES

1. *The current transfer ratio (I_C/I_F) is the ratio of the detector collector current to the LED input current with V_{CE} at 10 volts.*
2. *The frequency at which i_c is 3dB down from the 1 kHz value.*
3. *t_{ON} is measured from 10% of the leading edge of the input pulse to the 90% point on the leading edge of the output pulse. t_{OFF} is measured from 90% of the trailing edge of the input pulse to the 10% point on the trailing edge of the output pulse.*

4N35 4N36 4N37

PACKAGE DIMENSIONS





Equivalent Circuit

DESCRIPTION

The 4N35, 4N36, and 4N37 series of optocouplers have an NPN silicon planar phototransistor optically coupled to a gallium arsenide infrared emitting diode.

FEATURES & APPLICATIONS

- AC line/digital logic isolator
- Digital logic/digital logic isolator
- Telephone/telegraph line receiver
- Twisted pair line receiver
- High frequency power supply feedback control
- Relay contact monitor
- Power supply monitor
- Industrial controls
- Covered under UL component recognition program, reference File E90700
- High DC current transfer ratio

ABSOLUTE MAXIMUM RATINGS

TOTAL PACKAGE

*Relative humidity	85% @ 85°C
*Storage temperature	−55°C to 150°C
*Operating temperature	−55°C to 100°C
*Lead temperature (soldering, 10 sec)	260°C

INPUT DIODE

*Forward DC current (continuous)	60 mA
Reverse voltage	6 volts
*Peak forward current (1 μs pulse, 300 pps)	3.0 A
*Power dissipation at T_A=25°C	100 mW†
*Power dissipation at T_C=25°C (T_C indicates collector lead temp 1/32″ from case)	100 mW†

OUTPUT TRANSISTOR

*Power dissipation at 25°C ambient	300 mW
Derate linearly above 25°C	4 mW/°C
*Power dissipation at T_C=25°C (T_C indicates collector lead temp 1/32″ from case)	500 mW††
*V_{CEO}	30 volts
*V_{CBO}	70 volts
*V_{ECO}	7 volts
*Collector current (continuous)	100 mA

*Indicates JEDEC registered values †Derate 1.33 mW/°C above 25°C. ††Derate 6.7 mW/°C above 25°C.

ELECTRO-OPTICAL CHARACTERISTICS

(25°C Free Air Temperature Unless Otherwise Specified)

INDIVIDUAL COMPONENT CHARACTERISTICS

CHARACTERISTIC	SYMBOL	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS
INPUT DIODE						
*Forward voltage	V_F	.8		1.50	V	$I_F=10$ mA
*Forward voltage temp. coefficient	V_F	.9		1.7	V	$I_F=10$ mA, $T_A=-55$°C
*Forward voltage	V_F	.7		1.4	V	$I_F=10$ mA, $T_A=+100$°C
*Junction capacitance	C_J			100	pF	$V_F=0$ V, f=1 mHz
*Reverse leakage current			.01	10	μA	$V_R=6.0$ V
DETECTOR						
DC forward current gain	h_{FE}		250			$V_{CE}=5$ V, $I_C=100$ μA
*Collector to emitter breakdown voltage	BV_{CEO}	30	65		V	$I_C=10$ mA, $I_F=0$
*Collector to base breakdown voltage	BV_{CBO}	70	165		V	$I_C=100$ μA, $I_F=0$
*Emitter to collector breakdown voltage	BV_{ECO}	7	14		V	$I_E=100$ μA, $I_F=0$
Collector to emitter, leakage current	I_{CEO}		5	50	nA	$V_{CE}=10$ V, $I_F=0$
*Collector to emitter leakage current (dark)	I_{CEO}			500	μA	$V_{CE}=30$ V, $I_F=0$, $T_A=100$°C
Capacitance collector to emitter	C_{CEW}		8		pF	$V_{CE}=0$
Capacitance collector to base	C_{CBO}		20		pF	$V_{CB}=10$ V
Capacitance base to emitter	C_{BEO}		10		pF	$V_{BE}=0$

TRANSFER CHARACTERISTICS

CHARACTERISTICS	SYMBOL	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS
COUPLED						
†*DC current transfer ratio	CTR	100			%	$I_F=10$ mA, $V_{CE}=10$ V
†*DC current transfer ratio	CTR	40			%	$I_F=10$ mA, $V_{CE}=10$ V, $T_A=-55$°C
†*DC current transfer ratio	CTR	40			%	$I_F=10$ mA, $V_{CE}=10$ V, $T_A=+100$°C
*Saturation voltage—collector to emitter	$V_{CE(SAT)}$			.3	volts	$I_F=10$ mA, $I_C=0.5$ mA

TRANSFER CHARACTERISTICS

AC CHARACTERISTICS	SYMBOL	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS
*Turn on time	t_{ON}		5	10	μsec	$V_{CC}=10$ V, $I_C=2$ mA, $R_L=100\Omega$, (Fig. 10 and Fig. 11)
*Turn off time	t_{OFF}		5	10	μsec	$V_{CC}=10$ V, $I_C=2$ mA, $R_L=100\Omega$, (Fig. 10 and Fig. 11)

*Indicates JEDEC registered values

†Pulse test: pulse width=300μS,
duty cycle≤2.0%

ELECTRO-OPTICAL CHARACTERISTICS

(25°C Free Air Temperature Unless Otherwise Specified) (Cont'd)

ISOLATION CHARACTERISTICS

CHARACTERISTICS	SYMBOL	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS
Isolation voltage all devices	V_{ISO}	5300			V_{RMS}	$I_{I\text{-}O} \leq 1\mu A$ t=1 minute
*Input to output isolation current (pulse width=8 msec) (see Note 1)	$I_{I\text{-}O}$					
4N35				100	μA	V_{iso}=3550 VAC (peak)
4N36				100	μA	V_{iso}=2500 VAC (peak)
4N37				100	μA	V_{iso}=1500 VAC (peak)
*Input to output resistance	$R_{I\text{-}O}$	100			gigaohms	Input to output voltage= 500 V (see Note 1)
*Input to output capacitance	$C_{I\text{-}O}$			2.5	picofarads	Input to output voltage= O V, f=1 MHz (see Note 1)

*Indicates JEDEC registered values

†Pulse test: pulse width=300μS, duty cycle≤2.0%

TYPICAL ELECTRO-OPTICAL CHARACTERISTIC CURVES

(25°C Free Air Temperature Unless Otherwise Specified)

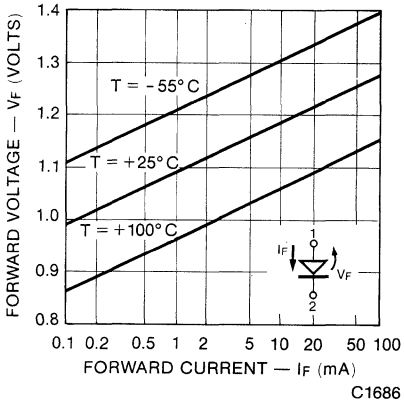


Fig. 1. Forward Voltage vs. Current

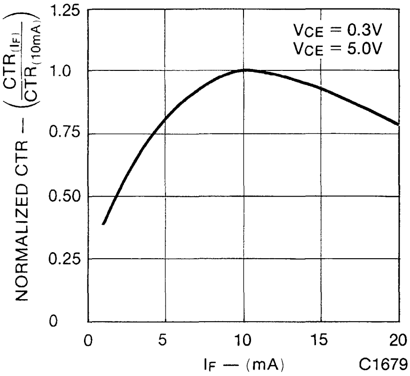


Fig. 2. Normalized CTR vs. Forward Current

TYPICAL ELECTRO-OPTICAL CHARACTERISTIC CURVES

(25°C Free Air Temperature Unless Otherwise Specified) (Cont'd)

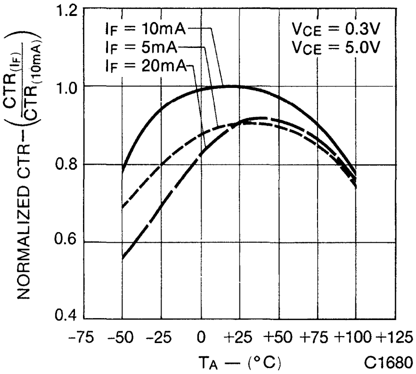


Fig. 3. Normalized CTR vs. Temperature

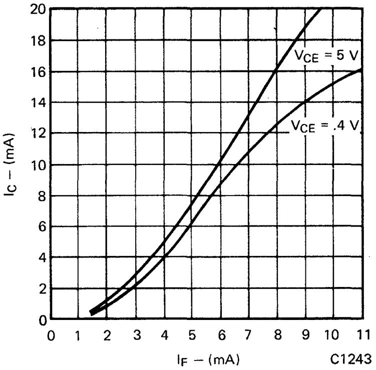


Fig. 4. Collector Current vs. Forward Current

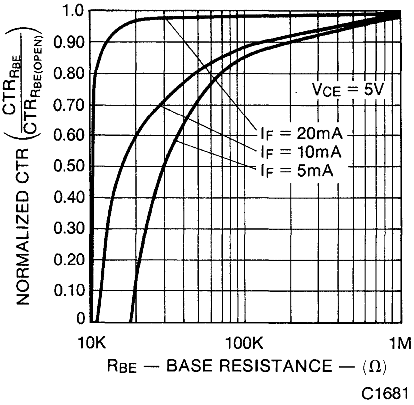


Fig. 5. CTR vs. RBE (Unsaturated)

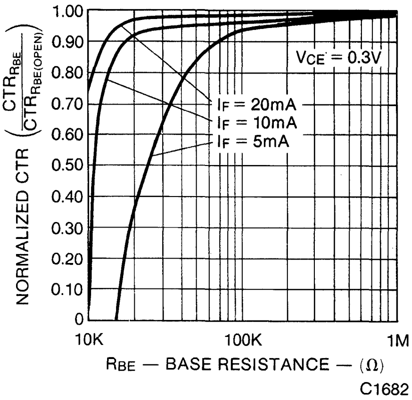


Fig. 6. CTR vs. RBE (Saturated)

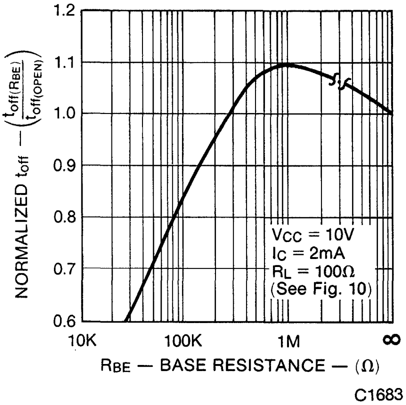


Fig. 7. Normalized T_{OFF} vs. RBE

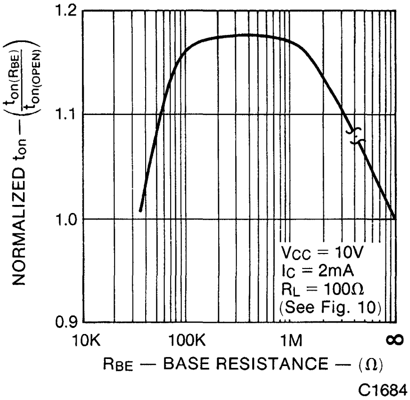


Fig. 8. Normalized T_{ON} vs. RBE

TYPICAL ELECTRO-OPTICAL CHARACTERISTIC CURVES

(25°C Free Air Temperature Unless Otherwise Specified) (Cont'd)

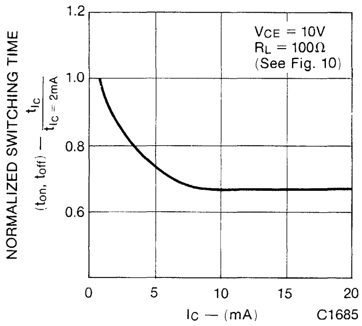


Fig. 9. Switching Time vs. IC

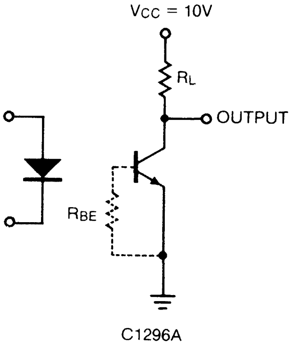


Fig. 10. Switching Time Test Circuit

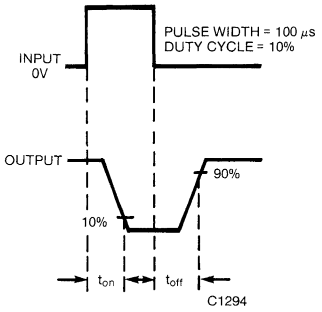


Fig. 11. Switching Time Waveforms

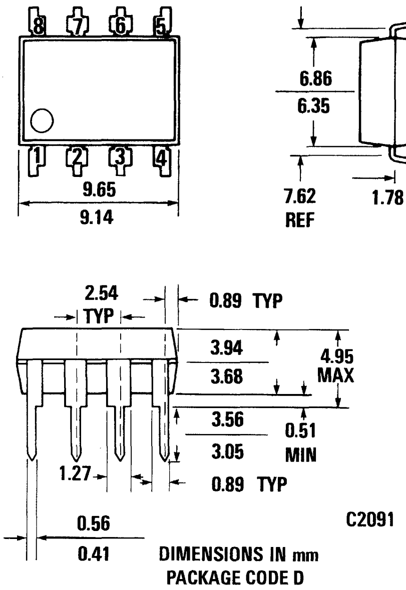
NOTES

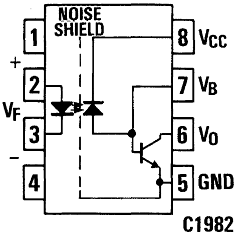
1. *Tests of input to output isolation current resistance and capacitance are performed with the input terminals (diode) shorted together and the output terminals (transistor) shorted together.*
2. *The current transfer ratio (I_C/I_F) is the ratio of the detector collector current to the LED input current with V_{CE} at 10 volts.*
3. *Rise time (t_r) is the time required for the collector current to increase from 10% of its final value, to 90%.*
   Fall time (t_f) is the time required for the collector current to decrease from 90% of its initial value to 10%.

HIGH-SPEED TRANSISTOR OPTOCOUPLERS

HCPL-2503 HCPL-4502 6N136 6N135

PACKAGE DIMENSIONS





Equivalent Circuit

The HCPL-4502 has the same specifications as the 6N136 but has no base connection.

DESCRIPTION

The HCPL-4502/HCPL-2503 and 6N136/5 optocouplers contain a 700 nm GaAsP LED emitter, which is optically coupled to a high speed photodetector transistor.

A separate connection for the bias of the photodiode improves the speed by several orders of magnitude over conventional phototransistor optocouplers by reducing the base-collector capacitance of the input transistor.

An internal noise shield provides superior common mode rejection of 10 kV/μs. An improved package allows superior insulation permitting a 480 V working voltage compared to industry standard of 220 V.

FEATURES

- High Speed—1 MBit/s
- Superior CMR—10 kV/μs
- Double working voltage—480 V RMS
- CTR guaranteed 0-70°C
- U.L. recognized (File #E50151)

APPLICATIONS

- Line receivers
- Pulse transformer replacement
- Output interface to CMOS-LSTTL-TTL
- Wide bandwidth analog coupling

ABSOLUTE MAXIMUM RATINGS†

Storage temperature	−55°C to 125°C	Reverse input voltage	5 V
Operating temperature	−55°C to 100°C	Input power dissipation	45 mW *(3)*
Lead solder temperature	260°C for 10s	Average output current	8 mA
Average forward input current	25 mA *(1)*	Peak output current	16 mA
Peak forward input current (50% duty cycle, 1ms P.W.)	50 mA *(2)*	Emitter-base reverse voltage	5 V
		Supply and output voltage	−0.5 V to 15 V
Peak transient input current - I_F (≤1 μs P.W., 300 pps)	1.0 A	Base current	5 mA
		Output power dissipation	100 mW *(4)*

†*Absolute Maximum Ratings are JEDEC Registered Data for 6N136 and 6N135. 6N136 and 6N135 are the only JEDEC Registered Parts on this data sheet.*

ELECTRICAL CHARACTERISTICS (T_A=0-70° Unless Otherwise Specified)

INDIVIDUAL COMPONENT CHARACTERISTICS

PARAMETER	SYMBOL	DEVICE	TEST CONDITIONS	MIN	TYP**	MAX.	UNITS
INPUT DIODE							
Input forward voltage	V_F		I_F=16mA T_A=25°C		1.5	1.7	V
Input reverse breakdown	B_{VR}		I_R=10uA, T_A=25°C	5			V
Temperature coefficient of forward voltage	$\frac{\Delta V_F}{\Delta T_A}$		I_F=16mA		−1.6		mV/°C
DETECTOR							
Logic high output current	I_{OH}		I_F=0mA V_O=V_{CC}=5.5V T_A=25°C		3	500	nA
			I_F=0mA, V_O=V_{CC}=15V T_A=25°C		0.01	1	uA
			I_F=0mA V_O=V_{CC}=15V			50	uA
Logic low supply	I_{CCL}		I_F=16mA V_O=OPEN V_{CC}=15V			40	uA
Logic high supply	I_{CCH}		I_F=0mA V_O=OPEN V_{CC}=15V T_A=25°C			1	uA
			I_F=0mA V_O=OPEN V_{CC}=15			2	uA

TRANSFER CHARACTERISTICS

PARAMETER	SYMBOL	DEVICE	TEST CONDITIONS	MIN	TYP**	MAX.	UNITS
COUPLED							
Current transfer Ratio (Note 5)	CTR	6N135	I_F=16mA, V_O=0.4V V_{CC}=4.5V T_A=25°C	7	18		%
		6N136 HCPL-4502		19	24		%
		HCPL-2503		12	18		%
		6N135	I_F=16mA, V_O=0.5V V_{CC}=4.5V	5	19		%
		6N136 HCPL-4502		15	25		%
		HCPL-2503		9			%
Logic low output voltage	V_{OL}	6N135	I_F=16mA, I_O=1.1mA V_{CC}=4.5V T_A=25°C		0.1	0.4	V
		6N136 HCPL-4502 HCPL-2503	I_F=16mA, I_O=2.4mA V_{CC}=4.5V T_A=25°C		0.1	0.4	V

SWITCHING CHARACTERISTICS (T_A=25°C Unless Otherwise Specified V_{CC}=5V)

PARAMETER	SYMBOL	DEVICE	TEST CONDITIONS	MIN	TYP**	MAX.	UNITS
Propagation delay time to logic low	t_{PHL}	6N135	R_L=4.1K I_F=16mA Note 8 Fig. 7		0.2	1.5	uS
		6N136 HCPL-4502 HCPL-2503	R_L=1.9K I_F=16mA Note 9 Fig. 7		0.2	0.8	uS
Propagation delay time to logic low	t_{PHL}	6N135	R_L=4.1K I_F=16mA Note 8 Fig. 7		1.3	1.5	uS
		6N136 HCPL-4502 HCPL-2503	R_L=1.9K I_F=16mA Note 9 Fig. 7 Note 7 Fig. 6		0.6	0.8	uS
Common mode transient immunity at logic high	$\mid CM_H \mid$	6N135	I_F=0mA, V_{CM}=10$V_{P\text{-}P}$, R_L=4.1K		10,000		V/uS
		6N136 HCPL-4502 HCPL-2503	I_F=0mA, V_{CM}=10$V_{P\text{-}P}$ R_L=1.9K Note 7 Fig. 6		10,000		V/us
Common mode transient immunity at logic low	$\mid CM_L \mid$	6N135	I_F=16mA, V_{CM}=10$V_{P\text{-}P}$, R_L=4.1K		10,000		V/uS
		6N136 HCPL-4502 HCPL-2503	I_F=16mA, V_{CM}=10$V_{P\text{-}P}$ R_L=1.9K Note 7 Fig. 6		10,000		V/us
Bandwidth	BW		See test circuit Note 10		2		MHz

ISOLATION CHARACTERISTICS

PARAMETER	SYMBOL	DEVICE	TEST CONDITIONS	MIN	TYP**	MAX.	UNITS
Input-output insulation leakage	I_{IO}		45% relative humidity t=5sec $V_{I\text{-}O}$=3000VDC T_A=25°C, note 6			1.0	uA
Withstand insulation voltage	V_{ISO}		RH≤50% t=1 min T_A=25°C Note 11	2500			V RMS
Resistance input-output	$R_{I\text{-}O}$		$V_{I\text{-}O}$=500VDC		10^{12}		Ω
Capacitance	$C_{I\text{-}O}$		F=1MHz		0.6		pF
DC current gain	HFE		I_O=3mA V_O=5V		150		

NOTES

1. *Derate linearly above 70°C free-air temperature at a rate of 0.8 mA/°C.*
2. *Derate linearly above 70°C free-air temperature at a rate of 1.6 mA/°C.*
3. *Derate linearly above 70°C free-air temperature at a rate of 0.9 mW/°C.*
4. *Derate linearly above 70°C free-air temperature at a rate of 1.0 mW/°C.*
5. *CURRENT TRANSFER RATIO is defined as the ratio of output collector current, I_O, to the forward LED input current, I_F, times 100%.*
6. *Device considered a two-terminal: Pins 1, 2, 3, and 4 shorted together and Pins 5, 6, 7, and 8 shorted together.*
7. *Common mode transient immunity in Logic High level is the maximum tolerable (positive) dV_{CM}/dt on the leading edge of the common mode pulse V_{CM}, to assure that the output will remain in a Logic High state (i.e., V_O>2.0 V). Common mode transient immunity in Logic Low level is the maximum tolerable (negative) dV_{CM}/dt on the trailing edge of the common mode pulse signal, V_{CM} to assure that the output will remain in a Logic Low state (i.e., V_O<0.8 V).*
8. *The 4.1 KΩload represents 1 LSTTL unit load of 0.36 mA and 6.1 KΩ.*
9. *The 1.9 KΩ load represents 1 TTL unit load of 1.6 mA and the 5.6 KΩ pull-up resistor.*
10. *The frequency at which the ac output voltage is 3 dB below the low frequency asymptote.*
11. *The 2500 Vac/1 min capability is validated by a factory 3.1K Vac (rms)/1 sec dielectric voltage withstand test.*

ELECTRICAL CHARACTERISTIC CURVES (T_A=25°C Unless Otherwise Specified)

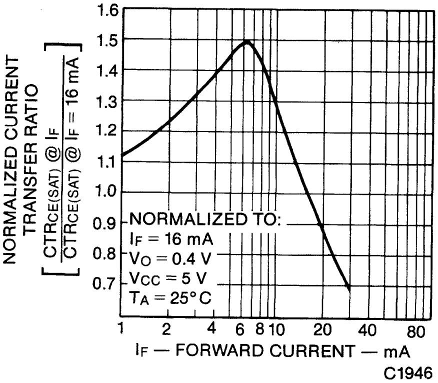


Fig. 1. Normalized Current Transfer Ratio vs. Forward Current

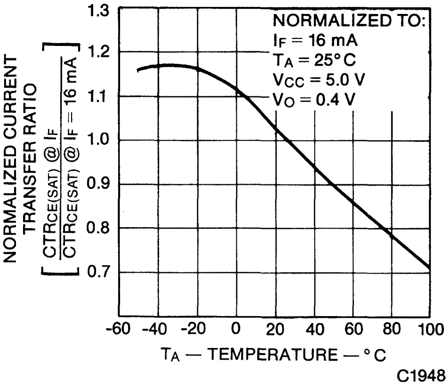


Fig. 2. Normalized Current Transfer Ratio vs. Temperature

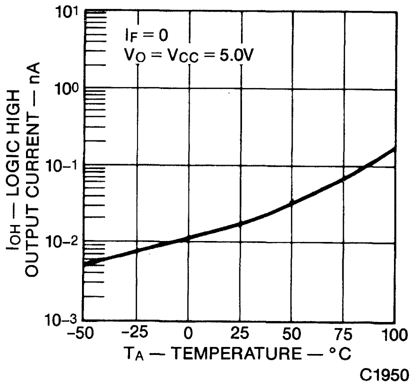


Fig. 3. Logic High Output Current vs. Temperature

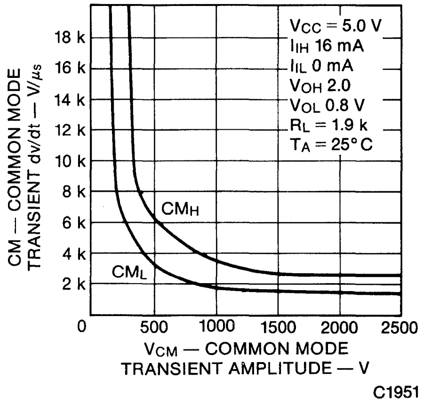


Fig. 4. Common Mode Transient Immunity vs. Common Mode Transient Amplitude

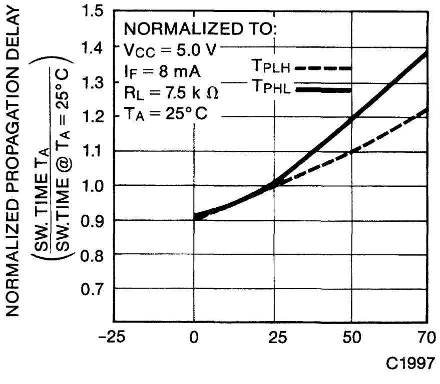


Fig. 5. Normalized Propagation Delay vs. Temperature at I_F=8 mA

ELECTRICAL CHARACTERISTIC CURVES

(T_A=25°C Unless Otherwise Specified) (Cont'd)

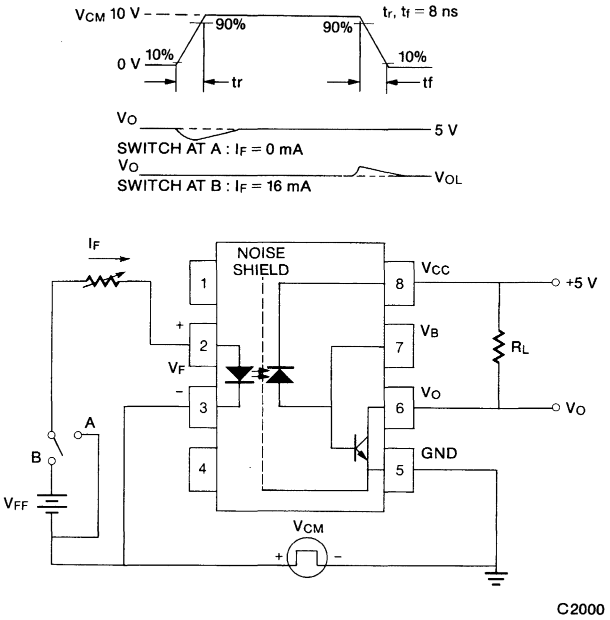


Fig. 6. Common Mode Immunity Test Circuit

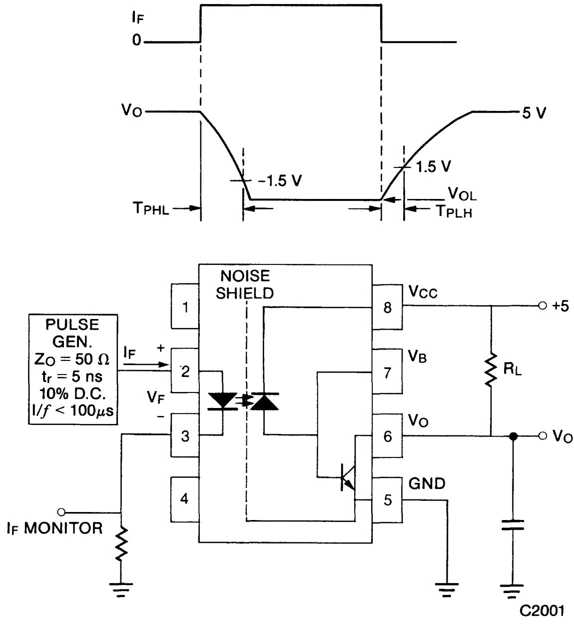


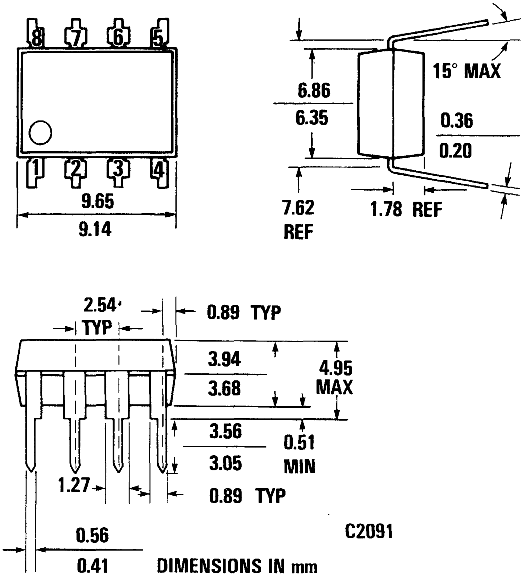
Fig. 7. Switching Time Test Circuit

QT OPTOELECTRONICS

VERY HIGH-SPEED LOGIC GATE OPTOCOUPLERS

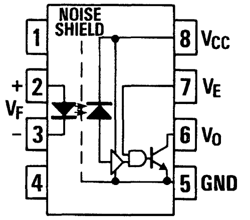
6N137
HCPL-2611
10 MBit/s LOGIC GATE HCPL-2601

PACKAGE DIMENSIONS



C2091

DIMENSIONS IN mm
PACKAGE CODE D



C2092

Equivalent Circuit

TRUTH TABLE
(Positive Logic)

Input	Enable	Output
H	H	L
L	H	H
H	L	H
L	L	H

A 0.1μF bypass capacitor must be connected between pins 8 and 5. (See note 1)

DESCRIPTION

The 6N137 and HCPL-2601 single-channel optocouplers consists of a 700 nm GaAsP LED, optically coupled to a very high speed integrated photodetector logic gate with a strobable output. This output features an open collector, thereby permitting wired-OR outputs. The coupled parameters are guaranteed over the temperature range of 0-70°C. A maximum input signal of 5 mA will provide a minimum output sink current of 13 mA (fan-out of 8).

An internal noise shield provides superior common mode rejection of typically 10 kV/μs. The HCPL-2601 has a minimum CMR of 1 kV/μs. The HCPL-2611 has a minimum CMR of 3.5kV/μsec.

An improved package allows superior insulation, permitting a 480 V working voltage compared to industry standard 220 V.

FEATURES

- Very high speed—10 MBit/s
- Superior CMR—10 kV/μs
- Double working voltage—480 V
- Fan-out of 8 over 0-70°C
- Logic gate output
- Strobable output
- Wired-OR—open collector
- U.L. recognized (File #E50151)

APPLICATIONS

- Ground loop elimination
- LSTTL to TTL, LSTTL or 5-volt CMOS
- Line receiver, data transmission
- Data multiplexing
- Switching power supplies
- Pulse transformer replacement
- Computer-peripheral interface

ABSOLUTE MAXIMUM RATINGS

Storage temperature	−55°C to +125°C
Operating temperature	0°C to +70°C
Lead solder temperature	260°C for 10 s
INPUT DIODE	
DC/average forward input current	20 mA
Enable input voltage, (V_E) (not to exceed V_{CC} by more than 500 mV)	5.5 V
Reverse input voltage	5.0 V
Reverse supply voltage ($-V_{CC}$)	−500 mV

OUTPUT TRANSISTOR

Supply voltage, (V_{CC})	7.0 V/1 minute maximum
Output current, (I_O)	25 mA
Output voltage, (V_O)	7.0 V
Collector output power dissipation	40 mW

VERY HIGH-SPEED LOGIC GATE OPTOCOUPLERS

RECOMMENDED OPERATING CONDITIONS

	SYMBOL	MIN.	MAX	UNITS
Input current, low level	I_{FL}	0	250	μA
Input current, high level	I_{FH}	*6.3	15	mA
Supply voltage, output	V_{CC}	4.5	5.5	V
Enable voltage low level	V_{EL}	0	0.8	V
Enable voltage high level	V_{EH}	2.0	V_{CC}	V
Operating temperature	T_A	0	70	°C
Fan out (TTL load)	N		8	

**6.3 mA is a guard banded value which allows for at least 20% CTR degradation. Initial input current threshold value is 5.0 mA or less.*

ELECTRICAL CHARACTERISTICS (T_A=0°C to 70°C Unless Otherwise Specified)

INDIVIDUAL COMPONENT CHARACTERISTICS

PARAMETER	SYM.	MIN.	TYP.**	MAX.	UNITS	TEST CONDITIONS
INPUT DIODE						
Input forward voltage	V_F		1.55	1.75*	V	I_F=10 mA, T_A=25°C
Input reverse breakdown voltage	B_{VR}	5.0*			V	I_R=10 μA, T_A=25°C
Input capacitance	C_{IN}		60		pF	V_F=0, f=1 MHz
Input diode temperature coefficient	$\Delta V_F/\Delta T_A$		−1.4		mV/°C	I_F=10 mA
DETECTOR						
High level supply current	I_{CCH}		10	15*	mA	V_{CC}=5.5 V, I_F=0 mA V_E=0.5 V
Low level supply current	I_{CCL}		15	18*	mA	V_{CC}=5.5 V, I_F=10 mA V_E=0.5 V
Low level enable current	I_{EL}		−1.5	−2.0*	mA	V_{CC}=5.5 V, V_E=0.5 V
High level enable current	I_{EH}		−1.0		mA	V_{CC}=5.5 V, V_E=2.0 V
High level enable voltage	V_{EH}	2.0			V	V_{CC}=5.5 V, I_F=10 mA
Low level enable voltage	V_{EL}			0.8	V	Note: 11

TRANSFER CHARACTERISTICS

DC CHARACTERISTICS	SYM.	MIN.	TYP.**	MAX.	UNITS	TEST CONDITIONS
High level output current	I_{OH}		.02	250*	μA	V_{CC}=5.5 V, V_O=5.5 V I_F=250 μA, V_E=2.0 V
Low level output voltage	V_{OL}		.34	0.6*	V	V_{CC}=5.5 V, I_F=5 mA V_E=2.0 V, I_{OL}=13 mA

6N137 HCPL-2611 HCPL-2601

ELECTRICAL CHARACTERISTICS (T_A=25°C Unless Otherwise Specified) (Cont'd)

TRANSFER CHARACTERISTICS

AC CHARACTERISTICS	SYM.	MIN.	TYP.**	MAX.	UNITS	TEST CONDITIONS
Propagation delay time (for output high level)	T_{PLH}		48	75*	ns	R_L=350Ω C_L=15pF Fig. 7
Propagation delay time (for output low level)	T_{PHL}		48	75*	ns	R_L=350 Ω Fig. 7 C_L=15 pF
Output rise time (10-90%)	t_r		30		ns	I_F=7.5 mA Fig. 7
Output fall time (90-10%)	t_f		14		ns	Notes 2, 3, 4 & 5, Fig. 7
Enable propagation delay time (for output high level)	t_{ELH}		25		ns	I_F=7.5 mA V_{EH}=3.0 V Fig. 8
Enable propagation delay time (for output low level)	t_{EHL}		14		ns	R_L=350 Ω, C_L=15 pf Notes 6 & 7, Fig. 8
Common mode transient immunity (at output high level)	CM_H		10,000		V/μs	V_{CM}=50 V (Peak) I_F=0 mA, V_{OH} (Min.)=2.0 V R_L=350 Ω, Note 9 6N137
		1000	10,000			Fig. 13 HCPL-2601
		3500	12,000			V_{CM}=400 V HCPL-2611
Common mode transient immunity (at output low level)	CM_L		10,000		V/μs	V_{CM}=50 V (Peak) I_F=7.5 mA, V_{OL} (Max.)=0.8 V R_L=350 Ω 6N137
		1000	10,000			Note 8, Fig. 13 HCPL-2601
		3500	11,000			V_{CM}=400 V HCPL-2611

ISOLATION CHARACTERISTICS

CHARACTERISTICS	SYM.	MIN.	TYP.**	MAX.	UNITS	TEST CONDITIONS
Input-output Insulation leakage current	I_{I-O}			1.0*	μA	Relative humidity=45% T_A=25°C, t=5 s V_{I-O}=3000 VDC Note: 10
Withstand insulation test voltage	V_{ISO}	2500			V_{RMS}	RH<50% T_A=25°C t=1 min.
Resistance (input to output)	R_{I-O}		10^{12}		Ω	V_{I-O}=500 V, Note: 10
Capacitance (input to output)	C_{I-O}		0.6		pF	f=1 MHz, Note: 10

**JEDEC Registered Data*
***All typical values are at V_{CC}=5 V, T_A=25°C*

TYPICAL CHARACTERISTIC CURVES (T_A=25°C Unless Otherwise Specified)

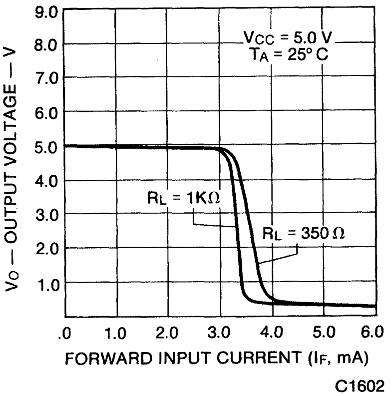


Fig. 1. Output Voltage vs. Forward Input Current

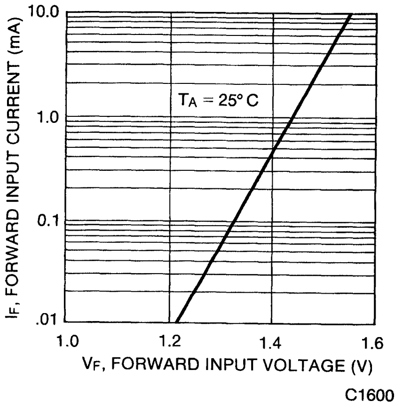


Fig. 2. Forward Input Current vs. Forward Input Voltage

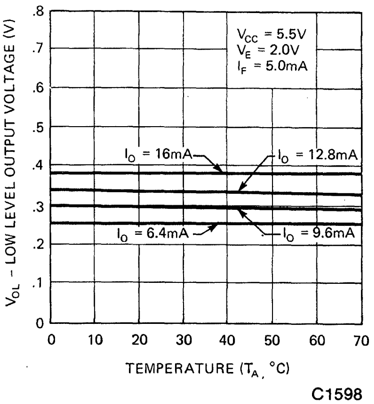


Fig. 3. Low Level Output Voltage vs. Temperature

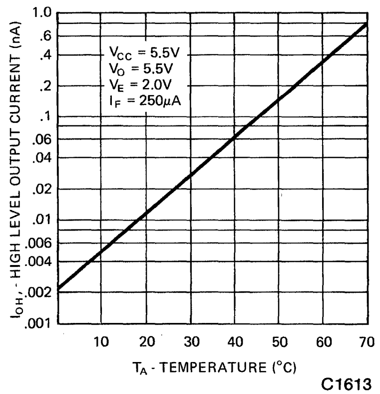


Fig. 4. High Level Output Current vs. Temperature

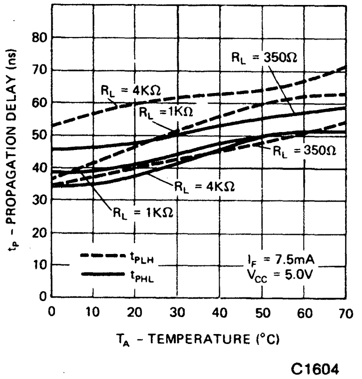


Fig. 5. Propagation Delay vs. Temperature

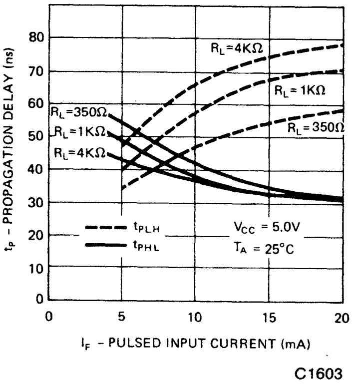


Fig. 6. Propagation Delay vs. Pulse Input Current

TYPICAL CHARACTERISTIC CURVES (T_A=25°C Unless Otherwise Specified) (Cont'd)

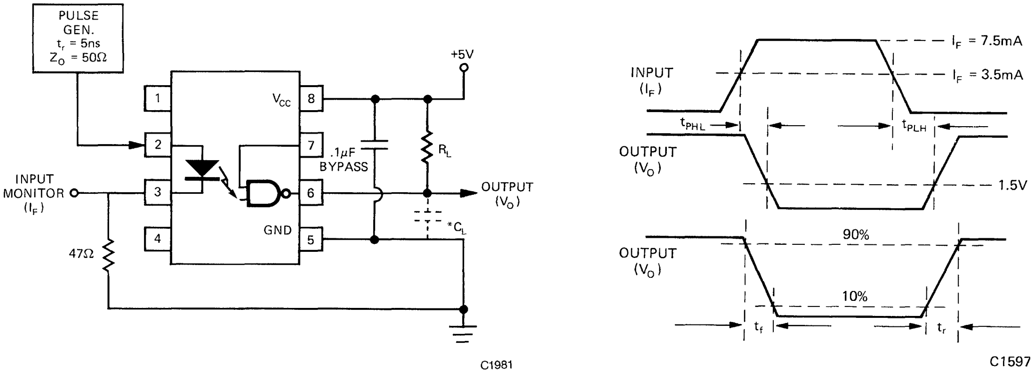


Fig. 7. Test Circuit and Waveforms for t_{PLH}, t_r, and t_f

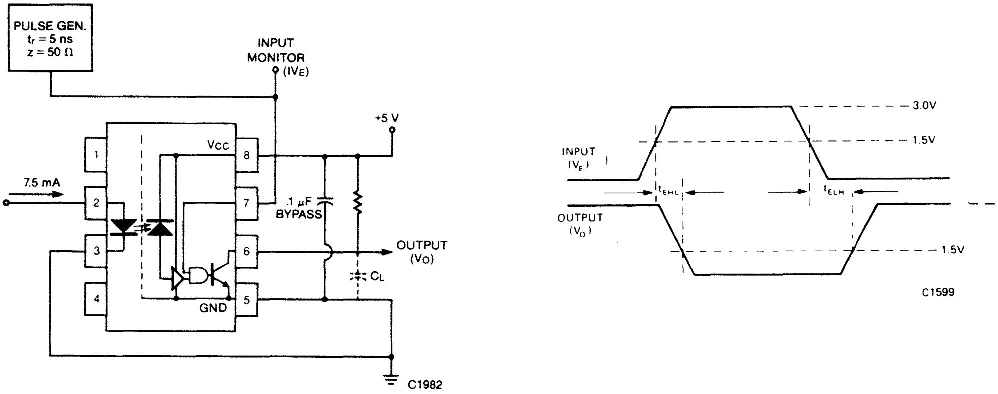


Fig. 8. Test Circuit t_{EHL} and t_{ELH}

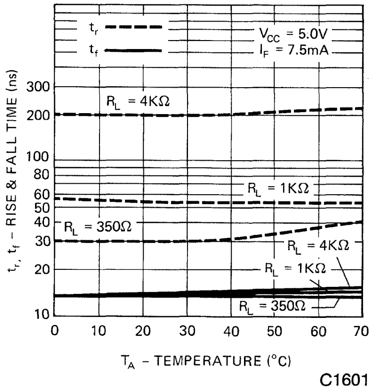


Fig. 9. Rise and Fall Time vs. Temperature

TYPICAL CHARACTERISTIC CURVES (T_A=25°C Unless Otherwise Specified) (Cont'd)

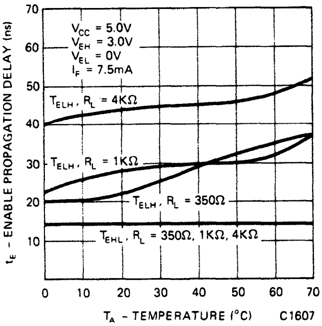


Fig. 10. Enable Propagation Delay vs. Temperature

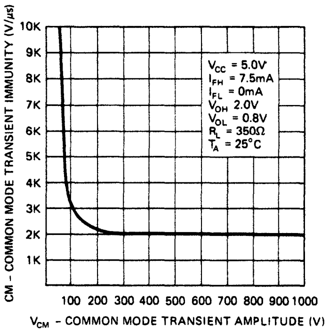


Fig. 11. Relative Common Mode Transient Immunity vs. Common Mode Transient Amplitude

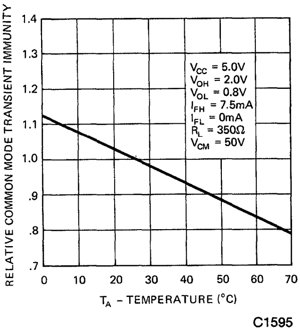


Fig. 12. Relative Common Mode Transient Immunity vs. Temperature

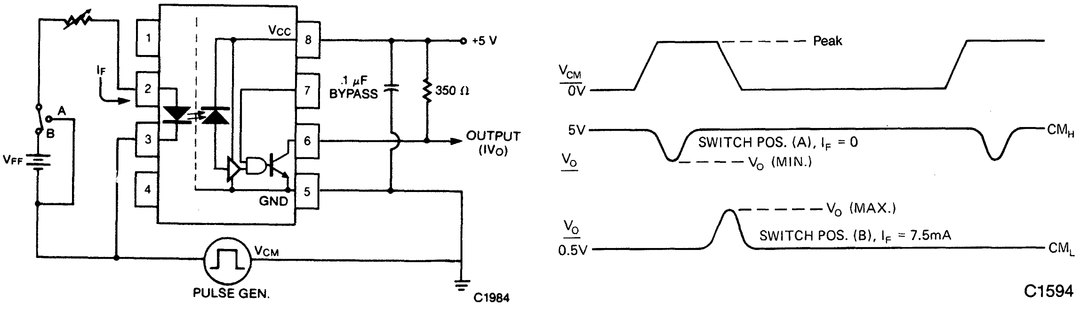


Fig. 13. Test Circuit Common Mode Transient Immunity

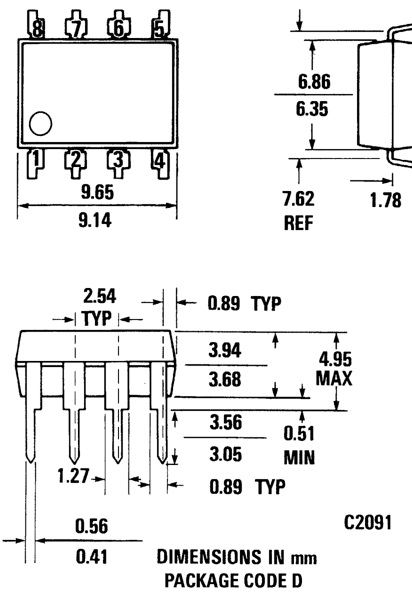
NOTES

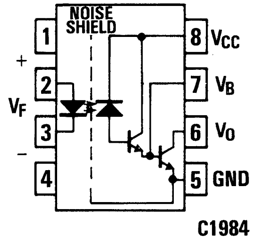
1. The V_{CC} supply voltage to each 6N137 isolator must be bypassed by a 0.1 μF capacitor or larger. This can be either a ceramic or solid tantalum capacitor with good high frequency characteristic and should be connected as close as possible to the package V_{CC} and GND pins of each device.
2. t_{PHL} - Propagation delay is measured from the 3.75 mA level on the LOW to HIGH transition of the input current pulse to the 1.5 V level on the HIGH to LOW transition of the output voltage pulse.
3. t_{PHL} - Propagation delay is measured from the 3.75 mA level on the LOW to HIGH transition of the input current pulse to the 1.5 V level on the HIGH to LOW transition of the output voltage pulse.
4. t_f - Fall time is measured from the 10% to the 90% levels of the HIGH to LOW transition on the output pulse.
5. t_r - Rise time is measured from the 90% to the 10% levels of the LOW to HIGH transition on the output pulse.
6. t_{EHL} - Enable input propagation delay is measured from the 1.5 V level on the LOW to HIGH transition of the input voltage pulse to the 1.5 V level on the HIGH to LOW of the output voltage pulse.
7. t_{ELH} - Enable input propagation delay is measured from the 1.5 V level on the HIGH to LOW transition of the input voltage pulse to the 1.5 V level on the LOW to HIGH transition of the output voltage pulse.
8. CM_L - The maximum tolerable rate of fall of the common mode voltage to ensure the output will remain in the low output state (i.e., V_{OUT}<0.8 V). Measured in volts per microsecond (V/μs).
9. CM_H - The maximum tolerable rate of rise of the common mode voltage to ensure the output will remain in the high state (i.e., V_{OUT}>2.0 V). Measured in volts microsecond (V/μs).
10. - Device considered a two-terminal device: Pins 1, 2, 3 and 4 shorted together, and Pins 5, 6, 7 and 8 shorted together. The 2500 V_{AC}/1 minute capability guarantees 3000 V_{DC}/5 sec. as registered with JEDEC and is validated by a factory 3.1 K V_{AC}/1 second.
11. Enable Input - No pull up resistor required as the device has an internal pull up resistor.
12. - DC current transfer ratio is defined as the ratio of the output collector current to the forward bias input current times 100%.

HIGH GAIN SPLIT-DARLINGTON OPTOCOUPLERS

6N138
6N139

PACKAGE DIMENSIONS





Equivalent Circuit

DESCRIPTION

The 6N138/9 single channel optocouplers contain a 700 nm GaAsP LED emitter which is optically coupled to a high gain detector in a split Darlington configuration, providing extremely high current transfer ratio.

The split darlington configuration separating the input photodiode and the first stage gain from the output transistor permits lower output saturation voltage and higher speed operation than possible with conventional darlington phototransistor optocoupler.

The combination of a very low input current of 0.5 mA and a high current transfer ratio of 2000% makes this family particularly useful for input interface to MOS, CMOS, LSTTL and EIA RS232C, while output compatibility is ensured to CMOS as well as high fan-out TTL requirements.

An internal noise shield provides exceptional common mode rejection of 10 kV/μs. An improved package allows superior insulation permitting a 480 V working voltage compared to industry standard 220 V.

FEATURES

- Low current—0.5 mA
- Superior CTR—2000%
- Superior CMR—10 kV/μs
- Double working voltage—480 V RMS
- CTR guaranteed 0-70°C
- U.L. recognized (File #E50151)

APPLICATIONS

- Digital logic ground isolation
- Telephone ring detector
- EIA RS-232C line receiver
- High common mode noise line receiver
- μP bus isolation
- Current loop receiver

ABSOLUTE MAXIMUM RATINGS

TOTAL PACKAGE	
Storage temperature	−55°C to +125°C
Operating temperature	0°C to +70°C
Lead solder temperature	260°C for 10 sec
INPUT DIODE	
Average input current	20 mA *(1)*
Peak input current (50% duty cycle, 1 ms P.W.)	40 mA
Peak transient input current—I_F (≤1 μsec P.W., 300 pps)	1.0 A
Reverse input voltage	5V
Input power dissipation	35 mW *(2)*

OUTPUT TRANSISTOR	
Output current (Pin 6)	60 mA *(3)*
Emitter-base reverse voltage (Pin 5-7)	.5 V
Supply and output voltage—V_{CC} (Pin 8-5), V_O (Pin 6-5)	
6N138	−0.5 to 7 V
6N139	−0.5 to 18 V
Output power dissipation	100 mW *(4)*

HIGH GAIN SPLIT-DARLINGTON OPTOCOUPLERS

ELECTRICAL SPECIFICATIONS (T_A=0°C to +70°C Unless Otherwise Specified)

INDIVIDUAL COMPONENT CHARACTERISTICS

PARAMETER	SYMBOL	DEVICE	MIN.	TYP.**	MAX.	UNITS	TEST CONDITIONS
INPUT DIODE							
Input forward voltage	V_F			1.45	1.7*	V	I_F=1.6 mA, T_A=25°C
Reverse breakdown voltage	BV_R		5*			V	I_R=10μA, T_A=25°C
Temperature coefficient of forward voltage	$\frac{\Delta V_F}{\Delta T_A}$			−1.8		mV/°C	I_F=1.6 mA
Input capacitance	C_O			60		pF	f=1 MHz, V_F=0
DETECTION							
Logic low supply current (Note 6)	I_{CCL}			0.20		mA	I_F=1.6 mA, V_O=Open, V_{CC}=5 V
Logic high supply current (Note 6)	I_{CCH}			10.0		nA	I_F=0 mA, V_O=Open, V_{CC}=5 V

TRANSFER CHARACTERISTICS

DC CHARACTERISTICS	SYMBOL	DEVICE	MIN.	TYP.**	MAX.	UNITS	TEST CONDITIONS
Current transfer ratio (Notes 5, 6)	CTR	6N139	400*	2000		%	I_F=0.5 mA, V_O=0.4 V, V_{CC}=4.5 V
		6N139	500*	2000		%	I_F=1.6 mA, V_O=0.4 V, V_{CC}=4.5 V
		6N138	300*	2000		%	I_F=1.6 mA, V_O=0.4 V, V_{CC}=4.5 V
Logic low output voltage (Note 6)	V_{OL}	6N139		0.06	0.4	V	I_F=1.6 mA, I_O=6.4 mA, V_{CC}=4.5 V
		6N139		0.08	0.4	V	I_F=5 mA, I_O=15 mA, V_{CC}=4.5 V
		6N139		0.09	0.4	V	I_F=12 mA, I_O=24 mA, V_{CC}=4.5 V
		6N138		0.06	0.4	V	I_F=1.6 mA, I_O=4.8 mA, V_{CC}=4.5 V
Logic high output current (Note 6)	I_{OH}	6N139		0.1	100*	μA	I_F=0 mA, V_O=V_{CC}=18 V
		6N138		0.001	250*	μA	I_F=0 mA, V_O=V_{CC}=7 V

SWITCHING SPECIFICATIONS (T_A=25°C, V_{CC}=5.0 V)

PARAMETER	SYMBOL	DEVICE	MIN.	TYP.**	MAX.	UNITS	TEST CONDITIONS
TRANSISTOR AC							
Propagation delay time to logic low at output (see Fig. 5; Notes 6, 8)	t_{PHL}	6N139		5.0	25*	μs	I_F=0.5 mA, R_L=4.7 kΩ
		6N139		0.2	1*	μs	I_F=12 mA, R_L=270 Ω
		6N138		1.0	10*	μs	I_F=1.6 mA, R_L=2.2 kΩ
Propagation delay time to logic high at output (see Fig. 5; Notes 6, 8)	t_{PLH}	6N139		1.0	60*	μs	I_F=0.5 mA, R_L=4.7 kΩ
		6N139		1.0	7*	μs	I_F=12 mA, R_L=270 Ω
		6N138		4.0	35*	μs	I_F=1.6 mA, R_L=2.2 kΩ
Common mode transient immunity at logic high level output (see Fig. 6; Note 9)	CM_H		1000	10,000		V/μs	I_F=0 mA, R_L=2.2 kΩ $\lvert V_{cm}\rvert$=10 $V_{p\text{-}p}$
Common mode transient immunity at logic low level output (see Fig. 6; Note 9)	CM_L		−1000	−10,000		V/μs	I_F=1.6 mA, R_L=2.2 kΩ $\lvert V_{cm}\rvert$=10 $V_{p\text{-}p}$

**JEDEC registered data*

***All typicals at T_A=25°C and V_{CC}=5 V*

HIGH GAIN
SPLIT-DARLINGTON OPTOCOUPLERS

ISOLATION CHARACTERISTICS

CHARACTERISTICS	SYMBOL	DEVICE	MIN.	TYP.**	MAX.	UNITS	TEST CONDITIONS
Isolation leakage (Input-Output) (Note 7)	$I_{I\text{-}O}$				1.0*	μA	45% Relative Humidity, T_A=25°C $V_{I\text{-}O}$=3000 V, t_d=5 sec
Withstand isolation test voltage	V_{ISO}		2500			V_{RMS}	RH≤50%, T_A=25°C, t=1 min
Resistance (Input-Output) (Note 7)	$R_{I\text{-}O}$			10^{12}		Ω	$V_{I\text{-}O}$=500 Vdc
Capacitance (Input-Output) (Note 7)	$C_{I\text{-}O}$			0.6		pF	f=1 MHz

NOTES

1. *Derate linearly above 50°C free-air temperature at a rate of 0.4 mA/°C.*
2. *Derate linearly above 50°C free-air temperature at a rate of 0.7 mW/°C.*
3. *Derate linearly above 25°C free-air temperature at a rate of 0.7 mA/°C.*
4. *Derate linearly above 25°C free-air temperature at a rate of 2.0 mW/°C.*
5. *DC CURRENT TRANSFER RATIO is defined as the ratio of output collector current, I_O, to the forward LED input current, I_F, times 100%.*
6. *Pin 7 Open.*
7. *Device considered a two-terminal device: Pins 1, 2, 3, and 4 shorted together and Pins 5, 6, 7, and 8 shorted together.*
8. *Use of a resistor between pin 5 and 7 will decrease gain and delay time.*
9. *Common mode transient immunity in Logic High level is the maximum tolerable (positive) dv_{cm}/dt on the leading edge of the common mode pulse, V_{cm}, to assure that the output will remain in a Logic High state (i.e., V_O>2.0 V). Common mode transient immunity in Logic Low level is the maximum tolerable (negative) dv_{cm}/dt on the trailing edge of the common mode pulse signal, V_{cm}, to assure that the ouput will remain in a Logic Low state (i.e., V_O<0.8 V).*

ELECTRICAL CHARACTERISTIC CURVES (T_A=25°C Unless Otherwise Specified)

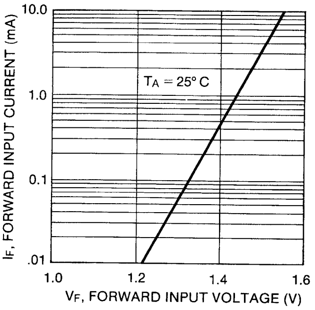


Fig. 1. Input Diode Forward Current vs. Forward Voltage

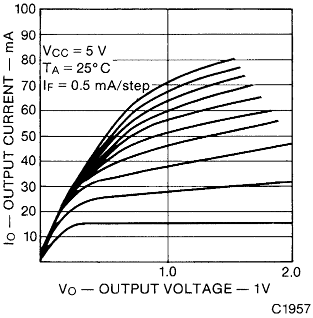


Fig. 2. 6N138/9 DC Transfer Characteristics

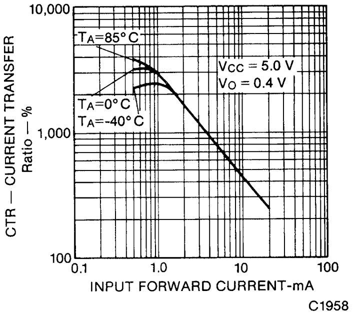


Fig. 3. Current Transfer Ratio vs. Input Forward Current

ELECTRICAL CHARACTERISTIC CURVES (T$_A$=25°C Unless Otherwise Specified) (Cont'd)

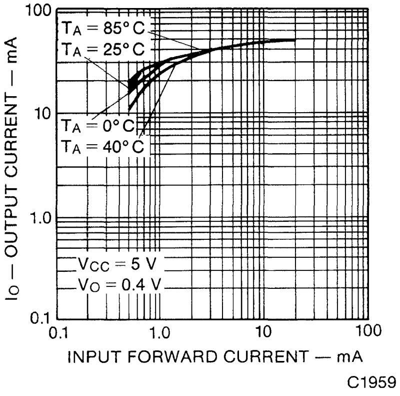


Fig. 4. 6N138 Output Current vs.
Input Diode Forward Current

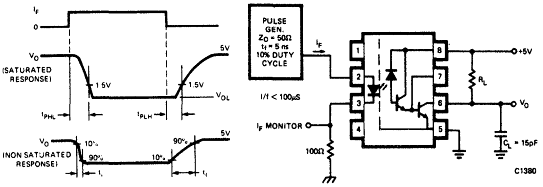


Fig. 5. Switching Test Circuit

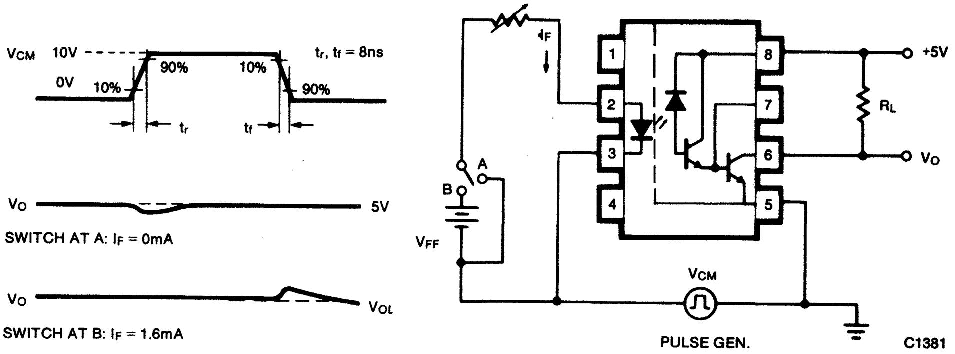
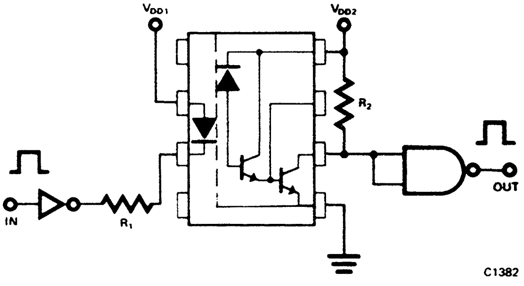
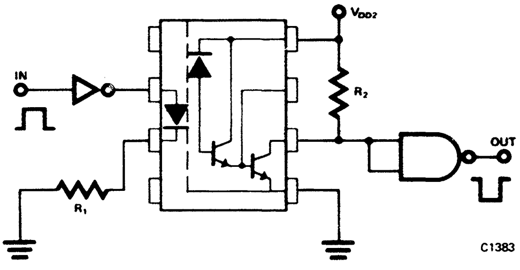


Fig. 6. Test Circuit for Transient Immunity and Typical Waveforms



Non-Inverting Logic Interface



Inverting Logic Interface

ELECTRICAL CHARACTERISTIC CURVES (T_A=25°C Unless Otherwise Specified) (Cont'd)

$$R_1 \text{ (NON-INVERT)} = \frac{V_{DD1} - V_{DF} - V_{OL1}}{I_F}$$

$$R_1 \text{ (INVERT)} = \frac{V_{DD1} - V_{OH1} - V_{DF}}{I_F}$$

$$R_2 = \frac{V_{DD2} - V_{OLX} (@I_L + I_2)}{I_L}$$

WHERE: V_{DD1} : INPUT SUPPLY VOLTAGE
V_{DD2} : OUTPUT SUPPLY VOLTAGE
V_{DF} : DIODE FORWARD VOLTAGE
V_{OL1} : LOGIC "0" VOLTAGE OF DRIVER
V_{OH1} : LOGIC "1" VOLTAGE OF DRIVER
I_F : DIODE FORWARD CURRENT
V_{OLX} : SATURATION VOLTAGE OF MCC670
I_L : LOAD CURRENT THROUGH RESISTOR R_2
I_2 : INPUT CURRENT OF OUTPUT GATE.

Current Limiting Resistor Calculation

			OUTPUT						
			CMOS @ 5V	CMOS @ 10V	74XX	74LXX	74SXX	74LSXX	74HXX
INPUT		R_1 (Ω)	R_2 (Ω)	R_2 (Ω)	R_2 (Ω)	R_2 (Ω)	R_2 (Ω)	R_2 (Ω)	R_2 (Ω)
CMOS @ 5V	NON-INV.	2000	1000	2200	750	1000	1000	1000	560
	INV.	510							
CMOS @ 10V	NON-INV.	5100							
	INV.	4700							
74XX	NON-INV.	2200							
	INV.	180							
74LXX	NON-INV.	1800							
	INV.	100							
74SXX	NON-INV.	2000							
	INV.	360							
74LSXX	NON-INV.	2000							
	INV.	180							
74HXX	NON-INV.	2000							
	INV.	180							

Resistor Values for Logic Interface

QT
OPTOELECTRONICS

HIGH-SPEED LOGIC-TO-LOGIC OPTOCOUPLERS

OPTOLOGIC™

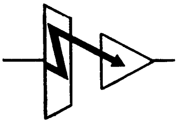
LSTTL to

TTL BUFFER	74**OL**6000
TTL INVERTER	74**OL**6001
CMOS BUFFER	74**OL**6010
CMOS INVERTER	74**OL**6011

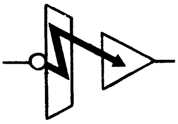
ORDER INFORMATION

PART NUMBER	LOGIC COMPATIBILITY		LOGIC FUNCTION	OUTPUT CONFIGURATION
	INPUT	OUTPUT		
74**OL**6000	LSTTL	TTL	BUFFER	TOTEM POLE
74**OL**6001	LSTTL	TTL	INVERTER	TOTEM POLE
74**OL**6010	LSTTL	CMOS	BUFFER	OPEN COLLECTOR
74**OL**6011	LSTTL	CMOS	INVERTER	OPEN COLLECTOR

SYMBOL



Buffer



Inverter

APPLICATIONS

- Transmission line interface—receiver and driver
- Excellent as bridged receiver in fast LAN highways
- Bus interface
- Logic family interface with ground loop noise elimination
- High speed AC/DC voltage sensing
- Driver for power semiconductor devices
- Level shifting
- Replaces fast pulse transformers

FEATURES

- Industry first LSTTL to TTL and LSTTL to CMOS complete logic-to-logic optocoupler
- Incorporates LED drive circuitry—use as logic gate
- Very high speed
- Choice of buffer or inverter
- Choice of TTL or CMOS compatible output up to 15 volts
- Fan-out of 10 TTL loads, fan-in 1 LSTTL load
- Internal noise shield—very high CMR of ±15 kV/μs
- Provides superior 5300 VRMS Withstand Test Voltage (WTV)—guarantees 480 VAC operation
- Compact 6-pin DIP
- UL recognized (File #E90700)
- Same noise immunity as LSTTL/TTL.

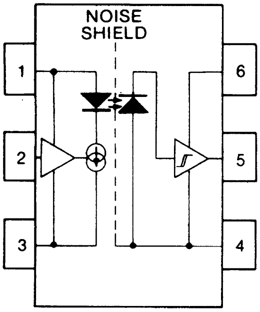
PIN CONFIGURATION

1–V_{CCI} (Input V_{CC})
2–V_{IN} (Data in)
3–GND_I (Input GND)

6–V_{CCO} (Output V_{CC})
5–V_O (Data out)
4–GND_O (Output GND)

EQUIVALENT CIRCUITS

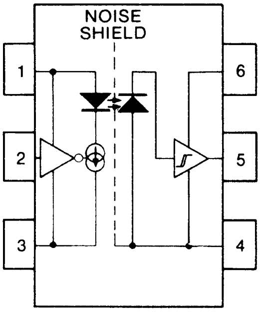
74OL6000



C2004

LSTTL to TTL Buffer

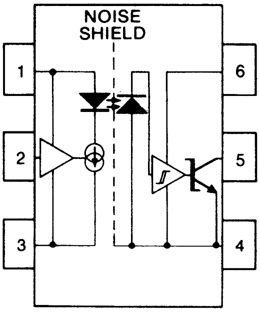
74OL6001



C2005

LSTTL to TTL Inverter

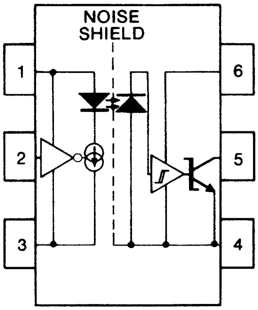
74OL6010



C2002

LSTTL to CMOS Buffer

74OL6011



C2003

LSTTL to CMOS Inverter

HIGH-SPEED LOGIC-TO-LOGIC OPTOCOUPLERS

DESCRIPTION

OPTOLOGIC™ is the first family of truly logic compatible optically coupled logic interface gates.

The family consists of four device types offering LSTTL to TTL and LSTTL to CMOS interfacing. Each of these interfacing functions is available as a buffer (A=B), or as an inverter (A=$\overline{B}$).

The LSTTL input compatibility is provided by an input integrated circuit, with industry standard logic levels. This input amplifier IC switches a temperature compensated current source driving a high speed GaAsP/GaAs 700 nm LED emitter.

This novel integration scheme eliminates CTR degradation over time and temperature.

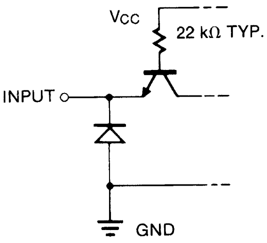
The emitter is optically coupled to an integrated photodetector/high-gain, high-speed output amplifier IC. The superior 15 kV/μs common-mode noise rejection is ensured through the use of an optically transparent noise shield.

The TTL compatible output has a totem-pole with a fan-out of 10. The CMOS compatible output has an open collector Schottky-clamped transistor that interfaces to any CMOS logic between 4.5 and 15 volts.

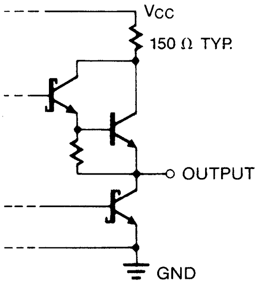
The 74**OL**6010/11 may also be used to drive power MOS FETS or transistors up to 15 volts.

The Optologic coupler family typically offers propagation of delays of 60 ns and can support 15 MBaud data communication.

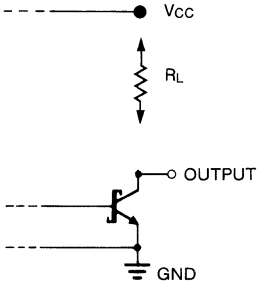
The two input chips and the output chip are assembled in a 6-pin DIP high insulation voltage plastic package. It provides a withstand test voltage of 5300 VRMS (1 minute), which is recognized as a working voltage of 480 VRMS.



LSTTL INPUT CIRCUIT
C2010
All Inputs



TTL OUTPUT CIRCUIT
C2009
*74***OL**6000/01 Output



CMOS OUTPUT CIRCUIT
C2026
*74***OL**6010/11 Output

ABSOLUTE MAXIMUM RATINGS 74OL6000/01

Storage temperature range	−55°C to +125°C
Operating temperature range	0°C to +70°C
Input supply voltage	7 V
Input voltage	7 V
Output supply voltage	7 V
Output voltage	7 V
Output current	40 mA
Power dissipation	350 mW
Lead temperature (soldering, 10 sec)	260°C

ABSOLUTE MAXIMUM RATINGS 74OL6010/11

Storage temperature range	−55°C to +125°C
Operating temperature range	0°C to +70°C
Input supply voltage	7 V
Input voltage	7 V
Output supply voltage	18 V
Output voltage	18 V
Output current	40 mA
Power dissipation	350 mW*
Lead temperature (soldering, 10 sec)	260°C

*See Fig. 12 for maximum allowable output supply voltage.

ELECTRICAL CHARACTERISTICS (T$_A$=0°C to 70°C Unless Otherwise Specified)

PARAMETER	SYM	MIN	TYP*	MAX	UNITS	TEST CONDITIONS 74OL6000	TEST CONDITIONS 74OL6001	TEST CONDITIONS 74OL6000/01	FIG.	NOTES
TTL OUTPUT 74OL6000/01										
Input supply voltage	V_{CCI}	4.5	5.0	5.5	V					1
Output supply voltage	V_{CCO}	4.5	5.0	5.5	V					1
High-level input voltage	V_{IH}	2.0			V					1
Low-level input voltage	V_{IL}			0.8	V					1
Input clamp voltage	V_{IK}			−1.2	V			V_{CCI}=4.5 V, I_I=−18 mA		1
High-level input current	I_{IH}		1.0	40.0	μA			V_{CCI}=5.5 V, V_{IH}=4.5 V		1
Low-level input current	I_{IL}		−200.0	−400.0	μA			V_{CCI}=5.5 V, V_{IL}=0.4 V		1
Input supply current (high)	I_{CCIH}		10.0	14.0	mA			V_{CCI}=5.5 V, V_{IN}=V_{IH}		1
Input supply current (low)	I_{CCIL}		10.0	14.0	mA			V_{CCI}=5.5 V, V_{IN}=V_{IL}		1
High-level output voltage	V_{OH}	2.4	3.0		V	V_{IN}=2.0 V	V_{IN}=0.8 V	V_{CCI}=4.5 V, V_{CCO}=4.5 V, I_{OH}=−400μA		1
Low-level output voltage	V_{OL}		0.3	0.6	V	V_{IN}=0.8 V	V_{IN}=2.0 V	V_{CCI}=4.5 V, V_{CCO}=4.5 V, I_{OL}=16 mA		1
				0.5	V			V_{CCI}=4.5 V, V_{CCO}=4.5 V, I_{OL}=4 mA		
High-level output current	I_{OH}		−8.0	−10.0	mA	V_{IN}=V_{IH}	V_{IN}=V_{IL}	V_{CCI}=4.5 V, V_{CCO}=4.5 V, V_{OH}=2.4 V		1
Low-level output current	I_{OL}	16.0			mA	V_{IN}=0.8 V	V_{IN}=2.0 V	V_{CCI}=4.5 V, V_{CCO}=4.5 V, V_{OL}=0.6 V		1
Short-circuit output current	I_{OS}	−5.0	−25.0	−40.0	mA	V_{IN}=V_{IH}	V_{IN}−V_{IL}	V_{CCI}=5.5 V, V_{CCO}=5.5 V		1
Output supply current (high)	I_{CCOH}		9.0	15.0	mA	V_{IN}=V_{IH}	V_{IN}=V_{IL}	V_{CCI}=5.5 V, V_O=V_{OH}, V_{CCO}=5.5 V		1
Output supply current (low)	I_{CCOL}		8.0	12.0	mA	V_{IN}=V_{IL}	V_{IN}=V_{IH}	V_{CCI}=5.5 V, V_O=V_{OL}, V_{CCO}=5.5 V		1

**All typical values are at T_A=25°C*

SWITCHING CHARACTERISTICS (T$_A$=25°C Unless Otherwise Specified)

PARAMETER	SYM	MIN	TYP	MAX	UNITS	TEST CONDITIONS	FIG.	NOTES
TTL OUTPUT 74OL6000/01								
Propagation delay time for output low level	t_{PHL}		60	100	ns	V_{CCI}=5 V, V_{CCO}=5 V	15, 17	1
Propagation delay time for output high level	t_{PLH}		70	100	ns		15, 17	1
Output rise time for output high level	t_r		45		ns		15, 17	1
Output fall time for output low level	t_f		5		ns		15, 17	1

HIGH-SPEED LOGIC-TO-LOGIC OPTOCOUPLERS

ELECTRICAL CHARACTERISTICS (T_A=0°C to 70°C Unless Otherwise Specified)

PARAMETER	SYM	MIN	TYP*	MAX	UNITS	TEST CONDITIONS			FIG.	NOTES
						74OL6010	74OL6011	74OL6010/11		
CMOS OUTPUT 74OL6010/11										
Input supply voltage	V_{CCI}	4.5	5.0	5.5	V					1
Output supply voltage	V_{CCO}	4.5		15.0	V					1, 3
High-level input voltage	V_{IH}	2.0			V					1
Low-level input voltage	V_{IL}			0.8	V					1
Input clamp voltage	V_{IK}			−1.2	V			V_{CCI}=4.5 V, I_I=−18 mA		1
High-level input current	I_{IH}		1.0	40.0	μA			V_{CCI}=5.5 V, V_{IH}=4.5 V		1
Low-level input current	I_{IL}		−200.0	−400.0	μA			V_{CCI}=5.5 V, V_{IL}=0.4 V		1
Input supply current (high)	I_{CCIH}		10.0	14.0	mA			V_{CCI}=5.5 V, V_{IN}=V_{IH}		1
Input supply current (low)	I_{CCIL}		10.0	14.0	mA			V_{CCI}=5.5 V, V_{IN}=V_{IL}		1
Low-level output voltage	V_{OL}		0.4	0.6	V	V_{IN}=0.8 V	V_{IN}=2.0 V	V_{CCI}=4.5 V, V_{CCO}=4.5 V, I_{OL}=16 mA		1
				0.5				V_{CCI}=4.5 V, V_{CCO}=4.5 V, I_{OL}=4 mA		
High-level output current	I_{OH}		1.0	100.0	μA	V_{IN}=V_{IH}	V_{IN}=V_{IL}	V_{CCI}=4.5 V, V_{OH}=15 V, V_{CCO}=4.5 −15 V		1
Low-level output current	I_{OL}	16.0			mA	V_{IN}=0.8 V	V_{IN}=2.0 V	V_{CCI}=4.5 V, V_{OL}=0.6 V, V_{CCO}=4.5 −15 V		1
Output supply current (high)	I_{CCOH}		9.0	12.0	mA	V_{IN}=V_{IH}	V_{IN}=V_{IL}	V_{CCI}=5.5 V, V_O=V_{OH}, V_CC_O=4.5 V		1
			11.0	18.0				V_{CCI}=5.5 V, V_O=V_{OH}, V_{CCO}=15 V		
Output supply current (low)	I_{CCOL}		8.0	12.0	mA	V_{IN}=V_{IL}	V_{IN}=V_{IH}	V_{CCI}=5.5 V, V_O=V_{OL}, V_{CCO}=4.5 V		1
			11.0	18.0				V_{CCI}=5.5 V, V_O=V_{OL}, V_{CCO}=15 V		

All typical values are at T_A=25°C

SWITCHING CHARACTERISTICS (T_A=25°C Unless Otherwise Specified)

PARAMETER	SYM	MIN	TYP	MAX	UNITS	TEST CONDITIONS	FIG.	NOTES
TTL OUTPUT 74OL6010/11								
Propagation delay time for output low level	t_{PHL}		60	120	ns	V_{CCI}=5 V, V_{CCO}=5 V, R_L=470 Ω	15, 18	1
Propagation delay time for output high level	t_{PLH}		100	180	ns		15, 18	1
Output rise time for output high level	t_r		50		ns		15, 18	1
Output fall time for output low level	t_f		5		ns		15, 18	1

ELECTRICAL CHARACTERISTICS (T_A=0°C to 70°C Unless Otherwise Specified)

PARAMETER	SYMBOL	MIN	TYP	MAX	UNITS	TEST CONDITIONS	FIG.	NOTES
74OL6000/01/10/11								
Common mode transient immunity at logic high level output	CM_H	5000	15000		V/μs	V_{CCI}=5 V, V_{CCO}=5 V, V_{CM}=50 V_{p-p}	16, 19	
Common mode transient immunity at logic low level output	CM_L	−5000	−15000		V/μs		16, 19	
Common mode coupling capacitance	C_{CM}		0.005		pF			
Capacitance (input-output)	C_{I-O}		0.7		pF	V_{I-O}=0, f=1 MHz		2
Withstand insulation test voltage	V_{ISO}	5300			VRMS	T_A=25°C, t=1 min, $I_{I-O} \leq 1$ μA		2
Insulation resistance	R_{ISO}		10^{11}		Ω	V_{I-O}=500 VDC		2

TYPICAL CHARACTERISTIC CURVES (T_A=25°C Unless Otherwise Specified)

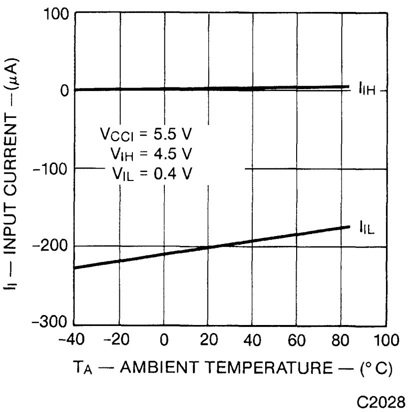


Fig. 1. Input Current vs. Ambient Temperature

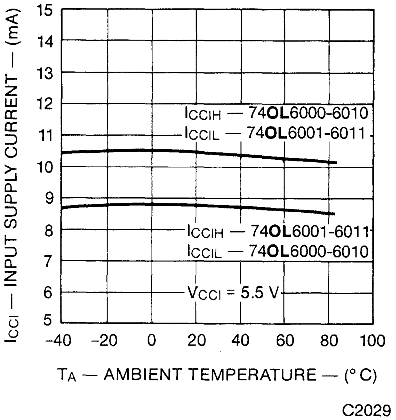


Fig. 2. Input Supply Current vs. Ambient Temperature

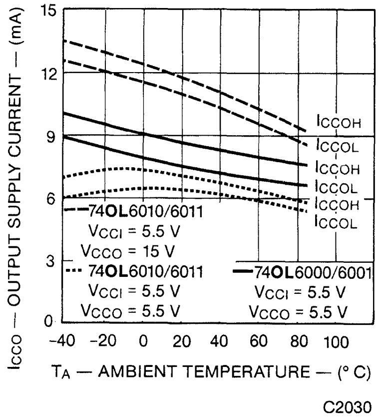


Fig. 3. Output Supply Current vs. Ambient Temperature

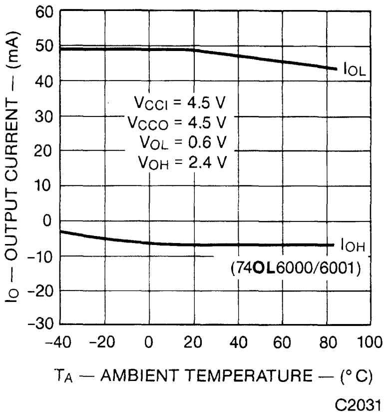


Fig. 4. Output Current vs. Ambient Temperature

TYPICAL CHARACTERISTIC CURVES (T_A=25°C Unless Otherwise Specified) (Cont'd)

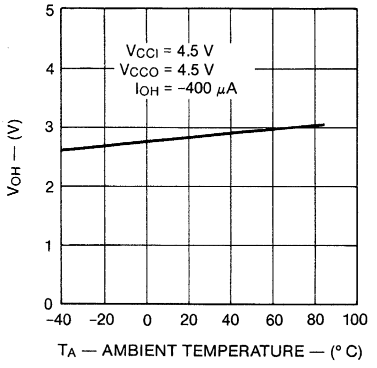


Fig. 5. High-Level Output Voltage vs. Ambient Temperature

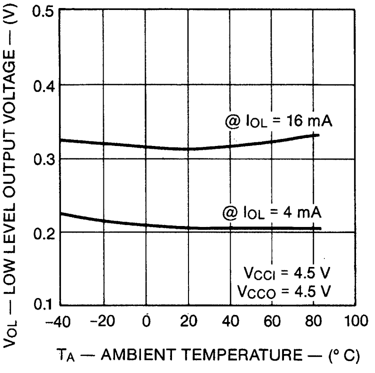


Fig. 6. Low-Level Output Voltage vs. Ambient Temperature

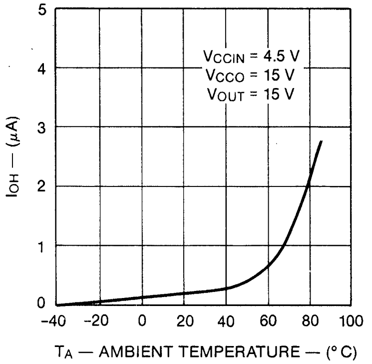


*Fig. 7. 74***OL***6010/11 Leakage Current vs. Ambient Temperature*

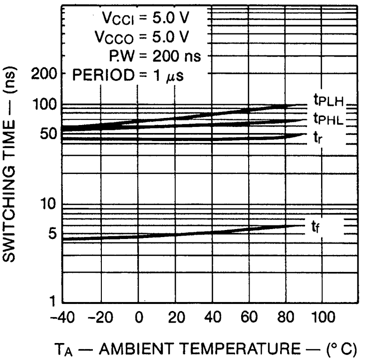


*Fig. 8. 74***OL***6000/01 Switching Times vs. Ambient Temperature*

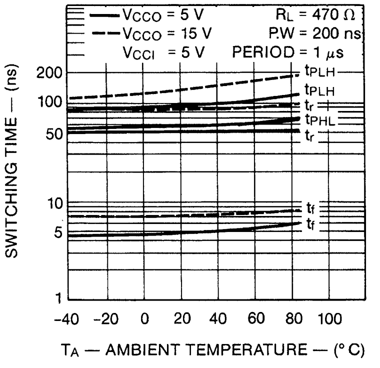


*Fig. 9. 74***OL***6010/11 Switching Times vs. Ambient Temperature*

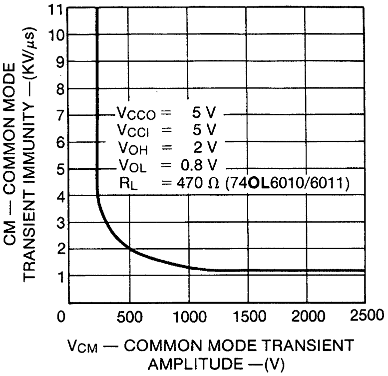
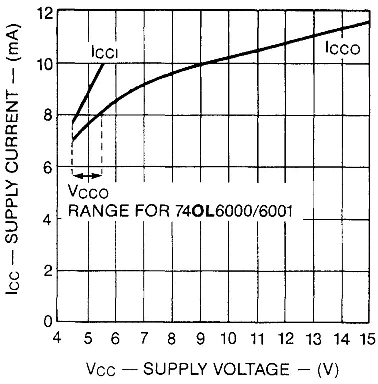


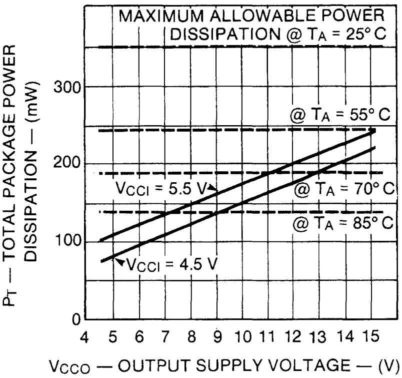
Fig. 10. Common Mode Rejection vs. Common Mode Voltage

TYPICAL CHARACTERISTIC CURVES (T_A=25°C Unless Otherwise Specified) (Cont'd)



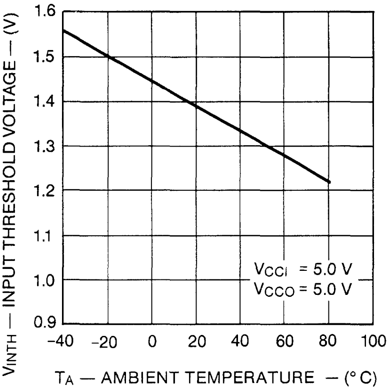
C2038

Fig. 11. Supply Current vs. Supply Voltage



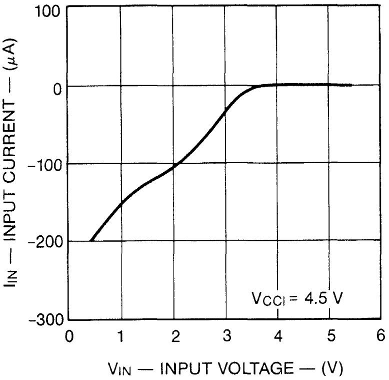
C2039

Fig. 12. Power Dissipation vs. Ambient Temperature



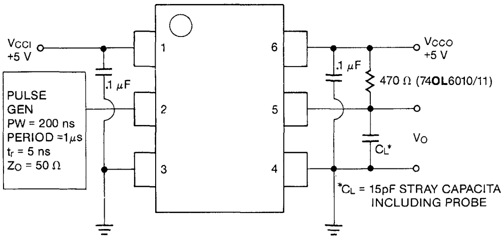
C2040

Fig. 13. Input Threshold Voltage vs. Ambient Temperature



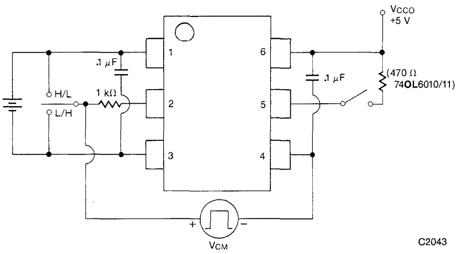
C2041

Fig. 14. Input Current vs. Input Voltage



C2042

Fig. 15. Switching Time Test Circuit



C2043

Fig. 16. Common Mode Rejection Test Circuit

TYPICAL CHARACTERISTIC CURVES (T_A=25°C Unless Otherwise Specified) (Cont'd)

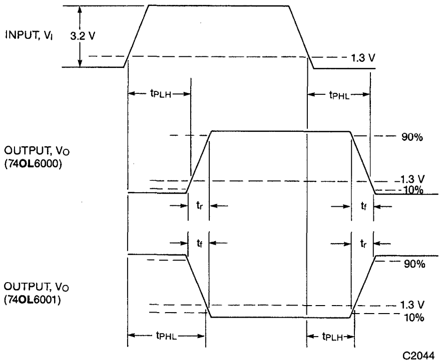


Fig. 17. 74**OL**6000/01 Switching Times vs. Ambient Temperature

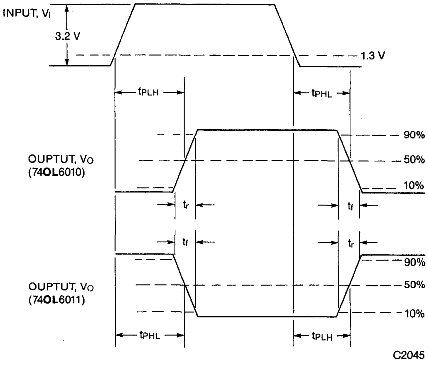
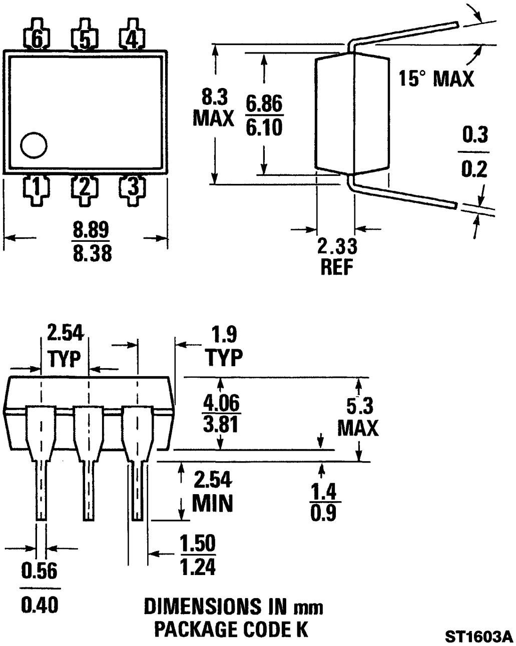


Fig. 18. Switching Parameters 74**OL**6010/11

PACKAGE DIMENSIONS



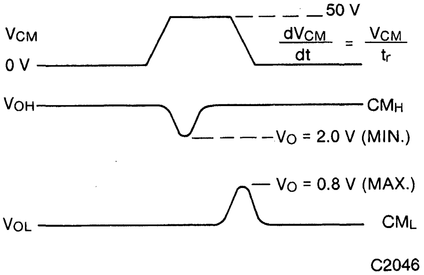


Fig. 19. Common Mode Rejection Waveforms

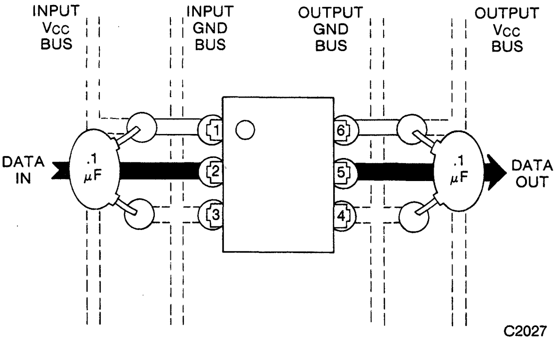
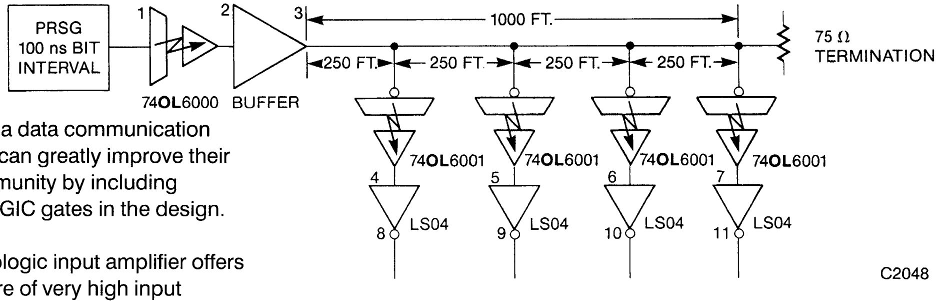


Fig. 20. Suggested PCB Lay-out

NOTES

1. *The V_{CCO} and V_{CCI} supply voltages to the device must each be bypassed by a 0.1 μf capacitor or larger. This can be either a ceramic or solid tantalum capacitor with good high frequency characteristics. Its purpose is to stabilize the operation of the high-gain amplifiers. Failure to provide the bypass will impair the DC and switching properties. The total lead length between capacitor and optocoupler should not exceed 1.5mm. See Fig. 20.*
2. *Device considered a two-terminal device: Pins 1, 2 and 3 shorted together, and Pins 4, 5 and 6 shorted together.*
3. *For example, assuming a V_{CCI} of 5.0 V, and an ambient temperature of 70°C, the maximum allowable V_{CCO} is 12.1 V.*

APPLICATION

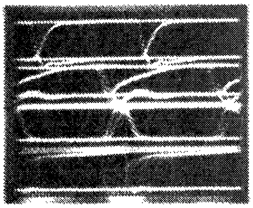


Local area data communication systems can greatly improve their noise immunity by including OPTOLOGIC gates in the design.

The Optologic input amplifier offers the feature of very high input impedance that permits their use as bridged line receivers. The system shown above illustrates an optically isolated transmitter and multidrop receiver system. The network uses a 74**OL**6000 and buffer (Figure D) to isolate the transmitter and drive the 75Ω coax cable. This application uses a 1000 ft. aerial suspension 75Ω CATV coax cable with data taps at 250 ft. intervals. The 74**OL**6001s function as bridged receivers, and as many as 30 receivers could be placed along the line with minimal signal degradation. The communication cable is terminated with a single 75Ω load at the far end of the line.

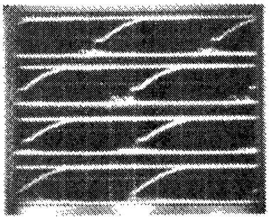
Signal quality "Eye Pattern" is shown in Figures A, B and C with a 10MBaud NRZ Psuedo-Random Sequence (PRS). Traces 1-3 in Figure A describes the transmitter section. Traces 4-7 in Figure B show the output of the four Optologic bridged terminations. Traces 8-11 in Figure C illustrate "Eye Pattern" as seen at the output of a 74LS04 logic gate. The data quality is well preserved in that only a 30% Eye closure is seen at the receiver located 1000 ft. from the transmitter.

The data communication system is completely optically isolated from all of the terminal equipments. Power for the transmitter (V_{CCO}) and receiver (V_{CCI}) is taken from an isolated power supply and distributed through a drain or messenger wire.



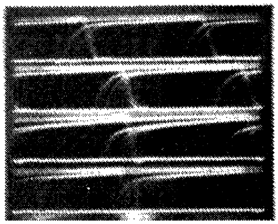
HORIZONTAL=20 ns/DIV 42-11
VERTICAL=2 V/DIV

Figure A



HORIZONTAL=20 ns/DIV 42-12,02
VERTICAL=2 V/DIV

Figure B



HORIZONTAL=20 ns/DIV 42-13,03
VERTICAL=2 V/DIV

Figure C

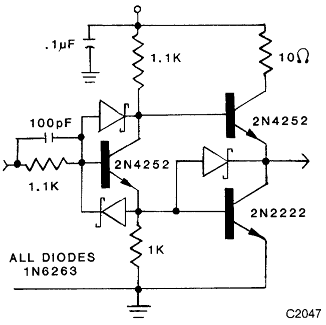


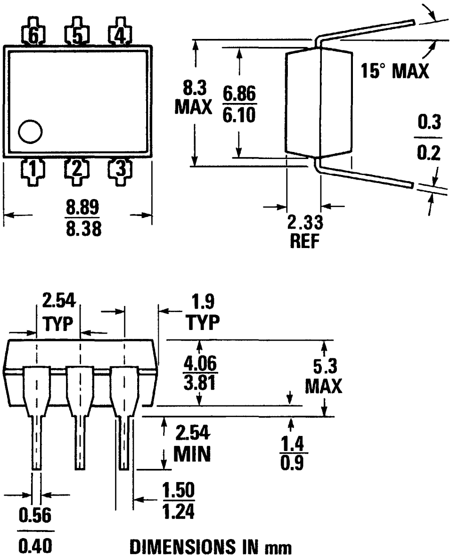
Figure D Buffer

NOTES

— All Optologic Gate Input and Output Amplifiers Bypassed With 0.1 µF Capacitors
— PRSG=Pseudo Random Sequence Generator
— 1 to 11 Refer To Testpoints; See Waveforms on Figs. A, B and C

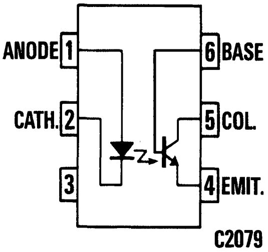
CNY17-1 CNY17-3
CNY17-2 CNY17-4

PACKAGE DIMENSIONS



DIMENSIONS IN mm
PACKAGE CODE K

ST1603A



Equivalent Circuit

DESCRIPTION

The CNY17 series consists of a Gallium Arsenide IRED coupled with an NPN phototransistor.

FEATURES

- High isolation voltage
  5300 VAC RMS—1 minute
  7500 VAC PEAK—1 minute
- High BV_{CEO} minimum 70 volts
- Current transfer ratio in selected groups:

CNY17-1:	40%- 80%
CNY17-2:	63%-125%
CNY17-3:	100%-200%
CNY17-4:	160%-320%

- Maximum switching time in saturation specified
- Underwriters Laboratory (UL) recognized File #E90700

APPLICATIONS

- Power supply regulators
- Digital logic inputs
- Microprocessor inputs
- Appliance sensor systems
- Industrial controls

ABSOLUTE MAXIMUM RATINGS

TOTAL PACKAGE

Storage temperature	−55°C to 150°C
Operating temperature	−55°C to 100°C
Lead temperature (soldering, 10 sec)	260°C
Total package power dissipation @ 25°C (LED plus detector)	260 mW
Derate linearly from 25°C	3.5 mW/°C

INPUT DIODE

Forward DC current	90 mA
Reverse voltage	6 V
Peak forward current (1 μs pulse, 300 pps)	3.0 A
Power dissipation 25°C ambient	135 mW
Derate linearly from 25°C	1.8 mW/°C

OUTPUT TRANSISTOR

Power dissipation @ 25°C	200 mW
Derate linearly from 25°C	2.67 mW/°C

ELECTRO-OPTICAL CHARACTERISTICS (25°C Temperature Unless Otherwise Specified)

INDIVIDUAL COMPONENT CHARACTERISTICS

CHARACTERISTIC	SYMBOL	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS
INPUT DIODE						
Forward voltage	V_F		1.3	1.50	V	I_F=60 mA
Forward voltage temp. coefficient	$\frac{\Delta V_F}{\Delta T_A}$		−1.8		mV/°C	
Reverse voltage	V_R	6.0	15		V	I_R=10 μA
Junction capacitance	C_J		50		pF	V_F=0 V, f=1 MHz
			65		pF	V_F=1 V, f=1 MHz
Reverse leakage current	I_R		.35	10	μA	V_R=3.0 V
OUTPUT TRANSISTOR						
DC forward current gain	h_{FE}	100	500			V_{CE}=5 V, I_C=100 μA
Breakdown voltage						
Collector to emitter	BV_{CEO}	70			V	I_C=1.0 mA, I_F=0
Collector to base	BV_{CBO}	70			V	I_C=10 μA, I_F=0
Emitter to collector	BV_{ECO}	7			V	I_E=100μA, I_F=0
Leakage current						
Collector to emitter	I_{CEO}		5	50	nA	V_{CE}=10 V, I_F=0
Collector to base	I_{CBO}			20	nA	V_{CB}=10 V, I_F=0
Capacitance						
Collector to emitter			8		pF	V_{CE}=0, f=1 MHz
Collector to base			20		pF	V_{CB}=5, f=1 MHz
Emitter to base			10		pF	V_{EB}=0, f=1 MHz

TRANSFER CHARACTERISTICS

DC CHARACTERISTICS	SYMBOL	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS
Current Transfer Ratio, collector to emitter	CTR				%	I_F=10 mA; V_{CE}=5 V
CNY17-1		40		80		
CNY17-2		63		125		
CNY17-3		100		200		
CNY17-4		160		320		
Saturation voltage	$V_{CE(SAT)}$		0.27	.40	V	I_F=10 mA; I_C=2.5 mA

TRANSFER CHARACTERISTICS

AC CHARACTERISTICS	SYMBOL	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS
SWITCHING TIMES						
Non-saturated						
Turn-on time	t_{on}		6.0	10	μs	R_L=100 Ω; I_C=2 mA; V_{CC}=10 V
Turn-off time	t_{off}		5.5	10	μs	See Fig. 10 and Fig. 11.

ELECTRO-OPTICAL CHARACTERISTICS

(25°C Temperature Unless Otherwise Specified) (Cont'd)

TRANSFER CHARACTERISTICS (Cont'd)

AC CHARACTERISTICS	SYMBOL	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS
SATURATED SWITCHING TIMES						
Turn-on time	t_{on}					
CNY17-1			3.0	5.5	μs	I_F=20 mA, V_{CE}=0.4 V
CNY17-2, CNY17-3, CNY17-4			4.2	8.0	μs	I_F=10 mA, V_{CE}=0.4 V
Rise-time	t_r					
CNY17-1			2.0	4.0	μs	I_F=20 mA, V_{CE}=0.4 V
CNY17-2, CNY17-3, CNY17-4			3.0	6.0	μs	I_F=10 mA, V_{CE}=0.4 V
Turn-off time	t_{off}					
CNY17-1			18	34	μs	I_F=20 mA, V_{CE}=0.4 V
CNY17-2, CNY17-3, CNY17-4			23	39	μs	I_F=10 mA, V_{CE}=0.4 V
Fall-time	t_f					
CNY17-1			11	20	μs	I_F=20 mA, V_{CE}=0.4 V
CNY17-2, CNY17-3, CNY17-4			14	24	μs	I_F=10 mA, V_{CE}=0.4 V

ISOLATION CHARACTERISTICS

CHARACTERISTICS	SYMBOL	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS
Isolation Voltage	V_{iso}	5300			V_{AC} RMS	$I_{I\text{-}O} \leq 1$ μA, 1 minute
	V_{iso}	7500			V_{AC} PEAK	$I_{I\text{-}O} \leq 1$ μA, 1 minute
Isolation resistance	R_{iso}	10^{11}			ohms	$V_{I\text{-}O}$=500 VDC
Isolation capacitance	C_{iso}		0.5		pF	f=1 MHz

ELECTRICAL CHARACTERISTIC CURVES

(25°C Free Air Temperature Unless Otherwise Specified)

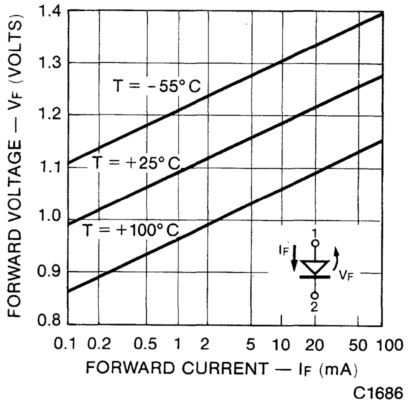


Fig. 1. Forward Voltage vs. Current

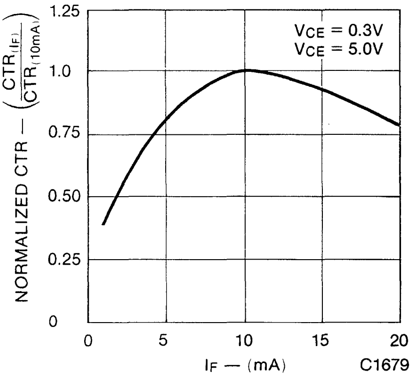


Fig. 2. Normalized CTR vs. Forward Current

ELECTRICAL CHARACTERISTIC CURVES

(25°C Free Air Temperature Unless Otherwise Specified) (Cont'd)

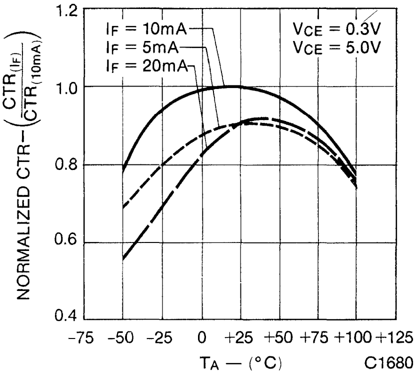


Fig. 3. Normalized CTR vs. Temperature

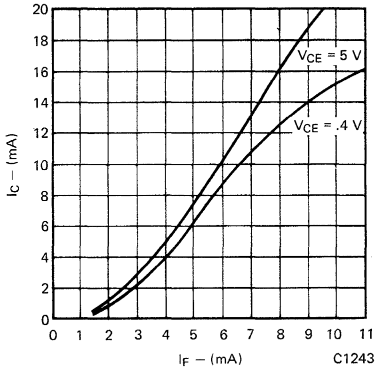


Fig. 4. Collector Current vs. Forward Current

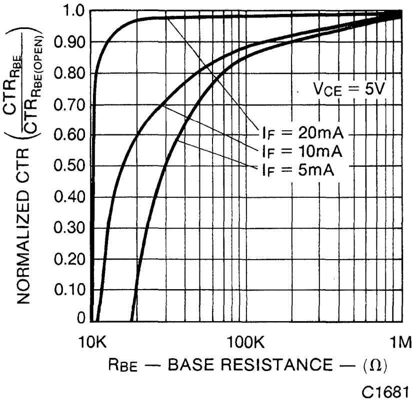


Fig. 5. CTR vs. RBE (Unsaturated)

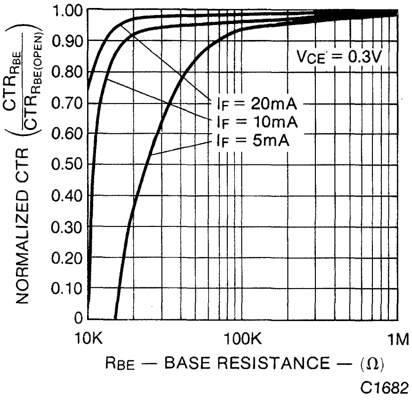


Fig. 6. CTR vs. RBE (Saturated)

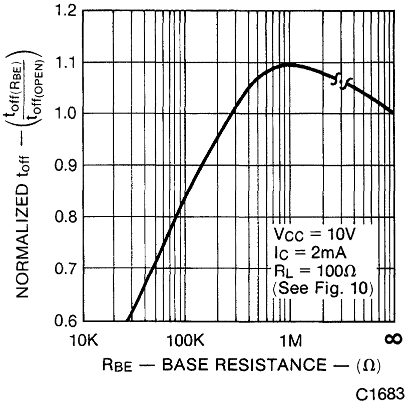


Fig. 7. Normalized T_{OFF} vs. RBE

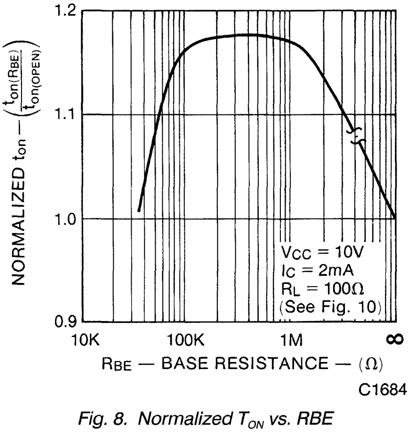


Fig. 8. Normalized T_{ON} vs. RBE

ELECTRICAL CHARACTERISTIC CURVES

(25°C Free Air Temperature Unless Otherwise Specified) (Cont'd)

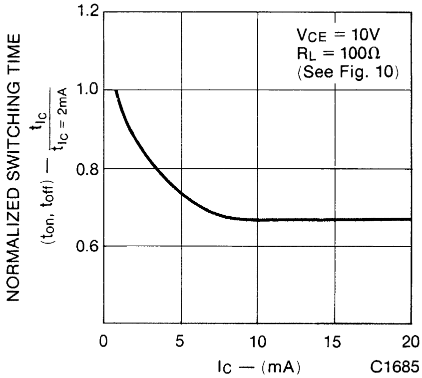


Fig. 9. Switching Time vs. IC

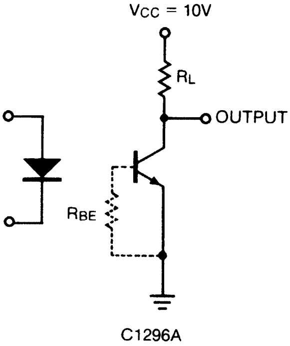


Fig. 10. Switching Time Test Circuit

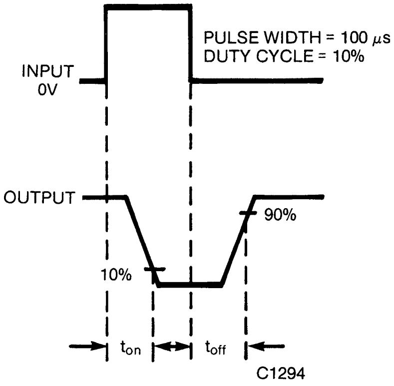
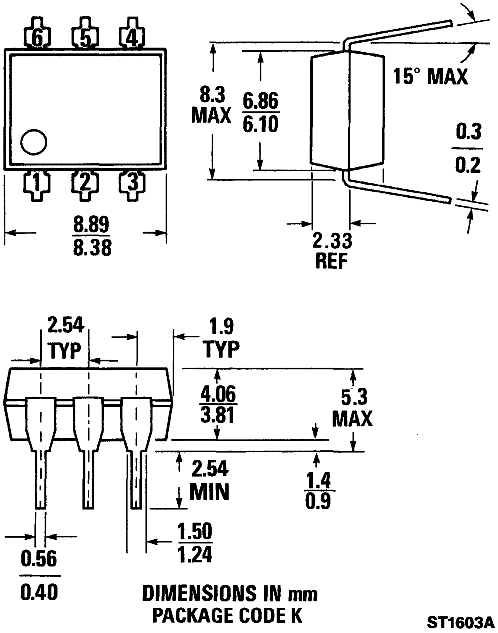


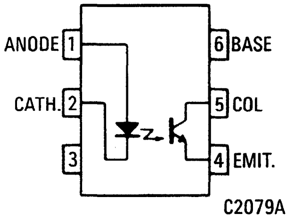
Fig. 11. Switching Time Waveforms

CNY17F-1
CNY17F-2
CNY17F-3

PACKAGE DIMENSIONS



DIMENSIONS IN mm
PACKAGE CODE K



Equivalent Circuit

DESCRIPTION

The CNY17 series consists of a Gallium Arsenide IRED coupled with an NPN phototransistor.

FEATURES

- High isolation voltage
  5300 VAC RMS—1 minute
  7500 VAC PEAK—1 minute
- High BV_{CEO} minimum 70 volts
- Current transfer ratio in selected groups:
  CNY17F1: 40%- 80%
  CNY17F2: 63%-125%
  CNY17F3: 100%-200%
- Maximum switching time in saturation specified
- Underwriters Laboratory (UL) recognized File #E90700

APPLICATIONS

- Power supply regulators
- Digital logic inputs
- Microprocessor inputs
- Appliance sensor systems
- Industrial controls

ABSOLUTE MAXIMUM RATINGS

TOTAL PACKAGE

Storage temperature	−55°C to 150°C
Operating temperature	−55°C to 100°C
Lead temperature (soldering, 10 sec)	260°C
Total package power dissipation @ 25°C (LED plus detector)	260 mW
Derate linearly from 25°C	3.5 mW/°C

INPUT DIODE

Forward DC current	90 mA
Reverse voltage	6 V
Peak forward current (1 μs pulse, 300 pps)	3.0 A
Power dissipation 25°C ambient	135 mW
Derate linearly from 25°C	1.8 mW/°C

OUTPUT TRANSISTOR

Power dissipation @ 25°C	200 mW
Derate linearly from 25°C	2.67 mW/°C

ELECTRO-OPTICAL CHARACTERISTICS (25°C Temperature Unless Otherwise Specified)

INDIVIDUAL COMPONENT CHARACTERISTICS

CHARACTERISTIC	SYMBOL	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS
INPUT DIODE						
Forward voltage	V_F		1.3	1.50	V	I_F=60 mA
Forward voltage temp. coefficient	$\frac{\Delta V_F}{\Delta T_A}$		−1.8		mV/°C	
Reverse voltage	V_R	6.0	15		V	I_R=10 µA
Junction capacitance	C_J		50		pF	V_F=0 V, f=1 MHz
			65		pF	V_F=1 V, f=1 MHz
Reverse leakage current	I_R		.35	10	µA	V_R=3.0 V
OUTPUT TRANSISTOR						
Breakdown voltage						
Collector to emitter	BV_{CEO}	70			V	I_C=1.0 mA, I_F=0
Emitter to collector	BV_{ECO}	7			V	I_E=100µA, I_F=0
Leakage current						
Collector to emitter	I_{CEO}		5	50	nA	V_{CE}=10 V, I_F=0
Capacitance						
Collector to emitter			8		pF	V_{CE}=0, f=1 MHz

TRANSFER CHARACTERISTICS

DC CHARACTERISTICS	SYMBOL	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS
Current Transfer Ratio, collector to emitter	CTR				%	I_F=10 mA; V_{CE}=5 V
CNY17F-1		40		80		
CNY17F-2		63		125		
CNY17F-3		100		200		
Saturation voltage	$V_{CE(SAT)}$		0.27	.40	V	I_F=10 mA; I_C=2.5 mA

TRANSFER CHARACTERISTICS

AC CHARACTERISTICS	SYMBOL	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS
SWITCHING TIMES						
Non-saturated						R_L=100 Ω; I_C=2 mA;
Turn-on time	t_{on}		6.0	10	µs	V_{CC}=10 V
Turn-off time	t_{off}		5.5	10	µs	See Fig. 10.

ELECTRO-OPTICAL CHARACTERISTICS

(25°C Temperature Unless Otherwise Specified) (Cont'd)

TRANSFER CHARACTERISTICS (Cont'd)

AC CHARACTERISTICS	SYMBOL	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS
SATURATED SWITCHING TIMES						
Turn-on time	t_{on}					
CNY17F-1			3.0	5.5	μs	I_F=20 mA, V_{CE}=0.4 V
CNY17F-2, CNY17F-3			4.2	8.0	μs	I_F=10 mA, V_{CE}=0.4 V
Rise-time	t_r					
CNY17F-1			2.0	4.0	μs	I_F=20 mA, V_{CE}=0.4 V
CNY17F-2, CNY17F-3			3.0	6.0	μs	I_F=10 mA, V_{CE}=0.4 V
Turn-off time	t_{off}					
CNY17F-1			18	34	μs	I_F=20 mA, V_{CE}=0.4 V
CNY17F-2, CNY17F-3			23	39	μs	I_F=10 mA, V_{CE}=0.4 V
Fall-time	t_f					
CNY17F-1			11	20	μs	I_F=20 mA, V_{CE}=0.4 V
CNY17F-2, CNY17F-3			14	24	μs	I_F=10 mA, V_{CE}=0.4 V

ISOLATION CHARACTERISTICS

CHARACTERISTICS	SYMBOL	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS
Isolation Voltage	V_{iso}	5300			V_{AC} RMS	$I_{I-O} \leq 1$ μA, 1 minute
	V_{iso}	7500			V_{AC} PEAK	$I_{I-O} \leq 1$ μA, 1 minute
Isolation resistance	R_{iso}	10^{11}			ohms	V_{I-O}=500 VDC
Isolation capacitance	C_{iso}		0.5		pF	f=1 MHz

ELECTRICAL CHARACTERISTIC CURVES

(25°C Free Air Temperature Unless Otherwise Specified)

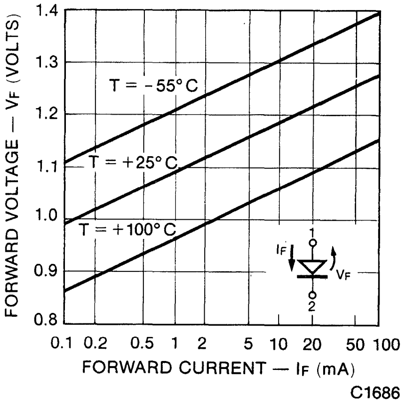


Fig. 1. Forward Voltage vs. Current

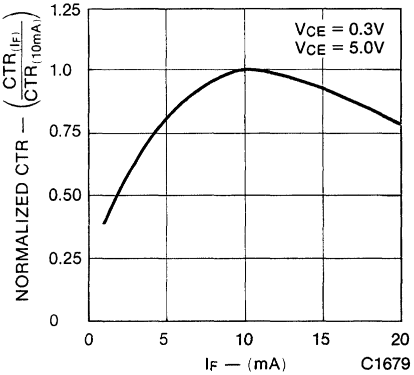


Fig. 2. Normalized CTR vs. Forward Current

ELECTRICAL CHARACTERISTIC CURVES

(25°C Free Air Temperature Unless Otherwise Specified) (Cont'd)

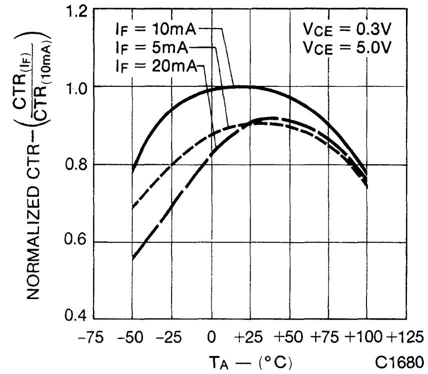


Fig. 3. Normalized CTR vs. Temperature

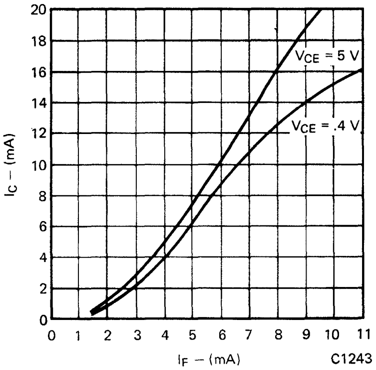


Fig. 4. Collector Current vs. Forward Current

ELECTRICAL CHARACTERISTIC CURVES

(25°C Free Air Temperature Unless Otherwise Specified) (Cont'd)

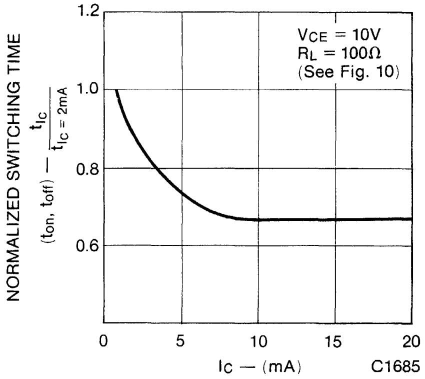


Fig. 5. Switching Time vs. IC

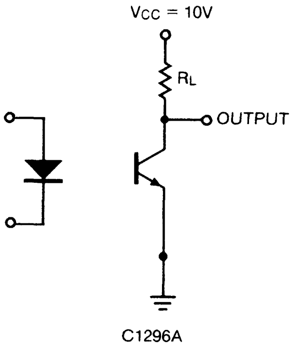


Fig. 6. Switching Time Test Circuit

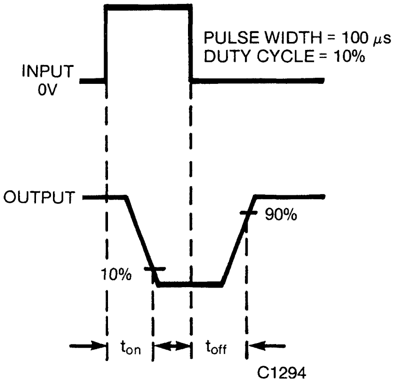


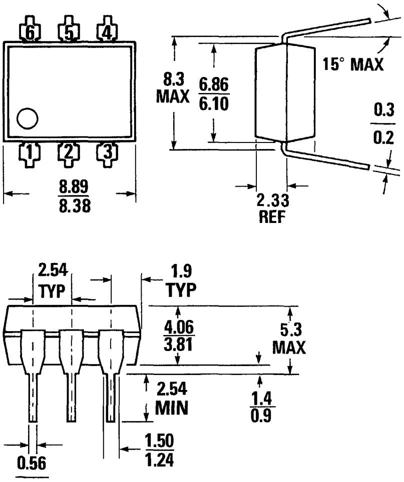
Fig. 7. Switching Time Waveforms

QT OPTOELECTRONICS

TRANSISTOR OUTPUT OPTOCOUPLER

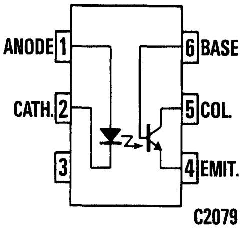
H11A1

PACKAGE DIMENSIONS



DIMENSIONS IN mm
PACKAGE CODE K

ST1603A



Equivalent Circuit

DESCRIPTION

The H11A1 is a phototransistor-type optically coupled isolator. An infrared emitting diode manufactured from specially grown gallium arsenide is selectively coupled with an NPN silicon phototransistor in a standard plastic six-pin dual-in-line package.

FEATURES

- High isolation voltage
  5300 VAC RMS—1 minute
  7500 VAC PEAK—1 minute
- Minimum current transfer ratio of 50%
- Underwriters Laboratory (UL) recognized File #E90700

APPLICATIONS

- Power supply regulators
- Digital logic inputs
- Microprocessor inputs
- Appliance sensor systems
- Industrial controls

ABSOLUTE MAXIMUM RATINGS (T_A=25°C Unless Otherwise Specified)

TOTAL PACKAGE

Storage temperature	−55°C to 150°C
Operating temperature	−55°C to 100°C
Lead temperature (soldering, 10 sec)	260°C
Total package power dissipation @ 25°C (LED plus detector)	260 mW
Derate linearly from 25°C	3.5 mW/°C

INPUT DIODE

Forward DC current	60 mA
Reverse voltage	6 V
Peak forward current (1 μs pulse, 300 pps)	3.0 A
Power dissipation 25°C ambient	100 mW
Derate linearly from 25°C	1.8 mW/°C

OUTPUT TRANSISTOR

Power dissipation @ 25°C	150 mW
Derate linearly from 25°C	2.67 mW/°C
V_{CEO}	30 V
V_{CBO}	70 V
V_{ECO}	7 V
Collector current (continuous)	100 mA

TRANSISTOR OUTPUT OPTOCOUPLER

ELECTRO-OPTICAL CHARACTERISTICS (25°C Temperature Unless Otherwise Specified)

INDIVIDUAL COMPONENT CHARACTERISTICS

CHARACTERISTIC	SYMBOL	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS
INPUT DIODE						
Forward voltage	V_F		1.1	1.50	V	I_F=10 mA
Forward voltage temperature coefficient	$\frac{\Delta V_F}{\Delta T_A}$		−1.8		mV/°C	
Reverse voltage	V_R	3.0	15		V	I_R=10 µA
Junction capacitance	C_J		50 65		pF pF	V_F=0 V, f=1 MHz V_F=1 V, f=1 MHz
Reverse leakage current	I_R		0.35	10	µA	V_R=3.0 V
OUTPUT TRANSISTOR						
Breakdown voltage Collector to emitter	BV_{CEO}	30	45		V	I_C=10 mA, I_F=0
Collector to base	BV_{CBO}	70	130		V	I_C=100 µA, I_F=0
Emitter to collector	BV_{ECO}	7	10		V	I_E=100µA, I_F=0
Leakage current Collector to emitter	I_{CEO}		5	50	nA	V_{CE}=10 V, I_F=0
Collector to base	I_{CBO}			20	nA	V_{CB}=10 V, I_F=0
Capacitance Collector to emitter			8		pF	V_{CE}=0, f=1 MHz
Collector to base			20		pF	V_{CB}=5, f=1 MHz
Emitter to base			10		pF	V_{EB}=0, f=1 MHz

TRANSFER CHARACTERISTICS

DC CHARACTERISTICS	SYMBOL	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS
Current Transfer Ratio collector to emitter	CTR	50			%	I_F=10 mA, V_{CE}=10 V
Saturation voltage	$V_{CE(SAT)}$		0.1	0.4	V	I_F=10 mA; I_C=0.5 mA

TRANSFER CHARACTERISTICS

CHARACTERISTICS	SYMBOL	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS
SWITCHING TIMES						
Non-saturated Turn-on time	t_{on}		2		µs	(V_{CE}=10V, I_{CE} 2 mA, R_L=100 Ω)
Turn-off time	t_{off}		2		µs	See Fig. 10 and 11
Non-saturated Turn-on time	t_{on}		300		ns	(V_{CE}=10 V, I_{CE} 50 µA, R_L=100 Ω)
Turn-off time	t_{off}		300		ns	See Fig. 10 and 11

ISOLATION CHARACTERISTICS

CHARACTERISTICS	SYMBOL	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS
Isolation voltage	V_{ISO}	5300			V_{AC} RMS	$I_{I\text{-}O}$≤1 µA, 1 minute
		7500			V_{AC} PEAK	$I_{I\text{-}O}$≤1 µA, 1 minute
Isolation resistance	R_{ISO}	10^{11}			ohms	$V_{I\text{-}O}$=500 VDC
Isolation capacitance	C_{ISO}		0.5		pF	f=1 MHz

ELECTRICAL CHARACTERISTIC CURVES (T_A=25°C Unless Otherwise Specified)

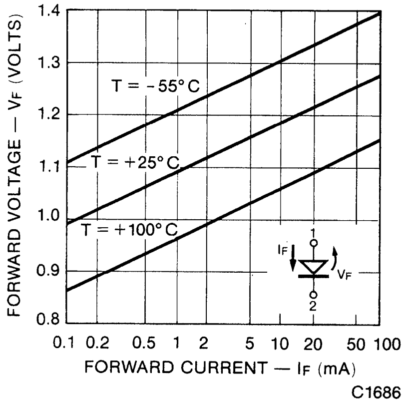


Fig. 1. Forward Voltage vs. Current

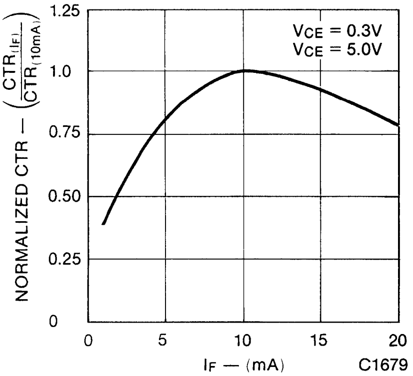


Fig. 2. Normalized CTR vs. Forward Current

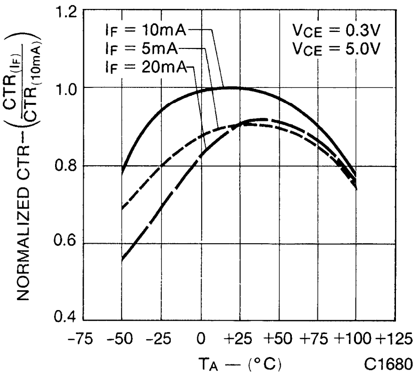


Fig. 3. Normalized CTR vs. Temperature

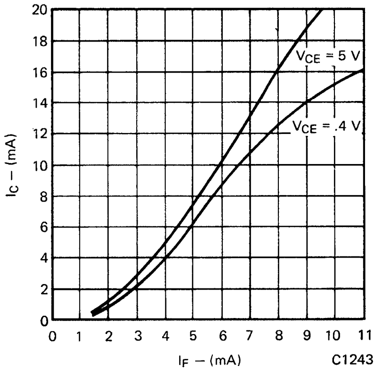


Fig. 4. Collector Current vs. Forward Current

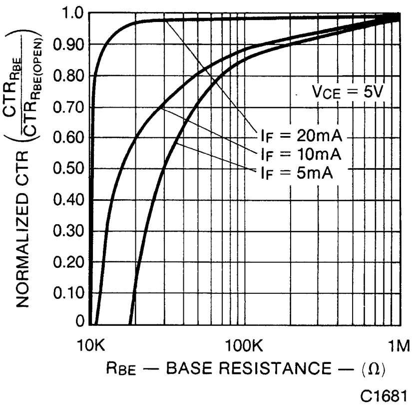


Fig. 5. CTR vs. RBE (Unsaturated)

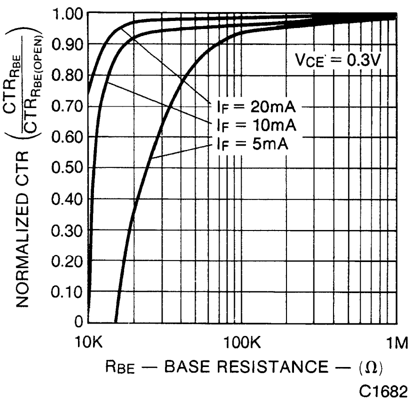


Fig. 6. CTR vs. RBE (Saturated)

ELECTRICAL CHARACTERISTIC CURVES (T_A=25°C Unless Otherwise Specified) (Cont'd)

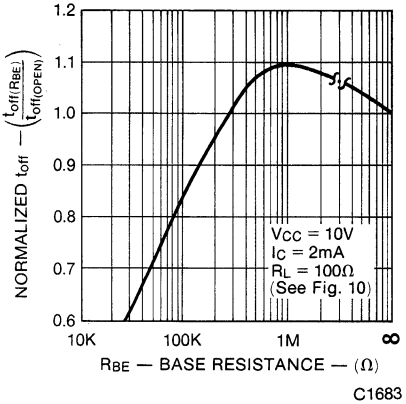


Fig. 7. Normalized T_{OFF} vs. RBE

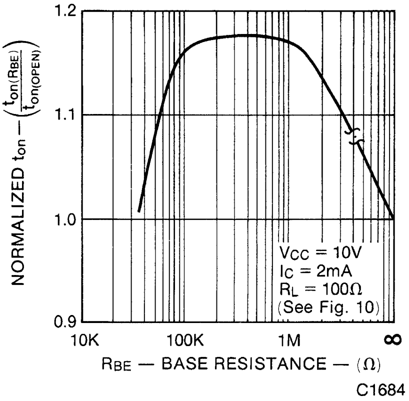


Fig. 8. Normalized T_{ON} vs. RBE

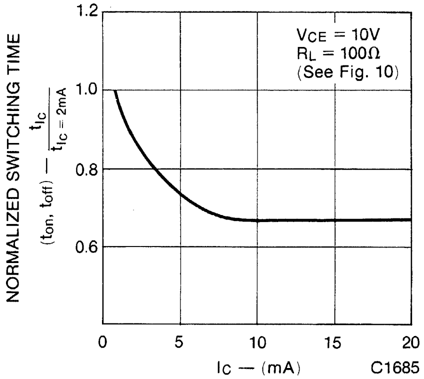


Fig. 9. Switching Time vs. IC

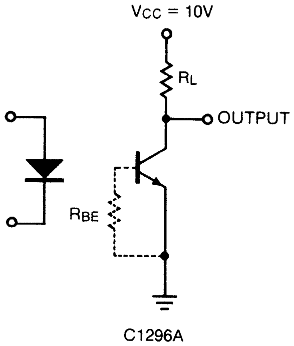


Fig. 10. Switching Time Test Circuit

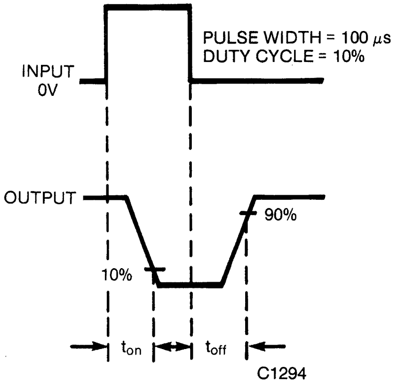


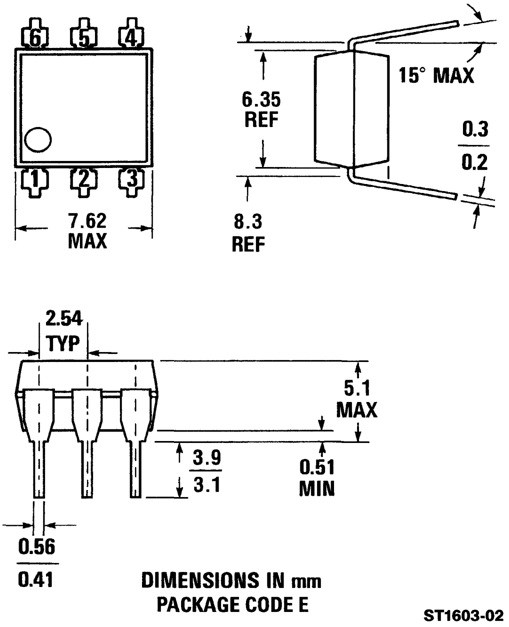
Fig. 11. Switching Time Waveforms

QT
OPTOELECTRONICS

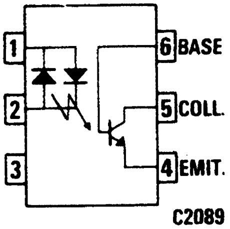
AC INPUT/PHOTOTRANSISTOR OPTOCOUPLERS

H11AA1 H11AA3
H11AA2 H11AA4

PACKAGE DIMENSIONS



DIMENSIONS IN mm
PACKAGE CODE E



Equivalent Circuit

DESCRIPTION

The H11AAX family of devices has two GaAs emitters connected in inverse parallel driving a single silicon phototransistor output.

FEATURES

- Bi-polar emitter input
- Built-in reverse polarity input protection
- UL recognized (File #E90700)

APPLICATIONS

- AC line monitor
- Unknown polarity DC sensor
- Telephone line interface

ABSOLUTE MAXIMUM RATINGS

TOTAL PACKAGE

Power dissipation	350 mW
Derate linearly from 25°C	4.6 mW
Storage temperature	−55°C to 150°C
Operating temperature	−55°C to 100°C
Lead temperature (soldering, 10 sec)	260°C

INPUT DIODE

Forward current	100 mA
Peak forward current (1 μs pulse, 300 pps)	±1.0 A
Power dissipation	200 mW
Derate linearly from 25°C	2.6 mW/°C

OUTPUT TRANSISTOR

Power dissipation	300 mW
Derate linearly from 25°C	4.0 mW/°C

OPTOELECTRONICS

AC INPUT/PHOTOTRANSISTOR OPTOCOUPLERS

INDIVIDUAL COMPONENT CHARACTERISTICS (T_A=25°C Unless Otherwise Specified)

CHARACTERISTIC	SYMBOL	DEVICE	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS
INPUT DIODE							
Forward voltage	V_F	ALL		1.2	1.5	V	$I_F=\pm10$ mA
Forward voltage coefficient	$\Delta V_F/\Delta T_A$	ALL		−1.9		mV/°C	I_F=2 mA
Junction capacitance	C_J	ALL		80		pF	V_F=0 V, f=1 MHz
OUTPUT TRANSISTOR							
Breakdown voltage Collector to emitter	BV_{CEO}	ALL	30			V	I_C=1 mA, I_F=0
Collector to base	BV_{CBO}	ALL	70			V	I_C=100 μA, I_F=0
Emitter to base	BV_{EBO}	ALL	5			V	I_E=100 μA, I_F=0
Emitter to collector	BV_{ECO}	ALL	7			V	I_E=100 μA, I_F=0
Leakage current	I_{CEO}	H11AA1,3,4			50	nA	V_{CE}=10 V, I_F=0
	I_{CEO}	H11AA2			200	nA	V_{CE}=10 V, I_F=0
Capacitance Collector to emitter	C_{CE}	ALL		10		pF	V_{CE}=0, f=1 MHz
Collector to base	C_{CB}	ALL		80		pF	V_{CE}=0, f=1 MHz
Emitter to base	C_{EB}	ALL		15		pF	V_{CE}=0, f=1 MHz

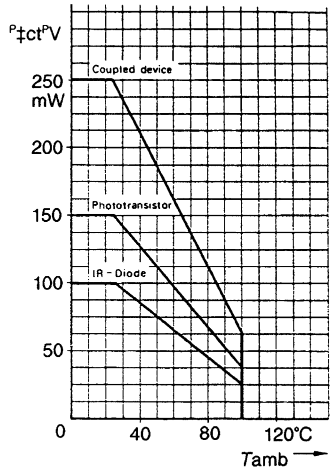
TRANSFER CHARACTERISTICS (T_A=25°C Unless Otherwise Specified)

CHARACTERISTIC	SYMBOL	DEVICE	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS
Current transfer (Collector-Emitter)	CTR_{CE}	H11AA4	100			%	$I_F=\pm10$ mA, V_{CE}=10 V
		H11AA3	50				$I_F=\pm10$mA, V_{CE}=10 V
		H11AA1	20				$I_F=\pm10$mA, V_{CE}=10 V
		H11AA2	10				$I_F=\pm10$mA, V_{CE}=10 V
Current transfer ratio symmetry		ALL	0.33		3.0		$I_F=\pm10$ mA, V_{CE}=10 V Fig. 6
Saturation voltage (Collector-Emitter)	$V_{CE}SAT$	ALL			0.4	V	$I_F=\pm10$ mA, I_{CE}=0.5 mA
		H11AA3,4		0.4		V	$I_F=\pm16$ mA, I_{CE}=2.0 mA

ISOLATION CHARACTERISTICS (T_A=25°C Unless Otherwise Specified)

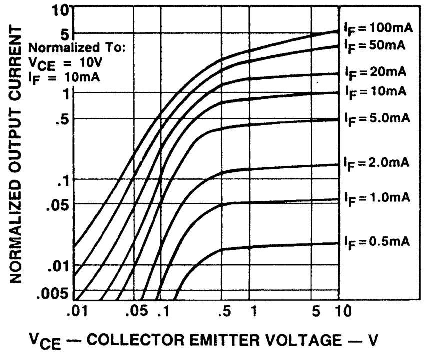
CHARACTERISTIC	SYMBOL	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS
Package capacitance input/output	C_{I-O}		0.7		pF	V_{I-O}=0, f=1 MHz
Withstand insulation test voltage	V_{ISO}	5300			$V_{AC(RMS)}$	$I_{I-O}\leq1$ μA, 1 minute
Insulation resistance	R_{ISO}	10^{11}			Ohms	V_{I-O}=500 V

ELECTRICAL CHARACTERISTIC CURVES (T_A=25°C Unless Otherwise Specified)



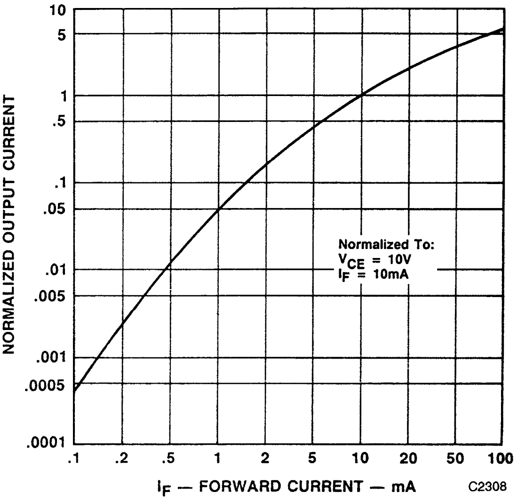
C2303

Fig. 1.



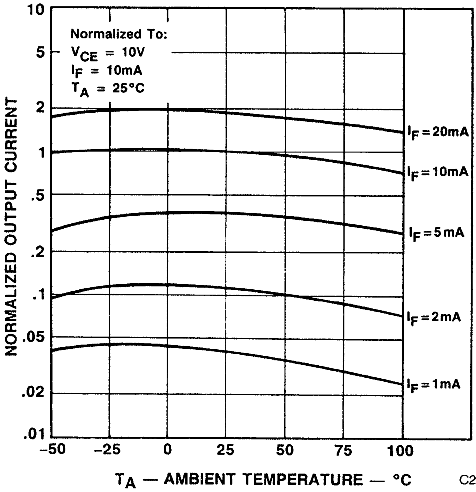
C2309

Fig. 2. Transfer Characteristics



C2308

Fig. 3. Input Current vs.
Output Current



C2305

Fig. 4. Output Current vs.
Temperature

ELECTRICAL CHARACTERISTIC CURVES (T_A=25°C Unless Otherwise Specified) (Cont'd)

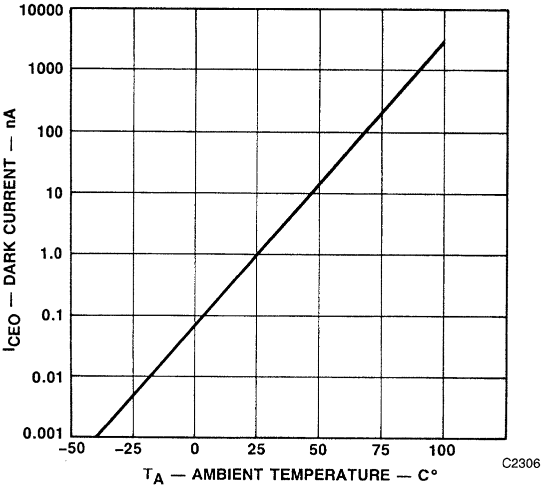


Fig. 5 Dark Current vs. Temperature

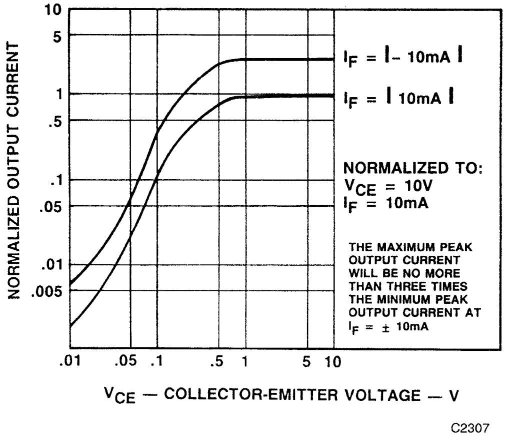


Fig. 6. Output Symmetry Characteristics

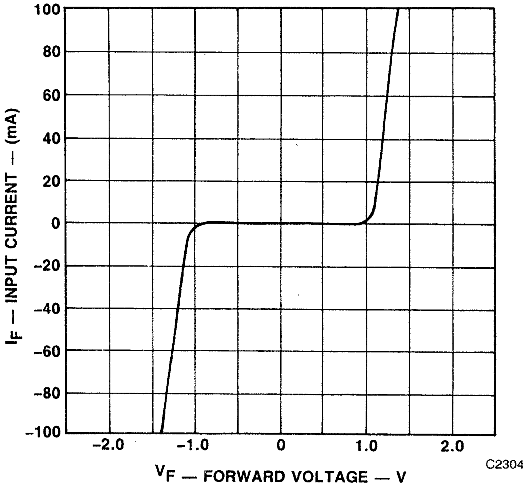
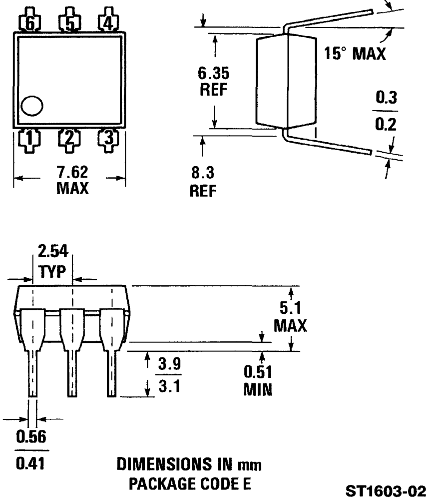


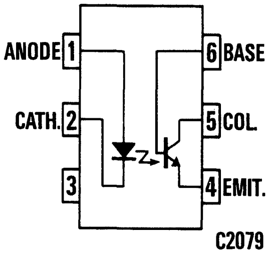
Fig. 7.

HIGH-VOLTAGE PHOTOTRANSISTOR OPTOCOUPLERS

H11D1 H11D2 H11D3

PACKAGE DIMENSIONS





Equivalent Circuit

DESCRIPTION

The H11DX is a phototransistor-type optically coupled isolator. An infrared emitting diode manufactured from specially grown gallium arsenide is selectively coupled with an NPN silicon phototransistor. The device is supplied in a standard plastic six-pin dual-in-line package.

FEATURES

- High voltage
  H11D1-D2, BV_{CER}=300 V
  H11D3, BV_{CER}=200 V
- High isolation voltage
  5300 VAC RMS—1 minute
  7500 VAC PEAK—1 minute
- Minimum current transfer ratio of H11D1, H11D2, H11D3—20%
- Underwriters Laboratory (UL) recognized File #E90700

APPLICATIONS

- Power supply regulators
- Digital logic inputs
- Microprocessor inputs
- Appliance sensor systems
- Industrial controls

ABSOLUTE MAXIMUM RATINGS (T_A=25°C Unless Otherwise Specified)

TOTAL PACKAGE

Storage temperature	−55°C to 150°C
Operating temperature	−55°C to 100°C
Lead temperature (soldering, 10 sec)	260°C
Total package power dissipation at 25°C (LED plus detector)	260° mW
Derate linearly from 25°C	3.5 mW/°C

INPUT DIODE

Forward DC current	60 mA
Reverse voltage	6 V
Peak forward current (1 μs pulse, 300 pps)	3.0 A
Power dissipation 25°C ambient	100 mW
Derate linearly from 25°C	1.8 mW/°C

OUTPUT TRANSISTOR

Power dissipation at 25°C	300 mW
Derate linearly from 25°C	4.0 mW/°C

	H11D1-D2	H11D3
V_{CER}	300 V	200 V
V_{CBO}	300 V	200 V
V_{ECO}	6 V	6 V
Collector current (continuous)	100 mA	100 mA

HIGH-VOLTAGE PHOTOTRANSISTOR OPTOCOUPLERS

ELECTRO-OPTICAL CHARACTERISTICS (T_A=25°C Unless Otherwise Specified)

INDIVIDUAL COMPONENT CHARACTERISTICS

CHARACTERISTIC	SYMBOL	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS
INPUT DIODE Forward voltage	V_F		1.1	1.50	V	$I_F=10$ mA
Forward voltage temp. coefficient	$\frac{\Delta V_F}{\Delta T_A}$		−1.8		mV/°C	
Reverse breakdown voltage	V_R	3.0	25		V	$I_R=10$ μA
Junction capacitance	C_J		50 65		pF pF	$V_F=0$ V, f=1 MHz $V_F=1$ V, f=1 MHz
Reverse leakage current	I_R		0.35	10	μA	$V_R=3.0$ V
OUTPUT TRANSISTOR Breakdown voltage Collector to emitter H11D1, H11D2,	BV_{CER}	300			V	$I_C=1$ mA; $I_F=0$,
H11D3		200			V	$R_{BE}=1$ meg
Collector to base H11D1, H11D2,	BV_{CBO}	300			V	$I_C=100$ μA; $I_F=0$
H11D3		200			V	
Emitter to base	BV_{EBO}	5	7		V	$I_E=100$ μA, $I_F=0$
Leakage current Collector to emitter (R_{BE}=1 meg.) H11D1, H11D2,	I_{CER}			100	nA	$V_{CE}=200V$; $I_F=0$; $T_A=25°C$
				250	μA	$V_{CE}=200V$; $I_F=0$; $T_A=100°C$
H11D3	I_{CER}			100	nA	$V_{CE}=100V$; $I_F=0$; $T_A=25°C$
				250	μA	$V_{CE}=100V$; $I_F=0$; $T_A=100°C$

TRANSFER CHARACTERISTICS

DC CHARACTERISTICS	SYMBOL	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS
Current Transfer Ratio, collector to emitter H11D1, H11D2, H11D3	CTR	20			%	$I_F=10$ mA; $V_{CE}=10V$ $R_{BE}=1$ meg
Saturation voltage	$V_{CE(SAT)}$		0.1	.40	V	$I_F=10$ mA; $I_C=0.5$ mA $R_{BE}=1$ meg

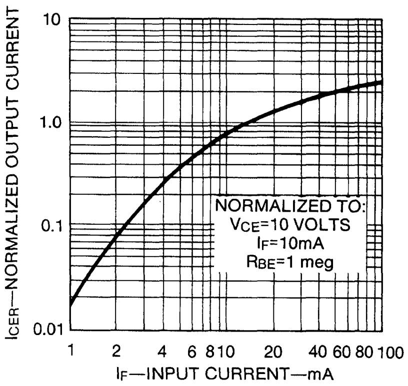
TRANSFER CHARACTERISTICS

CHARACTERISTICS	SYMBOL	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS
SWITCHING TIMES Non-saturated Turn-on	t_{on}		5		μs	$V_{CE}=10V$, $I_{CE}=2mA$,
Turn-off time	t_{off}		5		μs	$R_L=100\ \Omega$

ISOLATION CHARACTERISTICS

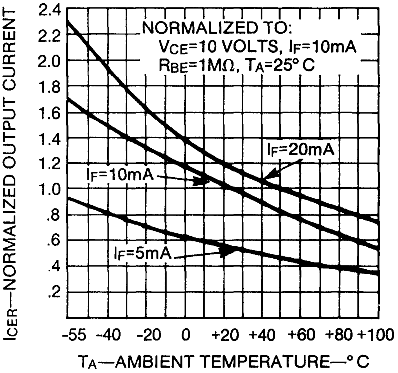
CHARACTERISTICS	SYMBOL	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS
Isolation voltage	V_{ISO}	5300			V_{AC}RMS	$I_{I-O}\leq 1$ μA, 1 minute
	V_{ISO}	7500			V_{AC} PEAK	$I_{I-O}\leq 1$ μA, 1 minute
Isolation resistance	R_{ISO}	10^{11}			ohms	$V_{I-O}=500$ VDC
Isolation capacitance	C_{ISO}		0.5		pF	f=1 MHz

TYPICAL CHARACTERISTICS



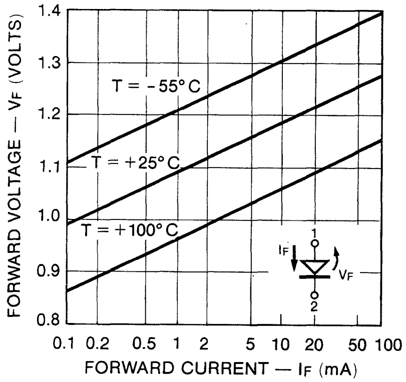
C1770

Fig. 1. Output Current vs. Input Current



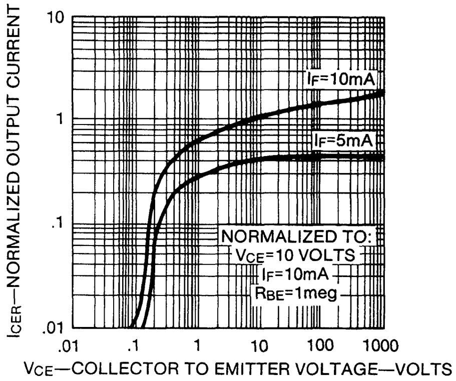
C1771

Fig. 2. Output Current vs. Temperature



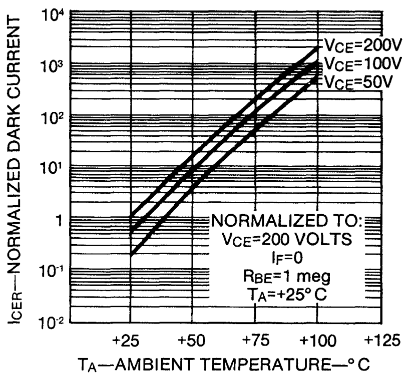
C1686

Fig. 3. Input Characteristics



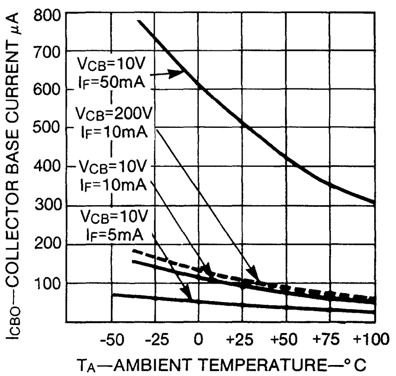
C1773

Fig. 4. Output Characteristics



C1774

Fig. 5. Normalized Dark Current vs. Temperature



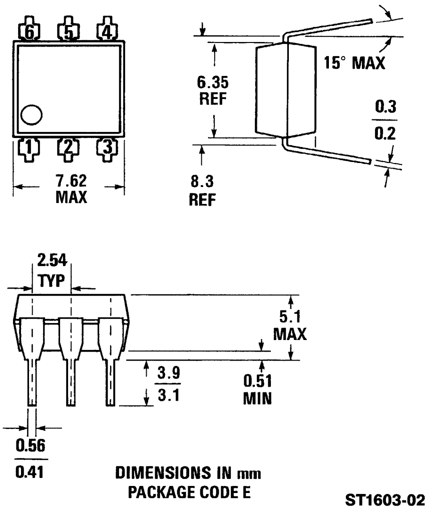
C1775

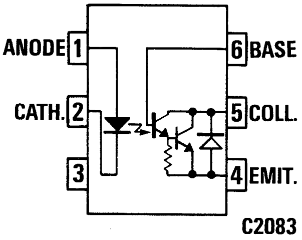
Fig. 6. Collector Base Current vs. Temperature

HIGH VOLTAGE PHOTODARLINGTON OPTOCOUPLERS

H11G1
H11G2

PACKAGE DIMENSIONS





Equivalent Circuit

DESCRIPTION

The H11G1 and H11G2 are the photodarlington-type optically coupled optoisolators. Both devices have a gallium arsenide infrared emitting diode coupled with a silicon darlington connected phototransistor which has an integral base-emitter resistor to optimize elevated temperature characteristics.

FEATURES

- High BV_{CEO}
  Minimum 100V for H11G1
  Minimum 80V for H11G2
- High sensitivity to low input current—Minimum 500 percent CTR at I_F=1 mA
- Low leakage current at elevated temperature (maximum 100 μA at 80°C).
- Underwriters Laboratory (UL) recognized File #E90700

APPLICATIONS

- CMOS logic interface
- Telephone ring detector
- Low input TTL interface
- Power supply isolation
- Replace pulse transformer

ABSOLUTE MAXIMUM RATINGS

TOTAL PACKAGE

Storage temperature	−55°C to 150°C
Operating temperature	−55°C to 100°C
Lead temperature (soldering, 10 sec)	260°C
Total package power dissipation at 25°C (LED plus detector)	260 mW
Derate linearly from 25°C	3.5 mW/°C
Isolation voltage	7500 VAC PEAK

INPUT DIODE

Forward DC current	60 mA
Reverse voltage	6 V
Peak forward current (1 μs pulse, 300 pps)	3.0 A
Power dissipation 25°C ambient	100 mW
Derate linearly from 25°C	1.8 mW/°C

OUTPUT TRANSISTOR

Power dissipation @ 25°C	200 mW
Derate linearly from 25°C	2.67 mW/°C
Collector to emitter voltage H11G1	100 V
Collector to emitter voltage H11G2	80 V

QT
OPTOELECTRONICS

HIGH VOLTAGE PHOTODARLINGTON OPTOCOUPLERS

ELECTRO-OPTICAL CHARACTERISTICS (25°C Temperature Unless Otherwise Specified)

INDIVIDUAL COMPONENT CHARACTERISTICS

CHARACTERISTIC	SYMBOL	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS
INPUT DIODE						
Forward voltage	V_F		1.3	1.50	V	$I_F=10$ mA
Forward voltage temp. coefficient	$\frac{\Delta V_F}{\Delta T_A}$	−1.8		mV/°C		
Reverse breakdown voltage	BV_R	3.0	25		V	$I_R=10\ \mu A$
Junction capacitance	C_J		50 65		pF pF	$V_F=0$ V, f=1 MHz $V_F=1$ V, f=1 MHz
Reverse leakage current	I_R		0.35	10	μA	$V_R=3.0$ V
OUTPUT DARLINGTON						
Breakdown voltage						
Collector to emitter	BV_{CEO}					
H11G1		100			V	$I_C=1.0$ mA; $I_F=0$
H11G2		80			V	
Collector to base	BV_{CBO}					
H11G1		100			V	$I_C=100\ \mu A$
H11G2		80			V	
Emitter to base	BV_{EBO}	7	10		V	$I_E=100\ \mu A$, $I_F=0$
Leakage current						
Collector to emitter	I_{CEO}					
H11G1				100	nA	$V_{CE}=80V$, $I_F=0$
H11G2				100	nA	$V_{CE}=60V$, $I_F=0$
H11G1				100	μA	$V_{CE}=80V$, $I_F=0$, $T_A=80°C$
H11G2				100	μA	$V_{CE}=60V$, $I_F=0$, $T_A=80°C$

TRANSFER CHARACTERISTICS

DC CHARACTERISTICS	SYMBOL	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS
Current Transfer Ratio, collector to emitter	CTR					
H11G1/2		1000			%	$I_F=10$ mA; $V_{CE}=1$ V
H11G1/2		500			%	$I_F=1$ mA; $V_{CE}=5$ V
Saturation voltage	$V_{CE(SAT)}$		0.85	1.0	V	$I_F=16$ mA; $I_C=50$ mA
			0.75	1.0	V	$I_F=1$ mA; $I_C=1$ mA

TRANSFER CHARACTERISTICS

CHARACTERISTICS	SYMBOL	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS
SWITCHING TIMES						
Turn-on time	t_{on}		5		μs	$R_L=100\Omega$; $I_F=10$ mA
Turn-off time	t_{off}		100		μs	$V_{CE}=5V$ Pulse width ≤ 300 μsec, f ≤ 30 Hz

ELECTRO-OPTICAL CHARACTERISTICS

(25°C Temperature Unless Otherwise Specified) (Cont'd)

ISOLATION CHARACTERISTICS

CHARACTERISTICS	SYMBOL	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS
Isolation voltage	V_{iso}	7500			VAC-PEAK	$I_{I\text{-}O} \leq 1\ \mu A$, 1 minute
		5300			VAC-rms	$I_{I\text{-}O} \leq 1\ \mu A$, 1 minute
Isolation resistance	R_{iso}	10^{11}			ohms	$V_{I\text{-}O}$=500 VDC
Isolation capacitance	C_{iso}		0.5		pF	f=1 MHz

TYPICAL ELECTRICAL CHARACTERISTIC CURVES

(25°C Free Air Temperature Unless Otherwise Specified)

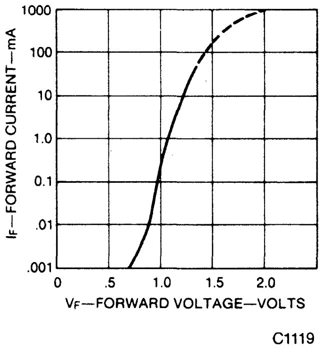


Fig. 1. Forward Voltage vs. Forward Current

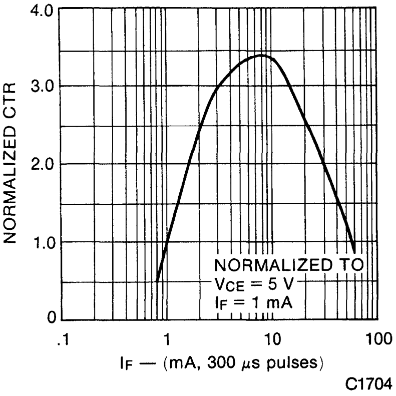


Fig. 2. Normalized CTR vs. Input Current

TYPICAL ELECTRICAL CHARACTERISTIC CURVES

(25°C Free Air Temperature Unless Otherwise Specified) (Cont'd)

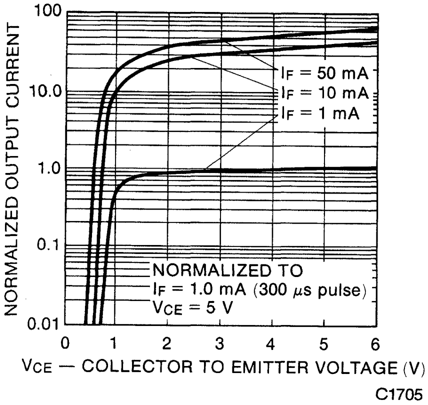


Fig. 3. Output Characteristics

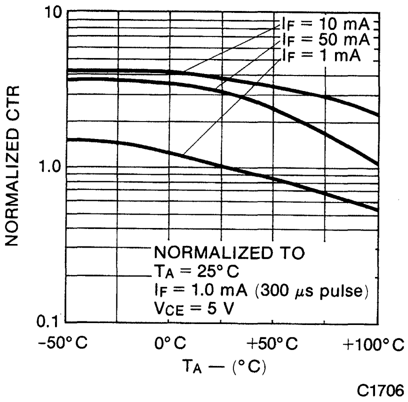


Fig. 4. Normalized CTR vs. Temperature

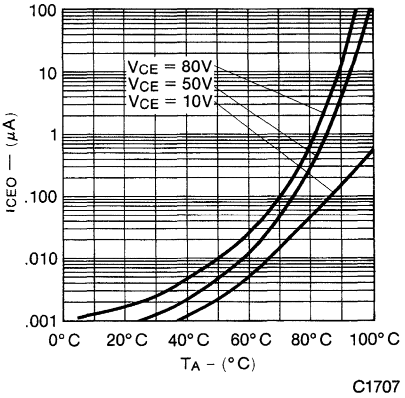


Fig. 5. Dark Current vs. Temperature

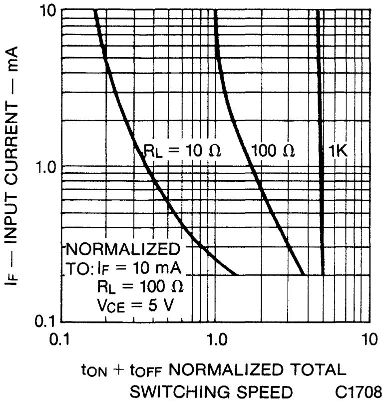


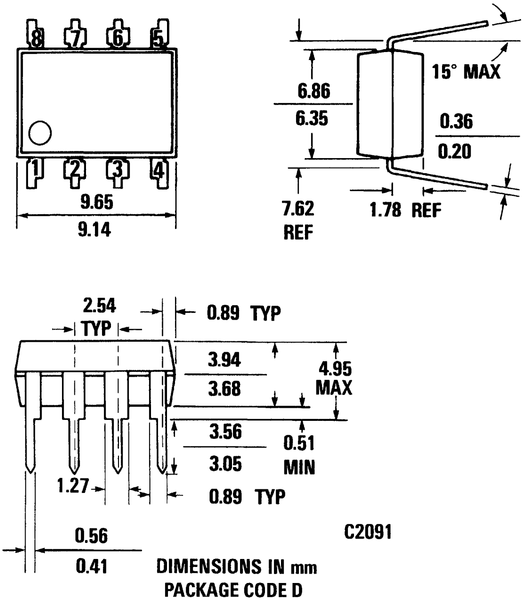
Fig. 6. Switching Speed

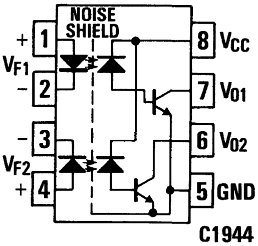
QT OPTOELECTRONICS

DUAL HIGH-SPEED TRANSISTOR OPTOCOUPLERS

HCPL-2530 HCPL-2531

PACKAGE DIMENSIONS





Equivalent Circuit

DESCRIPTION

The HCPL-2530/31 dual optocouplers contain two completely separated 700 nm GaAsP LED emitters each optically coupled to a high speed photodetector transistor.

A separate pin for the bias of the photodiodes improves the speed by several orders of magnitude by reducing the base-collector capacitance.

An internal noise shield provides superior common mode rejection of 10 kV/μs. An improved package allows superior insulation permitting a 480 V working voltage compared to industry standard of 220 V.

FEATURES

- High speed 1 MBit/s
- Superior CMR—10 kV/μs
- Double working voltage—480 V RMS
- CTR guaranteed 0-70°C
- U.L. recognized (File #E50151)

APPLICATIONS

- Line receivers
- Pulse transformer replacement
- Output interface to CMOS-LSTTL-TTL
- Wide bandwidth analog coupling

ABSOLUTE MAXIMUM RATINGS

TOTAL PACKAGE

Storage temperature	−55°C to 125°C
Operating temperature	−55°C to 100°C
Lead solder temperature	260°C for 10s

INPUT DIODE

Average forward input current (each channel)	25 mA (1)
Peak forward input current (each channel) (50% duty cycle, 1 ms pulse width)	50 mA (2)
Peak transient input current—I_F (each channel) (≤1μs P.W., 300	1.0 A
Reverse input voltage (each channel)	5 V
Input power dissipation (each channel)	45 mW (3)

OUTPUT TRANSISTOR

Average output current (each channel)	8 mA
Peak output current (each channel)	16 mA
Supply voltage - V_{CC} (Pin 8-5)	−0.5 V to 30 V
Output voltage - V_O (Pin 7, 6-5)	−0.5 V to 20 V
Output power dissipation (each channel)	35 mW (4)

QT
OPTOELECTRONICS

DUAL HIGH-SPEED TRANSISTOR OPTOCOUPLERS

ELECTRICAL CHARACTERISTICS (T_A=0°C to 70°C Unless Otherwise Specified)

INDIVIDUAL COMPONENT CHARACTERISTICS

PARAMETER	SYM.	DEVICE HCPL	MIN.	TYP.*	MAX.	UNITS	TEST CONDITIONS	FIG.	NOTE
DIODE Input forward Voltage	V_F			1.5	1.7	V	I_F=16 mA, T_A=25°C	3	5
Input reverse breakdown volt.	B_{VR}		5			V	I_R=10 μA		5
Temp. coefficient of forward volt.	$\frac{\Delta V_F}{\Delta T_A}$			−1.6		mV/°C	I_F=16 mA		5
DETECTOR Logic high output current	I_{OH}			.02	500	nA	$I_{F1}=I_{F2}$=0 mA, T_A=25°C $V_{O1}=V_{O2}=V_{CC}$=5.5 V	6	5
					10	μA	$I_{F1}=I_{F2}$=0 mA $V_{O1}=V_{O2}=V_{CC}$=15 V		5
Logic low supply current	I_{CCL}			80		μA	$I_{F1}=I_{F2}$=16 mA, V_{CC}=15 V $V_{O1}=V_{O2}$=Open		
Logic high supply current	I_{CCH}			.01	4	μA	$I_{F1}=I_{F2}$=0 mA, V_{CC}=15 V $V_{O1}=V_{O2}$=Open		

TRANSFER CHARACTERISTICS

DC CHARACTERISTICS	SYM.	DEVICE HCPL	MIN.	TYP.*	MAX.	UNITS	TEST CONDITIONS	FIG.	NOTE
Current transfer ratio	CTR	2530	7	18		%	I_F=16 mA T_A=25°C, V_O=0.5 V, V_{CC}=4.5 V	1,2	5,6
		2531	19						
		2530	5	21			I_F=16 mA, V_O=0.5 V, V_{CC}=4.5 V	1,2	5,6
		2531	15						
Logic low output voltage	V_{OL}	2530		.1	0.5	v	I_F=16 mA I_O=1.1 mA, V_{CC}=4.5 V T_A=25°C		5
		2531		.1	0.5	V	I_F=16 mA I_O=2.4 mA, V_{CC}=4.5 V T_A=25°C		

SWITCHING CHARACTERISTICS (T_A=25°C V_{CC}=5.0 V)

PARAMETER	SYM.	DEVICE HCPL	MIN.	TYP.*	MAX.	UNITS	TEST CONDITIONS	FIG.	NOTE
Propagation delay time (For output low level)	t_{PLH}	2530		0.5	1.5	μs	I_F=16 mA, R_L=4.1 kΩ	5,11	10,11
		2531		0.3	0.8	μs	I_F=16 mA, R_L=1.9 kΩ		
Propagation delay time (For output high level)	t_{PHL}	2530		0.2	1.5	μs	I_F=16 mA, R_L=4.1 kΩ	5,11	10,11
		2531		0.1	0.8	μs	I_F=16 mA, R_L=1.9 kΩ		
Common mode transient immunity at logic high level output	CM_H	2530	1000	10000		V/μs	R_L=4.1 kΩ; I_F=0 mA, V_{CM}=10 $V_{p\text{-}p}$	10	9,10,11
		2531	1000	10000			R_L=1.9 kΩ		
Common mode transient immunity at logic low level output	CM_L	2530	−1000	−10000		V/μs	R_L=4.1 kΩ; I_F=16 mA, V_{CM}=10 $V_{p\text{-}p}$	10	9,10,11
		2531	−1000	−10000			R_L=1.9 kΩ		
Bandwidth	BW			3		MHz	R_L=100 Ω	9	12

*All typicals at T_A=25°C

ISOLATION CHARACTERISTICS

CHARACTERISTICS	SYM.	DEVICE HCPL	MIN.	TYP.*	MAX.	UNITS	TEST CONDITIONS	FIG.	NOTE
Input capacitance	C_{IN}			60		pF	V_F=0 V, f=1 MHz		5
Withstand Insulation test voltage	V_{ISO}		2500			V_{RMS}	RH≤50% T_A=25°C, t=1 min		7,13
Resistance (input-output)	R_{I-O}			10^{12}		Ω	V_{I-O}=500 VDC		7
Capacitance (input-output)	C_{I-O}			0.6		pF	f=1 MHz		7
Input-Input insulation leakage current	I_{I-I}			0.005		μA	RH≤50% V_{I-I}=500 VDC t=5 s		8
Resistance (input-input)	R_{I-I}			10^{11}		Ω	V_{I-I}=500 VDC		8
Capacitance (input-input)	C_{I-I}			0.25		pF	f=1 MHz		8

**All typicals at T_A=25°C*

NOTES

1. *Derate linearly above 70°C free-air temperature at a rate of 0.8 mA/°C.*
2. *Derate linearly above 70°C free-air temperature at a rate of 1.6 mA/°C.*
3. *Derate linearly above 70°C free-air temperature at a rate of 0.9 mW/°C.*
4. *Derate linearly above 70°C free-air temperature at a rate of 1.0 mW/°C.*
5. *Each channel.*
6. *CURRENT TRANSFER RATIO is defined as the ratio of output collector current, I_O, to the forward LED input current, I_F, times 100%.*
7. *Device considered a two-terminal device: Pins 1, 2, 3, and 4 shorted together and Pins 5, 6, 7, and 8 shorted together.*
8. *Measured between pins 1 and 2 shorted together, and pins 3 and 4 shorted together.*
9. *Common mode transient immunity in Logic High level is the maximum tolerable (positive) dV_{CM}/dt on the leading edge of the common mode pulse V_{CM}, to assure that the output will remain in a logic High State (i.e., V_O) 2.0 V). Common mode transient immunity in Logic Low level is the maximum tolerable (negative) dV_{CM}/dt on the trailing edge of the common mode pulse signal, V_{CM} to assure that the ouput will remain in a Logic Low state (i.e., V_O (0.8 V).*
10. *The 1.9 KΩ load represents 1 TTL unit load of 1.6 mA and the 5.6 KΩ pull-up resistor.*
11. *The 4.1 KΩ load represents 1 LSTTL unit load of 0.36 mA and 6.1 KΩ pull-up resistor.*
12. *The frequency at which the ac output voltage is 3dB below the low frequency asymptote.*
13. *The 2500 V_{RMS}/1 min capability is validated by a factory 3.1 kV_{RMS}/1 sec dielectric voltage withstand test.*

TYPICAL ELECTRO-OPTICAL CHARACTERISTICS (T_A=25° Unless Otherwise Specified)

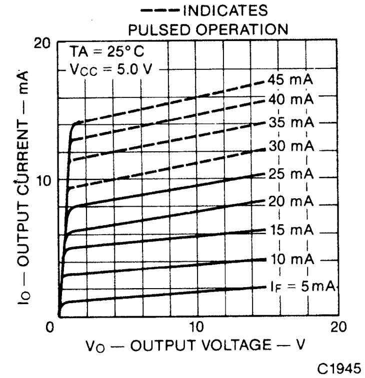


Fig. 1. DC and Pulsed Transfer Characteristics

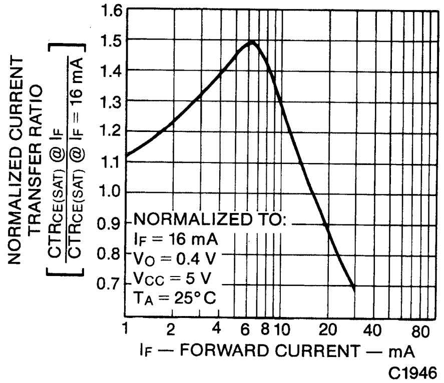


Fig. 2. Normalized Current Transfer Ratio vs. Forward Current

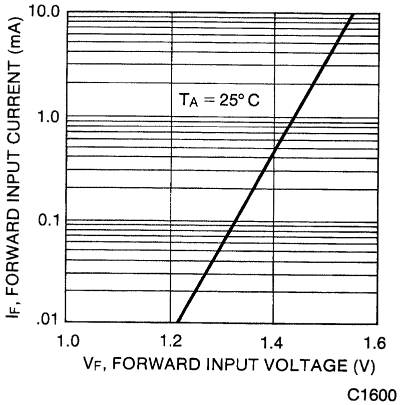


Fig. 3. Forward Input Current vs. Forward Input Voltage

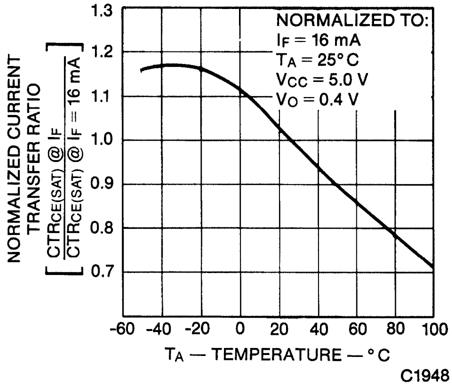


Fig. 4. Normalized Current Transfer Ratio vs. Temperature

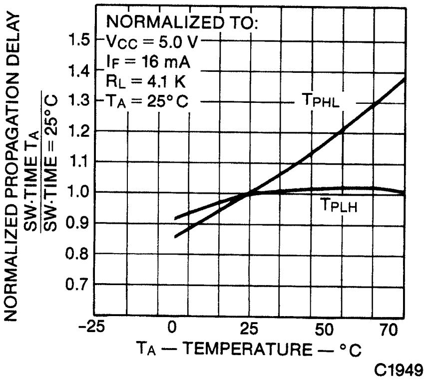


Fig. 5. Normalized Propagation Delay vs. Temperature

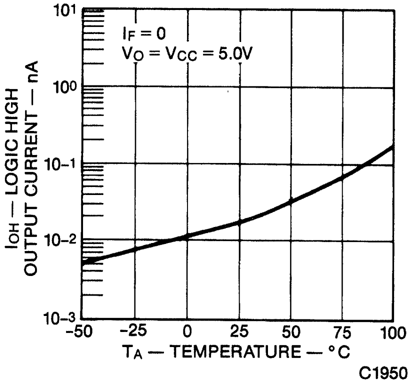


Fig. 6. Logic High Output Current vs. Temperature

TYPICAL ELECTRO-OPTICAL CHARACTERISTICS

(T_A=25° Unless Otherwise Specified) (Cont'd)

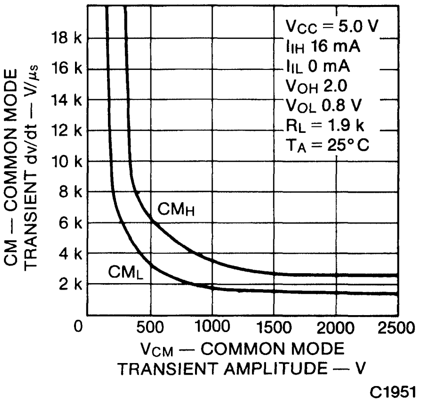


Fig. 7. Common Mode Transient Immunity vs. Common Mode Transient Amplitude

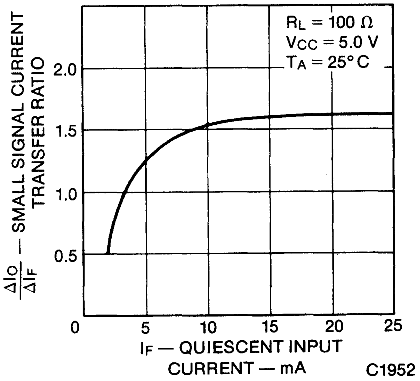


Fig. 8. Small Signal Transfer Ratio vs. Quiescent Input Current

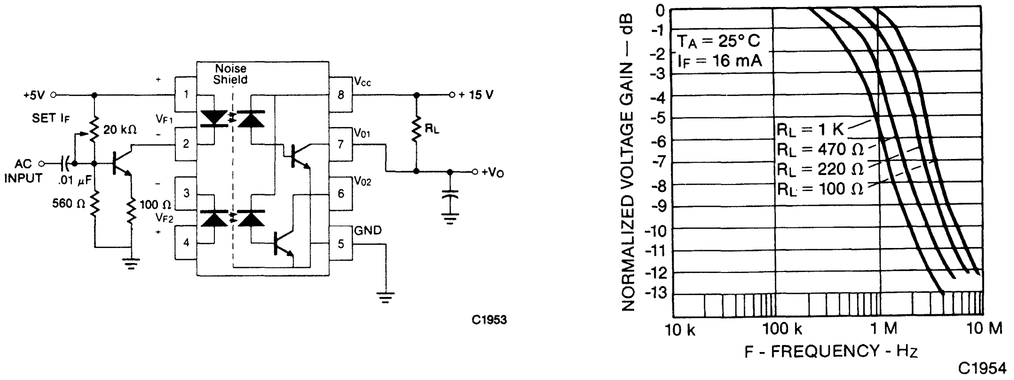


Fig. 9. Frequency Response

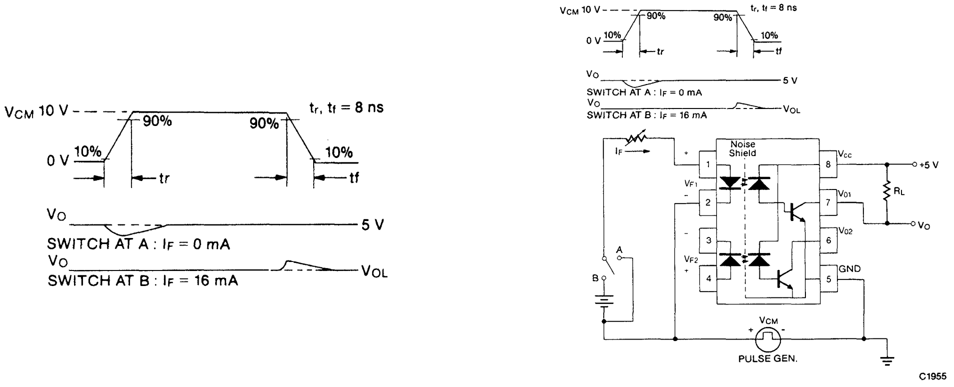


Fig. 10. Test Circuit for Transient Immunity and Typical Waveforms

TYPICAL ELECTRO-OPTICAL CHARACTERISTICS

(T_A=25° Unless Otherwise Specified) (Cont'd)

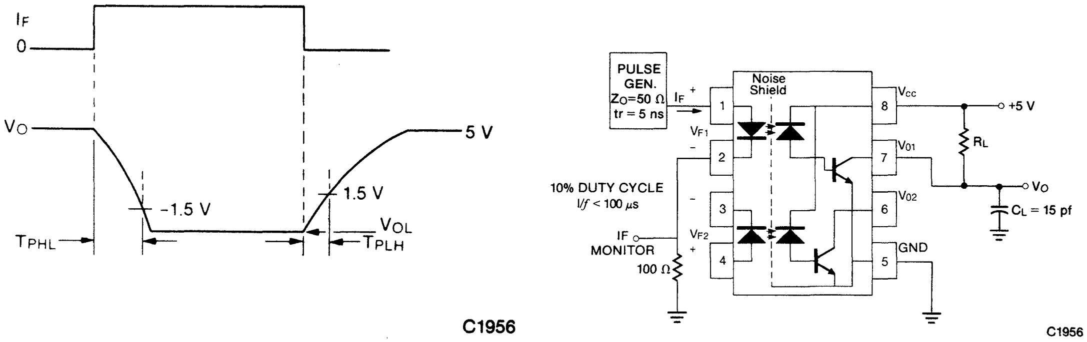


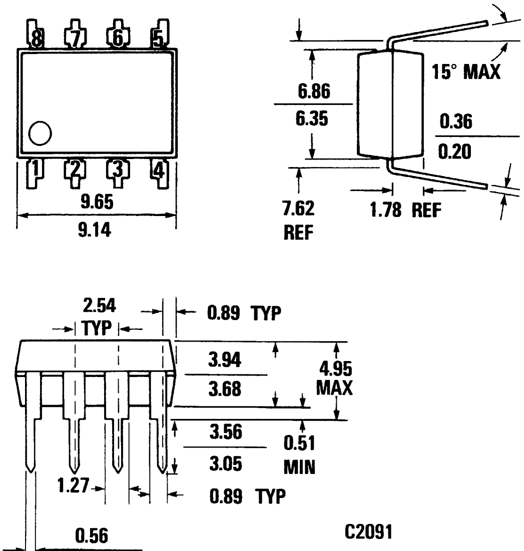
Fig. 11. Switching Test Circuit

QT
OPTOELECTRONICS

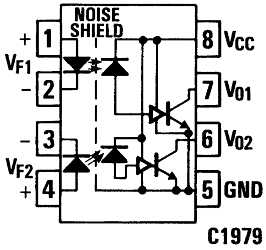
DUAL VERY HIGH-SPEED LOGIC GATE OPTOCOUPLERS

HCPL-2630
DUAL 10 MBit/s LOGIC GATE HCPL-2631

PACKAGE DIMENSIONS



DIMENSIONS IN mm
PACKAGE CODE D



A 0.1μF bypass capacitor must be connected between pins 8 and 5. (See note 1)

Equivalent Circuit

DESCRIPTION

The HCPL-2630 and HCPL-2631 dual channel optocouplers have two channels, each consisting of a 700 nm GaAsP LED, optically coupled to a very high speed integrated photodetector logic gate. The outputs feature open collectors, thereby permitting wired-OR outputs. The coupled parameters are guaranteed over the temperature range of 0-70°C. A maximum input signal of 5 mA will provide a minimum output sink current of 13 mA (fan-out of 8).

An internal noise shield provides superior common mode rejection of typically 10 kV/μs. The HCPL-2631 has a minimum CMR of 1 kV/μs.

An improved double-molded package allows superior insulation, permitting a 480 V working voltage compared to industry standard 220 V.

FEATURES

- Very high speed—10 MBit/s
- Superior CMR—10 kV/μs
- Double working voltage—480 V
- Fan-out of 8 over 0-70°C
- Logic gate output
- Wired-OR—open collector
- U.L. recognized (File #E50151)

APPLICATIONS

- Ground loop elimination
- LSTTL to TTL, LSTTL or 5-volt CMOS
- Line receiver, data transmission
- Data multiplexing
- Switching power supplies
- Pulse transformer replacement
- Computer-peripheral interface

ABSOLUTE MAXIMUM RATINGS

Storage temperature	−55°C to +125°C
Operating temperature	0°C to +70°C
Lead solder temperature	260°C for 10s
INPUT DIODE	
DC/average forward input current (each channel)	15 mA
Peak forward input current (each channel)	30 mA (≤1 msec duration)
Reverse input voltage (each channel)	5.0 V
Reverse supply voltage ($-V_{CC}$)	−500 mV

OUTPUT TRANSISTOR	
Supply voltage, (V_{CC})	7.0 V/1 minute maximum
Output current, (I_O) (each channel)	16 mA
Output voltage, (V_O) (each channel)	7.0 V
Collector output power dissipation	60 mW

DUAL VERY HIGH-SPEED LOGIC GATE OPTOCOUPLERS

RECOMMENDED OPERATING CONDITIONS

	SYMBOL	MIN.	MAX.	UNITS
Input current, low level	I_{FL}	0	250	μA
Input current, high level	I_{FH}	6.3*	15	mA
Supply voltage, output	V_{CC}	4.5	5.5	V
Operating temperature	T_A	0	70	°C
Fan out (TTL load)	N		8	

**6.3 mA is a guard banded value which allows for at least 20% CTR degradation. Initial input current threshold value is 5.0 mA or less.*

ELECTRICAL CHARACTERISTICS (T_A=0°C to 70°C Unless Otherwise Specified)

INDIVIDUAL COMPONENT CHARACTERISTICS

PARAMETER	SYMBOL	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS
DIODE						
Input forward voltage	V_F		1.55	1.75	V	I_F=10 mA, T_A=25°C
Input reverse breakdown voltage	B_{VR}	5.0			V	I_R=10 μA, T_A=25°C
Input capacitance	C_{IN}		60		pF	V_F=0, f=1 MHz
Input diode temperature coefficient	$\Delta V_F/\Delta T_A$		−1.4		mV/°C	I_F=10 mA
DETECTOR						
High level supply current	I_{CCH}		14	30	mA	V_{CC}=5.5 V, I_F=0 mA (Both channels)
Low level supply current	I_{CCL}		26	36	mA	V_{CC}=5.5 V, I_F=10 mA (Both channels)

TRANSFER CHARACTERISTICS

DC CHARACTERISTICS	SYMBOL	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS
High level output current	I_{OH}		2	250	μA	V_{CC}=5.5 V, V_O=5.5 V I_F=250 μA, Note 6
Low level output voltage	V_{OL}		0.34	0.6	V	V_{CC}=5.5 V, I_F=5 mA Note 6, I_{OL}=13 mA

SWITCHING CHARACTERISTICS (T_A=25°C, V_{CC}=5.0 V Unless Otherwise Specified)

AC CHARACTERISTICS	SYMBOL	DEVICE	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS
Propagation delay time (for output high level)	t_{PLH}			48	75	ns	
Propagation delay time (for output low level)	t_{PHL}			48	75	ns	R_L=350 Ω C_L=15 pF
Output rise time (10-90%)	t_r			30		ns	I_F=7.5 mA
Output fall time (90-10%)	t_f			14		ns	Notes 2, 3, 4 & 5, Fig. 7
Common mode transient immunity (At output high level)	CM_H	2631 2630	1000 	10,000 10,000		V/μs	V_{CM}=50 V (peak) I_F=0 mA, V_{OL} (min)=2.0 V R_L=350 Ω, Note 9, Fig. 11
Common mode transient immunity (at output low level)	CM_L	2631 2630	−1000 	−10,000 −10,000		V/μs	V_{CM}=50 V (peak) I_F=7.5 mA, V_{OL} (max)=0.8 V R_L=350 Ω, Note 8, Fig. 11

**All typical values are at V_{CC}=5 V, T_A=25°C (each channel).*

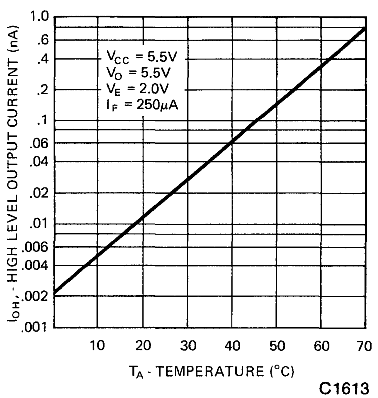
DUAL VERY HIGH-SPEED LOGIC GATE OPTOCOUPLERS

ISOLATION CHARACTERISTICS

CHARACTERISTICS	SYMBOL	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS
Input-input insulation leakage current	I_{I-I}		0.005		μA	Relative humidity=45% t=5 s, V_{I-I}=500 V, Note 7
Resistance (input-input)	R_{I-I}		10^{11}		Ω	V_{I-I}=500 V, Note 7
Capacitance (input-input)	C_{I-I}		0.25		pF	f=1 MHz, Note 7
Input-output insulation leakage current	I_{I-O}			1.0	μA	Relative humidity=45% T_A=25°C, t=5s V_{I-O}=3000 V dc Note 10
Resistance (input to output)	R_{I-O}		10^{12}		Ω	V_{I-O}=500 V, Note 10
Capacitance (input to output)	C_{I-O}		0.6		pF	f=1 MHz, Note 10
Withstand insulation test voltage	V_{ISO}	2500			V_{RMS}	RH<50% T_A=25°C t=1 min

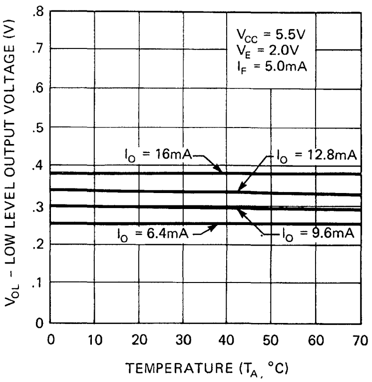
**All typical values are at V_{CC}=5 V, T_A=25°C (each channel).*

TYPICAL CHARACTERISTIC CURVES (T_A=25°C Unless Otherwise Specified)



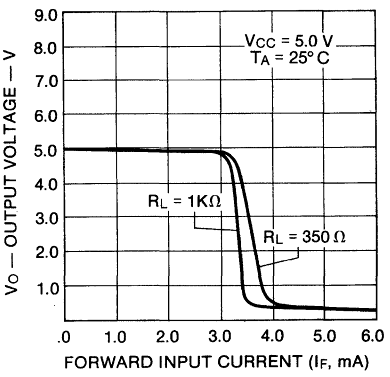
C1613

Fig. 1. High Level Output Current vs. Temperature



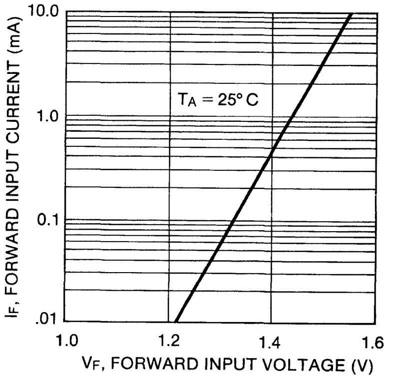
C1598

Fig. 2. Low Level Output Voltage vs. Temperature



C1602

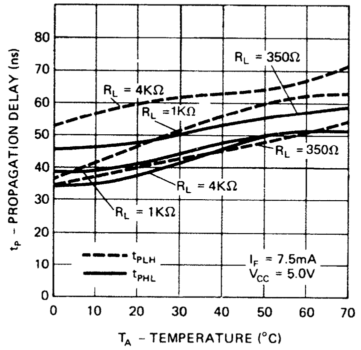
Fig. 3. Output Voltage vs. Forward Input Current



C1600

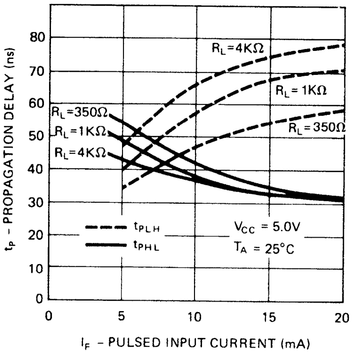
Fig. 4. Forward Input Current vs. Forward Input Voltage

TYPICAL CHARACTERISTIC CURVES (T_A=25°C Unless Otherwise Specified) (Cont'd)



C1604

Fig. 5. Propagation Delay vs. Temperature



C1603

Fig. 6. Propagation Delay vs. Pulse Input Current

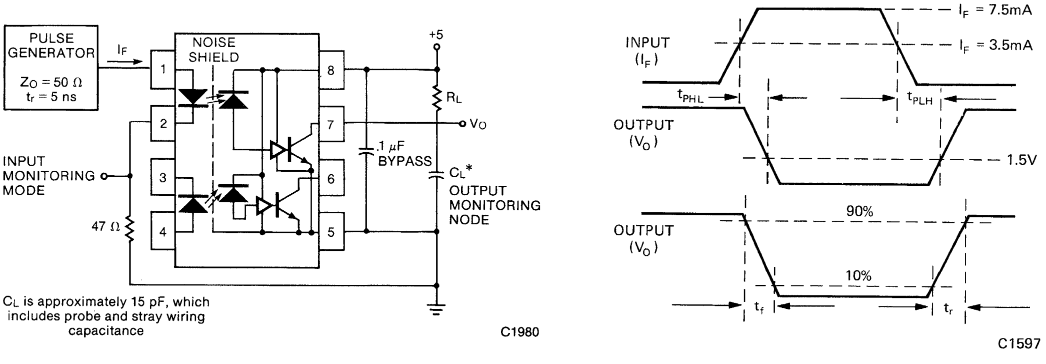
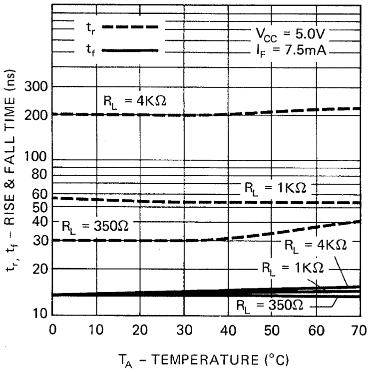
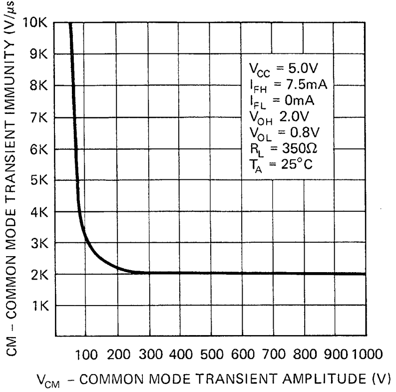


Fig. 7. Test Circuit t_{PHL}, t_{PLH}, t_r and t_r



C1601

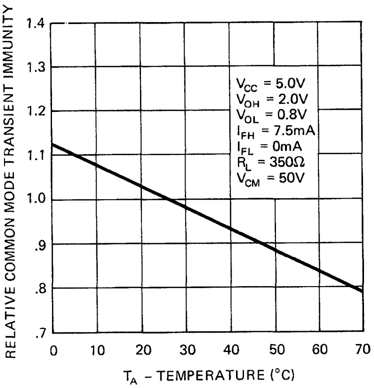
Fig. 8. Rise and Fall Time vs. Temperature



C1590

Fig. 9. Relative Common Mode Transient Immunity vs. Common Mode Transient Complitude

TYPICAL CHARACTERISTIC CURVES (T_A=25°C Unless Otherwise Specified) (Cont'd)



C1595

Fig. 10. Relative Common Mode Transient Immunity vs. Temperature

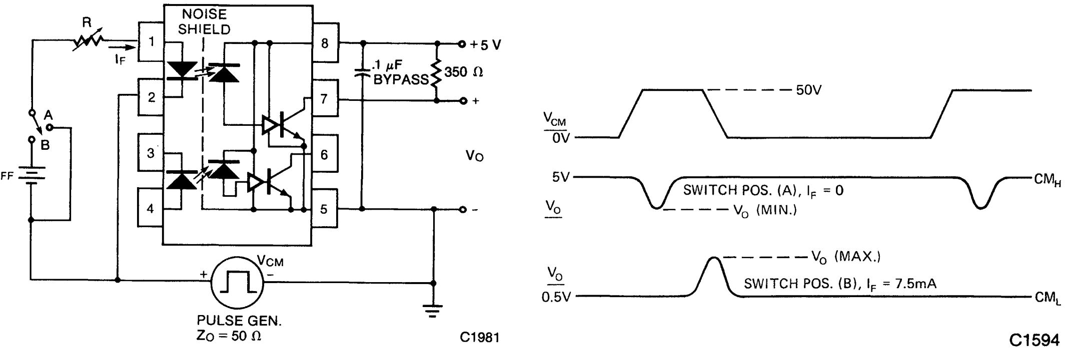


Fig. 11. Test Circuit for Transient Immunity and Typical Waveforms

NOTES

1. *The V_{CC} supply voltage to each MCL2630 isolator must be bypassed by a 0.1 μF capacitor or larger. This can be either a ceramic or solid tantalum capacitor with good high frequency characteristic and should be connected as close as possible to the package V_{CC} and GND pins of each device.*
2. *t_{PHL} - Propagation delay is measured from the 3.75 mA level on the LOW to HIGH transition of the input current pulse to the 1.5 V level on the HIGH to LOW transition of the output voltage pulse.*
3. *t_{PLH} - Propagation delay is measured from the 3.75 mA level on the HIGH to LOW transition of the input current pulse to the 1.5 V level on the LOW to HIGH transition of the output voltage pulse.*
4. *t_f - Fall time is measured from the 10% to the 90% levels of the HIGH to LOW transition on the output pulse.*
5. *t_r - Rise time is measured from the 90% to the 10% levels of the LOW to HIGH transition on the output pulse.*
6. *Each channel.*
7. *Measured between pins 1 and 2 shorted together, and pins 3 and 4 shorted together.*
8. *CM_L - The maximum tolerable rate of fall of the common mode voltage to ensure the output will remain in the low output state (i.e., $V_{OUT}>0.8$ V). Measured in volts per microsecond (V/%s).*
9. *CM_H - The maximum tolerable rate of rise of the common mode voltage to ensure the output will remain in the high state (i.e., $V_{OUT}>2.0$ V). Measured in volts microsecond (V/μs).*
   Volts/microsecond can be translated to sinusoidial voltages:

$$V/\mu s = \frac{(dV_{CM})}{dt} \text{ Max.} = \pi f_{CM} \, V_{CM}(p.p.)$$

   Example: $V_{CM}=318$ V_{pp} when $f_{CM}=1$ MHz using CM_L and $CM_H=1000$ V/μs.

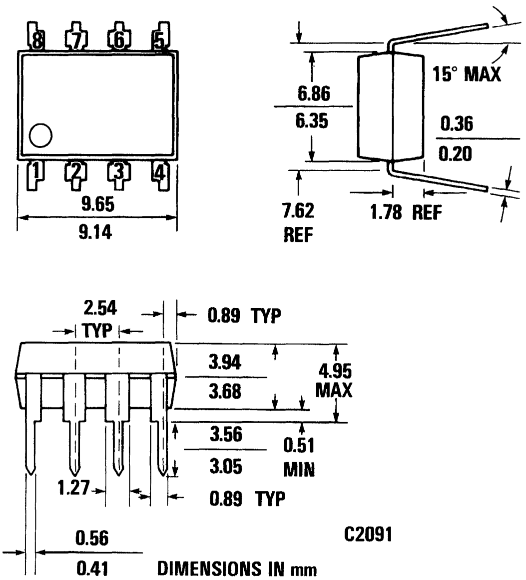
10. *- Device considered a two-terminal device: Pins 1, 2, 3 and 4 shorted together, and Pins 5, 6, 7 and 8 shorted together.*

QT
OPTOELECTRONICS

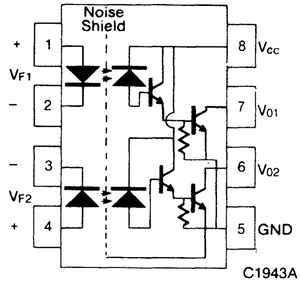
DUAL SPLIT-DARLINGTON OPTOCOUPLERS

1.6 mA DUAL HCPL-2730
0.5 mA DUAL HCPL-2731

PACKAGE DIMENSIONS



DIMENSIONS IN mm
PACKAGE CODE D



Equivalent Circuit

DESCRIPTION

The HCPL-2730/31 dual channel optocouplers contain two completely separated 700nm GaAsP LED emitters. Each channel is optically coupled to high gain detector in a split Darlington Configuration, which provides extremely high current transfer ratio.

The split darlington configuration separating the input photodiode and the first stage gain from the output transistor permits lower output saturation voltage and higher speed operation than possible with conventional darlington phototransistor optocoupler. An integrated emitter-base resistor provides superior stability over temperature.

The combination of a very low input current of 0.5 mA and a high current transfer ratio of 2000% make this family particularly useful for input interface to MOS, CMOS, LSTTL and EIA RS232C, while output compatibility is ensured to CMOS as well as high fan-out requirements.

An internal noise shield provides exceptional common mode rejection of 10 kV/μs. An improved package allows superior insulation permitting a 480 V working voltage compared to industry standard 220 V.

FEATURES

- Low current—0.5 mA
- Superior CTR—2000%
- Superior CMR—10 kV/μs
- Double working voltage—480 V RMS
- CTR guaranteed 0-70°C

APPLICATIONS

- Digital logic ground isolation
- Telephone ring detector
- High common-mode-noise line receiver

ABSOLUTE MAXIMUM RATINGS

Storage temperature	−55°C to +125°C
Operating temperature	−40°C to +85°C
Lead solder temperature	260°C for 10 s
INPUT DIODE	
DC/average forward input current (each channel)	20 mA *(1)*
Peak forward input current (each channel)	40 mA
(≤1 msec duration, 50% duty cycle) (1)	
Reverse input voltage (each channel)	5.0 V
Input power dissipation (each channel)	35 mW *(2)*

OUTPUT TRANSISTOR	
Output current (each channel)	60 mA *(3)*
Supply and output voltage (V_{CC},V_O)	
MCL2730 (HCPL-2730)	−0.5 to 7 V
MCL2731 (HCPL-2731)	−0.5 to 18 V
Output power dissipation (each channel)	100 mW *(4)*

DUAL
SPLIT-DARLINGTON OPTOCOUPLERS

ELECTRICAL CHARACTERISTICS (T_A=0°C to 70°C Unless Otherwise Specified)

INDIVIDUAL COMPONENT CHARACTERISTICS

PARAMETER	SYM.	DEVICE	MIN.	TYP.*	MAX.	UNITS	TEST CONDITIONS	FIG.	NOTE
DIODE									
Input forward voltage	V_F			1.5	1.7	V	$I_F=1.6$ mA, $T_A=25$°C	4	5
Input reverse breakdown voltage	B_{VR}		5			V	$I_R=10$ μA, $T_A=25$°C		5
Temperature coefficient of forward voltage	$\frac{\Delta V_F}{\Delta T_A}$			−1.6		mV/°C	$I_F=1.6$ mA		5
Input capacitance	C_{IN}			60		pF	$V_F=0$, f=1 MHz		5
DETECTOR									
Logic high output current	I_{OH}	2730		0.01	100	μA	$I_F=0$ mA, $V_O=V_{CC}=7$ V		5
		2731		0.01	100	μA	$I_F=0$ mA, $V_O=V_{CC}=18$ V		
Logic low supply current	I_{CCL}	2730		.4		mA	$I_{F1}=I_{F2}=1.6$ mA, $V_{CC}=7$ V		
		2731		.5		mA	$V_{O1}=V_{O2}=$Open, $V_{CC}=18$ V		
Logic high supply current	I_{CCH}	2730		4		nA	$I_{F1}=I_{F2}=0$ mA, $V_{CC}=7$ V		
		2731		5		nA	$V_{O1}=V_{O2}=$Open, $V_{CC}=18$ V		

TRANSFER CHARACTERISTICS

DC CHARACTERISTICS	SYM.	DEVICE	MIN.	TYP.*	MAX.	UNITS	TEST CONDITIONS	FIG.	NOTE
Current transfer ratio	CTR	2730	300	2000		%	$I_F=1.6$ mA, $V_O=0.4$ V, $V_{CC}=4.5$ V	2	5,6
		2731	400	2000		%	$I_F=0.5$ mA, $V_O=0.4$ V, $V_{CC}=4.5$ V		
			500	2000		%	$I_F=1.6$ mA, $V_O=0.4$ V, $V_{CC}=4.5$ V		
Logic low output voltage	V_{OL}	2730		.1	0.4	V	$I_F=1.6$ mA, $I_O=4.8$ mA, $V_{CC}=4.5$ V	1	5
		2731		.1	0.4	V	$I_F=0.5$ mA, $I_O=2$ mA, $V_{CC}=4.5$ V		
				.1	0.4	V	$I_F=1.6$ mA, $I_O=8$ mA, $V_{CC}=4.5$ V		
				.1	0.4	V	$I_F=5$ mA, $I_O=15$ mA, $V_{CC}=4.5$ V		
				.2	0.4	V	$I_F=12$ mA, $I_O=24$ mA, $V_{CC}=4.5$ V		

SWITCHING CHARACTERISTICS (T_A=25°C, V_{CC}=5.0 V)

AC CHARACTERISTICS	SYM.	DEVICE	MIN.	TYP.*	MAX.	UNITS	TEST CONDITIONS	FIG.	NOTE
Propagation delay time (For output low level)	t_{PHL}	2730/1		4	20	μs	$I_F=1.6$ mA, $R_L=2.2$ kΩ	6	5
				0.5	2	μs	$I_F=12$ mA, $R_L=270$ Ω		
		2731		25	100	μs	$I_F=0.5$ mA, $R_L=4.7$ kΩ		
Propagation delay time (For output high level)	t_{PLH}	2730/1		12	35	μs	$I_F=1.6$ mA, $R_L=2.2$ kΩ	6	5
				4	10	μs	$I_F=12$ mA, $R_L=270$ Ω		
		2731		20	60	μs	$I_F=0.5$ mA, $R_L=4.7$ kΩ		
Common mode transient immunity at logic high level output	CM_H		1000	10000		V/μs	$I_F=0$mA, $R_L=2.2$ kΩ $V_{CM}=10\ V_{p\text{-}p}$	7	5,9
Common mode transient immunity at logic low level output	CM_L		−1000	−10000		V/μs	$I_F=16$ mA, $R_L=2.2$ kΩ $V_{CM}=10\ V_{p\text{-}p}$	7	5,8

*All typicals at T_A=25°C

ISOLATION CHARACTERISTICS

CHARACTERISTICS	SYM.	DEVICE	MIN.	TYP.*	MAX.	UNITS	TEST CONDITIONS	FIG.	NOTE
Withstand insulation test voltage	V_{ISO}		2500			V_{RMS}	RH≤50%, T_A=25°C t=1 min		10,11
Resistance (input-output)	R_{I-O}			10^{12}		Ω	V_{I-O}=500 VDC		10
Capacitance (input-output)	C_{I-O}			0.6		pF	f=1 MHz		10
Insulation leakage current (input-input)	I_{I-I}			0.005		μA	RH≤50%, V_{I-I}=500 VDC t=5 sec		7
Resistance (input-input)	R_{I-I}			10^{11}		Ω	V_{I-I}=500 VDC		7
Capacitance (input-input)	C_{I-I}			0.25		pF	f=1 MHz		7

**All typicals at T_A=25°C*

NOTES

1. *Derate linearly above 70°C free-air temperature at a rate of 0.5 mA/°C.*
2. *Derate linearly above 70°C free-air temperature at a rate of 0.9 mW/°C.*
3. *Derate linearly above 70°C free-air temperature at a rate of 0.6 mA/°C.*
4. *Derate linearly above 35°C free-air temperature at a rate of 1.7 mW/°C.
   Output power=(Collector output)+(supply power).*
5. *Each channel.*
6. *CURRENT TRANSFER RATIO is defined as the ratio of the output collector current, I_O, to the forward LED input current I_F, times 100%.*
7. *Measured between pins 1 and 2 shorted together, and pins 3 and 4 shorted together.*
8. *CM_L - The maximum tolerable rate of the common mode voltage to ensure the output will remain in the low output state (i.e., $V_{OUT}>0.8$ V). Measured in volts per microsecond (V/μS).*
9. *CM_H - The maximum tolerable rate of rise of the common mode voltage to ensure the output will remain in the high state (i.e., $V_{OUT}>2.0$ V). Measured in volts per microsecond (V/μS).*

   $$V/\mu s = \frac{dV_{CM}}{dt} Max = \pi f_{CM} V_{CM}(p.p.)$$

10. *Device considered a two-terminal device: Pins 1, 2, 3 and 4 shorted together, and Pins 5, 6, 7 and 8 shorted together.*
11. *The 2.5 kV RMS/1 minute capability is validated by a factory 3.1 kV RMS/1 sec.*

TYPICAL ELECTRO-OPTICAL CHARACTERISTICS

(T_A=0°C to 70°C Unless Otherwise Specified)

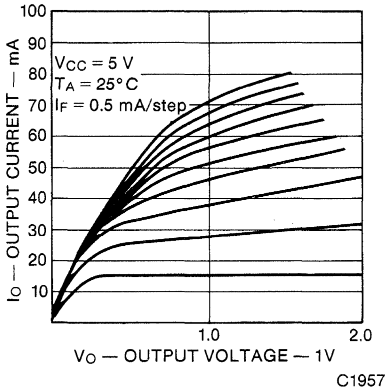


Fig. 1. DC Transfer Characteristics

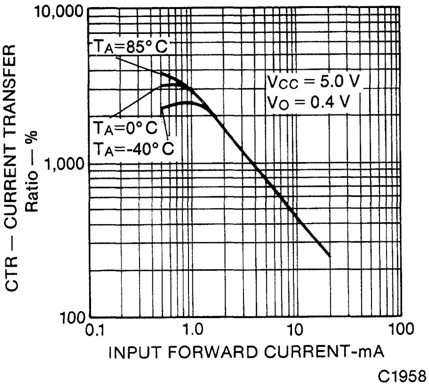


Fig. 2. Current Transfer Ratio vs. Input Forward Current

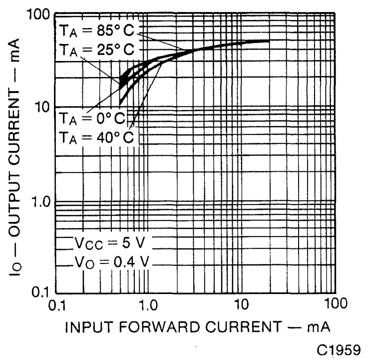


Fig. 3. Output Current vs. Input Forward Current

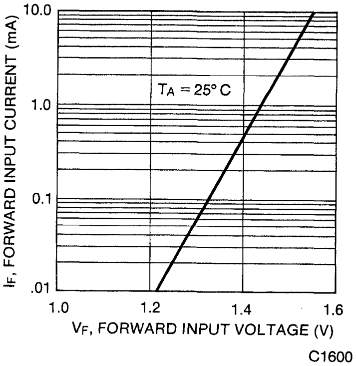


Fig. 4. Forward Input Current vs. Forward Input Voltage

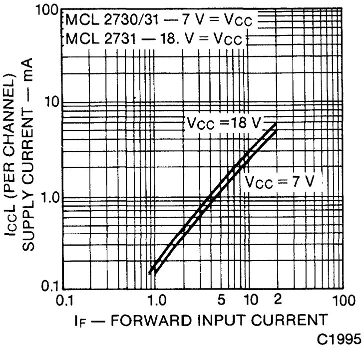


Fig. 5. Supply Current Per Channel vs. Input Forward Current

TYPICAL ELECTRO-OPTICAL CHARACTERISTICS

(T_A=0°C to 70°C Unless Otherwise Specified) (Cont'd)

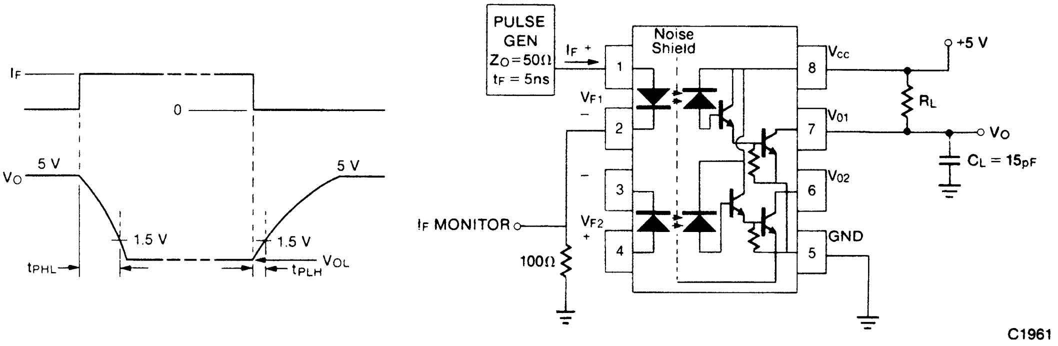


Fig. 6. Switching Test Circuit and Waveforms

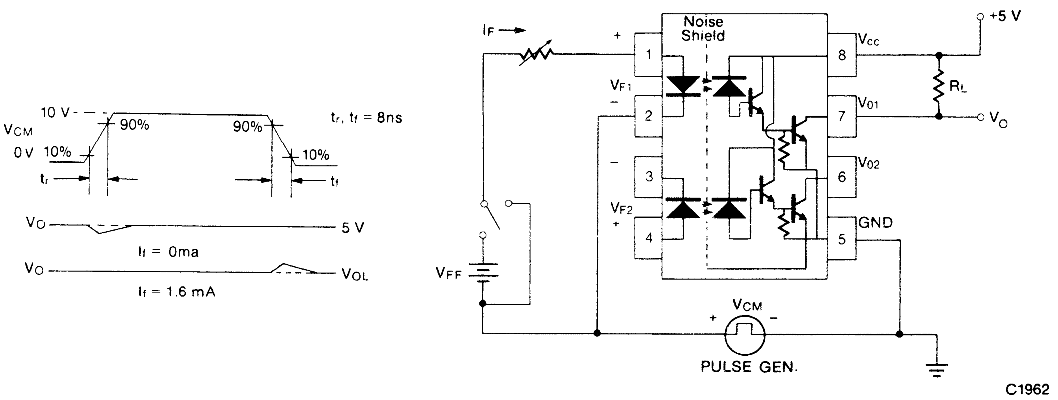


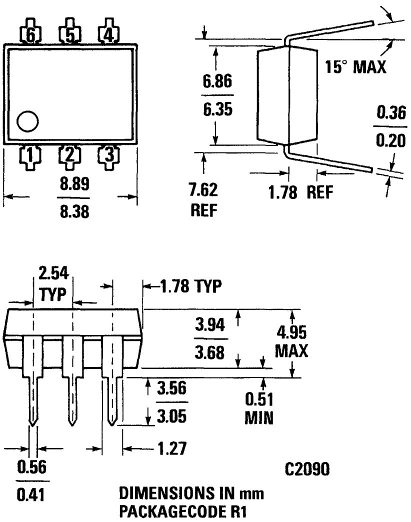
Fig. 7. Test Circuit for Common Mode Transient Immunity and Waveforms

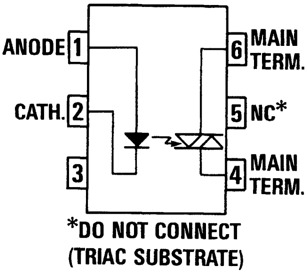
QT
OPTOELECTRONICS

NON-ZERO-CROSSING TRIACS

MCP3009 MCP3010 MCP3011

PACKAGE DIMENSIONS





Equivalent Circuit

DESCRIPTION

The MCP3009, MCP3010 and MCP3011 are optically isolated triac driver devices. These devices contain a GaAs infrared emitting diode and a light activated silicon bilateral switch, which functions like a triac. This series is designed for interfacing between electronic controls and power triacs to control resistive and inductive loads for 120 VAC operations.

FEATURES

- Low input current required (typically 5mA—MCP3011)
- Minimum commutating dv/dt is specified at 0.1V/μsec
- Pin for pin replacement for the MOC3009, 3010 and 3011 devices
- High isolation voltage—minimum 7500 VAC peak
- Underwriters Laboratory (UL) recognized—File E50151

APPLICATIONS

- Triac driver
- Industrial controls
- Traffic lights
- Vending machines
- Motor control
- Solid state relay

ABSOLUTE MAXIMUM RATINGS

TOTAL PACKAGE

Storage temperature	−55°C to 150°C
Operating temperature	−40°C to 100°C
Lead temperature (soldering 10 sec)	260°C
Total package power dissipation @ 25°C (LED plus detector)	330 mW
Derate linearly from 25°C	4.0 mW/°C
Withstand test voltage	7500 VAC Peak (50-60 Hz)

INPUT DIODE

Forward DC current	60 mA
Reverse voltage	3 V
Peak forward current (1 μs pulse, 300 pps)	3.0 A
Power dissipation 25°C ambient	100 mW
Derate linearly from 25°C	1.33 mW/°C

OUTPUT DRIVER

Off-state output terminal voltage		250 volts
On-state RMS current	T_A=25°C	100 mA
(Full cycle, 50 to 60 Hz)	T_A=70°C	50 mA
Peak nonrepetitive surge current (PW=10 ms, DC=10%)		1.2 A
Total power dissipation @ T_A=25°C		300 mW
Derate above 25°C		4.0 mW/°C

NON-ZERO-CROSSING TRIACS

ELECTRO-OPTICAL CHARACTERISTICS (25°C Temperature Unless Otherwise Specified)

INDIVIDUAL COMPONENT CHARACTERISTICS

CHARACTERISTIC	SYMBOL	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS
INPUT DIODE						
Forward voltage	V_F		1.3	1.50	V	I_F=30 mA
Forward voltage temp. coefficient	$\frac{\Delta V_F}{\Delta T_A}$		−1.8		mV/°C	
Reverse breakdown voltage	BV_R	3.0	25		V	I_R=10 μA
Junction capacitance	C_J		50		pF	V_F=0 V, f=1 MHz
			65		pF	V_F=1 V, f=1 MHz
Reverse leakage current	I_R		.35	10	μA	V_R=3.0 V
OUTPUT DETECTOR						
Peak blocking current, either direction	I_{DRM}	—	10	100	nA	V_{DRM}=250 V, Note 1
Peak on-state voltage, either direction	V_{TM}	—	2.0	3.0	Volts	I_{TM}=100 mA Peak

Note 1. Test voltage must be applied within dv/dt rating.

TRANSFER CHARACTERISTICS

DC CHARACTERISTICS		SYMBOL	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS
LED trigger current (current required to latch output)	MCP3009	I_{FT}	—	15.0	30	mA	Main terminal voltage=3.0 V
	MCP3010	I_{FT}	—	10.0	15	mA	
	MCP3011	I_{FT}	—	5	10	mA	
Holding current		I_H	—	200	—	μA	Either direction

TRANSFER CHARACTERISTICS

CHARACTERISTICS	SYMBOL	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS
AC dv/dt RATING						
Critical rate of rise of off-state voltage	dv/dt	—	10.0	—	V/μs	Static dv/dt (see Fig. 4)
Critical rate of rise of commutating voltage	dv/dt	0.1	0.2	—	V/μS	Commutating dv/dt I_{LOAD}=15 mA (see Fig. 4)

ISOLATION CHARACTERISTICS

CHARACTERISTICS	SYMBOL	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS
Isolation voltage	V_{iso}	5300			V_{AC}RMS	$I_{I-O} \leqslant 1$ μA, 1 minute
	V_{iso}	7500			V_{AC}PEAK	$I_{I-O} \leqslant 1$ μA, 1 minute
Isolation resistance	R_{iso}	10^{11}			ohms	V_{I-O}=500 VDC
Isolation capacitance	C_{iso}		0.5		pF	f=1 MHz

TYPICAL ELECTRICAL CHARACTERISTIC CURVES

(25°C Free Air Temperature Unless Otherwise Specified)

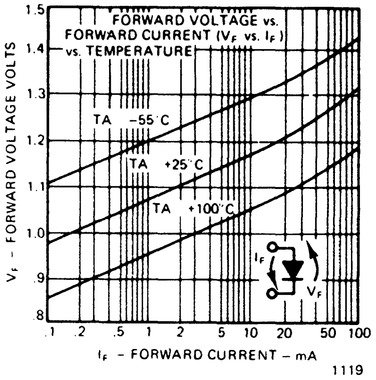


Fig. 1. Forward Voltage Drop vs. Forward Current

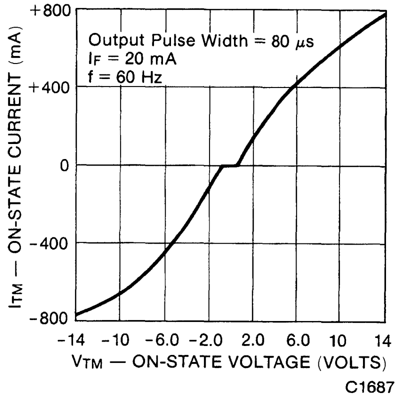


Fig. 2. On-State Characteristics

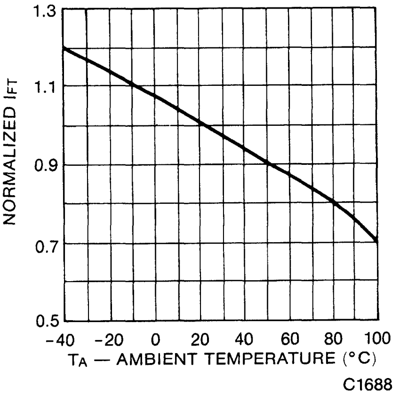
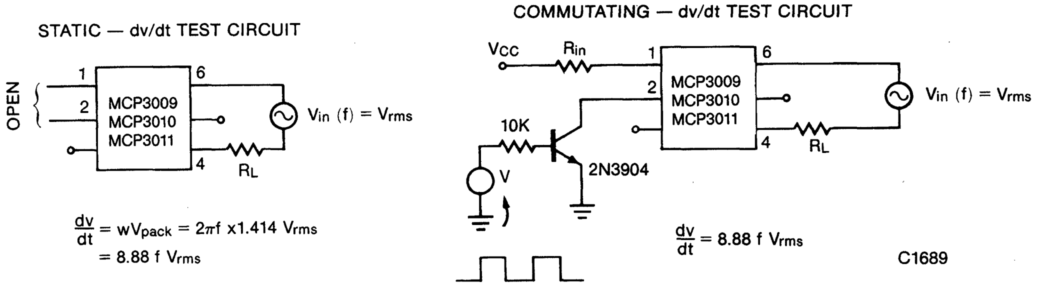


Fig. 3. Trigger Current vs. Temperature



$\frac{dv}{dt} = wV_{pack} = 2\pi f \; x1.414 \; V_{rms}$
$= 8.88 \; f \; V_{rms}$

$\frac{dv}{dt} = 8.88 \; f \; V_{rms}$

Fig. 4. dV/dt Test Circuits

TYPICAL ELECTRICAL CHARACTERISTIC CURVES

(25°C Free Air Temperature Unless Otherwise Specified) (Cont'd)

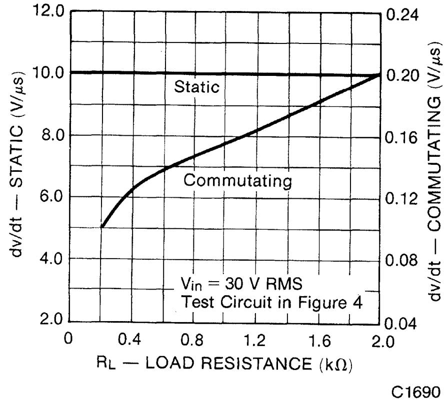


Fig. 5. dV/dt vs. Load Resistance

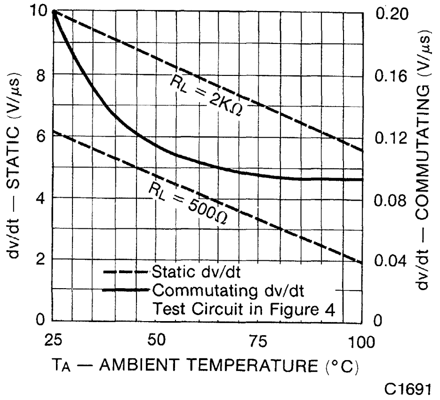


Fig. 6. dV/dt vs. Temperature

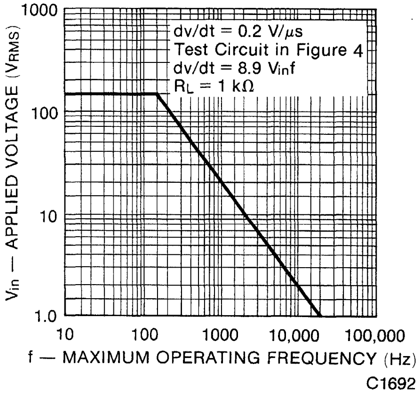


Fig. 7. Commutating dV/dt vs. Frequency

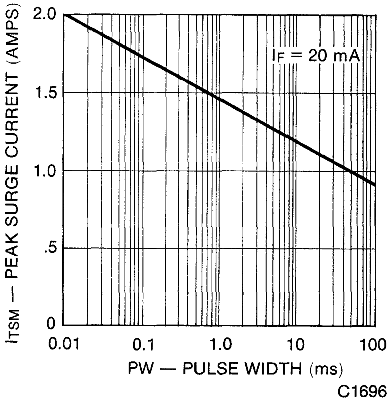


Fig. 8. Maximum Nonrepetitive Surge Current

TYPICAL APPLICATION CIRCUITS

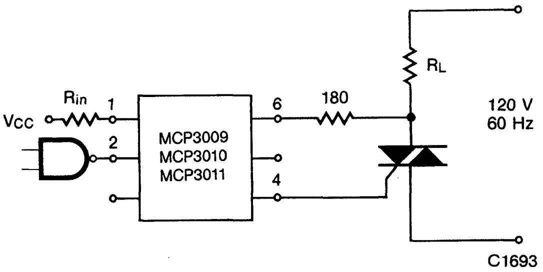


Fig. 9. Resistive Load

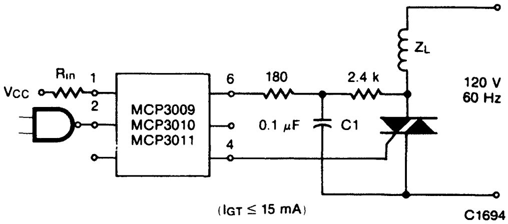


Fig. 10. Inductive Load With Sensitive Gate Triac

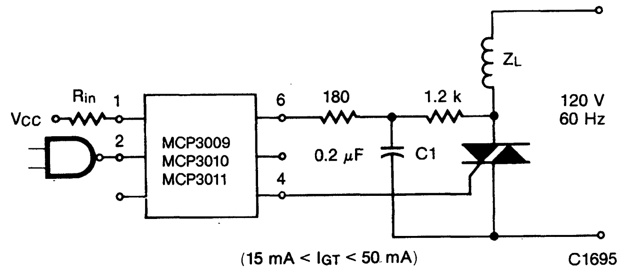


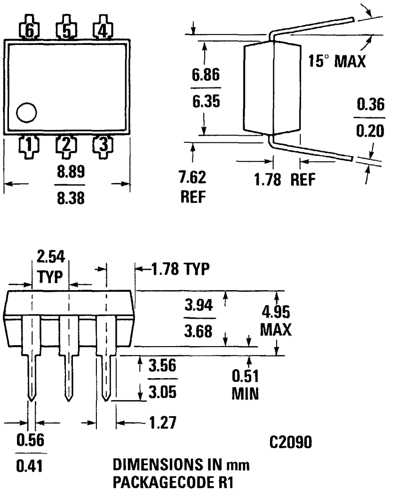
Fig. 11. Inductive Load With Non-Sensitive Gate Triac

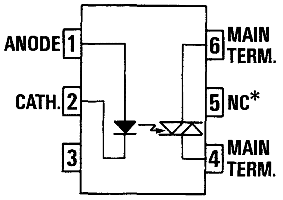
OPTOELECTRONICS

NON-ZERO-CROSSING TRIACS

MCP3020 MCP3021 MCP3022

PACKAGE DIMENSIONS





C2081

Equivalent Circuit

DESCRIPTION

The MCP3020, MCP3021 and MCP3022 are optically isolated triac driver devices. These devices contain a GaAs infrared emitting diode and a light activated silicon bilateral switch, which functions like a triac. This is designed for interfacing between electronic controls and power triacs to control resistive and inductive loads for 240 VAC operations.

FEATURES

- Minimum commutating dv/dt is specified at 0.1 V/μsec
- Excellent I_{FT} stability—IR emitting diode has low degradation
- Pin for pin replacement for the MOC3020, MOC3021 and MOC3022
- High isolation voltage—minimum 7500 VAC peak
- Underwriters Laboratory (UL) recognized—File #E50151

APPLICATIONS

- European applications for 240 VAC
- Triac driver
- Industrial controls
- Traffic lights
- Vending machines
- Motor control
- Solid state relay

ABSOLUTE MAXIMUM RATINGS

TOTAL PACKAGE

Storage temperature	−55°C to 150°C
Operating temperature	−40°C to 100°C
Lead temperature (soldering, 10 sec)	260°C
Total package power dissipation @ 25°C (LED plus detector)	330 mW
Derate linearly from 25°C	4.0 mW/°C
Surge isolation voltage	7500 VAC Peak

INPUT DIODE

Forward DC current	60 mA
Reverse voltage	3 V
Peak forward current (1 μs pulse, 300 pps)	3.0 A
Power dissipation 25°C ambient	100 mW
Derate linearly from 25°C	1.33 mW/°C

OUTPUT DRIVER

Off-state output terminal voltage		400 Volts
On-state RMS current	T_A=25°C	100 mA
(Full cycle, 50 to 60 Hz)	T_A=70°C	50 mA
Peak nonrepetitive surge current (PW=10 ms, DC=10%)		1.2 A
Total power dissipation @ T_A=25°C		300 mW
Derate above 25°C		4.0 mW/°C

ELECTRO-OPTICAL CHARACTERISTICS (25°C Temperature Unless Otherwise Specified)

INDIVIDUAL COMPONENT CHARACTERISTICS

CHARACTERISTIC	SYMBOL	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS
INPUT DIODE						
Forward voltage	V_F		1.3	1.50	V	I_F=30 mA
Forward voltage temperature coefficient	$\frac{\Delta V_F}{\Delta T_A}$		−1.8		mV/°C	
Reverse breakdown voltage	BV_R	3.0	25		V	I_R=10 μA
Junction capacitance	C_J		50 65		pF pF	V_F=0 V, f=1 MHz V_F=1 V, f=1 MHz
Reverse leakage current	I_R		.35	10	μA	V_R=3.0 V
OUTPUT DETECTOR						
Peak blocking current, either direction	I_{DRM}	—	10	100	nA	V_{DRM}=400 V, Note 1
Peak on-state voltage, either direction	V_{TM}	—	2.0	3.0	Volts	I_{TM}=100 mA Peak

Note 1. Test voltage must be applied within dv/dt rating.

TRANSFER CHARACTERISTICS

DC CHARACTERISTICS		SYMBOL	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS
LED trigger current (current required	MCP3020	I_{FT}	—	15	30	mA	Main terminal
to latch output)	MCP3021	I_{FT}	—	8	15	mA	voltage=3.0 V
	MCP3022	I_{FT}	—	5	10	mA	
Holding current		I_H	—	200	—	μA	Either direction

TRANSFER CHARACTERISTICS

CHARACTERISTICS	SYMBOL	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS
dv/dt RATING						
Critical rate of rise of off-state voltage	dv/dt	—	15	—	V/μs	Static dv/dt, T_A=85°C (see Fig. 3)
Critical rate of rise of commutating voltage	dv/dt	0.1	0.2	—	V/μs	Commutating dv/dt I_{LOAD}=15 mA (see Fig. 4)

ISOLATION CHARACTERISTICS

CHARACTERISTICS	SYMBOL	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS
Isolation voltage	V_{iso}	5300			V_{AC}RMS	$I_{I\text{-}O} \leqslant 1$ μA, 1 minute
	V_{iso}	7500			V_{AC}PEAK	$I_{I\text{-}O} \leqslant 1$ μA, 1 minute
Isolation resistance	R_{iso}	10^{11}			ohms	$V_{I\text{-}O}$=500 VDC
Isolation capacitance	C_{iso}		0.5		pF	f=1 MHz

TYPICAL ELECTRICAL CHARACTERISTIC CURVES

(25°C Free Air Temperature Unless Otherwise Specified)

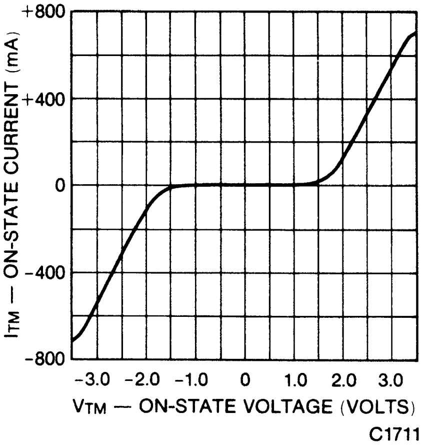


Fig. 1. On-State Characteristics

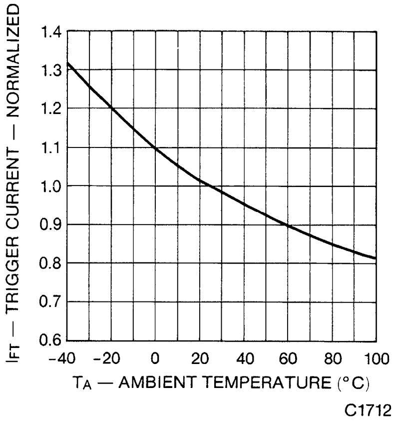
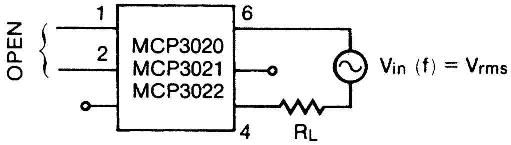


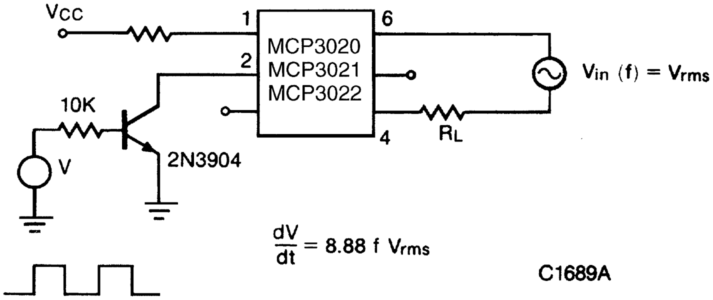
Fig. 2. Trigger Current vs. Temperature

TEST CIRCUITS FOR dV/dt MEASUREMENTS



$$\frac{dV}{dt} = wV_{pack} = 2\pi f \times 1.414\ V_{rms}$$
$$= 8.88\ f\ V_{rms}$$

Fig. 3. Static dV/dt



$$\frac{dV}{dt} = 8.88\ f\ V_{rms}$$

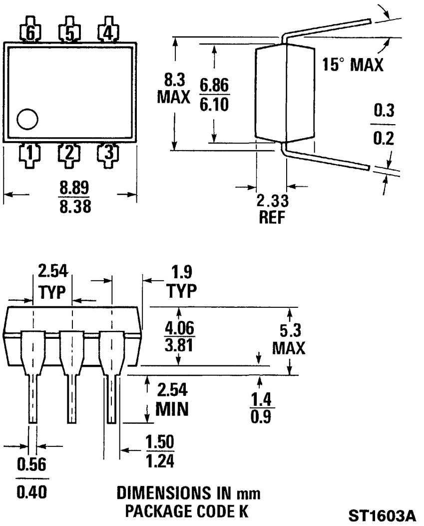
C1689A

Fig. 4. Commutating dV/dt

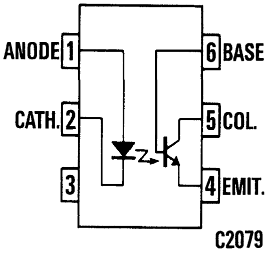
PHOTOTRANSISTOR OPTOCOUPLER

MCT2

PACKAGE DIMENSIONS



DIMENSIONS IN mm
PACKAGE CODE K



Equivalent Circuit

DESCRIPTION

The MCT2 is a NPN silicon planar phototransistor optically coupled to a gallium arsenide infrared emitting diode.

FEATURES & APPLICATIONS

- AC line/digital logic isolator
- Digital logic/digital logic isolator
- Telephone/telegraph line receiver
- Twisted pair line receiver
- High frequency power supply feedback control
- Relay contact monitor
- Power supply monitor
- UL recognized—File E90700

ABSOLUTE MAXIMUM RATINGS

TOTAL PACKAGE

Storage temperature	−55°C to 150°C
Operating temperature	−55°C to 100°C
Lead soldering temperature (10 sec)	260°C

INPUT DIODE

Forward current	60 mA
Reverse voltage	3.0 V
Peak forward current (1 μs pulse, 300 pps)	3.0 A
Power dissipation 25°C ambient	200 mW
Derate linearly from 25°C	2.6 mW/°C

OUTPUT TRANSISTOR

Power dissipation at 25°C ambient	200 mW
Derate linearly from 25°C	2.6 mW/°C
Total package power dissipation at 25°C ambient (LED plus detector)	250 mW
Derate linearly from 25°C	3.3 mW/°C
Collector-emitter current (I_{CE})	50 mA

ELECTRO-OPTICAL CHARACTERISTICS
(25°C Free Air Temperature Unless Otherwise Specified)

INDIVIDUAL COMPONENT CHARACTERISTICS

CHARACTERISTIC	SYMBOL	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS
INPUT DIODE						
Forward voltage	V_F		1.25	1.50	V	I_F=20 mA
Reverse voltage	V_R	3.0	25		V	I_R=10 μA
Junction capacitance	C_J		50		pF	V_F=0 V, F=1 MHz
Reverse leakage current	I_R		.01	10	μA	V_R=3.0 V
DETECTOR						
DC forward current gain	h_{FE}		250			V_{CE}=5 V, I_C=100 μA
Collector to emitter breakdown volt	BV_{CEO}	30	85		V	I_C=1.0 mA, I_F=0
Collector to base breakdown voltage	BV_{CBO}	70	165		V	I_C=10 μA, I_F=0
Emitter to collector breakdown voltage	BV_{ECO}	7	14		V	I_E=100 μA, I_F=0
Collector to emitter, leakage current	I_{CEO}		5	50	nA	V_{CE}=10 V, I_F=0
Collector to base leakage current	I_{CBO}		0.1	20	nA	V_{CB}=10 V, I_F=0
Capacitance collector to emitter	C_{CEO}		8		pF	V_{CE}=0
Capacitance collector to base	C_{CBO}		20		pF	V_{CB}=10 V
Capacitance emitter to base	C_{EBO}		10		pF	V_{BE}=0

TRANSFER CHARACTERISTICS

CHARACTERISTICS	SYMBOL	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS
COUPLED						
DC collector current transfer ratio	CTR_{CE}	20	60		%	V_{CE}=10 V, I_F=10 mA, Note 1
DC base current transfer ratio	CTR_{CB}		.35		%	V_{CB}=10 V, I_F=10 mA
Collector-emitter, saturation voltage	V_{CE}(sat)		0.24	0.4	V	I_C=2.0 mA, I_F=16 mA

TRANSFER CHARACTERISTICS

AC CHARACTERISTICS		SYMBOL	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS
Bandwidth (see note 2)		B_W		150		KH$_z$	I_C=2 mA, V_{CE}=10 V, R_L=100Ω
SWITCHING TIMES							
Saturated t on (from 5 V to 0.8 V)		t_{on} (SAT)		10		μs	R_L=2 KΩ, I_F=15 mA, V_{CC}=5 V
t off (from SAT to 2.0 V)		t_{off} (SAT)		30		μs	R_B=open (Fig. 10 and Fig. 11)
Saturated t on (from 5 V to 0.8 V)		t_{on} (SAT)		10		μs	R_L=2 KΩ, I_F=20 mA, V_{CC}=5 V
t off (from SAT to 2.0 V)		t_{off} (SAT)		27		μs	R_B=100 KΩ (Fig. 10 and Fig. 11)
Non-saturated Base	Rise Time	t_r		300		ns	R_L=1 KΩ, V_{CB}=10 V
	Fall Time	t_f		300		ns	

ELECTRO-OPTICAL CHARACTERISTICS

25°C Free Air Temperature Unless Otherwise Specified) (Cont'd)

ISOLATION CHARACTERISTICS

CHARACTERISTICS	SYMBOL	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS
Isolation voltage		7500			VAC PEAK	1 minute
		5300			VRMS	1 minute
Isolation resistance		10^{11}	10^{12}		Ω	V_{I-O}=500 V
Isolation capacitance			.5		pF	f=1 MHz

TYPICAL ELECTRO-OPTICAL CHARACTERISTIC CURVES

(25°C Free Air Temperature Unless Otherwise Specified)

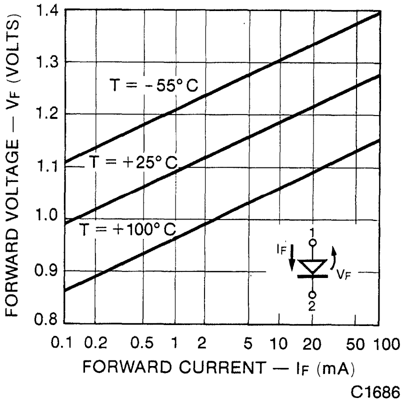


Fig. 1. Forward Voltage vs. Current

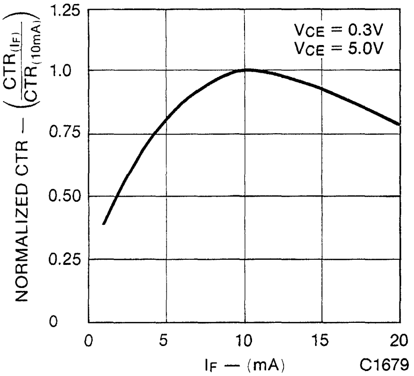


Fig. 2. Normalized CTR vs. Forward Current

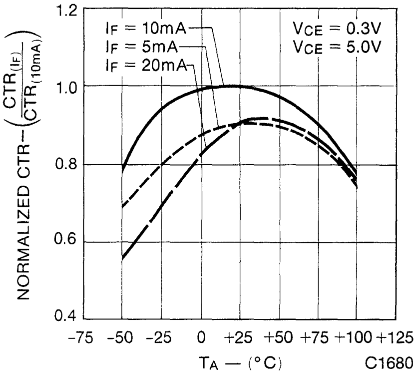


Fig. 3. Normalized CTR vs. Temperature

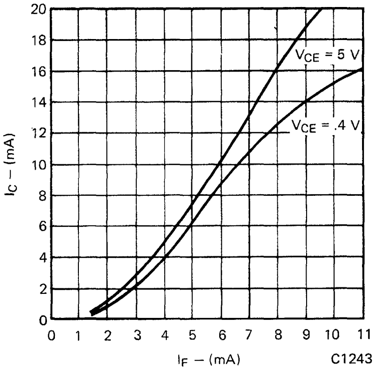


Fig. 4. Collector Current vs. Forward Current

TYPICAL ELECTRO-OPTICAL CHARACTERISTIC CURVES

(25°C Free Air Temperature Unless Otherwise Specified) (Cont'd)

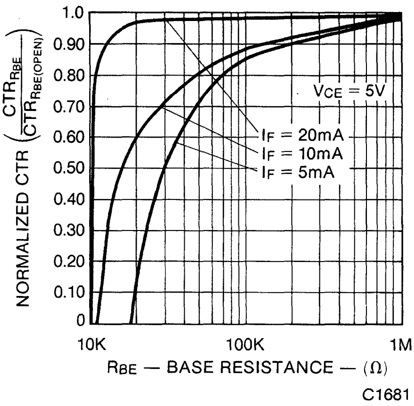


Fig. 5. CTR vs. RBE (Unsaturated)

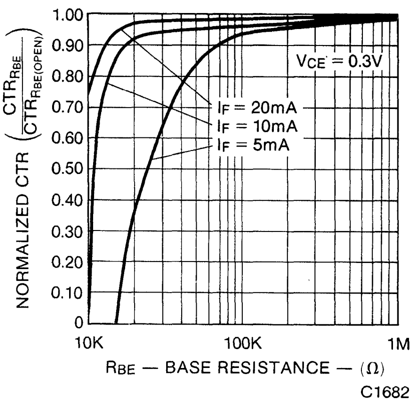


Fig. 6. CTR vs. RBE (Saturated)

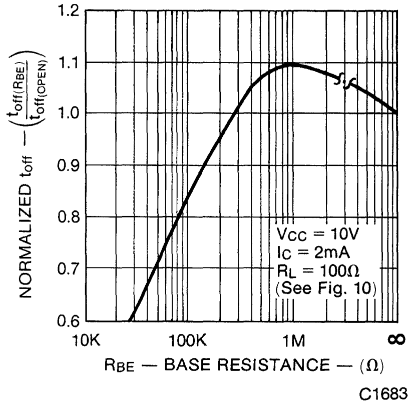


Fig. 7. Normalized T_{OFF} vs. RBE

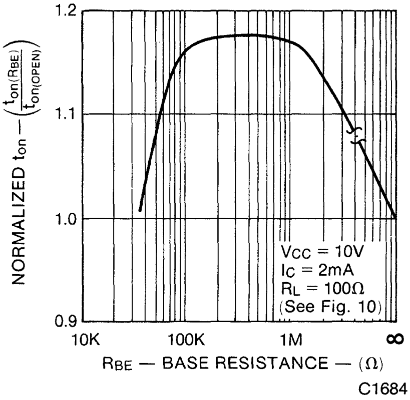


Fig. 8. Normalized T_{ON} vs. RBE

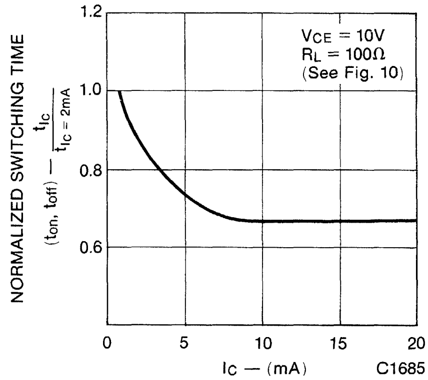


Fig. 9. Switching Time vs. IC

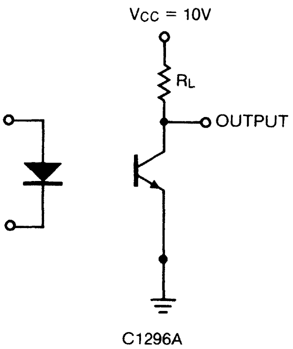


Fig. 10. Switching Time Test Circuit

TYPICAL ELECTRO-OPTICAL CHARACTERISTIC CURVES

(25°C Free Air Temperature Unless Otherwise Specified) (Cont'd)

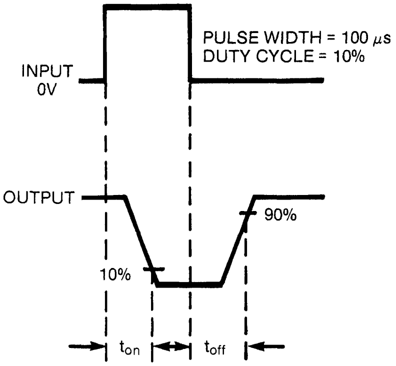


Fig. 11. Switching Time Waveforms

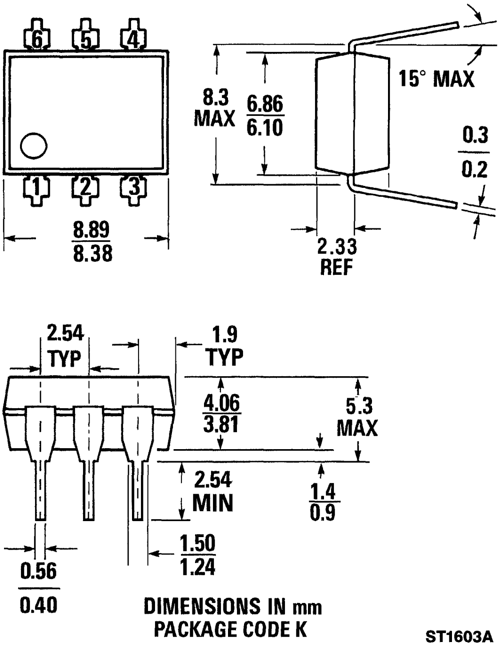
NOTES

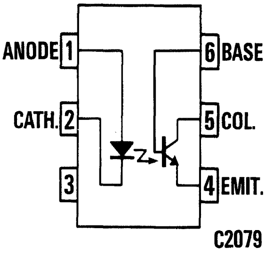
1. *The current transfer ratio (I_C/I_F) is the ratio of the detector collector current to the LED input current with V_{CE} at 10 volts.*
2. *The frequency at which i_c is 3 dB down from the 1 kHz value.*
3. *Rise time (t_r) is the time required for the collector current to increase from 10% of its final value, to 90%.*
   Fall time (t_f) is the time required for the collector current to decrease from 90% of its inital value, to 10%.

PHOTOTRANSISTOR OPTOCOUPLER

MCT2E

PACKAGE DIMENSIONS





Equivalent Circuit

DESCRIPTION

The MCT2E is a NPN silicon planar phototransistor optically coupled to a gallium arsenide infrared emitting diode.

FEATURES & APPLICATIONS

- Utility/economy isolator
- AC line/digital logic isolator
- Digital logic/digital logic isolator
- Telephone/telegraph line receiver
- Twisted pair line receiver
- High frequency power supply feedback control
- Relay contact monitor
- Power supply monitor
- UL recognized — File E90700

ABSOLUTE MAXIMUM RATINGS

Storage temperature	−55°C to 150°C
Operating temperature	−55°C to 100°C
Lead soldering temperature (10 sec)	260°C

INPUT DIODE

Forward current	60 mA
Reverse voltage	3.0 V
Peak forward current (1 μs pulse, 300 pps)	3.0 A
Power dissipation at 25°C ambient	200 mW
Derate linearly from 25°C	2.6 mW/°C

OUTPUT TRANSISTOR

Power dissipation at 25°C ambient	200 mW
Derate linearly from 25°C	2.6 mW/°C
Total package power dissipation at 25°C ambient (LED plus detector)	250 mW
Derate linearly from 25°C	3.3 mW/°C
Collector-Emitter Current (I_{CE})	50 mA

PHOTOTRANSISTOR OPTOCOUPLER

ELECTRO-OPTICAL CHARACTERISTICS

(25°C Free Air Temperature Unless Otherwise Specified)

INDIVIDUAL COMPONENT CHARACTERISTICS

CHARACTERISTIC	SYMBOL	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS
INPUT DIODE						
Forward voltage	V_F		1.25	1.50	V	I_F=20 mA
Reverse voltage	V_R	3.0	25		V	I_R=10 μA
Junction capacitance	C_J		50		pF	V_F=0 V, F=1 MHz
Reverse leakage current	I_R		.01	10	μA	V_R=3.0V
OUTPUT TRANSISTOR						
DC forward current gain	h_{FE}	100	250			V_{CE}=5 V, I_C=100 μA
Collector to emitter breakdown volt.	BV_{CEO}	30	85		V	I_C=1.0 mA, I_F=0
Collector to base breakdown voltage	BV_{CBO}	70	165		V	I_C=10 μA, I_F=0
Emitter to collector breakdown voltage	BV_{ECO}	7	14		V	I_E=100 μA, I_F=0
Collector to emitter, leakage current	I_{CEO}		5	50	nA	V_{CE}=10 V, I_F=0
Collector to base leakage current	I_{CBO}		0.1	20	nA	V_{CB}=10 V, I_F=0
Capacitance collector to emitter	C_{CEO}		8		pF	V_{CE}=0
Capacitance collector to base	C_{CBO}		20		pF	V_{CB}=10 V
Capacitance emitter to base	C_{EBO}		10		pF	V_{BE}=0

TRANSFER CHARACTERISTICS

DC CHARACTERISTICS	SYMBOL	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS
DC collector current transfer ratio	CTR_{CE}	20	60		%	V_{CE}=10 V, I_F=10 mA, Note 1
DC base current transfer ratio	CTR_{CB}		.35		%	V_{CB}=10 V, I_F=10 mA
Collector-emitter, saturation voltage	V_{CE} (sat)		0.24	0.4	V	I_C=2.0 mA, I_F=16 mA

TRANSFER CHARACTERISTICS

CHARACTERISTICS		SYMBOL	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS
SWITCHING TIMES							
Non-saturated collector	Delay time	t_d		0.5		μs	R_L=100 Ω, I_C=2 mA, V_{CC}=10 V
	Rise time	t_r		2.5		μs	Fig. 10
	Storage time	t_s		0.1		μs	
	Fall time	t_f		2.6		μs	
Saturated collector	Delay time	t_d		2.0		μs	R_L=1 KΩ, I_C=2 mA, V_{CC}=10 V
	Rise time	t_r		15		μs	
	Storage time	t_s		0.1		μs	
	Fall time	t_r		15		μs	

ELECTRO-OPTICAL CHARACTERISTICS

(25°C Free Air Temperature Unless Otherwise Specified) (Cont'd)

TRANSFER CHARACTERISTICS (Cont'd)

	SYMBOL	TYP.	UNITS	TEST CONDITIONS
SWITCHING TIMES (Cont'd)				
Saturated t on (from 5 V to 0.8 V)	t_{on} (SAT)	5	μs	R_L=2 KΩ, I_F=15 mA, V_{CC}=5 V
t off (from SAT to 2.0 V)	t_{off} (SAT)	25		R_B=open
Saturated t on (from 5 V to 0.8 V)	t_{on} (SAT)	5	μs	R_L=2 KΩ, I_F=20 mA, V_{CC}=5 V
t off (from SAT to 2.0 V)	t_{off} (SAT)	18		R_B=100 KΩ
Non-saturated Base Rise time	t_r	175	ns	R_L=1 KΩ, V_{CB}=10 V
Fall time	t_f	175	ns	
Bandwidth (see note 2)	B_W	150	KHz	I_C=2 mA, V_{CE}=10 V, R_L=100Ω

ISOLATION CHARACTERISTICS

CHARACTERISTICS	SYMBOL	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS
Steady state isolation voltage	V_{iso}	7500			VAC-PEAK	$I_{I-O} \leq 1\ \mu$A, 1 minute
		5300			VAC-rms	$I_{I-O} \leq 1\ \mu$A, 1 minute
Isolation resistance		10^{11}	10^{12}		Ω	V_{I-O}=500 V
Isolation capacitance			.5		pF	F=1 MHz

TYPICAL ELECTRO-OPTICAL CHARACTERISTIC CURVES

(25°C Free Air Temperature Unless Otherwise Specified)

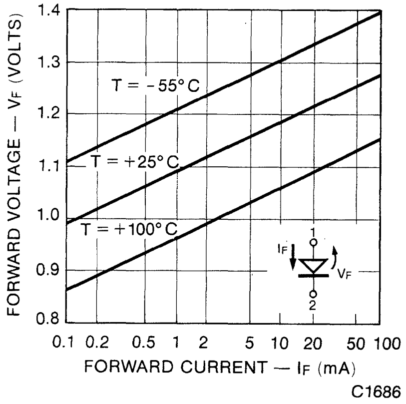


Fig. 1. Forward Voltage vs. Current

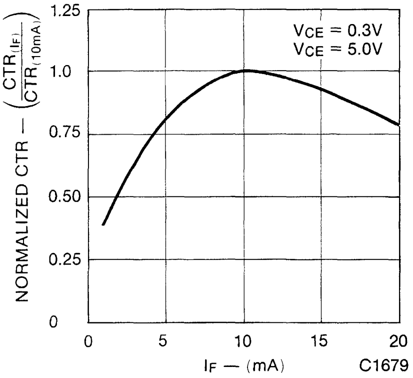


Fig. 2. Normalized CTR vs. Forward Current

TYPICAL ELECTRO-OPTICAL CHARACTERISTIC CURVES

(25°C Free Air Temperature Unless Otherwise Specified) (Cont'd)

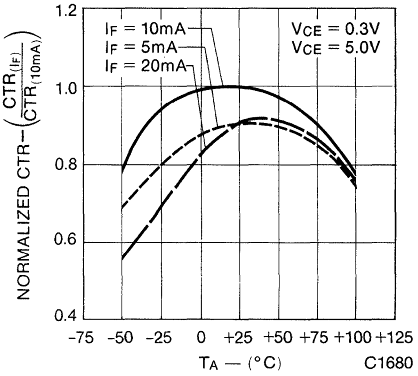


Fig. 3. Normalized CTR vs. Temperature

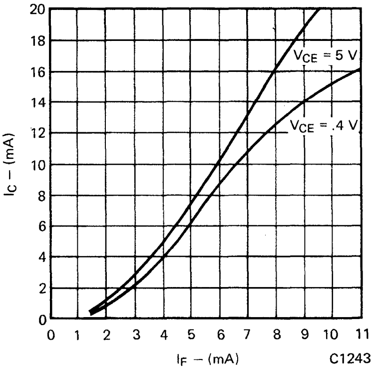


Fig. 4. Collector Current vs. Forward Current

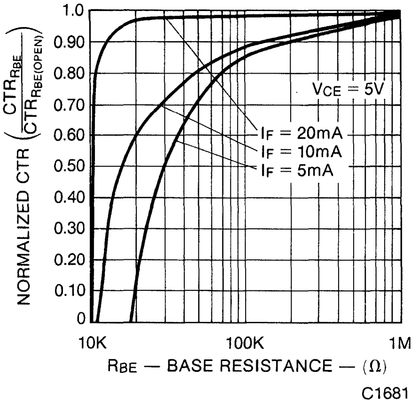


Fig. 5. CTR vs. RBE (Unsaturated)

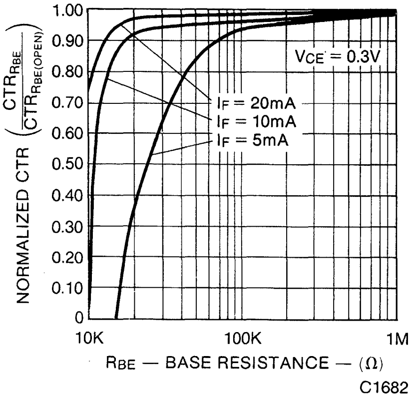


Fig. 6. CTR vs. RBE (Saturated)

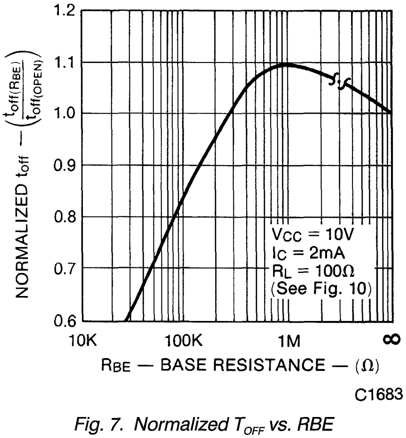


Fig. 7. Normalized T_{OFF} vs. RBE

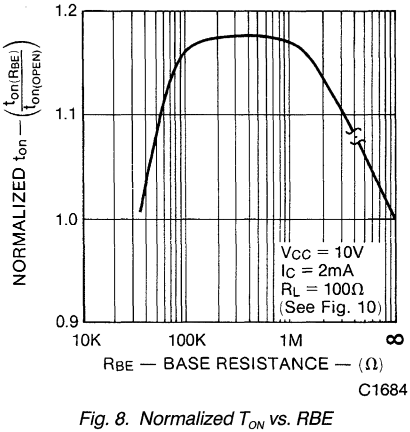


Fig. 8. Normalized T_{ON} vs. RBE

TYPICAL ELECTRO-OPTICAL CHARACTERISTIC CURVES

(25°C Free Air Temperature Unless Otherwise Specified) (Cont'd)

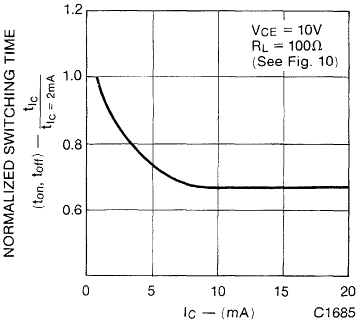


Fig. 9. Switching Time vs. IC

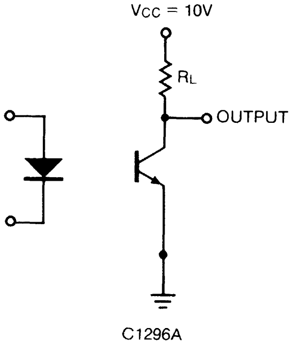


Fig. 10. Switching Time Test Circuit

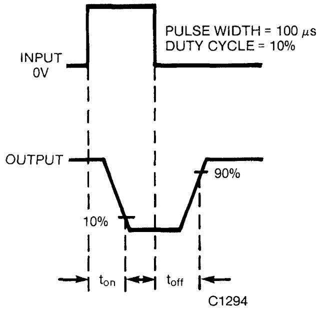
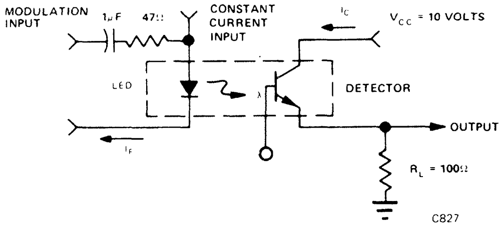


Fig. 11. Switching Time Waveforms

OPERATING SCHEMATICS



Modulation Circuit Used to Obtain Output vs. Frequency Plot

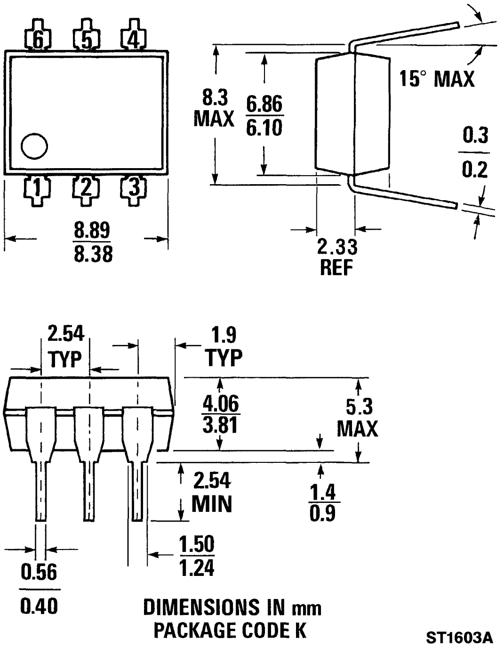
NOTES

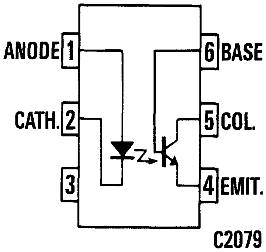
1. *The current transfer ratio (I_C/I_F) is the ratio of the detector collector current to the LED input current with V_{CE} at 10 volts.*
2. *The frequency at which i_c is 3 dB down from the 1 kHz value.*
3. *Rise time (t_r) is the time required for the collector current to increase from 10% of its final value, to 90%.*
   Fall time (t_f) is the time required for the collector current to decrease from 90% of its initial value, to 10%.

PHOTOTRANSISTOR OPTOCOUPLER

MCT210

PACKAGE DIMENSIONS





Equivalent Circuit

DESCRIPTION

The MCT210 incorporates a NPN silicon planar phototransistor optically coupled to a gallium arsenide infrared emitting diode. The MCT210 has a specified minimum CTR of 50%, saturated, and 150%, unsaturated.

