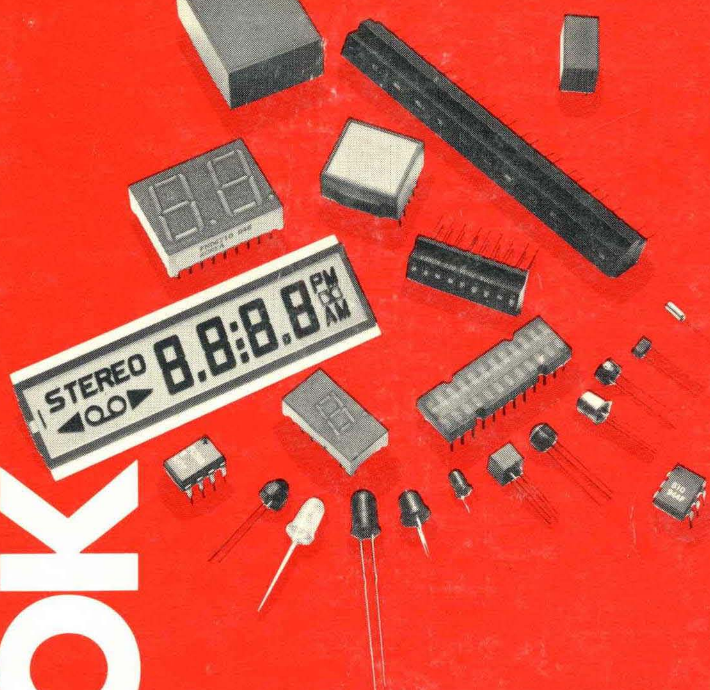
OPTOELECTRONICS DATA BOOK



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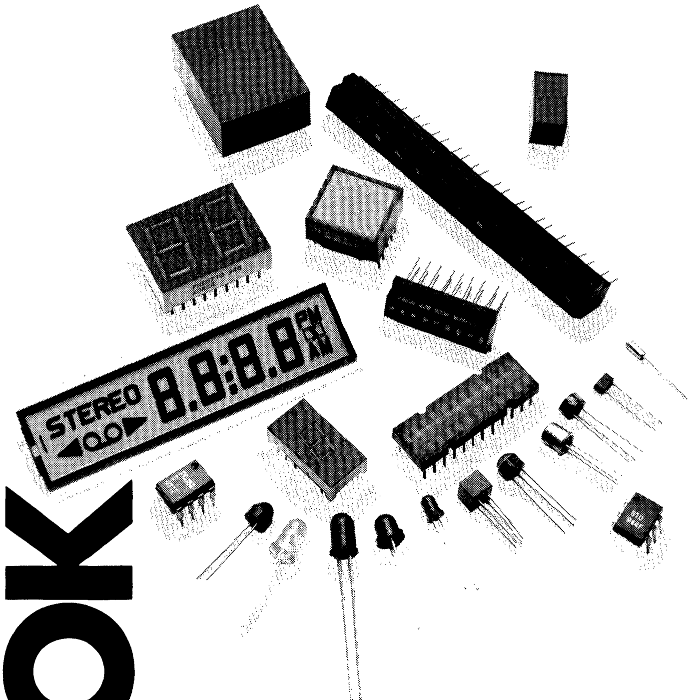

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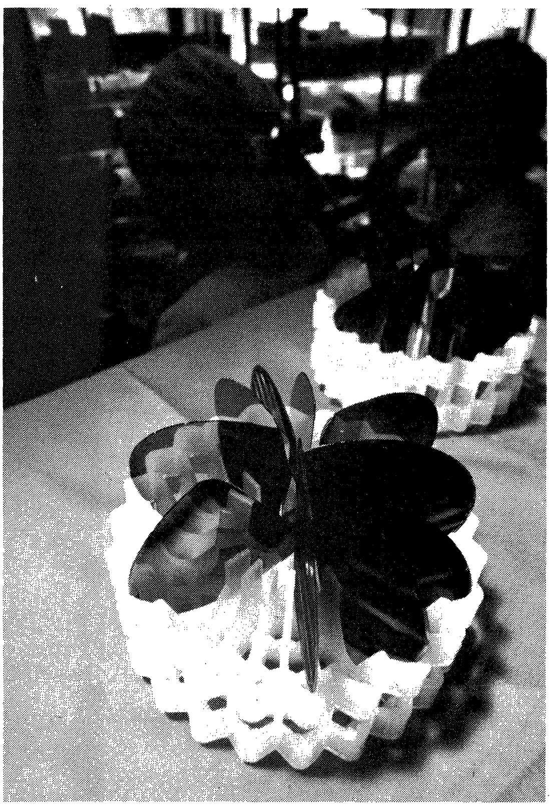
Introduction



The philosophy that quality must be built into each product starts in the fabrication process. These LED wafers were produced from ultra-pure materials in the controlled environment of Fairchild's crystal-growing facility. Here, each wafer is being carefully inspected for correct mask alignment prior to diffusion.

Welcome to Fairchild Optoelectronics!

From our introduction of a phototransistor into the marketplace 15 years ago, Fairchild Optoelectronics has grown to be a major supplier of quality opto-electronic products, offering the broadest product range in the industry, including:

LED Lamps and Lamp Hardware
7-Segment LED Displays and Display Arrays
Photocouplers
Phototransistors
Photodiodes
Photo Arrays
Liquid Crystal Displays

Within this product breadth are incorporated our philosophies of quality, reliability and cost-competitiveness, backed by a sincere belief in customer service and satisfaction.

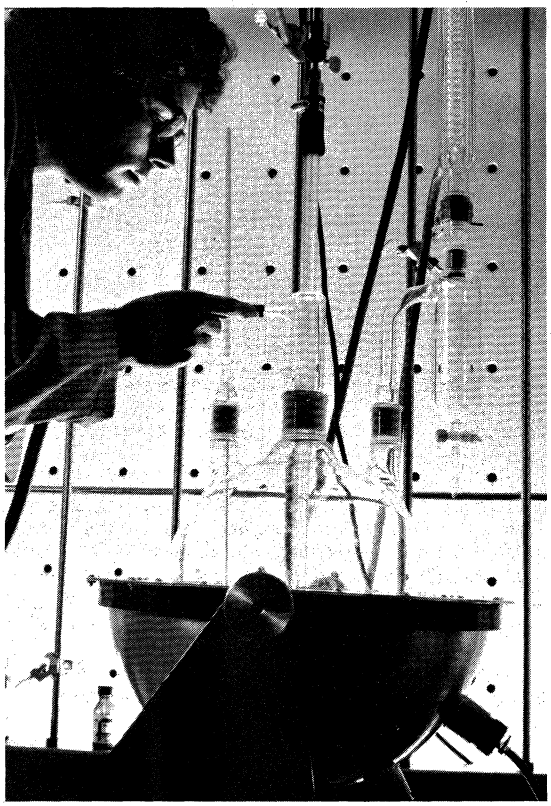
Our catalog has been designed with you, the customer, in mind. If you have further inquiries outside the realm of our data book, we hope you will contact the local Fairchild sales office, franchised distributor or sales representative in your area. A complete listing of these worldwide locations is contained in Section 10.

We welcome you to the world of Fairchild Opto-electronics. We look forward to serving your opto-electronic requirements.

Our Philosophies

Quality—*built-in*
The philosophy of the Optoelectronics R&QA department is that quality must be built into each and every optoelectronic device that leaves Fairchild for the marketplace. *Built-in* quality begins in the product design stages and continues, under strict monitoring, throughout the development, production and testing of that product. All semiconductor and liquid-crystal materials used in processing LEDs, phototransistors and LCDs are produced by Fairchild, with optimum yield, superior quality and reliability as prime design considerations. Product testing and comparative studies are ongoing processes at Fairchild in our continuous search for newer and more effective methods of manufacturing products with *built-in* quality.

Introduction (Cont'd)



Fairchild maintains a high standard of process control by manufacturing many of the primary fabrication materials. This research chemist is experimenting with new compounds to improve LCD performance. Fairchild is one of the few companies that produces its own liquid crystal material.

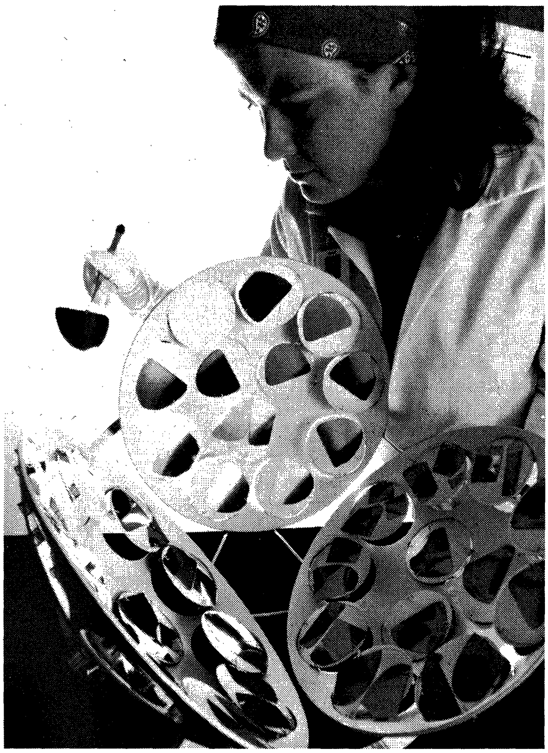
Service—*timely*
The philosophy of our service groups is based on *timeliness.* With Fairchild sales offices, sales representatives and franchised distributors based worldwide, the ability for us to respond to a customer request is only a local phone call away. Our sales teams are eager to respond to all customer requests, from answering product and pricing questions, to arranging technical seminars and training sessions. Included within our vast network of field sales offices are our field application engineers, trained specialists who offer valuable technical assistance and recommendations regarding our optoelectronics line. In addition to field support, we have a factory equally dedicated to serving customer needs. Our Customer-Service team is a group of conscientious, customer-oriented people whose main objective is supplying accurate information in a *timely* manner. A customer's time is highly respected and considered when our services are required, and customer satisfaction is a primary goal.

Delivery—*credible*
The philosophy of our Production Control department is based on *credibility.* We currently enjoy the position of being able to quote short lead times on most of our optoelectronic products and offer products that are available *now.* Current lead times for all our optoelectronic devices are telexed to every Fairchild sales office around the world on a monthly basis. Our Production Control staff consistently reviews the influx of new orders against our current backlog in order to accurately gear production capacity to meet customer demand.

Our Product

LED Lamps
Semiconductor lamps have come a long way from the large incandescent lamps of the past. The reduction in both size and power consumption has allowed these tiny LEDs to be used in an expanding range of applications, from general-purpose indicators to show on/off status, to being the light source for activating phototransistors. Fairchild Optoelectronics offers a variety of both diffused and non-diffused (point source) lamps in a wide range of packages, profiles, colors and luminous intensities. We offer our own proprietary (FLV) lamp series, in addition to second sourcing several GI (MV), TI (TIL) and HP (5082) series lamps. Lamp hardware is also available for both our proprietary lamp series and for our second-source GI lamps.

Introduction (Cont'd)



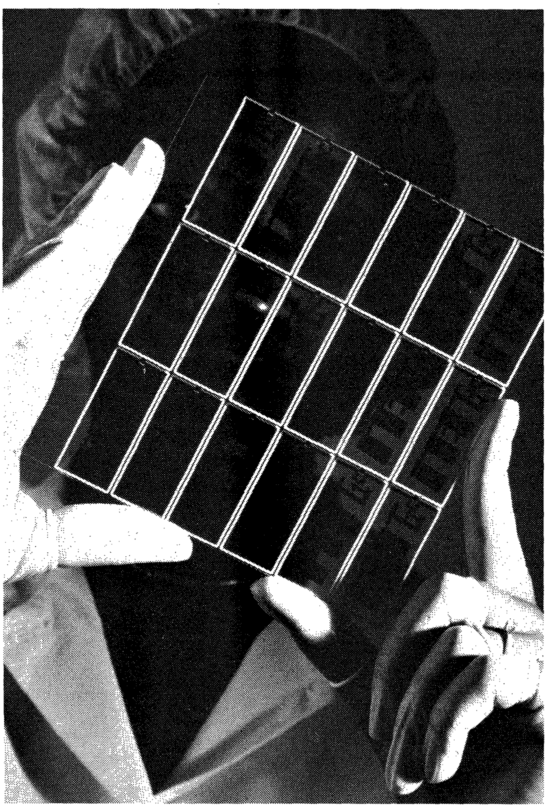
Fairchild Optoelectronics' modern Palo Alto facility fabricates wafers for LED display and photo devices. This technician is preparing wafers for aluminum coating.

LED Displays
With the advent of LED watches, clocks and calculators in the consumer marketplace came an increased demand for electronic digital read-outs in many other marketplaces. Their popularity continues to grow, as applications expand into gas pumps, microwave ovens, TV channel indicators, industrial test equipment and electronic toys and games. Fairchild Optoelectronics' line of 7-segment LED displays continues to grow with this increasing demand, offering a variety of colors, including red, orange, yellow and green. Digit sizes include .3-inch, .362-inch, .5-inch, .56-inch and .8-inch. In addition, we offer both the air-gap light pipe and filled-digit technologies. Our digit line includes our own proprietary FND series, in addition to second sourcing several GI (MAN) and HP (5082) series digits. Hardware is also available for our .362-inch line.

Photo
From the introduction of one phototransistor 15 years ago, Fairchild Optoelectronics' photo line now encompasses over 150 device types offering a wide range of both proprietary and second-source products in a variety of packages. This range includes photocouplers, phototransistors, photodiodes, photo emitters and photo arrays. In the photocoupler line we offer both transistor and Darlington output in the standard 6-pin mini DIP and in the 8-pin DIP. Not only do we offer our FCD proprietary series and the standard JEDEC 4N coupler series, we also second source TI (TIL series), GI (MCT and MCA series), GE (H11 series) and Litronix (ILD series). In the other photo areas, we offer many highly sensitive, highly reliable photo emitters and photosensors in a variety of packages for use in both the visible and infrared light ranges. Package options include plastic, glob top, TO-18 and miniature coaxial.

Introduction (Cont'd)

LCD (Liquid Crystal Displays)
The addition of LCD technology to the Fairchild Optoelectronic group continues our commitment to serve the ever-expanding optoelectronic marketplace with the most suitable device and technology for the optimum end customer application. LCD has become the preferred technology over LED in many modern design applications due to its low power consumption, excellent readability in full sunlight and its alphanumeric capabilities. Our commitment to quality and reliability in our LCD product line starts with our unique, fully hermetic glass-frit seal technique. This technique is used on all displays to seal the LCD material from the external environment for long-term display reliability and performance. Our current standard LCD line offers both a variety of watch displays and large area displays (LAD), including 3½- and 4-digit digital panel meter-type displays, a 4-digit stereo display, a 12-digit telephone display and an 8-digit alphanumeric display. Custom displays, outside the realm of our standard LCD line, are reviewed on an individual basis, and we welcome the opportunity to discuss and review your application needs.



Fairchild employs several innovative technologies for manufacturing LCD devices. This glass frit seal, along with a final solder seal, is a unique Fairchild feature that ensures both a fully hermetic package and long-term reliability.

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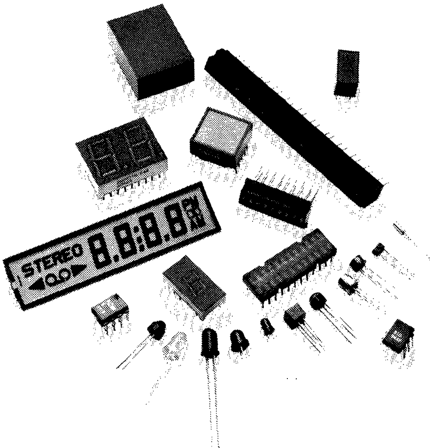
Alphanumeric Listing


STEREO

Section 1 Selection Guides

LED Visible Lamps

Device No.	Lens Characteristic	Max Forward Current mA	Typical Luminous Intensity mcd	Typical Forward Voltage @ I_F = 20 mA V	Data Sheet Page No.
FLV100	Red Point Source	50	0.5 @ 20 mA	1.8	2-4
FLV101	Red Diffused	50	0.45 @ 20 mA	1.8	2-4
FLV102	Red Diffused	50	1.0 @ 20 mA	1.8	2-4
FLV104	Clear	100	150 @ 100 mA	2.0*	2-6
FLV104A	Clear	100	150 @ 100 mA	2.0*	2-6
FLV110	Red Diffused	50	2.0 @ 20 mA	1.7	2-10
FLV111	Clear Point Source	50	2.0 @ 20 mA	1.7	2-13
FLV112	Clear Diffused	50	2.0 @ 20 mA	1.7	2-13
FLV117	Red Diffused	50	1.0 @ 20 mA	1.7	2-13
FLV140	Red Diffused	50	2.0 @ 20 mA	1.7	2-10
FLV150	Red Diffused	50	2.0 @ 20 mA	1.7	2-10
FLV160	Red Diffused	50	2.0 @ 20 mA	1.7	2-10
FLV310	Green Diffused	35	3.2 @ 20 mA	2.3	2-15
FLV340	Green Diffused	35	3.2 @ 20 mA	2.3	2-15
FLV350	Green Diffused	35	3.2 @ 20 mA	2.3	2-15
FLV360	Green Diffused	35	3.2 @ 20 mA	2.3	2-15
FLV410	Yellow Diffused	35	3.2 @ 20 mA	2.3	2-18
FLV440	Yellow Diffused	35	3.2 @ 20 mA	2.3	2-18
FLV450	Yellow Diffused	35	3.2 @ 20 mA	2.3	2-18
FLV460	Yellow Diffused	35	3.2 @ 20 mA	2.3	2-18
FLV510	Red Diffused	35	10 @ 20 mA	2.1	2-21
FLV540	Red Diffused	35	10 @ 20 mA	2.1	2-21
FLV550	Red Diffused	35	10 @ 20 mA	2.1	2-21
FLV560	Red Diffused	35	10 @ 20 mA	2.1	2-21

*I_F = 100 mA

LED Visible Lamps (Cont'd)

Device No.	Lens Characteristic	Max Forward Current mA	Typical Luminous Intensity mcd	Typical Forward Voltage @ I_F = 20 mA V	Data Sheet Page No.
MV5050	Clear Point Source	100	2.0 @ 20 mA	1.7	2-25
MV5051	Clear Diffused	100	1.6 @ 20 mA	1.7	2-25
MV5052	Red Point Source	100	2.0 @ 20 mA	1.7	2-25
MV5053	Red Diffused	100	1.6 @ 20 mA	1.7	2-25
MV5054-1	Red Semi-Diffused	100	2.0 @ 10 mA	1.8	2-28
MV5054-2	Red Semi-Diffused	100	3.0 @ 10 mA	1.8	2-28
MV5054-3	Red Semi-Diffused	100	4.0 @ 10 mA	1.8	2-28
MV5055	Red Diffused	100	0.6 @ 20 mA	1.7	2-31
MV5056	Red Diffused	100	0.8 @ 20 mA	1.7	2-31
MV5152	Amber Point Source	35	20 @ 20 mA	2.0	2-34
MV5153	Amber Diffused	35	4.0 @ 20 mA	2.0	2-34
MV5154	Amber Semi-Diffused	35	8.0 @ 20 mA	2.0	2-34
MV5252	Green Point Source	35	30 @ 20 mA	2.2	2-37
MV5253	Green Diffused	35	3.0 @ 20 mA	2.2	2-37
MV5254	Green Semi-Diffused	35	6.0 @ 20 mA	2.2	2-37
MV5352	Yellow Point Source	35	20 @ 20 mA	2.1	2-40
MV5353	Yellow Diffused	35	6.0 @ 20 mA	2.1	2-40
MV5354	Yellow Semi-Diffused	35	10 @ 20 mA	2.1	2-40
MV5752	Red Point Source	35	30 @ 20 mA	2.0	2-43
MV5753	Red Diffused	35	4.0 @ 20 mA	2.0	2-43
MV5754	Red Semi-Diffused	35	8.0 @ 20 mA	2.0	2-43
TIL209A	Red Diffused T-1	40	1.0 @ 20 mA	1.6	2-46
TIL212	Yellow Diffused T-1	30	4.0 @ 25 mA	1.6	2-46
TIL232	Green Diffused T-1	30	4.0 @ 25 mA	1.6	2-46
5082-4480	Red Diffused	50	0.8 @ 20 mA	1.6	2-48
5082-4483	Clear Diffused	50	0.8 @ 20 mA	1.6	2-48
5082-4486	Clear Point Source	50	0.8 @ 20 mA	1.6	2-48

LED Lamp Mounting Hardware

Device No.	Panel Thickness	Panel Hole	Description	Data Sheet Page No.
FLS010	.060 to .250	.265 ±.002	1-Piece Black Panel Mount Adapter for LED Lamps	2-3
MP52	.125	.250 ±.003	2-Piece Black Panel Mount Adapter for LED Lamps	2-24

7-Segment Numeric Displays

Device No.	Character Height Inches	Polarity	Color	Description	Decimal Point	V_F $I_F = 20$ mA/Seg V	Luminous/Typ Intensity/Seg $I_F = 20$ mA μcd	Data Sheet Page No.
FND350	.362	CA	Red	7-Segment Display	RH	1.7	450	3-5
FND357	.362	CC	Red	7-Segment Display	RH	1.7	450	3-5
FND358	.362	CC	Red	Overflow ± 1 Digit	RH	1.7	450	3-9
FND360	.362	CA	Red	7-Segment Display	RH	1.7	900	3-5
FND367	.362	CC	Red	7-Segment Display	RH	1.7	900	3-5
FND368	.362	CC	Red	Overflow ± 1 Digit	RH	1.7	900	3-9
FND500	.500	CC	Red	7-Segment Display	RH	1.7	600	3-12
FND501	.500	CC	Red	Overflow ± 1 Digit	RH	1.7	600	3-15
FND507	.500	CA	Red	7-Segment Display	RH	1.7	600	3-12
FND508	.500	CA	Red	Overflow ± 1 Digit	RH	1.7	600	3-15
FND530	.500	CC	Grn	7-Segment Display	RH	2.2	2000	3-18
FND531	.500	CC	Grn	Overflow ± 1 Digit	RH	2.2	2000	3-21
FND537	.500	CA	Grn	7-Segment Display	RH	2.2	2000	3-18
FND538	.500	CA	Grn	Overflow ± 1 Digit	RH	2.2	2000	3-21
FND540	.500	CC	Yel	7-Segment Display	RH	2.2	1000	3-18
FND541	.500	CC	Yel	Overflow ± 1 Digit	RH	2.2	2000	3-21
FND547	.500	CA	Yel	7-Segment Display	RH	2.2	1000	3-18
FND548	.500	CA	Yel	Overflow ± 1 Digit	RH	2.2	2000	3-21
FND550	.500	CC	Amb	7-Segment Display	RH	2.2	2000	3-18
FND551	.500	CC	Amb	Overflow ± 1 Digit	RH	2.2	2000	3-21
FND557	.500	CA	Amb	7-Segment Display	RH	2.2	2000	3-18
FND558	.500	CA	Amb	Overflow ± 1 Digit	RH	2.2	2000	3-21
FND560	.500	CC	Red	7-Segment Display	RH	2.2	1200	3-12
FND561	.500	CC	Red	Overflow ± 1 Digit	RH	1.7	1200	3-15
FND567	.500	CA	Red	7-Segment Display	RH	1.7	1200	3-12
FND568	.500	CA	Red	Overflow ± 1 Digit	RH	1.7	1200	3-15
FND800	.800	CC	Red	7-Segment Display	RH	1.7	1100	3-24
FND807	.800	CA	Red	7-Segment Display	RH	1.7	1100	3-24
MAN71A	.300	CA	Red	7-Segment Display	RH	1.6	250	3-28
MAN72A	.300	CA	Red	7-Segment Display	LH	1.6	250	3-28
MAN73A	.300	CA	Red	Overflow ± 1 Digit	None	1.7	450	3-28
MAN74A	.300	CC	Red	7-Segment Display	RH	1.6	250	3-28

7-Segment Numeric Displays (Cont'd)

Device No.	Character Height Inches	Polarity	Color	Description	Decimal Point	V_F I_F = 20 mA/Seg V	Luminous/Typ Intensity/Seg I_F = 20 mA μcd	Data Sheet Page No.
MAN3610A	.300	CA	Orange	7-Segment Display	RH	2.5	510*	3-32
MAN3620A	.300	CA	Orange	7-Segment Display	LH	2.5	510*	3-32
MAN3630A	.300	CA	Orange	Overflow ±1 Digit	RH	2.5	510*	3-32
MAN3640A	.300	CC	Orange	7-Segment Display	RH	2.5	510*	3-32
MAN6610	.560	CA	Orange	7-Segment Display	RH	2.5	510*	3-36
MAN6640	.560	CC	Orange	7-Segment Display	RH	2.5	510*	3-36
MAN6710	.560	CA	Red	Dual-Digit Display	RH	1.7	250	3-39
MAN6740	.560	CC	Red	Dual-Digit Display	RH	1.7	250	3-39
5082-7650	.430	CA	Red	7-Segment Display	LH	2.0	1720	3-42
5082-7651	.430	CA	Red	7-Segment Display	RH	2.0	1720	3-42
5082-7653	.430	CC	Red	7-Segment Display	RH	2.0	1720	3-42
5082-7750	.430	CA	Red	7-Segment Display	LH	1.6	400	3-45
5082-7751	.430	CA	Red	7-Segment Display	RH	1.6	400	3-45
5082-7760	.430	CC	Red	7-Segment Display	RH	1.6	400	3-45

*I_F = 10 mA

LED Bar Graph Display, Digit Hardware

Bar Graph Display

Device No.	Character Height Inches	Polarity	Color	Description	Decimal Point	V_F I_F = 20 mA/Seg V	Luminous/Typ Intensity/Seg I_F = 20 mA μcd	Data Sheet Page No.
FNA12	.050	Both	Red	12-Element Bar Display	None	1.7	200	3-3

Digit Hardware

Device No.	Description	Data Sheet Page No.
FNS700	10-Position DIP Socket for Use with .362″ FND300 Series 7-Segment Displays	3-27

Photo Arrays

Device No.	Description	Source I_F mA/cell Max	Source V_F I_F = 50 mA V Typ	Sensor $I_{CE(lt)}$ H = 1.0 mW/cm² (GaAs) V_{CE} = 5.0 V mA Typ	Sensor $V_{CE(sat)}$ I_{CE} = 4.0 mA V Typ	Matching Factor $\frac{I_{OUT(Min)}}{I_{OUT(Max)}}$ I_F = 50 mA V_{CE} = 5.0 V Distance = 0.05″ Min	Matching Factor Typ	Data Sheet Page No.
FPA100	9-Element Source/ Sensor Array .100″ Centers Matched Pair	1.50	1.25	4.5	0.4	0.5	0.65	4-3
FPA101	12-Element Source/ Sensor Array .250″ Centers Matched Pair	1.50	1.25	4.5	0.4	0.5	0.65	4-3
FPA102	10-Element Source/ Sensor Array .087″ Centers Matched Pair	1.50	1.25	4.5	0.4	0.5	0.65	4-3

Photo Sensors

Device No.	Description	Diode I_F mA Max	Diode V_F $I_F = 20$ mA V Typ	Photo-Transistor V_{CEO} $I_{CE} = 1.0$ mA V Min	Combined I_{OUT} $I_F = 50$ mA $V_{CE} = 5.0$ V Distance = 0.40″ μA Min	Combined I_{OUT} μA Max	Data Sheet Page No.
FPA103	Light Reflective Transducer, Clear	75	1.25	12	20		4-8
FPA104	Light Reflective Transducer, Clear	75	1.25	12	60	180	4-8
FPA105	Light Reflective Transducer, Clear	75	1.25	12	80	160	4-8
FPA106	Light Reflective Transducer w/Ambient Light Filter	75	1.25	12	20		4-8
FPA107	Light Reflective Transducer w/Ambient Light Filter	75	1.25	12	60	180	4-8
FPA108	Light Reflective Transducer w/Ambient Light Filter	75	1.25	12	80	160	4-8

Photo Sensors (Cont'd)

Device No.	Description	I_{CE} mA Max	V_{CEO} I_C = 1.0 mA V Typ	$I_{CE(lt)}$ H = 10 mW/cm² Tung. @ 2854°K mA Typ	$V_{CE(sat)}$ H = 20 mW/cm² I_C = 500 mA V Typ	Matching Factor $\frac{I_{OUT(Min)}}{I_{OUT(Max)}}$ I_F = 50 mA V_{CE} = 5.0 V Distance = 0.05″ Min	Typ	Data Sheet Page No.
FPA700	9-Element Sensor Array .100″ Centers	25	35	1.75	0.16	0.5	0.65	4-11
FPA700A	9-Element Sensor Array .100″ Centers	25	35	1.75	0.16	0.75	0.85	4-11
FPA710	12-Element Sensor Array .250″ Centers	25	35	1.75	0.16	0.5	0.65	4-15
FPA710A	12-Element Sensor Array .250″ Centers	25	35	1.75	0.16	0.75	0.85	4-15
FPA720	10-Element Sensor Array .100″ Centers	25	35	1.75	0.16	0.5	0.65	4-19
FPA720A	10-Element Sensor Array .100″ Centers	25	35	1.75	0.16	0.75	0.85	4-19

Infrared Photo Emitters

Device No.	Description	I_F mA Max	V_F I_F = 100 mA V Typ	Wavelength @ Peak Emission nm Typ	Axial Intensity I_F = 100 mA mW/sr Typ	Data Sheet Page No.
FPE104	Lead Frame Package Narrow Beam	100	1.35	890	10	4-23
FPE106	Miniature .085″ × .150″ × .095″ Tall Flat Lens	100	1.35	890	0.4	4-26
FPE500	TO-18, Dome Lens	150	1.35	890	10.0	4-28
FPE510	TO-18, Flat Lens	150	1.35	890	1.0	4-28
FPE520	TO-18, Dome Lens	150	1.35	940	50	4-31
FPE530	TO-18, Flat Lens	150	1.35	940	5.0	4-31
FPE700	T-1 Clear Epoxy	40	1.35	890	2.0*	4-34
TIL38	T-1¾ Grey Tinted	150	1.40	940	12	4-72

*I_F = 40 mA

Phototransistors

Device No.	Description	V_{CEO} $I_C = 1.0$ mA V Min	Typ	$I_{CE(lt)}$ $V_{CE} = 5.0$ V mA Min	Typ	Max	$V_{CE(sat)}$ H = 20 mW/cm² V Min	Typ	Max	t_r/t_f µs Typ	Data Sheet Page No.
FPT100	Plastic, Dome Lens			H = 5.0 mW/cm²			I_C = 500 µA				
	General Purpose	30	50	0.2	1.4			0.16	0.3	2.8	4-35
FPT100A	Plastic, Dome Lens			H = 5.0 mW/cm²			I_C = 500 µA				
	1:3 Sensitivity	30	50	1.0	1.4	3.0		0.16	0.3	2.8	4-35
FPT100B	Plastic, Dome Lens			H = 5.0 mW/cm²			I_C = 500 µA				
	1:2 Sensitivity	30	50	1.3	1.4	2.6		0.16	0.3	2.8	4-35
FPT101	Miniature, 0.080″ Dia	I_C = 0.1 mA, H < 0.1 µW/cm²		H = 20 mW/cm²			I_C = 0.4 mA				
	Hermetic Package	30	60	0.8	3.5			0.25	0.3	2.8	4-39
FPT110	Plastic Flat Lens			H = 5.0 mW/cm²			I_C = 500 µA				
	General Purpose	30	50	0.2	0.88			0.16	0.33	2.8	4-35
FPT110A	Plastic Flat Lens			H = 5.0 mW/cm²			I_C = 500 µA				
	1:3 Sensitivity	30	50	0.6	0.88	1.8		0.16	0.33	2.8	4-35
FPT110B	Plastic Flat Lens			H = 5.0 mW/cm²			I_C = 500 µA				
	1:2 Sensitivity	30	50	0.8	0.88	1.6		0.16	0.33	2.8	4-35
FPT120	Plastic, Dome Lens			H = 1.0 mW/cm²			I_C = 1.0 mA				
	High Sensitivity	20	50	0.4	1.5			0.25	0.55	18	4-47
FPT120A	Plastic, Dome Lens			H = 1.0 mW/cm²			I_C = 1.0 mA				
	1:3 Sensitivity	15	30	1.5		4.5		0.25	0.55	18	4-47
FPT120B	Plastic, Dome Lens			H = 1.0 mW/cm²			I_C = 1.0 mA				
	1:1.5 Sensitivity	15	30	2.0		4.0		0.25	0.55	18	4-47
FPT120C	Plastic Cup,			H = 5.0 mW/cm²			I_C = 1.0 mA				
	Dome Lens	11	20	16		25		0.35	0.55	18	4-47
FPT130	Plastic, Flat Lens			H = 1.0 mW/cm²			I_C = 1.0 mA				
	High Sensitivity	20	50	0.4	0.9			0.25	0.55	18	4-47
FPT130A	Plastic, Flat Lens			H = 1.0 mW/cm²			I_C = 1.0 mA				
	1:3 Sensitivity	15	30	0.9		2.7		0.25	0.55	18	4-47
FPT130B	Plastic, Flat Lens			H = 1.0 mW/cm²			I_C = 1.0 mA				
	1:2 Sensitivity	15	30	1.2		2.4		0.25	0.55	18	4-47
FPT131	Plastic, Dome Lens			H = 5.0 mW/cm²			I_C = 500 µA				
		15	50	0.1	4.2			0.16	0.7	2.8	4-51
FPT132	Plastic, Dome Lens			H = 1.0 mW/cm²			I_C = 1.0 mA				
		10	30	0.2	1.5			0.15	0.7	18	4-55
FPT136	Plastic, Flat Lens			H = 5.0 mW/cm²			I_C = 500 µA				
		15	50	0.2	2.7			0.16	0.7	2.8	4-51

Phototransistors (Cont'd)

Device No.	Description	V_{CEO} I_C = 1.0 mA V Min	Typ	$I_{CE(lt)}$ V_{CE} = 5.0 V mA Min	Typ	Max	$V_{CE(sat)}$ H = 20 mW/cm² V Min	Typ	Max	t_r/t_f µs Typ	Data Sheet Page No.
FPT137	Plastic, Flat Lens			H = 1.0 mW/cm²			I_C = 1.0 mA				
		10	30	0.2	0.9			0.15	0.7	18	4-55
FPT400	Plastic, Dome Lens			H = 1.0 mW/cm²							
	Photo Darlington	30	60	3.0	7.5			0.9	1.0	100	4-58
FPT410	Plastic, Flat Lens			H = 1.0 mW/cm²							
	Photo Darlington	30	60	2.0	5.0			0.9	1.0	100	4-58
FPT500	TO-18, Dome Lens			H = 1.0 mW/cm²							
		45	60	1.0	3.0			0.16	0.33	3.0	4-60
FPT500A	TO-18, Dome Lens			H = 1.0 mW/cm²							
	1:3 Sensitivity	45	60	2.0		6.0		0.16	0.33	3.0	4-60
FPT510	TO-18, Flat Lens			H = 5.0 mW/cm²							
		45	60	0.5	1.5			0.16	0.33	3.0	4-62
FPT510A	TO-18, Flat Lens			H = 5.0 mW/cm²							
	1:3 Sensitivity	45	60	1.0		3.0		0.16	0.33	3.0	4-62
FPT520	TO-18, Dome Lens			H = 1.0 mW/cm²							
		30	60	5.0	8.0			0.16	0.33	8.0	4-60
FPT520A	TO-18, Dome Lens			H = 1.0 mW/cm²							
	1:3 Sensitivity	30	60	6.0		18		0.16	0.33	8.0	4-60
FPT530	TO-18, Flat Lens			H = 5.0 mW/cm²							
		30	60	3.0	5.0			0.16	0.33	10	4-62
FPT530A	TO-18, Flat Lens			H = 5.0 mW/cm²							
	1:3 Sensitivity	30	60	4.0		12		0.16	0.33	10	4-62
FPT540	TO-18, Dome Lens			H = 1.0 mW/cm²							
		12	30	8.0	1.5			0.25	0.55	18	4-60
FPT540A	TO-18, Dome Lens			H = 1.0 mW/cm²							
	1:3 Sensitivity	12	30	10		30		0.25	0.55	18	4-60
FPT550	TO-18, Flat Lens			H = 5.0 mW/cm²							
		12	30	8.0	10			0.25	0.55	18	4-62
FPT550A	TO-18, Flat Lens			H = 5.0 mW/cm²							
	1:3 Sensitivity	12	30	8.0		24		0.25	0.55	18	4-62
FPT560	TO-18, Dome Lens			H = 1.0 mW/cm²							
	Photo Darlington	30	60	10	30			0.9	1.0	100	4-64
FPT570	TO-18, Flat Lens			H = 5.0 mW/cm²							
	Photo Darlington	30	60	1.0	6.0			0.9	1.0	100	4-64
FPT610	Ceramic Miniature,			H = 5.0 mW/cm²			I_C = 500 µA				
	.085″ X .150″	30	60	0.2	1.0			0.16	0.33	18	4-66
FPT630	Flat Lens			H = 5.0 mW/cm²			I_C = 1.0 mA				
	.85″ X .185″ X 0.95″ Tall	20	60	2.0	5.0			0.16	0.33	18	4-66
FPT700	T-1, Clear Plastic			H = 5.0 mW/cm²							
	Phototransistor	15	50	0.10	0.88			0.16	0.7	2.8	4-68

Photodiodes

Device No.	Description	BV $I_R = 5.0\ \mu A$, $H \leq 0.1\ \mu W/cm^2$ Min	Typ	V_R V	I_R $V_R = -10$ V $H \leq 0.1\ \mu W/cm^2$ Typ	Max	I_{LT} $V_R = -10$ V $H = 20\ mW/cm^2$ Min	Typ	R(Tungsten) Responsivity $\mu A/mW/cm^2$ $T_C = 2854°K$ Min	Typ	R @ 0.9 μ Responsivity $\mu A/mW/cm^2$ No bias, GaAs Typ	Data Sheet Page No.
FPT102	Photodiode Hermetic Package	50	20	50	0.1	25	12	20	0.6	1.0	3.0	4-44
FPT720	Photodiode T-1 Clear Epoxy	120	160	50	0.3	35	15	25	0.6	1.0	3.9	4-70

Device No.	Output	Max Ratings @ T_A = 25°C					Coupled Characteristics			
			Transistor		Diode			Min Current Transfer Ratio		
		P_D mW	I_C mA	V_{CEO} V	V_R V	I_F mA	V_{ISO} kV	I_C/I_F %	@I_F mA	@V_{CE} V
FCD810(1)	Trans	250	25	20	3.0	60	1.5 ac	10	10	10
FCD810A(1)	Trans	250	25	20	3.0	60	1.5	10	10	10
FCD810B(1)	Trans	250	25	20	3.0	60	2.5	10	10	10
FCD810C(1)	Trans	250	25	20	3.0	60	5.0	10	10	10
FCD810D(1)	Trans	250	25	20	3.0	60	6.0	10	10	10
FCD820(1, 3)	Trans	250	25	30	3.0	60	1.5 ac	20	10	0.4
FCD820A(1)	Trans	250	25	30	3.0	60	1.5	20	10	10
FCD820B(1)	Trans	250	25	30	3.0	60	2.5	20	10	10
FCD820C(1)	Trans	250	25	30	3.0	60	5.0	20	10	10
FCD820D(1)	Trans	250	25	30	3.0	60	6.0	20	10	10
FCD825(1, 5)	Trans	250	25	30	3.0	60	1.5 ac	50	10	10
FCD825A(1, 5)	Trans	250	25	30	3.0	60	1.5	50	10	10
FCD825B(1, 5)	Trans	250	25	30	3.0	60	2.5	50	10	10
FCD825C(1, 5)	Trans	250	25	30	3.0	60	5.0	50	10	10
FCD825D(1, 5)	Trans	250	25	30	3.0	60	6.0	50	10	10
FCD830(2, 3)	Trans	250	25	30	3.0	60	1.5	20	10	0.4
FCD830A(2)	Trans	250	25	30	3.0	60	1.5 ac	20	10	10
FCD830B(2)	Trans	250	25	30	3.0	60	2.5	20	10	10
FCD830C(2)	Trans	250	25	30	3.0	60	5.0	20	10	10

Notes
1. Standard Transistor output
2. High-speed transistor output
   guaranteed 2.0 μs max t_r and t_f with 100 Ω R_L
   8.0 μs typ at 1 kΩ R_L
3. CTR guaranteed with transistor in saturation
4. JEDEC registered data and conditions
5. CTR typ at 1.0 mA = 40%

Device No.	Output	Max Ratings @ T_A = 25°C					Coupled Characteristics			
			Transistor		Diode			Min Current Transfer Ratio		
		P_D mW	I_C mA	V_{CEO} V	V_R V	I_F mA	V_{ISO} kV	I_C/I_F %	@I_F mA	@V_{CE} V
FCD830D(2)	Trans	250	25	30	3.0	60	6.0	20	10	10
FCD831(2)	Trans	250	25	30	3.0	60	1.5 ac	10	10	10
FCD831A(2)	Trans	250	25	30	3.0	60	1.5	10	10	10
FCD831B(2)	Trans	250	25	30	3.0	60	2.5	10	10	10
FCD831C(2)	Trans	250	25	30	3.0	60	5.0	10	10	10
FCD831D(2)	Trans	250	25	30	3.0	60	6.0	10	10	10
FCD836(2)	Trans	250	25	20	3.0	60	1.5 ac	6.0	10	10
FCD836C(2)	Trans	250	25	20	3.0	60	5.0	6.0	10	10
FCD836D(2)	Trans	250	25	20	3.0	60	6.0	6.0	10	10
FCD850	Darlg	250	125	30	3.0	80	1.5 ac	100	10	5.0
FCD850C	Darlg	250	125	30	3.0	80	5.0	100	10	5.0
FCD850D	Darlg	250	125	30	3.0	80	6.0	100	10	5.0
FCD855	Darlg	250	125	55	3.0	80	1.5 ac	100	10	5.0
FCD855C	Darlg	250	125	55	3.0	80	5.0	100	10	5.0
FCD855D	Darlg	250	125	55	3.0	80	6.0	100	10	5.0
FCD860(3)	Darlg	250	125	30	3.0	80	1.5 ac	200	1.0	1.0
FCD860C(3)	Darlg	250	125	30	3.0	80	5.0	200	1.0	1.0
FCD860D(3)	Darlg	250	125	30	3.0	80	6.0	200	1.0	1.0
FCD865(3)	Darlg	250	125	30	3.0	80	1.5 ac	400	0.5	1.0
FCD865C(3)	Darlg	250	125	30	3.0	80	5.0	400	0.5	1.0
FCD865D(3)	Darlg	250	125	30	3.0	80	6.0	400	0.5	1.0

Notes
1. Standard Transistor output
2. High-speed transistor output
   guaranteed 2.0 μs max t_r and t_f with 100 Ω R_L
   8.0 μs typ at 1 kΩ R_L
3. CTR guaranteed with transistor in saturation
4. JEDEC registered data and conditions
5. CTR typ at 1.0 mA = 40%

Couplers

Coupled Characteristics		Input Diode Characteristics		Output Transistor Characteristics			Output Darlington Characteristics			
T_r µs Typ	t_f µs Typ	V_F V Max	@ I_F mA	$V_{CE(sat)}$ V Max	@ I_C mA	@ I_F mA	I_{CEO} µA Max	@ V_{CE} V	Data Sheet Page No.	Device No.
4.0	4.0	1.5	10	0.7	2.6	50			5-3	FCD810[1]
4.0	4.0	1.5	10	0.7	2.6	50			5-3	FCD810A[1]
4.0	4.0	1.5	10	0.7	1.6	50			5-3	FCD810B[1]
4.0	4.0	1.5	10	0.7	2.6	50			5-3	FCD810C[1]
4.0	4.0	1.5	10	0.7	2.6	50			5-3	FCD810D[1]
2.5	2.5	1.5	60	0.4	2.0	10			5-6	FCD820[1, 3]
2.5	2.5	1.5	60	0.4	2.2	15			5-6	FCD820A[1]
2.5	2.5	1.5	60	0.4	2.2	15			5-6	FCD820B[1]
2.5	2.5	1.5	60	0.4	2.2	15			5-6	FCD820C[1]
2.5	2.5	1.5	60	0.4	2.2	15			5-6	FCD820D[1]
3.0	3.0	1.5	60	0.4	2.0	10			5-9	FCD825[1, 5]
3.0	3.0	1.5	60	0.4	2.0	10			5-9	FCD825A[1, 5]
3.0	3.0	1.5	60	0.4	2.0	10			5-9	FCD825B[1, 5]
3.0	3.0	1.5	60	0.4	2.0	10			5-9	FCD825C[1, 5]
3.0	3.0	1.5	60	0.4	2.0	10			5-9	FCD825D[1, 5]
1.6	1.6	1.5	60	0.4	2.0	10			5-11	FCD830[2, 3]
1.6	1.6	1.5	60	0.4	2.2	15			5-11	FCD830A[2]
1.6	1.6	1.5	60	0.4	2.2	15			5-11	FCD830B[2]
1.6	1.6	1.5	60	0.4	2.2	15			5-11	FCD830C[2]

Couplers (Cont'd)

1

Coupled Characteristics		Input Diode Characteristics		Output Transistor Characteristics			Output Darlington Characteristics			
T_r μs Typ	t_f μs Typ	V_F V Max	@ I_F mA	$V_{CE(sat)}$ V Max	@ I_C mA	@ I_F mA	I_{CEO} μA Max	@ V_{CE} V	Data Sheet Page No.	Device No.
1.6	1.6	1.5	60	0.4	2.2	15			5-11	FCD830D(2)
1.6	1.6	1.5	60	0.5	2.0	50			5-13	FCD831(2)
1.6	1.6	1.5	60	0.5	2.0	50			5-13	FCD831A(2)
1.6	1.6	1.5	60	0.5	2.0	50			5-13	FCD831B(2)
1.6	1.6	1.5	60	0.5	2.0	50			5-13	FCD831C(2)
1.6	1.6	1.5	60	0.5	2.0	50			5-13	FCD831D(2)
1.6	1.6	1.5	20	0.7	2.0	50			5-15	FCD836(2)
1.6	1.6	1.5	20	0.7	2.0	50			5-15	FCD836C(2)
1.6	1.6	1.5	20	0.7	2.0	50			5-15	FCD836D(2)
15	150	1.5	20	1.0	50	50	0.1	10	5-17	FCD850
15	150	1.5	20	1.0	50	50	0.1	10	5-17	FCD850C
15	150	1.5	20	1.0	50	50	0.1	10	5-17	FCD850D
15	150	1.5	20	1.0	50	50	0.1	10	5-17	FCD855
15	150	1.5	20	1.0	50	50	0.1	10	5-17	FCD855C
15	150	1.5	20	1.0	50	50	0.1	10	5-17	FCD855D
80	150	1.5	20	1.0	2.0	1.0	0.1	10	5-19	FCD860(3)
80	150	1.5	20	1.0	2.0	1.0	0.1	10	5-19	FCD860C(3)
80	150	1.5	20	1.0	2.0	1.0	0.1	10	5-19	FCD860D(3)
80	150	1.5	20	1.0	2.0	1.0	0.1	10	5-19	FCD865(3)
80	150	1.5	20	1.0	2.0	1.0	0.1	10	5-19	FCD865C(3)
80	150	1.5	20	1.0	2.0	1.0	0.1	10	5-19	FCD865D(3)

Device No.	Output	Max Ratings @ T_A = 25°C					Coupled Characteristics			
			Transistor		Diode			Min Current Transfer Ratio		
		P_D mW	I_C mA	V_{CEO} V	V_R V	I_F mA	V_{ISO} kV	I_C/I_F %	@I_F mA	@V_{CE} V
H11A1	Trans	250	100	30	3.0	60	2.5	50	10	10
H11A2	Trans	250	100	30	3.0	60	1.5	20	10	10
H11A3	Trans	250	100	30	3.0	60	2.5	20	10	10
H11A4	Trans	250	100	30	3.0	60	1.5	10	10	10
H11B1	Darlg	250	100	25	3.0	60	2.5	50	10	5.0
H11B2	Darlg	250	100	25	3.0	60	1.5	20	10	5.0
H11D1	Trans	250	25	300	6.0	50	2.5	20	10	10
H11D2	Trans	250	25	300	6.0	50	1.5	20	10	10
H11D3	Trans	250	25	200	6.0	50	1.5	20	10	10
H11D4	Trans	250	25	200	6.0	50	1.5	10	10	10
MCA230	Darlg	300	0.1	30	3.0	60	1.5	40	10	5.0
MCA231(3)	Darlg	300	0.1	30	3.0	60	1.5	4.0	1.0	1.0
MCA255	Darlg	300	0.1	55	3.0	60	1.5	40	10	5.0
MCT2	Trans	250	—	30	3.0	60	1.5	20	10	10
MCT2E	Trans	250	—	30	3.0	60	2.5	20	10	10
MCT26	Trans	250	—	30	3.0	60	1.5	6.0	10	10
TIL111(3)	Trans	250	—	30	3.0	100	1.5	7.0	16	0.4
TIL112	trans	250	—	20	3.0	100	1.5	2.0	10	5.0
TIL113(3)	Trans	250	—	30	3.0	100	1.5	100	10	1.0
TIL114(3)	Trans	250	—	30	3.0	100	2.5	7.0	16	0.4
TIL115	Trans	250	—	20	3.0	100	2.5	2.0	10	5.0
TIL116	Trans	250	—	30	3.0	100	2.5	5.0	10	10
TIL117	Trans	250	—	30	3.0	100	2.5	9.0	10	10
TIL118	Trans	250	—	20	3.0	100	1.5	10	10	5.0
TIL119	Darlg	250	—	30	3.0	100	1.5	160	10	2.0

Notes
1. Standard Transistor output
2. High-speed transistor output
   guaranteed 2.0 μs max t_r and t_f with 100 Ω R_L
   8.0 μs typ at 1 kΩ R_L
3. CTR guaranteed with transistor in saturation
4. JEDEC registered data and conditions
5. CTR typ at 1.0 mA = 40%

Couplers (Cont'd)

Coupled Characteristics		Input Diode Characteristics		Output Transistor Characteristics			Output Darlington Characteristics			
T_r µs Typ	t_f µs Typ	V_F V Max	@ I_F mA	$V_{CE(sat)}$ V Max	@ I_C mA	@ I_F mA	I_{CEO} µA Max	@ V_{CE} V	Data Sheet Page No.	Device No.
2.0	2.0	1.5	10	0.4	0.5	10			5-25	H11A1
2.0	2.0	1.5	10	0.4	0.5	10			5-25	H11A2
2.0	2.0	1.5	10	0.4	0.5	10			5-25	H11A3
2.0	2.0	1.5	10	0.4	0.5	10			5-25	H11A4
125	100	1.5	10	1.0	1.0	1.0	0.1	10	5-27	H11B1
125	100	1.5	10	1.0	1.0	1.0	0.1	10	5-27	H11B2
5.0	5.0	1.5	10	0.4	0.5	10			5-29	H11D1
5.0	5.0	1.5	10	0.4	0.5	10			5-29	H11D2
5.0	5.0	1.5	10	0.4	0.5	10			5-29	H11D3
5.0	5.0	1.5	10	0.4	0.5	10			5-29	H11D4
40	50	1.5	20	1.0	50	50	0.1	10	5-33	MCA230
40	50	1.5	20	1.0	2.0	1.0	0.1	10	5-33	MCA231(3)
40	50	1.5	20	1.0	50	50	0.1	10	5-33	MCA255
2.5	2.5	1.5	20	0.4	2.0	16			5-35	MCT2
2.5	2.5	1.5	20	0.4	2.0	16			5-35	MCT2E
2.5	2.5	1.5	20	0.5	1.6	60			5-35	MCT26
2.5	2.5	1.4	16	0.4	2.0	16			5-40	TIL111(3)
15.0	15.0	1.4	16	0.5	2.0	50			5-43	TIL112
50	50	1.5	10	1.0	125	50	0.1	10	5-45	TIL113(3)
2.0	2.0	1.4	16	0.4	2.0	16			5-40	TIL114(3)
15.0	15.0	1.5	10	0.5	2.0	50			5-43	TIL115
2.0	2.0	1.5	60	0.4	2.2	15			5-40	TIL116
2.0	2.0	1.4	16	0.4	0.5	10			5-40	TIL117
15.0	15.0	1.5	10	0.5	2.0	50			5-43	TIL118
50	50	1.5	10	1.0	10	10	0.1	10	5-45	TIL119

Device No.	Output	Max Ratings @ T_A = 25°C					Coupled Characteristics			
			Transistor		Diode			Min Current Transfer Ratio		
		P_D	I_C	V_{CEO}	V_R	I_F	V_{ISO}	I_C/I_F	@I_F	@V_{CE}
		mW	mA	V	V	mA	kV	%	mA	V
4N25(4)	Trans	250	—	30	3.0	80	2.5	20	10	10
4N26(4)	Trans	250	—	30	3.0	80	1.5	20	10	10
4N27(4)	Trans	250	—	30	3.0	80	1.5	10	10	10
4N28(4)	Trans	250	—	30	3.0	80	0.5	10	10	10
4N29(4)	Darlg	250	125	30	3.0	80	2.5	100	10	10
4N30(4)	Darlg	250	125	30	3.0	80	1.5	100	10	10
4N31(4)	Darlg	250	125	30	3.0	80	1.5	50	10	10
4N32(4)	Darlg	250	125	30	3.0	80	2.5	500	10	10
4N33(4)	Darlg	250	125	30	3.0	80	1.5	500	10	10
4N35(4)	Trans	300	—	30	6.0	60	3.5	100	10	10
4N36(4)	Trans	300	—	30	6.0	60	2.5	100	10	10
4N37(4)	Trans	300	—	30	6.0	60	1.5	100	10	10

Notes
1. Standard Transistor output
2. High-speed transistor output
   guaranteed 2.0 μs max t_r and t_f with 100 Ω R_L
   8.0 μs typ at 1 kΩ R_L
3. CTR guaranteed with transistor in saturation
4. JEDEC registered data and conditions
5. CTR typ at 1.0 mA = 40%

Couplers (Cont'd)

Coupled Characteristics		Input Diode Characteristics		Output Transistor Characteristics			Output Darlington Characteristics			
T_r μs Typ	t_f μs Typ	V_F V Max	@ I_F mA	$V_{CE(sat)}$ V Max	@ I_C mA	@ I_F mA	I_{CEO} μA Max	@ V_{CE} V	Data Sheet Page No.	Device No.
2.5	2.5	1.5	50	0.5	2.0	50			5-47	4N25(4)
2.5	2.5	1.5	50	0.5	2.0	50			5-47	4N26(4)
2.5	2.5	1.5	50	0.5	2.0	50			5-47	4N27(4)
2.5	2.5	1.5	50	0.5	2.0	50			5-47	4N28(4)
10	45	1.5	50	1.0	2.0	8.0	0.1	10	5-49	4N29(4)
10	45	1.5	50	1.0	2.0	8.0	0.1	10	5-49	4N30(4)
10	45	1.5	50	1.2	2.0	8.0	0.1	10	5-49	4N31(4)
10	120	1.5	50	1.0	2.0	8.0	0.1	10	5-49	4N32(4)
10	120	1.5	50	1.0	2.0	8.0	0.1	10	5-49	4N33(4)
8.0	8.0	1.5	10	0.3	0.5	10			5-51	4N35(4)
8.0	8.0	1.5	10	0.3	0.5	10			5-51	4N36(4)
8.0	8.0	1.5	10	0.3	0.5	10			5-51	4N37(4)

Device No.	Output	Max Ratings @ T_A = 25°C					Coupled Characteristics			
			Transistor		Diode			Min Current Transfer Ratio		
		P_D mW	I_C mA	V_{CEO} V	V_R V	I_F mA	V_{ISO} kV	I_C/I_F %	@I_F mA	@V_{CE} V
FCD880	Trans	400	30	30	3.0	60	2.5	30	10	10
FCD885	Trans	400	30	30	3.0	60	2.5	10	10	10
FCD890	Darlg	400	30	30	3.0	60	2.5	200	1.0	1.0
ILD74	Trans	150	30	20	3.0	100	1.5	12.5	16	5.0
MCT6	Trans	100	30	30	3.0	60	1.5	20	10	10
MCT66	Trans	100	30	30	3.0	60	1.5	6	10	10

Notes
1. Standard Transistor output
2. High-speed transistor output
   guaranteed 2.0 μs max t_r and t_f with 100 Ω R_L
   8.0 μs typ at 1 kΩ R_L
3. CTR guaranteed with transistor in saturation
4. JEDEC registered data and conditions
5. CTR typ at 1.0 mA = 40%

Dual Couplers

Coupled Characteristics		Input Diode Characteristics		Output Transistor Characteristics			Output Darlington Characteristics			
T_r µs Typ	t_f µs Typ	V_F V Max	@ I_F mA	$V_{CE(sat)}$ V Max	@ I_C mA	@ I_F mA	I_{CEO} µA Max	@ V_{CE} V	Data Sheet Page No.	Device No.
2.0	2.0	1.5	60	0.4	2.0	16			5-21	FCD880
2.0	2.0	1.5	60	0.3	2.5	20			5-21	FCD885
80	80	1.5	20	1.0	2.0	1.0	0.1	10	5-23	FCD890
6.0	6.0	1.3	60	0.5	2.0	16			5-31	ILD74
2.0	2.0	1.5	20	0.4	2.0	16			5-38	MCT6
2.0	2.0	1.5	20	0.4	2.0	40			5-38	MCT66

LCD Large Area Displays

Device No. (Note 1)	No. Digits	Digit Height in. (mm)	Package Size in. (mm)	Connector Type	Description	Data Sheet Page No.
FLB1208X1	12	.30 (7.6)	3.00 (76.20) X .866 (22.00)	Elastomer	Decimal after each digit	6-3
FLB3511X1	3½	.45 (11.4)	2.00 (50.80) X 1.20 (30.48)	Elastomer[2]	Decimals, Colon, ±, "BT" Indicator	6-6
FLB3513X1	3½	.50 (12.5)	2.00 (50.80) X 1.20 (30.48)	Elastomer	Decimals, Colon, ±, Arrow Indicator	6-9
FLB3513X2	3½	.50 (12.5)	2.00 (50.80) X 1.20 (30.48)	Pins	Decimals, Colon, ±, Arrow Indicator	6-9
FLB3513X3	3½	.50 (12.5)	2.00 (50.80) X 1.20 (30.48)	Elastomer	Decimals, Colon, ±, "LO BAT" Indicator	6-12
FLB3513X4	3½	.50 (12.5)	2.00 (50.80) X 1.20 (30.48)	Pins	Decimals, Colon, ±, "LO BAT" Indicator	6-12
FLB4010X1	4	.40 (10.2)	2.70 (68.58) X .866 (22.00)	Elastomer	Stereo Radio, Cassette Readout; Decimal, Colon, Stereo, Dolby™, AM, FM, PM, Cassette and Tape Direction Indicators	6-15
FLB4013X1	4	.50 (12.5)	2.00 (50.80) X 1.20 (30.48)	Elastomer	Decimals, Colon	6-17
FLB4013X2	4	.50 (12.5)	2.00 (50.80) X 1.20 (30.48)	Pins	Decimals, Colon	6-17
FLB4018X1	4	.70 (17.8)	2.75 (69.85) X 1.50 (38.10)	Elastomer	Decimals, Colon	6-20
FLB4018X2	4	.70 (17.8)	2.75 (69.85) X 1.50 (38.10)	Pins	Decimals, Colon	6-20
FLB8009X1	8	.35 (9.0)	3.00 (76.20) X .866 (22.00)	Elastomer	14-Seg, Alphanumeric, Upper and Lower Decimal	6-23

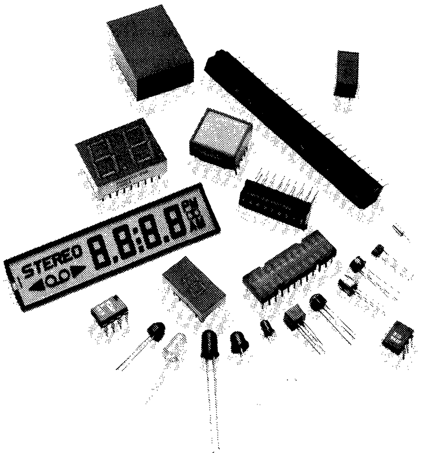
Notes
1. X specifies polarizer configuration
2. All connections made from side of display

™ Dolby and the double-D symbol are trademarks of Dolby Laboratories

LCD Watch Displays

Device No. (Note 1)	No. Digits	Digit Height in. (mm)	Package Size in. (mm)	Special Features	Data Sheet Page No.
FLB350401	3½	.160 (4.40)	.590 (15.00) X .354 (9.00)	Colon	6-27
FLB350407	3½	.150 (3.81)	.590 (15.00) X .354 (9.00)	Colon, Alarm Bell, P Annunciator	6-28
FLB350501	3½	.180 (4.57)	.808 (20.52) X .520 (13.21)	Colon	6-29
FLB350502	3½	.200 (5.08)	.827 (21.00) X .460 (11.70)	Colon	6-30
FLB350508	3½	.200 (5.08)	.808 (20.52) X .520 (13.21)	Colon, Alarm Bell, P Annunciator	6-31
FLB350601	3½	.220 (5.59)	.808 (20.52) X .520 (13.21)	Colon	6-32
FLB350701	3½	.263 (6.68)	.910 (23.10) X .570 (14.48)	Colon	6-33
FLB450401*	4½	.150 (3.81)	.590 (15.00) X .354 (9.00)	Colon, Alarm & PM Indicators	6-34
FLB450501*	4½	.200 (5.08)	.808 (20.52) X .520 (13.21)	Colon, Alarm & PM Indicators	6-35
FLB550503	5½	.210 (5.35)	.910 (23.10) X .570 (14.48)	Colon, Date, Day of Week Flags	6-36
FLB600301	6	.118 (3.00)	.583 (14.80) X .354 (9.00)	European Colon, A/N, Flag (1)	6-37
FLB600506	6	.190 (4.82)	.827 (21.00) X .460 (11.70)	European Colon, A/N, Flag (1)	6-38
FLB600601	6	.220 (5.59)	.941 (23.90) X .453 (11.50)	European Colon, A/N, Flag (1)	6-39
FLB600602	6	.220 (5.59)	.941 (23.90) X .453 (11.50)	European Colon, A/N, Flag (1)	6-40
FLB650401	6	.157 (4.00)	.910 (23.10) X .570 (14.48)	Colon, Chrono, Date, Alarm, A/N	6-41

*1980 proposed new product


STEREO

Front Panel Adapter For LED Lamp

FLS010

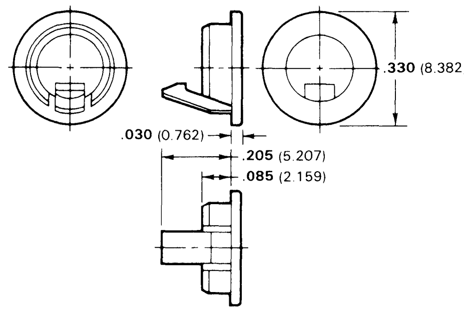
Optoelectronic Products

General Description
The FLS010 is a panel mount adapter specially designed for use with all Fairchild .200-inch LED lamps.

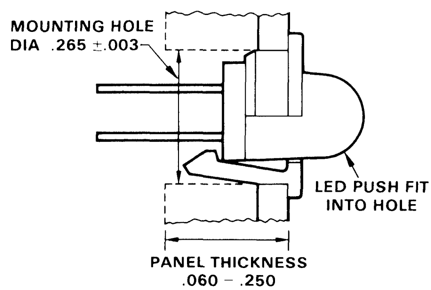
Single Part Construction
Simple Assembly Technique
Black Finish Gives Maximum On/Off Contrast
Fits Panels .060-Inch to .250-Inch Thick
Fits Lamps .280-Inch Through .360-Inch Tall
Removable From Either Front Or Rear
Orients To Flat On LED For Easy Polarity Inspection
Nearly Flush With Front Panel Surface
Requires Standard H-Size Drill Hole In Panel

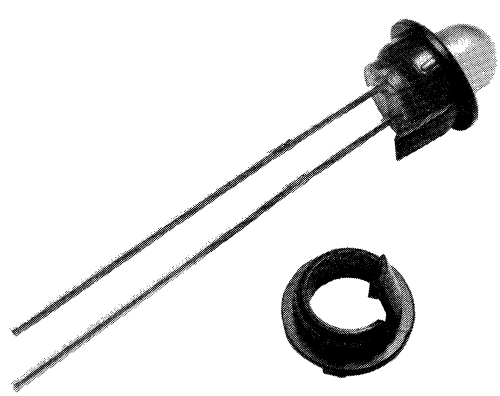
Mounting Instructions
1. The panel hole for the mounting clip should be 0.265-inch (±.002), and the hole edges should be deburred (this permits a 17/64-inch or H-sized drill to be used).
2. Insert the LED, lens first, with the flat flush against the tab, into the tab end of the clip. Press firmly until the tab snaps over the flat and locks the unit into the clip.
3. Insert the mounting clip and LED assembly into the panel hole, pins first, from the front side of the panel. Use a hollowed cylinder with an internal diameter greater than .200-inch and less than .24-inch (i.e., either a piece of 3/8-inch poly-flo tubing or 3/16-inch nut driver) to "press fit" the clip into the panel until the flange is seated snugly on the panel.

Dimensional Data



Typical Mounting Technique





Red GaAsP LED Lamps

Optoelectronic Products

FLV100
FLV101
FLV102

General Description

The FLV100, FLV101 and FLV102 are red light-emitting diodes encapsulated in plastic. Each light source is contained in a black case, giving excellent contrast when on, yet appearing black when off.

High Brightness—1500 fL @ 200 mA
Low Power Consumption—IC Compatible
Vibration/Shock Resistant
High On/Off Contrast
FLV100 Is A Highly Intense Point Source
FLV101 Is A Highly Diffused Light Source
Viewable Over A Full 180° Angle
Frosted Surface Eliminates Glare From Ambient Light
FLV102 Is A Large-Area Light Source

Absolute Maximum Ratings

Maximum Temperature and Humidity

Storage Temperature	−40°C to +100°C
Operating Temperature	−40°C to +100°C
Pin Temperature (Soldering 5 s .1-inch from seating plane)	250°C
Relative Humidity at 65°C	98%

Maximum Power Dissipation

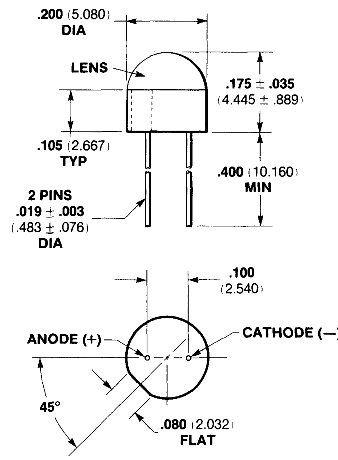
Total Dissipation at T_A = 25°C	100 mW
Derate Linearly from 25°C	1.3 mW/°C

Maximum Voltage and Currents

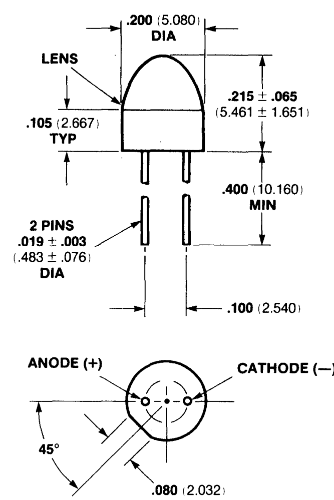
V_R	Reverse Voltage	3.0 V
I_F	Forward dc Current	50 mA

Package Outlines

FLV100/101



FLV102



Notes

*Package height of the FLV102 is **.190–.260** (4.826-6.604)
All dimensions in inches **bold** and millimeters (parentheses)
All pins electrically isolated from case
Tolerance unless specified = ±**.015** (±.381)

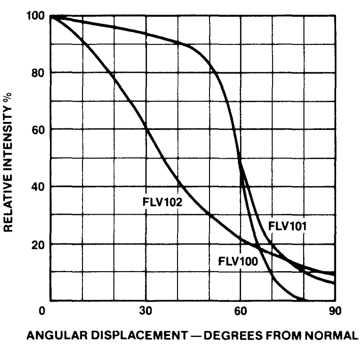
Typical Electrical Characteristic Curves

FLV100
FLV101
FLV102

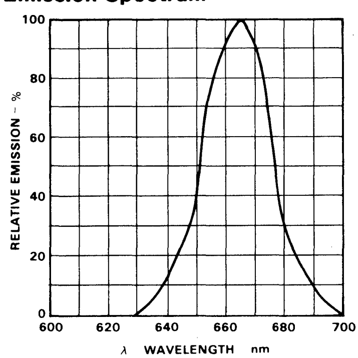
Electrical and Radiant Characteristics $T_A = 25°C$

Symbol	Characteristic	Min	Typ	Max	Units	Test Conditions
V_F	Forward Voltage		1.7	2.0	V	$I_F = 20$ mA
BV_R	Reverse Breakdown Voltage	3.0	8.0		V	$I_R = 10\ \mu A$
I_O	Axial Luminous Intensity					
	FLV100	.15	0.5		mcd	$I_F = 20$ mA
	FLV101	.10	0.45		mcd	
	FLV102	0.3	1.0		mcd	
λ_{pk}	Peak Wavelength		665			$I_F = 20$ mA
$\theta_{1/2}$	Angle of Half Intensity					
	FLV100		80		degrees	$I_F = 20$ mA
	FLV101		80		degrees	
	FLV102		30		degrees	

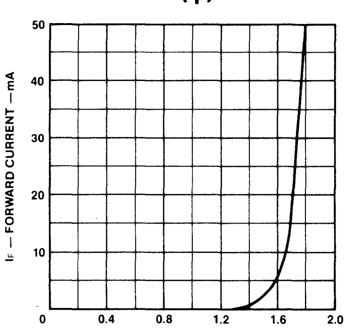
Relative Intensity vs Viewing Angle



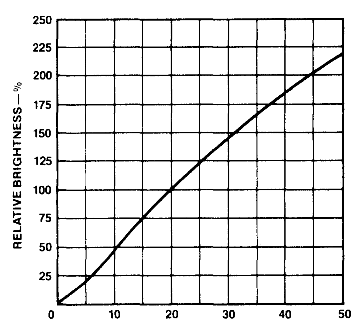
Emission Spectrum



Forward Current (I_F) vs Forward Voltage (V_F)



Brightness vs Forward Current (I_F)



Narrow Beam GaAsP Lamps

Optoelectronic Products

FLV104
FLV104A

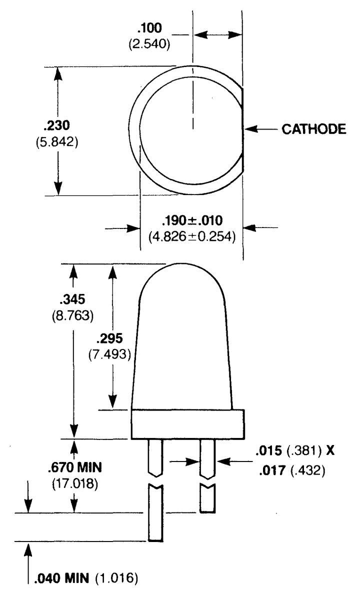
General Description

The FLV104 and FLV104A, narrow beam visible lamps, are high-intensity sources specifically intended for excitation of photosensors, especially photodiodes and transistors, when the separation distances are measured from millimeters to several meters.

The FLV104 and FLV104A are visible beam companion devices to the FPE104 infrared LED. All three devices have identical optics and therefore identical radiation patterns.

Very High Axial Intensity
Narrow Beamwidth
FLV104 8°
FLV104A 4°
Detectable at 30 ft

Package Outline



Notes
All dimensions in inches **bold** and millimeters (parentheses)
Tolerance unless specified = ±**.015** (±.381)

Absolute Maximum Ratings

Maximum Temperatures and Humidity

Storage Temperature	−55°C to +100°C
Operating Temperature	−55°C to +125°C
Pin Temperature (Soldering, 5 s)	260°C
Relative Humidity at 65°C	98%

Maximum Power Dissipation

Total Dissipation at T_A = 25°C	200 mW
Derate Linearly from 25°C	2.6 mW/°C

Maximum Voltages and Currents

V_R	Reverse Voltage	3.0 V
I_F	Forward dc Current	1.0 A
I_{pk}	Peak Forward Current (100 μs pulsewidth, 1% duty cycle)	100 mA

Electrical Characteristics T_A = 25°C

Symbol	Characteristic	Min	Typ	Max	Units	Test Conditions
V_F	Forward Voltage		2.0	2.5	V	I_F = 100 mA
BV_R	Reverse Breakdown Voltage	3.0	8.0		V	I_R = 10 μA

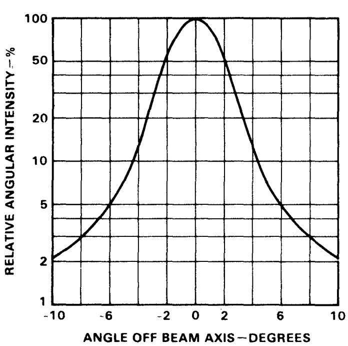
Typical Electrical Characteristics

FLV104
FLV104A

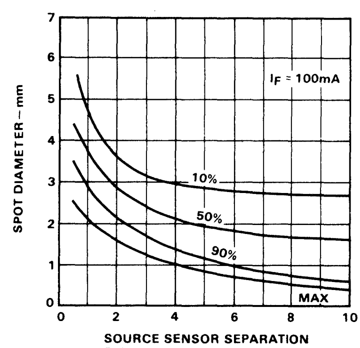
Optoelectronic Characteristics I_F = 100 mA, T_A = 25°C

Symbol	Characteristic	Min	Typ	Max	Units
I_L	Axial Luminous Intensity	50	150		mcd
I	Axial Radiometric Intensity		4.0		mw/sr
L	Average Effective Luminance		5.0		cd/cm^2
N	Average Effective Radiance (Axial)		140		$mw/sr/cm^2$
A_s	Effective Emitting Source Area (Axial)		0.028		cm^2
$\Delta I/\Delta T$	Temperature Coefficient of Intensity (Note 1)		0.5		%/°C
$\Delta I \Delta I_F$	Excitation Coefficient of Intensity (Note 1)		1.0		%/°C
λpk	Peak Spectral Wavelength		670		nm
$\Delta\lambda$	Spectral Bandwidth		20		nm
$\Delta\lambda pk/\Delta T$	Temperature Spectral Shift Coefficient (Note 2)		0.17		nm/°C
$\Delta\lambda pk/\Delta T_F$	Excitation Spectral Shift Coefficient (Note 2)		0.1		nm/mA
$\theta 50$	Beam Angle at 50% Axial Intensity		4.3		degrees
$\Delta\theta A$	Beam Axis to Mechanical Axis		1.5		degrees
t_r and t_f	Light Output Rise and Fall Time (Note 3)		10		ns
C_o	Capacitance (V = 0, f = 1.0 MHz)		100		pF

Beam Pattern of Intensity



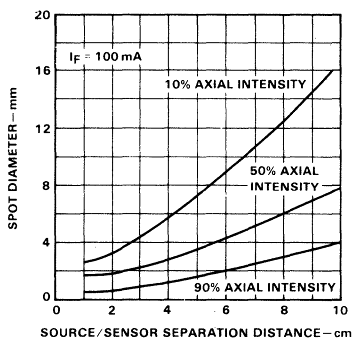
Spot Diameter vs Separation Distance (Near Field)



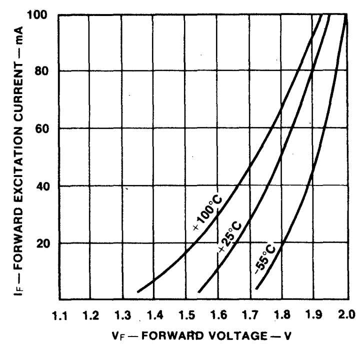
Typical Electrical Characteristic Curves

FLV104
FLV104A

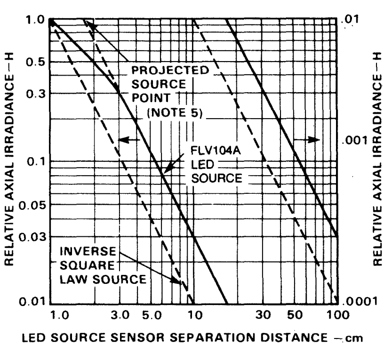
Spot Diameter vs Separation Distance (Near Field)



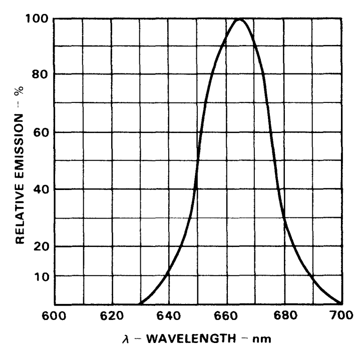
Forward V-I Characteristics



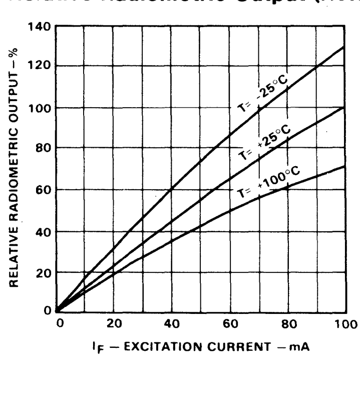
Average Axial Irradiance, H (Note 6)



Emission Spectrum



Relative Radiometric Output (Note 4)



Notes

1. $\Delta I/\Delta T$ and $\Delta I/\Delta I_F$ are the percentage derating factors for all radiometric output characteristics referenced to their typical value at 25°C ambient and I_F = 100 mA.
2. $\Delta\lambda pk/\Delta T$ and $\Delta\lambda pk/\Delta I_F$ are the derating factors for all wavelength characteristics referenced to their typical value at 25°C ambient and I_F = 100 mA.
3. Time for a 10% to 90% change in light intensity with a step change in current.
4. Normalization: LED intensity $\simeq$ 10 mW/sr sensor 1 mm^2 area.
5. Projected source point is the distance, Sp from which LED inverse square LAW characteristics may be computed for $S \geq 5$ cm.

$$H = \frac{1.0\ \text{mW}}{\text{cm}^2} \times \frac{Sp^2}{(S - Sp)^2} \qquad 1 < Sp < S\text{cm}$$

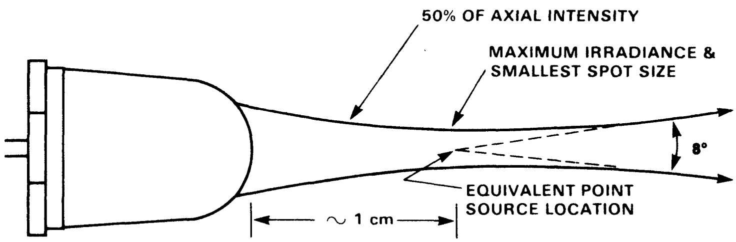
6. Irradiance (H) normalized to 4 mW/cm^2 @ S = 1 cm.

Narrow Beam Shape

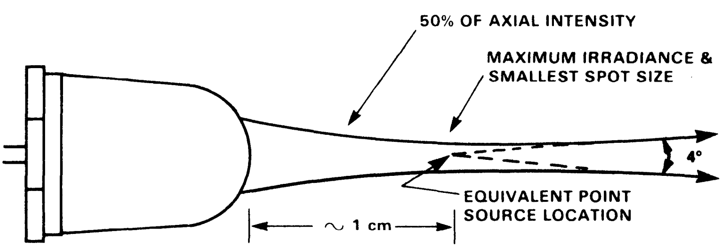
FLV104
FLV104A

Narrow Beam Shape

FLV104



FLV104A



Red GaAsP LED Lamps

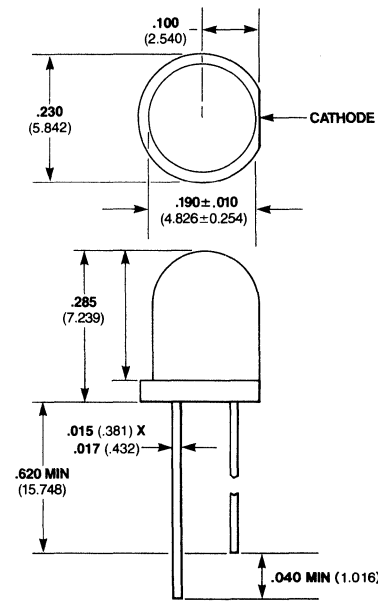
Optoelectronic Products

FLV110, FLV140 FLV150, FLV160

General Description
The FLV110, FLV140, FLV150 and FLV160 are red light-emitting diodes encapsulated in diffused plastic. These LED devices provide an intense large-area light source with wide-angle viewing. Visual light emission is in the 600 nm to 700 nm range.

Solid State Thus No Replacement Required
No Socket Required
High On/Off Contrast
Flexible Pin On FLV110, FLV140 land FLV150
  For Good Heat Sinking
  For Right-Angle Bending
  Fits Standard Sockets and Drilled Holes
Heavy Copper Leads On FLV160
  For Wire Wrapping
  For Rigid Standoff From PC Board
Single Molded Body Eliminates
  Thermal Cycling Problems
High-Temperature Epoxy Encapsulation Withstands
  Severe Environmental Temperatures
Low Power Consumption Means IC Compatibility

Package Outline
FLV110



Notes
All dimensions in inches **bold** and millimeters (parentheses)
Tolerance unless specified = ±**.015** (±.381)
Other packages on following page

Absolute Maximum Ratings

Maximum Temperature and Humidity

Storage Temperature	−55°C to +100°C
Operating Temperature	−55°C to +100°C
Pin Temperature (Soldering, 5 s)	260°C
Relative Humidity at 85°C	85%

Maximum Power Dissipation

Total Dissipation at T_A = 25°C	120 mW
Derate Linearly from 25°C	1.6 mW/°C

Maximum Voltage and Currents

V_R	Reverse Voltage	3.0 V
I_F	Forward dc Current	50 mA
I_{pk}	Peak Forward Current (1.0 μs pulse width)	1.0 A

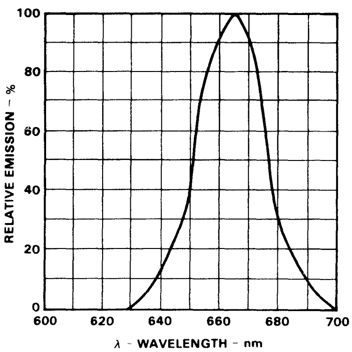
Electrical and Radiant Characteristics T_A = 25°C

Symbol	Characteristic	Min	Typ	Max	Units	Test Conditions
V_F	Forward Voltage		1.7	2.0	V	I_F = 20 mA
BV_R	Reverse Breakdown Voltage	3.0	8.0		V	I_R = 10 μA
I_O	Axial Luminous Intensity	0.8	2.0		mcd	I_F = 20 mA
$\theta_{1/2}$	Angle of Half Intensity		±35		degrees	I_F = 20 mA
λ_{pk}	Peak Wavelength		665		nm	I_F = 20 mA

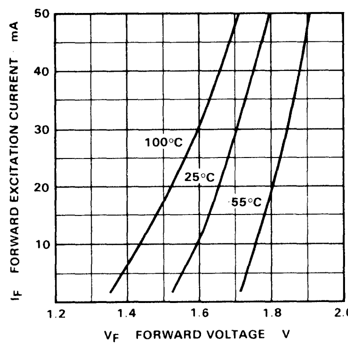
Typical Electrical Characteristic Curves

FLV110, FLV140 FLV150, FLV160

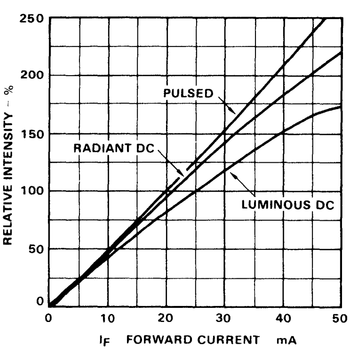
Emission Spectrum



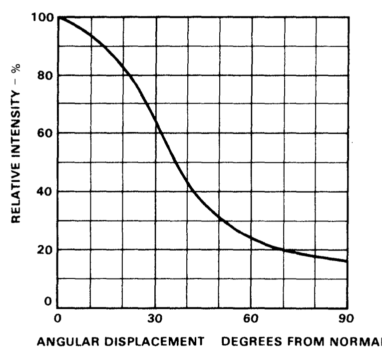
Forward Current vs Forward Voltage



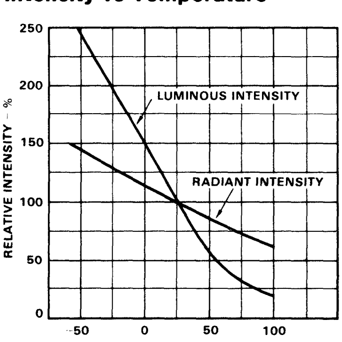
Intensity vs Forward Current



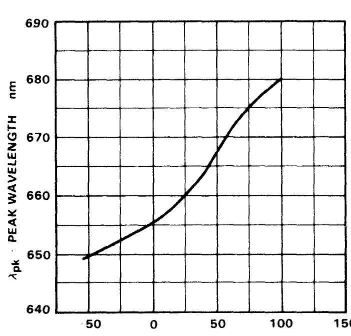
Intensity vs Viewing Angle



Intensity vs Temperature



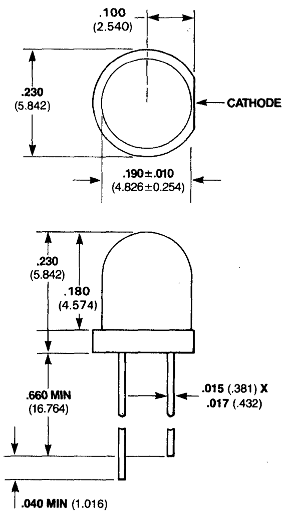
Peak Wavelength vs Temperature



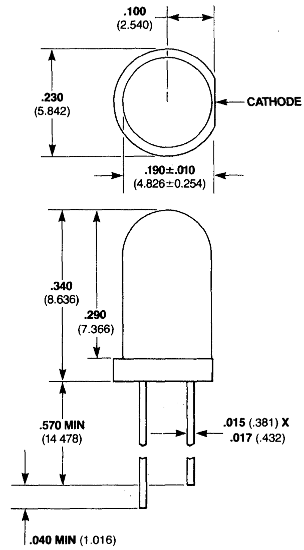
Package Outlines

FLV110, FLV140 FLV150, FLV160

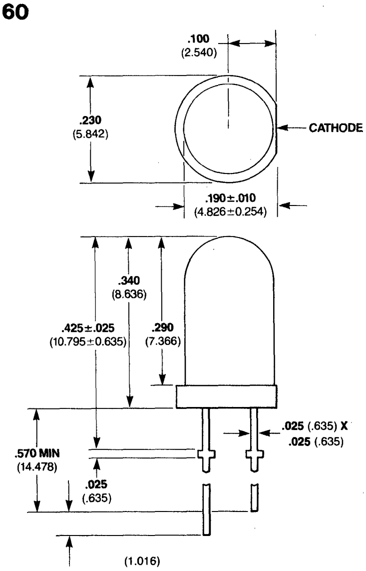
FLV140



FLV150



FLV160



Red GaAsP LED Lamps

Optoelectronic Products

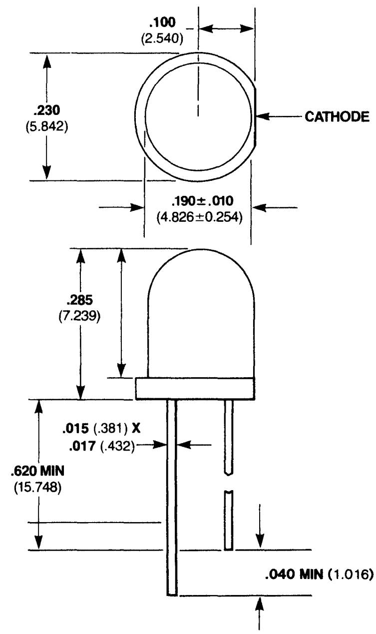
FLV111
FLV112
FLV117

General Description

The FLV111 is a water clear version of the FLV110. The FLV112 is a diffused lens in clear (non-red) epoxy. FLV117 is a low-cost lamp encapsulated in diffused red epoxy. Visual light emission is in the 600-700 nm range.

Solid State—No Replacement Required
No Socket Required
High On/Off Contrast
Flexible Pins For Good Heat Sinking And Right-Angle Bending
Fits Standard Sockets And Drilled Holes
Single Molded Body Eliminates Thermal Cycling Problems
High-Temperature Epoxy Encapsulation Withstands Severe Environmental Temperatures
Low Power Consumption Means IC Compatibility

Package Outline



Notes
All dimensions in inches **bold** and millimeters (parentheses)
Tolerance unless specified = ±**.015** (±.381)

Absolute Maximum Ratings

Maximum Temperature and Humidity

Storage Temperature	−55°C to +150°C
Junction Temperature	125°C
Pin Temperature (Soldering, 5 s)	260°C
Relative Humidity at 85°C	85%

Maximum Power Dissipation

Total Dissipation at T_A = 25°C	100 mW
Derate Linearly from 100°C	4.0 mW/°C

Maximum Voltage and Currents

V_R	Reverse Voltage	3.0 V
I_F	Forward dc Current	50 mA
I_{pk}	Peak Forward Current (1.0 μs pulse)	1.0 A

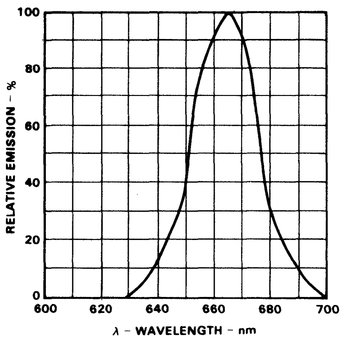
Electrical and Radiant Characteristics T_A = 25°C

Symbol	Characteristic	Min	Typ	Max	Units	Test Conditions
V_F	Forward Voltage		1.7	3.0	V	I_F = 20 mA
BV_R	Reverse Voltage		8.0		V	I_R = 10 μA
I_O	Axial Luminous Intensity					
	FLV111, FLV112	0.8	2.0		mcd	I_F = 20 mA
	FLV117	0.2	1.0		mcd	I_F = 20 mA
$\theta_{1/2}$	Angle of Half Intensity					
	FLV111, FLV112		±35		degrees	I_F = 20 mA
	FLV117		±20		degrees	I_F = 20 mA
λ_{pk}	Peak Wavelength		665		nm	I_F = 20 mA

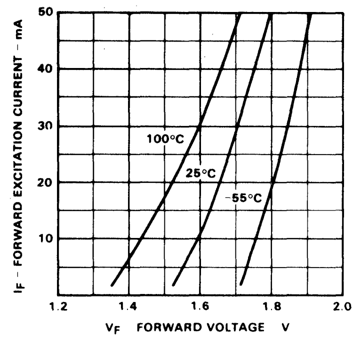
Typical Electrical Characteristic Curves

FLV111
FLV112
FLV117

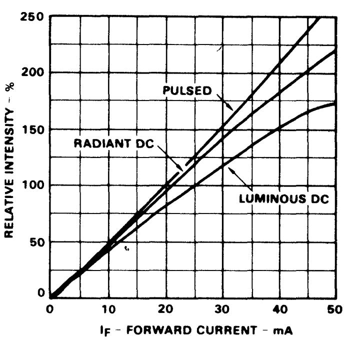
Emission Spectrum



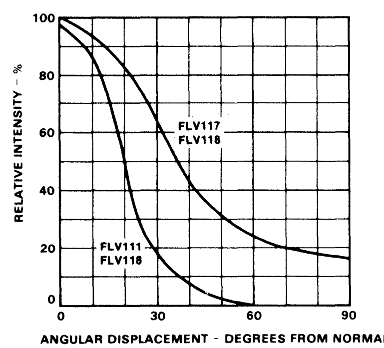
Forward Current vs Forward Voltage



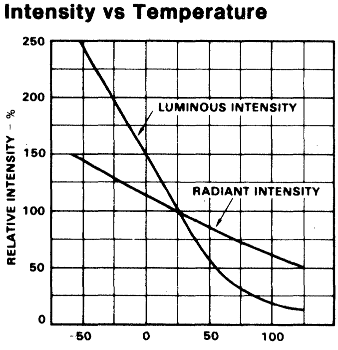
Intensity vs Forward Current



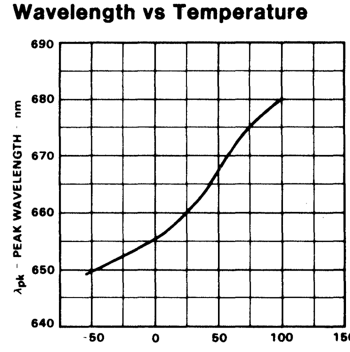
Intensity vs Viewing Angle



Intensity vs Temperature



Wavelength vs Temperature



Green GaP LED Lamps

Optoelectronic Products

FLV310, FLV340 FLV350, FLV360

General Description

The FLV310, FLV340, FLV350 and FLV360 are green light-emitting diodes encapsulated in green diffused plastic. These devices provide an intense large light source with wide-angle viewing. Visual light emission is in the 525 to 625 nm range.

