PHILIPS

Data handbook

PHILIPS Electronic components and materials

Semiconductors

Part 2 May 1980

Rectifier diodes

Regulator diodes

High-voltage rectifier stacks

Thyristors

Triacs

SEMICONDUCTORS

Part 2—MAY 1980

POWER DIODES, THYRISTORS, TRIACS

DATA HANDBOOK SYSTEM

Our Data Handbook System is a comprehensive source of information on electronic components, sub-assemblies and materials; it is made up of three series of handbooks each comprising several parts.

ELECTRON TUBES	BLUE
SEMICONDUCTORS AND INTEGRATED CIRCUITS	RED
COMPONENTS AND MATERIALS	GREEN

The several parts contain all pertinent data available at the time of publication, and each is revised and reissued periodically.

Where ratings or specifications differ from those published in the preceding edition they are pointed out by arrows. Where application information is given it is advisory and does not form part of the product specification.

If you need confirmation that the published data about any of our products are the latest available, please contact our representative. He is at your service and will be glad to answer your inquiries.

ELECTRON TUBES (BLUE SERIES)

Starting in 1980, new part numbers and corresponding codes are being introduced. The former code of the preceding issue is given in brackets under the new code.

Part 1	**February 1980**	**T1 02-80** **(ET1a 12-75)**	**Tubes for r.f. heating**
Part 2	**April 1980**	**T2 04-80** **(ET1b 08-77)**	**Transmitting tubes for communications**
Part 2a	**November 1977**	**ET2a 11-77**	**Microwave tubes** Communication magnetrons, magnetrons for microwave heating, klystrons, travelling-wave tubes, diodes, triodes T-R switches
Part 2b	**May 1978**	**ET2b 05-78**	**Microwave semiconductors and components** Gunn, Impatt and noise diodes, mixer and detector diodes, backward diodes, varactor diodes, Gunn oscillators, sub-assemblies, circulators and isolators
Part 3	**January 1975**	**ET3 01-75**	**Special Quality tubes, miscellaneous devices**
Part 4	**March 1975**	**ET4 03-75**	**Receiving tubes**
Part 5a	**October 1979**	**ET5a 10-79**	**Cathode-ray tubes** Instrument tubes, monitor and display tubes, C.R. tubes for special applications
Part 5b	**December 1978**	**ET5b 12-78**	**Camera tubes and accessories, image intensifiers**
Part 6	**January 1977**	**ET6 01-77**	**Products for nuclear technology** Channel electron multipliers, neutron tubes, Geiger-Müller tubes
Part 7a	**March 1977**	**ET7a 03-77**	**Gas-filled tubes** Thyratrons, industrial rectifying tubes, ignitrons, high-voltage rectifying tubes
Part 7b	**May 1979**	**ET7b 05-79**	**Gas-filled tubes** Segment indicator tubes, indicator tubes, switching diodes, dry reed contact units
Part 8	**July 1979**	**ET8 07-79**	**Picture tubes and components** Colour TV picture tubes, black and white TV picture tubes, monitor tubes, components for colour television, components for black and white television.
Part 9	**March 1978**	**ET9 03-78**	**Photomultiplier tubes; phototubes**

SEMICONDUCTORS AND INTEGRATED CIRCUITS (RED SERIES)

Starting in 1980, new part numbers and corresponding codes are being introduced. The former code of the preceding issue is given in brackets under the new code.

Part 1	**March 1980**	**S1 03-80** **(SC1b 05-77)**	**Diodes** Small-signal germanium diodes, small-signal silicon diodes, special diodes, voltage regulator diodes (< 1,5 W), voltage reference diodes, tuner diodes, rectifier diodes
Part 2	**May 1980**	**S2 05-80** **(SC1a 08-78)**	**Power diodes, thyristors, triacs** Rectifier diodes, voltage regulator diodes (> 1,5 W), rectifier stacks, thyristors, triacs
Part 2	**June 1979**	**SC2 06-79**	**Low-frequency power transistors**
Part 3	**January 1978**	**SC3 01-78**	**High-frequency, switching and field-effect transistors***
Part 3	**April 1980**	**S3 04-80** **(SC2 11-77, partly)** **(SC3 01-78, partly)**	**Small-signal transistors**
Part 4a	**December 1978**	**SC4a 12-78**	**Transmitting transistors and modules**
Part 4b	**September 1978**	**SC4b 09-78**	**Devices for optoelectronics** Photosensitive diodes and transistors, light-emitting diodes, photocouplers, infrared sensitive devices, photoconductive devices
Part 4c	**July 1978**	**SC4c 07-78**	**Discrete semiconductors for hybrid thick and thin-film circuits**
Part 5a	**November 1976**	**SC5a 11-76**	**Professional analogue integrated circuits**
Part 5b	**March 1977**	**SC5b 03-77**	**Consumer integrated circuits** Radio, audio, television
Part 6	**October 1977**	**SC6 10-77**	**Digital integrated circuits** LOCMOS HE4000B family
Part 6b	**August 1979**	**SC6b 08-79**	**ICs for digital systems in radio and television receivers**
Signetics integrated circuits			Bipolar and MOS memories 1979 Bipolar and MOS microprocessors 1978 Analogue circuits 1979 Logic - TTL 1978

* Field-effect transistors and wideband transistors will be transferred to S5 and SC3c respectively. The old book SC3 01-78 should be kept until then.

COMPONENTS AND MATERIALS (GREEN SERIES)

Starting in 1980, new part numbers and corresponding codes are being introduced.
The former code of the preceding issue is given in brackets under the new code.

Part 1	July 1979	CM1 07-79	**Assemblies for industrial use** PLC modules, high noise immunity logic FZ/30 series, NORbits 60-series, 61-series, 90-series, input devices, hybrid integrated circuits, peripheral devices
Part 3a	September 1978	CM3a 09-78	**FM tuners, television tuners, surface acoustic wave filters**
Part 3b	October 1978	CM3b 10-78	**Loudspeakers**
Part 4a	November 1978	CM4a 11-78	**Soft Ferrites** Ferrites for radio, audio and television, beads and chokes, Ferroxcube potcores and square cores, Ferroxcube transformer cores
Part 4b	February 1979	CM4b 02-79	**Piezoelectric ceramics, permanent magnet materials**
Part 6	April 1977	CM6 04-77	**Electric motors and accessories** Small synchronous motors, stepper motors, miniature direct current motors
Part 7	September 1971	CM7 09-71	**Circuit blocks** Circuit blocks 100 kHz-series, circuit blocks 1-series, circuit blocks 10-series, circuit blocks for ferrite core memory drive
Part 7a	January 1979	CM7a 01-79	**Assemblies** Circuit blocks 40-series and CSA70 (L), counter modules 50-series, input/output devices
Part 8	June 1979	CM8 06-79	**Variable mains transformers**
Part 9	August 1979	CM9 08-79	**Piezoelectric quartz devices** Quartz crystal units, temperature compensated crystal oscillators
Part 10	April 1978	CM10 04-78	**Connectors**
Part 11	December 1979	CM11 12-79	**Non-linear resistors** Voltage dependent resistors (VDR), light dependant resistors (LDR), negative temperature coefficient thermistors (NTC), positive temperature coefficient thermistors (PTC)
Part 12	November 1979	CM12 11-79	**Variable resistors and test switches**
Part 13	December 1979	CM13 12-79	**Fixed resistors**
Part 14	April 1980	C14 04-80 (CM2b 02-78)	**Electrolytic and solid capacitors**
Part 15	May 1980	C15 05-80 (CM2b 02-78)	**Film capacitors, ceramic capacitors, variable capacitors**

INDEX OF TYPE NUMBERS

Data Handbooks Semiconductors

The inclusion of a type number in this publication does not necessarily imply its availability.

type no.	part	section	type no.	part	section	type no.	part	section
AA119	S1	PC	BAV20	S1	WD	BB405G	S1	T
AAZ13	S1	GB	BAV21	S1	WD	BBY31	4c	Mm
AAZ15	S1	GB	BAV45	S1	Sp	BC107	S3	Sm
AAZ17	S1	GB	BAV70	4c	Mm	BC108	S3	Sm
AAZ18	S1	GB	BAV99	4c	Mm	BC109	S3	Sm
BA182	S1	T	BAW56	4c	Mm	BC140	S3	Sm
BA220	S1	WD	BAW62	S1	WD	BC141	S3	Sm
BA221	S1	WD	BAX12	S1	WD	BC146	S3	Sm
BA223	S1	T	BAX12A	S1	WD	BC147	S3	Sm
BA243	S1	T	BAX13	S1	WD	BC148	S3	Sm
BA244	S1	T	BAX14A	S1	WD	BC149	S3	Sm
BA280	S1	T	BAX16	S1	WD	BC157	S3	Sm
BA314	S1	Vrg	BAX17	S1	WD	BC158	S3	Sm
BA315	S1	Vrg	BAX18A	S1	WD	BC159	S3	Sm
BA316	S1	WD	BB105B	S1	T	BC160	S3	Sm
BA317	S1	WD	BB105G	S1	T	BC161	S3	Sm
BA318	S1	WD	BB106	S1	T	BC177	S3	Sm
BA379	S1	T	BB109G	S1	T	BC178	S3	Sm
BAS11	S1	WD	BB110B	S1	T	BC179	S3	Sm
BAS16	4c	Mm	BB110G	S1	T	BC200	S3	Sm
BAT17	4c	Mm	BB119	S1	T	BC264A	SC3	FET
BAT18	4c	Mm	BB204B	S1	T	BC264B	SC3	FET
BAV10	S1	WD	BB204G	S1	T	BC264C	SC3	FET
BAV18	S1	WD	BB212	S1	T	BC264D	SC3	FET
BAV19	S1	WD	BB405B	S1	T	BC327	S3	Sm

FET = Field-effect transistors
GB = Germanium gold bonded diodes
Mm = Discrete semiconductors for hybrid thick and thin-film circuits
PC = Germanium point contact diodes
Sm = Small-signal transistors
Sp = Special diodes
T = Tuner diodes
Vrg = Voltage regulator diodes
WD = Silicon whiskerless diodes

INDEX

FET = Field-effect transistors

Mm = Discrete semiconductors for hybrid thick and thin-film circuits

P = Low-frequency power transistors

Sm = Small-signal transistors

FET = Field-effect transistors
HFSW = High-frequency and switching transistors

Mm = Discrete semiconductors for hybrid thick and thin-film circuits

P = Low-frequency power transistors
PDT = Photodiodes or transistors
R = Rectifier diodes
Sm = Small-signal transistors
Th = Thyristors
Tra = Transmitting transistors and modules

* = series.

GB = Germanium gold bonded diodes
I = Infrared devices
LED = Light-emitting diodes
Mm = Discrete semiconductors for hybrid thick and thin-film circuits
P = Low-frequency power transistors
PC = Germanium point contact diodes
Ph = Photoconductive devices
PhC = Photocouplers
R = Rectifier diodes

* = series.

Sm = Small-signal transistors
St = Rectifier stacks
Th = Thyristors
Tri = Triacs

TS = Transient suppressor diodes
Vrf = Voltage reference diodes
Vrg = Voltage regulator diodes
WD = Silicon whiskerless diodes

A = Accessories
DH = Diecast heatsinks
FET = Field-effect transistors
HE = Heatsink extrusions
HFSW = High-frequency and switching transistors
I = Infrared devices

P = Low-frequency power transistors
R = Rectifier diodes
Sm = Small-signal transistors
Tra = Transmitting transistors and modules
Vrf = Voltage reference diodes
WD = Silicon whiskerless diodes

SELECTION GUIDE

RECTIFIER DIODES

General purpose

$I_{F(AV)max}$ A		V_{RRMmax} (V) 300	600	800	1000	1200	1600
1.4	BYX22		•			•	
6	BYX49	•	•			•	
6	BYX38	•	•			•	
10	BYX98	•	•			•	
12	BYX42	•	•			•	
15	BYX99	•	•			•	
30	BYX96	•	•			•	•
47	BYX97	•	•			•	•
48	BYX52	•	•			•	
150	BYX32		•	•	•	•	•

Avalanche

$I_{F(AV)max}$ A		V_{RWMmax} (V) 600	800	1000	1200	1400
1.5	BYX45	•	•	•	•	•
9.5	BYX39	•	•	•	•	•
20	BYX25	•	•	•	•	•
48	BYX56	•	•	•	•	•

Bridges

$I_{O(AV)max}$ A		$V_{I(RMS)max}$ (V) 50	60	80	140	220	280	420
PCB-mounted types								
1	BY179						•	
1.2	BY164		•					
1.5	BY256			•				
1.5	BY257						•	
4.8	BY224					•	•	
4.8	BY225	•		•				
Bolt-down types								
12	BY260				•		•	•
25	BY261				•		•	•

Efficiency diodes

I_{FWMmax} A		V_{RRMmax} (V) 600	750	1500
5	BY223			•
10	BY277	•	•	

Fast-recovery rectifier diodes

Schottky types

$I_{F(AV)max}$ A	Type	V_{RRMmax} (V) 30	35	40	45
28	BYV21	●	●	●	●

Ultra-fast types

$I_{F(AV)max}$ A	Type	V_{RRMmax} (V) 50	100	150	200	300	350	400	500	600	800	1000
7	BYW29	●	●	●								
12	BYW30	●	●	●								
25	BYW31	●	●	●								
35	BYW92	●	●	●								
Super-fast types												
7	BYX50				●	●						
12	BYV30				●	●		●				
35	BYV92				●	●		●				
Very-fast types												
6	1N3879	●										
6	1N3880		●									
6	1N3881				●							
6	1N3882					●						
12	1N3889	●										
12	1N3890		●									
12	1N3891				●							
12	1N3892					●						
14	BYX30*				●	●		●	●	●		
20	1N3899	●										
20	1N3900		●									
20	1N3901				●							
20	1N3902					●						
20	1N3903							●				
22	BYX46*				●	●		●	●	●		
30	1N3909	●										
30	1N3910		●									
30	1N3911				●							
30	1N3912					●						
30	1N3913							●				
Fast types												
7	BY229				●			●		●	●	
7	BYW19										●	●
7	BYX71						●			●		
40	BYW25										●	

*With avalanche characterisitics

REGULATOR DIODES

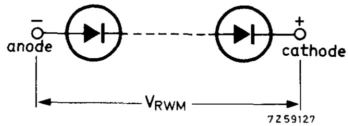
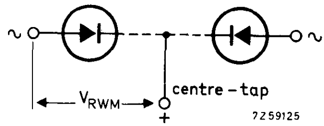
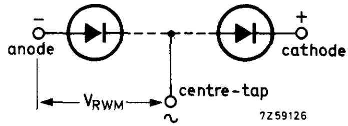
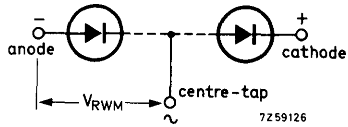
<table>
<tr><th rowspan="4">Regulated voltage</th><th rowspan="4">Suppression stand-off voltage</th><th colspan="9">REGULATOR SERVICE $P_{tot\ max}$</th></tr>
<tr><th colspan="3">2.5 W</th><th>15 W</th><th>–</th><th>20 W</th><th>100 W</th><th>–</th><th>–</th></tr>
<tr><th colspan="9">SUPPRESSOR SERVICE $P_{RSM\ max}$</th></tr>
<tr><th>190 W</th><th colspan="2">700 W</th><th>–</th><th>700 W</th><th>700 W</th><th>9.5 kW</th><th>25 kW</th><th>27 kW</th></tr>
<tr><td>4.7 V</td><td>3.6 V</td><td rowspan="8">Type No. BZY96</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>5.1 V</td><td>3.9 V</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>5.6 V</td><td>4.3 V</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>6.2 V</td><td>4.7 V</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>6.8 V</td><td>5.1 V</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>7.5 V</td><td>5.6 V</td><td rowspan="25">Type No. BZX70</td><td></td><td></td><td rowspan="26">Type No. BZW70</td><td rowspan="25">Type No. BZY93</td><td rowspan="25">Type No. BZY91</td><td></td><td></td></tr>
<tr><td>8.2 V</td><td>6.2 V</td><td></td><td></td><td></td><td rowspan="25">Type No. BZW91</td></tr>
<tr><td>9.1 V</td><td>6.8 V</td><td></td><td></td><td></td></tr>
<tr><td>10 V</td><td>7.5 V</td><td></td><td rowspan="22">Type No. BZY95</td><td rowspan="22">Type No. BZV15</td><td rowspan="22">Type No. BZW86</td></tr>
<tr><td>11 V</td><td>8.2 V</td><td></td></tr>
<tr><td>12 V</td><td>9.1 V</td><td></td></tr>
<tr><td>13 V</td><td>10 V</td><td></td></tr>
<tr><td>15 V</td><td>11 V</td><td></td></tr>
<tr><td>16 V</td><td>12 V</td><td></td></tr>
<tr><td>18 V</td><td>13 V</td><td></td></tr>
<tr><td>20 V</td><td>15 V</td><td></td></tr>
<tr><td>22 V</td><td>16 V</td><td></td></tr>
<tr><td>24 V</td><td>18 V</td><td></td></tr>
<tr><td>27 V</td><td>20 V</td><td></td></tr>
<tr><td>30 V</td><td>22 V</td><td></td></tr>
<tr><td>33 V</td><td>24 V</td><td></td></tr>
<tr><td>36 V</td><td>27 V</td><td></td></tr>
<tr><td>39 V</td><td>30 V</td><td></td></tr>
<tr><td>43 V</td><td>33 V</td><td></td></tr>
<tr><td>47 V</td><td>36 V</td><td></td></tr>
<tr><td>51 V</td><td>39 V</td><td></td></tr>
<tr><td>56 V</td><td>43 V</td><td></td></tr>
<tr><td>62 V</td><td>47 V</td><td></td></tr>
<tr><td>68 V</td><td>51 V</td><td></td></tr>
<tr><td>75 V</td><td>56 V</td><td></td></tr>
<tr><td>82 V</td><td>62 V</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td colspan="2">Outline</td><td>DO-1</td><td>SOD-18</td><td>DO-1</td><td>SOD-38</td><td>SOD-18</td><td>DO-4</td><td>DO-5</td><td>DO-30</td><td>DO-5</td></tr>
<tr><td colspan="2">Polarity</td><td>normal</td><td>normal</td><td>normal</td><td>both</td><td>normal</td><td>both</td><td>both</td><td>both</td><td>both</td></tr>
</table>

Transient suppressor bridges

Type No.	V_I V	$V_{O(CL)}$ V	$I_{(CL)SM}$ A
BZW10–12	12	30	50
BZW10–15	15	34	40

Normal polarity (cathode to stud)	no end-letter
Reverse polarity (anode to stud)	R
Both polarities available	(R)

HIGH-VOLTAGE RECTIFIER STACKS

Type No.	$I_{F(AV)}$ max.	V_{RWM} max.	Configuration
OSS9110–3 to –30	3.5 A (6 A in oil)	3 kV to 30 kV	
OSS9210–3 to –30	5 A (20 A in oil)		
OSS9310–3 to –30	4 A (12 A in oil)		
OSS9410–3 to –30	10 A (30 A in oil)		
OSB9110–4 to –30	7 A (12 A in oil)	2 kV to 15 kV	
OSB9210–4 to –30	10 A (40 A in oil)		
OSB9310–4 to –30	4 A (12 A in oil)		
OSB9410–4 to –30	20 A (60 A in oil)		
OSM9110–4 to –30	3.5 A (6 A in oil)	2 kV to 15 kV	
OSM9210–4 to –30	5 A (20 A in oil)		
OSM9310–4 to –30	4 A (12 A in oil)		
OSM9410–4 to –30	10 A (30 A in oil)		
OSM9510–8 to –12	1.5 A	8 kV to 12 kV	

THYRISTORS

General purpose thyristors

$I_{T(RMS)max}$ A		V_{RRMmax} (V) 100	200	300	400	500	600	650	800	1000	1200	1400	1600
1.6	BTX18	•	•	•	•	•							
12	BT151					•		•					
16	BTY79				•	•	•		•	•			
16	BTW38						•		•	•	•		
16	BTW42						•		•	•	•		
20	BT152				•		•		•				
25	BTW45				•		•		•	•	•		
25	BTW47								•	•	•	•	•
25	BTY87				•	•	•		•				
25	BTY91				•	•	•		•				
32	BTW40				•		•		•				
32	BTW92								•	•	•	•	•
55	BTW24						•		•	•	•	•	•
140	BTW23						•		•	•	•	•	•

Fast turn-off thyristors

$I_{T(RMS)max}$ A		V_{DRMmax} (V) 500	750	800	1000	1200
6	BT153	•				
8	BT154		•			
24	BTW30S			•	•	•
31	BTW31W			•	•	•
110	BTW33			•	•	•

Thyristor tetrode BRY39T: V_{RRMmax} = 70 V; I_{Tmax} = 250 mA

Bi-directional trigger device BR100/03: $V_{(BO)}$ = 28 to 36 V; I_{FRMmax} = 2 A

TRIACS

$I_{T(RMS)max}$ A	Type	V_{DRMmax} (V) 400	500	600	800	1000	1200	1400	1600
4	BT136		●	●					
8	BT137		●	●					
12	BT138		●	●					
15	BTW43G			●	●	●	●		
15	BTW43H			●	●	●	●		
16	BT139		●	●					
25	BTX94H	●		●	●	●	●		
25	BTX94J	●		●	●	●	●		
55	BTW34G			●	●	●	●	●	●
55	BTW34H			●	●	●	●	●	●

GENERAL SECTION

Type Designation
Rating Systems
Letter Symbols
Quality Conformance and Reliability

A

A

PRO ELECTRON TYPE DESIGNATION CODE FOR SEMICONDUCTOR DEVICES

This type designation code applies to discrete semiconductor devices — as opposed to integrated circuits —, multiples of such devices and semiconductor chips.

A basic type number consists of:

TWO LETTERS FOLLOWED BY A SERIAL NUMBER

FIRST LETTER

The first letter gives information about the material used for the active part of the devices.

A. GERMANIUM or other material with band gap of 0,6 to 1,0 eV.
B. SILICON or other material with band gap of 1,0 to 1,3 eV.
C. GALLIUM-ARSENIDE or other material with band gap of 1,3 eV or more.
R. COMPOUND MATERIALS (e.g. Cadmium-Sulphide).

SECOND LETTER

The second letter indicates the function for which the device is primarily designed.

A. DIODE; signal, low power
B. DIODE; variable capacitance
C. TRANSISTOR; low power, audio frequency ($R_{th\ j\text{-}mb} > 15$ °C/W)
D. TRANSISTOR; power, audio frequency ($R_{th\ j\text{-}mb} \leq 15$ °C/W)
E. DIODE; tunnel
F. TRANSISTOR; low power, high frequency ($R_{th\ j\text{-}mb} > 15$ °C/W)
G. MULTIPLE OF DISSIMILAR DEVICES — MISCELLANEOUS; e.g. oscillator
H. DIODE; magnetic sensitive
L. TRANSISTOR; power, high frequency ($R_{th\ j\text{-}mb} \leq 15$ °C/W)
N. PHOTO-COUPLER
P. RADIATION DETECTOR; e.g. high sensitivity phototransistor
Q. RADIATION GENERATOR; e.g. light-emitting diode (LED)
R. CONTROL AND SWITCHING DEVICE; e.g. thyristor, low power ($R_{th\ j\text{-}mb} > 15$ °C/W)
S. TRANSISTOR; low power, switching ($R_{th\ j\text{-}mb} > 15$ °C/W)
T. CONTROL AND SWITCHING DEVICE; e.g. thyristor, power ($R_{th\ j\text{-}mb} \leq 15$ °C/W)
U. TRANSISTOR; power, switching ($R_{th\ j\text{-}mb} \leq 15$ °C/W)
X. DIODE: multiplier, e.g. varactor, step recovery
Y. DIODE; rectifying, booster
Z. DIODE; voltage reference or regulator (transient suppressor diode, with third letter W)

The remainder of the type number is a **serial number** indicating a particular design or development and is in one of the following two groups:

(a) **A serial number** consisting of three figures from 100 to 999.

(b) **A serial number** consisting of one letter (Z, Y, X, W, etc.) followed by two figures.

RANGE NUMBERS

Where there is a range of variants of a basic type of rectifier diode, thyristor or voltage regulator diode the type number as defined above is often used to identify the range; further letters and figures are added after a hyphen to identify associated types within the range. These additions are as follows:

RECTIFIER DIODES, THYRISTORS AND TRIACS

A group of figures indicating the rated repetitive peak reverse voltage, V_{RRM}, or the rated repetitive peak off-state voltage, V_{DRM}, whichever value is lower, in volts for each type.

The final letter R is used to denote a reverse polarity version (stud-anode) where applicable. The normal polarity version (stud cathode) has no special final letter.

REGULATOR DIODES

A first letter indicating the nominal percentage tolerance in the operating voltage V_Z.

A. 1% (according to IEC 63: series E96)
B. 2% (according to IEC 63: series E48)
C. 5% (according to IEC 63: series E24)
D. 10% (according to IEC 63: series E12)
E. 20% (according to IEC 63: series E6)

A group of figures indicating the typical operating voltage V_Z for each type at the nominal operating current I_Z rating of the range.

The letter V is used to denote a decimal sign.

The final letter R is used to denote a reverse polarity version (stud anode) where applicable. The normal polarity version (stud cathode) has no special final letter.

Examples:

BYX38-600	Silicon rectifier in the BYX38 range with 600 V maximum repetitive peak voltage, normal polarity, stud connected to cathode.
BTW24-800R	Silicon thyristor in the BTW24 range with 800 V maximum repetitive peak voltage, reverse polarity, stud connected to anode.
BZY91-C7V5	Silicon voltage regulator diode in the BZY91 range with 7.5 V operating ±5% tolerance, normal polarity, stud connected to cathode.

RATING SYSTEMS

The rating systems described are those recommended by the International Electrotechnical Commission (IEC) in its Publication 134.

DEFINITIONS OF TERMS USED

Electronic device. An electronic tube or valve, transistor or other semiconductor device.

Note
This definition excludes inductors, capacitors, resistors and similar components.

Characteristic. A characteristic is an inherent and measurable property of a device. Such a property may be electrical, mechanical, thermal, hydraulic, electro-magnetic, or nuclear, and can be expressed as a value for stated or recognized conditions. A characteristic may also be a set of related values, usually shown in graphical form.

Bogey electronic device. An electronic device whose characteristics have the published nominal values for the type. A bogey electronic device for any particular application can be obtained by considering only those characteristics which are directly related to the application.

Rating. A value which establishes either a limiting capability or a limiting condition for an electronic device. It is determined for specified values of environment and operation, and may be stated in any suitable terms.

Note
Limiting conditions may be either maxima or minima.

Rating system. The set of principles upon which ratings are established and which determine their interpretation.

Note
The rating system indicates the division of responsibility between the device manufacturer and the circuit designer, with the object of ensuring that the working conditions do not exceed the ratings.

ABSOLUTE MAXIMUM RATING SYSTEM

Absolute maximum ratings are limiting values of operating and environmental conditions applicable to any electronic device of a specified type as defined by its published data, which should not be exceeded under the worst probable conditions.

These values are chosen by the device manufacturer to provide acceptable serviceability of the device, taking no responsibility for equipment variations, environmental variations, and the effects of changes in operating conditions due to variations in the characteristics of the device under consideration and of all other electronic devices in the equipment.

The equipment manufacturer should design so that, initially and throughout life, no absolute maximum value for the intended service is exceeded with any device under the worst probable operating conditions with respect to supply voltage variation, equipment component variation, equipment control adjustment, load variations, signal variation, environmental conditions, and variations in characteristics of the device under consideration and of all other electronic devices in the equipment.

DESIGN MAXIMUM RATING SYSTEM

Design maximum ratings are limiting values of operating and environmental conditions applicable to a bogey electronic device of a specified type as defined by its published data, and should not be exceeded under the worst probable conditions.

These values are chosen by the device manufacturer to provide acceptable serviceability of the device, taking responsibility for the effects of changes in operating conditions due to variations in the characteristics of the electronic device under consideration.

The equipment manufacturer should design so that, initially and throughout life, no design maximum value for the intended service is exceeded with a bogey device under the worst probable operating conditions with respect to supply voltage variation, equipment component variation, variation in characteristics of all other devices in the equipment, equipment control adjustment, load variation, signal variation and environmental conditions.

DESIGN CENTRE RATING SYSTEM

Design centre ratings are limiting values of operating and environmental conditions applicable to a bogey electronic device of a specified type as defined by its published data, and should not be exceeded under normal conditions.

These values are chosen by the device manufacturer to provide acceptable serviceability of the device in average applications, taking responsibility for normal changes in operating conditions due to rated supply voltage variation, equipment component variation, equipment control adjustment, load variation, signal variation, environmental conditions, and variations in the characteristics of all electronic devices.

The equipment manufacturer should design so that, initially, no design centre value for the intended service is exceeded with a bogey electronic device in equipment operating at the stated normal supply voltage.

LETTER SYMBOLS FOR RECTIFIER DIODES, THYRISTORS AND TRIACS

LETTER SYMBOLS FOR CURRENTS, VOLTAGES AND POWERS

Basic letters : - The basic letters to be used are:

I, i = current   V, v = voltage   P, p = power

Lower-case basic letters shall be used for the representation of instantaneous values which vary with time. In all other instances upper-case letters shall be used.

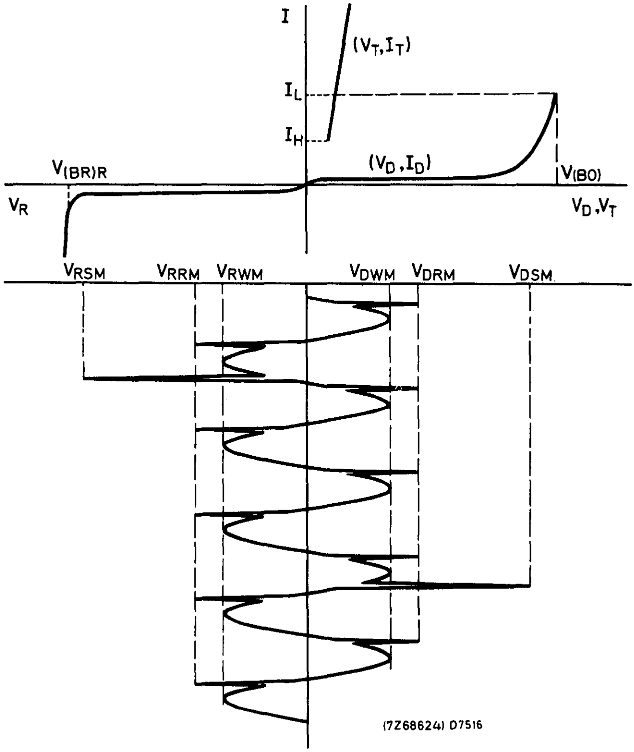
Subscripts

amb	Ambient
(AV), (av)	Average value
(BO)	Breakover
(BR)	Breakdown
case	Case
D,d	Forward off-state [1]), non-triggered (gate voltage or current)
F,f	Forward [1]), fall
G,g	Gate terminal
H	Holding
I,i	Input
J,j	Junction
L	Latching
M,m	Peak or crest value
min	Minimum
O,o	Output, open circuit
(OV)	Overload
P,p	Pulse
Q,q	Turn-off
R,r	As first subscript: reverse, rise As second subscript: repetitive, recovery
(RMS), (rms)	R.M.S. value
S,s	As first subscript: storage, stray, series, source As second subscript: non-repetitive
stg	Storage
T,t	Forward on-state [1]), triggered (gate voltage or current)
th	Thermal
(TO)	Threshold
tot	Total
W	Working
Z	Reference or regulator (i.e. zener)

For power rectifier diodes, thyristors and triacs, the terminals are not indicated in the subscript, except for the gate-terminal of thyristors and triacs.

1) For the anode-cathode voltage of thyristors and triacs, F is replaced either by D or T, to distinguish between "off-state" (non-triggered) and "on-state" (triggered).

Example of the use of letter symbols



Simplified thyristor characteristic together with an anode-cathode voltage as a function of time (no gate signal).

QUALITY CONFORMANCE AND RELIABILITY

In addition to 100% testing of all major device parameters in production department, independently controlled statistical sampling for conformance and reliability takes place using BS6001 'Sampling Procedures and Tables'. BS6001 is consistent with MIL-STD-105D, DEF131A, ISO2859, CA-C-115.

The methods used and standards applied are compatible with CECC, BS and IEC rules and procedures, and many products are available to BS9300 and CECC 50000 series detail specifications.

High reliability products, which have had special inspections and 'burn-in', are also available.

RECTIFIER DIODES

B

B

RECTIFIER DIODES

REVERSE RECOVERY

When a semiconductor rectifier diode has been conducting in the forward direction sufficiently long to establish the steady state, there will be a charge due to minority carriers present. Before the device can block in the reverse direction this charge must be extracted. This extraction takes the form of a transient reverse current and this, together with the reverse bias voltage results in additional power dissipation which reduces the rectification efficiency. At sine-wave frequencies up to about 400 Hz these effects can often be ignored, but at higher frequencies and for square waves the switching losses must be considered.

Stored charge

The area under the I_R- time curve is known as the stored charge (Q_s) and is normally quoted in micro- or nanocoulombs. Low stored charge devices are preferred for fast switching applications.

Reverse recovery time

Another parameter which can be used to determine the speed of the rectifier is the reverse recovery time (t_{rr}). This is measured from the instant the current passes through zero (from forward to reverse) to the instant the current recovers to 10% of its peak reverse value. Low reverse recovery times are associated with low stored charge devices.

The conditions which need to be specified are:

a. Steady-state forward current (I_F); high currents increase recovery time.
b. Reverse bias voltage (V_R); low reverse voltage increases recovery time.
c. Rate of fall of anode current (dI_F/dt); high rates of fall reduce recovery time, but increase stored charge.
d. Junction temperature (T_j); high temperatures increase both recovery time and stored charge.

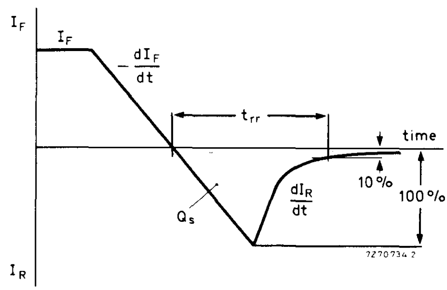


Fig. 1 Waveform showing the reverse recovery aspects.

REVERSE RECOVERY (continued)

Softness of recovery

In many switching circuits it is not just the magnitude but the shape of the reverse recovery characteristic that is important. If the positive-going edge of the characteristic has a fast rise time (as in a so-called 'snap-off' device) this edge may cause conducted or radiated r.f.i., or it may generate high voltages across inductors which may be in series with the rectifier. The maximum slope of the reverse recovery current (dI_R/dt) is quoted as a measure of the 'softness' of the characteristic. Low values are less liable to give r.f.i. problems. The measurement conditions which need to be specified are as above. When stored charges are very low, e.g. for epitaxial and Schottky-barrier rectifier diodes,this softness characteristic can be ignored.

DOUBLE-DIFFUSED RECTIFIER DIODES

A single-diffused diode with a two layer p-n structure cannot combine a high forward current density with a high reverse blocking voltage.

A way out of this dilemma is provided by the three layer double-diffused structure. A lightly doped silicon layer, called the base, is sandwiched between highly doped diffused p^+ and n^+ outer layers giving a $p^+ - pn^+$ or $p^+ - nn^+$ layer. Generally, the base gives the diode its high reverse voltage, and the two diffused regions give the high forward current rating.

Although double-diffused diodes are highly efficient, a slight compromise is still necessary. Generally, for a given silicon chip area, the thicker the base layer the higher the V_R and the lower the I_F. Reverse switching characteristics also determine the base design. Fast recovery diodes usually have n-type base regions to give 'soft' recovery. Other diodes have the base type, n or p, chosen to meet their specific requirements.

ULTRA FAST RECTIFIER DIODES

Ultra fast rectifier diodes, made by epitaxial technology, are intended for use in applications where low conduction and switching losses are of paramount importance and relatively low reverse blocking voltage (V_{RWM} = 150 V) is required: e.g., switched-mode power supplies operating at frequencies of about 50 kHz.

The use of epitaxial technology means that there is very close control over the almost ideal diffusion profile and base width giving very high carrier injection efficiencies leading to lower conduction losses than conventional technology permits. The well defined diffusion profile also allows a tight control of stored minority carriers in the base region, so that very fast turn-off times (35 ns) can be achieved. The range of devices also has a soft reverse recovery and a low forward recovery voltage.

SCHOTTKY-BARRIER RECTIFIER DIODES

Schottky-barrier rectifiers find application in low-voltage switched-mode power supplies (e.g. 5 V output) where they give an increase in efficiency due to the very low forward drop, and low switching losses. Power Schottky diodes are made by a metal-semiconductor barrier process to minimise forward voltage losses, and being majority carrier devices have no stored charge. They are therefore capable of operating at extremely high speeds. Electrical performance in forward and reverse conduction is uniquely defined by the device's metal-semiconductor 'barrier height'. We have a process to minimise forward voltage, whilst maintaining reverse leakage current at full rated working voltage and $T_{j\,max}$ at an acceptable level.

To obtain the maximum benefit from the use of Schottky devices it is recommended that particular attention be paid to the adequate suppression of voltage transients in practical circuit designs.

SWITCHING LOSSES (see also Fig.3)

The product of transient reverse current and reverse bias voltage is a power dissipation, most of which occurs during the fall time. In repetitive operation an average power can be calculated. This is then added to the forward dissipation to give the total power.

The conditions which need to be specified are:

a. Forward current (I_F); high currents increase switching losses.
b. Rate of fall of anode current (dI_F/dt); high rates of fall increase switching losses. This is particularly important in square-wave operation. Power losses in sine-wave operation for a given frequency are considerably less due to the much lower dI_F/dt.
c. Frequency (f); high frequency means high losses.
d. Reverse bias voltage (V_R); high reverse bias means high losses.
e. Junction temperature (T_j); high temperature means high losses.

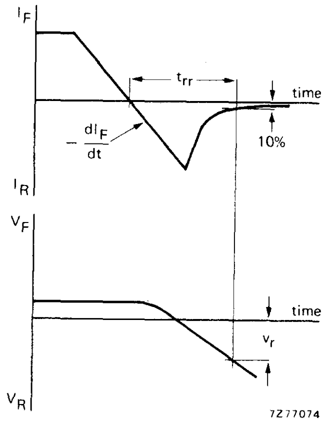


Fig. 2 Waveforms showing the reverse switching losses aspects.

SWITCHING LOSSES (continued)

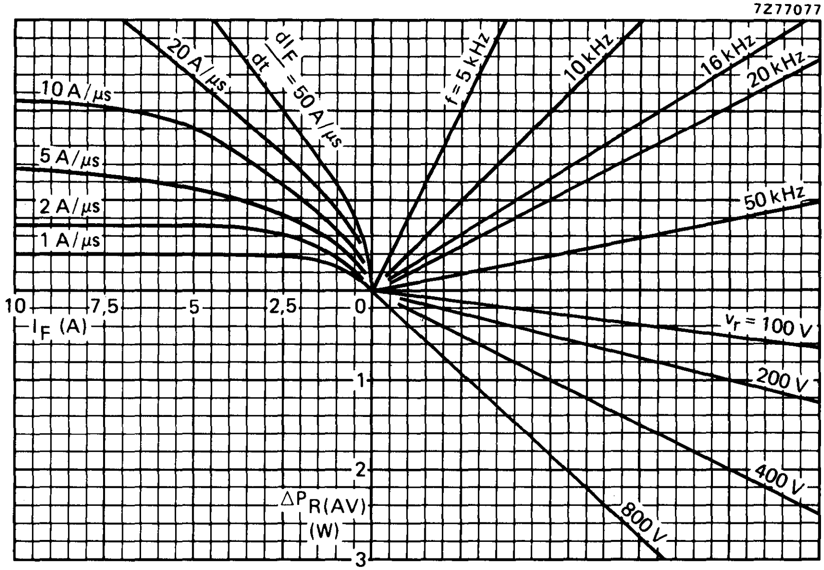


Fig. 3 **Nomogram** (example of reverse switching losses). Power loss $\Delta P_{R(AV)}$ due to switching only (to be added to steady-state power losses). I_F = forward current just before switching off; T_j = 150 °C.

FORWARD RECOVERY

At the instant a semiconductor rectifier diode is switched into forward conduction there are no carriers present at the junction, hence the forward voltage drop may be instantaneously of a high value. As the stored charge builds-up, conductivity modulation takes place and the forward voltage drop rapidly falls to the steady-state value. The peak value of forward voltage drop is known as the forward recovery voltage (V_{fr}). The time from the instant the current reaches 10% of its steady-state value to the time the forward voltage drop falls to within 10% of its final steady-state value is known as the forward recovery time (t_{fr}).

The conditions which need to be specified are:

a. Forward current (I_F); high currents give high recovery voltages.
b. *Current pulse rise time (t_r); short rise times give high recovery voltages.*
c. Junction temperature (T_j); the influence of temperature is slight.

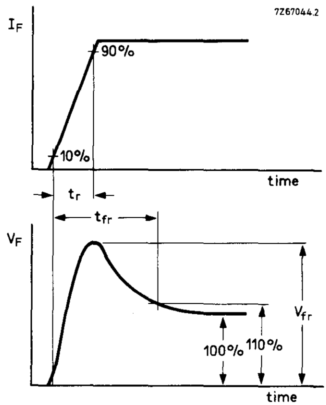
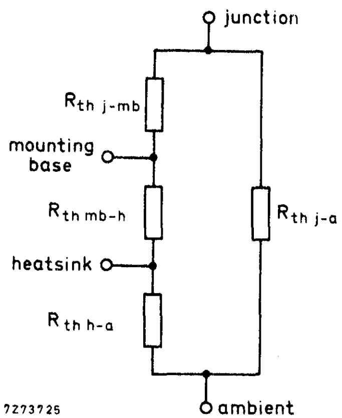


Fig. 4 Waveforms showing the forward recovery aspects.

MOUNTING CONSIDERATIONS FOR STUD-MOUNTED DIODES

Losses generated in a silicon device must flow through the case and to a lesser extent the leads.
The greatest proportion of the losses flow out through the case into a heat exchanger which can be either free convection cooled, forced convection or even liquid cooled. For the majority of devices in our range natural convection is generally adequate, however, where other considerations such as space saving must be taken into account then methods such as forced convection etc. can be considered.
The thermal path from junction to ambient may be considered as a number of resistances in series.
The first thermal resistance will be that of junction to mounting base, usually denoted by $R_{th\ j\text{-}mb}$.
The second is the contact thermal resistance $R_{th\ mb\text{-}h}$ and finally there is the thermal resistance of the heatsink $R_{th\ h\text{-}a}$.
In the rating curves, the contact thermal resistance and heatsink thermal resistances are combined as a single figure - $R_{th\ mb\text{-}a}$.
In addition to the steady state thermal conditions of the system, consideration should also be given to the possibility of any transient thermal excursions. These can be caused for example by starting conditions or overloads and in order to calculate the effect on the device, a graph of transient thermal resistance $Z_{th\ j\text{-}mb}$ as a function of time is given in each data sheet.



When mounting the device on the heatsink, care should be taken that the contact surfaces are free from burrs or projections of any kind and must be thoroughly clean.
In the case where an anodised heatsink is used, the anodising should be removed from the contact surface ensuring good electrical and thermal contact.
The contact surfaces should be smeared with a metallic oxide-loaded grease to ensure good heat transfer.
Where the device is mounted in a tapped hole, care should be taken that the hole is perpendicular to the surface of the heatsink. When mounting the device to the heatsink, it is essential that a proper torque wrench is used, applying the correct amount of torque as specified in the published data.
Excessive torque can distort the threads of the device and may even cause mechanical stress on the wafer, leading to the possible failure.
Where isolation of the device from the heatsink is required, it is common practice to use a mica washer between contact surfaces, and where a clearance hole is used, a p.t.f.e. insulating bush is inserted. A metallic oxide-loaded heatsink compound should be smeared on all contact surfaces, including the mica washer, to ensure optimum heat transfer. The use of ordinary silicone grease is not recommended.

OPERATING NOTES

When there is a possibility that transients, due to the energy stored in the transformer, will exceed the maximum permissible non-repetitive peak reverse voltage [1]), a damping circuit should be connected across the transformer.

Either a series RC circuit or a voltage dependent resistor may be used. Suitable component values for an RC circuit across the transformer primary or secondary may be calculated as follows:

$\frac{V_{RSM}}{V_{RWM}}$	RC across primary of transformer		RC across secondary of transformer	
	C (μF)	R (Ω)	C (μF)	R (Ω)
2.0	$200\frac{I_{mag}}{V_1}$	$\frac{150}{C}$	$225\frac{I_{mag}T^2}{V_1}$	$\frac{200}{C}$
1.5	$400\frac{I_{mag}}{V_1}$	$\frac{225}{C}$	$450\frac{I_{mag}T^2}{V_1}$	$\frac{275}{C}$
1.25	$550\frac{I_{mag}}{V_1}$	$\frac{260}{C}$	$620\frac{I_{mag}T^2}{V_1}$	$\frac{310}{C}$
1.0	$800\frac{I_{mag}}{V_1}$	$\frac{300}{C}$	$900\frac{I_{mag}T^2}{V_1}$	$\frac{350}{C}$

where I_{mag} = magnetising primary r.m.s. current (A)

V_1 = transformer primary r.m.s. voltage (V)

V_2 = transformer secondary r.m.s. voltage (V)

$T = V_1/V_2$

V_{RSM} = the transient voltage peak produced by the transformer

V_{RWM} = the actually applied crest working reverse voltage

The capacitance values calculated from the above table are minimum values; to allow for circuit variations and component tolerances, larger values should be used.

[1]) For controlled avalanche types read: non-repetitive peak reverse power.

SILICON BRIDGE RECTIFIER

Plastic-encapsulated bridge rectifier comprising four silicon double-diffused diodes. It is primarily intended for use in the power supplies of many types of transistorised equipment operating at frequencies up to 400 Hz.

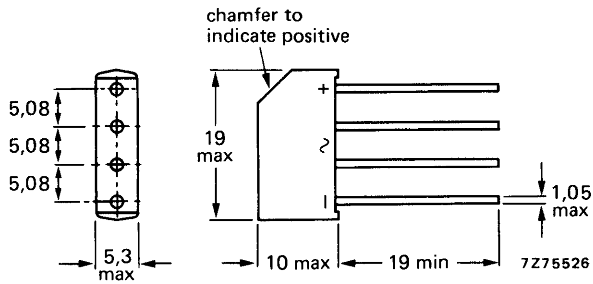
QUICK REFERENCE DATA

Input				
R.M.S. voltage	$V_{I(RMS)}$	max.	60	V
Repetitive peak voltage	V_{IRM}	max.	120	V
Non-repetitive peak current	I_{ISM}	max.	25	A
Output				
Average current	$I_{O(AV)}$	max.	1.2	A

MECHANICAL DATA

Dimensions in mm

Fig. 1 SOD-28



The sealing of the plastic envelope withstands the accelerated damp heat test of IEC recommendation 68-2 (test D, severity IV, 6 cycles).

RATINGS

Limiting values in accordance with the Absolute Maximum System (IEC 134)

Input

R.M.S. voltage	$V_{I(RMS)}$	max.	60	V
Crest working voltage	V_{IWM}	max.	85	V
Repetitive peak voltage	V_{IRM}	max.	120	V
Non repetitive peak voltage; $t \leqslant 10$ ms	V_{ISM}	max.	120	V
Non-repetitive peak current (see also Fig.8)	I_{ISM}	max.	25	A

Output

Average current with C load	See Figs. 3, 6			
Average current with R and L load (see also Fig.5) $V_{I(RMS)} \leqslant 60$ V	$I_{O(AV)}$	max.	1.2	A
Repetitive peak current	I_{ORM}	max.	5	A

Temperatures

Storage temperature	T_{stg}		−55 to +125	°C
Junction temperature	T_j	max.	150	°C

THERMAL RESISTANCE

Influence of mounting method

The quoted values of $R_{th\ j\text{-}a}$ should be used only when no leads of other dissipating components run to the same tie-point.

1. Mounted to solder tags at a lead-length a > 5 mm. $R_{th\ j\text{-}a}$ = 40 °C/W
2. Mounted on printed-wiring board at a = maximum lead-length. $R_{th\ j\text{-}a}$ = 50 °C/W
3. Mounted on printed-wiring board at a lead-length a = 5 mm. $R_{th\ j\text{-}a}$ = 55 °C/W
4. Mounted on printed-wiring board at a lead-length a = 1.5 mm. $R_{th\ j\text{-}a}$ = 60 °C/W
(distance -a- includes printed-wiring board thickness)

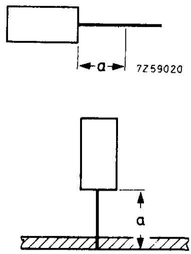


Fig.2

MOUNTING INSTRUCTIONS

1. The maximum permissible temperature of the soldering iron or bath is 270 °C; it must not be in contact with the joint for more than 3 seconds.
2. Avoid hot spots due to handling or mounting; the body of the device must not come into contact with or be exposed to a temperature higher than 150 °C.
3. Exert no axial pull when bending.

CHARACTERISTICS

Forward voltage (2 diodes in series)				
I_F = 2 A; T_j = 25 °C	V_F	<	2.2	V*

*Measured under pulse conditions to avoid excessive dissipation.

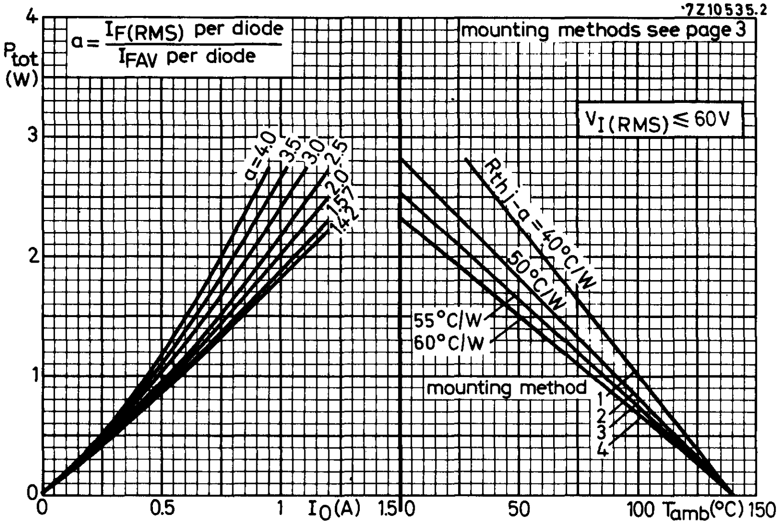


Fig.3

From the left-hand graph the total power dissipation can be found as a function of the average output current.