FEATURES

- TTL compatible 1-10 gate loads
- High CTR with transistor output MCT210—150% min.
- Specified CTR over temperature range
- Good logic load characteristics
  V_{OL}=0.4 V @ 1.6 mA to 16mA
  output sinking (I_{OL})
- UL recognized (File #E90700)

APPLICATIONS

- Digital logic isolation
- Line receivers
- Feedback control circuits
- Monitoring circuits

ABSOLUTE MAXIMUM RATINGS

TOTAL PACKAGE

Storage temperature	−55°C to 150°C
Operating temperature	−55°C to 100°C
Lead temperature (soldering, 10 sec)	260°C
Total package power dissipation @ 25°C (LED plus detector)	260 mW
Derate linearly from 25°C	3.4 mW/°C

INPUT DIODE

Forward current	60 mA
Reverse voltage	3.0 V
Peak forward current (1 μs pulse, 300 pps)	3.0 A
Power dissipation 25°C to 70° ambient	90 mW
Derate linearly from +70°C	2.0 mW/°C

OUTPUT TRANSISTOR

Power dissipation @ 25°C	200 mW
Derate linearly from 25°C	2.67 mW/°C

ELECTRO-OPTICAL CHARACTERISTICS

(0° to +70°C Temperature Unless Otherwise Specified)

INDIVIDUAL COMPONENT CHARACTERISTICS

CHARACTERISTIC	SYMBOL	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS
INPUT DIODE						
Forward voltage	V_F		1.25	1.50	V	I_F=40 mA
Forward voltage temp. coefficient	$\frac{\Delta V_F}{\Delta T_A}$		−1.8		mV/°C	
Reverse breakdown voltage	BV_R	6.0	15		V	I_R=10 μA
Junction capacitance	C_J		50 65		pF pF	V_F=0 V, f=1 MHz V_F=1 V, f=1 MHz
Reverse leakage current	I_R		.01	10	μA	V_R=6.0 V
OUTPUT TRANSISTOR						
DC forward current gain	h_{FE}		400			V_{CE}=5 V, I_C=10 mA
Breakdown voltage						
Collector to emitter	BV_{CEO}	30	45		V	I_C=1.0 mA, I_F=0
Collector to base	BV_{CBO}	30			V	I_C=10 μA, I_F=0
Emitter to collector	BV_{ECO}	6	8		V	I_E=100 μA, I_F=0
Leakage current						
Collector to emitter	I_{CEO}		5	50	nA	V_{CE}=5 V, I_F=0, T_A=+25°C
				30	μA	V_{CE}=5 V, I_F=0
Capacitance						
Collector to emitter			8		pF	V_{CE}=0, f=1 MHz
Collector to base			20		pF	V_{CB}=5, f=1 MHz
Emitter to base			10		pF	V_{EB}=0, f=1 MHz

TRANSFER CHARACTERISTICS

DC CHARACTERISTIC	SYMBOL	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS
Current transfer ratio, collector to emitter MCT210 (a)	I_{CE}/I_F	50	70		%	V_{CE}=0.4 V, I_F=3.2 mA to 32 mA
		150	225		%	V_{CE}=5.0 V, I_F=10 mA
Current transfer ratio, collector to base	I_{CB}/I_F		0.6		%	V_{CB}=5.0 V, I_F=10 mA
Saturation voltage collector to emitter	$V_{CE(SAT)}$		0.2	0.4	V	I_C=16 mA, I_F=32 mA

ELECTRO-OPTICAL CHARACTERISTICS

(**0° to +70°C** Temperature Unless Otherwise Specified) (Cont'd)

TRANSFER CHARACTERISTICS (Cont'd)

CHARACTERISTIC	SYMBOL	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS
SWITCHING TIMES						
Non-saturated						
Rise time	t_r		4		μs	R_L=100 Ω, I_C=2 mA, V_{CC}=5 V
Fall time	t_f		5		μs	See Figs. 15 and 16
Saturated						
Rise time	t_r		2.5		μs	R_L=560 Ω, I_F=16 mA
Fall time	t_f		25		μs	See Figs. 15 and 16
Propagation delay						
High to low	$T_{PD(HL)}$		2		μs	R_L=2.7K, I_F=16 mA
Low to high	$T_{PD(LH)}$		10		μs	See Figs. 15 and 16

ISOLATION CHARACTERISTICS

CHARACTERISTIC	SYMBOL	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS
Steady state isolation	V_{iso}	7500			VAC-PEAK	$I_{I\text{-}O} \leq 1\ \mu$A, 1 minute
		5300			VAC-RMS	$I_{I\text{-}O} \leq 1\ \mu$A, 1 minute
Isolation resistance	R_{iso}	10^{11}	5×10^{12}		ohms	$V_{I\text{-}O}$=500 VDC, T_A=+25°C
Isolation capacitance	C_{iso}		1.0		pF	f=1 MHz

TYPICAL ELECTRICAL CHARACTERISTIC CURVES

(25°C Free Air Temperature Unless Otherwise Specified)

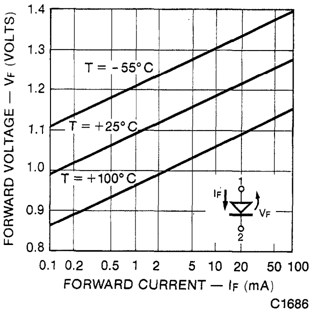


Fig. 1. Forward Voltage vs. Forward Current

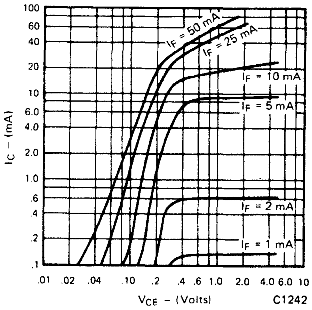


Fig. 2. Collector Current vs. Collector to Emitter Voltage

TYPICAL ELECTRICAL CHARACTERISTIC CURVES

(25°C Free Air Temperature Unless Otherwise Specified) (Cont'd)

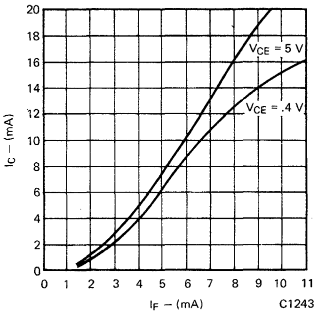


Fig. 3. Collector Current vs. Forward Current

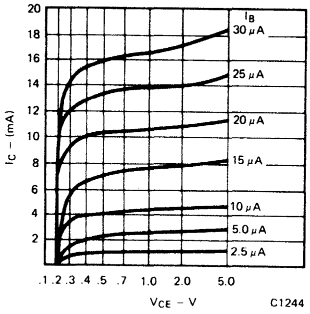


Fig. 4. Collector Current vs. Collector to Emitter Voltage

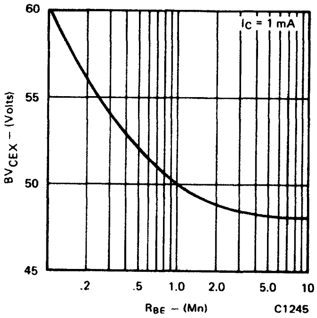


Fig. 5. Collector to Emitter Breakdown Voltage vs. Base to Emitter Resistance

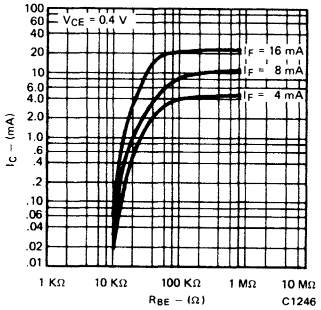


Fig. 6. Saturated CTR vs. Base to Emitter Resistance

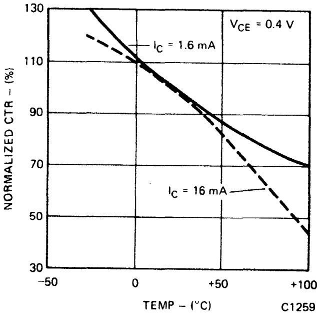


Fig. 7. Current Transfer Ratio (saturated) vs. Temperature

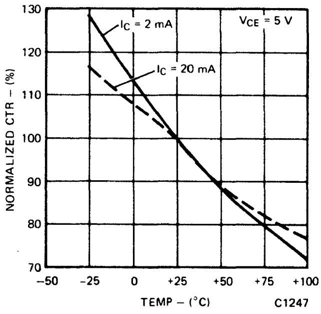


Fig. 8. Current Transfer Ratio (unsaturated) vs. Temperature

TYPICAL ELECTRICAL CHARACTERISTIC CURVES

(25°C Free Air Temperature Unless Otherwise Specified) (Cont'd)

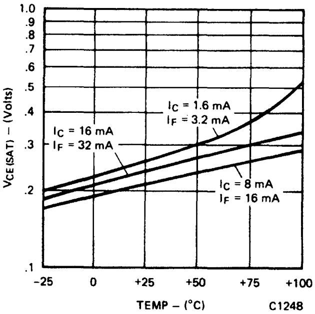


Fig. 9. Collector to Emitter Saturation Voltage vs. Temperature

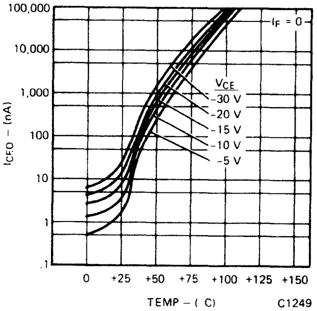


Fig. 10 Collector to Emitter Leakage Current vs. Temperature

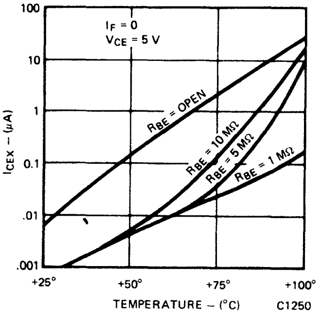


Fig. 11. Collector to Emitter Leakage Current vs.Temperature

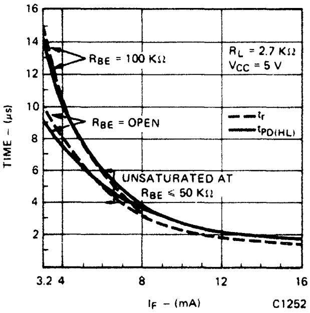


Fig. 12. Switch-on Time vs. I_F Drive (saturated)

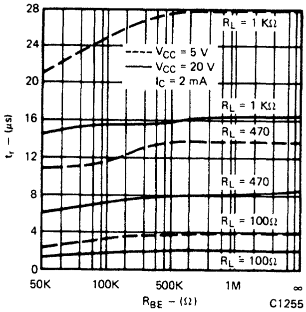


Fig. 13. Rise Time vs. Base to Emitter Resistance (non-saturated)

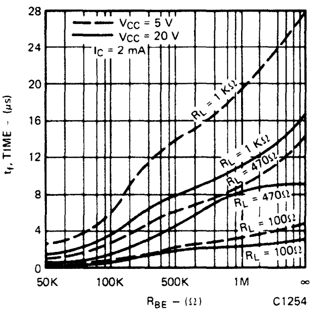


Fig. 14. Fall Time vs. Base to Emitter Resistance (non-saturated)

TYPICAL ELECTRICAL CHARACTERISTIC CURVES

(25°C Free Air Temperature Unless Otherwise Specified) (Cont'd)

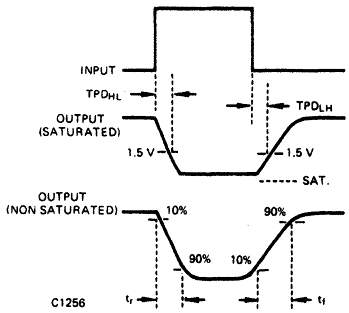


Fig. 15 Switching Time Waveforms

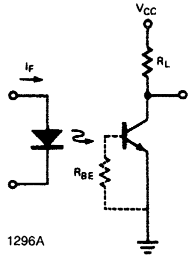


Fig. 16 Switching Time Test Circuits

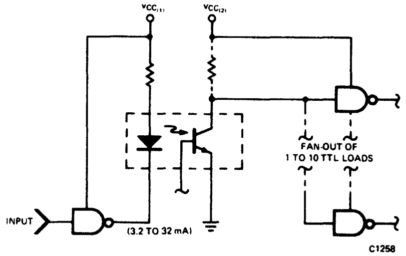
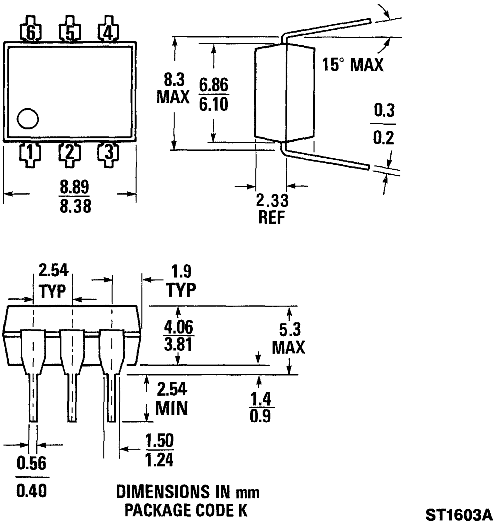


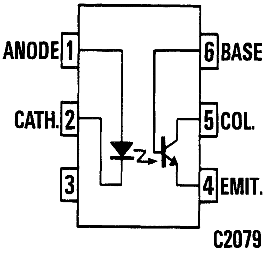
Fig. 17. Typical TTL Interface at Operating Temperatures of 0° to 70°C

PHOTOTRANSISTOR OPTOCOUPLERS

MCT2200
MCT2201
MCT2202

PACKAGE DIMENSIONS





Equivalent Circuit

DESCRIPTION

The MCT2200, MCT2201 and MCT2202 are opto-isolators with phototransistor output. A gallium arsenide infrared emitting diode is selectively coupled with an NPN silicon phototransistor.

FEATURES

- Minimum current transfer ratio of 100%
- Maximum turn-on, turn-off time — 10 μs
- Underwriters Laboratory (UL) recognized File #E90700

APPLICATIONS

- Power supply regulators
- Digital logic inputs
- Appliance sensor systems
- Industrial controls

ABSOLUTE MAXIMUM RATINGS

TOTAL PACKAGE

Storage temperature	−55°C to 150°C
Operating temperature	−55°C to 100°C
Lead soldering temperature (10 sec.)	260°C
Total package power dissipation at 25°C ambient (LED plus detector)	260 mW
Derate linearly from 25°	3.5 mW/°C

INPUT DIODE

Forward current	60 mA
Reverse voltage	3.0 V
Peak forward current (1 μs pulse, 300 pps)	3.0 A
Power dissipation at 25°C ambient	135 mW
Derate linearly from 25°C	1.8 mW/°C

OUTPUT TRANSISTOR

Power dissipation at 25°C ambient	200 mW
Derate linearly from 25°C	2.67 mW/°C

ELECTRO-OPTICAL CHARACTERISTICS (25°C Unless Otherwise Specified)

INDIVIDUAL COMPONENT CHARACTERISTICS

CHARACTERISTIC	SYMBOL	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS
INPUT DIODE Forward voltage	V_F		1.3	1.50	V	I_F=20 mA
Forward voltage temperature coefficient	$\frac{\Delta V_F}{\Delta T_A}$		−1.8		mV/°C	
Reverse voltage	V_R	3.0	25		V	I_R=10 μA
Junction capacitance	C_J		50		pF	V_F=0 V, f=1 MHz
			65		pF	V_F=0 V, f=1 MHz
Reverse leakage current	I_R		.35	10	μA	V_R=3.0 V
OUTPUT TRANSISTOR Breakdown voltage Collector to emitter	BV_{CEO}	30	45		V	I_C=1.0 mA, I_F=0
Collector to base	BV_{CBO}	70	130		V	I_C=10 μA, I_F=0
Emitter to base	BV_{EBO}	5	7		V	I_E=100 μA, I_F=0
Leakage current Collector to emitter	I_{CEO}		5	50	nA	V_{CE}=10 V, I_F=0
Collector to base	I_{CBO}			20	nA	V_{CB}=10 V, I_F=0
Capacitance Collector to emitter			8		pF	V_{CE}=0, f=1 MHz
Collector to base			20		pF	V_{CB}=5, f=1 MHz
Emitter to base			10		pF	V_{EB}=0, f=1 MHz

TRANSFER CHARACTERISTICS

DC CHARACTERISTICS	SYMBOL	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS
Current Transfer Ratio, collector to emitter MCT2200	CTR	20	60		%	
MCT2201		100	200		%	I_F=10 mA; V_{CE}=5V
MCT2202		63	95	125	%	
Saturation voltage	$V_{CE(SAT)}$		.21	.40	V	I_F=10 mA; I_C=2.5 mA

TRANSFER CHARACTERISTICS

CHARACTERISTICS	SYMBOL	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS
SWITCHING TIMES Non-saturated Turn-on time	t_{on}		6.0	10	μs	R_L=100 Ω; I_C=2 mA; V_{CC}=10 V
Turn-off time	t_{off}		5.5	10	μs	See Figure 10.

ISOLATION CHARACTERISTICS

CHARACTERISTICS	SYMBOL	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS
Isolation voltage	V_{iso}	5300			V_{AC} RMS	$I_{I-O}\leq 1$ μA, 1 minute
	V_{iso}	7500			V_{AC} PEAK	$I_{I-O}\leq 1$ μA, 1 minute
Isolation resistance	R_{iso}	10^{11}			ohms	V_{I-O}=500 VDC
Isolation capacitance	C_{iso}		0.5		pF	f=1 MHz

ELECTRICAL CHARACTERISTIC CURVES

(25°C Free Air Temperature Unless Otherwise Specified)

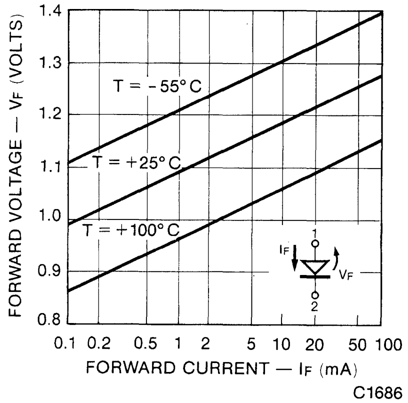


Fig. 1. Forward Voltage vs. Current

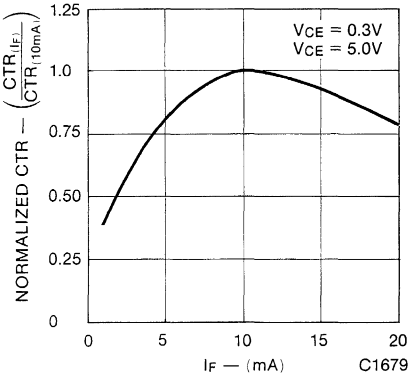


Fig. 2. Normalized CTR vs. Forward Current

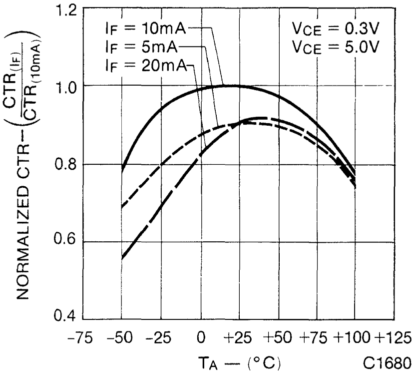


Fig. 3. Normalized CTR vs. Temperature

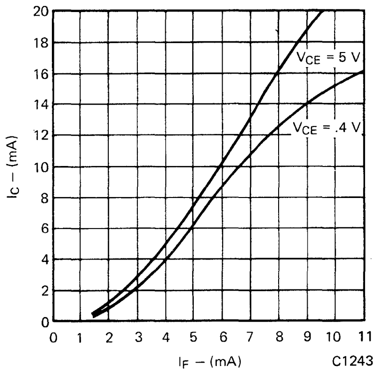


Fig. 4. Collector Current vs. Forward Current

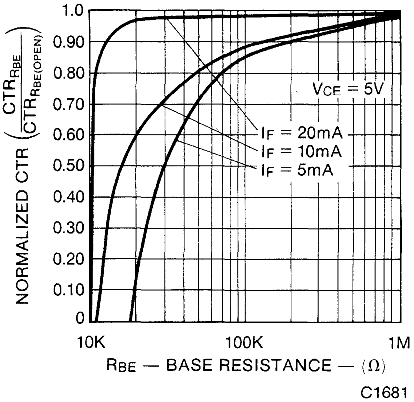


Fig. 5. CTR vs. RBE (Unsaturated)

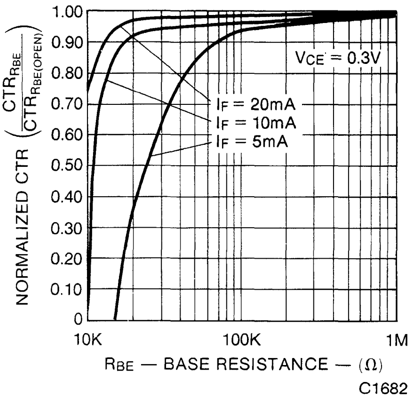


Fig. 6. CTR vs. RBE (Saturated)

ELECTRICAL CHARACTERISTIC CURVES
(25°C Free Air Temperature Unless Otherwise Specified) (Cont'd)

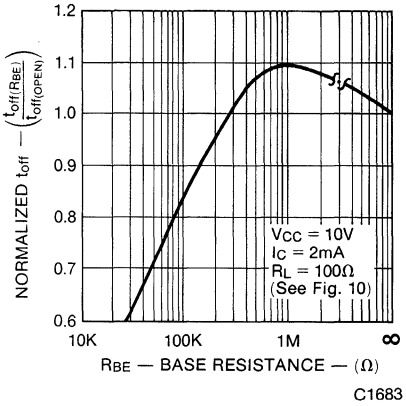


Fig. 7. Normalized T_{OFF} vs. RBE

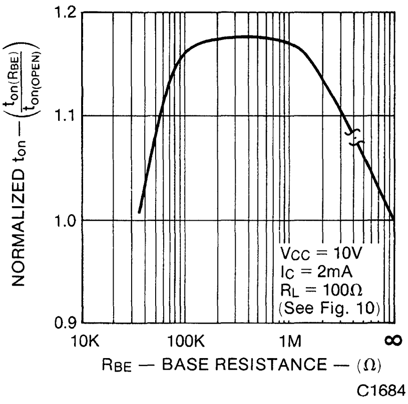


Fig. 8. Normalized T_{ON} vs. RBE

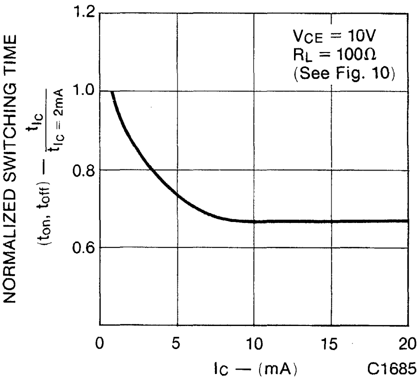


Fig. 9. Switching Time vs. IC

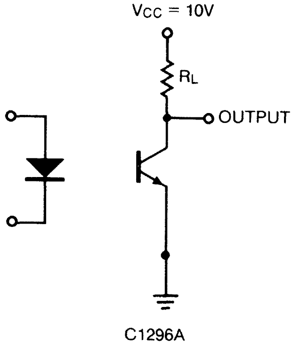


Fig. 10. Switching Time Test Circuit

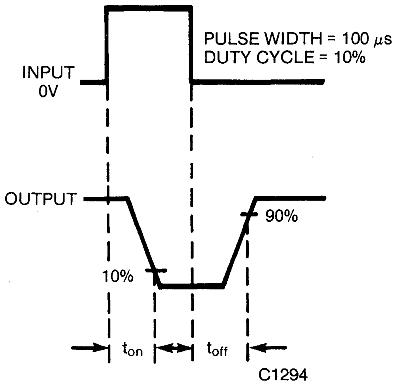
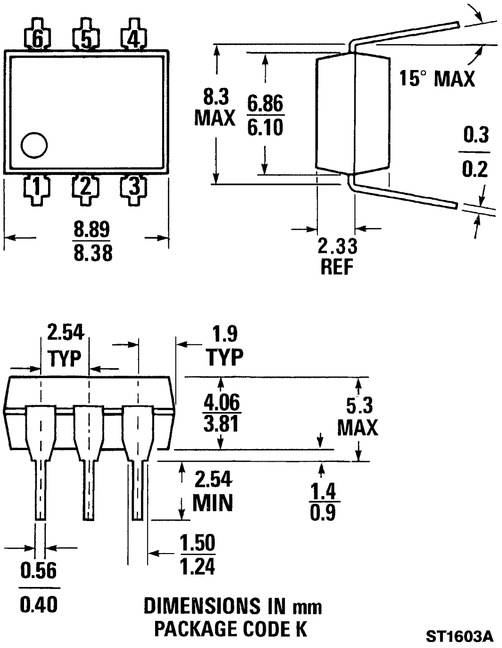


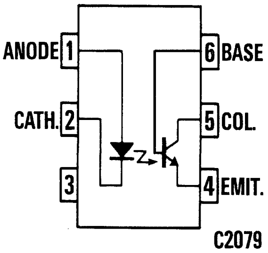
Fig. 11. Switching Time Waveforms

PHOTOTRANSISTOR OPTOCOUPLER

MCT270

PACKAGE DIMENSIONS





Equivalent Circuit

DESCRIPTION

The MCT270 is a phototransistor-type optically coupled isolator. A gallium arsenide infrared emitting diode is selectively coupled with an NPN silicon phototransistor.

FEATURES

- Minimum current transfer ratio of 50%
- Maximum turn-on, turn-off time 10μ seconds specified
- Underwriters Laboratory (UL) recognized File E90700

APPLICATIONS

- Power supply regulators
- Digital logic inputs
- Microprocessor inputs
- Appliance sensor systems
- Power supply regulators
- Industrial controls

ABSOLUTE MAXIMUM RATINGS

TOTAL PACKAGE	
Storage temperature	−55°C to 150°C
Operating temperature	−55°C to 100°C
Lead tempertaure (soldering , 10 sec)	260°C
Total package power dissipation @ 25 (LED plus detector)	260 mW
Derate linearly from 25°C	3.5 mW/°C
INPUT DIODE	
Forward DC current	90 mA
Reverse voltage	3 V
Peak forward current (1 μs pulse, 300 pps)	3.0 A
Power dissipation 25°C ambient	135 mW
Derate linearly from 25°C	1.8 mW/°C
OUTPUT TRANSISTOR	
Power dissipation @ 25°C	200 mW
Derate linearly from 25°C	2.67 mW/°C

PHOTOTRANSISTOR OPTOCOUPLER

ELECTRO-OPTICAL CHARACTERISTICS (25°C Temperature Unless Otherwise Specified)

INDIVIDUAL COMPONENT CHARACTERISTICS

CHARACTERISTIC	SYMBOL	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS
INPUT DIODE						
Forward voltage	V_F		1.3	1.50	V	I_F=20 mA
Forward voltage temp. coefficient	$\frac{\Delta V_F}{\Delta T_A}$		−1.8		mV/°C	
Reverse voltage	V_R	3.0	25		V	I_R=10 μA
Junction capacitance	C_J		50 65		pF pF	V_F=0 V, f=1 MHz V_F=1 V, f=1 MHz
Reverse leakage current	I_R		0.35	10	μA	V_R=3.0 V
OUTPUT TRANSISTOR						
DC forward current gain	h_{FE}	100	500			V_{CE}=5 V, I_C=100 μA
Breakdown voltage Collector to emitter	BV_{CEO}	30	45		V	I_C=1.0 mA, I_F=0
Collector to base	BV_{CBO}	70	130		V	I_C=10 μA, I_F=0
Emitter to base	BV_{EBO}	5	7		V	I_E=100 μA, I_F=0
Leakage current Collector to emitter	I_{CEO}		5	50	nA	V_{CE}=10 V, I_F=0
Collector to base	I_{CBO}			20	nA	V_{CB}=10 V, I_F=0
Capacitance Collector to emitter			8		pF	V_{CE}=0, f=1 MHz
Collector to base			20		pF	V_{CB}=5, f=1 MHz
Emitter to base			10		pF	V_{EB}=0, f=1 MHz

TRANSFER CHARACTERISTICS

DC CHARACTERISTICS	SYMBOL	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS
Current transfer ratio, collector to emitter	CTR_{CE}	50	115		%	I_F=10 mA; V_{CE}=10 V
Current transfer ratio, collector to base	CTR_{CB}	0.045	0.15		%	I_F=16 mA; V_{CB}=10 V
Saturation voltage	$V_{CE(SAT)}$		.21	.40	V	I_F=10 mA; I_C=2 mA

TRANSFER CHARACTERISTICS

CHARACTERISTICS	SYMBOL	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS
SWITCHING TIMES						
Non-saturated Turn-on time	t_{on}		6.0	10	μs	R_L=100Ω; I_C=2 mA; V_{CC}=5 V
Turn-off time	t_{off}		5.5	10	μs	See Figs. 10, 11
Saturated Turn-on time	t_{on}		3.9		μs	I_F=16 mA; R_L=1.9 KΩ
Turn-off time (Approximates a typical TTL interface)	t_{off}		48		μs	See Figs. 10, 11
Turn-on time	t_{on}		3.9		μs	I_F=16 mA; R_L=4.7 KΩ
Turn-off time (Approximates a typical low power TTL interface)	t_{off}		110		μs	See Figs. 10, 11

ELECTRO-OPTICAL CHARACTERISTICS
(25°C Temperature Unless Otherwise Specified) (Cont'd)

ISOLATION CHARACTERISTICS

CHARACTERISTICS	SYMBOL	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS
Steady state isolation	V_{iso}	7500			VAC-PEAK	$I_{I-O} \leq 1\ \mu A$, 1 minute
		5300			VAC-rms	$I_{I-O} \leq 1\ \mu A$, 1 minute
Isolation resistance	R_{iso}	10^{11}			ohms	V_{I-O}=500 VDC
Isolation capacitance	C_{iso}		0.5		pF	f=1 MHz

TYPICAL ELECTRICAL CHARACTERISTIC CURVES
(25°C Free Air Temperature Unless Otherwise Specified)

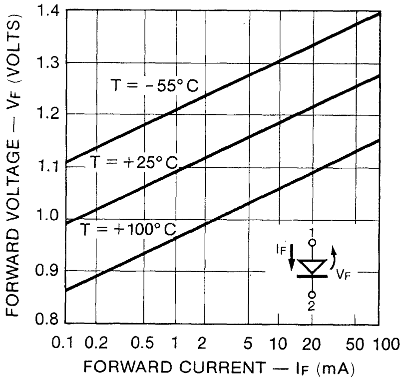


Fig. 1. Forward Voltage vs. Current

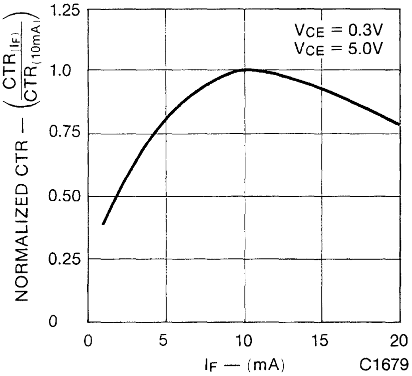


Fig. 2. Normalized CTR vs. Forward Current

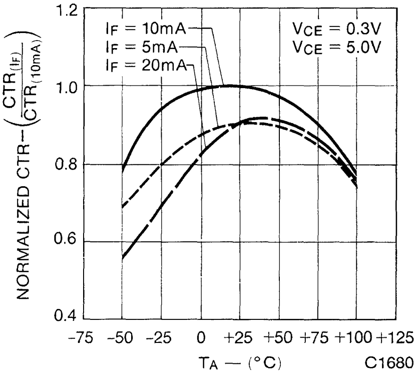


Fig. 3. Normalized CTR vs. Temperature

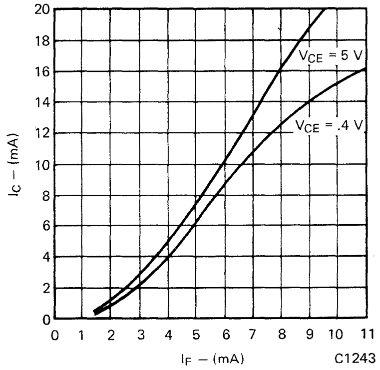


Fig. 4. Collector Current vs. Forward Current

TYPICAL ELECTRICAL CHARACTERISTIC CURVES

(25°C Free Air Temperature Unless Otherwise Specified) (Cont'd)

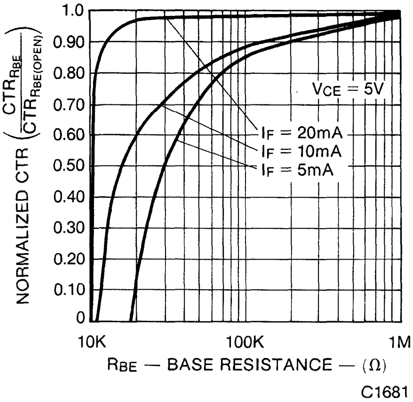


Fig. 5. CTR vs. RBE (Unsaturated)

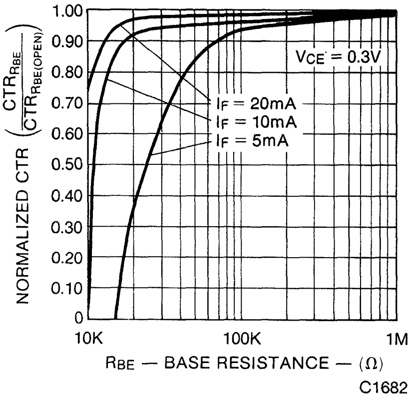


Fig. 6. CTR vs. RBE (Saturated)

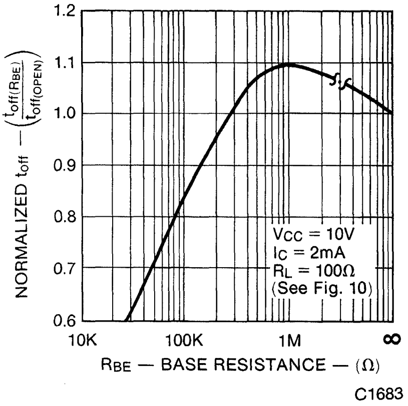


Fig. 7. Normalized T_{OFF} vs. RBE

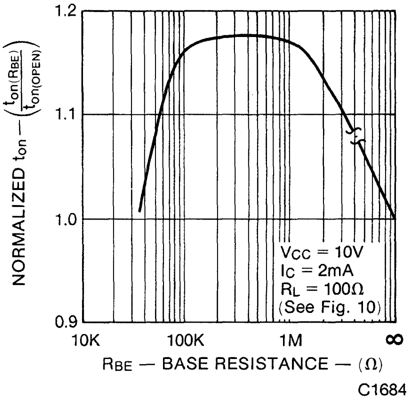


Fig. 8. Normalized T_{ON} vs. RBE

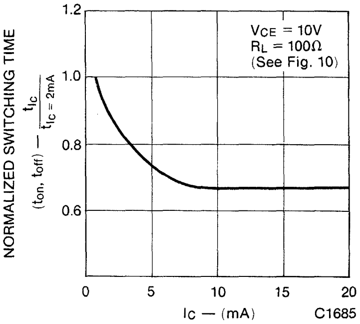


Fig. 9. Switching Time vs. IC

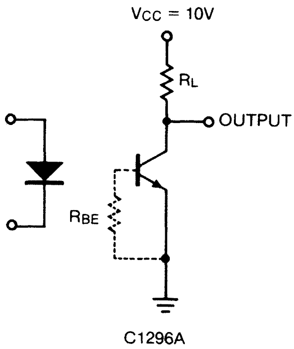


Fig. 10. Switching Time Test Circuit

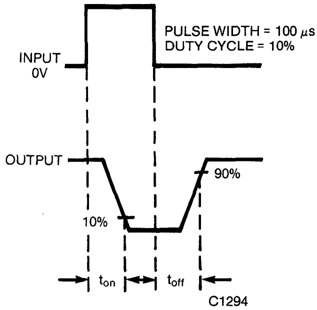


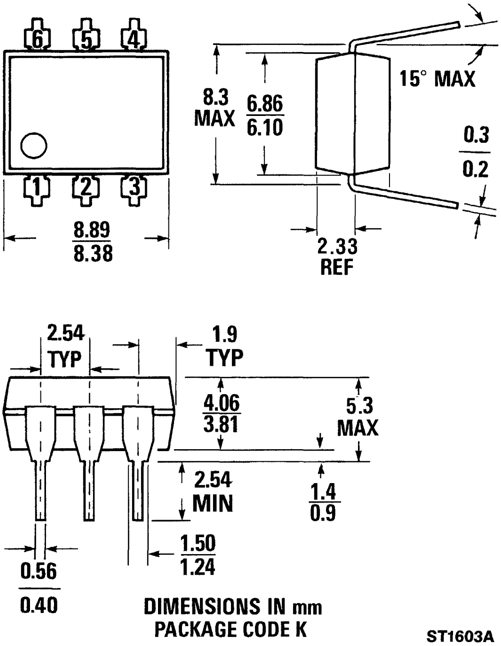
Fig. 11. Switching Time Waveforms

QT
OPTOELECTRONICS

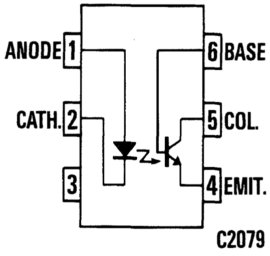
PHOTOTRANSISTOR OPTOCOUPLER

MCT271

PACKAGE DIMENSIONS



DIMENSIONS IN mm
PACKAGE CODE K



Equivalent Circuit

DESCRIPTION

The MCT271 is a phototransistor-type optically coupled isolator. A gallium arsenide infrared emitting diode is selectively coupled with an NPN silicon phototransistor.

FEATURES

- Controlled Current Transfer Ratio—45% to 90% (specified conditions)
- Maximum Turn-on-time—7 μseconds (specified condition)
- Maximum Turn-off-time—7 μseconds (specified condition)
- Underwriters Laboratory (U.L.) recognized—File E90700

APPLICATIONS

- Switching networks
- Power supply regulators
- Digital logic inputs
- Microprocessor inputs
- Appliance sensor systems

ABSOLUTE MAXIMUM RATINGS

TOTAL PACKAGE

Storage temperature	−55°C to 150°C
Operating temperature	−55°C to 100°C
Lead temperature (soldering, 10 sec)	260°C
Total package power dissipation @ 25°C (LED plus detector)	260 mW
Derate linearly from 25°C	3.4 mW/°C

INPUT DIODE

Forward DC current	60 mA
Reverse voltage	3 V
Peak forward current (1 μs pulse, 300 pps)	3.0 A
Power dissipation 25°C ambient	90 mW
Derate linearly from 25°C	1.2 mW/°C

OUTPUT TRANSISTOR

Power dissipation @ 25°C	200 mW
Derate linearly from 25°C	2.67 mW/°C

PHOTOTRANSISTOR OPTOCOUPLER

ELECTRO-OPTICAL CHARACTERISTICS (25°C Temperature Unless Otherwise Specified)

INDIVIDUAL COMPONENT CHARACTERISTICS

CHARACTERISTIC	SYMBOL	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS
INPUT DIODE						
Forward voltage	V_F		1.20	1.50	V	I_F=20 mA
Forward voltage temp. coefficient	$\frac{\Delta V_F}{\Delta T_A}$		−1.8		mV/°C	
Reverse voltage	V_R	3.0	25		V	I_R=10 μA
Junction capacitance	C_J		50 65		pF pF	V_F=0 V, f=1 MHz V_F=1 V, f=1 MHz
Reverse leakage current	I_R		0.35	10	μA	V_R=3.0 V
OUTPUT TRANSISTOR						
DC forward current gain	h_{FE}	100	420			V_{CE}=5 V, I_C=100 μA
Breakdown voltage Collector to emitter	BV_{CEO}	30	45		V	I_C=1.0 mA, I_F=0
Collector to base	BV_{CBO}	70	130		V	I_C=10 μA, I_F=0
Emitter to base	BV_{EBO}	5	7		V	I_E=100 μA, I_F=0
Leakage current Collector to emitter	I_{CEO}		5	50	nA	V_{CE}=10 V, I_F=0
Capacitance Collector to emitter			8		pF	V_{CE}=0, f=1 MHz
Collector to base			20		pF	V_{CB}=5, f=1 MHz
Emitter to base			10		pF	V_{EB}=0, f=1 MHz

TRANSFER CHARACTERISTICS

DC CHARACTERISTICS	SYMBOL	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS
Current transfer ratio, collector to emitter (a)	CTR_{CE}	45	67	90	%	I_F=10 mA; V_{CE}=10 V
Current transfer ratio, collector to base	CTR_{CB}		0.15		%	I_F=10 mA; V_{CB}=10 V
Saturation voltage	$V_{CE(SAT)}$		0.14	.40	V	I_F=16 mA; I_C=2 mA

TRANSFER CHARACTERISTICS

CHARACTERISTICS	SYMBOL	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS
SWITCHING TIMES						
Non-saturated Turn-on time	t_{on}		4.9	7	μs	R_L=100Ω; I_C=2 mA; V_{CC}=5 V
Turn-off time	t_{off}		4.5	7	μs	See Figs. 10, 11
Saturated Turn-on time	t_{on}		5.2		μs	I_F=16 mA; R_L=1.9 KΩ
Turn-off time (Approximates a typical TTL interface)	t_{off}		38		μs	See Figs. 10, 11
Turn-on time	t_{on}		4.9		μs	I_F=16 mA; R_L=4.7 KΩ
Turn-off time (Approximates a typical low power TTL interface)	t_{off}		90		μs	See Figs. 10, 11

ELECTRO-OPTICAL CHARACTERISTICS

(25°C Temperature Unless Otherwise Specified) (Cont'd)

ISOLATION CHARACTERISTICS

CHARACTERISTICS	SYMBOL	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS
Steady state isolation	V_{iso}	7500 5300			VAC-PEAK VAC-rms	$I_{I\text{-}O} \leqslant 1\ \mu A$ 1 minute
Isolation resistance	R_{iso}	10^{11}			ohms	$V_{I\text{-}O}$=500 VDC
Isolation capacitance	C_{iso}		0.5		pF	f=1 MHz

TYPICAL ELECTRICAL CHARACTERISTIC CURVES

(25°C Free Air Temperature Unless Otherwise Specified)

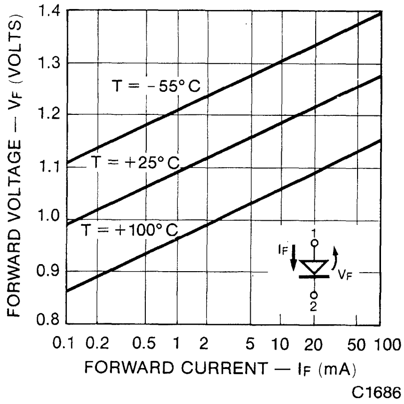


Fig. 1. Forward Voltage vs. Current

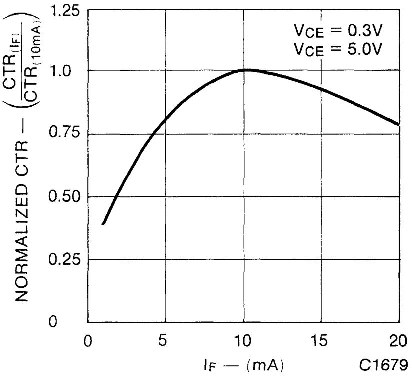


Fig. 2. Normalized CTR vs. Forward Current

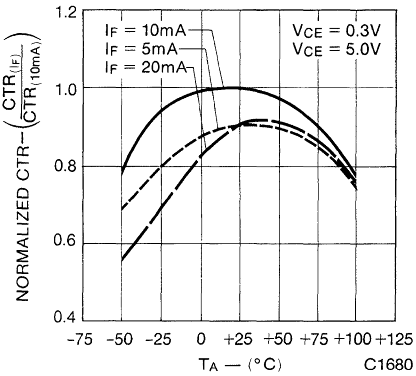


Fig. 3. Normalized CTR vs. Temperature

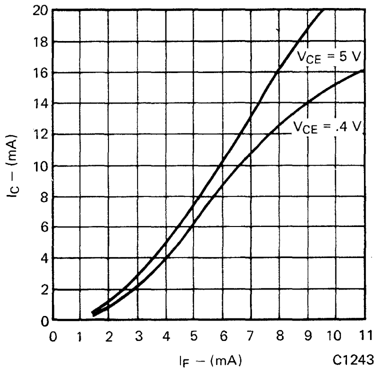


Fig. 4. Collector Current vs. Forward Current

TYPICAL ELECTRICAL CHARACTERISTIC CURVES

(25°C Free Air Temperature Unless Otherwise Specified) (Cont'd)

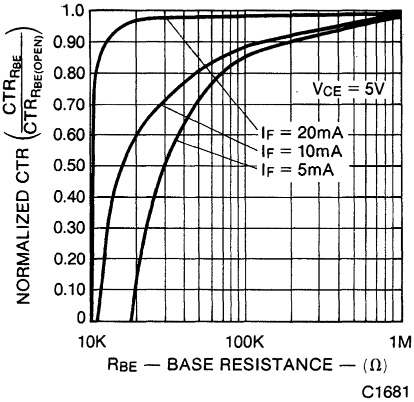


Fig. 5. CTR vs. RBE (Unsaturated)

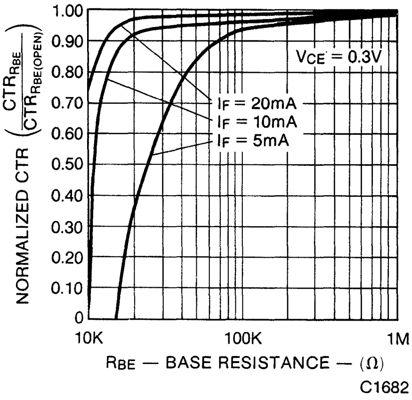


Fig. 6. CTR vs. RBE (Saturated)

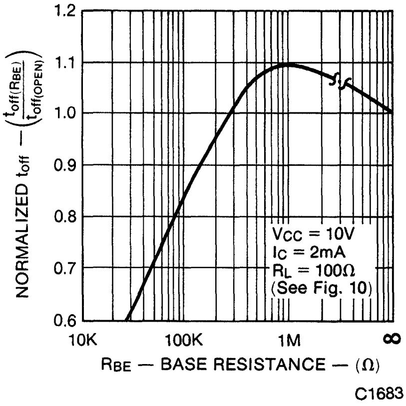


Fig. 7. Normalized T_{OFF} vs. RBE

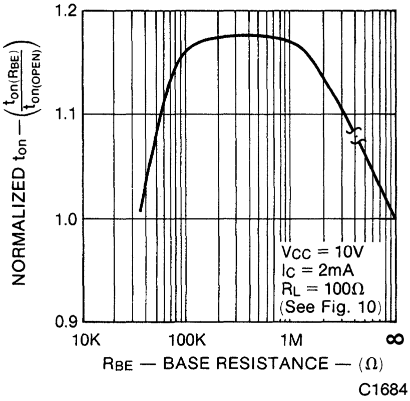


Fig. 8. Normalized T_{ON} vs. RBE

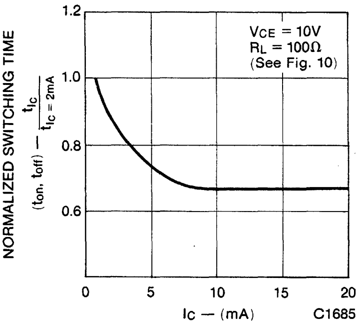


Fig. 9. Switching Time vs. IC

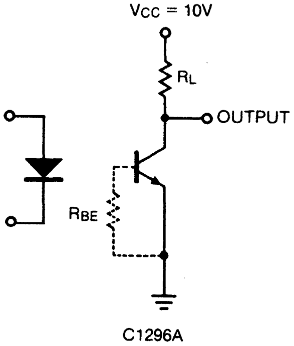


Fig. 10. Switching Time Test Circuit

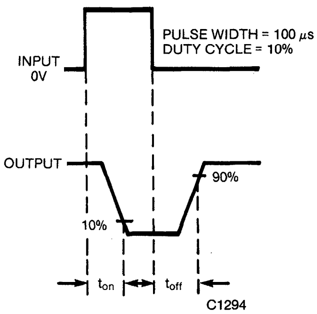
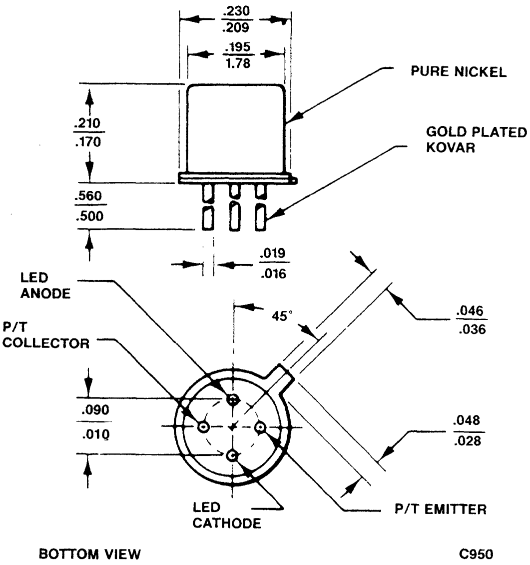


Fig. 11. Switching Time Waveforms

PHOTOTRANSISTOR OPTOCOUPLER

MCT4

PACKAGE DIMENSIONS



DIMENSIONS IN INCHES

DESCRIPTION

The MCT4 is a standard four-lead, TO-18 package containing a GaAs infrared emitting diode optically coupled to an NPN silicon planar phototransistor.

FEATURES

- Hermetic package
- High current transfer ratio; typically 35%
- High isolation resistance; 10^{11} ohms at 500 volts
- High voltage isolation emitter to detector

ABSOLUTE MAXIMUM RATINGS

Storage temperature	−65°C to 150°C
Operating temperature	−55°C to 125°C
Lead soldering temperature (10 sec)	260°C
LED (GaAs Diode)	
Power dissipation at 25°C ambient	90 mW
Derate linearly from 25°C	1.2 mW/°C
Continuous forward current	40 mA
Reverse voltage	3.0 V
Peak forward current (1 μs pulse, 300 pps)	3.0 A
Total power dissipation	250 mW
Derate linearly from 25°C	3.3 mW/°C
DETECTOR (Silicon phototransistor)	
Power dissipation at 25°C ambient	200 mW
Derate linearly from 25°C	2.67 mW/°C
Collector-emitter breakdown voltage (BV_{CEO})	30 V
Emitter-collector breakdown voltage (BV_{ECO})	7.0 V
ISOLATION VOLTAGE	1000 VDC

ELECTRO-OPTICAL CHARACTERISTICS
(25°C Free Air Temperature Unless Otherwise Specified)

INDIVIDUAL COMPONENT CHARACTERISTICS

CHARACTERISTICS	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS
EMITTER					
Forward voltage		1.3	1.5	V	I_F=40 mA
Reverse current		.15	10	μA	V_R=3.0 V
Capacitance		150		pF	V=0
DETECTOR					
BV_{CEO}	30			V	I_C=1.0 mA, I_F=0
BV_{ECO}	7	12		V	I_E=100 μA, I_F=0
I_{CEO} (Dark)		5	50	nA	V_{CE}=10 V, I_F=0
Capacitance collector-emitter		2		pF	V_{CE}=0

TRANSFER CHARACTERISTICS

CHARACTERISTICS	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS
COUPLED					
DC current transfer ratio	15	35		%	I_F=10 mA, V_{CE}=10 V
$V_{CE(SAT)}$		0.1		V	I_C=500 μA, I_F=10 mA
		0.2	0.5	V	I_C=2 mA, I_F=50 mA

TRANSFER CHARACTERISTICS

AC CHARACTERISTICS	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS
Capacitance LED to detector		1.8		pF	
Bandwidth (see figure 5)		300		kHz	Note 2
Rise time and fall time (see operating schematic)		2		μs	I_C=2 mA, V_{CE}=10 V Note 3

ISOLATION CHARACTERISTICS

CHARACTERISTICS	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS
Breakdown voltage	1000	1500		VDC	t=1 second
Resistance emitter-detector	10^{11}	10^{12}		ohms	V=500 VDC

TYPICAL ELECTRO-OPTICAL CHARACTERISTIC CURVES

(25°C Free Air Temperature Unless Otherwise Specified)

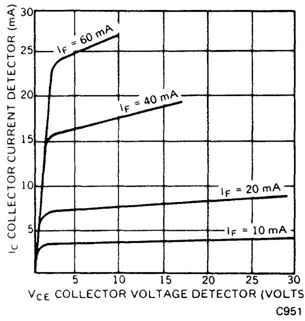


Fig. 1. Detector Output Characteristics

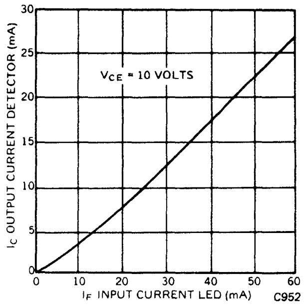


Fig. 2. Input Current vs. Output Current

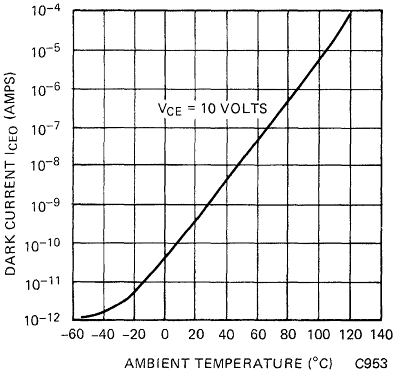


Fig. 3. Dark Current vs. Temperature (°C)

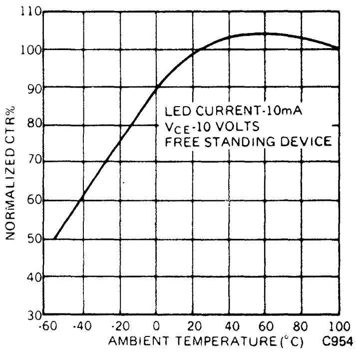


Fig. 4. Current Output vs. Temperature

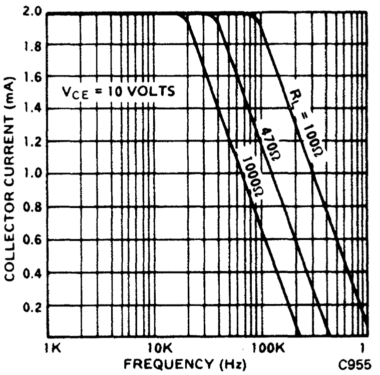


Fig. 5. Output vs. Frequency

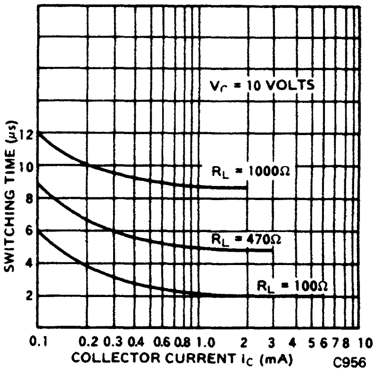


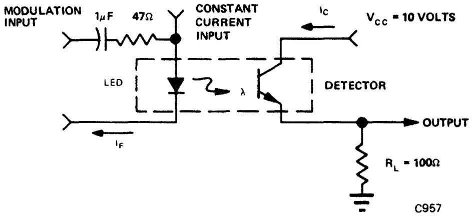
Fig. 6. Switching Time vs. Collector Current

For additional characteristic curves, see MCT2

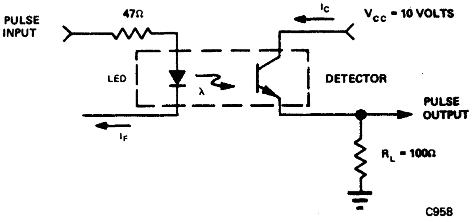
OPTOELECTRONICS

PHOTOTRANSISTOR OPTOCOUPLER

OPERATING SCHEMATICS



Modulation Circuit Used to Obtain Output vs. Frequency Plot



Circuit Used to Obtain Switching Time vs. Collector Current Plot

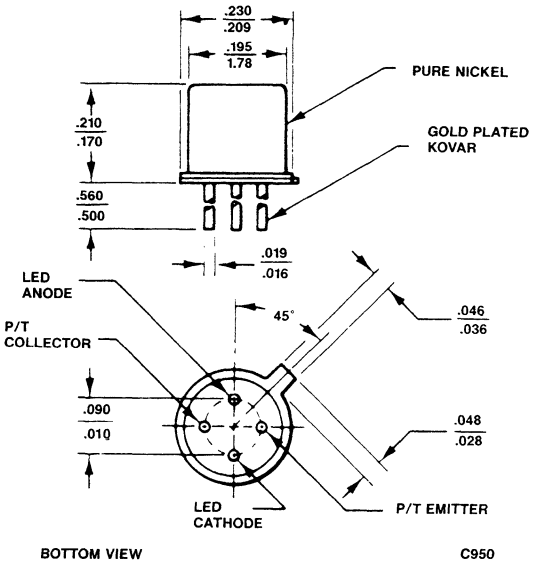
NOTES

1. *The current transfer ratio (I_C/I_F) is the ratio of the detector collector current to the LED input current with V_{CE} at 10 volts.*
2. *The frequency at which i_c is 3 dB down from the 1 kHz value.*
3. *Rise time (t_r) is the time required for the collector current to increase from 10% of its final value, to 90%. Fall time (t_f) is the time required for the collector current to decrease from 90% of its initial value to 10%.*

RELIABILITY CONDITIONED HERMETIC PHOTOTRANSISTOR OPTOCOUPLER

MCT4R

PACKAGE DIMENSIONS



DIMENSIONS IN INCHES

DESCRIPTION

The MCT4R is a standard four-lead, TO-18 package containing a GaAs infrared emitting diode optically coupled to a silicon planar phototransistor.

FEATURES

- Hermetic package
- High current transfer ratio; typically 35%
- High isolation resistance, 10^{11} ohms at 500 volts
- High voltage isolation emitter to detector
- Screened to MIL-STD-883 Class B

APPLICATIONS

The MCT4R is designed and manufactured to conform to the requirements of military systems. Reliability testing has proven the product capable of conforming to the screening and quality conformance requirements of MIL-STD-883C Class B devices.

SCREEN—100%

Characteristic	Method	
Internal Visual	2010	— Characteristics applicable to device
Stabilization Bake	1008	— 150°C. for 48 hours
Temperature Cycle	1010	— 10 cycles; −55°C., 25°C., 150°., 25°C.
Centrifuge	2001	— Test Condition E
Hermeticity	1014	— Fine and Gross
Critical Electrical	—	Data Sheet
Burn In	1015	— 160 hours @ 125°C
Final Electrical	—	Data Sheet
Group A Sample Inspection	5005	Table I Subgroups
External Visual	2009	

RELIABILITY CONDITIONED HERMETIC PHOTOTRANSISTOR OPTOCOUPLER

LOT QUALIFICATION TESTS

CHARACTERISTIC	METHOD	LTPD
Subgroup I		
Visual Mechanical		
Marking Permanency	2008	15%
Physical Dimensions		
Subgroup II		
Solderability	2003	15%
Subgroup III		
Thermal Shock	1011 — 15 cycles; 150°C. to −65°C.	
Temperature Cycle	1010 — 10 cycles; −55°C., 25°C., 150°C., 25°C.	15%
Moisture Resistance	1004	
Critical Electrical	— Data Sheet	
Subgroup IV		
Mechanical Shock	2002 — Condition B	15%
Vibration Fatigue	2005 — Condition A	
Vibration Variable Frequency	2007 — Condition A	
Constant Acceleration	2001 — Condition E	
Critical Electrical	— Data Sheets	
Subgroup V		
Lead Fatigue	2004 — Condition B_2	15%
Hermeticity	1014 — Fine Condition A	
	Gross Condition C	
Subgroup VI		
Salt Atmosphere	1009 — Condition A	15%

LIFE TESTING 7% LTPD

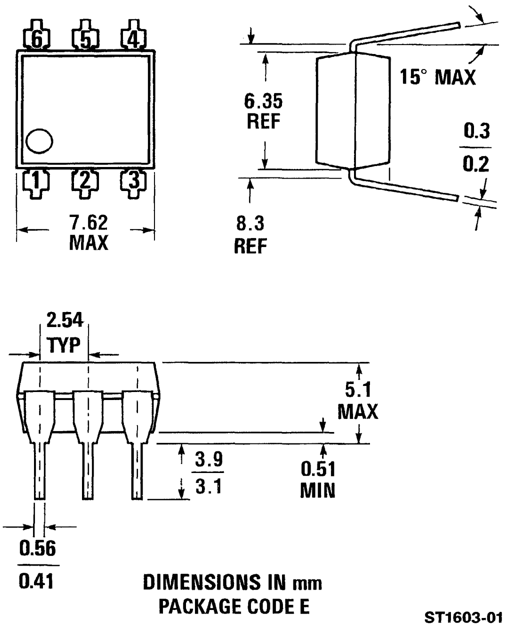
CHARACTERISTIC	METHOD	LTPD
Subgroup VII		
High Temperature Storage	1008 — 150°C. for 1000 hours	7%
Critical Electrical	— Data Sheet	
Subgroup VIII		
Operating Life	1005 — Condition B	7%
Critical Electrical	— Data Sheets	
Subgroup IX		
Steady State Reverse Bias	1015 — Condition A; 72 hours at 150°C.	7%
Subgroup X		
Bond Strength	2001 — Condition C; 10 devices only	

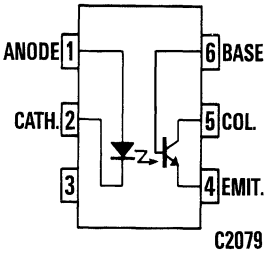
Reference: MIL-STD-883C Test Methods and Procedures for Microelectronics.

HIGH-PERFORMANCE AlGaAs PHOTOTRANSISTOR OPTOCOUPLERS

MCT5200
MCT5201

PACKAGE DIMENSIONS





Equivalent Circuit

DESCRIPTION

The MCT520X are high performance logic compatible phototransistor type optically coupled isolator products. They are constructed using a very low degradation and high-efficiency AlGaAs, 890 nm infrared emitter, coupled to a high speed NPN phototransistor, in a six-pin dual-in-line package. They provide a very high current transfer ratio (CTR), high switching speed and 5300 VAC RMS withstand test voltage performance. The critical circuit design parameters of CTR_{CE} and CTR_{CB} are guaranteed over a temperature range of 0-70°C resulting in guaranteed switching propagation delays when interfaced to LSTTL logic.

The MCT5201 has a minimum saturated CTR of 120% for a LED input current of 5 mA. Maximum LSTTL interface propagation delays of 30 μs are guaranteed with the use of an external 330K resistor between the base and emitter. The MCT5200 is specified for a minimum saturated CTR of 75% for an input current of 10 mA.

FEATURES

- High $CTR_{CE\ (SAT)}$ comparable to Darlingtons
- Guaranteed switching speed with LSTTL load
- Performance guaranteed over 0°C to 70°C
- High common mode rejection—5 kV/μs
- Data rates up to 150 kbits/s (NRZ)
- Underwriters Laboratory (UL) recognized file #E90700

APPLICATIONS

- LSTTL digital logic isolation
- IEEE 488 isolated inputs
- Switching power supply
- High speed industrial interfaces
- Isolated microprocessor inputs

ABSOLUTE MAXIMUM RATINGS

TOTAL PACKAGE

Storage temperature	−55°C to 150°C
Operating temperature	−55°C to 100°C
Lead temperature (soldering, 10 sec)	260°C
Total package, power dissipation (LED plus detector)	260 mW
Derate linearly from 25°C	3.5 mW/°C

INPUT DIODE

Forward DC current	40 mA
Reverse voltage	6 V
Peak forward current (1 μs pulse, 300 pps)	1.0 A
Power dissipation	54 mW
Derate linearly from 25°C	0.7 mW/°C

OUTPUT TRANSISTOR

Power dissipation	200 mW
Derate linearly from 25°C	2.67 mW/°C

INDIVIDUAL COMPONENT CHARACTERISTICS (T_A=25°C Unless Otherwise Specified)

CHARACTERISTIC	SYMBOL	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS	FIG.	NOTE
INPUT DIODE								
Forward voltage	V_F		1.3	1.5	V	I_F=5 mA	1	
Forward voltage coefficient	$\Delta V_F/\Delta T_A$		−1.9		mV/°C	I_F=2 mA	1	
Reverse voltage	V_R	6			V	I_R=10 μA		
Junction capacitance	C_J		18		pF	V_F=0 V, f=1 MHz		
			112			V_F=1 V, f=1 MHz		
OUTPUT TRANSISTOR								
DC forward current gain	$h_{FE(SAT)}$		400	—		V_{CE}=0.4 V, I_{CE}=6 mA	8,9	
Breakdown voltage								
Collector to emitter	BV_{CEO}	30	45		V	I_C=1.0 mA, I_F=0		
Collector to base	BV_{CBO}	30	70		V	I_C=10 μA, I_F=0		
Emitter to base	BV_{EBO}	5	7		V	I_E=10 μA		
Leakage								
Collector to emitter	I_{CER}		5	100	nA	V_{CE}=10 V, I_F=0, R_{BE}=1 MΩ	11	
Capacitance								
Collector to emitter	C		8		pF	V_{CE}=0, f=1 MHz		
Collector to base			20		pF	V_{CB}=5, f=1 MHz	12	
Emitter to base			7		pF	V_{EB}=0, f=1 MHz		

TRANSFER CHARACTERISTICS

(Over Recommended Temperature, T_A=**0°C to 70°C** Unless Otherwise Specified)

DC CHARACTERISTICS	SYMBOL	DEVICE	MIN.	TYP.*	MAX.	UNITS	TEST CONDITIONS	FIG.	NOTE
Saturated current transfer ratio (collector to emitter)	$CTR_{CE(SAT)}$	MCT5200	75	150		%	I_F=10 mA, V_{CE}=0.4V	2, 3, 4	1
		MCT5201	120	225		%	I_F=5.0 mA, V_{CE}=0.4 V	2, 3, 5	
Current transfer ratio (collector to emitter)	CTR_{CE}	MCT5200		200		%	I_F=10 mA, V_{CE}=5.0 V		1
		MCT5201		300		%	I_F=5 mA, V_{CE}=5.0 V		
Current transfer ratio (collector to base)	CTR_{CB}	MCT5200	0.2	0.3		%	I_F=10 mA, V_{CB}=4.3V		2
		MCT5201	0.28	0.5		%	I_F=5.0 mA, V_{CB}=4.3 V	6,7	
Saturation voltage (collector to emitter)	$V_{CE(SAT)}$	MCT5200		0.2	0.4	V	I_F=10 mA, I_{CE}=7.5 mA		
		MCT5201		0.2	0.4	V	I_F=5 mA, I_{CE}=6 mA		

**All typicals T_A=25°C*

HIGH-PERFORMANCE AlGaAs PHOTOTRANSISTOR OPTOCOUPLERS

SWITCHING CHARACTERISTICS

(Over Recommended Temperature, T_A=**0°C to 70°C** Unless Otherwise Specified)

AC CHARACTERISTICS	SYMBOL	MIN.	TYP.*	MAX.	UNITS	TEST CONDITIONS	FIG.	NOTE
MCT-5200								
Delay time	t_d		3	7	µs	I_F=10 mA, V_{CE}=0.4 V R_L=1.0 K, R_{BE}=330 K V_{CC}=5.0 V	15,18	3,4 5,6
Rise time	t_r		2	6	µs			
Storage time	t_s		12	18	µs			
Fall time	t_f		17	30	µs			
Propagation delay H→L	t_{PHL}	µs	5	12	µs	I_F=10 mA, V_{CE}=0.4 V V_{CC}=5.0 V, R_L=(Fig. 18) R_{BE}=330 K		7
Propagation delay L→H	t_{PLH}	µs	13	20	µs			
MCT-5201								
Delay time	t_d		7	15	µs	I_F=5 mA, V_{CE}=0.4 V R_L=1.0 K, R_{BE}=330 K V_{CC}=5.0 V	13,18	3,4 5,6
Rise time	t_r		6	20	µs			
Storage time	t_s		8	13	µs			
Fall time	t_f		19	30	µs			
Propagation delay H→L	t_{PHL}		12	30	µs	I_F=5 mA, V_{CE}=0.4 V V_{CC}=5.0 V, R_L=(Fig. 18) R_{BE}=330 K		7
Propagation delay L→H	t_{PLH}		8	13	µs			

All typicals T_A=25°C

ISOLATION CHARACTERISTICS

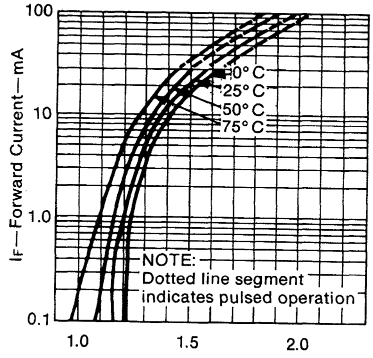
(T_A=25°C Unless Otherwise Specified)

CHARACTERISTICS	SYMBOL	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS	FIG.	NOTE
Common mode rejection—output high	CM_H		5000		v/µs	V_{CM}=50 $V_{p\text{-}p}$ R_L=1 KΩ, I_F=0	17	
Common mode rejection—output low	CM_L		5000		v/µs	V_{CM}=50 $V_{p\text{-}p}$ R_L=1 KΩ, I_F=5 mA		
Common mode coupling capacitor	C_{cm}		0.2		pF		8	
Package capacitance input/output	$C_{I\text{-}O}$		0.7		pF	$V_{I\text{-}O}$=0, f=1 MHz	9	
Withstand insulation test voltage	V_{ISO}	5300			$V_{AC(RMS)}$	$I_{I\text{-}O}$≤1 µA, 1 minute	10	8
	V_{ISO}	7500			$V_{AC(Peak)}$	$I_{I\text{-}O}$≤1 µA, 1 minute	10	8
Insulation resistance	R_{ISO}	10^{11}			Ohms	$V_{I\text{-}O}$=500 V		

NOTES

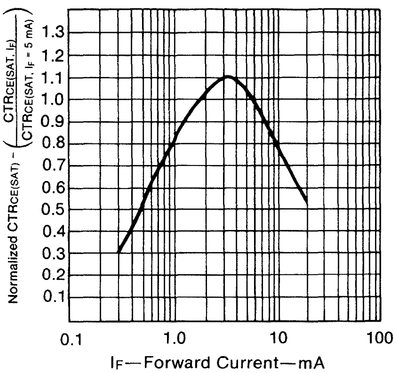
1. *DC current transfer ratio (CTR_{CE}) is defined as the transistor collector current (I_{CE}) divided by input LED current (I_F)×100%, at a specified voltage collector to emitter (V_{CE}).*
2. *Current transfer ratio is defined as the collector to base photocurrent (I_{CB}) divided by the input LED current (I_F) times 100%.*
3. *Switching delay time (t_d) is measured for 50% of LED current to 90% falling edge of V_O.*
4. *Rise time (t_r) is measured from the 90% to 10% of V_O falling edge.*
5. *Storage time (t_s) is measured from 50% of falling edge of LED current to 10% of rise edge of V_O.*
6. *Fall time (t_f) is measured from the 10% to 90% of the rising edge of V_O.*
7. *The t_{PLH} propagation delay is measured from 50% point on the falling edge of the input pulse to the 1.3 V point on the rising edge of the output pulse. The t_{PHL} propagation delay is measured from 50% point on the rising edge of input to 1.3 V point on falling edge of output pulse.*
8. *Device considered a two terminal device: Pins 1, 2, and 3 are shorted together. Pins 4, 5, and 6 are shorted together.*

TYPICAL ELECTRO-OPTICAL CHARACTERISTICS (T_A=25°C Unless Otherwise Specified)



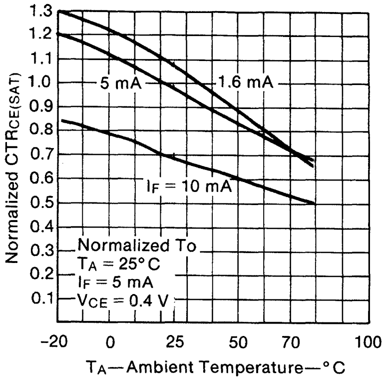
C1804

Fig. 1. Forward Voltage vs. Forward Current



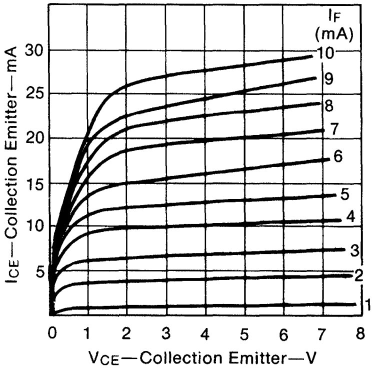
C1805

Fig. 2. Normalized Current Transfer Ratio vs. Forward Current



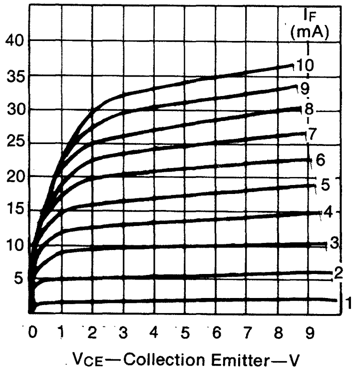
C1806

Fig. 3. Normalized CTR vs. Temperature



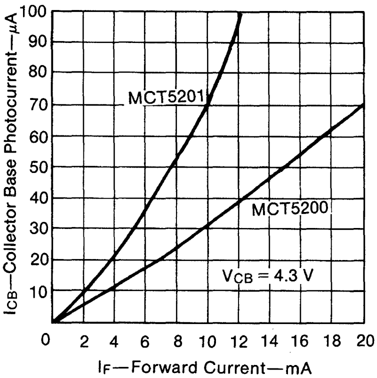
C1807

Fig. 4. MCT5200 Collector Current vs. Collector to Emitter Voltage



C1808

Fig. 5. MCT5201 Collector Current vs. Collector to Emitter Voltage



C1809

Fig. 6. Collector Base Photocurrent vs. Forward Current

TYPICAL ELECTRO-OPTICAL CHARACTERISTICS

(T_A=25°C Unless Otherwise Specified) (Cont'd)

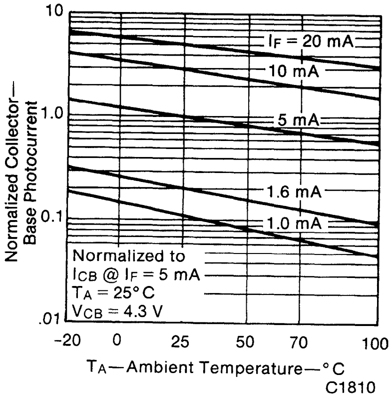


Fig. 7. Normalized Collector Base Photocurrent vs. Ambient Temperature

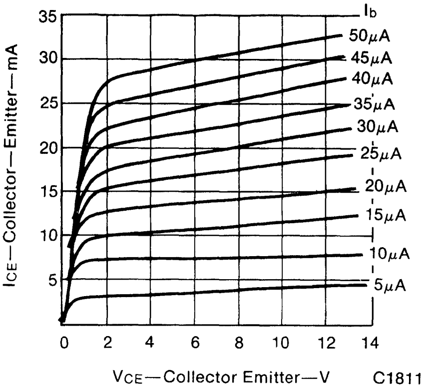


Fig. 8. Collector Current vs. Collector to Emitter Voltage

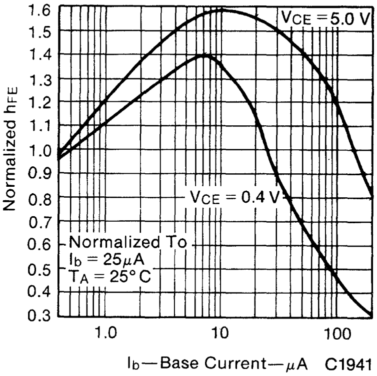


Fig. 9. Normalized h_{FE} vs. Base Current

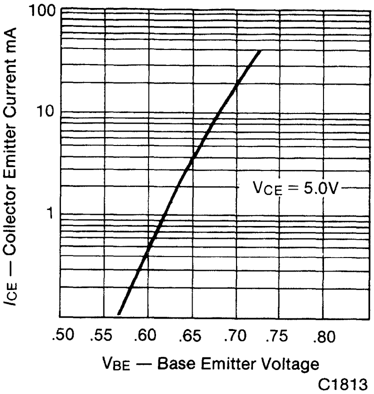


Fig. 10. Collector Current (I_{CE}) vs. Base Emitter Voltage (V_{BE})

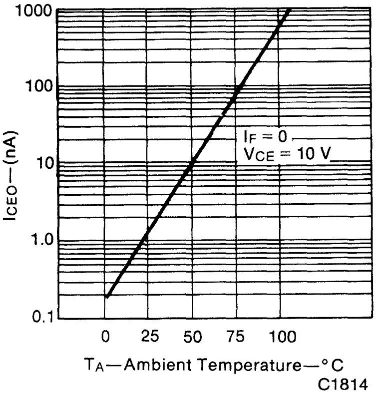


Fig. 11. Collector to Emitter Leakage Current vs. Temperature

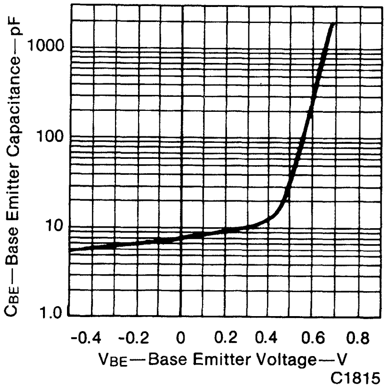
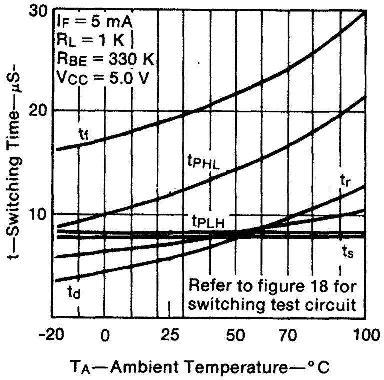


Fig. 12. Base Emitter Capacitance vs. Base Emitter Voltage

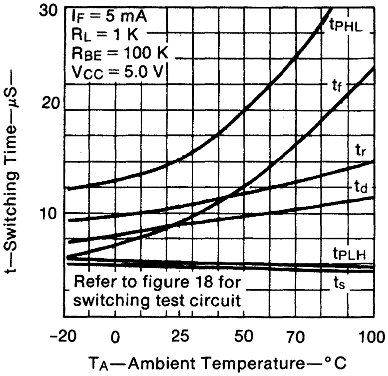
TYPICAL ELECTRO-OPTICAL CHARACTERISTICS

(T_A=25°C Unless Otherwise Specified) (Cont'd)



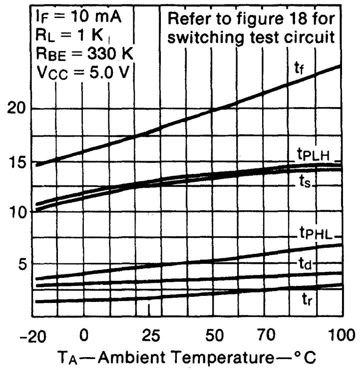
C1816

Fig. 13. Switching Time vs. Temperature I_F=5 mA R_{BE}=330 K



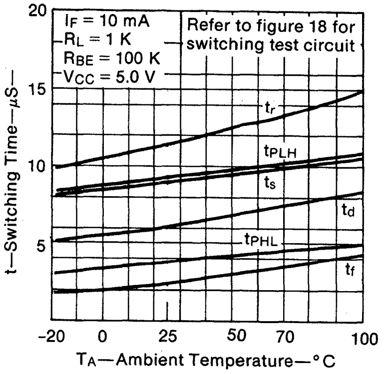
C1817

Fig. 14. Switching Speed vs. Temperature I_F=5 mA R_{BE}=100 K



C1818

Fig. 15. Switching Speed vs. Temperature I_F=5 mA R_{BE}=330 K



C1819

Fig. 16. Switching Speed vs. Temperature I_F=5 mA R_{BE}=100 K

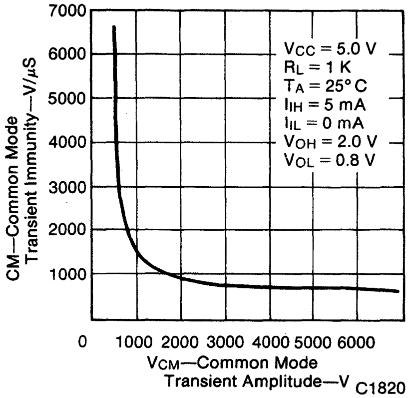
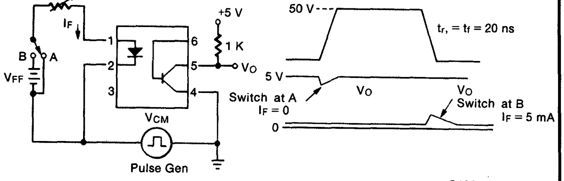


Fig. 17. Common Mode Transient Rejection vs. Common Mode Transient Voltage

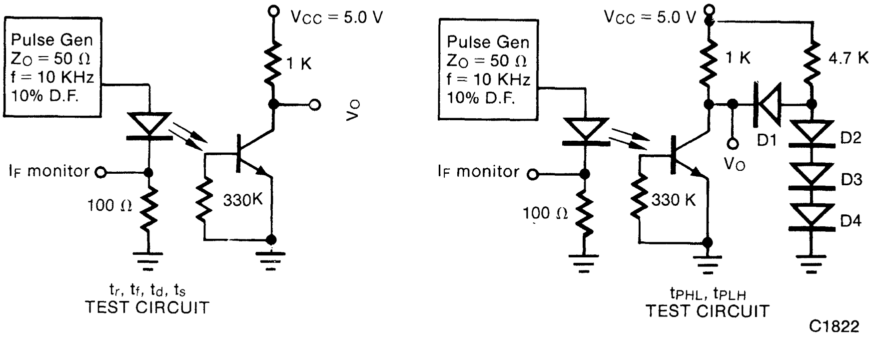


C1821

Fig. 18. Text Circuit for Transient Immunity and Typical Waveforms

TYPICAL ELECTRO-OPTICAL CHARACTERISTICS

(T_A=25°C Unless Otherwise Specified) (Cont'd)



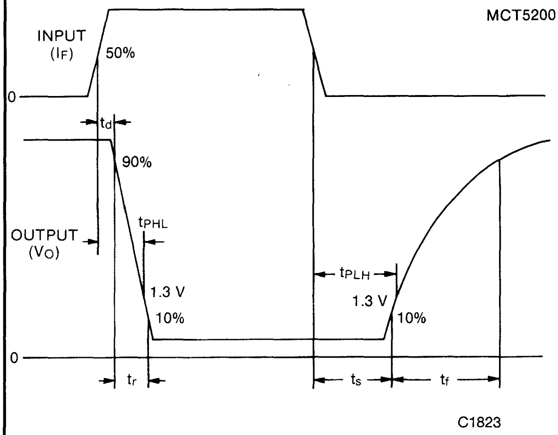
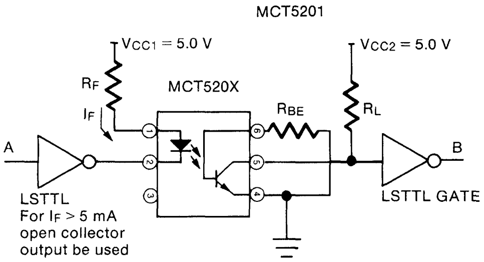


Fig. 19. Switching Circuit Waveforms

MCT5200



IF mA	RF Ω	RL Ω	RBE Ω	tPHL µs	tPLH µs	DATA* RATE NRZ
1.6	2 K	10 K	∞	15	12	37 K
3.0	1.1 K	4.7 K	470 K	10	10	50 K
5.0	620	1 K	330 K	12	8	50 K
10.0	330	1 K	100 K	7	11	56 K
10.0	330	2 K	47 K	3	4	140 K

data
$$\text{*NRZ} = \frac{1}{t_{PLH} + t_{PHL}}$$

C1824

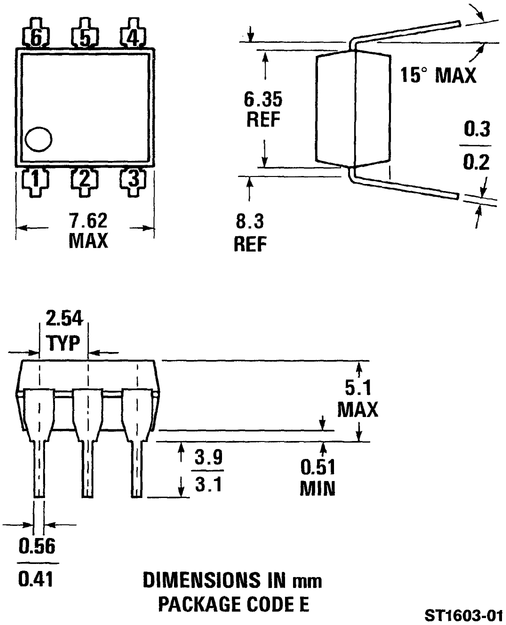
Fig. 20. Typical Non-Inverting LSTTL to LSTTL Interface

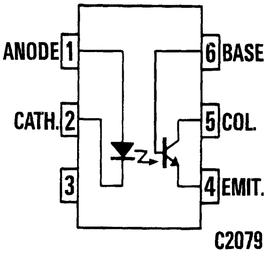
QT
OPTOELECTRONICS

HIGH-PERFORMANCE AlGaAs PHOTOTRANSISTOR OPTOCOUPLERS

MCT5210
MCT5211

PACKAGE DIMENSIONS





Equivalent Circuit

DESCRIPTION

The MCT-521X are high performance CMOS/LSTTL logic compatible phototransistor type optically coupled isolator products. They are constructed using a very low degradation and high-efficiency AlGaAs, infrared emitter, coupled to a photoefficient high gain NPN phototransistor in a six pin dual-in-line package. This package provides a minimum of 5300 VAC Withstand Test Insulation, and 5000 V/μs common mode transient rejection.

The MCT-5211 is well suited for CMOS to LSTT/TTL interfaces, for it offers 250% CTR$_{CE(SAT)}$ with 1 mA of LED input current. When an LED input current of 1.6 mA is supplied data rates to 20K bits/s are possible.

The MCT-5210 can easily interface LSTTL to LSTTL/TTL, and with use of an external base to emitter resistor data rates of 100 K bits/s can be achieved.

FEATURES

- High CTR$_{CE(SAT)}$ comparable to Darlingtons
- CTR guaranteed 0°C to 70°C
- High common mode transient rejection—5 kV/μs
- Data rates up to 50 kbits/s (NRZ)
- Underwriters Laboratory (UL) recognized file #E90700

APPLICATIONS

- CMOS to CMOS/LSTTL logic isolation
  LSTTL to CMOS/LSTTL logic isolation
- RS-232 line receiver
- Telephone ring detector
- AC line voltage sensing

ABSOLUTE MAXIMUM RATINGS

TOTAL PACKAGE

Storage temperature	−55°C to 150°C
Operating temperature	−55°C to 100°C
Lead temperature (soldering, 10 sec.)	260°C
Total package power dissipation at 25°C (LED plus detector)	260 mW
Derate linearly from 25°C	3.5 mW/°C

INPUT DIODE

Forward DC current	40 mA
Reverse voltage	6 V
Peak forward current (1 μs pulse, 300 pps)	1.0 A
Power dissipation	54 mW
Derate linearly from 25°C	0.7 mW/°C

OUTPUT TRANSISTOR

Power dissipation	200 mW
Derate linearly from 25°C	2.67 mW/°C

HIGH PERFORMANCE AlGaAs PHOTOTRANSISTOR OPTOCOUPLERS

INDIVIDUAL COMPONENT CHARACTERISTICS (T_A=25°C Unless Otherwise Specified)

CHARACTERISTICS	SYMBOL	MIN	TYP	MAX	UNITS	TEST CONDITIONS	FIG.	NOTE
INPUT DIODE								
Forward voltage	V_F		1.3	1.5	V	I_F=5 mA	1	
Forward voltage coefficient	$\Delta V_F/\Delta T_A$		−1.9		mV/°C	I_F=2 mA	1	
Reverse voltage	V_R	5			V	I_R=10 μA		
Junction capacitance	C_J		18		pF	V_F=0 V, f=1 MHz		
			112		pF	V_F=1 V, f=1 MHz		
OUTPUT TRANSISTOR								
DC forward current gain	$h_{FE(SAT)}$		350		—	V_{CE}=0.4 V, I_{CE}=2 mA	8,9	
Breakdown voltage Collector to emitter	BV_{CEO}	30	45		V	I_C=1.0 mA, I_F=0		
Collector to base	BV_{CBO}	30	70		V	I_C=10 μA, I_F=0		
Emitter to base	BV_{EBO}	5	7		V	I_C=10 μA, I_F=0		
Leakage current Collector to emitter	I_{CER}			100	nA	V_{CE}=10 V, I_F=0, R_{BE}=1 MΩ		
Capacitance Collector to emitter	C		10		pF	V_{CE}=0, f=1 MHz		
Collector to base			80		pF	V_{CB}=0, f=1 MHz		
Emitter to base			15		pF	V_{EB}=0, f=1 MHz	11	

TRANSFER CHARACTERISTICS OVER RECOMMENDED TEMPERATURE

(T_A=0°C to 70°C Unless Otherwise Specified)

CHARACTERISTICS	SYMBOL	DEVICE	MIN	TYP*	MAX	UNITS	TEST CONDITIONS	FIG.	NOTE
Saturated current Transfer ratio (Collector to emitter)	$CTR_{CE\ SAT}$	MCT5210	60	350		%	I_F=3.0 mA, V_{CE}=0.4 V	2	1
		MCT5211	100	300		%	I_F=1.6 mA, V_{CE}=0.4 V	3	
			75	250		%	I_F=1.0 mA, V_{CE}=0.4 V		
Current transfer ratio (Collector to emitter)	CTR_{CE}	MCT5210	70	400		%	I_F=3.0 mA, V_{CE}=5.0 V	5	1
		MCT5211	150	350		%	I_F=1.6 mA, V_{CE}=5.0 V	4	
			110	300		%	I_F=1.0 mA, V_{CE}=5.0 V		
Current transfer ratio (Collector to base)	CTR_{CB}	MCT5210	0.2	0.9		%	I_F=3.0 mA, V_{CB}=4.3 V	6	2
		MCT5211	0.3	0.75		%	I_F=1.6 mA, V_{CB}=4.3 V	7	
			0.25	0.6		%	I_F=1.0 mA, V_{CB}=4.3 V		
Saturation voltage (Collector to emitter)	$V_{CE\ SAT}$	MCT5210		0.2	0.4	V	I_F=3.0 mA, I_{CE}=1.8 mA		
		MCT5211		0.2	0.4	V	I_F=1.6 mA, I_{CE}=1.6 mA		

*All typicals T_A=25°C

MCT5210 MCT5211

HIGH PERFORMANCE AlGaAs PHOTOTRANSISTOR OPTOCOUPLERS

SWITCHING CHARACTERISTICS (T_A=25°C Unless Otherwise Specified)

CHARACTERISTICS	SYMBOL	DEVICE	MIN	TYP	MAX	UNITS	TEST CONDITIONS		FIG.	NOTE
Propagation delay H-L	t_{PHL}	MCT-5210		10		µs	R_L=330 Ω, R_{BE}=∞	I_F=3.0 mA		
				12		µs	R_L=3.3 K, R_{BE}=39 K	V_{CC}=5.0 V		
		MCT-5211		20		µs	R_L=750 Ω, R_{BE}=∞	I_F=1.6 mA	12	3
				25		µs	R_L=4.7 K, R_{BE}=91 K	V_{CC}=5.0 V	13	
				40		µs	R_L=1.5 K, R_{BE}=∞	I_F=1.0 mA		
				45		µs	R_L=10 K, R_{BE}=160 K	V_{CC}=5.0 V		
Propagation delay L-H	t_{PLH}	MCT-5210		10		µs	R_L=330 Ω, R_{BE}=∞	I_F=3.0 mA		
				12		µs	R_L=3.3 K, R_{BE}=39 K	V_{CC}=5.0 V		
		MCT-5211		20		µs	R_L=750 Ω, R_{BE}=∞	I_F=1.6 mA		
				25		µs	R_L=4.7 K, R_{BE}=91 K	V_{CC}=5.0 V	12	4
				40		µs	R_L=1.5 K, R_{BE}=∞	I_F=1.0 mA	13	
				45		µs	R_L=10 K, R_{BE}=160 K	V_{CC}=5.0 V		

ISOLATION CHARACTERISTICS (T_A=0°C Unless Otherwise Specified)

CHARACTERISTICS	SYMBOL	MIN	TYP	MAX	UNITS	TEST CONDITIONS	FIG.	NOTE
Common mode transient Rejection - output high	CM_H		5000		v/µs	V_{CM}=50 $V_{p\text{-}p}$, R_L=750 Ω I_F=0	14	
Common mode transient Rejection - output low	CM_L		5000		v/µs	V_{CM}=50 $I_{p\text{-}p}$ R_L=750 Ω I_F=1.6 mA		
Common mode coupling capacitor	C_{CM}		0.2		pF		14	5
Package capacitance input/output	$C_{I\text{-}O}$		0.7		pF	$V_{I\text{-}O}$=0, f=1 MHz		6
Withstand insulation test voltage	V_{ISO}	5300			$V_{AC(RMS)}$	$I_{I\text{-}O}$≤1 µA, 1 minute		7
	V_{ISO}	7500			$V_{AC(Peak)}$			
Insulation resistance	R_{ISO}	10^{11}			Ohms	$V_{I\text{-}O}$=500 V		

NOTES

1. *DC Current Transfer Ratio (CTR_{CE}) is defined as the transistor collector current (I_{CE}) divided by the input LED current (I_F) x 100%, at a specified voltage between the collector and emitter (V_{CE}).*
2. *The collector base Current Transfer Ratio (CTR_{CB}) is defined as the collector base photocurrent (I_{CB}) divided by the input LED current (I_F) time 100%.*
3. *Referring to Figure 13 the t_{PHL} propagation delay is measured from the rising edge of the data input (A) to the rising edge of the rising edge of the data output (B).*
4. *Referring to Figure 13 the t_{PLH} propagation delay is measured from the falling edge of data input (A) to the falling edge of the data output (B).*
5. *C_{CM} is the capacitance between the LED (input assembly) to the base of the phototransistor.*
6. *$C_{I\text{-}O}$ is the capacitance between the input (pins 1, 2, 3 connected) and the output, (pins 4, 5, 6 connected).*
7. *Device considered a two terminal device: Pins 1, 2, and 3 shorted together, and pins 5, 6, and 7 are shorted together.*

TYPICAL ELECTRO-OPTICAL CHARACTERISTICS (T$_A$=25°C Unless Otherwise Specified)

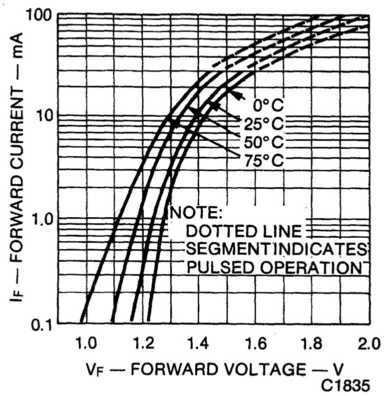


Fig. 1. Forward Voltage vs. Forward Current

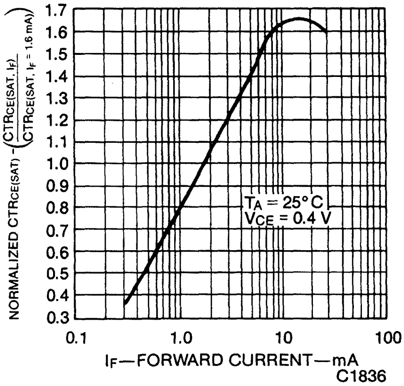


Fig. 2. Normalized Current Transfer Ratio vs. Forward Current

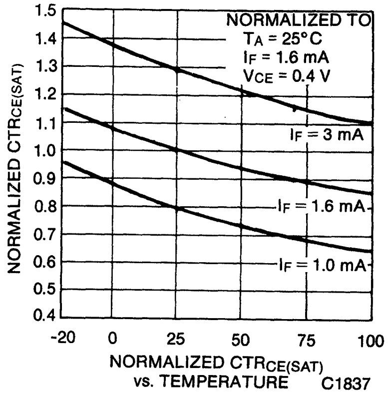


Fig. 3. Normalized CTR vs. Temperature

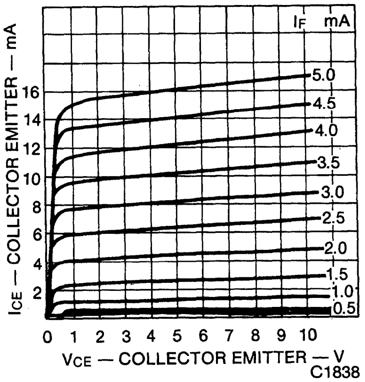


Fig. 4. DC Characteristics MCT5210

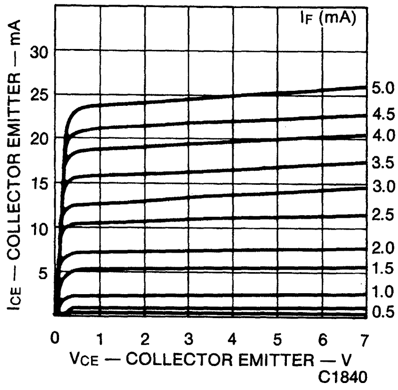


Fig. 5. DC Characteristics MCT5211

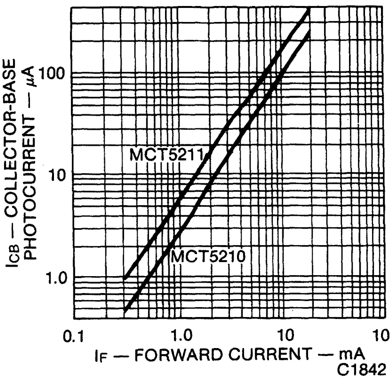


Fig. 6. Collector Base Photocurrent vs. Forward Current

TYPICAL ELECTRO-OPTICAL CHARACTERISTICS

(T_A=25°C Unless Otherwise Specified) (Cont'd)

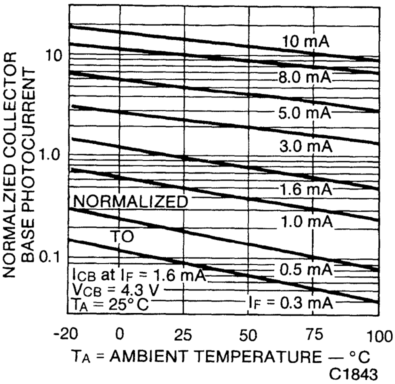


Fig. 7. Normalized Collector Base Photocurrent vs. Temperature

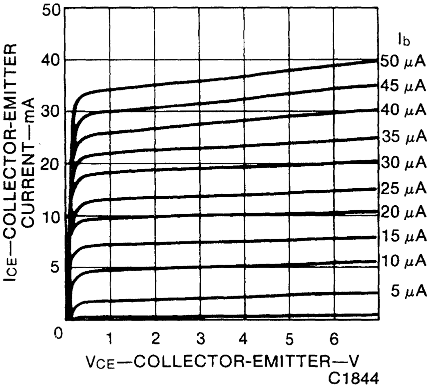


Fig. 8. Transistor DC Characteristics

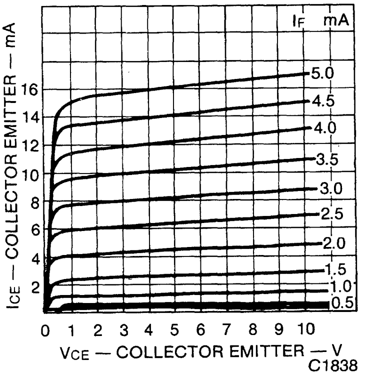


Fig. 9. $h_{FE(SAT)}$ vs. I_b vs. Temperature

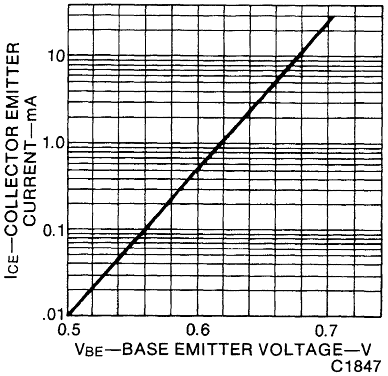


Fig. 10. Collector Current vs. Base Emitter Voltage

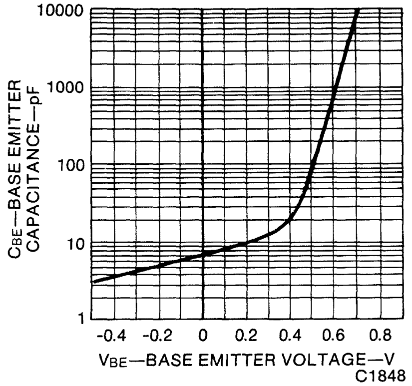


Fig. 11. C_{BE} vs. V_{BE}

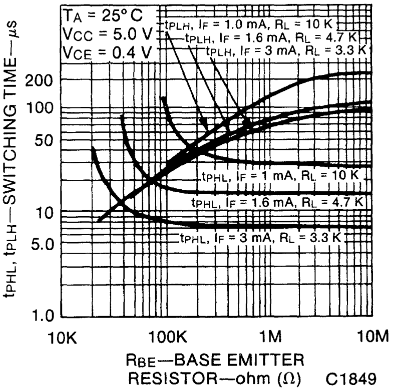
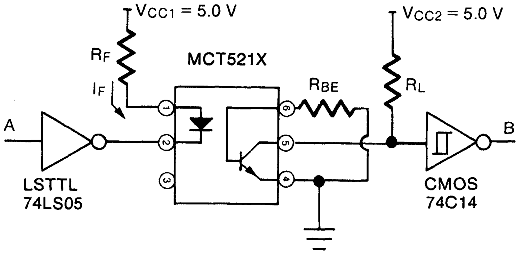
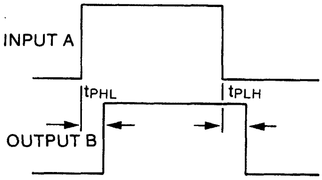


Fig. 12. Switching Time vs. R_{BE}

TYPICAL ELECTRO-OPTICAL CHARACTERISTICS

(T_A=25°C Unless Otherwise Specified) (Cont'd)





TYPICAL SWITCHING TIME T_A = 25° C

I_F mA	R_F KΩ	R_L KΩ	R_{BE} KΩ	t_{PHL} µs	t_{PLH} µs	Data K bit/s
1.0	3.3	1.5	∞	40	40	12.5
1.0	3.3	10	160	45	45	11
1.6	2.0	750	∞	20	20	25
1.6	2.0	4.7	91	25	25	20
3.0	1.1	.33	∞	10	10	50
3.0	1.1	3.3	39	12	12	42

C1850

Fig. 13. Switching Speed Test Circuit

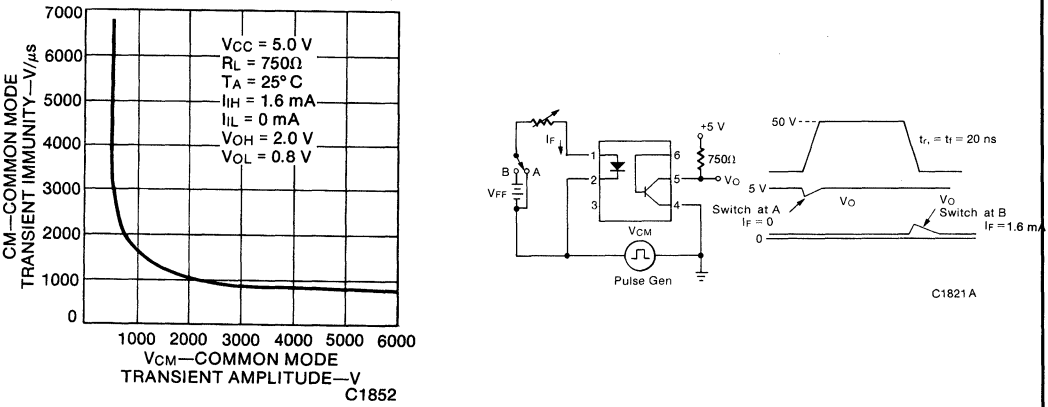


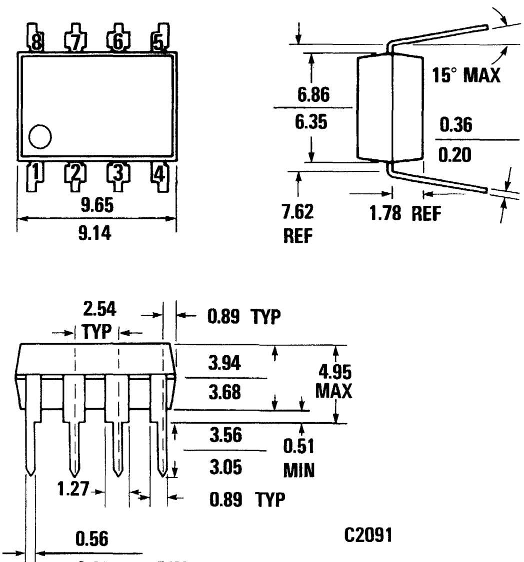
Fig. 14. Common Mode Transient Rejection & Test Circuit

QT OPTOELECTRONICS

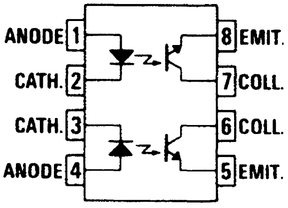
DUAL PHOTOTRANSISTOR OPTOCOUPLERS

MCT6 MCT62 MCT61

PACKAGE DIMENSIONS



DIMENSIONS IN mm
PACKAGE CODE G



C2085

Equivalent Circuit

DESCRIPTION

The MCT6X optoisolators have two channels for high density applications. For four channel applications, two-packages fit into a standard 16-pin DIP socket. Each channel is an NPN silicon planar phototransistor optically coupled to a gallium arsenide infrared emitting diode.

FEATURES

- Two isolated channels per package
- Two packages fit into a 16 lead DIP socket
- Choice of 3 current transfer ratios
- Underwriters Laboratory (U.L.) recognized File E50151

APPLICATIONS

- AC Line/Digital Logic—Isolate high voltage transients
- Digital Logic/Digital Logic—Eliminate spurious grounds
- Digital Logic/AC Triac Control—Isolate high voltage transients
- Twisted pair line receiver—Eliminate ground loop feedthrough
- Telephone/Telegraph line receiver—Isolate high voltage transients
- High Frequency Power Supply Feedback Control—Maintain floating ground
- Relay contact monitor—Isolate floating grounds and transients
- Power Supply Monitor—Isolate transients

ABSOLUTE MAXIMUM RATINGS

Storage temperature	−55°C to 150°C
Operating temperature	−55°C to 100°C
Lead temperature	(soldering, 10 sec.) 250°C

TOTAL INPUT

Power dissipation at 25°C ambient	100 mW
Derate linearly from 25°C	1.3 mW/°C

COUPLED

Input to output breakdown voltage	2500 volts V_{RMS}
Total package power dissipation @ 25°C ambient	400 mW
Derate linearly from 25°C	5.33 mW/°C

INPUT DIODE (each channel)

Forward current	60 mA
Reverse voltage	3.0 V
Peak forward current (1 μs pulse, 300 pps)	3 A

OUTPUT TRANSISTOR (each channel)

Power dissipation @ 25°C ambient	150 mW
Derate linearly from 25°C	2 mW/°C
Collector current	30 mA

QT OPTOELECTRONICS

DUAL PHOTOTRANSISTOR OPTOCOUPLERS

ELECTRO-OPTICAL CHARACTERISTICS

(25°C Free Air Temperature Unless Otherwise Specified)

INDIVIDUAL COMPONENT CHARACTERISTICS

CHARACTERISTICS	SYMBOL	MIN.	TYP.	MAX.	UNITS	TEST CONDITION
INPUT DIODE						
Rated forward voltage	V_F		1.25	1.50	V	I_F=20 mA
Reverse voltage	V_R	3.0	25		V	I_R=10 μA
Reverse current	I_R		.001	10	μA	V_R=3.0 V
Junction capacitance	C_J		50		pF	V_F=0 V
OUTPUT TRANSISTOR (I_F=0)						
Breakdown voltage, collector to emitter	BV_{CEO}	30	85		V	I_C=1.0 mA
Breakdown voltage, emitter to collector	BV_{ECO}	6	13		V	I_E=100 μA
Leakage current, collector to emitter	I_{CEO}		5	100	nA	V_{CE}=10 V
Capacitance collector to emitter	C_{CE}		8		pF	V_{CE}=0 V

TRANSFER CHARACTERISTICS

CHARACTERISTICS	SYMBOL	MIN.	TYP.	MAX.	UNITS	TEST CONDITION
COUPLED						
DC current transfer ratio (I_C/I_F)=CTR MCT6		20			%	V_{CE}=10 V, I_F=10 mA
MCT61		50			%	V_{CE}=5 V, I_F=5 mA
MCT62		100			%	V_{CE}=5 V, I_F=5 mA
Saturation voltage—collector to emitter MCT6, 61, 62	$V_{CE\ (SAT)}$		0.2	0.4	V	I_C=2 mA, I_F=16 mA

TRANSFER CHARACTERISTICS

CHARACTERISTICS	SYMBOL	MIN.	TYP.	MAX.	UNITS	TEST CONDITION
SWITCHING TIMES, OUTPUT TRANSISTOR						
Non-saturated rise time, fall time (Note 3)			2.4		μs	I_C=2 mA, V_{CE}=10 V, R_L=100Ω
Non-saturated rise time, fall time (Note 3)			15		μs	I_C=2 mA, V_{CE}=10 V, R_L=1KΩ
Saturated turn-on time (from 5.0V to 0.8V)			5		μs	R_L=2KΩ, I_F=40 mA
Saturated turn-off time (from saturation to 2.0V)			25		μs	R_L=2KΩ, I_F=40 mA
Bandwidth B_W			150		kHz	I_C=2 mA, V_{CE}=10 V, R_L=100Ω

ISOLATION CHARACTERISTICS

CHARACTERISTICS	SYMBOL	MIN.	TYP.	MAX.	UNITS	TEST CONDITION
Isolation voltage	$BV_{(I-O)}$	2500			V_{RMS}	t=1 minute
Isolation resistance MCT6X—	$R_{(I-O)}$	10^{11}	10^{12}		Ω	V_{I-O}=500 VDC
Breakdown voltage—channel-to-channel MCT6X			500		VDC	Relative humidity=40% f=1 MHz
Capacitance between channels			0.4		pF	

TYPICAL ELECTRO-OPTICAL CHARACTERISTIC CURVES

(25°C Free Air Temperature Unless Otherwise Specified)

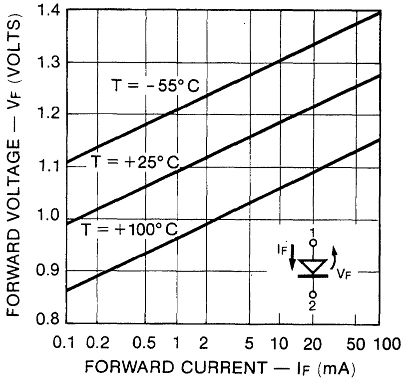


Fig. 1. Forward Voltage vs. Current

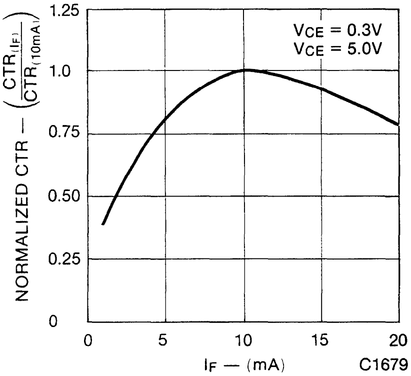


Fig. 2. Normalized CTR vs. Forward Current

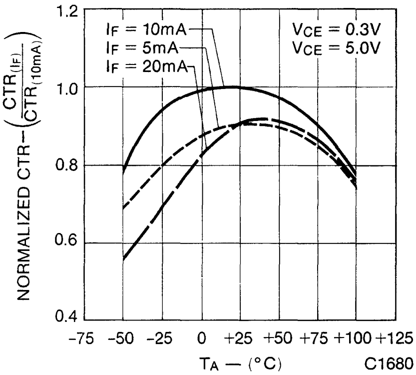


Fig. 3. Normalized CTR vs. Temperature

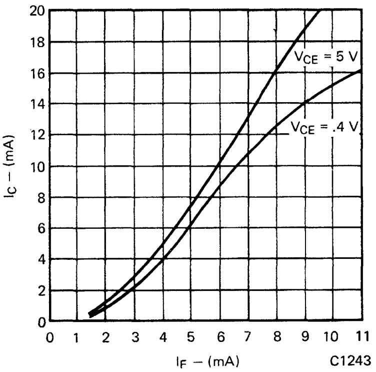


Fig. 4. Collector Current vs. Forward Current

TYPICAL ELECTRO-OPTICAL CHARACTERISTIC CURVES

(25°C Free Air Temperature Unless Otherwise Specified) (Cont'd)

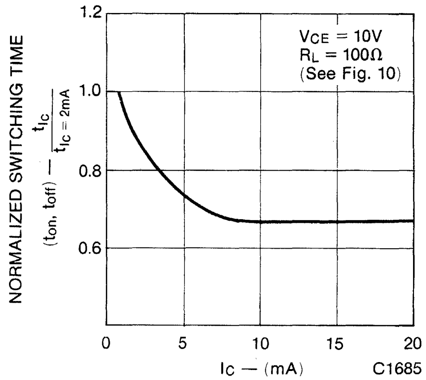


Fig. 5. Switching Time vs. IC

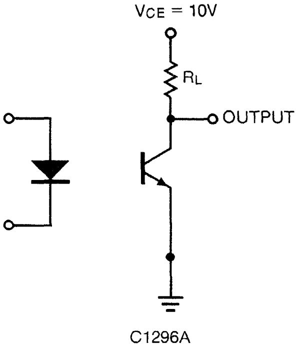


Fig. 6. Switching Time Test Circuit

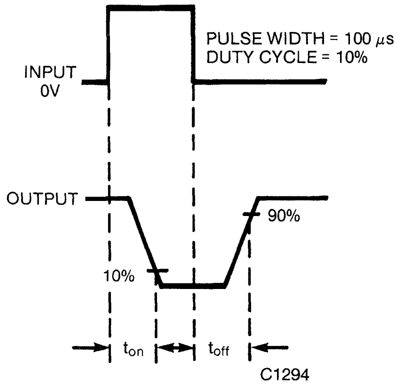


Fig. 7. Switching Time Waveforms

NOTES

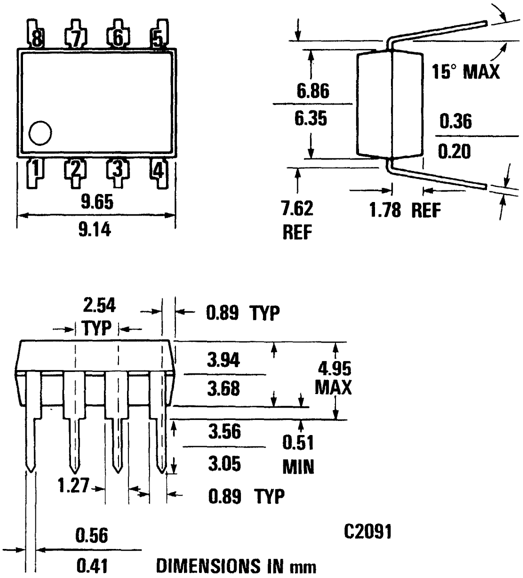
1. Normalized CTR degradation $= \frac{CTR_O\text{-}CTR}{CTR_O}$
2. The current transfer ratio (I_C/I_F) is the ratio of the detector collector current to the LED input current with V_{CE} at 10 volts.
3. The frequency at which i_C is 3 dB down from the 1 kHz value.
4. Rise time (t_r) is the time required for the collector current to increase from 10% of its final value to 90%.
   Fall time (t_f) is the time required for the collector current to decrease from 90% of its initial value to 10%.

QT OPTOELECTRONICS

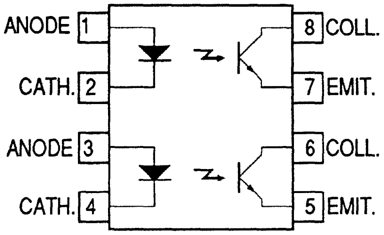
DUAL PHOTOTRANSISTOR OPTOCOUPLER

MCT9001

PACKAGE DIMENSIONS



DIMENSIONS IN mm
PACKAGE CODE G



DESCRIPTION

The MCT9001 is a two channel optocoupler in a standard, end stackable, 8 pin dual-in-line package. This part offers the same packing density as 4 pin optocouplers, while minimizing component count and insertion costs.

FEATURES

- Two isolated channels per package
- Two packages fit into a 16 lead DIP socket
- Underwriters Laboratory (UL) recognized File E50151

APPLICATIONS

- High voltage isolation
- Ground loop elimination
- Transient protection
- Common mode noise reduction
- AC line to logic interface
- Telephone line receiver
- Isolated feedback control
- Logic to power interface

ABSOLUTE MAXIMUM RATINGS

Storage temperature	−55°C to 150°C
Operating temperature	−55°C to 100°C
Lead temperature (soldering, 10 sec)	250°C

INPUT DIODE (each channel)

Forward current	60 mA
Reverse voltage	5.0 V
Peak forward current (1 μs pulse, 300 pps)	3 A

TOTAL INPUT

Power dissipation 25°C ambient	100 mW
Derate linearly from 25°C	1.1 mW/°C

OUTPUT TRANSISTOR (each channel)

Power dissipation at 25°C ambient	150 mW
Derate linearly from 25°C	1.67 mW/°C
Collector current	50 mA

COUPLED

Input to output breakdown voltage	2500V_{RMS}
Total package power dissipation at 25°C ambient	400 mW
Derate linearly from 25°C	4.83 mW/°C

DUAL PHOTOTRANSISTOR OPTOCOUPLER

TYPICAL ELECTRICAL CHARACTERISTIC CURVES

(25°C Free Air Temperature Unless Otherwise Specified)

INDIVIDUAL COMPONENT CHARACTERISTICS

CHARACTERISTICS	SYMBOL	MIN.	TYP.	MAX.	UNITS	TEST CONDITION
INPUT DIODE						
Forward voltage	V_F		1.0	1.3	V	I_F=10 mA
Junction capacitance	C_J		50		pF	V_F=0V; f=1MHz
Reverse leakage current	I_R			10	μA	V_R=5.0V
OUTPUT TRANSISTOR						
Breakdown voltage Collector to emitter	BV_{CEO}	55			V	I_C=0.5 mA; I_F=0
Emitter to collector	BV_{ECO}	7			V	I_E=100 μA
Leakage current Collector to emitter	I_{CEO}			100	nA	V_{CE}=24V; I_F=0
				50	μA	V_{CE}=24V; T_A=85°C
Capacitance Collector to emitter			8		pF	V_{CE}=0; f=1MHz

TRANSFER CHARACTERISTICS

DC CHARACTERISTICS	SYMBOL	MIN.	TYP.	MAX.	UNITS	TEST CONDITION
Current transfer ratio	CTR_{CE}	50		600	%	I_F=5 mA; V_{CE}=5 V
Saturated current	$CTR_{CE\ (SAT)}$	30			%	I_F=8 mA; V_{CE}=.4V
transfer ratio Saturation voltage	$V_{CE\ (SAT)}$			0.4	V	I_F=8 mA; I_C=2.4 mA

TRANSFER CHARACTERISTICS

CHARACTERISTICS	SYMBOL	MIN.	TYP.	MAX.	UNITS	TEST CONDITION
SWITCHING TIMES						
Non-saturated Rise time	t_r		2.4		μs	R_L=100Ω; I_C=2 mA;
Fall time	t_f		2.4		μs	V_{CE}=10 V
Turn on time	t_{on}		3.0		μs	R_L=100Ω; I_C=2 mA;
Turn off time	t_{off}		3.0		μs	V_{CE}=10 V
Saturated Turn on time	t_{on}		2.4		μs	I_F=16 mA; R_L=1.9KΩ
Turn off time	t_{off}		25.0		μs	V_{CE}=5 V

ISOLATION CHARACTERISTICS

CHARACTERISTICS	SYMBOL	MIN.	TYP.	MAX.	UNITS	TEST CONDITION
Surge isolation voltage	V_{ISO}	4000			VDC	Relative humidity ≤50%; $I_{I\text{-}O}$≤10μA
		3000			VAC-rms	1 second
Steady state isolation voltage	V_{ISO}	3500			VDC	Relative humidity ≤50%; $I_{I\text{-}O}$≤10μA
		2500			VAC-rms	1 minute
Isolation resistance	R_{ISO}	10^{11}			ohms	$V_{I\text{-}O}$=500 VDC
Isolation capacitance	C_{ISO}		0.5		pF	f=1MHz

TYPICAL ELECTRICAL CHARACTERISTIC CURVES

(25°C Free Air Temperature Unless Otherwise Specified)

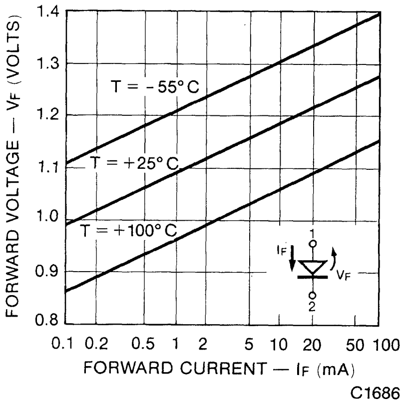


Fig. 1. Forward Voltage vs. Current

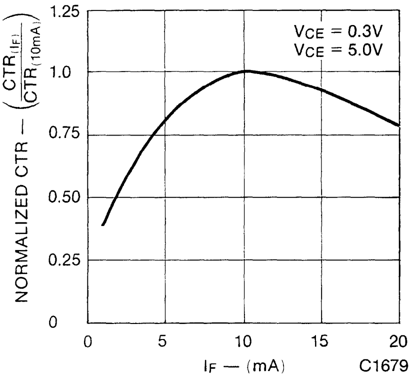


Fig. 2. Normalized CTR vs. Forward Current

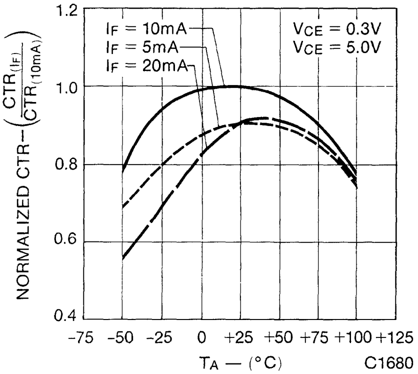


Fig. 3. Normalized CTR vs. Temperature

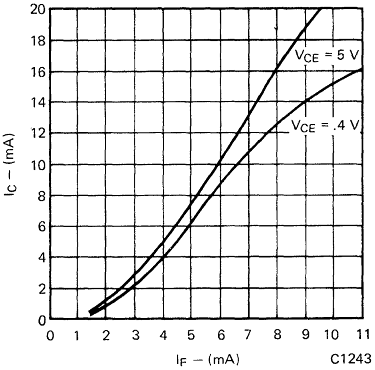


Fig. 4. Collector Current vs. Forward Current

TYPICAL ELECTRICAL CHARACTERISTIC CURVES

(25°C Free Air Temperature Unless Otherwise Specified) (Cont'd)

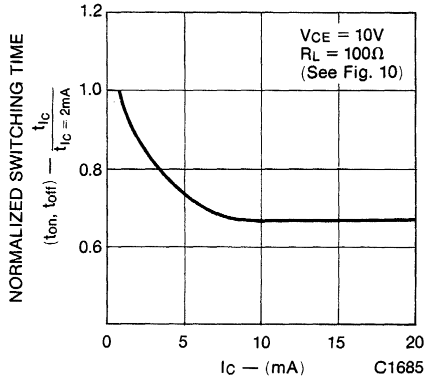


Fig. 5. Switching Time vs. IC

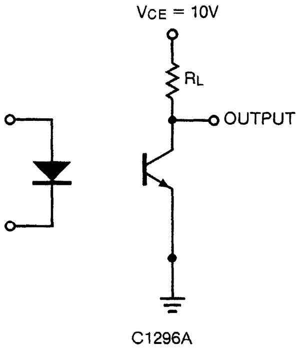


Fig. 6. Switching Time Test Circuit

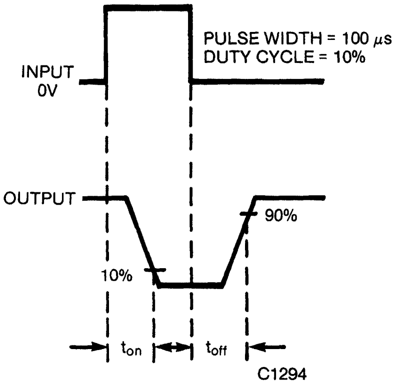


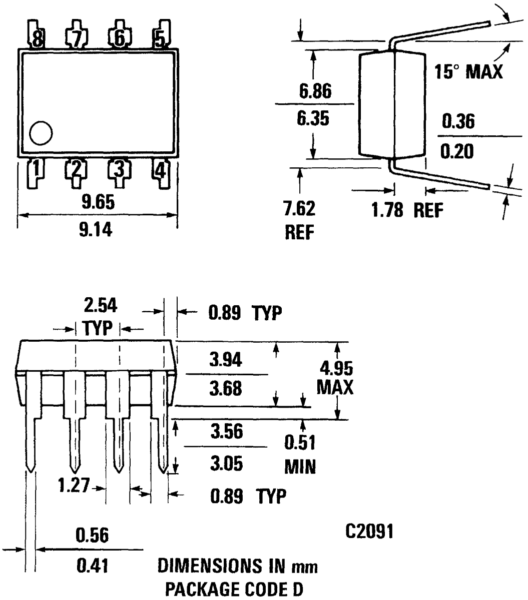
Fig. 7. Switching Time Waveforms

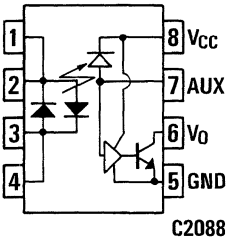
QT OPTOELECTRONICS

AC LINE MONITOR LOGIC-OUT DEVICE

MID400

PACKAGE DIMENSIONS





Equivalent Circuit

DESCRIPTION

The MID400 is an optically isolated AC line-to-logic interface device. It is packaged in an 8-lead plastic DIP. The AC line voltage is monitored by two back-to-back GaAs LED diodes in series with an external resistor. A high gain detector circuit senses the LED current and drives the output gate to a logic low condition.

The MID400 has been designed solely for use as an AC line **monitor**. It is recommended for use in any AC-to-DC control application where excellent optical isolation, solid state reliability, TTL compatibility, small size, low power, and low frequency operation are required.

FEATURES

- Direct operation from any line voltage with the use of an external resistor
- Externally adjustable time delay
- Externally adjustable AC voltage sensing level
- High voltage isolation between input and output
- Compact plastic DIP package
- Logic level compatibility
- UL recognized (File #E50151)

APPLICATIONS

- Monitoring of the AC/DC "line-down" condition
- "Closed-loop" interface between electromechanical elements such as solenoids, relay contacts, small motors, and microprocessors
- Time delay isolation switch

ABSOLUTE MAXIMUM RATINGS

INPUT—LED CIRCUIT

RMS current	25 mA
DC current	±30 mA
Power dissipation at 25°C ambient	45 mW
Derate linearly from 70°C	2.0 mW/°C

OUTPUT—DETECTOR CIRCUIT

Low level output current (I_{OL})	20 mA
High level output voltage (V_{OH})	7.0 V
Supply voltage (V_{CC})	7.0 V
Power dissipation at 25°C ambient	70 mW
Derate linearly from 70°C	2.0 mW/°C

TOTAL PACKAGE

Storage temperature	−55°C to +125°C
Operating temperature	−40°C to +85°C
Lead soldering temperature, 10 sec.	260°C
Power dissipation at 25°C ambient	115 mW
Derate linearly from 70°C	4.0 mW/°C
Surge isolation	3550 VDC 2500 V RMS
Steady state isolation	3200 VDC 2250 V RMS

AC LINE MONITOR LOGIC-OUT DEVICE

ELECTRICAL CHARACTERISTICS

(0°C to 70°C Free Air Temperature Unless Otherwise Specified—All Typical Values Are At 25°C)

INDIVIDUAL COMPONENT CHARACTERISTICS

PARAMETER	SYMBOL	MIN	TYP	MAX	UNITS	TEST CONDITIONS
INPUT						
LED Forward Voltage	V_F			1.5	V	$I_F=\pm30$ mA DC
DETECTOR						
Logic Low Output Supply Current	I_{CCL}			3.0	mA	$I_{IN}=4.0$ mA RMS $V_O=$Open, $V_{CC}=5.5$ V 24 V$\leq V_{I(ON)}$ RMS$\leq$240 V
Logic High Output Supply Current	I_{CCH}			0.80	mA	$I_{IN}=0.15$ mA RMS $V_{CC}=5.5$ V $V_{I(OFF)}$RMS$\geq$5.5 V

TRANSFER CHARACTERISTICS

DC CHARACTERISTICS	SYMBOL	MIN	TYP	MAX	UNITS	TEST CONDITIONS
Logic Low Output Voltage	V_{OL}		.18	0.40	V	$I_{IN}=I_{I(ON)}$RMS $I_O=16$ mA, $V_{CC}=4.5$ V 24 V$\leq V_{I(ON)}$RMS$\leq$240 V
Logic High Output Current	I_{OH}		.02	100	μA	$I_{IN}=0.15$ mA RMS $V_O=V_{CC}=5.5$ V $V_{I(OFF)}$RMS$\geq$5.5 V
On-state RMS Input Voltage	$V_{I(ON)}$RMS	90			V	$V_O=0.4$ V, $I_O=16$ mA $V_{CC}=4.5$ V, $R_{IN}=22$ KΩ
Off-state RMS Input Voltage	$V_{I(OFF)}$RMS			5.5	V	$V_O=V_{CC}=5.5$ V, $I_O\leq100\mu$A, $R_{IN}=22$ KΩ
On-state RMS Input Current	$I_{I(ON)}$RMS	4.0			mA	$V_O=0.4$ V, $I_O=16$ mA $V_{CC}=4.5$ V 24 V$\leq V_{I(ON)}$RMS$\leq$240 V
Off-state RMS Input Current	$I_{I(OFF)}$RMS			.15	mA	$V_O=V_{CC}=5.5$ V, $I_O\leq100\mu$A, $V_{I(OFF)}$RMS$\geq$5.5 V

TRANSFER CHARACTERISTICS

CHARACTERISTICS	SYMBOL	MIN	TYP	MAX	UNITS	TEST CONDITIONS
SWITCHING TIME ($T_A=+25$°C)						
Turn-On Time	t_{ON}		1.0		mS	$I_{IN}=4.0$ mA RMS $I_O=16$ mA, $V_{CC}=4.5$ V $R_{IN}=22$ KΩ (See Test Circuit 2)
Turn-Off Time	t_{OFF}		1.0		mS	I_{IN} 4.0 mA RMS $I_O=16$ mA, $V_{CC}=4.5$ V $R_{IN}=22$ KΩ (See Test Circuit 2)

ISOLATION CHARACTERISTICS ($T_A=+25$°C)

CHARACTERISTICS	SYMBOL	MIN	TYP	MAX	UNITS	TEST CONDITIONS
Surge Isolation Voltage	V_{ISO}	3550			VDC	Relative Humidity$\leq$50%, $I_{I\text{-}O}\leq10\mu$A
		2500			VACRMS	1 Second, 60 Hz
Steady State Isolation Voltage	V_{ISO}	3200			VDC	Relative Humidity$\leq$50%, $I_{I\text{-}O}\leq10\mu$A
		2250			VACRMS	1 Minute, 60 Hz
Isolation Resistance	R_{ISO}	10^{11}			Ω	$V_{I\text{-}O}=500$ VDC
Isolation Capacitance	C_{ISO}		2		pF	f=IMHZ

(RMS=True RMS Voltage at 60 Hz, THD≤1%.)

AC LINE MONITOR LOGIC-OUT DEVICE

DESCRIPTION/APPLICATIONS

The input of the MID400 consists of two back-to-back LED diodes which will accept and convert alternating currents into light energy. An integrated photo diode-detector amplifier forms the output network. Optical coupling between input and output provides 3550 V DC voltage isolation. A very high current transfer ratio, (defined as the ratio of the DC output current and the DC input current) is achieved through the use of a high gain amplifier. The detector amplifier circuitry operates from a 5 V DC supply and drives an open collector transistor output. The switching times are intentionally designed to be slow in order to enable the MID400, when used as an AC line monitor, to respond only to changes of input voltage exceeding many milliseconds. The short period of time during zero-crossing which occurs once every half cycle of the power line is completely ignored. To operate the MID400, always add a resistor, R_{IN}, in series with the input (as shown in test circuit 1) to limit the current to the required value. The value of the resistor can be determined by the following equation:

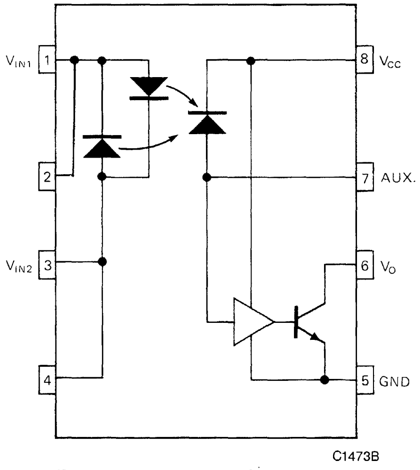
$$R_{IN} = \frac{V_{IN} - V_F}{I_{IN}}$$

Where V_{IN} (RMS) is the input voltage.
V_F is the forward voltage drop across the LED.
I_{IN} (RMS) is the desired input current required to sustain a logic "O" on the output.

PIN DESCRIPTION

DESIGNATION	PIN #	FUNCTION
V_{IN1}, V_{IN2}	1, 3	Input terminals.
V_{CC}	8	Supply voltage, output circuit.
AUX.	7	Auxiliary terminal. Programmable capacitor input to adjust AC voltage sensing level and time delay.
V_O	6	Output terminal; open collector.
GND	5	Circuit ground potential.

SCHEMATIC DIAGRAM



NOTE: DO NOT CONNECT PIN 2 AND 4

GLOSSARY

VOLTAGES

$V_{I(ON)}$ RMS	On-state RMS input voltage The RMS voltage at an input terminal for a specified input current with output conditions applied that according to the product specification will cause the output switching element to be sustained in the on-state within one full cycle.
$V_{I(OFF)}$ RMS	Off-state RMS input voltage The RMS voltage at an input terminal for a specified input current with output conditions applied that according to the product specification will cause the output switching element to be sustained in the off-state within one fill cycle.
V_{OL}	Low-level output voltage The voltage at an output terminal for a specific output current I_{OL} with input conditions applied that according to the product specification will establish a low-level at the output.
V_{OH}	High-level output voltage The voltage at an output terminal for a specified output current I_{OH} with input conditions applied that according to the product specification will establish a high-level at the output.
V_F	LED forward voltage The voltage developed across the LED when input current I_F is applied to the anode of the LED.

CURRENTS

$I_{I(ON)}$ RMS	On-state RMS input current The RMS current flowing into an input with output conditions applied that according to the product specification will cause the output switching element to be sustained in the on-state within one full cycle.
$I_{I(OFF)}$ RMS	Off-state RMS input current The RMS current flowing into an input with output conditions applied that according to the product specification will cause the output switching element to be sustained in the off-state within one full cycle.
I_{OH}	High-level output current The current flowing into * an output with input conditions applied that according to the product specification will establish a high-level at the output.
I_{OL}	Low-level output current The current flowing into * an output with input conditions applied that according to the product specification will establish a low-level at the output.
I_{CCL}	Supply current, output low The current flowing into * the V_{CC} supply terminal of a circuit when the output is at a low-level voltage.
I_{CCH}	Supply current, output high The current flowing into * the V_{CC} supply terminal of a circuit when the output is at a high-level voltage.

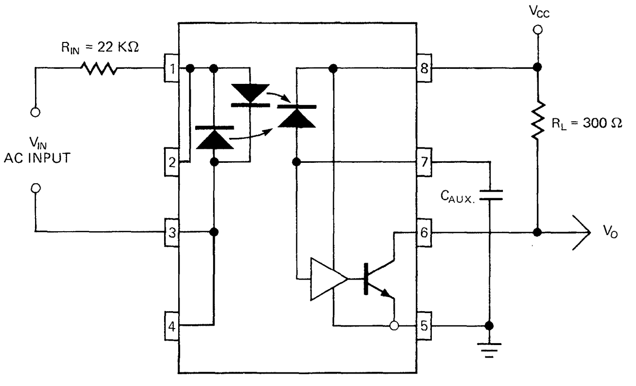
DYNAMIC CHARACTERISTICS

t_{ON}	Turn-on time The time between the specified reference points on the input and the output voltage waveforms with the output changing from the defined high-level to the defined low-level.
t_{OFF}	Turn-off time The time between the specified reference points on the input and output voltage waveforms with the output changing from the defined low-level to the defined high-level.

**Current flowing out of a terminal is a negative value.*

AC LINE MONITOR LOGIC-OUT DEVICE

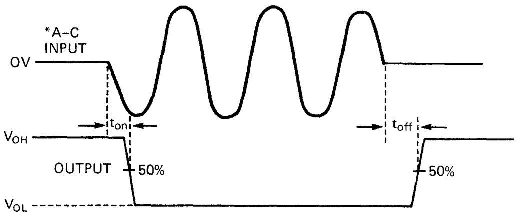
OPERATING SCHEMATICS



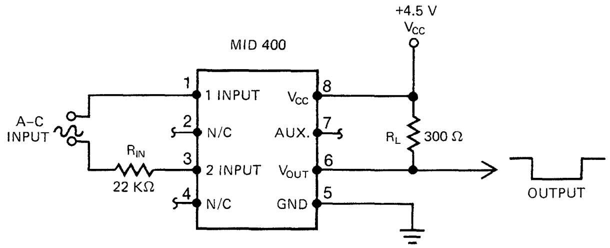
INPUT CURRENT VS. CAPACITANCE, $C_{AUX.}$ CIRCUIT

C1478A

Test Circuit 1



*INPUT TURNS ON AND OFF AT ZERO CROSSING.



TEST CIRCUIT

C1479B

Test Circuit 2
MID400 Switching Time

TYPICAL CURVES

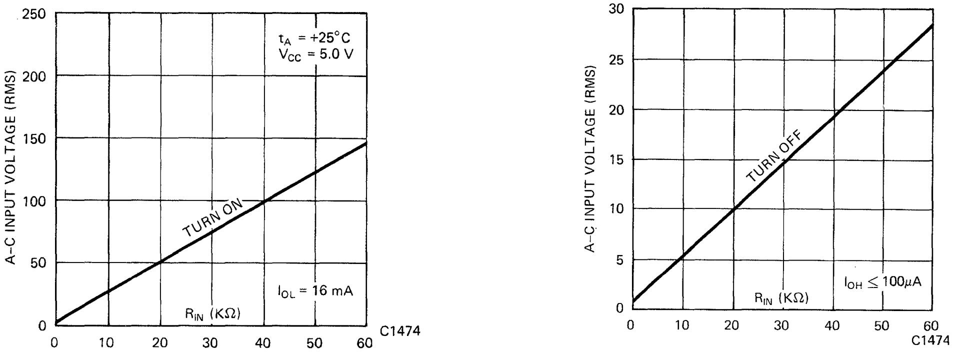


Fig. 2. Input Voltage vs. Input Resistance

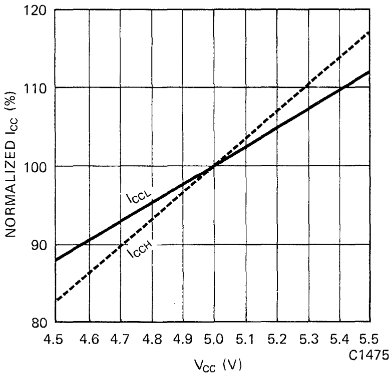


Fig. 3. Supply Current vs. Supply Voltage

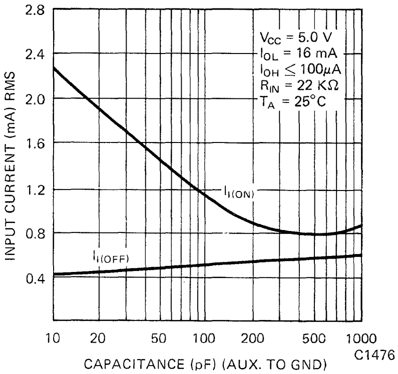


Fig. 4. Input Current vs. Capacitance
(See test circuit 1)

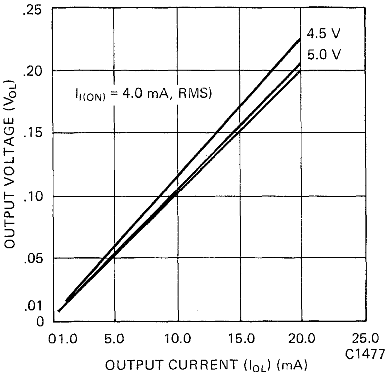
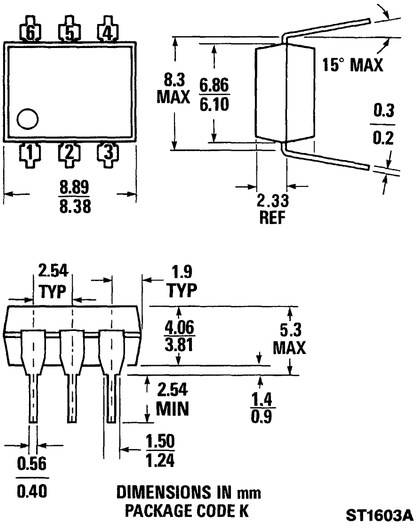


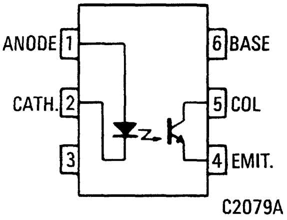
Fig. 5. Output Voltage vs.
Output Current

MOC8111
MOC8112
MOC8113

PACKAGE DIMENSIONS



DIMENSIONS IN mm
PACKAGE CODE K



Equivalent Circuit

DESCRIPTION

The MOC series consists of a Gallium Arsenide IRED coupled with an NPN phototransistor.

FEATURES

- High isolation voltage
  5300 VAC RMS—1 minute
  7500 VAC PEAK—1 minute
- High BV_{CEO} minimum 70 volts
- Current transfer ratio in selected groups:
  MOC8111: 20% min.
  MOC8112: 50% min.
  MOC8113: 100% min.
- Maximum switching time in saturation specified
- Underwriters Laboratory (UL) recognized File #E90700

APPLICATIONS

- Power supply regulators
- Digital logic inputs
- Microprocessor inputs
- Appliance sensor systems
- Industrial controls

ABSOLUTE MAXIMUM RATINGS

TOTAL PACKAGE

Storage temperature	−55°C to 150°C
Operating temperature	−55°C to 100°C
Lead temperature (soldering, 10 sec)	260°C
Total package power dissipation @ 25°C (LED plus detector)	260 mW
Derate linearly from 25°C	3.5 mW/°C

INPUT DIODE

Forward DC current	90 mA
Reverse voltage	6 V
Peak forward current (1 μs pulse, 300 pps)	3.0 A
Power dissipation 25°C ambient	135 mW
Derate linearly from 25°C	1.8 mW/°C

OUTPUT TRANSISTOR

Power dissipation @ 25°C	200 mW
Derate linearly from 25°C	2.67 mW/°C

ELECTRO-OPTICAL CHARACTERISTICS (25°C Temperature Unless Otherwise Specified)

INDIVIDUAL COMPONENT CHARACTERISTICS

CHARACTERISTIC	SYMBOL	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS
INPUT DIODE						
Forward voltage	V_F		1.3	1.50	V	I_F=60 mA
Forward voltage temp. coefficient	$\frac{\Delta V_F}{\Delta T_A}$		−1.8		mV/°C	
Reverse voltage	V_R	6.0	15		V	I_R=10 μA
Junction capacitance	C_J		50		pF	V_F=0 V, f=1 MHz
			65		pF	V_F=1 V, f=1 MHz
Reverse leakage current	I_R		.35	10	μA	V_R=3.0 V
OUTPUT TRANSISTOR						
Breakdown voltage Collector to emitter	BV_{CEO}	70			V	I_C=1.0 mA, I_F=0
Emitter to collector	BV_{ECO}	7			V	I_E=100μA, I_F=0
Leakage current Collector to emitter	I_{CEO}		5	50	nA	V_{CE}=10 V, I_F=0
Capacitance Collector to emitter			8		pF	V_{CE}=0, f=1 MHz

TRANSFER CHARACTERISTICS

DC CHARACTERISTICS	SYMBOL	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS
Current Transfer Ratio, collector to emitter	CTR				%	I_F=10 mA; V_{CE}=5 V
MOC8111		20				
MOC8112		50				
MOC8113		100				
Saturation voltage	$V_{CE(SAT)}$		0.27	.40	V	I_F=10 mA; I_C=2.5 mA

TRANSFER CHARACTERISTICS

AC CHARACTERISTICS	SYMBOL	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS
SWITCHING TIMES						
Non-saturated Turn-on time	t_{on}		6.0	10	μs	R_L=100 Ω; I_C=2 mA; V_{CC}=10 V
Turn-off time	t_{off}		5.5	10	μs	See Fig. 10.

ELECTRO-OPTICAL CHARACTERISTICS

(25°C Temperature Unless Otherwise Specified) (Cont'd)

TRANSFER CHARACTERISTICS (Cont'd)

AC CHARACTERISTICS	SYMBOL	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS
SATURATED SWITCHING TIMES						
Turn-on time	t_{on}					
MOC8111			3.0	5.5	μs	I_F=20 mA, V_{CE}=0.4 V
MOC8112, MOC8113			4.2	8.0	μs	I_F=10 mA, V_{CE}=0.4 V
Rise-time	t_r					
MOC8111			2.0	4.0	μs	I_F=20 mA, V_{CE}=0.4 V
MOC8112, MOC8113			3.0	6.0	μs	I_F=10 mA, V_{CE}=0.4 V
Turn-off time	t_{off}					
MOC8111			18	34	μs	I_F=20 mA, V_{CE}=0.4 V
MOC8112, MOC8113			23	39	μs	I_F=10 mA, V_{CE}=0.4 V
Fall-time	t_f					
MOC8111			11	20	μs	I_F=20 mA, V_{CE}=0.4 V
MOC8112, MOC8113			14	24	μs	I_F=10 mA, V_{CE}=0.4 V

ISOLATION CHARACTERISTICS

CHARACTERISTICS	SYMBOL	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS
Isolation voltage	V_{iso}	5300			V_{AC} RMS	$I_{I-O} \leq 1$ μA, 1 minute
	V_{iso}	7500			V_{AC} PEAK	$I_{I-O} \leq 1$ μA, 1 minute
Isolation resistance	R_{iso}	10^{11}			ohms	V_{I-O}=500 VDC
Isolation capacitance	C_{iso}		0.5		pF	f=1 MHz

ELECTRICAL CHARACTERISTIC CURVES

(25°C Free Air Temperature Unless Otherwise Specified)

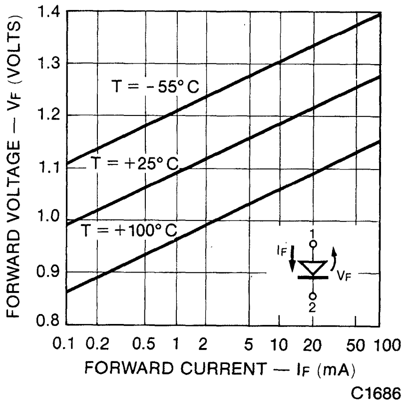


Fig. 1. Forward Voltage vs. Current

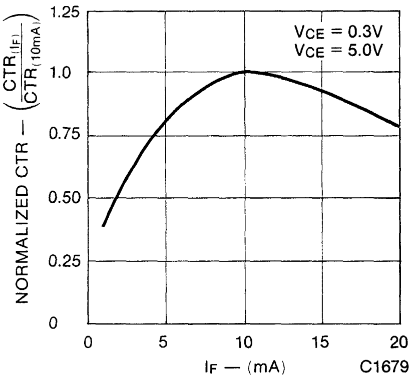


Fig. 2. Normalized CTR vs. Forward Current

ELECTRICAL CHARACTERISTIC CURVES

(25°C Free Air Temperature Unless Otherwise Specified) (Cont'd)

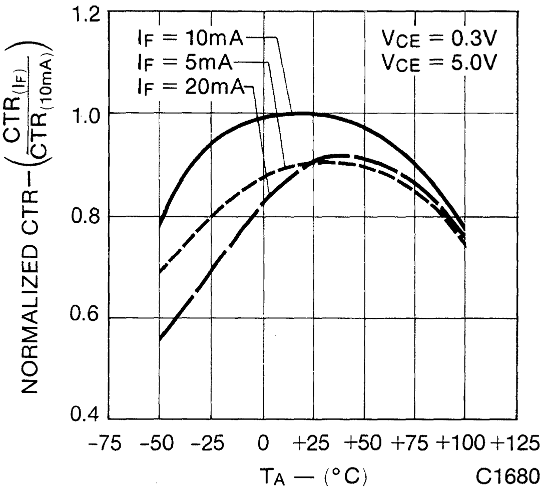


Fig. 3. Normalized CTR vs. Temperature

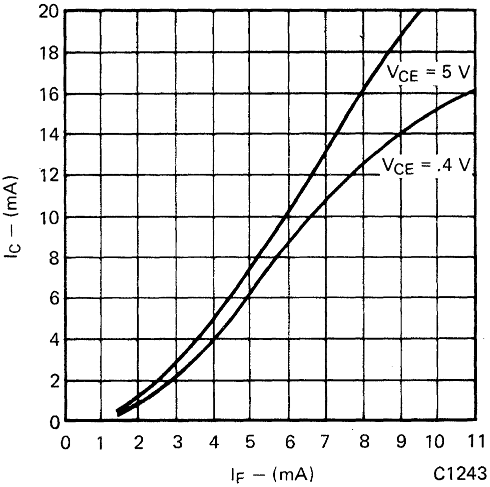


Fig. 4. Collector Current vs. Forward Current

ELECTRICAL CHARACTERISTIC CURVES

(25°C Free Air Temperature Unless Otherwise Specified) (Cont'd)

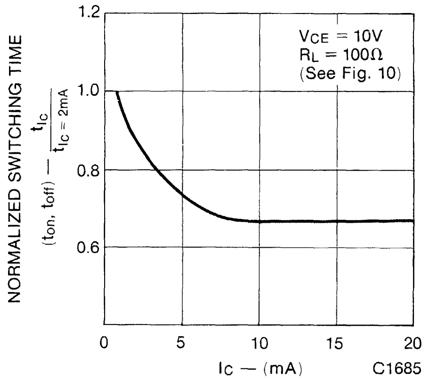


Fig. 5. Switching Time vs. IC

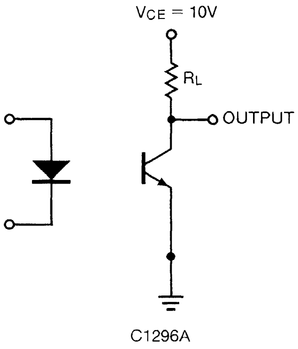


Fig. 6. Switching Time Test Circuit

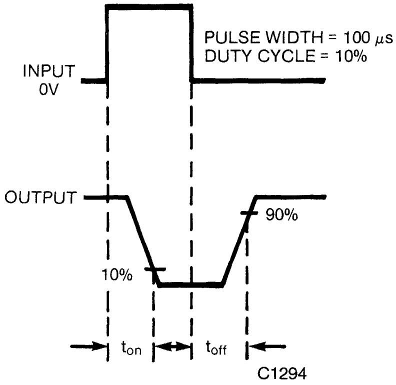
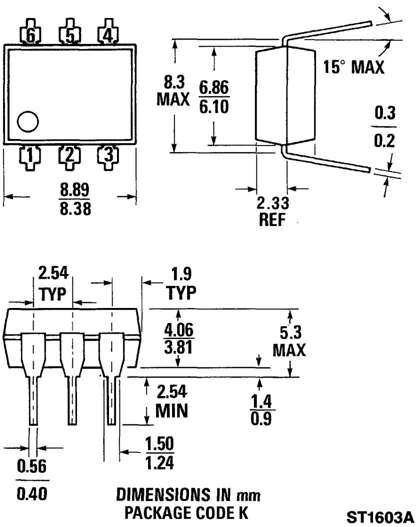


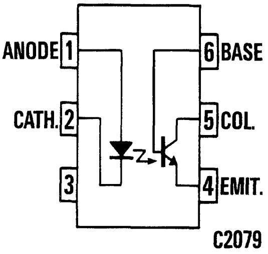
Fig. 7. Switching Time Waveforms

PHOTOTRANSISTOR OPTOISOLATOR

TIL111

PACKAGE DIMENSIONS





DESCRIPTION

The TIL111 is a phototransistor-type optically coupled isolator. An infrared emitting diode manufactured from specially grown gallium arsenide is selectively coupled with an NPN silicon phototransistor. The device is supplied in a standard plastic six-pin dual-in-line package.

FEATURES

- Underwriters Laboratory (UL) recognized File #E90700

APPLICATIONS

- Power supply regulators
- Digital logic inputs
- Microprocessor inputs
- Appliance sensor systems
- Industrial controls

ABSOLUTE MAXIMUM RATINGS (T_A=25°C Unless Otherwise Specified)

TOTAL PACKAGE

Storage temperature	−55°C to 150°C
Operating temperature	−55°C to 100°C
Lead temperature (soldering, 10 sec)	260°C
Total package power dissipation at 25°C (LED plus detector)	260 mW
Derate linearly from 25°C	3.3 mW/°C

INPUT DIODE

Forward DC current	100 mA
Reverse voltage	3 V
Peak forward current (1 μs pulse, 300 pps)	3.0 A
Power dissipation 25°C ambient	150 mW
Derate linearly from 25°C	2 mW/°C

OUTPUT TRANSISTOR

Power dissipation at 25°C	150 mW
Derate linearly from 25°C	2 mW/°C
V_{CEO}	30 V
V_{CBO}	70 V
V_{ECO}	7 V
Collector current (continuous)	100 mA

PHOTOTRANSISTOR OPTOISOLATOR

ELECTRICAL CHARACTERISTICS (At 25°C Free-Air Temperature)

INDIVIDUAL COMPONENT CHARACTERISTICS

PARAMETER	SYMBOL	TIL111			UNIT	TEST CONDITIONS
		MIN.	TYP.	MAX.		
INPUT DIODE						
Input diode static reverse current	I_R			10	μA	V_R=3 V
Input diode static forward voltage	V_F		1.2	1.4	V	I_F=16 mA
OUTPUT TRANSISTOR						
Collector-base breakdown voltage	$V_{(BR)CBO}$	70			V	I_C=10 μA, I_E=0, I_F=0
Collector-emitter breakdown voltage	$V_{(BR)CEO}$	30			V	I_C=1 mA, I_B=0, I_F=0
Emitter-base breakdown voltage	$V_{(BR)EBO}$	7			V	I_E=10 μA, I_C=0, I_F=0
Transistor static forward current transfer ratio	h_{FE}	100	300			V_{CE}=5 V, I_C=10 mA, I_F=0

TRANSFER CHARACTERISTICS

PARAMETER		SYMBOL	TIL111			UNIT	TEST CONDITIONS
			MIN.	TYP.	MAX.		
On-state collector current	Phototransistor operation	$I_{C(on)}$	2	7		mA	V_{CE}=0.4 V, I_F=16 mA, I_B=0
	Photodiode operation	$I_{C(on)}$	7	20		μA	V_{CB}=0.4 V, I_F=16 mA, I_E=0
Off-state collector current	Phototransistor operation	$I_{C(off)}$		1	50	nA	V_{CE}=10 V, I_F=0, I_B=0
	Photodiode operation	$I_{C(off)}$		0.1	20		V_{CB}=10 V, I_F=0, I_E=0
Collector-emitter saturation voltage		$V_{CE(sat)}$		0.25	0.4	V	I_C=2 mA, I_F=16 mA, I_B=0

SWITCHING CHARACTERISTICS (At 25°C Free-Air Temperature)

PARAMETER		SYMBOL	TIL111			UNIT	TEST CONDITIONS
			MIN.	TYP.	MAX.		
Rise time	Phototransistor operation	t_r		5	10	μs	V_{CC}=10 V, $I_{C(on)}$=2 mA, R_L - 100 Ω
Fall time		t_f					
Rise time	Photodiode operation	t_r		1		μs	V_{CC}=10 V, $I_{C(on)}$=20 μA, R_L - 1 kΩ
Fall time		t_f					

ISOLATION CHARACTERISTICS

PARAMETER	SYMBOL	TIL111			UNIT	TEST CONDITIONS
		MIN.	TYP.	MAX.		
Input-to-output internal resistance	r_{IO}	10^{11}			Ω	V_{ISO}=±1.5 kV
Input-to-output capacitance	C_{IO}		1	1.3	pF	$V_{in\text{-}out}$=0, f=1 MHz, See Note 6
Isolation voltage	V_{iso}	7500 5300			VAC-PEAK VAC-RMS	$I_{I\text{-}O}$≤1 μA, 1 minute $I_{I\text{-}O}$≤1 μA, 1 minute

PHOTOTRANSISTOR OPTOISOLATOR

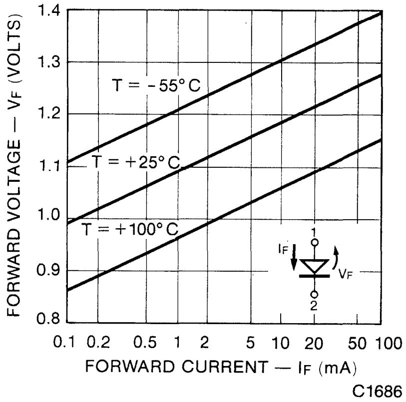


Fig. 1. Forward Voltage vs. Current

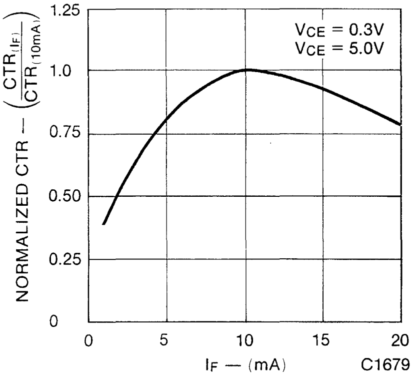


Fig. 2. Normalized CTR vs. Forward Current

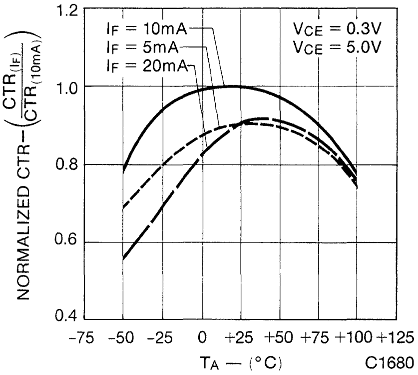


Fig. 3. Normalized CTR vs. Temperature

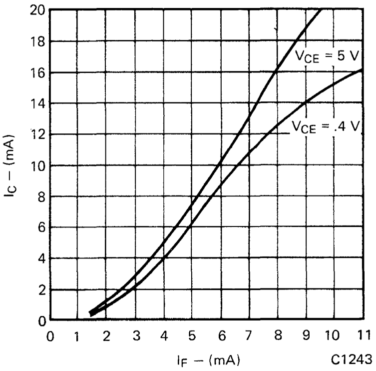


Fig. 4. Collector Current vs. Forward Current

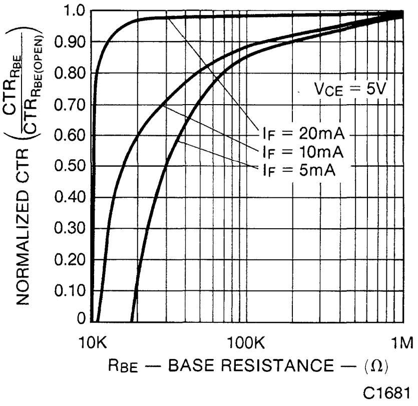


Fig. 5. CTR vs. RBE (Unsaturated)

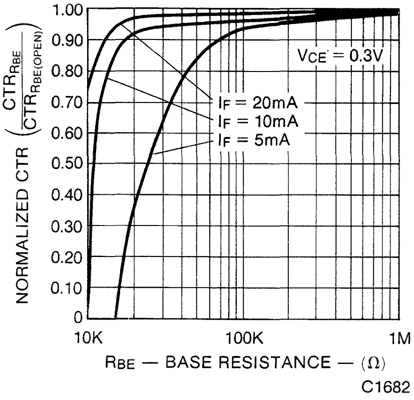


Fig. 6. CTR vs. RBE (Saturated)

PHOTOTRANSISTOR OPTOISOLATOR

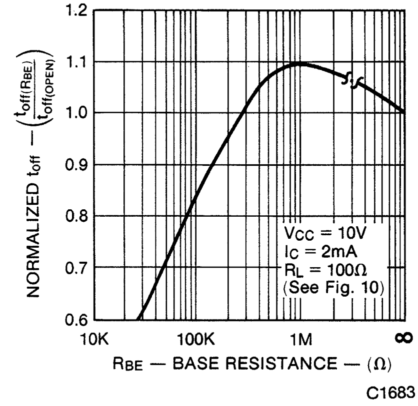


Fig. 7. Normalized T_{OFF} vs. RBE

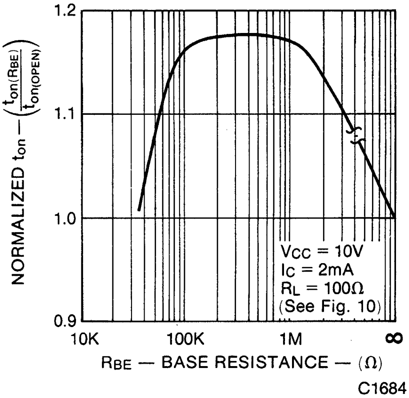


Fig. 8. Normalized T_{ON} vs. RBE

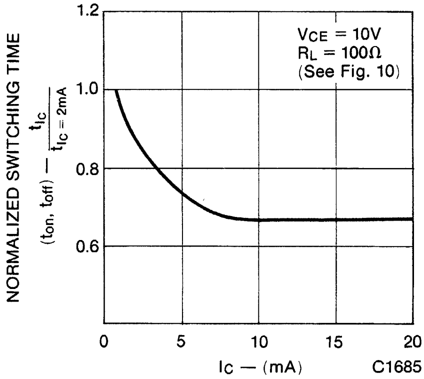


Fig. 9. Switching Time vs. IC

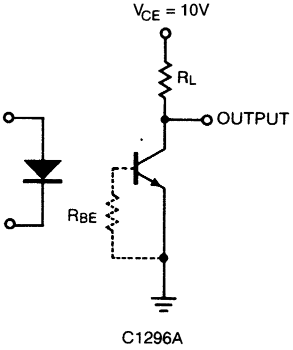


Fig. 10. Switching Time Test Circuit

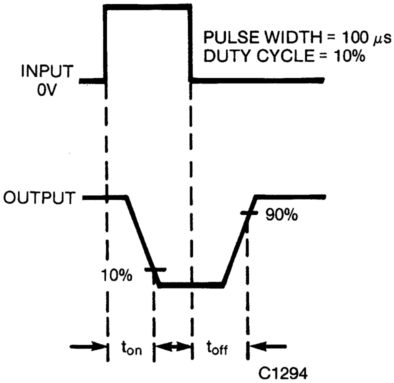


Fig. 11. Switching Time Waveforms

OPTOCOUPLER INPUT DRIVE CIRCUITS
CNY17 SERIES

AN1071

An optocoupler is a combination of a light source and a photo-sensitive detector. In the optocoupler, or photon coupled pair, the coupling is achieved by light being generated on one side of a transparent insulating gap and being detected on the other side of the gap without an electrical connection between the two sides (except for a minor amount of coupling capacitance). In the Quality Technologies optocouplers, the light is generated by an infrared light emitting diode, and the photo-detector is a silicon diode, transistor, or SCR. The sensitivity of the silicon material peaks at the wavelength emitted by the LED, giving maximum signal coupling.

Since the input to all the optocouplers is a LED, the input characteristics will be the same, independent of the type of detector employed. The LED diode characteristics are shown in Figure 1. The forward bias current threshold is shown at approximately 1 volt, and the current increases exponentially, the useful range of I_F between 1 mA and 100 mA being delivered at a V_F between 1.2 and 1.3 volts. The dynamic values of the forward bias impedance are current dependent and are shown on the insert graph for R_{DF} and ΔR as defined in the figure. Reverse leakage is in the nanoampere range before avalanche breakdown.

The LED equivalent circuit is represented in Figure 2, along with typical values of the components. The diode equations are provided if needed for computer modeling and the constants of the equations are given for the IR LED's. Note that the junction capacitance is large and increases with applied forward voltage. An actual plot of this capacitance variation with applied voltage is shown on the graph of Figure 3. It is this large capacitance controlled by the driver impedance which influences the pulse response of the LED. The capacitance must be charged before there is junction current to create light emission. This effect causes an inherent delay of 10-20 nanoseconds or more between applied current and light emission in fast pulse conditions.

The LED is used in the forward biased mode. Since the current increases very rapidly above threshold, the device should always be driven in a current mode, not voltage driven. The simplest method of achieving the current drive is to provide a series current-limiting resistor, as shown in Figure 4, such that the difference between V_F and V_{APP} is dropped across the resistor at the desired I_F, determined from other criteria. A silicon diode is shown installed inversely parallel to the LED. This diode is used to protect the reverse breakdown of the LED and is the simplest method of achieving this protection. The LED must be protected from excessive power dissipation in the reverse avalanche region. A small amount of reverse current will not harm the LED, but it must be guarded against unexpected current surges.

The forward voltage of the LED has a negative temperature coefficient of 1.05 mW/°C and the variation is shown in Figure 5.

The brightness of the IR LED showly decreases in an exponential fashion as a function of forward current (I_F) and time. The amount of light degradation is graphed in Figure 6 which is based on experimental data out to 20,000 hours. A 50% degradation is considered to be the failure point. This degradation must be considered in the initial design of optoisolator circuits to allow for the decrease and still remain within design specifications on the current-transfer-ratio (CTR) over the design lifetime of the equipment. Also, a limitation on I_F drive is shown to extend useful lifetime of the device.

In some circumstances it is desirable to have a definite threshold for the LED above the normal 1.1 volts of the diode V_F. This threshold adjustment can be obtained by shunting the LED by a resistor, the value of which is determined by a ratio between the applied voltage, the series resistor, and the desired threshold. The circuit of Figure 7 shows the relationship between these values. The calculations will determine the resistor values required for a given I_{FT} and V_A. It is also quite proper to connect several LED's in series to share the same I_F. The V_F of the series is the sum of the individual V_F's. Zener diodes may also be used in series.

Where the input applied voltage is reversible or alternating and it is desired to detect the phase or polarity of the input, the bipolar input circuit of Figure 8 can be employed. The individual optocouplers could control different functions or be paralleled to become polarity independent. Note that in this connection, the LED's protect each other in reverse bias.

OPTOCOUPLER INPUT DRIVE CIRCUITS
CNY17 SERIES

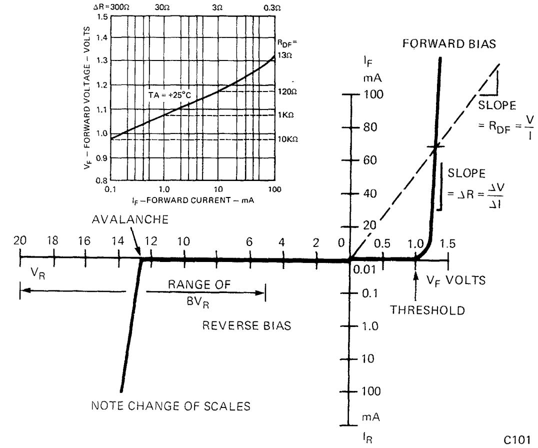
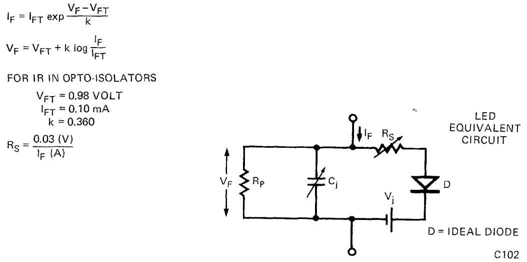


Fig. 1. Characteristics of IR LED



V_F	−5	0	–	–	–	V
I_F	–	–	1	10	100	mA
C_I	55	100	300	500	–	pF
V_I		1.0	1.1	1.2	1.3	V
I_R	<10	0	–	–	–	nA
R_S		∞	30	3	0.3	Ω
R_P	$>10^9$	–	–	–	–	Ω

$$I_F = I_{FT} \exp \frac{V_F - V_{FT}}{k}$$

$$V_F = V_{FT} + k \log \frac{I_F}{I_{FT}}$$

FOR IR IN OPTO-ISOLATORS

$V_{FT} = 0.98$ VOLT
$I_{FT} = 0.10$ mA
$k = 0.360$

$$R_S = \frac{0.03\ (V)}{I_F\ (A)}$$

Fig. 2. Equivalent Circuit Equations

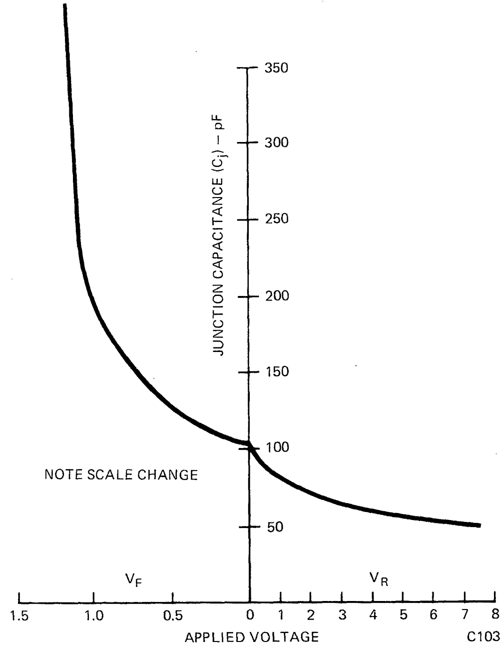


Fig. 3. Voltage Dependence of Junction Capacitance

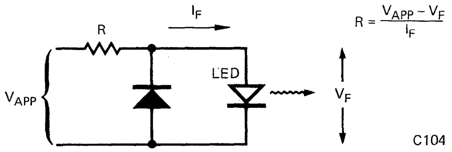


Fig. 4. Typical LED Drive Circuit

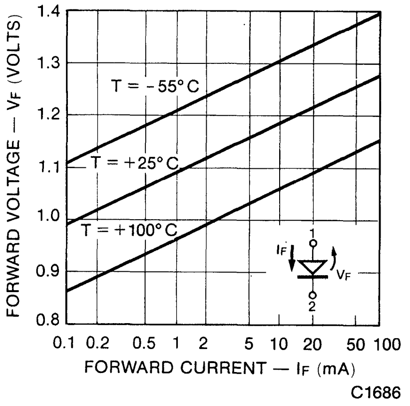


Fig. 5. IR Forward Voltage vs. Forward Current and Temperature

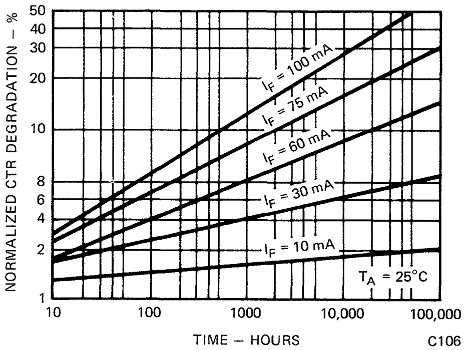


Fig. 6. Brightness Degradation vs. Forward Current and Time

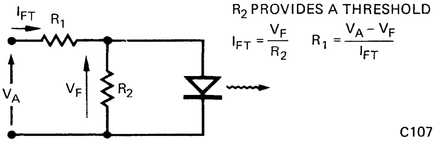


Fig. 7. LED Threshold Adjustment

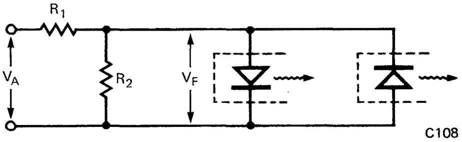


Fig. 8. Bipolar Input Selects LED

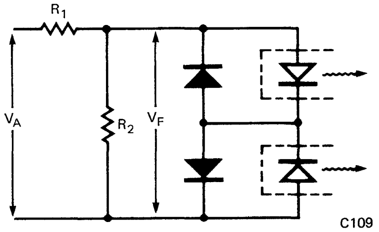


Fig. 9. High Threshold Bipolar Input

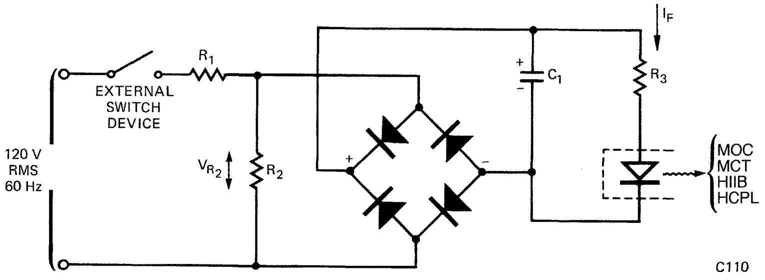


Fig. 10. AC Input to LED Drive Circuit

Another method of obtaining a high threshold for high level noise immunity is shown in Figure 9, where the LED's are in inverse series with inverse parallel diodes to conduct the opposite polarity currents. In this circuit the V_F is the total forward drop of the LED and silicon diode in series. The resistors serve their normal threshold and current limiting functions. The silicon diodes could be replaced by LED's from other optocouplers or visible signal indicators.

In some situations it may be necessary to drive the LED from a 120 VRMS, 60 Hz or 400 Hz source. Since the LED responds in nanoseconds, it will follow the AC excursions faithfully, turning on and off at each zero-crossing of the input. If a constant output is desired from the optocoupler detector, as in AC to logic coupling, it is necessary to rectify and filter the input to the LED. The circuit of Figure 10 illustrates a simple filtering scheme to deliver a DC current to the LED. In some cases the filter could be designed into the detector side of the optocoupler, allowing the LED to pulse at line frequency. In the circuit of Figure 10, the value of C_1 is selected to reduce the variations in the I_F between half cycles below the current that is detectable by the detector portion. This condition usually means that the detector is functioning in saturation, so that minor variations of I_F will not be sensed. The values of R_1, R_2 and R_3 are adjusted to optimize the filtering function, R_3C_1 time constant, etc. Speed of turn-off may be a determining factor. More complicated transistor filtering may be required, such as that shown in Figure 11, where a definite time delay, rise time and fall time can be designed in. In this circuit, C_1 and R_3 serve the same basic function as in Figure 10. The transistor provides a high impedance load to the R_4C_2 filter network, which, once reaching the V_F value, suddenly turns on the LED and pulls the transistor quickly into saturation. The turn-off transient consists of the discharge of C_1 through R_3 and the LED.

In logic-to-logic coupling using the optocoupler, a simple transistor drive circuit can be used as shown in Figure 12. In the normally-off situation, the LED is energized only when the transistor is in saturation. The design equations are given for calculating the value of the series current limiting resistor. With the transistor off, only minor collector leakage current will flow through the LED. If this small leakage is detectable in the optocoupler detector, the leakage can be bypassed around the LED by the addition of another resistor in parallel with the LED shown as R_1. The value of R_1 can be large, calculated so that the leakage current develops less than threshold V_F (~0.8 volt) from Figure 5. The drive transistor can be the normal output current sink of a TTL or DTL integrated circuit, which will sink 16 mA at 0.2 volt nominal and up to 50 mA in saturation.

If the logic is not capable of sinking the necessary I_F, an auxiliary drive transistor can be employed to boost current capability. The circuit of Figure 13 shows how a PNP transistor is connected as an emitter follower, or common collector, to obtain current gain. When the output of the gate (G_1) is low, Q_1 is turned on and current flows through the LED. The calculation of R_1 must now include the base-emitter forward biased voltage drop, V_{BE}, as shown in the figure.

In the normally on situation of Figure 14, the transistor is required to shunt the I_F around the LED, with a V_{SAT} of less than threshold V_F. Typical switching transistors

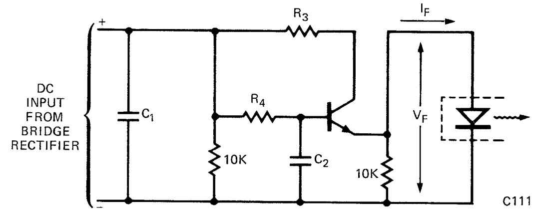
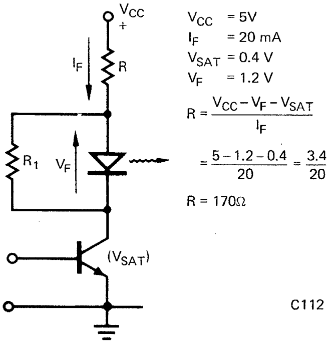


Fig. 11. R-C-Transistor Filter Circuit



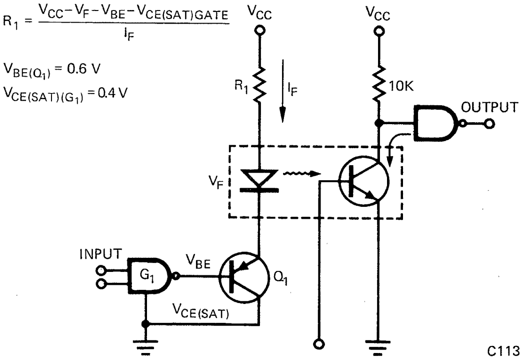
$V_{CC} = 5V$
$I_F = 20\ mA$
$V_{SAT} = 0.4\ V$
$V_F = 1.2\ V$

$$R = \frac{V_{CC} - V_F - V_{SAT}}{I_F}$$

$$= \frac{5 - 1.2 - 0.4}{20} = \frac{3.4}{20}$$

$R = 170\Omega$

Fig. 12. Transistor Drive, Normally Off



$$R_1 = \frac{V_{CC} - V_F - V_{BE} - V_{CE(SAT)GATE}}{I_F}$$

$V_{BE(Q_1)} = 0.6\ V$
$V_{CE(SAT)(G_1)} = 0.4\ V$

Fig. 13. Logic to LED Series Booster

have saturation voltages less than 0.4 volts at I_C=20 mA or less. The value of the series resistor is determined to provide the required I_F with the transistor off.

Again, if the logic cannot sink the I_F, a booster transistor can be employed as shown in Figure 15. With the output of the gate low the transistor Q_1 will be on, and the sum of V_{CE} (SAT) of G_1 and V_{BE} of Q_1 will be less than the threshold V_F of the LED. With the gate high, Q_1 is not conducting and the LED is. The value of R_1 is calculated normally, but shunt current will be greater than I_F. The normally-on or normally-off conditions are selected depending on the required function of the detector portion of the optocoupler and fail-safe operation of the circuits.

In many applications it is found necessary to pulse drive the LED to values beyond the DC ratings of the device. In these situations a "pulse" is defined as an on-off transient occurring and ending before thermal equilibrium is established between the LED, the lead frame, and the ambient. This equilibrium will normally occur within one millisecond. For a pulse width in the microsecond range, the I_F can be driven above the DC ratings, if the duty cycle is low. The chart of Figure 16 shows the relationship between the amount of overdrive, duty cycle, and pulse width. The overdrive is normalized to the I_{DC} value listed as maximum on the device data sheet. Average power dissipation is the limiting parameter at high duty cycles and short pulse widths. For longer pulse widths, the equilibrium temperature occurs at lower duty cycle values, and peak power is the limiting parameter.

For duty cycles of 1% or less the pulse becomes similar to a non-recurrent surge allowing additional ratings such as the I^2t used in rectifier diodes. Average current is used for lifetime calculation. The pulse response of the detector must be considered in choosing drive conditions.

There are situations where it is not desirable to pass all of the input current through the LED. One method to achieve this is to provide a bypass resistor as suggested in Figure 7 for threshold adjustment. This method is satisfactory where the input current is switched on and off completely, but, if the information on the current is only a small variation riding on a constant DC level, the bypass resistor also bypasses a large portion of the desired signal around the LED. Two methods can be used to retrieve the signal with little

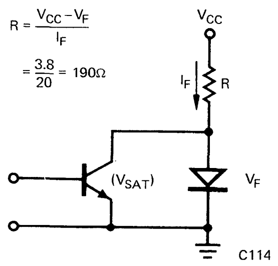


Fig. 14. Transistor Drive, Normally On

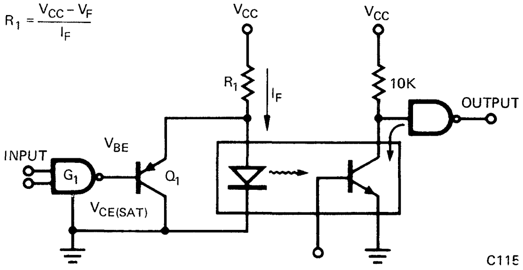


Fig. 15. Logic to LED Shunt Booster

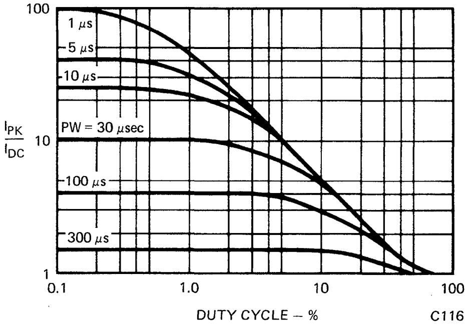


Fig. 16. Maximum Peak I_F Pulse Normalized to Max I_{DC} for Pulse Width (PW) and Duty Cycle (%)

attenuation. If the signal has a rapid variation (e.g., the audio signal on a telephone line), the DC component can be cancelled in the detector by feedback circuits. If the variation is slow, a dynamic shunt can be used instead of the fixed resistor. If a constant-current device or circuit is used in parallel with the LED, as shown in Figure 17, the adjusted component of the DC will flow through the dynamic inpedance, and any current variations will result in a change of terminal voltage. Therefore, the total current change will flow through the paralleled LED circuit. The graph of Figure 18 shows the performance of this particular circuit adjusted to center on I_L=120 mA and a circuit node voltage of 3.4 volts. In the circuit shown the detector portions of the CNY17-1 and CNY17-4 were employed for convenience. Note that in Figure 18 most of the current variation occurs as I_F. The ratio between the DC resistance (R_D) and dynamic impedance (Rd) for the shunt is 50, which represents the signal transfer gain achieved over a fixed resistor.

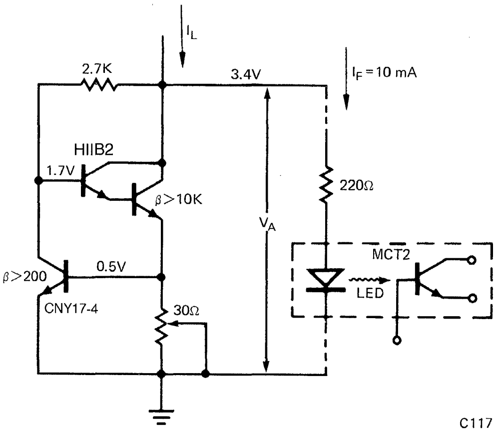


Fig. 17. Constant-Current Shunt Impedance

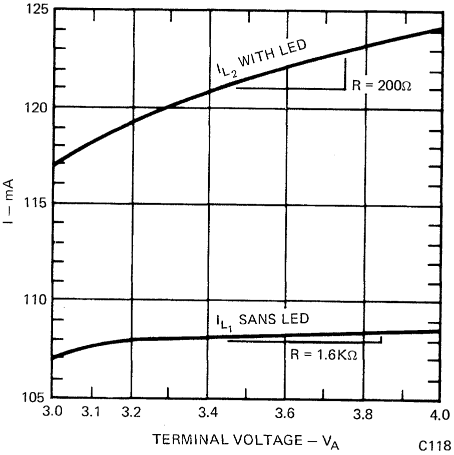


Fig. 18. Shunt Impedance Performance

OPTOELECTRONICS

LOW CURRENT INPUT CIRCUIT IDEAS
6N139/138 SERIES

AN1074

Introduction

Advancements in opto-coupling and LED technology have given us the 6N139. This unique optocoupler, having an input LED current specification at 500 microamperes, has opened some interesting design doors. Besides the obvious and much written about ability to be directly driven by CMOS circuits, the 6N139 can be considered for signal detection, transient detection, matrices and non-loading line receiving. Following are but a few circuit ideas to stimulate the designer's interest.

Signal Detection

The detection of noise, spikes or oscillations can easily and directly be detected by the input of the 6N139 as shown in the circuit of Figure 1.

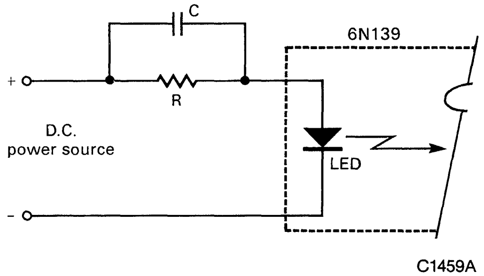


Fig. 1. 6N139 Input Circuit For Signal Detection

For the detection of undesirable signals on a D.C. power source use:

$$R=\frac{\text{Power supply voltage}-1.5\text{ volts}}{50\text{ microamperes}}$$

C=To effect 500 microamperes into LED

X=Latching or non-latching output circuitry to follow

LED=Input diode of 6N139

The LED is provided with a 50 microampere forward current to charge the LED capacity to the V_F level. In this way, the LED is not causing conduction in its output circuitry but is prepared to conduct very quickly. Any noise or oscillation on the "D.C. power source" is coupled through "C" which develops a signal across the LED. Even small unwanted signals can cause a large change in the LED forward current. Once the LED's forward current equals or exceeds 500 microamperes, the output circuitry will conduct indicating the presence of the unwanted signal.

Transient Detection

The detection of the presence or absence of waveforms can easily be detected by the circuit in Figure 2.

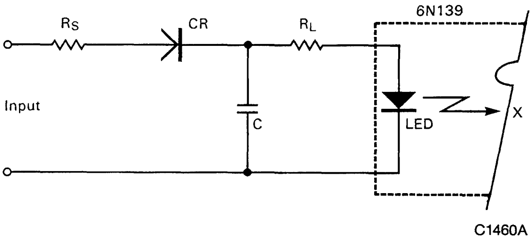


Fig. 2. Pulse or Waveform Detection Circuit

For the detection of the presence of a desired signal, pulse or waveform use:

CR=Silicon diode

$$R_L=\frac{(\text{Positive Vpk. of input})-2.5\text{ volts}}{1\text{ milliampere}}$$

$$C\text{min}=\frac{\text{Pulse interval of }1/_F}{R_L}$$

$$R_S\text{max}=\frac{\text{Pulse width or }1/4F}{5C}$$

X=Non-latching output circuitry to follow

LED=Input diode of 6N139

Examples:
A desired pulse train to be present is shown in Figure 3.

LOW CURRENT INPUT CIRCUIT IDEAS
6N139/138 SERIES

The resulting LED forward current that will keep the output circuitry conducting is shown as the result of proper design.

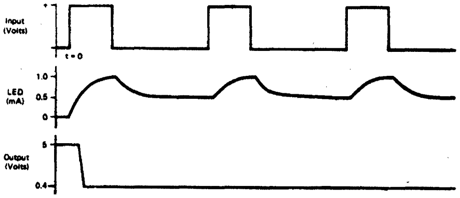


Fig. 3. Pulse Train Waveforms

A desired sine wave to be present is shown in Figure 4. The resulting LED forward current that will keep the output circuitry conducting is shown as the result of proper design.

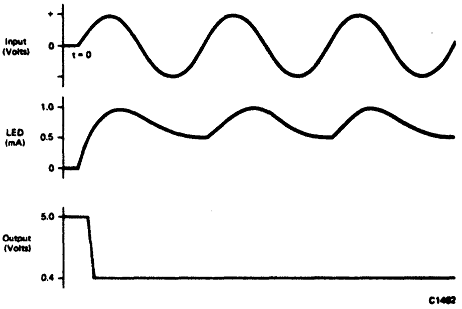


Fig. 4. Sine Wave Waveforms

Matrices Opto-Coupling

With the low input LED current advantage of the 6N139, the ability to drive matrices with but one TTL output is now possible as shown in Figure 5.

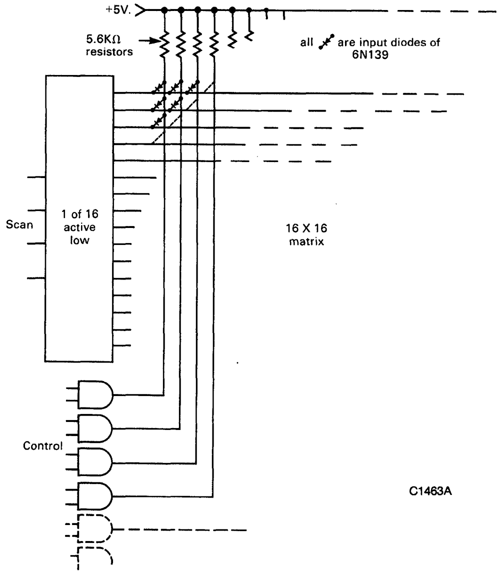


Fig. 5. Opto-Coupling out of Matrices

Non-Loading Line Receiver

For virtual non-loading, the 6N139 is compatible with the differential amplifier circuit of Figure 6.

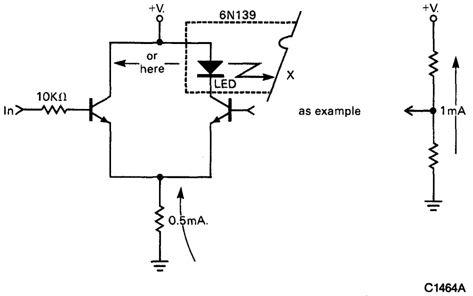


Fig. 6. Differential Amplifier Drive

For a virtual no-load optoisolator circuit use:

X=Non-latching output circuitry to follow

LED=Input diode of 6N139

Current requirement at "in" will be less than 20 microamperes.

Example:
If "REF" is made to be +1.4 volts and the resistor common to the emitters is 1.2KΩ, the circuit will respond nicely to TTL "0" and "1" levels. That is, a "0" at "In" will cause LED current resulting in the conduction of the output circuitry. Conversely, a "1" at "In" will result in no LED current. Notice that depending upon which collector the LED is in series with it will give the option of LED current flowing with a "0" or a "1" at "In".

6N139 Output Circuitries

The following are two examples of 6N139 output circuitry. One latching (Figure 7); the other non-latching (Figure 8), but both capable of driving a TTL gate directly.

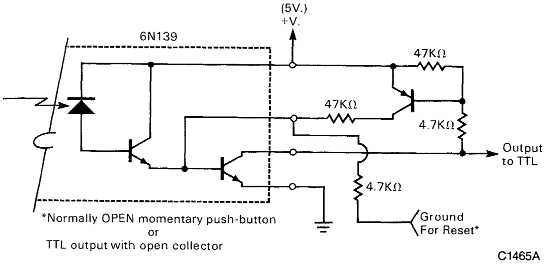


Fig. 7. Latching Output Circuit for 6N139

Referring to Figure 7 and assuming that the "RESET" has been actuated by a momentary ground and no input signal is being received, all transistors shown are non-conducting (Output high, "1"). The arrival of an input signal will cause all transistors to turn on. (Output low, "0"). The PNP transistor, being turned on by the output transistor, will in turn latch that same output transistor or until the "RESET" is again initiated.

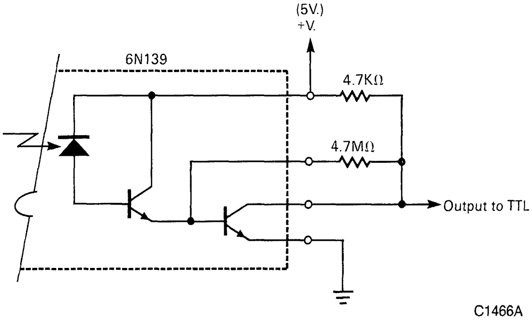


Fig. 8. Non-Latching Output Circuit For 6N139

In Figure 8, where no signal is being received, the input transistor is not conducting. The output transistor is very slightly conducting. The 4.7MΩ resistor causing this slight conduction will *not* bring the "Output" to a "0" level. The purpose of this slight conduction is to reduce the turn-on delay time. When a signal is received, both input and output transistors are turned on causing the "Output" to a logic "0" state. The 4.7MΩ resistor will now tend to reduce the output transistor's turn-off time.

If you have not looked over the 6N139 specification sheet, you may not be totally aware of the current capabilities of Quality Technologies optocouplers.

MID400 POWER LINE MONITOR

AN1075

INTRODUCTION

The MID400 is an optically isolated AC line-to-logic interface device for monitoring ON or OFF status of an AC power line. The logic circuitry operates from a standard 5V supply. The MID400 is packaged in a compact 8-pin plastic MINI-DIP. The optical isolation provided by the MID400 makes it suitable for power-to-logic interface applications such as industrial control medical equipment computers and other fail-safe type monitor systems in which status information about the AC line is essential.

INTERNAL COMPONENTS

During assembly two infrared GaAs LED diodes are mounted on an input lead frame, and a photodetector/ amplifier chip is mounted on an output frame. Use of two separate lead frames insures high electrical isolation between input and output terminals after trimming of the lead frame edges. Light emitted by the input LED's is optically coupled through solid transparent material to the surface of the photodetector. The LED's are connected back-to-back, and power line status is monitored by the LED's in series with an external current limiting resistor. When the high gain photodetector and amplifier senses light output from the two LED's, it drives an output NPN transistor to the ON state.

The photodetector amplifier circuit is shown in Figure 1. The Photodiode D3 is coupled into a high gain 3 stage emitter follower current amplifier ($Q_1Q_3Q_5$) driving into an output transistor Q_8. The emitter follower loads are comprised of constant current circuits formed by Q_2, R_2, Q_4, R_3, Q_6, and R_4. Constant current level in these devices is established by the constant voltage source formed by the base emitter voltage of Q_7 and R_5.

The common point of the output photodiode/amplifier is brought out to pin 7 to allow connection of an external integrator capacitor or other circuits. Because the amplifier has a high current gain factor of 10,000 to 100,000, its input impedance (at pin 7) is extremely high.

Switching time of the amplifier is intentionally designed to be slow, so that the MID400 only responds to an absence of input signal over a few milliseconds, and not during the short zero-crossing period of the AC input voltage waveform.

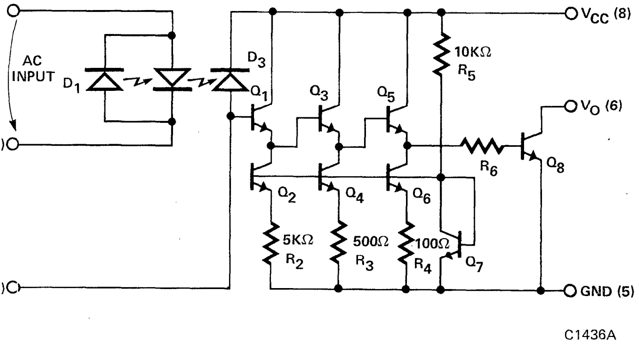


Fig. 1. Circuit Schematic of MID400 AC Line Monitor

MID400 POWER LINE MONITOR

BASIC CIRCUIT OPERATION

Consider the test circuit shown in Figure 2. Back-to-back input diodes D_1 and D_2 each conduct on every half cycle of the AC input waveform, producing 120Hz light pulses. The light output causes the photodiode to conduct, raising the potential of the input to the amplifier, and in turn driving the output NPN transistor ON. When input current is removed, light from the two LED's ceases, charge established by the photodiode current on the input amplifier leaks away, and the NPN transistor turns OFF. There are basically three operation modes: Saturated, unsaturated, and the "OFF" STATE mode.

SATURATED MODE

When input AC is above the recommended 4mA RMS minimum input current, the 120Hz photodiode pulses are sufficient to saturate the amplifier, so that the MID400 output is low at pin 6 as long as AC input signal is present, (see Figure 3).

UNSATURATED MODE

If input current is dropped below the recommended 4mA RMS, the amplifier drops out of saturation during the zero-crossing periods of the input AC waveform and 120Hz pulses appear on MID400 output pin 6, (see Figure 4). Under these conditions the device makes an attractive, simple 120Hz clock generator that is free from most of the normal power line transients for many digital applications.

OFF-STATE MODE

When the input RMS AC input current is below 0.15mA the MID400 output will be in the high state as per specifications.

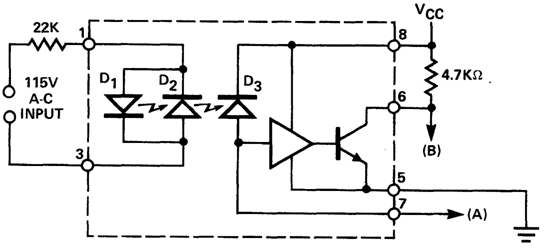
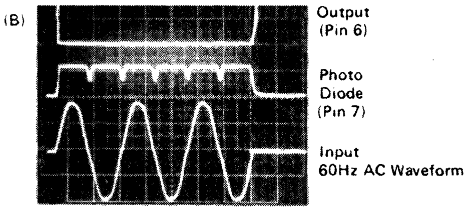


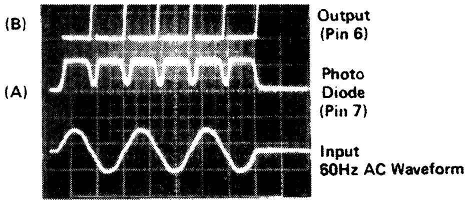
Fig. 2. Test Circuit



Horiz. = 5mS/cm
Vert. = Uncalibrated

Fig. 3. Saturated Operation

NOTE: Normal specified 4mA RMS input I_F current. Output saturated (latched). The 120Hz pulses from the photodiode D_3 are above the threshold of the amplifier; therefore, the MID400 output is low anytime the AC current is present.



Horiz. = 5mS/cm
Vert. = Uncalibrated

Fig. 4. Unsaturated Operation

NOTE: Below normal specified 4mA RMS input I_F current. The level of 120Hz pulses from the photodiode are now below the input threshold of the amplifier and the pulses appear on the output. The output pulse width depends on the AC input drive level.

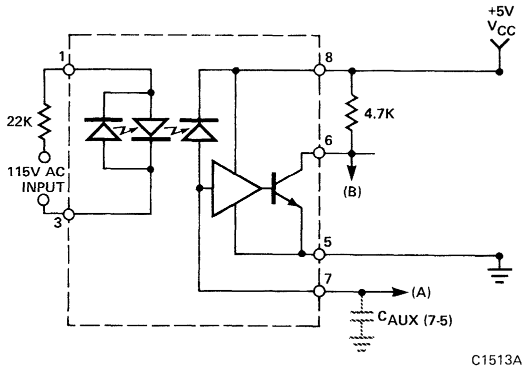


Fig. 5. Circuit with Addition of Capacitor at Pin 7

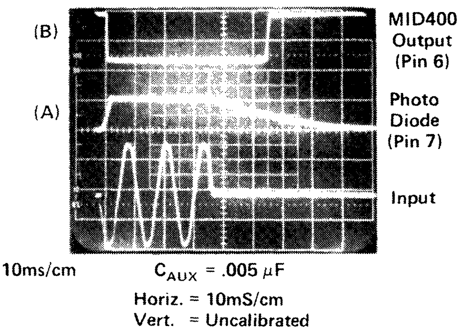


Fig. 6. Waveforms with Capacitor Added at Pin 7

OPERATION WITH AN EXTERNAL CAPACITOR

Figure 5 shows a basic delay circuit obtained by addition of an integrating capacitor C_X to the photodiode/amplifier input point pin 7. Delay at POWER ON is short, as the photodiode, when conducting, has a low impedance providing a fast charge to the capacitor. The delay when AC is removed is long, because the capacitor discharges through various leakages of the amplifier and the photodiode. The waveforms in Figure 6 shows the capacitance on both TURN-ON and TURN-OFF delays. Figures 7 and 8 show plots of capacitance versus turn-on and turn-off time.

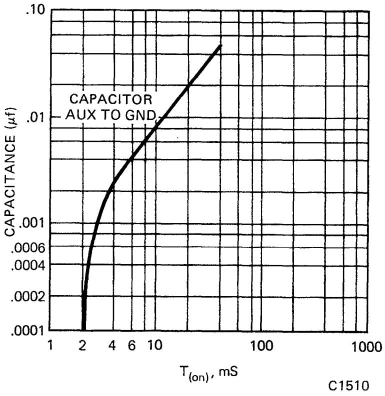


Fig. 7. Plot of Capacitance Versus Turn-on Time

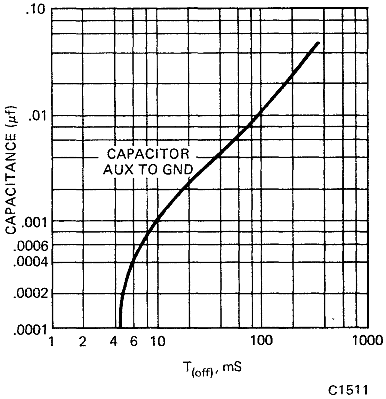


Fig. 8. Plot of Capacitance Versus Turn-off Time

MID400 INTERFACE CIRCUITS USING A 555 TIMER

Addition of a 555 Timer at the MID400 output, as shown in Figure 9, produces an interface circuit with improved drive capability and output switching times, and better noise immunity. Figure 10 illustrates these switching time improvements.

MID400 POWER LINE MONITOR

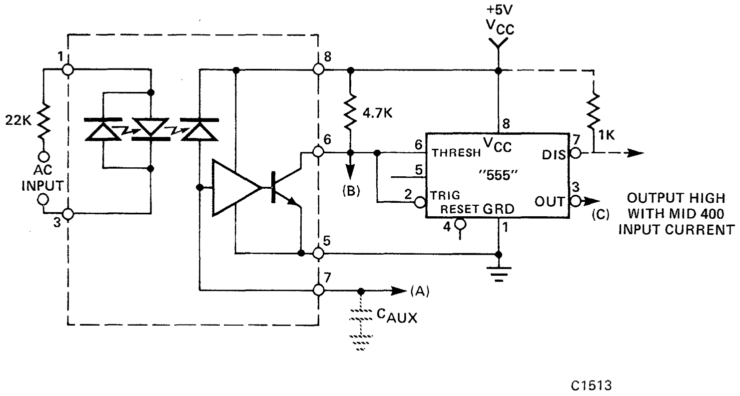


Fig. 9. Circuit with 555 Timer Added

The 555 Timer is basically being used as a SCHMITT trigger circuit with well defined input thresholds. The input HIGH state is 2/3 V_{cc}, +5 volts in this case), and its LOW state is 1/3 V_{cc}.

The output may be taken from either 555 pin 3 or from pin 7 discharge point with a pullup resistor. Both these pins are high when AC current is applied to the MID400.

The 555 output is capable of supplying both sink and source currents up to 200mA. One advantage of using the 555 discharge output pin is that it can be tied to another similar unit to provide the "AND" function. That is both AC inputs to both units must be present before the 555 outputs can be high.

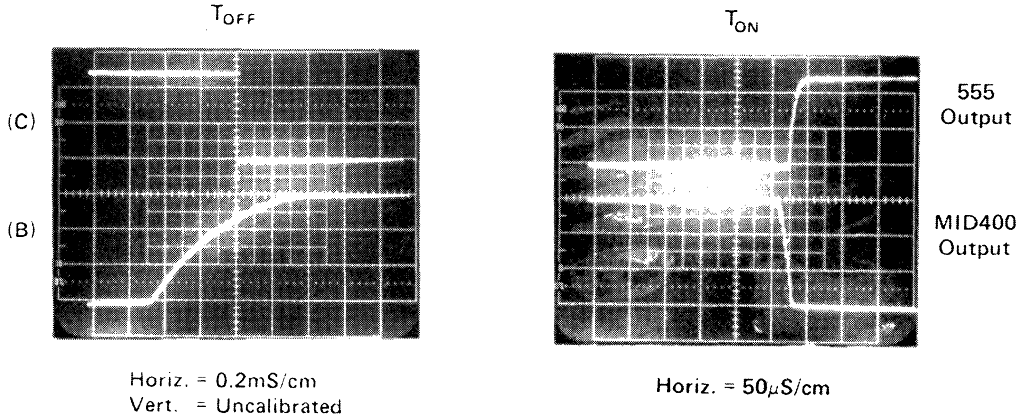


Fig. 10. Output Waveforms for $T_{ON}T_{OFF}$. Pin 7 Auxiliary Input Open Using the 555 Circuit (Fig. 9)

Figure 11 shows a circuit which includes a 555 Timer for shaping of waveforms. This circuit can provide an adjustable delay either at power on or power off. Delay is adjusted by the time constant of R_x and C_x. Insertion of diode D_1 across R_x provides either a fast charge and slow discharge of C_x, or a slow charge and fast discharge when diode polarity is reversed. See waveforms in Figures 12 through 14. Because charge on capacitor is established by the output of MID400, the delay will vary according to whether MID400 is operated in saturated mode or unsaturated mode. In the unsaturated mode delay will depend upon the ratio of the pulse ON to OFF time (Duty Factor).

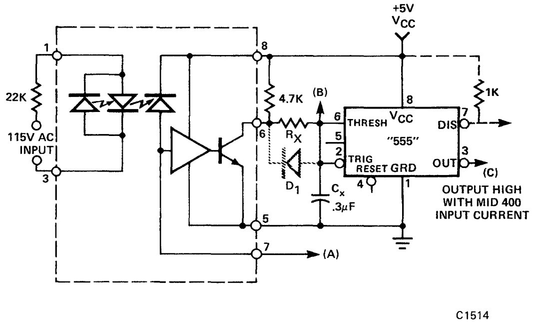
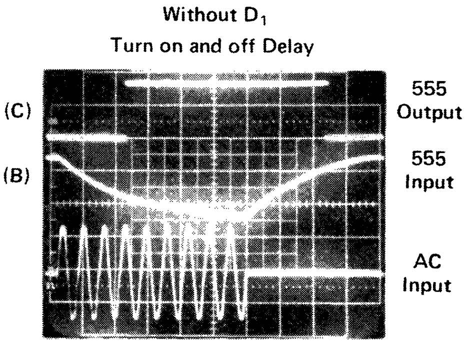


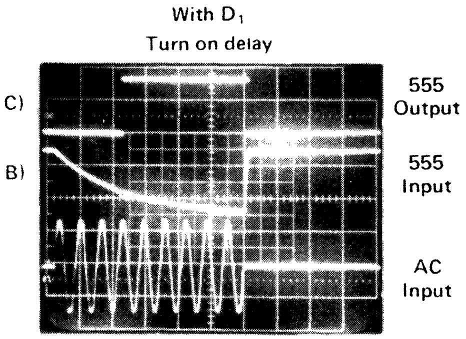
Fig. 11. Adjustable Delay Turn Off/On Circuit



Horiz. = 20mS/cm
Vert. = Uncalibrated

R_X = 200KΩ
C_X = 0.3µF

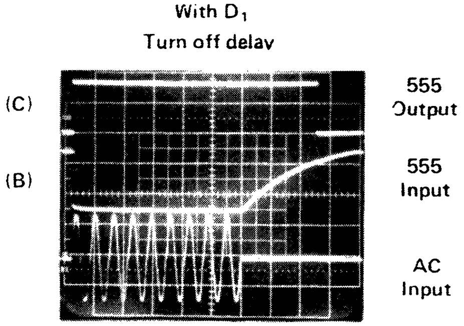
Fig. 12. Output Without D_1 Diode



Horiz. = 20mS/cm
Vert. = Uncalibrated

R_X = 200KΩ
C_X = 0.3µF

Fig. 13. Delayed Turn On, Diode D_1 Connected Opposite to Shown in Circuit Schematic



Horiz. = 20mS/cm
Vert. = Uncalibrated

R_X = 200KΩ
C_X = 0.3µF

Fig. 14. Delayed Turn Off, Diode D_1 Connected As Shown in Circuit Schematic

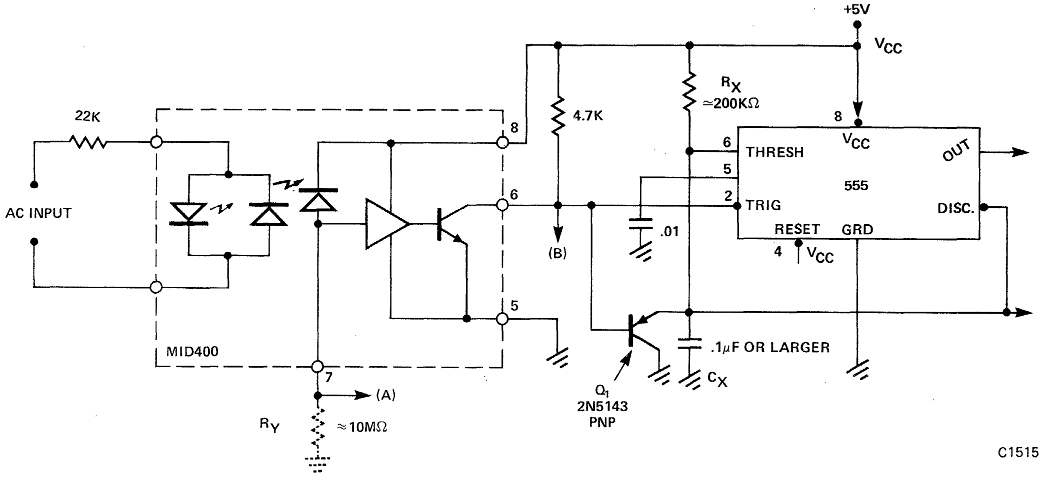


Fig. 15. Precision Delay Circuit

Figure 15 shows a precision delay circuit. Here delay is provided by using the 555 Timer as a missing pulse detector or one-shot. The time out is independent of whether the MID400 is operated in saturated or unsaturated mode. In unsaturated mode the Timer is continuously being reset by the 120Hz pulses from the MID400 and output of the 555 is high. When an AC line fails, there are no 120 Hz pulses, the 555 times out and the output then goes low. Refer to waveforms in Figure 16.

A larger capacitor at C_x will increase the time-out period of the 555 causing it not to detect the missing input cycles as shown in Figure 17.

With the MID400 operated in the saturated mode, output of MID400 is low, which turns on the PNP transistor Q_1, stopping C_x from charging, and the 555 output is high.

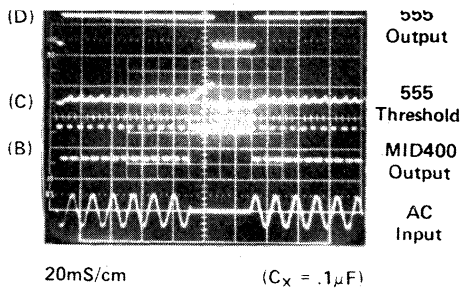


Fig. 16. Unsaturated Mode — Detects Missing AC Input Cycles (when more than one cycle is missing)

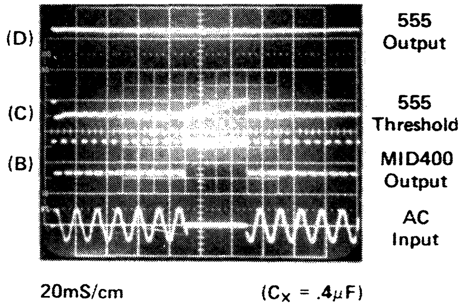


Fig. 17. Unsaturated Mode — Does NOT Detect Missing AC Input Cycles

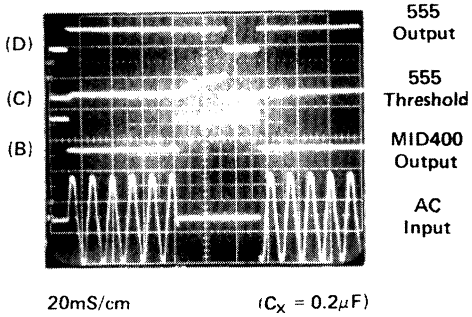


Fig. 18. Saturated Mode — Detects Missing AC Input Cycles

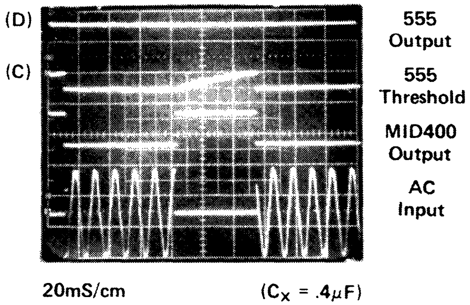


Fig. 19. Saturated Mode — Does NOT Detect Missing AC Input Cycles

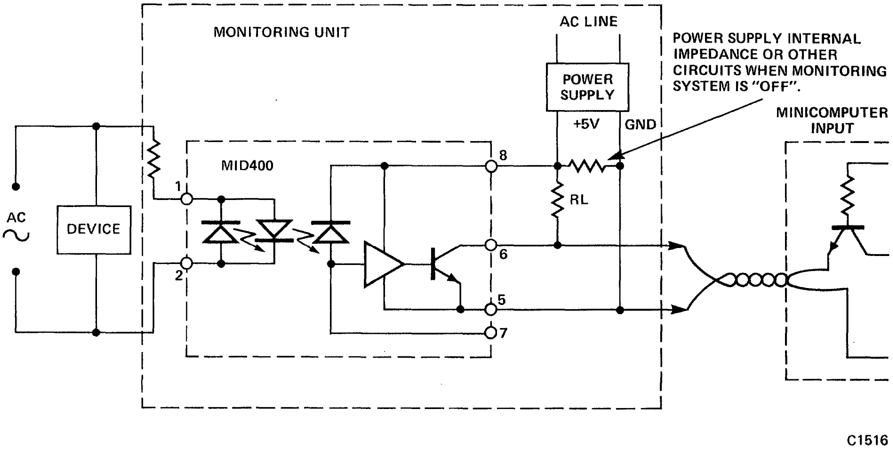


Fig. 20. Example For Fail-Safe Considerations

On AC line failure the MID400 goes high, causing Q_1 to turn off and allowing C_x to charge, so that after the required time the 555 is allowed to go LOW. Refer to the waveform in Figure 18.

By the choice of the time constant R_xC_x the circuit in either a saturated or unsaturated mode can be made to either respond or not respond to one or more AC input cycles as shown in Figures 16 through 19.

OTHER SPECIAL DESIGN CONSIDERATIONS

Special mention must be made about effects on MID400 operation caused by leakage at pin 7. To avoid problems keep impedance at 10 megohm or greater. If a capacitor is connected to pin 7, make sure it is a high quality type (such as Mylar) that exhibits very low leakage. (Even current leakage between printed circuit traces can have noticeable effects on circuit operation if the board material has poor dielectric insulation characteristics.)

DESIGNS FOR FAIL-SAFE OPERATION

In those industrial, military, computer, and medical system applications where fail-safe operation is important, circuit response must also be considered when AC input or the V_{cc} supply, (or even both), switch off.

Table I lists the MID400 output response under these conditions. This "Truth Table" shows that the MID400 output NPN transistor can be ON (conducting) only when AC current is flowing through MID400 input LED diodes **and** the 5V V_{cc} to the MID400 is present (ON).

Table 1. FAIL-SAFE TRUTH TABLE

AC Line Input	+5 V_{cc} Supply	MID400 Output Condition
ON	ON	ON (conducting)
ON	OFF	OPEN (non-conducting)
OFF	ON	OPEN (non-conducting)
OFF	OFF	OPEN (non-conducting)

This truth table reflects a MID400 being operated from a +5 volt supply which has a high impedance when not "ON." However, other external factors can influence the apparent state of the MID400 output. For example, Figure 20 shows an application where the MID400 is monitoring the AC voltage of a device. The MID400 is supplied by a separate 5V supply in the "MONITOR UNIT" fed from a separate AC line. The output of MID400 is fed to a remote minicomputer with a TTL type input circuit.

In this system it is quite feasible to get an erroneous apparent output from the MID400 if R_L is 1000 ohms, or less, and the 5V power supply in the monitor system presents a low impedance when OFF. The TTL input to the minicomputer might appear low due to current being forced through R_L and the low impedance of the OFF 5V power supply. This can be eliminated by the addition of a diode D_x as shown in Figure 21.

In some applications additional circuitry may have to be added to insure fail-safe operation. One such example is the monitor circuit shown later, Figure 24. There both voltage and current are monitored.

Another interesting condition to consider is operation of the MID400 if its LED input diodes are "blown out" by excessive current. In this case the MID400 output will be in the high state, still indicating an error condition.

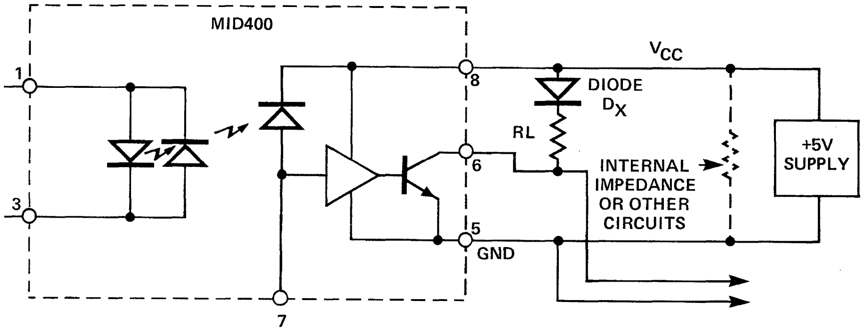


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Fig. 21. Diode D_x Added to Stop Reverse Current When MID400 +5v V_{cc} Line is Off

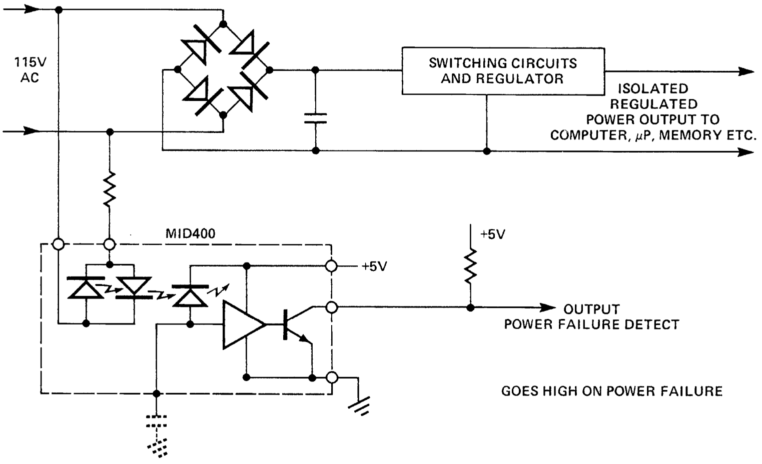


Fig. 22. Circuit for Switching Power Supply

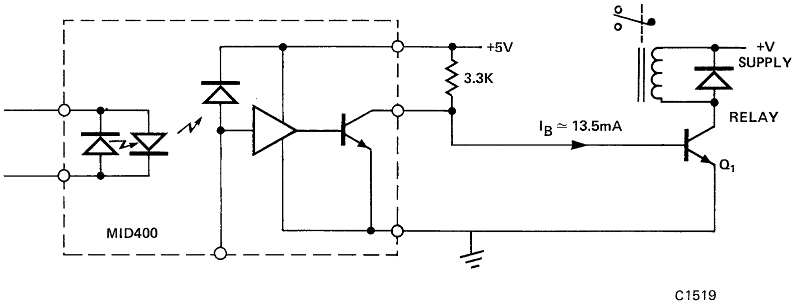


Fig. 23. Relay Interface Circuit

APPLICATION CIRCUITS

Figure 22 shows a circuit for a switching power supply to give advanced warning of power failure to computer, microprocessor, memory etc., so that an orderly power down sequence can be initiated. Such a circuit is useful because a switching power supply inherently provides power storage for a limited period of time after removal of AC input power.

Figure 23 shows a circuit that allows a relay or solenoid of almost any voltage and current rating to be controlled by the MID400. NPN transistor Q_1 must have adequate beta and voltage/current ratings for the application. Relay is energized when no AC current is flowing in the MID400 input diodes.

Figure 24 shows a circuit that uses two MID400s to monitor both voltage and current. When both voltage and current are being supplied to the load, the output of "NOR" gate is high. If load current drops due to either open circuit or failure, the output of "NOR" gate is low.

If both voltage and current are not present the output is low. Care must be taken in overall systems design to insure fail-safe operation is achieved for all possible conditions. This topic was discussed previously in this Note.

Figure 25 shows a circuit to monitor a fuse or a circuit breaker. With this circuit consideration must be given to Fail-Safe operation. Note that if load is a very high impedance there might not be sufficient current to operate the MID400. In other words, the output of MID400 is low on open fuse or breaker. If V_{cc} to MID400 is off and fuse opens, no MID400 indication will result.

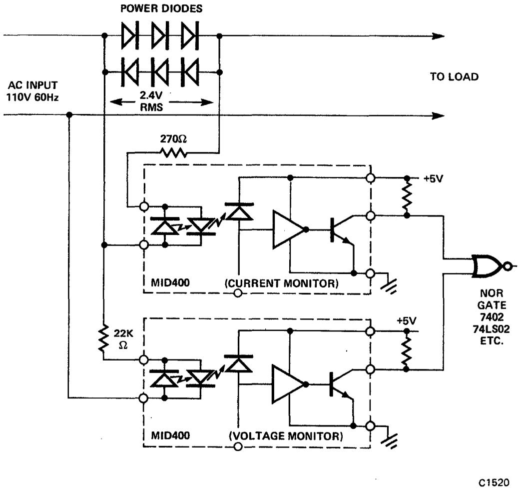


Fig. 24. AC Power Line Voltage and Current Monitor

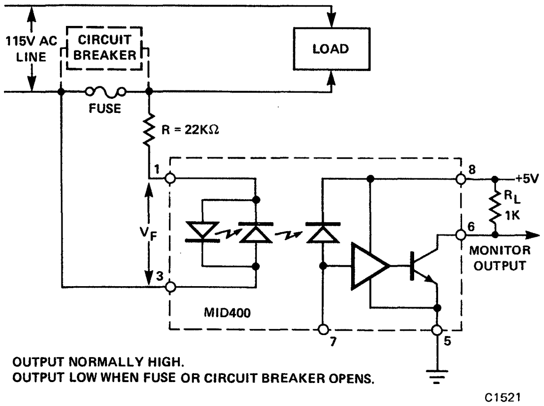
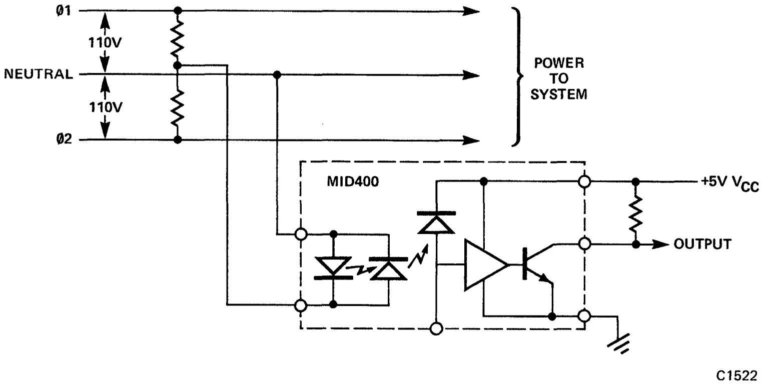
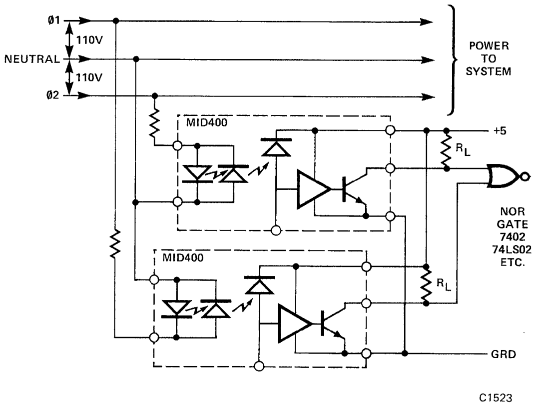


Fig. 25. Fuse or Circuit Breaker Monitor



NOTE: Circuit detects failure of either but not both phases

Fig. 26. Monitor Circuit for Two Phase Power Line



NOTE: Circuit detects failure of either or both phases

Fig. 27. Alternate Monitor Circuit for Two Phase Power Line

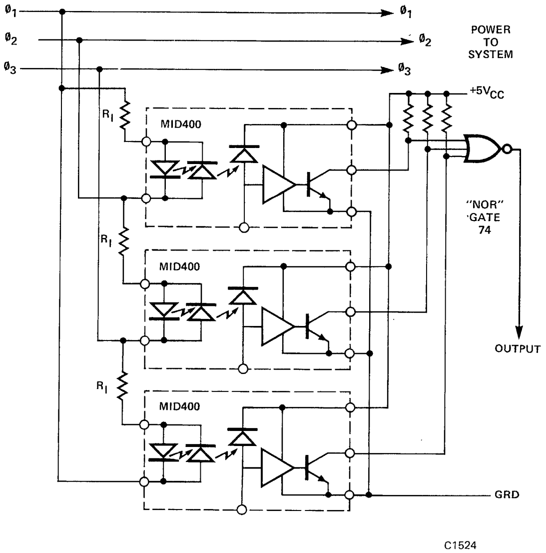


Fig. 28. Monitor Circuit for Three Phase Power Line

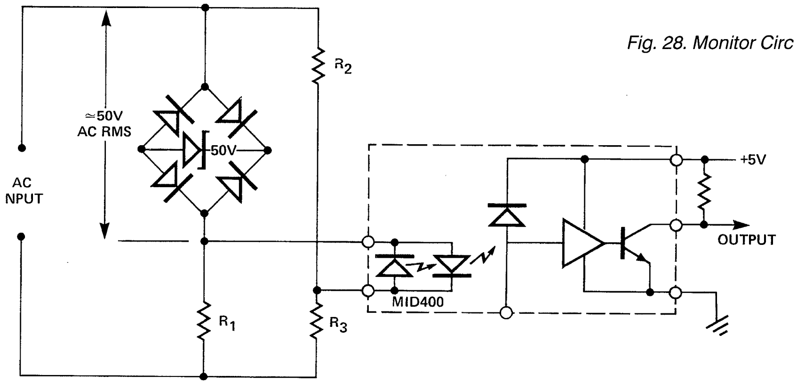


Fig. 29. AC Voltage Deviation Monitor

ADDITIONAL APPLICATION IDEAS

The following circuits are included for their intrinsic value, but may need further refining for use in a specific application.

Figure 26 shows a circuit to detect failure of either but not **both** phases on a two phase AC power line. The MID400 output goes LOW when a phase fails. Figure 27 shows a more complicated circuit that will detect failure of either or both phases on a two phase line. The NOR gate output stays HIGH so long as **both** phases are present, but switches to LOW if either or both phases fail.

Figure 28 shows a circuit to monitor a three phase line. This circuit detects a failure on a single phase, as well as all phases failing simultaneously. The output from the NOR gate is normally high when all phases are present.

The input current limiting resistor R_L is chosen so the MID400s operate in saturated mode. If a phase fails, for example phase 01 goes open circuit, this effectively places MID400's #A and #B in series, causing them now to operate in non-saturated mode and produce 120Hz pulses. Therefore the output "NOR" gate outputs pulses to indicate phase failure. The output NOR gate is low when there is no power on any phase.

In some applications, for example when monitoring the power to a three phase motor, if a phase opens when the motor is running, it might run "single phase." The motor might then generate sufficient back EMF on the open phase to keep input current to MID400, and under such a condition this MID400 monitoring system is not effective.

MID400 POWER LINE MONITOR

Figure 29 illustrates the basic circuit concept for an AC voltage deviation monitor. Here the zener diode and bridge rectifier establish a given AC voltage, irrespective of AC input voltage, over a given range. This is compared with the voltage developed by R_2 and R_3. Depending upon choice of zener voltage and ratio of R_2 and R_3 the circuit can operate in a number of modes:

1. Voltage Deviation Monitor to give a low output when AC voltage deviates from set standard. The voltage at junction of R_2 and R_3 is made equal to zener voltage for given AC input voltage. A deviation from standard causes current flow through MID400 diodes.
2. Over Voltage Monitor (over given range). For normal AC input voltage R_2 and R_3 are chosen for a current flow thorugh the MID400; when AC input voltage goes too high the current ceases through MID400 input diodes.
3. Under Voltage Monitor (over given range). Similar to above, except R_2 and R_3 are chosen so current through MID400 input diodes ceases if AC with low input voltage is too low.

It should be noted that in this circuit the magnitude of current through the MID400 input diodes is governed by choice of R_1, R_2, and R_3 resistor values.

MID400 BENEFITS

This small size device connects through an external resistor directly to AC power lines and offers both input-to-output noise immunity as well as electrical surge isolation, up to 2500 VRMS (or 3550 VDC). Its output is compatible with TTL logic. Also the MID400 is UL recognized (File #E50151), has low power consumption, and operates from a single V_{cc} supply up to 7 volts. Besides inputs from power lines, the MID400 can also be connected to AC surces of other frequencies and even to DC sources (for detection of power). Output current is 16mA when a minimum 4mA RMS input current is applied to the input LEDs. When the inexpensive and readily avaialble 555 Timer is connected to the MID400 output, circuits can be built having high sink and source current drive capabilities. These simple circuits can also be designed for a wide range of adjustable delay, and with rise and fall times compatible with TTL computer circuits.

CONCLUSION

This Application Note has summarized internal operation of the MID400 and described several classes of application circuits. Refer to the MID400 Data Sheet for a listing of Absolute Maximum Ratings and specifications for its Electrical Characteristics.

APPLICATIONS AND OPERATION OF OPTOLOGIC™

OPTOLOGIC™

AN3000

INTRODUCTION

Since the introduction of the optically coupled isolator, digital design engineers have struggled with the problem of achieving logic-in to logic-out compatibility over temperature, minimizing the effects of LED degradation, and obtaining high speed operation. Typically this problem is approached by selecting input/output resistors, and often by trial and error.

This guesswork type of interfacing is now a thing of the past. Enter the new OPTOLOGIC™ family of logic-to-logic compatible, optically coupled isolators. This easy to use logic element offers LSTTL-in to TTL-out or LSTTL-in to CMOS-out. The device eliminates the resistor selection and features guaranteed DC parameters over temperature.

This ease of design-in and operation is made possible through use of an input amplifier that provides the interface between the driving LSTTL gate and the LED emitter. The output circuitry consists of a multistage high speed amplifier available with either a totem pole or open collector ouptut. The input amplifier, LED, and output amplifier are assembled in an industry standard six-pin package.

The Optologic devices not only provide the isolated logic-to-logic interface function, but due to many unique features of the input amplifier, offer solutions for high speed data communications and precise DC level sensing. These applications, and the operation of the Optologic interface gate, will be discussed in this application note.

OPTOLOGIC OPERATION

Functionally the Optologic gate consists of an input amplifier, high speed GaAsP/GaAs LED emitter, and an output amplifier. Figure 1 illustrates the block diagram of the LSTTL to TTL logic gate.

The input network is a hybrid assembly of a silicon IC amplifier and LED emitter. The input functionally consists of four elements: 1) open emitter input with Schottky diode clamp, 2) differential comparator, 3) voltage reference, and 4) current steering LED driver.

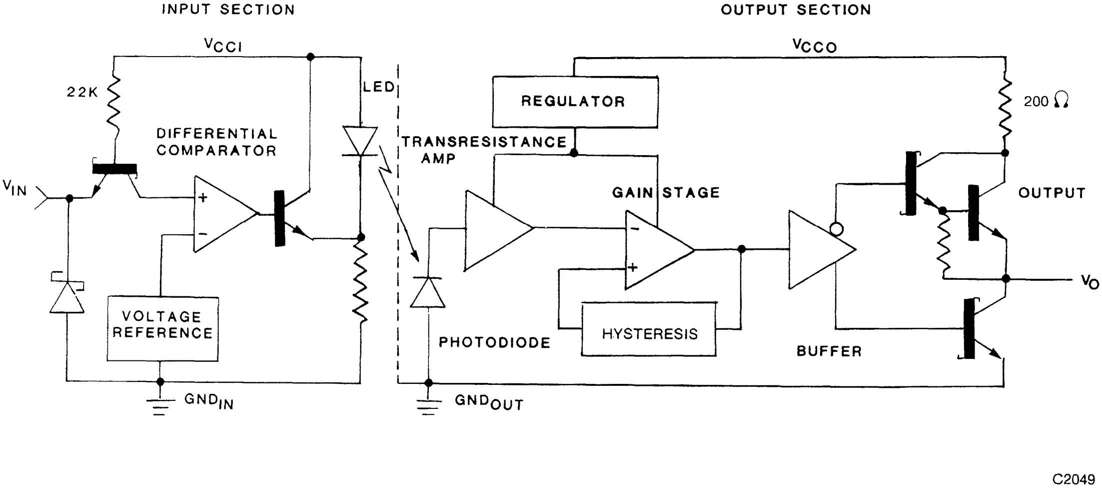


Fig. 1. 74**OL**6000 Block Diagram

APPLICATIONS AND OPERATION OF OPTOLOGIC™

The input of the IC is very similar to standard bipolar logic. It consists of a Schottky clamp diode connected between the emitter of an NPN transistor and ground. The input sources input current over the nominal LSTTL logic levels. Figure 2 shows the typical input current/voltage characteristics. The input offers a 20K ohm input resistance between −0.5 to 3.0 V. The input resistance drops to 7.5 K from 3.0 to 3.4 V, while between 3.4 to 7 V the resistance is greater than 1 megohm. Input voltages more negative than 0.5 V activate the Schottky diode clamp.

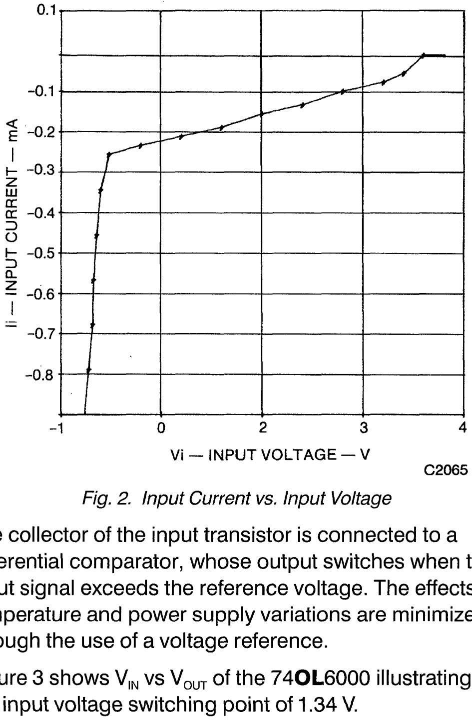


Fig. 2. Input Current vs. Input Voltage

The collector of the input transistor is connected to a differential comparator, whose output switches when the input signal exceeds the reference voltage. The effects of temperature and power supply variations are minimized through the use of a voltage reference.

Figure 3 shows V_{IN} vs V_{OUT} of the 74**OL**6000 illustrating the input voltage switching point of 1.34 V.

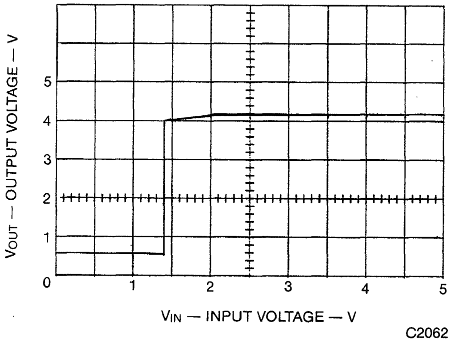


*Fig. 3. 74**OL**6000*

The output of the comparator controls a current steering LED driver. The LED is enabled when the transistor is OFF. When the transistor is driven into saturation, it steers the current away from the LED by dropping the LED voltage below its 1.5 V conduction threshold. This technique of driving has the advantage of pre-biasing the LED, thus minimizing the switching speed reduction caused by the diode junction capacitance. It has the added advantage of greatly reducing power supply noise.

The output IC consists of seven functional circuits. These include: 1) PN photodiode, 2) transresistance amplifier, 3) differential gain stage, 4) hysteresis loop, 5) buffer amplifier, 6) output stage, and 7) voltage regulator.

The optical flux developed by the LED emitter is converted to an electrical current by a reversed biased PN photodiode. This photocurrent is amplified and converted to a voltage by a transresistance gain stage. This stage is connected to the inverting input of a differential amplifier, while the hysteresis network is connected to the non-inverting input. The output of this amplifier drives a buffer that provides the level shifts and signal splitting needed to drive the totem pole output stage. Power supply noise is rejected through the use of a voltage regulator that powers the transresistance amplifier and the differential gain stage.

The output of the amplifier is offered as either an open collector (74**OL**6010/11) or a totem pole (74**OL**6000/01). The open collector output is designed to interface with CMOS logic, with a supply voltage up to 15 volts. The output transistor will drive 10 standard TTL loads with a V_{OL} of 0.4 V, and its safe operating range allows it to sink up to 60 mA peak. The active pull-up will source an I_{OH} in excess of 10 mA with a V_{OH} greater than 2.4 V. The output characteristics of the Optologic gates are shown in Figures 4 and 5.

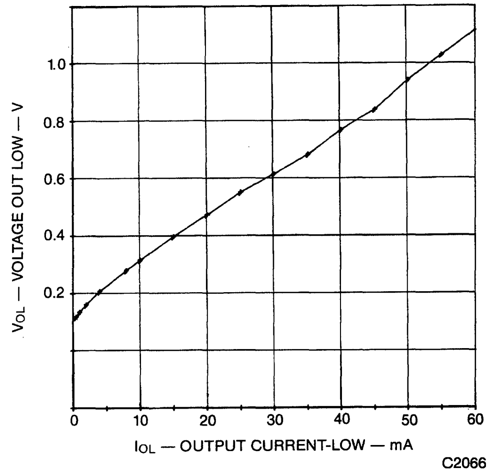


*Fig. 4. 74**OL**6000 V_{OL} vs I_{OL}*

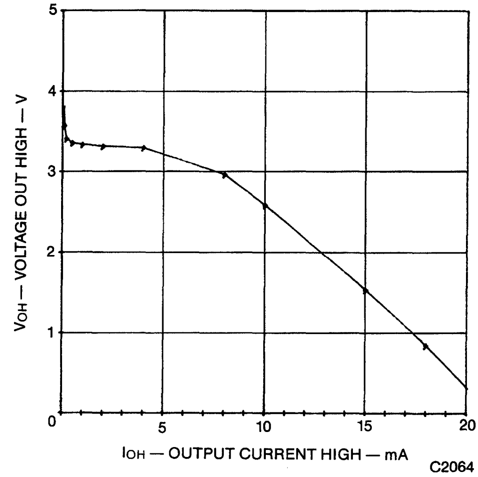


*Fig. 5. 74**OL**6000 V_{OH} vs I_{OH}*

The effects of common mode transients and other noise sources on the output amplifier are reduced by an optically transparent, electrically conductive noise shield, as well as by amplifier hysteresis. The shield shunts the noise away from the input stage and channels it to logic ground. The amplifier hysteresis eliminates false output pulses caused by a slowly varying input signal, or power supply noise found on the input network of the Optologic gate.

These three chips are assembled in an industry standard six-pin dual-in-line package. Quality Technologies uses its patented over/under split lead-frame assembly process. This process has proven to be very reliable given environments typically found in industrial interface applicaitons. This package is recognized under Underwriters Laboratories File E#50151, and with a withstand test voltage of 2500 V_{RMS}, guarantees continuous operation at 440 VAC.

SWITCHING OPERATION

The Optologic optocoupler was designed to interface directly with LSTTL at the input and either TTL or CMOS at the output. In addition, the switching levels are identical to the standards established for each of these logic families.

There are four Optologic devices currently available. Two of these devices are LSTTL to TTL compatible. The 74**OL**6000 is a logic buffer and the 74**OL**6001 is an inverter logic. LSTTL to CMOS is provided by the 74**OL**6010 buffer and the 74**OL**6011 inverter. The switching operation is shown below.

DEVICE	INPUT	LED	OUTPUT
74**OL**6000	HIGH LOW	OFF ON	HIGH LOW
74**OL**6001	HIGH LOW	ON OFF	LOW HIGH
74**OL**6010	HIGH LOW	OFF ON	OFF ON
74**OL**6011	HIGH LOW	ON OFF	ON OFF

The preceding table indicates that the Optologic gate is effectively two cascaded logic gates. The first is the input network and the second the output. Both the totem pole and open collector output amplifier function as inverters. Thus, when the LED is ON, the output will be a logic low state. Therefore, in order to create an Optologic buffer (74**OL**6000, 74**OL**6010), the input amplifier must function as an inverter for controlling the LED emitter. The Optologic inverter gates (74**OL**6001, 74**OL**6011) use a non-inverting input amplifier.

One will note that the output chip is always HIGH (OFF) when the LED is OFF, and the output is forced LOW (ON) when the LED is ON. Thus, the Optologic input has a switching threshold of 1.34 V.

The operational sequence of LED and input/output chips will give the designer insight when combinations of inverters and buffers are used in parallel data transfer applications. In these types of applications, the rate of data transfer is greatly affected by the propagation delay difference between the slowest to fastest Optologic gate. The propagation delay is the sum of the delays of the input chip, LED, and output amplifier. The typical delay times for the 74**OL**6000/01 are 65ns, with rise times of 45ns and fall times of 5ns. The rise and fall time difference is the result of the operation of the output amplifier. The typical switching characteristics of the 74**OL**6000/01 are shown in Figures 6 and 7. When output edge detection is used, the fastest response will be obtained when the falling edge (H-L) is sensed. This is true for both the inverter and buffer Optologic gates.

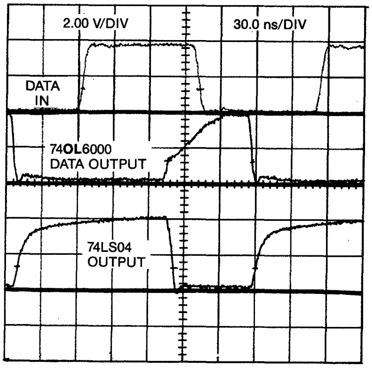


*Fig. 6. 74**OL**6000 Switching Characteristics*

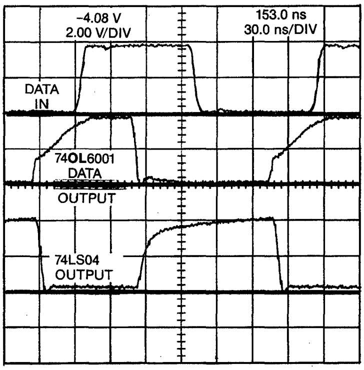


*Fig. 7. 74**OL**6001 Switching Characteristics*

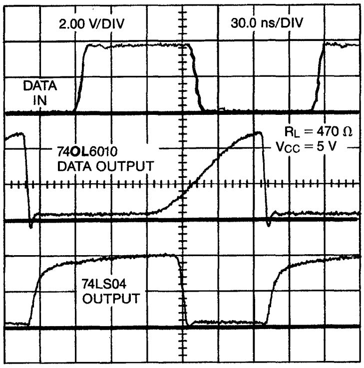


*Fig. 8. 74**OL**6010 Switching Characteristics*

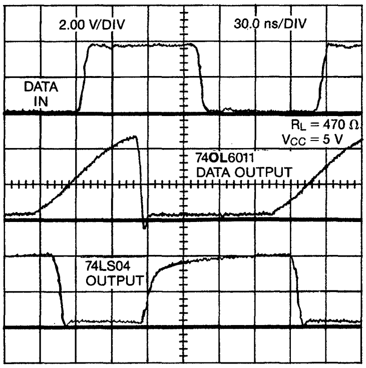


*Fig. 9. 74**OL**6011 Switching Characteristics*

The CMOS compatible output family (74**OL**6010/11) satisfies the V_{OH} by using an open collector transistor and an external pull-up resistor. The high to low propagation delay and fall time is very similar to the 74**OL**6000/01 Optologic gates. The low to high propagation delay and rise time is greatly influenced by the value of the pull-up resistor. When a 470 ohm pull-up resistor is used, the typical propagation delay for low to high is 100ns. The typical switching characteristics of the 74**OL**6010/11 are shown in Figures 8 and 9.

The Optologic gate's input and output chips ensure a constant propagation delay over the temperature range of −40°C to 85°C. This consistency is shown in Figures 10 and 11.

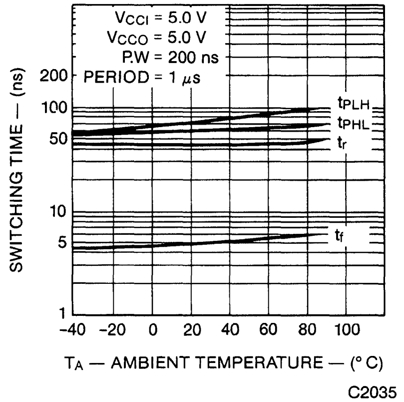


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*Fig. 10. 74**OL**6000/01 Switching Times vs. Ambient Temperature*

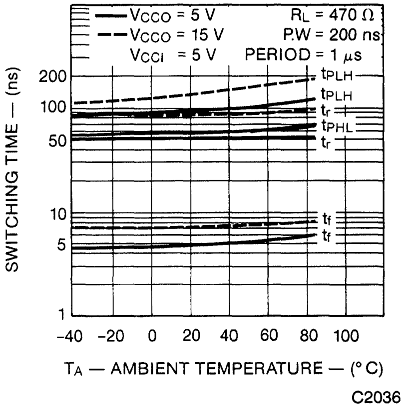

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*Fig. 11. 74**OL**6010/11 Switching Times vs. Ambient Temperature*

OPERATIONAL CONSIDERATIONS

The Optologic gates have eliminated the need to perform a worst case analysis for logic family compatability and switching speed. Operational performance degradation is greatly minimized through the optimal selection of the LED emitter and output amplifier. These features make the Optologic gates the easiest optocouplers to use for logic-to-logic interfacing.

OPERATIONAL CONSIDERATIONS

The consistent performance of the Optologic gates will be obtained if the designer ensures that package power dissipation and operational supply voltage does not exceed their absolute maximum ratings. The 74**OL**6000/01 were designed to operate from standard 4.5 to 5.5 volt supplies and, under these conditions, the devices will operate successfully over a −40°C to 85°C range. The 74**OL**6010/11 output amplifier will operate from a 15V supply over a temperature range of −40°C to 55°C, however, the output amplifier power supply voltage must be derated at a rate of −0.27V/°C above an operational temperature of 55°C. This function is shown graphically in Figure 12.

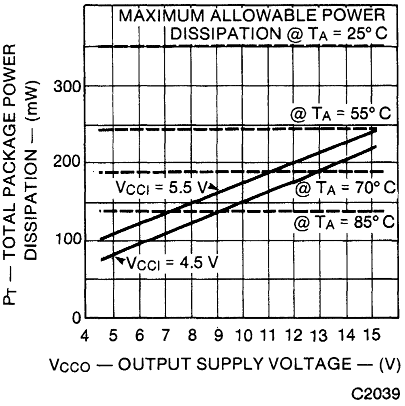

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Fig. 12. Power Dissipation vs. Ambient Temperature

Operational stability is optimized when low impedance V_{CC} and V_{DD} supplies are used to power the Optologic gates. This can be ensured by the common practice of including 0.1 μF bypass capacitors for the input and output amplifier supplies. These capacitors are placed immediately next to the V_{CC} and ground connections of the input and output amplifier. These capacitors minimize output ringing and improve the power supply noise rejection. A suggested printed circuit board layout is shown in Figure 13.

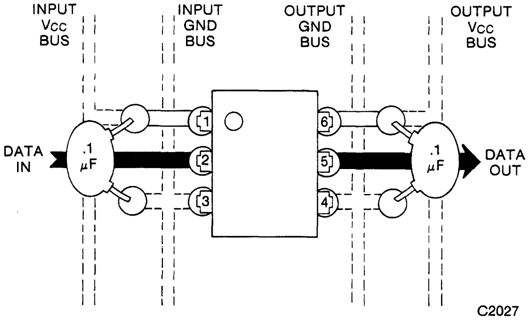

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Fig. 13. Suggested PCB Lay-out

DATA COMMUNICATIONS INTERFACING

The common LED input/phototransistor output and high speed logic compatible output have found their way into point-to-point (simplex) data communications applications. When used as a line receiver the designer was required to design a matching network to provide the minimum reflection caused by the non-linear input impedance of the light emitting diode. These matching networks were commonly designed for a specific cable distance between the receiver and the transmitter. Therefore, if the cable distance were to be changed, a new matching network would be required in order to effect proper operation.

This need of designing matching networks and allowing only point-to-point communications is a thing of the past with the introduction of the Optologic gates. The Optologic gate, when used as a line receiver, does not require a matching network. Its input amplifier offers a 22Kohm input resistance which permits it to bridge the transmission. When it is used as the only receiver connected to the end of the transmission line, optimum speed performance will be obtained when the transmission line is terminated in its characteristic impedance (Zo).

When multiple data taps are required, all the designer need do is bridge the Optologic gate across the transmission line at the desired cable length. Figure 14 illustrates a simplex multi-drop (tap) data communications system that has incorporated four 74**OL**6001 gates as receivers, evenly spaced along a 1000 foot, 75 ohms co-axial transmission line. The cable used in this example is a Times Fiber & Cable Model RG59/U Series 2000. This cable includes a third insulated conductor that is used as the V_{CC} supply source for the input amplifier of the Optologic gates connected to the transmission line. This third conductor permits one simple isolated supply to power all the Optologic gates connected to the communications cable.

The common mode rejection and insulation of the communications system can be greatly improved by incorporating an Optologic gate as a line driver. When driving low impedance transmission lines such as the 75 ohm coax shown in Figure 14, a buffer is required to drive the line. This buffer is shown in Figure 15.

The signal quality "Eye Pattern" for the communications system shown in Figure 14 is provided in Figures 16 through 18 with a 10 MBaud NRZ Pseudo-Random Sequence (PRS). Traces 1-3 in Figure 16 describe the transmitter section. Traces 4-7 of Figure 17 show the output of the four Optologic bridged terminations. Traces 8-11 in Figure 18 illustrate the "Eye Pattern," as seen at the output of the 74**LS**04 logic gate. The data quality is well preserved, in that only a 30% eye closure is seen at the receiver located 1000 feet from the transmitter.

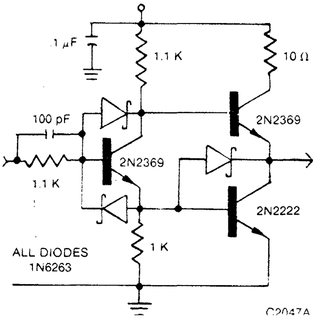


Fig. 15. Buffer

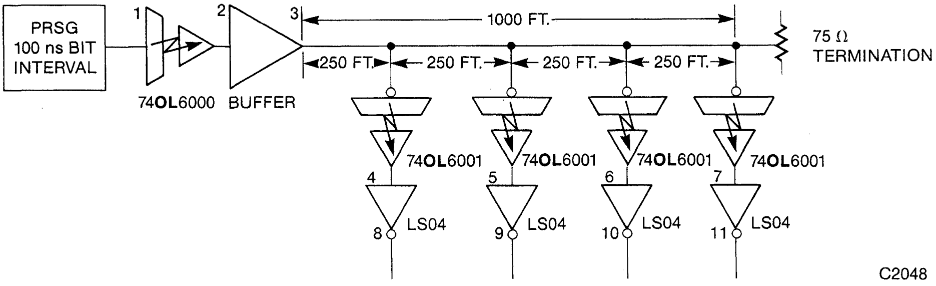


Fig. 14. Simplex Multi-drop Data Communications System

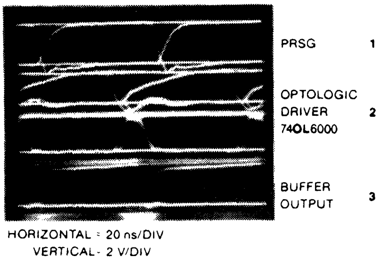


Fig. 16.

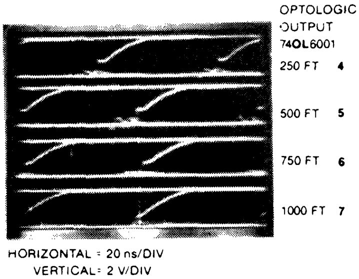


Fig. 17.

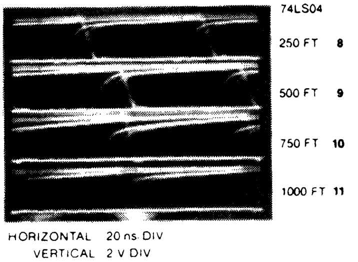


Fig. 18.

Through the use of the tri-state line driver, shown in Figure 19, a half duplex multi-drop communications system can be configured. This is done by adding this driver at each of the tap positions shown in Figure 14. This sytem provides the most common data communications configuration of high speed bi-directional communications, with the added features of vastly improved common mode transient rejection and insulation when compared to a common integrated line receiver.

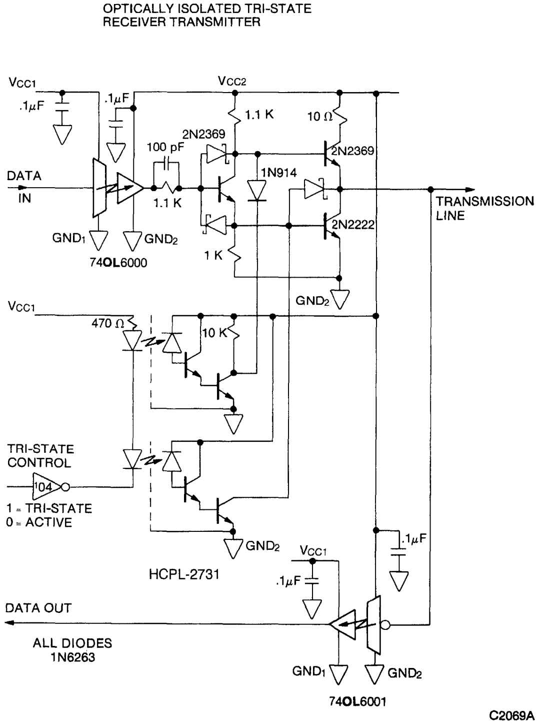


Fig. 19.

When high differential and common mode rejection are required, the differentially driven and received communications topology is considered. Figure 20 shows a full duplex point-to-point communications system that is implemented with twisted pair shielded cable. Given the higher impedance of this type of cable, it is possible for the Optologic gates to drive the line directly. Here, a 74**OL**6000 and 74**OL**6001 are used in a push-pull mode to differentially drive the line. The receiving end of the line is simply terminated in Zo. Bridging this termination is a DM8820 differential line receiver that is connected to the 74**OL**6000 Optologic gate. Power for the line receiver and the Optologic gate is derived from two insulated shields of the twisted pair cable. This system offers a data rate in excess of 1 MBaud NRZ at a distance of 600 feet.

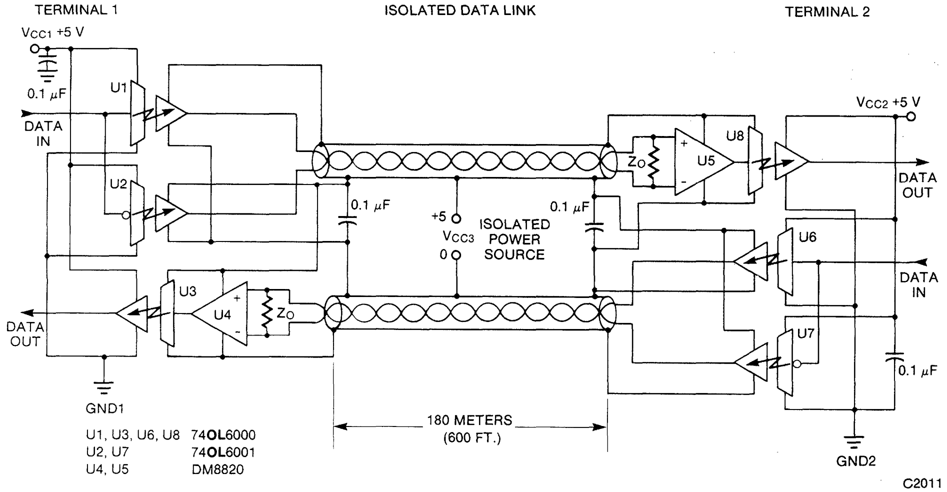


Fig. 20. 1 MBaud Full Duplex Differential Optically Isolated Transmit and Receive Data Transmission System with Shielded Twisted Pair.

AC VOLTAGE LEVEL MONITOR

The machine and process control industry has used optocouplers as voltage sensing devices for a number of years. These have proven very versatile when the presence or absence of power is to be determined. The monitoring of specific voltage levels has required the designer to commonly use selected couplers that have guaranteed gain at a specific LED drive current. Once armed with this specification, a resistor divider network is designed that will support 1 to 10 mA required by the LED. As the line voltage threshold increases, the power dissipation in the passive divier network can approach 2 watts.

Using the Optologic gate, a fixed AC or DC level monitor can easily be designed. Recall the Optologic gate has a fixed reference source built into the input amplifier. The stability and consistency of this reference source allows the designer to construct a level detector using standard product that will offer an accuracy of ±15%. If higher accuracy is needed, the factory can provide devices with tighter reerence voltage tolerance. Not only is high accuracy possible, but power required from the line is typically less than 0.2 W.

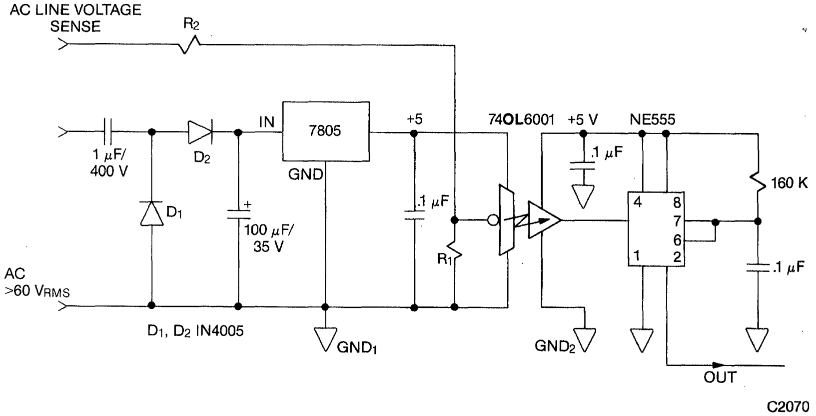


Fig. 21. Optologic Voltage Line Monitor and Power Supply

The most significant feature of the Optologic, in this application, is the small amount of current that is required to flow in the voltage divider. Under worst case design considerations, this sensing current will not exceed 500 μA. This low current permits the use of .25 W or smaller precision resistors, thus allowing even greater monitor accuracy.

For example, when sensing a voltage of 110 VAC, the power dissipated in the divider network is only 45mW.

Figure 21 shows a typical AC Line Monitor circuit. The threshold is determined by selecting the value of R1 and R2. Best accuracy is achieved when R1 is equal to or less than 2.2Kohm. Once R1 is selected, the value of R2 can be determined with the following equation.

$$R2 = \frac{R1\ R_N\ (Vth\ -\ Vref)}{Vref(R_N + R1)\ -\ R1V}$$

Where

Vth = Selected AC or DC switching level
Vref = 1.34V
R_N = 22Kohm
V = 4.3V

This equation has been solved graphically in Figure 22.

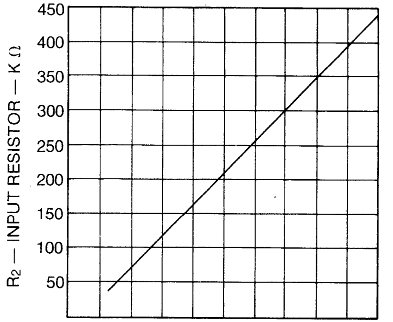


Fig. 22. Input Resistor vs. Threshold Voltage

The monitor circuit shown in Figure 21 consists of three elements. The first is an Optologic power supply, the second is the voltage divider, and the third is the retriggerable one-shot.

The power supply consists of a capacitor voltage divider and 5V regulator. A capacitor divider was used to minimize the power consumption from the AC line. This power supply will provide over 15 mA when the line voltage exceeds 60V RMS.

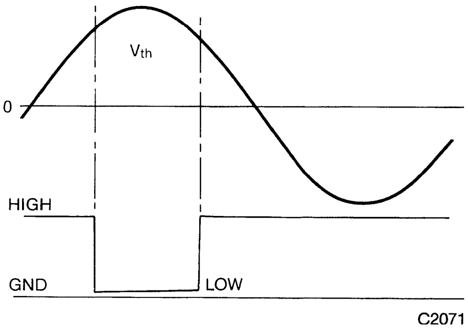


*Fig. 23. 74**OL**0001 AC Level Detection Waveform*

The voltage divider (R1, R2) sets the monitor threshold point of the sensor. R1 is used as an Optologic input pull-down, thus, as the input voltage rises, it forces current through R1 which raises its voltage up to the Vref of the Optologic input. Once the reference voltage is exceeded, the output of the Optologic will change state. Figure 23 illustrates the relationship of the input voltage to the 74**OL**6001 output. It can be seen that the output is a series of pulses, whose width is determined by the duration that the input waveform exceeds the voltage threshold.

The final section of the sensor consists of a retriggerable one-shot, constructed with an NE555 timer. This one-shot is included to convert the pulse train into a constant logic level. For best stability, a time constant of 1-1/4 cycles was selected. When a 60Hz power main is to be monitored, this becomes a time constant of 18ms. Thus, as the input voltage exceeds the monitor threshold, the output of the 74**OL**6001 changes from high to low, thus triggering the NE555 timer. Once triggered, the NE555 outputs a logic high and will stay high as long as it is triggered every 16ms.

CONCLUSION

The Optologic family of TTL and CMOS compatible devices is a new and easy-to-use optically coupled logic circuit element. This Application Note has provided but few of many new uses for this versatile device. Not only does this device provide high noise immunity and level shifting for logic-to-logic interfaces, it also has numerous applications in data communications and industrial control systems.

FORMER HARRIS OPTOCOUPLER PRODUCTS

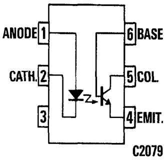
Products described in this Data Book section include optocouplers formerly manufactured by Harris Semiconductor. These products were acquired in 1991 when QTC purchased Harris' optoelectronics business.

A new OPTOPLANAR™ assembly process is now in use for all former Harris 6-pin Optocoupler Products. A brief description of this process can be found on page 7 of this Data Book.