High Luminous Intensity For Room Ambient Light Levels
Solid State Thus No Replacement Is Required
High On/Off Contrast
Flexible Pins On FLV310, FLV340 And FLV350
- **For Good Heat Sinking**
- **For Right-Angle Bending**
- **Fits Standard Sockets And Drilled Holes**

Heavy Copper Pins On FLV360 For Wire Wrap Applications And Rigid Standoff From PC Board
Single Molded Body Eliminates Thermal Cycling Problems
High-Temperature Epoxy Encapsulation Withstands Severe Environmental Temperatures
Low Power Means IC Compatibility

Absolute Maximum Ratings

Maximum Temperature and Humidity

Storage Temperature	−55°C to +100°C
Operating Temperature	−55°C to +100°C
Pin Temperature (Soldering, 5 s)	260°C
Relative Humidity at 85°C	85%

Maximum Power Dissipation

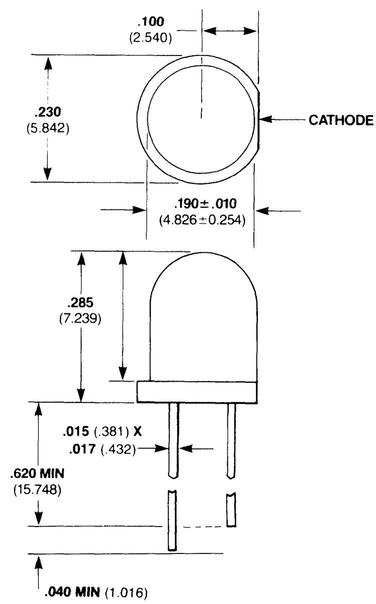
Total Dissipation at T_A = 25°C	120 mW
Derate Linearly from 50°C	1.6 mW/°C

Maximum Voltage and Currents

V_R	Reverse Voltage	5.0 V
I_F	Forward dc Current	35 mA
I_{pk}	Peak Forward Current (1.0 μs pulse width)	1.0 A

Package Outline

FLV310



Notes
All dimensions in inches **bold** and millimeters (parentheses)
Tolerance unless specified = ±**.015** (±.381)
Other packages following

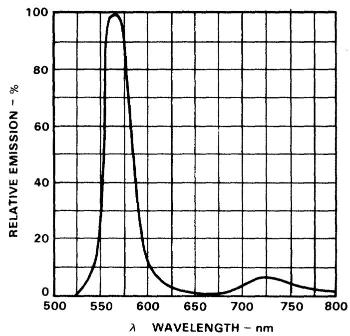
Electrical and Radiant Characteristics T_A = 25°C

Symbol	Characteristic	Min	Typ	Max	Units	Test Conditions
V_F	Forward Voltage		2.3	3.0	V	I_F = 20 mA
BV_R	Reverse Breakdown Voltage	5.0	18		V	I_R = 100 μA
I_O	Axial Luminous Intensity	1.6	3.2		mcd	I_F = 20 mA
$\theta_{1/2}$	Viewing Angle to Half Intensity		±25		degrees	I_F = 20 mA
λ_{pk}	Peak Wavelength		565		nm	I_F = 10 mA

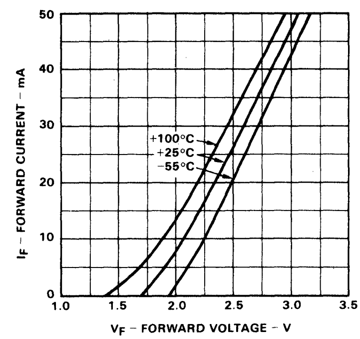
Typical Electrical Characteristic Curves

FLV310, FLV340 FLV350, FLV360

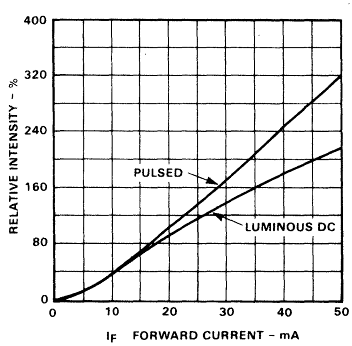
Emission Spectrum



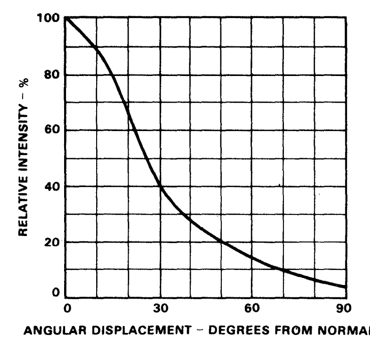
Forward Current vs Forward Voltage



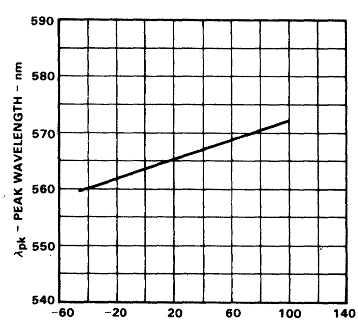
Intensity vs Forward Current



Intensity vs Viewing Angle



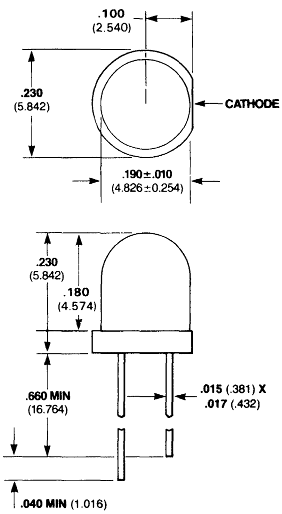
Peak Wavelength vs Temperature



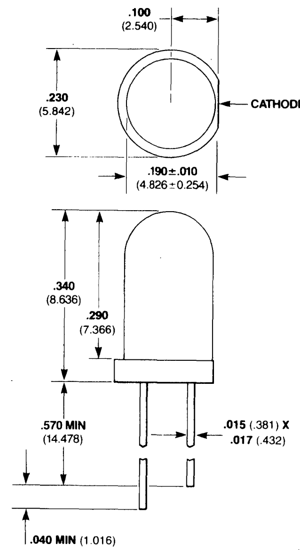
Package Outlines

FLV310, FLV340 FLV350, FLV360

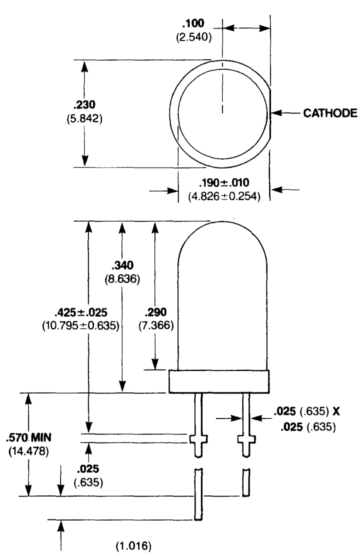
FLV340



FLV350



FLV360



Yellow GaP LED Lamps

Optoelectronic Products

FLV410, FLV440 FLV450, FLV460

General Description

The FLV410, FLV440, FLV450 and FLV460 are yellow light-emitting diodes encapsulated in yellow diffused plastic. These devices provide an intense large-area light source with wide-angle viewing. Visual light emission is in the 625 nm range.

High Luminous Intensity For Room Ambient Light Levels
Solid State Thus No Replacement Is Required
High On/Off Contrast
Flexible Pins On FLV410, FLV440 and FLV450
  For Good Heat Sinking
  For Right-Angle Bending
  Fits Standard Sockets and Drilled Holes
Heavy Copper Pins On FLV460 For Wire Wrap Applications and Rigid Standoff From PC Board
Single Molded Body Eliminates Thermal Cycling Problems
High-Temperature Epoxy Encapsulation Withstands Severe Environmental Temperatures
Low Power Means IC Compatibility

Absolute Maximum Ratings

Maximum Temperature and Humidity

Storage Temperature	−55°C to +100°C
Operating Temperature	−55°C to +100°C
Pin Temperature (Soldering, 5 s)	260°C
Relative Humidity at 85°C	85%

Maximum Power Dissipation

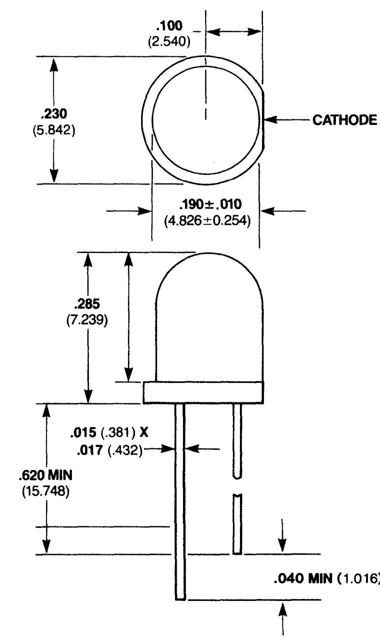
Total Dissipation at T_A = 25°C	120 mW
Derate Linearly from 25°C	1.6 mW/°C

Maximum Voltage and Currents

V_R	Reverse Voltage	5.0 V
I_F	Forward dc Current	10 mA
I_{pk}	Peak Forward Current (1.0 μs pulse width)	1.0 A

Package Outline

FLV410



Notes
All dimensions in inches **bold** and millimeters (parentheses)
Tolerance unless specified = ±**.015** (0.381)
Other packages following

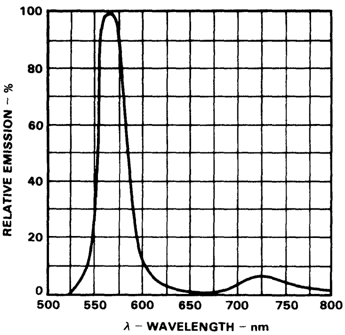
Electrical and Radiant Characteristics T_A = 25°C

Symbol	Characteristic	Min	Typ	Max	Units	Test Conditions
V_F	Forward Voltage		2.3	3.0	V	I_F = 20 mA
BV_R	Reverse Breakdown Voltage	5.0	18		V	I_R = 100 μA
I_O	Axial Luminous Intensity	1.6	3.2		mcd	I_F = 20 mA
$\theta_{1/2}$	Viewing Angle to Half Intensity		±25		degrees	I_F = 20 mA
λ_{pk}	Peak Wavelength		585		nm	I_F = 20 mA

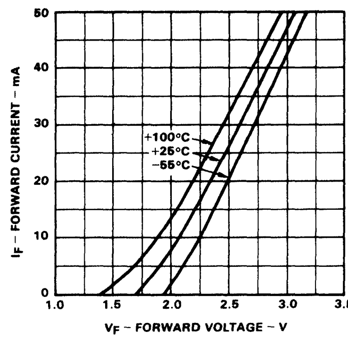
Typical Electrical Characteristic Curves

FLV410, FLV440 FLV450, FLV460

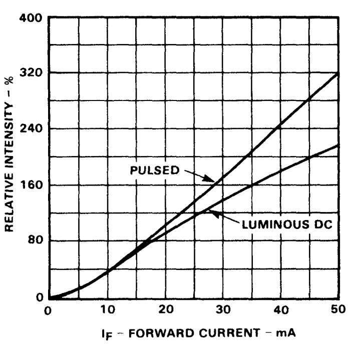
Emission Spectrum



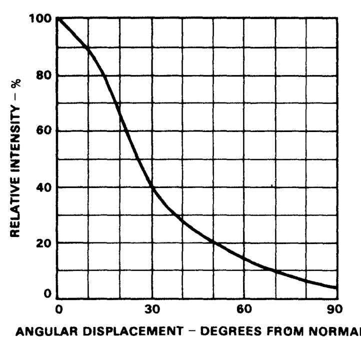
Forward Current vs Forward Voltage



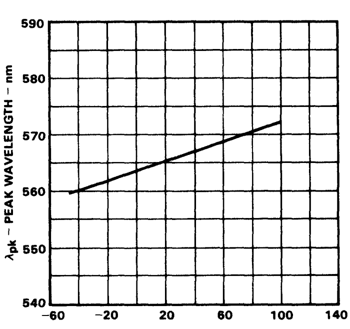
Intensity vs Forward Current



Intensity vs Viewing Angle



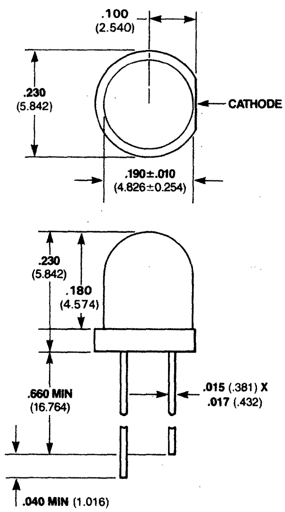
Peak Wavelength vs Temperature



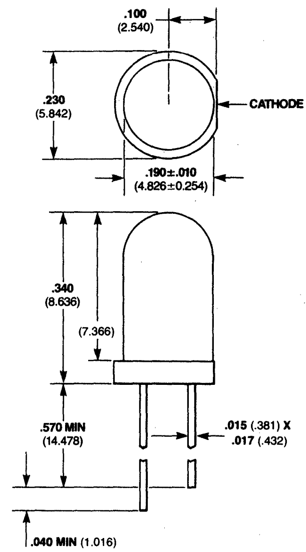
Package Outlines

FLV410, FLV440
FLV450, FLV460

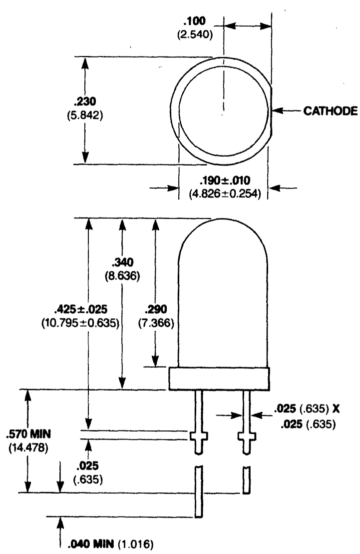
FLV440



FLV450



FLV460



Red Super GaAsP LED Lamps

Optoelectronic Products

FLV510, FLV540 FLV550, FLV560

General Description

The FLV510, FLV540, FLV550 and FLV560 are high-efficiency red light-emitting diodes encapsulated in red diffused plastic. These devices provide an intense large-area light source with wide-angle viewing. Visual light emission is in the 600 to 700 nm range.

High Luminous Intensity For Room Ambient Light Levels
Solid State Thus No Replacement Is Required
High On/Off Contrast
Flexible Pins On FLV510, FLV540 And FLV550
- **For Good Heat Sinking**
- **For Right-Angle Bending**
- **Fits Standard Sockets And Drilled Holes**

Heavy Copper Pins On FLV560 For Wire Wrap Applications and Rigid Standoff From PC Board
Single Molded Body Eliminates Thermal Cycling Problems
High-Temperature Epoxy Encapsulation Withstands Severe Environmental Temperatures
Low Power Means IC Compatibility

Absolute Maximum Ratings

Maximum Temperature and Humidity

Storage Temperature	−55°C to +100°C
Operating Temperature	−55°C to +100°C
Pin Temperature (Soldering, 5 s)	260°C
Relative Humidity at 85°C	85%

Maximum Power Dissipation

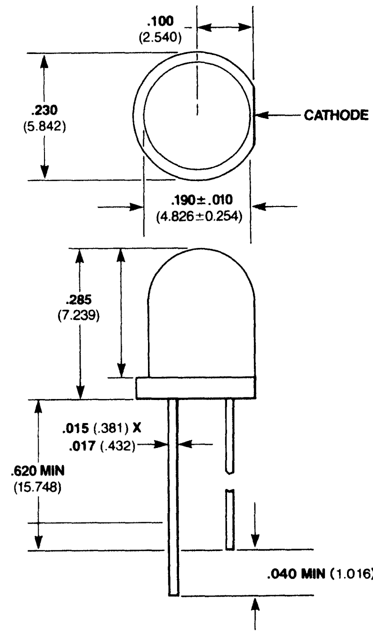
Total Dissipation at T_A = 25°C	200 mW
Derate Linearly from 25°C	2.6 mW/°C

Maximum Voltage and Currents

V_R	Reverse Voltage	5.0 V
I_F	Forward dc Current	35 mA
I_{pk}	Peak Forward Current (1.0 μs pulse width)	1.0 A

Package Outline

FLV510



Notes
All dimensions in inches bold and millimeters (parentheses)
Tolerance unless specified = ±.015 (±.381)

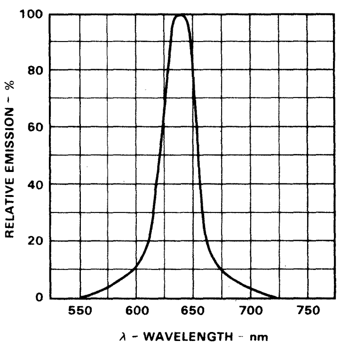
Electrical and Radiant Characteristics T_A = 25°C

Symbol	Characteristic	Min	Typ	Max	Units	Test Conditions
V_F	Forward Voltage		2.1	2.8	V	I_F = 10 mA
				3.0	V	I_F = 20 mA
BV_R	Reverse Breakdown Voltage	5.0	8.0		V	I_R = 100 μA
I_O	Axial Luminous Intensity	3.0	10		mcd	I_F = 20 mA
$\theta_{1/2}$	Viewing Angle to Half Intensity		±35		degrees	I_F = 20 mA
λ_{pk}	Peak Wavelength		640		nm	I_F = 10 mA

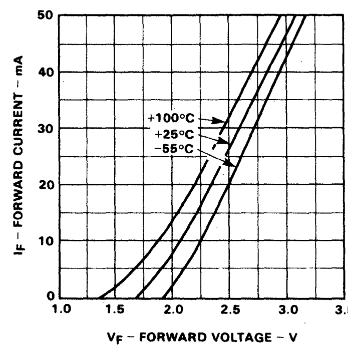
Typical Electrical Characteristic Curves

FLV510, FLV540 FLV550, FLV560

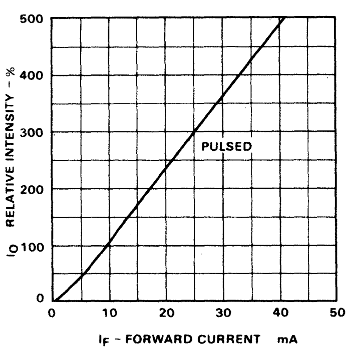
Emission Spectrum



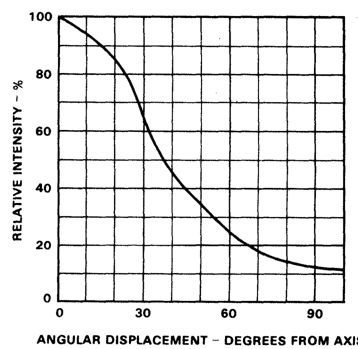
Forward Current vs Forward Voltage



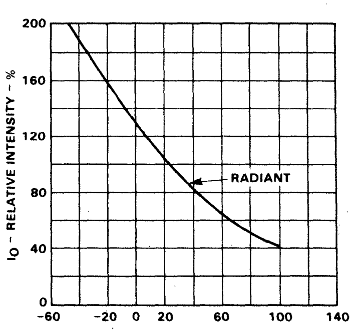
Intensity vs Forward Current



Intensity vs Viewing Angle



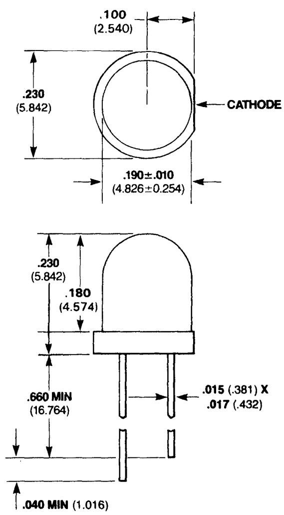
Intensity vs Temperature



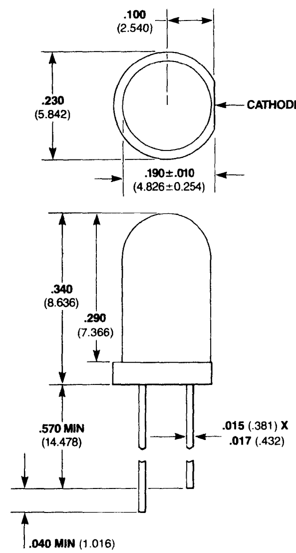
Package Outlines

FLV510, FLV540 FLV550, FLV560

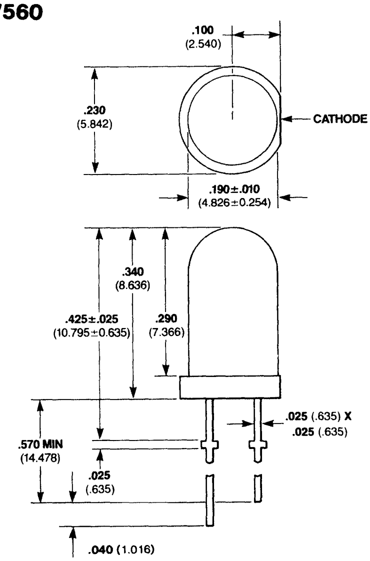
FLV540



FLV550



FLV560



Notes
All dimensions in inches **bold** and millimeters (parentheses)
Tolerance unless specified = ±**.015** (±.381)

Front Panel Adapter for LED Lamp

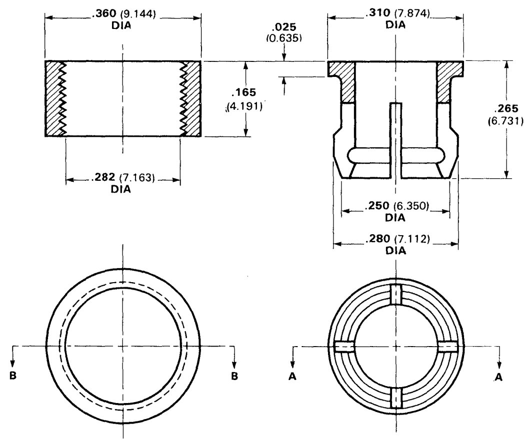
MP52

Optoelectronic Products

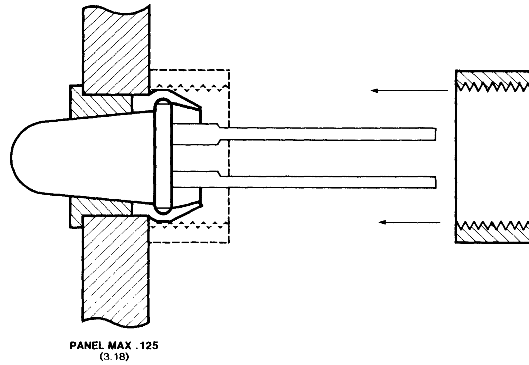
General Description

The MP52 is a two-piece black plastic adapter for panel mounting many standard MV series LED indicator lamps. This adapter will easily mount the applicable lamps on any panel thickness up to .125-inch (3.18 mm).

Dimensional Data

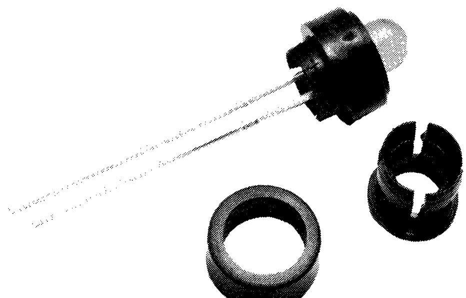


Typical Mounting Technique



Note

All dimensions in inches **bold** and millimeters (parentheses)
Tolerance unless specified = ±**.015** (±.381)



Red GaAsP LED Lamps

Optoelectronic Products

MV5050, MV5051 MV5052, MV5053

General Description

The MV5050, MV5051, MV5052 and MV5053 are red light-emitting diodes encapsulated in diffused plastic. These devices provide an intense large-area light source with wide-angle viewing. Visual light emission is in the 600 nm to 700 nm range.

Solid State Thus No Replacement Required
No Socket Required
High On/Off Contrast
Flexible Pins On All Lamps
For Good Heat Sinking
For Right-Angle Bending
Fits Standard Sockets or Drilled Holes
Single Molded Body Eliminates Thermal Cycling Problems
High-Temperature Epoxy Encapsulation Withstands Severe Environmental Temperatures
Low Power Consumption Means IC Compatibility
MV5050 In Clear Non-Diffused Epoxy
MV5051 In Clear Diffused Epoxy
MV5052 In Red Non-Diffused Epoxy
MV5053 In Red Diffused Epoxy

Absolute Maximum Ratings

Maximum Temperature and Humidity

Storage Temperature	−55°C to +100°C
Operating Temperature	−55°C to +100°C
Pin Temperature (Soldering, 5 s)	260°C
Relative Humidity at 85°C	85%

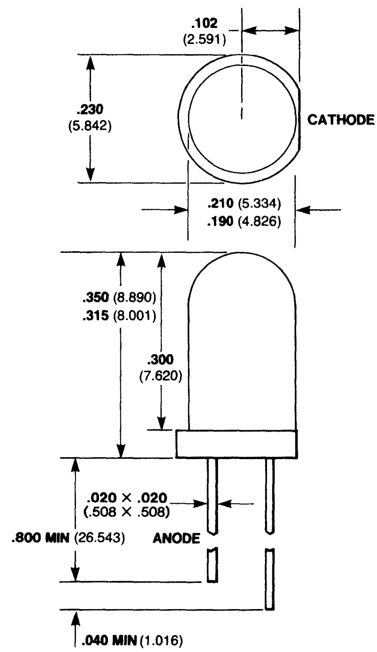
Maximum Power Dissipation

Total Dissipation at T_A = 25°C	180 mW
Derate Linearly from 25°C	2.0 mW/°C

Maximum Voltage and Currents

V_R	Reverse Voltage	5.0 V
I_F	Forward dc Current at T_A = 25°C	100 mA
	Forward dc Current at T_A = 100°C	15 mA
I_{pk}	Peak Forward Current, 1.0 μs pulse width, 0.1% duty cycle	1.0 A

Package Outline



Notes
All dimensions in inches **bold** and millimeters (parentheses)
Tolerance unless specified = ±**.015** (0.381)

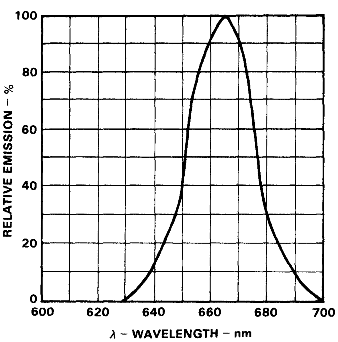
Typical Electrical Characteristics

MV5050, MV5051 MV5052, MV5053

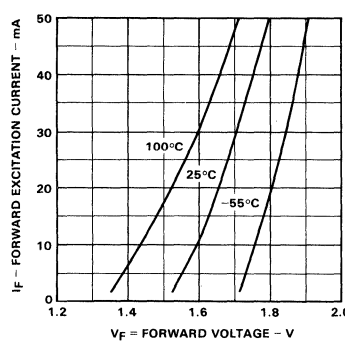
Electrical and Radiant Characteristics $T_A = 25°C$

Symbol	Characteristic	Min	Typ	Max	Units	Test Conditions
V_F	Forward Voltage		1.7	2.2	V	$I_F = 20$ mA
BV_R	Reverse Breakdown Voltage	5.0	25		V	$I_R = 100\ \mu A$
I_O	Axial Luminous Intensity				mcd	$I_F = 20$ mA
	MV5050/MV5052	0.5/0.7	2.0			
	MV5051/MV5053	0.4/0.5	1.6			
θ	Viewing Angle Total				degrees	$I_F = 20$ mA
	MV5050		50			
	MV5051/MV5052		70			
	MV5053		80			
λ_{pk}	Peak Wavelength		670		nm	$I_F = 20$ mA

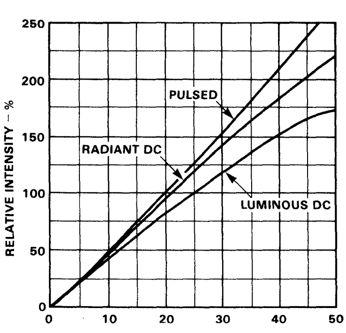
Emission Spectrum



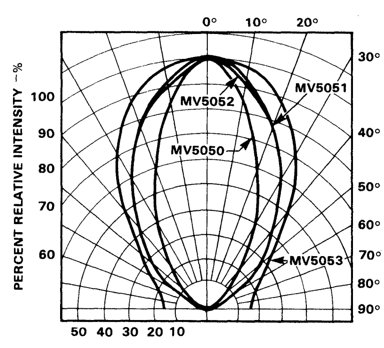
Forward Current vs Forward Voltage



Intensity vs Forward Current



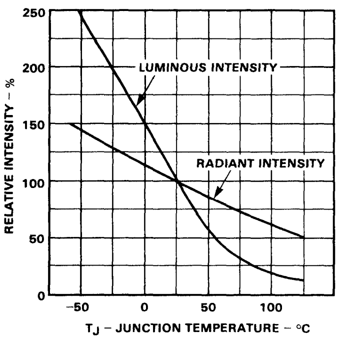
Intensity vs Viewing Angle



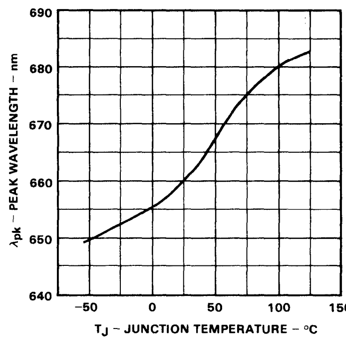
Typical Electrical Characteristic Curves

MV5050, MV5051 MV5052, MV5053

Intensity vs Temperature



Peak Wavelength vs Temperature



Red GaAsP LED Lamps

Optoelectronic Products

MV5054-1
MV5054-2
MV5054-3

General Description

The MV5054 series lamps are red light-emitting diodes encapsulated in red diffused plastic. These devices provide an intense large-area light source with wide-angle viewing. Visual light emission is in the 600 nm to 700 nm range. Three brightness levels are available.

Solid State Thus No Replacement Required
No Socket Required
High On/Off Contrast
Flexible Pins On All Lamps
For Good Heat Sinking
For Right-Angle Bending
Fits Standard Sockets or Drilled Holes
Single Molded Body Eliminates Thermal Cycling Problems
High-Temperature Epoxy Encapsulation Withstands Severe Environmental Temperatures
Low Power Consumption Means IC Compatibility
MV5054-1 Has 2.0 mcd TYP Luminous Intensity
MV5054-2 Has 3.0 mcd TYP Luminous Intensity
MV5054-3 Has 4.0 mcd TYP Luminous Intensity

Absolute Maximum Ratings

Maximum Temperature and Humidity

Storage Temperature	−55°C to +100°C
Operating Temperature	−55°C to +100°C
Pin Temperature (Soldering, 5 s)	260°C
Relative Humidity at 85°C	85%

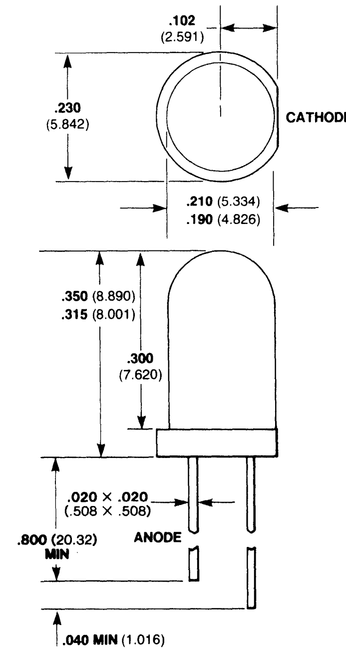
Maximum Power Dissipation

Total Dissipation at $T_A = 25°C$	180 mW
Derate Linearly from 25°C	2.0 mW/°C

Maximum Voltage and Currents

V_R	Reverse Voltage	5.0 V
I_F	Forward dc Current at $T_A = 25°C$	100 mA
	Forward dc Current at $T_A = 100°C$	15 mA
I_{pk}	Peak Forward Current, 1.0 μs pulse width, 0.1% duty cycle	1.0 A

Package Outline



Notes
All dimensions in inches **bold** and millimeters (parentheses)
Tolerance unless specified = ±**.015** (0.381)
Not direct replacement for Monsanto package. Monsanto has offset on lead.

Typical Electrical Characteristics

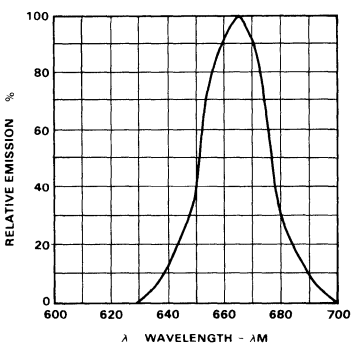
MV5054-1
MV5054-2
MV5054-3

Electrical and Radiant Characteristics $T_A = 25°C$

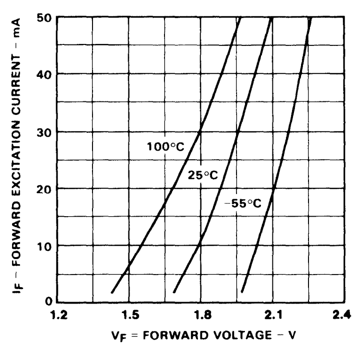
Symbol	Characteristic	Min	Typ	Max	Units	Test Conditions
V_F	Forward Voltage		1.8	2.2	V	$I_F = 10$ mA
BV_R	Reverse Breakdown Voltage	5.0	8.0		V	$I_R = 100\ \mu A$
I_O	Axial Luminous Intensity				mcd	$I_F = 10$ mA
	MV5054-1	1.0	2.0			
	MV5054-2	2.0	3.0			
	MV5054-3	3.0	4.0			
θ	Viewing Angle Total		40		degrees	$I_F = 20$ mA
λ_{pk}	Peak Wavelength		660		nm	$I_F = 20$ mA

2

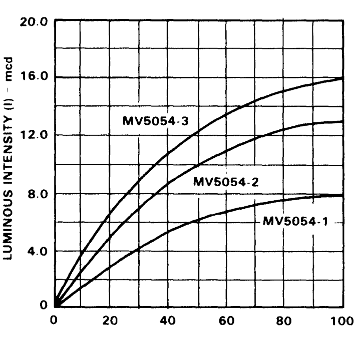
Emission Spectrum



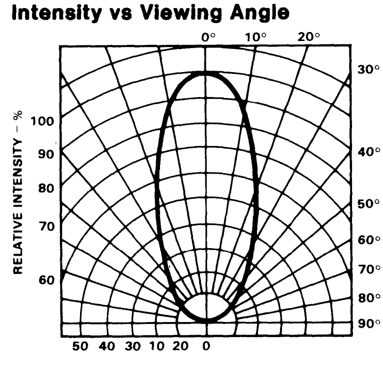
Forward Current vs Forward Voltage



Intensity vs Forward Current



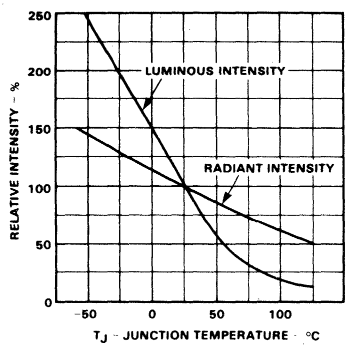
Intensity vs Viewing Angle



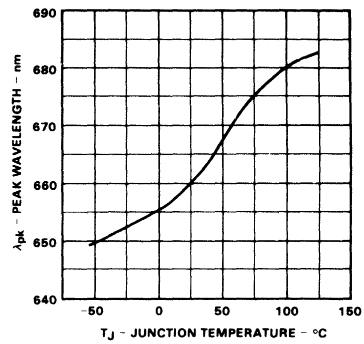
Typical Electrical Characteristic Curves

MV5054-1
MV5054-2
MV5054-3

Intensity vs Temperature



Peak Wavelength vs Temperature



Wide-Angle Red GaAsP LED Lamps

Optoelectronic Products

MV5055
MV5056

General Description

The MV5055 and MV5056 are red light-emitting diodes encapsulated in diffused plastic. These LED devices provide an intense large-area light source. Visual light emission is in the 600 nm to 700 nm range. The design has maximized viewing angle.

Solid State Thus No Replacement Required
No Socket Required
High On/Off Contrast
Flexible Pins On All Lamps
- **For Good Heat Sinking**
- **For Right-Angle Bending**
- **Fits Standard Sockets For Drilled Holes**

Single Molded Body Eliminates Thermal Cycling Problems
High-Temperature Epoxy Encapsulation Withstand Severe Environmental Temperatures
Low Power Consumption Means IC Compatibility
MV5055 In Red Diffused Epoxy
MV5056 In Red Diffused Epoxy

Absolute Maximum Ratings

Maximum Temperature and Humidity

Operating Temperature	−55°C to +110°C
Storage Temperature	−55°C to +100°C
Pin Temperature (Soldering, 5 s)	260°C
Relative Humidity at 85°C	85%

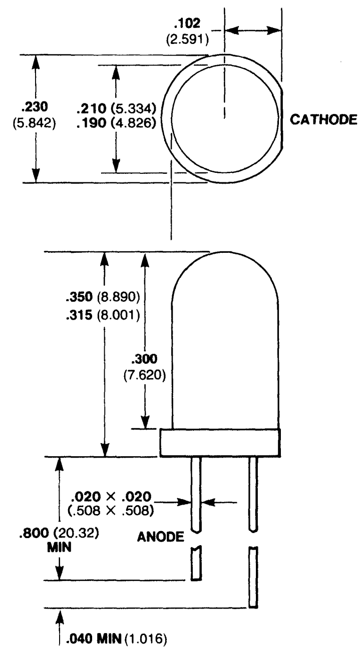
Maximum Power Dissipation

Total Dissipation at T_A = 25°C	180 mW
Derate Linearly from 25°C	2 mW/°C

Maximum Voltage and Currents

V_R	Reverse Voltage	5.0 V
I_F	Forward dc Current at T_A = 25°C	100 mA
	Forward dc Current at T_A = 100°C	15 mA
I_{pk}	Peak Forward Current, 1.0 μs pulse	1.0 A

Package Outline



Notes
All dimensions in inches **bold** and milimeters (parentheses)
Tolerance unless specified = ±**.015** (0.381)

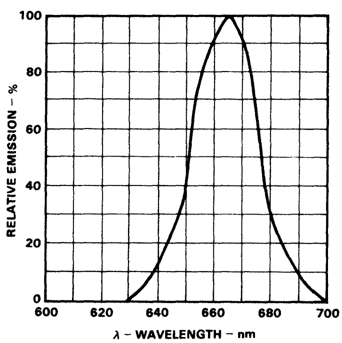
Typical Electrical Characteristics

MV5055
MV5056

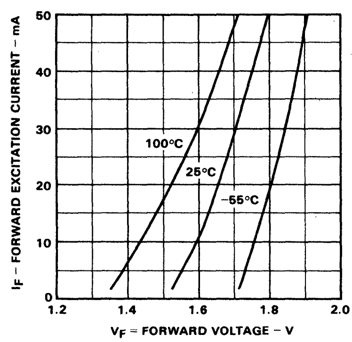
Electrical and Radiant Characteristics $T_A = 25°C$

Symbol	Characteristic	Min	Typ	Max	Units	Test Conditions
V_F	Forward Voltage		1.7	2.2	V	$I_F = 20$ mA
V_R	Reverse Voltage	5.0	25		V	$I_R = 100\ \mu A$
I_O	Axial Luminous Intensity				mcd	$I_F = 20$ mA
	MV5055	0.1	0.6			
	MV5056	0.2	0.8			
θ	Viewing Angle Total				degrees	$I_F = 20$ mA
	MV5055		150			
	MV5056		110			
λ_{pk}	Peak Wavelength		660		nm	$I_F = 20$ mA

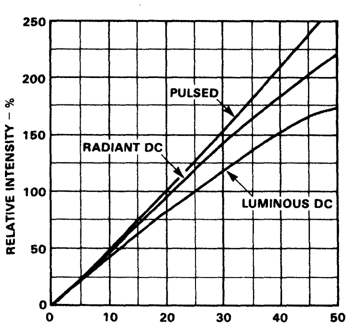
Emission Spectrum



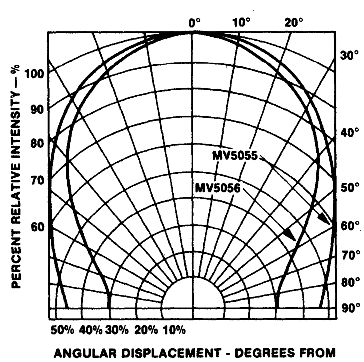
Forward Current vs Forward Voltage



Intensity vs Forward Current



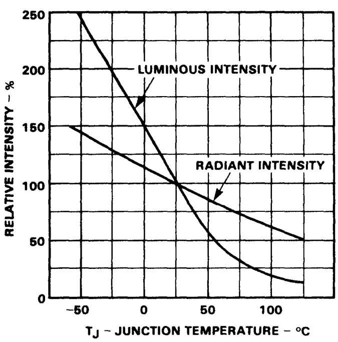
Intensity vs Angle



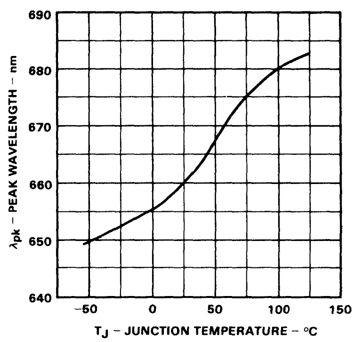
Typical Electrical Characteristic Curves

MV5055
MV5056

Intensity vs Temperature



Wavelength vs Temperature



Amber Super GaAsP LED Lamps

Optoelectronic Products

MV5152
MV5153
MV5154

General Description

The MV5152, MV5153 and MV5154 are red light-emitting diodes encapsulated in amber epoxy. Viewing angle can be selected from point source to wide angle. Visual light emission is in the 590 nm to 660 nm range.

High Luminous Intensity For Ambient Light Levels
Solid State—No Replacement Required
High On/Off Contrast
Flexible Pins On All Lamps
- **For Good Heat Sinking**
- **For Right-Angle Bending**
- **Fits Standard Sockets Or Drilled Holes**

Single Molded Body Eliminates Thermal Cycling Problems
Low Power For IC Compatibility
MV5152 For Point Source Lamps
MV5153 For Wide Angle Lamps
MV5154 For Intermediate Dispersion Lamps

Absolute Maximum Ratings

Maximum Temperature and Humidity

Storage Temperature	−55°C to +100°C
Operating Temperature	−55°C to +100°C
Pin Temperature (Soldering, 5 s)	260°C
Relative Humidity at 85°C	85%

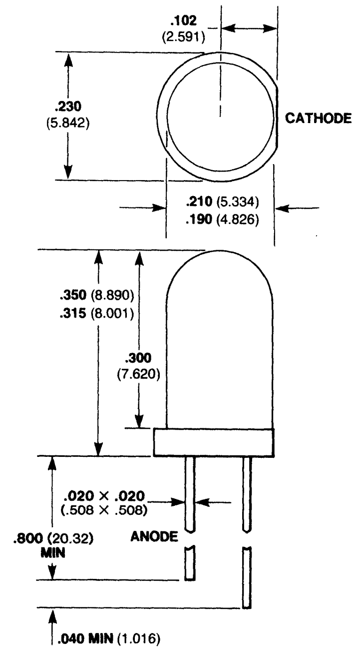
Maximum Power Dissipation

Total Dissipation at $T_A = 25°C$	105 mW
Derate Linearly from 25°C	1.14 mW/°C

Maximum Voltage and Currents

V_R	Reverse Voltage	5.0 V
I_F	Forward dc Current at $T_A = 25°C$	35 mA
I_{pk}	Peak Forward Current (1.0 μs pulse width, 0.1% duty cycle)	1.0 A

Package Outline



Notes
All dimensions in inches **bold** and millimeters (parentheses)
Tolerance unless specified = ±**.015** (0.381)

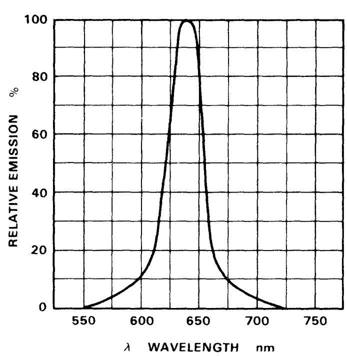
Typical Electrical Characteristics

MV5152
MV5153
MV5154

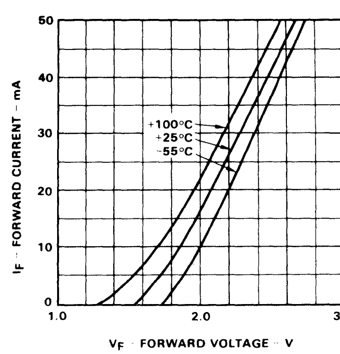
Electrical and Radiant Characteristics $T_A = 25°C$

Symbol	Characteristic	Min	Typ	Max	Units	Test Conditions
V_F	Forward Voltage		2.0	3.0	V	$I_F = 20$ mA
BV_R	Reverse Breakdown Voltage	5.0	25		V	$I_R = 100\ \mu A$
I_O	Axial Luminous Intensity				mcd	$I_F = 20$ mA
	MV5152	17	40			
	MV5153	3.0	6.0			
	MV5154	3.0	8.0			
θ	Viewing Angle Total				degrees	$I_F = 20$ mA
	MV5152		28			
	MV5153		65			
	MV5154		24			
λ_{pk}	Peak Wavelength		635		nm	$I_F = 20$ mA

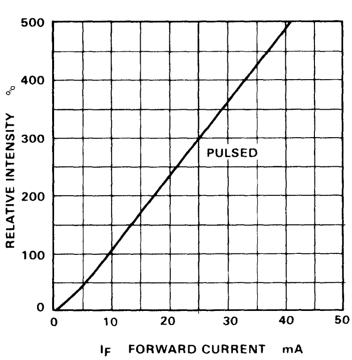
Emission Spectrum



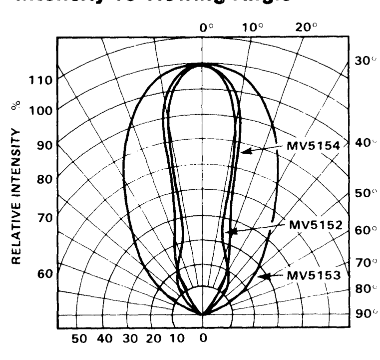
Forward Current vs Forward Voltage



Intensity vs Temperature



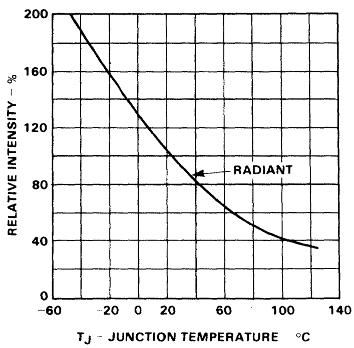
Intensity vs Viewing Angle



Typical Electrical Characteristic Curves

MV5152
MV5153
MV5154

Intensity vs Forward Current



Green GaP LED Lamps

Optoelectronic Products

MV5252
MV5253
MV5254

General Description

The MV5252, MV5253 and MV5254 are green light emitting diodes encapsulated in green epoxy. Viewing angle can be selected from point source to wide angle. Visual light emission is in the 530 nm to 590 nm range.

High Luminous Intensity For Ambient Light Levels
Solid State—No Replacement Required
High On/Off Contrast
Flexible Pins On All Lamps
- **For Good Heat Sinking**
- **For Right-Angle Bending**
- **Fits Standard Sockets or Drilled Holes**

Single Molded Body Eliminates Thermal Cycling Problems
Low Power for IC Compatibility
MV5252 For Point Source Lamps
MV5253 For Wide Angle Lamps
MV5254 For Intermediate Dispersion Lamps

Absolute Maximum Ratings

Maximum Temperature and Humidity

Storage Temperature	−55°C to +100°C
Operating Temperature	−55°C to +100°C
Pin Temperature (Soldering, 5 s)	260°C
Relative Humidity at 85°C	85%

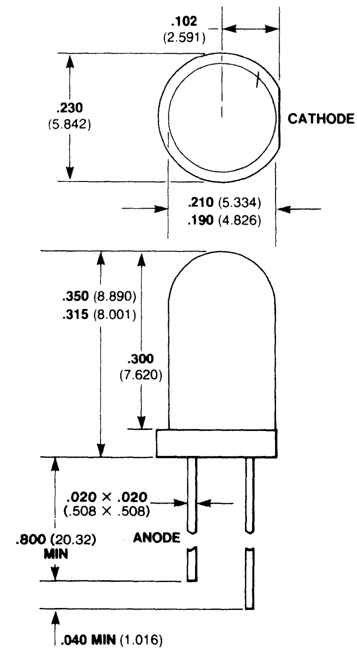
Maximum Power Dissipation

Total Dissipation at T_A = 25°C	105 mW
Derate Linearly from 25°C	1.14 mW/°C

Maximum Voltage and Currents

V_R	Reverse Voltage	5.0 V
I_F	Forward dc Current at T_A = 25°C	35 mA
I_{pk}	Peak Forward Current (1.0 μs pulse width, 0.1% duty cycle)	1.0 A

Package Outline



Notes

All dimensions in inches **bold** and millimeters (parentheses)

Tolerance unless specified = ±**.015** (±.381)

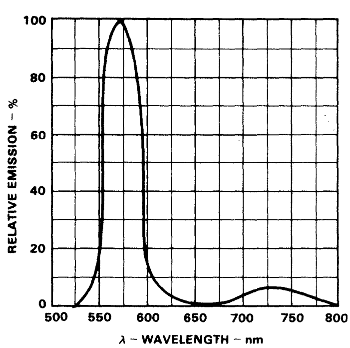
Typical Electrical Characteristics

MV5252
MV5253
MV5254

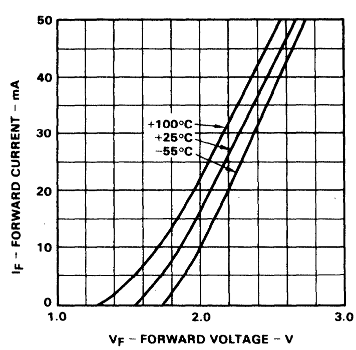
Electrical and Radiant Characteristics $T_A = 25°C$

Symbol	Characteristic	Min	Typ	Max	Units	Test Conditions
V_F	Forward Voltage		2.1	3.0	V	$I_F = 20$ mA
BV_R	Reverse Breakdown Voltage	5.0	25		V	$I_R = 100$ μA
I_O	Axial Luminous Intensity				mcd	$I_F = 20$ mA
	MV5252	2.0	15			
	MV5253	0.8	1.5			
	MV5254	0.9	3.0			
θ	Viewing Angle Total				degrees	$I_F = 20$ mA
	MV5252		28			
	MV5253		65			
	MV5254		24			
λ_{pk}	Peak Wavelength		565		nm	$I_F = 20$ mA

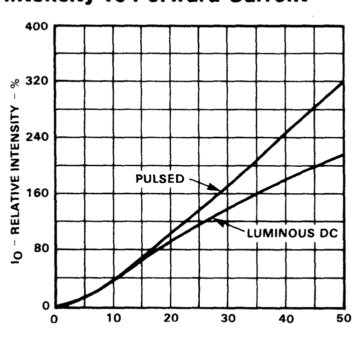
Emission Spectrum



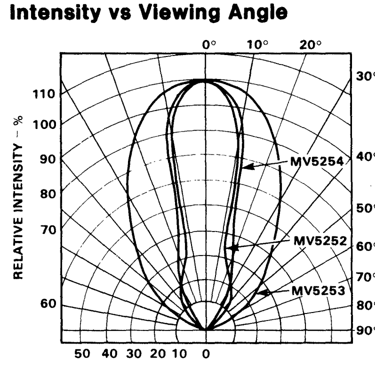
Forward Current vs Forward Voltage



Intensity vs Forward Current



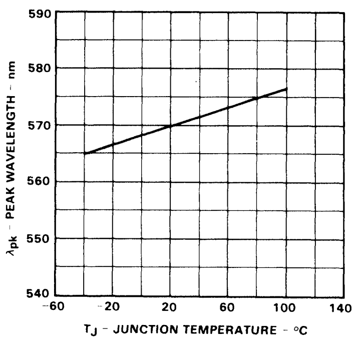
Intensity vs Viewing Angle



Typical Electrical Characteristic Curves

MV5252
MV5253
MV5254

Peak Wavelength vs Temperature



Yellow GaP LED Lamps

Optoelectronic Products

MV5352
MV5353
MV5354

General Description
The MV5352, MV5353 and MV5354 are yellow light-emitting diodes encapsulated in yellow epoxy. Viewing angle can be selected from point source to wide angle. Visual light emission is in the 525 nm to 625 nm range.

High Luminous Intensity For Ambient Light Levels
Solid State — No Replacement Required
High On/Off Contrast
Flexible Pins On All Lamps
- **For Good Heat Sinking**
- **For Right-Angle Bending**
- **Fits Standard Sockets or Drilled Holes**

Single Molded Body Eliminates Thermal Cycling Problems
Low Power For IC Compatibility
MV5352 For Point Source Lamps
MV5353 For Wide Angle Lamps
MV5354 For Intermediate Dispersion Lamps

Absolute Maximum Ratings

Maximum Temperature and Humidity

Storage Temperature	−55°C to +100°C
Operating Temperature	−55°C to +100°C
Pin Temperature (Soldering, 5 s)	260°C
Relative Humidity at 85°C	85%

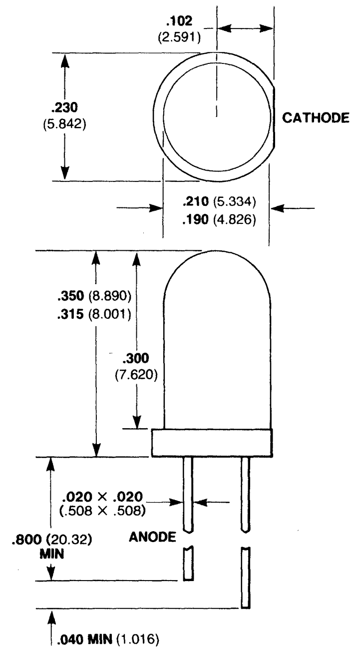
Maximum Power Dissipation

Total Dissipation at T_A = 25°C	105 mW
Derate Linearly from 25°C	1.14 mW/°C

Maximum Voltage and Currents

V_R	Reverse Voltage	5.0 V
I_F	Forward dc Current at T_A = 25°C	35 mA
I_{pk}	Peak Forward Current (1.0 μs pulse width, 0.1% duty cycle)	1.0 A

Package Outline



Notes
All dimensions in inches **bold** and millimeters (parentheses)
Tolerance unless specified = ±**.015** (0.381)

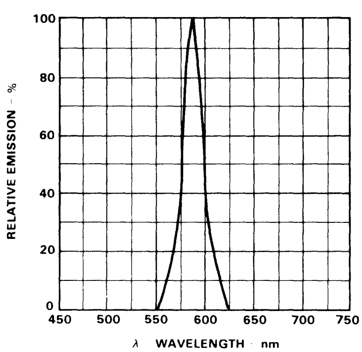
Typical Electrical Characteristics

MV5352
MV5353
MV5354

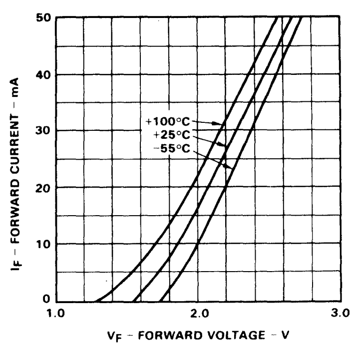
Electrical and Radiant Characteristics $T_A = 25°C$

Symbol	Characteristic	Min	Typ	Max	Units	Test Conditions
V_F	Forward Voltage		2.1	3.0	V	$I_F = 20$ mA
BV_R	Reverse Breakdown Voltage	5.0	25		V	$I_R = 100\ \mu A$
I_O	Axial Luminous Intensity				mcd	$I_F = 20$ mA
	MV5352	10	45			
	MV5353	2.5	6.0			
	MV5354	3.0	10			
θ	Viewing Angle Total				degrees	$I_F = 20$ mA
	MV5352		28			
	MV5353		65			
	MV5354		24			
λ_{pk}	Peak Wavelength		585		nm	$I_F = 20$ mA

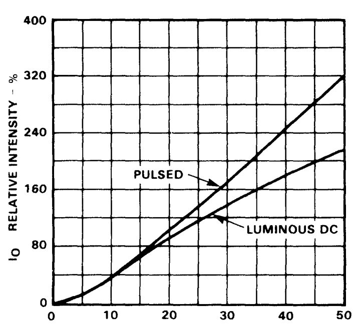
Emission Spectrum



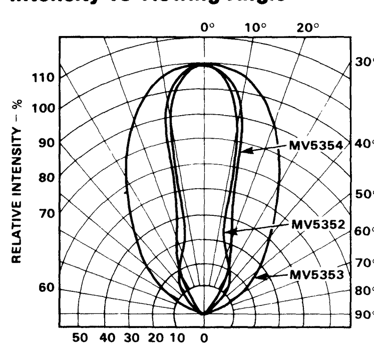
Forward Current vs Forward Voltage



Intensity vs Forward Current



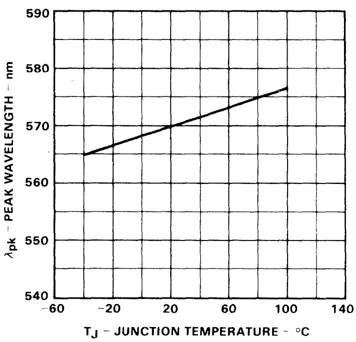
Intensity vs Viewing Angle



Typical Electrical Characteristic Curves

MV5352
MV5353
MV5354

Peak Wavelength vs Temperature



Red Super GaAsP LED Lamps

Optoelectronic Products

MV5752
MV5753
MV5754

2

General Description

The MV5752, MV5753 and MV5754 are high-efficiency red light-emitting diodes encapsulated in red epoxy. Viewing angle can be selected from point source to wide angle. Visual light emission is in the 590 nm to 660 nm range.

High Luminous Intensity For Ambient Light Levels
Solid State—No Replacement Required
High On/Off Contrast
Flexible Pins On All Lamps
- **For Good Heat Sinking**
- **For Right-Angle Bending**
- **Fits Standard Sockets or Drilled Holes**

Single Molded Body Eliminates Thermal Cycling Problems
Low Power for IC Compatibility
MV5752 For Point Source Lamps
MV5753 For Wide Angle Lamps
MV5754 For Intermediate Dispersion Lamps

Absolute Maximum Ratings

Maximum Temperature and Humidity

Storage Temperature	−55°C to +100°C
Operating Temperature	−55°C to +100°C
Pin Temperature (Soldering, 5 s)	260°C
Relative Humidity at 85°C	85%

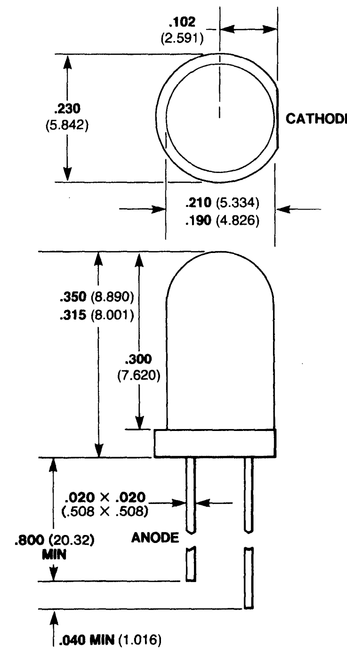
Maximum Power Dissipation

Total Dissipation at T_A = 25°C	105 mW
Derate Linearly from 25°C	1.14 mW/°C

Maximum Voltage and Currents

V_R	Reverse Voltage	5.0 V
I_F	Forward dc Current at T_A = 25°C	35 mA
I_{pk}	Peak Forward Current (1.0 μs pulse width, 0.1% duty cycle)	1.0 A

Package Outline



Notes
All dimensions in inches **bold** and millimeters (parentheses)
Tolerance unless specified = ±**.015** (0.381)

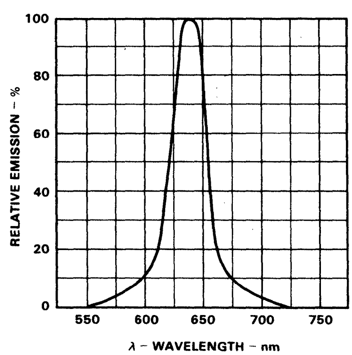
Typical Electrical Characteristics

MV5752 MV5753 MV5754

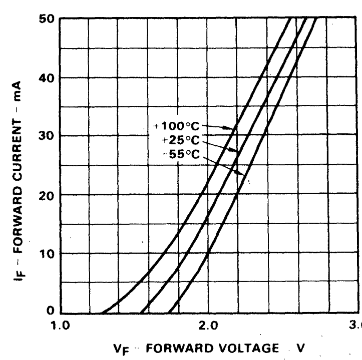
Electrical and Radiant Characteristics $T_A = 25°C$

Symbol	Characteristic	Min	Typ	Max	Units	Test Conditions
V_F	Forward Voltage		2.0	3.0	V	$I_F = 20$ mA
BV_R	Reverse Breakdown Voltage	5.0	25		V	$I_R = 100\ \mu A$
I_O	Axial Luminous Intensity				mcd	$I_F = 20$ mA
	MV5752	17	40			
	MV5753	3.0	6.0			
	MV5754	3.0	8.0			
θ	Viewing Angle Total				degrees	$I_F = 20$ mA
	MV5752		28			
	MV5753		65			
	MV5754		24			
λ_{pk}	Peak Wavelength		635		nm	$I_F = 20$ mA

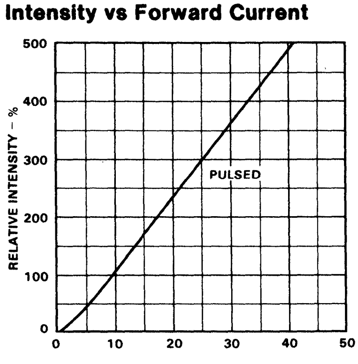
Emission Spectrum



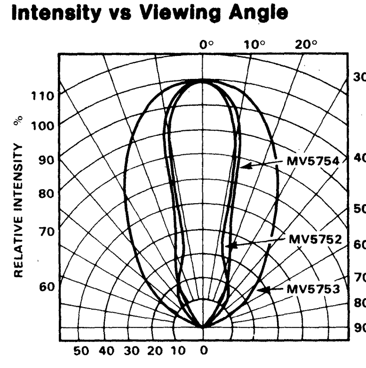
Forward Current vs Forward Voltage



Intensity vs Forward Current



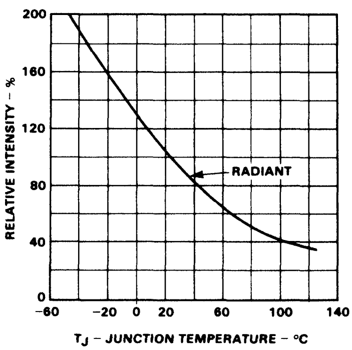
Intensity vs Viewing Angle



Typical Electrical Characteristic Curves

MV5752
MV5753
MV5754

Intensity vs Temperature



Red, Green and Yellow T-1 LED Lamps

Optoelectronic Products

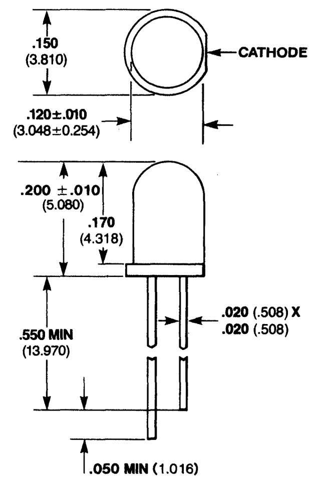
TIL209A
TIL212
TIL232

General Description

The TIL209A is a red GaAsP T-1 lamp. The TIL212 is a yellow GaAsP/GaP T-1 lamp, and the TIL232 is a green GaP T-1 lamp. These devices provide a low-cost lamp for applications where space is at a premium.

Small Size
Three Colors Available
Low Power Consumption Means IC Compatibility
No Socket Required

Package Outline



Notes
All dimensions in inches **bold** and millimeters (parentheses)
Tolerance unless specified = ±**.015** (±.381)

Absolute Maximum Ratings

Maximum Temperature and Humidity

Operating Temperature	−40°C to +80°C
Storage Temperature	−40°C to +80°C
Pin Temperature (Soldering, 5 s)	230°C
Relative Humidity at 85°C	85%

Maximum Power Dissipation

Total Dissipation at T_A = 25°C	100 mW
Derate Linearly from 25°C	1.33 mW/°C

Maximum Voltage and Currents

V_R	Reverse Voltage	3.0 V
I_F	Forward dc Current	
	TIL209A	40 mA
	TIL212, TIL232	30 mA
I_{pk}	Peak Forward Current	
	(1.0 µs pulse width)	1.0 A

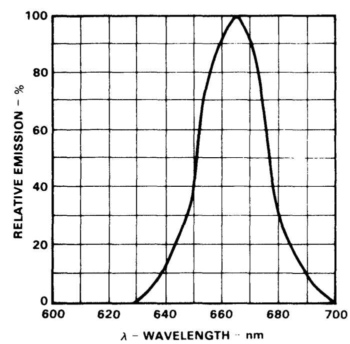
Electrical and Radiant Characteristics T_A = 25°C

Symbol	Characteristic	Min	Typ	Max	Units	Test Conditions
V_F	Forward Voltage					
	TIL209A		1.6	2.0	V	I_F = 20 mA
	TIL212, TIL232		2.3	3.2	V	I_F = 25 mA
V_R	Reverse Voltage					
	TIL209A	3.0			V	I_R = 100 µA
	TIL212, TIL232	5.0			V	I_R = 100 µA
I_O	Axial Luminous Intensity					
	TIL209A, TIL232-1	0.5			mcd	I_F = 20 mA
	TIL212-1	0.8			mcd	I_F = 20 mA
	TIL212-2	2.1			mcd	I_F = 20 mA
	TIL232-2	1.3			mcd	I_F = 20 mA
λ_{pk}	Peak Wavelength					
	TIL209A		665		nm	I_F = 20 mA
	TIL212		585		nm	I_F = 20 mA
	TIL232		565		nm	I_F = 20 mA

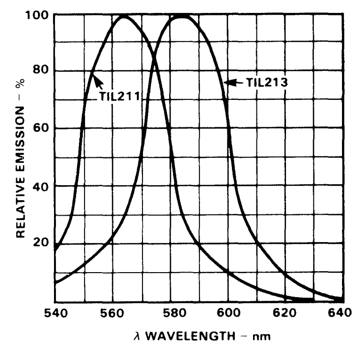
Typical Electrical Characteristic Curves

TIL209A
TIL212
TIL232

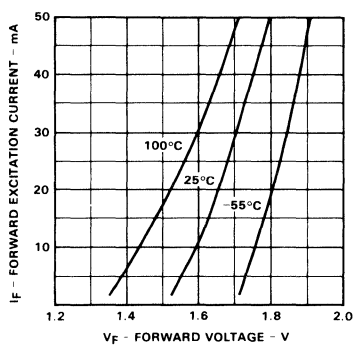
Emission Spectrum
TIL209A



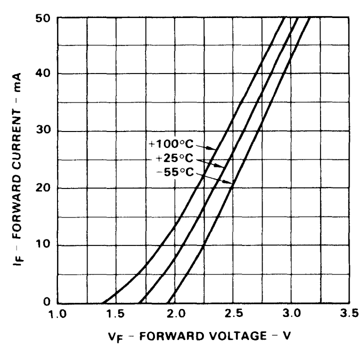
Emission Spectrum
TIL212, TIL232



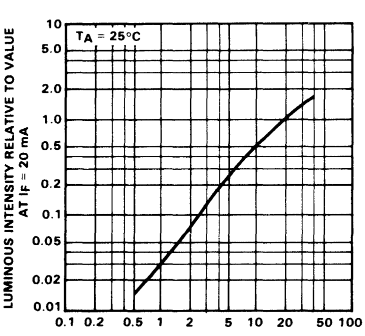
Forward Current vs Forward Voltage
TIL209A



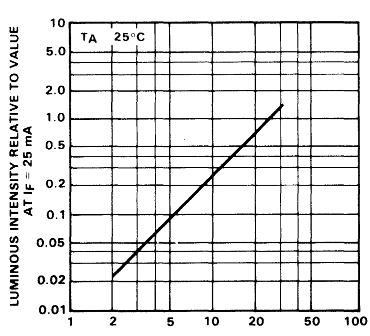
Forward Current vs Forward Voltage
TIL212, TIL232



Relative Luminous Intensity vs Forward Current
TIL209A



Relative Luminous Intensity vs Forward Current
TIL212, TIL232



Red GaAsP T-1 LED Lamps

Optoelectronic Products

5082-4480
5082-4483
5082-4486

General Description

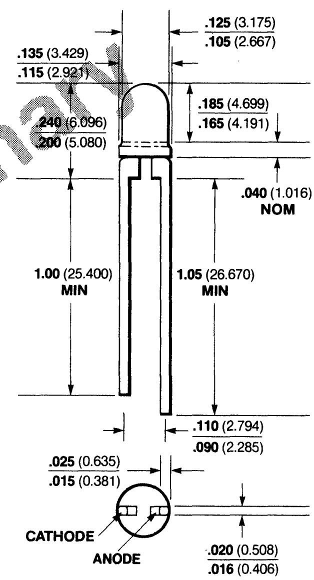
The 5082-4480, 5082-4483 and 5082-4486 are red light-emitting diodes encapsulated in plastic. The 5082-4480 has a red diffused lens, the 5082-4483 has a clear diffused lens, and the 5082-4486 has a clear non-diffused lens. These LED devices are designed for applications where space is at a premium. Visual light emission is in the 600 nm to 700 nm range.

High Intensity—0.8 mcd Typical
Wide Viewing Angle
Small Size T-1 Diameter 0.125 inches (3.18 mm)
IC Compatible
Reliable and Rugged
5082-4480—Red Diffused Lens
- **Excellent On/Off Contrast Ratio**
- **High Axial Luminous Intensity**
- **Wide Viewing Angle**

5082-4483—Clear Diffused
- **Masks Red in Off Condition**

5082-4486—Clear Non-diffused
- **For Illuminating External Lens, Annunciators or Photodetectors**

Package Outline



Notes
All dimensions in inches **bold** and millimeters (parentheses).
Silver plated pins.
An epoxy meniscus may extend about **.040** inches (1 mm) down the leads.

Absolute Maximum Ratings

Maximum Temperature

Storage Temperature	−55°C to +100°C
Operating Temperature	−55°C to +100°C
Pin Temperature (Soldering, 7 s)	230°C

Maximum Power Dissipation

Total Dissipation at T_A = 25°C	100 mW
Derate Linearly from 50°C	

Maximum Voltage and Currents

I_F	Forward dc Current at T_A = 25°C	50 mA
I_{pk}	Peak Forward Current at 1.0 μs pulse width, 300 pps	1.0 A

Electrical and Radiant Characteristics T_A = 25°C

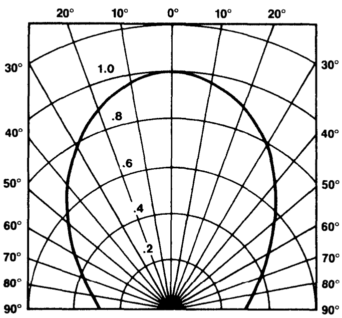
Symbol	Characteristic	Min	Typ	Max	Units	Test Conditions
I_V	Luminous Intensity	0.3	0.8		mcd	I_F = 20 mA
λ_{pk}	Wavelength		655		nm	Measurement at Peak
V_F	Forward Voltage		1.6	2.0	V	I_F = 20 mA
BV_R	Reverse Beakdown Voltage	3.0	10		V	I_R = 10 μA

Typical Electrical Characteristic Curves

5082-4480
5082-4483
5082-4486

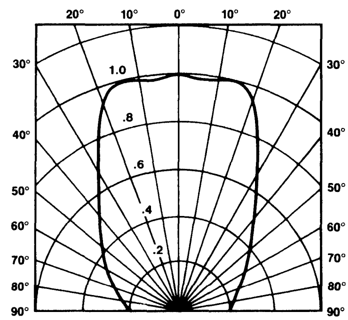
Relative Luminous Intensity vs Angular Displacement

5082-4480 • 5082-4483

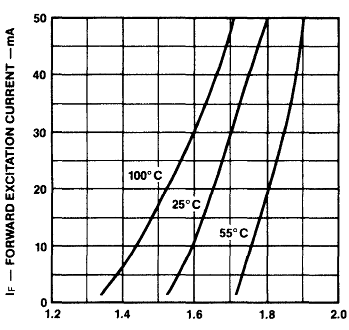


Relative Luminous Intensity vs Angular Displacement

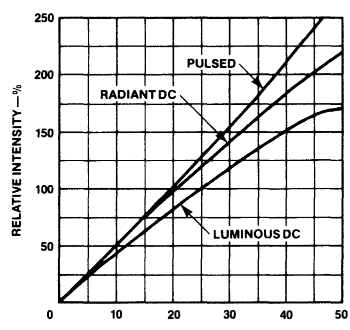
5082-4486

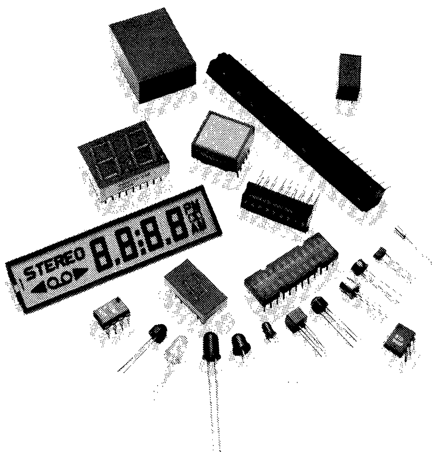


Forward Current vs Forward Voltage



Intensity vs Forward Current




STEREO

12-Element Bar Display FNA12

Optoelectronic Products

General Description

The FNA12 is a red 12-element analog display in a convenient, stackable dual in-line package. Applications include analog meter readouts, radio frequency indicator, or computer register displays.

12-Element Dual In-Line Package
End-Stackable For Scale Expansion
Separate Anode And Cathode Connections For Wiring Convenience
Up To 100 mA Peak Drive Current (20% Duty Cycle For High Ambient Conditions)

Absolute Maximum Ratings

Maximum Temperature and Humidity

Operating Temperature	−40°C to +80°C
Storage Temperature	−40°C to +80°C
Pin Temperature (Soldering, 5 s)	230°C
Relative Humidity at 85°C	85%

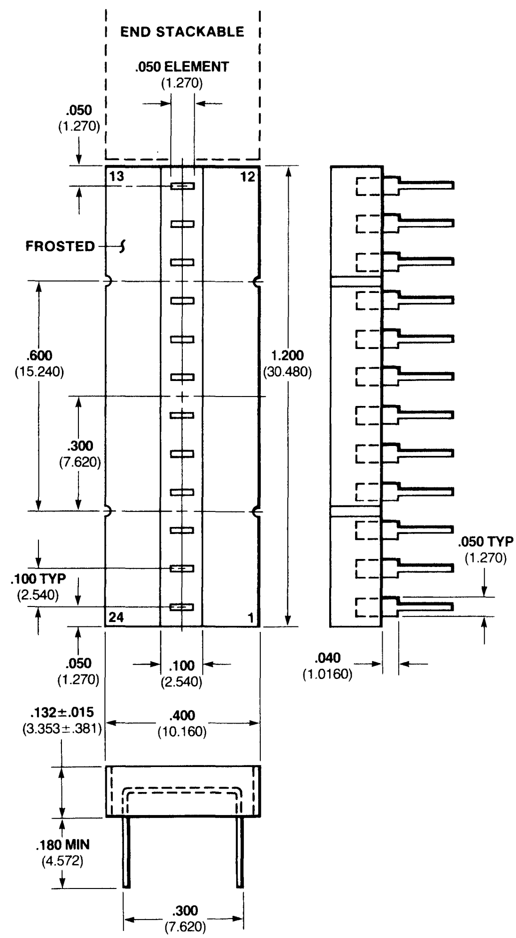
Maximum Power Dissipation

Total Dissipation at T_A = 25°C	100 mW
Derate Linearly from 25°C	1.33 mW/°C

Maximum Voltage and Currents

V_R	Reverse Voltage	3.0 V
I_F	Average Forward dc Current per Element	20 mA
I_{pk}	Peak Forward Current (1.0 μs Pulse Width)	1.0 A

Package Outline



Notes
All dimensions in inches **bold** and millimeters (parentheses)
Tolerance unless specified = ±**.015** (0.381)

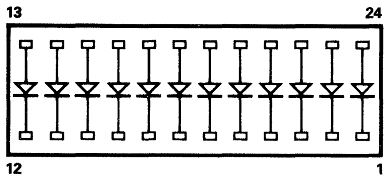
Electrical and Radiant Characteristics T_A = 25°C

Symbol	Characteristic	Min	Typ	Max	Units	Test Conditions
V_F	Forward Voltage		1.7	2.0	V	I_F = 20 mA/seg
V_R	Reverse Voltage	3.0			V	I_R = 100 μA
I_O	Axial Luminous Intensity	60	100		μcd	I_F = 6 mA/seg
		100	200		μcd	I_F = 10 mA
λ_{pk}	Peak Wavelength		665		nm	I_F = 20 mA/seg
ΔI	Intensity Matching Maximum Variation		±33		%	

Connection Diagram Typical Electrical Characteristic Curves

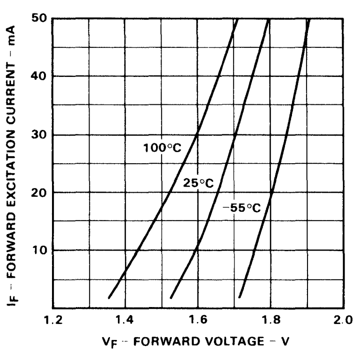
FNA12

Connection Diagram Bottom View

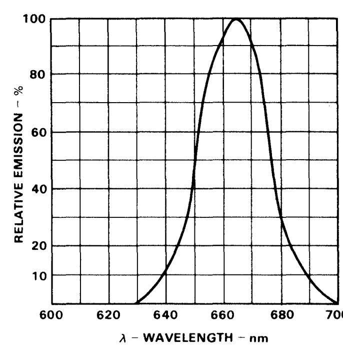


Pin		Pin	
1	Cathode 1	13	Anode 12
2	Cathode 2	14	Anode 11
3	Cathode 3	15	Anode 10
4	Cathode 4	16	Anode 9
5	Cathode 5	17	Anode 8
6	Cathode 6	18	Anode 7
7	Cathode 7	19	Anode 6
8	Cathode 8	20	Anode 5
9	Cathode 9	21	Anode 4
10	Cathode 10	22	Anode 3
11	Cathode 11	23	Anode 2
12	Cathode 12	24	Anode 1

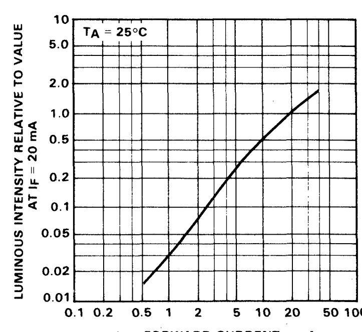
Forward Current vs Forward Voltage



Emission Spectrum



Relative Luminous Intensity vs Forward Current



Red GaAsP 0.362-Inch 7-Segment Numeric LED Displays

Optoelectronic Products

FND350, FND360 FND357, FND367

General Description

The FND350, FND360, FND357 and FND367 are red GaAsP 7-segment LED displays with a 0.362-inch character height. These displays are designed for applications in which the viewer is within fifteen feet of the display.

Compact— 10 Digits In 3-Inch Panel Width
Low Current Requirements 2-20 mA/Segment
Low Forward Voltage—V_F = 1.7 V
Intensity Code Marking For Uniform Displays
Maximized Contrast Ratio With Integral Lens Cap
FND360, FND367 Suitable For Use In High Ambient Light
FND350—Common Anode, Right Hand Decimal Point
FND360–Common Anode, Right Hand Decimal Point, High Brightness
FND357—Common Cathode, Right Hand Decimal Point
FND367—Common Cathode, Right Hand Decimal Point, High Brightness

Absolute Maximum Ratings

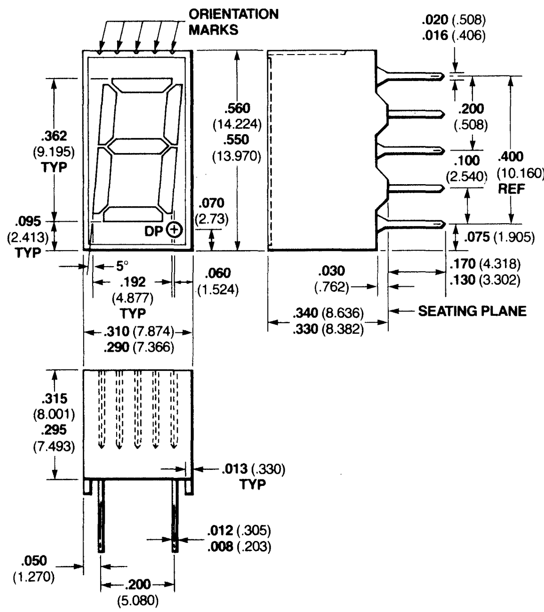
Maximum Temperature and Humidity

Operating Temperature	−25°C to +85°C
Storage Temperature	−25°C to +85°C
Pin Temperature (Soldering, 5 s)	260°C
Relative Humidity at 65°C	98%

Maximum Voltage and Currents

V_R	Reverse Voltage	3.0 V
I_F	Average Forward dc Current/Segment or Decimal Point	25 mA
	Derate from 25°C Ambient Temperature	0.3 mA/°C
I_{pk}	Peak Current/Segment or Decimal Point (100 μs pulse) 1000 pps, T_A = 25°C	200 mA

Package Outline

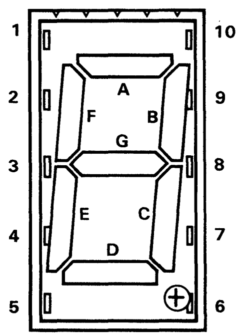


Notes
All dimensions in inches **bold** and millimeters (parentheses)
Tolerance unless specified = ±**.015** (±.381)

Connection Diagram Typical Electrical Characteristics

FND350, FND357 FND360, FND367

Pin Connections
(Front View)



Pin	FND357/367	FND350/360
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	Decimal Point
8	Segment C	Segment C
9	Segment B	Segment B
10	Segment A	Segment A

Electrical Characteristics $T_A = 25°C$

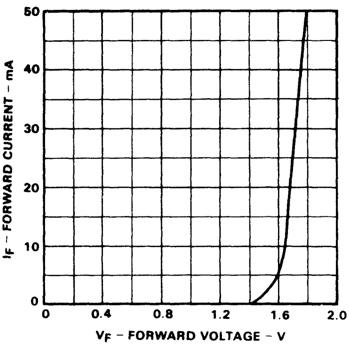
Symbol	Characteristics	Min	Typ	Max	Units	Test Conditions
V_F	Forward Voltage		1.7	2.0	V	$I_F = 20$ mA
BV_R	Reverse Breakdown Voltage	3.0	12		V	$I_R = 1.0$ mA
I_O	Axial Luminous Intensity					
	Each Segment (Note 1)					
	FND350, 357	240	450		μcd	$I_F = 20$ mA
	FND360, 367	590	900			
ΔI_O	Intensity Matching, Segment-to-Segment					
	(Note 3)		±33		%	$I_F = 20$ mA
	Intensity Matching Within One Intensity Class		±20		%	$I_F = 20$ mA, all segments at once
L_O	Average Segment Luminance (Note 2)					
	FND350, 357		26		ftL	$I_F = 20$ mA
	FND360, 367		52			
$\theta_{1/2}$	Viewing Angle to Half Intensity		±27		degrees	
λ_{pk}	Peak Wavelength		665		nm	$I_F = 20$ mA

Notes
1. Typical operating current under single digit (dc) drive is approximately 2 to 20 mA average per segment for most ambient light conditions. The 125 mA specification is a representative peak current.
2. Measured on mechanical axis of package. See Average Luminous Intensity curve for other forward currents.
3. Segment-to-segment from average segment intensity.

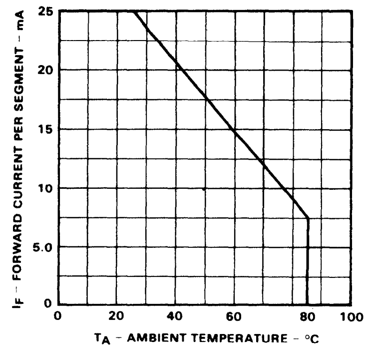
Typical Electrical Characteristic Curves

FND350, FND357 FND360, FND367

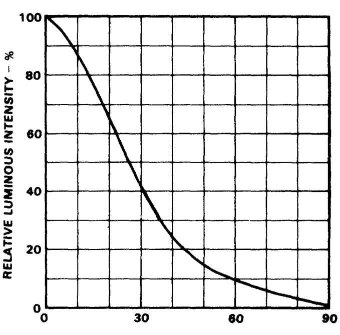
Forward Current vs Forward Voltage



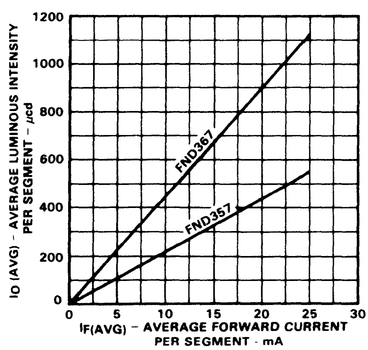
Maximum Average Current Rating vs Ambient Temperature



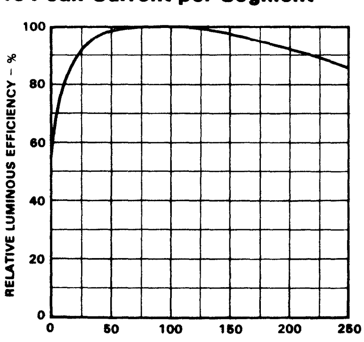
Angular Distribution of Luminous Intensity



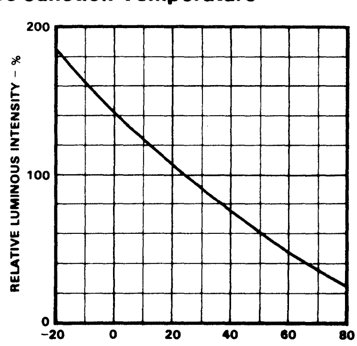
Average Luminous Intensity vs Average Forward Current



Relative Luminous Efficiency (mcd per mA) vs Peak Current per Segment



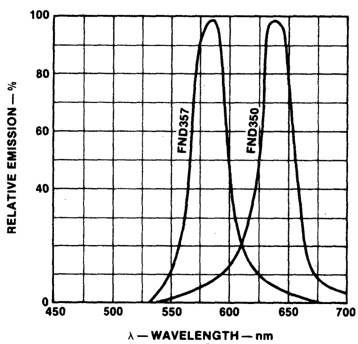
Relative Luminous Intensity vs Junction Temperature



Typical Electrical Characteristic Curves (Cont'd)

FND350, FND357 FND360, FND367

Emission Spectrum



Red GaAsP 0.362-Inch ± 1 LED Displays

Optoelectronic Products

FND358
FND368

General Description

The FND358 and FND368 are red GaAsP ± 1 LED displays with nominal 0.362-inch character height in common-cathode configuration. These displays are for applications in which the viewer is within fifteen feet of the display.

Ideal Companion to FND357/FND367
Low Current Requirements 2–20 mA/Segment
Low Forward Voltage—Typically V_F = 1.7 V
Intensity Code Marking For Uniform Displays
FND368 Suitable For Use In High Ambient Light
Maximized Contrast Ratio With Integral Lens Cap
FND358—Common Cathode, Right-Hand Decimal Point
FND368—Common Cathode, Right-Hand Decimal Point, High Brightness

Absolute Maximum Ratings

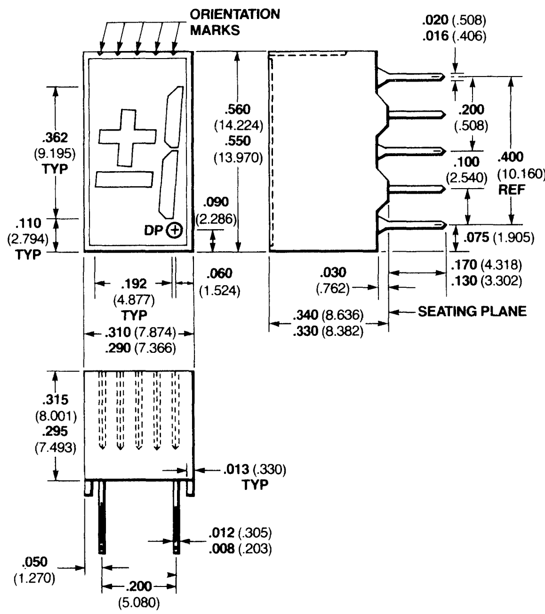
Maximum Temperature and Humidity

Storage Temperature	−25°C to +85°C
Operating Temperature	−25°C to +85°C
Pin Temperature (Soldering, 5 s)	260°C
Relative Humidity at 65°C	98%

Maximum Voltage and Currents

V_R	Reverse Voltage	3.0 V
I_F	Average Forward dc Current/Segment or Decimal Point	25 mA
	Derate from 25°C Ambient Temperature	0.3 mA/°C
I_{pk}	Peak Forward Current/ Segment or Decimal Point (100 μs pulse width) 1000 pps, T_A = 25°C	200 mA

Package Outline



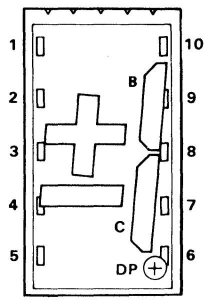
Notes
All dimensions in inches **bold** and millimeters (parentheses)
For polarity indication the top surface is ribbed
The unit LED segments cannot necessarily be seen through the lens cap
Lens cap color is red for red LED
Pins 1 and 6 are common
All dimensions are ±**.015** (.381)

3

Connection Diagram Typical Electrical Characteristics

FND358 FND368

Pin Connections (Top View)



Pin

1 Common Cathode
2 Plus Sign
3 Minus Sign
4 NC
5 Omitted
6 Common Cathode
7 Decimal Point
8 Segment C
9 Segment B
10 NC

Electrical and Radiant Characteristics $T_A = 25°C$

Symbol	Characteristic	Min	Typ	Max	Units	Test Conditions
V_F	Forward Voltage	1.5	1.7	2.0	V	$I_F = 20$ mA
BV_R	Reverse Breakdown Voltage	3.0	12		V	$I_R = 1.0$ mA
I_O	Axial Luminous Intensity, Average Each Segment (Note 1)					
	FND358	240	450		μcd	$I_F = 20$ mA
	FND368	590	900		μcd	$I_F = 20$ mA
ΔI_O	Intensity Matching, Segment-to-Segment (Note 3)		±33		%	$I_F = 20$ mA
	Intensity Matching Within One Intensity Class		±20		%	$I_F = 20$ mA, all segments at once
L_O	Average Segment Luminance (Note 2)					
	FND358		26		ftL	$I_F = 20$ mA
	FND368		52		ftL	$I_F = 20$ mA
$\theta_{1/2}$	Viewing Angle to Half Intensity		±27		degrees	
λ_{pk}	Peak Wavelength		665		nm	$I_F = 20$ mA

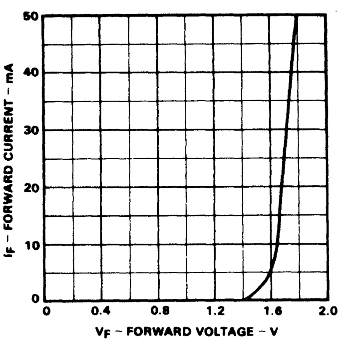
Notes

1. Typical operating current under single digit (dc) drive is approximately 2 to 20 mA average per segment for most ambient light conditions.
2. Measured on mechanical axis of package. See Average Luminous Intensity curve for other forward currents.
3. Segment-to-segment from average segment intensity.

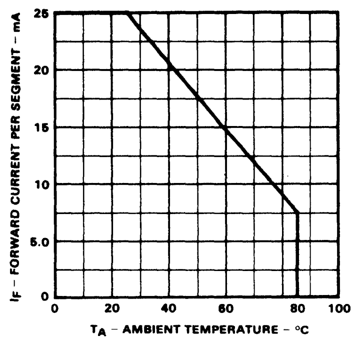
Typical Electrical Characteristic Curves

FND358
FND368

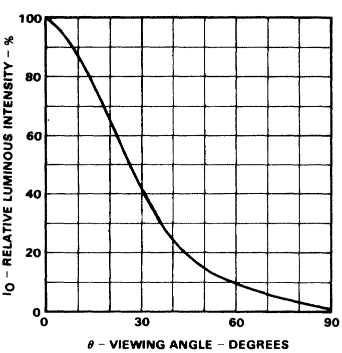
Forward Current vs Forward Voltage



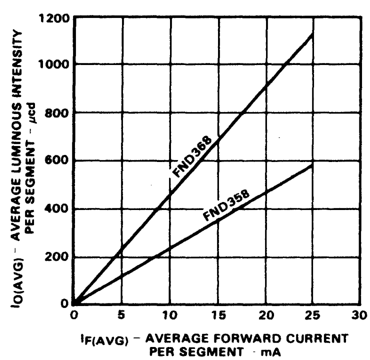
Maximum Average Current Rating vs Ambient Temperature



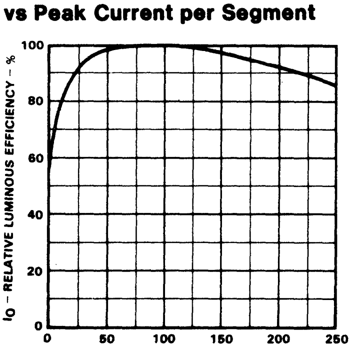
Angular Distribution of Luminous Intensity



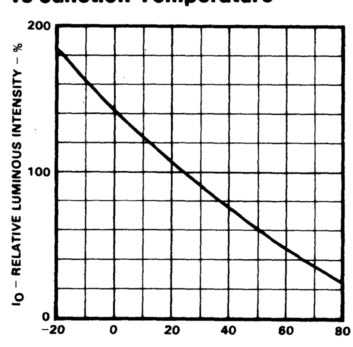
Average Luminous Intensity vs Average Forward Current



Relative Luminous Efficiency (mcd per mA) vs Peak Current per Segment



Relative Luminous Intensity vs Junction Temperature



Red GaAsP 0.5-Inch 7-Segment Numeric LED Displays

Optoelectronic Products

FND500, FND507 FND560, FND567

General Description

The FND500, FND507, FND560 and FND567 are red GaAsP single-digit 7-Segment LED displays with a 0.5-inch character height. These displays are designed for applications in which the viewer is within twenty feet of the display.