The parameter $a = \frac{I_{F(RMS)} \text{ per diode}}{I_{F(AV)} \text{ per diode}}$ depends on $\omega R_L C_L$ and $\frac{R_t + R_{diff}}{R_L}$ and can be found from existing graphs.

See Application Book: RECTIFIER DIODES.

Once the power dissipation is known, the max. permissible ambient temperature follows from the right-hand graph.
For the series resistance, added to limit the initial peak rectifier current, the required minimum value can be found from Fig.5.
R_{diff} is shown in Fig.4.

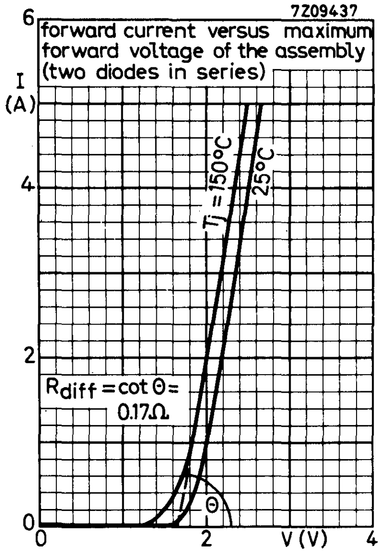


Fig.4

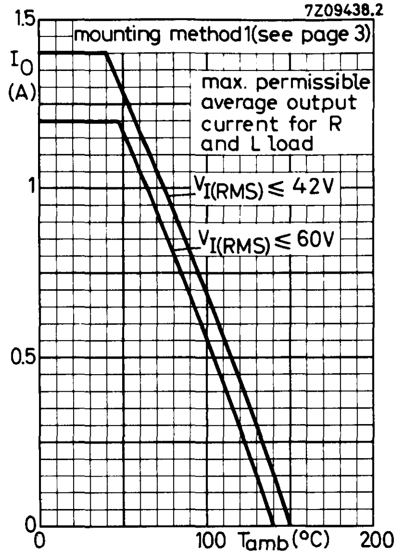


Fig.5

Example: Rectifier with C load

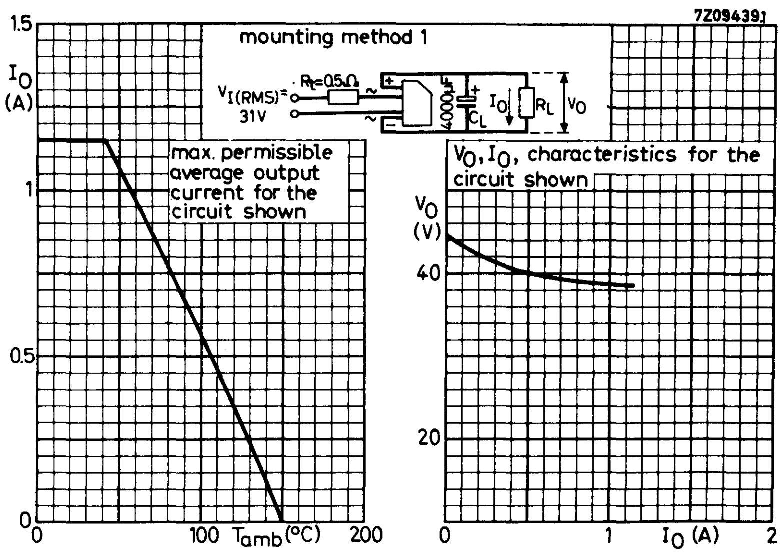


Fig.6

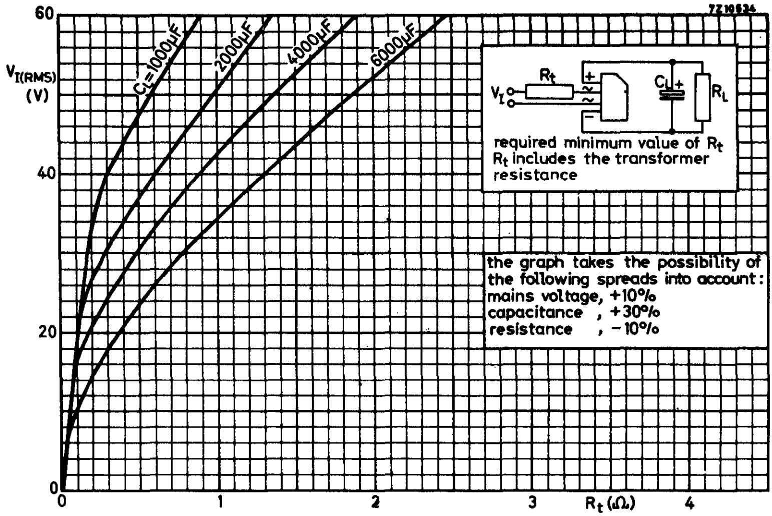

7Z10634
60
40
20
0
$V_{I(RMS)}$
(V)
C_L=1000μF
2000μF
4000μF
6000μF
R_t
V_I
C_L
R_L
required minimum value of R_t
R_t includes the transformer resistance
the graph takes the possibility of the following spreads into account:
mains voltage, +10%
capacitance , +30%
resistance , −10%
0
1
2
3
R_t (Ω)
4

Fig.7

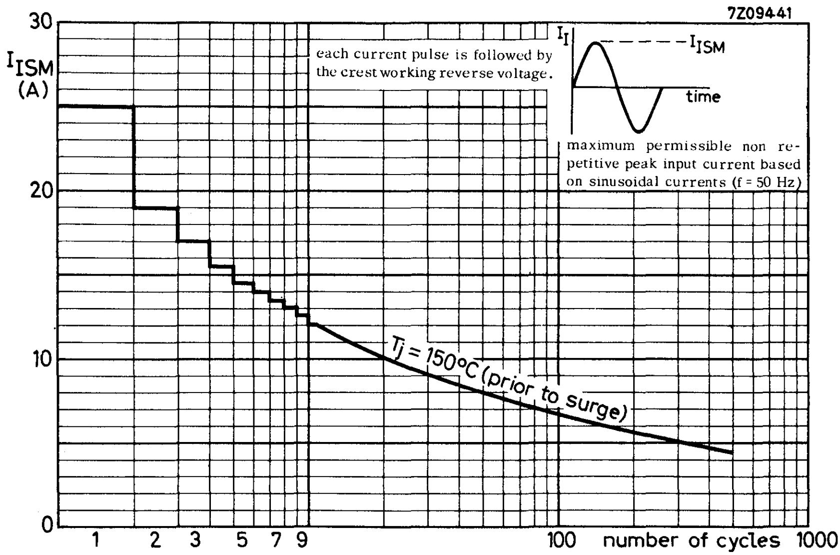

7Z09441
30
I_{ISM}
(A)
20
10
0
each current pulse is followed by the crest working reverse voltage.
I_I
I_{ISM}
time
maximum permissible non repetitive peak input current based on sinusoidal currents (f = 50 Hz)
T_j = 150°C (prior to surge)
1
2
3
5
7
9
100
number of cycles
1000

Fig.8

SILICON BRIDGE RECTIFIER

Plastic-encapsulated bridge rectifier comprising four silicon double-diffused diodes. It is primarily intended for equipment drawing its power from mains with frequencies up to 400 Hz.

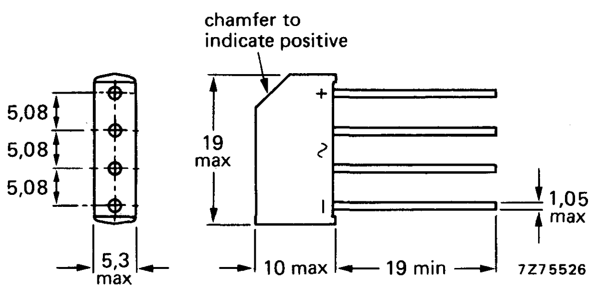
QUICK REFERENCE DATA

Input				
R.M.S. voltage	$V_{I(RMS)}$	max.	280	V
Repetitive peak voltage	V_{IRM}	max.	800	V
Non-repetitive peak current	I_{ISM}	max.	25	A
Output				
Average current	$I_{O(AV)}$	max.	1	A

MECHANICAL DATA

Dimensions in mm

Fig.1 SOD-28



The sealing of the plastic envelope withstands the accelerated damp heat test of IEC recommendation 68-2 (test D, severity IV, 6 cycles).

RATINGS

Limiting values in accordance with the Absolute Maximum System (IEC 134)

Input

R.M.S. voltage	$V_{I(RMS)}$	max.	280	V
Crest working voltage	V_{IWM}	max.	400	V
Repetitive peak voltage	V_{IRM}	max.	800	V
Non repetitive peak voltage; $t \leqslant$ 10 ms	V_{ISM}	max.	800	V
Non repetitive peak current (see also Fig.8)	I_{ISM}	max.	25	A

Output

Average current with C load	See Figs 3, 6			
Average current with R and L load up to T_{amb} = 40 °C (see also Fig.5)	$I_{O(AV)}$	max.	1	A
Repetitive peak current	I_{ORM}	max.	5	A

Temperatures

Storage temperature	T_{stg}		−55 to +125	°C
Junction temperature	T_j	max.	125	°C

THERMAL RESISTANCE

Influence of mounting method

The quoted values of $R_{th\ j\text{-}a}$ should be used only when no leads of other dissipating components run to the same tie-point

1. Mounted to solder tags at a lead-length a > 5 mm. $R_{th\ j\text{-}a}$ = 40 °C/W
2. Mounted on printed-wiring board at a = maximum lead-length. $R_{th\ j\text{-}a}$ = 50 °C/W
3. Mounted on printed-wiring board at a lead-length a = 5 mm. $R_{th\ j\text{-}a}$ = 55 °C/W
4. Mounted on printed-wiring board at a lead length a = 1.5 mm. $R_{th\ j\text{-}a}$ = 60 °C/W (distance -a- includes printed-wiring board thickness)

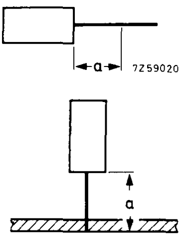


Fig.2

MOUNTING INSTRUCTIONS

1. The maximum permissible temperature of the soldering iron or bath is 270 °C; it must not be in contact with the joint for more than 3 seconds.
2. Avoid hot spots due to handling or mounting; the body of the device must not come into contact with or be exposed to a temperature higher than 150 °C.
3. Exert no axial pull when bending.

CHARACTERISTICS

Forward voltage (2 diodes in series)

I_F = 2 A; T_j = 25 °C	V_F	<	2.2	V*

*Measured under pulse conditions to avoid excessive dissipation.

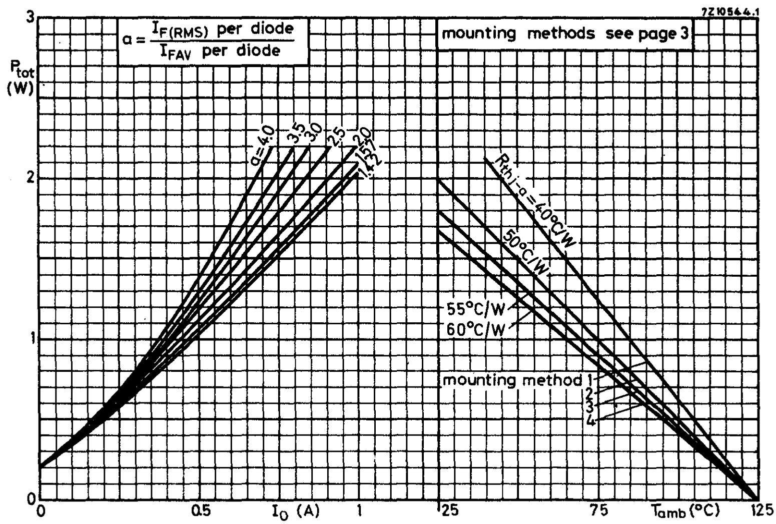


Fig.3

From the left-hand graph the total power dissipation can be found as a function of the average output current.

The parameter $a = \frac{I_{F(RMS)} \text{ per diode}}{I_{F(AV)} \text{ per diode}}$ depends on $\omega R_L C_L$ and $\frac{R_t + R_{diff}}{R_L}$ and can be found from existing graphs.

See Application Book: RECTIFIER DIODES

Once the power dissipation is known, the max. permissible ambient temperature follows from the right-hand graph.

For the series resistance, added to limit the initial peak rectifier current, the required minimum value can be found from Fig.7.
R_{diff} is shown in Fig.4.

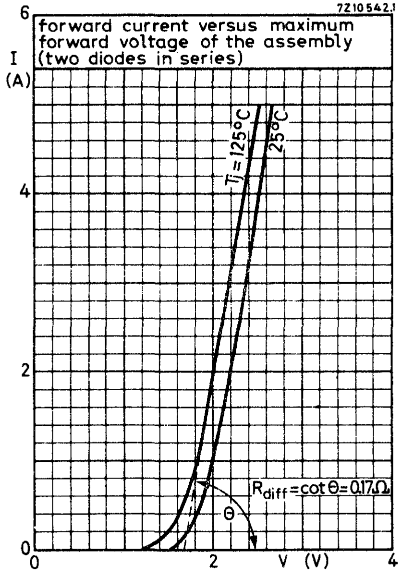


Fig.4

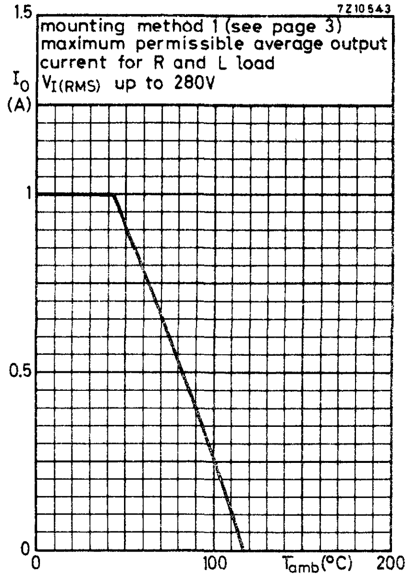


Fig.5

Example: Rectifier with C load

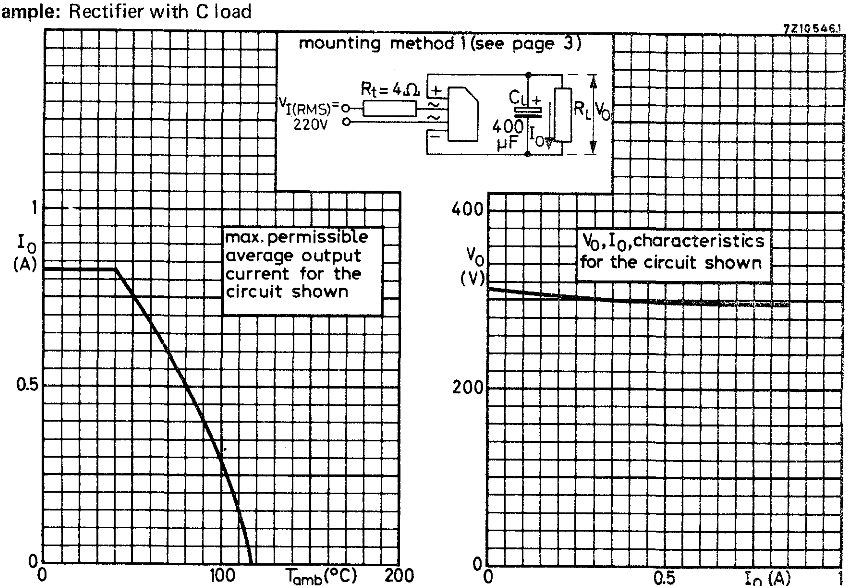


Fig.6

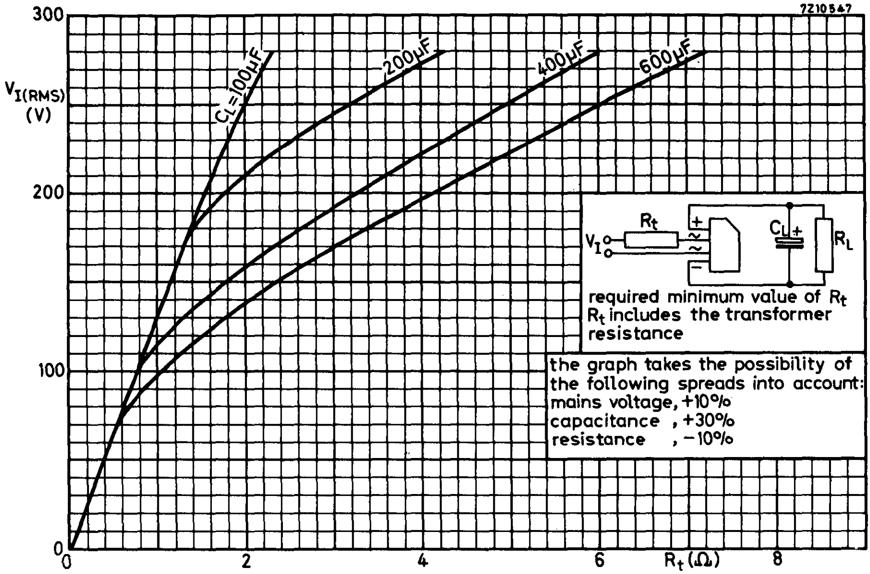

7Z10547
300
200
100
0
$V_{I(RMS)}$ (V)
0
2
4
6
8
R_t (Ω)
C_L=100μF
200μF
400μF
600μF
R_t
V_I
C_L
R_L
required minimum value of R_t
R_t includes the transformer resistance
the graph takes the possibility of the following spreads into account:
mains voltage, +10%
capacitance , +30%
resistance , −10%

Fig.7

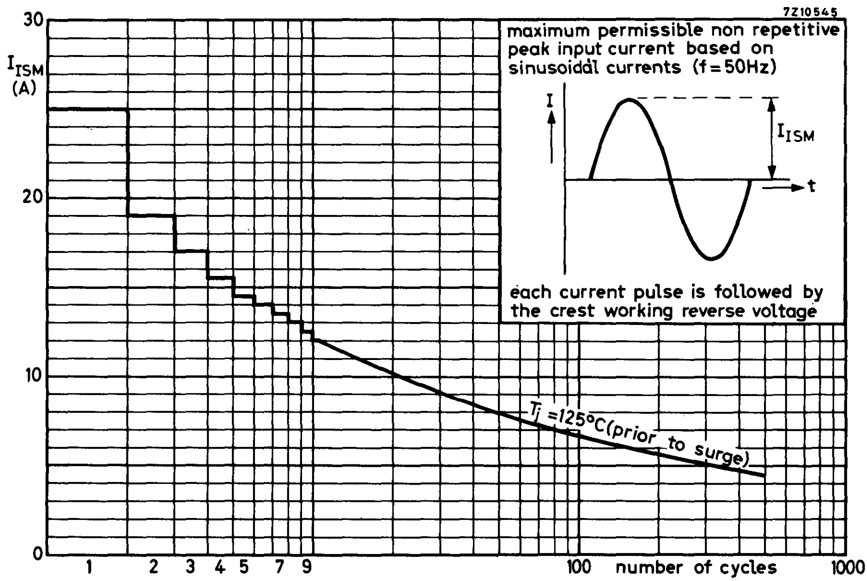

7Z10545
30
20
10
0
I_{ISM} (A)
1
2
3
4
5
7
9
100
number of cycles
1000
maximum permissible non repetitive peak input current based on sinusoidal currents (f = 50Hz)
I
I_{ISM}
t
each current pulse is followed by the crest working reverse voltage
T_j = 125°C (prior to surge)

Fig.8

PARALLEL-EFFICIENCY AND ENERGY-RECOVERY DIODE

Silicon double-diffused rectifier diode in a plastic envelope, intended for use as efficiency diode in transistorised horizontal deflection circuits of colour television receivers, and as an energy-recovery diode in thyristor commutation circuits such as 3-phase a.c. motor speed control inverters.

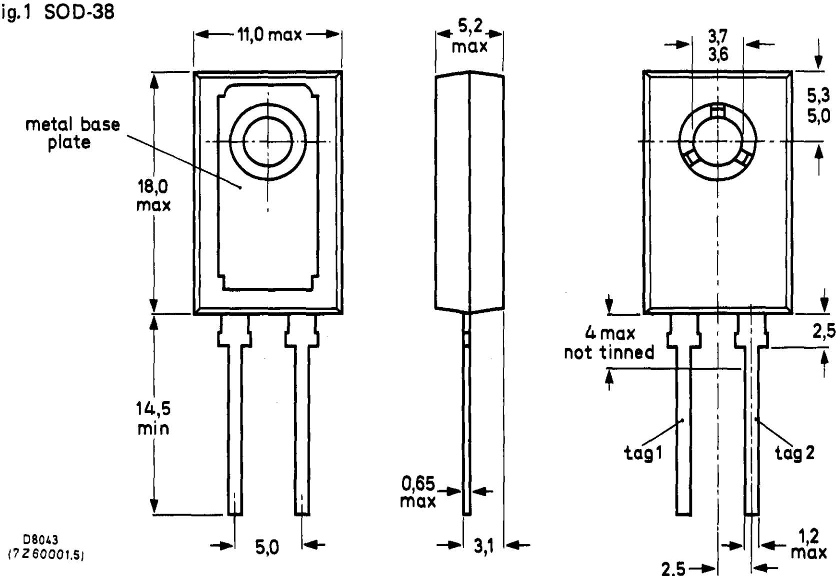
QUICK REFERENCE DATA

Repetitive peak reverse voltage	V_{RRM}	max.	1500	V
Average forward current	$I_{F(AV)}$	max.	4.5	A
Working peak forward current	I_{FWM}	max.	5	A
Repetitive peak forward current (t_p = 100 μs)	I_{FRM}	max.	200	A
Reverse recovery time	t_{rr}	<	1.0	μs

MECHANICAL DATA

Dimensions in mm

Fig.1 SOD-38



Polarity of connections: tag 1 = anode, tag 2 = cathode

The exposed metal base-plate is directly connected to tag 1

Net mass: 2.5 g

Torque on screw: min. 0.95 Nm (9.5 kg cm)
max. 1.5 Nm (15 kg cm)

Accessories:
supplied with the device: washer 56355
available on request: 56316 (mica insulating washer)

RATINGS

Limiting values in accordance with the Absolute Maximum System (IEC 134)

Voltages

Transient rating (subsequent to flashover)	$V_{RM(flashover)}$	max.	1650	V
Non-repetitive peak reverse voltage ($t \leqslant 10$ ms)	V_{RSM}	max.	1500	V
Repetitive peak reverse voltage	V_{RRM}	max.	1500	V
Working reverse voltage*	V_{RW}	max.	1500	V
Continuous reverse voltage	V_R	max.	800	V

Currents

Average forward current (averaged over any 20 ms period) up to T_{mb} = 85 °C	$I_{F(AV)}$	max.	4.5	A
R.M.S. forward current	$I_{F(RMS)}$	max.	10	A
Working peak forward current (see Fig.8)	I_{FWM}	max.	5	A
Repetitive peak forward current (t_p = 100 μs)	I_{FRM}	max.	200	A
Repetitive peak forward current	I_{FRM}	max.	10	A
Non-repetitive peak forward current (t = 10 ms; half-sinewave) T_j = 125 °C prior to surge	I_{FSM}	max.	20	A

Temperatures

Storage temperature	T_{stg}		−40 to +125	°C
Junction temperature	T_j	max.	125	°C

THERMAL RESISTANCE

From junction to mounting base	$R_{th\ j\text{-}mb}$	=	4.5	°C/W
Transient thermal impedance; t = 1 ms	$Z_{th\ j\text{-}mb}$	=	0.3	°C/W

Influence of mounting method

1. *Heatsink mounted*

From mounting base to heatsink

a. with heatsink compound	$R_{th\ mb\text{-}h}$	=	1.5	°C/W
b. with heatsink compound and 56316 mica washer	$R_{th\ mb\text{-}h}$	=	2.7	°C/W
c. without heatsink compound	$R_{th\ mb\text{-}h}$	=	2.7	°C/W
d. without heatsink compound; with 56316 mica washer	$R_{th\ mb\text{-}h}$	=	5	°C/W

* At $t_p \leqslant 20$ μs; $\delta = t_p/T \leqslant 0.25$; see Fig.8.

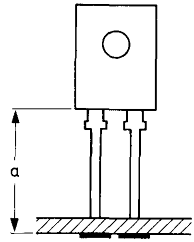
THERMAL RESISTANCE (continued)

2. *Free air operation*

The quoted values of $R_{th\ j\text{-}a}$ should be used only when no leads of other dissipating components run to the same tie-points.

From junction to ambient in free air mounted on a printed circuit board at a = maximum lead length and with a copper laminate

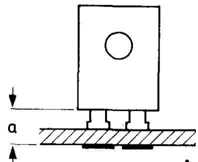
a. $> 1\ cm^2$ — $R_{th\ j\text{-}a} = 50\ ^oC/W$.
b. $< 1\ cm^2$ — $R_{th\ j\text{-}a} = 55\ ^oC/W$



D8044 (7Z62315.1)

at a lead length a = 3 mm and with a copper laminate

c. $> 1\ cm^2$ — $R_{th\ j\text{-}a} = 55\ ^oC$
d. $< 1\ cm^2$ — $R_{th\ j\text{-}a} = 60\ ^oC$



D8045 (7Z62314)

SOLDERING AND MOUNTING NOTES

1. Soldered joints must be at least 2.5 mm from the seal.
2. The maximum permissible temperature of the soldering iron or bath is 270 ^oC; contact with the joint must not exceed 3 seconds.
3. The device should not be immersed in oil, and few potting resins are suitable for re-encapsulation. Advice on these materials is available on request.
4. Leads should not be bent less than 2.5 mm from the seal. Exert no axial pull when bending.
5. For good thermal contact, heatsink compound should be used between base-plate and heatsink.

CHARACTERISTICS

Forward voltage				
I_F = 20 A; T_j = 25 °C	V_F	<	2.3	V*
Reverse current				
$V_R = V_{RW}$ max; T_j = 125 °C	I_R	<	0.6	mA
Reverse recovery when switched from				
I_{FWM} = 4 A; $-dI_F/dt$ = 0.2 A/μs; T_j = 125 °C total recovery time	t_{tot}	<	20	μs
I_F = 2 A; $-dI_F/dt$ = 20 A/μs; T_j = 125 °C recovery time	t_{rr}	<	1.0	μs
Forward recovery time				
when switched to I_{FRM} = 5 A with t_r = 0.1 μs; T_j = 125 °C	t_{fr}	<	1.0	μs

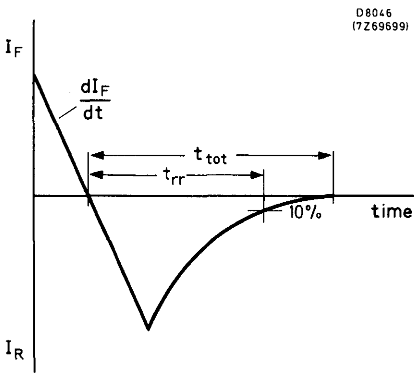


Fig.2 Definition of reverse recovery times.

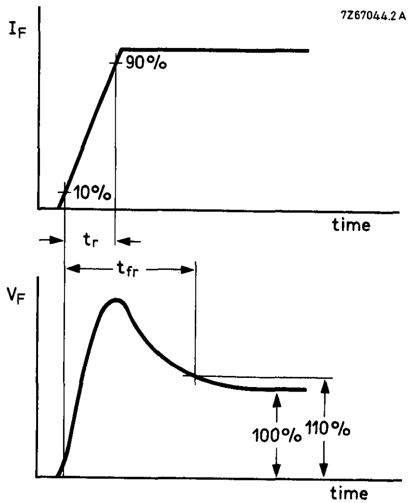


Fig.3 Definition of forward recovery time

* Measured under pulse conditions to avoid excessive dissipation.

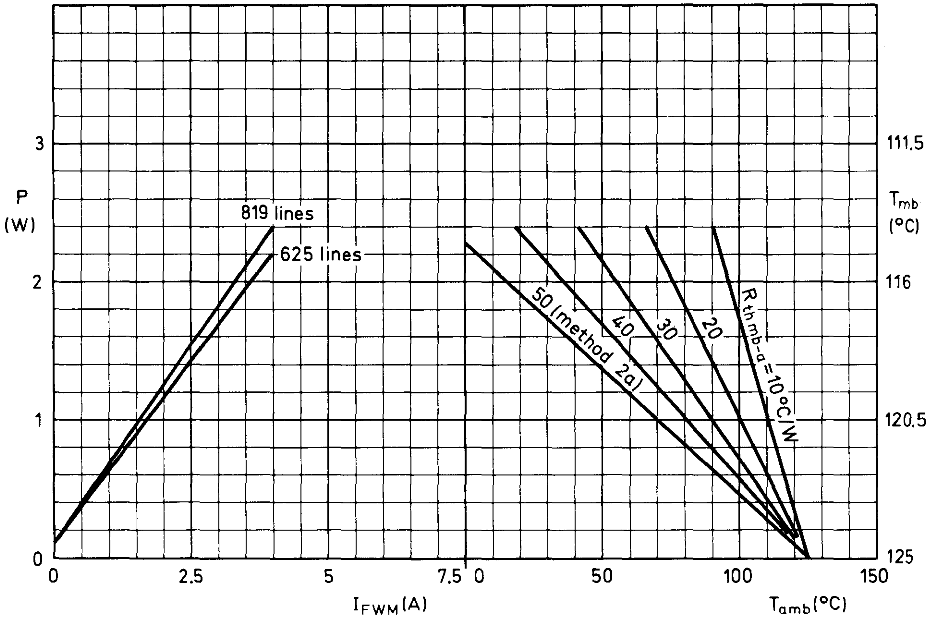


Fig.4 Interrelationship between the power dissipation (based on the waveforms shown in Fig.8) and the maximum permissible temperatures.
P = power dissipation including switching losses.

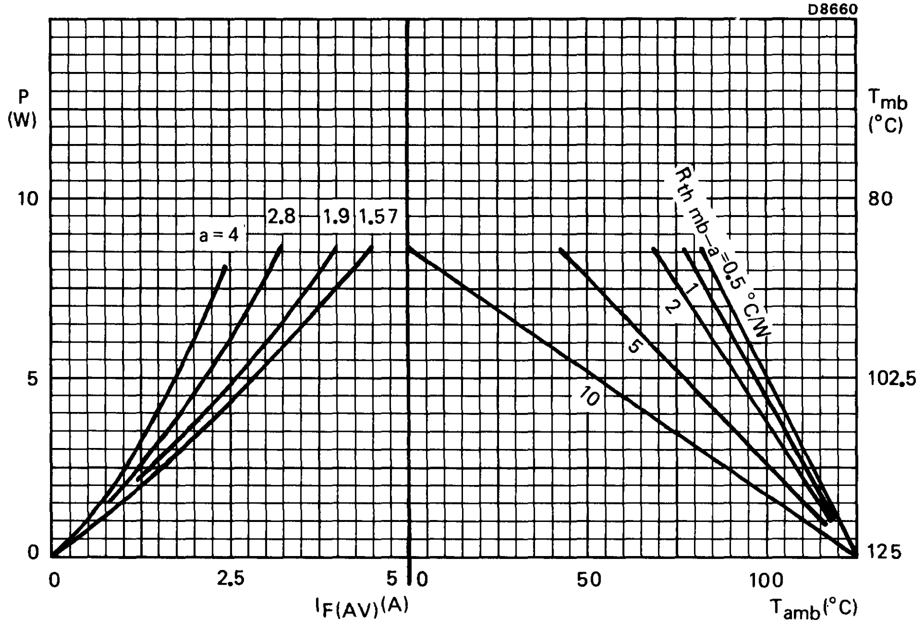


Fig.5 The right-hand part shows the interrelationship between the power dissipation (derived from the left-hand part) and the maximum permissible temperatures.
P = power dissipation including switching losses.
a = form factor = $I_{F(RMS)}/I_{F(AV)}$

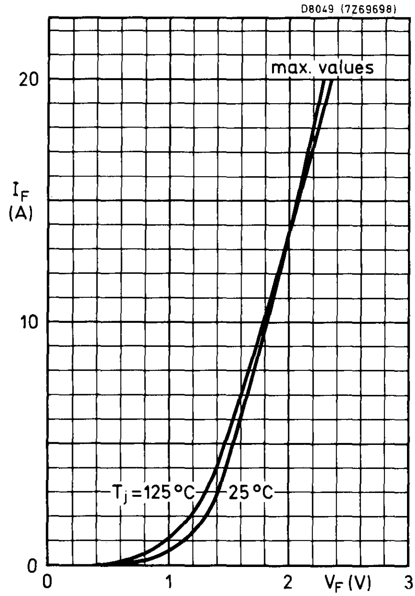

D8049 (7Z69698)
max. values
20
I_F
(A)
10
0
T_j = 125 °C
25 °C
0
1
2
V_F (V)
3

Fig.6

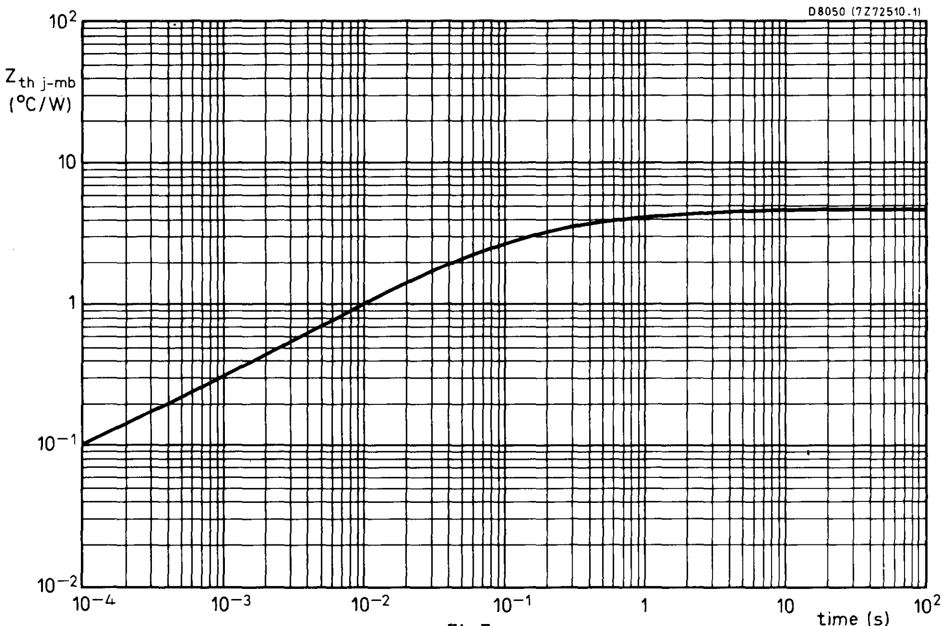

D8050 (7Z72510.1)
10^2
$Z_{th\ j-mb}$
(°C/W)
10
1
10^{-1}
10^{-2}
10^{-4}
10^{-3}
10^{-2}
10^{-1}
1
10
time (s)
10^2

Fig.7

APPLICATION INFORMATION

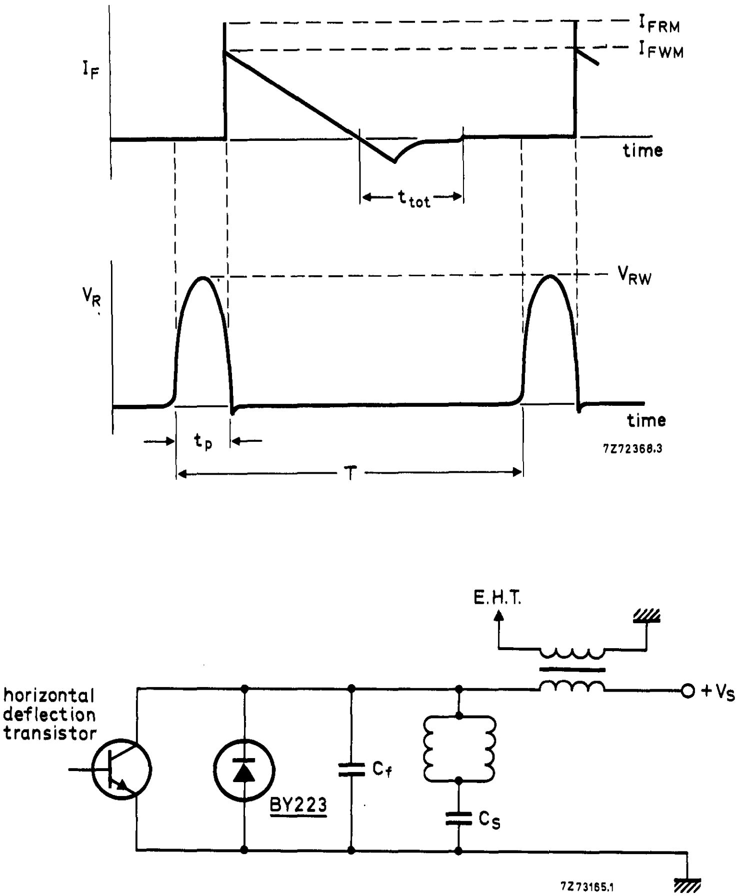


Fig.8 Basic circuit and waveforms

SILICON BRIDGE RECTIFIERS

Ready-for-use mains full-wave bridges, each consisting of four double-diffused silicon diodes, in a plastic encapsulation. The bridges are intended for use in equipment supplied from mains with r.m.s. voltages up to 280 V and are capable of delivering up to 1000 W into capacitive loads. They may be used in free air or clipped to a heatsink.

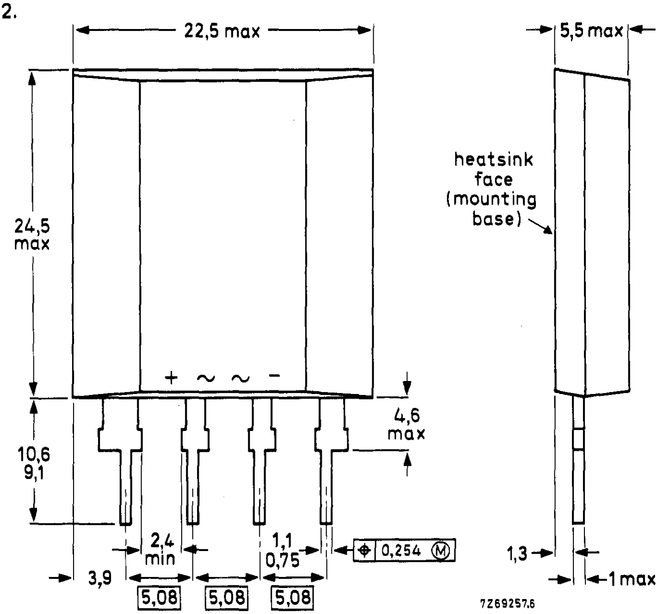
QUICK REFERENCE DATA

			BY224–400	600	
Input					
R.M.S. voltage	$V_{I(RMS)}$	max.	220	280	V
Repetitive peak voltage	V_{IRM}	max.	400	600	V
Non-repetitive peak current	I_{ISM}	max.		100	A
Peak inrush current	I_{IIM}	max.		200	A
Output					
Average current	$I_{O(AV)}$	max.		4,8	A

MECHANICAL DATA (see also Fig.1a)

Dimensions in mm

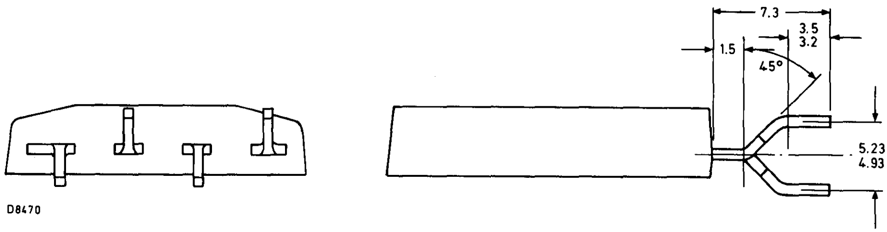
Fig. 1 SOT-112.



Net mass: 6,8 g
Accessories supplied on request: 56366 (clip); for mounting instructions see data 56366.
The sealing of the plastic withstands the accelerated damp heat test of IEC recommendation 68-2 (test D, severity IV, 6 cycles).

MECHANICAL DATA (continued)

→ Fig. 1a



A version with cranked pins (as shown in figure 1a) is available on request.

RATINGS

Limiting values in accordance with the Absolute Maximum System (IEC 134)

Input			BY224–400	600	
Non-repetitive peak voltage ($t \leqslant 10$ ms)	V_{ISM}	max.	400	600	V
Repetitive peak voltage	V_{IRM}	max.	400	600	V
Crest working voltage	V_{IWM}	max.	350	400	V
R.M.S. voltage (sine-wave)	$V_{I(RMS)}$	max.	220	280	V
Non-repetitive peak current					
half sine-wave; t = 20 ms; with reapplied V_{IWMmax}					
T_j = 25 °C prior to surge	I_{ISM}	max.		100	A
→ T_j = 150 °C prior to surge	I_{ISM}	max.		85	A
Peak inrush current (see Fig. 6)	I_{IIM}	max.		200	A
Output					
Average current (averaged over any 20 ms period; see Figs 2 and 3)					
heatsink operation up to T_{mb} = 90 °C	$I_{O(AV)}$	max.		4,8	A
free-air operation at T_{amb} = 45 °C; (mounting method 1a)	$I_{O(AV)}$	max.		2,5	A
Repetitive peak current	I_{ORM}	max.		50	A
→ **Temperatures**					
Storage temperature	T_{stg}			−40 to +150	°C
Junction temperature	T_j	max.		150	°C

THERMAL RESISTANCE

From junction to mounting base	$R_{th\ j-mb}$	=	4,0 °C/W

Influence of mounting method

1. Free-air operation

The quoted values of $R_{th\ j-a}$ should be used only when no loads of other dissipating components run to the same tie-point (see Fig. 3).

Thermal resistance from junction to ambient in free air

a. Mounted on a printed-circuit board with 4 cm^2 of copper laminate to + and – leads	$R_{th\ j-a}$	=	19,5 °C/W
b. Mounted on a printed-circuit board with minimal copper laminate	$R_{th\ j-a}$	=	25 °C/W

2. Heatsink mounted with clip (see *mounting instructions*)

Thermal resistance from mounting base to heatsink

a. With zinc-oxide heatsink compound	$R_{th\ mb-h}$	=	1,0 °C/W
b. Without heatsink compound	$R_{th\ mb-h}$	=	2,0 °C/W

MOUNTING INSTRUCTIONS

1. Soldered joints must be at least 4 mm from the seal.
2. The maximum permissible temperature of the soldering iron or bath is 270 °C; contact with the joint must not exceed 3 seconds.
3. Avoid hot spots due to handling or mounting; the body of the device must not come into contact with or be exposed to a temperature higher than 150 °C. ←
4. Leads should not be bent less than 4 mm from the seal. Exert no axial pull when bending.
5. Recommended force of clip on device is 120 N (12 kgf).
6. The heatsink should be in contact with the entire mounting base of the device and heatsink compound should be used.

CHARACTERISTICS

Forward voltage (2 diodes in series) $I_F = 10$ A; $T_j = 25$ °C	V_F	<	2,3 V*
Reverse current (2 diodes in parallel) $V_R = V_{IWMmax}$; $T_j = 25$ °C	I_R	<	200 μA

* Measured under pulse conditions to avoid excessive dissipation.

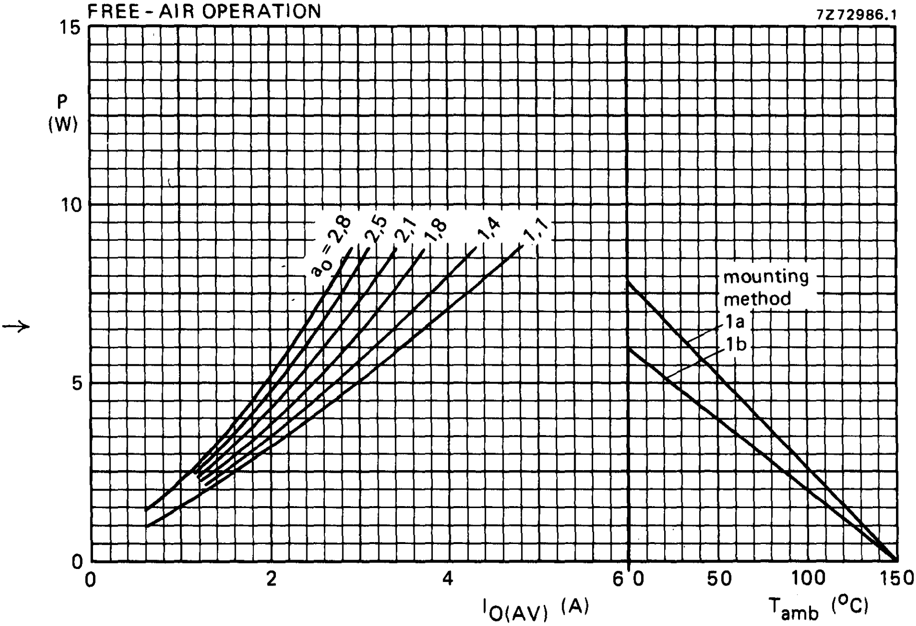


Fig. 2 The right-hand part shows the interrelationship between the power (derived from the left-hand graph) and the maximum permissible ambient temperature.

Output form factor $a_o = I_{O(RMS)}/I_{O(AV)} = 0,707 \times I_{F(RMS)}/I_{F(AV)}$ per diode.

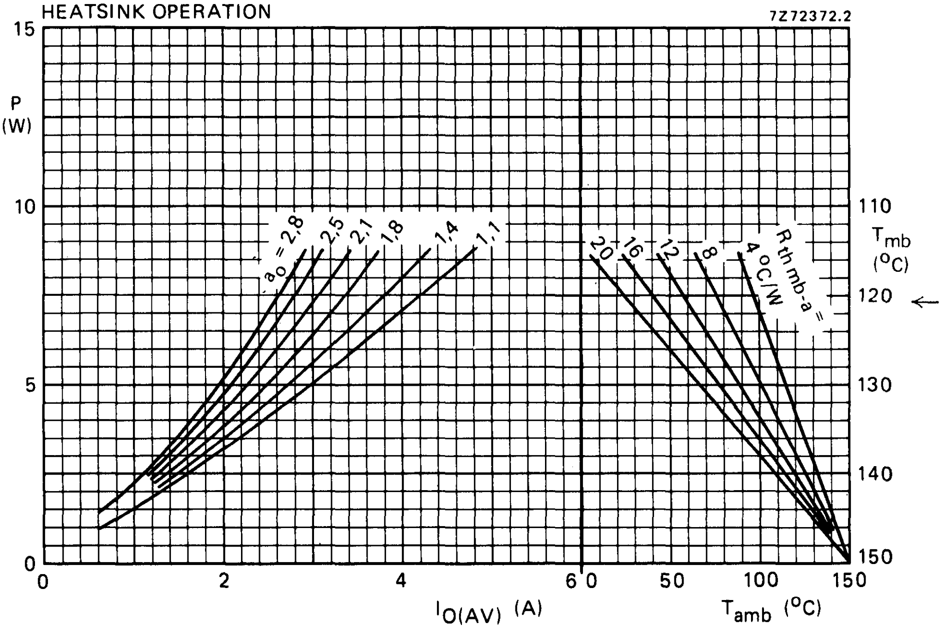


Fig. 3 The right-hand part shows the interrelationship between the power (derived from the left-hand graph) and the maximum permissible temperatures.

Output form factor $a_o = I_{O(RMS)}/I_{O(AV)} = 0{,}707 \times I_{F(RMS)}/I_{F(AV)}$ per diode.

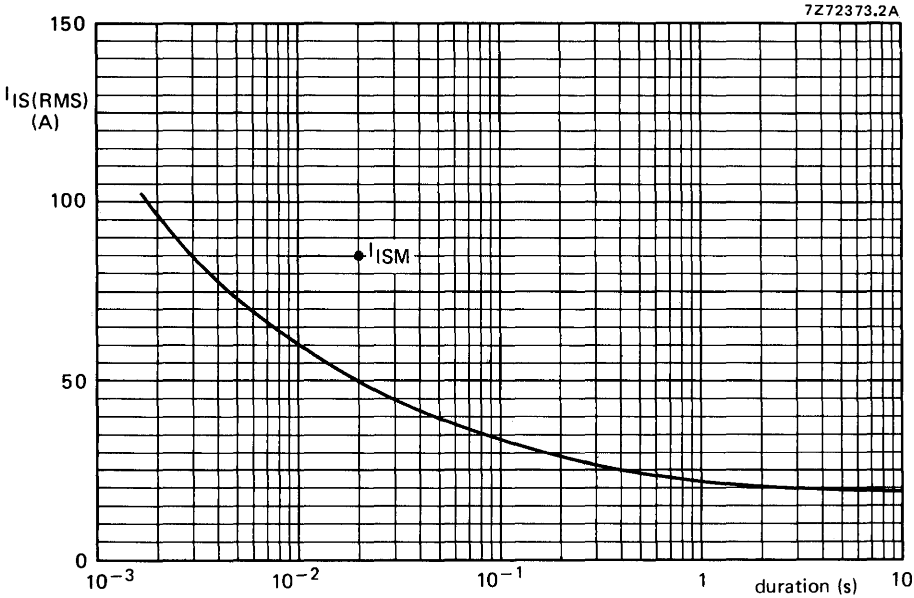
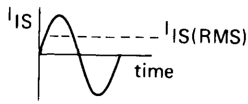


Fig.4 Maximum permissible non-repetitive r.m.s. input current based on sinusoidal currents (f = 50 Hz); → T_j = 150 °C prior to surge; with reapplied V_{IWMmax}.