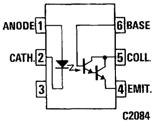
FORMER HARRIS OPTOCOUPLERS

Alphanumeric Product Listing

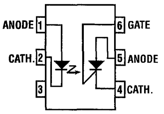
OPTOCOUPLERS TRANSISTOR-OUTPUT

EQUIVALENT CIRCUIT	PART NUMBER	$CTR_{CE(SAT)}$ MIN.		CTR_{CE} MIN.			BV_{CEO}	$VDE^{1,2}$ AVAIL	WITHSTAND TEST VOLTAGE	PAGE
		@ I_F =	mA	@ V_{CE} =	V	I_F = mA				
	H11A1	5%	10	50%	10	10	30	VDE	7500 VAC PEAK	2-13
	H11A2	5%	10	20%	10	10	30	VDE	7500 VAC PEAK	2-13
	H11A3	5%	10	20%	10	10	30	VDE	7500 VAC PEAK	2-13
	H11A4	5%	10	10%	10	10	30	VDE	7500 VAC PEAK	2-13
	H11A5	5%	10	30%	10	10	30	VDE	7500 VAC PEAK	2-13
	H11AG1	25%	2.0	300%	5	1.0	30	VDE	7500 VAC PEAK	2-17
	H11AG1	25%	2.0	100%	0.6	1.0	30	VDE	7500 VAC PEAK	2-17
	H11AG1	25%	2.0	100%	1.5	0.2	30	VDE	7500 VAC PEAK	2-17
	H11AG2	25%	2.0	200%	5	1.0	30	VDE	7500 VAC PEAK	2-17
	H11AG2	25%	2.0	50%	0.6	1.0	30	VDE	7500 VAC PEAK	2-17
	H11AG2	25%	2.0	50%	1.5	0.2	30	VDE	7500 VAC PEAK	2-17
	H11AG3	25%	2.0	100%	5	1.0	30	VDE	7500 VAC PEAK	2-17
	H11AG3	25%	2.0	20%	0.6	1.0	30	VDE	7500 VAC PEAK	2-17

OPTOCOUPLERS DARLINGTON-OUTPUT

EQUIVALENT CIRCUIT	PART NUMBER	$CTR_{CE(SAT)}$ MIN.			CTR_{CE} MIN. @ IF = mA	BV_{CEO} MIN VOLT	$VDE^{1,2}$ AVAIL	WITHSTAND TEST VOLTAGE	PAGE
		@ I_F =	mA	$VCE_{(SAT)}$					
	H11B1	100%	1.0	1.0V	500% 1.0	25	VDE	7500 VAC PEAK	2-21
	H11B2	100%	1.0	1.0V	200% 1.0	25	VDE	7500 VAC PEAK	2-21
	H11B3	100%	1.0	1.0V	100% 1.0	25	VDE	7500 VAC PEAK	2-21

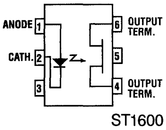
OPTOCOUPLERS SCR-OUTPUT

EQUIVALENT CIRCUIT	PART NUMBER	I_{FT} Max		V_{DM} MIN	V_{RM} MIN	$VDE^{1,2}$ AVAIL.	WITHSTAND TEST VOLTAGE	PAGE
		@ VAK =	V					
 ST1602	4N39	30mA	50	200V	200V	VDE	7500 VAC PEAK	2-7
	4N39	14mA	100	200V	200V	VDE	7500 VAC PEAK	2-7
	4N40	30mA	50	400V	400V	VDE	7500 VAC PEAK	2-7
	4N40	14mA	100	400V	400V	VDE	7500 VAC PEAK	2-7
	H11C1	20mA	50	200V	200V	VDE	7500 VAC PEAK	2-25
	H11C1	11mA	100	200V	200V	VDE	7500 VAC PEAK	2-25
	H11C2	20mA	50	200V	200V	VDE	7500 VAC PEAK	2-25
	H11C2	11mA	100	200V	200V	VDE	7500 VAC PEAK	2-25
	H11C3	30mA	50	200V	200V	VDE	7500 VAC PEAK	2-25
	H11C3	14mA	100	200V	200V	VDE	7500 VAC PEAK	2-25
	H11C4	20mA	50	400V	400V	VDE	7500 VAC PEAK	2-25
	H11C4	11mA	100	400V	400V	VDE	7500 VAC PEAK	2-25
	H11C5	20mA	50	400V	400V	VDE	7500 VAC PEAK	2-25
	H11C5	11mA	100	400V	400V	VDE	7500 VAC PEAK	2-25
	H11C6	30mA	50	400V	400V	VDE	7500 VAC PEAK	2-25
	H11C6	14mA	100	400V	400V	VDE	7500 VAC PEAK	2-25

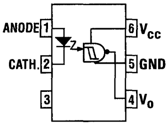
[1] To order VDE Device, Add −.300 suffix to part number

[2] VDE qualification pending. Call QT.

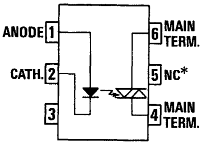
OPTOCOUPLER FET-OUTPUT

EQUIVALENT CIRCUIT	PART NUMBER	BV_{46} MIN	r_{46} MAX.	r_{64} MAX.	VDE[1,2] AVAIL.	WITHSTAND TEST VOLTAGE	PAGE
 ST1600	H11F1	30V	200Ω	200Ω	VDE	7500 VAC PEAK	2-31
	H11F2	30V	330Ω	330Ω	VDE	7500 VAC PEAK	2-31
	H11F3	30V	470Ω	470Ω	VDE	7500 VAC PEAK	2-31

OPTOCOUPLER SCHMITT TRIGGER OUTPUT

EQUIVALENT CIRCUIT	PART NUMBER	$IF_{(ON)}$ MAX.	$IF_{(ON)}$ MIN.	VOL MAX.	VDE[1,2] AVAIL.	WITHSTAND TEST VOLTAGE	PAGE
 ST1601	H11L1	1.6mA		0.4V	VDE	7500 VAC PEAK	2-35
	H11L2	10.0mA		0.4V	VDE	7500 VAC PEAK	2-35
	H11L3	5.0mA		0.4V	VDE	7500 VAC PEAK	2-35
	H11N1	3.2mA	0.8mA	0.5V	VDE	7500 VAC PEAK	2-41
	H11N2	5.0mA	2.3mA	0.5V	VDE	7500 VAC PEAK	2-41
	H11N3	10.0mA	4.1mA	0.5V	VDE	7500 VAC PEAK	2-41

OPTOCOUPLER TRIAC OUTPUT

EQUIVALENT CIRCUIT	PART NUMBER	I_{FT} MAX.	V_{DRM} MIN.	VDE[1,2] AVAIL.	WITHSTAND TEST VOLTAGE	PAGE
 *DO NOT CONNECT (TRIAC SUBSTRATE) C2081	MOC3009	30mA	250V	VDE	7500 VAC PEAK	2-55
	MOC3010	15mA	250V	VDE	7500 VAC PEAK	2-55
	MOC3011	10mA	250V	VDE	7500 VAC PEAK	2-55
	MOC3012	5mA	250V	VDE	7500 VAC PEAK	2-55
	MOC3020	30mA	400V	VDE	7500 VAC PEAK	2-61
	MOC3021	15mA	400V	VDE	7500 VAC PEAK	2-61
	MOC3022	10mA	400V	VDE	7500 VAC PEAK	2-61
	MOC3023	5mA	400V	VDE	7500 VAC PEAK	2-61

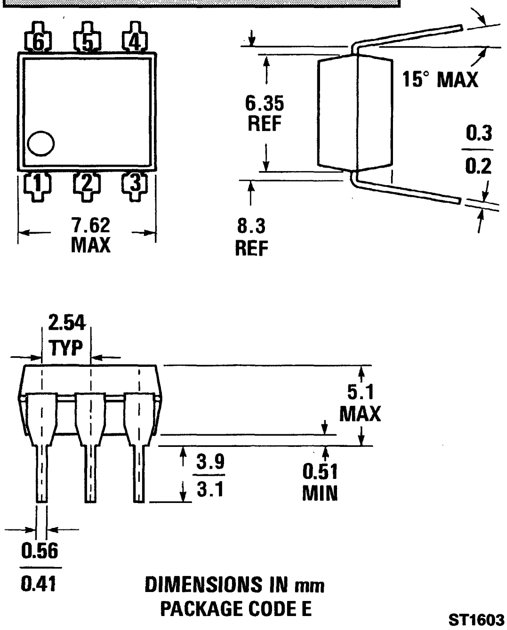
[1] To order VDE device, add .300 suffix to part number

[2] VDE qualification pending. Call QT.

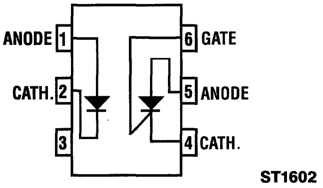
PHOTO SCR OPTOCOUPLERS

4N39 4N40

PACKAGE DIMENSIONS



DIMENSIONS IN mm
PACKAGE CODE E



Equivalent Circuit

DESCRIPTION

The 4N39 and 4N40 have a gallium-arsenide infrared emitting diode optically coupled with a light activated silicon controlled rectifier in a dual in-line package.

FEATURES & APPLICATIONS

- High efficiency, low degradation, liquid epitaxial LED
- 10 A, T²L compatible, solid state relay
- 25 W logic indicator lamp driver
- 400 V symmetrical transistor coupler
- Underwriters Laboratory (UL) recognized — File #E90700

ABSOLUTE MAXIMUM RATINGS

TOTAL PACKAGE

*Storage temperature	−55°C to 150°C
*Operating temperature	−55°C to 100°C
*Lead solder temperature	260°C for 10 sec
*Total power dissipation (−55°C to 50°C)	450 mW
Derate linearly (above 50°C)	9.0 mW/°C

INPUT DIODE

*Power dissipation (−55°C to 50°C)	100 mW
Derate linearly (above 50°C)	2 mW/°C
*Continuous forward current (−55°C to 50°C)	60 mA
*Peak forward current (−55°C to 50°C)	1 A
*Reverse voltage (−55°C to 50°C)	6 V

DETECTOR

*Power dissipation (−55°C to 50°C)		400 mW
Derate linearly (above 50°C)		8 mW/°C
*Off-state and reverse voltage	4N39	200 V
*(−55°C to +100°C)	4N40	400 V
*Peak reverse gate voltage(−55°C to 50°C)		6 V
*Direct on-state current (−55°C to 50°C)		300 mA
*Surge on-state current (−55°C to 50°C) (100μS)		10 A
*Peak gate current (−55°C to 50°C)		10 mA

*Indicates JEDEC Registered Data

ELECTRICAL CHARACTERISTICS (T_A= 25° Unless Otherwise Specified)

INDIVIDUAL COMPONENT CHARACTERISTICS

PARAMETER	SYMBOL	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS
INPUT DIODE						
*Forward voltage	V_F		1.1	1.5	V	I_F=10 mA
*Reverse leakage current	I_R			10	µA	V_R=3 V
Capacitance	C_J		50		pF	V=0 V, f=1 MHz
OUTPUT DETECTOR						
*Peak off-state voltage (4N39)	V_{DM}	200			V	R_{GK}=10 kΩ, T_A=100°C
(4N40)	V_{DM}	400			V	R_{GK}=10 kΩ, T_A=100°C
*Peak reverse voltage (4N39)	V_{RM}	200			V	T_A=100°C
(4N40)	V_{RM}	400			V	T_A=100°C
*On-state voltage	V_T			1.3	V	I_T=300 mA
*Off-state current (4N39)	I_{DM}			50	µA	V_{DM}=200 V, T_A=100°C, I_F=0, R_{GK}=10 KΩ
(4N40)	I_{DM}			150	µA	V_{DM}=400 V, T_A=100°C, I_F=0, R_{GK}=10 KΩ
*Reverse current (4N39)	I_R			50	µA	V_R=200 V, T_A=100°C, I_F=0
(4N40)	I_R			150	µA	V_R=400 V, T_A=100°C, I_F=0
*Holding current	I_R			1.0	mA	V_{Fx}=50 V, R_{GK}=27 kΩ

TRANSFER CHARACTERISTICS

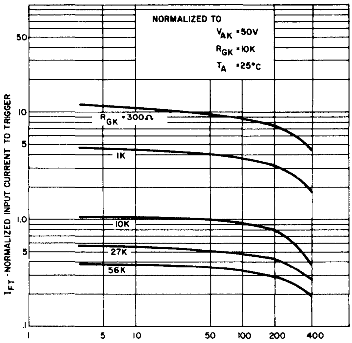
CHARACTERISTIC	SYMBOL	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS
*Input current to trigger (4N39, 4N40)	I_{FT}			30	mA	V_{AK}=50 V, R_{GK}=10 kΩ
(4N39, 4N40)	I_{FT}			14	mA	V_{AK}=100 V, R_{GK}=27 kΩ
*Turn-on time	t_{on}			50	µs	V_{AK}=50 V, I_F=30 mA, R_{GK}=10 kΩ, RL=200 Ω
Package capacitance (input to output)				2	pF	Input to putput voltage=0 f=1 MHz
Coupled dv/dt, input to output (figure 13)		500			V/µs	

ISOLATION CHARACTERISTICS

CHARACTERISTIC	SYMBOL	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS
Surge isolation voltage	V_{ISO}	7500			V	1 Minute
Isolation voltage	V_{ISO}	5300			V	1 Minute
*Isolation resistance	R_{ISO}	10^{11}			ohms	V_{I-O}=500 VDC

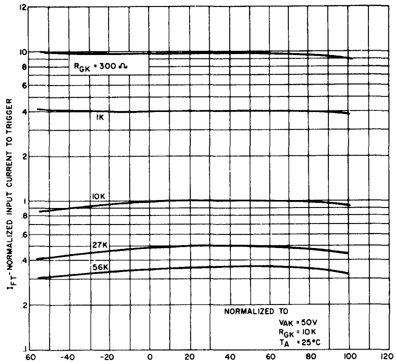
*Indicates JEDEC Registered Data

TYPICAL CHARACTERISTICS



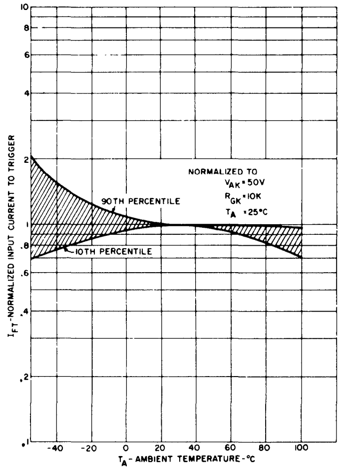
ST2104

Figure 1. Input Current To Trigger vs. Anode-Cathode Voltage



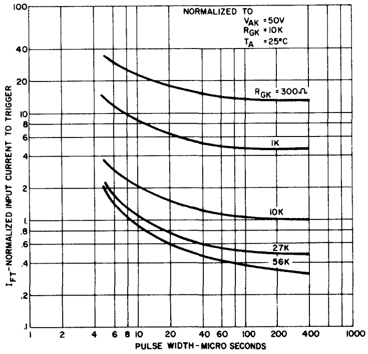
ST2106

Figure 2. Input Current To Trigger vs. Temperature



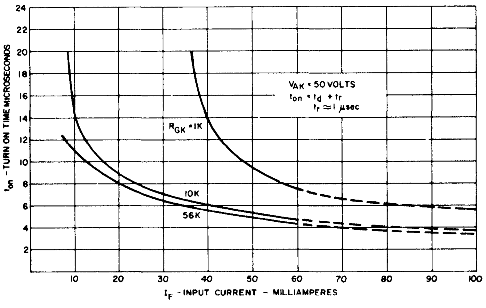
ST2107

Figure 3. Input Current To Trigger Distribution vs. Temperature



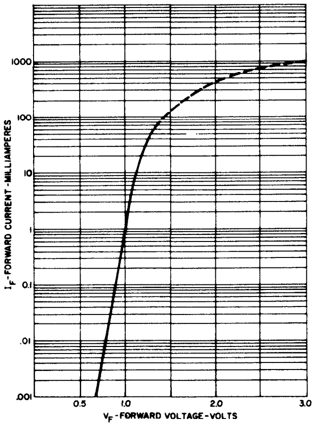
ST2108

Figure 4. Input Current To Trigger vs. Pulse Width



ST2109

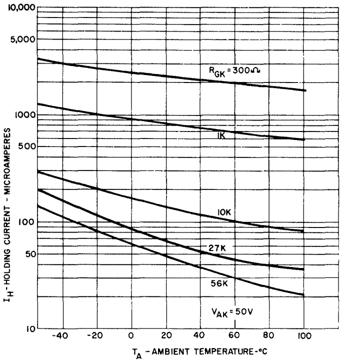
Figure 5. Turn-On Time vs. Input Current



ST2110

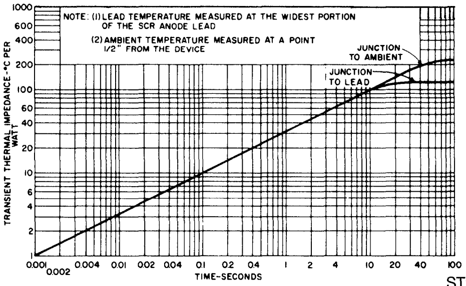
Figure 6. Input Characteristics I_F vs. V_F

TYPICAL CHARACTERISTICS OF OUTPUT (SCR)



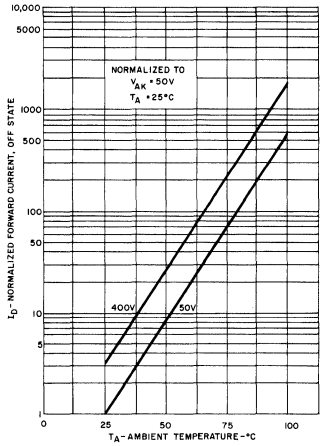
ST2111

Figure 7. Holding Current vs. Temperature



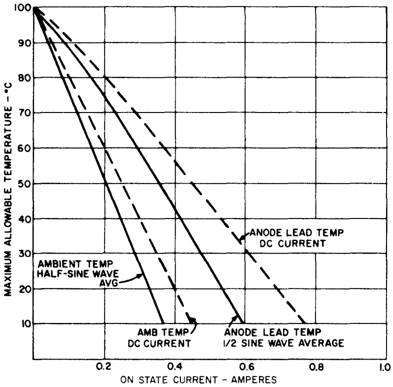
ST2112

Figure 8. Maximum Transient Thermal Impedance



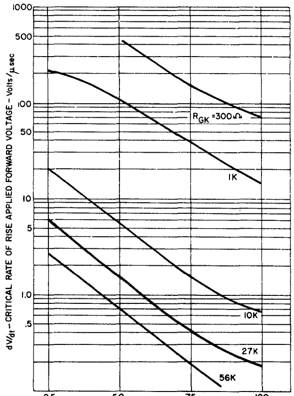
ST2113

Figure 9. Off-State Forward Current vs. Temperature



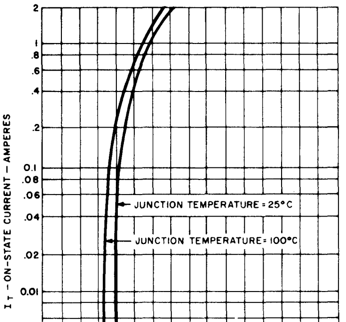
ST2114

Figure 10. On-State Current vs Maximum Allowable Temperature



ST2115

Figure 11. dv/dt vs. Temperature



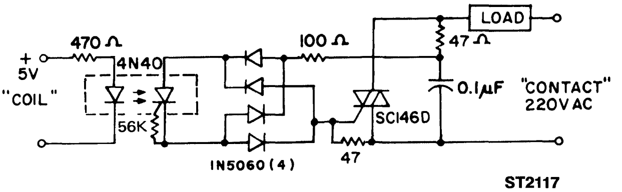
ST2116

Figure 12. On-State Characteristics

TYPICAL APPLICATIONS

10A, T²L COMPATIBLE, SOLID STATE RELAY

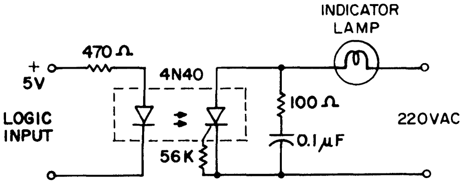
Use of the 4N40 for high sensitivity, 5300V isolation capability, provides this highly reliable solid state relay design. This design is compatible with 74, 74S and 74H series T²L logic systems inputs and 220V AC loads up to 10A.



ST2117

25W, LOGIC INDICATOR LAMP DRIVER

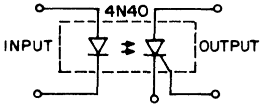
The high surge capability and non-reactive input characteristics of the 4N40 allow it to directly couple, without buffers, T²L and DTL logic to indicator alarm devices, without danger of introducing noise and logic glitches.



ST2118

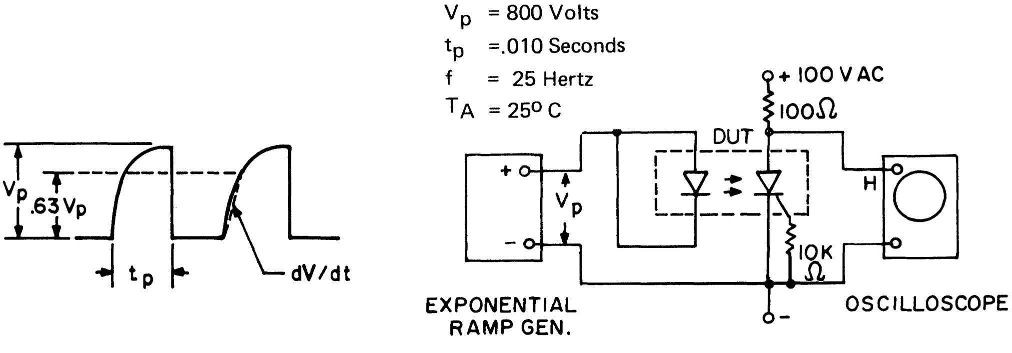
400V SYMMECTRICAL TRANSISTOR COUPLER

Use of the high voltage PNP portion of the 4N40 provides a 400V transistor capable of conducting positive and negative signals with current transfer ratios of over 1%. This function is useful in remote instrumentation, high voltage power supplies and test equipment. Care should be taken not to exceed the 400 mW power dissipation rating when used at high voltages.



ST2119

FIGURE 13
COUPLED dv/dt - TEST CIRCUIT



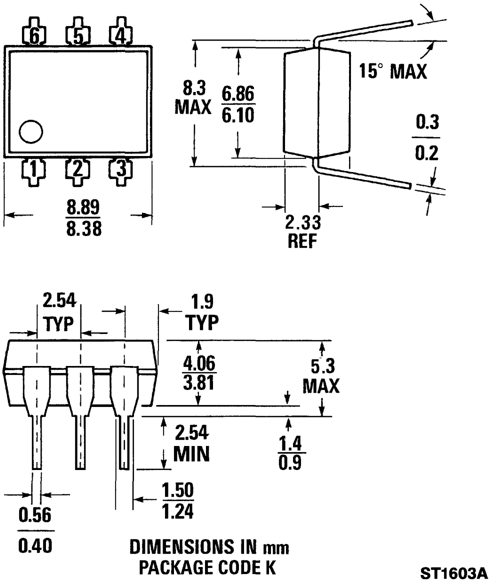
V_p = 800 Volts
t_p =.010 Seconds
f = 25 Hertz
T_A = 25° C

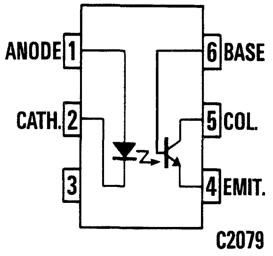
ST2120

PHOTOTRANSISTOR OPTOCOUPLERS

H11A1 H11A2 H11A3
H11A4 H11A5

PACKAGE DIMENSIONS





Equivalent Circuit

DESCRIPTION

The H11A series consists of a gallium arsenide infrared emitting diode. coupled with a silicon phototransistor in a dual in-line package.

FEATURES

- Power supply regulators
- Digital logic inputs
- Microprocessor inputs
- Appliance sensor systems
- Industrial controls
- Underwriters Laboratory (UL) recognized—File #E90700

ABSOLUTE MAXIMUM RATINGS

TOTAL PACKAGE

Storage temperature	−55°C to 150°C
Operating temperature	−55°C to 100°C
Lead solder temperature	260°C for 10 sec

INPUT DIODE

Power dissipation (25°C ambient)	100 mW
Derate linearly (above 25°C ambient)	1.33 mW/°C
Continuous forward current	60 mA
Peak forward current (1 μs pulse, 300pps)	3 A
Reverse voltage	3 V

DETECTOR

Power dissipation (at 25°C ambient)	150 mW
Derate linearly (above 25°C)	2.0 mW/°C
V_{CEO}	30 V
V_{CBO}	70 V
V_{ECO}	7 V
Continuous collector current	100 mA

ELECTRICAL CHARACTERISTICS (T_A= 25°C Unless Otherwise Specified)

INDIVIDUAL COMPONENT CHARACTERISTICS

PARAMETER	SYMBOL	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS
INPUT DIODE Forward voltage	V_F		1.1	1.5	V	I_F=10 mA
Reverse leakage current	I_R			10	μA	V_R=3 V
Capacitance	C		50		pF	V=0 V, f=1 MHz
OUTPUT DETECTOR Breakdown voltage Collector to emitter	BV_{CEO}	30			V	I_C = 10 mA, I_F = 0
Breakdown voltage Collector to base	BV_{CBO}	70			V	I_C = 100 μA, I_F = 0
Breakdown voltage Emitter to Collector	BV_{ECO}	7			V	I_E = 100 μA, I_F = 0
Collector dark current	I_{CEO}		5	50	nA	V_{CE} = 10 V, I_F = 0
Capacitance	C		2		pF	V_{CE} = 10 V, f = 1 MHz

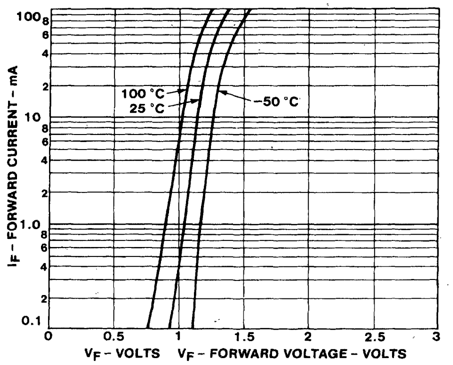
TRANSFER CHARACTERISTICS

CHARACTERISTIC		SYMBOL	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS
DC current transfer ratio	(H11A1)	I_C	5.0			mA	I_F = 10 mA, V_{CE} = 10 V
	(H11A2)	I_C	2.0			mA	I_F = 10 mA, V_{CE} = 10 V
	(H11A3)	I_C	2.0			mA	I_F = 10 mA, V_{CE} = 10 V
	(H11A4)	I_C	1.0			mA	I_F = 10 mA, V_{CE} = 10 V
	(H11A5)	I_C	3.0			mA	I_F = 10 mA, V_{CE} = 10 V
Saturation voltage		$V_{CE(SAT)}$		0.1	0.4	V	I_F = 10 mA, I_C = 0.5 mA
Rise/fall time		$t_{r/f}$		2		μs	I_{CE} = 2 mA, V_{CE} = 10 V, R_L = 100Ω
Rise/fall time		$t_{r/f}$		300		ns	I_{CB} = 50 μA, V_{CB} = 10 V, R_L = 100Ω

ISOLATION CHARACTERISTICS

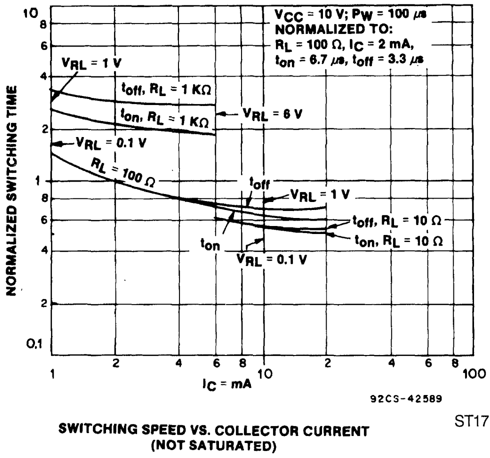
Surge isolation voltage	V_{ISO}	7500			V_{Peak}	1 Minute
Surge isolation voltage	V_{ISO}	5300			V_{RMS}	1 Minute
Isolation resistance	R_{ISO}	10^{11}			ohms	V_{I-O} = 500 VDC
Isolation capacitance	C_{ISO}			2	pF	V_{I-O} = 0, f = 1 MHz

TYPICAL CHARACTERISTICS



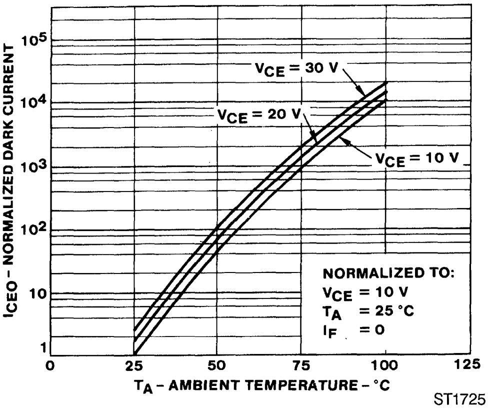
ST1723

1. *Input Characteristics*



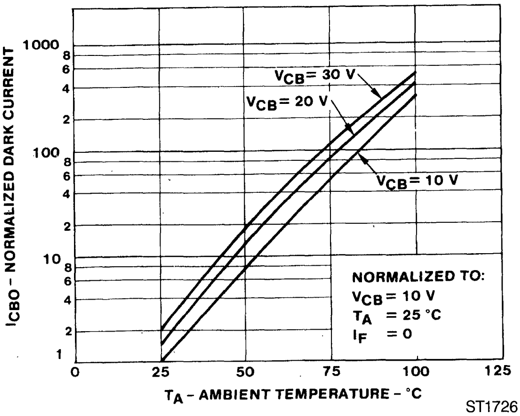
ST1724

2. *Switching Speed vs. Collector Current (Not Saturated)*



ST1725

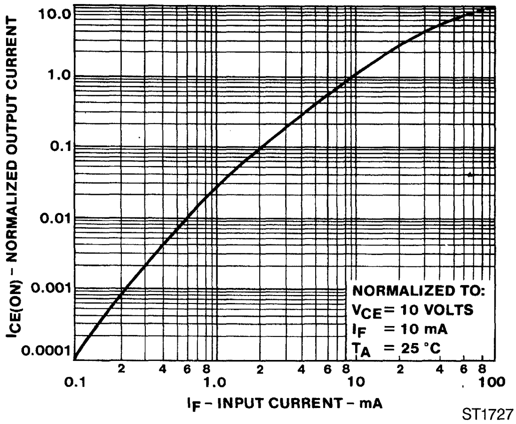
3. *Dark I_{CEO} Current vs. Temperature*



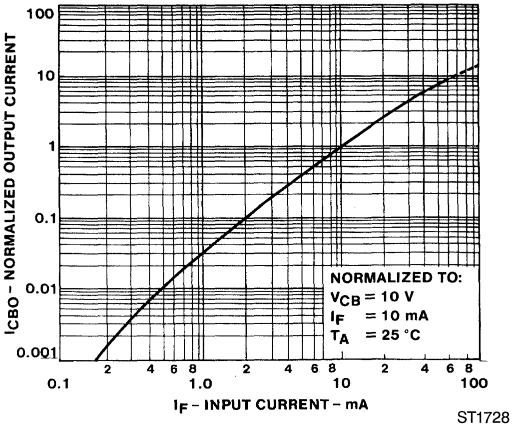
ST1726

4. *I_{CBO} vs. Temperature*

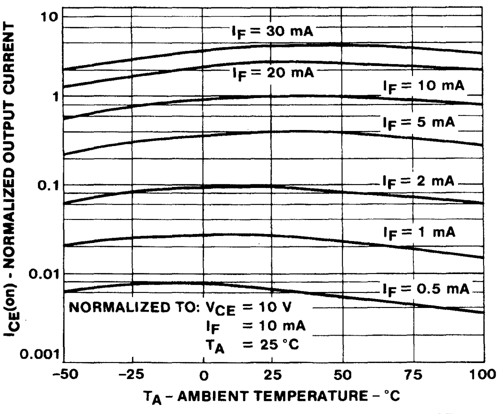
TYPICAL CHARACTERISTICS



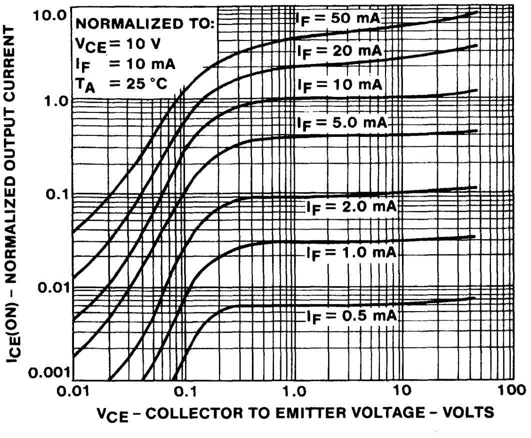
5. *Output Current vs. Input Current*



6. *Output Current — Collector To Base vs. Input Current*



7. *Output Current vs. Temperature*

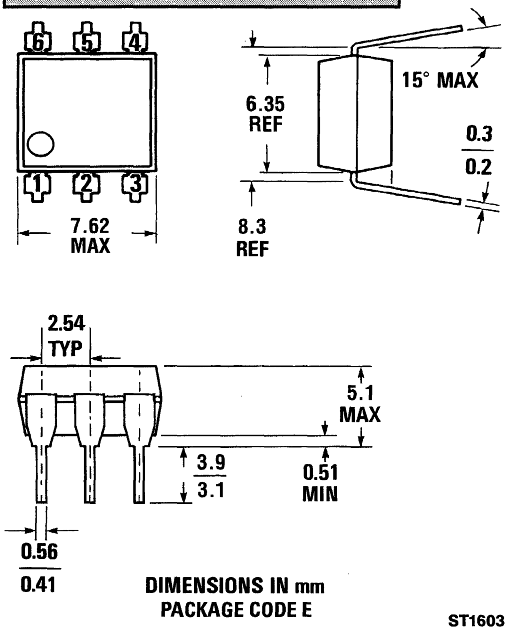


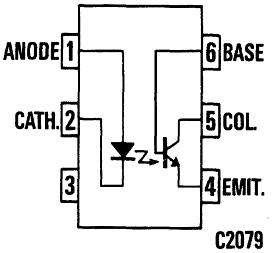
8. *Output Characteristics*

QT OPTOELECTRONICS

H11AG1 H11AG2 H11AG3

PACKAGE DIMENSIONS





Equivalent Circuit

DESCRIPTION

The H11AG series consists of a gallium-aluminum-arsenide infrared emitting diode coupled with a silicon phototransistor in a dual in-line package. This device provides the unique feature of high current transfer ratio at both low output voltage and low input current. This makes it ideal for use in low power logic circuits, telecommunications equipment and portable electronics isolation applications.

FEATURES

- High efficiency low degradation liquid epitaxial IRED
- Logic level compatible, input and output currents, with CMOS and LS/TTL
- High DC current transfer ratio at low input currents
- Underwriters Laboratory (UL) recognized — File #E90700

APPLICATIONS

- CMOS driven solid state relay
- Telephone ring detector
- Digital logic isolation

ABSOLUTE MAXIMUM RATINGS

TOTAL PACKAGE

Storage temperature	−50°C to 150°C
Operating temperature	−50°C to 100°C
Lead solder temperature	260°C for 10 sec

INPUT DIODE

Power dissipation (25°C ambient)	75 mW
Derate linearly (above 25°C)	1.0 mW/°C
Continuous forward current	50 mA
Reverse voltage	6 V

DETECTOR

Power dissipation (at 25°C ambient)	150 mW
Derate linearly (above 25°C ambient)	2.0 mW/°C
V_{CEO}	30 V
V_{CBO}	70 V
V_{ECO}	7 V
Continuous collector current	50 mA

ELECTRICAL CHARACTERISTICS (T_A=0-70° Unless Otherwise Specified)

INDIVIDUAL COMPONENT CHARACTERISTICS

PARAMETER	SYMBOL	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS
INPUT DIODE Forward voltage	V_F			1.5	V	I_F=1 mA
Reverse current	I_R			10	μA	V_R=5 V, T_A=25°C
	I_R			100	μA	V_R=5 V, T_A=70°C
Capacitance	C_J			100	pF	V=0, f=1 MHz
OUTPUT DETECTOR Breakdown voltage Collector to emitter	BV_{CEO}	30			V	I_C=1 mA, I_F=0
Breakdown voltage Collector to base	BV_{CBO}	70			V	I_C=100 μA, I_F=0
Breakdown voltage Emitter to Collector	BV_{ECO}	7			V	I_C=100 μA, I_F=0
Leakage current Collector to emitter	I_{CEO}		5	10	μA	V_{CE}=10 V, I_F=0
Capacitance	C_{CE}		2		pF	V_{CE}=10 V, f=1 MHz

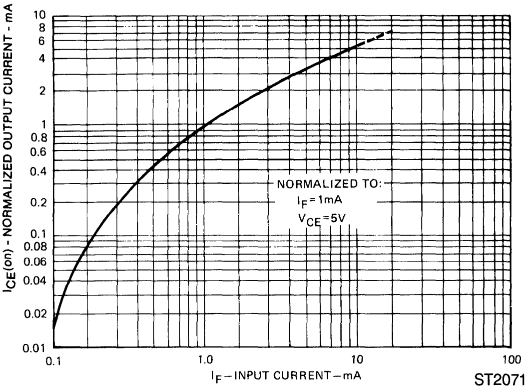
TRANSFER CHARACTERISTICS

CHARACTERISTIC		SYMBOL	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS
DC current transfer ratio	(H11AG1)	CTR	300			%	I_F=1 mA, V_{CE}=5V
	(H11AG2)	CTR	200			%	I_F=1 mA, V_{CE}=5V
	(H11AG3)	CTR	100			%	I_F=1 mA, V_{CE}=5V
	(H11AG1)	CTR	100			%	I_F=1 mA, V_{CE}=0.6V
	(H11AG2)	CTR	50			%	I_F=1 mA, V_{CE}=0.6V
	(H11AG3)	CTR	20			%	I_F=1 mA, V_{CE}=0.6V
	(H11AG1)	CTR	100			%	I_F=0.2 mA, V_{CE}=1.5V
	(H11AG2)	CTR	50			%	I_F=0.2 mA, V_{CE}=1.5V
Saturation voltage		$V_{CE(SAT)}$			0.4	V	I_F=2.0 mA, I_C=0.5 mA
Turn-on time		t_{on}		5		μs	V_{cc}=5 V, I_F=1 mA, R_L=100 Ω
Turn-off time		t_{off}		5		μs	V_{cc}=5 V, I_F=1 mA, R_L=100 Ω

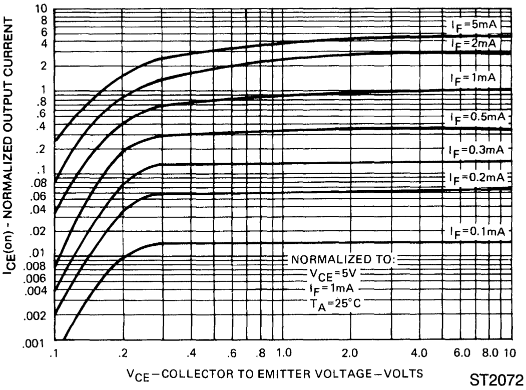
ISOLATION CHARACTERISTICS

Surge isolation voltage	V_{ISO}	7500	V_{Peak}	1 Minute
Surge isolation voltage	V_{ISO}	5300	V_{RMS}	1 Minute

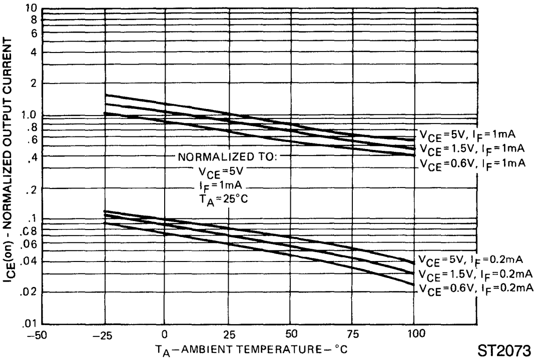
TYPICAL CHARACTERISTICS



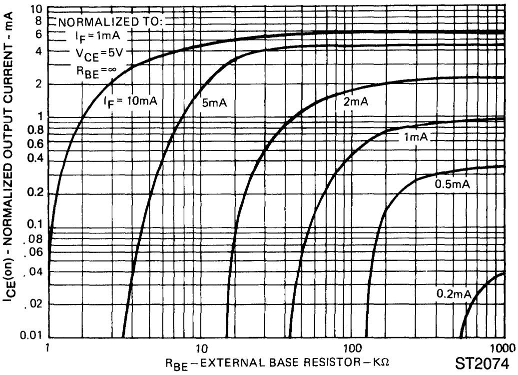
Output Current vs. Input Current



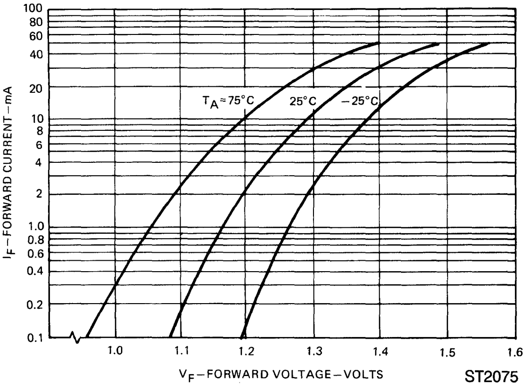
Output Current vs. Collector-Emitter Voltage



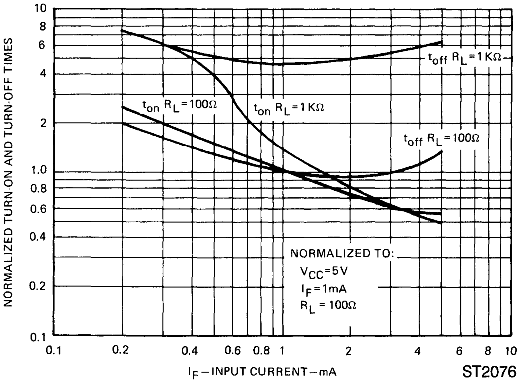
Output Current vs. Temperature



Output Current vs. Base Emitter Resistance

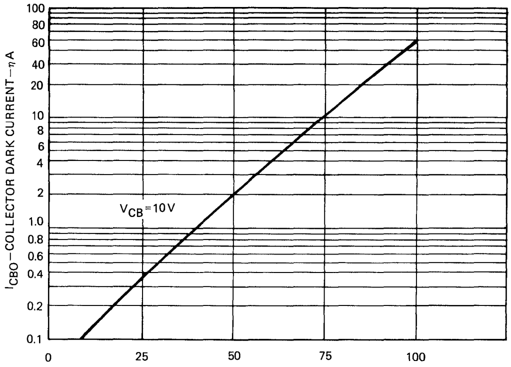


Input Voltage vs. Input Current



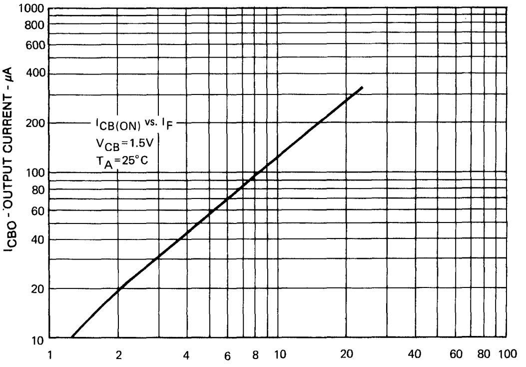
Switching Times vs. Input Current

TYPICAL CHARACTERISTICS



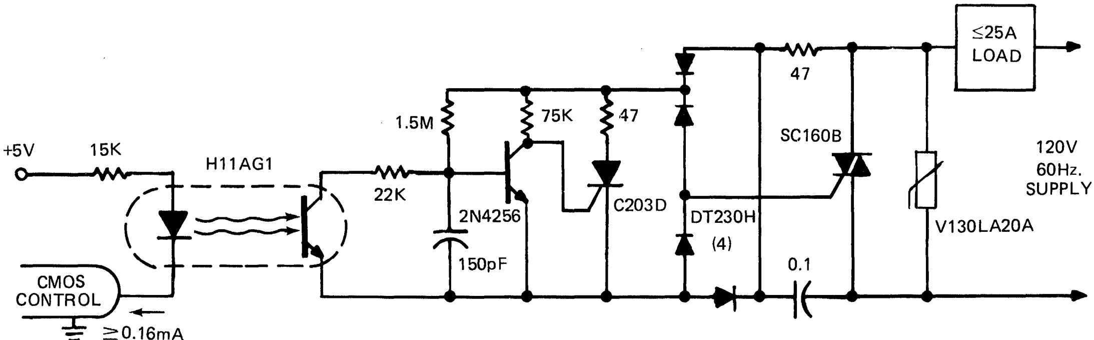
ST2122

I_{CBO} vs. Temperature



ST2123

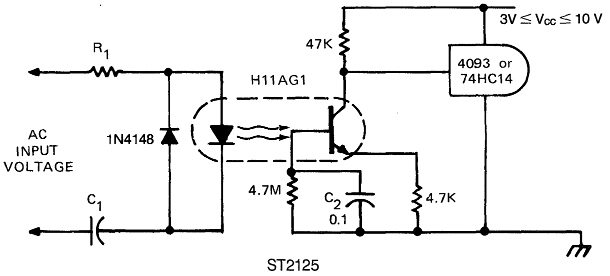
Output Current — Collector-Base vs. Input Current



ST2124

CMOS Input, 3KW, Zero Voltage Switching Solid State Relay

The H11AG1 superior performance at low input currents allows standard CMOS logic circuits to directly operate a 25A solid state relay. Circuit operation is as follows: power switching is provided by the SC160B, 25A triac. Its gate is controlled by the C203B via the DT230H rectifier bridge. The C203B turn-on is inhibited by the 2N4256 when line voltage is above 12V and/or the H11AG1 is off. False trigger and dv/dt protection are provided by the combination of a GE-MOV® varistor and RC snubber network.



ST2125

INPUT	R_1	C_1	Z
40-90 VRMS 20 Hz.	75K 1/10 W	0.1 μF 100 V	109K
95-135 VRMS 60 Hz.	180K 1/10 W	12 ηF 200 V	285K
200-280 VRMS 50/60 Hz.	390K 1/4 W	6.80 ηF 400 V	550K

DC component of input voltage is ignored due to C1

TELEPHONE RING DETECTOR/A.C. LINE CMOS INPUT ISOLATOR

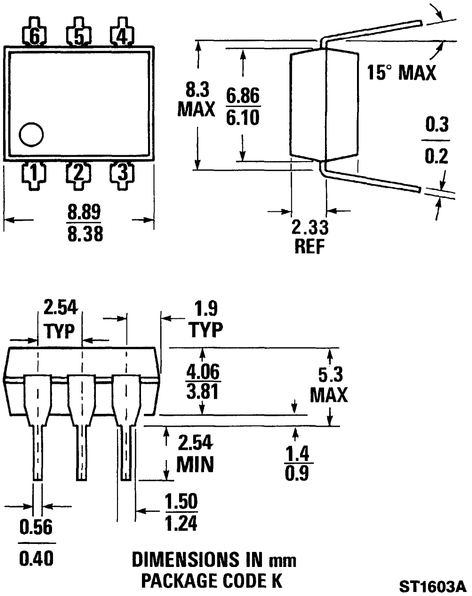
The H11AG1 uses less input power than the neon bulb traditionally used to monitor telephone and line voltages. Additionally, response time can be tailored to ignore telephone dial tap, switching transients and other undesired signals by modifying the value of C2. The high impedance to line voltage also can simplify board layout spacing requirements.

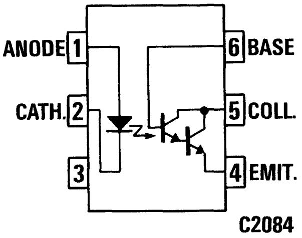
QT OPTOELECTRONICS

PHOTODARLINGTON OPTOCOUPLERS

H11B1 H11B2
H11B3

PACKAGE DIMENSIONS





Equivalent Circuit

DESCRIPTION

The H11B series consists of a gallium arsenide infrared emitting diode. coupled with a silicon photodarlington transistor in a dual in-line package.

FEATURES

- High current transfer ratio
  H11B1 - 500% min.
  H11B2 - 200% min.
  H11B3 - 100% min.
- Underwriters Laboratory (UL) recognized file #E90700

APPLICATIONS

- Isolated, logic ontrolled, indicator lamp switch
- Replace pulse transformers
- Form multiple contact, NO/NC relays
- Useful for telephone lines, SCR triggers, hospital monitoring systems, airborne systems, remote data gathering systems and remote control systems
- Use a low-current alarm monitor for battery powered supplies

ABSOLUTE MAXIMUM RATINGS

TOTAL PACKAGE

Storage temperature	−55°C to 150°C
Operating temperature	−55°C to 100°C
Lead solder temperature	260°C for 10 sec

INPUT DIODE

Power dissipation (25°C ambient)	100 mW
Derate linearly (above 25°C)	1.33 mW/°C
Continuous forward current	60 mA
Peak forward current (1 μs pulse, 300pps)	3 A
Reverse voltage	3 V

DETECTOR

Power dissipation (at 25°C ambient)	150 mW
Derate linearly (above 25°C)	2.0 mW/°C
V_{CEO}	25 V
V_{CBO}	30 V
V_{EBO}	7 V
Continuous collector current	100 mA

ELECTRICAL CHARACTERISTICS (T_A= 25°C Unless Otherwise Specified)

INDIVIDUAL COMPONENT CHARACTERISTICS

PARAMETER		SYMBOL	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS
INPUT DIODE							
Forward voltage	(H11B1,H11B2)	V_F		1.1	1.5	V	I_F=10 mA
	(H11B3)	V_F		1.1	1.5	V	I_F=50 mA
Reverse current		I_R			10	μA	V_R=3 V
Capacitance		C_J			50	pF	V=0 V, f=1 MHz
OUTPUT DETECTOR							
Breakdown voltage Collector to emitter		BV_{CEO}	25			V	I_C = 10 mA, I_F = 0
Breakdown voltage Collector to base		BV_{CBO}	30			V	I_C = 100 μA, I_F = 0
Breakdown voltage Emitter to Collector		BV_{ECO}	7			V	I_C = 100 μA, I_F = 0
Capacitance		C_{CE}		6		pF	V_{CE} = 10 V, f = 1 MHz
Leakage Current Collector to emitter		I_{CEO}		5	100	nA	V_{CE} = 10 V, I_F = 0

TRANSFER CHARACTERISTICS

CHARACTERISTIC		SYMBOL	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS
DC current transfer ratio	(H11B1)	I_C	5.0			mA	I_F = 1 mA, V_{CE} = 5 V
	(H11B2)	I_C	2.0			mA	I_F = 1 mA, V_{CE} = 5 V
	(H11B3)	I_C	1.0			mA	I_F = 1 mA, V_{CE} = 5 V
Saturation voltage		$V_{CE(SAT)}$		0.7	1.0	V	I_F = 1 mA, I_C = 1 mA
Turn-on time		$t_{(on)}$		125		μs	I_C = 10 mA, V_{CE} = 10 V, R_L = 100Ω
Turn-off time		$t_{(off)}$		100		μs	I_C = 10 mA, V_{CE} = 10 V, R_L = 100Ω

ISOLATION CHARACTERISTICS

Surge isolation voltage	V_{ISO}	7500			V_{Peak}	1 Minute
Surge isolation voltage	V_{ISO}	5300			V_{RMS}	1 Minute
Isolation resistance	R_{ISO}	10^{11}			ohms	V_{I-O} = 500 VDC
Isolation capacitance	C_{ISO}			2	pF	V_{I-O} = 0, f = 1 MHz

TYPICAL CHARACTERISTICS

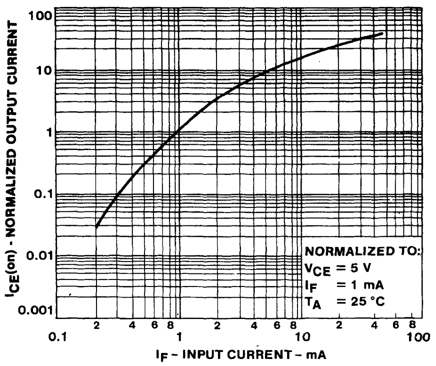


Fig. 1. Output Current vs. Input Current ST1731

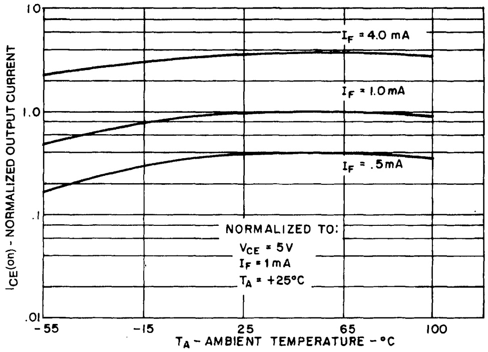


Fig. 2. Output Current vs. Temperature ST1732

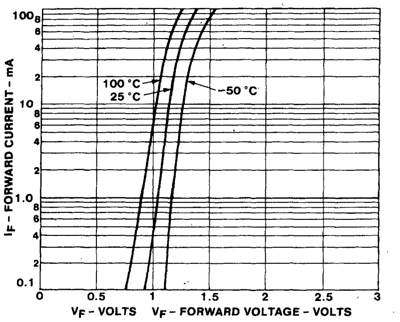


Fig. 3. Input Characteristics ST1723

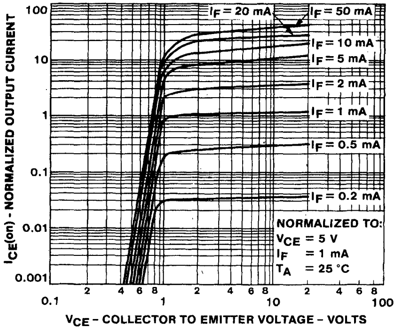


Fig. 4. Output Characteristics ST1734

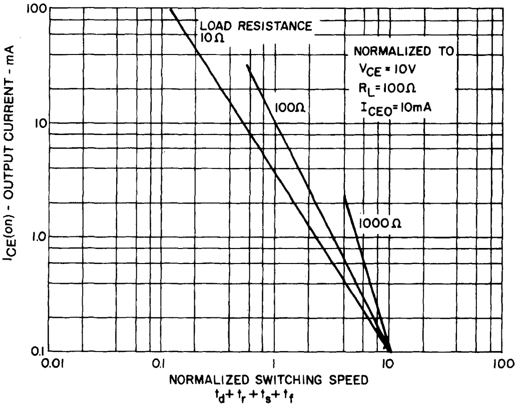


Fig. 5. Switching Speed vs. Output Current ST1735

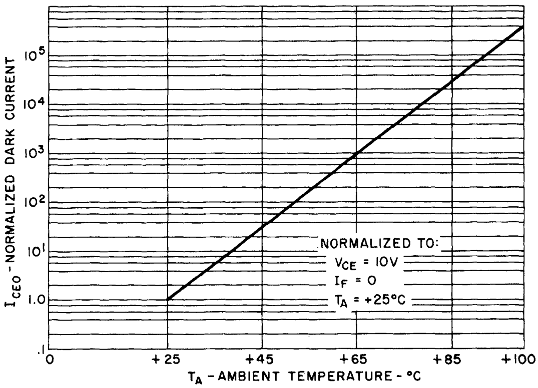
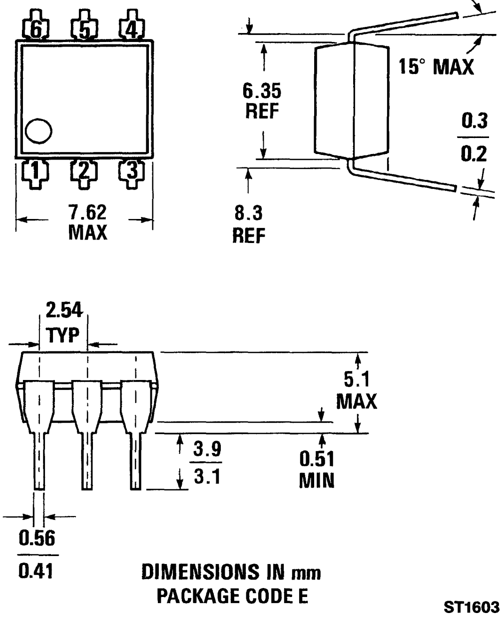


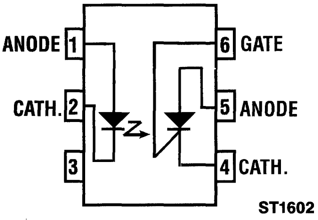
Fig. 6. Normalized Dark Current vs. Temperature ST1736

PHOTO SCR OPTOCOUPLERS

H11C1 H11C2 H11C3
H11C4 H11C5 H11C6

PACKAGE DIMENSIONS





Equivalent Circuit

DESCRIPTION

The H11C series consists of a gallium-arsenide infrared emitting diode optically coupled with a light activated silicon controlled rectifier in a dual-in-line package.

FEATURES & APPLICATIONS

- 10 A, T²L compatible, solid state relay
- 25 W logic indicator lamp driver
- High efficiency, low degradation, liquid epitaxial LED
- 200 V symmetrical transistor coupler (H11C1, H11C2, H11C3)
- 400 V symmetrical transistor coupler (H11C4, H11C5, H11C6)
- Underwriters Laboratory (UL) recognized—File #E90700

ABSOLUTE MAXIMUM RATINGS (T$_A$=25° unless otherwise specified)

TOTAL PACKAGE

Storage temperature	−55°C to 150°C
Operating temperature	55°C to 100°C
Lead solder temperature	−260°C for 10 sec

INPUT DIODE

Power dissipation	100 mW
Derate linearly (above 25°C)	1.33 mW/°C
Continuous forward current	60 mA
Peak forward current (1 μs pulse, 300 pps)	3 A
Reverse voltage	6 V

DETECTOR

Power dissipation (ambient)	400 mW
Derate linearly (above 25°C ambient)	5.3 mW/°C
Power dissipation (case)	1 W
Derate linearly (above 25°C case)	13.3 mW/°C
Peak reverse gate voltage	6 V
RMS on-state current	300 mA
Peak on-state current (100 μs, 1% duty cycle)	10 A
Surge current (10 ms)	5 A
Peak forward voltage (H11C1, H11C2, H11C3)	200 V
Peak forward voltage (H11C4, H11C5, H11C6)	400 V

ELECTRICAL CHARACTERISTICS (T_A=25° Unless Otherwise Specified)

INDIVIDUAL COMPONENT CHARACTERISTICS

PARAMETER	SYMBOL	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS
INPUT DIODE Forward voltage	V_F		1.2	1.5	V	I_F=10 mA
Reverse leakage current	I_R			10	μA	V_R=3 V
Capacitance	C		50		pF	V=0, f=1 MHz
OUTPUT DETECTOR Off-state voltage (H11C1, H11C2, H11C3)	V_{DM}	200			V	R_{GK}=10 kΩ, T_A=100°C, I_R=50μA
(H11C4, H11C5, H11C6)	V_{DM}	400			V	R_{GK}=10 kΩ, T_A=100°C, I_R=150μA
Reverse voltage (H11C1, H11C2, H11C3)	V_{RM}	200			V	R_{GK}=10 kΩ, T_A=100°C, I_R=50μA
(H11C4, H11C5, H11C6)	V_{RM}	400			V	R_{GK}=10 kΩ, T_A=100°C, I_R=150μA
On-state voltage	V_{TM}		1.1	1.3	V	I_{TM}=300 mA
Off-state current (H11C1, H11C2, H11C3)	I_{DM}			50	μA	V_{DM}=200 V, T_A=100°C, I_F=0, R_{GK}=10 kΩ
(H11C4, H11C5, H11C6)	I_{DM}			150	μA	V_{DM}=400 V, T_A=100°C, I_F=0, R_{GK}=10 kΩ
Reverse current (H11C1, H11C2, H11C3)	I_R			50	μA	V_R=200 V, T_A=100°C, I_F=0
(H11C4, H11C5, H11C6)	I_R			150	μA	V_R=400 V, T_A=100°C, I_F=0

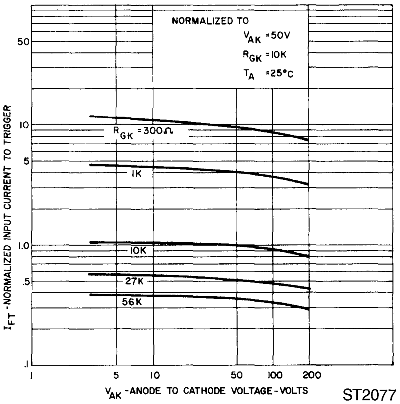
TRANSFER CHARACTERISTICS

CHARACTERISTIC	SYMBOL	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS
Input current to trigger (H11C1, H11C2, H11C4, H11C5)	I_{FT}			20	mA	V_{AK}=50 V, R_{GK}=10 kΩ
(H11C3, H11C6)	I_{FT}			30	mA	V_{AK}=50 V, R_{GK}=10 kΩ
(H11C1, H11C2, H11C4, H11C5)	I_{FT}			11	mA	V_{AK}=100 V, R_{GK}=27 kΩ
(H11C3, H11C6)	I_{FT}			14	mA	V_{AK}=100 V, R_{GK}=27 kΩ
Coupled dv/dt, input to output (fig. 13)	dv/dt	500			V/μs	
Input to output capacitance				2	pF	Input to output voltage=0 f=1 MHz

ISOLATION CHARACTERISTICS

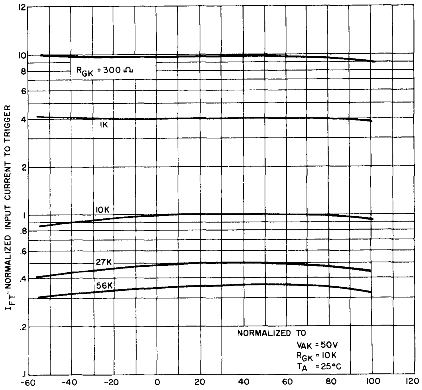
CHARACTERISTIC	SYMBOL	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS
Surge isolation voltage	V_{ISO}	7500			V	1 Minute
Isolation voltage	V_{ISO}	5300			V	1 Minute
Isolation resistance	R_{ISO}	10^{11}			ohms	$V_{I\text{-}O}$=500 VDC

TYPICAL CHARACTERISTICS



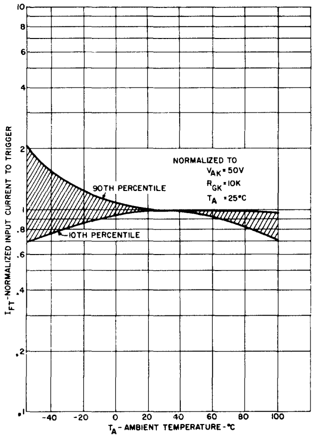
ST2077

Figure 1. Input Current To Trigger vs. Anode-Cathode Voltage



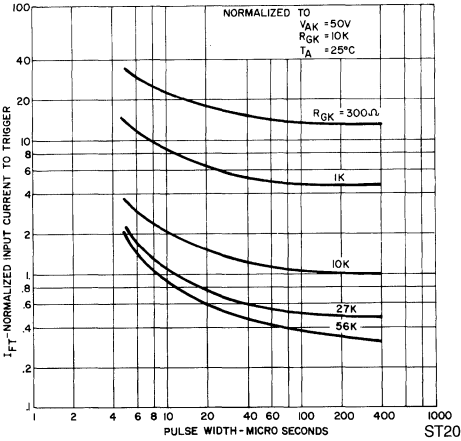
ST2078

Figure 2. Input Current To Trigger vs. Temperature



ST2079

Figure 3. Input Current to Trigger Distribution vs. Temperature



ST2080

Figure 4. Input Current to Trigger vs. Pulse Width

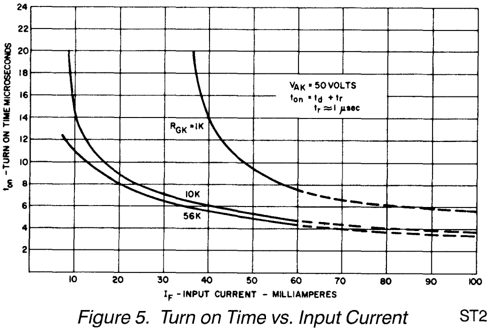


Figure 5. Turn on Time vs. Input Current ST2081

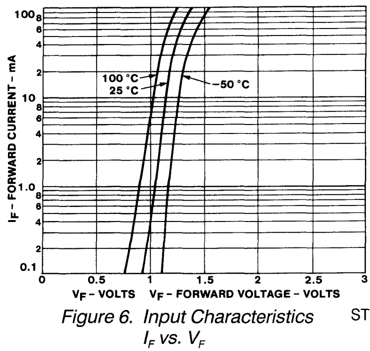
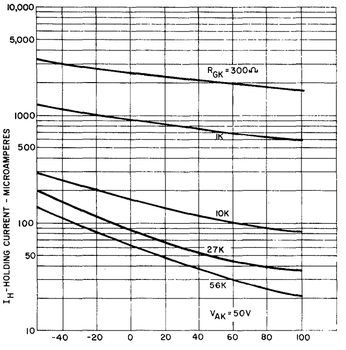


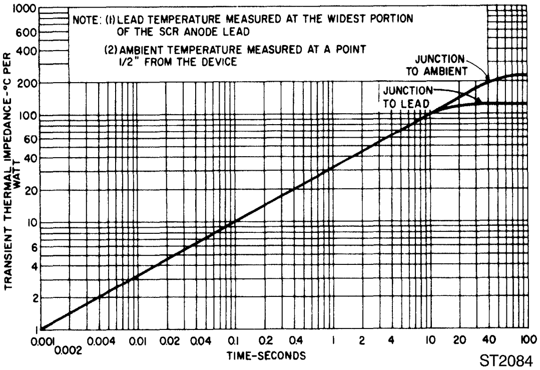
Figure 6. Input Characteristics I_F vs. V_F ST2082

TYPICAL CHARACTERISTICS OF OUTPUT (SCR)



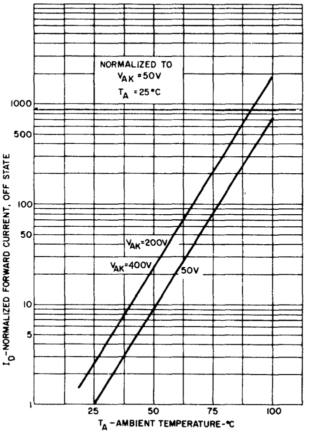
ST2083

Figure 7. Holding Current vs. Temperature



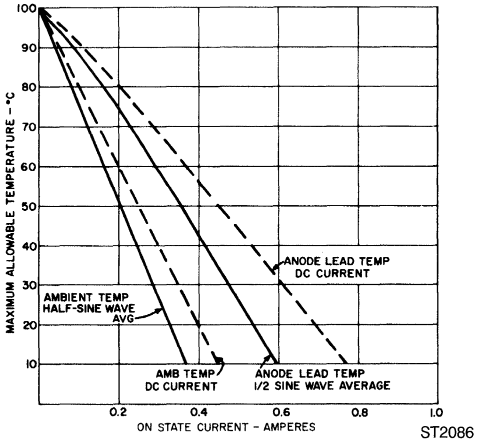
ST2084

Figure 8. Maximum Transient Thermal Impedance



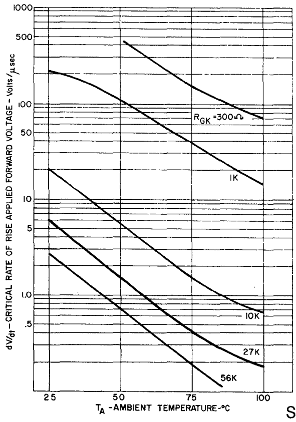
ST2085

Figure 9. Off State Forward Current vs. Temperature



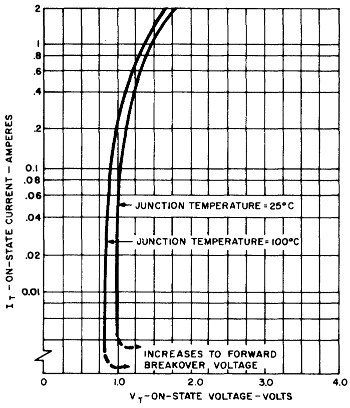
ST2086

Figure 10. On State Current vs. Maximum Allowable Temperature



ST2087

Figure 11. dV/dt vs. Temperature



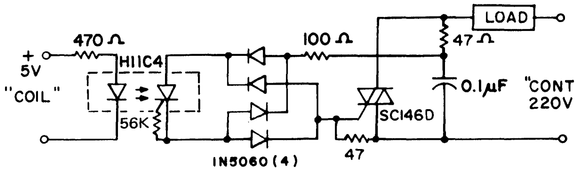
ST2088

Figure 12. On-State Characteristics

TYPICAL APPLICATIONS

10A, T²L COMPATIBLE, SOLID STATE RELAY

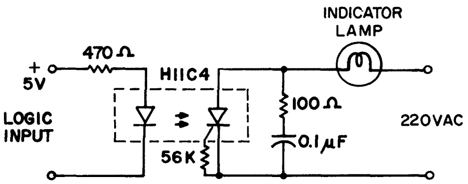
Use of the H11C4 for high sensitivity, 5300V isolation capability, provides this highly reliable solid state relay design. This design is compatible with 74, 74S and 74H series T²L logic systems inputs and 220V AC loads up to 10A.



ST2047

25W LOGIC INDICATOR LAMP DRIVER

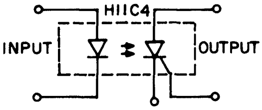
The high surge capability and non-reactive input characteristics of the H11C allow it to directly couple, without buffers, T²L and DTL logic to indicator and alarm devices, without danger of introducing noise and logic glitches.



ST2048

400V SYMMETRICAL TRANSISTOR COUPLER

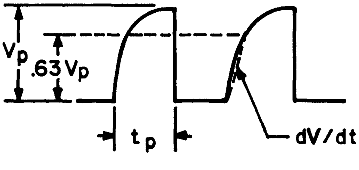
Use of the high voltage PNP portion of the H11C provides a 400V transistor capable of conducting positive and negative signals with current transfer ratios over 1%. This function is useful in remote instrumentation, high voltage power supplies and test equipment. Care should be taken not to exceed the H11C 400 mW power dissipation rating when used at high voltages.

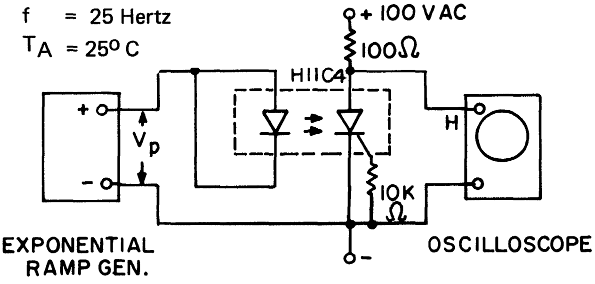


ST2049

Fig 13.
Coupled **dV/dt** - Test circuit

V_p = 800 Volts
t_p =.010 Seconds
f = 25 Hertz
T_A = 25° C





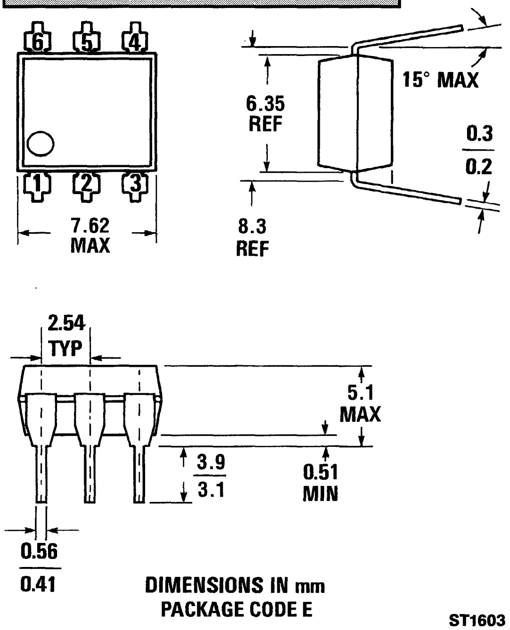
ST2050

QT
OPTOELECTRONICS

PHOTO FET OPTOCOUPLERS

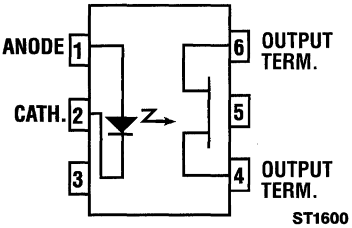
H11F1 H11F2 H11F3

PACKAGE DIMENSIONS



DIMENSIONS IN mm
PACKAGE CODE E

ST1603



Equivalent Circuit

DESCRIPTION

The H11F series has a gallium-aluminum-arsenide infrared emitting diode coupled to a symmetrical bilateral silicon photodetector. The detector is electrically isolated from the input and performs like an ideal isolated FET designed for distortion-free control of low level ac and dc analog signals. The H11F series devices are mounted in dual in-line packages.

FEATURES

As a remote variable resistor—

- ≤100 Ω to ≥300 MΩ
- ≥99.9% linearity
- ≤15 pF shunt capacitance
- ≥100 GΩ I/O isolation resistance

As an analog switch—

- Extremely low offset voltage
- 60 V pk-pk signal capability
- No charge injection or latchup
- t_{on}, t_{off} ≤15 μs
- Underwriters Laboratory (UL) recognized—File #E90700

APPLICATIONS

As a variable resistor—

- Isolated variable attenuator
- Automatic gain control
- Active filter fine tuning/band switching

As an analog switch—

- Isolated sample and hold circuit
- Multiplexed, optically isolated A/D conversion

ABSOLUTE MAXIMUM RATINGS

TOTAL PACKAGE

Storage temperature	−55°C to 150°C
Operating temperature	−55°C to 100°C
Lead solder temperature	260°C for 10 sec

INPUT DIODE

Power dissipation (25°C ambient)	100 mW
Derate linearly (above 25°C)	1.33 mW/°C
Continuous forward current	60 mA
Peak forward current (10μs pulse, 1% duty cycle)	1 A
Reverse voltage	6 V

DETECTOR

Power dissipation (at 25°C ambient)	300 mW
Derate linearly (above 25°C ambient)	4 mW/°C
Breakdown voltage (H11F1, H11F2)	±30 V
Breakdown voltage (H11F3)	±15 V
Continuous detector current	±100 mA

ELECTRICAL CHARACTERISTICS (T_A=25° Unless Otherwise Specified)

INDIVIDUAL COMPONENT CHARACTERISTICS

PARAMETER	SYMBOL	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS
INPUT DIODE						
Forward voltage	V_F		1.1	1.75	V	I_F=16 mA
Reverse current	I_R			10	μA	V_R=5 V
Capacitance	C_J		50		pF	V=0, f=1 MHz
OUTPUT DETECTOR (Either polarity)						
Breakdown voltage (H11F1, H11F2)	BV_{46}	30			V	I_C=10 μA, I_F=0
(H11F3)	BV_{46}	15			V	I_C=10 μA, I_F=0
Off-state dark current	I_{46}			50	nA	V_{46}=15 V, I_F=0
	I_{46}			50	μA	V_{46}=15 V, I_F=0, T_A=100°C
Off-state resistance	r_{46}	300			MΩ	V_{46}=15 V, I_F=0
Capacitance	C_{46}			15	pF	V_{46}=0, I_F=0, f=1 MHz

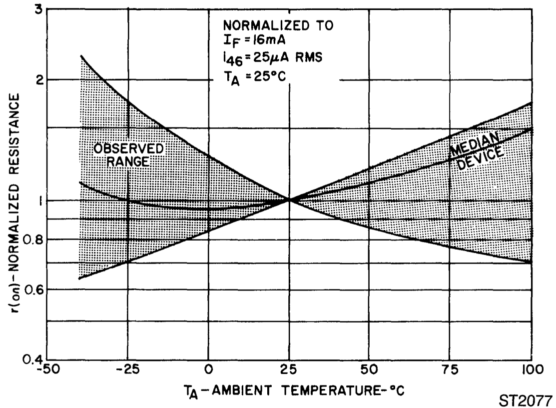
TRANSFER CHARACTERISTICS

CHARACTERISTIC		SYMBOL	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS
On-state resistance	(H11F1)	r_{46}			200	Ω	I_F=16 mA, I_{46}=100 μA
	(H11F2)	r_{46}			330	Ω	I_F=16 mA, I_{46}=100 μA
	(H11F3)	r_{46}			470	Ω	I_F=16 mA, I_{46}=100 μA
On-state resistance	(H11F1)	r_{64}			200	Ω	I_F=16 mA, I_{64}=100 μA
	(H11F2)	r_{64}			330	Ω	I_F=16 mA, I_{64}=100 μA
	(H11F3)	r_{64}			470	Ω	I_F=16 mA, I_{64}=100 μA
Turn-on time		t_{on}			25	μs	I_F=16 mA, V_{46}=5 V, R_L=50 Ω
Turn-off time		t_{off}			25	μs	I_F=16 mA, V_{46}=5 V, R_L=50 Ω
Resistance, non-linearity and asymmetry					0.1	%	I_F=16 mA, R_L=50 Ω, V_{46}=5 V

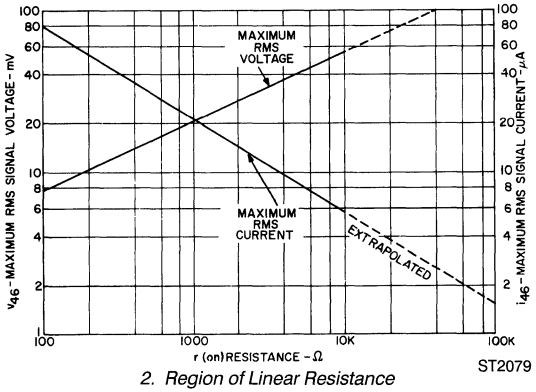
ISOLATION CHARACTERISTICS

Surge isolation voltage	V_{ISO}	7500			V_{Peak}	1 Minute
Surge isolation voltage	V_{ISO}	5300			V_{RMS}	1 Minute
Isolation resistance (input to output)		10^{11}			Ω	V_{IO}=0, f=1 MHz
Input to output capacitance				2	pF	V_{IO}=0, f=1 MHz

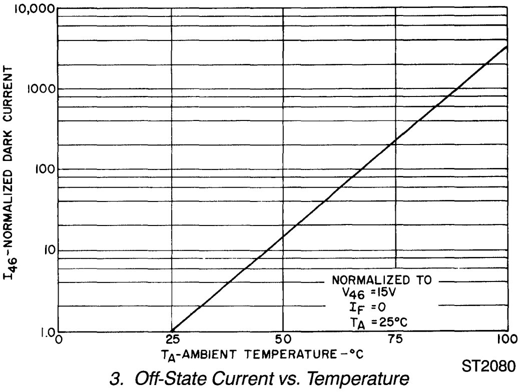
TYPICAL CHARACTERISTICS



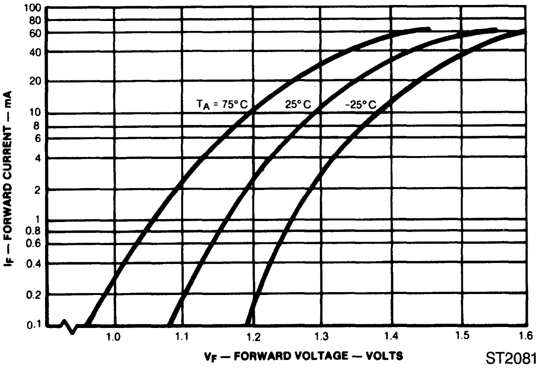
1. Resistance vs. Temperature



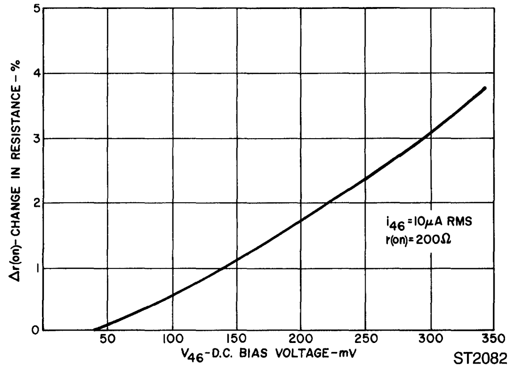
2. Region of Linear Resistance



3. Off-State Current vs. Temperature



4. Input Voltage vs. Input Current

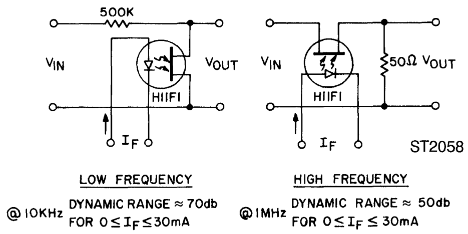


5. Resistive non-linearity vs. D.C. Bias

TYPICAL APPLICATIONS

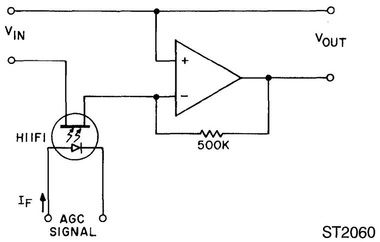
AS A VARIABLE RESISTOR

ISOLATED VARIABLE ATTENUATORS



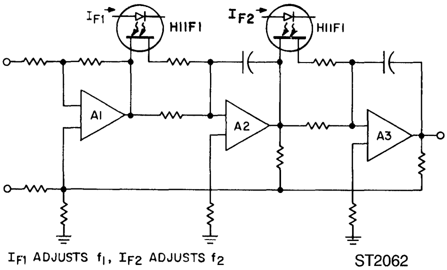
Distortion free attenuation of low level A.C. signals is accomplished by varying the IRED current, I_F. Note the wide dynamic range and absence of coupling capacitors; D.C. level shifting or parasitic feedback to the controlling function.

AUTOMATIC GAIN CONTROL



This simple circuit provides over 70db of stable gain control for an AGC signal range of from 0 to 30mA. This basic circuit can be used to provide programmable fade and attack for electronic music.

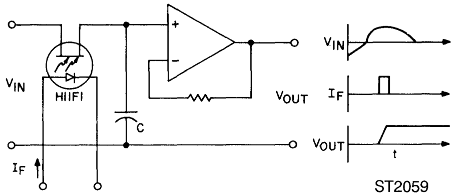
ACTIVE FILTER FINE TUNING/BAND SWITCHING



The linearity of resistance and the low offset voltage of the H11F allows the remote tuning or band-switching of active filters without switching glitches or distortion. This schematic illustrates the concept, with current to the H11F1 IRED's controlling the filter's transfer characteristic.

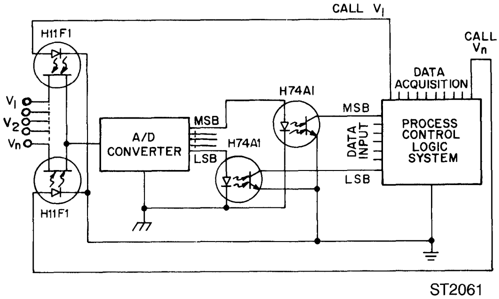
AS AN ANALOG SIGNAL SWITCH

ISOLATED SAMPLE AND HOLD CIRCUIT



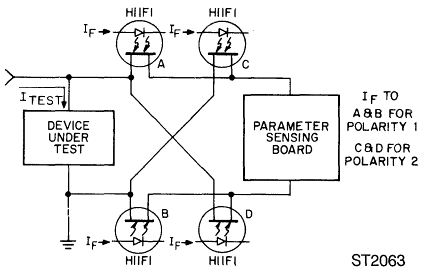
Accuracy and range are improved over conventional FET switches because the H11F has no charge injection from the control signal. The H11F also provides switching of either polarity input signal up to 30V magnitude.

MULTIPLEXED, OPTICALLY-ISOLATED A/D CONVERSION



The optical isolation, linearity and low offset voltage of the H11F allows the remote multiplexing of low level analog signals from such transducers as thermocouplers, Hall effect devices, strain gauges, etc. to a single A/D converter.

TEST EQUIPMENT — KELVIN CONTACT POLARITY

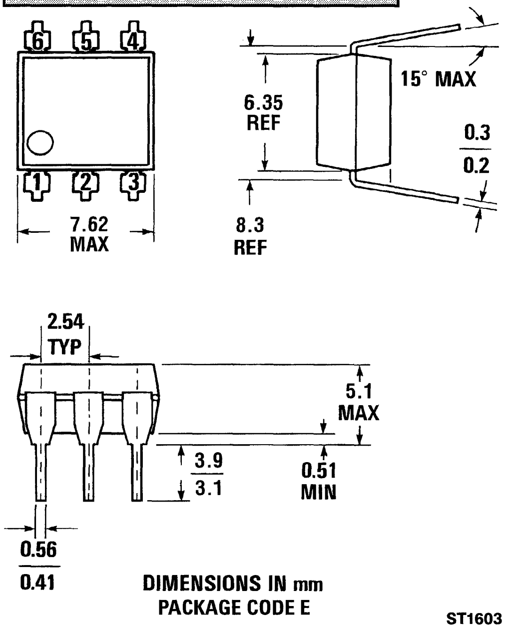


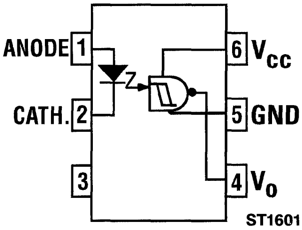
In many test equipment designs the auto polarity function uses reed relay contacts to switch the Kelvin Contact polarity. These reeds are normally one of the highest maintenance cost items due to sticking contacts and mechanical problems. The totally solid-state H11F eliminates these troubles while providing faster switching.

MICROPROCESSOR COMPATIBLE GaAs SCHMITT TRIGGER OPTOCOUPLERS

H11L1 H11L2 H11L3

PACKAGE DIMENSIONS





Equivalent Circuit

DESCRIPTION

The H11L series has a medium-to-high speed integrated circuit detector optically coupled to a gallium-arsenide infrared emitting diode. The output incorporates a Schmitt trigger, which provides hysteresis for noise immunity and pulse shaping. The detector circuit is optimized for simplicity of operation and utilizes an open collector output for maximum application flexibility.

FEATURES

- High data rate, 1 MHz typical (NRZ)
- Free from latch up and oscillation throughout voltage and temperature ranges.
- Microprocessor compatible drive
- Logic compatible output sinks 16 mA at 0.4 V maximum
- Guaranteed on/off threshold hysteresis
- High common mode rejection ratio
- Fast switching: t_r, t_f=100 ns typical
- Wide supply voltage capability, compatible with all popular logic systems
- Underwriters Laboratory (UL) recognized — file #E90700

APPLICATIONS

- Logic to logic isolator
- Programmable current level sensor
- Line receiver—eliminate noise and transient problems
- A.C. to TTL conversion—square wave shaping
- Digital programming of power supplies
- Interfaces computers with peripherals

ABSOLUTE MAXIMUM RATINGS

TOTAL PACKAGE

Storage temperature	−55°C to 150°C
Operating temperature	−55°C to 100°C
Lead solder temperature	260°C for 10 sec

INPUT DIODE

Power dissipation (25°C ambient)	100 mW
Derate linearly (above 25°C ambient)	1.33 mW/°C
Continuous forward current	60 mA
Peak forward current (1 μs pulse, 300pps)	3 A
Reverse voltage	6 V

DETECTOR

Power dissipation (at 25°C ambient)	150 mW
Derate linearly (above 25°C ambient)	2 mW/°C
V_{45} allowed range	0 to 16 V
V_{65} allowed range	0 to 16 V
I_4 output current	50 mA

MICROPROCESSOR COMPATIBLE GaAs SCHMITT TRIGGER OPTOCOUPLERS

ELECTRICAL CHARACTERISTICS (T_A= 0-70°C Unless Otherwise Specified)

INDIVIDUAL COMPONENT CHARACTERISTICS

PARAMETER	SYMBOL	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS
INPUT DIODE						
Forward voltage	V_F		1.1	1.5	V	I_F=10 mA
	V_F	0.75	0.95		V	I_F=0.3 mA
Reverse current	I_R			10	μA	V_R=3 V
Capacitance	C_J			100	pF	V=0, f=1 MHz
OUTPUT DETECTOR						
Operating voltage range	V_{CC}	3		15	V	
Supply current	$I_{6(off)}$		1.0	5.0	mA	I_F=0, V_{CC}=5 V
Output current, high	I_{OH}			100	μA	I_F=0, V_{CC}=V_O=15 V

TRANSFER CHARACTERISTICS

CHARACTERISTIC		SYMBOL	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS
Supply current		$I_{6(on)}$		1.6	5	mA	I_F=10 mA, V_{CC}=5 V
Output voltage, low		V_{OL}		0.2	0.4	V	R_L=270 Ω, V_{CC}=5 V, I_F=$I_{F(on)}$ max.
Turn-on threshold current	(H11L1)	$I_{F(on)}$		1.0	1.6	mA	R_L=270 Ω, V_{CC}=5 V
	(H11L2)	$I_{F(on)}$		6.0	10.0	mA	R_L=270 Ω, V_{CC}=5 V
	(H11L3)	$I_{F(on)}$		3.0	5.0	mA	R_L=270 Ω, V_{CC}=5 V
Turn-off threshold current		$I_{F(off)}$	0.3	1.0		mA	R_L=270 Ω, V_{CC}=5 V
Hysteresis ratio		$I_{F(off)}/I_{F(on)}$	0.50	0.75	0.90		R_L=270 Ω, V_{CC}=5 V

DYNAMIC CHARACTERISTICS

PARAMETER	SYMBOL	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS
SWITCHING SPEED						
Turn-on time	t_{ON}		1.0		μs	C=0, R_E=1.2 kΩ
	t_{ON}		0.65		μs	C=270 pF, R_E=1.2 kΩ f≤100 KHz, tp≥1 μs
Fall time	t_f		0.1		μs	C=0,R_E=1.2 kΩ
	t_f		0.05		μs	C=270 pF, R_E=1.2 kΩ f≤100 KHz, tp≥1 μs
Turn-off time	t_{OFF}		2.0		μs	C=0,R_E=1.2 kΩ
	t_{OFF}		1.20		μs	C=270 pF, R_E=1.2 kΩ f≤100 KHz, tp≥1 μs
Rise time	t_r		0.1		μs	C=0,R_E=1.2 kΩ
	t_r		0.07		μs	C=270 pF, R_E=1.2 kΩ f≤100 KHz, tp≥1 μs
Data rate			1.0*		MHz	

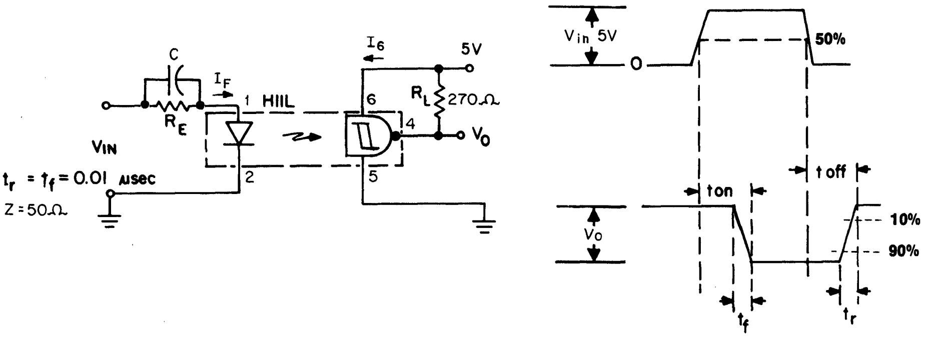
ISOLATION CHARACTERISTICS

CHARACTERISTIC	SYMBOL	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS
Surge isolation voltage	V_{ISO}	7500			V_{PEAK}	1 Minute
Surge isolation voltage	V_{ISO}	5300			V_{RMS}	1 Minute

***Maximum data rate will vary depending on the bias conditions and is usually highest when R_E and C are matched to $I_{F(ON)}$ and V_{CC} is between 3 and 15 V. With this optimized bias, most units will operate over 1.5 MHz (NRZ).**

MICROPROCESSOR COMPATIBLE GaAs SCHMITT TRIGGER OPTOCOUPLERS

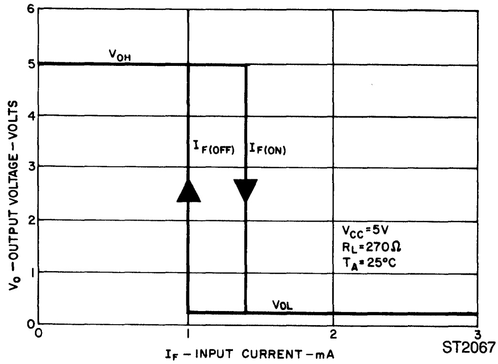
SWITCHING CHARACTERISTICS (25°C) H11L1



ST2066

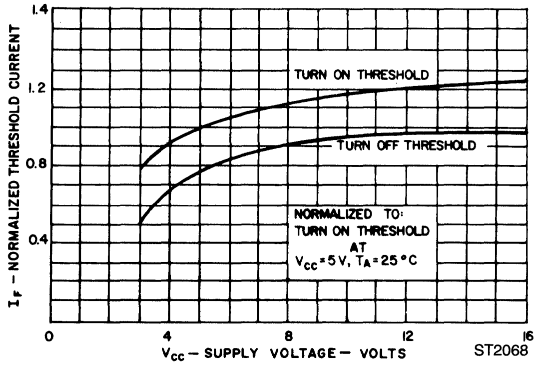
SWITCHING TEST CIRCUIT

TYPICAL CHARACTERISTICS



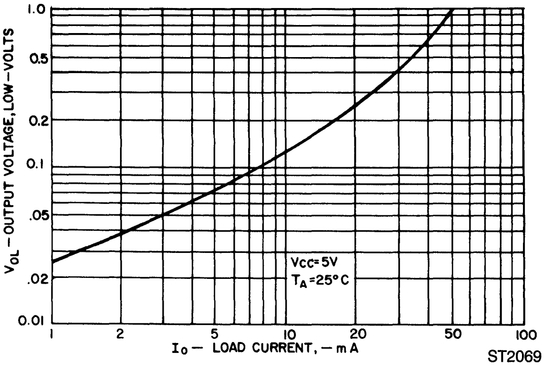
ST2067

TRANSFER CHARACTERISTICS



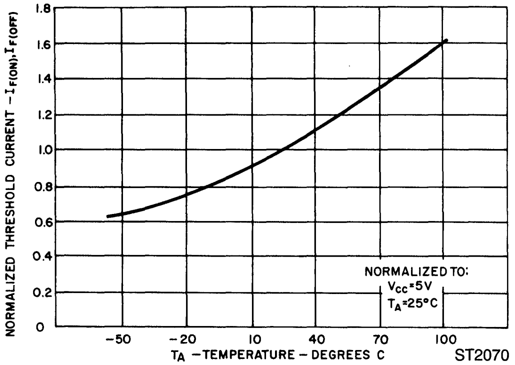
ST2068

THRESHOLD CURRENT VS. SUPPLY VOLTAGE



ST2069

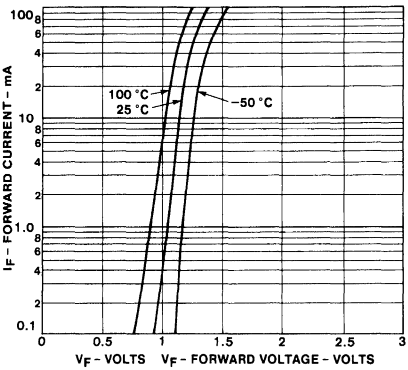
ON VOLTAGE VS. LOAD CURRENT



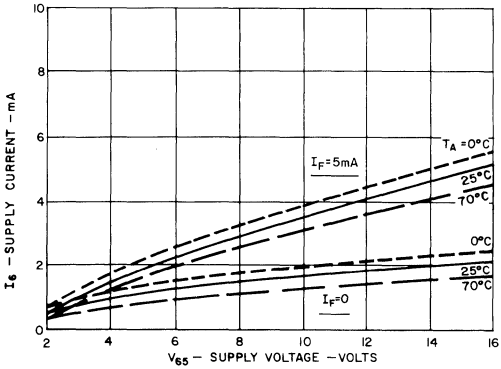
ST2070

THRESHOLD CURRENTS VS. TEMPERATURE

TYPICAL CHARACTERISTICS (Cont'd)



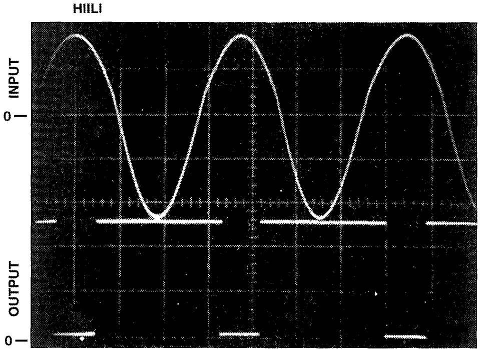
ST2015



ST2016

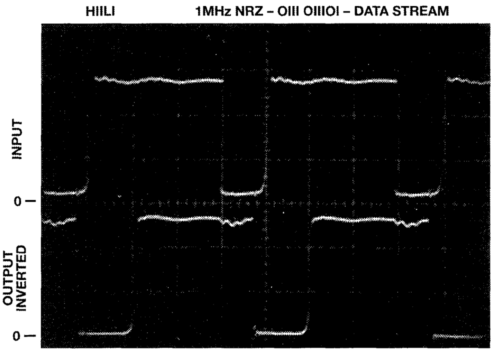
FORWARD VOLTAGE VS. FORWARD CURRENT

SUPPLY CURRENT VS. SUPPLY VOLTAGE



V = 2V / DIV
H = 5mS / DIV
R_L = 270Ω
R_L = 1200Ω
C = 0

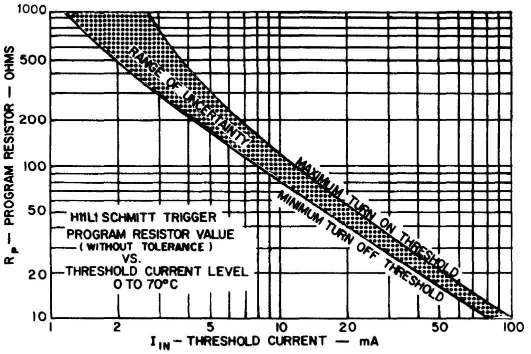
ST2017

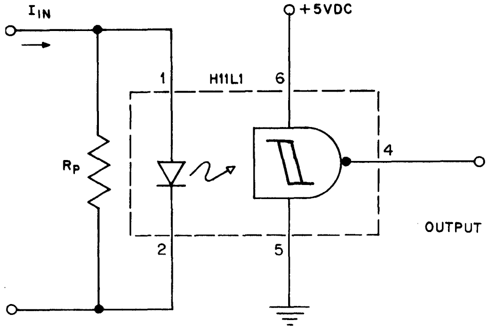


V = 2V / DIV
H = 1μS / DIV
R_L = 270Ω
R_E = 1.2KΩ
C=270pf

ST2018

TYPICAL APPLICATION





ST2019

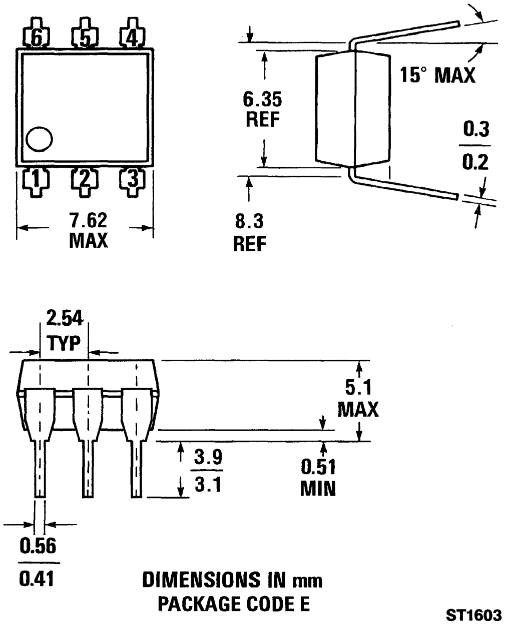
PROGRAMMABLE CURRENT
THRESHOLD SENSING CIRCUIT

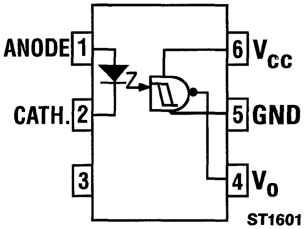
QT OPTOELECTRONICS

HIGH-SPEED AlGaAS SCHMITT TRIGGER OPTOCOUPLERS

H11N1 H11N2 H11N3

PACKAGE DIMENSIONS





Equivalent Circuit

DESCRIPTION

The H11N series has a medium-to-high speed integrated circuit detector optically coupled to a gallium-aluminum-arsenide infrared emitting diode. The output incorporates a Schmitt trigger, which provides hysteresis for noise immunity and pulse shaping. The detector circuit is optimized for simplicity of operation and utilizes an open collector output for maximum application flexibility.

FEATURES & APPLICATIONS

- High data rate, 5 MHz typical (NRZ)
- Free from latch up and oscillation throughout voltage and temperature ranges
- Microprocessor compatible drive
- Logic compatible output sinks 16 mA at 0.5 V maximum
- Guaranteed on/off threshold hysteresis
- High common mode transient immunity 2000 V/μs minimum
- Fast switching: t_r, t_f=10 ns typical
- Wide supply voltage capability, compatible with all popular logic systems
- Underwriters Laboratory (UL) recognized — file #E90700
- Logic to logic isolator
- Programmable current level sensor
- Line receiver—eliminates noise and transient problems
- Logic level shifter—couples TTL to CMOS
- A.C. to TTL conversion—square wave shaping
- Isolated power MOS driver for power supplies
- Interfaces computers with peripherals

ABSOLUTE MAXIMUM RATINGS

TOTAL PACKAGE

Storage temperature	−55°C to 125°C
Operating temperature	−25°C to 85°C
Lead solder temperature	260°C for 10 sec

INPUT DIODE

Power dissipation (25°C ambient)	50 mW
Derate linearly (above 70°C)	1.67 mW/°C
Continuous forward current	30 mA
Peak forward current (300μs pulse, 2% duty cycle)	50 mA
Reverse voltage	6 V

DETECTOR

Power dissipation (at 25°C ambient)	150 mW
Derate linearly (above 25°C ambient)	5 mW/°C
V_{45} allowed range	0 to 16 V
V_{65} allowed range	0 to 16 V
I_4 output current	50 mA

ELECTRICAL CHARACTERISTICS (T_A= 0-70°C Unless Otherwise Specified) Note 1

INDIVIDUAL COMPONENT CHARACTERISTICS

PARAMETER	SYMBOL	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS
INPUT DIODE Forward voltage	V_F		1.6	2.0	V	I_F=10 mA
	V_F	0.75	1.45		V	I_F=0.3 mA
Reverse current	I_R			10	μA	V_R=5 V, T_A=25°C
	I_R			100	μA	V_R=5 V, T_A=100°C
Capacitance	C_J			100	pF	V=0 V, f=1 MHz
OUTPUT DETECTOR Operating voltage range	V_{CC}	4		15	V	
Supply current	$I_{6(off)}$		5.5	10	mA	I_F=0, V_{CC}=5 V
Output current, high	I_{OH}			100	μA	I_F=0.3 mA, V_{CC}=V_O=15 V

TRANSFER CHARACTERISTICS (T_A = 0-70°C) Note 1

CHARACTERISTIC		SYMBOL	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS
Supply current		$I_{6(on)}$		5	10	mA	I_F=10 mA, V_{CC}=5 V
Output voltage, low		V_{OL}		0.3	0.5	V	R_L=270 Ω, V_{CC}=5 V, I_F=$I_{F(on)}$ max.
Turn-on threshold current	(H11N1)	$I_{F(on)}$	0.8		3.2	mA	R_L=270 Ω, V_{CC}=5 V
	(H11N2)	$I_{F(on)}$	2.3		5.0	mA	R_L=270 Ω, V_{CC}=5 V
	(H11N3)	$I_{F(on)}$	4.1		10.0	mA	R_L=270 Ω, V_{CC}=5 V
Turn-off threshold current		$I_{F(off)}$	0.3	1.5		mA	R_L=270 Ω, V_{CC}=5 V
Hysteresis ratio		$I_{F(off)}/I_{F(on)}$	0.65	0.8	0.95		R_L=270 Ω, V_{CC}=5 V

DYNAMIC CHARACTERISTICS (T_A = 0-70°C) Note 1

PARAMETER	SYMBOL	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS
SWITCHING SPEED (Figures 7&8)						
Propagation delay, high to low	t_{PHL}		150	330	ns	C=120 pF, t_p=1 μs, R_E: Note 4
Rise time	t_r		10		ns	C=120 pF, t_p=1 μs, R_E: Note 4
Propagation delay, low to high	t_{PLH}		150	330	ns	C=120 pF, t_p=1 μs, R_E: Note 4
Fall time	t_f		15		ns	C=120 pF, t_p=1 μs, R_E: Note 4
Data rate			5		MHz	Note 3
OVERDRIVE SWITCHING (FIGURES 7&8), NOTE 2						
Turn-off time	t_{off}		0.2	0.5	μs	C=O, R_L=270 Ω, I_F(MAX) H11N1: 5 mA H11N2: 10 mA H11N3: 20 mA
TRANSIENT IMMUNITY (FIGURE 9)						
Common mode transient immunity	CM_H	±2000	±10000		V/μs	V_{pk}=50 V, V_{CC}=5 V, R_L=270 Ω, I_F=0
Common mode transient immunity	CM_L	±2000	±10000		V/μs	V_{pk}=50 V, V_{CC}=5 V, R_L=270 Ω, I_F=0

ISOLATION CHARACTERISTICS

CHARACTERISTIC	SYMBOL	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS
Surge isolation voltage	V_{ISO}	7500			V_{PEAK}	1 Minute
Surge isolation voltage	V_{ISO}	5300			V_{RMS}	1 Minute

Notes

1. *All measurements are with 100nF bypass capacitor from pin 6 to pin 5.*
2. *Steady overdrive increases t_{off}. Use of a large R_E and a small C as in figure 7 is preferred over overdrive current.*
3. *Maximum data rate will vary depending on the bias conditions and is usually highest when R_E and C are matched to $I_{F(ON)}$ and V_{CC} is between 5 and 15V. With this optimized bias, most units will operate at over 10 MHz, NRZ.*
4. *H11N1: R_E = 910Ω, H11N2: R_E = 560Ω, H11N3: R_E = 240Ω.*

TYPICAL CHARACTERISTICS

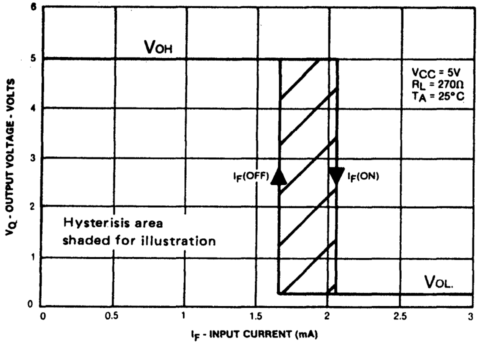


Figure 1. Transfer characteristics ST2022

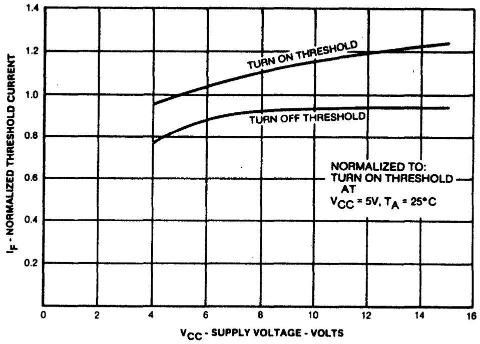


Figure 2. Threshold current vs. supply voltage ST2023

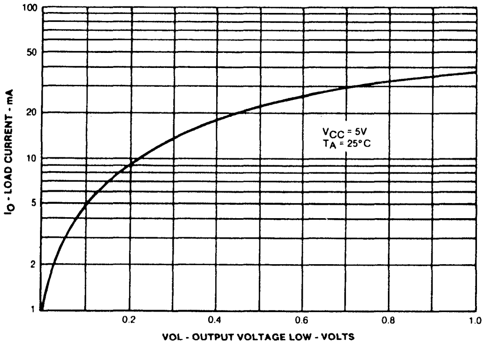


Figure 3. ON voltage vs. current ST2024

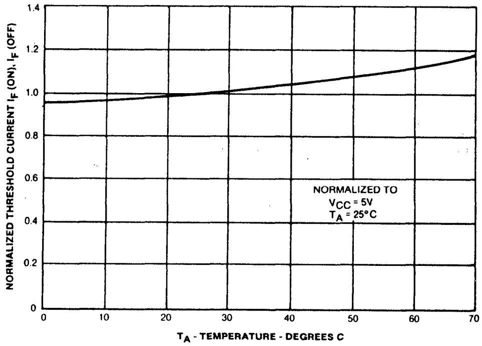
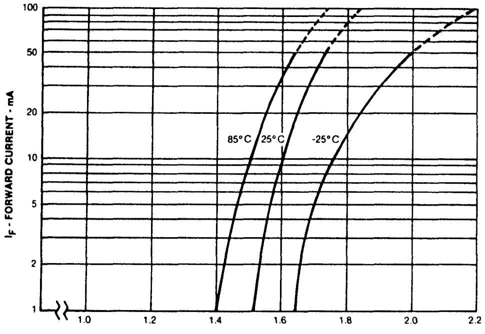
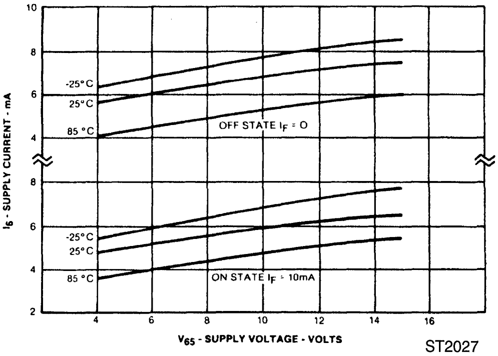


Figure 4. Threshold current vs. temperature ST2025



ST2026

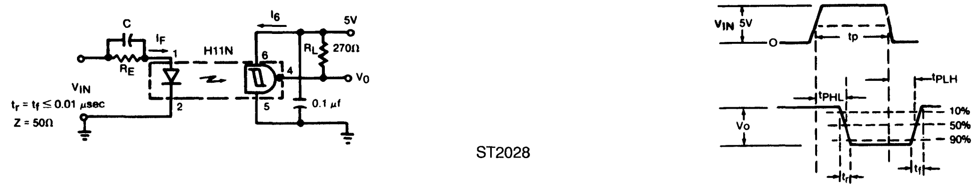
Figure 5. Forward voltage vs. forward current



ST2027

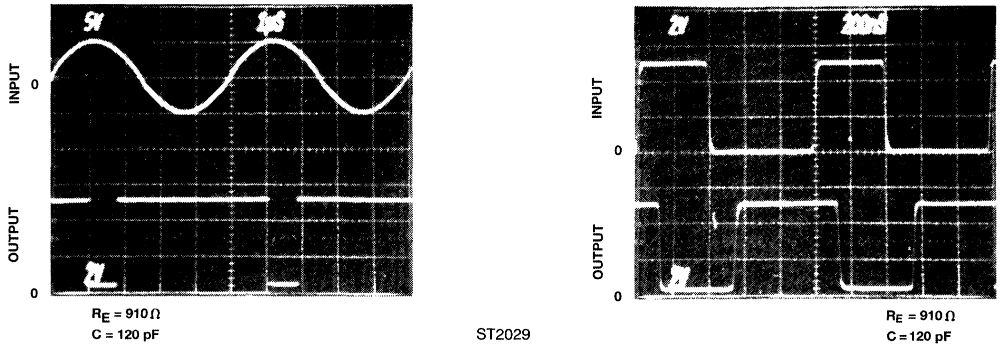
Figure 6. Supply current vs. supply voltage

TYPICAL CHARACTERISTICS



ST2028

Figure 7. Switching test circuit

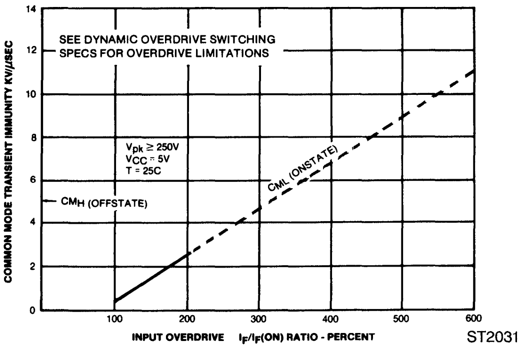


ST2029

Figure 8. Switching test waveforms

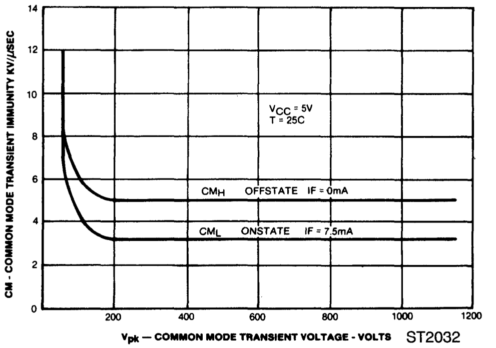
ST2030

Figure 9. Common-mode transient immunity, test circuit and voltage waveforms



ST2031

Figure 10. CM_L and CM_H input current

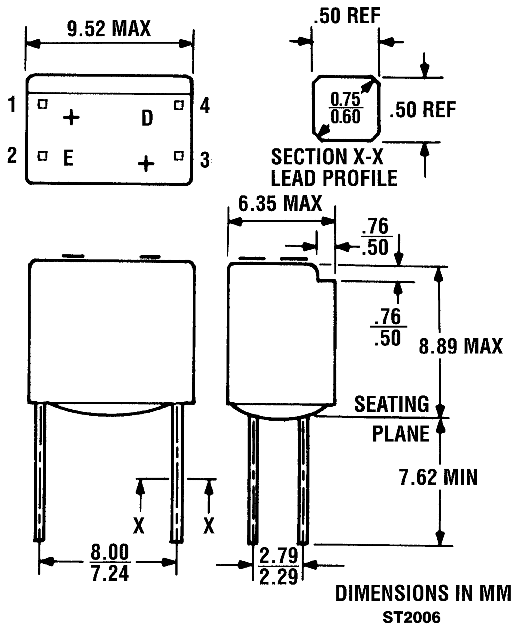


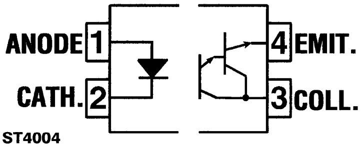
ST2032

Figure 11. CM_L and CM_H vs. common-mode transient voltage

H24A1 H24A2

PACKAGE DIMENSIONS





Equivalent Circuit

DESCRIPTION

The H24A series consists of a gallium arsenide infrared emitting diode coupled with a silicon phototransistor. The devices are housed in a low-cost plastic package with lead spacing compatible with a dual in-line package.

FEATURES

- 4-pin configuration
- Small package size and low cost
- UL recognized-file E51868

APPLICATIONS

- Digital logic inputs
- Microprocessor inputs
- Industrial controls

ABSOLUTE MAXIMUM RATINGS

TOTAL PACKAGE

Storage temperature	−55°C to 85°C
Operating temperature	−55°C to 85°C
Lead solder temperature	260°C for 5 sec

INPUT DIODE

Power dissipation (25°C ambient)	100 mW
Derate linearly (above 25°C)	1.67 mW/°C
Continuous forward current	60 mA
Reverse voltage	4 V

DETECTOR

Power dissipation (25°C ambient)	150 mW
Derate linearly (above 25°C)	2.5 mW/°C
V_{CEO}	30 V
V_{ECO}	6 V
Continuous forward current	100 mA

ELECTRICAL CHARACTERISTICS (25°C Temperature Unless Otherwise Specified)

INDIVIDUAL COMPONENT CHARACTERISTICS

CHARACTERISTIC	SYMBOL	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS
INPUT DIODE						
Forward voltage	V_F			1.7	V	I_F=60 mA
Reverse current	I_R			1	μA	V_R=3 V
Reverse breakdown voltage	$V_{(BR)R}$	4			V	I_R=10 μA
Capacitance	C_J		30		pF	V=0, f=1 MHz
OUTPUT DETECTOR						
Breakdown voltage Collector to emitter	BV_{CEO}	30			V	I_C=1 mA, I_F=0
Breakdown voltage Emitter to Collector	BV_{ECO}	7			V	I_C=100 μA, I_F=0
Collector dark current	I_{CEO}		5	100	nA	V_{CE}=10 V, I_F=0
Capacitance	C_{CE}		3.3		pF	V_{CE}=5 V, f=1 MHz

TRANSFER CHARACTERISTICS

CHARACTERISTIC	SYMBOL	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS
DC CURRENT TRANSFER RATIO						
H24A1	I_C	10.0			mA	I_F=10 mA, V_{CE}=10 V
H24A2	I_C	2.0			mA	I_F=10 mA, V_{CE}=10 V
Saturation voltage	$V_{CE(SAT)}$		0.1	0.4	V	I_F=10 mA, I_C=0.5 mA
Turn-on time	t_{on}		9		μs	I_C=2 mA, V_{CE}=10 V, R_L=100 Ω
Turn-off time	t_{off}		4		μs	I_F=2 mA, V_{CE}=10 V, R_L=100 Ω
Turn-on time	t_{on}		6.5		μs	I_F=10 mA, V_{CE}=5 V, R_L=10KΩ
Turn-off time	t_{off}		165		μs	I_F=10 mA, V_{CE}=5 V, R_L=10KΩ

ISOLATION CHARACTERISTICS

CHARACTERISTICS	SYMBOL	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS
Surge isolation voltage	V_{ISO}	6000			V_{Peak}	1 Minute
Steady-state isolation voltage	V_{ISO}	5300			V_{RMS}	1 Minute
Isolation resistance	R_{ISO}	10^{11}			ohms	$V_{I\text{-}O}$=500 VDC
Isolation capacitance	C_{ISO}		0.5		pF	$V_{I\text{-}O}$=0, f=1 MHz

TYPICAL ELECTRICAL CHARACTERISTIC CURVES

(25°C Free Air Temperature Unless Otherwise Specified)

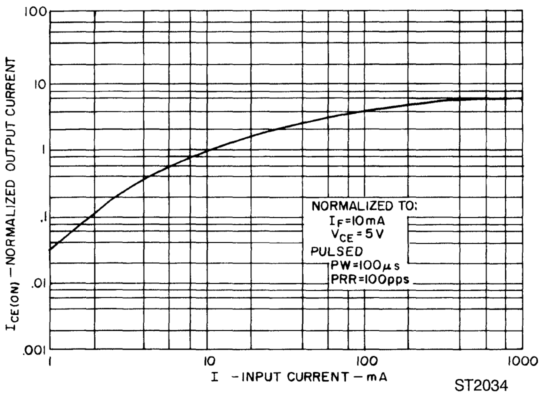


Fig. 1. Output Current vs. Input Current

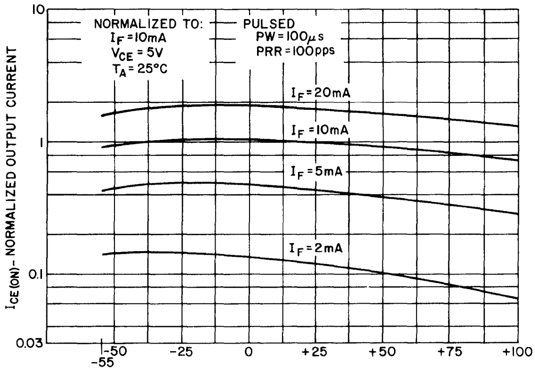


Fig. 2. Output Current vs. Temperature

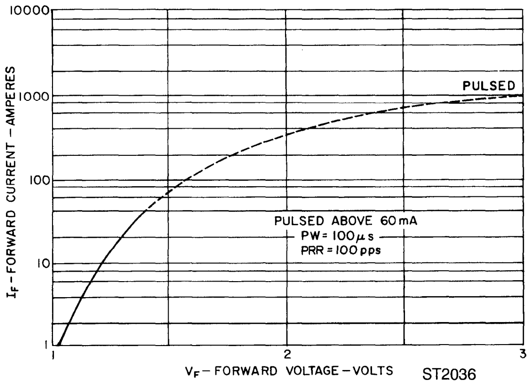


Fig. 3. Input Characteristics

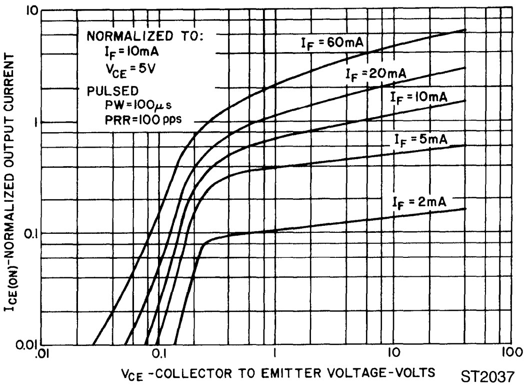


Fig. 4. Output Characteristics

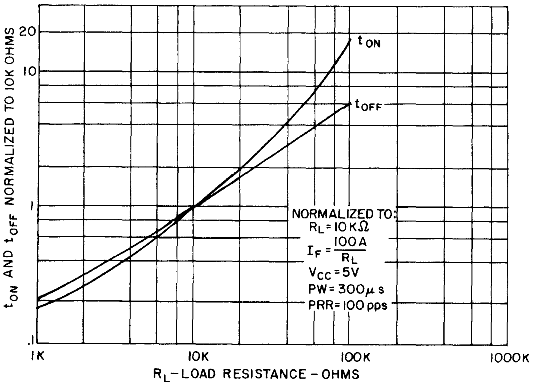


Fig. 5. Switching Speed vs. R_L

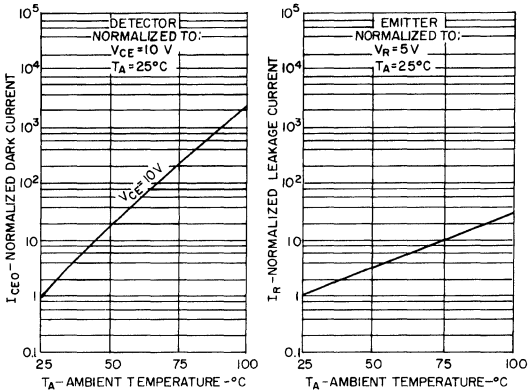
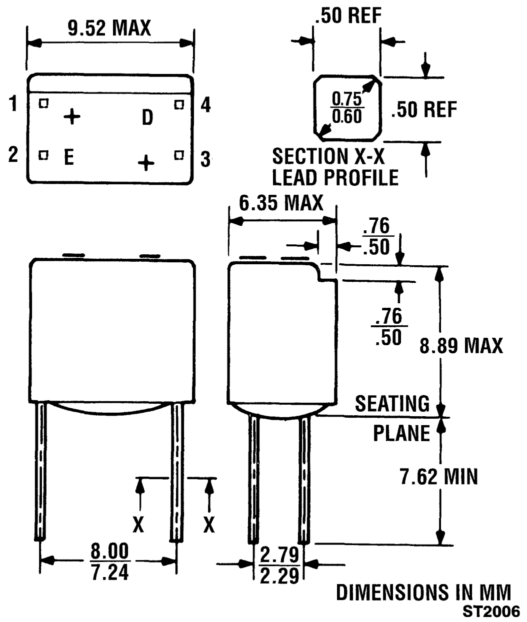
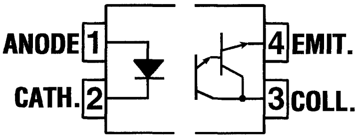


Fig. 6. Leakage Current vs. Temperature

H24B1 H24B2

PACKAGE DIMENSIONS





Equivalent Circuit

DESCRIPTION

The H24B series consists of a gallium arsenide infrared emitting diode coupled with a silicon phototransistor. The devices are housed in a low-cost plastic package with lead spacing compatible with a dual in-line package.

FEATURES

- 4-pin configuration
- Small package size and low cost
- UL recognized-file E51868
- High current transfer ratio

ABSOLUTE MAXIMUM RATINGS

TOTAL PACKAGE

Storage temperature	−55°C to 85°C
Operating temperature	−55°C to 85°C
Lead solder temperature	260°C for 5 sec

INPUT DIODE

Power dissipation (25°C ambient)	100 mW
Derate linearly (above 25°C)	1.67 mW/°C
Continuous forward current	60 mA
Peak forward current (1 μs pulse, 300pps)	3 A
Reverse voltage	4 V

DETECTOR

Power dissipation (at 25°C ambient)	150 mW
Derate linearly (above 25°C ambient)	2.5 mW/°C
V_{CEO}	30 V
V_{ECO}	7 V
Continuous forward current	100 mA

QT
OPTOELECTRONICS

PHOTOTRANSISTOR OPTOCOUPLERS

ELECTRICAL CHARACTERISTICS (25°C Temperature Unless Otherwise Specified)

INDIVIDUAL COMPONENT CHARACTERISTICS

CHARACTERISTIC	SYMBOL	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS
INPUT DIODE						
Forward voltage	V_F			1.7	V	I_F=60 mA
Reverse current	I_R			1	μA	V_R=3 V
Reverse breakdown voltage	$V_{(BR)R}$	4			V	I_R=10 μA
Capacitance	C_J		30		pF	V=0, f=1 MHz
OUTPUT DETECTOR						
Breakdown voltage Collector to emitter	BV_{CEO}	30			V	I_C=1 mA, I_F=0
Breakdown voltage Emitter to Collector	BV_{ECO}	7			V	I_C=100 μA, I_F=0
Collector dark current	I_{CEO}		5	100	nA	V_{CE}=10 V, I_F=0
Capacitance	C_{CE}		5		pF	V_{CE}=5 V, f=1 MHz

TRANSFER CHARACTERISTICS

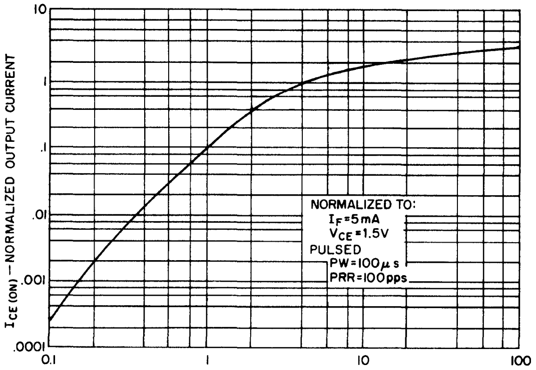
CHARACTERISTIC	SYMBOL	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS
DC CURRENT TRANSFER RATIO						
H24B1	I_C	50.0			mA	I_F=5 mA, V_{CE}=1.5 V
H24B2	I_C	20.0			mA	I_F=5 mA, V_{CE}=1.5 V
Saturation voltage	$V_{CE(SAT)}$		0.8	1.0	V	I_F=5 mA, I_C=2 mA
Turn-on time	t_{on}		105		μs	I_C=10 mA, V_{CE}=10 V, R_L=100 Ω
Turn-off time	t_{off}		60		μs	I_F=10 mA, V_{CE}=10 V, R_L=100 Ω
Turn-on time	t_{on}		10		μs	I_F=10 mA, V_{CE}=5 V, R_L=1 Ω
Turn-off time	t_{off}		700		μs	I_F=10 mA, V_{CE}=5 V, R_L=1 Ω

ISOLATION CHARACTERISTICS

CHARACTERISTICS	SYMBOL	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS
Surge isolation voltage	V_{ISO}	6000			V_{Peak}	1 Minute
Steady-state isolation voltage	V_{ISO}	5300			V_{RMS}	1 Minute
Isolation resistance	R_{ISO}	10^{11}			ohms	V_{I-O}=500 VDC
Isolation capacitance	C_{ISO}		0.5		pF	V_{I-O}=0, f=1 MHz

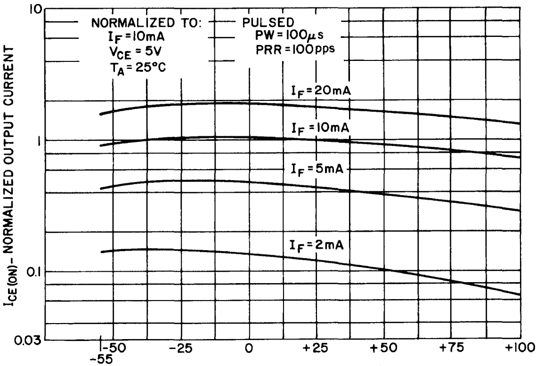
TYPICAL ELECTRICAL CHARACTERISTIC CURVES

(25°C Free Air Temperature Unless Otherwise Specified)



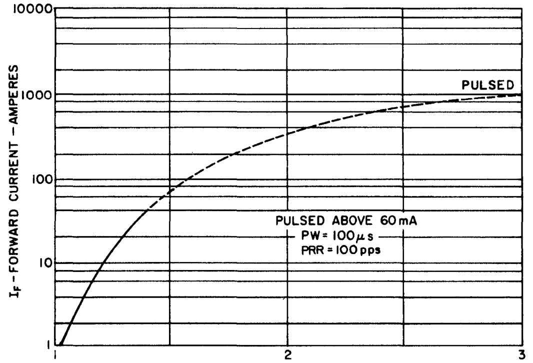
ST2009

Fig. 1. Output Current vs. Input Current



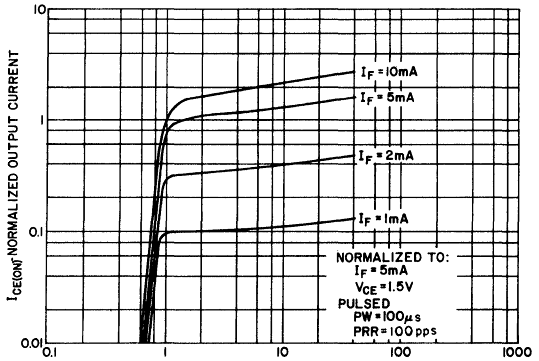
ST2035

Fig. 2. Output Current vs. Temperature



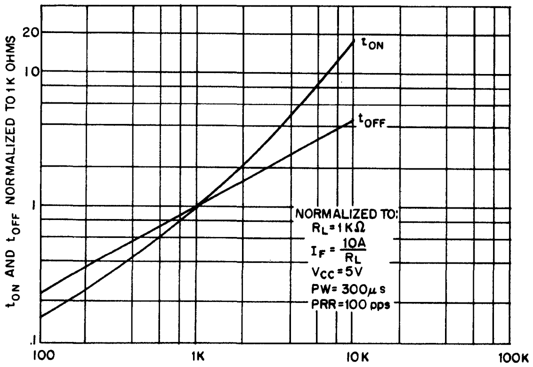
ST2011

Fig. 3. Input Characteristics



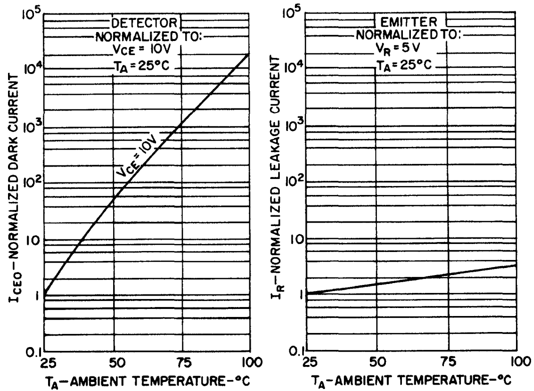
ST2012

Fig. 4. Output Characteristics



ST2013

Fig. 5. Switching Speed vs. RL



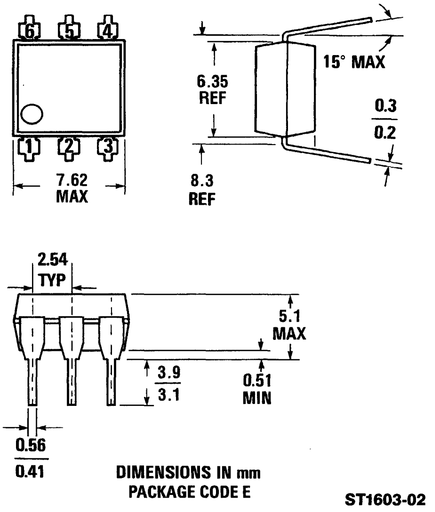
ST2014

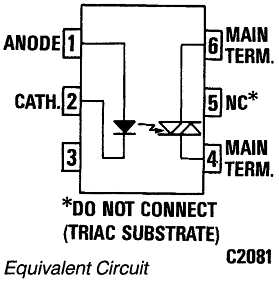
Fig. 6. Leakage Current vs. Temperature

NON-ZERO-CROSSING TRIACS

MOC3009 MOC3010
MOC3011 MOC3012

PACKAGE DIMENSIONS





Equivalent Circuit

DESCRIPTION

The MOC3009, MOC3010, MOC3011 and MOC3012 are optically isolated triac driver devices. These devices contain a GaAs infrared emitting diode and a light activated silicon bilateral switch, which functions like a triac. This series is designed for interfacing between electronic controls and power triacs to control resistive and inductive loads for 120 VAC operations.

FEATURES

- Low input current required (typically 5mA—MOC3011)
- High isolation voltage—minimum 7500 VAC peak
- Underwriters Laboratory (UL) recognized—File E90700

APPLICATIONS

- Triac driver
- Industrial controls
- Traffic lights
- Vending machines
- Motor control
- Solid state relay

ABSOLUTE MAXIMUM RATINGS

TOTAL PACKAGE

Storage temperature	−55°C to 150°C
Operating temperature	−40°C to 100°C
Lead temperature (soldering 10 sec)	260°C
Withstand test voltage	7500 VAC Peak (50-60 Hz)

INPUT DIODE

Forward DC current	50 mA
Reverse voltage	3 V
Peak forward current (1 μs pulse, 300 pps)	3.0 A
Power dissipation (25°C ambient)	100 mW
Derate linearly (above 25°C)	1.33 mW/°C

OUTPUT DRIVER

Off-state output terminal voltage		250 volts
On-state RMS current	T_A=25°C	100 mA
(Full cycle, 50 to 60 Hz)	T_A=70°C	50 mA
Peak nonrepetitive surge current (PW=10 ms, DC=10%)		1.2 A
Total power dissipation @ T_A=25°C		300 mW
Derate above 25°C		4.0 mW/°C

ELECTRO-OPTICAL CHARACTERISTICS (25°C Temperature Unless Otherwise Specified)

INDIVIDUAL COMPONENT CHARACTERISTICS

CHARACTERISTIC	SYMBOL	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS
INPUT DIODE						
Forward voltage	V_F		1.2	1.50	V	I_F=10 mA
Junction capacitance	C_J		50		pF	V_F=0 V, f=1 MHz
Reverse leakage current	I_R			100	μA	V_R=3.0 V
OUTPUT DETECTOR						
Peak blocking current, either direction	I_{DRM}	—		100	nA	V_{DRM}=250 V, Note 1
Peak on-state voltage, either direction	V_{TM}	—	2.0	3.0	Volts	I_{TM}=100 mA Peak

Note 1. Test voltage must be applied within dv/dt rating.

TRANSFER CHARACTERISTICS

DC CHARACTERISTICS		SYMBOL	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS
LED trigger current (current required to latch output)	MOC3009	I_{FT}	—	15.0	30	mA	Main terminal voltage=3.0 V, R_L = 150Ω
	MOC3010	I_{FT}	—	10.0	15	mA	
	MOC3011	I_{FT}	—	5	10	mA	
	MOC3012	I_{FT}	—	—	5	mA	
Holding current		I_H	—	100	—	μA	Either direction

TRANSFER CHARACTERISTICS

CHARACTERISTICS	SYMBOL	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS
AC dv/dt RATING						
Critical rate of rise of off-state voltage	dv/dt	—	12.0	—	V/μs	Static dv/dt (see Fig. 4)
Critical rate of rise of commutating voltage	dv/dt	—	0.2	—	V/μS	Commutating dv/dt I_{LOAD}=15 mA (see Fig. 4)

ISOLATION CHARACTERISTICS

CHARACTERISTICS	SYMBOL	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS
Isolation voltage	V_{iso}	5300			V_{AC}RMS	$I_{I-O}\leqslant 1$ μA, 1 Minute
	V_{iso}	7500			V_{AC}PEAK	$I_{I-O}\leqslant 1$ μA, 1 Minute
Isolation resistance	R_{iso}	10^{11}			ohms	V_{I-O}=500 VDC
Isolation capacitance	C_{iso}		0.5		pF	f=1 MHz

TYPICAL ELECTRICAL CHARACTERISTIC CURVES

(25°C Free Air Temperature Unless Otherwise Specified)

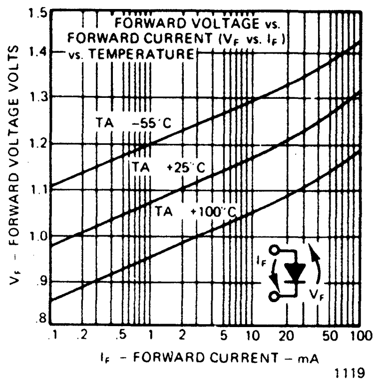


Fig. 1. Forward Voltage Drop vs. Forward Current

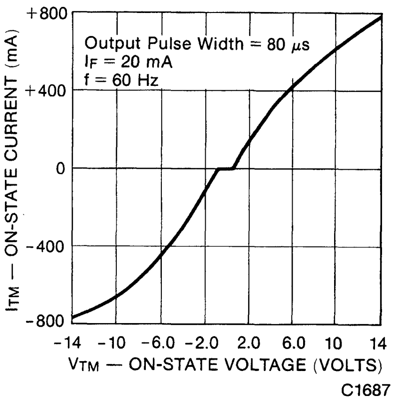


Fig. 2. On-State Characteristics

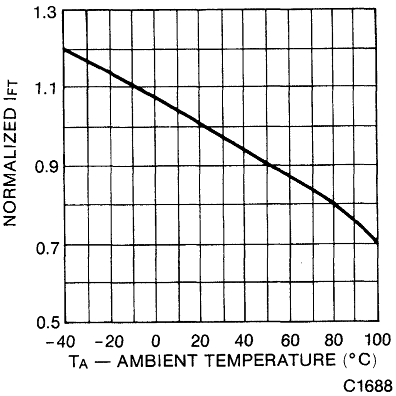
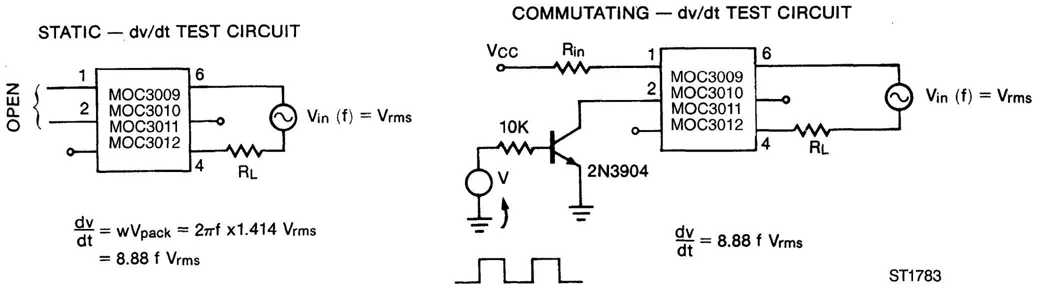


Fig. 3. Trigger Current vs. Temperature



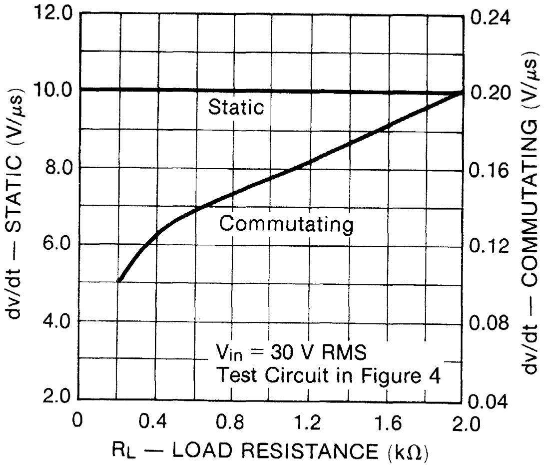
$$\frac{dv}{dt} = wV_{pack} = 2\pi f \times 1.414\ V_{rms}$$
$$= 8.88\ f\ V_{rms}$$

$$\frac{dv}{dt} = 8.88\ f\ V_{rms}$$

Fig. 4. dV/dt Test Circuits

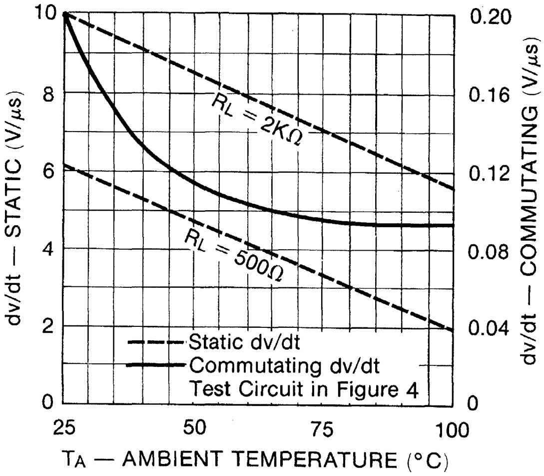
TYPICAL ELECTRICAL CHARACTERISTIC CURVES

(25°C Free Air Temperature Unless Otherwise Specified) (Cont'd)



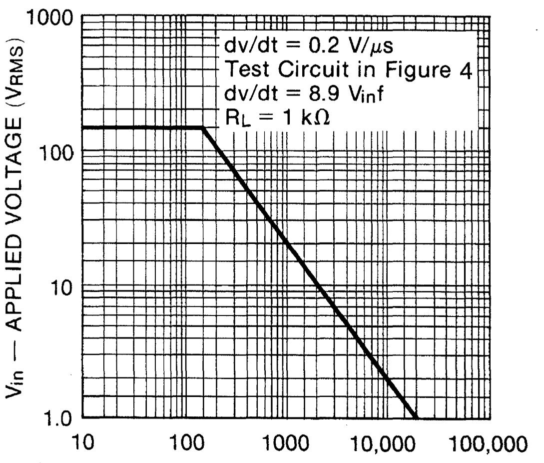
C1690

Fig. 5. dV/dt vs. Load Resistance



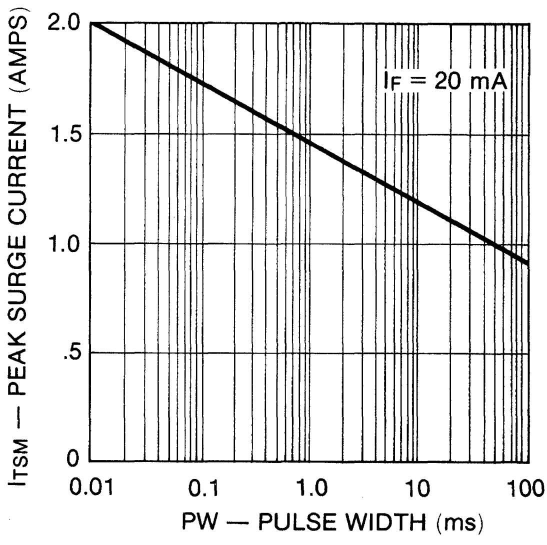
C1691

Fig. 6. dV/dt vs. Temperature



C1692

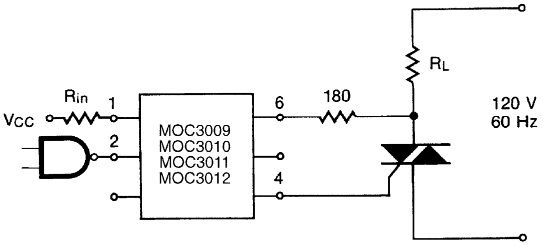
Fig. 7. Commutating dV/dt vs. Frequency



C1696

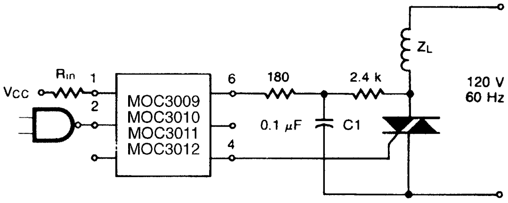
Fig. 8. Maximum Nonrepetitive Surge Current

TYPICAL APPLICATION CIRCUITS



ST1784

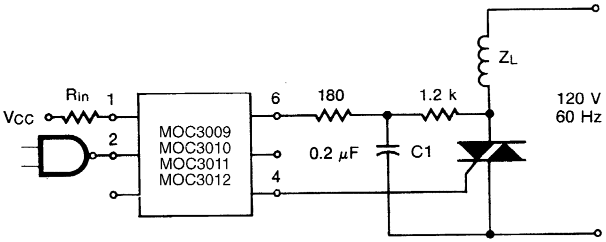
Fig. 9. Resistive Load



(IGT ≤ 15 mA)

ST1785

Fig. 10. Inductive Load With Sensitive Gate Triac



(15 mA < IGT < 50 mA)

Fig. 11. Inductive Load With Non-Sensitive Gate Triac

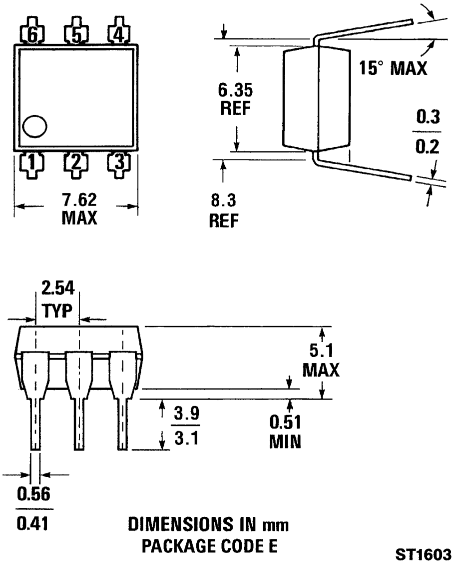
ST1786

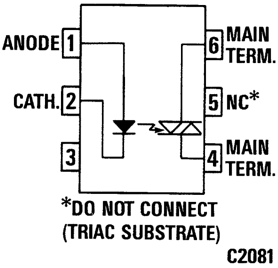
QT
OPTOELECTRONICS

NON-ZERO-CROSSING TRIACS

MOC3020 MOC3021
MOC3022 MOC3023

PACKAGE DIMENSIONS





Equivalent Circuit

DESCRIPTION

The MOC3020, MOC3021, MOC3022 and MOC3023 are optically isolated triac driver devices. These devices contain a GaAs infrared emitting diode and a light activated silicon bilateral switch, which functions like a triac. This is designed for interfacing between electronic controls and power triacs to control resistive and inductive loads for 240 VAC operations.

FEATURES

- Excellent I_{FT} stability—IR emitting diode has low degradation
- High isolation voltage—minimum 7500 VAC peak
- Underwriters Laboratory (UL) recognized—File #E90700

APPLICATIONS

- European applications for 240 VAC
- Triac driver
- Industrial controls
- Traffic lights
- Vending machines
- Motor control
- Solid state relay

ABSOLUTE MAXIMUM RATINGS

TOTAL PACKAGE

Storage temperature	−55°C to 150°C
Operating temperature	−40°C to 100°C
Lead temperature (soldering, 10 sec)	260°C

INPUT DIODE

Forward DC current	50 mA
Reverse voltage	3 V
Peak forward current (1 μs pulse, 300 pps)	3.0 A
Power dissipation (25°C ambient)	100 mW
Derate linearly (above 25°C ambient)	1.33 mW/°C

OUTPUT DRIVER

Off-state output terminal voltage		400 Volts
On-state RMS current	T_A=25°C	100 mA
(Full cycle, 50 to 60 Hz)	T_A=70°C	50 mA
Peak nonrepetitive surge current (PW=10 ms, DC=10%)		1.2 A
Total power dissipation (25°C ambient)		300 mW
Derate above 25°C		4.0 mW/°C

NON-ZERO-CROSSING TRIACS

ELECTRO-OPTICAL CHARACTERISTICS (25°C Temperature Unless Otherwise Specified)

INDIVIDUAL COMPONENT CHARACTERISTICS

CHARACTERISTIC	SYMBOL	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS
INPUT DIODE Forward voltage	V_F		1.2	1.50	V	I_F=10 mA
Junction capacitance	C_J		50		pF	V_F=0 V, f=1 MHz
Reverse leakage current	I_R			100	μA	V_R=3.0 V
OUTPUT DETECTOR Peak blocking current, either direction	I_{DRM}	—	10	100	nA	V_{DRM}=400 V, Note 1
Peak on-state voltage, either direction	V_{TM}	—	2.5	3.0	Volts	I_{TM}=100 mA Peak

Note 1. Test voltage must be applied within dv/dt rating.

TRANSFER CHARACTERISTICS

DC CHARACTERISTICS		SYMBOL	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS
LED trigger current (current required to latch output)	MOC3020	I_{FT}	—	—	30	mA	Main terminal voltage=3.0 V, R_L=150Ω
	MOC3021	I_{FT}	—	—	15	mA	
	MOC3022	I_{FT}	—	—	10	mA	
	MOC3023	I_{FT}	—	—	5	mA	
Holding current		I_H	—	100	—	μA	Either direction

TRANSFER CHARACTERISTICS

CHARACTERISTICS	SYMBOL	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS
dv/dt RATING Critical rate of rise of off-state voltage	dv/dt	—	12	—	V/μs	Static dv/dt, T_A=85°C (see Fig. 3)
Critical rate of rise of commutating voltage	dv/dt	—	0.2	—	V/μs	Commutating dv/dt I_{LOAD}=15 mA (see Fig. 4)

ISOLATION CHARACTERISTICS

CHARACTERISTICS	SYMBOL	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS
Isolation voltage	V_{iso}	5300			V_{AC}RMS	$I_{I\text{-}O} \leq 1$ μA, 1 Minute
	V_{iso}	7500			V_{AC}PEAK	$I_{I\text{-}O} \leq 1$ μA, 1 Minute
Isolation resistance	R_{iso}	10^{11}			ohms	$V_{I\text{-}O}$=500 VDC
Isolation capacitance	C_{iso}		0.5		pF	f=1 MHz

Note 1: Ratings apply to either polarity of pin 6 — referenced to pin 4. Voltages must be applied within dv/dt rating.

TYPICAL ELECTRICAL CHARACTERISTIC CURVES

(25°C Free Air Temperature Unless Otherwise Specified)

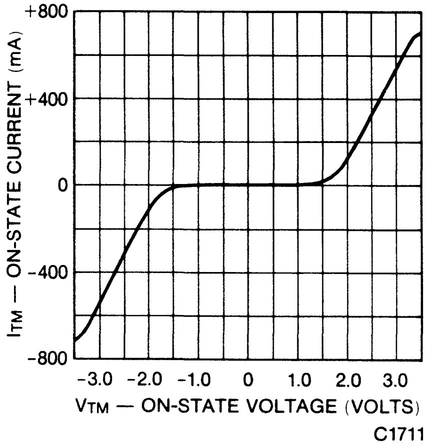


Fig. 1. On-State Characteristics

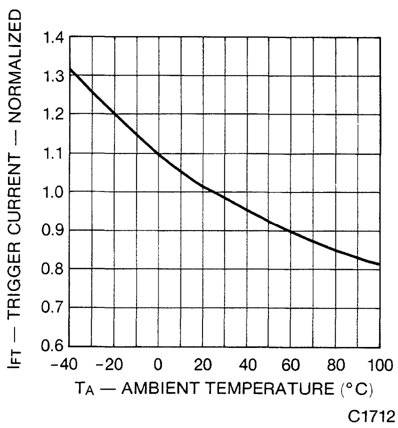
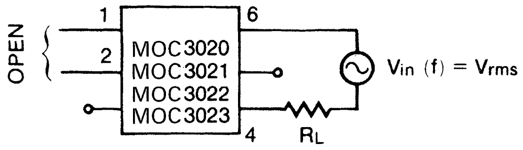


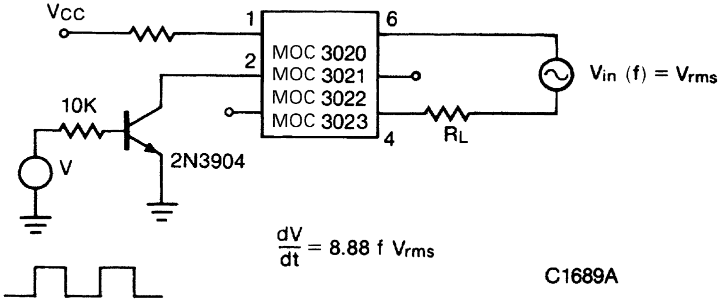
Fig. 2. Trigger Current vs. Temperature

TEST CIRCUITS FOR dV/dt MEASUREMENTS



$$\frac{dV}{dt} = wV_{pack} = 2\pi f \text{ x}1.414\ V_{rms}$$
$$= 8.88\ f\ V_{rms}$$

Fig. 3. Static dV/dt



$$\frac{dV}{dt} = 8.88\ f\ V_{rms}$$

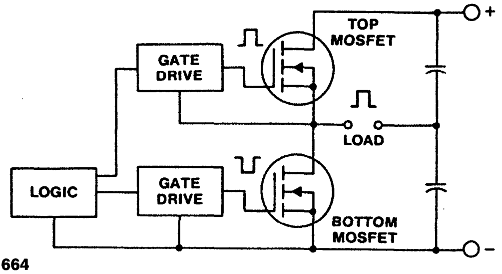
Fig. 4. Commutating dV/dt

Common-Drain Power-MOSFET Gate-Drive Solutions Using the H11N/L Optoisolators

by W.H. Sahm

Introduction

Power-MOSFET devices in the half-bridge configuration, Fig. 1, are becoming popular for both switching-power-supplies and PWM (pulse-width-modulated) motor controls. These circuits include a common-drain stage on which the gate and source-terminal potentials, i.e., the control-terminal potentials, rise and fall hundreds of volts in tens of nanoseconds. The magnitude and rate of change of this common-mode voltage places severe constraint on the gate-drive circuitry and represents a challenge to the circuit designer.



ST1664

Fig. 1 - Half-bridge power-MOSFET circuit.

This Note investigates several methods of gate control for these common-drain MOSFET devices. These methods include bootstrap techniques with level shifting accomplished through the use of transistors, optoisolators, and high-voltage ICs. The conclusions are applicable to the power MOSFET, the MOS-IGT, and hybrid MOS-bipolar power switches.

General Considerations

Fast-switching efficient power MOSFETs are widely used for PWM power-control applications. The common-drain-connected n-channel power MOSFET is often utilized in switching-power supplies, motor and solenoid control, and in series-connected high-voltage switches. Although it would appear advantageous to utilize common-source p-channel devices in these sockets to simplify gate-drive circuitry, the penalty caused by the use of p-channel devices is too severe in all but the lower-circuit lower-voltage application areas. This situation will remain until III-V enhancement-mode devices become widely available at low cost (if they ever prove viable), because silicon p-channel devices will always require much more silicon area to provide the same ratings. This large die area imposes an economic penalty in device cost, a perfromance penalty in the increased capacitance associated with the larger die area, and the complete lack of device availability in the higher current and/or voltage ratings. These facts assure a long life for the common-drain power-MOSFET configuration. Note also that a good MOSFET gate-drive design could allow replacement of a preamp bipolar with a MOSFET in the drive of a bipolar common-collector high-power output, which could almost eliminate the need for a floating current source.

The complexity of driving the gate of this common-drain power MOSFET derives from two fundamental facts: the lack of a fixed reference point for the gate signal and the need for a gate voltage with a value higher than the positive supply rail being controlled. Although these factors are also persent in bipolar-transistor common-collector stages, the fast switching and the magnitude of the gate signal in power-MOS devices places more stringent requirements on the circuit design. To minimize power dissipation in the conducting state, the gate-source voltage should be greater than 10V but less than 20V, assuring minimum on-state resistance without danger of damage to the fragile gate oxide. To minimize power dissipation during switching, the gate voltage should have fast rise and fall times when driving the highly capacitive gate. Although this explanation is simple and elementary, it is not trivial when examined from a practical viewpoint. Mass-produced circuits are constrained to be very compatible with automated assembly, to be very consistent in performance over the tolerance limits of the standard components used, to perform reliably in an application for long time periods and, if failure occurs, to fail in a manner that will not create a safety hazard.

This combination of performance, manufacturability, reliability, and safety impact the design of the gate-drive circuit, which must meet cost and design-schedule goals. The performance issues that will determine the gate-drive circuit configuration include adequate speed and drive capability, total system-power dissipation, and common-mode transient immunity. The manufacturability issues include standard components, tolerance sensitivity, automatic assembly, size, adaptability, cost, and quantity used. Reliability and safety are impacted by power dissipation, parts count, isolation, noise-transient overvoltage susceptability, ease and speed of shutdown, fault-sensing compatibility, and failure consequences. Although this is not an all-inclusive list, it serves as a starting point to evaluate a gate-drive configuration for a common-drain power MOS.

The simplest gate-drive circuit directly transfer energy to the gate from the control-circuitry low-voltage supply at logic ground. Although photovoltaic and piezoelectric elements are sometimes used, they provide too little output current to be compatible with fast charging and discharging of the MOSFET gate capacitance. Pulse transformers can supply large currents, although they can be difficult to obtain with risetime capability compatible with the power MOSFET. Other possible difficulties with pulse transformers include input-to-output capacitance, automatic-insertion compatibility, and the feedback of signals from the power stages to the control circuitry. Specialty transformers can be designed to overcome these disadvantages, although economic viability may suffer. Dielectric isolation in these energy-transfer devices eliminates the possibility of high-voltage power being present on the low-voltage control circuits in a fault condition.

The most common gate-drive circuits utilize a source of stored energy referenced to the source of the common-drain stage. Although this source can be a floating power supply powered through a transformer, or piezoelectric or photovoltaic element, it will usually be a capacitor that is chraged directly from wither the low-voltage control supply (flying capacitor) or the positive power rail (bootstrap) during periods when the common-drain stage is blocking. The bootstrap circuit capacitor may be rechargerd during long conduction periods of the common-drain MOSFET by using load current. Channel resistance is momentarily allowed to rise until drain-source voltage reaches the approximately 15V required to recharge. To provide this recharge or "refresh" of a flying-capacitor circuit, the common-drain stage must fullly turn offf and block full supply voltage. The charge on this capacitor is a supply for the gate of the common-drain power MOSFET and its control circuitry. The control circuitry can be a s simple as a resistor and high-voltage level-shift transistor, but usually consists of several devices to provide gain, fast swithcing, noise suppression, voltage stability, and other desired functions. Simple optoisolators are often used to provide the control-signal path from the low-voltage circuitry, although speed can be marginal in many cases. Until recently the more complex optoisolators would provide speed, but were limted in common-mode rejection and in voltage capability. The high-voltage integrated circuit (HVIC) has also become available recently, providing both the level shift of the control signal and the signal processing for teh common-drain MOSFET gate drive. It also can be designed to provide over-current protection, automatic refresh, and cooprdination of conduction times of the common-drain and common-source stages. Devices available to date can operate up to 500V and above 20 kHz. These HVICs are normally designed as application-specific devices for specific system applications.

Optoisolator Characteristics

Recently, high-speed optoisolators, with excellent common-mode rejection and wide supply-voltage compability, have become available. The simplest and least costly opf these devices are six-pin dual-in-line plastic-packaged infrared diode-input Schmitt-trigger-output configurations. Two basic derivations are commonly available, on being optimized for fast switching and one for low power consumption. These derivations are convenient for the power-MOSFET-circuit designer, as a basic "universal" circuit can be designed, and only the optoisolator changed for a choice of either longer duty cycles (>10 ms) at moderate speeds (≤200 kHz @ 150 ns t_r, t_f), or a shorter duty cycle operating to more than 2 MHz with 15-ns transitions. Duty cycles are limited by the Schmitt-trigger power-supply current draining the source capacitor and can be increased with larger storage capacitance, but at the cost of increased refresh time or more complex refresh circuitry. DC operation requires a refresh scheme or a small power supply, as mentioned above. Overall, these optoisolators appear to offer great advantages in driving common-drain powre MOSFETs and similar devices, such as IGT, MOS-gated thyristor, etc.

Test Circuit

To check the apparent advantages of the optoisolator approach, a circuit was built theat employed the H11L (slow) and H11N (fast) optoisolated Schmitt triggers. A plug-in prototype board was used to construct the circuit of Fig. 2. The circuit makes use of an IRF630 power-MOSFET switch and replaces the lower FET with a 45-ohm power-resistor source load. A 1-μF aluminum electrolytic capacitor was used as the bootstrap supply, with a variable dc power source for V_{BB} supply was kept below 75V to keep the circuit within the IRF630 ratings during the turn-off spike. No heatsinks or special wiring precautions were used. Although only the H11N1 is actually specified for common-mode rejection at 2000 V/μs minimum, the lower-cost H11L1 uses similar shielding in the IC chip, and identical packaging. These similar features of the H11L1 and N1 lead to the expectation of a similar ability to function under high dv/dt.

Tests of the ciruit confirmed the expected performance for both optoisolators in the circuit. The H11L was driven from 5V pulses with a 2K resistor, and drives the IRF630 at about 300 kHz with a 12% duty cycle. Turn-on and turn-off times of the IRF630 were about 60 ns, which yielded more than 2000-V/μs dv/dt during the 175V turn-off spike. These wavforms are illustrated in Fig. 3. The H11N1 was then substituted for the H11L, and the value of the infrated diode-limiting resistor was reduced to 680 ohms. Operation a 1 MHz was confirmed. Higher-frequency operation was obtainable through heatsinking of the IRF630 and the use of a higher-rated load resistor. The waveform presented in Fig. 4 illustrates this operation, and about the same dv/dt as the H11L provided.

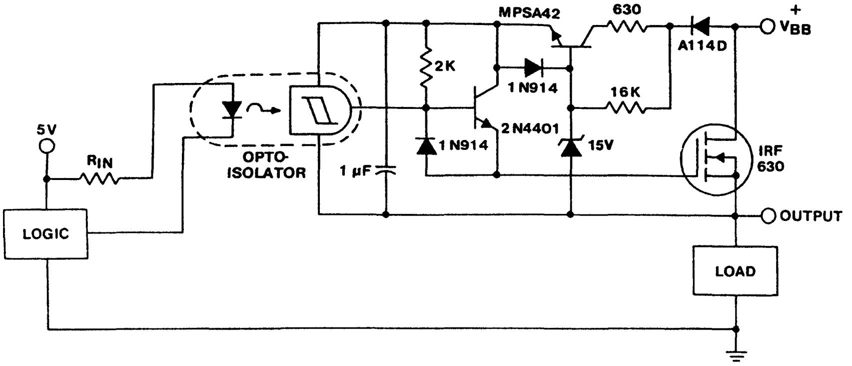
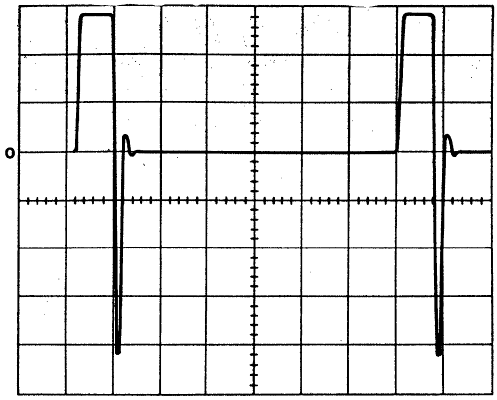
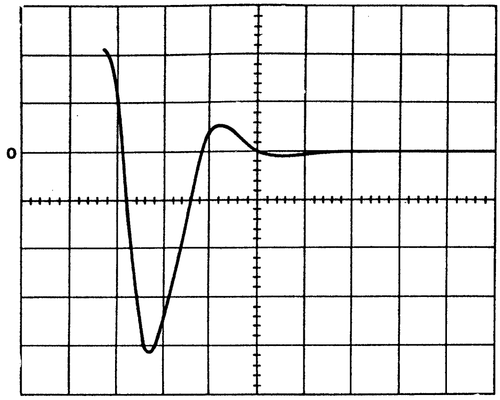


Fig. 2 - Optically isolated power-MOSFET-driver test circuit.



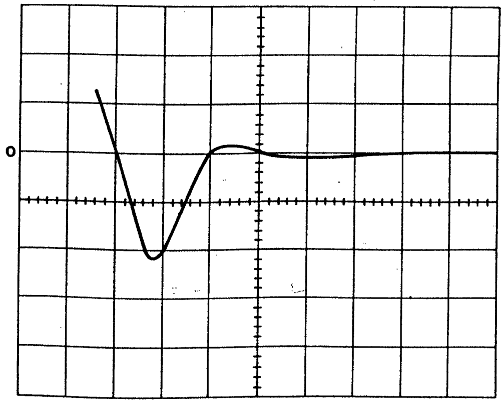
a) Load Voltage Across 45Ω
V=20 V/Division
t=500 ns/Division

Fig. 1.



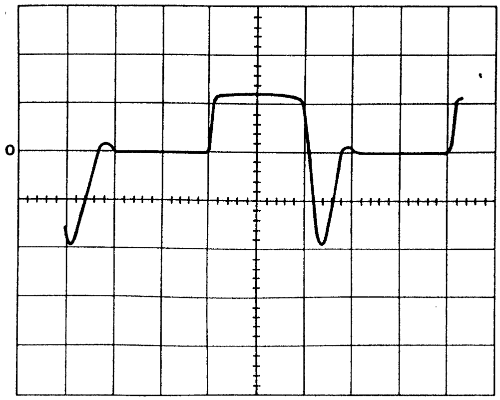
b) Expanded Scale of Turnoff Portion of Above Waveform
V=20 V/Division
t=50 ns/Division

Fig. 2.



c) Turnoff Waveforms with V_{BB} to Increase Load Voltage to 75V
V=50 V/Division
t=50 ns/Division

Fig. 3 Waveforms taken with an H11L in the test circuit.



V=50 V/Division
t=200 ns/Division

Fig. 4 Waveforms Taken With An H11N In The Test Circuit

INFRARED COMPONENTS AND ASSEMBLIES

Alphanumeric Product Listing

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INFRARED COMPONENTS AND ASSEMBLIES

Alphanumeric Product Listing

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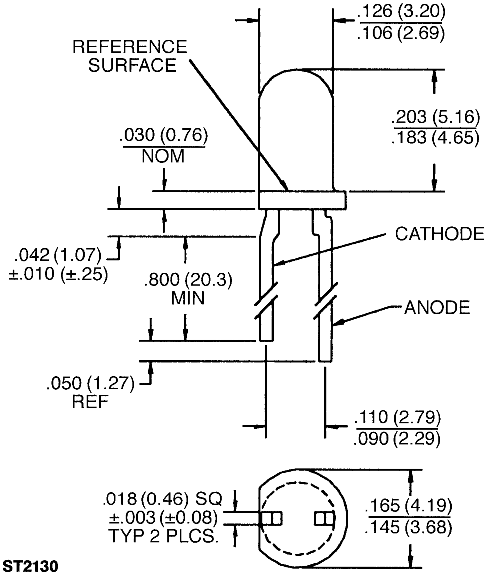
GaAs INFRARED EMITTING DIODE

QEC112/113

PACKAGE DIMENSIONS



ST2130

NOTES:
1. DIMENSIONS ARE IN INCHES (mm).
2. TOLERANCE IS ±.010 (.25) UNLESS OTHERWISE SPECIFIED.
3. FLAT DENOTES CATHODE.

DESCRIPTION

The QEC11X is a 940 nm GaAs LED encapsulated in a clear, peach tinted, plastic T-1 package.

FEATURES

- Tight production E_θ distribution.
- Steel lead frames for improved reliability in solder mounting.
- Good optical-to-mechanical alignment.
- Narrow emission angle.
- Mechanically and wavelength matched to QSC11X series phototransistor.
- Plastic package color allows easy recognition from phototransistor.
- High irradiance level.

GaAs INFRARED EMITTING DIODE

ABSOLUTE MAXIMUM RATINGS (T_A = 25°C Unless Otherwise Specified)

Storage Temperature .... −40°C to + 100°C
Operating Temperature .... −40°C to + 100°C
Soldering:
  Lead Temperature (Iron) .... 240°C for 5 sec. (2,3,4,5)
  Lead Temperature (Flow) .... 260°C for 10 sec. (2,3,5)
Continuous Forward Current .... 50 mA
Reverse Voltage .... 5.0 Volts
Power Dissipation .... 100 mW(1)

ELECTRICAL CHARACTERISTICS (T_A = 25°C Unless Otherwise Specified)
(All measurements made under pulse conditions.)

PARAMETER	SYMBOL	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS
Forward Voltage	V_F	—		1.50	V	I_F = 20 mA
Reverse Leakage Current	I_R	—		10	μA	V_R = 5.0 V
Peak Emission Wavelength	λ_P	—	940	—	nm	I_F = 20 mA
Emission Angle at ½ Power	θ	—	±8	—	Degrees	
Radiant Incidence QSC112	E_θ	0.03		0.15	mW/10° Cone	I_F = 20 mA(6,7)
Radiant Incidence QSC113	E_θ	0.07		—	mW/10° Cone	I_F = 20 mA(6,7)

NOTES

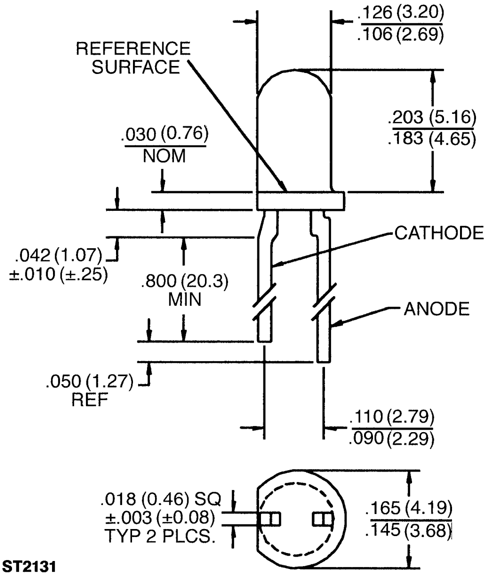
1. *Derate power dissipation linearly 1.33 mW/°C above 25°C.*
2. *RMA flux is recommended.*
3. *Methanol or Isopranol alcohols are recommended as cleaning agents.*
4. *Soldering iron tip 1⁄16″ (1.6 mm) minimum from housing.*
5. *As long as leads are not under any stress or spring tension.*
6. *Measurement is taken at the end of a single 100 μsec pulse.*
7. *E_θ is a measurement of the average apertured radiant energy incident upon a sensing area 0.444″ (11.3 mm) in diameter, perpendicular to and centered on the mechanical axis of the lens, and 2.54″ (64.4 mm) from the measurement surface. E_θ is not necessarily uniform within the measurement area.*

OPTOELECTRONICS

AlGaAs INFRARED EMITTING DIODE

QEC121/122

PACKAGE DIMENSIONS



ST2131

NOTES:
1. DIMENSIONS ARE IN INCHES (mm).
2. TOLERANCE IS ±.010 (.25)
   UNLESS OTHERWISE SPECIFIED.
3. FLAT DENOTES CATHODE.

DESCRIPTION

The QEC12X is an 880 nm AlGaAs LED encapsulated in a clear, purple tinted, plastic T-1 package.

FEATURES

- Tight production E_θ distribution.
- Steel lead frames for improved reliability in solder mounting.
- Good optical-to-mechanical alignment.
- Narrow emission angle.
- Mechanically and wavelength matched to QSC11X series phototransistor.
- Plastic package color allows easy recognition from phototransistor.
- High irradiance level.

OPTOELECTRONICS

AlGaAs INFRARED EMITTING DIODE

ABSOLUTE MAXIMUM RATINGS (T_A = 25°C Unless Otherwise Specified)

Storage Temperature	−40°C to + 100°C
Operating Temperature	−40°C to + 100°C
Soldering:	
Lead Temperature (Iron)	240°C for 5 sec. (2,3,4,5)
Lead Temperature (Flow)	260°C for 10 sec. (2,3,5)
Continuous Forward Current	50 mA
Reverse Voltage	5.0 Volts
Power Dissipation	100 mW(1)

ELECTRICAL CHARACTERISTICS (T_A = 25°C Unless Otherwise Specified)

(All measurements made under pulse conditions.)

PARAMETER	SYMBOL	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS
Forward Voltage	V_F	—		1.70	V	I_F = 20 mA
Reverse Leakage Current	I_R	—		10	μA	V_R = 5.0 V
Peak Emission Wavelength	λ_P	—	880	—	nm	I_F = 20 mA
Emission Angle at ½ Power	θ	—	±8	—	Degrees	
Radiant Incidence QEC121	E_θ	0.07		—	mW/10° Cone	I_F = 20 mA(6,7)
Radiant Incidence QEC122	E_θ	0.13		0.45	mW/10° Cone	I_F = 20 mA(6,7)

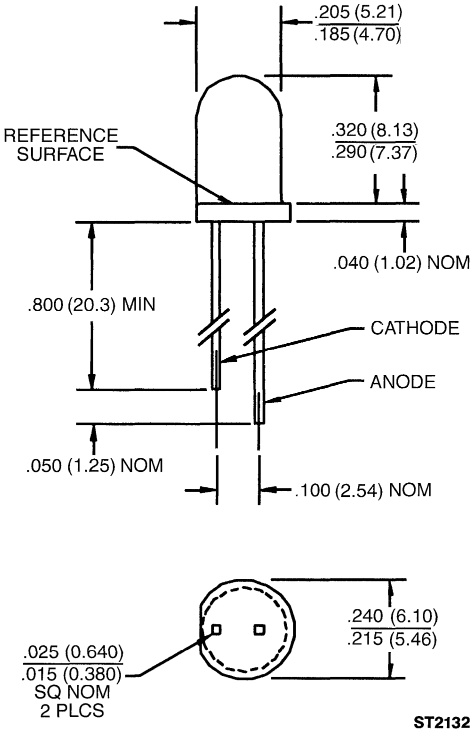
NOTES

1. *Derate power dissipation linearly 1.33 mW/°C above 25°C.*
2. *RMA flux is recommended.*
3. *Methanol or Isopranol alcohols are recommended as cleaning agents.*
4. *Soldering iron tip 1⁄16″ (1.6 mm) minimum from housing.*
5. *As long as leads are not under any stress or spring tension.*
6. *Measurement is taken at the end of a single 100 μsec pulse.*
7. *E_θ is a measurement of the average apertured radiant energy incident upon a sensing area 0.444″ (11.3 mm) in diameter, perpendicular to and centered on the mechanical axis of the lens, and 2.54″ (64.4 mm) from the measurement surface. E_θ is not necessarily uniform within the measurement area.*

AlGaAs INFRARED EMITTING DIODE

QED121/122/123

PACKAGE DIMENSIONS



ST2132

NOTES:
1. DIMENSIONS ARE IN INCHES (mm).
2. TOLERANCE IS ±.010 (.25) UNLESS OTHERWISE SPECIFIED.
3. FLAT DENOTES CATHODE.

DESCRIPTION

The QED12X is an 880 AlGaAs LED encapsulated in a clear, peach tinted, plastic T-1¾ package.

FEATURES

- Tight production E_θ distribution.
- Steel lead frames for improved reliability in solder mounting.
- Good optical-to-mechanical alignment.
- Very narrow emission angle.
- Mechanically and wavelength matched to QSD12X series phototransistor.
- Plastic package color allows easy recognition from phototransistor.
- High irradiance level.

AlGaAs INFRARED EMITTING DIODE

ABSOLUTE MAXIMUM RATINGS (T_A = 25°C Unless Otherwise Specified)

Storage Temperature .... −40°C to + 100°C
Operating Temperature .... −40°C to + 100°C
Soldering:
  Lead Temperature (Iron) .... 240°C for 5 sec. (2,3,4,5)
  Lead Temperature (Flow) .... 260°C for 10 sec. (2,3,5)
Continuous Forward Current .... 100 mA
Reverse Voltage .... 5.0 Volts
Power Dissipation .... 200 mW(1)

ELECTRICAL CHARACTERISTICS (T_A = 25°C Unless Otherwise Specified)

(All measurements made under pulse conditions.)

PARAMETER	SYMBOL	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS
Forward Voltage	V_F	—		1.70	V	I_F = 20 mA
Reverse Leakage Current	I_R	—		10	μA	V_R = 5.0 V
Peak Emission Wavelength	λ_P	—	880	—	nm	I_F = 20 mA
Emission Angle at ½ Power	θ	—	±9	—	Degrees	
Radiant Incidence QED121	E_θ	0.08		—	mW/10° Cone	I_F = 20 mA(6,7)
Radiant Incidence QED122	E_θ	0.16		0.56	mW/10° Cone	I_F = 20 mA(6,7)
Radiant Incidence QED123	E_θ	0.24		—	mW/10° Cone	I_F = 20 mA(6,7)

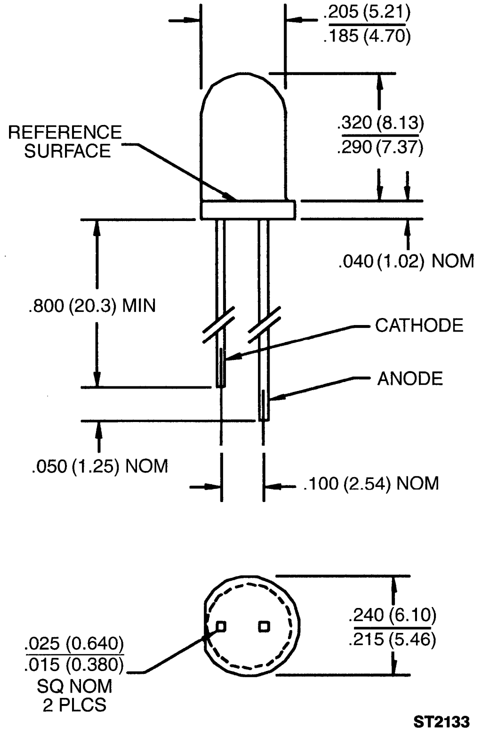
NOTES

1. *Derate power dissipation linearly 2.67 mW/°C above 25°C.*
2. *RMA flux is recommended.*
3. *Methanol or Isopropyl alcohols are recommended as cleaning agents.*
4. *Soldering iron tip 1⁄16″ (1.6 mm) minimum from housing.*
5. *As long as leads are not under any stress or spring tension.*
6. *Measurement is taken at the end of a single 100 μsec pulse.*
7. *E_θ is a measurement of the average apertured radiant energy incident upon a sensing area 0.444″ (11.3 mm) in diameter, perpendicular to and centered on the mechanical axis of the lens, and 2.54″ (64.4 mm) from the measurement surface. E_θ is not necessarily uniform within the measurement area.*

AlGaAs INFRARED EMITTING DIODE

QED221/222

PACKAGE DIMENSIONS



NOTES:
1. DIMENSIONS ARE IN INCHES (mm).
2. TOLERANCE IS ±.010 (.25) UNLESS OTHERWISE SPECIFIED.
3. FLAT DENOTES CATHODE.

DESCRIPTION

The QED22X is an 880nm AlGaAs LED encapsulated in a clear, purple tinted, plastic T-1¾ package.

FEATURES

- Tight production E_θ distribution.
- Steel lead frames for improved reliability in solder mounting.
- Good optical-to-mechanical alignment.
- Wide emission angle.
- Mechanical and wavelength matched to QSD12X series phototransistor.
- Plastic package color allows easy recognition from phototransistor.
- High irradiance level.

OPTOELECTRONICS

AlGaAs INFRARED EMITTING DIODE

ABSOLUTE MAXIMUM RATINGS (T_A = 25°C Unless Otherwise Specified)

Storage Temperature .... −40°C to + 100°C
Operating Temperature .... −40°C to + 100°C
Soldering:
  Lead Temperature (Iron) .... 240°C for 5 sec. (2,3,4,5)
  Lead Temperature (Flow) .... 260°C for 10 sec. (2,3,5)
Continuous Forward Current .... 100 mA
Reverse Voltage .... 5.0 Volts
Power Dissipation .... 200 mW(1)

ELECTRICAL CHARACTERISTICS (T_A = 25°C Unless Otherwise Specified) (All measurements made under pulse conditions.)

PARAMETER	SYMBOL	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS
Forward Voltage	V_F	—		1.70	V	I_F = 20 mA
Reverse Leakage Current	I_R	—		10	μA	V_R = 5.0 V
Peak Emission Wavelength	λ_P	—	880	—	nm	I_F = 20 mA
Emission Angle at ½ Power	θ	—	±20	—	Degrees	
Radiant Incidence QED221	E_θ	0.065		—	mW/10° Cone	I_F = 20 mA(6,7)
Radiant Incidence QED222	E_θ	0.085		0.24	mW/10° Cone	I_F = 20 mA(6,7)

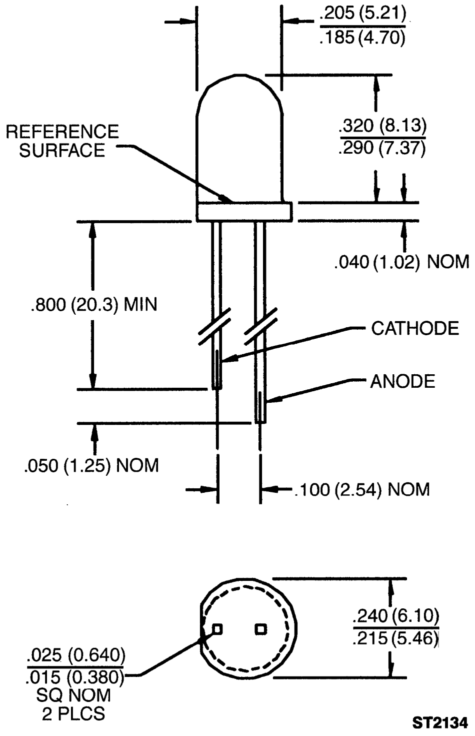
NOTES

1. *Derate power dissipation linearly 2.67 mW/°C above 25°C.*
2. *RMA flux is recommended.*
3. *Methanol or Isopropyl alcohols are recommended as cleaning agents.*
4. *Soldering iron tip 1/16" (1.6 mm) minimum from housing.*
5. *As long as leads are not under any stress or spring tension.*
6. *Measurement is taken at the end of a single 100 μsec pulse.*
7. *E_θ is a measurement of the average apertured radiant energy incident upon a sensing area 0.444" (11.3 mm) in diameter, perpendicular to and centered on the mechanical axis of the lens, and 2.54" (64.4 mm) from the measurement surface. E_θ is not necessarily uniform within the measurement area.*

GaAs INFRARED EMITTING DIODE

QED233/234

PACKAGE DIMENSIONS



NOTES:
1. DIMENSIONS ARE IN INCHES (mm).
2. TOLERANCE IS ±.010 (.25) UNLESS OTHERWISE SPECIFIED.
3. FLAT DENOTES CATHODE.

DESCRIPTION

The QED23X is a 940nm GaAs LED encapsulated in a clear plastic T-1¾ package.

FEATURES

- Tight production E_θ distribution.
- Steel lead frames for improved reliability in solder mounting.
- Good optical-to-mechanical alignment.
- Wide emission angle.
- Mechanical and wavelength matched to QSD12X series phototransistor.
- Plastic package color allows easy recognition from phototransistor.
- Medium and high irradiance level.

GaAs INFRARED EMITTING DIODE

ABSOLUTE MAXIMUM RATINGS (T_A = 25°C Unless Otherwise Specified)

Storage Temperature	−40°C to + 100°C
Operating Temperature	−40°C to + 100°C
Soldering:	
Lead Temperature (Iron)	240°C for 5 sec. (2,3,4,5)
Lead Temperature (Flow)	260°C for 10 sec. (2,3,5)
Continuous Forward Current	100 mA
Reverse Voltage	5.0 Volts
Power Dissipation	200 mW(1)

ELECTRICAL CHARACTERISTICS (T_A = 25°C Unless Otherwise Specified)
(All measurements made under pulse conditions.)

PARAMETER	SYMBOL	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS
Forward Voltage	V_F	—		1.50	V	I_F = 20 mA
Reverse Leakage Current	I_R	—		10	μA	V_R = 5.0 V
Peak Emission Wavelength	λ_P	—	940	—	nm	I_F = 20 mA
Emission Angle at ½ Power	θ	—	±20	—	Degrees	
Radiant Incidence QED233	E_θ	0.05		0.25	mW/10° Cone	I_F = 20 mA(6,7)
Radiant Incidence QED234	E_θ	0.13		—	mW/10° Cone	I_F = 20 mA(6,7)

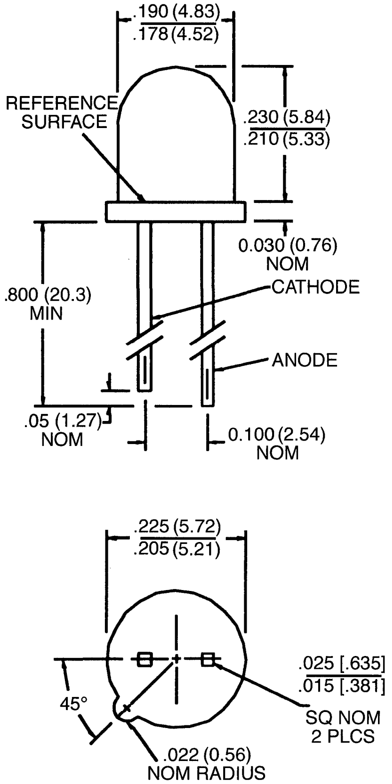
NOTES

1. *Derate power dissipation linearly 2.67 mW/°C above 25°C.*
2. *RMA flux is recommended.*
3. *Methanol or Isopropyl alcohols are recommended as cleaning agents.*
4. *Soldering iron tip 1⁄16″ (1.6 mm) minimum from housing.*
5. *As long as leads are not under any stress or spring tension.*
6. *Measurement is taken at the end of a single 100 μsec pulse.*
7. *E_θ is a measurement of the average apertured radiant energy incident upon a sensing area 0.444″ (11.3 mm) in diameter, perpendicular to and centered on the mechanical axis of the lens, and 2.54″ (64.4 mm) from the measurement surface. E_θ is not necessarily uniform within the measurement area.*

AlGaAs INFRARED EMITTING DIODE

QED422/423

PACKAGE DIMENSIONS



ST2135

NOTES:
1. DIMENSIONS ARE IN INCHES (mm).
2. TOLERANCE IS ±.010 (.25) UNLESS OTHERWISE SPECIFIED.
3. TAB DENOTES CATHODE.

DESCRIPTION

The QED42X is an 880nm AlGaAs LED encapsulated in a clear, purple tinted, plastic TO-46 package.

FEATURES

- Tight production E_θ distribution.
- Steel lead frames for improved reliability in solder mounting.
- Good optical-to-mechanical alignment.
- Wide emission angle.
- Mechanical and wavelength matched to QSD42X series phototransistor.
- Plastic package color allows easy recognition from phototransistor.
- High irradiance level.

AlGaAs INFRARED EMITTING DIODE

ABSOLUTE MAXIMUM RATINGS (T_A = 25°C Unless Otherwise Specified)

Storage Temperature	−40°C to + 100°C
Operating Temperature	−40°C to + 100°C
Soldering:	
Lead Temperature (Iron)	240°C for 5 sec. (2,3,4,5)
Lead Temperature (Flow)	260°C for 10 sec. (2,3,5)
Continuous Forward Current	100 mA
Reverse Voltage	5.0 Volts
Power Dissipation	200 mW(1)

ELECTRICAL CHARACTERISTICS (T_A = 25°C Unless Otherwise Specified)
(All measurements made under pulse conditions.)

PARAMETER	SYMBOL	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS
Forward Voltage	V_F	—		1.70	V	I_F = 20 mA
Reverse Leakage Current	I_R	—		10	μA	V_R = 5.0 V
Peak Emission Wavelength	λ_P	—	880	—	nm	I_F = 20 mA
Emission Angle at ½ Power	θ	—	±35	—	Degrees	
Radiant Incidence QED422	E_θ	0.05		0.25	mW/10° Cone	I_F = 20 mA(6,7)
Radiant Incidence QED234	E_θ	0.10		—	mW/10° Cone	I_F = 20 mA(6,7)

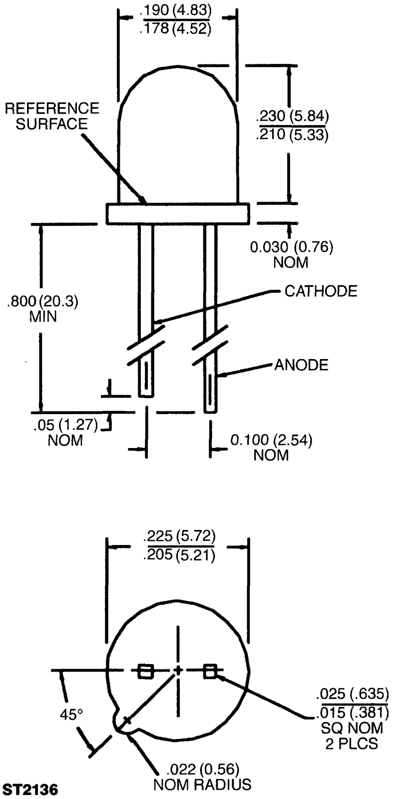
NOTES

1. *Derate power dissipation linearly 2.67 mW/°C above 25°C.*
2. *RMA flux is recommended.*
3. *Methanol or Isopropyl alcohols are recommended as cleaning agents.*
4. *Soldering iron tip 1⁄16″ (1.6 mm) minimum from housing.*
5. *As long as leads are not under any stress or spring tension.*
6. *Measurement is taken at the end of a single 100 μsec pulse.*
7. *E_θ is a measurement of the average apertured radiant energy incident upon a sensing area 0.444″ (11.3 mm) in diameter, perpendicular to and centered on the mechanical axis of the lens, and 2.54″ (64.4 mm) from the measurement surface. E_θ is not necessarily uniform within the measurement area.*

AlGaAs INFRARED EMITTING DIODE

QED522/523

PACKAGE DIMENSIONS



NOTES:
1. DIMENSIONS ARE IN INCHES (mm).
2. TOLERANCE IS ±.010 (.25)
   UNLESS OTHERWISE SPECIFIED.
3. TAB DENOTES CATHODE.

DESCRIPTION

The QED52X is an 880 nm AlGaAs LED encapsulated in a clear, peach tinted, plastic TO-46 package.

FEATURES

- Tight production E_θ distribution.
- Steel lead frames for improved reliability in solder mounting.
- Good optical-to-mechanical alignment.
- Narrow emission angle.
- Mechanically and wavelength matched to QSD72X series phototransistor.
- Plastic package color allows easy recognition from phototransistor.
- High irradiance level.

OPTOELECTRONICS

AlGaAs INFRARED EMITTING DIODE

ABSOLUTE MAXIMUM RATINGS (T_A = 25°C Unless Otherwise Specified)

Storage Temperature	−40°C to + 100°C
Operating Temperature	−40°C to + 100°C
Soldering:	
Lead Temperature (Iron)	240°C for 5 sec. (2,3,4,5)
Lead Temperature (Flow)	260°C for 10 sec. (2,3,5)
Continuous Forward Current	100 mA
Reverse Voltage	5.0 Volts
Power Dissipation	200 mW(1)

ELECTRICAL CHARACTERISTICS (T_A = 25°C Unless Otherwise Specified)
(All measurements made under pulse conditions.)

PARAMETER	SYMBOL	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS
Forward Voltage	V_F	—		1.70	V	I_F = 20 mA
Reverse Leakage Current	I_R	—		10	μA	V_R = 5.0 V
Peak Emission Wavelength	λ_P	—	880	—	nm	I_F = 20 mA
Emission Angle at ½ Power	θ	—	±15	—	Degrees	
Radiant Incidence QED522	E_θ	0.10		0.45	mW/10° Cone	I_F = 20 mA(6,7)
Radiant Incidence QED523	E_θ	0.20		—	mW/10° Cone	I_F = 20 mA(6,7)

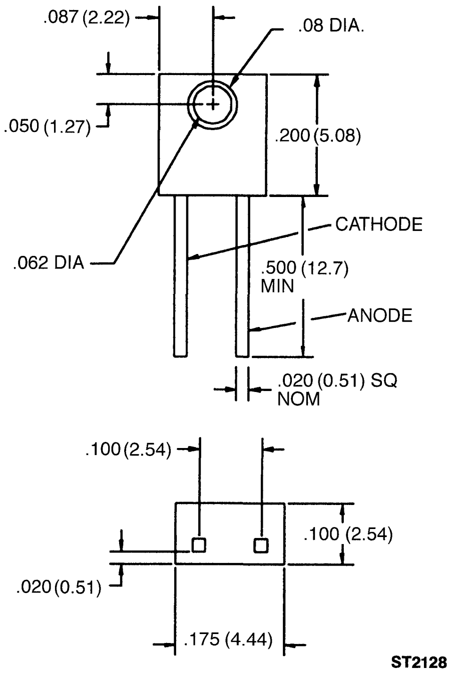
NOTES

1. *Derate power dissipation linearly 2.67 mW/°C above 25°C.*
2. *RMA flux is recommended.*
3. *Methanol or Isopropyl alcohols are recommended as cleaning agents.*
4. *Soldering iron tip 1⁄16″ (1.6 mm) minimum from housing.*
5. *As long as leads are not under any stress or spring tension.*
6. *Measurement is taken at the end of a single 100 μsec pulse.*
7. *E_θ is a measurement of the average apertured radiant energy incident upon a sensing area 0.444″ (11.3 mm) in diameter, perpendicular to and centered on the mechanical axis of the lens, and 2.54″ (64.4 mm) from the measurement surface. E_θ is not necessarily uniform within the measurement area.*

GaAs INFRARED EMITTING DIODE

QEE113

PACKAGE DIMENSIONS



NOTES:
1. DIMENSIONS ARE IN INCHES (mm).
2. TOLERANCE IS ±.010 (.25)
   UNLESS OTHERWISE SPECIFIED.

DESCRIPTION

The QEE113 is a 940 nm GaAs LED encapsulated in a wide angle, orange, plastic sidelooker shell package.

FEATURES

- Tight production E_θ distribution with min/max limits.
- Steel lead frames for improved reliability in solder mounting.
- Good optical-to-mechanical alignment.
- Mechanically and wavelength matched to QSE11X series phototransistor.
- Plastic package color allows easy recognition from phototransistor.
- High irradiance level.

OPTOELECTRONICS

GaAs INFRARED EMITTING DIODE

ABSOLUTE MAXIMUM RATINGS (T_A = 25°C Unless Otherwise Specified)

Storage Temperature	−40°C to + 100°C
Operating Temperature	−40°C to + 100°C
Soldering:	
Lead Temperature (Iron)	240°C for 5 sec. (2,3,4,5)
Lead Temperature (Flow)	260°C for 10 sec. (2,3,5)
Continuous Forward Current	50 mA
Reverse Voltage	5.0 Volts
Power Dissipation	100 mW(1)

ELECTRICAL CHARACTERISTICS (T_A = 25°C Unless Otherwise Specified)
(All measurements made under pulse conditions.)

PARAMETER	SYMBOL	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS
Forward Voltage	V_F	—		1.50	V	I_F = 20 mA
Reverse Leakage Current	I_R	—		10	μA	V_R = 5.0 V
Peak Emission Wavelength	λ_P	—	940	—	nm	I_F = 20 mA
Emission Angle at ½ Power	θ	—	±25	—	Degrees	
Radiant Incidence	E_θ	0.015			mW/10° Cone	I_F = 20 mA(6,7)

NOTES

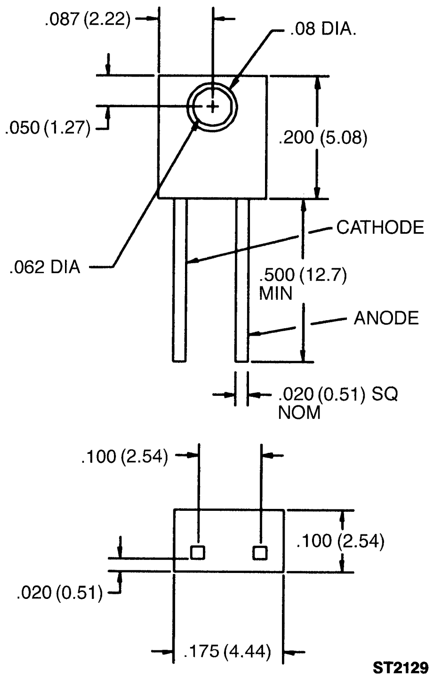
1. *Derate power dissipation linearly 1.33 mW/°C above 25°C.*
2. *RMA flux is recommended.*
3. *Methanol or Isopropyl alcohols are recommended as cleaning agents.*
4. *Soldering iron tip 1/16″ (1.6 mm) minimum from housing.*
5. *As long as leads are not under any stress or spring tension.*
6. *Measurement is taken at the end of a single 100 μsec pulse.*
7. *E_θ is a measurement of the average apertured radiant energy incident upon a sensing area 0.444″ (11.3 mm) in diameter, perpendicular to and centered on the mechanical axis of the lens, and 2.54″ (64.4 mm) from the measurement surface. E_θ is not necessarily uniform within the measurement area.*

OPTOELECTRONICS

AlGaAs INFRARED EMITTING DIODE

QEE122/123

PACKAGE DIMENSIONS



NOTES:
1. DIMENSIONS ARE IN INCHES (mm).
2. TOLERANCE IS ±.010 (.25)
   UNLESS OTHERWISE SPECIFIED.

DESCRIPTION

The QEE12X is an 880 nm AlGaAs LED encapsulated in a wide angle, dark green, plastic sidelooker shell package.

FEATURES

- Tight production E_θ distribution.
- Steel lead frames for improved reliability in solder mounting.
- Good optical-to-mechanical alignment.
- Mechanically and wavelength matched to QSE11X series phototransistor.
- Plastic package color allows easy recognition from phototransistor.
- High irradiance level.

AlGaAs INFRARED EMITTING DIODE

ABSOLUTE MAXIMUM RATINGS (T_A = 25°C Unless Otherwise Specified)

Storage Temperature	−40°C to + 100°C
Operating Temperature	−40°C to + 100°C
Soldering:	
Lead Temperature (Iron)	240°C for 5 sec. (2,3,4,5)
Lead Temperature (Flow)	260°C for 10 sec. (2,3,5)
Continuous Forward Current	50 mA
Reverse Voltage	5.0 Volts
Power Dissipation	100 mW(1)

ELECTRICAL CHARACTERISTICS (T_A = 25°C Unless Otherwise Specified) (All measurements made under pulse conditions.)

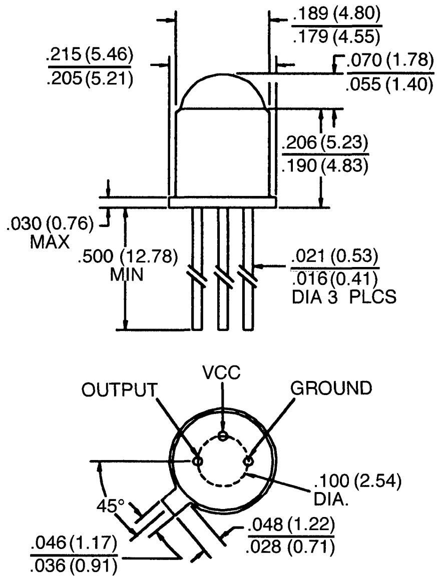
PARAMETER	SYMBOL	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS
Forward Voltage	V_F	—		1.70	V	I_F = 20 mA
Reverse Leakage Current	I_R	—		10	μA	V_R = 5.0 V
Peak Emission Wavelength	λ_P	—	880	—	nm	I_F = 20 mA
Emission Angle at ½ Power	θ	—	±25	—	Degrees	
Radiant Incidence QEE122	E_θ	0.02		0.08	mW/10° Cone	I_F = 20 mA(6,7)
Radiant Incidence QEE123	E_θ	0.04		—	mW/10° Cone	I_F = 20 mA(6,7)

NOTES

1. *Derate power dissipation linearly 1.33 mW/°C above 25°C.*
2. *RMA flux is recommended.*
3. *Methanol or Isopropyl alcohols are recommended as cleaning agents.*
4. *Soldering iron tip 1⁄16″ (1.6 mm) minimum from housing.*
5. *As long as leads are not under any stress or spring tension.*
6. *Measurement is taken at the end of a single 100 μsec pulse.*
7. E_θ *is a measurement of the average apertured radiant energy incident upon a sensing area 0.444″ (11.3 mm) in diameter, perpendicular to and centered on the mechanical axis of the lens, and 2.54″ (64.4 mm) from the measurement surface.* E_θ *is not necessarily uniform within the measurement area.*

QSA156/157/158/159

PACKAGE DIMENSIONS



ST2139

DESCRIPTION

The QSA15X family are OPTOLOGIC™ ICs which feature a Schmitt trigger at output which provides hysteresis for noise immunity and pulse shaping. The basic building block of this IC consists of a photodiode, a linear amplifier, voltage regulator, Schmitt trigger and four output options. The TTL/LSTTL compatible output can drive up to ten TTL loads over supply currents from 4.5 to 16.0 volts. The monolithic die is packaged in a narrow angle, hermetically sealed, TO-18 metal can package.

FEATURES

- High noise immunity.
- Direct TTL/LSTTL interface.
- Hermetically sealed package.
- Reception angle of ±12°.

ABSOLUTE MAXIMUM RATINGS (T_A = 25°C Unless Otherwise Specified)

Supply Voltage, V_{CC}	18 volts
Storage Temperature	−65°C to +125°C
Operating Temperature	−55°C to +105°C
Soldering:	
Lead Temperature (Iron)	240°C for 5 sec. (2,3,4,5)
Lead Temperature (Flow)	260°C for 10 sec. (2,3,5)
Power Dissipation	250 mW(1)
Duration of Output short to V_{CC}	1.00 sec.
Voltage at Output	35 volts
Sinking Current	50 mA
Sourcing Current (QSA156, QSA157)	10 mA
Irradiance	3.0 mW/cm²

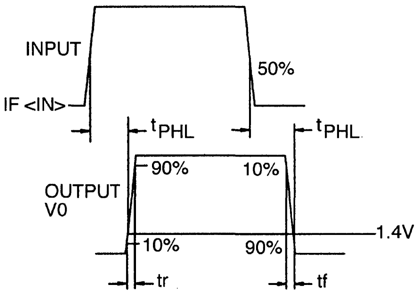
ELECTRICAL CHARACTERISTICS (T_A = −40°C to +85°C) (V_{CC} = 4.5 to 16 volts)

PARAMETER	SYMBOL	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS
Operating Supply Voltage	V_{CC}	4.5		16.0	V	
Positive Going Threshold Irradiance(6)	Ee (+)	0.025		0.250	mW/cm²	T_A = 25°C
Hysteresis Ratio	Ee(+)/Ee(−)	1.10		2.00		
Supply Current	I_{CC}	—		12.0	mA	Ee = 0 or .3 mW/cm² (6)
Peak to peak ripple which will cause false triggering		—		2.00	V	f = DC to 50 MHZ
QSA156 (BUFFER TOTEM POLE)						
High Level Output Voltage	V_{OH}	V_{CC} − 2.1		—	V	Ee = .3 mW/cm², I_{OH} = −1.0 mA(6)
Low Level Output Voltage	V_{OL}	—		0.40	V	Ee = 0, I_{OL} = 16 mA
QSA157 (INVERTER TOTEM POLE)						
High Level Output Voltage	V_{OH}	V_{CC} − 2.1		—	V	Ee = 0, I_{OH} = −1.0 mA
Low Level Output Voltage	V_{OL}	—		0.40	V	Ee = .3 mW/cm², I_{OL} = 16 mA(6)
QSA158 (BUFFER OPEN COLLECTOR)						
High Level Output Current	I_{OH}	—		100	μA	Ee = .3 mW/cm², V_{OH} = 30 V(6)
Low Level Output Voltage	V_{OL}	—		0.40	V	Ee = 0, I_{OL} = 16 mA
QSA159 (INVERTER OPEN COLLECTOR)						
High Level Output Current	I_{OH}	—		100	μA	Ee = 0, V_{OH} = 30 V
Low Level Output Voltage	V_{OL}	—		0.40	V	Ee = .3 mW/cm², I_{OL} = 16 mA(6)

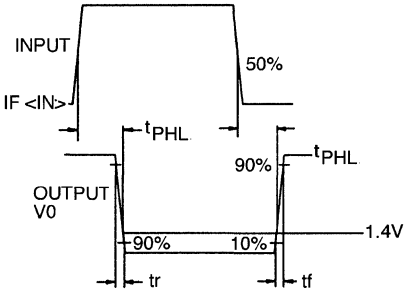
ELECTRICAL CHARACTERISTICS (T_A = −40°C to +85°C) (V_{CC} = 4.5 to 16 volts)

PARAMETER	SYMBOL	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS
QSA156, QSA157						
Output rise, fall times	tr, tf	—		70	nS	Ee=0 or .3 mW/cm², f=10K HZ DC=50%, R_L=10 TTL loads
Propagation delay	tphl, tplh		6.0		μS	
QSA158, QSA159						
Output rise, fall times	tr, tf	—		100	nS	Ee=0 or .3 mW/cm², f=10K HZ DC=50%, R_L=300Ω(6).
Propagation delay	tphl, tplh		6.0		μS	

Switching Test Curve For Buffers



Switching Test Curve For Inverters

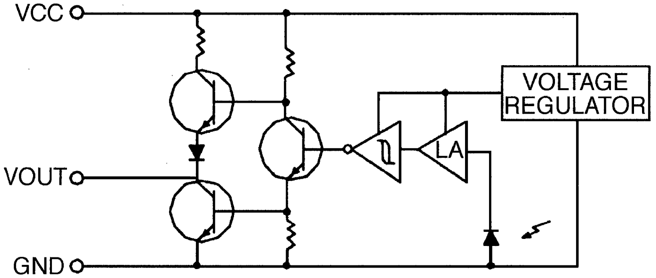


ST2141

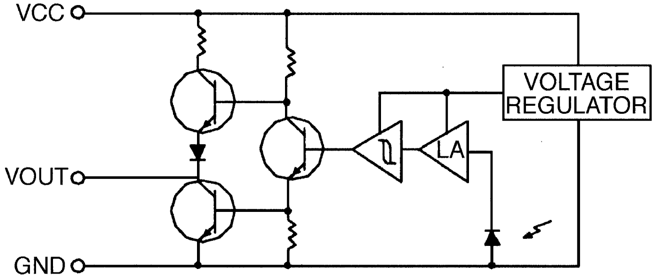
NOTES

1. *Derate power dissipation linearly 2.50 mW/°C above 25°C.*
2. *RMA flux is recommended.*
3. *Methanol or Isopropyl alcohols are recommended as cleaning agents.*
4. *Soldering iron tip 1⁄16″ (1.6 mm) minimum from housing.*
5. *As long as leads are not under any stress or spring tension.*
6. *Irradiance measurements are made with an AlGaAs LED emitting light at a peak wavelength of 880 nm.*

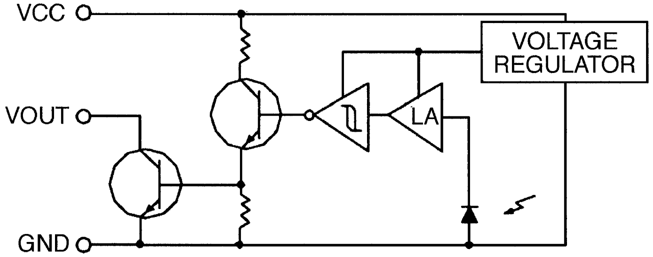
CIRCUIT SCHEMATICS



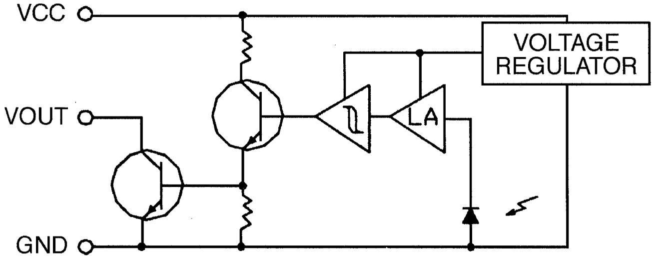
QSA156
Totem-Pole Output Buffer



QSA157
Totem-Pole Output Inverter



QSA158
Open-Collector Output Buffer



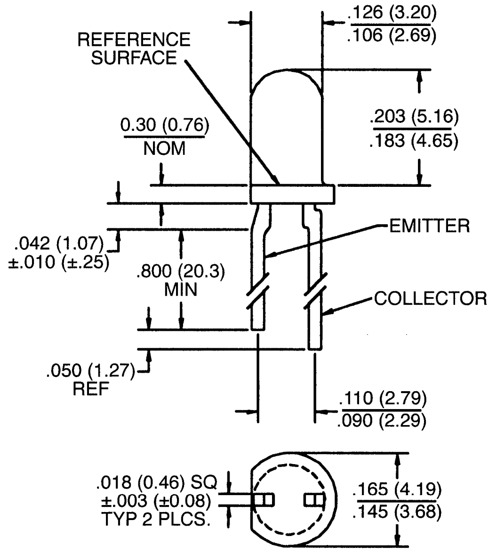
QSA159
Open-Collector Output Inverter

ST2140

PLASTIC SILICON PHOTOTRANSISTOR

QSC112/113/114

PACKAGE DIMENSIONS



ST2142

NOTES:
1. DIMENSIONS ARE IN INCHES (mm).
2. TOLERANCE IS ±.010 (.25) UNLESS OTHERWISE SPECIFIED.
3. FLAT DENOTES CATHODE.

DESCRIPTION

The QSC11X is a silicon phototransistor encapsulated in an infrared transparent, black T-1 package.

FEATURES

- Tight production distribution.
- Steel lead frames for improved reliability in solder mounting.
- Good optical-to-mechanical alignment.
- Plastic package is infrared transparent black to attenuate visible light.
- Mechanically and spectrally matched to the QECXXX LED.
- Black plastic body allows easy recognition from LED.

OPTOELECTRONICS

PLASTIC SILICON PHOTOTRANSISTOR

ABSOLUTE MAXIMUM RATINGS (T_A = 25°C Unless Otherwise Specified)

Storage Temperature	−40°C to + 100°C
Operating Temperature	−40°C to + 100°C
Soldering:	
Lead Temperature (Iron)	240°C for 5 sec. (2,3,4,5)
Lead Temperature (Flow)	260°C for 10 sec. (2,3,5)
Collector-Emitter Breakdown Voltage	30 Volts
Emitter-Collector Breakdown Voltage	5.0 Volts
Power Dissipation	100 mW(1)

ELECTRICAL CHARACTERISTICS (T_A = 25°C Unless Otherwise Specified)

(All measurements made under pulse conditions.)

PARAMETER	SYMBOL	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS
Collector-Emitter Breakdown	BV_{CEO}	30		—	V	I_C = 1.0 mA
Emitter-Collector Breakdown	BV_{ECO}	5.0		—	V	I_E = 100 μA
Collector-Emitter Leakage	I_{CEO}	—		100	nA	V_{CE} = 10 V
Reception Angle at ½ Sensitivity	θ	—	± 8	—	Degrees	
On-State Collector Current QSC112	$I_{C(ON)}$	1.0		4.0	mA	Ee = 0.5 mW/cm², V_{CE} = 5V(6)
On-State Collector Current QSC113	$I_{C(ON)}$	2.4		9.6	mA	Ee = 0.5 mW/cm², V_{CE} = 5V(6)
On-State Collector Current QSC114	$I_{C(ON)}$	4.0		—	mA	Ee = 0.5 mW/cm², V_{CE} = 5V(6)
Rise Time	t_r	—	5.0	—	μS	I_C = 2 mA, V_{CC} = 5 V, R_L = 100Ω
Fall Time	t_f	—	5.0	—	μS	I_C = 2 mA, V_{CC} = 5 V, R_L = 100Ω
Saturation Voltage	$V_{CE(SAT)}$	—		0.40	V	I_C = 0.50 mA, Ee = 0.5 mW/cm²(6)

NOTES

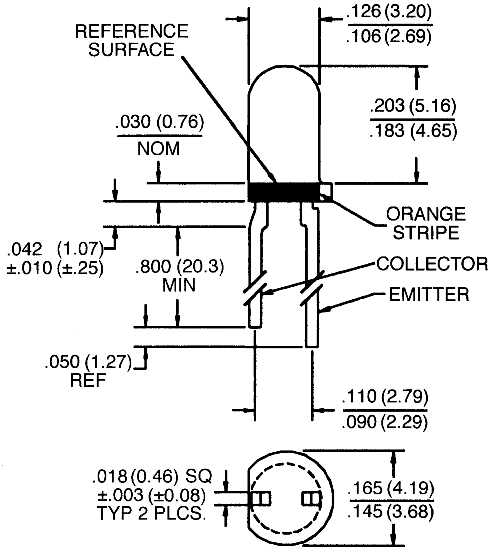
1. *Derate power dissipation linearly 1.33 mW/°C above 25°C.*
2. *RMA flux is recommended.*
3. *Methanol or Isopropyl alcohols are recommended as cleaning agents.*
4. *Soldering iron tip 1⁄16″ (1.6 mm) minimum from housing.*
5. *As long as leads are not under any stress or spring tension.*
6. *Light source is an AlGaAs LED emitting light at a peak wavelength of 880 nm.*

OPTOELECTRONICS

PLASTIC SILICON PHOTODARLINGTON

QSC133

PACKAGE DIMENSIONS



ST2143

NOTES:
1. DIMENSIONS ARE IN INCHES (mm).
2. TOLERANCE IS ±.010 (.25)
   UNLESS OTHERWISE SPECIFIED.
3. FLAT DENOTES COLLECTOR.

DESCRIPTION

The QSC133 is a silicon photodarlington encapsulated in an infrared transparent, black T-1 package.

FEATURES

- Steel lead frames for improved reliability in solder mounting.
- Good optical-to-mechanical alignment.
- Plastic package is infrared transparent and tinted to attenuate visible light.
- Mechanically and spectrally matched to the QECXXX LED.
- Black plastic body allows easy recognition from LED.

OPTOELECTRONICS

PLASTIC SILICON PHOTODARLINGTON

ABSOLUTE MAXIMUM RATINGS (T_A = 25°C Unless Otherwise Specified)

Storage Temperature	−40°C to + 100°C
Operating Temperature	−40°C to + 100°C
Soldering:	
Lead Temperature (Iron)	240°C for 5 sec. (2,3,4,5)
Lead Temperature (Flow)	260°C for 10 sec. (2,3,5)
Collector-Emitter Breakdown Voltage	30 Volts
Emitter-Collector Breakdown Voltage	5.0 Volts
Power Dissipation	100 mW(1)

ELECTRICAL CHARACTERISTICS (T_A = 25°C Unless Otherwise Specified) (All measurements made under pulse conditions.)

PARAMETER	SYMBOL	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS
Collector-Emitter Breakdown	BV_{CEO}	30		—	V	I_C = 1 mA
Emitter-Collector Breakdown	BV_{ECO}	5.0		—	V	I_E = 100 μA
Collector-Emitter Leakage	I_{CEO}	—		100	nA	V_{CE} = 10 V
Reception Angle at ½ Sensitivity	θ	—	± 8	—	Degrees	
On-State Collector Current	$I_{C(ON)}$	8.0		—	mA	Ee = 0.25 mW/cm², V_{CE} = 5V(6)
Collector-Emitter Saturation Voltage	$V_{CE(SAT)}$	—		1.0	V	I_C = 0.4 mA, Ee = 0.25 mW/cm²(6)
Rise Time	t_r	—	20	—	μS	I_C = .15 mA, V_{CC} = 5 V, R_L = 100Ω
Fall Time	t_f	—	50	—	μS	I_C = .15 mA, V_{CC} = 5 V, R_L = 100Ω

NOTES

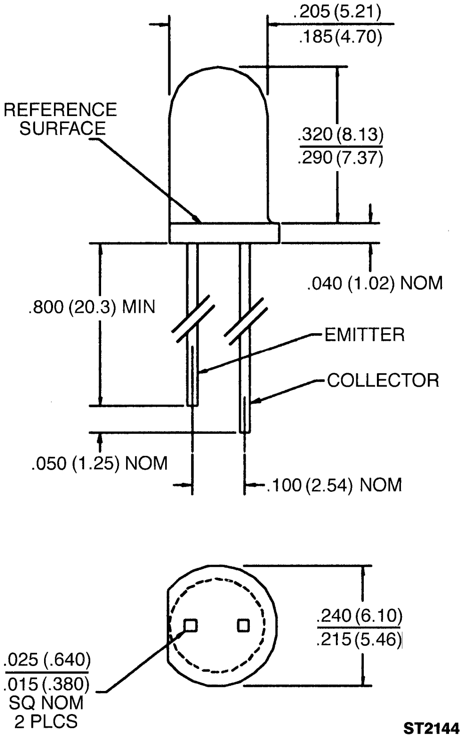
1. *Derate power dissipation linearly 1.33 mW/°C above 25°C.*
2. *RMA flux is recommended.*
3. *Methanol or Isopropyl alcohols are recommended as cleaning agents.*
4. *Soldering iron tip 1/16″ (1.6 mm) minimum from housing.*
5. *As long as leads are not under any stress or spring tension.*
6. *Light source is an AlGaAs LED emitting light at a peak wavelength of 880 nm.*

QT
OPTOELECTRONICS

PLASTIC SILICON PHOTOTRANSISTOR

QSD122/123/124

PACKAGE DIMENSIONS



NOTES:
1. DIMENSIONS ARE IN INCHES (mm).
2. TOLERANCE IS ±.010 (.25)
   UNLESS OTHERWISE SPECIFIED.
3. FLAT DENOTES EMITTER.

DESCRIPTION

The QSD12X is a silicon phototransistor encapsulated in an infrared transparent, black T-1¾ package.

FEATURES

- Tight production distribution.
- Steel lead frames for improved reliability in solder mounting.
- Good optical-to-mechnical alignment.
- Narrow reception angle.
- Plastic package is infrared transparent black to attenuate visible light.
- Mechanically and spectrally matched to the QED123/222 LED.
- Black plastic body allows easy recognition from LED.

PLASTIC SILICON PHOTOTRANSISTOR

ABSOLUTE MAXIMUM RATINGS (T_A = 25°C Unless Otherwise Specified)

Storage Temperature	−40°C to + 100°C
Operating Temperature	−40°C to + 100°C
Soldering:	
Lead Temperature (Iron)	240°C for 5 sec. (2,3,4,5)
Lead Temperature (Flow)	260°C for 10 sec. (2,3,5)
Collector-Emitter Breakdown Voltage	30 Volts
Emitter-Collector Breakdown Voltage	5.0 Volts
Power Dissipation	100 mW(1)

ELECTRICAL CHARACTERISTICS (T_A = 25°C Unless Otherwise Specified)
(All measurements made under pulse conditions.)

PARAMETER	SYMBOL	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS
Collector-Emitter Breakdown	BV_{CEO}	30		—	V	I_C = 1.0 mA
Emitter-Collector Breakdown	BV_{ECO}	5.0		—	V	I_E = 100 μA
Collector-Emitter Leakage	I_{CEO}	—		100	nA	V_{CE} = 10 V
Reception Angle at ½ Sensitivity	θ	—	± 12	—	Degrees	
On-State Collector Current QSD122	$I_{C(ON)}$	1.0		6.0	mA	Ee = 0.5 mW/cm², V_{CE} = 5V(6)
On-State Collector Current QSD123	$I_{C(ON)}$	4.0		16.0	mA	Ee = 0.5 mW/cm², V_{CE} = 5V(6)
On-State Collector Current QSD124	$I_{C(ON)}$	6.0		—	mA	Ee = 0.5 mW/cm², V_{CE} = 5V(6)
Rise Time	t_r	—	7.0	—	μS	I_C = .2 mA, V_{CC} = 5 V, R_L = 100Ω
Fall Time	t_f	—	7.0	—	μS	I_C = .2 mA, V_{CC} = 5 V, R_L = 100Ω
Saturation Voltage	$V_{CE(SAT)}$	—		0.40	V	I_C = 0.50 mA, Ee = 0.5 mW/cm²(6)

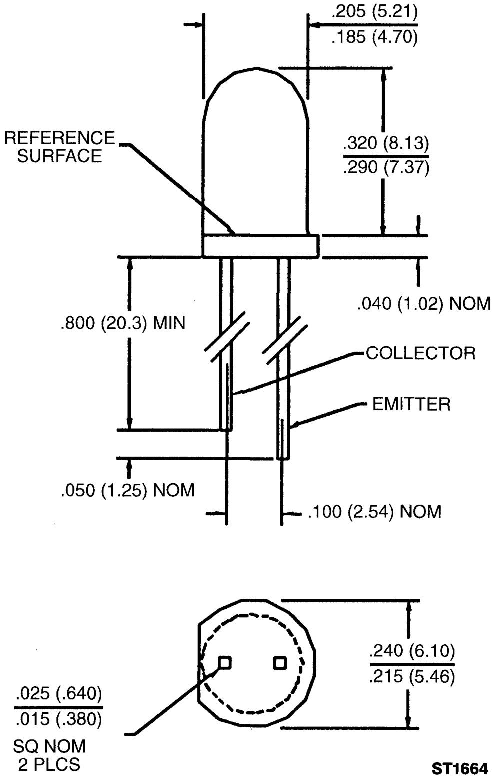
NOTES

1. *Derate power dissipation linearly 1.33 mW/°C above 25°C.*
2. *RMA flux is recommended.*
3. *Methanol or Isopropyl alcohols are recommended as cleaning agents.*
4. *Soldering iron tip 1⁄16″ (1.6 mm) minimum from housing.*
5. *As long as leads are not under any stress or spring tension.*
6. *Light source is an AlGaAs LED emitting light at a peak wavelength of 880 nm.*

PLASTIC SILICON PHOTOTRANSISTOR

QSD128

PACKAGE DIMENSIONS



NOTES:
1. DIMENSIONS ARE IN INCHES (mm).
2. TOLERANCE IS ±.010 (.25)
   UNLESS OTHERWISE SPECIFIED.
3. FLAT DENOTES COLLECTOR.

DESCRIPTION

The QSD128 is a phototransistor encapsulated in an infrared transparent, black T-1¾ package. The flat on the package indicates the collector lead.

FEATURE

- Steel lead frames for improved reliability in solder mounting
- Good optical-to-mechanical alignment
- Narrow reception angle
- Plastic package is infrared transparent black to attenuate visible light
- Mechanically and spectrally matched to the QED123/222 LED
- Black plastic body allows easy recognition from LED
- Low cost

QT
OPTOELECTRONICS

PLASTIC SILICON PHOTOTRANSISTOR

ABSOLUTE MAXIMUM RATINGS (T_A = 25°C Unless Otherwise Specified)

Storage Temperature	−40°C to +100°C
Operating Temperature	−40°C to +100°C
Soldering:	
Lead Temperature (Iron)	240°C for 5 sec.(2,3,4,5)
Lead Temperature (Flow)	260°C for 10 sec.(2,3,5)
Collector-Emitter Breakdown Voltage	30 Volts
Emitter-Collector Breakdown Voltage	5.0 Volts
Power Dissipation	100 mW(1)

ELECTRICAL CHARACTERISTICS (T_A = 25°C Unless Otherwise Specified) (All measurements made under pulse conditions.)

PARAMETER	SYMBOL	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS
Collector-Emitter Breakdown	BV_{CEO}	30		—	V	I_C = 1.0 mA
Emitter-Collector Breakdown	BV_{ECO}	5.0		—	V	I_E = 100 μA
Collector-Emitter Leakage	I_{CEO}	—		100	nA	V_{CE} = 10 V
Reception Angle at ½ Sensitivity	θ	—	±12	—	Degrees	Ee = 0.5 mW/cm^2, V_{CE} = 5V
On-State Collector Current	$I_{C(ON)}$	1.60		—	mA	Ee = 0.5 mW/cm^2, V_{CE} = 5V(6)
Saturation Voltage	$V_{CE(SAT)}$	—		0.40	V	I_C = 0.50 mA, Ee = 0.5 mW/cm^2(6)

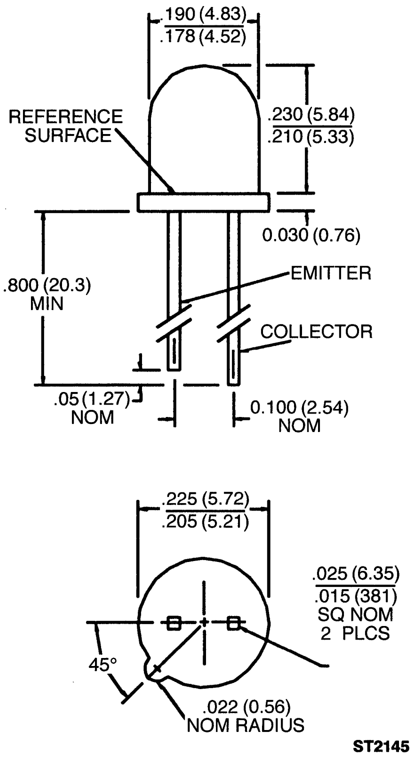
NOTES

1. *Derate power dissipation linearly 1.33 mW/°C above 25°C.*
2. *RMA flux is recommended.*
3. *Methanol or Isopropyl alcohols are recommended as cleaning agents.*
4. *Soldering iron tip 1/16″ (1.6 mm) from housing.*
5. *As long as leads are not under any stress or spring tension.*
6. *Light source is an AlGaAs LED emitting light at a peak wavelength of 880 nm.*

PLASTIC SILICON PHOTOTRANSISTOR

QSD422/423/424

PACKAGE DIMENSIONS



NOTES:
1. DIMENSIONS ARE IN INCHES (mm).
2. TOLERANCE IS ±.010 (.25)
   UNLESS OTHERWISE SPECIFIED.
3. TAB DENOTES EMITTER.

DESCRIPTION

The QSD42X is a silicon phototransistor encapsulated in an infrared transparent, black TO-18 package.

FEATURES

- Tight production distribution.
- Steel lead frames for improved reliability in solder mounting.
- Good optical-to-mechanical alignment.
- Narrow reception angle.
- Plastic package is infrared transparent black to attenuate visible light.
- Mechanically and spectrally matched to the QED423/523 LED.
- Black plastic body allows easy recognition from LED.

PLASTIC SILICON PHOTOTRANSISTOR

ABSOLUTE MAXIMUM RATINGS (T_A = 25°C Unless Otherwise Specified)

Storage Temperature	−40°C to + 100°C
Operating Temperature	−40°C to + 100°C
Soldering:	
Lead Temperature (Iron)	240°C for 5 sec. (4,5)
Lead Temperature (Flow)	260°C for 10 sec. (2,5)
Collector-Emitter Breakdown Voltage	30 Volts
Emitter-Collector Breakdown Voltage	5.0 Volts
Power Dissipation	100 mW(1)

ELECTRICAL CHARACTERISTICS (T_A = 25°C Unless Otherwise Specified)

(All measurements made under pulse conditions.)

PARAMETER	SYMBOL	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS
Collector-Emitter Breakdown	BV_{CEO}	30		—	V	I_C = 1.0 mA
Emitter-Collector Breakdown	BV_{ECO}	5.0		—	V	I_E = 100 μA
Collector-Emitter Leakage	I_{CEO}	—		100	nA	V_{CE} = 10 V
Reception Angle at ½ Sensitivity	θ	—	±35	—	Degrees	
On-State Collector Current QSD422	$I_{C(ON)}$	0.3		1.8	mA	Ee = 0.5 mW/cm², V_{CE} = 5V(6)
On-State Collector Current QSD423	$I_{C(ON)}$	1.2		4.8	mA	Ee = 0.5 mW/cm², V_{CE} = 5V(6)
On-State Collector Current QSD424	$I_{C(ON)}$	1.8		—	mA	Ee = 0.5 mW/cm², V_{CE} = 5V(6)
Rise Time	t_r	—	8.0	—	μS	I_C = .2 mA, V_{CC} = 5 V, R_L = 100Ω
Fall Time	t_f	—	8.0	—	μS	I_C = .2 mA, V_{CC} = 5 V, R_L = 100Ω
Saturation Voltage	$V_{CE(SAT)}$	—		0.40	V	I_C = 0.15 mA, Ee = 0.5 mW/cm²(6)

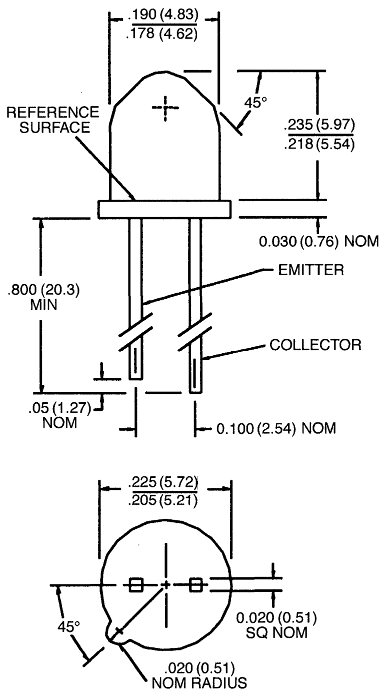
NOTES

1. *Derate power dissipation linearly 1.33 mW/°C above 25°C.*
2. *RMA flux is recommended.*
3. *Methanol or Isopropyl alcohols are recommended as cleaning agents.*
4. *Soldering iron tip 1⁄16″ (1.6 mm) minimum from housing.*
5. *As long as leads are not under any stress or spring tension.*
6. *Light source is an AlGaAs LED emitting light at a peak wavelength of 880 nm.*

PLASTIC SILICON PHOTOTRANSISTOR

QSD722/723/724

PACKAGE DIMENSIONS



ST2146

NOTES:
1. DIMENSIONS ARE IN INCHES (mm).
2. TOLERANCE IS ±.010 (.25) UNLESS OTHERWISE SPECIFIED.
3. TAB DENOTES EMITTER.

DESCRIPTION

The QSD72X is a silicon phototransistor encapsulated in an infrared transparent, black TO-18 package.

FEATURES

- Tight production distribution.
- Steel lead frames for improved reliability in solder mounting.
- Good optical-to-mechanical alignment.
- Narrow reception angle.
- Plastic package is infrared transparent black to attenuate visible light.
- Mechanically and spectrally matched to the QED423/523 LED.
- Black plastic body allows easy recognition from LED.

QT OPTOELECTRONICS

PLASTIC SILICON PHOTOTRANSISTOR

ABSOLUTE MAXIMUM RATINGS (T_A = 25°C Unless Otherwise Specified)

Storage Temperature .... −40°C to + 100°C
Operating Temperature .... −40°C to + 100°C
Soldering:
  Lead Temperature (Iron) .... 240°C for 5 sec. (2,3,4,5)
  Lead Temperature (Flow) .... 260°C for 10 sec. (2,3,5)
Collector-Emitter Breakdown Voltage .... 30 Volts
Emitter-Collector Breakdown Voltage .... 5.0 Volts
Power Dissipation .... 100 mW(1)

ELECTRICAL CHARACTERISTICS (T_A = 25°C Unless Otherwise Specified) (All measurements made under pulse conditions.)

PARAMETER	SYMBOL	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS
Collector-Emitter Breakdown	BV_{CEO}	30		—	V	I_C = 1.0 mA
Emitter-Collector Breakdown	BV_{ECO}	5.0		—	V	I_E = 100 μA
Collector-Emitter Leakage	I_{CEO}	—		100	nA	V_{CE} = 10 V
Reception Angle at ½ Sensitivity	θ	—	±20	—	Degrees	
On-State Collector Current QSD722	$I_{C(ON)}$	0.6		3.8	mA	Ee = 0.5 mW/cm², V_{CE} = 5V(6)
On-State Collector Current QSD723	$I_{C(ON)}$	2.5		10.0	mA	Ee = 0.5 mW/cm², V_{CE} = 5V(6)
On-State Collector Current QSD724	$I_{C(ON)}$	3.5		—	mA	Ee = 0.5 mW/cm², V_{CE} = 5V(6)
Rise Time	t_r	—	8.0	—	μS	I_C = .2 mA, V_{CC} = 5 V, R_L = 100Ω
Fall Time	t_f	—	8.0	—	μS	I_C = .2 mA, V_{CC} = 5 V, R_L = 100Ω
Saturation Voltage	$V_{CE(SAT)}$	—		0.40	V	I_C = 0.6mA, Ee = 0.5 mW/cm²(6)

NOTES

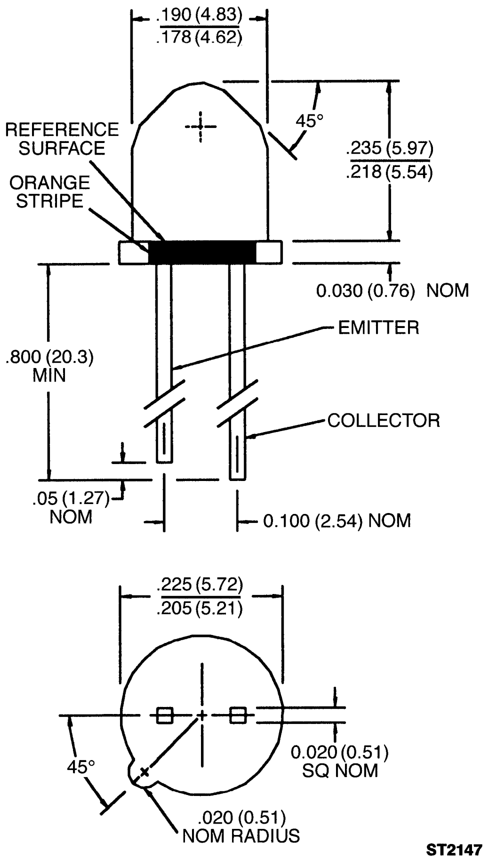
1. *Derate power dissipation linearly 1.33 mW/°C above 25°C.*
2. *RMA flux is recommended.*
3. *Methanol or Isopropyl alcohols are recommended as cleaning agents.*
4. *Soldering iron tip 1⁄16″ (1.6 mm) minimum from housing.*
5. *As long as leads are not under any stress or spring tension.*
6. *Light source is an AlGaAs LED emitting light at a peak wavelength of 880 nm.*

OPTOELECTRONICS

PLASTIC SILICON PHOTODARLINGTON

QSD733

PACKAGE DIMENSIONS



NOTES:
1. DIMENSIONS ARE IN INCHES (mm).
2. TOLERANCE IS ±.010 (.25) UNLESS OTHERWISE SPECIFIED.
3. TAB DENOTES EMITTER.

DESCRIPTION

The QSD733 is a silicon photodarlington encapsulated in an infrared transparent, black TO-18 package.

FEATURES

- Steel lead frames for improved reliability in solder mounting.
- Good optical-to-mechanical alignment.
- Narrow reception angle.
- Plastic package is infrared transparent black to attenuate visible light.
- Mechanically and spectrally matched to the QED523 LED.
- Black plastic body allows easy recognition from LED.

PLASTIC SILICON PHOTODARLINGTON

ABSOLUTE MAXIMUM RATINGS (T_A = 25°C Unless Otherwise Specified)

Storage Temperature	−40°C to + 100°C
Operating Temperature	−40°C to + 100°C
Soldering:	
Lead Temperature (Iron)	240°C for 5 sec. (2,3,4,5)
Lead Temperature (Flow)	260°C for 10 sec. (2,3,5)
Collector-Emitter Breakdown Voltage	30 Volts
Emitter-Collector Breakdown Voltage	5.0 Volts
Power Dissipation	100 mW(1)

ELECTRICAL CHARACTERISTICS (T_A = 25°C Unless Otherwise Specified) (All measurements made under pulse conditions.)

PARAMETER	SYMBOL	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS
Collector-Emitter Breakdown	BV_{CEO}	30		—	V	I_C = 1.0 mA
Emitter-Collector Breakdown	BV_{ECO}	5.0		—	V	I_E = 100 μA
Collector-Emitter Leakage	I_{CEO}	—		100	nA	V_{CE} = 10 V
Reception Angle at ½ Sensitivity	θ	—	±20	—	Degrees	
On-State Collector Current	$I_{C(ON)}$	5.0		—	mA	Ee = 0.125 mW/cm², V_{CE} = 5V(6)
Saturation Voltage	$V_{CE(SAT)}$	—		1.0	V	I_C = 2.0mA, Ee = 0.125 mW/cm²(6)
Rise Time	t_r	—	20	—	μS	I_C = .15mA, V_{CC} = 5V, R_L = 100Ω
Fall Time	t_f	—	50	—	μS	I_C = .15mA, V_{CC} = 5V, R_L = 100Ω

NOTES

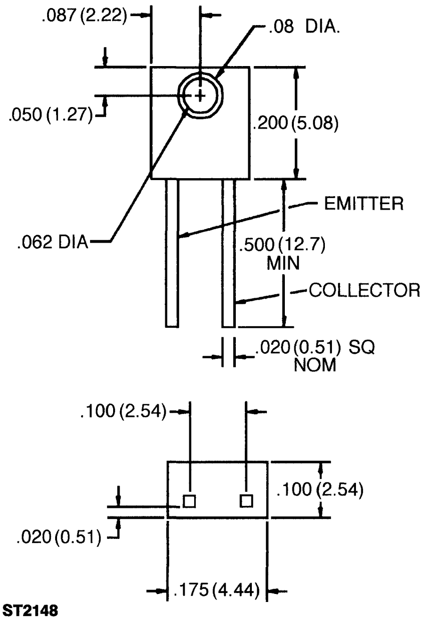
1. *Derate power dissipation linearly 1.33 mW/°C above 25°C.*
2. *RMA flux is recommended.*
3. *Methanol or Isopropyl alcohols are recommended as cleaning agents.*
4. *Soldering iron tip 1⁄16″ (1.6 mm) minimum from housing.*
5. *As long as leads are not under any stress or spring tension.*
6. *Light source is an AlGaAs LED emitting light at a peak wavelength of 880 nm.*

OPTOELECTRONICS

SIDELOOKER PHOTOTRANSISTOR

QSE113/114

PACKAGE DIMENSIONS



ST2148

NOTES:
1. DIMENSIONS ARE IN INCHES (mm).
2. TOLERANCE IS ±.010 (.25)
   UNLESS OTHERWISE SPECIFIED.

DESCRIPTION

The QSE11X family is a silicon phototransistor encapsulated in a wide angle, infrared transparent, dark blue, plastic sidelooker shell package.

FEATURES

- Tight production distribution with min/max limits.
- Steel lead frames for improved reliability in solder mounting.
- Good optical-to-mechanical alignment.
- Plastic package is infrared transparent and tinted to attenuate visible light.
- Mechanically and spectrally matched to the QEE113 and QEE123 LEDs.
- Dark blue shell body allows easy recognition from LED.

SIDELOOKER PHOTOTRANSISTOR

ABSOLUTE MAXIMUM RATINGS (T_A = 25°C Unless Otherwise Specified)

Storage Temperature	−40°C to + 100°C
Operating Temperature	−40°C to + 100°C
Soldering:	
Lead Temperature (Iron)	240°C for 5 sec. (2,3,4,5)
Lead Temperature (Flow)	260°C for 10 sec. (2,3,5)
Collector-Emitter Breakdown Voltage	30 Volts
Emitter-Collector Breakdown Voltage	5.0 Volts
Power Dissipation	100 mW(1)

ELECTRICAL CHARACTERISTICS (T_A = 25°C Unless Otherwise Specified) (All measurements made under pulse conditions.)

PARAMETER	SYMBOL	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS
Collector-Emitter Breakdown	BV_{CEO}	30		—	V	I_C = 1 mA
Emitter-Collector Breakdown	BV_{ECO}	5.0		—	V	I_E = 100 μA
Collector-Emitter Leakage	I_{CEO}	—		100	nA	V_{CE} = 10 V
Reception Angle at ½ Sensitivity	θ	—	±25	—	Degrees	
On-State Collector Current QSE113	$I_{C(ON)}$	0.25		1.5	mA	Ee = 0.5 mW/cm^2, V_{CE} = 5V(6)
On-State Collector Current QSE114	$I_{C(ON)}$	1.0		—	mA	Ee = 0.5 mW/cm^2, V_{CE} = 5V(6)
Collector-Emitter Saturation Voltage	$V_{CE(SAT)}$	—		0.4	V	I_c = 0.4 mA, Ee = 0.5mW/cm^2(6)
Rise Time	t_r	—	8.0	—	μS	I_C = .15 mA, V_{CC} = 5 V, R_L = 100Ω
Fall Time	t_f	—	8.0	—	μS	I_C = .15 mA, V_{CC} = 5 V, R_L = 100Ω

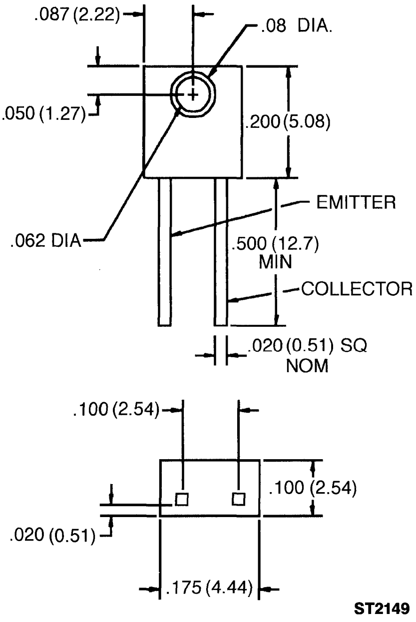
NOTES

1. *Derate power dissipation linearly 1.33 mW/°C above 25°C.*
2. *RMA flux is recommended.*
3. *Methanol or Isopropyl alcohols are recommended as cleaning agents.*
4. *Soldering iron tip 1/16″ (1.6 mm) minimum from housing.*
5. *As long as leads are not under any stress or spring tension.*
6. *Light source is an AlGaAs LED emitting light at a peak wavelength of 880 nm.*

SIDELOOKER PHOTOTRANSISTOR

QSE122/123

PACKAGE DIMENSIONS



NOTES:
1. DIMENSIONS ARE IN INCHES (mm).
2. TOLERANCE IS ±.010 (.25)
   UNLESS OTHERWISE SPECIFIED.

DESCRIPTION

The QSE12X family is a silicon phototransistor encapsulated in a wide angle, infrared transparent, dark blue, plastic sidelooker shell package.

FEATURES

- High Sensitivity.
- Steel lead frames for improved reliability in solder mounting.
- Good optical-to-mechanical alignment.
- Plastic package is infrared transparent and tinted to attenuate visible light.
- Mechanically and spectrally matched to the QEE113 and QEE123 LEDs.
- Dark blue shell body allows easy recognition from LED.

SIDELOOKER PHOTOTRANSISTOR

ABSOLUTE MAXIMUM RATINGS (T_A = 25°C Unless Otherwise Specified)

Storage Temperature	−40°C to + 100°C
Operating Temperature	−40°C to + 100°C
Soldering:	
Lead Temperature (Iron)	240°C for 5 sec. (2,3,4,5)
Lead Temperature (Flow)	260°C for 10 sec. (2,3,5)
Collector-Emitter Breakdown Voltage	30 Volts
Emitter-Collector Breakdown Voltage	5.0 Volts
Power Dissipation	100 mW(1)

ELECTRICAL CHARACTERISTICS (T_A = 25°C Unless Otherwise Specified) (All measurements made under pulse conditions.)

PARAMETER	SYMBOL	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS
Collector-Emitter Breakdown	BV_{CEO}	30		—	V	I_C = 1 mA
Emitter-Collector Breakdown	BV_{ECO}	5.0		—	V	I_E = 100 μA
Collector-Emitter Leakage	I_{CEO}	—		100	nA	V_{CE} = 10 V
Reception Angle at ½ Sensitivity	θ	—	±25	—	Degrees	
On-State Collector Current QSE122	$I_{C(ON)}$	3.0		12.0	mA	Ee = 0.5 mW/cm², V_{CE} = 5V(6)
On-State Collector Current QSE123	$I_{C(ON)}$	6.0		—	mA	Ee = 0.5 mW/cm², V_{CE} = 5V(6)
Collector-Emitter Saturation Voltage	$V_{CE(SAT)}$	—		0.4	V	I_c = 0.4 mA, Ee = 0.5mW/cm²(6)
Rise Time	t_r	—	8.0	—	μS	I_C = .15 mA, V_{CC} = 5 V, R_L = 100Ω
Fall Time	t_f	—	8.0	—	μS	I_C = .15 mA, V_{CC} = 5 V, R_L = 100Ω

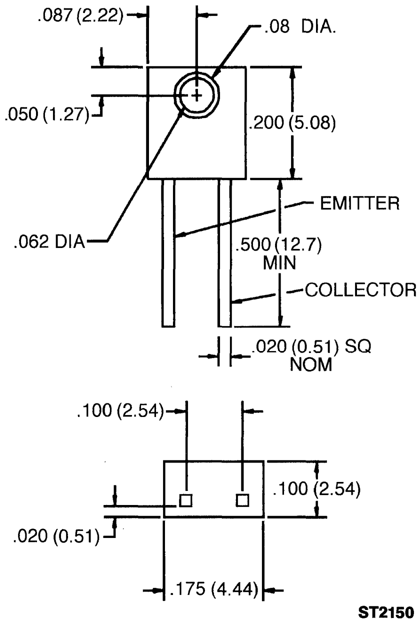
NOTES

1. *Derate power dissipation linearly 1.33 mW/°C above 25°C.*
2. *RMA flux is recommended.*
3. *Methanol or Isopropyl alcohols are recommended as cleaning agents.*
4. *Soldering iron tip 1⁄16″ (1.6 mm) minimum from housing.*
5. *As long as leads are not under any stress or spring tension.*
6. *Light source is an AlGaAs LED emitting light at a peak wavelength of 880 nm.*

SIDELOOKER PHOTODARLINGTON

QSE133

PACKAGE DIMENSIONS



NOTES:
1. DIMENSIONS ARE IN INCHES (mm).
2. TOLERANCE IS ±.010 (.25)
   UNLESS OTHERWISE SPECIFIED.

DESCRIPTION

The QSE133 is a silicon photodarlington encapsulated in a wide angle, infrared transparent, dark blue, plastic sidelooker shell package.

FEATURES

- Steel lead frames for improved reliability in solder mounting.
- Good optical-to-mechanical alignment.
- Plastic package is infrared transparent and tinted to attenuate visible light.
- Mechanically and spectrally matched to the QEE113 and QEE123 LEDs.
- Dark blue shell body allows easy recognition from LED.

SIDELOOKER PHOTODARLINGTON

ABSOLUTE MAXIMUM RATINGS (T_A = 25°C Unless Otherwise Specified)

Storage Temperature	−40°C to + 100°C
Operating Temperature	−40°C to + 100°C
Soldering:	
Lead Temperature (Iron)	240°C for 5 sec. (2,3,4,5)
Lead Temperature (Flow)	260°C for 10 sec. (2,3,5)
Collector-Emitter Breakdown Voltage	30 Volts
Emitter-Collector Breakdown Voltage	5.0 Volts
Power Dissipation	100 mW(1)

ELECTRICAL CHARACTERISTICS (T_A = 25°C Unless Otherwise Specified) (All measurements made under pulse conditions.)

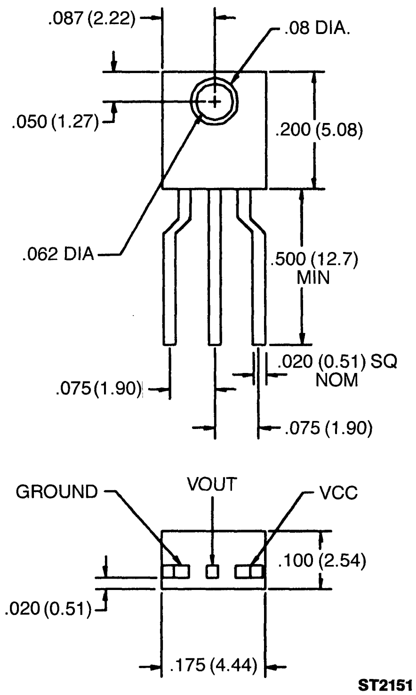
PARAMETER	SYMBOL	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS
Collector-Emitter Breakdown	BV_{CEO}	30.0		—	V	$I_C = 1$ mA
Emitter-Collector Breakdown	BV_{ECO}	5.0		—	V	$I_E = 100\ \mu A$
Collector-Emitter Leakage	I_{CEO}	—		100	nA	$V_{CE} = 10$ V
Reception Angle at ½ Sensitivity	θ	—	±25	—	Degrees	
On-State Collector Current	$I_{C(ON)}$	9.0		—	mA	Ee = 0.25 mW/cm², $V_{CE} = 5V^{(6)}$
Collector-Emitter Saturation Voltage	$V_{CE(SAT)}$	—		1.0	V	$I_c = 0.4$ mA, Ee = 0.5mW/cm²(6)
Rise Time	t_r	—	20	—	μS	$I_C = .15$ mA, $V_{CC} = 5$ V, $R_L = 100\Omega$
Fall Time	t_f	—	50	—	μS	$I_C = .15$ mA, $V_{CC} = 5$ V, $R_L = 100\Omega$

NOTES

1. *Derate power dissipation linearly 1.33 mW/°C above 25°C.*
2. *RMA flux is recommended.*
3. *Methanol or Isopropyl alcohols are recommended as cleaning agents.*
4. *Soldering iron tip 1⁄16″ (1.6 mm) minimum from housing.*
5. *As long as leads are not under any stress or spring tension.*
6. *Light source is an AlGaAs LED emitting light at a peak wavelength of 880 nm.*

QSE156/157/158/159

PACKAGE DIMENSIONS



NOTES:
1. DIMENSIONS ARE IN INCHES (mm).
2. TOLERANCE IS ±.010 (.25)
   UNLESS OTHERWISE SPECIFIED.

DESCRIPTION

The QSE15X family are OPTOLOGIC™ ICs which feature a Schmitt trigger at output which provides hysteresis for noise immunity and pulse shaping. The basic building block of this IC consists of a photodiode, a linear amplifier, voltage regulator, Schmitt trigger and four output options. The TTL/LSTTL compatible output can drive up to ten TTL loads over supply currents from 4.5 to 16.0 volts. The dark red epoxy packaging system is designed to optimize the mechanical resolution, coupling efficiency, cost, and reliability.

FEATURES

- High noise immunity.
- Direct TTL/LSTTL interface.
- Steel lead frames for improved solder mounting.
- Reception angle of ±25°.

ABSOLUTE MAXIMUM RATINGS (T_A = 25°C Unless Otherwise Specified)

Supply Voltage, V_{CC}	18 volts
Storage Temperature	−40°C + 100°C
Operating Temperature	−40°C to + 85°C
Soldering:	
Lead Temperature (Iron)	240°C for 5 sec. (2,3,4,5)
Lead Temperature (Flow)	260°C for 10 sec. (2,3,5)
Power Dissipation	100 mW(1)
Duration of Output short to V_{CC}	1.00 sec.
Voltage at Output	35 volts
Sinking Current	50 mA
Sourcing Current (QSE156, QSE157)	10 mA
Irradiance	3.0 mW/cm²

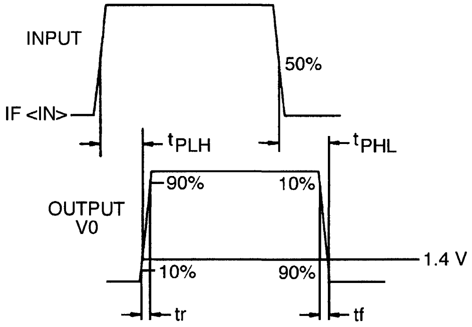
ELECTRICAL CHARACTERISTICS (T_A = −40°C to +85°C) (V_{CC} = 4.5 to 16 volts)

PARAMETER	SYMBOL	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS
Operating Supply Voltage	V_{CC}	4.5		16.0	V	
Positive Going Threshold Irradiance(6)	Ee (+)	0.025		0.250	mW/cm²	T_A = 25°C
Hysteresis Ratio	Ee(+)/Ee(−)	1.10		2.00		
Supply Current	I_{CC}	—		12.0	mA	Ee = 0 or .3 mW/cm² (6)
Peak to peak ripple which will cause false triggering		—		2.00	V	f = DC to 50 MHZ
QSE156 (BUFFER TOTEM POLE)						
High Level Output Voltage	V_{OH}	V_{CC}−2.1		—	V	Ee = .3 mW/cm², I_{OH} = −1.0 mA(6)
Low Level Output Voltage	V_{OL}	—		0.40	V	Ee = 0, I_{OL} = 16 mA
QSE157 (INVERTER TOTEM POLE)						
High Level Output Voltage	V_OH	V_{CC}−2.1		—	V	Ee = 0, I_{OH} = −1.0 mA
Low Level Output Voltage	V_{OL}	—		0.40	V	Ee = .3 mW/cm², I_{OL} = 16 mA(6)
QSE158 (BUFFER OPEN COLLECTOR)						
High Level Output Current	I_{OH}	—		100	μA	Ee = .3 mW/cm², V_{OH} = 30 V(6)
Low Level Output Voltage	V_{OL}	—		0.40	V	Ee = 0, I_{OL} = 16 mA
QSE159 (INVERTER OPEN COLLECTOR)						
High Level Output Current	I_{OH}	—		100	μA	Ee = 0, V_{OH} = 30 V
Low Level Output Voltage	V_{OL}	—		0.40	V	Ee = .3 mW/cm², I_{OL} = 16 mA (6)

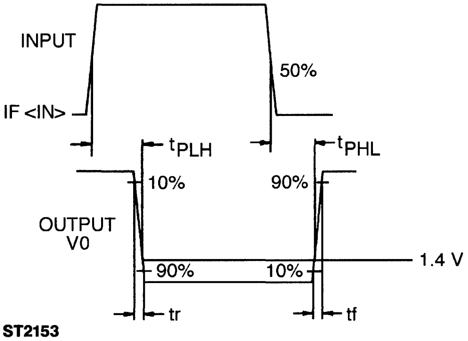
ELECTRICAL CHARACTERISTICS ($T_A = -40°C$ to $+85°C$) (V_{CC}=4.5 to 16 volts)

PARAMETER	SYMBOL	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS
QSE156, QSE157						
Output rise, fall times	tr, tf	—		70	nS	Ee=0 or .3 mW/cm², f=10K Hz DC=50%, R_L=10 TTL loads(6)
Propagation delay	tphl, tplh		6.0		µS	
QSE158, QSE159						
Output rise, fall times	tr, tf	—		100	nS	Ee=0 or .3 mW/cm², f=10K Hz DC=50%, R_L=300Ω(6).
Propagation delay	tphl, tplh		6.0		µS	

Switching Test Curve for Buffers



Switching Test Curve for Inverters

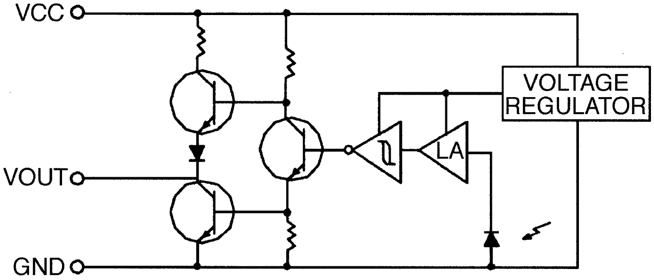


ST2153

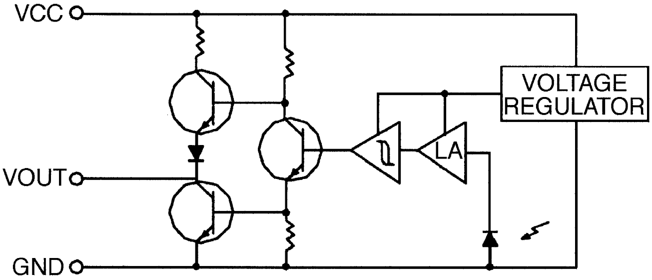
NOTES

1. *Derate power dissipation linearly 4.00 mW/°C above 25°C.*
2. *RMA flux is recommended.*
3. *Methanol or Isopropyl alcohols are recommended as cleaning agents.*
4. *Soldering iron tip 1⁄16" (1.6 mm) minimum from housing.*
5. *As long as leads are not under any stress or spring tension.*
6. *Irradiance measurements are made with an AlGaAs LED emitting light at a peak wavelength of 880 nm.*

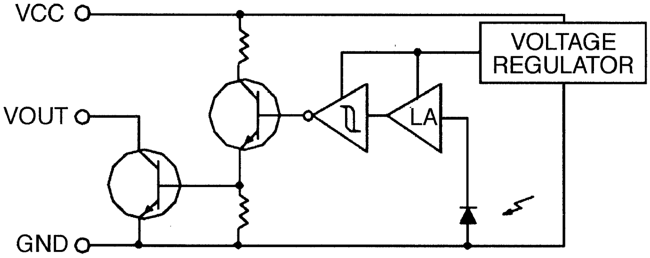
CIRCUIT SCHEMATICS



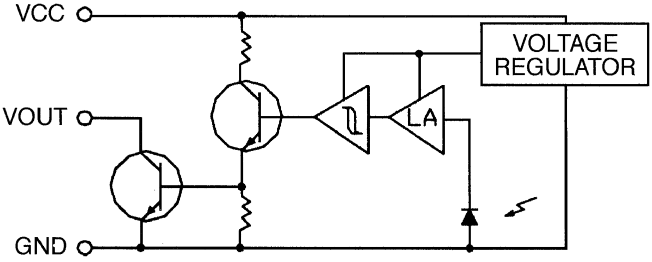
QSE156
Totem-Pole Output Buffer



QSE157
Totem-Pole Output Inverter



QSE158
Open-Collector Output Buffer



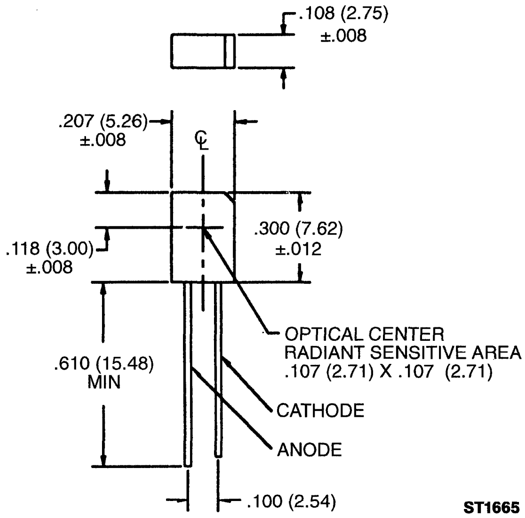
QSE159
Open-Collector Output Inverter

QT OPTOELECTRONICS

SIDELOOKER PIN PHOTODIODE

QSE773

PACKAGE DIMENSIONS



NOTES:
1. DIMENSIONS ARE IN INCHES (mm).

DESCRIPTION

The QSE773 is a silicon PIN photodiode encapsulated in an infrared transparent, black, plastic sidelooker package.

FEATURES

- High sensitivity
- Low cost
- Plastic package is infrared transparent and tinted to attenuate visible light

SIDELOOKER PIN PHOTODIODE

ABSOLUTE MAXIMUM RATINGS (T_A = 25°C Unless Otherwise Specified)

Storage Temperature .... −40°C to +85°C
Operating Temperature .... −40°C to +85°C
Soldering:
  Lead Temperature (Iron) .... 240°C for 5 sec.(2,3,4,5)
  Lead Temperature (Flow) .... 260°C for 10 sec.(2,3,5)

Reverse Voltage .... 32 Volts
Power Dissipation .... 150 mW(1)

ELECTRICAL CHARACTERISTICS (T_A = 25°C Unless Otherwise Specified) (All measurements made under pulse conditions.)

PARAMETER	SYMBOL	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS
Reverse Voltage	V_R	32		—	V	I_R = 0.1 mA
Dark Reverse Current	$I_{R(D)}$	—		30	nA	V_R = 10 V
Peak Sensitivity	λpk		930		nm	V_R = 5 V
Reception Angle at ½ Power	θ		±60		Degrees	
Photosensitivity	S	30		—	μA	Ee = 1.0 mW/cm², V_{CE} =5V(6)
Capacitance	C		20		pf	V_R = 3 V
Rise Time	t_r		50		nS	V_R = 5 V, R_L = 1KΩ
Fall Time	t_f		50		nS	V_R = 5 V, R_L = 1KΩ

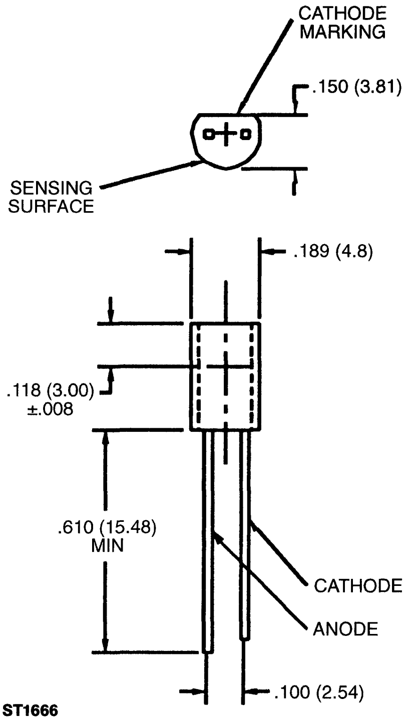
NOTES

1. *Derate power dissipation linearly 2.50 mW/°C above 25°C.*
2. *RMA flux is recommended.*
3. *Methanol or Isopropyl alcohols are recommended as cleaning agents.*
4. *Soldering iron tip 1⁄16″ (1.6 mm) from housing.*
5. *As long as leads are not under any stress or spring tension.*
6. *Light source is an GaAs LED emitting light at a peak wavelength of 940 nm.*

SIDELOOKER PIN PHOTODIODE

QSE973

PACKAGE DIMENSIONS



ST1666

NOTES:
1. DIMENSIONS ARE IN INCHES (mm).

DESCRIPTION

The QSE973 is a silicon PIN photodiode encapsulated in an infrared transparent, black, plastic sidelooker package.

FEATURES

- High sensitivity
- Low cost
- Plastic package is infrared transparent and tinted to attenuate visible light

SIDELOOKER PIN PHOTODIODE

ABSOLUTE MAXIMUM RATINGS (T_A = 25°C Unless Otherwise Specified)

Storage Temperature	−40°C to +85°C
Operating Temperature	−40°C to +85°C
Soldering:	
Lead Temperature (Iron)	240°C for 5 sec.(2,3,4,5)
Lead Temperature (Flow)	260°C for 10 sec.(2,3,5)
Reverse Voltage	32 Volts
Power Dissipation	150 mW(1)

ELECTRICAL CHARACTERISTICS (T_A = 25°C Unless Otherwise Specified) (All measurements made under pulse conditions.)

PARAMETER	SYMBOL	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS
Reverse Voltage	V_R	32		—	V	I_R = 0.1 mA
Dark Reverse Current	$I_{R(D)}$	—		30	nA	V_R = 10 V
Peak Sensitivity	λpk		930		nm	V_R = 5 V
Reception Angle at ½ Power	θ		±45		Degrees	
Photosensitivity	S	30		—	μA	Ee = 1.0 mW/cm², V_{CE} =5V(6)
Capacitance	C		20		pf	V_R = 3 V
Rise Time	t_r		50		nS	V_R = 5 V, R_L = 1KΩ
Fall Time	t_f		50		nS	V_R = 5 V, R_L = 1KΩ

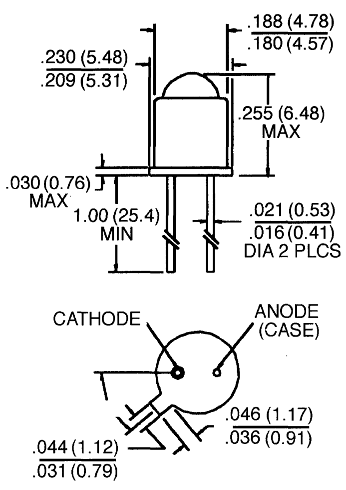
NOTES

1. *Derate power dissipation linearly 2.50 mW/°C above 25°C.*
2. *RMA flux is recommended.*
3. *Methanol or Isopropyl alcohols are recommended as cleaning agents.*
4. *Soldering iron tip 1⁄16″ (1.6 mm) from housing.*
5. *As long as leads are not under any stress or spring tension.*
6. *Light source is an GaAs LED emitting light at a peak wavelength of 940 nm.*

HERMETIC PAIR

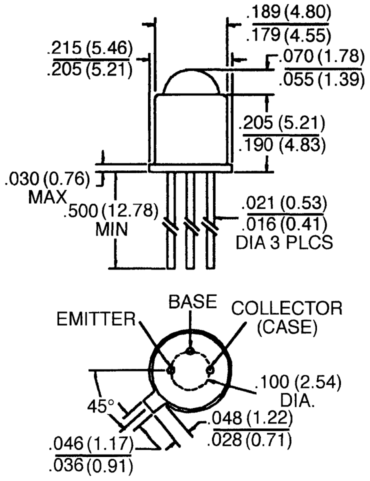
QPA1223

PACKAGE DIMENSIONS



INFRARED LED

ST2137



PHOTOTRANSISTOR

ST2137

NOTES:
1. DIMENSIONS ARE IN INCHES (mm).
2. TOLERANCE IS ±.010 (.25)
   UNLESS OTHERWISE SPECIFIED.

DESCRIPTION

The QPA1223 consists of an 880 nm AlGaAs LED and a silicon phototransistor mounted in TO-46 (LED) and TO-18 (sensor) metal can packages.

FEATURE

- Narrow emission/reception angle.
- Hermetically sealed packages.