Low Forward Voltage—Typically V_F = 1.7 V
Fits Standard DIP Sockets with 0.6-Inch Pin Row
Maximized Contrast Ratio With Integral Lens Cap
Horizontal Stacking 0.6-Inch Minimum, 1-Inch Typical
FND560/567 Suitable For Use In High Ambient Light
FND500 Common Cathode, Right-Hand Decimal Point
FND507 Common Anode, Right-Hand Decimal Point
FND560 Common Cathode, Right-Hand Decimal Point, High Brightness
FND567 Common Anode, Right-Hand Decimal Point, High Brightness

Absolute Maximum Ratings

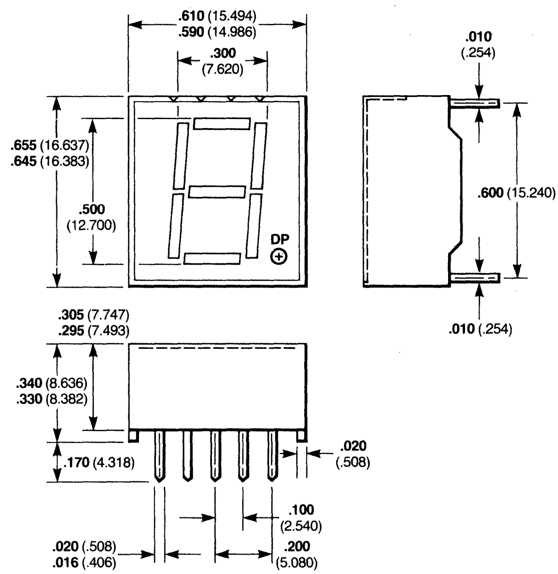
Maximum Temperature and Humidity

Storage Temperature	−25°C to +85°C
Operating Temperature	−25°C to +85°C
Pin Temperature (Soldering, 5 s)	260°C
Relative Humidity at 65°C	98%

Maximum Voltage and Currents

V_R	Reverse Voltage	3.0 V
I_F	Average Forward dc Current/Segment or Decimal Point	25 mA
	Derate from 25°C Ambient Temperature	0.3 mA/°C
I_{pk}	Peak Forward Current Segment or Decimal Point (100 μs pulse width) 1000 pps, T_A = 25°C	200 mA

Package Outline

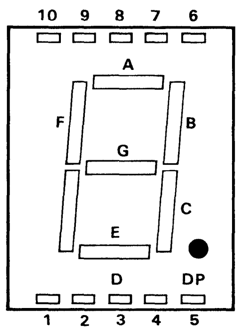


Notes
All dimensions in inches **bold** and millimeters (parentheses)
Tolerance unless specified = ±**.015** (±.381)

Connection Diagram Typical Electrical Characteristics

FND500, FND507 FND560, FND567

Pin Connections (Front View)



Pin	FND507/567	FND500/560
1	Segment E	Segment E
2	Segment D	Segment D
3	Common Anode	Common Cathode
4	Segment C	Segment C
5	Decimal Point	Decimal Point
6	Segment B	Segment B
7	Segment A	Segment A
8	Common Anode	Common Cathode
9	Segment F	Segment F
10	Segment G	Segment G

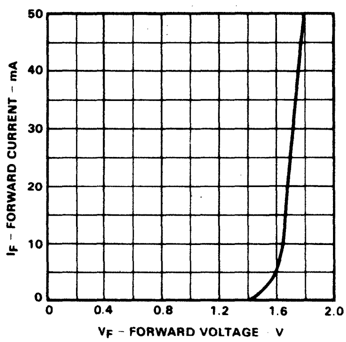
Electrical and Radiant Characteristics $T_A = 25°C$

Symbol	Characteristic	Min	Typ	Max	Units	Test Conditions
V_F	Forward Voltage	1.5	1.7	2.0	V	$I_F = 20$ mA
BV_R	Reverse Breakdown Voltage	3.0	12		V	$I_R = 1.0$ mA
I_O	Axial Luminous Intensity, Average Each Segment					
	FND500, FND507	300	600		μcd	$I_F = 20$ mA
	FND560, FND567	740	1200		μcd	$I_F = 20$ mA
ΔI_O	Intensity Matching, Segment-to-Segment		±33		%	$I_F = 20$ mA
	Intensity Matching Within One Intensity Class		±20		%	$I_F = 20$ mA, all segments at once
L_O	Average Segment Luminance					
	FND500, FND507		35		ftL	$I_F = 20$ mA
	FND560, FND567		70		ftL	$I_F = 20$ mA
$\theta_{1/2}$	Viewing Angle to Half Intensity		±27		degrees	
λ_{pk}	Peak Wavelength		665		nm	$I_F = 20$ mA

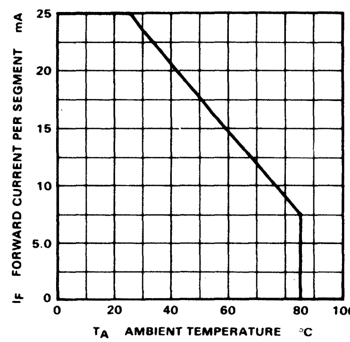
Typical Electrical Characteristic Curves

FND500, FND507 FND560, FND567

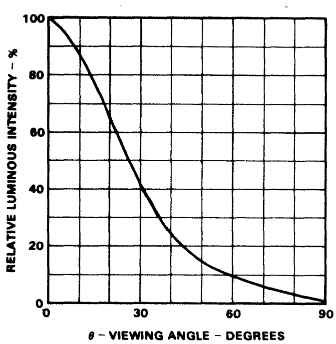
Forward Current vs Forward Voltage



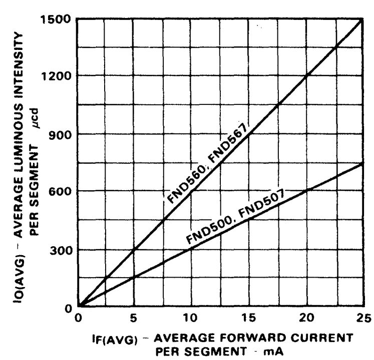
Maximum Average Current Rating vs Ambient Temperature



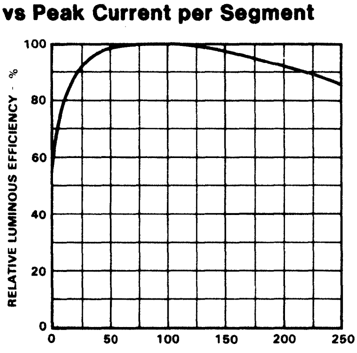
Angular Distribution of Luminous Intensity



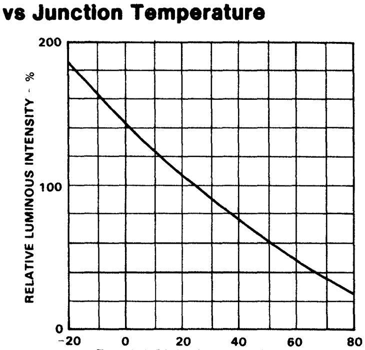
Average Luminous Intensity vs Average Forward Current



Relative Luminous Efficiency (mcd per mA) vs Peak Current per Segment



Relative Luminous Intensity vs Junction Temperature



Red GaAsP 0.5-Inch ± 1 LED Displays

FND501, FND508 FND561, FND568

Optoelectronic Products

General Description

The FND501, FND561, FND508 and FND568 are red GaAsP overflow LED displays with a nominal 0.5-inch character height. These displays are for applications where the viewer is within twenty feet of the display.

Low Forward Voltage—Typically V_F = 1.7 V
Fits Standard DIP Sockets With 0.6-Inch Pin Row
Maximized Contrast Ratio With Integral Lens Cap
Horizontal Stacking 0.6-Inch Minimum, 1-Inch Typical
The FND561 And FND568 Are Suitable For Applications In High Ambient Light
FND501—Common Cathode, Right-Hand Decimal Point
FND508—Common Anode, Right-Hand Decimal Point
FND561—Common Cathode, Right-Hand Decimal Point, High Brightness
FND568—Common Anode, Right-Hand Decimal Point, High Brightness

Absolute Maximum Ratings

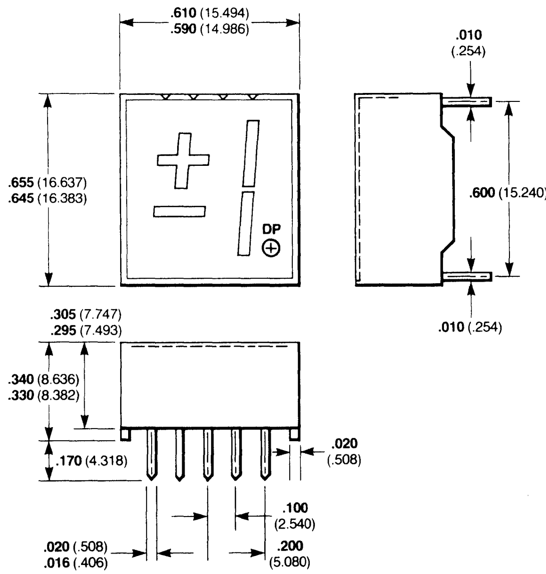
Maximum Temperature and Humidity

Storage Temperature	−25°C to +85°C
Operating Temperature	−25°C to +85°C
Pin Temperature (Soldering, 5 s)	260°C
Relative Humidity at 65°C	98%

Maximum Voltage and Currents

V_R	Reverse Voltage	3.0 V
I_F	Average Forward dc Current/Segment or Decimal Point	25 mA
	Derate from 25°C Ambient Temperature	0.3 mA/°C
I_{pk}	Peak Forward Current/Segment or Decimal Point (100 μs pulse width) 1000 pps, T_A = 25°C	200 mA

Package Outline



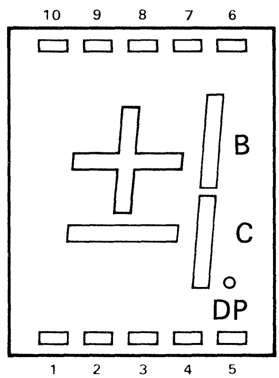
Notes

All dimensions in inches **bold** and millimeters (parentheses)
Tolerance unless specified = ±**.015** (0.381)
For polarity indication the surface is ribbed
The unit LED segments cannot necessarily be seen through the lens cap
Lens cap color is red for red LED
Pins 3 and 8 are common

Connection Diagram Typical Electrical Characteristics

FND501, FND508 FND561, FND568

Pin Connections (Top View)



Pin	FND501/561	FND508/568
1	Minus	Minus
2	Cathode ±	Anode ±
3	Segment C	Segment C
4	Cathode 1/DP	Anode 1/DP
5	DP	DP
6	Segment B	Segment B
7	Cathode 1/DP	Anode 1/DP
8	Cathode ±	Anode ±
9	Plus	Plus
10	NC	NC

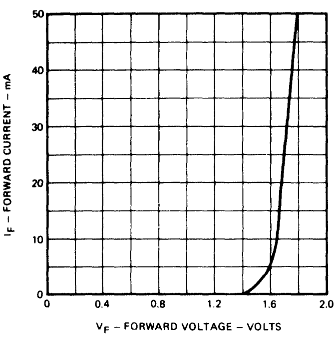
Electrical and Radiant Characteristics $T_A = 25°C$

Symbol	Characteristic	Min	Typ	Max	Units	Test Conditions
V_F	Forward Voltage		1.7	2.0	V	$I_F = 20$ mA
BV_R	Reverse Breakdown Voltage	3.0	12		V	$I_R = 1.0$ mA
I_O	Axial Luminous Intensity, Each Segment					
	FND501, FND508	300	600		μcd	$I_F = 20$ mA
	FND561, FND568	740	1200		μcd	$I_F = 20$ mA
ΔI_O	Intensity Matching, Segment-to-Segment		±33		%	$I_F = 20$ mA
	Intensity Matching Within One Intensity Class		±20		%	$I_F = 20$ mA, all segments at once
L_O	Average Segment Luminance					
	FND501, FND508		35		ftL	$I_F = 20$ mA
	FND561, FND568		70		ftL	$I_F = 20$ mA
$\theta_{1/2}$	Viewing Angle to Half Intensity		±27		degrees	
λ_{pk}	Peak Wavelength		665		nm	$I_F = 20$ mA

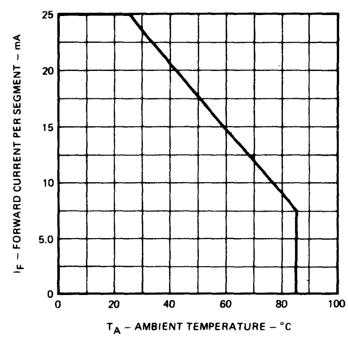
Typical Electrical Characteristic Curves

FND501, FND508 FND561, FND568

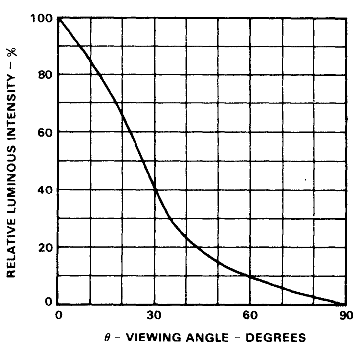
Forward Current vs Forward Voltage



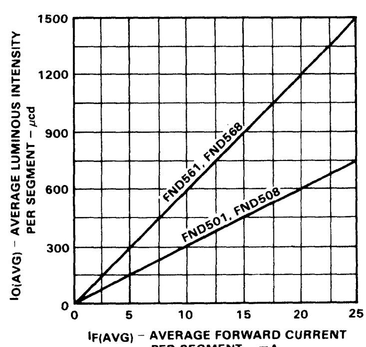
Maximum Average Current Rating vs Ambient Temperature



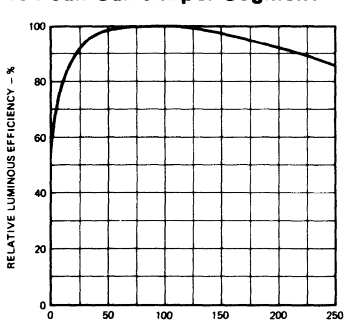
Angular Distribution of Luminous Intensity



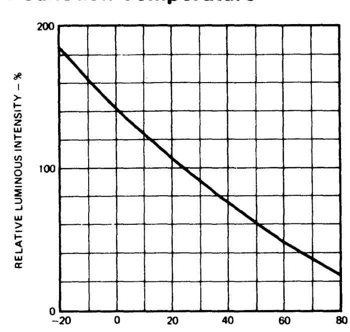
Average Luminous Intensity vs Average Forward Current



Relative Luminous Efficiency (mcd per mA) vs Peak Current per Segment



Relative Luminous Intensity vs Junction Temperature



Green GaP Yellow Super GaAsP Amber Super GaAsP 0.5-Inch 7-Segment LED Displays

Optoelectronic Products

FND530, FND537 FND540, FND547 FND550, FND557

General Description

The FND530 and FND537 are green GaP 7-segment LED displays; the FND540 and FND547 are yellow Super GaAsP 7-segment LED displays; and the FND550 and FND557 are amber Super GaAsP 7-segment LED displays. All have a 0.50-inch nominal character height. These displays are for applications where the viewer is within 20 feet of the display.

Fits Standard Sockets With 0.6-Inch Pin Row
Intensity Code Marking For Uniform Displays
Maximized Contrast Ratio With Integral Lens Cap
Maximized Use Of Digit Face
FND550/FND557—Suitable For Use In High Ambient Light
FND530—Common Cathode, Right-Hand Decimal Point, Green
FND537—Common Anode, Right-Hand Decimal Point, Green
FND540—Common Cathode, Right-Hand Decimal Point, Yellow
FND547—Common Anode, Right-Hand Decimal Point, Yellow
FND550—Common Cathode, Right-Hand Decimal Point, Amber
FND557—Common Anode, Right-Hand Decimal Point, Amber

Absolute Maximum Ratings

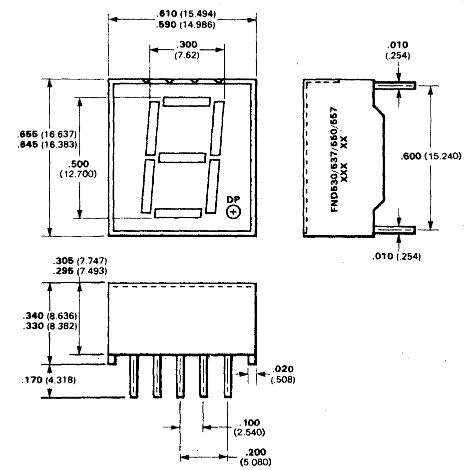
Maximum Temperature and Humidity

Storage Temperature	−25°C to +85°C
Operating Temperature	−25°C to +85°C
Pin Temperature (Soldering, 5 s)	260°C
Relative Humidity at 60°C	90%

Maximum Voltage and Currents

V_R	Reverse Voltage	3.0 V
I_F	Average Forward dc Current/Segment or Decimal Point	20 mA
I_{pk}	Peak Forward Current/ Segment or Decimal Point (100 μs pulse width) 1000 pps, T_A = 25°C	80 mA

Package Outline



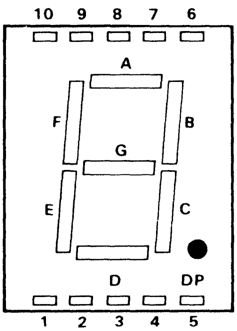
Notes

All dimensions in inches **bold** and millimeters (parentheses)
For polarity indication the surface is ribbed
The unlit LED segments cannot necessarily be seen through the lens cap
Lens cap color is red for red LED
Pins 3 and 8 are common
All dimensions are ±**.015** (±.381)

Connection Diagram Typical Electrical Characteristics

FND530, FND537 FND540, FND547 FND550, FND557

Pin Connections (Front View)



Pin	FND530/540/550	FND537/547/557
1	Segment E	Segment E
2	Segment D	Segment D
3	Common Cathode	Common Anode
4	Segment C	Segment C
5	Decimal Point	Decimal Point
6	Segment B	Segment B
7	Segment A	Segment A
8	Common Cathode	Common Anode
9	Segment F	Segment F
10	Segment G	Segment G

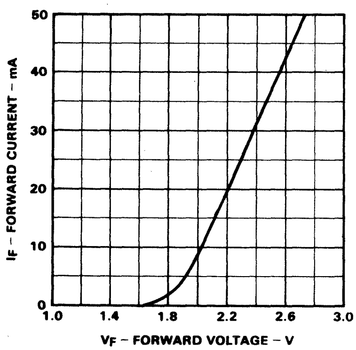
Electrical and Radiant Characteristics $T_A = 25°C$

Symbol	Characteristic	Min	Typ	Max	Units	Test Conditions
V_F	Forward Voltage		2.2	3.2	V	$I_F = 20$ mA
BV_R	Reverse Breakdown Voltage	3.0			V	$I_R = 1.0$ mA
I_O	Axial Luminous Intensity					
	Average Each Segment					
	FND530, FND537		600	2000	μcd	$I_F = 20$ mA
	FND540, FND547		600	1000	μcd	$I_F = 20$ mA
	FND550, FND557		700	2000	μcd	$I_F = 20$ mA
$\theta_{½}$	Viewing Angle to Half Intensity		±30		degrees	$I_F = 20$ mA
λ_{pk}	Peak Wavelength					
	FND530, FND537		565		nm	$I_F = 20$ mA
	FND540, FND547		585		nm	$I_F = 20$ mA
	FND550, FND557		635		nm	$I_F = 20$ mA
L_O	Average Segment Luminance					
	FND530, FND537		104		ftL	$I_F = 20$ mA
	FND540, FND547		52		ftL	$I_F = 20$ mA
	FND550, FND557		104		ftL	$I_F = 20$ mA
ΔI_O	Intensity Matching Segment-to-Segment		±33		%	$I_F = 20$ mA
	Intensity Matching Within One Intensity Class		±20		%	$I_F = 20$ mA

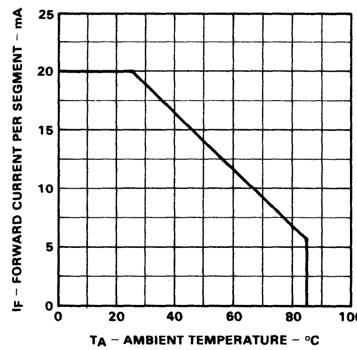
Typical Electrical Characteristic Curves

FND530, FND537 FND540, FND547 FND550, FND557

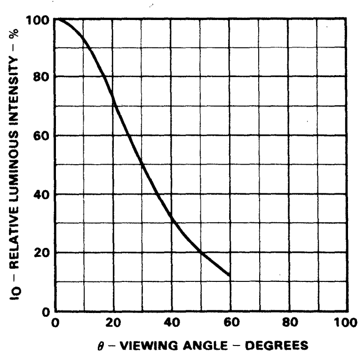
Forward Current vs Forward Voltage



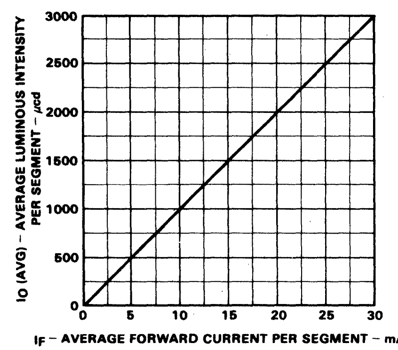
Maximum Average Current Rating vs Ambient Temperature



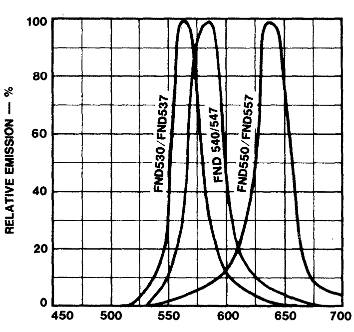
Angular Distribution Of Luminous Intensity



Average Luminous Intensity vs Average Forward Current



Emission Spectrum



Green GaP Yellow Super GaAsP Amber Super GaAsP 0.50 Inch ± 1 LED Displays

Optoelectronic Products

FND531, FND538 FND541, FND548 FND551, FND558

General Description
The FND531 and FND538 are Green GaP ± 1 LED displays with a nominal 0.50-inch character height. The FND541 and FND548 are yellow Super GaAsP ± 1 LED displays with a nominal 0.50-inch character height. The FND551 and FND558 are amber Super GaAsP ± 1 LED displays with a nominal 0.50-inch character height. These displays are for applications where the viewer is within 20 feet of the display.

Fits Standard Sockets With 0.6-Inch Pin Row
Intensity Code Marking for Uniform Displays
Maximized Contrast Ratio With Integral Lens Cap
Maximized Use of Digit Face
Ideal Companions to FND Series 7-Segment LED Displays
FND531/FND538 With FND530/FND537
FND541/FND548 With FND540/FND547
FND551/FND558 With FND550/FND557
FND531—Common Cathode, Right-Hand Decimal Point, Green
FND538—Common Anode, Right-Hand Decimal Point, Green
FND541—Common Cathode, Right-Hand Decimal Point, Yellow
FND548—Common Anode, Right-Hand Decimal Point, Yellow
FND551—Common Cathode, Right-Hand Decimal Point, Amber
FND558—Common Anode, Right-Hand Decimal Point, Amber

Absolute Maximum Ratings

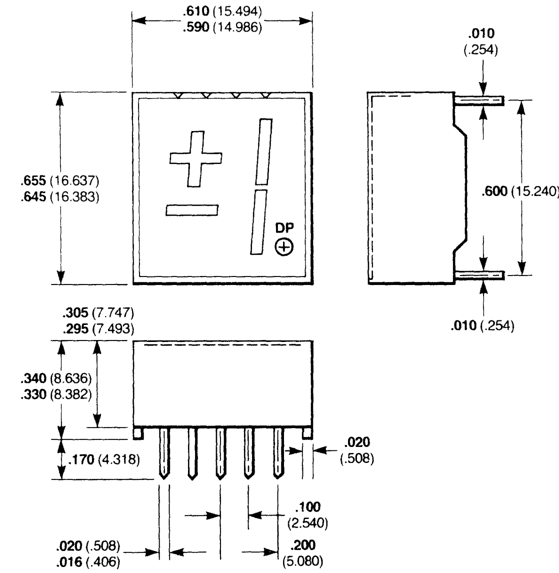
Maximum Temperature and Humidity

Storage Temperature	−25°C to +85°C
Operating Temperature	−25°C to +85°C
Pin Temperature (Soldering, 5 s)	260°C
Relative Humidity at 60°C	90%

Maximum Voltage and Currents

V_R	Reverse Voltage	3.0 V
I_F	Average Forward dc Current/Segment or Decimal Point	20 mA
I_{pk}	Peak Forward Current/ Segment or Decimal Point (100 μs pulse width) 1000 pps, T_A = 25°C	80 mA

Package Outline

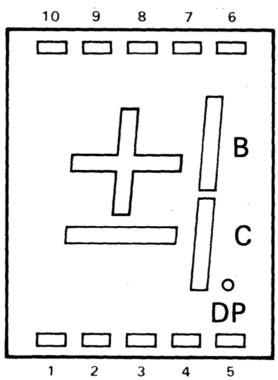


Notes
All dimensions in inches **bold** and millimeters (parentheses).
For polarity indication the surface is ribbed.
The unlit LED segments cannot necessarily be seen through the lens cap.
Lens cap color is red for red LED.
Pins 3 and 8 are common.
All dimensions are ±**.015** (±0.381).

Connection Diagram Typical Electrical Characteristics

FND531, FND538 FND541, FND548 FND551, FND558

Connection Diagram
(Top View)



Pin	FND531 FND541 FND551	FND538 FND548 FND558
1	Minus	Minus
2	Cathode ±	Anode ±
3	Segment C	Segment C
4	Cathode 1/DP	Anode 1/DP
5	Decimal Point	Decimal Point
6	Segment B	Segment B
7	Cathode 1/DP	Anode 1/DP
8	Cathode ±	Anode ±
9	Plus	Plus
10	NC	NC

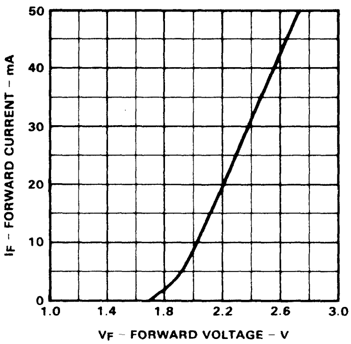
Electrical and Radiant Characteristics $T_A = 25°C$

Symbol	Characteristic	Min	Typ	Max	Units	Test Conditions
V_F	Forward Voltage		2.2	3.2	V	$I_F = 20$ mA
BV_R	Reverse Voltage Breakdown	3.0			V	$I_R = 1.0$ mA
I_O	Axial Luminous Intensity					
	Average each Segment					
	FND531, FND538	600	2000		μcd	$I_F = 20$ mA
	FND541, FND548	700	2000		μcd	$I_F = 20$ mA
	FND551, FND558	700	2000		μcd	$I_F = 20$ mA
$\theta_{1/2}$	Viewing Angle to Half Intensity		±30		degrees	
λ_{pk}	Peak Wavelength					
	FND531, FND538		565		nm	$I_F = 20$ mA
	FND541, FND548		570		nm	$I_F = 20$ mA
	FND551, FND558		635		nm	$I_F = 20$ mA
L_O	Average Segment Luminance		104		ftL	$I_F = 20$ mA
ΔI_O	Intensity Matching Segment-to-Segment		±33		%	$I_F = 20$ mA
	Intensity Matching Within One Intensity Glass		±20		%	$I_F = 20$ mA

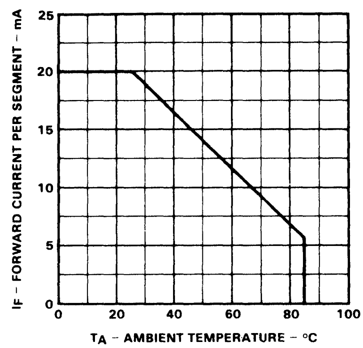
Typical Electrical Characteristic Curves

FND531, FND538 FND541, FND548 FND551, FND558

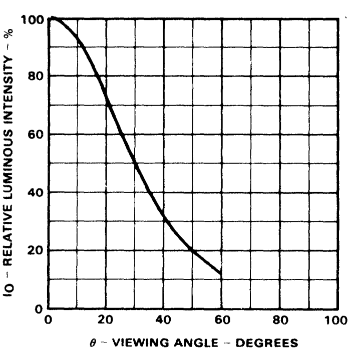
Forward Current vs Forward Voltage



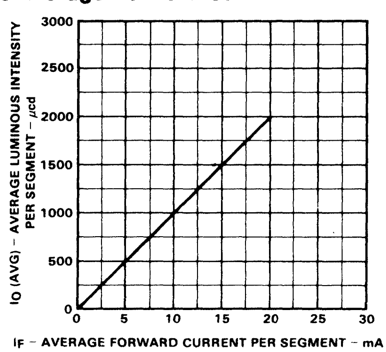
Maximum Average Current Rating vs Ambient Temperature



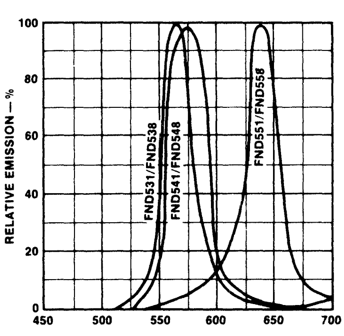
Angular Distribution of Luminous Intensity



Average Luminous Intensity vs Average Forward Current



Emission Spectrum



Red GaAsP 0.8-Inch 7-Segment Numeric LED Display

Optoelectronic Products

FND800
FND807

General Description

The FND800 and FND807 are red GaAsP 7-Segment LED Displays with a nominal 0.8-inch character height. These displays are for applications where the viewer is within thirty feet of the display.

Low Current Requirements of Typically 10 mA/ Segment
Low Forward Voltage Typically V_F = 1.7 V
Fits Standard DIP Sockets With 0.6-Inch Pin Row
Decimal Point On Lower Right-Hand Side
Overflow Point On Upper Left-Hand Side With Digit Reversed
Maximized Contrast Ratio With Integral Lens Cap
Horizontal Stacking 1-Inch Typical
FND800—Common Cathode, Right-Hand Decimal Point
FND807—Common Anode, Right-Hand Decimal Point

Absolute Maximum Ratings

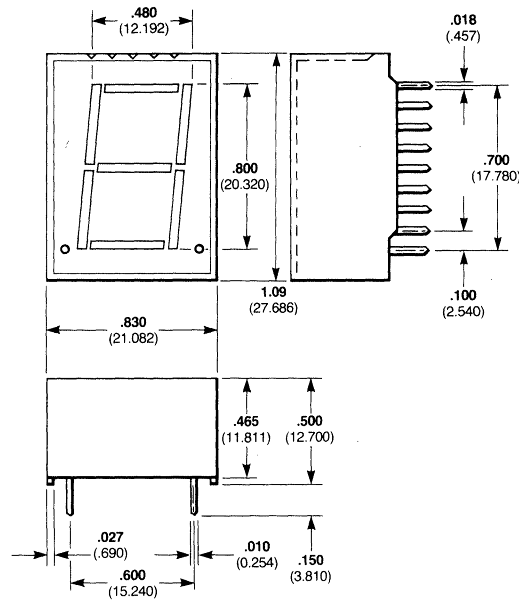
Maximum Temperature and Humidity

Storage Temperature	−25°C to +85°C
Operating Temperature	−25°C to +85°C
Pin Temperature (Soldering, 5 s)	260°C
Relative Humidity at 65°C	98%

Maximum Voltage and Currents

V_R	Reverse Voltage	3.0 V
I_F	Average Forward dc Current/Segment or Decimal Point	25 mA
	Derate from 25°C Ambient Temperature	0.3 mA/°C
I_{pk}	Peak Current/Segment or Decimal Point (100 μs pulse width) 1000 pps, T_A = 25°C	200 mA

Package Outline

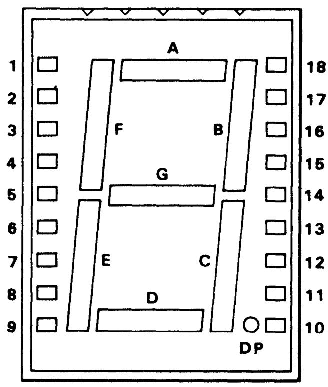


Notes
All dimensions in inches bold and millimeters (parentheses)
Tolerance unless specified = ±.015 (±.381)
For polarity indication the surface is ribbed.
The unlit LED segments cannot necessarily be seen through the lens cap.
Lens cap color is red for red LED.
Pins 4, 6, 12 and 17 are common.

Connection Diagram Typical Electrical Characteristics

FND800 FND807

Pin Connections (Top View)



Pin	FND800	FND807
1	Omitted	Omitted
2	Segment A	Segment A
3	Segment F	Segment F
4	Common Cathode	Common Anode
5	Segment E	Segment E
6	Common Cathode	Common Anode
7	NC	NC
8	Omitted	Omitted
9	Omitted	Omitted
10	Decimal Point	Decimal Point
11	Segment D	Segment D
12	Common Cathode	Common Anode
13	Segment C	Segment C
14	Segment G	Segment G
15	Segment B	Segment B
16	Omitted	Omitted
17	Common Cathode	Common Anode
18	Omitted	Omitted

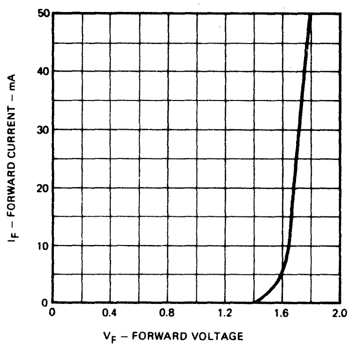
Electrical and Radiant Characteristics $T_A = 25°C$

Symbol	Characteristic	Min	Typ	Max	Units	Test Conditions
V_F	Forward Voltage	1.5	1.7	2.0	V	$I_F = 20$ mA
BV_R	Reverse Breakdown Voltage	3.0	12		V	$I_R = 1.0$ mA
I_O	Axial Luminous Intensity, Average Each Segment	380	1100		μcd	$I_F = 20$ mA
ΔI_O	Intensity Matching, Segment-to-Segment		±33		%	$I_F = 20$ mA
	Intensity Matching Within One Intensity Class		±20		%	$I_F = 20$ mA, all segments at once
L_O	Average Segment Luminance		64		ftL	$I_F = 20$ mA
$\theta_{1/2}$	Viewing Angle to Half Intensity		±25		degrees	
λ_{pk}	Peak Wavelength		665		nm	$I_F = 20$ mA

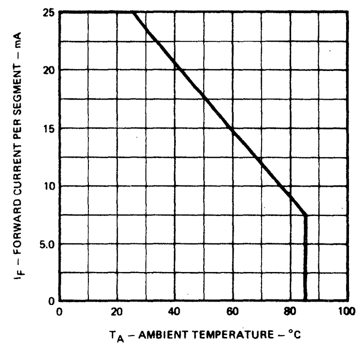
Typical Electrical Characteristic Curves

FND800 FND807

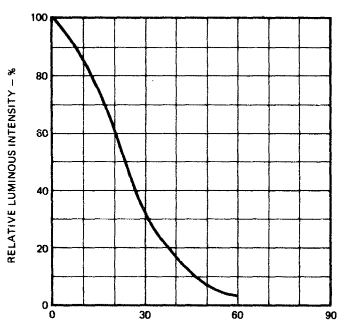
Forward Current vs Forward Voltage



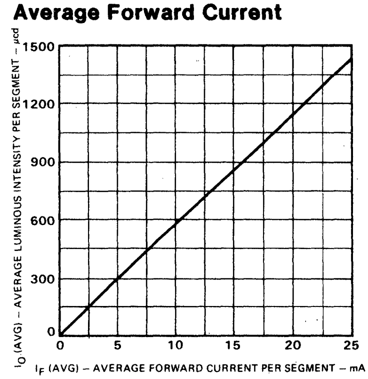
Maximum Average Current Rating vs Ambient Temperature



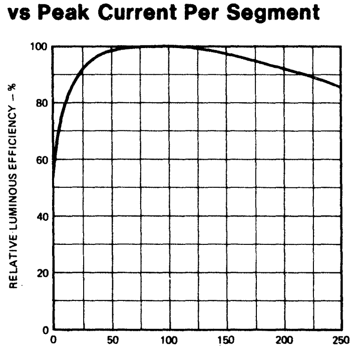
Angular Distribution of Luminous Intensity



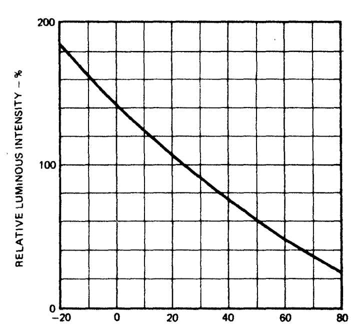
Average Luminous Intensity vs Average Forward Current



Relative Luminous Efficiency (mcd Per mA) vs Peak Current Per Segment



Relative Luminous Intensity vs Junction Temperature



10-Position DIP Socket

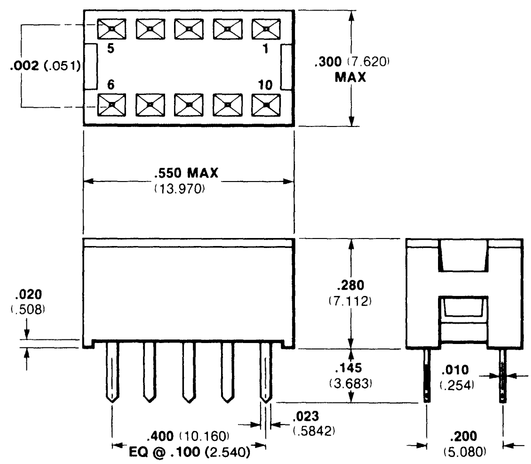
Optoelectronic Products

FNS700

General Description

The FNS700 is a 10-position DIP socket with two rows of five positions each. It is designed for use with all Fairchild 0.362-inch 7-segment LED displays (FND300 Series).

Package Outline



Notes

All dimensions in inches **bold** and millimeters (parentheses)

Tolerance unless specified = ±**.015** (±.381)

Black nylon, glass-filled Wellamid, or equivalent, insulator.

Phosphorous bronze and tin plate contact.

Red GaAsP 0.3-Inch 7-Segment Digit

Optoelectronic Products

MAN71A, MAN72A MAN73A, MAN74A

General Description
The MAN71A, MAN72A, MAN73A and MAN74A are red GaAsP 7-segment LED displays with 0.3-inch character height. They can be mounted in arrays with 0.400-inch center-to-center spacing.

Low Power Consumption
Solid State Reliability—Long Operation Life
Impact Resistant Plastic Case
Standard 14-Pin DIP Configuration
Wide Viewing Angle
Intensity Coding for Uniform Display
MAN71A—Common Anode Digit, Right-Hand Decimal Point
MAN72A—Common Anode Digit, Left-Hand Decimal Point
MAN73A—Common Anode Overflow ± Digit, Left-Hand Decimal Point
MAN74A—Common Cathode Digit, Right-Hand Decimal Point

Absolute Maximum Ratings

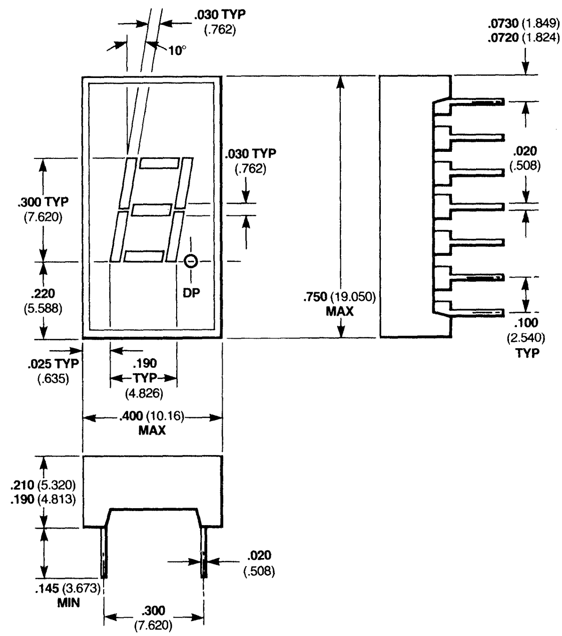
Maximum Temperature and Humidity

Storage Temperature	−40°C to +85°C
Operating Temperature	−40°C to +85°C
Pin Temperature (Soldering, 5 s)	260°C
Relative Humidity at 65°C	98%

Maximum Voltage and Currents

V_R	Reverse Voltage	5.0 V
I_F	Average Forward dc Current/Segment or Decimal Point	30 mA
	Derate from 25°C Ambient Temperature	0.5 mA/°C
I_{pk}	Peak Forward Current/Segment or Decimal Point (100 μs pulse) 1000 pps, T_A = 25°C	200 mA

Package Outline
MAN71A



TOLERANCE ± .015 (.381)

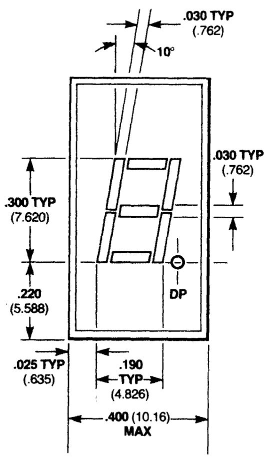
Notes
All dimensions in inches **bold** and millimeters (parentheses)
Tolerance unless specified = ±**.015** (±.381)
Other packages following

Electrical and Radiant Characteristics T_A = 25°C

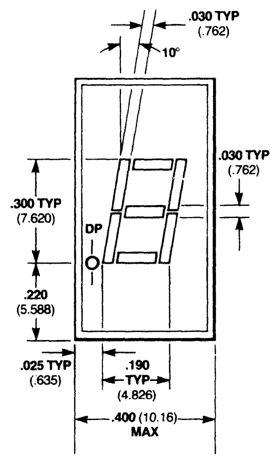
Symbol	Characteristic	Min	Typ	Max	Units	Test Conditions
V_F	Forward Voltage, Each Segment		1.7	2.0	V	I_F = 20 mA
I_R	Reverse Current, Each Segment			100	μA	V_R = 5.0 V
I_O	Axial Luminous Intensity, Each Segment	125	250		μcd	I_F = 10 mA
ΔI_O	Intensity Matching, Segment-to-Segment		±33		%	I_F = 20 mA
	Intensity Matching Within One Intensity Class		±20		%	I_F = 20 mA, all segments at once
λ_{pk}	Peak Wavelength		660		nm	I_F = 20 mA

Connection Diagrams

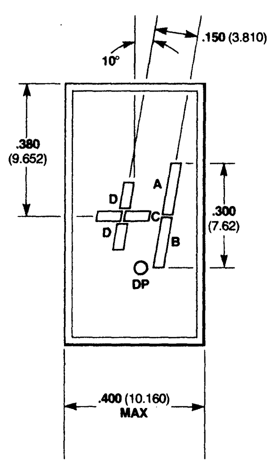
MAN71A, MAN72A MAN73A, MAN74A



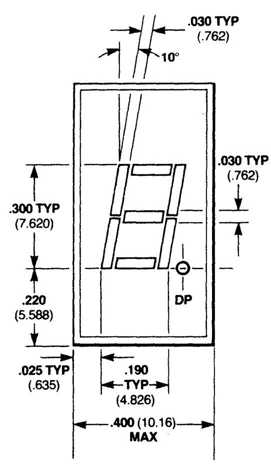
Pin	MAN71A
1	Cathode A
2	Cathode F
3	Common Anode
4	No Pin
5	No Pin
6	NC
7	Cathode E
8	Cathode D
9	Cathode DP
10	Cathode C
11	Cathode G
12	No Pin
13	Cathode B
14	Common Anode



Pin	MAN72A
1	Cathode A
2	Cathode F
3	Common Anode
4	No Pin
5	No Pin
6	Cathode DP
7	Cathode E
8	Cathode D
9	NC
10	Cathode C
11	Cathode G
12	No Pin
13	Cathode B
14	Common Anode



Pin	MAN73A
1	Anode C, D
2	No Pin
3	Anode C, D
4	No Pin
5	No Pin
6	No Pin
7	Cathode D
8	Cathode C
9	NC
10	Cathode B
11	Cathode A
12	No Pin
13	No Pin
14	Anode A, B



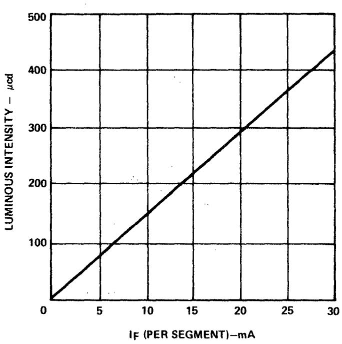
Pin	MAN74A
1	Anode F
2	Anode G
3	No Pin
4	Common Cathode
5	No Pin
6	Anode E
7	Anode D
8	Anode C
9	Anode DP
10	No Pin
11	No Pin
12	Common Cathode
13	Anode B
14	Anode A

3

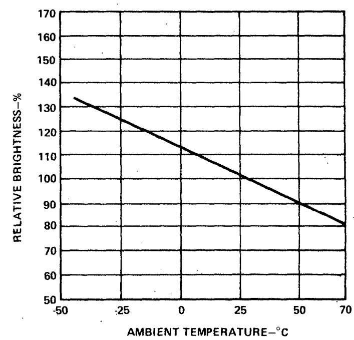
Typical Electrical Characteristic Curves

MAN71A, MAN72A MAN73A, MAN74A

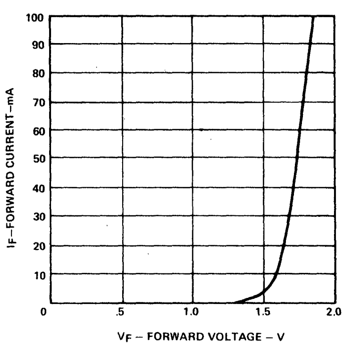
Luminous Intensity vs Forward Current



Luminous Intensity vs Temperature



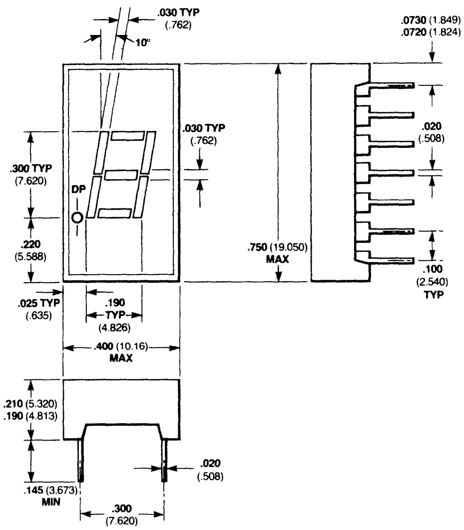
Forward Current vs Forward Voltage



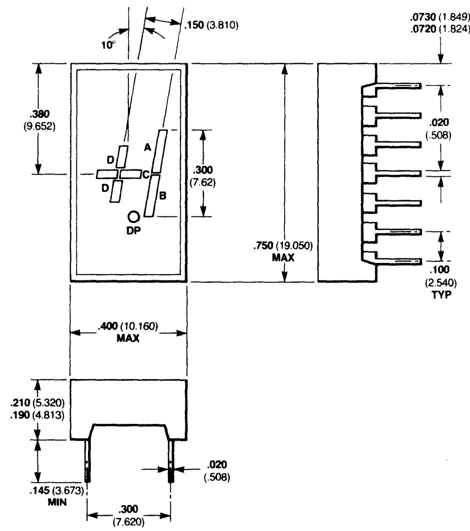
Package Outlines

MAN71A, MAN72A MAN73A, MAN74A

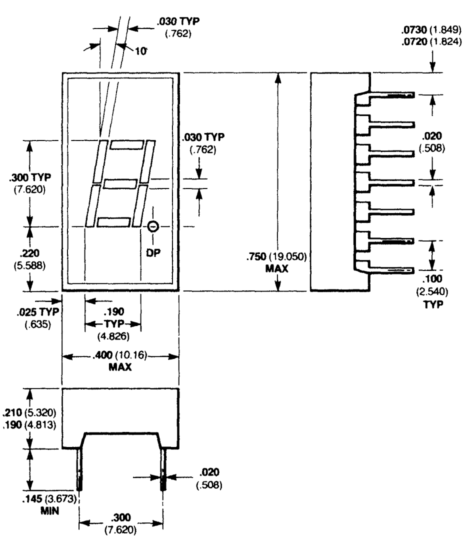
MAN72A



MAN73A



MAN74A



Notes
All dimensions in inches bold and millimeters (parentheses)
Tolerance unless specified = ±.015 (±.381)

Orange Super GaAsP 0.3-Inch 7-Segment Digit

MAN3610A, MAN3620A MAN3630A, MAN3640A

Optoelectronic Products

General Description

The MAN3610A, MAN3620A, MAN3630A, and MAN3640A are orange Super GaAsP 7-segment displays with a 0.3-inch character height. They can be mounted in arrays with 0.400-inch center-to-center.

Low Power Consumption
Solid State Reliability—Long Operation Life
Impact Resistant Plastic Case
Standard 14-pin DIP Configuration
Wide Viewing Angle
Categorized for Luminous Intensity
MAN3610A—Common Anode, Right-Hand Decimal Point
MAN3620A—Common Anode, Left-Hand Decimal Point
MAN3630A—Common Anode, Overflow ±, Right-Hand Decimal Point
MAN3640A—Common Cathode, Right-Hand Decimal Point

Absolute Maximum Ratings

Maximum Temperature and Humidity

Operating Temperature	−40°C to +85°C
Storage Temperature	−40°C to +85°C
Pin Temperature (Soldering, 5 s)	260°C

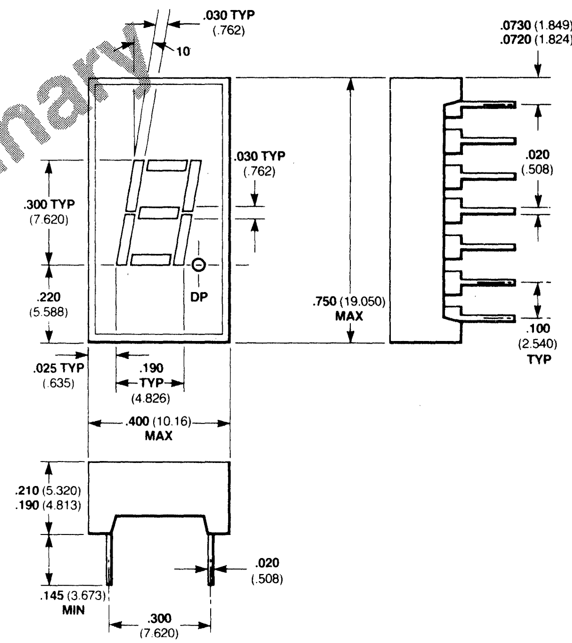
Maximum Power Dissipation

Total Dissipation at T_A = 25°C	
MAN3610A, MAN3620A, MAN3640A	600 mW
MAN3630A	375 mW
Derate Linearly from 25°C	
MAN3610, MAN3620	−8.6 mW/°C
MAN3640A	−8.6 mW/°C
MAN3630A	−5.36 mW/°C

Maximum Voltage and Currents

V_R	Reverse Voltage	6.0 V
I_F	Average Forward dc Current/Segment or Decimal Point	30 mA

Package Outline
MAN3610A

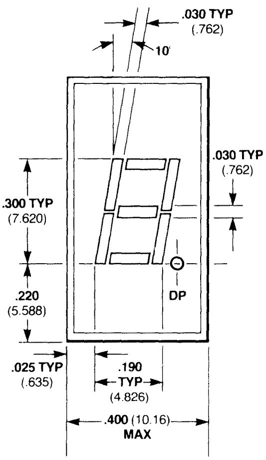


TOLERANCE ± .015 (.381)

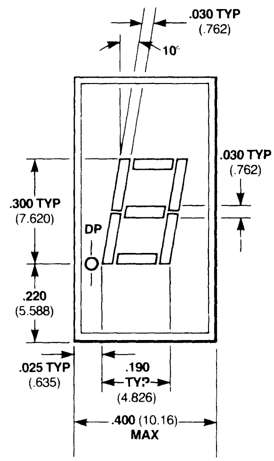
Notes
All dimensions in inches **bold** and millimeters (parentheses).
Other packages following.

Connection Diagrams and Pin Assignments

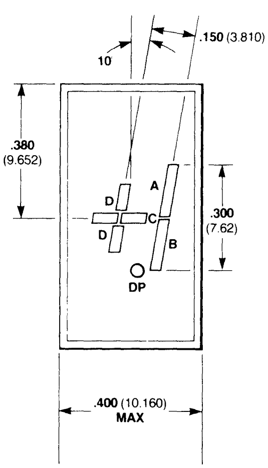
MAN3610A, MAN3620A MAN3630A, MAN3640A



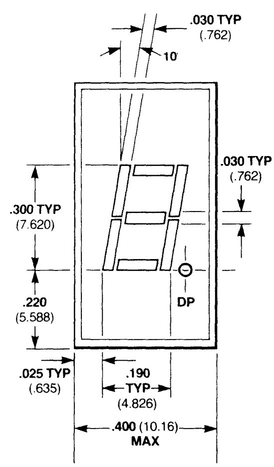
Pin	MAN3610A
1	Cathode A
2	Cathode F
3	Common Anode
4	No Pin
5	No Pin
6	NC
7	Cathode E
8	Cathode D
9	Cathode DP
10	Cathode C
11	Cathode G
12	No Pin
13	Cathode B
14	Common Anode



Pin	MAN3620A
1	Cathode A
2	Cathode F
3	Common Anode
4	No Pin
5	No Pin
6	Cathode DP
7	Cathode E
8	Cathode D
9	NC
10	Cathode C
11	Cathode G
12	No Pin
13	Cathode B
14	Common Anode



Pin	MAN3630A
1	Anode C, D
2	No Pin
3	Anode C, D
4	No Pin
5	No Pin
6	No Pin
7	Cathode D
8	Cathode C
9	NC
10	Cathode B
11	Cathode A
12	No Pin
13	No Pin
14	Anode A, B



Pin	MAN3640A
1	Anode F
2	Anode G
3	No Pin
4	Common Cathode
5	No Pin
6	Anode E
7	Anode D
8	Anode C
9	Anode DP
10	No Pin
11	No Pin
12	Common Cathode
13	Anode B
14	Anode A

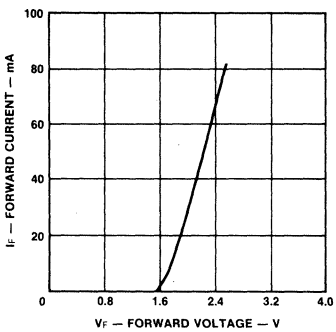
Electrical and Radiant Characteristics $T_A = 25°C$

Symbol	Characteristics	Min	Typ	Max	Units	Test Conditions
V_F	Forward Voltage / Segment or Decimal Point			2.5	V	$I_F = 20$ mA
I_R	Reverse Current / Segment or Decimal Point			100	μA	$V_R = 5.0$ A
I_O	Axial Luminous Intensity, Each Segment	510			μcd	$I_F = 10$ mA
I_O	D.P. and Segment C, D of MAN3630A	265			μcd	$I_F = 10$ mA
ΔI_O	Intensity Matching, Segment-to-Segment		±33		%	$I_F = 20$ mA
	Intensity Matching Within One Intensity Class		±20		%	$I_F = 20$ mA
λ_{pk}	Peak Wavelength		630		nm	

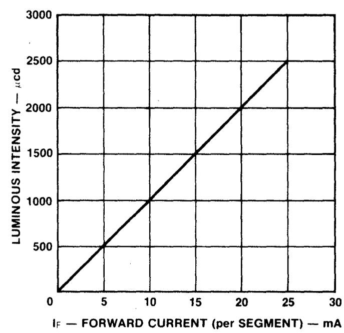
Typical Electrical Characteristic Curves

MAN3610A, MAN3620A MAN3630A, MAN3640A

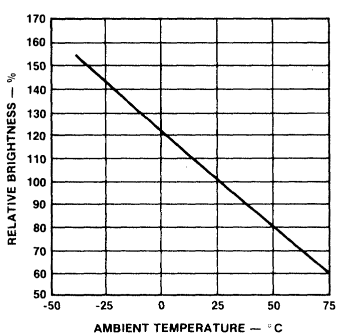
Forward Current vs Forward Voltage



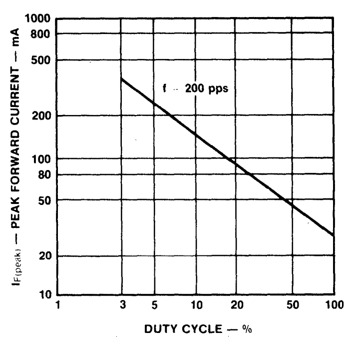
Luminous Intensity vs Forward Current



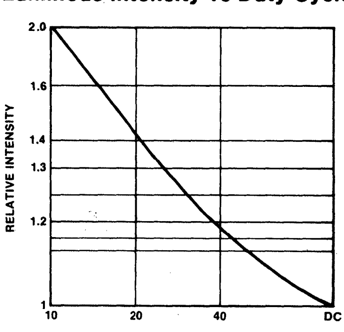
Luminous Intensity vs Temperature



Max Peak Current vs Duty Cycle



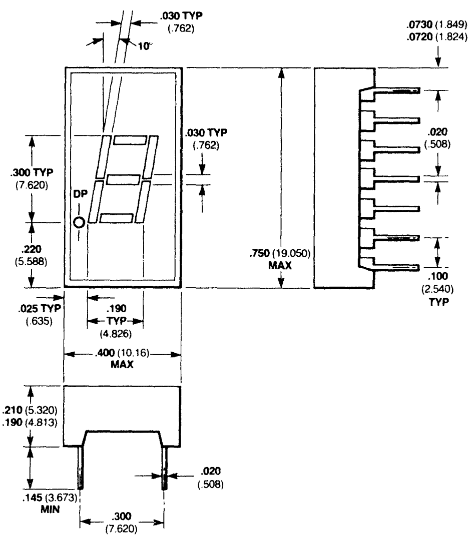
Luminous Intensity vs Duty Cycle



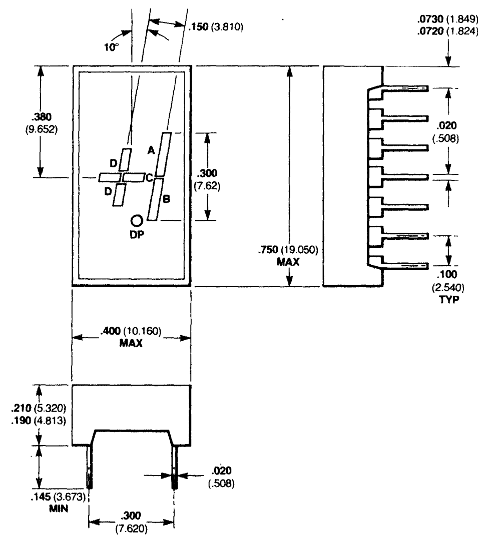
Package Outlines

MAN3610A, MAN3620A MAN3630A, MAN3640A

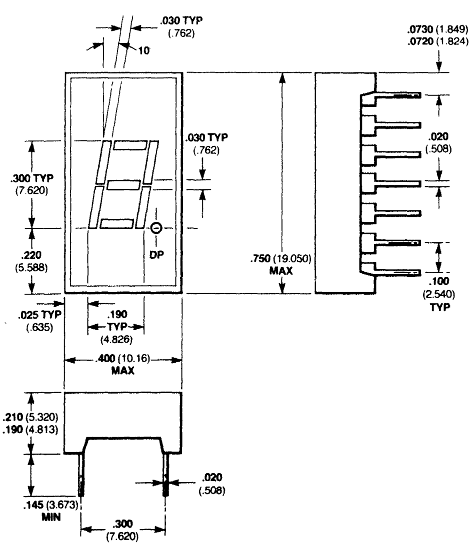
MAN3620A



MAN3630A



MAN3640A



Notes
All dimensions in inches bold and millimeters (parentheses).
Total intensity divided by number of segments.

Orange Super GaAsP 0.56-Inch Dual-Digit 7-Segment LED Display

MAN6610 MAN6640

Optoelectronic Products

General Description

The MAN6610 and MAN6640 are high-performance orange Super GaAsP 7-Segment dual-digit LED displays with right-hand decimal points.

High Brightness and High Contrast
Low Power Consumption
Solid State Reliability
IC Compatible
Wide Angle Viewing
Standard Double-DIP Pin Configuration
Low Forward Voltage
MAN6610—Common Anode, Right-Hand Decimal Points
MAN6640—Common Cathode, Right-Hand Decimal Points

Absolute Maximum Ratings

Maximum Temperature

Operating Temperature	−40°C to +85°C
Storage Temperature	−40°C to +85°C
Pin Temperature (Soldering, 5 s)	260°C

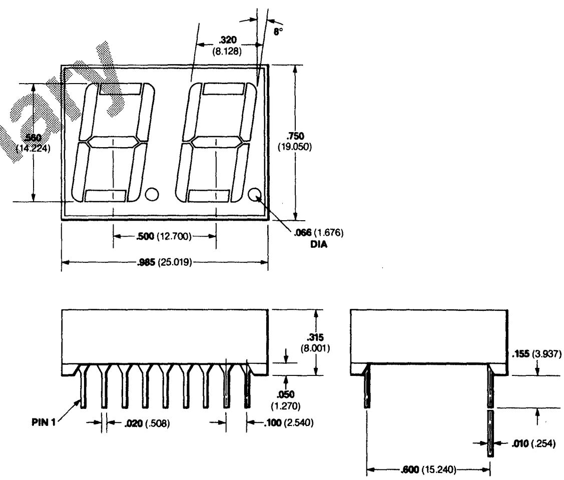
Maximum Power Dissipation

Total Dissipation at $T_A = 25°C$	1200 mW
Derate Linearly from 50°C	−17.1 mW/°C

Maximum Voltage and Currents

V_R	Reverse Voltage/Segment or Decimal Point	6.0 V
I_F	Average Forward dc Current Total	480 mA
	Per Segment or Decimal Point	30 mA

Package Outline



Notes
All dimensions in inches **bold** and millimeters (parentheses)
Tolerance unless specified = ±**.015** (±.381)

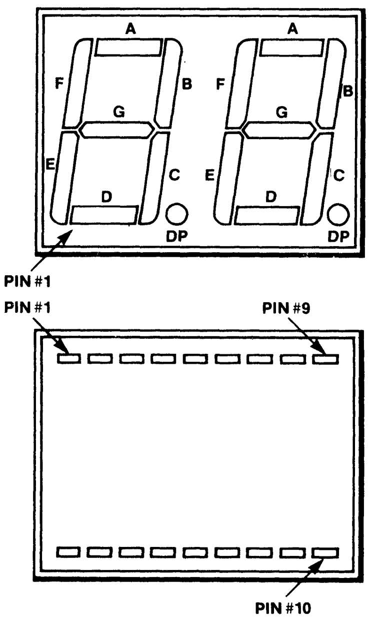
Electrical and Radiant Characteristics $T_A = 25°C$ Per Digit

Symbol	Characteristic	Min	Typ	Max	Units	Test Conditions
V_F	Forward Voltage/Segment or Decimal Point		2.0	2.5	V	$I_F = 20$ mA
I_R	Reverse Current/Segment or Decimal Point			100	μA	$V_R = 3.0$ V
ΔI_O	Axial Luminous Intensity/Segment	510			μcd	$I_F = 10$ mA
I_O	Intensity Matching, Segment-to-Segment		±33		%	$I_F = 10$ mA
λ_{pk}	Peak Wavelength		630		nm	$I_F = 20$ mA

Pin Connections

MAN6610
MAN6640

Pin Connections



Pin	MAN6610
1	Cathode E, Digit 1
2	Cathode D, Digit 1
3	Cathode C, Digit 1
4	Cathode DP, Digit 1
5	Cathode E, Digit 2
6	Cathode D, Digit 2
7	Cathode G, Digit 2
8	Cathode C, Digit 2
9	Cathode DP, Digit 2
10	Cathode B, Digit 2
11	Cathode A, Digit 2
12	Cathode F, Digit 2
13	Anode, Digit 2
14	Anode, Digit 1
15	Cathode B, Digit 1
16	Cathode A, Digit 1
17	Cathode G, Digit 1
18	Cathode F, Digit 1

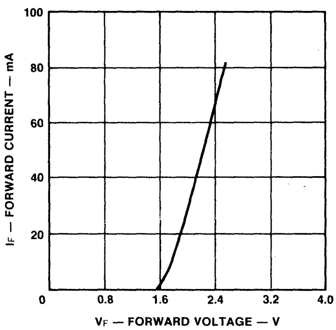
Pin	MAN6640
1	Anode E, Digit 1
2	Anode D, Digit 1
3	Anode C, Digit 1
4	Anode DP, Digit 1
5	Anode E, Digit 2
6	Anode D, Digit 2
7	Anode G, Digit 2
8	Anode C, Digit 2
9	Anode DP, Digit 2
10	Anode B, Digit 2
11	Anode A, Digit 2
12	Anode F, Digit 2
13	Cathode, Digit 2
14	Cathode, Digit 1
15	Anode B, Digit 1
16	Anode A, Digit 1
17	Anode G, Digit 1
18	Anode F, Digit 1

3

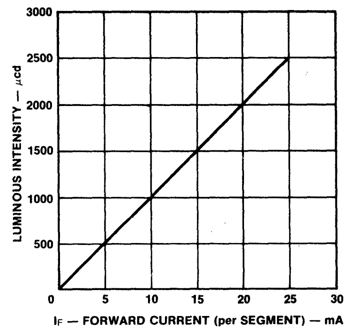
Typical Electrical Characteristic Curves

MAN6610 MAN6640

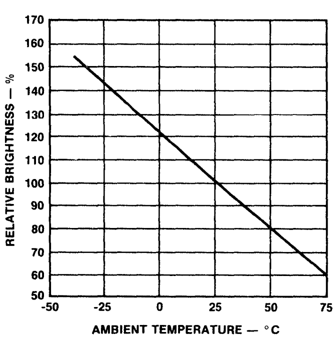
Forward Current vs Forward Voltage



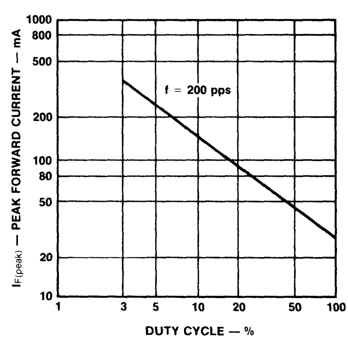
Luminous Intensity vs Forward Current



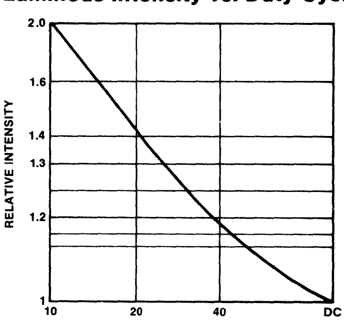
Luminous Intensity vs Temperature



Max Peak Current vs Duty Cycle



Luminous Intensity vs. Duty Cycle



Red GaAsP 0.56-Inch Dual-Digit 7-Segment LED Display

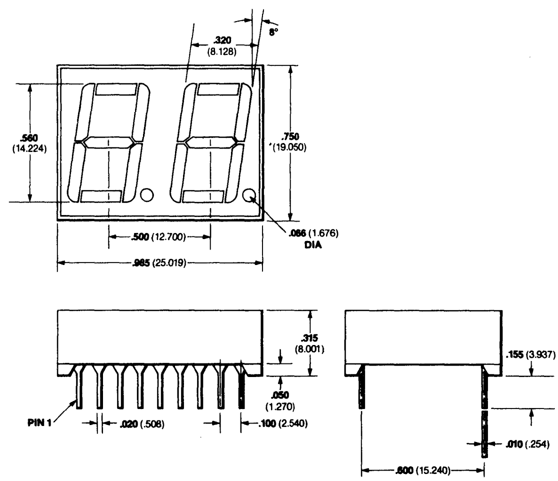
Optoelectronic Products

MAN6710 MAN6740

General Description
MAN6710 and MAN6740 are high-performance red GaAsP 7-segment dual-digit LED displays with right-hand decimal points.

Low Current Requirements—Typically 8 mA/Segment
Low Forward Voltage—V_F = 1.7 V
Standard Double-DIP Pin Configuration
Stackable on 0.5-Inch Centers
Maximized Contrast Ratio
Wide Viewing Angle
MAN6710—Common Anode, Right-Hand Decimal Points
MAN6740—Common Cathode, Right-Hand Decimal Points

Package Outline



Note
All dimensions in inches **bold** and millimeters (parentheses)

Absolute Maximum Ratings

Maximum Temperature and Humidity

Operating Temperature	−40°C to +85°C
Storage Temperature	−40°C to +85°C
Pin Temperature (Soldering, 5 s)	260°C
Relative Humidity at 65°C	98%

Maximum Voltage and Current

V_R	Reverse Voltage	6.0 V
I_F	Average Forward Current/ Segment or Decimal Point	30 mA
	Derate from 25°C Ambient Temperature/Segment	1.0 mW/°C
I_{pk}	Peak Current/Segment or Decimal Point (100 μs pulse) 1000 pps, T_A = 25°C	200 mA

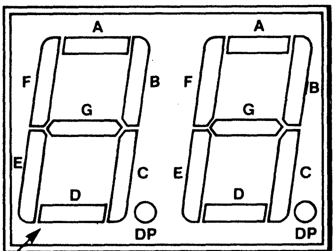
Electrical and Radiant Characteristics T_A = 25°C

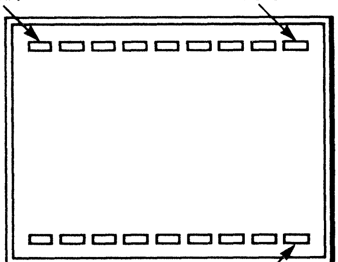
Symbol	Characteristic	Min	Typ	Max	Units	Test Conditions
V_F	Forward Voltage	1.5	1.7	2.0	V	I_F = 20 mA
I_R	Reverse Current			100	μA	V_R = 5.0 V
ΔI_O	Axial Luminous Intensity, Each Segment	125	250		μcd	I_F = 10 mA
I_O	Intensity Matching, Segment-to-Segment		±33		%	I_F = 10 mA
λ_{pk}	Peak Wavelength		665		nm	I_F = 20 mA

Pin Connections Typical Electrical Characteristic Curves

MAN6710 MAN6740

Pin Assignment





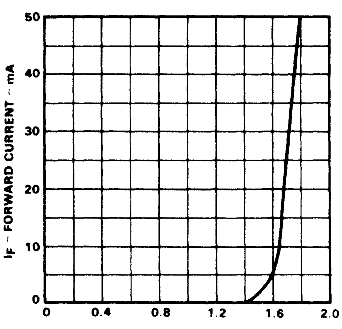
MAN6710

Pin	Assignment	Pin	Assignment
1	E Cathode Digit 1	10	B Cathode Digit 2
2	D Cathode Digit 1	11	A Cathode Digit 2
3	C Cathode Digit 1	12	F Cathode Digit 2
4	DP Cathode Digit 1	13	Digit 2 Anode
5	E Cathode Digit 2	14	Digit 1 Anode
6	D Cathode Digit 2	15	B Cathode Digit 1
7	G Cathode Digit 2	16	A Cathode Digit 1
8	C Cathode Digit 2	17	G Cathode Digit 1
9	DP Cathode Digit 2	18	F Cathode Digit 1

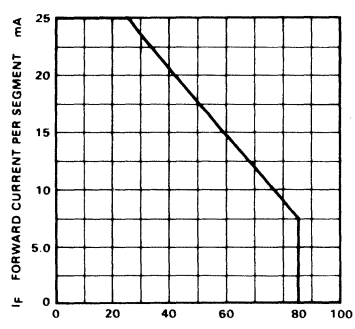
MAN6740

Pin	Assignment	Pin	Assignment
1	E Anode Digit 1	10	B Anode Digit 2
2	D Anode Digit 1	11	A Anode Digit 2
3	C Anode Digit 1	12	F Anode Digit 2
4	DP Anode Digit 1	13	Digit 2 Cathode
5	E Anode Digit 2	14	Digit 1 Cathode
6	D Anode Digit 2	15	B Anode Digit 1
7	G Anode Digit 2	16	A Anode Digit 1
8	C Anode Digit 2	17	G Anode Digit 1
9	DP Anode Digit 2	18	F Anode Digit 1

Forward Current vs Forward Voltage



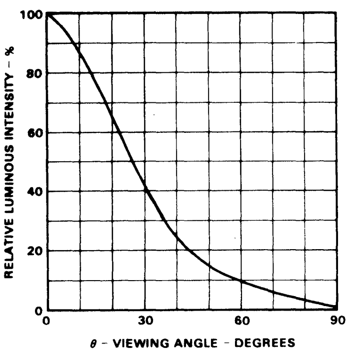
Maximum Average Current Rating vs Ambient Temperature



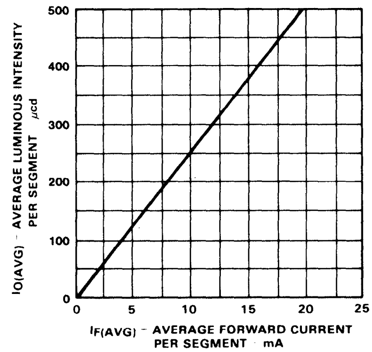
Typical Electrical Characteristic Curves (Cont'd)

MAN6710 MAN6740

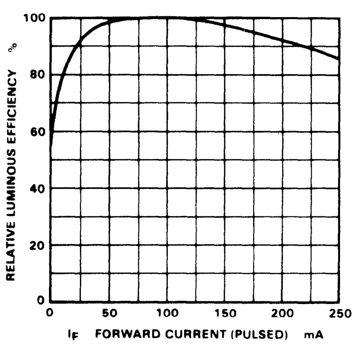
Angular Distribution of Luminous Intensity



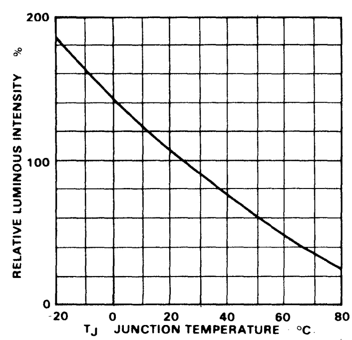
Average Luminous Intensity vs Average Forward Current



Relative Luminous Efficiency (mcd per mA) vs Peak Current per Segment



Relative Luminous Intensity vs Junction Temperature



3

High Efficiency Red Super GaAsP .43-Inch 7-Segment Numeric LED Displays

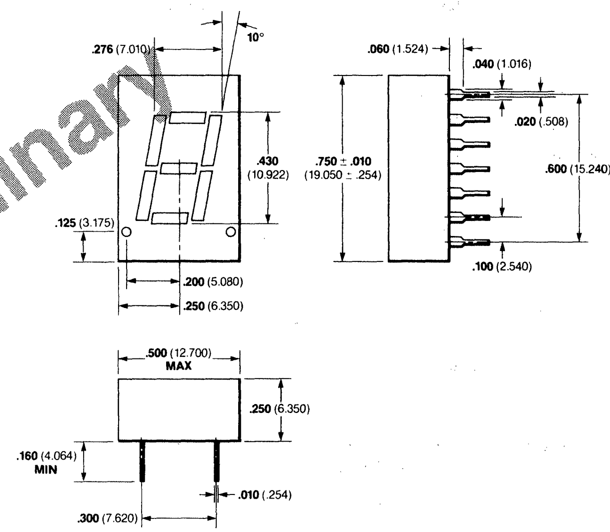
5082-7650
5082-7651
5082-7653

Optoelectronic Products

General Description
The 5082-7650, 5082-7651 and 5082-7653 are high efficiency red Super GaAsP 7-segment displays with 0.43-inch character height.

Low Current Operation
Wide Viewing Angle
Easy Mounting on PC Board or Sockets
.3-inch (7.62 mm) DIP pins on .1-inch (2.54 mm) Centers
Intensity Code Marking for Uniform Displays
IC Compatible
5082-7650—Common Anode, Left-Hand Decimal Point
5082-7651—Common Anode, Right-Hand Decimal Point
5082-7653—Common Cathode, Right-Hand Decimal Point

Package Outline



Notes
All dimensions in inches **bold** and millimeters (parentheses)
Tolerance unless specified = ±**.015** (±.381)

Absolute Maximum Ratings

Maximum Temperature and Humidity

Operating Temperature	−40°C to +85°C
Storage Temperature	−40°C to +85°C
Pin Temperature, Soldering, 3 s (See Note)	260°C

Maximum Power Dissipation

Total Dissipation at T_A = 25°C/ Segment or Decimal Point	50 mW
Derate Linearly from 25°C/Segment	0.83 mW/°C

Maximum Voltage and Currents

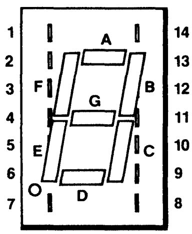
V_R	Reverse Voltage/ Segment or Decimal Point	6.0 V
I_F	Average Forward dc Current/Segment or Decimal Point T_A = 25°C	20 mA
I_{pk}	Peak Forward Current/ Segment or Decimal Point T_A = 25°C	60 mA

Note
1/16-inch (1.59 mm) below seating plane. Clean only in water, isopropanol, ethanol, Freon TF or TE (or equivalent) and Genesolv DI-15 or DE-15 (or equivalent).

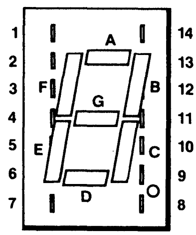
Pin Connections Typical Electrical Characteristic

5082-7650 5082-7651 5082-7653

Pin Connections



5082-7650



5082-7651
5082-7653

Pin Assignments

Pin	5082-7650	5082-7651	5082-7653
1	Cathode A	Cathode A	Anode A
2	Cathode F	Cathode F	Anode F
3	Anode	Anode	Cathode
4	No Pin	No Pin	No Pin
5	No Pin	No Pin	No Pin
6	Cathode DP	NC	NC
7	Cathode E	Cathode E	Anode E
8	Cathode D	Cathode D	Anode D
9	NC	Catode DP	Anode DP
10	Cathode C	Cathode C	Anode C
11	Cathode G	Cathode G	Anode G
12	No Pin	No Pin	No Pin
13	Cathode B	Cathode B	Anode B
14	Anode	Anode	Cathode

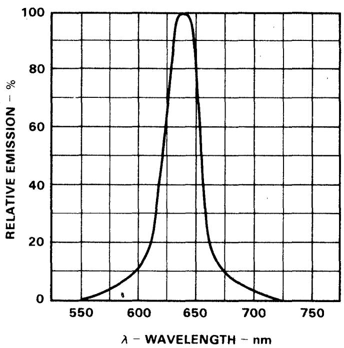
Electrical and Radiant Characteristics $T_A = 25°C$

Symbol	Characteristic	Min	Typ	Max	Units	Test Conditions
I_V	Luminous Intensity/Segment	135	300		μcd	$I_F = 5$ mA
			1720		μcd	$I_F = 20$ mA
λ_{pk}	Peak Wavelength		635		nm	
V_F	Forward Voltage/Segment or Decimal Point		1.7		V	$I_F = 5$ mA
			2.0	2.5	V	$I_F = 20$ mA
I_R	Reverse Current/Segment or Decimal Point		10		μA	$V_R = 6$ V

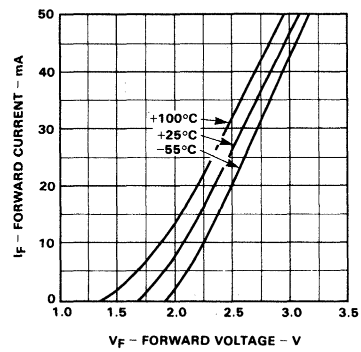
Typical Electrical Characteristic Curves

5082-7650 5082-7651 5082-7653

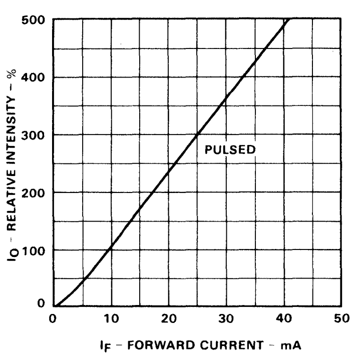
Emission Spectrum



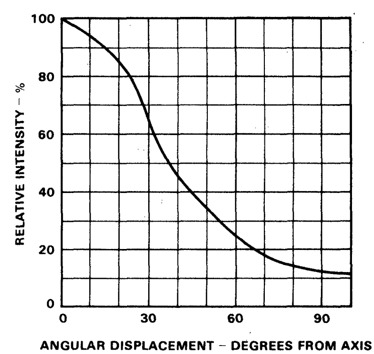
Forward Current vs Forward Voltage



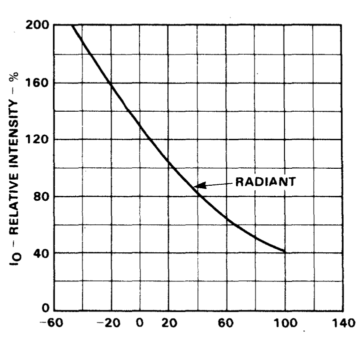
Intensity vs Forward Current



Intensity vs Viewing Angle



Intensity vs Temperature



Red GaAsP 0.43-Inch 7-Segment Numeric LED Displays

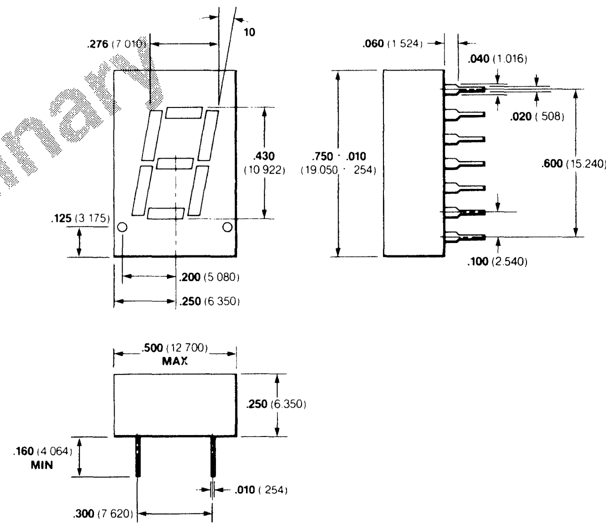
5082-7750
5082-7751
5082-7760

Optoelectronic Products

General Description
The 5082-7750, 5082-7751 and 5082-7760 are red GaAsP 7-segment LED displays with a 0.43-inch character height. These displays are designed for viewing distances up to 20 feet and provide a high contrast and a wide viewing angle.

Wide Viewing Angle
High Contrast
IC Compatible
Easy Mounting on PC Board or Sockets
.3-inch (7.62 mm) DIP pins on .1-inch (2.54 mm) Centers
Intensity Code Marking for Uniform Displays
5082-7750—Common Anode, Left-Hand Decimal Point
5082-7751—Common Anode, Right-Hand Decimal Point
5082-7760—Common Cathode, Right-Hand Decimal Point

Package Outline



Notes
All dimensions in inches **bold** and millimeters (parentheses)
Tolerance unless specified = ±**.015** (±.381)

Absolute Maximum Ratings

Maximum Temperature and Humidity

Operating Temperature	−40°C to +85°C
Storage Temperature	−40°C to +85°C
Pin Temperature (Soldering, 3 s) (Note)	260°C

Maximum Power Dissipation

Total Dissipation at T_A = 25°C/ Segment or Decimal Point	50 mW
Derate Linearly from 25°C/ Segment	0.42 mA/°C

Maximum Voltage and Currents

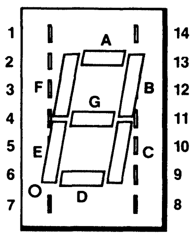
V_R	Reverse Voltage/Segment or Decimal Point	6.0 V
I_F	Average Forward dc Current/Segment or Decimal Point at T_A = 25°C	25 mA
I_{pk}	Peak Forward Current/ Segment or Decimal Point at T_A = 25°C	150 mA

Note
1/16-inch (1.59 mm) below seating plane. Clean only in water, isopropanol, ethanol, Freon TF or TE (or equivalent) and Genesolv DI-15 or DE-15 (or equivalent).

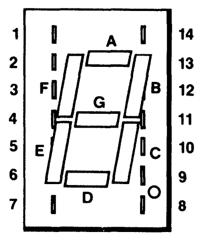
Connection Diagram

5082-7750
5082-7751
5082-7760

Pin Connections



5082-7750



5082-7751
5082-7760

Pin Assignments

Pin	5082-7750	5082-7751	5082-7760
1	Cathode A	Cathode A	Anode A
2	Cathode F	Cathode F	Anode F
3	Anode	Anode	Cathode
4	No Pin	No Pin	No Pin
5	No Pin	No Pin	No Pin
6	Cathode DP	NC	NC
7	Cathode E	Cathode E	Anode E
8	Cathode D	Cathode D	Anode D
9	NC	Cathode DP	Anode DP
10	Cathode C	Cathode C	Anode C
11	Cathode G	Cathode G	Anode G
12	No Pin	No Pin	No Pin
13	Cathode B	Cathode B	Anode B
14	Anode	Anode	Cathode

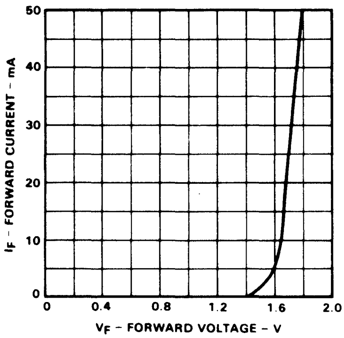
Electrical and Radiant Characteristics $T_A = 25°C$

Symbol	Characteristic	Min	Typ	Max	Units	Test Conditions
I_V	Luminous Intensity/Segment (Digit Average)	150	400		μcd	$I_F = 20$ mA
λ_{pk}	Peak Wavelength		655		nm	$I_F = 20$ mA
V_F	Forward Voltage/Segment or Decimal Point		1.6	2.0	V	$I_F = 20$ mA
I_R	Reverse Current/Segment or Decimal Point		10		μA	$V_R = 6$ V

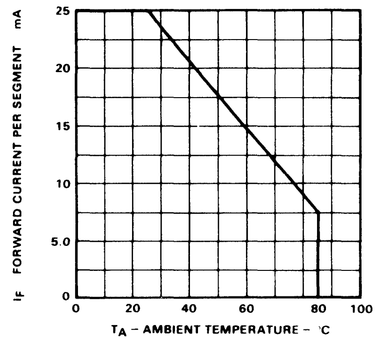
Typical Electrical Characteristic Curves

5082-7750
5082-7751
5082-7760

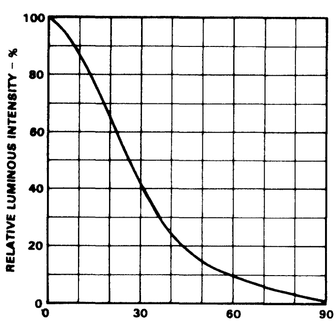
Forward Current vs Forward Voltage



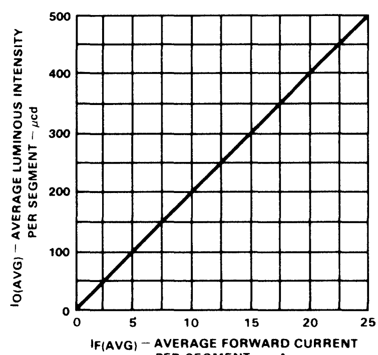
Maximum Average Current Rating vs Ambient Temperature



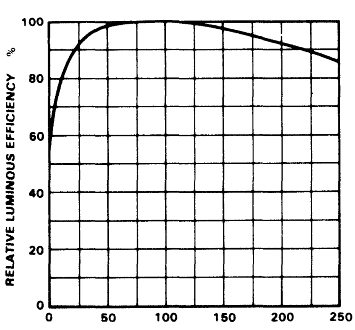
Angular Distribution of Luminous Intensity



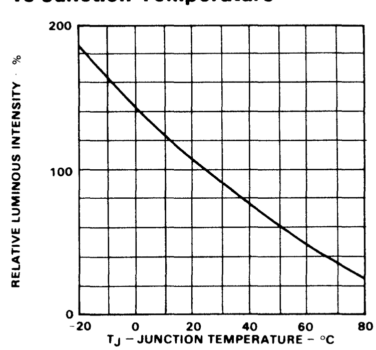
Average Luminous Intensity vs Average Forward Current

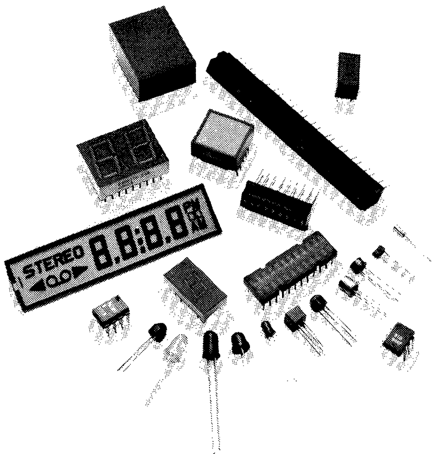


Relative Luminous Efficiency (mcd Per mA) vs Peak Current Per Segment



Relative Luminous Intensity vs Junction Temperature




STEREO

Emitter And Sensor Matched Pair Arrays

Optoelectronic Products

FPA100
FPA101
FPA102

General Description
The FPA100, FPA101 and FPA102 are source/sensor arrays each of which consists of a set of two modules: one, an array of infrared emitters, and two, an array of infrared sensors.

The source module consists of an array of GaAs infrared-emitting diodes. When forward biased, these diodes emit an intense narrow band of infrared (non-visible) radiation at a wavelength of 900 nm. The sensor modules consist of an array of npn phototransistors which are sensitive to visible as well as infrared radiation (400 to 1100 nm). They are most sensitive to infrared radiation; therefore, the source module's emission wavelength is very nearly perfect for maximum coupling efficiency. The source and sensor modules of each set are identical in construction; when the modules are placed facing one another, each infrared emitting diode has a photo-transistor directly opposite it.

The FPA100 has nine source/sensor pairs in a single line on 0.100-inch centers, matching the format of standard-punched paper tape. The FPA101 has 12 source/sensor pairs in a single line on 0.250-inch centers, matching the row spacing of standard tab cards. The FPA102 has 10 source/sensor pairs in a single line on 0.087-inch centers, matching the column spacing of standard tab cards.

Reduces Mechanical Design And Packaging Problems
Low Temperature Coefficient
Designed For Reading Punched Cards And Punched Tapes With The Sensor
Outputs Operable Directly Into Standard Digital ICs
Applications: Transmissible Reading Shaft Encoding and Multi-Channel Optical Coupling

Absolute Maximum Ratings

Maximum Temperatures and Humidity

Storage Temperature	−40°C to +100°C
Operating Temperature	−40°C to +100°C
Pin Temperature (Soldering, 10 s)	260°C
Relative Humidity at 65°C	85%

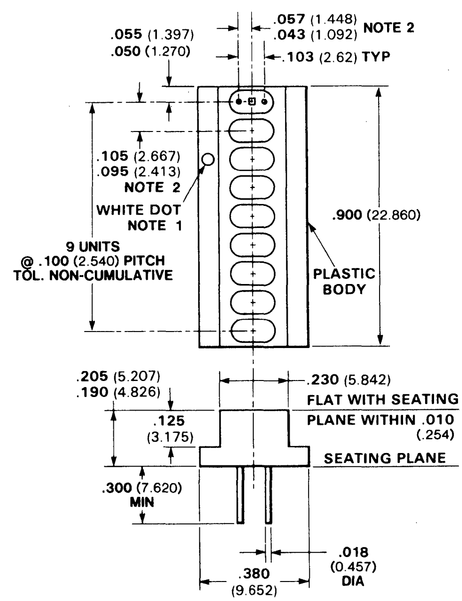
Maximum Power Dissipation (Note 1)

Total Dissipation at T_A = 25°C for Source Array	110 mW/cell
Derate Linearly from 25°C	1.47 mW/°C
Total Dissipation at T_A = 25°C for Sensor Array	167 mW/cell
Derate Linearly from 25°C	2.22 mW/°C

Maximum Voltage and Currents

Source Array		
I_F	Forward dc Current/Cell	75 mA
V_R	Reverse Voltage	3.0 V
Sensor Array		
$V_{CE(Sus)}$	Collector-to-Emitter Sustaining Voltage (Note 2)	12 V
I_C	Collector Current	25 mA

Package Outline
FPA100



Notes
1. Emitter terminal side of phototransistor (sensor array) or anode terminal side of diode (source array) defined by white dot.
2. The center of each element is aligned to ±**.010** along the length and ±**.005** across the width.
3. All dimensions in inches **bold** and millimeters (parentheses).
4. Tolerance unless specified = ±**0.15** (0.381).
5. Other packages following.

Typical Electrical Characteristics

FPA100
FPA101
FPA102

Electrical Characteristics—Source Array $T_A = 25°C$

Symbol	Characteristic	Min	Typ	Max	Units	Test Conditions
V_F	Forward Voltage		1.25	1.50	V	$I_F = 50$ mA
BV_R	Reverse Breakdown Voltage	3.0	6.0		V	$I_R = 100\ \mu A$

Sensor Array

Symbol	Characteristic	Min	Typ	Max	Units	Test Conditions
$V_{CEO(sus)}$	Sustaining Voltage (Notes 2 and 3)	12	20		V	$I_C = 1.0$ mA, pulsed
BV_{ECO}	Emitter-to-Collector Breakdown Voltage (Note 2)		5.0		V	$I_{EC} = 100\ \mu A$
$V_{CE(sat)}$	Saturation Voltage (Note 4)		0.4		V	$I_C = 4$ mA, $H = 10$ mW/cm^2 (GaAs)
I_{CEO}	Collector Dark Current (Note 2)		10	100	nA	$V_{CE} = 5.0$ V, $H \leq 0.1\ \mu W/cm^2$
$I_{CE(lt)}$	Photo Current (Note 4)		4.5		mA	$V_{CE} = 5.0$ V, $H = 1.0$ mW/cm^2 (GaAs)

Combination Source/Sensor Array

Symbol	Characteristic	Min	Typ	Max	Units	Test Conditions
I_{OUT}	Output Current	4.5	9.0	13.5	mA	$I_{IN} = 50$ mA, d = .050-inch, $V_{CE} = 5.0$ V
$\frac{I_{OUT(min)}}{I_{OUT(max)}}$	Matching Factor	0.5	0.65			$I_{IN} = 50$ mA, d = .050-inch $V_{CE} = 5.0$ V
$V_{CE(sat)}$	Saturation Voltage		0.4	0.7	V	$I_{IN} = 50$ mA, d = .050-inch, $I_{OUT} = 3.7$ mA
t_r	Light Current Fall Time (Note 5)		40		μs	$I_{IN} = 50$ mA, d = .050-inch
t_f	Light current Rise Time (Note 5)		40		μs	$I_{IN} = 50$ mA, d = .050-inch

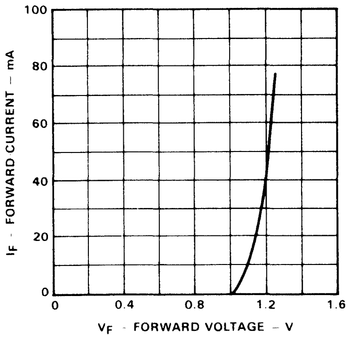
Notes

1. These are steady-state limits. The factory should be consulted on applications involving pulsed or low duty cycle operation.
2. Measured with radiation flux intensity of less than 0.1 μW/cm^2 over the spectrum from 0.1 micron to 1.5 microns.
3. Rating refers to a high current point where collector-to-emitter voltage is lowest.
4. Measured at an irradiance of 5.0 mW/cm^2 as emitted from a gallium arsenide diode.
5. Rise time is defined as the time required for I_{CE} to rise from 10% to 90% of the peak value. Fall time is defined as the time required for I_{CE} to decrease from 90% to 10% of the peak value.