→

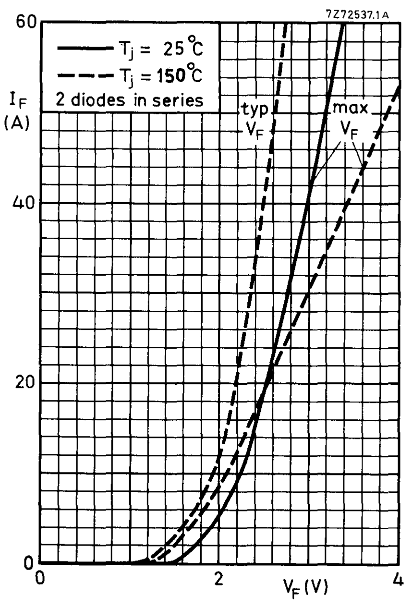
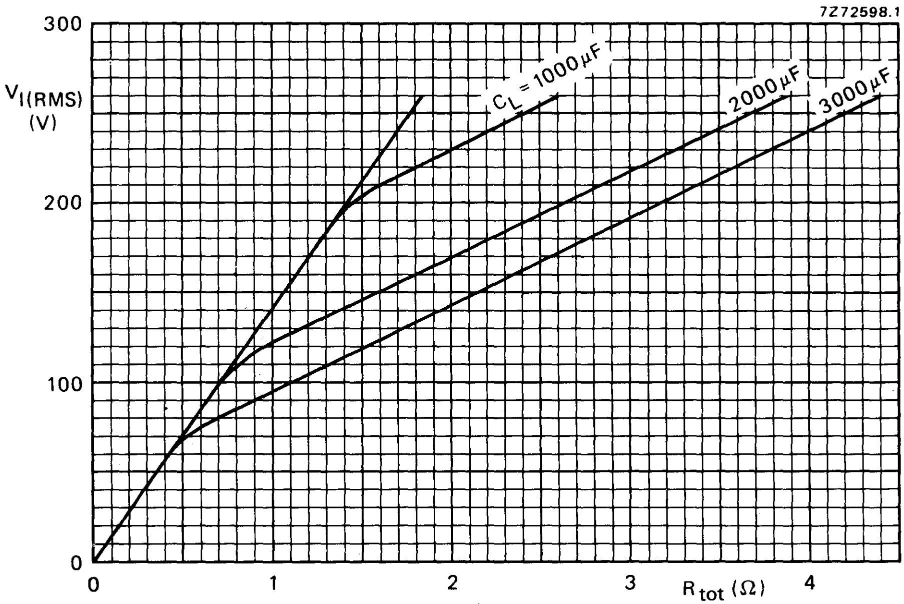
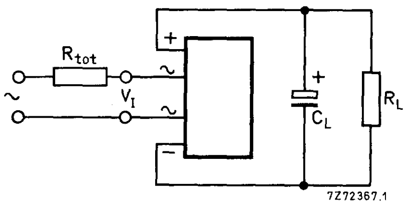


Fig.5



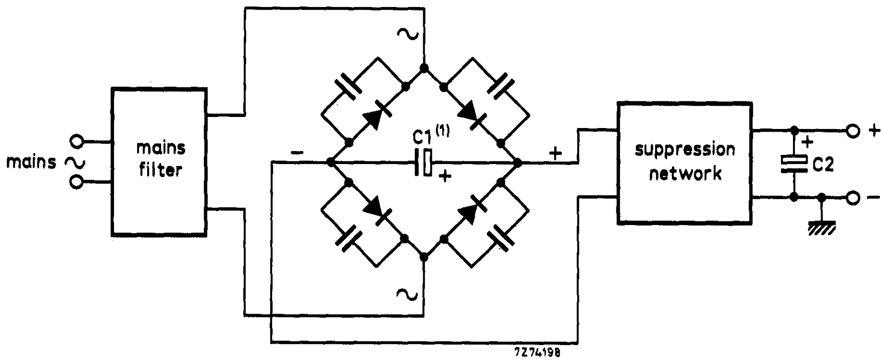


The graph takes the possibility of the following spreads into account:

mains voltage	+10%
capacitance	+50%
resistance	−10%

Fig. 6 Minimum value of the total series resistance R_{tot} (including the transformer resistance) required to limit the peak inrush current.

APPLICATION INFORMATION



(1) External capacitor.

Fig. 7 Because smoothing capacitor C2 is not always connected directly across the bridge (a suppression network may be sited between capacitor and bridge as shown), it is necessary to connect a capacitor of about 1 μF, C1, between the + and – terminals of the bridge. This capacitor should be as close to the bridge as possible, to give optimum suppression of mains transients.

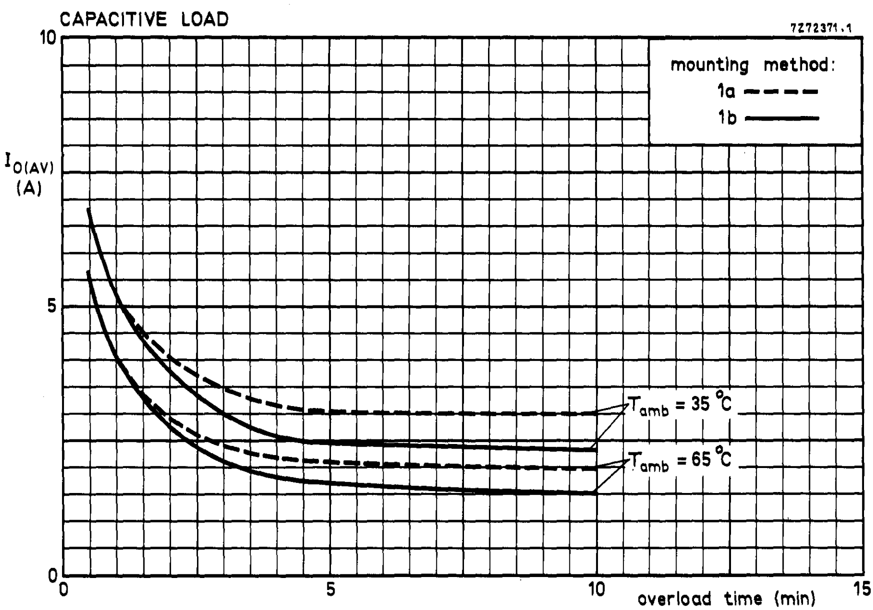


Fig.8

SILICON BRIDGE RECTIFIERS

Ready-for-use full-wave bridge rectifiers in a plastic encapsulation. The bridges are intended for use in equipment supplied from a.c. with r.m.s. voltages up to 80 V and are capable of delivering output currents up to 4,8 A. They are also suitable for use in hi-fi audio equipments and low-voltage industrial power supplies. They may be used in free air or clipped to a heatsink.

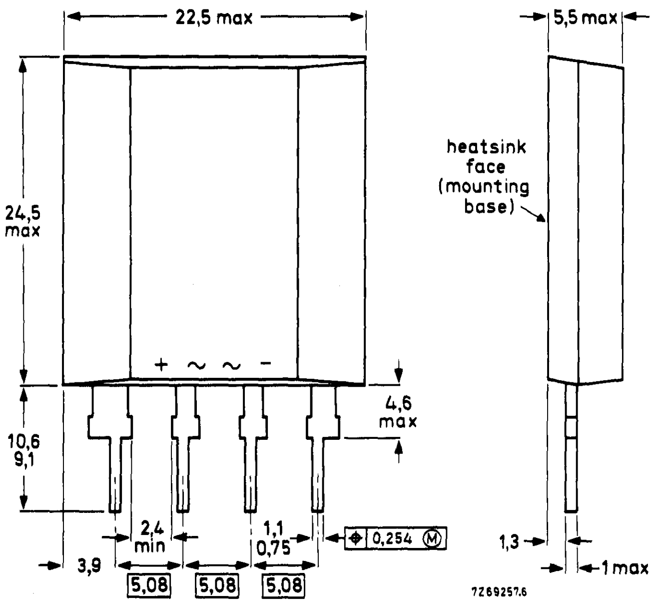
QUICK REFERENCE DATA

			BY225–100	200	
Input					
R.M.S. voltage	$V_{I(RMS)}$	max.	50	80	V
Repetitive peak voltage	V_{IRM}	max.	100	200	V
Non-repetitive peak current	I_{ISM}	max.		100	A
Peak inrush current	I_{IIM}	max.		200	A
Output					
Average current	$I_{O(AV)}$	max.		4,8	A

MECHANICAL DATA

Dimensions in mm

Fig. 1 SOT-112.



Net mass: 6,8 g

Accessories supplied on request: 56366 (clip); for mounting instructions see data 56366.

The sealing of the plastic withstands the accelerated damp heat test of IEC recommendation 68-2 (test D, severity IV, 6 cycles).

RATINGS

Limiting values in accordance with the Absolute Maximum System (IEC 134)

Input

			BY225–100	200	
Non-repetitive peak voltage ($t \leq 10$ ms)	V_{ISM}	max.	100	200	V
Repetitive peak voltage	V_{IRM}	max.	100	200	V
Crest working voltage	V_{IWM}	max.	70	112	V
R.M.S. voltage (sine-wave)	$V_{I(RMS)}$	max.	50	80	V
Non-repetitive peak current; half sine-wave; t = 20 ms; with reapplied V_{IWMmax}					
T_j = 25 °C prior to surge	I_{ISM}	max.		100	A
T_j = 150 °C prior to surge	I_{ISM}	max.		85	A
Peak inrush current (see Fig. 6)	I_{IIM}	max.		200	A

Output

Average current (averaged over any 20 ms period; see Figs 2 and 3)				
heatsink operation up to T_{mb} = 115 °C	$I_{O(AV)}$	max.	4,8	A
heatsink operation at T_{mb} = 125 °C	$I_{O(AV)}$	max.	3,6	A
free-air operation at T_{amb} = 45 °C; (mounting method 1a)	$I_{O(AV)}$	max.	3,2	A
Repetitive peak current	I_{ORM}	max.	50	A

Temperatures

Storage temperature	T_{stg}		−40 to +150	°C
Junction temperature	T_j	max.	150	°C

THERMAL RESISTANCE

From junction to mounting base	$R_{th\,j\text{-}mb}$	=	4,0 °C/W

Influence of mounting method

1. Free-air operation

The quoted values of $R_{th\,j\text{-}a}$ should be used only when no leads of other dissipating components run to the same tie-point (see Fig. 2).

Thermal resistance from junction to ambient in free air

a. Mounted on a printed-circuit board with 4 cm^2 of copper laminate to + and − leads	$R_{th\,j\text{-}a}$	=	19,5 °C/W
b. Mounted on a printed-circuit board with minimal copper laminate	$R_{th\,j\text{-}a}$	=	25 °C/W

2. Heatsink mounted with clip (see mounting instructions)

Thermal resistance from mounting base to heatsink

a. With zinc-oxide heatsink compound	$R_{th\,mb\text{-}h}$	=	1,0 °C/W
b. Without heatsink compound	$R_{th\,mb\text{-}h}$	=	2,0 °C/W

MOUNTING INSTRUCTIONS

1. Soldered joints must be at least 4 mm from the seal.
2. The maximum permissible temperature of the soldering iron or bath is 270 °C; contact with the joint must not exceed 3 seconds.
3. Avoid hot spots due to handling or mounting; the body of the device must not come into contact with or be exposed to a temperature higher than 150 °C.
4. Leads should not be bent less than 4 mm from the seal. Exert no axial pull when bending.
5. Recommended force of clip on device is 120 N (12 kgf).
6. The heatsink should be in contact with the entire mounting base of the device and heatsink compound should be used.

CHARACTERISTICS

Forward voltage (2 diodes in series) I_F = 10 A; T_j = 25 °C	V_F	<	2,3 V *
Reverse current (2 diodes in parallel) $V_R = V_{IWMmax}$; T_j = 25 °C	I_R	<	200 μA

* Measured under pulse conditions to avoid excessive dissipation.

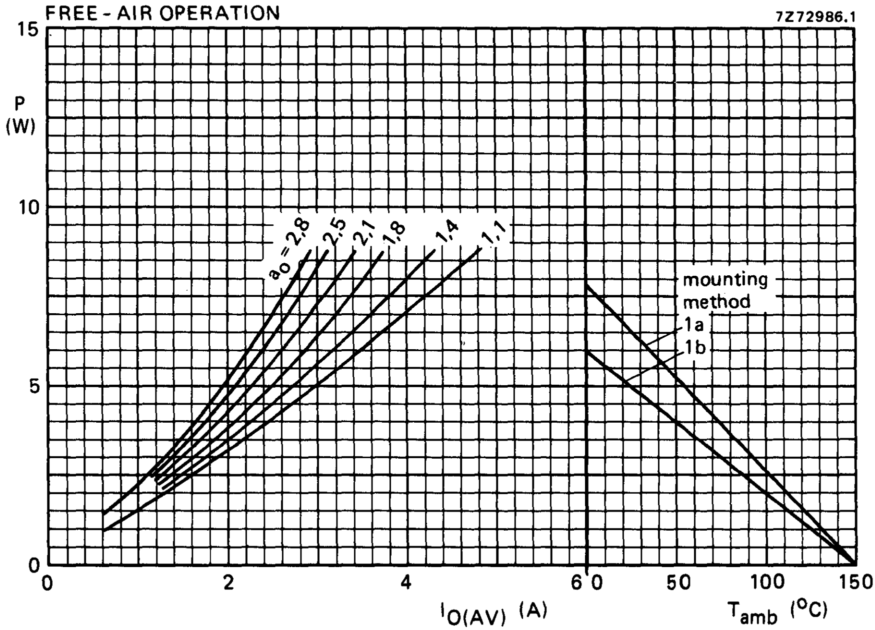


Fig. 2 The right-hand part shows the interrelationship between the power (derived from the left-hand graph) and the maximum permissible ambient temperature.

Output form factor $a_o = I_{O(RMS)}/I_{O(AV)} = 0{,}707 \times I_{F(RMS)}/I_{F(AV)}$ per diode.

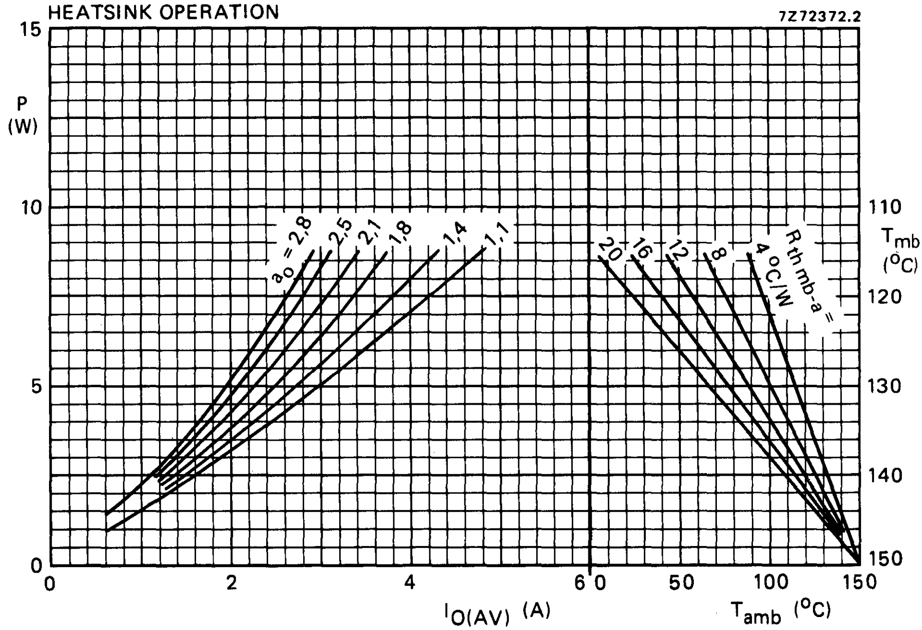


Fig. 3 The right-hand part shows the interrelationship between the power (derived from the left-hand graph) and the maximum permissible temperatures.

Output form factor $a_o = I_{O(RMS)}/I_{O(AV)} = 0{,}707 \times I_{F(RMS)}/I_{F(AV)}$ per diode.

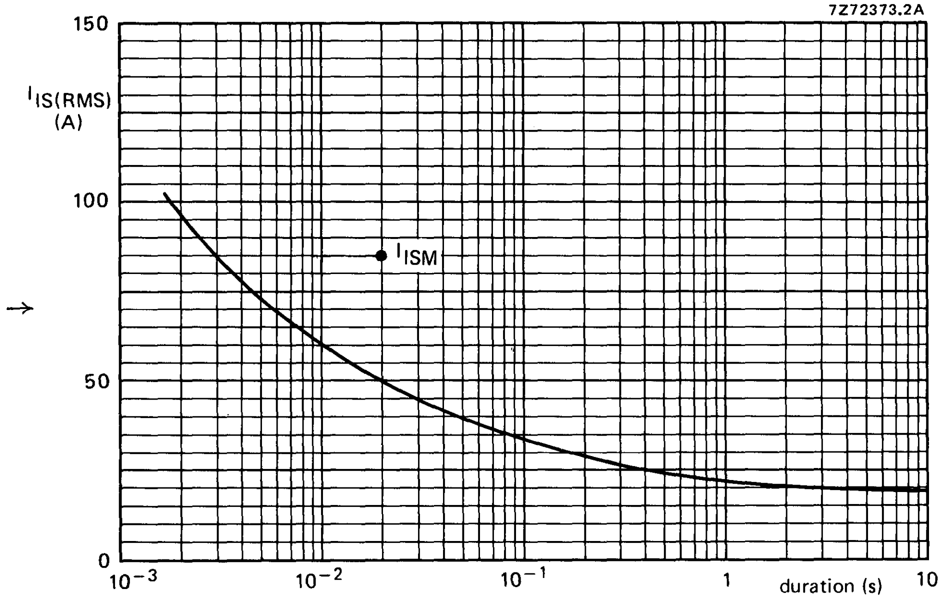
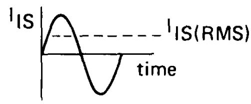


Fig. 4 Maximum permissible non-repetitive r.m.s. input current based on sinusoidal currents (f = 50 Hz); T_j = 150 °C prior to surge; with reapplied V_{IWMmax}.



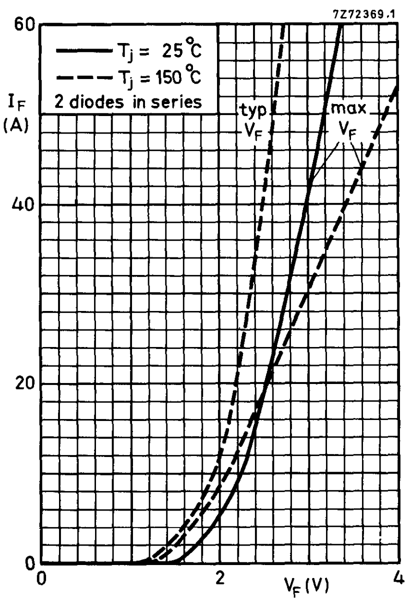
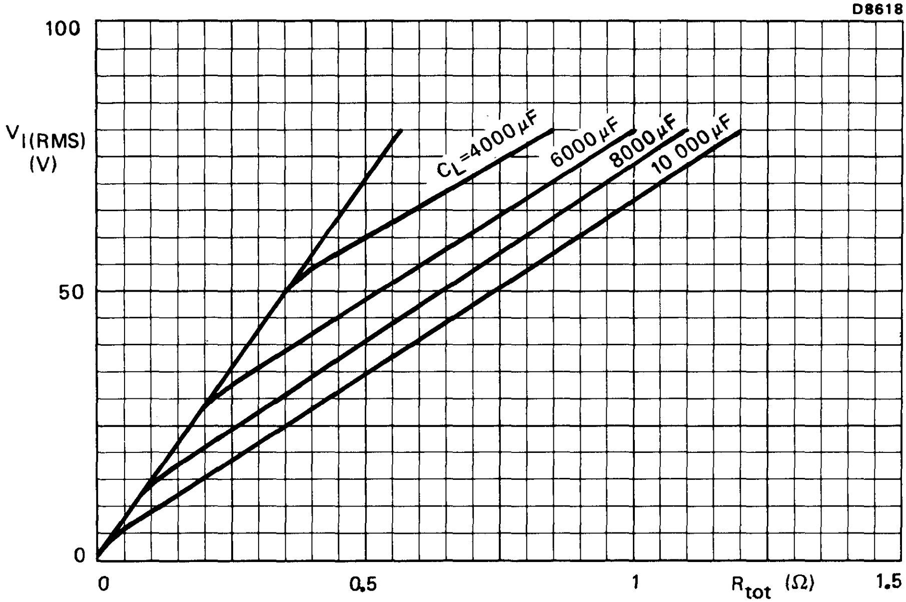
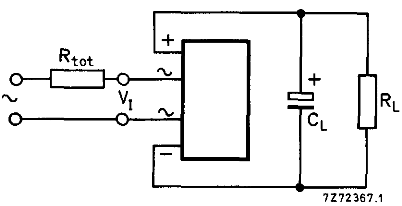


Fig. 5.





The graph takes the possibility of the following spreads into account:

input voltage	+10%
capacitance	+50%
resistance	−10%

Fig. 6 Minimum value of the total series resistance R_{tot} (including the transformer resistance) required to limit the peak inrush current.

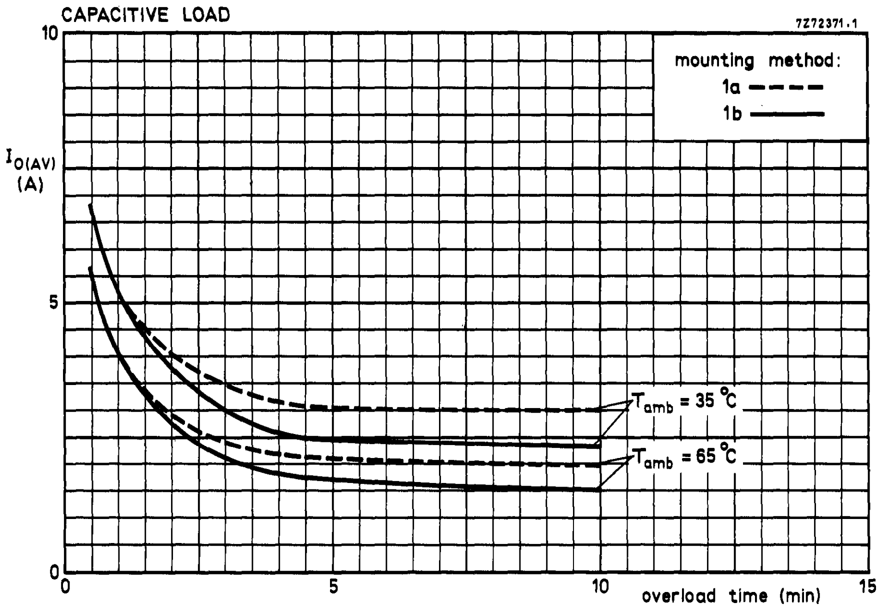

CAPACITIVE LOAD
7Z72371.1
mounting method:
1a
1b
$I_{O(AV)}$ (A)
10
5
0
0
5
10
15
overload time (min)
T_{amb} = 35 °C
T_{amb} = 65 °C

Fig. 7.

FAST SOFT-RECOVERY RECTIFIER DIODES

Glass-passivated double-diffused rectifier diodes in plastic envelopes, featuring fast reverse recovery times and non-snap-off characteristics. They are intended for use in chopper applications as well as in switched-mode power supplies, as efficiency diodes and scan rectifiers in television receivers.
The series consists of normal polarity (cathode to mounting base) types.

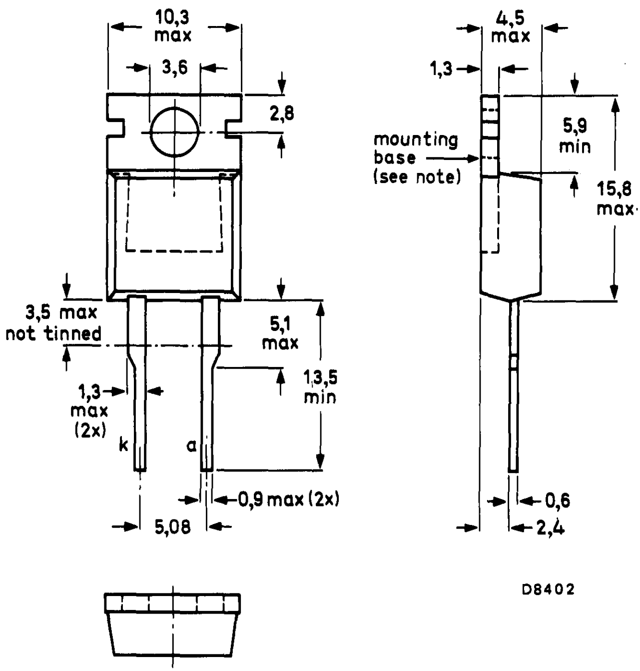
QUICK REFERENCE DATA

			BY229–200	400	600	800	
Repetitive peak reverse voltage	V_{RRM}	max.	200	400	600	800	V
Average forward current	$I_{F(AV)}$	max.	7				A
Non-repetitive peak forward current	I_{FSM}	max.	60				A
Reverse recovery time	t_{rr}	<	450				ns

MECHANICAL DATA

Dimensions in mm

Fig.1 SOD–59 (TO–220AC).



Note: The exposed metal mounting base is directly connected to the cathode. Accessories supplied on request: see data sheets Mounting instructions and accessories for TO–220 envelopes.

RATINGS

Limiting values in accordance with the Absolute Maximum System (IEC 134)

Voltages*			BY229–200	400	600	800	
Non-repetitive peak reverse voltage	V_{RSM}	max.	200	400	600	800	V
Repetitive peak reverse voltage	V_{RRM}	max.	200	400	600	800	V
Crest working reverse voltage	V_{RWM}	max.	150	300	500	600	V
Continuous reverse voltage	V_R	max.	150	300	500	600	V

Currents

Average forward current assuming zero switching losses				
square-wave; δ = 0.5; up to T_{mb} = 100 °C	$I_{F(AV)}$	max.	7	A
square-wave; δ = 0.5; at T_{mb} = 125 °C	$I_{F(AV)}$	max.	4.1	A
sinusoidal; up to T_{mb} = 101 °C	$I_{F(AV)}$	max.	6.5	A
sinusoidal; at T_{mb} = 125 °C	$I_{F(AV)}$	max.	4	A
R.M.S. forward current	$I_{F(RMS)}$	max.	10	A
Repetitive peak forward current	I_{FRM}	max.	60	A
Repetitive peak forward current t_p = 20 μs; $\delta \leqslant$ 0.02	I_{FRM}	max.	75	A
Non-repetitive peak forward current; t = 10 ms half sine-wave; T_j = 150 °C prior to surge; with reapplied V_{RWMmax}	I_{FSM}	max.	60	A

Temperatures

Storage temperature	T_{stg}		–40 to +150	°C
Junction temperature	T_j	max.	150	°C

*To ensure thermal stability: $R_{th\ j\text{-}a} \leqslant$ 15 °C/W for continuous reverse voltage.

THERMAL RESISTANCE

From junction to mounting base $R_{th\ j\text{-}mb}$ = 4.5 °C/W

Influence of mounting method

1. Heatsink mounted with clip (see mounting instructions)

Thermal resistance from mounting base to heatsink

a. with heatsink compound $R_{th\ mb\text{-}h}$ = 0.3 °C/W

b. with heatsink compound and 0.06 mm maximum mica insulator $R_{th\ mb\text{-}h}$ = 1.4 °C/W

c. with heatsink compound and 0.1 mm maximum mica insulator (56369) $R_{th\ mb\text{-}h}$ = 2.2 °C/W

d. with heatsink compound and 0.25 mm maximum alumina insulator (56367) $R_{th\ mb\text{-}h}$ = 0.8 °C/W

e. without heatsink compound $R_{th\ mb\text{-}h}$ = 1.4 °C/W

2. Free-air operation

The quoted value of $R_{th\ j\text{-}a}$ should be used only when no leads of other dissipating components run to the same tie-point. Thermal resistance from junction to ambient in free air: mounted on a printed-circuit board at a = any lead length.

$R_{th\ j\text{-}a}$ = 60 °C/W

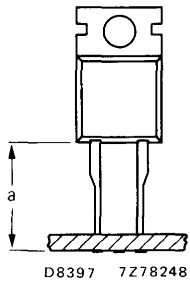


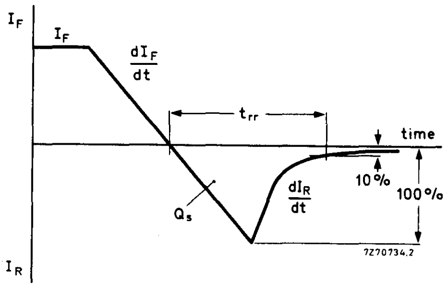
Fig.2

MOUNTING INSTRUCTIONS

1. The device may be soldered directly into the circuit, but the maximum permissible temperature of the soldering iron or bath is 275 °C; it must not be in contact with the joint for more than 5 seconds. Soldered joints must be at least 4.7 mm from the seal.
2. The leads should not be bent less than 2.4 mm from the seal, and should be supported during bending.
3. It is recommended that the circuit connection be made to the cathode tag, rather than direct to the heatsink.
4. Mounting by means of a spring clip is the best mounting methode because it offers:
   a. a good thermal contact under the crystal area and slightly lower $R_{th\ mb\text{-}h}$ values than screw mounting;
   b. safe isolation for mains operation.
   However, if a screw is used, it should be M3 cross-recess pan head. Care should be taken to avoid damage to the plastic body.
5. For good thermal contact heatsink compound should be used between base-plate and heatsink. Values of $R_{th\ mb\text{-}h}$ given for mounting with heatsink compound refer to the use of a metallic-oxide loaded compound. Ordinary silicone grease is not recommended.
6. The device should not be pop-riveted to the heatsink. However, it is permissible to press-rivet providing that rivets of soft material are used, and the press forces are slowly and carefully controlled so as to avoid shock and deformation of either heatsink or mounting tab.

CHARACTERISTICS

Forward voltage				
$I_F = 20$ A; $T_j = 25$ °C	V_F	<	1.85	V*
Reverse current				
$V_R = V_{RWMmax}$; $T_j = 125$ °C	I_R	<	0.4	mA
Reverse recovery when switched from $I_F = 2$ A to $V_R \geqslant 30$ V with $-dI_F/dt = 20$ A/µs; $T_j = 25$ °C				
Recovered charge	Q_s	<	0.7	µC
Recovery time	t_{rr}	<	450	ns
Maximum slope of the reverse recovery current				
$I_F = 2$ A; $-dI_F/dt = 20$ A/µs	$\|dI_R/dt\|$	<	60	A/µs



D8403

Fig. 3 Definition of t_{rr} and Q_s

*Measured under pulse conditions to avoid excessive dissipation.

SQUARE-WAVE OPERATION

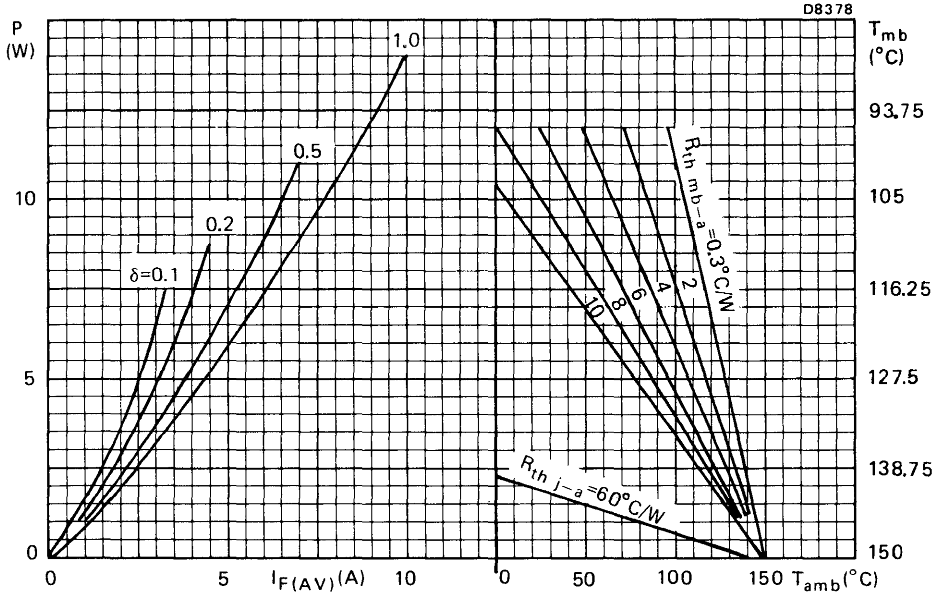
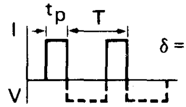


Fig. 4 The right-hand part shows the interrelationship between the power (derived from the left-hand part) and the maximum permissible temperatures.
P = power including reverse current losses but excluding switching losses.



$\delta = \frac{t_p}{T}$

$I_{F(AV)} = I_{F(RMS)} \times \sqrt{\delta}$

SINUSOIDAL OPERATION

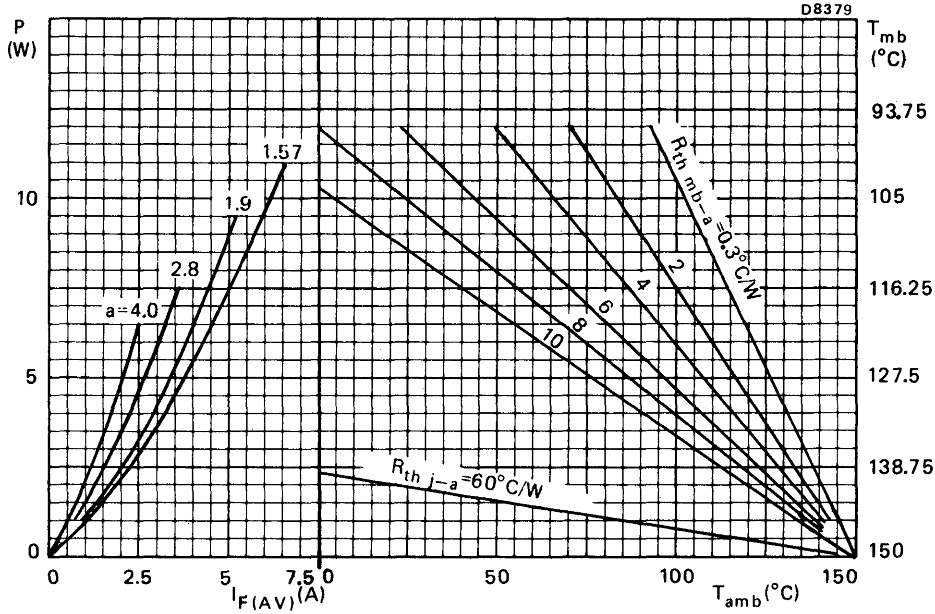


Fig. 5 The right-hand part shows the interrelationship between the power (derived from the left-hand part) and the maximum permissible temperatures.
P = power including reverse current losses but excluding switching losses.
a = form factor = $I_{F(RMS)}/I_{F(AV)}$.

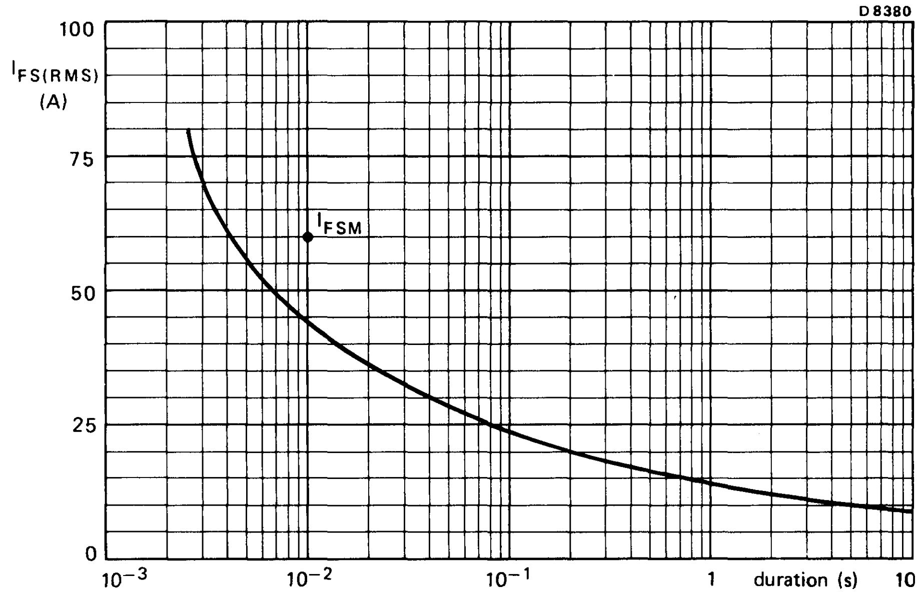
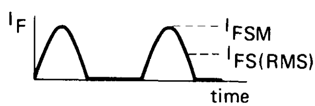


Fig. 6 Maximum permissible non-repetitive r.m.s. forward current based on sinusoidal currents (f = 50 Hz); T_j = 150 °C prior to surge; with reapplied V_{RWMmax}.



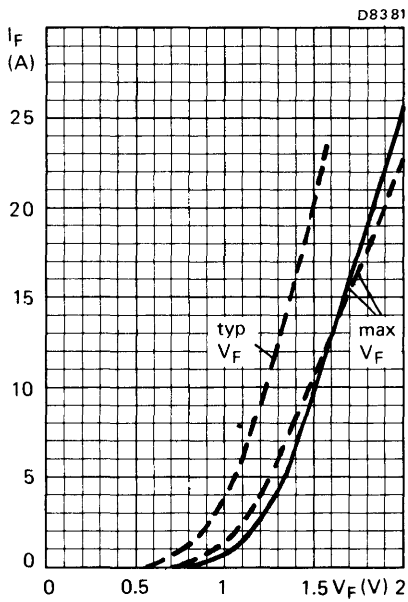


Fig. 7 ——— T_j = 25 °C; – – – –T_j = 125 °C

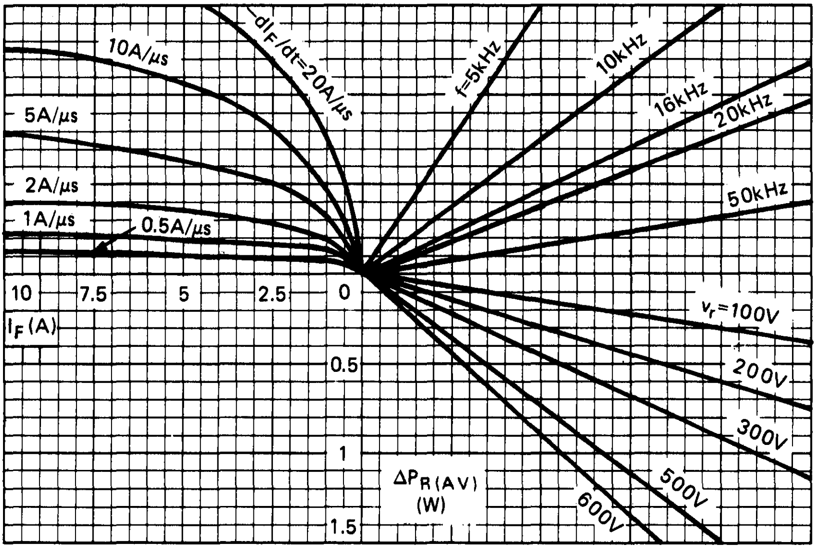
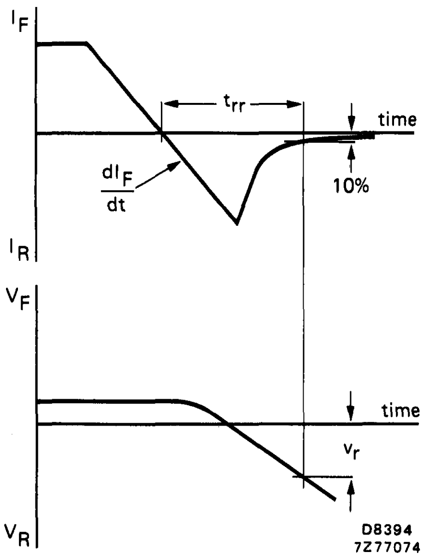


Fig. 8 NOMOGRAM

Power loss $\Delta P_{R(AV)}$ due to switching only (to be added to steady state power losses). I_F = forward current just before switching off; T_j = 150 °C



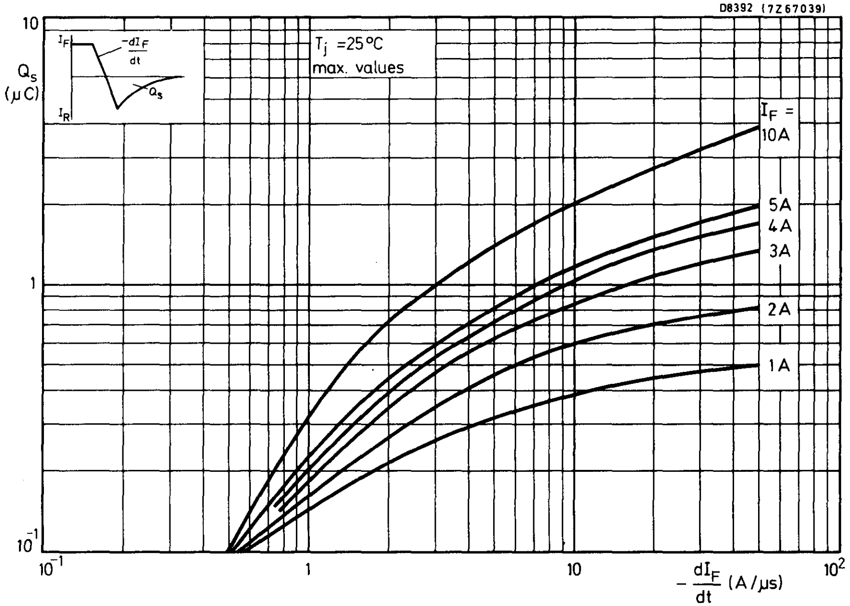

D8392 (7Z67039)
T_j =25°C
max. values
Q_s (μC)
I_F =
10A
5A
4A
3A
2A
1A
$-\frac{dI_F}{dt}$ (A/μs)
Q_s

Fig.9

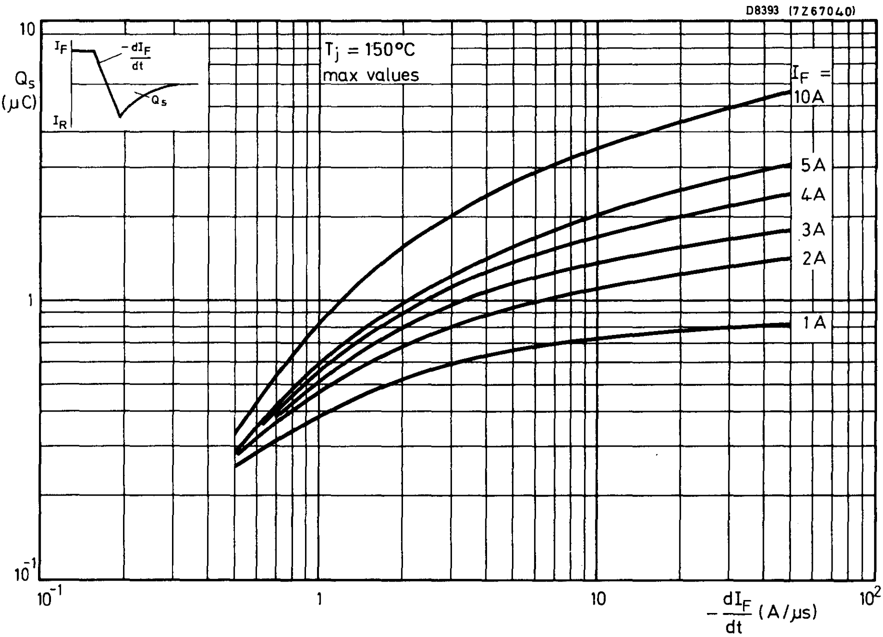

D8393 (7Z67040)
T_j = 150°C
max values
Q_s (μC)
I_F =
10A
5A
4A
3A
2A
1A
$-\frac{dI_F}{dt}$ (A/μs)
Q_s

Fig.10

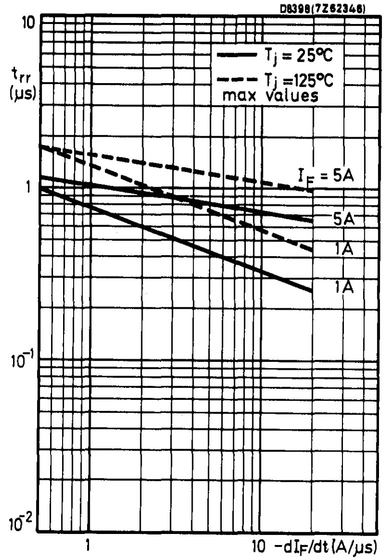


Fig. 11

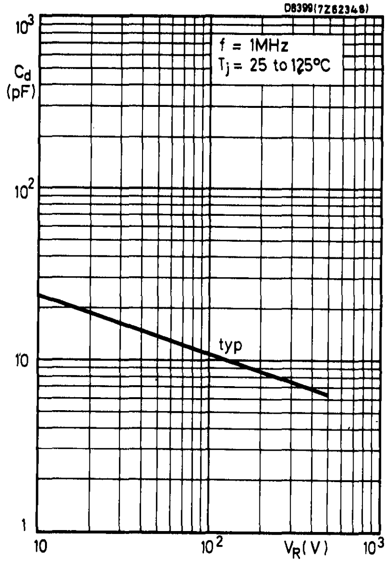


Fig. 12

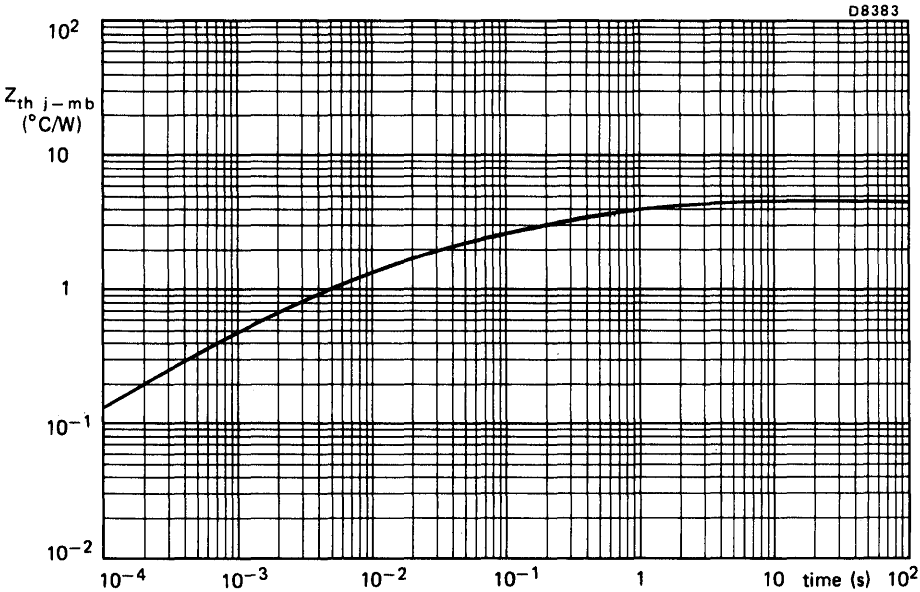


Fig. 13

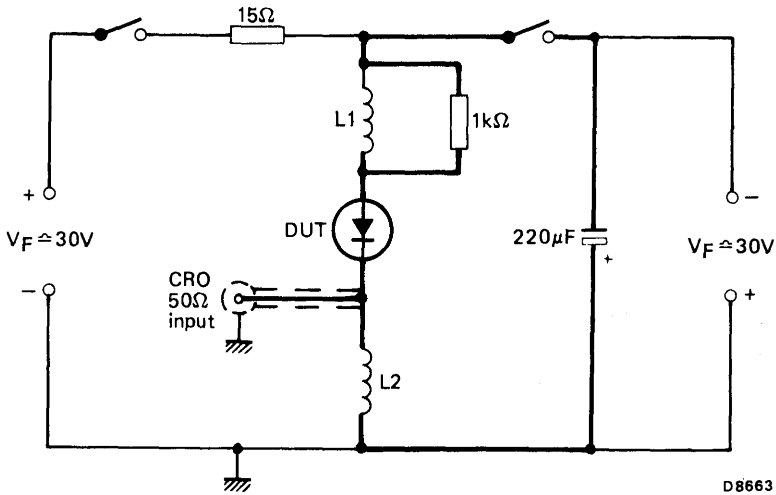


Fig.14 Simplified circuit diagram of practical apparatus to test softness of recovery.

NOTES

1. Duty factor of forward current should be low, <2%.
2. dI_F/dt is set by L1, 1.5 µH gives 20 A/µs
3. dI_R/dt is measured across L2, 200 nH gives 5A/µs/V.
4. Wiring shown in heavy should be kept as short as possible.

SILICON BRIDGE RECTIFIER

Ready-for-use full-wave bridge rectifier in a plastic encapsulation. The bridge is intended for use in equipment supplied from a.c. with r.m.s. voltages up to 80 V and is capable of delivering output currents up to 1.5 A.

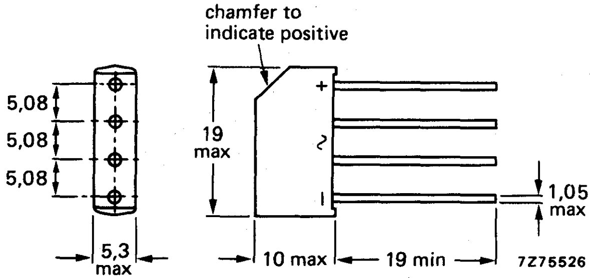
QUICK REFERENCE DATA

Input				
R.M.S. voltage	$V_{I(RMS)}$	max.	80	V
Repetitive peak voltage	V_{IRM}	max.	200	V
Non-repetitive peak current	I_{ISM}	max.	50	A
Output				
Average current	$I_{O(AV)}$	max.	1.5	A

MECHANICAL DATA

Dimensions in mm

Fig.1 SOD–28



The sealing of the plastic envelope withstands the accelerated damp heat test of IEC recommendation 68–2 (test D, severity IV, 6 cycles).