HERMETIC PAIR

ABSOLUTE MAXIMUM RATINGS (T_A = 25°C Unless Otherwise Specified)

Storage Temperature	−65°C to + 150°C
Operating Temperature	−65°C to + 125°C
Soldering:	
Lead Temperature (Iron)	240°C for 5 sec. (2,3,5)
Lead Temperature (Flow)	260°C for 10 sec. (2,5)
INPUT DIODE	
Continuous Forward Current	100 mA
Reverse Voltage	5.0 Volts
Power Dissipation	170 mW(1)
OUTPUT TRANSISTOR	
Collector-Emitter Voltage	30 Volts
Emitter-Collector Voltage	5.0 Volts
Power Dissipation	300 mW(1)

ELECTRICAL CHARACTERISTICS (T_A = 25°C Unless Otherwise Specified)

(All measurements made under pulse conditions.)

PARAMETER	SYMBOL	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS
INPUT DIODE						
Forward Voltage	V_F	—		1.70	V	I_F = 20 mA
Reverse Leakage Current	I_R	—		100	μA	V_R = 5.0 V
OUTPUT TRANSISTOR						
Collector-Emitter Breakdown	BV_{CEO}	30		—	V	I_F = 1.0 mA, Ee = 0
Collector-Emitter Leakage	I_{CEO}	—		100	nA	V_{CE} = 10.0 V, Ee = 0
COUPLED						
On-State Collector Current						
QPA1223	$I_{C(ON)}$	7.5		—	mA	I_F = 20mA, V_{CC} = 5.0V, D=.250″(4)

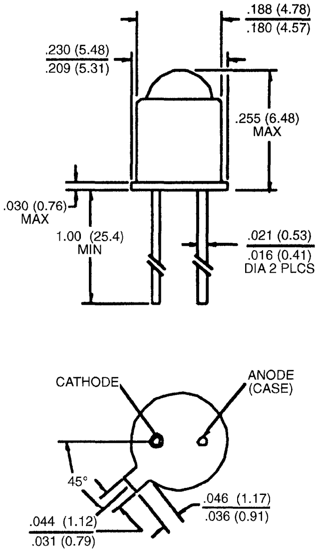
NOTES

1. *Derate power dissipation linearly 1.70 mW/°C above 25°C for input diode; 3.00 mW/°C for output transistor.*
2. *RMA flux is recommended.*
3. *Soldering iron tip 1⁄16″ (1.6 mm) minimum from case.*
4. *D is the distance from lens tip to lens tip.*
5. *As long as leads are not under any stress or spring tension.*

HERMETIC PAIR

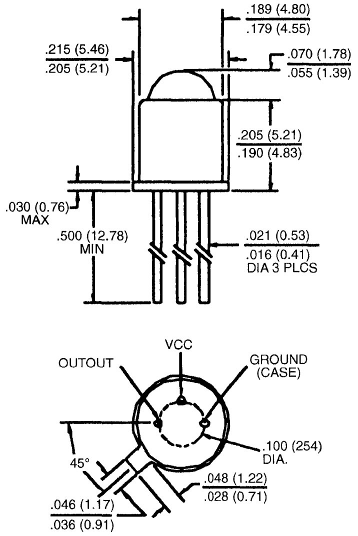
QPA8259

PACKAGE DIMENSIONS



INFRARED LED

ST1660



PHOTOSENSOR

ST1661

NOTES:
1. DIMENSIONS ARE IN INCHES [mm].
2. TOLERANCE IS ±.010 [.25]
   UNLESS OTHERWISE SPECIFIED.

DESCRIPTION

The QPA8259 consists of an 880nm AlGaAs LED and an OPTOLOGIC™ silicon photosensor mounted in hermatically sealed packages.

FEATURE

- Narrow emission/reception angle
- Hermetically sealed packages

ABSOLUTE MAXIMUM RATINGS (T_A = 25°C Unless Otherwise Specified)

Storage Temperature	−65°C to +150°C
Operating Temperature	−65°C to +125°C
Soldering:	
Lead Temperature (Iron)	240°C for 5 sec.(3,4,5)
Lead Temperature (Flow)	260°C for 10 sec.(3,4)
INPUT DIODE	
Continuous Forward Current	60 mA
Reverse Voltage	3.0 Volts
Power Dissipation	170 mW(1)
OUTPUT OPTOLOGIC™	
Output Current	50 mA
Operation Voltage Allowed Range	4.5 to 16 Volts
Output Voltage Allowed Range	4.5 to 16 Volts
Power Dissipation	250 mW(2)

ELECTRICAL CHARACTERISTICS (T_A = 25°C Unless Otherwise Specified)

PARAMETER	SYMBOL	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS
INPUT DIODE						
Forward Voltage	V_F	—		1.7	V	I_F = 20 mA
Reverse Leakage Current	I_R	—		10	μA	V_R = 3 V
OUTPUT OPTOLOGIC™						
Operating Supply Voltage	V_{CC}	4.5		16.0	V	
Supply Current	I_{CC}	—		12.0	mA	E_e = 0 or 0.3 mW/cm²
Output Current High	I_{OH}	—		10	μA	E_e = 0, V_{OH} = 30 V
Low Level Output Voltage	V_{OL}	—		0.4	V	E_e = .3 mW/cm², R_L = 270Ω
COUPLED						
Turn-On Threshold Current	$I_{F(+)}$	—		20.0	mA	V_{CC} = 5 V, R_L = 270Ω, D = .250″(6)
Turn-Off Threshold Current	$I_{F(-)}$	1.0		—	mA	V_{CC} = 5 V, R_L = 270Ω, D = .250″(6)
Hysteresis Ratio	$I_{F(+)}/I_{F(-)}$	1.1		2.0		V_{CC} = 5 V, R_L = 270Ω, D = .250″(6)

NOTES

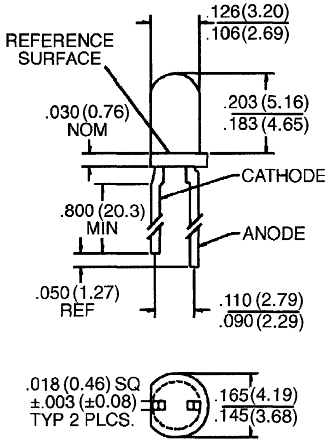
1. *Derate power dissipation linearly 1.70 mW/°C above 25°C.*
2. *Derate power dissipation linearly 2.50 mW/°C above 25°C.*
3. *RMA flux is recommended.*
4. *Methanol or Isopropyl alcohols are recommended as cleaning agents.*
5. *Soldering iron tip 1/16″ (1.6 mm) from housing.*
6. *D is the distance from lens tip to lens tip.*

QPA8259

PLASTIC T-1 PAIR

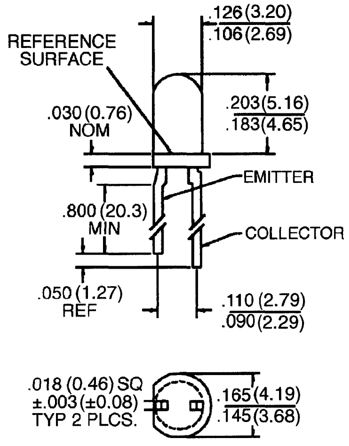
QPC1213

PACKAGE DIMENSIONS



INFRARED LED

ST2138



PHOTOTRANSISTOR

ST2138

NOTES:
1. DIMENSIONS ARE IN INCHES (mm).
2. TOLERANCE IS ±.010 (.25)
   UNLESS OTHERWISE SPECIFIED.

DESCRIPTION

The QPC1213 consists of an 880 nm AlGaAs LED and a silicon phototransistor mounted in plastic T-1 packages.

FEATURE

- Steel lead frames for improved reliability in solder mounting.
- Good optical-to-mechanical alignment.
- Narrow emission/reception angle.
- Black plastic body allows easy recognition of sensor.

PLASTIC T-1 PAIR

ABSOLUTE MAXIMUM RATINGS (T_A = 25°C Unless Otherwise Specified)

Storage Temperature	−40°C to + 100°C
Operating Temperature	−40°C to + 100°C
Soldering:	
Lead Temperature (Iron)	240°C for 5 sec. (2,3,5)
Lead Temperature (Flow)	260°C for 10 sec. (2,5)
INPUT DIODE	
Continuous Forward Current	50 mA
Reverse Voltage	5.0 Volts
Power Dissipation	100 mW(1)
OUTPUT TRANSISTOR	
Collector-Emitter Voltage	30 Volts
Emitter-Collector Voltage	5.0 Volts
Power Dissipation	100 mW(1)

ELECTRICAL CHARACTERISTICS (T_A = 25°C Unless Otherwise Specified)
(All measurements made under pulse conditions.)

PARAMETER	SYMBOL	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS
INPUT DIODE						
Forward Voltage	V_F	—		1.70	V	I_F = 20 mA
Reverse Leakage Current	I_R	—		100	μA	V_R = 5.0 V
OUTPUT TRANSISTOR						
Collector-Emitter Breakdown	BV_{CEO}	30		—	V	I_F = 1.0 mA, Ee = 0
Collector-Emitter Leakage	I_{CEO}	—		100	nA	V_{CE} = 10.0 V, Ee = 0
COUPLED						
On-State Collector Current						
QPC1213	$I_{C(ON)}$	5.0		—	mA	I_F = 20mA, V_{CC} = 5.0V, D = .250″(4)

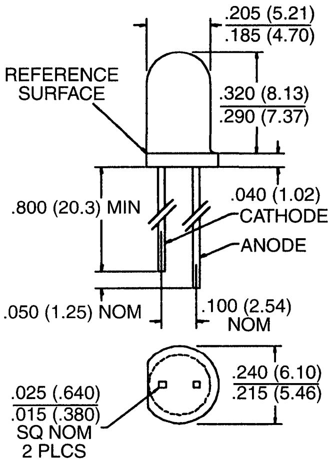
NOTES

1. *Derate power dissipation linearly 1.33 mW/°C above 25°C.*
2. *RMA flux is recommended.*
3. *Soldering iron tip 1/16″ (1.6 mm) minimum from case.*
4. *D is the distance from lens tip to lens tip.*
5. *As long as leads are not under any stress or spring tension.*

PLASTIC T-1¾ PAIR

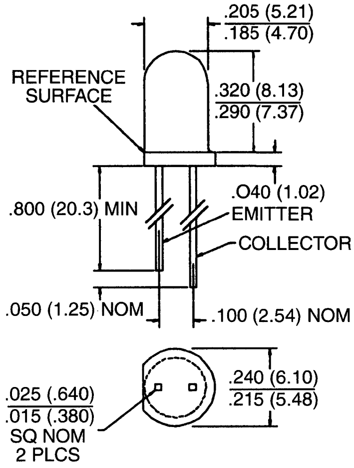
QPD1223

PACKAGE DIMENSIONS



INFRARED LED

ST2169



PHOTOTRANSISTOR

ST2169

NOTES:
1. DIMENSIONS ARE IN INCHES (mm).
2. TOLERANCE IS ±.010 (.25) UNLESS OTHERWISE SPECIFIED.

DESCRIPTION

The QPD1223 consists of an 880 nm AlGaAs LED and a silicon phototransistor mounted in plastic T-1¾ packages.

FEATURE

- Steel lead frames for improved reliability in solder mounting.
- Good optical-to-mechanical alignment.
- Narrow emission/reception angle.
- Black plastic body allows easy recognition of sensor.

PLASTIC T-1¾ PAIR

ABSOLUTE MAXIMUM RATINGS (T_A = 25°C Unless Otherwise Specified)

Storage Temperature	−40°C to + 100°C
Operating Temperature	−40°C to + 100°C
Soldering:	
Lead Temperature (Iron)	240°C for 5 sec. (2,3,5)
Lead Temperature (Flow)	260°C for 10 sec. (2,5)
INPUT DIODE	
Continuous Forward Current	100 mA
Reverse Voltage	5.0 Volts
Power Dissipation	200 mW(1)
OUTPUT TRANSISTOR	
Collector-Emitter Voltage	30 Volts
Emitter-Collector Voltage	5.0 Volts
Power Dissipation	100 mW(1)

ELECTRICAL CHARACTERISTICS (T_A = 25°C Unless Otherwise Specified) (All measurements made under pulse conditions.)

PARAMETER	SYMBOL	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS
INPUT DIODE						
Forward Voltage	V_F	—		1.70	V	I_F = 20 mA
Reverse Leakage Current	I_R	—		100	μA	V_R = 5.0 V
OUTPUT TRANSISTOR						
Collector-Emitter Breakdown	BV_{CEO}	30		—	V	I_F = 1.0 mA, Ee = 0
Collector-Emitter Leakage	I_{CEO}	—		100	nA	V_{CE} = 10.0 V, Ee = 0
COUPLED						
On-State Collector Current						
QPD1223	$I_{C(ON)}$	10.0		—	mA	I_F = 20mA, V_{CC} = 5.0V, D = .250″(4)

NOTES

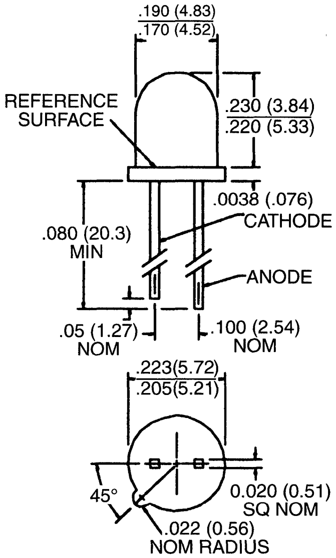
1. *Derate power dissipation linearly 2.67 mW/°C above 25°C for LED and 1.33 mW/°C for sensor.*
2. *RMA flux is recommended.*
3. *Soldering iron tip 1⁄16″ (1.6mm) minimum from case.*
4. *D is the distance from lens tip to lens tip.*
5. *As long as leads are not under any stress or spring tension.*

OPTOELECTRONICS

PLASTIC TO-46/TO-18 PAIR

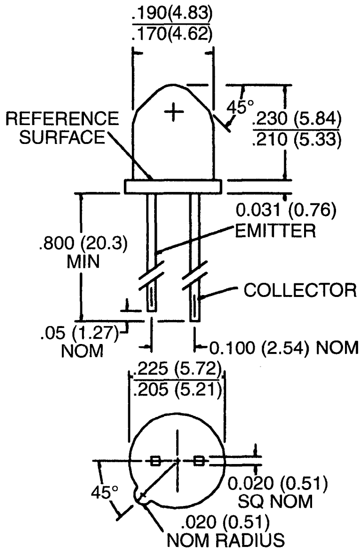
QPD5223

PACKAGE DIMENSIONS



INFRARED LED

ST2170



PHOTOTRANSISTOR

ST2170

NOTES:
1. DIMENSIONS ARE IN INCHES (mm).
2. TOLERANCE IS ±.010 (.25) UNLESS OTHERWISE SPECIFIED.

DESCRIPTION

The QPD5223 consists of an 880 nm AlGaAs LED and a silicon phototransistor mounted in plastic TO-46 (LED) and TO-18 (sensor) packages.

FEATURE

- Steel lead frames for improved reliability in solder mounting.
- Good optical-to-mechanical alignment.
- Narrow emission/reception angle.
- Black plastic body allows easy recognition of sensor.

PLASTIC TO-46/TO-18 PAIR

ABSOLUTE MAXIMUM RATINGS (T_A = 25°C Unless Otherwise Specified)

Storage Temperature	−40°C to + 100°C
Operating Temperature	−40°C to + 100°C
Soldering:	
Lead Temperature (Iron)	240°C for 5 sec. (2,3,5)
Lead Temperature (Flow)	260°C for 10 sec. (2,5)
INPUT DIODE	
Continuous Forward Current	50 mA
Reverse Voltage	5.0 Volts
Power Dissipation	200 mW(1)
OUTPUT TRANSISTOR	
Collector-Emitter Voltage	30 Volts
Emitter-Collector Voltage	5.0 Volts
Power Dissipation	100 mW(1)

ELECTRICAL CHARACTERISTICS (T_A = 25°C Unless Otherwise Specified) (All measurements made under pulse conditions.)

PARAMETER	SYMBOL	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS
INPUT DIODE						
Forward Voltage	V_F	—		1.70	V	I_F = 20 mA
Reverse Leakage Current	I_R	—		100	μA	V_R = 5.0 V
OUTPUT TRANSISTOR						
Collector-Emitter Breakdown	BV_{CEO}	30		—	V	I_F = 1.0 mA, Ee = 0
Collector-Emitter Leakage	I_{CEO}	—		100	nA	V_{CE} = 10.0 V, Ee = 0
COUPLED						
On-State Collector Current						
QPD5223	$I_{C(ON)}$	7.5		—	mA	I_F = 20mA, V_{CC} = 5.0V, D = .250″(4)

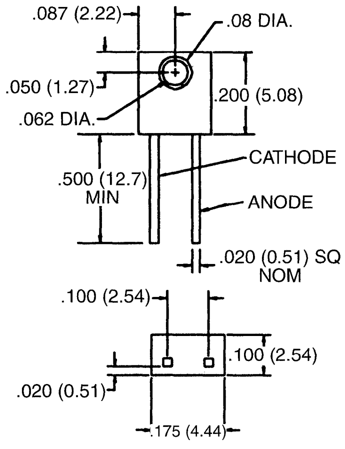
NOTES

1. *Derate power dissipation linearly 2.67 mW/°C above 25°C for LED and 1.33 mW/°C for the sensor.*
2. *RMA flux is recommended.*
3. *Soldering iron tip 1⁄16″ (1.6mm) minimum from case.*
4. *D is the distance from lens tip to lens tip.*
5. *As long as leads are not under any stress or spring tension.*

PLASTIC SIDELOOKER PAIR

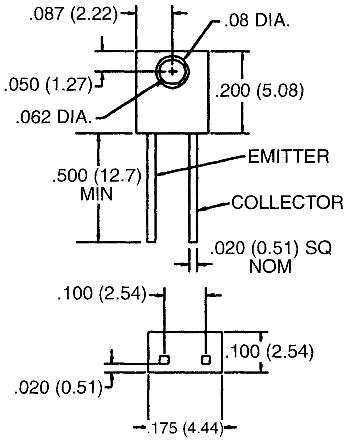
QPE1113

PACKAGE DIMENSIONS



INFRARED LED

ST2171



PHOTOTRANSISTOR

ST2171

NOTES:
1. DIMENSIONS ARE IN INCHES (mm).
2. TOLERANCE IS ±.010 (.25)
UNLESS OTHERWISE SPECIFIED.

DESCRIPTION

The QPE1113 consists of a 940nm GaAs LED and a silicon phototransistor mounted in plastic sidelooker packages.

FEATURE

- Steel lead frames for improved reliability in solder mounting.
- Excellent optical-to-mechanical alignment.
- Wide emission/reception angle.
- Black plastic body allows easy recognition of sensor and filters ambient visible light.

PLASTIC SIDELOOKER PAIR

ABSOLUTE MAXIMUM RATINGS (T_A = 25°C Unless Otherwise Specified)

Storage Temperature	−40°C to + 100°C
Operating Temperature	−40°C to + 100°C
Soldering:	
Lead Temperature (Iron)	240°C for 5 sec. (2,3,5)
Lead Temperature (Flow)	260°C for 10 sec. (2,5)
INPUT DIODE	
Continuous Forward Current	60 mA
Reverse Voltage	5.0 Volts
Power Dissipation	100 mW(1)
OUTPUT TRANSISTOR	
Collector-Emitter Voltage	30 Volts
Emitter-Collector Voltage	5.0 Volts
Power Dissipation	100 mW(1)

ELECTRICAL CHARACTERISTICS (T_A = 25°C Unless Otherwise Specified)
(All measurements made under pulse conditions.)

PARAMETER	SYMBOL	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS
INPUT DIODE						
Forward Voltage	V_F	—		1.50	V	I_F =20 mA
Reverse Leakage Current	I_R	—		100	μA	V_R =5.0 V
OUTPUT TRANSISTOR						
Collector-Emitter Breakdown	BV_{CEO}	30		—	V	I_C = 1.0 mA, Ee = 0
Collector-Emitter Leakage	I_{CEO}	—		100	nA	V_{CE} = 10.0 V, Ee = 0
COUPLED						
On-State Collector Current						
QPE1113	$I_{C(ON)}$	0.30		—	mA	I_F = 20mA, V_{CC} = 5.0V, D=.155″(4,5)

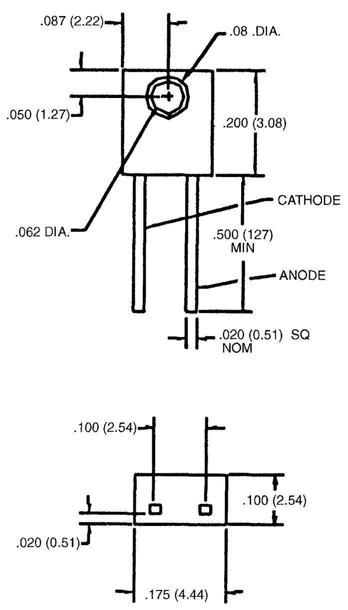
NOTES

1. *Derate power dissipation linearly 133 mW/°C above 25°C.*
2. *RMA flux is recommended.*
3. *Soldering iron tip 1/16″ (1.6mm) minimum from case.*
4. *D is the distance from lens tip to lens tip.*
5. *As long as leads are not under any stress or spring tension.*

PLASTIC SIDELOOKER PAIR

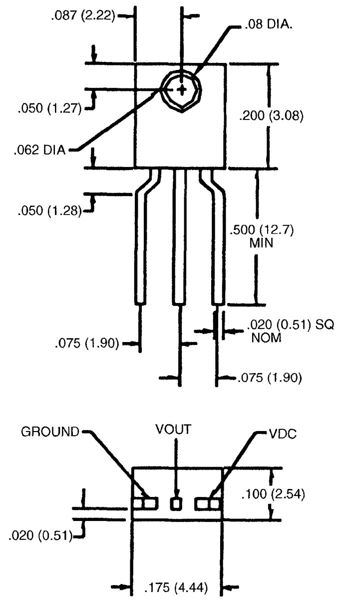
QPE1259

PACKAGE DIMENSIONS



INFRARED LED

ST1662



PHOTOSENSOR

ST1663

NOTES:
1. DIMENSIONS ARE IN INCHES [mm].
2. TOLERANCE IS ±.010 [.25] UNLESS OTHERWISE SPECIFIED.

DESCRIPTION

The QPE1259 consists of a gallium arsenide LED and an OPTOLOGIC™ silicon photosensor mounted in plastic sidelooker packages.

FEATURE

- Steel lead frames for improved reliability in solder mounting
- Excellent optical-to-mechanical alignment
- Wide emission/reception angle
- Black plastic body allows easy recognition of sensor and filters ambient visible light

QT
OPTOELECTRONICS

PLASTIC SIDELOOKER PAIR

ABSOLUTE MAXIMUM RATINGS (T_A = 25°C Unless Otherwise Specified)

Storage Temperature	−40°C to +100°C
Operating Temperature	−40°C to +85°C
Soldering:	
Lead Temperature (Iron)	240°C for 5 sec.(3,4,5)
Lead Temperature (Flow)	260°C for 10 sec.(3,4)
INPUT DIODE	
Continuous Forward Current	60 mA
Reverse Voltage	6.0 Volts
Power Dissipation	100 mW(1)
OUTPUT OPTOLOGIC™	
Output Current	50 mA
Operation Voltage Allowed Range	4.5 to 16 Volts
Output Voltage Allowed Range	2.4 to 30 Volts
Power Dissipation	200 mW(2)

ELECTRICAL CHARACTERISTICS (T_A = 25°C Unless Otherwise Specified)

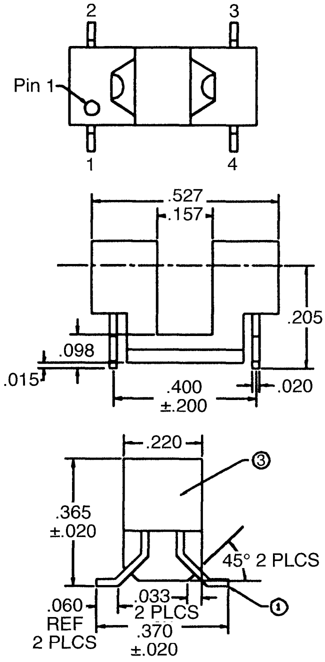
PARAMETER	SYMBOL	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS
INPUT DIODE						
Forward Voltage	V_F	—		1.5	V	I_F = 20 mA
Reverse Leakage Current	I_R	—		10	μA	V_R = 3 V
OUTPUT OPTOLOGIC™						
Operating Supply Voltage	V_{CC}	4.5		16.0	V	
Supply Current	I_{CC}	—		12.0	mA	E_e = 0 or 0.3 mW/cm^2
Output Current High	I_{OH}	—		100	μA	E_e = 0, V_{OH} = 30 V
Low Level Output Voltage	V_{OL}	—		0.4	V	E_e = .3 mW/cm^2, R_L = 270Ω
COUPLED						
Turn-On Threshold Current	$I_{F(+)}$	—		20.0	mA	V_{CC} = 5 V, R_L = 270Ω, D = .155″(6)
Turn-Off Threshold Current	$I_{F(-)}$	1.0		—	mA	V_{CC} = 5 V, R_L = 270Ω, D = .155″(6)
Hysteresis Ratio	$I_{F(+)}/I_{F(-)}$	1.1		2.0		V_{CC} = 5 V, R_L = 270Ω, D = .155″(6)

NOTES

1. *Derate power dissipation linearly 1.67 mW/°C above 25°C.*
2. *Derate power dissipation linearly 3.33 mW/°C above 25°C.*
3. *RMA flux is recommended.*
4. *Methanol or Isopropyl alcohols are recommended as cleaning agents.*
5. *Soldering iron tip 1⁄16″ (1.6 mm) from housing.*
6. *D is the distance from lens tip to lens tip.*

QCK3/QCK4 SURFACE MOUNTABLE OPTO INTERRUPTER

PACKAGE DIMENSIONS



ST2168

PIN OUT:
1 - ANODE
2 - CATHODE
3 - COLLECTOR
4 - EMITTER

NOTES:
1. ALL LEADS ARE CO-PLANAR WITHIN .006″.
2. UNLESS SPECIFIED, GENERAL TOLERANCE IS ±.010″.
3. HOUSING MATERIAL IS ELECTRICALLY CONDUCTIVE.

DESCRIPTION

The QCK3/QCK4 is a slotted optical switch designed for surface mount applications where extreme temperatures are experienced during solder reflow. The switch consists of a GaAs LED and a silicon photodarlington facing each other across a .157″ (4.0 mm) gap. The leads are formed to sit flush on a PCB during solder reflow.

FEATURES

- Unique single piece housing designed to reduce cost.
- High temperature housing material to withstand extreme temperature.
- High current transfer ratios (CTR) for low drive current at extreme temperature.
- Shipped in plastic tubes for protection of leads and to feed automatic placement equipment.
- Sensor package is infrared transparent and tinted to attenuate visible light.

SLOTTED OPTICAL SWITCH

ABSOLUTE MAXIMUM RATINGS (T_A = 25°C Unless Otherwise Specified)

Storage Temperature	−40°C to + 100°C
Operating Temperature	−40°C to + 100°C
Surface mount soldering temperature: (IR reflow solder chamber)	
Pre-heating stage 60 seconds max.	183°C
Reflow stage 5 seconds max.	230°C

NOTE: The rate of temperature rise shall be between 3°C and 10°C per second.

INPUT DIODE

Continuous Forward Current	50 mA
Reverse Voltage	5.0 Volts
Power Dissipation	100 mW⁽¹⁾

OUTPUT TRANSISTOR

Collector-Emitter Voltage	30 Volts
Emitter-Collector Voltage	5.0 Volts
Collector Current	40 mA
Power Dissipation	100 mW⁽¹⁾

ELECTRICAL CHARACTERISTICS (T_A = 25°C)

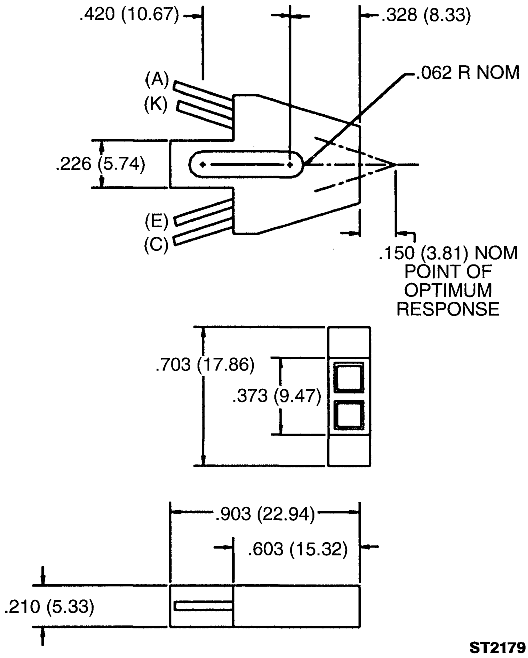
PARAMETER	SYMBOL	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS
INPUT DIODE						
Forward Voltage	V_F	—		1.40	V	I_F = 2.0 mA
Reverse Leakage Current	I_R	—		100	μA	V_R = 2.0 V
OUTPUT TRANSISTOR						
Collector-Emitter Breakdown	BV_{CEO}	30		—	V	I_C = 1.0 mA, Ee = 0
Collector-Emitter Leakage	I_{CEO}	—		30	μA	V_{CE} = 5.25 V, Ee = 0
COUPLED						
On-State Collector Current						
QCK3	$I_{C(ON)}$	1.0		—	mA	I_F = 5.0mA, V_{CC} = 5.0V
QCK4	$I_{C(ON)}$	3.0		15.0	mA	I_F = 5.0mA, V_{CC} = 5.0V
Saturation Voltage	$V_{CE(SAT)}$	—		1.0	V	I_F = 5.0mA, I_C = 5.0 mA

NOTES

1. *Derate power dissipation linearly 1.33 mW/°C above 25°C.*

QRB1113/1114

PACKAGE DIMENSIONS



FUNCTION
(C) COLLECTOR
(E) EMITTER
(K) CATHODE
(A) ANODE

NOTES:
1. DIMENSIONS ARE IN INCHES (mm).
2. TOLERANCE IS ±.010″ (.25)
UNLESS OTHERWISE SPECIFIED.

DESCRIPTION

The QRB1113/1114 consists of an infrared emitting diode and an NPN silicon phototransistor mounted side by side on a converging optical axis in a black plastic housing. The phototransistor responds to radiation from the emitting diode only when a reflective object passes within its field of view. The area of the optimum response approximates a circle .200″ in diameter.

FEATURES

- Phototransistor output
- High Sensitivity
- Low cost plastic housing
- IR transparent plastic covers for dust protection.

ABSOLUTE MAXIMUM RATINGS (T_A = 25°C Unless Otherwise Specified)

Storage Temperature	−40°C to + 85°C
Operating Temperature	−40°C to + 85°C
Soldering:	
Lead Temperature (Iron)	240°C for 5 sec. (2,3,4)
Lead Temperature (Flow)	260°C for 10 sec. (2,3)
INPUT DIODE	
Continuous Forward Current	50 mA
Reverse Voltage	5.0 Volts
Power Dissipation	100 mW(1)
OUTPUT TRANSISTOR	
Collector-Emitter Voltage	30 Volts
Emitter-Collector Voltage	5.0 Volts
Collector Current	40 mA
Power Dissipation	100 mW(1)

ELECTRICAL CHARACTERISTICS (T_A = 25°C Unless Otherwise Specified)

PARAMETER	SYMBOL	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS
INPUT DIODE						
Forward Voltage	V_F	—		1.70	V	I_F = 40 mA
Reverse Leakage Current	I_R	—		100	μA	V_R = 2.0 V
OUTPUT TRANSISTOR						
Emitter-Collector Breakdown	BV_{ECO}	5		—	V	I_E = 100μA, Ee = 0
Collector-Emitter Breakdown	BV_{CEO}	30		—	V	I_C = 1.0 mA, Ee = 0
Collector-Emitter Leakage	I_{CEO}	—		100	nA	V_{CE} = 10.0 V, Ee = 0
COUPLED						
On-State Collector Current						
QRB1113	$I_{C(ON)}$	0.20		—	mA	I_F = 40 mA, V_{CE} = 5 V, D = .150″ (5,6)
QRB1114	$I_{C(ON)}$	0.60		3.00	mA	I_F = 40 mA, V_{CE} = 5 V, D = .150″ (5,6)
Crosstalk	I_{CX}	—		1.00	μA	I_F = 40 mA, V_{CE} = 5V(7)
Saturation Voltage	$V_{CE(SAT)}$	—		.4	V	I_F = 40 mA, I_C = 0.1 mA, D = .150″(5,6)

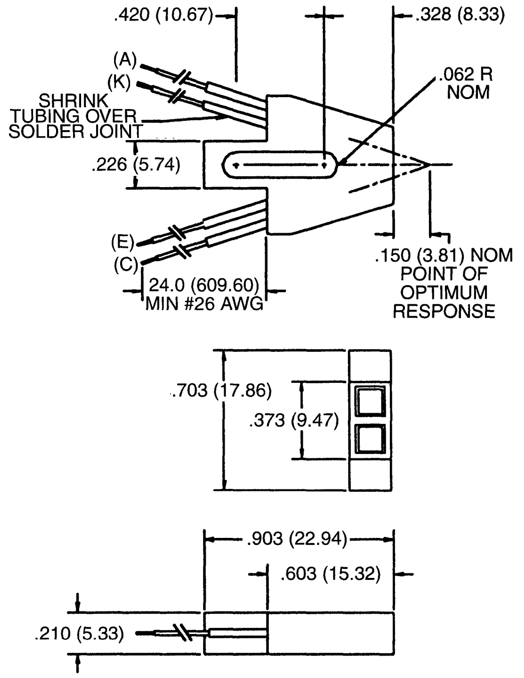
NOTES

1. *Derate power dissipation linearly 1.67 mW/°C above 25°C.*
2. *RMA flux is recommended.*
3. *Methanol or Isopropyl alcohols are recommended as cleaning agents.*
4. *Soldering iron 1⁄16″ (1.6mm) from housing*
5. *D is the distance from the assembly face to the reflective surface.*
6. *Measured using Eastman Kodak neutral test card with 90% diffused reflecting surface.*
7. *Cross talk is the photocurrent measured with current to the input diode and no reflecting surface.*

REFLECTIVE OBJECT SENSORS

QRB1133/1134

PACKAGE DIMENSIONS



ST2177

FUNCTION	WIRE COLOR
(C) COLLECTOR	WHITE
(E) EMITTER	BLUE
(K) CATHODE	GREEN
(A) ANODE	ORANGE

NOTES:
1. DIMENSIONS ARE IN INCHES (mm).
2. TOLERANCE IS ±.010″ (.25) UNLESS OTHERWISE SPECIFIED.

DESCRIPTION

The QRB1133/1134 consists of an infrared emitting diode and an NPN silicon phototransistor mounted side by side on a converging optical axis in a black plastic housing. The phototransistor responds to radiation from the emitting diode only when a reflective object passes within its field of view. The area of the optimum response approximates a circle .200″ in diameter.

FEATURES

- Phototransistor output
- High Sensitivity
- Low cost plastic housing
- #26 AWG, 24 inch PVC wire termination
- Infrared transparent plastic covers for dust protection.

OPTOELECTRONICS

ABSOLUTE MAXIMUM RATINGS (T_A = 25°C Unless Otherwise Specified)

Storage Temperature	−40°C to + 85°C
Operating Temperature	−40°C to + 85°C
Soldering:	
Lead Temperature (Iron)	240°C for 5 sec. (2,3,4)
Lead Temperature (Flow)	260°C for 10 sec. (2,3)
INPUT DIODE	
Continuous Forward Current	50 mA
Reverse Voltage	5.0 Volts
Power Dissipation	100 mW(1)
OUTPUT TRANSISTOR	
Collector-Emitter Voltage	30 Volts
Emitter-Collector Voltage	5.0 Volts
Collector Current	40 mA
Power Dissipation	100 mW(1)

ELECTRICAL CHARACTERISTICS (T_A = 25°C Unless Otherwise Specified)

PARAMETER	SYMBOL	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS
INPUT DIODE						
Forward Voltage	V_F	—		1.70	V	$I_F = 40$ mA
Reverse Leakage Current	I_R	—		100	μA	$V_R = 2.0$ V
OUTPUT TRANSISTOR						
Emitter-Collector Breakdown	BV_{ECO}	5		—	V	$I_E = 100\mu A$, Ee = 0
Collector-Emitter Breakdown	BV_{CEO}	30		—	V	$I_C = 1.0$ mA, Ee = 0
Collector-Emitter Leakage	I_{CEO}	—		100	nA	$V_{CE} = 10.0$ V, Ee = 0
COUPLED						
On-State Collector Current						
QRB1133	$I_{C(ON)}$	0.20		—	mA	$I_F = 40$ mA, $V_{CE} = 5$ V, D = .150″ (5,7)
QRB1134	$I_{C(ON)}$	0.60		3.00	mA	$I_F = 40$ mA, $V_{CE} = 5$ V, D = .150″(5,7)
Crosstalk	I_{CX}	—		1.00	μA	$I_F = 40$ mA, $V_{CE} = 5$V(6)
Saturation Voltage	$V_{CE(SAT)}$	—		0.40	V	$I_F = 40$ mA, $I_C = 0.1$ mA, D = .150″(5,7)

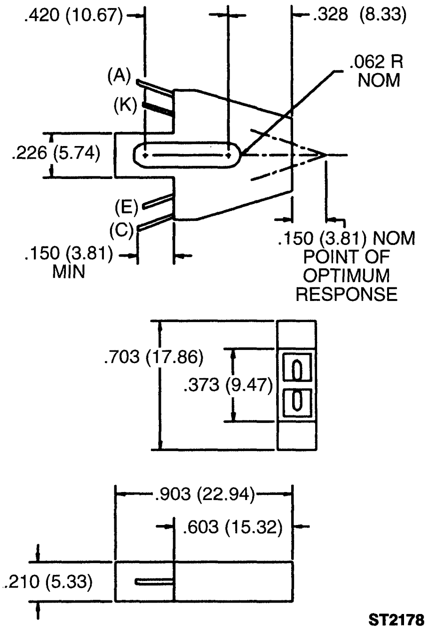
NOTES

1. *Derate power dissipation linearly 1.67 mW/°C above 25°C.*
2. *RMA flux is recommended.*
3. *Methanol or Isopropanol alcohols are recommended as cleaning agents.*
4. *Soldering iron 1⁄16″ (1.6mm) from housing*
5. *D is the distance from the assembly face to the reflective surface.*
6. *Cross talk is the photocurrent measured with current to the input diode and no reflecting surface.*
7. *Measured using Eastman Kodak neutral test card with 90% diffused reflecting surface.*

REFLECTIVE OBJECT SENSORS

QRC1113

PACKAGE DIMENSIONS



(C) COLLECTOR
(E) EMITTER
(K) CATHODE
(A) ANODE

NOTES:
1. CATHODE AND EMITTER LEADS ARE .050 NOM SHORTER THAN ANODE AND COLLECTOR LEADS.
2. DIMENSIONS ARE IN INCHES (mm).
3. TOLERANCE IS ±.010" [.25] UNLESS OTHERWISE SPECIFIED.

DESCRIPTION

The QRC1113 consists of an infrared emitting diode and an NPN silicon phototransistor mounted side by side on a converging optical axis in a black plastic housing. The phototransistor responds to radiation from the emitting diode only when a reflective object passes within its field of view. The area of the optimum response approximates a circle .200" in diameter.

FEATURES

- Phototransistor output
- High Sensitivity
- Low cost plastic housing

ABSOLUTE MAXIMUM RATINGS (T_A = 25°C Unless Otherwise Specified)

Storage Temperature	−40°C to + 85°C
Operating Temperature	−40°C to + 85°C
Soldering:	
Lead Temperature (Iron)	240°C for 5 sec. (2,3,4)
Lead Temperature (Flow)	260°C for 10 sec. (2,3)
INPUT DIODE	
Continuous Forward Current	50 mA
Reverse Voltage	5.0 Volts
Power Dissipation	100 mW(1)
OUTPUT TRANSISTOR	
Collector-Emitter Voltage	30 Volts
Emitter-Collector Voltage	5.0 Volts
Collector Current	40 mA
Power Dissipation	100 mW(1)

ELECTRICAL CHARACTERISTICS (T_A = 25°C Unless Otherwise Specified)

PARAMETER	SYMBOL	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS
INPUT DIODE						
Forward Voltage	V_F	—		1.70	V	I_F = 40 mA
Reverse Leakage Current	I_R	—		100	μA	V_R = 2.0 V
OUTPUT TRANSISTOR						
Emitter-Collector Breakdown	BV_{ECO}	5		—	V	I_E = 100μA, Ee = 0
Collector-Emitter Breakdown	BV_{CEO}	30		—	V	I_C = 1.0 mA, Ee = 0
Collector-Emitter Leakage	I_{CEO}	—		100	nA	V_{CE} = 10.0 V, Ee = 0
COUPLED						
On-State Collector Current	$I_{C(ON)}$	.200		—	mA	I_F = 40 mA, V_{CE} = 5 V, D = .150″(5,7)
Crosstalk	I_{CX}	—		1.0	μA	I_F = 40 mA, V_{CE} = 5 V(6)
Saturation Voltage	$V_{CE(SAT)}$	—		0.40	V	I_F = 40 mA, I_C = .1 mA, D = .150″(5,7)

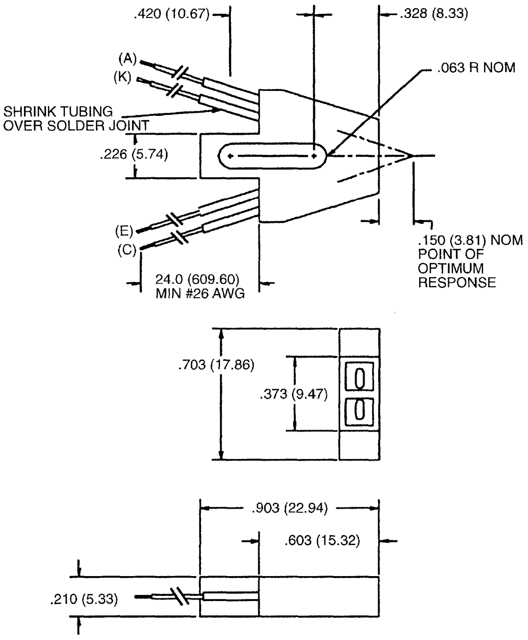
NOTES

1. *Derate power dissipation linearly 1.67 mW/°C above 25°C.*
2. *RMA flux is recommended.*
3. *Methanol or Isopropyl alcohols are recommended as cleaning agents.*
4. *Soldering iron 1⁄16″ (1.6mm) from housing.*
5. *D is the distance from the assembly face to the reflective surface.*
6. *Cross talk is the photocurrent measured with current to the input diode and no reflecting surface.*
7. *Measured using Eastman Kodak neutral test card with 90% diffused reflecting surface.*

REFLECTIVE OBJECT SENSOR

QRC1133

PACKAGE DIMENSIONS



ST1781

FUNCTION	WIRE COLOR
(C) COLLECTOR	WHITE
(E) EMITTER	BLUE
(K) CATHODE	GREEN
(A) ANODE	ORANGE

NOTES:
1. DIMENSIONS ARE IN INCHES (mm).
2. TOLERANCE IS ±.010 (.25)
   UNLESS OTHERWISE SPECIFIED.

DESCRIPTION

The QRC1133 consists of an infrared emitting diode and an NPN silicon phototransistor mounted side by side on a converging optical axis in a black plastic housing. The phototransistor reponds to radiation from the emitting diode only when a reflective object passes within its field of view. The area of optimum response approximates a circle .200″ in diameter.

FEATURES

- Phototransistor output
- High Sensitivity
- Low cost plastic housing
- #26 AWG, 24 inch PVC wire termination

REFLECTIVE OBJECT SENSOR

ABSOLUTE MAXIMUM RATINGS (T_A = 25°C Unless Otherwise Specified)

Storage Temperature	−40°C to +85°C
Operating Temperature	−40°C to +85°C
Soldering:	
Lead Temperature (Iron)	240°C for 5 sec.(2,3,4)
Lead Temperature (Flow)	260°C for 10 sec.(2,3)
INPUT DIODE	
Continuous Forward Current	50 mA
Reverse Voltage	5.0 Volts
Power Dissipation	100 mW(1)
OUTPUT TRANSISTOR	
Collector-Emitter Voltage	30 V
Emitter-Collector Voltage	5 V
Collector Current	40 mA
Power Dissipation	100 mW(1)

ELECTRICAL CHARACTERISTICS (T_A = 25°C)

PARAMETER	SYMBOL	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS
INPUT DIODE						
Forward Voltage	V_F	—		1.70	V	I_F = 40 mA
Reverse Leakage Current	I_R	—		100	μA	V_R = 2.0 V
OUTPUT TRANSISTOR						
Emitter-Collector Breakdown	BV_{CEO}	5		—	V	I_E = 100 μA
Collector-Emitter Breakdown	BV_{CEO}	30		—	V	I_C = 1.0 mA
Collector-Emitter Leakage	I_{CEO}	—		100	nA	V_{CE} = 10.0 V
COUPLED						
On-State Collector Current	$I_{C(ON)}$	0.20		—	mA	I_F = 40 mA, V_{CE} = 5 V, D = .150″(5,7)
Crosstalk	I_{CX}	—		1.00	μA	I_F = 40 mA, V_{CE} = 5 V(6)
Saturation Voltage	$V_{CE(SAT)}$	—		0.40	V	I_F = 40 mA, I_C = 0.1 mA, D = .150″

NOTES

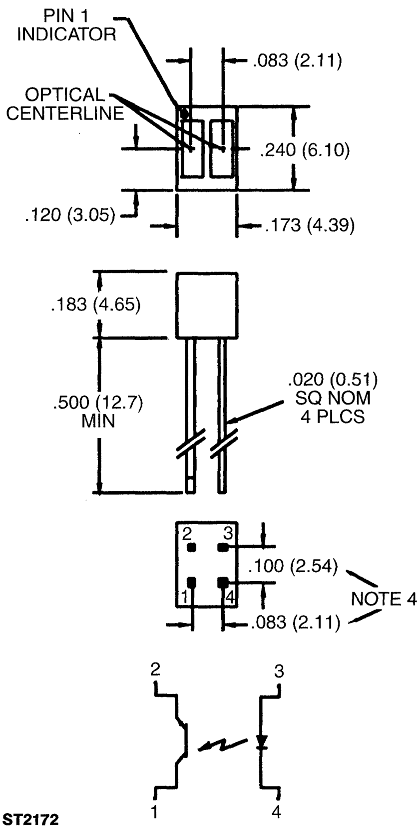
1. *Derate power dissipation linearly 1.67 mW/°C above 25°C.*
2. *RMA flux is recommended.*
3. *Methanol or Isopropyl alcohols are recommended as cleaning agents.*
4. *Soldering iron tip 1/16″ (1.6 mm) from housing.*
5. *D is the distance from the assembly face to the reflective surface.*
6. *Cross talk is the photocurrent measured with current to the input diode and no reflecting surface.*
7. *Measured using Eastman Kodak neutral test card with 90% diffused reflecting surface.*

OPTOELECTRONICS

REFLECTIVE OBJECT SENSOR

QRD1113/1114

PACKAGE DIMENSIONS



ST2172

NOTES:
1. PINS 2 AND 4 TYPICALLY .050″ SHORTER THAN PINS 1 AND 3
2. DIMENSIONS ARE IN INCHES (mm).
3. TOLERANCE IS ±.010″ [.25] UNLESS OTHERWISE SPECIFIED.
4. THESE DIMENSIONS ARE CONTROLLED AT HOUSING SURFACE.

DESCRIPTION

The QRD1113/1114 reflective sensors consist of an infrared emitting diode and an NPN silicon phototransistor mounted side by side in a black plastic housing. The on-axis radiation of the emitter and the on-axis response of the detector are both perpendicular to the face of the QRD1113/1114. The phototransistor responds to radiation emitted from the diode only when a reflective object or surface is in the field of view of the detector.

FEATURES

- Phototransistor output.
- Unfocused for sensing diffused surfaces.
- Low cost plastic housing.
- Designed for paper path and other non-contact surface sensing.

REFLECTIVE OBJECT SENSOR

ABSOLUTE MAXIMUM RATINGS (T_A = 25°C Unless Otherwise Specified)

Storage Temperature	−40°C to + 100°C
Operating Temperature	−40°C to + 100°C
Soldering:	
Lead Temperature (Iron)	240°C for 5 sec. (2,3,4)
Lead Temperature (Flow)	260°C for 10 sec. (2,4)
INPUT DIODE	
Continuous Forward Current	50 mA
Reverse Voltage	5.0 Volts
Power Dissipation	100 mW(1)
OUTPUT TRANSISTOR	
Collector-Emitter Voltage	30 Volts
Emitter-Collector Voltage	5.0 Volts
Power Dissipation	100 mW(1)

ELECTRICAL CHARACTERISTICS (T_A = 25°C Unless Otherwise Specified)
(All measurements made under pulse conditions.)

PARAMETER	SYMBOL	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS
INPUT DIODE						
Forward Voltage	V_F	—		1.70	V	I_F = 20 mA
Reverse Leakage Current	I_R	—		100	μA	V_R = 5.0 V
OUTPUT TRANSISTOR						
Collector-Emitter Breakdown	BV_{CEO}	30		—	V	I_C = 1.0 mA, Ee = 0
Collector-Emitter Leakage	I_{CEO}	—		100	nA	V_{CE} = 10.0 V, Ee = 0
COUPLED						
On-State Collector Current						
QRD1113	$I_{C(ON)}$	0.30		—	mA	I_F = 20 mA, V_{CC} = 5.0V, D = .050″ (5,7)
QRD1114	$I_{C(ON)}$	1.0		5.0	mA	I_F = 20 mA, V_{CC} = 5.0V, D = .050″ (5,7)
Crosstalk	I_{CX}	—	200	—	nA	I_F = 20 mA, V_{CC} = 5.0V, Ee = 0(6)
Saturation Voltage	$V_{CE(SAT)}$	—		0.40	V	I_F = 40 mA, I_C = 100μA, D = .050″(5,7)

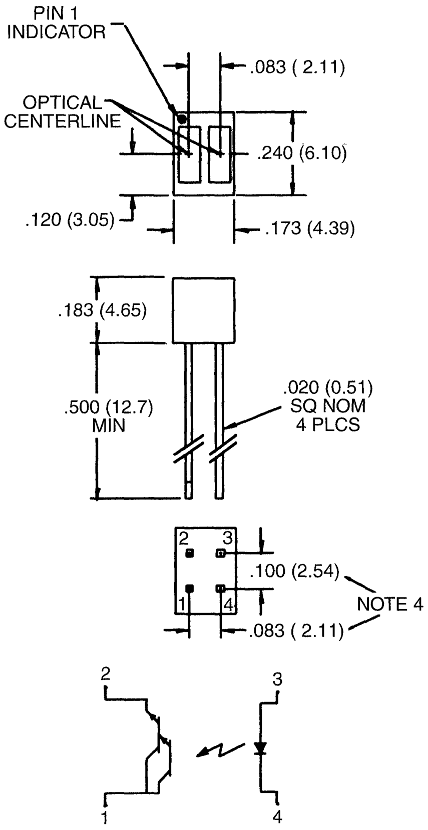
NOTES

1. *Derate power dissipation linearly 1.33 mW/°C above 25°C.*
2. *RMA flux is recommended.*
3. *Soldering iron 1/16″ (1.6mm) from housing.*
4. *As long as leads are not under any stress or spring tension.*
5. *D is the distance from the sensor face to the reflective surface.*
6. *Crosstalk(I_{CX}) is the collector current measured with the indicated current on the input diode and with no reflective surface.*
7. *Measured using Eastman Kodak neutral white test card with 90% diffused reflecting as a reflecting surface.*

REFLECTIVE OBJECT SENSOR

QRD1313

PACKAGE DIMENSIONS



ST2173

NOTES:

1. PINS 2 AND 4 TYPICALLY .050" SHORTER THAN PINS 1 AND 3
2. DIMENSIONS ARE IN INCHES (mm).
3. TOLERANCE IS +.010" [.25] UNLESS OTHERWISE SPECIFIED.
4. THESE DIMENSIONS ARE CONTROLLED AT HOUSING SURFACE.

DESCRIPTION

The QRD1313 reflective sensors consists of an infrared emitting diode and an NPN silicon photodarlington mounted side by side in a black plastic housing. The on-axis radiation of the emitter and the on-axis response of the detector are both perpendicular to the face of the QRD1313. The photodarlington responds to radiation emitted from the diode only when a reflective object or surface is in the field of view of the detector.

FEATURES

- Photodarlington output.
- Unfocused for sensing diffused surfaces.
- Low cost plastic housing.
- Designed for paper path and other non-contact surface sensing.

REFLECTIVE OBJECT SENSOR

ABSOLUTE MAXIMUM RATINGS (T_A = 25°C Unless Otherwise Specified)

Storage Temperature .... −40°C to + 100°C
Operating Temperature .... −40°C to + 100°C
Soldering:
Lead Temperature (Iron) .... 240°C for 5 sec. (2,3,4)
Lead Temperature (Flow) .... 260°C for 10 sec. (2,4)

INPUT DIODE
Continuous Forward Current .... 50 mA
Reverse Voltage .... 5.0 Volts
Power Dissipation .... 100 mW(1)

OUTPUT DARLINGTON
Collector-Emitter Voltage .... 15 Volts
Emitter-Collector Voltage .... 5.0 Volts
Power Dissipation .... 100 mW(1)

ELECTRICAL CHARACTERISTICS (T_A = 25°C Unless Otherwise Specified)

(All measurements made under pulse conditions.)

PARAMETER	SYMBOL	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS
INPUT DIODE						
Forward Voltage	V_F	—		1.70	V	$I_F = 20$ mA
Reverse Leakage Current	I_R	—		100	μA	$V_R = 2.0$ V
OUTPUT DARLINGTON						
Collector-Emitter Breakdown	BV_{CEO}	15.0		—	V	$I_C = 100$ μA, Ee = 0
Emitter-Collector Breakdown	BV_{CEO}	5.0		—	V	$I_E = 100$ μA, Ee = 0
Collector-Emitter Leakage	I_{CEO}	—		250	nA	$V_{CE} = 5.0$ V, Ee = 0
COUPLED						
On-State Collector Current	$I_{C(ON)}$	10.0		—	mA	$I_F = 20$ mA, $V_{CC} = 5.0$V, D = .050″ (5,7)
Crosstalk	I_{CX}	—		10	μA	$I_F = 20$ mA, $V_{CC} = 5.0$V, Ee = 0(6)
Saturation Voltage	$V_{CE(SAT)}$	—		1.10	V	$I_F = 20$ mA, $I_C = 2$mA, D = .050″(5,7)

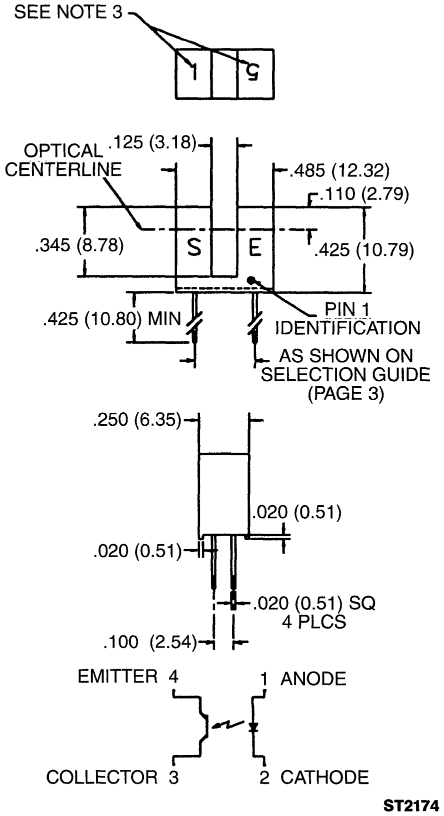
NOTES

1. *Derate power dissipation linearly 1.33 mW/°C above 25°C.*
2. *RMA flux is recommended.*
3. *Soldering iron 1/16″ (1.6mm) minimum from housing.*
4. *As long as leads are not under any stress or spring tension.*
5. *D is the distance from the sensor face to the reflective surface.*
6. *Crosstalk(I_{CX}) is the collector current measured with the indicated current on the input diode and with no reflective surface.*
7. *Measured using Eastman Kodak neutral white test card with 90% diffused reflecting as a reflecting surface.*

SLOTTED OPTICAL SWITCH

QVA SERIES

PACKAGE DIMENSIONS



NOTES:
1. DIMENSIONS ARE IN INCHES (mm).
2. TOLERANCE IS ±.010 (.25) UNLESS OTHERWISE SPECIFIED.
3. NUMBER INDICATES APERTURE SIZE. (5 = .050″, 1 = .010″)

DESCRIPTION

The QVA series of switches is designed to allow the user maximum flexibility in applications. Each switch consists of an infrared emitting diode facing an NPN phototransistor across a .125″ (3.18 mm) gap. A unique housing design provides a smooth external surface to prevent dust and dirt buildup while molded internal apertures give precise positioning and also provide protection from ambient light interference.

FEATURES

- Ambient light and dust protection.
- Lead spacing available at .220″, .300″, or .320″.
- .010″ and .050″ apertures.

SLOTTED OPTICAL SWITCH

ABSOLUTE MAXIMUM RATINGS (T_A = 25°C Unless Otherwise Specified)

Storage Temperature	−40°C to + 85°C
Operating Temperature	−40°C to + 85°C
Soldering:	
Lead Temperature (Iron)	240°C for 5 sec. (2,3,4)
Lead Temperature (Flow)	260°C for 10 sec. (2,3)
INPUT DIODE	
Continuous Forward Current	50 mA
Reverse Voltage	5.0 Volts
Power Dissipation	100 mW(1)
OUTPUT TRANSISTOR	
Collector-Emitter Voltage	30.0 Volts
Emitter-Collector Voltage	5.0 Volts
Power Dissipation	100 mW(1)

ELECTRICAL CHARACTERISTICS (T_A = 25°C Unless Otherwise Specified)

PARAMETER	SYMBOL	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS
INPUT DIODE						
Forward Voltage	V_F	—		1.70	V	I_F = 20 mA
Reverse Leakage Current	I_R	—		100	μA	V_R = 2.0 V
OUTPUT TRANSISTOR						
Emitter-Collector Breakdown	BV_{ECO}	5		—	V	I_E = 100 μA, Ee = 0
Collector-Emitter Breakdown	BV_{CEO}	30		—	V	I_C = 1.0 mA, Ee = 0
Collector-Emitter Leakage	I_{CEO}	—		100	nA	V_{CE} = 10.0 V, Ee = 0
COUPLED						
On-State Collector Current	$I_{C(ON)}$	See selection guide page 3.			mA	I_F = 20 mA, V_{CE} = 5 V
Saturation Voltage	$V_{CE(SAT)}$	—		0.40	V	I_F= 20 mA, I_C = 0.25 mA

NOTES

1. *Derate power dissipation linearly 1.67 mW/°C above 25°C.*
2. *RMA flux is recommended.*
3. *Methanol or Isopropyl alcohols are recommended as cleaning agents.*
4. *Soldering iron tip 1⁄16″ (1.6 mm) from housing.*

SLOTTED OPTICAL SWITCH

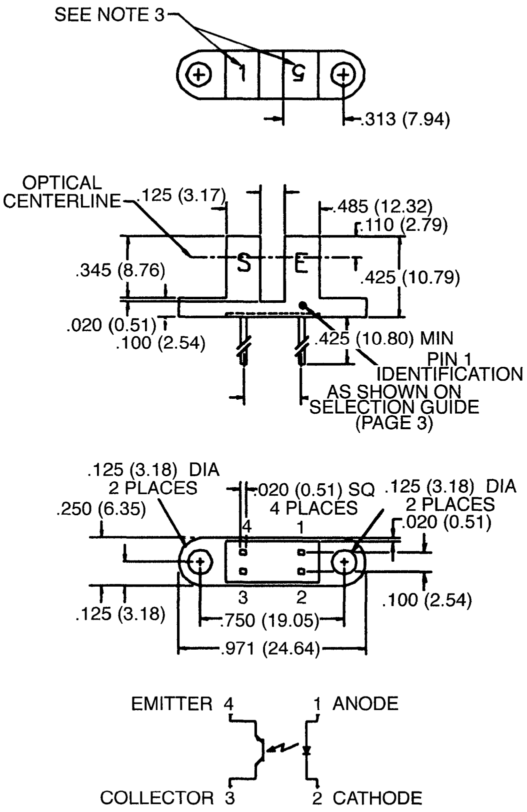
QVAXXXXX OPTICAL SWITCH SELECTION GUIDE

PART NUMBER	LEAD SPACING	APERTURES LED	APERTURES SENSOR	$I_{C(ON)}$ MIN	$I_{C(ON)}$ MAX
QVA11123	.220″	0.050″	0.010″	0.20	—
QVA11124	.220″	0.050″	0.010″	0.50	—
QVA11223	.300″	0.050″	0.010″	0.20	—
QVA11224	.300″	0.050″	0.010″	0.50	—
QVA11323	.320″	0.050″	0.010″	0.20	—
QVA11324	.320″	0.050″	0.010″	0.50	—
QVA11133	.220″	0.050″	0.050″	0.50	—
QVA11134	.220″	0.050″	0.050″	1.00	—
QVA11233	.300″	0.050″	0.050″	0.50	—
QVA11234	.300″	0.050″	0.050″	1.00	—
QVA11333	.320″	0.050″	0.050″	0.50	—
QVA11334	.320″	0.050″	0.050″	1.00	—
QVA21113	.220″	0.010″	0.010″	0.10	—
QVA21114	.220″	0.010″	0.010″	0.20	—
QVA21213	.300″	0.010″	0.010″	0.10	—
QVA21214	.300″	0.010″	0.010″	0.20	—
QVA21313	.320″	0.010″	0.010″	0.10	—
QVA21314	.320″	0.010″	0.010″	0.20	—

SLOTTED OPTICAL SWITCH

QVB SERIES

PACKAGE DIMENSIONS



ST2175

NOTES:
1. DIMENSIONS ARE IN INCHES (mm).
2. TOLERANCE IS ±.010 (.25)
   UNLESS OTHERWISE SPECIFIED.
3. NUMBER INDICATES APERTURE SIZE.
   (5 = .050″, 1 = .010″)

DESCRIPTION

The QVB series of switches is designed to allow the user maximum flexibility in applications. Each switch consists of an infrared emitting diode facing an NPN phototransistor across a .125″ (3.18 mm) gap. A unique housing design provides a smooth external surface to prevent dust and dirt buildup while molded internal apertures give precise positioning and also provide protection from ambient light interference.

FEATURES

- Ambient light and dust protection.
- Lead spacing available at .220″, .300″, or .320″.
- .050″ and .010″ aperatures available.

SLOTTED OPTICAL SWITCH

ABSOLUTE MAXIMUM RATINGS (T_A = 25°C Unless Otherwise Specified)

Storage Temperature	−40°C to + 85°C
Operating Temperature	−40°C to + 85°C
Soldering:	
Lead Temperature (Iron)	240°C for 5 sec. (2,3,4)
Lead Temperature (Flow)	260°C for 10 sec. (2,3)
INPUT DIODE	
Continuous Forward Current	50 mA
Reverse Voltage	5.0 Volts
Power Dissipation	100 mW(1)
OUTPUT TRANSISTOR	
Collector-Emitter Voltage	30 Volts
Emitter-Collector Voltage	5.0 Volts
Collector Current	40 mA
Power Dissipation	100 mW(1)

ELECTRICAL CHARACTERISTICS (T_A = 25°C Unless Otherwise Specified)

PARAMETER	SYMBOL	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS
INPUT DIODE						
Forward voltage	V_F	—		1.70	V	$I_F = 20$ mA
Reverse Leakage Current	I_R	—		100	μA	$V_R = 2.0$ V
OUTPUT TRANSISTOR						
Emitter-Collector Breakdown	BV_{ECO}	5		—	V	$I_E = 100\ \mu$A, Ee = 0
Collector-Emitter Breakdown	BV_{CEO}	30		—	V	$I_C = 1.0$ mA, Ee = 0
Collector-Emitter Leakage	I_{CEO}	—		100	nA	$V_{CE} = 10.0$ V, Ee = 0
COUPLED						
On-State Collector Current	$I_{C(ON)}$	See selection guide page 3.			mA	$I_F = 20$ mA, $V_{CE} = 5$ V
Saturation Voltage	$V_{CE(SAT)}$	—		0.40	V	$I_F = 20$ mA, $I_C = 0.1$ mA

NOTES

1. *Derate power dissipation linearly 1.67 mW/°C above 25°C.*
2. *RMA flux is recommended.*
3. *Methanol or Isopropanol alcohols are recommended as cleaning agents.*
4. *Soldering iron tip 1⁄16″ (1.6 mm) from housing.*

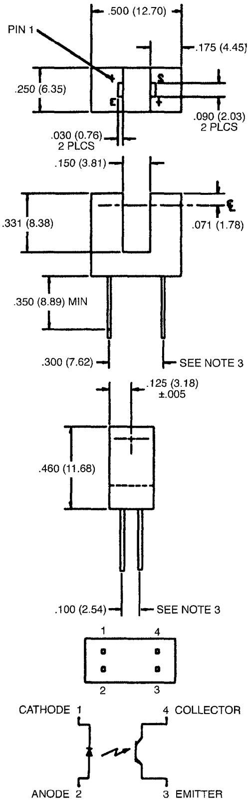
QVBXXXX OPTICAL SWITCH SELECTION GUIDE

		APERTURES		$I_{C(ON)}$	
PART NUMBER	**LEAD SPACING**	**LED**	**SENSOR**	**MIN**	**MAX**
QVB11123	.220″	0.050″	0.010″	0.20	—
QVB11124	.220″	0.050″	0.010″	0.50	—
QVB11223	.300″	0.050″	0.010″	0.20	—
QVB11224	.300″	0.050″	0.010″	0.50	—
QVB11323	.320″	0.050″	0.010″	0.20	—
QVB11324	.320″	0.050″	0.010″	0.50	—
QVB11133	.220″	0.050″	0.050″	0.50	—
QVB11134	.220″	0.050″	0.050″	1.00	—
QVB11233	.300″	0.050″	0.050″	0.50	—
QVB11234	.300″	0.050″	0.050″	1.00	—
QVB11333	.320″	0.050″	0.050″	0.50	—
QVB11334	.320″	0.050″	0.050″	1.00	—
QVB21113	.220″	0.010″	0.010″	0.10	—
QVB21114	.220″	0.010″	0.010″	0.20	—
QVB21213	.300″	0.010″	0.010″	0.10	—
QVB21214	.300″	0.010″	0.010″	0.20	—
QVB21313	.320″	0.010″	0.010″	0.10	—
QVB21314	.320″	0.010″	0.010″	0.20	—

SLOTTED OPTICAL SWITCH

QVE11233

PACKAGE DIMENSIONS



ST2176

NOTES:
1. DIMENSIONS ARE IN INCHES (mm).
2. TOLERANCE IS ±.010 (.25) UNLESS OTHERWISE SPECIFIED.
3. THIS DIMENSION IS CONTROLLED AT THE HOUSING SURFACE.

DESCRIPTION

The QVE11233 is designed to allow the user maximum flexibility in applications. Each switch consists of an infrared emitting diode facing an NPN phototransistor across a .150″ (3.81 mm) gap.

FEATURES

- Lead spacing .300″.
- Gap width of .150″.
- Printed circuit board mounting.
- 2 mm aperture width.

SLOTTED OPTICAL SWITCH

ABSOLUTE MAXIMUM RATINGS (T_A = 25°C Unless Otherwise Specified)

Storage Temperature	−40°C to + 85°C
Operating Temperature	−40°C to + 85°C
Soldering:	
Lead Temperature (Iron)	240°C for 5 sec. (2,3,4)
Lead Temperature (Flow)	260°C for 10 sec. (2,3)
INPUT DIODE	
Continuous Forward Current	50 mA
Reverse Voltage	5.0 Volts
Power Dissipation	100 mW(1)
OUTPUT TRANSISTOR	
Collector-Emitter Voltage	30.0 Volts
Emitter-Collector Voltage	5.0 Volts
Power Dissipation	100 mW(1)

ELECTRICAL CHARACTERISTICS (T_A = 25°C Unless Otherwise Specified)

PARAMETER	SYMBOL	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS
INPUT DIODE						
Forward voltage	V_F	—		1.70	V	I_F = 20 mA
Reverse Leakage Current	I_R	—		100	μA	V_R = 2.0 V
OUTPUT TRANSISTOR						
Emitter-Collector Breakdown	BV_{ECO}	5		—	V	I_E = 100 μA, Ee = 0
Collector-Emitter Breakdown	BV_{CEO}	30		—	V	I_C = 1.0 mA, Ee = 0
Collector-Emitter Leakage	I_{CEO}	—		100	nA	V_{CE} = 10.0 V, Ee = 0
COUPLED						
On-State Collector Current	$I_{C(ON)}$	0.50		—	mA	I_F = 20 mA, V_{CE} = 5 V
Saturation Voltage	$V_{CE(SAT)}$	—		0.40	V	I_F= 20 mA, I_C = 0.25 mA

NOTES

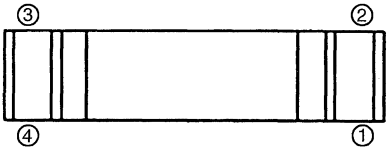
1. *Derate power dissipation linearly 1.67 mW/°C above 25°C.*
2. *RMA flux is recommended.*
3. *Methanol or Isopropyl alcohols are recommended as cleaning agents.*
4. *Soldering iron tip 1⁄16″ (1.6 mm) from housing.*

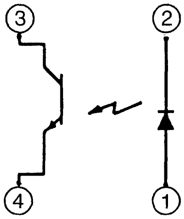
OPTOELECTRONICS

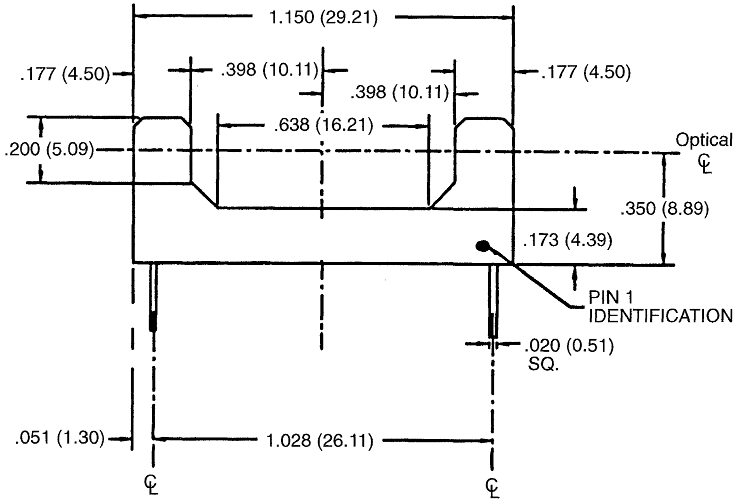
SLOTTED OPTICAL SWITCH

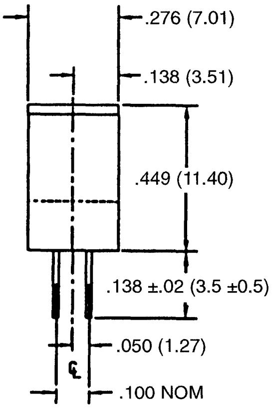
QVL21653

PACKAGE DIMENSIONS









NOTES:
1. DIMENSIONS ARE IN INCHES (mm).
2. TOLERANCE IS ±.010
UNLESS OTHERWISE SPECIFIED.

ST1667

DESCRIPTION

The QVL21653 consists of an infrared light emitting diode coupled to an NPN silicon phototransistor packaged into an injection molded housing. The housing is designed for wide gap, non contact sensing.

FEATURE

- 20mm wide gap
- PC Board mount
- .060″ apertures
- Sensor filter to attenuate visible light

SLOTTED OPTICAL SWITCH

ABSOLUTE MAXIMUM RATINGS (T_A = 25°C Unless Otherwise Specified)

Storage Temperature	−40°C to +85°C
Operating Temperature	−40°C to +85°C
Soldering:	
Lead Temperature (Iron)	240°C for 5 sec.(2,3,4)
Lead Temperature (Flow)	260°C for 10 sec.(2,3)
INPUT DIODE	
Continuous Forward Current	50 mA
Reverse Voltage	5 Volts
Power Dissipation	100 mW(1)
OUTPUT TRANSISTOR	
Collector-Emitter Voltage	30 V
Emitter-Collector Voltage	5 V
Power Dissipation	100 mW(1)

ELECTRICAL CHARACTERISTICS (T_A = 25°C)

PARAMETER	SYMBOL	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS
INPUT DIODE						
Forward Voltage	V_F	—		1.70	V	I_F = 20 mA
Reverse Leakage Current	I_R	—		100	μA	V_R = 5 V
OUTPUT TRANSISTOR						
Breakdown Voltage Collector-Emitter	BV_{CEO}	30		—	V	I_C = 1 mA
Breakdown Voltage Emitter-Collector	BV_{ECO}	5		—	V	I_E = 100 μA
Collector-Emitter Leakage	I_{CEO}	—		100	nA	V_{CE} = 10 V
COUPLED						
On-State Collector Current	$I_{C(ON)}$	100		—	μA	I_F = 20 mA, V_{CC} = 5 V
Voltage Saturation	$V_{CE(SAT)}$	—		0.5	V	I_F = 20 mA, I_C = 50 μA

NOTES

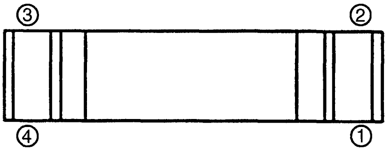
1. *Derate power dissipation linearly, on each component, 1.67 mW/°C above 25°C.*
2. *RMA flux is recommended.*
3. *Methanol or Isopropanol alcohols are recommended as cleaning agents.*
4. *Soldering iron tip 1/16″ (1.6 mm) from housing.*

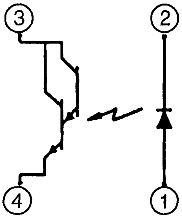
OPTOELECTRONICS

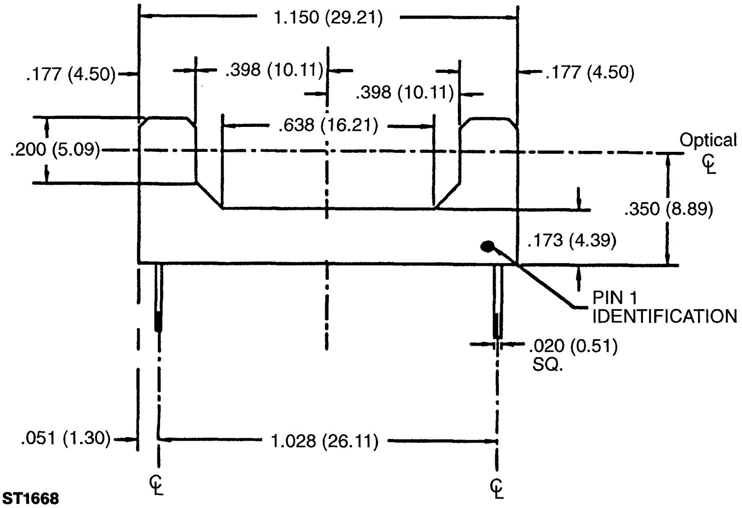
SLOTTED OPTICAL SWITCH

QVL25335

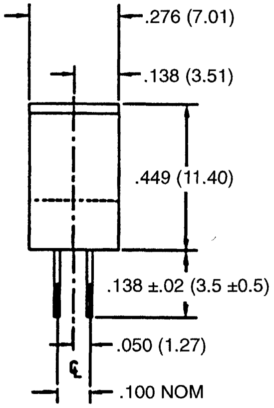
PACKAGE DIMENSIONS







ST1668



NOTES:
1. DIMENSIONS ARE IN INCHES [mm].
2. TOLERANCE IS ±.010
   UNLESS OTHERWISE SPECIFIED.

DESCRIPTION

The QVL25335 consists of an infrared light emitting diode coupled to an NPN silicon photodarlington packaged into an injection molded housing.

FEATURE

- 20 mm wide gap
- PC Board mount
- .060″ apertures
- Sensor filter to attenuate visible light
- High CTR

QT
OPTOELECTRONICS

SLOTTED OPTICAL SWITCH

ABSOLUTE MAXIMUM RATINGS (T_A = 25°C Unless Otherwise Specified)

Storage Temperature	−40°C to +85°C
Operating Temperature	−40°C to +85°C
Soldering:	
Lead Temperature (Iron)	240°C for 5 sec.(2,3,4)
Lead Temperature (Flow)	260°C for 10 sec.(2,3)
INPUT DIODE	
Continuous Forward Current	50 mA
Reverse Voltage	5 Volts
Power Dissipation	100 mW(1)
OUTPUT DARLINGTON	
Collector-Emitter Voltage	30 V
Emitter-Collector Voltage	5 V
Power Dissipation	100 mW(1)

ELECTRICAL CHARACTERISTICS (T_A = 25°C)

PARAMETER	SYMBOL	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS
INPUT DIODE						
Forward Voltage	V_F	—		1.70	V	I_F = 20 mA
Reverse Leakage Current	I_R	—		100	μA	V_R = 5 V
OUTPUT DARLINGTON						
Breakdown Voltage Collector-Emitter	BV_{CEO}	30		—	V	I_C = 1 mA
Breakdown Voltage Emitter-Collector	BV_{ECO}	5		—	V	I_E = 100 μA
Collector-Emitter Leakage	I_{CEO}	—		100	nA	V_{CE} = 10 V
COUPLED						
On-State Collector Current	$I_{C(ON)}$	5.0		—	mA	I_F = 10 mA, V_{CC} = 5 V
Voltage Saturation	$V_{CE(SAT)}$	—		1.0	V	I_F = 10 mA, I_C = 2 mA

NOTES

1. *Derate power dissipation linearly, on each component, 1.67 mW/°C above 25°C.*
2. *RMA flux is recommended.*
3. *Methanol or Isopropanol alcohols are recommended as cleaning agents.*
4. *Soldering iron tip 1/16″ (1.6 mm) from housing.*

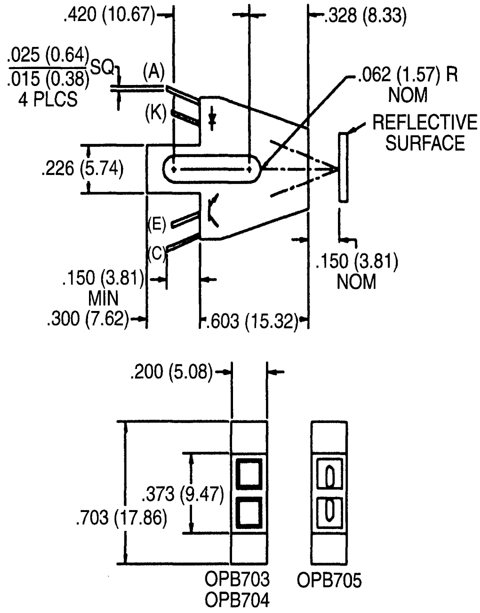
QVL25335

QT OPTOELECTRONICS

REFLECTIVE OBJECT SENSORS

OPB703/OPB704/OPB705

PACKAGE DIMENSIONS



(C) COLLECTOR
(E) EMITTER
(K) CATHODE
(A) ANODE

ST2154

NOTES:
1. CATHODE AND EMITTER LEADS ARE .050" NOM SHORTER THAN ANODE AND COLLECTOR LEADS.
2. DIMENSIONS ARE IN INCHES (mm).
3. TOLERANCE IS ±.010 (.25) UNLESS OTHERWISE SPECIFIED.

OPB703 - IR TRANSPARENT DUST COVER
OPB704 - IR TRANSPARENT DUST COVER
OPB705 - OFFSET LENS

DESCRIPTION

The OPB703, OPB704, and OPB705 consist of an infrared emitting diode and an NPN silicon phototransistor mounted side by side on a converging optical axis in a black plastic housing. The phototransistor responds to radiation from the emitting diode only when a reflective object passes within its field of view. The area of the optimum response approximates a circle .200" in diameter.

FEATURES

- Phototransistor output.
- High Sensitivity.
- Low cost plastic housing.
- OPB703/OPB704, dust cover; lens.
- OPB705, offset lens.

SLOTTED OPTICAL SWITCH

ABSOLUTE MAXIMUM RATINGS (T_A = 25°C Unless Otherwise Specified)

Storage Temperature	−40°C to + 85°C
Operating Temperature	−40°C to + 85°C
Soldering:	
Lead Temperature (Iron)	240°C for 5 sec. (2,3,4)
Lead Temperature (Flow)	260°C for 10 sec. (2,3)
INPUT DIODE	
Continuous Forward Current	50 mA
Reverse Voltage	5.0 Volts
Power Dissipation	100 mW(1)
OUTPUT TRANSISTOR	
Collector-Emitter Voltage	30 Volts
Emitter-Collector Voltage	5.0 Volts
Collector Current	25 mA
Power Dissipation	100 mW(1)

ELECTRICAL CHARACTERISTICS (T_A = 25°C Unless Otherwise Specified)

PARAMETER	SYMBOL	MIN.	MAX.	UNITS	TEST CONDITIONS
INPUT DIODE					
Forward Voltage	V_F	—	1.70	V	I_F = 40 mA
Reverse Leakage Current	I_R	—	100	μA	V_R = 2.0 V
OUTPUT TRANSISTOR					
Emitter-Collector Breakdown	BV_{ECO}	5	—	V	I_E = 100 μA, Ee = 0
Collector-Emitter Breakdown	BV_{CEO}	30	—	V	I_C = 100 μA, Ee = 0
Collector-Emitter Leakage	I_{CEO}	—	100	nA	V_{CE} = 10.0 V, Ee = 0
COUPLED					
On-State Collector Current					
OPB703	$I_{C(ON)}$	200		μA	I_F = 40 mA, V_{CE} = 5 V, D = .150″ (5,6)
OPB704	$I_{C(ON)}$	200		μA	I_F = 40 mA, V_{CE} = 5 V, D = .150″ (5,6)
OPB705	$I_{C(ON)}$	100		μA	I_F = 40 mA, V_{CE} = 5 V, D = .150″ (5,6)
Crosstalk	I_{CX}	—	20	μA	I_F = 40 mA, V_{CE} = 5V(7)

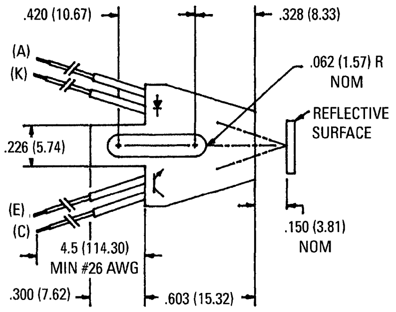
NOTES

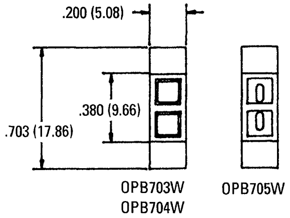
1. *Derate power dissipation linearly 1.67 mW/°C above 25°C.*
2. *RMA flux is recommended.*
3. *Methanol or Isopropyl alcohols are recommended as cleaning agents.*
4. *Soldering iron tip 1/16″ (1.6 mm) from housing.*
5. *D is the distance from the assembly face to the reflective surface.*
6. *Measured using Eastman Kodak neutral test card with 90% diffused reflecting surface.*
7. *Cross talk is the photocurrent measured with current to the input diode and no reflective surface.*

REFLECTIVE OBJECT SENSORS

OPB703W/OPB704W/OPB705W

PACKAGE DIMENSIONS





FUNCTION	WIRE COLOR
(C) COLLECTOR	WHITE
(E) EMITTER	BLUE
(K) CATHODE	GREEN
(A) ANODE	ORANGE

NOTES
1. DIMENSIONS ARE IN INCHES (mm).
2. TOLERANCE IS ±.010 (.25)

OPB703W - IR TRANSPARENT DUST COVER
OPB704W - IR TRANSPARENT DUST COVER
OPB705W - OFFSET LENS

ST4018

DESCRIPTION

The OPB703W, OPB704W, and OPB705W consist of an infrared emitting diode and an NPN silicon phototransistor mounted side by side on a converging optical axis in a black plastic housing. The phototransistor responds to radiation from the emitting diode only when a reflective object passes within its field of view. The area of the optimum response approximates a circle .200″ in diameter. Leads are 26 AWG, PVC insulation, 4.5″ (114.3 mm) minimum length, stripped and tinned.

FEATURES

- Phototransistor output.
- High Sensitivity.
- Low cost plastic housing.
- Pre wired with 4.5 inch, 26 gauge leads.
- OPB703W/OPB704W, dust cover; lens.
- OBP705W, offset lens.

QT
OPTOELECTRONICS

REFLECTIVE OBJECT SENSORS

ABSOLUTE MAXIMUM RATINGS (T_A = 25°C Unless Otherwise Specified)

Storage Temperature	−40°C to + 85°C
Operating Temperature	−40°C to + 85°C
Soldering:	
Lead Temperature (Iron)	240°C for 5 sec. (2,3,4)
Lead Temperature (Flow)	260°C for 10 sec. (2,3)
INPUT DIODE	
Continuous Forward Current	50 mA
Reverse Voltage	5.0 Volts
Power Dissipation	100 mW(1)
OUTPUT TRANSISTOR	
Collector-Emitter Voltage	30 Volts
Emitter-Collector Voltage	5.0 Volts
Collector Current	25 mA
Power Dissipation	100 mW(1)

ELECTRICAL CHARACTERISTICS (T_A = 25°C Unless Otherwise Specified)

PARAMETER	SYMBOL	MIN.	MAX.	UNITS	TEST CONDITIONS
INPUT DIODE					
Forward Voltage	V_F	—	1.70	V	I_F = 40 mA
Reverse Leakage Current	I_R	—	100	μA	V_R = 2.0 V
OUTPUT TRANSISTOR					
Emitter-Collector Breakdown	BV_{ECO}	5	—	V	I_E = 100 μA, Ee = 0
Collector-Emitter Breakdown	BV_{CEO}	30	—	V	I_C = 100 μA, Ee = 0
Collector-Emitter Leakage	I_{CEO}	—	100	nA	V_{CE} = 10.0 V, Ee = 0
COUPLED					
On-State Collector Current					
OPB703W	$I_{C(ON)}$	200	—	μA	I_F = 40 mA, V_{CE} = 5 V, D = .150" (5,6)
OPB704W	$I_{C(ON)}$	200	—	μA	I_F = 40 mA, V_{CE} = 5 V, D = .150" (5,6)
OPB705W	$I_{C(ON)}$	100	—	μA	I_F = 40 mA, V_{CE} = 5 V, D = .150" (5,6)
Crosstalk	I_{CX}	—	20	μA	I_F = 40 mA, V_{CE} = 5 V(7)

NOTES

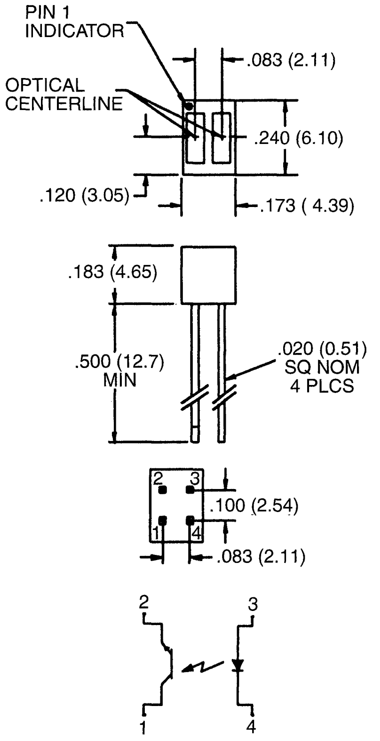
1. *Derate power dissipation linearly 1.67 mW/°C above 25°C.*
2. *RMA flux is recommended.*
3. *Methanol or Isopropyl alcohols are recommended as cleaning agents.*
4. *Soldering iron tip $\frac{1}{16}$" (1.6 mm) from housing.*
5. *D is the distance from the assembly face to the reflective surface.*
6. *Measured using Eastman Kodak neutral test card with 90% diffused reflecting surface.*
7. *Cross talk is the photocurrent measured with current to the input diode and no reflective surface.*

OPB703W/OPB704W/OPB705W

REFLECTIVE OBJECT SENSOR

OPB706A/B/C

PACKAGE DIMENSIONS



ST2156

NOTES:
1. PINS 2 AND 4 ARE TYPICALLY .050″ SHORTER THAN PINS 1 AND 3.
2. DIMENSIONS ARE IN INCHES (mm).
3. TOLERANCE IS ±.010 (.25) UNLESS OTHERWISE SPECIFIED.

DESCRIPTION

The OPB706A/B/C reflective sensors consist of an infrared emitting diode and an NPN silicon phototransistor mounted side by side in a black plastic housing. The on-axis radiation of the emitter and the on-axis response of the detector are both perpendicular to the face of the OPB706A/B/C. The phototransistor responds to radiation emitted from the diode only when a reflective object or surface is in the field of view of the detector.

FEATURES

- Phototransistor output.
- Unfocused for sensing diffused surfaces.
- Low cost plastic housing.
- Designed for paper path and other non-contact surface sensing.

REFLECTIVE OBJECT SENSOR

ABSOLUTE MAXIMUM RATINGS (T_A = 25°C Unless Otherwise Specified)

Storage Temperature	−40°C to + 85°C
Operating Temperature	−40°C to + 85°C
Soldering:	
Lead Temperature (Iron)	240°C for 5 sec. (2,3,4)
Lead Temperature (Flow)	260°C for 10 sec. (2,3)
INPUT DIODE	
Continuous Forward Current	50 mA
Reverse Voltage	5.0 Volts
Power Dissipation	75 mW(1)
OUTPUT TRANSISTOR	
Collector-Emitter Voltage	30 Volts
Emitter-Collector Voltage	5.0 Volts
Power Dissipation	75 mW(1)

ELECTRICAL CHARACTERISTICS (T_A = 25°C Unless Otherwise Specified) (All measurements made under pulse conditions.)

PARAMETER	SYMBOL	MIN.	TYPE.	MAX.	UNITS	TEST CONDITIONS
INPUT DIODE						
Forward voltage	V_F	—		1.70	V	I_F = 20 mA
Reverse Leakage Current	I_R	—		100	μA	V_R = 5.0 V
OUTPUT TRANSISTOR						
Collector-Emitter Breakdown	BV_{ECO}	30		—	V	I_C = 100 μA, Ee = 0
Collector-Emitter Breakdown	BV_{CEO}	5		—	V	I_E = 100 μA, Ee = 0
Collector-Emitter Leakage	I_{CEO}	—		100	nA	V_{CE} = 10.0 V, Ee = 0
COUPLED						
On-State Collector Current						
OPB706A	$I_{C(ON)}$	500		—	μA	I_F = 20 mA, V_{CC} = 5.0 V, D = .050″ (5,7)
OPB706B	$I_{C(ON)}$	350		—	μA	I_F = 20 mA, V_{CC} = 5.0 V, D = .050″ (5,7)
OPB706C	$I_{C(ON)}$	200		—	μA	I_F = 20 mA, V_{CC} = 5.0 V, D = .050″ (5,7)
Crosstalk	I_{CX}	—	200	—	nA	I_F = 20 mA, V_{CC} = 5.0 V, Ee = 0(6)
Saturation Voltage	$V_{CE(SAT)}$	—		0.40	V	I_F = 40 mA, I_C = 100μA, D = .050″(5,7)

NOTES

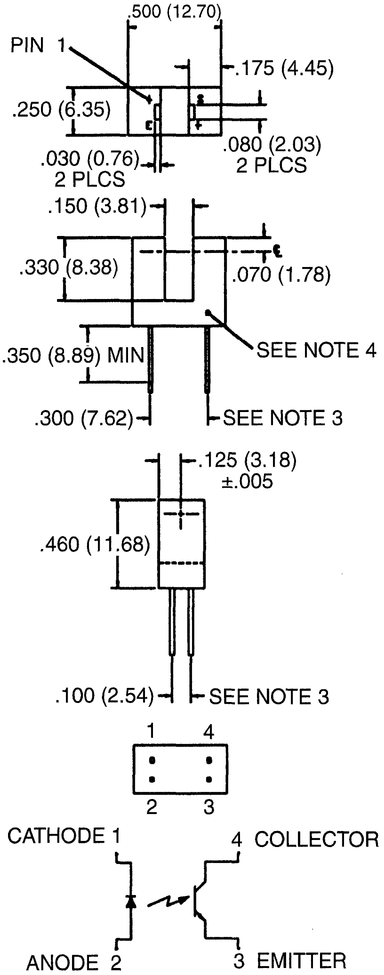
1. *Derate power dissipation linearly 1.25 mW/°C above 25°C.*
2. *RMA flux is recommended.*
3. *Soldering iron tip 1/16″ (1.6 mm) minimum from housing.*
4. *As long as leads are not under any stress or spring tension.*
5. *D is the distance from the sensor face to the reflective surface.*
6. *Crosstalk (I_{CX}) is the collector current measured with the indicated current on the input diode and with no reflective surface.*
7. *Measured using Eastman Kodak neutral white test card with 90% diffused reflectance as a reflecting surface.*

OPTOELECTRONICS

SLOTTED OPTICAL SWITCH

OPB804

PACKAGE DIMENSIONS



ST2157

NOTES:
1. DIMENSIONS ARE IN INCHES (mm.)
2. TOLERANCE IS ±.010 (0.25)
   UNLESS OTHERWISE SPECIFIED.
3. THIS DIMENSION IS CONTROLLED
   AT THE HOUSING SURFACE.
4. WHITE DOT ADJACENT TO
   COLLECTOR LEAD.

DESCRIPTION

The OPB804 is an optical slotted switch that consists of an infrared emitting diode facing and NPN phototransistor across a .150″ (3.81 mm) gap. Phototransistor switching takes place when an opaque object breaks the light path.

FEATURES

- .150″ wide gap.
- .300″ lead spacing.
- Printed circuit board mounting.
- Non contact switching.
- 2mm aperture width.

QT OPTOELECTRONICS

SLOTTED OPTICAL SENSOR

ABSOLUTE MAXIMUM RATINGS (T_A = 25°C Unless Otherwise Specified)

Storage Temperature	−40°C to + 85°C
Operating Temperature	−40°C to + 85°C
Soldering:	
Lead Temperature (Iron)	240°C for 5 sec. (2,3,4)
Lead Temperature (Flow)	260°C for 10 sec. (2,3)
INPUT DIODE	
Continuous Forward Current	50 mA
Reverse Voltage	5.0 Volts
Power Dissipation	100 mW(1)
OUTPUT TRANSISTOR	
Collector-Emitter Voltage	30.0 Volts
Emitter-Collector Voltage	5.0 Volts
Power Dissipation	100 mW(1)

ELECTRICAL CHARACTERISTICS (T_A = 25°C Unless Otherwise Specified)

PARAMETER	SYMBOL	MIN.	TYPE.	MAX.	UNITS	TEST CONDITIONS
INPUT DIODE						
Forward Voltage	V_F	—		1.70	V	I_F = 20 mA
Reverse Leakage Current	I_R	—		100	μA	V_R = 2.0 V
OUTPUT TRANSISTOR						
Emitter-Collector Breakdown	BV_{ECO}	5		—	V	I_E = 100 μA, Ee = 0
Collector-Emitter Breakdown	BV_{CEO}	30		—	V	I_C = 1.0 mA, Ee = 0
Collector-Emitter Leakage	I_{CEO}	—		100	nA	V_{CE} = 10.0 V, Ee = 0
COUPLED						
On-State Collector Current	$I_{C(ON)}$	500		—	μA	I_F = 20 mA, V_{CE} = 5 V
Saturation Voltage	$V_{CE(SAT)}$	—		0.40	V	I_F = 20 mA, I_C = 0.25 mA

NOTES

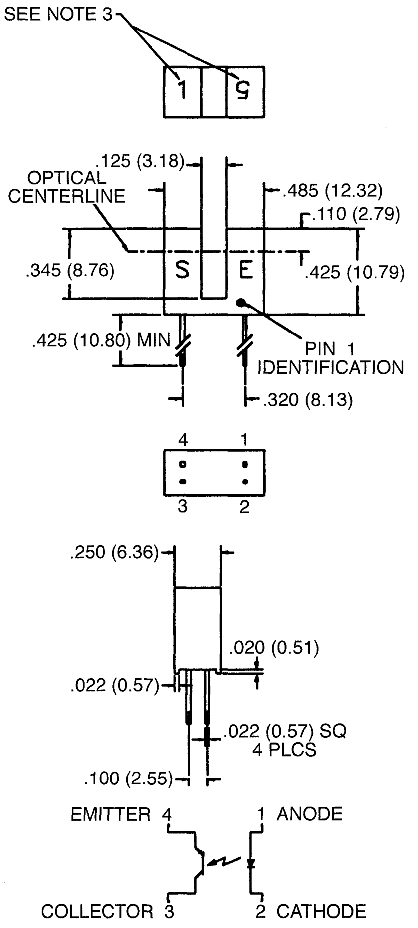
1. *Derate power dissipation linearly 1.67 mW/°C above 25°C.*
2. *RMA flux is recommended.*
3. *Methanol or Isopropyl alcohols are recommended as cleaning agents.*
4. *Soldering iron tip 1⁄16" (1.6 mm) from housing.*

OPTOELECTRONICS

SLOTTED OPTICAL SWITCH

OPB860N11/OPB860N51/OPB860N55

PACKAGE DIMENSIONS



ST2158

NOTES:
1. DIMENSIONS ARE IN INCHES (mm).
2. TOLERANCE IS ±.010 (.25)
   UNLESS OTHERWISE SPECIFIED.
3. NUMBER INDICATES APERTURE SIZE.
   (5=.050", 1=.010")

APERTURE OPTIONS:

	LED	PHOTOTRANSISTOR
OPB860N11	.010	.010
OPB860N51	.050	.010
OPB860N55	.050	.050

DESCRIPTION

The OPB860N series of switches is designed to allow the user maximum flexibility in applications. Each switch consists of an infrared emitting diode facing an NPN phototransistor across a .125" (3.18 mm) gap. A unique housing design provides a smooth external surface to prevent dust build-up while molded internal apertures give precise positioning and also provide protection from ambient light interference.

FEATURES

- Fully enclosed design allows dust and ambient light protection.
- Lead spacing at .320".
- .050" and .010" aperture options.
- PCB mountable.

SLOTTED OPTICAL SWITCH

ABSOLUTE MAXIMUM RATINGS (T_A = 25°C Unless Otherwise Specified)

Storage Temperature	−40°C to + 85°C
Operating Temperature	−40°C to + 85°C
Soldering:	
Lead Temperature (Iron)	240°C for 5 sec. (2,3,4)
Lead Temperature (Flow)	260°C for 10 sec. (2,3)
INPUT DIODE	
Continuous Forward Current	50 mA
Reverse Voltage	5.0 Volts
Power Dissipation	100 mW(1)
OUTPUT TRANSISTOR	
Collector-Emitter Voltage	30.0 Volts
Emitter-Collector Voltage	5.0 Volts
Power Dissipation	100 mW(1)

ELECTRICAL CHARACTERISTICS (T_A = 25°C Unless Otherwise Specified)

PARAMETER	SYMBOL	MIN.	MAX.	UNITS	TEST CONDITIONS
INPUT DIODE					
Forward Voltage	V_F	—	1.70	V	I_F = 20 mA
Reverse Leakage Current	I_R	—	100	μA	V_R = 2.0 V
OUTPUT TRANSISTOR					
Emitter-Collector Breakdown	BV_{ECO}	5	—	V	I_E = 100 μA, Ee = 0
Collector-Emitter Breakdown	BV_{CEO}	30	—	V	I_C = 1.0 mA, Ee = 0
Collector-Emitter Leakage	I_{CEO}	—	100	nA	V_{CE} = 10.0 V, Ee = 0
COUPLED					
On-State Collector Current					
OPB860N11	$I_{C(ON)}$	500	—	μA	I_F = 20 mA, V_{CE} = 5 V
OPB860N51	$I_{C(ON)}$	500	—	μA	I_F = 20 mA, V_{CE} = 5 V
OPB860N55	$I_{C(ON)}$	500	—	μA	I_F = 20 mA, V_{CE} = 5 V
Saturation Voltage	$V_{CE(SAT)}$	—	0.40	V	I_F = 20 mA, I_C = 400 μA

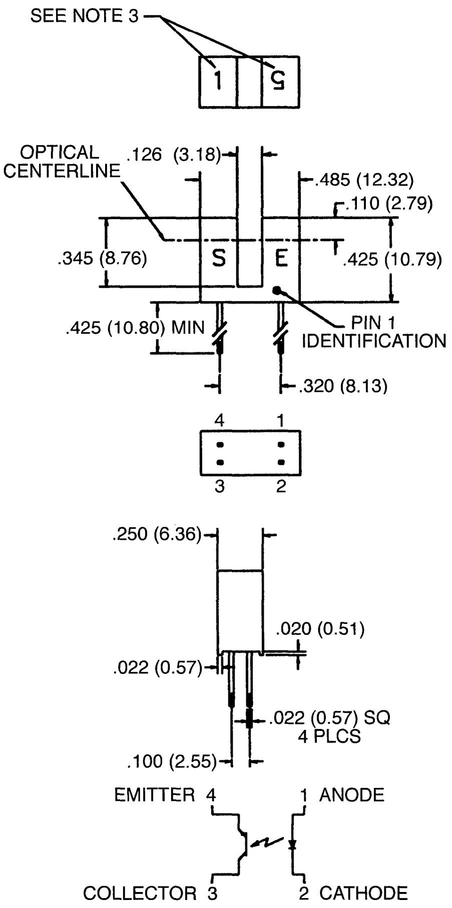
NOTES

1. *Derate power dissipation linearly 1.67 mW/°C above 25°C.*
2. *RMA flux is recommended.*
3. *Methanol or Isopropyl alcohols are recommended as cleaning agents.*
4. *Soldering iron tip 1/16″ (1.6 mm) from housing.*

SLOTTED OPTICAL SWITCH

OPB861N51/OPB861N55

PACKAGE DIMENSIONS



ST2159

NOTES:
1. DIMENSIONS ARE IN INCHES (mm).
2. TOLERANCE IS ±.010 (.25) UNLESS OTHERWISE SPECIFIED.
3. NUMBER INDICATES APERTURE SIZE. (5=.050″, 1=.010″)

APERTURE OPTIONS:

	LED	PHOTOTRANSISTOR
OPB861N51	.050	.010
OPB861N55	.050	.050

DESCRIPTION

The OPB861N series of switches is designed to allow the user maximum flexibility in applications. Each switch consists of an infrared emitting diode facing an NPN phototransistor across a .125″ (3.18 mm) gap. A unique housing design provides a smooth external surface to prevent dust build-up while molded internal apertures give precise positioning and also provide protection from ambient light interference.

FEATURES

- Fully enclosed design allows dust and ambient light protection.
- Lead spacing at .320″.
- .050″ and .010″ aperture options.
- PCB mountable.

QT
OPTOELECTRONICS

SLOTTED OPTICAL SWITCH

ABSOLUTE MAXIMUM RATINGS (T_A = 25°C Unless Otherwise Specified)

Storage Temperature	−40°C to + 85°C
Operating Temperature	−40°C to + 85°C
Soldering:	
Lead Temperature (Iron)	240°C for 5 sec. (2,3,4)
Lead Temperature (Flow)	260°C for 10 sec. (2,3)
INPUT DIODE	
Continuous Forward Current	50 mA
Reverse Voltage	5.0 Volts
Power Dissipation	100 mW(1)
OUTPUT TRANSISTOR	
Collector-Emitter Voltage	30.0 Volts
Emitter-Collector Voltage	5.0 Volts
Power Dissipation	100 mW(1)

ELECTRICAL CHARACTERISTICS (T_A = 25°C Unless Otherwise Specified)

PARAMETER	SYMBOL	MIN.	MAX.	UNITS	TEST CONDITIONS
INPUT DIODE					
Forward Voltage	V_F	—	1.70	V	I_F = 20 mA
Reverse Leakage Current	I_R	—	100	μA	V_R = 2.0 V
OUTPUT TRANSISTOR					
Emitter-Collector Breakdown	BV_{ECO}	5	—	V	I_E = 100 μA, Ee = 0
Collector-Emitter Breakdown	BV_{CEO}	30	—	V	I_C = 1.0 mA, Ee = 0
Collector-Emitter Leakage	I_{CEO}	—	100	nA	V_{CE} = 10.0 V, Ee = 0
COUPLED					
On-State Collector Current					
OPB861N51	$I_{C(ON)}$	1.0	—	mA	I_F = 10 mA, V_{CE} = 5 V
OPB861N55	$I_{C(ON)}$	1.0	—	mA	I_F = 10 mA, V_{CE} = 5 V
Saturation Voltage	$V_{CE(SAT)}$	—	0.40	V	I_F = 10 mA, I_C = 800 μA

NOTES

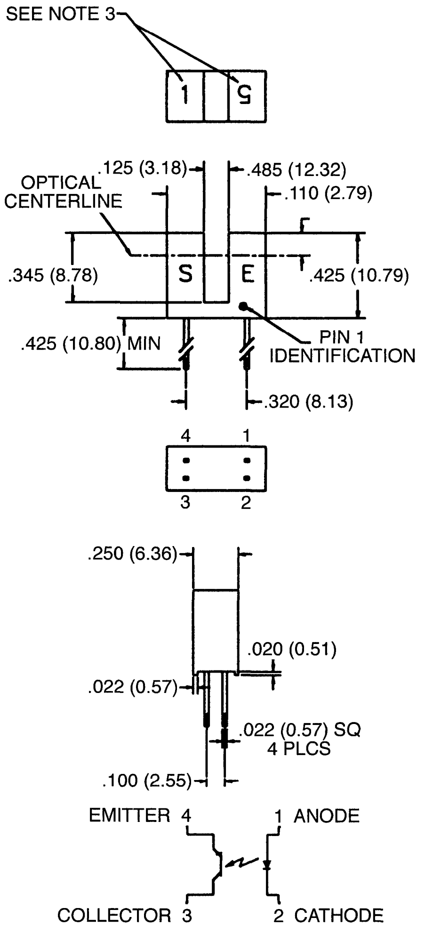
1. *Derate power dissipation linearly 1.67 mW/°C above 25°C.*
2. *RMA flux is recommended.*
3. *Methanol or Isopropyl alcohols are recommended as cleaning agents.*
4. *Soldering iron tip 1⁄16″ (1.6 mm) from housing.*

QT
OPTOELECTRONICS

SLOTTED OPTICAL SWITCH

OPB862N51/OPB862N55

PACKAGE DIMENSIONS



ST2161

NOTES:
1. DIMENSIONS ARE IN INCHES (mm).
2. TOLERANCE IS ±.010 (.25) UNLESS OTHERWISE SPECIFIED.
3. NUMBER INDICATES APERTURE SIZE. (5=.050″, 1=.010″)

APERTURE OPTIONS:

	LED	PHOTOTRANSISTOR
OPB862N51	.050	.010
OPB862N55	.050	.050

DESCRIPTION

The OPB862N series of switches is designed to allow the user maximum flexibility in applications. Each switch consists of an infrared emitting diode facing an NPN phototransistor across a .125″ (3.18 mm) gap. A unique housing design provides a smooth external surface to prevent dust build-up while molded internal apertures give precise positioning and also provide protection from ambient light interference.

FEATURES

- Fully enclosed design allows dust and ambient light protection.
- Lead spacing at .320″.
- .050″ and .010″ aperture options.
- PCB mountable.

SLOTTED OPTICAL SWITCH

ABSOLUTE MAXIMUM RATINGS (T_A = 25°C Unless Otherwise Specified)

Storage Temperature	−40°C to + 85°C
Operating Temperature	−40°C to + 85°C
Soldering:	
Lead Temperature (Iron)	240°C for 5 sec. (2,3,4)
Lead Temperature (Flow)	260°C for 10 sec. (2,3)
INPUT DIODE	
Continuous Forward Current	50 mA
Reverse Voltage	5.0 Volts
Power Dissipation	100 mW(1)
OUTPUT TRANSISTOR	
Collector-Emitter Voltage	30.0 Volts
Emitter-Collector Voltage	5.0 Volts
Power Dissipation	100 mW(1)

ELECTRICAL CHARACTERISTICS (T_A = 25°C Unless Otherwise Specified)

PARAMETER	SYMBOL	MIN.	MAX.	UNITS	TEST CONDITIONS
INPUT DIODE					
Forward Voltage	V_F	—	1.70	V	I_F = 20 mA
Reverse Leakage Current	I_R	—	100	μA	V_R = 2.0 V
OUTPUT TRANSISTOR					
Emitter-Collector Breakdown	BV_{ECO}	5	—	V	I_E = 100 μA, Ee = 0
Collector-Emitter Breakdown	BV_{CEO}	30	—	V	I_C = 1.0 mA, Ee = 0
Collector-Emitter Leakage	I_{CEO}	—	100	nA	V_{CE} = 10.0 V, Ee = 0
COUPLED					
On-State Collector Current					
OPB862N51	$I_{C(ON)}$	1.8	—	mA	I_F = 20 mA, V_{CE} = 0.6 V
OPB862N55	$I_{C(ON)}$	1.8	—	mA	I_F = 20 mA, V_{CE} = 0.6 V
Saturation Voltage	$V_{CE(SAT)}$	—	0.60	V	I_F = 20 mA, I_C = 1.8 mA

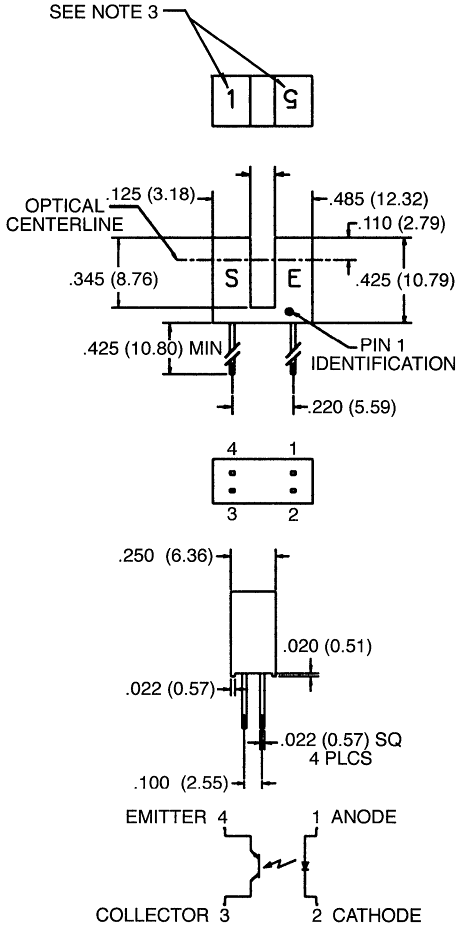
NOTES

1. *Derate power dissipation linearly 1.67 mW/°C above 25°C.*
2. *RMA flux is recommended.*
3. *Methanol or Isopropyl alcohols are recommended as cleaning agents.*
4. *Soldering iron tip 1⁄16″ (1.6 mm) from housing.*

SLOTTED OPTICAL SWITCH

OPB865N11/OPB865N51/OPB865N55

PACKAGE DIMENSIONS



ST2163

NOTES:
1. DIMENSIONS ARE IN INCHES (mm).
2. TOLERANCE IS ±.010 (.25) UNLESS OTHERWISE SPECIFIED.
3. NUMBER INDICATES APERTURE SIZE. (5=.050″, 1=.010″)

APERTURE OPTIONS:

	LED	PHOTOTRANSISTOR
OPB865N11	.010	.010
OPB865N51	.050	.010
OPB865N55	.050	.050

DESCRIPTION

The OPB865N series of switches is designed to allow the user maximum flexibility in applications. Each switch consists of an infrared emitting diode facing an NPN phototransistor across a .125″ (3.18 mm) gap. A unique housing design provides a smooth external surface to prevent dust build-up while molded internal apertures give precise positioning and also provide protection from ambient light interference.

FEATURES

- Fully enclosed design allows dust and ambient light protection.
- Lead spacing at .220″.
- .050″ and .010″ aperture options.
- PCB mountable.

ABSOLUTE MAXIMUM RATINGS (T_A = 25°C Unless Otherwise Specified)

Storage Temperature	−40°C to + 85°C
Operating Temperature	−40°C to + 85°C
Soldering:	
Lead Temperature (Iron)	240°C for 5 sec. (2,3,4)
Lead Temperature (Flow)	260°C for 10 sec. (2,3)
INPUT DIODE	
Continuous Forward Current	50 mA
Reverse Voltage	5.0 Volts
Power Dissipation	100 mW(1)
OUTPUT TRANSISTOR	
Collector-Emitter Voltage	30.0 Volts
Emitter-Collector Voltage	5.0 Volts
Power Dissipation	100 mW(1)

ELECTRICAL CHARACTERISTICS (T_A = 25°C Unless Otherwise Specified)

PARAMETER	SYMBOL	MIN.	MAX.	UNITS	TEST CONDITIONS
INPUT DIODE					
Forward Voltage	V_F	—	1.70	V	I_F = 20 mA
Reverse Leakage Current	I_R	—	100	μA	V_R = 2.0 V
OUTPUT TRANSISTOR					
Emitter-Collector Breakdown	BV_{ECO}	5	—	V	I_E = 100 μA, Ee = 0
Collector-Emitter Breakdown	BV_{CEO}	30	—	V	I_C = 1.0 mA, Ee = 0
Collector-Emitter Leakage	I_{CEO}	—	100	nA	V_{CE} = 10.0 V, Ee = 0
COUPLED					
On-State Collector Current					
OPB865N11	$I_{C(ON)}$	500	—	μA	I_F = 20 mA, V_{CE} = 5 V
OPB865N51	$I_{C(ON)}$	500	—	μA	I_F = 20 mA, V_{CE} = 5 V
OPB865N55	$I_{C(ON)}$	500	—	μA	I_F = 20 mA, V_{CE} = 5 V
Saturation Voltage	$V_{CE(SAT)}$	—	0.40	V	I_F = 20 mA, I_C = 400 μA

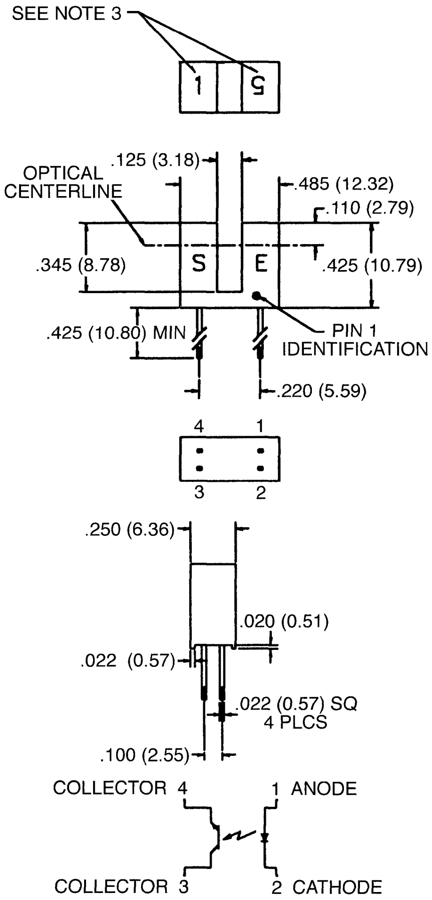
NOTES

1. *Derate power dissipation linearly 1.67 mW/°C above 25°C.*
2. *RMA flux is recommended.*
3. *Methanol or Isopropyl alcohols are recommended as cleaning agents.*
4. *Soldering iron tip 1⁄16″ (1.6 mm) from housing.*

SLOTTED OPTICAL SWITCH

OPB866N51/OPB866N55

PACKAGE DIMENSIONS



ST2165

NOTES:
1. DIMENSIONS ARE IN INCHES (mm).
2. TOLERANCE IS ±.010 (.25)
   UNLESS OTHERWISE SPECIFIED.
3. NUMBER INDICATES APERTURE SIZE.
   (5=.050″, 1=.010″)

APERTURE OPTIONS:

	LED	PHOTOTRANSISTOR
OPB866N51	.050	.010
OPB866N55	.050	.050

DESCRIPTION

The OPB866N series of switches is designed to allow the user maximum flexibility in applications. Each switch consists of an infrared emitting diode facing an NPN phototransistor across a .125″ (3.18 mm) gap. A unique housing design provides a smooth external surface to prevent dust build-up while molded internal apertures give precise positioning and also provide protection from ambient light interference.

FEATURES

- Fully enclosed design allows dust and ambient light protection.
- Lead spacing at .220″.
- .050″ and .010″ aperture options.
- PCB mountable.

SLOTTED OPTICAL SWITCH

ABSOLUTE MAXIMUM RATINGS (T_A = 25°C Unless Otherwise Specified)

Storage Temperature .... −40°C to + 85°C
Operating Temperature .... −40°C to + 85°C
Soldering:
Lead Temperature (Iron) .... 240°C for 5 sec. (2,3,4)
Lead Temperature (Flow) .... 260°C for 10 sec. (2,3)

INPUT DIODE
Continuous Forward Current .... 50 mA
Reverse Voltage .... 5.0 Volts
Power Dissipation .... 100 mW(1)

OUTPUT TRANSISTOR
Collector-Emitter Voltage .... 30.0 Volts
Emitter-Collector Voltage .... 5.0 Volts
Power Dissipation .... 100 mW(1)

ELECTRICAL CHARACTERISTICS (T_A = 25°C Unless Otherwise Specified)

PARAMETER	SYMBOL	MIN.	MAX.	UNITS	TEST CONDITIONS
INPUT DIODE					
Forward Voltage	V_F	—	1.70	V	I_F = 20 mA
Reverse Leakage Current	I_R	—	100	μA	V_R = 2.0 V
OUTPUT TRANSISTOR					
Emitter-Collector Breakdown	BV_{ECO}	5	—	V	I_E = 100 μA, Ee = 0
Collector-Emitter Breakdown	BV_{CEO}	30	—	V	I_C = 1.0 mA, Ee = 0
Collector-Emitter Leakage	I_{CEO}	—	100	nA	V_{CE} = 10.0 V, Ee = 0
COUPLED					
On-State Collector Current					
OPB866N51	$I_{C(ON)}$	1.0	—	mA	I_F = 10 mA, V_{CE} = 5 V
OPB866N55	$I_{C(ON)}$	1.0	—	mA	I_F = 10 mA, V_{CE} = 5 V
Saturation Voltage	$V_{CE(SAT)}$	—	0.40	V	I_F = 10 mA, I_C = 800 μA

NOTES

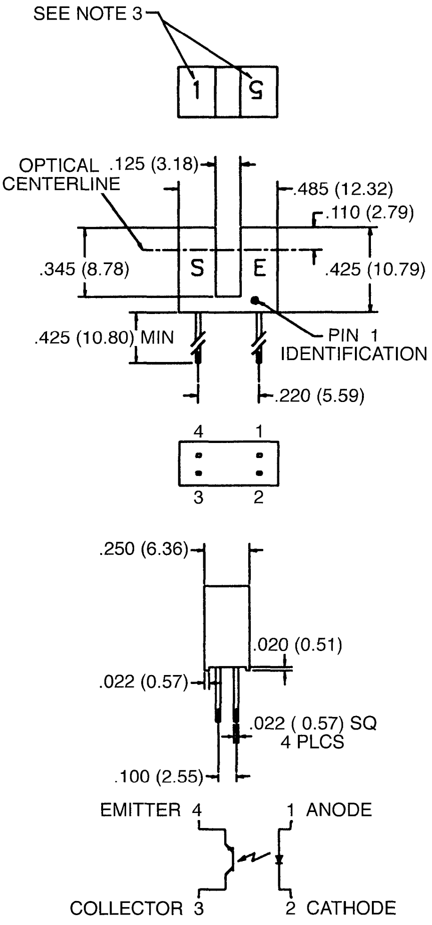
1. *Derate power dissipation linearly 1.67 mW/°C above 25°C.*
2. *RMA flux is recommended.*
3. *Methanol or Isopropyl alcohols are recommended as cleaning agents.*
4. *Soldering iron tip 1⁄16″ (1.6 mm) from housing.*

OPTOELECTRONICS

SLOTTED OPTICAL SWITCH

OPB867N51/OPB867N55

PACKAGE DIMENSIONS



ST2167

NOTES:
1. DIMENSIONS ARE IN INCHES (mm).
2. TOLERANCE IS ±.010 (.25)
   UNLESS OTHERWISE SPECIFIED.
3. NUMBER INDICATES APERTURE SIZE.
   (5=.050″, 1=.010″)

APERTURE OPTIONS:

	LED	PHOTOTRANSISTOR
OPB867N51	.050	.010
OPB867N55	.050	.050

DESCRIPTION

The OPB867N series of switches is designed to allow the user maximum flexibility in applications. Each switch consists of an infrared emitting diode facing an NPN phototransistor across a .125″ (3.18 mm) gap. A unique housing design provides a smooth external surface to prevent dust build-up while molded internal apertures give precise positioning and also provide protection from ambient light interference.

FEATURES

- Fully enclosed design allows dust and ambient light protection.
- Lead spacing at .220″.
- .050″ and .010″ aperture options.
- PCB mountable.

SLOTTED OPTICAL SWITCH

ABSOLUTE MAXIMUM RATINGS (T_A = 25°C Unless Otherwise Specified)

Storage Temperature	−40°C to + 85°C
Operating Temperature	−40°C to + 85°C
Soldering:	
Lead Temperature (Iron)	240°C for 5 sec. (2,3,4)
Lead Temperature (Flow)	260°C for 10 sec. (2,3)
INPUT DIODE	
Continuous Forward Current	50 mA
Reverse Voltage	5.0 Volts
Power Dissipation	100 mW(1)
OUTPUT TRANSISTOR	
Collector-Emitter Voltage	30.0 Volts
Emitter-Collector Voltage	5.0 Volts
Power Dissipation	100 mW(1)

ELECTRICAL CHARACTERISTICS (T_A = 25°C Unless Otherwise Specified)

PARAMETER	SYMBOL	MIN.	MAX.	UNITS	TEST CONDITIONS
INPUT DIODE					
Forward Voltage	V_F	—	1.70	V	I_F = 20 mA
Reverse Leakage Current	I_R	—	100	μA	V_R = 2.0 V
OUTPUT TRANSISTOR					
Emitter-Collector Breakdown	BV_{ECO}	5	—	V	I_E = 100 μA, Ee = 0
Collector-Emitter Breakdown	BV_{CEO}	30	—	V	I_C = 1.0 mA, Ee = 0
Collector-Emitter Leakage	I_{CEO}	—	100	nA	V_{CE} = 10.0 V, Ee = 0
COUPLED					
On-State Collector Current					
OPB867N51	$I_{C(ON)}$	1.8	—	mA	I_F = 20 mA, V_{CE} = 0.6 V
OPB867N55	$I_{C(ON)}$	1.8	—	mA	I_F = 20 mA, V_{CE} = 0.6 V
Saturation Voltage	$V_{CE(SAT)}$	—	0.60	V	I_F = 20 mA, I_C = 1.8 mA

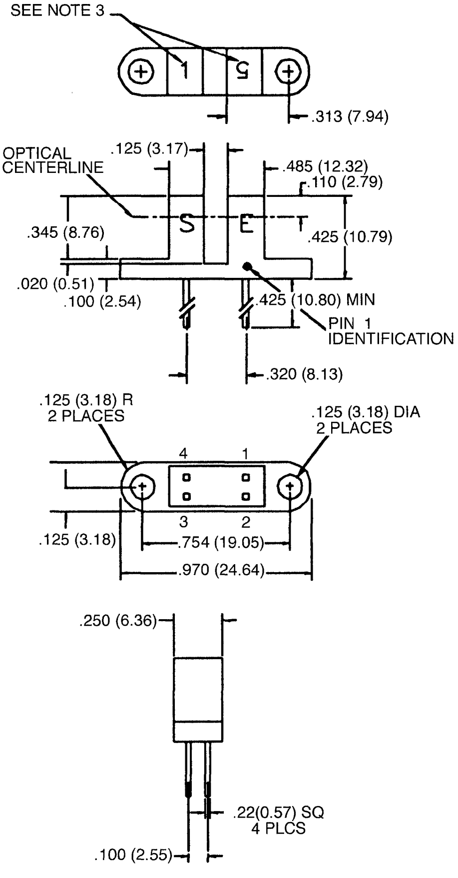
NOTES

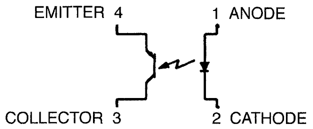
1. *Derate power dissipation linearly 1.67 mW/°C above 25°C.*
2. *RMA flux is recommended.*
3. *Methanol or Isopropyl alcohols are recommended as cleaning agents.*
4. *Soldering iron tip 1/16" (1.6 mm) from housing.*

SLOTTED OPTICAL SWITCH

OPB860T11/OPB860T51/OPB860T55

PACKAGE DIMENSIONS





ST1782

NOTES:

1. DIMENSIONS ARE IN INCHES (mm).
2. TOLERANCE IS ±.010 (.25) UNLESS OTHERWISE SPECIFIED.
3. NUMBER INDICATES APERTURE SIZE. (5=.050″, 1=.010″)

APERTURE OPTIONS:

	LED	PHOTOTRANSISTOR
OP8860T11	.010	.010
OP8860T51	.050	.010
OP8860T55	.050	.050

DESCRIPTION

The OPB860T series of switches is designed to allow the user maximum flexibility in applications. Each switch consists of an infrared emitting diode facing an NPN phototransistor across a .125″ (3.18mm) gap. A unique housing design provides a smooth external surface to prevent dust build-up while molded internal apertures give precise positioning and also provide protection from ambient light interference.

FEATURES

- Fully enclosed design allows dust protection.
- Lead spacing at .320″.
- .050″ and .010″ aperture options.
- PCB mountable.

SLOTTED OPTICAL SWITCH

ABSOLUTE MAXIMUM RATINGS (T_A = 25°C Unless Otherwise Specified)

Storage Temperature	−40°C to +85°C
Operating Temperature	−40°C to +85°C
Soldering:	
Lead Temperature (Iron)	240°C for 5 sec.(2,3,4)
Lead Temperature (Flow)	260°C for 10 sec.(2,3)
INPUT DIODE	
Continuous Forward Current	50 mA
Reverse Voltage	5.0 Volts
Power Dissipation	100 mW(1)
OUTPUT TRANSISTOR	
Collector-Emitter Voltage	30 V
Emitter-Collector Voltage	5 V
Power Dissipation	100 mW(1)

ELECTRICAL CHARACTERISTICS (T_A = 25°C)

PARAMETER	SYMBOL	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS
INPUT DIODE						
Forward Voltage	V_F	—		1.70	V	I_F = 20 mA
Reverse Leakage Current	I_R	—		100	μA	V_R = 2.0 V
OUTPUT TRANSISTOR						
Emitter-Collector Breakdown	BV_{ECO}	5		—	V	I_E = 100 μA, Ee = 0
Collector-Emitter Breakdown	BV_{CEO}	30		—	V	I_C = 1.0 mA, Ee = 0
Collector-Emitter Leakage	I_{CEO}	—		100	nA	V_{CE} = 10.0 V, Ee = 0
COUPLED						
On-State Collector Current						
OPB860T11	$I_{C(ON)}$	500		—	μA	I_F = 20 mA, V_{CE} = 5 V
OPB860T51	$I_{C(ON)}$	500		—	μA	I_F = 20 mA, V_{CE} = 5 V
OPB860T55	$I_{C(ON)}$	500		—	μA	I_F = 20 mA, V_{CE} = 5 V
Saturation Voltage	$V_{CE(SAT)}$	—		0.40	V	I_F = 20 mA, I_C = 400 μA

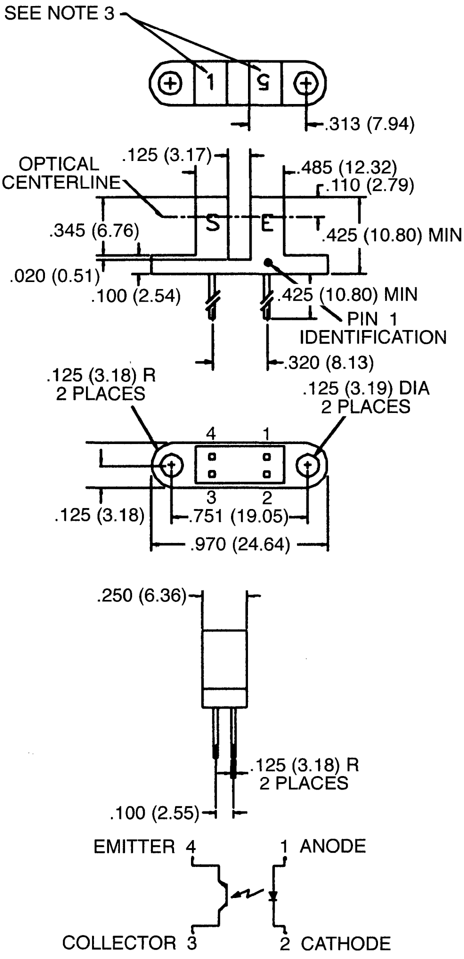
NOTES

1. *Derate power dissipation linearly 1.67 mW/°C above 25°C.*
2. *RMA flux is recommended.*
3. *Methanol or Isopropyl alcohols are recommended as cleaning agents.*
4. *Soldering iron tip 1/16" (1.6 mm) from housing.*

SLOTTED OPTICAL SWITCH

OPB861T51/OPB861T55

PACKAGE DIMENSIONS



ST2160

NOTES:
1. DIMENSIONS ARE IN INCHES (mm).
2. TOLERANCE IS ±.010 (.25) UNLESS OTHERWISE SPECIFIED.
3. NUMBER INDICATES APERTURE SIZE. (5=.050″, 1=.010″)

APERTURE OPTIONS:

	LED	PHOTOTRANSISTOR
OPB861T51	.050	.010
OPB861T55	.050	.050

DESCRIPTION

The OPB861T series of switches is designed to allow the user maximum flexibility in applications. Each switch consists of an infrared emitting diode facing an NPN phototransistor across a .125″ (3.18 mm) gap. A unique housing design provides a smooth external surface to prevent dust build-up while molded internal apertures give precise positioning and also provide protection from ambient light interference.

FEATURES

- Fully enclosed design allows dust and ambient light protection.
- Lead spacing at .320″.
- .050″ and .010″ aperture options.
- PCB mountable.

SLOTTED OPTICAL SWITCH

ABSOLUTE MAXIMUM RATINGS (T_A = 25°C Unless Otherwise Specified)

Storage Temperature	−40°C to + 85°C
Operating Temperature	−40°C to + 85°C
Soldering:	
Lead Temperature (Iron)	240°C for 5 sec. (2,3,4)
Lead Temperature (Flow)	260°C for 10 sec. (2,3)
INPUT DIODE	
Continuous Forward Current	50 mA
Reverse Voltage	5.0 Volts
Power Dissipation	100 mW(1)
OUTPUT TRANSISTOR	
Collector-Emitter Voltage	30.0 Volts
Emitter-Collector Voltage	5.0 Volts
Power Dissipation	100 mW(1)

ELECTRICAL CHARACTERISTICS (T_A = 25°C Unless Otherwise Specified)

PARAMETER	SYMBOL	MIN.	MAX.	UNITS	TEST CONDITIONS
INPUT DIODE					
Forward Voltage	V_F	—	1.70	V	I_F = 20 mA
Reverse Leakage Current	I_R	—	100	μA	V_R = 2.0 V
OUTPUT TRANSISTOR					
Emitter-Collector Breakdown	BV_{ECO}	5	—	V	I_E = 100 μA, Ee = 0
Collector-Emitter Breakdown	BV_{CEO}	30	—	V	I_C = 1.0 mA, Ee = 0
Collector-Emitter Leakage	I_{CEO}	—	100	nA	V_{CE} = 10.0 V, Ee = 0
COUPLED					
On-State Collector Current					
OPB861T51	$I_{C(ON)}$	1.0	—	mA	I_F = 10 mA, V_{CE} = 5 V
OPB861T55	$I_{C(ON)}$	1.0	—	mA	I_F = 10 mA, V_{CE} = 5 V
Saturation Voltage	$V_{CE(SAT)}$	—	0.40	V	I_F = 10 mA, I_C = 800 μA

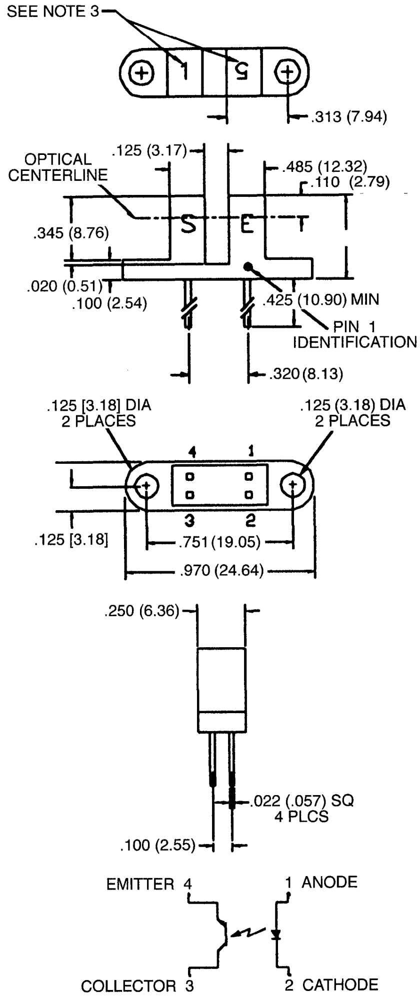
NOTES

1. *Derate power dissipation linearly 1.67 mW/°C above 25°C.*
2. *RMA flux is recommended.*
3. *Methanol or Isopropyl alcohols are recommended as cleaning agents.*
4. *Soldering iron tip 1/16″ (1.6 mm) from housing.*

SLOTTED OPTICAL SWITCH

OPB862T51/OPB862T55

PACKAGE DIMENSIONS



ST2162

NOTES:
1. DIMENSIONS ARE IN INCHES (mm).
2. TOLERANCE IS ±.010 (.25) UNLESS OTHERWISE SPECIFIED.
3. NUMBER INDICATES APERTURE SIZE. (5=.050″, 1=.010″)

APERTURE OPTIONS:

	LED	PHOTOTRANSISTOR
OPB862T51	.050	.010
OPB862T55	.050	.050

DESCRIPTION

The OPB862T series of switches is designed to allow the user maximum flexibility in applications. Each switch consists of an infrared emitting diode facing an NPN phototransistor across a .125″ (3.18 mm) gap. A unique housing design provides a smooth external surface to prevent dust build-up while molded internal apertures give precise positioning and also provide protection from ambient light interference.

FEATURES

- Fully enclosed design allows dust and ambient light protection.
- Lead spacing at .320″.
- .050″ and .010″ aperture options.
- PCB mountable.

SLOTTED OPTICAL SWITCH

ABSOLUTE MAXIMUM RATINGS (T_A = 25°C Unless Otherwise Specified)

Storage Temperature	−40°C to + 85°C
Operating Temperature	−40°C to + 85°C
Soldering:	
Lead Temperature (Iron)	240°C for 5 sec. (2,3,4)
Lead Temperature (Flow)	260°C for 10 sec. (2,3)
INPUT DIODE	
Continuous Forward Current	50 mA
Reverse Voltage	5.0 Volts
Power Dissipation	100 mW(1)
OUTPUT TRANSISTOR	
Collector-Emitter Voltage	30.0 Volts
Emitter-Collector Voltage	5.0 Volts
Power Dissipation	100 mW(1)

ELECTRICAL CHARACTERISTICS (T_A = 25°C Unless Otherwise Specified)

PARAMETER	SYMBOL	MIN.	MAX.	UNITS	TEST CONDITIONS
INPUT DIODE					
Forward Voltage	V_F	—	1.70	V	I_F = 20 mA
Reverse Leakage Current	I_R	—	100	μA	V_R = 2.0 V
OUTPUT TRANSISTOR					
Emitter-Collector Breakdown	BV_{ECO}	5	—	V	I_E = 100 μA, Ee = 0
Collector-Emitter Breakdown	BV_{CEO}	30	—	V	I_C = 1.0 mA, Ee = 0
Collector-Emitter Leakage	I_{CEO}	—	100	nA	V_{CE} = 10.0 V, Ee = 0
COUPLED					
On-State Collector Current					
OPB862T51	$I_{C(ON)}$	1.8	—	mA	I_F = 20 mA, V_{CE} = 0.6 V
OPB862T55	$I_{C(ON)}$	1.8	—	mA	I_F = 20 mA, V_{CE} = 0.6 V
Saturation Voltage	$V_{CE(SAT)}$	—	0.60	V	I_F = 20 mA, I_C = 1.8 mA

NOTES

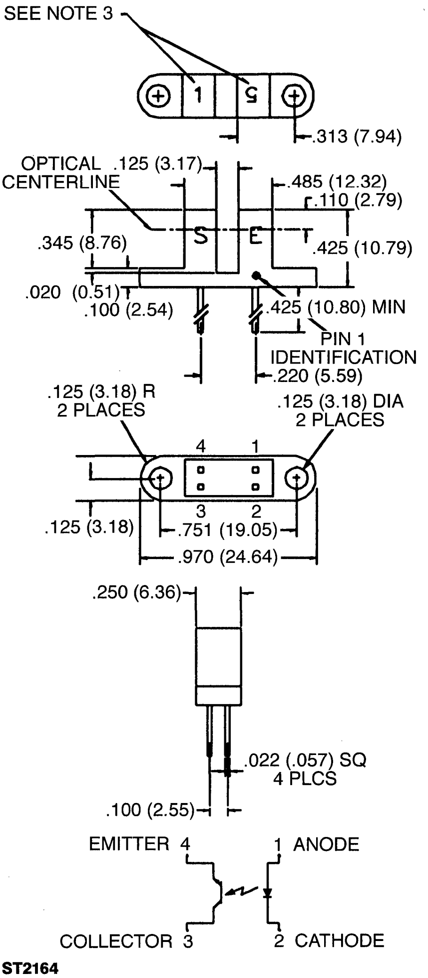
1. *Derate power dissipation linearly 1.67 mW/°C above 25°C.*
2. *RMA flux is recommended.*
3. *Methanol or Isopropyl alcohols are recommended as cleaning agents.*
4. *Soldering iron tip 1⁄16″ (1.6 mm) from housing.*

QT OPTOELECTRONICS

SLOTTED OPTICAL SWITCH

OPB865T11/OPB865T51/OPB865T55

PACKAGE DIMENSIONS



ST2164

NOTES:
1. DIMENSIONS ARE IN INCHES (mm).
2. TOLERANCE IS ±.010 (.25) UNLESS OTHERWISE SPECIFIED.
3. NUMBER INDICATES APERTURE SIZE. (5=.050″, 1=.010″)

APERTURE OPTIONS:

	LED	PHOTOTRANSISTOR
OPB865T11	.010	.010
OPB865T51	.050	.010
OPB865T55	.050	.050

DESCRIPTION

The OPB865T series of switches is designed to allow the user maximum flexibility in applications. Each switch consists of an infrared emitting diode facing an NPN phototransistor across a .125″ (3.18 mm) gap. A unique housing design provides a smooth external surface to prevent dust build-up while molded internal apertures give precise positioning and also provide protection from ambient light interference.

FEATURES

- Fully enclosed design allows dust and ambient light protection.
- Lead spacing at .220″.
- .050″ and .010″ aperture options.
- PCB mountable.

SLOTTED OPTICAL SWITCH

ABSOLUTE MAXIMUM RATINGS (T_A = 25°C Unless Otherwise Specified)

Storage Temperature	−40°C to + 85°C
Operating Temperature	−40°C to + 85°C
Soldering:	
Lead Temperature (Iron)	240°C for 5 sec. (2,3,4)
Lead Temperature (Flow)	260°C for 10 sec. (2,3)
INPUT DIODE	
Continuous Forward Current	50 mA
Reverse Voltage	5.0 Volts
Power Dissipation	100 mW(1)
OUTPUT TRANSISTOR	
Collector-Emitter Voltage	30.0 Volts
Emitter-Collector Voltage	5.0 Volts
Power Dissipation	100 mW(1)

ELECTRICAL CHARACTERISTICS (T_A = 25°C Unless Otherwise Specified)

PARAMETER	SYMBOL	MIN.	MAX.	UNITS	TEST CONDITIONS
INPUT DIODE					
Forward Voltage	V_F	—	1.70	V	I_F = 20 mA
Reverse Leakage Current	I_R	—	100	μA	V_R = 2.0 V
OUTPUT TRANSISTOR					
Emitter-Collector Breakdown	BV_{ECO}	5	—	V	I_E = 100 μA, Ee = 0
Collector-Emitter Breakdown	BV_{CEO}	30	—	V	I_C = 1.0 mA, Ee = 0
Collector-Emitter Leakage	I_{CEO}	—	100	nA	V_{CE} = 10.0 V, Ee = 0
COUPLED					
On-State Collector Current					
OPB865T11	$I_{C(ON)}$	500	—	μA	I_F = 20 mA, V_{CE} = 5 V
OPB865T51	$I_{C(ON)}$	500	—	μA	I_F = 20 mA, V_{CE} = 5 V
OPB865T55	$I_{C(ON)}$	500	—	μA	I_F = 20 mA, V_{CE} = 5 V
Saturation Voltage	$V_{CE(SAT)}$	—	0.40	V	I_F = 20 mA, I_C = 400 μA

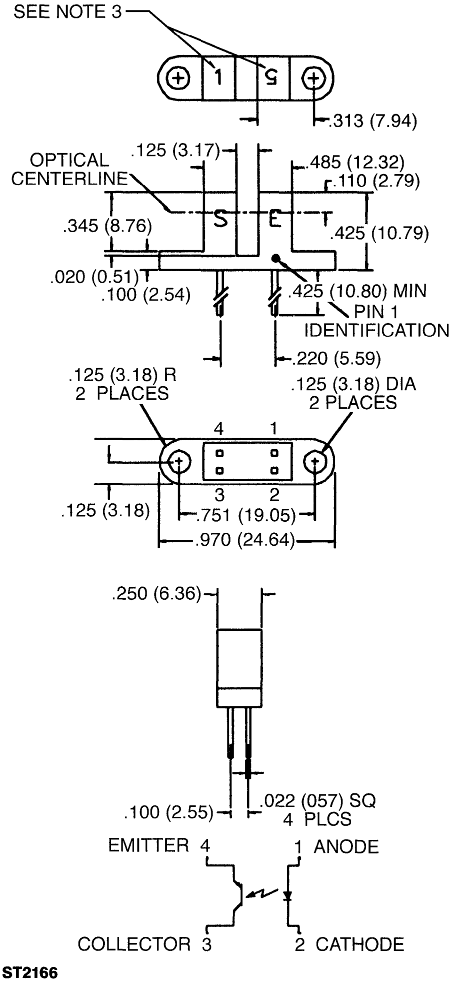
NOTES

1. *Derate power dissipation linearly 1.67 mW/°C above 25°C.*
2. *RMA flux is recommended.*
3. *Methanol or Isopropyl alcohols are recommended as cleaning agents.*
4. *Soldering iron tip 1⁄16″ (1.6 mm) from housing.*

SLOTTED OPTICAL SWITCH

OPB866T51/OPB866T55

PACKAGE DIMENSIONS



ST2166

NOTES:
1. DIMENSIONS ARE IN INCHES (mm).
2. TOLERANCE IS ±.010 (.25) UNLESS OTHERWISE SPECIFIED.
3. NUMBER INDICATES APERTURE SIZE. (5=.050″, 1=.010″)

APERTURE OPTIONS:

	LED	PHOTOTRANSISTOR
OPB866T51	.050	.010
OPB866T55	.050	.050

DESCRIPTION

The OPB866T series of switches is designed to allow the user maximum flexibility in applications. Each switch consists of an infrared emitting diode facing an NPN phototransistor across a .125″ (3.18 mm) gap. A unique housing design provides a smooth external surface to prevent dust build-up while molded internal apertures give precise positioning and also provide protection from ambient light interference.

FEATURES

- Fully enclosed design allows dust and ambient light protection.
- Lead spacing at .220″.
- .050″ and .010″ aperture options.
- PCB mountable.

SLOTTED OPTICAL SWITCH

ABSOLUTE MAXIMUM RATINGS (T$_A$ = 25°C Unless Otherwise Specified)

Storage Temperature	−40°C to + 85°C
Operating Temperature	−40°C to + 85°C
Soldering:	
Lead Temperature (Iron)	240°C for 5 sec. (2,3,4)
Lead Temperature (Flow)	260°C for 10 sec. (2,3)
INPUT DIODE	
Continuous Forward Current	50 mA
Reverse Voltage	5.0 Volts
Power Dissipation	100 mW(1)
OUTPUT TRANSISTOR	
Collector-Emitter Voltage	30.0 Volts
Emitter-Collector Voltage	5.0 Volts
Power Dissipation	100 mW(1)

ELECTRICAL CHARACTERISTICS (T$_A$ = 25°C Unless Otherwise Specified)

PARAMETER	SYMBOL	MIN.	MAX.	UNITS	TEST CONDITIONS
INPUT DIODE					
Forward Voltage	V_F	—	1.70	V	$I_F = 20$ mA
Reverse Leakage Current	I_R	—	100	μA	$V_R = 2.0$ V
OUTPUT TRANSISTOR					
Emitter-Collector Breakdown	BV_{ECO}	5	—	V	$I_E = 100$ μA, Ee = 0
Collector-Emitter Breakdown	BV_{CEO}	30	—	V	$I_C = 1.0$ mA, Ee = 0
Collector-Emitter Leakage	I_{CEO}	—	100	nA	$V_{CE} = 10.0$ V, Ee = 0
COUPLED					
On-State Collector Current					
OPB866T51	$I_{C(ON)}$	1.0	—	mA	$I_F = 10$ mA, $V_{CE} = 5$ V
OPB866T55	$I_{C(ON)}$	1.0	—	mA	$I_F = 10$ mA, $V_{CE} = 5$ V
Saturation Voltage	$V_{CE(SAT)}$	—	0.40	V	$I_F = 10$ mA, $I_C = 800$ μA

NOTES

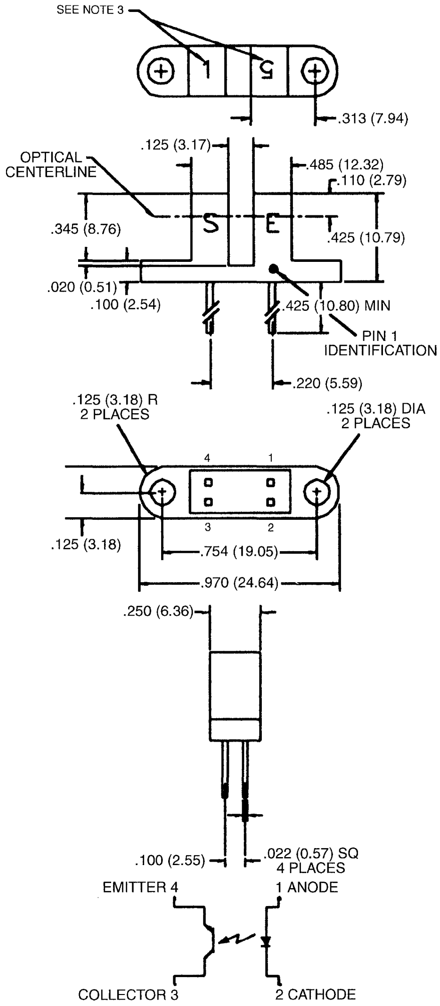
1. *Derate power dissipation linearly 1.67 mW/°C above 25°C.*
2. *RMA flux is recommended.*
3. *Methanol or Isopropyl alcohols are recommended as cleaning agents.*
4. *Soldering iron tip 1/16″ (1.6 mm) from housing.*

QT
OPTOELECTRONICS

SLOTTED OPTICAL SWITCH

OPB867T51/OPB867T55

PACKAGE DIMENSIONS



ST2127

NOTES:
1. DIMENSIONS ARE IN INCHES (mm).
2. TOLERANCE IS ±.010 (.25) UNLESS OTHERWISE SPECIFIED.
3. NUMBER INDICATES APERTURE SIZE. (5=.050″, 1=.010″)

APERTURE OPTIONS:

	LED	PHOTOTRANSISTOR
OPB867T51	.050	.010
OPB867T55	.050	.050

DESCRIPTION

The OPB867T series of switches is designed to allow the user maximum flexibility in applications. Each switch consists of an infrared emitting diode facing an NPN phototransistor across a .125″ (3.18 mm) gap. A unique housing design provides a smooth external surface to prevent dust build-up while molded internal apertures give precise positioning and also provide protection from ambient light interference.

FEATURES

- Fully enclosed design allows dust and ambient light protection.
- Lead spacing at .220″.
- .050″ and .010″ aperture options.
- PCB mountable.

OPTOELECTRONICS

SLOTTED OPTICAL SWITCH

ABSOLUTE MAXIMUM RATINGS (T_A = 25°C Unless Otherwise Specified)

Storage Temperature	−40°C to + 85°C
Operating Temperature	−40°C to + 85°C
Soldering:	
Lead Temperature (Iron)	240°C for 5 sec. (2,3,4)
Lead Temperature (Flow)	260°C for 10 sec. (2,3)
INPUT DIODE	
Continuous Forward Current	50 mA
Reverse Voltage	5.0 Volts
Power Dissipation	100 mW(1)
OUTPUT TRANSISTOR	
Collector-Emitter Voltage	30.0 Volts
Emitter-Collector Voltage	5.0 Volts
Power Dissipation	100 mW(1)

ELECTRICAL CHARACTERISTICS (T_A = 25°C Unless Otherwise Specified)

PARAMETER	SYMBOL	MIN.	MAX.	UNITS	TEST CONDITIONS
INPUT DIODE					
Forward Voltage	V_F	—	1.70	V	I_F = 20 mA
Reverse Leakage Current	I_R	—	100	μA	V_R = 2.0 V
OUTPUT TRANSISTOR					
Emitter-Collector Breakdown	BV_{ECO}	5	—	V	I_E = 100 μA, Ee = 0
Collector-Emitter Breakdown	BV_{CEO}	30	—	V	I_C = 1.0 mA, Ee = 0
Collector-Emitter Leakage	I_{CEO}	—	100	nA	V_{CE} = 10.0 V, Ee = 0
COUPLED					
On-State Collector Current					
OPB867T51	$I_{C(ON)}$	1.8	—	mA	I_F = 20 mA, V_{CE} = 0.6 V
OPB867T55	$I_{C(ON)}$	1.8	—	mA	I_F = 20 mA, V_{CE} = 0.6 V
Saturation Voltage	$V_{CE(SAT)}$	—	0.60	V	I_F = 20 mA, I_C = 1.8 mA

NOTES

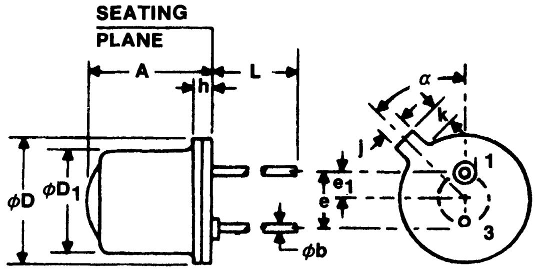
1. *Derate power dissipation linearly 1.67 mW/°C above 25°C.*
2. *RMA flux is recommended.*
3. *Methanol or Isopropyl alcohols are recommended as cleaning agents.*
4. *Soldering iron tip 1/16″ (1.6 mm) from housing.*

QT
OPTOELECTRONICS

GaAs INFRARED EMITTING DIODE

1N6264

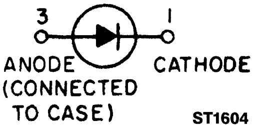
PACKAGE DIMENSIONS



ST1332

SYMBOL	INCHES		MILLIMETERS		NOTES
	MIN.	MAX.	MIN.	MAX.	
A		.255		6.47	
ϕb	.016	.021	.407	.533	
ϕD	.209	.230	5.31	5.84	
ϕD_1	.180	.188	4.57	4.77	
e	.100 NOM.		2.54 NOM.		2
e_1	.050 NOM.		1.27 NOM.		2
h		.030		.76	
j	.031	.044	.79	1.11	
k	.036	.046	.92	1.16	1
L	1.00		25.4		
α	45°	45°	45°	45°	3

PACKAGE OUTLINE



ST1604

NOTES:
1. MEASURED FROM MAXIMUM DIAMETER OF DEVICE.
2. LEADS HAVING MAX. DIAMETER .021″ (.533mm) MEASURED IN GAUGING PLANE .054″ + .001″ − .000 (137 + 025 − 000mm) BELOW THE REFERENCE PLANE OF THE DEVICE SHALL BE WITHIN .007″ (.778mm) THEIR TRUE POSITION RELATIVE TO A MAXIMUM WIDTH TAB.
3. FROM CENTERLINE TAB.

DESCRIPTION

The 1N6264 is a 940nm LED in a narrow angle, T0-46 package.

FEATURES

- Good optical to mechanical alignment
- Mechanically and wavelength matched to TO-18 series phototransistor
- Hermetically sealed package
- High irradiance level
- (*) indicates JEDEC registered values

GaAs INFRARED EMITTING DIODE

ABSOLUTE MAXIMUM RATINGS (T_A = 25°C Unless Otherwise Specified)

*Storage Temperature	−65°C to +150°C
Operating Temperature	−65°C to +125°C
*Soldering:	
*Lead Temperature (Iron)	240°C for 5 sec.(3,4,5,6)
*Lead Temperature (Flow)	260°C for 10 sec.(3,4,6)
*Continuous Forward Current	100 mA
*Forward Current (pw, 1μS; 200 Hz)	10 A
*Reverse Voltage	3 Volts
*Power Dissipation (T_A = 25°C)	170 mW(1)
Power Dissipation (T_C = 25°C)	1.3 W(2)

ELECTRICAL CHARACTERISTICS (T_A = 25°C Unless Otherwise Specified)

(All measurements made under pulse conditions.)

PARAMETER	SYMBOL	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS
*Forward Voltage	V_F	—		1.7	V	I_F = 100 mA
*Reverse Leakage Current	I_R	—		10	μA	V_R = 3 V
*Peak Emission Wavelength	λ_p	935		955	nm	I_F = 100 mA
Emission Angle at ½ Power	θ		±8		Degrees	
*Total Power	Po	6		—	mW	I_F = 100 mA(7)
Rise Time 0-90% of output	t_r		1.0		μS	
Fall Time 100-10% of output	t_f		1.0		μS	

NOTES

1. *Derate power dissipation linearly 1.70 mW/°C above 25°C ambient.*
2. *Derate power dissipation linearly 13.0 mW/°C above 25°C case.*
3. *RMA flux is recommended.*
4. *Methanol or Isopranol alcohols are recommended as cleaning agents.*
5. *Soldering iron tip 1/16″ (1.6 mm) minimum from housing.*
6. *As long as leads are not under any stress or spring tension.*
7. *Total power output, Po, is the total power radiated by the device into a solid angle of 2π steradians.*

GaAs INFRARED EMITTING DIODE

TYPICAL CHARACTERISTICS

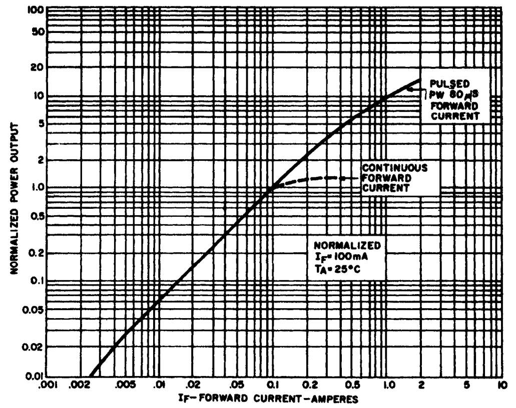


Fig. 1. Power Output vs. Input Current ST1002

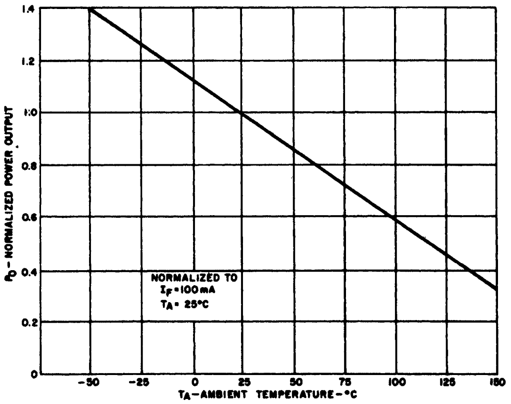


Fig. 2. Power Output vs. Temperature ST1007

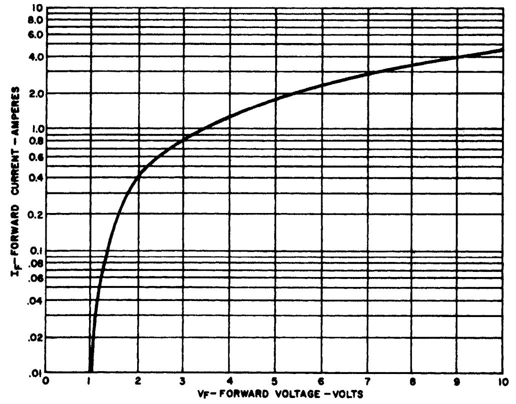


Fig. 3. Forward Voltage vs. Forward Current ST1003

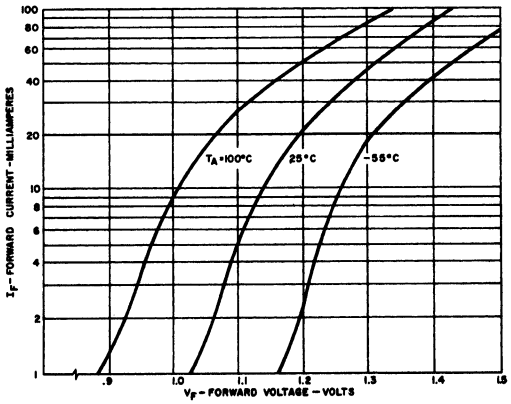


Fig. 4. Forward Voltage vs. Forward Current ST1006

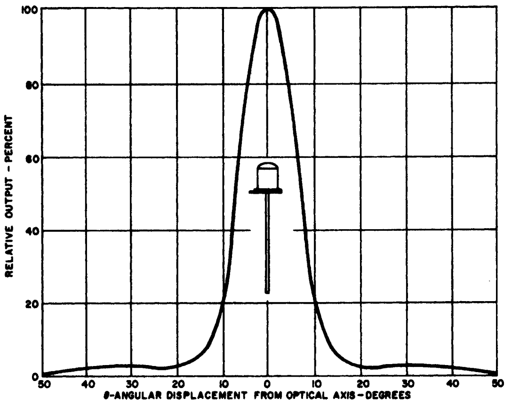


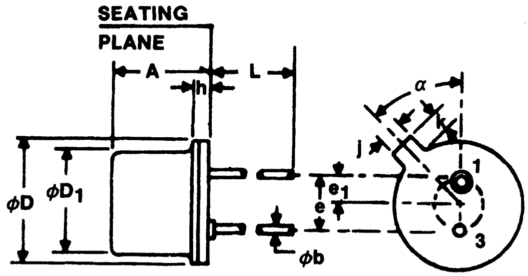
Fig. 5. 1N6264 — Typical Radiation Pattern ST1004

OPTOELECTRONICS

GaAs INFRARED EMITTING DIODE

1N6265

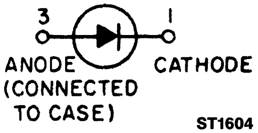
PACKAGE DIMENSIONS



ST1331

SYMBOL	INCHES		MILLIMETERS		NOTES
	MIN.	MAX.	MIN.	MAX.	
A		.155		3.93	
ϕb	.016	.021	.407	.533	
ϕD	.209	.230	5.31	5.84	
ϕD_1	.180	.187	4.57	4.77	
e	.100 NOM.		2.54 NOM.		2
e_1	.050 NOM.		1.27 NOM.		2
h		.030		.76	
j	.031	.044	.79	1.11	
k	.036	.046	.92	1.16	1
L	1.00		25.4		
α	45°	45°	45°	45°	3

PACKAGE OUTLINE



ST1604

NOTES:
1. MEASURED FROM MAXIMUM DIAMETER OF DEVICE.
2. LEADS HAVING MAX. DIAMETER .021″ (.533mm) MEASURED IN GAUGING PLANE .054″ + .001″ − .000 (137 + 025 − 000mm) BELOW THE REFERENCE PLANE OF THE DEVICE SHALL BE WITHIN .007″ (.778mm) THEIR TRUE POSITION RELATIVE TO A MAXIMUM WIDTH TAB.
3. FROM CENTERLINE TAB.

DESCRIPTION

The 1N6265 is a 940nm LED in a wide angle, T0-46 package.

FEATURES

- Good optical to mechanical alignment
- Mechanically and wavelength matched to TO-18 series phototransistor
- Hermetically sealed package
- High irradiance level
- (*) indicates JEDEC registered values

QT
OPTOELECTRONICS

GaAs INFRARED EMITTING DIODE

ABSOLUTE MAXIMUM RATINGS (T_A = 25°C Unless Otherwise Specified)

*Storage Temperature	−65°C to +150°C
Operating Temperature	−65°C to +125°C
*Soldering:	
*Lead Temperature (Iron)	240°C for 5 sec.(3,4,5,6)
*Lead Temperature (Flow)	260°C for 10 sec.(3,4,6)
*Continuous Forward Current	100 mA
*Forward Current (pw, 1μS; 200 Hz)	10 A
*Reverse Voltage	3 Volts
*Power Dissipation (T_A = 25°C)	170 mW(1)
Power Dissipation (T_C = 25°C)	1.3 W(2)

ELECTRICAL CHARACTERISTICS (T_A = 25°C Unless Otherwise Specified)
(All measurements made under pulse conditions.)

PARAMETER	SYMBOL	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS
*Forward Voltage	V_F	—		1.7	V	I_F = 100 mA
*Reverse Leakage Current	I_R	—		10	μA	V_R = 3 V
*Peak Emission Wavelength	λ_p	935		955	nm	I_F = 100 mA
Emission Angle at ½ Power	θ		±40		Degrees	
*Total Power	Po	6		—	mW	I_F = 100 mA(7)
Rise Time 0-90% of output	t_r		1.0		μS	
Fall Time 100-10% of output	t_f		1.0		μS	

NOTES

1. *Derate power dissipation linearly 1.70 mW/°C above 25°C ambient.*
2. *Derate power dissipation linearly 13.0 mW/°C above 25°C case.*
3. *RMA flux is recommended.*
4. *Methanol or Isopranol alcohols are recommended as cleaning agents.*
5. *Soldering iron tip 1⁄16″ (1.6 mm) minimum from housing.*
6. *As long as leads are not under any stress or spring tension.*
7. *Total power output, Po, is the total power radiated by the device into a solid angle of 2π steradians.*

QT
OPTOELECTRONICS

GaAs INFRARED EMITTING DIODE

TYPICAL CHARACTERISTICS

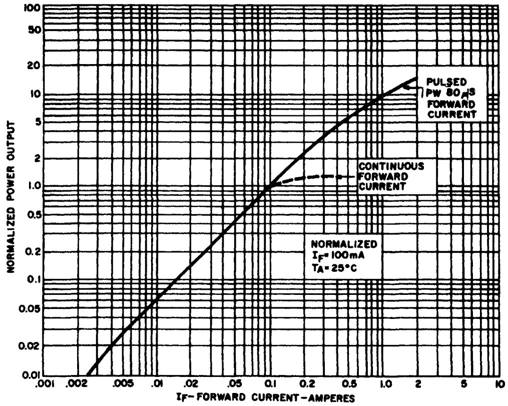


Fig. 1. Power Output vs. Input Current ST1002

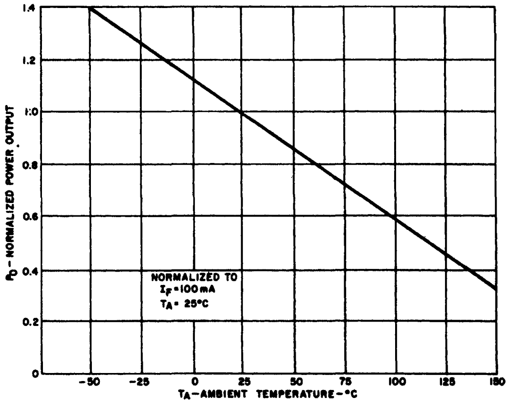


Fig. 2. Power Output vs. Temperature ST1007

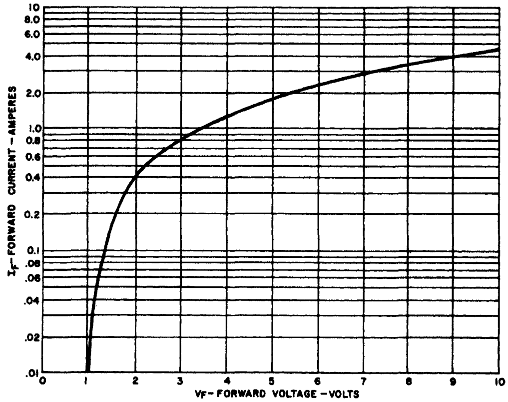


Fig. 3. Forward Voltage vs. Forward Current ST1003

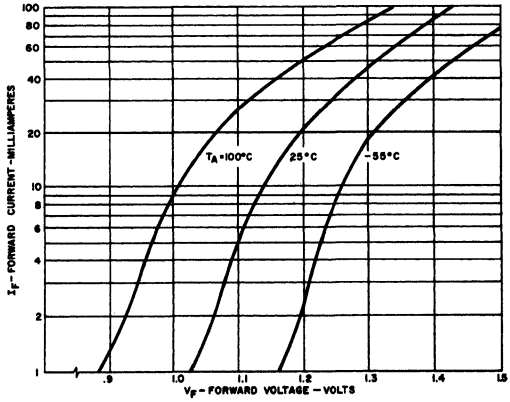


Fig. 4. Forward Voltage vs. Forward Current ST1006

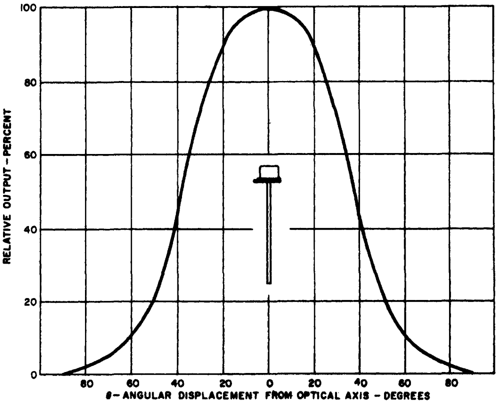


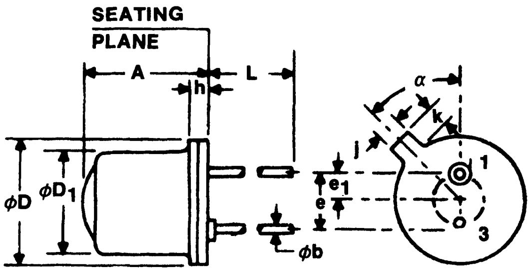
Fig. 6. 1N6265 — Typical Radiation Pattern ST1005

OPTOELECTRONICS

GaAs INFRARED EMITTING DIODE

1N6266

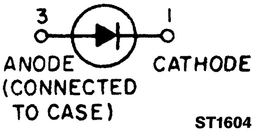
PACKAGE DIMENSIONS



ST1332

SYMBOL	INCHES		MILLIMETERS		NOTES
	MIN.	MAX.	MIN.	MAX.	
A		.255		6.47	
ϕb	.016	.021	.407	.533	
ϕD	.209	.230	5.31	5.84	
ϕD1	.180	.188	4.57	4.77	
e	.100 NOM.		2.54 NOM.		2
e1	.050 NOM.		1.27 NOM.		2
h		.030		.76	
j	.031	.044	.79	1.11	
k	.036	.046	.92	1.16	1
L	1.00		25.4		
α	45°	45°	45°	45°	3

PACKAGE OUTLINE



ST1604

NOTES:

1. MEASURED FROM MAXIMUM DIAMETER OF DEVICE.
2. LEADS HAVING MAX. DIAMETER .021″ (.533mm) MEASURED IN GAUGING PLANE .054″ + .001″ − .000 (137 + 025 − 000mm) BELOW THE REFERENCE PLANE OF THE DEVICE SHALL BE WITHIN .007″ (.778mm) THEIR TRUE POSITION RELATIVE TO A MAXIMUM WIDTH TAB.
3. FROM CENTERLINE TAB.

DESCRIPTION

The 1N6266 is a 940nm LED in a narrow angle, T0-46 package.

FEATURES

- Good optical to mechanical alignment
- Mechanically and wavelength matched to TO-18 series phototransistor
- Hermetically sealed package
- High irradiance level
- (*) indicates JEDEC registered values

GaAs INFRARED EMITTING DIODE

ABSOLUTE MAXIMUM RATINGS (T_A = 25°C Unless Otherwise Specified)

*Storage Temperature	−65°C to +150°C
Operating Temperature	−65°C to +125°C
*Soldering:	
*Lead Temperature (Iron)	240°C for 5 sec.(3,4,5,6)
*Lead Temperature (Flow)	260°C for 10 sec.(3,4,6)
*Continuous Forward Current	100 mA
*Forward Current (pw, 1μS; 200 Hz)	10 A
*Reverse Voltage	3 Volts
*Power Dissipation (T_A = 25°C)	170 mW(1)
Power Dissipation (T_C = 25°C)	1.3 W(2)

ELECTRICAL CHARACTERISTICS (T_A = 25°C Unless Otherwise Specified)

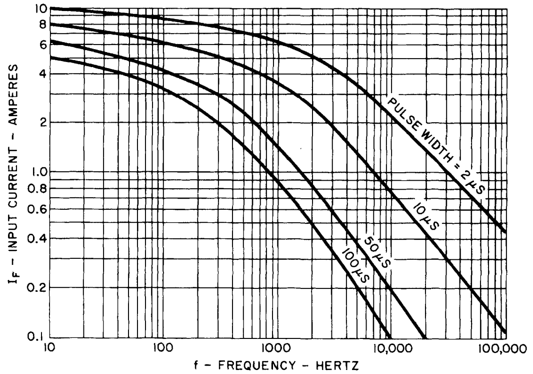
(All measurements made under pulse conditions.)

PARAMETER	SYMBOL	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS
Forward Voltage	V_F	—		1.7	V	I_F = 100 mA
*Reverse Leakage Current	I_R	—		10	μA	V_R = 3 V
*Peak Emission Wavelength	λ_p	935		955	nm	I_F = 100 mA
Emission Angle at ½ Power	θ	—	±10	—	Degrees	
*Radiant Intensity	Ie	25		—	mW/sr	I_F = 100 mA
Rise Time 0-90% of output	t_r	—	1.0	—	μS	
Fall Time 100-10% of output	t_f	—	1.0	—	μS	

NOTES

1. *Derate power dissipation linearly 1.70 mW/°C above 25°C ambient.*
2. *Derate power dissipation linearly 13.0 mW/°C above 25°C case.*
3. *RMA flux is recommended.*
4. *Methanol or Isopranol alcohols are recommended as cleaning agents.*
5. *Soldering iron tip 1⁄16″ (1.6 mm) minimum from housing.*
6. *As long as leads are not under any stress or spring tension.*

MAXIMUM RATING CURVES



ST1008

Fig. 1. Maximum Pulse Capability

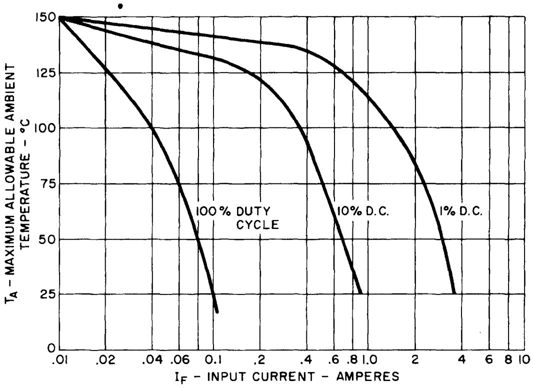
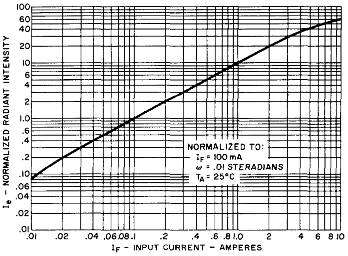


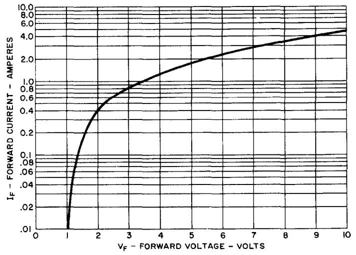
Fig. 2. Maximum Temperature vs. Input Current

ST1009



ST1012

Fig. 3. Radiant Intensity vs.
Input Current ΔIe/ΔI



ST1013

Fig. 4. Forward Voltage vs.
Forward Current

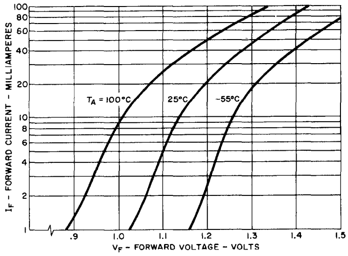


Fig. 5. Forward Voltage vs.
Forward Current

ST1014

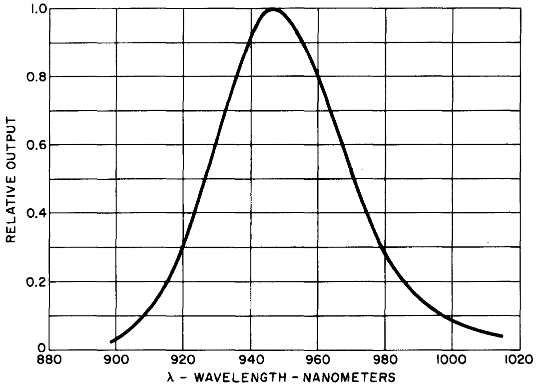


Fig. 6. Spectral Output

ST1016

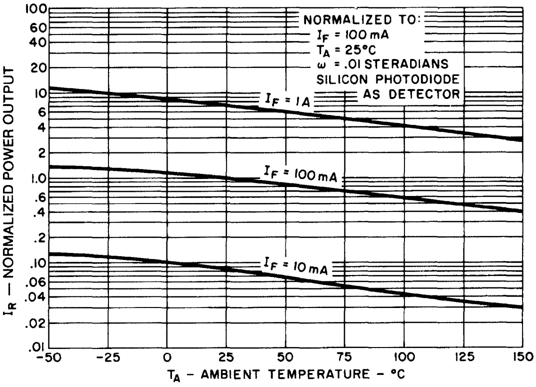


Fig. 7. Output vs.
Temperature

ST1020

INFRARED EMITTING DIODE RADIANT INTENSITY

The design of an Infrared Emitting Diode (IRED)-photodetector system normally requires the designer to determine the minimum amount of infrared irradiance received by the photodetector, which then allows definition of the photodetector current. Prior to the introduction of the 1N6266, the best method of estimating the photodetector received infrared was to geometrically proportion the piecewise integration of the typical beam pattern with the specified minimum total power output of the IRED. However, due to the inconsistencies of the IRED integral lenses and the beam lobes, this procedure will not provide a valid estimation.

The 1N6266 now provides the designer specifications which precisely define the infrared beam along the device's mechanical axis. The 1N6266 is a premium device selected to give a minimum radiant intensity of 25 mW/steradian into the 0.01 steradians referenced by the device's mechanical axis and seating plane. Radiant intensity is the IRED beam power output, within a specified solid angle, per unit solid angle.

A quick review of geometry indicates that a steradian is a unit of solid angle, referenced to the center of a sphere, defined by 4π times the ratio of the area projected by the solid angle to the area of the sphere. The solid angle is equal to the projected area divided by the squared radius.

$$\text{Steradians} = 4\pi A/4\pi R^2 = A/R^2 = \omega.$$

As the projected area has a circular periphery, a geometric integration will solve to show the relationship of the Cartesian angle (α) of the cone, (from the center of the sphere) to the projected area.

$$\omega = 2\pi\,(1-\mathrm{COS}\,\tfrac{\alpha}{2}).$$

Radiant intensity provides an easy, accurate tool to calculate the infrared power received by a photodetector located on the IRED axis. As the devices are selected for beam characteristics, the calculated results are valid for worst case analysis. For many applications a simple approximation for photodetector irradiance is:

$$H \cong I_e/d^2, \text{ in mw/cm}^2$$

where d is the distance from the IRED to the detector in cm.

IRED power output, and therefore I_e, depends on IRED current. This variation ($\Delta I_e/\Delta I$) is documented in Figure 1, and completes the approximation: $H = I_e/d^2\,(\Delta I_e/\Delta I)$. This normally gives a conservative value of irradiance. For more accurate results, the effect of precise angle viewed by the detector must be considered. This is documented in Figure 2 ($\Delta I_e/\Delta\omega$) giving:

$$H = I_e/d^2\,(\Delta I_e/\Delta I) \text{ in mw/cm}^2.$$

For worst case designs, temperature coefficients and tolerances must also be considered.

The minimum output current of the detector (I_L) can be determined for a given distance (d) of the detector from the IRED.

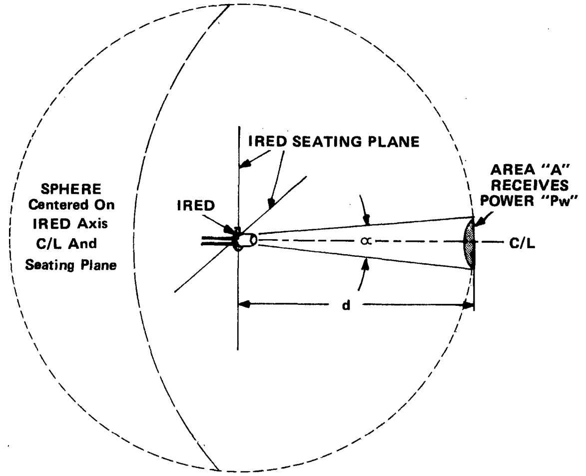
$$I_L = (S)H \cong (S)I_e/d^2$$

or

$$I_L = (S)H = (S)\,(I_e/d^2)\,(\Delta I_e/\Delta\omega)\,(\Delta I_e/\Delta I)$$

where S is the sensitivity of the detector in terms of output current per unit irradiance from a GaAs source.

IRED RADIANT INTENSITY SPECIFICATION CONCEPT



$\omega = A/d^2 = 2\pi\,(1 - \cos\frac{\alpha}{2})$ Steradians

$I_e = Pw/\omega$ mW/Steradian

$H = Pw/A = I_e/d^2$ mW/cm²

MATCHING A PHOTOTRANSISTOR WITH 1N6266

Assume a system requiring a 10mA I_L at an IRED to detector spacing of 2cm (seating plane to seating plane), with bias conditions at specification points.

Given: $d_1 = 2$ cm; $I_{L_1} = 10$ mA min.; Ie = 25 mW/Steradian

Then: $H_1 \cong Ie/D_1{}^2 = 25/(2)^2 = 6.25$ mW/cm².

Detector Evaluation:

TYPE	I_L MIN. @ mA	H (Tungsten) mw/cm²	≅	H(GaAs) mw/cm²	S(GaAs) mA/mw/cm²
L14G1	6	10		3	2
L14G2	3	10		3	1

Calculated $I_L = d_1$ is:

L14G1 (S) H_1 = (2) 6.25 = 12.5 mA
L14G2 (S) H_1 = (1) 6.25 = 6.25 mA

Since the system requires an I_L of 10 mA minimum the correct device to use is the L14G1.

TYPICAL CHARACTERISTICS

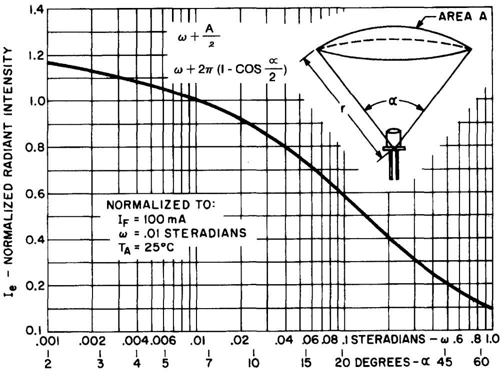


Fig. 1 Intensity and Power vs. Angle
$\Delta Ie/\Delta\omega$

TYPICAL CHARACTERISTICS

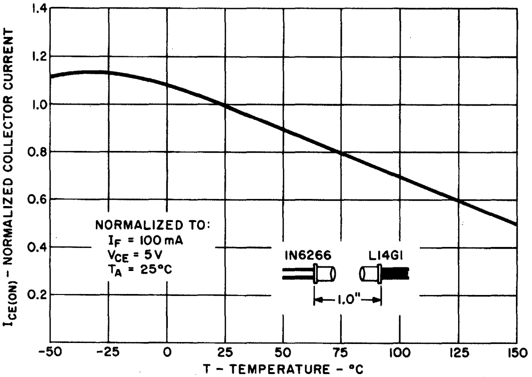


Fig. 2. Output vs. Temperature IRED/Phototransistor Pair

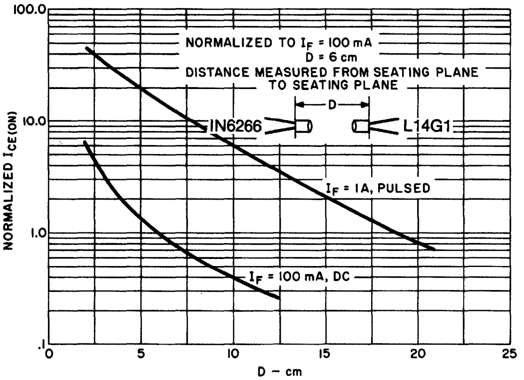
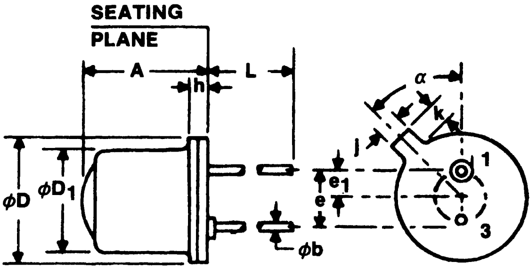


Fig. 3. I_L vs. Distance IRED/Phototransistor Pair

AlGaAs INFRARED EMITTING DIODE

F5D1/2/3

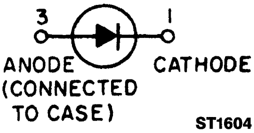
PACKAGE DIMENSIONS



ST1332

SYMBOL	INCHES		MILLIMETERS		NOTES
	MIN.	MAX.	MIN.	MAX.	
A	—	.255	—	6.47	
ϕb	.016	.021	.407	.533	
ϕD	.209	.230	5.31	5.84	
ϕD_1	.180	.188	4.57	4.77	
e	.100 NOM.		2.54 NOM.		2
e_1	.050 NOM.		1.27 NOM.		2
h	—	.030	—	.76	
j	.031	.044	.79	1.11	
k	.036	.046	.92	1.16	1
L	1.00	—	25.4	—	
α	45°	45°	45°	45°	3

PACKAGE OUTLINE



ST1604

NOTES:
1. MEASURED FROM MAXIMUM DIAMETER OF DEVICE.
2. LEADS HAVING MAXIMUM DIAMETER .021" (.533mm) MEASURED IN GAUGING PLANE .054" + .001" − .000 (137 + 025 − 000mm) BELOW THE REFERENCE PLANE OF THE DEVICE SHALL BE WITHIN .007" (.778mm) THEIR TRUE POSITION RELATIVE TO A MAXIMUM WIDTH TAB.
3. FROM CENTERLINE TAB.

DESCRIPTION

The F5D series is 880nm LEDs in a narrow angle, T0-46 package.

FEATURES

- Good optical to mechanical alignment
- Mechanically and wavelength matched to TO-18 series phototransistor
- Hermetically sealed package
- High irradiance level

AlGaAs INFRARED EMITTING DIODE

ABSOLUTE MAXIMUM RATINGS (T_A = 25°C Unless Otherwise Specified)

Storage Temperature	−65°C to +150°C
Operating Temperature	−65°C to +125°C
Soldering:	
Lead Temperature (Iron)	240°C for 5 sec.(3,4,5,6)
Lead Temperature (Flow)	260°C for 10 sec.(3,4,6)
Continuous Forward Current	100 mA
Forward Current (pw, 10μS; 100 Hz)	3 A
Forward Current (pw, 1μS; 200 Hz)	10 A
Reverse Voltage	3 Volts
Power Dissipation (T_A = 25°C)	170 mW(1)
Power Dissipation (T_C = 25°C)	1.3 W(2)

ELECTRICAL CHARACTERISTICS (T_A = 25°C Unless Otherwise Specified) (All measurements made under pulse conditions.)

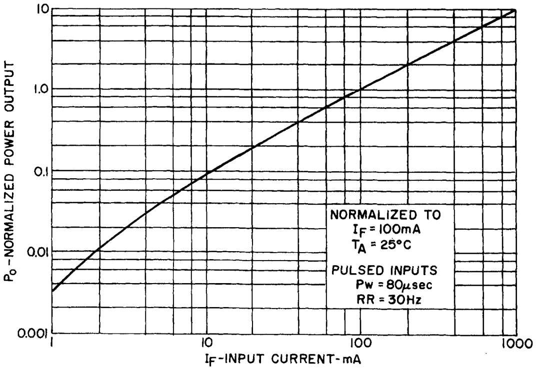
PARAMETER	SYMBOL	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS
Forward Voltage	V_F	—		1.7	V	I_F = 100 mA
Reverse Leakage Current	I_R	—		10	μA	V_R = 3 V
Peak Emission Wavelength	λ_p		880		nm	I_F = 100 mA
Emission Angle at ½ Power	θ		±10		Degrees	
Total Power F5D1	Po	12.0		—	mW	I_F = 100 mA(7)
Total Power F5D2	Po	9.0		—	mW	I_F = 100 mA(7)
Total Power F5D3	Po	10.5		—	mW	I_F = 100 mA(7)
Rise Time 0-90% of output	t_r		1.5		μS	
Fall Time 100-10% of output	t_f		1.5		μS	

NOTES

1. *Derate power dissipation linearly 1.70 mW/°C above 25°C ambient.*
2. *Derate power dissipation linearly 13.0 mW/°C above 25°C case.*
3. *RMA flux is recommended.*
4. *Methanol or Isopranol alcohols are recommended as cleaning agents.*
5. *Soldering iron tip 1⁄16″ (1.6 mm) minimum from housing.*
6. *As long as leads are not under any stress or spring tension.*
7. *Total power output, Po, is the total power radiated by the device into a solid angle of 2π steradians.*

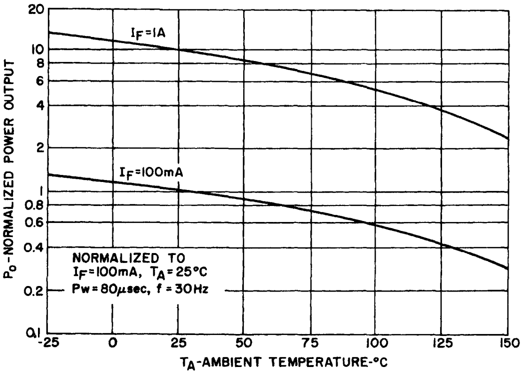
AlGaAs INFRARED EMITTING DIODE

TYPICAL CHARACTERISTICS



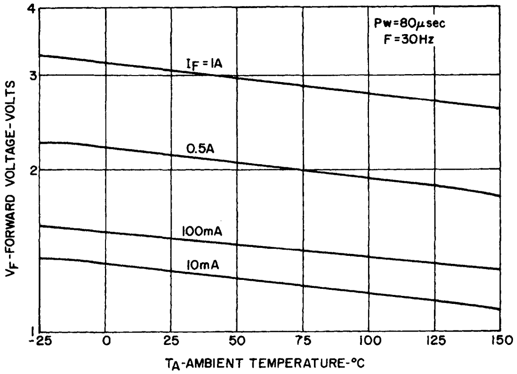
ST1025

Fig. 1. Power Output vs. Input Current



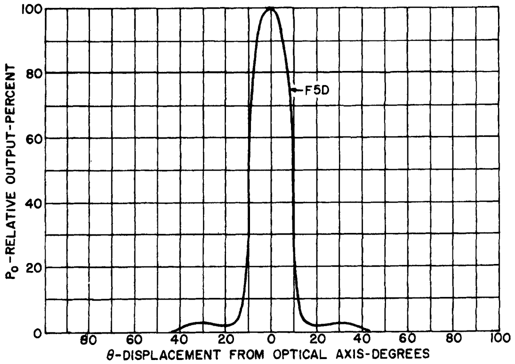
ST1026

Fig. 2. Power Output vs. Temperature



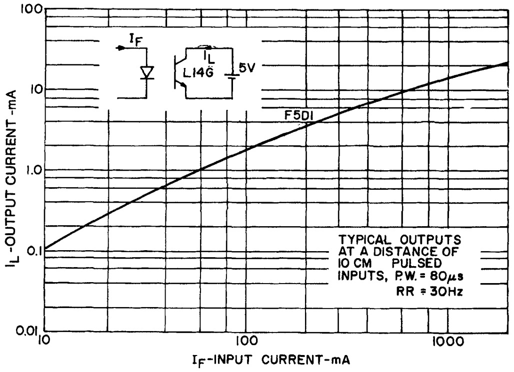
ST1027

Fig. 3. Forward Voltage vs. Temperature



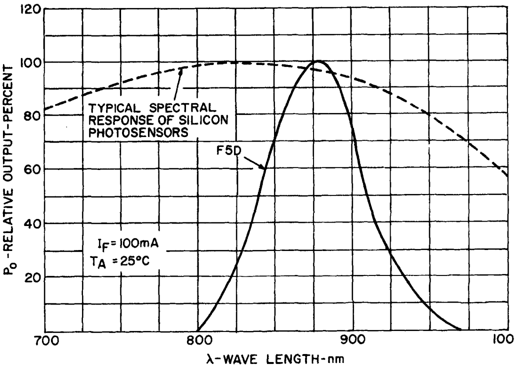
ST1028-99

Fig. 4. Typical Radiation Pattern



ST1029-99

Fig. 5. Output vs. Input with L14G Detector



ST1030-99

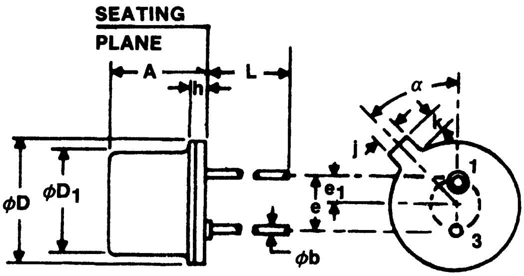
Fig. 6. Output vs. Wavelength

OPTOELECTRONICS

AlGaAs INFRARED EMITTING DIODE

F5E1/2/3

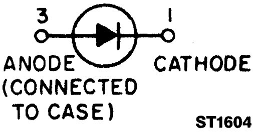
PACKAGE DIMENSIONS



ST1331

SYMBOL	INCHES		MILLIMETERS		NOTES
	MIN.	MAX.	MIN.	MAX.	
A	—	.155	—	3.93	
ϕb	.016	.021	.407	.533	
ϕD	.209	.230	5.31	5.84	
ϕD_1	.180	.188	4.57	4.77	
e	.100 NOM.		2.54 NOM.		2
e_1	.050 NOM.		1.27 NOM.		2
h	—	.030	—	.76	
j	.031	.044	.79	1.11	
k	.036	.046	.91	1.16	1
L	1.00	—	25.4	—	
α	45°	45°	45°	45°	3

PACKAGE OUTLINE



ST1604

NOTES:
1. MEASURED FROM MAXIMUM DIAMETER OF DEVICE.
2. LEADS HAVING MAXIMUM DIAMETER .021″ (.533mm) MEASURED IN GAUGING PLANE .054″ + .001″ − .000 (137 + 025 − 000mm) BELOW THE REFERENCE PLANE OF THE DEVICE SHALL BE WITHIN .007″ (.778mm) THEIR TRUE POSITION RELATIVE TO A MAXIMUM WIDTH TAB.
3. FROM CENTERLINE TAB.

DESCRIPTION

The F5E series is 880nm LEDs in a wide angle, T0-46 package.

FEATURES

- Good optical to mechanical alignment
- Mechanically and wavelength matched to TO-18 series phototransistor
- Hermetically sealed package
- High irradiance level

AlGaAs INFRARED EMITTING DIODE

ABSOLUTE MAXIMUM RATINGS (T_A = 25°C Unless Otherwise Specified)

Storage Temperature	−65°C to +150°C
Operating Temperature	−65°C to +125°C
Soldering:	
Lead Temperature (Iron)	240°C for 5 sec.(3,4,5,6)
Lead Temperature (Flow)	260°C for 10 sec.(3,4,6)
Continuous Forward Current	100 mA
Forward Current (pw, 10μS; 100 Hz)	3 A
Forward Current (pw, 1μS; 200 Hz)	10 A
Reverse Voltage	3 Volts
Power Dissipation (T_A = 25°C)	170 mW(1)
Power Dissipation (T_C = 25°C)	1.3 W(2)

ELECTRICAL CHARACTERISTICS (T_A = 25°C Unless Otherwise Specified)
(All measurements made under pulse conditions.)

PARAMETER	SYMBOL	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS
Forward Voltage	V_F	—		1.7	V	I_F = 100 mA
Reverse Leakage Current	I_R	—		10	μA	V_R = 3 V
Peak Emission Wavelength	λ_p		880		nm	I_F = 100 mA
Emission Angle at ½ Power	θ		±40		Degrees	
Total Power F5E1	Po	12.0		—	mW	I_F = 100 mA(7)
Total Power F5E2	Po	9.0		—	mW	I_F = 100 mA(7)
Total Power F5E3	Po	10.5		—	mW	I_F = 100 mA(7)
Rise Time 0-90% of output	t_r		1.5		μS	
Fall Time 100-10% of output	t_f		1.5		μS	

NOTES

1. *Derate power dissipation linearly 1.70 mW/°C above 25°C ambient.*
2. *Derate power dissipation linearly 13.0 mW/°C above 25°C case.*
3. *RMA flux is recommended.*
4. *Methanol or Isopranol alcohols are recommended as cleaning agents.*
5. *Soldering iron tip 1⁄16″ (1.6 mm) minimum from housing.*
6. *As long as leads are not under any stress or spring tension.*
7. *Total power output, Po, is the total power radiated by the device into a solid angle of 2π steradians.*

AlGaAs INFRARED EMITTING DIODE

TYPICAL CHARACTERISTICS

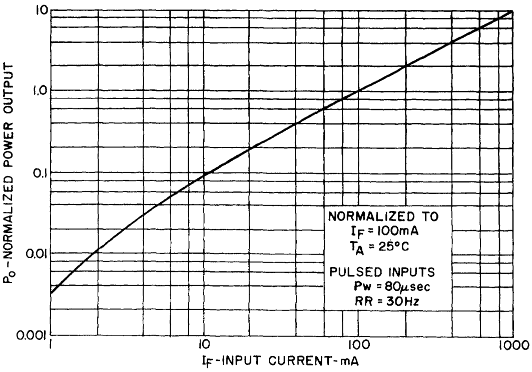


Fig. 1. Power Output vs. Input Current ST1025

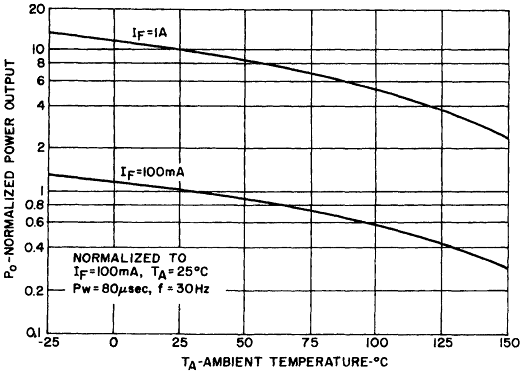


Fig. 2. Power Output vs. Temperature ST1026

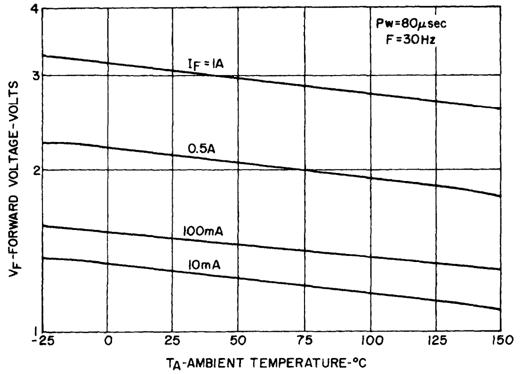


Fig. 3. Forward Voltage vs. Temperature ST1027

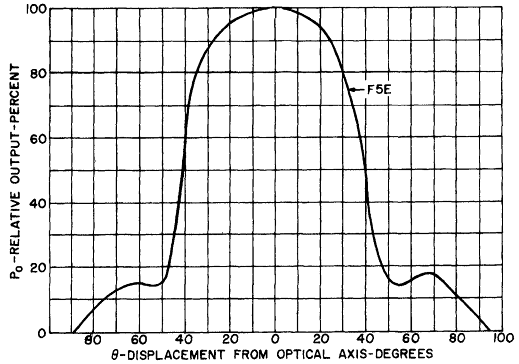


Fig. 4. Typical Radiation Pattern ST1028-98

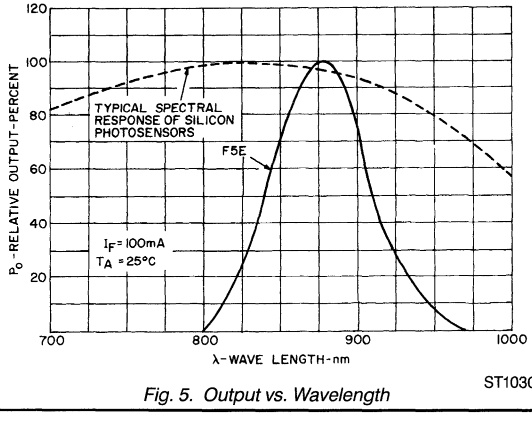
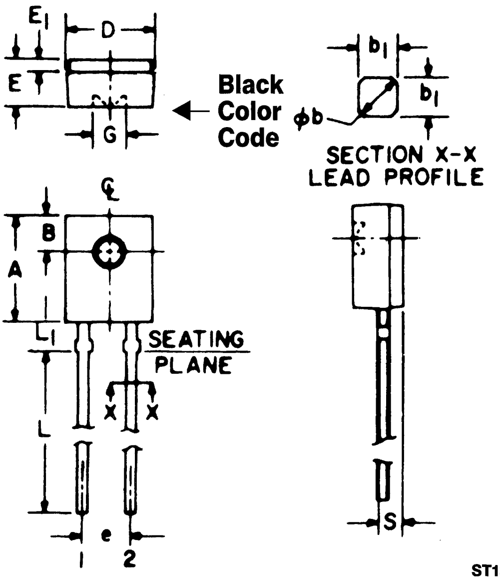


Fig. 5. Output vs. Wavelength ST1030-98

GaAs INFRARED EMITTING DIODE

F5F1

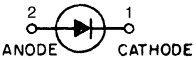
PACKAGE DIMENSIONS



ST1334

SYMBOL	MILLIMETERS		INCHES		NOTES
	MIN.	MAX.	MIN.	MAX.	
A	5.59	5.80	.220	.228	
B	1.78	NOM.	.070	NOM.	2
ϕb	.60	.75	.024	.030	1
b_1	.51	NOM.	.020	NOM.	1
D	4.45	4.70	.175	.185	
E	2.41	2.67	.095	.105	
E_1	.58	.69	.023	.027	
e	2.41	2.67	.095	.105	3
G	1.98	NOM.	.078	NOM.	
L	12.7	—	.500	—	
L_1	1.40	1.65	.055	.065	
S	.83	.94	.033	.037	3

PACKAGE OUTLINE



ST1604

NOTES:

1. TWO LEADS. LEAD CROSS SECTION DIMENSIONS UNCONTROLLED WITHIN 1.27 mm (.050") OF SEATING PLANE.
2. CENTERLINE OF ACTIVE ELEMENT LOCATED WITHIN .25 mm (.010") OF TRUE POSITION.
3. AS MEASURED AT THE SEATING PLANE.
4. INCH DIMENSIONS DERIVED FROM MILLIMETERS.

DESCRIPTION

The F5F1 is a 940nm LED encapsulated in a clear, wide angle, sidelooker package.

FEATURES

- Good optical to mechanical alignment
- Mechanically and wavelength matched to the L14Q series phototransistor
- Plastic package with a color stripe for easy recognition from phototransistor
- High irradiance level

GaAs INFRARED EMITTING DIODE

ABSOLUTE MAXIMUM RATINGS (T_A = 25°C Unless Otherwise Specified)

Storage Temperature . . . . −55°C to +100°C
Operating Temperature . . . . −55°C to +100°C
Soldering:
  Lead Temperature (Iron) . . . . 240°C for 5 sec.(2,3,4,5)
  Lead Temperature (Flow) . . . . 260°C for 10 sec.(2,3,5)
Continuous Forward Current . . . . 60 mA
Forward Current (pw, 1µS; ≤ 33 Hz) . . . . 3 A
Reverse Voltage . . . . 6 Volts
Power Dissipation . . . . 100 mW(1)

ELECTRICAL CHARACTERISTICS (T_A = 25°C Unless Otherwise Specified)
(All measurements made under pulse conditions.)

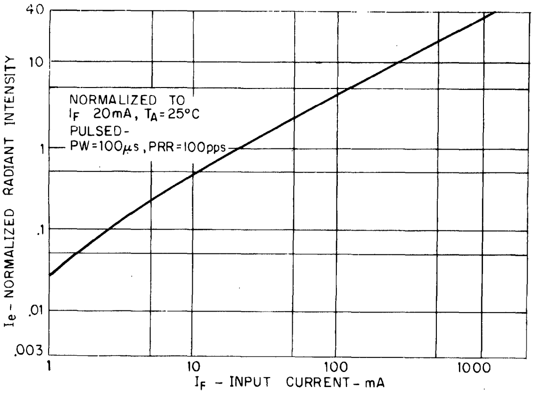
PARAMETER	SYMBOL	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS
Forward Voltage	V_F	—		1.7	V	I_F = 60 mA
Reverse Breakdown Voltage	V_R	6		—	V	I_R = 10 µA
Reverse Leakage Current	I_R	—		10	µA	V_R = 5 V
Peak Emission Wavelength	λ_p		940		nm	I_F = 100 mA
Emission Angle at ½ Power	θ		±35		Degrees	
Radiant Intensity	Ie	0.28		—	mW/sr	I_F = 20 mA(6)

NOTES

1. *Derate power dissipation linearly 1.33 mW/°C above 25°C ambient.*
2. *RMA flux is recommended.*
3. *Methanol or Isopranol alcohols are recommended as cleaning agents.*
4. *Soldering iron tip 1/16″ (1.6 mm) minimum from housing.*
5. *As long as leads are not under any stress or spring tension.*
6. *Ie measured with a 0.45 cm aperture placed 1.6 cm from the tip of the lens on the lens centerline perpendicular to the plane of the leads.*

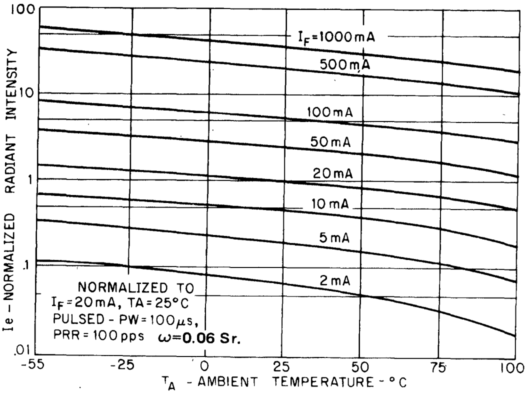
GaAs INFRARED EMITTING DIODE

TYPICAL CHARACTERISTICS



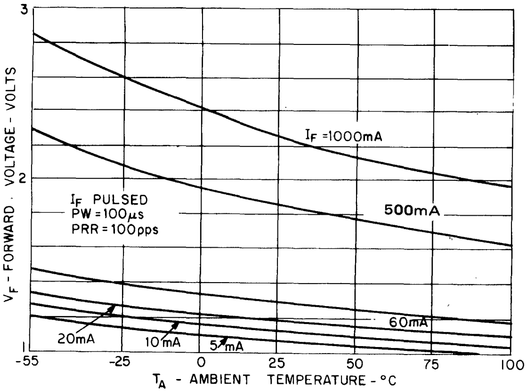
ST1033

Fig. 1. Radiant Intensity vs. Input Current



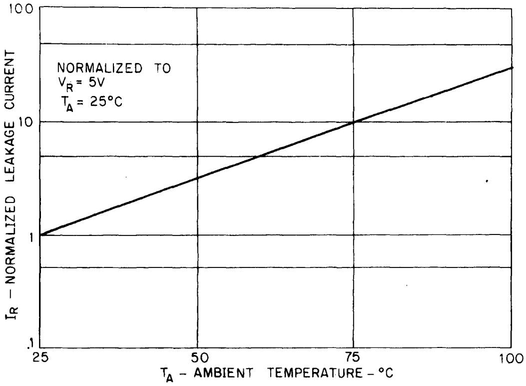
ST1038

Fig. 2. Radiant Intensity vs. Temperature



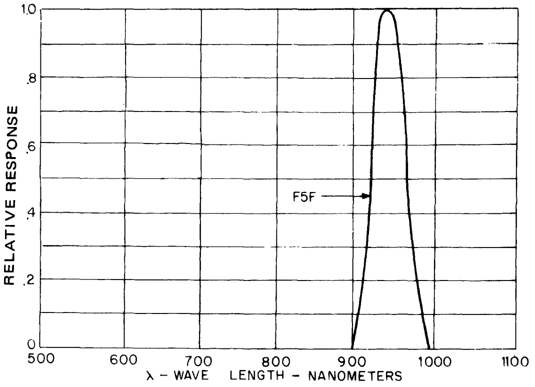
ST1034

Fig. 3. Forward Voltage vs. Temperature



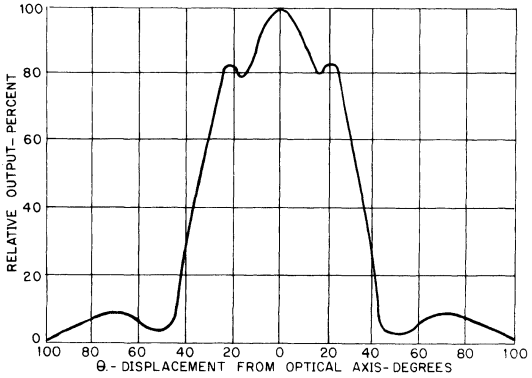
ST1037

Fig. 4. Leakage Current vs. Temperature



ST1035

Fig. 5. Spectral Response



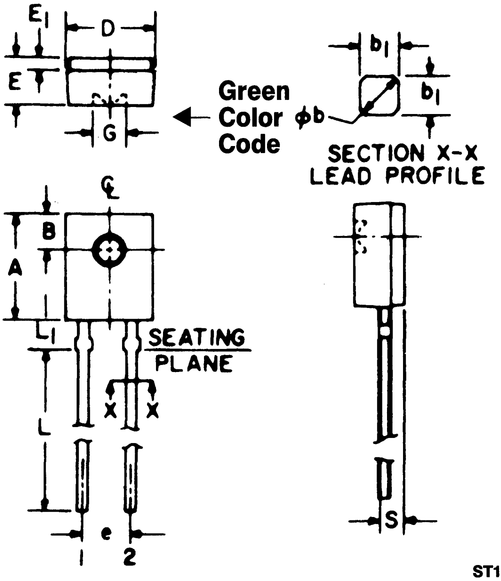
ST1036

Fig. 6. Typical Radiation Pattern

AlGaAs INFRARED EMITTING DIODE

F5G1

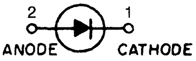
PACKAGE DIMENSIONS



ST1334

SYMBOL	MILLIMETERS		INCHES		NOTES
	MIN.	MAX.	MIN.	MAX.	
A	5.59	5.80	.220	.228	
B	1.78	NOM.	.070	NOM.	2
ϕb	.60	.75	.024	.030	1
b_1	.51	NOM.	.020	NOM.	1
D	4.45	4.70	.175	.185	
E	2.41	2.67	.095	.105	
E_1	.58	.69	.023	.027	
e	2.41	2.67	.095	.105	3
G	1.98	NOM.	.078	NOM.	
L	12.7	—	.500	—	
L_1	1.40	1.65	.055	.065	
S	.83	.94	.033	.037	3

PACKAGE OUTLINE



ST1604

NOTES:
1. TWO LEADS. LEAD CROSS SECTION DIMENSIONS UNCONTROLLED WITHIN 1.27 mm (.050″) OF SEATING PLANE.
2. CENTERLINE OF ACTIVE ELEMENT LOCATED WITHIN .25 mm (.010″) OF TRUE POSITION.
3. AS MEASURED AT THE SEATING PLANE.
4. INCH DIMENSIONS DERIVED FROM MILLIMETERS.

DESCRIPTION

The F5G1 is an 880nm LED encapsulated in a clear, wide angle, sidelooker package.

FEATURES

- Good optical to mechanical alignment
- Mechanically and wavelength matched to the L14Q series phototransistor
- Plastic package with a color stripe for easy recognition from phototransistor
- High irradiance level

AlGaAs INFRARED EMITTING DIODE

ABSOLUTE MAXIMUM RATINGS (T_A = 25°C Unless Otherwise Specified)

Storage Temperature	−55°C to +100°C
Operating Temperature	−55°C to +100°C
Soldering:	
Lead Temperature (Iron)	240°C for 5 sec.(2,3,4,5)
Lead Temperature (Flow)	260°C for 10 sec.(2,3,5)
Continuous Forward Current	50 mA
Forward Current (pw, 1μS; ≤ 33 Hz)	2 A
Reverse Voltage	6 Volts
Power Dissipation	100 mW(1)

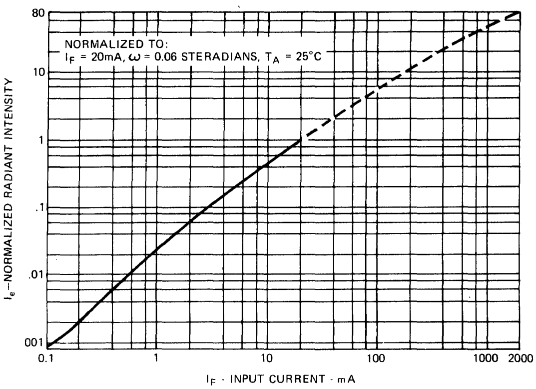
ELECTRICAL CHARACTERISTICS (T_A = 25°C Unless Otherwise Specified)
(All measurements made under pulse conditions.)

PARAMETER	SYMBOL	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS
Forward Voltage	V_F	—		1.7	V	I_F = 20 mA
Reverse Breakdown Voltage	V_R	6.0		—	V	I_R = 10 μA
Reverse Leakage Current	I_R	—		10	μA	V_R = 5 V
Peak Emission Wavelength	λ_p		880		nm	I_F = 100 mA
Emission Angle at ½ Power	θ		±35		Degrees	
Radiant Intensity	Ie	0.6		—	mW/sr	I_F = 20 mA(6)

NOTES

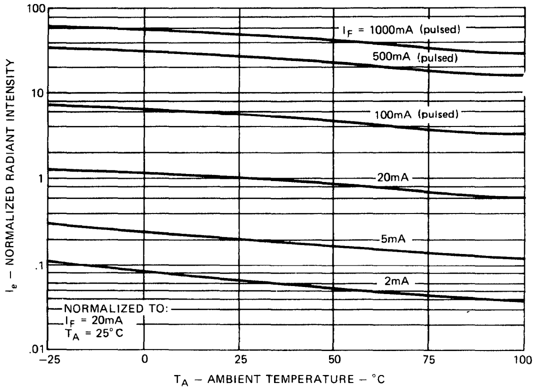
1. *Derate power dissipation linearly 1.33 mW/°C above 25°C ambient.*
2. *RMA flux is recommended.*
3. *Methanol or Isopranol alcohols are recommended as cleaning agents.*
4. *Soldering iron tip 1⁄16″ (1.6 mm) minimum from housing.*
5. *As long as leads are not under any stress or spring tension.*
6. *Ie measured with a 0.45 cm aperture placed 1.6 cm from the tip of the lens on the lens centerline perpendicular to the plane of the leads.*

TYPICAL CHARACTERISTICS



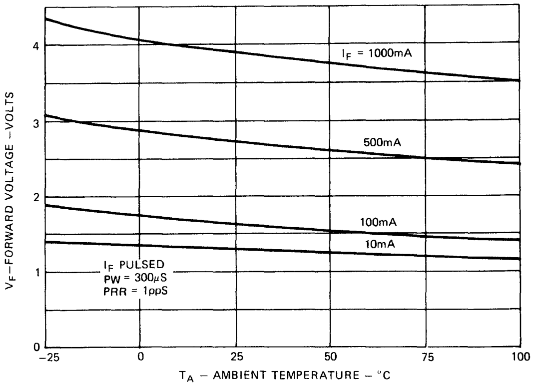
ST1041

Fig. 1. Radiant Intensity vs. Input Current



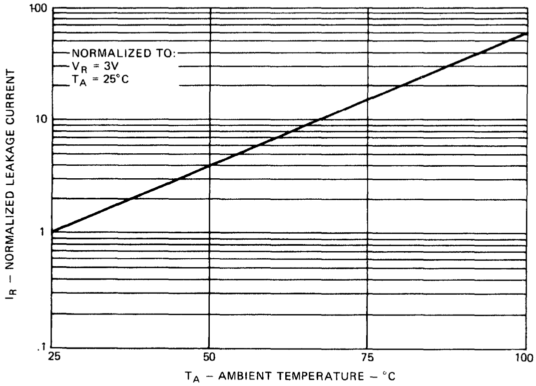
ST1046

Fig. 2. Radiant Intensity vs. Temperature



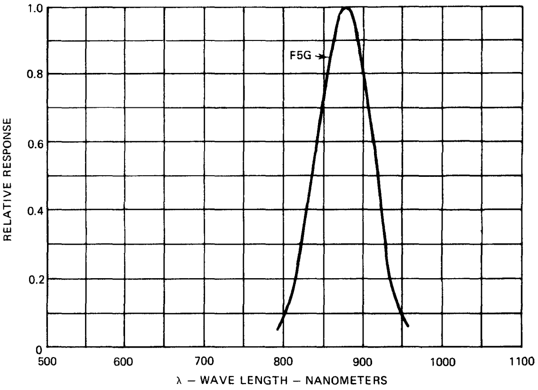
ST1042

Fig. 3. Forward Voltage vs. Temperature



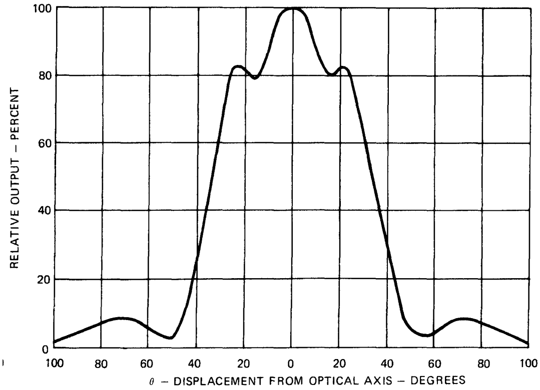
ST1045

Fig. 4. Leakage Current vs. Temperature



ST1043

Fig. 5. Spectral Response



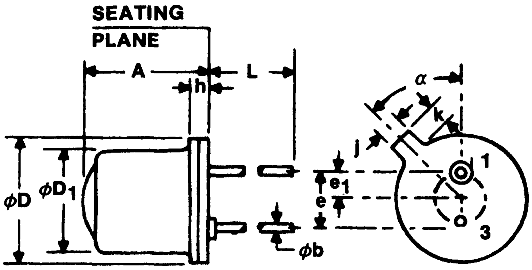
ST1044

Fig. 6. Typical Radiation Pattern

GaAs INFRARED EMITTING DIODE

LED55B/C, LED56

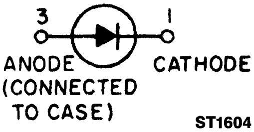
PACKAGE DIMENSIONS



ST1332

SYMBOL	INCHES		MILLIMETERS		NOTES
	MIN.	MAX.	MIN.	MAX.	
A		.255		6.47	
ϕb	.016	.021	.407	.533	
ϕD	.209	.230	5.31	5.84	
ϕD_1	.180	.188	4.57	4.77	
e	.100 NOM.		2.54 NOM.		2
e_1	.050 NOM.		1.27 NOM.		2
h		.030		.76	
j	.031	.044	.79	1.11	
k	.036	.046	.92	1.16	1
L	1.00		25.4		
α	45°	45°	45°	45°	3

PACKAGE OUTLINE



ST1604

NOTES:

1. MEASURED FROM MAXIMUM DIAMETER OF DEVICE.
2. LEADS HAVING MAX. DIAMETER .021″ (.533mm) MEASURED IN GAUGING PLANE .054″ + .001″ − .000 (137 + 025 − 000mm) BELOW THE REFERENCE PLANE OF THE DEVICE SHALL BE WITHIN .007″ (.778mm) THEIR TRUE POSITION RELATIVE TO A MAXIMUM WIDTH TAB.
3. FROM CENTERLINE TAB.

DESCRIPTION

The LED55B/C and LED56 are 940nm LEDs in a narrow angle, TO-46 package.

FEATURES

- Good optical to mechanical alignment
- Mechanically and wavelength matched to the TO-18 series phototransistor
- Hermetically sealed package
- High irradiance level

GaAs INFRARED EMITTING DIODE

ABSOLUTE MAXIMUM RATINGS (T_A = 25°C Unless Otherwise Specified)

Storage Temperature	−65°C to +150°C
Operating Temperature	−65°C to +125°C
Soldering:	
Lead Temperature (Iron)	240°C for 5 sec.(3,4,5,6)
Lead Temperature (Flow)	260°C for 10 sec.(3,4,6)
Continuous Forward Current	100 mA
Forward Current (pw, 1μS; 200 Hz)	10 A
Reverse Voltage	3 Volts
Power Dissipation (T_A = 25°C)	170 mW(1)
Power Dissipation (T_C = 25°C)	1.3 W(2)

ELECTRICAL CHARACTERISTICS (T_A = 25°C Unless Otherwise Specified)

(All measurements made under pulse conditions.)

PARAMETER	SYMBOL	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS
Forward Voltage	V_F	—		1.7	V	I_F = 100 mA
Reverse Leakage Current	I_R	—		10	μA	V_R = 3 V
Peak Emission Wavelength	λ_p		940		nm	I_F = 100 mA
Emission Angle at ½ Power	θ		±8		Degrees	
Total Power LED55B	Po	3.5		—	mW	I_F = 100 mA(7)
Total Power LED55C	Po	5.4		—	mW	I_F = 100 mA(7)
Total Power LED56	Po	1.5		—	mW	I_F = 100 mA(7)
Rise Time 0-90% of output	t_r		1.0		μS	
Fall Time 100-10% of output	t_f		1.0		μS	

NOTES

1. *Derate power dissipation linearly 1.70 mW/°C above 25°C ambient.*
2. *Derate power dissipation linearly 13.0 mW/°C above 25°C case.*
3. *RMA flux is recommended.*
4. *Methanol or Isopranol alcohols are recommended as cleaning agents.*
5. *Soldering iron tip 1/16″ (1.6 mm) minimum from housing.*
6. *As long as leads are not under any stress or spring tension.*
7. *Total power output, Po, is the total power radiated by the device into a solid angle of 2π steradians.*

GaAs INFRARED EMITTING DIODE

TYPICAL CHARACTERISTICS

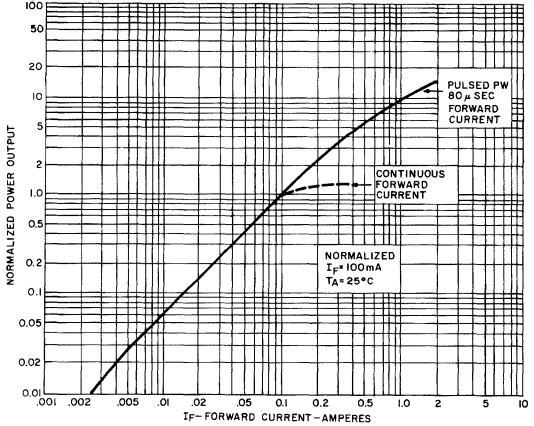


Fig. 1. Power Output vs. Input Current ST1052

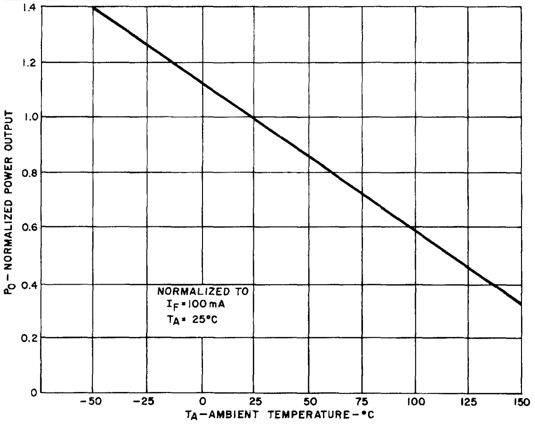


Fig. 2. Power Output vs. Temperature ST1057

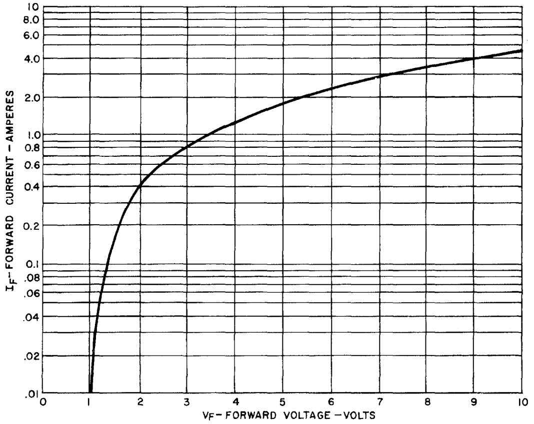


Fig. 3. Forward Voltage vs. Forward Current ST1053

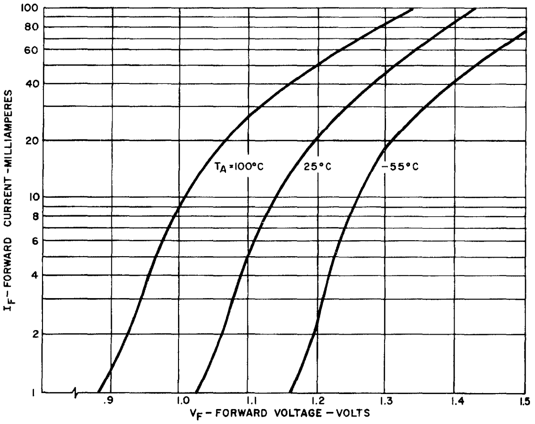


Fig. 4. Forward Voltage vs. Forward Current ST1056

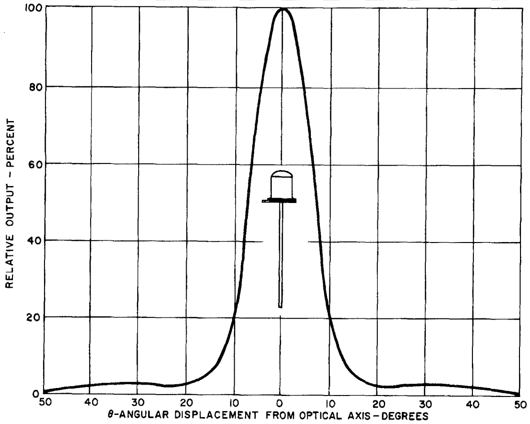
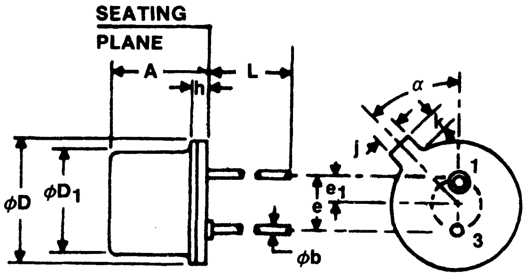


Fig. 5. Typical Radiation Pattern ST1054

GaAs INFRARED EMITTING DIODE

LED55BF/CF, LED56F

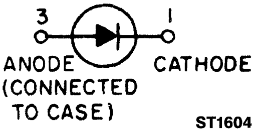
PACKAGE DIMENSIONS



ST1331

SYMBOL	INCHES		MILLIMETERS		NOTES
	MIN.	MAX.	MIN.	MAX.	
A		.155		3.93	
ϕb	.016	.021	.407	.533	
ϕD	.209	.230	5.31	5.84	
ϕD_1	.180	.188	4.57	4.77	
e	.100 NOM.		2.54 NOM.		2
e_1	.050 NOM.		1.27 NOM.		2
h		.030		.76	
j	.031	.044	.79	1.11	
k	.036	.046	.92	1.16	1
L	1.00		25.4		
α	45°	45°	45°	45°	3

PACKAGE OUTLINE



ST1604

NOTES:
1. MEASURED FROM MAXIMUM DIAMETER OF DEVICE.
2. LEADS HAVING MAX. DIAMETER .021″ (.533mm) MEASURED IN GAUGING PLANE .054″ + .001″ − .000 (137 + 025 − 000mm) BELOW THE REFERENCE PLANE OF THE DEVICE SHALL BE WITHIN .007″ (.778mm) THEIR TRUE POSITION RELATIVE TO A MAXIMUM WIDTH TAB.
3. FROM CENTERLINE TAB.

DESCRIPTION

The LED55BF/CF and LED56F are 940nm LEDs in a wide angle, TO-46 package.

FEATURES

- Good optical to mechanical alignment
- Mechanically and wavelength matched to the TO-18 series phototransistor
- Hermetically sealed package
- High irradiance level

GaAs INFRARED EMITTING DIODE

ABSOLUTE MAXIMUM RATINGS (T_A = 25°C Unless Otherwise Specified)

Storage Temperature	−65°C to +150°C
Operating Temperature	−65°C to +125°C
Soldering:	
Lead Temperature (Iron)	240°C for 5 sec.(3,4,5,6)
Lead Temperature (Flow)	260°C for 10 sec.(3,4,6)
Continuous Forward Current	100 mA
Forward Current (pw, 1μS; 200 Hz)	10 A
Reverse Voltage	3 Volts
Power Dissipation (T_A = 25°C)	170 mW(1)
Power Dissipation (T_C = 25°C)	1.3 W(2)

ELECTRICAL CHARACTERISTICS (T_A = 25°C Unless Otherwise Specified) (All measurements made under pulse conditions.)

PARAMETER	SYMBOL	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS
Forward Voltage	V_F	—		1.7	V	I_F = 100 mA
Reverse Leakage Current	I_R	—		10	μA	V_R = 3 V
Peak Emission Wavelength	λ_p		940		nm	I_F = 100 mA
Emission Angle at ½ Power	θ		±40		Degrees	
Total Power LED55BF	Po	3.5		—	mW	I_F = 100 mA(7)
Total Power LED55CF	Po	5.4		—	mW	I_F = 100 mA(7)
Total Power LED56F	Po	1.5		—	mW	I_F = 100 mA(7)
Rise Time 0-90% of output	t_r		1.0		μS	
Fall Time 100-10% of output	t_f		1.0		μS	

NOTES

1. *Derate power dissipation linearly 1.70 mW/°C above 25°C ambient.*
2. *Derate power dissipation linearly 13.0 mW/°C above 25°C case.*
3. *RMA flux is recommended.*
4. *Methanol or Isopranol alcohols are recommended as cleaning agents.*
5. *Soldering iron tip 1⁄16″ (1.6 mm) minimum from housing.*
6. *As long as leads are not under any stress or spring tension.*
7. *Total power output, Po, is the total power radiated by the device into a solid angle of 2π steradians.*

GaAs INFRARED EMITTING DIODE

TYPICAL CHARACTERISTICS

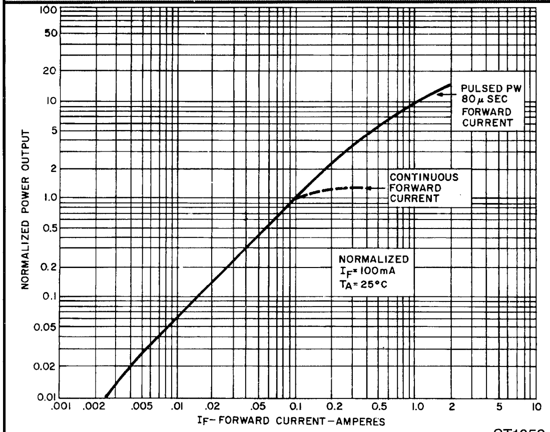


Fig. 1. Power Output vs. Input Current ST1052

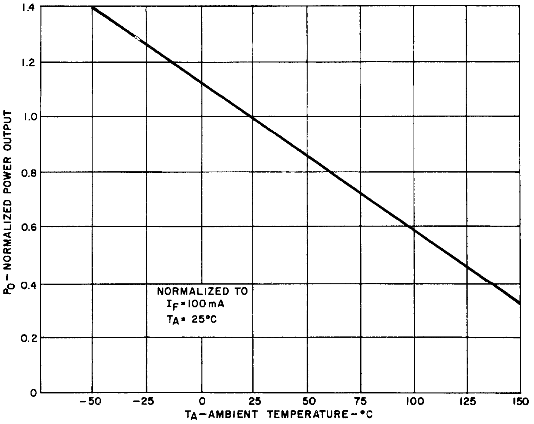


Fig. 2. Power Output vs. Temperature ST1057

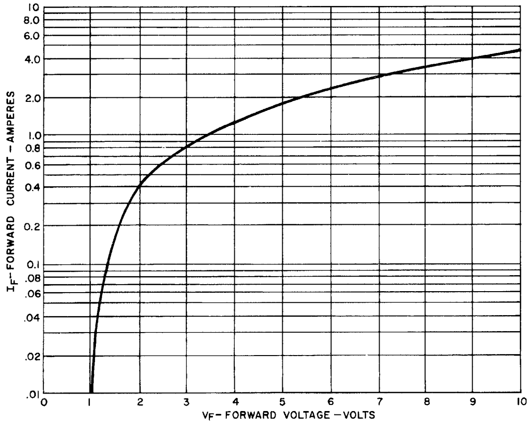


Fig. 3. Forward Voltage vs. Forward Current ST1053

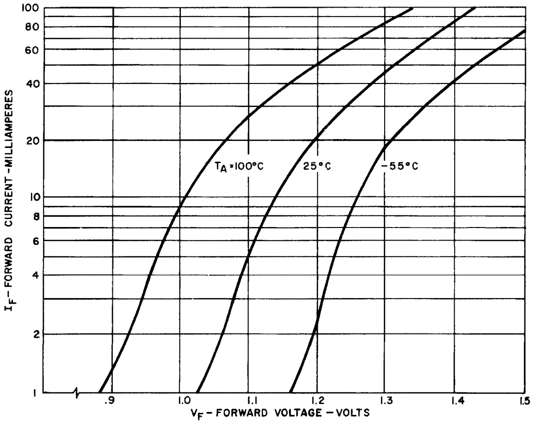


Fig. 4. Forward Voltage vs. Forward Current ST1056

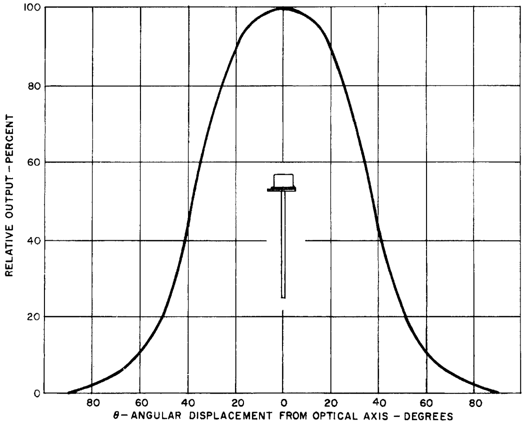
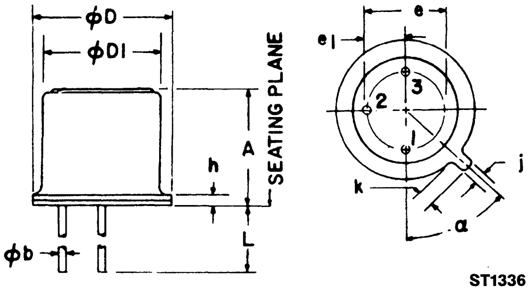


Fig. 5. Typical Radiation Pattern ST1055

HERMETIC SILICON PHOTOTRANSISTOR

L14C1/C2

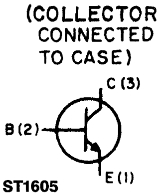
PACKAGE DIMENSIONS



ST1336

SYMBOL	INCHES		MILLIMETERS		NOTES
	MIN.	MAX.	MIN.	MAX.	
A	—	210	—	5.34	
ϕb	.016	.021	.406	.534	
ϕD	.209	.230	5.30	5.85	
ϕD_1	.178	.195	4.52	4.96	
e	.100 NOM.		2.54 NOM.		2
e_1	.050 NOM.		1.27 NOM.		2
h	—	.030	—	.76	
j	.036	.046	.91	1.17	
k	.028	.048	.71	1.22	1
L	.500	—	12.7	—	
α	45°	45°	45°	45°	3

PACKAGE OUTLINE



ST1605

NOTES:
1. MEASURED FROM MAXIMUM DIAMETER OF DEVICE.
2. LEADS HAVING MAXIMUM DIAMETER .021″ (.533mm) MEASURED IN GAUGING PLANE .054″ + .001″ − .000 (137 + 025 − 000mm) BELOW THE REFERENCE PLANE OF THE DEVICE SHALL BE WITHIN .007″ (.778mm) THEIR TRUE POSITION RELATIVE TO MAXIMUM WIDTH TAB.
3. FROM CENTERLINE TAB.

DESCRIPTION

The L14C series is a silicon phototransistor mounted in a wide angle, TO-18 package.

FEATURES

- Hermetically sealed package
- Wide reception angle

HERMETIC SILICON PHOTOTRANSISTOR

ABSOLUTE MAXIMUM RATINGS (T_A = 25°C Unless Otherwise Specified)

Storage Temperature . . . . −65°C to +150°C
Operating Temperature . . . . −65°C to +125°C
Soldering:
  Lead Temperature (Iron) . . . . 240°C for 5 sec.(3,4,5,6)
  Lead Temperature (Flow) . . . . 260°C for 10 sec.(3,4,6)
Collector-Emitter Breakdown Voltage . . . . 50 Volts
Collector-Base Breakdown Voltage . . . . 50 Volts
Emitter-Base Breakdown Voltage . . . . 7 Volts
Power Dissipation (T_A = 25°C) . . . . 300 mW(1)
Power Dissipation (T_C = 25°C) . . . . 600 mW(2)

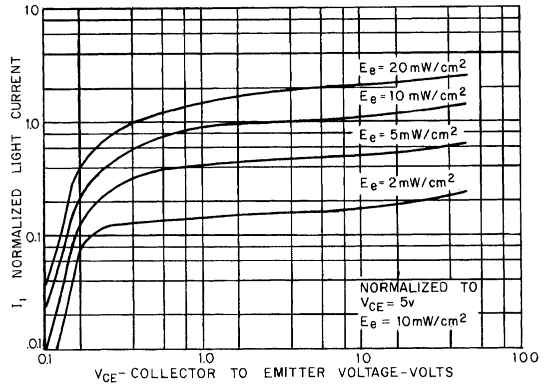
ELECTRICAL CHARACTERISTICS (T_A = 25°C Unless Otherwise Specified)
(All measurements made under pulse conditions.)

PARAMETER	SYMBOL	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS
Collector-Emitter Breakdown	BV_{CEO}	50		—	V	I_C = 10 mA, Ee = 0
Emitter-Base Breakdown	BV_{EBO}	7.0		—	V	I_E = 100μA, Ee = 0
Collector-Base Breakdown	BV_{CBO}	50		—	V	I_C = 100μA, Ee = 0
Collector-Emitter Leakage	I_{CEO}	—		100	nA	V_{CE} = 20 V, Ee = 0
Reception Angle at ½ Sensitivity	θ		±40		Degrees	
On-State Collector Current L14C1	$I_{C(ON)}$	1.0		—	mA	Ee = 3.0 mW/cm², V_{CE} = 5 V(7,8)
On-State Collector Current L14C2	$I_{C(ON)}$	0.5		—	mA	Ee = 3.0 mW/cm², V_{CE} = 5 V(7,8)
On-State Collector Current L14C2	$I_{C(ON)}$	1.0		—	mA	Ee = 6.0 mW/cm², V_{CE} = 5 V(7,8)
Turn-On Time	t_{on}		5		μS	I_C = 2 mA, V_{CC} = 10 V, R_L = 100Ω
Turn-Off Time	t_{off}		5		μS	I_C = 2 mA, V_{CC} = 10 V, R_L = 100Ω
Saturation Voltage	$V_{CE(SAT)}$	—		0.40	V	I_C = 0.40 mA, Ee = 6.0 mW/cm²(7,8)

NOTES

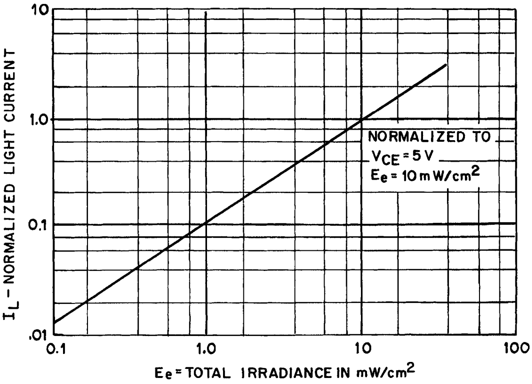
1. *Derate power dissipation linearly 3.00mW/°C above 25°C ambient.*
2. *Derate power dissipation linearly 6.00mW/°C above 25°C case.*
3. *RMA flux is recommended.*
4. *Methanol or Isopropyl alcohols are recommended as cleaning agents.*
5. *Soldering iron tip 1⁄16″ (1.6 mm) minimum from housing.*
6. *As long as leads are not under any stress or spring tension.*
7. *Light source is a GaAs LED emitting light at a peak wavelength of 940 nm.*
8. *Figure 1 and figure 2 use light source of tungsten lamp at 2870°K color temperature. A GaAs source of 3.0 mW/cm² is approximately equivalent to a tungsten source, at 2870°K, of 10 mW/cm².*

TYPICAL CHARACTERISTICS



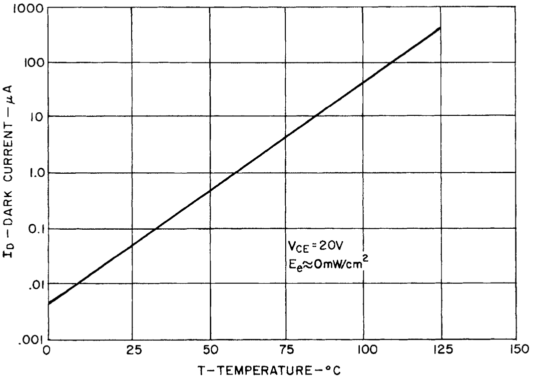
ST1062

Fig. 1. Light Current vs. Collector to Emitter Voltage



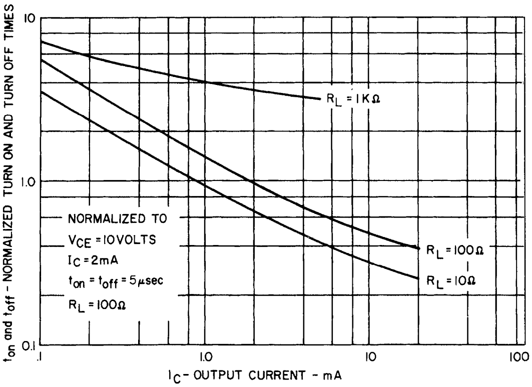
ST1067

Fig. 2. Normalized Light Current vs. Radiation



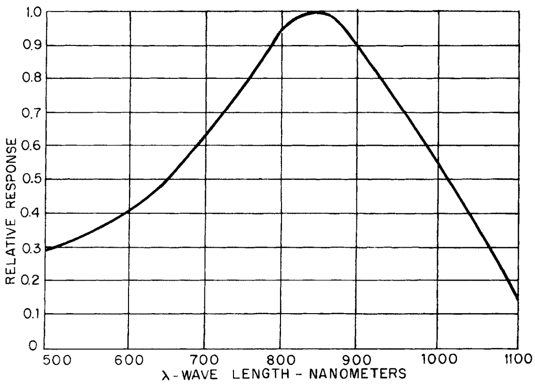
ST1063

Fig. 3. Dark Current vs. Temperature



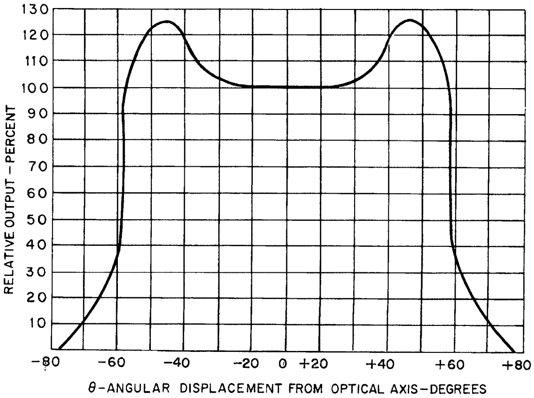
ST1066

Fig. 4. Switching Speed vs. Output Current



ST1064

Fig. 5. Spectral Response



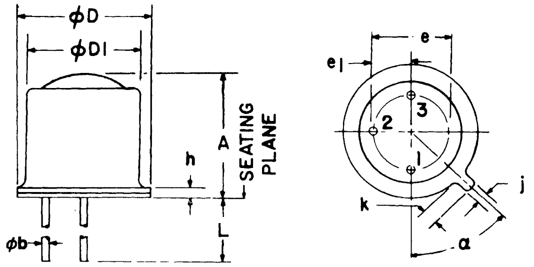
ST1065

Fig. 6. Angular Response Curve

HERMETIC SILICON PHOTODARLINGTON

L14F1/2

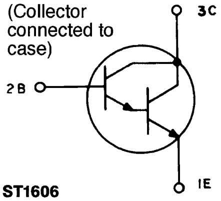
PACKAGE DIMENSIONS



ST1333

SYMBOL	INCHES		MILLIMETERS		NOTES
	MIN.	MAX.	MIN.	MAX.	
A	.225	.255	5.71	6.47	
ϕb	.016	.021	.407	533	
ϕD	.209	.230	5.31	5.84	
ϕD_1	.178	.195	4.52	4.96	
e	.100 NOM		2.54 NOM		2
e_1	.050 NOM		1.27 NOM		2
h	—	.030	—	.76	
j	.036	.046	.92	1.16	
k	.028	.048	.71	1.22	1
L	.500	—	12.7	—	
α	45°	45°	45°	45°	3

PACKAGE OUTLINE



ST1606

NOTES:

1. MEASURED FROM MAXIMUM DIAMETER OF DEVICE.
2. LEADS HAVING MAXIMUM DIAMETER .021″ (.533mm) MEASURED IN GAUGING PLANE .054″ + .001″ − .000 (137 + .025 − .000mm) BELOW THE REFERENCE PLANE OF THE DEVICE SHALL BE WITHIN .007″ (.778mm) THEIR TRUE POSITION RELATIVE TO A MAXIMUM WIDTH TAB.
3. FROM CENTERLINE TAB.

DESCRIPTION

The L14FX is a silicon photodarlington mounted in a narrow angle, TO-18 package.

FEATURES

- Hermetically sealed package
- Narrow reception angle

HERMETIC SILICON PHOTODARLINGTON

ABSOLUTE MAXIMUM RATINGS (T_A = 25°C Unless Otherwise Specified)

Storage Temperature	−65°C to +150°C
Operating Temperature	−65°C to +125°C
Soldering:	
Lead Temperature (Iron)	240°C for 5 sec.(3,4,5,6)
Lead Temperature (Flow)	260°C for 10 sec.(3,4,6)
Collector-Emitter Breakdown Voltage	25 Volts
Collector-Base Breakdown Voltage	25 Volts
Emitter-Base Breakdown Voltage	12 Volts
Power Dissipation (T_A = 25°C)	300 mW(1)
Power Dissipation (T_C = 25°C)	600 mW(2)

ELECTRICAL CHARACTERISTICS (T_A = 25°C Unless Otherwise Specified)
(All measurements made under pulse conditions.)

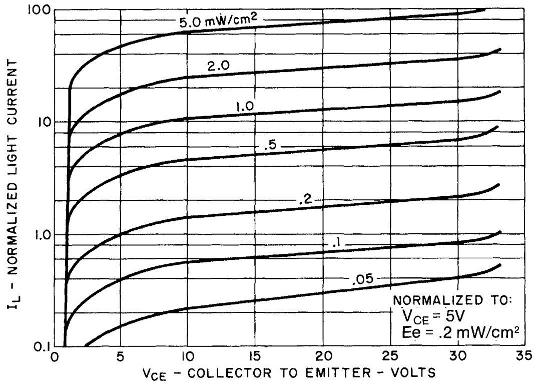
PARAMETER	SYMBOL	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS
Collector-Emitter Breakdown	BV_{CEO}	25		—	V	I_F = 10 mA, Ee = 0
Emitter-Base Breakdown	BV_{EBO}	12		—	V	I_E = 100 V, Ee = 0
Collector-Base Breakdown	BV_{CBO}	25		—	V	I_C = 100 μA, Ee = 0
Collector-Emitter Leakage	I_{CEO}	—		100	nA	V_{CE} = 12 V, Ee = 0
Reception Angle at ½ Sensitivity	θ		±6		Degrees	
On-State Collector Current L14F1	$I_{C(ON)}$	3.0		—	mA	Ee = .05 mW/cm², V_{CE} = 5 V(7)
On-State Collector Current L14F2	$I_{C(ON)}$	1.0		—	mA	Ee = .05 mW/cm², V_{CE} = 5 V(7)
Rise Time	t_r		300		μS	I_C = 10 mA, V_{CC} = 10 V, R_L = 100Ω
Fall Time	t_f		250		μS	I_C = 10 mA, V_{CC} = 10 V, R_L = 100Ω

NOTES

1. *Derate power dissipation linearly 3.00mW/°C above 25°C ambient.*
2. *Derate power dissipation linearly 6.00mW/°C above 25°C case.*
3. *RMA flux is recommended.*
4. *Methanol or Isopropyl alcohols are recommended as cleaning agents.*
5. *Soldering iron tip 1⁄16″ (1.6 mm) minimum from housing.*
6. *As long as leads are not under any stress or spring tension.*
7. *Light source is a GaAs LED emitting light at a peak wavelength of 940 nm.*
8. *Figure 1 and figure 2 use light source of tungsten lamp at 2870°K color temperature. A GaAs source of 0.05 mW/cm² is approximately equivalent to a tungsten source, at 2870°K, of 0.2 mW/cm².*

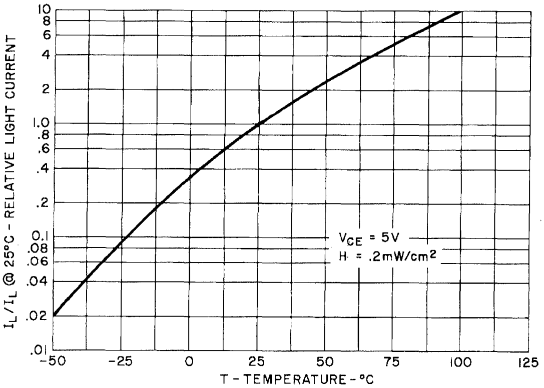
HERMETIC SILICON PHOTODARLINGTON

TYPICAL CHARACTERISTICS



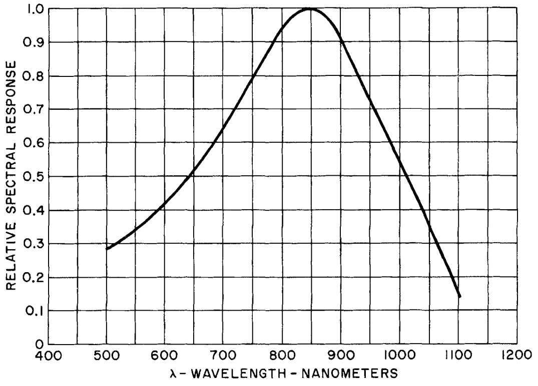
ST1072

Fig. 1. Light Current vs. Collector to Emitter Voltage



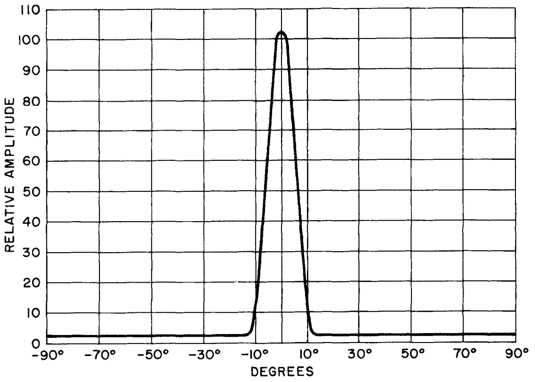
ST1077

Fig. 2. Relative Light Current vs. Ambient Temperature



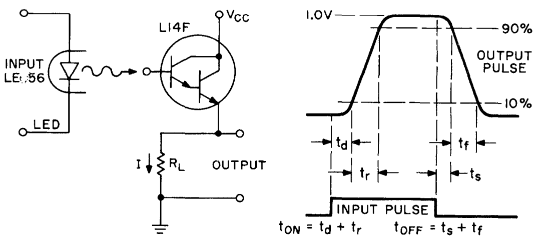
ST1073

Fig. 3. Spectral Response Curve



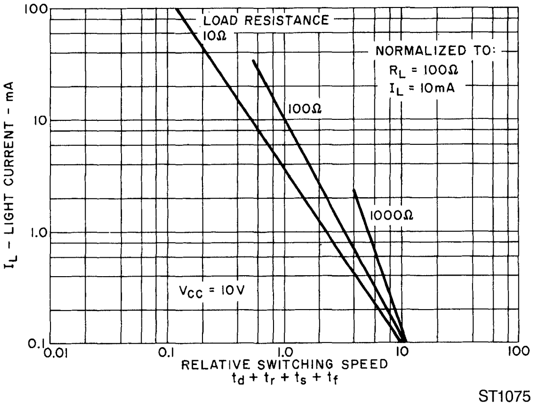
ST1076

Fig. 4. Angular Response



ST1074

Fig. 5. Test Circuit and Voltage Waveforms



ST1075

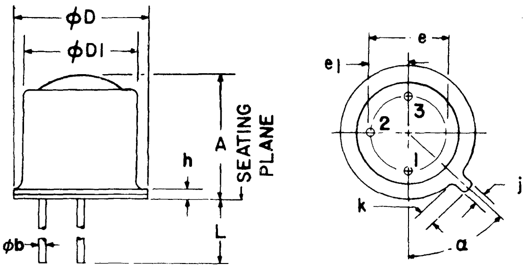
Fig. 6. Light Current vs. Relative Switching Speed

QT OPTOELECTRONICS

HERMETIC SILICON PHOTOTRANSISTOR

L14G1/2/3

PACKAGE DIMENSIONS

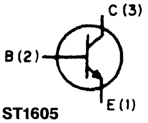


ST1333

SYMBOL	INCHES		MILLIMETERS		NOTES
	MIN.	MAX.	MIN.	MAX.	
A	.225	.255	5.71	6.47	
ϕb	.016	.021	.407	533	
ϕD	.209	.230	5.31	5.84	
ϕD_1	.178	.195	4.52	4.96	
e	.100 NOM		2.54 NOM		2
e_1	.050 NOM		1.27 NOM		2
h	—	.030	—	.76	
j	.036	.046	.92	1.16	
k	.028	.048	.71	1.22	1
L	.500	—	12.7	—	
α	45°	45°	45°	45°	3

PACKAGE OUTLINE

(COLLECTOR
CONNECTED
TO CASE)



ST1605

NOTES:
1. MEASURED FROM MAXIMUM DIAMETER OF DEVICE.
2. LEADS HAVING MAXIMUM DIAMETER .021" (.533mm) MEASURED IN GAUGING PLANE .054" + .001" − .000 (137 + .025 − .000mm) BELOW THE REFERENCE PLANE OF THE DEVICE SHALL BE WITHIN .007" (.778mm) THEIR TRUE POSITION RELATIVE TO MAXIMUM WIDTH TAB.
3. FROM CENTERLINE TAB.

DESCRIPTION

The L14G series is a silicon phototransister mounted in a narrow angle, TO-18 package.

FEATURES

- Hermetically sealed package
- Narrow reception angle

HERMETIC SILICON PHOTOTRANSISTOR

ABSOLUTE MAXIMUM RATINGS (T_A = 25°C Unless Otherwise Specified)

Storage Temperature . . . . −65°C to +150°C
Operating Temperature . . . . −65°C to +125°C
Soldering:
  Lead Temperature (Iron) . . . . 240°C for 5 sec.(3,4,5,6)
  Lead Temperature (Flow) . . . . 260°C for 10 sec.(3,4,6)
Collector-Emitter Breakdown Voltage . . . . 45 Volts
Collector-Base Breakdown Voltage . . . . 45 Volts
Emitter-Base Breakdown Voltage . . . . 5 Volts
Power Dissipation (T_A = 25°C) . . . . 300 mW(1)
Power Dissipation (T_C = 25°C) . . . . 600 mW(2)

ELECTRICAL CHARACTERISTICS (T_A = 25°C Unless Otherwise Specified)
(All measurements made under pulse conditions.)

PARAMETER	SYMBOL	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS
Collector-Emitter Breakdown	BV_{CEO}	45		—	V	I_C = 10 mA, Ee = 0
Emitter-Base Breakdown	BV_{EBO}	5.0		—	V	I_E = 100 μA, Ee = 0
Collector-Base Breakdown	BV_{CBO}	45		—	V	I_C = 100 μA, Ee = 0
Collector-Emitter Leakage	I_{CEO}	—		100	nA	V_{CE} = 10 V, Ee = 0
Reception Angle at ½ Sensitivity	θ		±10		Degrees	
On-State Collector Current L14G1	$I_{C(ON)}$	6.0		—	mA	Ee = 3.0 mW/cm², V_{CE} = 5 V(7,8)
On-State Collector Current L14G2	$I_{C(ON)}$	3.0		—	mA	Ee = 3.0 mW/cm², V_{CE} = 5 V(7,8)
On-State Collector Current L14G3	$I_{C(ON)}$	12.0		—	mA	Ee = 3.0 mW/cm², V_{CE} = 5 V(7,8)
Turn-On Time	t_{on}		8		μS	I_C = 2 mA, V_{CC} = 10 V, R_L = 100Ω
Turn-Off Time	t_{off}		7		μS	I_C = 2 mA, V_{CC} = 10 V, R_L = 100Ω
Saturation Voltage	$V_{CE(SAT)}$	—		0.40	V	I_C = 1.0 mA, Ee = 3.0 mW/cm²(7,8)

NOTES

1. *Derate power dissipation linearly 3.00mW/°C above 25°C ambient.*
2. *Derate power dissipation linearly 6.00mW/°C above 25°C case.*
3. *RMA flux is recommended.*
4. *Methanol or Isopropyl alcohols are recommended as cleaning agents.*
5. *Soldering iron tip 1⁄16″ (1.6 mm) minimum from housing.*
6. *As long as leads are not under any stress or spring tension.*
7. *Light source is a GaAs LED emitting light at a peak wavelength of 940 nm.*
8. *Figure 1 and figure 2 use light source of tungsten lamp at 2870°K color temperature. A GaAs source of 3.0 mW/cm² is approximately equivalent to a tungsten source, at 2870°K of 10 mW/cm².*

HERMETIC SILICON PHOTOTRANSISTOR

TYPICAL CHARACTERISTICS

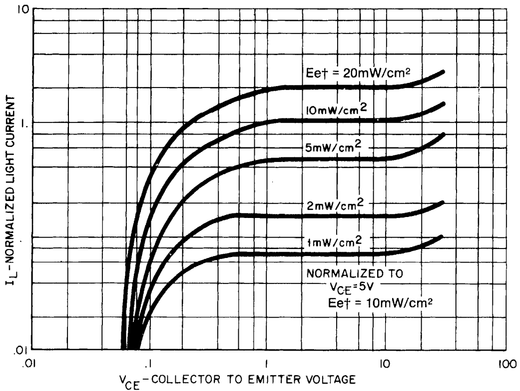


Fig. 1. Light Current vs. Collector to Emitter Voltage ST1082

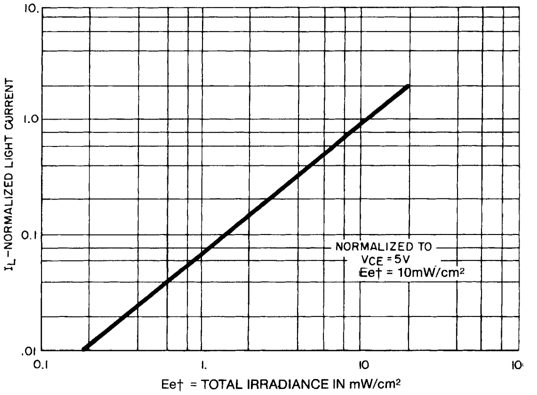


Fig. 2. Normalized Light Current vs. Radiation ST1087

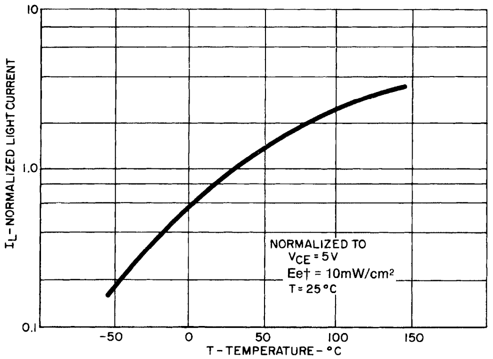


Fig. 3. Normalized Light Current vs. Temperature ST1083

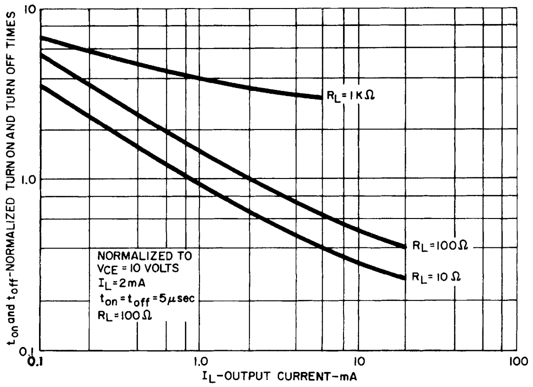


Fig. 4. Switching Times vs. Output Current ST1086

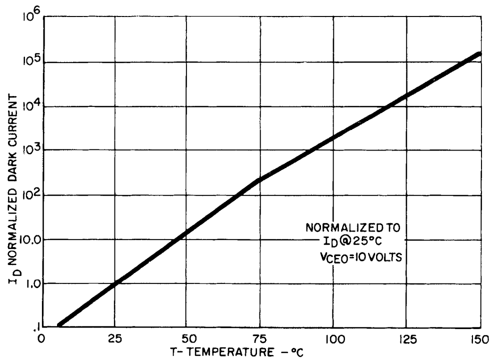


Fig. 5. Dark Current vs. Temperature ST1084

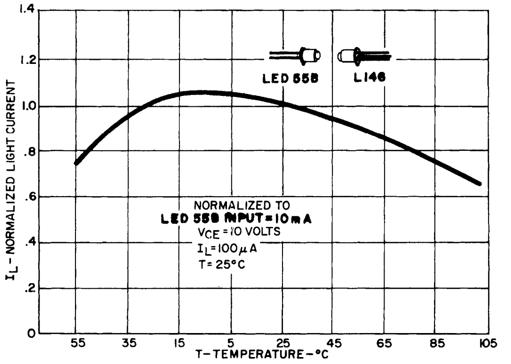
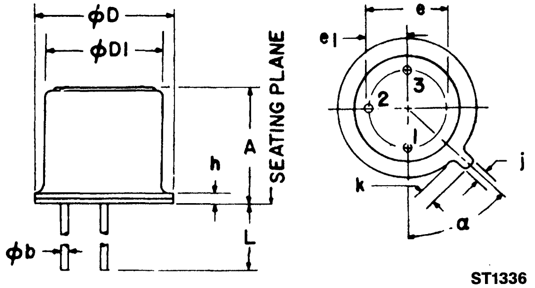


Fig. 6. Normalized Light Current vs. Temperature Both Emitter (LED55B) and Detector (L14G) at Same Temperature ST1085

HERMETIC SILICON PHOTOTRANSISTOR

L14N1/2

PACKAGE DIMENSIONS

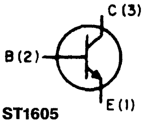


ST1336

SYMBOL	INCHES		MILLIMETERS		NOTES
	MIN.	MAX.	MIN.	MAX.	
A	—	210	—	5.34	
ϕb	.016	.021	.406	.534	
ϕD	.209	.230	5.30	5.85	
ϕD_1	.178	.195	4.52	4.96	
e	.100 NOM		2.54 NOM		2
e_1	0.50 NOM		1.27 NOM		2
h	—	.030	—	.76	
j	.036	.046	.91	1.17	
k	.028	.048	.71	1.22	1
L	.500	—	12.7	—	
α	45°	45°	45°	45°	3

PACKAGE OUTLINE

(COLLECTOR
CONNECTED
TO CASE)



ST1605

NOTES:
1. MEASURED FROM MAXIMUM DIAMETER OF DEVICE.
2. LEADS HAVING MAXIMUM DIAMETER .021″ (.533mm) MEASURED IN GAUGING PLANE .054″ + .001″ − .000 (137 + .025 − .000mm) BELOW THE REFERENCE PLANE OF THE DEVICE SHALL BE WITHIN .007″ (.778mm) THEIR TRUE POSITION RELATIVE TO MAXIMUM WIDTH TAB.
3. FROM CENTERLINE TAB.

DESCRIPTION

The L14N series is a silicon phototransister mounted in a wide angle, TO-18 package.

FEATURES

- Hermetically sealed package.
- Narrow reception angle.
- Device can be used as a photodiode by using the collector and base leads.

HERMETIC SILICON PHOTOTRANSISTOR

ABSOLUTE MAXIMUM RATINGS (T_A = 25°C Unless Otherwise Specified)

Storage Temperature	−65°C to +150°C
Operating Temperature	−65°C to +125°C
Soldering:	
Lead Temperature (Iron)	240°C for 5 sec.(3,4,5,6)
Lead Temperature (Flow)	260°C for 10 sec.(3,4,6)
Collector-Emitter Breakdown Voltage	30 Volts
Collector-Base Breakdown Voltage	40 Volts
Emitter-Base Breakdown Voltage	5 Volts
Power Dissipation (T_A = 25°C)	300 mW(1)
Power Dissipation (T_C = 25°C)	600 mW(2)

ELECTRICAL CHARACTERISTICS (T_A = 25°C Unless Otherwise Specified)
(All measurements made under pulse conditions.)