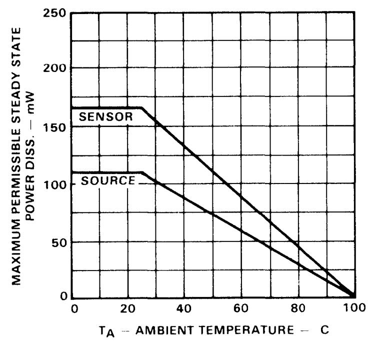
Typical Electrical Characteristic Curves

FPA100
FPA101
FPA102

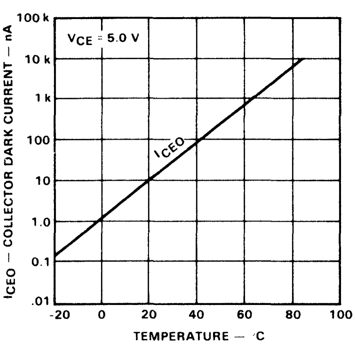
Forward Current vs Forward Voltage (dc)



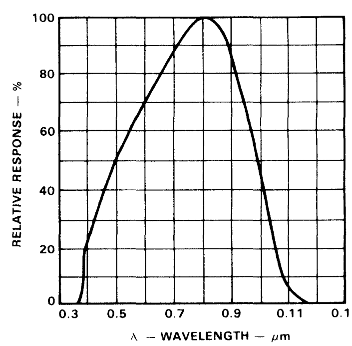
Maximum P_D vs Ambient Temperature



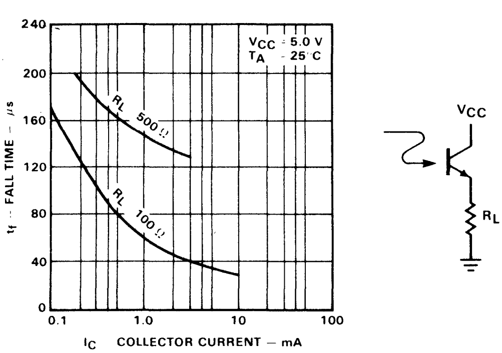
Collector Dark Current vs Temperature



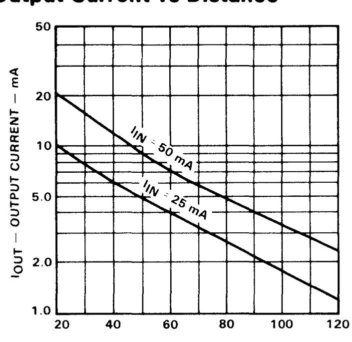
Relative Spectral Response



Rise and Fall Time vs Collector Current



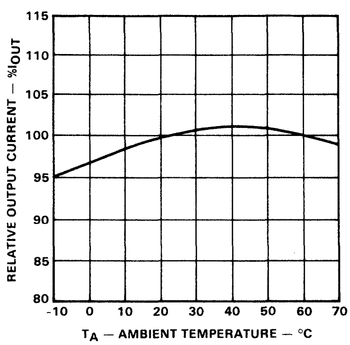
Output Current vs Distance



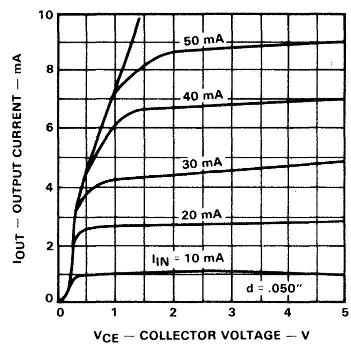
Typical Electrical Characteristic Curves Typical Circuits

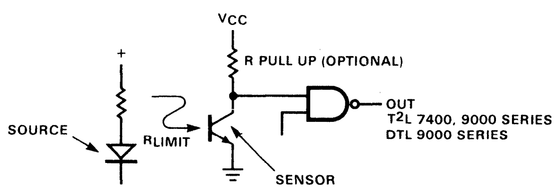
FPA100 FPA101 FPA102

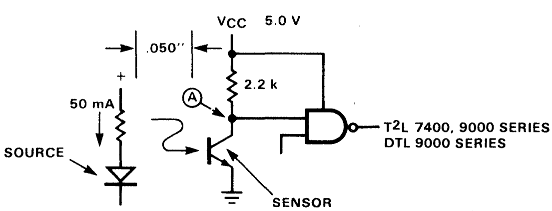
Relative Output vs Ambient Temperature

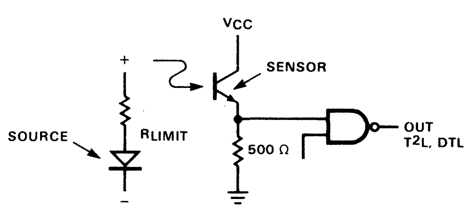


Output Current vs Collector Voltage



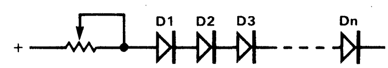




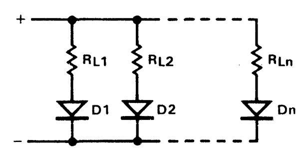


For a "hole" condition, point A for all sensors will be less than 0.8 V. For a "no hole" condition (where signal due to tape transmission is ≤ 15% of "hole"), point A will be greater than 2.0 V. These are the worst case conditions required to switch this type of logic.

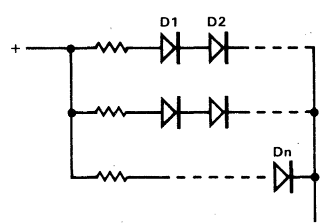
Source Circuits



Note
Use where $V_{supply} > 1.5$ n and transmission < 20%.



Note
Use where $V_{supply} < 1.5$ n and transmission < 20%. Rows must contain equal number of diodes.



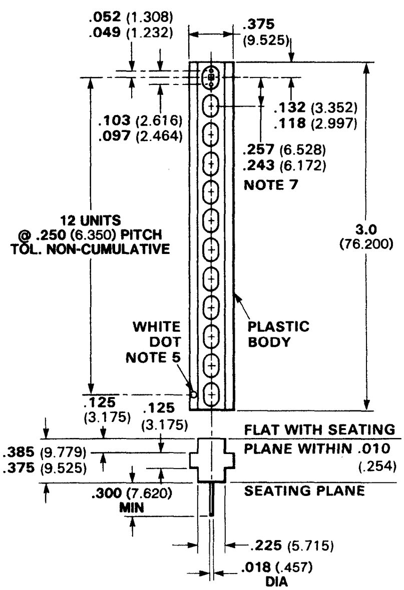
Note
Use where $V_{supply} < 1.5$ n and transmission > 20%. R_L may be adjusted so outputs of sensors are perfectly matched.

Typical Circuits (Cont'd) Package Outlines

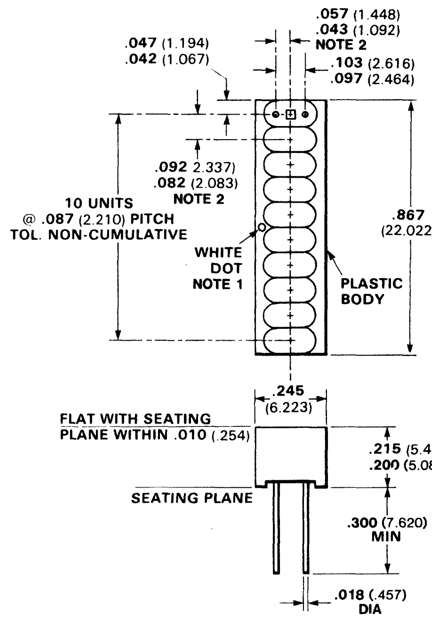
FPA100 FPA101 FPA102

Package Outlines

FPA101



FPA102



Notes

1. Emitter terminal side of phototransistor (sensor array) or anode terminal side of diode (source array) defined by white dot.
2. Leads alternate from emitter to collector (sensor) or anode to cathode (source), beginning from this end of the package.
3. All dimensions in inches **bold** and millimeters (parentheses).
4. Tolerance unless specified = ±**0.15** (0.381).

Notes

1. Emitter terminal side of phototransistor (sensor array) or anode terminal side of diode (source array) defined by white dot.
2. The center of each element is aligned to ±**.010** along the length and ±**.005** across the width.
3. All dimensions in inches **bold** and millimeters (parentheses).
4. Tolerance unless specified = ±**0.15** (0.381).

Light Reflection Emitter / Sensor Array

Optoelectronic Products

FPA103, FPA104 FPA105, FPA106 FPA107, FPA108

General Description

The FPA103/104/105/106/107/108 consists of a GaAs infrared-emitting diode and a silicon npn phototransistor. The axial radiant intensity of the diode and the axial response of the phototransistor are perpendicular to the face of the device; therefore, the phototransistor responds to radiation emitted from the diode only when a reflective object or surface is in the field of view of the phototransistor.

The diode used in the FPA103/104/105/106/107/108 is similar to Fairchild's FPE104 GaAs infrared-emitting diode. It emits an intense, narrow band of radiation, peaking at approximately 900 nm (non-visible) when forward biased. The phototransistor used in this device is sensitive to radiation over the wavelength range of 400 to 1100 nm.

The FPA106/107/108 is electrically equivalent to the FPA103/104/105 respectively, with the addition of an infrared filter to prevent visible light from entering the phototransistor.

Reduces Mechanical Design and Packaging Problems
High Sensitivity
Excellent Stability
Low Temperature Coefficient

Absolute Maximum Ratings

Maximum Temperature and Humidity

Storage Temperature	−40°C to +100°C
Operating Temperature	−40°C to +100°C
Pin Temperature (Soldering, 10 s)	260°C
Relative Humidity at 65°C	85%

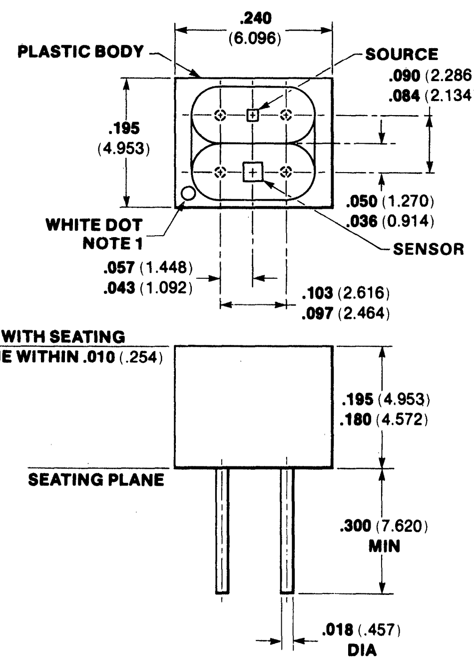
Input Diode

I_F	Forward dc Current	75 mA
V_R	Reverse Voltage	3.0 V
	Power Dissipation at $T_A = 25°C$	110 mW
	Derate Linearly from 25°C	1.47 mW/°C

Output Transistor

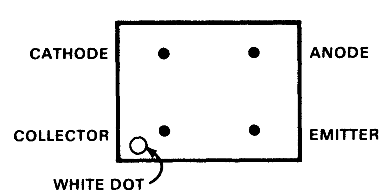
I_C	Collector dc Current	25 mA
V_{CE}	Collector-to-Emitter Voltage	12 V
	Power Dissipation at $T_A = 25°C$	167 mW
	Derate Linearly from 25°C	2.22 mW/°C

Package Outline



Notes
1. White dot defines collector of phototransistor. Read pinout clockwise, top view: collector, source cathode, source anode, emitter.
2. All dimensions in inches **bold** and millimeters (parentheses)
3. Tolerance unless specified = ±**.015** (0.381)

Connection Diagram (Top View)



Typical Electrical Characteristics

FPA103, FPA104 FPA105, FPA106 FPA107, FPA108

Electrical Characteristics—Input Diode $T_A = 25°C$

Symbol	Characteristic	Min	Typ	Max	Units	Test Conditions
V_F	Forward Voltage		1.25	1.5	V	$I_F = 50$ mA
BV_R	Reverse Breakdown Voltage	3.0	6.0		V	$I_R = 100 \mu A$

Electrical Characteristics—Output Transistor $T_A = 25°C$

Symbol	Characteristic	Min	Typ	Max	Units	Test Conditions
$V_{CEO(sus)}$	Sustaining Voltage (Note 2)	12	20		V	$I_C = 1.0$ mA, pulsed
BV_{ECO}	Emitter-to-Collector Breakdown Voltage (Note 2)		5.0		V	$I_{EC} = 100 \mu A$

Electrical Characteristics—Combination $T_A = 25°C$

Symbol	Characteristic	Min	Typ	Max	Units	Test Conditions
I_C	Photo Current					$I_F = 50$ mA, $V_{CE} = 5.0$ V
	(GaAs Source, Note 1)					d = 0.40-inch
	103-106	20	80		μA	
	104-107	60		180	μA	
	105-108	80		160	μA	
I_{CEO}	Collector Dark Current (Note 2)		10	100	nA	$I_F = 50$ mA, $V_{CE} = 5.0$ V, Non-reflecting external surface
$V_{CE(sat)}$	Saturation Voltage (Note 1)		0.3	0.7	V	$I_F = 50$ mA, $I_C = 5.0 \mu A$, d = 0.40-inch
t_r & t_f	Rise & Fall Time (Note 3)		100		μs	$I_C = 80 \mu A$, $V_{CC} = 5.0$ V, $R_L = 1$ kΩ

Notes

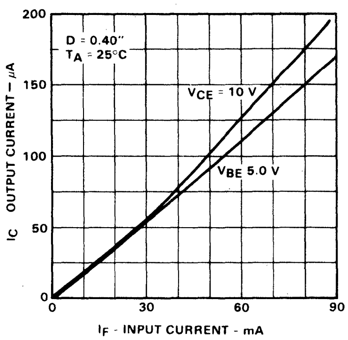
1. Photocurrent is that obtained from a 4.0-inch × 4.0-inch 90% white surface placed at a distance of 0.40-inch from the face of the device. For test purposes, an Eastman Kodak neutral white test card with 90% diffuse reflectance was employed.
2. Measured with radiation flux intensity of less than 0.1 $\mu W/cm^2$ over the spectrum from 0.1 micron to 1.5 microns.
3. Rise time is defined as the time required for I_{CE} to rise from 10% to 90% of the peak value. Fall time is defined as the time required for I_{CE} to decrease from 90% to 10% of the peak value.
4. White dot defines collector of phototransistor. Read pinout clockwise, top view: collector, source cathode, source anode, emitter.

4

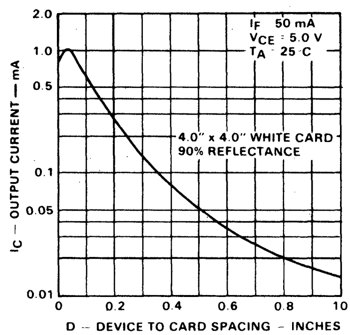
Typical Electrical Characteristic Curves

FPA103, FPA104 FPA105, FPA106 FPA107, FPA108

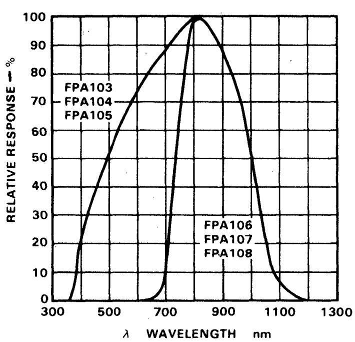
Output Current vs Input Current



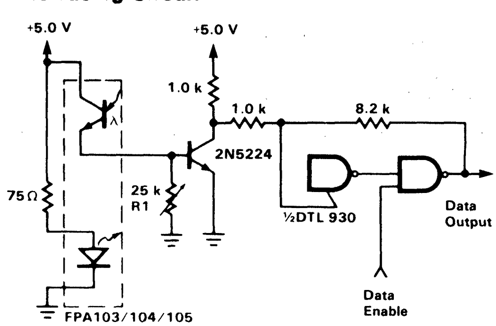
Output Current vs Device To Card Spacing



Spectral Characteristics



Interfacing Circuit



9-Element Phototransistor Tape Reader Array

FPA700 FPA700A

Optoelectronic Products

General Description

The FPA700 and FPA700A are 9-element npn Planar phototransistor arrays with exceptionally stable characteristics and high illumination sensitivity. Each transistor is electrically isolated and mounted on 100 mil centers. The case is a plastic compound with transparent resin encapsulation which exhibits stable characteristics under high humidity conditions.

High Illumination Sensitivity
Exhibits Stable Characteristics Under High Humidity
Especially Designed for Punched or Marked Card Reading and Optical Encoder Applications

Absolute Maximum Ratings

Maximum Temperature and Humidity

Storage Temperature	−40°C to +100°C
Operating Temperature	−40°C to +85°C
Pin Temperature (Soldering, 10 s)	260°C
Relative Humidity at 65°C	85%

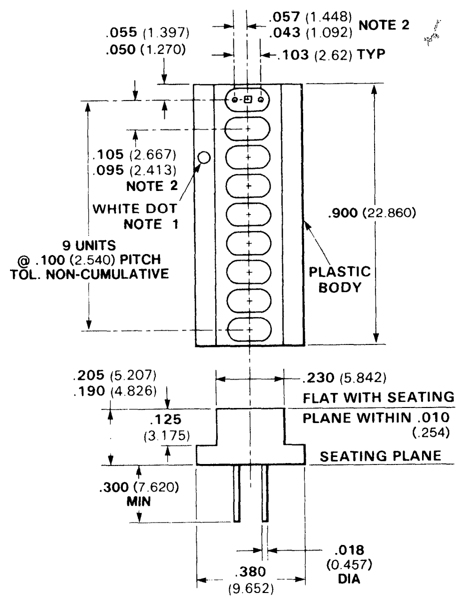
Maximum Power Dissipation

Total Dissipation at T_C = 25°C	200 mW
Derate Linearly from 25°C	3.33 mW/°C
Total Dissipation at T_A = 25°C	133 mW
Derate Linearly from 25°C	2.22 mW/°C

Maximum Voltages and Currents (Note 1)

$V_{CE(sus)}$	Collector-to-Emitter Sustaining Voltage	20 V
I_C	Collector Current	25 mA

Package Outline



Notes

1. Emitter terminal side of phototransistor (sensor array) or anode terminal side of diode (source array) defined by white dot.
2. The center of each element is aligned to ±**.010** along the length and ±**.005** across the width.
3. All dimensions in inches **bold** and millimeters (parentheses).
4. Tolerance unless specified = ±**0.15** (0.381).

Typical Electrical Characteristics

FPA700 FPA700A

Electrical Characteristics $T_A = 25°C$

Symbol	Characteristic	Min	Typ	Max	Units	Test Conditions
$V_{CEO(sus)}$	Collector-to-Emitter Sustaining Voltage (Note 2)	20	35		V	$I_C = 1.0$ mA
BV_{ECO}	Emitter-to-Collector Breakdown Voltage (Note 2)		7.0		V	$I_{EC} = 100$ μA
$V_{CE(sat)}$	Collector-to Emitter Saturation Voltage		0.16	0.33	V	$I_C = 500$ μA, H = 20 mW/cm²
I_{CEO}	Collector Dark Current/Cell (Note 2)		4.0	100	nA	$V_{CE} = 5.0$ V
$I_{CE(lt)}$	Photo Current, Tungsten Source (Note 3)	200	750		μA	$V_{CE} = 5.0$ V, H = 5 mW/cm²
$I_{CE(lt)}$	Photo Current, Tungsten Source (Note 3)		1.75		mA	$V_{CE} = 5.0$ V, H = 10 mW/cm²
$I_{CE(lt)}$	Photo Current, GaAs Source (Note 4)		2.25		mA	$V_{CE} = 5.0$ V, H = 5 mW/cm²
t_r	Light Current Rise Time (Note 6)		4.0		μs	GaAs, $I_C = 2.0$ mA
t_f	Light Current Fall Time (Note 6)		4.0		μs	$R_L = 100\ \Omega$, $V_{CC} = 5.0$ V
S_{min}/S_{max}	Matching Factor (Notes 3 and 5)					
	FPA700	0.5	0.65	1.0		$V_{CE} = 5.0$ V, H = mW/cm²
	FPA700A	0.75	0.85	1.0		$V_{CE} = 5.0$ V, H = mW/cm²

Notes
1. These are steady-state limits. The factory should be consulted on applications involving pulsed or low duty cycle operation.
2. Measured with radiation flux intensity of less than 0.1 μW/cm² over the spectrum from 0.1 micron to 1.5 microns.
3. Measured at noted irradiance as emitted from a tungsten lamp at a color temperature of 2854°K. The effective photosensitive areas is (0.8 mm²). Illuminance (in lumens/ft²) = irradiance H (in mW/cm²) X 20 at a color temperature of 2854°K.
4. Measured at an irradiance of 5.0 mW/cm² as emitted from a gallium arsenide diode.
5. Matching factor is the ratio of minimum sensitivity to maximum sensitivity of any two cells.
6. Rise time is defined as the time required for I_{CE} to rise from 10% to 90% of the peak value. Fall time is defined as the time required for I_{CE} to decrease from 90% to 10% of the peak value.
7. The center of each element is aligned to ±.010-inch along the length and ±.005-inch across the width.
8. Emitter-terminal side of phototransistor (sensor array) or anode-terminal side of diode (source array) defined by white dot.

Typical Electrical Characteristic Curves

FPA700
FPA700A

Photo Current Characteristics

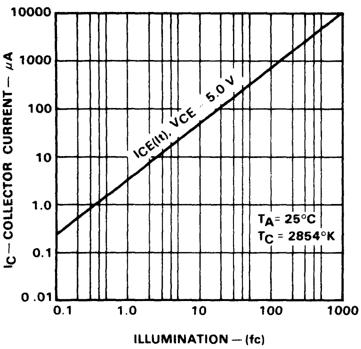
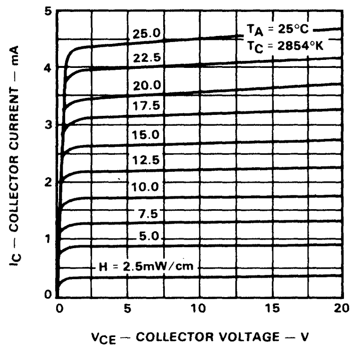
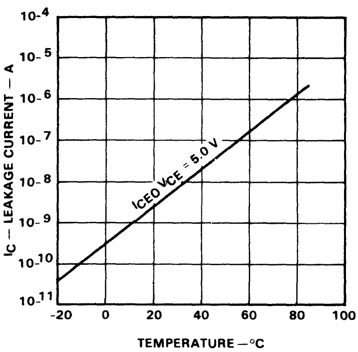


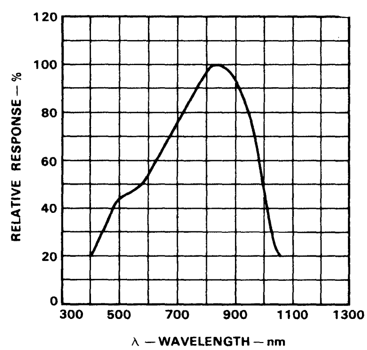
Photo Current vs Collector



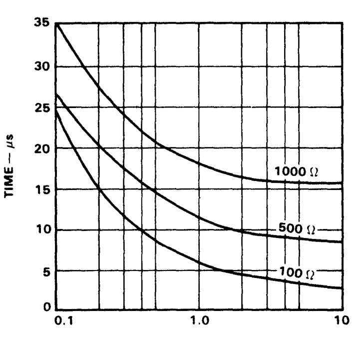
Collector Dark Current vs Temperature



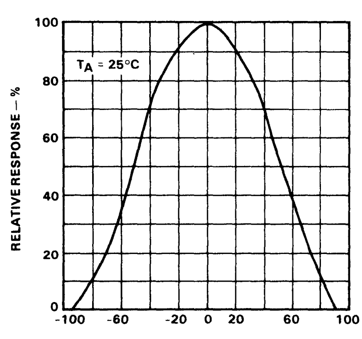
Relative Spectral Response



Rise and Fall Time vs Collector Current



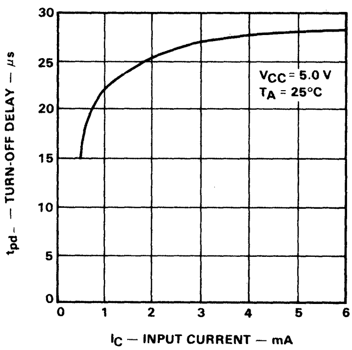
Angular Response



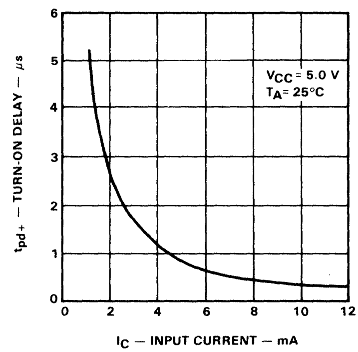
Typical Electrical Characteristic Curves (Cont'd) Switching Test Circuits

FPA700 FPA700A

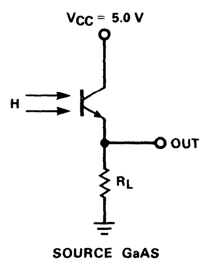
Turn-Off Delay Times



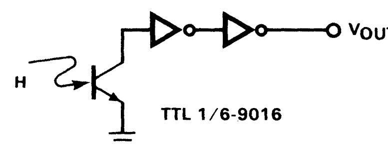
Turn-On Delay Times



Rise And Fall Times



Turn-On And Turn-Off Delay



12-Element Phototransistor Card Reader Array

Optoelectronic Products

FPA710 FPA710A

General Description

The FPA710 and FPA710A are 12-element npn Planar phototransistor arrays with exceptionally stable characteristics and high illumination sensitivity. Each transistor is electrically isolated and mounted on 250 mil centers. The case is a plastic compound with transparent resin encapsulation that exhibits stable characteristics under high humidity conditions.

High Illumination Sensitivity
Especially Designed For Punched Or Marked Card Reading And Optical Encoder Applications

Absolute Maximum Ratings

Maximum Temperatures and Humidity

Storage Temperature	−40°C to +100°C
Operating Temperature	−40°C to +85°C
Pin Temperature (Soldering, 10 s)	260°C
Relative Humidity at 65°C	85%

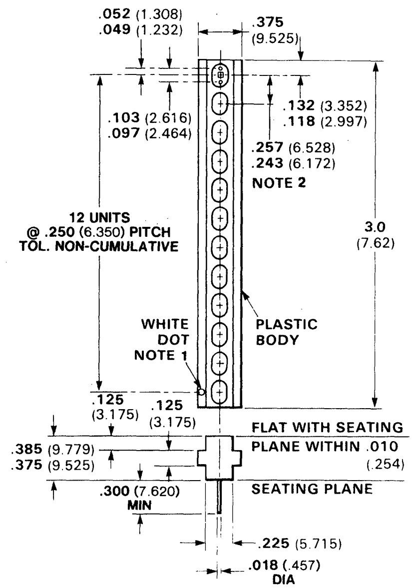
Maximum Power Dissipation per Cell

Total Dissipation at T_C = 25°C	200 mW
Derate Linearly from 25°C	3.33 mW/°C
Total Dissipation at T_A = 25°C	133 mW
Derate Linearly from 25°C	2.22 mW/°C

Maximum Voltages and Currents (Note 1)

$V_{CE(sus)}$	Collector-to-Emitter Sustaining Voltage	20 V
I_C	Collector Current	25 mA

Package Outline



Notes

1. Emitter terminal side of phototransistor (sensor array) or anode terminal side of diode (source array) defined by white dot.
2. The center of each element is aligned to ±.010" along the length and ±.005" across the width.
3. All dimensions in inches **bold** and millimeters (parentheses).
4. Tolerance unless specified = ±**0.15** (0.381).
5. Other packages following.

Typical Electrical Characteristics

FPA710
FPA710A

Electrical Characteristics $T_A = 25°C$

Symbol	Characteristic	Min	Typ	Max	Units	Test Conditions
$V_{CEO(sus)}$	Collector-to-Emitter Sustaining Voltage (Note 2)	20	35		V	$I_C = 1.0$ mA, pulsed
BV_{ECO}	Emitter-to-Collector Breakdown Voltage (Note 2)		7.0		V	$I_{EC} = 100\ \mu A$
$V_{CE(sat)}$	Collector-to-Emitter Saturation Voltage		0.16	0.33	V	$I_C = 500\ \mu A$, $H = 20$ mW/cm^2
I_{CEO}	Collector Dark Current (Note 2)		4.0	100	nA	$V_{CE} = 5.0$ V
$I_{CE(lt)}$	Photo Current, Tungsten Source (Note 3)	200	750		μA	$V_{CE} = 5.0$ V, $H = 5$ mW/cm^2
$I_{CE(lt)}$	Photo Current, Tungsten Source (Note 3)		1.75		mA	$V_{CE} = 5.0$ V, $H = 10$ mW/cm^2
$I_{CE(lt)}$	Photo Current, GaAs Source (Note 4)		2.25		mA	$V_{CE} = 5.0$ V, $H = 5$ mW/cm^2
t_r	Light Current Rise Time (Note 6)		4.0		μs	GaAs,
t_f	Light Current Fall Time (Note 6)		4.0		μs	$I_C = 2.0$ mA, $R_L = 100\ \Omega$, $V_{CC} = 5.0$ V
S_{min}/S_{max}	Matching Factor (Notes 3 and 5)					
	FPA710	0.5	0.65	1.0		$V_{CE} = 5.0$ V,
	FPA710A	0.75	0.85	1.0		$H = 5$ mW/cm^2

Notes
1. These are steady-state limits. The factory should be consulted on applications involving pulsed or low duty cycle operation.
2. Measured with radiation flux intensity of less than 0.1 μW/cm^2 over the spectrum from 0.1 micron to 1.5 microns.
3. Measured at noted irradiance as emitted from a tungsten lamp at a color temperature of 2854°K. The effective photosensitive area is (0.8 mm^2). Illuminance (in lumens/ft^2) = irradiance H (in mW/cm^2) × 20 at a color temperature of 2854°K.
4. Measured at an irradiance of 5.0 mW/cm^2 as emitted from a gallium arsenide diode.
5. Matching factor is the ratio of minimum sensitivity to maximum sensitivity of any two cells.
6. Rise time is defined as the time required for I_{CE} to rise from 10% to 90% of the peak value. Fall time is defined as the time required for I_{CE} to decrease from 90% to 10% of peak value.

Photo Current Characteristics

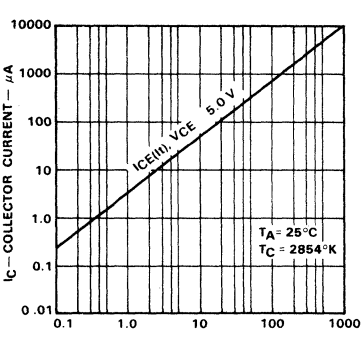
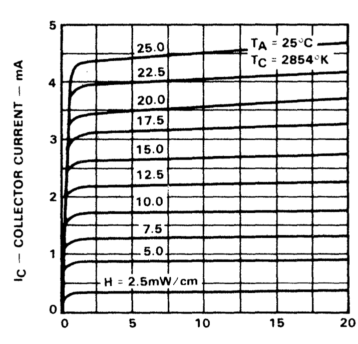


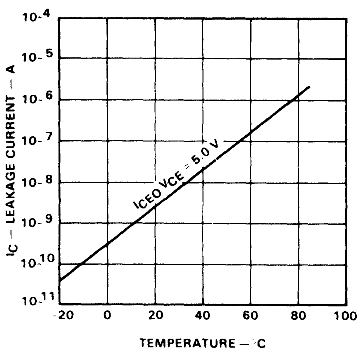
Photo Current vs Collector Voltage



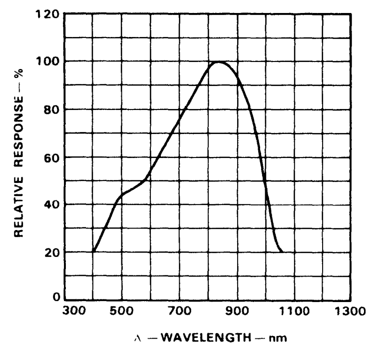
Typical Electrical Characteristic Curves

FPA710
FPA710A

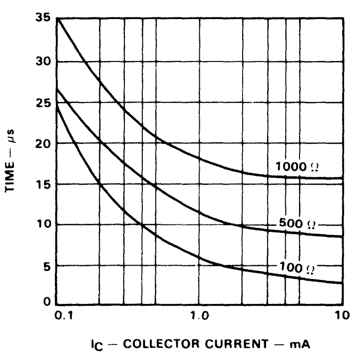
Collector Dark Current vs Temperature



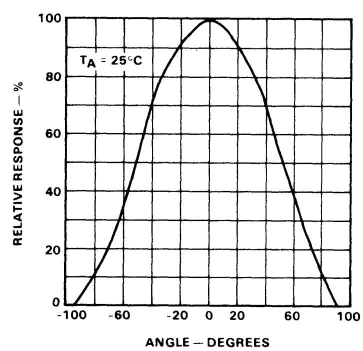
Relative Spectral Response



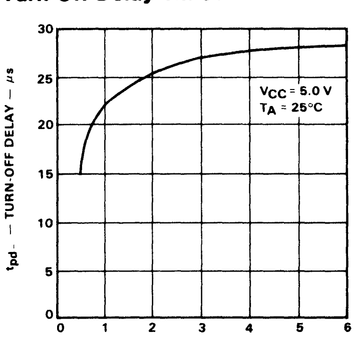
Rise And Fall Time vs Collector Current



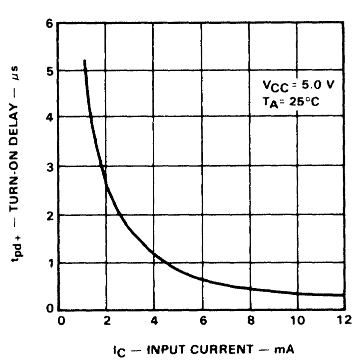
Angular Response



Turn-Off Delay Times



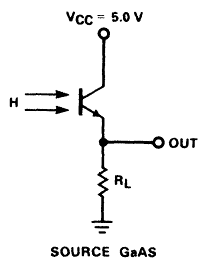
Turn-On Delay Times



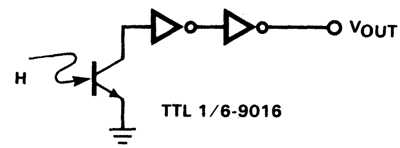
Switching Test Circuits

FPA710 FPA710A

Rise And Fall Times



Turn-On And Turn-Off Delay



10-Element Phototransistor Card Reader Array

Optoelectronic Products

FPA720
FPA720A

General Description

The FPA720 and FPA720A are 9-element npn Planar phototransistor arrays with exceptionally stable characteristics and high illumination sensitivity. Each transistor is electrically isolated and mounted on 100 mil centers. The case is a plastic compound with transparent resin encapsulation that exhibits stable characteristics under high humidity conditions.

High Illumination Sensitivity
Especially Designed For Punched Or Marked Card Reading And Optical Encoder Applications

Absolute Maximum Ratings

Maximum Temperatures and Humidity

Storage Temperature	−40°C to +100°C
Operating Temperature	−40°C to +85°C
Pin Temperature (Soldering, 10 s)	260°C
Relative Humidity at 65°C	85%

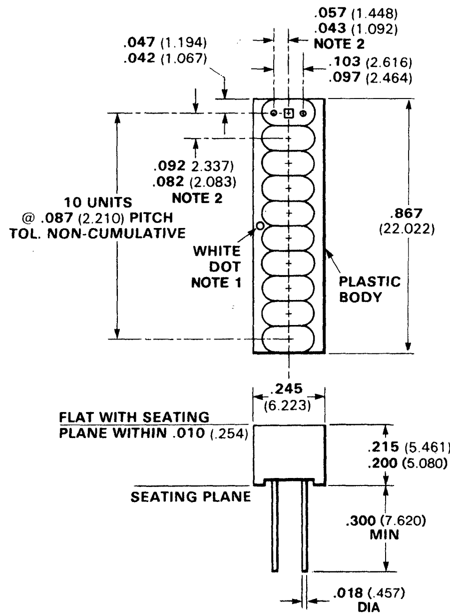
Maximum Power Dissipation per Cell

Total Dissipation at $T_C = 25°C$	200 mW
Derate Linearly from 25°C	3.33 mW / °C
Total Dissipation at $T_A = 25°C$	133 mW
Derate Linearly from 25°C	2.22 mW / °C

Maximum Voltages and Currents (Note 1)

$V_{CE(sus)}$	Collector-to-Emitter Sustaining Voltage	20 V
I_C	Collector Current	25 mA

Package Outline



Notes
1. Emitter terminal side of phototransistor (sensor array) or anode terminal side of diode (source array) defined by white dot.
2. The center of each element is aligned to ±.010 along the length and ±.005 across the width.
3. All dimensions in inches **bold** and millimeters (parentheses).
4. Tolerance unless specified = ±0.15 (0.381).

Typical Electrical Characteristics

FPA720
FPA720A

Electrical Characteristics $T_A = 25°C$

Symbol	Characteristic	Min	Typ	Max	Units	Test Conditions
$V_{CEO(sus)}$	Collector-to-Emitter Sustaining Voltage (Note 7)	20	35		V	$I_C = 1.0$ mA pulsed
BV_{ECO}	Emitter-to-Collector Breakdown Voltage (Note 7)		7.0		V	$I_{EC} = 100\ \mu A$
$V_{CE(sat)}$	Collector-to-Emitter Saturation Voltage		0.16	0.33	V	$I_C = 500\ \mu A$, $H = 20$ mW/cm^2
I_{CEO}	Collector Dark Current/Cell (Note 2)		4.0	100	nA	$V_{CE} = 5.0$ V
$I_{CE(lt)}$	Photo Current, Tungsten Source (Note 3)	200	750		μA	$V_{CE} = 5.0$ V, $H = 5$ mW/cm^2
$I_{CE(lt)}$	Photo Current, Tungsten Source (Note 3)		1.75		mA	$V_{CE} = 5.0$ V, $H = 10$ mW/cm^2
$I_{CE(lt)}$	Photo Current, GaAs Source (Note 4)		2.25		mA	$V_{CE} = 5.0$ V, $H = 5$ mW/cm^2
t_r	Light Current Rise Time (Note 6)		4.0		μs	GaAs,
t_f	Light Current Fall Time (Note 6)		4.0		μs	$I_C = 2.0$ mA, $R_L = 100\ \Omega$, $V_{CC} = 5.0$ V
S_{min}/S_{max}	Matching Factor (Notes 3 and 5)					
	FPA720	0.5	0.65	1.0		$V_{CE} = 5.0$ V,
	FPA720A	0.75	0.85	1.0		$H = 5$ mW/cm^2

Notes
1. These are steady-state limits. The factory should be consulted on applications involving pulsed or low duty cycle operation.
2. Measured with radiation flux intensity of less than 0.1 μW/cm^2 over the spectrum from 0.1 micron to 1.5 microns.
3. Measured at noted irradiance as emitted from a tungsten lamp at a color temperature of 2854°K. The effective photosensitive area is (0.8 mm^2). Illuminance (in lumens/ft^2) = irradiance H (in mW/cm^2) × 20 at a color temperature of 2854°K.
4. Measured at an irradiance of 5.0 mW/cm^2 as emitted from a gallium arsenide diode.
5. Matching factor is the ratio of minimum sensitivity to maximum sensitivity of any two cells.
6. Rise time is defined as the time required for I_{CE} to rise from 10% to 90% of the peak value. Fall time is defined as the time required for I_{CE} to decrease from 90% to 10% of peak value.
7. Rating refers to a high current point where collector-to-emitter voltage is lowest.

Photo Current Characteristics

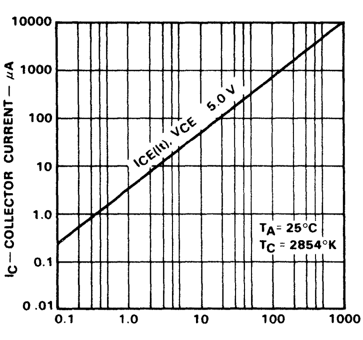
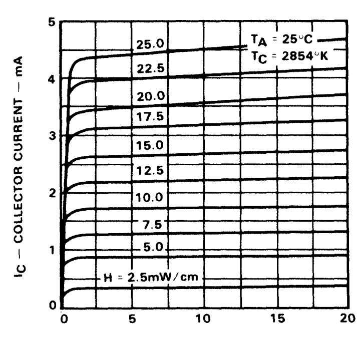


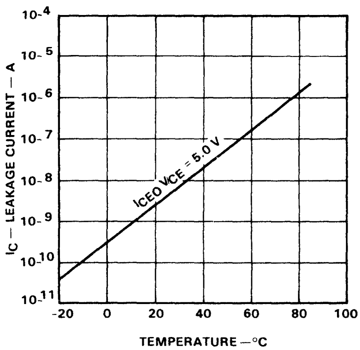
Photo Current vs Collector Voltage



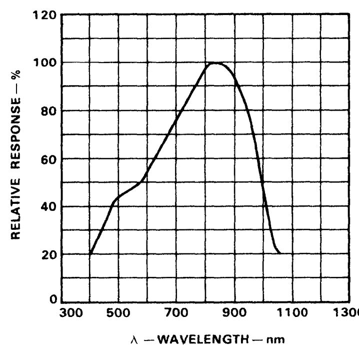
Typical Electrical Characteristic Curves

FPA720
FPA720A

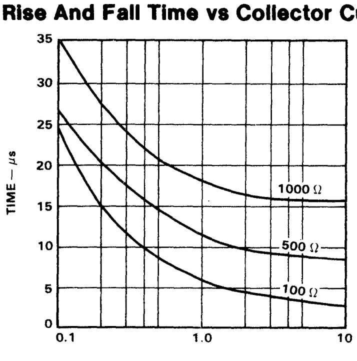
Collector Dark Current vs Temperature



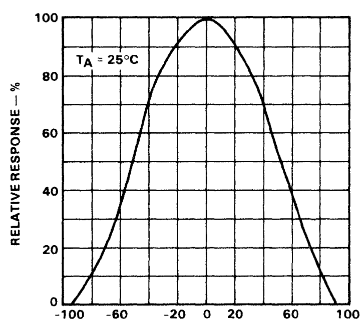
Relative Spectral Response



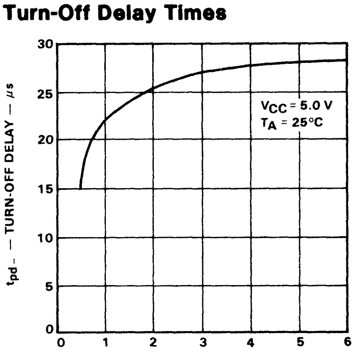
Rise And Fall Time vs Collector Current



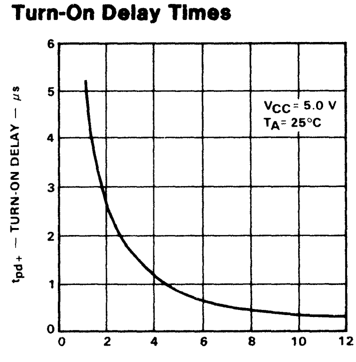
Angular Response



Turn-Off Delay Times



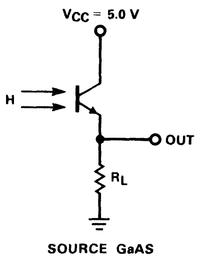
Turn-On Delay Times



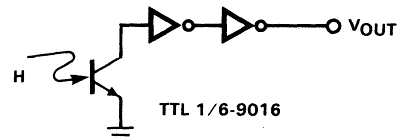
Test Circuits

FPA720
FPA720A

Switching Circuit For Rise And Fall Times



Circuit For Turn-On And Turn-Off Delay



GaAs Narrow Beam Infrared Emitter

FPE104

Optoelectronic Products

General Description

The FPE104 narrow beam infrared emitter is a high-intensity source specifically intended for excitation of photosensors, especially photodiodes and transistors, when the separation distances are measured from mm to several meters.

The FPE104 is the invisible infrared beam companion device to the FLV104, visible beam LED. Both devices have identical optics and, therefore, identical radiation patterns.

Very High Axial Intensity
Narrow (4°) Beamwidth
Detectable At 30 Feet

Absolute Maximum Ratings

Maximum Temperature and Humidity

Storage Temperature	−55°C to +100°C
Junction Temperature	−55°C to +100°C
Pin Temperature (Soldering, 10 s)	260°C
Relative Humidity at 65°C	98%

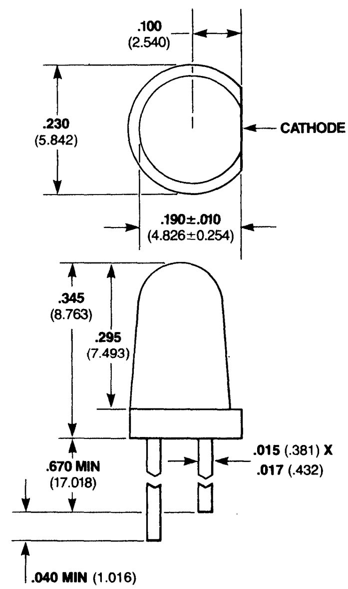
Maximum Power Dissipation

Total Dissipation at T_A = 25°C	200 mW
Derate Linearly from 25°C	2.6 mW/°C

Maximum Voltages and Currents

V_R	Reverse Voltage	3.0 V
I_F	Forward dc Current	1.0 A
I_{pk}	Peak Forward Current, 100 μs pulse, 1% duty cycle	100 mA

Package Outline



Notes
All dimensions in inches **bold** and millimeters (parentheses)
Tolerance unless specified = ±**.015** (±.381)

Electrical Characteristics T_A = 25°C

Symbol	Characteristic	Min	Typ	Max	Units
V_F	Forward Voltage at I_F = 100 mA		1.3	1.9	V
BV_R	Reverse Breakdown Voltage (I_R = 100 μA)	3.0	6.0		V

4

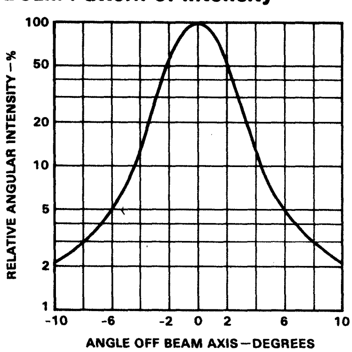
Typical Electrical Characteristics

FPE104

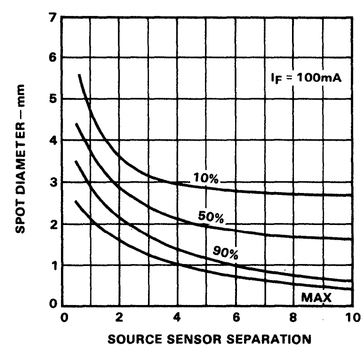
Optoelectronic Characteristics @ I_F = 100 mA T_A = 25°C

Symbol	Characteristic	Min	Typ	Max	Units
I_O	Axial Intensity	3.0	10		mW/sr
A_s	Effective Source Area (Axial)		0.028		cm^2
N	Average Effective Source Radiance (Axial)		360		mW/sr/cm^2
$\Delta I/\Delta T$	Temperature Coefficient of Intensity (Note 1)		0.5		%/°C
$\Delta I/\Delta I_F$	Excitation Coefficient of Intensity (Note 1)		1.0		%/mA
λ_{pk}	Peak Spectral Wavelength		890		nm
$\Delta\lambda$	Spectral Bandwidth		40		nm
$\Delta\lambda_{pk}/\Delta T$	Temperature Spectral Shift Coefficient (Note 2)		0.3		nm/°C
$\Delta\lambda_{pk}/\Delta I$	Excitation Spectral Shift Coefficient (Note 2)		0.1		nm/mA
$\theta_{1/2}$	Beam Angle at 50% Axial Intensity		4.3		degrees
$\Delta\theta_A$	Beam Axis to Mechanical Axis		1.5		degrees
t_r, t_f	Light Output Rise and Fall Time (Note 3)		10		ns
C_O	Capacitance (V = 0, f = 1.0 MHz)		100		pF

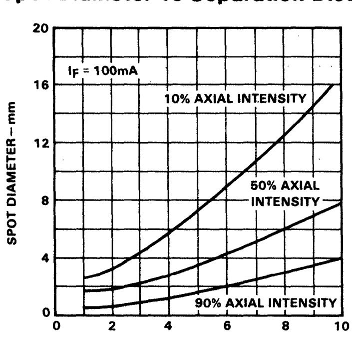
Beam Pattern of Intensity



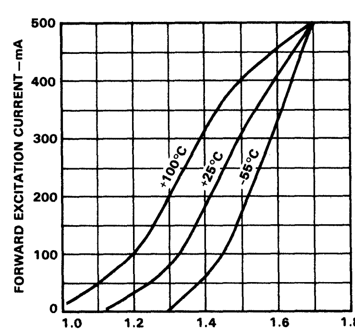
Spot Diameter vs Separation Distance (Near Field)



Spot Diameter vs Separation Distance (Near Field)



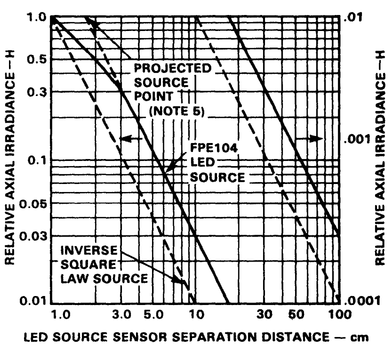
Forward V-I Characteristics



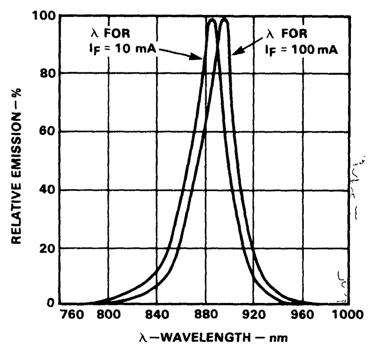
Typical Electrical Characteristic Curves Narrow Beam Shape

FPE104

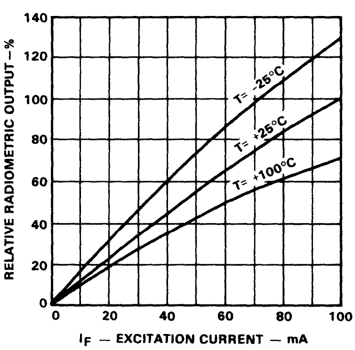
Average Axial Irradiance, H (Note 6)



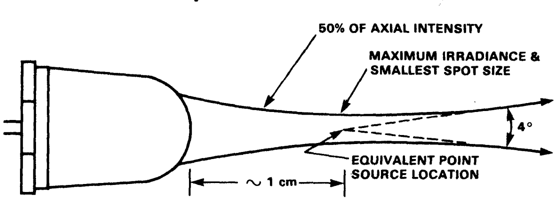
Emission Spectrum Infrared (GaAs) LED



Relative Radiometric Output—% (Note 4)



Narrow Beam Shape



Notes

1. $\Delta I/\Delta T$ and $\Delta I/\Delta I_F$ are the percentage derating factors for all radiometric output characteristics referenced to their typical value at 25°C ambient and I_F = 100 mA.
2. $\Delta\lambda_{pk}/\Delta T$ and $\Delta\lambda_{pk}/\Delta I_F$ are the derating factors for all wavelength characteristics referenced to their typical value at 25°C ambient and I_F = 100 mA.
3. Time for a 10%-90% change in light intensity with a step change in current.
4. Normalization: LED intensity $\simeq$ 10 mW/sr sensor 1 mm² area.
5. Projected source point is the distance, Sp from which LED inverse square LAW characteristics may be computed for S $\geq$ 5 cm.
   $H = \frac{1.0\ mW}{cm^2} \times \frac{SP^2}{(S - Sp)^2}, \quad 1 < Sp < 2\ cm$
6. Irradiance (H) normalized to 4 mW/cm² @ S = 1 cm.

GaAs Infrared Emitter

FPE106

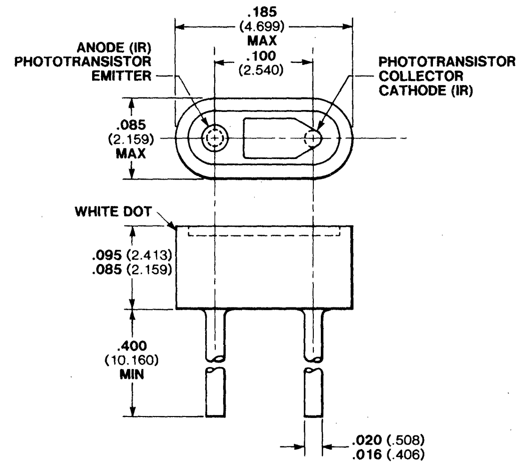
Optoelectronic Products

General Description

The FPE106 is a GaAs infrared light-emitting diode in a miniature ceramic case with exceptionally stable characteristics. This device is used in applications where space is limited such as custom tape and card readers.

Exceptionally Stable Characteristics
Miniature—85 × 185 × 95 Mils
Suitable For PC Card Mounting

Package Outline



Notes
All dimensions in inches **bold** and millimeters (parentheses)
Tolerance unless specified = ±**.015** (0.381)

Absolute Maximum Ratings

Maximum Temperature and Humidity

Storage Temperature	−40°C to +100°C
Operating Temperature	−40°C to +85°C
Pin Temperature (Soldering, 10 s)	260°C
Relative Humidity at 65°C	85%

Maximum Power Dissipation

Total Dissipation at T_A = 25°C	150 mW
Derate Linearly from 25°C	2.5 mW / °C

Maximum Voltages and Currents

V_R	Reverse Voltage	3.0 V
I_F	Forward dc Current	100 mA

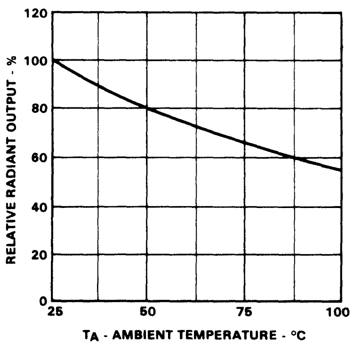
Electrical Radiant Characteristics T_A = 25°C

Symbol	Characteristic	Min	Typ	Max	Units	Test Conditions
V_F	Forward Voltage		1.3	1.5	V	I_F = 50 mA
V_R	Reverse Voltage	3.0	6.0		V	I_R = 100 μA
I_O	Axial Intensity	35	200		μW / sr	I_F = 50 mA
$\theta_{1/2}$	Beam Angle at Half Power	3.5	80		degrees	
λ_{pk}	Peak Spectral Wavelength		890		nm	

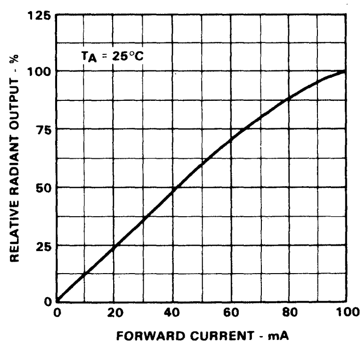
Typical Electrical Characteristic Curves

FPE106

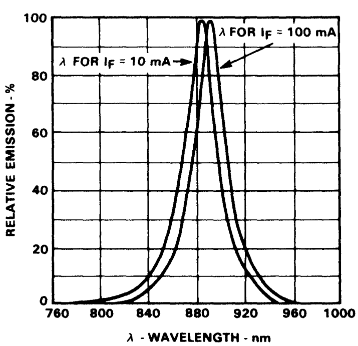
Radiant Output vs Temperature



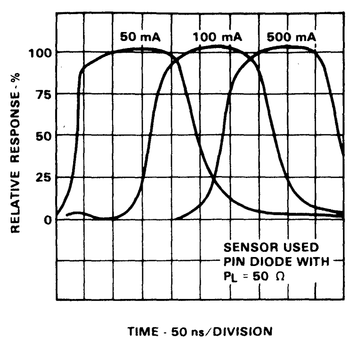
Radiant Output vs DC Forward Current



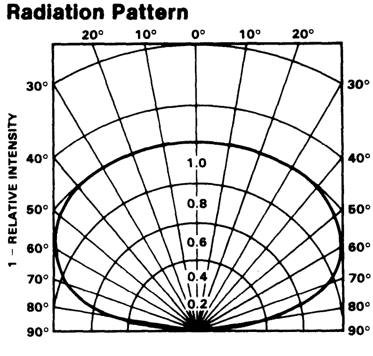
Emission Spectrum



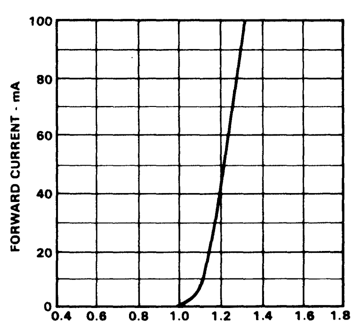
Radiant Emission Transient Response



Radiation Pattern



Forward Current vs Forward Voltage (DC)



GaAs Infrared Emitters

Optoelectronic Products

FPE500
FPE510

General Description

The FPE500/FPE510 are GaAs infrared-emitting diodes. When forward-biased, they emit an intense, narrow band of radiation peaking at approximately 900 nm (non-visible). The devices are packaged in TO-18 style hermetically-sealed packages with a glass lens.

These solid-state lamps are ideally suited for use in conjunction with silicon photosensors, since their spectral peaks are closely matched. The FPE500/FPE510 use a Planar process and are especially designed for high reliability and long life.

High Reliability
Long Life
Ideally Suited For Use In Conjunction With Silicon Photosensors
Applications Include: Punched Card And Paper Tape Reading, Optical Shaft Encoders, Choppers, High-Speed High-Voltage Isolation Switches and High-Speed Optoelectronic Signal Links
Hermetic Metal Package For Stability And Reliability

Absolute Maximum Ratings

Maximum Temperatures and Humidity

Storage Temperature	−65°C to +200°C
Operating Temperature	−65°C to +125°C
Pin Temperature (Soldering, 5 s)	260°C
Relative Humidity at 65°C	85%

Maximum Power Distribution

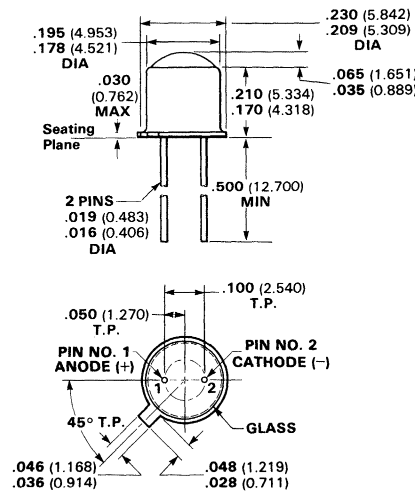
Power Dissipation	250 mW
Derate Linearly from 25°C	2.5 mW/°C

Maximum Voltages and Currents

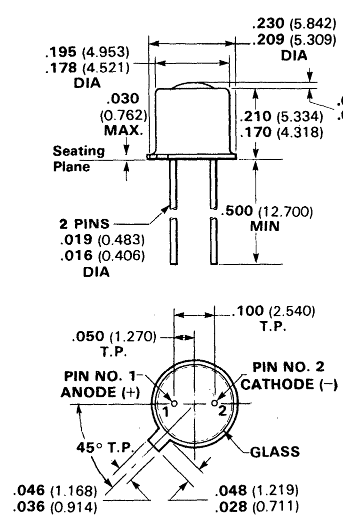
V_R	Reverse Voltage	3.0 V
I_F	Forward dc Current	150 mA

Package Outlines

FPE500



FPE510



Notes
All dimensions in inches **bold** and millimeters (parentheses)
Tolerance unless specified = ±**0.15** (0.381)

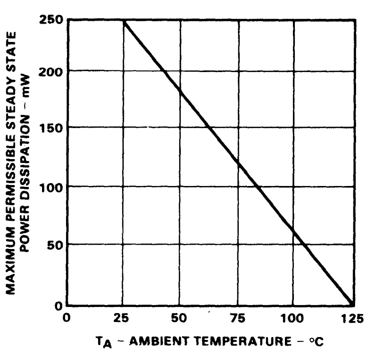
Typical Electrical Characteristics

FPE500
FPE510

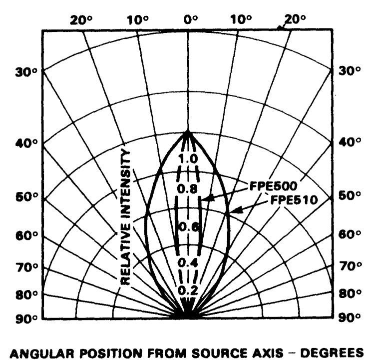
Electrical Characteristics $T_A = 25°C$, $I_F = 100$ mA

Symbol	Characteristic	Min	Typ	Max	Units	Test Conditions
V_F	Forward Voltage		1.35	1.7	V	
BV_R	Reverse Breakdown Voltage	3.0	6.0		V	$I_R = 100\ \mu A$
I_O	Axial Intensity					
	FPE500	1.0	3.0		mW / Sr	
	FPE510	0.3	1.0		mW / Sr	
P_O	Infrared Total Power Output		0.5		mW	
$\Delta P_O / \Delta T$	Temperature Dependence of Power, Output		−0.8		% / °C	
BW	Spectral Bandwidth		50		nm	
$\theta_{1/2}$	Viewing Angle to Half Intensity					
	FPE500		9.0		degrees	
	FPE510		30		degrees	
t_r, t_f	Emission Rise and Fall Time		10		ns	$I_F = 50$ mA, 10 to 90%

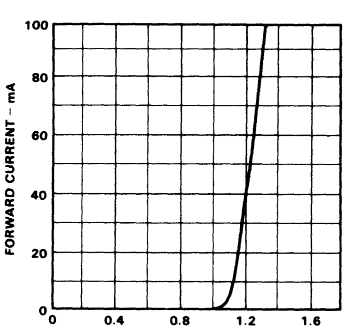
Power Dissipation vs Ambient Temperature



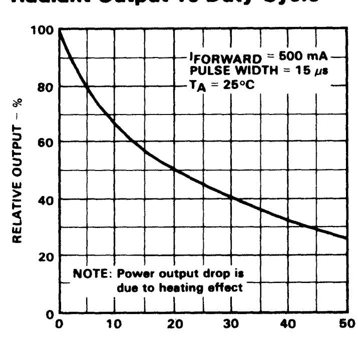
Radiation Pattern



Forward Current vs Forward Voltage (DC)



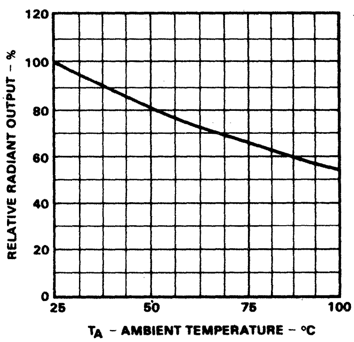
Radiant Output vs Duty Cycle



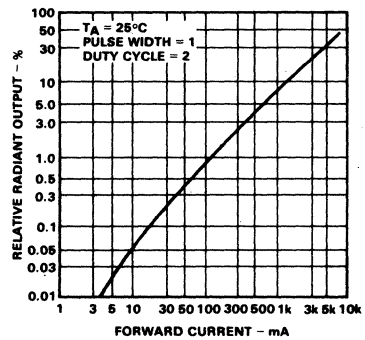
Typical Electrical Characteristic Curves

FPE500
FPE510

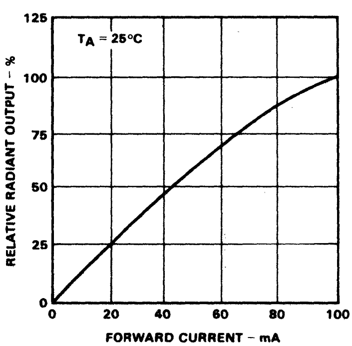
Radiant Output vs Temperature



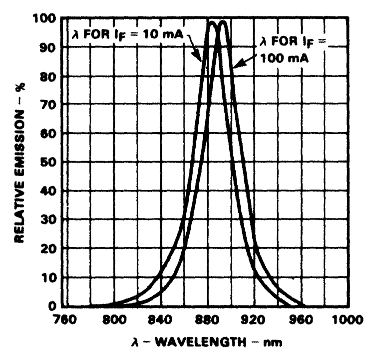
Radiant Output vs Forward Current (Pulsed)



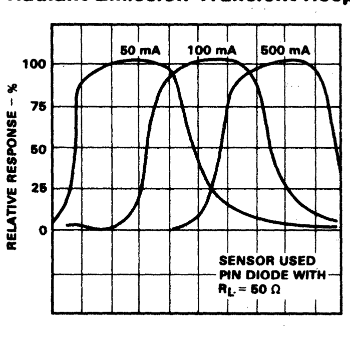
Radiant Output vs DC Forward Current



Typical Emission Spectrum



Radiant Emission Transient Response



GaAs Infrared Emitters

Optoelectronic Products

FPE520
FPE530

General Description

The FPE520 and FPE530 are GaAs infrared-emitting diodes. When forward-biased, they emit an intense, narrow band of radiation peaking at approximately 940 nm (non-visible). The devices are packaged in TO-18 style hermetically-sealed packages with a glass lens.

These solid state lamps are ideally suited for use in conjunction with silicon photosensors, since their spectral peaks are closely matched.

- **High Reliability**
- **Long Life**
- **Ideally Suited For Use In Conjunction With Silicon Photosensors**
- **Applications: Punched Card And Paper Tape Readers, Optical Shaft Encoders, Choppers, High-Speed, High-Voltage, Isolation Switches and High-Speed Optoelectronic Signal Links**
- **Hermetic Metal Package For Stability And Reliability**

Absolute Maximum Ratings

Maximum Temperatures

Storage Temperature	−65°C to +200°C
Operating Temperature	−65°C to +150°C
Pin Temperature (Soldering, 5 s)	260°C
Relative Humidity at 85°C	85%

Maximum Power Dissipation

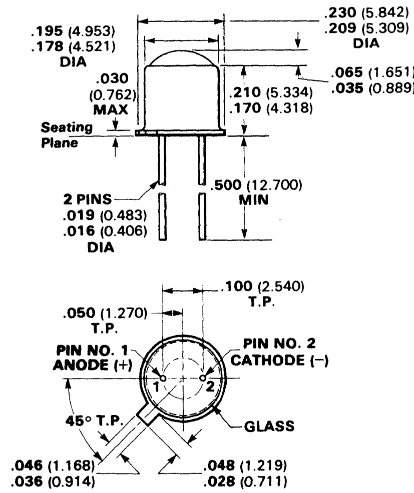
Total Dissipation at $T_A = 25°C$	250 mW
Derate Linearly from 25°C	2.0 mW/°C

Maximum Voltage and Currents

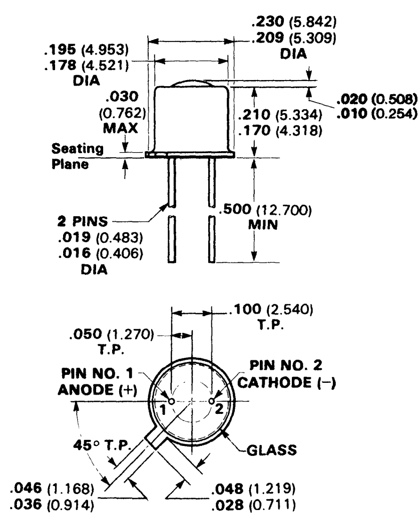
V_R	Reverse Voltage	3.0 V
I_F	Forward dc Current	150 mA

Package Outlines

FPE520



FPE530



Notes

All dimensions in inches **bold** and millimeters (parentheses)

Tolerance unless specified = ±**.015** (0.381)

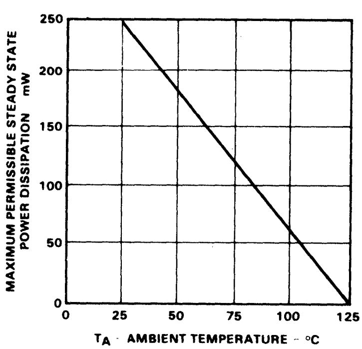
Typical Electrical Characteristics

FPE520 FPE530

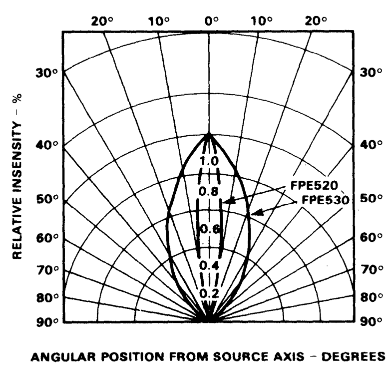
Electrical Characteristics $T_A = 25°C$, $I_F = 100$ mA, unless otherwise specified

Symbol	Characteristic	Min	Typ	Max	Units	Test Conditions
V_F	Forward Voltage		1.35	1.7	V	
V_R	Reverse Voltage	3.0	6.0		V	$I_R = 100\ \mu A$
I_O	Axial Intensity					
	FPE520	3.0	6.0		mW/sr	
	FPE530	1.0	2.0		mW/sr	
P_O	Infrared Total Power Output		1.5		mW	
$\Delta P_O/\Delta T$	Temperature Dependence of Power Output		−0.8		%/°C	
λ_{pk}	Peak Spectral Wavelength		940		nm	
BW	Spectral Bandwidth		50		nm	
$\theta_{1/2}$	Viewing Angle to Half Intensity					
	FPE520		9.0		degrees	
	FPE530		30		degrees	
t_r, t_f	Emission Rise and Fall Time		500		ns	$I_F = 50$ mA, 10 to 90%

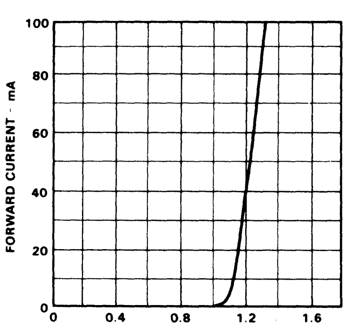
Power Dissipation vs Ambient Temperature



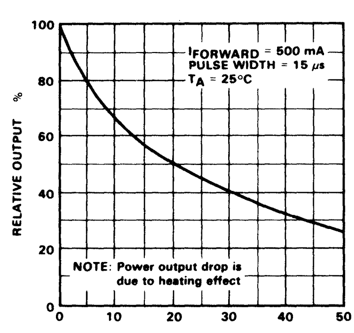
Radiation Pattern



Forward Current vs Forward Voltage (DC)



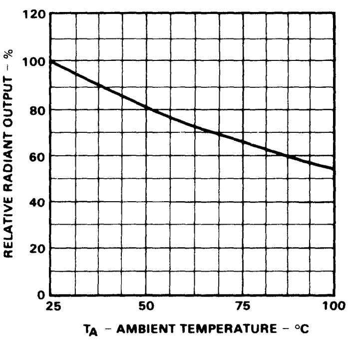
Radiant Output vs Duty Cycle



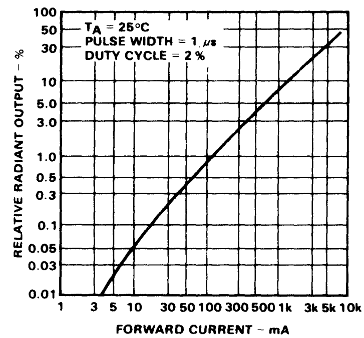
Typical Electrical Characteristic Curves

FPE520
FPE530

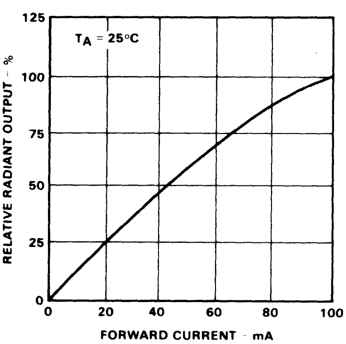
Radiant Output vs Temperature



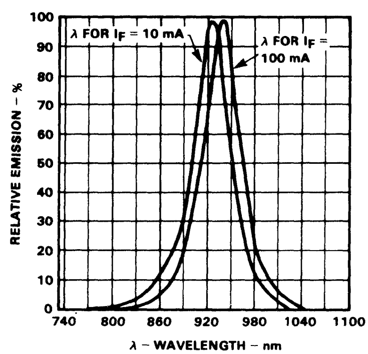
Radiant Output vs Forward Current (Pulsed)



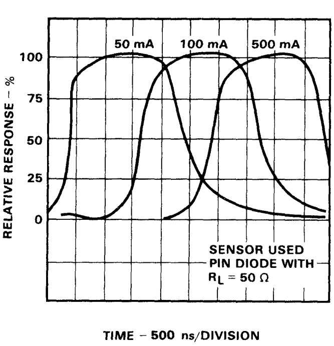
Radiant Output vs DC Forward Current



Emission Spectrum



Radiant Emission Transient Response



Low-Cost General-Purpose GaAs Infrared Emitter

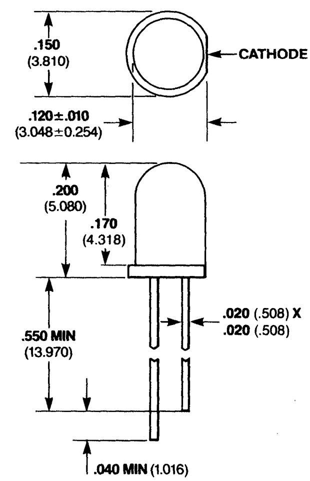
FPE700

Optoelectronic Products

General Description

The FPE700 is a low-cost, general-purpose, GaAs infrared-emitting diode encapsulated in a clear plastic T1 package.

Package Outline



Notes
All dimensions in inches **bold** and millimeters (parentheses).
Tolerance unless specified = ±**.015** (±.381).

Absolute Maximum Ratings

Maximum Temperature and Humidity

Operating Temperature	−40°C to +85°C
Storage Temperature	−55°C to +100°C
Pin Temperature (Soldering, 5 s)	230°C
Relative Humidity at 85°C	85%

Maximum Power Dissipation

Total Dissipation at T_A = 25°C	70 mW
Derate Linearly from 25°C	1.33 mW/°C

Maximum Voltage and Current

V_R	Reverse Voltage	3.0 V
I_F	Forward dc Current	40 mA

Electrical and Radiant Characteristics T_A = 25°C

Symbol	Characteristic	Min	Typ	Max	Units	Test Conditions
V_F	Forward Voltage		1.35	1.7	V	I_F = 40 mA
BV_R	Reverse Breakdown Voltage	3.0	6.0		V	I_R = 100 μA
I_O	Axial Intensity	0.12	0.2		mW/Sr	I_F = 40 mA
P_O	Infrared Total Power Output		0.1		mW	I_F = 40 mA
$\theta_{1/2}$	Viewing Angle to Half Intensity		25		degrees	
t_r, t_f	Emission Rise and Fall Time		200		ns	I_F = 20 mA, 10% to 90%
λ_{pk}	Peak Spectral Wavelength		900		nm	

General-Purpose Silicon Planar Phototransistor

FPT100/A/B
FPT110/A/B

Optoelectronic Products

General Description

The FPT100 and FPT110 are 3-terminal npn Planar phototransistors with exceptionally stable characteristics and high illumination sensitivity. The availability of the base pin gives wide latitude for flexible circuit design. The case is a special plastic compound with transparent resin encapsulation that exhibits stable characteristics under high humidity conditions. The controlled sensitivities offered in the A and B versions give the circuit designer increased flexibility.

Exceptionally Stable Characteristics
Controlled Sensitivities

Absolute Maximum Ratings

Maximum Temperature and Humidity

Storage Temperature	−55°C to +100°C
Operating Temperature	−55°C to +85°C
Pin Temperature (Soldering, 5 s)	260°C
Relative Humidity at 65°C	85%

Maximum Power Dissipation (Notes 1 and 2)

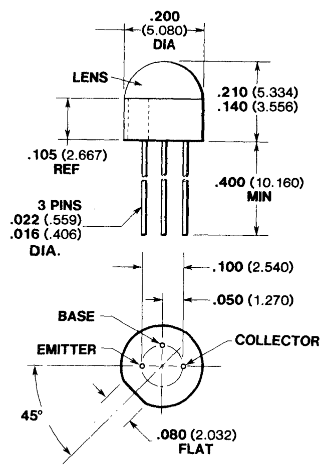
Total Dissipation at T_C = 25°C	200 mW
Total Dissipation at T_A = 25°C	100 mW

Maximum Voltages and Current (Note 5)

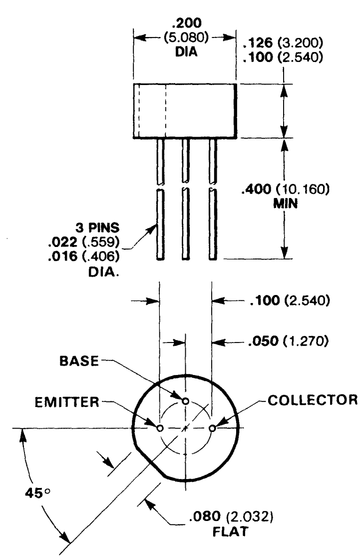
V_{CB}	Collector-to-Base Voltage	50 V
V_{CE}	Collector-to-Emitter Sustaining Voltage (Note 3)	30 V
I_C	Collector Current	25 mA

Package Outlines

FPT100/A/B



FPT110/A/B



Notes
All dimensions in inches **bold** and millimeters (parentheses)
Tolerance unless specified = ±**.015** (±.381)

Typical Electrical Characteristics

FPT100/A/B FPT110/A/B

Electrical Characteristics T_A = 25°C unless otherwise noted

Symbol	Characteristic	Min	Typ	Max	Units	Test Conditions
I_{CBO}	Collector Dark Current		0.25	25	nA	V_{CB} = 10 V (Note 5)
I_{CBO}	Collector Dark Current		0.025	0.5	μA	V_{CB} = 10 V, T_A = 65°C (Note 5)
I_{CEO}	Collector Dark Current		2.0	100	nA	V_{CE} = 5.0 V (Note 5)
R_{CB}	Responsivity (Tungsten)					
	FPT100/A/B	0.6	1.6		μA/	V_{CB} = 10 V
	FPT110/A/B	0.6	1.0		mW/cm²	(Notes 3 and 8)
R_{CB}	Responsivity (GaAs)					
	FPT100/A/B	1.8	4.8		μA/	V_{CB} = 10 V
	FPT110/A/B	1.8	3.0		mW/cm²	(Notes 4 and 8)
$I_{CE(lt)}$	Photo Current (Tungsten)					
	FPT100/A/B	0.2	1.4		mA	V_{CE} = 5.0 V
	FPT110/A/B	0.2	0.88			H = 5.0 mW/cm² (Notes 3 and 7)
$I_{CE(lt)}$	Photo Current (GaAs)					
	FPT100/A/B	0.6	4.2		mA	V_{CE} = 5.0 V
	FPT110/A/B	0.6	2.7			H = 5.0 mW/cm² (Notes 4 and 7)
t_r	Light Current Rise Time		2.8		μs	(Note 6)
t_f	Light Current Fall Time		2.8		μs	(Note 6)
$V_{CEO(sat)}$	Collector-to-Emitter Saturation Voltage					
	FPT100/A/B		0.16	0.3	V	I_C = 500 μA
	FPT110/A/B		0.16	0.33		H = 20 mW/cm²
BV_{CBO}	Collector-to-Base Breakdown Voltage	50	120		V	I_C = 100 μA (Note 5)
$V_{CEO(sus)}$	Collector-to-Emitter Sustaining Voltage	30	50		V	I_C = 1.0 mA (pulsed) (Note 5)
BV_{ECO}	Emitter-to-Collector Breakdown		7.0		V	I_E = 100 μA (Note 5)

The following values affect the A and B versions only:

Symbol	Characteristic	Min	Typ	Max	Units	Test Conditions
$I_{CE(lt)}$	Photo Current (Tungsten Source)					V_{CE} = 5.0 V
	FPT100A	1.0		3.0	mA	(Note 3)
	FPT110A	0.6		1.8		H = 5.0 mW/cm²
$I_{CE(lt)}$	Photo Current (Tungsten Source)					V_{CE} = 5.0 V
	FPT100B	1.3		2.6	mA	(Note 3)
	FPT110B	0.8		1.6		H = 5.0 mW/cm²

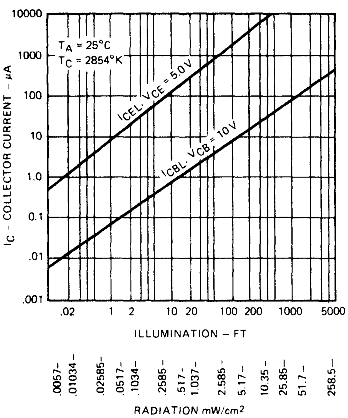
Notes

1. These are steady-state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
2. These ratings give a maximum junction temperature of 85°C and junction-to-case thermal resistance of 300°C/W (derating factor of 3.33 mW/°C), and a junction-to-ambient thermal resistance of 600°C/W (derating factor of 1.67 mW/°C).
3. Measured at noted irradiance as emitted from a tungsten filament lamp at a color temperature of 2854°K. The effective photosensitive area is typically 1.25 mm² (FPT100A/B) and 0.78 mm² (FPT110A/B).
4. These are values obtained at noted irradiance as emitted from a GaAs source at 900 nm.
5. Measured with radiation flux intensity of less than 0.1 μW/cm² over the spectrum from 100 to 1500 nm.
6. Rise time is defined as the time required for I_{CE} to rise from 10% to 90% of peak value. Fall time is defined as the time required for I_{CE} to decrease from 90% to 10% of peak value. Test conditions are: I_{CE} = 4.0 mA, V_{CE} = 5.0 V, R_L = 100 Ω, GaAs source.
7. No electrical connection to base lead.
8. No electrical connection to emitter lead.

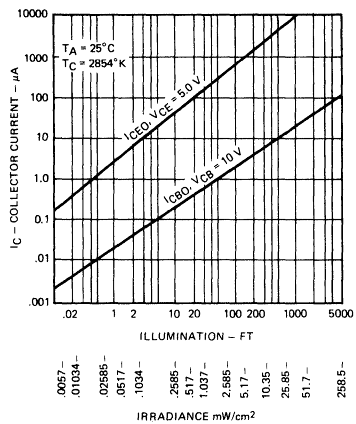
Typical Electrical Characteristic Curves

FPT100/A/B FPT110/A/B

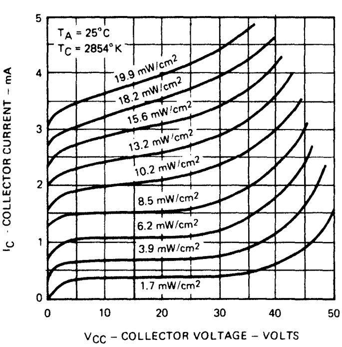
FPT100/A/B Photo Current Characteristics



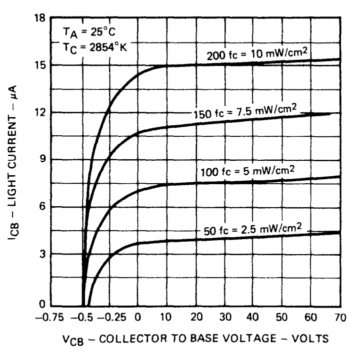
FPT110/A/B Photo Current Characteristics



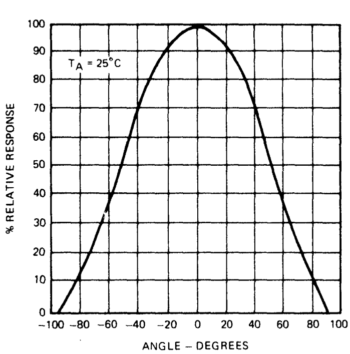
Collector Current vs Collector Voltage



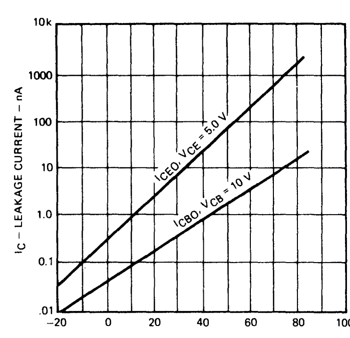
Collector Base Characteristics



Angular Response



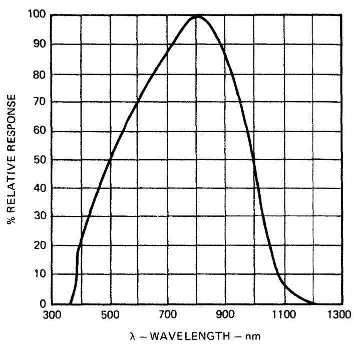
Collector Dark Current vs Temperature



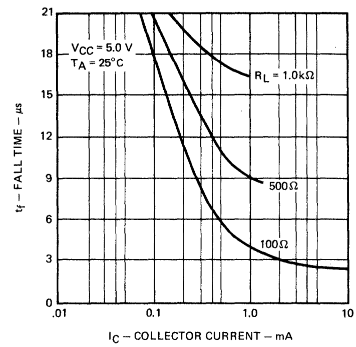
Typical Electrical Characteristic Curves Circuits

FPT100/A/B
FPT110/A/B

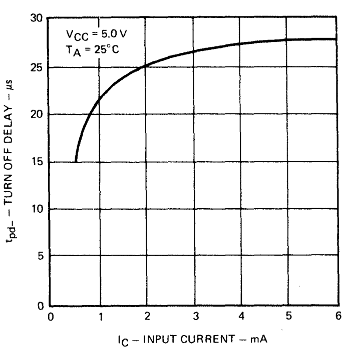
Spectral Characteristics



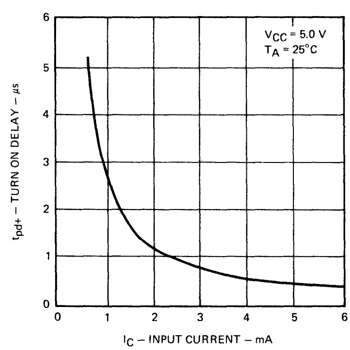
Rise And Fall Time vs Collector Current



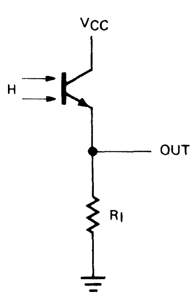
Turn-Off Delay Times For Circuit



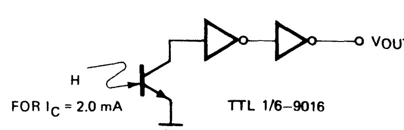
Turn-On Delay Times For Circuit



Switching Circuit For Rise And Fall Times



Circuit For Turn-On And Turn-Off Data



Hermetic Coaxial Silicon Phototransistor

Optoelectronic Products

FPT101

General Description

The FPT101 is a miniature phototransistor in a hermetic, welded case. A large photosensitive base combined with a flat window affords exceptional sensitivity without the need for critical alignment. In tape and card reader applications, the flat window permits flush mounting in the wear-plate thereby minimizing cross-talk. The spectral response, extending from 400 to 1100 nm, is compatible with daylight, tungsten and gallium arsenide sources.

Precision Optical Alignment
Miniature—80 Mils In Diameter
Suitable For PC Board Mounting
Applications Include Tape And Card Readers

Absolute Maximum Ratings

Maximum Temperatures and Humidity

Storage Temperature	−65°C to +150°C
Operating Temperature	−65°C to +150°C
Pin Temperature (Soldering, 10 s)	260°C
Relative Humidity at 65°C	85%

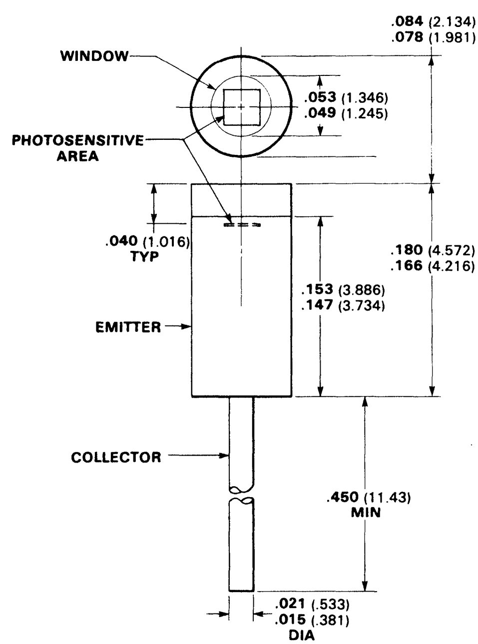
Maximum Power Dissipation

Total Dissipation at $T_C = 25°C$	75 mW
Derate Linearly from 25°C	0.6 mW / °C

Maximum Voltages and Currents (Note 1)

$V_{CE(sus)}$	Collector-to-Emitter Sustaining Voltage	30 V
$V_{EC(sus)}$	Emitter-to-Collector Sustaining Voltage	5 V
I_C	Collector Current	25 mA

Package Outline



Notes
All dimensions in inches **bold** and millimeters (parentheses)
Tolerance unless specified = ±.015 (±.381)

Typical Electrical Characteristics

FPT101

Electrical Characteristics $T_A = 25°C$

Symbol	Characteristic	Min	Typ	Max	Units	Test Conditions
$V_{CEO(sus)}$	Collector-to-Emitter Sustaining Voltage	30	60		V	$I_C = 0.1$ mA, $H < 0.1\ \mu W/cm^2$
BV_{ECO}	Emitter-to-Collector Breakdown Voltage		7.0		V	$I_C = 0.1$ mA, $H < 0.1\ \mu W/cm^2$
$V_{CE(sat)}$	Collector Saturation Voltage (Note 2)		0.25	0.3	V	$I_C = 0.4$ mA, $H = 20$ mW/cm^2
I_{CEO}	Collector Dark Current		2.0	100	nA	$V_{CE} = 5.0$ V, $H < 0.1\ \mu W/cm^2$
$I_{CE(lt)}$	Collector Photo Current (Notes 2 & 4)	0.8	3.5		mA	$V_{CE} = 5.0$ V, $H = 20$ mW/cm^2
$I_{CE(lt)}$	Collector Photo Current (Notes 2 & 4)		0.8		mA	$V_{CE} = 5.0$ V, $H = 5.0$ mW/cm^2

Notes
1. These are steady-state limits. The factory should be consulted on applications involving pulsed or low duty cycle operation.
2. Irradiation source is an unfiltered tungsten lamp operated at 2854°K color temperature. Unless otherwise stated, all H values refer to this color temperature.
3. Switching time is defined here as the 10% to 90% rise time of I_{CE} for an irradiance step input. The rise and fall times are essentially equal.
4. Silicon radiometric photocurrent efficiency with typical GaAs irradiance is approximately three times greater than with tungsten at 2854°K color temperature. Therefore, all graphs with H as a parameter of variable will apply for GaAs irradiation if the H values are divided by three.
5. Emitter is connected to the case.

Relative Spectral Response

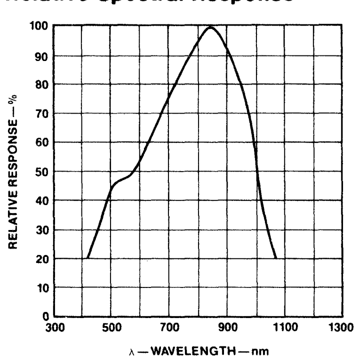
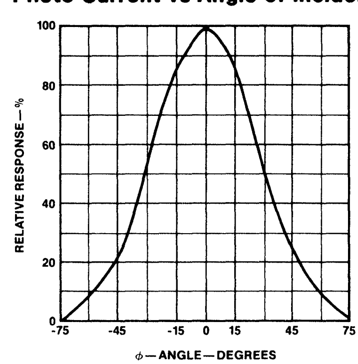


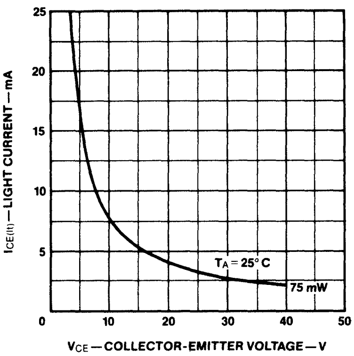
Photo Current vs Angle of Incidence



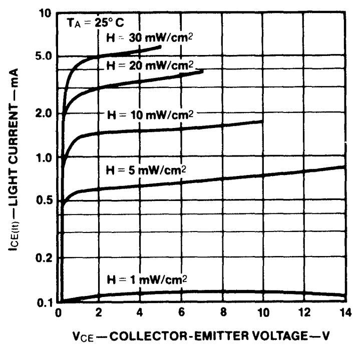
Typical Electrical Characteristic Curves

FPT101

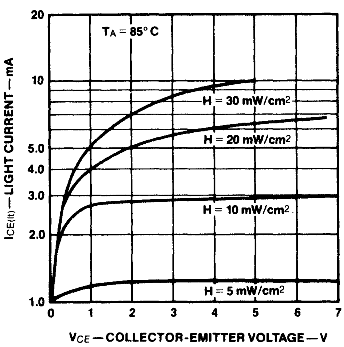
Maximum Power Limits



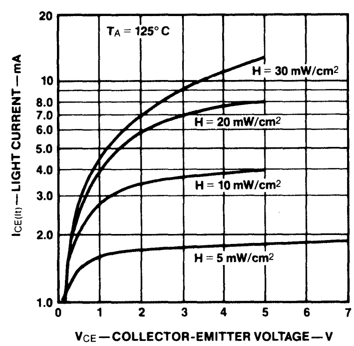
Collector Characteristics



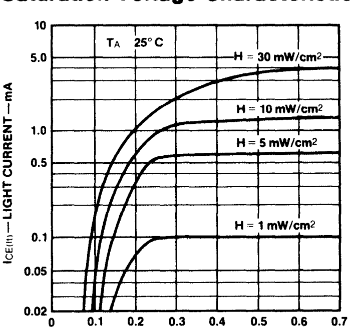
Collector Characteristics



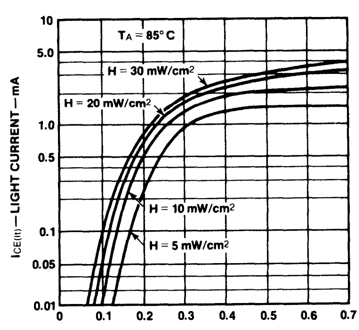
Collector Characteristics



Saturation Voltage Characteristics



Saturation Voltage Characteristics



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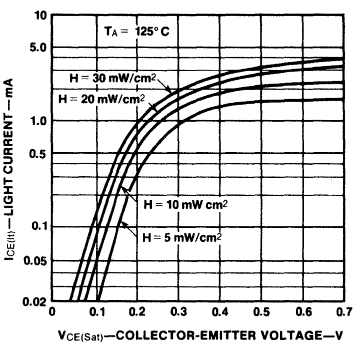
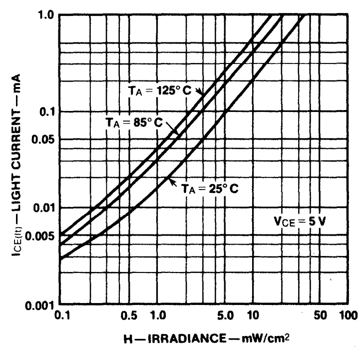
Typical Electrical Characteristic Curves (Cont'd)

FPT101

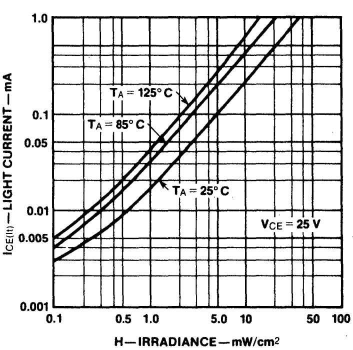
Saturation Voltage Characteristics



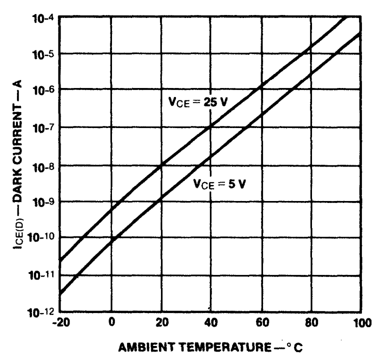
Light Current vs Irradiance



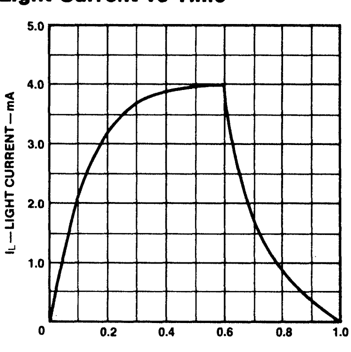
Light Current vs Irradiance



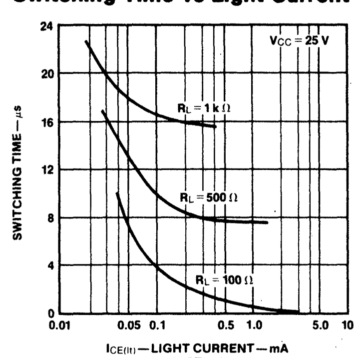
Dark Current Characteristics



Light Current vs Time



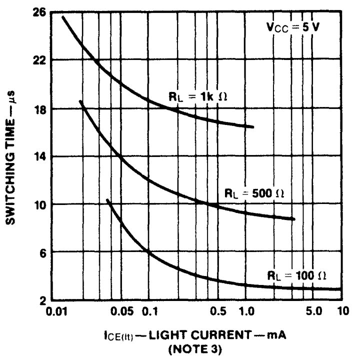
Switching Time vs Light Current



Typical Electrical Characteristic Curves (Cont'd)

FPT101

Switching Time vs Light Current



Hermetic Coaxial Silicon Photodiode

Optoelectronic Products

FPT102

General Description

The FPT102 is a miniature light-sensing diode in a hermetic, welded case. In the reverse-bias mode of operation, excellent photocurrent linearity is obtained. In the photovoltaic mode, the open-circuit voltage varies in a logarithmic manner and is most sensitive to low-level light variations.