RATINGS

Limiting values in accordance with the Absolute Maximum System (IEC 134)

Input

Non-repetitive peak voltage ($t \leq 10$ ms)	V_{ISM}	max.	200	V
Repetitive peak voltage	V_{IRM}	max.	200	V
Crest working voltage	V_{IWM}	max.	112	V
R.M.S. voltage (sine-wave)	$V_{I(RMS)}$	max.	80	V
Non-repetitive peak current; half sine-wave; t = 20 ms; with reapplied V_{IWMmax} T_j = 150 °C prior to surge	I_{ISM}	max.	50	A

Output

Average current (averaged over any 20 ms period); see Fig.3) free-air operation at T_{amb} = 45 °C; (mounting method a)	$I_{O(AV)}$	max.	1.5	A
Repetitive peak current	I_{ORM}	max.	10	A

Temperatures

Storage temperature	T_{stg}	−55 to +150		°C
Junction temperature	T_j	max.	150	°C

THERMAL RESISTANCE

Influence of mounting method

1. Free-air operation

The quoted values of $R_{th\ j\text{-}a}$ should be used only when no leads of other dissipating components run to the same tie-point

Thermal resistance from junction to ambient in free air

a. Mounted on a printed-circuit board with 4 cm^2 of copper laminate to + and – leads	$R_{th\ j\text{-}a}$	=	38	°C/W
b. Mounted on a printed-circuit board with minimal copper laminate; 1.5 mm lead length	$R_{th\ j\text{-}a}$	=	52	°C/W
c. Mounted on a printed-circuit board with minimal copper laminate; maximum lead length	$R_{th\ j\text{-}a}$	=	44	°C/W

MOUNTING INSTRUCTIONS

1. The maximum permissible temperature of the soldering iron or bath is 270 °C; it must not be in contact with the joint for more than 3 seconds.
2. Avoid hot spots due to handling or mounting; the body of the device must not come into contact with or be exposed to a temperature higher than 150 °C
3. Exert no axial pull when bending.

CHARACTERISTICS

Forward voltage (2 diodes in series) $I_F = 2$ A; $T_j = 25$ °C	V_F	<	2.1	V*

*Measured under pulse conditions to avoid excessive dissipation.

OPERATING NOTES

The various components of junction temperature rise above ambient are illustrated below.

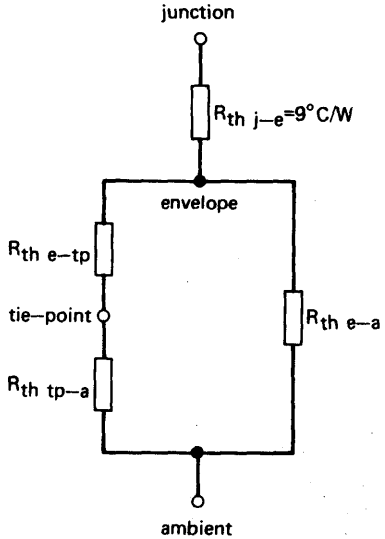


Fig.2

The thermal resistance between envelope and tie-point and between envelope and ambient depend on lead length:

lead length	1.5	5	10	15	max.	mm
$R_{th\ e\text{-}tp}$	1.2	4	8	12	15.2	°C/W
$R_{th\ e\text{-}a}$	110	87	73	65	60	°C/W

The thermal resistance between tie-point and ambient depends on the mounting method; for mounting on a 1.5 mm thick epoxy-glass printed-circuit board with a copper-thickness ≥ 40 μm, the following values apply:

1. Mounting with minimal copper laminate: $R_{th\ tp\text{-}a} = 70$ °C/W
2. Mounted on a printed-circuit board with a copper laminate to the + and – lead of:

1 cm²: $R_{th\ tp\text{-}a} = 55$ °C/W
2.25 cm²: $R_{th\ tp\text{-}a} = 45$ °C/W
4 cm²: $R_{th\ tp\text{-}a} = 40$ °C/W

Note: Any temperature can be calculated by using the dissipation graphs and the above thermal model.

FREE-AIR OPERATION

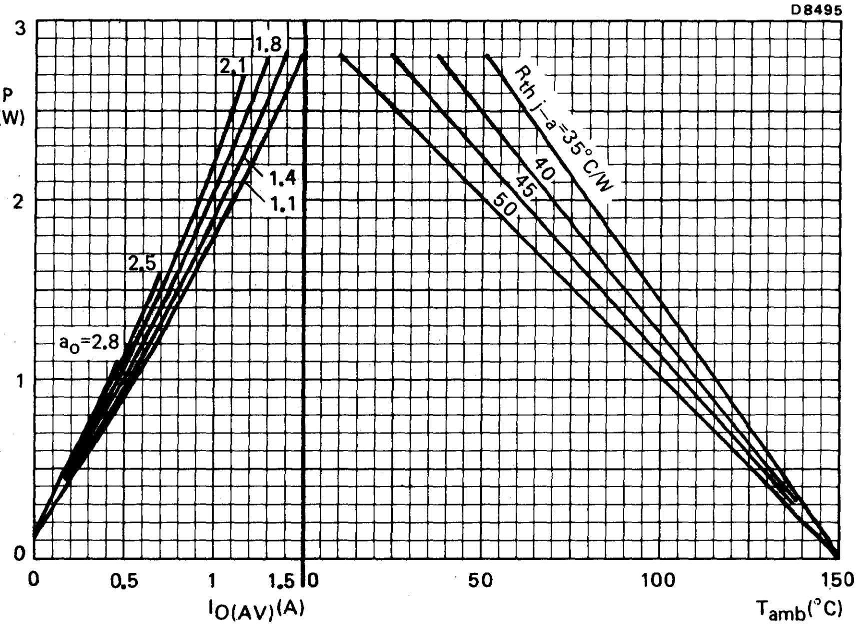


Fig.3 The right-hand part shows the interrelationship between the power (derived from the left-hand graph) and the maximum permissible ambient temperature.

Output form factor $a_o = I_{O(RMS)}/I_{O(AV)} = 0.707 \times I_{F(RMS)}/I_{F(AV)}$ per diode.

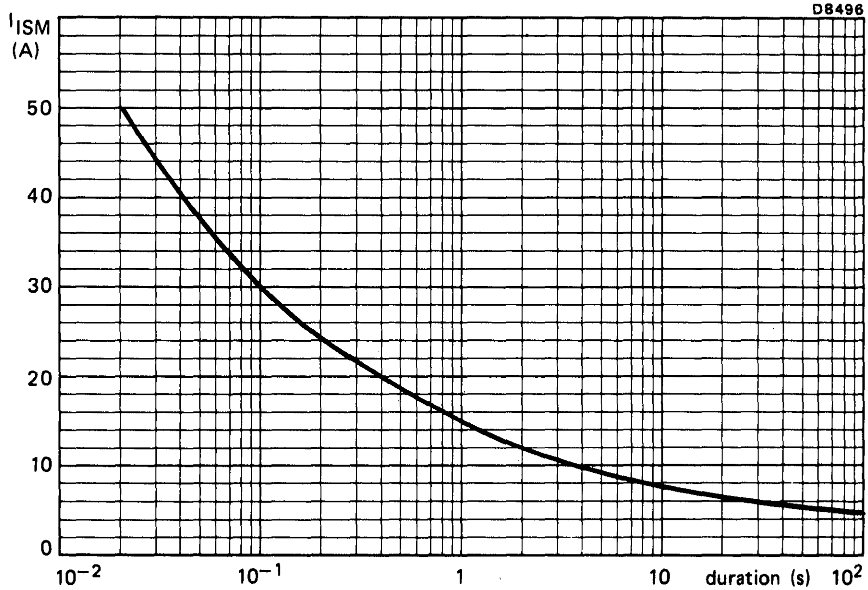


Fig.4 Maximum permissible non-repetitive peak input current based on sinusoidal currents (f = 50 Hz); T_j = 150 °C prior to surge; with reapplied V_{IWMmax}.

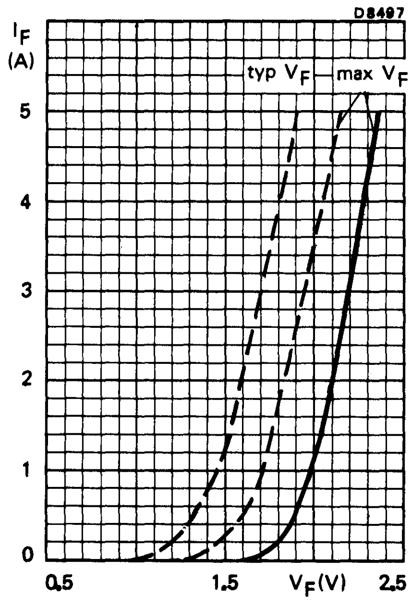
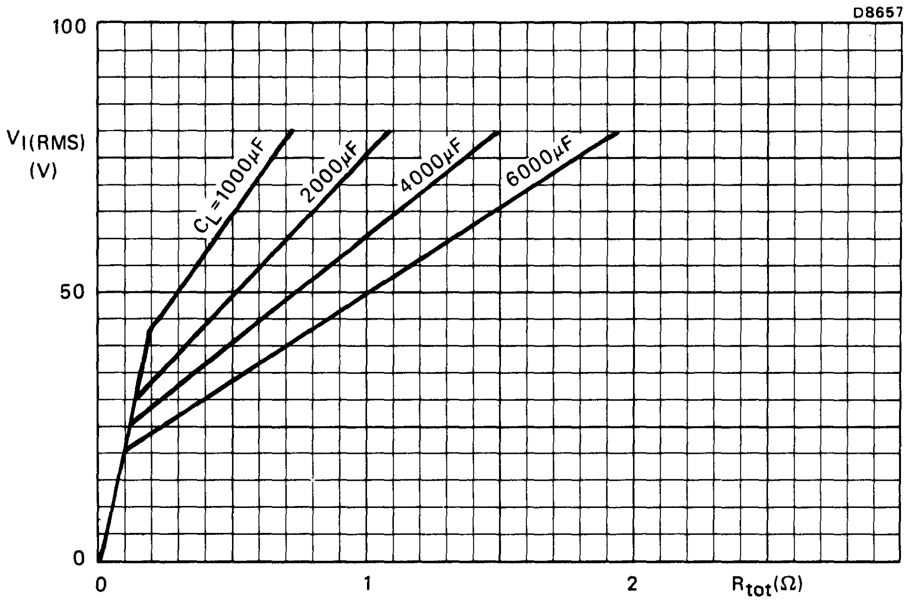
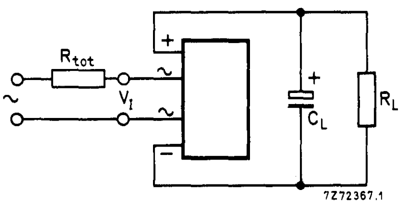


Fig.5 ——— T_j = 25 °C; – – – T_j = 150 °C;
2 diodes in series.





The graph takes the possibility of the following spreads into account:

input voltage	+10%
capacitance	+50%
resistance	−10%

Fig.6 Minimum value of the total series resistance R_{tot} (including the transformer resistance) required to limit the peak inrush current.

SILICON BRIDGE RECTIFIER

Ready-for-use full-wave bridge rectifier in a plastic encapsulation. The bridge is intended for use in equipment supplied from mains with r.m.s. voltages up to 280 V and is capable of delivering output currents up to 1.5 A.

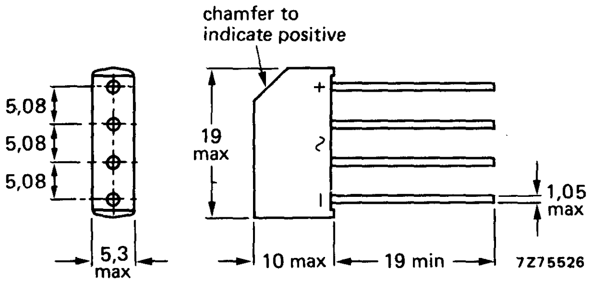
QUICK REFERENCE DATA

Input				
R.M.S. voltage	$V_{I(RMS)}$	max.	280	V
Repetitive peak voltage	V_{IRM}	max.	600	V
Non-repetitive peak current	I_{ISM}	max.	50	A
Output				
Average current	$I_{OA(V)}$	max.	1.5	A

MECHANICAL DATA

Dimensions in mm

Fig. 1 SOD–28



The sealing of the plastic envelope withstands the accelerated damp heat test of IEC recommendation 68–2 (test D, severity IV, 6 cycles).

RATINGS

Limiting values in accordance with the Absolute Maximum System (IEC 134)

Input

Non-repetitive peak voltage ($t \leq 10$ ms)	V_{ISM}	max.	600	V
Repetitive peak voltage	V_{IRM}	max.	600	V
Crest working voltage	V_{IWM}	max.	400	V
R.M.S. voltage (sine-wave)	$V_{I(RMS)}$	max.	280	V
Non-repetitive peak current;* half sine-wave; t = 20 ms; with reapplied V_{IWMmax} T_j = 150 °C prior to surge	I_{ISM}	max.	50	A

Output

Average current (averaged over any 20 ms period; see Fig.3) free-air operation at T_{amb} = 45 °C; (mounting method a)	$I_{O(AV)}$	max.	1.5	A
Repetitive peak current	I_{ORM}	max.	10	A

Temperatures

Storage temperature	T_{stg}	–55 to +150		°C
Junction temperature	T_j	max.	150	°C

THERMAL RESISTANCE

Influence of mounting method

1. Free-air operation

The quoted values of $R_{th\ j\text{-}a}$ should be used only when no leads of other dissipating components run to the same tie-point.

Thermal resistance from junction to ambient in free air

a. Mounted on a printed-circuit board with 4 cm^2 of copper laminate to + and − leads	$R_{th\ j\text{-}a}$	=	38	°C/W
b. Mounted on a printed-circuit board with minimal copper laminate; 1.5 mm lead length	$R_{th\ j\text{-}a}$	=	52	°C/W
c. Mounted on a printed-circuit board with minimal copper laminate; maximum lead length	$R_{th\ j\text{-}a}$	=	44	°C/W

MOUNTING INSTRUCTIONS

1. The maximum permissible temperature of the soldering iron or bath is 270 °C; it must not be in contact with the joint for more than 3 seconds.
2. Avoid hot spots due to handling or mounting; the body of the device must not come into contact with or be exposed to a temperature higher than 150 °C.
3. Exert no axial pull when bending.

CHARACTERISTICS

Forward voltage (2 diodes in series)

I_F = 2 A; T_j = 25 °C	V_F	<	2.1	V*

*Measured under pulse conditions to avoid excessive dissipation.

OPERATING NOTES

The various components of junction temperature rise above ambient are illustrated below.

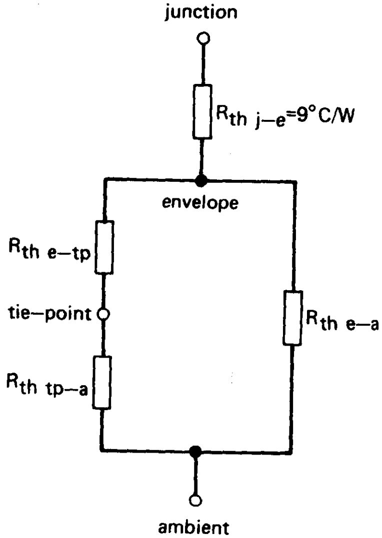


Fig.2

The thermal resistance between envelope and tie-point and between envelope and ambient depend on lead length:

lead length	1.5	5	10	15	max.	mm
$R_{th\ e\text{-}tp}$	1.2	4	8	12	15.2	°C/W
$R_{th\ e\text{-}a}$	110	87	73	65	60	°C/W

The thermal resistance between tie-point and ambient depends on the mounting method. For mounting on a 1.5 mm thick epoxy-glass printed-circuit board with a copper-thickness ⩾ 40 μm, the following values apply:

1. Mounting with minimal copper laminate: $R_{th\ tp\text{-}a}$ = 70 °C/W
2. Mounted on a printed-circuit board with a copper laminate to the + and – lead of:

1 cm^2 : $R_{th\ tp\text{-}a}$ = 55 °C/W
2.25 cm^2 : $R_{th\ tp\text{-}a}$ = 45 °C/W
4 cm^2 : $R_{th\ tp\text{-}a}$ = 40 °C/W

Note: Any temperature can be calculated by using the dissipation graphs and the above thermal model.

FREE-AIR OPERATION

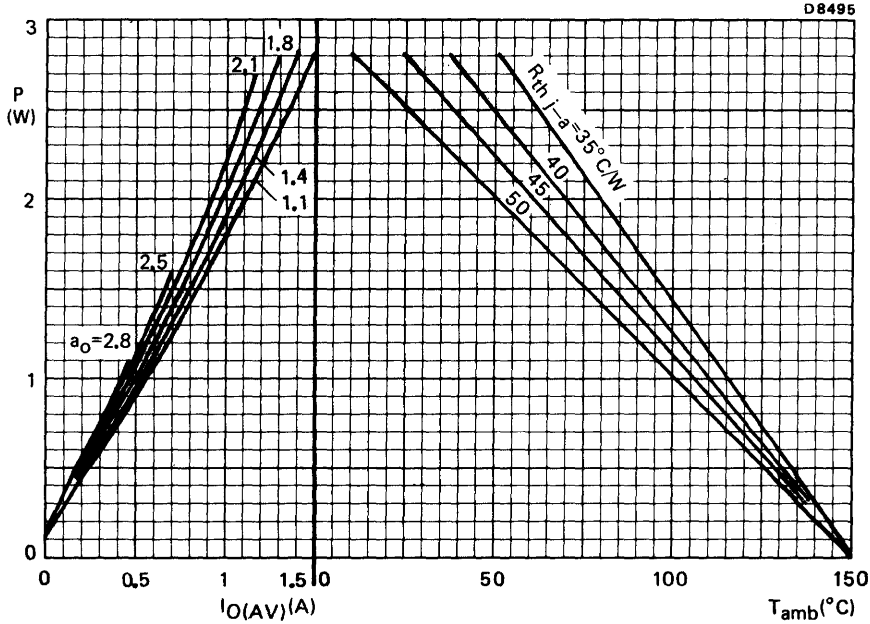


Fig.3 The right-hand part shows the interrelationship between the power (derived from the left-hand graph) and the maximum permissible ambient temperature.

Output form factor $a_o = I_{O(RMS)}/I_{O(AV)} = 0.707 \times I_{F(RMS)}/I_{F(AV)}$ per diode.

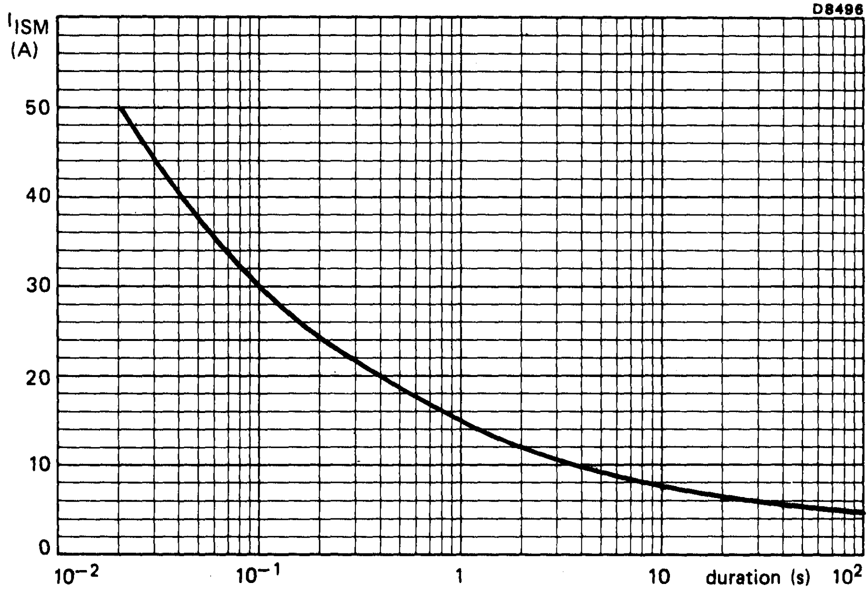


Fig.4 Maximum permissible non-repetitive peak input current based on sinusoidal currents (f = 50 Hz); T_j = 150 °C prior to surge; with reapplied V_{IWMmax};

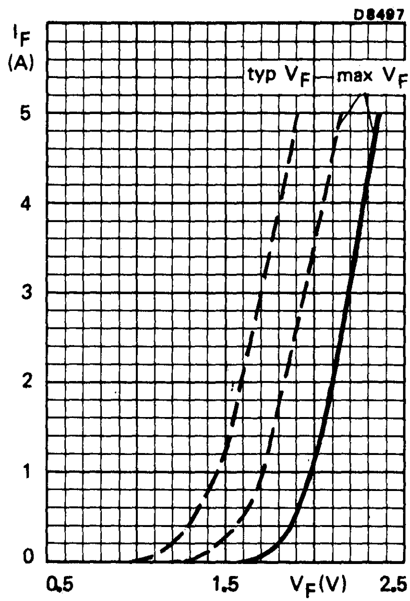
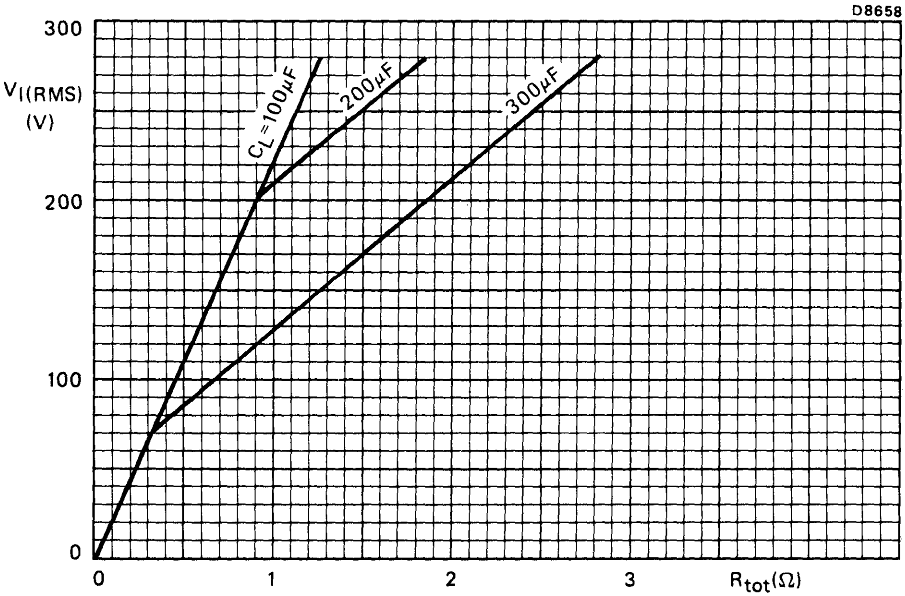
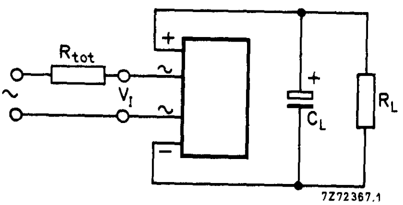


Fig.5 ——— T_j = 25 °C; – – – T_j = 150 °C;
2 diodes in series





The graph takes the possibility of the following spreads into account:

input voltage	+10%
capacitance	+50%
resistance	−10%

Fig.6 Minimum value of the total series resistance R_{tot} (including the transformer resistance) required to limit the peak inrush current.

SILICON BRIDGE RECTIFIERS

Ready for use full-wave bridge rectifiers in a plastic encapsulation.
The bridges are intended for use in equipment supplied from a.c. with r.m.s. voltages up to 420 V and are capable of delivering output currents up to 12A. They are also suitable for use in hi-fi audio equipments and low-voltage industrial power supplies. They may be used in free air or on a heatsink.

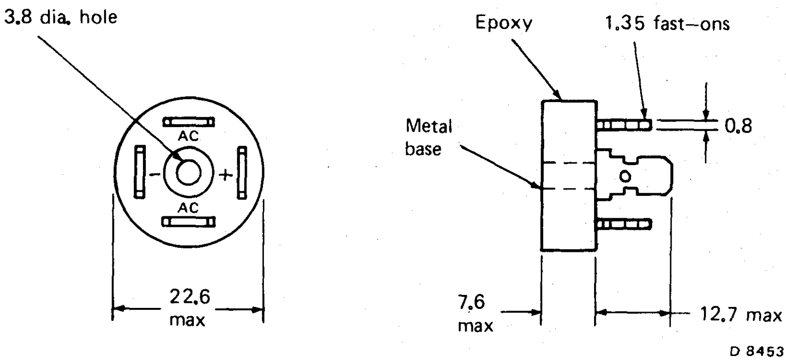
QUICK REFERENCE DATA

			BY260–200	400	600	
Input						
R.M.S. voltage	$V_{I(RMS)}$	max.	140	280	420	V
Repetitive peak voltage	V_{IRM}	max.	200	400	600	V
Non-repetitive peak current	I_{ISM}	max.		125		A
Peak inrush current	I_{IIM}	max.		250		A
Output						
Average current	$I_{O(AV)}$	max.		12		A

MECHANICAL DATA

Dimensions in mm

Fig. 1.



RATINGS

Limiting values in accordance with the Absolute Maximum System (IEC134).

Input

			BY260–200	400	600	
Non-repetitive peak voltage ($t \leq 10$ ms)	V_{ISM}	max.	200	400	600	V
Repetitive peak voltage	V_{IRM}	max.	200	400	600	V
Crest working voltage	V_{IWM}	max.	200	400	600	V
R.M.S. voltage (sine-wave)	$V_{I(RMS)}$	max.	140	280	420	V

Non-repetitive peak current half-sinewave; t = 20 ms; with reapplied V_{IWMmax}				
$T_j = 25\ ^oC$ prior to surge	I_{ISM}	max.	125	A
$T_j = 150\ ^oC$ prior to surge	I_{ISM}	max.	100	A
Peak inrush current (see Fig. 5)	I_{IIM}	max.	250	A

Output

Average current (averaged over any 20 ms period)				
heatsink operation up to $T_{mb} = 60\ ^oC$ (R-load)	$I_{O(AV)}$	max.	12	A
heatsink operation up to $T_{mb} = 60\ ^oC$ (C-load)	$I_{O(AV)}$	max.	7.5	A
Repetitive peak current	I_{ORM}	max.	20	A

Temperatures

Storage temperature	T_{stg}		−55 to +150	^oC
Junction temperature	T_j	max.	150	^oC

THERMAL RESISTANCE

From junction to mounting base	$R_{th\ j\text{-}mb}$	=	4.5	$^oC/W$

CHARACTERISTICS

Forward voltage (2 diodes in series) $I_F = 7$ A; $T_j = 25\ ^oC$	V_F	<	2.0	V*
Reverse current (2 diodes in parallel) $V_R = V_{IWMmax}$; $T_j = 100\ ^oC$	I_R	<	150	μA

*Measured under pulse conditions to avoid excessive dissipation.

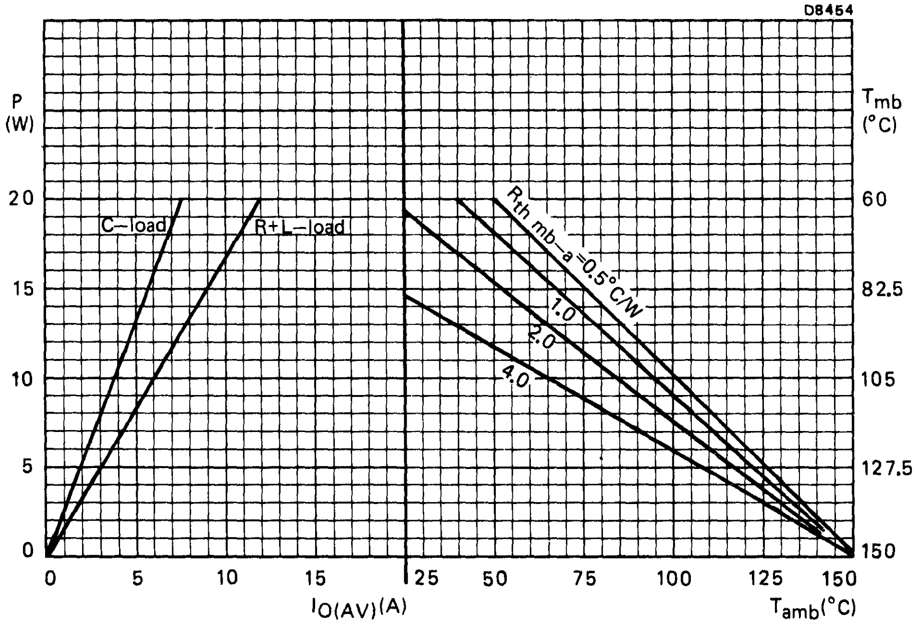


Fig.2 The right-hand part shows the interrelationship between the power (derived from the left-hand graph) and the maximum permissible temperatures.

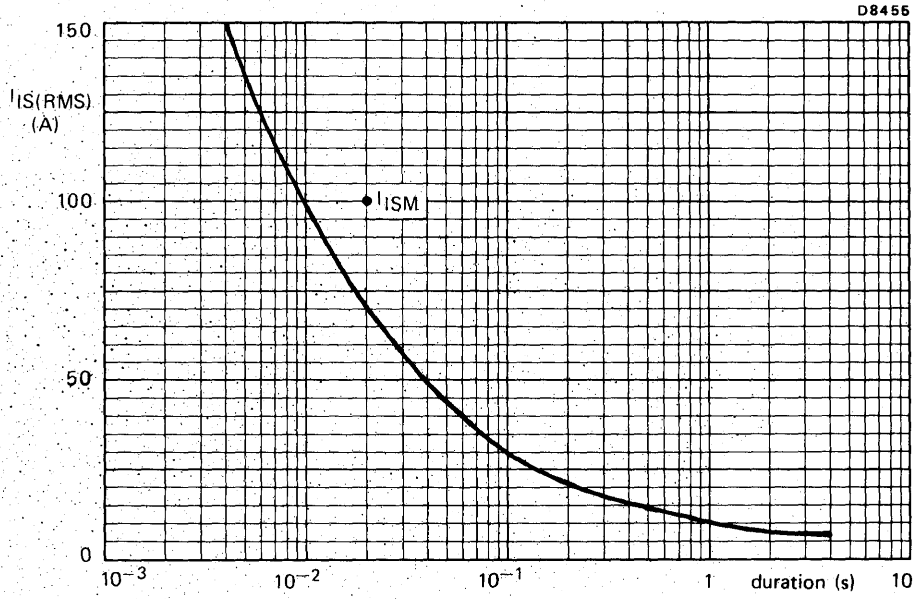
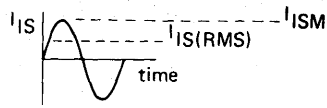


Fig.3 Maximum permissible non-repetitive r.m.s. input current based on sinusoidal currents (f = 50 Hz); T_j = 150 °C prior to surge, with reapplied V_{IWMmax}.



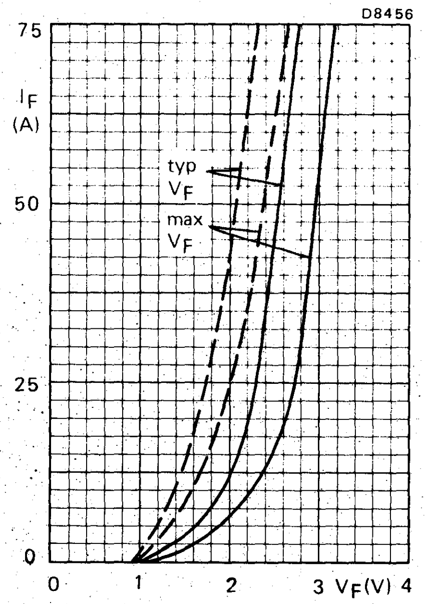
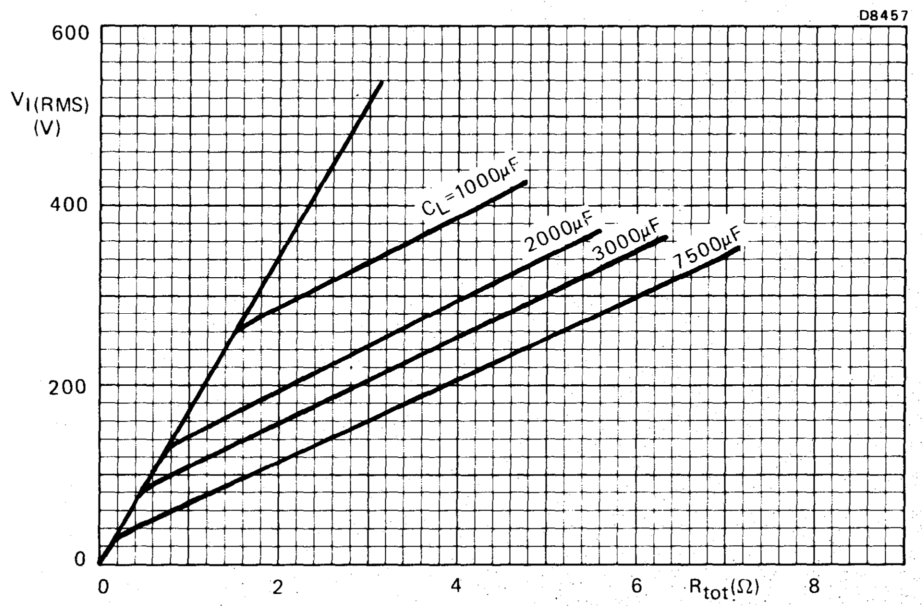
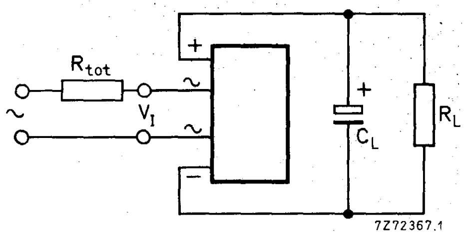


Fig.4 Two diodes in series;
——— T_j = 25 °C; – – – – T_j = 150 °C





The graph takes the possibility of the following spreads into account:

mains voltage	+10%
capacitance	+50%
resistance	−10%

Fig.5 Minimum value of the total series resistance R_{tot} (including the transformer resistance) required to limit the peak inrush current.

SILICON BRIDGE RECTIFIERS

Ready for use full-wave bridge rectifiers in a plastic encapsulation.
The bridges are intended for use in equipment supplied from a.c. with r.m.s. voltages up to 420 V and are capable of delivering output currents up to 25A. They may be used in free air or on a heatsink.

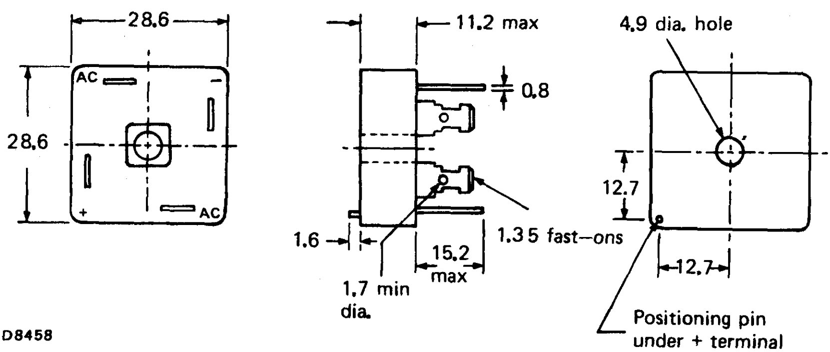
QUICK REFERENCE DATA

Input			BY261–200	400	600	
R.M.S. voltage	$V_{I(RMS)}$	max.	140	280	420	V
Repetitive peak voltage	V_{IRM}	max.	200	400	600	V
Non-repetitive peak current	I_{ISM}	max.		320		A
Peak inrush current	I_{IIM}	max.		640		A
Output						
Average current	$I_{O(AV)}$	max.		25		A

MECHANICAL DATA

Dimensions in mm

Fig. 1



RATINGS

Limiting values in accordance with the Absolute Maximum System (IEC134).

Input

			BY261–200	400	600	
Non-repetitive peak voltage ($t \leq 10$ ms)	V_{ISM}	max.	200	400	600	V
Repetitive peak voltage	V_{IRM}	max.	200	400	600	V
Crest working voltage	V_{IWM}	max.	200	400	600	V
R.M.S. voltage (sine-wave)	$V_{I(RMS)}$	max.	140	280	420	V

Non-repetitive peak current half sinewave; t = 20 ms; with reapplied V_{IWMmax}				
T_j = 25 °C prior to surge	I_{ISM}	max.	320	A
T_j = 150 °C prior to surge	I_{ISM}	max.	250	A
Peak inrush current (see Fig. 5)	I_{IIM}	max.	640	A

Output

Average current (averaged over any 20 ms period)				
heatsink operation; up to T_{mb} = 55 °C (R-load)	$I_{O(AV)}$	max.	25	A
heatsink operation; up to T_{mb} = 55 °C (C-load)	$I_{O(AV)}$	max.	18	A
Repetitive peak current	I_{ORM}	max.	75	A

Temperatures

Storage temperature	T_{stg}		–55 to +175	°C
Junction temperature	T_j	max.	175	°C

THERMAL RESISTANCE

From junction to mounting base	$R_{th\ j\text{-}mb}$	=	2.5	°C/W

CHARACTERISTICS

Forward voltage (2 diodes in series) I_F = 12 A; T_j = 25 °C	V_F	<	2.3	V*
Reverse current (2 diodes in parallel) $V_R = V_{IWMmax}$; T_j = 100 °C	I_R	<	200	μA

*Measured under pulse conditions to avoid excessive dissipation.

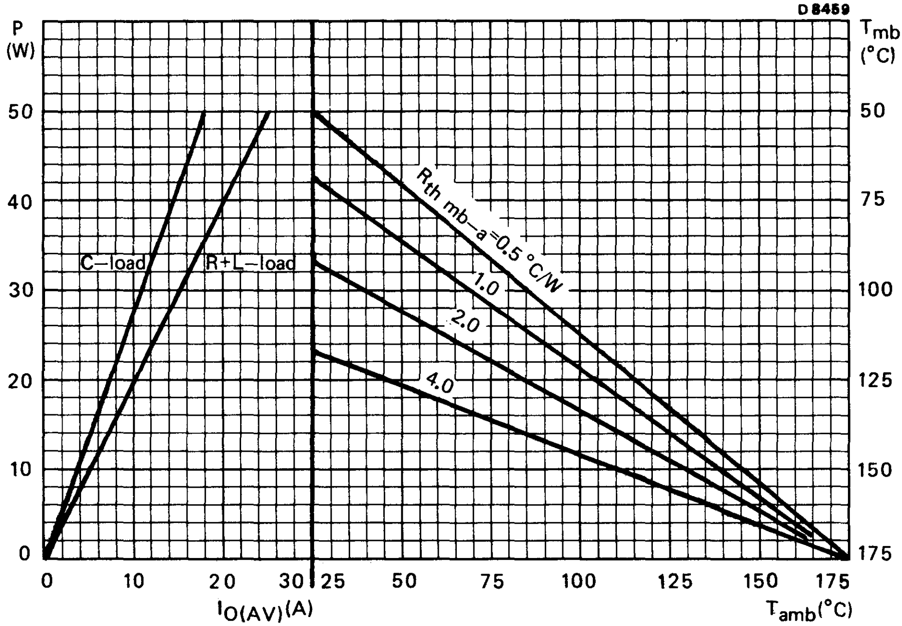


Fig. 2 The right-hand part shows the interrelationship between the power (derived from the left-hand graph) and the maximum permissible temperatures.

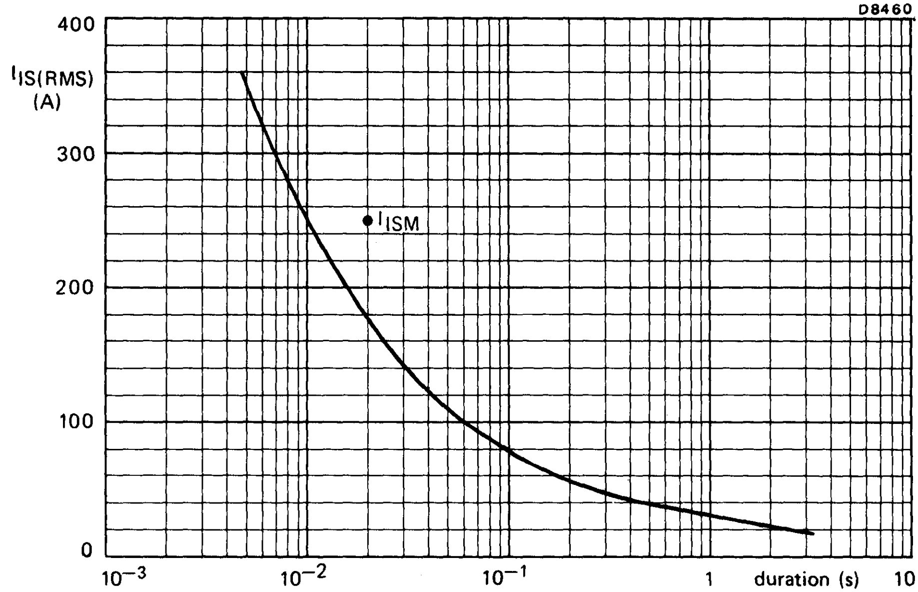
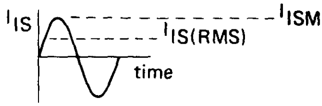


Fig.3 Maximum permissible non-repetitive r.m.s. input current based on sinusoidal currents (f = 50 Hz); T_j = 150 °C prior to surge; with reapplied V_{IWMmax}.



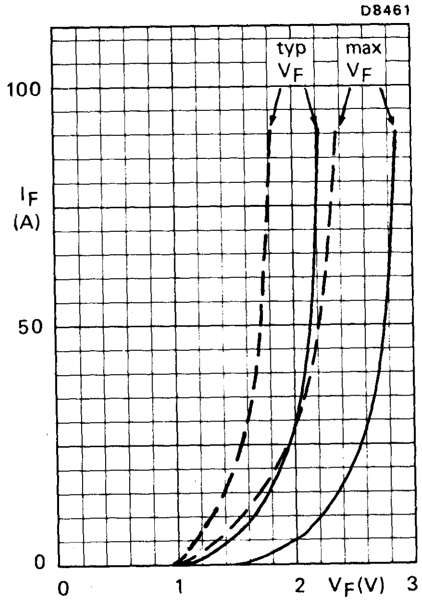
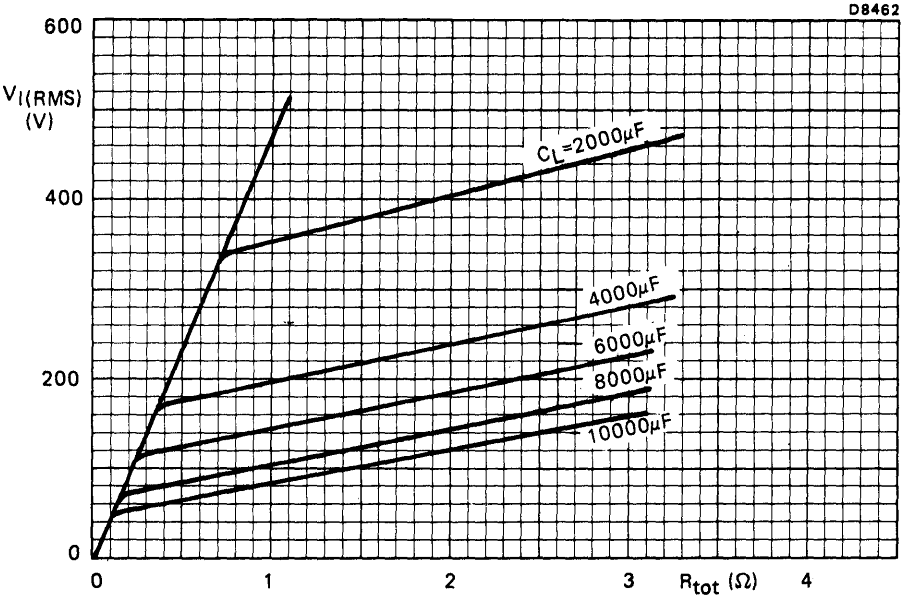
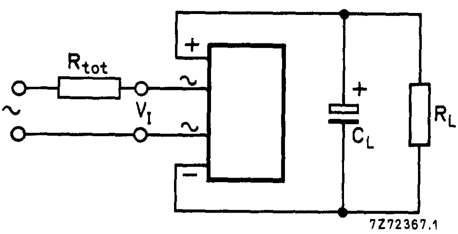


Fig.4 Two diodes in series;
——— T_j = 25 °C; – – – – T_j = 150 °C





The graph takes the possibility of the following spreads into account:

input voltage	+10%
capacitance	+50%
resistance	−10%

Fig. 5 Minimum value of the total series reistance R_{tot} (including the transformer resistance) required to limit the peak inrush current.

PARALLEL EFFICIENCY DIODES

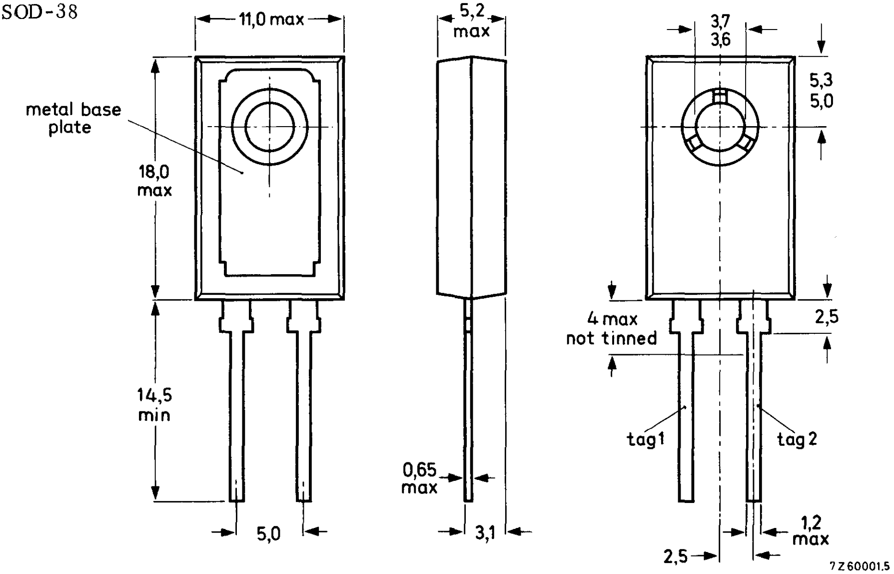
Silicon double-diffused rectifier diodes in plastic envelopes, intended for use as efficiency diode in thyristor horizontal deflection circuits of colour television receivers.
The devices feature low forward recovery voltage and non-snap-off characteristics which makes them particularly suitable for this application.

QUICK REFERENCE DATA

			BY277-600R	750R	
Repetitive peak reverse voltage	V_{RRM}	max.	600	750	V
Working peak forward current	I_{FWM}	max.	10		A
Repetitive peak forward current	I_{FRM}	max.	20		A
Reverse recovery time	t_{rr}	<	400		ns

MECHANICAL DATA (see also page 2) Dimensions in mm

SOD-38



Polarity of connections: tag 1 = anode, tag 2 = cathode.

The exposed metal base-plate is directly connected to tag 1.

MECHANICAL DATA (continued)

Net mass: 2,5 g

Recommended diameter of fixing screw: 3,5 mm

Torque on screw:
when using washer and heatsink compound: min. 0,95 Nm (9,5 kg cm)
max. 1,5 Nm (15 kg cm)

Accessories:
supplied with device: washer
available on request: 56316 (mica insulating washer)

RATINGS Limiting values in accordance with the Absolute Maximum System (IEC 134)

Voltages			BY277-600R	750R	
Non-repetitive peak reverse voltage	V_{RSM}	max.	600	800	V
Repetitive peak reverse voltage ($\delta \leq 0,01$)	V_{RRM}	max.	600	750	V
Working reverse voltage [1]	V_{RW}	max.	500	600	V

Currents				
R.M.S. forward current	$I_{F(RMS)}$	max.	3	A
Working peak forward current up to T_{mb} = 112 °C	I_{FWM}	max.	10	A
Repetitive peak forward current	I_{FRM}	max.	20	A
Non-repetitive peak forward current	I_{FSM}	max.	50	A

Temperatures				
Storage temperature	T_{stg}		−40 to +125	°C
Junction temperature	T_j	max.	125	°C

[1]) At $t_p \leq 20\ \mu s$; $\delta = t_p/T \leq 0,25$; see page 9.

THERMAL RESISTANCE

From junction to mounting base	$R_{th\ j\text{-}mb}$	=	4,5	°C/W
Transient thermal impedance (t = 1 ms)	$Z_{th\ j\text{-}mb}$	=	0,3	°C/W

Influence of mounting method

1. Heatsink mounted

From mounting base to heatsink

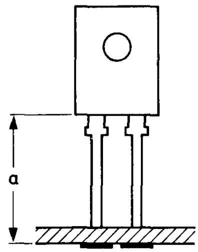
a. with heatsink compound	$R_{th\ mb\text{-}h}$	=	1,5	°C/W
b. with heatsink compound and 56316 mica washer	$R_{th\ mb\text{-}h}$	=	2,7	°C/W
c. without heatsink compound	$R_{th\ mb\text{-}h}$	=	2,7	°C/W
d. without heatsink compound; with 56316 mica washer	$R_{th\ mb\text{-}h}$	=	5	°C/W

2. Free air operation

The quoted values of $R_{th\ j\text{-}a}$ should be used only when no leads of other dissipating components run to the same tie-points.