PARAMETER	SYMBOL	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS
Collector-Emitter Breakdown	BV_{CEO}	30		—	V	I_C = 10 mA, Ee = 0
Emitter-Base Breakdown	BV_{EBO}	5		—	V	I_E = 100 μA, Ee = 0
Collector-Base Breakdown	BV_{CBO}	40		—	V	I_C = 100 μA, Ee = 0
Collector-Emitter Leakage	I_{CEO}	—		100	nA	V_{CE} = 10 V, Ee = 0
Collector-Base Leakage	I_{CBO}	—		25	nA	V_{CB} = 25 V, Ee = 0
Reception Angle at ½ Sensitivity	θ		±40		Degrees	
On-State Collector Current L14N1	$I_{C(ON)}$	3.0		—	mA	Ee = 1.5 mW/cm^2, V_{CE} = 5 V(7,8)
On-State Collector Current L14N2	$I_{C(ON)}$	6.0			mA	Ee = 1.5 mW/cm^2, V_{CE} = 5 V(7,8)
On-State Photodiode Current	$I_{CB(ON)}$		5.0		μA	Ee = 1.5 mW/cm^2, V_{CB} = 5 V
Rise Time	t_r		14		μS	I_C = 10 mA, V_{CC} = 5 V, R_L = 100Ω
Fall Time	t_f		16		μS	I_C = 10 mA, V_{CC} = 5 V, R_L = 100Ω
Saturation Voltage L14N1	$V_{CE(SAT)}$	—		0.40	V	I_C = 0.8 mA, Ee = 3.0 mW/cm^2(7,8)
Saturation Voltage L14N2	$V_{CE(SAT)}$	—		0.40	V	I_C = 1.6 mA, Ee = 3.0 mW/cm^2(7,8)

NOTES

1. *Derate power dissipation linearly 3.00mW/°C above 25°C ambient.*
2. *Derate power dissipation linearly 6.00mW/°C above 25°C case.*
3. *RMA flux is recommended.*
4. *Methanol or Isopropyl alcohols are recommended as cleaning agents.*
5. *Soldering iron tip 1⁄16″ (1.6 mm) minimum from housing.*
6. *As long as leads are not under any stress or spring tension.*
7. *Light source is a GaAs LED emitting light at a peak wavelength of 940 nm.*
8. *Figure 1 and figure 2 use light source of tungsten lamp at 2870°K color temperature. A GaAs source of 3.0 mW/cm^2 is approximately equivalent to a tungsten source, at 2870°K, of 10 mW/cm^2.*

HERMETIC SILICON PHOTOTRANSISTOR

TYPICAL CHARACTERISTICS

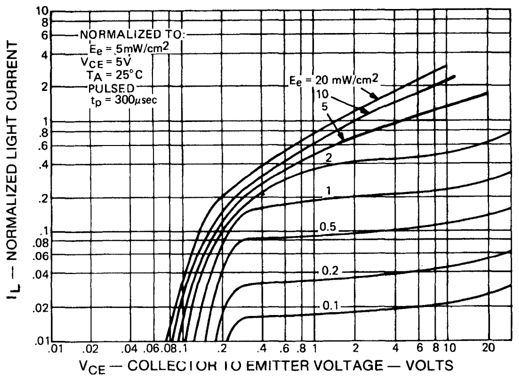


Fig. 1. Light Current vs. Collector to Emitter Voltage ST1092

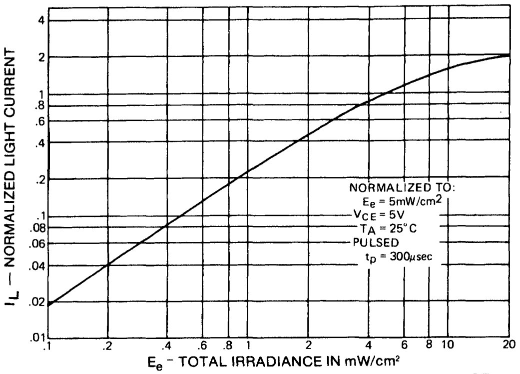


Fig. 2. Light Current vs. Radiation ST1097

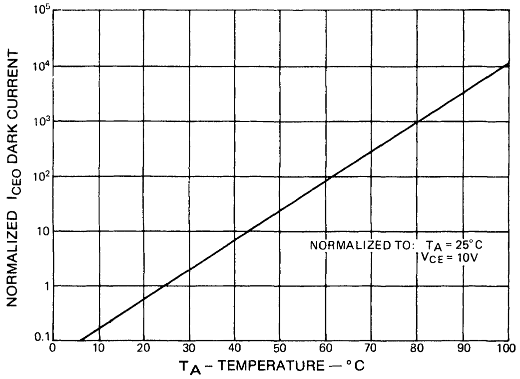


Fig. 3. Dark Current vs. Temperature ST1093

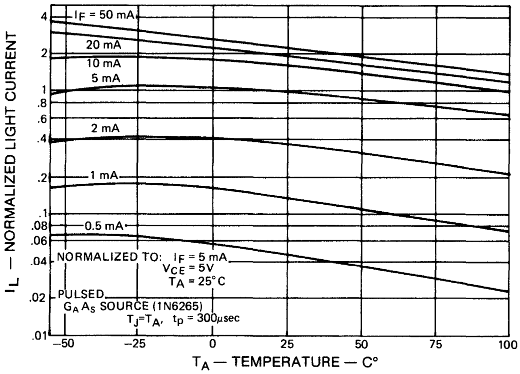
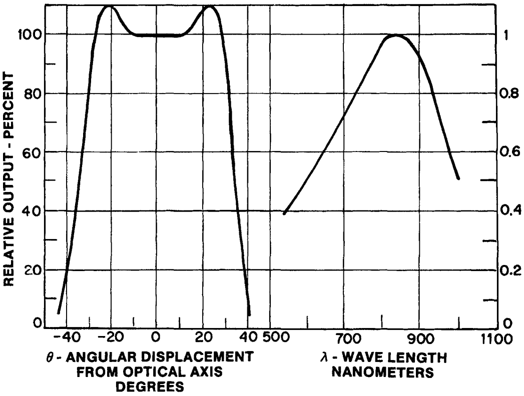
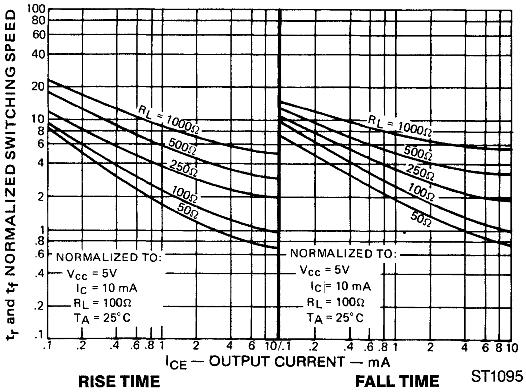


Fig. 4. Light Current vs. Temperature ST1096



ST1094

Fig. 5. Angular and Spectral Response



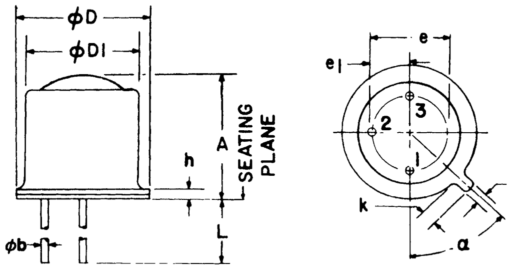
ST1095

Fig. 6. Switching Speed vs. Bias

HERMETIC SILICON PHOTOTRANSISTOR

L14P1/2

PACKAGE DIMENSIONS

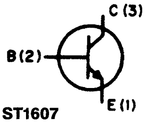


ST1333

SYMBOL	INCHES		MILLIMETERS		NOTES
	MIN.	MAX.	MIN.	MAX.	
A	.225	.255	5.71	6.47	
ϕb	.016	.021	.407	533	
ϕD	.209	.230	5.31	5.84	
ϕD_1	.178	.195	4.52	4.96	
e	100 NOM		2.54 NOM		2
e_1	.050 NOM		1.27 NOM		2
h	—	.030	—	.76	
j	.036	.046	.92	1.16	
k	.028	.048	.71	1.22	1
L	.500	—	12.7	—	
α	45°	45°	45°	45°	3

PACKAGE OUTLINE

(COLLECTOR CONNECTED TO CASE)



ST1607

NOTES:
1. MEASURED FROM MAXIMUM DIAMETER OF DEVICE.
2. LEADS HAVING MAXIMUM DIAMETER .021″ (.533mm) MEASURED IN GAUGING PLANE .054″ + .001″ − .000 (137 + .025 − .000mm) BELOW THE REFERENCE PLANE OF THE DEVICE SHALL BE WITHIN .007″ (.778mm) THEIR TRUE POSITION RELATIVE TO MAXIMUM WIDTH TAB.
3. FROM CENTERLINE TAB.

DESCRIPTION

The L14P series is a silicon phototransister mounted in a narrow angle, TO-18 package.

FEATURES

- Hermetically sealed package
- Narrow reception angle
- Devices can be used as a photodiode by wiring the collector and base leads.

QT
OPTOELECTRONICS

HERMETIC SILICON PHOTOTRANSISTOR

ABSOLUTE MAXIMUM RATINGS (T_A = 25°C Unless Otherwise Specified)

Storage Temperature	−65°C to +150°C
Operating Temperature	−65°C to +125°C
Soldering:	
Lead Temperature (Iron)	240°C for 5 sec.(3,4,5,6)
Lead Temperature (Flow)	260°C for 10 sec.(2,3,6)
Collector-Emitter Breakdown Voltage	30 Volts
Collector-Base Breakdown Voltage	40 Volts
Emitter-Base Breakdown Voltage	5 Volts
Power Dissipation (T_A = 25°C)	300 mW(1)
Power Dissipation (T_C = 25°C)	600 mW(2)

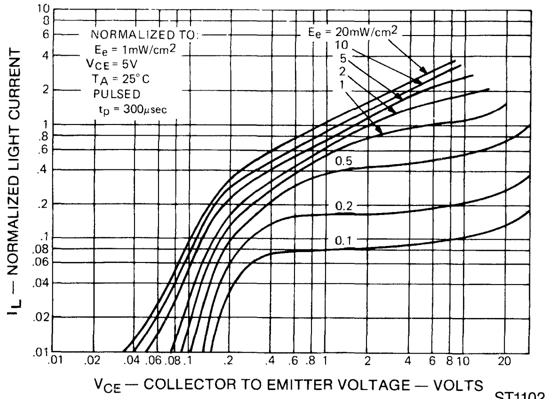
ELECTRICAL CHARACTERISTICS (T_A = 25°C Unless Otherwise Specified) (All measurements made under pulse conditions.)

PARAMETER	SYMBOL	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS
Collector-Emitter Breakdown	BV_{CEO}	30		—	V	I_C = 10 mA, Ee = 0
Emitter-Base Breakdown	BV_{EBO}	5.0		—	V	I_E = 100 μA, Ee = 0
Collector-Base Breakdown	BV_{CBO}	40		—	V	I_C = 100 μA, Ee = 0
Collector-Emitter Leakage	I_{CEO}	—		100	nA	V_{CE} = 10 V, Ee = 0
Collector-Base Leakage	I_{CBO}	—		25	nA	V_{CB} = 25 V, Ee = 0
Reception Angle at ½ Sensitivity	θ		±12		Degrees	
On-State Collector Current L14P1	$I_{C(ON)}$	4.0		—	mA	Ee = 0.3 mW/cm^2, V_{CE} = 5 V(7,8)
On-State Collector Current L14P2	$I_{C(ON)}$	8.0		—	mA	Ee = 0.3 mW/cm^2, V_{CE} = 5 V(7,8)
On-State Photodiode Current	$I_{CB(ON)}$		6.0		μA	Ee = 0.3 mW/cm^2, V_{CB} = 5 V
Rise Time	t_r		10		μS	I_C = 10 mA, V_{CC} = 5 V, R_L = 100Ω
Fall Time	t_f		12		μS	I_C = 10 mA, V_{CC} = 5 V, R_L = 100Ω
Saturation Voltage L14P1	$V_{CE(SAT)}$	—		0.40	V	I_C = 0.8 mA, Ee = .6 mW/cm^2(7,8)
Saturation Voltage L14P2	$V_{CE(SAT)}$	—		0.40	V	I_C = 1.6 mA, Ee = .6 mW/cm^2(7,8)

NOTES

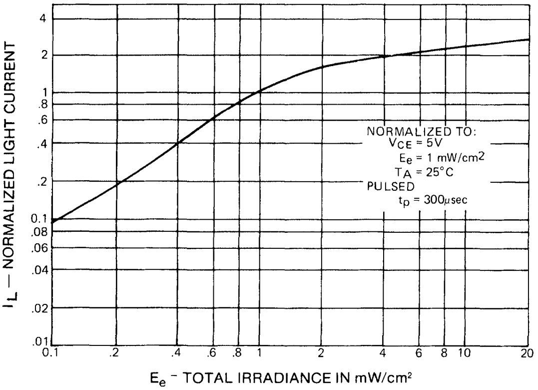
1. *Derate power dissipation linearly 3.00mW/°C above 25°C ambient.*
2. *Derate power dissipation linearly 6.00mW/°C above 25°C case.*
3. *RMA flux is recommended.*
4. *Methanol or Isopropyl alcohols are recommended as cleaning agents.*
5. *Soldering iron tip 1⁄16″ (1.6 mm) minimum from housing.*
6. *As long as leads are not under any stress or spring tension.*
7. *Light source is a GaAs LED emitting light at a peak wavelength of 940 nm.*
8. *Figure 1 and figure 2 use light source of tungsten lamp at 2870°K color temperature. A GaAs source of 3.0 mW/cm^2 is approximately equivalent to a tungsten source, at 2870°K, of 10 mW/cm^2.*

TYPICAL CHARACTERISTICS



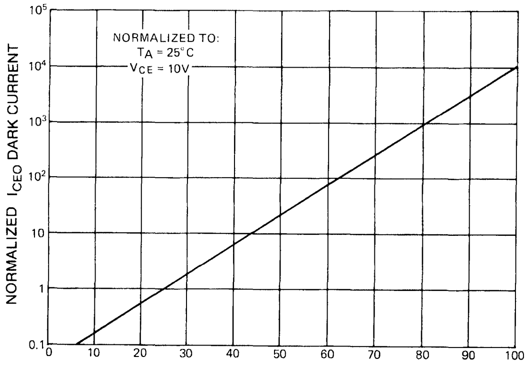
ST1102

Fig. 1. Light Current vs. Collector to Emitter Voltage



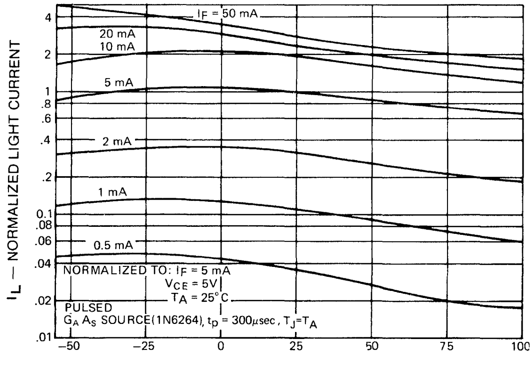
ST1107

Fig. 2. Light Current vs. Radiation



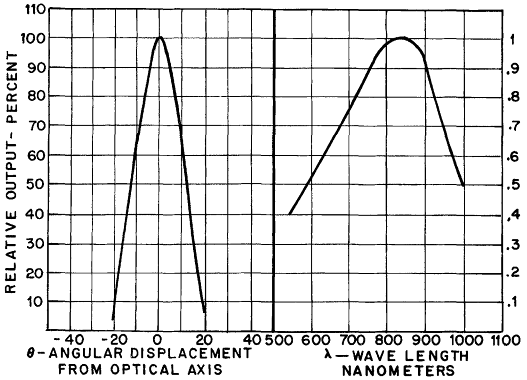
ST1103

Fig. 3. Dark Current vs. Temperature



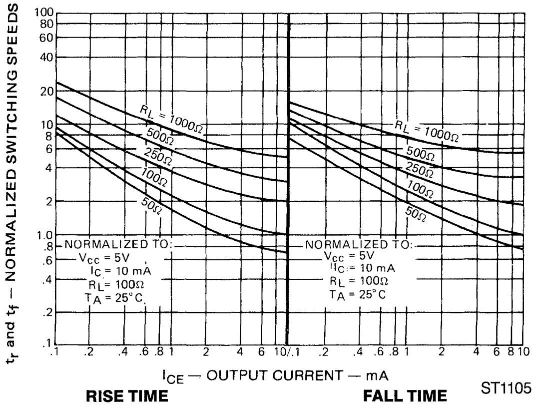
ST1106

Fig. 4. Light Current vs. Temperature



ST1104

Fig. 5. Angular and Spectral Response



RISE TIME **FALL TIME**

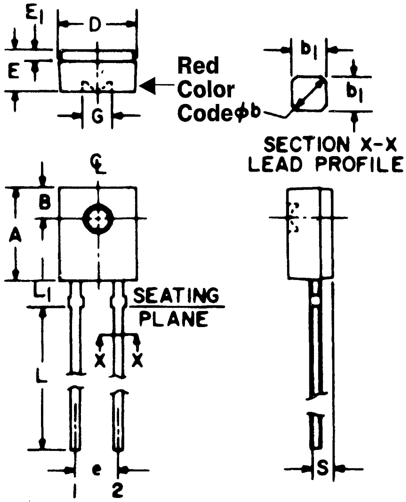
ST1105

Fig. 6. Switching Speed vs. Bias

PLASTIC SILICON PHOTOTRANSISTOR

L14Q1

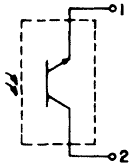
PACKAGE DIMENSIONS



ST1335

SYMBOL	MILLIMETERS		INCHES		NOTES
	MIN.	MAX.	MIN.	MAX.	
A	5.59	5.80	.220	.228	
B	1.78	NOM.	.070	NOM.	2
ϕb	.60	.75	.024	.030	1
b_1	.51	NOM.	.020	NOM.	1
D	4.45	4.70	.175	.185	
E	2.41	2.67	.095	.105	
E_1	.58	.69	.023	.027	
e	2.41	2.67	.095	.105	3
G	1.98	NOM.	.078	NOM.	
L	12.7	—	.500	—	
L_1	1.40	1.65	.055	.065	
S	.83	.94	.033	.037	3

PACKAGE OUTLINE



ST1608

NOTES:
1. TWO LEADS. LEAD CROSS SECTION DIMENSIONS UNCONTROLLED WITHIN 1.27mm (.050″) OF SEATING PLANE.
2. CENTERLINE OF ACTIVE ELEMENT LOCATED WITHIN .25mm (.010″) OF TRUE POSITION.
3. AS MEASURED AT THE SEATING PLANE.
4. INCH DIMENSIONS DERIVED FROM MILLIMETERS.

DESCRIPTION

The L14Q1 is a silicon phototransister encapsulated is a clear, wide angle, sidelooker package.

FEATURES

- Good optical to mechanical alignment
- Mechanically and wavelength matched to the F5F LED
- Plastic package with a color stripe for easy recognition from LED

QT OPTOELECTRONICS

PLASTIC SILICON PHOTOTRANSISTOR

ABSOLUTE MAXIMUM RATINGS (T_A = 25°C Unless Otherwise Specified)

Storage Temperature .... −55°C to +100°C
Operating Temperature .... −55°C to +100°C
Soldering:
  Lead Temperature (Iron) .... 240°C for 5 sec.(2,3,4,5)
  Lead Temperature (Flow) .... 260°C for 10 sec.(2,3,5)
Collector-Emitter Breakdown Voltage .... 30 Volts
Emitter-Collector Breakdown Voltage .... 6 Volts
Power Dissipation .... 150 mW(1)

ELECTRICAL CHARACTERISTICS (T_A = 25°C Unless Otherwise Specified) (All measurements made under pulse conditions.)

PARAMETER	SYMBOL	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS
Collector-Emitter Breakdown	BV_{CEO}	30		—	V	I_C = 10 mA, Ee = 0
Emitter-Collector Breakdown	BV_{ECO}	6.0		—	V	I_E = 100 μA, Ee = 0
Collector-Emitter Leakage	I_{CEO}	—		100	nA	V_{CE} = 25 V, Ee = 0
Reception Angle at ½ Sensitivity	θ		±35		Degrees	
On-State Collector Current	$I_{C(ON)}$	1.0		—	mA	Ee = 1.5 mW/cm², V_{CE} = 5 V(6,7)
Turn-On Time	t_{on}		8		μS	I_F = 30 mA, V_{CC} = 5 V, R_L = 2.5 KΩ
Turn-Off Time	t_{off}		50		μS	I_C = 30 mA, V_{CC} = 5 V, R_L = 2.5 KΩ
Saturation Voltage	$V_{CE(SAT)}$	—		0.40	V	I_C = .5 mA, Ee = .60 mW/cm²(6,7)

NOTES

1. *Derate power dissipation linearly 2.00mW/°C above 25°C ambient.*
2. *RMA flux is recommended.*
3. *Methanol or Isopropyl alcohols are recommended as cleaning agents.*
4. *Soldering iron tip 1/16″ (1.6 mm) minimum from housing.*
5. *As long as leads are not under any stress or spring tension.*
6. *Light source is a GaAs LED emitting light at a peak wavelength of 940 nm.*
7. *Figure 1 and figure 2 use light source of tungsten lamp at 2870°K color temperature. A GaAs source of 3.0 mW/cm² is approximately equivalent to a tungsten source, at 2870°K, of 10 mW/cm².*

OPTOELECTRONICS

PLASTIC SILICON PHOTOTRANSISTOR

TYPICAL CHARACTERISTICS

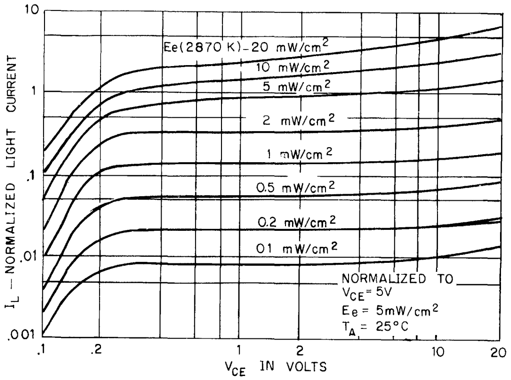


Fig. 1. Light Current vs. Collector to Emitter Voltage ST1110-11

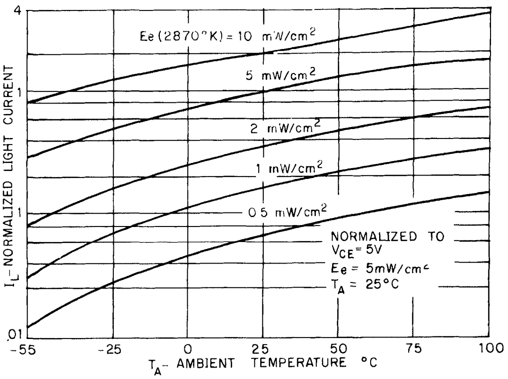


Fig. 2. Light Current vs. Ambient Temperature ST1113-11

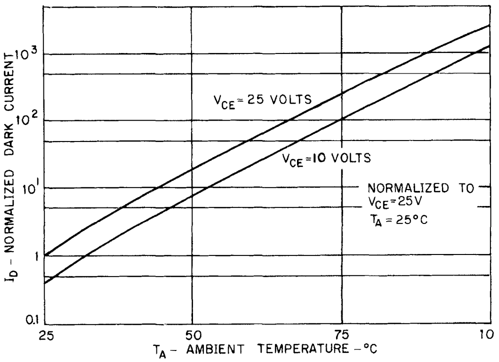


Fig. 3. Leakage Current vs. Temperature ST1111-11

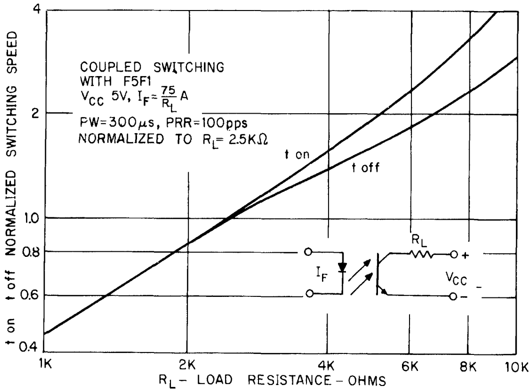


Fig. 4. Switching Time vs. Load Resistance ST1114-11

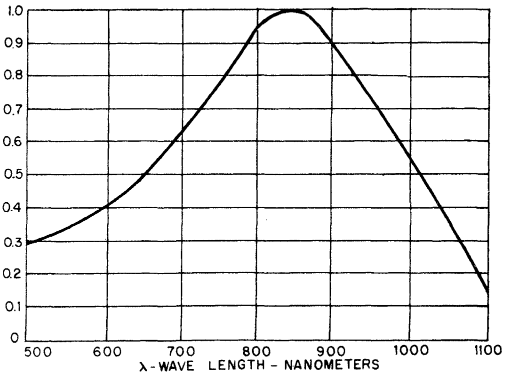


Fig. 5. Spectral Response ST1112-11

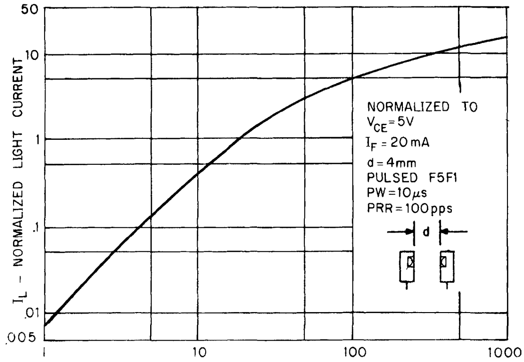
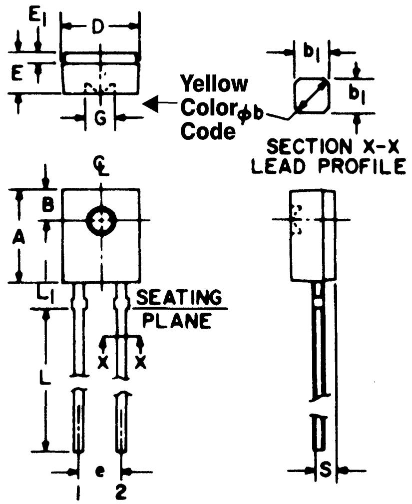


Fig. 6. Coupled Light Current vs. F5F1 Input Current ST1115-11

PLASTIC SILICON PHOTODARLINGTON

L14R1

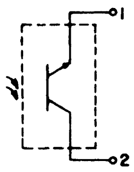
PACKAGE DIMENSIONS



ST1335

SYMBOL	MILLIMETERS		INCHES		NOTES
	MIN.	MAX.	MIN.	MAX.	
A	5.59	5.80	.220	.228	
B	1.78	NOM.	.070	NOM.	2
φb	.60	.75	.024	.030	1
b_1	.51	NOM.	.020	NOM.	1
D	4.45	4.70	.175	.185	
E	2.41	2.67	.095	.105	
E_1	.58	.69	.023	.027	
e	2.41	2.67	.095	.105	3
G	1.98	NOM.	.078	NOM.	
L	12.7	—	.500	—	
L_1	1.40	1.65	.055	.065	
S	.83	.94	.033	.037	3

PACKAGE OUTLINE



ST1608

NOTES:
1. TWO LEADS. LEAD CROSS SECTION DIMENSIONS UNCONTROLLED WITHIN 1.27mm (.050″) OF SEATING PLANE.
2. CENTERLINE OF ACTIVE ELEMENT LOCATED WITHIN .25mm (.010″) OF TRUE POSITION.
3. AS MEASURED AT THE SEATING PLANE.
4. INCH DIMENSIONS DERIVED FROM MILLIMETERS.

DESCRIPTION

The L14R1 is a silicon photodarlington encapsulated in a clear, wide angle, sidelooker package.

FEATURES

- Good optical to mechanical alignment
- Mechanically and wavelength matched to the F5F LED
- Plastic package with a color stripe for easy recognition from LED

PLASTIC SILICON PHOTODARLINGTON

ABSOLUTE MAXIMUM RATINGS (T_A = 25°C Unless Otherwise Specified)

Storage Temperature	−55°C to +100°C
Operating Temperature	−55°C to +100°C
Soldering:	
Lead Temperature (Iron)	240°C for 5 sec.(2,3,4,5)
Lead Temperature (Flow)	260°C for 10 sec.(2,3,5)
Collector-Emitter Breakdown Voltage	30 Volts
Emitter-Collector Breakdown Voltage	7 Volts
Power Dissipation	150 mW(1)

ELECTRICAL CHARACTERISTICS (T_A = 25°C Unless Otherwise Specified) (All measurements made under pulse conditions.)

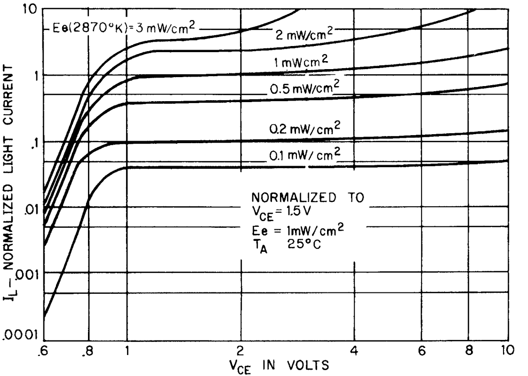
PARAMETER	SYMBOL	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS
Collector-Emitter Breakdown	BV_{CEO}	30		—	V	I_C = 10 mA, Ee = 0
Emitter-Collector Breakdown	BV_{ECO}	7.0		—	V	I_E = 100 μA, Ee = 0
Collector-Emitter Leakage	I_{CEO}	—		100	nA	V_{CE} = 25, Ee = 0
Reception Angle at ½ Sensitivity	θ		±35		Degrees	
On-State Collector Current	$I_{C(ON)}$	5.0		—	mA	Ee = 0.3 mW/cm^2, V_{CE} = 1.5 V(6,7)
Turn-On Time	t_{on}		45		μS	I_F = 10 mA, V_{CC} = 5 V, R_L = 750Ω
Turn-Off Time	t_{off}		250		μS	I_F = 10 mA, V_{CC} = 5 V, R_L = 750Ω
Saturation Voltage	$V_{CE(SAT)}$	—		1.2	V	I_C = 20 mA, Ee = .60 mW/cm^2(6,7)

NOTES

1. *Derate power dissipation linearly 2.00mW/°C above 25°C ambient.*
2. *RMA flux is recommended.*
3. *Methanol or Isopropyl alcohols are recommended as cleaning agents.*
4. *Soldering iron tip 1⁄16″ (1.6 mm) minimum from housing.*
5. *As long as leads are not under any stress or spring tension.*
6. *Light source is a GaAs LED emitting light at a peak wavelength of 940 nm.*
7. *Figure 1 and figure 2 use light source of tungsten lamp at 2870°K color temperature. A GaAs source of 3.0 mW/cm^2 is approximately equivalent to a tungsten source, at 2870°K, of 10 mW/cm^2.*

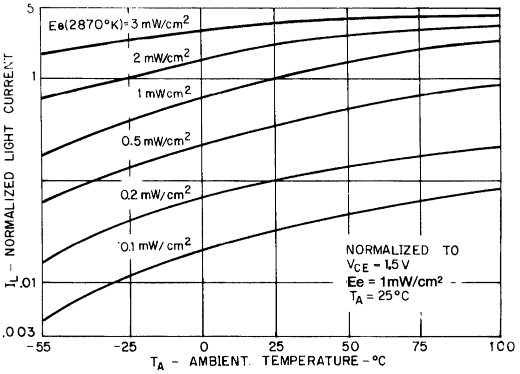
PLASTIC SILICON PHOTODARLINGTON

TYPICAL CHARACTERISTICS



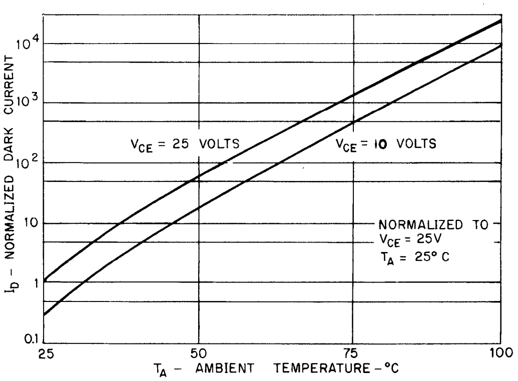
ST1118-11

Fig. 1. Light Current vs. Collector-Emitter Voltage



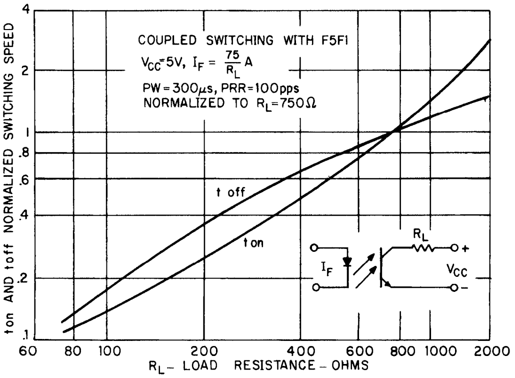
ST1123-11

Fig. 2. Light Current vs. Ambient Temperature



ST1119-11

Fig. 3. Leakage Current vs. Temperature



ST1122-11

Fig. 4. Switching Time vs. Load Resistance

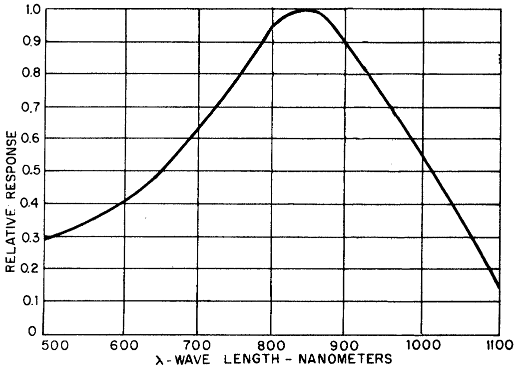


Fig. 5. Spectral Response

ST1120-11

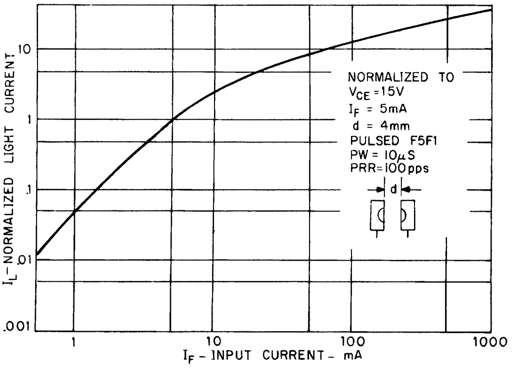


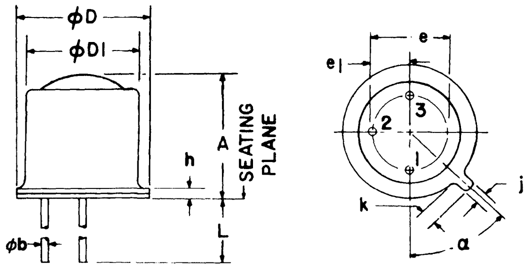
Fig. 6. Coupled Light Current vs. F5F1 Input Current

ST1121-11

HERMETIC SILICON PHOTOTRANSISTOR

BPW36/BPW37

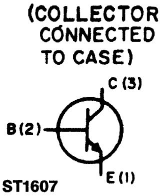
PACKAGE DIMENSIONS



ST1333

SYMBOL	INCHES		MILLIMETERS		NOTES
	MIN.	MAX.	MIN.	MAX.	
A	.225	.255	5.71	6.47	
ϕb	.016	.021	.407	533	
ϕD	.209	.230	5.31	5.84	
ϕD_1	.178	.195	4.52	4.96	
e	.100 NOM		2.54 NOM		2
e_1	.050 NOM		1.27 NOM		2
h	—	.030	—	.76	
j	.036	.046	.92	1.16	
k	.028	.048	.71	1.22	1
L	.500	—	12.7	—	
α	45°	45°	45°	45°	3

PACKAGE OUTLINE



ST1607

NOTES:
1. MEASURED FROM MAXIMUM DIAMETER OF DEVICE.
2. LEADS HAVING MAXIMUM DIAMETER .021" (.533mm) MEASURED IN GAUGING PLANE .054" + .001" − .000 (137 + .025 − .000mm) BELOW THE REFERENCE PLANE OF THE DEVICE SHALL BE WITHIN .007" (.778mm) THEIR TRUE POSITION RELATIVE TO MAXIMUM WIDTH TAB.
3. FROM CENTERLINE TAB.

DESCRIPTION

The BPW36/37 are silicon phototransisters mounted in narrow angle TO-18 packages.

FEATURES

- ■ Hermetically sealed package
- ■ Narrow reception angle
- ■ European "Pro Electron" registered

OPTOELECTRONICS

HERMETIC SILICON PHOTOTRANSISTOR

ABSOLUTE MAXIMUM RATINGS (T_A = 25°C Unless Otherwise Specified)

Storage Temperature	−65°C to +150°C
Operating Temperature	−65°C to +125°C
Soldering:	
Lead Temperature (Iron)	240°C for 5 sec.(3,4,5,6)
Lead Temperature (Flow)	260°C for 10 sec.(3,4,6)
Collector-Emitter Breakdown Voltage	45 Volts
Collector-Base Breakdown Voltage	45 Volts
Emitter-Base Breakdown Voltage	5 Volts
Power Dissipation (T_A = 25°C)	300 mW(1)
Power Dissipation (T_C = 25°C)	600 mW(2)

ELECTRICAL CHARACTERISTICS (T_A = 25°C Unless Otherwise Specified)
(All measurements made under pulse conditions.)

PARAMETER	SYMBOL	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS
Collector-Emitter Breakdown	BV_{CEO}	45		—	V	I_C = 10 mA, Ee = 0
Emitter-Base Breakdown	BV_{EBO}	5.0		—	V	I_E = 100 μA, Ee = 0
Collector-Base Breakdown	BV_{CBO}	45		—	V	I_C = 100 μA, Ee = 0
Collector-Emitter Leakage	I_{CEO}	—		100	nA	V_{CE} = 10 V, Ee = 0
Reception Angle at ½ Sensitivity	θ		±10		Degrees	
On-State Collector Current BPW36	$I_{C(ON)}$	6.0		—	mA	Ee = 3.0 mW/cm², V_{CE} = 5 V(7)
On-State Collector Current BPW37	$I_{C(ON)}$	3.0		—	mA	Ee = 3.0 mW/cm², V_{CE} = 5 V(7)
Turn-On Time	t_{on}		8		μS	I_C = 2 mA, V_{CC} = 10 V, R_L = 100Ω
Turn-Off Time	t_{off}		7		μS	I_C = 2 mA, V_{CC} = 10 V, R_L = 100Ω
Saturation Voltage	$V_{CE(SAT)}$	—		0.40	V	I_C = 1.0 mA, Ee = 3.0 mW/cm²(7)

NOTES

1. *Derate power dissipation linearly 3.00mW/°C above 25°C ambient.*
2. *Derate power dissipation linearly 6.00mW/°C above 25°C case.*
3. *RMA flux is recommended.*
4. *Methanol or Isopropyl alcohols are recommended as cleaning agents.*
5. *Soldering iron tip 1/16″ (1.6 mm) minimum from housing.*
6. *As long as leads are not under any stress or spring tension.*
7. *Light source is a GaAs LED emitting light at a peak wavelength of 940 nm.*
8. *Figure 1 and figure 2 use light source of tungsten lamp at 2870°K color temperature. A GaAs source of 3.0 mW/cm² is approximately equivalent to a tungsten source, at 2870°K, of 10 mW/cm².*

OPTOELECTRONICS

HERMETIC SILICON PHOTOTRANSISTOR

TYPICAL CHARACTERISTICS

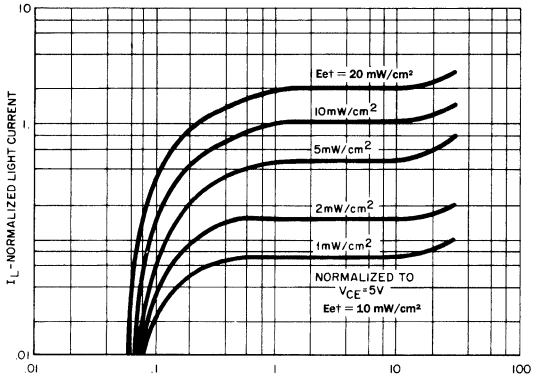


Fig. 1. Light Current vs. Collector to Emitter Voltage ST1250

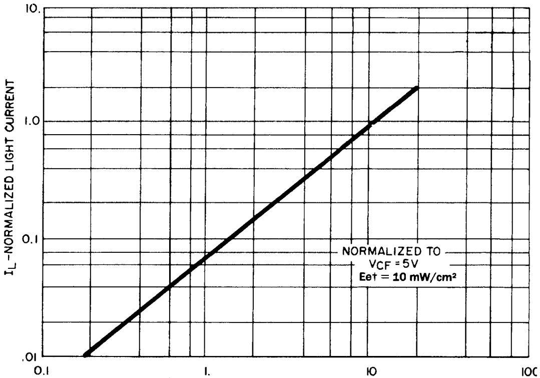


Fig. 2. Normalized Light Current vs. Radiation ST1255

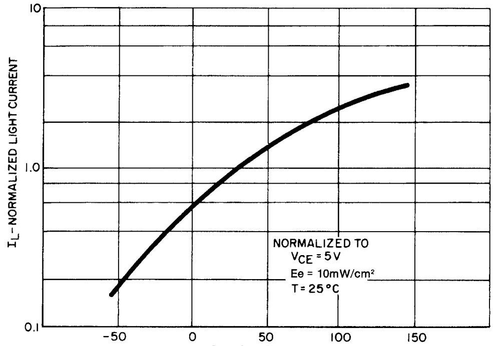


Fig. 3. Normalized Light Current vs. Temperature ST1251

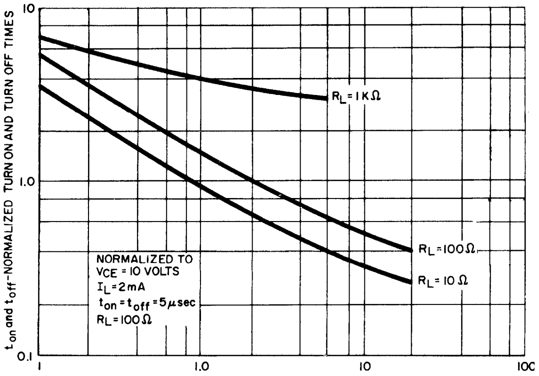


Fig. 4. Switching Times vs. Output Current ST1254

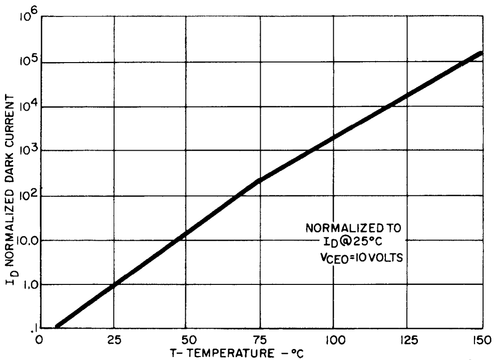


Fig. 5. Dark Current vs. Temperature ST1252

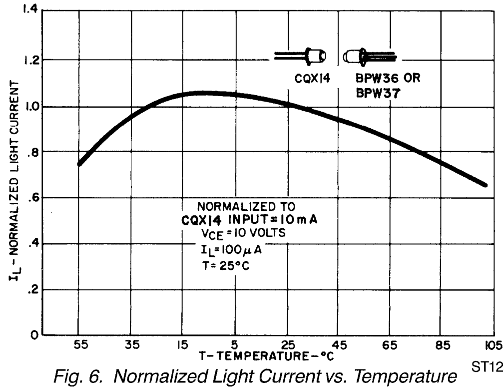
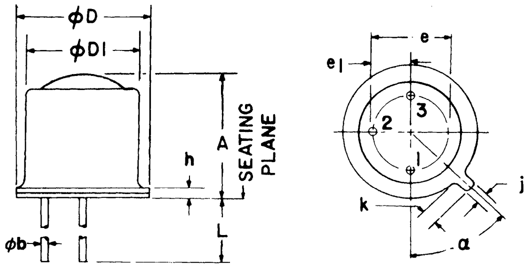


Fig. 6. Normalized Light Current vs. Temperature Both Emitter (CQX14) and Detector (BPW36 or BPW37) at Same Temperature ST1253

HERMETIC SILICON PHOTODARLINGTON

BPW38

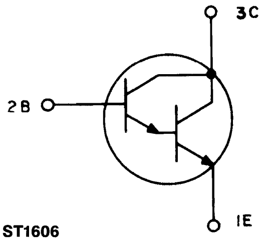
PACKAGE DIMENSIONS



ST1333

SYMBOL	INCHES		MILLIMETERS		NOTES
	MIN.	MAX.	MIN.	MAX.	
A	.225	.255	5.71	6.47	
ϕb	.016	.021	.407	533	
ϕD	.209	.230	5.31	5.84	
ϕD_1	.178	.195	4.52	4.96	
e	.100 NOM		2.54 NOM		2
e_1	.050 NOM		1.27 NOM		2
h	—	.030	—	.76	
j	.036	.046	.92	1.16	
k	.028	.048	.71	1.22	1
L	.500	—	12.7	—	
α	45°	45°	45°	45°	3

PACKAGE OUTLINE



ST1606

NOTES:
1. MEASURED FROM MAXIMUM DIAMETER OF DEVICE.
2. LEADS HAVING MAXIMUM DIAMETER .021″ (.533mm) MEASURED IN GAUGING PLANE .054″ + .001″ − .000 (137 + .025 − .000mm) BELOW THE REFERENCE PLANE OF THE DEVICE SHALL BE WITHIN .007″ (.778mm) THEIR TRUE POSITION RELATIVE TO MAXIMUM WIDTH TAB.
3. FROM CENTERLINE TAB.

DESCRIPTION

The BPW38 is a silicon photodarlington mounted in a narrow angle TO-18 package.

FEATURES

- Hermetically sealed package
- Narrow reception angle
- European “Pro Electron” registered

QT
OPTOELECTRONICS

HERMETIC SILICON PHOTODARLINGTON

ABSOLUTE MAXIMUM RATINGS (T_A = 25°C Unless Otherwise Specified)

Storage Temperature	−65°C to +150°C
Operating Temperature	−65°C to +125°C
Soldering:	
Lead Temperature (Iron)	240°C for 5 sec.(3,4,5,6)
Lead Temperature (Flow)	260°C for 10 sec.(3,4,6)
Collector-Emitter Breakdown Voltage	25 Volts
Collector-Base Breakdown Voltage	25 Volts
Emitter-Base Breakdown Voltage	12 Volts
Power Dissipation (T_A = 25°C)	300 mW(1)
Power Dissipation (T_C = 25°C)	600 mW(2)

ELECTRICAL CHARACTERISTICS (T_A = 25°C Unless Otherwise Specified) (All measurements made under pulse conditions.)

PARAMETER	SYMBOL	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS
Collector-Emitter Breakdown	BV_{CEO}	25		—	V	I_C = 10 mA, Ee = 0
Emitter-Base Breakdown	BV_{EBO}	12		—	V	I_E = 100 μA, Ee = 0
Collector-Base Breakdown	BV_{CBO}	25		—	V	I_C = 100 μA, Ee = 0
Collector-Emitter Leakage	I_{CEO}	—		100	nA	V_{CE} = 12 V, Ee = 0
Reception Angle at ½ Sensitivity	θ		±8		Degrees	
On-State Collector Current	$I_{C(ON)}$	3.0		—	mA	Ee = .05 mW/cm², V_{CE} = 5 V(7,8)
Rise Time	t_r		300		μS	I_C = 10 mA, V_{CC} = 10 V, R_L = 100Ω
Fall Time	t_f		250		μS	I_C = 10 mA, V_{CC} = 10 V, R_L = 100Ω

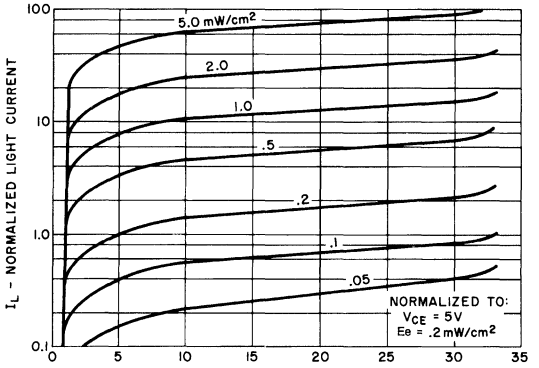
NOTES

1. *Derate power dissipation linearly 3.00mW/°C above 25°C ambient.*
2. *Derate power dissipation linearly 6.00mW/°C above 25°C case.*
3. *RMA flux is recommended.*
4. *Methanol or Isopropyl alcohols are recommended as cleaning agents.*
5. *Soldering iron tip 1⁄16″ (1.6 mm) minimum from housing.*
6. *As long as leads are not under any stress or spring tension.*
7. *Light source is a GaAs LED emitting light at a peak wavelength of 940 nm.*
8. *Figure 1 and figure 2 use light source of tungsten lamp at 2870°K color temperature. A GaAs source of 0.05 mW/cm² is approximately equivalent to a tungsten source, at 2870°K, of 0.2 mW/cm².*

OPTOELECTRONICS

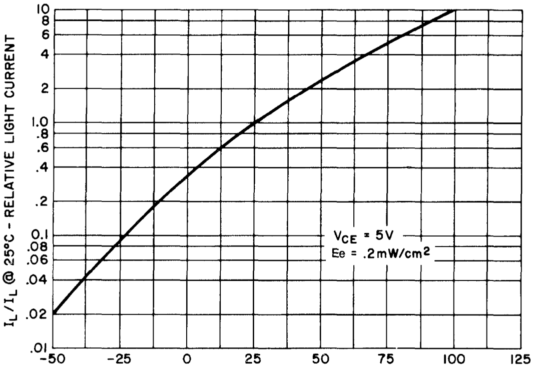
HERMETIC SILICON PHOTODARLINGTON

TYPICAL CHARACTERISTICS



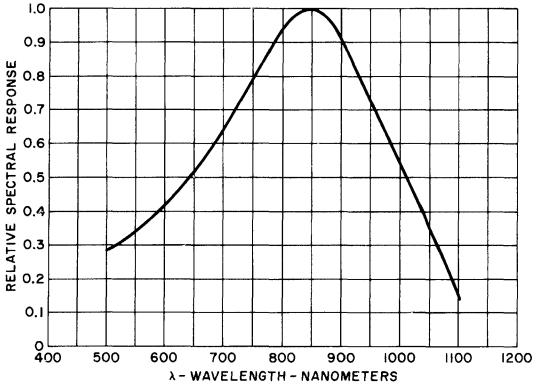
ST1260

Fig. 1. Light Current vs. Collector to Emitter Voltage



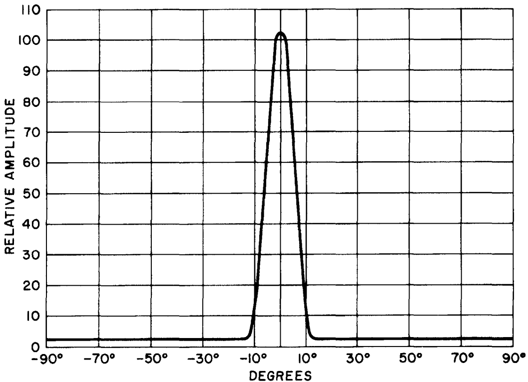
ST1265

Fig. 2. Relative Light Current vs. Ambient Temperature



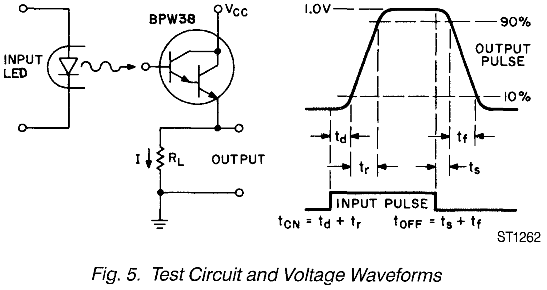
ST1261

Fig. 3. Spectral Response Curve



ST1264

Fig. 4. Angular Response



ST1262

Fig. 5. Test Circuit and Voltage Waveforms

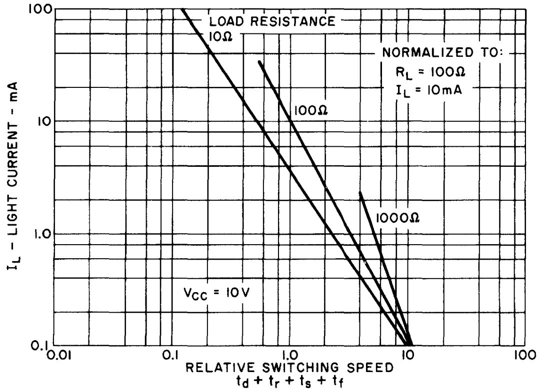


Fig. 6. Light Current vs. Relative Switching Speed

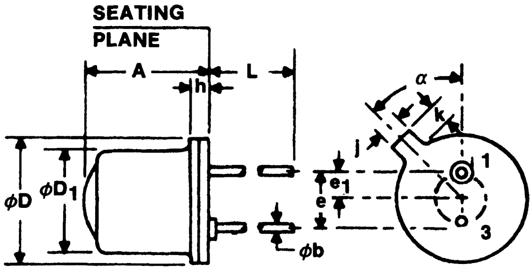
ST1263

QT OPTOELECTRONICS

GaAs INFRARED EMITTING DIODE

CQX14, CQX16

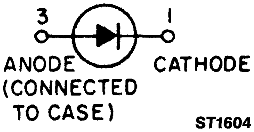
PACKAGE DIMENSIONS



ST1332

SYMBOL	INCHES		MILLIMETERS		NOTES
	MIN.	MAX.	MIN.	MAX.	
A		.255		6.47	
φb	.016	.021	.407	.533	
φD	.209	.230	5.31	5.84	
ϕD_1	.180	.187	4.52	4.77	
e	.100 NOM.		2.54 NOM.		2
e_1	.050 NOM.		1.27 NOM.		2
h		.030		.76	
j	.031	.044	.79	1.11	
k	.036	.046	.92	1.16	1
L	1.00		25.4		
α	45°	45°	45°	45°	3

PACKAGE OUTLINE



ST1604

NOTES:

1. MEASURED FROM MAXIMUM DIAMETER OF DEVICE.
2. LEADS HAVING MAXIMUM DIAMETER .021" (.533mm) MEASURED IN GAUGING PLANE .054" + .001" – .000 (137 + 025 – 000mm) BELOW THE REFERENCE PLANE OF THE DEVICE SHALL BE WITHIN .007" (.778mm) THEIR TRUE POSITION RELATIVE TO MAXIMUM WIDTH TAB.
3. FROM CENTERLINE TAB.

DESCRIPTION

The CQX14/16 are 940nm LEDs in narrow angle, TO-46 packages.

FEATURES

- Good optical to mechanical alignment
- Mechanically and wavelength matched to TO-18 phototransistor
- Hermetically sealed package
- High irradiance level
- European "Pro Electron" registered

QT
OPTOELECTRONICS

GaAs INFRARED EMITTING DIODE

ABSOLUTE MAXIMUM RATINGS (T_A = 25°C Unless Otherwise Specified)

Storage Temperature	−65°C to +150°C
Operating Temperature	−65°C to +125°C
Soldering:	
Lead Temperature (Iron)	240°C for 5 sec.(3,4,5,6)
Lead Temperature (Flow)	260°C for 10 sec.(3,4,6)
Continuous Forward Current	100 mA
Forward Current (pw, 1 μS; 200 Hz)	10 A
Reverse Voltage	3 Volts
Power Dissipation (T_A = 25°C)	170 mW(1)
Power Dissipation (T_C = 25°C)	1.3 W(2)

ELECTRICAL CHARACTERISTICS (T_A = 25°C Unless Otherwise Specified) (All measurements made under pulse conditions.)

PARAMETER	SYMBOL	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS
Forward Voltage	V_F	—		1.7	V	I_F = 100 mA
Reverse Leakage Current	I_R	—		10	μA	V_R = 3 V
Peak Emission Wavelength	λ_P		940		nm	I_F = 100 mA
Emission Angle at ½ Power	θ		±8		Degrees	
Total Power CQX14	P_O	5.4		—	mW	I_F = 100 mA(7)
Total Power CQX16	P_O	1.5		—	mW	I_F = 100 mA(7)
Rise Time 0-90% of output	t_r		1.0		μS	
Fall Time 100-10% of output	t_f		1.0		μS	

NOTES

1. *Derate power dissipation linearly 1.70mW/°C above 25°C ambient.*
2. *Derate power dissipation linearly 13.0mW/°C above 25°C case.*
3. *RMA flux is recommended.*
4. *Methanol or Isopranol alcohols are recommended as cleaning agents.*
5. *Soldering iron tip 1⁄16″ (1.6 mm) minimum from housing.*
6. *As long as leads are not under any stress or spring tension.*
7. *Total power output, Po, is the total power radiated by the device into a solid angle of 2π steradians.*

TYPICAL CHARACTERISTICS

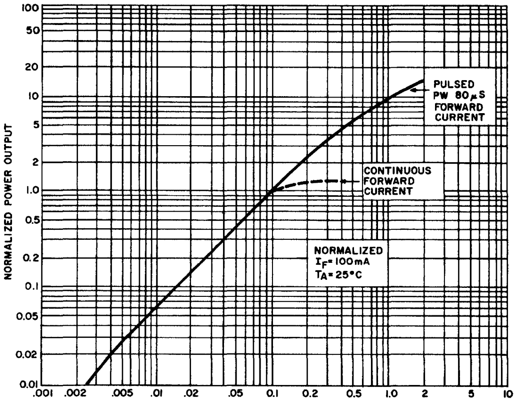


Fig. 1. Power Output vs. Input Current ST1271

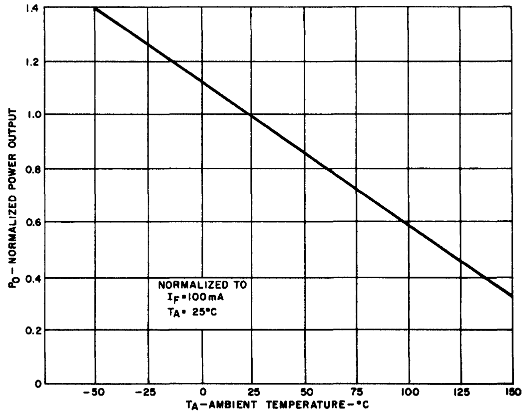


Fig. 2. Power Output vs. Temperature ST1276

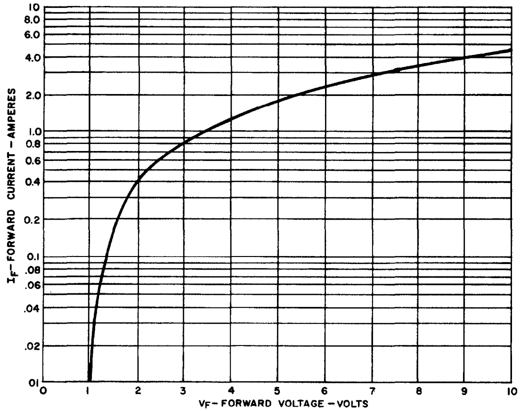


Fig. 3. Forward Voltage vs. Forward Current ST1272

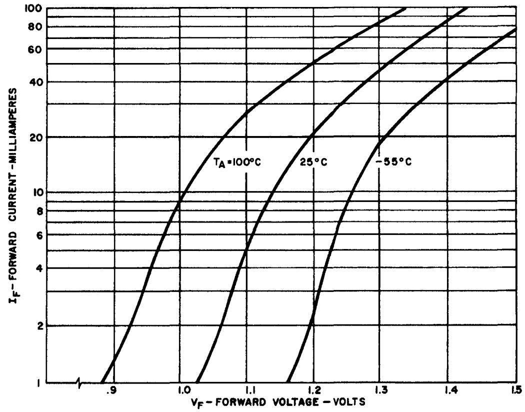


Fig. 4. Forward Voltage vs. Forward Current ST1275

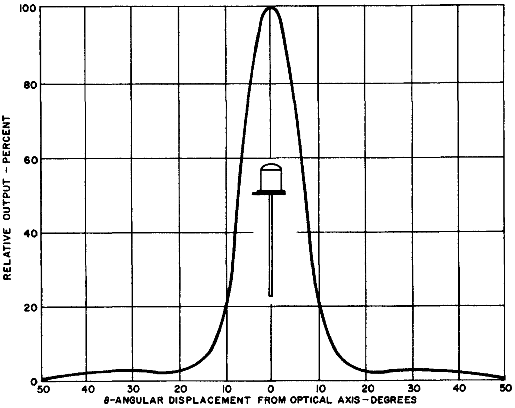


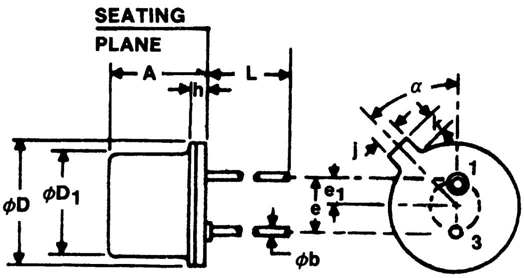
Fig. 5. Typical Radiation Pattern ST1273

QT OPTOELECTRONICS

GaAs INFRARED EMITTING DIODE

CQX15, CQX17

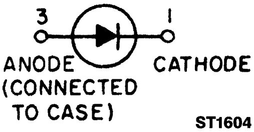
PACKAGE DIMENSIONS



ST1331

SYMBOL	INCHES		MILLIMETERS		NOTES
	MIN.	MAX.	MIN.	MAX.	
A		.155		3.93	
ϕb	.016	.021	.407	.533	
ϕD	.209	.230	5.31	5.84	
ϕD_1	.180	.187	4.57	4.77	
e	.100 NOM.		2.54 NOM.		2
e_1	.050 NOM.		1.27 NOM.		2
h		.030		.76	
j	.031	.044	.79	1.11	
k	.036	.046	.92	1.16	1
L	1.00		25.4		
α	45°	45°	45°	45°	3

PACKAGE OUTLINE



ST1604

NOTES:
1. MEASURED FROM MAXIMUM DIAMETER OF DEVICE.
2. LEADS HAVING MAXIMUM DIAMETER .021" (.533mm) MEASURED IN GAUGING PLANE .054" + .001" − .000 (137 + 025 − 000mm) BELOW THE REFERENCE PLANE OF THE DEVICE SHALL BE WITHIN .007" (.778mm) THEIR TRUE POSITION RELATIVE TO MAXIMUM WIDTH TAB.
3. FROM CENTERLINE TAB.

DESCRIPTION

The CQX15/17 are 940nm LEDs in wide angle, TO-46 packages.

FEATURES

- Good optical to mechanical alignment
- Mechanically and wavelength matched to TO-18 phototransistor
- Hermetically sealed package
- High irradiance level
- European "Pro Electron" registered

GaAs INFRARED EMITTING DIODE

ABSOLUTE MAXIMUM RATINGS (T_A = 25°C Unless Otherwise Specified)

Storage Temperature	−65°C to +150°C
Operating Temperature	−65°C to +125°C
Soldering:	
Lead Temperature (Iron)	240°C for 5 sec.(3,4,5,6)
Lead Temperature (Flow)	260°C for 10 sec.(3,4,6)
Continuous Forward Current	100 mA
Forward Current (pw, 1 µS; 200 Hz)	10 A
Reverse Voltage	3 Volts
Power Dissipation (T_A = 25°C)	170 mW(1)
Power Dissipation (T_C = 25°C)	1.3 W(2)

ELECTRICAL CHARACTERISTICS (T_A = 25°C Unless Otherwise Specified)

(All measurements made under pulse conditions.)

PARAMETER	SYMBOL	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS
Forward Voltage	V_F	—		1.7	V	I_F = 100 mA
Reverse Leakage Current	I_R	—		10	µA	V_R = 3 V
Peak Emission Wavelength	λ_P		940		nm	I_F = 100 mA
Emission Angle at ½ Power	θ		±40		Degrees	
Total Power CQX15	P_O	5.4		—	mW	I_F = 100 mA(7)
Total Power CQX17	P_O	1.5		—	mW	I_F = 100 mA(7)
Rise Time 0-90% of output	t_r		1.0		µS	
Fall Time 100-10% of output	t_f		1.0		µS	

NOTES

1. *Derate power dissipation linearly 1.70mW/°C above 25°C ambient.*
2. *Derate power dissipation linearly 13.0mW/°C above 25°C case.*
3. *RMA flux is recommended.*
4. *Methanol or Isopranol alcohols are recommended as cleaning agents.*
5. *Soldering iron tip 1⁄16″ (1.6 mm) minimum from housing.*
6. *As long as leads are not under any stress or spring tension.*
7. *Total power output, P_O, is the total power radiated by the device into a solid angle of 2π steradians.*

TYPICAL CHARACTERISTICS

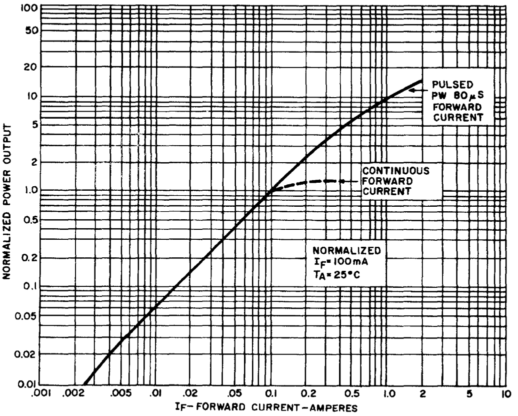


Fig. 1. Power Output vs. Input Current ST1271

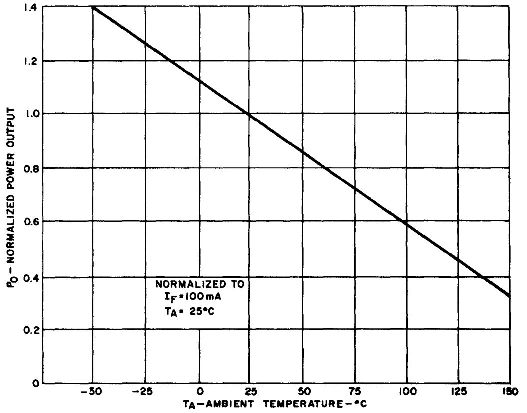


Fig. 2. Power Output vs. Temperature ST1276

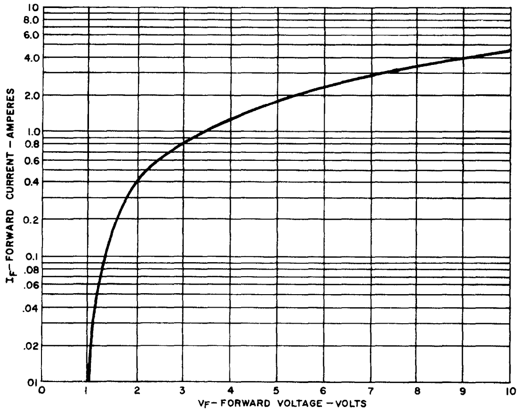


Fig. 3. Forward Voltage vs. Forward Current ST1272

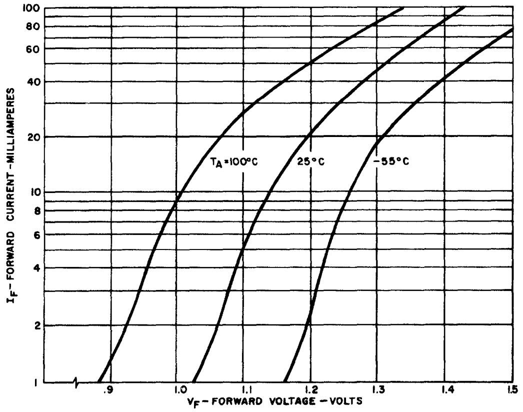


Fig. 4. Forward Voltage vs. Forward Current ST1275

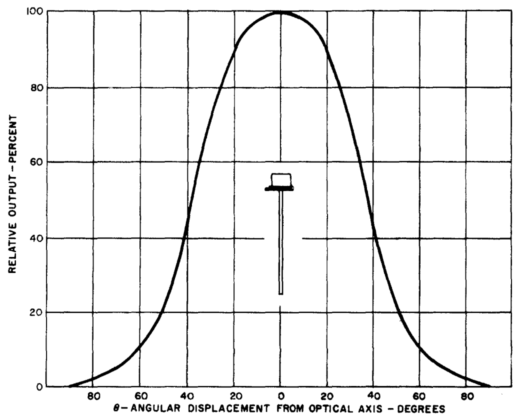
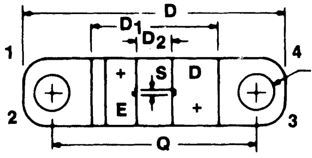


Fig. 5. Typical Radiation Pattern ST1274

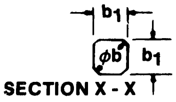
SLOTTED OPTICAL SWITCH

H21A1/2/3

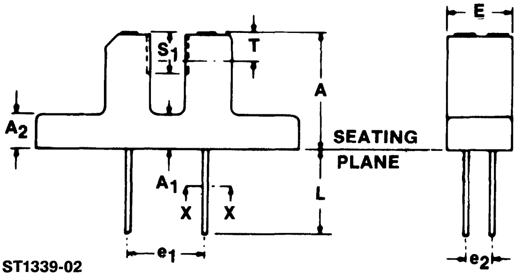
PACKAGE DIMENSIONS



ST1339-01



SECTION X - X
LEAD PROFILE

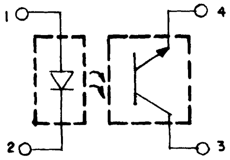


ST1339-02

SYMBOL	MILLIMETERS		INCHES		NOTES
	MIN.	MAX.	MIN.	MAX.	
A	10.7	11.0	.422	.433	
A_1	3.0	3.2	.119	.125	
A_2	3.0	3.2	.119	.125	
ϕb	.600	.750	.024	.030	2
b_1	.50 NOM.		.020 NOM.		2
D	24.3	24.7	.957	.972	
D_1	11.6	12.0	.457	.472	
D_2	3.0	3.3	.119	.129	
e_1	6.9	7.5	.272	.295	
e_2	2.3	2.8	.091	.110	
E	6.15	6.35	.243	.249	
L	8.00		.315		
ϕp	3.2	3.4	.126	.133	
Q	18.9	19.2	.745	.755	
S	.85	1.0	.034	.039	
S_1	3.45	3.75	.136	.147	
T	2.6 NOM.		.103 NOM.		3

NOTES:
1. INCH DIMENSIONS ARE DERIVED FROM MILLIMETERS.
2. FOUR LEADS. LEAD CROSS SECTION IS CONTROLLED BETWEEN 1.27mm (.050″) FROM SEATING PLANE AND THE END OF THE LEADS.
3. THE SENSING AREA IS DEFINED BY THE "S" DIMENSION AND BY DIMENSION "T" ±0.75mm (±.030 INCH).

PACKAGE OUTLINE



ST1609

DESCRIPTION

The H21A Slotted Optical Switch is a gallium arsenide light emitting diode coupled to a silicon phototransistor in a plastic housing. The packaging system is designed to optimize the mechanical resolution, coupling efficiency, ambient light rejection, cost and reliability. The gap in the housing provides a means of interrupting the signal with an opaque material, switching the output from an "ON" to an "OFF" state.

FEATURES

- Opaque housing
- Low cost
- .035″ apertures
- High $I_{C(ON)}$

SLOTTED OPTICAL SWITCH

ABSOLUTE MAXIMUM RATINGS (T_A = 25°C Unless Otherwise Specified)

Storage Temperature . . . . −55°C to +100°C
Operating Temperature . . . . −55°C to +100°C
Soldering:
  Lead Temperature (Iron) . . . . 240°C for 5 sec.(3,4,5)
  Lead Temperature (Flow) . . . . 260°C for 10 sec.(3,4)

INPUT DIODE

Continuous Forward Current . . . . 60 mA
Reverse Voltage . . . . 6.0 Volts
Power Dissipation . . . . 100 mW(1)

OUTPUT TRANSISTOR

Collector-Emitter Voltage . . . . 30 Volts
Emitter-Collector Voltage . . . . 6 Volts
Power Dissipation . . . . 150 mW(2)

ELECTRICAL CHARACTERISTICS (T_A = 25°C Unless Otherwise Specified)
(All measurements made under pulse conditions.)

PARAMETER	SYMBOL	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS
INPUT DIODE						
Forward Voltage	V_F	—		1.7	V	I_F = 60 mA
Reverse Breakdown Voltage	V_R	6.0		—	V	I_R = 10μA
Reverse Leakage Current	I_R	—		1.0	μA	V_R = 3 V
OUTPUT TRANSISTOR						
Emitter-Collector Breakdown	BV_{ECO}	6.0		—	V	I_E = 100 μA, Ee = 0
Collector-Emitter Breakdown	BV_{CEO}	30		—	V	I_C = 1 mA, Ee = 0
Collector-Emitter Leakage	I_{CEO}	—		100	nA	V_{CE} = 25 V, Ee = 0
COUPLED						
On-State Collector Current	$I_{C(ON)}$		See page 3.		mA	
Saturation Voltage	$V_{CE(SAT)}$		See page 3.		V	
Turn-On Time	t_{on}		See page 3.		μS	
Turn-Off Time	t_{off}		See page 3.		μS	

NOTES

1. *Derate power dissipation linearly 1.33 mW/°C above 25°C.*
2. *Derate power dissipation linearly 2.00 mW/°C above 25°C.*
3. *RMA flux is recommended.*
4. *Methanol or Isopropyl alcohols are recommended as cleaning agents.*
5. *Soldering iron tip 1⁄16″ (1.6 mm) from housing.*

$I_{C(ON)}$, $V_{CE(SAT)}$, t_{on}, AND t_{off}

PARAMETER	SYMBOL	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS
ON-STATE COLLECTOR CURRENT						
H21A1	$I_{C(ON)}$	0.15	—	—	mA	I_F = 5mA, V_{CE} = 5V
H21A2	$I_{C(ON)}$	0.30	—	—	mA	I_F = 5mA, V_{CE} = 5V
H21A3	$I_{C(ON)}$	0.60	—	—	mA	I_F = 5mA, V_{CE} = 5V
H21A1	$I_{C(ON)}$	1.0	—	—	mA	I_F = 20mA, V_{CE} = 5V
H21A2	$I_{C(ON)}$	2.0	—	—	mA	I_F = 20mA, V_{CE} = 5V
H21A3	$I_{C(ON)}$	4.0	—	—	mA	I_F = 20mA, V_{CE} = 5V
H21A1	$I_{C(ON)}$	1.9	—	—	mA	I_F = 30mA, V_{CE} = 5V
H21A2	$I_{C(ON)}$	3.0	—	—	mA	I_F = 30mA, V_{CE} = 5V
H21A3	$I_{C(ON)}$	5.5	—	—	mA	I_F = 30mA, V_{CE} = 5V
SATURATION VOLTAGE						
H21A2	$V_{CE(SAT)}$	—	—	0.40	V	I_F = 20mA, I_C = 1.8mA
H21A3	$V_{CE(SAT)}$	—	—	0.40	V	I_F = 20mA, I_C = 1.8mA
H21A1	$V_{CE(SAT)}$	—	—	0.40	V	I_F = 30mA, I_C = 1.8mA
Turn-On Time	t_{on}	—	8	—	μS	V_{CC} = 5V, I_F = 30 mA, R_L = 2.5KΩ
Turn-Off Time	t_{off}	—	50	—	μS	V_{CC} = 5V, I_F = 30 mA, R_L = 2.5KΩ

SLOTTED OPTICAL SWITCH

TYPICAL CHARACTERISTICS

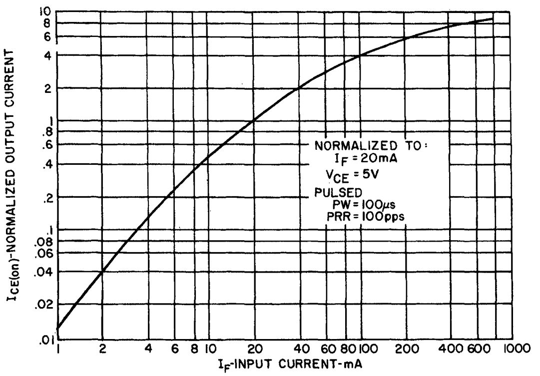


Fig. 1. Output Current vs. Input Current ST1129-11

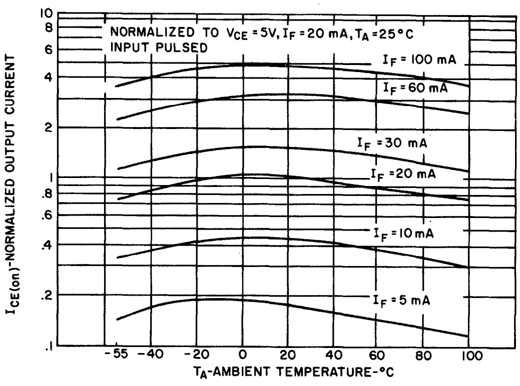


Fig. 2. Output Current vs. Temperature ST1134-11

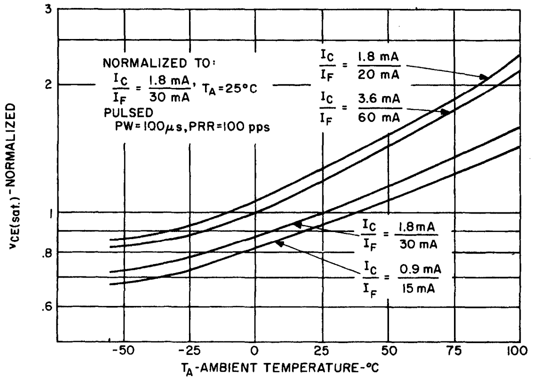


Fig. 3. $V_{CE(SAT)}$ vs. Temperature ST1130-11

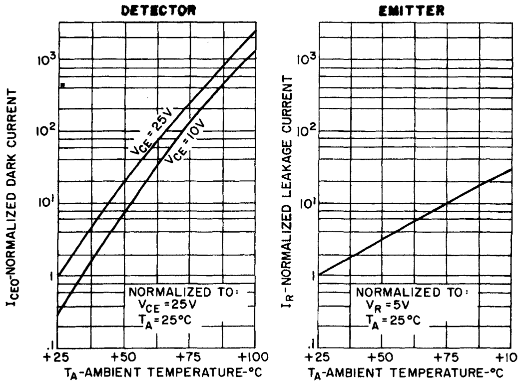


Fig. 4. Leakage Currents vs. Temperature ST1133-11

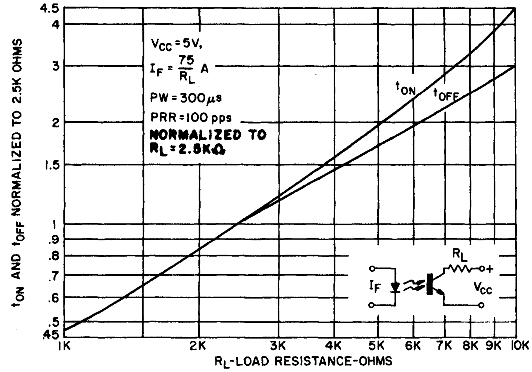


Fig. 5. Switching Speed vs. R_L ST1131-11

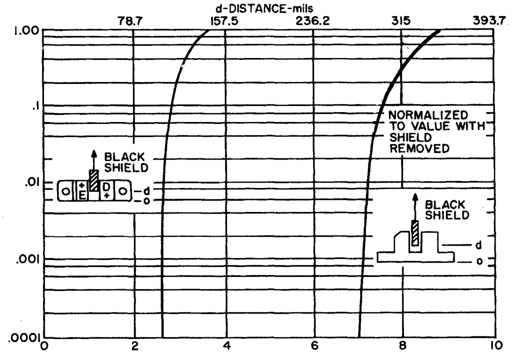


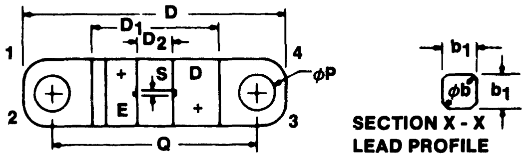
Fig. 6. Output Current vs. Distance ST1132-11

QT
OPTOELECTRONICS

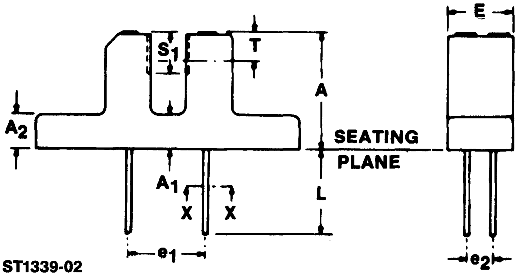
SLOTTED OPTICAL SWITCH

H21A4/5/6

PACKAGE DIMENSIONS



ST1339-01

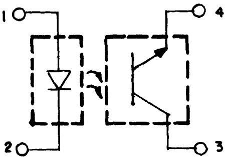


ST1339-02

SYMBOL	MILLIMETERS		INCHES		NOTES
	MIN.	MAX.	MIN.	MAX.	
A	10.7	11.0	.422	.433	
A_1	3.0	3.2	.119	.125	
A_2	3.0	3.2	.119	.125	
ϕb	.600	.750	.024	.030	2
b_1	.50 NOM.		.020 NOM.		2
D	24.3	24.7	.957	.972	
D_1	11.6	12.0	.457	.472	
D_2	3.0	3.3	.119	.129	
e_1	6.9	7.5	.272	.295	
e_2	2.3	2.8	.091	.110	
E	6.15	6.35	.243	.249	
L	8.00		.315		
ϕp	3.2	3.4	.126	.133	
Q	18.9	19.2	.745	.755	
S	.85	1.0	.034	.039	
S_1	3.45	3.75	.136	.147	
T	2.6 NOM.		.103 NOM.		3

NOTES:
1. INCH DIMENSIONS ARE DERIVED FROM MILLIMETERS.
2. FOUR LEADS. LEAD CROSS SECTION IS CONTROLLED BETWEEN 1.27mm (.050″) FROM SEATING PLANE AND THE END OF THE LEADS.
3. THE SENSING AREA IS DEFINED BY THE “S” DIMENSION AND BY DIMENSION “T” ±0.75mm (±.030 INCH).

PACKAGE OUTLINE



ST1609

DESCRIPTION

The H21A Slotted Optical Switch is a gallium arsenide light emitting diode coupled to a silicon phototransistor in a plastic housing. The packaging system is designed to optimize the mechanical resolution, coupling efficiency, ambient light rejection, cost and reliability. The gap in the housing provides a means of interrupting the signal with an opaque material, switching the output from an “ON” to an “OFF” state.

FEATURES

- Opaque housing
- Low cost
- .035″ apertures
- High $I_{C(ON)}$

SLOTTED OPTICAL SWITCH

ABSOLUTE MAXIMUM RATINGS (T_A = 25°C Unless Otherwise Specified)

Storage Temperature	−55°C to +100°C
Operating Temperature	−55°C to +100°C
Soldering:	
Lead Temperature (Iron)	240°C for 5 sec.(3,4,5)
Lead Temperature (Flow)	260°C for 10 sec.(3,4)
INPUT DIODE	
Continuous Forward Current	60 mA
Reverse Voltage	6.0 Volts
Power Dissipation	100 mW(1)
OUTPUT TRANSISTOR	
Collector-Emitter Voltage	55 Volts
Emitter-Collector Voltage	6 Volts
Power Dissipation	150 mW(2)

ELECTRICAL CHARACTERISTICS (T_A = 25°C Unless Otherwise Specified)

PARAMETER	SYMBOL	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS
INPUT DIODE						
Forward Voltage	V_F	—		1.7	V	I_F = 60 mA
Reverse Breakdown Voltage	V_R	6.0		—	V	I_R = 10μA
Reverse Leakage Current	I_R	—		1.0	μA	V_R = 3 V
OUTPUT TRANSISTOR						
Emitter-Collector Breakdown	BV_{ECO}	6.0		—	V	I_E = 100 μA, Ee = 0
Collector-Emitter Breakdown	BV_{CEO}	55		—	V	I_C = 1 mA, Ee = 0
Collector-Emitter Leakage	I_{CEO}	—		100	nA	V_{CE} = 45 V, Ee = 0
COUPLED						
On-State Collector Current	$I_{C(ON)}$		See page 3.		mA	
Saturation Voltage	$V_{CE(SAT)}$		See page 3.		V	
Turn-On Time	t_{on}		See page 3.		μS	
Turn-Off Time	t_{off}		See page 3.		μS	

NOTES

1. *Derate power dissipation linearly 1.33 mW/°C above 25°C ambient.*
2. *Derate power dissipation linearly 2.00 mW/°C above 25°C case.*
3. *RMA flux is recommended.*
4. *Methanol or Isopropyl alcohols are recommended as cleaning agents.*
5. *Soldering iron tip 1/16″ (1.6 mm) from housing.*

SLOTTED OPTICAL SWITCH

$I_{C(ON)}$, $V_{CE(SAT)}$, t_{on}, AND t_{off}

PARAMETER	SYMBOL	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS
ON-STATE COLLECTOR CURRENT						
H21A4	$I_{C(ON)}$	0.15	—	—	mA	I_F = 5mA, V_{CE} = 5V
H21A5	$I_{C(ON)}$	0.30	—	—	mA	I_F = 5mA, V_{CE} = 5V
H21A6	$I_{C(ON)}$	0.60	—	—	mA	I_F = 5mA, V_{CE} = 5V
H21A4	$I_{C(ON)}$	1.0	—	—	mA	I_F = 20mA, V_{CE} = 5V
H21A5	$I_{C(ON)}$	2.0	—	—	mA	I_F = 20mA, V_{CE} = 5V
H21A6	$I_{C(ON)}$	4.0	—	—	mA	I_F = 20mA, V_{CE} = 5V
H21A4	$I_{C(ON)}$	1.9	—	—	mA	I_F = 30mA, V_{CE} = 5V
H21A5	$I_{C(ON)}$	3.0	—	—	mA	I_F = 30mA, V_{CE} = 5V
H21A6	$I_{C(ON)}$	5.5	—	—	mA	I_F = 30mA, V_{CE} = 5V
SATURATION VOLTAGE						
H21A5	$V_{CE(SAT)}$	—	—	0.40	V	I_F = 20mA, I_C = 1.8mA
H21A6	$V_{CE(SAT)}$	—	—	0.40	V	I_F = 20mA, I_C = 1.8mA
H21A4	$V_{CE(SAT)}$	—	—	0.40	V	I_F = 30mA, I_C = 1.8mA
Turn-On Time	t_{on}	—	8	—	μS	V_{CC} = 5V, I_F = 30 mA, R_L = 2.5KΩ
Turn-Off Time	t_{off}	—	50	—	μS	V_{CC} = 5V, I_F = 30 mA, R_L = 2.5KΩ

TYPICAL CHARACTERISTICS

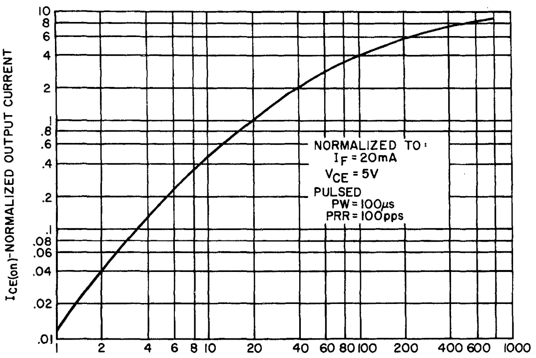


Fig. 1. Output Current vs. Input Current ST1140-11

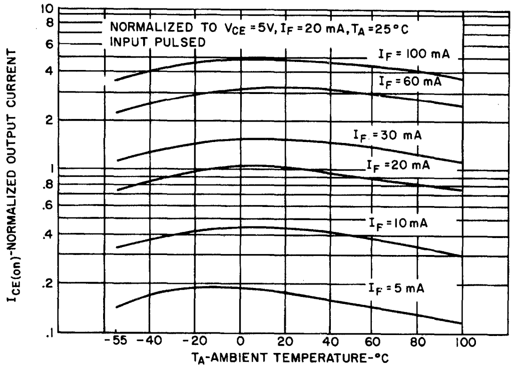


Fig. 2. Output Current vs. Temperature ST1144-11

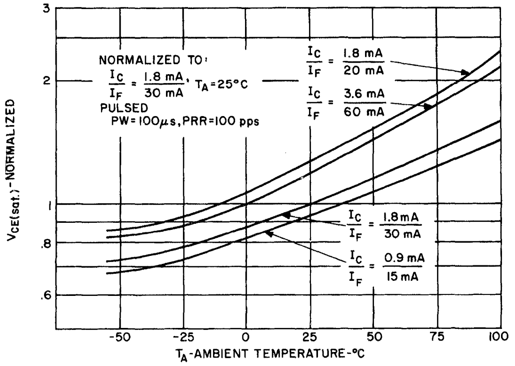


Fig. 3. $V_{CE(SAT)}$ vs. Temperature ST1141-11

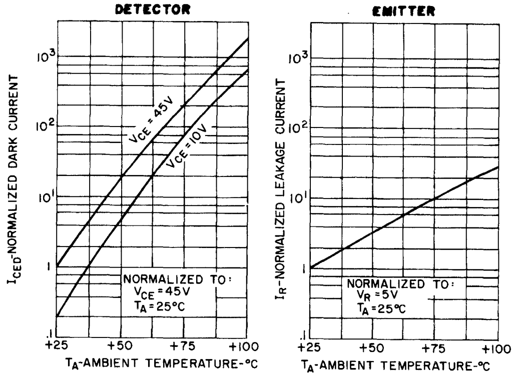


Fig. 4. Leakage Current vs. Temperature ST1145-11

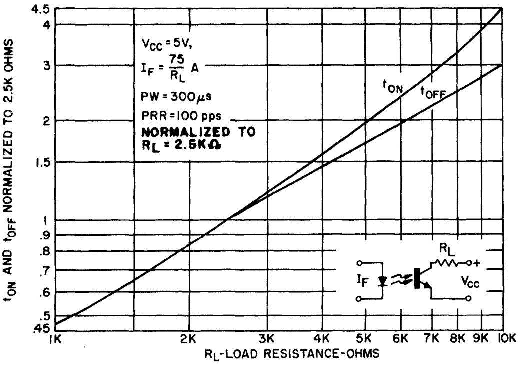


Fig. 5. Switching Speed vs. R_L ST1142-11

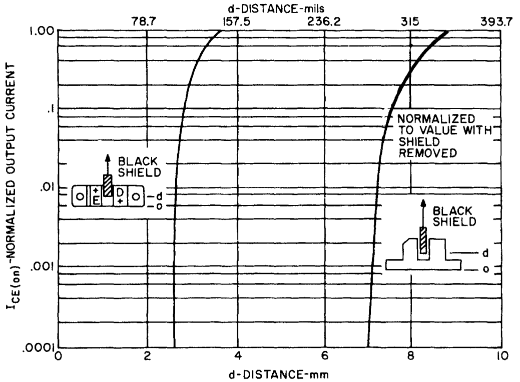
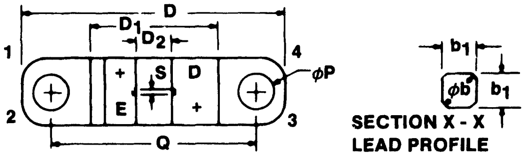


Fig. 6. Output Current vs. Shield Distance ST1143-11

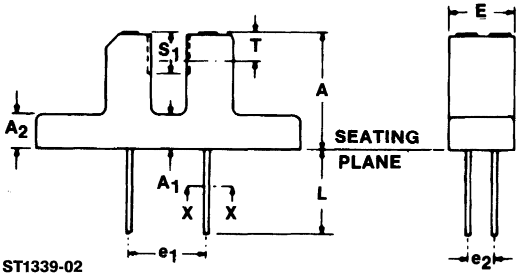
SLOTTED OPTICAL SWITCH

H21B1/2/3

PACKAGE DIMENSIONS



ST1339-01



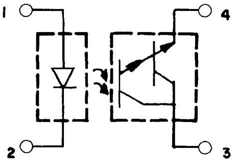
ST1339-02

SYMBOL	MILLIMETERS		INCHES		NOTES
	MIN.	MAX.	MIN.	MAX.	
A	10.7	11.0	.422	.433	
A_1	3.0	3.2	.119	.125	
A_2	3.0	3.2	.119	.125	
ϕb	.600	.750	.024	.030	2
b_1	.50 NOM.		.020 NOM.		2
D	24.3	24.7	.957	.972	
D_1	11.6	12.0	.457	.472	
D_2	3.0	3.3	.119	.129	
e_1	6.9	7.5	.272	.295	
e_2	2.3	2.8	.091	.110	
E	6.15	6.35	.243	.249	
L	8.00		.315		
ϕp	3.2	3.4	.126	.133	
Q	18.9	19.2	.745	.755	
S	.85	1.0	.034	.039	
S_1	3.45	3.75	.136	.147	
T	2.6 NOM.		.103 NOM.		3

NOTES:

1. INCH DIMENSIONS ARE DERIVED FROM MILLIMETERS.
2. FOUR LEADS. LEAD CROSS SECTION IS CONTROLLED BETWEEN 1.27mm (.050″) FROM SEATING PLANE AND THE END OF THE LEADS.
3. THE SENSING AREA IS DEFINED BY THE "S" DIMENSION AND BY DIMENSION "T" ±0.75mm (±.030 INCH).

PACKAGE OUTLINE



ST1191

DESCRIPTION

The H21B Slotted Optical Switch is a gallium arsenide light emitting diode coupled to a silicon photodarlington in a plastic housing. The packaging system is designed to optimize the mechanical resolution, coupling efficiency, ambient light rejection, cost and reliability. The gap in the housing provides a means of interrupting the signal with an opaque material, switching the output from an "ON" to an "OFF" state.

FEATURES

- Opaque housing
- Low cost
- .035″ apertures
- High $I_{C(ON)}$

QT
OPTOELECTRONICS

SLOTTED OPTICAL SWITCH

ABSOLUTE MAXIMUM RATINGS (T_A = 25°C Unless Otherwise Specified)

Storage Temperature	−55°C to +100°C
Operating Temperature	−55°C to +100°C
Soldering:	
Lead Temperature (Iron)	240°C for 5 sec.(3,4,5)
Lead Temperature (Flow)	260°C for 10 sec.(3,4)
INPUT DIODE	
Continuous Forward Current	60 mA
Reverse Voltage	6.0 Volts
Power Dissipation	100 mW(1)
OUTPUT DARLINGTON	
Collector-Emitter Voltage	30 Volts
Emitter-Collector Voltage	7 Volts
Power Dissipation	150 mW(2)

ELECTRICAL CHARACTERISTICS (T_A = 25°C Unless Otherwise Specified)

PARAMETER	SYMBOL	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS
INPUT DIODE						
Forward Voltage	V_F	—		1.7	V	I_F = 60 mA
Reverse Breakdown Voltage	V_R	6.0		—	V	I_R = 10μA
Reverse Leakage Current	I_R	—		1.0	μA	V_R = 3 V
OUTPUT DARLINGTON						
Emitter-Collector Breakdown	BV_{ECO}	7.0		—	V	I_E = 100 μA, Ee = 0
Collector-Emitter Breakdown	BV_{CEO}	30		—	V	I_C = 1 mA, Ee = 0
Collector-Emitter Leakage	I_{CEO}	—		100	nA	V_{CE} = 25 V, Ee = 0
COUPLED						
On-State Collector Current	$I_{C(ON)}$		See page 3.		mA	
Saturation Voltage	$V_{CE(SAT)}$		See page 3.		V	
Turn-On Time	t_{on}		See page 3.		μS	
Turn-Off Time	t_{off}		See page 3.		μS	

NOTES

1. *Derate power dissipation linearly 1.33 mW/°C above 25°C.*
2. *Derate power dissipation linearly 2.00 mW/°C above 25°C.*
3. *RMA flux is recommended.*
4. *Methanol or Isopropyl alcohols are recommended as cleaning agents.*
5. *Soldering iron tip 1⁄16″ (1.6 mm) from housing.*

$I_{C(ON)}$, $V_{CE(SAT)}$, t_{on}, AND t_{off}

PARAMETER	SYMBOL	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS
ON-STATE COLLECTOR CURRENT						
H21B1	$I_{C(ON)}$	0.5	—	—	mA	$I_F = 2mA, V_{CE} = 1.5V$
H21B2	$I_{C(ON)}$	1.0	—	—	mA	$I_F = 2mA, V_{CE} = 1.5V$
H21B3	$I_{C(ON)}$	2.0	—	—	mA	$I_F = 2mA, V_{CE} = 1.5V$
H21B1	$I_{C(ON)}$	2.5	—	—	mA	$I_F = 5mA, V_{CE} = 1.5V$
H21B2	$I_{C(ON)}$	5.0	—	—	mA	$I_F = 5mA, V_{CE} = 1.5V$
H21B3	$I_{C(ON)}$	10	—	—	mA	$I_F = 5mA, V_{CE} = 1.5V$
H21B1	$I_{C(ON)}$	7.5	—	—	mA	$I_F = 10mA, V_{CE} = 1.5V$
H21B2	$I_{C(ON)}$	14	—	—	mA	$I_F = 10mA, V_{CE} = 1.5V$
H21B3	$I_{C(ON)}$	25	—	—	mA	$I_F = 10mA, V_{CE} = 1.5V$
SATURATION VOLTAGE						
H21B1	$V_{CE(SAT)}$	—	—	1.0	V	$I_F = 10mA, I_C = 1.8mA$
H21B2	$V_{CE(SAT)}$	—	—	1.0	V	$I_F = 10mA, I_C = 1.8mA$
H21B3	$V_{CE(SAT)}$	—	—	1.0	V	$I_F = 10mA, I_C = 1.8mA$
H21B2	$V_{CE(SAT)}$	—	—	1.5	V	$I_F = 60mA, I_C = 50mA$
H21B3	$V_{CE(SAT)}$	—	—	1.5	V	$I_F = 60mA, I_C = 50mA$
Turn-On Time						
H21B1, H21B2, H21B3	t_{on}	—	45	—	μS	$V_{CC} = 5V, I_F = 10mA, R_L = 750\Omega$
H21B1, H21B2, H21B3	t_{on}	—	7	—	μS	$V_{CC} = 5V, I_F = 60mA, R_L = 75\Omega$
Turn-Off Time						
H21B1, H21B2, H21B3	t_{off}	—	250	—	μS	$V_{CC} = 5V, I_F = 10mA, R_L = 750\Omega$
H21B1, H21B2, H21B3	t_{off}	—	45	—	μS	$V_{CC} = 5V, I_F = 60mA, R_L = 75\Omega$

SLOTTED OPTICAL SWITCH

TYPICAL CHARACTERISTICS

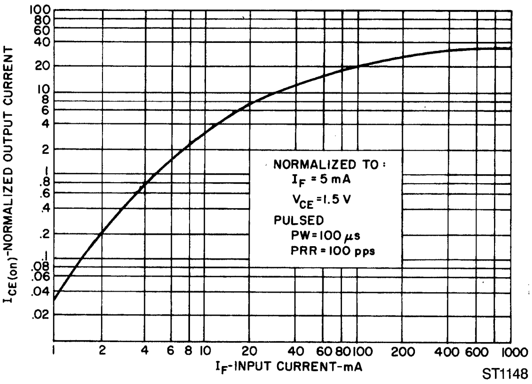


Fig. 1. Output Current vs. Input Current

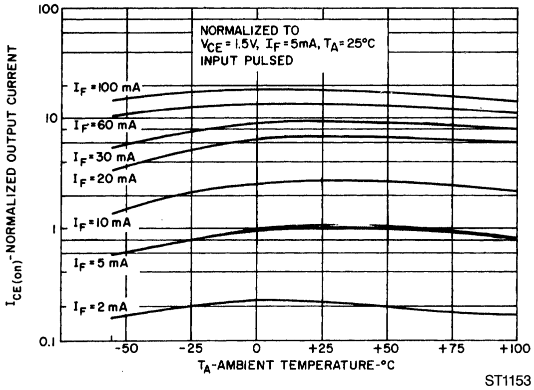


Fig. 2. Output Current vs. Temperature

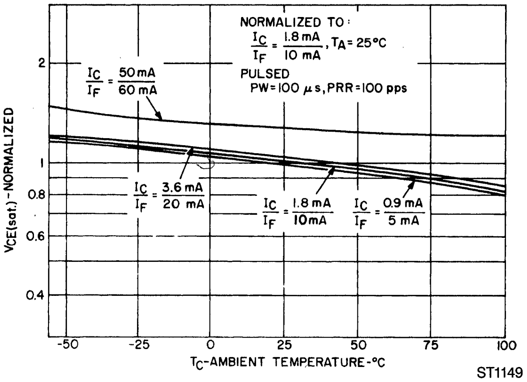


Fig. 3. $V_{CE(SAT)}$ vs. Temperature

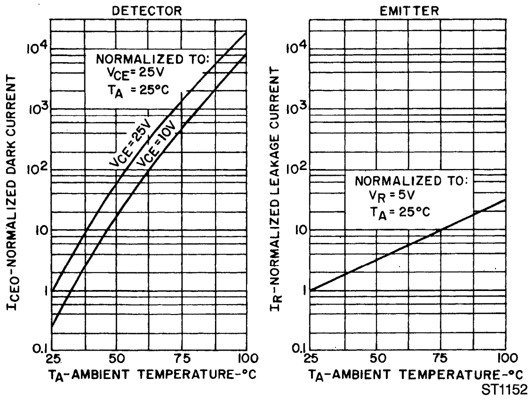


Fig. 4. Leakage Current vs. Temperature

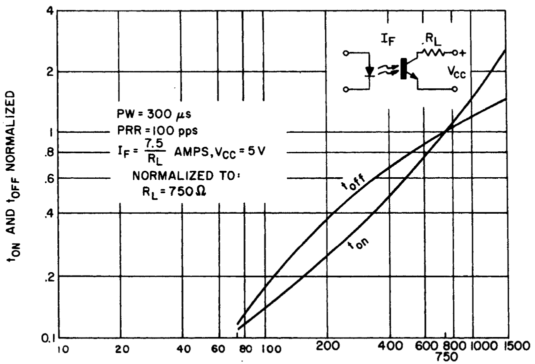


Fig. 5. Switching Speed vs. R_L

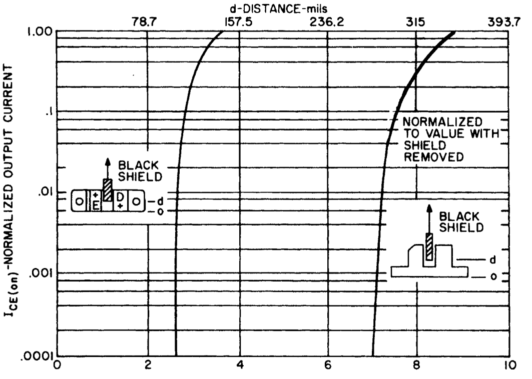
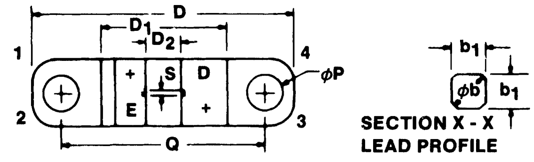


Fig. 6. Output Current vs. Shield Distance

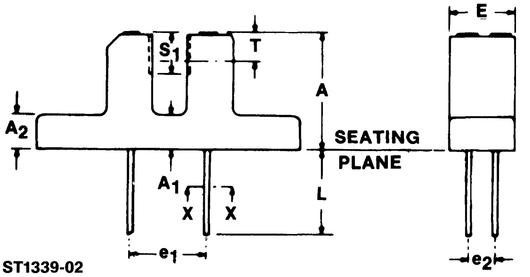
SLOTTED OPTICAL SWITCH

H21B4/5/6

PACKAGE DIMENSIONS



ST1339-01

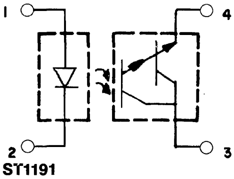


ST1339-02

SYMBOL	MILLIMETERS		INCHES		NOTES
	MIN.	MAX.	MIN.	MAX.	
A	10.7	11.0	.422	.433	
A_1	3.0	3.2	.119	.125	
A_2	3.0	3.2	.119	.125	
ϕb	.600	.750	.024	.030	2
b_1	.50 NOM.		.020 NOM.		2
D	24.3	24.7	.957	.972	
D_1	11.6	12.0	.457	.472	
D_2	3.0	3.3	.119	.129	
e_1	6.9	7.5	.272	.295	
e_2	2.3	2.8	.091	.110	
E	6.15	6.35	.243	.249	
L	8.00		.315		
ϕp	3.2	3.4	.126	.133	
Q	18.9	19.2	.745	.755	
S	.85	1.0	.034	.039	
S_1	3.45	3.75	.136	.147	
T	2.6 NOM.		.103 NOM.		3

NOTES:
1. INCH DIMENSIONS ARE DERIVED FROM MILLIMETERS.
2. FOUR LEADS. LEAD CROSS SECTION IS CONTROLLED BETWEEN 1.27mm (.050″) FROM SEATING PLANE AND THE END OF THE LEADS.
3. THE SENSING AREA IS DEFINED BY THE "S" DIMENSION AND BY DIMENSION "T" ±0.75mm (±.030 INCH).

PACKAGE OUTLINE



ST1191

DESCRIPTION

The H21B Slotted Optical Switch is a gallium arsenide light emitting diode coupled to a silicon photodarlington in a plastic housing. The packaging system is designed to optimize the mechanical resolution, coupling efficiency, ambient light rejection, cost and reliability. The gap in the housing provides a means of interrupting the signal with an opaque material, switching the output from an "ON" to an "OFF" state.

FEATURES

- Opaque housing
- Low cost
- .035″ apertures
- High $I_{C(ON)}$

QT
OPTOELECTRONICS

SLOTTED OPTICAL SWITCH

ABSOLUTE MAXIMUM RATINGS (T_A = 25°C Unless Otherwise Specified)

Storage Temperature	−55°C to +100°C
Operating Temperature	−55°C to +100°C
Soldering:	
Lead Temperature (Iron)	240°C for 5 sec.(3,4,5)
Lead Temperature (Flow)	260°C for 10 sec.(3,4)
INPUT DIODE	
Continuous Forward Current	60 mA
Reverse Voltage	6.0 Volts
Power Dissipation	100 mW(1)
OUTPUT DARLINGTON	
Collector-Emitter Voltage	55 Volts
Emitter-Collector Voltage	7 Volts
Power Dissipation	150 mW(2)

ELECTRICAL CHARACTERISTICS (T_A = 25°C Unless Otherwise Specified)

PARAMETER	SYMBOL	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS
INPUT DIODE						
Forward Voltage	V_F	—		1.7	V	I_F = 60 mA
Reverse Breakdown Voltage	V_R	6.0		—	V	I_R = 10μA
Reverse Leakage Current	I_R	—		1.0	μA	V_R = 3 V
OUTPUT DARLINGTON						
Emitter-Collector Breakdown	BV_{ECO}	7.0		—	V	I_E = 100 μA, Ee = 0
Collector-Emitter Breakdown	BV_{CEO}	55		—	V	I_C = 1 mA, Ee = 0
Collector-Emitter Leakage	I_{CEO}	—		100	nA	V_{CE} = 45 V, Ee = 0
COUPLED						
On-State Collector Current	$I_{C(ON)}$		See page 3.		mA	
Saturation Voltage	$V_{CE(SAT)}$		See page 3.		V	
Turn-On Time	t_{on}		See page 3.		μS	
Turn-Off Time	t_{off}		See page 3.		μS	

NOTES

1. *Derate power dissipation linearly 1.33 mW/°C above 25°C.*
2. *Derate power dissipation linearly 2.00 mW/°C above 25°C.*
3. *RMA flux is recommended.*
4. *Methanol or Isopropyl alcohols are recommended as cleaning agents.*
5. *Soldering iron tip 1/16″ (1.6 mm) from housing.*

$I_{C(ON)}$, $V_{CE(SAT)}$, t_{on}, AND t_{off}

PARAMETER	SYMBOL	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS
ON-STATE COLLECTOR CURRENT						
H21B4	$I_{C(ON)}$	0.5	—	—	mA	$I_F = 2mA$, $V_{CE} = 1.5V$
H21B5	$I_{C(ON)}$	1.0	—	—	mA	$I_F = 2mA$, $V_{CE} = 1.5V$
H21B6	$I_{C(ON)}$	2.0	—	—	mA	$I_F = 2mA$, $V_{CE} = 1.5V$
H21B4	$I_{C(ON)}$	2.5	—	—	mA	$I_F = 5mA$, $V_{CE} = 1.5V$
H21B5	$I_{C(ON)}$	5.0	—	—	mA	$I_F = 5mA$, $V_{CE} = 1.5V$
H21B6	$I_{C(ON)}$	10	—	—	mA	$I_F = 5mA$, $V_{CE} = 1.5V$
H21B4	$I_{C(ON)}$	7.5	—	—	mA	$I_F = 10mA$, $V_{CE} = 1.5V$
H21B5	$I_{C(ON)}$	14	—	—	mA	$I_F = 10mA$, $V_{CE} = 1.5V$
H21B6	$I_{C(ON)}$	25	—	—	mA	$I_F = 10mA$, $V_{CE} = 1.5V$
SATURATION VOLTAGE						
H21B4	$V_{CE(SAT)}$	—	—	1.0	V	$I_F = 10mA$, $I_C = 1.8mA$
H21B5	$V_{CE(SAT)}$	—	—	1.0	V	$I_F = 10mA$, $I_C = 1.8mA$
H21B6	$V_{CE(SAT)}$	—	—	1.0	V	$I_F = 10mA$, $I_C = 1.8mA$
H21B5	$V_{CE(SAT)}$	—	—	1.5	V	$I_F = 60mA$, $I_C = 50mA$
H21B6	$V_{CE(SAT)}$	—	—	1.5	V	$I_F = 60mA$, $I_C = 50mA$
Turn-On Time						
H21B4, H21B5, H21B6	t_{on}	—	45	—	μS	$V_{CC} = 5V$, $I_F = 10mA$, $R_L = 750\Omega$
H21B4, H21B5, H21B6	t_{on}	—	7	—	μS	$V_{CC} = 5V$, $I_F = 60mA$, $R_L = 75\Omega$
Turn-Off Time						
H21B4, H21B5, H21B6	t_{off}	—	250	—	μS	$V_{CC} = 5V$, $I_F = 10mA$, $R_L = 750\Omega$
H21B4, H21B5, H21B6	t_{off}	—	45	—	μS	$V_{CC} = 5V$, $I_F = 60mA$, $R_L = 75\Omega$

TYPICAL CHARACTERISTICS

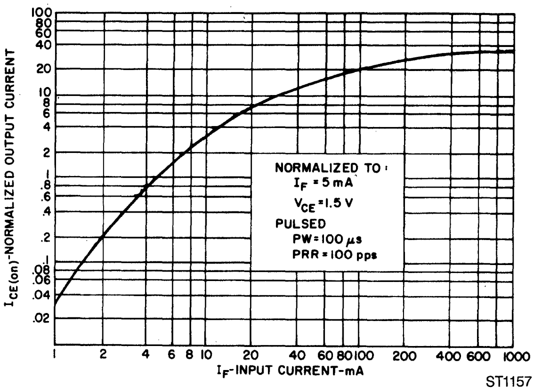


Fig. 1. Output Current vs. Input Current

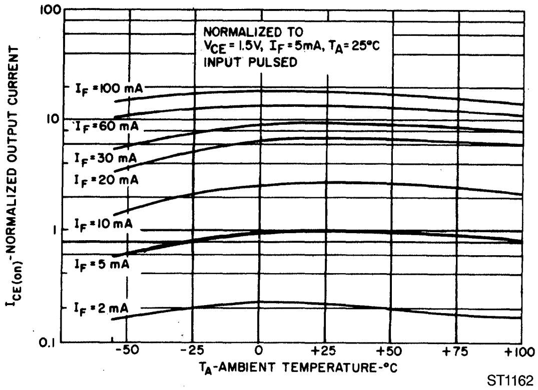


Fig. 2. Output Current vs. Temperature

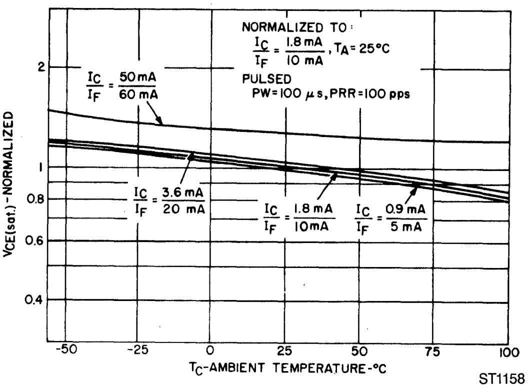


Fig. 3. $V_{CE(SAT)}$ vs. Temperature

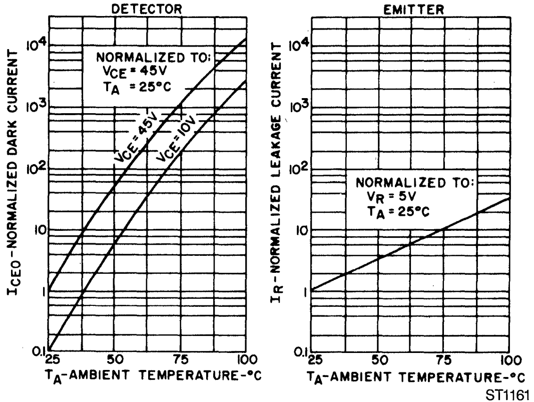


Fig. 4. Leakage Currents vs. Temperature

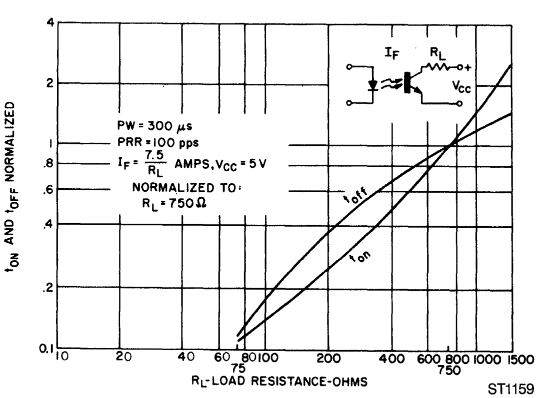


Fig. 5. Switching Speed vs. R_L

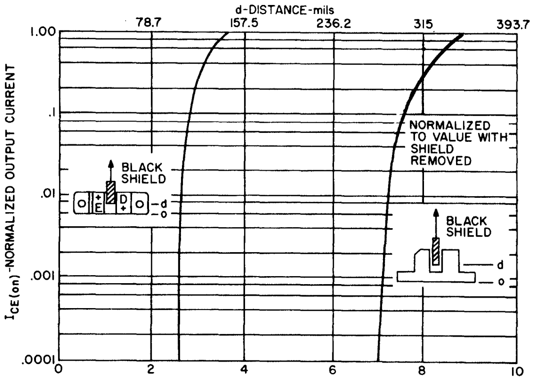
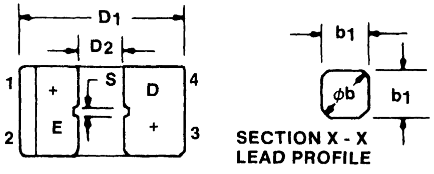


Fig. 6. Output Current vs. Shield Distance

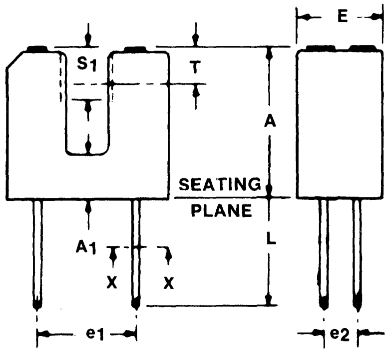
SLOTTED OPTICAL SWITCH

H22A1/2/3

PACKAGE DIMENSIONS



ST1340-01



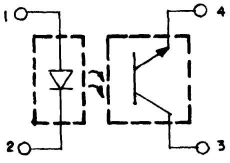
ST1340-02

SYMBOL	MILLIMETERS		INCHES		NOTES
	MIN.	MAX.	MIN.	MAX.	
A	10.7	11.0	.422	.433	
A_1	3.0	3.2	.119	.125	
ϕb	.600	.750	.024	.030	2
b_1	.50 NOM.		.020 NOM.		2
D_1	11.6	12.0	.457	.472	
D_2	3.0	3.3	.119	.129	
e_1	6.9	7.5	.272	.295	
e_2	2.3	2.8	.091	.110	
E	6.15	6.35	.243	.249	
L	8.00		.315		
S	.85	1.0	.034	.039	
S_1	3.45	3.75	.136	.147	
T	2.6 NOM.		.103 NOM.		3

NOTES:

1. INCH DIMENSIONS ARE DERIVED FROM MILLIMETERS.
2. FOUR LEADS. LEAD CROSS SECTION IS CONTROLLED BETWEEN 1.27mm (.050″) FROM SEATING PLANE AND THE END OF THE LEADS.
3. THE SENSING AREA IS DEFINED BY THE "S" DIMENSION AND BY DIMENSION "T" ±0.75mm (±.030 INCH).

PACKAGE OUTLINE



ST1609

DESCRIPTION

The H22A Slotted Optical Switch is a gallium arsenide light emitting diode coupled to a silicon photodarlington in a plastic housing. The packaging system is designed to optimize the mechanical resolution, coupling efficiency, ambient light rejection, cost and reliability. The gap in the housing provides a means of interrupting the signal with an opaque material, switching the output from an "ON" to an "OFF" state.

FEATURES

- Opaque housing
- Low cost
- .035″ apertures
- High $I_{C(ON)}$

QT
OPTOELECTRONICS

SLOTTED OPTICAL SWITCH

ABSOLUTE MAXIMUM RATINGS (T_A = 25°C Unless Otherwise Specified)

Storage Temperature	−55°C to +100°C
Operating Temperature	−55°C to +100°C
Soldering:	
Lead Temperature (Iron)	240°C for 5 sec.(3,4,5)
Lead Temperature (Flow)	260°C for 10 sec.(3,4)
INPUT DIODE	
Continuous Forward Current	60 mA
Reverse Voltage	6.0 Volts
Power Dissipation	100 mW(1)
OUTPUT TRANSISTOR	
Collector-Emitter Voltage	30 Volts
Emitter-Collector Voltage	6 Volts
Power Dissipation	150 mW(2)

ELECTRICAL CHARACTERISTICS (T_A = 25°C Unless Otherwise Specified)

PARAMETER	SYMBOL	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS
INPUT DIODE						
Forward Voltage	V_F	—		1.7	V	$I_F = 60$ mA
Reverse Breakdown Voltage	V_R	6.0		—	V	$I_R = 10\mu$A
Reverse Leakage Current	I_R	—		1.0	µA	$V_R = 3$ V
OUTPUT TRANSISTOR						
Emitter-Collector Breakdown	BV_{ECO}	6.0		—	V	$I_E = 100\ \mu$A, Ee = 0
Collector-Emitter Breakdown	BV_{CEO}	30		—	V	$I_C = 1$ mA, Ee = 0
Collector-Emitter Leakage	I_{CEO}	—		100	nA	$V_{CE} = 25$ V, Ee = 0
COUPLED						
On-State Collector Current	$I_{C(ON)}$		See page 3.		mA	
Saturation Voltage	$V_{CE(SAT)}$		See page 3.		V	
Turn-On Time	t_{on}		See page 3.		µS	
Turn-Off Time	t_{off}		See page 3.		µS	

NOTES

1. *Derate power dissipation linearly 1.33 mW/°C above 25°C.*
2. *Derate power dissipation linearly 2.00 mW/°C above 25°C.*
3. *RMA flux is recommended.*
4. *Methanol or Isopropyl alcohols are recommended as cleaning agents.*
5. *Soldering iron tip 1/16″ (1.6 mm) from housing.*

$I_{C(ON)}$, $V_{CE(SAT)}$, t_{on}, AND t_{off}

PARAMETER	SYMBOL	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS
ON-STATE COLLECTOR CURRENT						
H22A1	$I_{C(ON)}$	0.15	—	—	mA	$I_F = 5mA, V_{CE} = 5V$
H22A2	$I_{C(ON)}$	0.30	—	—	mA	$I_F = 5mA, V_{CE} = 5V$
H22A3	$I_{C(ON)}$	0.60	—	—	mA	$I_F = 5mA, V_{CE} = 5V$
H22A1	$I_{C(ON)}$	1.0	—	—	mA	$I_F = 20mA, V_{CE} = 5V$
H22A2	$I_{C(ON)}$	2.0	—	—	mA	$I_F = 20mA, V_{CE} = 5V$
H22A3	$I_{C(ON)}$	4.0	—	—	mA	$I_F = 20mA, V_{CE} = 5V$
H22A1	$I_{C(ON)}$	1.9	—	—	mA	$I_F = 30mA, V_{CE} = 5V$
H22A2	$I_{C(ON)}$	3.0	—	—	mA	$I_F = 30mA, V_{CE} = 5V$
H22A3	$I_{C(ON)}$	5.5	—	—	mA	$I_F = 30mA, V_{CE} = 5V$
SATURATION VOLTAGE						
H22A2	$V_{CE(SAT)}$	—	—	0.40	V	$I_F = 20mA, I_C = 1.8mA$
H22A3	$V_{CE(SAT)}$	—	—	0.40	V	$I_F = 20mA, I_C = 1.8mA$
H22A1	$V_{CE(SAT)}$	—	—	0.40	V	$I_F = 30mA, I_C = 1.8mA$
Turn-On Time	t_{on}	—	8	—	μS	$V_{CC} = 5V, I_F = 30\ mA, R_L = 2.5K\Omega$
Turn-Off Time	t_{off}	—	50	—	μS	$V_{CC} = 5V, I_F = 30\ mA, R_L = 2.5K\Omega$

OPTOELECTRONICS

SLOTTED OPTICAL SWITCH

TYPICAL CHARACTERISTICS

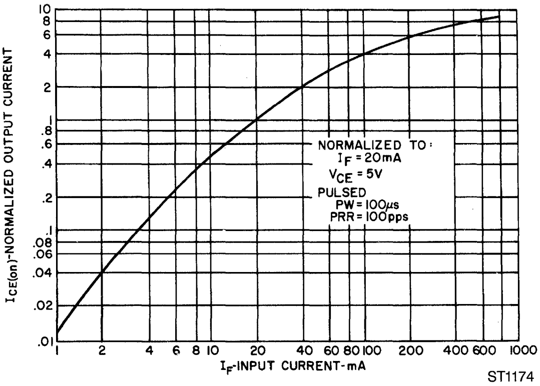


Fig. 1. Output Current vs. Input Current

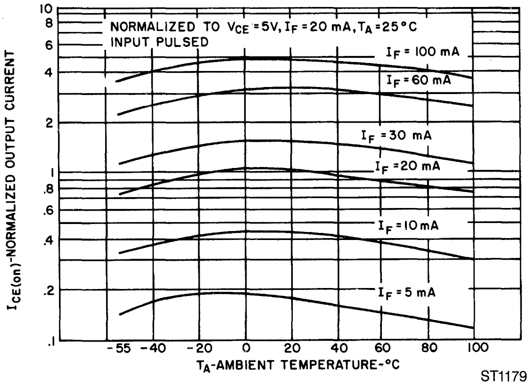


Fig. 2. Output Current vs. Temperature

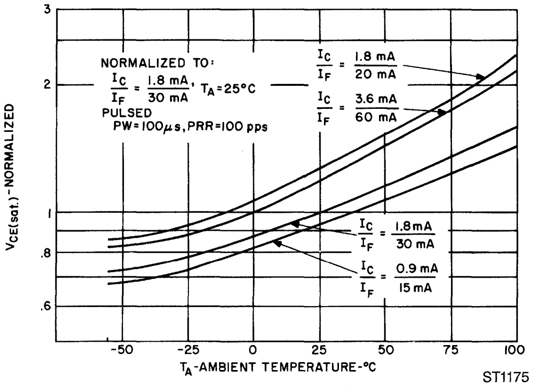


Fig. 3. $V_{CE(SAT)}$ vs. Temperature

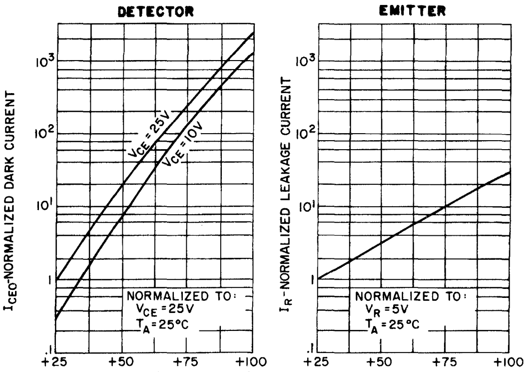


Fig. 4. Leakage Currents vs. Temperature

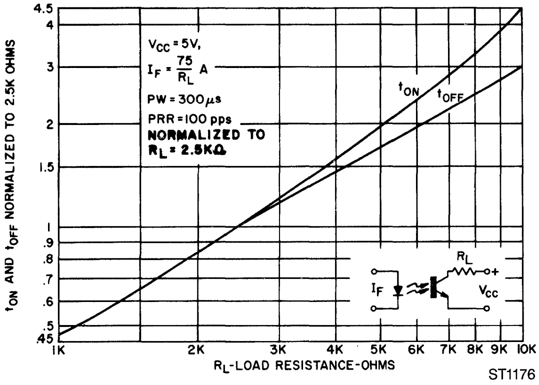


Fig. 5. Switching Speed vs. R_L

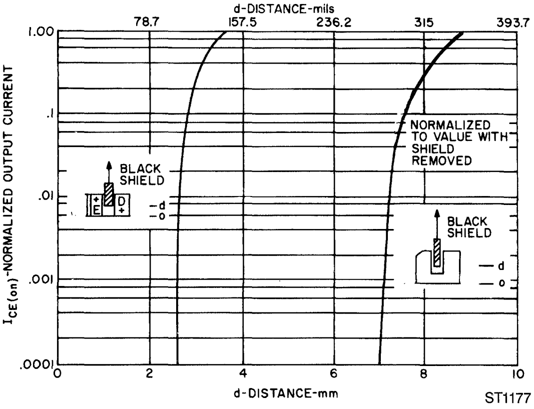
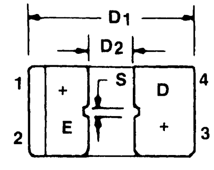


Fig. 6. Output Current vs. Shield Distance

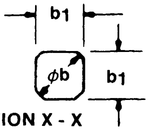
SLOTTED OPTICAL SWITCH

H22A4/5/6

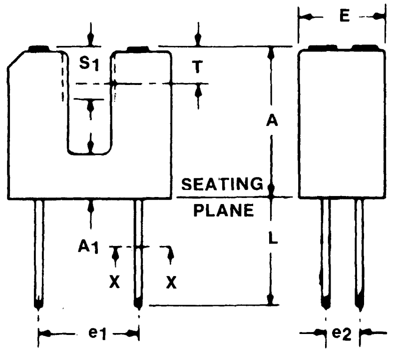
PACKAGE DIMENSIONS



ST1340-01



SECTION X - X
LEAD PROFILE

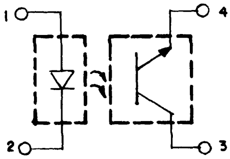


ST1340-02

SYMBOL	MILLIMETERS		INCHES		NOTES
	MIN.	MAX.	MIN.	MAX.	
A	10.7	11.0	.422	.433	
A_1	3.0	3.2	.119	.125	
ϕb	.600	.750	.024	.030	2
b_1	.50 NOM.		.020 NOM.		2
D_1	11.6	12.0	.457	.472	
D_2	3.0	3.3	.119	.129	
e_1	6.9	7.5	.272	.295	
e_2	2.3	2.8	.091	.110	
E	6.15	6.35	.243	.249	
L	8.00		.315		
S	.85	1.0	.034	.039	
S_1	3.45	3.75	.136	.147	
T	2.6 NOM.		.103 NOM.		3

NOTES:
1. INCH DIMENSIONS ARE DERIVED FROM MILLIMETERS.
2. FOUR LEADS. LEAD CROSS SECTION IS CONTROLLED BETWEEN 1.27mm (.050″) FROM SEATING PLANE AND THE END OF THE LEADS.
3. THE SENSING AREA IS DEFINED BY THE "S" DIMENSION AND BY DIMENSION "T" ±0.75mm (±.030 INCH).

PACKAGE OUTLINE



ST1609

DESCRIPTION

The H22A Slotted Optical Switch is a gallium arsenide light emitting diode coupled to a silicon photodarlington in a plastic housing. The packaging system is designed to optimize the mechanical resolution, coupling efficiency, ambient light rejection, cost and reliability. The gap in the housing provides a means of interrupting the signal with an opaque material, switching the output from an "ON" to an "OFF" state.

FEATURES

- Opaque housing
- Low cost
- .035″ apertures
- High $I_{C(ON)}$

SLOTTED OPTICAL SWITCH

ABSOLUTE MAXIMUM RATINGS (T_A = 25°C Unless Otherwise Specified)

Storage Temperature	−55°C to +100°C
Operating Temperature	−55°C to +100°C
Soldering:	
Lead Temperature (Iron)	240°C for 5 sec.(3,4,5)
Lead Temperature (Flow)	260°C for 10 sec.(3,4)
INPUT DIODE	
Continuous Forward Current	60 mA
Reverse Voltage	6.0 Volts
Power Dissipation	100 mW(1)
OUTPUT TRANSISTOR	
Collector-Emitter Voltage	55 Volts
Emitter-Collector Voltage	6 Volts
Power Dissipation	150 mW(2)

ELECTRICAL CHARACTERISTICS (T_A = 25°C Unless Otherwise Specified)

PARAMETER	SYMBOL	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS
INPUT DIODE						
Forward Voltage	V_F	—		1.7	V	I_F = 60 mA
Reverse Breakdown Voltage	V_R	6.0		—	V	I_R = 10μA
Reverse Leakage Current	I_R	—		1.0	μA	V_R = 3 V
OUTPUT TRANSISTOR						
Emitter-Collector Breakdown	BV_{ECO}	6		—	V	I_E = 100 μA, Ee = 0
Collector-Emitter Breakdown	BV_{CEO}	55		—	V	I_C = 1 mA, Ee = 0
Collector-Emitter Leakage	I_{CEO}	—		100	nA	V_{CE} = 45 V, Ee = 0
COUPLED						
On-State Collector Current	$I_{C(ON)}$		See page 3.		mA	
Saturation Voltage	$V_{CE(SAT)}$		See page 3.		V	
Turn-On Time	t_{on}		See page 3.		μS	
Turn-Off Time	t_{off}		See page 3.		μS	

NOTES

1. *Derate power dissipation linearly 1.33 mW/°C above 25°C.*
2. *Derate power dissipation linearly 2.00 mW/°C above 25°C.*
3. *RMA flux is recommended.*
4. *Methanol or Isopropyl alcohols are recommended as cleaning agents.*
5. *Soldering iron tip 1/16″ (1.6 mm) from housing.*

$I_{C(ON)}$, $V_{CE(SAT)}$, t_{on}, AND t_{off}

PARAMETER	SYMBOL	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS
ON-STATE COLLECTOR CURRENT						
H22A4	$I_{C(ON)}$	0.15	—	—	mA	$I_F = 5mA, V_{CE} = 5V$
H22A5	$I_{C(ON)}$	0.30	—	—	mA	$I_F = 5mA, V_{CE} = 5V$
H22A6	$I_{C(ON)}$	0.60	—	—	mA	$I_F = 5mA, V_{CE} = 5V$
H22A4	$I_{C(ON)}$	1.0	—	—	mA	$I_F = 20mA, V_{CE} = 5V$
H22A5	$I_{C(ON)}$	2.0	—	—	mA	$I_F = 20mA, V_{CE} = 5V$
H22A6	$I_{C(ON)}$	4.0	—	—	mA	$I_F = 20mA, V_{CE} = 5V$
H22A4	$I_{C(ON)}$	1.9	—	—	mA	$I_F = 30mA, V_{CE} = 5V$
H22A5	$I_{C(ON)}$	3.0	—	—	mA	$I_F = 30mA, V_{CE} = 5V$
H22A6	$I_{C(ON)}$	5.5	—	—	mA	$I_F = 30mA, V_{CE} = 5V$
SATURATION VOLTAGE						
H22A5	$V_{CE(SAT)}$	—	—	0.40	V	$I_F = 20mA, I_C = 1.8mA$
H22A6	$V_{CE(SAT)}$	—	—	0.40	V	$I_F = 20mA, I_C = 1.8mA$
H22A4	$V_{CE(SAT)}$	—	—	0.40	V	$I_F = 30mA, I_C = 1.8mA$
Turn-On Time	t_{on}	—	8	—	μS	$V_{CC} = 5V, I_F = 30 mA, R_L = 2.5K\Omega$
Turn-Off Time	t_{off}	—	50	—	μS	$V_{CC} = 5V, I_F = 30 mA, R_L = 2.5K\Omega$

TYPICAL CHARACTERISTICS

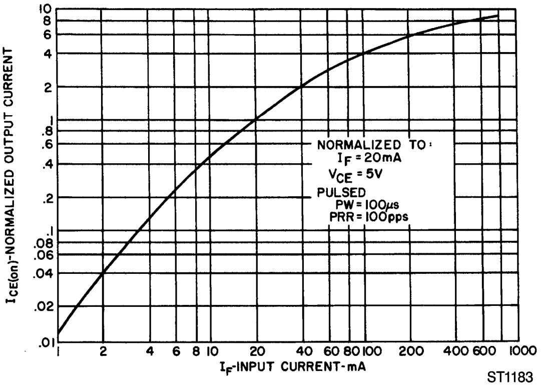


Fig. 1. Output Current vs. Input Current

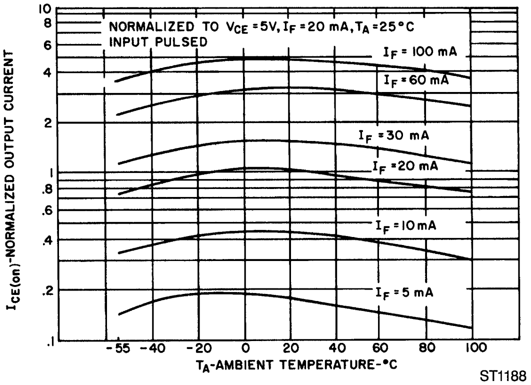


Fig. 2. Output Current vs. Temperature

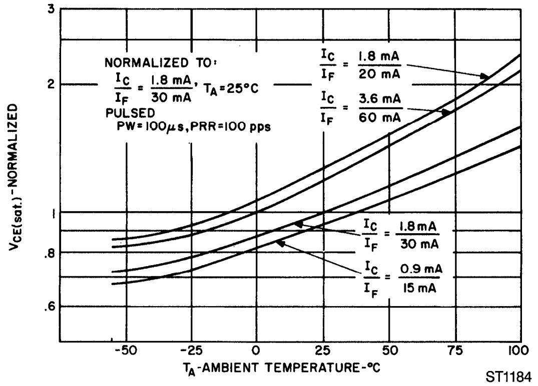


Fig. 3. $V_{CE(SAT)}$ vs. Temperature

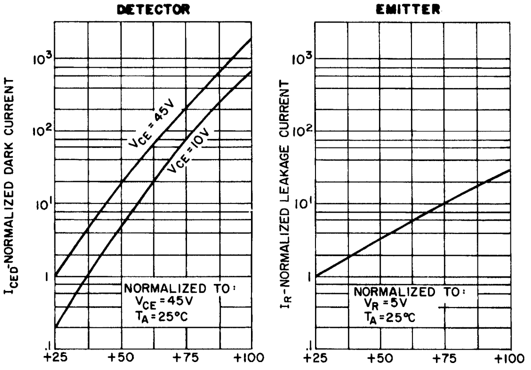


Fig. 4. Leakage Currents vs. Temperature

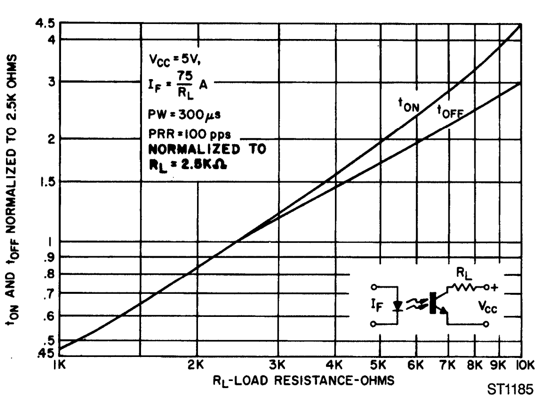


Fig. 5. Switching Speed vs. R_L

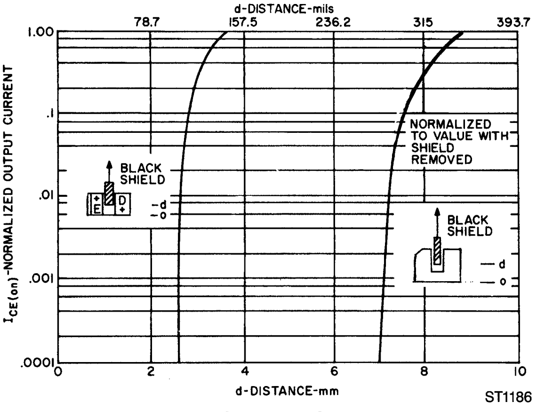
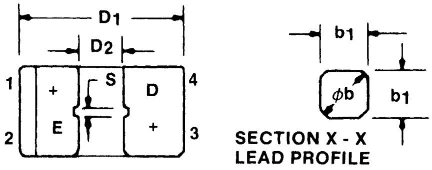


Fig. 6. Output Current vs. Shield Distance

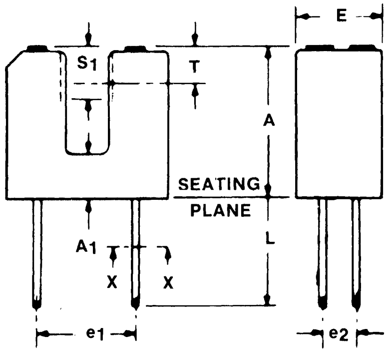
SLOTTED OPTICAL SWITCH

H22B1/2/3

PACKAGE DIMENSIONS



ST1340-01

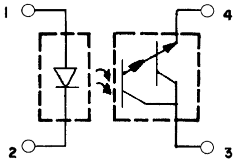


ST1340-02

SYMBOL	MILLIMETERS		INCHES		NOTES
	MIN.	MAX.	MIN.	MAX.	
A	10.7	11.0	.422	.433	
A_1	3.0	3.2	.119	.125	
ϕb	.600	.750	.024	.030	2
b_1	.50 NOM.		.020 NOM.		2
D_1	11.6	12.0	.457	.472	
D_2	3.0	3.3	.119	.129	
e_1	6.9	7.5	.272	.295	
e_2	2.3	2.8	.091	.110	
E	6.15	6.35	.243	.249	
L	8.00		.315		
S	.85	1.0	.034	.039	
S_1	3.45	3.75	.136	.147	
T	2.6 NOM.		.103 NOM.		3

NOTES:
1. INCH DIMENSIONS ARE DERIVED FROM MILLIMETERS.
2. FOUR LEADS. LEAD CROSS SECTION IS CONTROLLED BETWEEN 1.27mm (.050″) FROM SEATING PLANE AND THE END OF THE LEADS.
3. THE SENSING AREA IS DEFINED BY THE "S" DIMENSION AND BY DIMENSION "T" ±0.75mm (±.030 INCH).

PACKAGE OUTLINE



ST1191

DESCRIPTION

The H22B Slotted Optical Switch is a gallium arsenide light emitting diode coupled to a silicon photodarlington in a plastic housing. The packaging system is designed to optimize the mechanical resolution, coupling efficiency, ambient light rejection, cost and reliability. The gap in the housing provides a means of interrupting the signal with an opaque material, switching the output from an "ON" to an "OFF" state.

FEATURES

- Opaque housing
- Low cost
- .035″ apertures
- High $I_{C(ON)}$

SLOTTED OPTICAL SWITCH

ABSOLUTE MAXIMUM RATINGS (T_A = 25°C Unless Otherwise Specified)

Storage Temperature	−55°C to +100°C
Operating Temperature	−55°C to +100°C
Soldering:	
Lead Temperature (Iron)	240°C for 5 sec.(3,4,5)
Lead Temperature (Flow)	260°C for 10 sec.(3,4)
INPUT DIODE	
Continuous Forward Current	60 mA
Reverse Voltage	6.0 Volts
Power Dissipation	100 mW(1)
OUTPUT DARLINGTON	
Collector-Emitter Voltage	30 Volts
Emitter-Collector Voltage	7 Volts
Power Dissipation	150 mW(2)

ELECTRICAL CHARACTERISTICS (T_A = 25°C Unless Otherwise Specified)

PARAMETER	SYMBOL	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS
INPUT DIODE						
Forward Voltage	V_F	—		1.7	V	I_F = 60 mA
Reverse Breakdown Voltage	V_R	6.0		—	V	I_R = 10μA
Reverse Leakage Current	I_R	—		1.0	μA	V_R = 3 V
OUTPUT DARLINGTON						
Emitter-Collector Breakdown	BV_{ECO}	7.0		—	V	I_E = 100 μA, Ee = 0
Collector-Emitter Breakdown	BV_{CEO}	30		—	V	I_C = 1 mA, Ee = 0
Collector-Emitter Leakage	I_{CEO}	—		100	nA	V_{CE} = 25 V, Ee = 0
COUPLED						
On-State Collector Current	$I_{C(ON)}$		See page 3.		mA	
Saturation Voltage	$V_{CE(SAT)}$		See page 3.		V	
Turn-On Time	t_{on}		See page 3.		μS	
Turn-Off Time	t_{off}		See page 3.		μS	

NOTES

1. *Derate power dissipation linearly 1.33 mW/°C above 25°C.*
2. *Derate power dissipation linearly 2.00 mW/°C above 25°C.*
3. *RMA flux is recommended.*
4. *Methanol or Isopropyl alcohols are recommended as cleaning agents.*
5. *Soldering iron tip 1⁄16″ (1.6 mm) from housing.*

SLOTTED OPTICAL SWITCH

$I_{C(ON)}$, $V_{CE(SAT)}$, t_{on}, AND t_{off}

PARAMETER	SYMBOL	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS
ON-STATE COLLECTOR CURRENT						
H22B1	$I_{C(ON)}$	0.5	—	—	mA	$I_F = 2mA, V_{CE} = 1.5V$
H22B2	$I_{C(ON)}$	1.0	—	—	mA	$I_F = 2mA, V_{CE} = 1.5V$
H22B3	$I_{C(ON)}$	2.0	—	—	mA	$I_F = 2mA, V_{CE} = 1.5V$
H22B1	$I_{C(ON)}$	2.5	—	—	mA	$I_F = 5mA, V_{CE} = 1.5V$
H22B2	$I_{C(ON)}$	5.0	—	—	mA	$I_F = 5mA, V_{CE} = 1.5V$
H22B3	$I_{C(ON)}$	10	—	—	mA	$I_F = 5mA, V_{CE} = 1.5V$
H22B1	$I_{C(ON)}$	7.5	—	—	mA	$I_F = 10mA, V_{CE} = 1.5V$
H22B2	$I_{C(ON)}$	14	—	—	mA	$I_F = 10mA, V_{CE} = 1.5V$
H22B3	$I_{C(ON)}$	25	—	—	mA	$I_F = 10mA, V_{CE} = 1.5V$
SATURATION VOLTAGE						
H22B1	$V_{CE(SAT)}$	—	—	1.0	V	$I_F = 10mA, I_C = 1.8mA$
H22B2	$V_{CE(SAT)}$	—	—	1.0	V	$I_F = 10mA, I_C = 1.8mA$
H22B3	$V_{CE(SAT)}$	—	—	1.0	V	$I_F = 10mA, I_C = 1.8mA$
H22B2	$V_{CE(SAT)}$	—	—	1.5	V	$I_F = 60mA, I_C = 50mA$
H22B3	$V_{CE(SAT)}$	—	—	1.5	V	$I_F = 60mA, I_C = 50mA$
Turn-On Time						
H22B1, H22B2, H22B3	t_{on}	—	45	—	μS	$V_{CC} = 5V, I_F = 10mA, R_L = 750\Omega$
H22B1, H22B2, H22B3	t_{on}	—	7	—	μS	$V_{CC} = 5V, I_F = 60mA, R_L = 75\Omega$
Turn-Off Time						
H22B1, H22B2, H22B3	t_{off}	—	250	—	μS	$V_{CC} = 5V, I_F = 10mA, R_L = 750\Omega$
H22B1, H22B2, H22B3	t_{off}	—	45	—	μS	$V_{CC} = 5V, I_F = 60mA, R_L = 75\Omega$

TYPICAL CHARACTERISTICS

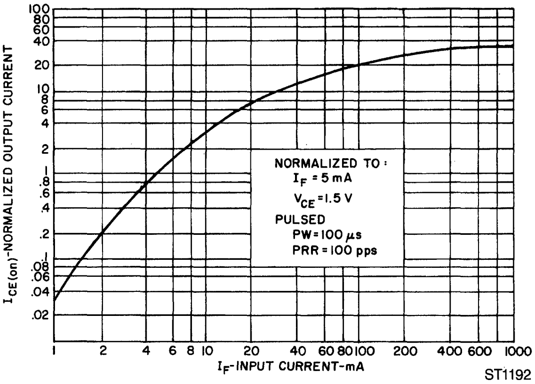


Fig. 1. Output Current vs. Input Current

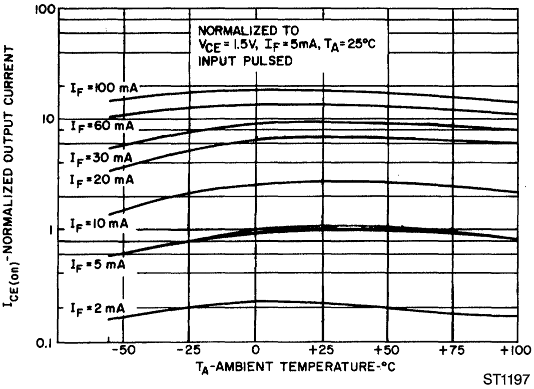


Fig. 2. Output Current vs. Temperature

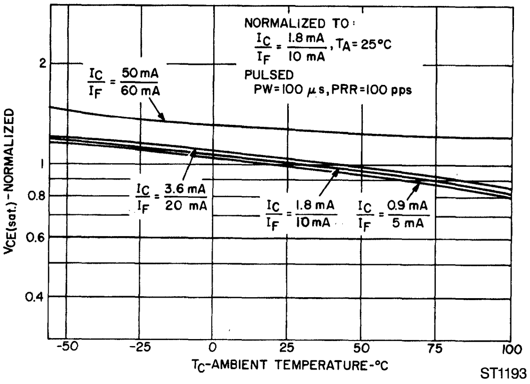


Fig. 3. $V_{CE(SAT)}$ vs. Temperature

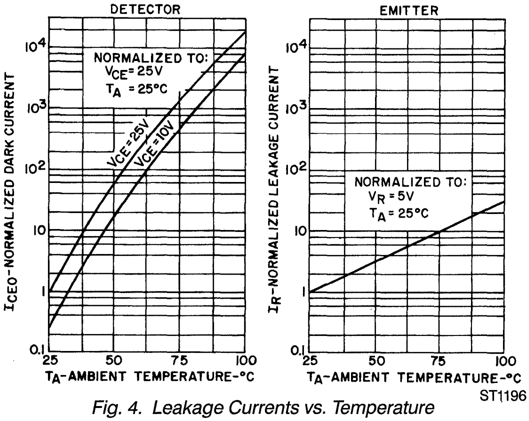


Fig. 4. Leakage Currents vs. Temperature

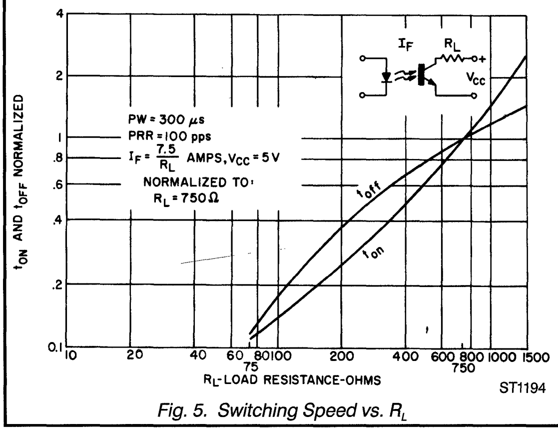


Fig. 5. Switching Speed vs. R_L

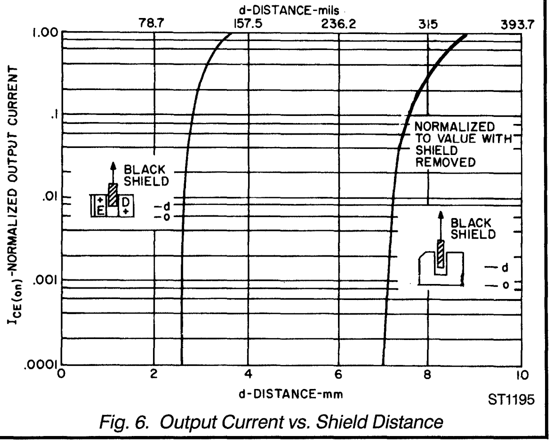


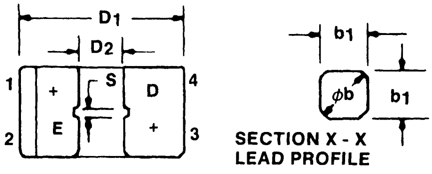
Fig. 6. Output Current vs. Shield Distance

QT OPTOELECTRONICS

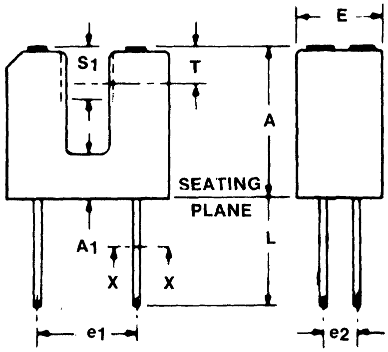
SLOTTED OPTICAL SWITCH

H22B4/5/6

PACKAGE DIMENSIONS



ST1340-01

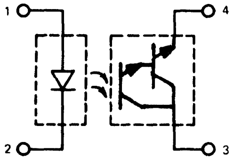


ST1340-02

SYMBOL	MILLIMETERS		INCHES		NOTES
	MIN.	MAX.	MIN.	MAX.	
A	10.7	11.0	.422	.433	
A_1	3.0	3.2	.119	.125	
ϕb	.600	.750	.024	.030	2
b_1	.50 NOM.		.020 NOM.		2
D_1	11.6	12.0	.457	.472	
D_2	3.0	3.3	.119	.129	
e_1	6.9	7.5	.272	.295	
e_2	2.3	2.8	.091	.110	
E	6.15	6.35	.243	.249	
L	8.00		.315		
S	.85	1.0	.034	.039	
S_1	3.45	3.75	.136	.147	
T	2.6 NOM.		.103 NOM.		3

NOTES
1. INCH DIMENSIONS ARE DERIVED FROM MILLIMETERS.
2. FOUR LEADS, LEAD CROSS SECTION IS CONTROLLED BETWEEN 1.27 MM (.050″) FROM SEATING PLANE AND THE END OF THE LEADS.
3. THE SENSING AREA IS DEFINED BY THE "S" DIMENSION AND BY DIMENSION "T" ±0.75 MM (±.030 INCH).

PACKAGE OUTLINE



ST1199

DESCRIPTION

The H22B Slotted Optical Switch is a gallium arsenide light emitting diode coupled to a silicon photodarlington in a plastic housing. The packaging system is designed to optimize the mechanical resolution, coupling efficiency, ambient light rejection, cost and reliability. The gap in the housing provides a means of interrupting the signal with an opaque material, switching the output from an "ON" to an "OFF" state.

FEATURES

- Opaque housing
- Low cost
- .035″ apertures
- High $I_{C(ON)}$

SLOTTED OPTICAL SWITCH

ABSOLUTE MAXIMUM RATINGS (T_A = 25°C Unless Otherwise Specified)

Storage Temperature . . . . −55°C to +100°C
Operating Temperature . . . . −55°C to +100°C
Soldering:
  Lead Temperature (Iron) . . . . 240°C for 5 sec.(3,4,5)
  Lead Temperature (Flow) . . . . 260°C for 10 sec.(3,4)

INPUT DIODE
Continuous Forward Current . . . . 60 mA
Reverse Voltage . . . . 6.0 Volts
Power Dissipation . . . . 100mW(1)

OUTPUT DARLINGTON
Collector-Emitter Voltage . . . . 55 Volts
Emitter-Collector Voltage . . . . 7 Volts
Power Dissipation . . . . 150 mW (2)

ELECTRICAL CHARACTERISTICS (T_A = 25°C Unless Otherwise Specified)

PARAMETER	SYMBOL	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS
INPUT DIODE						
Forward Voltage	V_F	—		1.7	V	I_F = 60 mA
Reverse Breakdown Voltage	V_R	6.0		—	V	I_R = 10µA
Reverse Leakage Current	I_R	—		1.0	µA	V_R = 3V
OUTPUT DARLINGTON						
Emitter-Collector Breakdown	BV_{ECO}	7.0		—	V	I_E = 100µA, E_e = 0
Collector-Emitter Breakdown	BV_{CEO}	55		—	V	I_C = 1 mA, E_e = 0
Collector-Emitter Leakage	I_{CEO}	—		100	nA	V_{CE} = 45 V, E_e = 0
COUPLED						
On-State Collector Current	$I_{C(ON)}$		See page 3.		mA	
Saturation Voltage	$V_{CE(SAT)}$		See page 3.		V	
Turn-On Time	t_{on}		See page 3.		µS	
Turn-Off Time	t_{off}		See page 3.		µS	

NOTES

1. *Derate power dissipation linearly 1.33mW/°C above 25°C.*
2. *Derate power dissipation linearly 2.00mW/°C above 25°C.*
3. *RMA flux is recommended.*
4. *Methanol or Isopropyl alcohols are recommended as cleaning agents.*
5. *Soldering iron tip 1/16″ (1.6 mm) minimum from housing.*

$I_{C(ON)}$, $V_{CE(SAT)}$, t_{on}, AND t_{off}

PARAMETER	SYMBOL	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS
ON-STATE COLLECTOR CURRENT						
H22B4	$I_{C(on)}$	0.5	—	—	mA	$I_F = 2mA, V_{CE} = 1.5V$
H22B5	$I_{C(on)}$	1.0	—	—	mA	$I_F = 2mA, V_{CE} = 1.5V$
H22B6	$I_{C(on)}$	2.0	—	—	mA	$I_F = 2mA, V_{CE} = 1.5V$
H22B4	$I_{C(on)}$	2.5	—	—	mA	$I_F = 5mA, V_{CE} = 1.5V$
H22B5	$I_{C(on)}$	5.0	—	—	mA	$I_F = 5mA, V_{CE} = 1.5V$
H22B6	$I_{C(on)}$	10	—	—	mA	$I_F = 5mA, V_{CE} = 1.5V$
H22B4	$I_{C(on)}$	7.5	—	—	mA	$I_F = 10mA, V_{CE} = 1.5V$
H22B5	$I_{C(on)}$	14	—	—	mA	$I_F = 10mA, V_{CE} = 1.5V$
H22B6	$I_{C(on)}$	25	—	—	mA	$I_F = 10mA, V_{CE} = 1.5V$
SATURATION VOLTAGE						
H22B4	$V_{CE(SAT)}$	—	—	1.0	V	$I_F = 10mA, I_C = 1.8mA$
H22B5	$V_{CE(SAT)}$	—	—	1.0	V	$I_F = 10mA, I_C = 1.8mA$
H22B6	$V_{CE(SAT)}$	—	—	1.0	V	$I_F = 10mA, I_C = 1.8mA$
H22B5	$V_{CE(SAT)}$	—	—	1.5	V	$I_F = 60mA, I_C = 50mA$
H22B6	$V_{CE(SAT)}$	—	—	—	V	$I_F = 60mA, I_C = 50mA$
Turn-On Time						
H22B4, H22B5, H22B6	t_{on}	—	45	—	µS	$V_{CC} = 5V, I_F = 10mA, R_L = 750\Omega$
H22B4, H22B5, H22B6	t_{on}	—	—	—	µS	$V_{CC} = 5V, I_F = 60mA, R_L = 75\Omega$
Turn-Off Time						
H22B4, H22B5, H22B6	t_{off}	—	250	—	µS	$V_{CC} = 5V, I_F = 10mA, R_L = 750\Omega$
H22B4, H22B5, H22B6	t_{off}	—	—	—	µS	$V_{CC} = 5V, I_F = 60mA, R_L = 75\Omega$

TYPICAL CHARACTERISTICS

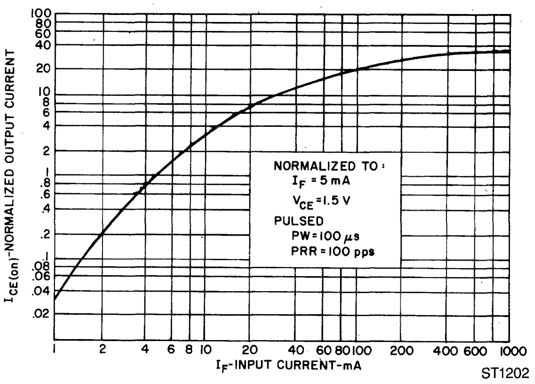


Fig. 1. Output Current vs. Input Current

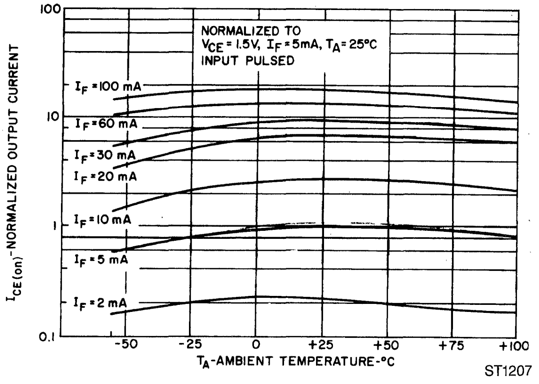


Fig. 2. Output Current vs. Temperature

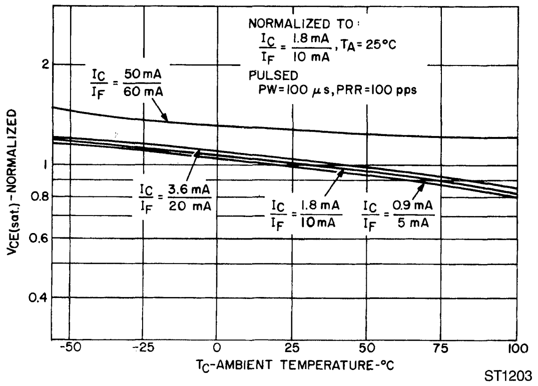


Fig. 3. $V_{CE(SAT)}$ vs. Temperature

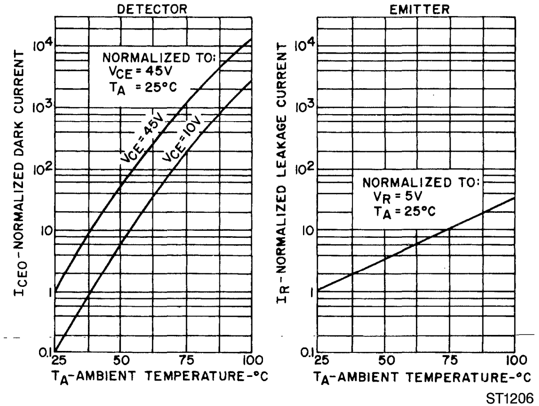


Fig. 4. Leakage Currents vs. Temperature

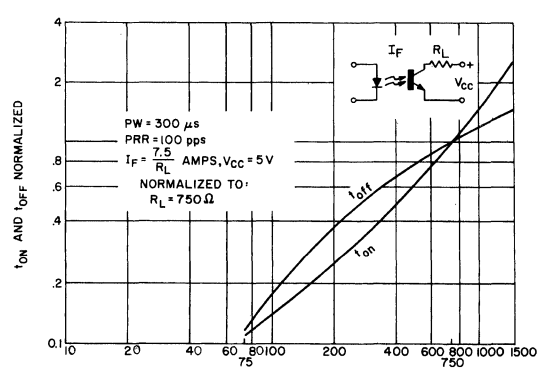


Fig. 5. Switching Speed vs. R_L

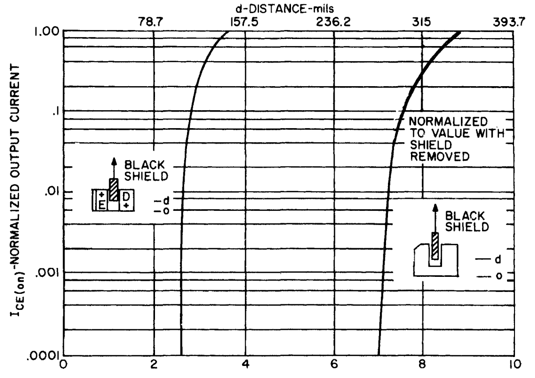
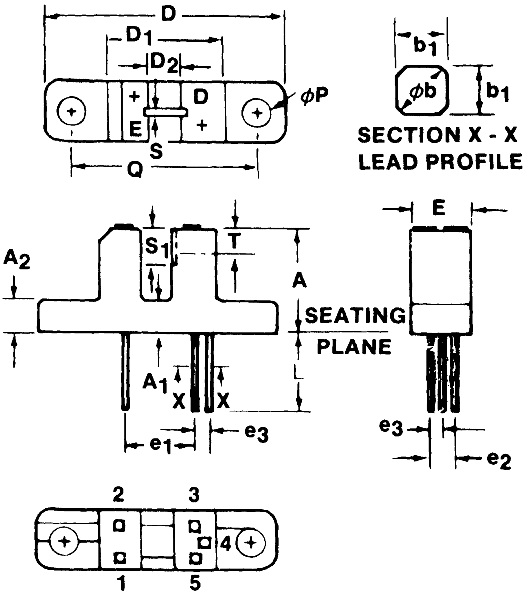


Fig. 6. Output Current vs. Shield Distance

SLOTTED OPTICAL SWITCH

H21L1/2

PACKAGE DIMENSIONS

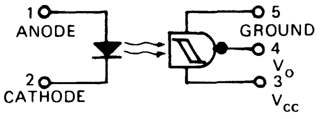


ST1344

SYMBOL	MILLIMETERS		INCHES		NOTES
	MIN.	MAX.	MIN.	MAX.	
A	10.7	11.0	.422	.433	
A_1	3.0	3.2	.119	.125	
A_2	3.0	3.2	.119	.125	
ϕb	.600	.750	.024	.030	2
b_1	.50 NOM.		.020 NOM.		2
D	24.3	24.7	.957	.972	
D_1	11.6	12.0	.457	.472	
D_2	3.0	—	.119	—	
e_1	6.9	7.5	.272	.295	
e_2	2.3	2.8	.091	.110	
e_3	1.14	1.40	.045	.055	
E	6.15	6.35	.243	.249	
L	8.00	—	.315	—	
ϕp	3.2	3.4	.126	.133	
Q	18.9	19.2	.745	.755	
S	.85	1.0	.034	.039	
S_1	3.94 NOM.		.155 NOM.		
T	2.6 NOM.		.103 NOM.		3

NOTES
1. INCH DIMENSIONS ARE DERIVED FROM MILLIMETERS.
2. FIVE LEADS, LEAD CROSS SECTION IS CONTROLLED BETWEEN 1.27 mm (.050″) FROM SEATING PLANE AND THE END OF THE LEADS.
3. THE SENSING AREA IS DEFINED BY THE "S" DIMENSION AND BY DIMENSION "T" ±0.75 mm (±.030 INCH).

PACKAGE OUTLINE



ST1610

DESCRIPTION

The H21L Slotted Optical Switch is a gallium arsenide light emitting diode coupled to a high speed integrated circuit detector in a plastic housing. The output incorporates a Schmitt trigger which provides hysteresis for noise immunity and pulse shaping. The packaging system is designed to optimize the mechanical resolution, coupling efficiency, ambient light rejection, cost and reliability. The gap in the housing provides a means of interrupting the signal with an opaque material, switching the output from an "ON" to an "OFF" state.

FEATURES

- Opaque housing
- Low cost
- .035″ apertures

QT
OPTOELECTRONICS

SLOTTED OPTICAL SWITCH

ABSOLUTE MAXIMUM RATINGS (T_A = 25°C Unless Otherwise Specified)

Storage Temperature	−55°C to +85°C
Operating Temperature	−55°C to +85°C
Soldering:	
Lead Temperature (Iron)	240°C for 5 sec.(3,4,5)
Lead Temperature (Flow)	260°C for 10 sec.(3,4)
INPUT DIODE	
Continuous Forward Current	60 mA
Reverse Voltage	6.0 Volts
Power Dissipation	100mW(1)
OUTPUT OPTOLOGIC™	
Output Current I_4	50 mA
Allowed Range V_{35}	4 to 16 Volts
Allowed Range V_{45}	2.4 to 16 Volts
Power Dissipation	150 mW (2)

ELECTRICAL CHARACTERISTICS (T_A = 25°C Unless Otherwise Specified)

PARAMETER	SYMBOL	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS
INPUT DIODE						
Forward Voltage	V_F	—		1.6	V	I_F = 20 mA
Reverse Leakage Current	I_R	—		10	μA	V_R = 3V
OUTPUT OPTOLOGIC™						
Operating Voltage Range	V_C	4		16	V	
Supply Current	$I_{3(off)}$	—		5.0	mA	I_F = 0, V_{CC} = 5V
Supply Current	$I_{3(on)}$	—		5.0	mA	I_F = 30mA, V_{CC} = 5V

NOTES

1. *Derate power dissipation linearly 1.33mW/°C above 25°C.*
2. *Derate power dissipation linearly 2.00mW/°C above 25°C.*
3. *RMA flux is recommended.*
4. *Methanol or Isopropyl alcohols are recommended as cleaning agents.*
5. *Soldering iron tip 1⁄16″ (1.6 mm) minimum from housing.*

COUPLED ELECTRICAL CHARACTERISTICS

PARAMETER	SYMBOL	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS
Output Current High	I_{OH}	—		100	μA	$I_F = 0$, $V_{CC} = 5V$, $V_O = 16 V$
Output Voltage, Low	V_{OL}	—	0.2	0.4	V	$R_L = 270\Omega$, $V_{CC} = 5V$, $I_F = 30mA$
TURN-ON THRESHOLD CURRENT						
H21L1	$I_{F(ON)}$	—		30	mA	$R_L = 270\Omega$, $V_{CC} = 5V$
H21L2	$I_{F(ON)}$	—		15.0	mA	$R_L = 270\Omega$, $V_{CC} = 5V$
TURN-OFF THRESHOLD CURRENT						
H21L1	$I_{F(OFF)}$	0.5	15	—	mA	$R_L = 270\Omega$, $V_{CC} = 5V$
H21L2	$I_{F(OFF)}$	0.5	8	—	mA	$R_L = 270\Omega$, $V_{CC} = 5V$
Hysteresis Ratio	$I_{F(OFF)}/I_{F(ON)}$	0.50	0.75	0.90	—	$R_L = 270\Omega$, $V_{CC} = 5V$
SWITCHING SPEEDS						
Rise Time	t_r	—	0.1	—	μS	$R_L = 270\Omega$, $V_{CC} = 5V$, $I_F = 20mA$
Fall Time	t_f	—	0.1	—	μS	$R_L = 270\Omega$, $V_{CC} = 5V$, $I_F = 20mA$

TYPICAL CHARACTERISTICS

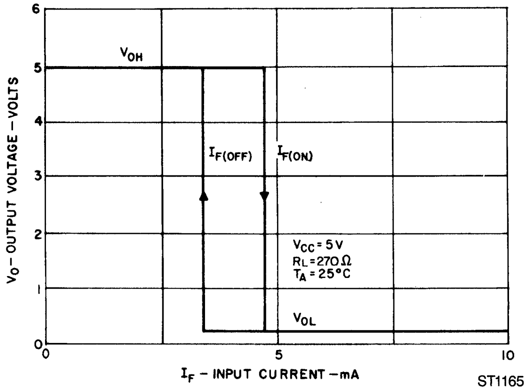


Fig. 1. Transfer Characteristics

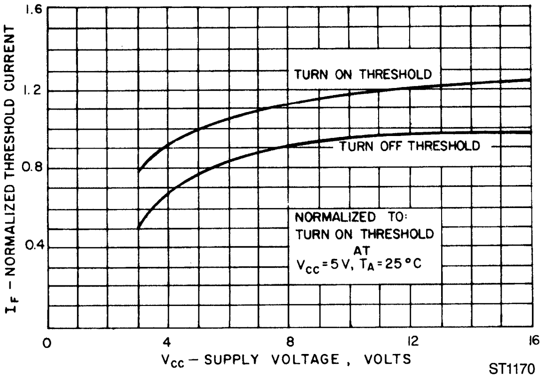


Fig. 2. Threshold Current vs. Supply Voltage

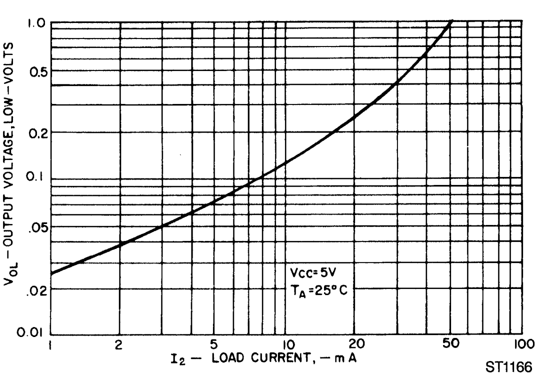


Fig. 3. On Voltage vs. Load Current

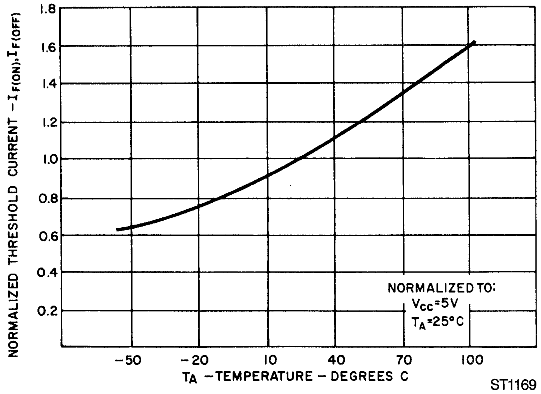


Fig. 4. Threshold Currents vs. Temperature

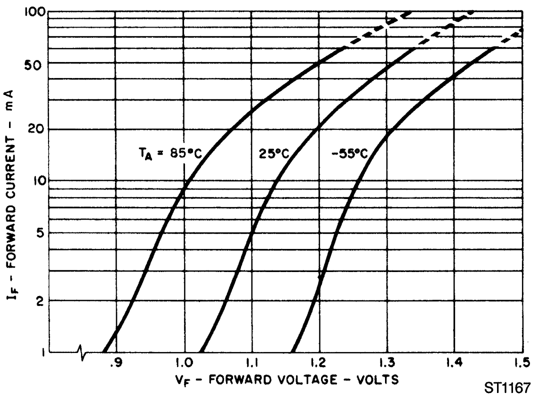


Fig. 5. Forward Voltage vs. Forward Current

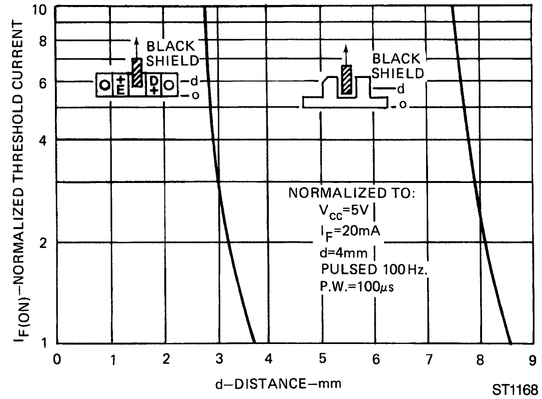
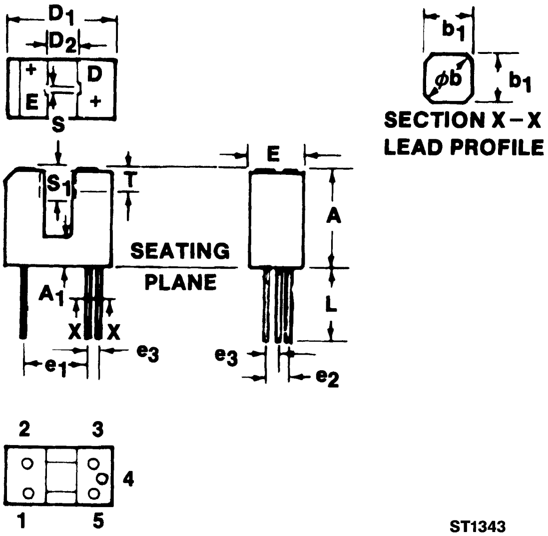


Fig. 6. Threshold Current vs. Shield Distance

SLOTTED OPTICAL SWITCH

H22L1/2

PACKAGE DIMENSIONS



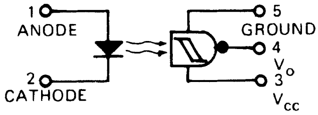
ST1343

SYMBOL	MILLIMETERS		INCHES		NOTES
	MIN.	MAX.	MIN.	MAX.	
A	10.7	11.0	.422	.433	
A_1	3.0	3.2	.119	.125	
ϕb	.600	.750	.024	.030	2
b_1	.50 NOM.		.020 NOM.		2
D_1	11.6	12.0	.457	.472	
D_2	3.0	—	.119	—	
e_1	6.9	7.5	.272	.295	
e_2	2.3	2.8	.091	.110	
e_3	1.14	1.4	.045	.055	
E	6.15	6.35	.243	.249	
L	8.00	—	.315	—	
S	.85	1.0	.034	.039	
S_1	3.94 NOM.		.155 NOM.		
T	2.6 NOM.		.103 NOM.		3

NOTES

1. INCH DIMENSIONS ARE DERIVED FROM MILLIMETERS.
2. FIVE LEADS, LEAD CROSS SECTION IS CONTROLLED BETWEEN 1.27 mm (.050″) FROM SEATING PLANE AND THE END OF THE LEADS.
3. THE SENSING AREA IS DEFINED BY THE "S" DIMENSION AND BY DIMENSION "T" ±0.75 mm (±.030 INCH).

PACKAGE OUTLINE



ST1610

DESCRIPTION

The H22L Slotted Optical Switch is a gallium arsenide light emitting diode coupled to a high speed integrated circuit detector in a plastic housing. The output incorporates a Schmitt trigger which provides hysteresis for noise immunity and pulse shaping. The packaging system is designed to optimize the mechanical resolution, coupling efficiency, ambient light rejection, cost and reliability. The gap in the housing provides a means of interrupting the signal with an opaque material, switching the output from an "ON" to an "OFF" state.

FEATURES

- Opaque housing
- Low cost
- .035″ apertures

SLOTTED OPTICAL SWITCH

ABSOLUTE MAXIMUM RATINGS (T_A = 25°C Unless Otherwise Specified)

Storage Temperature	−55°C to +85°C
Operating Temperature	−55°C to +85°C
Soldering:	
Lead Temperature (Iron)	240°C for 5 sec.(3,4,5)
Lead Temperature (Flow)	260°C for 10 sec.(3,4)
INPUT DIODE	
Continuous Forward Current	60 mA
Reverse Voltage	6.0 Volts
Power Dissipation	100 mW(1)
OUTPUT OPTOLOGIC™	
Output Current I_4	50 mA
Allowed Range V_{35}	4 to 16 Volts
Allowed Range V_{45}	2.4 to 16 Volts
Power Dissipation	150 mW (2)

ELECTRICAL CHARACTERISTICS (T_A = 25°C Unless Otherwise Specified)

PARAMETER	SYMBOL	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS
INPUT DIODE						
Forward Voltage	V_F	—		1.6	V	I_F = 20 mA
Reverse Leakage Current	I_R	—		10	μA	V_R = 3V
OUTPUT OPTOLOGIC™						
Operating Supply Voltage	V_C	4		15	V	
Supply Current	$I_{3(off)}$	—		5.0	mA	I_F = 0, V_{CC} = 5V
Supply Current	$I_{3(on)}$	—		5.0	mA	I_F = 30 mA, V_{CC} = 5V

NOTES

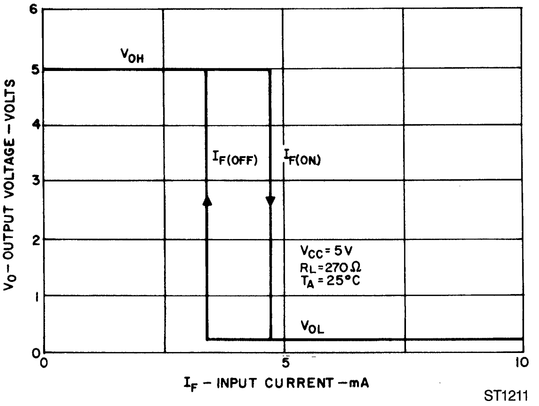
1. *Derate power dissipation linearly 1.33mW/°C above 25°C.*
2. *Derate power dissipation linearly 2.00mW/°C above 25°C.*
3. *RMA flux is recommended.*
4. *Methanol or Isopropyl alcohols are recommended as cleaning agents.*
5. *Soldering iron tip 1⁄16″ (1.6 mm) minimum from housing.*

SLOTTED OPTICAL SWITCH

COUPLED ELECTRICAL CHARACTERISTICS

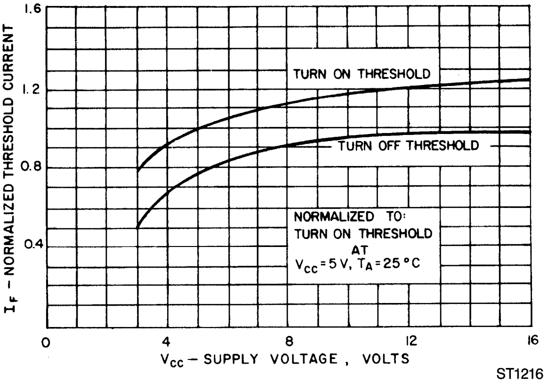
PARAMETER	SYMBOL	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS
Output Current High	I_{OH}	—		100	μA	$I_F = 0$, $V_{CC} = 5V$, $V_O = 16V$
Output Voltage, Low	V_{OL}	—	0.2	0.4	V	$R_L = 270\Omega$, $V_{CC} = 5V$, $I_F = 30mA$
TURN-ON THRESHOLD CURRENT						
H22L1	$I_{F(ON)}$	—	20	30	mA	$R_L = 270\Omega$, $V_{CC} = 5V$
H22L2	$I_{F(ON)}$	—	10	15.0	mA	$R_L = 270\Omega$, $V_{CC} = 5V$
TURN-OFF THRESHOLD CURRENT						
H22L1	$I_{F(OFF)}$	0.5	15	—	mA	$R_L = 270\Omega$, $V_{CC} = 5V$
H22L2	$I_{F(OFF)}$	0.5	8	—	mA	$R_L = 270\Omega$, $V_{CC} = 5V$
Hysteresis Ratio	$I_{F(OFF)}/I_{F(ON)}$	0.50	0.75	0.90	—	$R_L = 270\Omega$, $V_{CC} = 5V$
SWITCHING SPEEDS						
Rise Time	t_r	—	0.1	—	μS	$R_L = 270\Omega$, $V_{CC} = 5V$, $T_A = 25°C$, $I_F = 20mA$
Fall Time	t_f	—	0.1	—	μS	$R_L = 270\Omega$, $V_{CC} = 5V$, $T_A = 25°C$, $I_F = 20mA$

TYPICAL CHARACTERISTICS



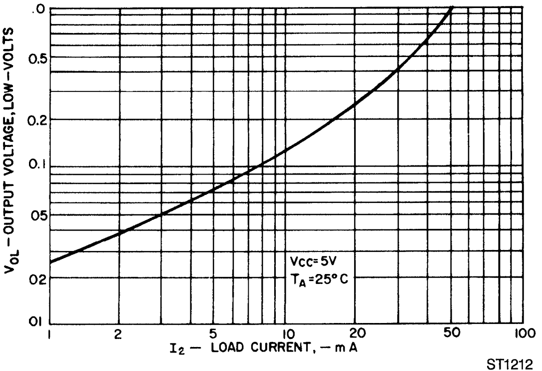
ST1211

Fig. 1. Transfer Characteristics



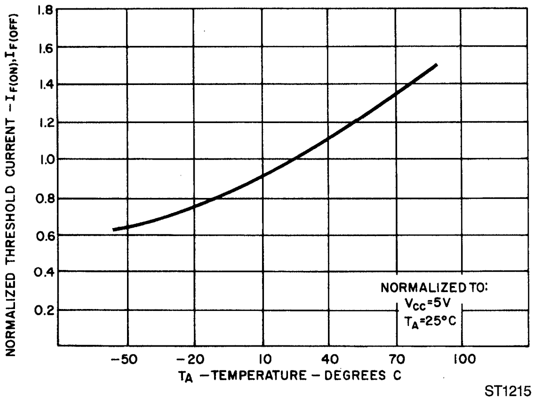
ST1216

Fig. 2. Threshold Current vs. Supply Voltage



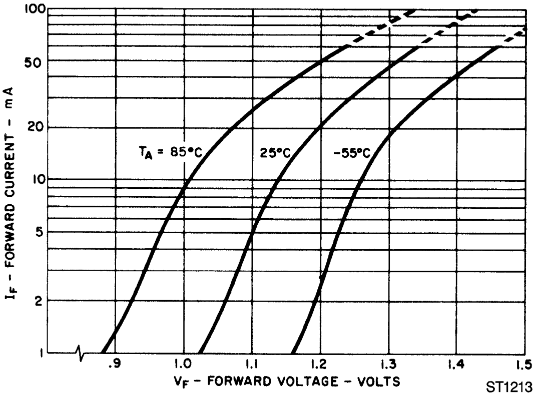
ST1212

Fig. 3. On Voltage vs. Load Current



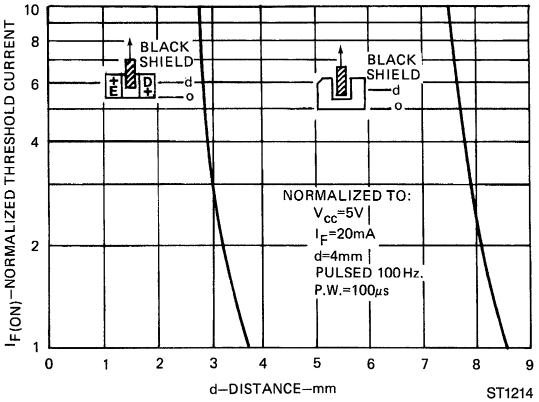
ST1215

Fig. 4. Threshold Current vs. Temperature



ST1213

Fig. 5. Forward Voltage vs. Forward Current



ST1214

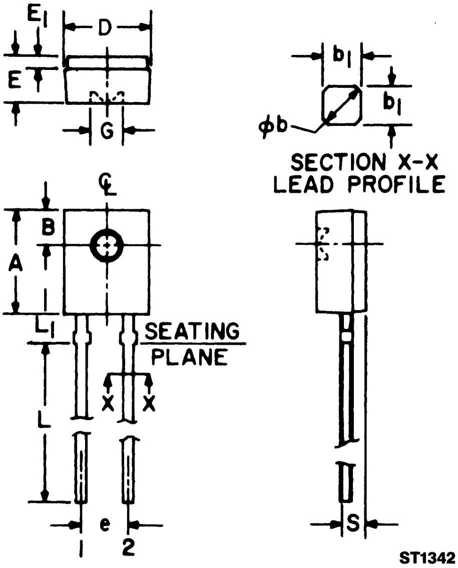
Fig. 6. Threshold Current vs. Shield Distance

QT OPTOELECTRONICS

PLASTIC SIDELOOKER PAIR

H23A1/2

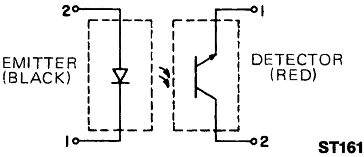
PACKAGE DIMENSIONS



ST1342

SYMBOL	MILLIMETERS		INCHES		NOTES
	MIN.	MAX.	MIN.	MAX.	
A	5.59	5.80	.220	.228	
B	1.78	NOM.	.070	NOM.	2
φb	.60	.75	.024	.030	1
b_1	.51	NOM.	.020	NOM.	1
D	4.45	4.70	.175	.185	
E	2.41	2.67	.095	.105	
E_1	.58	.69	.023	.027	
e	2.41	2.67	.095	.105	3
G	1.98	NOM.	.078	NOM.	
L	12.7	—	.500	—	
L_1	1.40	1.65	.055	.065	
S	.83	.94	.033	.037	3

PACKAGE OUTLINE



ST1611

NOTES

1. TWO LEADS. LEAD CROSS SECTION DIMENSIONS UNCONTROLLED WITHIN 1.27 mm (0.50″) OF SEATING PLANE.
2. CENTERLINE OF ACTIVE ELEMENT LOCATED WITHIN .25 mm (.010″) OF TRUE POSITION.
3. AS MEASURED AT THE SEATING PLANE.
4. INCH DIMENSIONS DERIVED FROM MILLIMETERS.

DESCRIPTION

The H23A is a matched emitter-detector pair which consists of a gallium arsenide infrared emitting diode and a silicon phototransistor. The clear epoxy packaging system is designed to optimize the mechanical resolution, coupling efficiency, cost, and reliability. The devices are marked with a color dot for easy identification of the emitter and detector.

FEATURES

- Good optical to mechanical alignment
- Color dot for easy recognition of LED and phototransistor
- Low cost

QT
OPTOELECTRONICS

PLASTIC SIDELOOKER PAIR

ABSOLUTE MAXIMUM RATINGS (T_A = 25°C Unless Otherwise Specified)

Storage Temperature	−55°C to +100°C
Operating Temperature	−55°C to +100°C
Soldering:	
Lead Temperature (Iron)	240°C for 5 sec.(3,4,5)
Lead Temperature (Flow)	260°C for 10 sec.(3,4,5)
INPUT DIODE	
Continuous Forward Current	60 mA
Forward Current (pw, 1μS; 33 Hz)	3 A
Reverse Voltage	6.0 Volts
Power Dissipation	100mW(1)
OUTPUT TRANSISTOR	
Collector-Emitter Voltage	30 Volts
Emitter-Collector Voltage	6 Volts
Power Dissipation	150 mW (2)

ELECTRICAL CHARACTERISTICS (T_A = 25°C Unless Otherwise Specified)

PARAMETER	SYMBOL	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS
INPUT DIODE						
Forward Voltage	V_F	—		1.7	V	I_F = 60 mA
Reverse Leakage Current	I_R	—		10	μA	V_R = 6V
Reverse Breakdown Voltage	BV_R	6.0		—	V	I_R = 10μA
OUTPUT TRANSISTOR						
Emitter-Collector Breakdown	BV_{ECO}	6.0		—	V	I_E = 100μA
Collector-Emitter Breakdown	BV_{CEO}	30		—	V	I_C = 10 mA
Collector-Emitter Leakage	I_{CEO}	—		100	nA	V_{CE} = 10 V
COUPLED						
On-State Collector Current	$I_{C(ON)}$		See page 3.			
Saturation Voltage	$V_{CE(SAT)}$		See page 3.			
Turn-On Time	t_{on}		150		μS	I_F=30 mA, V_{CC}=5V R_L=2.5KΩ
Turn-Off Time	t_{off}		150		μS	I_F=30 mA, V_{CC}=5V R_L=2.5KΩ

NOTES

1. *Derate power dissipation linearly 1.33mW/°C above 25°C.*
2. *Derate power dissipation linearly 2.00mW/°C above 25°C.*
3. *RMA flux is recommended.*
4. *Methanol or Isopropyl alcohols are recommended as cleaning agents.*
5. *Soldering iron tip 1/16″ (1.6 mm) minimum from housing.*
6. *Coupled characteristics are measured at a separation distance of .155″ (4 mm) with the lenses of the emitter and detector on a common axis within 0.1mm and parallel within 5°.*

$I_{C(ON)}$ and $V_{CE(SAT)}$ TABLE

PARAMETER	SYMBOL	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS
ON-STATE COLLECTOR CURRENT						
H23A1	$I_{C(ON)}$	1.5	—	—	mA	I_F = 30mA, V_{CE} = 5V (6)
H23A2	$I_{C(ON)}$	0.5	—	—	mA	I_F = 30mA, V_{CE} = 5V (6)
SATURATION VOLTAGE						
H23A1	$V_{CE(SAT)}$	—	—	0.40	V	I_F = 30mA, I_C = 1.0mA (6)
H23A2	$V_{CE(SAT)}$	—	—	0.40	V	I_F = 30mA, I_C = .4mA (6)

TYPICAL CHARACTERISTICS

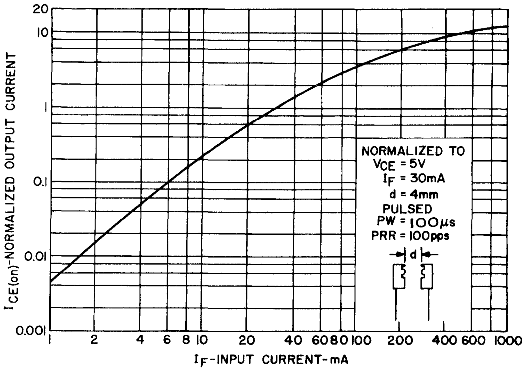


Fig. 1. Output Current vs. Input Current

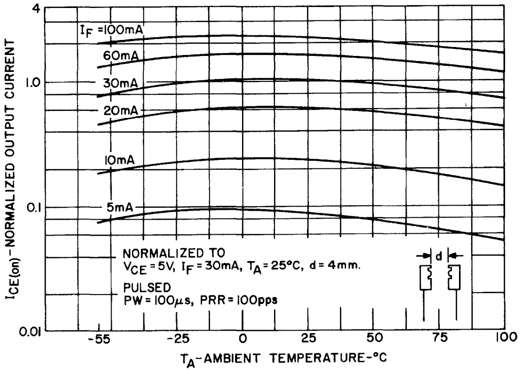


Fig. 2. Output Current vs. Temperature

ST1220

ST1225

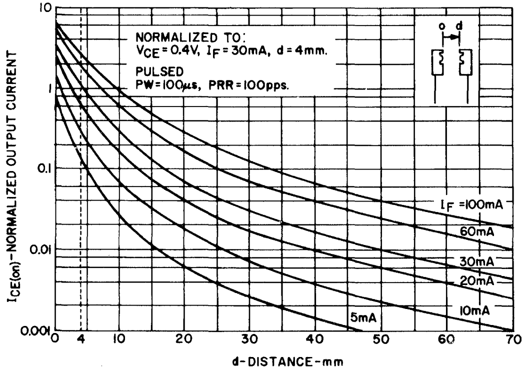


Fig. 3. Output Current vs. Distance

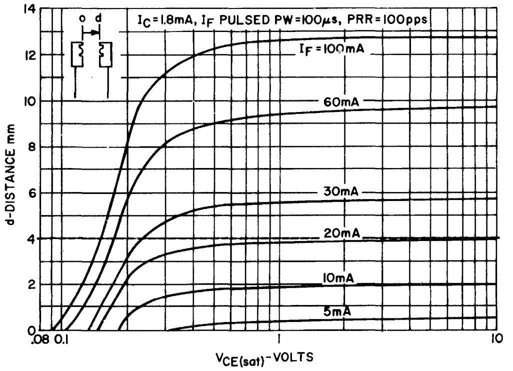


Fig. 4. $V_{CE(SAT)}$ vs. Distance

ST1221

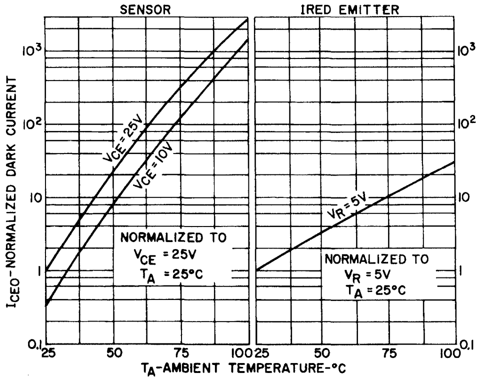


Fig. 5. Leakage Currents vs. Temperature

ST1222

ST1224

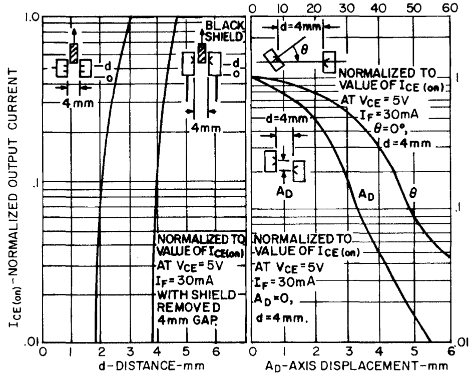


Fig 6A. Output Current vs. Shield Distance

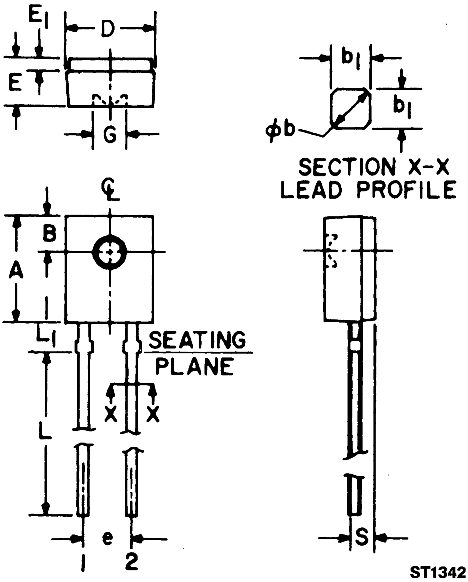
6B. Output Current vs. Displacement (Angular & Axis)

ST1223

PLASTIC SIDELOOKER PAIR

H23B1

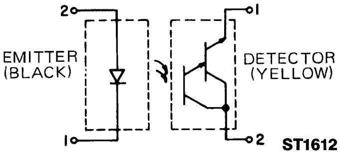
PACKAGE DIMENSIONS



ST1342

SYMBOL	MILLIMETERS		INCHES		NOTES
	MIN.	MAX.	MIN.	MAX.	
A	5.59	5.80	.220	.228	
B	1.78	NOM.	.070	NOM.	2
φb	.60	.75	.024	.030	1
b_1	.51	NOM.	.020	NOM.	1
D	4.45	4.70	.175	.185	
E	2.41	2.67	.095	.105	
E_1	.58	.69	.023	.027	
e	2.41	2.67	.095	.105	3
G	1.98	NOM.	.078	NOM.	
L	12.7	—	.500	—	
L_1	1.40	1.65	.055	.065	
S	.83	.94	.033	.037	3

PACKAGE OUTLINE



ST1612

NOTES

1. TWO LEADS. LEAD CROSS SECTION DIMENSIONS UNCONTROLLED WITHIN 1.27 mm (0.50″) OF SEATING PLANE.
2. CENTERLINE OF ACTIVE ELEMENT LOCATED WITHIN .25 mm (.010″) OF TRUE POSITION.
3. AS MEASURED AT THE SEATING PLANE.
4. INCH DIMENSIONS DERIVED FROM MILLIMETERS.

DESCRIPTION

The H23B1 is a matched emitter-detector pair which consists of a gallium arsenide infrared emitting diode and a silicon photodarlington. The clear epoxy packaging system is designed to optimize the mechanical resolution, coupling efficiency, cost, and reliability. The devices are marked with a color dot for easy identification of the emitter and detector.

FEATURES

- Good optical to mechanical alignment
- Color dot for easy recognition of LED and phototransistor
- Low cost

QT
OPTOELECTRONICS

PLASTIC SIDELOOKER PAIR

ABSOLUTE MAXIMUM RATINGS (T_A = 25°C Unless Otherwise Specified)

Storage Temperature	−55°C to +100°C
Operating Temperature	−55°C to +100°C
Soldering:	
Lead Temperature (Iron)	240°C for 5 sec.(3,4,5)
Lead Temperature (Flow)	260°C for 10 sec.(3,4)
INPUT DIODE	
Continuous Forward Current	60 mA
Reverse Voltage	6.0 Volts
Power Dissipation	100mW(1)
OUTPUT DARLINGTON	
Collector-Emitter Voltage	30 Volts
Emitter-Collector Voltage	7 Volts
Power Dissipation	150 mW (2)

ELECTRICAL CHARACTERISTICS (T_A = 25°C Unless Otherwise Specified)

PARAMETER	SYMBOL	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS
INPUT DIODE						
Forward Voltage	V_F	—		1.7	V	I_F = 60 mA
Reverse Leakage Current	I_R	—		1.0	μA	V_R = 3V
Reverse Breakdown Voltage	V_R	6.0		—	V	I_R = 10μA
OUTPUT DARLINGTON						
Emitter-Collector Breakdown	BV_{ECO}	7.0		—	V	I_E = 100μA, Ee=0
Collector-Emitter Breakdown	BV_{CEO}	30		—	V	I_C = 1 mA, Ee=0
Collector-Emitter Leakage	I_{CEO}	—		100	nA	V_{CE} = 25 V, Ee=0
COUPLED						
On-State Collector Current	$I_{C(ON)}$	7.5		—	mA	I_F = 10 mA, V_{CE} = 1.5 V (6)
Saturation Voltage	$V_{CE(SAT)}$	—		1.0	V	I_F = 10 mA, I_C = 1.8 mA (6)
Turn-On Time	t_{on}		8		μS	I_F = 30 mA, V_{CC} = 5 V, R_L=2.5KΩ(6)
Turn-Off Time	t_{off}		50		μS	I_F = 30 mA, V_{CC} = 5 V, R_L=2.5KΩ(6)

NOTES

1. *Derate power dissipation linearly 1.33mW/°C above 25°C.*
2. *Derate power dissipation linearly 2.00mW/°C above 25°C.*
3. *RMA flux is recommended.*
4. *Methanol or Isopropyl alcohols are recommended as cleaning agents.*
5. *Soldering iron tip 1⁄16″ (1.6 mm) minimum from housing.*
6. *Coupled characteristics are measured at a separation distance of .155″ (4 mm) with the lenses of the emitter and detector on a common axis within 0.1mm and parallel within 5°.*

PLASTIC SIDELOOKER PAIR

TYPICAL CHARACTERISTICS

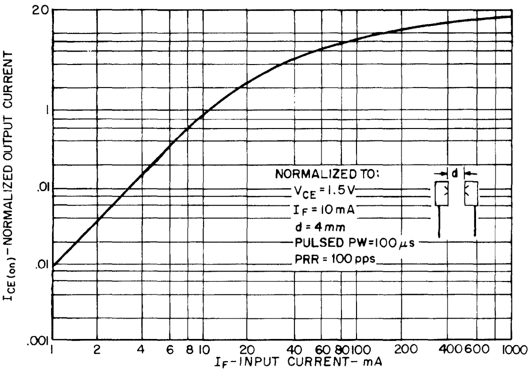


Fig. 1. Output Current vs. Input Current

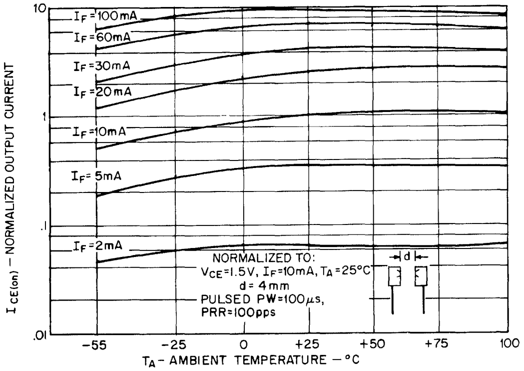


Fig. 2. Output Current vs. Temperature

ST1228

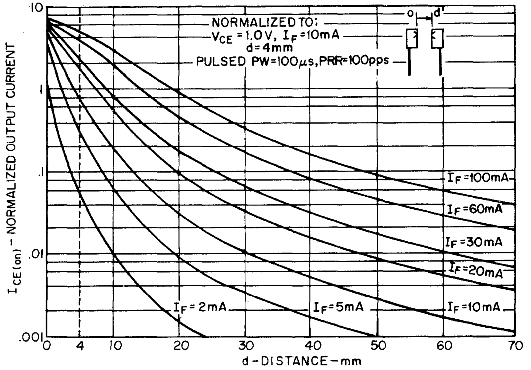


Fig. 3. Output Current vs. Distance

ST1233

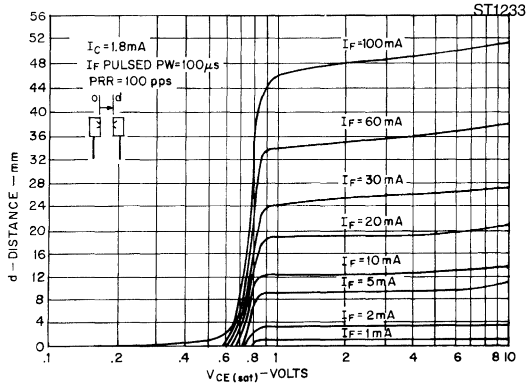


Fig. 4. $V_{CE(SAT)}$ vs. Distance

ST1229

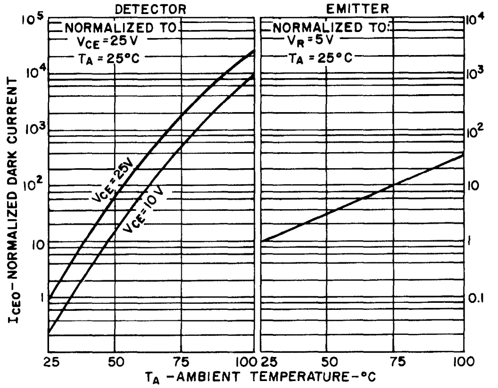


Fig. 5. Leakage Currents vs. Temperature

ST1230

ST1232

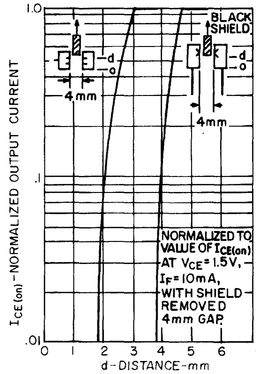
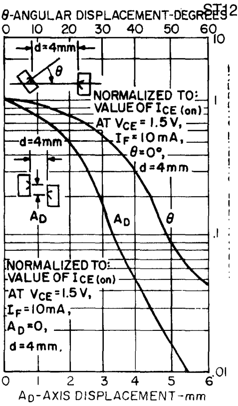


Fig 6A. Output Current vs. Shield Distance



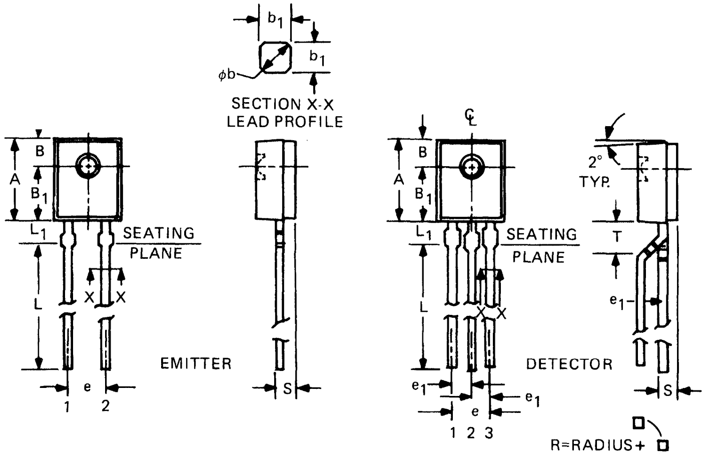
6B. Output Current vs. Displacement (Angular & Axis)

ST1231

PLASTIC SIDELOOKER PAIR

H23L1

PACKAGE DIMENSIONS



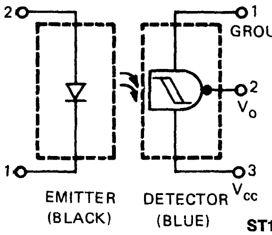
ST1614

SYMBOL	MILLIMETERS		INCHES		NOTES
	MIN.	MAX.	MIN.	MAX.	
A	5.59	5.80	.220	.228	
B	1.78	NOM.	.070	NOM.	2
B_1	3.68	3.94	.145	.155	
ϕb	.60	.75	.024	.030	1
b_1	.51	NOM.	.020	NOM.	1
D	4.45	4.70	.175	.185	
E	2.41	2.67	.095	.105	
E_1	.58	.69	.023	.027	
e	2.41	2.67	.095	.105	3
e_1	1.14	1.40	.045	.055	3
G	1.98	NOM.	.078	NOM.	
L	12.7	—	.500	—	
L_1	1.40	1.65	.055	.065	1
R	1.27	NOM.	.050	NOM.	
S	.83	.94	.033	.037	3
T	—	1.65	—	.065	

NOTES

1. LEADS. LEAD CROSS SECTION DIMENSIONS UNCONTROLLED WITHIN 1.27 mm (0.50″) OF SEATING PLANE.
2. CENTERLINE OF ACTIVE ELEMENT LOCATED WITHIN .25 mm (.010″) OF TRUE POSITION.
3. AS MEASURED AT THE SEATING PLANE.
4. INCH DIMENSIONS DERIVED FROM MILLIMETERS.

PACKAGE OUTLINE



ST1613

DESCRIPTION

The H23L1 is a matched emitter-detector pair which consists of a gallium arsenide infrared light emitting diode and a high speed integrated circuit detector. The output incorporates a Schmitt trigger which provides hysteresis for noise immunity and pulse shaping. The detector circuit is optimized for simplicity of operation and utilizes an open collector output for maximum application flexibility. The clear epoxy packaging system is designed to optimize the mechanical resolution, coupling efficiency, cost, and reliability. The devices are marked with a color dot for easy identification of the emitter and detector.

FEATURES

- Good optical to mechanical alignment
- Color dot for easy recognition of LED and detector
- Low cost

PLASTIC SIDELOOKER PAIR

ABSOLUTE MAXIMUM RATINGS (T_A = 25°C Unless Otherwise Specified)

Storage Temperature . . . . −55°C to +85°C
Operating Temperature . . . . −55°C to +85°C

Soldering:
  Lead Temperature (Iron) . . . . 240°C for 5 sec.(3,4,5)
  Lead Temperature (Flow) . . . . 260°C for 10 sec.(3,4)

INPUT DIODE
Continuous Forward Current . . . . 60 mA
Continuous Forward Current . . . . 3 mA
Reverse Voltage . . . . 6.0 Volts
Power Dissipation . . . . 100mW(1)

OUTPUT OPTOLOGIC™
Output Current I_2 . . . . 50 mA
Allowed Range V_{CC} . . . . 4 to 16 Volts
Allowed Range V_{21} . . . . 2.4 to 16 Volts
Power Dissipation . . . . 150 mW (2)

ELECTRICAL CHARACTERISTICS (T_A = 25°C Unless Otherwise Specified)

PARAMETER	SYMBOL	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS
INPUT DIODE						
Forward Voltage	V_F	—		1.5	V	I_F = 20 mA
Reverse Leakage Current	I_R	—		10	μA	V_R = 3V
OUTPUT OPTOLOGIC™						
Operating Supply Voltage	V_{CC}	4		16	V	
Supply Current	$I_{3(off)}$	—		5.0	mA	I_F = 0, V_{CC} = 5 V
Supply Current	$I_{3(on)}$	—		5.0	mA	I_F = 30 mA, V_{CC} = 5 V

NOTES

1. *Derate power dissipation linearly 1.33mW/°C above 25°C.*
2. *Derate power dissipation linearly 2.00mW/°C above 25°C.*
3. *RMA flux is recommended.*
4. *Methanol or Isopropyl alcohols are recommended as cleaning agents.*
5. *Soldering iron tip 1⁄16″ (1.6 mm) from housing.*
6. *Coupled characteristics are measured at a separation distance of .155″ (4 mm) with the lens of the emitter and detector on a common axis within 0.1 mm and parallel within 5°.*

COUPLED ELECTRICAL CHARACTERISTICS

PARAMETER	SYMBOL	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS
Output Current High	I_{OH}	—		100	μA	$I_F = 0$, $V_{CC} = 5V$, $V_O = 16V$
Output Voltage, Low	V_{OL}	—	0.2	0.4	V	$R_L = 270\Omega$, $V_{CC} = 5V$, I_F=20 mA
Turn-On Threshold Current	$I_{F(ON)}$	—	10.0	20.0	mA	$R_L = 270\Omega$, $V_{CC} = 5V$
Turn-Off Threshold Current	$I_{F(OFF)}$	1.0	7.5	—	mA	$R_L = 270\Omega$, $V_{CC} = 5V$
Hysteresis Ratio	$I_{F(OFF)}/I_{F(ON)}$	0.50	0.75	0.90	—	$R_L = 270\Omega$, $V_{CC} = 5V$
SWITCHING SPEEDS						
Rise Time	t_r	—	0.1	—	μS	$R_L = 270\Omega$, $V_{CC} = 5V$, I_F = 20 mA
Fall Time	t_f	—	0.1	—	μS	$R_L = 270\Omega$, $V_{CC} = 5V$, I_F = 20 mA

TYPICAL CHARACTERISTICS

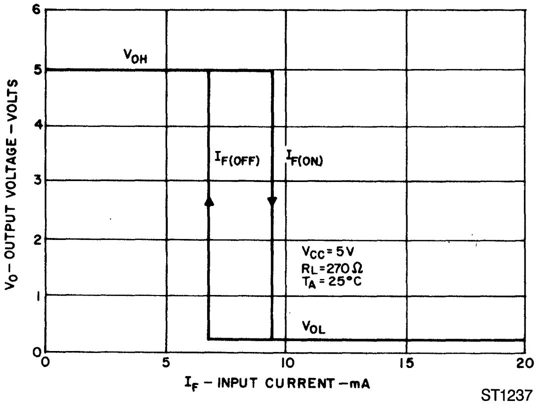


Fig. 1. Transfer Characteristics

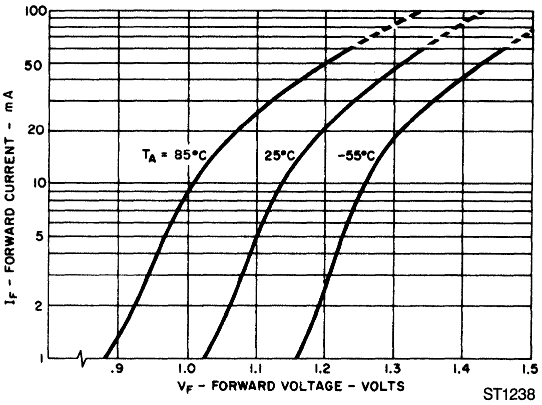


Fig. 2. Forward Voltage vs. Forward Current

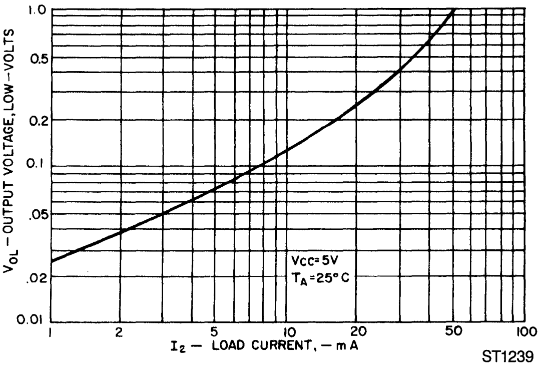


Fig. 3. On Voltage vs. Load Current

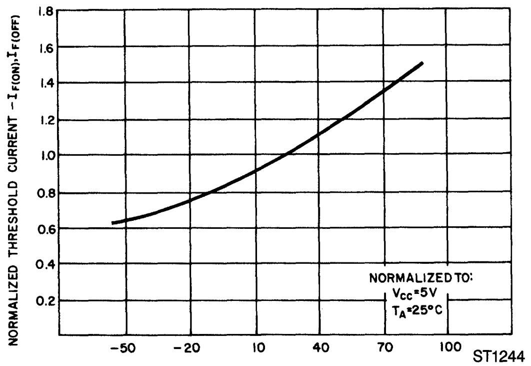


Fig. 4. Threshold Currents vs. Temperature

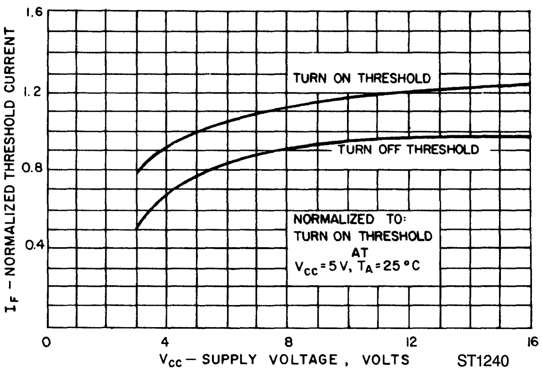


Fig. 5. Threshold Current vs. Supply Voltage

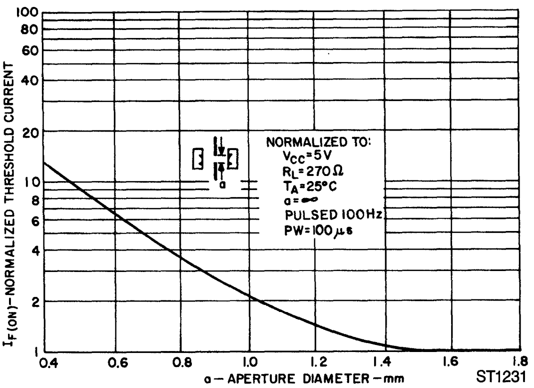


Fig. 6. Threshold Current vs. Aperture Diameter

TYPICAL CHARACTERISTICS

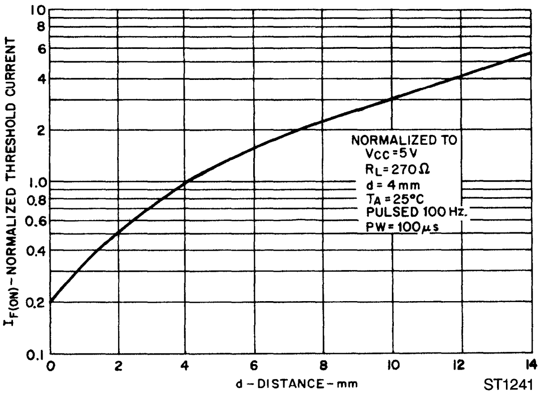


Fig. 7. Threshold Current vs. Distance

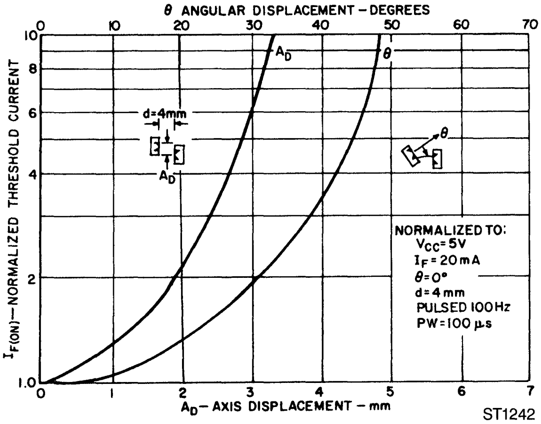


Fig. 8. Theshold Current vs. Displacement (Angular and Axis)

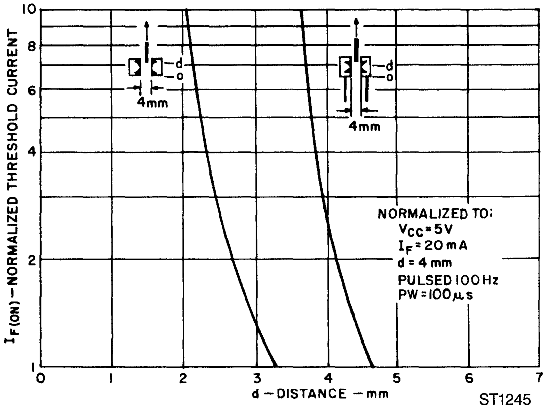


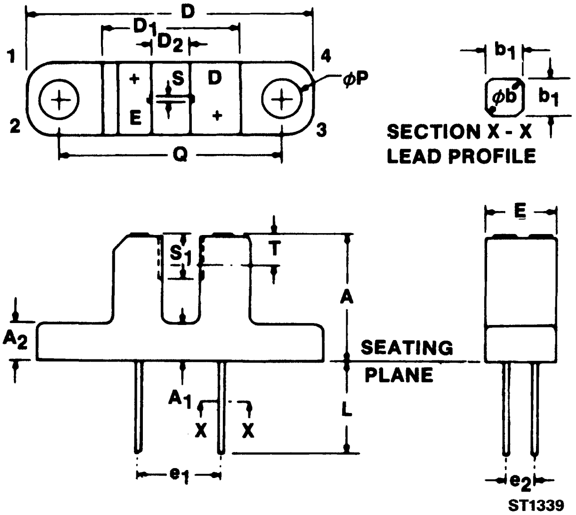
Fig. 9. Threshold Current vs. Shield Distance

QT OPTOELECTRONICS

SLOTTED OPTICAL SWITCH

CNY28

PACKAGE DIMENSIONS

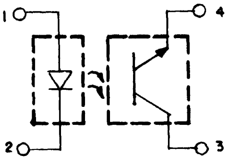


ST1339

SYMBOL	MILLIMETERS		INCHES		NOTES
	MIN.	MAX.	MIN.	MAX.	
A	10.7	11.0	.422	.433	
A_1	3.0	3.2	.119	.125	
A_2	3.0	3.2	.119	.125	
φb	.600	.750	.024	.030	2
b_1	.50 NOM.		.020 NOM.		2
D	24.3	24.7	.957	.972	
D_1	11.0	12.0	.457	.472	
D_2	3.0	3.3	.119	.129	
e_1	6.9	7.5	.272	.295	
e_2	2.3	2.8	.091	.110	
E	.615	6.35	.243	.249	
L	6.00		.315		
φp	3.2	3.4	.126	.133	
Q	18.9	19.2	.745	.755	
S	.85	1.0	.034	.039	
S_1	3.45	3.75	.136	.147	
T	2.6 NOM.		.103 NOM.		3

NOTES:
1. INCH DIMENSIONS ARE DERIVED FROM MILLIMETERS.
2. FOUR LEADS. LEAD CROSS SECTION IS CONTROLLED BETWEEN 1.27mm (.050″) FROM SEATING PLANE AND THE END OF THE LEADS.
3. THE SENSING AREA IS DEFINED BY THE "S" DIMENSION AND BY DIMENSION "T" ±0.75mm (±.030 INCH).

PACKAGE OUTLINE



ST1609

DESCRIPTION

The CNY28 is a gallium arsenide infrared emitting diode coupled with a silicon phototransistor in a plastic housing. The gap in the housing provides a means of interrupting the signal with tape, cards, shaft encoders, or other opaque material, switching the output from an "ON" to an "OFF" state.

FEATURES

- Opaque housing
- Low cost
- .035″ apertures
- European "Pro Electron" registered

QT
OPTOELECTRONICS

SLOTTED OPTICAL SWITCH

ABSOLUTE MAXIMUM RATINGS (T_A = 25°C Unless Otherwise Specified)

Storage Temperature	−55°C to +85°C
Operating Temperature	−55°C to +85°C
Soldering:	
Lead Temperature (Iron)	240°C for 5 sec.(3,4,5)
Lead Temperature (Flow)	260°C for 10 sec.(3,4)
INPUT DIODE	
Continuous Forward Current	60 mA
Reverse Voltage	3.0 Volts
Power Dissipation	100 mW(1)
OUTPUT TRANSISTOR	
Collector-Emitter Voltage	30 Volts
Emitter-Collector Voltage	5 Volts
Power Dissipation	150 mW(2)

ELECTRICAL CHARACTERISTICS (T_A = 25°C Unless Otherwise Specified)

PARAMETER	SYMBOL	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS
INPUT DIODE						
Forward Voltage	V_F	—		1.7	V	I_F = 10 mA
Reverse Leakage Current	I_R	—		10	μA	V_R = 2 V
OUTPUT TRANSISTOR						
Emitter-Collector Breakdown	BV_{ECO}	5.0		—	V	I_E = 100 μA, Ee=0
Collector-Emitter Breakdown	BV_{CEO}	30		—	V	I_C = 10 mA, Ee=0
Collector-Emitter Leakage	I_{CEO}	—		100	nA	V_{CE} = 10 V, Ee=0
COUPLED						
On-State Collector Current	$I_{C(ON)}$	0.20		—	mA	I_F = 20 mA, V_{CE} = 10 V
Saturation Voltage	$V_{CE(SAT)}$	—		0.40	V	I_F = 20 mA, I_C = 25 μA
Turn-On Time	t_{on}		5		μS	I_F = 30 mA, V_{CC} = 5 V, R_L=2.5KΩ
Turn-Off Time	t_{off}		5		μS	I_F = 30 mA, V_{CC} = 5 V, R_L=2.5KΩ

NOTES

1. *Derate power dissipation linearly 1.67 mW/°C above 25°C.*
2. *Derate power dissipation linearly 2.50 mW/°C above 25°C.*
3. *RMA flux is recommended.*
4. *Methanol or Isopropyl alcohols are recommended as cleaning agents.*
5. *Soldering iron tip 1/16″ (1.6 mm) from housing.*

SLOTTED OPTICAL SWITCH

TYPICAL CHARACTERISTICS

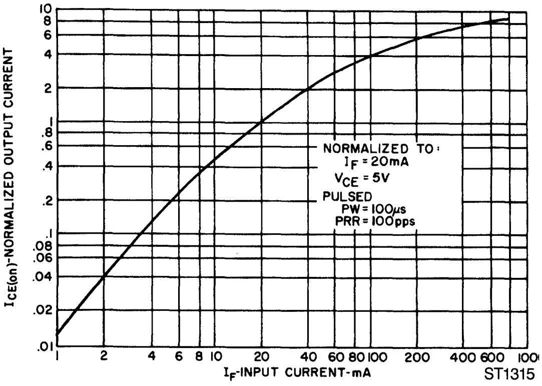


Fig. 1. Output Current vs. Input Current

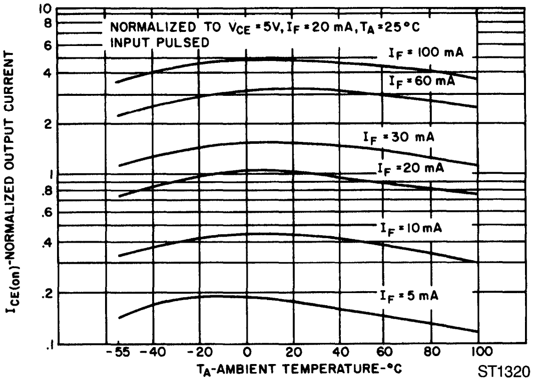


Fig. 2. Output Current vs. Temperature

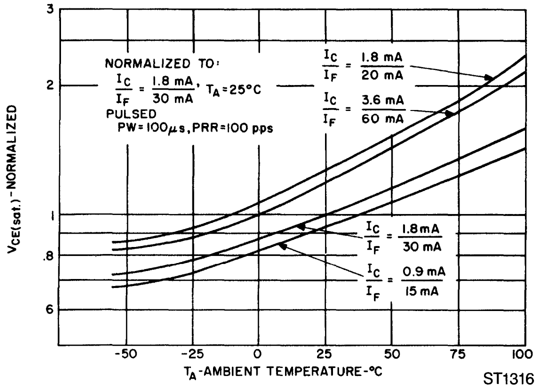


Fig. 3. $V_{CE(SAT)}$ vs. Temperature

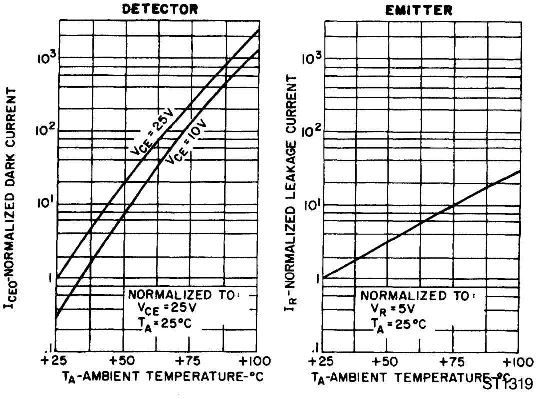


Fig. 4. Leakage Current vs. Temperature

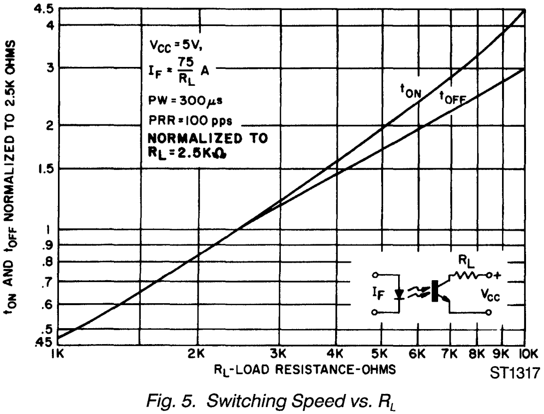


Fig. 5. Switching Speed vs. R_L

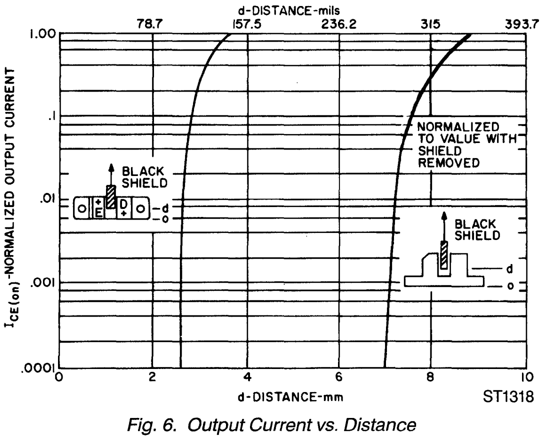
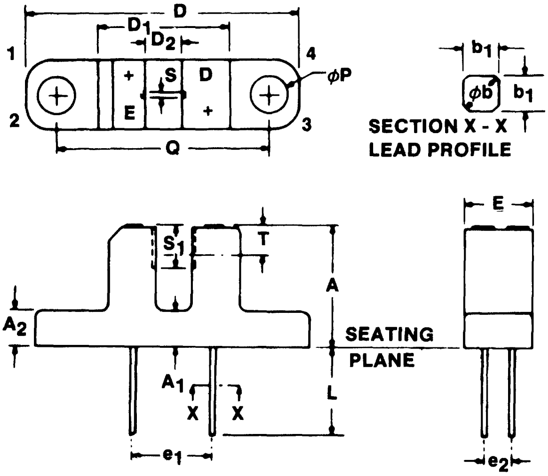


Fig. 6. Output Current vs. Distance

SLOTTED OPTICAL SWITCH

CNY29

PACKAGE DIMENSIONS

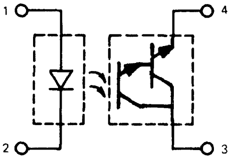


ST1339

SYMBOL	MILLIMETERS		INCHES		NOTES
	MIN.	MAX.	MIN.	MAX.	
A	10.7	11.0	.422	.433	
A_1	3.0	3.2	.119	.125	
A_2	3.0	3.2	.119	.125	
ϕb	.600	.750	.024	.030	2
b_1	.50 NOM.		.020 NOM.		2
D	24.3	24.7	.957	.972	
D_1	11.0	12.0	.457	.472	
D_2	3.0	3.3	.119	.129	
e_1	6.9	7.5	.272	.295	
e_2	2.3	2.8	.091	.110	
E	.615	6.35	.243	.249	
L	6.00		.315		
ϕp	3.2	3.4	.126	.133	
Q	18.9	19.2	.745	.755	
S	.85	1.0	.034	.039	
S_1	3.45	3.75	.136	.147	
T	2.6 NOM.		.103 NOM.		3

NOTES:
1. INCH DIMENSIONS ARE DERIVED FROM MILLIMETERS.
2. FOUR LEADS. LEAD CROSS SECTION IS CONTROLLED BETWEEN 1.27mm (.050″) FROM SEATING PLANE AND THE END OF THE LEADS.
3. THE SENSING AREA IS DEFINED BY THE "S" DIMENSION AND BY DIMENSION "T" ±0.75mm (±.030 INCH).

PACKAGE OUTLINE



ST1609

DESCRIPTION

The CNY29 is a gallium arsenide infrared emitting diode coupled with a silicon photodarlington in a plastic housing. The gap in the housing provides a means of interrupting the signal with tape, cards, shaft encoders, or other opaque material, switching the output from an "ON" to an "OFF" state.

FEATURES

- Opaque housing
- Low cost
- .035″ apertures
- European "Pro Electron" registered

SLOTTED OPTICAL SWITCH

ABSOLUTE MAXIMUM RATINGS (T_A = 25°C Unless Otherwise Specified)

Storage Temperature	−55°C to +85°C
Operating Temperature	−55°C to +85°C
Soldering:	
Lead Temperature (Iron)	240°C for 5 sec.(3,4,5)
Lead Temperature (Flow)	260°C for 10 sec.(3,4)
INPUT DIODE	
Continuous Forward Current	60 mA
Reverse Voltage	3.0 Volts
Power Dissipation	100 mW(1)
OUTPUT DARLINGTON	
Collector-Emitter Voltage	25 Volts
Emitter-Collector Voltage	7 Volts
Power Dissipation	150 mW(2)

ELECTRICAL CHARACTERISTICS (T_A = 25°C Unless Otherwise Specified)

PARAMETER	SYMBOL	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS
INPUT DIODE						
Forward Voltage	V_F	—		1.7	V	I_F = 10 mA
Reverse Leakage Current	I_R	—		10	μA	V_R = 2 V
OUTPUT DARLINGTON						
Emitter-Collector Breakdown	BV_{ECO}	7.0		—	V	I_E = 100 μA, Ee=0
Collector-Emitter Breakdown	BV_{CEO}	25		—	V	I_C = 10 mA, Ee=0
Collector-Emitter Leakage	I_{CEO}	—		100	nA	V_{CE} = 10 V, Ee=0
COUPLED						
On-State Collector Current	$I_{C(ON)}$	2.5		—	mA	I_F = 20 mA, V_{CE} = 10 V
Saturation Voltage	$V_{CE(SAT)}$	—		1.2	V	I_F = 20 mA, I_C = 0.5 mA
Turn-On Time	t_{on}		150		μS	I_C = 2.0 mA, V_{CC} = 10 V, R_L=750Ω
Turn-Off Time	t_{off}		150		μS	I_C = 2.0 mA, V_{CC} = 10 V, R_L=750Ω

NOTES

1. *Derate power dissipation linearly 1.67 mW/°C above 25°C.*
2. *Derate power dissipation linearly 2.50 mW/°C above 25°C.*
3. *RMA flux is recommended.*
4. *Methanol or Isopropyl alcohols are recommended as cleaning agents.*
5. *Soldering iron tip 1⁄16″ (1.6 mm) from housing.*

SLOTTED OPTICAL SWITCH

TYPICAL CHARACTERISTICS

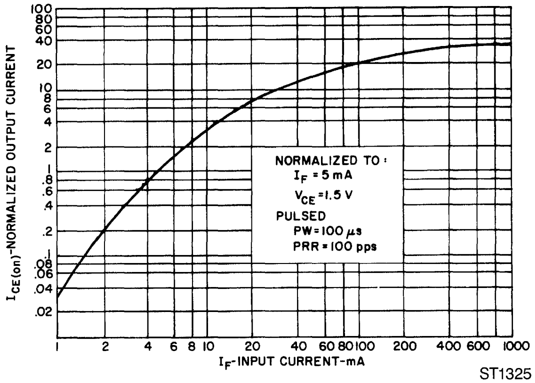


Fig. 1. Output Current vs. Input Current

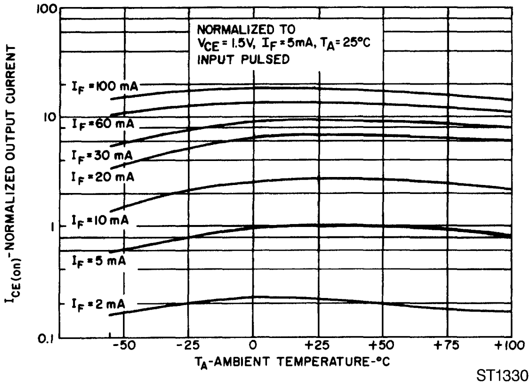


Fig. 2. Output Current vs. Temperature

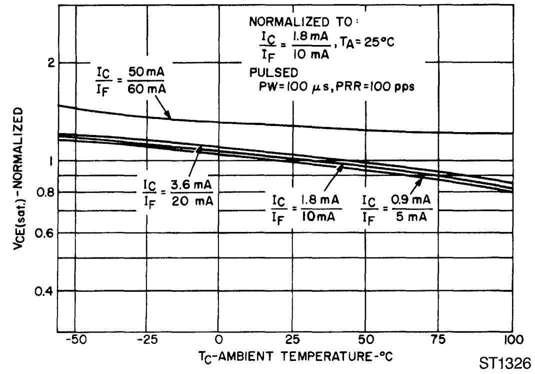


Fig. 3. $V_{CE(SAT)}$ vs. Temperature

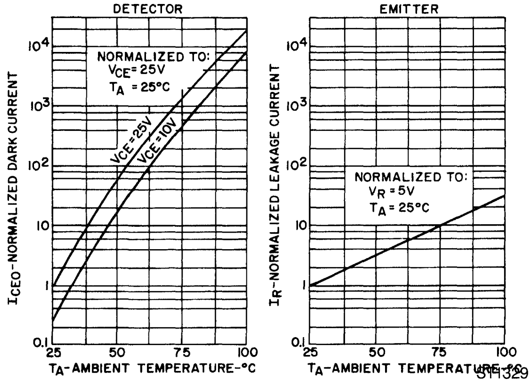


Fig. 4. Leakage Current vs. Temperature

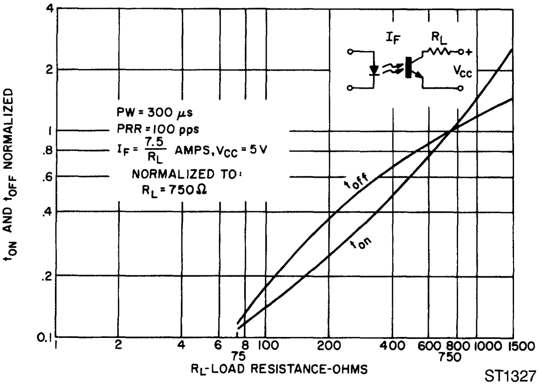


Fig. 5. Switching Speed vs. R_L

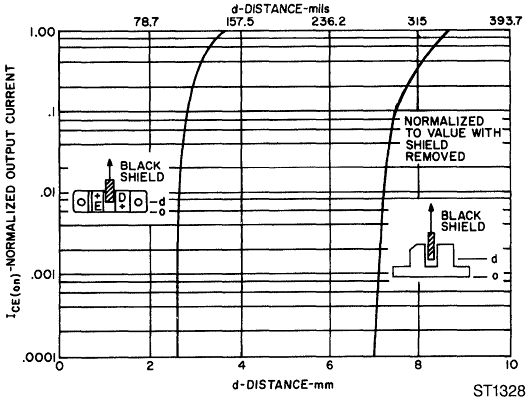


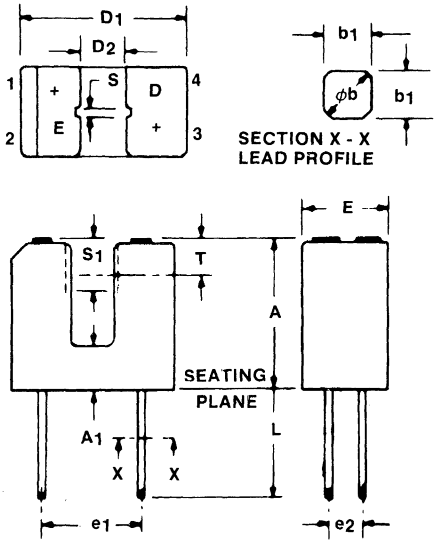
Fig. 6. Output Current vs. Distance

OPTOELECTRONICS

SLOTTED OPTICAL SWITCH

CNY36

PACKAGE DIMENSIONS



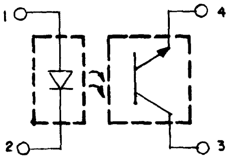
ST1340

SYMBOL	MILLIMETERS		INCHES		NOTES
	MIN.	MAX.	MIN.	MAX.	
A	10.7	11.0	.422	.433	
A_1	3.0	3.2	.119	.125	
ϕb	.600	.750	.024	.030	2
b_1	.50 NOM.		.020 NOM.		2
D_1	11.6	12.0	.457	.472	
D_2	3.0	3.3	.119	.129	
e_1	6.9	7.5	.272	.295	
e_2	2.3	2.8	.091	.110	
E	6.15	6.35	.243	.249	
L	8.00		.315		
S	.85	1.0	.034	.039	
S_1	3.45	3.75	.136	.147	
T	2.6 NOM.		.103 NOM.		3

NOTES:

1. INCH DIMENSIONS ARE DERIVED FROM MILLIMETERS.
2. FOUR LEADS. LEAD CROSS SECTION IS CONTROLLED BETWEEN 1.27mm (.050″) FROM SEATING PLANE AND THE END OF THE LEADS.
3. THE SENSING AREA IS DEFINED BY THE "S" DIMENSION AND BY DIMENSION "T" ±0.75mm (±.030 INCH).

PACKAGE OUTLINE



ST1609

DESCRIPTION

The CNY36 is a gallium arsenide infrared emitting diode coupled with a silicon phototransistor in a plastic housing. The gap in the housing provides a means of interrupting the signal with tape, cards, shaft encoders, or other opaque material, switching the output from an "ON" to an "OFF" state.

FEATURES

- Opaque housing
- Low cost
- .035″ apertures
- European "Pro Electron" registered

SLOTTED OPTICAL SWITCH

ABSOLUTE MAXIMUM RATINGS (T_A = 25°C Unless Otherwise Specified)

Storage Temperature	−55°C to +85°C
Operating Temperature	−55°C to +85°C
Soldering:	
Lead Temperature (Iron)	240°C for 5 sec.(3,4,5)
Lead Temperature (Flow)	260°C for 10 sec.(3,4)
INPUT DIODE	
Continuous Forward Current	60 mA
Reverse Voltage	3.0 Volts
Power Dissipation	100 mW(1)
OUTPUT TRANSISTOR	
Collector-Emitter Voltage	30 Volts
Emitter-Collector Voltage	5 Volts
Power Dissipation	150 mW(2)

ELECTRICAL CHARACTERISTICS (T_A = 25°C Unless Otherwise Specified)

PARAMETER	SYMBOL	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS
INPUT DIODE						
Forward Voltage	V_F	—		1.7	V	I_F = 10 mA
Reverse Leakage Current	I_R	—		10	μA	V_R = 2 V
OUTPUT TRANSISTOR						
Emitter-Collector Breakdown	BV_{ECO}	5.0		—	V	I_E = 100 μA, Ee=0
Collector-Emitter Breakdown	BV_{CEO}	30		—	V	I_C = 10 mA, Ee=0
Collector-Emitter Leakage	I_{CEO}	—		100	nA	V_{CE} = 10 V, Ee=0
COUPLED						
On-State Collector Current	$I_{C(ON)}$	0.20		—	mA	I_F = 20 mA, V_{CE} = 10 V
Saturation Voltage	$V_{CE(SAT)}$	—		0.40	V	I_F = 20 mA, I_C = 25 μA
Turn-On Time	t_{on}		5		μS	I_F = 30 mA, V_{CC} = 5 V, R_L=100Ω
Turn-Off Time	t_{off}		5		μS	I_F = 30 mA, V_{CC} = 5 V, R_L=100Ω

NOTES

1. *Derate power dissipation linearly 1.67 mW/°C above 25°C.*
2. *Derate power dissipation linearly 2.50 mW/°C above 25°C.*
3. *RMA flux is recommended.*
4. *Methanol or Isopropyl alcohols are recommended as cleaning agents.*
5. *Soldering iron tip 1/16″ (1.6 mm) from housing.*

SLOTTED OPTICAL SWITCH

TYPICAL CHARACTERISTICS

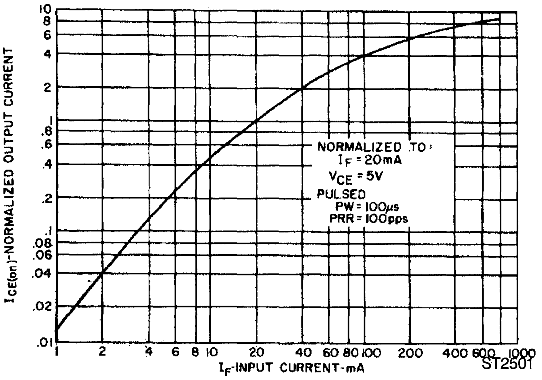


Fig. 1. Output Current vs. Input Current

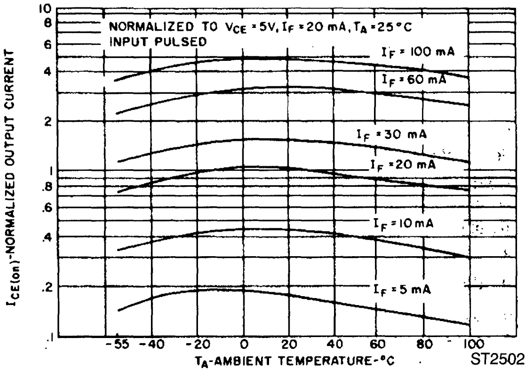


Fig. 2. Output Current vs. Temperature

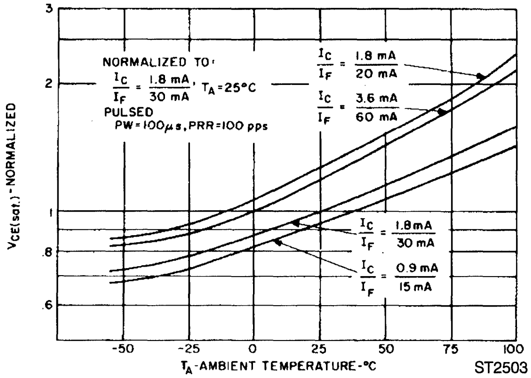


Fig. 3. $V_{CE(SAT)}$ vs. Temperature

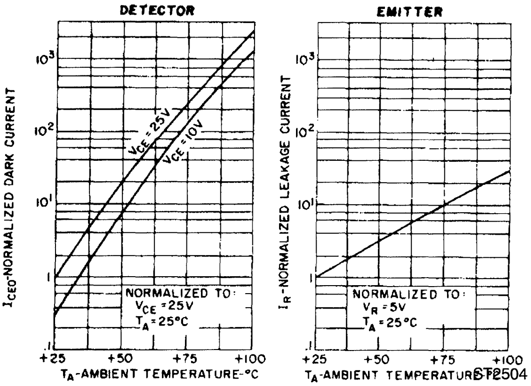


Fig. 4. Leakage Current vs. Temperature

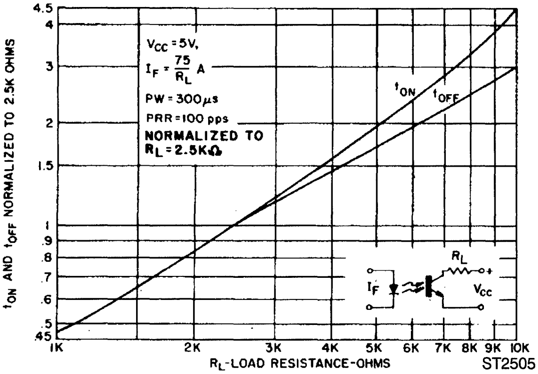


Fig. 5. Switching Speed vs. R_L

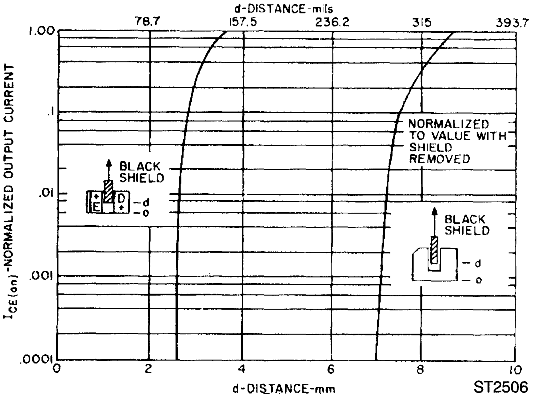


Fig. 6. Output Current vs. Distance

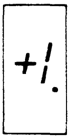
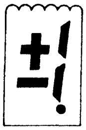
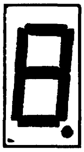
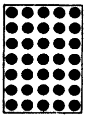
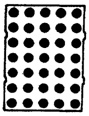
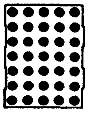
DISPLAYS

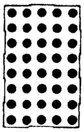
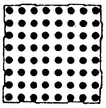
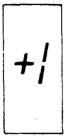
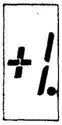
Alphanumeric Product Listing

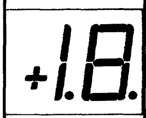
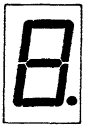
DISPLAYS

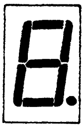
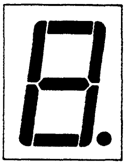
Alphanumeric Product Listing

DISPLAYS

PACKAGE	PART NUMBER	COLOR	DESCRIPTION	BRIGHTNESS OR LUMINOUS INTENSITY (TYPICAL)	PAGE
	5082-7650 5082-7750	High Efficiency Red Red	.43-Inch; Common Anode; LHDP	840 μcd @ 5 mA 980 μcd @ 20 mA	4-61 4-61
	5082-7651 5082-7653 5082-7751 5082-7760	High Efficiency Red High Efficiency Red Red Red	.43-Inch; Common Anode; RHDP .43-Inch; Common Cathode; RHDP .43-Inch; Common Anode; RHDP .43-Inch; Common Cathode; RHDP	840 μcd @ 5 mA 840 μcd @ 5 mA 980 μcd @ 20 mA 980 μcd @ 20 mA	4-61 4-61 4-61 4-61
	5082-7656 5082-7756	High Efficiency Red Red	.43-Inch; Universal Overflow ±1; RHDP	840 μcd @ 5 mA 980 μcd @ 20 mA	4-61 4-61
	FND318C FND358C FND368C	High Efficiency Red Red High Bright Red	.362-Inch; Common Cathode ±1; RHDP	450 μcd @ 20 mA 450 μcd @ 20 mA 450 μcd @ 20 mA	4-41 4-45 4-45
	FND310C FND350C FND360C	High Efficiency Red Red High Bright Red	.362-Inch; Common Anode; RHDP	2700 μcd @ 20 mA 450 μcd @ 20 mA 450 μcd @ 20 mA	4-41 4-45 4-45
	FND317C FND357C FND367C	High Efficiency Red Red High Efficiency Red	.362-Inch; Common Cathode; RHDP	2700 μcd @ 20 mA 450 μcd @ 20 mA 450 μcd @ 20 mA	4-41 4-45 4-45
	GMX7175CA GMX7475CA GMX7975CA	High Efficiency Red Yellow Green	0.7-Inch; 5 x 7 Array Common Anode and Common Cathode	3000 μcd @ 20 mA @ 48 mA Peak 1/8 Duty Cycle	4-112 4-113
	GMX7175C GMX7475C GMX7975C	High Efficiency Red Yellow Green	0.7-Inch; 5 x 7 Array Common Anode and Common Cathode	3000 μcd @ 20 mA @ 48 mA Peak 1/8 Duty Cycle	4-107 4-107 4-107
	GMX8475C GMX8875C GMX8975C GMX8675C	Yellow High Efficiency Red Green Red/Green	1.2-Inch; 5 x 7 Array Common Anode and Common Cathode	3000 μcd @ 20 mA @ 48 mA Peak 1/8 Duty Cycle	4-119 4-119 4-119 4-119
	GMX2475C GMX2675C GMX2875C GMX2975C	High Efficiency Green Bicolor Red/Green Yellow High Efficiency Red	2.0-Inch; 5 x 7 Array Common Anode and Common Cathode	400 μcd @ 48 mA Peak 1/8 Duty Cycle	4-127 4-127 4-127 4-127

PACKAGE	PART NUMBER	COLOR	DESCRIPTION	BRIGHTNESS OR LUMINOUS INTENSITY (TYPICAL)	PAGE
	GMX2485C GMA2685C GMX2885C GMX2985C	High Efficiency Green Bicolor Red/Green Yellow High Efficiency Red	2.3-Inch; 5 x 8 Array Common Anode and Common Cathode	400 µcd @ 48 mA Peak 1/8 Duty Cycle	4-135 4-135 4-135 4-135
	GMX2488C GMC2688C GMX2888C GMX2988C	Green Red/Green Yellow High Efficiency Red	2.3-Inch; 8 x 8 Array Common Anode and Common Cathode	3000 µcd @ 20 mA @ 48 mA Peak 1/8 Duty Cycle	4-143 4-143 4-143 4-143
	MAN3010A MAN3210A MAN3410A MAN3610A MAN3810A MAN3910A MAN71A	AlGaAs Red AlGaAs Red High Efficiency Green Orange Yellow High Efficiency Red Red	.3-Inch; Common Anode; RHDP	3600 µcd @ 5 mA 12000 µcd @ 20 mA 3200 µcd @ 10 mA 1800 µcd @ 10 mA 1700 µcd @ 10 mA 1900 µcd @ 10 mA 350 µcd @ 10 mA	4-7 4-15 4-21 4-21 4-21 4-37 4-21
	MAN3020A MAN3220A MAN3420A MAN3620A MAN3820A MAN3920A MAN72A	AlGaAs Red AlGaAs Red High Efficiency Green Orange Yellow High Efficiency Red Red	.3-Inch; Common Anode; LHDP	3600 µcd @ 5 mA 12000 µcd @ 20 mA 3200 µcd @ 10 mA 1800 µcd @ 10 mA 1700 µcd @ 10 mA 1900 µcd @ 10 mA 350 µcd @ 10 mA	4-7 4-15 4-21 4-21 4-21 4-37 4-21
	MAN3630A MAN73A	Orange Red	.3-Inch; Common Anode; Polarity and Overflow	1800 µcd @ 10 mA 350 µcd @ 10 mA	4-21 4-21
	MAN3040A MAN3240A MAN3440A MAN3640A MAN3840A MAN3940A MAN74A	AlGaAs Red AlGaAs Red High Efficiency Green Orange Yellow High Efficiency Red Red	.3-Inch; Common Cathode; RHDP	3600 µcd @ 5 mA 12000 µcd @ 20 mA 3200 µcd @ 10 mA 1800 µcd @ 10 mA 1700 µcd @ 10 mA 1900 µcd @ 10 mA 350 µcd @ 10 mA	4-7 4-15 4-21 4-21 4-21 4-37 4-21
	MAN3480A MAN3680A MAN3880A MAN3980A MAN78A	High Efficiency Green Orange Yellow High Efficiency Red Red	.3-Inch; Common Cathode; RHDP; 10-Pin	3200 µcd @ 10 mA 1800 µcd @ 10 mA 1700 µcd @ 10 mA 1900 µcd @ 10 mA 350 µcd @ 10 mA	4-29 4-29 4-29 4-29 4-29
	MAN4705A MAN4630A	Red Orange	.4-Inch; Universal (CA/CC) Overflow ±1; RHDP	350 µcd @ 10 mA 1800 µcd @ 10 mA	4-49 4-49

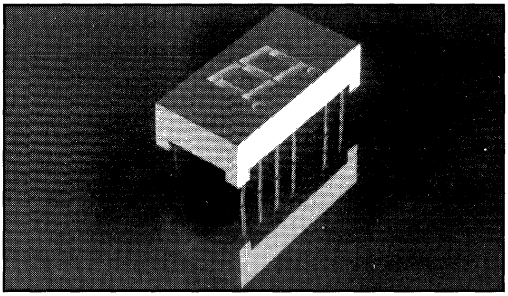
PACKAGE	PART NUMBER	COLOR	DESCRIPTION	BRIGHTNESS OR LUMINOUS INTENSITY (TYPICAL)	PAGE
	MAN4410A	High Efficiency Green	.4-Inch; Common Anode; RHDP	3200 μcd @ 10 mA	4-49
	MAN4610A	Orange		1800 μcd @ 10 mA	4-49
	MAN4710A	Red		350 μcd @ 10 mA	4-49
	MAN4910A	High Efficiency Red		1900 μcd @ 10 mA	4-57
	MAN4440A	High Efficiency Green	.4-Inch; Common Cathode; RHDP	3200 μcd @ 10 mA	4-49
	MAN4640A	Orange		1800 μcd @ 10 mA	4-49
	MAN4740A	Red		350 μcd @ 10 mA	4-49
	MAN4940A	High Efficiency Red		1900 μcd @ 10 mA	4-57
	MAN5350	Yellow	.51-Inch; Common Anode; RHDP	1200 μcd @ 20 mA	4-67
	MAN5960		.51-Inch; Common Cathode; RHDP		4-67
	MAN5450	Green	.51-Inch; Common Anode; RHDP	3000 μcd @ 20 mA	4-67
	MAN5460		.51-Inch; Common Cathode; RHDP		4-67
	MAN5750	Red	.51-Inch; Common Anode; RHDP	500 μcd @ 20 mA	4-67
	MAN5760		.51-Inch; Common Cathode; RHDP		4-67
	MAN5950	Orange Red	.51-Inch; Common Anode; RHDP	2500 μcd @ 20 mA	4-67
	MAN5360		.51-Inch; Common Cathode; RHDP		4-67
	MAN6410	High Efficiency Green	0.56-Inch; Common Anode; RHDP; 2-Digit	3300 μcd @ 10 mA	4-75
	MAN6440		0.56-Inch; Common Cathode; RHDP; 2-Digit		4-75
	MAN6610	Orange	0.56-Inch; Common Anode; RHDP; 2-Digit	2200 μcd @ 10 mA	4-79
	MAN6640		0.56-Inch; Common Cathode; RHDP; 2-Digit		4-79
	MAN6710	Red	0.56-Inch; Common Anode; RHDP; 2-Digit	420 μcd @ 10 mA	4-85
	MAN6740		0.56-Inch; Common Cathode; RHDP; 2-Digit		4-85
	MAN6910	High Efficiency Red	0.56-Inch; Common Anode; RHDP; 2-Digit	2200 μcd @ 10 mA	4-89
	MAN6940		0.56-Inch; Common Cathode; RHDP; 2-Digit		4-89
	MAN6630	Orange	0.56-Inch; Common Anode; RHDP; 1½-Digit	2200 μcd @ 10 mA	4-79
	MAN6650		0.56-Inch; Common Cathode; RHDP; 1½-Digit		4-79
	MAN6730	Red	0.56-Inch; Common Anode; RHDP; 1½-Digit	420 μcd @ 10 mA	4-85
	MAN6750		0.56-Inch; Common Cathode; RHDP; 1½-Digit		4-85
	MAN6930	High Efficiency Red	0.56-Inch; Common Anode; Overflow ±1.8, RHDP	2200 μcd @ 10 mA	4-89
	MAN6950		0.56-Inch; Common Cathode; Overflow ±1.8, RHDP		4-89
	MAN6060	AlGaAs Red Low Current	0.56-Inch; Common Anode; RHDP	4200 μcd @ 5 mA	4-7
	MAN6080		0.56-Inch; Common Cathode; RHDP		4-7
	MAN6260	AlGaAs Red Hi. Intensity	0.56-Inch; Common Anode; RHDP	15000 μcd @ 20 mA	4-15
	MAN6280		0.56-Inch; Common Cathode; RHDP		4-15
	MAN6460	High Efficiency Green	0.56-Inch; Common Anode; RHDP;	3300 μcd @ 10 mA	4-75
	MAN6480		0.56-Inch; Common Cathode; RHDP		4-75
	MAN6660	Orange	0.56-Inch; Common Anode; RHDP;	2200 μcd @ 10 mA	4-79
	MAN6680		0.56-Inch; Common Cathode; RHDP		4-79

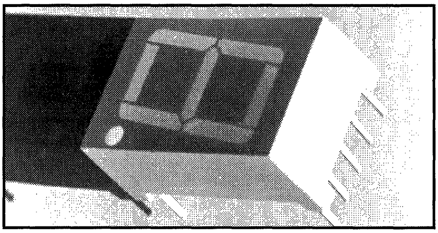
PACKAGE	PART NUMBER	COLOR	DESCRIPTION	BRIGHTNESS OR LUMINOUS INTENSITY (TYPICAL)	PAGE
	MAN6760 MAN6780	Red	0.56-Inch; Common Anode; RHDP; 0.56-Inch; Common Cathode; RHDP	420 μcd @ 10 mA	4-85 4-85
	MAN6960 MAN6980	High Efficiency Red	0.56-Inch; Common Anode; RHDP; 0.56-Inch; Common Cathode; RHDP	2200 μcd @ 10 mA	4-89 4-89
	MAN6675 MAN6695	Orange	0.56-Inch; Common Anode; RHDP; ±1 Overflow 0.56-Inch; Common Cathode; RHDP; ±1 Overflow	2200 μcd @ 10 mA	4-79 4-79
	MAN8010 MAN8040	AlGaAs Red	.800-Inch; Common Anode; RHDP .800-Inch; Common Cathode; RHDP	3500 μcd @ 5 mA	4-7 4-7
	MAN8210 MAN8240	AlGaAs Red	.800-Inch; Common Anode; RHDP .800-Inch; Common Cathode; RHDP	11000 μcd @ 20 mA	4-15 4-15
	MAN8410 MAN8440	High Efficiency Green	.800-Inch; Common Anode; RHDP; .800-Inch; Common Cathode; RHDP	3200 μcd @ 10 mA	4-95 4-95
	MAN8610 MAN8640	Orange	.800-Inch; Common Anode; RHDP; .800-Inch; Common Cathode; RHDP	2200 μcd @ 10 mA	4-99 4-99
	MAN8910 MAN8940	High Efficiency Red	.800-Inch; Common Anode; RHDP; .800-Inch; Common Cathode; RHDP	2200 μcd @ 10 mA	4-103 4-103

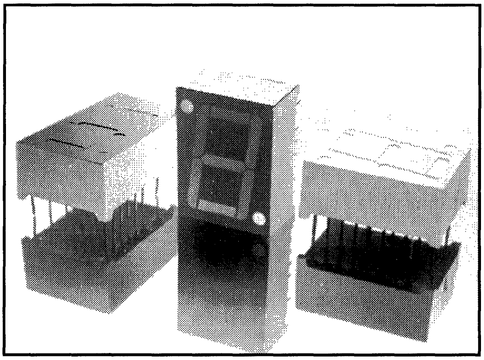
QT
OPTOELECTRONICS

DOUBLE HETEROJUNCTION AlGaAs RED LOW CURRENT DISPLAYS

7.6mm (0.3in) MAN30X0A
14.2mm (0.56in) MAN60X0
20.0mm (0.8in) MAN80X0







DESCRIPTION

This line of solid state LED displays uses newly developed Double Heterojunction (HD) AlGaAs/GaAs material to emit deep red light at 650 nm. This material has outstanding efficiency at low drive currents and can be either DC or pulse driven. Viewability at up to 10 meters (MAN8000 Series) is available for applications such as instruments weighing scales, meters and point-of-sale terminals.

FEATURES

- Low Power Consumption
  Typical power consumption is 1.6mA/seg. at 1mA drive ideal for battery operated applications
- Typical intensity of 650μcd/seg at 1mA drive
- Excellent for multiplexing long digit strings
- Compatible with monolithic LED display drivers
- Three Character Sizes
  7.6mm (0.3in), 14.2mm (0.56in), 20.0mm (0.8in)
- Common anode or common cathode
- Excellent character appearance
  Wide viewing angle
  Grey body for optimum contrast
- Categorized for luminous intensity. Use of like categorizes yields a uniform display

MODEL NUMBERS

PART NO.	CHARACTER SIZE	DESCRIPTION	PACKAGE DRAWING
MAN3010A		Common anode; right hand decimal	A
MAN3040A		Common cathode; right hand decimal	B
MAN3020A	0.3″ (7.6mm)	Common anode; left hand decimal	C
MAN6060		Common anode; right hand decimal	D
MAN6080	0.56″ (14.2mm)	Common cathode; right hand decimal	E
MAN8010		Common anode; right hand decimal	F
MAN8040	0.8″ (20mm)	Common cathode; right hand decimal	G

DOUBLE HETEROJUNCTION AlGaAs RED LOW CURRENT DISPLAYS

ELECTRICAL/OPTICAL CHARACTERISTICS AT T_A=25°C

DESCRIPTION	SYMBOL	DEVICE	TEST CONDITIONS	MIN.	TYP.	MAX.	UNITS
Luminous intensity/segment [1.2] (digit average)	I_V	MAN3000A Series	1 mA DC	315	600		
			5 mA DC		3600		
			20 mA Pk: 1 of 4 Duty Factor		3300		µcd
		MAN6000 Series	1 mA DC	400	700		
			5 mA DC		4200		
			20 mA Pk: 1 of 4 Duty Factor		3900		µcd
		MAN8000 Series	1 mA DC	270	500		
			5 mA DC		3500		
			20 mA Pk: 1 of 4 Duty Factor		3300		µcd
Peak wavelength	λ Peak	All Devices			650		nm
Dominant wavelength [3]	λd	All Devices			642		nm
Forward voltage/segment or DP	V_F	All Devices	I_F=1 mA I_F=5 mA I_F=20 mA Pk		1.6 1.7 1.8	2.0 2.1 2.2	V
Reverse voltage/segment or DP	V_R	All Devices	I_R=100 µA	3.0	15		V
Temp. coefficient of V_F/seg. or DP	ΔV_F/°C				−2mV		MV/°C
Thermal resistance LED junction—to—pin	RθJ-PIN	MAN3000 MAN6000 MAN8000			255 400 430		°C/W/Seg.

NOTES

1. *Case temperature of the device immediately prior to the intensity measurement is 25°C.*
2. *The digits are categorized for luminous intensity with the intensity category designated by a letter on the side of the package.*
3. *The dominant wavelength, λ_d, is derived from the CIE chromaticity diagram and is that single wavelength which defines the color of the device.*

QT OPTOELECTRONICS

DOUBLE HETEROJUNCTION AlGaAs RED LOW CURRENT DISPLAYS

ABSOLUTE MAXIMUM RATINGS (All Products)

Average power per segment or DP (T_A=25°C)	37 mW
Peak forward current per segment or DP (T_A=25°C)[1]	45 mA
Average or DC forward current per segment or DP (T_A=25°C)	15 mA
Operating temperature range	−20°C to +85°C
Storage temperature range	−40°C to +85°C
Reverse voltage per segment or DP	3.0 V
Lead solder temperature (1.59 mm [1/16″] below seating plane)	260°C for 3 sec.