Sensitive At Low Light Level Applications
Excellent Photocurrent Linearity
Fast Response To Light Pulses
Precision Optical Alignment
Miniature—80 Mils In Diameter

Absolute Maximum Ratings

Maximum Temperatures and Humidity

Storage Temperature	−55°C to +150°C
Junction Temperature	−55°C to +100°C
Pin Temperature (Soldering, 10 s)	260°C
Relative Humidity at 65°C	85%

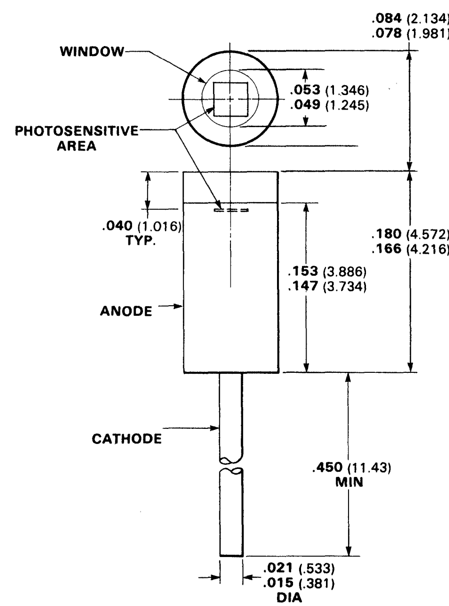
Maximum Power Dissipation

Total Dissipation at $T_C = 25°C$	75 mW
Derate Linearly from 25°C	0.6 mW/°C

Maximum Voltages

V_R	Reverse Voltage	50 V

Package Outline



Notes
All dimension in inches **bold** and millimeters (parentheses)
Tolerance unless specified = ±**0.15** (0.381)

Typical Electrical Characteristics

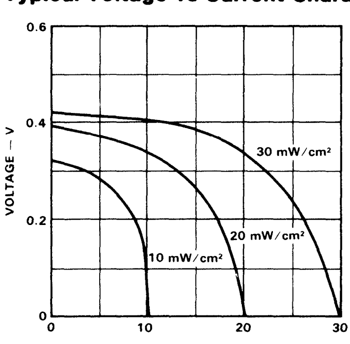
FPT102

Electrical Characteristics $T_A = 25°C$

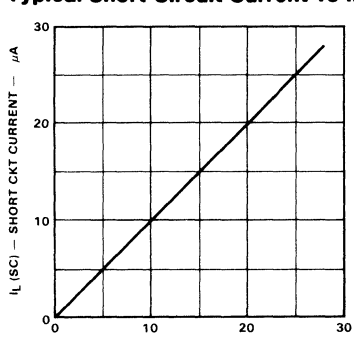
Symbol	Characteristic	Min	Typ	Max	Units	Test Conditions
BV	Breakdown Voltage	50	120		V	$I_R = 5.0\ \mu A$, $H \leq 0.1\ \mu W/cm^2$
V_{OC}	Open Circuit Voltage (Note 1)	380	400		mV	No bias, $H = 20\ mW/cm^2$
I_R	Dark Current		0.1	25	nA	$V_R = -10.0$ V, $H \leq 0.1\ \mu W/cm^2$
I_L	Photo Current (Note 1)	12	16		μA	$V_R = -10.0$ V, $H = 20\ mW/cm^2$
$I_{L(sc)}$	Short Circuit Current (Note 1)	12	16		μA	No bias, $H = 20\ mW/cm^2$
R (Tungsten)	Responsitivity (Notes 1 & 2)	0.6	1.0		$\mu A/mW/cm^2$	No bias, $T_C = 2854°$ K
R @ 0.9 μ	Responsitivity 0.9 μ (Note 2)		3.0		$\mu A/mW/cm^2$	No bias, GaAs
C_O	Open Circuit Capacitance		70		pF	$V_R = 0$, $H \leq 0.1\ mW/cm^2$
C_R	Reversed Bias Capacitance		20		pF	$V_R = -10$ V, $H \leq 0.1\ \mu W/cm^2$
R_{max}	Responsitivity (absolute) at Spectral Peak (Note 2)		0.6		A/W	$V_R = 0$, $\lambda = 0.80\ \mu$
NEP	Noise Equivalent Power (Note 2)		1.0×10^{-14}		W	$V_R = -10$ V, $\lambda = 0.80\ \mu$, $\Delta f = 1.0$ Hz
D	Detectivity (Note 2)		8.8×10^{12}		$\frac{cm\sqrt{Hz}}{W}$	$V_R = 10$ V, $\lambda = 0.80\ \mu$, $f = 1.0$ kHz, $\Delta f = 1.0$ Hz

Notes
1. Irradiation source is an unfiltered tungsten lamp operated at 2854°K color temperature.
2. Sensitive Area = 7.75×10^{-3} cm^2. (Response at metalization is negligible.)

Typical Voltage vs Current Characteristics



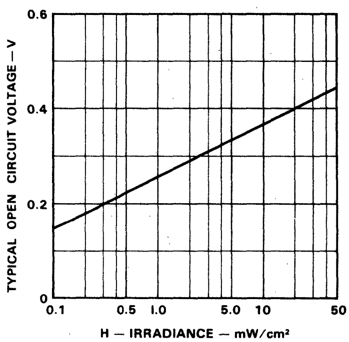
Typical Short Circuit Current vs Irradiation



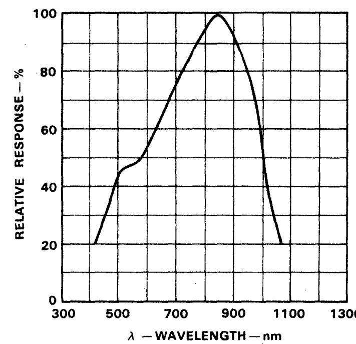
Typical Electrical Characteristic Curves

FPT102

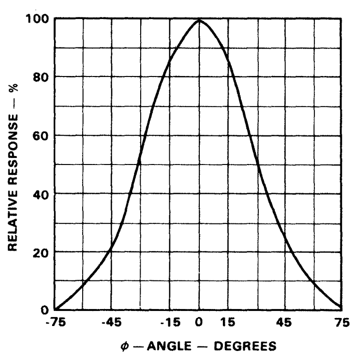
Typical Open Circuit Voltage vs Irradiation



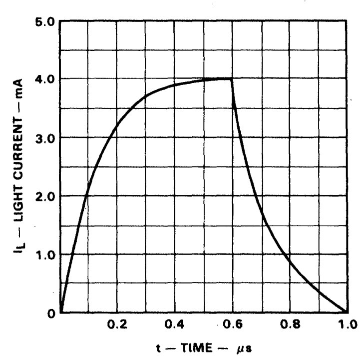
Relative Spectral Response



Typical Photo Current vs Angle of Incidence



Typical Light Current vs Time



High-Sensitivity Silicon Phototransistors

Optoelectronic Products

FPT120/A/B/C FPT130/A/B

General Description
The FPT120/A/B/C and FPT130/A/B are silicon nitride protected npn Planar phototransistors with exceptionally stable characteristics and high illumination-sensitivity. The case is made of a special plastic compound with transparent resin encapsulation. The controlled sensitivities offered in the A, B and C versions give the circuit designer increased flexibility.

High Illumination Sensitivity
Availability Of Base Pins For Flexible Circuit Design

Absolute Maximum Ratings

Maximum Temperature and Humidity

Storage Temperature	−55°C to +100°C
Operating Temperature	−55°C to +85°C
Pin Temperature (Soldering, 5 s)	260°C
Relative Humidity at 65°C	85%

Maximum Power Dissipation (Note 1)

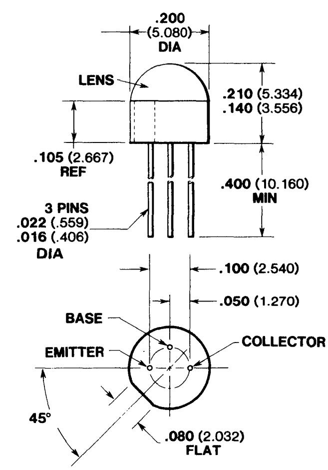
Total Dissipation at T_C = 25°C	200 mW
Derate Linearly from 25°C	3.33 mW/°C
Total Dissipation at T_A = 25°C	100 mW
Derate Linearly from 25°C	1.67 mW/°C

Maximum Voltage and Currents

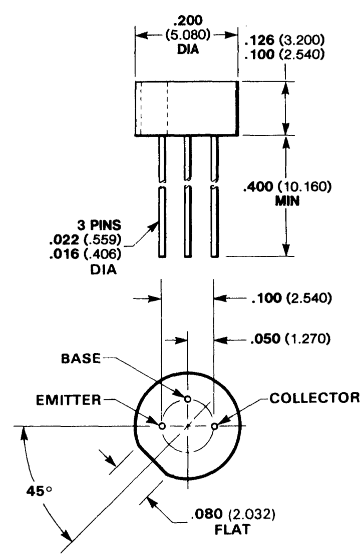
$V_{CE(sus)}$	Collector-to-Emitter Sustaining Voltage (Note 4)	20 V
I_C	Collector Current	25 mA

Package Outlines
FPT120/A/B/C

PHYSICAL DIMENSIONS



FPT130/A/B



Notes
All dimensions in inches **bold** and millimeters (parentheses)
Tolerance unless specified = ±**.015** (±.381)

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Typical Electrical Characteristics

FPT120/A/B/C FPT130/A/B

Electrical Characteristics $T_A = 25°C$

Symbol	Characteristic	Min	Typ	Max	Units	Test Conditions
$V_{CEO(sus)}$	Collector-to-Emitter Sustaining Voltage (Note 4)	20	50		V	$I_C = 1$ mA (Pulsed)
BV_{ECO}	Emitter-to-Collector Breakdown Voltage (Note 4)		5.0		V	$I_{EC} = 100\ \mu A$
$V_{CE(sat)}$	Collector-to-Emitter Saturation Voltage, Tungsten Source (Note 2)		0.25	0.55	V	$I_C = 1$ mA, $H = 20\ mW/cm^2$
I_{CEO}	Collector Dark Current (Note 4)		10	100	nA	$V_{CE} = 5.0$ V
$I_{CE(lt)}$	Photo Current, Tungsten Source (Note 2)				mA	$V_{CE} = 5.0$ V, $H = 5\ mW/cm^2$
	FPT120	2.0	7.5			
	FPT120A (Note 6)	7.5		22.5		
	FPT120B (Note 6)	10		20		
	FPT120C (Note 6)	16		25		
	FPT130	2.0	4.5			
	FPT130A (Note 7)	4.5		13.5		
	FPT130B (Note 7)	6.0		12		
$I_{CE(lt)}$	Photo Current, GaAs Source (Note 3)				mA	$V_{CE} = 5.0$ V, $H = 1\ mW/cm^2$
	FPT120	0.7	4.5			
	FPT130	0.7	2.7			
t_r	Light Current Rise Time (Note 5)		18		μs	
t_f	Light Current Fall Time (Note 5)		18		μs	

Notes

1. These are steady-state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
2. Measured at noted irradiance as emitted from a tungsten filament lamp at a color temperature of 2854°K. The effective photosensitive area is typically 1.25 mm^2 (FPT120A/B) and 0.78 mm^2 (FPT130A/B).
3. These are values obtained at noted irradiance as emitted from a GaAs source at 900 nm.
4. Measured with radiation flux intensity of less than 0.1 $\mu W/cm^2$ over the spectrum from 100-1500 nm.
5. Rise time is defined as the time required for I_{CE} to rise from 10% to 90% of peak value. Fall time is defined as the time required for I_{CE} to decrease from 90% to 10% of peak value. Test conditions are: $V_{CE} = 5.0$ V, $I_{CC} = 4.0$ mA, $R_L = 100\ \Omega$, GaAs source.
6. Same electrical characteristics as FPT120 except for $I_{CE(lt)}$.
7. Same electrical characteristics as FPT130 except for $I_{CE(lt)}$.

Typical Electrical Characteristic Curves

FPT120/A/B/C FPT130/A/B

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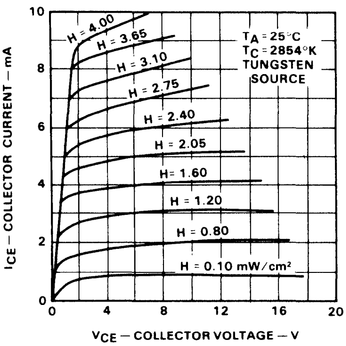
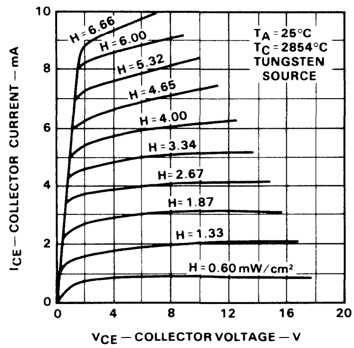
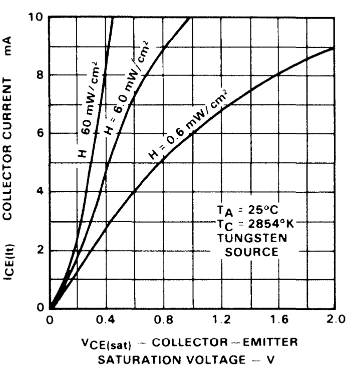
FPT120/A/B/C Collector Current vs Collector Voltage



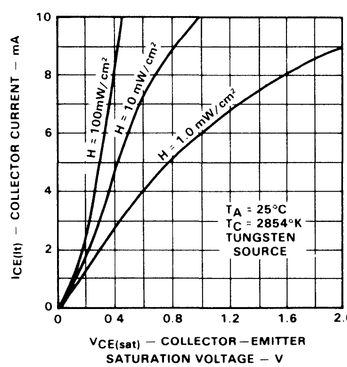
FPT130/A/B/C Collector Current vs Collector Voltage



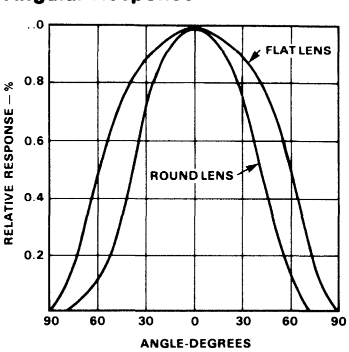
Collector-Emitter Saturation Voltage vs Collector Current



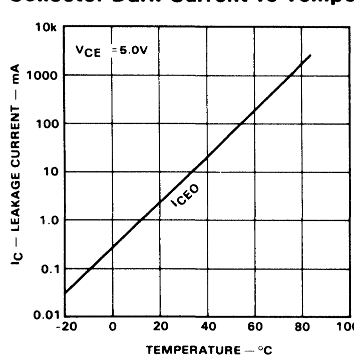
Collector-Emitter Saturation Voltage vs Collector Current



Angular Response



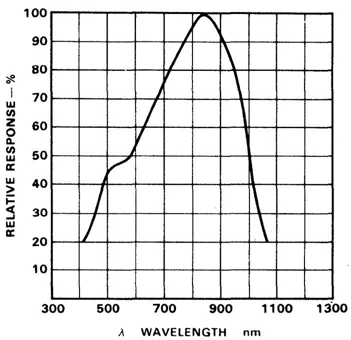
Collector Dark Current vs Temperature



Typical Electrical Characteristic Curves (Cont'd)

FPT120/A/B/C FPT130/A/B

Relative Spectral Response



Rise And Fall Time vs Collector Current

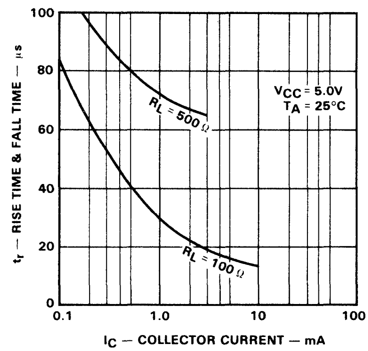
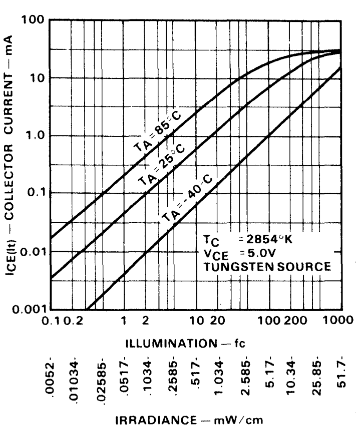
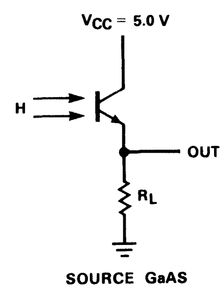


Photo Current Characteristics



Switching Time Measurement Circuit



General-Purpose Silicon Phototransistors

Optoelectronic Products

FPT131
FPT136

General Description
The FPT131 and FPT136 are 3-terminal npn Planar phototransistors with exceptionally stable characteristics and high illumination sensitivity. The availability of the base pins gives wide latitude for flexible circuit design. The case is a special plastic compound with transparent resin encapsulation that exhibits stable characteristics under high humidity conditions.

High Illumination Sensitivity
Availability Of Base Pins For Flexible Circuit Design
Low Cost

Absolute Maximum Ratings

Maximum Temperature and Humidity

Storage Temperature	−55°C to +100°C
Operating Temperature	−55°C to +85°C
Pin Temperature (Soldering, 10 s)	260°C
Relative Humidity at 65°C	85%

Maximum Power Dissipation (Note 1)

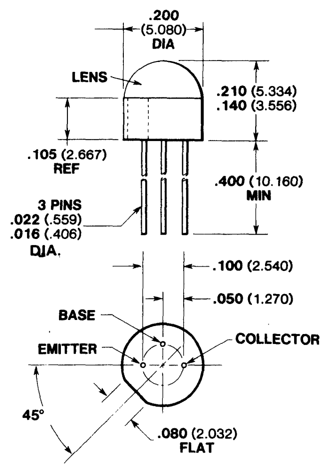
Total Dissipation at $T_C = 25°C$	200 mW
Derate Linearly from 25°C	3.33 mW/°C
Total Dissipation at $T_A = 25°C$	100 mW
Derate Linearly from 25°C	1.67 mW/°C

Maximum Voltages and Current (Note 4)

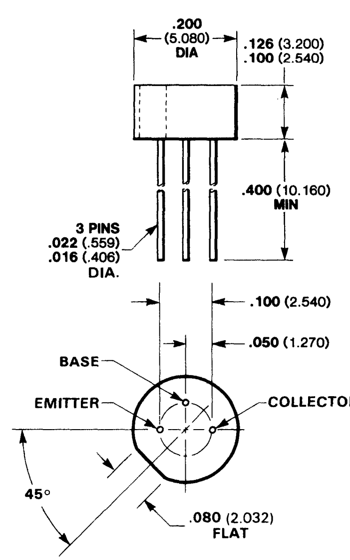
V_{CB}	Collector-to-Base Voltage	20 V
$V_{CE(sus)}$	Collector-to-Emitter Sustaining Voltage (Note 4)	15 V
I_C	Collector Current	25 mA

Package Outlines

FPT131



FPT136



Notes
All dimensions in inches **bold** and millimeters (parentheses)
Tolerance unless specified = ±**.015** (±.381)

Typical Electrical Characteristics

FPT131
FPT136

Electrical Characteristics $T_A = 25°C$

Symbol	Characteristic	Min	Typ	Max	Units	Test Conditions
$V_{CEO(sus)}$	Collector-to-Emitter Sustaining Voltage (Note 4)	15	50		V	$I_C = 1.0$ mA (Pulsed)
BV_{CBO}	Collector-to-Base Breakdown Voltage (Note 4)	20	120		V	$I_C = 100\ \mu A$
BV_{ECO}	Emitter-to-Collector Breakdown Voltage (Note 4)		7.0		V	$I_{EC} = 100\ \mu A$
$V_{CE(sat)}$	Collector-to-Emitter Saturation Voltage		0.16	0.7	V	$I_C = 500\ \mu A$ $H = 20$ mW/cm^2
I_{CEO}	Collector Dark Current (Note 4)		10	500	nA	$V_{CE} = 5.0$ V
I_{CBO}	Collector Dark Current (Note 4)		0.25		nA	$V_{CB} = 10$ V
$I_{CE(lt)}$	Photo Current, Tungsten (Notes 2 and 6)					
	FPT131	0.1	1.4		mA	$V_{CE} = 5.0$ V
	FPT136	0.1	0.88			$H = 5.0$ mW/cm^2
$I_{CE(lt)}$	Photo Current, GaAs (Notes 3 and 6)					
	FPT131	0.2	4.2		mA	$V_{CE} = 5.0$ V
	FPT136	0.2	2.7			$H = 5.0$ mW/cm^2
t_r	Light Current Rise Time (Note 5)		2.8		μs	
t_f	Light Current Fall Time (Note 5)		2.8		μs	
R_{CB}	Responsivity, Tungsten (Notes 2 and 7)					
	FPT131		1.6		μA/	$V_{CB} = 10$ V
	FPT136		1.0		mW/cm^2	
R_{CB}	Responsivity, GaAs (Notes 3 and 7)					
	FPT131		4.8		μA/	$V_{CB} = 20$ V
	FPT136		3.0		mW/cm^2	

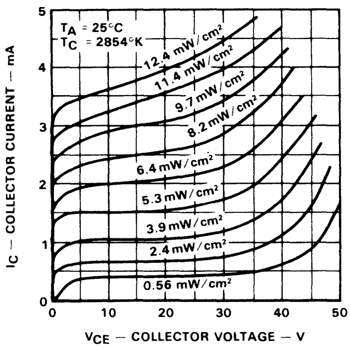
Notes

1. These are steady-state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
2. Measured at noted irradiance as emitted from a tungsten filament lamp at a color temperature of 2854°K. The effective photosensitive area is typically 1.25 mm^2 (FPT131) and 0.78 mm^2 (FPT136).
3. These are values obtained at noted irradiance as emitted from a GaAs source at 900 nm.
4. Measured with radiation flux intensity of less than 0.1 μW/cm^2 over the spectrum from 100-1500 nm.
5. Rise time is defined as the time required for I_{CE} to rise from 10% to 90% of peak value. Fall time is defined as the time required for I_{CE} to decrease from 90% to 10% of peak value. Test conditions are: $I_{CE} = 4.0$ mA, $V_{CE} = 5.0$ V, $R_L = 100\ \Omega$, GaAs source.
6. No electrical connection to base pin.
7. No electrical connection to emitter pin.

Typical Electrical Characteristic Curves

FPT131
FPT136

FPT131 Collector Current vs Collector Voltage



FPT136 Collector Current vs Collector Voltage

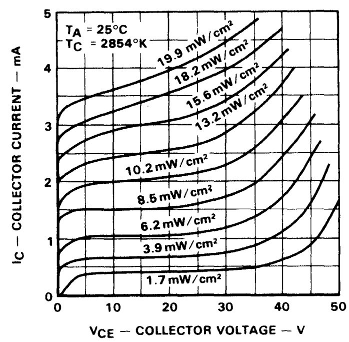
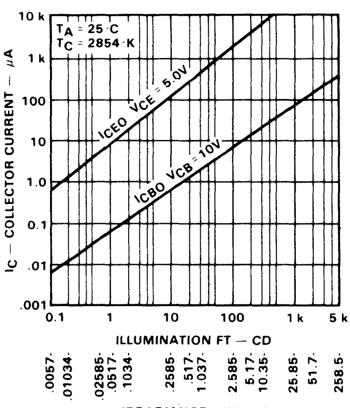
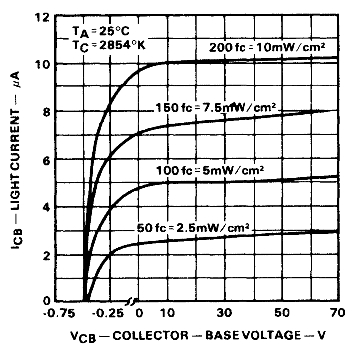


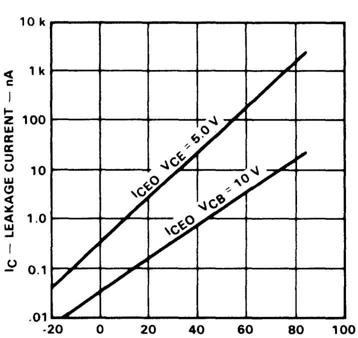
Photo Current Characteristics



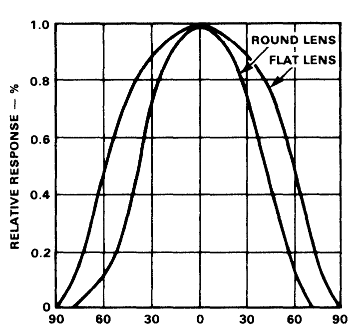
Collector Base Characteristics



Collector Dark Current vs Temperature



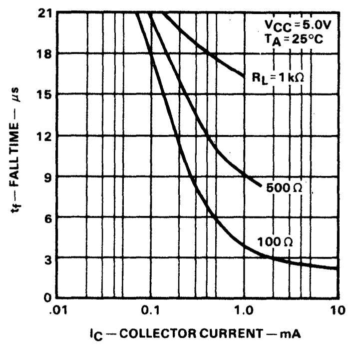
Angular Response



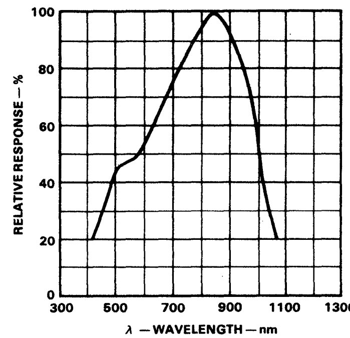
Typical Electrical Characteristic Curves (Cont'd)

FPT131 FPT136

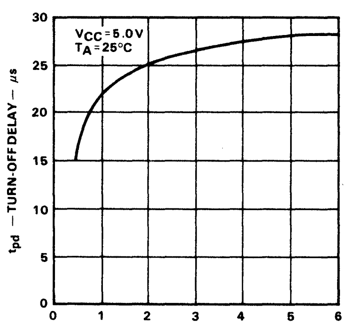
Rise And Fall Time vs Collector Current



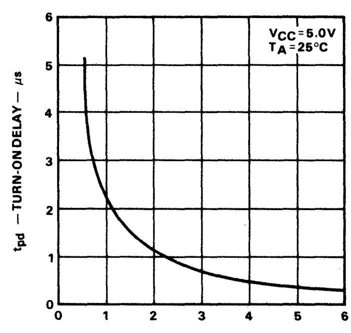
Relative Spectral Response



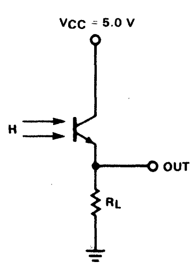
Turn-Off Times For Circuit Shown



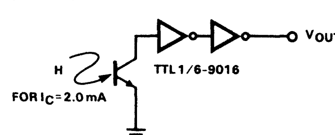
Turn-On Delay Times For Circuit Shown



Switching Circuit For Rise And Fall Times



Circuit For Turn-On And Turn-Off Data



General-Purpose, High-Sensitivity Silicon Phototransistors

Optoelectronic Products

FPT132 FPT137

General Description

The FPT 132 and FPT137 are silicon nitride protected npn Planar phototransistors with exceptionally stable characteristics and high illumination sensitivity. The case is made of a special plastic compound with transparent resin encapsulation that exhibits stable characteristics under high humidity conditions.

High Illumination Sensitivity
Low Cost

Absolute Maximum Ratings

Maximum Temperatures and Humidity

Storage Temperature	−55°C to +100°C
Operating Temperature	−55°C to +85°C
Pin Temperature (Soldering, 5 s)	260°C
Relative Humidity at 65°C	85%

Maximum Power Dissipation (Note 3)

Total Dissipation at T_C = 25°C	200 mW
Derate Linearly from 25°C	3.33 mW/°C
Total Dissipation at T_A = 25°C	100 mW
Derate Linearly from 25°C	1.67 mW/°C

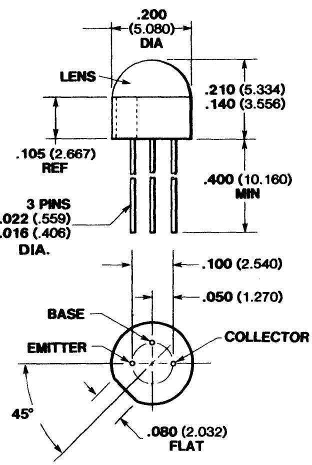
Maximum Voltages and Current (Note 4)

$V_{CEO(sus)}$	Collector-to-Emitter Sustaining Voltage (Note 4)	10 V
I_C	Collector Current	25 mA

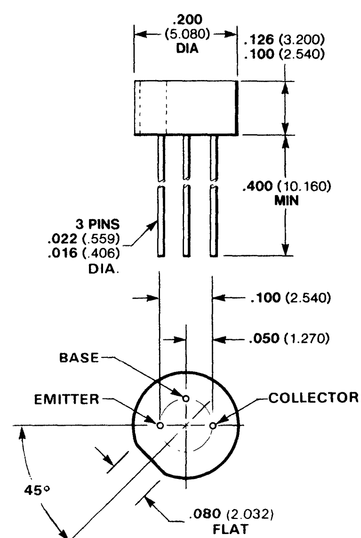
Package Outlines

FPT132

PHYSICAL DIMENSIONS



FPT137



Notes
All dimensions in inches **bold** and millimeters (parentheses)
Tolerance unless specified = ±**.015** (±.381)

Typical Electrical Characteristics

FPT132 FPT137

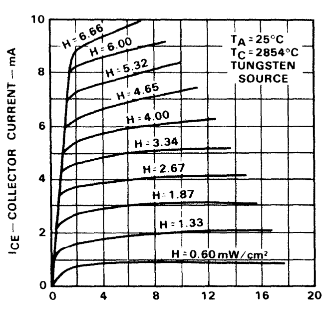
Electrical Characteristics $T_A = 25°C$

Symbol	Characteristic	Min	Typ	Max	Units	Test Conditions
$V_{CEO(sus)}$	Collector-to-Emitter Sustaining Voltage (Note 4)	10	30		V	I_C = 1 mA (Pulsed)
BV_{ECO}	Emitter-to-Collector Breakdown Voltage (Note 4)		3.0		V	I_{EC} = 100 μA
$V_{CE(sat)}$	Collector-to-Emitter Saturation Voltage, Tungsten Source (Note 2)		0.15	0.7	V	I_C = 1 mA, H = 20 mW/cm²
I_{CEO}	Collector Dark Current (Note 4)		10	500	nA	V_{CE} = 5.0 V
$I_{CE(lt)}$	Photo Current, Tungsten Source (Note 2)					
	FPT132	0.2	1.5		mA	V_{CE} = 5.0 V,
	FPT137	0.2	0.9			H = 1 mW/cm²
$I_{CE(lt)}$	Photo Current, Tungsten Source (Note 2)					
	FPT132		7.5		mA	V_{CE} = 5.0 V,
	FPT137		4.5			H = 5 mW/cm²
$I_{CE(lt)}$	Photo Current, GaAs Source (Note 3)					
	FPT132	0.4	4.5		mA	V_{CE} = 5.0 V,
	FPT137	0.4	2.7			H = 1 mW/cm²
t_r	Light Current Rise Time (Note 5)		18		μs	
t_f	Light Current Fall Time (Note 5)		18		μs	

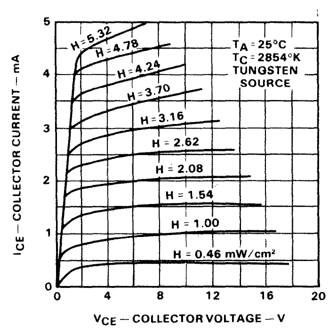
Notes

1. These are steady-state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
2. Measured at noted irradiance as emitted from a tungsten filament lamp at a color temperature of 2854°K. The effective photosensitive area is typically 1.25 mm² (FPT132), and 0.78 mm² (FPT137).
3. These are values obtained at noted irradiance as emitted from a GaAs source at 900 nm.
4. Measured with radiation flux intensity of less than 0.1 μW/cm² over the spectrum from 100-1500 nm.
5. Rise time is defined as the time required for I_{CE} to rise from 10% to 90% of peak value. Fall time is defined as the time required for I_{CE} to decrease from 90% to 10% of peak value. Test conditions are: V_{CE} = 5.0 V, I_{CE} = 4.0 mA, R_L = 100 Ω, GaAs source.

FPT132 Collector Current vs Collector Voltage



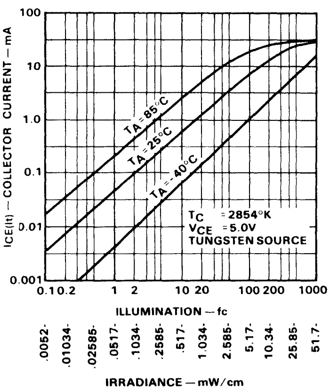
FPT137 Collector Current vs Collector Voltage



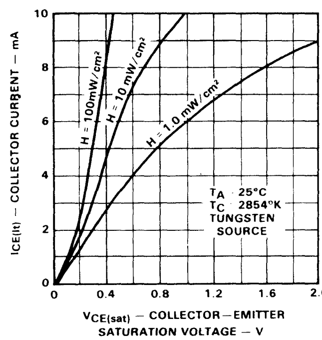
Typical Electrical Characteristic Curves

FPT132
FPT137

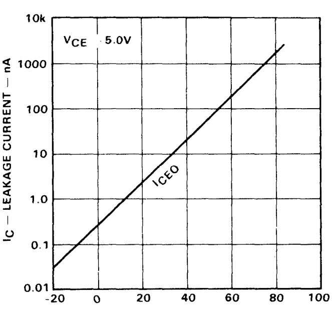
Photo Current Characteristics



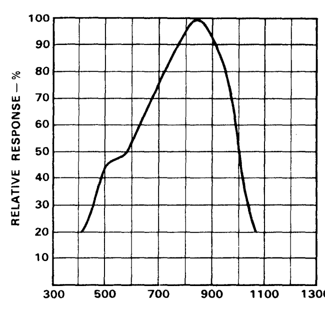
Collector-Emitter Saturation Voltage vs Collector Current



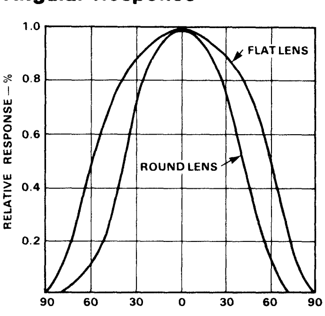
Collector Dark Current vs Temperature



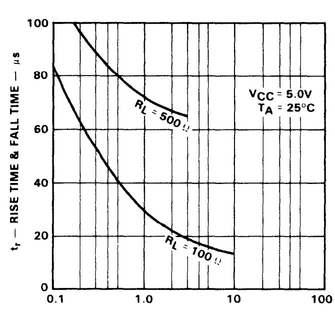
Relative Spectral Response



Angular Response



Rise Time And Fall Time vs Collector Current



4

Very High-Sensitivity Photo Darlingtons

FPT400
FPT410

Optoelectronic Product

General Description
The FPT400 and FPT410 are 3-terminal npn Planar photo-Darlingtons with exceptionally stable characteristics and high illumination sensitivity. The availability of the base pins gives wide latitude for flexible circuit design. The case is a special plastic compound with transparent resin encapsulation that exhibits stable characteristics under high humidity conditions.

Super High Illumination Sensitivity
Exceptionally Stable Characteristics
Excellent For Low Light Level Applications
High Output Current

Absolute Maximum Ratings

Maximum Temperature and Humidity

Storage Temperature	−55°C to +100°C
Operating Temperature	−55°C to +85°C
Relative Humidity at 65°C	85%

Maximum Power Dissipation (Note 7 and 8)

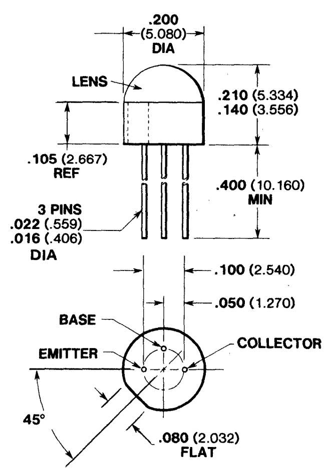
Total Dissipation at $T_C = 25°C$	200 mW
Derate Linearly from 25°C	3.3 mW/°C
Total Dissipation at $T_A = 25°C$	100 mW
Derate Linearly from 25°C	1.67 mW/°C

Maximum Voltages and Currents

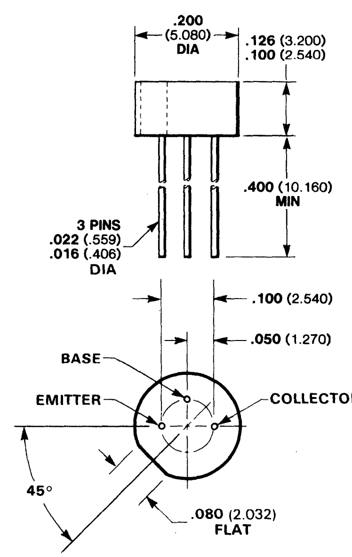
V_{CB}	Collector-to-Base Voltage	30 V
V_{CE}	Collector-to-Emitter Voltage	30 V
I_C	Collector Current	50 mA

Package Outlines
FPT400

PHYSICAL DIMENSIONS



FPT410



Notes
All dimensions in inches **bold** and millimeters (parentheses)
Tolerance unless specified = ±**.015** (0.381)

Typical Electrical Characteristics

FPT400
FPT410

Electrical Characteristics $T_A = 25°C$

Symbol	Characteristic	Min	Typ	Max	Units	Test Conditions
$V_{CEO(sus)}$	Collector-to-Emitter Sustaining Voltage	30	60		V	$I_C = 1.0$ mA (Note 3)
V_{CBO}	Collector-to-Base Voltage	30	60		V	$I_C = 100\ \mu A$ (Note 3)
V_{ECO}	Emitter-to-Collector Voltage		10		V	$I_E = 100\ \mu A$ (Note 3)
$V_{CE(sat)}$	Collector-to-Emitter Saturation Voltage		0.9	1.0	V	$I_C = 5.0$ mA, H = 5.0 mW/cm² (Note 1)
I_{CEO}	Collector Dark Current		10	100	nA	$V_{CE} = 5.0$ V (Note 3)
$I_{CE(lt)}$	Photo Current (Tungsten)					
	FPT400	3.0	7.5		mA	$V_{CE} = 5.0$ V
	FPT410	2.0	5.0		mA	H = 1.0 mW/cm² (Notes 1, 5)
$I_{CE(lt)}$	Photo Current (GaAs)					
	FPT400	6.0	15		mA	$V_{CE} = 5.0$ V,
	FPT410	4.0	10		mA	H = 1.0 mW/cm² (Notes 2, 5)
t_r	Light Current Rise Time		100		μs	(Note 4)
t_f	Light Current Fall Time		100		μs	(Note 4)

Notes

1. Measured at noted irradiance as emitted from a Tungsten filament lamp at a color temperature of 2854°K. The effective photosensitive area is typically 7 mm².
2. These are values obtained at noted irradiance as emitted from a GaAs source at 900 nm.
3. Measured with radiation flux intensity of less than 0.1 μW/cm² over the spectrum from 100-1500 nm.
4. Rise time is defined as the time required for I_{CE} to rise from 10% to 90% of peak value. Fall time is defined as the time required for I_{CE} to decrease from 90% to 10% of peak value. Test conditions are V_{CE} = 10 V, I_{CC} = 10 mA, R_L = 100 Ω GaAs source.
5. No electrical connection to base pin.
6. No electrical connection to emitter pin.
7. These are steady-state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.
8. These ratings give a maximum junction temperature of 85°C and junction-to-case thermal resistance of 300°C/Watt (derating factor of 3.33 mW/°C, and a junction-to-ambient thermal resistance of 600°C/Watt (derating factor of 1.67 mW/°C).

Hermetic TO-18 Silicon Phototransistors

Optoelectronic Products

FPT500, FPT500A FPT520, FPT520A FPT540, FPT540A

General Description

FPT500/FPT520/FPT540 are nitride-passivated npn Planar silicon phototransistors. These devices are packaged in a TO-18 style, hermetically sealed package with lens cap. For most applications two pins are used (collector and emitter pins). The availability of the base pin gives wide latitude for flexible circuit design. Phototransistors can be used as photodiodes (collector-base) which have excellent photo current linearity (for analog applications).

High Illumination Sensitivity
Exceptionally Stable Characteristics
Large Range of Controlled Sensitivities
Hermetic Metal Package
High Operating Temperature

Absolute Maximum Ratings

Maximum Temperature and Humidity

Storage Temperature	−65°C to +200°C
Operating Temperature	−55°C to +150°C
Pin Temperature (Soldering, 5 s)	260°C
Relative Humidity at 65°C	85%

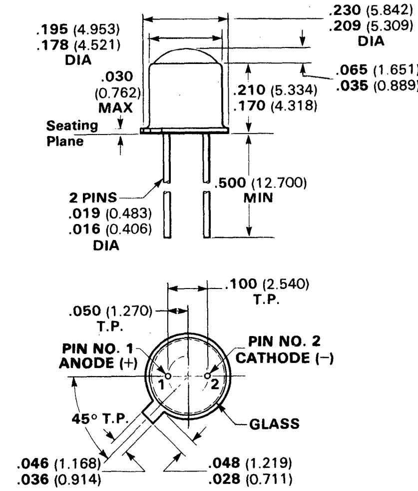
Maximum Power Dissipation

Total Dissipation at T_C = 25°C	600 mW
Derate Linearly from 25°C	4.8 mW/°C
Total Dissipation at T_A = 25°C	300 mW
Derate Linearly from 25°C	2.4 mW/°C

Maximum Voltages and Currents

V_{CB}	Collector-to-Base Voltage	
	FPT500/FPT500A	60 V
	FPT520/FPT520A	50 V
	FPT540/FPT540A	30 V
$V_{CE(sus)}$	Collector-to-Emitter Sustaining Voltage	
	FPT500/FPT500A	45 V
	FPT520/FPT520A	30 V
	FPT540/FPT540A	12 V
I_C	Collector Current	50 mA

Package Outline



Notes

All dimensions in inches **bold** and millimeters (parentheses)
Tolerance unless specified = ±**.015** (±.381)

Typical Electrical Characteristics

FPT500, FPT500A FPT520, FPT520A FPT540, FPT540A

Electrical Characteristics $T_A = 25°C$

Symbol	Characteristic	Min	Typ	Max	Units	Test Conditions
$V_{CEO(sus)}$	Collector-to-Emitter Sustaining Voltage				V	$I_C = 1.0$ mA (Note 3)
	FPT500/FPT500A	45	60			
	FPT520/FPT520A	30	60			
	FPT540/FPT540A	12	30			
V_{CBO}	Collector-to-Base Voltage				V	$I_C = 100\ \mu A$ (Note 3)
	FPT500/FPT500A	60	100			
	FPT520/FPT520A	50	80			
	FPT540/FPT540A	30	50			
V_{EBO}	Emitter-to-Collector Voltage				V	$I_E = 100\ \mu A$ (Note 3)
	FPT500/FPT500A		10			
	FPT520/FPT520A		10			
	FPT540/FPT540A		7.0			
$V_{CE(sat)}$	Collector-to-Emitter Saturation Voltage				V	$I_C = 500\ \mu A$
	FPT500/FPT500A		0.16	0.33		(Note 1)
	FPT520/FPT520A		0.16	0.33		$H = 2.0\ mW/cm^2$
	FPT540/FPT540A		0.25	0.55		$I_C = 1.0$ mA (Note 1) $H = 2.0\ mW/cm^2$
I_{CEO}	Collector Dark Current		10	100	nA	$V_{CE} = 5.0$ V (Note 3)
I_{CBO}	Collector Dark Current		0.25	25	nA	$V_{CB} = 10$ V (Note 3)
$I_{CB(lt)}$	Photo Current		10		μA	$V_{CB} = 5.0$ V (Note 6) $H = 1.0\ mW/cm^2$
θ_{50}	50% Angular Response		15		degrees	
t_r	Light Current Rise Time					
	FPT500/FPT500A		3.0		μs	(Note 4)
	FPT520/FPT520A		8.0			
	FPT540/FPT540A		18			
t_f	Light Current Fall Time					
	FPT500/FPT500A		3.0		μs	(Note 4)
	FPT520/FPT520A		8.0			
	FPT540/FPT540A		18			
$I_{CE(lt)}$	Photo Current (Tungsten)				mA	$V_{CE} = 5.0$ V
	FPT500	1.0	3.0			$H = 1.0\ mW/cm^2$
	FPT500A	2.0		6.0		(Notes 1, 5)
	FPT520	5.0	8.0			
	FPT520A	6.0		18		
	FPT540	8.0	15			
	FPT540A	10		30		
$I_{CE(lt)}$	Photo Current (GaAs)				mA	$V_{CE} = 5.0$ V
	FPT500	3.0	6.0			$H = 1.0\ mW/cm^2$
	FPT520	10	24			(Notes 2, 5)
	FPT540	16	30			

Notes
1. Measured at noted irradiance as emitted from a Tungsten filament lamp at a color temperature of 2854°K. The effective photosensitive area is typically 7 mm².
2. These are values obtained at noted irradiance as emitted from a GaAs source at 900 nm.
3. Measured with radiation flux intensity of less than 0.1 $\mu W/cm^2$ over the spectrum from 100-1500 nm.
4. Rise time is defined as the time required for I_{CE} to rise from 10% to 90% of peak value. Fall time is defined as the time required for I_{CE} to decrease from 90% to 10% of peak value. Test conditions are: $V_{CE} = 10$ V, $I_{CC} = 10$ mA, $R_L = 100\ \Omega$, GaAs source.
5. No electrical connection to base pin.
6. No electrical connection to emitter pin.

Hermetic TO-18 Silicon Phototransistors

Optoelectronic Products

FPT510, FPT510A FPT530, FPT530A FPT550, FPT550A

General Description

FPT510/FPT530/FPT550 are nitride-passivated npn Planar silicon phototransistors. These devices are packaged in a TO-18 style, hermetically sealed package with lens cap. For most applications two pins are used (collector and emitter pins). The availability of the base pin gives wide latitude for flexible circuit design. Phototransistors can be used as photodiodes (collector-base) which have excellent photo current linearity (for analog applications).

High Illumination Sensitivity
Exceptionally Stable Characteristics
Large Range of Sensitivities
Hermetic Metal Package
High Operating Temperature

Absolute Maximum Ratings

Maximum Temperature and Humidity

Storage Temperature	−65°C to +200°C
Operating Temperature	−55°C to +150°C
Pin Temperature (Soldering, 5 s)	260°C
Relative Humidity at 65°C	85%

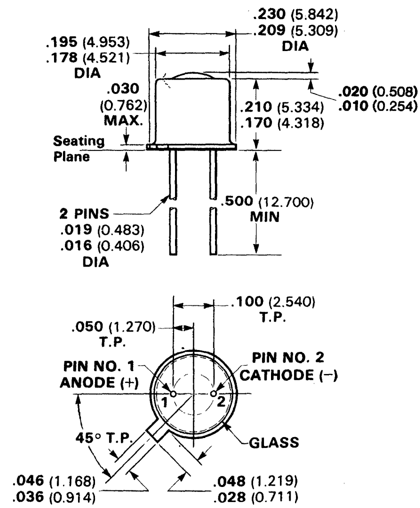
Maximum Power Dissipation

Total Dissipation at T_C = 25°C	600 mW
Derate Linearly from 25°C	4.8 mW/°C
Total Dissipation at T_A = 25°C	300 mW
Derate Linearly from 25°C	2.4 mW/°C

Maximum Voltages and Currents

V_{CB}	Collector-to-Base Voltage	
	FPT510/FPT510A	60 V
	FPT530/FPT530A	50 V
	FPT550/FPT550A	30 V
$V_{CE(sus)}$	Collector-to-Emitter Sustaining Voltage	
	FPT510/FPT510A	45 V
	FPT530/FPT530A	30 V
	FPT550/FPT550A	12 V
I_C	Collector Current	50 mA

Package Outline



Notes
All dimensions in inches **bold** and millimeters (parentheses)
Tolerance unless specified = ±**.015** (±.381)

Typical Electrical Characteristics

FPT510, FPT510A
FPT530, FPT530A
FPT550, FPT550A

Electrical Characteristics $T_A = 25°C$

Symbol	Characteristic	Min	Typ	Max	Units	Test Conditions
$V_{CEO(sus)}$	Collector-to-Emitter Sustaining Voltage				V	$I_C = 1.0$ mA
	FPT510/FPT510A	45	60			(Note 3)
	FPT530/FPT530A	30	60			
	FPT550/FPT550A	12	30			
V_{CBO}	Collector-to-Base Voltage				V	$I_C = 100$ µA
	FPT510/FPT510A	60	100			(Note 3)
	FPT530/FPT530A	50	80			
	FPT550/FPT550A	30	50			
V_{EBO}	Emitter-to-Collector Voltage				V	$I_E = 100$ µA
	FPT510/FPT510A		10			(Note 3)
	FPT530/FPT530A		10			
	FPT550/FPT550A		7.0			
$V_{CE(sat)}$	Collector-to-Emitter Saturation Voltage				V	$I_C = 500$ µA
	FPT510/FPT510A		0.16	0.33		(Note 1)
	FPT530/FPT530A		0.16	0.33		H = 2.0 mW/cm²
	FPT550/FPT550A		0.25	0.55		$I_C = 1.0$ mA
						(Note 1)
						H = 2.0 mW/cm²
I_{CEO}	Collector Dark Current		10	100	nA	$V_{CE} = 5.0$ V
						(Note 3)
I_{CBO}	Collector Dark Current		0.25	25	nA	$V_{CB} = 10$ V
						(Note 3)
$I_{CB(lt)}$	Photo Current		5.0		µA	$V_{CB} = 5.0$ V
						(Note 6)
						H = 5.0 mW/cm²
θ_{50}	50% Angular Response		15		degrees	
t_r	Light Current Rise Time					
	FPT510/FPT510A		3.0		µs	(Note 4)
	FPT530/FPT530A		8.0			
	FPT550/FPT550A		18			
t_f	Light Current Fall Time					
	FPT510/FPT510A		3.0		µs	(Note 4)
	FPT530/FPT530A		8.0			
	FPT550/FPT550A		18			
$I_{CE(lt)}$	Photo Current (Tungsten)				mA	$V_{CE} = 5.0$ V
	FPT510	0.5	1.5			H = 5.0 mW/cm²
	FPT510A	1.0		3.0		(Notes 1, 5)
	FPT530	3.0	5.0			
	FPT530A	4.0		12		
	FPT550	8.0	10			
	FPT550A	8.0		24		
$I_{CE(lt)}$	Photo Current (GaAs)				mA	$V_{CE} = 5.0$ V
	FPT510	1.5	4.5			H = 5.0 mW/cm²
	FPT530	6.0	15			(Notes 2, 5)
	FPT550	16	30			

Notes
1. Measured at noted irradiance as emitted from a Tungsten filament lamp at a color temperature of 2854°K. The effective photosensitive area is typically 7 mm².
2. These are values obtained at noted irradiance as emitted from a GaAs source at 900 nm.
3. Measured with radiation flux intensity of less than 0.1 µW/cm² over the spectrum from 100-1500 nm.
4. Rise time is defined as the time required for I_{CE} to rise from 10% to 90% of peak value. Fall time is defined as the time required for I_{CE} to decrease from 90% to 10% of peak value. Test conditions are: $V_{CE} = 10$ V, $I_{CC} = 10$ mA, $R_L = 100\ \Omega$, GaAs source.
5. No electrical connection to base pin.
6. No electrical connection to emitter pin.

Very High-Sensitivity Photo-Darlingtons

FPT560 FPT570

Optoelectronic Products

General Description

FPT560/FPT570 are nitride passivated silicon photo Darlingtons. Each device is packaged in a TO-18 style, hermetically sealed package with lens cap. For most applications two pins are used (collector and emitter pins). The availability of the base pin gives wide latitude for flexible circuit design.

Super High Illumination Sensitivity
Exceptionally Stable Characteristics
Excellent For Low Light Level Applications
High Output Current

Absolute Maximum Ratings

Maximum Temperature and Humidity

Storage Temperature	−65°C to +200°C
Operating Temperature	−55°C to +150°C
Pin Temperature (Soldering, 5 s)	260°C
Relative Humidity at 65°C	85%

Maximum Power Dissipation

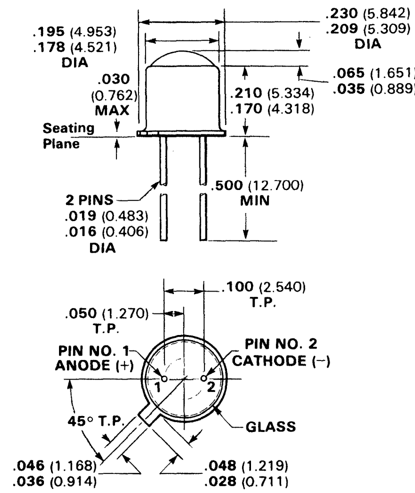
Total Dissipation at $T_C = 25°C$	600 mW
Derate Linearly from 25°C	4.8 mW/°C
Total Dissipation at $T_A = 25°C$	300 mW
Derate Linearly from 25°C	2.4 mW/°C

Maximum Voltages and Currents

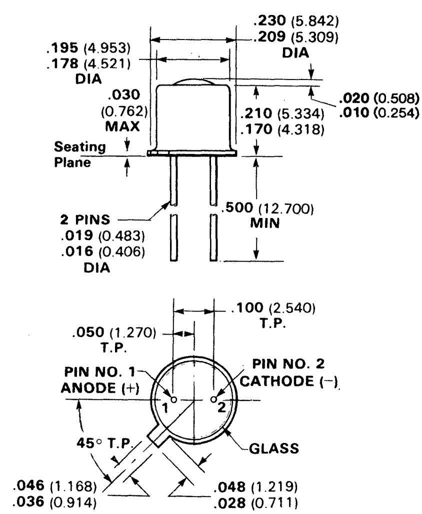
V_{CB}	Collector-to-Base Voltage	30 V
V_{CE}	Collector-to-Emitter Voltage	30 V
I_C	Collector Current	125 mA

Package Outlines

FPT560



FPT570



Notes
All dimensions in inches **bold** and millimeters (parentheses)
Tolerance unless specified = ±**.015** (±.381)

Typical Electrical Characteristics

FPT560 FPT570

Electrical and Radiant Characteristics $T_A = 25°C$

Symbol	Characteristic	Min	Typ	Max	Units	Test Conditions
$V_{CEO(sus)}$	Collector-to-Emitter Sustaining Voltage	30	60		V	$I_C = 1.0$ mA (Note 3)
V_{CBO}	Collector-to-Base Voltage	30	60		V	$I_C = 100$ μA (Note 3)
V_{ECO}	Emitter-to-Collector Voltage		10		V	$I_E = 100$ μA (Note 3)
$V_{CE(sat)}$	Collector-to-Emitter Saturation Voltage		0.9	1.0	V	$I_C = 25$ mA, $H = 2.0$ mW/cm^2 (Note 1)
I_{CEO}	Collector Dark Current		10	100	nA	$V_{CE} = 5.0$ V (Note 3)
$I_{CE(lt)}$	Photo Current (Tungsten)					
	FPT560	10	30		mA	$V_{CE} = 5.0$ V,
	FPT570	1.0	6.0		mA	$H = 1.0$ mW/cm^2 (Notes 1, 5)
$I_{CE(lt)}$	Photo Current (GaAs)					
	FPT560	30	90		mA	$V_{CE} = 5.0$ V,
	FPT570	3.0	18		mA	$H = 1.0$ mW/cm^2 (Notes 2, 5)
θ_{50}	50% Response Angle		15		degrees	
t_r	Light Current Rise Time		100		μs	(Note 4)
t_f	Light Current Fall Time		100		μs	(Note 4)

Notes

1. Measured at noted irradiance as emitted from a Tungsten filament lamp at a color temperature of 2854°K. The effective photosensitive area is typically 7 mm^2.
2. These are values obtained at noted irradiance as emitted from a GaAs source at 900 nm.
3. Measured with radiation flux intensity of less than 0.1 μW/cm^2 over the spectrum from 100-1500 nm.
4. Rise time is defined as the time required for I_{CE} to rise from 10% to 90% of peak value. Fall time is defined as the time required for I_{CE} to decrease from 90% to 10% of peak value. Test conditions are: $V_{CE} = 10$ V, $I_{CC} = 10$ mA, $R_L = 100\ \Omega$, GaAs source.
5. No electrical connection to base pin.
6. No electrical connection to emitter pin.

4

Miniature Ceramic Silicon Phototransistors

FPT610 FPT630

Optoelectronic Products

General Description
The FPT610 and FPT630 are miniature phototransistors with exceptionally stable characteristics. They utilize a ceramic case with transparent resin encapsulation. The spectral response, extending from 400 to 1100 nm, is compatible with daylight, tungsten and gallium arsenide sources.

High Illumination Sensitivity
Exceptionally Stable Characteristics
Can Be Staked On .087-Inch Centers
Miniature—85 × 185 × 95 Mils High

Absolute Maximum Ratings

Maximum Temperature and Humidity

Storage Temperature	−40°C to +100°C
Operating Temperature	−40°C to +100°C
Pin Temperature (Soldering, 5 s)	260°C
Relative Humidity at 65°C	85%

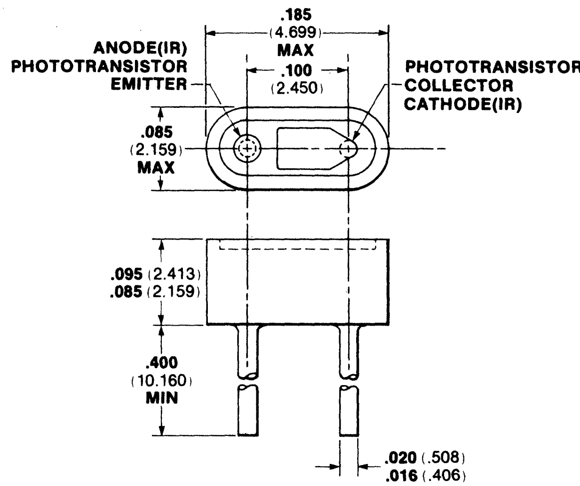
Maximum Power Dissipation

Total Dissipation at T_A = 25°C	100 mW
Derate Linearly from 25°C	1.33 mW/°C

Maximum Voltages and Currents

$V_{CE(sus)}$	Collector-to-Emitter Sustaining Voltage	
	FPT610	30 V
	FPT630	20 V
I_C	Collector Current	50 mA

Package Outline



Notes
All dimensions in inches **bold** and millimeters (parentheses)
Tolerance unless specified = ±**.015** (±.381)

Typical Electrical Characteristics

FPT610
FPT630

Electrical Characteristics $T_A = 25°C$

Symbol	Characteristic	Min	Typ	Max	Units	Test Conditions
$V_{CEO(sus)}$	Collector-to-Emitter Sustaining Voltage (Note 1)					$I_C = 1.0$ mA
	FPT610	30	60		V	
	FPT630	20	40		V	
V_{ECO}	Emitter-to-Collector Voltage (Note 1)		10		V	$I_E = 100\ \mu A$
$V_{CE(sat)}$	Collector-to-Emitter Saturation Voltage (Note 2)		0.16	0.33	V	$I_C = 500\ \mu A$ $H = 20$ mW/cm²
I_{CEO}	Collector Dark Current (Note 1)		10	100	nA	$V_{CE} = 5.0$ V
$I_{CE(lt)}$	Photo Current (Tungsten) (Note 2)					
	FPT610	0.2	1.0		mA	$V_{CE} = 5.0$ V
	FPT630	2.0	5.0			$H = 5.0$ mW/cm²
$I_{CE(lt)}$	Photo Current (GaAs) (Note 3)					
	FPT610	0.4	3.0		mA	$V_{CE} = 5.0$ V
	FPT630	4.0	15			$H = 5.0$ mW/cm²
t_r	Rise Time (Note 4)					
	FPT610		3.0		μs	$I_C = 2.0$ mA,
	FPT630		18			$R_L = 100\ \Omega$
t_f	Fall Time (Note 4)					
	FPT610		3.0		μs	$I_C = 2.0$ mA,
	FPT630		18			$R_L = 100\ \Omega$

Notes
1. Measured with radiation flux intensity of less than 0.1 μW/cm² over the spectrum from 100-1500 nm.
2. Measured at noted irradiance as emitted from a Tungsten filament lamp at a color temperature of 2854°K.
3. These are values obtained at noted irradiance as emitted from a GaAs source at 900 nm.
4. Rise time is defined as the time required for I_{CE} to rise from 10% to 90% of peak value. Fall time is defined as the time required for I_{CE} to decrease from 90% or 10% of peak value. Test conditions are: $I_{CE} = 4.0$ mA, $V_{CE} = 5.0$ V, $R_L = 100\ \Omega$, GaAs source.

Low-Cost, General-Purpose NPN Silicon Phototransistor

FPT700

Optoelectronic Products

General Description

The FPT700 is a low-cost, general-purpose, NPN silicon phototransistor encapsulated in a clear plastic T1 package.

Absolute Maximum Ratings

Maximum Temperature and Humidity

Operating Temperature	−40°C to +85°C
Storage Temperature	−55°C to +100°C
Pin Temperature (Soldering, 5 s)	230°C
Relative Humidity at 85°C	85%

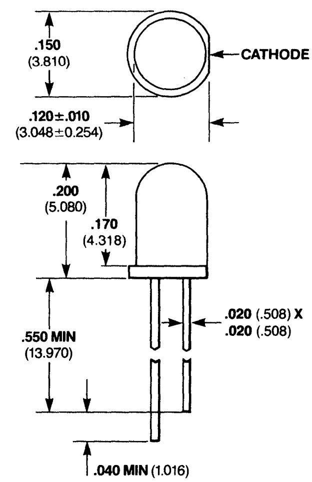
Maximum Power Dissipation

Total Dissipation at $T_A = 25°C$	100 mW
Derate Linearly from 25°C	1.33 mW/°C

Maximum Voltage and Current

$V_{CE(sus)}$	Collector-to-Emitter Sustaining Voltage	15 V
I_C	Collector Current	25 mA

Package Outline



Notes
All dimensions in inches **bold** and millimeters (parentheses)
Tolerance unless specified = ±**.015** (±.381)

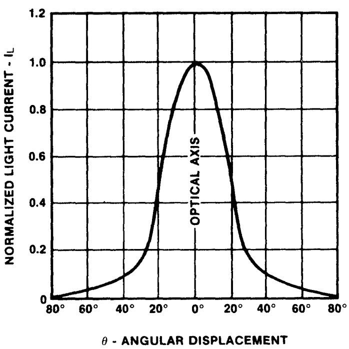
Electrical Characteristics $T_A = 25°C$

Symbol	Characteristic	Min	Typ	Max	Units	Test Conditions
$V_{CEO(sus)}$	Collector-to-Emitter Sustaining Voltage	15	50		V	$I_C = 1.0$ mA (Pulsed)
BV_{ECO}	Emitter-to-Collector Breakdown Voltage		7.0		V	$I_C = 100\ \mu A$
$V_{CE(sat)}$	Collector-to-Emitter Saturation Voltage		0.16	0.7	V	$I_C = 500\ \mu A$, $H = 20$ mW/cm^2
I_{CEO}	Collector Dark Current		10	500	nA	$V_{CE} = 5.0$ V
$I_{CE(lt)}$	Photo Current, Tungsten Source at Color Temperature of 2854°K	0.10	1.0		mA	$V_{CE} = 5.0$ V, $H = 5.0$ mW/cm^2
t_r	Light Rise Time (10% to 90%)		2.8		μs	$I_{CE} = 4.0$ mA, $V_{CE} = 5.0$ V
t_f	Light Fall Time (90% to 10%)		2.8		μs	$R_L = 100\ \Omega$

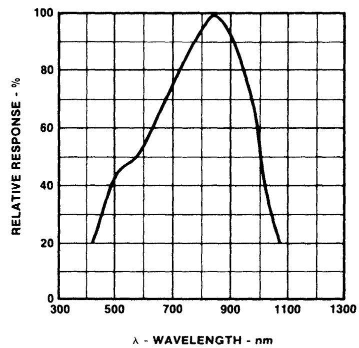
Typical Electrical Characteristic Curves

FPT700

Normalized Light Current vs Angular Displacement



Relative Spectral Response



Low-Cost, General-Purpose Silicon Photodiode

Optoelectronics Group

FPT720

General Description

The FPT720 is a low-cost, general-purpose, silicon photodiode encapsulated in a clear plastic T1 package.

Absolute Maximum Ratings

Maximum Temperature and Humidity

Operating Temperature	−40°C to +85°C
Storage Temperature	−55°C to +100°C
Pin Temperature (Soldering, 5 s)	230°C
Relative Humidity at 85°C	85%

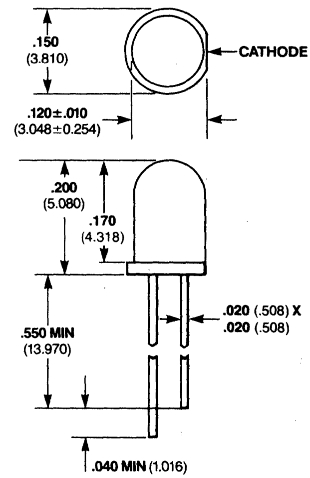
Maximum Power Dissipation

Total Dissipation at $T_A = 25°C$	100 mW
Derate Linearly from 25°C	1.33 mW / °C

Maximum Voltage and Current

V_R Reverse Voltage	50 V

Package Outline



Notes

All dimensions in inches **bold** and millimeters (parentheses)

Tolerance unless specified = ±**.015** (±.381)

Blue Dot on package side differentiates PHOTODIODE from PHOTO EMITTER

Typical Electrical Characteristic

FPT720

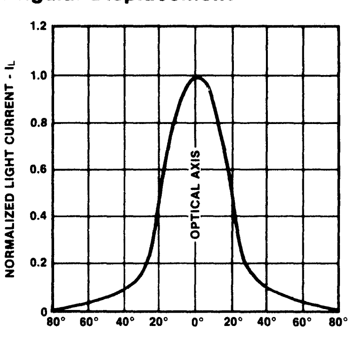
4

Electrical Characteristics $T_A = 25°C$

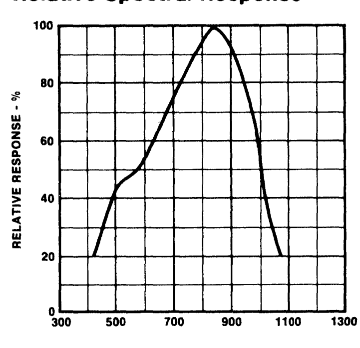
Symbol	Characteristic	Min	Typ	Max	Units	Test Conditions
BV	Breakdown Voltage	50	120		V	$I_R = 10\ \mu A$, $H \leq 0.1\ \mu W/cm^2$
V_{OC}	Open-Circuit Voltage (Note)	380	400		mV	No Bias, $H = 20\ mW/cm^2$
I_R	Dark Current		0.3	35	nA	$V_R = -10\ V$, $H \leq 0.1\ \mu W/cm^2$
I_L	Photo Current (Note)	15	25		μA	$V_R = -10\ V$, $H = 20\ mW/cm^2$
$I_{L(sc)}$	Short-Circuit Current (Note)	15	25		μA	No Bias, $H = 20\ mW/cm^2$
R (Tungsten)	Responsivity (Note)	0.6	1.0		$\mu A/mW/cm^2$	No Bias, $T_C = 2854°K$
R @ 900 nm	Responsivity 900 nm		3.9		$\mu A/mW/cm^2$	No Bias, GaAs
C_O	Open-Circuit Capacitance		60		pF	$V_R = 0\ V$, $H \leq 0.1\ mW/cm^2$
C_R	Reversed Bias Capacitance		20		pF	$V_R = -10\ V$, $H \leq 0.1\ \mu W/cm^2$
R_{max}	Responsivity (Absolute) at Spectral Peak		0.6		A/W	$V_R = 0\ V$, $\lambda = 800\ nm$
NEP	Noise Equivalent Power		1.0×10^{-14}		W	$V_R = -10\ V$, $\lambda = 800\ nm$, $\Delta f = 1.0\ Hz$
D	Detectivity		8.8×10^{12}		$\frac{cm\sqrt{Hz}}{W}$	$V_R = -10\ V$, $\lambda = 800\ nm$, $f = 1.0\ kHz$, $\Delta f = 1.0\ Hz$

Note
Irradiation source is an unfiltered Tungsten Lamp operated at 2854°K color temperature

Normalized Light Current vs Angular Displacement



Relative Spectral Response



P-N GaAs Infrared-Emitting Diode

TIL38

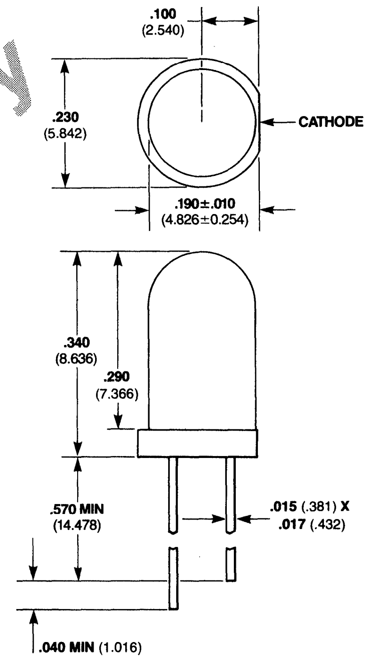
Optoelectronic Products

General Description

The TIL38 is a p-n GaAs infrared-emitting diode in a low-cost plastic T1-¾ package.

Output Spectrally Compatible With Silicon Sensors
High Power Output
High Radiant Intensity

Package Outline



Notes
This device has a gray-tinted plastic body
All dimensions in inches **bold** and millimeters (parentheses)
Tolerance unless specified = ±**.015** (±.381)

Absolute Maximum Ratings

Maximum Temperature

Operating Temperature	−55°C to +100°C
Storage Temperature	−55°C to +100°C
Pin Temperature (Soldering, 3 s)	260°C

Maximum Power Dissipation

Total Dissipation at T_A = 25°C	125 mW
Derate Linearly at 25°C	1.3 mW/°C

Maximum Voltage and Current

V_R	Reverse Voltage	5 V
I_F	Forward dc Current (25°C)	150 mA

Electrical Characteristics T_A = 25°C

Symbol	Characteristic	Min	Typ	Max	Units	Test Conditions
P_O	Radiant Power Output	6	12		mW	I_F = 100 mA
λ_{pk}	Wavelength @ Peak Emission	915	940	975	nm	I_F = 100 mA
$\Delta\lambda$	Spectral Bandwidth Between Half-Power Points		50	75	nm	I_F = 100 mA
θ_{HI}	Emission Beam Angle Between Half Intensity		60		degree	I_F = 100 mA
C	Capacitance		25		pF	V_F = 0, f = 1 MHz
t_r	Radiant Rise Time		600		ns	I_{FM} = 20 mA, t_w = 2 μs
t_f	Radiant Fall Time		350		ns	f = 45 kHz
V_F	Forward Voltage		2.55		V	I_F = 1 A

Silicon Photodiode

TIL100

Optoelectronic Products

General Description

The TIL100 is a high-speed PIN photodiode operating in a reverse-bias mode. It is spectrally matched with the TIL38 emitter. This photodiode was designed for infrared remote-control system.

Low Capacitance
High Photosensitivity With Fast Response

Absolute Maximum Ratings

Maximum Temperature

Operating Temperature	−25°C to +100°C
Storage Temperature	−25°C to +100°C
Pin Temperature (Soldering, 3 s)	260°C

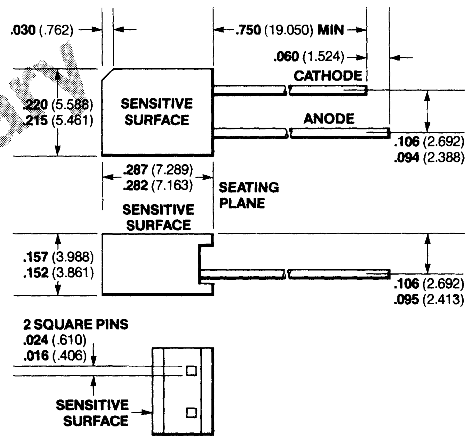
Maximum Power Dissipation

Total Dissipation at T_A = 25°C	150 mW
Derate Linearly at 25°C	2 mW / °C

Maximum Voltage

BV Breakdown Voltage	30 V

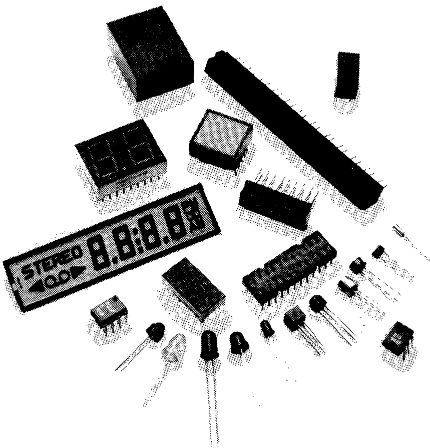
Package Outline



Notes
All dimensions in inches **bold** and millimeters (parentheses)
Tolerance unless specified = ±**.015** (±.381)

Electrical Characteristics T_A = 25°C

Symbol	Characteristic	Min	Typ	Max	Units	Test Conditions
C_T	Total Capacitance		35	50	pF	V_R = 3 V, H = 0, f = 1 MHz
t_r	Rise Time			100	ns	V_R = 10 V, R_L = 1 kΩ
t_f	Fall Time			100	ns	V_R = 10 V, R_L = 1 kΩ
I_L	Light Current		10		μA	V_R = 10 V, H = 250 W / cm² at 940 nm
I_D	Dark Current			50	nA	V_R = 10 V, H = 0


STEREO

Optically-Coupled Isolator

Optoelectronic Products

FCD810/A/B/C/D

General Description

The FCD810 series of optoisolators combines a GaAs infrared-emitting diode and a silicon npn phototransistor in close proximity. Optical intercoupling provides a high degree of ac and dc isolation. A capability for continuous operation of the input diode results in a frequency response extending to dc. Connection to the transistor base is also provided for design flexibility.

Glassolated™
1500 V To 6000 V Minimum Isolation Input-to-Output
10^{11} Ω Isolation Resistance
Low Coupling Capacitance—Typically 1.0 pF

Absolute Maximum Ratings

Storage Temperature	−55°C to +150°C
Operating Temperature	−55°C to +100°C
Pin Temperature (Soldering, 5 s)	260°C
Total Package Power Dissipation at T_A = 25°C (LED plus Detector)	250 mW
Derate Linearly from 25°C	3.3 mW/°C

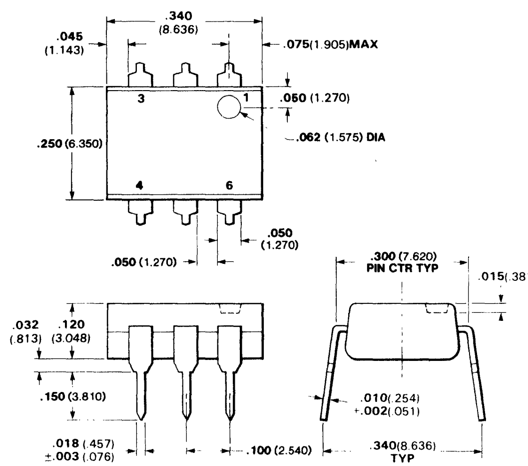
Input Diode

V_R	Reverse Voltage	3.0 V
I_F	Forward dc Current	60 mA
I_{pk}	Peak Forward Current at 1 μs pulse width, 300 pps	3.0 A
P_D	Power Dissipation at T_A = 25°C	100 mW
	Derate Linearly from 25°C	1.33 mW/°C

Output Transistor

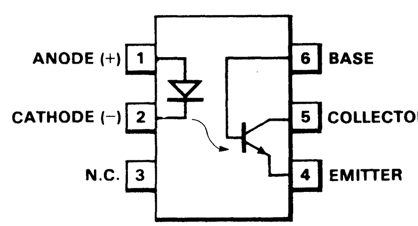
V_{CE}	Collector-to-Emitter Voltage	20 V
V_{CB}	Collector-to-Base Voltage	50 V
I_C	Collector Current	25 mA
P_D	Power Dissipation at T_A = 25°C	150 mW
	Derate Linearly from 25°C	2.0 mW/°C

Package Outline



Notes
All dimensions in inches **bold** and millimeters (parentheses)
Tolerance unless specified = ±.015 (±.381)

Connection Diagram DIP (Top View)



Pin		
1	Anode (+)	Input Diode
2	Cathode (−)	Input Diode
3	NC	
4	Emitter	Output npn Phototransistor
5	Collector	Output npn Phototransistor
6	Base	Output npn Phototransistor

Typical Electrical Characteristics

FCD810/A/B/C/D

Electrical Characteristics—Input Diode $T_A = 25°C$

Symbol	Characteristic	Min	Typ	Max	Units	Test Conditions
V_F	Forward Voltage		1.2	1.5	V	$I_F = 10$ mA
BV_R	Reverse Breakdown Voltage	3.0	8.0		V	$I_R = 1.0$ mA

Electrical Characteristics—Output Transistor $T_A = 25°C$

Symbol	Characteristic	Min	Typ	Max	Units	Test Conditions
V_{CEO}	Collector-to-Emitter Voltage	20	50		V	$I_C = 1.0$ mA, $I_F = 0$
V_{CBO}	Collector-to-Base Voltage	50			V	$I_C = 100$ μA, $I_F = 0$
I_{CEO}	Collector-to-Emitter Leakage Current			100	nA	$V_{CE} = 10$ V, $I_F = 0$
I_{CBO}	Collector-to-Base Leakage Current			100	nA	$V_{CB} = 10$ V, $I_F = 0$
h_{FE}	Forward Current Gain	50	250			$V_{CE} = 5.0$ V, $I_C = 100$ μA
C_{cb}	Collector-to-Base Capacitance		20		pF	$V_{CB} = 10$ V
C_{eb}	Emitter-to-Base Capacitance		10		pF	$V_{EB} = 0$

Electrical Characteristics—Coupled $T_A = 25°C$

Symbol	Characteristic	Min	Typ	Max	Units	Test Conditions
V_{IO}	Input-to-Output Voltage					
	FCD810	1500			V_{rms}	
	FCD810A	1500			V_{pk}	
	FCD810B	2500			V_{pk}	
	FCD810C	5000			V_{pk}	
	FCD810D	6000			V_{pk}	
$V_{CE(sat)}$	Collector-to-Emitter Saturation Voltage		0.3	0.7	V	$I_C = 2.6$ mA, $I_F = 50$ mA
I_C/I_F(CTR)	Collector Current Transfer Ratio (Note 1)	10	25		%	$V_{CE} = 10$ V, $I_F = 10$ mA
R_{IO}	Input-to-Output Resistance	10^{11}			Ω	$V_{IO} = 500$ V
C_{IO}	Input-to-Output Capacitance		1.0		pF	f = 1.0 MHz
t_r, t_f	Collector Rise and Fall Times (Note 2)		4.0		μs	$I_C = 2.0$ mA, $V_{CE} = 10$ V, $R_L = 100$ Ω

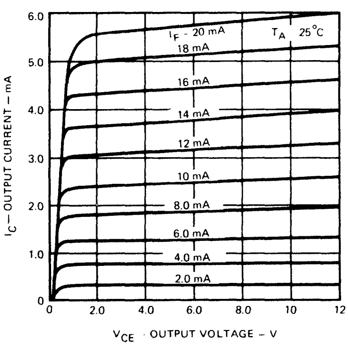
Notes

1. Collector current transfer ratio is defined as the ratio of the collector current to the forward bias input current.
2. Rise time is defined as the time for the collector current to rise from 10% to 90% of peak value. Fall time is defined as the time required for the current to decrease from 90% to 10% of peak value.

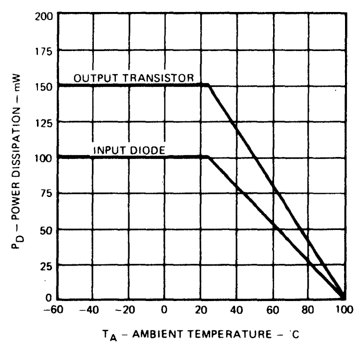
Typical Electrical Characteristic Curves

FCD810/A/B/C/D

Low Level Transfer Characteristics



Maximum Power Dissipation Rating vs Ambient Temperature



Optically-Coupled Isolator

Optoelectronic Products

FCD820/A/B/C/D

General Description

The FCD820 series of optoisolators combines a GaAs infrared-emitting diode and a silicon npn phototransistor in close proximity. Optical intercoupling provides a high degree of ac and dc isolation. A capability for continuous operation of the input diode results in a frequency response extending to dc. Connection to the transistor base is also provided for design flexibility. The FCD820 is covered under UL component recognition program, reference file E55299.

Glassolated™
High Current Transfer Ratio—Typically 50%
1500 V To 6000 V Minimum Isolation Input-To-Output
10^{11} Ω Isolation Resistance
Low Coupling Capacitance—Typically 1.0 pF

Absolute Maximum Ratings

Maximum Temperature and Humidity

Storage Temperature	−55°C to +150°C
Operating Temperature	−55°C to +100°C
Pin Temperature (Soldering, 5s)	260°C
Total Package Power Dissipation at T_A = 25°C (LED plus Detector)	250 mW
Derate Linearly from 25°C	3.3 mW/°C

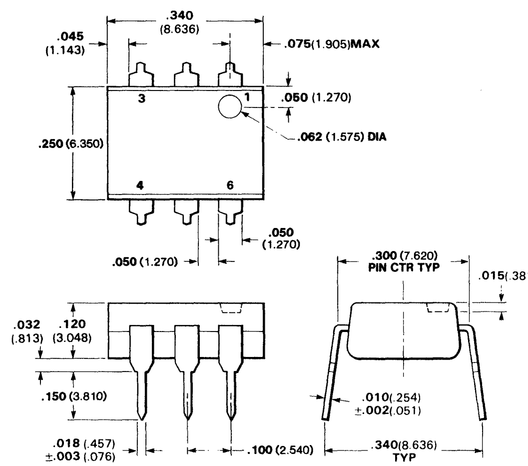
Input Diode

V_R	Reverse Voltage	3.0 V
I_F	Forward dc Current	60 mA
I_{pk}	Peak Forward Current (1 μs pulse width, 300 pps)	3.0 A
P_D	Power Dissipation at T_A = 25°C	100 mW
	Derate Linearly from 25°C	1.33 mW/°C

Output Transistor

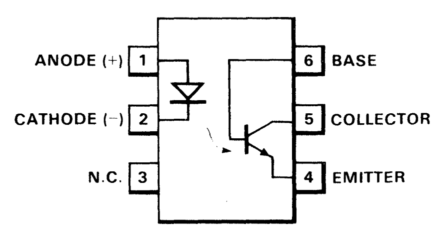
V_{CE}	Collector to Emitter Voltage	30 V
V_{CB}	Collector to Base Voltage	70 V
I_C	Collector Current	25 mA
P_D	Power Dissipation at T_A = 25°C	150 mW
	Derate Linearly from 25°C	2.0 mW/°C

Package Outline



Notes
All dimensions in inches **bold** and millimeters (parentheses).
Tolerance unless specified = ±**.015** (0.381)

Connection Diagram
DIP (Top View)



Pin		
1	Anode (+)	Input Diode
2	Cathode (−)	
3	NC	
4	Emitter	Output npn Phototransistor
5	Collector	
6	Base	

Typical Electrical Characteristics

FCD820/A/B/C/D

Electrical Characteristics—Input Diode $T_A = 25°C$

Symbol	Characteristic	Min	Typ	Max	Units	Test Conditions
V_F	Forward Voltage		1.2	1.5	V	$I_F = 60$ mA
BV_R	Reverse Breakdown Voltage	3.0	8.0		V	$I_R = 10\ \mu A$

Electrical Characteristics—Output Transistor $T_A = 25°C$

Symbol	Characteristic	Min	Typ	Max	Units	Test Conditions
V_{CEO}	Collector-to-Emitter Voltage	30	65		V	$I_C = 1.0$ mA, $I_F = 0$
V_{CBO}	Collector-to-Base Voltage	70	165		V	$I_C = 100\ \mu A$, $I_F = 0$
I_{CEO}	Collector-to-Emitter Leakage Current			50	nA	$V_{CE} = 10$ V, $I_F = 0$
I_{CBO}	Collector-to-Base Leakage Current			20	nA	$V_{CB} = 10$ V, $I_F = 0$
h_{FE}	Forward Current Gain	100	250			$V_{CE} = 5.0$ V, $I_C = 100\ \mu A$
C_{cb}	Collector-to-Base Capacitance		20		pF	$V_{CB} = 10$ V
C_{eb}	Emitter-to-Base Capacitance		10		pF	$V_{EB} = 0$

Electrical Characteristics—Coupled $T_A = 25°C$

Symbol	Characteristic	Min	Typ	Max	Units	Test Conditions
V_{IO}	Input-to-Output Voltage					
	FCD820	1500			V_{rms}	
	FCD820A	1500			V_{pk}	
	FCD820B	2500			V_{pk}	
	FCD820C	5000			V_{pk}	
	FCD820D	6000			V_{pk}	
$V_{CE(sat)}$	Collector-to-Emitter Saturation Voltage		0.24	0.40	V	$I_C = 2.2$ mA, $I_F = 15$ mA (FCD820, $I_C = 2.0$ mA, $I_F = 10$ mA)
I_C/I_F(CTR)	Collector Current Transfer Ratio (Note 1)	20	50		%	$V_{CE} = 10$ V, $I_F = 10$ mA (FCD820, $V_{CE} = 0.4$ V)
R_{IO}	Input-to-Output Resistance	10^{11}			Ω	$V_{IO} = 500$ V
C_{IO}	Input-to-Output Capacitance		1.0		pF	f = 1.0 MHz
t_r, t_f	Collector Rise and Fall Times (Note 2)		2.5		μs	$I_C = 2.0$ mA, $V_{CE} = 10$ V, $R_L = 100\ \Omega$

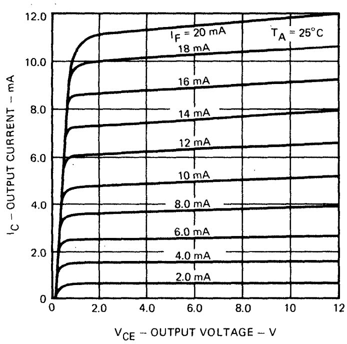
Notes
1. Collector current transfer ratio is defined as the ratio of the collector current to the forward bias input current.
2. Rise time is defined as the time for the collector current to rise from 10% to 90% of peak value. Fall time is defined as the time required for the current to decrease from 90% to 10% of peak value.

5

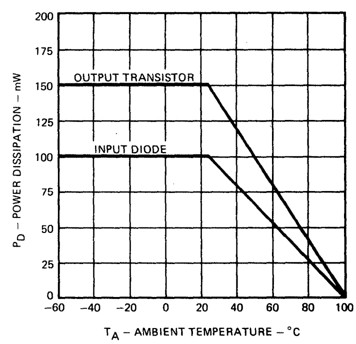
Typical Electrical Characteristic Curves

FCD820/A/B/C/D

Low Level Transfer Characteristics



Maximum Power Dissipation Rating vs Ambient Temperature



Optically-Coupled Isolator

Optoelectronic Products

FCD 825/A/B/C/D

General Description

The FCD825 series of optoisolators have a npn silicon Planar phototransistor and a GaAs diode in close proximity. Optical intercoupling provides a high degree of ac and dc isolation. A capability for continuous operation of the input diode results in a frequency response extending to dc. Connection to the transistor base is also provided for design flexibility.

Glassolated™
High Current Transfer Ratio—Typically 80%
1500 V To 6000 V Minimum Isolation Input-To-Output
10^{11} Ω Isolation Resistance
Low Coupling Capacitance—Typically 1.0 pF

Absolute Maximum Ratings

Maximum Temperature and Humidity

Storage Temperature	−55°C to +150°C
Operating Temperature	−55°C to +100°C
Pin Temperature (Soldering, 5 s)	260°C
Total Package Power Dissipation at T_A = 25°C (LED plus Detector)	250 mW
Derate Linearly from 25°C	3.3 mW/°C

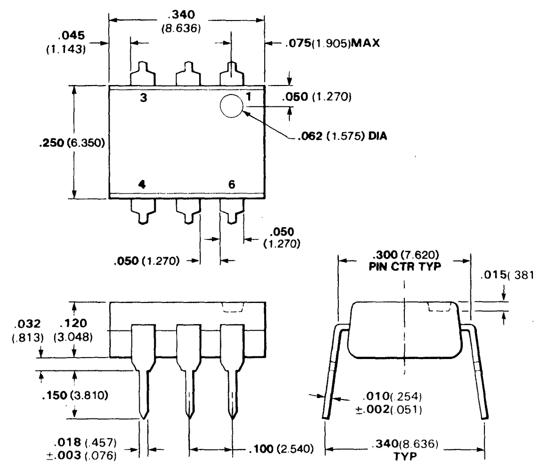
Input Diode

V_R	Reverse Voltage	3.0 V
I_F	Forward dc Current	60 mA
I_{pk}	Peak Forward Current (1 μs pulse width, 300 pps)	3.0 A
P_D	Power Dissipation at T_A = 25°C	100 mW
	Derate Linearly from 25°C	1.33 mW/°C

Output Transistor

V_{CE}	Collector-to-Emitter Voltage	30 V
V_{CB}	Collector-to-Base Voltage	70 V
I_C	Collector Current	25 mA
P_D	Power Dissipation at T_A = 25°C	150 mW
	Derate Linearly from 25°C	2.0 mW/°C

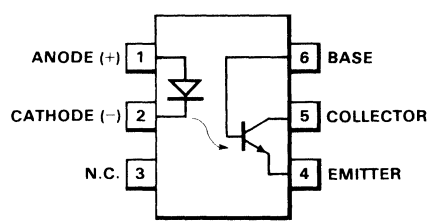
Package Outline



Notes
All dimensions in inches **bold** and millimeters (parentheses).
Tolerance unless specified = ±**.015** (0.381)

Connection Diagram

DIP (Top View)



Pin		
1	Anode (+)	Input Diode
2	Cathode (−)	
3	NC	
4	Emitter	Output npn Phototransistor
5	Collector	
6	Base	

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Typical Electrical Characteristics

FCD825/A/B/C/D

Electrical Characteristics—Input Diode $T_A = 25°C$

Symbol	Characteristic	Min	Typ	Max	Units	Test Conditions
V_F	Forward Voltage		1.3	1.5	V	$I_F = 60$ mA
BV_R	Reverse Breakdown Voltage	3.0	8.0		V	$I_R = 10\ \mu A$

Electrical Characteristics—Output Transistor $T_A = 25°C$

Symbol	Characteristic	Min	Typ	Max	Units	Test Conditions
V_{CEO}	Collector-to-Emitter Voltage	30	50		V	$I_C = 1.0$ mA, $I_F = 0$
V_{CBO}	Collector-to-Base Voltage	70	150		V	$I_C = 10\ \mu A$, $I_F = 0$
I_{CEO}	Collector-to-Emitter Leakage Current		2.0	50	nA	$V_{CE} = 10$ V, $I_F = 0$
I_{CBO}	Collector-to-Base Leakage Current			20	nA	$V_{CB} = 10$ V, $I_F = 0$
h_{FE}	Forward Current Gain	100	350			$V_{CE} = 5.0$ V, $I_C = 100\ \mu A$
C_{cb}	Collector-to-Base Capacitance		20		pF	$V_{CB} = 10$ V
C_{eb}	Emitter-to-Base Capacitance		10		pF	$V_{EB} = 0$

Electrical Characteristics—Coupled $T_A = 25°C$

Symbol	Characteristic	Min	Typ	Max	Units	Test Conditions
V_{IO}	Input-to-Output Voltage					
	FCD825	1500			V_{rms}	
	FCD825A	1500			V_{pk}	
	FCD825B	2500			V_{pk}	
	FCD825C	5000			V_{pk}	
	FCD825D	6000			V_{pk}	
$V_{CE(sat)}$	Collector-to-Emitter Saturation Voltage		0.24	0.4	V	$I_C = 2.0$ mA, $I_F = 10$ mA
I_C/I_F(CTR)	Collector Current Transfer Ratio (Note 1)	50	80		%	$V_{CE} = 10$ V, $I_F = 10$ mA
R_{IO}	Input-to-Output Resistance	10^{11}			Ω	$V_{IO} = 500$ V
C_{IO}	Input-to-Output Capacitance		1.0		pF	f = 1.0 MHz
t_r, t_f	Collector Rise and Fall Times (Note 2)		3.5		μs	$I_C = 2.0$ mA, $V_{CE} = 10$ V, $R_L = 100\ \Omega$

Notes
1. Collector current transfer ratio is defined as the ratio of the collector current to the forward bias input current.
2. Rise time is defined as the time for the collector current to rise from 10% to 90% of peak value. Fall time is defined as the time required for the current to decrease from 90% to 10% of peak value.

Optically-Coupled Isolator

Optoelectronic Products

FCD830/A/B/C/D

General Description

The FCD830 series of optoisolators have a npn silicon Planar phototransistor in close proximity with a GaAs diode. Optical coupling provides a high degree of ac and dc isolation. A capability for continuous operation of the input diode results in a frequency response extending to dc. Connection to the transistor base is also provided for design flexibility.