From junction to ambient in free air mounted on a printed-circuit board at a = maximum lead length and with a copper laminate

a. > 1 cm² $R_{th\ j\text{-}a}$ = 50 °C/W
b. < 1 cm² $R_{th\ j\text{-}a}$ = 55 °C/W



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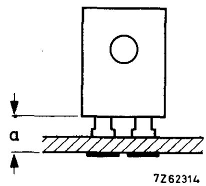
at a lead length a = 3 mm and with a copper laminate

c. > 1 cm² $R_{th\ j\text{-}a}$ = 55 °C
d. < 1 cm² $R_{th\ j\text{-}a}$ = 60 °C



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CHARACTERISTICS

Forward voltage

I_F = 10 A; T_j = 25 °C	V_F	<	1,4	V [1]

Reverse current

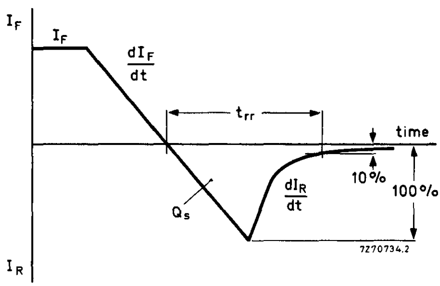
$V_R = V_{RWmax}$; T_j = 100 °C	I_R	<	0,2	mA

Reverse recovery when switched from

I_F = 2 A to $V_R \geqslant$ 30 V; $-dI_F/dt$ = 20 A/µs; T_j = 25 °C Recovery charge	Q_s	<	0,9	µC
I_F = 1 A to $V_R \geqslant$ 30 V; $-dI_F/dt$ = 20 A/µs; T_j = 25 °C Recovery time	t_{rr}	<	400	ns

Maximum slope of the reverse recovery current

(in horizontal deflection circuits) when switched from I_F = 5 A to $V_R \geqslant$ 30 V; with $-dI_F/dt$ = 1 A/µs; T_j = 25 °C	$\lvert dI_R/dt \rvert$	<	2	A/µs

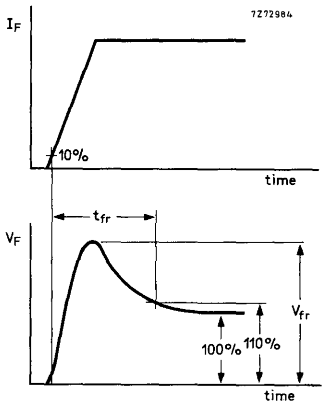


[1]) Measured under pulse conditions to avoid excessive dissipation.

CHARACTERISTICS (continued)

Forward recovery when switched to

I_F = 1 A; T_j = 25 °C				
Recovery time	t_{fr}	<	0,3	μs
Recovery voltage	V_{fr}	<	13	V
I_F = 20 mA; T_j = 25 °C				
Recovery time	t_{fr}	<	0,3	μs
Recovery voltage	V_{fr}	<	5	V



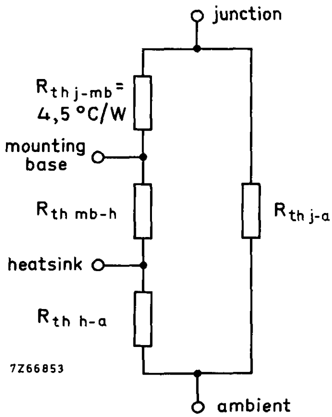
MOUNTING INSTRUCTIONS

1. Soldered joints must be at least 2, 5 mm from the seal.
2. The maximum permissible temperature of the soldering iron or bath is 270 °C; contact with the joint must not exceed 3 seconds.
3. The devices should not be immersed in oil, and few potting resins are suitable for re-encapsulation. Advice on these materials is available on request.
4. Leads should not be bent less than 2, 5 mm from the seal. Exert no axial pull when bending.
5. For good thermal contact heatsink compound should be used between base-plate and heatsink.

OPERATING NOTES

Dissipation and heatsink considerations:

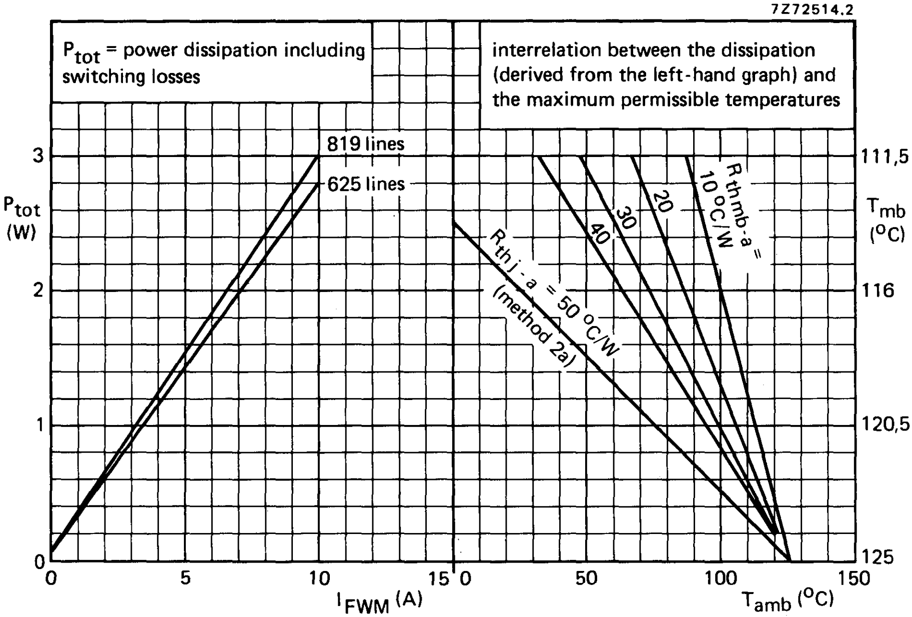
a. The various components of junction temperature rise above ambient are illustrated below:

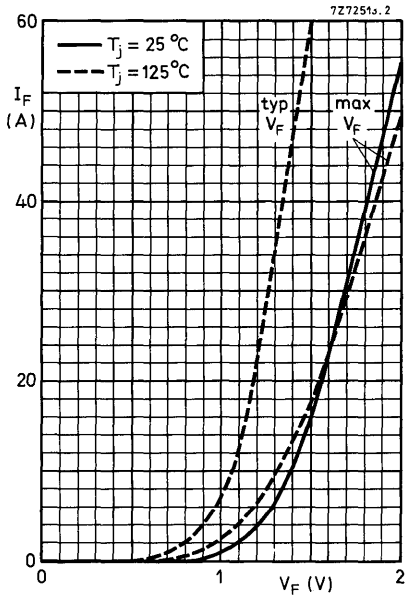


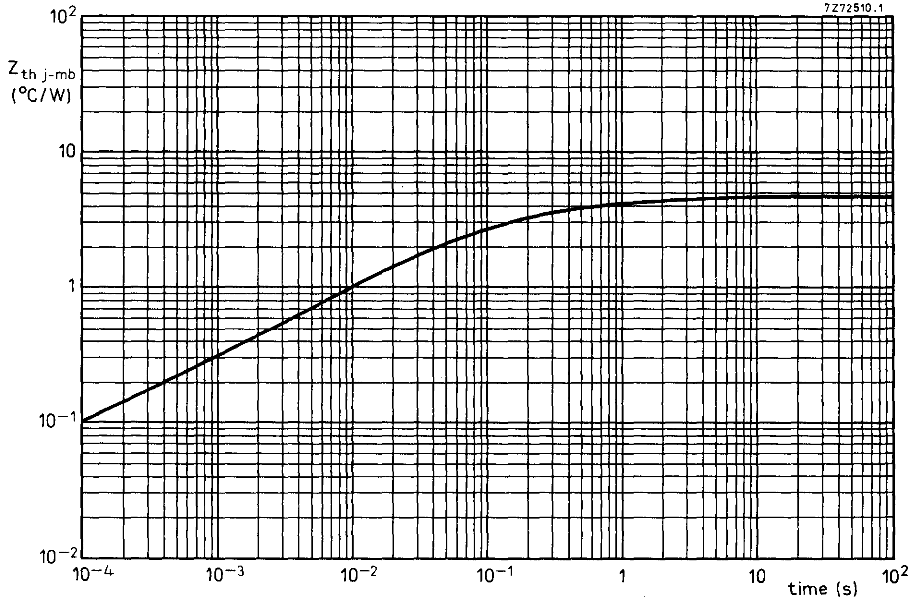
b. The method of using the graph on page 7 is as follows:
Starting with the required current on the I_{FWM} axis, trace upwards to meet the appropriate 625/819-curve. Trace right horizontally and upwards from the appropriate value on the T_{amb} scale. The intersection determines the $R_{th\ mb-a}$.
The heatsink thermal resistance value ($R_{th\ h-a}$) can now be calculated from:

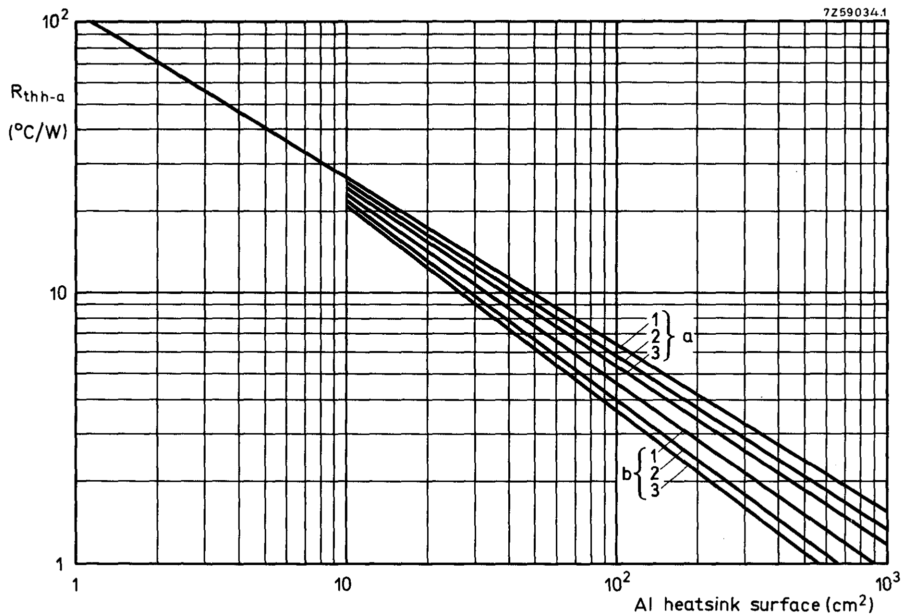
$$R_{th\ h-a} = R_{th\ mb-a} - R_{th\ mb-h}.$$

Any measurement of heatsink temperature should be made immediately adjacent to the device.


7Z72514.2
P_{tot} = power dissipation including switching losses
interrelation between the dissipation (derived from the left-hand graph) and the maximum permissible temperatures
819 lines
625 lines
P_{tot} (W)
I_{FWM} (A)
T_{amb} (°C)
T_{mb} (°C)
111,5
116
120,5
125
$R_{th\,mb-a}$ = 10 °C/W
20
30
40
$R_{th\,j-a}$ = 50 °C/W (method 2a)
0
1
2
3
5
10
15
50
100
150

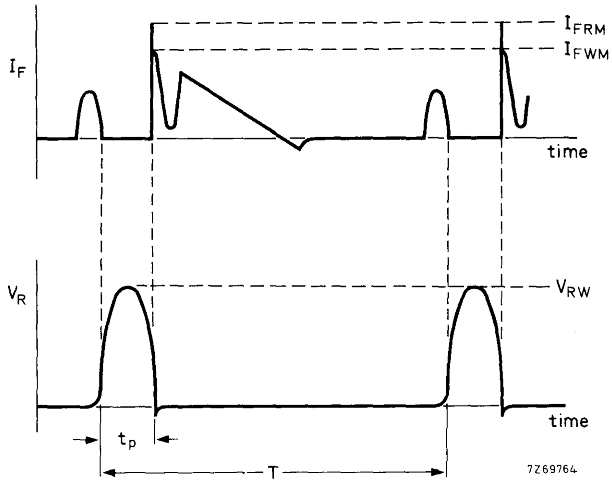

7Z72515.2
T_j = 25 °C
T_j = 125 °C
I_F (A)
typ V_F
max V_F
V_F (V)
0
20
40
60
1
2

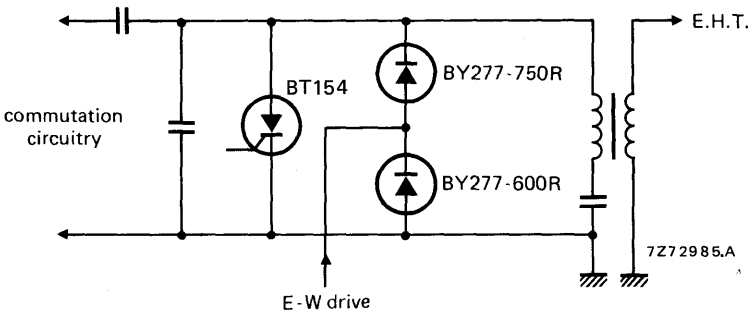




Thermal resistance $R_{th\ h-a}$ from aluminium heatsink to ambient (free air) versus heat-sink surface (one side). 1, 2 and 3 are thicknesses in mm, a is for a bright surface, b is for a black surface.

APPLICATION INFORMATION





Basic circuit and waveforms

SCHOTTKY-BARRIER RECTIFIER DIODES

High-efficiency rectifier diodes in DO–4 metal envelopes, featuring low forward voltage drop, low capacitance, absence of stored charge and high temperature stability. They are intended for use in low output voltage switched-mode power supplies and high-frequency circuits in general, where low conduction and switching losses are important.
The series consists of normal polarity (cathode to stud) types: BYV21–30, BYV21–35, BYV21–40 and BYV21–45.

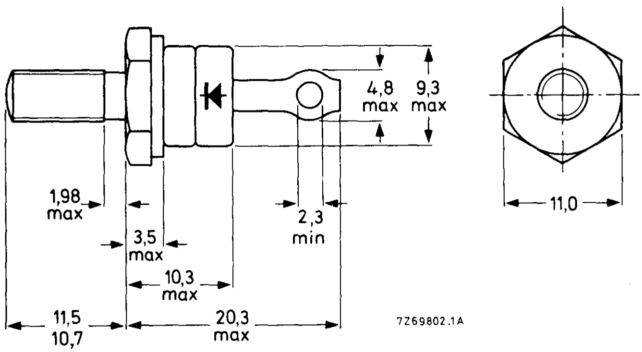
QUICK REFERENCE DATA

			BYV21–30	35	40	45	
Repetitive peak reverse voltage	V_{RRM}	max.	30	35	40	45	V
Average forward current	$I_{F(AV)}$	max.		28			A
Forward voltage	V_F	<		0.55			V

MECHANICAL DATA

Dimensions in mm

Fig.1 DO–4 with 10–32 UNF stud (ϕ4.83 mm) as standard.
Metric M5 stud (ϕ5 mm) is available on request.



Net mass: 7 g

Diameter of clearance hole: 5.2 mm

Accessories supplied on request: 56295
(PTFE bush, 2 mica washers, plain washer, tag).

Supplied with device: 1 nut, 1 lock washer.

Nut dimensions across the flats: M5, 8.0 mm
10–32 UNF, 9.5 mm

Torque on nut:
min. 0.9 (9 kg cm),
max. 1.7 (17 kg cm).

RATINGS

Limiting values in accordance with the Absolute Maximum System (IEC134).

Voltages

			BYV21–30	35	40	45	
Non-repetitive peak reverse voltage	V_{RSM}	max.	36	42	48	54	V
Repetitive peak reverse voltage*	V_{RRM}	max.	30	35	40	45	V
Crest working reverse voltage	V_{RWM}	max.	30	35	40	45	V
Continuous reverse voltage**	V_R	max.	30	35	40	45	V

Currents

Average forward current; switching losses negligible				
sinusoidal; up to T_{mb} = 100 °C	$I_{F(AV)}$	max.	25	A
square-wave; up to T_{mb} = 100 °C; δ = 0.5	$I_{F(AV)}$	max.	28	A
R.M.S. forward current	$I_{F(RMS)}$	max.	40	A
Non-repetitive peak forward current t = 10 ms; half sine-wave; T_j = 125 °C prior to surge; with reapplied V_{RWMmax}	I_{FSM}	max.	600	A
I^2t for fusing	I^2t	max.	1800	A^2s

Temperatures

Storage temperature	T_{stg}		−55 to +150	°C
Junction temperature; with full applied continuous reverse voltage V_{Rmax}	T_j	max.	125	°C

THERMAL RESISTANCE

From junction to mounting base	$R_{th\ j\text{-}mb}$	<	1	°C/W
From mounting base to heatsink				
with heatsink compound	$R_{th\ mb\text{-}h}$	=	0.3	°C/W
without heatsink compound	$R_{th\ mb\text{-}h}$	=	0.5	°C/W
Transient thermal impedance; t = 1 ms	$Z_{th\ j\text{-}mb}$	=	0.15	°C/W

MOUNTING INSTRUCTIONS

The top connector should be neither bent nor twisted; it should be soldered into the circuit so that there is no strain on it.
During soldering the heat conduction to the junction should be kept to a minimum.

* For t_p = 200 ns a 20% increase in V_{RRM} is allowed.

** To ensure thermal stability: $R_{th\ j\text{-}a} < 2$ °C/W

CHARACTERISTICS

Forward voltage				
$I_F = 30$ A; $T_j = 100$ °C	V_F	<	0.55	V*
$I_F = 80$ A; $T_j = 25$ °C	V_F	<	0.88	V*
Rate of rise of reverse voltage				
$V_R = V_{RWMmax}$	$\frac{dV_R}{dt}$	<	1500	V/µs
Reverse current				
$V_R = V_{RWMmax}$; $T_j = 125$ °C	I_R	<	150	mA
Capacitance at f = 1 MHz				
$V_R = 5$ V; $T_j = 25$ to 125 °C	C_d	typ.	900	pF

*Measured under pulse conditions to avoid excessive dissipation.

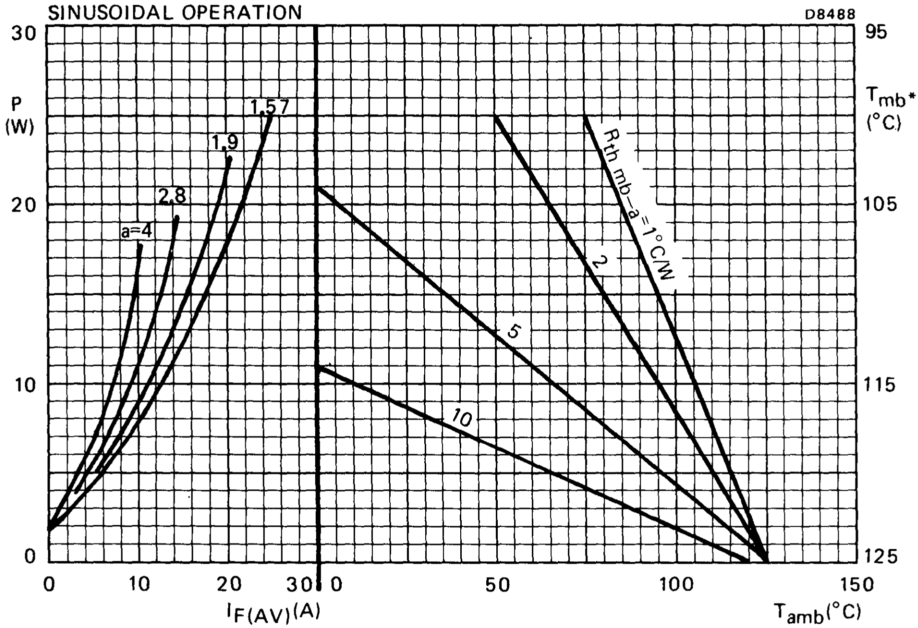


Fig.2 The right-hand part shows the interrelationship between the power (derived from the left-hand part) and the maximum permissible temperatures.
a = form factor = $I_{F(RMS)}/I_{F(AV)}$.

*T_{mb} scale is for comparison purpose and is correct only for $R_{th\ mb\text{-}a} < 6.4$ °C/W.

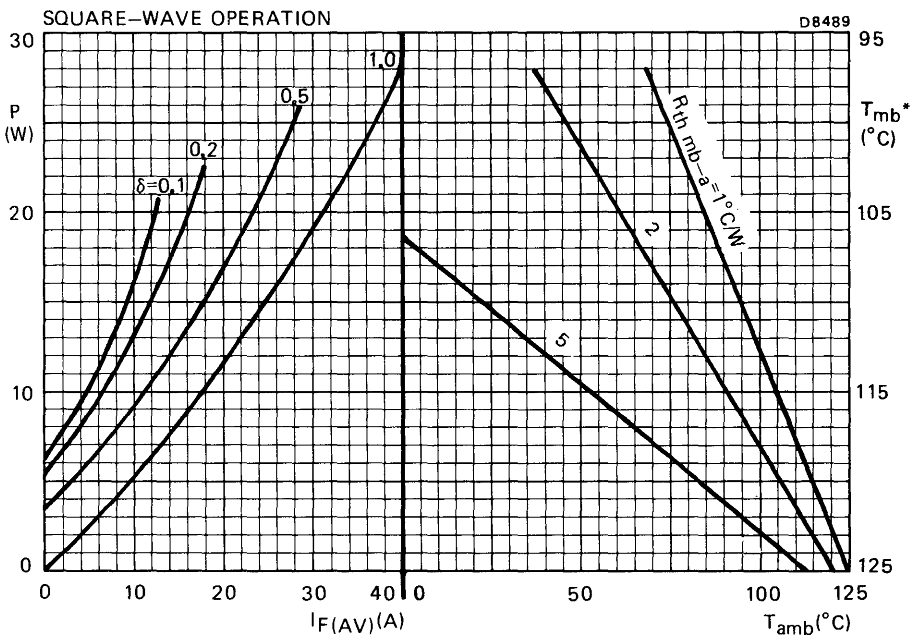
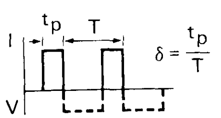


Fig.3 The right-hand part shows the interrelationship between the power (derived from the left-hand part) and the maximum permissible temperatures.



$I_{F(AV)} = I_{F(RMS)} \times \sqrt{\delta}$

*T_{mb} scale is for comparison purpose and is correct only for $R_{th\ mb\text{-}a} < 6.4\ ^{o}C/W$.

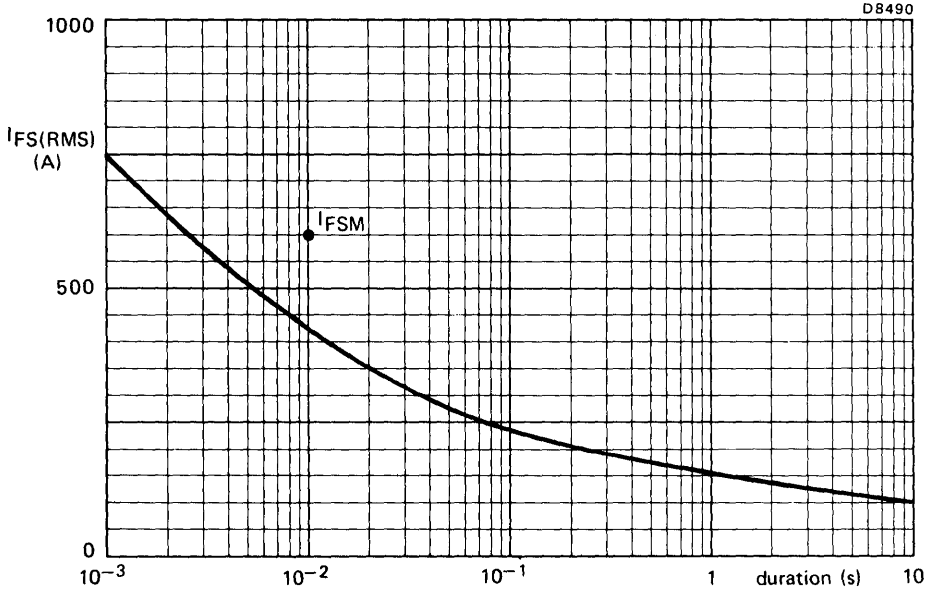


Fig.4 Maximum permissible non-repetitive r.m.s. forward current based on sinusoidal currents (f = 50 Hz); T_j = 125 °C prior to surge; with reapplied V_{RWMmax}.

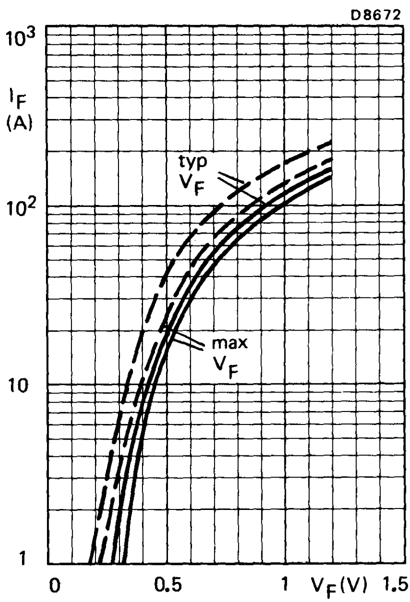


Fig. 5 ——— T_j = 25 °C; – – – T_j = 100 °C.

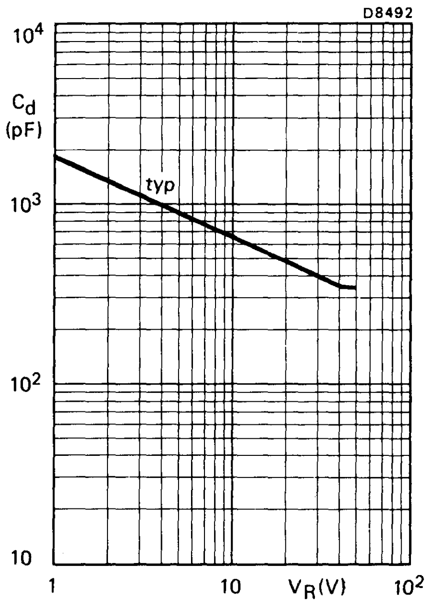


Fig.6 f = 1 MHz; T_j = 25 to 125 °C

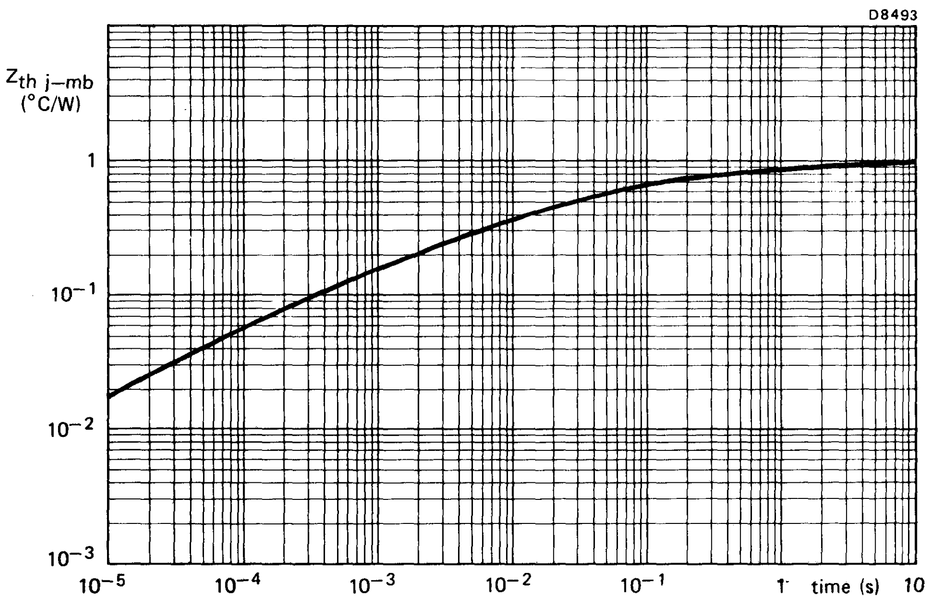


Fig.7

VERY FAST SOFT-RECOVERY RECTIFIER DIODES

High-efficiency rectifier diodes in DO–4 metal envelopes, featuring low forward voltage drop, high reverse voltage capability, very fast reverse recovery times and non-snap-off characteristics.
They are intended for use in switched-mode power supplies and high-frequency inverter circuits, in general, where high output voltages and low conduction and switching losses are essential.
The series consists of the following types:
Normal polarity (cathode to stud): BYV30–200, BYV30–300 and BYV30–400.
Reverse polarity (anode to stud): BYV30–200R, BYV30–300R, and BYV30–400R.

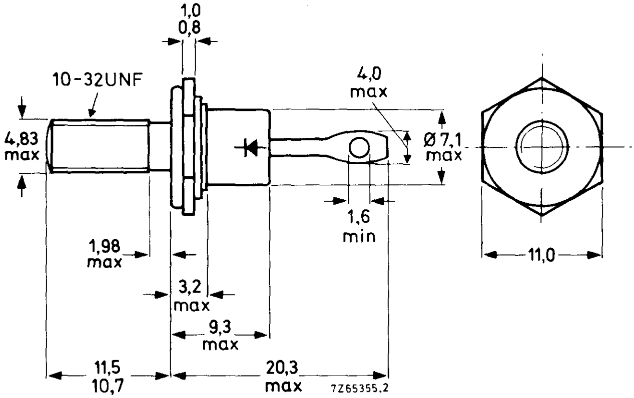
QUICK REFERENCE DATA

			BYV30–200(R)	300(R)	400(R)	
Repetitive peak reverse voltage	V_{RRM}	max.	200	300	400	V
Average forward current	$I_{F(AV)}$	max.		12		A
Forward voltage	V_F	<		1.05		V
Reverse recovery time	t_{rr}	<		100		ns

MECHANICAL DATA

Dimensions in mm

Fig.1 DO–4



Net mass: 6 g
Diameter of clearance hole: max. 5.2 mm
Accessories supplied on request:
56295 (PTFE bush, 2 mica washers, plain washer, tag).
Supplied with device: 1 nut, 1 lock washer.
Nut dimensions across the flats: 9.5 mm
The mark shown applies to the normal polarity types.

Torque on nut:
min. 0.9 Nm (9 kg cm),
max. 1.7 Nm (17 kg cm)

RATINGS

Limiting values in accordance with the Absolute Maximum System (IEC134)

Voltages

			BYV30–200(R)	300(R)	400(R)	
Non-repetitive peak reverse voltage ($t \leq 10$ ms)	V_{RSM}	max.	250	350	450	V
Repetitive peak reverse voltage	V_{RRM}	max.	200	300	400	V
Crest working reverse voltage	V_{RWM}	max.	200	300	400	V

Currents

Average forward current assuming zero switching losses (averaged over any 20 ms period)				
up to T_{mb} = 100 °C	$I_{F(AV)}$	max.	12	A
at T_{mb} = 125 °C	$I_{F(AV)}$	max.	7	A
R.M.S. forward current	$I_{F(RMS)}$	max.	20	A
Repetitive peak forward current	I_{FRM}	max.	140	A
Non-repetitive peak forward current T_j = 150 °C prior to surge; half sine-wave with reapplied V_{RWMmax};				
t = 10 ms	I_{FSM}	max.	140	A
t = 8.3 ms	I_{FSM}	max.	150	A
I^2t for fusing (t = 10 ms)	I^2t	max.	100	A^2s

Temperatures

Storage temperature	T_{stg}		−65 to +175	°C
Operating junction temperature	T_j	max.	150	°C

THERMAL RESISTANCE

From junction to ambient in free air	$R_{th\ j\text{-}a}$	=	50	°C/W
From junction to mounting base	$R_{th\ j\text{-}mb}$	=	2.2	°C/W
From mounting base to heatsink	$R_{th\ mb\text{-}h}$	=	0.5	°C/W
Transient thermal impedance; t = 1 ms	$Z_{th\ j\text{-}mb}$	=	0.8	°C/W

CHARACTERISTICS

Forward voltage				
I_F = 10 A; T_j = 25 °C	V_F	<	1.35	V*
I_F = 10 A; T_j = 150 °C	V_F	<	1.05	V*
Reverse current				
$V_R = V_{RWMmax}$; T_j = 125 °C	I_R	<	3	mA
Reverse recovery when switched from				
I_F = 1 A to V_R = 30 V; $-dI_F/dt$ = 35 A/μs; T_j = 25 °C Recovery time	t_{rr}	<	100	ns
I_F = 2 A to V_R = 30 V; $-dI_F/dt$ = 20 A/μs; T_j = 25 °C Recovery charge	Q_s	<	125	nC
I_F = 1 A to V_R = 30 V; $-dI_F/dt$ = 2 A/μs; T_j = 25 °C Max. slope of the reverse recovery current	$\|dI_R/dt\|$	<	5	A/μs

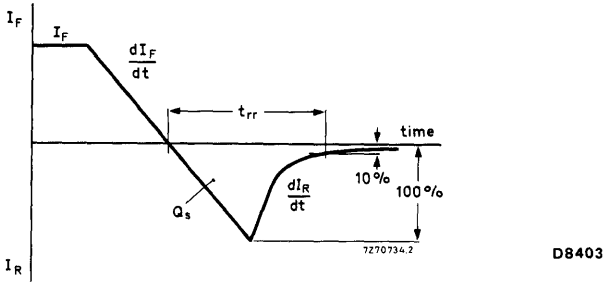


Fig. 2 Definition of t_{rr} and Q_s.

*Measured under pulse conditions to avoid excessive dissipation.

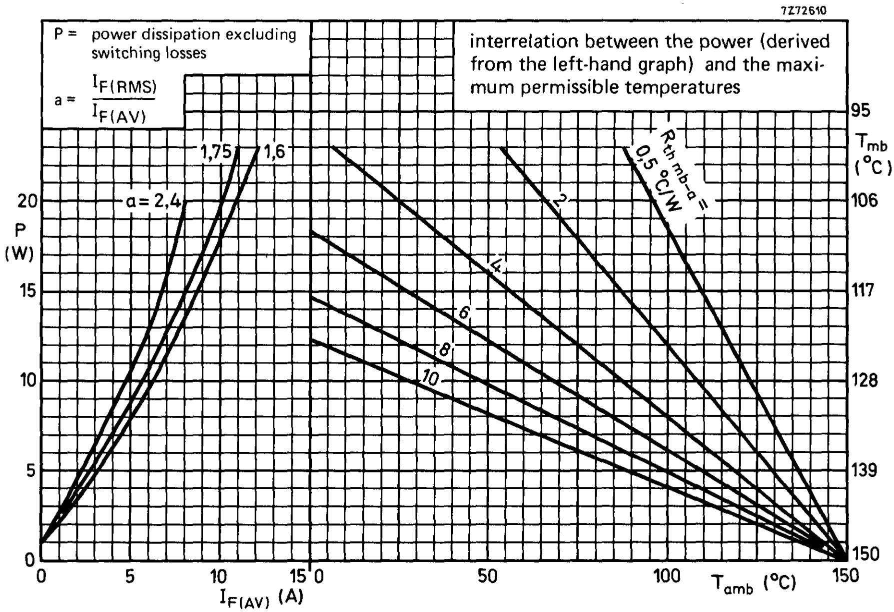

7Z72610
P = power dissipation excluding switching losses
a = IF(RMS) / IF(AV)
interrelation between the power (derived from the left-hand graph) and the maximum permissible temperatures
a = 2,4
1,75
1,6
P (W)
IF(AV) (A)
Rth mb-a = 0,5 °C/W
2
4
6
8
10
Tamb (°C)
Tmb (°C)
95
106
117
128
139
150

Fig. 3

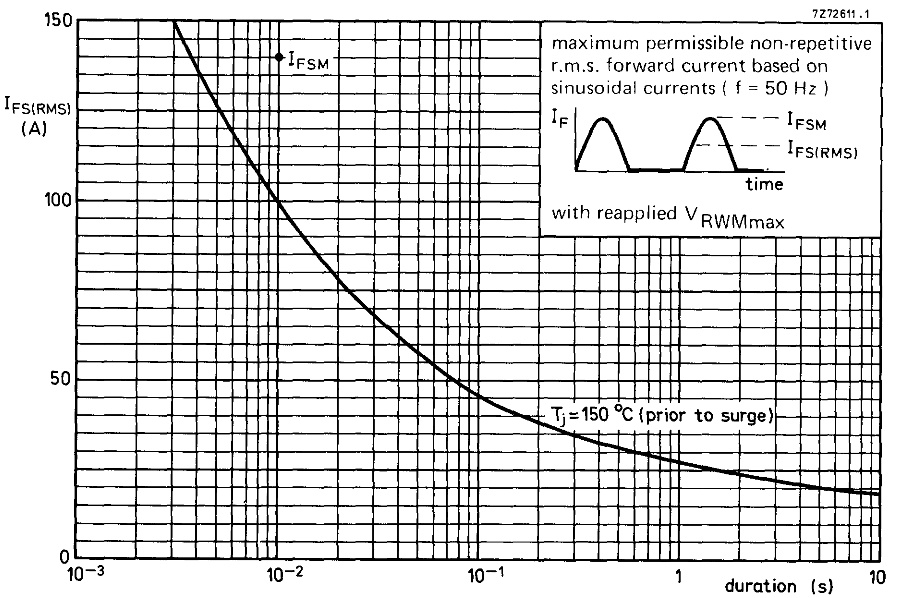

7Z72611.1
maximum permissible non-repetitive r.m.s. forward current based on sinusoidal currents (f = 50 Hz)
IF
IFSM
IFS(RMS)
time
with reapplied VRWMmax
IFS(RMS) (A)
Tj = 150 °C (prior to surge)
duration (s)

Fig. 4

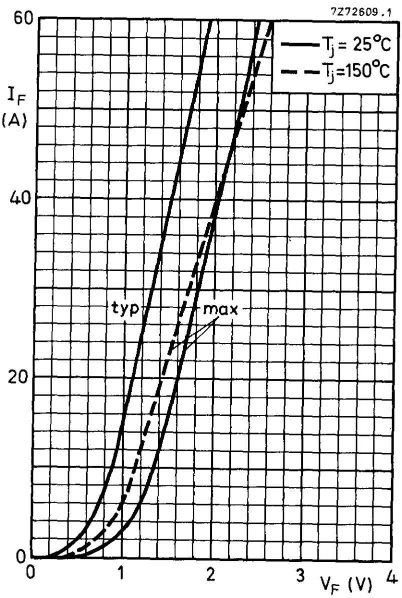


Fig. 5

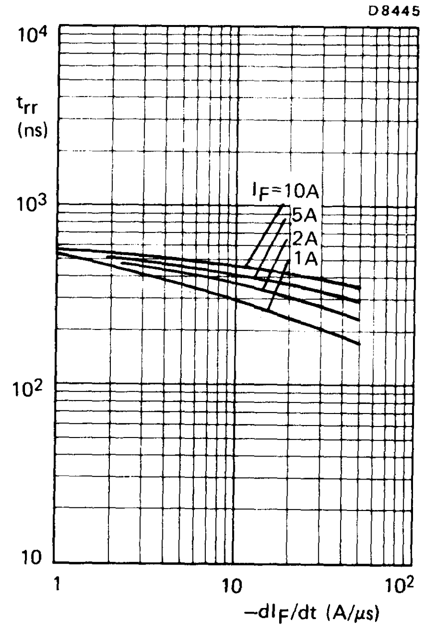


Fig. 6 Maximum values; T_j = 150 °C.

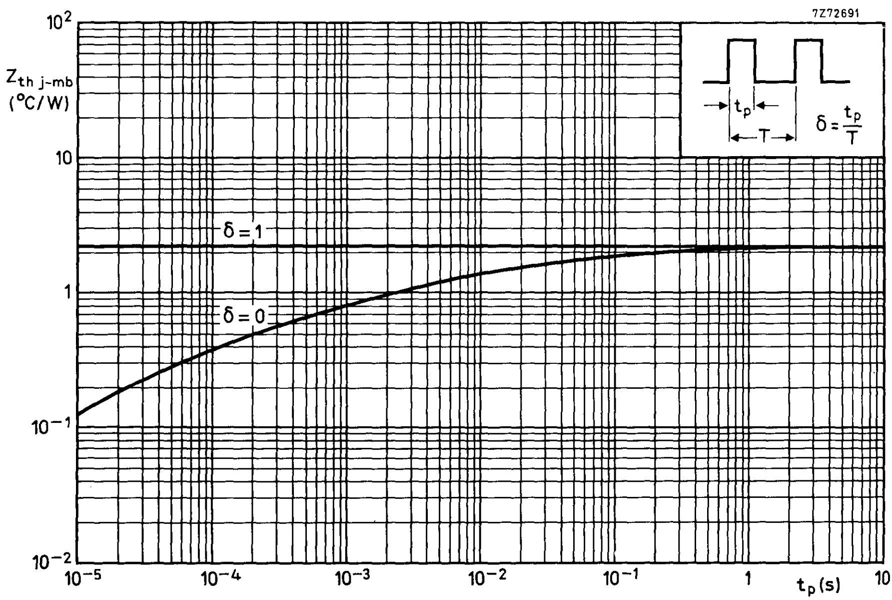


Fig.7

VERY FAST SOFT-RECOVERY DIODES

High-efficiency rectifier diodes in DO-5 metal envelopes, featuring low forward voltage drop, high reverse voltage capability, very fast reverse recovery times and non-snap-off characteristics.
They are intended for use in switched-mode power supplies and high-frequency inverter circuits, in general, where high output voltages and low conduction and switching losses are essential.
The series consists of the following types:
Normal polarity (cathode to stud): BYV92–200, BYV92–300 and BYV92–400. ←
Reverse polarity (anode to stud): BYV92–200R, BYV92–300R and BYV92–400R.

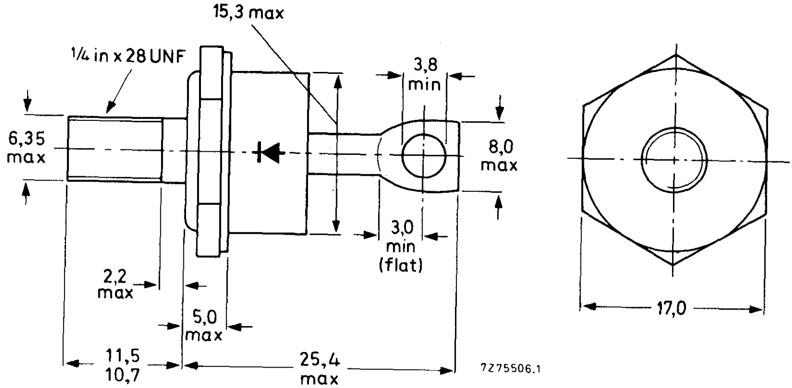
QUICK REFERENCE DATA

			BYV92–200(R)	300(R)	400(R)	
Repetitive peak reverse voltage	V_{RRM}	max.	200	300	400	V
Average forward current	$I_{F(AV)}$	max.		35		A
Forward voltage	V_F	<		1.05		V
Reverse recovery time	t_{rr}	<		100		ns

MECHANICAL DATA

Dimensions in mm

Fig. 1 DO-5; Supplied with device: 1 nut, 1 lock-washer
Nut dimensions across the flats: 11.1 mm



Net mass: 22 g
Diameter of clearance hole: max. 6.5 mm
Accessories supplied on request:
56264A (mica washer, insulating ring, tag)

Torque on nut:
min. 1.7 Nm (17 kg cm)
max. 2.5 Nm (25 kg cm)

RATINGS

Limiting values in accordance with the Absolute Maximum System (IEC 134)

Voltages*

→

			BYV92–200(R)	300(R)	400(R)	
Non-repetitive peak reverse voltage	V_{RSM}	max.	200	300	400	V
Repetitive peak reverse voltage	V_{RRM}	max.	200	300	400	V
Crest working reverse voltage	V_{RWM}	max.	200	300	400	V
Continuous reverse voltage	V_R	max.	200	300	400	V

Currents

Average forward current assuming zero switching losses;				
sinusoidal; up to T_{mb} = 100 °C	$I_{F(AV)}$	max.	35	A
sinusoidal; at T_{mb} = 125 °C	$I_{F(AV)}$	max.	20	A
square wave; δ = 0.5; up to T_{mb} = 95 °C	$I_{F(AV)}$	max.	40	A
square wave; δ = 0.5; at T_{mb} = 125 °C	$I_{F(AV)}$	max.	19	A
R.M.S. forward current	$I_{F(RMS)}$	max.	55	A
Repetitive peak forward current	I_{FRM}	max.	500	A
Non-repetitive peak forward current t = 10 ms; half sine-wave; T_j = 150 °C prior to surge; with re-applied V_{RWMmax}	I_{FSM}	max.	500	A
I^2t for fusing (t = 10 ms)	I^2t	max.	1250	A^2s

Temperatures

Storage temperatures	T_{stg}		−55 to +150	°C
Junction tempeature	T_j	max.	150	°C

THERMAL RESISTANCE

From junction to mounting base	$R_{th\ j\text{-}mb}$	=	1.0	°C/W
From mounting base to heatsink				
with heatsink compound	$R_{th\ mb\text{-}h}$	=	0.3	°C/W
without heatsink compound	$R_{th\ mb\text{-}h}$	=	0.5	°C/W
Transient thermal impedance; t = 1 ms	$Z_{th\ j\text{-}mb}$	=	0.2	°C/W

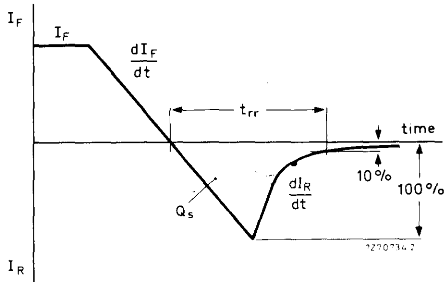
MOUNTING INSTRUCTIONS

The top connector should neither be bent nor twisted; it should be soldered into the circuit so that there is no strain on it.
During soldering the heat conduction to the junction should be kept to a minimum.

*To ensure thermal stability: $R_{th\ j\text{-}a} \leq 6$ °C/W (continuous reverse voltage) up to T_{amb} = 110 °C

CHARACTERISTICS

Forward voltage				
I_F = 100 A; T_j = 25 °C	V_F	<	1.4	V*
I_F = 35 A; T_j = 100 °C	V_F	<	1.05	V*
Reverse current				
$V_R = V_{RWMmax}$; T_j = 100 °C	I_R	<	1.5	mA
Reverse recovery when switched from				
I_F = 1 A to $V_R \geq 30$ V with $-dI_F/dt$ = 50 A/µs; T_j = 25 °C Recovery time	t_{rr}	<	100	ns
I_F = 2 A to $V_R \geq 30$ V with $-dI_F/dt$ = 20 A/µs; T_j = 25 °C Recovered charge	Q_s	<	100	nC
Maximum slope of the reverse recovery current when switched from I_F = 1 A to $V_R \geq 30$ V; with $-dI_F/dt$ = 2 A/µs; T_j = 25 °C	$\|dI_R/dt\|$	<	5	A/µs



D8403

Fig. 2 Definitions of t_{rr} and Q_s.

*Measured under pulse conditions to avoid excessive dissipation.

SQUARE-WAVE OPERATION

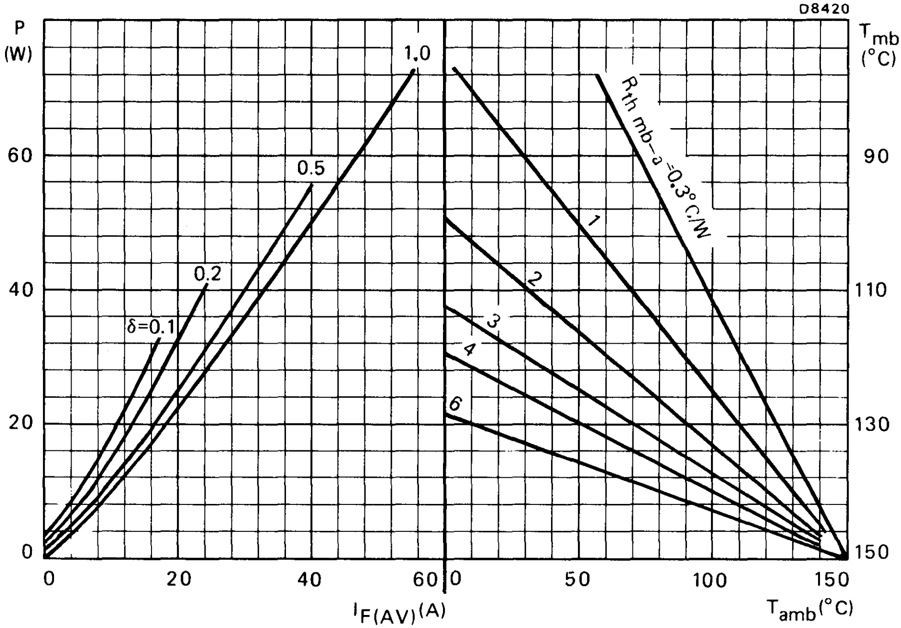
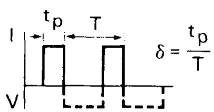


Fig.3 The right-hand part shows the interrelationship between the power (derived from the left-hand part) and the maximum permissible temperatures.
P = power including reverse current losses but excluding switching losses.



$I_{F(AV)} = I_{F(RMS)} \times \sqrt{\delta}$

SINUSOIDAL OPERATION

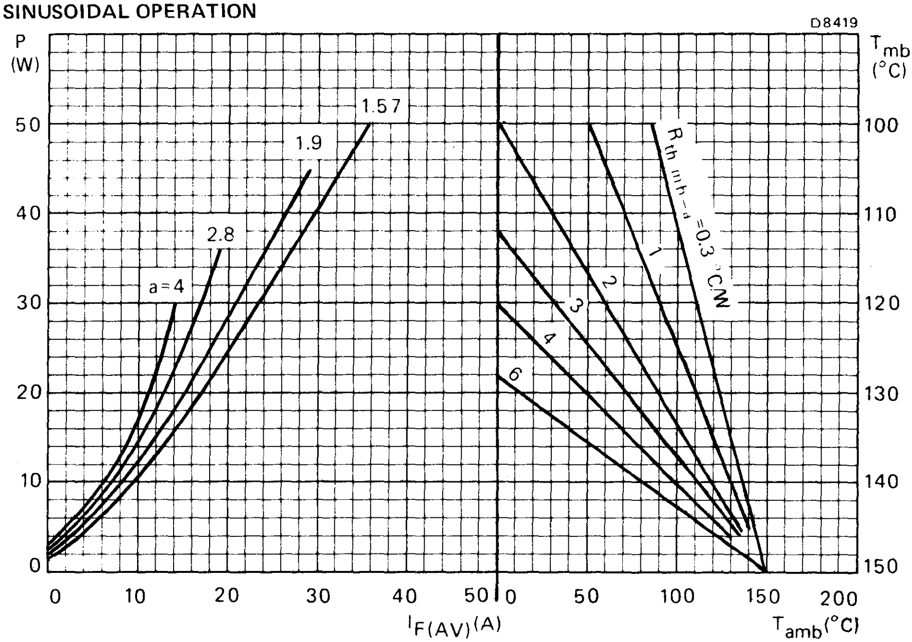


Fig.4 The right-hand part shows the interrelationship between the power (derived from the left-hand part) and the maximum permissible temperatures.
P = power including reverse current losses but excluding switching losses.
a = form factor = $I_{F(RMS)}/I_{F(AV)}$.