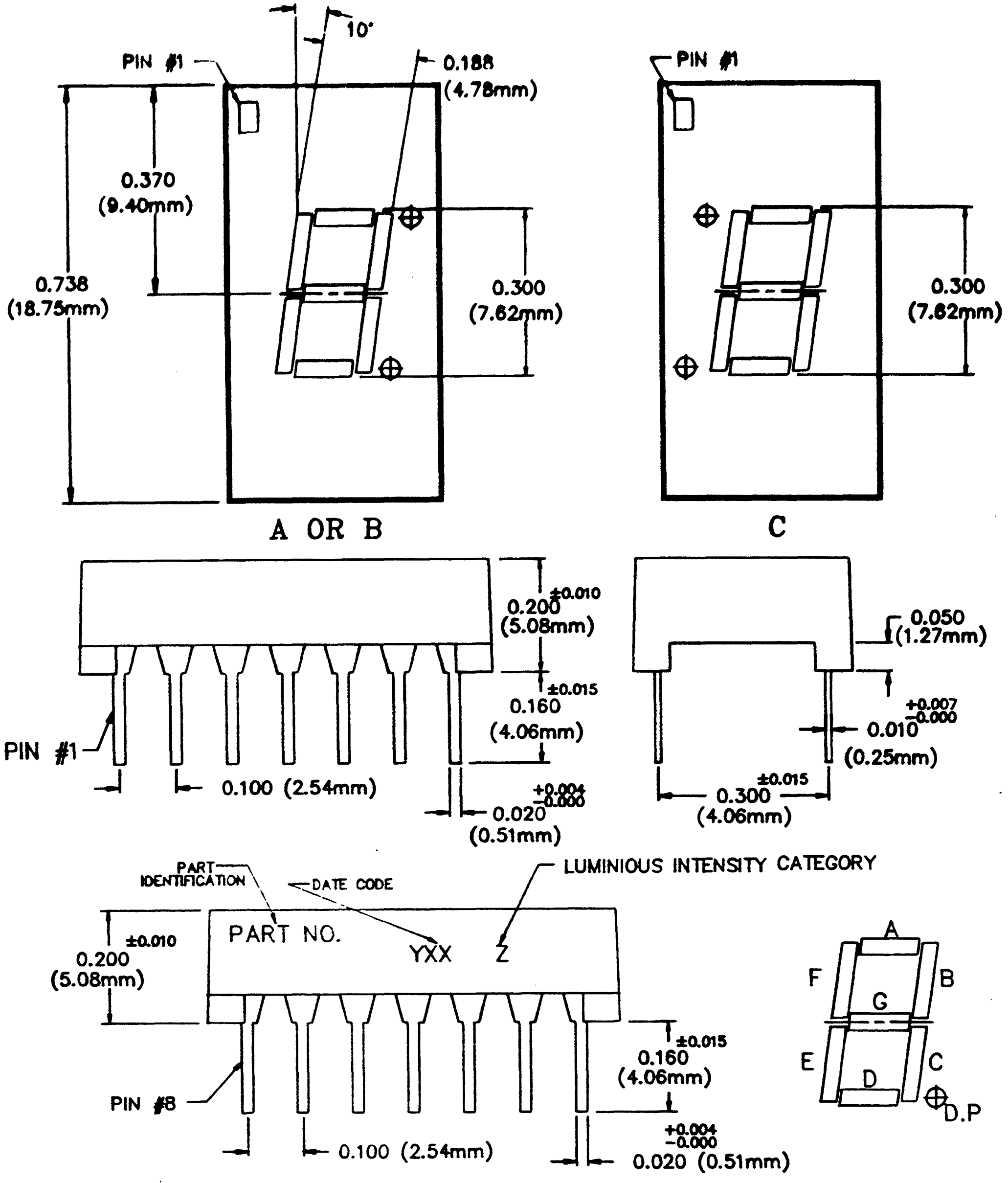
NOTES: *1. Do not exceed maximum average current per segment.*

NOTES

1. *The digit average Luminous Intensity is obtained by summing the Luminous Intensity of each segment and dividing by the total number of segments. Intensity will not vary more than ±33.3% between all segment within a digit.*
2. *Leads of the device immersed to 1/16″ from the body. Maximum device surface temperature is 140°C.*
3. *For flux removal, Freon TF, Freon TE, Isoproponal or water may be used up to their boiling points.*
4. *All displays are categorized for Luminous Intensity. The intensity category is marked on each part as a suffix letter to the part numbers.*

PACKAGE DIMENSIONS

MAN3000A SERIES



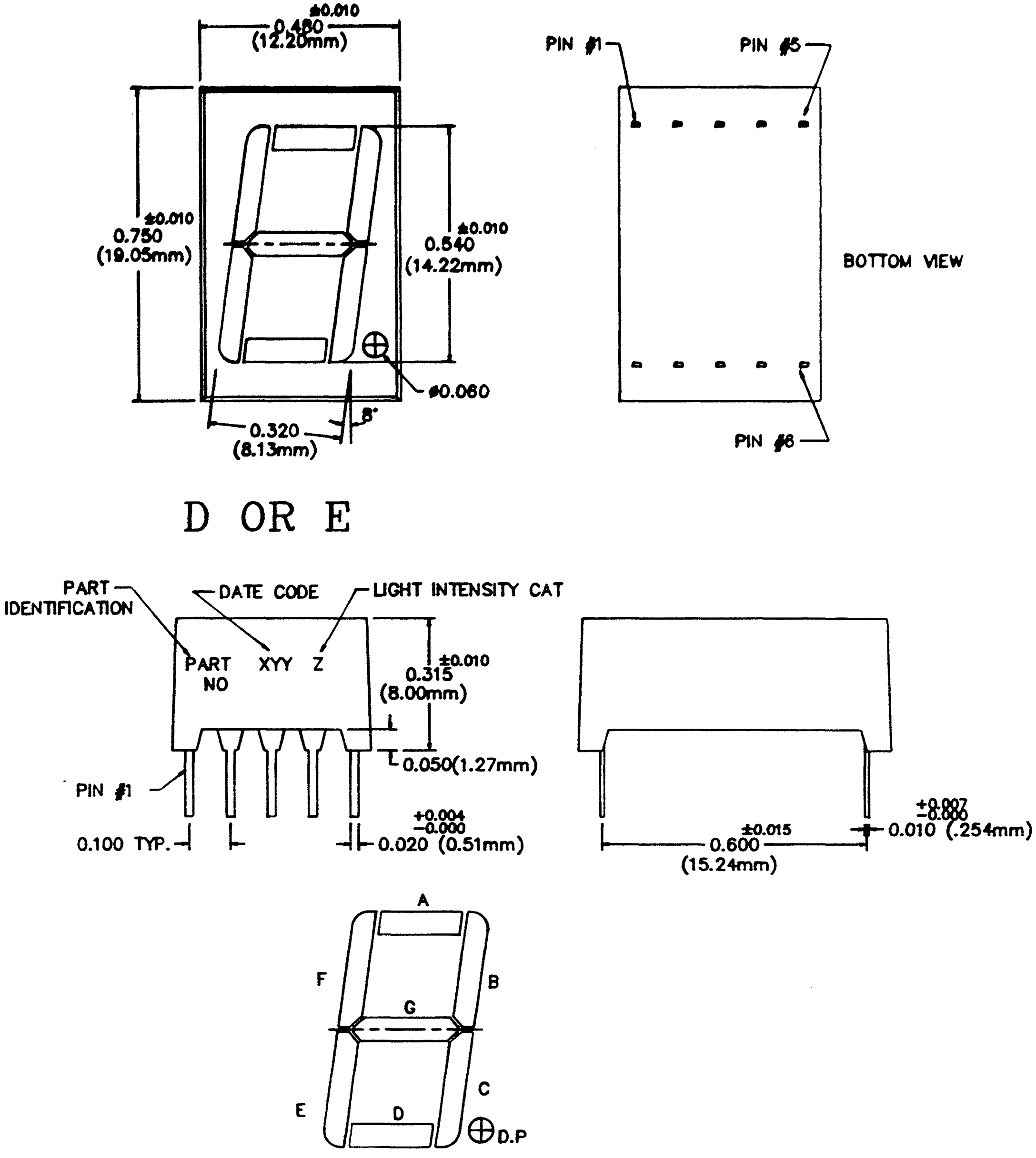
NOTE :
ALL DIMENSION ARE IN INCHES(mm)

C3060

DOUBLE HETEROJUNCTION
AlGaAs RED
LOW CURRENT DISPLAYS

PACKAGE DIMENSIONS

MAN6000 SERIES

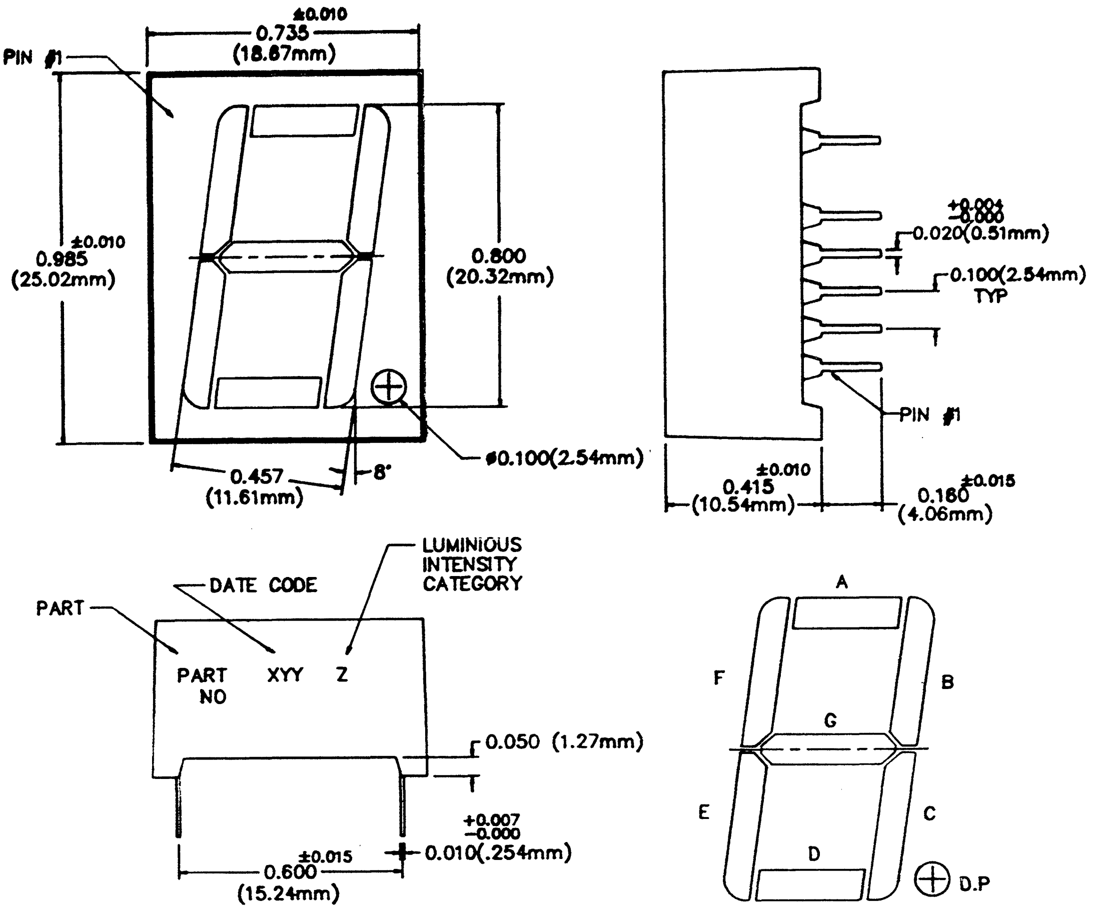


OPTOELECTRONICS

DOUBLE HETEROJUNCTION AlGaAs RED LOW CURRENT DISPLAYS

PACKAGE DIMENSIONS

MAN8000 SERIES



C3062

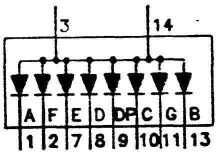
QT
OPTOELECTRONICS

DOUBLE HETEROJUNCTION AlGaAs RED LOW CURRENT DISPLAYS

ELECTRICAL CONNECTIONS

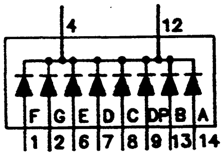
PIN NO.	A MAN3010A	B MAN3040A	C MAN3020A	D MAN6060	E MAN6080	F MAN8010	G MAN8040
1	Cathode A	Anode F	Cathode A	Cathode E	Anode E	No Connection	No Connection
2	Cathode F	Anode G	Cathode F	Cathode D	Anode D	A Cathode	A Anode
3	Common Anode	No Pin	Common Anode	Common Anode	Common Cathode	F Cathode	F Anode
4	No Pin	Common Cathode	No Pin	Cathode C	Anode C	Common Anode	Common Cathode
5	No Pin	No Pin	No Pin	Cathode D.P	Anode D.P	E Cathode	E Anode
6	No Connection	Anode E	Cathode D.P	Cathode B	Anode B	—	—
7	Cathode E	Anode D	Cathode E	Cathode A	Anode A	E Cathode	E Anode
8	Cathode D	Anode C	Cathode D	Common Anode	Common Cathode	—	—
9	Cathode D.P	Anode D.P	No Connection	Cathode F	Anode F	D Cathode	Common Cathode
10	Cathode C	No Pin	Cathode C	Cathode G	Anode G	D.P Cathode	D.P Anode
11	Cathode G	No Pin	Cathode G			D Cathode	D Anode
12	No Pin	Common Cathode	No Pin			Common Anode	Common Cathode
13	Cathode B	Anode B	Cathode B			C Cathode	C Anode
14	Common Anode	Anode A	Common Anode			G Cathode	G Anode
15						B Cathode	B Anode
16						—	—
17						Common Anode	Common Cathode
18						—	—

ELECTRICAL SCHEMATIC



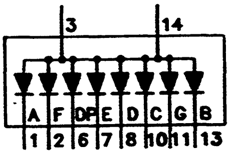
MAN3010
(A)

C3070



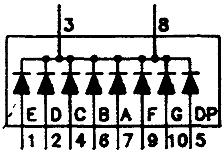
MAN3040
(B)

C3071



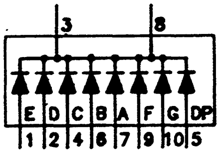
MAN3020
(C)

C3072



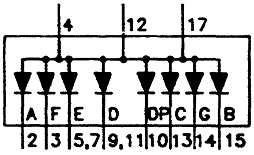
MAN6060
(D)

C3073



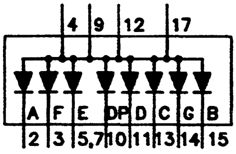
MAN6080
(E)

C3074



MAN8010
(F)

C3075



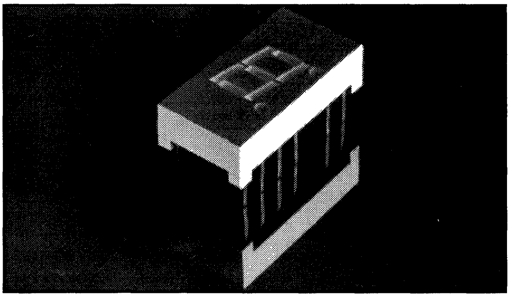
MAN8040
(G)

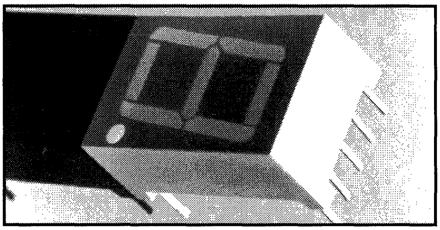
C3076

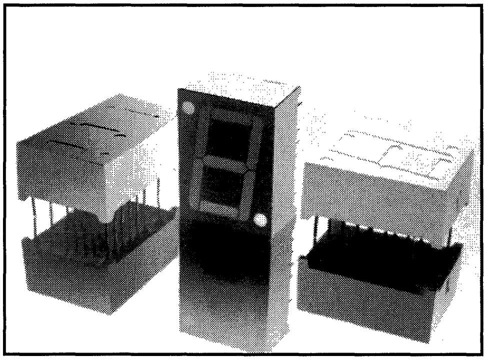
QT
OPTOELECTRONICS

DOUBLE HETEROJUNCTION AlGaAs RED SUNLIGHT VIEWABLE DISPLAYS

7.6mm (0.3in) MAN32X0A
14.2mm (0.56in) MAN62X0
20.0mm (0.8in) MAN82X0







DESCRIPTION

This line of solid state LED displays uses newly developed Double Heterojunction (DH) AlGaAs/GaAs material technology. This LED material has outstanding light output efficiency over a wide range of drive currents and can either be DC or pulse driven. The color is deep red at the dominant wavelength of 637 nanometers. Viewability of up to 10 meters (MAN8200 Series) is available for applications in bright sunlight such as automotive and avionic instrumentation, portable instruments, point-of-sale terminals and gas pumps.

FEATURES

- Sunlight Viewable
  Typical intensity of 15mcd/Seg at 20mA Drive
- Capable of high drive currents
- Excellent for multiplexing long digit strings
- Three Character Sizes
  7.6mm (0.3in), 14.2mm (0.56in), 20.0mm (0.8in)
- Excellent character appearance
  Evenly lighted segments
  Wide viewing angle
  Grey body for optimum contrast
- Categorized for luminous intensity. Use of like categorizes yields a uniform display

MODEL NUMBERS

PART NO.	CHARACTER SIZE	DESCRIPTION	PACKAGE DRAWING
MAN3210A		Common anode; right hand decimal	A
MAN3240A		Common cathode; right hand decimal	B
MAN3220A	0.3″ (7.6mm)	Common anode; left hand decimal	C
MAN6260		Common anode; right hand decimal	D
MAN6280	0.56″ (14.2mm)	Common cathode; right hand decimal	E
MAN8210		Common anode; right hand decimal	F
MAN8240	0.8″ (20mm)	Common cathode; right hand decimal	G

DOUBLE HETEROJUNCTION
AlGaAs RED
SUNLIGHT VIEWABLE DISPLAYS

ELECTRICAL/OPTICAL CHARACTERISTICS AT T_A=25°C

DESCRIPTION	SYMBOL	DEVICE	TEST CONDITIONS	MIN.	TYP.	MAX.	UNITS
Luminous intensity/segment [1.2] (digit average)	I_V	MAN3200A Series	I_F=20 mA DC	6.9	12.0		mcd
		MAN6200 Series	I_F=20 mA DC	9.1	15.0		mcd
		MAN8200 Series	I_F=20 mA DC	6.0	11.0		mcd
Peak wavelength	λ Peak	All Devices			645		nm
Dominant wavelength [3]	λd	All Devices			637		nm
Forward voltage/segment or DP	V_F	All Devices	I_F=100 mA		2.0	3.0	V
Reverse voltage/segment or DP	V_R	All Devices	I_R=100 μA	3.0	15		V
Temp. coefficient of V_F/seg. or DP	ΔV_F/°C				−2mV		mV/°C
Thermal resistance LED junction—to—pin	RθJ-PIN	MAN3200A			255		°C/W/Seg.
		MAN6200			400		
		MAN8200			430		

NOTES

1. *Case temperature of the device immediately prior to the intensity measurement is 25°C.*
2. *The digits are categorized for luminous intensity with the intensity category designated by a letter on the side of the package.*
3. *The dominant wavelength, λ_d, is derived from the CIE chromaticity diagram and is that single wavelength which defines the color of the device.*

ABSOLUTE MAXIMUM RATINGS (All Products)

Average power per segment or DP (T_A=25°C)	96 mA
Peak forward current per segment or DP (T_A=25°C) [1]	160 mA
Average or DC forward current per segment or DP (T_A=25°C)	40 mA
Operating temperature range	−20°C to +85°C
Storage temperature range	−40°C to +85°C
Reverse voltage per segment or DP	3.0 V
Lead solder temperature (1.59 mm [1/16″] below seating plane)	260°C for 3 sec.

NOTES: *1. Do not exceed maximum average current per segment.*

NOTES

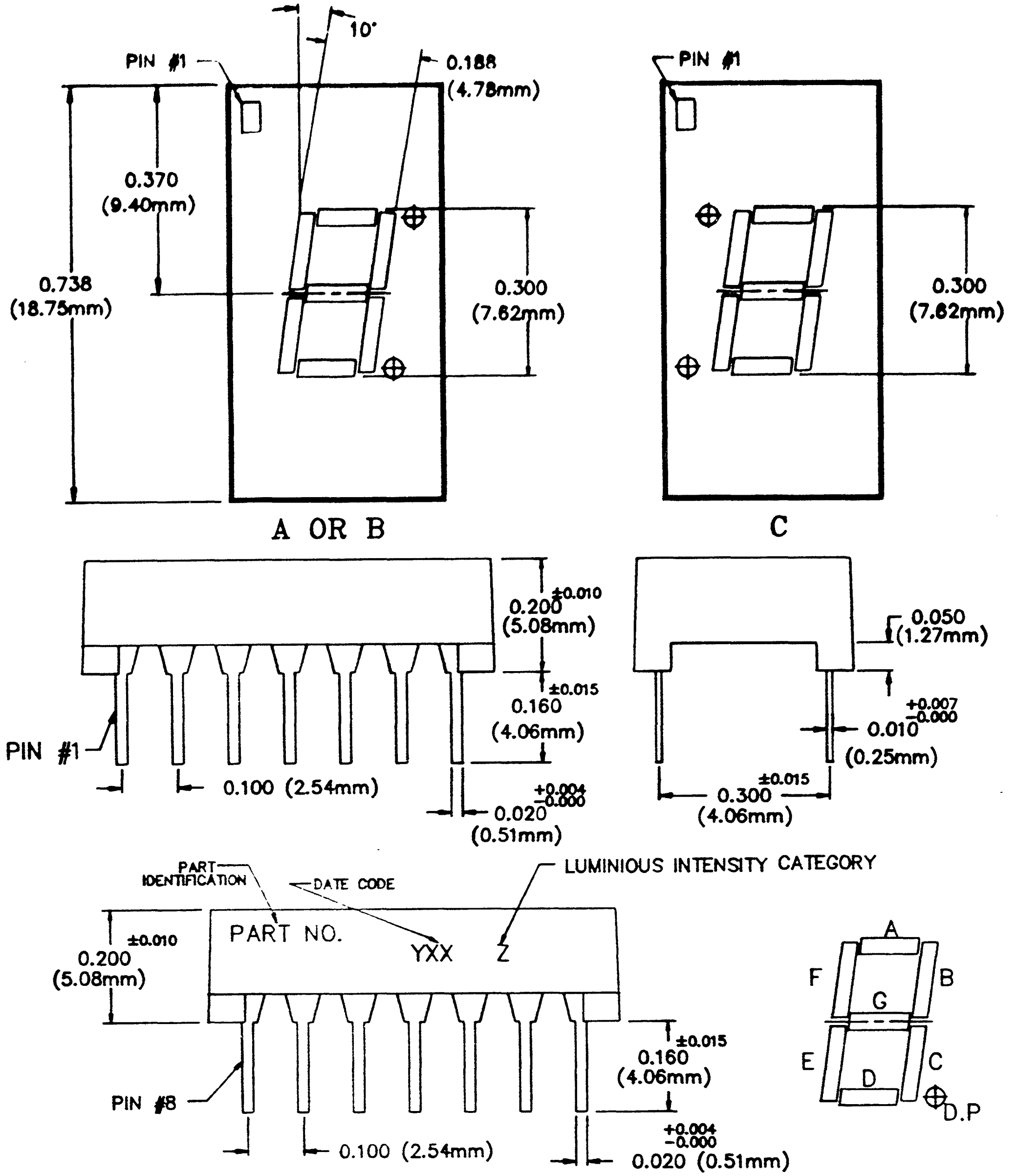
1. *The digit average Luminous Intensity is obtained by summing the Luminous Intensity of each segment and dividing by the total number of segments. Intensity will not vary more than ±33.3% between all segment within a digit.*
2. *Leads of the device immersed to 1/16″ from the body. Maximum device surface temperature is 140°C.*
3. *For flux removal, Freon TF, Freon TE, Isoproponal or water may be used up to their boiling points.*
4. *All displays are categorized for Luminous Intensity. The intensity category is marked on each part as a suffix letter to the part numbers.*

QT OPTOELECTRONICS

DOUBLE HETEROJUNCTION AlGaAs RED SUNLIGHT VIEWABLE DISPLAYS

PACKAGE DIMENSIONS

MAN3200A SERIES

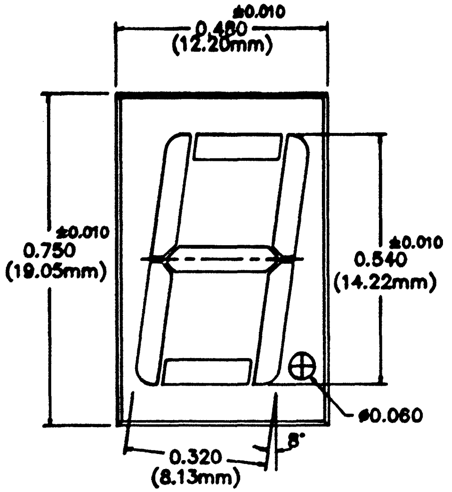


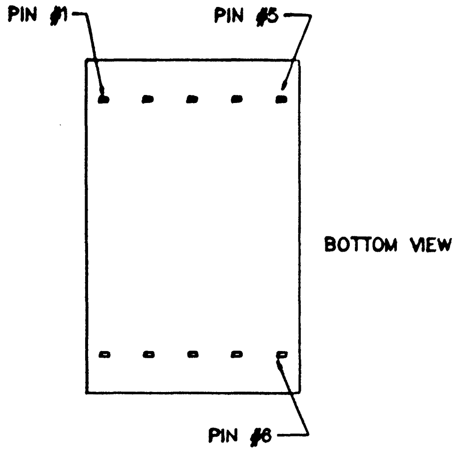
NOTE :
ALL DIMENSION ARE IN INCHES(mm)

C3060

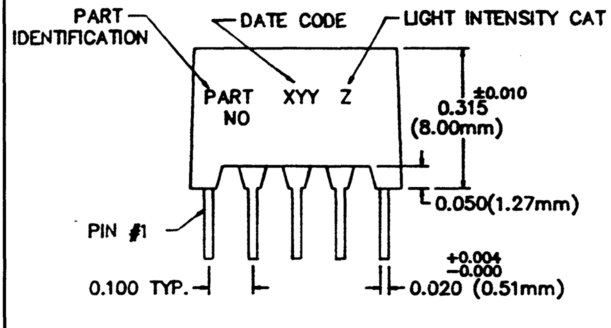
PACKAGE DIMENSIONS

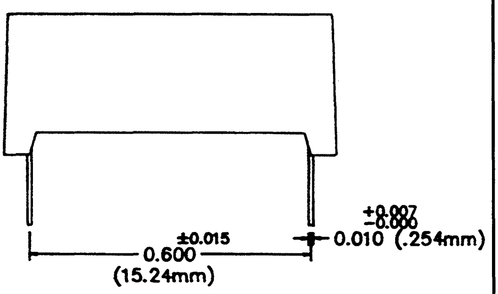
MAN6200 SERIES

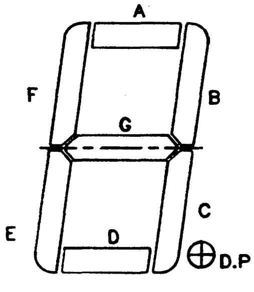




D OR E



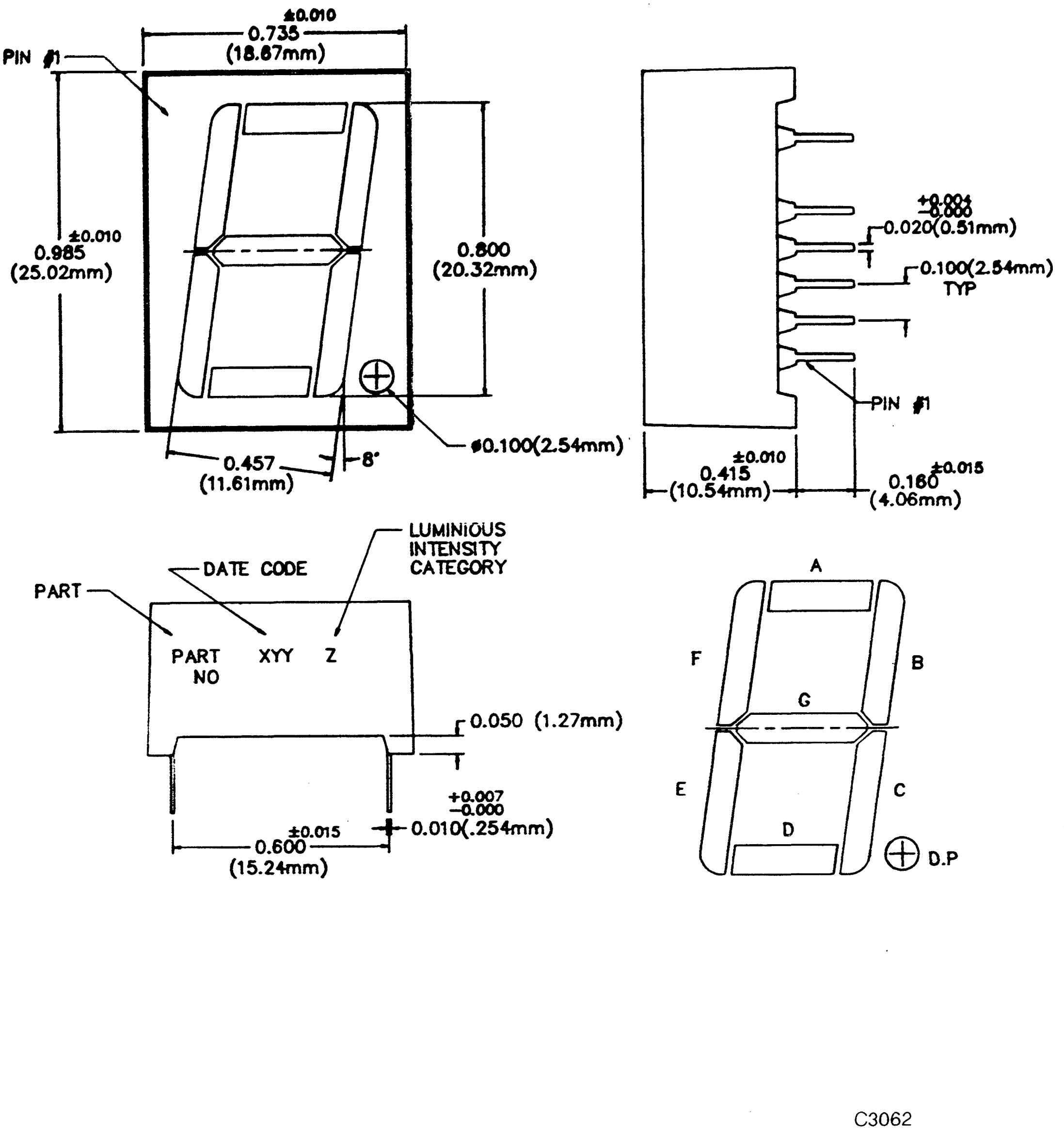




C3061

PACKAGE DIMENSIONS

MAN8200 SERIES



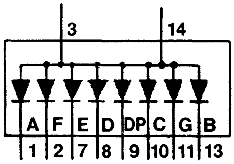
QT
OPTOELECTRONICS

DOUBLE HETEROJUNCTION
AlGaAs RED
SUNLIGHT VIEWABLE DISPLAYS

ELECTRICAL CONNECTIONS

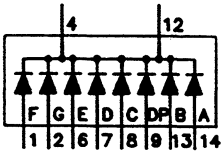
PIN NO.	A MAN3210A	B MAN3240A	C MAN3220A	D MAN6260	E MAN6280	F MAN8210	G MAN8240
1	Cathode A	Anode F	Cathode A	Cathode E	Anode E	No Connection	No Connection
2	Cathode F	Anode G	Cathode F	Cathode D	Anode D	A Cathode	A Anode
3	Common Anode	No Pin	Common Anode	Common Anode	Common Cathode	F Cathode	F Anode
4	No Pin	Common Cathode	No Pin	Cathode C	Anode C	Common Anode	Common Cathode
5	No Pin	No Pin	No Pin	Cathode D.P	Anode D.P	E Cathode	E Anode
6	No Connection	Anode E	Cathode D.P	Cathode B	Anode B	—	—
7	Cathode E	Anode D	Cathode E	Cathode A	Anode A	E Cathode	E Anode
8	Cathode D	Anode C	Cathode D	Common Anode	Common Cathode	—	—
9	Cathode D.P	Anode D.P	No Connection	Cathode F	Anode F	D Cathode	Common Cathode
10	Cathode C	No Pin	Cathode C	Cathode G	Anode G	D.P Cathode	D.P Anode
11	Cathode G	No Pin	Cathode G			D Cathode	D Anode
12	No Pin	Common Cathode	No Pin			Common Anode	Common Cathode
13	Cathode B	Anode B	Cathode B			C Cathode	C Anode
14	Common Anode	Anode A	Common Anode			G Cathode	G Anode
15						B Cathode	B Anode
16						—	—
17						Common Anode	Common Cathode
18						—	—

ELECTRICAL SCHEMATIC



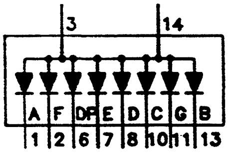
MAN3210
(A)

C3063



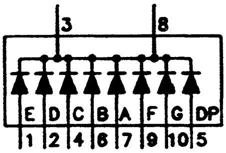
MAN3240
(B)

C3064



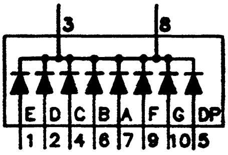
MAN3220
(C)

C3065



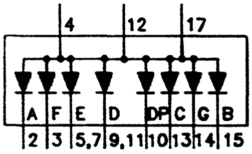
MAN6260
(D)

C3066



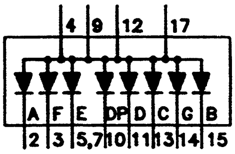
MAN6280
(E)

C3067



MAN8210
(F)

C3068



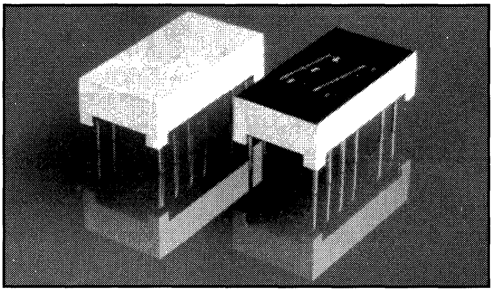
MAN8240
(G)

C3069

QT
OPTOELECTRONICS

0.300-INCH
SEVEN SEGMENT DISPLAYS

HIGH EFFICIENCY GREEN **MAN3400A** RED **MAN70A**
ORANGE **MAN3600A** YELLOW **MAN3800A**



DESCRIPTION

The MAN3400A, MAN3600A, MAN70A and MAN3800A Series provides a choice of color of LED displays. Standard units are available in Red, Green, Orange and Yellow. They can be mounted in arrays with 0.400-inch (10.16 mm) center-to-center spacing. Yellow and High Efficiency Green displays are constructed with Grey face and neutral segment color. Red displays have Black faces and Red segment color. Others have face and segment color corresponding to the emitted light.

FEATURES

- Common anode or common cathode models
- Red, Yellow, Green and Orange
- Fast switching — excellent for multiplexing
- Low power consumption
- Bold solid segments that are highly legible
- Solid state reliability — long operation life
- Impact resistant plastic construction
- Directly compatible with integrated circuits
- High brightness with high contrast
- Categorized for Luminous Intensity (See Note 6)
- Standard 14 pin dual-in-line package configuration
- Wide angle viewing...150°

APPLICATIONS

- Digital readout displays
- Instrument panels
- Point of sale equipment
- Calculators
- Digital clocks

MODEL NUMBERS

PART NUMBER	COLOR	DESCRIPTION
MAN3410A	High Efficiency Green	Common Anode; Right Hand Decimal
MAN3420A	High Efficiency Green	Common Anode; Left Hand Decimal
MAN3440A	High Efficiency Green	Common Cathode; Right Hand Decimal
MAN3610A	Orange	Common Anode; Right Hand Decimal
MAN3620A	Orange	Common Anode; Left Hand Decimal
MAN3630A	Orange	Common Anode; Overflow ±1
MAN3640A	Orange	Common Cathode; Right Hand Decimal
MAN71A	Red	Common Anode; Right Hand Decimal
MAN72A	Red	Common Anode; Left Hand Decimal
MAN73A	Red	Common Anode; Overflow ±1
MAN74A	Red	Common Cathode; Right Hand Decimal
MAN3810A	Yellow	Common Anode; Right Hand Decimal
MAN3820A	Yellow	Common Anode; Left Hand Decimal
MAN3840A	Yellow	Common Cathode; Right Hand Decimal

ELECTRO-OPTICAL CHARACTERISTICS

(25°C Free Air Temperature Unless Otherwise Specified)

	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS
MAN3410A, 3420A, 3440A					
Luminous Intensity, digit average	750	3200		µcd	I_F=10 mA
(See Notes 1 and 3)	900	4000		µcd	I_F=60 mA peak, 1:6 DF
Peak emission wavelength		562		nm	
Spectral line half width		30		nm	
Forward voltage					
Segment		2.2	3.0	V	I_F=20 mA
Decimal point		2.2	3.0	V	I_F=20 mA
Dynamic resistance					
Segment		12		Ω	I_F=20 mA
Decimal point		12		Ω	I_F=20 mA
Capacitance					
Segment		40		pF	V=0
Decimal point		40		pF	V=0
Reverse current					
Segment			100	µA	V_R=5.0 V
Decimal point			100	µA	V_R=5.0 V
MAN3610A, 3620A, 3630A, 3640A					
Luminous Intensity, digit average	510	1800		µcd	I_F=10 mA
(See Note 1 and 3)					
Peak emission wavelength		630		nm	
Spectral line half width		40		nm	
Forward voltage					
Segment			2.5	V	I_F=20 mA
Decimal point			2.5	V	I_F=20 mA
Dynamic resistance					
Segment		26		Ω	I_F=20 mA
Decimal point		26		Ω	I_F=20 mA
Capacitance					
Segment		35		pF	V=0
Decimal point		35		pF	V=0
Reverse current					
Segment			100	µA	V_R=5.0 V
Decimal point			100	µA	V_R=5.0 V

ELECTRO-OPTICAL CHARACTERISTICS
(25°C Free Air Temperature Unless Otherwise Specified) (Cont'd)

	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS
MAN71A, 72A, 73A, 74A					
Luminous Intensity, digit average (See Note 1 and 3)	125	350		μcd	I_F=10 mA
Peak emission wavelength		660		nm	
Spectral line half width		20		nm	
Forward voltage					
Segment			2.0	V	I_F=20 mA
Decimal point			2.0	V	I_F=20 mA
Dynamic resistance					
Segment		2		Ω	I_{pk}=100 mA
Decimal point		2		Ω	I_{pk}=100 mA
Capacitance					
Segment		35	80	pF	V=0
Decimal point		35	80	pF	V=0
Reverse current					
Segment			100	μA	V_R=5.0 V
Decimal point			100	μA	V_R=5.0 V
MAN3810A, 3820A, 3840A					
Luminous Intensity, digit average (See Note 1 and 3)	450	1700		μcd	I_F=10 mA
Peak emission wavelength		585		nm	
Spectral line half width		40		nm	
Forward voltage					
Segment			3.0	V	I_F=20 mA
Decimal point			3.0	V	I_F=20 mA
Dynamic resistance					
Segment		26		Ω	I_F=20 mA
Decimal point		26		Ω	I_F=20 mA
Capacitance					
Segment		35		pF	V=0
Decimal point		35		pF	V=0
Reverse current					
Segment			100	μA	V_R=5.0 V
Decimal point			100	μA	V_R=5.0 V

0.300-INCH
SEVEN SEGMENT DISPLAYS

RECOMMENDED OPTICAL FILTERS

For optimum ON and OFF contrast, one of the following filters or equivalents should be used over the display:

DEVICE TYPE	FILTER	DEVICE TYPE	FILTER
MAN3610A MAN3620A MAN3630A MAN3640A	Panelgraphic Scarlet 65 Homalite 100-1670	MAN71A MAN72A MAN73A MAN74A	Panelgraphic Red 60 Homalite 100-1605
MAN3410A MAN3420A MAN3440A	Panelgraphic Green 48 Homalite 100-1440 Green	MAN3810A MAN3820A MAN3840A	Panelgraphic Yellow 25 or Amber 23 Homalite 100-1720 or 100-1726 Panelgraphic Grey 10 Homalite 100-1266 Grey

ABSOLUTE MAXIMUM RATINGS

	HIGH EFF. GREEN **MAN3410A** **MAN3420A** **MAN3440A**	**RED** **MAN71A** **MAN72A** **MAN74A**	**MAN73A**
Power dissipation at 25°C ambient	600 mW	480 mW	300 mW
Derate linearly from 50°C	−12 mW/°C	−6.9 mW/°C	−4.29 mW/°C
Storage and operating temperature	−40°C to +85°C	−40°C to +85°C	−40°C to +85°C
Continuous forward current			
Total	240 mA	240 mA	150 mA
Per segment	30 mA	30 mA	30 mA
Decimal point	30 mA	30 mA	30 mA
Reverse voltage			
Per segment	6.0 V	6.0 V	6.0 V
Decimal point	6.0 V	6.0 V	6.0 V
Soldering time at 260°C (See Notes 4 and 5)	5 sec.	5 sec.	5 sec.

	YELLOW **MAN3810A** **MAN3820A** **MAN3840A**	**ORANGE** **MAN3610A** **MAN3620A** **MAN3640A**	**MAN3630A**
Power dissipation at 25°C ambient	600 mW	600 mW	375 mW
Derate linearly from 50°C	−10.3 mW/°C	−8.6 mW/°C	−5.36 mW/°C
Storage and operating temperature	−40°C to +85°C	−40°C to +85°C	−40°C to +85°C
Continuous forward current			
Total	200 mA	240 mA	150 mA
Per segment	25 mA	30 mA	30 mA
Decimal point	25 mA	30 mA	30 mA
Reverse voltage			
Per segment	6.0 V	6.0 V	6.0 V
Decimal point	6.0 V	6.0 V	6.0 V
Soldering time at 260°C (See Notes 4 and 5)	5 sec.	5 sec.	5 sec.

TYPICAL THERMAL CHARACTERISTICS

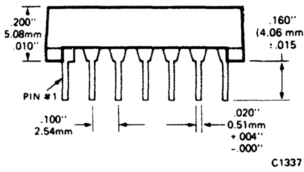
GREEN/YELLOW	
Thermal resistance junction to free air Φ_{JA}	160°C/W
Wavelength temperature coefficient (case temperature)	1.0Å/°C
Forward voltage temperature coefficient	−1.5 mV/°C
RED/ORANGE	
Thermal resistance junction to free air Φ_{JA}	160°C/W
Wavelength temperature coefficient (case temperature)	1.0Å/°C
Forward voltage temperature coefficient	−2.0 mV/°C

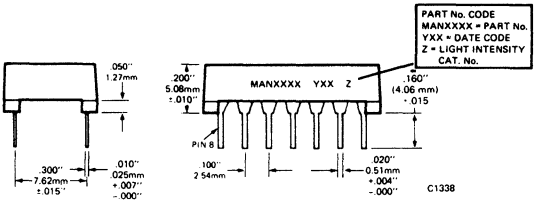
NOTES

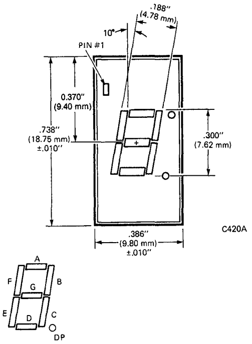
1. *The digit average Luminous Intensity is obtained by summing the Luminous Intensity of each segment and dividing by the total number of segments. Intensity will not vary more than ±33.3% between all segments within a digit.*
2. *The curve in Figures 3, 6, 9, and 12 is normalized to the brightness at 25°C to indicate the relative Luminous Intensity over the operating temperature range.*
3. *The decimal point is designed to have the same surface brightness as the segments, therefore, the Luminous Intensity of the decimal point is .3 times the Luminous Intensity of the segments, since the area of the decimal point is .3 times the area of the average segment.*
4. *Leads of the device immersed to 1/16 inch from the body. Maximum device surface temprature is 140°C.*
5. *For flux removal, Freon TF, Freon TE, Isopropanal or water may be used up to their boiling points.*
6. *All displays are categorized for Luminous Intensity. The Intensity category is marked on each part as a suffix letter to the part number.*

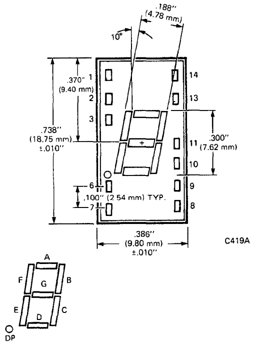
0.300-INCH SEVEN SEGMENT DISPLAYS

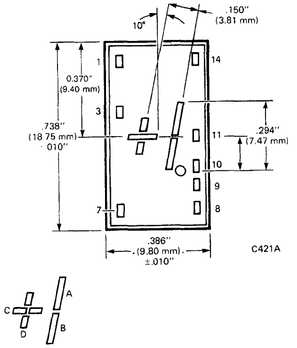
PACKAGE DIMENSIONS

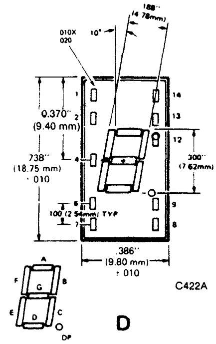








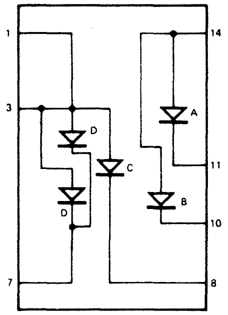




ELECTRICAL CONNECTIONS

Pin No.	ELECTRICAL CONNECTIONS A MAN3410A, 3610A, 71A, 3810A	B MAN3420A, 72A, 3620A, 3820A	C MAN3630A, 73A	D MAN3440A, 3640A, 74A, 3840A
1	Cathode A	Cathode A	Anode C, D	Anode F
2	Cathode F	Cathode F	No Pin	Anode G
3	Common Anode	Common Anode	Anode C, D	No Pin
4	No Pin	No Pin	No Pin	Common Cathode
5	No Pin	No Pin	No Pin	No Pin
6	No Connection	Cathode D.P.	No Pin	Anode E
7	Cathode E	Cathode E	Cathode D	Anode D
8	Cathode D	Cathode D	Cathode C	Anode C
9	Cathode D.P.	No Connection	No Connection	Anode D.P.
10	Cathode C	Cathode C	Cathode B	No Pin
11	Cathode G	Cathode G	Cathode A	No Pin
12	No Pin	No Pin	No Pin	Common Cathode
13	Cathode B	Cathode B	No Pin	Anode B
14	Common Anode	Common Anode	Anode A, B	Anode A

ELECTRICAL SCHEMATIC



0.300-INCH
SEVEN SEGMENT DISPLAYS

TYPICAL CHARACTERISTIC CURVES

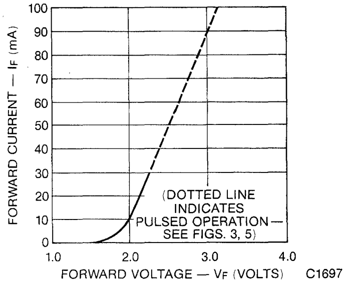


Fig. 1. Forward Current vs. Forward Voltage

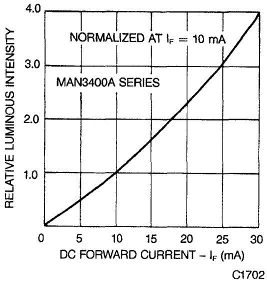


Fig. 2. Relative Luminous Intensity vs. DC Forward Current

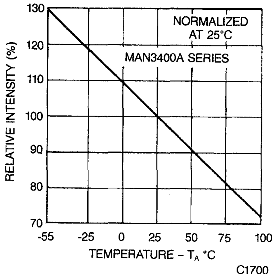


Fig. 3. Relative Luminous Intensity vs. Temperature

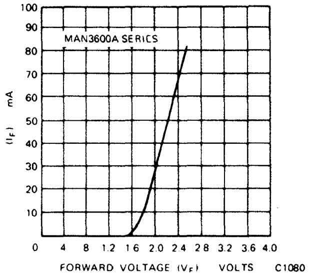


Fig. 4. Forward Current vs. Forward Voltage

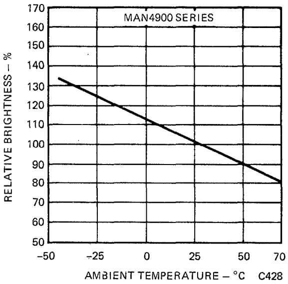


Fig. 5. Relative Luminous Intensity vs. Temperature

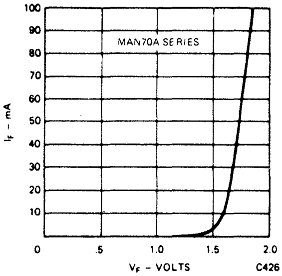


Fig. 6. Forward Current vs. Forward Voltage

TYPICAL CHARACTERISTIC CURVES (Cont'd)

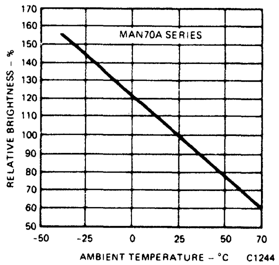


Fig. 7. Relative Luminous Intensity vs. Temperature

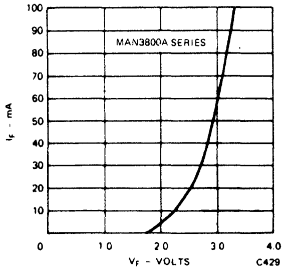


Fig. 8. Forward Current vs. Forward Voltage

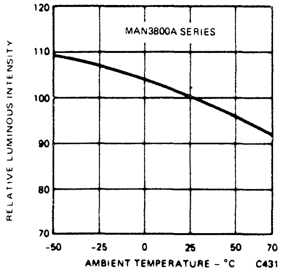


Fig. 9. Relative Luminous Intensity vs. Temperature

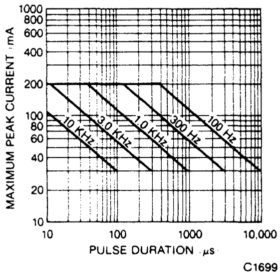


Fig. 10. Maximum Peak Current vs. Pulse Duration

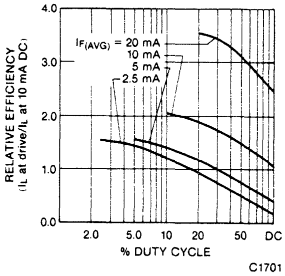


Fig. 11. Relative Efficiency vs. Duty Cycle

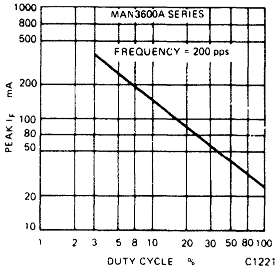


Fig. 12. Max Peak Current vs. Duty Cycle

TYPICAL CHARACTERISTIC CURVES (Cont'd)

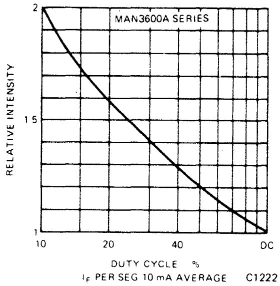


Fig. 13. Luminous Intensity vs. Duty Cycle

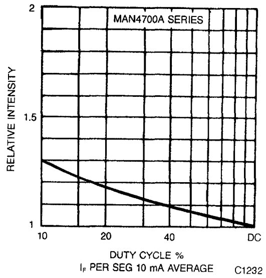


Fig. 14. Luminous Intensity vs. Duty Cycle

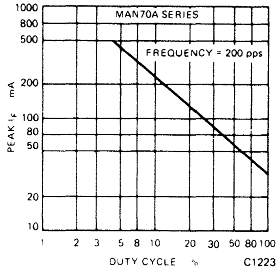


Fig. 15. Max Peak Current vs. Duty Cycle

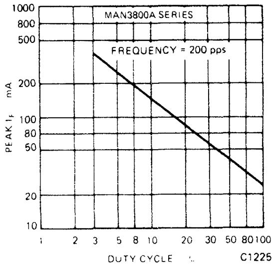


Fig. 16. Max Peak Current vs. Duty Cycle

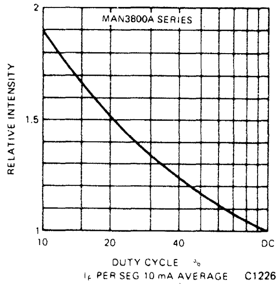


Fig. 17. Luminous Intensity vs. Duty Cycle

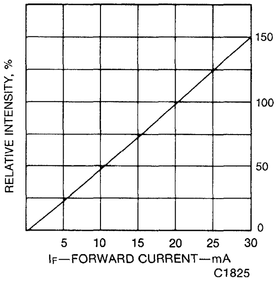
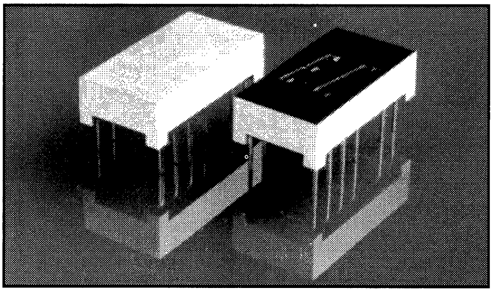


Fig. 18. Relative Luminous Intensity vs. Forward Current

QT OPTOELECTRONICS

0.300-INCH SEVEN SEGMENT DISPLAYS

RED MAN78A
HIGH EFFICIENCY GREEN MAN3480A
YELLOW MAN3880A
ORANGE MAN3680A
HIGH EFFICIENCY RED MAN3980A



DESCRIPTION

The MAN3480A, MAN3680A, MAN78A, MAN3880A and MAN3980A are common cathode displays which provide a choice of color of LED displays. They are pin and functional replacements for the 0.300-inch Hewlett-Packard common cathode displays. The series is complementary to the MAN3400A, MAN3600A, MAN70A, MAN3800A and MAN3900A families of displays. They can be mounted in arrays with 0.400-inch (10.16 mm) center-to-center spacing. Yellow and High Efficiency Green displays are constructed with Grey face and neutral segment color. Red displays have Black faces and Red segment color. Others have face and segment color corresponding to the emitted light.

FEATURES

- Hewlett-Packard compatible common cathode displays
- Red, Yellow, Green, Orange and High Efficiency Red
- Fast switching — excellent for multiplexing
- Low power consumption
- Bold solid segments that are highly legible
- Solid state reliability — long operation life
- Impact resistant plastic construction
- Directly compatible with integrated circuits
- High brightness with high contrast
- Categorized for Luminous Intensity (See Note 6)
- Standard 10 pin dual-in-line package configuration
- Wide viewing angle...150°

APPLICATIONS

- Digital readout displays
- Instrument panels
- Point of sale terminals
- Calculators
- Digital clocks

MODEL NUMBERS

PART NO.	COLOR	DESCRIPTION
MAN3480A	High Efficiency Green	Common Cathode; Right Hand Decimal
MAN3680A	Orange	Common Cathode; Right Hand Decimal
MAN78A	Red	Common Cathode; Right Hand Decimal
MAN3880A	Yellow	Common Cathode; Right Hand Decimal
MAN3980A	High Efficiency Red	Common Cathode; Right Hand Decimal

0.300-INCH
SEVEN SEGMENT DISPLAYS

RECOMMENDED OPTICAL FILTERS

For optimum ON and OFF contrast, one of the following filters or equivalents should be used over the display:

DEVICE TYPE	FILTER	DEVICE TYPE	FILTER
MAN3480A	Panelgraphic Green 48 Homalite 100-1440 Green	MAN3980A MAN78A	Panelgraphic Red 60 Homalite 100-1605
MAN3680A	Panelgraphic Scarlet 65 Homalite 100-1670	MAN3880A	Panelgraphic Yellow 25 or Amber 23 Homalite 100-1720 or 100-1726 Panelgraphic Grey 10 Homalite 100-1266 Grey

ELECTRO-OPTICAL CHARACTERISTICS

(25°C Free Air Temperature Unless Otherwise Specified)

	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS
MAN3480A					
Luminous Intensity, digit average	750	3200		μcd	I_F=10 mA
(See Notes 1 and 3)	900	4000		μcd	I_F=60 mA peak, 1:6 DF
Peak emission wavelength		562		nm	
Spectral line half width		30		nm	
Forward voltage					
Segment		2.2	3.0	V	I_F=20 mA
Decimal point		2.2	3.0	V	I_F=20 mA
Dynamic resistance					
Segment		12		Ω	I_F=20 mA
Decimal point		12		Ω	I_F=20 mA
Capacitance					
Segment		40		pF	V=0
Decimal point		40		pF	V=0
Reverse current					
Segment			100	μA	V_R=5.0 V
Decimal point			100	μA	V_R=5.0 V
MAN3680A					
Luminous Intensity, digit average (See Note 1 and 3)	510	1800		μcd	I_F=10 mA
Peak emission wavelength		630		nm	
Spectral line half width		40		nm	
Forward voltage					
Segment			2.5	V	I_F=20 mA
Decimal point			2.5	V	I_F=20 mA
Dynamic resistance					
Segment		26		Ω	I_F=20 mA
Decimal point		26		Ω	I_F=20 mA
Capacitance					
Segment		35		pF	V=0
Decimal point		35		pF	V=0
Reverse current					
Segment			100	μA	V_R=5.0 V
Decimal point			100	μA	V_R=5.0 V

ELECTRO-OPTICAL CHARACTERISTICS

(25°C Free Air Temperature Unless Otherwise Specified) (Cont'd)

	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS
MAN78A					
Luminous Intensity, digit average (See Note 1 and 3)	125	350		μcd	I_F=10 mA
Peak emission wavelength		660		nm	
Spectral line half width		20		nm	
Forward voltage					
Segment			2.0	V	I_F=20 mA
Decimal point			2.0	V	I_F=20 mA
Dynamic resistance					
Segment		2		Ω	I_{pk}=100 mA
Decimal point		2		Ω	I_{pk}=100 mA
Capacitance					
Segment		35	80	pF	V=0
Decimal point		35	80	pF	V=0
Reverse current					
Segment			100	μA	V_R=5.0 V
Decimal point			100	μA	V_R=5.0 V
MAN3880A					
Luminous Intensity, digit average (See Note 1 and 3)	450	1700		μcd	I_F=10 mA
Peak emission wavelength		585		nm	
Spectral line half width		40		nm	
Forward voltage					
Segment			3.0	V	I_F=20 mA
Decimal point			3.0	V	I_F=20 mA
Dynamic resistance					
Segment		26		Ω	I_F=20 mA
Decimal point		26		Ω	I_F=20 mA
Capacitance					
Segment		35		pF	V=0
Decimal point		35		pF	V=0
Reverse current					
Segment			100	μA	V_R=5.0 V
Decimal point			100	μA	V_R=5.0 V
MAN3980A					
Luminous Intensity, digit average (See Note 1 and 3)	450	1900		μcd	I_F=10 mA
Peak emission wavelength		635		nm	
Spectral line half width		40		nm	
Forward voltage					
Segment			2.5	V	I_F=20 mA
Decimal point			2.5	V	I_F=20 mA
Dynamic resistance					
Segment		26		Ω	I_F=20 mA
Decimal point		26		Ω	I_F=20 mA
Capacitance					
Segment		35		pF	V=0
Decimal point		35		pF	V=0
Reverse current					
Segment			100	μA	V_R=5.0 V
Decimal point			100	μA	V_R=5.0 V

OPTOELECTRONICS

0.300-INCH SEVEN SEGMENT DISPLAYS

ABSOLUTE MAXIMUM RATINGS

	HIGH EFF. GREEN MAN3480A	RED MAN78A	ORANGE YELLOW HIGH EFF. RED MAN3680A MAN3680A MAN3980A
Power dissipation at 25°C ambient	600 mW	480 mW	600 mW
Derate linearly from 50°C	−12 mW/°C	−6.9 mW/°C	−10.3 mW/°C
Storage and operating temperature	−40°C to +85°C	−40°C to +85°C	−40°C to +85°C
Continuous forward current			
Total	240 mA	240 mA	200 mA
Per segment	30 mA	30 mA	25 mA
Decimal point	30 mA	30 mA	25 mA
Reverse voltage			
Per segment	6.0 V	6.0 V	6.0 V
Decimal point	6.0 V	6.0 V	6.0 V
Soldering time at 260°C (See Notes 4 and 5)	5 sec.	5 sec.	5 sec.

TYPICAL THERMAL CHARACTERISTICS

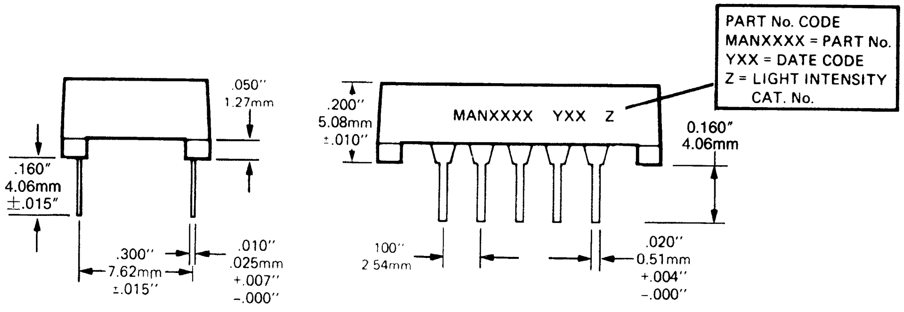
GREEN/YELLOW	
Thermal resistance junction to free air Φ_{JA}	160°C/W
Wavelength temperature coefficient (case temperature)	1.0Å/°C
Forward voltage temperature coefficient	−1.5 mV/°C
RED/ORANGE/HIGH EFFICIENCY RED	
Thermal resistance junction to free air Φ_{JA}	160°C/W
Wavelength temperature coefficient (case temperature)	1.0Å/°C
Forward voltage temperature coefficient	−2.0 mV/°C

NOTES

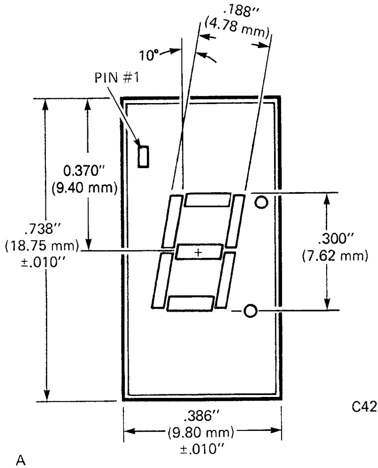
1. *The digit average Luminous Intensity is obtained by summing the Luminous Intensity of each segment and dividing by the total number of segments. Intensity will not vary more than ±33.3% between all segments within a digit.*
2. *The curve in Figures 3, 6, 9, and 12 is normalized to the brightness at 25°C to indicate the relative Luminous Intensity over the operating temperature range.*
3. *The decimal point is designed to have the same surface brightness as the segments, therefore, the Luminous Intensity of the decimal point is .3 times the Luminous Intensity of the segments, since the area of the decimal point is .3 times the area of the average segment.*
4. *Leads of the device immersed to 1/16 inch from the body. Maximum device surface temperature is 140°C.*
5. *For flux removal, Freon TF, Freon TE, Isopropornal or water may be used up to their boiling points.*
6. *All displays are categorized for Luminous Intensity. The Intensity category is marked on each part as a suffix letter to the part number.*

0.300-INCH
SEVEN SEGMENT DISPLAYS

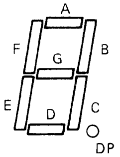
PACKAGE DIMENSIONS



C3000



C420A



ELECTRICAL CONNECTIONS

PIN NO.	ELECTRICAL CONNECTIONS
1	Common Cathode
2	Anode F
3	Anode G
4	Anode E
5	Anode D
6	Common Cathode
7	Anode D.P.
8	Anode C
9	Anode B
10	Anode A

TYPICAL CHARACTERISTIC CURVES

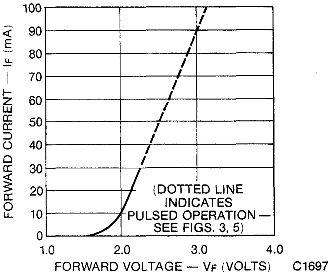


Fig. 1. Forward Current vs. Forward Voltage

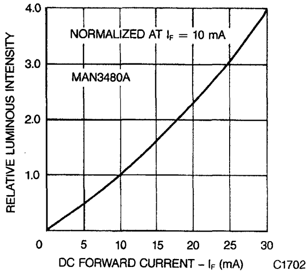


Fig. 2. Relative Luminous Intensity vs. DC Forward Current

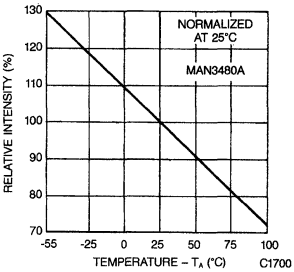


Fig. 3. Relative Luminous Intensity vs. Temperature

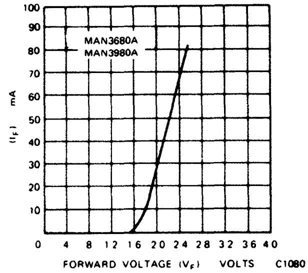


Fig. 4. Forward Current vs. Forward Voltage

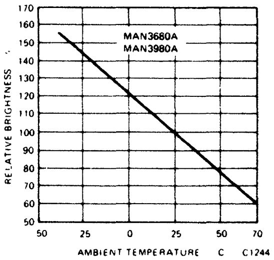


Fig. 5. Relative Luminous Intensity vs. Temperature

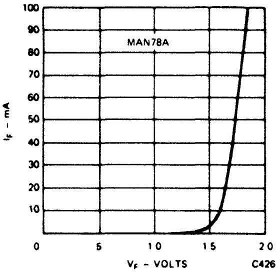


Fig. 6. Forward Current vs. Forward Voltage

TYPICAL CHARACTERISTIC CURVES (Cont'd)

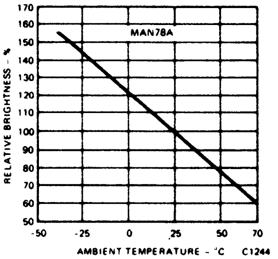


Fig. 7. Relative Luminous Intensity vs. Temperature

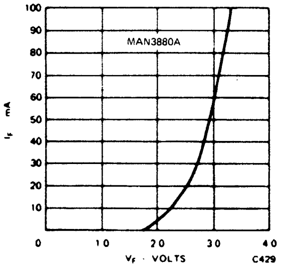


Fig. 8. Forward Current vs. Forward Voltage

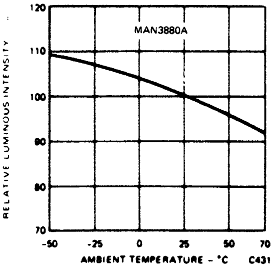


Fig. 9. Relative Luminous Intensity vs. Temperature

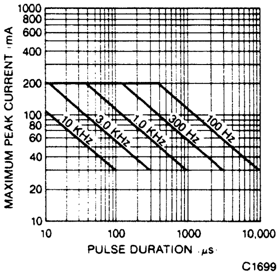


Fig. 10. Maximum Peak Current vs. Pulse Duration

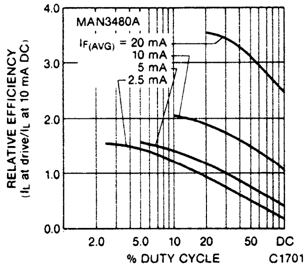


Fig. 11. Relative Efficiency vs. Duty Cycle

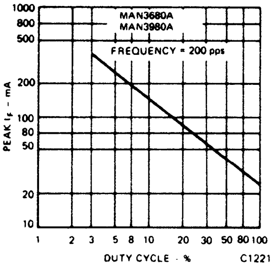


Fig. 12. Max Peak Current vs. Duty Cycle

TYPICAL CHARACTERISTIC CURVES (Cont'd)

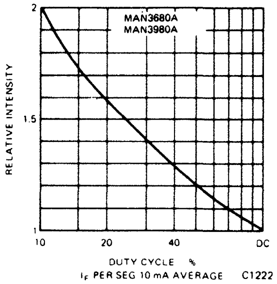


Fig. 13. Luminous Intensity vs. Duty Cycle

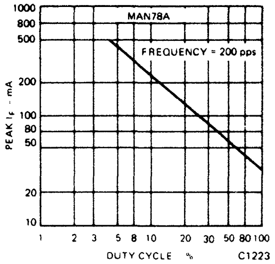


Fig. 14. Max Peak Current vs. Duty Cycle

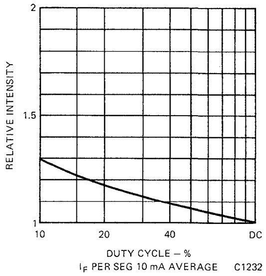


Fig. 15. Luminous Intensity vs. Duty Cycle

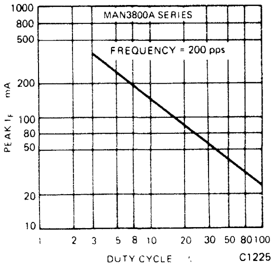


Fig. 16. Max Peak Current vs. Duty Cycle

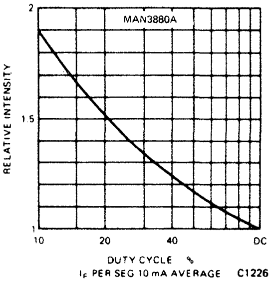


Fig. 17. Luminous Intensity vs. Duty Cycle

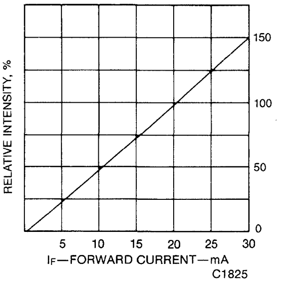
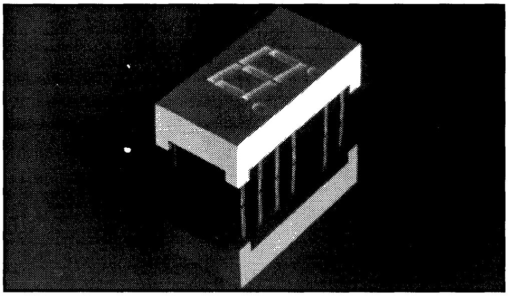


Fig. 18. Relative Luminous Intensity vs. Forward Current

QT
OPTOELECTRONICS

0.300-INCH
SEVEN SEGMENT DISPLAYS

HIGH EFFICIENCY RED **MAN3900A SERIES**



DESCRIPTION

The MAN3900A Series is a High Efficiency Red LED display. Standard units are also available in Red, Green, Orange and Yellow, with common anode right hand decimal, common anode left hand decimal, and common cathode right hand decimal. They can be mounted in arrays with 0.400-inch (10.16 mm) center-to-center spacing. Units are constructed with Red face and segment color.

FEATURES

- Common anode or common cathode models
- High Efficiency Red
- Fast switching—excellent for multiplexing
- Low power consumption
- Bold solid segments that are highly legible
- Solid state reliability—long operation life
- Impact resistant plastic construction
- Directly compatible with integrated circuits
- High brightness with high contrast
- Categorized for Luminous Intensity (See Note 6)
- Standard dual-in-line package configuration
- Wide angle viewing . . . 150°
- These devices have a Red face and Red segments

APPLICATIONS

For industrial and consumer applications such as:

- Digital readout displays
- Instrument panels
- Point of sale equipment
- Calculators
- Digital clocks

MODEL NUMBERS

PART NUMBER	COLOR	PACKAGE	DESCRIPTION	PIN OUT SPECIFICATION
MAN3910A	High Efficiency Red	A	Common Anode; Right Hand Decimal	A
MAN3920A	High Efficiency Red	B	Common Anode; Left Hand Decimal	B
MAN3940A	High Efficiency Red	C	Common Cathode; Right Hand Decimal	C
MAN3980A	High Efficiency Red	D	Common Cathode; Right Hand Decimal	D

RECOMMENDED OPTICAL FILTERS

For optimum ON and OFF contrast, one of the following filters or equivalents should be used over the display:

DEVICE TYPE	FILTER
MAN3910A MAN3920A MAN3940A MAN3980A	Panelgraphic Scarlet 65 Homalite 100-1670

0.300-INCH
SEVEN SEGMENT DISPLAYS

ELECTRO-OPTICAL CHARACTERISTICS
(25°C Free Air Temperature Unless Otherwise Specified)

	MIN.	TYP.	MAX.	UNITS	TEST CONDITONS
MAN3910A, 3920A, 3940A, 3980A					
Luminous Intensity, digit average (See Note 1 and 3)	450	1900		μcd	I_F=10 mA
Peak emission wavelength		635		nm	
Spectral line half width		40		nm	
Forward voltage					
Segment			2.5	V	I_F=20 mA
Decimal point			2.5	V	I_F=20 mA
Dynamic resistance					
Segment		26		Ω	I_F=20 mA
Decimal point		26		Ω	I_F=20 mA
Capacitance					
Segment		35		pF	V=0
Decimal point		35		pF	V=0
Reverse current					
Segment			100	μA	V_R=5.0V
Decimal point			100	μA	V_R=5.0 V

ABSOLUTE MAXIMUM RATINGS

MAN3910A, MAN3920A, MAN3940A, MAN3980A

Power dissipation at 25°C ambient	600 mW
Derate linearly from 50°C	−8.6 mW/°C
Storage and operating temperature	−40°C to +85°C
Continuous forward current	
Total	240 mA
Per segment	30 mA
Decimal point	30 mA
Reverse voltage	
Per segment	6.0 V
Decimal point	6.0 V
Soldering time at 260°C (See Notes 4 and 5)	5 sec.

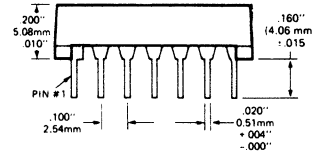
TYPICAL THERMAL CHARACTERISTICS

HIGH EFFICIENCY RED

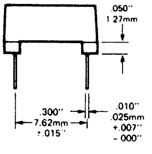
Thermal resistance junction to free air Φ_{JA}	160°C/W
Wavelength temperature coefficient (case temperature)	1.0Å/°C
Forward voltage temperature coefficient	−2.0 mV/°C

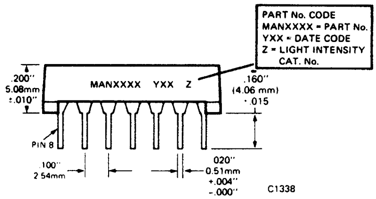
0.300-INCH
SEVEN SEGMENT DISPLAYS

PACKAGE DIMENSIONS

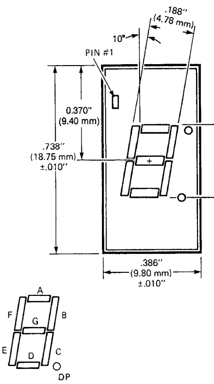


C1337

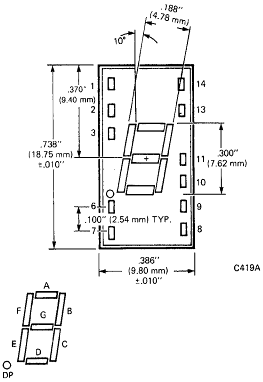




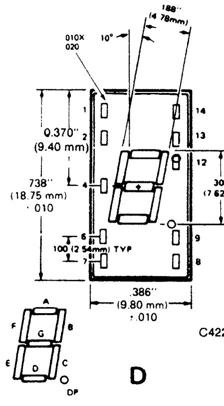
C1338



C420A



C419A



C422A

D

NOTES

1. The digit average Luminous Intensity is obtained by summing the Luminous Intensity of each segment and dividing by the total number of segments. Intensity will not vary more than ±33.3% between all segments within a digit.
2. The curve in Figure 3 is normalized to the brightness at 25°C to indicate the relative Luminous Intensity over the operating temperature range.
3. The decimal point is designed to have the same surface brightness as the segments, therefore, the Luminous Intensity of the decimal point is .3 times the Luminous Intensity of the segments, since the area of the decimal point is .3 times the area of the average segment.
4. Leads of the device immersed to 1/16 inch from the body. Maximum device surface temperature is 140°C.
5. For flux removal, Freon TF, Freon TE, Isoproponal or water may be used to their boiling points.
6. All displays are categorized for Luminous Intensity. The Intensity category is marked on each part as a suffix letter to the part number.

OPTOELECTRONICS

0.300-INCH SEVEN SEGMENT DISPLAYS

ELECTRICAL CONNECTIONS

PIN NO.	ELECTRICAL CONNECTIONS			
	A MAN3910A	B MAN3920A	C MAN3940A	D MAN3980A
1	Cathode A	Cathode A	Anode F	Common Cathode
2	Cathode F	Cathode F	Anode G	Anode F
3	Common Anode	Common Anode	No Pin	Anode G
4	No Pin	No Pin	Common Cathode	Anode E
5	No Pin	No Pin	No Pin	Anode D
6	No Connection	Cathode D.P.	Anode E	Common Cathode
7	Cathode E	Cathode E	Anode D	Anode D.P.
8	Cathode D	Cathode D	Anode C	Anode C
9	Cathode D.P.	No Connection	Anode D.P.	Anode B
10	Cathode C	Cathode C	No Pin	Anode A
11	Cathode G	Cathode G	No Pin	
12	No Pin	No Pin	Common Cathode	
13	Cathode B	Cathode B	Anode B	
14	Common Anode	Common Anode	Anode A	

TYPICAL CHARACTERISTIC CURVES

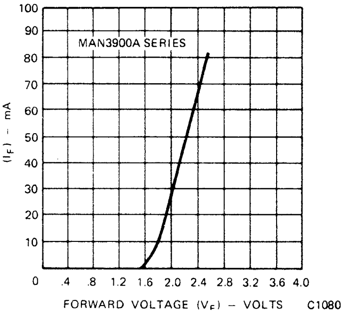


Fig. 1. Forward Current vs. Forward Voltage

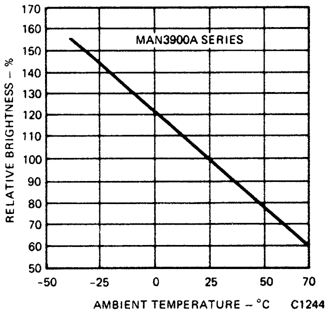


Fig. 2. Relative Luminous Intensity vs. Temperature

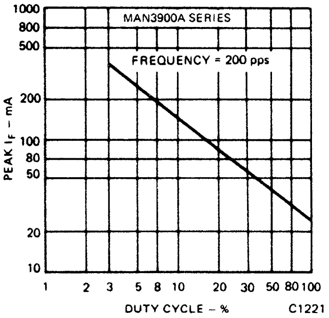


Fig. 3. Max Peak Current vs. Duty Cycle

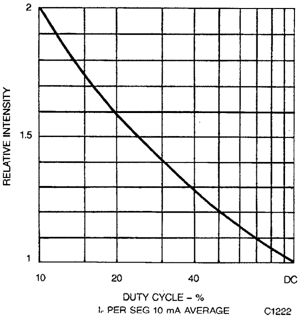


Fig. 4. Luminous Intensity vs. Duty Cycle

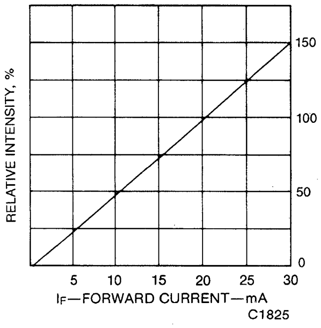


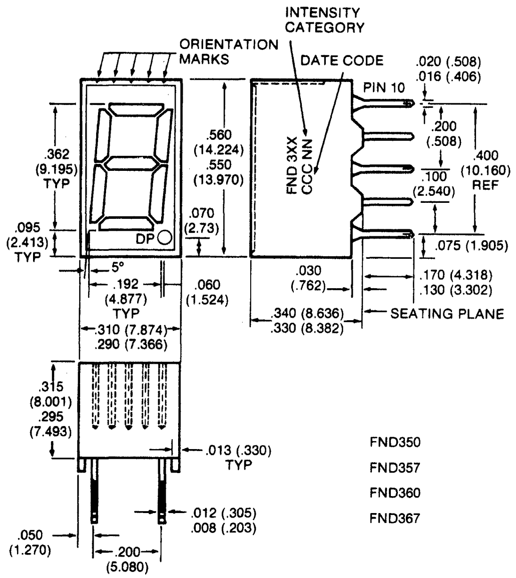
Fig. 5. Relative Luminous Intensity vs. Forward Current

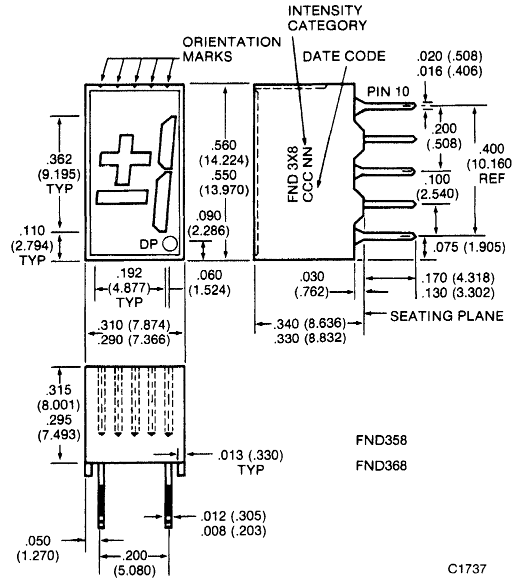
QT
OPTOELECTRONICS

0.362 - INCH
7 - SEGMENT DISPLAY

HIGH EFFICIENCY RED **FND310C FND317C FND318C**

PACKAGE DIMENSIONS





NOTES:
1. ALL DIMENSIONS ARE IN MM (INCH)
2. TOLERANCE ARE ±0.010 INCH UNLESS OTHERWISE SPECIFIED

DESCRIPTION

The FND310C, FND317C and FND318D are high efficiency red GaP 7-segment displays with nominal 0.362″ digit height. Reflector cap, PCB and encapsulant are used in the construction of these FND3XXCs.

FEATURES

- Exactly pin and package compatible with FND3XX
- Compact — 10 digits in 3-inch panel width
- Wide viewing angle
- Right-hand decimal configuration
- Categorized for luminous intensity
- Rugged encapsulated plastic construction

MODEL NUMBERS

PART NUMBER	COLOR	DESCRIPTION
FND310C	Hi. Eff. Red	Common anode seven segment display
FND317C	Hi. Eff. Red	Common cathode seven segment display
FND318C	Hi. Eff. Red	Common cathode ±1 overflow display

QT OPTOELECTRONICS

0.362-INCH
7-SEGMENT DISPLAY

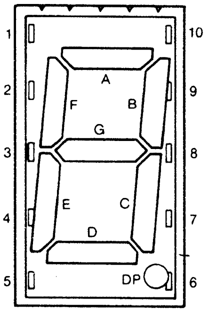
ABSOLUTE MAXIMUM RATINGS

	FND310C/317C	FND318C
Power dissipation at 25°C ambient	500 mW	320 mW
Continuous forward current		
Total	200 mA	125 mA
Per segment or decimal point	25 mA	25 mA
Reverse voltage		
Per segment or decimal point	6 V	6 V
Storage and operating temperature	−25°C to +85°C	−25°C to +85°C
Soldering time at 250°C (1⁄16 inch from the seating plane)	3 sec	3 sec

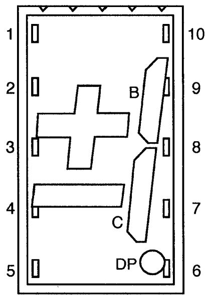
ELECTRO-OPTICAL CHARACTERISTICS (TA=25°C Unless Otherwise Specified)

PARAMETER	MIN.	TYP.	MAX.	UNIT	TEST CONDITIONS
Forward voltage - V (per diode)		2.0	2.5	V	I_F=20 mA
Luminous intensity - Iv	1800	2700		μcd	I_F=20 mA
Peak wavelength		655		nm	I_F=20 mA
Spectrum radiation bandwidth		45		nm	I_F=20 mA
Reverse voltage-V_R	5			V	I_R=100 μA
Capacitance - C		35		pF	V=O, F=1 MHz

PIN CONNECTIONS

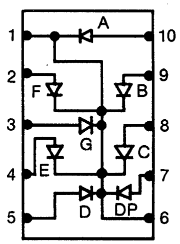


Pin	FND317C	FND310C
1	Common Cathode	Common Anode
2	Segment F	Segment F
3	Segment G	Segment G
4	Segment E	Segment E
5	Segment D	Segment D
6	Common Cathode	Common Cathode
7	Decimal Point DP	Decimal Point DP
8	Segment C	Segment C
9	Segment B	Segment B
10	Segment A	Segment A

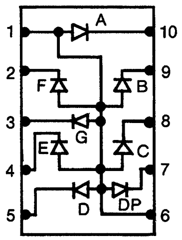


Pin	FND318C
1	Common Cathode
2	Plus Sign
3	Minus Sign
4	NC
5	Omitted
6	Common Cathode
7	Decimal Point DP
8	Segment C
9	Segment B
10	NC

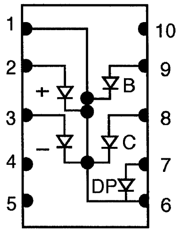
ELECTRICAL SCHEMATIC



FND317C



FND310C



FND318C

0.362 - INCH
7 - SEGMENT DISPLAY

TYPICAL ELECTRO - OPTICAL CHARACTERISTIC CURVES

(T_A=25°C Unless otherwise specified)

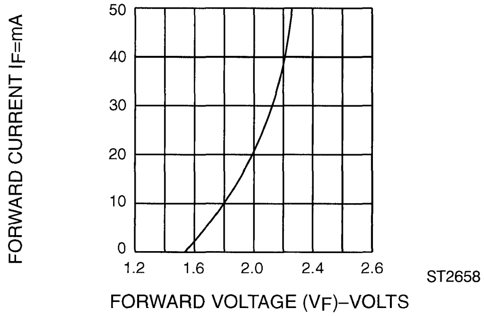


Fig. 1 Forward Current vs. Forward Voltage

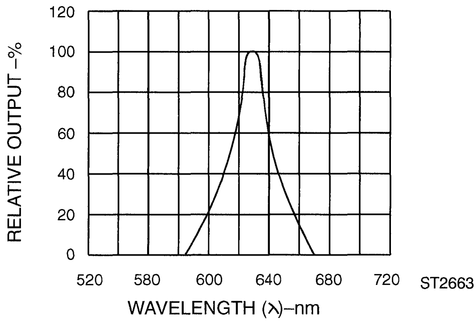


Fig 2. Spectral Response

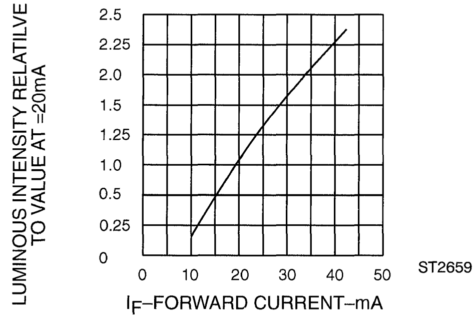


Fig. 3 Relative Luminous Intensity vs. Forward Current

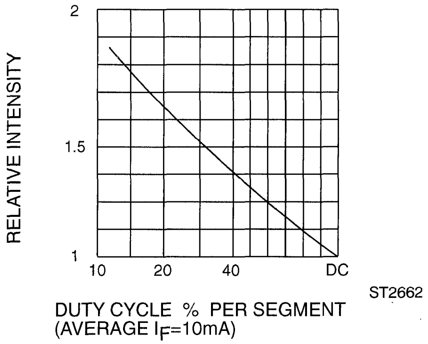


Fig. 5 Luminous Intensity vs. Duty Cycle

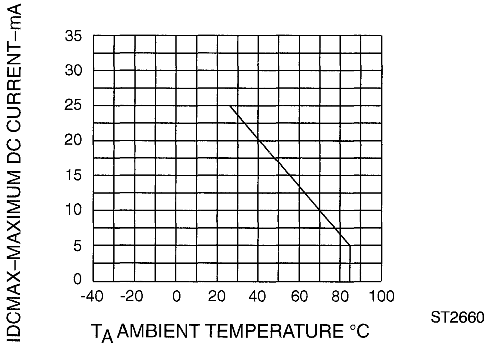


Fig. 4 Maximum Allowable DC Current Per Segment vs. a Function of Ambient Temperature

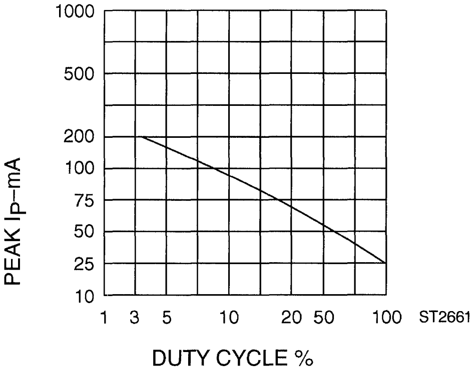


Fig. 6 Max Peak Current vs. Duty Cycle % (Refresh Rate f=1.KHz)

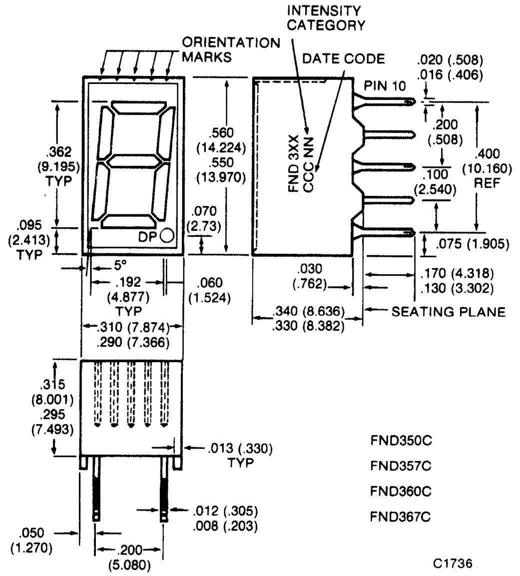
Clean the displays only in water, isopropanol, ethanol, freon TF or TE (or equivalent)

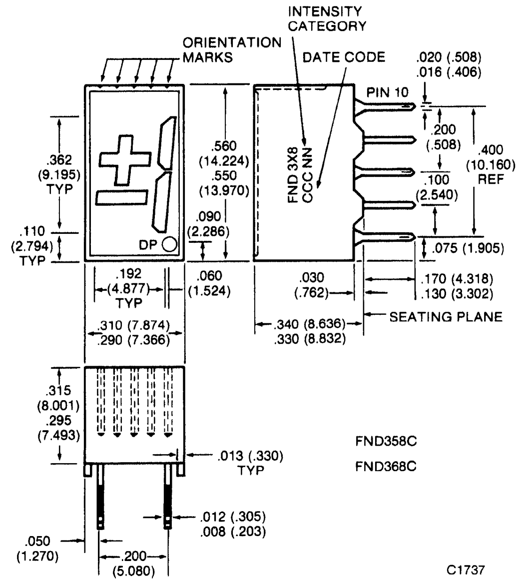
OPTOELECTRONICS

0.362-INCH
SEVEN SEGMENT DISPLAYS

RED FND350C FND357C FND358C
HI-BRITE RED FND360C FND367C FND368C

PACKAGE DIMENSIONS





NOTES:
1. ALL DIMENSIONS ARE IN MM (INCH)
2. TOLERANCES ARE ±0.010 INCH
   UNLESS OTHERWISE SPECIFIED

DESCRIPTION

The FND35XC are red GaAsP/GaAs displays and FND36XC are hi-brite GaP/GaP displays. Both series are of nominal size of 0.362″ in digit height and are of right hand decimal configuration.

FEATURES

- Exactly pin and package compatible with FND3XX.
- Compact—10 digits in 3 inch panel width
- Right hand decimal configuration
- Wide viewing angle
- Categorized for luminous intensity
- Rugged encapsulated plastic construction

MODEL NUMBERS

PART NUMBER	COLOR	DESCRIPTION
FND350C	Red	Common anode seven segment display
FND357C	Red	Common cathode seven segment display
FND358C	Red	Common cathode ±1 overflow display
FND360C	Hi-brite Red	Common anode seven segment display
FND367C	Hi-brite Red	Common cathode seven segment display
FND368C	Hi-brite Red	Common cathode ±1 overflow display

FND350C FND357C FND358C FND360C FND367C FND368C

QT OPTOELECTRONICS

0.362-INCH SEVEN SEGMENT DISPLAYS

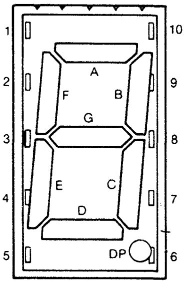
ABSOLUTE MAXIMUM RATINGS

	FND350C FND357C	FND358C	FND360C FND367C	FND368C
Power dissipation at 25°C ambient	400 mW	250 mW	320 mW	200mW
Continuous forward current Total	200 mA	125 mA	200 mA	125 mA
Per segment or decimal point	25 mA	25 mA	25 mA	25 mA
Reverse voltage Per segment or decimal point	6 V	6 V	6 V	6 V
Storage and operating temperature	−25° to +85°C			
Soldering time at 250°C (1/16 inch from the seating plane)	3 sec			

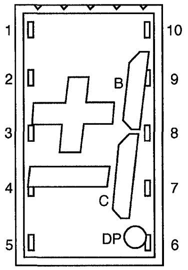
ELECTRO-OPTICAL CHARACTERISTICS (T_A=25°C Unless Otherwise Specified)

Parameter	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS
Forward voltage - V (per doide)					
FND35XC		1.7	2.0	V	I_F=20 mA
FND36XC		2.1	2.6	V	I_F=20 mA
Luminous intensity - Iv					
FND35XC	240	450		ucd	I_F=20 mA
FND36XC	240	450		ucd	I_F=20 mA
Peak wavelength					
FND35XC		655		nm	I_F=20 mA
FND36XC		655		nm	I_F**20 mA**
Reverse voltage - V_R	5			V	I_R=100 μA
Capacitance - C (per diode)		23		pF	V=0, F=1 MHz

PIN CONNECTIONS

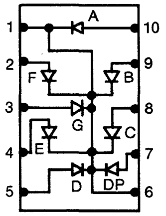


Pin	FND357C FND367C	FND350C FND360C
1	Common Cathode	Common Anode
2	Segment F	Segment F
3	Segment G	Segment G
4	Segment E	Segment E
5	Segment D	Segment D
6	Common Cathode	Common Anode
7	Decimal Point DP	Decimal Point DP
8	Segment C	Segment C
9	Segment B	Segment B
10	Segment A	Segment A

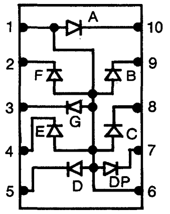


Pin	FND358C FND368C
1	Common Cathode
2	Plus Sign
3	Minus Sign
4	NC
5	Omitted
6	Common Cathode
7	Decimal Point DP
8	Segment C
9	Segment B
10	NC

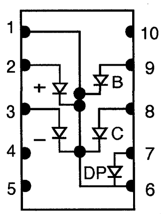
ELECTRICAL SCHEMATIC



FND357C
FND367C



FND350C
FND360C



FND358C
FND368C

0.362 - INCH
SEVEN SEGMENT DISPLAY

TYPICAL ELECTRO - OPTICAL CHARACTERISTIC CURVES

(T_A=25°C Unless Otherwise Specified)

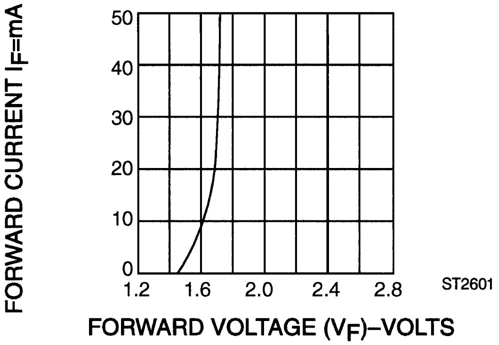


Fig. 1 Forward Current vs. Forward Voltage

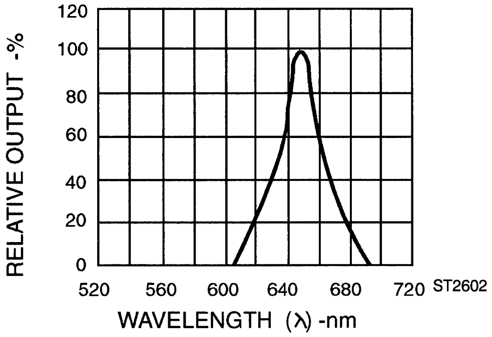


Fig 2. Spectral Response

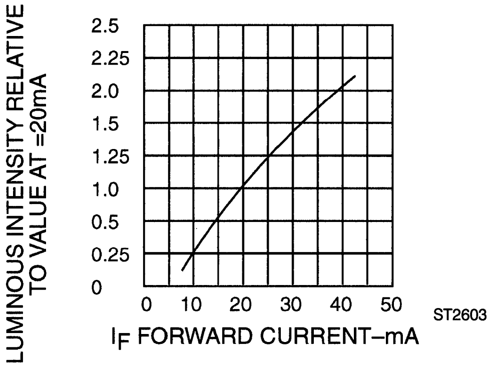


Fig. 3 Relative Luminous Intensity vs. Forward Current

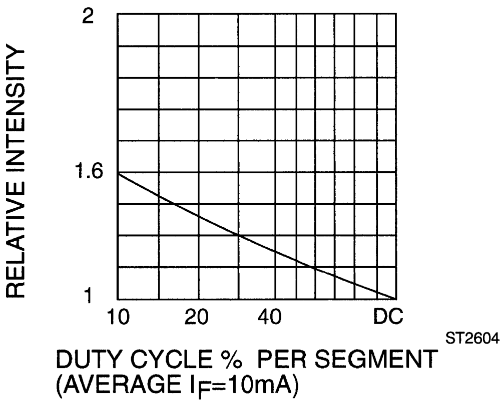


Fig. 5 Luminous Intensity vs. Duty Cycle

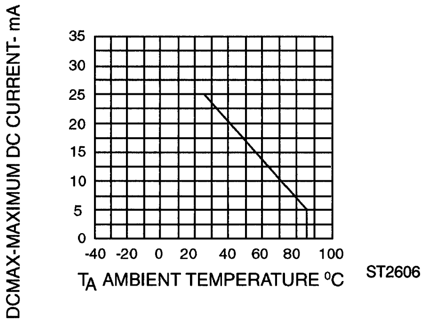


Fig. 4 Maximum Allowable DC Current Per Segment vs. A Function Of Ambient Temperature

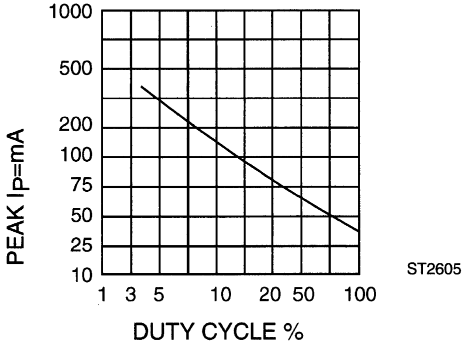


Fig. 6 Max Peak Current vs. Duty Cycle % (Refresh Rate f=1 KHz)

Clean the displays only in water, isopropanol, ethanol, freon TF or TE (or equivalent)

TYPICAL ELECTRO - OPTICAL CHARACTERISTIC CURVES

(T_A=25°C Unless otherwise specified)

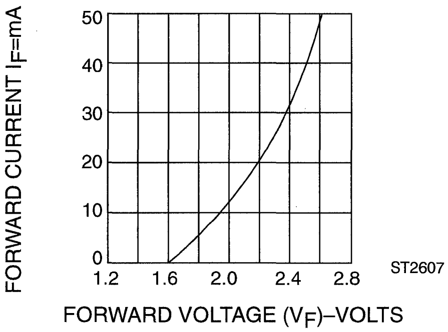


Fig. 1 Forward Current vs. Forward Voltage

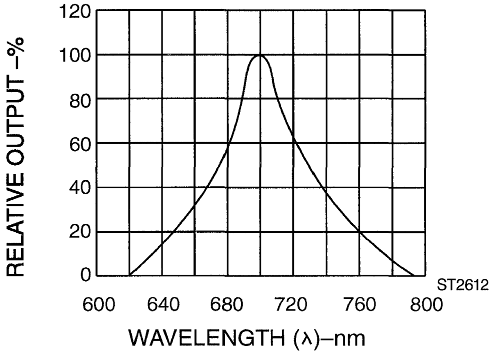


Fig 2. Spectral Response

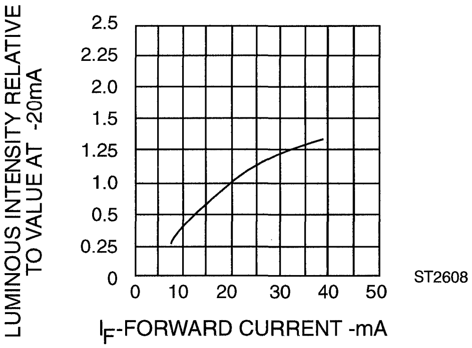


Fig. 3 Relative Luminous Intensity vs. Forward Current

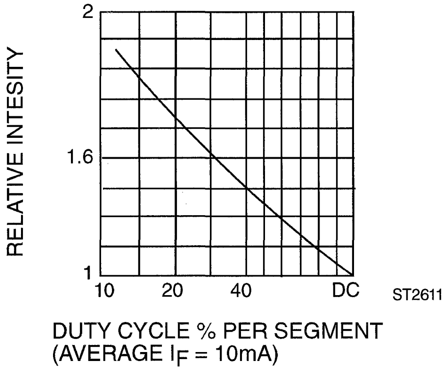


Fig. 5 Luminous Intensity vs.Duty Cycle

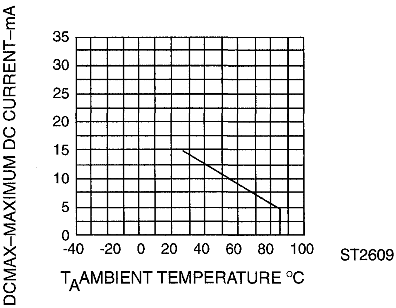


Fig. 4 Maximum Allowable DC Current Per Segment vs. A Function Of Ambient Temperature

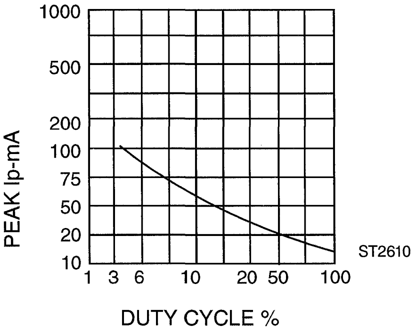
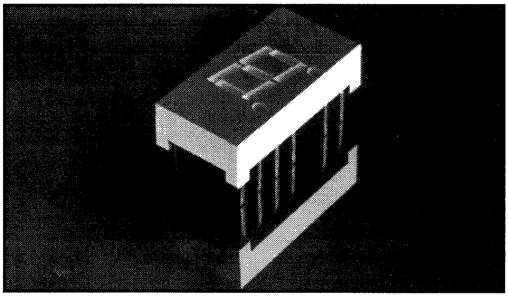


Fig. 6 Max Peak Current vs. Duty Cycle % (Refresh Rate f=1 KHz)

Clean the displays only in water, isopropanol, ethanol, freon TF or TE (or equivalent)

0.400-INCH
SEVEN SEGMENT DISPLAYS

HIGH EFFICIENCY GREEN MAN4400A SERIES
ORANGE MAN4600A SERIES
RED MAN4700A SERIES



DESCRIPTION

The MAN4400, MAN4600, MAN4700 and MAN4800 Series provides superior brightness in a choice of color LED displays. Standard units are available in Red, Green, and Orange. They can be mounted in arrays with 0.400-inch (10.16 mm) center-to-center spacing. The Green displays are constructed with Grey face and neutral segment color. Red displays have Black faces and Red segment color. Others have face and segment color corresponding to the emitted light.

FEATURES

- Common anode or common cathode models
- Red, Green and Orange
- Fast switching—excellent for multiplexing
- Low power consumption
- Bold solid segments that are highly legible
- Solid state reliability—long operation life
- Impact resistant plastic construction
- Directly compatible with integrated circuits
- High brightness with high contrast
- Categorized for Luminous Intensity (See Note 6)
- Standard 14 pin dual-in-line package configuration
- Wide angle viewing . . . 150°
- Package size and lead configuration is the same as MAN50A/3600A/70A/80A Series

APPLICATIONS

For industrial and consumer applications such as:

- Digital readout displays
- Instrument panels
- Point of sale equipment
- Calculators
- Digital clocks
- High ambient light conditions

MODEL NUMBERS

PART NUMBER	COLOR	DESCRIPTION	PACKAGE DRAWING	PIN OUT SPECIFICATION
MAN4410A	Green	Common Anode; Right Hand Decimal	A	A
MAN4440A	Green	Common Cathode; Right Hand Decimal	A	C
MAN4610A	Orange	Common Anode; Right Hand Decimal	A	A
MAN4630A	Orange	Common Anode; Overflow ±1; Right Hand Decimal	B	B
MAN4640A	Orange	Common Cathode; Right Hand Decimal	A	C
MAN4705A	Red	Universal (CA or CC) Overflow ±1; Right Hand Decimal	B	D
MAN4710A	Red	Common Anode; Right Hand Decimal	A	A
MAN4740A	Red	Common Cathode; Right Hand Decimal	A	C

0.400-INCH
SEVEN SEGMENT DISPLAYS

RECOMMENDED OPTICAL FILTER

For optimum ON and OFF contrast, one of the following filters or equivalents should be used over the display:

DEVICE TYPE	FILTER	DEVICE TYPE	FILTER
MAN4410A MAN4440A	Panelgraphic Green 48	MAN4705A MAN4710A MAN4740A	Panelgraphic Red 60 Homalite 100-1605
MAN4610A MAN4630A MAN4640A	Panelgraphic Scarlet 65 Homalite 100-1670		

NOTE: When using the Grey face MAN4480 or MAN4880 in situations of high ambient light, a neutral density filter can be used to achieve a greater contrast. The following or equivalent can be used: Panelgraphic Grey 10.

ELECTRO-OPTICAL CHARACTERISTICS

(25°C Free Air Temperature Unless Otherwise Specified)

	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS
MAN4410A/4440A					
Luminous Intensity, digit average (See Note 1 and 3)	750	3200		µcd	I_F=10 mA
Peak emission wavelength		562		nm	
Forward voltage					
Segment		2.2	3.0	V	I_F=20 mA
Decimal point		2.2	3.0	V	I_F=20 mA
Dynamic resistance					
Segment		12		Ω	I_F=20 mA
Decimal point		12		Ω	I_F=20 mA
Capacitance					
Segment		40		pF	V=0
Decimal point		40		pF	V=0
Reverse current					
Segment			100	µA	V_R=5.0 V
Decimal point			100	µA	V_R=5.0 V
MAN4610A/4630A/4640A					
Luminous Intensity, digit average (See Note 1 and 3)	510	1800		µcd	I_F=10 mA
Peak emission wavelength		630		nm	
Forward voltage					
Segment		2.2	2.5	V	I_F=20 mA
Decimal point		2.2	2.5	V	I_F=20 mA
Dynamic resistance					
Segment		26		Ω	I_F=20 mA
Decimal point		26		Ω	I_F=20 mA
Capacitance					
Segment		35		pF	V=0
Decimal point		35		pF	V=0
Reverse current					
Segment			100	µA	V_R=5.0 V
Decimal point			100	µA	V_R=5.0 V

OPTOELECTRONICS

0.400-INCH
SEVEN SEGMENT DISPLAYS

ELECTRO-OPTICAL CHARACTERISTICS
(25°C Free Air Temperature Unless Otherwise Specified)

	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS
MAN4705A/4710A/4740A					
Luminous Intensity, digit average (See Note 1 and 3)	125	350		μcd	I_F=10 mA
Peak emission wavelength		660		nm	
Forward voltage					
Segment		1.6	2.0	V	I_F=20 mA
Decimal point		1.6	2.0	V	I_F=20 mA
Dynamic resistance					
Segment		2		Ω	I_F=20 mA
Decimal point		2		Ω	I_F=20 mA
Capacitance					
Segment		35	80	pF	V=0
Decimal point		35	80	pF	V=0
Reverse current					
Segment			100	μA	V_R=5.0 V
Decimal point			100	μA	V_R=5.0 V

ABSOLUTE MAXIMUM RATINGS

	MAN4410A MAN4440A	MAN4705A	MAN4710A MAN4740A
Power dissipation at 25°C ambient	600 mW	360 mW	480 mW
Derate linearly from 50°C	−12 mW/°C	−5.2 mW/°C	−6.9 mW/°C
Storage and operating temperature	−40°C to +85°C	−40°C to +85°C	−40°C to +85°C
Continuous forward current			
Total	240 mA	180 mA	240 mA
Per segment	30 mA	30 mA	30 mA
Decimal point	30 mA	30 mA	30 mA
Reverse voltage			
Per segment	6.0 V	6.0 V	6.0 V
Decimal point	6.0 V	6.0 V	6.0 V
Soldering time at 260°C (See Notes 4 and 5)	5 sec.	5 sec.	5 sec.

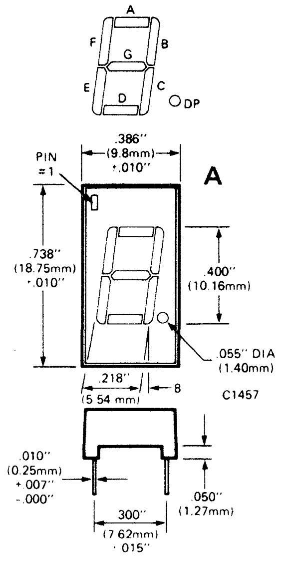
	MAN4630A	MAN4610A MAN4640A
Power dissipation at 25°C ambient	450 mW	600 mW
Derate linearly from 50°C	−6.4 mW/°C	−8.6 mW/°C
Storage and operating temperature	−40°C to +85°C	−40°C to +85°C
Continuous forward current		
Total	180 mA	240 mA
Per segment	30 mA	30 mA
Decimal point	30 mA	30 mA
Reverse voltage		
Per segment	6.0 V	6.0 V
Decimal point	6.0 V	6.0 V
Soldering time at 260°C (See Notes 4 and 5)	5 sec.	5 sec.

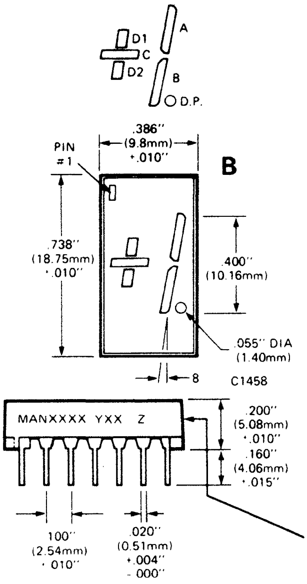
TYPICAL THERMAL CHARACTERISTICS

GREEN/YELLOW	
Thermal resistance junction to free air Φ_{JA}	160°C/W
Wavelength temperature coefficient (case temperature)	1.0 Å/°C
Forward voltage temperature coefficient	−1.5 mV/°C
RED/ORANGE	
Thermal resistance junction to free air Φ_{JA}	160°C/W
Wavelength temperature coefficient (case temperature)	1.0 Å/°C
Forward voltage temperature coefficient	−2.0 mV/°C

0.400-INCH SEVEN SEGMENT DISPLAYS

PACKAGE DIMENSIONS





LEADS ARE TIN/LEAD
SOLDER DIPPED

TOLERANCE .015" (.381mm)

PART NO. CODE:
MANXXXX = PART NO.
YXX = DATE CODE
Z = LIGHT INTENSITY
CAT NO.

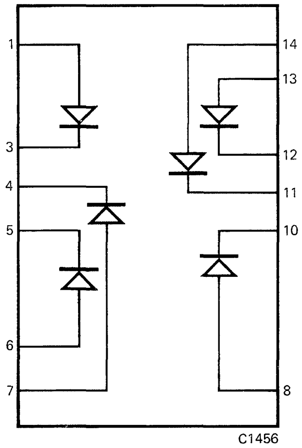
NOTES

1. *The digit average Luminous Intensity is obtained by summing the Luminous Intensity of each segment and dividing by the total number of segments. Intensity will not vary more than ±33.3% between all segments within a digit.*
2. *The curve in Figures 3, 6, 9, and 12 is normalized to the brightness at 25°C to indicate the relative Luminous Intensity over the operating temperature range.*
3. *The decimal point is designed to have the same surface brightness as the segments, therefore, the Luminous Intensity of the decimal point is .3 times the Luminous Intensity of the segments, since the area of the decimal point is .3 times the area of the average segment.*
4. *Leads of the device immersed to 1/16 inch from the body. Maximum device surface temperature is 140°C.*
5. *For flux removal, Freon TF, Freon TE, Isoproponal or water may be used up to their boiling points.*
6. *All displays are categorized for Luminous Intensity. The Intensity category is marked on each part as a suffix letter to the part number.*

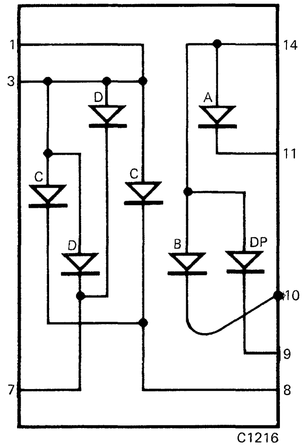
ELECTRICAL CONNECTIONS

PIN NO.	ELECTRICAL CONNECTIONS			
	A MAN4410A/4610A/4710A	B MAN4630A	C MAN4440A/4640A/4740A	D MAN4705A
1	Cathode A	Anode C, D	Anode F	Anode D1
2	Cathode F	No Pin	Anode G	No Pin
3	Common Anode	Anode C, D	No Pin	Cathode D1
4	No Pin	No Pin	Common Cathode	Cathode C
5	No Pin	No Pin	No Pin	Cathode D2
6	No Pin	No Connection	Anode E	Anode D2
7	Cathode E	Cathode D	Anode D	Anode C
8	Cathode D	Cathode C	Anode C	Anode D.P.
9	Cathode D.P.	Cathode D.P.	Anode D.P.	No Pin
10	Cathode C	Cathode B	No Pin	Cathode D.P.
11	Cathode G	Cathode A	No Connection	Cathode B
12	No Pin	No Pin	Common Cathode	Cathode A
13	Cathode B	No Pin	Anode B	Anode A
14	Common Anode	Anode A, B, & D.P.	Anode A	Anode B

ELECTRICAL SCHEMATIC



MAN4705A



MAN4630A

TYPICAL CHARACTERISTIC CURVES

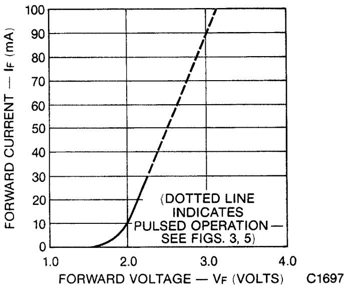


Fig. 1. Forward Current vs. Forward Voltage

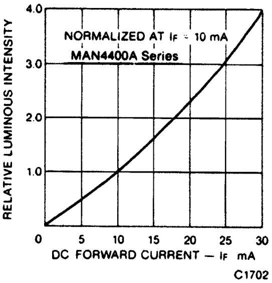


Fig. 2. Luminous Intensity vs. Forward Current

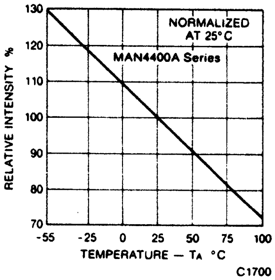


Fig. 3. Relative Luminous Intensity vs. Temperature

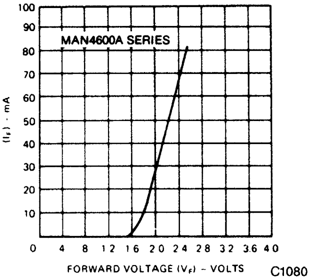


Fig. 4. Forward Current vs. Forward Voltage

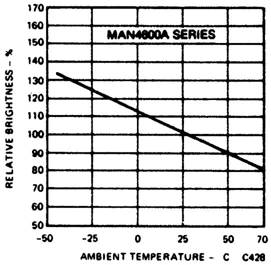


Fig. 5. Relative Luminous Intensity vs. Temperature

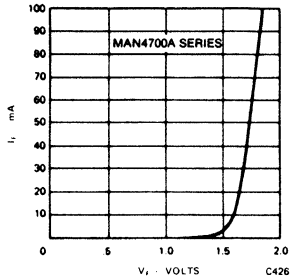


Fig. 6. Forward Current vs. Forward Voltage

TYPICAL CHARACTERISTIC CURVES (Cont'd)

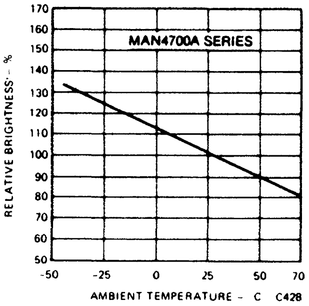


Fig. 7. Relative Luminous Intensity vs. Temperature

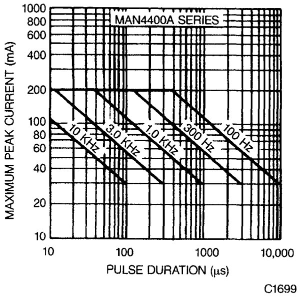


Fig. 8. Max Peak Current vs. Duty Cycle

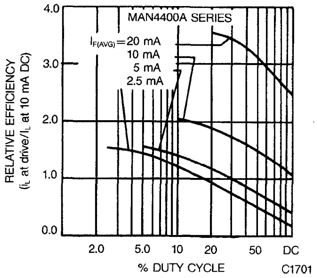


Fig. 9. Relative Luminous Intensity vs. Duty Cycle

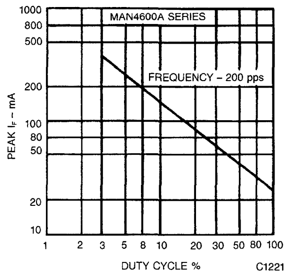


Fig. 10. Max Peak Current vs. Duty Cycle

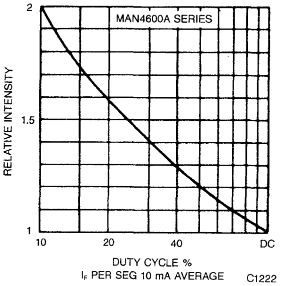


Fig. 11. Relative Luminous Intensity vs. Duty Cycle

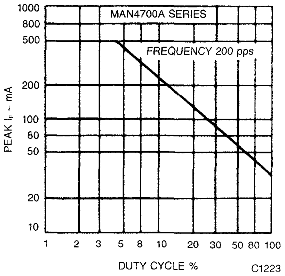


Fig. 12. Max Peak Current vs. Duty Cycle

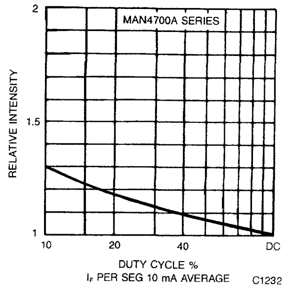


Fig. 13. Relative Luminous Intensity vs. Duty Cycle

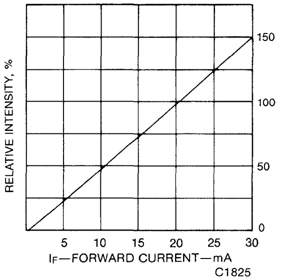
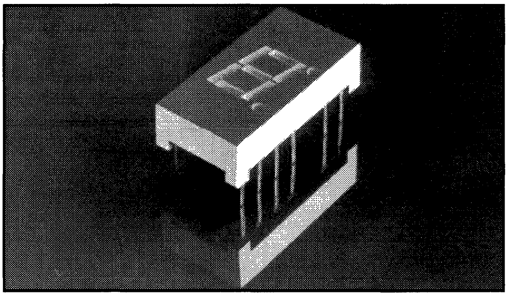


Fig. 14. Relative Luminous Intensity vs. Forward Current

0.400-INCH
SEVEN SEGMENT DISPLAYS

HIGH EFFICIENCY RED **MAN4900A SERIES**



DESCRIPTION

The MAN4900A Series provides superior brightness High Efficiency Red LED display. Standard units are also available in Red, Green, and Orange. They can be mounted in arrays with 0.400-inch (10.16 mm) center-to-center spacing. Units are constructed with Red face and segment color.

FEATURES

- Common anode or common cathode models
- High Efficiency Red
- Fast switching—excellent for multiplexing
- Low power consumption
- Bold solid segments that are highly legible
- Solid state reliability—long operation life
- Impact resistant plastic construction
- Directly compatible with integrated circuits
- High brightness with high contrast
- Categorized for Luminous Intensity (See Note 6)
- Standard dual-in-line package configuration
- Wide angle viewing . . . 150°
- Package size and lead configuration is the same as MAN3600A/70A Series
- These devices have a Red face and Red segments

APPLICATIONS

For industrial and consumer applications such as:

- Digital readout displays
- Instrument panels
- Point of sale equipment
- Calculators
- Digital clocks
- High ambient light conditions

MODEL NUMBERS

PART NUMBER	COLOR	DESCRIPTION	PACKAGE DRAWING	PIN OUT SPECIFICATION
MAN4910A	High Efficiency Red	Common Anode; Right Hand Decimal	A	A
MAN4940A	High Efficiency Red	Common Cathode; Right Hand Decimal	A	B

RECOMMENDED OPTICAL FILTERS

For optimum ON and OFF contrast, one of the following filters or equivalents should be used over the display:

DEVICE TYPE	FILTER
MAN4910A	Panelgraphic Scarlet 65
MAN4940A	Homalite 100-1670

0.400-INCH
SEVEN SEGMENT DISPLAYS

ELECTRO-OPTICAL CHARACTERISTICS

(25°C Free Air Temperature Unless Otherwise Specified)

	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS
MAN4910A/4940A					
Luminous Intensity, digit average (See Note 1 and 3)	450	1900		μcd	I_F=10 mA
Peak emission wavelength		635		nm	
Forward voltage					
Segment		2.2	2.5	V	I_F=20 mA
Decimal point		2.2	2.5	V	I_F=20 mA
Dynamic resistance					
Segment		26		Ω	I_F=20 mA
Decimal point		26		Ω	I_F=20 mA
Capacitance					
Segment		35		pF	V=0
Decimal point		35		pF	V=0
Reverse current					
Segment			100	μA	V_R=5.0 V
Decimal point			100	μA	V_R=5.0 V

ABSOLUTE MAXIMUM RATINGS

Power dissipation at 25°C ambient	600 mW
Derate linearly from 50°C	−8.6 mW/°C
Storage and operating temperature	−40°C to +85°C
Continuous forward current	
Total	240 mA
Per segment	30 mA
Decimal point	30 mA
Reverse voltage	
Per segment	6.0 V
Decimal point	6.0 V
Soldering time at 260°C (See Notes 4 and 5)	5 sec.

TYPICAL THERMAL CHARACTERISTICS

Thermal resistance junction to free air Φ_{JA}	160°C/W
Wavelength temperature coefficient (case temperature)	1.0 Å/°C
Forward voltage temperature coefficient	−2.0 mV/°C

NOTES

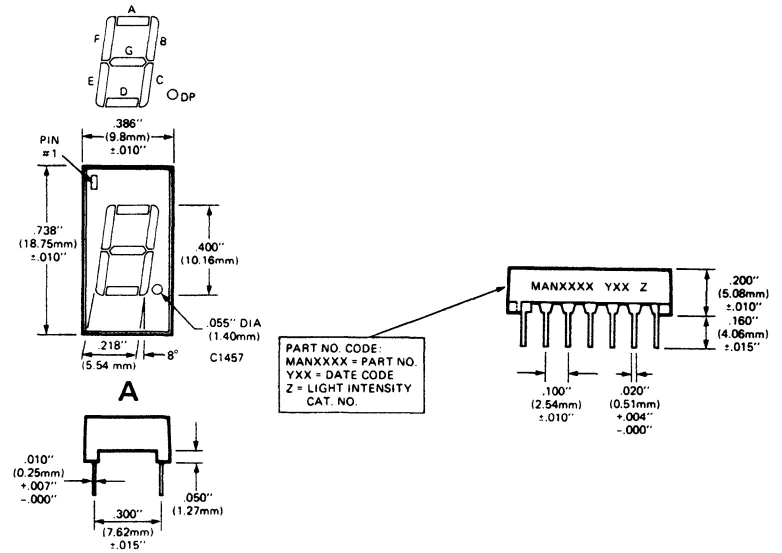
1. *The digit average Luminous Intensity is obtained by summing the Luminous Intensity of each segment and dividing by the total number of segments. Intensity will not vary more than ±33.3% between all segments within a digit.*
2. *The curve in Figure 3 is normalized to the brightness at 25°C to indicate the relative Luminous Intensity over the operating temperature range.*
3. *The decimal point is designed to have the same surface brightness as the segments, therefore, the Luminous Intensity of the decimal point is .3 times the Luminous Intensity of the segments, since the area of the decimal point is .3 times the area of the average segment.*
4. *Leads of the device immersed to 1/16 inch from the body. Maximum device surface temperature is 140°C.*
5. *For flux removal, Freon TF, Freon TE, Isoproponal or water may be used up to their boiling points.*
6. *All displays are categorized for Luminous Intensity. The Intensity category is marked on each part as a suffix letter to the part number.*

0.400-INCH
SEVEN SEGMENT DISPLAYS

PACKAGE DIMENSIONS

LEADS ARE TIN/LEAD SOLDER DIPPED

TOLERANCE: .015" (.381mm)



ELECTRICAL CONNECTIONS

PIN NO.	ELECTRICAL CONNECTIONS	
	A MAN4910A	B MAN4940A
1	Cathode A	Anode F
2	Cathode F	Anode G
3	Common Anode	No Pin
4	No Pin	Common Cathode
5	No Pin	No Pin
6	No Connection	Anode E
7	Cathode E	Anode D
8	Cathode D	Anode C
9	Cathode D.P.	Anode D.P.
10	Cathode C	No Pin
11	Cathode G	No Connection
12	No Pin	Common Cathode
13	Cathode B	Anode B
14	Common Anode	Anode A

TYPICAL CHARACTERISTIC CURVES

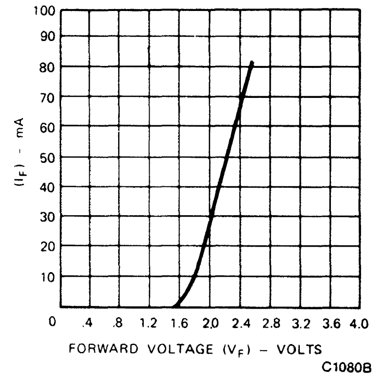


*Fig. 1. Forward Current vs.
Forward Voltage*

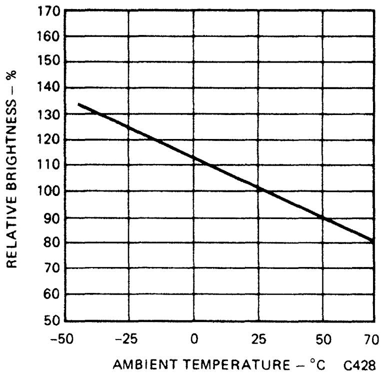


*Fig. 2. Relative Luminous Intensity vs.
Temperature*

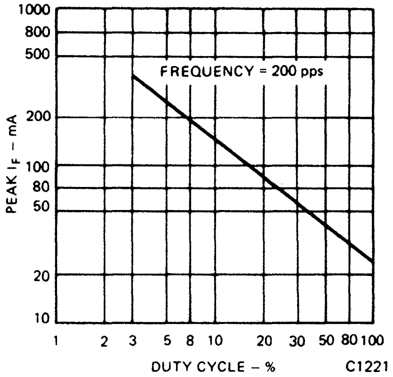


*Fig. 3. Max Peak Current vs.
Duty Cycle*

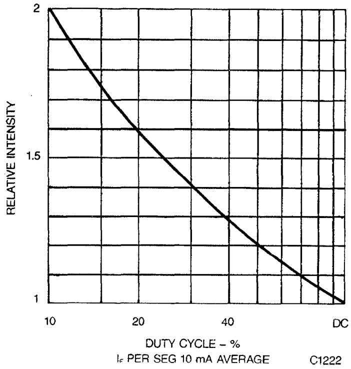


*Fig. 4. Luminous Intensity vs.
Duty Cycle*

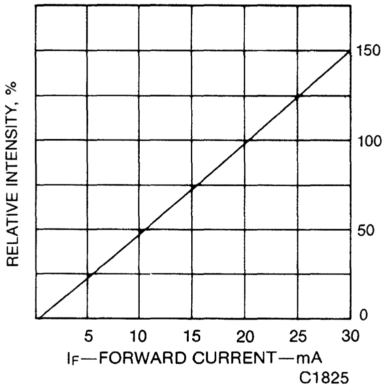
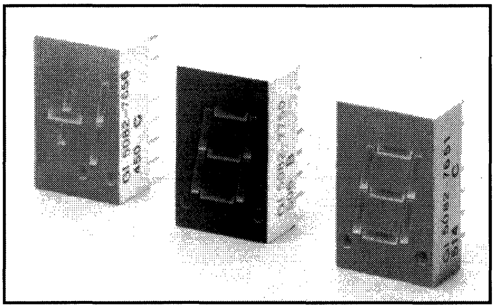


*Fig. 5. Relative Luminous Intensity vs.
Forward Current*

QT
OPTOELECTRONICS

0.43-INCH SEVEN SEGMENT DISPLAYS

HIGH EFFICIENCY RED 5082-7650 SERIES
RED 5082-7700 SERIES



FEATURES

- Industry-standard 0.43-inch displays
- High Efficiency Red and standard Red models
- Left or right decimal versions
- Common anode or common cathode
- Solid state reliability — long operating life
- Impact-resistant plastic construction
- Standard 14 pin DIP configuration
- Categorized for Luminous Intensity
- Wide viewing angle...150°
- Directly compatible with integrated circuits

DESCRIPTION

The 5082-7650 and 5082-7700 Series are families of High Efficiency Red and Red seven segment LED displays with 0.43-inch digit height. For maximum ON/OFF contrast, 5082-7650 Series displays have Red face and Red segment color. 5082-7700 Series have Black face and Red segment color.

APPLICATIONS

- Instrumentation
- Point of sale terminals
- Appliances
- Digital clocks
- Industrial control equipment

MODEL NUMBERS

PART NO.	COLOR	DESCRIPTION
5082-7650	High Efficiency Red	Common Anode; Left Hand Decimal
5082-7651	High Efficiency Red	Common Anode; Right Hand Decimal
5082-7653	High Efficiency Red	Common Cathode; Right Hand Decimal
5082-7656	High Efficiency Red	Universal Overflow ±1; Right Hand Decimal
5082-7750	Red	Common Anode; Left Hand Decimal
5082-7751	Red	Common Anode; Right Hand Decimal
5082-7756	Red	Universal Overflow ±1; Right Hand Decimal
5082-7760	Red	Common Cathode; Right Hand Decimal

RECOMMENDED OPTICAL FILTER

5082-7650 SERIES	5082-7750 SERIES
Panelgraphic Scarlet 65	Panelgraphic Red 60
Homalite 100-1670	Homalite 100-1605
Panelgraphic Gray 10	
Homalite 100-126	

0.43-INCH
SEVEN SEGMENT DISPLAYS

ELECTRO-OPTICAL CHARACTERISTICS
(Per Diode at 25°C Free Air Temperature Unless Otherwise Specified)

PARAMETER	SYMBOL	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS
5082-7650 SERIES						
Luminous Intensity	I_L	340	840		µcd	I_F=5 mA DC
(Digit average, seven segments Notes 1, 2)			3500 1765		µcd µcd	I_F=20 mA DC I_F=60 mA pk, 1:6 DF
Peak emission wavelength	λ_p		630		nm	
Spectral line halfwidth	$\Delta\lambda\frac{1}{2}$		40		nm	
Forward voltage	V_F		2.0	2.5	V	I_F=20 mA DC
Dynamic resistance	R_d		26		Ω	$I_{FTH,}$ V_{FTH}
Capacitance	C		35		pf	V_F=0
Reverse current	I_R			100	µA	V_R=3.0 V
Ratio I_L (max. I_L/min. I_L)	r			2.0:1		I_F=20 mA DC
5082-7750 SERIES						
Luminous Intensity	I_L	320	980		µcd	I_F=20 mA
(Digit average, seven segments Notes 1, 2)			610		µcd	I_F=100 mA Pk 1:10 DF
Peak emission wavelength	λ_p		650		nm	
Spectral line halfwidth	$\Delta\lambda\frac{1}{2}$		20		nm	
Forward voltage	V_F		1.6	2.0	V	I_F=20 mA
Dynamic resistance	R_d		2.0		Ω	$I_{FTH,}$ V_{FTH}
Capacitance	C		35		pf	V_F=0
Reverse current	I_R			100	µA	V_R=5.0 V
Ratio I_L (max. I_L/min. I_L)	r			2.0:1		I_F=20 mA

ABSOLUTE MAXIMUM RATINGS

	HIGH EFFICIENCY RED		RED	
	5082-7650 5082-7651 5082-7653	5082-7656	5082-7750 5082-7751 5082-7760	5082-7756
Power dissipation at 50°C ambient	840 mW	630 mW	520 mW	390 mW
Derate linearly from 50°C	−16 mW/C°	−12 mW/C°	−6.9 mW/C°	−5.2 mW/C°
Storage and operating temperature	−40°C to +85°C		−40°C to +85°C	
Continuous forward current				
Total	240 mA	180 mA	200 mA	150 mA
Per segment or decimal point	30 mA	30 mA	25 mA	25 mA
Reverse voltage				
Per segment or decimal point	3 V	3 V	3 V	3 V
Soldering time at 260°C (See Notes 4 and 5.)	3 sec.	3 sec.	3 sec.	3 sec.

NOTES

1. *The digit average Luminous Intensity is obtained by summing the Luminous Intensity of each segment and dividing by the total number of segments excluding decimal points. Intensity will not vary more than ±33.3% between all segments within a digit.*
2. *All displays are categorized for Luminous Intensity. The Intensity category is marked on each part as a suffix letter to the part number.*
3. *Intensity adjusted for smaller areas of the "+" and decimal points.*
4. *Leads immersed to 1/16 inch from the body of the device. Maximum unit surface temperature is 140°C.*
5. *For flux removal, use Freon TF, Freon TE, Isoproponal, or water up to their boiling points.*

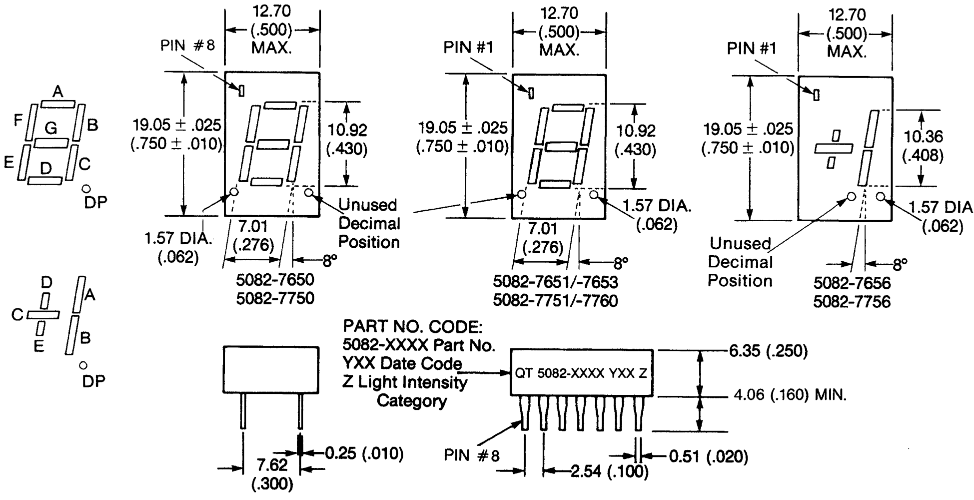
QT
OPTOELECTRONICS

0.43-INCH SEVEN SEGMENT DISPLAYS

TYPICAL THERMAL CHARACTERISTICS

	5082-765X	5082-775X	SYMBOL	TEST CONDITIONS
Thermal resistance junction to ambient	280°C/W	280°C/W	θ_{JA}	
Wavelength temperature coefficient (case temp.)	0.1 nm/°C	0.3 nm/°C	$\Delta\lambda/\lambda T$	I_F=20 mA
Forward voltage temperature coefficient	−2.2 mV/°C	−1.6 mV/°C	$\Delta V_F/\Delta T$	I_F=2 mA

PACKAGE DIMENSIONS



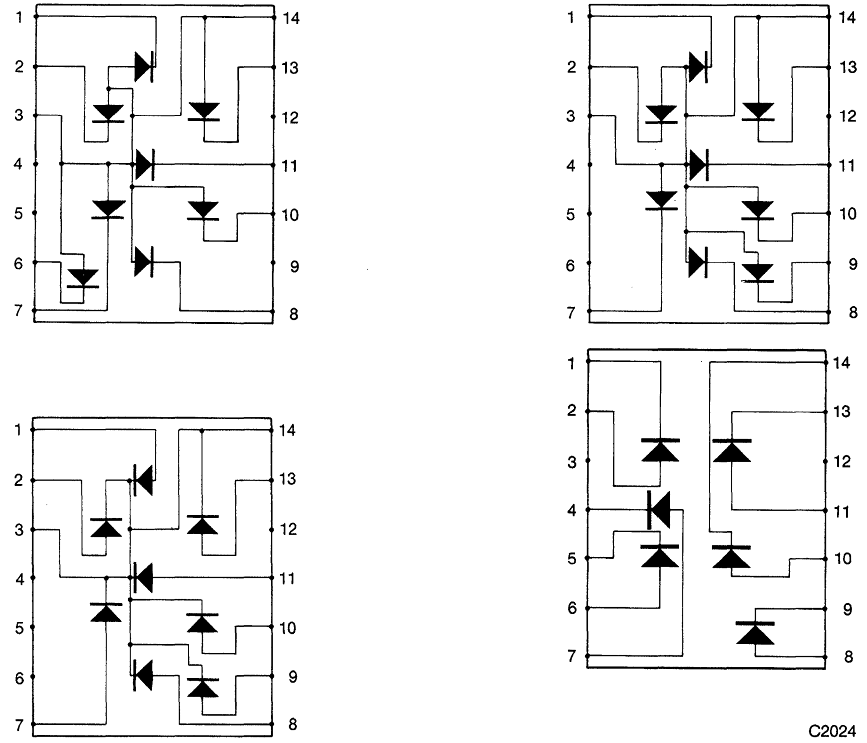
NOTE: DIMENSIONS IN MILLIMETERS (INCHES).
TOLERANCES ± 0.25 (± 0.010) UNLESS
OTHERWISE INDICATED.

C2023

CONNECTIONS

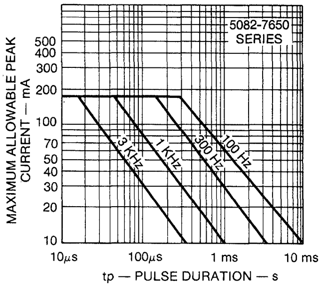
PIN NO.	ELECTRICAL CONNECTIONS			
	A	B	C	D
	5082-7650/-7750	5082-7651/-7751	5082-7653/-7760	5082-7656/-7756
1	Cathode A	Cathode A	Anode A	Cathode D
2	Cathode F	Cathode F	Anode F	Anode D
3	Common Anode	Common Anode	Common Cathode	No Pin
4	No Pin	No Pin	No Pin	Cathode C
5	No Pin	No Pin	No Pin	Cathode E
6	Cathode D.P.	No Connection	No Connection	Anode E
7	Cathode E	Cathode E	Anode E	Anode C
8	Cathode D	Cathode D	Anode D	Anode D.P.
9	No Connection	Cathode D.P.	Anode D.P.	Cathode D.P.
10	Cathode C	Cathode C	Anode C	Cathode B
11	Cathode G	Cathode G	Anode G	Cathode A
12	No Pin	No Pin	No Pin	No Pin
13	Cathode B	Cathode B	Anode B	Anode A
14	Common Anode	Common Anode	Common Cathode	Anode B

ELECTRICAL SCHEMATIC



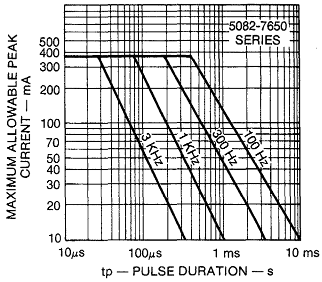
C2024

TYPICAL CURVES



C2017

Fig. 1. Maximum Tolerable Peak Current vs. Pulse Duration



C2018

Fig. 2. Maximum Tolerable Peak Current vs. Pulse Duration

TYPICAL CHARACTERISTIC CURVES (Cont'd)

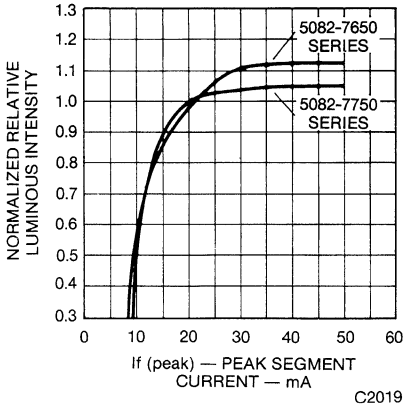


Fig. 3. Relative Efficiency (Average Luminous Intensity Per Unit Current) vs. Peak Current Per Segment

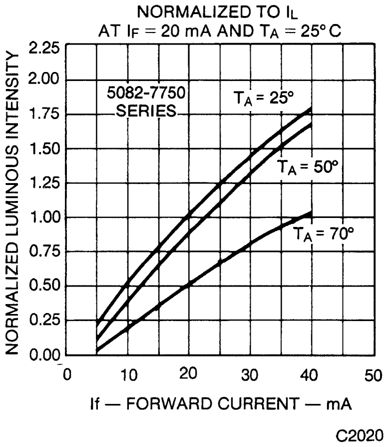


Fig. 4. Normalized Luminous Intensity vs. Forward Current Over Temperature

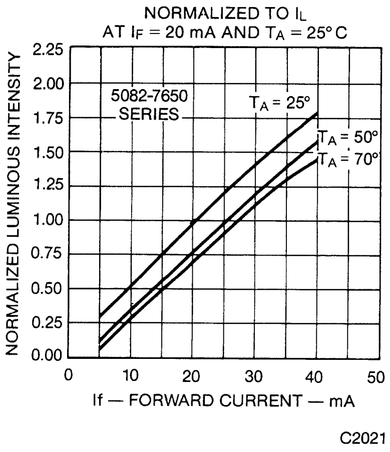


Fig. 5. Normalized Luminous Intensity vs. Forward Current Over Temperature

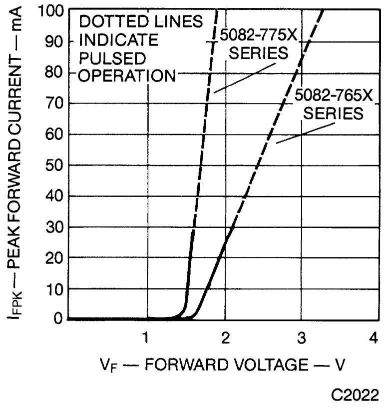
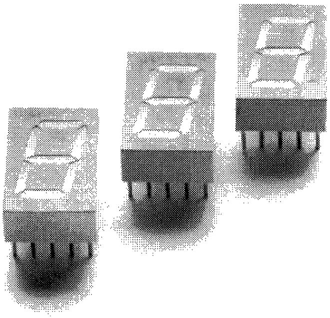


Fig. 6. Peak Forward Current vs. Forward Voltage

QT
OPTOELECTRONICS

0.510 INCH (13 MM) SEVEN SEGMENT DISPLAYS

YELLOW **MAN5350/5360** RED **MAN5750/5760**
GREEN **MAN5450/5460** ORANGE-RED **MAN5950/5960**



FEATURES

- Large, easy to read, digits
- Common anode or common cathode models
- Fast switching - excellent for multiplexing
- Low power consumption
- Bold solid segments that are highly legible
- Solid state reliability - long operation life
- Rugged plastic construction
- Directly compatible with integrated circuits
- High brightness with high contrast
- Categorized for luminous intensity (see Note 5)
- Wide angle viewing . . . 150°
- Low forward voltage
- Untinted segments on grey face

DESCRIPTION

This display series is a family of large digits 0.510 inches in height. All models have right hand decimal points and are available in common anode or common cathode configurations. All units are constructed with untinted segments on grey face to enhance ON/OFF contrast. Standard units are available in red, orange-red, green and yellow.

APPLICATIONS

For industrial and consumer applications such as:

- Digital readout displays
- Instrument panels
- Point of sale equipment
- Digital clocks
- TV and radios

MODEL NUMBERS

PART NUMBER	COLOR	DESCRIPTION	PIN OUT SPECIFICATION (See Page 5)
MAN5350	Yellow	Common Anode	A
MAN5360	Yellow	Common Cathode	B
MAN5450	Green	Common Anode	A
MAN5460	Green	Common Cathode	B
MAN5750	Red	Common Anode	A
MAN5760	Red	Common Cathode	B
MAN5950	Orange-Red	Common Anode	A
MAN5960	Orange-Red	Common Cathode	B

NOTE: These devices are exact equivalents to the TELEFUNKEN Part Numbers TDSR 5150/5160, TDSO 5150/5160, TDSY 5150/5160, TDSG 5150/5160.

0.510 INCH (13 MM)
SEVEN SEGMENT DISPLAYS

ELECTRO-OPTICAL CHARACTERISTICS (TA = 25° Unless Otherwise Specified)

	MIN.	TYP.	MAX.	UNITS	TEST CONDITION
YELLOW MAN5350/MAN5360					
Luminous Intensity, digit average (See Note 1)	820	1200 480		µcd µcd	I_F=10 mA I_F=5 mA
Peak emission wavelength		585		nm	I_F=10 mA
Dominant wavelength	582		593	nm	I_F=10 mA
Spectral line half width		40		nm	
Forward voltage		2.4	3.0	V	I_F=20 mA
Dynamic resistance		26			I_F=20 mA
Capacitance		35		pF	V_R=0, f=1MHz
Reverse current			10	µA	V_R=6.0 V
GREEN MAN5450/MAN5460					
Luminous Intensity, digit average (See Note 1)	820	3000 1000		µcd µcd	I_F=10 mA I_F=5 mA
Peak emission wavelength		562		nm	I_F=10 mA
Dominant wavelength	564		574	nm	I_F=10 mA
Spectral line half width		30		nm	
Forward voltage		2.4	3.0	V	I_F=20 mA
Dynamic resistance		12			I_F=20 mA
Capacitance		40		pF	V_R=0, f=1MHz
Reverse current			10	µA	V_R=6.0 V

0.510 INCH (13 MM)
SEVEN SEGMENT DISPLAYS

ELECTRO-OPTICAL CHARACTERISTICS (TA = 25° Unless Otherwise Specified)

	MIN.	TYP.	MAX.	UNITS	TEST CONDITION
RED **MAN5750/MAN5760**					
Luminous Intensity, digit average (See Note 1)	280	500 250		μcd μcd	I_F=10 mA I_F=5 mA
Peak emission wavelength		655		nm	I_F=10 mA
Dominant wavelength		645		nm	I_F=10 mA
Spectral line half width		20		nm	
Forward voltage		1.6	2.0	V	I_F=20 mA
Dynamic resistance		2			I_F=20 mA
Capacitance		35		pF	V_R=0, f=1MHz
Reverse current			10	μA	V_R=6.0 V
ORANGE-RED **MAN5950/MAN5960**					
Luminous Intensity, digit average (See Note 1)	820	2500 700		μcd μcd	I_F=10 mA I_F=5 mA
Peak emission wavelength		635		nm	I_F=10 mA
Dominant wavelength	615		630	nm	I_F=10 mA
Spectral line half width		40		nm	
Forward voltage		2.0	3.0	V	I_F=20 mA
Dynamic resistance		26			I_F=20 mA
Capacitance		35		pF	V_R=0, f=1MHz
Reverse current			10	μA	V_R=6.0 V

OPTOELECTRONICS

0.510 INCH (13 MM)
SEVEN SEGMENT DISPLAYS

ABSOLUTE MAXIMUM RATINGS

	MAN5350 **MAN5360**	**MAN5450** **MAN5460**	**MAN5750** **MAN5760**	**MAN5950** **MAN5960**
Power Dissipation at 25°C Ambient	600 mW	570 mW	480 mW	600 mW
Derate linearly from 50°C	−10.3 mW/°C	−12 mW/°C	−6.9 mW/°C	−8.6 mW/°C
Storage and operating temperature	−40°C to +85°C	−40°C to +85°C	−40°C to +85°C	−40°C to +85°C
Continuous forward current				
Total	200 mA	240 mA	240 mA	240 mA
Per segment	25 mA	30 mA	30 mA	30 mA
Decimal point	25 mA	30 mA	30 mA	30 mA
Reverse voltage				
Per segment	6.0 V	6.0 V	6.0 V	6.0 V
Decimal point	6.0 V	6.0 V	6.0 V	6.0 V
Soldering time at 260°C (See Notes 3 and 4)	5 sec.	5 sec.	5 sec.	5 sec.

NOTES

1. *The digit average Luminous Intensity is obtained by summing the Luminous Intensity of each segment and dividing by the total number of segments. Intensity will not vary more than ±33.3% between all segments within a digit.*
2. *The relative luminous intensity in this curve is normalized to the brightness at 25°C to indicate the relative efficiency over the operating temperature range.*
3. *Leads of the device immersed to 1/16 inch from the body. Maximum device surface temperature is 140°C.*
4. *For flux removal, Freon TF, Freon TE, Isoproponal or water may be used up to their boiling points.*
5. *All displays are categorized for Luminous Intensity. The intensity category is marked on each part as a suffix letter to the part number.*

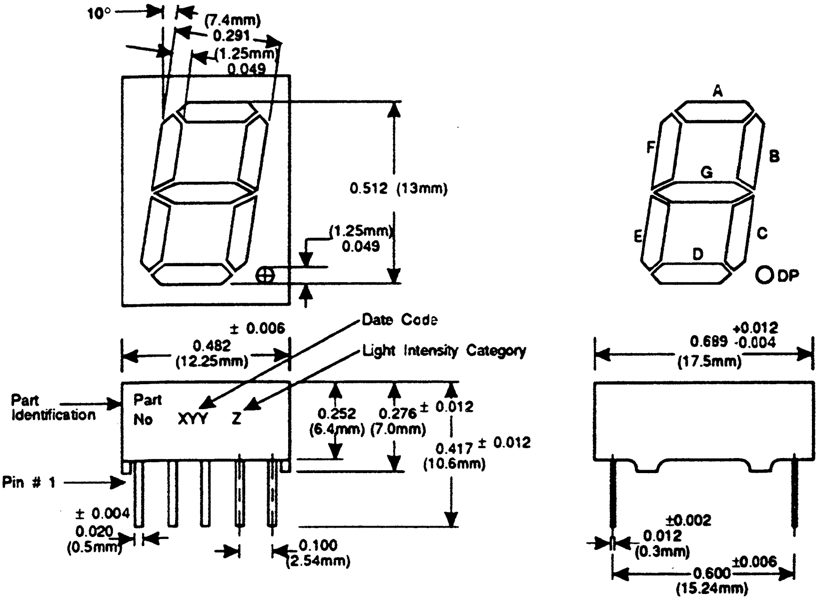
RECOMMENDED OPTICAL FILTERS

For optimum ON and OFF contrast, one of the following filters or equivalents should be used over the display:

DEVICE TYPE	FILTER	DEVICE TYPE	FILTER
MAN5350 MAN5360	Panelgraphic Yellow 25 or Amber 23 Homalite 100-1720 or 100-1726 Panelgraphic Grey 10 Homalite 100-1266 Grey	MAN5450 MAN5460	Panelgraphic Green 48 Homalite 100-1440 Green Panelgraphic Grey 10 Homalite 100-1266 Grey
MAN5750 MAN5760	Panelgraphic Red 60 Homalite 100-1605	MAN5950 MAN5960	Panelgraphic Scarlet 65 Homalite 100-1670

0.510 INCH (13 MM)
SEVEN SEGMENT DISPLAYS

PACKAGE DIMENSIONS

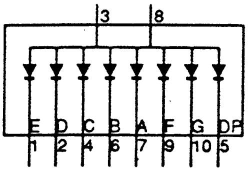


NOTE: Dimensions in inches (mm)
Tolerances ±0.010″ unless otherwise specified

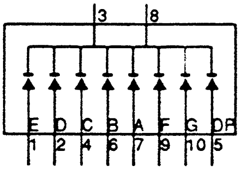
ELECTRICAL CONNECTIONS

PIN NO.	A MAN 5 X 50	B MAN 5 X 60
1	Cathode E	Anode E
2	Cathode D	Anode D
3	Com. Anode	Com. Cathode
4	Cathode C	Anode C
5	Cathode D.P.	Anode D.P.
6	Cathode B	Anode B
7	Cathode A	Anode A
8	Com. Anode	Com. Cathode
9	Cathode F	Anode F
10	Cathode G	Anode G

INTERNAL CONNECTIONS



MAN 5 X 50



MAN 5 X 60

0.510 INCH (13 MM)
SEVEN SEGMENT DISPLAYS

TYPICAL CHARACTERISTIC CURVES

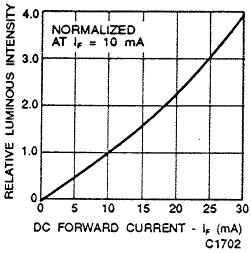


Fig. 1A. Relative Luminous Intensity vs. DC Forward Current

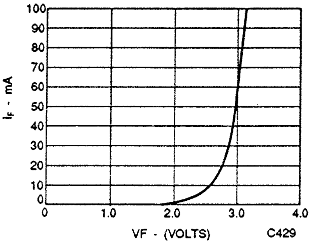


Fig. 1B. Foward Current vs. Forward Voltage

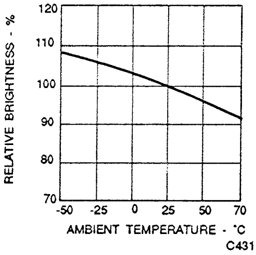


Fig. 1C. Relative Luminous Intensity vs. Temperature (See Note 2)

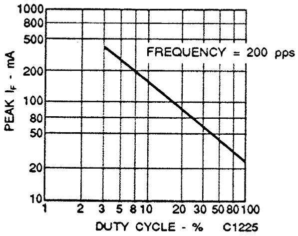


Fig. 1D. Max Peak Current vs. Duty Cycle

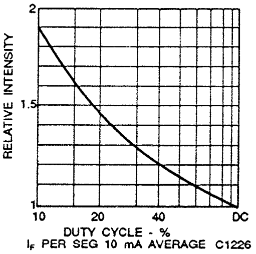


Fig. 1E. Relative Luminous Intensity vs. Duty Cycle

FIGURE 1: MAN5350/MAN5360

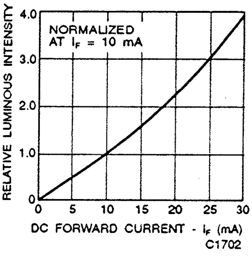


Fig. 2A. Relative Luminous Intensity vs. Forward Current

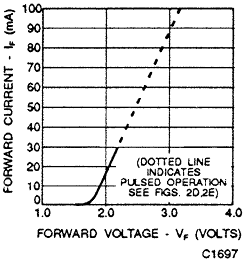


Fig. 2B. Forward Current vs. Foward Voltage

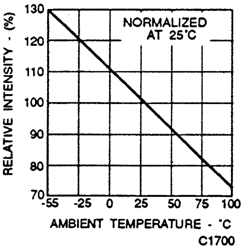


Fig. 2C. Relative Luminous Intensity vs. Temperature (See Note 2)

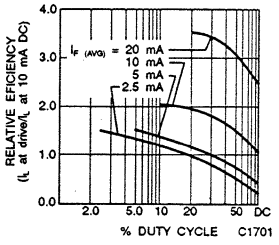


Fig. 2D. Relative Efficiency vs. Duty Cycle

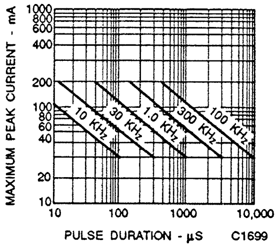


Fig. 2E. Maximum Peak Current vs. Pulse Duration

FIGURE 2: MAN5450/MAN5460

TYPICAL CHARACTERISTIC CURVES

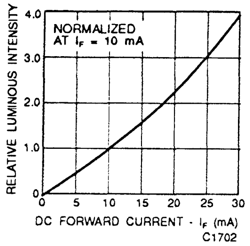


Fig. 3A. Relative Luminous Intensity vs. DC Forward Current

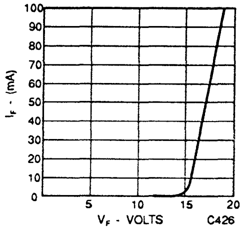


Fig. 3B. Foward Current vs. Forward Voltage

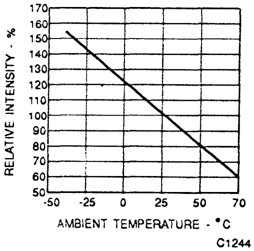


Fig. 3C. Relative Luminous Intensity vs. Temperature (See Note 2)

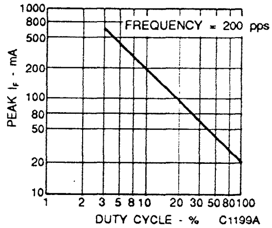


Fig. 3D. Max Peak Current vs. Duty Cycle

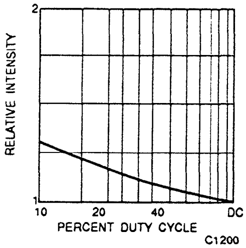


Fig. 3E. Relative Luminous Intensity vs. Duty Cycle

FIGURE 3: MAN5750/MAN5760

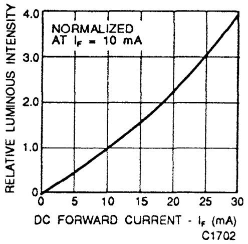


Fig. 4A. Relative Luminous Intensity vs. Forward Current

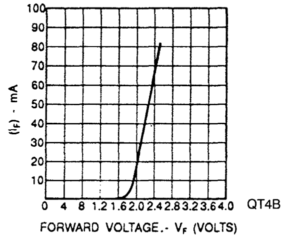


Fig. 4B. Forward Current vs. Foward Voltage

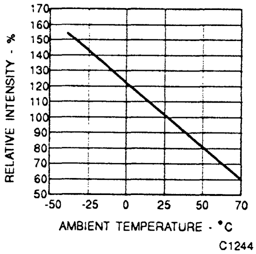


Fig. 4C. Relative Luminous Intensity vs. Temperature (See Note 2)

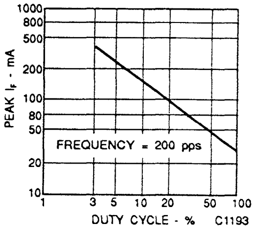


Fig. 4D. Maximum Peak Current vs. Duty Cycle

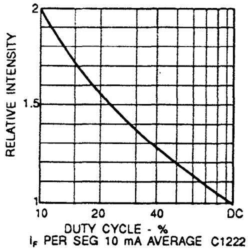


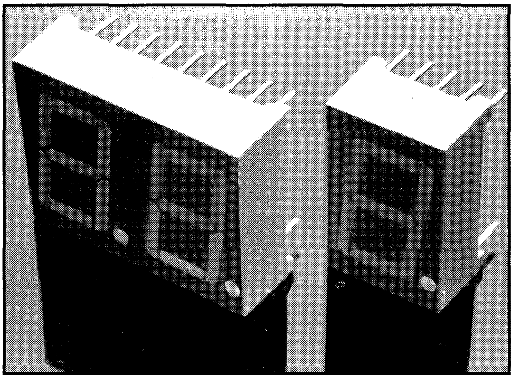
Fig. 4E. Relative Luminous Intensity vs. Duty Cycle

FIGURE 4: MAN5950/MAN5960

QT
OPTOELECTRONICS

0.560-INCH SEVEN SEGMENT DISPLAYS

HIGH EFFICIENCY GREEN **MAN6400 SERIES**



DESCRIPTION

The MAN6400 Series is a family of large digits which includes double and single digits. The series features the sculptured font which minimizes "gappiness" at the segment intersections. All models have right hand decimal points and are available in common anode or common cathode configuration. This device has a Grey face and clear segment to enhance ON and OFF contrast.

FEATURES

- High Efficiency Green nitrogen-doped GaAsP on GaP
- Large, easy to read, digits
- Common anode or common cathode models
- Fast switching — excellent for multiplexing
- Low power consumption
- Bold solid segments that are highly legible
- Solid state reliability — long operation life
- Rugged plastic construction
- Directly compatible with integrated circuits
- High brightness with high contrast
- Categorized for Luminous Intensity (See Note 5)
- Wide angle viewing...150°
- Low forward voltage
- Two-digit package simplifies alignment and assembly

APPLICATIONS

For industrial and consumer applications such as:
- Digital readout displays
- Instrument panels
- Point of sale equipment
- Digital clocks
- TV and radios

MODEL NUMBERS

PART NUMBER	COLOR	DESCRIPTION	PACKAGE DRAWING	PIN OUT SPECIFICATION
MAN6410	High Eff. Green	2 Digit; Common Anode; Rt. Hand Decimal	A	A
MAN6440	High Eff. Green	2 Digit; Common Cathode; Rt. Hand Decimal	A	B
MAN6460	High Eff. Green	Single Digit; Common Anode; Rt. Hand Decimal	B	C
MAN6480	High Eff. Green	Single Digit; Common Cathode; Rt. Hand Decimal	B	D

RECOMMENDED OPTICAL FILTERS

For optimum ON and OFF contrast, one of the following filters or equivalents should be used over the display:

DEVICE TYPE	FILTER
MAN6400 Series	Panelgraphic Green 48 Homalite 100-1440 Green Panelgraphic Grey 10 Homalite 100-1266 Grey

ELECTRO-OPTICAL CHARACTERISTICS

(Per Diode at 25°C Free Air Temperature Unless Otherwise Specified)

	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS
Luminous Intensity, digit average (See Notes 1 and 4)	750	3300		μcd	I_F=10 mA
Pulsed Luminous Intensity, digit average	900	4100		μcd	I_F=60 mA peak, 1:6 DF
Peak emission wavelength		562		nm	
Dominant wavelength		567		nm	
Spectral line half width		30		nm	
Forward voltage		2.2	3.0	V	I_F=20 mA
Dynamic resistance (See Figure 1)		12		Ω	I_F=20 mA
Light rise time		500		nsec	I_F=10 mA
Capacitance		40		pF	V=0, f = 1 MHz
Reverse current			100	μA	V_R=3.0 V

ABSOLUTE MAXIMUM RATINGS

	MAN6410 **MAN6440**	**MAN6460** **MAN6480**
Power dissipation at 25°C ambient	1140 mW	570 mW
Derate linearly from 50°C	−24 mW/°C	−12 mW/°C
Storage and operating temperature	−40°C to +85°C	−40°C to +85°C
Continuous forward current		
Total	480 mA	240 mA
Per diode	30 mA	30 mA
Reverse voltage		
Per diode	6.0 V	6.0 V
Soldering time at 260°C (See Notes 2 and 3)	5 sec.	5 sec.

TYPICAL THERMAL CHARACTERISTICS

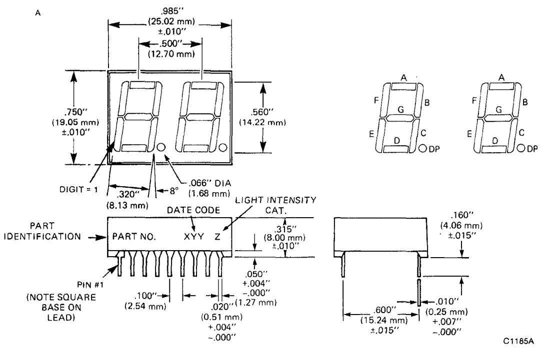
Thermal resistance junction to free air Φ_{JA}	160°C/W
Wavelength temperature coefficient (case temperature)	1.0Å/°C
Forward voltage temperature coefficient	−1.4 mV/°C

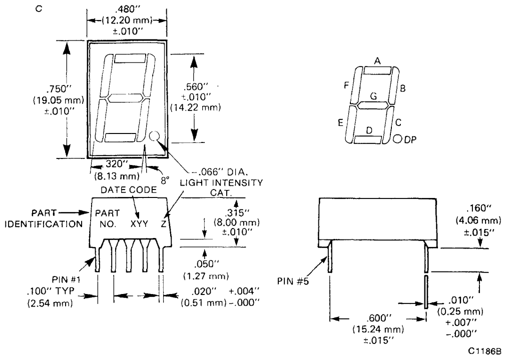
NOTES

1. *The digit average Luminous Intensity is obtained by summing the Luminous Intensity of each segment and dividing by the total number of segments. Intensity will not vary more than ±33.3% between all segments within a digit.*
2. *Leads of the device immersed to 1/16 inch from the body. Maximum device surface temperature is 140°C.*
3. *For flux removal, Freon TF, Freon TE, Isoproponal or water may be used up to their boiling points.*
4. *Intensity adjusted for smaller areas of the "+" and decimal points.*
5. *All displays are categorized for Luminous Intensity. The Intensity category is marked on each part as a suffix letter to the part number.*

0.560-INCH SEVEN SEGMENT DISPLAYS

PACKAGE DIMENSIONS





ELECTRICAL CONNECTIONS

Pin No.	ELECTRICAL CONNECTIONS A MAN6410	B MAN6440	C MAN6460	D MAN6480
1	Cathode E 1	Anode E 1	Cathode E	Anode E
2	Cathode D 1	Anode D 1	Cathode D	Anode D
3	Cathode C 1	Anode C 1	Common Anode	Common Cathode
4	Cathode D.P. 1	Anode D.P. 1	Cathode C	Anode C
5	Cathode E 2	Anode E 2	Cathode D.P.	Anode D.P.
6	Cathode D 2	Anode D 2	Cathode B	Anode B
7	Cathode G 2	Anode G 2	Cathode A	Anode A
8	Cathode C 2	Anode C 2	Common Anode	Common Cathode
9	Cathode D.P. 2	Anode D.P. 2	Cathode F	Anode F
10	Cathode B 2	Anode B 2	Cathode G	Anode G
11	Cathode A 2	Anode A 2		
12	Cathode F 2	Anode F 2		
13	Anode Digit 2	Cathode Digit 2		
14	Anode Digit 1	Cathode Digit 1		
15	Cathode B 1	Anode B 1		
16	Cathode A 1	Anode A 1		
17	Cathode G 1	Anode G 1		
18	Cathode F 1	Anode F 1		

TYPICAL CHARACTERISTIC CURVES

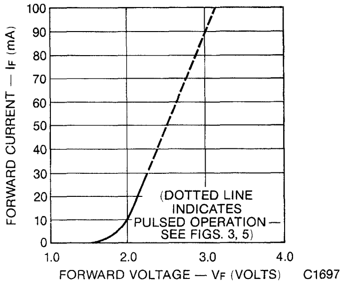


Fig. 1. Forward Current vs. Forward Voltage

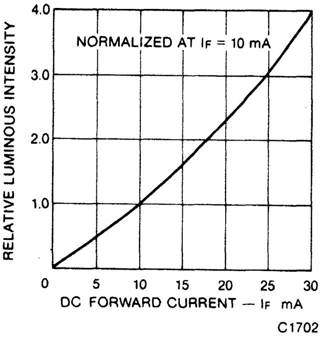


Fig. 2. Relative Luminous Intensity vs. DC Forward Current

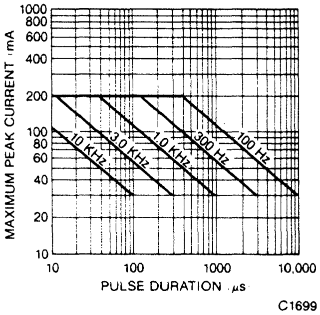


Fig. 3. Maximum Peak Current vs. Pulse Duration

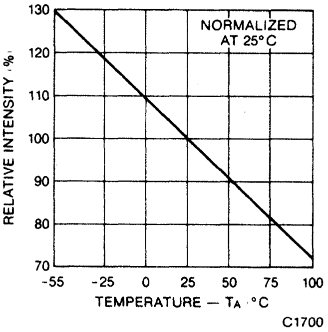


Fig. 4. Relative Luminous Intensity vs. Temperature

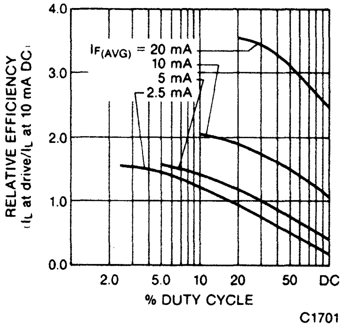
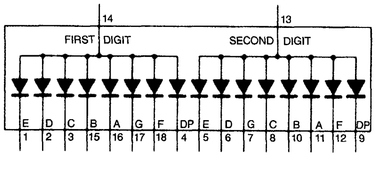
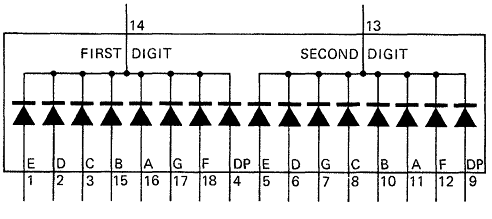


Fig. 5. Relative Efficiency vs. Duty Cycle

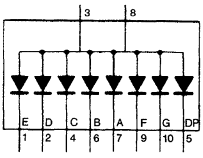
INTERNAL CONNECTIONS



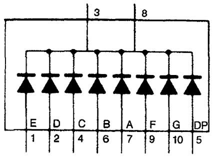
MAN6410



MAN6640



MAN6460

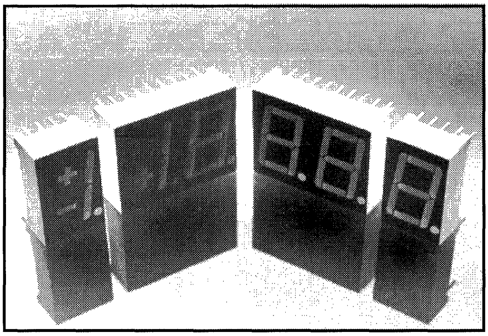


MAN6480

QT
OPTOELECTRONICS

0.560-INCH SEVEN SEGMENT DISPLAYS

ORANGE MAN6600 SERIES



DESCRIPTION

The MAN6600 Series is a family of large digits which includes double and single digits. The series features the sculptured font which minimizes "gappiness" at the segment intersections. Available models include two-digit, one and one-half digits with polarity sign, single digits, and single polarity/overflow digits. All models have right hand decimal points and are available in common anode or common cathode configuration. Units are constructed with Orange face and segment color.

FEATURES

- High performance nitrogen-doped GaAsP on GaP
- Large, easy to read, digits
- Common anode or common cathode models
- Fast switching — excellent for multiplexing
- Low power consumption
- Bold solid segments that are highly legible
- Solid state reliability — long operation life
- Rugged plastic construction
- Directly compatible with integrated circuits
- High brightness with high contrast
- Categorized for Luminous Intensity (See Note 6)
- Wide viewing angle...150°
- Low forward voltage
- Two-digit package simplifies alignment and assembly

APPLICATIONS

For industrial and consumer applications such as:

- Digital readout displays
- Instrument panels
- Point of sale equipment
- Digital clocks
- TV and radios

MODEL NUMBERS

PART NUMBER	COLOR	DESCRIPTION	PACKAGE DRAWING	PIN OUT SPECIFICATION
MAN6610	Orange	2 Digit; Common Anode; Rt. Hand Decimal	A	A
MAN6630	Orange	1½ Digit; Common Anode; Overflow ±1.8; Rt. Hand Decimal	B	B
MAN6640	Orange	2 Digit; Common Cathode; Rt. Hand Decimal	A	C
MAN6650	Orange	1½ Digit; Common Cathode; Overflow ±1.8; Rt. Hand Decimal	B	D
MAN6660	Orange	Single Digit; Common Anode; Rt. Hand Decimal	C	E
MAN6675	Orange	Single Digit; Common Anode; Overflow ±1.0; Rt. Hand Decimal	D	G
MAN6680	Orange	Single Digit; Common Cathode; Rt. Hand Decimal	C	F
MAN6695	Orange	Single Digit; Common Cathode; Overflow ±1.0; Rt. Hand Decimal	D	H

RECOMMENDED OPTICAL FILTERS

For optimum ON and OFF contrast, one of the following filters or equivalents should be used over the display:

DEVICE TYPE	FILTER
MAN6600 Series	Panelgraphic Scarlet 65 Homalite 100-1670

0.560-INCH
SEVEN SEGMENT DISPLAYS

ELECTRO-OPTICAL CHARACTERISTICS
(Per Diode at 25°C Free Air Temperature Unless Otherwise Specified)

	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS
Luminous Intensity, digit average (See Note 1)	510	2200		μcd	I_F=10 mA
Peak emission wavelength		630		nm	
Spectral line half width		40		nm	
Forward voltage					
Segment			2.5	V	I_F=20 mA
Decimal point			2.5	V	I_F=20 mA
Dynamic resistance					
Segment		26		Ω	I_F=20 mA
Decimal point		26		Ω	I_F=20 mA
Capacitance					
Segment		35		pF	V=0
Decimal point		35		pF	V=0
Reverse current					
Segment			100	μA	V_R=3.0 V
Decimal point			100	μA	V_R=3.0 V
Ratio I_L			2:1	—	I_F=10 mA

ABSOLUTE MAXIMUM RATINGS

	MAN6610 MAN6640	MAN6630 MAN6650	MAN6660 MAN6680	MAN6675 MAN6695
Power dissipation at 25°C ambient	1200 mW	1050 mW	600 mW	375 mW
Derate linearly from 50°C	−17 mW/°C	−15.0 mW/°C	−8.6 mW/°C	−5.4 mW/°C
Storage and operating temperature	−40°C to +85°C	−40°C to +85°C	−40°C to +85°C	−40°C to +85°C
Continuous forward current				
Total	480 mA	420 mA	240 mA	150 mA
Per segment	30 mA	30 mA	30 mA	30 mA
Decimal point	30 mA	30 mA	30 mA	30 mA
Reverse voltage				
Per segment	6.0 V	6.0 V	6.0 V	6.0 V
Decimal point	6.0 V	6.0 V	6.0 V	6.0 V
Soldering time at 260°C (See Notes 3 and 4)	5 sec.	5 sec.	5 sec.	5 sec.

TYPICAL THERMAL CHARACTERISTICS

Thermal resistance junction to free air Φ_{JA}	160°C/W
Wavelength temperature coefficient (case temperature)	1.0Å/°C
Forward voltage temperature coefficient	−2.0 mV/°C

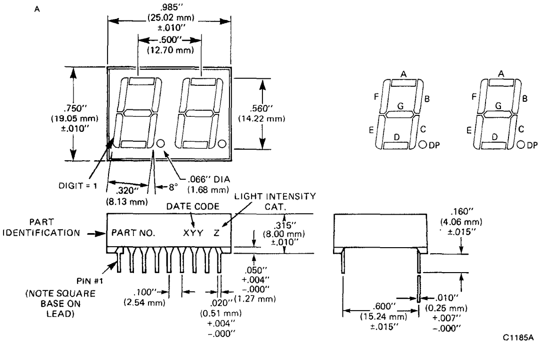
NOTES

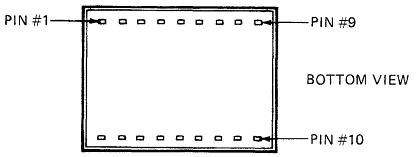
1. *The digit average Luminous Intensity is obtained by summing the Luminous Intensity of each segment and dividing by the total number of segments. Intensity will not vary more than ±33.3% between all segments within a digit.*
2. *The curve in Figure 3 is normalized to the brightness at 25°C to indicate the relative efficiency over the operating temperature range.*
3. *Leads of the device immersed to 1/16 inch from the body. Maximum device surface temperature is 140°C.*
4. *For flux removal, Freon TF, Freon TE, Isoproponal or water may be used up to their boiling points.*
5. *All displays are categorized for Luminous Intensity. The Intensity category is marked on each part as a suffix letter to the part number.*

0.560-INCH SEVEN SEGMENT DISPLAYS

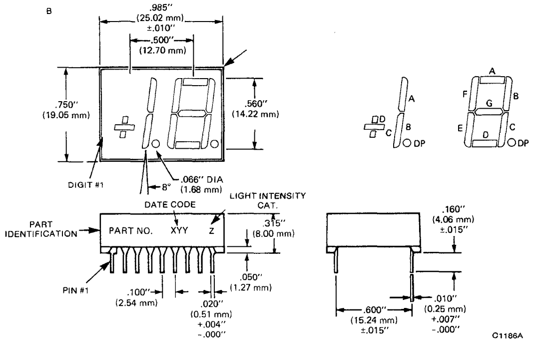
PACKAGE DIMENSIONS

A

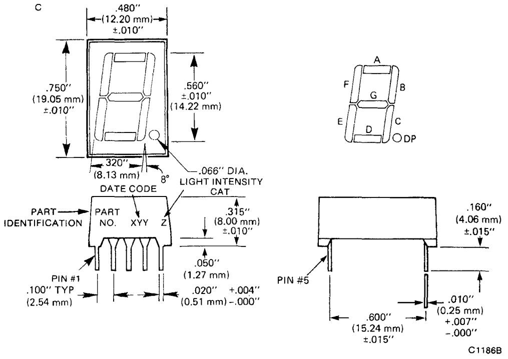


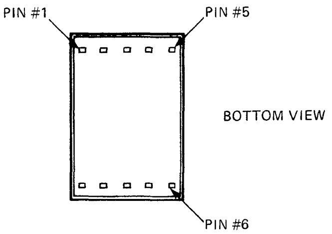


B



C





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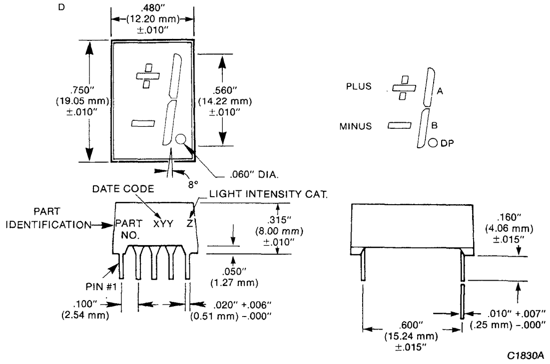


0.560-INCH SEVEN SEGMENT DISPLAYS

ELECTRICAL CONNECTIONS

Pin No.	ELECTRICAL CONNECTIONS							
	A MAN6610	**B MAN6630**	**C MAN6640**	**D MAN6650**	**E MAN6660**	**F MAN6680**	**G MAN6675**	**H MAN6695**
1	E Cath. (#1)	C Cath. (#1)	E An. (#1)	C An. (#1)	E Cath.	E An.	Minus Cath.	Minus An.
2	D Cath. (#1)	D Cath. (#1)	D An. (#1)	D An. (#1)	D Cath.	D An.	Com. An. ±	Com. Cath. ±
3	C Cath. (#1)	B Cath. (#1)	C An. (#1)	B An. (#1)	Com. An.	Com. Cath.	Seg. B Cath.	Seg. B An.
4	DP Cath. (#1)	DP Cath. (#1)	DP An. (#1)	DP An. (#1)	C Cath.	C An.	Com. An. A, B, DP	Com. Cath. A, B, DP
5	E Cath. (#2)	E Cath. (#2)	E An. (#2)	E An. (#2)	DP Cath.	DP An.	DP Cath.	DP An.
6	D Cath. (#2)	D Cath. (#2)	D An. (#2)	D An. (#2)	B Cath.	B An.	Seg. A Cath.	Seg. A An.
7	G Cath. (#2)	G Cath. (#2)	G An. (#2)	G An. (#2)	A Cath.	A An.	Com. An. A, B, DP	Com. Cath. A, B, DP
8	C Cath. (#2)	C Cath. (#2)	C An. (#2)	C An. (#2)	Com. An.	Com. Cath.	Com. An. ±	Com. Cath. ±
9	DP Cath. (#2)	DP Cath. (#2)	DP An. (#2)	DP An. (#2)	F Cath.	F An.	Plus Cath.	Plus An.
10	B Cath. (#2)	B Cath. (#2)	B An. (#2)	B An. (#2)	G Cath.	G An.	N.C.	N.C.
11	A Cath. (#2)	A Cath. (#2)	A An. (#2)	A An. (#2)				
12	F Cath. (#2)	F Cath. (#2)	F An. (#2)	F An. (#2)				
13	Digit #2 An.	Digit #2 An.	Digit #2 Cath.	Digit #2 Cath.				
14	Digit #1 An.	Digit #1 An.	Digit #1 Cath.	Digit #1 Cath.				
15	B Cath. (#1)	A Cath. (#1)	B An. (#1)	A An. (#1)				
16	A Cath. (#1)	N.C.	A An. (#1)	N.C.				
17	G Cath. (#1)	N.C.	G An. (#1)	N.C.				
18	F Cath. (#1)	N.C.	F An. (#1)	N.C.				

TYPICAL CHARACTERISTIC CURVES

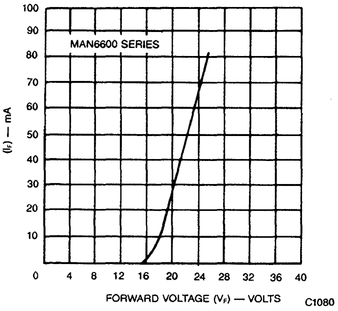


Fig. 1. Forward Current vs. Forward Voltage

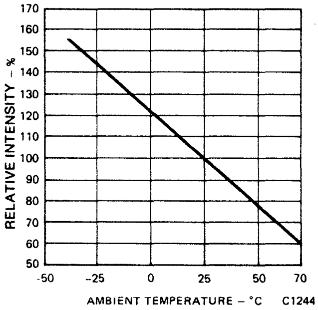


Fig. 2. Relative Luminous Intensity vs. Temperature (see Note 2)

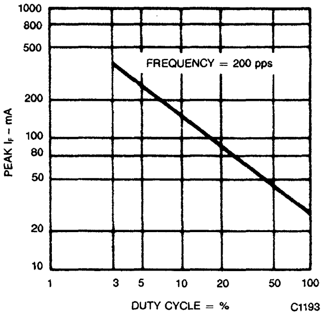


Fig. 3. Max Peak Current vs. Duty Cycle

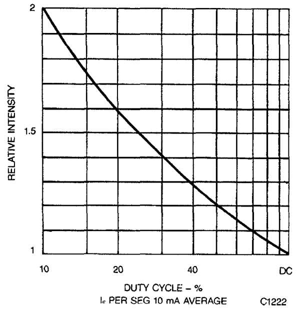


Fig. 4. Luminous Intensity vs. Duty Cycle

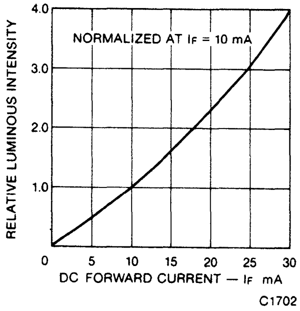
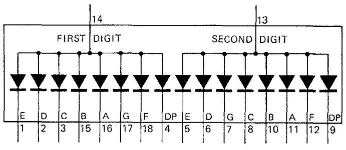


Fig. 5. Relative Luminous Intensity vs. Forward Current

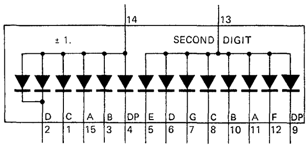
OPTOELECTRONICS

0.560-INCH SEVEN SEGMENT DISPLAYS

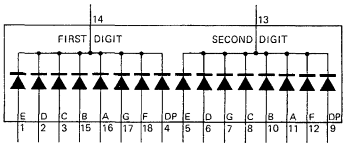
INTERNAL CONNECTIONS



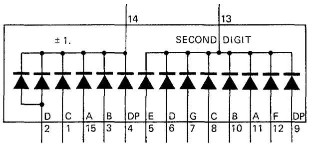
MAN6610 C1195



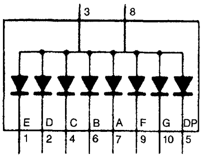
MAN6630 C1196



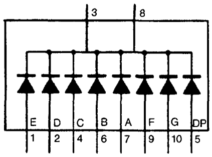
MAN6640 C1197



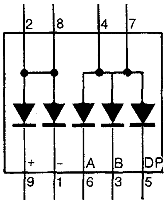
MAN6650 C1198



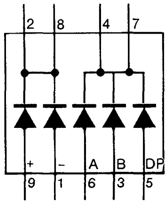
MAN6660 C1238



MAN6680 C1239



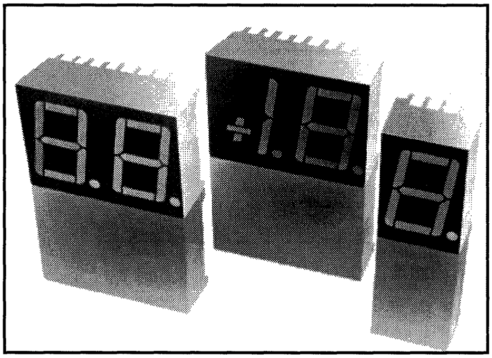
MAN6675 C1828



MAN6695 C1829

0.560-INCH SEVEN SEGMENT DISPLAYS

RED MAN6700 SERIES



FEATURES

- High performance GaAsP
- Large, easy to read, digits
- Common anode or common cathode models
- Also available in Orange (MAN6600 Series)
- Fast switching — excellent for multiplexing
- Low power consumption
- Bold solid segments that are highly legible
- Solid state reliability — long operation life
- Rugged plastic construction
- Directly compatible with integrated circuits
- High brightness with high contrast
- Categorized for Luminous Intensity (See Note 7)
- Wide viewing angle...150°
- Standard double-dip lead configuration
- Low forward voltage

DESCRIPTION

The MAN6700 Series is a family of large digits which includes double and single digits. The series features the sculptured font which minimizes "gappiness" at the segment intersections. Available models include two-digit, one and one-half digits with polarity sign, and single digits. All models have right hand decimal points and are available in common anode or common cathode configuration. Units are constructed with Black face and Red segment color.

APPLICATIONS

For industrial and consumer applications such as:
- Two-digit package simplifies alignment and assembly
- Digital readout displays
- Instrument panels
- Point of sale equipment
- Digital clocks
- TV and radios

MODEL NUMBERS

PART NUMBER	COLOR	DESCRIPTION	PACKAGE DRAWING	PIN OUT SPECIFICATION
MAN6710	Red	2 Digit; Common Anode; Rt. Hand Decimal	A	A
MAN6730	Red	1½ Digit; Common Anode; Overflow ±1.8; Rt. Hand Decimal	B	B
MAN6740	Red	2 Digit; Common Cathode; Rt. Hand Decimal	A	C
MAN6750	Red	1½ Digit; Common Cathode; Overflow ±1.8; Rt. Hand Decimal	B	D
MAN6760	Red	Single Digit; Common Anode; Rt. Hand Decimal	C	E
MAN6780	Red	Single Digit; Common Cathode; Rt. Hand Decimal	C	F

RECOMMENDED OPTICAL FILTERS

For optimum ON and OFF contrast, one of the following filters or equivalents should be used over the display:

DEVICE TYPE	FILTER
MAN6700 Series	Panelgraphic Red 60 Homalite 100-1605

0.560-INCH SEVEN SEGMENT DISPLAYS

ELECTRO-OPTICAL CHARACTERISTICS

(Per Diode at 25°C Free Air Temperature Unless Otherwise Specified)

	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS
Luminous Intensity, digit average (See Note 1)	125	420		μcd	I_F=10 mA
Peak emission wavelength		650		nm	
Spectral line half width		20		nm	
Forward voltage					
Segment			2.0	V	I_F=20 mA
Decimal point			2.0	V	I_F=20 mA
Dynamic resistance					
Segment		2		Ω	I_F=20 mA
Decimal point		2		Ω	I_F=20 mA
Capacitance					
Segment		35		pF	V=0
Decimal point		35		pF	V=0
Reverse current					
Segment			100	μA	V_R=5.0 V
Decimal point			100	μA	V_R=5.0 V
Segment C or D of "+" (6730/6750)			100	μA	V_R=5.0 V

ABSOLUTE MAXIMUM RATINGS

	MAN6710 MAN6740	MAN6730 MAN6750	MAN6760 MAN6780
Power dissipation at 25°C ambient	960 mW	840 mW	480 mW
Derate linearly from 25°C	−13.7 mW/°C	−12.0 mW/°C	−6.9 mW/°C
Storage and operating temperature	−40°C to +85°C	−40°C to +85°C	−40°C to +85°C
Continuous forward current			
Total	480 mA	420 mA	240 mA
Per segment	30 mA	30 mA	30 mA
Decimal point	30 mA	30 mA	30 mA
Reverse voltage			
Per segment	6.0 V	6.0 V	6.0 V
Decimal point	6.0 V	6.0 V	6.0 V
Soldering time at 260°C (See Notes 3 and 4)	5 sec.	5 sec.	5 sec.

TYPICAL THERMAL CHARACTERISTICS

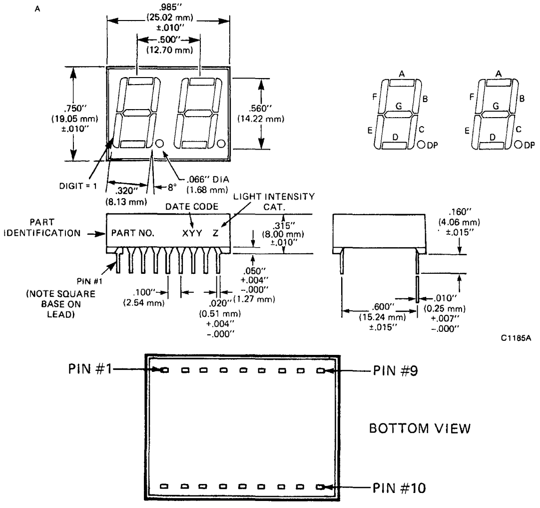
Thermal resistance junction to free air Φ_{JA}	160°C/W
Wavelength temperature coefficient (case temperature)	3.0Å/°C
Forward voltage temperature coefficient	−2.0 mV/°C

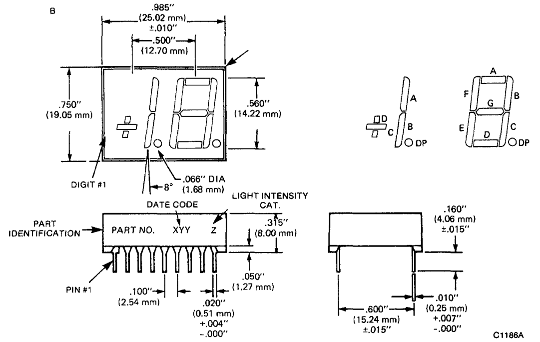
NOTES

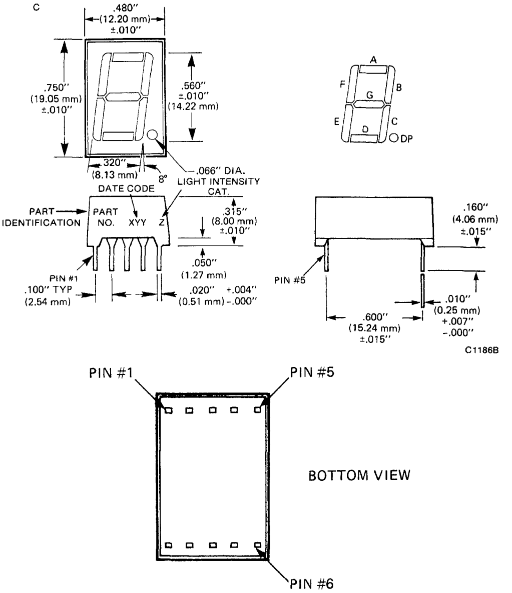
1. *The digit average Luminous Intensity is obtained by summing the Luminous Intensity of each segment and dividing by the total number of segments. Intensity will not vary more than ±33.3% between all segments within a digit.*
2. *The curve in Figure 3 is normalized to the brightness at 25°C to indicate the relative efficiency over the operating temperature range.*
3. *Leads of the device immersed to 1/16 inch from the body. Maximum device surface temperature is 140°C.*
4. *For flux removal, Freon TF, Freon TE, Isoproponal or water may be used up to their boiling points.*
5. *Pins 3 and 8 on MAN6760 and MAN6780 ar redundant anodes or cathodes.*
6. *All displays are categorized for Luminous Intensity. The Intensity category is marked on each part as a suffix letter to the part number.*

0.560-INCH SEVEN SEGMENT DISPLAYS

PACKAGE DIMENSIONS







ELECTRICAL CONNECTIONS

Pin No.	ELECTRICAL CONNECTIONS					
	A MAN6710	B MAN6730	C MAN6740	D MAN6750	E MAN6760	F MAN6780
1	Cathode E 1	Cathode C 1	Anode E 1	Anode C 1	Cathode E	Anode E
2	Cathode D 1	Cathode D 1	Anode D 1	Anode D 1	Cathode D	Anode D
3	Cathode C 1	Cathode B 1	Anode C 1	Anode B 1	Com. Anode	Com. Cathode
4	Cathode D.P. 1	Cathode D.P. 1	Anode D.P. 1	Anode D.P. 1	Cathode C	Anode C
5	Cathode E 2	Cathode E 2	Anode E 2	Anode E 2	Cathode D.P.	Anode D.P.
6	Cathode D 2	Cathode D 2	Anode D 2	Anode D 2	Cathode B	Anode B
7	Cathode G 2	Cathode G 2	Anode G 2	Anode G 2	Cathode A	Anode A
8	Cathode C 2	Cathode C 2	Anode C 2	Anode C 2	Com. Anode	Com. Cathode
9	Cathode D.P. 2	Cathode D.P. 2	Anode D.P. 2	Anode D.P. 2	Cathode F	Anode F
10	Cathode B 2	Cathode B 2	Anode B 2	Anode B 2	Cathode G	Anode G
11	Cathode A 2	Cathode A 2	Anode A 2	Anode A 2		
12	Cathode F 2	Cathode F 2	Anode F 2	Anode F 2		
13	Anode Digit 2	Anode Digit 2	Cathode Digit 2	Cathode Digit 2		
14	Anode Digit 1	Anode Digit 1	Cathode Digit 1	Cathode Digit 1		
15	Cathode B 1	Cathode A 1	Anode B 1	Anode A 1		
16	Cathode A 1	No Connection	Anode A 1	No Connection		
17	Cathode G 1	No Connection	Anode G 1	No Connection		
18	Cathode F 1	No Connection	Anode F 1	No Connection		

TYPICAL CHARACTERISTIC CURVES

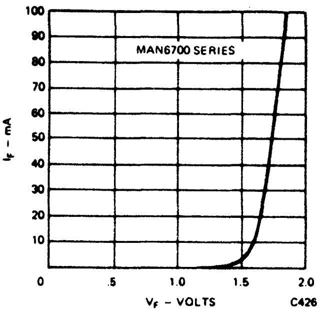


Fig. 1. Forward Current vs. Forward Voltage

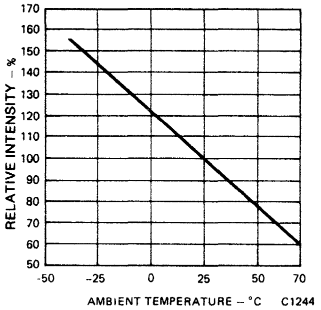


Fig. 2. Relative Luminous Intensity vs. Temperature (See Note 2)

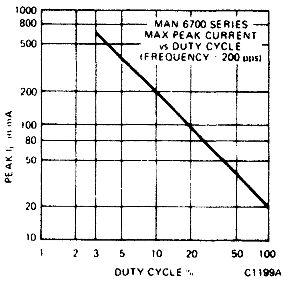


Fig. 3. Max Peak Current vs. Duty Cycle

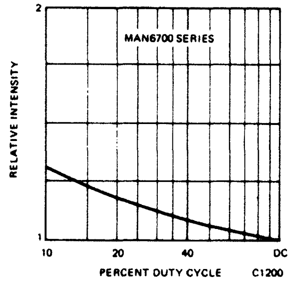


Fig. 4. Luminous Intensity vs. Duty Cycle

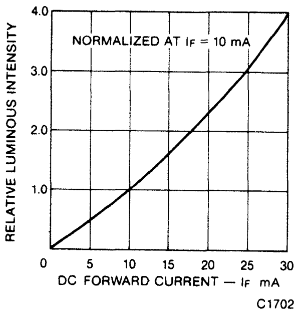
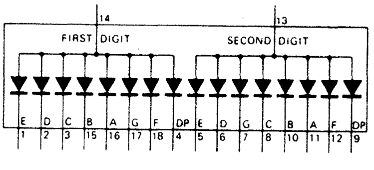
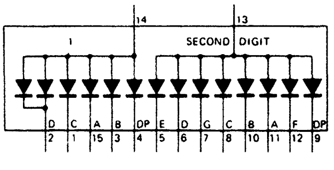


Fig. 5. Relative Luminous Intensity vs. Forward Current

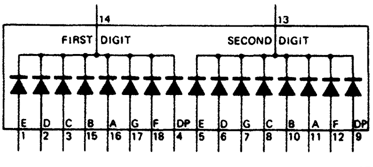
INTERNAL CONNECTIONS



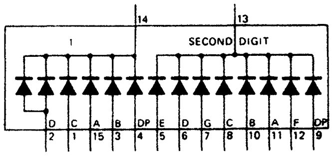
MAN6710 C1195



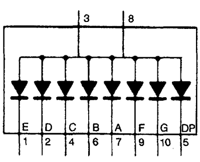
MAN6730 C1196



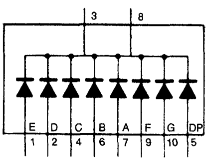
MAN6740 C1197



MAN6750 C1198



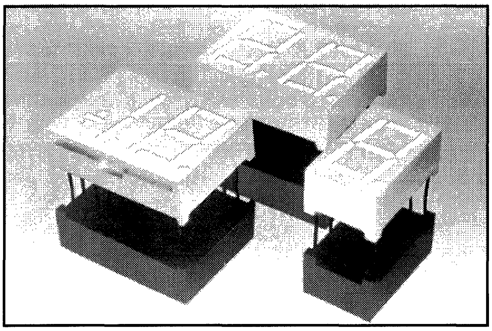
MAN6160 C1238



MAN6180 C1239

0.560-INCH
SEVEN SEGMENT DISPLAYS

HIGH EFFICIENCY RED **MAN6900 SERIES**



DESCRIPTION

The MAN6900 Series is a family of large digits which includes double and single digits. The series features the sculptured font which minimizes "gappiness" at the segment intersections. Available models include two-digit, one and one-half digits with polarity sign, and single digits. All models have right hand decimal points and are available in common anode or common cathode configuration. This device has a Red face and Red segments.

FEATURES

- High Efficiency Red nitrogen-doped GaAsP on GaP
- Large, easy to read, digits
- Common anode or common cathode models
- Fast switching — excellent for multiplexing
- Low power consumption
- Bold solid segments that are highly legible
- Solid state reliability — long operation life
- Rugged plastic construction
- Directly compatible with integrated circuits
- High brightness with high contrast
- Categorized for Luminous Intensity (See Note 6)
- Wide angle viewing...150°
- Low forward voltage
- Two-digit package simplifies alignment and assembly

APPLICATIONS

For industrial and consumer applications such as:

- Digital readout displays
- Instrument panels
- Point of sale equipment
- Digital clocks
- TV and radios

MODEL NUMBERS

PART NUMBER	COLOR	DESCRIPTION	PACKAGE DRAWING	PIN OUT SPECIFICATION
MAN6910	High Eff. Red	2 Digit; Common Anode; Rt. Hand Decimal	A	A
MAN6930	High Eff. Red	1½ Digit; Common Anode; Overflow ±1.8; Rt. Hand Decimal	B	B
MAN6940	High Eff. Red	2 Digit; Common Cathode; Rt. Hand Decimal	A	C
MAN6950	High Eff. Red	1½ Digit; Common Cathode; Overflow ±1.8; Rt. Hand Decimal	B	D
MAN6960	High Eff. Red	Single Digit; Common Anode; Rt. Hand Decimal	C	E
MAN6980	High Eff. Red	Single Digit; Common Cathode; Rt. Hand Decimal	C	F

RECOMMENDED OPTICAL FILTERS

For optimum ON and OFF contrast, one of the following filters or equivalents should be used over the display:

DEVICE TYPE	FILTER
MAN6900 Series	Panelgraphic Scarlet 65 Homalite 100-1670

0.560-INCH
SEVEN SEGMENT DISPLAYS

ELECTRO-OPTICAL CHARACTERISTICS
(Per Diode at 25°C Free Air Temperature Unless Otherwise Specified)

	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS
Luminous Intensity, digit average (See Note 1)	510	2200		μcd	I_F=10 mA
Peak emission wavelength		635		nm	
Spectral line half width		40		nm	
Forward voltage					
Segment			2.5	V	I_F=20 mA
Decimal point			2.5	V	I_F=20 mA
Dynamic resistance					
Segment		26		Ω	I_F=20 mA
Decimal point		26		Ω	I_F=20 mA
Capacitance					
Segment		35		pF	V=0
Decimal point		35		pF	V=0
Reverse current					
Segment			100	μA	V_R=5.0 V
Decimal point			100	μA	V_R=5.0 V

ABSOLUTE MAXIMUM RATINGS

	MAN6910 **MAN6940**	**MAN6930** **MAN6950**	**MAN6960** **MAN6980**
Power dissipation at 25°C ambient	1200 mW	1050 mW	600 mW
Derate linearly from 50°C	−17.1 mW/°C	−15.0 mW/°C	−8.6 mW/°C
Storage and operating temperature	−40°C to +85°C	−40°C to +85°C	−40°C to +85°C
Continuous forward current			
Total	480 mA	420 mA	240 mA
Per segment	30 mA	30 mA	30 mA
Decimal point	30 mA	30 mA	30 mA
Reverse voltage			
Per segment	6.0 V	6.0 V	6.0 V
Decimal point	6.0 V	6.0 V	6.0 V
Soldering time at 260°C (See Notes 3 and 4)	5 sec.	5 sec.	5 sec.

TYPICAL THERMAL CHARACTERISTICS

Thermal resistance junction to free air Φ_{JA}	160°C/W
Wavelength temperature coefficient (case temperature)	1.0Å/°C
Forward voltage temperature coefficient	−2.0 mV/°C

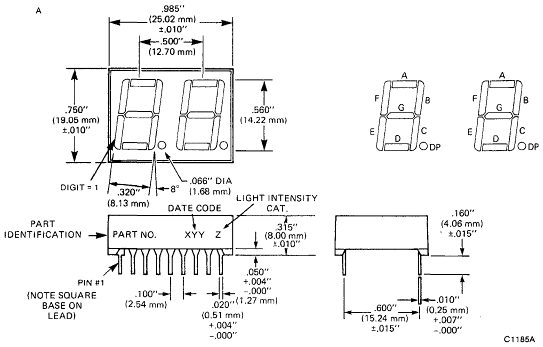
NOTES

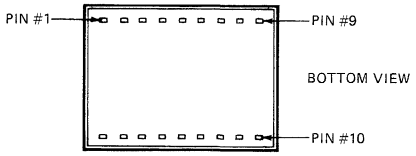
1. *The digit average Luminous Intensity is obtained by summing the Luminous Intensity of each segment and dividing by the total number of segments. Intensity will not vary more than ±33.3% between all segments within a digit.*
2. *The curve in Figure 3 is normalized to the brightness at 25°C to indicate the relative efficiency over the operating temperature range.*
3. *Leads of the device immersed to 1/16 inch from the body. Maximum device surface temperature is 140°C.*
4. *For flux removal, Freon TF, Freon TE, Isoproponal or water may be used up to their boiling points.*
5. *All displays are categorized for Luminous Intensity. The Intensity category is marked on each part as a suffix letter to the part number.*

0.560-INCH SEVEN SEGMENT DISPLAYS

PACKAGE DIMENSIONS

A





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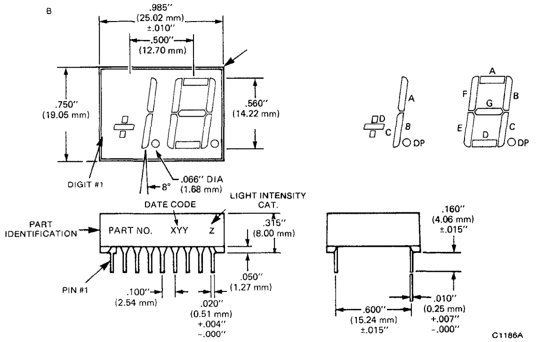

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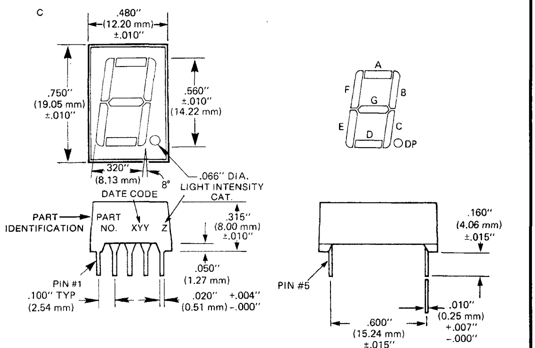
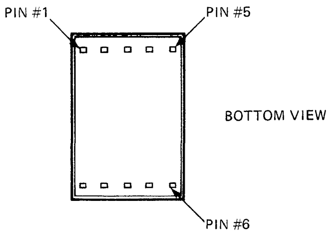




0.560-INCH
SEVEN SEGMENT DISPLAYS

ELECTRICAL CONNECTIONS

PIN NO.	ELECTRICAL CONNECTIONS					
	A MAN6910	**B MAN6930**	**C MAN6940**	**D MAN6950**	**E MAN6960**	**F MAN6980**
1	Cathode E 1	Cathode C 1	Anode E 1	Anode C 1	Cathode E	Anode E
2	Cathode D 1	Cathode D 1	Anode D 1	Anode D 1	Cathode D	Anode D
3	Cathode C 1	Cathode B 1	Anode C 1	Anode B 1	Com. Anode	Com. Cathode
4	Cathode D.P. 1	Cathode D.P. 1	Anode D.P. 1	Anode D.P. 1	Cathode C	Anode C
5	Cathode E 2	Cathode E 2	Anode E 2	Anode E 2	Cathode D.P.	Anode D.P.
6	Cathode D 2	Cathode D 2	Anode D 2	Anode D 2	Cathode B	Anode B
7	Cathode G 2	Cathode G 2	Anode G 2	Anode G 2	Cathode A	Anode A
8	Cathode C 2	Cathode C 2	Anode C 2	Anode C 2	Com. Anode	Com. Cathode
9	Cathode D.P. 2	Cathode D.P. 2	Anode D.P. 2	Anode D.P. 2	Cathode F	Anode F
10	Cathode B 2	Cathode B 2	Anode B 2	Anode B 2	Cathode G	Anode G
11	Cathode A 2	Cathode A 2	Anode A 2	Anode A 2		
12	Cathode F 2	Cathode F 2	Anode F 2	Anode F 2		
13	Anode Digit 2	Anode Digit 2	Cathode Digit 2	Cathode Digit 2		
14	Anode Digit 1	Anode Digit 1	Cathode Digit 1	Cathode Digit 1		
15	Cathode B 1	Cathode A 1	Anode B 1	Anode A 1		
16	Cathode A 1	No Connection	Anode A 1	No Connection		
17	Cathode G 1	No Connection	Anode G 1	No Connection		
18	Cathode F 1	No Connection	Anode F 1	No Connection		

TYPICAL CHARACTERISTIC CURVES

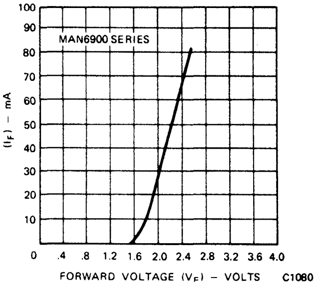


Fig. 1. Forward Current vs. Forward Voltage

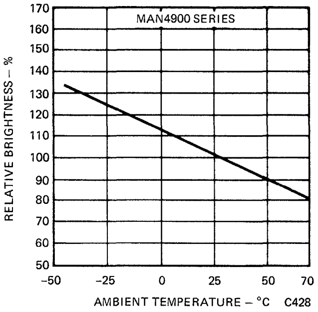


Fig. 2. Luminous Intensity vs. Forward Current

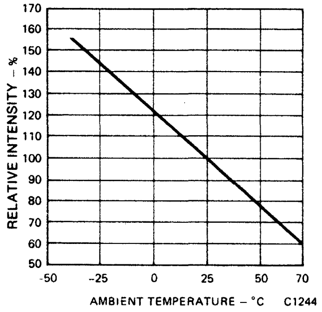


Fig. 3. Luminous Intensity vs. Temperature (See Note 2)

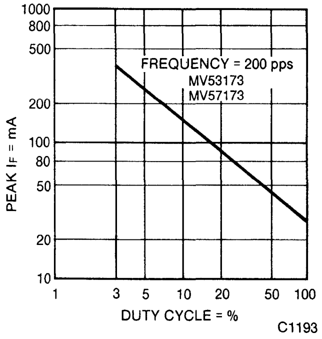


Fig. 4 Max Peak Current vs. Duty Cycle

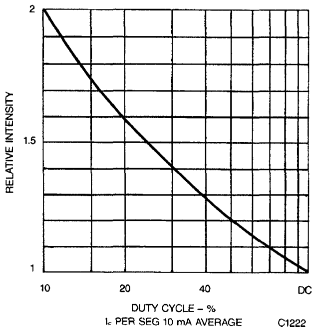


Fig. 5. Luminous Intensity vs. Duty Cycle

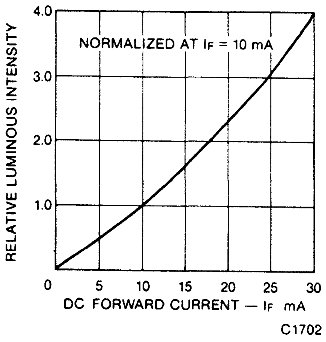
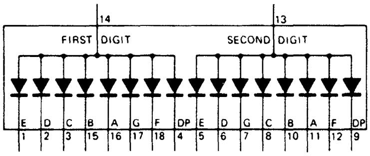
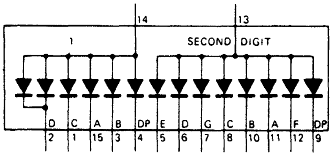


Fig. 6. Relative Luminous Intensity vs. Forward Current

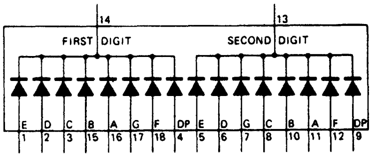
INTERNAL CONNECTIONS



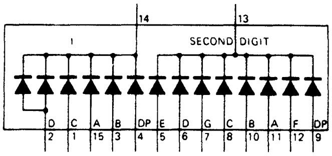
MAN6910 C1195



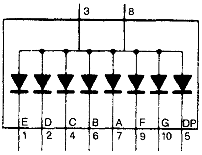
MAN6930 C1196



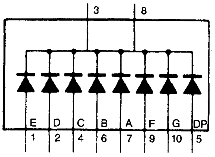
MAN6940 C1197



MAN6950 C1198



MAN6960 C1238

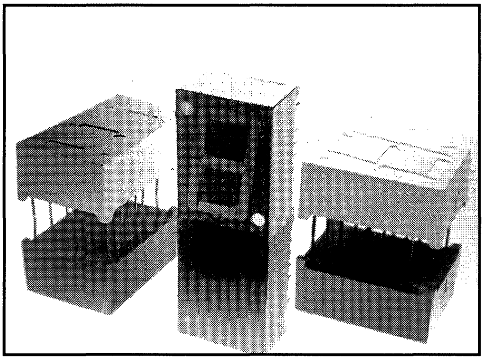


MAN6980 C1239

QT
OPTOELECTRONICS

0.800-INCH
SEVEN SEGMENT DISPLAYS

HIGH EFFICIENCY GREEN **MAN8400 SERIES**



DESCRIPTION

The MAN8400 Series is a family of large digits 0.8-inches in height. This series combines high brightness, large size, good aesthetics and is designed to be used where accurate readable displays need to be viewed over a distance. All models use right hand decimal points. The display ON and OFF contrast has been optimized for high ambient light conditions by use of a neutral Grey face and diffused White segments. Construction makes use of a metal leadframe, plastic reflector cap with epoxy-filled segments and back.

FEATURES

- High Efficiency Green nitrogen-doped GaAsP on GaP
- Large, easy to read, digits
- Common anode or common cathode models
- Fast switching — excellent for multiplexing
- Low power consumption
- Bold solid segments that are highly legible
- Solid state reliability — long operation life
- Rugged plastic construction
- Directly compatible with integrated circuits
- High brightness with high contrast
- Categorized for Luminous Intensity (See Note 5)
- Wide angle viewing...150°
- Low forward voltage
- Two-digit package simplifies alignment and assembly

APPLICATIONS

For industrial and consumer applications such as:

- Digital readout displays
- Instrument panels
- Point of sale equipment
- Digital clocks
- TV and radios

MODEL NUMBERS

PART NUMBER	COLOR	DESCRIPTION	PACKAGE DRAWING
MAN8410	High Efficiency Green	Common Anode; Right Hand Decimal	1
MAN8440	High Efficiency Green	Common Cathode; Right Hand Decimal	1

RECOMMENDED OPTICAL FILTERS

For optimum ON and OFF contrast, one of the following filters or equivalents should be used over the display:

DEVICE TYPE	FILTER
MAN8400 Series	Panelgraphic Green 48 Homalite 100-1440 Green Panelgraphic Grey 10 Homalite 100-1266 Grey

0.800-INCH
SEVEN SEGMENT DISPLAYS

ELECTRO-OPTICAL CHARACTERISTICS

(Per Diode at 25°C Free Air Temperature Unless Otherwise Specified)

	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS
Luminous Intensity, digit average (See Notes 1 and 4)	750	3200		μcd	I_F=10 mA
Pulsed Luminous Intensity, digit average	900	4000		μcd	I_F=60 mA peak 1:6 DF
Peak emission wavelength		562		nm	
Dominant wavelength		567		nm	
Spectral line half width		30		nm	
Forward voltage		2.2	3.0	V	I_F=20 mA
Dynamic resistance (See Figure 1)		12		Ω	I_F=20 mA
Light rise time		500		nsec	I_F=10 mA
Capacitance		40		pF	V=0, f=MHz
Reverse current			100	μA	V_R=3.0 V

ABSOLUTE MAXIMUM RATINGS

Power dissipation at 25°C ambient .... 600 mW
Derate linearly from 50°C .... −12 mW/°C
Storage and operating temperature .... −40°C to +85°C
Continuous forward current
  Total .... 240 mA
  Per segment .... 30 mA
  Decimal point .... 30 mA
Reverse voltage
  Per segment .... 6.0 V
  Decimal point .... 6.0 V
Soldering time at 260°C (See Notes 2 and 3) .... 5 sec.

TYPICAL THERMAL CHARACTERISTICS

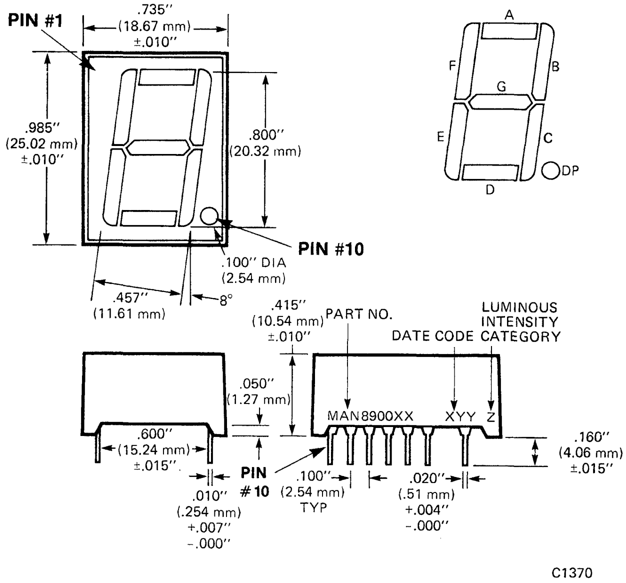
Thermal resistance junction to free air Φ_{JA} .... 160°C/W
Wavelength temperature coefficient (case temperature) .... 1.0Å/°C
Forward voltage temperature coefficient .... −1.4 mV/°C

NOTES

1. *The digit average Luminous Intensity is obtained by summing the Luminous Intensity of each segment and dividing by the total number of segments. Intensity will not vary more than ±33.3% between all segments within a digit.*
2. *Leads of the device immersed to 1/16 inch from the body. Maximum device surface temperature is 140°C.*
3. *For flux removal, Freon TF, Freon TE, Isoproponal or water may be used up to their boiling points.*
4. *Intensity adjusted for smaller areas of the "+" and decimal points.*
5. *All displays are categorized for Luminous Intensity. The Intensity category is marked on each part as a suffix letter to the part number.*

0.800-INCH
SEVEN SEGMENT DISPLAYS

PACKAGE DIMENSIONS



ELECTRICAL CONNECTIONS

	ELECTRICAL CONNECTIONS	
	MAN8410	**MAN8440**
	Digit	Digit
	Common Anode	Common Cathode
PIN #	Package Dimensions	Package Dimensions
1	No Connection	No Connection
2	A Cathode	A Anode
3	F Cathode	F Anode
4	Common Anode	Common Cathode
5	E Cathode	E Anode
6	—	—
7	E Cathode	E Anode
8	—	—
9	D Cathode	Common Cathode
10	DP Cathode	DP Anode
11	D Cathode	D Anode
12	Common Anode	Common Cathode
13	C Cathode	C Anode
14	G Cathode	G Anode
15	B Cathode	B Anode
16	—	—
17	Common Anode	Common Anode
18	—	—

0.800-INCH
SEVEN SEGMENT DISPLAYS

TYPICAL CHARACTERISTIC CURVES

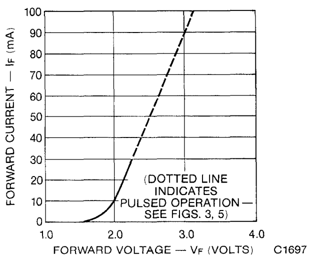


Fig. 1. Forward Current vs. Forward Voltage

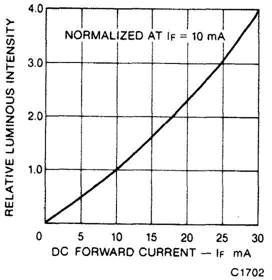


Fig. 2. Relative Luminous Intensity vs. DC Forward Current

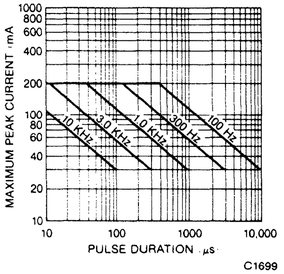


Fig. 3. Maximum Peak Current vs. Pulse Duration

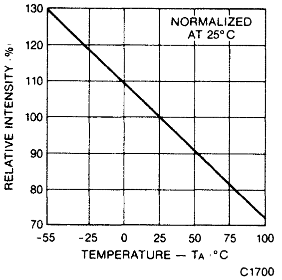


Fig. 4. Relative Luminous Intensity vs. Temperature

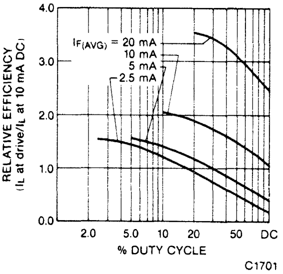
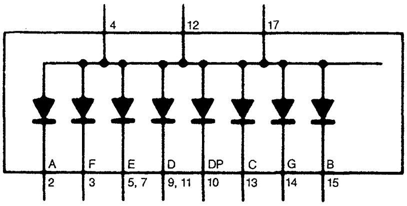
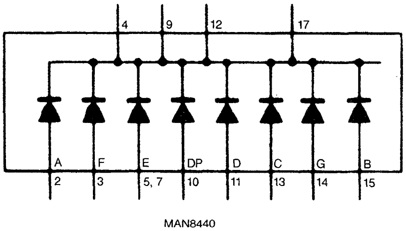


Fig. 5. Relative Efficiency vs. Duty Cycle

INTERNAL CONNECTIONS



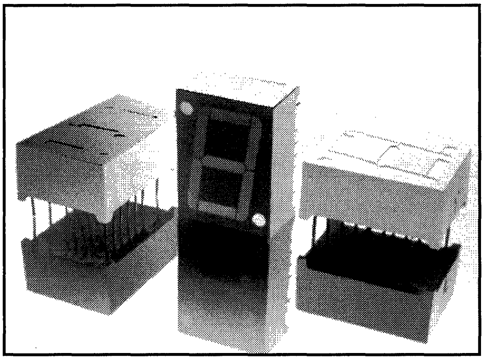
MAN8410



MAN8440

0.800-INCH
SEVEN SEGMENT DISPLAYS

HIGH EFFICIENCY RED (ORANGE) MAN8600 SERIES



DESCRIPTION

The MAN8600 Series is a family of large digits 0.8-inches in height. This series combines high brightness, large size, good aesthetics and is designed to be used where accurate readable displays need to be viewed over a distance. All models use right hand decimal points. Units are constructed with Grey face and neutral segment color.

FEATURES

- High performance nitrogen-doped GaAsP on GaP
- Large, easy to read, digits
- Common anode or common cathode models
- Fast switching — excellent for multiplexing
- Low power consumption
- Bold solid segments that are highly legible
- Solid state reliability — long operation life
- Rugged plastic construction
- Directly compatible with integrated circuits
- High brightness with high contrast
- Categorized for Luminous Intensity (See Note 6)
- Wide angle viewing...150°
- Low forward voltage
- Grey face for use in high ambient light conditions

APPLICATIONS

For industrial and consumer applications such as:
- Digital readout displays
- Instrument panels
- Point of sale equipment
- Digital clocks
- TV and radios

MODEL NUMBERS

PART NUMBER	COLOR	DESCRIPTION	PACKAGE DRAWING
MAN8610	High Efficiency Red (Orange)	Common Anode; Right Hand Decimal	1
MAN8640	High Efficiency Red (Orange)	Common Cathode; Right Hand Decimal	1

RECOMMENDED FILTERS

For optimum ON and OFF contrast, one of the following filters or equivalents should be used over the display:

Panelgraphic Scarlet 65
Homalite 100-1670

In situations of high ambient light, contrast with the Grey face can be enhanced by using a neutral density filter. The following or an equivalent can be used:

Panelgraphic Grey 10

0.800-INCH
SEVEN SEGMENT DISPLAYS

ELECTRO-OPTICAL CHARACTERISTICS
(25°C Free Air Temperature Unless Otherwise Specified)

	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS
Luminous Intensity, digit average (See Note 1)	600	2200		µcd	I_F=10 mA
Peak emission wavelength		630		nm	
Spectral line half width		40		nm	
Forward voltage					
Segment			2.5	V	I_F=20 mA
Decimal point			2.5	V	I_F=20 mA
Dynamic resistance					
Segment		26		Ω	I_F=20 mA
Decimal point		26		Ω	I_F=20 mA
Capacitance					
Segment		35		pF	V=0
Decimal point		35		pF	V=0
Reverse current					
Segment			100	µA	V_R=3.0 V
Decimal point			100	µA	V_R=3.0 V
Luminous Intensity Ratio I_L (segment-to-segment)			2:1	—	I_F=10 mA

ABSOLUTE MAXIMUM RATINGS

Power dissipation at 25°C ambient	600 mW
Derate linearly from 50°C	−8.6 mW/°C
Storage and operating temperature	−40°C to +85°C
Continuous forward current	
Total	240 mA
Per segment	30 mA
Decimal point	30 mA
Reverse voltage	
Per segment	6.0 V
Decimal point	6.0 V
Soldering time at 260°C (See Note 4)	5 sec.
Peak forward current per segment (I_{max}) (See Figure 4)	—

TYPICAL THERMAL CHARACTERISTICS

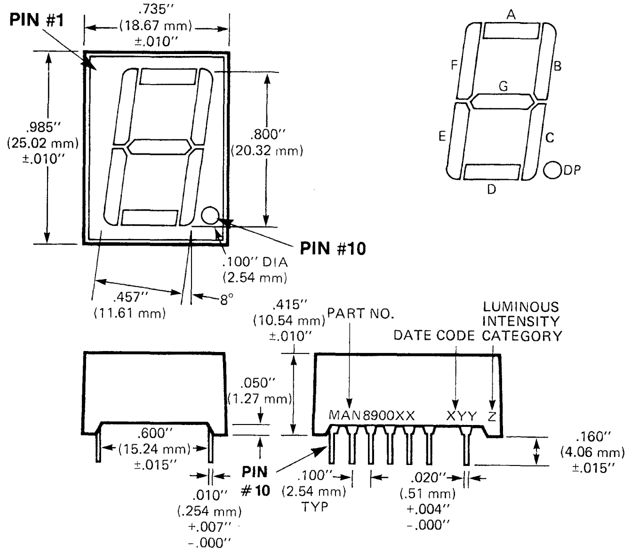
Thermal resistance junction to free air Φ_{JA}	160°C/W
Wavelength temperature coefficient (case temperature)	1.0Å/°C
Forward voltage temperature coefficient	−2.0 mV/°C

NOTES

1. *The digit average Luminous Intensity is obtained by summing the Luminous Intensity of each segment and dividing by the total number of segments. Intensity will not vary more than ±33.3% between all segments within a digit.*
2. *The curve in Figure 3 is normalized to the brightness at 25°C to indicate the relative efficiency over the operating temperature range.*
3. *Leads of the device immersed to 1/16 inch from the body. Maximum device surface temperature is 140°C.*
4. *For flux removal, Freon TF, Freon TE, Isoproponal or water may be used up to their boiling points.*
5. *All displays are categorized for Luminous Intensity. The Intensity category is marked on each part as a suffix letter to the part number.*

0.800-INCH
SEVEN SEGMENT DISPLAYS

PACKAGE DIMENSIONS



C1370

ELECTRICAL CONNECTIONS

	ELECTRICAL CONNECTIONS	
	MAN8610	**MAN8640**
	Digit	Digit
	Common Anode	Common Cathode
PIN #	Package Dimensions	Package Dimensions
1	No Connection	No Connection
2	A Cathode	A Anode
3	F Cathode	F Anode
4	Common Anode	Common Cathode
5	E Cathode	E Anode
6	—	—
7	E Cathode	E Anode
8	—	—
9	D Cathode	Common Cathode
10	DP Cathode	DP Anode
11	D Cathode	D Anode
12	Common Anode	Common Cathode
13	C Cathode	C Anode
14	G Cathode	G Anode
15	B Cathode	B Anode
16	—	—
17	Common Anode	Common Cathode
18	—	—

TYPICAL CHARACTERISTIC CURVES

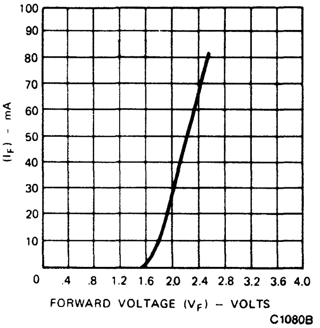


Fig. 1. Forward Current vs. Forward Voltage

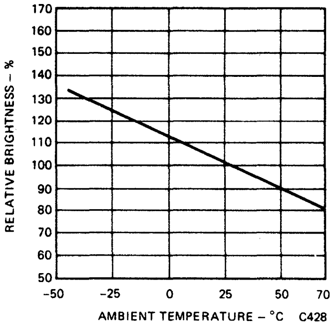


Fig. 2. Luminous Intensity vs. Temperature (See Note 2)

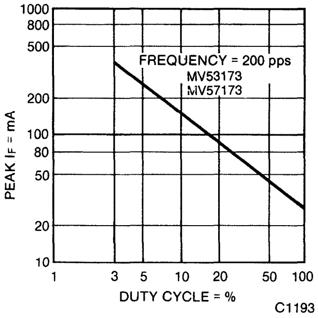


Fig. 3. Max Peak Current vs. Duty Cycle

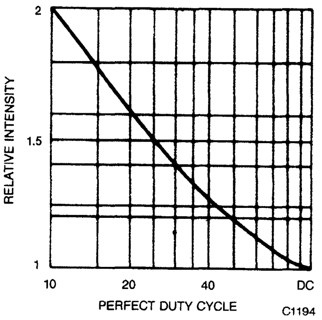


Fig. 4. Luminous Intensity vs. Duty Cycle

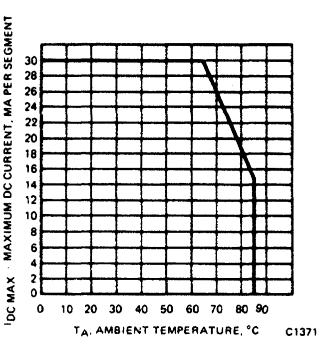


Fig. 5. Maximum DC Current vs. Temperature

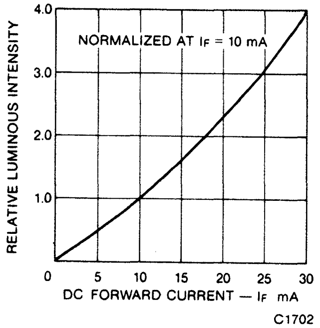
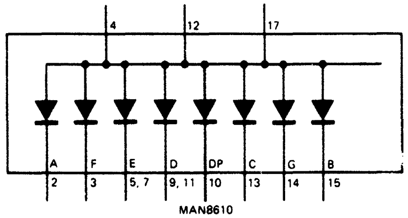
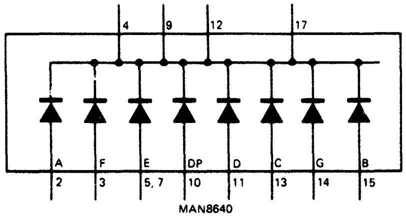


Fig. 6. Relative Luminous Intensity vs. Forward Current

INTERNAL CONNECTIONS

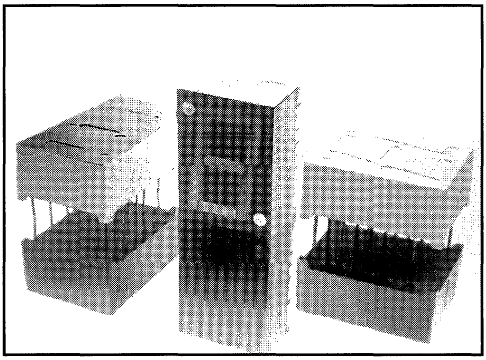




QT OPTOELECTRONICS

0.800-INCH SEVEN SEGMENT DISPLAYS

HIGH EFFICIENCY RED **MAN8900 SERIES**



DESCRIPTION

The MAN8900 Series is a family of large digits 0.8-inches in height. This series combines high brightness, large size, good aesthetics and is designed to be used where accurate readable displays need to be viewed over a distance. All models use right hand decimal points.

FEATURES

- High performance nitrogen-doped GaAsP on GaP
- Large, easy to read, digits
- Common anode or common cathode models
- Fast switching — excellent for multiplexing
- Low power consumption
- Bold solid segments that are highly legible
- Solid state reliability — long operation life
- Rugged plastic construction
- Directly compatible with integrated circuits
- High brightness with high contrast
- Categorized for Luminous Intensity (See Note 6)
- Wide angle viewing...150°
- Low forward voltage
- Red face and Red segment for good ON or OFF contrast
- These devices have a Red face and Red segments

APPLICATIONS

For industrial and consumer applications such as:

- Digital readout displays
- Instrument panels
- Point of sale equipment
- Digital clocks
- TV and radios

MODEL NUMBERS

PART NUMBER	COLOR	DESCRIPTION	PACKAGE DRAWING
MAN8910	High Efficiency Red	Common Anode; Right Hand Decimal	1
MAN8940	High Efficiency Red	Common Cathode; Right Hand Decimal	1

RECOMMENDED FILTERS

For optimum ON and OFF contrast, one of the following filters or equivalents should be used over the display:

Panelgraphic Scarlet 65
Homalite 100-1670

0.800-INCH SEVEN SEGMENT DISPLAYS

ELECTRO-OPTICAL CHARACTERISTICS

(25°C Free Air Temperature Unless Otherwise Specified)

	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS
Luminous Intensity, digit average (See Note 1)	600	2200		μcd	I_F=10 mA
Peak emission wavelength		635		nm	
Spectral line half width		40		nm	
Forward voltage					
Segment			2.5	V	I_F=20 mA
Decimal point			2.5	V	I_F=20 mA
Dynamic resistance					
Segment		26		Ω	I_F=20 mA
Decimal point		26		Ω	I_F=20 mA
Capacitance					
Segment		35		pF	V=0
Decimal point		35		pF	V=0
Reverse current					
Segment			100	μA	V_R=3.0 V
Decimal point			100	μA	V_R=3.0 V
Luminous Intensity Ratio I_L (segment-to-segment)			2:1	—	I_F=10 mA

ABSOLUTE MAXIMUM RATINGS

Power dissipation at 25°C ambient	600 mW
Derate linearly from 50°C	−8.6 mW/°C
Storage and operating temperature	−40°C to +85°C
Continuous forward current	
Total	240 mA
Per segment	30 mA
Decimal point	30 mA
Reverse voltage	
Per segment	6.0 V
Decimal point	6.0 V
Soldering time at 260°C (See Note 4)	5 sec.
Peak forward current per segment (I_{max}) (See Figure 4)	—

TYPICAL THERMAL CHARACTERISTICS

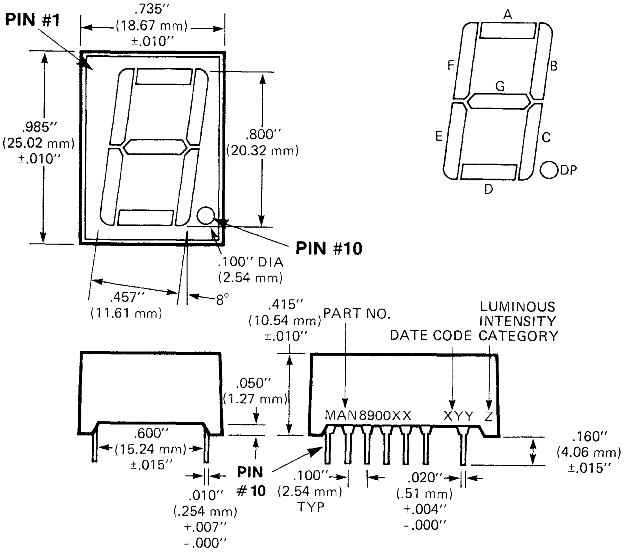
Thermal resistance junction to free air Φ_{JA}	160°C/W
Wavelength temperature coefficient (case temperature)	1.0Å/°C
Forward voltage temperature coefficient	−2.0 mV/°C

NOTES

1. *The digit average Luminous Intensity is obtained by summing the Luminous Intensity of each segment and dividing by the total number of segments. Intensity will not vary more than ±33.3% between all segments within a digit.*
2. *The curve in Figure 3 is normalized to the brightness at 25°C to indicate the relative efficiency over the operating temperature range.*
3. *Leads of the device immersed to 1/16 inch from the body. Maximum device surface temperature is 140°C.*
4. *For flux removal, Freon TF, Freon TE, Isoproponal or water may be used up to their boiling points.*
5. *All displays are categorized for Luminous Intensity. The Intensity category is marked on each part as a suffix letter to the part number.*

0.800-INCH
SEVEN SEGMENT DISPLAYS

PACKAGE DIMENSIONS



C1370

ELECTRICAL CONNECTIONS

	ELECTRICAL CONNECTIONS	
	MAN8910	**MAN8940**
	Digit	Digit
	Common Anode	Common Cathode
PIN #	Package Dimensions	Package Dimensions
1	No Connection	No Connection
2	A Cathode	A Anode
3	F Cathode	F Anode
4	Common Anode	Common Cathode
5	E Cathode	E Anode
6	—	—
7	E Cathode	E Anode
8	—	—
9	D Cathode	Common Cathode
10	DP Cathode	DP Anode
11	D Cathode	D Anode
12	Common Anode	Common Cathode
13	C Cathode	C Anode
14	G Cathode	G Anode
15	B Cathode	B Anode
16	—	—
17	Common Anode	Common Cathode
18	—	—

0.800-INCH SEVEN SEGMENT DISPLAYS

TYPICAL CHARACTERISTIC CURVES

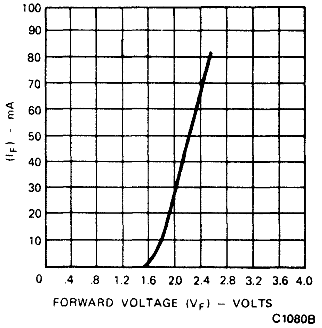


Fig. 1. Forward Current vs. Forward Voltage

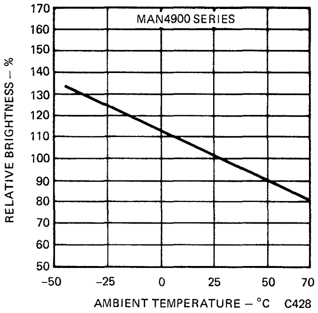


Fig. 2. Luminous Intensity vs. Temperature (See Note 2)

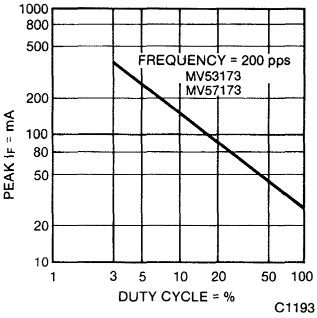


Fig. 3. Max Peak Current vs. Duty Cycle

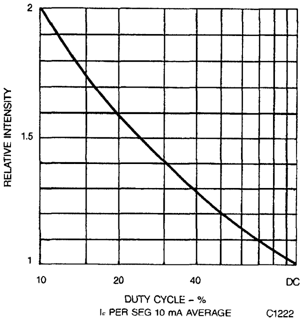


Fig. 4. Luminous Intensity vs. Duty Cycle

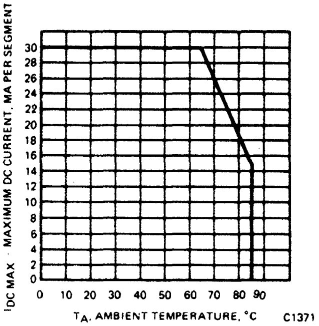


Fig. 5. Maximum DC Current vs. Temperature

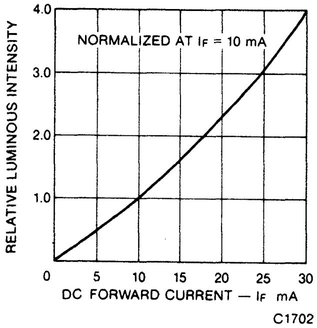
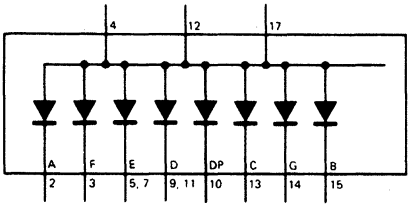
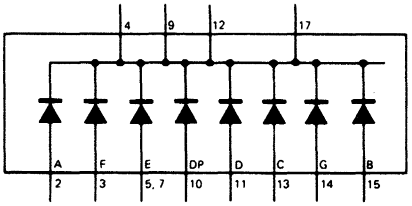


Fig. 6. Relative Luminous Intensity vs. Forward Current

INTERNAL CONNECTIONS



MAN8910



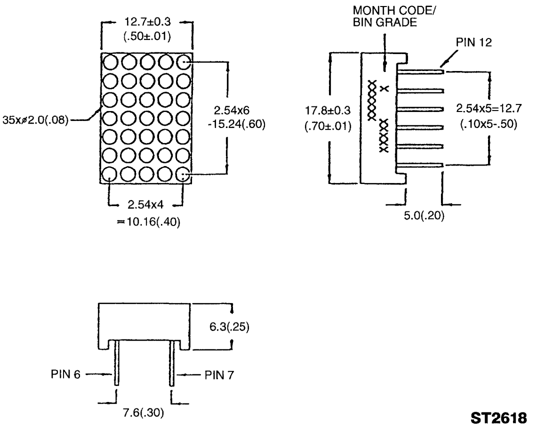
MAN8940

QT
OPTOELECTRONICS

0.7″ 5×7
DOT MATRIX DISPLAYS

HER GMA 7175C GMC 7175C
YELLOW GMA 7475C GMC 7475C
GREEN GMA 7975C GMC 7975C

PACKAGE DIMENSIONS



ST2618

NOTES:
1. ALL PINS ARE ø0.5 (.02).
2. DIMENSION IN MILLIMETERS (INCH), TOLERANCE IS 0.25 (.01) UNLESS OTHERWISE NOTED.

DESCRIPTION

The GMX7X75C series are 0.7″ (17.2mm) matrix height 5 X 7 dot matrix displays. All these parts are available in grey face and white dot color.

The X in GMX denotes row anode or row cathode.

FEATURES

- 0.7″ (17.8mm) matrix height
- Choice of 3 colors — green, yellow and HER
- Low power consumption
- 5×7 array with X-Y select
- Stackable vertically and horizontally
- Choice of 2 matrix orientation cathode column or anode column
- Easy mounting on PCB or sockets
- Categorized for luminous intensity

ABSOLUTE MAXIMUM RATING (T_A=25°C unless otherwise specified)

	YELLOW	HER	GREEN	UNITS
Power dissipation per dot	60	70	75	mW
Peak forward current per dot (Duty cycle 1/10, 10KHz)	80	100	100	mA
Continuous I_F per dot	20	25	25	mA
Reverse voltage per dot	5	5	5	V
Operating and operating temperature range				−25°C to +85°C
Soldering time at 260°C (1/16 inch below seating plane)				3 sec

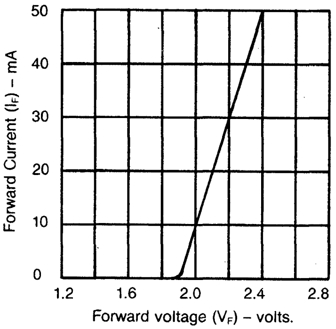
0.7″ 5×7
DOT MATRIX DISPLAYS

ELECTRICAL/OPTICAL CHARACTERISTICS (T_A=25°C Unless otherwise specified) GMX 7175C (HER)

PARAMETER	MIN	TYP	MAX	UNITS	TEST CONDITIONS
Average luminous intensity		3000		μcd	I_F=20 mA
Peak emission wavelength		635		nm	I_F=20 mA
Spectral line half-width		40		nm	I_F=20 mA
Forward voltage, any dot		2.1	2.8	V	I_F=20 mA
Reverse voltage, any dot			100	μA	V_R=5V

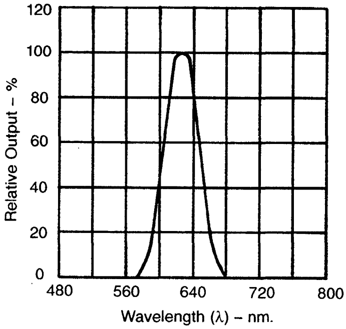
TYPICAL ELECTRICAL/OPTICAL CHARACTERISTIC CURVES

(T_A=25°C Unless otherwise specified)



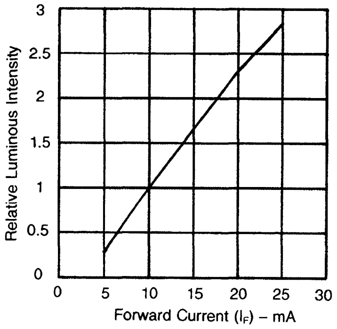
C3031

Fig. 1. Forward Current vs. Forward Voltage



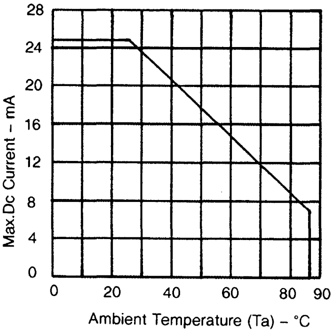
C3032

Fig. 2. Spectral Response



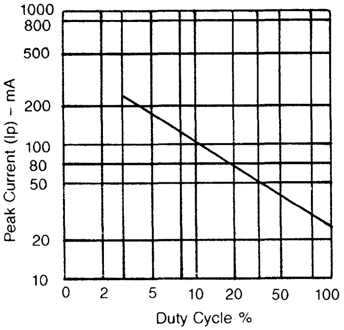
C3033

Fig. 3. Relative Luminous Intensity vs. Forward Current (Per Segment)



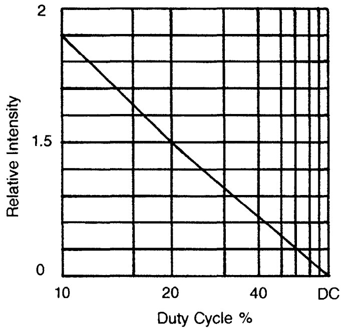
C3034

Fig. 4. Max. Forward Allowable DC Current Per Seg. vs. Ambient Temperature



C3035

Fig. 5. Max. Peak Current vs. Duty Circle % (Refresh Rate–F=1 KHz)



C3036

Fig. 6. Luminous Intensity vs. Duty Cycle % (Average 1=10 mA Per Seg.)

QT
OPTOELECTRONICS

0.7″ 5×7
DOT MATRIX DISPLAYS

ELECTRICAL/OPTICAL CHARACTERISTICS (T_A=25°C Unless otherwise specified)
GMX 7475C (YELLOW)

PARAMETER	MIN	TYP	MAX	UNITS	TEST CONDITIONS
Average luminous intensity		3000		μcd	I_F=20 mA
Peak emission wavelength		585		nm	I_F=20 mA
Spectral line half-width		35		nm	I_F=20 mA
Forward voltage, any dot		2.1	2.8	V	I_F=20 mA
Reverse voltage, any dot			100	μA	V_R=5V

TYPICAL ELECTRICAL/OPTICAL CHARACTERISTIC CURVES
(T_A=25°C Unless Otherwise Noted)

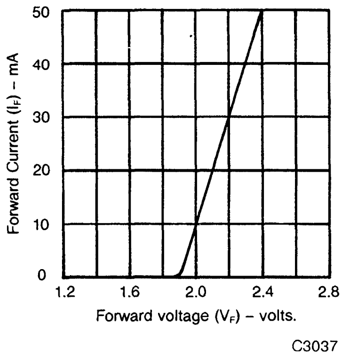


Fig. 1. Forward Current vs. Forward Voltage

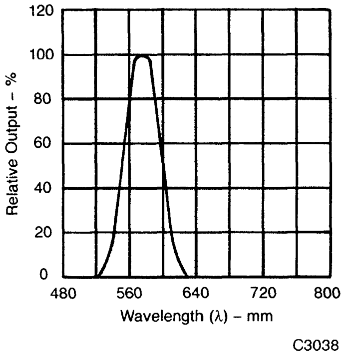


Fig. 2. Spectral Response

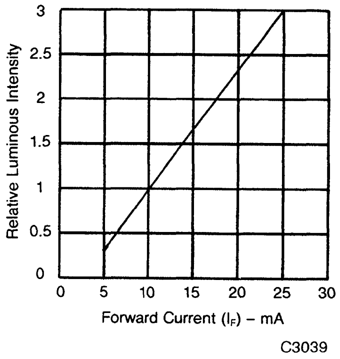


Fig. 3. Relative Luminous Intensity vs. Forward Current (Per Segment)

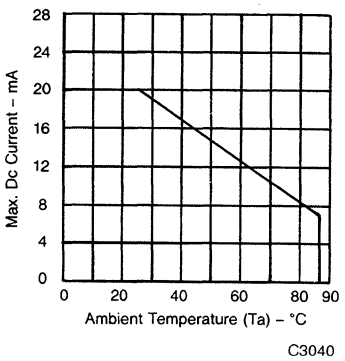


Fig. 4. Max. Forward Allowable DC Current Per Seg. vs. Ambient Temperature

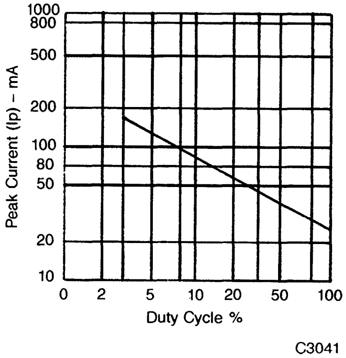


Fig. 5. Max. Peak Current vs. Duty Circle % (Refresh Rate–F=1 KHz)

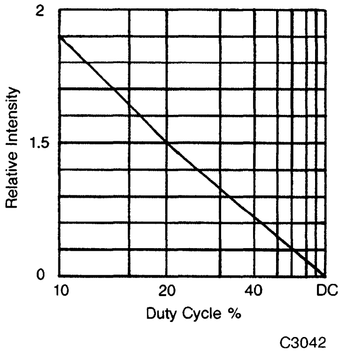


Fig. 6. Luminous Intensity vs. Duty Cycle % (Average 1=10 mA Per Seg.)

0.7″ 5×7
DOT MATRIX DISPLAYS

ELECTRICAL/OPTICAL CHARACTERISTICS (T_A=25°C Unless otherwise specified)
GMX 7975C (GREEN)

PARAMETER	MIN	TYP	MAX	UNITS	TEST CONDITIONS
Average luminous intensity		3000		μcd	I_F=20 mA
Peak emission wavelength		565		nm	I_F=20 mA
Spectral line half-width		30		nm	I_F=20 mA
Forward voltage, any dot		2.1	2.8	V	I_F=20 mA
Reverse voltage, any dot			100	μA	V_R=5V

TYPICAL ELECTRICAL/OPTICAL CHARACTERISTIC CURVES
(T_A=25°C Unless otherwise specified)

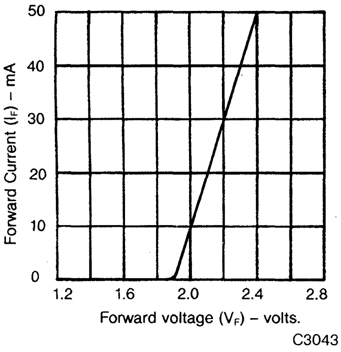


Fig. 1. Forward Current vs. Forward Voltage

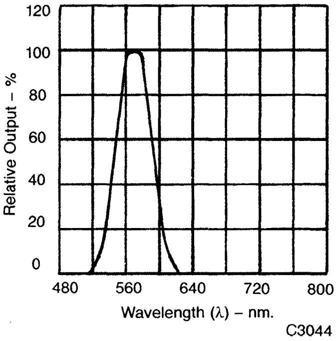


Fig. 2. Spectral Response

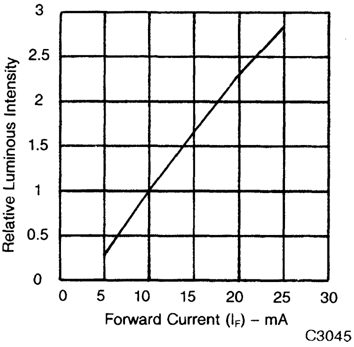


Fig. 3. Relative Luminous Intensity vs. Forward Current (Per Segment)

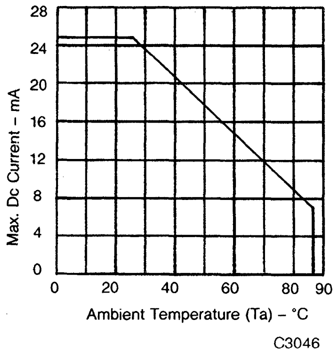


Fig. 4. Max. Forward Allowable DC Current Per Seg. vs. Ambient Temperature

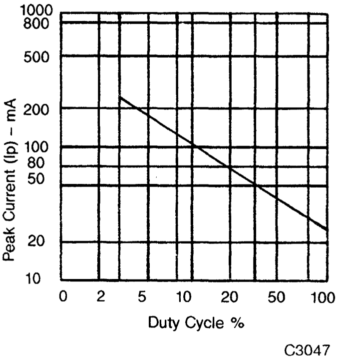


Fig. 5. Max. Peak Current vs. Duty Circle % (Refresh Rate–F=1 KHz)

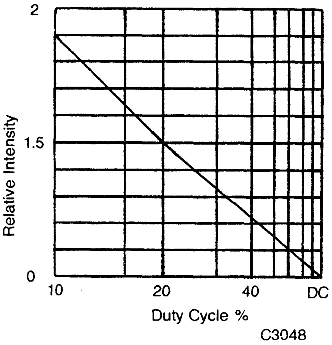


Fig. 6. Luminous Intensity vs. Duty Cycle % (Average 1=10 mA Per Seg.)

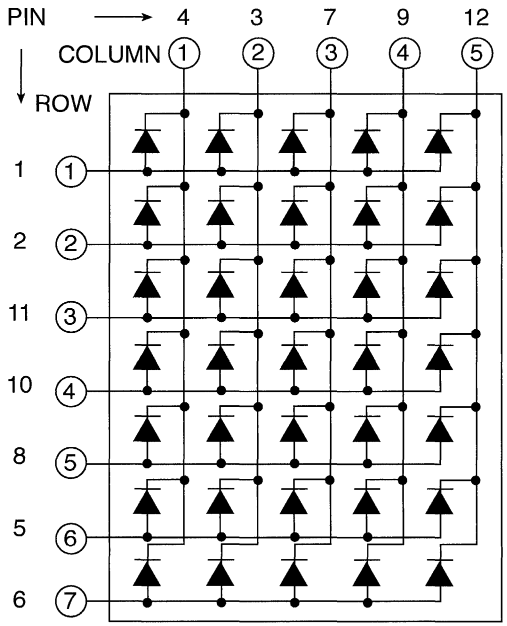
0.7″ 5×7
DOT MATRIX DISPLAYS

PIN CONNECTION

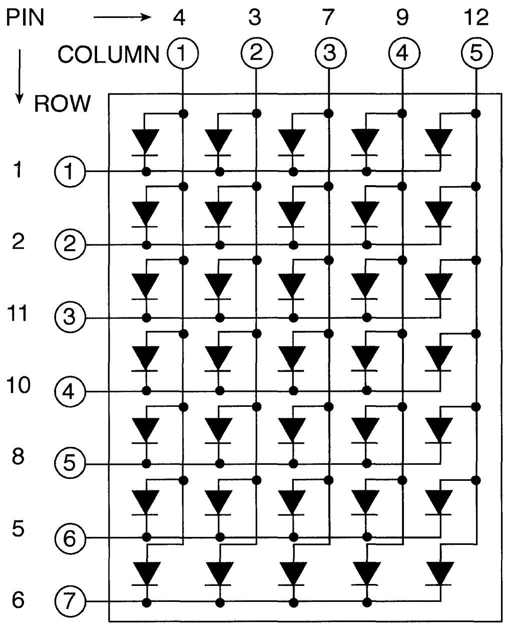
PIN NO.	GMA7X75C	GMC7X75C
1	Anode row 1	Cathode row 1
2	Anode row 2	Cathode row 2
3	Cathode column 2	Anode column 2
4	Cathode column 1	Anode column 1
5	Anode row 6	Cathode row 6
6	Anode row 7	Cathode row 7
7	Cathode column 3	Anode column 3
8	Anode row 5	Cathode row 5
9	Cathode column 4	Anode column 4
10	Anode row 4	Cathode row 4
11	Cathode row 3	Anode row 3
12	Cathode row 5	Anode row 5

INTERNAL CIRCUIT DIAGRAM

GMA7X75C



GMC7X75C

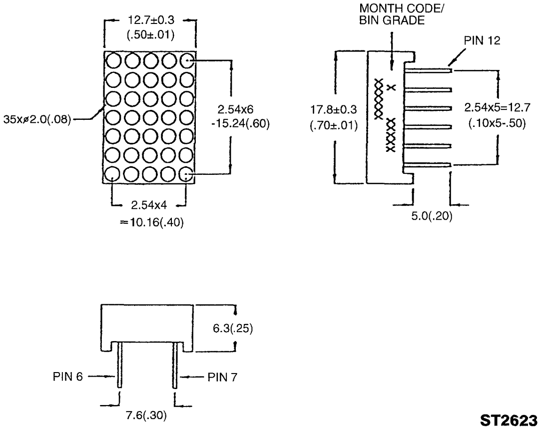


QT
OPTOELECTRONICS

0.7″ 5×7
DOT MATRIX DISPLAYS

HER **GMA 7175CA GMC 7175CA**
YELLOW **GMA 7475CA GMC 7475CA**
GREEN **GMA 7975CA GMC 7975CA**

PACKAGE DIMENSIONS



ST2623

NOTES:
1. ALL PINS ARE θ0.5 (.02).
2. DIMENSION IN MILLIMETERS (INCH), TOLERANCE IS 0.25 (.01) UNLESS OTHERWISE NOTED.

DESCRIPTION

The GMX7X75CA series are 0.7″ (17.2mm) matrix height 5 X 7 dot matrix displays. All these parts are available in grey face and white dot color.

The X in GMX denotes row anode or row cathode.

FEATURES

- 0.7″ (17.8mm) matrix height
- Choice of 3 colors — green, yellow and HER
- Low power consumption
- 5 X 7 array with X-Y select
- Stackable vertically and horizontally
- Choice of 2 matric orientation cathode column or anode column
- Easy mounting on PCB or sockets
- Categorized for luminous intensity

ABSOLUTE MAXIMUM RATING (T_A=25°C unless otherwise specified)

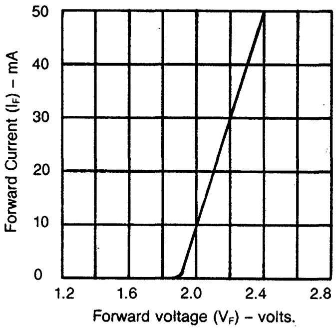
	YELLOW	HER	GREEN	UNITS
Power dissipation per dot	60	70	75	mW
Peak forward current per dot . . . . (Duty cycle 1/10, 10KHz)	80	100	100	mA
Continuous I_F per dot	20	25	25	mA
Reverse voltage per dot	5	5	5	V
Operating and operating temperature range				−25°C to +85°C
Soldering time at 260°C (1/16 inch below seating plane)				3 sec

0.7″ 5×7
DOT MATRIX DISPLAYS

ELECTRICAL/OPTICAL CHARACTERISTICS (T_A=25°C Unless otherwise specified)
GMX7175CA (HER)

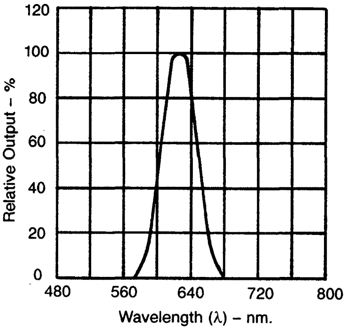
PARAMETER	MIN	TYP	MAX	UNITS	TEST CONDITIONS
Average luminous intensity		3000		μcd	I_F=20 mA
Peak emission wavelength		635		nm	I_F=20 mA
Spectral line half-width		40		nm	I_F=20 mA
Forward voltage, any dot		2.1	2.8	V	I_F=20 mA
Reverse voltage, any dot			100	μA	V_R=5V

TYPICAL ELECTRICAL/OPTICAL CHARACTERISTIC CURVES
(T_A=25°C Unless otherwise specified)



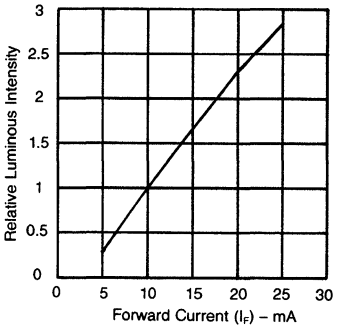
C3031

Fig. 1. Forward Current vs. Forward Voltage



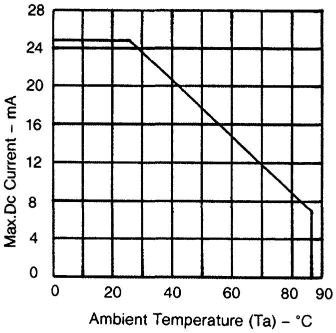
C3032

Fig. 2. Spectral Response



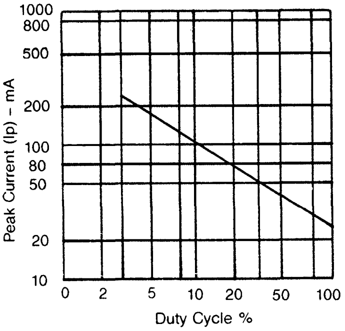
C3033

Fig. 3. Relative Luminous Intensity vs. Forward Current (Per Segment)



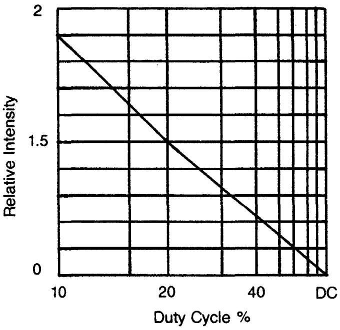
C3034

Fig. 4. Max. Forward Allowable DC Current Per Seg. vs. Ambient Temperature



C3035

Fig. 5. Max. Peak Current vs. Duty Circle % (Refresh Rate–F=1 KHz)



C3036

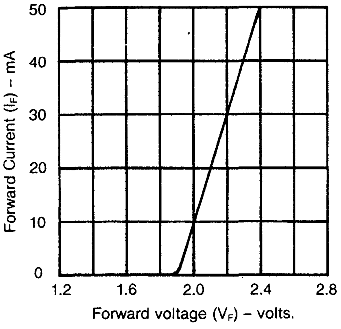
Fig. 6. Luminous Intensity vs. Duty Cycle % (Average 1=10 mA Per Seg.)

0.7″ 5×7
DOT MATRIX DISPLAYS

ELECTRICAL/OPTICAL CHARACTERISTICS (T_A=25°C Unless otherwise specified)
GMX 7475CA (YELLOW)

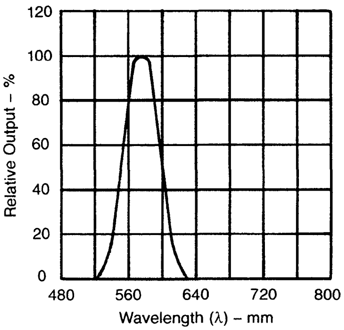
PARAMETER	MIN	TYP	MAX	UNITS	TEST CONDITIONS
Average luminous intensity		3000		µcd	I_F=20 mA
Peak emission wavelength		585		nm	I_F=20 mA
Spectral line half-width		35		nm	I_F=20 mA
Forward voltage, any dot		2.1	2.8	V	I_F=20 mA
Reverse voltage, any dot			100	µA	V_R=5V

TYPICAL ELECTRICAL/OPTICAL CHARACTERISTIC CURVES
(T_A=25°C Unless Otherwise Noted)



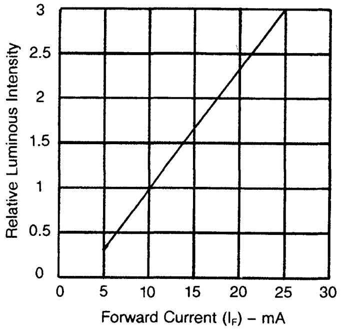
C3037

Fig. 1. Forward Current vs. Forward Voltage



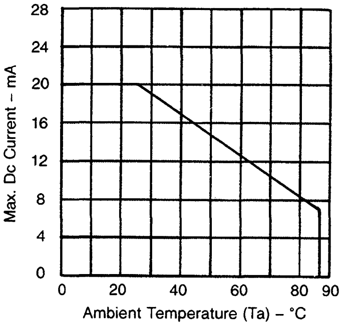
C3038

Fig. 2. Spectral Response



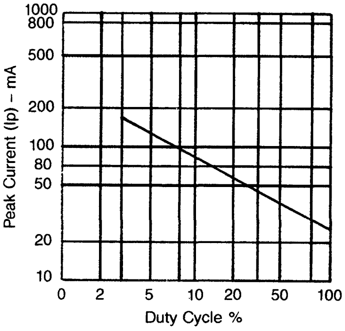
C3039

Fig. 3. Relative Luminous Intensity vs. Forward Current (Per Segment)



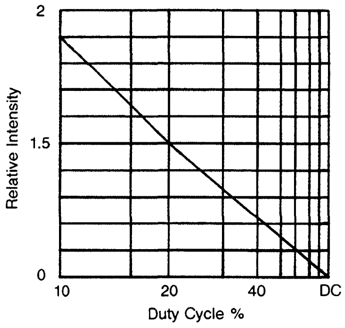
C3040

Fig. 4. Max. Forward Allowable DC Current Per Seg. vs. Ambient Temperature



C3041

Fig. 5. Max. Peak Current vs. Duty Circle % (Refresh Rate–F=1 KHz)



C3042

Fig. 6. Luminous Intensity vs. Duty Cycle % (Average 1=10 mA Per Seg.)