Glassolated™
High Current Transfer Ratio—Typically 50%
1500 V To 6000 V Minimum Isolation Input-to-Output
10^{11} Isolation Resistance
Low Coupling Capacitance—Typically 1.0 pF
High Speed

Absolute Maximum Ratings

Storage Temperature	−55°C to +150°C
Operating Temperature	−55°C to +100°C
Pin Temperature (Soldering, 5 s)	260°C
Total Package Power Dissipation at T_A = 25°C (LED plus Detector)	250 mW
Derate Linearly from 25°C	3.3 mW/°C

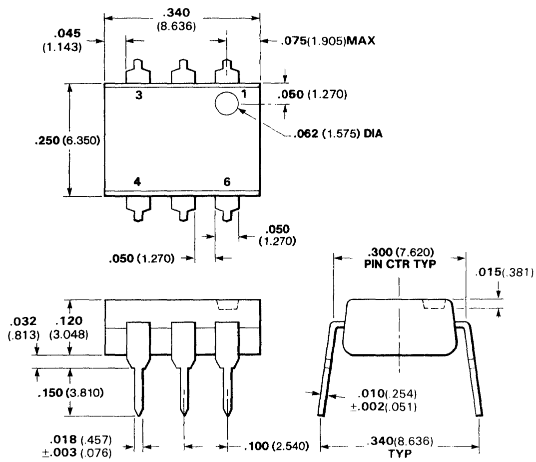
Input Diode

V_R	Reverse Voltage	3.0 V
I_F	Forward dc Current	60 mA
I_{pk}	Peak Forward Current (1 μs pulse width, 300 pps)	3.0 A
P_D	Power Dissipation at T_A = 25°C	100 mW
	Derate Linearly from 25°C	1.33 mW/°C

Output Transistor

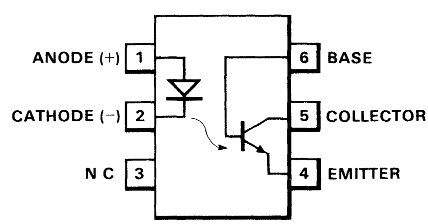
V_{CE}	Collector-to-Emitter Voltage	30 V
V_{CB}	Collector-to-Base Voltage	70 V
I_C	Collector Current	20 mA
P_D	Power Dissipation at T_A = 25°C	150 mW
	Derate Linearly from 25°C	2.6 mW/°C

Package Outline



Notes
All dimensions in inches **bold** and millimeters (parentheses).
Tolerance unless specified = ±**.015** (0.381)

Connection Diagram DIP (Top View)



Pin		
1	Anode (+)	Input Diode
2	Cathode (−)	
3	NC	
4	Emitter	Output npn Phototransistor
5	Collector	
6	Base	

Typical Electrical Characteristics

FCD830/A/B/C/D

Electrical Characteristics—Input Diode $T_A = 25°C$

Symbol	Characteristic	Min	Typ	Max	Units	Test Conditions
V_F	Forward Voltage		1.3	1.5	V	$I_F = 60$ mA
BV_R	Reverse Breakdown Voltage	3.0	8.0		V	$I_R = 10\ \mu A$

Electrical Characteristics—Output Transistor $T_A = 25°C$

Symbol	Characteristic	Min	Typ	Max	Units	Test Conditions
V_{CEO}	Collector-to-Emitter Voltage	30	65		V	$I_C = 1.0$ mA, $I_F = 0$
V_{CBO}	Collector-to-Base Voltage	70	165		V	$I_C = 10\ \mu A$, $I_F = 0$
I_{CEO}	Collector-to-Emitter Leakage Current		2.0	50	nA	$V_{CE} = 10$ V, $I_F = 0$
I_{CBO}	Collector-to-Base Leakage Current		0.1	20	nA	$V_{CB} = 10$ V, $I_F = 0$
h_{FE}	Forward Current Gain	100				$V_{CE} = 5.0$ V, $I_C = 100\ \mu A$
C_{cb}	Collector-to-Base Capacitance		7.5		pF	$V_{CB} = 10$ V
C_{eb}	Emitter-to-Base Capacitance		10		pF	$V_{EB} = 0$

Electrical Characteristics—Coupled $T_A = 25°C$

Symbol	Characteristic	Min	Typ	Max	Units	Test Conditions
V_{IO}	Input-to-Output Voltage					
	FCD830	1500			V_{rms}	
	FCD830A	1500			V_{pk}	
	FCD830B	2500			V_{pk}	
	FCD830C	5000			V_{pk}	
	FCD830D	6000			V_{pk}	
$V_{CE(sat)}$	Collector-to-Emitter Saturation Voltage		0.24	0.40	V	$I_C = 2.2$ mA, $I_F = 15$ mA (FCD830, $I_C = 2.0$ mA, $I_F = 10$ mA)
I_C/I_F (CTR)	Collector Current Transfer Ratio (Note 1)	20	50		%	$V_{CE} = 10$ V, $I_F = 10$ mA (FCD830, $V_{CE} = 0.4$ V)
R_{IO}	Input-to-Output Resistance	10^{11}			Ω	$V_{IO} = 500$ V
C_{IO}	Input-to-Output Capacitance		1.0		pF	f = 1.0 MHz
t_r, t_f	Collector Rise and Fall Times (Note 2)		1.6	2.0	μs	$I_C = 2.0$ mA, $V_{CC} = 10$ V, $R_L = 100\ \Omega$

Notes
1. Collector current transfer ratio is defined as the ratio of the collector current to the forward bias input current.
2. Rise time is defined as the time for the collector current to rise from 10% to 90% of peak value. Fall time is defined as the time required for the current to decrease from 90% to 10% of peak value.

Optically-Coupled Isolator

Optoelectronic Products

FCD831/A/B/C/D

General Description

The FCD831 series of optoisolators combines a GaAs infrared emitting diode and a silicon npn phototransistor in close proximity. Optical intercoupling provides a high degree of ac and dc isolation. A capability for continuous operation of the input diode results in a frequency response extending to dc. Connection to the transistor base is also provided for design flexibility.

Glassolated™
1500 V to 6000 V Minimum Isolation Input-to-Output
10^{11} Ω Isolation Resistance
Low Coupling Capacitance—Typically 1.0 pF
High Speed

Absolute Maximum Ratings

Maximum Temperature and Humidity

Storage Temperature	−55°C to +150°C
Operating Temperature	−55°C to +100°C
Pin Temperature (Soldering, 5 s)	260°C
Total Package Power Dissipation at T_A = 25°C,	
LED plus Detector	250 mW
Derate Linearly from 25°C	3.3 mW/°C

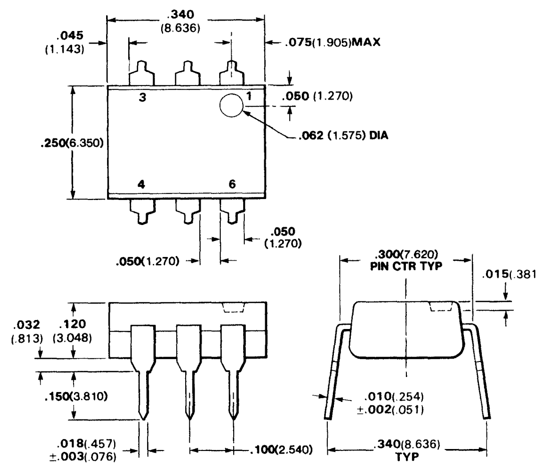
Input Diode

V_R	Reverse Voltage	3.0 V
I_F	Forward dc Current	60 mA
I_{pk}	Peak Forward Current at 1 μs pulse width, 300 pps	3.0 A
P_D	Power Dissipation at T_A = 25°C	100 mW
	Derate Linearly from 25°C	1.33 mW/°C

Output Transistor

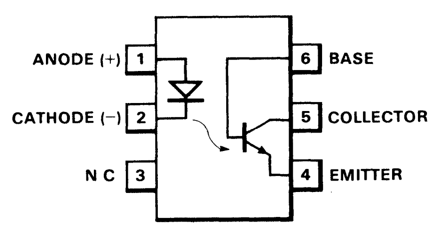
V_{CE}	Collector-to-Emitter Voltage	30 V
V_{CB}	Collector-to-Base Voltage	70 V
I_C	Collector Current	20 mA
P_D	Power Dissiption at T_A = 25°C	150 mW
	Derate Linearly from 25°C	2.0 mW/°C

Package Outline



Notes
All dimensions in inches **bold** and millimeters (parentheses)
Tolerance unless specified = ±**.015** (±.381)

Connection Diagram
DIP (Top View)



Pin		
1	Anode (+)	Input Diode
2	Cathode (−)	
3	NC	
4	Emitter	Output npn Phototransistor
5	Collector	
6	Base	

Typical Electrical Characteristics

FCD831/A/B/C/D

Electrical Characteristics—Input Diode $T_A = 25°C$

Symbol	Characteristic	Min	Typ	Max	Units	Test Conditions
V_F	Forward Voltage		1.3	1.5	V	$I_F = 60$ mA
BV_R	Reverse Breakdown Voltage	3.0	8.0		V	$I_R = 10\ \mu A$

Electrical Characteristics—Output Transistor $T_A = 25°C$

Symbol	Characteristic	Min	Typ	Max	Units	Test Conditions
V_{CEO}	Collector-to-Emitter Voltage	30	65		V	$I_C = 1.0$ mA, $I_F = 0$
V_{CBO}	Collector-to-Base Voltage	70	165		V	$I_C = 10\ \mu A$, $I_F = 0$
I_{CEO}	Collector-to-Emitter Leakage Current		2.0	50	nA	$V_{CE} = 10$ V, $I_F = 0$
I_{CBO}	Collector-to-Base Leakage Current		0.1	20	nA	$V_{CB} = 10$ V, $I_F = 0$
h_{FE}	Forward Current Gain	100	250			$V_{CE} = 5.0$ V, $I_C = 100\ \mu A$
C_{cb}	Collector-to-Base Capacitance		7.5		pF	$V_{CB} = 10$ V
C_{eb}	Emitter-to-Base Capacitance		10		pF	$V_{EB} = 0$

Electrical Characteristics—Coupled $T_A = 25°C$

Symbol	Characteristic	Min	Typ	Max	Units	Test Conditions
V_{IO}	Input-to-Output Voltage					
	FCD831	1500			V_{rms}	
	FCD831A	1500			V_{pk}	
	FCD831B	2500			V_{pk}	
	FCD831C	5000			V_{pk}	
	FCD831D	6000			V_{pk}	
$V_{CE(sat)}$	Collector-to-Emitter Saturation Voltage		0.30	0.5	V	$I_C = 2.0$ mA, $I_F = 50$ mA
I_C/I_F (CTR)	Collector Current Transfer Ratio (Note 1)	10	15		%	$V_{CE} = 10$ V, $I_F = 10$ mA
R_{IO}	Input-to-Output Resistance	10^{11}			Ω	$V_{IO} = 500$ V
C_{IO}	Input-to-Output Capacitance		1.0		pF	f = 1.0 MHz
t_r, t_f	Collector Rise and Fall Times (Note 2)		1.6	2.0	μs	$I_C = 2.0$ mA, $V_{CE} = 10$ V, $R_L = 100\ \Omega$

Notes
1. Collector current transfer ratio is defined as the ratio of the collector current to the forward bias input current.
2. Rise time is defined as the time for the collector current to rise from 10% to 90% of peak value. Fall time is defined as the time required for the current to decrease from 90% ot 10% of peak value.

Optically-Coupled Isolator

Optoelectronic Products

FCD836/C/D

General Description

The FCD836 series of optoisolators combines a GaAs infrared-emitting diode and a silicon npn phototransistor in close proximity. Optical intercoupling provides a high degree of ac and dc isolation. A capability for continuous operation of the input diode results in a frequency response extending to dc. Connection to the transistor base is also provided for design flexibility.

Glassolated™
1500 V to 6000 V Minimum Isolation Input-to-Output
10^{11} Ω Isolation Resistance
Low Coupling Capacitance—Typically 1.0 pF
High Speed

Absolute Maximum Ratings

Maximum Temperature and Humidity

Storage Temperature	−55°C to +150°C
Operating Temperature	−55°C to +100°C
Pin Temperature (Soldering, 5 s)	260°C
Total Package Power Dissipation at T_A = 25°C (LED plus Detector)	250 mW
Derate Linearly from 25°C	3.3 mW/°C

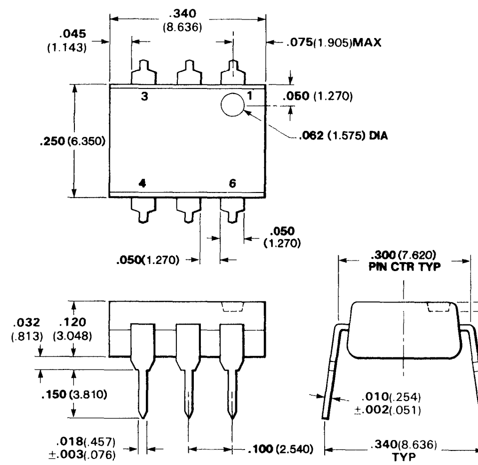
Input Diode

V_R	Reverse Voltage	3.0 V
I_F	Forward dc Current	60 mA
I_{pk}	Peak Forward Current (1 μs pulse width, 300 pps)	3.0 A
P_D	Power Dissipation at T_A = 25°C	100 mW
	Derate Linearly from 25°C	1.33 mW/°C

Output Transistor

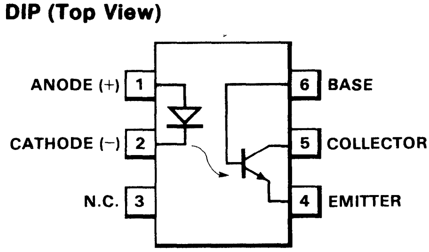
V_{CE}	Collector-to-Emitter Voltage	20 V
V_{CB}	Collector-to-Base Voltage	30 V
I_C	Collector Current	20 mA
P_D	Power Dissipation at T_A = 25°C	150 mW
	Derate Linearly from 25°C	2.0 mW/°C

Package Outline



Notes
All dimensions in inches **bold** and millimeters (parentheses)
Tolerance unless specified = ±**.015** (±.381)

Connection Diagram
DIP (Top View)



Pin		
1	Anode (+)	Input Diode
2	Cathode (−)	
3	NC	
4	Emitter	Output npn Phototransistor
5	Collector	
6	Base	

Typical Electrical Characteristics

FCD836 / C / D

Electrical Characteristics—Input Diode $T_A = 25°C$

Symbol	Characteristic	Min	Typ	Max	Units	Test Conditions
V_F	Forward Voltage		1.3	1.5	V	$I_F = 10$ mA
BV_R	Reverse Breakdown Voltage	3.0	8.0		V	$I_R = 10\ \mu A$

Electrical Characteristics—Output Transistor $T_A = 25°C$

Symbol	Characteristic	Min	Typ	Max	Units	Test Conditions
V_{CEO}	Collector-to-Emitter Voltage	20	50		V	$I_C = 1.0$ mA, $I_F = 0$
V_{CBO}	Collector-to-Base Voltage	30	60		V	$I_C = 10\ \mu A$, $I_F = 0$
I_{CEO}	Collector-to-Emitter Leakage Current		2.0	100	nA	$V_{CE} = 10$ V, $I_F = 0$
I_{CBO}	Collector-to-Base Leakage Current		0.1	20	nA	$V_{CB} = 10$ V, $I_F = 0$
h_{FE}	Forward Current Gain	50	250			$V_{CE} = 5.0$ V, $I_C = 100\ \mu A$
C_{cb}	Collector-to-Base Capacitance		7.5		pF	$V_{CB} = 10$ V
C_{eb}	Emitter-to-Base Capacitance		10		pF	$V_{EB} = 0$

Electrical Characteristics—Coupled $T_A = 25°C$

Symbol	Characteristic	Min	Typ	Max	Units	Test Conditions
V_{IO}	Input-to-Output Voltage					
	FCD836	1500			V_{rms}	
	FCD836C	5000			V_{pk}	
	FCD836D	6000			V_{pk}	
$V_{CE(sat)}$	Collector-to-Emitter Saturation Voltage		0.35	0.7	V	$I_C = 2.0$ mA, $I_F = 50$ mA
I_C/I_F(CTR)	Collector Current Transfer Ratio (Note 1)	6.0	10		%	$V_{CE} = 10$ V, $I_F = 10$ mA
R_{IO}	Input-to-Output Resistance	10^{11}			Ω	$V_{IO} = 500$ V
C_{IO}	Input-to-Output Capacitance		1.0		pF	f = 1.0 MHz
t_r, t_f	Collector Rise and Fall Times (Note 2)		1.6	2.0	μs	$I_C = 2.0$ mA, $V_{CE} = 10$ V, $R_L = 100\ \Omega$

Notes
1. Collector current transfer ratio is defined as the ratio of the collector current to the forward bias input current.
2. Rise time is defined as the time for the collector current to rise from 10% to 90% of peak value. Fall time is defined as the time required for the current to decrease from 90% to 10% of peak value.

Optically-Coupled Darlington Isolator

Optoelectronic Products

FCD850/C/D FCD855/C/D

General Description

The FCD850, FCD855 series of optoisolators have a silicon npn Planar Darlington phototransistor coupled to a GaAs diode. Each is mounted in a 6-pin plastic dual in-line package. The FCD850/FCD850C has a minimum collector-emitter breakdown voltage of 30 V; the FCD855/FCD855C has a minimum collector-emitter breakdown voltage of 55 V.

Glassolated™
High Current Transfer Ratio
1500 V to 6000 V Minimum Isolation Input-to-Output
10^{11} Ω Isolation Resistance
Low Coupling Capacitance—Typically 1.0 pF

Absolute Maximum Ratings

Storage Temperature	−55°C to +150°C
Operating Temperature	−55°C to +100°C
Pin Temperature (Soldering, 10 s)	260°C
Total Package Power Dissipation at T_A = 25°C,	
LED plus Detector	250 mW
Derate Linearly from 25°C	3.3 mW/°C

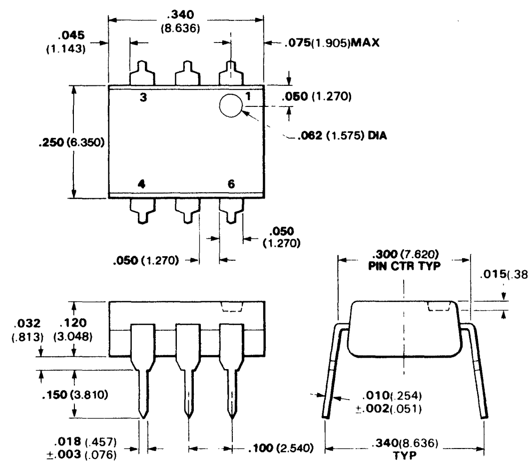
Input Diode

V_R	Reverse Voltage	3.0 V
I_F	Forward Current	60 mA
I_{pk}	Peak Forward Current at 1 μs pulse width, 300 pps	3.0 A
P_D	Power Dissipation at T_A = 25°C	150 mW
	Derate Linearly from 25°C	1.33 mW/°C

Output Transistor (Darlington)

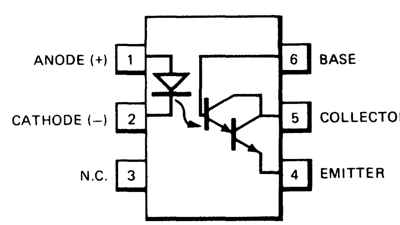
V_{CE}	Collector-to-Emitter Voltage	
	FCD850	30 V
	FCD855	55 V
V_{CB}	Collector-to-Base Voltage	
	FCD850	30 V
	FCD855	55 V
V_{EC}	Emitter-to-Collector Voltage	7.0 V
I_C	Collector Current	125 mA
P_D	Power Dissipation at T_A = 25°C	150 mW
	Derate Linearly from 25°C	2.0 mW/°C

Package Outline



Notes
All dimensions in inches **bold** and millimeters (parentheses)
Tolerance unless specified = ±**.015** (±.381)

Connection Diagram DIP (Top View)



Pin		
1	Anode (+)	Input Diode
2	Cathode (−)	
3	NC	
4	Emitter	Output npn Phototransistor
5	Collector	
6	Base	

Typical Electrical Characteristics

FCD850/C/D FCD855/C/D

Electrical Characteristics—Input Diode $T_A = 25°C$

Symbol	Characteristic	Min	Typ	Max	Units	Test Conditions
V_F	Forward Voltage		1.25	1.5	V	$I_F = 20$ mA
BV_R	Reverse Breakdown Voltage	3.0	5.0		V	$I_R = 10\ \mu A$
C	Capacitance		150		pF	$V_R = 0$ V, f = 1 MHz

Electrical Characteristics—Output Transistor $T_A = 25°C$

Symbol	Characteristic	Min	Typ	Max	Units	Test Conditions
V_{CEO}	Collector-to-Emitter Voltage					
	FCD850, FCD850C	30			V	$I_C = 100\ \mu A$, $I_F = 0$
	FCD855, FCD855C	55			V	$I_C = 100\ \mu A$, $I_F = 0$
V_{ECO}	Emitter-to-Collector Voltage	7.0			V	$I_E = 100\ \mu A$, $I_F = 0$
V_{EBO}	Emitter-to-Base Voltage	8.0			V	$I_E = 100\ \mu A$, $I_F = 0$
I_{CEO}	Collector-to-Emitter Leakage Current			100	nA	$V_{CE} = 10$ V, $I_F = 0$
h_{FE}	Forward Current Gain		7000			$V_{CE} = 5.0$ V, $I_C = 25$ mA
C_{cb}	Collector-to-Base Capacitance		25		pF	$V_{CB} = 10$ V

Electrical Characteristics—Coupled $T_A = 25°C$

Symbol	Characteristic	Min	Typ	Max	Units	Test Conditions
V_{IO}	Input-to-Output Voltage (Note 1)					
	FCD850, FCD855	1500			V_{rms}	
	FCD850C, FCD855C	5000			V_{pk}	
	FCD850D, FCD855D	6000			V_{pk}	
$V_{CE(sat)}$	Collector-to-Emitter Saturation Voltage			1.0	V	$I_C = 50$ mA, $I_F = 50$ mA
I_C	Collector Output Current	10	150		mA	$V_{CE} = 5.0$ V, $I_F = 10$ mA
R_{IO}	Input-to-Output Resistance		10^{11}		Ω	$V_{IO} = 500$ V
C_{IO}	Input-to-Output Capacitance		1.5		pF	$V_{IO} = 0$, f = 1.0 MHz
t_r	Rise Time (Note 2)		15		μs	$I_C = 125$ mA, $V_{CC} = 13.5$ V, $R_L = 100\ \Omega$
t_f	Fall Time (Note 2)		150		μs	$I_C = 125$ mA, $V_{CC} = 13.5$ V, $R_L = 100\ \Omega$

Notes
1. Isolation voltage defined as minimum of 5 s continuous application
2. Rise time is defined as the time for the collector current to rise from 10% to 90% of peak value. Fall time is defined as the time required for the current to decrease from 90% to 10% of peak value.

Optically-Coupled Darlington Isolator

Optoelectronic Products

FCD860/C/D FCD865/C/D

General Description

The FCD860, FCD865 series of optoisolators have a silicon npn Planar Darlington phototransistor coupled to a GaAs diode. Each is mounted in a 6-pin plastic dual in-line package. The series was designed specifically as a high-sensitivity type for operation in the 1.0/mA input region.

Glassolated™
High Current Transfer Ratio at Low Input Current
1500 V to 6000 V Minimum Isolation Input-to-Output
10^{11} Ω Isolation Resistance
Low Coupling Capacitance—Typically 1.5 pF

Absolute Maximum Ratings

Maximum Temperature and Humidity

Storage Temperature	−55°C to + 150°C
Operating Temperature	−55°C to +100°C
Pin Temperature (Soldering, 10 s)	260°C
Total Package Power Dissipation at T_A = 25°C (LED plus Detector)	250 mW
Derate Linearly from 25°C	3.3 mW/°C

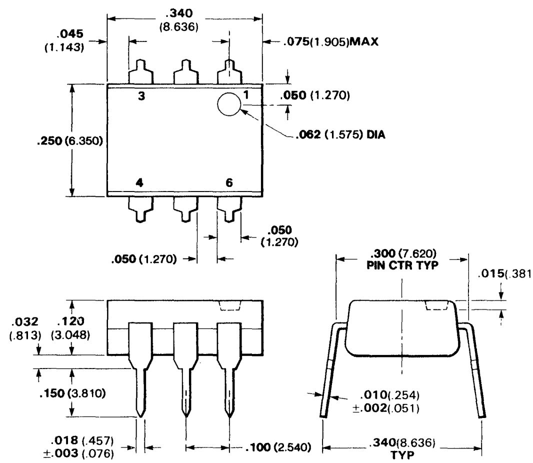
Input Diode

V_R	Reverse Voltage	3.0 V
I_F	Forward dc Current	80 mA
I_{pk}	Peak Forward Current (1 μs pulse width, 300 pps)	3.0 A
P_D	Power Dissipation at T_A = 25°C	150 mW
	Derate Linearly from 25°C	2.0 mW/°C

Output Transistor (Darlington)

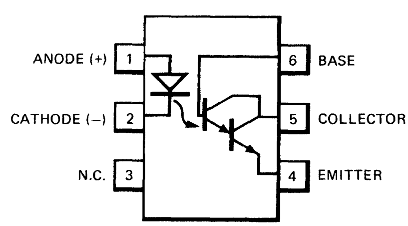
V_{CE}	Collector-to-Emitter Voltage	30 V
V_{CB}	Collector-to-Base Voltage	30 V
V_{EC}	Emitter-to-Collector Voltage	7.0 V
P_D	Power Dissipation at T_A = 25°C ($I_{C(max)}$ 100 mA at V_{CE} = 1.5 V)	150 mW
	Derate Linearly from 25°C	2.0 mW/°C

Package Outline



Notes
All dimensions in inches **bold** and millimeters (parentheses)
Tolerance unless specified = ±**.015** (±.381)

Connection Diagram
DIP (Top View)



Pin

1	Anode (+)	Input Diode
2	Cathode (−)	
3	NC	
4	Emitter	Output npn Phototransistor
5	Collector	
6	Base	

5

Typical Electrical Characteristics

FCD860/C/D
FCD865/C/D

Electrical Characteristics—Input Diode $T_A = 25°C$

Symbol	Characteristic	Min	Typ	Max	Units	Test Conditions
V_F	Forward Voltage		1.25	1.5	V	$I_F = 20$ mA
BV_R	Reverse Breakdown Voltage	3.0	5.0		V	$I_R = 10\ \mu A$
C	Capacitance		150		pF	$V_R = 0$ V, f = 1 MHz

Electrical Characteristics—Output Transistor $T_A = 25°C$ (Darlington)

Symbol	Characteristic	Min	Typ	Max	Units	Test Conditions
V_{CEO}	Collector-to-Emitter Voltage	30			V	$I_C = 1.0$ mA, $I_F = 0$
V_{CBO}	Collector-to-Base Voltage	30			V	$I_C = 10\ \mu A$, $I_F = 0$
V_{ECO}	Emitter-to-Collector Voltage	7.0			V	$I_E = 100\ \mu A$, $I_F = 0$
V_{EBO}	Emitter-to-Base Voltage	6.0	8.0		V	$I_E = 100\ \mu A$, $I_F = 0$
I_{CEO}	Collector-to-Emitter Leakage Current			100	nA	$V_{CE} = 10$ V, $I_F = 0$
h_{FE}	Forward Current Gain		20 k			$V_{CE} = 5.0$ V, $I_C = 25$ mA

Electrical Characteristics—Coupled $T_A = 25°C$

Symbol	Characteristic	Min	Typ	Max	Units	Test Conditions
V_{IO}	Input-to-Output Voltage (Note 1)					
	FCD860, FCD865	1500			V_{rms}	
	FCD860C, FCD865C	5000			V_{pk}	
	FCD860D, FCD865D	6000			V_{pk}	
$V_{CE(sat)}$	Collector-to-Emitter Saturation Voltage			1.0	V	$I_C = 2.0$ mA, $I_F = 1.0$ mA
I_C	Collector Output Current					
	FCD860, FCD860C	2.0			mA	$V_{CE} = 1.0$ V, $I_F = 1.0$ mA
	FCD865, FCD865C	2.0			mA	$V_{CE} = 1.0$ V, $I_F = 0.5$ mA
R_{IO}	Input-to-Output Resistance		10^{11}		Ω	$V_{IO} = 500$ V
C_{IO}	Input-to-Output Capacitance		1.5		pF	$V_{IO} = 0$, f = 1.0 MHz
t_r, t_f	Rise and Fall Times (Note 2)		80		μs	$I_C = 10$ mA, $V_{CC} = 10$ V, $R_L = 100\ \Omega$

Notes
1. Isolation voltage defined as minimum of 5 s continuous application.
2. Rise time is defined as the time for the collector current to rise from 10% to 90% of peak value. Fall time is defined as the time required for the current to decrease from 90% to 10% of peak value.

Dual Optically-Coupled Isolator
Optoelectronic Products

FCD880, FCD885

General Description
The FCD880 and FCD885 comprise two distinct optoisolators with transistor output, in a single 8-pin dual in-line package. Each channel consists of a GaAs emitter optically coupled to a phototransistor.

High Current Transfer Ratio
2500 V Minimum Isolation Input-to-Output
10^{11} Ω Isolation Resistance
Low Coupling Capacitance—Typically 1.0 pF
I/O Compatible With Integrated Circuits
Two Packages Fit Into a Standard 16-Pin DIP Socket

Absolute Maximum Ratings

Storage Temperature	−55°C to +150°C
Operating Temperature	−55°C to +100°C
Pin Temperature (Soldering, 5 s)	260°C
Total Package Power Dissipation at T_A = 25°C	400 mW
Derate Linearly from 25°C	5.3 mW/°C

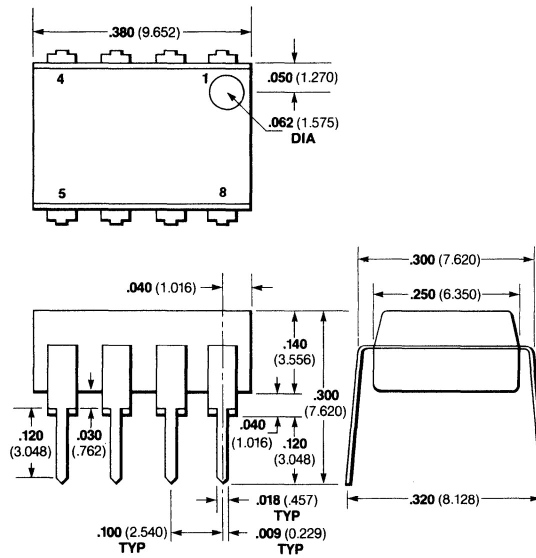
Input Diode (Each Channel)

V_R	Reverse Voltage	3.0 V
I_F	Forward dc Current	60 mA
I_{pk}	Peak Forward Current (1 μs pulse, 330 pps)	3.0 A
P_D	Power Dissipation at T_A = 25°C	100 mW
	Derate Linearly from 50°C	2 mW/°C

Output Transistor (Each Channel)

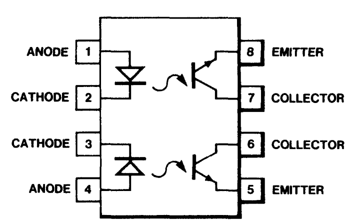
V_{CE}	Collector-to-Emitter Voltage	30 V
V_{EC}	Emitter-to-Collector Voltage	6.0 V
P_D	Power Dissipation at T_A = 25°C	150 mW
	Derate Linearly from 25°C	2 mW/°C
I_C	Collector Current	30 mA

Package Outline



Notes
All dimensions in inches **bold** and millimeters (parentheses)
Tolerance unless specified = ±**.015** (±.381)
Package weight is 0.4 gram

Connection Diagram
DIP (Top View)



Pin		
1	Anode	Channel #1
2	Cathode	
3	Cathode	Channel #2
4	Anode	
5	Emitter	Channel #2
6	Collector	
7	Collector	Channel #1
8	Emitter	

Typical Electrical Characteristics

FCD880
FCD885

Electrical Characteristics—Input Diode $T_A = 25°C$

Symbol	Characteristic	Min	Typ	Max	Units	Test Conditions
V_F	Forward Voltage		1.25	1.5	V	$I_F = 60$ mA
V_R	Reverse Voltage	3.0	5.5		V	$I_R = 10\ \mu A$
C_J	Junction Capacitance		100		pF	$V_F = 0$ V

Electrical Characteristics—Output Transistor $T_A = 25°C$

Symbol	Characteristic	Min	Typ	Max	Units	Test Conditions
V_{CEO}	Collector-to-Emitter Voltage					
	FCD880, FCD885	30	65		V	$I_C = 1.0$ mA, $I_F = 0$
V_{ECO}	Emitter-to-Collector Voltage					
	FCD880, FCD885	6.0	10		V	$I_C = 100\ \mu A$
I_{CEO}	Collector-to-Emitter Leakage Current					
	FCD880, FCD885		5.0	100	nA	$V_{CE} = 10$ V, $I_F = 0$
C_{CE}	Collector-to-Emitter Capacitance		8.0		pF	$V_{CE} = 0$

Electrical Characteristics—Coupled $T_A = 25°C$

Symbol	Characteristic	Min	Typ	Max	Units	Test Conditions
V_{IO}	Input-to-Output Voltage	2500	4000		V	
$V_{CE(sat)}$	Collector-to-Emitter Saturation Voltage					
	FDC880		0.24	0.4	V	$I_C = 2.0$ mA, $I_F = 16$ mA
	FCD885		0.2	0.3	V	$I_C = 250\ \mu A$, $I_F = 20$ mA
I_C/I_F(CTR)	Collector Current Transfer Ratio (Note 1)					
	FCD880	30	50		%	$V_{CE} = 10$ V, $I_F = 10$ mA
	FCD885	10	20		%	$V_{CE} = 10$ V, $I_F = 10$ mA
R_{IO}	Input-to-Output Resistance		10^{11}		Ω	$V_{IO} = 500$ V
C_{IO}	Input-to-Output Capacitance		1.0		pF	f = 1.0 MHz
	Collector Rise and Fall Times (Note 2)		2.0		μs	$I_C = 2.0$ mA, $V_{CE} = 10$ V, $R_L = 100\ \Omega$

Notes
1. Collector current transfer ratio is defined as the ratio of the collector current to the forward bias input current.
2. Rise time is defined as the time for the collector current to rise from 10% to 90% of peak value. Fall time is defined as the time required for the current to decrease from 90% to 10% of peak value.

Dual Optically-Coupled Darlington Isolator

Optoelectronic Products

FCD890

General Description

The FCD890 comprises two distinct optoisolators with transistor output, in a single 8-pin dual in-line package. Each channel consists of a GaAs emitter optically coupled to a photo-Darlington. The coupler was designed specifically as a high-sensitivity type for operation in the 1.0 mA input region.

High Current Transfer Ratio at Low Input Current
2500 V Minimum Isolation Input-to-Output
10^{11} Ω Isolation Resistance
Low Coupling Capacitance—Typically 1.0 pF
I/O Compatible With Integrated Circuits
Two Packages Fit Into a Standard 16-Pin DIP Socket

Absolute Maximum Ratings

Maximum Temperature and Humidity

Storage Temperature	−55°C to +150°C
Operating Temperature	−55°C to +100°C
Pin Temperature (Soldering, 5s)	260°C
Total Package Power Dissipation at T_A = 25°C	400 mW
Derate Linearly from 25°C	5.3 mW/°C

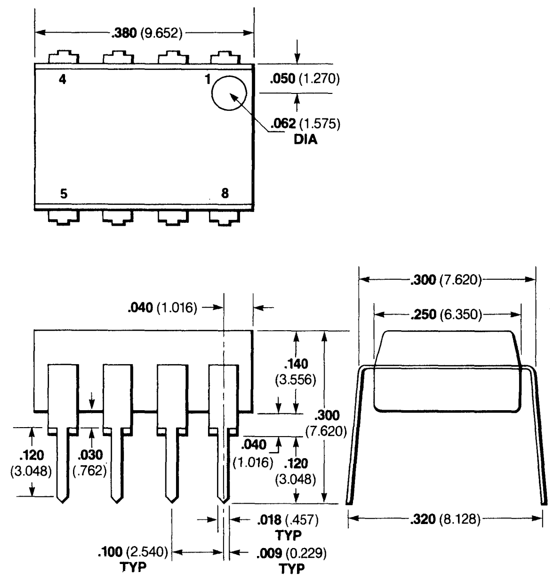
Input Diode (Each Channel)

V_R	Reverse Voltage	3.0 V
I_F	Forward dc Current	60 mA
I_{pk}	Peak Forward Current at 1 μs pulse, 300 pps	3.0 A
P_D	Power Dissipation at T_A = 25°C	150 mW
	Derate Linearly from 50°C	2 mW/°C

Output Transistor (Each Channel)

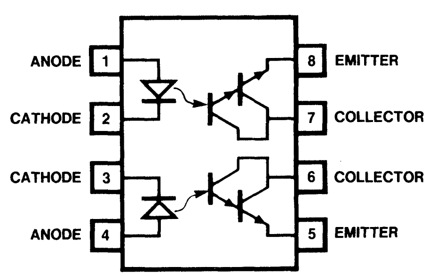
V_{CE}	Collector-to-Emitter Voltage	30 V
V_{EC}	Emitter-to-Collector Voltage	7.0 V
P_D	Power Dissipation at T_A = 25°C	150 mW
	Derate Linearly from 25°C	2 mW/°C
I_C	Collector Current	30 mA

Package Outline



Notes
All dimensions in inches **bold** and millimeters (parentheses)
Tolerance unless specified = ±**.015** (±.381)
Package weight is 0.4 gram

Connection Diagram DIP (Top View)



Pin		
1	Anode	
2	Cathode	Channel #1
3	Cathode	
4	Anode	Channel #2
5	Emitter	
6	Collector	Channel #2
7	Collector	
8	Emitter	Channel #1

Typical Electrical Characteristics

FCD890

Electrical Characteristics—Input Diode $T_A = 25°C$

Symbol	Characteristic	Min	Typ	Max	Units	Test Conditions
V_F	Forward Voltage		1.25	1.5	V	$I_F = 20$ mA
V_R	Reverse Voltage	3.0	5.5		V	$I_R = 10\ \mu A$
C_J	Junction Capacitance		150		pF	$V_R = 0$ V, f = 1 MHz

Electrical Characteristics—Output Transistor $T_A = 25°C$ (Darlington)

Symbol	Characteristic	Min	Typ	Max	Units	Test Conditions
V_{CEO}	Collector-to-Emitter Voltage	30	65		V	$I_C = 1.0$ mA, $I_F = 0$
V_{ECO}	Emitter-to-Collector Voltage	7.0	10		V	$I_C = 100\ \mu A$
I_{CEO}	Collector-to-Emitter Leakage Current		5.0	100	nA	$V_{CE} = 10$ V, $I_F = 0$
h_{FE}	Forward Current Gain		20 k			$V_{CE} = 5.0$ V, $I_C = 25$ mA

Electrical Characteristics—Coupled $T_A = 25°C$

Symbol	Characteristic	Min	Typ	Max	Units	Test Conditions
V_{IO}	Input-to-Output Voltage	2500	4000		V	
$V_{CE(sat)}$	Collector-to-Emitter Saturation Voltage			1.0	V	$I_C = 2.0$ mA, $I_F = 1.0$ mA
I_C/I_F(CTR)	Collector Current Transfer Ratio (Note 1)	200			%	$V_{CE} = 1.0$ V, $I_F = 1.0$ mA
R_{IO}	Input-to-Output Resistance		10^{11}		Ω	$V_{IO} = 500$ V
C_{IO}	Input-to-Output Capacitance		1.0		pF	f = 1.0 MHz, $V_{IO} = 0$
t_r, t_f	Collector Rise and Fall Times (Note 2)		80		μs	$I_C = 10$ mA, $V_{CE} = 10$ V, $R_L = 100\ \Omega$

Notes

1. Collector current transfer ratio is defined as the ratio of the collector current to the forward bias input current.
2. Rise time is defined as the time for the collector current to rise from 10% to 90% of peak value. Fall time is defined as the time required for the current to decrease from 90% to 10% of peak value.

Optically-Coupled Isolator

Optoelectronic Products

H11A1, H11A2 H11A3, H11A4

General Description

The H11A1, H11A2, H11A3 and H11A4 optical isolators are electrical and mechanical replacements for the General Electric series. Optical intercoupling provides a high degree of ac and dc isolation. A capability for continuous operation of the input diode results in a frequency response extending to dc. Connection to the base is also provided for design flexibility.

Glassolated™
Electrically Equivalent to GE Devices
Pin-for-Pin Equivalent to GE Devices
Availability of Base Pin for Flexible Design

Absolute Maximum Ratings

Maximum Temperature and Humidity

Storage Temperature	−55°C to +150°C
Operating Temperature	−55°C to +100°C
Pin Temperature (Soldering, 5 s)	260°C
Total Package Power Dissipation at T_A = 25°C, LED plus Detector	250 mW
Derate Linearly from 25°C	3.3 mW/°C

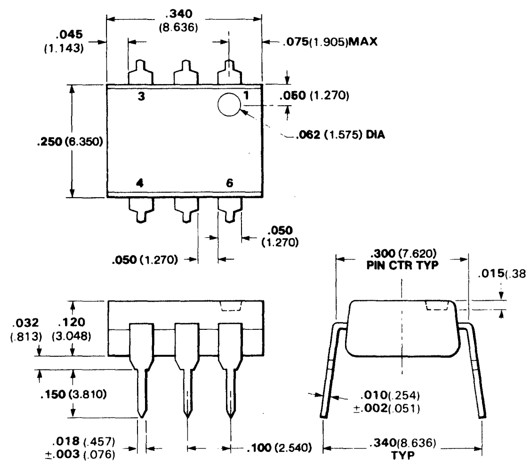
Input Diode

V_R	Reverse Voltage	3.0 V
I_F	Forward dc Current	60 mA
I_{pk}	Peak Forward Current at 1 μs pulse width, 300 pps	3.0 A
P_D	Power Dissipation at T_A = 25°C	100 mW/°C
	Derate Linearly from 25°C	1.33 mW/°C

Output Transistor

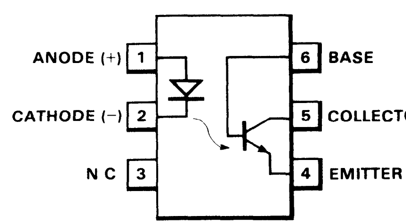
V_{CE}	Collector-to-Emitter Voltage	30 V
V_{CB}	Collector-to-Base Voltage	70 V
I_C	Collector Current	100 mA
P_D	Power Dissipation at T_A = 25°C	150 mW
	Derate Linearly from 25°C	2.0 mW/°C

Package Outline



Notes
All dimensions in inches **bold** and millimeters (parentheses)
Tolerance unless specified = **±.015** (±.381)

Connection Diagram DIP (Top View)



Pin		
1	Anode (+)	Input Diode
2	Cathode (−)	
3	NC	
4	Emitter	Output npn Phototransistor
5	Collector	
6	Base	

Typical Electrical Characteristics

H11A1, H11A2 H11A3, H11A4

Electrical Characteristics—Input Diode $T_A = 25°C$

Symbol	Characteristic	Min	Typ	Max	Units	Test Conditions
V_F	Forward Voltage		1.1	1.5	V	$I_F = 10$ mA
I_R	Reverse Current			10	μA	$V_R = 3.0$ V

Electrical Characteristics—Output Transistor $T_A = 25°C$

Symbol	Characteristic	Min	Typ	Max	Units	Test Conditions
V_{CEO}	Collector-to-Emitter Voltage	30			V	$I_C = 10$ mA, $I_F = 0$
V_{CBO}	Collector-to-Base Voltage	70			V	$I_C = 100\ \mu$A, $I_F = 0$
V_{ECO}	Emitter-to-Collector Voltage	7.0			V	$I_E = 100\ \mu$A, $I_F = 0$
I_{CEO}	Collector-to-Emitter Leakage Current		5.0	50	nA	$V_{CE} = 10$ V, $I_F = 0$

Electrical Characteristics—Coupled $T_A = 25°C$

Symbol	Characteristic	Min	Typ	Max	Units	Test Conditions
V_{ISO}	Isolation Voltage (Note 3)					
	H11A1, H11A3	2500			V	Peak
	H11A2, H11A4	1500			V	Peak
$V_{CE(sat)}$	Collector-to-Emitter Saturation Voltage		0.1	0.4	V	$I_C = 0.5$ mA, $I_F = 50$ mA
I_C/I_F(CTR)	Collector Current Transfer Ratio (Note 1)					$V_{CE} = 10$ V, $I_F = 10$ mA
	H11A1	50			%	
	H11A2, H11A3	20			%	
	H11A4	10			%	
R_{IO}	Input-to-Output Resistance	10^{11}			Ω	$V_{IO} = 500$ V
C_{IO}	Input-to-Output Capacitance		2.0		pF	f = 1.0 MHz
t_r, t_f	Collector Rise and Fall Times (Note 2)		2.0		μs	$I_C = 2.0$ mA, $V_{CE} = 10$ V, $R_L = 100\ \Omega$

Notes

1. Collector current transfer ratio is defined as the ratio of the collector current to the forward bias input current.
2. Rise time is defined as the time for the collector current to rise from 10% to 90% of peak value. Fall time is defined as the time required for the current to decrease from 90% to 10% of peak value.
3. Isolation voltage defined as minimum of 5 s continuous application.

Optically-Coupled Darlington Isolator

Optoelectronic Products

H11B1 H11B2

General Desription

The H11B1 and H11B2 optical isolators are electrical and mechanical replacements for the General Electric series. Optical intercoupling provides a high degree of ac and dc isolation. A capability for continuous operation of the input diode results in a frequency response extending to dc. Connection to the base is also provided for design flexibility.

Glassolated™
Electrically Equivalent to GE Devices
Pin-For-Pin Equivalent to GE Devices
Availability of Base Pin for Flexible Design

Absolute Maximum Ratings

Maximum Temperature and Humidity

Storage Temperature	−55°C to +150°C
Operating Temperature	−55°C to +100°C
Pin Temperature (Soldering, 10 s)	260°C
Total Package Power Dissipation at T_A=25°C	
LED plus Detector	250 mW
Derate Linearly from 25°C	3.3 mW/°C

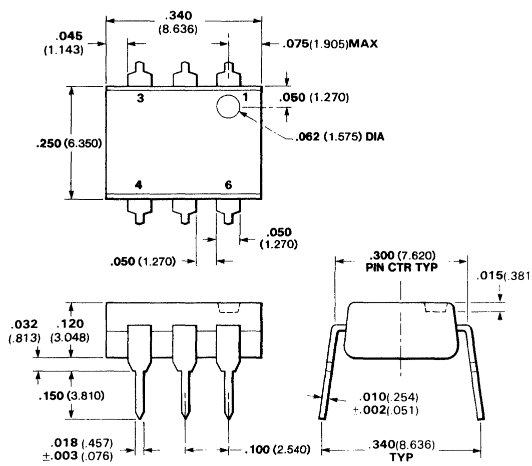
Input Diode

I_F	Forward dc Current Continuous	60 mA
V_R	Reverse Voltage	3.0 V
I_{pk}	Peak Forward Current (1μs pulse width, 300 pps)	3.0 A
P_D	Power Dissipation at T_A = 25°C	100 mW
	Derate Linearly from 25°C	1.33 mW/°C

Output Transistor (Darlington)

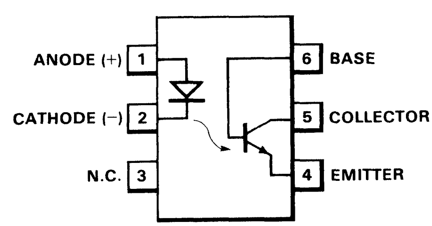
V_{CE}	Collector to Emitter Voltage	25 V
V_{CB}	Collector-to-Base Voltage	30 V
V_{EC}	Emitter-to-Collector Voltage	7.0 V
P_D	Power Dissipation at T_A = 25°C, I_C (max) = 100 mA at V_{CE} = 1.5 V	150 mW
	Derate Linearly from 25°C	2.0 mW/°C

Package Outline



Notes
All dimensions in inches **bold** and millimeters (parentheses)
Tolerance unless specified = ±**.015** (±.381)

Connection Diagram
DIP (Top View)



Pin		
1	Anode (+)	Input Diode
2	Cathode (−)	
3	NC	
4	Emitter	Output npn Phototransistor
5	Collector	
6	Base	

Typical Electrical Characteristics

H11B1 H11B2

Electrical Characteristics—Input Diode $T_A = 25°C$

Symbol	Characteristic	Min	Typ	Max	Units	Test Conditions
V_F	Forward Voltage		1.2	1.5	V	$I_F = 10$ mA
I_R	Reverse Current			10	μA	$V_R = 3.0$ V
C	Capacitance		150		pF	$V_R = 0$ V, f = 1 MHz

Electrical Characteristics—Output Transistor (Darlington) $T_A = 25°C$

Symbol	Characteristic	Min	Typ	Max	Units	Test Conditions
BV_{CEO}	Collector-to-Emitter Breakdown Voltage	25			V	$I_C = 10$ mA, $I_F = 0$
BV_{ECO}	Emitter-to-Collector Breakdown Voltage	7.0			V	$I_E = 100$ μA, $I_F = 0$
BV_{CBO}	Collector-to-Base Breakdown Voltage	30			V	$I_C = 100$ μA
I_{CEO}	Collector-to-Emitter Leakage Current			100	nA	$V_{CE} = 10$ V, $I_F = 0$
C_{CE}	Capacitance Collector-to-Emitter Junction		6.0		pF	$V_{CE} = 10$ V, f = 1.0 MHz

Electrical Characteristics—Coupled $T_A = 25°C$

Symbol	Characteristic	Min	Typ	Max	Units	Test Conditions
I_C	Collector Output Current (Pulsed)					
	H11B1	50			mA	$I_F = 10$ mA, $V_{CE} = 5$ V
	H11B2	20			mA	
V_{ISO}	Isolation Voltage (Note 2)					
	H11B1	2500			V	Peak
	H11B2	1500			V	Peak
R_{ISO}	Isolation Resistance		10^{11}		Ω	V = 500 V
$V_{CE(sat)}$	Collector-to-Emitter Saturation Voltage			1.0	V	$I_C = 1.0$ mA, $I_F = 1.0$ mA
C_{ISO}	Isolation Capacitance		2.0		pF	V = 0, f = 1.0 MHz
t_{on}	Turn-on Time (Note 1)		125		μs	$I_C = 10$ mA, $V_{CC} = 10$ V, $R_L = 100$ Ω
t_{off}	Turn-off Time		100		μs	$I_C = 10$ mA, $V_{CC} = 10$ V, $R_L = 100$ Ω

Notes

1. Turn-on time is defined as the time for the (base collector) current to rise from 10% to 90% of peak value. Turn-off time is defined as the time required for the current to decrease from 90% to 10% of peak value.
2. Isolation voltage defined as minimum of 5 s continuous application.

Optically-Coupled Isolator

Optoelectronic Products

H11D1, H11D2 H11D3, H11D4

General Description

The H11D1, H11D2, H11D3, and H11D4 are optoisolators which have an npn silicon high-voltage phototransistor coupled to a GaAs infrared-emitting diode. Each is mounted in a 6-pin plastic DIP package.

200 V or 300 V Phototransistor Breakdown
1500 V or 2500 V Peak Minimum Isolation Input-to-Output
10^{11} Ω Isolation Resistance
Low Coupling Capacitance—Typically 1.0 pF

Absolute Maximum Ratings

Maximum Temperature and Humidity

Storage Temperature	−55°C to +150°C
Operating Temperature	−55°C to +100°C
Pin Temperature (Soldering, 5 s)	260°C
Total Package Power Dissipation at T_A = 25°C,	
LED plus Detector	250 mW
Derate Linearly from 25°C	3.3 mW/°C

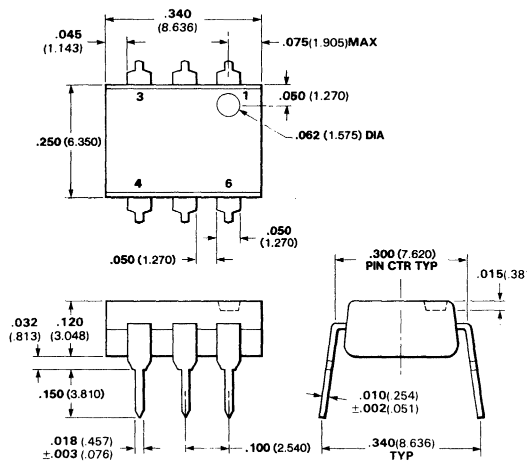
Input Diode

V_R	Reverse Voltage	6.0 V
I_F	Forward dc Current	60 mA
I_{pk}	Peak Forward Current at 1 μs pulse width, 300 pps	3.0 A
P_D	Power Dissipation at T_A = 25°C	100 mW
	Derate Linearly from 25°C	1.33 mW/°C

Output Transistor

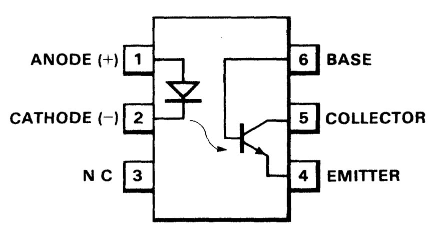
V_{CE}	Collector-to-Emitter Voltage	
	H11D1, H11D2	300 V
	H11D3, H11D4	200 V
V_{CB}	Collector-to-Base Voltage	
	H11D1, H11D2	300 V
	H11D3, H11D4	200 V
V_{EC}	Emitter-to-Collector Voltage	7.0 V
P_D	Power Dissipation at T_A = 25°C	150 mW
	Derate Linearly from 25°C	2.0 mW/°C

Package Outline



Notes
All dimensions in inches **bold** and millimeters (parentheses)
Tolerance unless specified = ±**.015** (±.381)

Connection Diagram
DIP (Top View)



Pin

1	Anode (+)	Input Diode
2	Cathode (−)	
3	NC	
4	Emitter	Output npn Phototransistor
5	Collector	
6	Base	

Typical Electrical Characteristics

H11D1, H11D2 H11D3, H11D4

Electrical Characteristics—Input Diode $T_A = 25°C$

Symbol	Characteristic	Min	Typ	Max	Units	Test Conditions
V_F	Forward Voltage		1.20	1.50	V	$I_F = 10$ mA
C	Capacitance		50		pF	$V_R = 0$ V, f = 1 MHz
I_R	Reverse Leakage Current		0.05	10	μA	$V_R = 6.0$ V

Electrical Characteristics—Output Transistor $T_A = 25°C$

Symbol	Characteristic	Min	Typ	Max	Units	Test Conditions
BV_{CEO}	Collector-to-Emitter Breakdown Voltage					$I_C = 1.0$ mA,
	H11D1, H11D2	300	350		V	Pulsed
	H11D3, H11D4	200	250		V	$I_f = 0$
BV_{CBO}	Collector-to-Base Breakdown Voltage					
	H11D1, H11D2	300	350		V	$I_C = 100$ μA
	H11D3, H11D4	200	250		V	$I_f = 0$
I_{CEO}	Collector Dark Current					
	H11D1, H11D2 (25°C)			100	nA	$V_{CE} = 200$ V,
	(100°C)			250	μA	$I_F = 0$
	H11D3, H11D4 (25°C)			100	nA	$V_{CE} = 100$ V,
	(100°C)			250	μA	$I_F = 0$
BV_{EBO}	Emitter-to-Base Breakdown Voltage	7.0			V	$I_E = 100$ μA, $I_F = 0$

Electrical Characteristics—Coupled $T_A = 25°C$

Symbol	Characteristic	Min	Typ	Max	Units	Test Conditions
I_C	Collector Output Current					$V_{CE} = 10$ V,
	H11D1, H11D2, H11D3	2.0	5.0		mA	$I_F = 10$ mA,
	H11D4	1.0	3.0			$I_B = 0$
V_{ISO}	Isolation Voltage					
	H11D1	2500			V_{rms}	
	H11D2, H11D3, H11D4	1500			V_{rms}	
R_{IO}	Isolation Resistance	10^{11}			Ω	V = 500 V
$V_{CE(sat)}$	Collector-to-Emitter Saturation Voltage		0.2	0.4	V	$I_C = 0.5$ mA, $I_F = 10$ mA
C_{IO}	Isolation Capacitance		1.0		pF	V = 0, f = 1.0 MHz
t_r, t_f	Rise and Fall Times (Note)		5.0		μs	$I_C = 2.0$ mA, $V_{CE} = 10$ V, $R_L = 100$ Ω

Notes
Rise time is defined as the time for the collector current to rise from 10% to 90% of peak value. Fall time is defined as the time required for the current to decrease from 90% to 10% of peak value.

Dual Optically-Coupled Isolator

ILD-74

Optoelectronic Products

General Description

The ILD-74 comprises two distinct optoisolators with transistor output, in a single 8-pin dual in-line package. Each channel consists of a GaAs emitter optically coupled to a phototransistor.

High Current Transfer Ratio
1500 V Minimum Isolation Input-to-Output
10^{11} Ω Isolation Resistance
Low Coupling Capacitance—Typically 0.5 pF
I/O Compatible With Integrated Circuits
Two Packages Fit Into a Standard 16-Pin DIP Socket

Absolute Maximum Ratings

Maximum Temperature

Storage Temperature	−55°C to +150°C
Operating Temperature	−55°C to +100°C
Pin Temperature (Soldering, 7 s)	260°C
Total Package Power Dissipation at T_A = 25°C	400 mW
Derate Linearly from 25°C	5.33 mW/°C

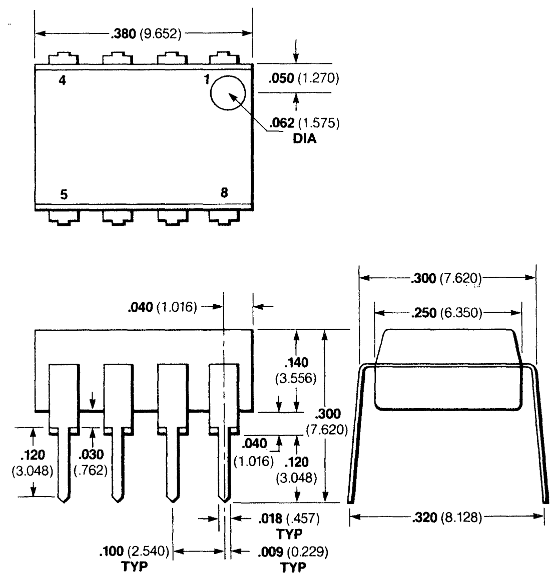
Input Diode (Each Channel)

V_R	Reverse Voltage	3.0 V
I_F	Forward dc Current	100 mA
I_{pk}	Peak Forward Current at 1 μs pulse, 300 pps	3.0 A
P_D	Power Dissipation at T_A = 25°C	150 mW
	Derate Linearly from 50°C	1.33 mW/°C

Output Transistor (Each Channel)

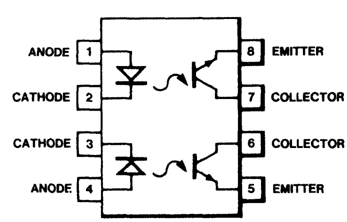
V_{CE}	Collector-to-Emitter Voltage	20 V
V_{EC}	Emitter-to-Collector Voltage	6.0 V
P_D	Power Dissipation at T_A = 25°C	150 mW
	Derate Linearly from 25°C	2.0 mW/°C
I_C	Collector Current	30 mA

Package Outline



Notes
All dimensions in inches **bold** and millimeters (parentheses)
Tolerance unless specified = ±**.015** (±.381)
Package weight is 0.4 gram

Connection Diagram DIP (Top View)



Pin		
1	Anode	Channel #1
2	Cathode	
3	Cathode	Channel #2
4	Anode	
5	Emitter	Channel #2
6	Collector	
7	Collector	Channel #1
8	Emitter	

Typical Electrical Characteristics

ILD-74

Electrical Characteristics—Input Diode $T_A = 25°C$

Symbol	Characteristic	Min	Typ	Max	Units	Test Conditions
V_F	Forward Voltage		1.3		V	$I_F = 60$ mA
V_R	Reverse Voltage		3.0		V	$I_R = 100\ \mu A$
C_J	Junction Capacitance		100		pF	$V_F = 0$ V

Electrical Characteristics—Output Transistor $T_A = 25°C$

Symbol	Characteristic	Min	Typ	Max	Units	Test Conditions
V_{CEO}	Collector-to-Emitter Voltage	20			V	$I_C = 1.0$ mA, $I_F = 0$
I_{CEO}	Collector-to-Emitter Leakage Current		5.0	500	nA	$V_{CE} = 5.0$ V, $I_F = 0$
C_{CE}	Collector-to-Emitter Capacitance		2.0		pF	$V_{CE} = 0$

Electrical Characteristics—Coupled $T_A = 25°C$

Symbol	Characteristic	Min	Typ	Max	Units	Test Conditions
V_{IO}	Input-to-Output Voltage	1500			V	
$V_{CE(sat)}$	Collector-to-Emitter Saturation Voltage			0.5	V	$I_C = 2.0$ mA, $I_F = 16$ mA
I_C/I_F(CTR)	Collector Current Transfer Ratio (Note 1)	12.5	35		%	$V_{CE} = 5.0$ V, $I_F = 16$ mA
R_{IO}	Input-to-Output Resistance		10^{14}		Ω	$V_{IO} = 500$ V
C_{IO}	Input-to-Output Capacitance		0.5		pF	f = 1.0 MHz
$t_{D(on)}$	Propagation Delay Times		6.0		μs	$V_{CE} = 5.0$ V, $I_F = 16$ mA
$t_{D(off)}$			25		μs	$R_L = 2.4$ kΩ

Notes
1. Collector current transfer ratio is defined as the ratio of the collector current to the forward bias input current.
2. Rise time is defined as the time for the collector current to rise from 10% to 90% of peak value. Fall time is defined as the time required for the current to decrease from 90% to 10% of peak value.

Optically-Coupled Darlington Isolator

Optoelectronic Products

MCA230
MCA231
MCA255

General Description

The MCA230, MCA231 and MCA255 series of optically-coupled isolators are electrical and mechanical replacements for the Monsanto series. Optical intercoupling provides a high degree of ac and dc isolation. Connection to the base is also provided for design flexibility.

Glassolated™
High Current Transfer Ratio At Low Input Current
10^{11} Ω Isolation Resistance
Low Coupling Capacitance—Typically 1.5 pF

Absolute Maximum Ratings

Storage Temperature	−55°C to +150°C
Operating Temperature	−55°C to +100°C
Pin Temperature (Soldering, 10 s)	260°C
Total Package Power Dissipation at T_A = 25°C (LED plus Detector)	300 mW
Derate Linearly from 25°C	4.0 mW/°C

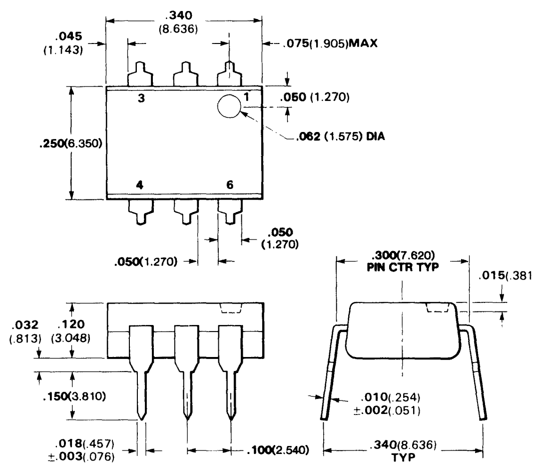
Input Diode

V_R	Reverse Voltage	3.0 V
I_F	Forward dc Current	60 mA
I_{pk}	Peak Forward Current (1 μs pulse width, 300 pps)	3.0 A
P_D	Power Dissipation at T_A = 25°C	90 mW
	Derate Linearly from 55°C	2.0 mW/°C

Output Transistor (Darlington)

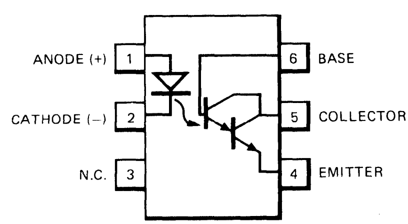
V_{CE}	Collector-to-Emitter Voltage	
	MCA230/231	30 V
	MCA255	55 V
V_{CB}	Collector-to-Base Voltage	
	MCA230/231	30 V
	MCA255	55 V
P_D	Power Dissipation at T_A = 25°C	210 mW
	Derate Linearly from 25°C	2.8 mW/°C

Package Outline



Notes
All dimensions in inches **bold** and millimeters (parentheses)
Tolerance unless specified = ±**.015** (±.381)

Connection Diagram
DIP (Top View)



Pin		
1	Anode (+)	Input Diode
2	Cathode (−)	Input Diode
3	NC	
4	Emitter	Output npn Phototransistor
5	Collector	Output npn Phototransistor
6	Base	Output npn Phototransistor

Electrical Characteristics—Input Diode T_A = 25°C

Symbol	Characteristic	Min	Typ	Max	Units	Test Conditions
V_F	Forward Voltage		1.2	1.5	V	I_F = 20 mA
BV_R	Reverse Breakdown Voltage	3.0	5.0		V	I_R = 10 μA

Typical Electrical Characteristics

MCA230
MCA231
MCA255

Electrical Characteristics—Output Transistor $T_A = 25°C$

Symbol	Characteristic	Min	Typ	Max	Units	Test Conditions
V_{CEO}	Collector-to-Emitter Voltage					
	MCA230/231	30			V	$I_C = 1.0$ mA, $I_F = 0$
	MCA255	55			V	$I_C = 1.0$ mA, $I_F = 0$
V_{CBO}	Collector-to-Base Voltage					
	MCA230/231	30			V	$I_C = 10\ \mu A$, $I_F = 0$
	MCA255	55				
I_{CEO}	Collector-to-Emitter Leakage Current		1.0	100	nA	$V_{CE} = 10$ V, $I_F = 0$
h_{FE}	Forward Current Gain		25 k			$V_{CE} = 5.0$ V, $I_C = 500\ \mu A$
V_{EBO}	Emitter-to-Base Voltage					$I_E = 10\ \mu A$
	MCA230/255	8			V	
	MCA231	6			V	

Electrical Characteristics—Coupled $T_A = 25°C$

Symbol	Characteristic	Min	Typ	Max	Units	Test Conditions
I_C	Collector Output Current					
	MCA230	10	40		mA	$V_{CE} = 5.0$ V, $I_F = 10$ mA
	MCA231	2.0	4.0		mA	$V_{CE} = 1.0$ V, $I_F = 1.0$ mA
	MCA255	10	40		mA	$V_{CE} = 5.0$ V, $I_F = 10$ mA
V_{ISO}	Isolation Voltage	1.5 k	2.0 k		V	
R_{ISO}	Isolation Resistance		10^{11}		Ω	V = 500 V
$V_{CE(sat)}$	Collector-to-Emitter Saturation Voltage					
	MCA230, MCA255		0.8	1.0	V	$I_C = 50$ mA, $I_F = 50$ mA
	MCA231		0.8	1.0	V	$I_C = 2.0$ mA, $I_F = 1.0$ mA
	MCA231		0.8	1.0	V	$I_C = 10$ mA, $I_F = 5$ mA
	MCA231		0.9	1.2	V	$I_C = 40$ mA, $I_F = 10$ mA
t_{on}	Turn-on Time		40		μs	$I_C = 1.0$ mA, $V_{CC} = 10$ V, $R_L = 100\ \Omega$
t_{off}	Turn-off Time (See Note 1)		50		μs	

Notes
1. Collector current transfer ratio is defined as the ratio of the collector current to the forward bias input current.
2. Rise time is defined as the time for the collector current to rise from 10% to 90% of peak value. Fall time is defined as the time required for the current to decrease from 90% to 10% of peak value.

Optically-Coupled Isolator

Optoelectronic Products

MCT2, MCT2E MCT26

General Description

The MCT2, MCT2E and MCT26 optical isolators are electrical and mechanical replacements for the Monsanto series. Optical intercoupling provides a high degree of ac and dc isolation. A capability for continuous operation of the input diode results in a frequency response extending to dc. Connection to the base is also provided for design flexibility.

Glassolated™
Electrically Equivalent to Monsanto Devices
Pin-for-Pin Equivalent to Monsanto Devices
Availability of Base Pin for Flexible Design

Absolute Maximum Ratings

Maximum Temperature and Humidity

Storage Temperature	−55°C to +150°C
Operating Temperature	−55°C to +100°C
Pin Temperature (Soldering, 5 s)	260°C
Total Package Power Dissipation at T_A = 25°C,	
LED plus Detector	250 mW
Derate Linearly from 25°C	3.3 mW/°C

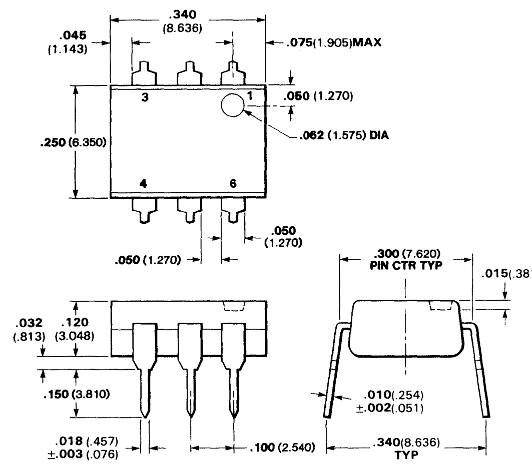
Input Diode

V_R	Reverse Voltage	3.0 V
I_F	Forward Current	60 mA
I_{pk}	Peak Forward Current, 1 μs pulse width, 330 pps	3.0 A
P_D	Power Dissipation	
	at T_A = 25°C	200 mW
	Derate Linearly from 25°C	2.6 mW/°C

Output Transistor

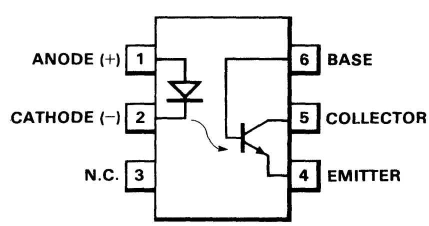
V_{CE}	Collector-to-Emitter Voltage	30 V
V_{CB}	Collector-to-Base Voltage	30 V
V_{EC}	Emitter-to-Collector Voltage	7.0 V
P_D	Power Dissipation	
	at T_A = 25°C	200 mW
	Derate Linearly from 25°C	2.6 mW/°C

Package Outline



Notes
All dimensions in inches **bold** and millimeters (parentheses)
Tolerance unless specified = ±**.015** (±.381)

Connection Diagram
DIP (Top View)



Pin		
1	Anode (+)	Input Diode
2	Cathode (−)	
3	NC	
4	Emitter	Output npn Phototransistor
5	Collector	
6	Base	

Typical Electrical Characteristics

MCT2, MCT2E MCT26

Electrical Characteristics—Input Diode $T_A = 25°C$

Symbol	Characteristic	Min	Typ	Max	Units	Test Conditions
V_F	Forward Voltage		1.25	1.5	V	$I_F = 20$ mA
BV_R	Reverse Breakdown Voltage	3.0	5.5		V	$I_R = 10\ \mu A$

Electrical Characteristics—Output Transistor $T_A = 25°C$

Symbol	Characteristic	Min	Typ	Max	Units	Test Conditions
V_{CEO}	Collector-to-Emitter Voltage					
	MCT2/MCT2E	30	65		V	$I_C = 1.0$ mA, $I_F = 0$
	MCT26	30	75		V	$I_C = 1.0$ mA, $I_F = 0$
V_{CBO}	Collector-to-Base Voltage					
	MCT2/MCT2E	70	165		V	$I_C = 100\ \mu A$
	MCT26	30	100		V	$I_C = 100\ \mu A$
V_{ECO}	Emitter-to-Collector Voltage					
	MCT2/MCT2E	7.0	14		V	$I_C = 100\ \mu A$
	MCT26	7.0	12		V	$I_C = 100\ \mu A$
I_{CEO}	Collector-to-Emitter Leakage Current					
	MCT2/MCT2E		5.0	50	nA	$V_{CE} = 10$ V, $I_F = 0$
	MCT26		5.0	100	nA	$V_{CE} = 5.0$ V, $I_F = 0$
I_{CBO}	Collector-to-Base Leakage Current					
	MCT2/MCT2E		0.1	20	nA	$V_{CB} = 10$ V, $I_F = 0$
	MCT26		1.0	100	nA	$V_{CB} = 5.0$ V, $I_F = 0$
h_{FE}	Forward Current Gain					
	MCT2/MCT2E	100	250			$V_{CE} = 5.0$ V, $I_C = 100\ \mu A$
	MCT26	100	150			$V_{CE} = 5.0$ V, $I_C = 100\ \mu A$
C_{ce}	Collector-to-Emitter Capacitance					
	MCT2/MCT2E, MCT26		8.0		pF	$V_{CE} = 0$
C_{cb}	Collector-to-Base Capacitance					
	MCT2/MCT2E		20		pF	$V_{CB} = 10$ V
C_{eb}	Emitter-to-Base Capacitance					
	MCT2/MCT2E		10		pF	$V_{BE} = 0$

Typical Electrical Characteristics (Cont'd)

MCT2, MCT2E MCT26

Electrical Characteristics—Coupled $T_A = 25°C$

Symbol	Characteristic	Min	Typ	Max	Units	Test Conditions
V_{IO}	Input-to-Output Voltage					
	MCT2	1500	2300		V_{dc}	f = 60 Hz
	MCT2E	2500			V_{dc}	
	MCT26	1500	2500		V_{dc}	
	MCT2, MCT26	800			V_{rms}	
$V_{CE(sat)}$	Collector-to-Emitter Saturation Voltage					
	MCT2, MCT2E		0.24	0.4	V	$I_C = 2.0$ mA, $I_F = 16$ mA
	MCT26		0.2	0.3	V	$I_C = 250\ \mu A$, $I_F = 20$ mA
I_C/I_F(CTR)	Collector Current Transfer Ratio (Note 1)					
	MCT2, MCT2E	20	50		%	$V_{CE} = 10$ V, $I_F = 10$ mA
	MCT26	6	14		%	
R_{IO}	Input-to-Output Resistance					
	MCT2		10^{11}		Ω	$V_{IO} = 500$ V
	MCT2E		10^{11}	10^{12}	Ω	
C_{IO}	Input-to-Output Capacitance					
	MCT2, MCT2E		1.0		pF	f = 1.0 MHz
	MCT26		1.0	2.0	pF	
t_r, t_f	Collector Rise and Fall Times (Note 2)					
	MCT26		2.0		μs	$I_C = 2.0$ mA, $V_{CE} = 10$ V

Notes

1. Collector current transfer ratio is defined as the ratio of the collector current to the forward bias input current.
2. Rise time is defined as the time for the collector current to rise from 10% to 90% of peak value. Fall time is defined as the time required for the current to decrease from 90% to 10% of peak value.

Dual Optically-Coupled Isolator

MCT6, MCT66

Optoelectronic Products

General Description

The MCT6 and MCT66 comprise two distinct optoisolators with transistor output, in a single 8-pin dual in-line package. Each channel consists of a GaAs emitter optically coupled to a phototransistor.

High Current Transfer Ratio
1500 V Minimum Isolation Input-to-Output
10^{11} Ω Isolation Resistance
Low Coupling Capacitance—Typically 1.0 pF
I/O Compatible with Integrated Circuits
Two Packages Fit Into a Standard 16-Pin DIP Socket

Absolute Maximum Ratings

Maximum Temperature

Storage Temperature	−55°C to +150°C
Operating Temperature	−55°C to +100°C
Pin Temperature (Soldering, 5 s)	250°C
Total Package Power Dissipation at T_A = 25°C	400 mW
Derate Linearly from 25°C	5.33 mW/°C

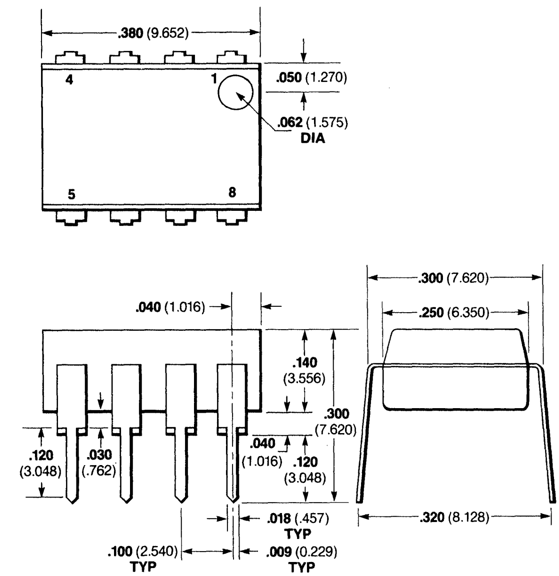
Input Diode (Each Channel)

V_R	Reverse Voltage	3.0 V
I_F	Forward Current	60 mA
I_{pk}	Peak Forward Current at 1 μs pulse, 300 pps	3.0 A
P_D	Power Dissipation at T_A = 25°C	100 mW
	Derate Linearly from 50°C	2.0 mW/°C

Output Transistor (Each Channel)

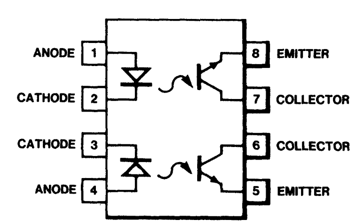
V_{CE}	Collector-to-Emitter Voltage	30 V
V_{EC}	Emitter-to-Collector Voltage	6.0 V
P_D	Power Dissipation at T_A = 25°C	150 mW
	Derate Linearly from 25°C	2.0 mW/°C
I_C	Collector Current	30 mA

Package Outline



Notes
All dimensions in inches **bold** and millimeters (parentheses)
Tolerance unless specified = ±**.015** (±.381)
Package weight is 0.4 gram

Connection Diagram
DIP (Top View)



Pin		
1	Anode	
2	Cathode	Channel #1
3	Cathode	
4	Anode	Channel #2
5	Emitter	
6	Collector	Channel #2
7	Collector	
8	Emitter	Channel #1

Typical Electrical Characteristics

MCT6, MCT66

Electrical Characteristics—Input Diode T_A = 25°C

Symbol	Characteristic	Min	Typ	Max	Units	Test Conditions
V_F	Forward Voltage		1.25	1.5	V	I_F = 20 mA
V_R	Reverse Voltage	3.0	5.5		V	I_R = 10 μA
C_J	Junction Capacitance		50		pF	V_F = 0 V
I_R	Reverse Current		0.01	10	μA	V_R = 3.0 V

Electrical Characteristics—Output Transistor T_A = 25°C

Symbol	Characteristic	Min	Typ	Max	Units	Test Conditions
V_{CEO}	Collector-to-Emitter Voltage	30	85		V	I_C = 1.0 mA, I_F = 0
V_{ECO}	Emitter-to-Collector Voltage	6.0	13		V	I_C = 100 μA
I_{CEO}	Collector-to-Emitter Leakage Current		5.0	100	nA	V_{CE} = 10 V, I_F = 0
C_{CE}	Collector-to-Emitter Capacitance		8.0		pF	V_{CE} = 0

Electrical Characteristics—Coupled T_A = 25°C

Symbol	Characteristic	Min	Typ	Max	Units	Test Conditions
V_{IO}	Input-to-Output Voltage	1500	2500		V	
$V_{CE(sat)}$	Collector-to-Emitter Saturation Voltage					
	MCT6		0.20	0.4	V	I_C = 2.0 mA, I_F = 16 mA
	MCT66		0.20	0.4	V	I_C = 2.0 mA, I_F = 40 mA
I_C/I_F(CTR)	Collector Current Transfer Ratio (Note 1)					
	MCT6	20	50		%	V_{CE} = 10 V, I_F = 10 mA
	MCT66	6	15		%	V_{CE} = 10 V, I_F = 10 mA
R_{IO}	Input-to-Output Resistance	10^{11}	10^{12}		Ω	V_{IO} = 500 V
C_{IO}	Input-to-Output Capacitance		0.5		pF	f = 1.0 MHz
t_r t_f	Collector Rise and Fall Times (Note 2)		2.0		μs	I_C = 2.0 mA, V_{CE} = 10 V, R_L = 100 Ω
B_W	Bandwidth		150		kHz	I_C = 2.0 mA, V_{CC} = 10 V, R_L = 100 Ω
BV_{C-C}	Breakdown Voltage Channel-to-Channel		1500		V	
C_{C-C}	Capacitance Channel-to-Channel		0.4		pF	f = 1.0 MHz

Notes
1. Collector current transfer ratio is defined as the ratio of the collector current to the forward bias input current.
2. Rise time is defined as the time for the collector current to rise from 10% to 90% of peak value. Fall time is defined as the time required for the current to decrease from 90% to 10% of peak value.

5

Optically-Coupled Isolator

TIL111, TIL114 TIL116, TIL117

Optoelectronic Products

General Description

The TIL111, TIL114, TIL116 and TIL117 series of optically-coupled isolators are electrical and mechanical replacements for the Texas Instruments series. Optical intercoupling provides a high degree of ac and dc isolation. Connection to the base is also provided for design flexibility.

Glassolated™
High Current Transfer Ratio
High-Speed Switching—Typically 2 μs
10^{11} Ω Isolation Resistance
Low Coupling Capacitance—Typically 1.0 pF

Absolute Maximum Ratings

Maximum Temperature

Storage Temperature	−55°C to +150°C
Operating Temperature	−55°C to +100°C
Pin Temperature (Soldering, 5 s)	260°C
Total Package Power Dissipation at T_A = 25°C, LED plus Detector	250 mW
Derate Linearly from 25°C	3.3 mW/°C

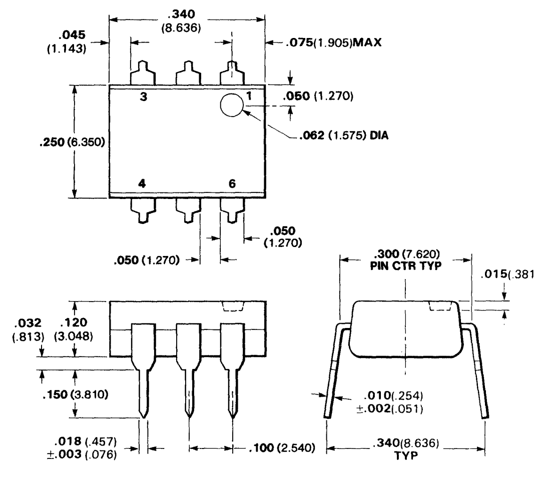
Input Diode

V_R	Reverse Voltage	3.0 V
I_F	Forward dc Current	100 mA
I_{pk}	Peak Forward Current at 1 μs pulse width, 300 pps	3.0 A
P_D	Power Dissipation at T_A = 25°C	150 mW
	Derate Linearly from 25°C	2.6 mW/°C

Output Transistor

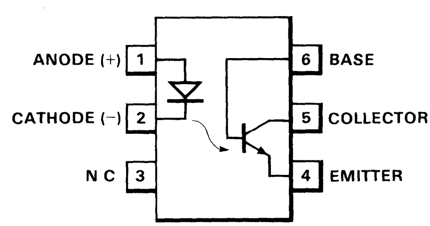
V_{CE}	Collector-to-Emitter Voltage	30 V
V_{CB}	Collector-to-Base Voltage	70 V
P_D	Power Dissipation at T_A = 25°C	150 mW
	Derate Linearly from 25°C	2.6 mW/°C

Package Outline



Notes
All dimensions in inches bold and millimeters (parentheses)
Tolerance unless specified = ±.015 (±.381)

Connection Diagram
DIP (Top View)



Pin		
1	Anode (+)	Input Diode
2	Cathode (−)	
3	NC	
4	Emitter	Output npn Phototransistor
5	Collector	
6	Base	

Typical Electrical Characteristics

TIL111, TIL114 TIL116, TIL117

Electrical Characteristics—Input Diode $T_A = 25°C$

Symbol	Characteristic	Min	Typ	Max	Units	Test Conditions
V_F	Forward Voltage					
	TIL111, TIL114, TIL117		1.2	1.4	V	$I_F = 16$ mA
	TIL116		1.2	1.5	V	$I_F = 60$ mA
BV_R	Reverse Breakdown Voltage	3.0	5.0		V	$I_R = 10\ \mu A$

Electrical Characteristics—Output Transistor $T_A = 25°C$

Symbol	Characteristic	Min	Typ	Max	Units	Test Conditions
V_{CEO}	Collector-to-Emitter Voltage	30			V	$I_C = 1.0$ mA, $I_F = 0$
V_{CBO}	Collector-to-Base Voltage	70			V	$I_C = 10\ \mu A$, $I_F = 0$
V_{EBO}	Emitter-to-Base Voltage	7.0			V	$I_E = 10\ \mu A$
I_{CEO}	Collector-to-Emitter Leakage Current		1.0	50	nA	$V_{CE} = 10$ V, $I_F = 0$
I_{CBO}	Collector-to-Base Leakage Current		0.1	20	nA	$V_{CB} = 10$ V, $I_F = 0$
h_{FE}	Forward Current Gain					
	TIL111, TIL114	100	300			$V_{CE} = 5$ V, $I_C = 10$ mA
	TIL116	100	300			$V_{CE} = 5$ V, $I_C = 100\ \mu A$
	TIL117	200	550			$V_{CE} = 5$ V, $I_C = 10$ mA

Typical Electrical Characteristics (Cont'd)

TIL111, TIL114 TIL116, TIL117

Electrical Characteristics—Coupled $T_A = 25°C$

Symbol	Characteristic	Min	Typ	Max	Units	Test Conditions
I_C	Collector Output Current					
	TIL111, TIL114	2.0	7.0		mA	$V_{CE} = 0.4$ V, $I_F = 16$ mA
	TIL116	2.0	5.0		mA	$V_{CE} = 10$ V, $I_F = 10$ mA
	TIL117	5.0	9.0		mA	$V_{CE} = 10$ V, $I_F = 10$ mA
I_B	Collector-to-Base Current	10	20		μA	$V_{CB} = 0.4$ V, $I_F = 16$ mA
V_{ISO}	Isolation Voltage					
	TIL111	1500			V	
	TIL114, TIL116, TIL117	2500			V	
R_{ISO}	Isolation Resistance	10^{11}			Ω	V = 500 V
$V_{CE(sat)}$	Collector-to-Emitter Saturation Voltage					
	TIL111, TIL114		0.25	0.4	V	$I_C = 2.0$ mA, $I_F = 16$ mA
	TIL116		0.25	0.4		$I_C = 2.2$ mA, $I_F = 15$ mA
	TIL117		0.25	0.4	V	$I_C = 0.5$ mA, $I_F = 10$ mA
C_{ISO}	Isolation Capacitance		1.0	1.3	pF	V = 0, f = 1.0 MHz
t_r, t_f	Rise Time, Fall time (See Note)					$I_C = 2.0$ mA, $V_{CC} = 10$ V, $R_L = 100\ \Omega$ (See Note)
	TIL111, TIL114		5.0	10	μs	
	TIL116		5.0	10	μs	
	TIL117		5.0	10	μs	

Note
Rise time is defined as the time for the collector current to rise from 10% to 90% of peak value. Fall time is defined as the time required for the current to decrease from 90% to 10% of peak value.

Optically-Coupled Isolator

Optoelectronic Products

TIL112
TIL115
TIL118

General Description

The TIL112, TIL115 and TIL118 series of optical isolators are electrical and mechanical replacements for the Texas Instrument series. Optical intercoupling provides a high degree of ac and dc isolation. Connection to the base is also provided for design flexibility.

Glassolated™
High Current Transfer Ratio
High-Speed Switching—Typically 2 μs
10^{11} Ω Isolation Resistance
Low Coupling Capacitance—Typically 1.0 pF

Absolute Maximum Ratings

Maximum Temperature

Storage Temperature	−55°C to +150°
Operating Temperature	−55°C to +100°C
Pin Temperature (Soldering, 5 s)	260°C
Total Package Power Dissipation at T_A = 25°C, LED plus Detector	250 mW
Derate Linearly from 25°C	3.3 mW/°C

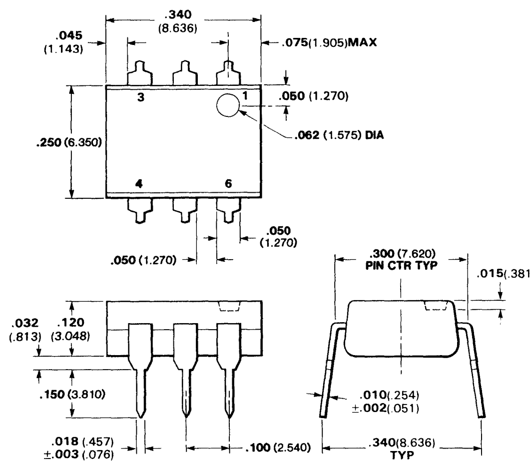
Input Diode

V_R	Reverse Voltage	3.0 V
I_F	Forward dc Current	100 mA
I_{pk}	Peak Forward Current at 1 μs pulse width, 300 pps	3.0 A
P_D	Power Dissipation at T_A = 25°C	150 mW
	Derate Linearly from 25°C	2.0 mW/°C

Output Transistor

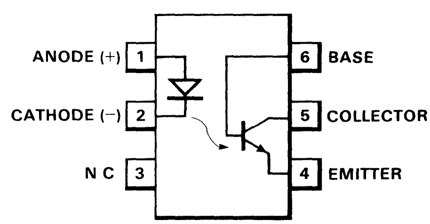
V_{CE}	Collector-to-Emitter Voltage	20 V
V_{CB}	Collector-to-Base Voltage	30 V
P_D	Power Dissipation at T_A = 25°C	150 mW
	Derate Linearly from 25°C	2.0 mW/°C

Package Outline



Notes
All dimensions in inches **bold** and millimeters (parentheses)
Tolerance unless specified = ±**.015** (±**.381**)

Connection Diagram
DIP (Top View)



Pin		
1	Anode (+)	Input Diode
2	Cathode (−)	
3	NC	
4	Emitter	Output npn Phototransistor
5	Collector	
6	Base	

Typical Electrical Characteristics

TIL112 TIL115 TIL118

Electrical Characteristics—Input Diode $T_A = 25°C$

Symbol	Characteristic	Min	Typ	Max	Units	Test Conditions
V_F	Forward Voltage		1.2	1.5	V	$I_F = 10$ mA
BV_R	Reverse Breakdown Voltage	3.0	5.0		V	$I_R = 10\ \mu A$

Electrical Characteristics—Output Transistor $T_A = 25°C$

Symbol	Characteristic	Min	Typ	Max	Units	Test Conditions
V_{CEO}	Collector-to-Emitter Voltage	20			V	$I_C = 1.0$ mA, $I_F = 0$
V_{CBO}	Collector-to-Base Voltage	30			V	$I_C = 10\ \mu A$, $I_F = 0$
V_{EBO}	Emitter-to-Collector Voltage (V_{ECO} on TIL118)	4.0			V	$I_E = 10\ \mu A$, $I_F = 0$
I_{CEO}	Collector-to-Emitter Leakage Current		1.0	100	nA	$V_{CE} = 5.0$ V, $I_F = 0$
I_{CBO}	Collector-to-Base Leakage Current		0.1	50	nA	$V_{CB} = 5.0$ V, $I_F = 0$
h_{FE}	Forward Current Gain	50	200			$V_{CE} = 5.0$ V, $I_C = 10\ \mu A$

Electrical Characteristics—Coupled $T_A = 25°C$

Symbol	Characteristic	Min	Typ	Max	Units	Test Conditions
I_C	Collector Output Current					
	TIL112, TIL115	0.2	2.0		mA	$V_{CE} = 5.0$ V, $I_F = 10$ mA
	TIL118	1.0	2.0		mA	$V_{CE} = 5.0$ V, $I_F = 10$ mA
I_B	Collector-to-Base Current					
	TIL112, TIL115	2.0	10		μA	$V_{CB} = 5.0$ V, $I_F = 10$ mA
V_{ISO}	Isolation Voltage					
	TIL112, TIL118	1500			V	
	TIL115	2500			V	
R_{ISO}	Isolation Resistance		10^{11}		Ω	V = 500 V
C_{ISO}	Isolation Capacitance			2.0	pF	f = 1 MHz
$V_{CE(sat)}$	Collector-to-Emitter Saturation Voltage			0.5	V	$I_C = 2.0$ mA, $I_F = 50$ mA
t_r	Rise Time		2.0	15	μs	$I_C = 2.0$ mA, $V_{CC} = 10$ V, $R_L = 100\ \Omega$
t_f	Fall Time (See Note)		2.0	15	μs	$I_C = 2.0$ mA, $V_{CC} = 10$ V, $R_L = 100\ \Omega$

Note

Rise time is defined as the time for the collector current to rise from 10% to 90% of peak value. Fall time is defined as the time required for the current to decrease from 90% to 10% of peak value.

Optically-Coupled Darlington Isolator

TIL113
TIL119

Optoelectronic Products

General Description

The TIL113 and TIL119 optical isolators are electrical and mechanical replacements for the Texas Instrument series. Optical coupling provides a high degree of ac and dc isolation. A capability for continuous operation of the input diode results in a frequency response extending to dc. Connection to the base is also provided for design flexibility.