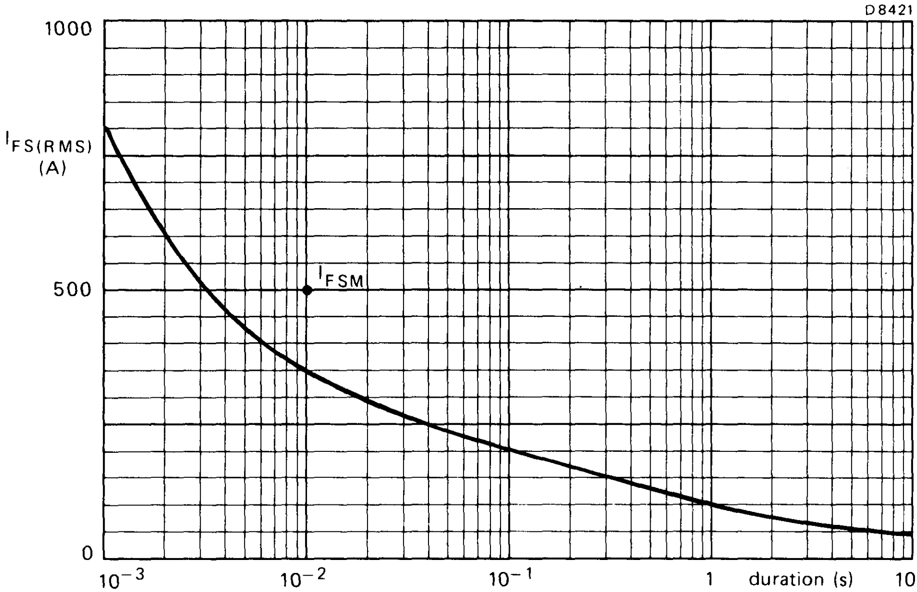
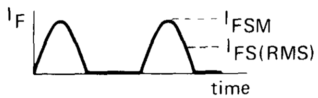


Fig.5 Maximum permissible non-repetitive r.m.s. forward current based on sinusoidal currents (f = 50 Hz); T_j = 150 °C prior to surge; with reapplied V_{RWMmax}.



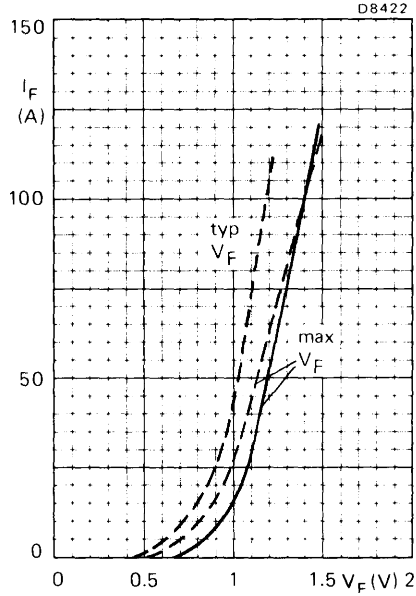


Fig. 6 —— T_j = 25 °C; – – – T_j = 100 °C

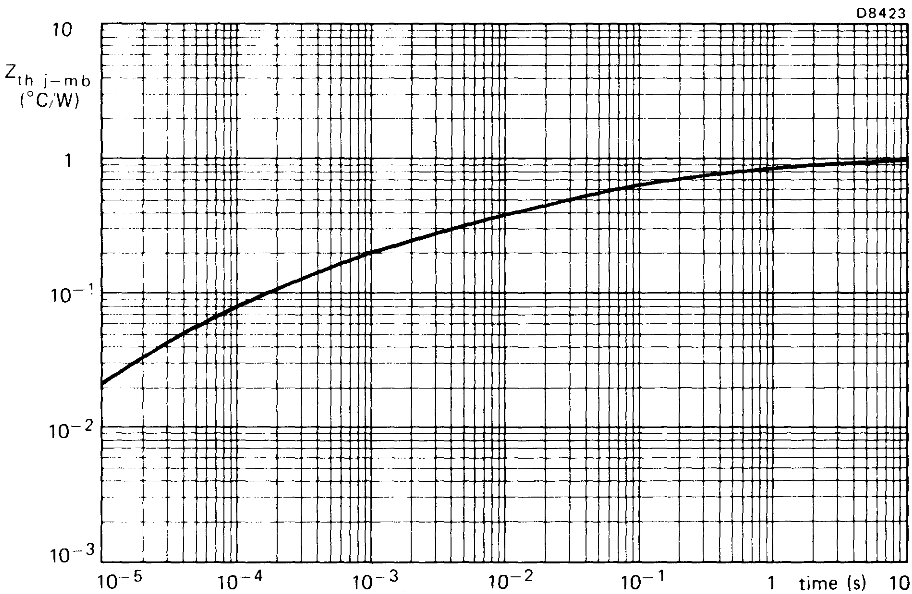


Fig. 7

FAST SOFT-RECOVERY RECTIFIER DIODES

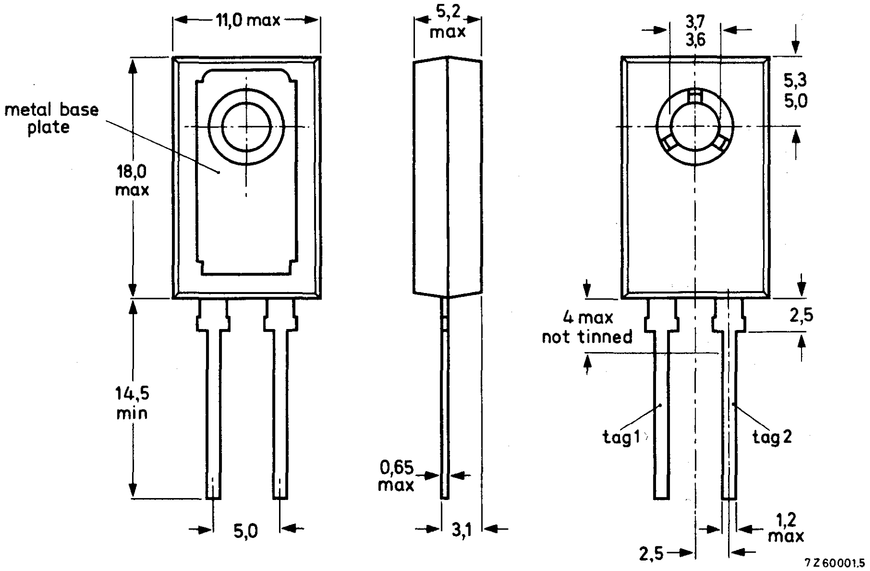
Silicon double-diffused rectifier diodes in plastic envelopes. They are intended for use as clamp diode, dV/dt limiter and output rectifier diodes in professional and consumer switched-mode power supply applications and as scan rectifier diodes in television receivers. The devices feature non-snap-off characteristics and a very fast turn-on behaviour, which makes them extremely suitable for clamp and dV/dt limiting applications.

QUICK REFERENCE DATA

			BYW19-800(R)	1000(R)	
Repetitive peak reverse voltage	V_{RRM}	max	800	1000	V
Average forward current	$I_{F(AV)}$	max	7		A
Non-repetitive peak forward current	I_{FSM}	max	40		A
Reverse recovery time	t_{rr}	<	450		ns

MECHANICAL DATA (see also page 2) Dimensions in mm

SOD-38



The exposed metal base-plate is directly connected to tag 1.

MECHANICAL DATA (continued)

Net mass: 2,5 g

Recommended diameter of fixing screw: 3,5 mm

Torque on screw
when using washer and heatsink compound: min 0,95 Nm (9,5 kg cm)
max 1,5 Nm (15 kg cm)

Accessories:
supplied with device: washer
available on request : 56316 (mica insulating washer)

POLARITY OF CONNECTIONS

	BYW19-800 and BYW19-1000	BYW19-800R and BYW19-1000R
Base-plate	cathode	anode
Tag 1	cathode	anode
Tag 2	anode	cathode

RATINGS

Limiting values in accordance with the Absolute Maximum System (IEC 134)

Voltages			BYW19-800(R)	1000(R)	
→ Non-repetitive peak reverse voltage	V_{RSM}	max	1000	1000	V
Repetitive peak reverse voltage	V_{RRM}	max	800	1000	V
Working reverse voltage	V_{RW}	max	800	800	V
Continuous reverse voltage	V_R	max	800	800	V

Currents

Average forward current assuming zero switching losses (averaged over any 20 ms period; see page 7)				
square-wave; δ = 0,5; up to T_{mb} = 98 °C	$I_{F(AV)}$	max	7	A
square-wave; δ = 0,5; at T_{mb} = 125 °C	$I_{F(AV)}$	max	4	A
sinusoidal; up to T_{mb} = 98 °C	$I_{F(AV)}$	max	7	A
sinusoidal; at T_{mb} = 125 °C	$I_{F(AV)}$	max	4	A
Repetitive peak forward current; t_p = 20 μs; $\delta \leqslant$ 0,02	I_{FRM}	max	75	A
Non-repetitive peak forward current square-wave; t = 10 ms; T_j = 150 °C prior to surge; with reapplied V_{RWmax}	I_{FSM}	max	40	A

Temperatures

Storage temperature	T_{stg}		−40 to +125	°C
Junction temperature	T_j	max	150	°C

THERMAL RESISTANCE

From junction to mounting base	$R_{th\ j\text{-}mb}$	=	4,5 °C/W
Transient thermal impedance (t = 1 ms)	$Z_{th\ j\text{-}mb}$	=	0,3 °C/W

Influence of mounting method

1. Heatsink mounted

Thermal resistance from mounting base to heatsink

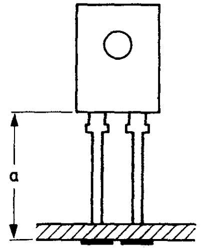
a. with heatsink compound	$R_{th\ mb\text{-}h}$	=	1,5 °C/W
b. with heatsink compound and 56316 mica washer	$R_{th\ mb\text{-}h}$	=	2,7 °C/W
c. without heatsink compound	$R_{th\ mb\text{-}h}$	=	2,7 °C/W
d. without heatsink compound with 56316 mica washer	$R_{th\ mb\text{-}h}$	=	5 °C/W

2. Free air operation

The quoted values of $R_{th\ j\text{-}a}$ should be used only when no leads of other dissipating components run to the same tie-points.

Thermal resistance from junction to ambient in free air:
mounted on a printed-circuit board at a = maximum lead length and with a copper laminate

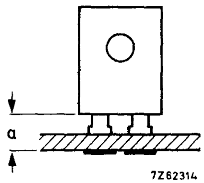
a. > 1 cm² $R_{th\ j\text{-}a}$ = 50 °C/W
b. < 1 cm² $R_{th\ j\text{-}a}$ = 55 °C/W



7Z62315.1

mounted on a printed-circuit board at a lead length a = 3 mm and with a copper laminate

c. > 1 cm² $R_{th\ j\text{-}a}$ = 55 °C/W
d. < 1 cm² $R_{th\ j\text{-}a}$ = 60 °C/W



7Z62314

CHARACTERISTICS

Forward voltage

I_F = 20 A; T_j = 25 °C	V_F	<	2,3 V *

Reverse current

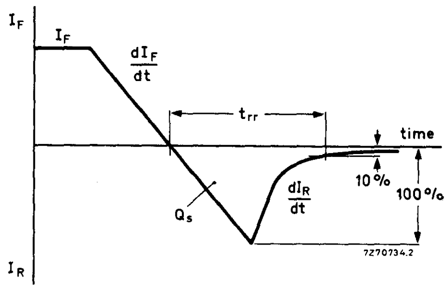
$V_R = V_{RWmax}$; T_j = 125 °C	I_R	<	0,6 mA

Reverse recovery when switched from

I_F = 2 A to $V_R \geq$ 30 V; $-dI_F/dt$ = 20 A/μs; T_j = 25 °C			
Recovered charge	Q_s	<	0,7 μC
Recovery time	t_{rr}	<	450 ns

Maximum slope of the reverse recovery current

when switched from I_F = 2 A to $V_R \geq$ 30 V; with $-dI_F/dt$ = 2 A/μs; T_j = 25 °C	$\lvert dI_R/dt \rvert$	<	5 A/μs



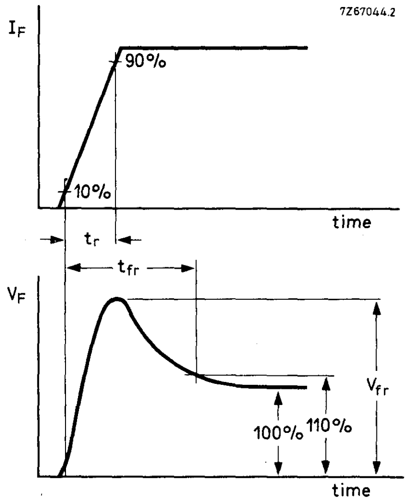
* Measured under pulse conditions to avoid excessive dissipation.

CHARACTERISTICS (continued)

Forward recovery when switched to

I_F = 10 A with t_r = 1 μs at T_j = 25 °C

Recovery time	t_{fr}	<	1 μs
Recovery voltage	V_{fr}	<	15 V



Forward output waveform

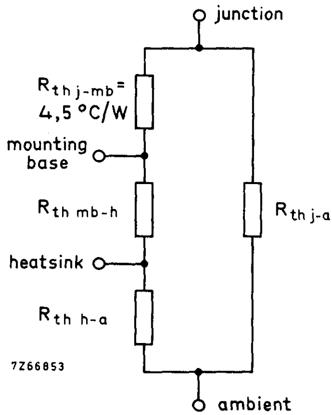
MOUNTING INSTRUCTIONS

1. Soldered joints must be at least 2,5 mm from the seal.
2. The maximum permissible temperature of the soldering iron or bath is 270 °C; contact with the joint must not exceed 3 seconds.
3. The devices should not be immersed in oil, and few potting resins are suitable for re-encapsulation. Advice on these materials is available on request.
4. Leads should not be bent less than 2,5 mm from the seal. Exert no axial pull when bending.
5. For good thermal contact heatsink compound should be used between base-plate and heatsink.

OPERATING NOTES

Dissipation and heatsink considerations:

a. The various components of junction temperature rise above ambient are illustrated below:

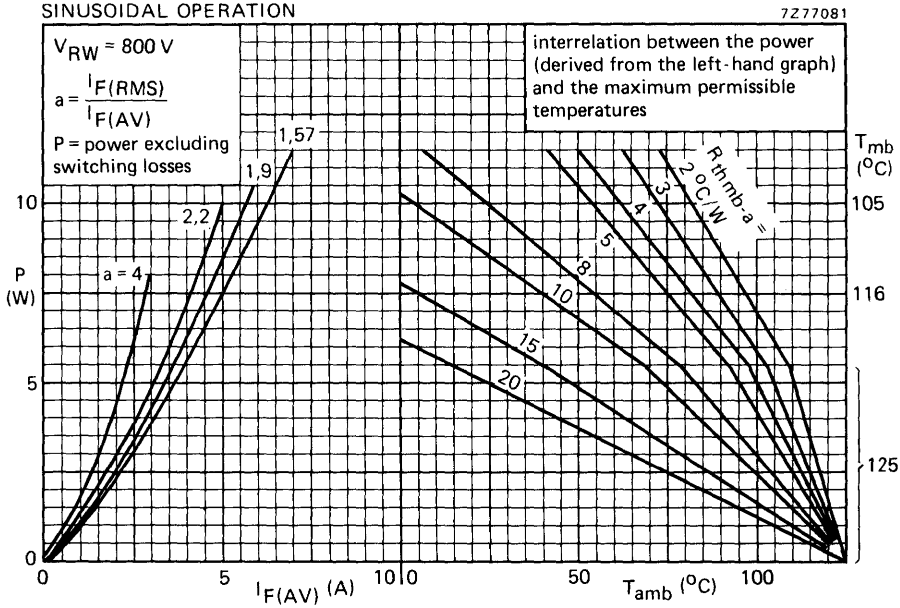


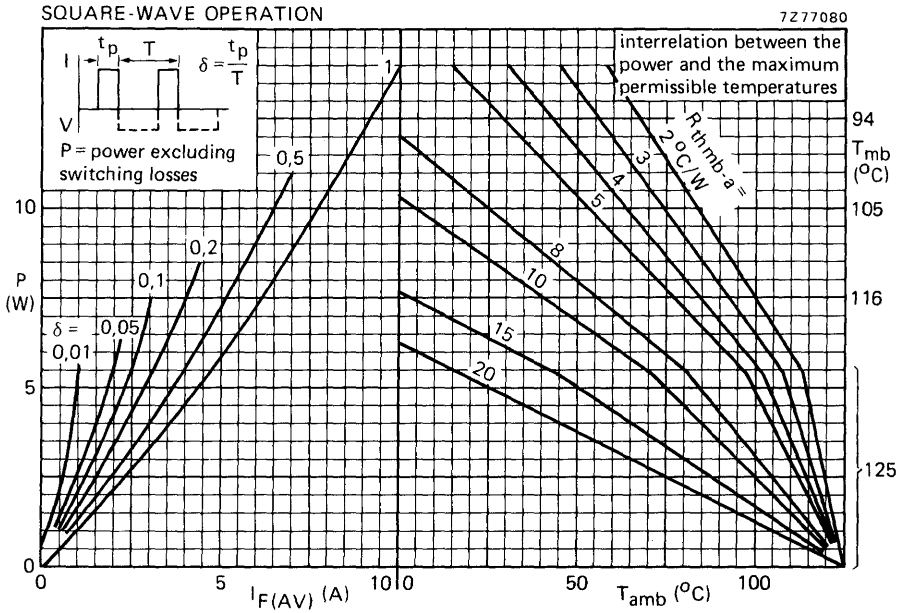
b. The method of using the graphs on page 7 is as follows:
Starting with the required current on the $I_{F(AV)}$ axis, trace upwards to meet the appropriate form factor curve. Trace right horizontally and upwards from the appropriate value on the T_{amb} scale. The intersection determines the $R_{th\ mb\text{-}a}$. The heatsink thermal resistance value ($R_{th\ h\text{-}a}$) can now be calculated from:

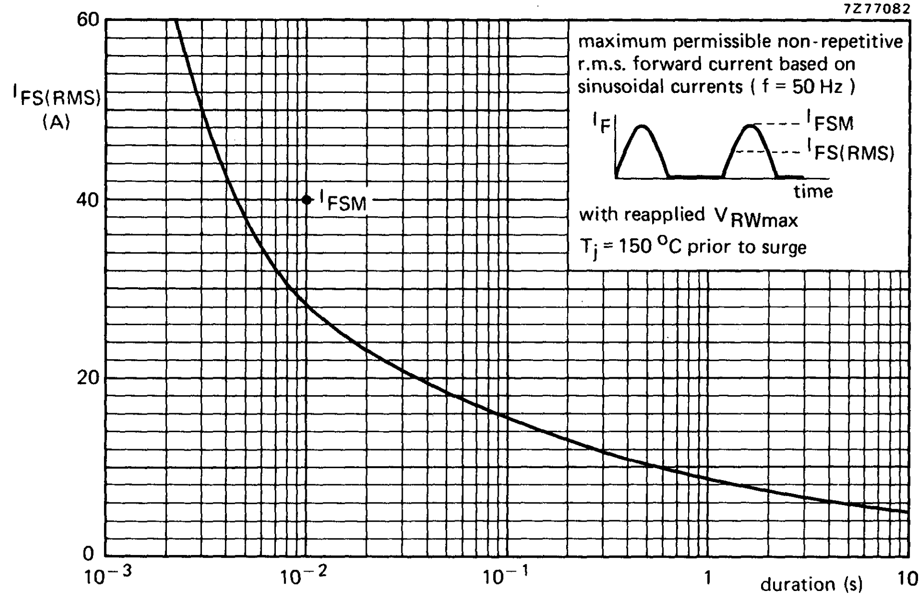
$$R_{th\ h\text{-}a} = R_{th\ mb\text{-}a} - R_{th\ mb\text{-}h}.$$

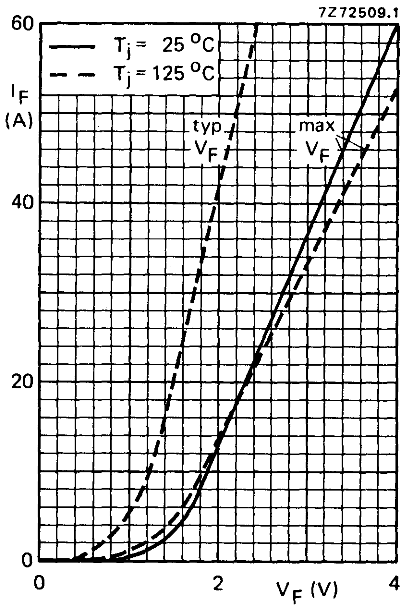
Any measurement of heatsink temperature should be made immediately adjacent to the device.

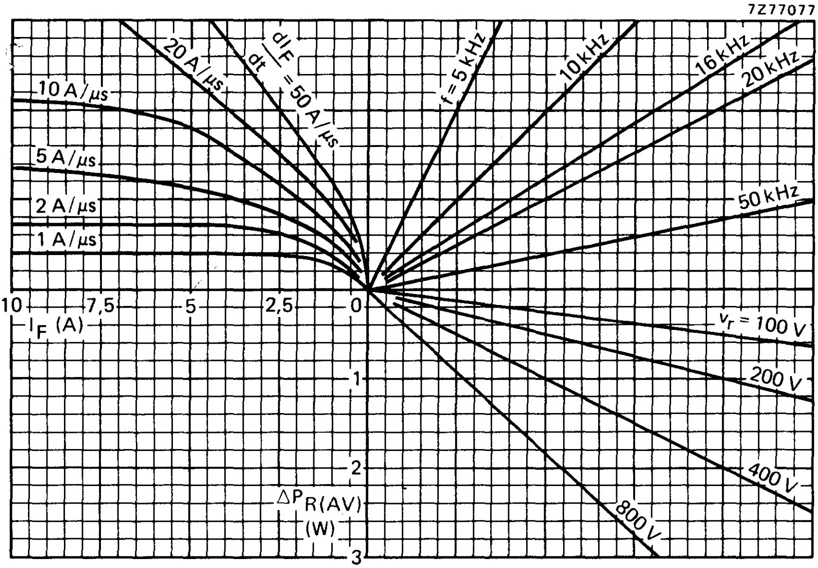
c. The heatsink curves are optimized to allow the junction temperature to run up to a maximum of 150 °C ($T_{j\ max}$) whilst limiting T_{mb} to 125 °C (or less).


SINUSOIDAL OPERATION
7Z77081
V_{RW} = 800 V
a = $\frac{I_{F(RMS)}}{I_{F(AV)}}$
P = power excluding switching losses
interrelation between the power (derived from the left-hand graph) and the maximum permissible temperatures
a = 4
2,2
1,9
1,57
P (W)
$I_{F(AV)}$ (A)
T_{amb} (°C)
T_{mb} (°C)
105
116
125
$R_{th\,mb-a}$ = 2 °C/W
3
4
5
8
10
15
20
0
5
10
50
100


SQUARE-WAVE OPERATION
7Z77080
t_p
T
δ = $\frac{t_p}{T}$
I
V
P = power excluding switching losses
interrelation between the power and the maximum permissible temperatures
δ = 0,01
0,05
0,1
0,2
0,5
1
P (W)
$I_{F(AV)}$ (A)
T_{amb} (°C)
94
T_{mb} (°C)
105
116
125
$R_{th\,mb-a}$ = 2 °C/W
3
4
5
8
10
15
20
0
5
10
50
100


7Z77082
60
40
20
0
$I_{FS(RMS)}$ (A)
I_{FSM}
maximum permissible non-repetitive r.m.s. forward current based on sinusoidal currents (f = 50 Hz)
I_F
I_{FSM}
$I_{FS(RMS)}$
time
with reapplied V_{RWmax}
T_j = 150 °C prior to surge
10^{-3}
10^{-2}
10^{-1}
1
duration (s)
10

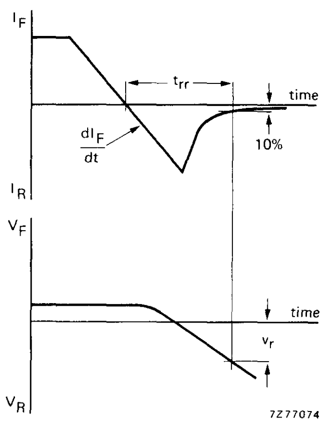

7Z72509.1
60
40
20
0
I_F (A)
T_j = 25 °C
T_j = 125 °C
typ V_F
max V_F
0
2
V_F (V)
4

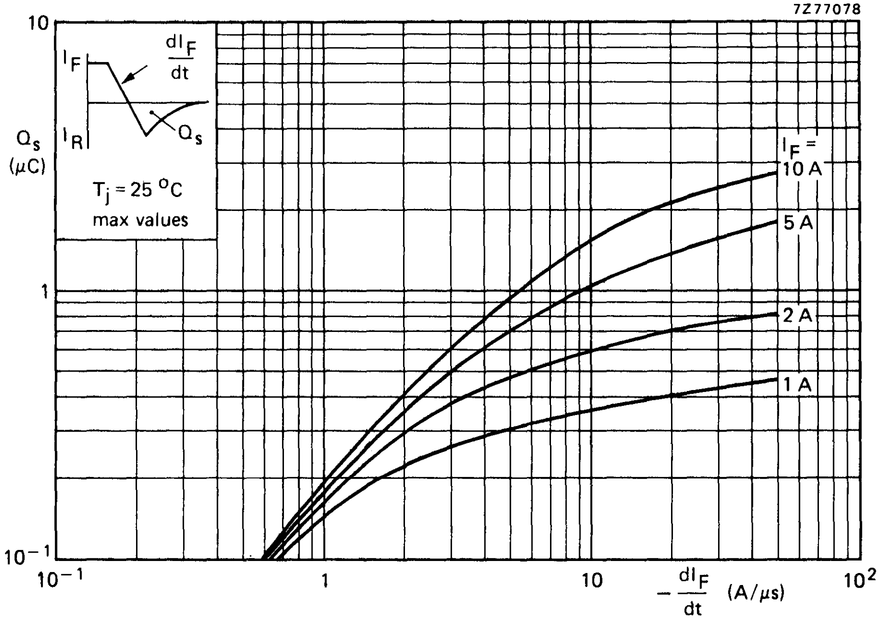


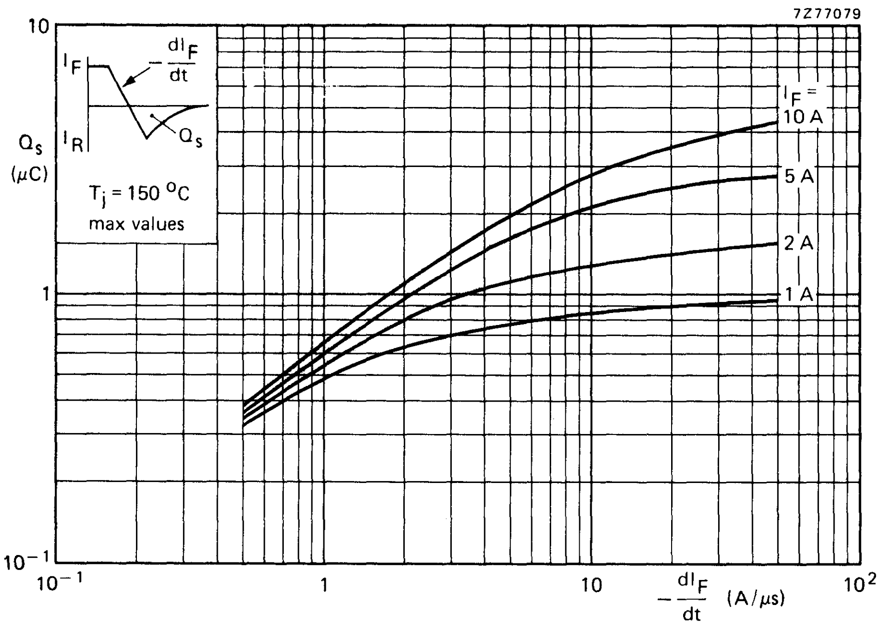
NOMOGRAM

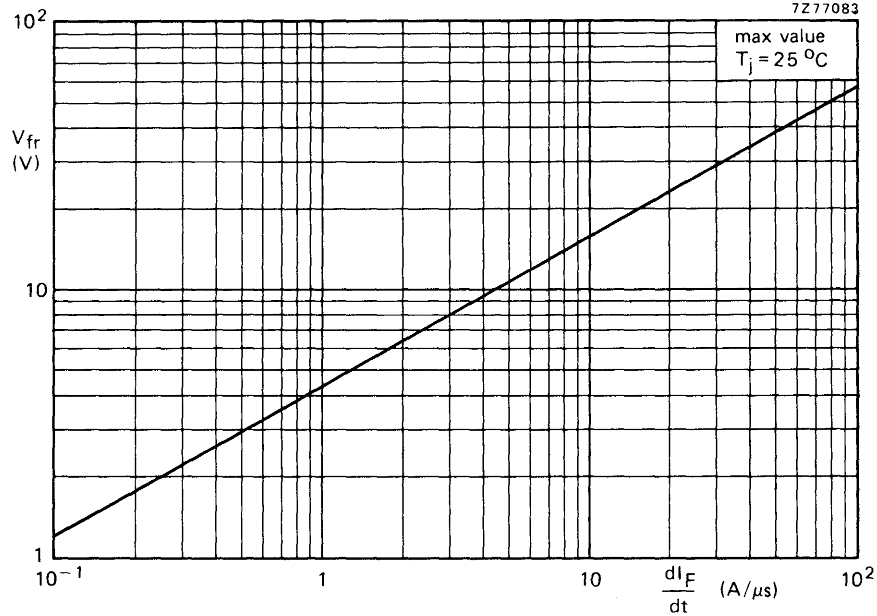
Power loss $\Delta P_{R(AV)}$ due to switching only (to be added to steady state power losses).

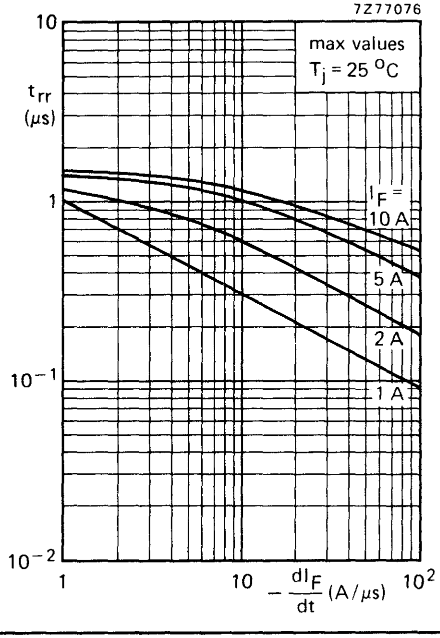
I_F = forward current just before switching off; T_j = 150 °C

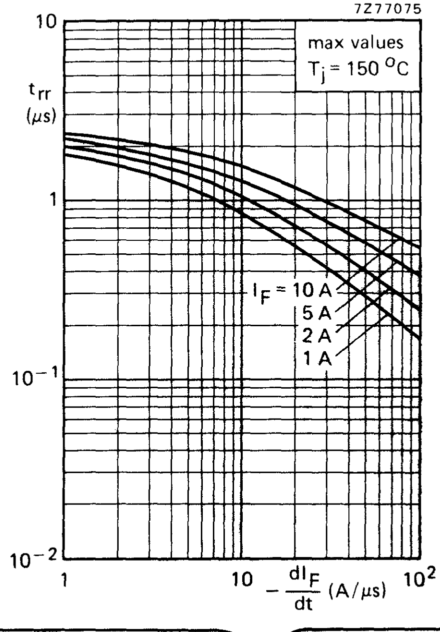


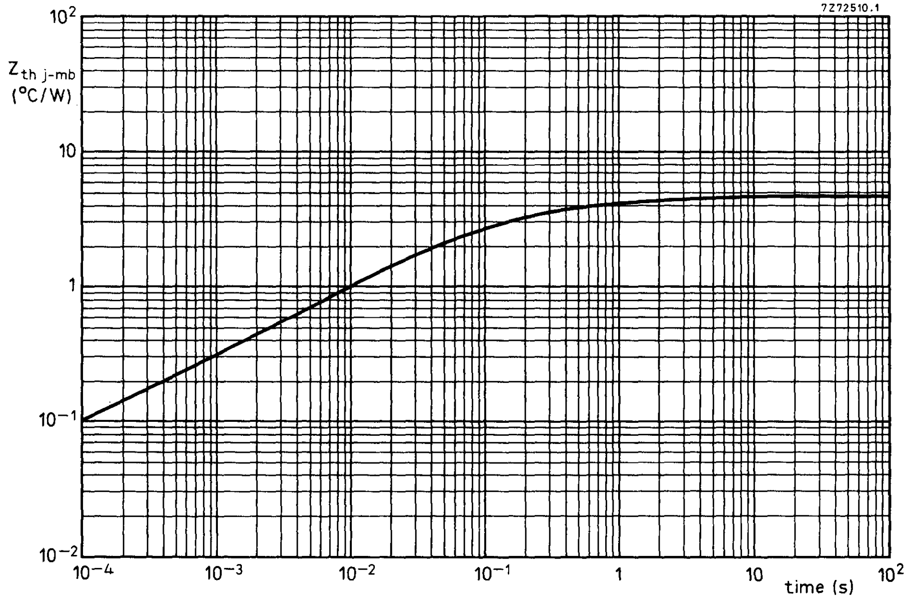

7Z77078
10
1
10^{-1}
10^{-1}
1
10
10^2
Q_s (μC)
I_F
I_R
$\frac{dI_F}{dt}$
Q_s
$T_j = 25\ ^oC$
max values
I_F =
10 A
5 A
2 A
1 A
$-\frac{dI_F}{dt}$ (A/μs)


7Z77079
10
1
10^{-1}
10^{-1}
1
10
10^2
Q_s (μC)
I_F
I_R
$-\frac{dI_F}{dt}$
Q_s
$T_j = 150\ ^oC$
max values
I_F =
10 A
5 A
2 A
1 A
$-\frac{dI_F}{dt}$ (A/μs)


7Z77083
max value
$T_j = 25\ ^oC$
V_{fr} (V)
10^2
10
1
10^{-1}
1
10
10^2
$\frac{dI_F}{dt}$ (A/μs)


7Z77076
max values
$T_j = 25\ ^oC$
t_{rr} (μs)
I_F = 10 A
5 A
2 A
1 A
10
1
10^{-1}
10^{-2}
1
10
10^2
$-\frac{dI_F}{dt}$ (A/μs)


7Z77075
max values
$T_j = 150\ ^oC$
t_{rr} (μs)
I_F = 10 A
5 A
2 A
1 A
10
1
10^{-1}
10^{-2}
1
10
10^2
$-\frac{dI_F}{dt}$ (A/μs)


7Z72510.1
$Z_{th\ j\text{-}mb}$ (°C/W)
10^2
10
1
10^{-1}
10^{-2}
10^{-4}
10^{-3}
10^{-2}
10^{-1}
1
10
10^2
time (s)

FAST SOFT-RECOVERY RECTIFIER DIODE

The BYW25 is a fast soft-recovery rectifier diode in a DO-5 metal envelope especially suitable for operation as main and commutating diode in 3-phase a.c. motor speed control inverters and in high frequency power supplies in general.

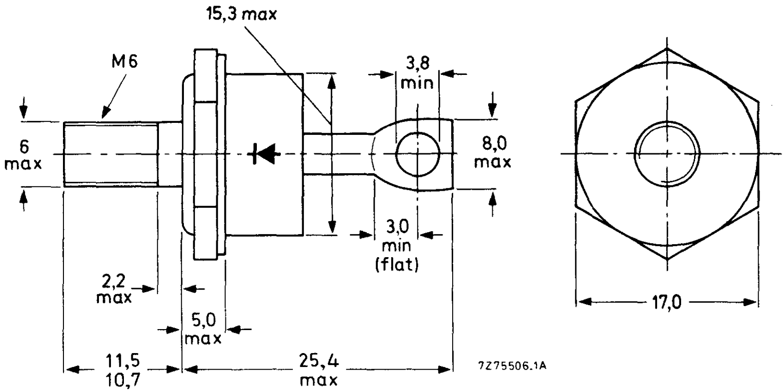
Two polarity versions are available:
Normal polarity (cathode to stud); BYW25.
Reverse polarity (anode to stud); BYW25R.

QUICK REFERENCE DATA

Repetitive peak reverse voltage	V_{RRM}	max.	800	V
Average forward current	$I_{F(AV)}$	max.	40	A
Repetitive peak forward current	I_{FRM}	max.	600	A
Reverse recovery time	t_{rr}	<	450	ns

MECHANICAL DATA

Fig. 1 DO-5: with metric M6 stud (ϕ6 mm)



Net mass: 22 g
Diameter of clearance hole: max. 6,5 mm
Torque on nut: min. 1,7 Nm (17 kg cm)
max. 3,5 Nm (35 kg cm)

Supplied with device: 1 nut, 1 lock washer
Nut dimensions across the flats: 10 mm
Supplied on request: accessories 56264A
(mica washer, insulating ring, tag)

RATINGS

Limiting values in accordance with the Absolute Maximum System (IEC 134)

Voltages *

Non-repetitive peak reverse voltage	V_{RSM}	max.	1000 V
Repetitive peak reverse voltage	V_{RRM}	max.	800 V
Continuous reverse voltage	V_R	max.	650 V

Currents

Average forward current; switching losses negligible up to 20 kHz			
sinusoidal; up to T_{mb} = 100 °C	$I_{F(AV)}$	max.	40 A
sinusoidal; at T_{mb} = 125 °C	$I_{F(AV)}$	max.	23 A
R.M.S. forward current	$I_{F(RMS)}$	max.	60 A
Repetitive peak forward current	I_{FRM}	max.	600 A
Non-repetitive peak forward current; t = 10 ms; half sine-wave; T_j = 150 °C prior to surge	I_{FSM}	max.	550 A
I^2t for fusing (t = 10 ms)	I^2t	max.	1500 A^2s

Temperatures

Storage temperature	T_{stg}		−55 to + 150 °C
Junction temperature	T_j	max.	150 °C

THERMAL RESISTANCE

From junction to mounting base	$R_{th\ j\text{-}mb}$	=	0,6 °C/W
From mounting base to heatsink			
with heatsink compound	$R_{th\ mb\text{-}h}$	=	0,3 °C/W
without heatsink compound	$R_{th\ mb\text{-}h}$	=	0,5 °C/W

* To ensure thermal stability: $R_{th\ j\text{-}a} \leqslant 1$ °C/W (continuous reverse voltage).

CHARACTERISTICS

Forward voltage			
I_F = 35 A; T_j = 25 °C	V_F	<	1,55 V *
I_F = 150 A; T_j = 25 °C	V_F	<	2,25 V *
Reverse current			
V_R = 650 V; T_j = 125 °C	I_R	<	7 mA
Reverse recovery when switched from			
I_F = 10 A to V_R = 30 V with $-dI_F/dt$ = 50 A/µs; T_j = 25 °C			
Recovery time	t_{rr}	<	450 ns
I_F = 600 A to $V_R \geqslant$ 30 V with $-dI_F/dt$ = 70 A/µs; T_{mb} = 85 °C			
Recovery time	t_{rr}	<	1 µs
Maximum slope of the reverse recovery current when switched from I_F = 600 A to $V_R \geqslant$ 30 V; with $-dI_F/dt$ = 35 A/µs; T_j = 25 °C	$\|dI_R/dt\|$	<	100 A/µs

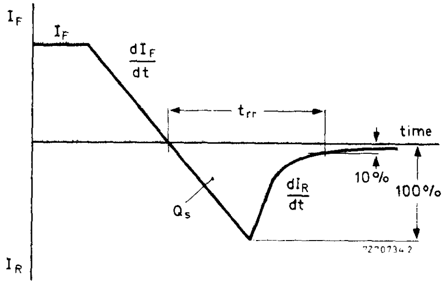


Fig. 2 Definitions of Q_s, t_{rr} and dI_R/dt.

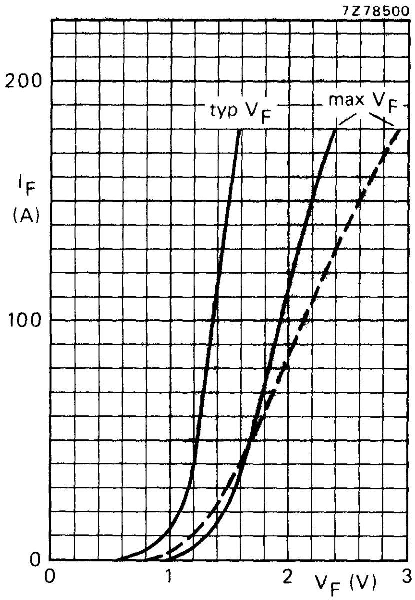


Fig. 3 —— T_j = 25 °C; – – – T_j = 150 °C.

* Measured under pulse conditions to avoid excessive dissipation.

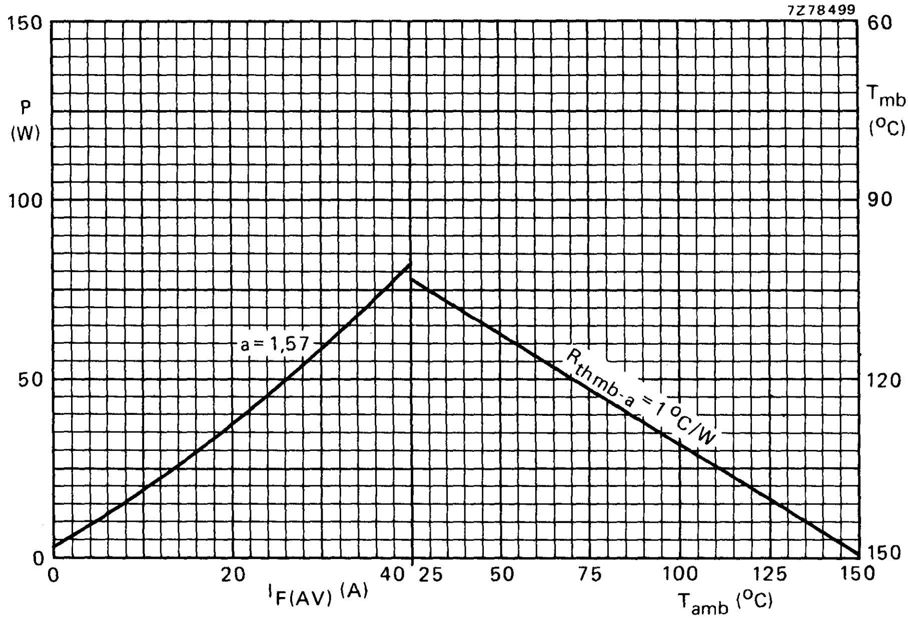


Fig. 4 The right-hand part shows the interrelationship between the power (derived from the left-hand part) and the maximum permissible temperatures.
P = power including reverse current losses and switching losses up to f = 20 kHz.
$a = I_{F(RMS)}/I_{F(AV)}$.

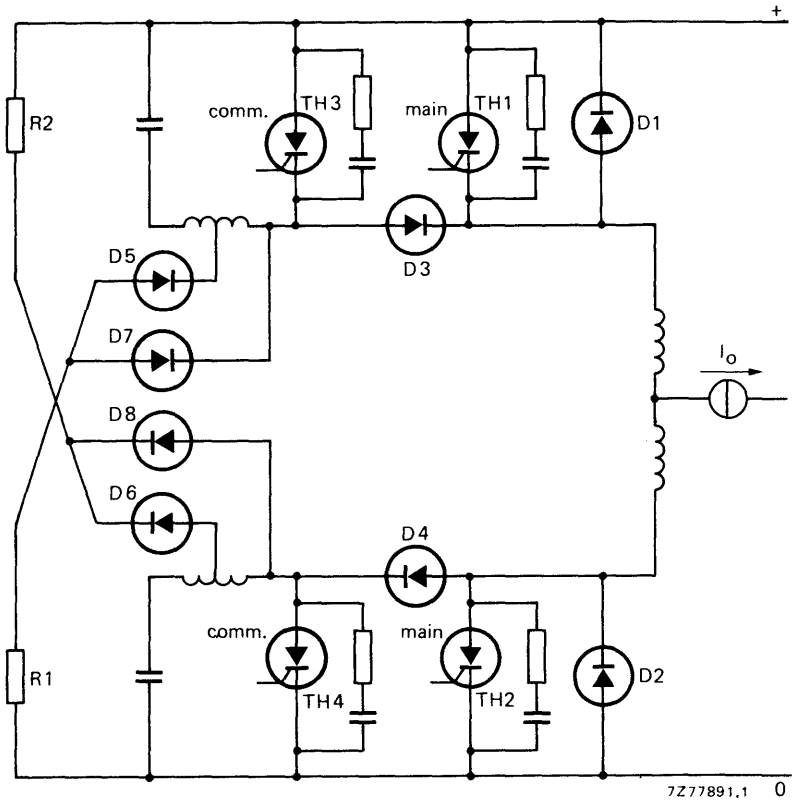


Fig. 5 One phase of a three-phase inverter for a.c. motor speed control.
D1 to D4 are BYW25 types.

VERY FAST RECOVERY RECTIFIER DIODES

Glass-passivated, high-efficiency, eutectically-bonded rectifier diodes in plastic envelopes, featuring low forward voltage drop, very fast reverse recovery times, very low stored charge and non-snap-off. They are intended for use in switched-mode power supplies, and high-frequency circuits in general, where low conduction and switching losses are essential. The series consists of normal polarity (cathode to mounting base) types.

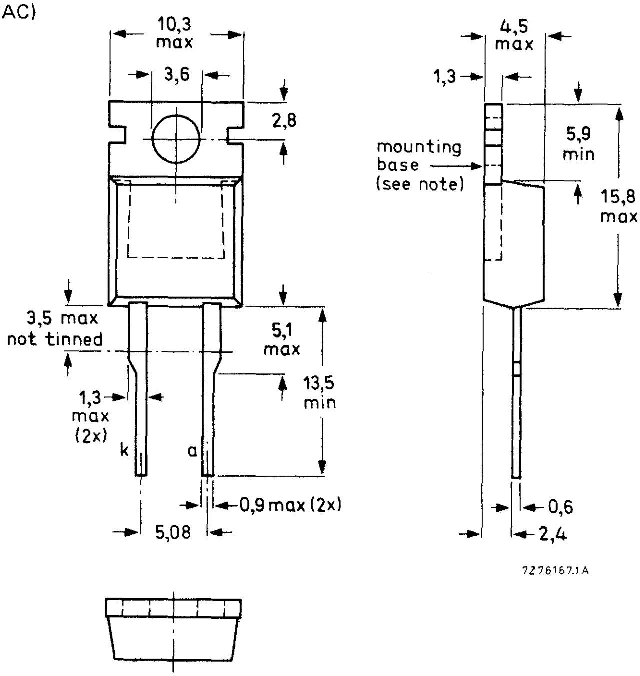
QUICK REFERENCE DATA

			BYW29-50	100	150	
Repetitive peak reverse voltage	V_{RRM}	max.	50	100	150	V
Average forward current	$I_{F(AV)}$	max.		7		A
Forward voltage	V_F	<		0,85		V
Reverse recovery time	t_{rr}	<		35		ns

MECHANICAL DATA

Dimensions in mm

Fig. 1 SOD-59 (TO-220AC)



Note: The exposed metal mounting base is directly connected to the cathode.

Accessories supplied on request: see data sheets Mounting instructions and accessories for TO-220 envelopes.

Products approved to CECC 50 009-014, available on request.

RATINGS

Limiting values in accordance with the Absolute Maximum System (IEC 134)

Voltages*

			BYW29–50	100	150	
Non-repetitive peak reverse voltage	V_{RSM}	max.	50	100	150	V
Repetitive peak reverse voltage	V_{RRM}	max.	50	100	150	V
Crest working reverse voltage	V_{RWM}	max.	50	100	150	V
Continuous reverse voltage	V_R	max.	50	100	150	V

Currents

Average forward current; switching losses negligible up to 500 kHz				
sinusoidal; up to T_{mb} = 125 °C	$I_{F(AV)}$	max.	7	A
square-wave; δ = 0,5; up to T_{mb} = 125 °C	$I_{F(AV)}$	max.	7,6	A
R.M.S. forward current	$I_{F(RMS)}$	max.	12	A
Repetitive peak forward current	I_{FRM}	max.	80	A
Non-repetitive peak forward current; t = 10 ms; half sine-wave; T_j = 150 °C prior to surge; with reapplied V_{RWMmax}	I_{FSM}	max.	80	A
I^2t for fusing (t = 10 ms)	I^2t	max.	32	A^2s

Temperatures

Storage temperature	T_{stg}		–40 to +150	°C
Junction temperature	T_j	max.	150	°C

* To ensure thermal stability: $R_{th\ j\text{-}a} \leqslant 16$ °C/W (continuous reverse voltage).