ELECTRICAL/OPTICAL CHARACTERISTICS (T_A=25°C Unless otherwise specified) GMX 7975CA (GREEN)

PARAMETER	MIN	TYP	MAX	UNITS	TEST CONDITIONS
Average luminous intensity		3000		μcd	I_F=20 mA
Peak emission wavelength		565		nm	I_F=20 mA
Spectral line half-width		30		nm	I_F=20 mA
Forward voltage, any dot		2.1	2.8	V	I_F=20 mA
Reverse voltage, any dot			100	μA	V_R=5V

TYPICAL ELECTRICAL/OPTICAL CHARACTERISTIC CURVES

(T_A=25°C Unless otherwise specified)

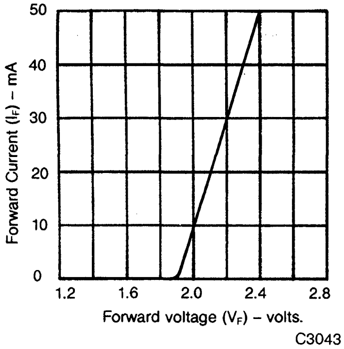


Fig. 1. Forward Current vs. Forward Voltage

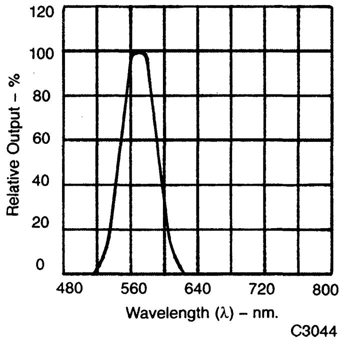


Fig. 2. Spectral Response

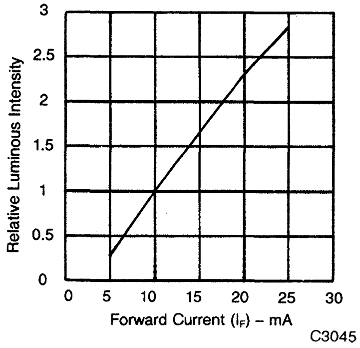


Fig. 3. Relative Luminous Intensity vs. Forward Current (Per Segment)

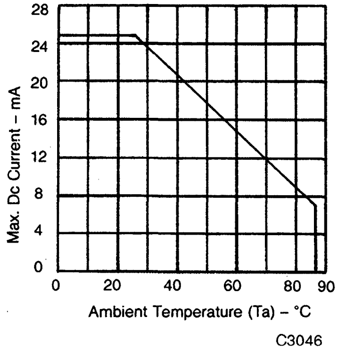


Fig. 4. Max. Forward Allowable DC Current Per Seg. vs. Ambient Temperature

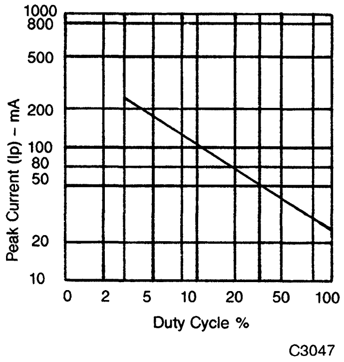


Fig. 5. Max. Peak Current vs. Duty Circle % (Refresh Rate–F=1 KHz)

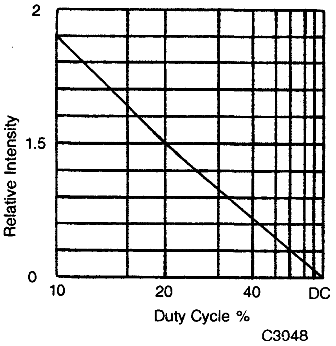


Fig. 6. Luminous Intensity vs. Duty Cycle % (Average 1=10 mA Per Seg.)

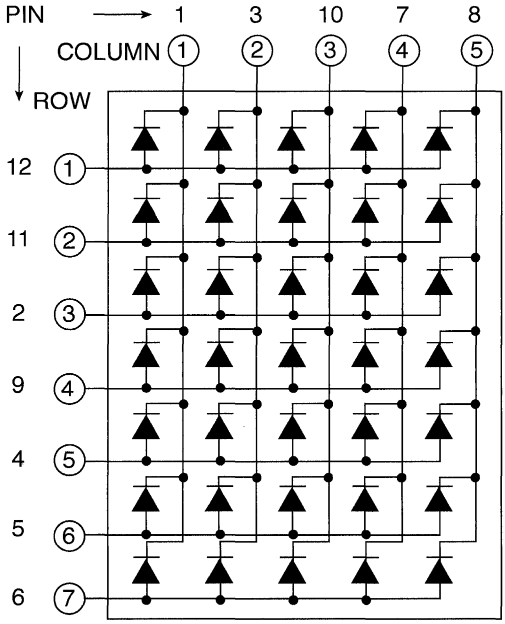
0.7″ 5×7
DOT MATRIX DISPLAYS

PIN CONNECTION

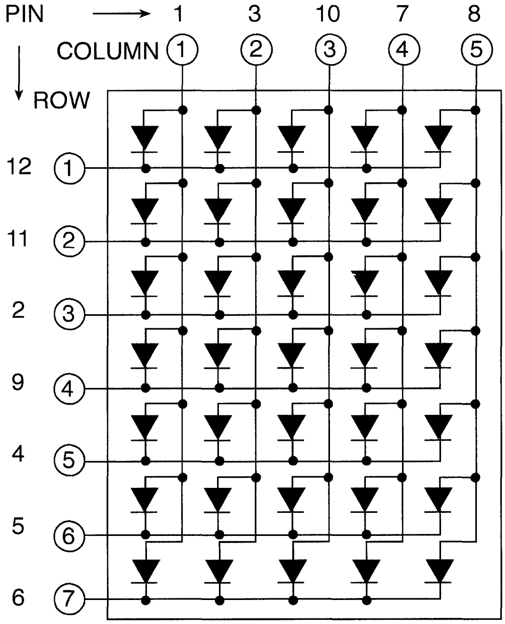
PIN NO.	GMA7X75CA	GMC7X75CA
1	Cathode column 1	Anode column 1
2	Anode row 3	Cathode row 3
3	Cathode column 2	Anode column 2
4	Anode row 5	Cathode row 5
5	Anode row 6	Cathode row 6
6	Anode row 7	Cathode row 7
7	Cathode column 4	Anode column 4
8	Cathode column 5	Anode column 5
9	Anode row 4	Cathode row 4
10	Cathode column 3	Anode column 3
11	Anode row 2	Cathode row 2
12	Anode row 1	Cathode row 1

INTERNAL CIRCUIT DIAGRAM

GMA7X75CA



GMC7X75CA



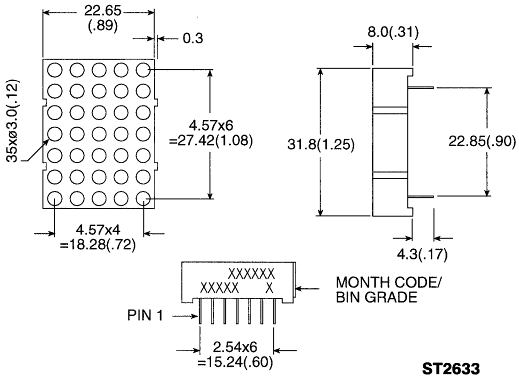
QT
OPTOELECTRONICS

1.2″ 5 × 7 DOT MATRIX DISPLAYS

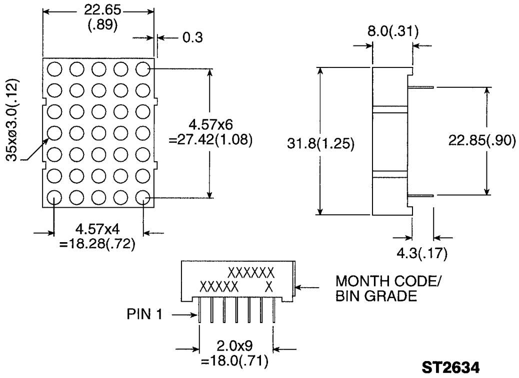
YELLOW GMA 8475C GMC 8475C
HER GMA 8875C GMC 8875C
GREEN GMA 8975C GMC 8975C
BICOLOR- RED/GREEN GMA 8675C GMC 8675C

PACKAGE DIMENSIONS

A. GMX8X75C



B. GMX8675C



NOTES:
1. ALL PINS ARE ø0.5 (.02).
2. DIMENSIONS IN MILLIMETER (INCH), TOLERANCE IS ±0.25 (.01) UNLESS OTHERWISE NOTED.

DESCRIPTION

The GMX8X75C series are 1.2″ (30 mm) matrix height 5 × 7 dot matrix displays. All these parts are available in gray face and white dot color.

The X in GMX denotes row anode or row cathode.

FEATURES

- 1.2″ (30 mm) matrix height
- Choice of 3 colors — green, yellow & HER and bicolor — red/green
- Low power consumption
- 5 × 7 array with X-Y select
- Stackable horizontally
- Choice of 2 matrix orientation cathode column or anode column
- Easy mounting or PCB on sockets
- Categorized for luminous intensity
- Multicolor color displays are applicable to 3 bright colors — green, orange (HER) and yellow (green and HER mixed)

1.2″ 5 × 7
DOT MATRIX DISPLAYS

ABSOLUTE MAXIMUM RATING (T_A = 25°C unless otherwise specified)

PARAMETER	YELLOW	HER	GREEN	UNITS
Power dissipation per dot	60	70	75	mW
Peak forward current per dot (Duty cycle 1/10, 10KHz)	80	100	100	mA
Continuous I_F per dot	20	5	25	mA
Reverse voltage per dot	5	5	5	V

Operating and storage temperature range . . . . . −25°C to +85°C
Soldering time at 260°C (1⁄16 inch below seating plane) . . . . . 3 sec

MODEL NUMBERS

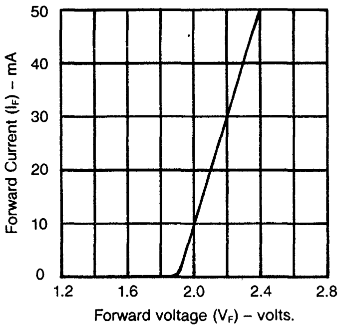
PART NO.						
YELLOW	HER	GREEN	MULTI-COLOR	DESCRIPTION	PACKAGE DIMENSION	INTERNAL CIRCUIT DIAGRAM
GMC8475C	GMC8875C	GMC8975C		Anode column, cathode row	A	A
GMA8475C	GMA8875C	GMA8975C		Cathode column, anode row	A	B
			GMA8675C	Cathode column, anode row	B	C
			GMC8675C	Anode column, cathode row	B	D

1.2″ 5 × 7
DOT MATRIX DISPLAYS

ELECTRICAL/OPTICAL CHARACTERISTICS (T_A = 25°C Unless otherwise specified) GMX8475C (YELLOW)

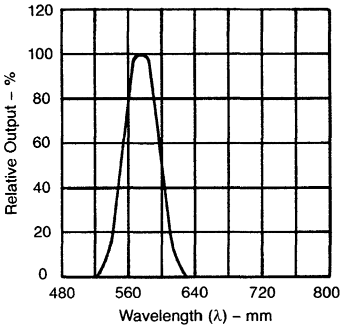
PARAMETER	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS
Average luminous intensity		3000		μcd	I_F=20 mA
Peak emission wavelength		585		nm	I_F=20 mA
Spectral line half-width		35		nm	I_F=20 mA
Forward voltage, any dot		2.1	2.8	V	I_F=20 mA
Reverse voltage, any dot			100	μA	V_R=5 V

TYPICAL ELECTRICAL/OPTICAL CHARACTERISTIC CURVES
(T_A=25°C Unless otherwise specified)



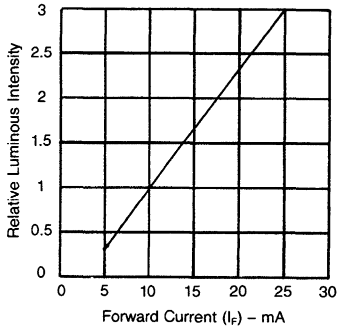
C3037

Fig. 1. Forward Current vs. Forward Voltage



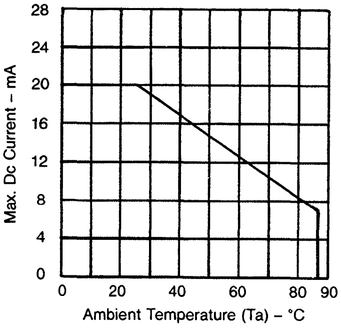
C3038

Fig. 2. Spectral Response



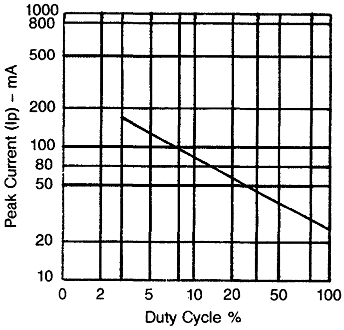
C3039

Fig. 3. Relative Luminous Intensity vs. Forward Current (Per Segment)



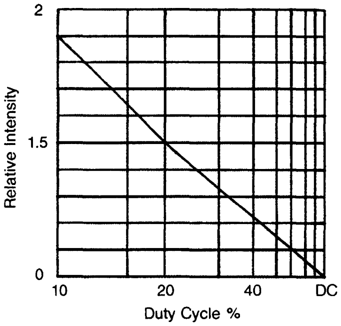
C3040

Fig. 4. Maximum Forward Allowable DC Current Per Segment vs. Ambient Temperature



C3041

Fig. 5. Max Peak Current vs. Duty Cycle % (Refresh Rate f=1 KHz)



C3042

Fig. 6. Luminous Intensity vs. Duty Cycle % (Average 1=10 mA Per Seg.)

OPTOELECTRONICS

1.2″ 5 × 7
DOT MATRIX DISPLAYS

ELECTRICAL/OPTICAL CHARACTERISTICS (T_A = 25°C Unless otherwise specified)
GMX8875C (HER)

PARAMETER	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS
Average luminous intensity		3000		μcd	I_F=20 mA
Peak emission wavelength		635		nm	I_F=20 mA
Spectral line half-width		30		nm	I_F=20 mA
Forward voltage, any dot		2.1	2.8	V	I_F=20 mA
Reverse voltage, any dot			100	μA	V_R=5 V

TYPICAL ELECTRICAL/OPTICAL CHARACTERISTIC CURVES
(T_A = 25°C Unless otherwise specified)

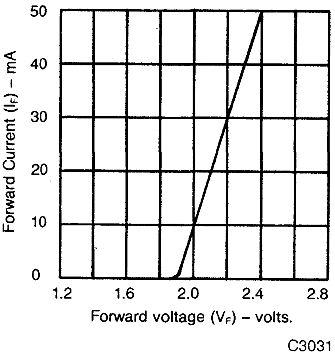


Fig. 1. Forward Current vs. Forward Voltage

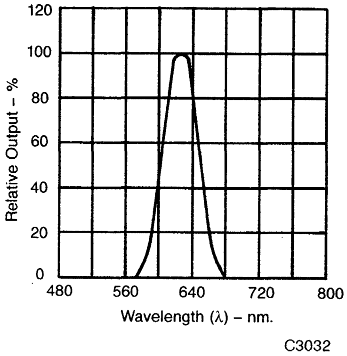


Fig. 2. Spectral Response

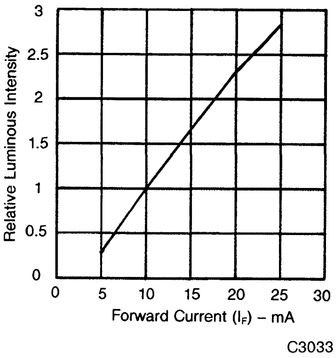


Fig. 3. Relative Luminous Intensity vs. Forward Current (Per Segment)

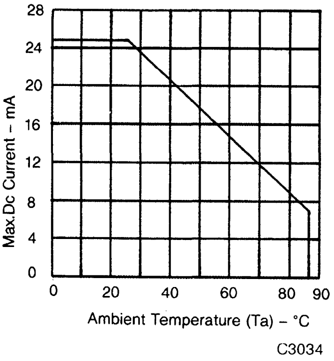


Fig. 4. Maximum Forward Allowable DC Current Per Segment vs. Ambient Temperature

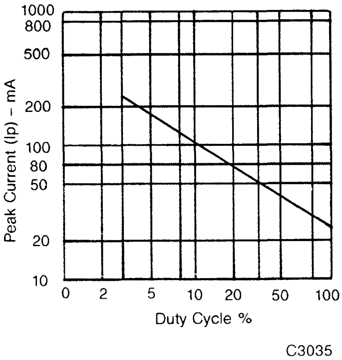


Fig. 5. Max Peak Current vs. Duty Cycle % (Refresh Rate f=1 KHz)

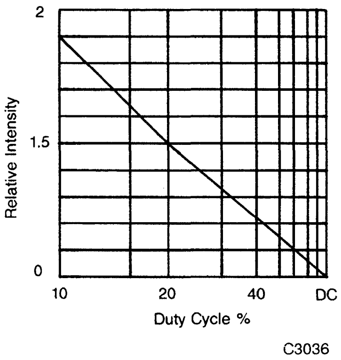


Fig. 6. Luminous Intensity vs. Duty Cycle % (Average 1=10 mA Per Seg.)

1.2″ 5 × 7
DOT MATRIX DISPLAYS

ELECTRICAL/OPTICAL CHARACTERISTICS (T_A = 25°C Unless otherwise specified)
GMX8975C (GREEN)

PARAMETER	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS
Average luminous intensity		3000		μcd	I_F=20 mA
Peak emission wavelength		565		nm	I_F=20 mA
Spectral line half-width		30		nm	I_F=20 mA
Forward voltage, any dot		2.1	2.8	V	I_F=20 mA
Reverse voltage, any dot			100	μA	V_R=5 V

TYPICAL ELECTRICAL/OPTICAL CHARACTERISTIC CURVES
(T_A = 25°C Unless otherwise specified)

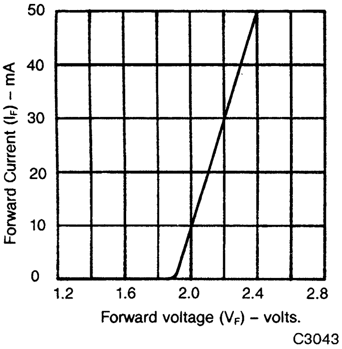


Fig. 1. Forward Current vs. Forward Voltage

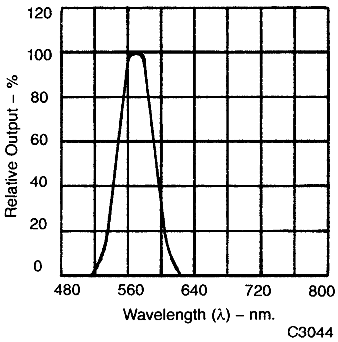


Fig. 2. Spectral Response

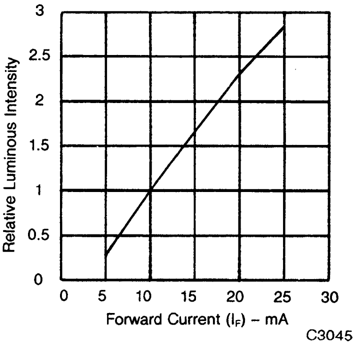


Fig. 3. Relative Luminous Intensity vs. Forward Current (Per Segment)

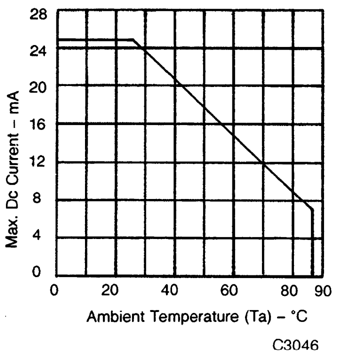


Fig. 4. Maximum Forward Allowable DC Current Per Segment vs. of Ambient Temperature

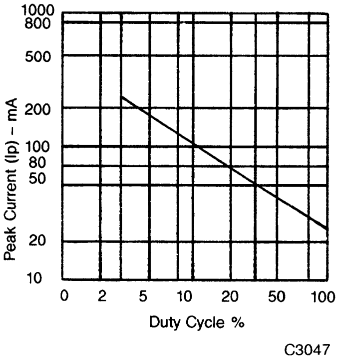


Fig. 5. Max Peak Current vs. Duty Cycle % (Refresh Rate f=1 KHz)

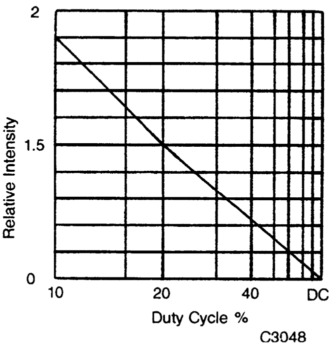


Fig. 6. Luminous Intensity vs. Duty Cycle % (Average 1=10 mA Per Seg.)

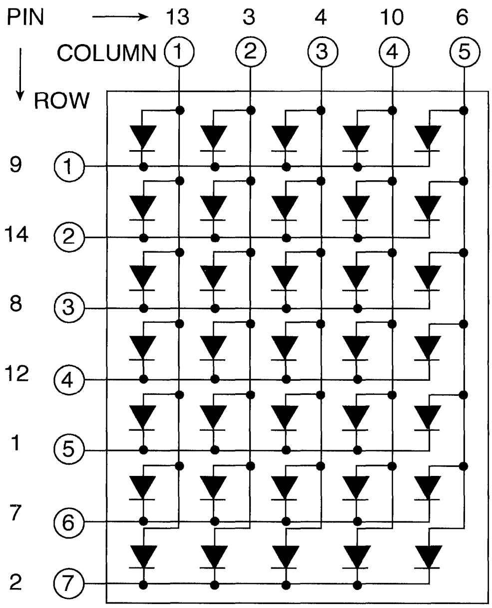
PIN CONNECTION

PIN NO.	GMA8X75C	GMC8X75C	GMC8675C	GMA8675C
1	Anode row 5	Cathode row 5	Cathode row 7 green	Anode row 7 green
2	Anode row 7	Cathode row 7	Cathode row 7 HER	Anode row 7 HER
3	Cathode column 2	Anode column 2	Anode column 1	Cathode column 1
4	Cathode column 3	Anode column 3	Anode column 2	Cathode column 2
5	Anode row 4	Cathode row 4	Anode column 3	Cathode column 3
6	Cathode column 5	Anode column 5	Anode column 4	Cathode column 4
7	Anode row 6	Cathode row 6	Anode column 5	Cathode column 5
8	Anode row 3	Cathode row 3	Cathode row 6 green	Anode row 6 green
9	Anode row 1	Cathode row 1	Cathode row 6 HER	Anode row 6 HER
10	Cathode column 4	Anode column 4	No connection	No connection
11	Cathode column 3	Anode column 3	Cathode row 5 green	Anode row 5 green
12	Anode row 4	Cathode row 4	Cathode row 5 HER	Anode row 5 HER
13	Cathode column 1	Anode column 1	Cathode row 4 green	Anode row 4 green
14	Anode row 2	Cathode row 2	Cathode row 4 HER	Anode row 4 HER
15			Cathode row 3 green	Anode row 3 green
16			Cathode row 3 HER	Anode row 3 HER
17			Cathode row 2 green	Anode row 2 green
18			Cathode row 2 HER	Anode row 2 HER
19			Cathode row 1 green	Anode row 1 green
20			Cathode row 1 HER	Anode row 1 HER

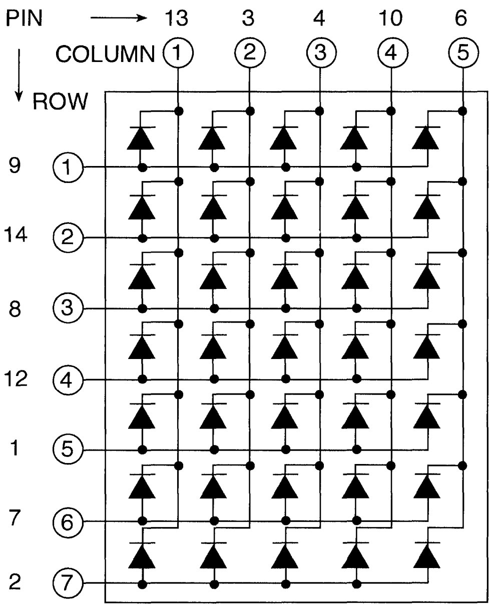
1.2″ 5 × 7
DOT MATRIX DISPLAYS

INTERNAL CIRCUIT DIAGRAM

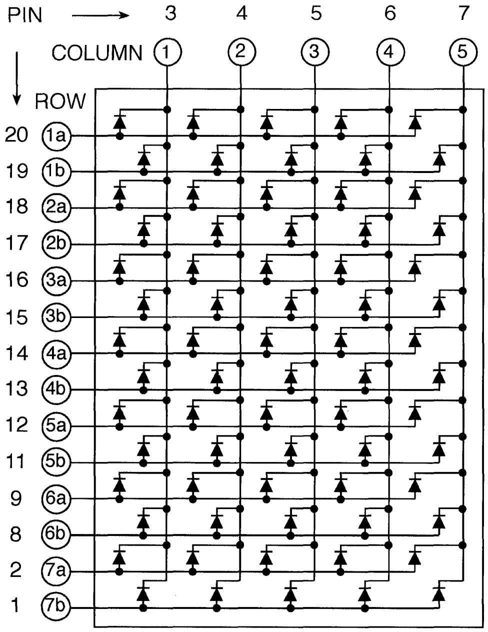
A. GMC8X75C



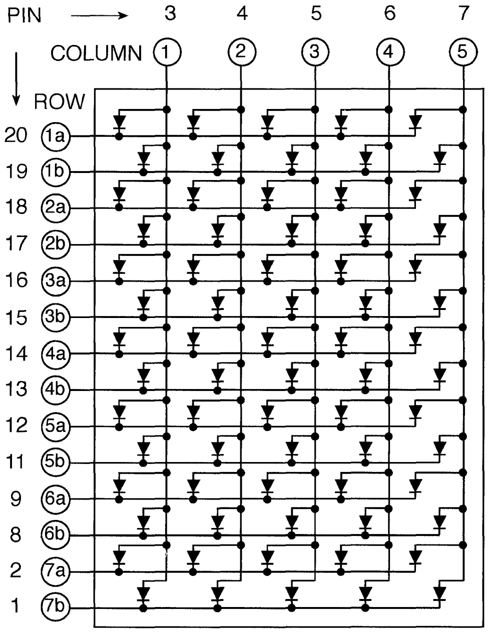
B. GMA8X75C



C. GMA8675C



D. GMC8675C



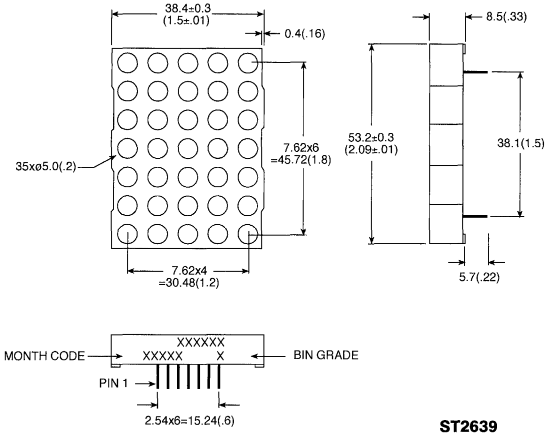
QT
OPTOELECTRONICS

2.0″ 5 × 7
DOT MATRIX DISPLAYS

YELLOW **GMA 2875C** **GMC 2875C**
HER **GMA 2975C** **GMC 2975C**
GREEN **GMA 2475C** **GMC 2475C**
BICOLOR RED/GREEN **GMA 2675C**

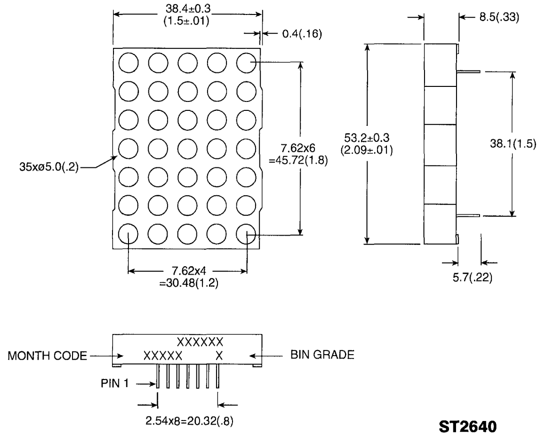
PACKAGE DIMENSIONS

A. GMX2X75C



ST2639

B. GMA2675C



ST2640

NOTES:
1. ALL PINS ARE ø0.5 (.02).
2. DIMENSIONS IN MILLIMETERS (INCH), TOLERANCE IS ±0.25 (.01) UNLESS OTHERWISE NOTED.

DESCRIPTION

These are 5×7 dot matrix displays with large emitting area (0.2″ diameter) LED sources. The GMX2X75C series are single color displays with the exception of GMA2675C which is a bicolor of red/green displays.

All displays have gray face and white dot color. Other face or dot colors are available with minimum requirement.

The X in GMX denotes row anode or row cathode.

FEATURES

- 2.0″ (50.7 mm) character height
- Low power requirement
- High contrast & brightness
- Wide viewing angle 130°
- 5 × 7 array with X-Y select
- Compatible with USASCII and EBCDIC codes
- X-Y stackable
- Choice of two matrix orientation anode or cathode column
- Easy mounting on PCB
- Categorized for luminous intensity
- Single color displays have the choice of 3 bright colors — yellow/orange/green
- Multicolor color displays are applicable to 3 bright colors — greens, orange (HER) and yellow (green and HER mixed)

2.0″ 5 × 7
DOT MATRIX DISPLAYS

ABSOLUTE MAXIMUM RATING (T_A = 25°C unless otherwise specified)

PARAMETER	YELLOW	HER	GREEN	UNITS
Power dissipation per dot/color	60	70	75	mW
Peak forward current per dot/color (duty cycle 1/10, 10KHz)	80	100	100	mA
Continuous I_F per dot/color	20	25	25	mA
Reverse voltage V_R per dot/color	5	5	5	V

Operating and storage temperature range .... −25°C to +85°C
Soldering time at 260°C (1/16 inch below seating plane) .... 3 sec

MODEL NUMBERS

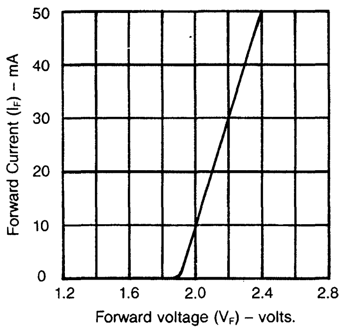
PART NO.						
YELLOW	HER	GREEN	MULTI-COLOR	DESCRIPTION	PACKAGE DIMENSION	INTERNAL CIRCUIT DIAGRAM
GMC2875C	GMC2975C	GMC2475C		Anode column, cathode row	A	A
GMA2875C	GMA2975C	GMA2475C		Cathode column, anode row	A	B
			GMA2675C	Cathode column, anode row	B	C

2.0″ 5 × 7
DOT MATRIX DISPLAYS

ELECTRICAL/OPTICAL CHARACTERISTICS (T_A = 25°C Unless otherwise specified)
GMX 2875C

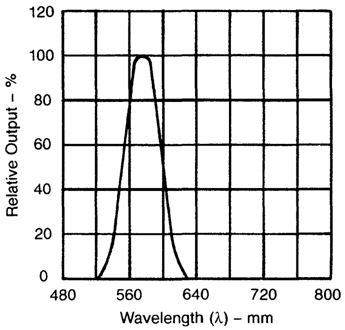
PARAMETER	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS
Average luminous intensity		3000		µcd	I_F=20 mA
Peak emission wavelength		585		nm	I_F=20 mA
Spectral line half-width		30		nm	I_F=20 mA
Forward voltage, any dot		2.1	2.8	V	I_F=20 mA
Reverse voltage, any dot			100	µA	V_R=5 V

TYPICAL ELECTRICAL/OPTICAL CHARACTERISTIC CURVES
(T_A=25°C Unless otherwise specified)



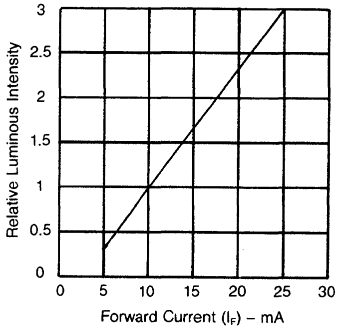
C3037

Fig. 1. Forward Current vs. Forward Voltage



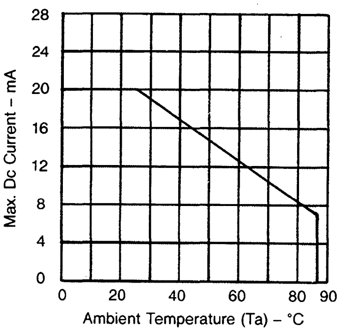
C3038

Fig. 2. Spectral Response



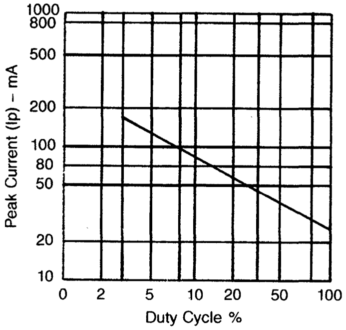
C3039

Fig. 3. Relative Luminous Intensity vs. Forward Current



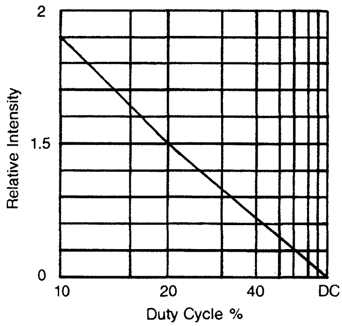
C3040

Fig. 4. Maximum Allowable DC Current Per Segment vs. A Function of Ambient Temperature



C3041

Fig. 5. Luminous Intensity vs. Duty Cycle



C3042

Fig. 6. Max Peak Current vs. Duty Cycle % (Refresh Rate f=1 KHz)

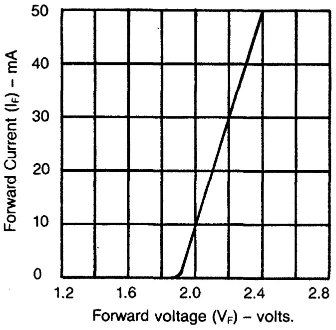
OPTOELECTRONICS

2.0″ 5 × 7
DOT MATRIX DISPLAYS

ELECTRICAL/OPTICAL CHARACTERISTICS (T_A = 25°C Unless otherwise specified) GMX 2975C

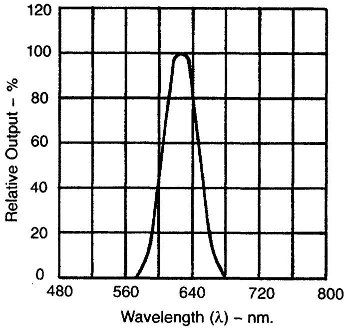
PARAMETER	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS
Average luminous intensity		3000		μcd	I_F=20 mA
Peak emission wavelength		635		nm	I_F=20 mA
Spectral line half-width		30		nm	I_F=20 mA
Forward voltage, any dot		2.1	2.8	V	I_F=20 mA
Reverse voltage, any dot			100	μA	V_R=5 V

TYPICAL ELECTRICAL/OPTICAL CHARACTERISTIC CURVES
(T_A = 25°C Unless otherwise specified)



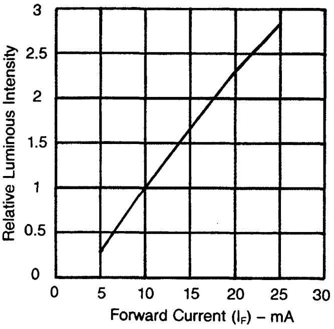
C3031

Fig. 1. Forward Current vs. Forward Voltage



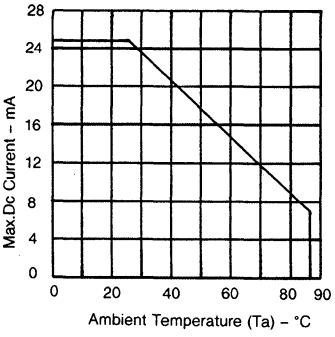
C3032

Fig. 2. Spectral Response



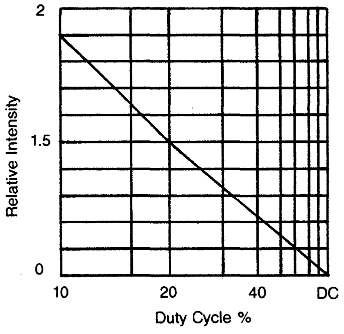
C3033

Fig. 3. Relative Luminous Intensity vs. Forward Current



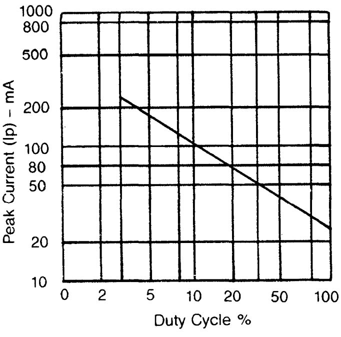
C3034

Fig. 4. Maximum Allowable DC Current Per Segment vs. A Function of Ambient Temperature



C3036

Fig. 5. Luminous Intensity vs. Duty Cycle



C3035

Fig. 6. Max. Peak Current vs. Duty Cycle % (Refresh Rate f=1 KHz)

ELECTRICAL/OPTICAL CHARACTERISTICS (T_A = 25°C Unless otherwise specified)
GMX 2475C

PARAMETER	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS
Average luminous intensity		3000		μcd	I_F=20 mA
Peak emission wavelength		565		nm	I_F=20 mA
Spectral line half-width		30		nm	I_F=20 mA
Forward voltage, any dot		2.1	2.8	V	I_F=20 mA
Reverse voltage, any dot			100	μA	V_R=5 V

TYPICAL ELECTRICAL/OPTICAL CHARACTERISTIC CURVES
(T_A = 25°C Unless otherwise specified)

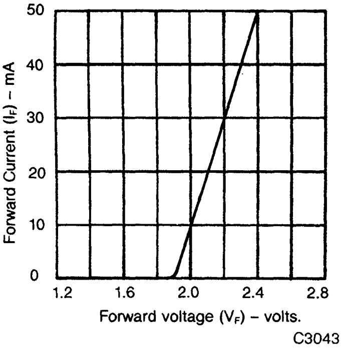


Fig. 1. Forward Current vs. Forward Voltage

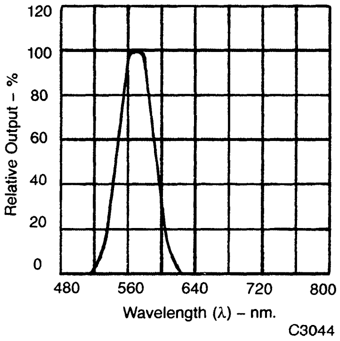


Fig. 2. Spectral Response

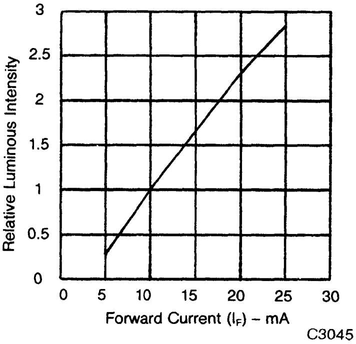


Fig. 3. Relative Luminous Intensity vs. Forward Current

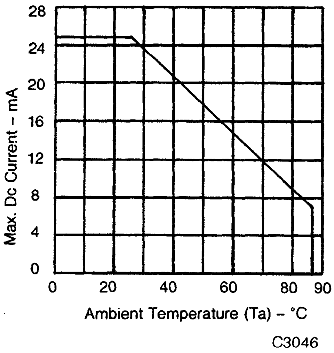


Fig. 4. Maximum Allowable DC Current Per Segment vs. A Function of Ambient Temperature

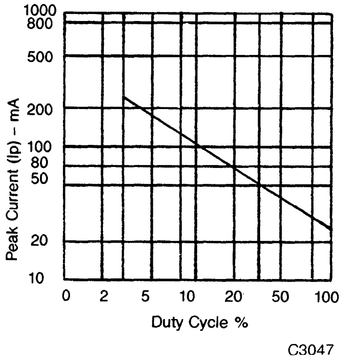


Fig. 5. Max Peak Current vs. Duty Cycle % (Refresh Rate f=1 KHz)

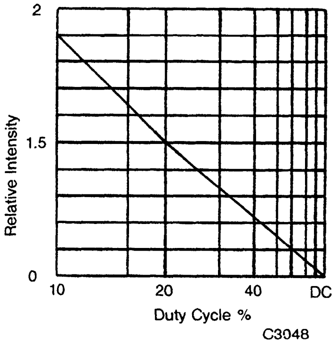


Fig. 6. Luminous Intensity vs. Duty Cycle (Average 1=10 mA Per Seg.)

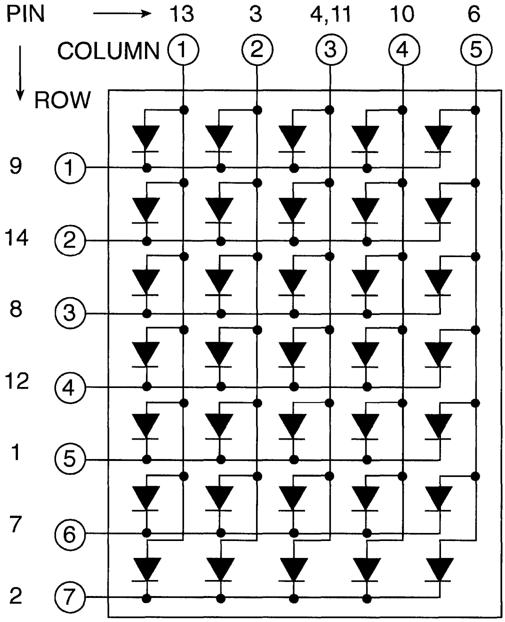
PIN CONNECTION

PIN NO.	GMC2X75C	GMA2X75C	GMA2675C
1	Cathode row 5	Anode row 5	Cathode column 1 green
2	Cathode row 7	Anode row 7	Cathode column 2 green
3	Anode column 2	Cathode column 2	Cathode column 2 HER
4	Anode column 3	Cathode column 3	Cathode column 3 HER
5	Cathode row 4	Anode row 4	Anode row 6
6	Anode column 5	Cathode column 5	Anode row 7
7	Cathode row 6	Anode row 6	Cathode column 4 HER
8	Cathode row 3	Anode row 3	Anode row 5
9	Cathode row 1	Anode row 1	No connection
10	Anode column 4	Cathode column 4	Cathode column 5 green
11	Anode column 3	Cathode column 3	Cathode column 5 HER
12	Cathode row 4	Anode row 4	Cathode column 4 green
13	Anode column 1	Cathode column 1	Anode column 3 green
14	Cathode row 2	Anode row 2	Anode row 4
15			Anode row 2
16			Anode row 1
17			Anode row 3
18			Cathode column 1 HER

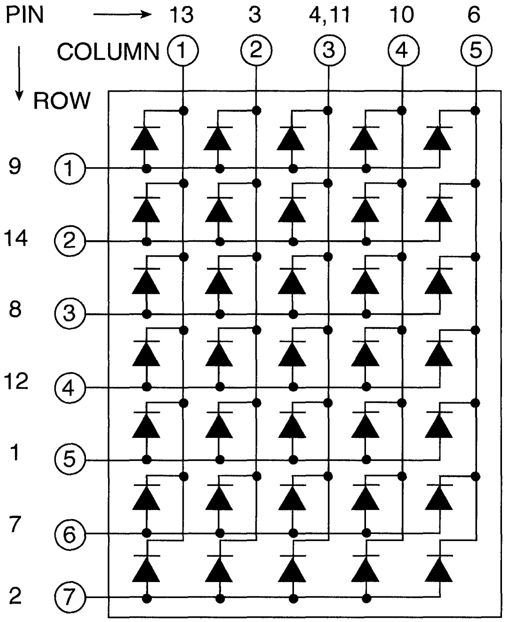
2.0″ 5 × 7
DOT MATRIX DISPLAYS

INTERNAL CIRCUIT DIAGRAM

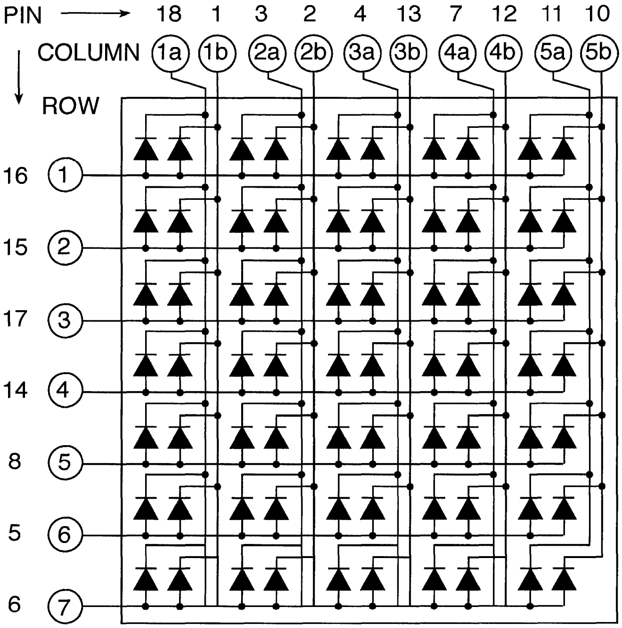
A. GMC2X75C



B. GMA2X75C



C. GMA2675C



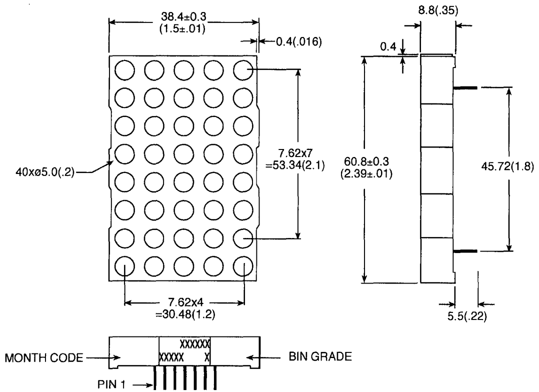
OPTOELECTRONICS

2.3″ 5 × 8
DOT MATRIX DISPLAYS

YELLOW GMA 2885C GMC 2885C
HER GMA 2985C GMC 2985C
GREEN GMA 2485C GMC 2485C
BICOLOR RED/GREEN GMA 2685C

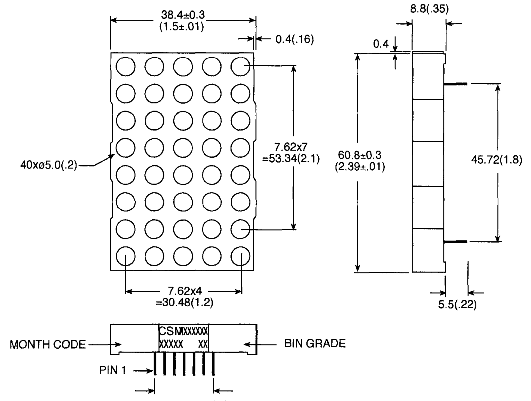
PACKAGE DIMENSIONS

A. GMX2X85C



ST2628

B. GMA2685C



ST2629

NOTES:
1. ALL PINS ARE θ0.5 (.02).
2. DIMENSIONS IN MILLIMETERS (INCH), TOLERANCE IS ±0.25 (.01) UNLESS OTHERWISE NOTED.

DESCRIPTION

These are 5×8 dot matrix displays with large emitting area (0.2″ diameter) LED sources. The GMX2X85C series are single color displays with the exception of GMA2685C which is a bicolor of red/green displays.

All displays have gray face and white dot color. Other face or dot colors are available with minimum requirement.

The X in GMX denotes row anode or row cathode.

FEATURES

- 2.3″ (58.4 mm) character height
- Low power requirement
- High contrast & brightness
- Wide viewing angle 130°
- 5 × 8 array with X-Y select
- Compatible with USASCII and EBCDIC codes
- X-Y stackable
- Choice of two matrix orientation anode or cathode column
- Easy mounting on PCB
- Categorized for luminous intensity
- Single color displays have the choice of 3 bright colors — yellow/orange/green
- Multicolor color displays are applicable to 3 bright colors — greens, orange (HER) and yellow (green and HER mixed)

QT

OPTOELECTRONICS

2.3″ 5 × 8
DOT MATRIX DISPLAYS

ABSOLUTE MAXIMUM RATING (T_A = 25°C unless otherwise specified)

PARAMETER	YELLOW	HER	GREEN	UNITS
Power dissipation per dot/color	60	70	75	mW
Peak forward current per dot/color (duty cycle 1/10, 10KHz)	80	100	100	mA
Continuous I_F per dot/color	20	25	25	mA
Reverse voltage V_R per dot/color	5	5	5	V
Operating and storage temperature range				−25°C to +85°C
Soldering time at 260°C (1/16 inch below seating plane)				3 sec

MODEL NUMBERS

PART NO.						
YELLOW	**HER**	**GREEN**	**MULTI-COLOR**	**DESCRIPTION**	**PACKAGE DIMENSION**	**INTERNAL CIRCUIT DIAGRAM**
GMC2885C	GMC2985C	GMC2485C		Anode column, cathode row	A	A
GMA2885C	GMA2985C	GMA2485C		Cathode column, anode row	A	B
			GMA2685C	Cathode column, anode row	B	C

2.3″ 5 × 8
DOT MATRIX DISPLAYS

ELECTRICAL/OPTICAL CHARACTERISTICS (T_A = 25°C Unless otherwise specified)
GMX 2485C

PARAMETER	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS
Average luminous intensity		3000		µcd	I_F=20 mA
Peak emission wavelength		565		nm	I_F=20 mA
Spectral line half-width		30		nm	I_F=20 mA
Forward voltage, any dot		2.1	2.8	V	I_F=20 mA
Reverse voltage, any dot			100	µA	V_R=5 V

TYPICAL ELECTRICAL/OPTICAL CHARACTERISTIC CURVES
(T_A=25°C Unless otherwise specified)

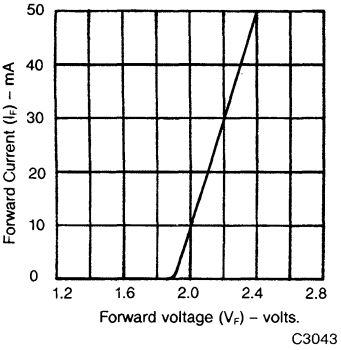


Fig. 1. Forward Current vs. Forward Voltage

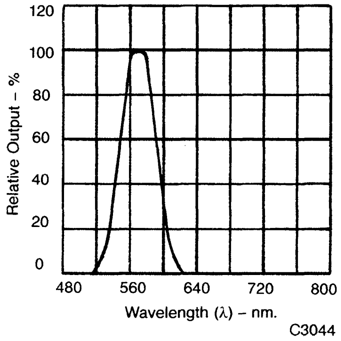


Fig. 2. Spectral Response

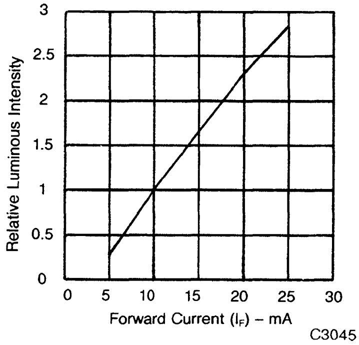


Fig. 3. Relative Luminous Intensity vs. Forward Current

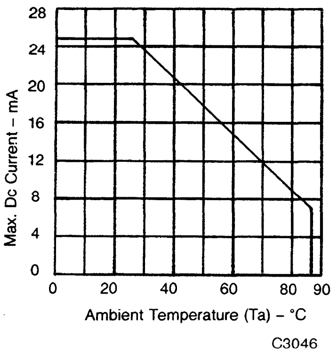


Fig. 4. Maximum Allowable DC Current Per Segment vs. A Function of Ambient Temperature

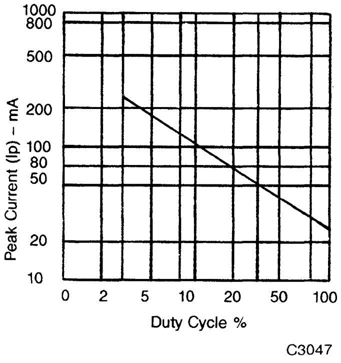


Fig. 5. Max Peak Current vs. Duty Cycle % (Refresh Rate f=1 KHz)

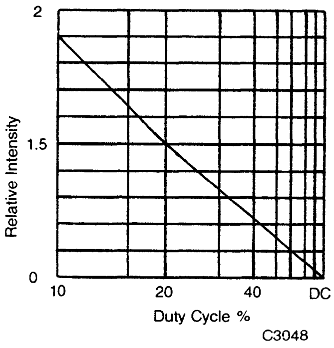


Fig. 6. Luminous Intensity vs. Duty Cycle % (Average 1=10 mA Per Seg.)

OPTOELECTRONICS

2.3″ 5 × 8
DOT MATRIX DISPLAYS

ELECTRICAL/OPTICAL CHARACTERISTICS (T_A = 25°C Unless otherwise specified)
GMX 2985C

PARAMETER	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS
Average luminous intensity		3000		μcd	I_F=20 mA
Peak emission wavelength		635		nm	I_F=20 mA
Spectral line half-width		30		nm	I_F=20 mA
Forward voltage, any dot		2.1	2.8	V	I_F=20 mA
Reverse voltage, any dot			100	μA	V_R=5 V

TYPICAL ELECTRICAL/OPTICAL CHARACTERISTIC CURVES
(T_A = 25°C Unless otherwise specified)

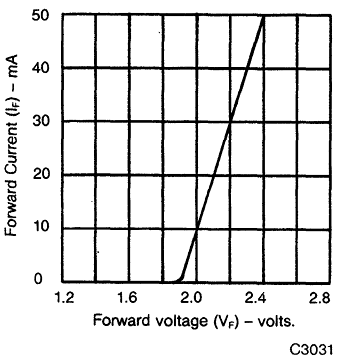


Fig. 1. Forward Current vs. Forward Voltage

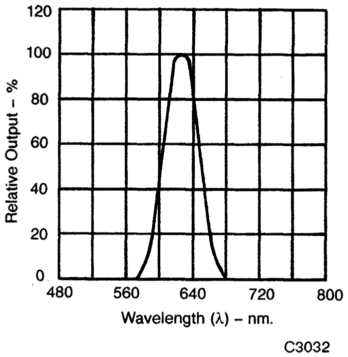


Fig. 2. Spectral Response

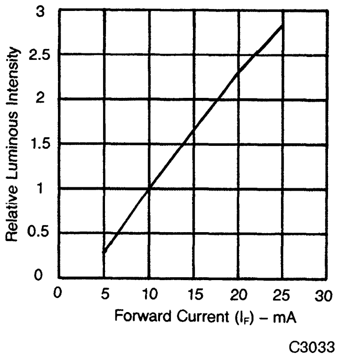


Fig. 3. Relative Luminous Intensity vs. Forward Current

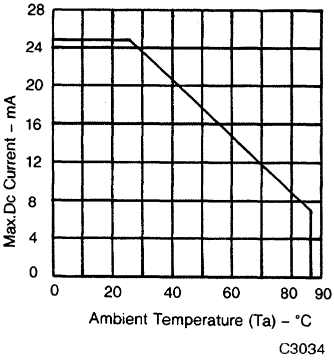


Fig. 4. Maximum Allowable DC Current Per Segment vs. A Function of Ambient Temperature

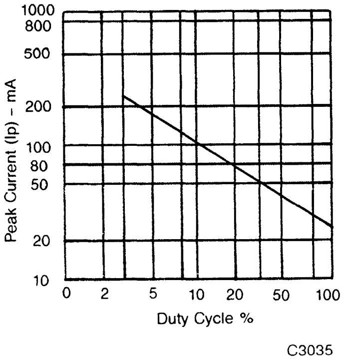


Fig. 5. Max. Peak Current vs. Duty Cycle % (Refresh Rate f=1 KHz)

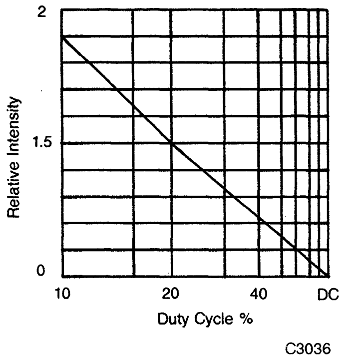


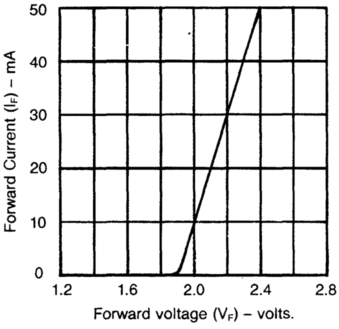
Fig. 6. Luminous Intensity vs. Duty Cycle %

2.3″ 5 × 8
DOT MATRIX DISPLAYS

ELECTRICAL/OPTICAL CHARACTERISTICS (T_A = 25°C Unless otherwise specified)
GMX 2885C

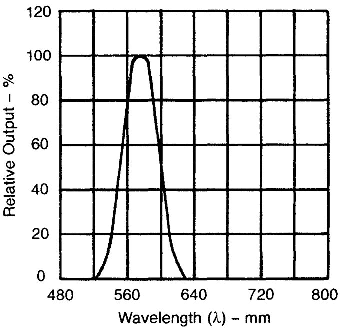
PARAMETER	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS
Average luminous intensity		3000		μcd	I_F=20 mA
Peak emission wavelength		585		nm	I_F=20 mA
Spectral line half-width		30		nm	I_F=20 mA
Forward voltage, any dot		2.1	2.8	V	I_F=20 mA
Reverse voltage, any dot			100	μA	V_R=5 V

TYPICAL ELECTRICAL/OPTICAL CHARACTERISTIC CURVES
(T_A = 25°C Unless otherwise specified)



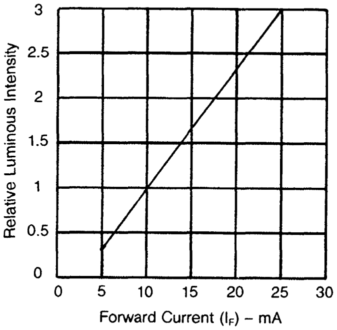
C3037

Fig. 1. Forward Current vs. Forward Voltage



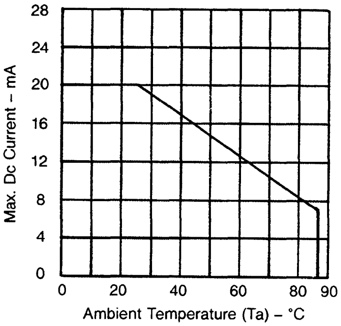
C3038

Fig. 2. Spectral Response



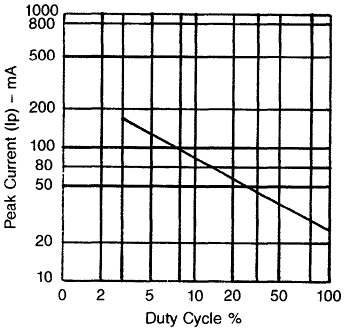
C3039

Fig. 3. Relative Luminous Intensity vs. Forward Current



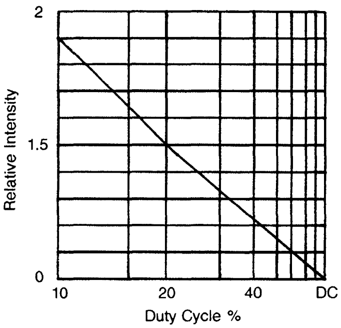
C3040

Fig. 4. Maximum Allowable DC Current Per Segment vs. A Function of Ambient Temperature



C3041

Fig. 5. Max Peak Current vs. Duty Cycle % (Refresh Rate f=1 KHz)



C3042

Fig. 6. Luminous Intensity vs. Duty Cycle % (Average 1=10 mA Per Seg.)

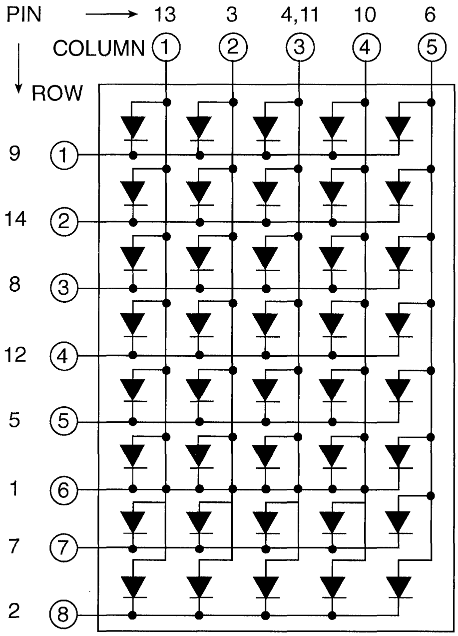
PIN CONNECTION

PIN NO.	GMC2X85C	GMA2X85C	GMC2685C
1	Cathode row 6	Anode row 6	Cathode column 1 green
2	Cathode row 8	Anode row 8	Cathode column 2 green
3	Anode column 2	Cathode column 2	Cathode column 2 HER
4	Anode column 3	Cathode column 3	Cathode column 3 HER
5	Cathode row 5	Anode row 5	Anode row 6
6	Anode column 5	Cathode column 5	Anode row 7
7	Cathode row 7	Anode row 7	Cathode column 4 HER
8	Cathode row 3	Anode row 3	Anode row 5
9	Cathode row 1	Anode row 1	Anode row 8
10	Anode column 4	Cathode column 4	Cathode column 5 green
11	Anode column 3	Cathode column 3	Cathode column 5 HER
12	Cathode row 4	Anode row 4	Cathode column 4 green
13	Anode column 1	Cathode column 1	Anode column 3 green
14	Cathode row 2	Anode row 2	Anode row 4
15			Anode row 2
15			Anode row 1
15			Anode row 3
15			Cathode column 1 HER

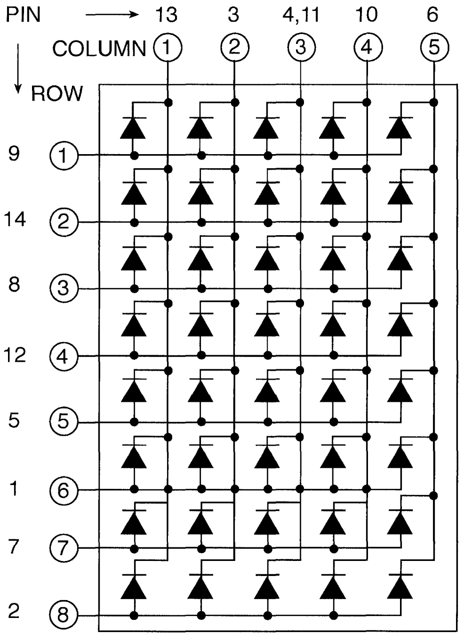
2.3″ 5 × 8 DOT MATRIX DISPLAYS

INTERNAL CIRCUIT DIAGRAM

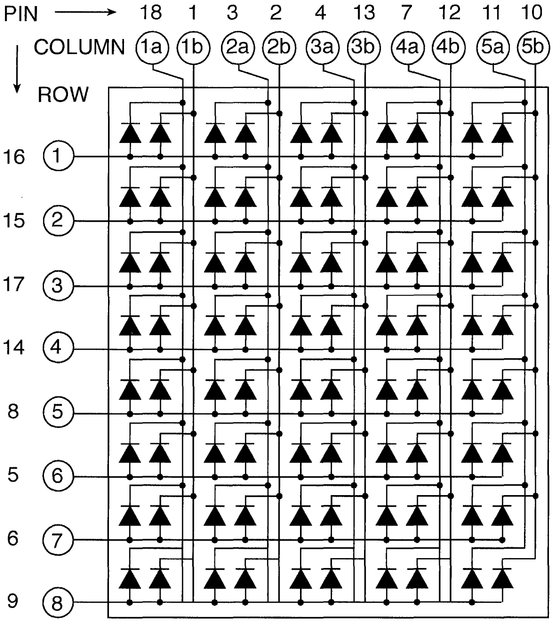
A. GMC2X85C



B. GMA2X85C



C. GMA2685C



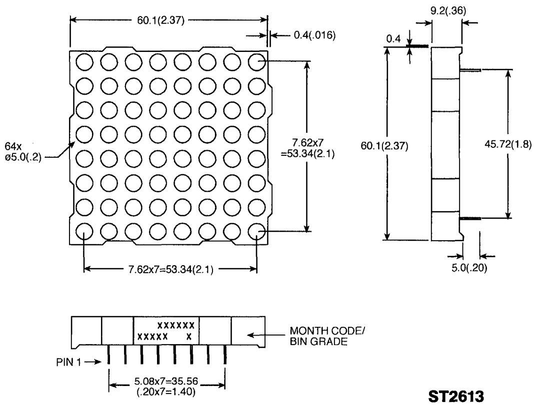
QT OPTOELECTRONICS

2.3″ 8×8
DOT MATRIX DISPLAYS

YELLOW GMA 2888C GMC 2888C
HER GMA 2988C GMC 2988C
GREEN GMA 2488C GMC 2488C
BICOLOR RED/GREEN GMC 2688C

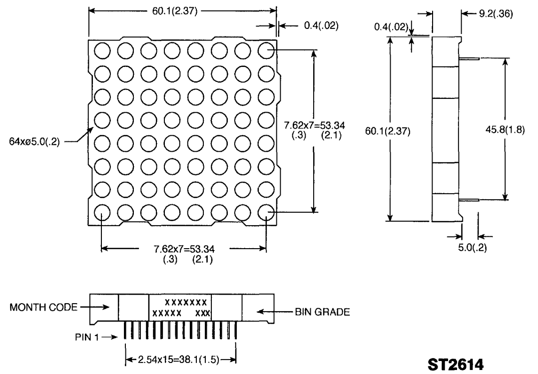
PACKAGE DIMENSIONS

A. GMX2X88C



ST2613

B. GMC2688C



ST2614

NOTES:
1. ALL PINS ARE ø0.5 (.02).
2. DIMENSIONS IN MILLIMETERS (INCH), TOLERANCE IS ±0.25 (.01) UNLESS OTHERWISE NOTED.

DESCRIPTION

These are 8×8 dot matrix displays with large emitting area (0.2″ diameter) LED sources. The GMX2X88C series are single color displays with the exception of GMC2688C, a bicolor of red/green displays.

All displays have gray face and white dot color. Other face or dot colors are available with minimum requirement.

The X in GMX denotes row anode or row cathode.

FEATURES

- 2.3″ (58.4mm) character height
- Low power requirement
- High contrast & brightness
- Wide viewing angle 130°
- 8×8 array with X-Y select
- Compatible with USASCII and EBCDIC codes
- X-Y stackable
- Choice of two matrix orientation anode or cathode column
- Easy mounting on PCB
- Categorized for luminous intensity
- Single color displays have the choice of 3 bright color — yellow/orange/green
- Multicolor color displays are applicable to 3 bright color—greens, orange (HER) and yellow (green and HER mixed)

QT
OPTOELECTRONICS

2.3″ 8×8
DOT MATRIX DISPLAYS

ABSOLUTE MAXIMUM RATING (T_A=25°C unless otherwise specified)

	YELLOW	HER	GREEN	UNITS
Power dissipation per dot/color	60	70	75	mW
Peak forward current per dot/color (duty cycle 1/10, 10KHz)	80	100	100	mA
Continuous I_F per dot/color	20	25	25	mA
Reverse voltage V_R per dot/color	5	5	5	V
Operating and storage temperature range				−25°C to +85°C
Soldering time at 260°C (1/16 inch below seating plane)				3 sec

MODEL NUMBERS

PART NO.						
YELLOW	HER	GREEN	MULTI-COLOR	DESCRIPTION	PACKAGE DIMENSION	INTERNAL CIRCUIT DIAGRAM
GMC2888C	GMC2988C	GMC2488C		Anode column, cathode row	A	A
GMA2888C	GMA2988C	GMA2488C		Cathode column, anode row	A	B
			GMC2688C	Anode column, cathode row	B	C

OPTOELECTRONICS

2.3″ 8×8
DOT MATRIX DISPLAYS

ELECTRICAL/OPTICAL CHARACTERISTICS (T_A=25°C Unless otherwise specified)
GMX 2888C

PARAMETER	MIN	TYP	MAX	UNITS	TEST CONDITIONS
Average luminous intensity		3000		μcd	I_F=20 mA
Peak emission wavelength		585		nm	I_F=20 mA
Spectral line half-width		35		nm	I_F=20 mA
Forward voltage, any dot		2.1	2.8	V	I_F=20 mA
Reverse voltage, any dot			100	μA	V_R=5V

TYPICAL ELECTRICAL/OPTICAL CHARACTERISTIC CURVES
(T_A=25°C Unless otherwise specified)

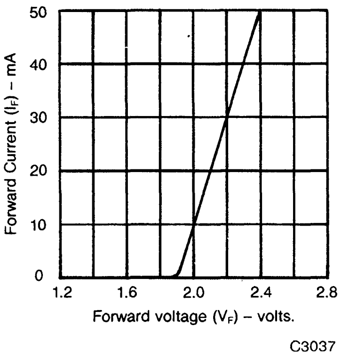


Fig. 1. Forward Current vs. Forward Voltage

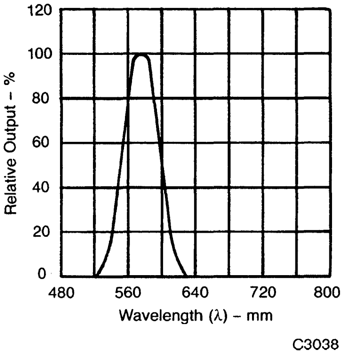


Fig. 2. Spectral Response

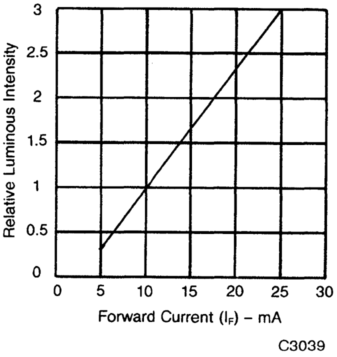


Fig. 3. Relative Luminous Intensity vs. Forward Current

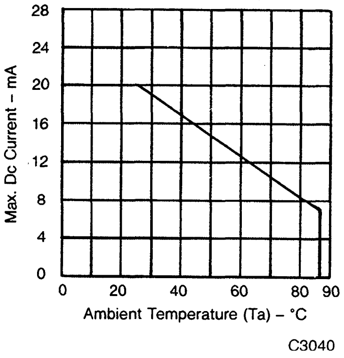


Fig. 4. Maximum Allowable DC Current Per Segment vs. A Function of Ambient Temperature

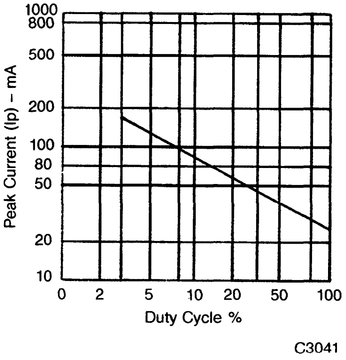


Fig. 5. Max Peak Current vs. Duty Cycle % (Refresh Rate f=1. KHz)

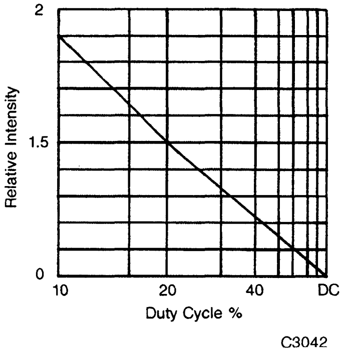


Fig. 6. Luminous Intensity vs. Duty Cycle % (Average 1=10 mA Per Seg.)

2.3″ 8×8
DOT MATRIX DISPLAYS

ELECTRICAL/OPTICAL CHARACTERISTICS (T$_A$=25°C Unless otherwise specified)
GMX 2988C

PARAMETER	MIN	TYP	MAX	UNITS	TEST CONDITIONS
Average luminous intensity		3000		μcd	I_F=20 mA
Peak emission wavelength		635		nm	I_F=20 mA
Spectral line half-width		40		nm	I_F=20 mA
Forward voltage, any dot		2.1	2.8	V	I_F=20 mA
Reverse voltage, any dot			100	μA	V_R=5V

TYPICAL ELECTRICAL/OPTICAL CHARACTERISTIC CURVES
(T$_A$=25°C Unless otherwise specified)

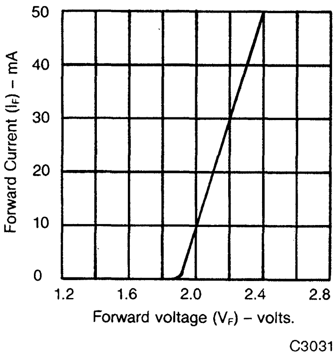


Fig. 1. Forward Current vs. Forward Voltage

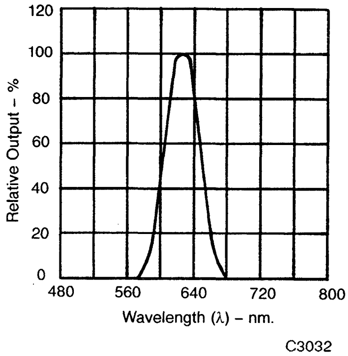


Fig. 2. Spectral Response

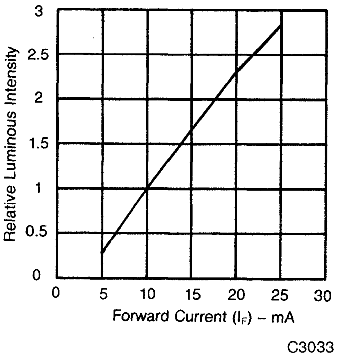


Fig. 3. Relative Luminous Intensity vs. Forward Current

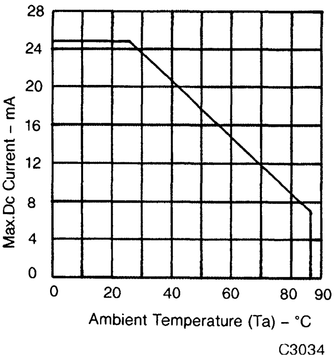


Fig. 4. Maximum Allowable DC Current Per Segment vs. A Function of Ambient Temperature

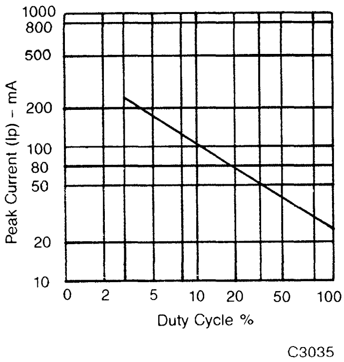


Fig. 5. Max. Peak Current vs. Duty Circle % (Refresh Rate F=1 KHz)

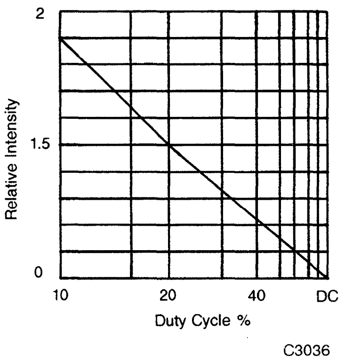


Fig. 6. Luminous Intensity vs. Duty Cycle

2.3″ 8×8
DOT MATRIX DISPLAYS

ELECTRICAL/OPTICAL CHARACTERISTICS (T_A=25°C Unless otherwise specified)
GMX 2488C

PARAMETER	MIN	TYP	MAX	UNITS	TEST CONDITIONS
Average luminous intensity		3000		µcd	I_F=20 mA
Peak emission wavelength		565		nm	I_F=20 mA
Spectral line half-width		30		nm	I_F=20 mA
Forward voltage, any dot		2.1	2.8	V	I_F=20 mA
Reverse voltage, any dot			100	µA	V_R=5V

TYPICAL ELECTRICAL/OPTICAL CHARACTERISTIC CURVES
(T_A=25°C Unless otherwise specified)

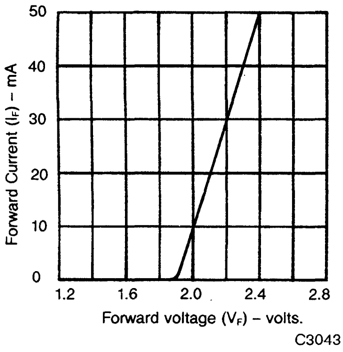


Fig. 1. Forward Current vs. Forward Voltage

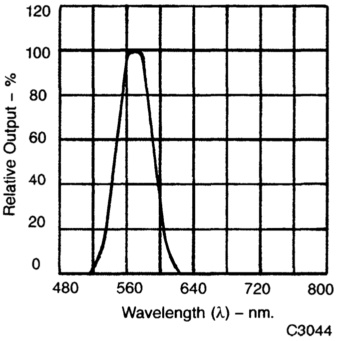


Fig. 2. Spectral Response

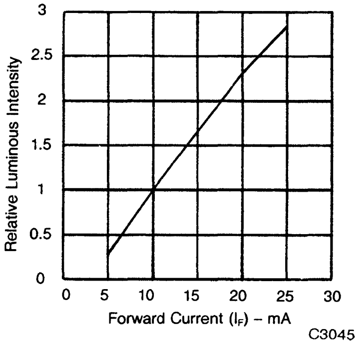


Fig. 3. Relative Luminous Intensity vs. Forward Current

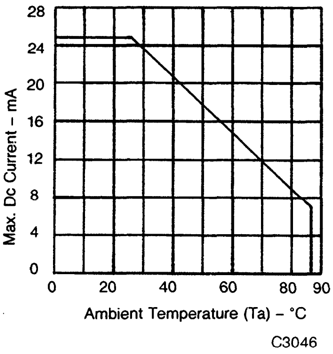


Fig. 4. Maximum Allowable DC Current Per Segment vs. A Function of Ambient Temperature

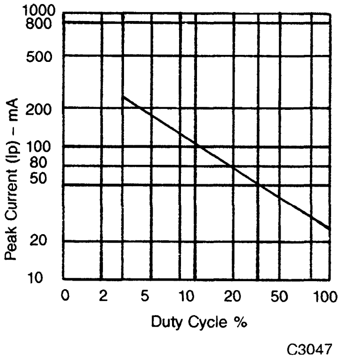


Fig. 5. Max Peak Current vs. Duty Cycle % (Refresh Rate f=1 KHz)

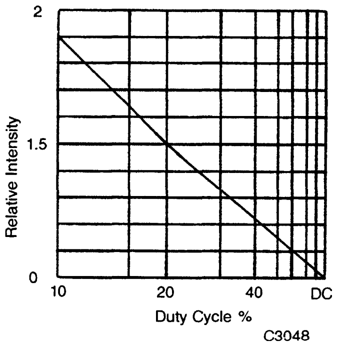


Fig. 6. Luminous Intensity vs. Duty Cycle % (Average 1=10 mA Per Seg.)

PIN CONNECTION

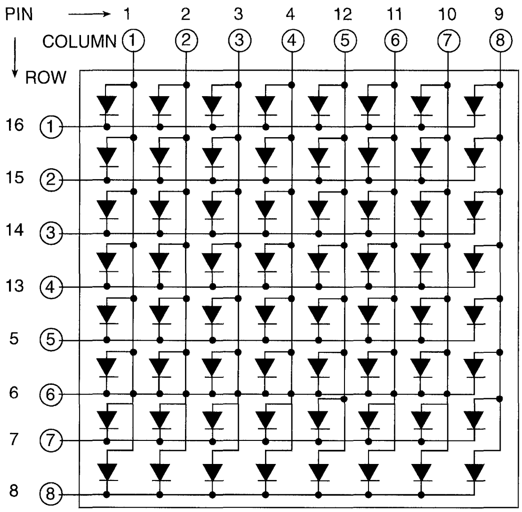
PIN NO.	GMC2X88C	GMA2X88C	GMC2688C
1	Anode column 1	Cathode column 1	Anode Column 1b
2	Anode column 2	Cathode column 2	Anode column 1a
3	Anode column 3	Cathode column 3	Anode column 2b
4	Anode column 4	Cathode column 4	Anode column 2a
5	Cathode row 5	Anode row 5	Anode column 3b
6	Cathode row 6	Anode row 6	Anode column 3a
7	Cathode row 7	Anode row 7	Anode column 4b
8	Cathode row 8	Anode row 8	Anode column 4a
9	Anode column 8	Cathode column 8	Cathode row 5b
10	Anode column 7	Cathode column 7	Cathode row 5a
11	Anode column 6	Cathode column 6	Cathode row 6b
12	Anode column 5	Cathode column 5	Cathode row 6a
13	Cathode row 4	Anode row 4	Cathode row 7b
14	Cathode row 3	Anode row 3	Cathode row 7a
15	Cathode row 2	Anode row 2	Cathode row 8b
16	Cathode row 1	Anode row 1	Cathode row 8a
17			Anode column 8b
18			Anode column 8a
19			Anode column 7b
20			Anode column 7a
21			Anode column 6b
22			Anode column 6a
23			Anode column 5b
24			Anode column 5a
25			Cathode row 4b
26			Cathode row 4a
27			Cathode row 3b
28			Cathode row 3a
29			Cathode row 2b
30			Cathode row 2a
31			Cathode row 1b
32			Cathode row 1a

"a" for HER chip *"b" for green chip*

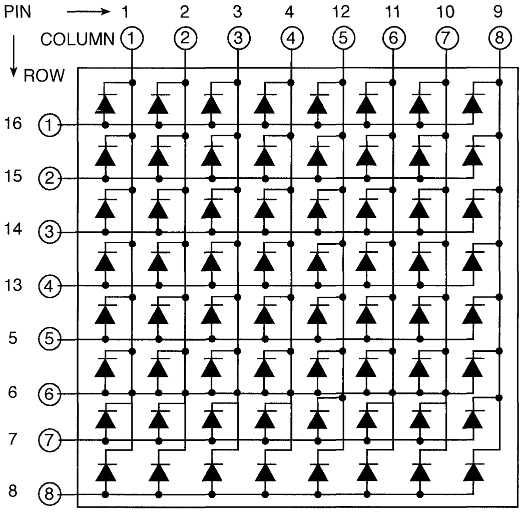
2.3″ 8×8
DOT MATRIX DISPLAYS

INTERNAL CIRCUIT DIAGRAM

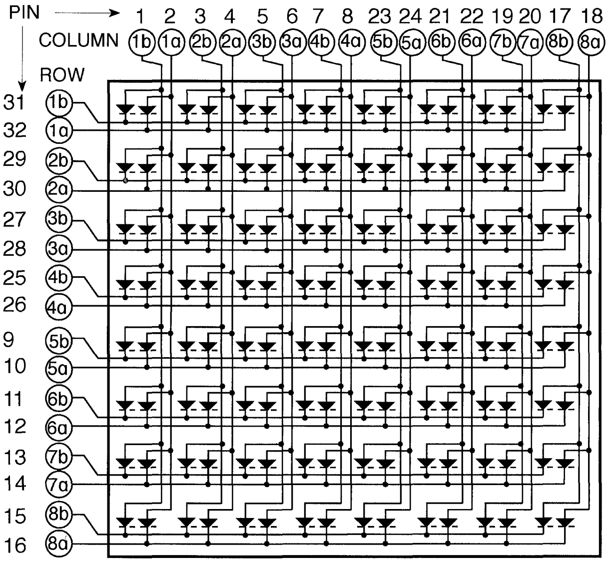
A. GMC2X88C



B. GMA2X88C

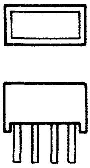
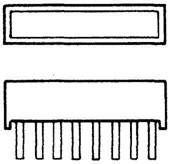
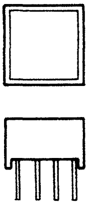
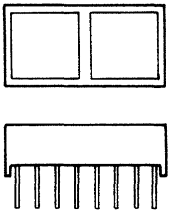
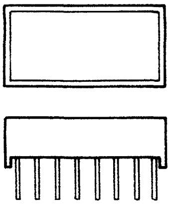


C. GMC2688C

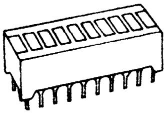
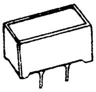


LIGHT BARS & BARGRAPH ARRAYS

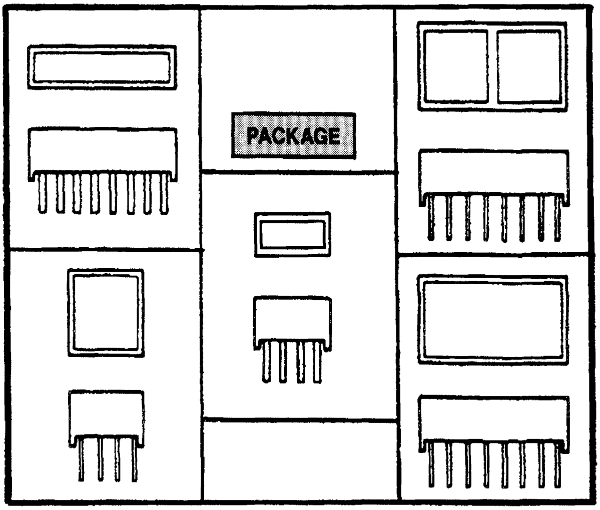
Alphanumeric Product Listing

PACKAGE	PART NUMBER	DESCRIPTION			TYPICAL LUMINOUS INTENSITY @ 20 mA	TYPICAL FORWARD VOLTAGE @ 20 mA	PAGE
		COLOR	PACKAGE	LENS			
	HLMP-2300	Hi. Eff. Red	4 Pin In-Line; .100″ Centers; .400″L x .195″W x .240″H (0.350″ x 0.150″ Emitting Area)	Diff.	23 mcd	2.0 V	5-5
	HLMP-2400	Yellow		Diff.	20 mcd	2.1 V	
	HLMP-2500	Green		Green Diff.	25 mcd	2.2 V	
	HLMP-2350	Hi. Eff. Red	8 Pin DIP; .100″ Centers; .800″L x .195″W x .240″H (0.750″ x 0.150″ Emitting Area)	Diff.	45 mcd	2.0 V	5-5
	HLMP-2450	Yellow		Diff.	38 mcd	2.1 V	
	HLMP-2550	Green		Green Diff.	50 mcd	2.2 V	
	HLMP-2655	Hi. Eff. Red	8 Pin DIP; .100″ Centers; .400″L x .400″W x .240″H Square Arrangement (0.350″ x 0.150″ Emitting Area)	Diff.	43 mcd	2.0 V	5-5
	HLMP-2755	Yellow		Diff.	35 mcd	2.1 V	
	HLMP-2855	Green		Green Diff.	50 mcd	2.2 V	
	HLMP-2670	Hi. Eff. Red	16 Pin DIP; .100″ Centers; .800″L x .400″W x .240″H Dual Square Arrangement	Diff.	45 mcd	2.0 V	5-5
	HLMP-2770	Yellow		Diff.	35 mcd	2.1 V	
	HLMP-2870	Green		Green Diff.	50 mcd	2.2 V	
	HLMP-2685	Hi. Eff. Red	16 Pin DIP: .100″ Centers; .800″L x .400″W x .240″H Single Bar Arrangement (0.350″ x 0.700″ Emitting Area)	Diff.	80 mcd	2.0 V	5-5
	HLMP-2785	Yellow		Diff.	70 mcd	2.1 V	
	HLMP-2885	Green		Green Diff.	100 mcd	2.2V	

BARGRAPHS AND PANEL INDICATORS

PACKAGE	PART NUMBER	SOURCE COLOR	SEGMENT/ FACE COLOR	I_V TYP. mcd/mA	$2\theta_{1/2}$	PAGE
10 Element 	MV53164	Yellow	Untinted Diff./Grey	1.0/10	130	5-15
	MV54164	Hi. Eff. Green	Untinted Diff./Grey			
	MV57164	Hi. Eff. Red	Red Diff./Grey			
	MV5A164	R,R,R,Y,Y,Y,Y,G,G,G	Untinted Diff./Grey	1.0/10	130	5-19
	MV5B164	R,R,Y,Y,G,G,Y,Y,R,R				
	MV5C164	G,G,G,G,G,G,Y,Y,Y,R				
	MV5D164	G,G,G,G,G,R,R,R,R,Y				
	MV5E164	G,Y,Y,Y,Y,Y,Y,R,R,R				
.5-Inch Rectangular 	MV53173	Yellow	Yellow Diff.	1.0/20	130	5-11
	MV54173	Hi. Eff. Green	Untinted Diff.			
	MV57173	Hi. Eff. Red	Red Diff.			

HIGH EFFICIENCY RED **HLMP-2300/2600 SERIES**
YELLOW **HLMP-2400/2700 SERIES**
HIGH EFFICIENCY GREEN **HLMP-2500/2800 SERIES**



DESCRIPTION

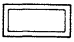
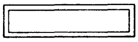
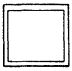
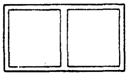
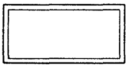
These LED Light Bar series are bright, large emitting area, rectangular devices that are designed for backlighting legend/message annunciators.

These devices are offered in single-in-line and dual-in-line packages that contain single or segmented light-emitting area. Each package style is offered in High Efficiency Red, Yellow, or Green emission color.

FEATURES

- Large area, uniform, bright light-emitting surfaces
- Select from six package styles
- Choice of three colors
- Categorized for intensity and color
- X-Y stackable
- Easily driven with I.C.s
- Alternate source for popular backlighting components

MODEL NUMBERS

PART NO.	COLOR	DESCRIPTION		PACKAGE	PIN OUT
HLMP-2300 HLMP-2400 HLMP-2500	High Efficiency Red Yellow High Efficiency Green	2 LED Single-in-line 0.35 in.×0.15 in. Area		A	A
HLMP-2350 HLMP-2450 HLMP-2550	High Efficiency Red Yellow High Efficiency Green	4 LED Single-in-line 0.75 in.×0.15 in. Area		B	B
HLMP-2655 HLMP-2755 HLMP-2855	High Efficiency Red Yellow High Efficiency Green	4 LED Dual-in-line 0.35 in.×0.35 in. Area		C	C
HLMP-2670 HLMP-2770 HLMP-2870	High Efficiency Red Yellow High Efficiency Green	Dual 0.35 in.×0.35 in. Area Dual-in-line package		D	D
HLMP-2685 HLMP-2785 HLMP-2885	High Efficiency Red Yellow High Efficiency Green	8 LED 0.35 in.×0.75 in. Area Dual-in-line package		E	D

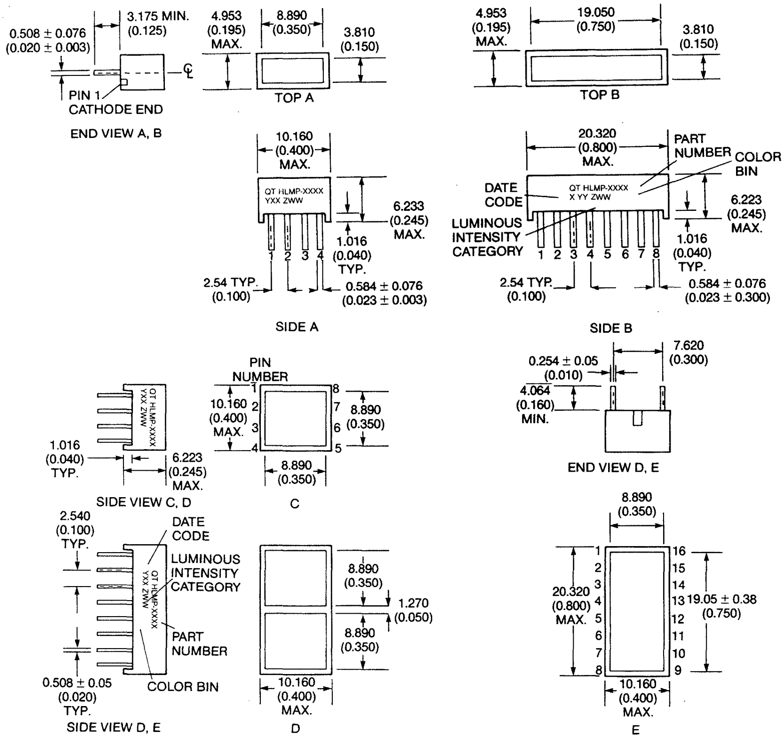
ABSOLUTE MAXIMUM RATINGS T_A=25°C (Unless Otherwise Stated)

	HIGH EFFICIENCY RED HIGH EFFICIENCY GREEN HLMP-2300/-2500 -2600/-2800 SERIES	YELLOW HLMP-2400/ -2700 SERIES
Power dissipation per LED chip (See Note 1)	135 mW	85 mW
Peak forward current per LED chip, T_A=50°C (max. pulse width=2 ms) (See Notes 1 and 2)	90 mA	60 mA
Average forward per LED chip pulsed conditions, T_A=50°C (See Note 2)	25 mA	20 mA
DC forward current per LED chip, T_A=50°C (See Note 3)	30 mA	25 mA
Reverse voltage per LED chip	6V	6V
Storage and operating temperature range	−40°C to +85°C	−40°C to +85°C
Soldering time at 260°C (See Note 4)	260°C for 3 sec.	260°C for 3 sec.

NOTES

1. *For HLMP-2300/-2500/-2600/-2800 Series, derate above T_A=25°C at 1.8 mW/°C per LED chip. For HLMP-2400/-2700 Series, derate above T_A=50°C at 1.8 mW/°C per LED chip.*
2. *See Figure 1/2 to establish pulse operating conditions.*
3. *For HLMP-2300/-2500/-2600/-2800 Series, derate above T_A=50°C at 0.5 mA/°C per LED chip. For HLMP-2400/-2700 Series derate above T_A=60°C at 9.5 mA/°C per LED chip.*
4. *Lead immersed to 1/16 in. from body of the device. Maximum unit surface temperature is 140°C.*

PACKAGE DIMENSIONS



NOTE: DIMENSIONS IN MILLIMETERS (INCHES). TOLERANCES ± 0.25 (± 0.010) UNLESS OTHERWISE INDICATED

C2015

ELECTRO-OPTICAL CHARACTERISTICS (T_A=25°C)
HIGH EFFICIENCY RED

PARAMETER		SYMBOL	HLMP					UNIT	TEST CONDITIONS
			-2300	-2350	-2655	-2670	-2685		
Luminous Intensity	min.	I_V	6.0	13	13	13	22	mcd	I_F=20 mA
	typ.		23	45	43	45	80	mcd	I_F=20 mA
	typ.		30	50	50	50	100	mcd	I_F=60 mA pK, 1:3 D.F.
Forward voltage	max.	V_F	2.6	2.6	2.6	2.6	2.6	V	I_F=20 mA
	typ.		2.0	2.0	2.0	2.0	2.0		
Peak wavelength	typ.	λ_p	630	630	630	630	630	nm	
Dominant wavelength	typ.	λ_d	626	626	626	626	626	nm	
Capacitance	typ.	C	45	45	45	45	45	pF	V_F=0, f=1 MHz
Reverse voltage	min.	V_R	6	6	6	6	6	V	I_R=100 μA
Thermal resistance	typ.	θ_{JL}	150	150	150	150	150	°C/W/ LED chip	

ELECTRO-OPTICAL CHARACTERISTICS (T_A=25°C)
YELLOW

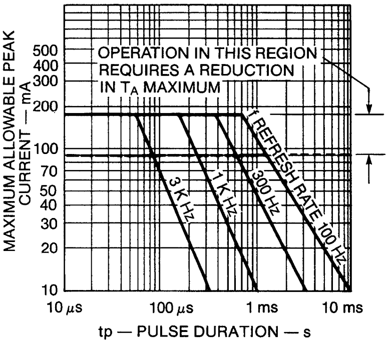
PARAMETER		SYMBOL	HLMP					UNIT	TEST CONDITIONS
			-2400	-2450	-2755	-2770	-2785		
Luminous Intensity	min.	I_V	6	13	13	13	26	mcd	I_F=20 mA
	typ.		20	38	35	35	70	mcd	I_F=20 mA
	typ.		33	60	60	60	115	mcd	I_F=60 mA pK, 1:3 D.F.
Forward voltage	max.	V_F	2.6	2.6	2.6	2.6	2.6	V	I_F=20 mA
	typ.		2.1	2.1	2.1	2.1	2.1		
Peak wavelength	typ.	λ_p	585	585	585	585	585	nm	
Dominant wavelength	typ.	λ_d	588	588	588	588	588	nm	
Capacitance	typ.	C	35	35	35	35	35	pF	V_F=0, f=1 MHz
Reverse voltage	min.	V_R	6	6	6	6	6	V	I_R=100 μA
Thermal resistance	typ.	θ_{JL}	150	150	150	150	150	°C/W/ LED chip	

ELECTRO-OPTICAL CHARACTERISTICS (T_A=25°C)
HIGH EFFICIENCY GREEN

PARAMETER		SYMBOL	HLMP					UNIT	TEST CONDITIONS
			-2500	-2550	-2855	-2870	-2885		
Luminous Intensity	min.	I_V	5	11	11	11	22	mcd	I_F=20 mA
	typ.		25	50	50	50	100	mcd	I_F=20 mA
	typ.		38	75	75	75	150	mcd	I_F=60 mA pK, 1:3 D.F.
Forward voltage	max.	V_F	2.6	2.6	2.6	2.6	2.6	V	I_F=20 mA
	typ.		2.2	2.2	2.2	2.2	2.2		
Peak wavelength	typ.	λ_p	565	565	565	565	565	nm	
Dominant wavelength	typ.	λ_d	567	567	567	567	567	nm	
Capacitance	typ.	C	40	40	40	40	40	pF	V_F=0, f=1 MHz
Reverse voltage	min.	V_R	6	6	6	6	6	V	I_R=100 μA
Thermal resistance	typ.	θ_{JL}	150	150	150	150	150	°C/W/ LED chip	

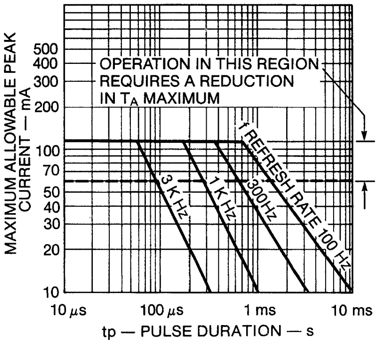
TYPICAL ELECTRO-OPTICAL CHARACTERISTIC CURVES

(25°C Free Air Temperature Unless Otherwise Specified)



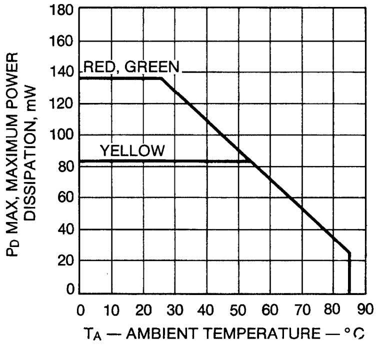
C2013

Fig. 1. Maximum Tolerable Peak Current per LED Chip vs. Pulse Duration for HLMP-23X0/-26XX/-25X0/-28XX



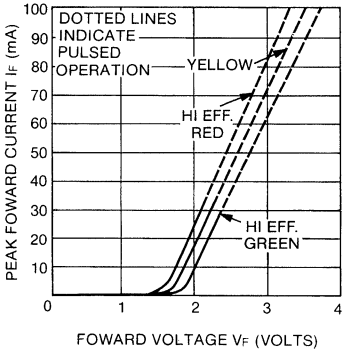
C2014

Fig. 2. Maximum Tolerable Peak Current per LED Chip vs.Pulse Duration for HLMP-24X0/-27XX Devices



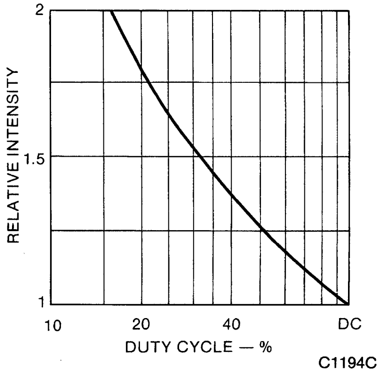
C2025

Fig. 3. Maximum Power Dissipation per LED vs. Ambient Temperature



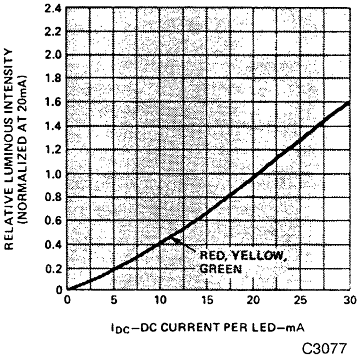
C1833A

Fig. 4. Forward Current vs. Forward Voltage



C1194C

Fig. 5. Luminous Intensity vs. Duty Cycle



C3077

Fig. 6. Luminous Intensity vs. Forward Current

TYPICAL ELECTRO-OPTICAL CHARACTERISTIC CURVES

(25°C Free Air Temperature Unless Otherwise Specified) (Cont'd)

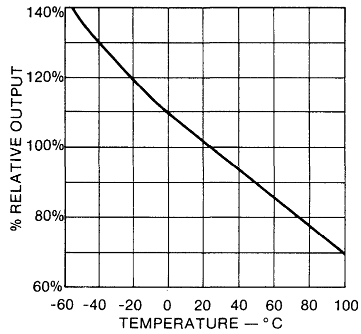
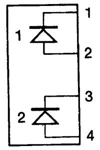


Fig. 7. Output vs. Temperature

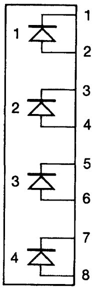
PIN CONNECTIONS TO ELECTRICAL SCHEMATIC

PIN	ELECTRICAL CONNECTION			
	HLMP-2X00	HLMP-2X50	HLMP-2X55	HLMP-2X70/-2X85
1	1 Cathode	1 Cathode	1 Cathode	1 Cathode
2	1 Anode	1 Anode	1 Anode	1 Anode
3	2 Cathode	2 Cathode	2 Anode	2 Anode
4	2 Anode	2 Anode	2 Cathode	2 Cathode
5		3 Cathode	3 Cathode	3 Cathode
6		3 Anode	3 Anode	3 Anode
7		4 Cathode	4 Anode	4 Anode
8		4 Anode	4 Cathode	4 Cathode
9				5 Cathode
10				5 Anode
11				6 Anode
12				6 Cathode
13				7 Cathode
14				7 Anode
15				8 Anode
16				8 Cathode

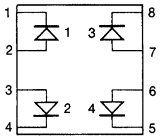
ELECTRICAL SCHEMATIC



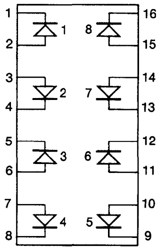
A
HLMP - 2X00



B
HLMP - 2X50



C
HLMP - 2X55



D
HLMP - 2X70

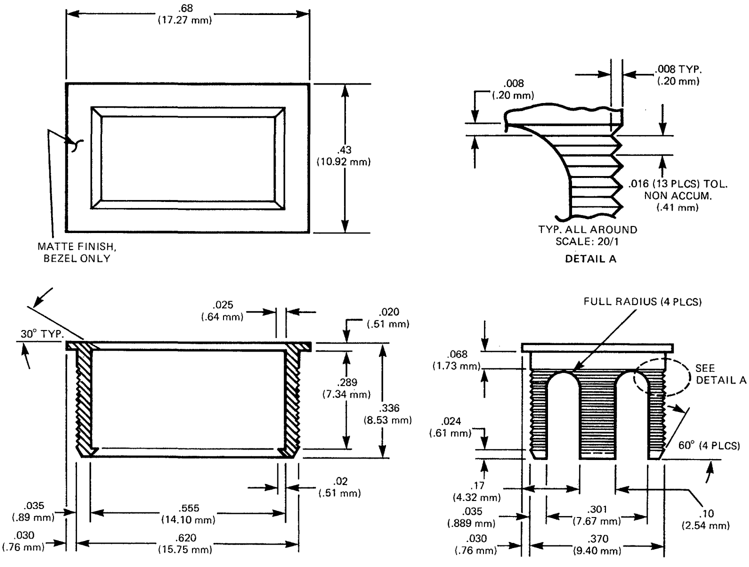
C2016

QT OPTOELECTRONICS

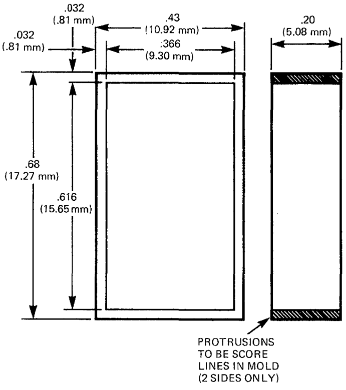
PANEL MOUNTING GROMMET FOR .500-INCH RECTANGULAR INDICATOR

MP73

PACKAGE DIMENSIONS



MATERIAL: POLYPROPYLENE – BLACK C 1480



MATERIAL: POLYPROPYLENE – BLACK C 1481

DESCRIPTION

These MP73 mounting grommet is intended for panel mounting the MV5X173 rectangular lamp. The grommets are made of Black plastic and provide the user with an easy-to-mount, professional appearance when viewed on a front panel.

The MP73 can be used on any panel thickness up to .125-inch (3.18 mm).

PANEL HOLE PUNCHING

Punches may be ordered from one of the following sources:

W.A. WHITNEY COMPANY
650 Race Street
Rockford, IL 61105
(815) 964-6771

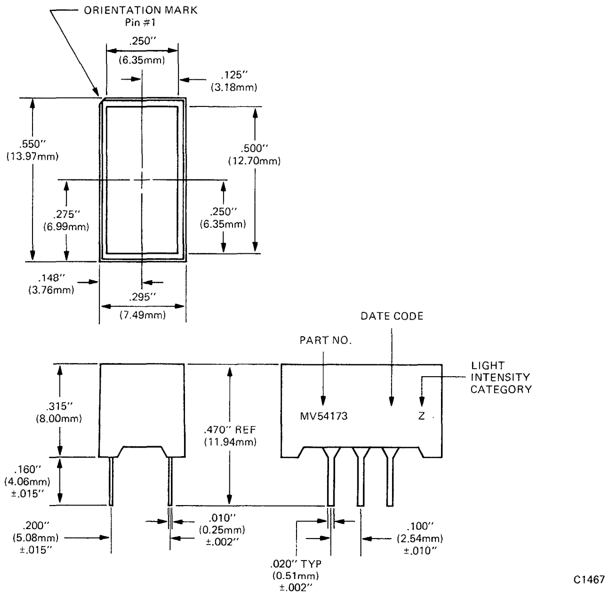
ROTEX PUNCH COMPANY, INC.
2350 Alvarado Street
San Leandro, CA 94577
(415) 357-3600

OPTOELECTRONICS

PANEL INDICATORS

YELLOW MV53173
HIGH EFFICIENCY GREEN MV54173
HIGH EFFICIENCY RED MV57173

PACKAGE DIMENSIONS



TOLERANCE ±.010" UNLESS SPECIFIED.

DESCRIPTION

The MV5X173 series is a large rectangular lamp which contains two LED chips with separate anodes and cathodes for each light. The illuminated area is 0.500-inches×0.250-inches (12.7 mm×6.35 mm).

FEATURES

- .500-inch×.250-inch lighted area available in three colors
- Solid state reliability
- Fast switching—excellent for multiplexing
- Low power consumption
- Directly compatible with IC's
- Wide viewing angle
- .2 inch DIP lead spacing
- Mounting hardware available
- Categorized for Luminous Intensity (See Note 1)

APPLICATIONS

- Panel indicators
- Backlight legends
- Light arrays

ABSOLUTE MAXIMUM RATINGS

	MV53173	MV54173	MV57173
Power dissipation at 25°C	190 mW	200 mW	200 mW
Derate linearly from 50°C	−4.3 mW/°C	−4.5 mW/°C	−4.3 mW/°C
Storage temperature	−40°C to +100°C	−40°C to +100°C	−40°C to +100°C
Operating temperature	−40°C to +85°C	−40°C to +85°C	−40°C to +85°C
Continuous forward current per light (25°C)	20 mA	30 mA	35 mA
Peak forward current per LED chip (1 μsec pulse width, 300 pps)	60 mA	90 mA	1.0 A
Lead soldering time at 260°C (See Notes 3 and 5)	5 sec.	5 sec.	5 sec.

TYPICAL ELECTRO-OPTICAL CHARACTERISTICS (25°C Free Air Temperature)

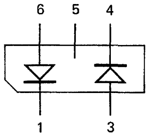
PARAMETER	TEST CONDITIONS	MV53173	MV54173	MV57173	UNITS
Forward voltage (V_F)					
Typ.	I_F=20 mA	2.0	2.2	2.0	V
Max.	I_F=20 mA	2.5	3.0	2.5	V
Luminous Intensity					
Min. (See Note 1)	I_F=20 mA	4.5	4.5	4.5	mcd
Peak wavelength					
Typ.	I_F=20 mA	585	562	635	nm
Spectral line half width	I_F=20 mA	45	30	45	nm
Capacitance					
Typ.	V=0, f=1 MHz	35	20	35	pF
Reverse voltage (V_R)					
Min.	I_R=100μA	5	5	5	V
Typ.	I_R=100μA	25	50	25	V
Viewing angle (total)		120	120	120	degrees

TYPICAL THERMAL CHARACTERISTICS

	MV53173	MV54173	MV57173
Thermal resistance juntion to free air Φ_{JA}	160°C/W	160°C/W	160°C/W
Wavelength temperature coefficient (case temp.)	1.0 A/°C	1.0 A/°C	1.0 Å/°C
Forward voltage temperature coefficient	−1.5 mV/°C	−1.4 mV/°C	−2.0 mV/°C

PIN CONNECTIONS

PIN NO.	ELECTRICAL CONNECTIONS
1	Cathode 1
2	No Pin
3	Anode 2
4	Cathode 2
5	NC
6	Anode 1



FILTER RECOMMENDATIONS

For optimum ON and OFF contrast, one of the following filters or equivalents may be used over the lamp:

MV53173	MV54173	MV57173
Panelgraphic Yellow 25 or Amber 23	Panelgraphic Green 48	Panelgraphic Red 60
Homalite 190—1720 or 100—1726	Homalite 100—1440 Green	Homalite 100—1605

In situations of high ambient light, a neutral density filter can be used to achieve greater contrast:

Panelgraphic Grey 10	Panelgraphic Grey 10 Homalite 100—1266 Grey

NOTES

1. *The average Luminous Intensity is obtained by summing the Luminous Intensity of each segment and dividing by the total number of segments. The standard of measurement is the Photo Research Corp. "Spectra" Microcandela Meter (Model IV-D) corrected for wavelength. Intensity will not vary more than ±33.3% between all segments within a unit.*
2. *Leads immersed to 1/16 inch (1.6 mm) from the body of the device. Maximum unit surface temperature is 140°C.*
3. *All units are categorized for Luminous Intensity. The Intensity category is marked on each part as a suffix letter to the part number.*
4. *For flux removal, Freon TF, Freon TE, Isoproponal or water may be used to their boiling points.*

TYPICAL CURVES (Per LED Chip Unless Indicated) (25°C Free Air Temperature)

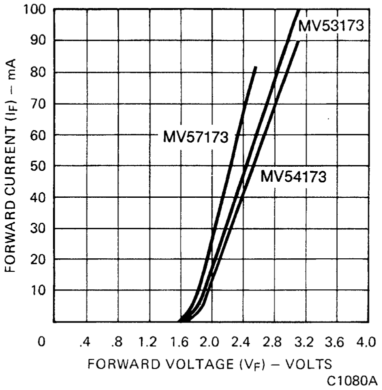


Fig. 1. Forward Current vs. Forward Voltage

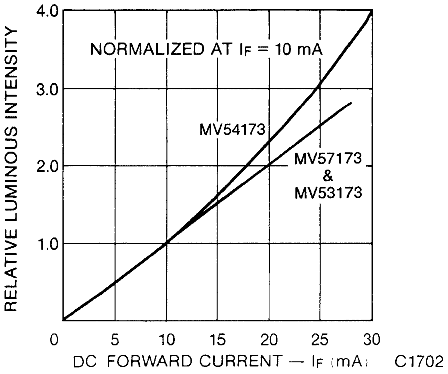


Fig. 2. Relative Luminous Intensity vs. DC Forward Current (Both LED Chips ON)

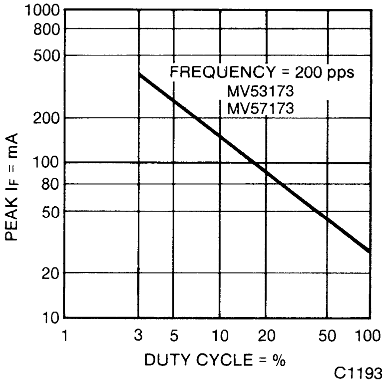


Fig. 3. Max Peak Current vs. Duty Cycle

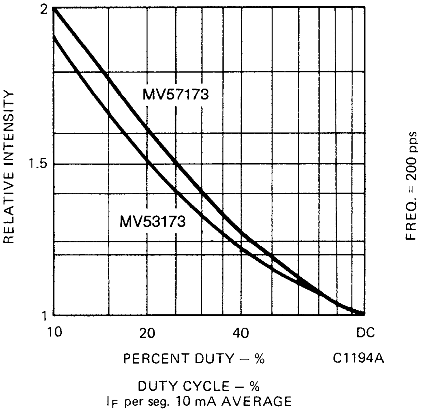


Fig. 4. Luminous Intensity vs. Duty Cycle

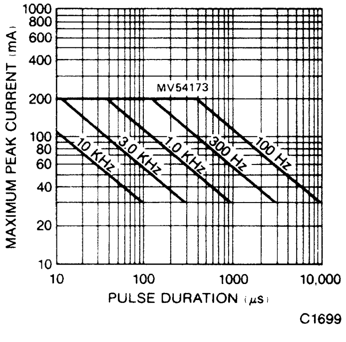


Fig. 5. Maximum Peak Current vs. Pulse Duration

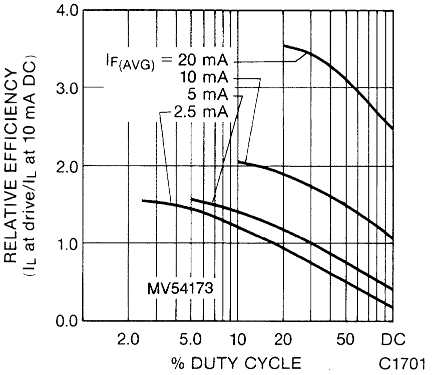


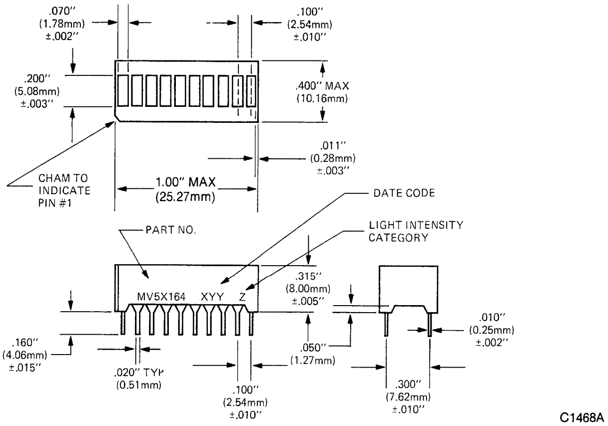
Fig. 6. Relative Efficiency vs. Duty Cycle

OPTOELECTRONICS

BARGRAPH DISPLAYS

YELLOW MV53164
HIGH EFFICIENCY GREEN MV54164
HIGH EFFICIENCY RED MV57164

PACKAGE DIMENSIONS



NOTE: TOLERANCES ±.010″ UNLESS SPECIFIED

DESCRIPTION

The MV5X164 series is a 10 segment bargraph display with separate anodes and cathodes for each light segment. The packages are end-stackable.

FEATURES

- Large segments, closely spaced
- End-stackable
- Fast switching—excellent for multiplexing
- Low power consumption
- Directly compatible with IC's
- Wide viewing angle
- Standard .3-inch DIP lead spacing
- Categorized for Luminous Intensity (See Note 1)

ABSOLUTE MAXIMUM RATINGS

	MV53164	MV54164	MV57164
Power dissipation at 25°C ambient	750 mW	750 mW	750 mW
Derate linearly from 50°C	−14.3 mW/°C	−14.3 mW/°C	−14.3 mW/°C
Storage and operating temperature	−40°C to +85°C	−40°C to +85°C	−40°C to +85°C
Continuous forward current			
Total	200 mA	300 mA	300 mA
Per segment	25 mA	30 mA	30 mA
Reverse voltage			
Per segment	6.0 V	6.0 V	6.0 V
Soldering time at 260°C (See Notes 3 and 5)	5 sec.	5 sec.	5 sec.

TYPICAL THERMAL CHARACTERISTICS

	MV53164	MV54164	MV57164
Thermal resistance junction to free air Φ_{JA}	160°C/W	160°C/W	160°C/W
Wavelength temperature coefficient (case temp.)	1.0 A/°C	1.0 A/°C	1.0 A/°C
Forward voltage temperature coefficient	−1.5 mV/°C	−1.4 mV/°C	−2.0 mV/°C

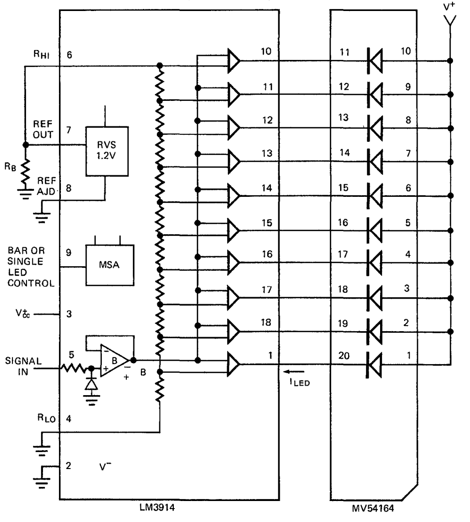
ELECTRO-OPTICAL CHARACTERISTICS

(25°C Free Air Temperature Unless Otherwise Specified)

	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS
Forward voltage MV53164, MV57164/MV54164		2.0/2.2	2.5/3.0	V	I_F=10 mA
Luminous Intensity (unit average) (See Note 1)	510	1800		μcd	I_F=10 mA
Pulsed Luminous Intensity (MV54164)	710	2500		μcd	I_F=60 mA peak; 1:6 DF
Peak emission wavelength					
MV53164		585		nm	
MV54164		562		nm	
MV57164		630		nm	
Spectral line half width MV53164, MV57164/MV54164		40/30		nm	
Dynamic resistance					
Segment MV53164, MV57164/MV54164		26/12		Ω	I_F=20 mA
Capacitance MV53164, MV57164/MV54164		35/40		pF	V=0, f=1 MHz
Switching time		500		ns	I_F=10 mA
Reverse voltage	6.0				I_R=100μA

TYPICAL DRIVE CIRCUIT

TYPICAL DRIVE CIRCUIT



RVS: REFERENCE VOLTAGE SOURCE
MSA: MODE SELECT AMPLIFIER
B: BUFFER
R_B: LED BRIGHTNESS CONTROL

C1471

PIN CONNECTIONS

PIN NO.	ELECTRICAL CONNECTIONS	PIN NO.	ELECTRICAL CONNECTIONS	PIN NO.	ELECTRICAL CONNECTIONS	PIN NO.	ELECTRICAL CONNECTIONS
1	Bar 1 Anode	6	Bar 6 Anode	11	Bar 10 Cathode	16	Bar 5 Cathode
2	Bar 2 Anode	7	Bar 7 Anode	12	Bar 9 Cathode	17	Bar 4 Cathode
3	Bar 3 Anode	8	Bar 8 Anode	13	Bar 8 Cathode	18	Bar 3 Cathode
4	Bar 4 Anode	9	Bar 9 Anode	14	Bar 7 Cathode	19	Bar 2 Cathode
5	Bar 5 Anode	10	Bar 10 Anode	15	Bar 6 Cathode	20	Bar 1 Cathode

TYPICAL CURVES MV53164 MV54164 MV57164 (PER SEGMENT) (25°C Free Air Temperature)

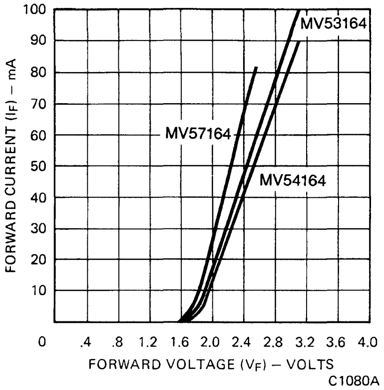


Fig. 1. Forward Current vs. Forward Voltage

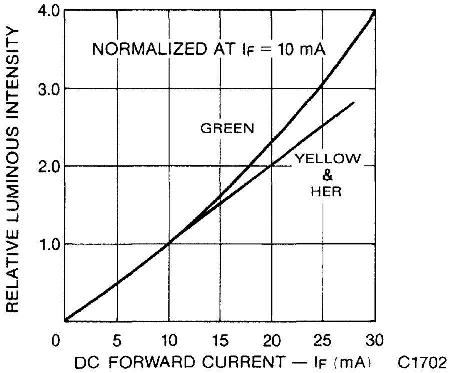


Fig. 2. Relative Luminous Intensity vs. DC Forward Current (Both LED Chips ON)

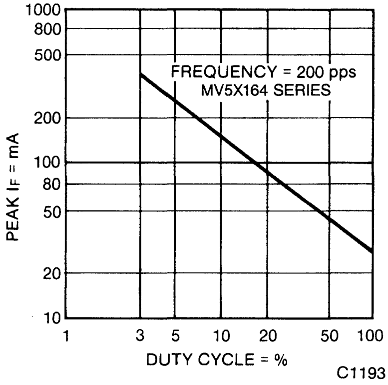


Fig. 3. Max Peak Current vs. Duty Cycle

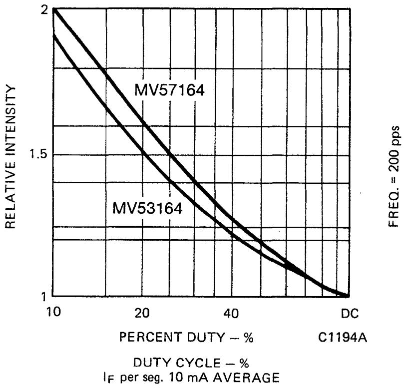


Fig. 4. Luminous Intensity vs. Duty Cycle

TYPICAL CURVES MV53164 MV54164 MV57164 (PER SEGMENT) (25°C Free Air Temperature) (Cont'd)

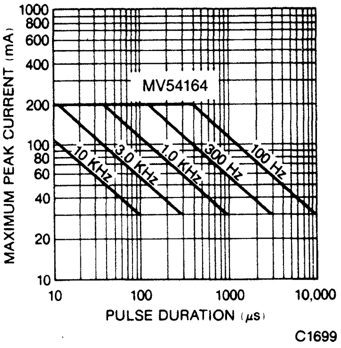


Fig. 5. Maximum Peak Current vs. Pulse Duration

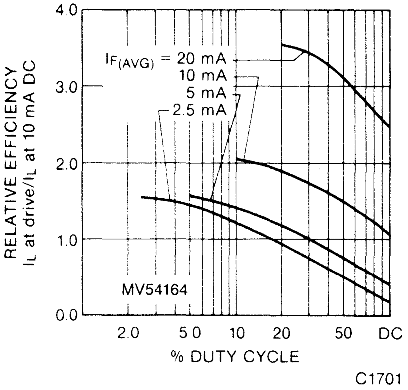


Fig. 6. Relative Efficiency vs. Duty Cycle

FILTER RECOMMENDATIONS

For optimum ON and OFF contrast, one of the following filters or equivalents may be used over the lamp:

MV53164	MV54164	MV57164
Panelgraphic Yellow 25 or Amber 23	Panelgraphic Green 48	Panelgraphic Red 60
Homalite 190—1720 or 100—1726	Homalite 100—1440 Green	Homalite 100—1605

In situations of high ambient light, a neutral density filter can be used to achieve greater contrast:

Panelgraphic Grey 10	Panelgraphic Grey 10
	Homalite 100—1266 Grey

NOTES

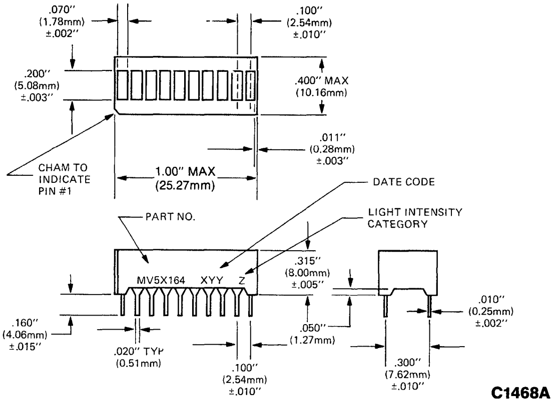
1. *The average Luminous Intensity is obtained by summing the Luminous Intensity of each segment and dividing by the total number of segments. The standard of measurement is the Photo Research Corp. "Spectra" Microcandela Meter (Model IV-D) corrected for wavelength. Intensity will not vary more than ±33.3% between all segments within a unit.*
2. *Leads immersed to 1/16 inch (1.6 mm) from the body of the device. Maximum unit surface temperature is 140°C.*
3. *All units are categorized for Luminous Intensity. The Intensity category is marked on each part as a suffix letter to the part number.*
4. *For flux removal, Freon TF, Freon TE, Isopropanal or water may be used to their boiling points.*

QT
OPTOELECTRONICS

MULTICOLOR BARGRAPH

MV5A164 MV5D164
MV5B164 MV5E164
MV5C164

PACKAGE DIMENSIONS



NOTE: TOLERANCES ±.010" UNLESS SPECIFIED

DESCRIPTION

These are 10 segments multicolor bargraphs with separate anodes and cathode for each segment. The packages are stackable.

FEATURES

- Large segments, closely spaced
- End stackable
- Fast switching — excellent for multiplexing
- Low power consumption
- Directly compatible with ICs.
- Standard 0.3" DIP lead spacing

Custom multicolor bargraphs are available with minimum delivery requirements.

ABSOLUTE MAXIMUM RATING

Power dissipation at 25°C ambient	750 mW
Derate linearly from 50°C	−14.3 mW/°C
Storage and operating temperature	−40°C to 85°C
Continuous forward current	
Total	200 mA
Per segment	25 mA
Reverse voltage	
Per segment	6 V
Soldering time at 260°C	5 Sec.

TYPICAL THERMAL CHARACTERISTICS

Thermal resistance Junction to free air $Ø_{JA}$	160°C/W
Wavelength temperature coefficient (case temperature)	1.0 A/°C
Forward voltage temperature coefficient	

Yellow	−1.5 mV/°C,	Green	−1.4 mV/°C,	HER	−2.0 mV/°C

OPTOELECTRONICS

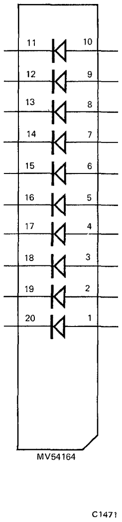
MULTICOLOR BARGRAPH

ELECTRO-OPTICAL CHARACTERISTICS

(25°C Free Air Temperature Unless Otherwise Specified)

CONDITIONS	MIN	TYP	MAX	UNITS	TEST
Forward voltage (HER, Green, Yellow)		2.2	3.0	V	I_F=10 mA
Luminous intensity (average)	510	1800		μcd	I_F=10 mA
Peak emission wavelength					
High efficiency red (HER)		630		nm	
Green		562		nm	
Yellow		585		nm	
Spectral line half width		40		nm	
Dynamic resistance — segment		26		ohm	I_F=20 mA
Switching time		500		ns	
Reverse voltage		6.0		V	I_R=100 μA

INTERNAL CIRCUIT DIAGRAMS



Pin connections

Pin No	Electrical connections	Pin No	Electrical connections
1	Bar 1 anode	11	Bar 10 cathode
2	Bar 2 anode	12	Bar 9 cathode
3	Bar 3 anode	13	Bar 8 cathode
4	Bar 4 anode	14	Bar 7 cathode
5	Bar 5 anode	15	Bar 6 cathode
6	Bar 6 anode	16	Bar 5 cathode
7	Bar 7 anode	17	Bar 4 cathode
8	Bar 8 anode	18	Bar 3 cathode
9	Bar 9 anode	19	Bar 2 cathode
10	Bar 10 anode	20	Bar 1 cathode

MULTICOLOR BARGRAPH SEGMENT COLOR

Segment	MV5A164	MV5B164	MV5C164	MV5D164	MV5E164
1	HER	HER	Green	Green	Green
2	HER	HER	Green	Green	Yellow
3	HER	Yellow	Green	Green	Yellow
4	Yellow	Yellow	Green	Green	Yellow
5	Yellow	Green	Green	Green	Yellow
6	Yellow	Green	Green	HER	Yellow
7	Yellow	Yellow	Yellow	HER	Yellow
8	Green	Yellow	Yellow	HER	HER
9	Green	HER	Yellow	HER	HER
10	Green	HER	HER	Yellow	HER

LAMPS

Alphanumeric Product Listing

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HLMP-0401	6-159
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HLMP-1302	6-57
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HLMP-1440	6-43
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HLMP-D640	6-131
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HLMP-M501	6-151
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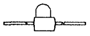
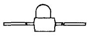
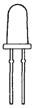
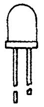
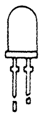
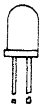
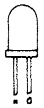
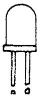
LAMPS

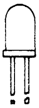
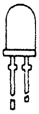
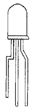
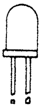
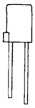
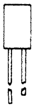
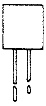
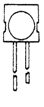
Alphanumeric Product Listing

PACKAGE	PART NUMBER	SOURCE COLOR	LENS TYPE	VIEWING ANGLE 2θ ½ (DEGREES)	LUMINOUS INTENSITY (TYPE. mcd/mA)	PAGE
T-¾ 	MV50BL	Standard Red	Water Clear	80	3.0/20	6-9
	MV54BL	Standard Red	Red Light Diff.	80	3.5/20	6-9
	MV53BL	Yellow	Yellow Clear	80	6.0/20	6-9
	MV64BL	High Eff. Green	Green Clear	80	8.0/20	6-9
	MV55ABL	High Eff. Red	Red Diff.	40	3.0/5	6-9
	MV57BL	High Eff. Red	Red Clear	80	8.0/20	6-9
T-3/4 Square Base 	MV6000	Red	Red Diffused	90	1.2/10	6-13
	MV6300	Yellow	Yellow Diffused	90	3.0/10	6-13
	HLMP-6405	Yellow	Yellow Clear	28	12/10	6-17
	HLMP-7019	Yellow	Yellow Diffused	90	0.6/2.0	6-19
	MV6400	Green	Green Diffused	90	3.0/10	6-13
	HLMP-6505	Green	Green Clear	28	12/10	6-17
	HLMP-7040	Green	Green Diffused	90	0.6/2.0	6-19
	HLMP-Q105	A1GaAs Red	Red Clear	28	35/20	6-17
	HLMP-Q150	A1GaAs Red	Red Diffused	90	1.8/1.0	6-19
	MV6700	Hi. Eff. Red	Red Diffused	90	3.0/10	6-13
	HLMP-6305	Hi. Eff. Red	Red Clear	28	12/10	6-17
	HLMP-7000	Hi. Eff. Red	Red Diffused	90	0.6/2.0	6-19
T-3/4 Resistor 	MR5000	Red	Red Diffused	40	0.6/5V	6-21
	MR5010	Red	Red Diffused	40	1.2/5V	6-21
	MR5020	Red	Red Diffused	40	2.0/5V	6-21
	MR5310	Yellow	Yellow Diffused	40	1.5/5V	6-21
	MR5410	Green	Green Diffused	40	0.6/5V	6-21
T-3/4 Square Base Resistor 	HLMP-6700	Yellow	Yellow Diffused	90	5/5V	6-25
	HLMP-6720	Yellow	Yellow Diffused	90	2/5V	6-25
	HLMP-6800	Green	Green Diffused	90	5/5V	6-25
	HLMP-6820	Green	Green Diffused	90	2/5V	6-25
	HLMP-6600	Hi. Eff. Red	Red Diffused	90	5/5V	6-25
	HLMP-6620	Hi. Eff. Red	Red Diffused	90	2/5V	6-25
T-3/4 Clear 	QTLP912-2	Red	Water Clear	25	80/20	6-27
	QTLP912-3	Yellow	Water Clear	25	30/20	6-27
	QTLP914-4	Green	Water Clear	25	50/20	6-27
	QTLP912-7	A1GaAs Red	Water Clear	25	170/20	6-27
T-3/4 Diffused 	QTLP913-2	Red	Red Diffused	50	40/20	6-27
	QTLP913-3	Yellow	Yellow Diffused	50	15/20	6-27
	QTLP913-4	Green	Green Diffused	50	25/20	6-27
	QTLP913-7	A1GaAs Red	Red Diffused	50	108/20	6-27
Flat Package Clear Lens 	QTLP282-2	Red	Water Clear	150	5.6/20	6-31
	QTLP282-3	Yellow	Water Clear	150	6.0/20	6-31
	QTLP282-4	Green	Water Clear	150	5.6/20	6-31
	QTLP282-7	A1GaAs Red	Water Clear	150	17/20	6-31
T-1 Low Profile 	MV5077C	Standard Red	Red Diffused	180	1.8/20	6-35
	MV5377C	Yellow	Yellow Diffused	180	7.0/20	6-35
	MV5477C	Hi. Eff. Green	Green Diffused	180	7.0/20	6-35
	MV5777C	Hi. Eff. Red	Red Diffused	180	7.0/20	6-35

PACKAGE	PART NUMBER	SOURCE COLOR	LENS TYPE	VIEWING ANGLE 2 θ ½ (DEGREES)	LUMINOUS INTENSITY (TYP. mcd/mA)	PAGE
T-1 	MV5074C	Standard Red	Red Clear	70	2.5/20	6-39
	MV5075C	Standard Red	Red Diffused	90	1.5/20	6-39
	MV5374C	Yellow	Yellow Diffused	90	9.0/20	6-39
	MV5474C	Hi. Eff. Green	Green Diffused	90	9.0/20	6-39
	MV5774C	Hi. Eff. Red	Red Diffused	90	9.0/20	6-39
T-1 Clear Lens 	HLMP-1440	Yellow	Pale Yellow Tint	45	60/20	6-43
	MV5360 (HLMP-1420)	Yellow	Pale Yellow Tint	45	12/10	6-43
	MV53621	Yellow	Yellow Clear	45	4/10	6-43
	MV53622	Yellow	Yellow Clear	45	8/10	6-43
	HLMP-1540	Hi. Eff. Green	Pale Green Tint	45	60/20	6-43
	MV5460 (HLMP-1520)	Hi. Eff. Green	Pale Green Tint	45	12/20	6-43
	MV54624 (HLMP-1521)	Hi. Eff. Green	Green Clear	45	12/20	6-43
	HLMP-K640	Pure Green	Water Clear	45	30/20	6-47
	HLMP-K155	AlGaAs Red	Clear	45	3/1.0	6-51
	HLMP-K105	AlGaAs Red	Clear	45	65/20	6-63
	HLMP-1340	Hi. Eff. Red	Pale Orange Tint	45	60/20	6-43
	MV5760 (HLMP-1320)	Hi. Eff. Red	Pale Orange Tint	45	12/10	6-43
	MV57620	Hi. Eff. Red	Red Clear	45	2/10	6-43
	MV57621	Hi. Eff. Red	Red Clear	45	4/10	6-43
	MV57622 (HLMP-1321)	Hi. Eff. Red	Red Clear	45	12/10	6-43
	MV5B66	Blue	Pale Blue Tint	14	3.0/20	6-55
T-1 Diffused 	MV50640	Standard Red	Red Diffused	90	1.5/20	6-57
	HLMP-1719	Yellow	Yellow Diffused	50	2.0/2	6-61
	MV53640	Yellow	Yellow Diffused	90	2.0/10	6-57
	MV53641	Yellow	Yellow Diffused	90	3.0/10	6-57
	MV53642	Yellow	Yellow Diffused	90	4.5/10	6-57
	HLMP-1790	Hi. Eff. Green	Green Diffused	50	2.0/2	6-61
	MV54643 (HLMP-1503)	Hi. Eff. Green	Green Diffused	90	5/20	6-57
	MV54644 (HLMP-1523)	Hi. Eff. Green	Green Diffused	90	10/20	6-57
	HLMP-K101	AlGaAs Red	Red Diffused	60	45/20	6-63
	HLMP-K150	AlGaAs Red	Red Diffused	60	2/1.0	6-51
	HLMP-1700	Hi. Eff. Red	Red Diffused	50	2.0/2	6-61
	MV57640 (HLMP-1300)	Hi. Eff. Red	Red Diffused	90	2.0/10	6-57
	MV57641 (HLMP-1301)	Hi. Eff. Red	Red Diffused	90	2.5/10	6-57
	MV57642 (HLMP-1302)	Hi. Eff. Red	Red Diffused	90	4.0/10	6-57
	HLMP-K400	Soft Orange	Orange Diffused	90	4.0/10	6-47
	HLMP-K401	Soft Orange	Orange Diffused	90	5.0/10	6-47
	HLMP-K402	Soft Orange	Orange Diffused	90	6.5/10	6-47
	HLMP-K600	Pure Green	Green Diffused	90	4.5/10	6-47
T-1 Resistor 	MR5060	Red	Red Diffused	60	1.5/5V	6-67
	MR5660	Red	Non Tinted Diffused	60	1.5/5F	6-67
	MR5360	Yellow	Yellow Diffused	60	4.0/5F	6-67
	MR5361	Yellow	Yellow Diffused	60	4.0/12V	6-67
	MR5460	Hi. Eff. Green	Green Diffused	60	4.0/5V	6-67
	MR5461	Hi. Eff. Green	Green Diffused	60	4.0/12V	6-67
	MR5760	Hi. Eff. Red	Red Diffused	60	4.0/5V	6-67
	MR5761	Hi. Eff. Red	Red Diffused	60	4.0/12V	6-67
T-1 White Contrast White Diffused 	MV6461	H.E.G./AlGaAs	White Diffused	100	10/20	6-71
	MV6661	H.E.R./AlGaAs	White Diffused	100	10/20	6-71
T-1¾ Taper 	MV5021A	Standard Red	White Diffused	90	1.6/20	6-73
	MV5022A	Standard Red	Red Clear	90	1.6/20	6-73
	MV5023A	Standard Red	Red Diffused	90	1.6/20	6-73
	MV5024A	Standard Red	Red Diffused	60	3.0/20	6-73
	MV5025A	Standard Red	Red Diffused	180	0.4/20	6-73
	MV5026A	Standard Red	Deep Red Diffused	90	0.6/20	6-73

PACKAGE	PART NUMBER	SOURCE COLOR	LENS TYPE	VIEWING ANGLE 2θ½ (DEGREES)	LUMINOUS INTENSITY (TYP. mcd/mA)	PAGE
T-1¾ Bullet 	MV50152	Standard Red	Red Clear	45	2.0/10	6-77
	MV53152	Yellow	Amber Clear	45	10/10	6-77
	MV54152	Hi. Eff. Green	Green Clear	45	15/10	6-77
	MV57152	Hi. Eff. Red	Orange Clear	45	10/10	6-77
	MV50154	Standard Red	Red. Lightly Diff.	50	1.5/10	6-77
	MV53154	Yellow	Amber Lightly Diff.	50	8/10	6-77
	MV54154	Hi. Eff. Green	Green Lightly Diff.	50	12/10	6-77
	MV57154	Hi. Eff. Red	Orange Lightly Diff.	50	8/10	6-77
T-1¾ Low Profile 	FLV110	Standard Red	Red. Diffused	70	3.0/20	6-81
T-1¾ Clear Stand-off 	HLMP-3850 (Ultrabright)	Yellow	Pale Yellow Tint	24	150/20	6-85
	HLMP-3950 (Ultrabright)	Hi. Eff. Green	Pale Green Tint	24	150/20	6-85
	HLMP-3750 (Ultrabright)	Hi. Eff. Red	Pale Orange Tint	24	150/20	6-85
	HLMP-D105	AlGaAs Red	Clear	24	240/20	6-63
	HLMP-D155	AlGaAs Red	Clear	24	10/1.0	6-51
T-1¾ Clear 	MV5052	Standard Red	Red Clear	72	2.0/20	6-89
	MV3350	Yellow	Pale Yellow Tint	24	150/20	6-85
	MV5352/MV6352	Yellow	Yellow Clear	28	90/20	6-93
	MV3450	Hi. Eff. Green	Pale Green Tint	24	150/20	6-85
	MV5452/MV64520	Hi. Eff. Green	Green Clear	35	25/20	6-93
	MV64521	Hi. Eff. Green	Green Clear	35	100/20	6-93
	MV5152/MV6152	Hi. Eff. Red	Amber Clear	28	100/20	6-93
	MV3750	Hi. Eff. Red	Pale Orange Tint	24	150/20	6-85
	MV5752/MV6752	Hi. Eff. Red	Red Clear	28	100/20	6-93
	HLMP-3315	Hi. Eff. Red	Red Clear	35	18/10	6-81
	HLMP-3316	Hi. Eff. Red	Red Clear	35	35/10	6-81
	MV5B54	Blue	Pale Blue Tint	24	2.0/20	6-55
	HLMP-D640	Pure Green	Water Clear	24	60/20	6-131
T-1¾ Diffused Narrow Angle 	MV5054A-1	Standard Red	Red Diffused	24	2.0/10	6-89
	MV5054A-2	Standard Red	Red Diffused	24	3.0/10	6-89
	MV5054A-3	Standard Red	Red Diffused	24	4.0/10	6-89
	HLMP-4719	Yellow	Yellow Diffused	35	2.0/2	6-61
	MV5354A/MV6354A	Yellow	Yellow Diffused	24	25/20	6-127
	HLMP-4740 (MV2454)	Hi. Eff. Green	Green Diffused	35	3.0/2	6-61
	MV5454A/MV6454A	Hi. Eff. Green	Green Diffused	24	30/20	6-127
	MV5154A/MV6154A	Hi. Eff. Red	Amber Diffused	24	25/20	6-127
	HLMP-4700	Hi. Eff. Red	Red Diffused	35	2.0/2	6-61
	MV5754A/MV6754A	Hi. Eff. Red	Red Diffused	24	25/20	6-127
	MV8190	AlGaAs Red	Red Diffused	45	100/20	6-109
	MV8191	AlGaAs Red	Red Diffused	45	200/20	6-109

PACKAGE	PART NUMBER	SOURCE COLOR	LENS TYPE	VIEWING ANGLE θ ½ (DEGREES)	LUMINOUS INTENSITY (TYP. mcd/mA)	PAGE
T-1¾ Super Bright Clear lens 	MV8102	AlGaAs Red	Water Clear	20	370/20	6-97
	MV8103	AlGaAs Red	Water Clear	20	940/20	6-97
	MV8104	AlGaAs Red	Water Clear	20	1500/20	6-97
	MV8111	AlGaAs Red	Water Clear	12	370/20	6-101
	MV8112	AlGaAs Red	Water Clear	12	940/20	6-101
	MV8113	AlGaAs Red	Water Clear	12	1500/20	6-101
	MV8114	AlGaAs Red	Water Clear	12	2400/20	6-101
	MV8132	AlGaAs Red	Water Clear	30	940/20	6-105
	MV8133	AlGaAs Red	Water Clear	30	1500/20	6-105
	MV8140	AlGaAs Red	Water Clear	45	220/20	6-109
	MV8141	AlGaAs Red	Water Clear	45	370/20	6-109
	MV8313	Yellow	Water Clear	12	940/20	6-113
	MV8314	Yellow	Water Clear	12	1500/20	6-113
	MV8332	Yellow	Water Clear	30	940/20	6-105
	MV8333	Yellow	Water Clear	30	1500/20	6-105
	MV8341	Yellow	Water Clear	45	220/20	6-117
	MV8342	Yellow	Water Clear	45	370/20	6-117
	MV8410	Green	Water Clear	12	240/20	6-121
	MV8411	Green	Water Clear	12	370/20	6-121
	MV8703	Orange	Water Clear	20	940/20	6-123
	MV8704	Orange	Water Clear	20	1500/20	6-123
	MV8741	Orange	Water Clear	45	370/20	6-123
	MV8742	Orange	Water Clear	45	600/20	6-123
T-1¾ Diffused Wide Angle 	MV5053/MV6053	Standard Red	Red Diffused	80	1.6/20	6-89
	MV5055	Standard Red	Red Diffused	150	0.1/20	6-89
	MV5353/MV6353	Yellow	Yellow Diffused	65	15/20	6-127
	MV5453/MV64530	Hi. Eff. Green	Green Diffused	75	20/20	6-127
	MV64531	Hi. Eff. Green	Green Diffused	75	25/20	6-127
	MV5153/MV6153	Hi. Eff. Red	Amber Diffused	65	15/20	6-127
	MV5753/MV6753	Hi. Eff. Red	Red Diffused	65	15/20	6-127
	HLMP-3300	Hi. Eff. Red	Red Diffused	65	3.5/10	6-81
	HLMP-3301	Hi. Eff. Red	Red Diffused	65	7.0/10	6-81
	HLMP-D101	AlGaAs Red	Red Diffused	65	70/20	6-63
	HLMP-D150	AlGaAs Red	Red Diffused	65	3/1.0	6-51
	HLMP-D400	Soft Orange	Orange Diffused	60	3.5/10	6-131
	HLMP-D401	Soft Orange	Orange Diffused	60	7.0/10	6-131
	HLMP-D600	Pure Green	Green Diffused	60	3.0/10	6-131
T-1¾ Resistor 	MR3050	Red	Red Diffused	60	2.0/5V	6-135
	MR3051	Red	Red Diffused	60	2.0/12V	6-135
	MR3350	Yellow	Yellow Diffused	60	4.0/5V	6-135
	MR3351	Yellow	Yellow Diffused	60	4.0/12V	6-135
	MR3450	Hi. Eff. Green	Green Diffused	60	4.0/5V	6-135
	MR3451	Hi. Eff. Green	Green Diffused	60	4.0/12V	6-135
	MR3750	Hi. Eff. Red	Red Diffused	60	4.0/5V	6-135
	MR3751	Hi. Eff. Red	Red Diffused	60	4.0/12V	6-135

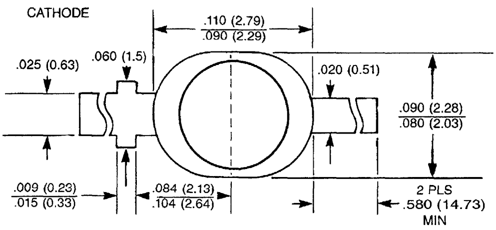
PACKAGE	PART NUMBER	SOURCE COLOR	LENS TYPE	VIEWING ANGLE 2 θ ½ (DEGREES)	LUMINOUS INTENSITY (TYP. mcd/mA)	PAGE
T-1¾ Max. Contrast White Diffused 	MV6351	Yellow	Pale Yellow Diffused	70	12.0/20	6-139
	MV6451	Hi. Eff. Green	Pale Green Diffused	70	12.0/20	6-139
	MV6151	Hi. Eff. Red	Pale Orange Diffused	70	12.0/20	6-139
	MV6951	Deep Red	Pale Pink Diffused	70	12.0/20	6-139
T-1¾ Bicolor White Diffused Stand Off 	MV5094A (Bipolar)	Red/Red	White Diffused	75	6.0/20	6-143
	MV5491A (Bicolor)	Red/Green	White Diffused	100	6.0/20	6-143
T-1¾ Max. Contrast White 	MV5437	H.E.G./H.E.R.	White Diffused	100	6/20	6-145
10 mm Clear Lens 	MV9100	AlGaAs Red	Water Clear	45	940/20	6-147
	MV9101	AlGaAs Red	Water Clear	45	1500/20	6-147
	MV9102	AlGaAs Red	Water Clear	45	2400/20	6-147
4mm Flat Top 	HLMP-M200/201	Hi. Eff. Red	Tint/Diffused	135	5/20	6-151
	HLMP-M250/251	Hi. Eff. Red	Tint/Clear	80	5/10	6-151
	HLMP-M300/301	Yellow	Tint/Diffused	135	5/20	6-151
	HLMP-M350/351	Yellow	Tint/Clear	80	5/10	6-151
	HLMP-M500/501	Hi. Eff. Green	Tint/Diffused	135	7/20	6-151
	HLMP-M550/551	Hi. Eff. Green	Tint/Clear	80	10/10	6-151
Rectangular 	MV53123	Yellow	Yellow Diffused	100	4.0/20	6-155
	MV54123	Hi. Eff. Green	Green Diffused	100	4.0/20	6-155
	MV57123	Hi. Eff. Red	Red Diffused	100	4.0/20	6-155
	HLMP-0400	Yellow	Yellow Diffused	100	2.5/20	6-159
	HLMP-0401	Yellow	Yellow Diffused	100	5.0/20	6-159
	HLMP-0503	Hi. Eff. Green	Green Diffused	100	3.0/20	6-159
	HLMP-0504	Hi. Eff. Green	Green Diffused	100	5.0/20	6-159
	HLMP-0300	Hi. Eff. Red	Red Diffused	100	2.5/20	6-159
	HLMP-0301	Hi. Eff. Red	Red Diffused	100	5.0/20	6-159
	MV53124A	Yellow	Yellow Diffused	100	6.0/20	6-163
	MV54124A	Hi. Eff. Green	Green Diffused	100	6.0/20	6-163
	MV57124A	Hi. Eff. Red	Red Diffused	100	6.0/20	6-163
	MV49124A (Bicolor)	Red/Green	White Diffused	100	6.0/20	6-163

SUBMINIATURE T-¾ SOLID STATE LAMPS

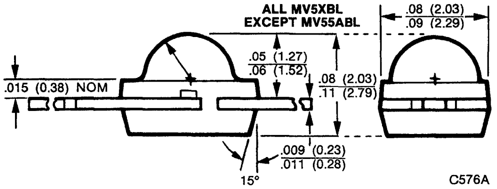
YELLOW MV53BL
HIGH EFFICIENCY GREEN MV64BL
STANDARD RED MV50BL HIGH EFFICIENCY RED MV55ABL
STANDARD RED MV54BL HIGH EFFICIENCY RED MV57BL

PACKAGE DIMENSIONS

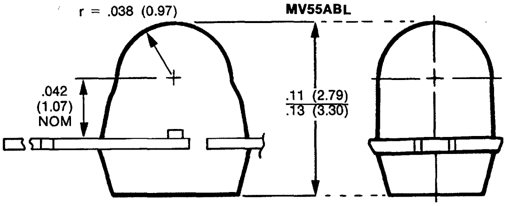
ALL MV5XBL



C1994A



C576A



NOTES:
1. ALL DIMENSIONS IN INCHES (mm)
2. TOLERANCES ARE ± .010 INCH UNLESS SPECIFIED

C593A

DESCRIPTION

The family of MV53BL, MV54BL, MV57BL, and MV64BL are non-diffused, tinted subminiature T-¾ radial lamps with wide viewing angle.
The MV50BL is Water Clear with wide viewing angle while MV55ABL is tinted, non-diffused narrow viewing angle specified at 5 mA.

FEATURES

The subminiature LED lamps are intended for high volume, low-cost status indication on PC boards and for backlighting switches and keyboard keys. The lamps are compatible with vapor phase reflow surface mount and conventional soldering switches.

- Subminiature package
- All colors
- Solid state reliability
- Choice of viewing angle

PHYSICAL CHARACTERISTICS

TYPE	SOURCE COLOR	LENS EFFECT
MV50BL	Standard Red	Water Clear
MV54BL	Standard Red	Red
MV53BL	Yellow	Yellow
MV64BL	High Efficiency Green	Green
MV55ABL	High Efficiency Red	Red/Narrow
MV57BL	High Efficiency Red	Red

OPTOELECTRONICS

SUBMINIATURE T-¾ SOLID STATE LAMPS

ELECTRO-OPTICAL CHARACTERISTICS (T_A=25°C Unless Otherwise Specified)

PARAMETER		SYMBOL	MV50BL	MV53BL	MV54BL	MV55ABL	MV57BL	MV64BL	UNITS	CONDITIONS
Luminous Intensity	min.	I_V	0.5	1.0	0.4	*	1.0	1.0	mcd	I_F=20 mA
	typ.		3.0	6.0	3.5	*	8.0	8.0	mcd	I_F=20 mA
Forward voltage	max.	V_F	2.0	3.0	2.0	*	3.0	3.0	V	I_F=20 mA
	typ.		1.65	2.1	1.65	2.2	2.1	2.2	V	I_F=20 mA
Peak wavelength		λp	660	585	660	635	635	565	nm	
Spectal line halfwidth	typ.		20	35	20	45	35	35	nm	
Reverse breakdown voltage	min.	V_{BR}	5	5	5	5	5	5	V	I_R=100 μA
Total viewing angle (5)	typ.	2θ½	80	80	80	40	80	80	degrees	

*MV55AB I_V min=0.2 mcd/5 mA, I_{VTYP}=3.0 mcd/5 mA, V_F max=2.0 V/5 mA, V_{FTYP}=1.6V/5 mA

ABSOLUTE MAXIMUM RATINGS (T_A=25°C Unless Otherwise Specified)

PARAMETER	YELLOW/ HI EFF. RED	STD. RED	HI EFF. GREEN	UNITS	NOTES
	MV53BL MV55ABL MV57BL	MV50BL MV54BL	MV64BL		
Power dissipation	85/105	105	105	mW	
Average forward current	20(3)/35 (1)	50 (2)	30 (3)	mA	1,2,3
Peak forward current (1 μs, PW 0.1% DF)	60/90	1000	90	mA	
Lead soldering time at 230° C	5	5	5	sec	4
Storage and operating temperatures		−55°C to +100°C			

NOTES

1. *Derate linearly from 50°C at 0.7 mA/°C*
2. *Derate linearly from 50°C at 1.0 mA/°C*
3. *Derate linearly from 50°C at 0.6 mA/°C*

TYPICAL ELECTRO-OPTICAL CHARACTERISTIC CURVES

(T_A=25°C Unless Otherwise Specified)

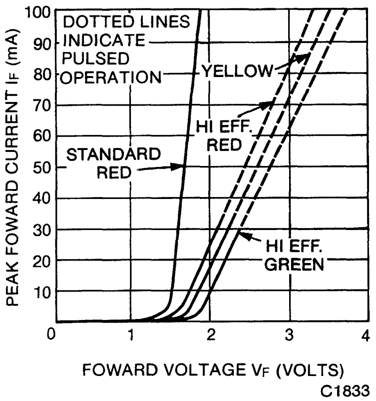


Fig. 1. Forward Current vs. Forward Voltage

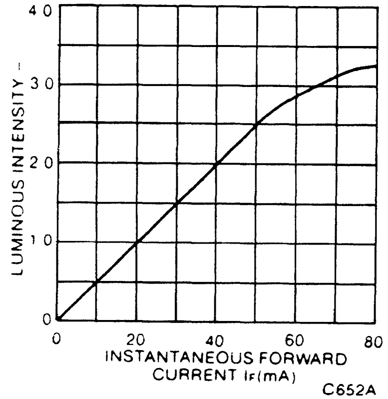


Fig. 2. Luminous Intensity vs. Forward Current

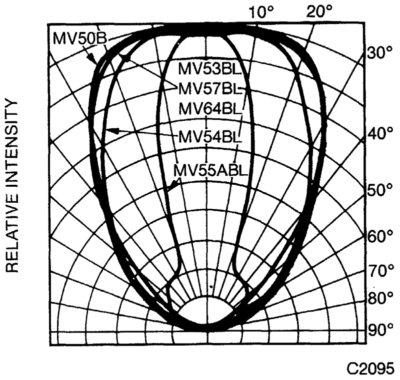


Fig. 3. Spatial Distribution

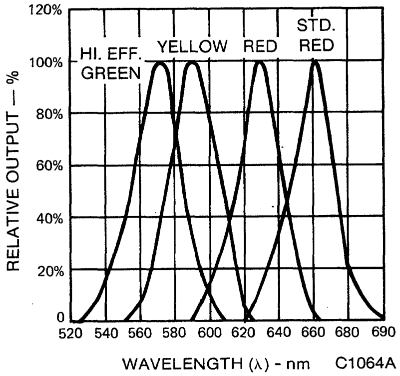


Fig. 4. Spectral Distribution

NOTES

4. The leads of the device were immersed in molten solder, heated to a temperature of 230°C, to a point 1/16 inch (1.6mm) from the body of the device per MIL-S-750, with dwell time of 5 sec.

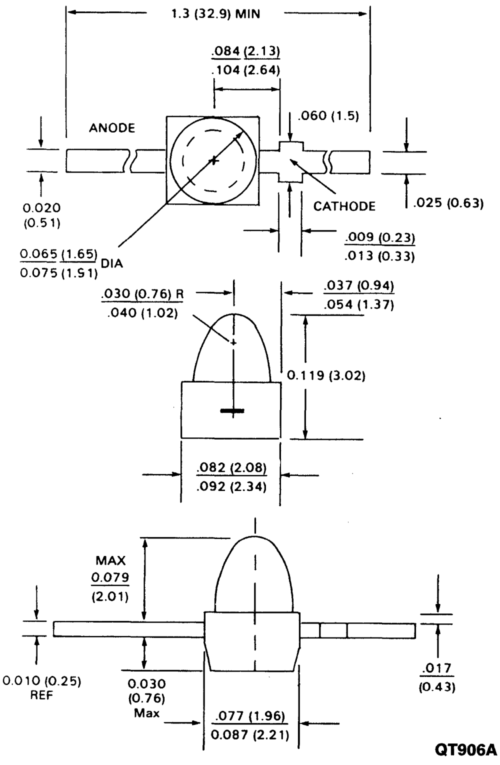
5. The axis of spatial distribution are typically within a 10° cone with reference to the central axis of the device.

QT OPTOELECTRONICS

SUBMINIATURE T-3/4 SOLID STATE LAMPS

RED **MV6000**
HIGH EFFICIENCY RED **MV6700**
YELLOW **MV6300**
HIGH EFFICIENCY GREEN **MV6400**

PACKAGE DIMENSIONS



DESCRIPTION

These subminiature lamps are constructed as axial leaded devices. They complement the MV5XBL series. The plastic lamp packages in this series have a "square-base" design; versus a "round" base for the MV5XBL series. The optics of wide-angle beam emission and sharp ON/OFF contrast are derived from the tinted, diffused epoxy lens package.

"YOKE" and "GULL-WING" lead bends and SMT tape & reel versions are available (see separate data sheet).

FEATURES

- Subminiature T-3/4 package
- Low package profile
- Axial leads
- Wide viewing angle
- SMT versions

NOTES:
1. ALL DIMENSIONS IN INCHES (mm)
2. TOLERANCES ARE ±.010 INCH UNLESS OTHERWISE SPECIFIED

PHYSICAL CHARACTERISTICS

TYPE	SOURCE COLOR	LENS COLOR
MV6000	Red	Red Diffused
MV6700	High Efficiency Red	Red Diffused
MV6300	Yellow	Yellow Diffused
MV6400	High Efficiency Green	Green Diffused

SUBMINIATURE T-3/4
SOLID STATE LAMPS

ELECTRO-OPTICAL CHARACTERISTICS (T_A = 25°C Unless Otherwise Specified)

PARAMETER	SYMBOL	DEVICE MV	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS
Luminous intensity	I_V	Standard Red 6000	0.5	1.2		mcd	I_F=10 mA
		High Efficiency Red 6700	1.0	3.0			
		Yellow 6300	1.0	3.0			
		High Efficiency Green 6400	1.0	3.0			
Total viewing angle	2θ½	All		90		Deg	
Peak wavelength	λ_P	Standard Red		655		nm	
		High Efficiency Red		635			
		Yellow		583			
		High Efficiency Green		565			
Spectral line halfwidth	Δ λ1/2	Standard Red		24		nm	
		High Efficiency Red		40			
		Yellow		36			
		High Efficiency Green		28			
Forward voltage	V_F	Standard Red	1.4	1.6	2.0	V	I_F=10 mA
		High Efficiency Red	1.5	1.8	3.0		
		Yellow	1.5	2.0	3.0		
		High Efficiency Green	1.5	2.0	3.0		
Reverse breakdown voltage	V_R	All	5.0			V	I_R=100 μA

ABSOLUTE MAXIMUM RATINGS (T_A = 25°C Unless Otherwise Specified)

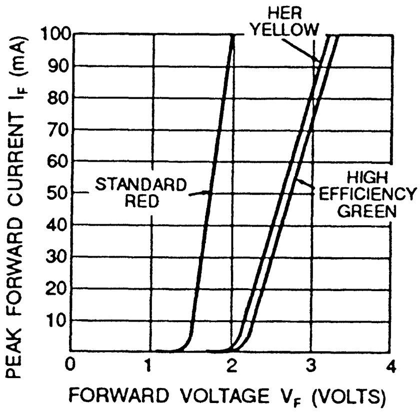
PARAMETER	HI EFF. RED	YELLOW	STD RED	HI EFF. GREEN	UNITS
	MV6700	**MV6300**	**MV6000**	**MV6400**	
Power dissipation	135	85	100	135	mW
Average forward current	30	20	50	30	mA
Peak forward current (see Note 1)	400	400	1000	90	mA
Lead soldering time at 260°C	3	3	3	3	sec
Storage and operating temperatures			−55°C to +100°C		

NOTE

1. 1μs, PW 0.1% DF

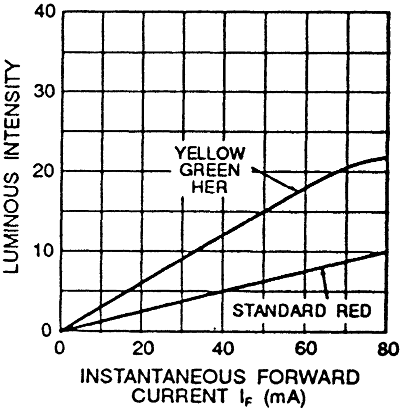
TYPICAL ELECTRO-OPTICAL CHARACTERISTIC CURVES

(T_A = 25°C Unless Otherwise Specified)



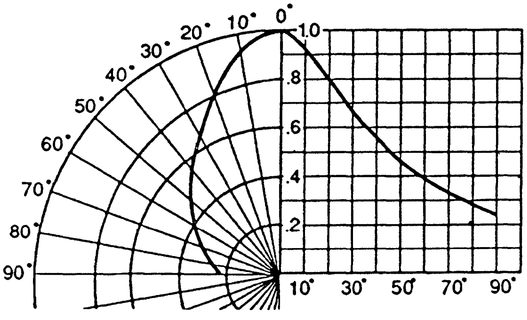
QT906A-02

Fig. 1. Forward Current vs. Forward Voltage



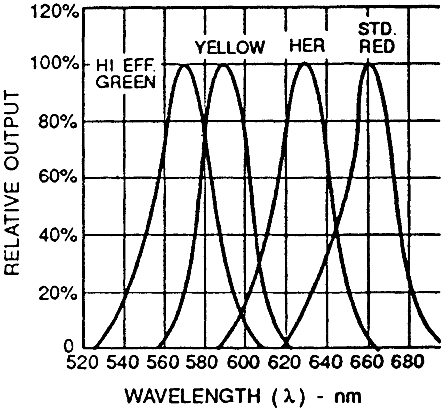
QT906A-03

Fig. 2. Luminous Intensity vs. Forward Current



QT906A-04

Fig. 3. Relative Luminous Intensity vs. Angular Displacement



QT906A-05

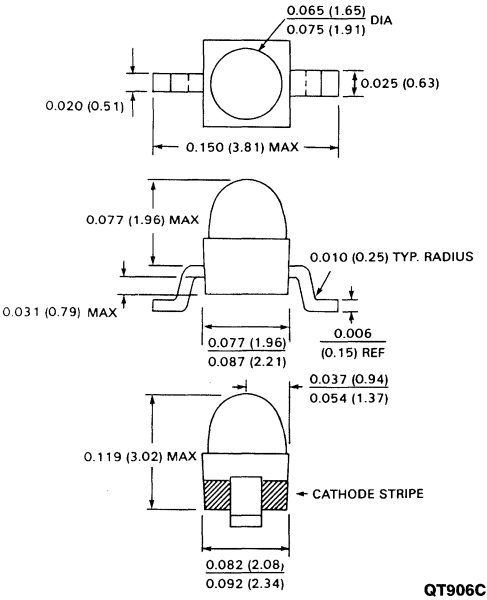
Fig. 4. Spectral Distribution

QT
OPTOELECTRONICS

SURFACE MOUNT OPTIONS FOR MV6X00 SUBMINIATURE LAMPS (T-3/4) GULL WING/YOKE LEAD/Z-BEND CONFIGURATION

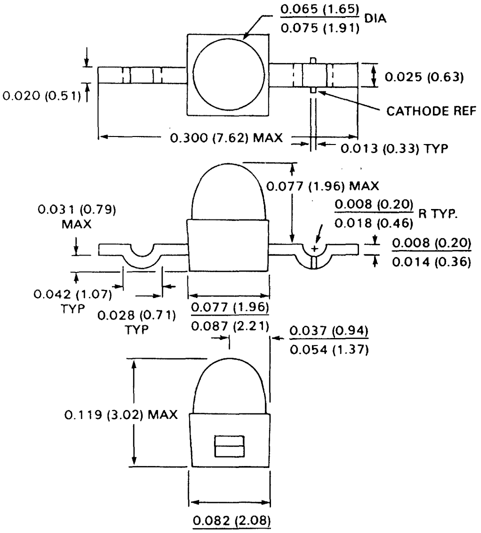
LEAD BEND OPTIONS

GULL WING LEAD CONFIGURATION



QT906C-01

YOKE LEAD CONFIGURATION



QT906C-02

DESCRIPTION

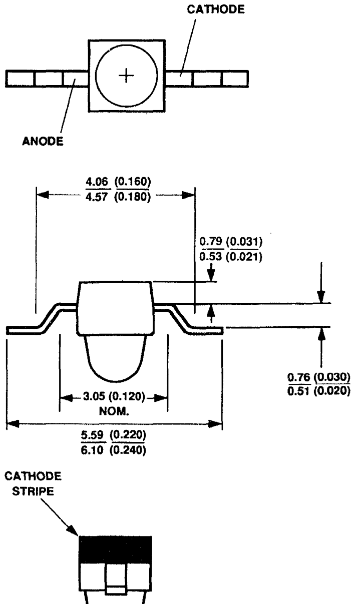
These subminiature solid state lamps are encapsulated in an axial lead package. The lens is diffused for even light dispersion.

Automatic placement equipment can be used to mount the LEDs on the PC board. The lamps can be mounted using either batch or in line vapor phase reflow solder processes. Subminiature lamps for surface mount applications are available in standard red, high efficiency red, yellow and green. The equivalent devices containing integral resistors can also be made available for surface mount applications.

FEATURES

- Gull Wing/Yoke Lead configurations for surface mount applications
- Compatible with automatic placement equipment
- Compatible with vapor phase reflow solder processes
- Long life—solid state reliability
- Supplied on tape and reel or in bulk packaging

Z-BEND LEAD CONFIGURATION



ST4000

NOTES:
1. ALL DIMENSIONS ARE IN INCHES (mm)
2. ALL TOLERANCES ARE ±.010" (.254 mm)
UNLESS OTHERWISE SPECIFIED.

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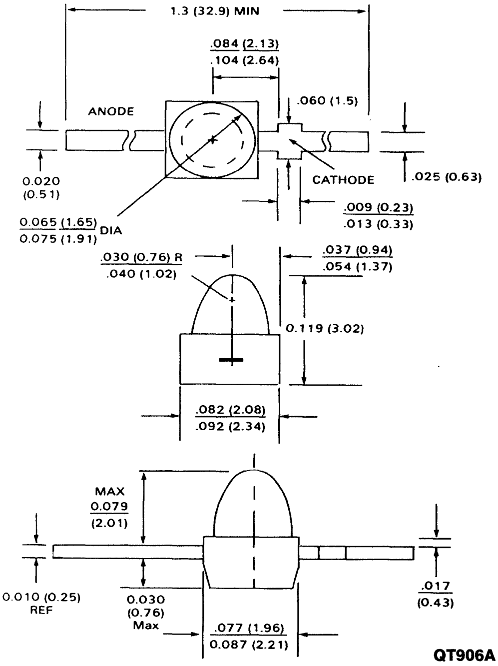
SUBMINIATURE T-¾ NON-DIFFUSED LAMPS

AlGaAs **HLMP-Q105**
YELLOW **HLMP-6405**
HIGH EFF. RED **HLMP-6305**
HIGH EFF. GREEN **HLMP-6505**

PACKAGE DIMENSIONS



NOTES:
1. ALL DIMENSIONS IN INCHES (mm)
2. TOLERANCES ARE ±.010 INCH UNLESS OTHERWISE SPECIFIED

DESCRIPTION

These subminiature are constructed as axial leaded devices. Non-diffused packages are used to provide high brightness.

FEATURES

- Subminiature T ¾ package
- Low package profile
- Excellence for back lighting and space limited applications
- "Gull Wing", "Yoke" and "Z" lead bents are available
- Axial and SMT version tape and reel are available

ABSOLUTE MAXIMUM RATING (T_A = 25°C Unless Otherwise Specified)

PARAMETER	A.RED	HER	YELLOW	GREEN	UNITS
Power dissipation	85	135	85	135	mW
DC forward current	30	30	20	30	mA
Peak forward current $_{\text{note1}}$	300	90	60	90	mA
Reverse voltage at I_R=100 μA	5	5	5	5	V
Operating temperature range	−20 to 100	−55 to 100	−55 to 100	−55 to 100	°C

Storage temperature range	−55°C to 100°C
Lead soldering time at 260°C	3 Sec.
Surface mount reflow soldering	
Convective IR at 235°C	90 Sec
Vapour phase at 213°C	3 min

NOTE 1 - 1 μS PW & 0.1% DF

TYPICAL THERMAL CHARACTERISTICS

Thermal resistance $\varnothing_{\text{Junc to pin}}$	HLMP-Q105	220°C/W

SUBMINIATURE T-¾ NON-DIFFUSED LAMPS

ELECTRO-OPTICAL CHARACTERISTICS (T_A = 25°C Unless Otherwise Specified)

PARAMETER	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS
Forward voltage - V_F					
HLMP-Q105		1.8	2.2	V	I_F=20 mA
HLMP-6305/6405/6505	1.5	1.8	3.0	V	I_F=10 mA
Reverse voltage - V_R					
HLMP-Q105	5	15		V	I_R=100μA
HLMP-6305	5	30		V	I_R=100μA
HLMP-6405/6505	5	50		V	I_R=100μA
Viewing angle - 2Ø½		28		Degree	
Luminous intensity - I_L					
HLMP-Q105	15	35		mcd	I_F=20 mA
HLMP-6305/6405/6505	3	12		mcd	I_F=10 mA
Peak wavelength					
HLMP-Q105		645		nm	
HLMP-6305		635		nm	
HLMP-6405		583		nm	
HLMP-6505		565		nm	
Dominant wavelength					
HLMP-Q105		637		nm	
HLMP-6305		626		nm	
HLMP-6405		585		nm	
HLMP-6505		569		nm	
Spectral line half width					
HLMP-Q105		20		nm	
HLMP-6305/6405/6505		35		nm	
Capacitance - C					
HLMP-Q105		30		pF	V_F=0, F=1 MHz
HLMP-6305/6405/6505		15		pF	V_F=0, F=1 MHz

TYPICAL ELECTRO-OPTICAL CHARACTERISTIC CURVES

(T_A = 25°C Unless Otherwise Specified)

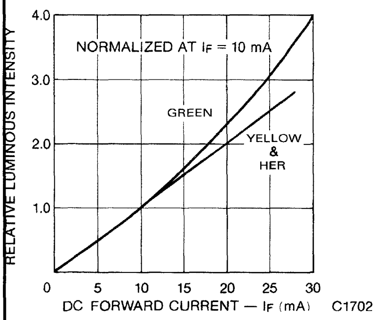


Fig. 1. Relative Luminous Intensity vs. Forward Current

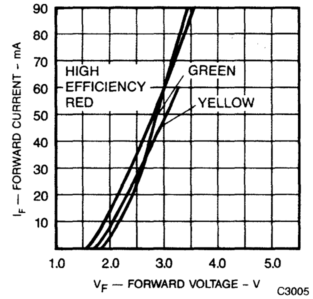


Fig. 2. Forward Current vs. Forward Voltage

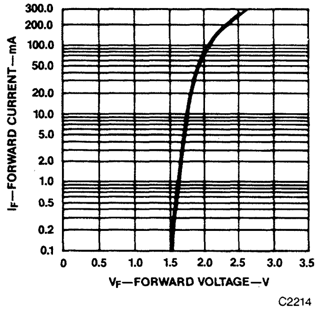


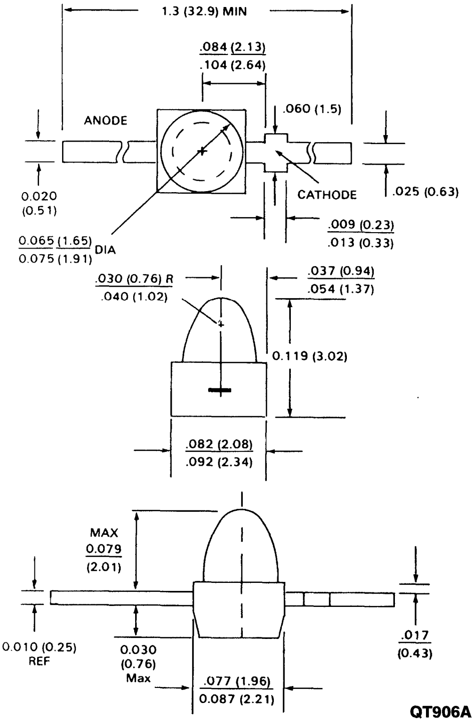
Fig. 3. Forward Current vs. Forward Voltage-AlGaAs

OPTOELECTRONICS

SUBMINIATURE T-¾ LOW CURRENT 2 MA DIFFUSED LAMPS

AlGaAs RED **HLMP-Q150** HIGH EFF. RED **HLMP-7000**
YELLOW **HLMP-7019** HIGH EFF. GREEN **HLMP-7040**

PACKAGE DIMENSIONS



QT906A

NOTES:
1. ALL DIMENSIONS IN INCHES (mm)
2. TOLERANCES ARE ±.010 INCH UNLESS OTHERWISE SPECIFIED

DESCRIPTION

These subminature lamps are constructed as axial leaded devices. High brightness chips; such as AlGaAs red and HER chips are used to achieve the low current and high brightness requirement. Color tinted, diffused epoxy packages are used for these packages.

FEATURES

- Subminiature T ¾ packages
- Low package profile
- Wide viewing angle
- Low current, high brightness
- Ideal for back lighting and space limited applications
- "Gull Wing", "Yoke" and "Z" lead bents are available
- Axial and SMT version tape and reel are available.

ABSOLUTE MAXIMUM RATING (T_A = 25°C Unless Otherwise Specified)

PARAMETER	A. Red	HER	YELLOW	GREEN	UNITS
Power dissipation	85	135	85	135	mW
DC forward current	30	30	20	30	mA
Peak forward current $_{\text{note1}}$	300	90	60	90	mA
Reverse voltage at I_R=100μA	5	5	5	5	V
Operating temperature range	−20 to 100	−55 to 100	−55 to 100	−55 to 100	°C

Storage temperature range .... −55=C to 100°C
Lead soldering time at 260°C .... 3 Sec
Surface mount reflow soldering
  Convective IR at 235°C .... 90 Seconds
  Vapour phase at 213°C .... 3 Minutes

NOTE 1-1μs PW & 0.1% DF

TYPICAL THERMAL CHARACTERISTICS

Thermal resistance $\varnothing_{\text{JUNC to pin}}$	HLMP-Q150	220°C/W
	HLMP-7000/19/40	120°C/W

QT OPTOELECTRONICS

SUBMINIATURE T-¾ LOW CURRENT 2 MA DIFFUSED LAMPS

ELECTRO-OPTICAL CHARACTERISTICS (T_A = 25°C Unless Otherwise Specified)

PARAMETER	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS
Forward voltage - V_F					
HLMP-Q150		1.6	1.8	V	I_F=1 mA
HLMP-7000	1.5	1.8	3.0	V	I_F=10 mA
HLMP-7019/40	1.5	2.0	3.0	V	I_F=10 mA
Reverse voltage - V_R					
HLMP-Q150	5	15		V	I_R=100μA
HLMP-7000	5	30		V	I_R=100μA
HLMP-7019/40	5	50		V	I_R=100μA
Viewing angle - 2θ½		90		Degree	
Luminous intensity - I_L					
HLMP-Q150	1.0	1.8		mcd	I_F=1 mA
HLMP-7000/19/40	0.4	0.6		mcd	I_F=2 mA
Peak wavelength					
HLMP-Q150		645		nm	
HLMP-7000		635		nm	
HLMP-7019		583		nm	
HLMP-7040		565		nm	
Dominant wavelength					
HLMP-Q150		637		nm	
HLMP-7000		626		nm	
HLMP-7019		585		nm	
HLMP-7040		569		nm	
Spectral line half width					
HLMP-Q150		20		nm	
HLMP-7000/19/40		35		nm	
Capacitance - C					
HLMP-Q150		30		pF	V_F=0, F=1 MHz
HLMP-7000/19/40		15		pF	V_F=0, F=1 MHz

TYPICAL ELECTRO-OPTICAL CHARACTERISTIC CURVES

(T_A = 25°C Unless Otherwise Specified)

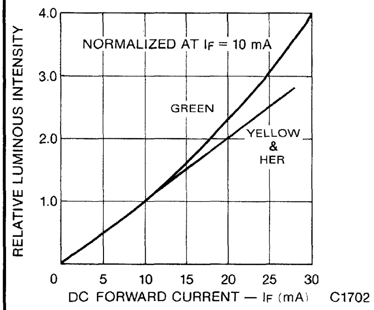


Fig. 1. Relative Luminous Intensity vs. Forward Current

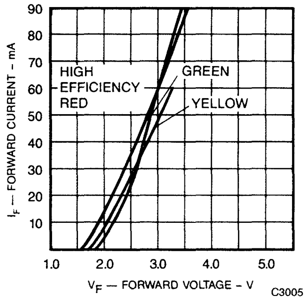


Fig. 2. Forward Current vs. Forward Voltage

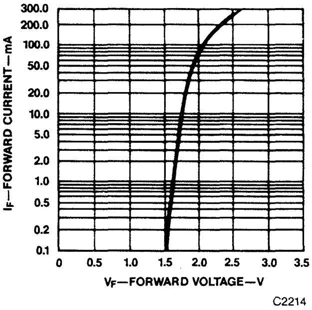
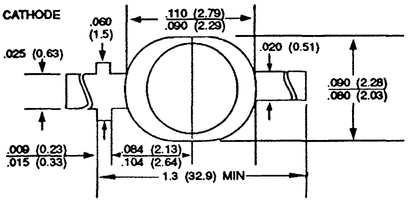


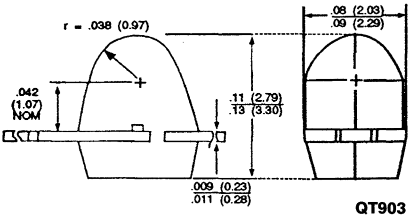
Fig. 3. Forward Current vs. Forward Voltage-ALGaAs

SUBMINIATURE T-3/4 RESISTOR LAMPS

RED **MR5000/5010/5020**
YELLOW **MR5310**
GREEN **MR5410**

PACKAGE DIMENSIONS





QT903

NOTES:
1. ALL DIMENSIONS IN INCHES (mm)
2. TOLERANCES ± .010 INCH UNLESS SPECIFIED

DESCRIPTION

These T-3/4 LED lamps contain an integral resistor which is in series with the emitter chip. This construction allows for operation in circuits with 5 volt supply voltage; without the use of an external current limiting resistor. Color tinted, diffused epoxy packages are used for all lamps in this group.

FEATURES

Applications include circuit board status indication; especially in TTL circuits. They allow for savings in component/assembly costs. The lamps are compatible with vapor phase reflow surface mount and conventional solder assembly.

- Integral Current Limiting Resistor (No external resistor required)
- Operates with 5 Volt Supply
- All Colors
  - MR5000/5010/5020 Red Diffused
  - MR5310 Yellow Diffused
  - MR5410 Green Diffused
- Subminiature Package
- Solid-State Reliability

PHYSICAL CHARACTERISTICS

TYPE	SOURCE COLOR	LENS COLOR
MR5000	Red	Red Diffused
MR5010	Red	Red Diffused
MR5020	Red	Red Diffused
MR5310	Yellow	Yellow Diffused
MR5410	Green	Green Diffused

SUBMINIATURE T-3/4 RESISTOR LAMPS

ELECTRO-OPTICAL CHARACTERISTICS (TA = 25°C Unless Otherwise Specified)

						RED					UNITS	TEST CONDITION
PARAMETER	SYMBOL		MR5000			MR5010			MR5020			
		MIN.	TYP.	MAX	MIN.	TYP.	MAX.	MIN.	TYP.	MAX.		
Axial Luminous Intensity	I_V	0.3	0.6		0.6	1.2		1.0	2.0		mcd	V_F=5 Volts
Total Viewing Angle	2θ1/2		40			40			40		Deg	
Peak Wavelength	λp		655			655			655		nm	
Spectral Line Halfwidth	Δ λ1/2		24			24			24			
Forward Current	I_F		3.0	4.0		6.0	8.0		16.0	21.0	mA	V_F=5 Volts
Reverse Breakdown Voltage	V_{BR}	6.0			6.0			6.0			V	I_R=10μA

ELECTRO-OPTICAL CHARACTERISTICS (TA = 25°C Unless Otherwise Specified)

			GREEN			YELLOW		UNITS	TEST CONDITION
PARAMETER	SYMBOL		MR5410			MR5310			
		MIN.	TYP.	MAX	MIN.	TYP.	MAX.		
Axial Luminous	I_V	0.3	0.5		0.3	0.6		mcd	V_F=5 Volts
Total Viewing Angle	2θ1/2		40			40		Deg	
Peak Wavelength	λp		565			583		nm	
Spectral Line	Δ λ1/2		28			36			
Forward Current	I_F		5.0	6.7		5.0	6.7	mA	V_F=5 Volts
Reverse Breakdown Voltage	V_{BR}	6.0			6.0			V	I_R=10μA

ABSOLUTE MAXIMUM RATINGS (TA = 25°C Unless Otherwise Specified)

	RED	GREEN	YELLOW
DC Forward Voltage	6 Volts	6 Volts	6 Volts
Reverse Voltage (I_R=10μA)	6 Volts	6 Volts	6 Volts
Operating Temperature Range	−55°C to +100°C	−55°C to +100°C	−55°C to +100°C
Storage Temperature Range	−55°C to +100°C	−55°C to +100°C	−55°C to +100°C
Lead Soldering Temperature	260°C for 3 Secs	260°C for 3 Secs	260°C for 3 Secs

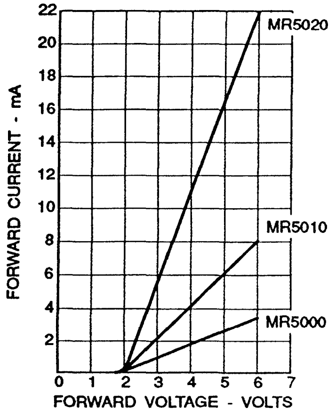
MR5000/5010/5020 MR5310 MR5410

TYPICAL ELECTRO-OPTICAL CHARACTERISTIC CURVES

(TA = 25°C Unless Otherwise Specified)

Red MR5000/5010/5020

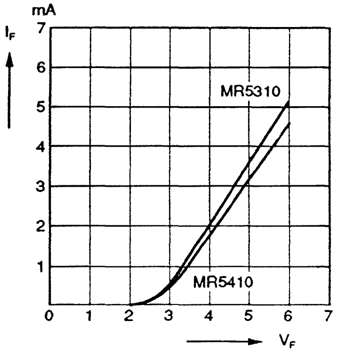
Forward Current vs. Forward Voltage



QT903-20

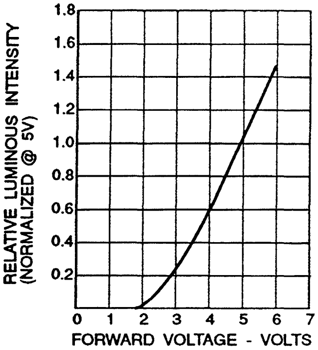
Green MR5410
Yellow MR5310

Forward Current vs. Forward Voltage



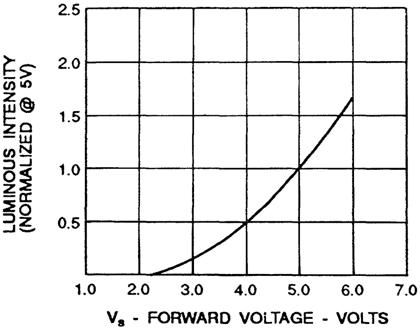
QT903-21

Relative Luminous Intensity
vs. Forward Voltage



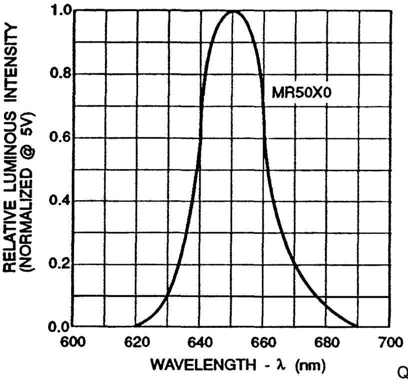
QT903-22

Relative Luminous Intensity
vs. Forward Voltage



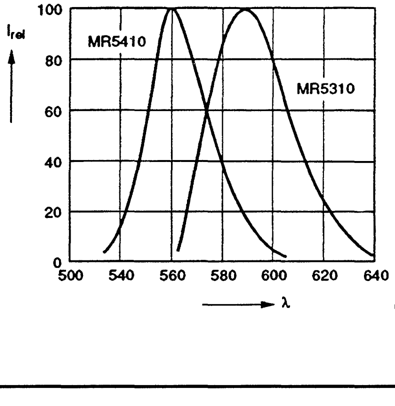
QT903-23

Spectral Distribution



QT903-24

Relative Spectral Emission $I_{rel} = f(\lambda)$

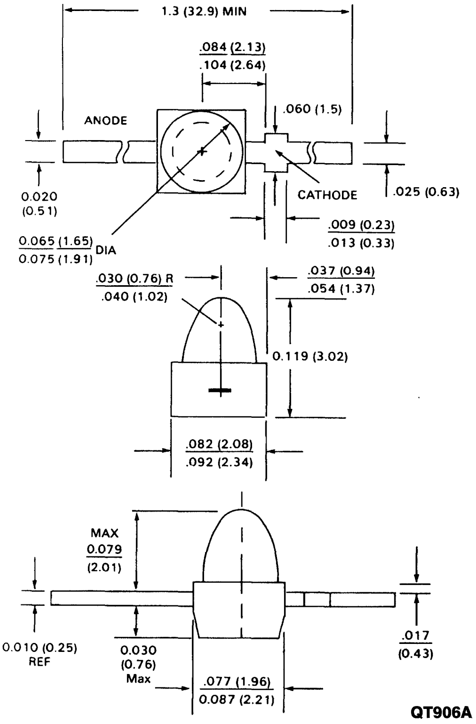


QT903-25

SUBMINIATURE T-¾
5 - VOLT RESISTOR LAMPS

HIGH EFFICIENCY RED **HLMP-6600/20**
YELLOW **HLMP-6700/20**
HIGH EFFICIENCY GREEN **HLMP-6800/20**

PACKAGE DIMENSIONS



NOTES:
1. ALL DIMENSIONS IN INCHES (mm)
2. TOLERANCE ARE ±.010 INCH UNLESS OTHERWISE SPECIFIED

DESCRIPTION

These T-¾ square based LEDs contain an integral resistor which is in series with the emitter chip. This construction allows for the operation in circuits with 5V supply voltage; without the use of an external resistor. Color tinted, diffused epoxy packages are used for these lamps.

FEATURES

- Integral current limiting resistor.
- TTL compatible
- Wide viewing angle
- Solid-state reliability
- SMT lead formings and T&R available

ABSOLUTE MAXIMUM RATING (T_A = 25°C unless otherwise specified)

PARAMETER	HER	YELLOW	GREEN	UNITS
Power dissipation	135	85	135	mW
DC forward voltage	6	6	6	V
Lead soldering time at	3	3	3	Sec
Surface mount reflow soldering				
Convective IR at 235°C				90 Seconds
Vapour phase at 213°C				3 Minutes
Operating temperature range				−40°C to 85°
Storage temperature range				−55°C to 100°C

TYPICAL THERMAL CHARACTERISTICS

Thermal resistance $Ø_{JA}$	120°C/W

QT OPTOELECTRONICS

SUBMINIATURE T-¾
5 - VOLT RESISTOR LAMPS

ELECTRO-OPTICAL CHARACTERISTICS (T_A = 25°C Unless Otherwise Specified)

PARAMETER	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS
Forward current - I_F					
HLMP-6600/6700/6800		9.6	13.0	mA	V_F=5 V
HLMP-6620/6720/6820		3.5	5.0	mA	V_F=5 V
Reverse voltage - V_R	5	30		V	I_R=100µA
Viewing angle - 2θ		90		Degree	
Luminous intensity - I_v					
HLMP-6600/6700/6800	1.3	5.0		mcd	V_F=5 V
HLMP-6620/6720/6820	0.8	2.0		mcd	V_F=5 V
Peak wavelength					
HLMP-6600/20		635		nm	
HLMP-6700/20		583		nm	
HLMP-6800/20		565		nm	
Dominant wavelength					
HLMP-6600/20		626		nm	
HLMP-6700/20		585		nm	
HLMP-6800/20		569		nm	
Spectral line half-width					
HLMP-6600/20		40		nm	
HLMP-6700/20		36		nm	
HLMP-6800/20		28		nm	
Capacitance - C					
HLMP-6600/20		11		pF	V_F=, F=1 MHz
HLMP-6700/20		15		pF	V_F=, F=1 MHz
HLMP-6800/20		18		pF	V_F=, F=1 MHz

TYPICAL ELECTRO-OPTICAL CHARACTERISTIC CURVES
(T_A = 25°C Unless Otherwise Specified)

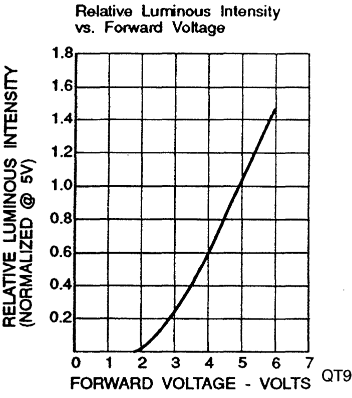


Fig. 1. Relative Luminous Intensity vs. Forward Voltage

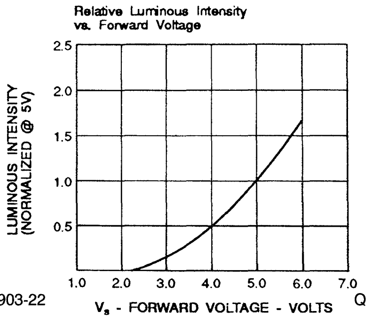


Fig. 2. Relative Luminous Intensity vs. Forward Voltage

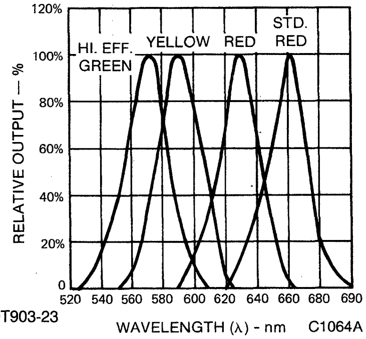


Fig. 3. Spectral Distribution

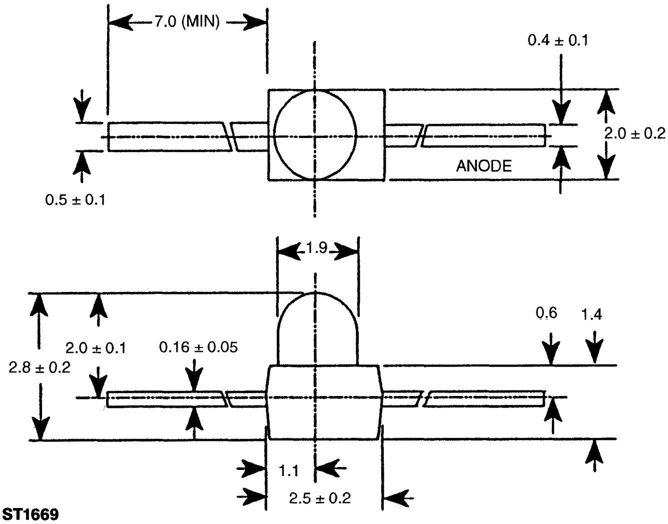
QT
OPTOELECTRONICS

SUBMINIATURE T-¾ (1.9 mm) SOLID STATE LAMPS

RED **QTLP913-2** RED DIFFUSED
YELLOW **QTLP913-3** YELLOW DIFFUSED
GREEN **QTLP913-4** GREEN DIFFUSED
AlGaAs/RED **QTLP913-7** RED DIFFUSED

RED **QTLP912-2** CLEAR
YELLOW **QTLP912-3** CLEAR
GREEN **QTLP912-4** CLEAR
AlGaAs/RED **QTLP912-7** CLEAR

PACKAGE DIMENSIONS



ST1669

DESCRIPTION

These subminiature LED lamps are intended for high volume, low cost status indication on PCBs, and for backlighting keyboards and switches. They are compatible with vapor phase reflow or wave solder surface mount equipment. Available in either clear, or tinted diffused lens and a choice of "Yoke", "Z-Bend", or "Gull-Wing" lead bends. Tape and reel options are also available.

FEATURES

- Subminiature package.
- Low package profile.
- Choice of clear or tinted diffused lens.
- Three lead bend options for surface mounting.

ABSOLUTE MAXIMUM RATING (T_A = 25°C Unless Otherwise Specified)

	Red	**Green**	**Yellow**	**AlGaAs (Red)**
DC forward current (I_f)	30 mA	30 mA	20 mA	40 mA
Operating temperature range	−40°C to +85°C			
Storage temperature range	−40°C to +100°C			
Lead soldering time (at 1⁄16 inch from the bottom of lamp)	5 seconds @ 260°C			
Peak forward current (at f = 1.0 KHz, Duty factor = 1/10)	160 mA	160 mA	160 mA	200 mA
Power dissipation (P_d)	100 mW	100 mW	85 mW	110 mA
Recommended operating current (I_f Rec)	20 mA			

SUBMINIATURE T-¾ (1.9 MM) SOLID STATE LAMPS

ELECTRO-OPTICAL CHARACTERISTICS (T_A=25°C Unless Otherwise Specified)

PART NUMBER QTLP-	**912-2**	**912-3**	**912-4**	**912-7**	**TEST CONDITIONS**
Luminous intensity (mcd)					I_F=20 mA
minimum	48	18	30	113	
typical	80	30	50	170	
Forward voltage (V_F)					I_F=20 mA
minimum	1.7	1.7	1.7	1.7	
typical	2.0	2.0	2.1	2.0	
maximum	2.8	2.8	2.8	2.8	
Peak wavelength (nm)	640	585	565	660	I_F=20 mA
Spectral line half width (nm)	45	35	30	20	I_F=20 mA
Reverse breakdown voltage (V_R)	5	5	5	5	I_R=10 μA
Viewing angle (°)	25	25	25	25	I_F=20 mA

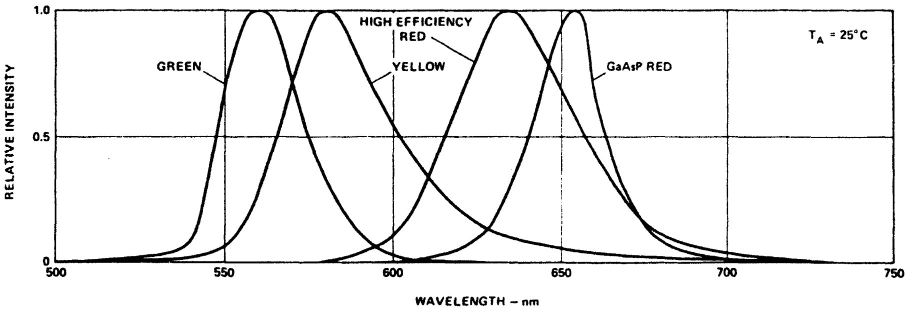
ELECTRO-OPTICAL CHARACTERISTICS (T_A=25°C Unless Otherwise Specified)

PART NUMBER QTLP-	**913-2**	**913-3**	**913-4**	**913-7**	**TEST CONDITIONS**
Luminous intensity (mcd)					I_F=20 mA
minimum	24	9	15	72	
typical	40	15	25	108	
Forward voltage (V_F)					I_F=20 mA
minimum	1.7	1.7	1.7	1.5	
typical	2.0	2.0	2.1	1.7	
maximum	2.8	2.8	2.8	2.4	
Peak wavelength (nm)	640	585	565	660	I_F=20 mA
Spectral line half width (nm)	45	35	30	20	I_F=20 mA
Reverse breakdown voltage (V_R)	5	5	5	5	I_R=10 μA
Viewing angle (°)	50	50	50	50	I_F=20 mA

OPTOELECTRONICS

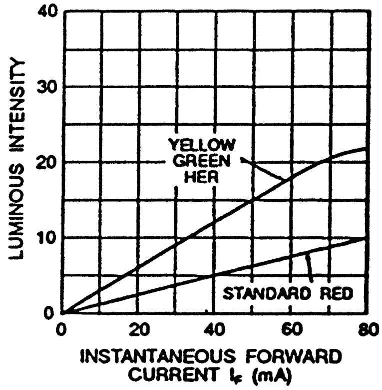
SUBMINIATURE T-¾ (1.9 mm) SOLID STATE LAMPS

TYPICAL ELECTRO-OPTICAL CHARACTERISTIC CURVES ($T_A = 25°C$)



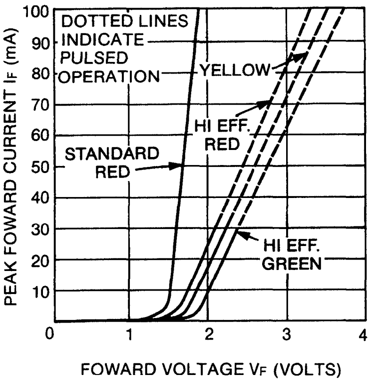
ST1717

Fig. 1 Relative Intensity Vs. Wavelength



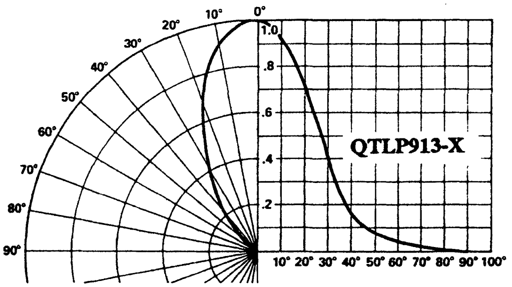
ST1718

Fig. 2. Relative Luminous Intensity Vs. DC Forward Current



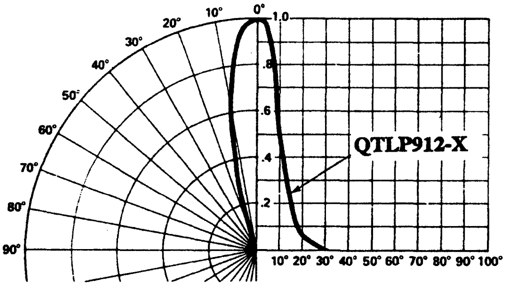
C1833

Fig. 3. Forward Current Vs. Forward Voltage



ST1720

Fig. 4. Relative Luminous Intensity vs. Angular Displacement



ST1721

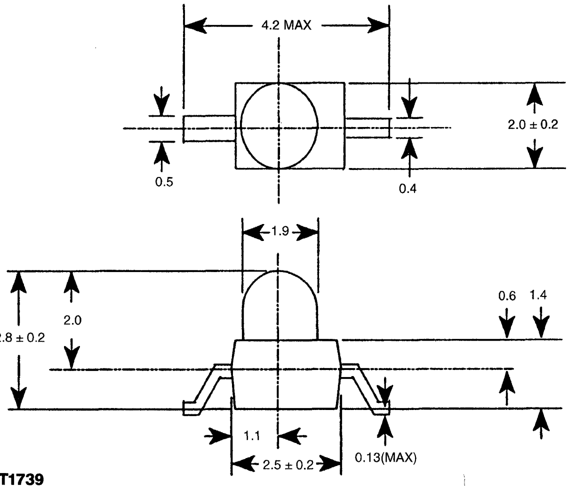
Fig. 5. Relative Luminous Intensity vs. Angular Displacement

QT OPTOELECTRONICS

SURFACE MOUNT OPTIONS FOR QTLP91X-X SUBMINIATURE T-¾ (1.9 mm) GULL WING/YOKE/Z-BEND LEADS

LEAD BEND OPTIONS

GULL WING LEAD CONFIGURATION



ST1739

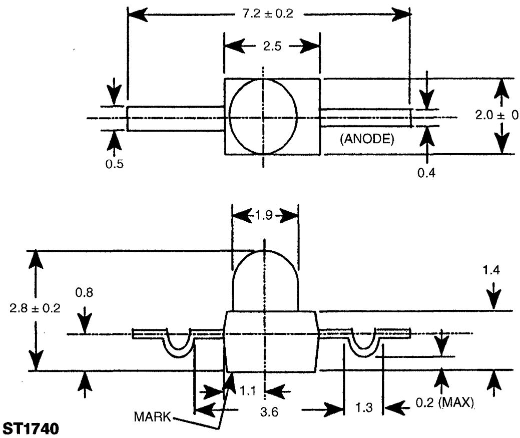
DESCRIPTION

These subminiature lamps are encapsulated in an axial lead package. Either a clear or diffused lenses are available. Automatic placement equipment can be used to mount these LEDs on PC boards. The lamps can be mounted using either batch or in line vapor phase reflow solder processes. Subminiature lamps are available in red, high efficiency red, yellow, and green.

FEATURES

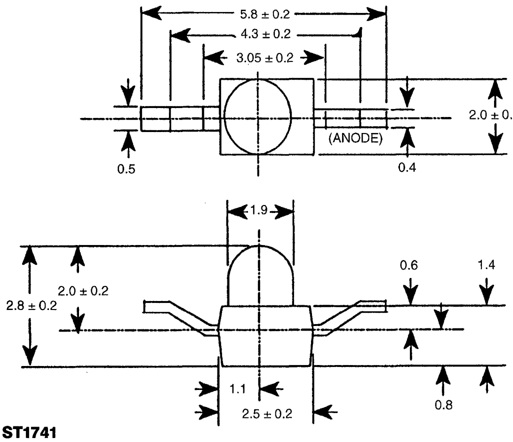
- Gull Wing, Yoke Lead, and Z-Bend configurations for surface mount applications.
- Compatible with automatic placement equipment
- Compatible with vapor phase reflow solder processes.
- Supplied on tape and reel or in bulk packaging

YOKE LEAD CONFIGURATION



ST1740

Z-BEND LEAD CONFIGURATION

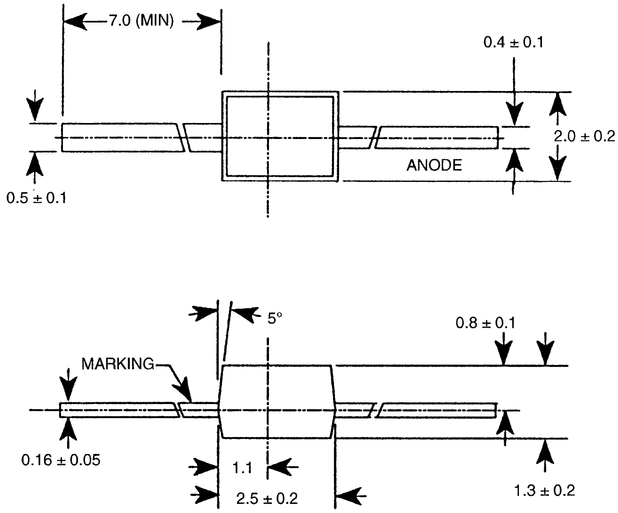


ST1741

SURFACE MOUNT LED LAMP
FLAT TYPE

RED **QTLP282-2** CLEAR
YELLOW **QTLP282-3** CLEAR
GREEN **QTLP282-4** CLEAR
AlGaAs/RED **QTLP282-7** CLEAR

PACKAGE DIMENSIONS



ST1709

NOTES:
1. ALL DIMENSIONS ARE IN MILLIMETERS
2. LEAD SPACING IS MEASURED WHERE THE LEADS EMERGE FROM THE PACKAGE
3. PROTRUDED RESIN UNDER THE FLANGE IS 1.5 mm (0.059″) MAXIMUM

DESCRIPTION

These subminiature LED lamps are intended for high volume, low cost status indication on PCBs, and for backlighting keyboards and switches. They are compatible with vapor phase reflow or wave solder surface mount equipment. Available in "Gull-Wing" lead bend configuration. They have clear, flat lenses. Tape and reel options are also available.

FEATURE

- Subminiature package
- Flat package profile
- Wide viewing angle
- Lead bend options for surface mounting

ABSOLUTE MAXIMUM RATINGS (T_A=25°C unless otherwise specified

PART NUMBER QTLP-	**282-2**	**282-3**	**282-4**	**282-7**
DC forward current (I_f)	30 mA	20 mA	30 mA	40 mA
Operating temperature range	−40°C to +85°C			
Storage temperature range	−40°C to +100°C			
Lead soldering time (at 1/16 inch (1.6 mm) from the bottom of lamp)	5 seconds @ 260°C			
Peak forward current (at f=1.0 KHz, Duty factor=1/10)	160 mA	160 mA	160 mA	200 mA
Power dissipation (P_d)	100 mW	85 mW	100 mW	110 mA
Recommended operating current (I_f Rec)	20 mA			

SURFACE MOUNT LED LAMP
FLAT TYPE

ELECTRO-OPTICAL CHARACTERISTICS (T_A=25°C Unless Otherwise Specified)

PART NUMBER	**282-2**	**282-3**	**282-4**	**282-7**	**TEST CONDITIONS**
Luminous intensity (mcd)					I_F=20 mA
minimum	1.5	3.5	1.0	11	
typical	5.6	6.0	5.6	17	
Forward voltage (V_F)					I_F=20 mA
minimum	1.7	1.7	1.7	1.7	
typical	2.0	2.0	2.1	2.0	
maximum	2.8	2.8	2.8	2.8	
Peak wavelength (nm)	640	585	565	660	I_F=20 mA
Spectral line half width (nm)	45	35	30	20	I_F=20 mA
Reverse breakdown voltage (V_R)	5	5	5	5	I_R=10 μA
Viewing angle (°)	150	150	150	150	I_F=20 mA

TYPICAL ELECTRO-OPTICAL CHARACTERISTIC CURVES (T_A = 25°C)

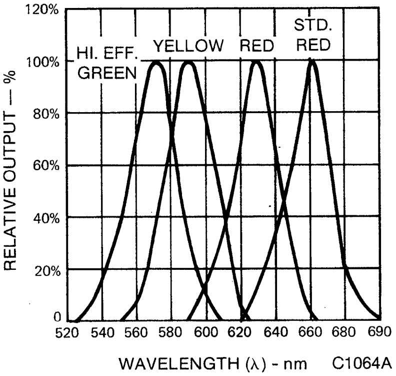


Fig. 1. Relative Intensity vs. Wavelength

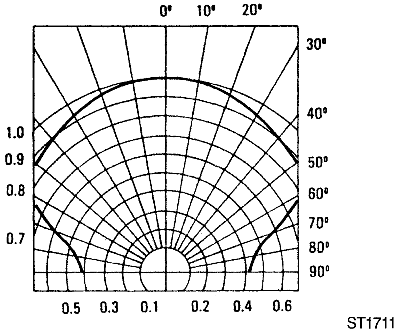
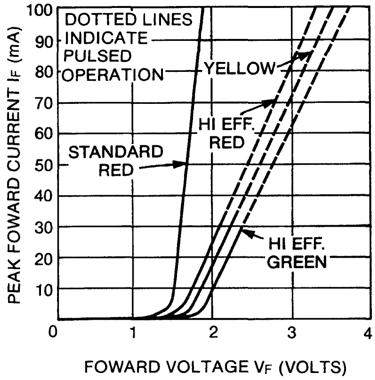


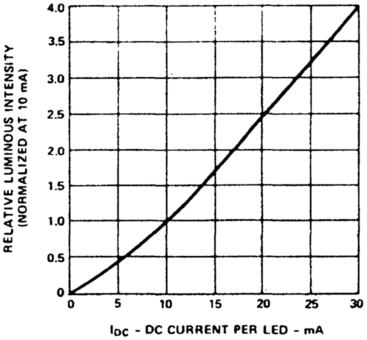
Fig. 2. Relative Luminous Intensity vs. Angular Displacement

TYPICAL ELECTRO-OPTICAL CHARACTERISTIC CURVES (T$_A$ = 25°C)



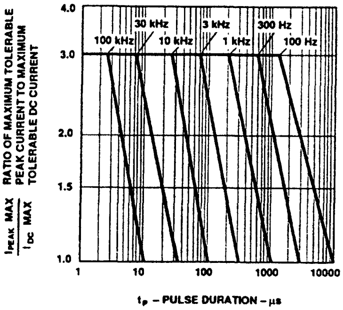
C1833

Fig. 3. Forward Current vs. Forward Voltage



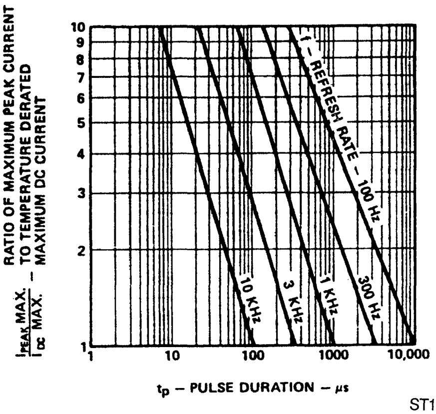
ST1627

Fig. 4. Relative Luminous Intensity vs. DC Forward Current



ST1714

Fig. 5. Maximum Peak Current vs. Pulse Duration



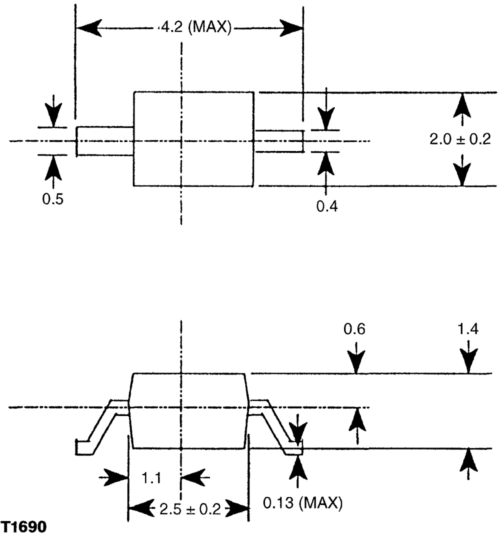
ST1642

Fig. 6. Maximum Peak Current Vs. Pulse Duration (AlGaAs Red)

QT OPTOELECTRONICS

SURFACE MOUNT OPTION FOR QTLP282-X FLAT TYPE LED LAMP GULL WING LEAD CONFIGURATION

LEAD BEND OPTIONS



ST1690

DESCRIPTION

These flat package LED lamps are encapsulated in an axial lead package with a clear lens. Automatic placement equipment can be used to mouont these LEDs on PC boards. The lamps can be mounted using either batch or in line vapor phase reflow solder processes. Subminature lamps are availabe in red, high efficiency red, yellow, and green.

FEATURES

- Gull Wing lead configuration for surface mount application
- Compatible with automatic placement equipment
- Compatible with vapor phase reflow solder processes.
- Supplied on tape and reel or in bulk packaging

ABSOLUTE MAXIMUM RATING (T_A = 25°C Unless Otherwise Specified)

Wave soldering temperature (1.6 mm (0.063″) from body)	260° for 3 seconds
Surface Mount Reflow Soldering:	
Convective IR	235°C for 90 seconds
Vapor phase	215°C for 3 minutes

ABSOLUTE MAXIMUM SOLDER RATINGS AND ELECTRICAL/OPTICAL CHARACTERISTICS

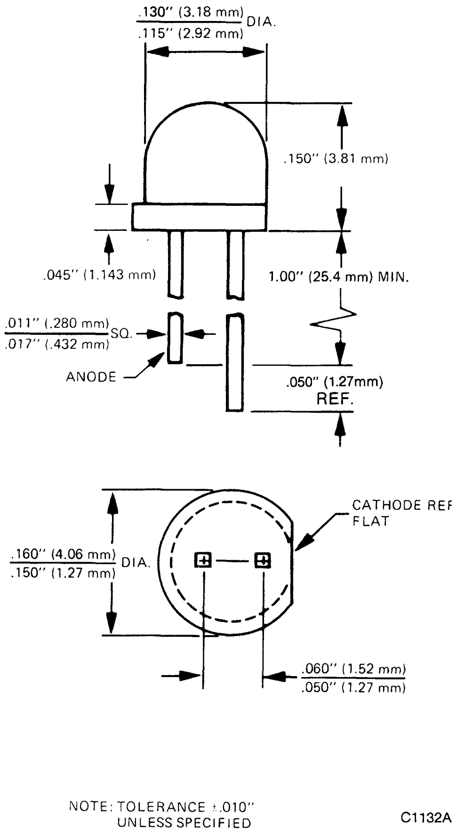
The absolute maximum ratings and electrical/optical specifications are identical to the basic catalogue device, except for the vapor phase soldering rating as specified above.

QT
OPTOELECTRONICS

LOW PROFILE T-1
SOLID STATE LAMPS

STANDARD RED **MV5077C** HIGH EFFICIENCY GREEN **MV5477C**
YELLOW **MV5377C** HIGH EFFICIENCY RED **MV5777C**

PACKAGE DIMENSIONS



NOTE: TOLERANCE ±.010"
UNLESS SPECIFIED

C1132A

DESCRIPTION

These solid state indicators offer a low profile T-1 package. The High Efficiency Red, Green and Yellow devices are made with a gallium arsenide phosphide on gallium phosphide. All are encapsulated in epoxy packages. Their small size (approximately T-1 size), good viewing angle, and small square leads contribute to their versatility as all purpose indicators.

FEATURES

- Square leads (will fit into .020-inch (.508 mm) diameter holes)
- Compact size
- Very wide viewing angle
- Long life, rugged
- Mount on approximately 3/16-inch (4.72 mm) centers
- Tinted diffused

PHYSICAL CHARACTERISTICS

TYPE	SOURCE COLOR	LENS COLOR	LENS EFFECT	PACKAGE STYLE
MV5077C	Standard Red	Red Diffused	Wide Beam	Low Profile
MV5377C	Yellow	Yellow Diffused	Wide Beam	Low Profile
MV5477C	High Efficiency Green	Green Diffused	Wide Beam	Low Profile
MV5777C	Red	Red Diffused	Wide Beam	Low Profile

OPTOELECTRONICS

LOW PROFILE T-1 SOLID STATE LAMPS

ELECTRO-OPTICAL CHARACTERISTICS (T_A=25°C Unless Otherwise Specified)

PARAMETER		SYMBOL	TEST COND.	UNITS	MV5077C	MV5377C	MV5477C	MV5777C
Forward voltage	typ.	V_F	I_F=20 mA	V	1.6	2.1	2.2	2.0
	max.		I_F=20 mA	V	2.0	3.0	3.0	3.0
Luminous Intensity								
	min.	I_V	I_F=20 mA	mcd	0.3	1.0	1.0	1.0
	typ.		I_F=20 mA	mcd	1.75	7.0	7.0	7.0
Peak wavelength		λp	I_F=20 mA	nm	660	585	565	635
Spectral line half width			I_F=20 mA	nm	20	35	35	45
Capacitance	typ.	C	V=0	pF	23	45	20	45
Reverse voltage	min.	V_R	I_R=100 μA	V	5	5	5	5
	typ.		I_R=100 μA	V	15	25	25	25
Viewing angle (total)	(Fig. 3)	2θ½		degrees	180	180	180	180

ABSOLUTE MAXIMUM RATINGS (T_A=25°C Unless Otherwise Specified)

Power dissipation	105 mW
Derate linearly from 25°C	−1.14 mW/°C
Storage and operating temperature	−55°C to +100°C
Continuous forward current (MV5377C=20 mA)	35 mA
Peak forward current (μsec pulse 0.3% duty cycle) (MV5477C=90 mA) (MV5377C=60 mA)	1.0 A
Reverse voltage	5.0 V
Lead soldering time at 260°C (See Note 1)	5 sec.

LOW PROFILE T-1
SOLID STATE LAMPS

TYPICAL ELECTRO-OPTICAL CHARACTERISTIC CURVES

(25°C Free Air Temperature Unless Otherwise Specified)

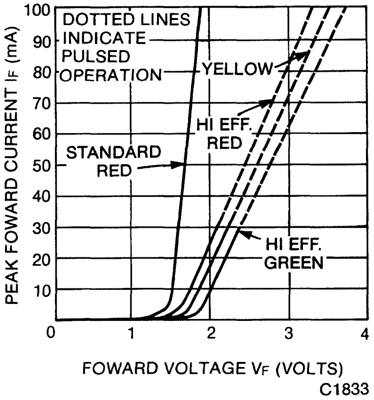


Fig. 1. Forward Current vs. Forward Voltage

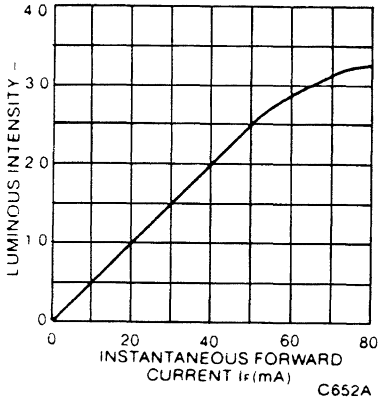


Fig. 2. Luminous Intensity vs. Forward Current

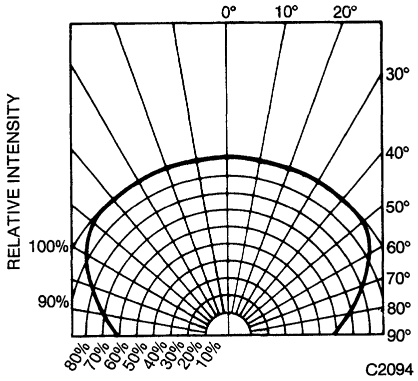


Fig. 3. Spatial Distribution

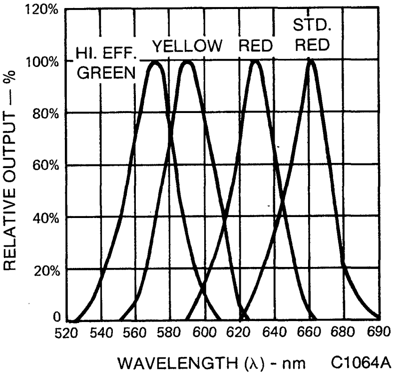


Fig. 4. Spectral Distribution

NOTES

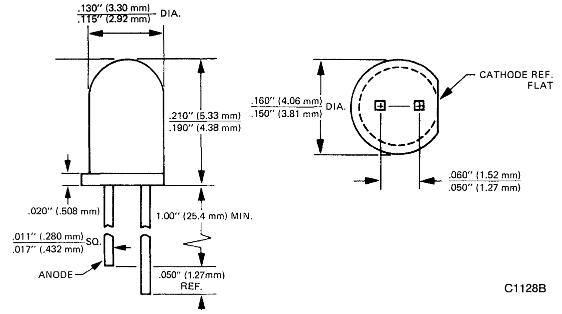
1. *The leads of the device were immersed in molten solder, at 260°C, to a point 1/16 inch (1.6 mm) from the body of the device per MIL-S-750, with a dwell time of 5 seconds.*

QT OPTOELECTRONICS

T-1
SOLID STATE LAMPS

YELLOW MV5374C
STANDARD RED MV5074C HIGH EFFICIENCY GREEN MV5474C
STANDARD RED MV5075C HIGH EFFICIENCY RED MV5774C

PACKAGE DIMENSIONS



DESCRIPTION

These solid state indicators offer a variety of color selection. The High Efficiency Red, Green and Yellow devices are made with a gallium arsenide phosphide on gallium phosphide. All are encapsulated in epoxy packages. Their small size (approximately T-1 size), good viewing angle, and small square leads contribute to their versatility as all purpose indicators.

FEATURES

- Square leads (will fit into .020-inch (.508mm) diameter hole)
- Compact size
- Long life, rugged
- 1-inch (25.4 mm) minimum lead length
- Mount on approximately 3/16-inch (4.72 mm) centers

PHYSICAL CHARACTERISTICS

TYPE	SOURCE COLOR	LENS COLOR	LENS EFFECT	PACKAGE STYLE
MV5074C	Standard Red	Red Clear	Narrow Beam	High Profile
MV5075C	Standard Red	Red Diffused	Wide Beam	High Profile
MV5374C	Yellow	Yellow Diffused	Wide Beam	High Profile
MV5474C	High Efficiency Green	Green Diffused	Wide Beam	High Profile
MV5774C	High Efficiency Red	Red Diffused	Wide Beam	High Profile

T-1
SOLID STATE LAMPS

ELECTRO-OPTICAL CHARACTERISTICS (T_A=25°C Unless Otherwise Specified)

PARAMETER		SYMBOL	TEST COND.	UNITS	MV5074C	MV5075C	MV5374C	MV5474C	MV5774C
Forward voltage	typ.	V_F	I_F=20 mA	V	1.6	1.6	2.1	2.2	2.0
	max.		I_F=20 mA	V	2.0	2.0	3.0	3.0	3.0
Luminous Intensity	min.	I_V	I_F=20 mA	mcd	0.7	0.6	1.5	1.2	1.5
	typ.		I_F=20 mA	mcd	2.5	1.5	9.0	9.0	9.0
Peak wavelength		λp	I_F=20 mA	nm	660	660	585	565	635
Spectral line half width			I_F=20 mA	nm	20	20	35	35	45
Capacitance	typ.	C	V=0	pF	23	23	45	20	45
Reverse voltage	min.	V_{BR}	I_R=100 μA	V	5	5	5	5	5
	typ.		I_R=100 μA	V	15	15	25	25	25
Reverse current	max.		V_R=5.0 V	μA	100	100	100	100	100
Viewing angle (total)		2θ ½	See Fig. 3	degrees	70	90	90	90	90

ABSOLUTE MAXIMUM RATINGS (T_A=25°C Unless Otherwise Specified)

Power dissipation	105 mW
Derate linearly from 25°C	−1.14 mW° C
Storage and operating temperature	−55°C to +100°C
Lead soldering time at 260° C (See Note 1)	5 sec.
Continuous forward current (MV5374C=20 mA)	35 mA
Peak forward current (μsec pulse 0.3% duty cycle) (MV5474C=90 mA) (MV5374C=60 mA)	1.0 A
Reverse voltage	5.0 V

TYPICAL ELECTRO-OPTICAL CHARACTERISTIC CURVES

(25°C Free Air Temperature Unless Otherwise Specified)

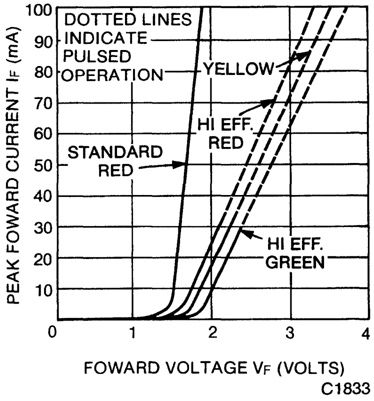


Fig. 1. Forward Current vs. Forward Voltage

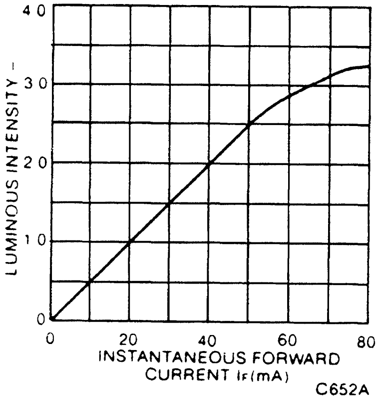


Fig. 2. Luminous Intensity vs. Forward Current

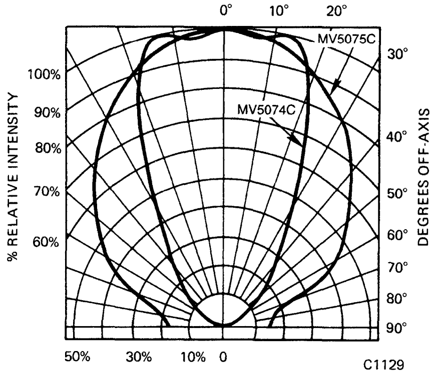


Fig. 3. Spatial Distribution

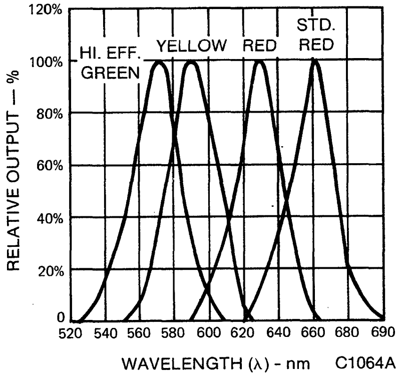


Fig. 4. Spectral Distribution

NOTES

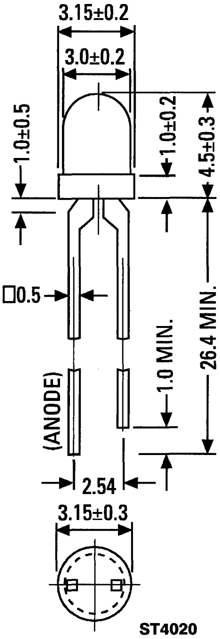
1. *The leads of the device were immersed in molten solder, at 260°C, to a point 1/16 inch (1.6 mm) from the body of the device per MIL-S-750, with a dwell time of 5 seconds.*

QT
OPTOELECTRONICS

CLEAR LENS T-100 SOLID STATE LAMPS

YELLOW **MV5362X** TINTED, **HLMP-1440**, **MV5360** PALE TINT
HIGH EFFICIENCY GREEN **MV5462X** TINTED, **HLMP-1540**, **MV5460** PALE TINT
HIGH EFFICIENCY RED **MV5762X** TINTED, **HLMP-1340**, **MV5760** PALE TINT

PACKAGE DIMENSIONS



NOTES:
1. ALL DIMENSIONS ARE IN MM.
2. LEAD SPACING IS MEASURED WHERE THE LEADS EMERGE FROM THE PACKAGE.
3. PROTRUDED RESIN UNDER THE FLANGE IS 1.5 mm (0.059") MAX.

DESCRIPTION

These solid state indicators offer a variety of color selection. The High Efficiency Red and Yellow devices are made with gallium arsenide phosphide on gallium phosphide. All are encapsulated in epoxy packages and have clear lenses. Their small size, wide viewing angle, and small square leads contribute to their versatility as all-purpose indicators. All types are tinted to aid identification.

FEATURES

- Standard and Ultrabright devices
- Clear tinted lenses
- 100 mil lead spacing
- High efficiency GaP
- Versatile mounting on PC board or panel
- Long life—solid state reliability
- Low power requirements
- Compact, rugged, lightweight
- T-1 diameter
- Replacement for the HLMP-1X20/1 Series
- Excellent for switch backlighting

PHYSICAL CHARACTERISTICS

TYPE		SOURCE COLOR	LENS EFFECT	LUMINOUS INTENSITY at 25°C (mcd) MIN.	TYP.	TEST CONDITION
Ultrabright	HLMP-1440	Yellow	Pale Tint	24.0	60.0	I_F=20 mA
	MV5360 (HLMP-1420)	Yellow	Pale Tint	6.0	12.0	I_F=10 mA
	MV53621	Yellow	Tinted	3.0	4.0	
	MV53622	Yellow	Tinted	6.0	8.0	
Ultrabright	HLMP-1540	High Efficiency Green	Pale Tint	24.0	60.0	I_F=20 mA
	MV5460 (HLMP-1520)	High Efficiency Green	Pale Tint	6.0	12.0	
	MV54624 (HLMP-1521)	High Efficiency Green	Tinted	6.0	12.0	
Ultrabright	HLMP-1340	High Efficiency Red	Pale Orange Tint	24.0	60.0	I_F=20 mA
	MV5760 (HLMP-1320)	High Efficiency Red	Pale Orange Tint	6.0	12.0	I_F=10 mA
	MV57620	High Efficiency Red	Tinted	1.5	2.0	
	MV57621	High Efficiency Red	Tinted	3.0	4.0	
	MV57622 (HLMP-1321)	High Efficiency Red	Tinted	6.0	12.0	

OPTOELECTRONICS

CLEAR LENS T-100 SOLID STATE LAMPS

ELECTRO-OPTICAL CHARACTERISTICS

(25°C Free Air Temperature Unless Otherwise Specified)

PARAMETER	TEST CONDITIONS	UNITS	MV5362X MV5360	MV5462X MV5460	MV5762X MV5760	HLMP-1340	HLMP-1440	HLMP-1540
Forward voltage (V_F)								
typ.	I_F=10 mA	V	2.1	2.1*	2.0	2.2*	2.2*	2.2*
max.			3.0	3.0*	3.0	3.0*	3.0*	3.0*
Peak wavelength		nm	585	565	635	635	585	565
Spectral line half width		nm	35	40	45	45	35	40
Capacitance								
typ.	f=1 MHz, V=0	pF	45	20	45	45	45	20
Reverse voltage (V_R)								
min.	I_R=100 μA	V	5.0	5.0	5.0	5.0	5.0	5.0
Viewing angle (total)								
typ.	See Fig. 3	degrees	45	45	45	45	45	45

*I_F=20 mA

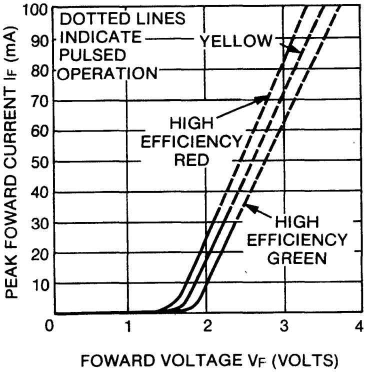
ABSOLUTE MAXIMUM RATING (T_A=25°C Unless Otherwise Specified)

Power dissipation	120 mW
Derate linearly from 50°	0.4 mA/°C
Storage and operating temperature	−55°C to +100°C
Lead soldering time at 260°C (1/16 inch from body)	5 sec.
Continuous forward current (MV5360/MV5362X/HLMP-1440=20 mA)	30 mA
Peak forward current (1 μsec pulse, 0.3% duty cycle) (MV5360/MV5362X/HLMP-1440=60 mA)	90 mA
Reverse voltage	5.0 V

OPTOELECTRONICS

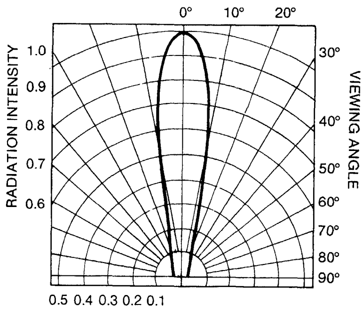
CLEAR LENS T-100
SOLID STATE LAMPS

TYPICAL ELECTRO-OPTICAL CHARACTERISTIC CURVES
(25°C Free Air Temperature Unless Otherwise Specified)



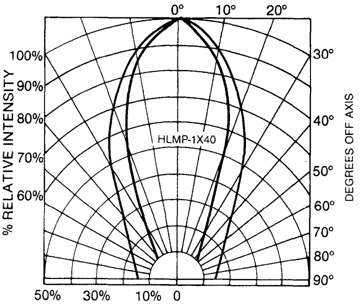
C1831C

Fig. 1. Forward Current vs. Forward Voltage



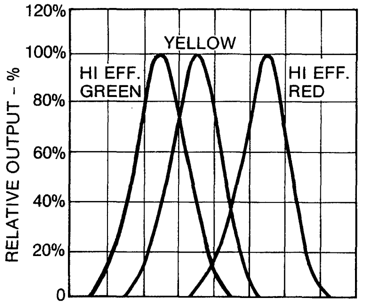
C1793

Fig. 2. Relative Luminous Intensity vs. Forward Current



C1129D

Fig. 3. Spatial Distribution



C1064C

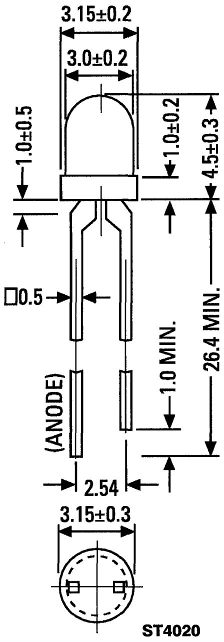
Fig. 4. Spectral Distribution

QT
OPTOELECTRONICS

T-1 (3 mm)
SOLID STATE LAMPS

PURE GREEN **HLMP-K600** TINTED
PURE GREEN **HLMP-K640** CLEAR
SOFT ORANGE **HLMP-K400** TINTED
SOFT ORANGE **HLMP-K401** TINTED
SOFT ORANGE **HLMP-K402** TINTED

PACKAGE DIMENSIONS



NOTES:
1. ALL DIMENSIONS ARE IN MM.
2. LEAD SPACING IS MEASURED WHERE THE LEADS EMERGE FROM THE PACKAGE.
3. PROTRUDED RESIN UNDER THE FLANGE IS 1.5 mm (0.059″) MAX.

DESCRIPTION

These T-1 LEDs are widely used as general purpose indicators. The pure green lamps are made with a GaP LEDs on a GaP substrate. The soft orange are made with GaAsP LEDs on a GaP substrate. They are encapsulated in epoxy packages and are designed to provide superior light output and a wide viewing angle.

FEATURES

- Popular T-1¾ package.
- Low drive current.
- Solid state reliability.
- Wide viewing angle.
- Choice of pure green or soft orange colors.

ABSOLUTE MAXIMUM RATING (T_A=25°C Unless Otherwise Specified)

DC forward current (I_f)	40 mA
Operating temperature range	−40°C to +85°C
Storage temperature range	−40°C to +100°C
Lead soldering time (at 1/16 inch from the bottom of lamp)	5 seconds @ 260°C
Peak forward current (I_f) (at f=1.0 KHz, Duty factor= 1/10)	200 mA
Power dissipation (P_d)	110 mW
Recommended operating current (I_f Rec)	20 mA

QT OPTOELECTRONICS

T-1 (3 mm)
SOLID STATE LAMPS

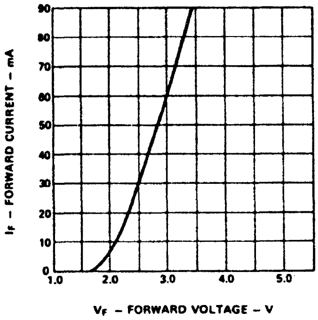
ELECTRO-OPTICAL CHARACTERISTICS (T_A = 25°C Unless Otherwise Specified)

PART NUMBER HLMP-	K600	K640*	K400	K401	K402	TEST CONDITIONS
Luminous intensity (mcd)						I_F=10 mA
minimum	1.0	4.2	1.0	2.0	3.0	
typical	4.5	30	4.0	5.0	6.5	
Forward voltage (V_F)						I_F=10 mA
minimum			1.5	1.5	1.5	
typical	2.1	2.2	1.9	1.9	1.9	
maximum	2.7	3.0	2.4	2.4	2.4	
Peak wavelength (nm)	560	560	612	612	612	I_F=10 mA
Spectral line half width (nm)	24	24	40	40	40	I_F=10 mA
Reverse breakdown voltage (V_R)	5	5	5	5	5	I_F=100 μA
Viewing angle (°)	90	45	90	90	90	I_F=10 mA

*NOTE: HLMP-K640 test conditon is I_F=20 mA

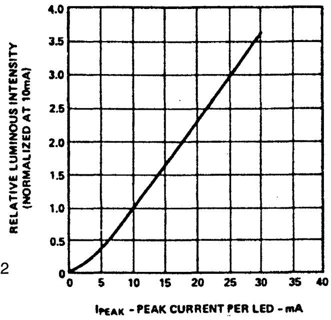
TYPICAL ELECTRO-OPTICAL CHARACTERISTIC CURVES (T_A=25°C)

Pure (Emerald) Green



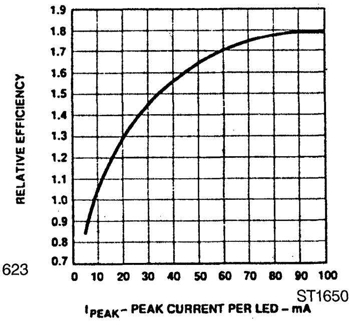
ST1622

Figure 1. Forward Current vs. Forward Voltage



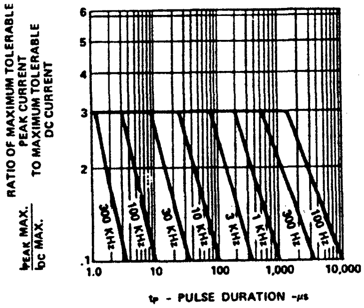
ST1623

Figure 2. Relative Luminous Intensity vs. Forward Current



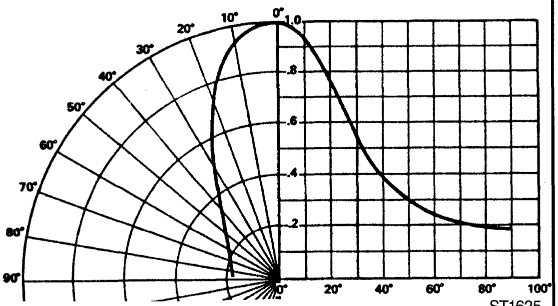
ST1650

Figure 3. Relative Efficiency vs. Peak LED Current



ST1624

Figure 4. Maximum Peak Current vs. Pulse Duration



ST1625

Figure 5. Relative Luminous Intensity vs. Angular Displacement

TYPICAL ELECTRO-OPTICAL CHARACTERISTIC CURVES (T_A=25°C)

Soft Orange

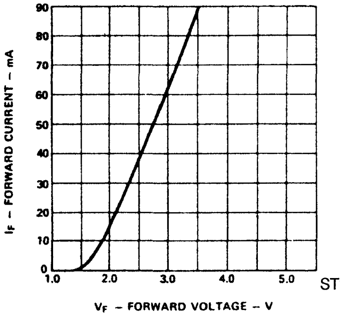


Figure 1. Forward Current vs. Forward Voltage

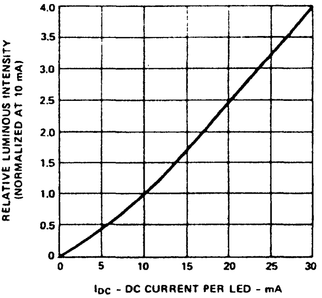


Figure 2. Relative Luminous Intensity vs. Forward Current

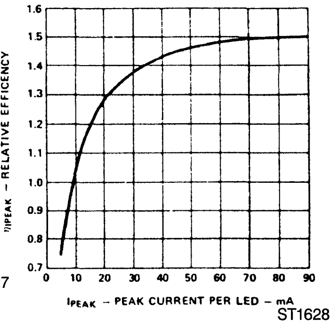


Figure 3. Relative Efficiency vs. Peak LED Current

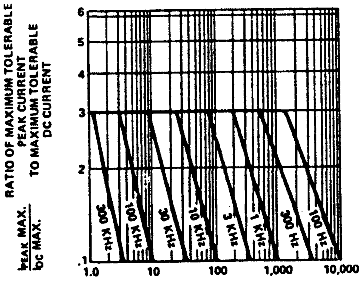


Figure 4. Maximum Peak Current vs. Pulse Duration

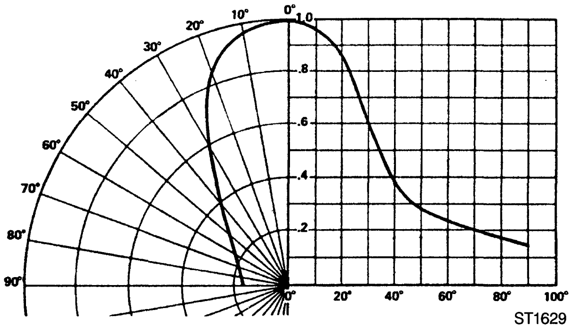


Figure 5. Relative Luminous Intensity vs. Angular Displacement

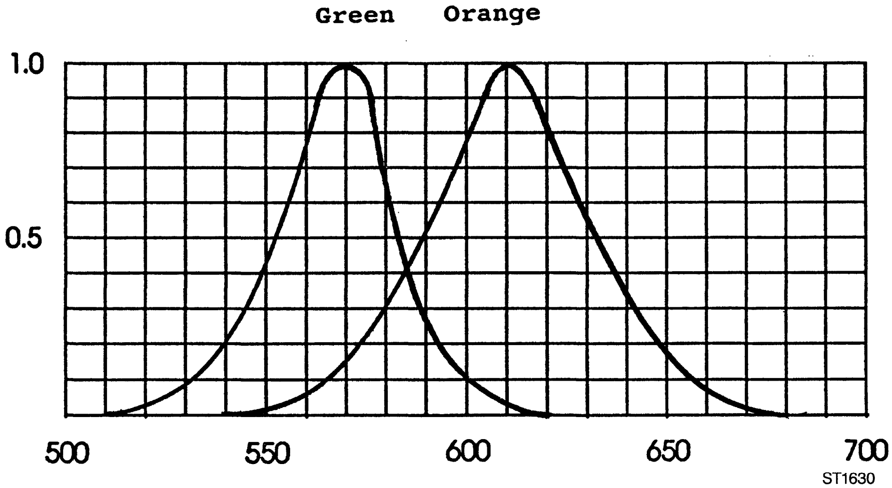


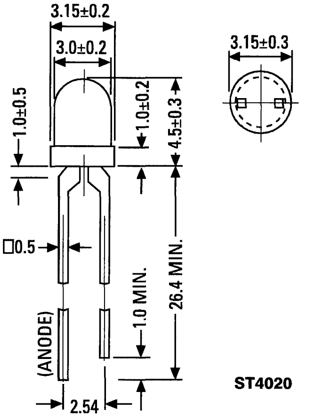
Fig. 6. Relative Intensity vs. Wavelength-nm

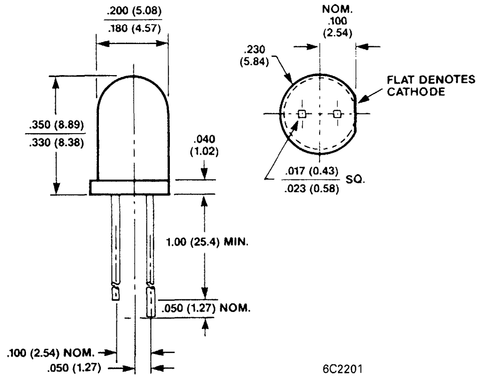
QT
OPTOELECTRONICS

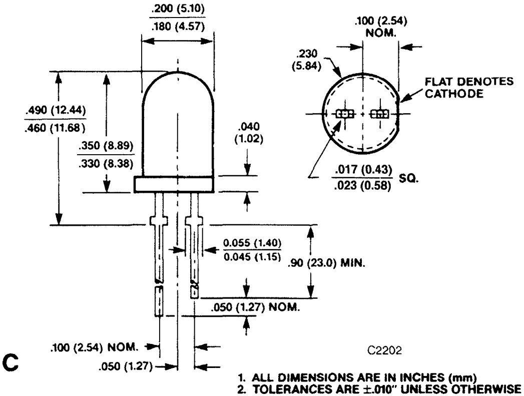
DOUBLE HETEROJUNCTION AlGaAs LOW CURRENT RED LED LAMPS

T-1¾ HLMP-D150A/D155A
T-1 HLMP-K150/K155

PACKAGE DIMENSIONS







C

1. ALL DIMENSIONS ARE IN INCHES (mm)
2. TOLERANCES ARE ±.010" UNLESS OTHERWISE SPECIFIED
3. AN EPOXY MENISCUS MAY EXTEND ABOUT .040" (1 mm) DOWN THE LEADS

DESCRIPTION

A recently developed double heterojunction (DH) AlGaAs/GaAs material technology is the basis of the light emitting chip utilized in these solid state lamps. Exceptional light output typifies these devices and provides for their use over a broad range of drive currents. At a dominant wavelength of 637 nanometers, the light is perceived as a deep red color. These lamps are ideally suited for use in applications where high light output is required with minimum power input.

FEATURES

- Luminous intensity specified at 1 mA
- High light output at low currents
- Wide viewing angle
- Low power/low forward voltage
- Outstanding material efficiency
- CMOS/MOS compatible
- TTL compatible
- Deep red color

APPLICATIONS

- Low power circuits
- Battery powered equipment
- Telecommunication indicators

QT
OPTOELECTRONICS

DOUBLE HETEROJUNCTION AlGaAs LOW CURRENT RED LED LAMPS

PHYSICAL CHARACTERISTICS

SIZE	TYPE	LENS EFFECT	I_V (mcd) MIN.	@ 1mA TYP.	VIEWING ANGLE 2Ø1/2 DEGREES	PKG.
T-1	HLMP-K150	Red Tinted Diffused	1.2	2	60	A
T-1	HLMP-K155	Clear	2	3	45	A
T-1¾	HLMP-D150A	Red Tinted Diffused	1.2	3	65	B
T-1¾	HLMP-D155A	Clear	5	10	24	C

ELECTRO-OPTICAL CHARACTERISTICS (T_A = 25°C Unless Otherwise Specified)

PARAMETER	SYMBOL	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS
Forward voltage	V_F		1.6	1.8	V	I_F=1 mA
Peak wavelength	λp		645		nm	I_F=1 mA
Dominant wavelength	λd		637		nm	I_F=1 mA
Spectral line half width	$\Delta\lambda 1/2$		20		nm	I_F=1 mA
Capacitance	C		30		pF	V_F=0, f=1 MHz
Reverse breakdown voltage	V_R	5.0	15.0		V	I_R=100 μA

ABSOLUTE MAXIMUM RATINGS (T_A = 25°C Unless Otherwise Specified)

Power dissipation	87 mW
Operating temperature	−20°C to +100°C
Storage temperature	−55°C to +100°C
Lead soldering time at 260°C	5 seconds
Peak forward current (see Note 1)	300 mA
Reverse voltage (I_R = 100μA)	5V
Average forward current (see Note 2)	20 mA

NOTES

1. *Maximum I_{peak} at f = 1 kHz, DF = 6.7%*
2. *Derate linearly as shown in Figure 4.*

DOUBLE HETEROJUNCTION AlGaAs LOW CURRENT RED LED LAMPS

TYPICAL ELECTRO-OPTICAL CHARACTERISTIC CURVES

(25°C Free Air Temperature)

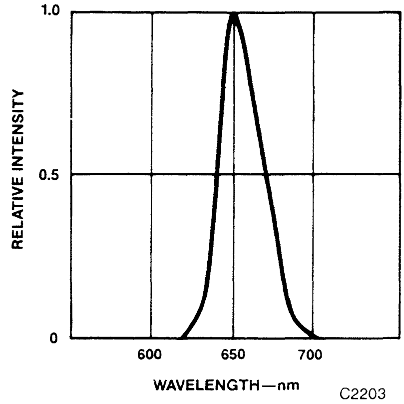


Fig. 1. Relative Intensity vs. Wavelength

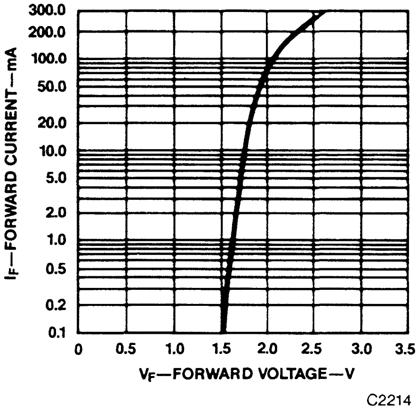


Fig. 2. Forward Current vs. Forward Voltage

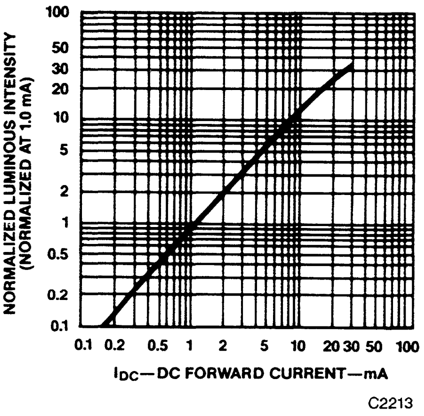


Fig. 3. Relative Luminous Intensity vs. DC Forward Current

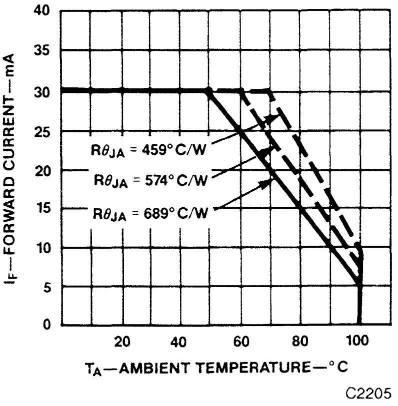


Fig. 4. Maximum Forwad DC Current vs. Ambient Temperature. Derating Based on T_J MAX = 110°C

TYPICAL ELECTRO-OPTICAL CHARACTERISTIC CURVES

(25°C Free Air Temperature) (Cont'd)

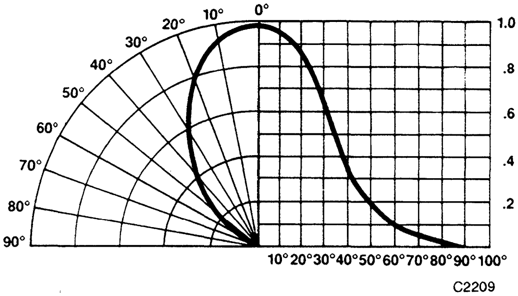


Fig. 5. Relative Luminous Intensity vs. Angular Displacement. HLMP-D150A

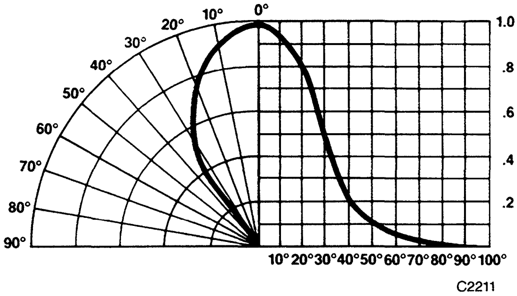


Fig. 6. Relative Luminous Intensity vs. Angular Displacement. HLMP-K150

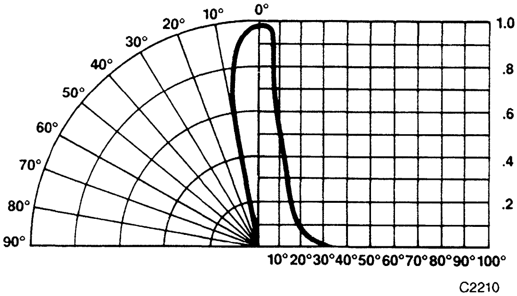


Fig. 7. Relative Luminous Intensity vs. Angular Displacement. HLMP-D155A

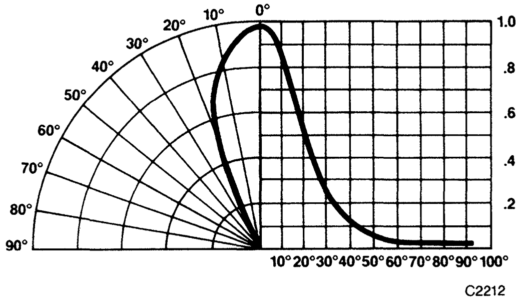


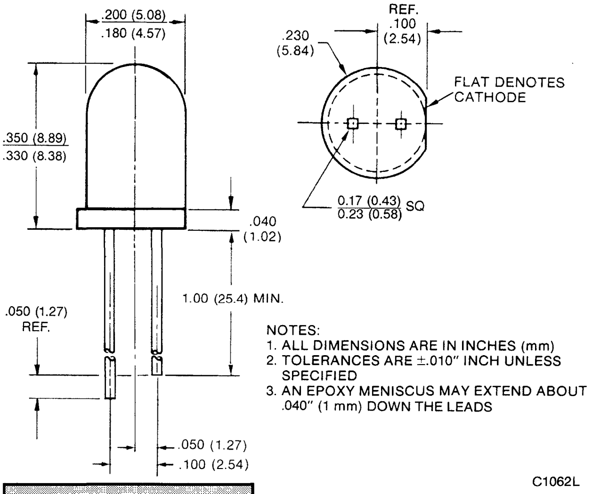
Fig. 8. Relative Luminous Intensity vs. Angular Displacement. HLMP-K155

QT
OPTOELECTRONICS

BLUE LEDS

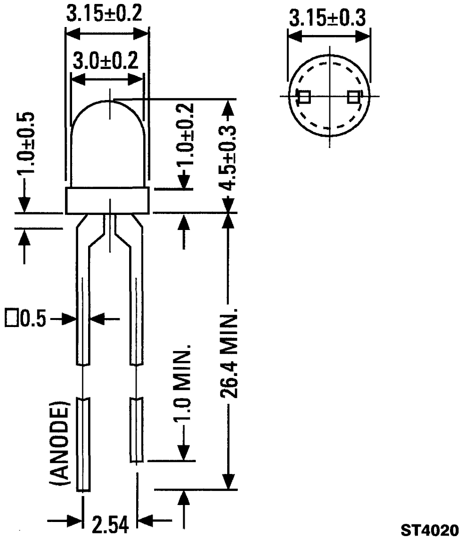
T-1¾ MV5B54
T-1 MV5B66

PACKAGE DIMENSIONS



NOTES:
1. ALL DIMENSIONS ARE IN INCHES (mm)
2. TOLERANCES ARE ±.010" INCH UNLESS SPECIFIED
3. AN EPOXY MENISCUS MAY EXTEND ABOUT .040" (1 mm) DOWN THE LEADS

C1062L



ST4020

DESCRIPTION

Both the T-1¾ and T1 package are lightly tinted LEDs. The LEDs is manufactured with the single crystal silicon carbide technology. The color emitted is an 80% saturated blue with a dominant wavelength of 481 nm.

FEATURE

- Silicon carbide technology
- 481 nm 80% saturated blue
- Standard T-1¾ and T1 package
- CMOS/MOS compatible

APPLICATIONS

- Medical instrumentation
- Front panel status indicator
- Moving message signs

ABSOLUTE MAXIMUM RATING (T$_A$ = 25°C Unless Otherwise Specified)

DC forward current	50 mA
Derate linearly from 50°C	−0.7 mA/°C
LED Junction temperature	110°C
Reverse voltage (at I_R = 100 μA)	5 V
Storage and operating temperature	−55°C to +100°C
Soldering time at 260°C	5 sec

TYPICAL THERMAL CHARACTERISTICS

Thermal Resistance Junction to free air θ_{JA}	330°C/W
Wavelength temperature coefficient (case temperature)	1.0 Å/°C
Forward voltage temperature coefficient	−1.4 mV/°C

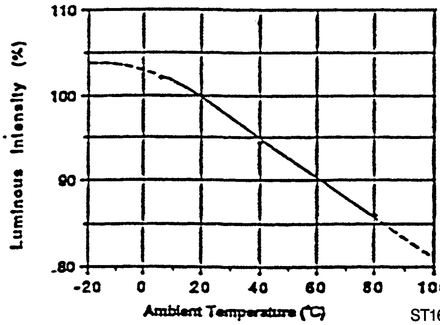
QT
OPTOELECTRONICS

BLUE LEDS

ELECTRO-OPTICAL CHARACTERISTICS (T_A = 25°C Unless Otherwise Specified)

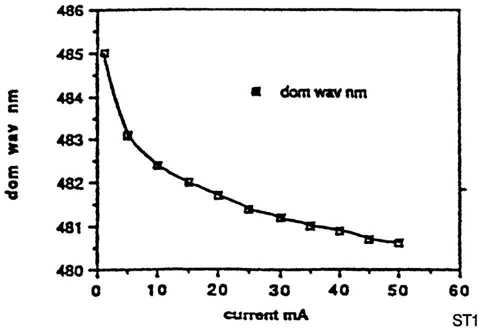
PARAMETER	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS
Luminous intensity I_V					
MV5B54	1	2		mcd	I_F=20 mA
MV5B66	2	3		mcd	I_F=20 mA
Forward voltage - V		3.0	3.3	V	I_F=20 mA
Peak wavelength		468		nm	
Spectral line half width		70		nm	
Reverse voltage - V		5	40	V	I_R=100 μA
Total viewing angle - 2θ½					
MV5B54		24		degree	
MV5B66		14		degree	

TYPICAL ELECTRO-OPTICAL CHARACTERISTIC CURVES
(T_A = 25°C Unless Otherwise Specified)



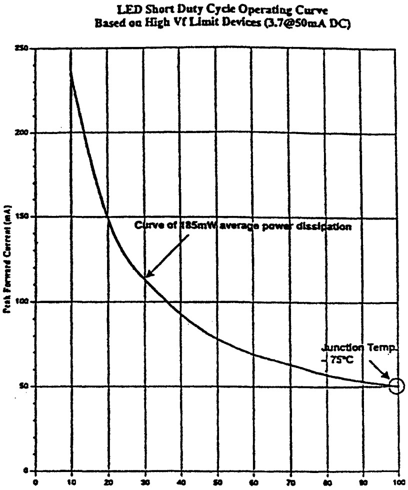
ST1672

Fig. 1. Between 20-80°C The equation of the curve is y = 104.3 - 0.233x
The dotted lines denote extrapolated data



ST1673

Fig. 2. The peak wavelength stays the same width respect to current



ST1674

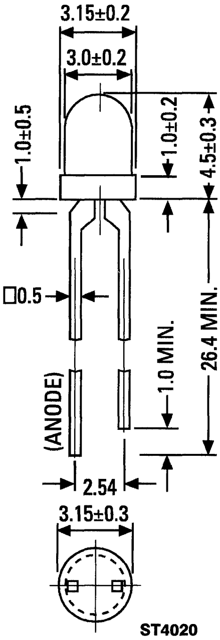
Fig. 3. Duty Cycle (%)

QT OPTOELECTRONICS

DIFFUSED T-100
SOLID STATE LAMPS

RED MV50640
YELLOW MV5364X
HIGH EFFICIENCY GREEN MV5464X/HLMP-15X3
HIGH EFFICIENCY RED MV5764X/HLMP-130X

PACKAGE DIMENSIONS



NOTES:
1. ALL DIMENSIONS ARE IN MM.
2. LEAD SPACING IS MEASURED WHERE THE LEADS EMERGE FROM THE PACKAGE.
3. PROTRUDED RESIN UNDER THE FLANGE IS 1.5 mm (0.059″) MAX.

DESCRIPTION

These solid state indicators offer a variety of color selection. The High Efficiency Red and Yellow devices are made with gallium arsenide phosphide on gallium phosphide. The High Efficiency Green utilizes an improved gallium phosphide light emitting diode. All are encapsulated in epoxy packages with diffused lenses. Their small size, wide viewing angle, and small square leads contribute to their versatility as all-purpose indicators.

FEATURES

- Replacement for the HLMP-1300 and -1500 product series
- 100 mil lead spacing T-1
- High efficiency GaP light
- Versatile mounting on PC board or panel
- Wide viewing angle
- Diffused tinted lens

PHYSICAL CHARACTERISTICS

TYPE	SOURCE COLOR	LENS EFFECT	LUMINOUS INTENSITY at 25°C (mcd) MIN.	TYP.	TEST CONDITIONS
MV50640	Standard Red	Red Diffused	0.5	1.5	I_F=20 mA
MV53640	Yellow	Yellow Diffused	1.0	2.0	I_F=10 mA
MV53641			1.5	3.0	
MV53642			2.5	4.5	
MV54643	High Efficiency Green	Green Diffused			
(HLMP-1503)			2.0	5.0	I_F=20 mA
MV54644					
(HLMP-1523)			6.0	10.0	
MV57640	High Efficiency Red	Red Diffused			
(HLMP-1300)			1.0	2.0	I_F=10 mA
MV57641					
(HLMP-1301)			2.0	2.5	
MV57642					
(HLMP-1302)			3.0	4.0	

QT
OPTOELECTRONICS

DIFFUSED T-100 SOLID STATE LAMPS

ELECTRO-OPTICAL CHARACTERISTICS

(25°C Free Air Temperature Unless Otherwise Specified)

PARAMETER		SYMBOL	TEST COND.	UNITS	MV50640* RED	MV5364X YELLOW	MV5464X HI. EFF. GREEN	MV5764X HI. EFF. RED
Forward voltage	typ.	V_F	I_F=10 mA	V	1.6	2.1	2.2*	2.0
	max.				2.0	3.0	3.0*	3.0
Peak wavelength		λ	I_F=10 mA	nm	660	585	562	635
Spectral line half width			I_F=10 mA	nm	20	35	30	45
Capacitance	typ.	C	V=0, f=1 MHz	pF	23	45	20	45
Reverse voltage	min.	V_{BR}	I_R=100 μA	V	5.0	5.0	5.0	5.0
Viewing angle (total)	typ.	2θ½	See Fig. 3	degrees	90	90	90	90

*I_F=20 mA

ABSOLUTE MAXIMUM RATINGS (T_A=25°C Unless Otherwise Specified)

	YLW.	STD. RED	HER/HEG
Power dissipation at 25°C ambient	85	120 mW	120 mW
Derate linearly from 50°C	1.6 mW/°C	1.6 mW/°C	1.6 mW/°C
Storage and operating temperatures	−55°C to +100°C	−55°C to +100°C	−55°C to +100°C
Lead soldering time at 260°C (1/16 inch from body)	5 sec.	5 sec.	5 sec.
Continuous forward current at 25°C	20 mA	30 mA	30 mA
Peak forward current (1 μsec pulse, 0.3% duty cycle)	60 mA	1.0 A	90 mA
Reverse voltage	5.0 V	5.0 V	5.0 V

TYPICAL ELECTRO-OPTICAL CHARACTERISTIC CURVES

(25°C Free Air Temperature Unless Otherwise Specified)

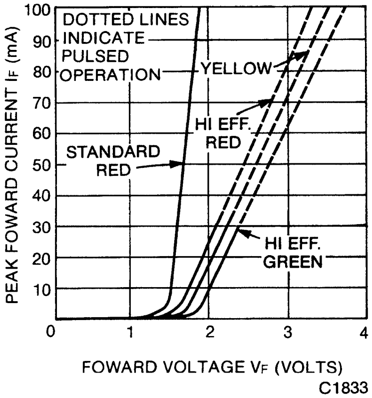


Fig. 1. Forward Current vs. Forward Voltage

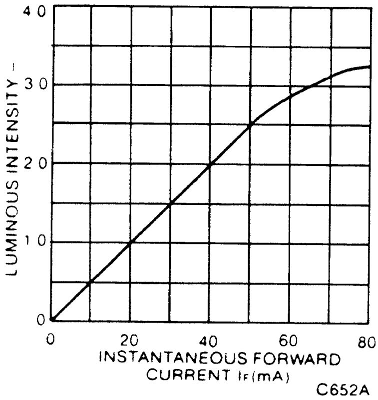


Fig. 2. Luminous Intensity vs. Forward Current

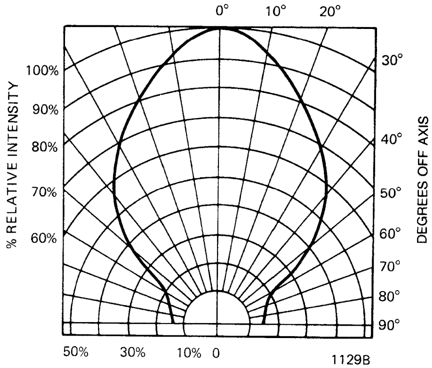


Fig. 3. Spatial Distribution

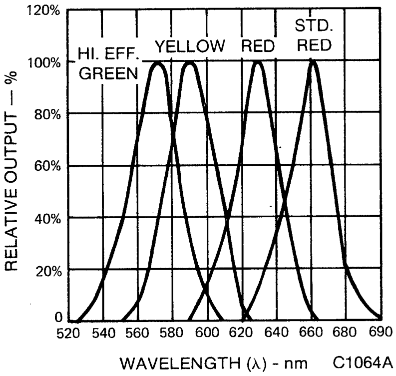


Fig. 4. Spectral Distribution

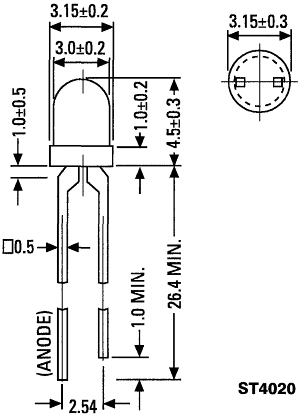
QT
OPTOELECTRONICS

LOW CURRENT T-100 & T-1¾ SOLID STATE LAMPS

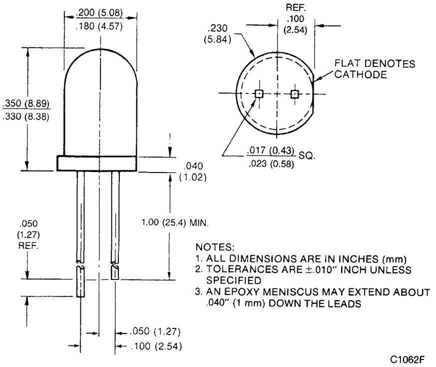
2 mA

HIGH EFFICIENCY RED HLMP-1700 HLMP-4700
YELLOW HLMP-1719 HLMP-4719
HIGH EFFICIENCY GREEN HLMP-1790 HLMP-4740 (MV2454)

PACKAGE DIMENSIONS



ST4020



NOTES:
1. ALL DIMENSIONS ARE IN INCHES (mm)
2. TOLERANCES ARE ±.010" INCH UNLESS SPECIFIED
3. AN EPOXY MENISCUS MAY EXTEND ABOUT .040" (1 mm) DOWN THE LEADS

C1062F

DESCRIPTION

The T-1¾ HLMP-4700 Series and T-1 HLMP-1700 Series are direct pin-for-pin replacements for the Hewlett-Packard lamps with the same part numbers. All devices are tinted diffused with a medium-wide viewing angle. The design of the LED chips is optimized for low current applications and is far superior in Luminous Intensity compared to standard LED lamps at very low current.