Glassolated™
Electrically Equivalent to TI Devices
Pin-for-Pin Equivalent
Availability of Base Pin for Flexible Design

Absolute Maximum Ratings

Storage Temperature	−55°C to +150°C
Operating Temperature	−55°C to +100°C
Pin Temperature (Soldering, 10 s)	260°C
Total Package Power Dissipation at T_A = 25°C (LED plus Detector)	250 mW
Derate Linearly from 25°C	3.3 mW/°C

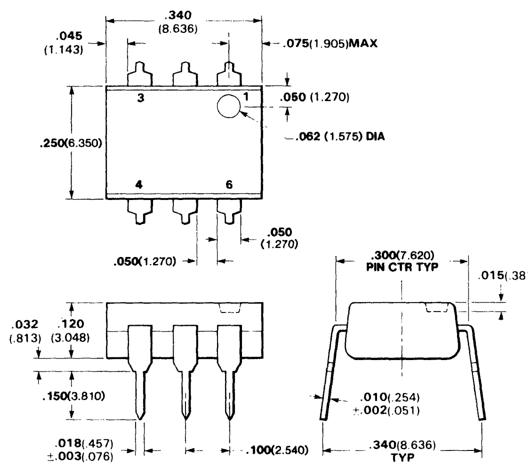
Input Diode

I_F	Forward dc Current Continuous	100 mA
V_R	Reverse Voltage	3.0 V
I_{pk}	Peak Forward Current, 1 µs pulse width, 300 pps	3.0 A
P_D	Power Dissipation at T_A = 25°C	150 mW
	Derate Linearly from 25°C	2.0 mW/°C

Output Transistor (Darlington)

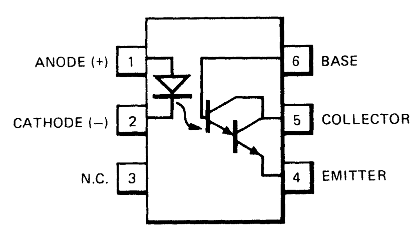
V_{CE}	Collector-to-Emitter Voltage	30 V
V_{CB}	Collector-to-Base Voltage	30 V
V_{EC}	Emitter-to-Collector Voltage	7.0 V
P_D	Power Dissipation at T_A = 25°C, $I_{C(max)}$ 100 mA, V_{CE} = 1.5 V	150 mW
	Derate Linearly from 25°C	2.0 mW/°C

Package Outline



Notes
All dimensions in inches **bold** and millimeters (parentheses)
Tolerance unless specified = ±**.015** (0.381)

Connection Diagram DIP (Top View)



Pin

1	Anode (+)	Input Diode
2	Cathode (−)	
3	NC	
4	Emitter	Output npn Phototransistor
5	Collector	
6	Base	

Electrical Characteristics—Input Diode T_A = 25°C

Symbol	Characteristic	Min	Typ	Max	Units	Test Conditions
V_F	Forward Voltage			1.5	V	I_F = 10 mA
I_R	Reverse Current			100	µA	V_R = 3.0 V

Typical Electrical Characteristics

TIL113
TIL119

Electrical Characteristics—Output Transistor (Darlington) $T_A = 25°C$

Symbol	Characteristic	Min	Typ	Max	Units	Test Conditions
BV_{CEO}	Collector-to-Emitter Breakdown Voltage	30			V	$I_C = 1.0$ mA, $I_F = 0$
BV_{CBO}	Collector-to-Base Breakdown Voltage TIL113	30				$IC = 10\ \mu A$, $I_F = 0$
BV_{ECO}	Emitter-to-Collector Breakdown Voltage TIL119	7.0			V	$I_E = 10\ \mu A$, $I_F = 0$
BV_{EBO}	Emitter-to-Base Breakdown Voltage TIL113	7.0			V	$I_E = 10\ \mu A$, $I_F = 0$
I_{CEO}	Collector-to-Emitter Leakage Current			100	nA	$V_{CE} = 10$ V, $I_F = 0$
h_{FE}	Forward Current Gain TIL113		15 k			$V_{CE} = 1.0$ V, $I_C = 10$ mA, $I_F = \phi$

Electrical Characteristics—Coupled $T_A = 25°C$

Symbol	Characteristic	Min	Typ	Max	Units	Test Conditions
I_C	Collector Output Current (Pulsed)					
	TIL113	30	100		mA	$I_F = 10$ mA, $V_{CE} = 1.0$ V
	TIL119	30	160		mA	$I_F = 10$ mA, $V_{CE} = 2.0$ V
V_{ISO}	Isolation Voltage (Note 2)	1.5 k			V	Peak
R_{ISO}	Isolation Resistance	10^{11}			Ω	V = 500 V
$V_{CE(sat)}$	Collector-to-Emitter Saturation Voltage					
	TIL113			1.0	V	$I_C = 125$ mA, $I_B = 0$, $I_F = 50$ mA
	TIL119			1.0	V	$I_C = 10$ mA, $I_F = 10$ mA
C_{ISO}	Isolation Capacitance		1.0	1.3	pF	V = 0, f = 1.0 MHz
t_r, t_f	Rise and Fall Time (Note 1) TIL113		300		μs	$I_C = 125$ mA, $V_{CC} = 15$ V, $R_L = 100\ \Omega$
t_r, t_f	Rise and Fall Time (Note 1) TIL119		300		μs	$I_C = 2.5$ mA, $V_{CC} = 10$ V, $R_L = 100\ \Omega$

Notes
1. Rise time is defined as the time for the (base collector) current to rise from 10% to 90% of peak value. Fall time is defined as the time required for the current to decrease from 90% to 10% of peak value.
2. Isolation voltage defined as minimum of 5 s continuous application.

Optically-Coupled Isolator

Optoelectronic Products

4N25, 4N26 4N27, 4N28

General Description

The 4N25, 4N26, 4N27, and 4N28 series of opto-isolators has a silicon npn Planar phototransistor coupled to a GaAs diode. Each is mounted in a 6-pin plastic dual in-line package.

Glassolated™
High Current Transfer Ratio—Typically 50%
500 V to 2500 V Minimum Isolation Input-To-Output
10^{11} Ω Isolation Resistance
Low Coupling Capacitance—Typically 1.0 pF

Absolute Maximum Ratings

Maximum Temperature and Humidity

Storage Temperature*	−55°C to 150°C
Operating Temperature	−55°C to 100°C
Pin Temperature	
Soldering, 10 s*	260°C
Total Package Power Dissipation at T_A = 25°C,	
LED plus Detector*	250 mW
Derate Linearly from 25°C*	3.3 mW/°C

Input Diode*

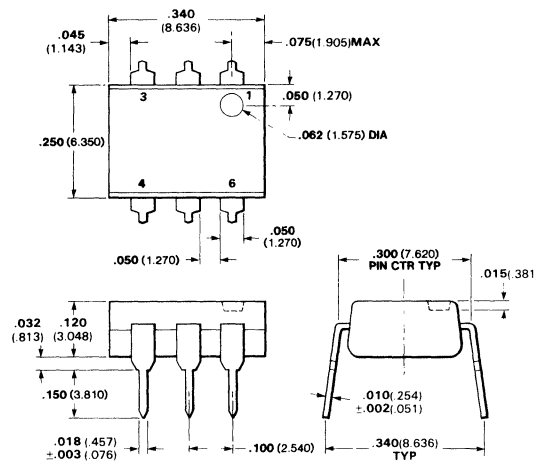
V_R*	Reverse Voltage	3.0 V
I_F*	Forward dc Current	80 mA
I_{pk}*	Peak Forward Current, 1 µs pulse width, 300 pps	3.0 A
P_D*	Power Dissipation at T_A = 25°C	150 mW
	Derate Linearly from 25°C	2.0 mW/°C

Output Transistor

V_{CE}*	Collector-to-Emitter Voltage	30 V
V_{CB}*	Collector-to-Base Voltage	70 V
V_{EC}*	Emitter-to-Collector Voltage	7.0 V
P_D*	Power Dissipation at T_A = 25°C	150 mW
	Derate Linearly from 25°C	2.0 mW/°C

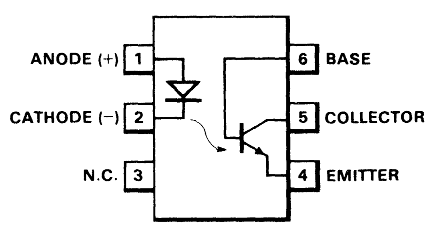
*Indicates JEDEC registered values.

Package Outline



Notes
All dimensions in inches **bold** and millimeters (parentheses)
Tolerance unless specified = ±**.015** (±.381)

Connection Diagram DIP (Top View)



Pin		
1	Anode (+)	Input Diode
2	Cathode (−)	
3	NC	
4	Emitter	Output npn Phototransistor
5	Collector	
6	Base	

Typical Electrical Characteristics

4N25, 4N26 4N27, 4N28

Electrical Characteristics—Input Diode $T_A = 25°C$

Symbol	Characteristic	Min	Typ	Max	Units	Test Conditions
V_F*	Forward Voltage		1.2	1.5	V	$I_F = 50$ mA
I_R*	Reverse Leakage Current		0.05	100	μA	$V_R = 3.0$ V, $R_L = 1$ MΩ
C	Capacitance		150		pF	$V_R = 0$ V, f = 1 MHz

Electrical Characteristics—Output Transistor $T_A = 25°C$

Symbol	Characteristic	Min	Typ	Max	Units	Test Conditions
V_{CEO}*	Collector-to-Emitter Voltage	30	65		V	$I_C = 1.0$ mA, $I_B = 0$
V_{CBO}*	Collector-to-Base Voltage	70	165		V	$I_C = 100$ μA, $I_E = 0$
V_{ECO}*	Emitter-to-Collector Voltage	7.0	14		V	$I_E = 100$ μA, $I_B = 0$
I_{CEO}*	Collector-to-Emitter Leakage Current					
	4N25, 4N26, 4N27		3.5	50	nA	$V_{CE} = 10$ V, Base Open
	4N28			100	nA	$V_{CE} = 10$ V, Base Open
I_{CBO}*	Collector-to-Base Leakage Current		0.1	20	nA	$V_{CB} = 10$ V, Emitter Open
h_{FE}	Forward Current Gain		250			$V_{CE} = 5.0$ V, $I_C = 500$ μA
C_{cb}	Collector-to-Base Capacitance		65		pF	$V_{CB} = 0$, f = 1 MHz

Electrical Characteristics—Coupled $T_A = 25°C$

Symbol	Characteristic	Min	Typ	Max	Units	Test Conditions
V_{IO}*	Input-to-Output Voltage					
	4N25	2500			V_{pk}	
	4N26, 4N27	1500			V_{pk}	
	4N28	500			V_{pk}	
$V_{CE(sat)}$*	Collector-to-Emitter Saturation Voltage		0.2	0.5	V	$I_C = 2.0$ mA, $I_F = 50$ mA
I_C*	Collector Output Current					
	4N25, 4N26	2.0	5.0		mA	$V_{CE} = 10$ V,
	4N27, 4N28	1.0	3.0		mA	$I_F = 10$ mA, $I_B = 0$
R_{IO}	Input-to-Output Resistance		10^{11}		Ω	$V_{IO} = 500$ V
BW	Collector Bandwidth		300		kHz	$I_C = 2.0$ mA, $V_{CC} = 10$ V, $R_L = 100$ Ω
C_{IO}	Input-to-Output Capacitance		1.3		pF	$V_{IO} = 0$, f = 1.0 MHz

*Indicates JEDEC registered values.

Optically-Coupled Darlington Isolator

Optoelectronics Products

4N29, 4N30 4N31, 4N32 4N33

General Description

The 4N29, 4N30, 4N31, 4N32 and 4N33 series of optoisolators has a silicon npn Planar photo-Darlington transistor coupled to a GaAs diode. Each is mounted in a 6-pin plastic DIP package.

High Current Transfer Ratio
1500 V or 2500 V Minimum Isolation Input-To-Output
10^{11} Ω Isolation Resistance
Low Coupling Capacitance

Absolute Maximum Ratings

Maximum Temperature and Humidity

Storage Temperature*	−55°C to 150°C
Operating Temperature	−55°C to 100°C
Pin Temperature	
Soldering, 10 s*	260°C
Total Package Power Dissipation at T_A = 25°C (LED plus Detector)*	250 mW
Derate Linearly from 25°C*	3.3 mW/°C

Input Diode*

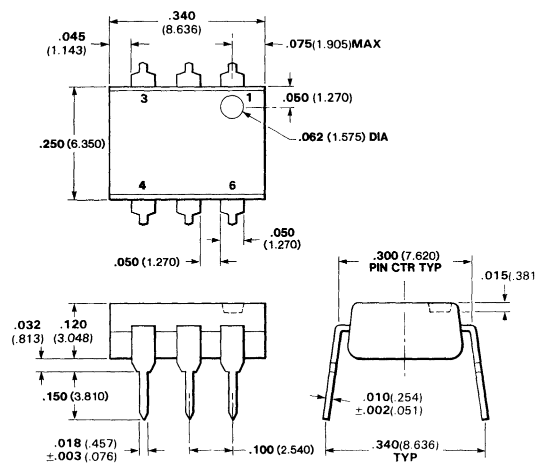
I_F	Forward dc Current Continuous *	80 mA
V_R	Reverse Voltage	3.0 V
I_{pk}	Peak Forward Current (1 μs pulse width, 300 pps)	3.0 A
P_D	Power Dissipation at T_A = 25°C	150 mW
	Derate Linearly from 25°C	2.0 mW/°C

Output Transistor (Darlington) *

V_{CE}	Collector-to-Emitter Voltage	30 V
V_{CB}	Collector-to-Base Voltage	50 V
V_{EB}	Emitter-to-Base Voltage	8.0 V
V_{EC}	Emitter-to-Collector Voltage	5.0 V
P_D	Power Dissipation at T_A = 25°C	150 mW
	Derate Linearly from 25°C	2.0 mW/°C

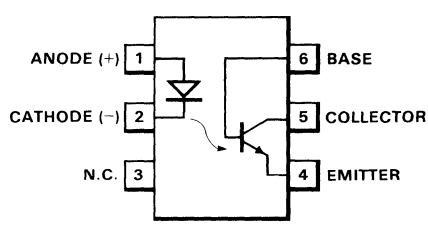
*Indicates JEDEC Registered Data

Package Outline



Notes
All dimensions in inches **bold** and millimeters (parentheses)
Tolerance unless specified = ±**.015** (±.381)

Connection Diagram DIP (Top View)



Pin		
1	Anode (+)	Input Diode
2	Cathode (−)	
3	NC	
4	Emitter	Output npn Phototransistor
5	Collector	
6	Base	

Electrical Characteristics—Input Diode T_A = 25°C

Symbol	Characteristic	Min	Typ	Max	Units	Test Conditions
V_F*	Forward Voltage		1.2	1.5	V	I = 50 mA
I_R*	Reverse Leakage Current		0.05	100	μA	V_R = 3.0 V
C	Capacitance		150		pF	V_R = 0 V, f = 1 MHz

Typical Electrical Characteristics

4N29, 4N30 4N31, 4N32 4N33

Electrical Characteristics—Output Transistor (Darlington) $T_A = 25°C$

Symbol	Characteristic	Min	Typ	Max	Units	Test Conditions
BV_{CEO}*	Collector-to-Emitter Breakdown Voltage	30	70		V	$I_C = 100\ \mu A$, $I_B = 0$
BV_{CBO}*	Collector-to-Base Breakdown Voltage	30			V	$I_C = 100\ \mu A$, $I_E = 0$
BV_{ECO}*	Emitter-to-Collector Breakdown Voltage	5.0			V	$I_E = 100\ \mu A$, $I_B = 0$
I_{CEO}*	Collector-to-Emitter Dark Current			100	nA	$V_{CE} = 10$ V, Base Open
h_{FE}	Forward Current Gain		2000			$V_{CE} = 5.0$ V, $I_C = 500\ \mu A$

Electrical Characteristics—Coupled $T_A = 25°C$

Symbol	Characteristic	Min	Typ	Max	Units	Test Conditions
I_C*	Collector Output Current					
	4N32, 4N33	50			mA	$V_{CE} = 10$ V, $I_F = 10$ mA
	4N29, 4N30	10			mA	$V_{CE} = 10$ V, $I_F = 10$ mA
	4N31	5.0			mA	$V_{CE} = 10$ V, $I_F = 10$ mA
V_{ISO}*	Isolation Voltage					
	4N29, 4N32	2500			V	
	4N30, 4N31, 4N33	1500			V	
R_{ISO}*	Isolation Resistance		10^{11}		Ω	V = 500 V
$V_{CE(sat)}$*	Collector-to-Emitter Saturation Voltage					
	4N31			1.2	V	$I_C = 2.0$ mA, $I_F = 8.0$ mA
	4N29, 4N30, 4N32, 4N33			1.0	V	$I_C = 2.0$ mA, $I_F = 8.0$ mA
C_{ISO}	Isolation Capacitance		1.5		pF	V = 0, f = 1.0 MHz
t_{on}	Turn-on Time		10		μs	$I_C = 50$ mA, $V_{CC} = 10$ V, $R_L = 180\ \Omega$, $I_F = 200$ mA
t_{off}	Turn-off Time (See Note)					$I_C = 50$ mA, $V_{CC} = 10$ V, $R_L = 180\ \Omega$, $I_F = 200$ mA
	4N29, 4N30, 4N31		20	45	μs	
	4N32, 4N33		60	120	μs	

Note
Turn-on time is defined as the time for the (base collector) current to rise from 10% to 90% of peak value. Turn-off time is defined as the time required for the current to decrease from 90% to 10% of peak value.
*Indicates JEDEC Registered Data.

Optically-Coupled Isolator

Optoelectronic Products

4N35
4N36
4N37

General Description

The 4N35, 4N36 and 4N37 series of optoisolators has a silicon npn Planar phototransistor in close proximity to a GaAs diode. Optical coupling provides a high degree of ac and dc isolation. A capability for continuous operation of the input diode results in a frequency response extending to dc. Connection to the transistor base is also provided for design flexibility. This isolator series is covered under UL component recognition program, reference file E55299.

Glassolated™
High Current Transfer Ratio—Minimum 100%
1500 V to 3500 V Minimum Isolation Input-to-Output
$10^{11}\ \Omega$ Isolation Resistance
Low Coupling Capacitance—Typically 1.0 pF

Absolute Maximum Ratings

Maximum Temperature and Humidity

Storage Temperature*	−55°C to +150°C
Operating Temperature	−55°C to +100°C
Pin Temperature (Soldering, 10 s)*	260°C
Relative Humidity at 85°C*	85%

Input Diode

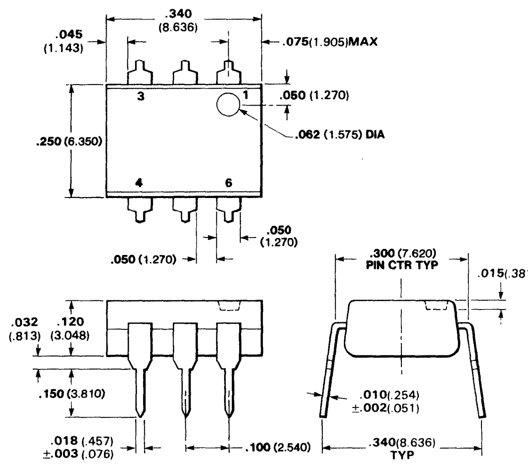
V_R*	Reverse Voltage	6.0 V
I_F*	Forward Current	60 mA
I_{pk}*	Peak Forward Current at 1 μs pulse width, 300 pps	3.0 A
P_D*	Power Dissipation at $T_A = 25°C$	100 mW
	Derate Linearly from 25°C	1.33 mW/°C

Output Transistor

V_{CE}*	Collector-to-Emitter Voltage	30 V
V_{CB}*	Collector-to-Base Voltage	70 V
V_{EC}*	Emitter-to-Collector Voltage	7.0 V
I_C*	Collector Current	100 mA
P_D*	Power Dissipation at $T_A = 25°C$	300 mW
	Derate Linearly from 25°C	4.0 mW/°C

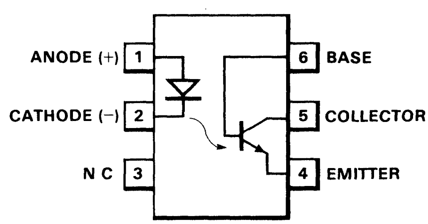
*Indicates JEDEC registered values.

Package Outline



Notes
All dimension in inches **bold** and millimeters (parentheses)
Tolerance unless specified = ±**0.15** (0.381)

Connection Diagram
DIP (Top View)



Pin		
1	Anode (+)	Input Diode
2	Cathode (−)	
3	NC	
4	Emitter	Output npn Phototransistor
5	Collector	
6	Base	

Typical Electrical Characteristics

4N35
4N36
4N37

Electrical Characteristics—Input Diode $T_A = 25°C$

Symbol	Characteristic	Min	Typ	Max	Units	Test Conditions
V_F*	Forward Voltage	0.8		1.5	V	$I_F = 10$ mA
I_R*	Reverse Leakage Current		0.01	10	μA	$V_R = 6.0$ V
C	Capacitance			100	pF	$V_R = 0$ V f = 1 MHz

Electrical Characteristics—Output Transistor $T_A = 25°C$

Symbol	Characteristic	Min	Typ	Max	Units	Test Conditions
V_{CEO}*	Collector-to-Emitter Voltage	30	65		V	$I_C = 10$ mA
V_{CBO}*	Collector-to-Base Voltage	70	165		V	$I_C = 100$ μA
V_{ECO}*	Emitter-to-Collector Voltage	7.0	14		V	$I_E = 100$ μA, $I_F = 0$
I_{CEO}*	Collector-to-Emitter Leakage Current		5.0	50	nA	$V_{CE} = 10$ V, $I_F = 0$
I_{CEO}*	Collector-to-Emitter Leakage Current			500	μA	$V_{CE} = 30$ V, $I_F = 0$, $T_A = 100°C$
h_{FE}	Forward Current Gain	100	250			$V_{CE} = 5.0$ V, $I_C = 100$ μA
C_{cb}	Collector-to-Base Capacitance		25		pF	$V_{CB} = 10$ V

Electrical Characteristics—Coupled $T_A = 25°C$

Symbol	Characteristic	Min	Typ	Max	Units	Test Conditions
I_{IO}*	Input-to-Output Current					PW = 8 ms
	4N35			100	μA	$V_{IO} = 3550$ V
	4N36			100	μA	$V_{IO} = 2500$ V
	4N37			100	μA	$V_{IO} = 1500$ V
$V_{CE(sat)}$*	Collector-to-Emitter Saturation Voltage			0.3	V	$I_C = 0.5$ mA, $I_F = 10$ mA
I_C/I_F(CTR)*	Collector Current Transfer Ratio (Note)	100			%	$V_{CE} = 10$ V, $I_F = 10$ mA
I_C/I_F(CTR)*	Collector Current Transfer Ratio (Note)	40			%	$V_{CE} = 10$ V, $I_F = 10$ mA, $T_A = -55°C$ to 100°C
R_{IO}	Input-to-Output Resistance	10^{11}			Ω	$V_{IO} = 500$ V
C_{IO}	Input-to-Output Capacitance		1.0	2.5	pF	$V_{IO} = 0$, f = 1.0 MHz
t_{on}	Turn-on Time		5.0	10	μs	$I_C = 2.0$ mA, $V_{CC} = 10$ V, $R_L = 100$ Ω
t_{off}	Turn-off Time		5.0	10	μs	$I_C = 2.0$ mA, $V_{CC} = 10$ V, $R_L = 100$ Ω

Notes
Collector current transfer ratio is defined as the ratio of the collector current to the forward bias input current.
*Indicates JEDEC registered values.

LSTTL/TTL Compatible Optocoupler

6N137

Optoelectronic Products

General Description

The 6N137 optocoupler consists of a GaAsP light-emitting diode and an integrated circuit detector. Light is collected in the detector by the photodiode; then, it is amplified by a high-gain linear amplifier that drives a Schottky-clamped, open-collector output transistor. Temperature, current and voltage are compensated in the circuit.

This isolator design achieves LSTTL/TTL circuit compatibility while attaining a maximum dc and ac circuit isolation between input and output. The circuit operates from a 5 V supply, and the output is guaranteed to sink at least 13 mA (eight TTL loads) over the 0°C to 70°C temperature range, when the input LED current is 5 mA. When the device is in the coupling and isolating mode, the typical propagation delay is 45 ns. An LSTTL/TTL-compatible, active-HIGH enable input gates the output with a typical propagation delay of 25 ns.

The 6N137 is applicable for interfacing between subsystems that operate at different ground potentials, signal levels, or in the presence of very high common-mode noise levels. These situations include programmable floating power supplies, motors and other machine control systems.

LSTTL/TTL Compatible: 5 V Supply
Ultra High Speed
Low Input Current Required
High Common-Mode Rejection
Guaranteed Performance Over Temperature
3000 V dc Insulation Voltage

Absolute Maximum Ratings* (No Derating Required Up to 70°C)

Maximum Temperature

Operating Temperature	0°C to +70°C
Storage Temperature	−55°C to +125°C
Pin Temperature (Soldering, 10 s) (1.6 mm below seating plane)	260°C

Maximum Power Dissipation

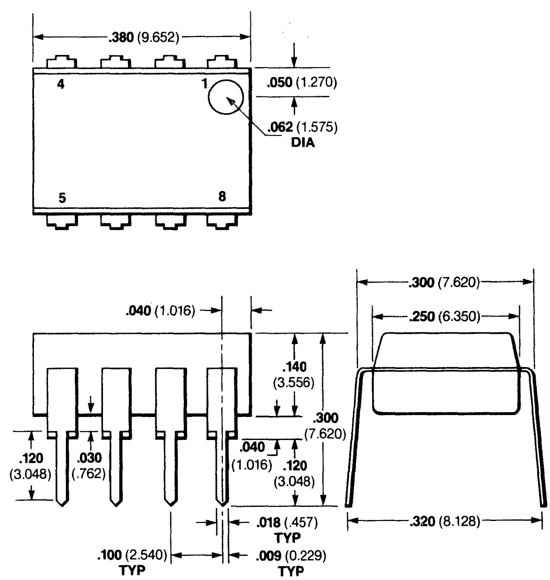
Output Collector Power Dissipation	85 mW

*JEDEC Registered Data

Maximum Voltage and Currents

V_R	Reverse Input Voltage	5.0 V
I_F	Average Forward Input Current	10 mA
I_{pk}	Peak Forward Input Current, 1 ≤ 1 ms duration	40 mA
V_E	Enable Input Voltage (Not to exceed V_{CC} by more than 500 mV)	5.5 V
V_{CC}	Supply Voltage (1 minute maximum)	7.0 V
I_{OUT}	Output Current	50 mA
V_{OUT}	Output Voltage	7.0 V

Package Outline



Notes
All dimensions in inches **bold** and millimeters (parentheses)
Tolerance unless specified = ±**.015** (±.381)

Typical Electrical Characteristics

6N137

Recommended Operating Conditions

Symbol	Characteristic	Min	Typ	Max	Units
I_{IL}	Input Current, Low Level, Each Channel	0		250	μA
I_{HL}	Input Current, High Level, Each Channel	6.3		15	mA
V_{EH}	High-Level Enable Voltage	2.0		V_{CC}	V
V_{EL}	Low-Level Enable Voltage (Output HIGH)	0		0.8	V
V_{CC}	Supply Voltage, Output	4.5		5.5	V
N	Fan Out (TTL Load)			8.0	
T_A	Operating Temperature	0		70	degrees

Note
6.3 mA condition permits at least 20% CTR degradation guardband. Initial switching threshold is 5 mA or less.

Electrical Characteristics Over Recommended Temperature T_A = 0°C to 70°C Unless Otherwise Noted

Symbol	Characteristic	Min	Typ**	Max	Units	Test Conditions
I_{OH}*	High-Level Output Current		50	250	μA	V_{CC} = 5.5 V, V_O = 5.5 V, I_F = 250 μA, V_F = 2.0 V
V_{OL}*	Low-Level Output Voltage		0.5	0.6	V	V_{CC} = 5.5 V, I_F = 5 mA, V_{EH} = 2.0 V, I_{OL} (Sinking) = 13 mA
I_{EH}	High-Level Enable Current		−1.0		mA	V_{CC} = 5.5 V, V_E = 2.0 V
I_{EL}*	Low-Level Enable Current		−1.6	−2.0	mA	V_{CC} = 5.5 V, V_E = 0.5 V
I_{CCH}*	High-Level Supply Current		7.0	15	mA	V_{CC} = 5.5 V, I_F = 0, V_E = 0.5 V
I_{CCL}*	Low-Level Supply		13	18	mA	V_{CC} = 5.5 V, I_F = 10 mA, V_E = 0.5 V
I_{IO}*	Input-Output Insulation Leakage Current			1.0	μA	Relative Humidity = 45%, T_A = 25°C, t = 5 s V_{IO} = 3000 V
R_{IO}	Resistance (Input-Output)		10^{12}		Ω	V_{IO} = 500 V, T_A = 25°C
C_{IO}	Capacitance (Input-Output)		0.6		pF	f = 1 MHz, T_A = 25°C
V_F	Input Forward Voltage		1.5	1.75	V	I_F = 10 mA, T_A = 25°C
BV_R*	Input Reverse Breakdown Voltage	5.0			V	I_R = 10 μA, T_A = 25°C
C_{IN}	Input Capacitance		60		pF	V_F = 0, f = 1 MHz
CTR	Current Transfer Ratio		700		%	I_F = 5.0 mA, R_L = 100 Ω

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

Typical Electrical Characteristics (Cont'd) Connection Diagram

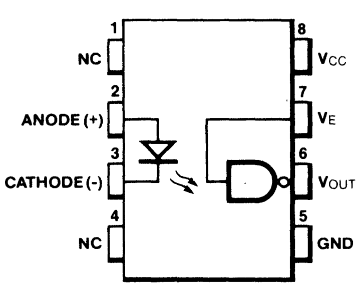
6N137

Switching Characteristics $T_A = 25°C$, $V_{CC} = 5\ V$

Symbol	Characteristic	Min	Typ	Max	Units	Test Conditions
t_{PLH}*	Propagation Delay Time to High Output Level		45	75	ns	$R_L = 350\ \Omega$, $C_L = 15\ pF$, $I_F = 7.5\ mA$
t_{PHL}*	Propagation Delay Time to Low Output Level		45	75	ns	$R_L = 350\ \Omega$, $C_L = 15\ pF$, $I_F = 7.5\ mA$
t_r, t_f	Output Rise-Fall Time (10–90%)		25		ns	$R_L = 350\ \Omega$, $C_L = 15\ pF$, $I_F = 7.5\ mA$
t_{ELH}	Propagation Delay Time of Enable from V_{EH} to V_{EL}		25		ns	$R_L = 350\ \Omega$, $C_L = 15\ pF$, $I_F = 7.5\ mA$, $V_{EH} = 3.0\ V$, $V_{EL} = 0.5\ V$
t_{EHL}	Propagation Delay Time of Enable from V_{EL} to V_{EH}		15		ns	$R_L = 350\ \Omega$, $C_L = 15\ pF$, $I_F = 7.5\ mA$, $V_{EH} = 3.0\ V$, $V_{EL} = 0.5\ V$
CM_H	Common-Mode Transient Immunity at Logic HIGH Output Level		50		V/µs	$V_{CM} = 10\ V$, $R_L = 350\ \Omega$, $V_{O(min)} = 2\ V$, $I_F = 0\ mA$
CM_L	Common-Mode Transient Immunity at Logic LOW Output Level		−150		V/µs	$V_{CM} = 10\ V$, $R_L = 350\ \Omega$, $V_{O(max)} = 0.8\ V$, $I_F = 5\ mA$

*JEDEC Registered Data

Connection Diagram



Pin

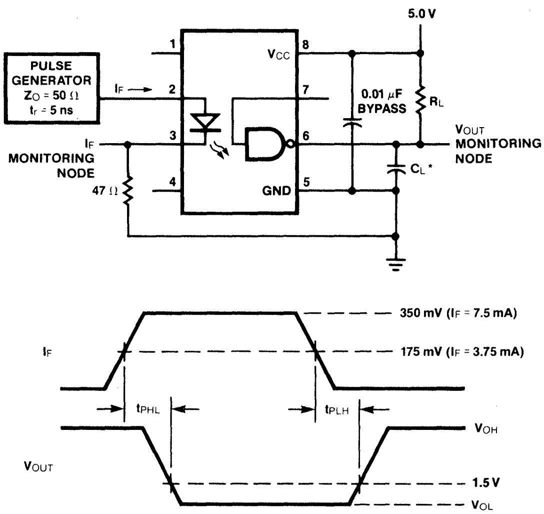
1 NC
2 Anode (+)
3 Cathode (−)
4 NC
5 Ground
6 V_{OUT}
7 V_E
8 V_{CC}

5

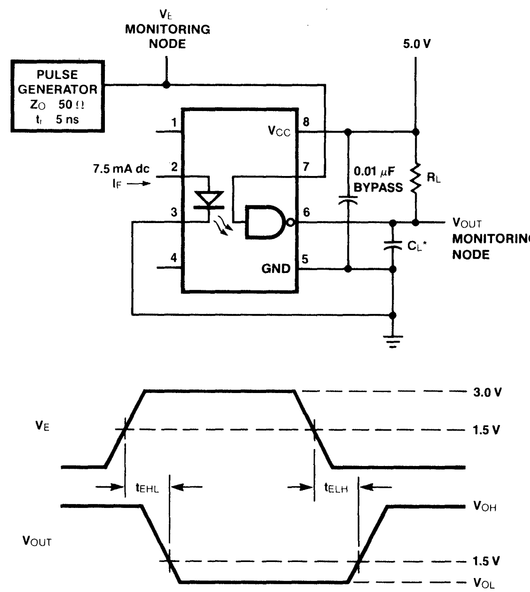
AC Test Circuits and Waveforms

6N137

Test Circuit for t_{PHL} and t_{PLH}

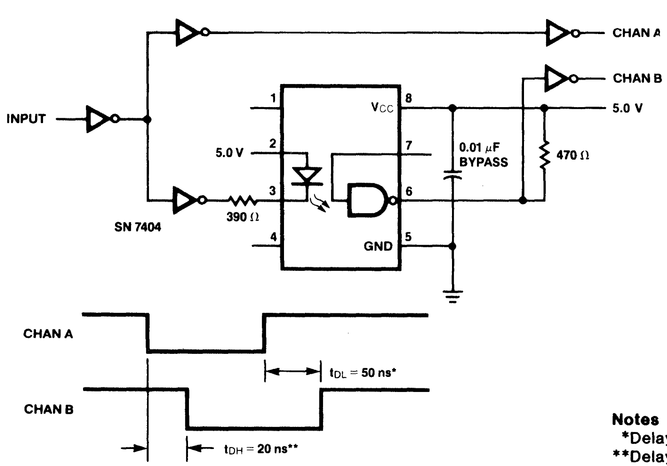


Test Circuit for t_{ELH} and t_{EHL}



Note
*C_L is approximately 15 pF, which includes probe and stray wiring capacitance.

Response Delay Between TTL Gates

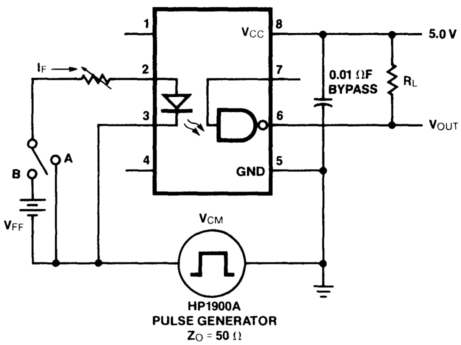


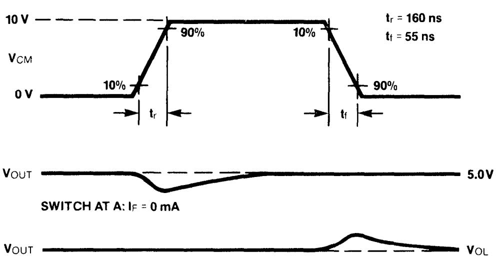
Notes
*Delay in response to logic HIGH level input
**Delay in response to logic LOW level input

AC Test Circuits and Waveforms

6N137

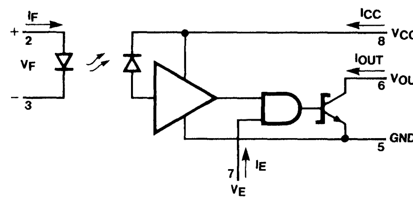
Test Circuit for Transient Immunity and Typical Waveforms





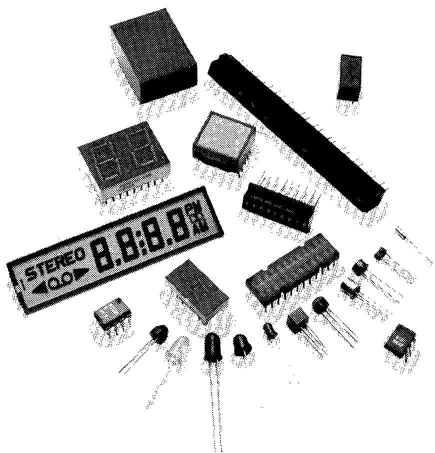
SWITCH AT B: I_F = 5 nA

Equivalent Circuit



Notes
Delay in response to logic HIGH level input
Delay in response to logic LOW level input

5


STEREO
8.8:8.8

12-Digit Telephone-Calculator Display

FLB1208X1

Optoelectronic Products

General Description

The FLB1208X1 is a non-multiplexed liquid crystal display that is hermetically sealed with glass frit. It interfaces with elastomeric connectors, is available in four polarizer options and operates at the standard temperature range of −20°C to +60°C. Applications include telephone, calculator and general instrumentation requiring multiple digits.

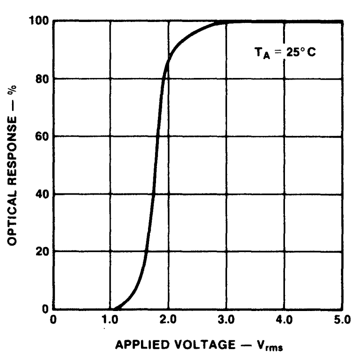
0.3-Inch Digits (7.6 mm)
12 Decimal Points
Four Polarizer Options
Glass-Frit Seal for High Reliability

Electrical Characteristics Measured at 25°C with drive voltage of 5.0 V, square wave at 32 Hz.

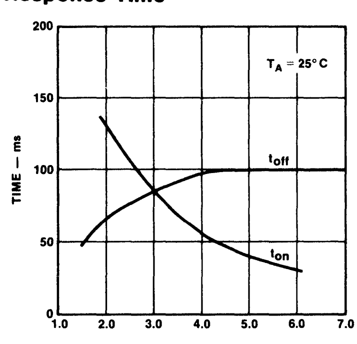
Characteristic	Min	Typ	Max	Units
Operating Voltage	2.8	5.0	12.0	V_{RMS}
Saturation Voltage	2.0	2.2	2.4	V_{RMS}
Operating Frequency Range	30	32	1000	Hz
Drive Current at 3.0 V, All Segments On			10	μA
Contrast Ratio		20:1		
Response Times: t_{on} (Includes Delay Time)		70	150	ms
t_{off} (Includes Delay Time)		100	150	ms
Operating Temperature Range (Note)	−20		60	°C
Storage Temperature Range	−20		80	°C
Humidity	50/60			°C/RH
Life Time		50k		hrs
DC Drive Component Allowable			50	mV

Note
Display may be operated beyond these limits for short periods of time. Extended periods of operation at high temperatures and humidities cause polarizer degradation reslting in reduced contrast. Higher operating temperature is available. Contact factory.

Voltage Characteristics



Response Time

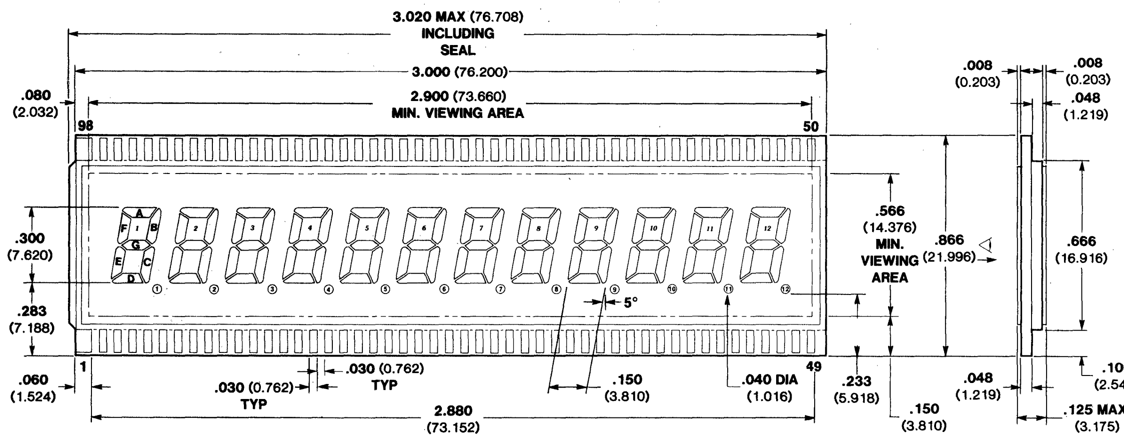


6

Package Outline Pin Assignments

FLB1208X1

Package Outline



Notes
Front and rear polarizers are same size.
All dimensions in inches **bold** and millimeters (parentheses).
Solder seal shall not exceed backglass width.

Pin Assignments

1 Backplane
2 Segment E_1
3 Segment D_1
4 Segment C_1
5 Decimal Point 1
6 Segment E_2
7 Segment D_2
8 Segment C_2
9 Decimal Point 2
10 Segment E_3
11 Segment D_3
12 Segment C_3
13 Decimal Point 3
14 Segment E_4
15 Segment D_4
16 Segment C_4
17 Decimal Point 4
18 Segment E_5
19 Segment D_5
20 Segment C_5
21 Decimal Point 5
22 Segment E_6
23 Segment D_6
24 Segment C_6
25 Decimal Point 6
26 Segment E_7
27 Segment D_7
28 Segment C_7
29 Decimal Point 7
30 Segment E_8
31 Segment D_8
32 Segment C_8
33 Decimal Point 8
34 Segment E_9
35 Segment D_9
36 Segment C_9
37 Decimal Point 9
38 Segment E_{10}
39 Segment D_{10}
40 Segment C_{10}
41 Decimal Point 10
42 Segment E_{11}
43 Segment D_{11}
44 Segment C_{11}
45 Decimal Point 11
46 Segment E_{12}
47 Segment D_{12}
48 Segment C_{12}
49 Decimal Point 12
50 Segment B_{12}
51 Segment A_{12}
52 Segment F_{12}
53 Segment G_{12}
54 Segment B_{11}
55 Segment A_{11}
56 Segment F_{11}
57 Segment G_{11}
58 Segment B_{10}
59 Segment A_{10}
60 Segment F_{10}
61 Segment G_{10}
62 Segment B_9
63 Segment A_9
64 Segment F_9
65 Segment G_9
66 Segment B_8
67 Segment A_8
68 Segment F_8
69 Segment G_8
70 Segment B_7
71 Segment A_7
72 Segment F_7
73 Segment G_7
74 Segment B_6
75 Segment A_6
76 Segment F_6
77 Segment G_6
78 Segment B_5
79 Segment A_5
80 Segment F_5
81 Segment G_5
82 Segment B_4
83 Segment A_4
84 Segment F_4
85 Segment G_4
86 Segment B_3
87 Segment A_3
88 Segment F_3
89 Segment G_3
90 Segment B_2
91 Segment A_2
92 Segment F_2
93 Segment G_2
94 Segment B_1
95 Segment A_1
96 Segment F_1
97 Segment G_1
98 Backplane

Ordering Information FLB1208X1

Ordering Information

Device Type	Polarizer Option
FLB1208A1	Non-Polarized
FLB1208B1	Transflective
FLB1208C1	Reflective (smooth)
FLB1208D1	Transmissive

Connectors
Display interfaces with elastomeric connectors.
See page 6-42 for elastomeric connector suppliers.

Drivers
See page 6-43 for available drivers.

3½-Digit Clock and Instrument Display

FLB3511X1

Optoelectronic Products

General Description

The FLB3511X1 is a liquid crystal display that is hermetically sealed with glass frit. It interfaces with elastomeric connectors, is available in four polarizer options and operates at the standard temperature range of −20°C to +60°C. Applications include clock, digital panel meter and general instrumentation.

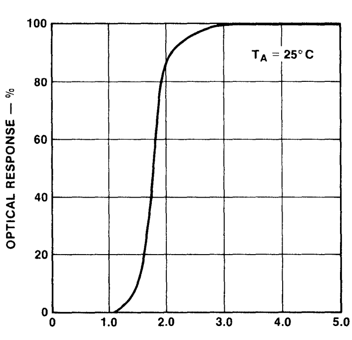
0.45-Inch Digits (11.4 mm)
Colon for Timekeeping
Polarity and Decimal Points for DPMs
Four Polarizer Options
Glass-Frit Seal for High Reliability

Electrical Characteristics Measured at 25°C with drive voltage of 5.0 V, square wave at 32 Hz.

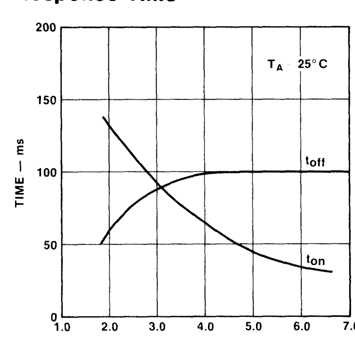
Characteristic	Min	Typ	Max	Units
Operating Voltage	2.8	5.0	12.0	V_{RMS}
Saturation Voltage	2.0	2.2	2.4	V_{RMS}
Operating Frequency Range	30	32	1000	Hz
Drive Current at 3.0 V, All Segments On			5	μA
Segment Capacitance			100	pF
Contrast Ratio		20:1		
Response Times: t_{on} (Includes Delay Time)		70	150	ms
t_{off} (Includes Delay Time)		100	150	ms
Operating Temperature Range (Note)	−20		60	°C
Storage Temperature Range	−20		80	°C
Humidity	50/60			°C/RH
Life Time		50k		hrs
DC Drive Component Allowable			50	mV

Note
Display may be operated beyond these limits for short periods of time. Extended periods of operation at high temperatures and humidities cause polarizer degradation resulting in reduced contrast. Higher operating temperature is available. Consult factory.

Voltage Characteristics



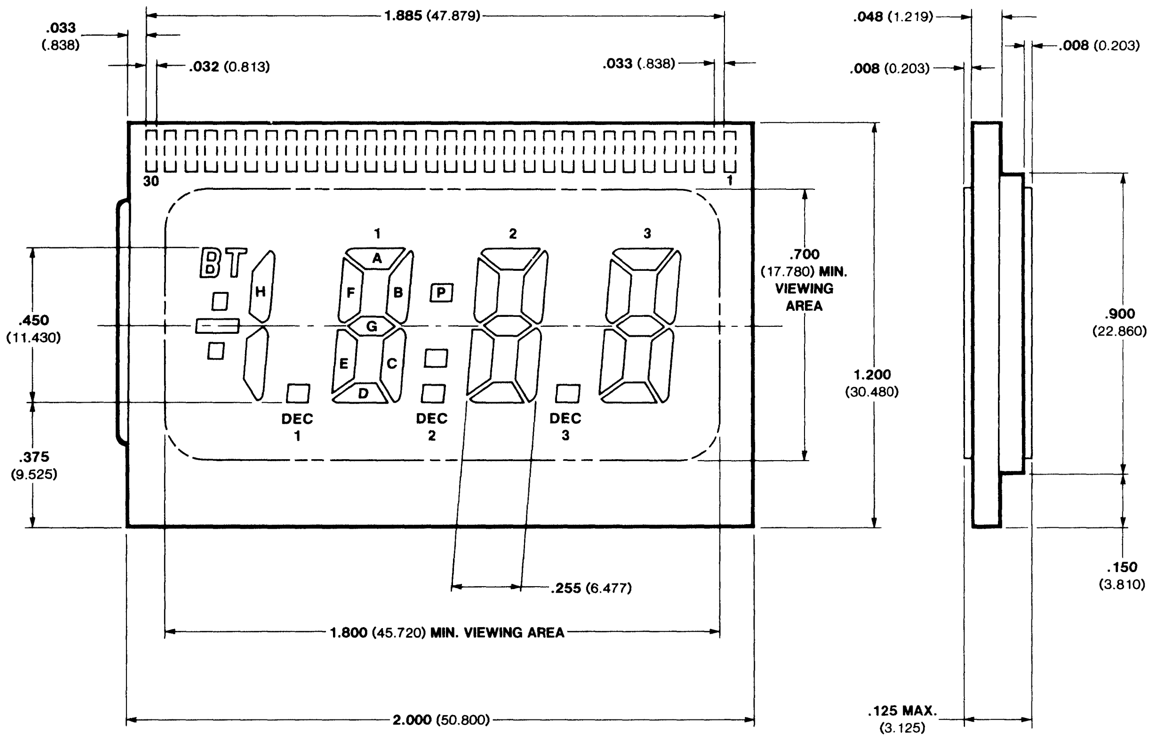
Response Time



Package Outline
Pin Assignments

FLB3511X1

Package Outline



Note
All dimensions in inches **bold** and millimeters (parentheses).

Pin Assignments

1 Segment D_3
2 Segment C_3
3 Segment B_3
4 Segment A_1
5 Segment F_3
6 Segment G_3
7 Segment E_3
8 Decimal 3
9 Segment D_2
10 Segment C_2
11 Segment B_2
12 Segment A_2
13 Segment F_2
14 Segment G_2
15 Segment E_2
16 Colon P
17 Decimal 2
18 Segment D_1
19 Segment C_1
20 Segment B_1
21 Segment A_1
22 Segment F_1
23 Segment G_1
24 Segment E_1
25 Decimal 1
26 Half Digit
27 Minus
28 Plus
29 BT
30 Backplane

Ordering Information FLB3511X1

Ordering Information

Device Type	Polarizer Option
FLB3511A1	Non-Polarized
FLB3511B1	Transflective
FLB3511C1	Reflective (smooth)
FLB3511D1	Transmissive

Connectors
Display interfaces with elastomeric connectors.
See page 6-42 for elastomeric connector suppliers.

Drivers
See page 6-43 for available drivers.

3½-Digit Clock and Instrument Display

Optoelectronic Products

FLB3513X1
FLB3513X2

General Description
The FLB3513X1 and FLB3513X2 are liquid crystal displays that are hermetically sealed with glass frit. They are available in pinned or elastomeric connector configurations, offer four polarizer options and operate at the standard temperature range of −20°C to +60°C. Applications include clock, digital panel meter and general instrumentation.

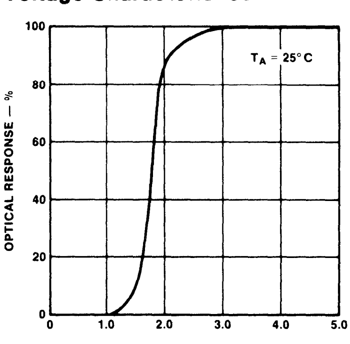
0.5-Inch Digits (13 mm)
Decimal Points for DPMs
Colon for Timekeeping
Four Polarizer Options
Glass-Frit Seal for High Reliability

Electrical Characteristics Measured at 25°C with drive voltage of 5.0 V, square wave at 32 Hz.

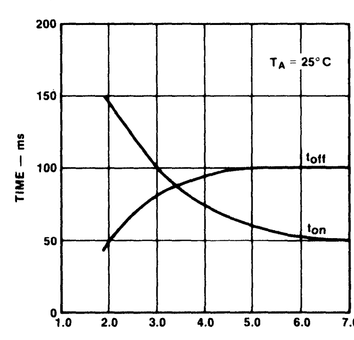
Characteristic	Min	Typ	Max	Units
Operating Voltage	2.8	5.0	12	V
Saturation Voltage	2.0	2.2	2.4	V
Operating Frequency Range	30	32	1000	Hz
Drive Current at 3.0 V, All Segments On			5.0	μA
Viewing Angle		45		degrees
Contrast Ratio		20:1		
Response Times: t_{on} (Includes Delay Time)		70	150	ms
t_{off} (Includes Delay Time)		100	150	ms
Operating Temperature Range (Note)	−20		60	°C
Storage Temperature Range	−20		80	°C
Humidity	50/60			°C/RH
Life Time		50K		hrs

Note
Higher operating temperature is available. Consult the factory for details.

Voltage Characteristics



Response Time



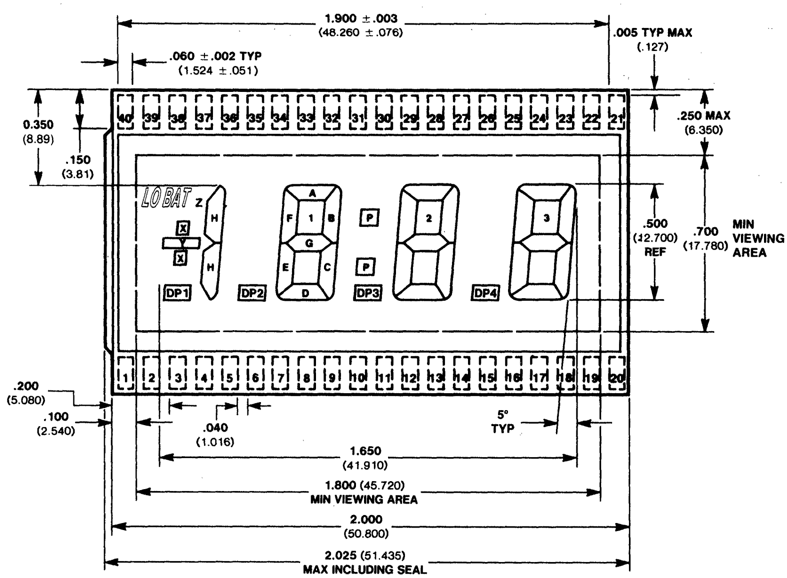
6

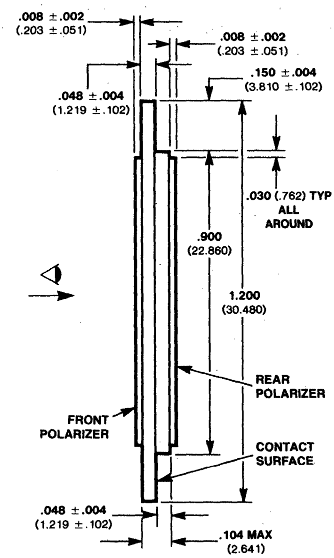
Package Outline

FLB3513X1
FLB3513X2

Package Outline

FLB3513X1 (Elastomer connection)





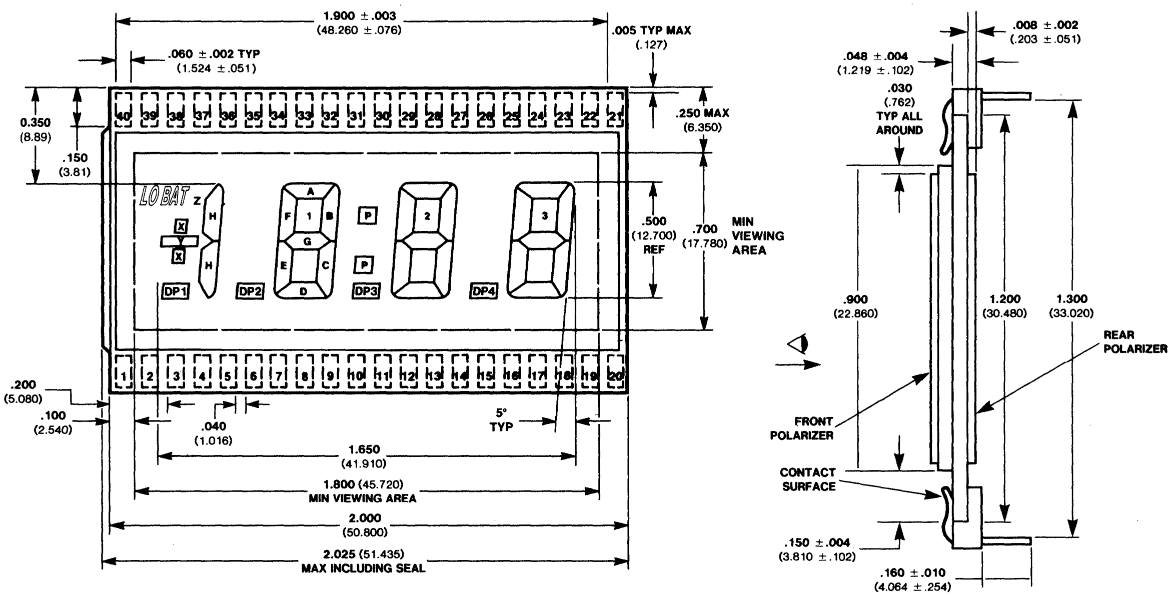
Pin Assignments

1 Backplane	9 Segment E_1	17 Segment E_3	25 Segment A_2	33 NC
2 Y	10 Segment D_1	18 Segment D_3	26 Segment F_2	34 NC
3 H	11 Segment C_1	19 Segment C_3	27 Segment G_2	35 NC
4 Decimal Point	12 Decimal Point 3	20 Segment B_3	28 Colon P	36 NC
5 NC	13 Segment E_2	21 Segment A_3	29 Segment B_1	37 NC
6 NC	14 Segment D_2	22 Segment F_3	30 Segment A_1	38 Z
7 NC	15 Segment C_2	23 Segment G_3	31 Segment F_1	39 X
8 Decimal Point 2	16 Decimal Point 4	24 Segment B_2	32 Segment G_1	40 Blank

Pin Assignments
Ordering Information

FLB3513X1
FLB3513X2

FLB3513X2 (Pin connection)



Notes
All dimensions in inches **bold** and millimeters (parentheses)

Ordering Information

Elastomeric Connector Configuration	Connector Pins	Polarizer Option
FLB3513A1	FLB3513A2	Non-polarized
FLB3513B1	FLB3513B2	Transflective
FLB3513C1	FLB3513C2	Reflective (smooth)
FLB3513D1	FLB3513D2	Transmissive

Connectors
Display is available in pinned or elastomeric configuration.
See page 6-42 for elastomeric connector suppliers.

Drivers
See page 6-43 for available drivers.

3½-Digit Clock and Instrument Display

Optoelectronic Products

FLB3513X3
FLB3513X4

General Description
The FLB3513X3 and FLB3513X4 are liquid crystal displays that are hermetically sealed with glass frit. They are available in pinned or elastomeric connector configurations, offer four polarizer options and operate at the standard temperature range of −20°C to +60°C. Applications include clock, digital panel meter and general instrumentation.

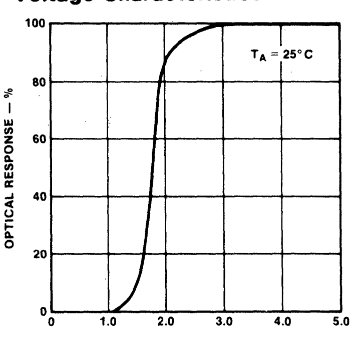
0.5-Inch Digits (13 mm)
Decimal Points for DPMs
Colon for Timekeeping
Four Polarizer Options
Glass-Frit Seal for High Reliability

Electrical Characteristics Measured at 25°C with drive voltage of 5.0 V, square wave at 32 Hz.

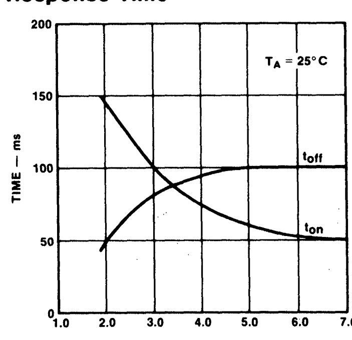
Characteristic	Min	Typ	Max	Units
Oerating Voltage	2.8	5.0	12	V
Saturation Voltage	2.0	2.2	2.4	V
Operating Frequency Range	30	32	1000	Hz
Drive Current at 3.0 V, All Segments On			5.0	μA
Viewing Angle		45		degrees
Contrast Ratio		20:1		
Response Times: t_{on} (Includes Delay Time)		70	150	ms
t_{off} (Includes Delay Time)		100	150	ms
Operating Temperature Range (Note)	−20		60	°C
Storage Temperature Range	−20		80	°C
Humidity	50/60			°C/RH
Life Time		50k		hrs

Note
Higher operating temperature is available. Consult the factory for details.

Voltage Characteristics



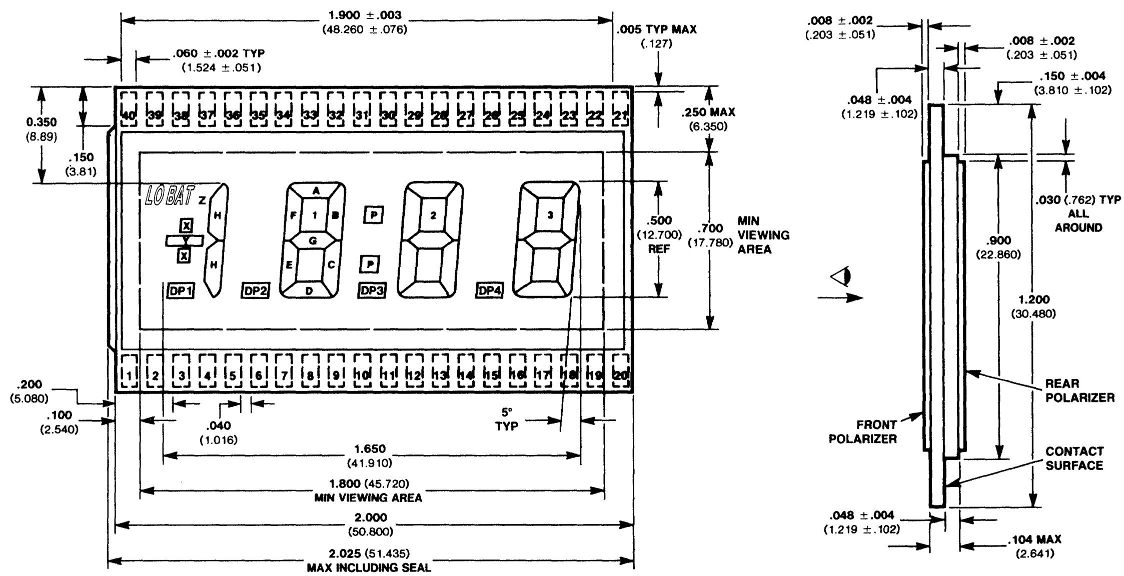
Response Time



Package Outline

FLB3513X3
FLB3513X4

FLB3513X3 Elastomer Connection



Note
All dimensions in inches bold and millimeters (parentheses)

Pin Assignments

1 Backplane	9 Segment E_1	17 Segment E_3	25 Segment A_2	33 NC
2 Y	10 Segment D_1	18 Segment D_3	26 Segment F_2	34 NC
3 H	11 Segment C_1	19 Segment C_3	27 Segment G_2	35 NC
4 Decimal Point 1	12 Decimal Point 3	20 Segment B_3	28 Segment P	36 NC
5 NC	13 Segment E_2	21 Segment A_3	29 Segment B_1	37 NC
6 NC	14 Segment D_2	22 Segment F_3	30 Segment A_1	38 Z
7 NC	15 Segment C_2	23 Segment G_3	31 Segment F_1	39 X
8 Decimal Point 2	16 Decimal Point 4	24 Segment B_2	32 Segment G_1	40 NC

Ordering Information

Elastomeric Connector Configuration	Connector Pins	Polarizer Option
FLB3513A3	FLB3513A4	Non-Polarized
FLB3513B3	FLB3513B4	Transflective
FLB3513C3	FLB3513C4	Reflective (smooth)
FLB3513D3	FLB3513D4	Transmissive

Connectors

Display is available in pinned or elastomeric configuration.
See page 6-42 for elastomeric connector suppliers.

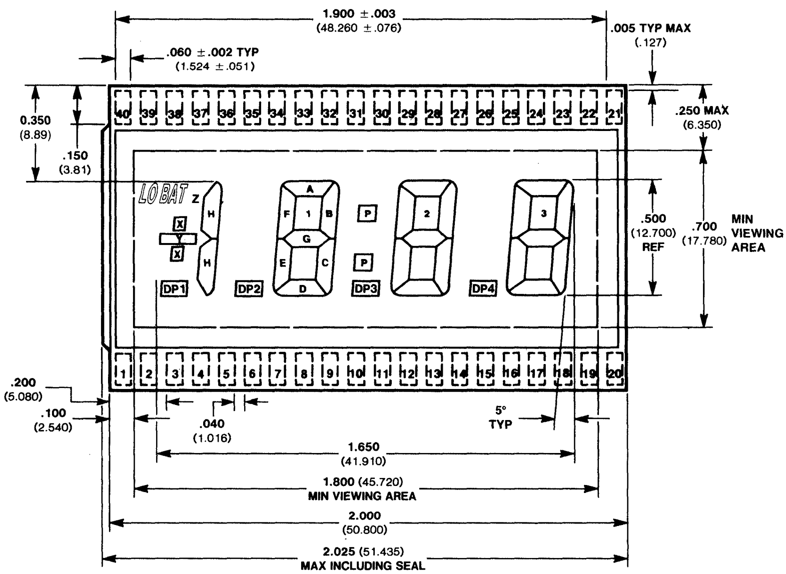
Drivers

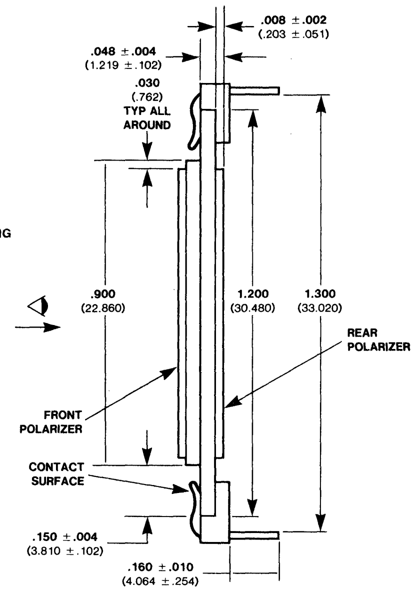
See page 6-43 for available drivers.

Pin Assignments
Ordering Information

FLB3513X3
FLB3513X4

FLB3513X4 (Pin Connection)





4-Digit Tape-Stereo-Radio-Clock Display

FLB4010X1

Optoelectronic Products

General Description
The FLB4010X1 is a liquid crystal display that is hermetically sealed with glass frit. It interfaces with elastomeric connectors, is available in four polarizer options and operates at the standard temperature range of −20°C to +60°C. The FLB4010X1 is intended for auto radio/stereo cassette player applications.

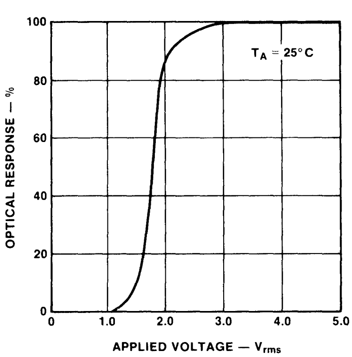
0.4-Inch Digits (10 mm)
Decimal Points
Colons for Time Display
Digital Readout for Frequency and Time Display
AM-PM Time Indicators
Dolby™ Symbol (Note 1)
AM-FM Radio Mode Indicators
Stereo Mode Indicator
Tape Mode Indicator
Forward-Reverse Tape Direction Indicator
Glass-Frit Seal for High Reliability

Electrical Characteristics Measured at 25°C with drive voltage of 5.0 V, square wave at 32 Hz.

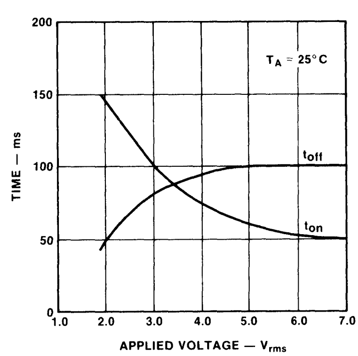
Characteristic	Min	Typ	Max	Units
Operating Voltage	2.8	5.0	12.0	V_{rms}
Saturation Voltage	2.0	2.2	2.4	V_{rms}
Operating Frequency Range	30	32	1000	Hz
Drive Current at 3.0 V, All Segments On			100	μA
Segment Capacitance			3.0	pF
Contrast Ratio		20:1		
Response Times: t_{on} (Includes Delay Time)		70	150	ms
t_{off} (Includes Delay Time)		100	150	ms
Operating Temperature Range (Note)	−20		60	°C
Storage Temperature Range	−20		80	°C
Humidity	50/60			°C/RH
Life Time		50k		hrs
DC Drive Component Allowable			50	mV

Note
Display may be operated beyond these limits for short periods of time. Extended periods of operation at high temperatures and humidities cause polarizer degradation resulting in reduced contrast. Higher operating temperature is available. Contact factory.

Voltage Characteristics



Response Time



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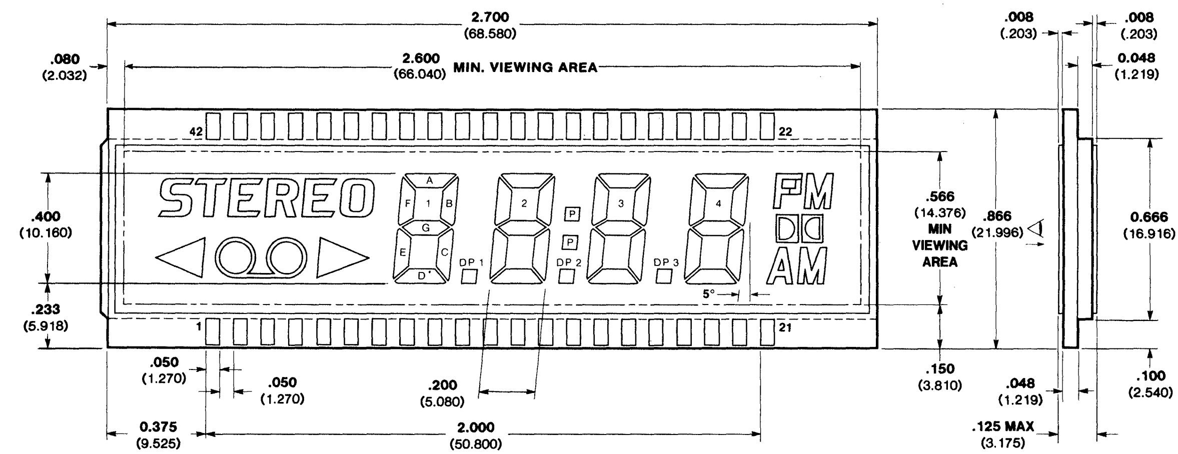
Package Outline Pin Assignments

FLB4010X1

Package Outline



Notes

Dolby and the double-D symbol are trademarks of Dolby Laboratories. Permission for their use must be obtained from Dolby Laboratories.
All polarizers are the same size.
All dimensions in inches **bold** and millimeters (parentheses).
Decimal Points and colons (P) are the same width as segment widths.
Seal shall not exceed width of back glass.

Pin Assignments

1 Backplane
2 ◁
3 ◯◯
4 ▷
5 Segment E_1
6 Segment D_1
7 Segment C_1
8 Decimal Point 1
9 Segment E_2
10 Segment D_2
11 Segment C_2
12 Decimal Point 2
13 Segment E_2
14 Segment D_3
15 Segment C_3
16 Decimal Point 3
17 Segment E_4
18 Segment D_4
19 Segment C_4
20 AM
21 NC
22 PM
23 FM
24 Dolby
25 Segment B_4
26 Segment A_4
27 Segment F_4
28 Segment G_4
29 Segment B_3
30 Segment A_3
31 Segment F_3
32 Segment G_3
33 Colon P
34 Segment B_2
35 Segment A_2
36 Segment F_2
37 Segment G_2
38 Segment B_1
39 Segment A_1
40 Segment F_1
41 Segment G_1
42 Stereo

Ordering Information

Device Type	**Polarizer Option**
FLB4010A1	Non-Polarized
FLB4010B1	Transflective
FLB4010C1	Reflective (smooth)
FLB4010D1	Transmissive

Connectors

Display interfaces with elastomeric connectors. See page 6-42 for elastomeric connector suppliers.

Drivers

See page 6-43 for available drivers.

4-Digit Large-Area Clock / DPM Display

FLB4013X1 FLB4013X2

Optoelectronic Products

General Description
The FLB4013X1 and FLB4013X2 are liquid crystal displays that are hermetically sealed with glass frit. They are available in pinned or elastomeric connector configurations, offer four polarizer options and operate at the standard temperature range of −20°C to +60°C. Applications include clock, digital panel meter and general instrumentation.

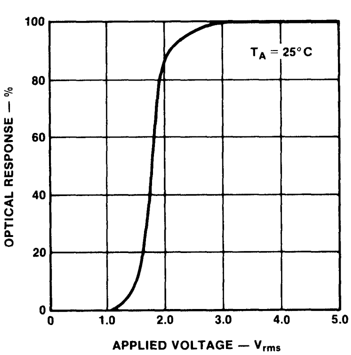
0.5-Inch Digits (13 mm)
Decimal Points for DPMs
Color for Timekeeping
Four Polarizer Options
Glass-Frit Seal for High Reliability

Electrical Characteristics Measured at 25°C with drive voltage of 5.0 V, square wave at 32 Hz.

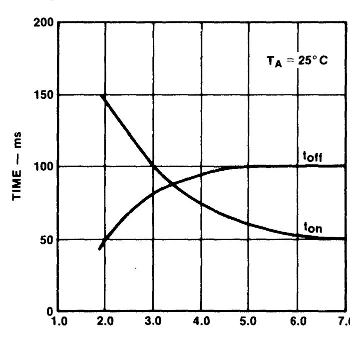
Characteristic	Min	Typ	Max	Units
Operating Voltage	2.8	5.0	12	V
Saturation Voltage	2.0	2.2	2.4	V
Operating Frequency Range	30	32	1000	Hz
Drive Current at 3.0 V, All Segments On			5.0	μA
Viewing Angle		45		degrees
Contrast Ratio		20:1		
Response Times: t_{on} (Includes Delay Time)		70	150	ms
t_{off} (Includes Delay Time)		100	150	ms
Operating Temperature Range (Note)	−20		60	°C
Storage Temperature Range	−20		80	°C
Humidity	50/60			°C/RH
Life Time		50k		hrs

Note
Higher operating temperature is available. Consult the factory for details.

Voltage Characteristics



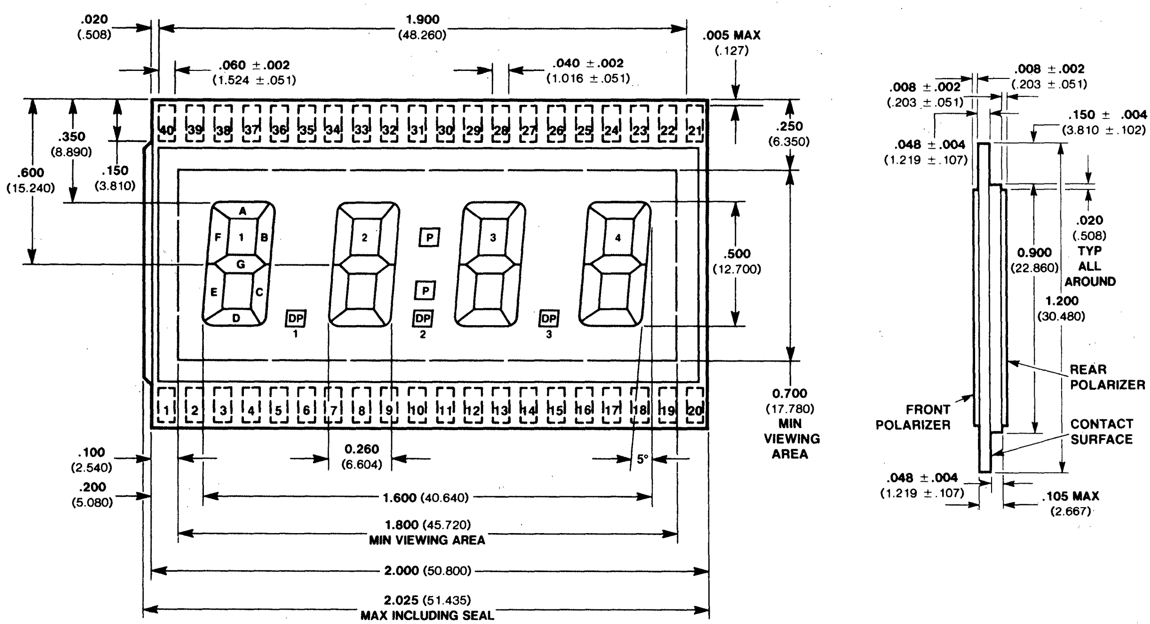
Response Time



Package Outline
Pin Assignments

FLB4013X1
FLB4013X2

FLB4013X1 (Elastomer Connection)



Note
All dimensions in inches **bold** and millimeters (parentheses).

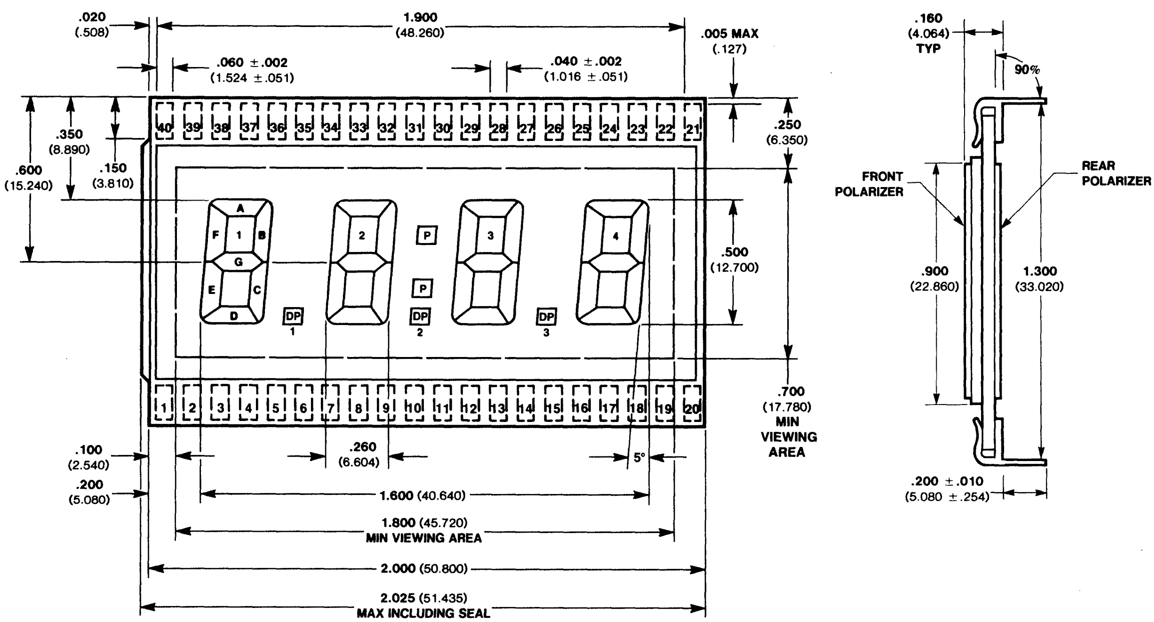
Pin Assignments

1 Backplane BP	9 Segment E_2	17 Segment E_4	25 Segment A_3	33 NC
2 NC	10 Segment D_2	18 Segment D_4	26 Segment F_3	34 Segment B_1
3 NC	11 Segment C_2	19 Segment C_4	27 Segment G_3	35 Segment A_1
4 NC	12 Decimal Point 2	20 Segment B_4	28 Colon P	36 Segment F_1
5 Segment E_1	13 Segment E_3	21 Segment A_4	29 Segment B_2	37 Segment G_1
6 Segment D_1	14 Segment D_3	22 Segment F_4	30 Segment A_2	38 NC
7 Segment C_1	15 Segment C_3	23 Segment G_4	31 Segment F_2	39 NC
8 Decimal Point 1	16 Decimal Point 3	24 Segment B_3	32 Segment G_2	40 NC

Pin Assignments (Cont'd) Ordering Information

FLB4013X1 FLB4013X2

FLB4013X2 (Pin Connection)



Note
All dimensions in inches **bold** and millimeters (parentheses).

Ordering Information

Elastomeric Connector Configuration	Connector Pins	Polarizer Option
FLB4013A1	FLB4013A2	Non-polarized
FLB4013B1	FLB4013B2	Transflective
FLB4013C1	FLB4013C2	Reflective (smooth)
FLB4013D1	FLB4013D2	Transmissive

Connectors

Display is available in pinned or elastomeric configuration.
See page 6-42 for elastomeric connector suppliers.

Drivers

See page 6-43 for available drivers.

4-Digit Large-Area Clock / DPM Display

FLB4018X1
FLB4018X2

Optoelectronic Products

General Description
The FLB4018X1 and FLB4018X2 are liquid crystal displays that are hermetically sealed with glass frit. They are available in pinned or elastomeric connector configurations, offer four polarizer options and operate at the standard temperature range of −20°C to +60°C. Applications include clock, digital panel meter and general instrumentation.

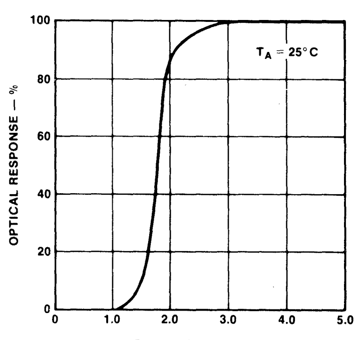
0.7-Inch Digits (18 mm)
Decimal Points for DPMs
Colon for Timekeeping
Four Polarizer Options
Glass-Frit Seal for High Reliability

Electrical Characteristics Measured at 25°C with drive voltage of 5.0 V, square wave at 32 Hz.

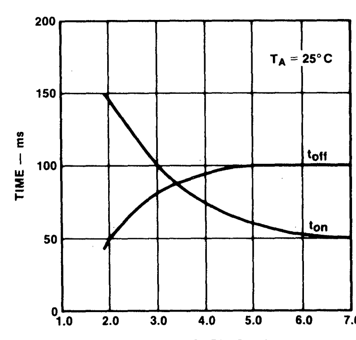
Characteristic	Min	Typ	Max	Units
Operating Voltage	2.8	5.0	12	V
Saturation Voltage	2.0	2.2	2.4	V
DC Drive Component Allowable			50	mV
Operating Frequency Range	30	32	1000	Hz
Drive Current at 3.0 V, All Segments On			10	μA
Viewing Angle		45		degrees
Contrast Ratio		20:1		
Response Times: t_{on} (Includes Delay Time)		70	150	ms
t_{off} (Includes Delay Time)		100	150	ms
Operating Temperature Range (Note)	−20		60	°C
Storage Temperature Range	−20		80	°C
Humidity	50/60			°C/RH
Life Time		50k		hrs

Note
Higher operating temperature is available. Consult the factory for details.

Voltage Characteristics



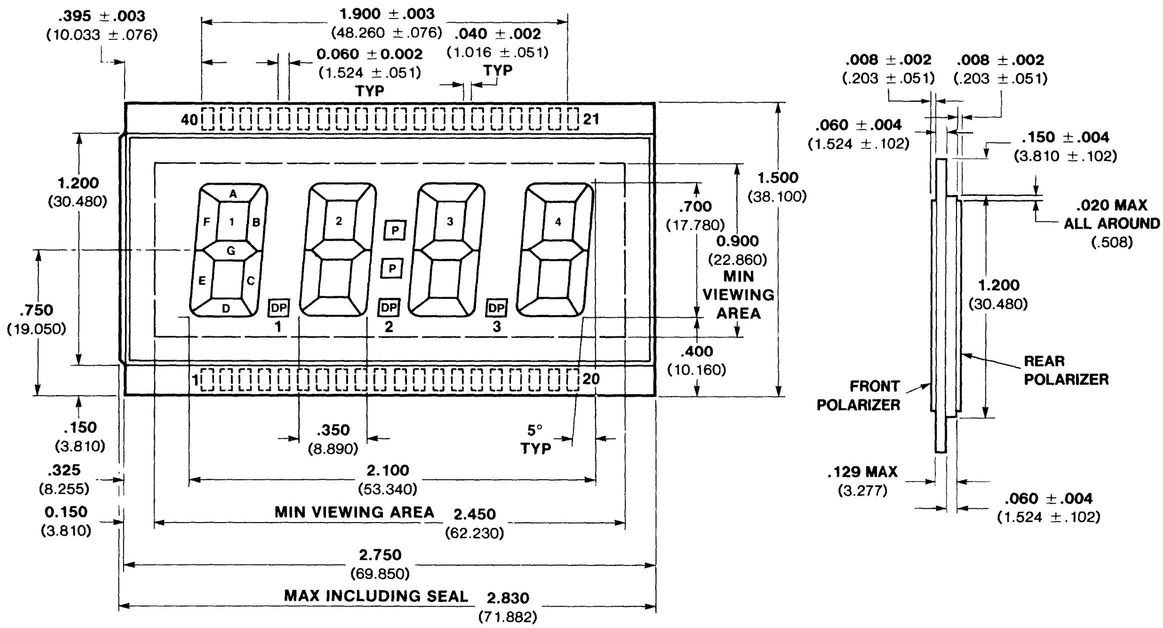
Response Time



Package Outline Pin Assignments

FLB4018X1 FLB4018X2

FLB4018X1 (Elastomer Connection)



Note
All dimensions in inches **bold** and millimeters (parentheses).

Pin Assignments

1 Backplane BP	9 Segment E_2	17 Segment E_4	25 Segment A_3	33 NC
2 NC	10 Segment D_2	18 Segment D_4	26 Segment F_3	34 Segment B_1
3 NC	11 Segment C_2	19 Segment C_4	27 Segment G_3	35 Segment A_1
4 NC	12 Decimal Point 2	20 Segment B_4	28 Colon P	36 Segment F_1
5 Segment E_1	13 Segment E_3	21 Segment A_4	29 Segment B_2	37 Segment G_1
6 Segment D_1	14 Segment D_3	22 Segment F_4	30 Segment A_2	38 NC
7 Segment C_1	15 Segment C_3	23 Segment G_4	31 Segment F_2	39 NC
8 Decimal Point 1	16 Decimal Point 3	24 Segment B_3	32 Segment G_2	40 NC

Ordering Information

Elastomeric Connector Configuration	Connector Pins	Polarizer Option
FLB4018A1	FLB4018A2	Non-polarized
FLB4018B1	FLB4018B2	Transflective
FLB4018C1	FLB4018C2	Reflective (smooth)
FLB4018D1	FLB4018D2	Transmissive

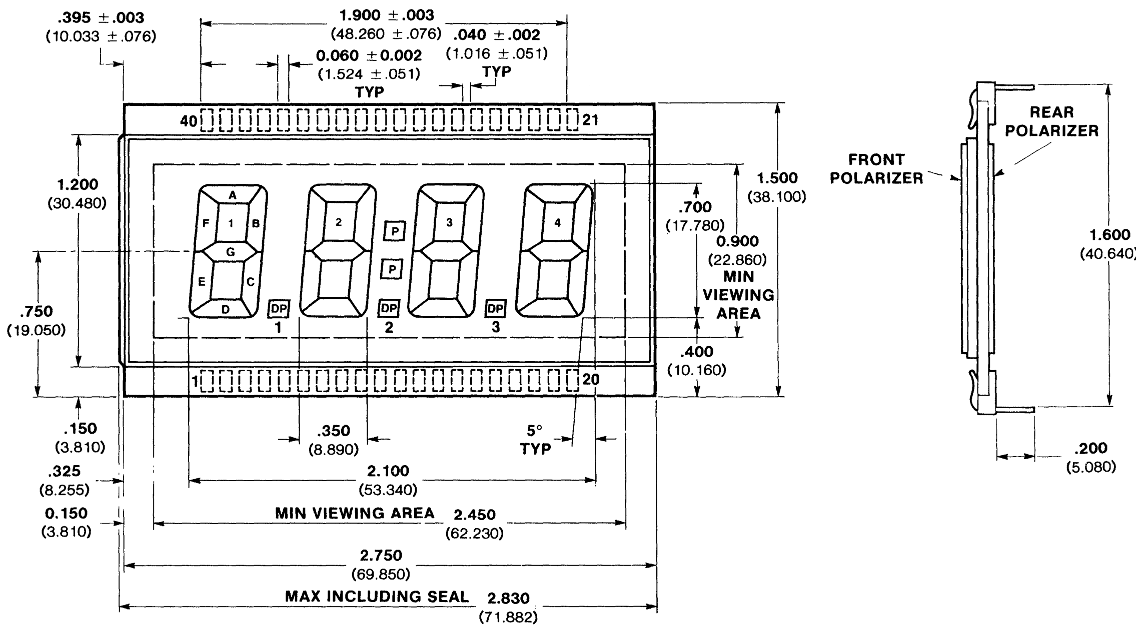
Connectors
Display is available in pinned or elastomeric configuration.
See page 6-42 for elastomeric connector suppliers.

Drivers
See page 6-43 for available drivers.

Pin Assignments

FLB4018X1
FLB4018X2

FLB4018X2 (Pin Connection)



Note
All dimensions in inches **bold** and millimeters (parentheses).

8-Character, 14-Segment Alphanumeric Display

FLB8009X1

Optoelectronic Products

General Description
The FLB8009X1 is a liquid crystal display that is hermetically sealed with glass frit. It interfaces with elastomeric connectors, is available in four polarizer options and operates at the standard temperature range of −20°C to +60°C. The 14-segment alphanumeric format is capable of displaying the alpha set, digits 0 through 9 and many of the special ASCII symbols. This display is suitable for general applications requiring alphanumeric capability.

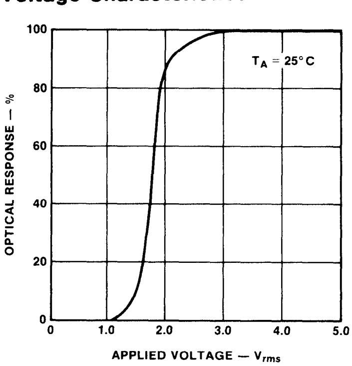
0.35-Inch Characters (9 mm)
Decimal Points
14-Segment Alphanumeric Format
Glass-Frit Seal for High Reliability

Electrical Characteristics Measured at 25°C with drive voltage of 5.0 V, square wave at 32 Hz.

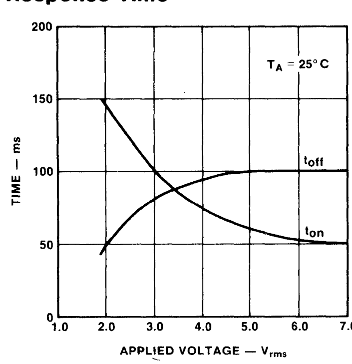
Characteristic	Min	Typ	Max	Units
Operating Voltage	2.8	5.0	12	V
Saturation Voltage	2.0	2.2	2.4	V
Operating Frequency Range	30	32	1000	Hz
Drive Current at 3.0 V, All Segments On			10	μA
Viewing Angle		45		degrees
Contrast Ratio		20:1		
Response Times: t_{on} (Includes Delay Time)		70	150	ms
t_{off} (Includes Delay Time)		100	150	ms
Operating Temperature Range (Note)	−20		60	°C
Storage Temperature Range	−20		80	°C
Humidity	50/60			°C/RH
Life Time		50k		hrs

Note
Higher operating temperature is available. Consult the factory for details.

Voltage Characteristics



Response Time

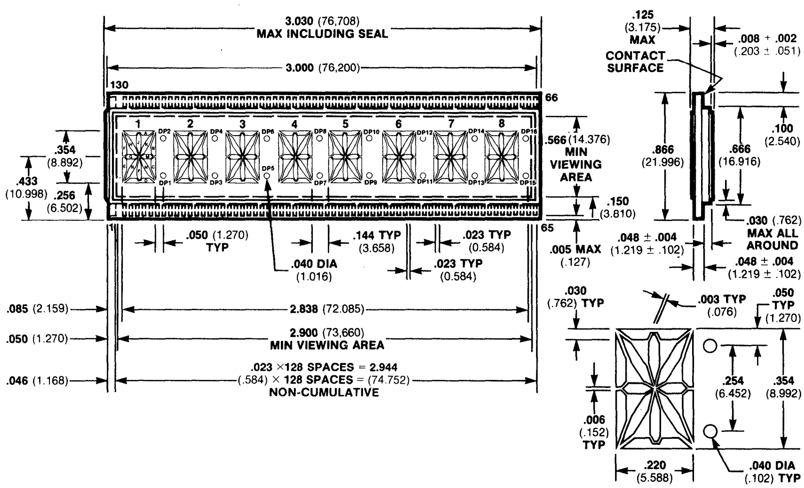


6

Package Outline Pin Assignments

FLB8009X1

Package Outline



Note
All dimensions in inches **bold** and millimeters (parentheses)

Pin Assignments

1 Backplane
2 Segment E_1
3 Segment R_1
4 Segment P_1
5 Segment D_1
6 Segment N_1
7 Segment C_1
8 Segment M_1
9 Decimal Point 1
10 Segment E_2
11 Segment R_2
12 Segment P_2
13 Segment D_2
14 Segment N_2
15 Segment C_2
16 Segment M_2
17 Decimal Point 3
18 Segment E_3
19 Segment R_3
20 Segment P_3
21 Segment D_3
22 Segment N_3
23 Segment C_3
24 Segment M_3
25. Decimal Point 5
26 Segment E_4
27 Segment R_4
28 Segment P_4
29 Segment D_4
30 Segment N_4
31 Segment C_4
32 Segment M_4
33 Decimal Point 7
34 Segment E_5
35 Segment R_5
36 Segment P_5
37 Segment D_5
38 Segment N_5
39 Segment C_5
40 Segment M_5
41 Decimal Point 9
42 Segment E_6
43 Segment R_6
44 Segment P_6
45 Segment D_6
46 Segment N_6
47 Segment C_6
48 Segment M_6
49 Decimal Point 11
50 Segment E_7
51 Segment R_7
52 Segment P_7
53 Segment D_7
54 Segment N_7
55 Segment C_7
56 Segment M_7
57 Decimal Point 13
58 Segment E_8
59 Segment R_8
60 Segment P_8
61 Segment D_8
62 Segment N_8
63 Segment C_8
64 Segment M_8
65 Decimal Point 15
66 Decimal Point 16
67 Segment B_8
68 Segment K_8
69 Segment J_8
70 Segment A_8
71 Segment H_8
72 Segment F_8
73 Segment G_8
74 Decimal Point 14
75 Segment B_7
76 Segment K_7
77 Segment J_7
78 Segment A_7
79 Segment H_7
80 Segment F_7
81 Segment G_7
82 Decimal Point 12
83 Segment B_6
84 Segment K_6
85 Segment J_6
86 Segment A_6
87 Segment H_6
88 Segment F_6
89 Segment G_6
90 Decimal Point 10
91 Segment B_5
92 Segment K_5
93 Segment J_5
94 Segment A_5
95 Segment H_5
96 Segment F_5
97 Segment G_5
98 Decimal Point 8
99 Segment B_4
100 Segment K_4
101 Segment J_4
102 Segment A_4
103 Segment H_4
104 Segment F_4
105 Segment G_4
106 Decimal Point 6
107 Segment B_3
108 Segment K_3
109 Segment J_3
110 Segment A_3
111 Segment H_3
112 Segment F_3
113 Segment G_3
114 Decimal Point 4
115 Segment B_2
116 Segment K_2
117 Segment J_2
118 Segment A_2
119 Segment H_2
120 Segment F_2
121 Segment G_2
122 Decimal Point 2
123 Segment B_1
124 Segment K_1
125 Segment J_1
126 Segment A_1
127 Segment H_1
128 Segment F_1
129 Segment G_1
130 Backplane

Ordering Information FLB8009X1

Ordering Information

Device Type	Polarizer Option
FLB8009A1	Non-Polarized
FLB8009B1	Transflective
FLB8009C1	Reflective (smooth)
FLB8009D1	Transmissive

Connectors
Display interfaces with elastomeric connectors.
See page 6-42 for elastomeric connector suppliers.

Drivers
See page 6-43 for available drivers.

Fairchild Watch Displays

Optoelectronic Products

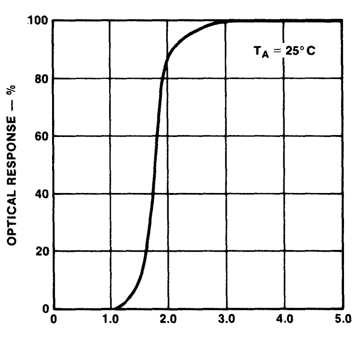
General Description

Fairchild watch displays are liquid crystal displays that are hermetically sealed with glass frit. They interface with elastomeric connectors and operate at the standard temperature range of −20°C to +60°C. Packages and pin assignments appear on the following pages.

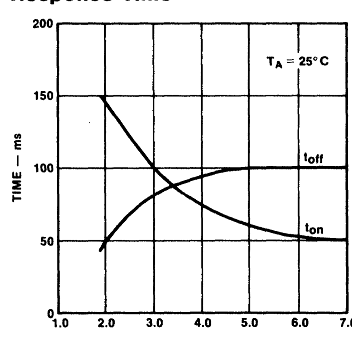
Electrical Characteristics Measured at 25°C with drive voltage of 3.0 V, square wave at 32 Hz.