THERMAL RESISTANCE

From junction to mounting base	$R_{th\ j\text{-}mb}$	=	2,7 °C/W
Transient thermal impedance; t = 1 ms	$Z_{th\ j\text{-}mb}$	=	0,26 °C/W

Influence of mounting method

1. Heatsink mounted with clip (see mounting instructions)

Thermal resistance from mounting base to heatsink

a. with heatsink compound	$R_{th\ mb\text{-}h}$	=	0,3 °C/W
b. with heatsink compound and 0,06 mm maximum mica insulator	$R_{th\ mb\text{-}h}$	=	1,4 °C/W
c. with heatsink compound and 0,1 mm maximum mica insulator (56369)	$R_{th\ mb\text{-}h}$	=	2,2 °C/W
d. with heatsink compound and 0,25 mm maximum alumina insulator (56367)	$R_{th\ mb\text{-}h}$	=	0,8 °C/W
e. without heatsink compound	$R_{th\ mb\text{-}h}$	=	1,4 °C/W

2. Free-air operation

The quoted values of $R_{th\ j\text{-}a}$ should be used only when no leads of other dissipating components run to the same tie-point.
Thermal resistance from junction to ambient in free air:
mounted on a printed-circuit board at a = any lead length and with copper laminate $R_{th\ j\text{-}a}$ = 60 °C/W

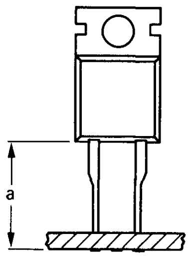


Fig. 2.

CHARACTERISTICS

Forward voltage			
I_F = 5 A; T_j = 100 °C	V_F	<	0,85 V*
I_F = 20 A; T_j = 25 °C	V_F	<	1,3 V*
Reverse current			
$V_R = V_{RWMmax}$; T_j = 100 °C	I_R	<	0,6 mA
Reverse recovery when switched from			
I_F = 1 A to $V_R \geqslant$ 30 V with $-dI_F/dt$ = 50 A/μs; T_j = 25 °C			
Recovery time	t_{rr}	<	35 ns
I_F = 2 A to $V_R \geqslant$ 30 V with $-dI_F/dt$ = 20 A/μs; T_j = 25 °C			
Recovered charge	Q_s	<	15 nC
Recovery time	t_{rr}	<	50 ns
Forward recovery when switched to I_F = 1 A with dI_F/dt = 10 A/μs			
Recovery voltage	V_{fr}	typ.	1,0 V

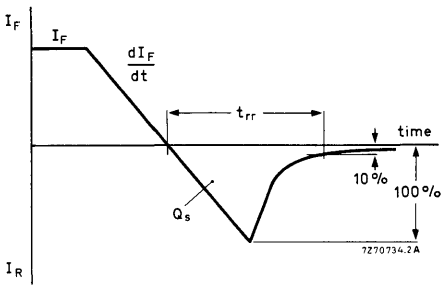


Fig. 3 Definitions of t_{rr} and Q_s.

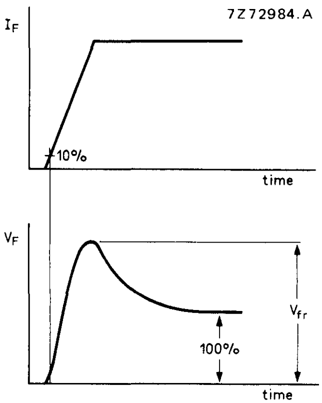


Fig. 4 Definition of V_{fr}.

* Measured under pulse conditions to avoid excessive dissipation.

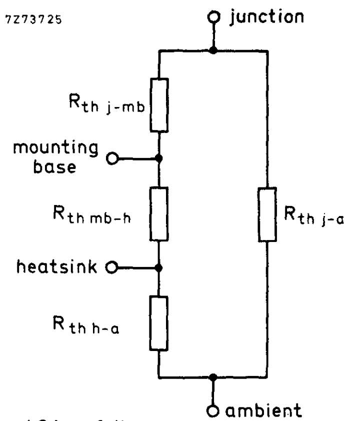
MOUNTING INSTRUCTIONS

1. The device may be soldered directly into the circuit, but the maximum permissible temperature of the soldering iron or bath is 275 °C; it must not be in contact with the joint for more than 5 seconds. Soldered joints must be at least 4,7 mm from the seal.
2. The leads should not be bent less than 2,4 mm from the seal, and should be supported during bending.
3. It is recommended that the circuit connection be made to the cathode tag, rather than direct to the heatsink.
4. Mounting by means of a spring clip is the best mounting method because it offers:
   a. a good thermal contact under the crystal area and slightly lower $R_{th\ mb\text{-}h}$ values than screw mounting.
   b. safe isolation for mains operation.
   However, if a screw is used, it should be M3 cross-recess pan head. Care should be taken to avoid damage to the plastic body.
5. For good thermal contact heatsink compound should be used between base-plate and heatsink. Values of $R_{th\ mb\text{-}h}$ given for mounting with heatsink compound refer to the use of a metallic-oxide loaded compound. Ordinary silicone grease is not recommended.
6. The device should not be pop-rivetted to the heatsink. However, it is permissible to press-rivet providing that rivets of soft material are used, and the press forces are slowly and carefully controlled so as to avoid shock and deformation of either heatsink or mounting tab.

OPERATING NOTES

Dissipation and heatsink considerations:

a. The various components of junction temperature rise above ambient are illustrated below:



b. The method of using Figs 5 and 6 is as follows:
   Starting with the required current on the $I_{F(AV)}$ axis, trace upwards to meet the appropriate form factor or duty factor curve. Trace right horizontally and upwards from the appropriate value on the T_{amb} scale. The intersection determines the $R_{th\ mb\text{-}a}$. The heatsink thermal resistance value ($R_{th\ h\text{-}a}$) can now be calculated from:

   $$R_{th\ h\text{-}a} = R_{th\ mb\text{-}a} - R_{th\ mb\text{-}h}.$$

c. Any measurement of heatsink temperature should be made immediately adjacent to the device.

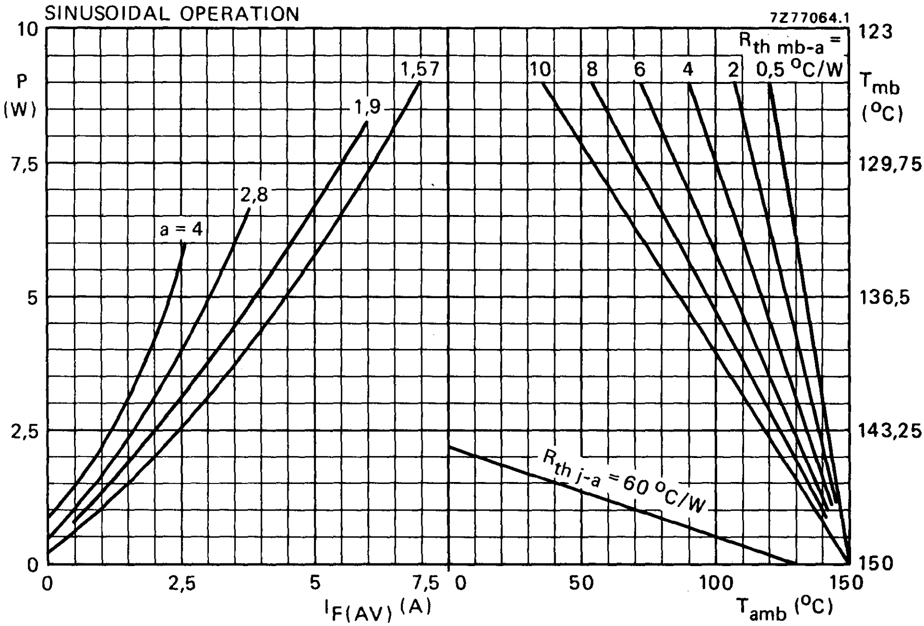


Fig. 5 The right-hand part shows the interrelationship between the power (derived from the left-hand part) and the maximum permissible temperatures.
P = power including reverse current losses and switching losses up to f = 500 kHz.
a = form factor = $I_{F(RMS)}/I_{F(AV)}$.

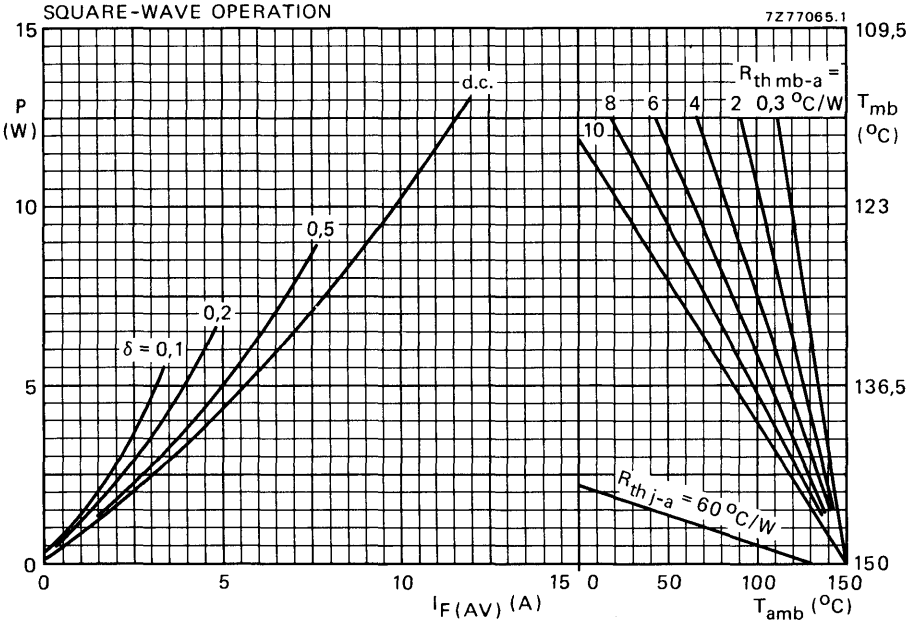
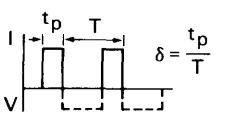


Fig. 6 The right-hand part shows the interrelationship between the power (derived from the left-hand part) and the maximum permissible temperatures.
P = power including reverse current losses and switching losses up to f = 500 kHz.



$I_{F(AV)} = I_{F(RMS)} \times \sqrt{\delta}$

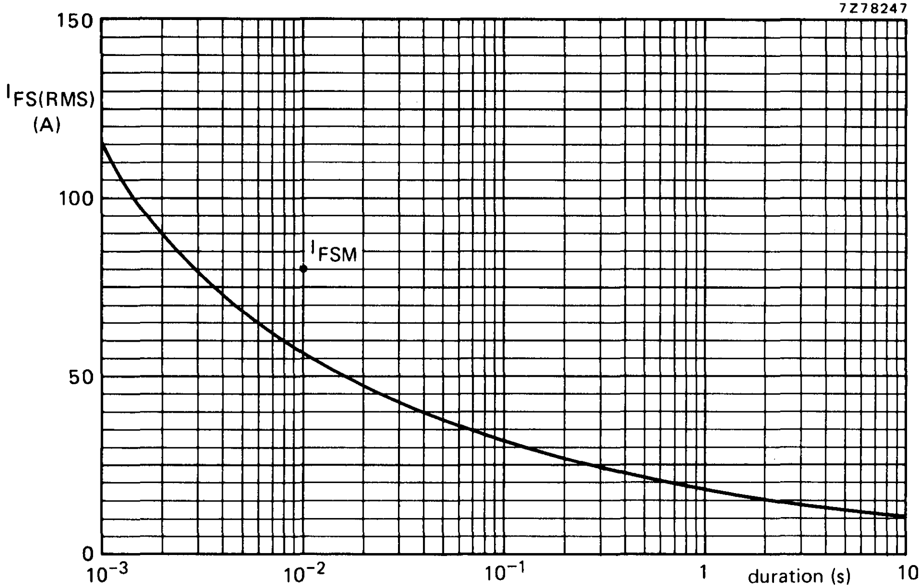
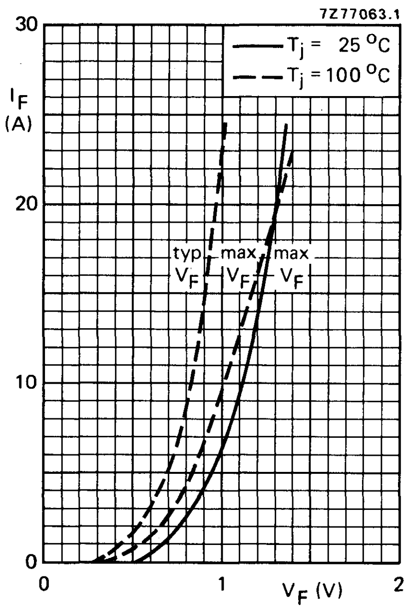


Fig. 7 Maximum permissible non-repetitive r.m.s. forward current based on sinusoidal currents (f = 50 Hz); T_j = 150 °C prior to surge; with reapplied V_{RWMmax}.



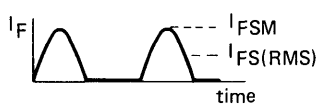


Fig. 8.

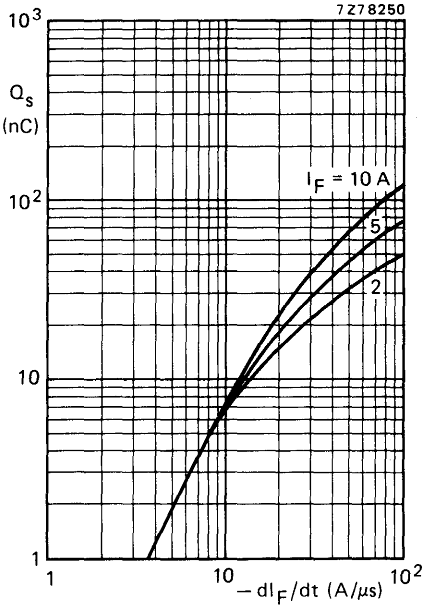


Fig. 9 T_j = 25 °C; maximum values.

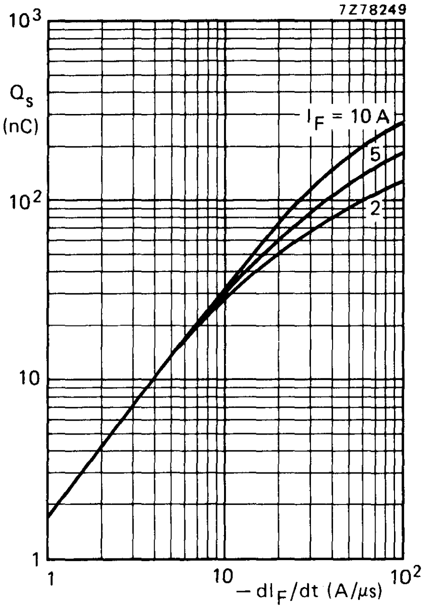
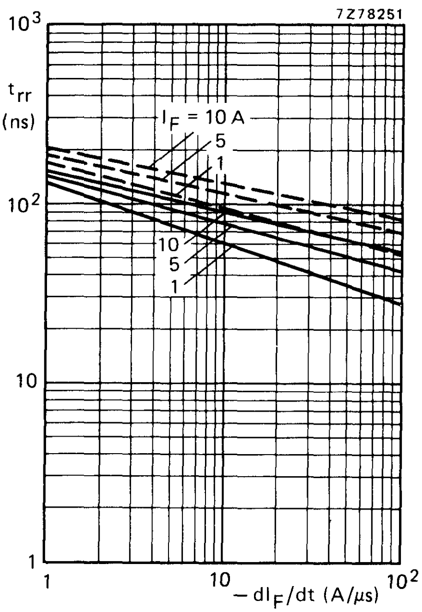
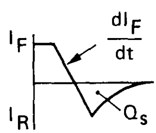


Fig. 10 T_j = 100 °C; maximum values.





Definition of Q_s in Figs 9 and 10.

Fig. 11 Maximum values; ——— T_j = 25 °C; – – – – T_j = 100 °C.

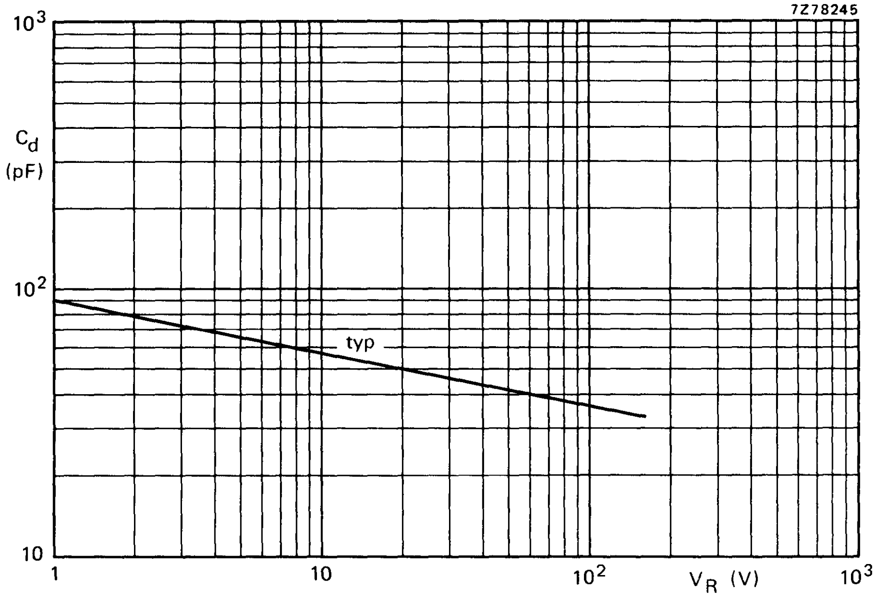


Fig. 12 f = 1 MHz; T_j = 25 °C.

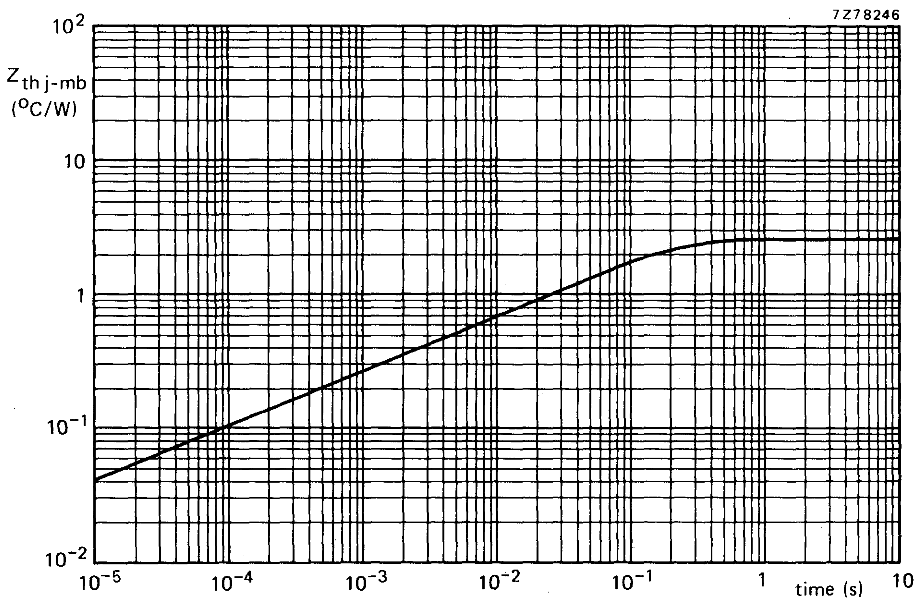


Fig. 13.

VERY FAST RECOVERY RECTIFIER DIODES

Glass-passivated, high-efficiency rectifier diodes in DO-4 metal envelopes, featuring low forward voltage drop, very fast reverse recovery times, very low stored charge and non-snap-off. They are intended for use in switched-mode power supplies, and high-frequency circuits in general, where low conduction and switching losses are essential. The series consists of normal polarity (cathode to stud) types.

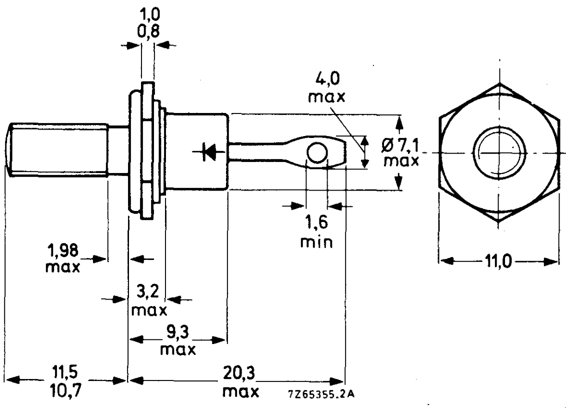
QUICK REFERENCE DATA

			BYW30–50	100	150	
Repetitive peak reverse voltage	V_{RRM}	max.	50	100	150	V
Average forward current	$I_{F(AV)}$	max.		12		A
Forward voltage	V_F	<		0,85		V
Reverse recovery time	t_{rr}	<		35		ns

MECHANICAL DATA

Dimensions in mm

Fig. 1 DO-4: with metric M5 stud (ϕ5 mm); e.g. BYW30-50.
with 10-32 UNF stud (ϕ4,83 mm); e.g. BYW30-50U.



Net mass: 6 g

Diameter of clearance hole: max. 5,2 mm

Accessories supplied on request: 56295
(PTFE bush, 2 mica washers, plain washer, tag)

Supplied with device: 1 nut, 1 lock washer
Nut dimensions across the flats; M5: 8,0 mm
10-32 UNF: 9,5 mm

Torque on nut: min. 0,9 Nm (9 kg cm)
max. 1,7 Nm (17 kg cm)

Products approved to CECC 50 009-001, available on request.

RATINGS

Limiting values in accordance with the Absolute Maximum System (IEC 134)

Voltages*

			BYW30-50	100	150	
Non-repetitive peak reverse voltage	V_{RSM}	max.	50	100	150	V
Repetitive peak reverse voltage	V_{RRM}	max.	50	100	150	V
Crest working reverse voltage	V_{RWM}	max.	50	100	150	V
Continuous reverse voltage	V_R	max.	50	100	150	V

Currents

Average forward current; switching losses negligible up to 500 kHz				
sinusoidal; up to T_{mb} = 120 °C	$I_{F(AV)}$	max.	12	A
sinusoidal; at T_{mb} = 125 °C	$I_{F(AV)}$	max.	10	A
square-wave; δ = 0,5; up to T_{mb} = 114 °C	$I_{F(AV)}$	max.	14	A
square-wave; δ = 0,5; at T_{mb} = 125 °C	$I_{F(AV)}$	max.	10	A
R.M.S. forward current	$I_{F(RMS)}$	max.	20	A
Repetitive peak forward current	I_{FRM}	max.	200	A
Non-repetitive peak forward current t = 10 ms; half sine-wave; T_j = 150 °C prior to surge with reapplied V_{RWMmax}	I_{FSM}	max.	200	A
I^2t for fusing (t = 10 ms)	I^2t	max.	200	A^2s

Temperatures

Storage temperature	T_{stg}		−55 to +150	°C
Junction temperature	T_j	max.	150	°C

THERMAL RESISTANCE

From junction to mounting base	$R_{th\ j\text{-}mb}$	=	2,2	°C/W
From mounting base to heatsink				
a. with heatsink compound	$R_{th\ mb\text{-}h}$	=	0,5	°C/W
b. without heatsink compound	$R_{th\ mb\text{-}h}$	=	0,6	°C/W
Transient thermal impedance; t = 1 ms	$Z_{th\ j\text{-}mb}$	=	0,3	°C/W

MOUNTING INSTRUCTIONS

The top connector should neither be bent nor twisted; it should be soldered into the circuit so that there is no strain on it.

During soldering the heat conduction to the junction should be kept to a minimum.

* To ensure thermal stability: $R_{th\ j\text{-}a} \leq 8{,}2$ °C/W (continuous reverse voltage).

CHARACTERISTICS

Forward voltage			
I_F = 10 A; T_j = 100 °C	V_F	<	0,85 V*
I_F = 50 A; T_j = 25 °C	V_F	<	1,3 V*
Reverse current			
$V_R = V_{RWMmax}$; T_j = 100 °C	I_R	<	1,3 mA
Reverse recovery when switched from			
I_F = 1 A to $V_R \geqslant$ 30 V with $-dI_F/dt$ = 20 A/μs; T_j = 25 °C			
Recovery time	t_{rr}	<	**35 ns**
I_F = 2 A to $V_R \geqslant$ 30 V with $-dI_F/dt$ = 20 A/μs; T_j = 25 °C			
Recovery charge	Q_s	<	15 nC
Recovery time	t_{rr}	<	50 ns
Forward recovery when switched to I_F = 10 A with dI_F/dt = 10 A/μs	V_{fr}	typ.	1,0 V

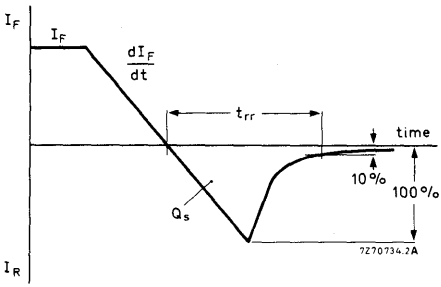


Fig. 2 Definitions of t_{rr} and Q_s.

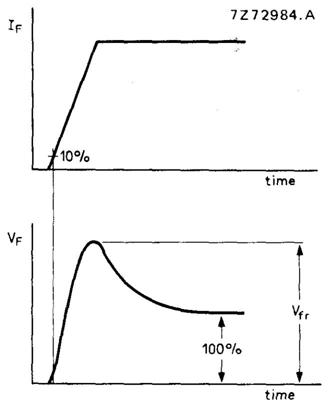


Fig. 3 Definition of V_{fr}.

* Measured under pulse conditions to avoid excessive dissipation.

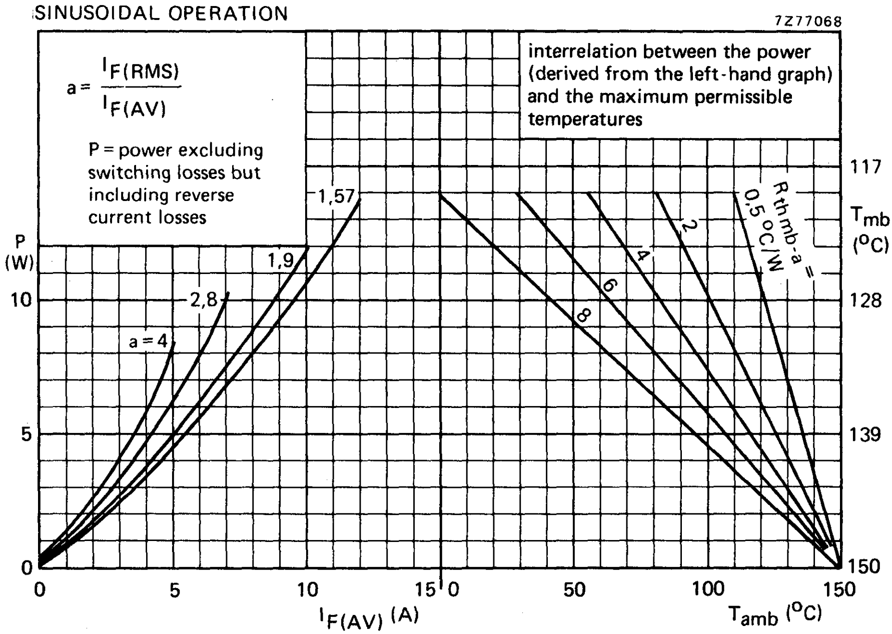

SINUSOIDAL OPERATION
7Z77068
a = I F(RMS) / I F(AV)
P = power excluding switching losses but including reverse current losses
interrelation between the power (derived from the left-hand graph) and the maximum permissible temperatures
P (W)
10
5
0
a = 4
2,8
1,9
1,57
0
5
10
15
I F(AV) (A)
0
50
100
150
Tamb (°C)
Rth mb-a = 0,5 °C/W
2
4
6
8
117
Tmb (°C)
128
139
150

Fig. 4.

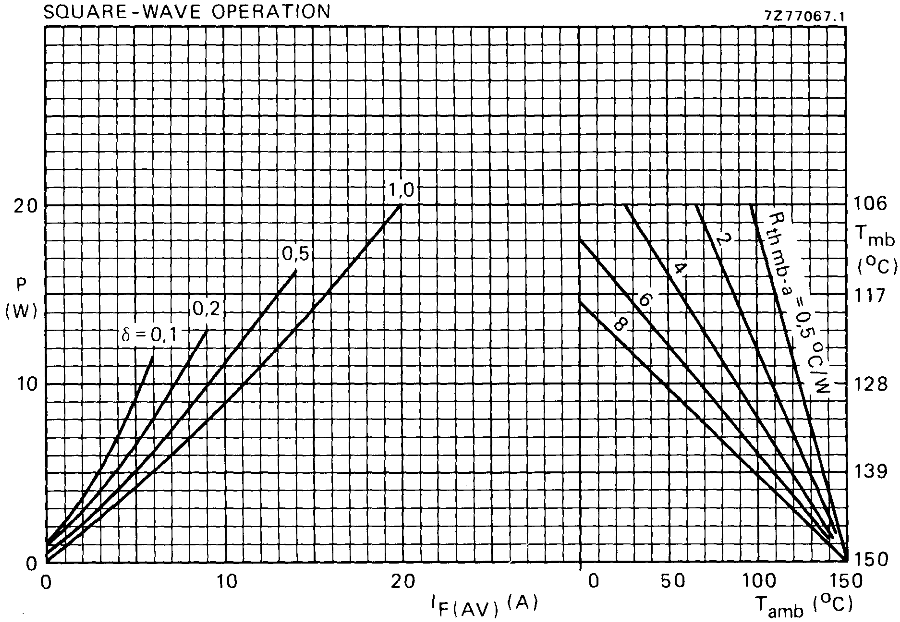
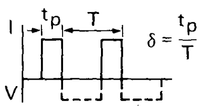


Fig. 5 The right-hand part shows the interrelationship between the power (derived from the left-hand part) and the maximum permissible temperatures.
P = power including reverse current losses and switching losses up to f = 500 kHz.



$I_{F(AV)} = I_{F(RMS)} \times \sqrt{\delta}$

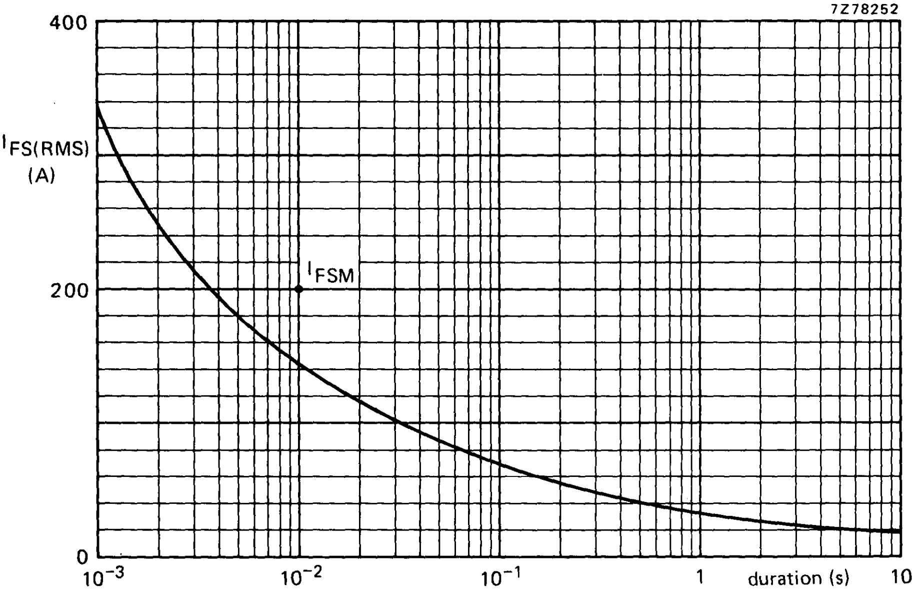


Fig. 6 Maximum permissible non-repetitive r.m.s. forward current based on sinusoidal currents (f = 50 Hz); T_j = 150 °C prior to surge; with reapplied V_{RWMmax}.

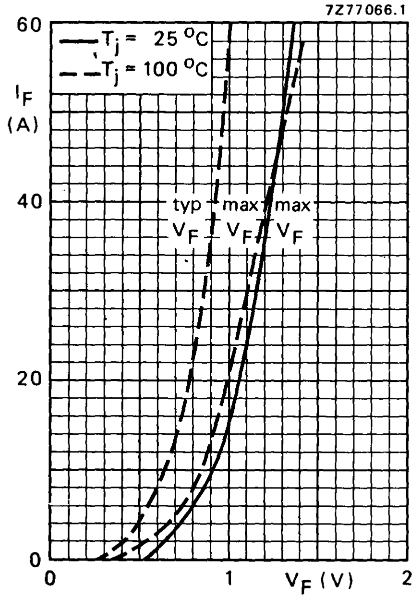


Fig. 7.

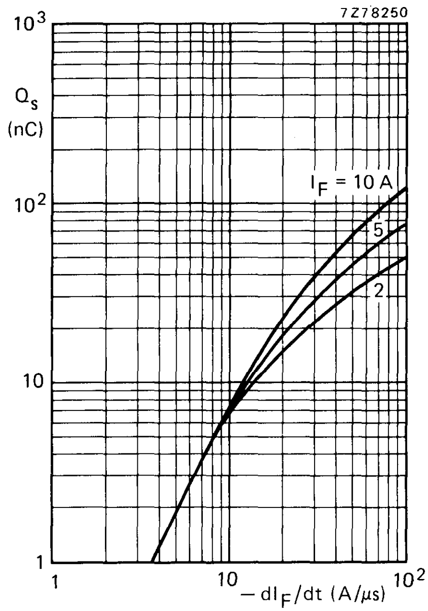


Fig. 8 T_j = 25 °C; maximum values.

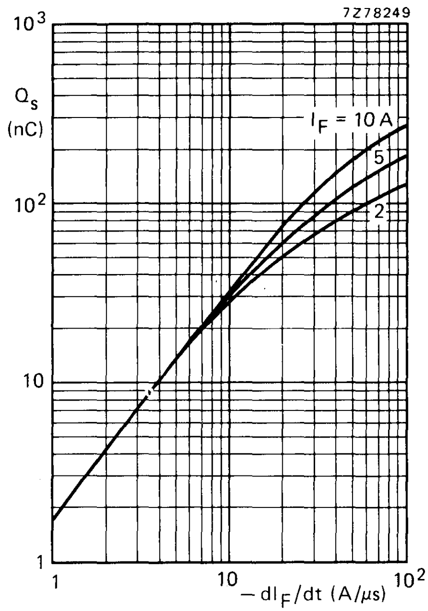
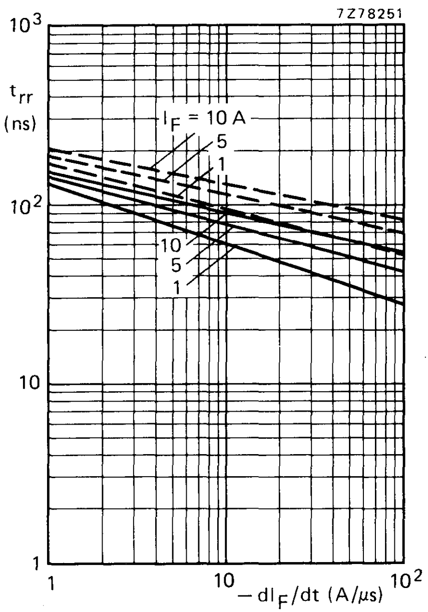
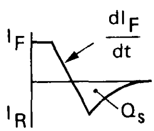


Fig. 9 T_j = 100 °C; maximum values.





Definition of Q_s in Figs 8 and 9.

Fig. 10 Maximum values; —— T_j = 25 °C; ---- T_j = 100 °C.

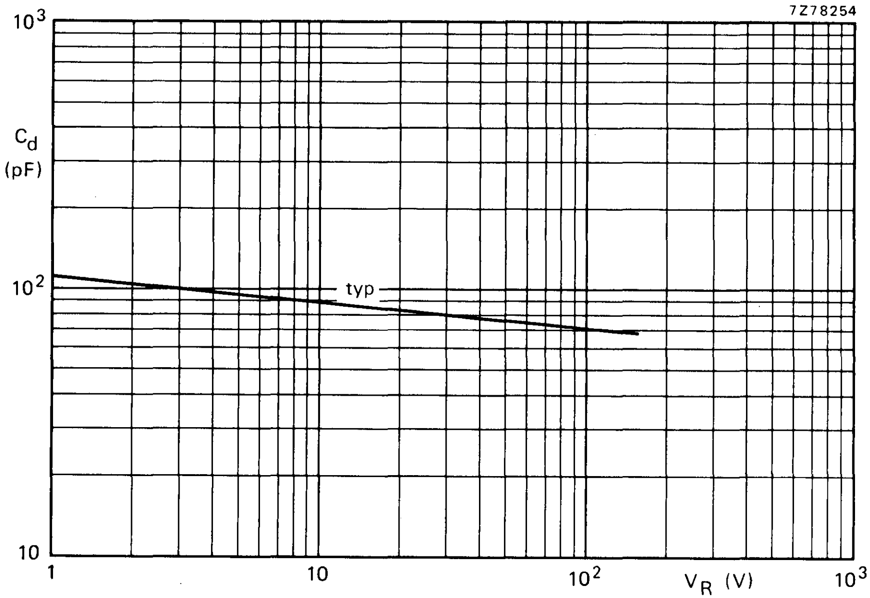


Fig. 11 f = 1 MHz; T_j = 25 °C.

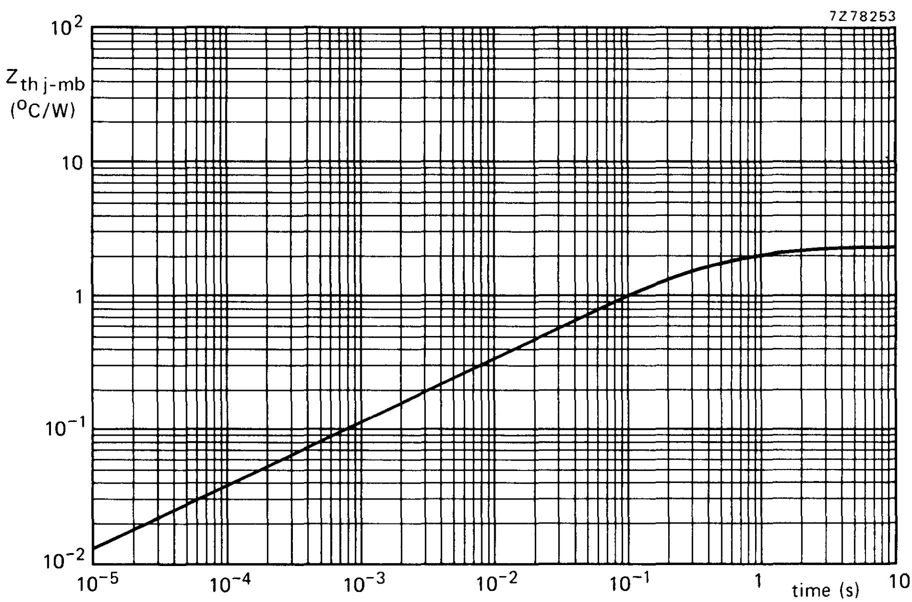


Fig. 12.

VERY FAST RECOVERY RECTIFIER DIODES

Glass-passivated, high-efficiency rectifier diodes in DO-4 metal envelopes, featuring low forward voltage drop, very fast reverse recovery times, very low stored charge and non-snap-off. They are intended for use in switched-mode power supplies, and high frequency circuits in general, where low conduction and switching losses are essential. The series consists of normal polarity (cathode to stud) types.

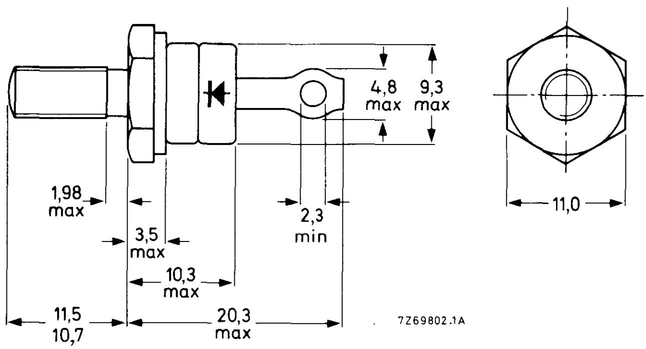
QUICK REFERENCE DATA

			BYW31-50	100	150	
Repetitive peak reverse voltage	V_{RRM}	max.	50	100	150	V
Average forward current	$I_{F(AV)}$	max.		25		A
Forward voltage	V_F	<		0,85		V
Reverse recovery time	t_{rr}	<		50		ns

MECHANICAL DATA

Dimensions in mm

Fig. 1 DO-4: with metric M5 stud (ϕ5 mm); e.g. BYW31-50.
with 10-32 UNF stud (ϕ4,83 mm); e.g. BYW31-50U.



Net mass: 7 g

Diameter of clearance hole: max. 5,2 mm

Accessories supplied on request: 56295
(PTFE bush, 2 mica washers, plain washer, tag)

Supplied with device: 1 nut, 1 lock washer
Nut dimensions across the flats; M5: 8,0 mm
10-32 UNF: 9,5 mm

Torque on nut: min. 0,9 (9 kg cm)
max. 1,7 (17 kg cm)

Products available to CECC 50 009-002, available on request.

RATINGS

Limiting values in accordance with the Absolute Maximum System (IEC 134)

Voltages *

			BYW31–50	100	150	
Non-repetitive peak reverse voltage	V_{RSM}	max.	50	100	150	V
Repetitive peak reverse voltage	V_{RRM}	max.	50	100	150	V
Crest working reverse voltage	V_{RWM}	max.	50	100	150	V
Continuous reverse voltage	V_R	max.	50	100	150	V

Currents

Average forward current; switching losses negligible up to 500 kHz				
sinusoidal; up to T_{mb} = 120 °C	$I_{F(AV)}$	max.	25	A
sinusoidal; at T_{mb} = 125 °C	$I_{F(AV)}$	max.	23	A
square-wave; δ = 0,5; up to T_{mb} = 119 °C	$I_{F(AV)}$	max.	28	A
square-wave; δ = 0,5; at T_{mb} = 125 °C	$I_{F(AV)}$	max.	23	A
R.M.S. forward current	$I_{F(RMS)}$	max.	40	A
Repetitive peak forward current	I_{FRM}	max.	320	A
Non-repetitive peak forward current t = 10 ms; half sine-wave; T_j = 150 °C prior to surge; with reapplied V_{RWMmax}	I_{FSM}	max.	320	A
I^2t for fusing (t = 10 ms)	I^2t	max.	500	A^2s

Temperatures

Storage temperature	T_{stg}		–55 to +150	°C
Junction temperature	T_j	max.	150	°C

THERMAL RESISTANCE

From junction to mounting base	$R_{th\ j\text{-}mb}$	=	1,0	°C/W
From mounting base to heatsink				
a. with heatsink compound	$R_{th\ mb\text{-}h}$	=	0,3	°C/W
b. without heatsink compound	$R_{th\ mb\text{-}h}$	=	0,5	°C/W
Transient thermal impedance: t = 1 ms	$Z_{th\ j\text{-}mb}$	=	0,2	°C/W

MOUNTING INSTRUCTIONS

The top connector should neither be bent nor twisted; it should be soldered into the circuit so that there is no strain on it.

During soldering the heat conduction to the junction should be kept to a minimum.

* To ensure thermal stability: $R_{th\ j\text{-}a} \leqslant 6$ °C/W (continuous reverse voltage).

CHARACTERISTICS

Forward voltage			
I_F = 20 A; T_j = 100 °C	V_F	<	0,85 V*
I_F = 100 A; T_j = 25 °C	V_F	<	1,3 V*
Reverse current			
$V_R = V_{RWMmax}$; T_j = 100 °C	I_R	<	1,5 mA ←
Reverse recovery when switched from			
I_F = 1 A to $V_R \geq$ 30 V with $-dI_F/dt$ = 50 A/μs; T_j = 25 °C			
Recovery time	t_{rr}	<	50 ns
I_F = 2 A to $V_R \geq$ 30 V with $-dI_F/dt$ = 20 A/μs; T_j = 25 °C			
Recovered charge	Q_s	<	20 nC
Forward recovery when switched to I_F = 10 A with dI_F/dt = 10 A/μs			
Recovery voltage	V_{fr}	typ.	1,0 V

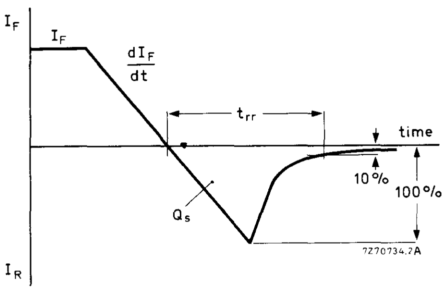


Fig. 2 Definitions of t_{rr} and Q_s.

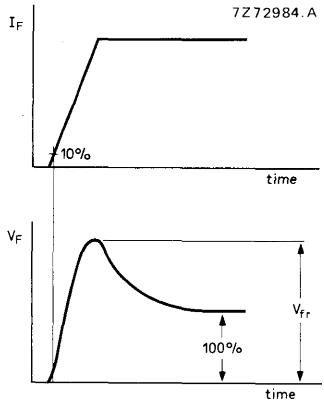


Fig. 3 Definition of V_{fr}.

* Measured under pulse conditions to avoid excessive dissipation.

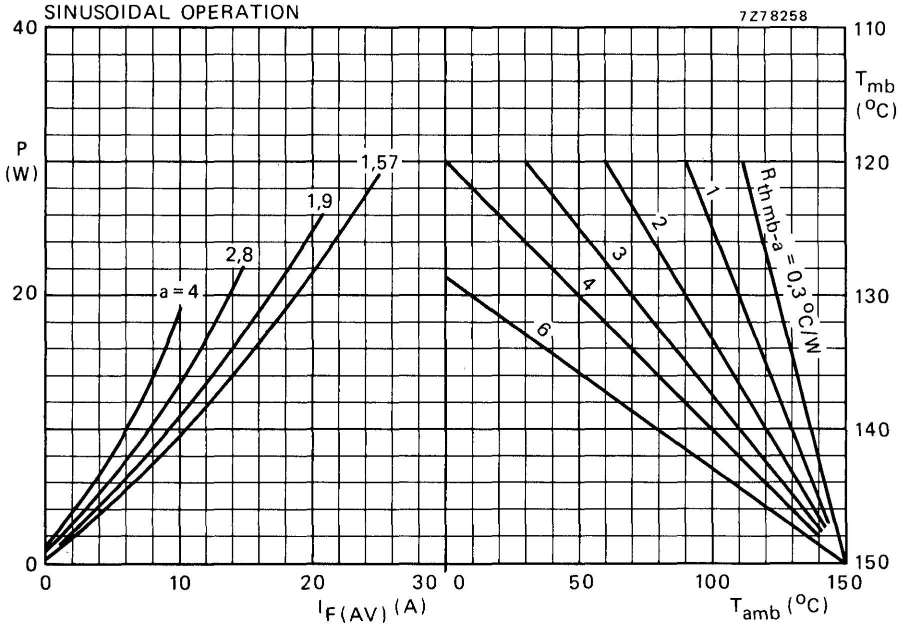


Fig. 4 The right-hand part shows the interrelationship between the power (derived from the left-hand part) and the maximum permissible temperatures.
P = power including reverse current losses and switching losses up to f = 500 kHz.
a = form factor = $I_{F(RMS)}/I_{F(AV)}$.

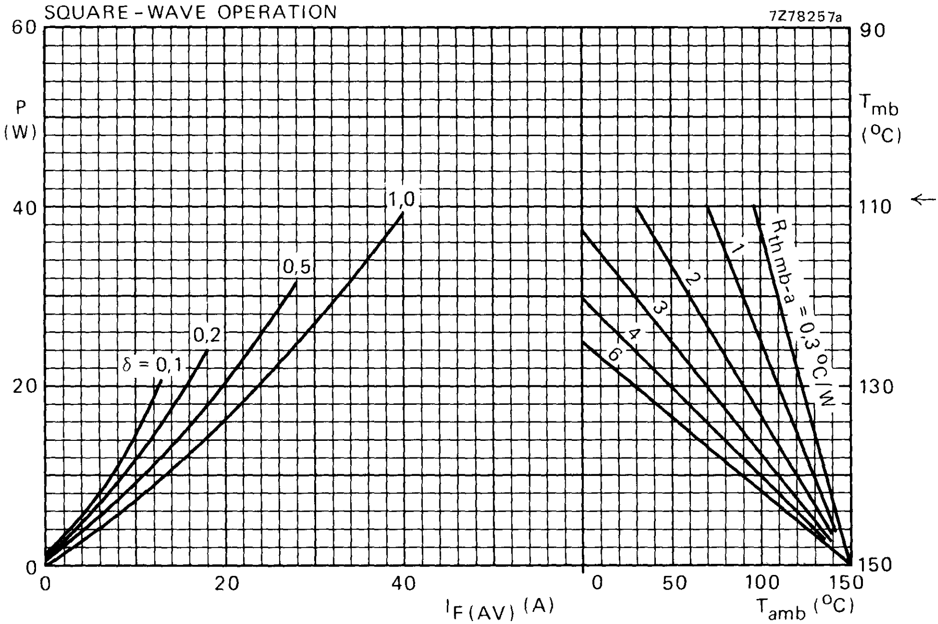
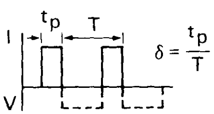


Fig. 5 The right-hand part shows the interrelationship between the power (derived from the left-hand part) and the maximum permissible temperatures.
P = power including reverse current losses and switching losses up to f = 500 kHz.