These low current lamps are primarily intended for direct view.

FEATURES

- Very low power — 4 mW
- 2 mA drive from low power TTL or CMOS
- All three colors
- Power savings in portable equipment
- Sturdier leads for easy assembly
- Both T-1¾ and T-1
- Use MP52 panel mounting grommet with HLMP-4700, HLMP-4719 and MV2454

APPLICATIONS

- Portable battery driven digital or linear electronic equipment like test instruments, robots and toys
- Multiple lamp applications to reduce power drain by 5 to 10 times and decrease power supply size and cost as in phones, PBX and signs

PHYSICAL CHARACTERISTICS

SIZE	TYPE	SOURCE COLOR	LENS EFFECT
T-1	HLMP-1700	High Efficiency Red	Red Diffused
	HLMP-1719	Yellow	Yellow Diffused
	HLMP-1790	High Efficiency Green	Green Diffused
T-1¾	HLMP-4700	High Efficiency Red	Red Diffused
	HLMP-4719	Yellow	Yellow Diffused
	HLMP-4740 (MV2454)	High Efficiency Green	Green Diffused

OPTOELECTRONICS

LOW CURRENT T-100 & T-1¾
SOLID STATE LAMPS

ELECTRO-OPTICAL CHARACTERISTICS (T_A=25°C Unless Otherwise Specified)

			T-1¾			T-1				
PARAMETER		**SYMBOL**	**HI. EFF RED HLMP-4700**	**YELLOW HLMP-4719**	**HI. EFF. GREEN HLMP-4740 (MV2454)**	**HI. EFF RED HLMP-1700**	**YELLOW HLMP-1719**	**HI. EFF. GREEN HLMP-1790**	**UNITS**	**TEST COND.**
Luminous Intensity	min.	I_V	1.2	1.2	1.2	1.0	1.0	1.0	mcd	I_F=2 mA
	typ.		2.0	2.0	3.0	2.0	2.0	2.0	mcd	I_F=2 mA
Forward voltage	max.	V_F	2.2	2.7	2.7	2.2	2.7	2.7	V	I_F=2 mA
	typ.		1.8	1.9	1.9	1.8	1.9	1.9	V	I_F=2 mA
Peak wavelength	typ.	λp	635	585	565	635	585	565	nm	I_F=2 mA
Reverse breakdown voltage	min.	V_{BR}	5	5	5	5	5	5	V	I_R=100 μA
Viewing angle (total)	typ.	$2\theta_{1/2}$	35	35	35	50	50	50	degrees	

ABSOLUTE MAXIMUM RATINGS (T_A=25°C Unless Otherwise Specified)

PARAMETER	**HI. EFF. RED**	**YELLOW**	**HI. EFF. GREEN**	**UNITS**	**NOTES**
Power dissipation	27	24	27	mW	1
DC forward current	7.5	7.5	7.5	mA	
Peak forward current (PW≤1 ms, DF ≤ 30%)	25	20	25	mA	
Lead soldering time at 260°C	5	5	5	sec	2
Operating and storage temperatures		−55°C to +100°C			

NOTES

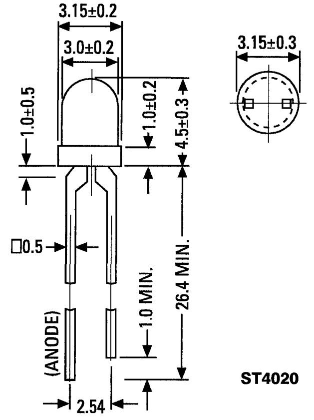
1. *Derate linearly from 92°C at 1 mA/°C.*
2. *At 1/16 inch (1.6 mm) from bottom of lamp.*

QT OPTOELECTRONICS

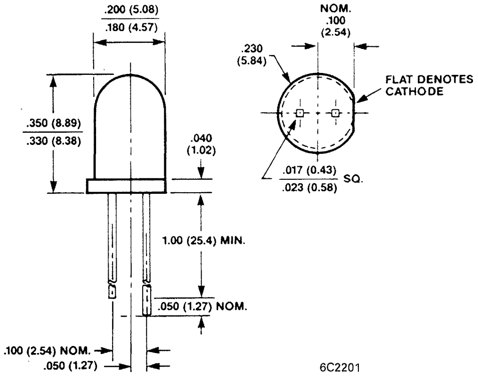
DOUBLE HETEROJUNCTION AlGaAs HIGH INTENSITY RED LED LAMPS

T-1¾ HLMP-D101A/D105A
T-1 HLMP-K101/K105

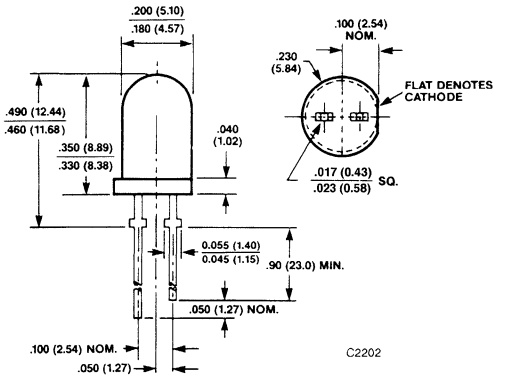
PACKAGE DIMENSIONS



ST4020



6C2201



C2202

C

1. ALL DIMENSIONS ARE IN INCHES (mm)
2. TOLERANCES ARE ±.010" UNLESS OTHERWISE SPECIFIED
3. AN EPOXY MENISCUS MAY EXTEND ABOUT .040" (1 mm) DOWN THE LEADS

DESCRIPTION

Exceptional light output typifies these devices and provides for their use over a broad range of drive currents. The LED material is based on recently developed double heterojunction (DH) AlGaAs/GaAs technology. The light emitted is perceived as a deep red color, characterized by a dominant wavelength of 637 nanometers.

FEATURES

- Exceptional Brightness
- Wide Viewing Angle
- Outstanding Material Efficiency
- Low Forward Voltage
- CMOS/MOS Compatible
- TTL Compatible
- Deep Red Color

APPLICATIONS

- Bright Ambient Lighting Conditions
- Moving Message Panels
- Portable Equipment
- General Use

QT
OPTOELECTRONICS

DOUBLE HETEROJUNCTION AlGaAs HIGH INTENSITY RED LED LAMPS

PHYSICAL CHARACTERISTICS

SIZE	TYPE	LENS EFFECT	I_V (mcd) MIN	@ 20mA TYPE	VIEWING ANGLE 2Ø1/2 DEGREES	PKG.
T-1	HLMP-K101	Red Tinted Diffused	22	45	60	A
T-1	HLMP-K105	Clear	35	65	45	A
T-1 3/4	HLMP-D101A	Red Tinted Diffused	35	70	65	B
T-1 3/4	HLMP-D105A	Clear	100	240	24	C

ELECTRO-OPTICAL CHARACTERISTICS (T_A = 25°C Unless Otherwise Specified)

PARAMETER	SYMBOL	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS
Forward voltage	V_F		1.8	2.2	V	I_F=20 mA
Peak wavelength	λp		645		nm	I_F=20 mA
Dominant wavelength	λd		637		nm	I_F=20 mA
Spectral line half width	Δλ1/2		20		nm	I_F=20 mA
Capacitance	C		30		pF	V_F=0, f=1 MHz
Reverse breakdown voltage	V_R	5.0	15.0		V	I_R=100 μA

ABSOLUTE MAXIMUM RATINGS (T_A = 25°C Unless Otherwise Specified)

Power dissipation	87 mW
Operating temperature	−20°C to +100°C
Storage temperature	−55°C to +100°C
Lead soldering time at 260°C	5 seconds
Peak forward current (see Note 1)	300 mA
Reverse voltage (I_R = 100 μA)	5V
Average forward current (see Note 2)	20 mA
D.C. current (see Note 3)	30 mA

NOTES

1. *Maximum I_{peak} at f = 1 kHz, DF = 6.7%*
2. *Refer to Figure 6 to establish pulsed operating conditions.*
3. *Derate linearly as shown in Figure 5.*

TYPICAL ELECTRO-OPTICAL CHARACTERISTIC CURVES

(25°C Free Air Temperature)

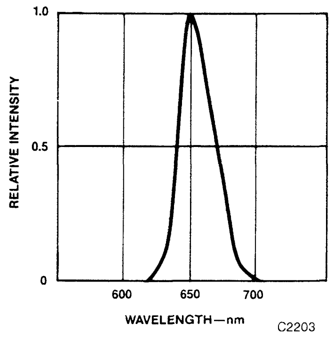


Fig. 1. Relative Intensity vs. Wavelength

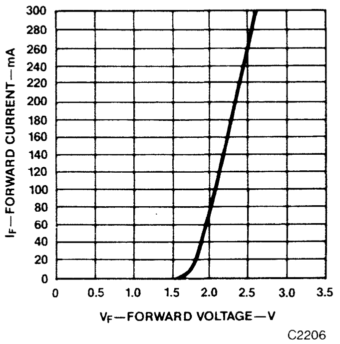


Fig. 2. Forward Current vs. Forward Voltage

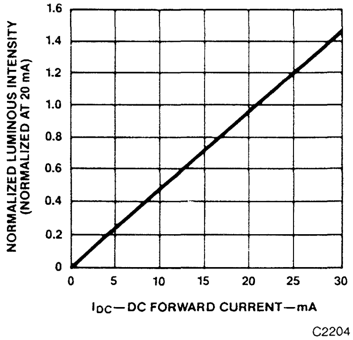


Fig. 3. Relative Luminous Intensity vs. DC Forward Current

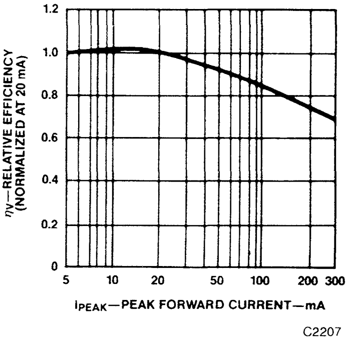


Fig. 4. Relative Efficiency vs. Peak Forward Current

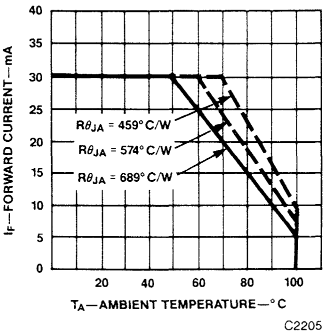


Fig. 5. Maximum Forward DC Current vs. Ambient Temperature. Derating Based on T_J MAX = 110°C.

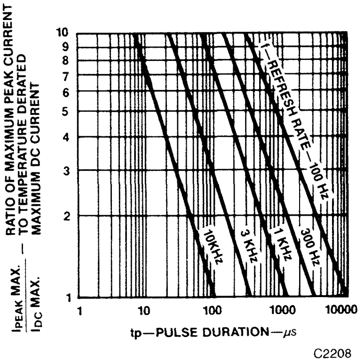


Fig. 6. Maximum Tolerable Peak Current vs. Peak Duration (I_{PEAK} MAX Determined from Temperature Derated I_{DC} MAX)

TYPICAL ELECTRO-OPTICAL CHARACTERISTIC CURVES

(25°C Free Air Temperature) (Cont'd)

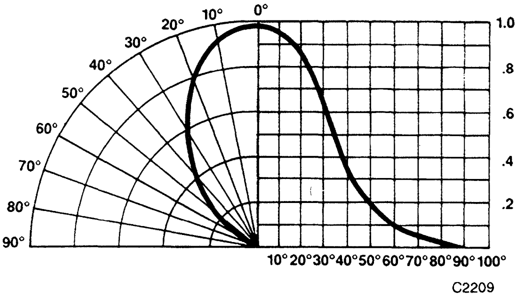


Fig. 7. Relative Luminous Intensity vs. Angular Displacement, HLMP-D101A

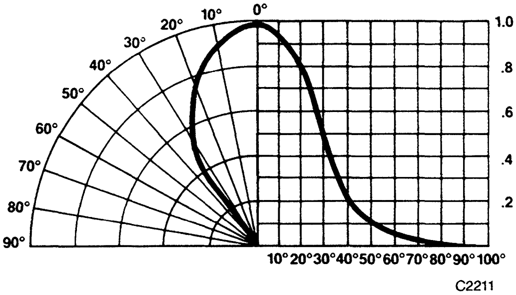


Fig. 8. Relative Luminous Intensity vs. Angular Displacement, HLMP-K101

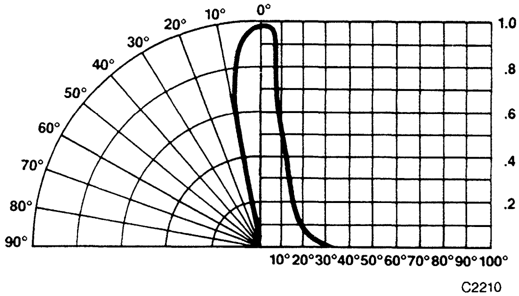


Fig. 9. Relative Luminous Intensity vs. Angular Displacement, HLMP-D105A

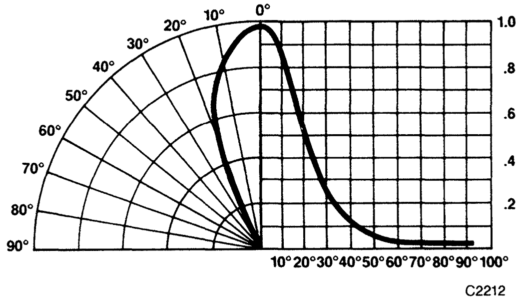


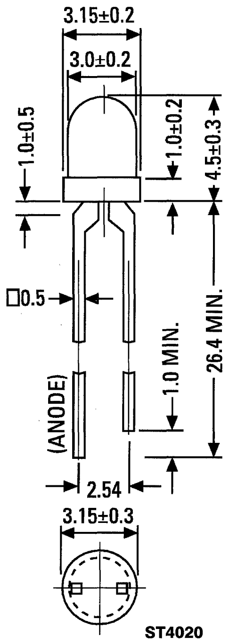
Fig. 10. Relative Luminous Intensity vs. Angular Displacement, HLMP-K105

OPTOELECTRONICS

INTEGRATED T-1 RESISTOR LAMPS
5 VOLT and 12 VOLT SERIES

RED **MR5060** TINTED/**MR5660** UNTINTED
HIGH EFFICIENCY RED **MR5760/MR5761** TINTED
YELLOW **MR5360/MR5361** TINTED
HIGH EFFICIENCY GREEN **MR5460/MR5461** TINTED

PACKAGE DIMENSIONS



ST4020

NOTES:
1. ALL DIMENSIONS ARE IN MM.
2. LEAD SPACING IS MEASURED WHERE THE LEADS EMERGE FROM THE PACKAGE.
3. PROTRUDED RESIN UNDER THE FLANGE IS 1.5 mm (0.059") MAX.

DESCRIPTION

This group of T-1 size LED lamps contain integral resistors. Operation at 5 volts (MR5X60 Part Nos.) or 12 volts (MR5X61 Part Nos.) is possible without the use of external current limiting resistors. Color tinted, diffused epoxy packages are used for all the lamps in this group; with the exception of the MR5660, which is no tint - but diffused.

FEATURES

- Integral Current Limiting Resistor (No external resistor required)
- TTL Compatible
- Operate with 5 Volt & 12 Volt Supplies
- All Colors - Red, HER, Yellow, Green
- Wide Viewing Angle
- Solid-State Reliability

PHYSICAL CHARACTERISTICS

TYPE	SOURCE COLOR	LENS COLOR
MR5060	Red	Red Diffused
MR5660	Red	Clear Diffused
MR5760	High Efficiency Red	Red Diffused
MR5761	High Efficiency Red	Red Diffused
MR5360	Yellow	Yellow Diffused
MR5361	Yellow	Yellow Diffused
MR5460	High Efficiency Green	Green Diffused
MR5461	High Efficiency Green	Green Diffused

OPTOELECTRONICS

INTEGRATED T-1 RESISTOR LAMPS
5 VOLT and 12 VOLT SERIES

ELECTRO-OPTICAL CHARACTERISTICS (TA = 25°C Unless Otherwise Specified)

		RED						HIGH EFFICIENCY RED						UNITS	TEST CONDITION
PARAMETER	SYMBOL	MR5060			MR5660			MR5760			MR5761				
		MIN.	TYP.	MAX	MIN.	TYP.	MAX.	MIN.	TYP.	MAX.	MIN.	TYP.	MAX.		
Luminous Intensity	I_V										1.5	4.0		mcd	$V_F=12$ V
Luminous Intensity	I_V	0.8	1.5		0.8	1.5		1.5	4.0					mcd	$V_F=5$ V
Total Viewing Angle	$2\theta1/2$		60			60			60			60		Deg	
Peak Wavelength	λp		655			655			635			635		nm	
Spectral Line Halfwidth	$\Delta\lambda1/2$		24			24			40			40		nm	
Forward Current 12V Devices	I_F											13	20	mA	$V_F=12$ V
Forward Current 5V Devices	I_F		13	20		13	20		10	15				mA	$V_F=5$ V
Reverse Breakdown Voltage	V_R	5.0			5.0			5.0			5.0				$I_R=100\mu A$

ELECTRO-OPTICAL CHARACTERISTICS (TA = 25°C Unless Otherwise Specified)

		YELLOW						HIGH EFFICIENCY GREEN						UNITS	TEST CONDITION
PARAMETER	SYMBOL	MR5360			MR5361			MR5460			MR5461				
		MIN.	TYP.	MAX	MIN.	TYP.	MAX.	MIN.	TYP.	MAX.	MIN.	TYP.	MAX.		
Luminous Intensity	I_V				1.5	4.0					1.5	4.0		mcd	$V_F=12$ V
Luminous Intensity	I_V	1.5	4.0					1.5	4.0					mcd	$V_F=5$ V
Total Viewing Angle	$2\theta1/2$		60			60			60			60		Deg	
Peak Wavelength	λp		583			583			565			565		nm	
Spectral Line Halfwidth	$\Delta\lambda1/2$		36			36			28			28		nm	
Forward Current 12V Devices	I_F					13	20					13	20	mA	$V_F=12$ V
Forward Current 5V Devices	I_F		10	15					12	15				mA	$V_F=5$ V
Reverse Breakdown Voltage	V_R	5.0			5.0			5.0			5.0				$I_R=100\mu A$

ABSOLUTE MAXIMUM RATINGS (TA = 25°C Unless Otherwise Specified)

	RED/HER/YELLOW 5 VOLT LAMPS	RED/HER/YELLOW 12 VOLT LAMPS	GREEN 5 VOLT LAMPS	GREEN 12 VOLT LAMPS
DC Forward Voltage ($T_A=25°C$)	7.5 Volts	15 Volts	7.5 Volts	15 Volts
Reverse Voltage ($I_R=100\ \mu A$)	5 Volts	5 Volts	5 Volts	5 Volts
Operating Temperature Range	−40°C to +85°C	−40°C to +85°C	−20°C to +85°C	−20°C to +85°C
Storage Temperature Range	−55°C to +100°C	−55°C to +100°C	−55°C to +100°C	−55°C to +100°C
Lead Soldering Temperature	260°C for 5 seconds			

INTEGRATED T-1 RESISTOR LAMPS
5 VOLT and 12 VOLT SERIES

TYPICAL ELECTRO-OPTICAL CHARACTERISTIC CURVES

(TA = 25°C Unless Otherwise Specified)

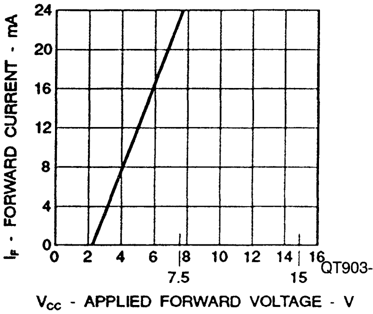


Fig. 1. Forward Current vs. Applied Forward Voltage 5 Volt Devices

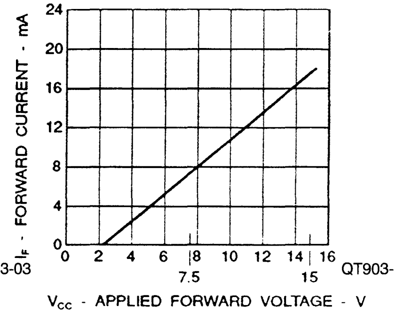


Fig. 2. Forward Current vs. Applied Forward Voltage 12 Volt Devices

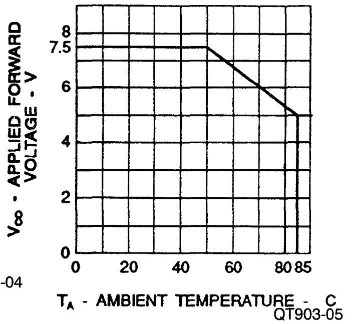


Fig. 3. Maximum Allowed Applied Forward Voltage vs. Ambient Temperature $R\theta_{JA}$=175°C/W 5 Volt Devices

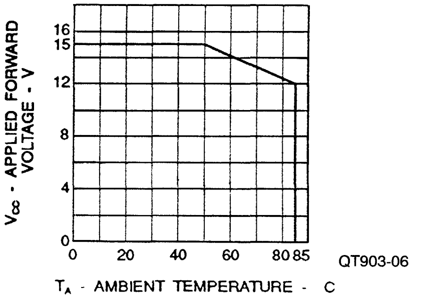


Fig. 4. Maximum Allowed Applied Forward Voltage vs. Ambient Temperature $R\theta_{JA}$=175°C/W 12 Volt Devices

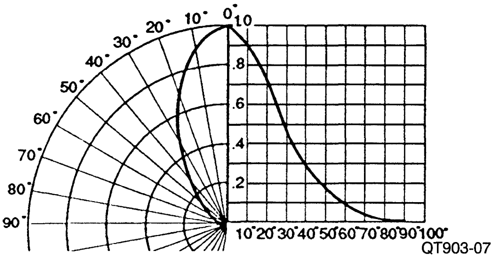


Fig. 5. Relative Luminous Intensity vs. Angular Displacement for T-1 Package

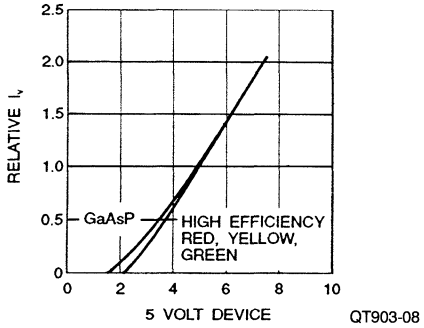


Fig. 6. Relative Luminous Intensity vs. Applied Forward Voltage 5 Volt Devices

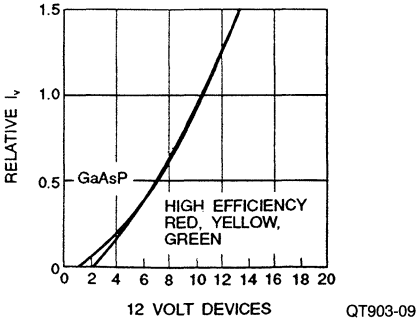


Fig. 7. Relative Luminous Intensity vs. Applied Forward Voltage 12 Volt Devices

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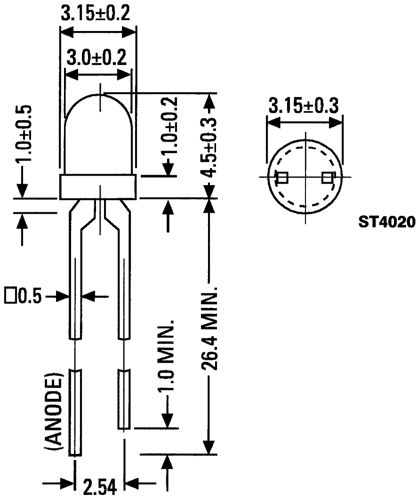
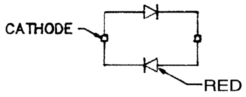
BICOLOR T-1
SOLID STATE LAMPS

HIGH EFFICIENCY GREEN/AlGaAs RED **MV6461**
HIGH EFFICIENCY RED/AlGaAs RED **MV6661**

PACKAGE DIMENSIONS





DESCRIPTION

The MV6461 is a White Diffused wide viewing angle, dual chip, 4-state lamp utilizing Deep Red AlGaAs and High Efficiency Green AC-driven, the LED lamp appears Orange. The MV6661 is a Red Diffused, wide viewing angle bipolar Red (AC) lamp featuring Red AlGaAs and High Efficiency Red chips.

FEATURES

- Excellent uniformity and visual appeal
- Very wide viewing angle for perfect direct view
- Increased reliability
- Radically improved die-off-center characteristics
- Same current for both colors for minimum component count
- Improved solder heat durability
- 4-state; Green, Red, Orange, OFF. (MV6461)
- 100 mil lead spacing

NOTES:
1. ALL DIMENSIONS ARE IN MM.
2. LEAD SPACING IS MEASURED WHERE THE LEADS EMERGE FROM THE PACKAGE.
3. PROTRUDED RESIN UNDER THE FLANGE IS 1.5 mm (0.059") MAX.

QT
OPTOELECTRONICS

BICOLOR T-1
SOLID STATE LAMPS

ELECTRO-OPTICAL CHARACTERISTICS (25°C Unless Otherwise Specified)

PARAMETER		SYMBOL	MV6661	MV6461	UNITS	TEST CONDITIONS
Luminous intensity	min.	I_v	2.5	2.5	mcd	I_F=20 mA
	typ.		10	10	mcd	I_F=20 mA
Forward voltage	max.	V_F	3.0	3.0	V	I_F=20 mA
	typ.		2.1	2.1	V	I_F=20 mA
Dominant wavelength	typ.	λ_d	630/650	567/650	nm	I_F=20 mA
Total viewing angle between half Luminous intensity points		2θ½	100	100	degree	I_F=20 mA

ABSOLUTE MAXIMUM RATINGS (T_A=25°C Unless Otherwise Specified)

PARAMETERS	RATING	UNITS	NOTES
Power dissipation	135	mW	1
Peak current	90	mA	
Average current	25	mA	2
Lead soldering time	5	seconds	
Storage and operating temperatures	−55°C to +100°C		3

NOTES

1. *Derate power linearly from 25°C at 1.8 mW/°C*
2. *Derate current linearly from 50°C at 0.5 mA/°C*
3. *To a point minimum 1/16 inch (1.6 mm) from the bottom lamp.*

TYPICAL ELECTRO-OPTICAL CHARACTERISTICS CURVES
(T_A=25°C Unless Otherwise Specified)

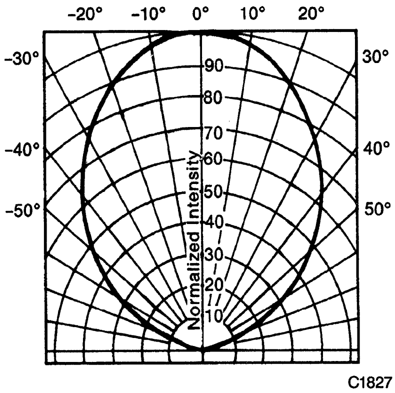


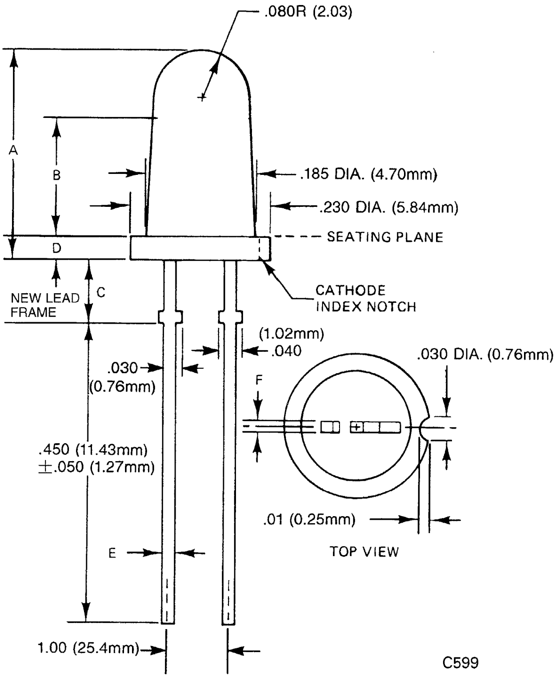
Fig. 1. Spatial Distribution

OPTOELECTRONICS

TAPERED PACKAGE T-1¾
SOLID STATE LAMPS

STANDARD RED **MV502XA**

PACKAGE DIMENSIONS



DESCRIPTION

The MV502X Series of solid state indicators is made with gallium arsenide phosphide light emitting diodes. Encapsulation and lens is epoxy. Various lens effects are available for many indicator applications.

FEATURES

- Tapered barrel T-1¾
- High Intensity Red light source with various lens colors and effects
- T-1¾ with stand-off
- Versatile mounting on PC board or panel
- Snap in panel mounting clip available (See MP22 for clip detail)

PHYSICAL CHARACTERISTICS

TYPE	A	B	C	D	E & F	SOURCE COLOR	LENS COLOR	LENS EFFECT	POP-IN MOUNTING	CIRCUIT BOARD MOUNTING
MV5021A	.340	.190	.100	.040	.020	Red	White Diffused	Soft	X	X
MV5022A	.340	.190	.100	.040	.020	Red	Transparent Red	Point	X	X
MV5023A	.340	.190	.100	.040	.020	Red	Red Diffused	Soft	X	X
MV5024A	.340	.160	.130	.040	.020	Red	Red Diffused	Soft	X	X
MV5025A	.340	.160	.130	.040	.020	Red	Red Diffused	Flooded	X	X
MV5026A	.340	.160	.130	.040	.020	Red	Dark Red Diffused	Flooded	X	X

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OPTOELECTRONICS

TAPERED PACKAGE T-1¾ SOLID STATE LAMPS

ELECTRO-OPTICAL CHARACTERISTICS

(25°C Free Air Temperature Unless Otherwise Specified)

PARAMETER		TEST CONDITIONS	UNITS	5021A	5022A	5023A	5024A	5025A	5026A
Luminous Intensity	min.	I_F=20 mA	mcd	0.5	0.6	0.4	0.9	0.1	0.1
	typ.	I_F=20 mA	mcd	1.6	1.6	1.6	3.0	0.4	0.6
Peak wavelength		I_F=20 mA	nm	660	660	660	660	660	660
Spectral line half width		I_F=20 mA	nm	20	20	20	20	20	20
Forward voltage	typ.	I_F=20 mA	V	1.65	1.65	1.65	1.65	1.65	1.65
V_F	max.	I_F=20 mA	V	2.0	2.0	2.0	2.0	2.0	2.0
Reverse current I_R	max.	V_R=5.0V	μA	100	100	100	100	100	100
Reverse voltage V_R	min.	I_R=100 μA	V	5.0	5.0	5.0	5.0	5.0	5.0
Capacitance	typ.	V=0	pF	35	35	35	35	35	35
Viewing angle		Between 50% Points	degrees	90	90	90	60	180	90
Rise time		10%-90% 50 Ω system	nsec	50	50	50	50	50	50
and fall time	typ.	90%-10% 50 Ω system	nsec	50	50	50	50	50	50

ABSOLUTE MAXIMUM RATINGS

Power dissipation at 25°C ambient .... 180 mW
Derate linearly from 25°C .... 2 mW/°C
Storage and operating temperatures .... −55°C to +100°C
Lead soldering time at 260°C (See Note 1) .... 5 sec.
Continuous forward current at 25°C .... 100 mA
Peak forward current (1μsec pulse, 0.3% duty cycle) .... 1.0 A
Reverse voltage .... 5.0 V

NOTES

1. *The leads of the device were immersed in molten solder at 260°C to a point 1/16 inch (1.6 mm) from the body of the device per MIL-S-750, with a dwell time of 5 seconds.*

TYPICAL ELECTRO-OPTICAL CHARACTERISTIC CURVES

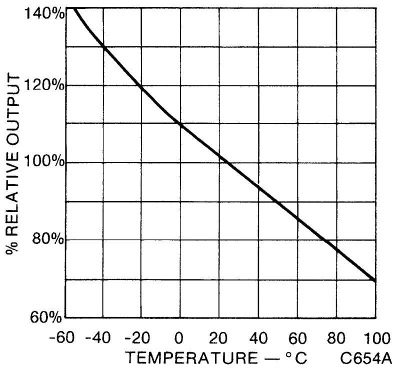


Fig. 1. Output vs. Temperature

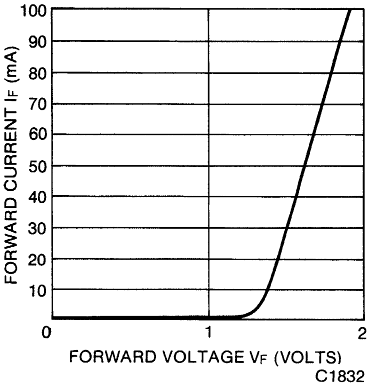


*Fig. 2. Forward Current vs.
Forward Voltage*

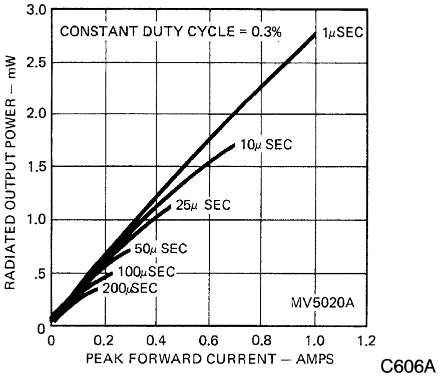


*Fig. 3. Radiated Output Power vs.
Peak Forward Current*

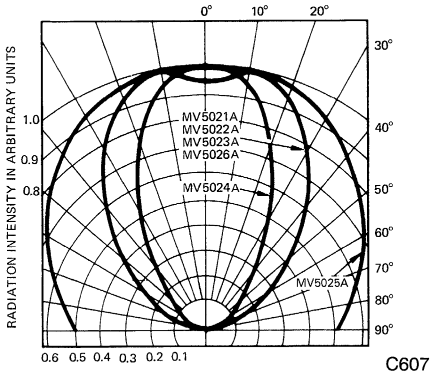


Fig. 4. Spatial Distribution

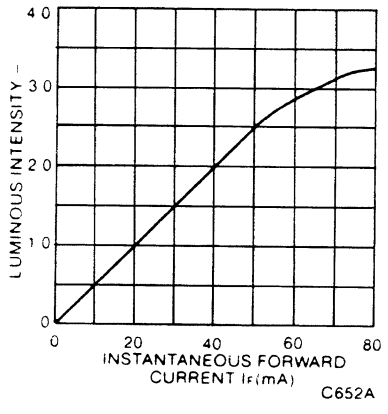


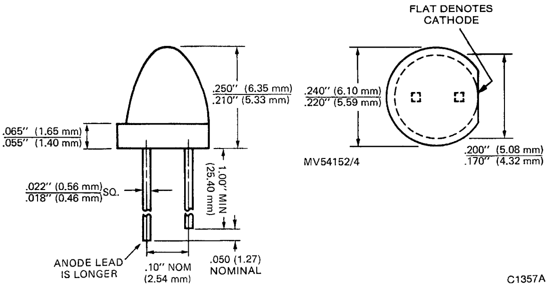
Fig. 5. Luminous Intensity vs. Forward Current

QT
OPTOELECTRONICS

BULLET PROFILE T-1¾ SOLID STATE LAMPS

STANDARD RED **MV50152/4** HIGH EFFICIENCY GREEN **MV54152/4**
YELLOW **MV53152/4** HIGH EFFICIENCY RED **MV57152/4**

PACKAGE DIMENSIONS



NOTES:
1. ALL DIMENSIONS ARE IN INCHES (mm)
2. TOLERANCES ARE .010 INCH UNLESS SPECIFIED
3. AN EPOXY MENISCUS MAY EXTEND ABOUT .040" (1 mm) DOWN THE LEADS

DESCRIPTION

These solid state indicators offer a variety of lens effects and color availability in a short barrel T-1¾ package. The High Efficiency Red, High Efficiency Green and Yellow devices are made with gallium phosphide.

FEATURES

- High intensity light source with two lens effects
- Red, High Efficiency Red, High Efficiency Red, High Efficiency Green and Yellow colors available
- Versatile mounting on PC board or panel
- Long life—solid state reliability
- Low power requirements
- Compact, rugged, lightweight
- High efficiency
- MV5X154 diffused, MV5X152 non-diffused
- Short T-1¾ size

PHYSICAL CHARACTERISTICS

TYPE	SOURCE COLOR	LENS COLOR	LENS EFFECT
MV50152	Standard Red	Red Clear	Point Source
MV50154	Standard red	Red Lightly Diffused	Soft Point Source
MV53152	Yellow	Amber Clear	Point Source
MV53154	Yellow	Amber Lightly Diffused	Soft Point Source
MV54152	High Efficiency Green	Green Clear	Point Source
MV54154	High Efficiency Green	Green Lightly Diffused	Soft Point Source
MV57152	High Efficiency Red	Orange Clear	Point Source
MV57154	High Efficiency Red	Orange Lightly Diffused	Soft Point Source

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OPTOELECTRONICS

BULLET PROFILE T-1¾ SOLID STATE LAMPS

ELECTRO-OPTICAL CHARACTERISTICS (T_A=25°C Unless Otherwise Specified)

PARAMETER		SYMBOL	TEST COND.	UNITS	50152	50154	53152	53154	54152	54154	57152	57154
Forward voltage	typ.	V_F	I_F=10 mA	V	1.6	1.6	2.1	2.1	2.2	2.2	2.0	2.0
	max.		I_F=10 mA		2.0	2.0	3.0	3.0	3.0	3.0	3.0	3.0
Luminous Intensity	min.	I_V	I_F=10 mA	mcd	0.6	0.4	3.0	1.5	2.5	2.0	4.0	2.0
	typ.		I_F=10 mA	mcd	2.0	1.5	10.	8.0	15.0	12.0	10.0	8.0
Peak wavelength		λp	I_F=10 mA	nm	660	660	585	585	565	565	630	630
Spectral line half width			I_F=10 mA	nm	20	20	35	35	35	35	45	45
Capacitance	typ.	C	V=0	pF	30	30	45	45	20	20	45	45
Reverse voltage	min.	V_{BR}	I_R=100 μA	V	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
Reverse current	max.	I_R	V_R=5.0 V	μA	100	100	100	100	100	100	100	100
Viewing angle (total) (See Fig. 2)		2θ½		degrees	45	50	45	50	45	50	45	50

ABSOLUTE MAXIMUM RATINGS (T_A=25°C Unless Otherwise Specified)

Power dissipation (MV5015X)	180 mW
Power dissipation (MV5315X=85 mW)	105 mW
Derate linearly from 25°C (MV5015X)	2.0 mW/°C
Derate linealy from 25°C	1.14 mW/°C
Storage and operating temperatures	−55°C to +100°C
Lead soldering time at 260°C (See Note 2)	5 sec.
Continuous forward current (MV5015X)	100 mA
Continuous forward current (MV5315X=20 mA)	35 mA
Peak forward current (1μsec pulse, 0.3% duty cycle) (MV5415X=90 mA) (MV5315X=60 mA)	1.0 A
Reverse voltage	5.0 V

NOTES

1. *The axis of spatial distribution are typically within a 10° cone with reference to the central axis of the device.*
2. *The leads of the device were immersed in molten solder at 260°C to a point 1/16 inch (1.6 mm) from the body of the device per MIL-Sd-750, with a dwell time of 5 seconds.*

TYPICAL ELECTRO-OPTICAL CHARACTERISTIC CURVES

(25°C Free Air Temperature Unless Otherwise Specified)

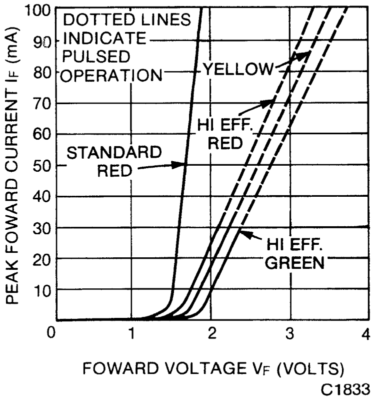


Fig. 1. Forward Current vs. Forward Voltage

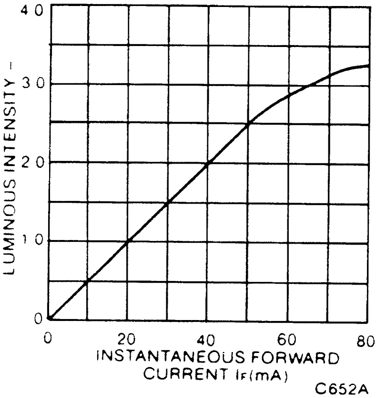


Fig. 2. Luminous Intensity vs. Forward Current

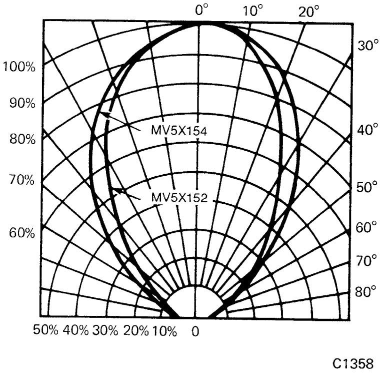


Fig. 3. Spatial Distribution (Note 1)

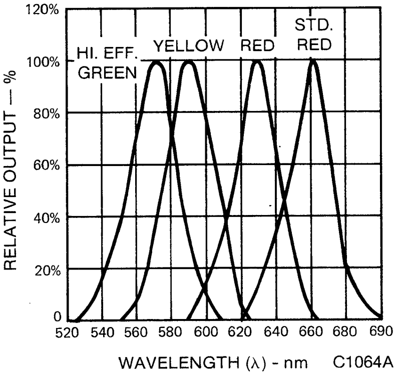


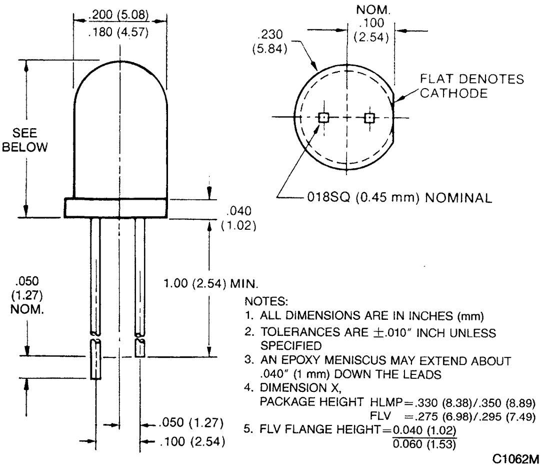
Fig. 4. Spectral Distribution

OPTOELECTRONICS

SECOND SOURCE T-1¾ SOLID STATE LAMPS

HIGH EFF. RED **HLMP-3300** HIGH EFF. RED **HLMP-3315**
HIGH EFF. RED **HLMP-3301** HIGH EFF. RED **HLMP-3316**
STANDARD RED **FLV110**

PACKAGE DIMENSIONS



NOTES:
1. ALL DIMENSIONS ARE IN INCHES (mm)
2. TOLERANCES ARE ±.010″ INCH UNLESS SPECIFIED
3. AN EPOXY MENISCUS MAY EXTEND ABOUT .040″ (1 mm) DOWN THE LEADS
4. DIMENSION X,
   PACKAGE HEIGHT HLMP=.330 (8.38)/.350 (8.89)
   FLV =.275 (6.98)/.295 (7.49)
5. FLV FLANGE HEIGHT=$\frac{0.040\ (1.02)}{0.060\ (1.53)}$

DESCRIPTION

Direct replacements for popular T-1¾ lamps from Fairchild and Hewlett-Packard. The FLV110 is a Standard Red Lamp with a low profile (.285 inch) lens. HLMP-33XX parts are High Efficiency Red with a standard T-1¾ package.

FLV110, HLMP-3300 and HLMP-3301 are diffused.

HLMP-3315 and HLMP-3316 are non-diffused.

FEATURES

- Replace Fairchild and Hewlett-Packard devices
- Popular, general purpose lamps
- Wide and narrow viewing angle devices for direct view or backlighting
- Solid state reliability
- Sturdy leads for easier assembly

QT
OPTOELECTRONICS

SECOND SOURCE T-1¾ SOLID STATE LAMPS

ELECTRO-OPTICAL CHARACTERISTICS (25°C Ambient Temperature)

PARAMETER		SYMBOL	HLMP-3300	HLMP-3301	HLMP-3315	HLMP-3316	FLV* 110	UNITS	TEST CONDITIONS
Luminous Intensity	min.	I_V	2.0	4.0	12	20	0.8*	mcd	I_F=10 mA
	typ.		3.5	7.0	18	35	3.0*	mcd	I_F=10 mA
Forward voltage	max.	V_F	3.0	3.0	3.0	3.0	2.0	V	I_F=10 mA
	typ.		2.2	2.2	2.2	2.2	1.6	V	I_F=10 mA
Peak wavelength	typ.	λp	635	635	635	635	665	nm	I_F=10 mA
Capacitance	typ.	C	45	45	45	45	30	pF	V=0, f=1 MHz
Reverse breakdown voltage	min.	V_{BR}	5	5	5	5	5	V	I_R=100μA
Total viewing angle between half Luminous Intensity Points	typ.	2θ½	65	65	35	35	70	degrees	

*For FLV110 Test I_F=20 mA

ABSOLUTE MAXIMUM RATINGS (T_A=25°C Unless Otherwise Specified)

Power dissipation	135 mW
Derate linearly from 25°C	1.8 mW/°C
Storage and operating temperatures	−55°C to +100°C
Lead soldering time @ 260°C (See Note 1)	5 sec.
Continuous forward current	30 mA
Peak forward current (1 μsec pulse, 0.3% duty cycle) (FLV110 1 amp)	90 mA
Reverse voltage	5.0 V

NOTES

1. *From a point minimum 1/16 inch (1.6 mm) from the bottom of the lamp.*

TYPICAL ELECTRO-OPTICAL CHARACTERISTICS CURVES
(25°C Free Air Temperature Unless Otherwise Specified)

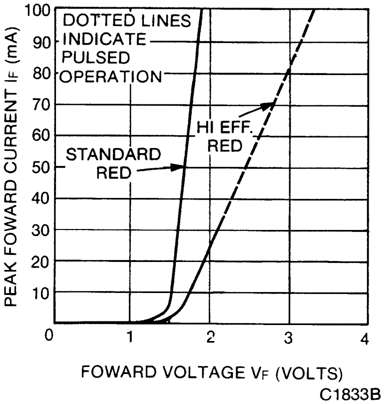


Fig. 1. Forward Current vs. Forward Voltage

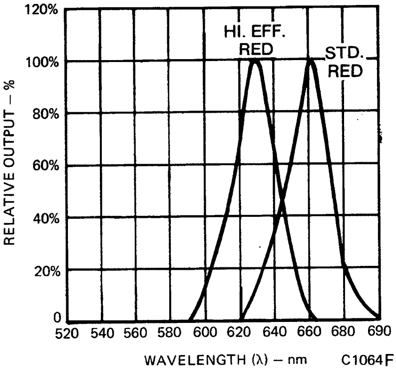


Fig. 2. Spectral Distribution

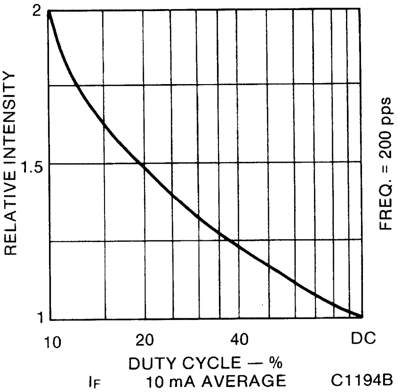
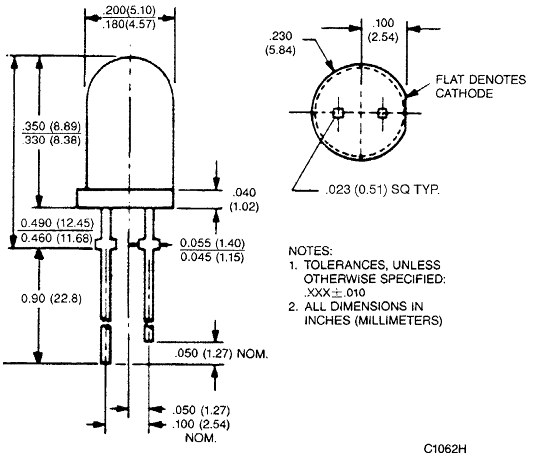


Fig. 3. Luminous Intensity vs. Duty Cycle

ULTRABRIGHT

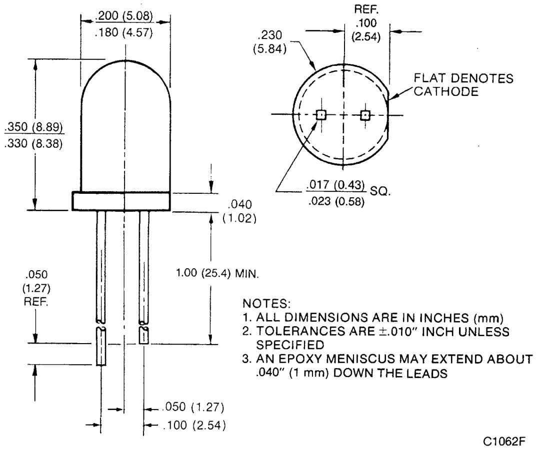
HLMP-3X50A SERIES
MV3X50A SERIES

PACKAGE DIMENSIONS



NOTES:
1. TOLERANCES, UNLESS OTHERWISE SPECIFIED: .XXX±.010
2. ALL DIMENSIONS IN INCHES (MILLIMETERS)

HLMP-3X50A



NOTES:
1. ALL DIMENSIONS ARE IN INCHES (mm)
2. TOLERANCES ARE ±.010" INCH UNLESS SPECIFIED
3. AN EPOXY MENISCUS MAY EXTEND ABOUT .040" (1 mm) DOWN THE LEADS

MV3X50A

DESCRIPTION

The Ultrabright HLMP-3X50A Series are direct, pin-for-pin replacements for the Hewlett-Packard devices with the same part numbers.

HLMP-3X50A in High Efficiency Red, Yellow and High Efficiency Green are very narrow viewing angle Clear lamps in a standard T-1¾ package.

By using more efficient LED chips, these lamps are superior in Luminous Intensity compared to other lamps.

Lamps have Pale Tinted package to aid identification.

FEATURES

- Minimum 80 mcd
- All three colors
- Pale Tint avoids mix problems
- Sturdy leads with or without stand-off on T-1¾
- Excellent for small area backlighting
- High Efficiency Red
  HLMP-3750A
  MV3750A
- High Efficiency Green
  HLMP-3950A
  MV3450A
- Yellow
  HLMP-3850A
  MV3350A

ULTRABRIGHT T-1¾ SOLID STATE LAMPS

ELECTRO-OPTICAL CHARACTERISTICS (T_A=25°C Unless Otherwise Specified)

PARAMETER		SYMBOL	MV3750A HLMP-3750A	MV3350A HLMP-3850A	MV3450A HLMP-3950A	UNITS	TEST CONDITIONS
Luminous Intensity	min.	I_V	80	80	80	mcd	I_F=20 mA
	typ.		150	150	150	mcd	I_F=20 mA
Forward voltage	max.	V_F	3.0	3.0	3.0	V	I_F=20 mA
	typ.		2.2	2.2	2.2	V	I_F=20 mA
Peak wavelength	typ.	λp	635	585	565	nm	I_F=10 mA
Capacitance	typ.	C	45	45	20	pF	V_F=0, f=1 MHz
Reverse breakdown voltage	min.	BV_R	5	5	5	V	I_R=100 μA
Total viewing angle between half Luminous Intensity points	typ.	2θ½	24	24	24	degrees	

ABSOLUTE MAXIMUM RATINGS (T_A=25°C Unless Otherwise Specified)

PARAMETER	HI. EFF. RED	YELLOW	HI. EFF. GREEN	UNITS	NOTES
Power dissipation	135	85	135	mW	1
Peak forward current	90	60	90	mA	
Average forwrd current	25	20	25	mA	
Continuous DC forward current	30	20	30	mA	2
Lead soldering time at 260°C	5	5	5	seconds	3
Operating and storage temperature		−55 to +100°C			

NOTES

1. *For High Efficiency Red and High Efficiency Green, derate power linearly from 25°C at 1.8 mW/°C. For Yellow derate power linearly from 50°C at 1.6 mW/°C.*
2. *For High Efficiency Red and High Efficiency Green derate linearly from 50°C at 0.5 mA/°C. For Yellow derate linearly from 50°C at 0.2 mA/°C.*
3. *To a point of minimum 1/16 inch (1.6 mm) from the bottom of the lamp.*

TYPICAL ELECTRO-OPTICAL CHARACTERISTIC CURVES

(25°C Free Air Temperature Unless Otherwise Specified)

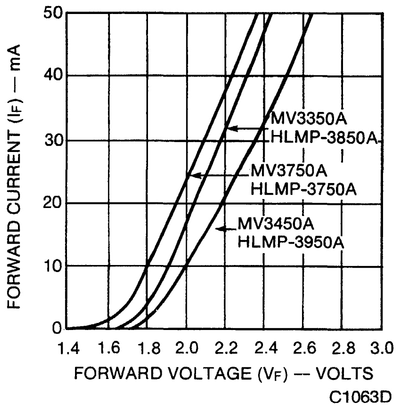


Fig. 1. Forward Voltage/ Forward Current

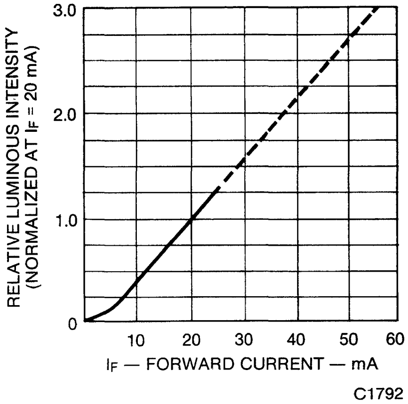


Fig. 2. Relative Luminous Intensity vs. DC Forward Current

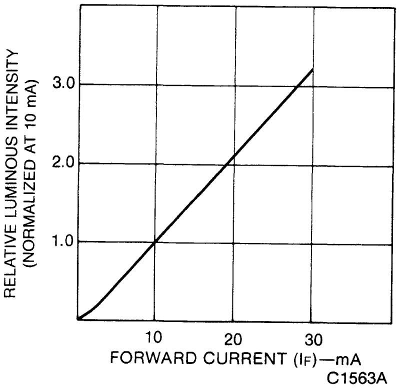


Fig. 3. Spatial Distribution

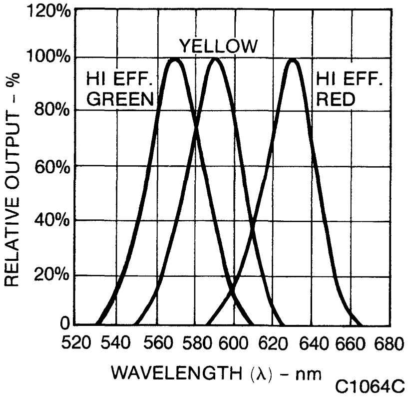


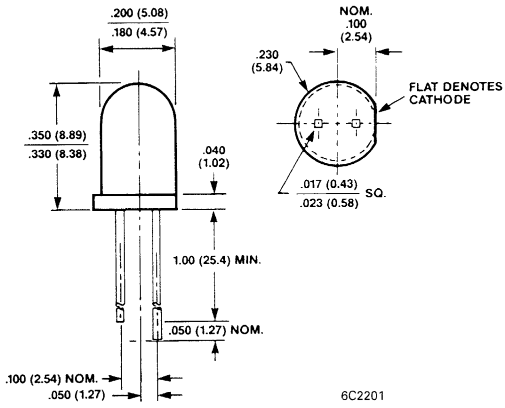
Fig. 4. Spectral Distribution

QT OPTOELECTRONICS

STANDARD RED T-1¾ SOLID STATE LAMPS

MV5052 MV5053/6053 MV5054A-1/2/3 MV5055

PACKAGE DIMENSIONS



DESCRIPTION

The MV505X Series of industry standard solid state indicators is made with gallium arsenide phosphide light emitting diodes encapsulated in epoxy lenses. Various lens effects give different design possibilities.

FEATURES

- Standard Red light source with various lens colors and effects
- Versatile mounting on PC board or panel
- Snap in mounting grommet MP52
- Long life—solid state reliability
- Low power requirements
- Compact, rugged, lightweight

PHYSICAL CHARACTERISTICS

CATHODE LONG	SOURCE COLOR	LENS TYPE	LENS EFFECT	APPLICATION
MV5052	Standard Red	Red Tint	Point Source	Backlighting
MV5053*	Standard Red	Red Diffused	Wide Beam	Direct View
MV5054A-1	Standard Red	Red Diffused	Narrow Beam	Direct View
MV5054A-2	Standard Red	Red Diffused	Narrow Beam	Direct View
MV5054A-3	Standard Red	Red Diffused	Narrow Beam	Direct View
MV5055	Standard Red	Red Diffused	Very Wide Beam	Direct View

*MV6053 – Anode Long also available.

QT OPTOELECTRONICS

STANDARD RED T-1¾ SOLID STATE LAMPS

ELECTRO OPTICAL CHARACTERISTICS (T_A=25°C Unless Otherwise Specified)

PARAMETER	TEST COND.	5052	6053 5053	5054A-1	5054A-2	5054A-3	5055	UNIT
Luminous Intensity	i_F=20 mA	0.7	0.5				0.1	mcd
I_V min.	I_F=10 mA			1.0	2.0	3.0		mcd
Forward voltage	I_F=20 mA	2.2	2.2				2.2	V
V_F mcd	I_F=10 mA			2.2	2.2	2.2		V
Peak wavelengths λp typical	I_F=20 mA	660	660	660	660	660	660	nm
Spectral line half width typical	I_F=20 mA	20	20	20	20	20	20	nm
Capacitance typical	V=0 f=1 MHz	30	30	30	30	30	30	pF
Reverse current I_R max.	V_R=5.0 V	100	100	100	100	100	100	μA
Viewing angle typical, See Figures		72	80	24	24	24	150	degrees

ABSOLUTE MAXIMUM RATINGS (T_A=25°C Unless Otherwise Specified)

Power dissipation	180 mW
Derate linearly from 25°	2.0 mW/° C
Storage and operating temperatures	−55°C to +100°C
Lead soldering time at 260°C (See Note 2)	5 sec.
Continuous forward current	100 mA
Peak forward current (1μsec pulse, 0.3% duty cycle)	1.0 A
Reverse voltage	5.0 V

NOTES

1. *The axis of spatial distribution are typically within a 10° cone with reference to the central axis of the device.*
2. *The leads of the device were immersed in molten solder at 260°C to a point 1⁄16(1.6 mm) from the body of the device per MIL-S-750, with a dwell time of 5 seconds.*

STANDARD RED T-1¾
SOLID STATE LAMPS

TYPICAL ELECTRO-OPTICAL CHARACTERISTICS (25°C Free Air Temperature)

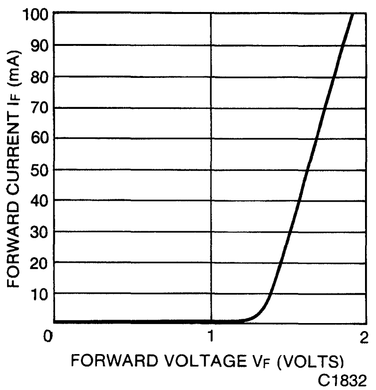


Fig. 1. Forward Current vs. Forward Voltage

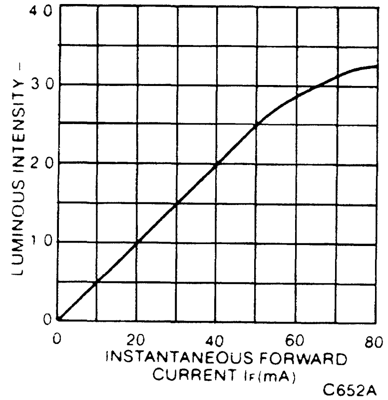


Fig. 2. Luminous Intensity vs. Forward Current

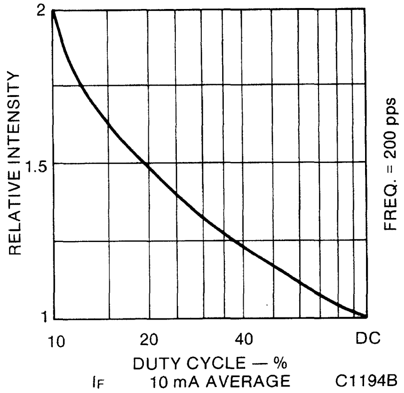


Fig. 3. Luminous Intensity vs. Duty Cycle

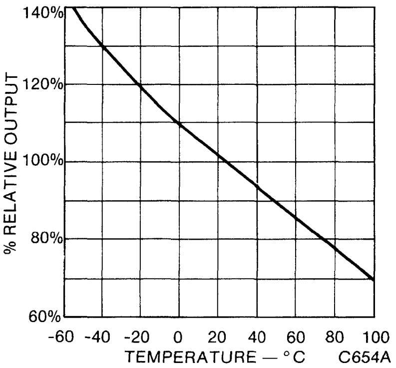


Fig. 4. Output vs. Temperature

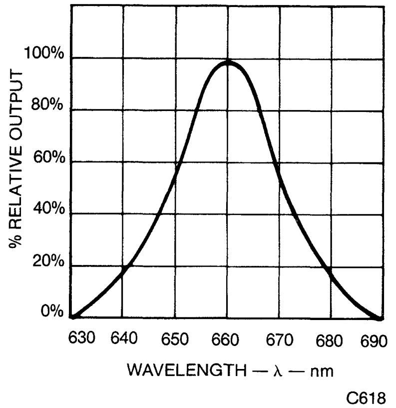


Fig. 5. Spectral Distribution

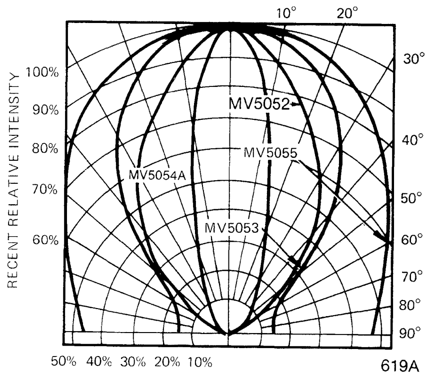


Fig. 6. Spatial Distribution (Note 1)

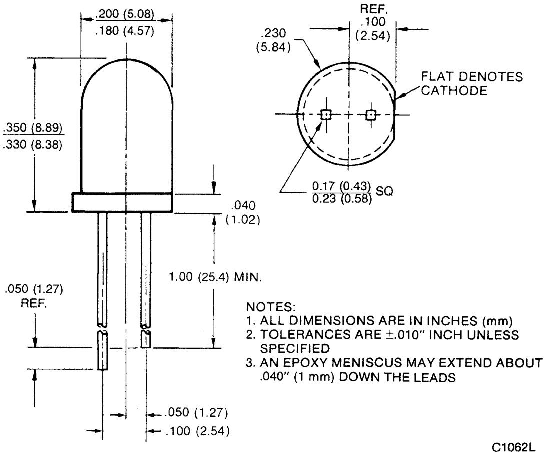
OPTOELECTRONICS

CLEAR LENS T-1¾
SOLID STATE LAMPS

ORANGE MV5152 MV6152
YELLOW MV5352 MV6352
HIGH EFFICIENCY GREEN MV5452 MV64520 MV64521
HIGH EFFICIENCY RED MV5752 MV6752

PACKAGE DIMENSIONS

MV5X52—LEAD CUT CATHODE LONG
MV6X52X—LEAD CUT ANODE LONG



NOTES:
1. ALL DIMENSIONS ARE IN INCHES (mm)
2. TOLERANCES ARE ±.010" INCH UNLESS SPECIFIED
3. AN EPOXY MENISCUS MAY EXTEND ABOUT .040" (1 mm) DOWN THE LEADS

DESCRIPTION

These Clear Tinted solid state indicators offer high brightness and color availability. The High Efficiency Red and Yellow devices are made with gallium arsenide phosphide on gallium phosphide. The High Efficiency Green units are made with gallium phosphide on gallium phosphide. All devices are available with cathode long as MV5X5X, or with anode long as MV6X5X.

FEATURES

- High on-axis light output
- High efficiency GaP light sources
- Versatile mounting on PC board or panel
- Snap in grommet MP52 available as separate order item
- Long life—solid state reliability
- Low power requirements
- Compact, rugged, lightweight

PHYSICAL CHARACTERISTICS

CATHODE LONG	ANODE LONG	SOURCE COLOR	LENS TYPE	LENS EFFECT	APPLICATION
MV5152	MV6152	High Efficiency Red	Amber Clear	Point Source	Backlighting
MV5352	MV6352	Yellow	Yellow Clear	Point Source	Backlighting
MV5452	MV64520	High Efficiency Green	Green Clear	Point Source	Backlighting
—	MV64521	High Efficiency Green	Green Clear	Point Source	Backlighting
MV5752	MV6752	High Efficiency Red	Red Clear	Point Source	Backlighting

OPTOELECTRONICS

CLEAR LENS T-1¾
SOLID STATE LAMPS

ELECTRO-OPTICAL CHARACTERISTICS (25°C Free Air Temeperature)

PARAMETER	TEST COND.	UNITS	MV6152 MV5152	MV6352 MV5352	MV64520 MV5452	MV64521	MV6752 MV5752
Forward voltage (V_F)							
typ.	I_F=20 mA	V	2.0	2.1	2.2	2.2	2.0
max.	I_F=20 mA	V	3.0	3.0	3.0	3.0	3.0
Luminous Intensity							
min.	I_F=20 mA	mcd	17.0	10.0	12.0	30.0	17.0
typ.	I_F=20 mA	mcd	100.0	90.0	25.0	100.0	100.0
Peak wavelength	I_F=20 mA	nm	635	585	562	562	635
Spectral line half width	I_F=20 mA	nm	45	35	30	30	45
Capacitance							
typ.	V=0, f=1 MHz	pF	45	45	20	20	45
Reverse voltage (V_R)							
min.	I_R=100 μA	V	5	5	5	5	5
Reverse current (I_R)							
max.	V_R=5.0 V	μ A	100	100	100	100	100
Viewing angle (total)	See Fig. 4	degrees	28	28	35	35	28

ABSOLUTE MAXIMUM RATINGS (T_A=25°C Unless Otherwise Specified)

	YELLOW	RED AND H. E. RED	GREEN
Power dissipation	85 mW	120 mW	120 mW
Derate linearly from 25°C (MVX452/4A from 50°C)	1.6 mW/°C	1.6 mW/°C	1.6 mW/°C
Storage and operating temperatures	−55°C to +100°C	−55°C to +100°C	−55°C to +100°C
Lead soldering time at 260° C (See Note 2)	5 sec.	5 sec.	5 sec.
Continuous forward current	20 mA	35 mA	30 mA
Peak forward current (1μsec pulse, 0.3% duty cycle)	60 mA	1.0 A	90 mA
Reverse voltage	5.0 V	5.0 V	5.0 V

NOTES

1. *The axis of spatial distribution are typically within a 10° cone within reference to the central axis of the device.*
2. *The leads of the device were immersed in molten solder, at 260°C, to a point 1/16 inch (1.6 mm) from the body of the device per MII-S-750, with a dwell time of 5 seconds.*

TYPICAL ELECTRO-OPTICAL CHARACTERISTIC CURVES

(25°C Free Air Temperature Unless Otherwise Specified)

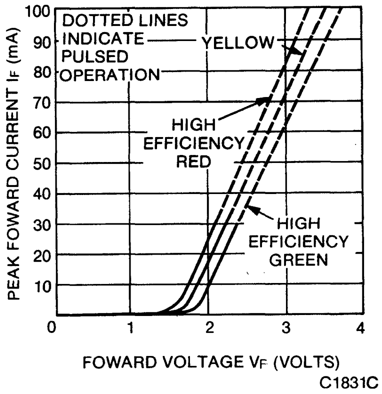


Fig. 1. Forward Current vs. Forward Voltage

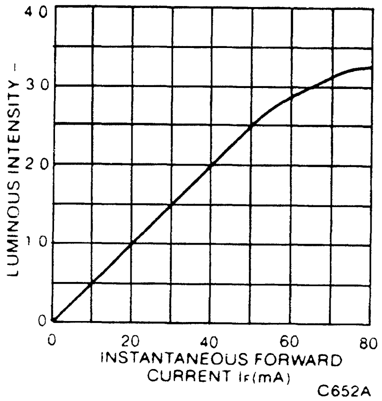


Fig. 2. Luminous Intensity vs. Forward Current

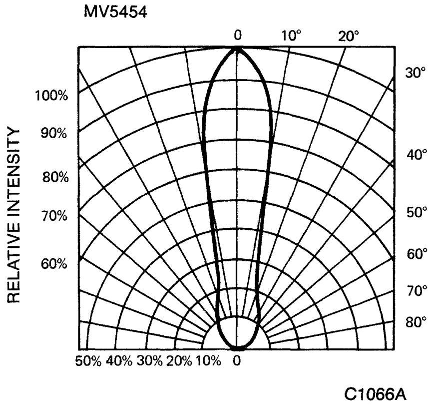


Fig. 3. Spatial Distribution (Note 1)

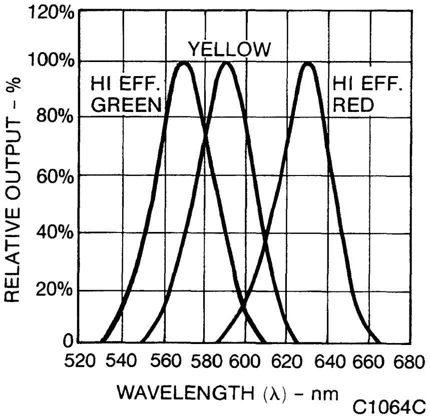
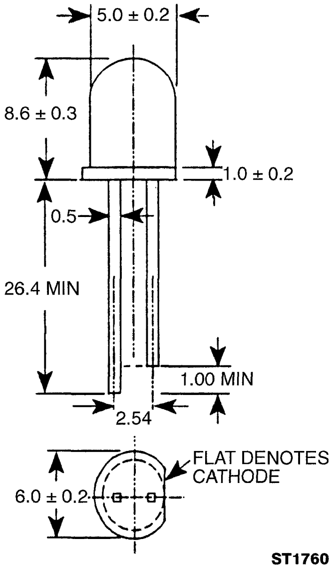


Fig. 4. Spectral Distribution

SUPER BRIGHT T-1¾ (5 mm) LED LAMPS

SUPER RED **MV8102** CLEAR
SUPER RED **MV8103** CLEAR
SUPER RED **MV8104** CLEAR

PACKAGE DIMENSIONS



ST1760

NOTES:
1. ALL DIMENSIONS ARE IN MILLIMETERS
2. LEAD SPACING IS MEASURED WHERE THE LEADS EMERGE FROM THE PACKAGE
3. PROTRUDED RESIN UNDER FLANGE IS 1.5 mm (0.059″) MAX.

DESCRIPTION

These T-1¾ super bright LEDs have a narrow 20° viewing angle for concentrated light output. The MV8101/2/3/4 are made with GaAlAs LEDs on a GaAlAs substrate. They are all encapsulated in an epoxy package and have water clear lenses.

FEATURES

- Outstanding material efficiency
- Popular T-1¾ package
- Low drive current
- Solid state reliability
- Super high brightness suitable for outdoors applications
- Standard 1 mil. lead spacing

ABSOLUTE MAXIMUM RATING (T_A = 25°C Unless Otherwise Specified)

DC forward current (I_f)	40 mA
Operating temperature range	−40°C to +85°
Storage temperature range	−40°C to +100°C
Lead soldering time (at 1⁄16 inch from bottom of lamp)	5 seconds @ 260°C
Peak forward current (at f=1.0 KHz, Duty factor=1/10)	200 mA
Power dissipation (P_d)	110 mW
Recommended operating current (I_f Rec)	20 mA

QT
OPTOELECTRONICS

SUPER BRIGHT T-1¾ (5 MM) LED LAMPS

ELECTRO-OPTICAL CHARACTERISTICS (T_A = 25°C Unless Otherwise Specified)

PARAMETER	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS
Luminous intensity					
MV8102	250	370		mcd	I_F=20 mA
MV8103	630	940		mcd	I_F=20 mA
MV8104	1000	1500		mcd	I_F=20 mA
Forward voltage	1.5	1.7	2.4	V	I_F=20 mA
Peak wavelength		660		nm	I_F=20 mA
Spectral line half width		40		nm	I_F=20 mA
Reverse breakdown voltage		5		V	I_R=10 μA
Viewing angle		20		degree	I_F=20 mA

TYPICAL ELECTRO-OPTICAL CHARACTERISTIC CURVES (T_A = 25°C)

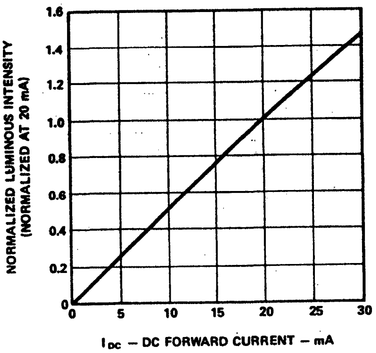


Fig. 1. Relative Luminous Intensity vs. DC Forward Current

ST1002

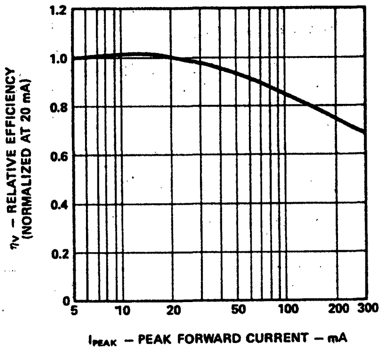


Fig. 2. Relative Efficiency vs. Peak Foreward Current

ST1761

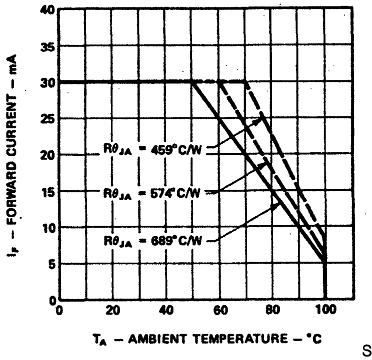


Fig. 3. Maximum Forward DC Current vs. Ambient Temperature Derating Based On TjMAX = 110°

ST1762

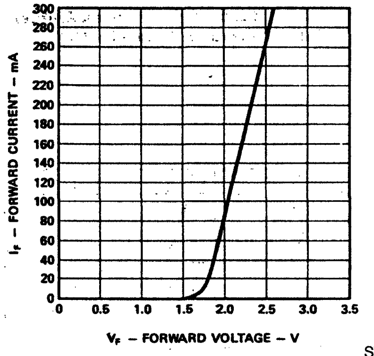


Fig. 4. Forward Current vs. Forward Voltage

ST1763

TYPICAL ELECTRO-OPTICAL CHARACTERISTIC CURVES (T$_A$=25°C)

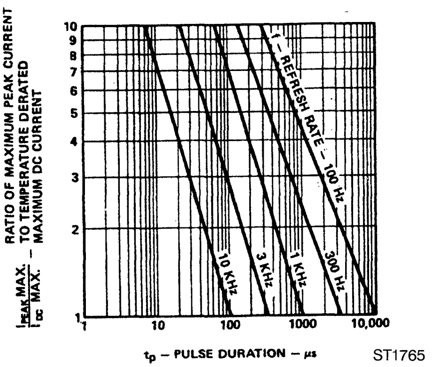


Fig. 5. Maximum Peak Current vs. Pulse Duration

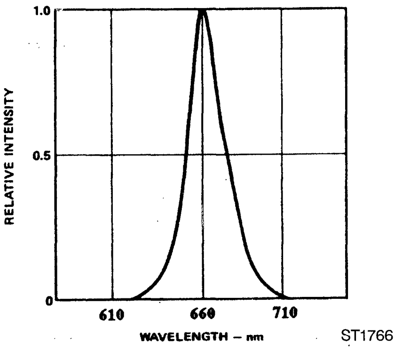


Fig. 6. Relative Intensity vs. Wavelength

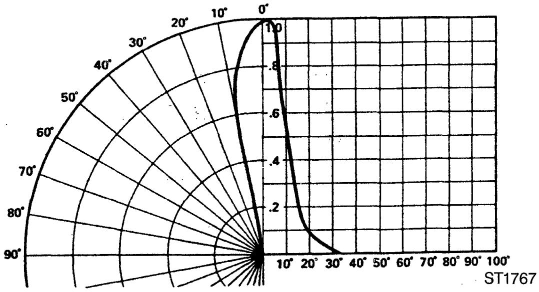


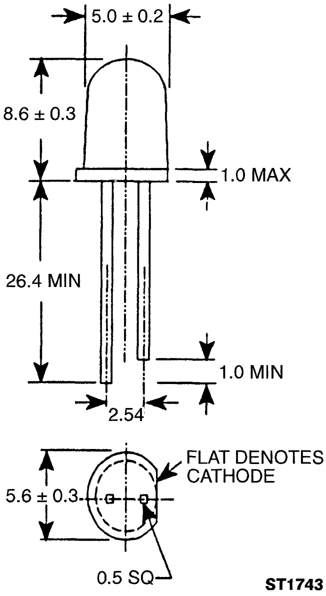
Fig. 7. Relative Luminous Intensity vs. Angular Displacement

QT
OPTOELECTRONICS

SUPER BRIGHT T-1¾ (5 mm) LED LAMPS

SUPER RED **MV8111** CLEAR
SUPER RED **MV8112** CLEAR
SUPER RED **MV8113** CLEAR
SUPER RED **MV8114** CLEAR

PACKAGE DIMENSIONS



NOTES:
1. ALL DIMENSIONS ARE IN MILLIMETERS
2. LEAD SPACING IS MEASURED WHERE THE LEADS EMERGE FROM THE PACKAGE
3. PROTRUDED RESIN UNDER FLANGE 1.5 mm (0.059″) MAX

DESCRIPTION

These T-1¾ super bright LEDs have a narrow 12° viewing angle for concentrated light output. The MV8111 is made with a GaAlAs/GaAs LED and the MV8112/3/4 are made with GaAlAs LEDs on a GaAlAs substrate. They are all encapsulated in an epoxy package and have water clear lenses.

FEATURES

- Popular T-1¾ package
- Low drive current
- Solid state reliability
- Super high brightness suitable for outdoor application
- Standard 1 mil. lead spacing

ABSOLUTE MAXIMUM RATING (T_A = 25°C Unless Otherwise Specified)

DC forward current (I_f)	40 mA
Operating temperature range	−40°C to +85°
Storage temperature range	−40°C to +100°C
Lead soldering time (at 1/16 inch from bottom of lamp)	5 seconds @ 260°C
Peak forward current (I_f) (at f=1.0 KHz, Duty factor=1/10)	200 mA
Power dissipation (P_d)	110 mW
Recommended operating current (I_f Rec)	20 mA

QT OPTOELECTRONICS

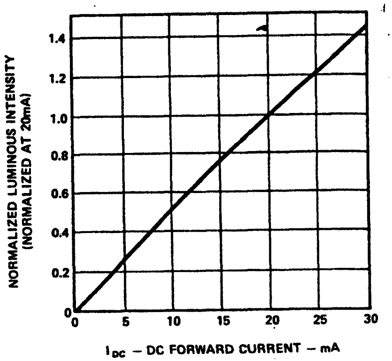
SUPER BRIGHT T-1¾ (5 MM) LED LAMPS

ELECTRO-OPTICAL CHARACTERISTICS (T_A = 25°C Unless Otherwise Specified)

PARAMETER	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS
Luminous intensity					
MV8111	250	370		mcd	I_F=20 mA
MV8112	630	940		mcd	I_F=20 mA
MV8113	1000	1500		mcd	I_F=20 mA
MV8114	1600	2400		mcd	I_F=20 mA
Forward voltage	1.5	1.7	2.4	V_F	I_F=20 mA
Peak wavelength		660		nm	I_F=20 mA
Spectral line half width		20		nm	I_F=20 mA
Reverse breakdown voltage		5		V_R	I_R=10 μA
Total viewing angle		12		degree	I_F=20 mA

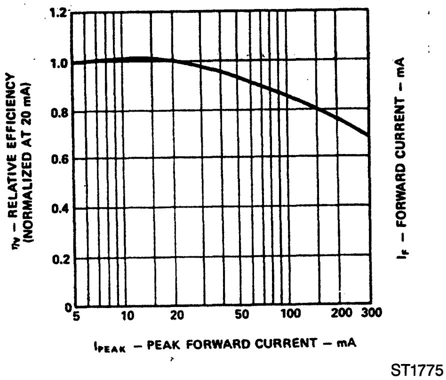
TYPICAL ELECTRO-OPTICAL CHARACTERISTIC CURVES

(T_A = 25°C Unless Otherwise Specified)



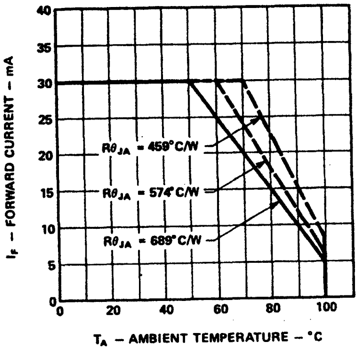
ST1774

Fig. 1. Relative Luminous Intensity vs. DC Forward Current



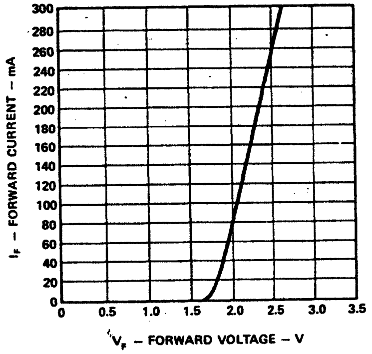
ST1775

Fig. 2. Relative Efficiency vs. Peak Foreward Current



ST1776

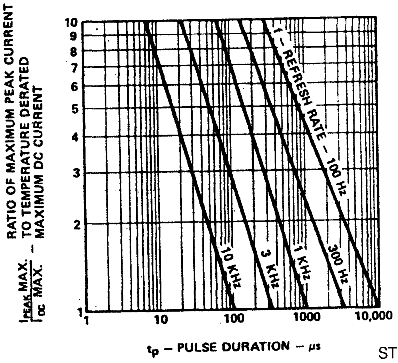
Fig. 3. Maximum Forward DC Current vs. Ambient Temperature Derating Based On TjMAX = 110°



ST1777

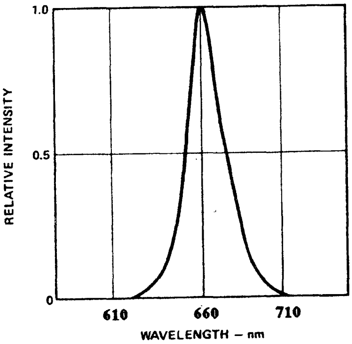
Fig. 4. Forward Current vs. Forward Voltage

TYPICAL ELECTRO-OPTICAL CHARACTERISTIC CURVES (T$_A$=25°C)



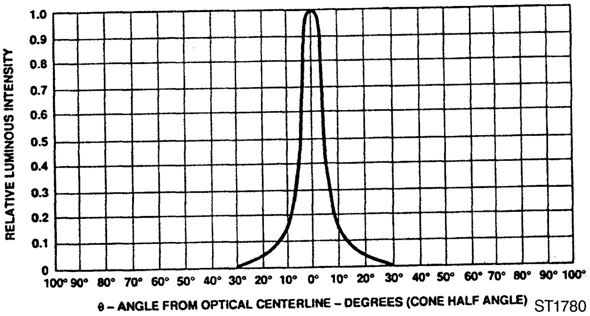
ST1778

Fig. 5. Maximum Peak Current vs. Pulse Duration



ST1779

Fig. 6. Relative Intensity vs. Wavelength



ST1780

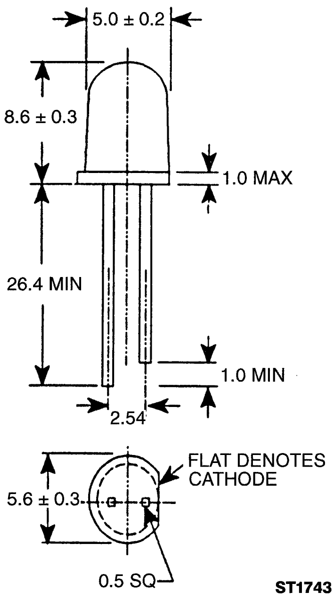
Fig. 7. Relative Luminous Intensity vs. Angular Displacement

QT OPTOELECTRONICS

SUPER BRIGHT T-1¾ (5 mm) LED LAMPS

SUPER RED **MV8132** CLEAR
SUPER RED **MV8133** CLEAR
SUPER YELLOW **MV8332** CLEAR
SUPER YELLOW **MV8333** CLEAR

PACKAGE DIMENSIONS



NOTES:
1. ALL DIMENSIONS ARE IN MILLIMETERS.
2. LEAD SPACING IS MEASURED WHERE THE LEADS EMERGE FROM THE PACKAGE.
3. PROTRUDED RESIN UNDER THE FLANGE IS 1.5 mm (0.059″) MAX.

DESCRIPTION

These T-1¾ super bright LEDs have a moderate 30° viewing angle. The MV8332/3 are made with an InGaA1P LED on a GaAs substrate and the MV8132/3 are made with a GaAlAs LED on a GaAlAs substrate. They are encapsulated in an epoxy package and have water clear lenses.

FEATURES

- Popular T-1¾ package
- Low drive current
- Solid state reliability
- Super high brightness suitable for outdoors applicatons
- Outstanding material efficiency

ABSOLUTE MAXIMUM RATING (T$_A$=25°C Unless Otherwise Specified)

DC forward current (I$_f$)	
MV813X	40 mA
MV833X	30 mA
Operating temperature range	−40°C to +85°C
Storage temperature range	−40°C to +100°C
Lead soldering time (at 1⁄16 inch from the bottom of lamp)	5 seconds @ 260°C
Peak forward current (I$_f$) (at f=1.0 KHz, Duty factor= 1/10)	
MV813X	200 mA
MV813X	160 mA
Power dissipation (P$_d$)	
MV813X	110 mW
MV813X	85 mW
Recommended operating current (I$_f$ Rec)	20 mA

SUPER BRIGHT T-1¾ (5 mm) LED LAMPS

ELECTRO-OPTICAL CHARACTERISTICS (T_A = 25°C Unless Otherwise Specified)

PART NUMBER	MV8132	MV8133	MV8332	MV8333	TEST CONDITIONS
Luminous intensity (mcd)					I_F=20 mA
minimum	630	1000	630	1000	
typical	940	1500	940	1500	
maximum					
Forward voltage (V_F)					I_F=20 mA
minimum	1.5	1.5	1.7	1.7	
typical	1.7	1.7	2.1	2.1	
maximum	2.4	2.4	2.8	2.8	
Peak wavelength (nm)	660	660	590	590	I_F=20 mA
Spectral line half width (nm)	40	40	13	13	I_F=20 mA
Reverse breakdown voltage (V_R)	5	5	5	5	I_F=10 μA
Viewing angle (°)	30	30	30	30	I_F=20 mA

TYPICAL ELECTRO-OPTICAL CHARACTERISTIC CURVES (T_A=25°C)

MV813X

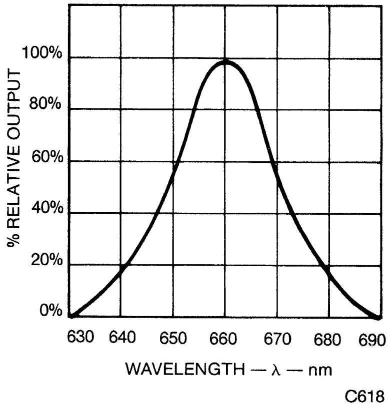


Figure 1. Relative Intensity vs. Wavelength

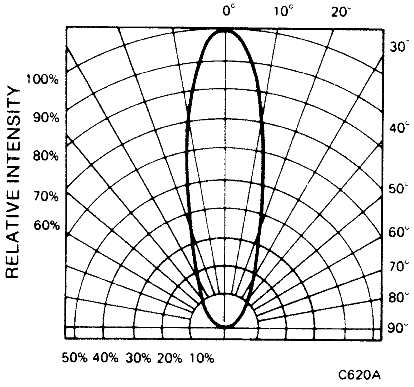


Figure 2. Relative Luminous Intensity vs. Angular Displacement

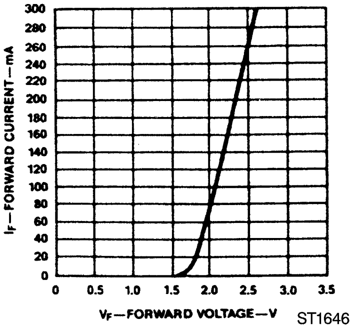


Figure 3. Forward Current vs. Forward Voltage

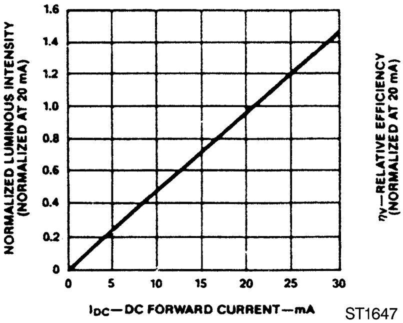


Figure 4. Relative Luminous Intensity vs. DC Forward Current

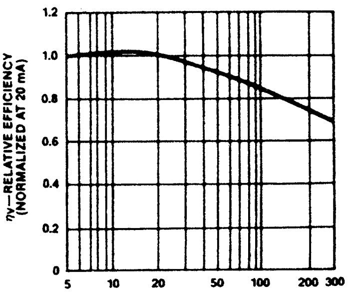


Figure 5. Relative Efficiency vs. Peak Forward Current

TYPICAL ELECTRO-OPTICAL CHARACTERISTIC CURVES (T_A=25°C)

MV833X

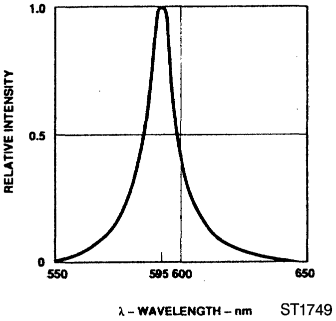


Fig. 1. Relative Intensity vs. Wavelength

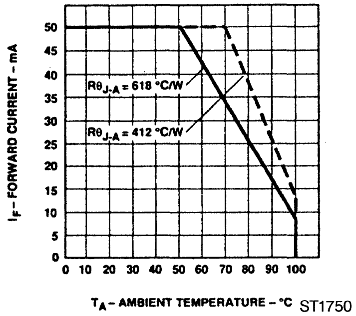


Fig. 2. Maximum Forward DC Current vs. Ambient Temperature Derating based on TjMax = 110°

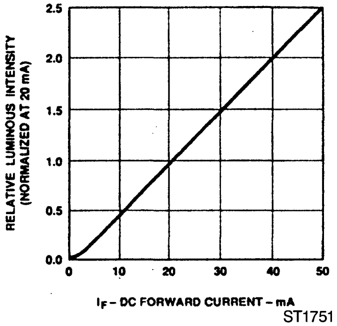


Fig. 3. Relative Luminous Intensity vs. DC Forward Current

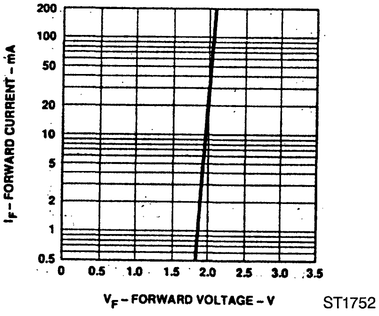


Fig. 4. Forward Current vs. Forward Voltage

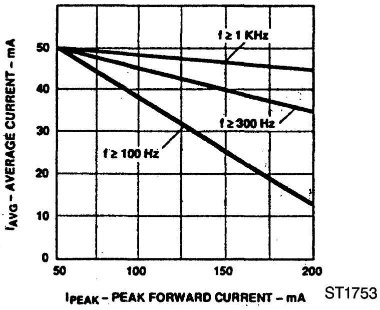


Fig. 5. Maximum Average Current vs. Foreward Current

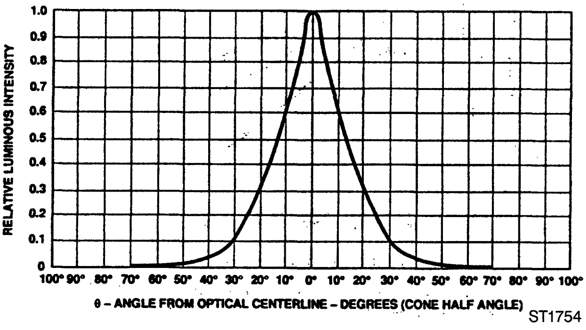


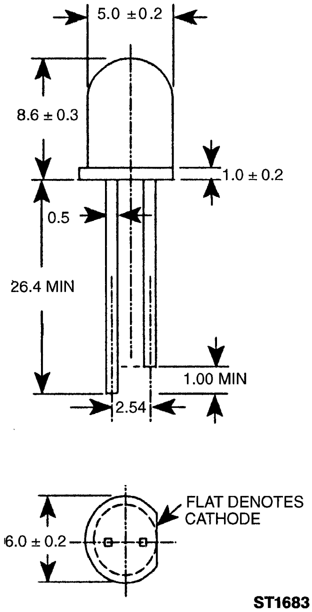
Fig. 6. Relative Luminous Intensity vs. Angular Displacement

QT OPTOELECTRONICS

SUPER BRIGHT T-1¾ (5 mm) LED LAMPS

SUPER RED **MV8140** CLEAR SUPER RED **MV8190** DIFFUSED
SUPER RED **MV8141** CLEAR SUPER RED **MV8191** DIFFUSED

PACKAGE DIMENSIONS



ST1683

NOTES:
1. ALL DIMENSIONS ARE IN MM.
2. LEAD SPACING IS MEASURED WHERE THE LEADS EMERGE FROM THE PACKAGE.
3. PROTRUDED RESIN UNDER THE FLANGE IS 1.5 mm (0.059″) MAX.

DESCRIPTION

These T-1¾ super bright LEDs have a moderate 40° or 45° viewing angle. The MV8190/1 are 40° and the MV8140/1 are 45°. All are made with GaA1As LEDs on a GaA1As substrate. They are encapsulated in an epoxy package. The MV8140/1 have a water clear lens while the MV8190/1 have a red diffused lens.

FEATURES

- Outstanding material efficiency.
- Popular T-1¾ package.
- Low drive current.
- Solid state reliability.
- Super high brightness.
- Standard 1 mil. lead spacing.

ABSOLUTE MAXIMUM RATING (T_A=25°C Unless Otherwise Specified)

DC forward current (I_f)	40 mA
Operating temperature range	−40°C to +85°C
Storage temperature range	−40°C to +100°C
Lead soldering time (at 1⁄16 inch from the bottom of lamp)	5 seconds @ 260°C
Peak forward current (I_f) (at f=1.0 KHz, Duty factor= 1/10)	200 mA
Power dissipation (P_d)	110 mW
Recommended operating current (I_f Rec)	20 mA

SUPER BRIGHT T-1¾ (5 mm) LED LAMPS

ELECTRO-OPTICAL CHARACTERISTICS (T_A = 25°C Unless Otherwise Specified)

PART NUMBER	MV8190	MV8191	MV8140	MV8141	TEST CONDITIONS
Luminous intensity (mcd)					I_F=20 mA
minimum	63	100	120	250	
typical	100	200	220	370	
maximum					
Forward voltage (V_F)					I_F=20 mA
minimum			1.5		
typical			1.7		
maximum			2.4		
Peak wavelength (nm)			660		I_F=20 mA
Spectral line half width (nm)			40		I_F=20 mA
Reverse breakdown voltage (V_R)			5		I_F=10 μA
Viewing angle (°)	45	45	40	40	I_F=20 mA

TYPICAL ELECTRO-OPTICAL CHARACTERISTIC CURVES (T_A=25°C)

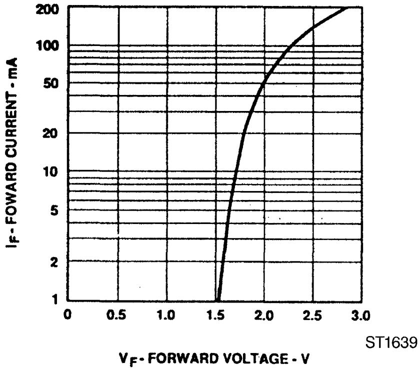


Fig. 1. Forward Current vs. Forward Voltage

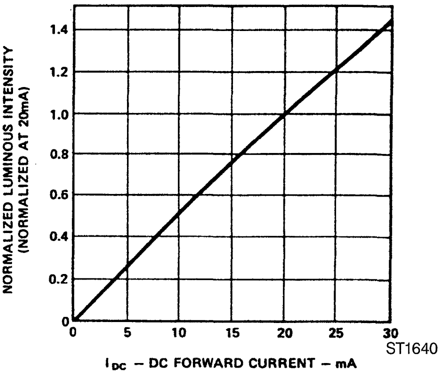


Fig. 2. Relative Luminous Intensity vs. Forward Current

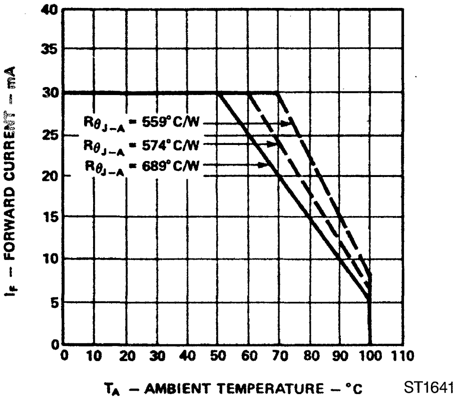


Fig. 3. Maximum Forward DC Current vs. Ambient Temperature Derating based on Tj MAX=110°.

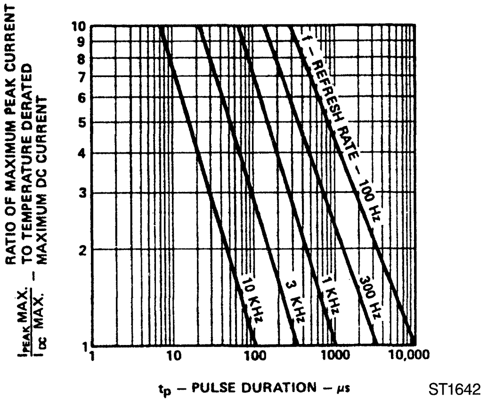
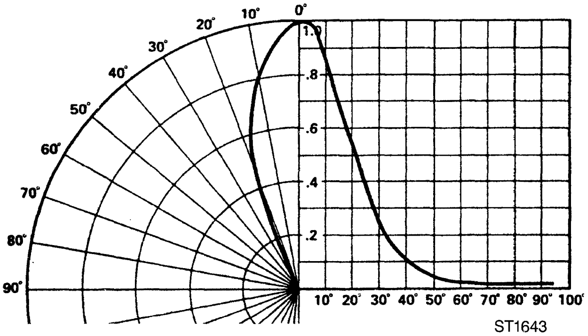


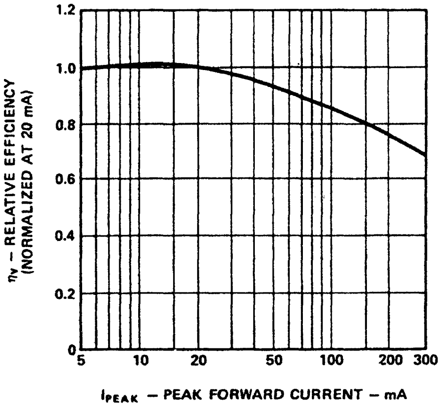
Fig. 4. Maximum Peak Current vs. Pulse Duration

TYPICAL ELECTRO-OPTICAL CHARACTERISTIC CURVES (T_A=25°C)



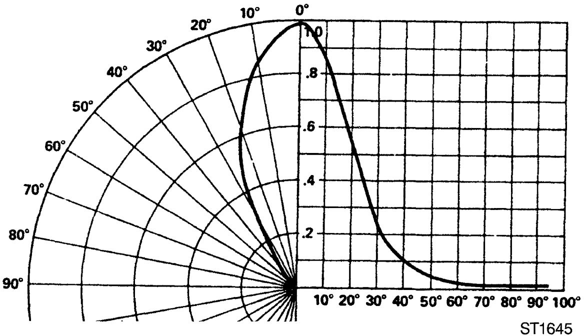
ST1643

Fig. 5. Relative Luminous Intensity vs. Angular Displacement MV8190/1



ST1644

Figure 6. Relative Efficiency vs. Peak Forward Current



ST1645

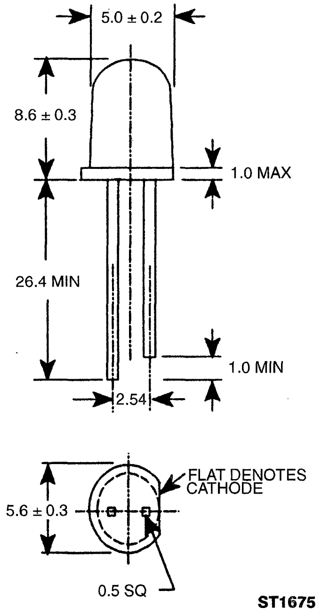
Fig. 7. Relative Luminous Intensity vs. Angular Displacement MV8140/1

OPTOELECTRONICS

SUPER BRIGHT T-1¾ (5 mm) LED LAMPS

SUPER YELLOW **MV8313** CLEAR
SUPER YELLOW **MV8314** CLEAR

PACKAGE DIMENSIONS



ST1675

NOTES:
1. ALL DIMENSIONS ARE IN MILLIMETERS
2. LEAD SPACING IS MEASURED WHERE THE LEADS EMERGE FROM THE PACKAGE
3. PROTRUDED RESIN UNDER FLANGE IS 1.5 mm (0.059″) MAX

DESCRIPTION

These T-1¾ super bright LEDs have a narrow 12° viewing angle for concentrated light output. The MV831X emit yellow light at 590 nm. They are encapsulated in an epoxy package and have water clear lenses.

FEATURES

- Popular T-1¾ package
- Low drive current
- Solid state reliability
- Super high brightness suitable for outdoors applications
- Standard 1 mil. lead spacing

ABSOLUTE MAXIMUM RATING (T_A = 25°C Unless Otherwise Specified)

DC forward current (I_f)	
MV831X	30 mA
Operating temperature range	−40°C to +85°
Storage temperature range	−40°C to +100°C
Lead soldering time (at $1/16$ inch from bottom of lamp)	5 seconds @ 260°C
Peak forward current (I_f) (at f=1.0 KHz, Duty factor=1/10)	160 mA
Power dissipation (P_d)	
MV831X	85 mW
Recommended operating current (I_f Rec)	20 mA

QT
OPTOELECTRONICS

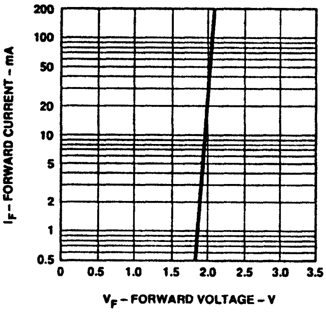
SUPER BRIGHT T-1¾ (5 MM) LED LAMPS

ELECTRO-OPTICAL CHARACTERISTICS (T_A = 25°C Unless Otherwise Specified)

PARAMETER	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS
Luminous intensity MV8313 MV8314	 630 1000	 940 1500		 mcd mcd	 I_F=20 mA I_F=20 mA
Forward voltage	1.7	2.1	2.8	V_F	I_F=20 mA
Peak wavelength MV8313, MV8314		 590		 nm	 I_F=20 mA
Spectral line half width		13		nm	I_F=20 mA
Reverse breakdown voltage		5		V_R	I_R=10 μA
Total viewing angle		12		degree	I_F=20 mA

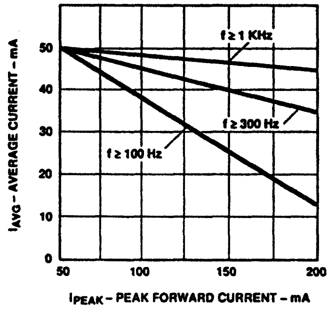
TYPICAL ELECTRO-OPTICAL CHARACTERISTIC CURVES

(T_A = 25°C Unless Otherwise Specified)



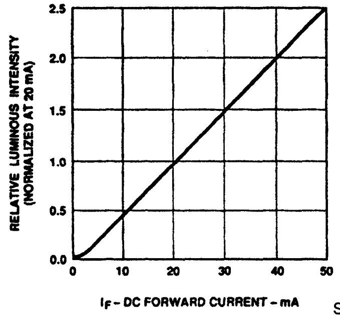
ST1706

Fig. 1. Forward Current vs. Forward Voltage



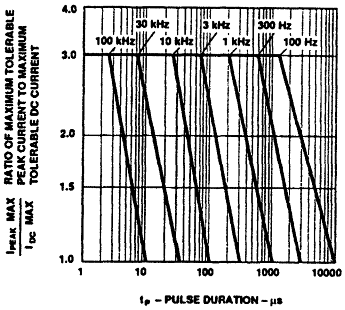
ST1677

Fig. 2. Maximum Average Current vs. Peak Foreward Current



ST1703

Fig. 3. Relative Luminous Intensity vs. Foreward Current



ST1714

Fig. 4. Maximum Peak Current vs. Pulse Duration

TYPICAL ELECTRO-OPTICAL CHARACTERISTIC CURVES (T_A=25°C)

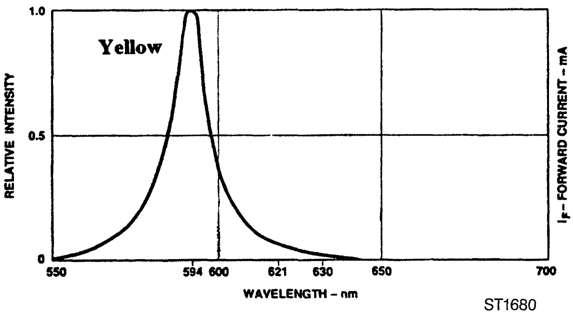


Fig. 5. Relative Intensity vs. Wavelength

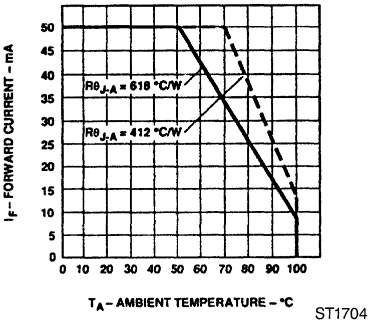


Fig. 6. Maximum Forward DC Current vs. Ambient Temperature Derating Based On TjMAX = 110°

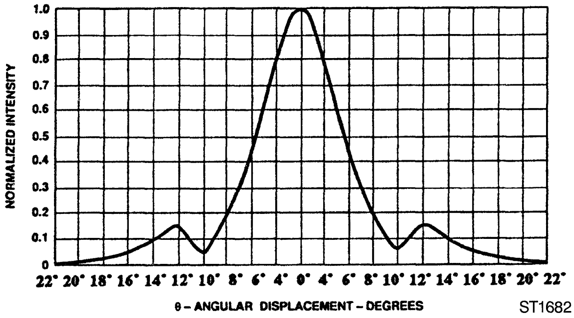


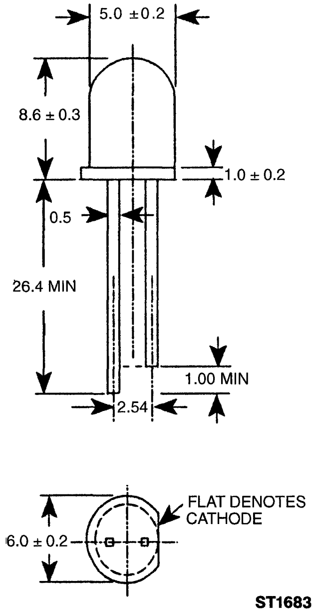
Fig. 7. Relative Luminous Intensity vs. Angular Displacement (MV8313)

QT OPTOELECTRONICS

SUPER BRIGHT T-1¾ (5 mm) LED LAMPS

SUPER YELLOW **MV8341** CLEAR
SUPER YELLOW **MV8342** CLEAR

PACKAGE DIMENSIONS



ST1683

NOTES:
1. ALL DIMENSIONS ARE IN INCHES MILLIMETERS
2. LEAD SPACING IS MEASURED WHERE THE LEADS EMERGE FROM THE PACKAGE
3. PROTRUDED RESIN UNDER THE FLANGE IS 1.5 mm (0.059″) MAX

DESCRIPTION

These T-1¾ super bright LEDs have a moderate 45° viewing angle for consistent light output. They are suitable as an indicator or for back lighting in high ambient light situations. The MV8341/2 are made with InGaAlP LEDs on a GaAs substrate. All are encapsulated in an epoxy package and have a water clear lens.

FEATURES

- Ouststanding material efficiency
- Popular T-1¾ package
- Low drive current
- Solid state reliability
- Super high brightness
- Standard 1 mil. lead spacing

ABSOLUTE MAXIMUM RATING (T_A = 25°C Unless Otherwise Specified)

DC forward current (I_f)	30 mA
Operating temperature range	−40°C to +85°C
Storage temperature range	−40°C to +100°C
Lead soldering time (at 1⁄16 inch from the bottom of lamp)	5 seconds @ 260°C
Peak forward current (I_f) (at f = 1.0 KHz, Duty factor = 1/10)	160 mA
Powr dissipation (P_d)	85 mW
Recommended operating current (I_f Rec)	20 mA

OPTOELECTRONICS

SUPER BRIGHT T-1¾ (5 MM) LED LAMPS

ELECTRO-OPTICAL CHARACTERISTICS (T_A = 25°C Unless Otherwise Specified)

PARAMETER	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS
Luminous intensity					
MV8341	160	220		mcd	I_F=20 mA
MV8342	250	370		mcd	I_F=20 mA
Forward voltage					
MV8341	1.7	2.1	2.8	V_F	I_F=20 mA
MV8342	1.7	2.1	2.8	V_F	I_F=20 mA
Peak wavelength					
MV8341		660		nm	I_F=20 mA
MV8342		590		nm	I_F=20 mA
Spectral line half width		13		nm	I_F=20 mA
Reverse breakdown voltage		5		V_R	I_R=100 μA
Viewing angle		45		degree	I_F=20 mA

TYPICAL ELECTRO-OPTICAL CHARACTERISTIC CURVES (T_A = 25°C)

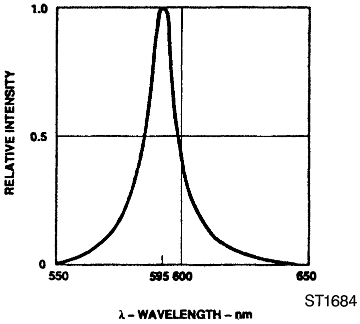


Fig. 1. Relative Intensity vs. Wavelength

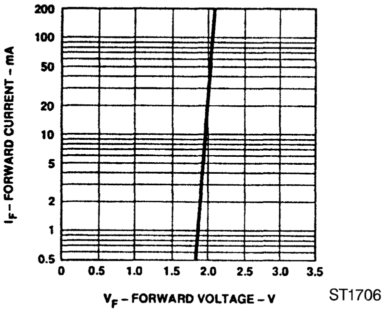


Fig. 2. Forward Current vs. Forward Voltage

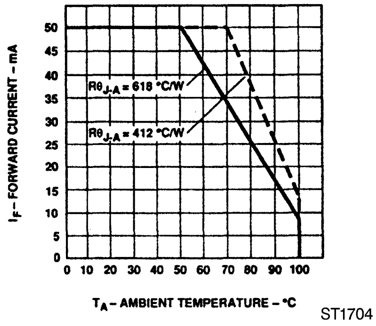


Fig. 3. Maximum Forward DC Current vs. Ambient Temperature Derating based on TjMax = 110°

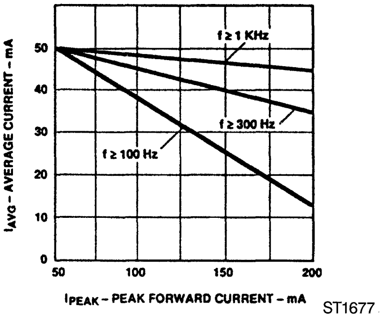


Fig. 4. Maximum Average Current vs. Foreward Current

TYPICAL ELECTRO-OPTICAL CHARACTERISTIC CURVES (T_A=25°C)

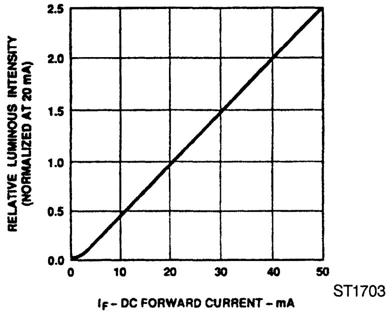


Fig. 5. Relative Luminous Intensity vs. DC Forward Current

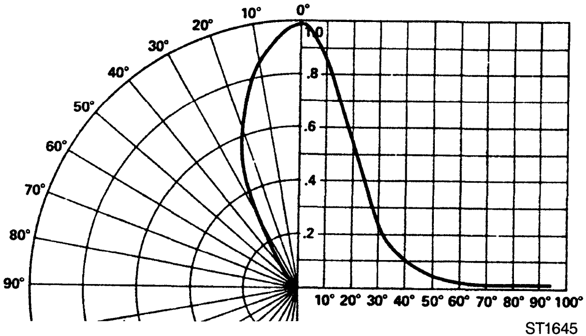


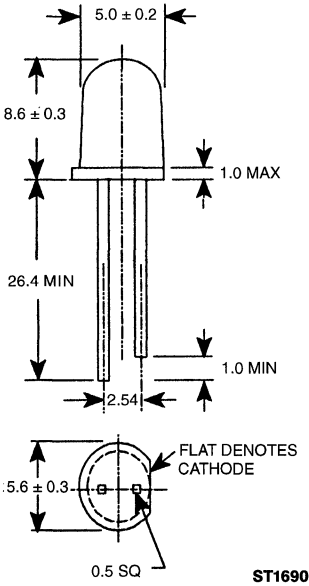
Fig. 6. Relative Luminous Intensity vs. Angular Displacement (MV8341/2)

QT
OPTOELECTRONICS

SUPER BRIGHT T-1¾ (5 mm) LED LAMPS

SUPER GREEN **MV8410** CLEAR
SUPER GREEN **MV8411** CLEAR

PACKAGE DIMENSIONS



ST1690-02

NOTES:
1. ALL DIMENSIONS ARE IN MILLIMETERS
2. LEAD SPACING IS MEASURED WHERE THE LEADS EMERGE FROM THE PACKAGE
3. PROTRUDED RESIN UNDER THE FLANGE IS 1.5 mm (0.059″) MAX

DESCRIPTION

These T-1¾ super bright LEDs have a narrow 12° viewing angle for concentrated light output. The MV8410/1 are made with GaP LEDs on a GaP substrate. They are encapsulated in an epoxy package and have a water clear lens.

FEATURES

- Popular T-1¾ package
- Low drive current
- Solid state reliability
- Super high brightness
- Standard 1 mil. lead spacing

ABSOLUTE MAXIMUM RATING (T_A = 25°C Unless Otherwise Specified)

DC forward current (I_f)	30 mA
Operating temperature range	−40°C to +85°C
Storage temperature range	−40°C to +100°C
Lead soldering time (at 1⁄16 inch from the bottom of lamp)	5 seconds @ 260°C
Peak forward current (I_f) (at f = 1.0 KHz, Duty factor = 1/10)	160 mA
Power dissipation (P_d)	85 mW
Recommended operating current (I_f Rec)	20 mA

QT OPTOELECTRONICS

SUPER BRIGHT T-1¾ (5 MM) LED LAMPS

ELECTRO-OPTICAL CHARACTERISTICS (T_A=25°C Unless Otherwise Specified)

PART NUMBER	**MV8410**	**MV8411**	**TEST CONDITIONS**
Luminous intensity (mcd)			I_F=20 mA
minimum	160	250	
typical	240	370	
maximum			
Forward voltage (V_F)			I_F=20 mA
minimum		1.7	
typical		2.1	
maximum		2.8	
Peak wavelength (nm)		565	I_F=20 mA
Spectral line half width (nm)		30	I_F=20 mA
Reverse breakdown voltage (V_R)		5	I_R=10 μA
Viewing angle (°)		12	I_F=20 mA

TYPICAL ELECTRO-OPTICAL CHARACTERISTIC CURVES (T_A = 25°C)

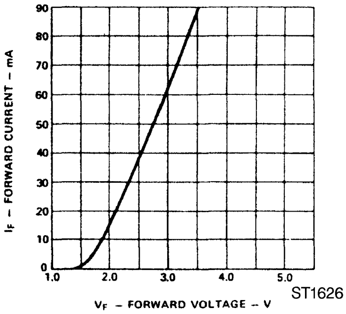


Fig. 1. Foward Current vs. Forward Voltage

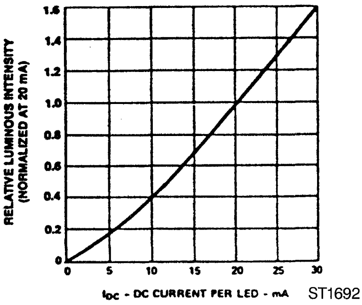


Fig. 2. Relative Luminous Intensity vs. Forward Current

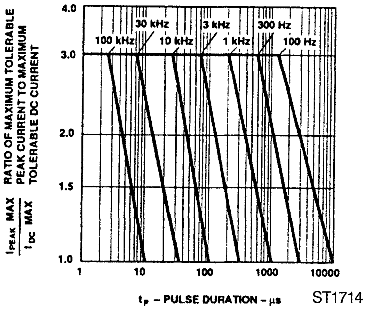


Fig. 3. Maximum Peak Current vs. Pulse Duration

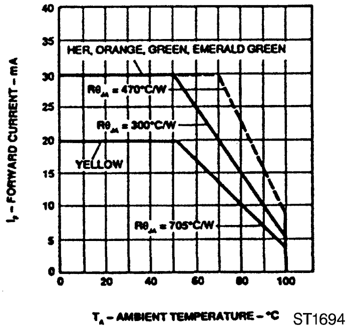


Fig. 4. Maximum Forward DC Current vs. Ambient Temperature Derating based on TjMax = 110°

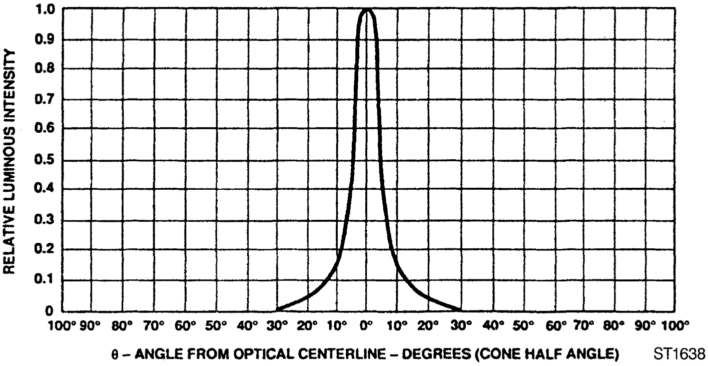
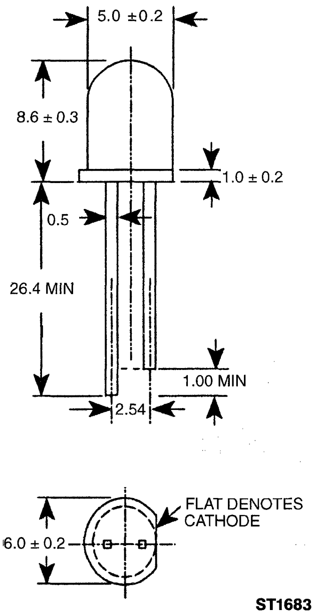


Fig. 5. Relative Luminous Intensity vs. Angular Displacement

SUPER BRIGHT T-1¾ (5 mm) LED LAMPS

SUNSET ORANGE **MV8741** CLEAR
SUNSET ORANGE **MV8742** CLEAR
SUNSET ORANGE **MV8703** CLEAR
SUNSET ORANGE **MV8704** CLEAR

PACKAGE DIMENSIONS



ST1683

NOTES:
1. ALL DIMENSIONS ARE IN MILLIMETERS
2. LEAD SPACING IS MEASURED WHERE THE LEADS EMERGE FROM THE PACKAGE
3. PROTRUDED RESIN UNDER THE FLANGE IS 1.5 mm (0.059″) MAX

DESCRIPTION

These T-1¾ super bright LEDs have either a narrow 20°, or a moderate 45° viewing angle. The MV8703/4 and the MV8741/2 are made with InGaAIP LEDs on a GaAs substrate that emit orange light at 620 nm. They are encapsulated in an epoxy package and have a water clear lens.

FEATURES

- Outstanding material efficiency
- Popular T-1¾ package
- Low drive current
- Solid state reliability
- Super high brightness suitable for outdoors applications
- Standard 1 mil. lead spacing

ABSOLUTE MAXIMUM RATING (T_A = 25°C Unless Otherwise Specified)

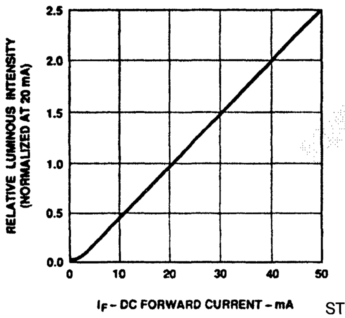
DC forward current (I_f)	50 mA
Operating temperature range	−40°C to +85°C
Storage temperature range	−40°C to +100°C
Lead soldering time (at 1⁄16 inch from the bottom of lamp)	5 seconds @ 260°C
Peak forward current (I_f) (at f = 1.0 KHz, Duty factor = 1/10)	160 mA
Power dissipation (P_d)	100 mW
Recommended operating current (I_f Rec)	20 mA

SUPER BRIGHT T-1¾ (5 MM)
LED LAMPS

ELECTRO-OPTICAL CHARACTERISTICS (T_A=25°C Unless Otherwise Specified)

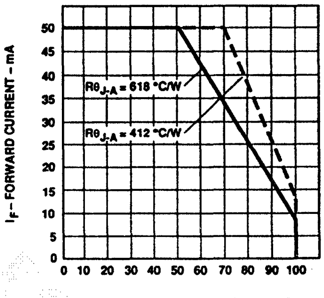
PART NUMBER	MV8741	MV8742	MV8703	MV8704	TEST CONDITIONS
Luminous intensity (mcd)					I_F=20 mA
minimum	250	400	630	1000	
typical	370	600	940	1500	
maximum					
Forward voltage (V_F)					I_F=20 mA
minimum			1.7		
typical			2.1		
maximum			2.8		
Peak wavelength (nm)			620		I_F=20 mA
Spectral line half width (nm)			18		I_F=20 mA
Reverse breakdown voltage (V_R)			5		I_R=10 μA
Viewing angle (°)	45	45	20	20	I_F=20 mA

TYPICAL ELECTRO-OPTICAL CHARACTERISTIC CURVES (T_A = 25°C)



ST1703

Fig. 1. Relative Luminous Intensity vs. DC Forward Current

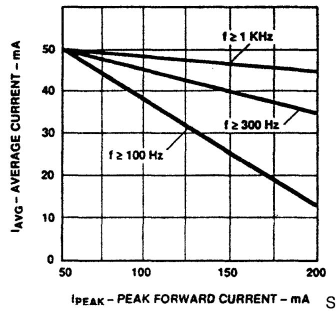


ST1704

Fig. 2. Maximum Forward DC Current vs. Ambinet Temperature Derating based on TjMAX=110°

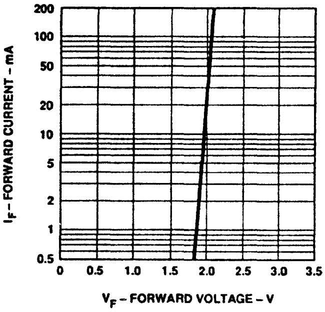
SUPER BRIGHT T-1¾ (5 mm) LED LAMPS

TYPICAL ELECTRO-OPTICAL CHARACTERISTIC CURVES (T$_A$ = 25°C)



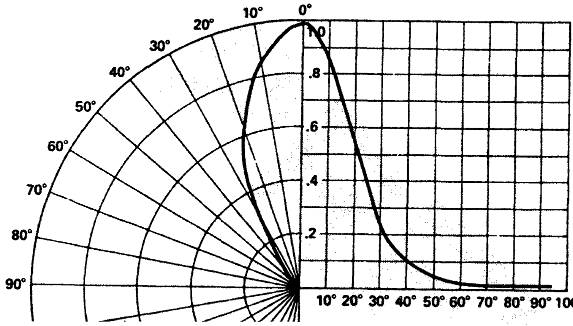
ST1705

Fig. 3. Relative Efficiency vs Peak Forward Current



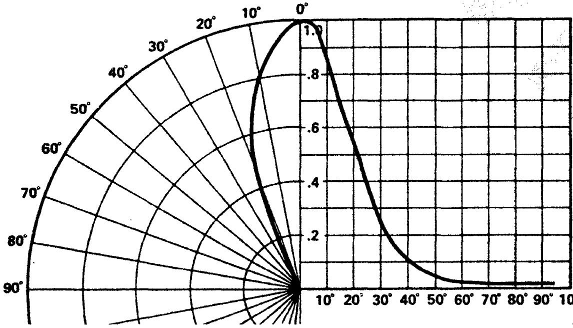
ST1706

Fig. 4. Forward Current vs Forward Voltage



ST1645

Fig. 5. Relative Luminous Intensity vs Angular Displacement. MV870X



ST1643

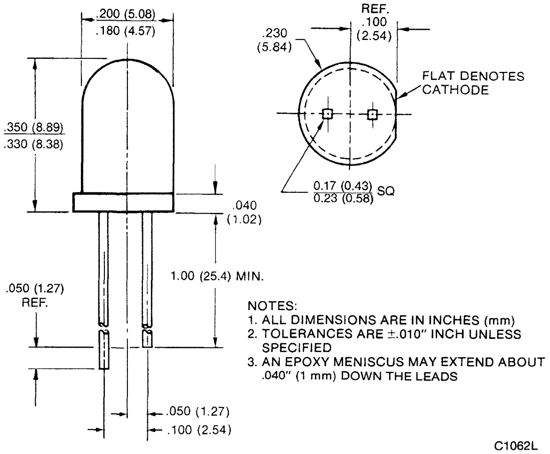
Fig. 6. Relative Luminous Intensity vs Angular Displacement MV874X

QT
OPTOELECTRONICS

DIFFUSED T-1¾ SOLID STATE LAMPS

ORANGE MV5153/4A MV6153/4A
YELLOW MV5353/4A MV6353/4A
HIGH EFFICIENCY GREEN MV5453/4A MV64530/1 MV6454A
HIGH EFFICIENCY RED MV5753/4A MV6753/4A

PACKAGE DIMENSIONS



NOTES:
1. ALL DIMENSIONS ARE IN INCHES (mm)
2. TOLERANCES ARE ±.010" INCH UNLESS SPECIFIED
3. AN EPOXY MENISCUS MAY EXTEND ABOUT .040" (1 mm) DOWN THE LEADS

DESCRIPTION

These solid state indicators offer a variety of diffused lens effects and color availability. The High Efficiency Red and Yellow devices are made with gallium arsenide phosphide on gallium phosphide. The Green units are made with gallium phosphide on gallium phosphide. All devices are available with cathode long as MV5X5X, or with anode long as MV6X5X.

FEATURES

- High efficiency GaP light source with various lens effects
- Versatile mounting on PC board or panel
- Snap in grommet MP52 available as separate order item
- Long life—solid state reliability
- Low power requirements
- Compact, rugged, lightweight

PHYSICAL CHARACTERISTICS

CATHODE LONG	ANODE LONG	SOURCE COLOR	LENS TYPE	LENS EFFECT	APPLICATION
MV5153	MV6153	High Efficiency Red	Amber Diffused	Wide Beam	Direct View
MV5154A	MV6154A	High Efficiency Red	Amber Diffused	Narrow Beam	High Bright Direct View
MV5353	MV6353	Yellow	Yellow Diffused	Wide Beam	Direct View
MV5354A	MV6354A	Yellow	Yellow Diffused	Narrow Beam	High Bright Direct View
MV5453	MV64530/1	High Efficiency Green	Green Diffused	Wide Beam	Direct View
MV5454A	MV6454A	High Efficiency Green	Green Diffused	Narrow Beam	High Bright Direct View
MV5753	MV6753	High Efficiency Red	Red Diffused	Wide Beam	Direct View
MV5754A	MV6754A	High Efficiency Red	Red Diffused	Narrow Beam	High Bright Direct View

DIFFUSED T-1¾ SOLID STATE LAMPS

ELECTRO-OPTICAL CHARACTERISTICS (25°C Free Air Temperature)

PARAMETER	TEST COND.	UNITS	6153 5153	6154A 5154A	6353 5353	6354A 5354A	64530 5453	64531	6454A 5454A	6753 5753	6754A 5754A
Forward voltage (V_F)											
typ.	I_F=20 mA	V	2.0	2.0	2.1	2.1	2.2	2.2	2.2	2.0	2.0
max.	I_F=20 mA	V	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Luminous Intensity											
min.	I_F=20 mA	mcd	3.0	10.0	2.5	10.0	3.0	7.0	10.0	3.0	10.0
typ.	I_F=20 mA	mcd	15	25	15	25	20	20	30	15	25
Peak wavelength	I_F=20 mA	nm	635	635	585	585	562	562	562	635	635
Spectral line half width	I_F=20 mA	nm	45	45	35	35	30	30	30	45	45
Capacitance											
typ.	V=0, f=1 MHz	pF	45	45	45	45	20	20	20	45	45
Reverse voltage (V_R)											
min.	I_R=100 μA	V	5	5	5	5	5	5	5	5	5
Reverse current (I_R)											
max.	V_R=5.0 V	μA	100	100	100	100	100	100	100	100	100
Viewing angle (total)	See Fig. 3	degrees	65	24	65	24	75	75	24	65	24

ABSOLUTE MAXIMUM RATINGS (T_A=25°C Unless Otherwise Specified)

	YELLOW	H.E. RED, ORANGE	GREEN
Power dissipation at 25°C ambient	85 mW	120 mW	120 mW
Derate linearly from 25°C (MVX453/4A from 50°C)	1.6 mW/°C	1.6 mW/°C	1.6 mW/°C
Storage and operating temperatures	−55°C to +100°C	−55°C to +100°C	−55°C to +100°C
Lead soldering time at 260°C (See Note 2)	5 sec.	5 sec.	5 sec.
Continuous forward current at 25°C	20 mA	35 mA	30 mA
Peak forward current (1μsec pulse, 0.3% duty cycle)	60 mA	1.0 A	90 mA
Reverse voltage	5.0 V	5.0 V	5.0 V

NOTES

1. *The axis of spatial distribution are typically within a 10° cone with reference to the central axis of the device.*
2. *The leads of the device were immersed in molten solder, at 260°C, to a point 1/16 inch (1.6 mm) from the bodyof the device per MIL-S-750, with a dwell time of 5 seconds.*

TYPICAL ELECTRO-OPTICAL CHARACTERISTIC CURVES

(25°C Free Air Temperature Unless Otherwise Specified)

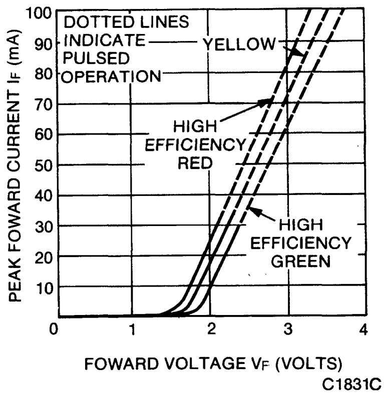


Fig. 1. Forward Current vs. Forward Voltage

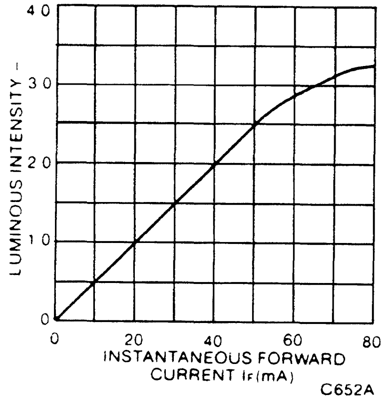


Fig. 2. Luminous Intensity vs. Forward Current

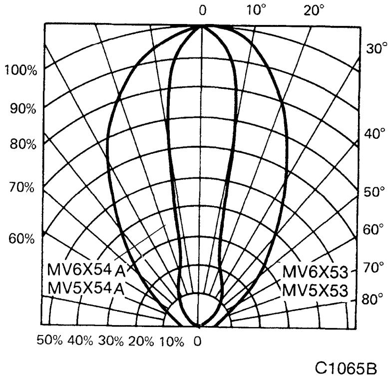


Fig. 3. Spatial Distribution (See Note 1)

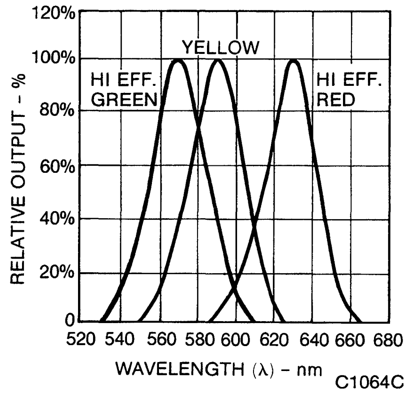


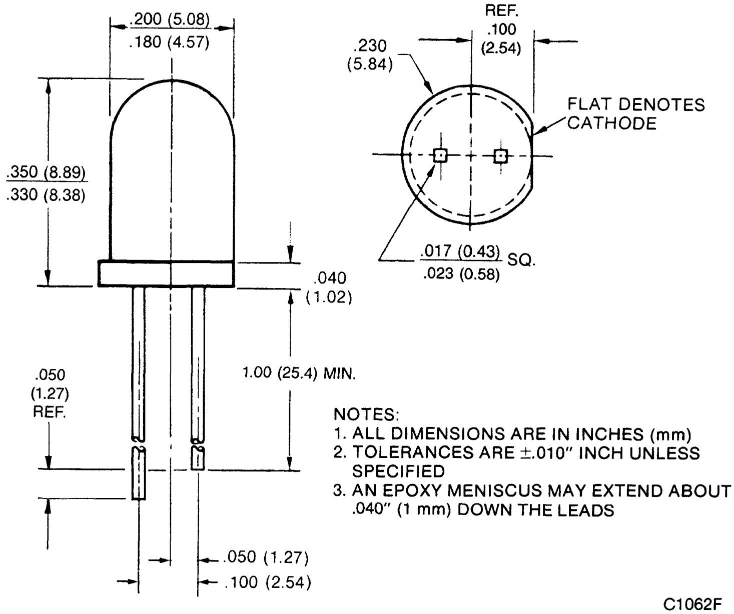
Fig. 4. Spectral Distribution

OPTOELECTRONICS

T-1¾ (5 mm) SOLID STATE LAMPS

PURE GREEN **HLMP-D600** TINTED
PURE GREEN **HLMP-D640** CLEAR
SOFT ORANGE **HLMP-D400** TINTED
SOFT ORANGE **HLMP-D401** TINTED

PACKAGE DIMENSIONS



NOTES:
1. ALL DIMENSIONS ARE IN INCHES (mm)
2. TOLERANCES ARE ±.010" INCH UNLESS SPECIFIED
3. AN EPOXY MENISCUS MAY EXTEND ABOUT .040" (1 mm) DOWN THE LEADS

C1062F

DESCRIPTION

These T-1¾ LEDs are widely used as general purpose indicators. The pure green lamps are made with a GaP LEDs on a GaP substrate. The soft orange are made with GaAsP LEDs on a GaP substrate. They are encapsulated in epoxy packages and are designed to provide superior light output and a wide viewing angle.

FEATURES

- Popular T-1¾ package
- Low drive current
- Solid state reliability
- Wide viewing angle
- Choice of pure green or soft orange colors

ABSOLUTE MAXIMUM RATING (T_A=25°C Unless Otherwise Specified)

DC forward current (I_f)	40 mA
Operating temperature range	−40°C to +85°C
Storage temperature range	−40°C to +100°C
Lead soldering time (at 1/16 inch from the bottom of lamp)	5 seconds @ 260°C
Peak forward current (I_f) (at f=1.0 KHz, Duty factor= 1/10)	200 mA
Power dissipation (P_d)	110 mW
Recommended operating current (I_f Rec)	20 mA

T-1¾ (5 mm)
SOLID STATE LAMPS

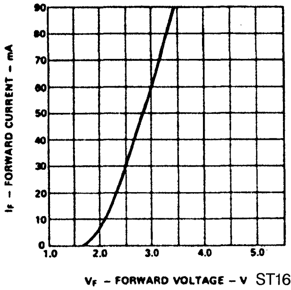
ELECTRO-OPTICAL CHARACTERISTICS (T_A = 25°C Unless Otherwise Specified)

PART NUMBER HLMP-	D600	D640*	D400	D401	TEST CONDITIONS
Luminous intensity (mcd)					I_F=10 mA
minimum	1.0	6.7	2.1	4.0	
typical	3.0	60	3.5	7.0	
Forward voltage (V_F)					I_F=10 mA
minimum			1.5	1.5	
typical	2.1	2.2	1.9	1.9	
maximum	2.7	3.0	2.4	2.4	
Peak wavelength (nm)	560	560	612	612	I_F=10 mA
Spectral line half width (nm)	24	24	40	40	I_F=10 mA
Reverse breakdown voltage (V_R)	5	5	5	5	I_F=100 μA
Viewing angle (°)	60	24	60	60	I_F=10 mA

*NOTE: HLMP-D640 test conditon is I_F=20 mA

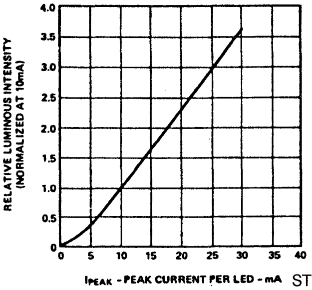
TYPICAL ELECTRO-OPTICAL CHARACTERISTIC CURVES (T_A=25°C)

Pure (Emerald) Green



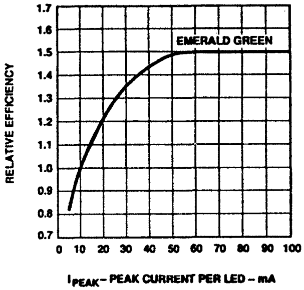
ST1622

Figure 1. Forward Current vs. Forward Voltage



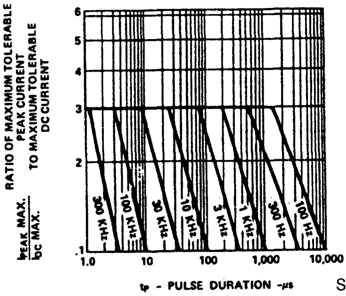
ST1623

Figure 2. Relative Luminous Intensity vs. Forward Current



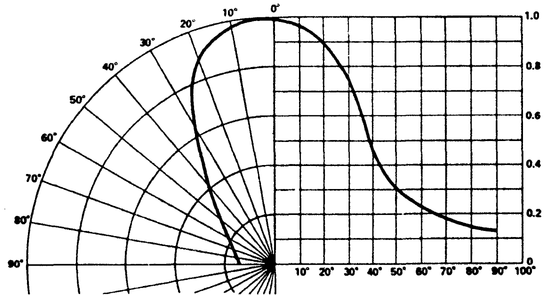
ST1620

Figure 3. Relative Efficiency vs. Peak LED Current



ST1624

Figure 4. Maximum Peak Current vs. Pulse Duration



ST1621

Figure 5. Relative Luminous Intensity vs. Angular Displacement

TYPICAL ELECTRO-OPTICAL CHARACTERISTIC CURVES (T_A=25°C)

Soft Orange

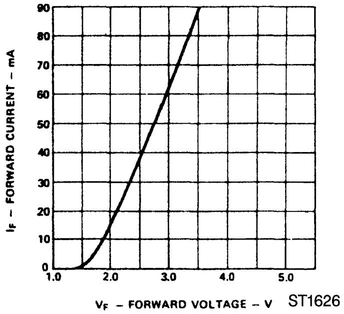


Figure 1. Forward Current vs. Forward Voltage

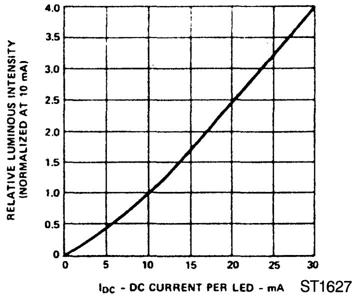


Figure 2. Relative Luminous Intensity vs. Forward Current

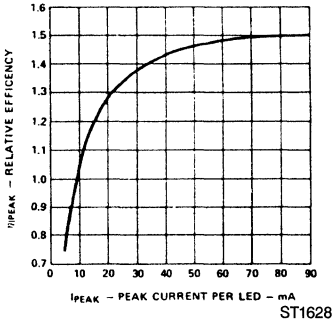


Figure 3. Relative Efficiency vs. Peak LED Current

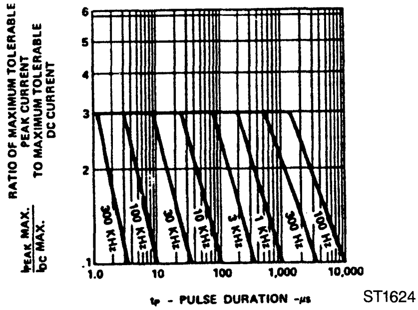


Figure 4. Maximum Peak Current vs. Pulse Duration

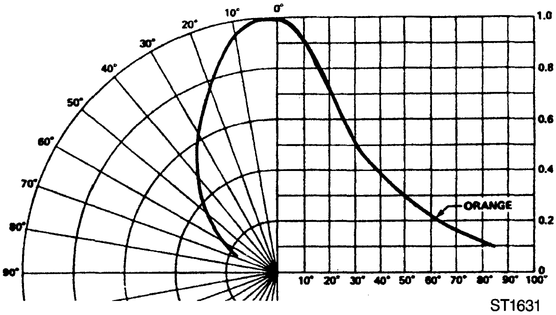


Figure 5. Relative Luminous Intensity vs. Angular Displacement

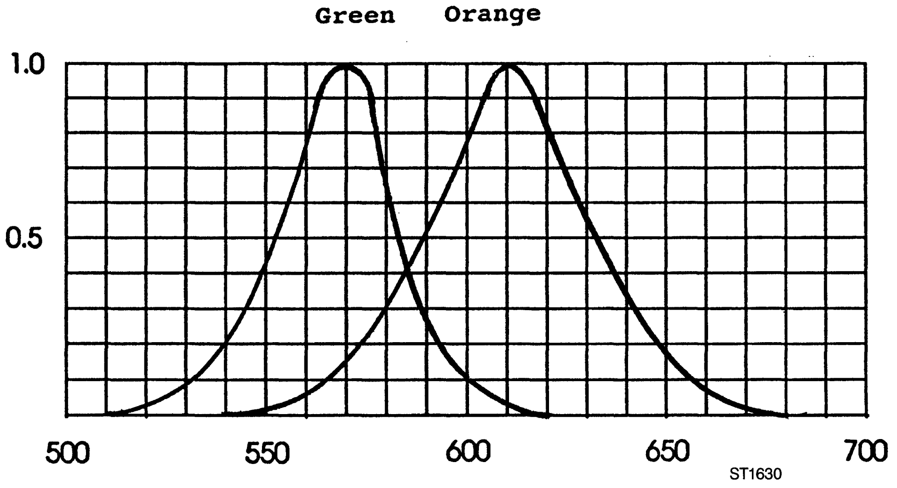


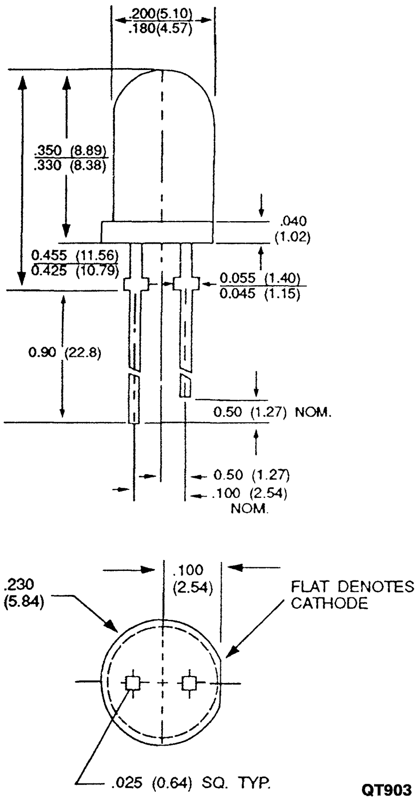
Fig. 6. Relative Intensity vs. Wavelength-nm

QT OPTOELECTRONICS

INTEGRATED T-1 3/4 RESISTOR LAMPS
5 VOLT and 12 VOLT SERIES

RED **MR3050/MR3051** TINTED
HIGH EFFICIENCY RED **MR3750/MR3751** TINTED
YELLOW **MR3350/MR3351** TINTED
HIGH EFFICIENCY GREEN **MR3450/MR3451** TINTED

PACKAGE DIMENSIONS



QT903

DESCRIPTION

This group of T-1 3/4 size LED lamps contain integral resistors. Operation at 5 volts (MR3X50 Part Nos.) or 12 volts (MR3X51 Part Nos.) is possible without the use of external current limiting resistors. Color tinted, diffused epoxy packages are used for all the lamps in this group.

FEATURES

- Integral Current Limiting Resistor (No external resistor required)
- TTL Compatible
- Operate with 5 Volt & 12 Volt Supplies
- All Colors - Red, HER, Yellow, Green
- Wide Viewing Angle
- Solid-State Reliability

NOTES:
1. ALL TOLERANCES, UNLESS OTHERWISE SPECIFIED: .XXX ± 010
2. ALL DIMENSIONS IN INCHES (MILLIMETERS)

PHYSICAL CHARACTERISTICS

TYPE	SOURCE COLOR	LENS COLOR
MR3050	Red	Red Diffused
MR3051	Red	Red Diffused
MR3750	High Efficiency Red	Red Diffused
MR3751	High Efficiency Red	Red Diffused
MR3350	Yellow	Yellow Diffused
MR3351	Yellow	Yellow Diffused
MR3450	High Efficiency Green	Green Diffused
MR3451	High Efficiency Green	Green Diffused

QT
OPTOELECTRONICS

INTEGRATED T-1 3/4 RESISTOR LAMPS
5 VOLT and 12 VOLT SERIES

ELECTRO-OPTICAL CHARACTERISTICS (TA = 25°C Unless Otherwise Specified)

		RED						HIGH EFFICIENCY RED						UNITS	TEST CONDITION
PARAMETER	**SYMBOL**	**MR3050**			**MR3051**			**MR3750**			**MR3751**				
		MIN.	**TYP.**	**MAX**	**MIN.**	**TYP.**	**MAX.**	**MIN.**	**TYP.**	**MAX.**	**MIN.**	**TYP.**	**MAX.**		
Luminous Intensity	I_V				1.0	2.0					1.5	4.0		mcd	$V_F=12$ V
Luminous Intensity	I_V	1.0	2.0					1.5	4.0					mcd	$V_F=5$ V
Total Viewing Angle	2θ1/2		60			60			60			60		Deg	
Peak Wavelength	λp		655			655			635			635		nm	
Spectral Line Halfwidth	Δ λ1/2		24			24			40			40		nm	
Forward Current 12V Devices	I_F											13	20	mA	$V_F=12$ V
Forward Current 5V Devices	I_F		13	20		13	20		10	15				mA	$V_F=5$ V
Reverse Breakdown Voltage	V_R	5.0			5.0			5.0			5.0				$I_R=100\mu A$

ELECTRO-OPTICAL CHARACTERISTICS (TA = 25°C Unless Otherwise Specified)

		YELLOW						HIGH EFFICIENCY GREEN						UNITS	TEST CONDITION
PARAMETER	**SYMBOL**	**MR3350**			**MR3351**			**MR3450**			**MR3451**				
		MIN.	**TYP.**	**MAX**	**MIN.**	**TYP.**	**MAX.**	**MIN.**	**TYP.**	**MAX.**	**MIN.**	**TYP.**	**MAX.**		
Luminous Intensity	I_V				1.5	4.0					1.5	4.0		mcd	$V_F=12$ V
Luminous Intensity	I_V	1.5	4.0					1.5	4.0					mcd	$V_F=5$ V
Total Viewing Angle	2θ1/2		60			60			60			60		Deg	
Peak Wavelength	λp		583			583			565			565		nm	
Spectral Line Halfwidth	Δ λ1/2		36			36			28			28		nm	
Forward Current 12V Devices	I_F					13	20					13	20	mA	$V_F=12$ V
Forward Current 5V Devices	I_F		10	15					12	15				mA	$V_F=5$ V
Reverse Breakdown Voltage	V_R	5.0			5.0			5.0			5.0				$I_R=100\mu A$

ABSOLUTE MAXIMUM RATINGS (TA = 25°C Unless Otherwise Specified)

	RED/HER/YELLOW 5 VOLT LAMPS	RED/HER/YELLOW 12 VOLT LAMPS	GREEN 5 VOLT LAMPS	GREEN 12 VOLT LAMPS
DC Forward Voltage ($T_A=25$°C)	7.5 Volts	15 Volts	7.5 Volts	15 Volts
Reverse Voltage ($I_R=100\ \mu A$)	5 Volts	5 Volts	5 Volts	5 Volts
Operating Temperature Range	−40°C to +85°C	−40°C to +85°C	−20°C to +85°C	−20°C to +85°C
Storage Temperature Range	−55°C to +100°C	−55°C to +100°C	−55°C to +100°C	−55°C to +100°C
Lead Soldering Temperature	260°C for 5 seconds			

INTEGRATED T-1 3/4 RESISTOR LAMPS
5 VOLT and 12 VOLT SERIES

TYPICAL ELECTRO-OPTICAL CHARACTERISTIC CURVES

(TA = 25°C Unless Otherwise Specified)

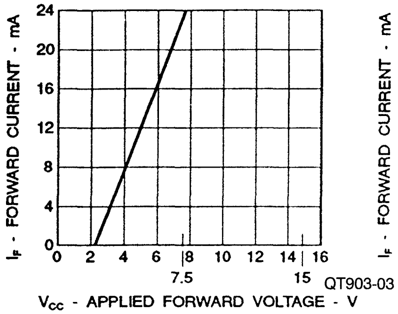


Fig. 1. Forward Current vs. Applied Forward Voltage 5 Volt Devices

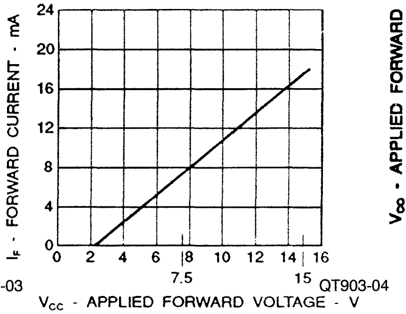


Fig. 2. Forward Current vs. Applied Forward Voltage 12 Volt Devices

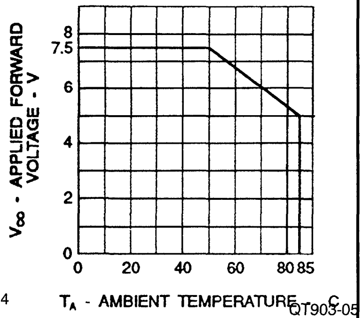


Fig. 3. Maximum Allowed Applied Forward Voltage vs. Ambient Temperature $R\theta_{JA}$=175°C/W 5 Volt Devices

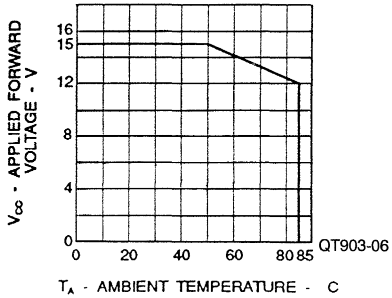


Fig. 4. Maximum Allowed Applied Forward Voltage vs. Ambient Temperature $R\theta_{JA}$=175°C/W 12 Volt Devices

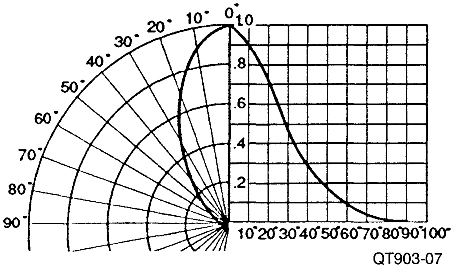


Fig. 5. Relative Luminous Intensity vs. Angular Displacement for T-1 3/4 Package

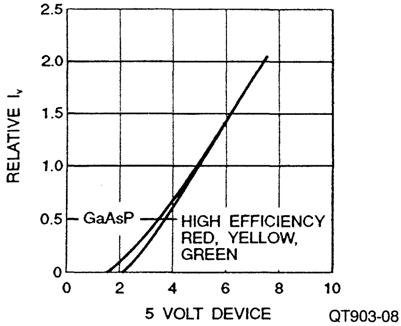


Fig. 6. Relative Luminous Intensity vs. Applied Forward Voltage 5 Volt Devices

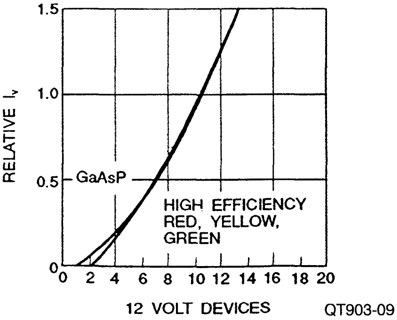
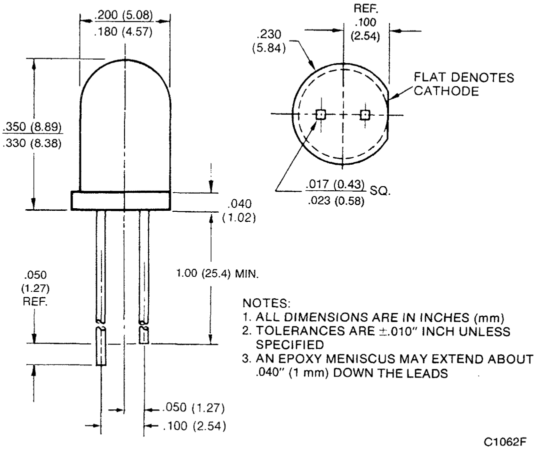


Fig. 7. Relative Luminous Intensity vs. Applied Forward Voltage 12 Volt Devices

HIGH CONTRAST T-1¾ SOLID STATE LAMPS

HIGH EFFICIENCY RED (ORANGE) **MV6151** HIGH EFFICIENCY GREEN **MV6451**
YELLOW **MV6351** AlGaAs RED **MV6951**

PACKAGE DIMENSIONS



NOTES:
1. ALL DIMENSIONS ARE IN INCHES (mm)
2. TOLERANCES ARE ±.010" INCH UNLESS SPECIFIED
3. AN EPOXY MENISCUS MAY EXTEND ABOUT .040" (1 mm) DOWN THE LEADS

DESCRIPTION

This White Diffused family of T-1¾ lamps gives maximum ON/OFF contrast in high ambient lighting levels. The family features Orange, AlGaAs Red (Dark Red), Yellow and High Efficiency Green as well as High Efficiency Red, which here is Orange. The family exhibits wide viewing angle intended for direct view.

FEATURES

- Excellent ON/OFF contrast
- Pale tint, diffused
- AlGaAs Red plus 3 bright colors: High Efficiency Red/Orange, Yellow and Green
- Alternative for popular MV6X53 family
- Snap-in grommet MP52 available as separate order item

PHYSICAL CHARACTERISTICS

TYPE	SOURCE COLOR	LENS COLOR	LENS EFFECT	APPLICATION
MV6151	High Efficiency Red	Pale Orange Diffused	Orange Diffused	Direct View
MV6351	Yellow	Pale Yellow Diffused	Yellow Diffused	Direct View
MV6451	High Efficiency Green	Pale Green Diffused	Green Diffused	Direct View
MV6951	AlGaAs Red	Pale Pink Diffused	Red Diffused	Direct View

QT
OPTOELECTRONICS

HIGH CONSTRAST T-1¾ SOLID STATE LAMPS

ELECTRO-OPTICAL CHARACTERISTICS (T_A=25°C Unless Otherwise Specified)

PARAMETER		SYMBOL	MV6151	MV6351	MV6451	MV6951	UNITS	TEST COND.	NOTES
Luminous Intensity	min.	I_V	3.0	3.0	3.0	3.0	mcd	I_F=20 mA	
	typ.		12	12	12	12	mcd	I_F=20 mA	
Forward voltage	max.	V_F	3.0	3.0	3.0	3.0	V	I_F=20 mA	
	typ.		2.1	2.2	2.3	2.4	V	I_F=20 mA	
Peak wavelength	typ.	λ_p	635	585	565	650	nm	I_F=20 mA	
Reverse breakdown voltage	min.	V_{BR}	5	5	5	5	V	I_F=100μA	
Total viewing angle between half luminous points	typ.	$2\theta_{1/2}$	70	70	70	70	degrees	I_F=20 mA	

ABSOLUTE MAXIMUM RATINGS (T_A=25°C Unless Otherwise Specified)

PARAMETER	YELLOW	HI EFF. RED RED	GREEN	UNITS	NOTES
Power dissipation	85	120	120	mW	1
Continuous forward current	20	35	30	mA	
Peak forward current (1μs, 0.3% DF)	60	1000	90	mA	
Lead soldering time at 260° C	5	5	5	seconds	2
Storage and operating temperatures	−55°C to +100°C		−55°C to +100°C		

NOTES

1. *Derate linearly from 25°C (MV6451 from 50°C) at 1.6 mW/°C.*
2. *From a point minimum 1/16 inch (1.6 mm) from the bottom of the lamp.*

TYPICAL ELECTRO-OPTICAL CHARACTERISTIC CURVES

(25°C Free Air Temperature Unless Otherwise Specified)

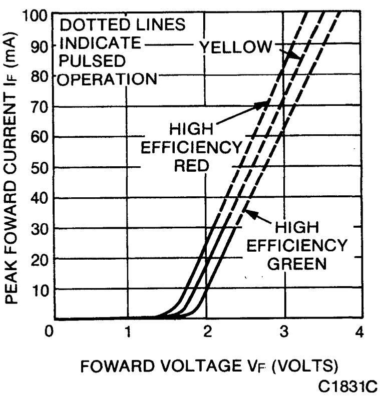


Fig. 1. Forward Current vs. Forward Voltage

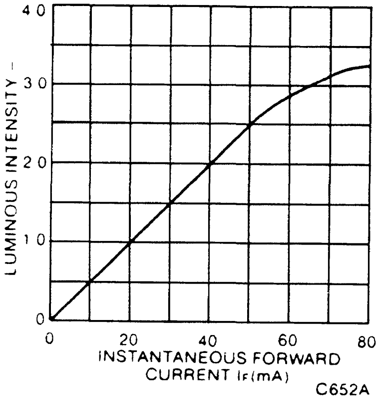


Fig. 2. Luminous Intensity vs. Forward Current

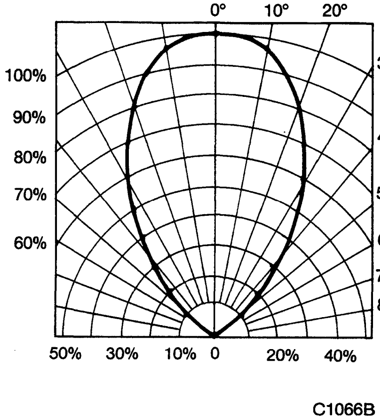


Fig. 3. Spatial Distribution

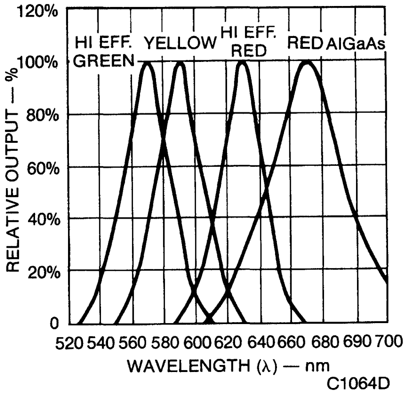


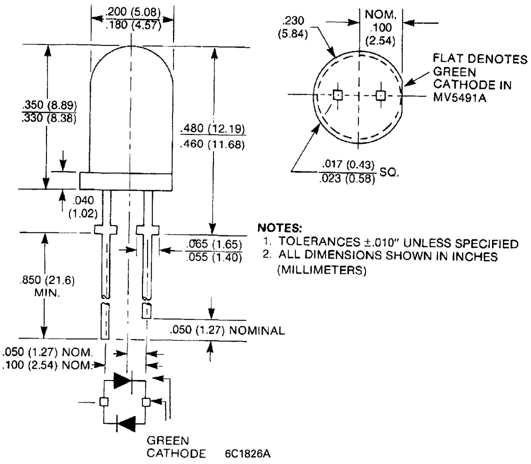
Fig. 4. Spectral Distribution

OPTOELECTRONICS

BICOLOR AND BIPOLAR T-1¾ SOLID STATE LAMPS

HIGH EFFICIENCY GREEN/AlGaAs RED **MV5491A**
HIGH EFFICIENCY RED/AlGaAs RED **MV5094A**

PACKAGE DIMENSIONS



NOTES:
1. TOLERANCES ±.010″ UNLESS SPECIFIED
2. ALL DIMENSIONS SHOWN IN INCHES (MILLIMETERS)

DESCRIPTION

The Green/Red MV5491A and Red/Red MV5094A are superior drop-in replacements for Quality Techologies' bicolor Green/Red MV5491 or MV9475 and for bipolar Red/Red MV5094 or MV9775. The MV5491A is a White Diffused, very wide viewing angle, dual chip, 4-state lamp utilizing Deep Red AlGaAs and High Efficiency Green. AC-driven, the LED lamp appears Orange. The MV5094A is a Red Diffused, very wide viewing angle bipolar Red (AC) lamp featuring Red AlGaAs and High Efficiency Red chips.

FEATURES

- Excellent uniformity and visual appeal
- Very wide viewing angle for perfect direct view
- Increased reliability
- Radically improved die-off-center characterstics
- Same current for both colors for minimum component count
- Improved solder heat durability
- 4-state; Green, Red, Orange, OFF (MV5491A)
- 1″ leads
- May be panel mounted—MP52 is separate order item

ELECTRO-OPTICAL CHARACTERISTICS (T_A=25°C Unless Otherwise Specified)

PARAMETER		SYMBOL	MV5491A	MV5094A	UNITS	TEST CONDITIONS
Luminous Intensity	min.	I_V	2.0	2.0	mcd	I_F=20 mA
	typ.		6.0	6.0	mcd	I_F=20 mA
Forward voltage	max.	V_F	3.0	3.0	V	I_F=20 mA
	typ.		2.3	2.3	V	I_F=20 mA
Dominant wavelength	typ.	λ_d	568/650	630/650	nm	I_F=20 mA
Total viewing angle between half luminous intensity points	typ.	$2\theta_{1/2}$	100	75	degrees	I_F=20 mA

ABSOLUTE MAXIMUM RATINGS (T_A=25°C Unless Otherwise Specified)

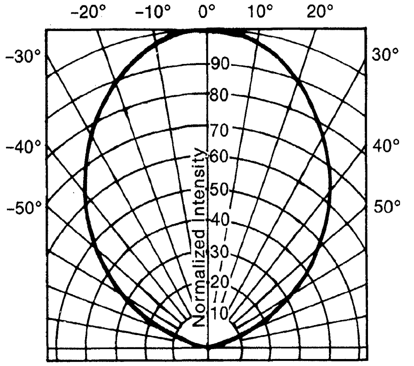
PARAMETER	RATING	UNITS	NOTES
Power dissipation	135	mW	1
Peak current	90	mA	
Average current	30	mA	2
Lead soldering time	5	seconds	
Lead soldering temperature	260°C		
Storage and operating temperatures	−55° C to +100°C		3

NOTES

1. *Derate power linearly from 25°C at 1.8 mW/°C.*
2. *Derate power linearly from 50°C at 0.5 mA/°C.*
3. *To a point minimum 1/16 inch (1.6 mm) from the bottom of the lamp.*

TYPICAL ELECTRO-OPTICAL CHARACTERISTIC CURVES

($T_A=25°C$ Unless Otherwise Specified)



6C1827

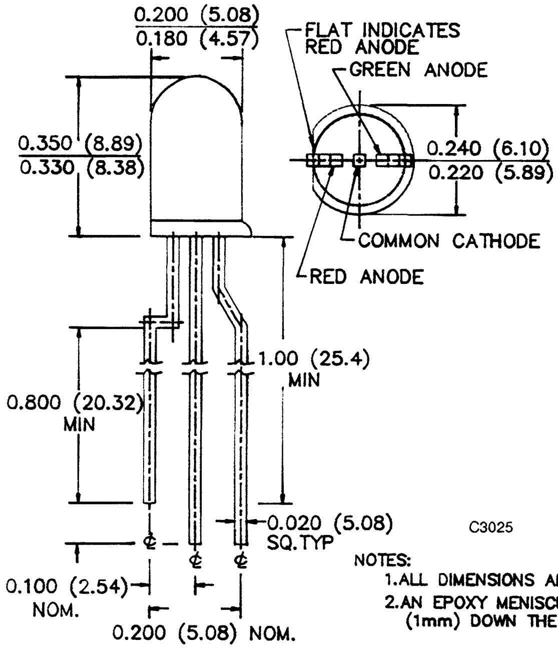
Fig. 1. Spatial Distribution

OPTOELECTRONICS

3 LEADS BICOLOR T-1¾ SOLID STATE LAMPS

HIGH EFFICIENCY GREEN/HIGH EFFICIENCY RED **MV5437**

PACKAGE DIMENSIONS



C3025

NOTES:
1.ALL DIMENSIONS ARE IN INCHES(mm)
2.AN EPOXY MENISCUS MAY EXTEND ABOUT 0.040" (1mm) DOWN THE LEADS.

DESCRIPTION

The MV5437 T-1¾ lamp is a three leaded bicolor light source with a central common cathode lead.

FEATURES

- Excellent uniformity and visual appeal
- Very wide viewing angle for perfect direct view
- Increased reliability
- Radically improved die-off-center characteristics
- Improved solder heat durability
- 4-state; Green, Red, Amber, OFF.
- TTL compatible

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BICOLOR T-1¾
SOLID STATE LAMPS

ELECTRO-OPTICAL CHARACTERISTICS (25°C Unless Otherwise Specified)

PARAMETER		SYMBOL	RED	GREEN	UNITS	TEST CONDITIONS
Luminous intensity	min. typ.	I_V	2.0 6.0	2.0 6.0	mcd mcd	I_F=20 mA I_F=20 mA
Forward voltage	max. typ.	V_F	3.0 2.1	3.0 2.1	V V	I_F=20 mA I_F=20 mA
Dominant wavelength	typ.	λ_d	630	567	nm	I_F=20 mA
Reverse breakdown	min.	V_{BR}	5.0	5.0	V	I_R=100 μA
Total viewing angle between half Luminous intensity points		2θ½	100	100	degree	I_F=20 mA

ABSOLUTE MAXIMUM RATINGS (T_A=25°C Unless Otherwise Specified)

PARAMETERS	RATING	UNITS	NOTES
Power dissipation	135	mW	1
Peak current	90	mA	
Average current	25	mA	2
Lead soldering time	5	seconds	
Storage and operating temperatures	−55°C TO +100°C		3

NOTES

1. Derate power linearly from 25°C at 1.8 mW/°C
2. Derate current linearly from 50°C at 0.5 mA/°C
3. To a point minimum 1/16 inch (1.6 mm) from the bottom lamp.

TYPICAL ELECTRO-OPTICAL CHARACTERISTICS CURVES

(T_A=25°C Unless Otherwise Specified)

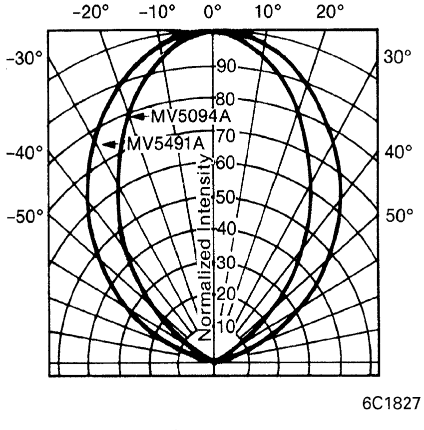

Fig. 1. Spatial Distribution

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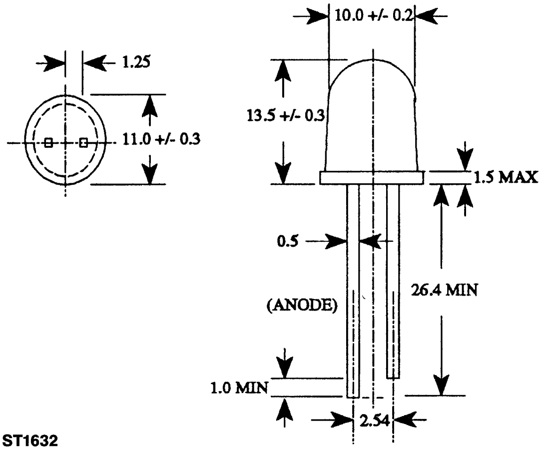
SUPER BRIGHT 10 mm LED LAMPS

SUPER RED **MV9100** CLEAR
SUPER RED **MV9101** CLEAR
SUPER RED **MV9102** CLEAR

PACKAGE DIMENSIONS



ST1632

NOTES:
1. ALL DIMENSIONS ARE IN MM.
2. LEAD SPACING IS MEASURED WHERE THE LEADS EMERGE FROM THE PACKAGE.
3. PROTRUDED RESIN UNDER THE FLANGE IS 1.5 mm (0.059″) MAX.

DESCRIPTION

These 10 mm super bright LEDs have a narrow 8° viewing angle for concentrated light output. The MV9100/1/2 are made with GaA1As LEDs on a GaAs substrate. They are all encapsulated in an epoxy package and have water clear lenses.

FEATURES

- Outstanding material efficiency.
- Low drive current.
- Solid state reliability.
- Super high brightness suitable for outdoor applications.
- Standard 1 mil. lead spacing.

ABSOLUTE MAXIMUM RATING (T_A=25°C Unless Otherwise Specified)

DC forward current (I_f)	40 mA
Operating temperature range	−40°C to +85°C
Storage temperature range	−40°C to +100°C
Lead soldering time (at 1⁄16 inch from the bottom of lamp)	5 seconds @ 260°C
Peak forward current (I_f) (at f=1.0 KHz, Duty factor= 1/10)	200 mA
Power dissipation (P_d)	110 mW
Recommended operating current (I_f Rec)	20 mA

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SUPER BRIGHT 10 mm LED LAMPS

ELECTRO-OPTICAL CHARACTERISTICS (T_A = 25°C Unless Otherwise Specified)

PART NUMBER	MV9100	MV9101	MV9102	TEST CONDITIONS
Luminous intensity (mcd)				I_F=20 mA
minimum	600	1000	1600	
typical	940	1500	2400	
Forward voltage (V_F)				I_F=20 mA
minimum		1.5		
typical		1.7		
maximum		2.4		
Peak wavelength (nm)		660		I_F=20 mA
Spectral line half width (nm)		20		I_F=20 mA
Reverse breakdown voltage (V_R)		5		I_F=10 μA
Viewing angle (°)		8		I_F=20 mA

TYPICAL ELECTRO-OPTICAL CHARACTERISTIC CURVES (T_A=25°C)

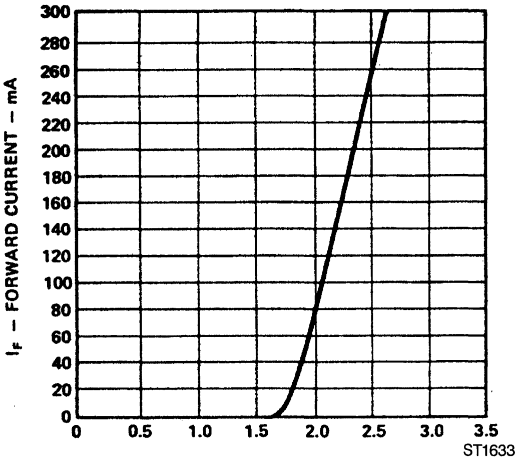


Figure 1. Forward Current vs. Forward Voltage

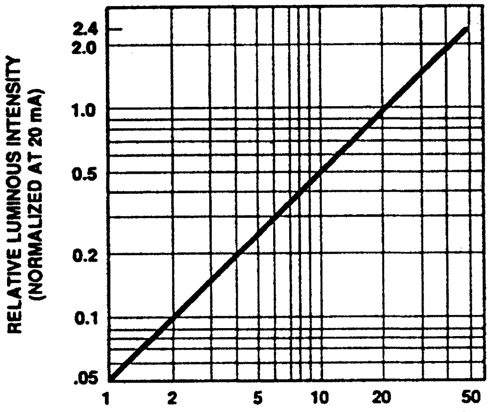


Figure 2. Relative Luminous Intensity vs. Forward Current

TYPICAL ELECTRO-OPTICAL CHARACTERISTIC CURVES (T_A=25°C)

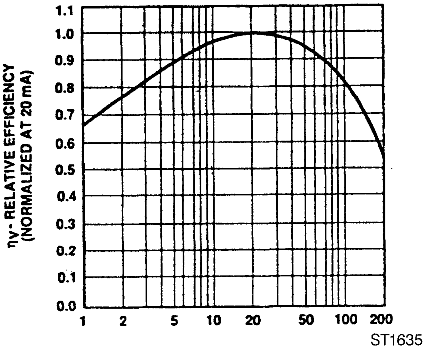


Figure 3. Relative Efficiency vs. Peak Forward Current

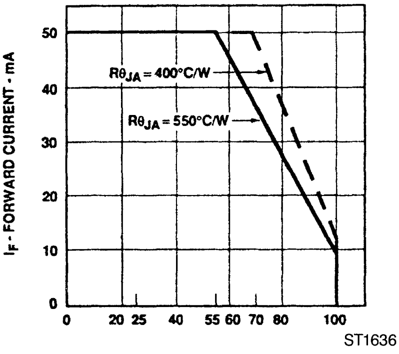


Figure 4. Maximum Forward DC Current vs. Ambient Temperature Derating based on T_J MAX=110°.

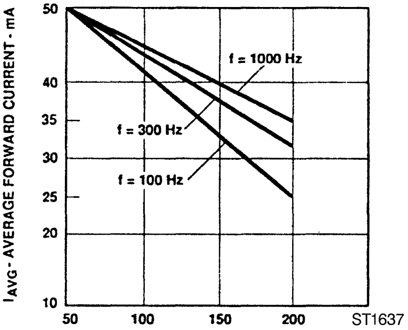


Figure 5. Maximum Average Current vs. Forward Current

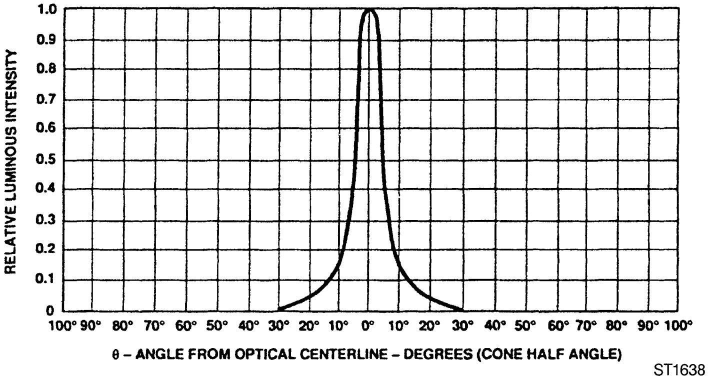
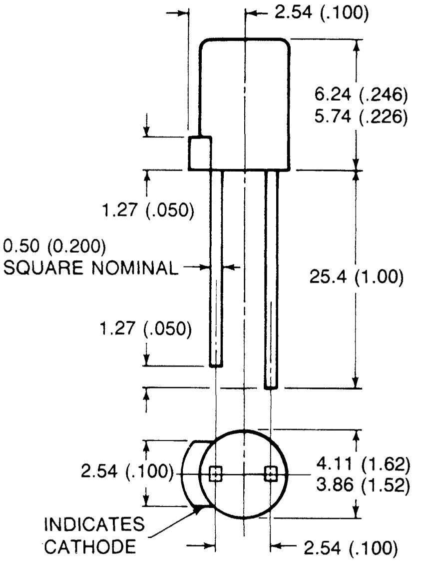


Figure 6. Relative Luminous Intensisty vs. Angular Displacement

4mm FLAT TOP LAMPS

RED (HIGH EFFICIENCY) HLMP-M200/M201 HLMP-M250/M251
YELLOW HLMP-M300/M301 HLMP-M350/M351
GREEN HLMP-M500/M501 HLMP-M550/M551

PACKAGE DIMENSIONS



DIMENSIONS IN MILLIMETERS (INCHES)

C3001

DESCRIPTION

Bright colors and a wide viewing angle are the outstanding features of the new 4 mm flat top lamps. The cylindrical shape and flat emitting surface make these lamps particularly well suited for applications requiring high light output in minimal space.

FEATURES

- Replaces Hewlett-Packard devices
- Wide viewing angle
- Excellent for backlighting small areas
- Solid state reliability
- Compact, rugged, lightweight
- Choice of tinted nondiffused and tinted diffused package

PHYSICAL CHARACTERISTICS

PART NUMBER	DESCRIPTION	I_V(mcd) MIN	TYPE	TEST CONDITION(mA)	TOTAL VIEWING ANGLE
HLMP-M200	Red, Diffused	3.4	5.0	20	135
HLMP-M201	Red, Diffused, High Brightness	5.4	7.0	20	
HLMP-M250	Red, Nondiffused	3.4	5.0	10	80
HLMP-M251	Red, Nondiffused, High Brightness	5.4	7.0	10	
HLMP-M300	Yellow, Diffused	3.6	5.0	20	135
HLMP-M301	Yellow, Diffused, High Brightness	5.7	7.0	20	
HLMP-M350	Yellow, Nondiffused	3.6	5.0	10	80
HLMP-M351	Yellow, Nondiffused, High Brightness	5.7	7.0	10	
HLMP-M500	Green, Diffused	4.2	7.0	20	135
HLMP-M501	Green, Diffused, High Brightness	6.7	10.0	20	
HLMP-M550	Green, Nondiffused	4.2	10.0	10	80
HLMP-M551	Green, Nondiffused, High Brightness	6.7	16.0	10	

4mm FLAT TOP LAMPS

ELECTRO-OPTICAL CHARACTERISTICS (T_A = 25°C)

PARAMETERS	H.E. RED HLMP-M2XX			YELLOW HLMP-M3XX			GREEN HLMP-M5XX			UNITS	TEST CONDITIONS
	MIN	TYP	MAX	MIN	TYP	MAX	MIN	TYP	MAX		
Forward Voltage		2.2	3.0		2.2	3.0		2.3	3.0	V	I_F = 20 mA
Speed of Response		90			90			500		ns	
Peak Wavelength		635			585			565		nm	
Thermal Resistance		120			120			120		°C/W	Junction to Cathode Lead
Capacitance		20			15			18		pF	V_F=0, F=1MHz
Reverse Breakdown Voltage	5.0			5.0			5.0			V	I_R = 100 μA

ABSOLUTE MAXIMUM RATINGS (T_A = 25°C unless otherwise specified)

PARAMETER	H.E. RED HLMP-M2XX	YELLOW HLMP-M3XX	GREEN HLMP-M5XX	UNITS
Power dissipation	135	120	135	mW
Derate linearly from 25°C	1.6	1.6	1.6	mW/°C
Storage & operating temperature	−55 to +100	−55 to +100	−55 to +100	°C
Lead soldering time at 260°C	5	5	5	sec.
Continuous forward current	35	20	30	mA
Peak forward current 1μ sec. pulse 0.3% duty cycle	90	60	90	mA
Reverse voltage (I_R = 100 μA)	5	5	5	V
Average forward current	25	20	25	mA
Transient forward current (10 μ sec pulse)	500	500	500	mA

TYPICAL ELECTRO-OPTICAL CHARACTERISTIC CURVES

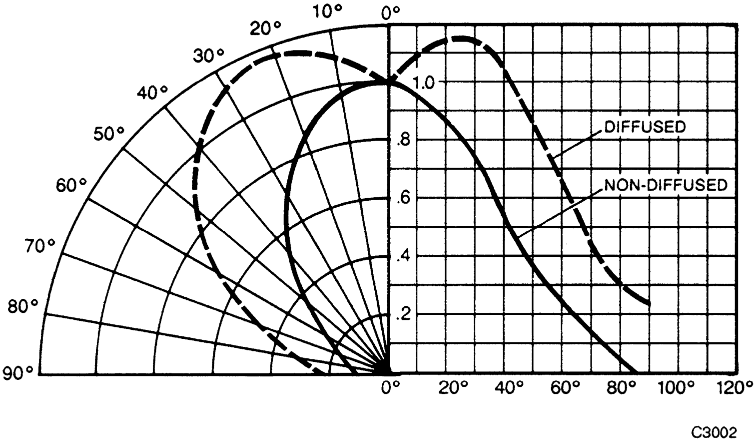


Fig. 1. Relative Luminous Intensity vs. Angular Displacement

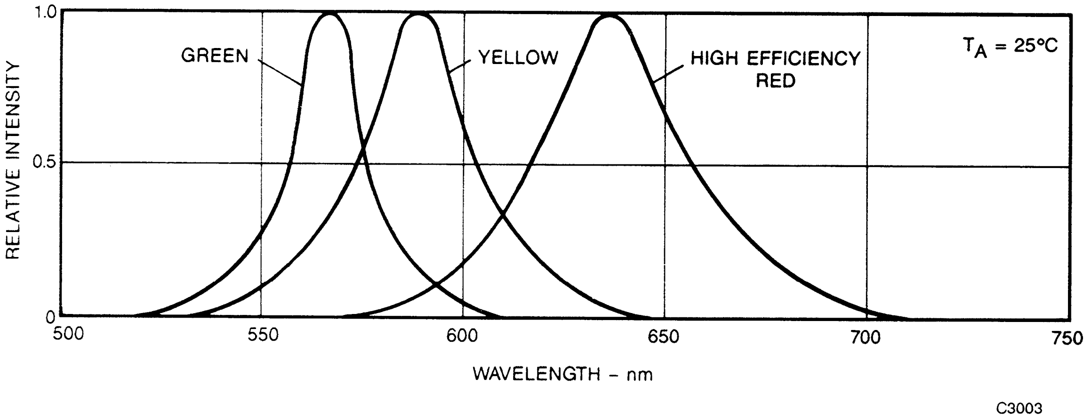


Fig. 2. Relative Intensity vs. Wavelength

TYPICAL ELECTRO-OPTICAL CHARACTERISTIC CURVES (Cont'd)

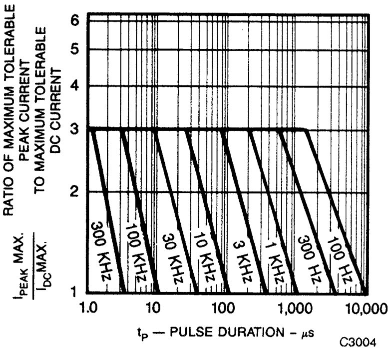


Fig. 3. Maximum Tolerable Peak Current vs. Pulse Duration (I_{DC}MAX as per MAX Ratings)

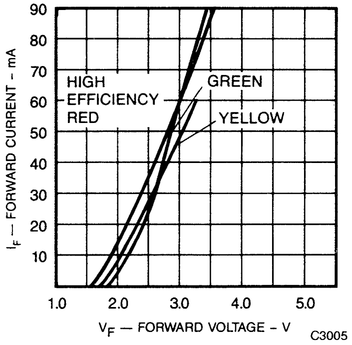


Fig. 4. Forward Current vs. Forward Voltage

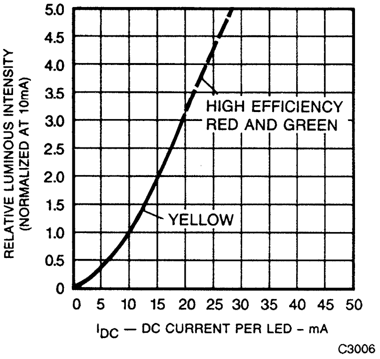


Fig. 5. Relative Luminous Intensity vs. Forward Current. Nondiffused Devices

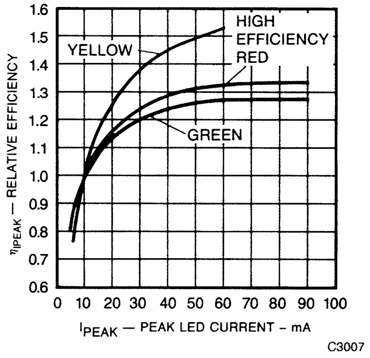


Fig. 6. Relative Efficiency (Luminous Intensity per Unit Current) vs. Peak LED Current. Nondiffused Devices

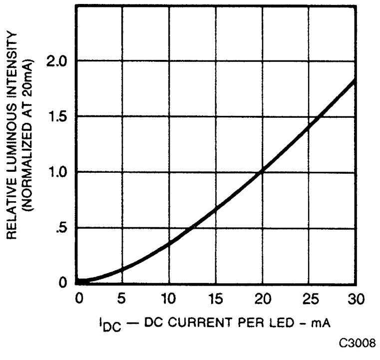


Fig. 7. Relative Luminous Intensity vs. Forward Current. Nondiffused Devices

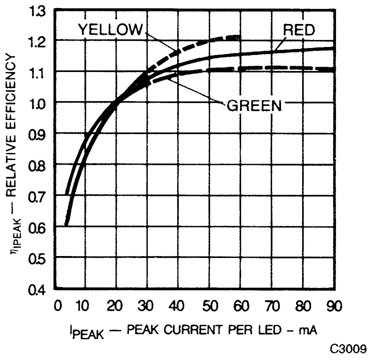


Fig. 8. Relative Efficiency (Luminous Intensity per Unit Current) vs. Peak LED Current. Nondiffused Devices

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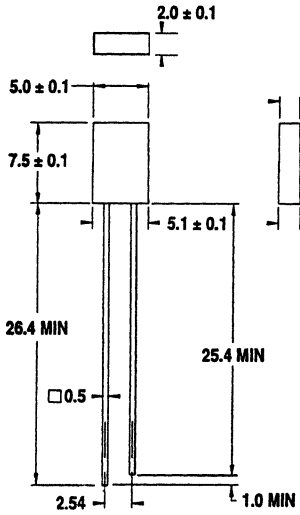
RECTANGULAR SOLID STATE LAMPS

YELLOW MV53123
HIGH EFFICIENCY GREEN MV54123
HIGH EFFICIENCY RED MV57123

PACKAGE DIMENSIONS



C1667A

NOTES:
1. ALL DIMENSIONS ARE IN INCHES (MM)
2. TOLERANCES ARE ±010″ INCHES UNLESS SPECIFIED.
3. AN EPOXY MENISCUS MAY EXTEND ABOUT .40″ (1MM) DOWN THE LEADS. THE BASE OF THE PACKAGE IS NOT FLAT.

DESCRIPTION

These rectangular LED lamps provide a lighted surface area 2 × 5 mm. The High Efficiency Red and Yellow solid state lamps contain a gallium arsenide phosphide on gallium phosphide light emitting diode. The High Efficiency Green Lamps utilize an improved gallium phosphide light emitting diode.

FEATURES

- 2 × 5 mm lighted area
- High brightness—typically 4 mcd at 20 mA
- Solid state reliability
- Compact, rugged, lightweight

APPLICATIONS

- Legend backlighting
- Illuminated pushbutton
- Panel indicator
- Bargraph meter

RECTANGULAR
SOLID STATE LAMPS

ELECTRO-OPTICAL CHARACTERISTICS (T_A=25°C Unless Otherwise Specified)

PARAMETER	TEST COND.	UNITS	MV53123	MV54123	MV57123
Forward voltage (V_F)					
typ.	I_F=20 mA	V	2.1	2.2	2.0
max.	I_F=20 mA	V	3.0	3.0	3.0
Luminous Intensity					
min.	I_F=20 mA	mcd	1.0	1.0	1.0
typ.	I_F=20 mA	mcd	4.0	4.0	4.0
Peak wavelength		mcd	585	562	635
half width	I_F=20 mA	nm	45	30	45
Capacitance					
typ.	V=0, f=1 MHz	pF	45	20	45
Reverse voltage (V_R)					
min.	I_R=100 μA	V	5.0	5.0	5.0
Viewing angle (total)		degrees	100	100	100

ABSOLUTE MAXIMUM RATINGS (T_A=25°C Unless Otherwise Specified)

	MV53123	MV54123 MV57123
Power dissipation	85 mW	120 mW
Derate linearly from 50°C	1.6 mW/°C	1.6 mW/°C
Storage and operating temperatures	−55°C to +100°C	−55°C to +100°C
Peak forward current (1 μsec pulse width 300 pps)	60 mA	90 mA
Forward current	20 mA	30 mA
Lead soldering time at 260°C (See Note 1)	5 sec.	5 sec.
Reverse voltage	5.0 V	5.0 V

TYPICAL ELECTRO-OPTICAL CHARACTERISTIC CURVES

(25°C Free Air Temperature)

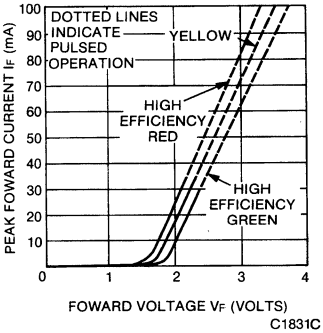


Fig. 1. Forward Current vs. Forward Voltage

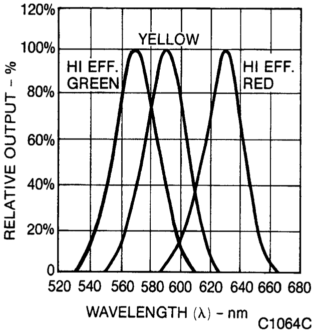


Fig. 2. Spectral Distribution

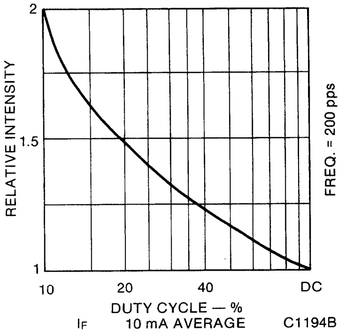


Fig. 3. Luminous Intensity vs. Duty Cycle

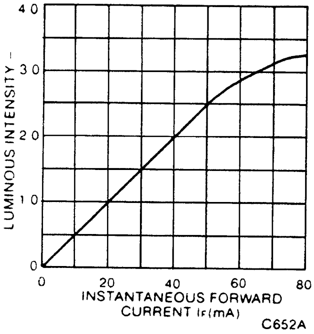


Fig. 4. Luminous Intensity vs. Forward Current

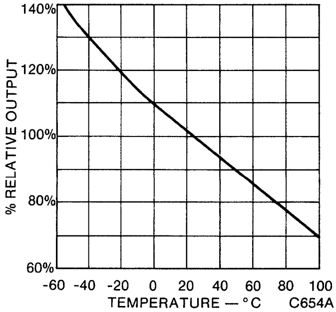


Fig. 5. Output vs. Temperature

NOTES

1. *The leads of the device immersed in molten solder, heated to a temperature of 260°C, to a point 1/16 inch (1.6 mm) from the body of the device per MIL-S-750, with dwell time of 5 seconds.*

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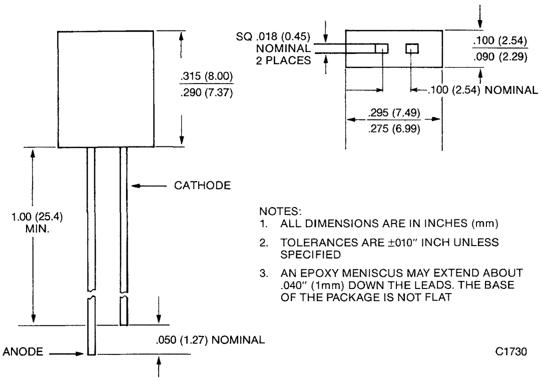
RECTANGULAR SOLID STATE LAMPS

HIGH EFFICIENCY RED **HLMP-0300/1**
YELLOW **HLMP-0400/1**
HIGH EFFICIENCY GREEN **HLMP-0503/4**

PACKAGE DIMENSIONS



NOTES:
1. ALL DIMENSIONS ARE IN INCHES (mm)
2. TOLERANCES ARE ±010" INCH UNLESS SPECIFIED
3. AN EPOXY MENISCUS MAY EXTEND ABOUT .040" (1mm) DOWN THE LEADS. THE BASE OF THE PACKAGE IS NOT FLAT

DESCRIPTION

The HLMP-0X0X Series of rectangular lamps are direct replacements for Hewlett-Packard's series with the same part numbering. The series is similar to MV5X123 except for the larger lens size. Like the MV5X123, the HLMP-0X0X is stackable. The lamps are tinted diffused and intended for direct view.

FEATURES

- 3 High Efficiency colors
- Rectangular light area
- Inexpensive panel indicators

PHYSICAL CHARACTERISTICS

DEVICE	SOURCE COLOR	LENS COLOR	LENS EFFECT	I_V MIN. AT 20 mA
HLMP-0300	High Efficiency Red	Red Diffused	Very Wide Beam	1.0
HLMP-0301	High Efficiency Red	Red Diffused	Very Wide Beam	2.5
HLMP-0400	Yellow	Yellow Diffused	Very Wide Beam	1.5
HLMP-0401	Yellow	Yellow Diffused	Very Wide Beam	3.0
HLMP-0503	High Efficiency Green	Green Diffused	Very Wide Beam	1.5
HLMP-0504	High Efficiency Green	Green Diffused	Very Wide Beam	3.0

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OPTOELECTRONICS

RECTANGULAR SOLID STATE LAMPS

ELECTRO-OPTICAL CHARACTERISTICS (T_A=25°C Unless Otherwise Specified)

			HLMP-							
			HI. EFF. RED		YELLOW		HI. EFF. GREEN			
PARAMETER		**SYMBOL**	**0300**	**0301**	**0400**	**0401**	**0503**	**0504**	**UNITS**	**TEST CONDITIONS**
Luminous Intensity	min. typ.	I_V	1.0 2.5	2.5 5.0	1.5 2.5	3.0 5.0	1.5 3.0	2.5 5.0	mcd mcd	I_F=20 mA I_F=20 mA
Forward voltage	max. typ.	V_F	3.0 2.1	3.0 2.1	3.0 2.2	3.0 2.2	3.0 2.3	3.0 2.3	V V	I_F=20 mA I_F=20 mA
Peak wavelength	typ.	λ_p	635	635	585	585	565	565	nm	I_F=20 mA
Spectral line half width	typ.	$\Delta\lambda/2$	45	45	35	35	35	35	nm	I_F=20 mA
Capacitance	typ.	C	45	45	45	45	20	20	pF	V_F=0, f=1 MHz
Reverse breakdown voltage	min.	BV_r	5	5	5	5	5	5	V	I_R=100 μA
Total viewing angle between half Luminous Intensity points	typ.	$2\theta_{1/2}$	100	100	100	100	100	100	degrees	

ABSOLUTE MAXIMUM RATINGS (T_A=25°C Unless Otherwise Specified)

Power dissipation at 25°C ambient (HLMP-040X=85 mA)	135 mW
Derate linearly from 25°C	1.6 mW/°C
Storage and operating temperatures	−55°C to +100°C
Lead soldering time at 260°C (See Note 1)	5 sec.
Continuous forward current at 25°C (HLMP-040X=20 mA)	30 mA
Peak forward current (1 μsec pulse, 0.3% DC) (HLMP-040X=60 mA)	90 mA

TYPICAL ELECTRO-OPTICAL CHARACTERISTIC CURVES

(T_A=25°C Unless Otherwise Specified)

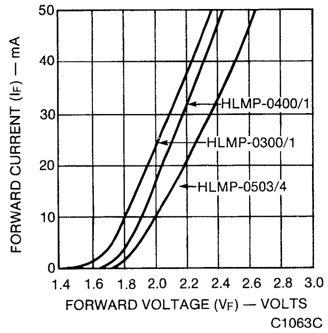


Fig. 1. Forward Current vs. Forward Voltage

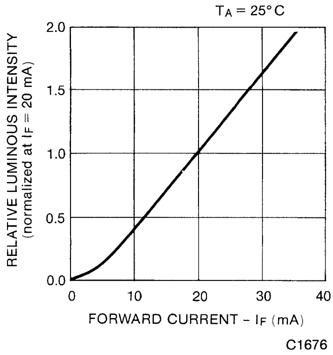


Fig. 2. Luminous Intensity vs. Forward Current

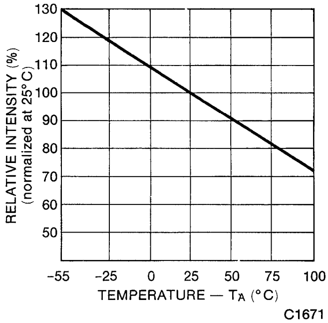


Fig. 3. Relative Luminous Intensity vs. Temperature

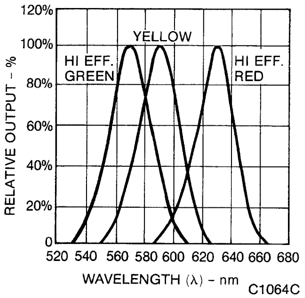


Fig. 4. Spectral Distribution

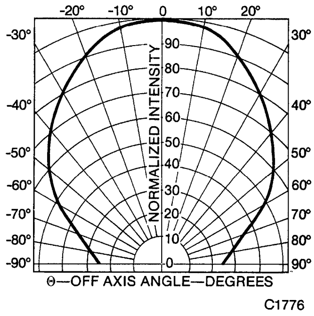


Fig. 5. Spatial Distribution

NOTES

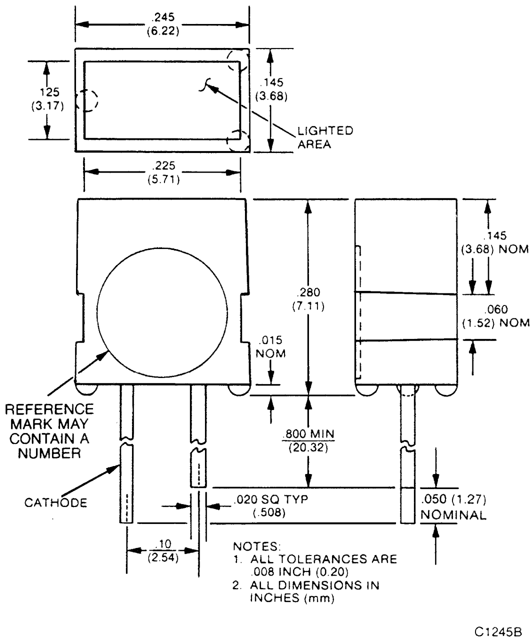
1. *The leads of the device immersed in molten solder, at 260°C, to a point 1/16 inch (1.6 mm) from the body of the device per MIL-S-750, with dwell time of 5 seconds.*

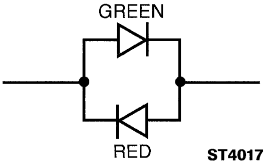
QT OPTOELECTRONICS

RECTANGULAR SOLID STATE LAMPS

YELLOW MV53124A
HIGH EFFICIENCY GREEN MV54124A
HIGH EFFICIENCY RED MV57124A
HIGH EFFICIENCY GREEN/AlGaAs RED MV49124A

PACKAGE DIMENSIONS





FOR MV49124A

DESCRIPTION

The MV5X124A Series of rectangular high performance LED lamps with reflector cap has been engineered for much improved light uniformity which is especially important in direct view and legend backlighting. Includes a Green/Red version—MV49124A. The Green chip is the same as is used in MV54124A, while the Red chip is AlGaAs at 660 nm to achieve a bright Dark Red color in the non-tinted diffused epoxy.

FEATURES

- Uniform illumination
- Increased typical brightness
- Tighter mechanical tolerances for base of design
- Stackable in X or Y direction without crosstalk
- .220″ × .125″ lighted area for direct view or legend backlighting
- Use Black MP65 two piece grommet for panel mounting
- Superior quality

APPLICATIONS

- Legend backlighting
- Panel indicator
- High quality bargraphs

PHYSICAL CHARACTERISTICS

TYPE	SOURCE COLOR	LENS EFFECT
MV53124A	Yellow	Yellow Diffused
MV53124A	High Eff. Green	Green Diffused
MV57124A	High Eff. Red	Red Diffused
MV49124A	High Eff. Green/AlGaAs Red	White Diffused

RECTANGULAR SOLID STATE LAMPS

ELECTRO-OPTICAL CHARACTERISTICS (25°C Temperature Unless Otherwise Specified)

PARAMETER		SYMBOL	MV 53124A	MV 54124A	MV 57124A	MV 49124A	UNITS	TEST COND.	NOTES
Luminous	min.	I_V	1.0	1.0	1.0	1.0	mcd	I_F=20 mA	
Intensity	typ.		6.0	6.0	6.0	6.0	mcd	I_F=20 mA	
Forward voltage	typ.	V_F	2.0	2.2	2.0	2.2	V	I_F=20 mA	
	max.		3.0	3.0	3.0	3.0	V	I_F=20 mA	
Peak wavelength		λp	585	562	635	562/660	nm	I_F=20 mA	
Spectral line half width			45	30	45	30/45	nm	I_F=20 mA	
Reverse voltage	min.	V_{BR}	5	5	5		V	I_R=100 μA	
Reverse current	max.	I_R	100	100	100		μA	V_R=5.0 V	
Capacitance		C	45	20	45	20/30	pF	V=0, f=1 MHz	
Viewing angle (total)		2θ½	100	100	100	100	degrees		

ABSOLUTE MAXIMUM RATINGS (25°C Unless Otherwise Specified)

PARAMETER	ALL DEVICES	UNITS	NOTES
Power dissipation	120	mW	1
Continuous forward current	30	mA	
Peak forward current (1 μs, 0.3% DF)	90	mA	
Lead soldering time at 260° C	5	seconds	2
Operating and storage temperatures	−55°C to +100°C		

NOTES

1. *Derate linearity from 25°C at 1.6 mW/°C.*
2. *From a point minimum 1/16 inch (1.6 mm) from the bottom of the lamp.*

TYPICAL ELECTRO-OPTICAL CHARACTERISTIC CURVES

(25°C Temperature Unless Otherwise Specified)

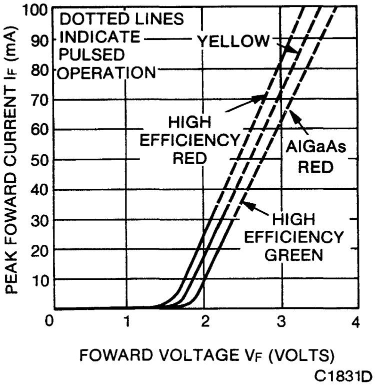


Fig. 1. Forward Current vs. Forward Voltage

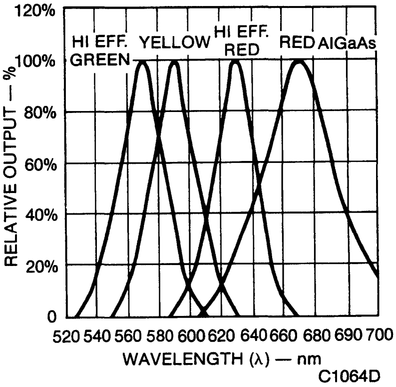


Fig. 2. Spectral Distribution

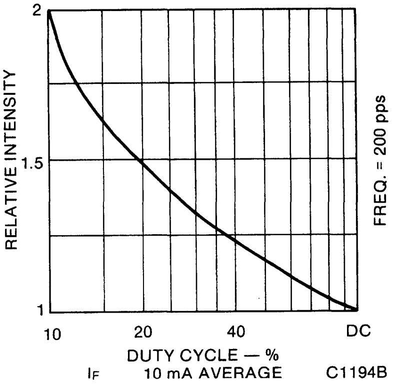


Fig. 3. Luminous Intensity vs. Duty Cycle

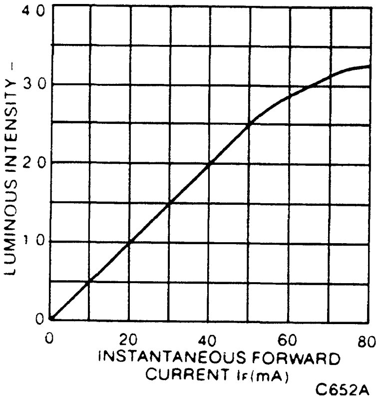


Fig. 4. Luminous Intensity vs. Forward Current

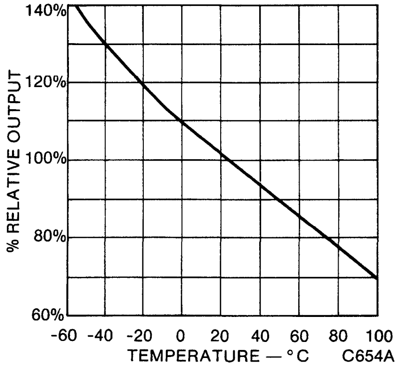


Fig. 5. Output vs. Temperature

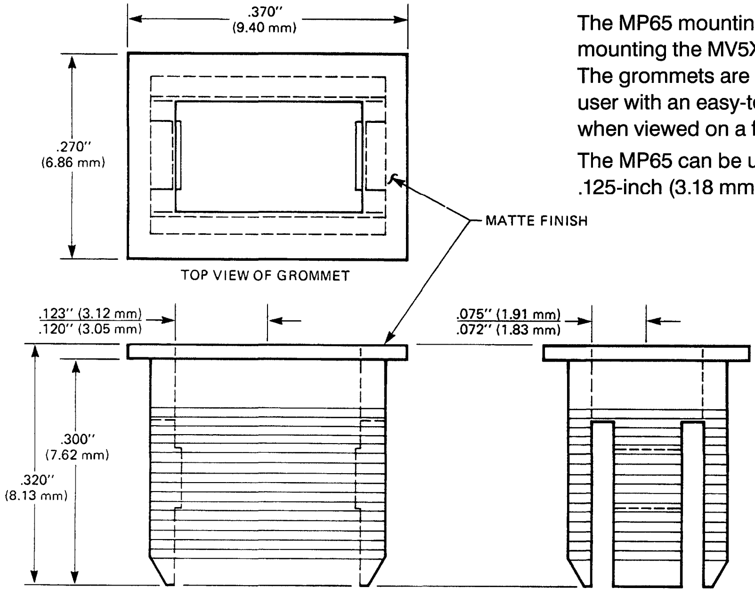
6

MV53124A MV54124A MV57124A MV49124A

MV5X124
PANEL MOUNTING GROMMET

MP65

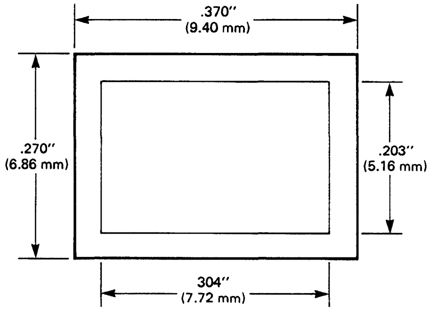
PACKAGE DIMENSIONS



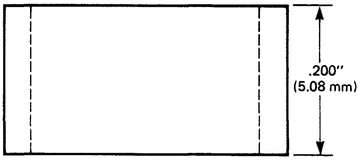
TOP VIEW OF GROMMET

SIDE VIEW OF GROMMET

END VIEW
OF GROMMET



TOP VIEW OF RING



SIDE VIEW OF RING

MATERIAL: POLYPROPYLENE BLACK

C1455

DESCRIPTION

The MP65 mounting grommet is intended for panel mounting the MV5X124 Series of rectangular lamps. The grommets are made of Black plastic and provide the user with an easy-to-mount, professional appearance when viewed on a front panel.

The MP65 can be used on any panel thickness up to .125-inch (3.18 mm).

PANEL HOLE PUNCHING

Punches can be ordered from one of the following sources:

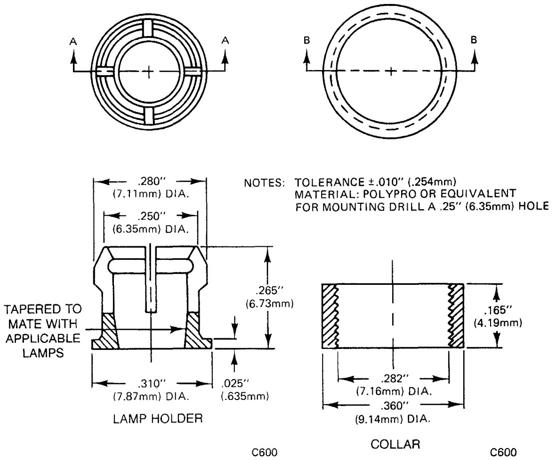
W.A. WHITNEY COMPANY
650 Race Street
Rockford, IL 61105
(815) 964-6771
(Request a 28xx series punch with dimensions of 5⁄16″ × 7⁄32″)

ROTEX PUNCH COMPANY, INC.
2350 Alvarado Street
San Leandro, CA 94577
(415) 357-3600
(Request a 3506 series punch with dimensions of 5⁄16″ × 7⁄32″)

T-1¾ PANEL MOUNTING GROMMETS

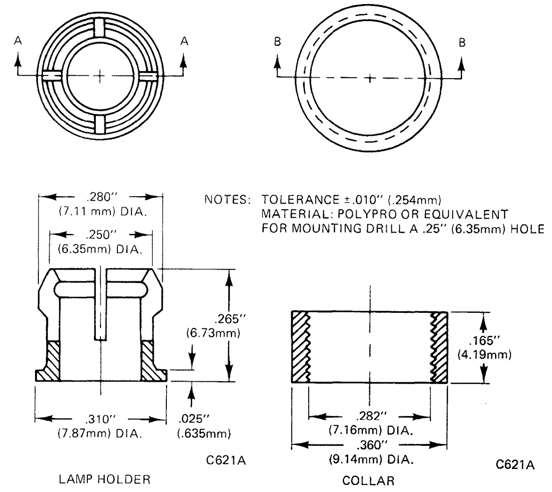
MP22 MP52

PACKAGE DIMENSIONS



NOTES: TOLERANCE ±.010" (.254mm)
MATERIAL: POLYPRO OR EQUIVALENT
FOR MOUNTING DRILL A .25" (6.35mm) HOLE

MP22 TWO-PIECE POP-INS FOR MV5X2XA



NOTES: TOLERANCE ±.010" (.254mm)
MATERIAL: POLYPRO OR EQUIVALENT
FOR MOUNTING DRILL A .25" (6.35mm) HOLE

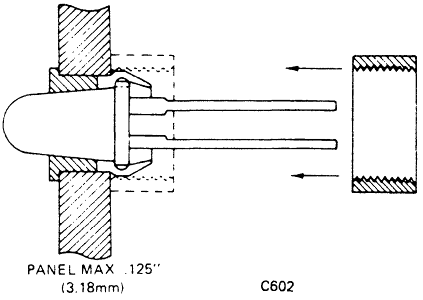
MP52 TWO-PIECE POP-INS FOR MV6X5X AND MV5X5X

DESCRIPTION

The MP Series of mounting grommets is intended for panel mounting of any standard T-1¾ Quality Technologies light emitting diode indicators. The grommets are made of plastic and are available in Black only.

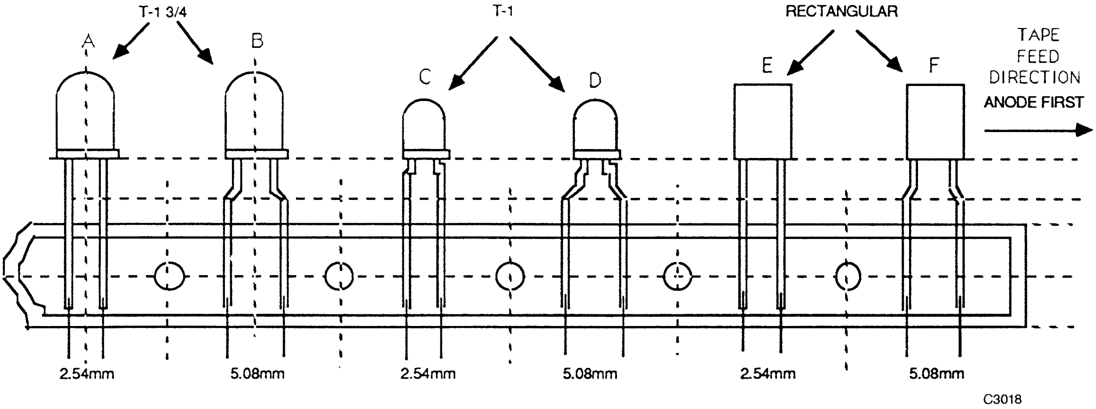
The MP65 Series will easily mount the applicable lamps on any panel thickness up to .125-inch (3.18 mm).

TYPICAL MOUNTING TECHNIQUE FOR EITHER TYPE



CONFIGURATIONS

CONFIGURATIONS:



FAMILY	CONFIGURATIONS AVAILABLE	QTY PER REEL	QTY PER AMMO-PACK
T-1 3/4*	A/B	1200	1200
T-1**	C/D	2000	2000
RECT. (MV5X123)	E/F	2000	2000
RECT. (MV5X124A)	E/F	1500	1200
RECT. (HLMP-0X0X)	E/F	2000	1500

* MV5X5X, MV5X15X, MV6X53X, FLVXXX, HLMP-3XXX, MV3X50

** MV5X6XX, HLMP-1XXX

FEATURES

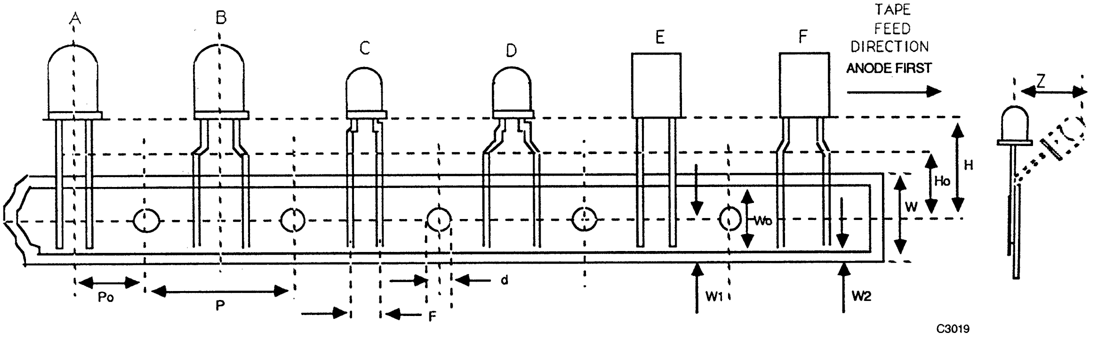
- Automatic PCB assembly of most T-1-3/4, T-1, and rectangular leds with radial insertion machines.
- Meets ANSI/EIA standard RS 468
- Standard 2.54mm (0.100″) lead spacing or preformed to 5.08mm (0.200″)
- Choice of a variety of "H" dimensions.
- One luminous intensity category per reel or ammopack

NOTES

1. *Tape & Reel is not available for MV5X (T-3/4) MV5X9XA or MV5X7X lamp families*
2. *Anode leaves Reel first.*

PACKAGE DIMENSIONS & TOLERANCES

PACKAGE DIMENSIONS & TOLERANCES:



		A	B	C	D	E	F
H	1	16.5	—	16.5	—	16.5	—
	2	17.5	—	17.5	—	17.5	—
	3	18.5	—	18.5	—	18.5	—
	4	20.5	20.5	20.5	20.5	20.5	20.5
	5	22.5	22.5	22.5	22.5	22.5	22.5
	6	24.5	24.5	24.5	24.5	24.5	24.5
Ho		—	16	—	16	—	16
F		2.54	5.08	2.54	5.08	2.54	5.08
		+0.6/−0.1					

P = 12.7 ±0.3

P$_o$ = 6.35 ±1.0

d = 4.0 ±0.2

Z = 2.0 max

H = ±1mm

H$_o$ = **±0.5mm**

W = 18.0 +1.0/−0.5

W$_o$ = **15.0 ±0.3**

W1 = 9.0 +0.75/−0.5

W2 = </=0.5

ALL DIMENSIONS IN MILLIMETERS (mm)

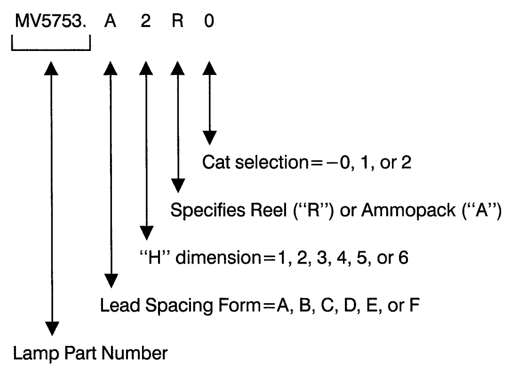
ORDERING INFORMATION

To order LED lamps packaged on Tape & Reel/Ammopack, include appropriate standard lamp part number and suffix code to specify configuration and optional features.

EXAMPLES:

MV5753.A2R0 - This specifies MV5753 lamps with A configuration ("A") - with H2 height dimension ("2") on Tape & Reel ("R") - with no category selection ("0").

MV5753.B4A2 - This specifies MV5753 lamps - with B configuration ("B") - with H4 height dimension ("4") on tape in ammopack ("A") - with two highest yield categories ("2"), Note: but only one category per ammopack.


MV5753. A 2 R 0

Cat selection=−0, 1, or 2

Specifies Reel ("R") or Ammopack ("A")

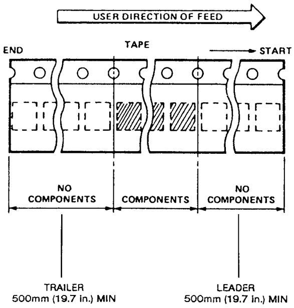
"H" dimension=1, 2, 3, 4, 5, or 6

Lead Spacing Form=A, B, C, D, E, or F

Lamp Part Number

TAPE AND REEL SPECIFICATIONS FOR SURFACE MOUNT OPTIONS

12 mm Tape and Reel



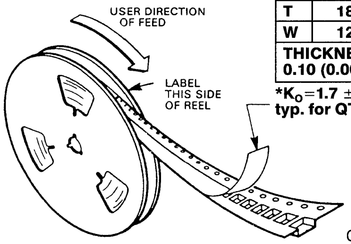
QT906C

DIMENSIONS PER ANSI/EIA STANDARD RS-481. ALL DIMENSIONS ARE IN MILLIMETERS (INCHES).

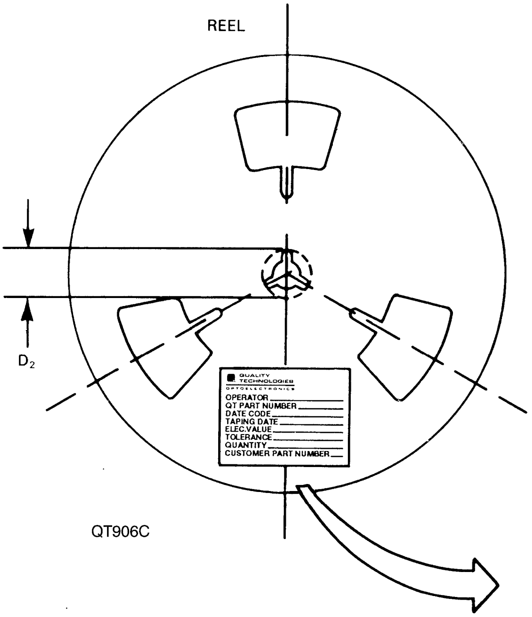
	A	**178.0 ± 2.0 (7.0 ± 0.08) DIA.**
	C	**13.0 (0.512) DIA. TYP.**
	D	**1.55 (0.061 ± 0.002) DIA**
	D_2	**20.2 (0.795) DIA. MIN.**
	E	**1.75 ± 0.1 (0.069)**
	F	**5.50 (0.127 ± 0.002)**
*	**K_0**	**3.05 ± 0.1 (0.120) TYP.**
	N	**50.0 (1.970) MIN.**
	P	**4.0 (0.157) TYP.**
	P_0	**4.0(0.157) TYP.**
	P_2	**2.0 (0.079 ± 0.002) TYP.**
	t	**0.3 (0.012) TYP.**
	T	**18.4 (0.72) MAX.**
	W	**12.0 ± 0.3 (0.472 ± 0.012)**

THICKNESS OF TOP COVER TAPE 0.10 (0.004) MAX.

$*K_0$=1.7 ±0.1 (0.067) typ. for QTLP282-X

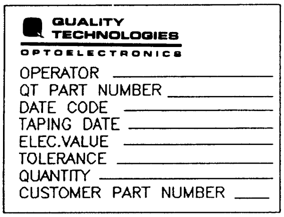


QT906C



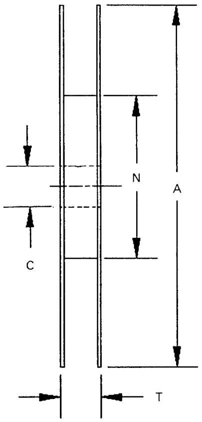
QT906C

TOLERANCES (UNLESS OTHERWISE SPECIFIED):
.X±0.1; .XX±0.05(.XXX±0.004)



QUALITY TECHNOLOGIES
OPTOELECTRONICS

OPERATOR __________
QT PART NUMBER __________
DATE CODE __________
TAPING DATE __________
ELEC.VALUE __________
TOLERANCE __________
QUANTITY __________
CUSTOMER PART NUMBER __________



ORDERING INFORMATION

To order MV6X00 subminiature lamps on tape and reel include appropriate standard lamp part number and suffix code to specify configuration and optional features.

EXAMPLES:
MV6000.GR—This specifies MV6000 lamp in Gull Wing Lead configuration on tape and reel.

MV6000.GB—This specifies MV6000 lamp in Gull Wing Lead configuration in bulk packaging

Suffix options:
GB = Gull Wing Lead, Bulk Packaging
GR = Gull Wing Lead, Tape and Reel
YB = Yoke Lead, Bulk Packaging
YR = Yoke Lead, Tape and Reel

MV6000 G R

Tape and Reel
Gull Wing Lead Configuration
Lamp Part Number

TAPE AND REEL SPECIFICATIONS FOR SURFACE MOUNT OPTIONS

ABSOLUTE MAXIMUM SOLDER RATING

Wave soldering temperature (1.6 mm (0.063″) from body)	260° for 3 seconds
Surface Mount Reflow Soldering:	
Convective IR	235°C for 90 seconds
Vapor phase	215°C for 3 minutes

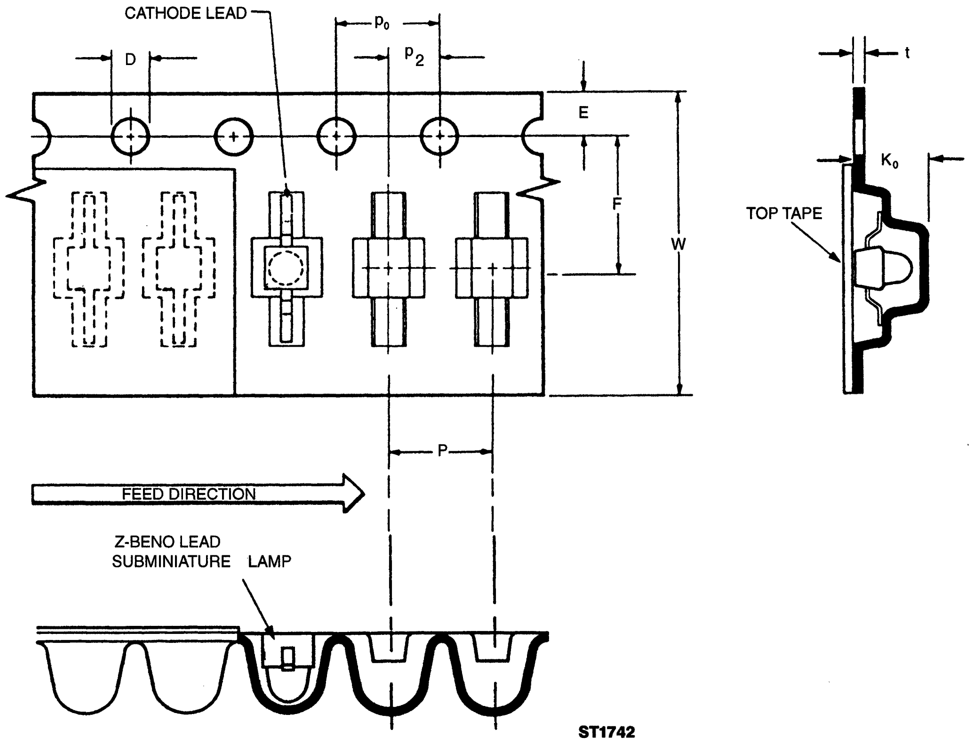
ABSOLUTE MAXIMUM SOLDER RATINGS AND ELECTRICAL/OPTICAL CHARACTERISTICS

The absolute maximum ratings and electrical/optical specifications are identical to the basic catalogue device, except for the vapor phase soldering rating as specified above.

TAPING OPTIONS

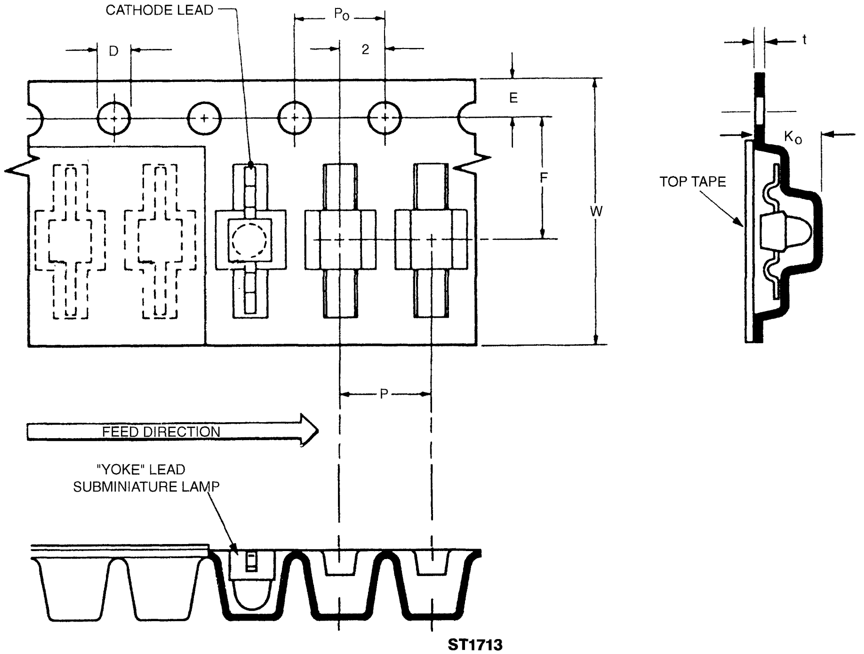
Tolerances (Unless otherwise Specified): .X±0.0; .XX±0.05; .XXX±0.004.

12 mm Tape & Reel, Z-Bend Lead, Option ZR



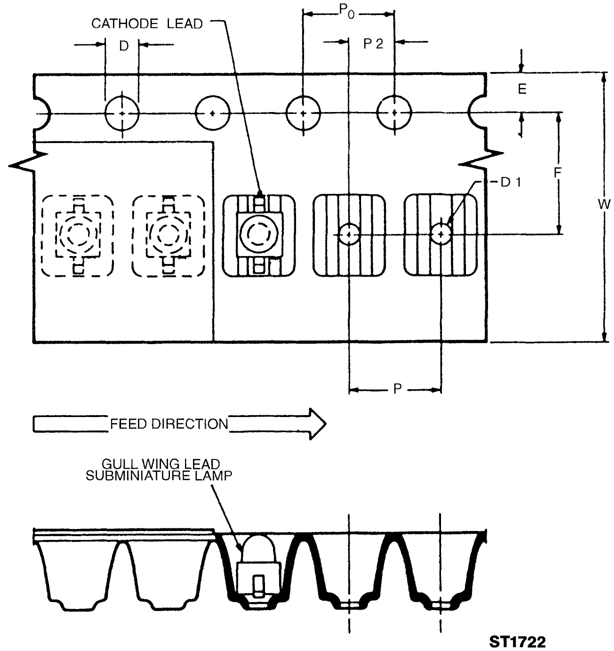
TAPE AND REEL SPECIFICATIONS FOR SURFACE MOUNT OPTIONS

12mm Tape & Reel, Yoke Lead, Option YR

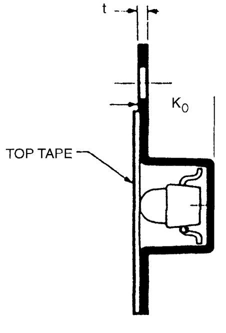


ST1713

12mm Tape and Reel, Gull Wing Lead, Option GR



ST1722



NOTES:
1. EMPTY COMPONENT POCKETS ARE SEALED WITH TOP COVER TAPE.
2. 7" REEL Z-BEND AND GULL WING; 1500 PIECES PER REEL. YOKE LEAD; 1200 PIECES PER REEL. FLAT PACKAGE; 2000 PIECES PER REEL.
3. MINIMUM LEADER LENGTH AT EITHER END OF THE TAPE IS 500 MM.
4. THE MAXIMUM NUMBER OF MISSING LAMPS IS TWO.
5. THE CATHODE OF ORIENTED TOWARDS THE TAPE SPROKET HOLE IN ACCORDANCE WITH ANSI/EIA RS-481 SPECIFICATIONS.

OPTOELECTRONICS

THE PHOTOMETRY OF LED'S
A PRIMER IN PHOTOMETRY

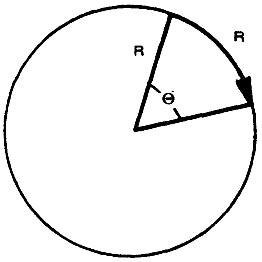
AN601

REVIEW OF GEOMETRIC PRINCIPLES

Any short discourse on the subject of photometry requires a brief review of geometric principles utilized.

RADIAN

In plane geometry the angle whose arc is equal to the radius generating it is called a radian. Therefore, if $C=2\pi R$ (Circumference of a circle) $2\pi R=360°$. Radian$=180°/\pi=57.27°$ (approx.).

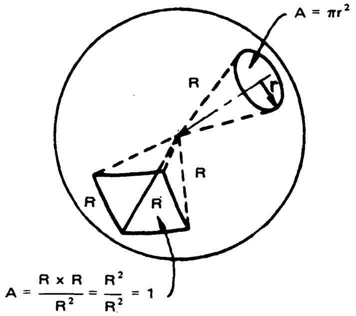


TWO DIMENSIONAL FIGURE

Fig. 1.

STERADIAN

In solid geometry one steradian is the solid angle subtended at the center of a sphere by a portion of the surface area equal to the square of the radius of the sphere. Therefore, if $AREA/R^2=1=1$ steradian and the area on the surface of a sphere equals $4\pi R^2$, then $4\pi R^2/R^2$ or 4π steradians of solid angle ω about the center of a sphere. The steradian is usually abbreviated as STER.



THREE DIMENSIONAL FIGURE

Fig. 2.

Other abbreviations of immediate concern are:

- Ae=Area of emitting (or reflecting) surface.
- Ap=Apparent area of an emitting source whose image is projected in space and viewed at some angle, θ.
- Ad=Detection area. Whether a physical target or merely a defined spatial area, it is the area of interest.

PHOTOMETRIC TERMINOLOGY
FLUX (Symbol F)

FLUX (Symbol F)

Any radiation, whether visible or otherwise, can be expressed by a number of FLUX LINES about the source, the number being proportional to the intensity of that source. This LUMINOUS flux is expressed in LUMENS for visible radiation.

LUMINOUS EMITTANCE (Symbol L)

A source measurement parameter. It is defined as the ratio of the luminous flux emitted from a source to the area of that source, or $L=F/Ae$. Typically expressed in units of:

lumens/cm² or one PHOT,
lumens/m² or one LUX (for one METER CANDLE),
lumens/ft² or one FOOT CANDLE.
The foot candle is the more common term used in this country.

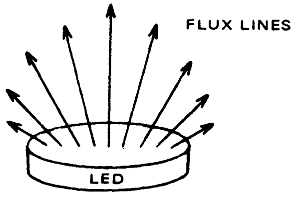


Fig. 3.

ILLUMINANCE (Symbol E)

This is a target or detector area measurement parameter. It is the ratio of flux lines incident on a surface to the area of that surface or E=L/Ad. Typical measurement units are the same for LUMINOUS EMITTANCE (above) i.e. lumen/cm^2=one phot, lumen/m^2=one lux, and lumen/ft^2=one ft. candle.

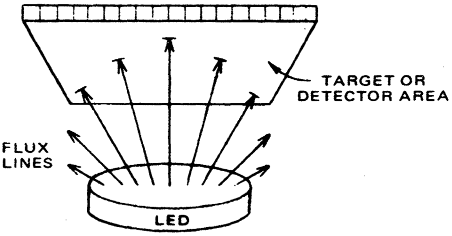


Fig. 4.

LUMINOUS INTENSITY (Symbol I)

A spatial flux density concept. It is the ratio of luminous flux of a source to the solid angle subtended by the detected area and that source. The LUMINOUS INTENSITY of a source assumes that source to be point rather than an area dimension. The LUMINOUS INTENSITY (or CANDLE POWER) of a source is measured in LUMENS/STERADIAN which is equal to one CANDELA (or loosely, one CANDLE).

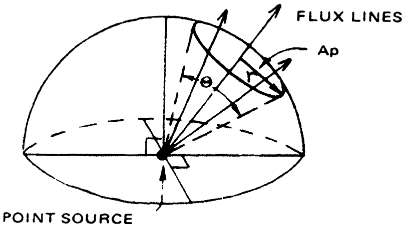


Fig. 5.

LUMINANCE (Symbol B)

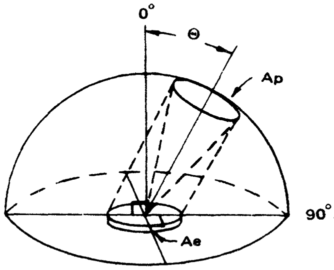
Sometimes called photometric brightness (although the term brightness should not be used alone as it encompasses other physiological factors such as color, sparkle, texture, etc.) it is applied to sources of appreciable area size. Mathematically, if the area of an emitter (circular for example) has a diameter or diagonal dimension greater than 0.1 the distance to the detector, it can be considered as an area source. If less than this 10% figure, the source can be treated as point in nature. This one to ten ratio of source diameter to distance is offered as it MATHEMATICALLY very closely approximates results obtained when comparing an area source to its point equivalent. LUMINANCE presents itself as an extremely useful parameter as it applies a figure of merit to:

1. Apparent or protected area of the source (Ap).
2. Amount of luminous flux contained within the projected area of the source (Ap).
3. Solid angle the projected area generates with respect to the center of the source.

NOTE: The projected area Ap varies directly as the cosine of θ i.e. max. at 0° or normal to the surface and minimum at 90°

$$Ap=Ae\cos\theta$$

LUMINANCE is defined as the ratio of LUMINOUS INTENSITY to the projected area of the source Ap.



$$\frac{\text{LUMINOUS INTENSITY}}{\text{Ap}} = \frac{\frac{\text{LUMENS}}{\text{STERADIAN}}}{\text{Ae}\cos\theta} = \frac{\text{CANDELAS}}{\text{(Sq. Unit)}}$$

And depending on the units used for area:

1 CANDELA/cm^2 = 1 STILB
1 CANDELA/m^2 = 1 NIT
1 CANDELA/in^2 =) no designator available.
1 CANDELA/ft^2 =)

Also:

1/π candela/cm^2 = LAMBERT
1/π candela/m^2 = APOSTILB (or BLONDEL)
1/π candela/in^2 = no designator available
1/π candela/ft^2 = FOOT LAMBERT

THE PHOTOMETRY OF LED'S
A PRIMER IN PHOTOMETRY

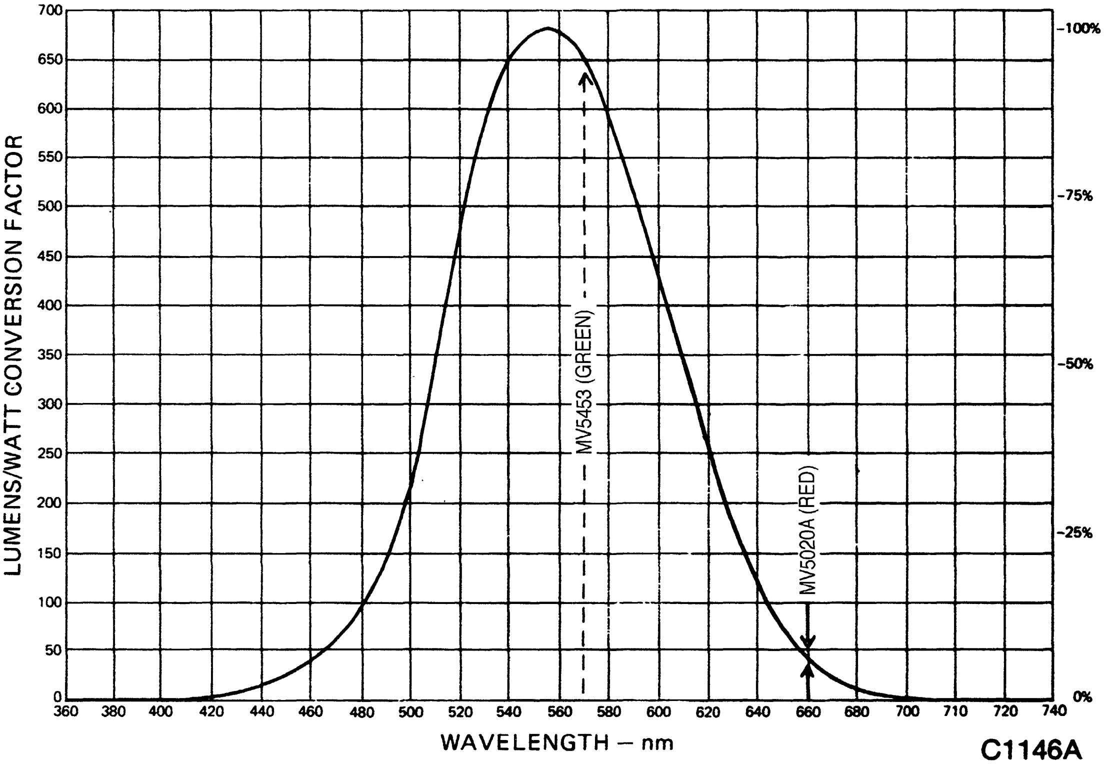
CIE CURVE

Following is the standard observer curve or "standard eyeball" established by the Commission Internationale de l'Eclair (commonly called the CIE curve). Whereas one watt of radiated energy at any frequency corresponds to one watt of radiated energy at any other frequency, this relationship fails to hold true for photometric measurement. The CIE curve is essential therefore, not only in determining the eye's efficiency at any particular wavelength, but also the corresponding lumens per watt conversion of that particular wavelength.

For example, the MV5020A which emits 180 μW of radiant energy at 6600Å (typical) or 41.4 lumens per watt has

$$180 \times 10^{-6} \text{ watts} \times \frac{41.4 \text{ lumens}}{\text{watt}} = 7.45 \text{ mLumens}$$

of flux emitted from it.



C1146A

Similarly, a green emitter such as the MV5453 operating at an identical input power as the red will emit 10 μwatts of radiant energy or

$$10 \times 10^{-6} \text{ watts} \times \frac{649 \text{ lumens}}{\text{watt}} = 6.49 \text{ mLumens}$$

of flux emitted from it. In short although there exists at least an order of magnitude difference in radiant power the eyes' compensating effect "magnifies" the green to appear equally bright.

THE PHOTOMETRY OF LED'S
A PRIMER IN PHOTOMETRY

LUMINOUS INTENSITY versus LUMINANCE

The successful application of either measurement parameter as a yardstick to duplicate mathematically the visual stimulation experienced by an observer is a controversy which will probably rage for some time. As the entire electromagnetic spectrum is bounded only by the capabilities of a detector to discern it, so for within the visual spectrum the eye is the limiting factor. SUBJECTIVELY speaking, the eye can discern finer increments of arc (computed from target to eye) than a 1 to 10 relationship, or approximately 5° 43 min. In fact, it can be shown that for view angles of much less than 2 minutes, the eye translates the source into a point and thus the photometric measurement of LUMINOUS INTENSITY (in candelas) most directly correlates with subjective brightness. For view angles of much greater than approximately 2 minutes, the eye sees the source as an area source, and thus the photometric measurement of LUMINANCE most directly correlates with subjective brightness. A two minute view angle computes to a 1/1666 ratio of source diameter to distance ratio. For the MV5025A this computes to approximately 22 feet (1666 x .16″ diameter, approximately 22 feet) well within the expected normal viewing distance of an observer.

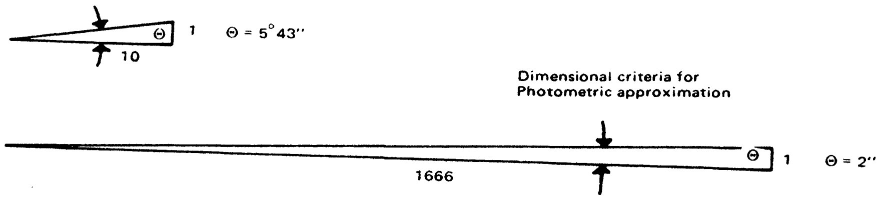


Fig. 7.

Considering that the usage of the discrete MV5025A LED is as an indicator and as such is utilized arms length or approximately 30″ away, it can be seen that the LUMINANCE parameter and its basic unit, the FOOT LAMBERT, most closely correlates with subjective brightness.

RADIOMETRY

While photometric units are concerned with only the visible spectrum of wavelength, all frequencies of emission, including the visible are expressable in RADIOMETRIC terms. Radiometric terms and their photometric equivalents are as follows:

RADIOMETRIC	PHOTOMETRIC
Radian flux (Symbol P) expressed in watts	**Luminous flux** (F) expressed in lumens
Irradiance (Symbol H) expressed in watts/sq. unit	**Illuminance** (E) expressed in lumens/sq. unit
Radiant Emittance (Symbol W) expressed in watts/sq. unit	**Luminous Emittance** (L) expressed in lumens/sq. unit
Radiant Intensity (Symbol J) expressed in watts/steradian	**Luminous Intensity** (Symbol I) expressed in lumens/steradian
Radiance (Symbol N) expressed in watts/ster/sq. unit	**Luminance** (B) expressed in lumens/ster/sq. unit

QT OPTOELECTRONICS

IMPROPER TESTING METHODS FOR LED DEVICES

AN603

In any manufacturing operation it is essential that the materials used in the fabrication process meet the minimum quality specifications of the device under production. To that end, prudent manufacturers establish specifications of the device under production. To that end, prudent manufacturers establish some sort of incoming quality assurance system to make sure that defective materials are culled at the door. It is equally important, however, that the screening system used in the Q.A. inspection does not reject materials which are acceptable, and that the testing procedures utilized in the system do not inadvertently damage materials which are otherwise acceptable. Unfortunately, this latter aspect of quality assurance procedures is often neglected, and whenever a device is rejected because of inappropriate testing methods, both the manufacturer and the vendor are subject to a great deal of unnecessary expense and inconvenience. Because many manufacturers who buy LED components are relatively inexperienced with the features and limitations of III-V devices, problems involving improper testing methods and unnecessary materials rejection are of particular concern to LED vendors. This note is intended to familiarize the user with the basic electrical and opto-electrical properties of LED devices and to clear up some of the problems involved in testing them.

THE MATERIAL

Historically, silicon and germanium were the first semiconductor materials to have been used for p-n junction devices such as transistors, diodes, and solar cells. However, following closely upon the invention of the germanium transistor in 1948, work was begun on predicting the semiconductivity of a material from its chemical compound. Based on energy band-gap experimentation, it was discovered that III-V materials have semiconductor properties.[1]

Gallium semiconducting materials, Gallium Arsenide (GaAs), Gallium Arsenide Phosphide (GaAsP), and Gallium Phosphide (GaP) are the materials from which LED's are fabricated. These materials have the ability to emit a narrow band of monochromatic light in either the visible or infrared spectrum, depending on the constituent and ratio of ingredients. The mechanism for this emission of radiant energy is best described in terms of semiconductor Energy-Band Theory. When an external, forward-biasing voltage is applied to a p-n junction, the conduction mechanism is such that electrons are excited by the electric field, gaining enough energy to cross the energy gap from the valence band to the conduction band, and then to relax back from the conduction band into the valence band. During the transition from the valence band to the conduction band, the electrons take energy from the field. As they pass back into the valence band, the electrons release this energy in the form of light photons. The amount of energy released is determined by the width of the energy gap. (The wavelength, or color, or the light is a function of the energy gap.) The light is emitted directly from the electrons within the depletion region formed between the two sides of the junction.

The electrical characteristics of LED's are also related to the energy gap. For example, the conduction threshold, or "knee" point on the I_f/V_f curve in the forward-biased direction occurs as approximately 1.0 volts for infrared LED's, at approximately 1.3 volts for visible red LED's, and from 1.8 to 2 volts for yellow and greed LED's. The brightness of the light is directly proportional to the operating current flowing in the forward direction.

GALLIUM VS. SILICON

As a semiconductor, III-V compounds using Gallium have several advantages over silicon and germanium—reverse leakage current is several orders of magnitude lower; forward current is lower below the "knee" point; inherent thermal noise is lower; and carrier mobility is high. Perhaps the greatest advantage, certainly where LED's are concerned, is the ability to produce light directly from electron flow.

Figure 1 shows a comparison between the forward conduction characteristics of diodes formed from III-V materials and silicon. Notice that the "knee" of the conduction curve for the Gallium diodes occurs at higher voltages, and is harder than the "knee" of silicon diodes. Notice also that as the wavelength progresses from the infrared toward the blue end of the spectrum, the GaAsP "knee" points get progressively higher and the slope of the I_f/V_f curve tends to decrease. Excluding exotic devices such as Schottky or Esaki diodes, silicon diode devices normally show little difference in the forward conduction curve.

The reverse characteristics of III-V materials are similar to those of silicon except that silicon's thermal leakage

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[1] E.G. Bylander, *Materials for Semiconductor Functions* (New York, 1971), p. 17.

THE PHOTOMETRY OF LED'S
A PRIMER IN PHOTOMETRY

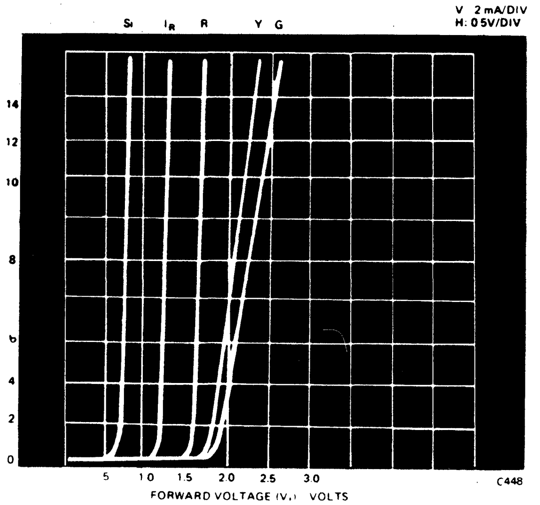

Fig. 1. Typical I_f/V_f Curves of Silicon, GaAs, and GaAsP, GaP (Silicon-IN914, IR-ME7024, Red-MV5053, Yellow-MV5353, Green-MV5253)

The reverse characteristics of III-V materials are similar to those of silicon except that silicon's thermal leakage current is higher at very low reverse voltages. The reverse breakdown voltages of silicon are typically higher, and the characteristics of silicon devices are usually controlled for reverse breakdown at particular voltages. The reverse breakdown characteristics of diodes used in LED devices are not particulary controlled, since the quality of light emission is the first priority. The MANX and MANXX series displays use LED's which have a typical reverse-mode breakdown voltage range of from 5 to 20 volts. However for guard-band purposes, the reverse voltage is specified on the data sheets at 5 volts minimum.

If a silicon device is subject to junction damage, it will often continue to perform adequately because of silicon's inherent annealing capability. When damage occurs to the junction of an LED device, however, the result is usually a softening of the "knee" or a flattening of the I_f/V_f curve. Although the device may continue to operate, performance will be less than satisfactory, and early failure may result.

DAMAGE MECHANISMS

The discussion which follows will treat, in some detail, the most common errors in LED test set-ups and will suggest either alternative testing methods or means by which improper testing methods can be corrected to produce more reliably accurate results.

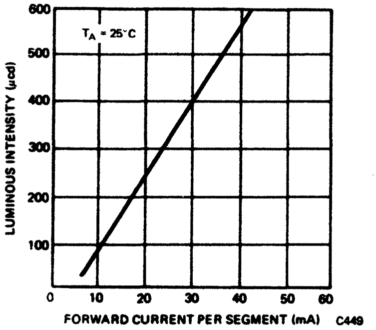

Fig. 2. Typical LED Curve Luminous Intensity vs. Forward Current for Constant Temperature

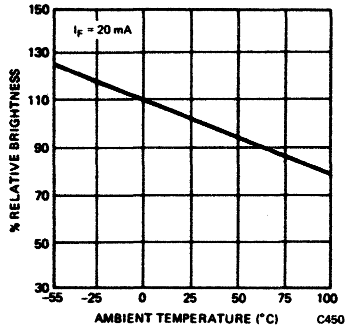

Fig. 3. Typical LED Curve Brightness vs. Temperature for Constant Current

Testing for Fabrication Defects

Thermal Shock—is a passive mode test involving a rapid refrigerate/heat cycle in which no current is applied to the device. This test is a good method for detecting weak bonds and, therefore, locating defective devices, but it should be used cautiously, especially with LED's. In LED's a 1-mil gold wire is bonded from the top of the die over to the side contact, whether it is lead frame or substrate. The wire is surrounded by the epoxy which encloses the die and forms the package. When the heat is applied, the epoxy, the gold, and the lead frame all expand at different rates. Thus, when the device is heated up too rapidly, the effects on the bond are similar to giving the wire a hard jerk. This action constitutes thermal shock and tends to weaken even good bonding and, consequently, shorten life expectancy.

Burn-In—consists of operating the device at elevated temperatures, thus accelerating the effects of operationally imposed heating. This method is frequently used in testing semiconductors, but its use is **not**

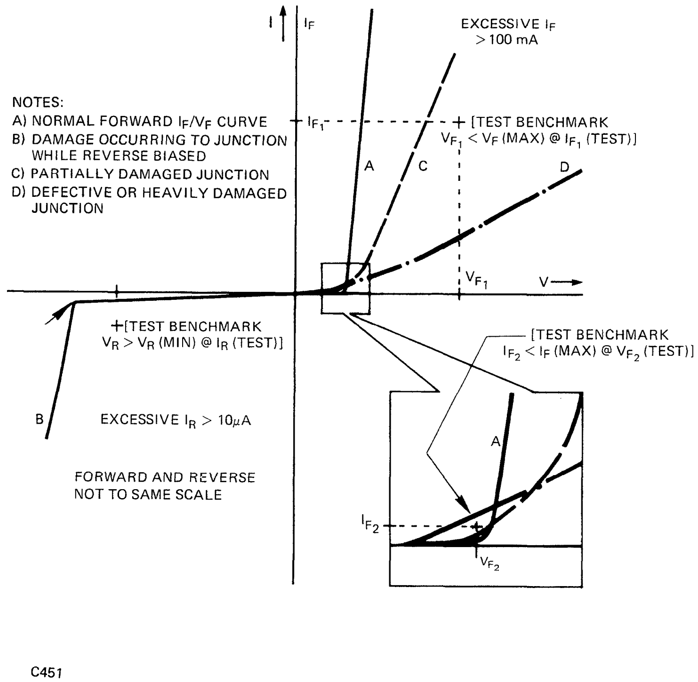

Fig. 4. Effects of Improper Testing Procedure

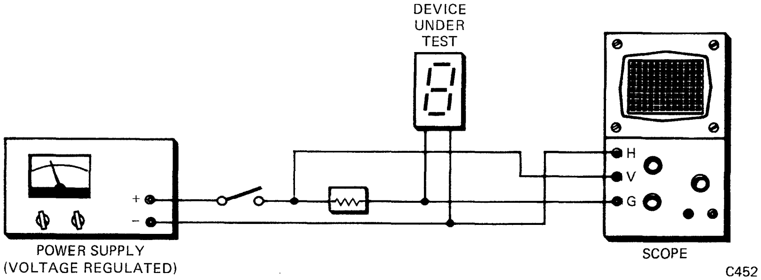

Fig. 5. Potentially Damaging Forward-Mode Test Setup

advised with LED's, especially if the testing involves operating with excess current or current which exceeds the device ratings for several hours. LED's exhibit a gradual degradation of brightness as a function of current, time, and temperature, and the higher the current, the faster the degradation. The graphs in Figures 2 and 3 illustrate typical LED responses to forward current and temperature. Exceeding the rated parameters in test can result in rapid degradation beyond an acceptable level. For the same reasons, burn-in is particularly inadvisable with LED's if the test set-up involves slow on-off cycles of overcurrent (cyclic room temperature to high temperature and then cooling).

Thermal Cycling—is an on-off cycling method which simulates operational heating effects. The device is allowed to heat up from room temperature with rated current, and is then cooled down. Thermal cycling is an excellent method for finding defective devices (poor bonds, fractures in the metalization, voids in the die-attach, etc.), and its use is recommended for testing LED's. Too often, such thermal cycling occurs in actual use, and defects are detected too late. However, to insure against exceeding the rated capabilities of a particular device, a thermal cycling test program (or operational program) should not be established without factory guidance.

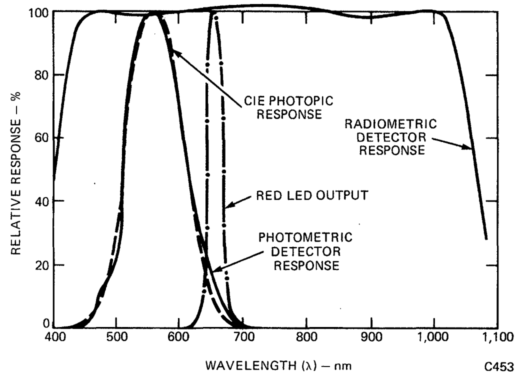

Fig. 6. Responses of Two Detectors to the Output of a Visible Red LED

Reverse Conduction Mode Problems

Reverse voltage testing can be hazardous since it may involve a system capable of delivering voltages and currents which considerably exceed the reverse voltage and power ratings of the device under test. Too much current at the avalanche voltage will dissipate excessive power, resulting in heat which will degrade the junction rapidly. The importance of adequate current limiting cannot be over-emphasized. Without it, damage to the junction can result from testing into the avalanche region and/or from the sudden application of voltage which exceeds the rated avalanche breakdown voltage of the device. Damage in the avalanche region is usually the result of an improperly set testing apparatus. As Figure 4 indicates, damage may not be immediately apparent, but it could result in poor performance during other test situations and possible rejection of the device due to excessive voltage or current values.

Forward Conduction Mode Problems

Forward mode testing is used to check such performance criteria as the forward V/I curve of the diode, brightness, ROP, and luminescence. The potential danger in examining the forward curve is damage to the diode junction, since the test circuitry can sometimes deliver very high energy bursts. For example, if a 50-volt regulated power supply is set for 5 volts to supply the test fixture, and if power is supplied through a switch as shown in Figure 5, it is possible to deliver current pulses of a high enough amplitude to result in junction damage. This problem is easily avoided by supplying low voltage power with current limiting to the test fixture. Another acceptable method, and the one which is used by General Instrument quality assurance engineers, is to use a power supply which is both full voltage regulated and current limited.

Brightness Tests

Optical measurements are typically, and in most instances, unavoidably, of very low accuracy. Optical measurements with errors of less than 1% are rare, and accuracy within 5% is difficult to obtain. With an experienced technician using good equipment it is possible to secure accuracy within 10% to 20% on a routine basis, but even here a slight difference in technique can result in errors in excess of 50%.

Detectors—A good detector approximates the CIE curve area with 2%. However, it is important to note that even when the detector is within 2% of perfect, it is still possible to produce mismatches at specific wavelengths which can cause the percentage of error to increase considerably. Therefore, in order to determine the margin of possible error, it is imperative that one know the detector's spectral response within the wavelength range of the device to be measured. To illustrate the problem of spectral mismatch, the reader is referred to Figure 6 where we show the responses of two detectors, a radiometric detector and a photometric detector, to the output of a visible red LED. The response of the radiometric detector is about 3% high. Notice, however, that the photometric detector, which provides a very close match to the CIE curve, produces a +25% error.[2]

Additional factors which must be considered are detector aging and filter deterioration, nonlinear detector responses, circuitry which is not temperature-compensated, and stray light. Periodic calibration is essential if a reasonable degree of accuracy is to be maintained.

Correlation Samples—Unless the testing apparatus is reciprocally related to a vendor-supplied correlation sample, test results may erroneously indicate that many devices in a shipment do not meet the minimum brightness that was specified on the order, and could result in the rejection of devices which do meet minimum standards. Correlation samples are also essential for the correction of instrumentation drift.

Subjectivity Problems—In some instances a visual comparison may be the best method for brightness testing. However, the manner by which the human eye "sees" is affected by various factors such as the nature of the light source, viewing distance, color, texture, the observer's visual acuity, and even the viewer's emotional state. Therefore, because of these highly subjective factors involved in human visual perception, such tests alone are usually inadequate and should be

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[2] Michael A. Zaha, "Shedding Some Needed Light on Optical Measurements," *Electronics,* November 6, 1972, pp. 94-96.

used only as a supplement to or in correlation with instrumentation. It has been our experience that manufacturers who rely solely on visual testing return many devices, a fair percentage of which can be reshipped and accepted.

Testing to Parameters Other Than Those Specified—This is a particularly important consideration when a manufacturer specifies his own parameters distinct from those normally specified. To avoid unnecessary rejection of devices, it is imperative that a device is **always tested to the parameters under which it will be expected to operate.**

SUGGESTIONS FOR PROPER TESTING

That which follows is a quick check list of "do's" which enable manufacturers to avoid many of the problems associated with running incoming quality assurance tests on LED's.

- In cooperation with the vendor, establish specifications which are economically feasible and ensure that devices are screened at their point of origin.
- Always obtain a correlation sample from the vendor before setting up the test procedure.
- Establish a reliable test procedure.
- Measure relevant parameters at relevant points.
- Make sure that the test circuitry will not erroneously indicate defects and that it will not generate failures later in the manufacturing cycle.
- Work closely with the vendor in establishing the test system.

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North American Sales
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Pine Brook, NJ.	(201) 227-7880
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Largo, FL.	(813) 530-1222
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Hauppauge, NY.	(516) 234-4000
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Rochester, NY.	(716) 387-9550
Beavercreek, OH.	(513) 426-0090
Mayfield Heights, OH.	(216) 449-6996
Beaverton, OR.	(503) 645-9454
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A company of Spoerle Electronic
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FAX - 06103/304201

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ITALY

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Silverstar Ltd.
Viale Fulvio Testi 280
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Nijverheidsstraat, 16
NL-7482 GZ Haaksbergen
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FAX - 5427-33 888

NORWAY

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FAX - 66/84 6545

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Quinta Grande, Lote 20
Alfragide
P-2700 Amadora
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FAX - 1/471 0802

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Allied Electronics Components
10 Skietlood Street
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SPAIN

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Albasanz 75
E-28037 Madrid
Tel. 1/304 3040
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Sutelco
Pilar de Zaragoza 23
E-28034 Madrid
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S-17 127 Solna
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FAX - 8/627 0280

SWITZERLAND

Elatex AG
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CH-5430 Wettingen
Tel. 056/275 111
FAX - 056/275 454

Fabrimex
Ein Unternehmen der Spoerle Electronic
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CH-8152 Opfikon-Glattbrugg
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Edinburgh Way
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DCD Electronics
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Belgium
Tel. 010/680 280
FAX - 010/680 282

Asian Authorized Reps and Distributors

AUSTRALIA

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Australia 2116,
Australia
Tel. (3) 467 4666
FAX - (3) 467 7183

HONG KONG

Tekcomp Electronics LTD., (REP)
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Kowloon,
Hong Kong
Tel. (2) 710 8121
FAX - (2) 780 5871

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