Characteristic	Min	Typ	Max	Units
Operating Voltage	2.8	3.0	6.0	V
Saturation Voltage	2.0	2.2	2.4	V
Operating Frequency Range	30		1000	Hz
Drive Current at 3.0 V, All Segments On			1.0	μA
Viewing Angle		45		degrees
Contrast Ratio		20:1		
Response Times: t_{on}		100	150	ms
t_{off}		80	150	ms
Operating Temperature Range	−20		55	°C
Storage Temperature Range	−20		65	°C
Humidity	50/60			°C/RH
Life Time		50k		hrs

Voltage Characteristics



Response Time



Connectors

All Fairchild watch displays interface with elastomeric connectors.

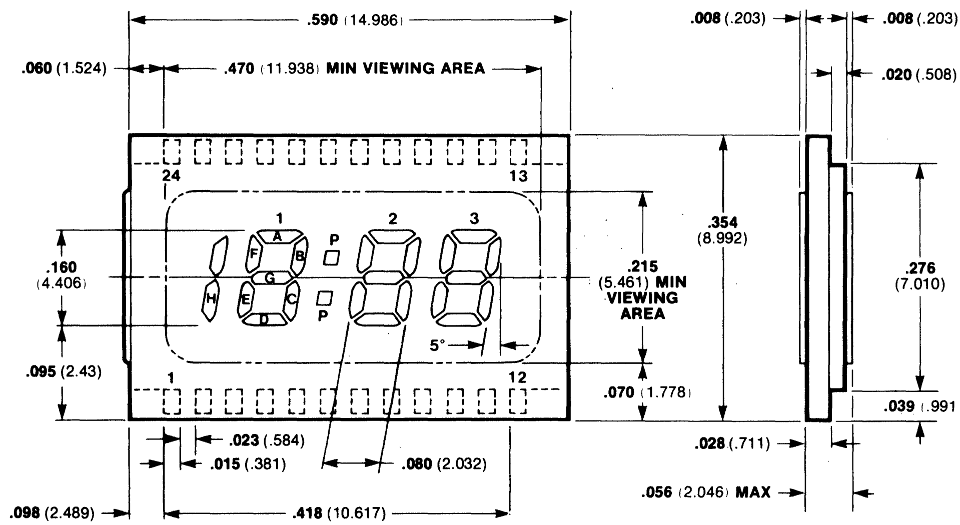
See page 6-42 for elastomeric connector suppliers.

Fairchild Watch Displays

Optoelectronic Products

FLB350401

Package Outline



Notes
All dimensions in inches bold and millimeters (parentheses)
Tolerance unless specified = ±.015 (±.381)

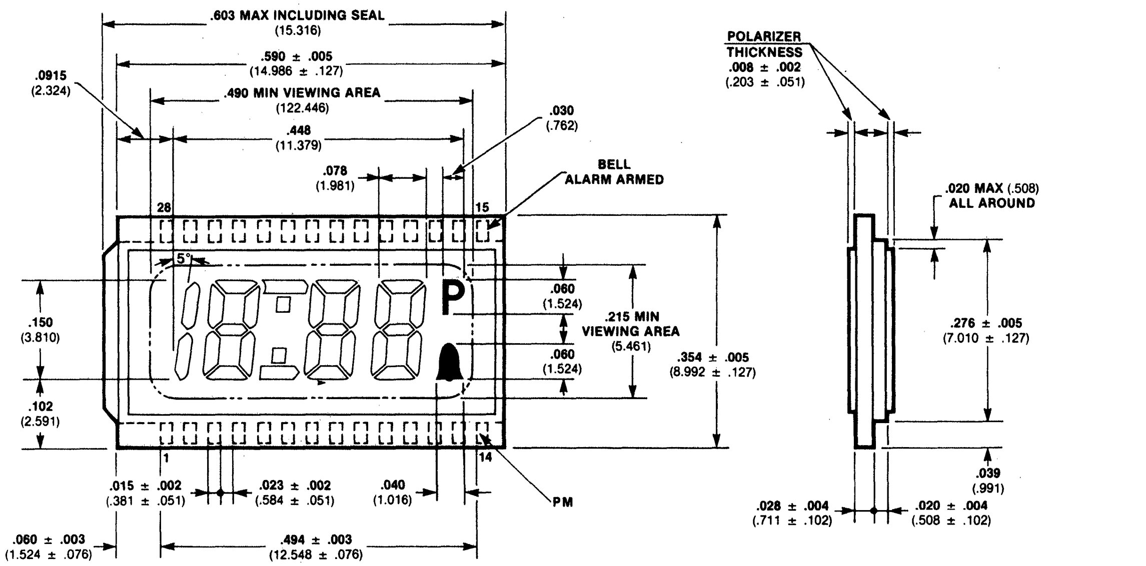
Pin Assignments

1 Backplane
2 Half Digit
3 Segment E_1
4 Segment D_1
5 Segment C_1
6 Colons
7 Segment E_2
8 Segment D_2
9 Segment C_2
10 Segment E_3
11 Segment D_3
12 Segment C_3
13 Segment B_3
14 Segment A_3
15 Segment F_3
16 Segment G_3
17 Segment B_2
18 Segment A_2
19 Segment F_2
20 Segment G_2
21 Segment B_1
22 Segment A_1
23 Segment F_1
24 Segment G_1

Fairchild Watch Displays
Optoelectronic Products

FLB350407

Package Outline



Notes
All dimensions in inches **bold** and millimeters (parentheses)
Tolerance unless specified = ±**.015** (±.381)

Pin Assignments

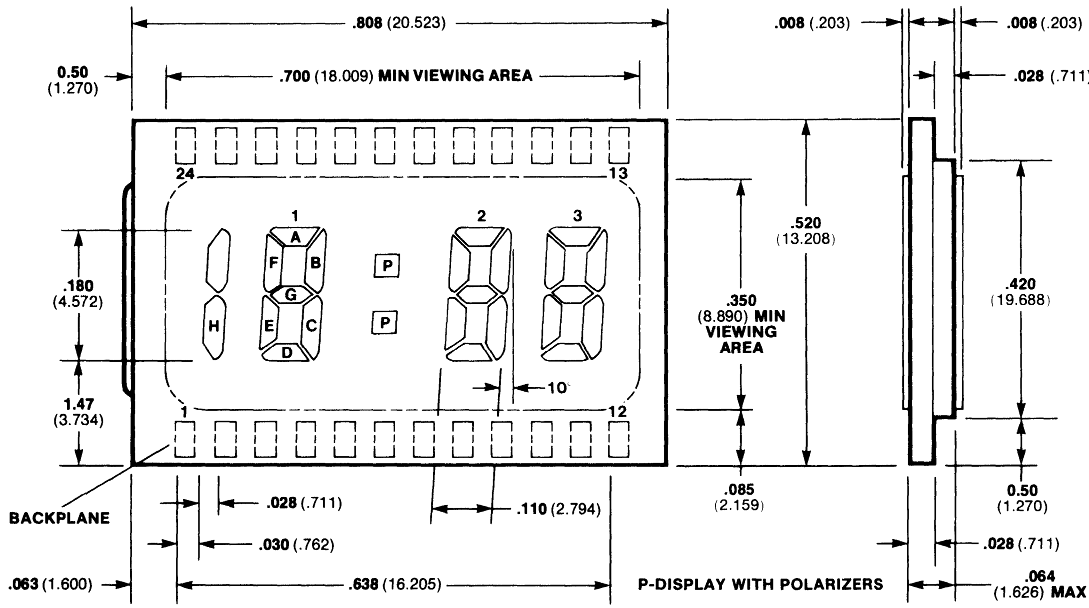
1 Backplane
2 Segment E_1
3 Segment D_1
4 Segment C_1
5 Segment P
6 Y
7 Segment E_2
8 Segment D_2
9 Segment C_2
10 Segment E_3
11 Segment D_3
12 Segment C_3
13 Segment G_3
14 PM
15 Bell Alarm Armed
16 Segment B_3
17 Segment A_3
18 Segment F_3
19 Segment G_2
20 Segment B_2
21 Segment A_2
22 Segment F_2
23 X
24 Segment B_1
25 Segment A_1
26 Segment F_1
27 Segment G_1
28 K

Fairchild Watch Displays

Optoelectronic Products

FLB350501

Package Outline



Notes
All dimensions in inches **bold** and millimeters (parentheses)
Tolerance unless specified = ±**.015** (±.381)

Pin Assignments

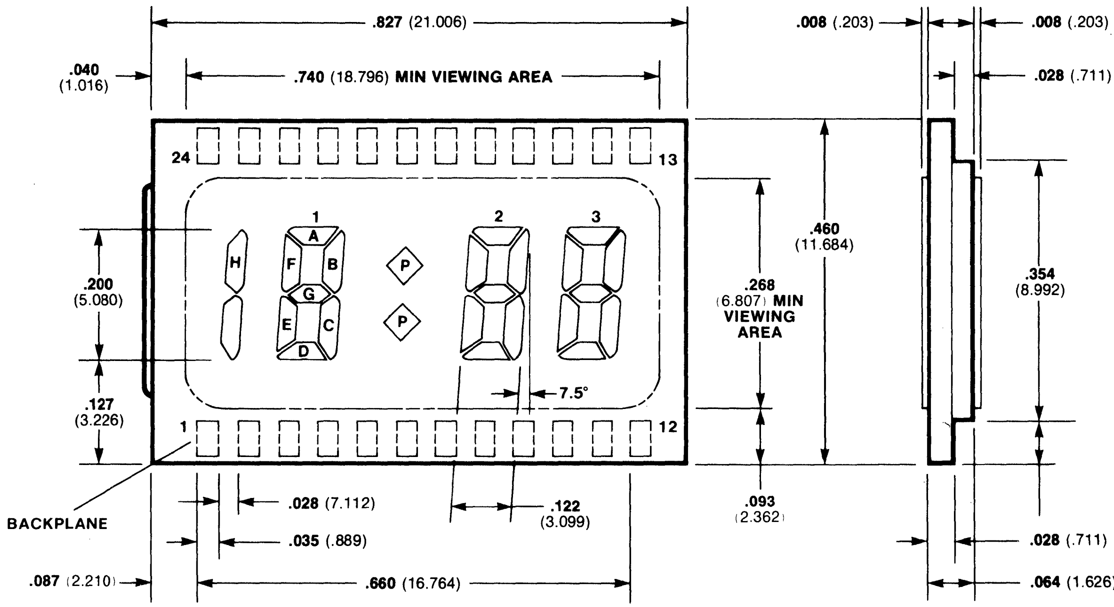
1 Backplane
2 Half Digit
3 Segment E_1
4 Segment D_1
5 Segment C_1
6 Colons
7 Segment E_2
8 Segment D_2
9 Segment C_2
10 Segment E_3
11 Segment D_3
12 Segment C_3
13 Segment B_3
14 Segment A_3
15 Segment F_3
16 Segment G_3
17 Segment B_2
18 Segment A_2
19 Segment F_2
20 Segment G_2
21 Segment B_1
22 Segment A_1
23 Segment F_1
24 Segment G_1

Fairchild Watch Displays

Optoelectronic Products

FLB350502

Package Outline



Notes
All dimensions in inches **bold** and millimeters (parentheses)
Tolerance unless specified = $\pm$**.015** ($\pm$.381)

Pin Assignments

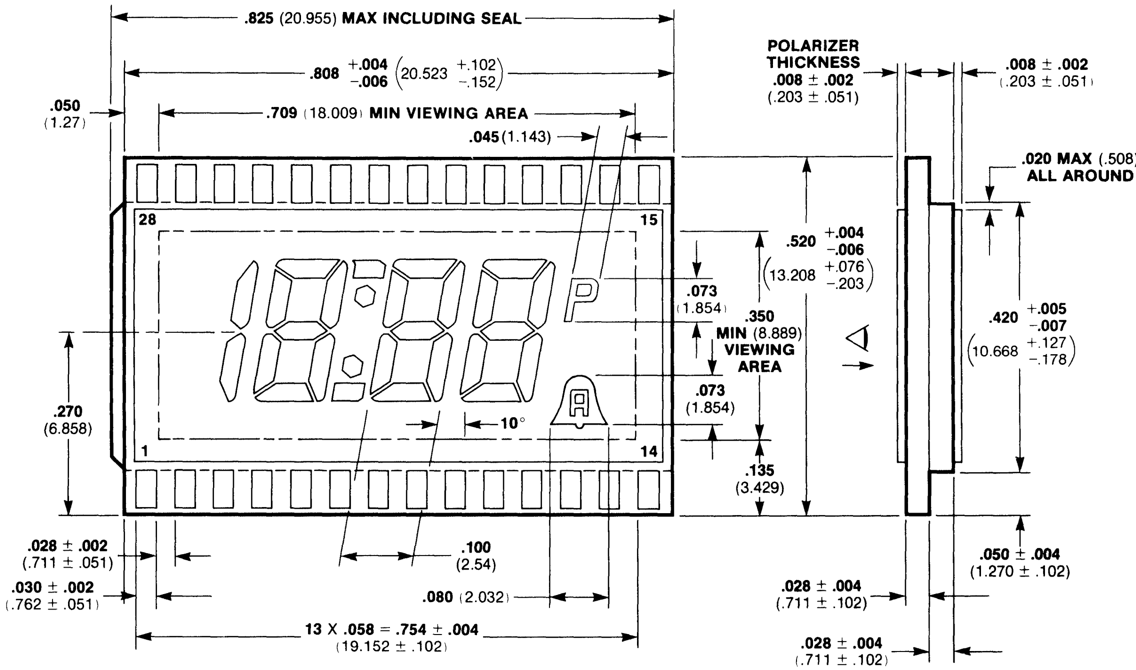
1 Backplane	6 Colons	11 Segment D_3	16 Segment G_3	21 Segment B_1
2 Half Digit	7 Segment E_2	12 Segment C_3	17 Segment B_2	22 Segment A_1
3 Segment E_1	8 Segment D_2	13 Segment B_3	18 Segment A_2	23 Segment F_1
4 Segment D_1	9 Segment C_2	14 Segment A_3	19 Segment F_2	24 Segment G_1
5 Segment C_1	10 Segment E_3	15 Segment F_3	20 Segment G_2	

Fairchild Watch Displays

Optoelectronic Products

FLB350508

Package Outline



Notes

All dimensions in inches **bold** and millimeters (parentheses)

Tolerance unless specified = ±**.015** (±.381)

Pin Assignments

1 Backplane
2 Segment E_1
3 Segment D_1
4 Segment C_1
5 Segment P
6 Y
7 Segment E_2
8 Segment D_2
9 Segment C_2
10 Segment E_3
11 Segment D_3
12 Segment C_3
13 Segment G_3
14 Alarm PM
15 Alarm AM
16 Segment B_3
17 Segment A_3
18 Segment F_3
19 Segment G_2
20 Segment B_2
21 Segment A_2
22 Segment F_2
23 X
24 Segment B_1
25 Segment A_1
26 Segment F_1
27 Segment G_1
28 K

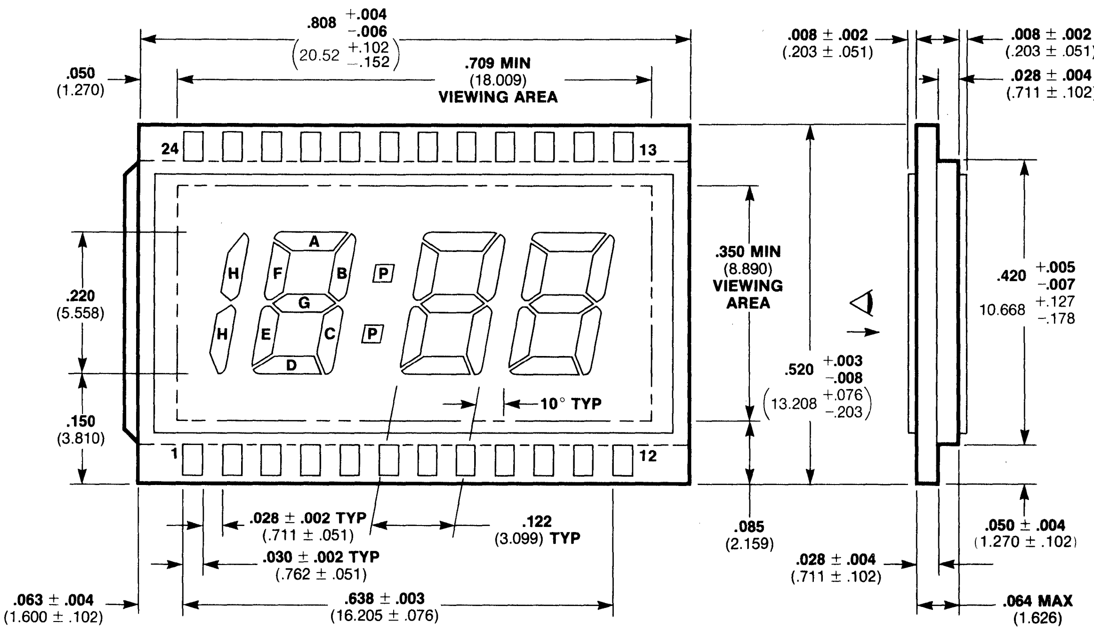
6

Fairchild Watch Displays

Optoelectronic Products

FLB350601

Package Outline



Notes

All dimensions in inches **bold** and millimeters (parentheses)

Tolerance unless specified = ±**.015** (±.381)

Pin Assignments

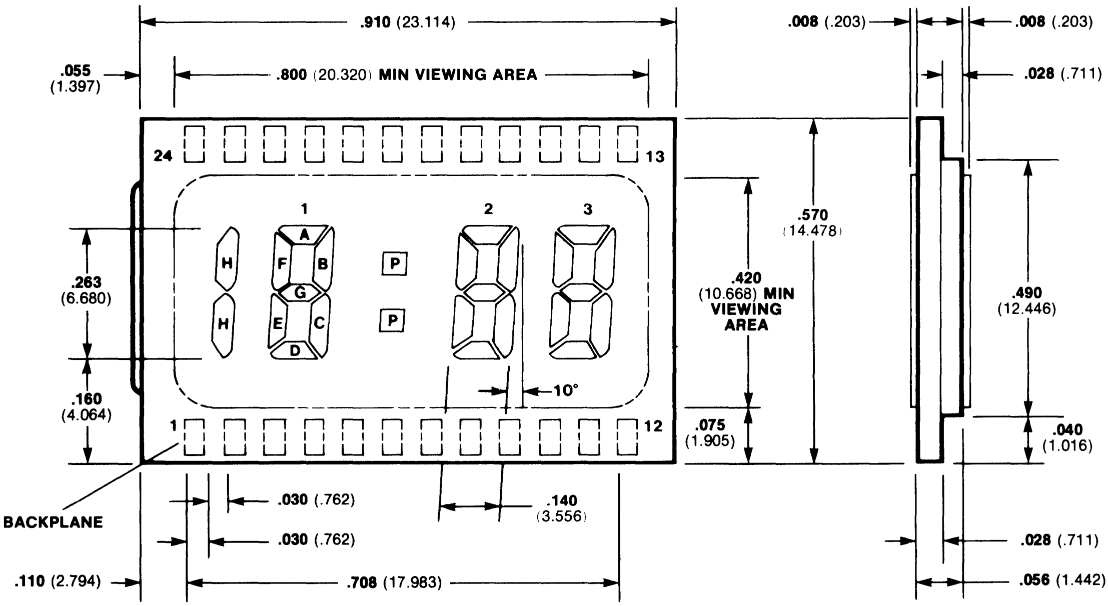
1 Backplane
2 Segment H
3 Segment E_1
4 Segment D_1
5 Segment C_1
6 Period
7 Segment E_2
8 Segment D_2
9 Segment C_2
10 Segment E_3
11 Segment D_3
12 Segment C_3
13 Segment B_3
14 Segment A_3
15 Segment F_3
16 Segment G_3
17 Segment B_2
18 Segment A_2
19 Segment F_2
20 Segment G_2
21 Segment B_1
22 Segment A_1
23 Segment F_1
24 Segment G_1

Fairchild Watch Displays

Optoelectronic Products

FLB350701

Package Outline



Notes
All dimensions in inches **bold** and millimeters (parentheses)
Tolerance unless specified = ±**.015** (±.381)

Pin Assignments

1 Backplane
2 Half Digit
3 Segment E_1
4 Segment D_1
5 Segment C_1
6 Colons
7 Segment E_2
8 Segment D_2
9 Segment C_2
10 Segment E_3
11 Segment D_3
12 Segment C_3
13 Segment B_3
14 Segment A_3
15 Segment F_3
16 Segment G_3
17 Segment B_2
18 Segment A_2
19 Segment F_2
20 Segment G_2
21 Segment B_1
22 Segment A_1
23 Segment F_1
24 Segment G_1

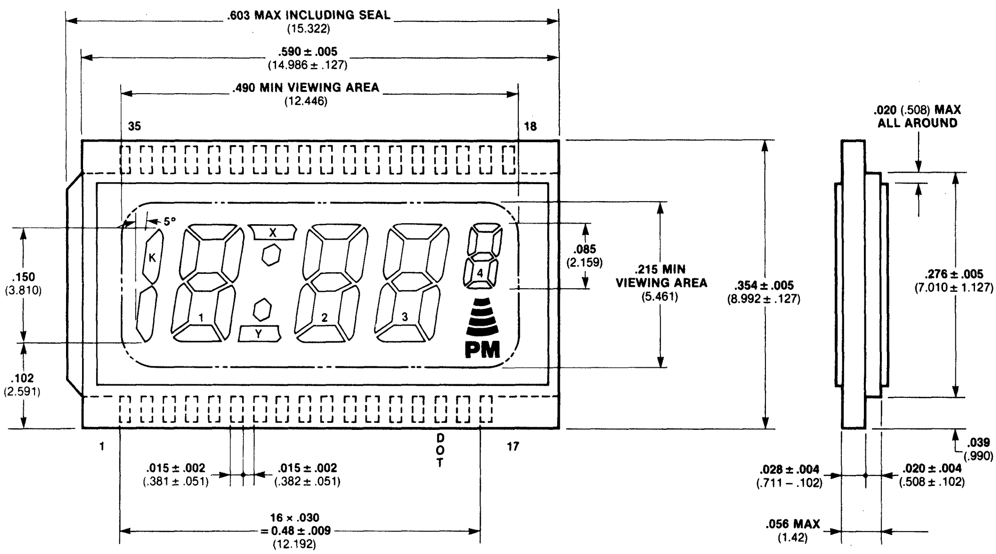
6

Fairchild Watch Displays

Optoelectronic Products

FLB450401

Package Outline



Notes
All dimensions in inches **bold** and millimeters (parentheses)
Tolerance unless specified = ±**.015** (±.381)

Pin Assignments

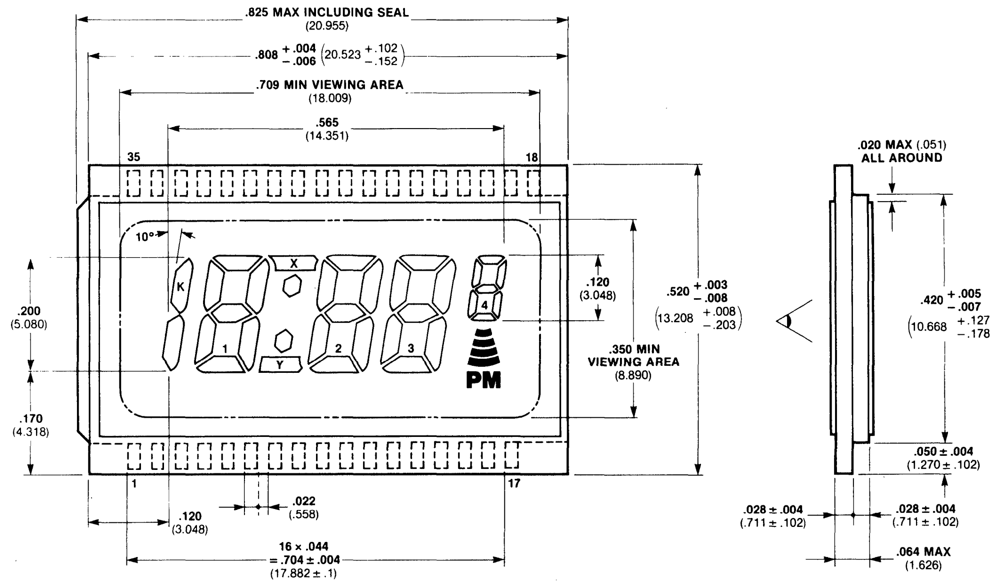
1 Common Backplane
2 Segment E1
3 Segment D1
4 Segment C1
5 Colon
6 Y
7 Segment E2
8 Segment D2
9 Segment C2
10 Segment E3
11 Segment D3
12 Segment C3
13 Segment G3
14 Alarm
15 PM
16 Segment D4
17 Segment C4
18 Segment G4
19 Segment B4
20 Segment A4
21 Segment F4
22 Segment E4
23 Segment B3
24 Segment A3
25 Segment F3
26 Segment G2
27 Segment B2
28 Segment A2
29 Segment F2
30 X
31 Segment B1
32 Segment A1
33 Segment F1
34 Segment G1
35 K

Fairchild Watch Displays

Optoelectronic Products

FLB450501

Package Outline



Notes

All dimensions in inches **bold** and millimeters (parentheses)

Tolerance unless specified = ±**.015** (±.381)

Pin Assignments

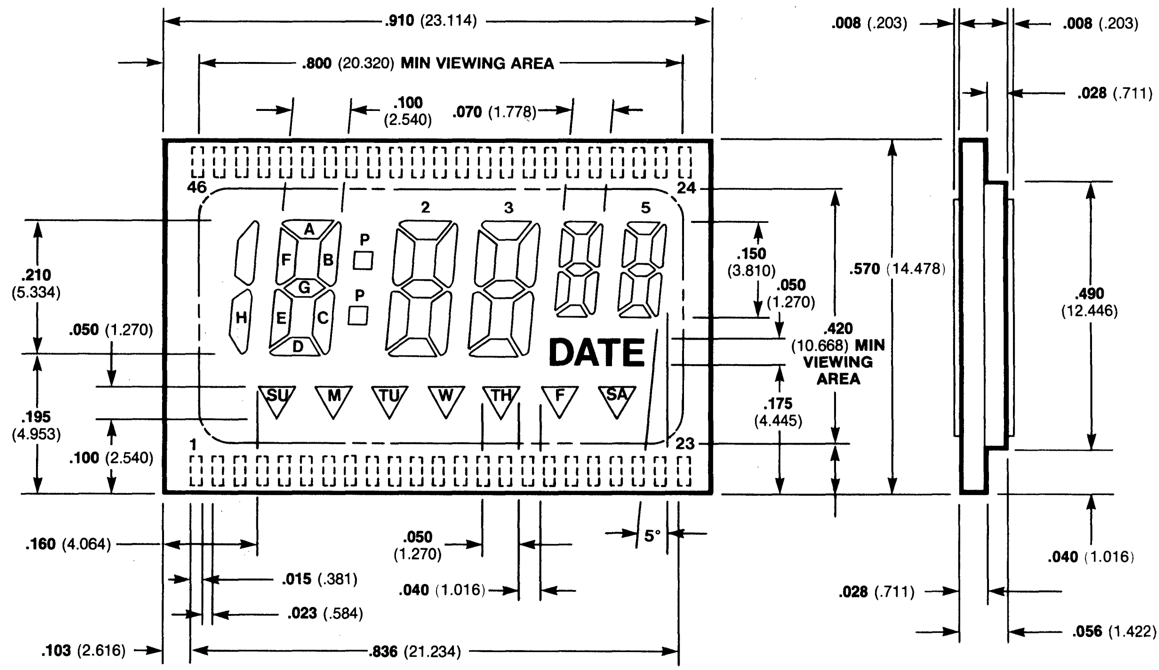
1 Common Backplane
2 Segment E1
3 Segment D1
4 Segment C1
5 Colon
6 Y
7 Segment E2
8 Segment D2
9 Segment C2
10 Segment E3
11 Segment D3
12 Segment C3
13 Segment G3
14 Alarm
15 PM
16 Segment D4
17 Segment C4
18 Segment G4
19 Segment B4
20 Segment A4
21 Segment F4
22 Segment E4
23 Segment B3
24 Segment A3
25 Segment F3
26 Segment G2
27 Segment B2
28 Segment A2
29 Segment F2
30 X
31 Segment B1
32 Segment A1
33 Segment F1
34 Segment G1
35 K

Fairchild Watch Displays

Optoelectronic Products

FLB550503

Package Outline



Notes
All dimensions in inches **bold** and millimeters (parentheses)
Tolerance unless specified = ±**.015** (±.381)

Pin Assignments

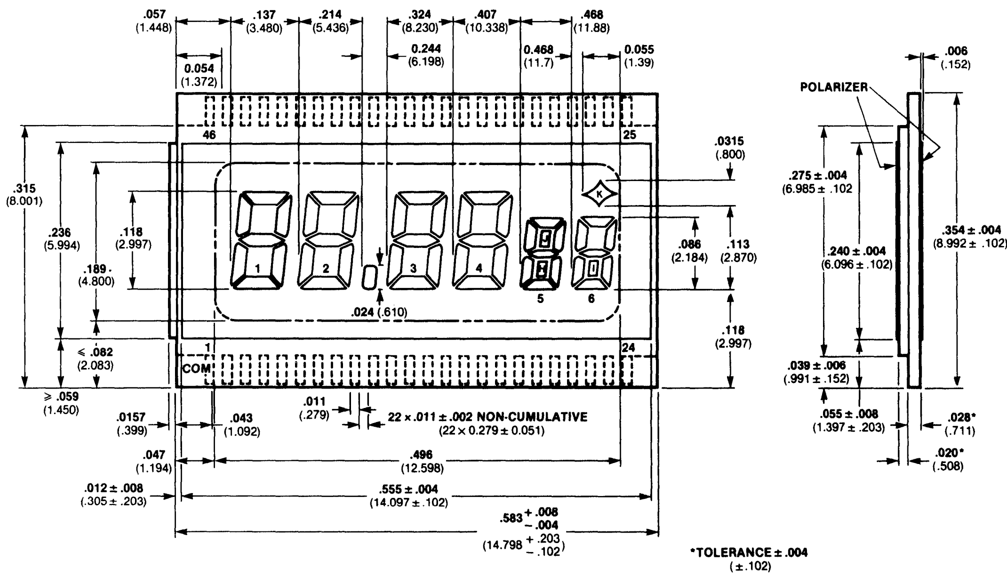
1 Backplane
2 Segment E_1
3 Segment SU
4 Segment D_1
5 Segment C_1
6 Segment M
7 Segment E_2
8 Segment D_2
9 Segment TU
10 Segment C_2
11 Segment E_3
12 Segment W
13 Segment D_3
14 Segment C_3
15 Segment TH
16 Segment E_4
17 Segment D_4
18 Segment F
19 Segment C_4
20 Date
21 Segment SA
22 Segment E_5
23 Segment D_5
24 Segment C_5
25 Segment B_5
26 Segment A_5
27 Segment F_5
28 Segment G_5
29 Segment B_4
30 Segment A_4
31 Segment F_4
32 Segment G_4
33 Segment B_3
34 Segment A_3
35 Segment F_3
36 Segment G_3
37 Segment B_2
38 Segment A_2
39 Segment F_2
40 Segment G_2
41 Colons
42 Segment B_1
43 Segment A_1
44 Segment F_1
45 Segment G_1
46 Half Digit

Fairchild Watch Displays

Optoelectronic Products

FLB600301

Package Outline



Notes

All dimensions in inches **bold** and millimeters (parentheses)

Tolerance unless specified = ± **.015** (± .381)

Pin Assignments

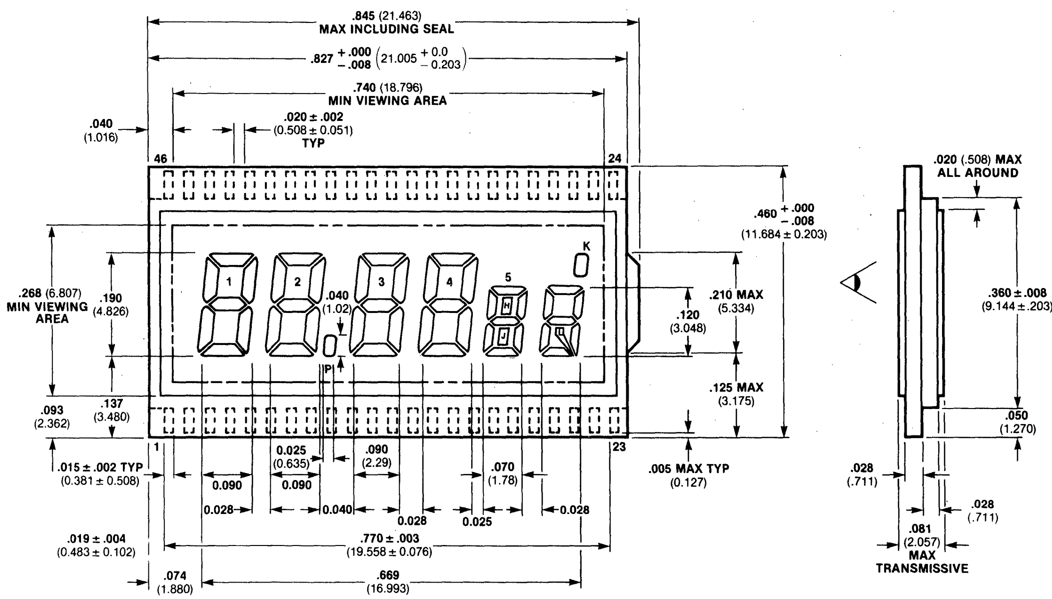
1 Common Backplane
2 Segment E1
3 Segment A/D1
4 Segment C1
5 Segment E2
6 Segment D2
7 Segment C2
8 Decimal Point
9 Segment E3
10 Segment A/D3
11 Segment C3
12 Segment E4
13 Segment D4
14 Segment C4
15 Segment E5
16 Segment H5
17 Segment D5
18 Segment C5
19 Segment E6
20 Segment I6
21 Segment D6
22 Segment C6
23 Segment G6
24 Segment K
25 Segment B6
26 Segment A6
27 Segment F6
28 Segment B5
29 Segment A5
30 Segment J5
31 Segment F5
32 Segment G5
33 Segment B4
34 Segment A4
35 Segment F4
36 Segment G4
37 Segment B3
38 Segment F3
39 Segment G3
40 Segment B2
41 Segment A2
42 Segment F2
43 Segment G2
44 Segment B1
45 Segment F1
46 Segment G1

Fairchild Watch Displays

Optoelectronic Products

FLB600506

Package Outline



Notes

All dimensions in inches **bold** and millimeters (parentheses)

Tolerance unless specified = ±**.015** (±.381)

Pin Assignments

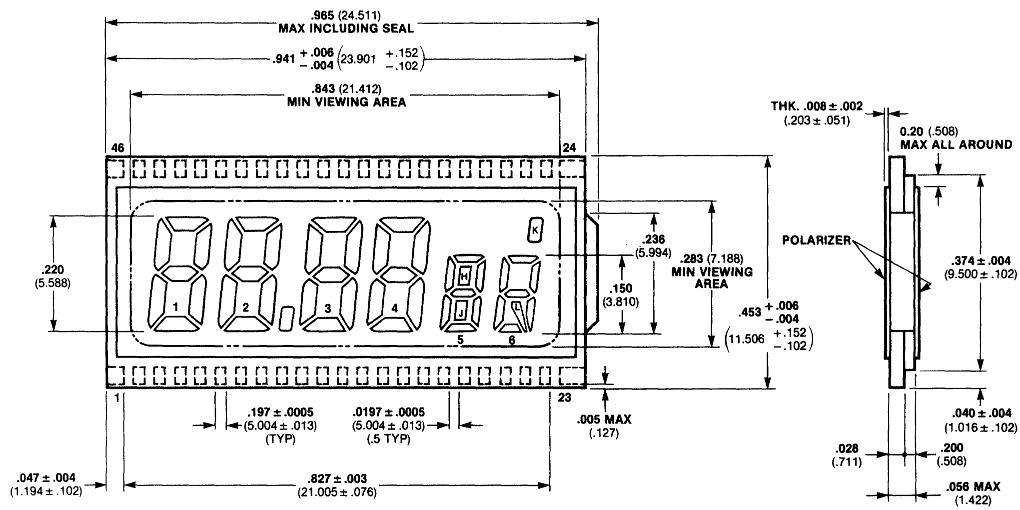
1 Segment E1
2 Segment A/D1
3 Segment C1
4 Segment E2
5 Segment D2
6 Segment C2
7 Decimal
8 Segment E3
9 Segment A3
10 Segment C3
11 Segment E4
12 Segment D4
13 Segment C4
14 Segment E5
15 Segment J5
16 Segment D5
17 Segment C5
18 Segment E6
19 Segment D6
20 Segment L6
21 Segment C6
22 Segment G6
23 Common Backplane
24 K
25 Segment B6
26 Segment A6
27 Segment F6
28 Segment B5
29 Segment A5
30 Segment H5
31 Segment F5
32 Segment G5
33 Segment B4
34 Segment A4
35 Segment F4
36 Segment G4
37 Segment B3
38 Segment F3
39 Segment G3
40 Segment B2
41 Segment A2
42 Segment F2
43 Segment G2
44 Segment B1
45 Segment F1
46 Segment G1

Fairchild Watch Displays

Optoelectronic Products

FLB600601

Package Outline



Notes
All dimensions in inches **bold** and millimeters (parentheses)
Tolerance unless specified = ±**.015** (±.381)

Pin Assignments

1 Segment E1
2 Segment A/D1
3 Segment C1
4 Segment E2
5 Segment D2
6 Segment C2
7 Decimal Point
8 Segment E3
9 Segment A/D3
10 Segment C3
11 Segment E4
12 Segment D4
13 Segment C4
14 Segment E5
15 Segment J5
16 Segment D5
17 Segment C5
18 Segment E6
19 Segment D6
20 Segment L6
21 Segment C6
22 Segment G6
23 Common Backplane
24 K
25 Segment B6
26 Segment A6
27 Segment F6
28 Segment B5
29 Segment A5
30 Segment H5
31 Segment F5
32 Segment G5
33 Segment B4
34 Segment A4
35 Segment F4
36 Segment G4
37 Segment B3
38 Segment F3
39 Segment G3
40 Segment B2
41 Segment A2
42 Segment F2
43 Segment G2
44 Segment B1
45 Segment F1
46 Segment G1

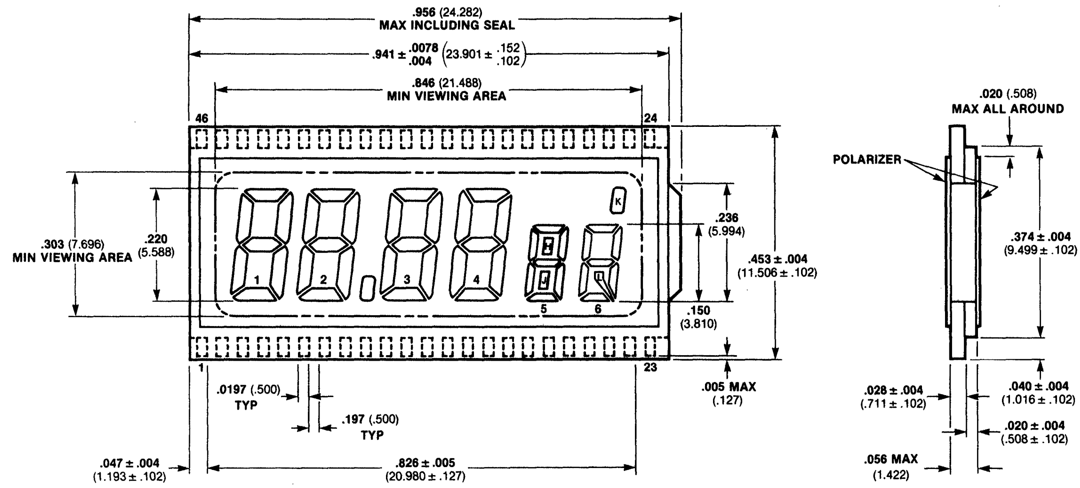
6

Fairchild Watch Displays

Optoelectronic Products

FLB600602

Package Outline



Notes
All dimensions in inches **bold** and millimeters (parentheses)
Tolerance unless specified = ±**.015** (±.381)

Pin Assignments

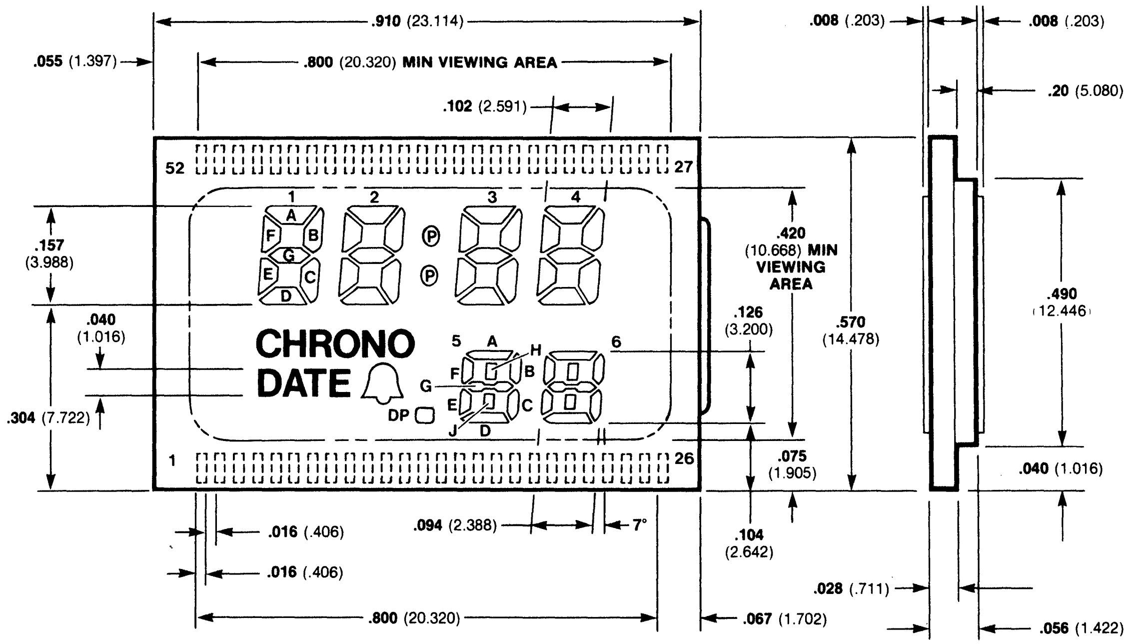
1 Segment E1
2 Segment A/D1
3 Segment C1
4 Segment E2
5 Segment D2
6 Segment C2
7 Decimal Point
8 Segment E3
9 Segment A/D3
10 Segment C3
11 Segment E4
12 Segment D4
13 Segment C4
14 Segment E5
15 Segment J5
16 Segment D5
17 Segment C5
18 Segment E6
19 Segment D6
20 Segment L6
21 Segment C6
22 Segment G6
23 Common Backplane
24 K
25 Segment B6
26 Segment A6
27 Segment F6
28 Segment B5
29 Segment A5
30 Segment H5
31 Segment F5
32 Segment G5
33 Segment B4
34 Segment A4
35 Segment F4
36 Segment G4
37 Segment B3
38 Segment F3
39 Segment G3
40 Segment B2
41 Segment A2
42 Segment F2
43 Segment G2
44 Segment B1
45 Segment F1
46 Segment G1

Fairchild Watch Displays

FLB650401

Optoelectronic Products

Package Outline



Notes
All dimensions in inches **bold** and millimeters (parentheses)
Tolerance unless specified = ±.015 (±.381)

Pin Assignments

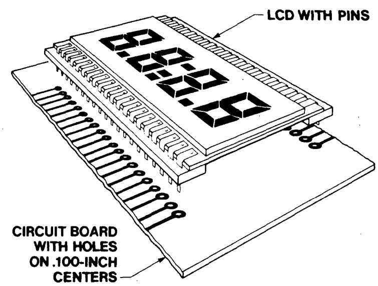
1 Alarm
2 Segment D_1
3 Segment C_1
4 Segment E_2
5 Segment D_2
6 Segment C_2
7 Segment B_5
8 Segment A_5
9 Segment H_5
10 Segment F_5
11 Segment G_5
12 Segment E_5
13 Decimal
14 Segment J_5
15 Segment D_5
16 Segment C_5
17 Segment G_6
18 Segment E_6
19 Segment D_6
20 Segment J_6
21 Segment C_6
22 Segment B_6
23 Segment H_6
24 Segment A_6
25 Segment F_6
26 Backplane
27 Segment D_4
28 Segment C_4
29 Segment G_4
30 Segment B_4
31 Segment A_4
32 Segment F_4
33 Segment E_4
34 Segment B_3
35 Segment A_3
36 Segment F_3
37 Segment G_3
38 Segment E_3
39 Segment D_3
40 Segment C_3
41 Colons
42 Segment G_2
43 Segment B_2
44 Segment A_2
45 Segment F_2
46 Segment B_1
47 Segment A_1
48 Segment F_1
49 Segment G_1
50 Segment E_1
51 Chrono
52 Date

LCD Connector Systems

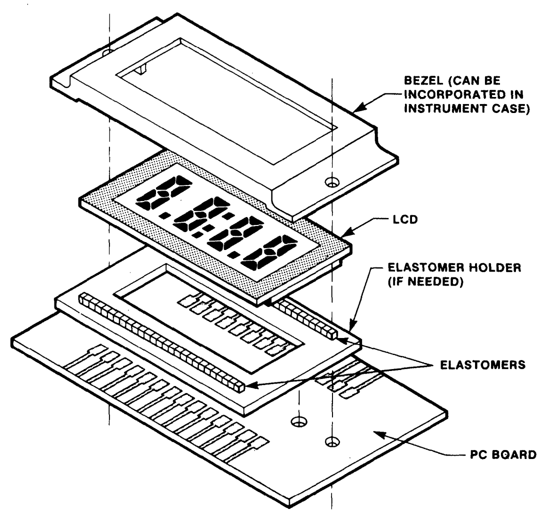
There are two basic connector systems that can be used with liquid crystal displays:

1. Pins
2. Elastomeric Connectors

1. Typical Pin Connector



2. Typical Elastomeric Connection System



Certain Fairchild LCDs work with pins while other Fairchild LCDs interface with elastomer connectors. Displays are shipped with pins when that configuration is ordered; connectors for the elastomeric version are available from the following sources:

Suppliers of Elastomeric Connectors

Tecknit
129 Dermody St.
Cranford, N.J. 07016
(201) 272-5500

AMP Incorporated
Harrisburg, Pa. 17105
(717) 564-0100

Conductive Rubber Technology
Olive Mill Plaza
1230 Coast Village Circle
Santa Barbara, Ca. 93108
(805) 969-5807

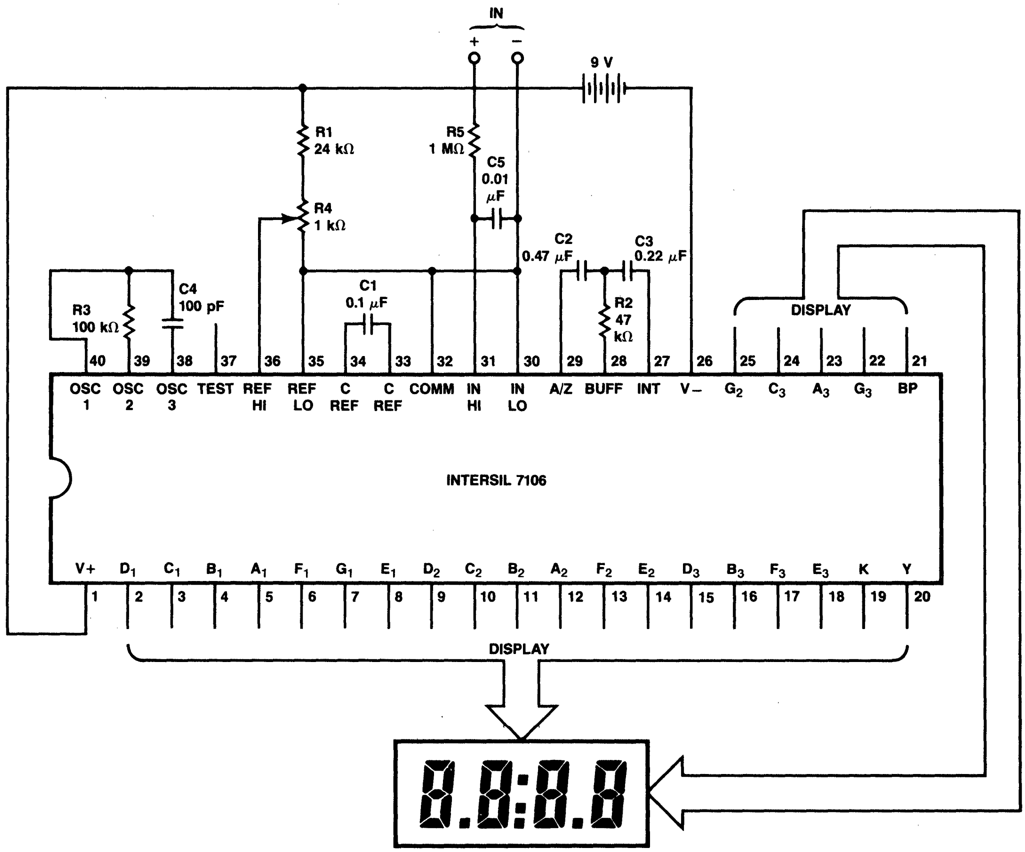
Hulltronics, Inc.
Davisville Road
Hatboro, Pa. 19040
(215) 672-0787

Liquid Crystal Display Drivers

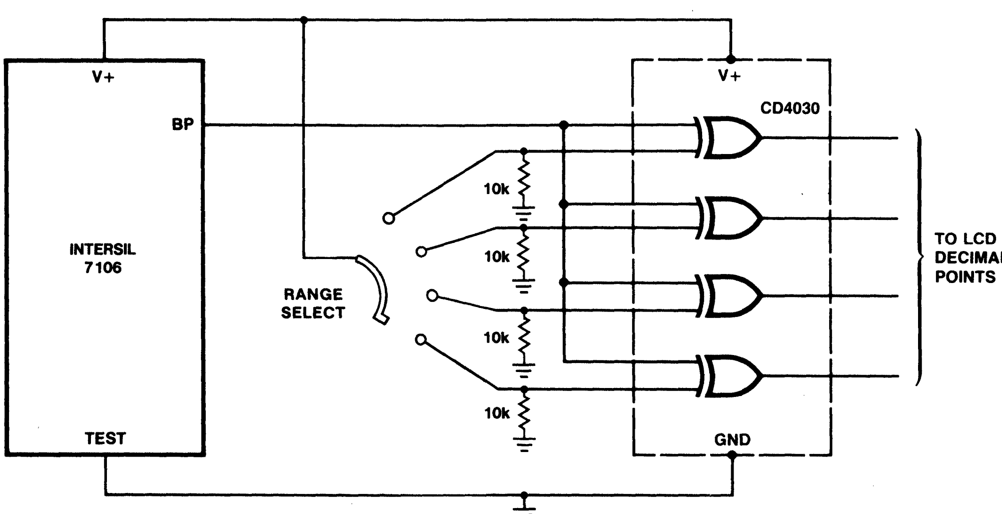
The following is a list of the most popular drivers for LCD's.

Description	Manufacturer	Part Number
Digit Drivers		
BCD to 7-Segment Single Digit	RCA	4054
	RCA, MITEL	4055
	RCA, MITEL	4056
	Motorola	MC14543B
Multiplexed BCD to 7-Segment Four Digit	Siliconix	DF411/412
	Hughes	HLCD-0437
	Intersil	ICM7211
Open Format Drivers		
Serial In—30 to 32 Segment Drivers	MITEL	4330, 4331, 4332
	Hughes	HLCD-0438
Special Purpose Chips		
3½-Digit Voltmeter/LCD Driver	Intersil	ICL7106
RF Counter/Clock/LCD Driver	OKI Electric	MSM5526
4½-Digit Counter/LCD Driver	Intersil	ICL7224
LCD Clock with Alarm	NEC	μPD833G
Microprocessors with Multiplexed LCD Output		
Four-Bit CMOS Processor	Sharp	SM4, SM5

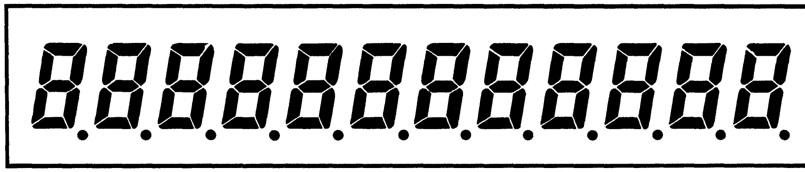
Digital Voltmeter



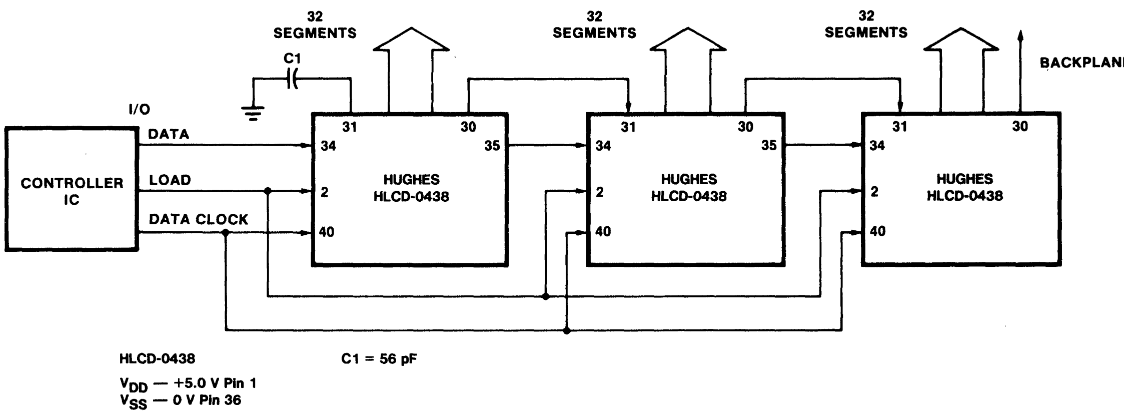
Exclusive 'OR' Gate For Decimal Point Drive



12-Digit Telephone Display Serial Drive



Serial Driven LCD Drivers



The drivers appear as a 96-bit shift register in this configuration. Fewer I/O outputs are required in the controller IC, when serial drive is selected over parallel drive.

Comments:

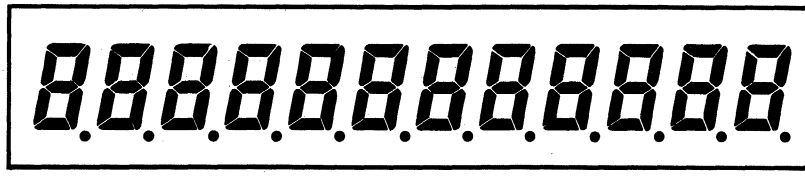
A. The capacitor, C1, determines the frequency of the output waveforms. 56 pF ≈ 30 Hz.

B. All segment lines must be in proper phase with the backplane. Therefore, the backplane output, Pin 30, is connected to Pin 31 of the following chip.

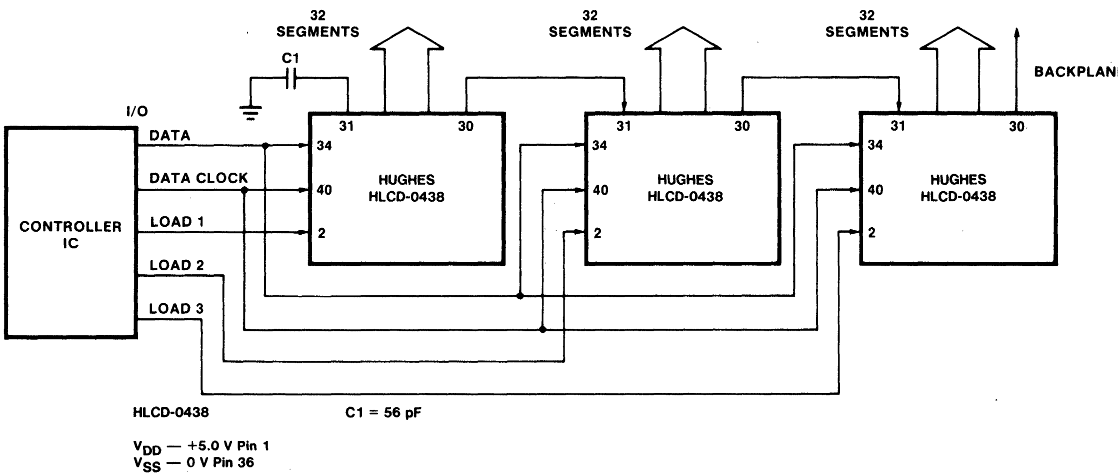
C. The display backplane driver should not be connected to another HLCD-0438.

12-Digit Telephone Display Parallel Drive

Fairchild FLB1208X1



Parallel Driven LCD Drivers



The drivers appear as a 32-bit shift register in this configuration. The maximum data shift required is 32 bits, when parallel drive is selected over serial drive.

Comments:

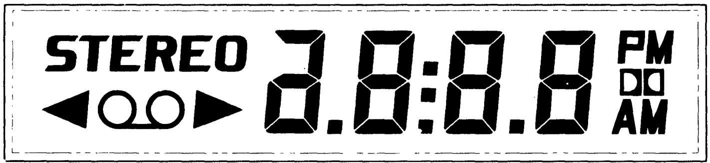
A. The capacitor, C1, determines the frequency of the output waveforms. 56 pF ≈ 30 Hz.

B. All segment lines must be in proper phase with the backplane. Therefore, the backplane output, Pin 30, is connected to Pin 31 of the following chip.

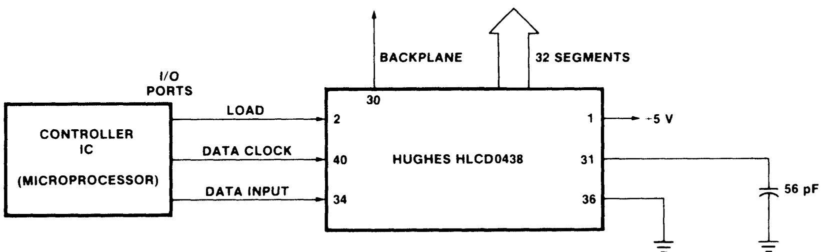
C. The display backplane driver should not be connected to another HLCD-0438.

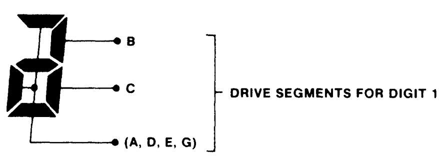
4-Digit Display, 24-Hour Clock

Provides for a combination tape cassette, stereo, 24-hour clock, and 3½-digit AM-FM radio display.



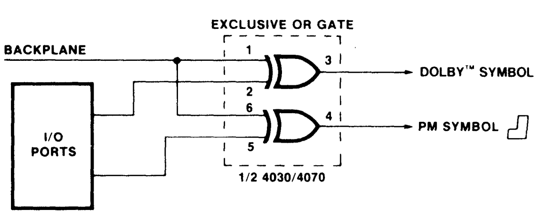
FAIRCHILD FLB4010X1

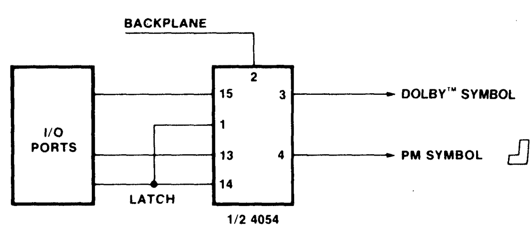




For a 24-hour clock form a "2" by connecting segments A, D, E and G, and drive as a single segment.

If more than 32 segments are to be used, additional LCD drive is required. Two additional segment drives are needed if the Dolby™ symbol and PM are desired.



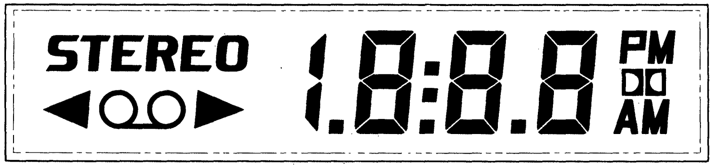


Use either of the two above schemes to add more than the 32 segments provided by the HLCD-4038.

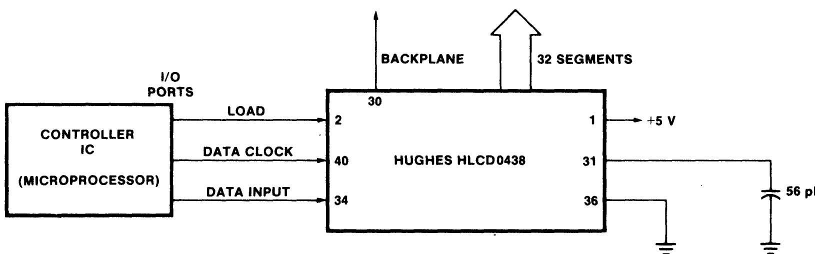
Dolby™ and the double-D symbol are trademarks of Dolby Laboratories. Permission for their use must be obtained from Dolby Laboratories.

3½-Digit Display, 12-Hour Clock

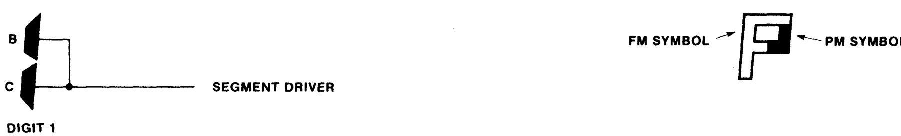
Provides for a combination tape cassette, stereo, 12-hour clock, and 3½-digit AM-FM radio display.



FAIRCHILD FLB4010X1



This display configuration requires one backplane connection and 32 segment connections.



Comments:

A. Connect segment B and segment C of digit 1 together to form one segment.

B. To form the symbol PM, both the FM and PM symbols must be on.

C. The 56 pF capacitor provides a display frequency of $\approx$ 30 Hz.

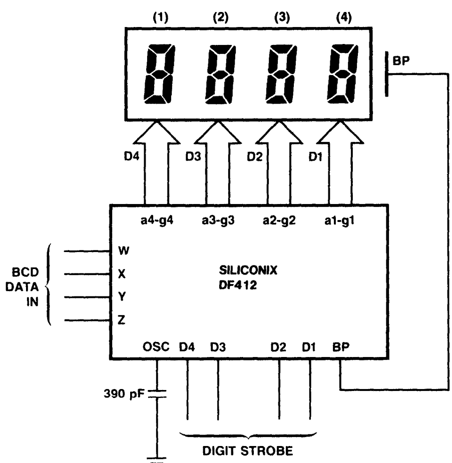
D. The Hughes HLCD-4038 is a 32-bit shift register which receives data in a serial mode from the data input. The data is clocked into the shift register using the data clock. With load HIGH a data clock will latch the information in the LCD drivers.

Dolby™ and the double-D symbol are trademarks of Dolby Laboratories. Permission for their use must be obtained from Dolby Laboratories.

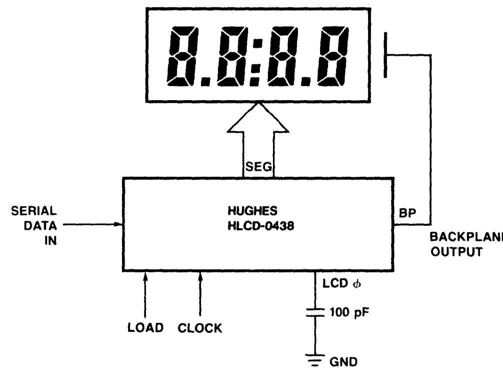
Liquid Crystal Interface Display Applications

The following circuits are typical applications of Fairchild liquid crystal displays.

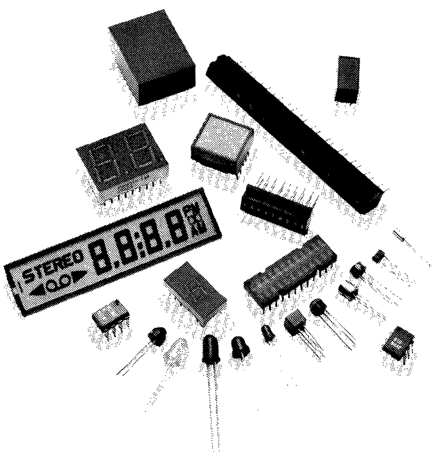
Multiplexed BCD Input



Serial Input



Note
Digit designations on DF412 do not match designations on display.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Section 7 Fiber Optics

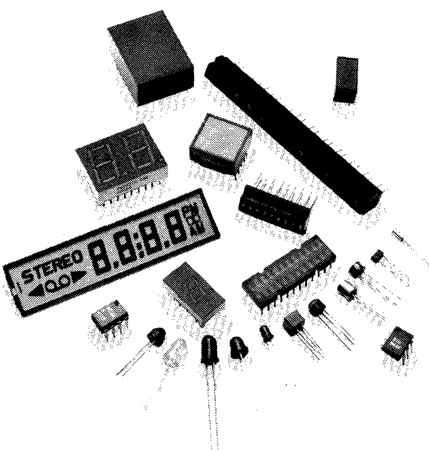
In 1972 Fairchild introduced the FPE104, a high-intensity, narrow-beam infrared emitter intended for excitation of photo detectors. This device can be used in fiber-optic systems in conjunction with Fairchild photo emitters and sensors.

In current designs, as with the FPE104, an objective of Fairchild Opto product development is to optimize device parameters for specific fiber-optic applications. At all times our customers' rapidly changing technological needs are considered. Each customer has individual fiber-optic package requirements, and Fairchild is currently evaluating packaging alternatives for this market.

Fairchild Optoelectronics products that are suitable for fiber-optic applications are:

FPE104
FLV104/104A
FPE500/510
FPT520/530
FPT500/550
FPT560/570
FPT700

For additional information contact your local Fairchild representative.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Section 8 Cross Reference

The following is a cross-reference of known equivalent optoelectronic devices at the time of printing. This list is meant to serve as a substitution guide for existing competitive devices to Fairchild's optoelectronic product line. Fairchild's nearest equivalent devices are selected on the basis of general similarity of electrical characteristics. Interchangeability in particular applications is not guaranteed. Before using a substitute, please compare the detailed specifications of the substitute device to the data sheet of the original device.

In the event the device we recommend does not exactly meet your needs, we encourage you to contact your nearest distributor or Fairchild sales office or representative for further information.

Code
A = Direct Replacement
B = Minor Electrical Difference
C = Minor Mechanical Difference
D = Significant Electrical Difference
E = Significant Mechanical Difference

Device	Company Name	Fairchild Device	Code
DL 701	LIT	MAN73A	A
DL 702	LIT	MAN74A	A
DL 704	LIT	MAN74A	A
DL 707	LIT	MAN72A	A
DL 707R	LIT	MAN71A	A
DL 721	LIT	MAN6730	E
DL 727	LIT	MAN6710	C
DL 728	LIT	MAN6740	C
FE0202A-E	AND	FLB4013X2	C
FE0202F-J	AND	FLB4013X1	C
FE0203A-E	AND	FLB3513X4	C
FE0203F-J	AND	FLB3513X3	C
FE0204A-E	AND	FLB3513X2	C
FE0204F-J	AND	FLB3513X1	C
GL 4484	LIT	TIL211	C
GL 4850	LIT	MV5253	C
H11A1	GE	H11A1	A
H11A2	GE	H11A2	A
H11A3	GE	H11A3	A
H11A4	GE	H11A4	A
H11A5	GE	FCD820A	A
H11A10	GE	4N26	B
H11A520	GE	FCD820D	A
H11A550	GE	FCD825D	A
H11A5100	GE	4N35	D
H11B1	GE	H11B1	A
H11B2	GE	H11B2	A
H11B3	GE	FCD850	A
H11B255	GE	FCD855	B
H11BX522	GE	FCD860C	B
H11D1	GE	H11D1	A
H11D2	GE	H11D2	A
H11D3	GE	H11D3	A
H11D4	GE	H11D4	A
H15A1	GE	FPA108	D
H15A2	GE	FPA108	D
H17A1	GE	FPT610	E
H17B1	GE	FPE106	E

Device	Company Name	Fairchild Device	Code
H5535	Crystalloid	FLB3513X2	C
H5540	Crystalloid	FLB4013X2	C
IL1	LIT	4N25	A
IL5	LIT	FCD825B	A
IL12	LIT	4N27	A
IL15	LIT	4N27	B
IL16	LIT	4N27	B
ILA30	LIT	MCA230	A
ILA55	LIT	MCA255	A
ILCA2-30	LIT	MCA230	A
ILCA2-55	LIT	MCA255	A
ILD74	LIT	ILD74	A
L14F1	GE	FPT400	B
L14G1	GE	FPT500	B
LAD201	LADCOR	FLB3513X2	C
LAD202	LADCOR	FLB3511X1	C
LAD203	LADCOR	FLB3513X1	C
LAD204	LADCOR	FLB4013X1	C
M5740	Crystalloid	FLB4018X2	C
MAN71A	MON	MAN71A	A
MAN72A	MON	MAN72A	A
MAN73A	MON	MAN73A	A
MAN74A	MON	MAN74A	A
MAN3610A	MON	MAN3610A	A
MAN3620A	MON	MAN3620A	A
MAN3630A	MON	MAN3630A	A
MAN3640A	MON	MAN3640A	A
MAN4630A	MON	FND557	E
MAN4640A	MON	FND550	E
MAN6610	MON	MAN6610	A
MAN6640	MON	MAN6640	A
MAN6710	MON	MAN6710	A
MAN6740	MON	MAN6740	A
MCA230	MON	MCA230	A
MCA231	MON	MCA231	A
MCA255	MON	MCA255	A
MCT2	MON	MCT2	A
MCT2E	MON	MCT2E	A

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Section 8 (Cont'd)

Cross Reference

Device	Company Name	Fairchild Device	Code
MCT6	MON	MCT6	A
MCT26	MON	MCT26	A
MCT66	MON	MCT66	A
MCT210	MON	*	
MLC210	MOT	FLB3513X2	C
MLC410	MOT	FLB3513X1	C
MLED930	MOT	FPE410	B
MOC119	MOT	TIL119	A
MOC1005	MOT	FCD820C	A
MOC1006	MOT	FCD810C	A
MOC1200	MOT	4N30	A
MRD160	MOT	FPT100	E
MRD300	MOT	FPT500	A
MRD360	MOT	FPT400	A
MRD810	MOT	FPT510	A
MRD3054	MOT	FPT510	A
MRD3055	MOT	FPT510A	A
MT2	MON	FPT500	B/C
MV5021	MON	FLV160	E
MV5023	MON	FLV160	C
MV5024	MON	FLV160	C
MV5025	MON	FLV160	C
MV5026	MON	FLV160	C
MV5050	MON	MV5050	A
MV5051	MON	MV5051	A
MV5052	MON	MV5052	A
MV5053	MON	MV5053	A
MV5054-1	MON	MV5054-1	A
MV5054-2	MON	MV5054-2	A
MV5054-3	MON	MV5054-3	A
MV5055	MON	MV5055	A
MV5056	MON	MV5056	A
MV5074B	MON	TIL209A	C
MV5074C	MON	TIL209A	C
MV5075B	MON	TIL209A	C
MV5075C	MON	TIL209A	C
MV5077B	MON	TIL209A	E
MV5077C	MON	TIL209A	E
MV5152	MON	MV5152	A
MV5153	MON	MV5153	A
MV5154	MON	MV5154	A
MV5252	MON	MV5252	A
MV5253	MON	MV5253	A
MV5254	MON	MV5254	A
MV5352	MON	MV5352	A
MV5353	MON	MV5353	A
MV5354	MON	MV5354	A
MV5752	MON	MV5752	A
MV5753	MON	MV5753	A
MV5754	MON	MV5754	A
MV5274B	MON	TIL211	C
MV5274C	MON	TIL211	C
MV5277B	MON	TIL211	E
MV5277C	MON	TIL211	E
MV5374B	MON	TIL213	C
MV5374C	MON	TIL213	C
MV5377B	MON	TIL213	E
MV5377C	MON	TIL213	E
MV5774B	MON	TIL209A	B/C
MV5774C	MON	TIL209A	B/C
MV5777B	MON	TIL209A	D/E
MV5777C	MON	TIL209A	D/E
RL2	LIT	FLV110	A
RL2-03	LIT	FLV112	A
RL2-04	LIT	FLV111	A
RL20	LIT	MV5054-1	A
RL21	LIT	MV5053	C
RL209	LIT	TIL209A	C
RL209-02	LIT	TIL209A	E
RL209-03	LIT	TIL209A	E
RL209-04	LIT	TIL209A	E
RL2000	LIT	MV5054-2	C
RL4403	LIT	MV5053	C
RL4415	LIT	MV5053	E
RL4484	LIT	TIL209A	C
RL4850	LIT	MV5053	C
RL5054-1	LIT	MV5054-1	C
RL5054-2	LIT	MV5054-2	C
RLT-1	LIT	TIL209A	E
RLT1-02	LIT	TIL209A	E
RLT1-03	LIT	TIL209A	E
RLT1-04	LIT	TIL209A	E
TIL78	TI	FPT700	B
TIL111	TI	TIL111	A
TIL112	TI	TIL112	A
TIL113	TI	TIL113	A
TIL114	TI	TIL114	A
TIL115	TI	TIL115	A
TIL116	TI	TIL116	A
TIL117	TI	TIL117	A
TIL118	TI	TIL118	A
TIL119	TI	TIL119	A
TIL125	TI	FCD820C	B
TIL126	TI	FCD825C	B
TIL127	TI	FCD855C	B
TIL209A	TI	TIL209A	A
TIL211	TI	TIL211	A
TIL212	TI	TIL212	A
TIL220	TI	MV5053	C
TIL221	TI	MV5050	C

* To be introduced in 1980

Section 8 (Cont'd)

Cross Reference

Device	Company Name	Fairchild Device	Code
TIL222	TI	MV5253	C
TIL232	TI	TIL232	A
TIL312	TI	MAN72A	B
TIL313	TI	MAN74A	C
TIL321	TI	FND507	A
TIL322	TI	FND500	A
TIL323	TI	FND537	A
TIL324	TI	FND530	A
TIL325	TI	FND557	A
TIL326	TI	FND550	A
TIL327	TI	MAN73A	C
TIL330	TI	FND508	A
TIL331	TI	FND538	A
TIL332	TI	FND558	A
YL4484	LIT	TIL232	C
YL4850	LIT	MV5353	C
4N25	MON/GE/MOT	4N25	A
4N26	MON/GE/MOT	4N26	A
4N27	MON/GE/MOT	4N27	A
4N28	MON/GE/MOT	4N28	A
4N29	MON/GE/MOT	4N29	A
4N30	MON/GE/MOT	4N30	A
4N31	MON/GE/MOT	4N31	A
4N32	MON/GE/MOT	4N32	A
4N33	MON/GE/MOT	4N33	A
4N35	MON/GE/MOT	4N35	A
4N36	MON/GE/MOT	4N36	A
4N37	MON/GE/MOT	4N37	A
1654	IEE	FLB3513X2	C
1657	IEE	FLB4013X2	C
1658	IEE	FLB4018X2	C
3901	Hamlin	FLB3513X4	C
3902	Hamlin	FLB3513X2	C
3906	Hamlin	FLB4013X2	C
3907	Hamlin	FLB4018X2	C
3933	Hamlin	FLB3513X3	C
3946	Hamlin	FLB8009X1	C
3962	Hamlin	FLB3513X1	C
3966	Hamlin	FLB4013X1	C
3967	Hamlin	FLB4018X1	C
5082-4403	HP	FLV160	C
5082-4415	HP	FLV160	E
5082-4440	HP	FLV160	C
5082-4444	HP	FLV160	E
5082-4480	HP	5082-4480	A
5082-4483	HP	5082-4483	A
5082-4484	HP	TIL209A	C
5082-4486	HP	5082-4486	A
5082-4487	HP	TIL209A	E
5082-4488	HP	TIL209A	E
5082-4494	HP	TIL209A	C
5082-4550	HP	MV5353	C
5082-4555	HP	MV5353	C
5082-4557	HP	MV5354	C
5082-4558	HP	MV5352	B/C
5082-4584	HP	TIL232	C
5082-4590	HP	FLV440	C
5082-4592	HP	FLV440	B/C
5082-4650	HP	MV5054-1	B
5082-4655	HP	MV5753	C
5082-4657	HP	MV5754	C
5082-4658	HP	MV5752	C
5082-4684	HP	TIL209A	B/C
5082-4690	HP	FLV540	C
5082-4693	HP	FLV540	B/C
5082-4694	HP	FLV540	E
5082-4695	HP	FLV540	E
5082-4790	HP	FLV140	C
5082-4791	HP	FLV140	B/C
5082-4850	HP	MV5053	C
5082-4855	HP	MV5053	C
5082-4880	HP	MV5054-1	C
5082-4881	HP	MV5054-1	C
5082-4882	HP	MV5054-2	C
5082-4883	HP	MV5054-1	E
5082-4884	HP	MV5054-1	E
5082-4885	HP	MV5054-2	E
5082-4886	HP	MV5054-1	E
5082-4887	HP	MV5054-1	E
5082-4888	HP	MV5054-2	E
5082-4950	HP	MV5253	C
5082-4955	HP	MV5253	B/C
5082-4957	HP	MV5254	B/C
5082-4958	HP	MV5252	B/C
5082-4984	HP	TIL211	C
5082-4990	HP	FLV340	C
5082-4992	HP	FLV340	B/C
5082-7610	HP	MAN72A	B
5082-7611	HP	MAN71A	B
5082-7650	HP	5082-7650	A
5082-7651	HP	5082-7651	A
5082-7653	HP	5082-7653	A
5082-7670	HP	FND537	E
5082-7671	HP	FND537	E
5082-7673	HP	FND530	E
5082-7676	HP	FND531	E
5082-7730	HP	MAN72A	A
5082-7731	HP	MAN71A	A
5082-7736	HP	MAN73A	C
5082-7740	HP	MAN74A	C

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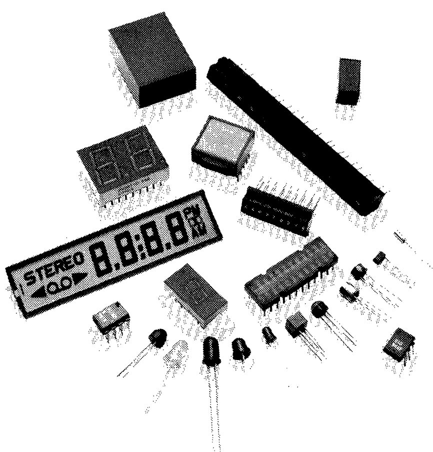
Section 8 (Cont'd) — Cross Reference

Device	Company Name	Fairchild Device	Code
5082-7750	HP	5082-7750	A
5082-7751	HP	5082-7751	A
5082-7760	HP	5082-7760	A
65050	OPTEL	FLB3513X1	C
739-2	Beckman	FLB3513X3	C
739-3	Beckman	FLB3513X1	C
739-4	Beckman	FLB4013X1	C
739-22	Beckman	FLB3513X4	C
739-23	Beckman	FLB3513X2	C
739-24	Beckman	FLB4013X2	C
7543	LXD	FLB3513X2	C
7544	LXD	FLB4013X2	C
7554	LXD	FLB4018X2	C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Section 9

Definition of Symbols and Terms

Angstrom (Å)
A unit of length particularly for measuring electromagnetic wavelengths; one angstrom = 10^{-10} meters = 10^{-4} microns = 3.937×10^{-9} inches.

Angular Alignment
A measure of the deviation of the optical axis from the mechanical axis.

Area Source
A source with a diameter greater than 10% of the distance between it and the detector.

Axial Intensity (I_O)
The ratio of the flux emitted by a source and contained within an incremental on axis solid angle subtended by a sensor [units: lumens/steradian (photometric) or watts/steradian (radiometric)].

B_L (also "B")
A photometric unit of luminance in (lumens/steradian)/ft^2 or foot-Lamberts.

Blackbody
A 100% efficient radiator and absorber of radiant energy used as a standard for all irradiance measurements.

Blackbody Luminous Efficiency
As a function of temperature, the efficiency of an incandescent blackbody in terms of visible light.

Candela
A photometric unit of luminous intensity (in lumens per steradian) defined as 1/60 the intensity of a one cm^2 blackbody radiator at platinum's solidification temperature (2,046°K).

Candela/cm^2
Luminance unit called "stilb".

($1/\pi$) candela/cm^2
Luminance unit called "Lambert".

Channel Impedance
The parallel resistance and capacitance appearing between the active and guard ring junctions.

Color Temperature
The temperature of a blackbody whose radiation has the same visible color as that of a given non-blackbody radiator. TYPICAL UNIT: K (formerly °K).

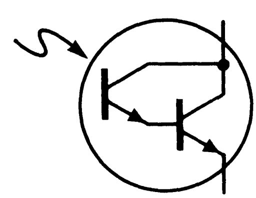
Conversion Efficiency (of a Photoemissive Device)
The ratio of maximum available luminous or radiant flux output to total input power.

Critical Angle
The maximum angle of incidence for which light will be transmitted from one medium to another. Light approaching the interface at angles greater than the critical angle will be reflected back into the first medium.

Dark Current (I_D)
The current which flows in a photodetector when there is no incident radiation on the detector.

Darlington Amplifier
A composite configuration of transistors which provides a high input impedance and a high degree of amplification.

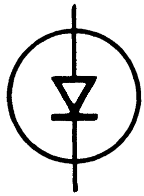
Darlington Connector Phototransistor
A phototransistor the collector and emitter of which are connected to the collector and base, respectively, of a second transistor. The emitter current of the input transistor is amplified by the second transistor and the device has very high sensitivity to light.



DC Transfer Ratio (of an Optically Coupled Isolator)
The ratio of the dc output current to the dc input current.

Delay Time (t_d)
The time interval from the point at which the leading edge of the input pulse has reached 10% of its maximum amplitude to the point at which the leading edge of the output pulse has reached 10% of its maximum amplitude.

Diode
A semiconductor device which passes current in only one direction.



Duty Cycle
A measure of the effect of a pulsed input to a lamp. Expressed as a percentage of on time as compared to total time.

E
Photometric unit of illuminance in lumens/ft^2 (foot-candle).

Emission Beam Angle Between Half-Power Points (θ_{HP})
The angle centered on the optical axis of a light-emitting diode within which the relative radiant power output or photon intensity is not less than half of the maximum output or intensity.

Fall Time (t_f)
The time duration during which the trailing edge of a pulse is decreasing from 90% to 10% of its maximum amplitude.

Flux
Power passing through a surface (energy per unit time); number of photons passing through a surface per unit time. Expressed in lumens or watts.

Flux Density
A measure of the strength of a wave; flux per unit area normal to the direction of the flux; number of photons passing through a surface per unit time per unit area. Expressed in watts/cm^2 or lumens/ft^2.

Foot-candle
Unit of illumination. Defined as the illuminance on a surface of one square foot on which there is a uniformly distributed flux of one lumen, or lumens/ft^2.

Foot-Lambert
Unit of luminance or brightness. Defined as the uniform luminance of a surface emitting or reflecting light at the rate of one lumen per square foot.

Forward Voltage (V_F)
The voltage across a semiconductor diode associated with the flow of forward current. The p-region is at a positive potential with respect to the n-region.

GaAs, GaAsP, GaP
The most commonly used emitter materials are gallium arsenide (GaAs), gallium arsenide phosphide (GaAsP) and gallium phosphide (GaP).

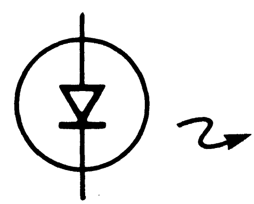
H
Irradiance or radiation flux density in watts/cm^2 (radiometric unit).

Half Intensity Beam Angle (θ_{HI})
The angle within which the radiant intensity is not less than half the maximum.

Homogeneous Orientation
The parallel orientation of the molecular axes of the nematic molecules in a nematic crystal, relative to the electrode plates.

Illumination (E_v)
The luminous flux density incident on a surface; the ratio of flux to area of illuminated surface.
TYPICAL UNITS: lm/ft^2, lx = lm/m^2. 1 lm/ft^2 = 10.764 lx.

Infrared Light-Emitting Diode (Infrared Emitter)
An optoelectronic device containing a semiconductor p-n junction which emits radiant energy in the 0.78 μm to 100 μm wavelength region when forward-biased.



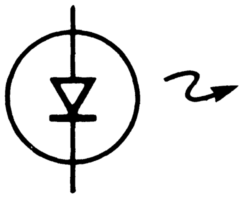
Irradiance (H or E_e)
The radiant flux density incident on a surface; the ratio of flux to area of irradiated surface.
TYPICAL UNITS: W/ft^2, W/m^2. 1 W/ft^2 = 10.764 W/m^2.

Junction Capacity
The capacitance appearing across the junction of a photodiode. It is analogous to a parallel plate capacitor having a voltage controlled dielectric.

Light
For the purpose of these definitions, radiant energy transmitted by wave motion with wavelengths from about 0.3 μm to 30 μm; this includes visible wavelengths (0.38 μm to 0.78 μm) and those wavelengths, such as ultraviolet and infrared, which can be handled by optical techniques used for the visible region. In more restricted usage, radiant energy within the limits of the visual spectrum.

Light Current (I_L)
The current that flows through a photosensitive device, such as a phototransistor or a photodiode, when it is exposed to illumination or irradiance.

Light-Emitting Diode (LED)
Light-emitting diode that emits visible light.



Liquid Crystals
Liquids that are doubly-refracting and that display interference patterns in polarized light. The turbid liquid produced on melting cholesteryl benzoate is an example of a liquid crystal.

Lumen
Unit of flux; flux through one steradian from a uniform point source of one candle.

Luminance (L) (Photometric Brightness)
The luminous intensity of a surface in a given direction per unit of projected area of the surface as viewed from that direction. TYPICAL UNITS: fL, cd/ft^2, cd/m^2.
$1\ fL = (1/\pi)\ cd/ft^2 = 3.4263\ cd/m^2$.

Luminescence
Emission of light due to any other cause than high temperature (incandescence).

Luminous Flux (Φ_V)
The time rate of flow of light. TYPICAL UNIT: lm

Note
Luminous flux is related to radiant flux by the eye-response curve of the International Commission on Illumination (CIE). At the peak response (λ = 555 nm), 1 W = 680 lm.

Luminous Intensity (I_V)
Luminous flux per unit solid angle in a given direction. TYPICAL UNIT: cd. 1 cd = 1 lm/sr.

Noise Current
The RMS noise current generated by a photodiode with no incident light energy. Under reverse bias conditions, the noise current is a combination of shot noise produced by the dark current and thermal noise produced by the channel resistance. When operated photovoltaically, the noise generated is a thermal noise that is related to the value of shunt resistance.

Off-State Collector Current (of an Optically Coupled Isolator) ($I_{C(off)}$)
The output current when the input current is zero.

On-State Collector Current (of an Optically Coupled Isolator) ($I_{C(on)}$)
The output current when the input current is above a threshold level. An increase in the input current will usually result in a corresponding increase in the on-state collector current.

Optical Axis
A line about which the radiant-energy pattern is centered; usually perpendicular to the active area.

Optically Coupled Isolator
An optoelectronic device consisting of a photoemissive device and a photodetector integrated into a single entity and intended for the transfer of a signal from the input to the output.

Optoelectronics
Circuitry involving solid-state light emitters and detectors.

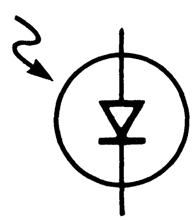
Optoelectronic Transistor
A transistor that uses an electroluminescent source, a transparent base and a photoelectric collector.

Oriented Crystal
A crystal having the axes of its grains aligned so that they have directional magnetic characteristics.

Photocurrent
The difference between light current (I_L) and dark current (I_D) in a photodetector.

Photodetector
A device which senses incident radiation.

Photodiode
A solid state device, much like an ordinary diode except that incident light on the pn junction causes the device to conduct. It acts as an open circuit (ideally) in the dark. The photodiode is characterized by a linear relationship between input radiation and output current. It has faster switching speeds than a phototransistor.



Photometric Axis
The direction from the source of radiant energy in which the measurement of photometric parameters is performed.

Photometric Brightness
See Luminance.

Photon
A quantum (the smallest possible unit) of radiant energy; a photon carries a quantity of energy equal to Planck's constant times the frequency.

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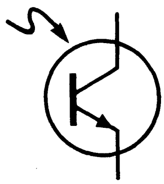
Phototransistor
Solid state device similar to an ordinary transistor except that light incident on the pn junctions controls the response of this device; offers built-in gain and greater sensitivity than photodiodes.



Point Source
Radiation source whose maximum dimension is less than 1/10 the distance between source and receiver.

Quantum Efficiency (of a Photosensitive Device)
The ratio of the number of carriers generated to the number of photons incident upon the active region.

Radiant Flux (Φ_e)
The time rate of flow of radiant energy.
TYPICAL UNIT: W.

Radiant Pulse Fall Time (t_f)
The time required for a photometric quantity to change from 90% to 10% of its peak value for a step change in electrical input.

Radiant Pulse Time (t_r)
The time required for a photometric quantity to change from 10% to 90% of its peak value for a step change in electrical input.

Radiation and Illumination Sources
The effect of a radiation source on a photodevice is dependent on the device spectral response and the spectral distribution of energy from the source. To discuss such energy, two related sets of terminology are available. The first, radiometric, is a physical system, and the second, photometric, is a physiological system, which defines energy relative to its visual effect.

The defining factor for the photometric system is the spectral response curve of a standard observer, whereas the defining spectral response of the radiometric system can be imagined as unit response for all wavelengths.

Rise Time (t_r)
The time duration during which the leading edge of a pulse is increasing from 10% to 90% of its maximum amplitude.

Series Resistance
The resistance of the undepleted bulk silicon.

Shunt Resistance
The dynamic resistance (d^V/d^i) of the junction at zero volts.

Spectral Output (of a Light-Emitting Diode)
A description of the radiant-energy or light-emission characteristic versus wavelength. This information is usually given by stating the wavelength at peak emission and the bandwidth between half-power points or by means of a curve.

Spectral Distribution of Energy (Eλ)
A plot showing the variation of spectral emission with wavelength.

Spectral Response (of a Photosensitive Device)
A curve of the electrical-output characteristic versus wavelength of radiant energy incident upon the device.

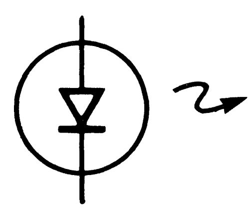
Steradian
Solid angle subtending an area on the surface of a sphere equal to the square of the radius; there are 4π steradians in a sphere.

Storage Time (t_s)
The time interval from a point at which the trailing edge of the input pulse has dropped to 90% of its maximum amplitude to a point at which the trailing edge of the output pulse has dropped to 90% of its maximum amplitude.

Threshold Voltage
Voltage at which a pn junction begins to pass a current; in a solid state lamp, the voltage at which light is first emitted.

Visible Emission, Visible Light
Radiation which is characterized by wavelengths of about 0.38 μm to 0.78 μm.

Visible-Light-Emitting Diode (VLED)
An optoelectronic device containing a semiconductor junction which emits visible light when forward-biased.



Wavelength at Peak Emission (λ_p)
The wavelength at which the power output from a light-emitting diode is maximum. TYPICAL UNITS: Å, μm, nm.
1 Å = 10^{-4} μm = 0.1 nm.

Conversion Table

Symbol	Unit	Note
A	Ampere	
Å	Angstrom	1 Å = 10^{-10} m = 10^{-4} μm = 0.1 nm
cd	Candela	1 cd = 1 lm/sr
°C	Degree Celsius	
°K		See K
ft	Foot	
fc	Foot-candle	The equivalent unit lm/ft^2 is preferred
fL	Foot-Lambert	1 fL = (1/π) cd/ft^2 = 3.4263 cd/m^2
Hz	Hertz	
in	Inch	
K-	Kelvin	Formerly °K, degree Kelvin
L	Lambert	
lm	lumen	
lx	Lux	1 lx = 1 lm/m^2
m	Meter	
μ	Micron	The equivalent unit μm is preferred
nt	Nit	1 nt = 1 cd/m^2
Ω	Ohm	
s	Second	
sr	Steradian	
sb	Stilb	1 sb = 1 cd/cm^2
V	Volt	
W	Watt	

Units of Measurement

To Convert From	To	Multiply By
Angstroms	Nanometers Millimicrons	0.1
Angstroms	Microns Micrometers	0.0001
Nanometers Millimicrons	Angstroms	10
Microns Micrometers	Angstroms	10,000
Nanometers Millimicrons	Microns Micrometers	.001
Microns Micrometers	Nanometers Millimicrons	1000

Description	Radiometric all wavelengths	Photometric visible light
Total Flux	Radiant Flux, P, in Watts	Luminous Flux, F, in Lumens.
Emitted Flux Density at a Source Surface	Radiant Emittance, W, in Watts/cm^2	Luminous Emittance, L, in Lumens/ft^2 (foot-Lamberts), or lumens/cm^2 (Lamberts)
Source Intensity (Point Source)	Radiant Intensity, I_r, in Watts/Steradian	Luminous Intensity, I_L, in Lumens/Steradian (Candela)
Source Intensity (Area Source)	Radiance, B_r, in (Watts/Steradian)/cm^2	Luminance, B_L, in (Lumens/Steradian)/ft^2 (foot-Lambert)
Flux Density Incident on a Receiver Surface	Irradiance, H, in Watts/cm^2	Illuminance, E, in Lumens/ft^2 (foot-candle)

Point Source Relationships

Description	Radiometric	Photometric
Point Source Intensity	I_r, Watts/Steradian	I_L, Lumens/Steradian
Incident Flux Density	H (Irradiance) = I_r/r^2 watts/distance^2	E (Illuminance) = I_L/r^2 lumens/distance^2
Total Flux Output of Point Source	P = $4\pi I_r$ Watts	F = $4\pi I_L$ Lumens

Design Relationships For An Area Source

Description	Radiometric	Photometric
Source Intensity	B_r, Watts/cm^2/steradian	B_L, Lumens/cm^2/steradian
Emitted Flux Density	W = πB_r, Watts/cm^2	L = πB_L, Lumens/cm^2
Incident Flux Density	$H = \frac{B_r A_s}{r^2 + d/2^2}$, watts/cm^2	$E = \frac{B_L A_S}{r^2 + d/2^2}$, Lumens/cm^2

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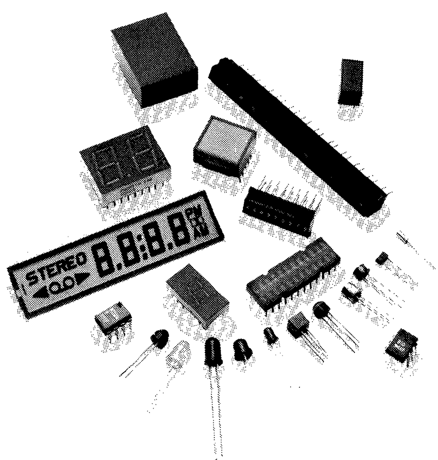
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