$I_{F(AV)} = I_{F(RMS)} \times \sqrt{\delta}$

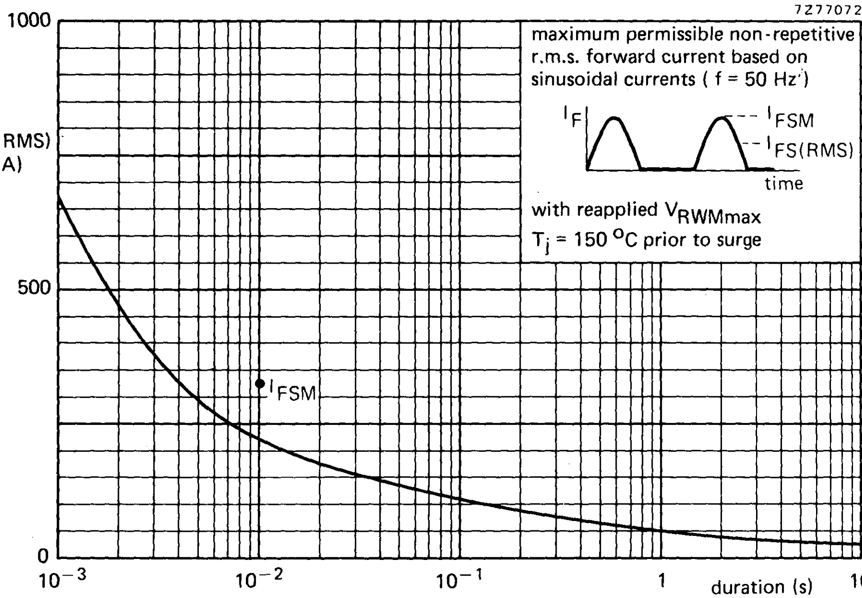


Fig. 6.

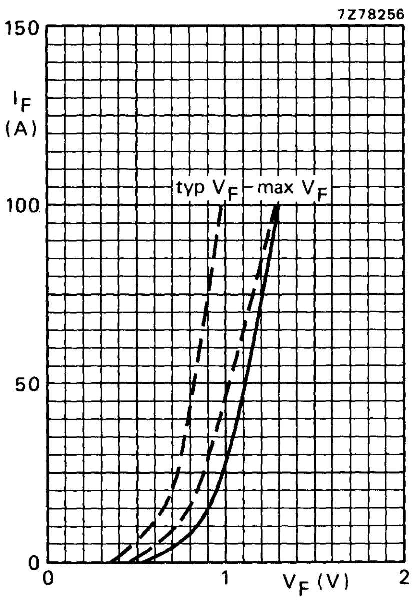


Fig. 7 ——— T_j = 25 °C; - - - T_j = 100 °C.

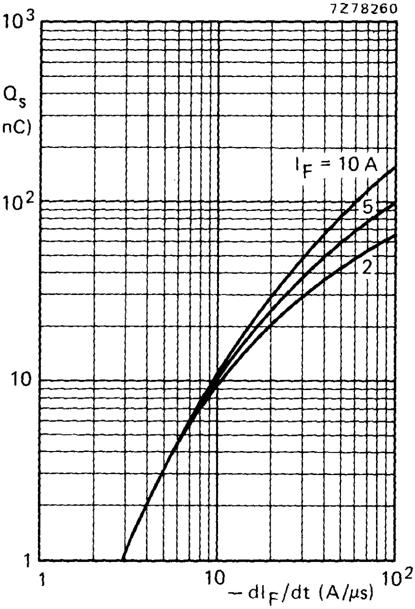


Fig. 8 T_j = 25 °C; maximum values.

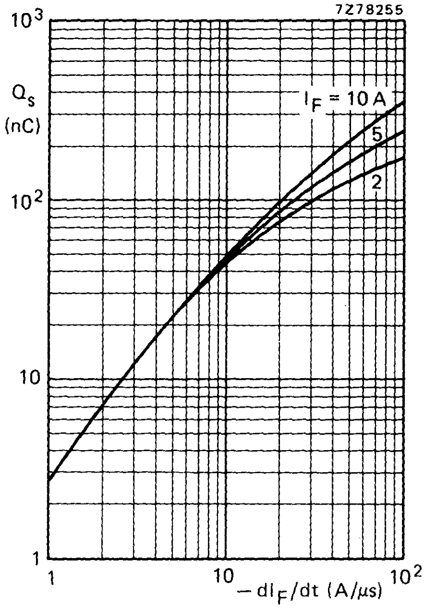
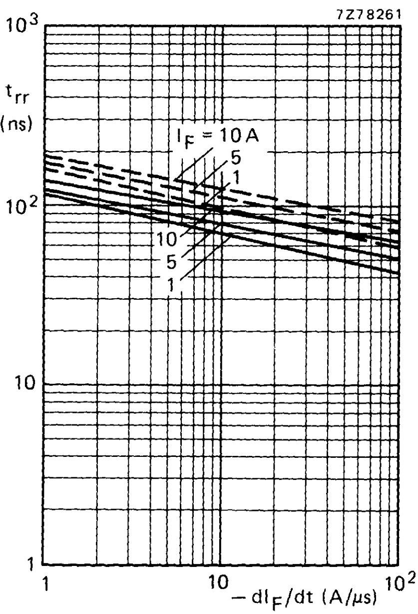
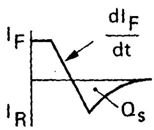


Fig. 9 T_j = 100 °C; maximum values.





Definition of Q_s in Figs 8 and 9.

Fig. 10 Maximum values; ——— T_j = 25 °C; - - - T_j = 100 °C.

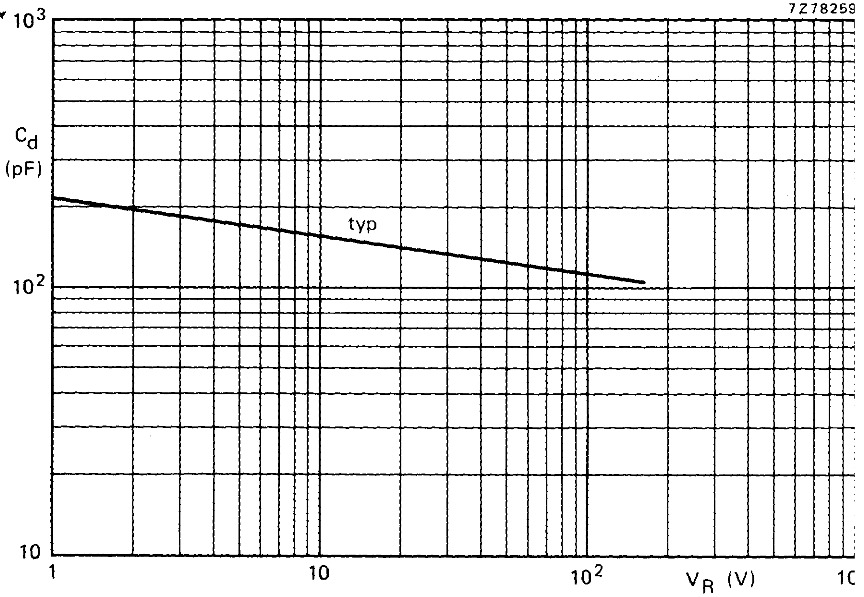


Fig. 11 f = 1 MHz; T_j = 25 °C.

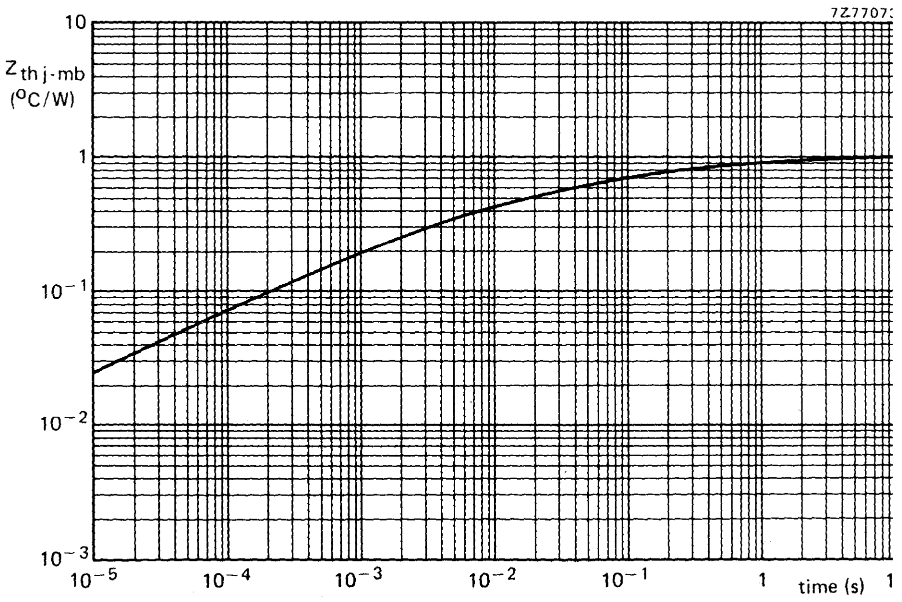


Fig. 12.

VERY FAST RECOVERY RECTIFIER DIODES

Glass-passivated, high-efficiency rectifier diodes in DO-5 metal envelopes, featuring low forward voltage drop, very fast reverse recovery times, very low stored charge and non-snap-off. They are intended for use in switched-mode power supplies and high-frequency inverter circuits in general, where low conduction and switching losses are essential. The series consists of normal polarity (cathode-to-stud) types.

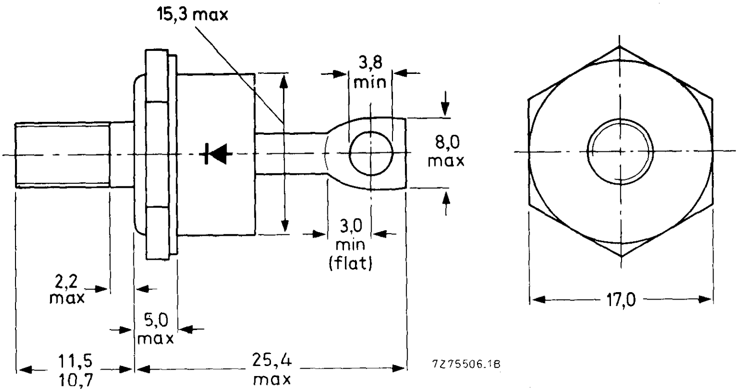
QUICK REFERENCE DATA

			BYW92-50	100	150	
Repetitive peak reverse voltage	V_{RRM}	max.	50	100	150	V
Average forward current	$I_{F(AV)}$	max.		35		A
Forward voltage	V_F	<		0,95		V
Reverse recovery time	t_{rr}	<		50		ns

MECHANICAL DATA

Dimensions in mm

Fig. 1 DO-5: with metric M6 stud (ϕ 6 mm); e.g. BYW92-50.
with ¼ in x 28UNF stud (ϕ 6,35mm); e.g. BYW92-50U.



Net mass: 22 g
Diameter of clearance hole: max. 6,5 mm
Torque on nut: min. 1,7 Nm (17 kg cm)
max. 3,5 Nm (35 kg cm)

Supplied with device: 1 nut, 1 lock washer
Nut dimensions across the flats;
M6: 10 mm
¼ in x 28UNF: 11,1 mm
Supplied on request: accessories 56264A
(mica washer, insulating ring, tag)

Products approved to CECC 50 009-003, available on request.

RATINGS

Limiting values in accordance with the Absolute Maximum System (IEC 134)

Voltages*

			BYW92-50	100	150	
Non-repetitive peak reverse voltage	V_{RSM}	max.	50	100	150	V
Repetitive peak reverse voltage	V_{RRM}	max.	50	100	150	V
Crest working reverse voltage	V_{RWM}	max.	50	100	150	V
Continuous reverse voltage	V_R	max.	50	100	150	V

Currents

Average forward current; switching losses negligible up to 500 kHz				
sinusoidal; up to T_{mb} = 105 °C	$I_{F(AV)}$	max.	35	A
sinusoidal; at T_{mb} = 125 °C	$I_{F(AV)}$	max.	23	A
square wave; δ = 0,5; up to T_{mb} = 102 °C	$I_{F(AV)}$	max.	40	A
square wave; δ = 0,5; at T_{mb} = 125 °C	$I_{F(AV)}$	max.	23	A
R.M.S. forward current	$I_{F(RMS)}$	max.	55	A
Repetitive peak forward current	I_{FRM}	max.	500	A
Non-repetitive peak forward current; t = 10 ms; half sine-wave; T_j = 150 °C prior to surge; with re-applied V_{RWMmax}	I_{FSM}	max.	500	A
I^2t for fusing (t = 10 ms)	I^2t	max.	1250	A^2s

Temperatures

Storage temperature	T_{stg}	−55 to +150		°C
Junction temperature	T_j	max.	150	°C

THERMAL RESISTANCE

From junction to mounting base	$R_{th\ j\text{-}mb}$	=	1,0	°C/W
From mounting base to heatsink				
a. with heatsink compound	$R_{th\ mb\text{-}h}$	=	0,3	°C/W
b. without heatsink compound	$R_{th\ mb\text{-}h}$	=	0,5	°C/W
Transient thermal impedance; t = 1 ms	$Z_{th\ j\text{-}mb}$	=	0,2	°C/W

MOUNTING INSTRUCTIONS

The top connector should neither be bent nor twisted; it should be soldered into the circuit so that there is no strain on it.

During soldering the heat conduction to the junction should be kept to a minimum.

* To ensure thermal stability: $R_{th\ j\text{-}a} \leqslant 6$ °C/W (continuous reverse voltage).

CHARACTERISTICS

Forward voltage			
I_F = 35 A; T_j = 100 °C	V_F	<	0,95 V*
I_F = 100 A; T_j = 25 °C	V_F	<	1,3 V*
Reverse current			
$V_R = V_{RWMmax}$; T_j = 100 °C	I_R	<	2,5 mA
Reverse recovery when switched from			
I_F = 1 A to $V_R \geq 30$ V with $-dI_F/dt$ = 50 A/μs; T_j = 25 °C			
Recovery time	t_{rr}	<	50 ns
I_F = 2 A to $V_R \geq 30$ V with $-dI_F/dt$ = 20 A/μs; T_j = 25 °C			
Recovered charge	Q_s	<	20 nC
Forward recovery when switched to I_F = 10 A with dI_F/dt = 10 A/μs			
Recovery voltage	V_{fr}	typ.	1,0 V

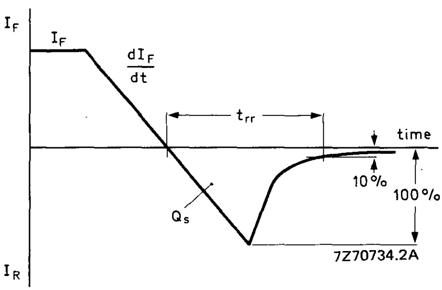


Fig. 2 Definitions of t_{rr} and Q_s.

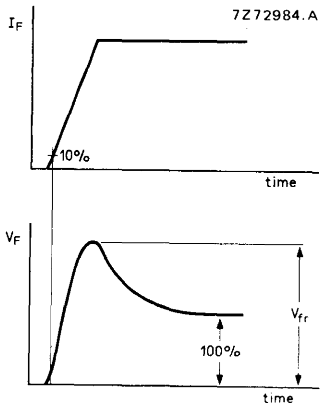


Fig. 3 Definition of V_{fr}.

* Measured under pulse conditions to avoid excessive dissipation.

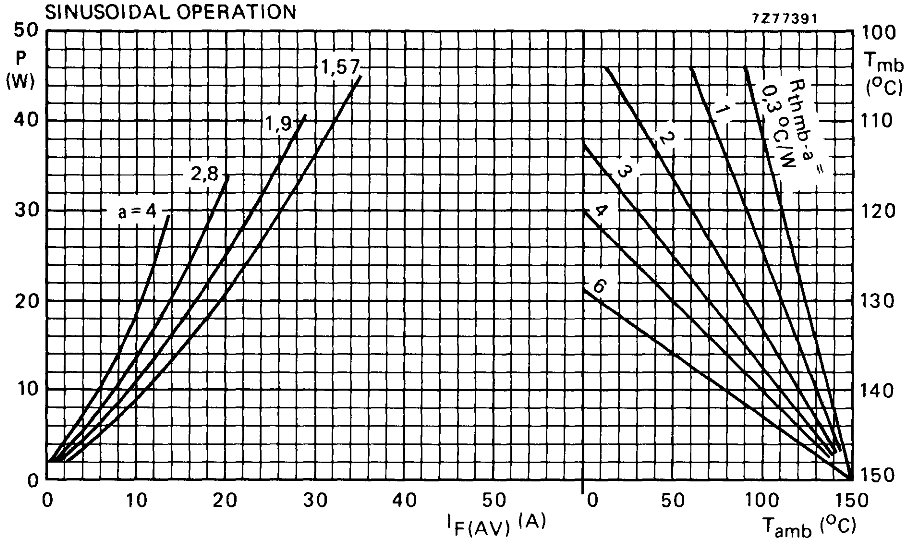


Fig. 4 P = power including reverse current losses and switching losses up to f = 500 kHz.
a = form factor = $I_{F(RMS)}/I_{F(AV)}$.

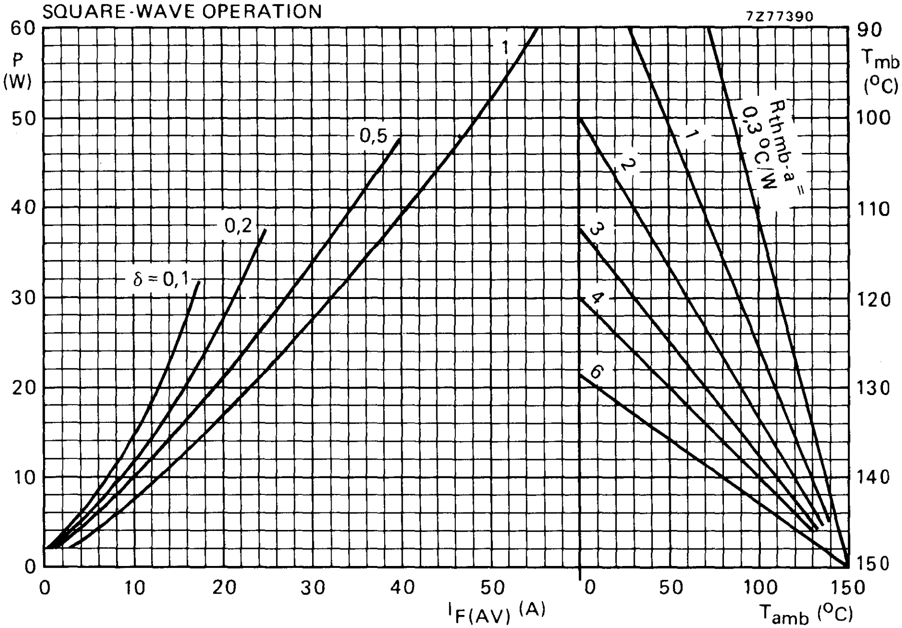
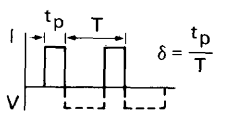


Fig. 5 P = power including reverse current losses and switching losses up to f = 500 kHz.



$I_{F(AV)} = I_{F(RMS)} \times \sqrt{\delta}$

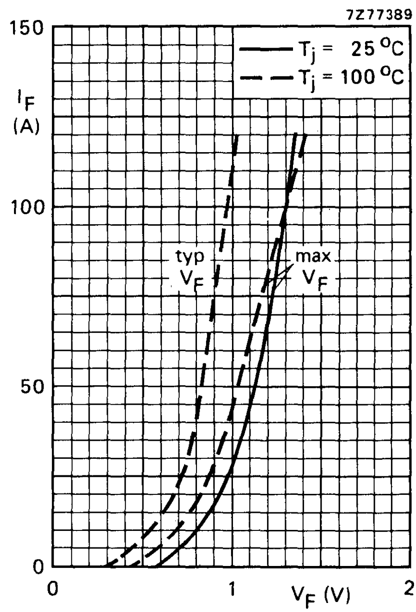


Fig. 6.

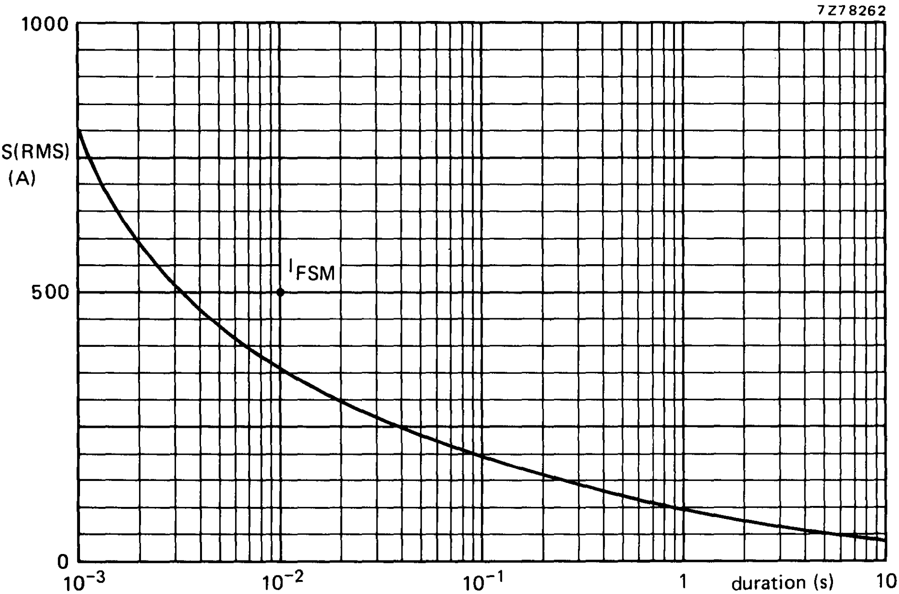
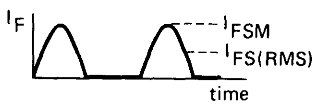


Fig. 7 Maximum permissible non-repetitive r.m.s. forward current based on sinusoidal currents (f = 50 Hz); T_j = 150 °C prior to surge; with reapplied V_{RWMmax}.



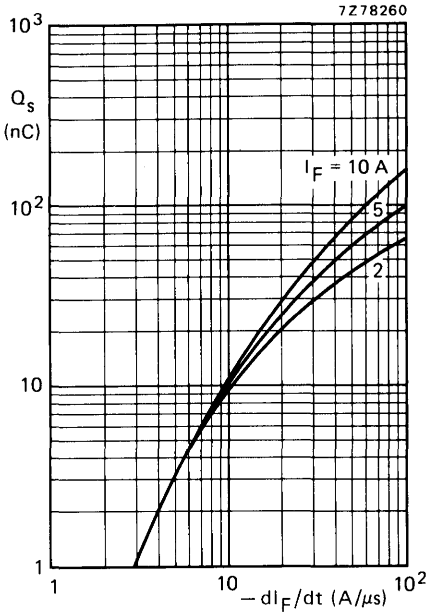


Fig. 8 T_j = 25 °C; maximum values.

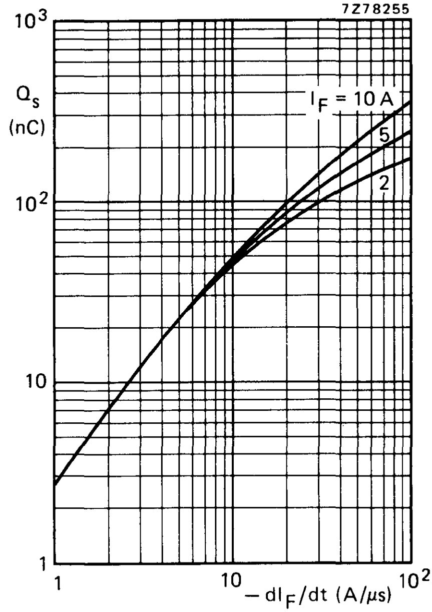
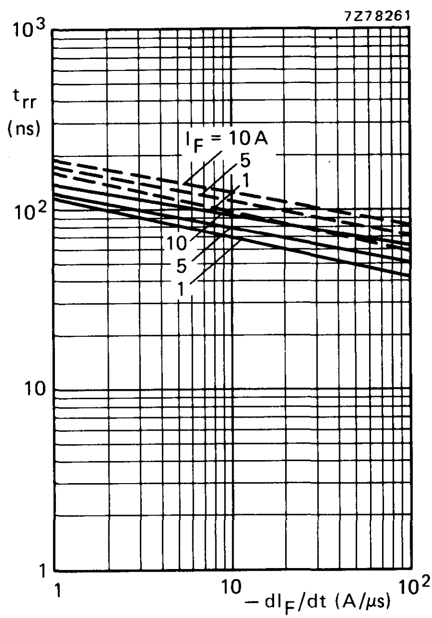
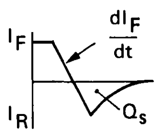


Fig. 9 T_j = 100 °C; maximum values.





Definition of Q_s in Figs 8 and 9.

Fig. 10 Maximum values; ——— T_j = 25 °C; ----- T_j = 100 °C.

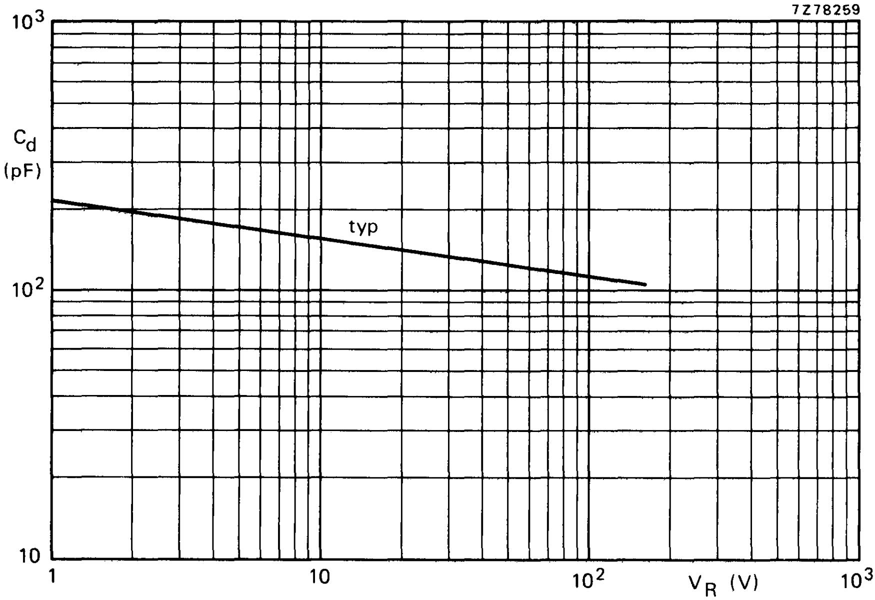


Fig. 11 f = 1 MHz; T_j = 25 °C.

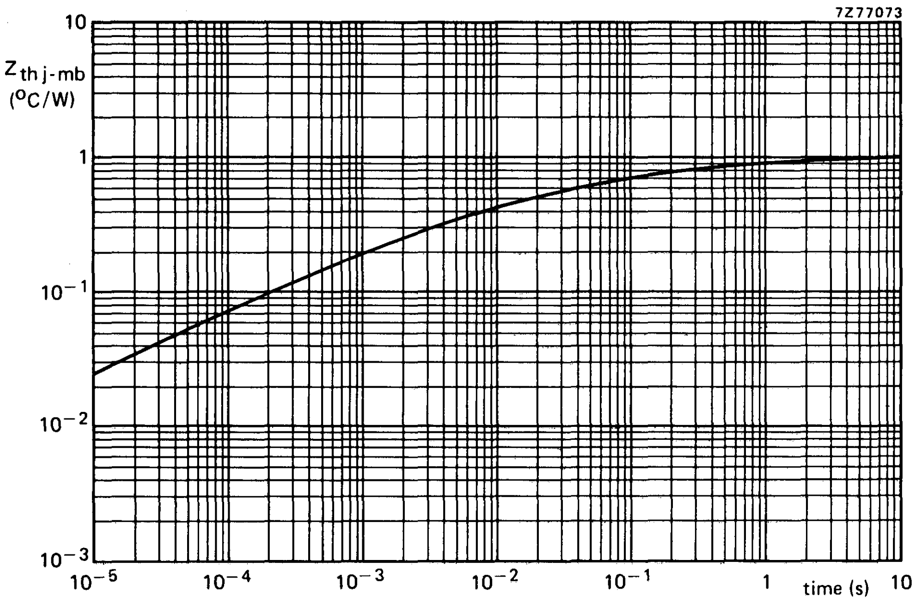


Fig. 12.

SILICON RECTIFIER DIODES

Also available to BS9331-F131

The BYX22–600 and BYX22–1200 are silicon diodes in a metal DO–1 envelope, intended for power rectifier applications up to 1.4 A.

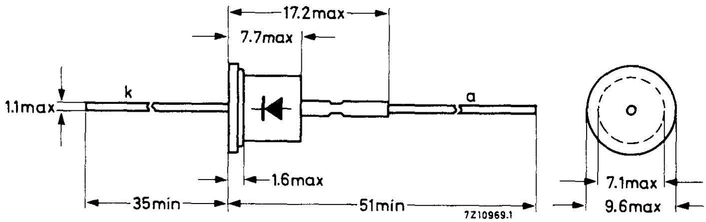
QUICK REFERENCE DATA

			BYX22–600	1200	
Crest working reverse voltage	V_{RWM}	max.	400	800	V
Repetitive peak reverse voltage	V_{RRM}	max.	600	1200	V
Average forward current	$I_{F(AV)}$	max.	1.4		A
Non-repetitive peak forward current	I_{FSM}	max.	40		A

MECHANICAL DATA

Dimensions in mm

DO–1



MOUNTING METHODS see page 3

RATINGS Limiting values in accordance with the Absolute Maximum System (IEC 134)

All information applies to frequencies up to 400Hz

Voltages

		BYX22-600	1200	
Crest working reverse voltage	V_{RWM}	max. 400	800	V
Repetitive peak reverse voltage ($d \leq 1\%$)	V_{RRM}	max. 600	1200	V
Non repetitive peak reverse voltage ($t \leq 10$ ms)	V_{RSM}	max. 600	1200	V

Currents

Average forward current (averaged over any 20 ms period) for R-load up to $T_{amb} = 30\,^oC$	I_{FAV}	max.	1.4	A
Forward current (d.c.) up to $T_{amb} = 30\,^oC$	I_F	max.	1.6	A
Repetitive peak forward current	I_{FRM}	max.	15	A
Non repetitive peak forward current $t = 10$ ms; $T_j = 150\,^oC$ (see page 6)	I_{FSM}	max.	40	A

Temperatures

Storage temperature	T_{stg}		-65 to +150	^oC
Ambient temperature	T_{amb}	max.	150	^oC

THERMAL RESISTANCE

From junction to ambient $R_{th\,j-a}$ See page 3

CHARACTERISTICS

Forward voltage at $I_F = 5A$; $T_{amb} = 25\,^oC$	V_F	<	1.5	V [1]
Reverse current at $V_R = V_{RWMmax}$; $T_{amb} = 125\,^oC$	I_R	<	120	μA

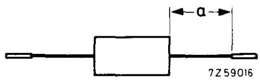
[1]) Measured under pulsed conditions to avoid excessive dissipation.

THERMAL RESISTANCE

Effect of mounting on thermal resistance $R_{th\ j-a}$

The quoted values apply when no other leads run to the tie-points. If leads of other dissipating components share the same tie-points, the thermal resistance will be higher than that quoted.

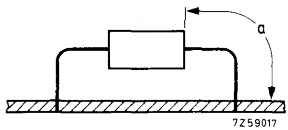
1. Mounted to solder tags at a lead-length a = 10 mm. $R_{th\ j-a}$ = 60 ^{o}C/W



2. Mounted to solder tags at a = maximum lead-length. $R_{th\ j-a}$ = 70 ^{o}C/W

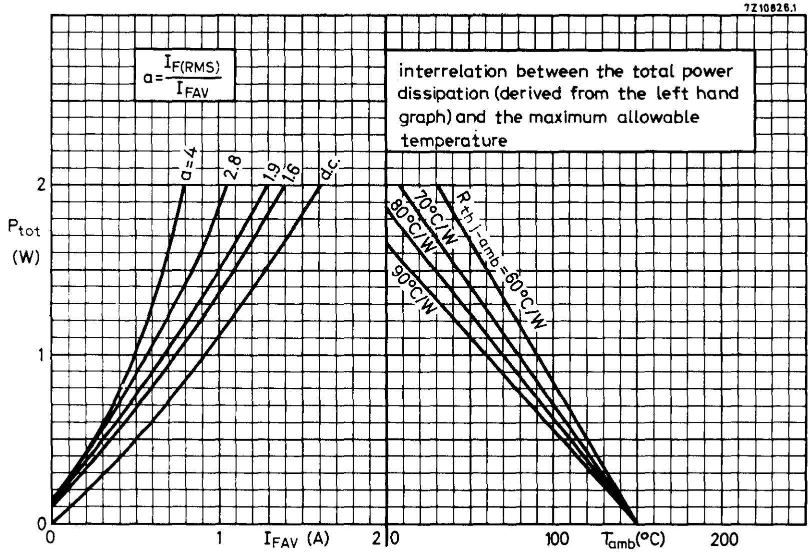
3. Mounted on printed-wiring board at a = maximum lead-length. $R_{th\ j-a}$ = 80 ^{o}C/W

4. Mounted on printed-wiring board at a lead-length a = 10 mm. $R_{th\ j-a}$ = 90 ^{o}C/W



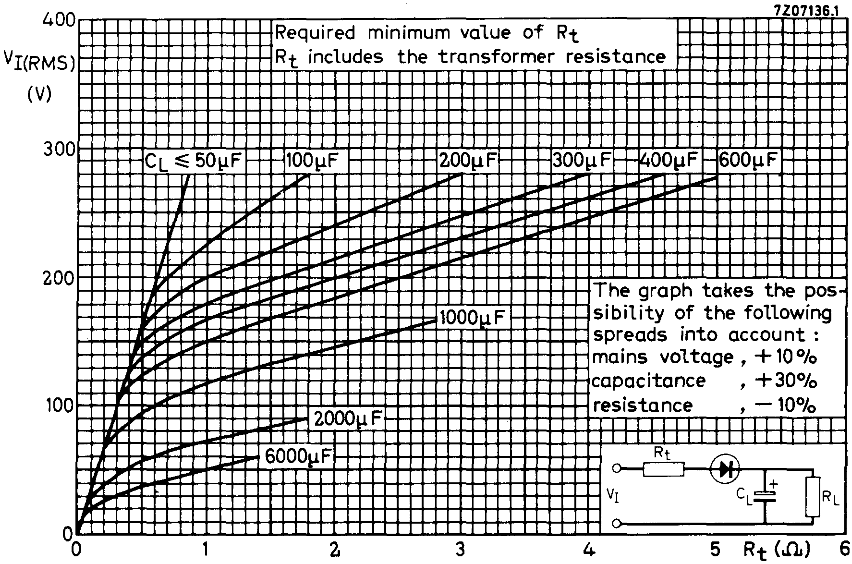
SOLDERING AND MOUNTING NOTES

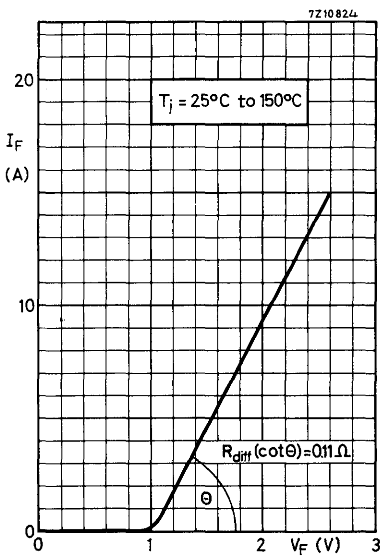
1. At a soldering iron or bath temperature of up to 245 ^{o}C, the maximum permissible soldering time is 10 s if the joint is 5 mm from the seal, 3 s if it is 1.5 mm from the seal.
2. At a temperature between 245 ^{o}C and 400 ^{o}C (max.), the joint must be more than 5 mm from the seal and soldering time must not exceed 5 s.
3. Leads should not be bent less than 1.5 mm from the seal; excert no axial pull when bending.

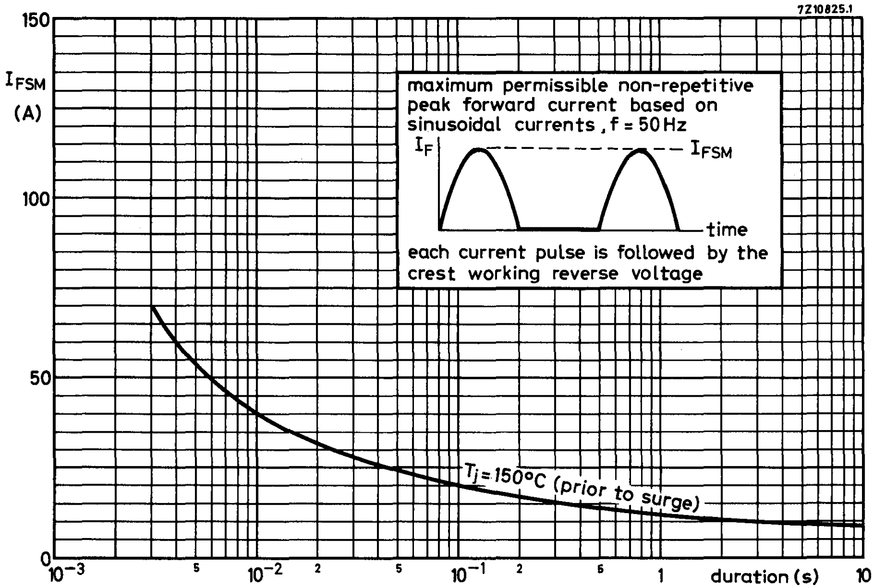


The form factor $a = \frac{I_{F(RMS)} \text{ per diode}}{I_{FAV} \text{ per diode}}$ depends on $n\omega R_L C_L$ and $\frac{R_t + R_{diff}}{nR_L}$ and can be found from existing graphs.

See Application Book: RECTIFIER DIODES.


7Z07136.1
Required minimum value of R_t
R_t includes the transformer resistance
400
$V_{I(RMS)}$
(V)
300
200
100
0
$C_L \leq 50\mu F$
100µF
200µF
300µF
400µF
600µF
1000µF
2000µF
6000µF
The graph takes the possibility of the following spreads into account :
mains voltage , +10%
capacitance , +30%
resistance , −10%
R_t
V_I
C_L
R_L
0
1
2
3
4
5
R_t (Ω)
6


7Z10824
T_j = 25°C to 150°C
20
I_F
(A)
10
0
R_{diff} (cotΘ)=0.11Ω
Θ
0
1
2
V_F (V)
3


7Z10825.1
150
I_{FSM}
(A)
100
50
0
maximum permissible non-repetitive peak forward current based on sinusoidal currents, f = 50 Hz
I_F
I_{FSM}
time
each current pulse is followed by the crest working reverse voltage
T_j = 150°C (prior to surge)
10^{-3}
5
10^{-2}
2
5
10^{-1}
2
5
1
duration (s)
10

CONTROLLED AVALANCHE RECTIFIER DIODES

Also available to BS9333–F003

Diffused silicon diodes in DO–4 metal envelopes, capable of absorbing transients and intended for power rectifier applications. The series consists of the following types:
Normal polarity (cathode to stud): BYX25–600 to BYX25–1400. ←
Reverse polarity (anode to stud): BYX25–600R to BYX25–1400R.

QUICK REFERENCE DATA

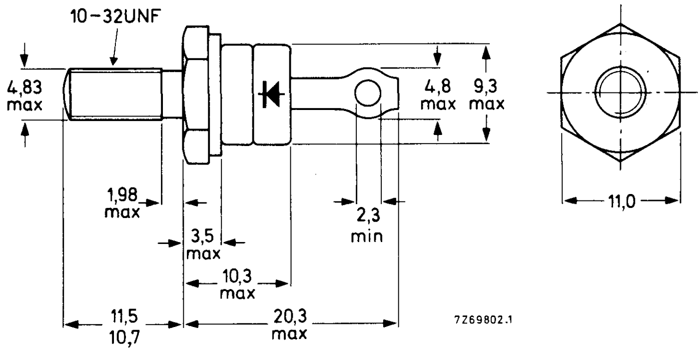
			BYX25–600(R)	800(R)	1000(R)	1200(R)	1400(R)	
Crest working reverse voltage	V_{RWM}	max.	600	800	1000	1200	1400	V
Reverse avalanche breakdown voltage	$V_{(BR)R}$	>	750	1000	1250	1450	1650	V
Average forward current	$I_{F(AV)}$	max.			20			A
Non-repetitive peak forward current	I_{FSM}	max.			360			A
Non-repetitive peak reverse power	P_{RSM}	max.			18			kW

←

MECHANICAL DATA

Dimensions in mm

Fig. 1 DO–4.



Net mass: 7 g.

Diameter of clearance hole: max. 5.2 mm.

Accessories supplied on request:
56295 (PTFE bush, 2 mica washers, plain washer, tag).
56262A (mica washer, insulating ring, plain washer).

Supplied with device: 1 nut, 1 lock washer.

Nut dimensions across the flats: 9.5 mm

The mark shown applies to the normal polarity types.

Torque on nut:
min. 0.9 Nm (9 kg cm),
max. 1.7 Nm (17 kg cm).

RATINGS

Limiting values in accordance with the Absolute Maximum System (IEC134)

→ **Voltages***

			BYX25–600(R)	800(R)	1000(R)	1200(R)	1400(R)	
Crest working reverse voltage	V_{RWM}	max.	600	800	1000	1200	1400	V
Continuous reverse voltage	V_R	max.	600	800	1000	1200	1400	V

Currents

Average forward current (averaged over any 20 ms period)	$I_{F(AV)}$	max.	20	A
Repetitive peak forward current	I_{FRM}	max.	440	A
Non-repetitive peak forward current t = 10 ms (half sine-wave); T_j = 175 °C prior to surge; with reapplied V_{RWMmax}	I_{FSM}	max.	360	A
I^2t for fusing	I^2t	max.	650	A^2s

Reverse power dissipation

Average reverse power dissipation (averaged over any 20 ms period); T_j = 175 °C	$P_{R(AV)}$	max.	38	W
Repetitive peak reverse power dissipation t = 10 μs (square-wave; f = 50 Hz); T_j = 175 °C	P_{RRM}	max.	3	kW
Non-repetitive peak reverse power dissipation t = 10 μs (square-wave) T_j = 25 °C prior to surge	P_{RSM}	max.	18	kW
T_j = 175 °C prior to surge	P_{RSM}	max.	3	kW

Temperatures

Storage temperature	T_{stg}		−55 to +175	°C
Junction temperature	T_j	max.	175	°C

*To ensure thermal stability: $R_{th\ j\text{-}a} < 5$ °C/W (a.c.)

THERMAL RESISTANCE

From junction to ambient in free air	$R_{th\ j\text{-}a}$	=	50	°C/W
From junction to mounting base	$R_{th\ j\text{-}mb}$	=	1.3	°C/W
From mounting base to heatsink	$R_{th\ mb\text{-}h}$	=	0.5	°C/W

CHARACTERISTICS

			BYX25–600(R)	800(R)	1000(R)	1200(R)	1400(R)	
Forward voltage I_F = 50 A; T_j = 25 °C	V_F	<	1.8	1.8	1.8	1.8	1.8	V*
Reverse avalanche breakdown voltage I_R = 5 mA; T_j = 25 °C	$V_{(BR)R}$	> <	750 2000	1000 2000	1250 2000	1450 2200	1650 2400	V V
Peak reverse current $V_R = V_{RWMmax}$; T_j = 125 °C	I_R	<	1.0	0.8	0.6	0.5	0.5	mA

←

*Measured under pulse conditions to avoid excessive dissipation.

OPERATING NOTES

1. **Voltage sharing of series connected controlled avalanche diodes.**

   If diodes with avalanche characteristics are connected in series, the usual R and C elements for voltage sharing can be omitted.

2. The top connector should not be bent; it should be soldered into the circuit so that there is no strain on it.

   During soldering the heat conduction to the junction should be kept to a minimum by using a thermal shunt.

Determination of the heatsink thermal resistance

Example:

Assume a diode, used in a three phase rectifier circuit.

frequency	f	= 50 Hz
average forward current	I_{FAV}	= 10 A (per diode)
ambient temperature	T_{amb}	= 40 °C
repetitive peak reverse power dissipation in the avalanche region	P_{RRM}	= 2 kW (per diode)
duration of P_{RRM}	t	= 40 µs

From the left hand part of the upper graph on page 5 it follows that at I_{FAV} = 10 A in a three phase rectifier circuit the average forward power + average leakage power = 19.5 W per diode (point A). The average reverse power in the avalanche region, averaged over any cycle, follows from:

$$P_{RAV} = \delta \times P_{RRM}, \text{ where the duty cycle } \delta = \frac{40\ \mu s}{20\ ms} = 0.002$$

Thus: $P_{RAV} = 0.002 \times 2\ kW = 4\ W$

Therefore the total device power dissipation $P_{tot} = (19.5 + 4)\ W = 23.5\ W$ (point B).

In order to avoid excessive peak junction temperatures resulting from the pulse character of the repetitive peak reverse power in the avalanche region, the value of the maximum junction temperature should be reduced. If the repetitive peak reverse power in the avalanche region is 2 kW; t = 40 µs; f = 50 Hz, the maximum allowable junction temperature should be 163 °C instead of 175 °C, thus 12 °C lower (see the lower graph on page 5).

Allowance can be made for this by assuming an ambient temperature 12 °C higher than before, in this case 52 °C instead of 40 °C.

Using this in the curve leads to a thermal resistance

$$R_{th\ mb\text{-}a} \approx 4\ ^oC/W$$

The contact thermal resistance $R_{th\ mb\text{-}h} = 0.5\ ^oC/W$

Hence the heatsink thermal resistance should be:

$$R_{th\ h\text{-}a} = R_{th\ mb\text{-}a} - R_{th\ mb\text{-}h} = (4 - 0.5)\ ^oC/W = 3.5\ ^oC/W$$

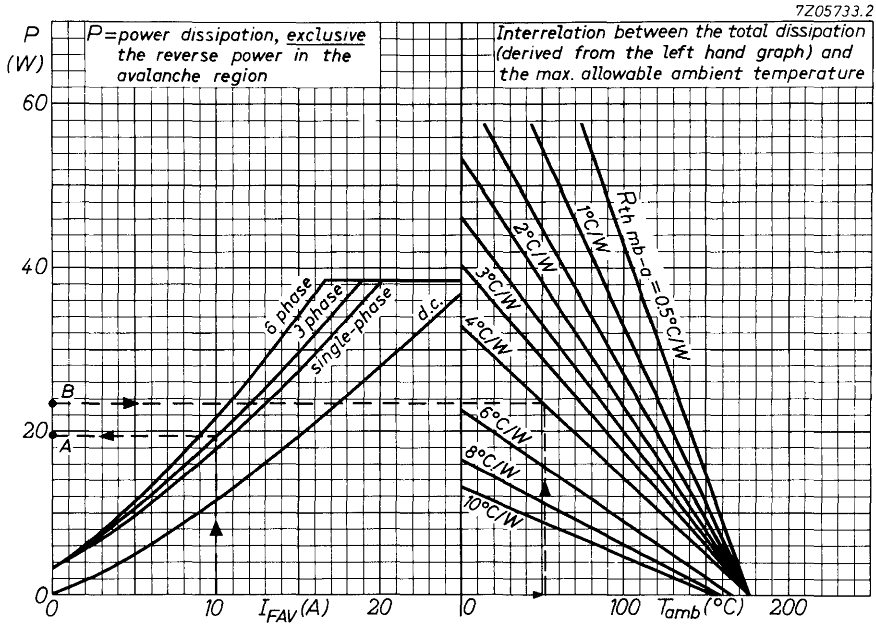

7Z05733.2
P (W)
P=power dissipation, exclusive the reverse power in the avalanche region
Interrelation between the total dissipation (derived from the left hand graph) and the max. allowable ambient temperature
6 phase
3 phase
single-phase
d.c.
B
A
Rth mb-a = 0.5°C/W
1°C/W
2°C/W
3°C/W
4°C/W
6°C/W
8°C/W
10°C/W
0
20
40
60
10
I_{FAV} (A)
100
T_{amb} (°C)
200

Fig.2

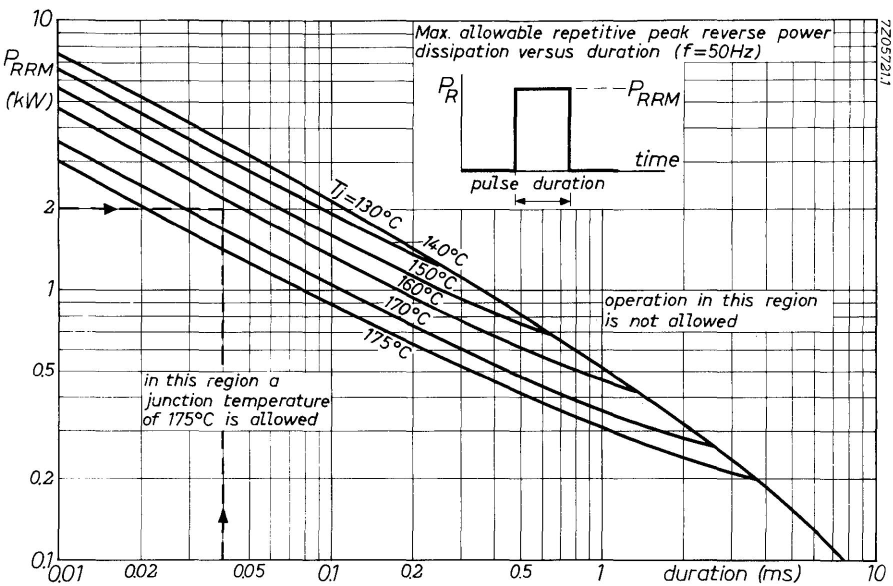

7Z05721.1
P_{RRM} (kW)
Max. allowable repetitive peak reverse power dissipation versus duration (f=50Hz)
P_R
P_{RRM}
time
pulse duration
T_j=130°C
140°C
150°C
160°C
170°C
175°C
operation in this region is not allowed
in this region a junction temperature of 175°C is allowed
10
2
1
0.5
0.2
0.1
0.01
0.02
0.05
0.1
0.2
0.5
1
duration (ms)
10

Fig.3

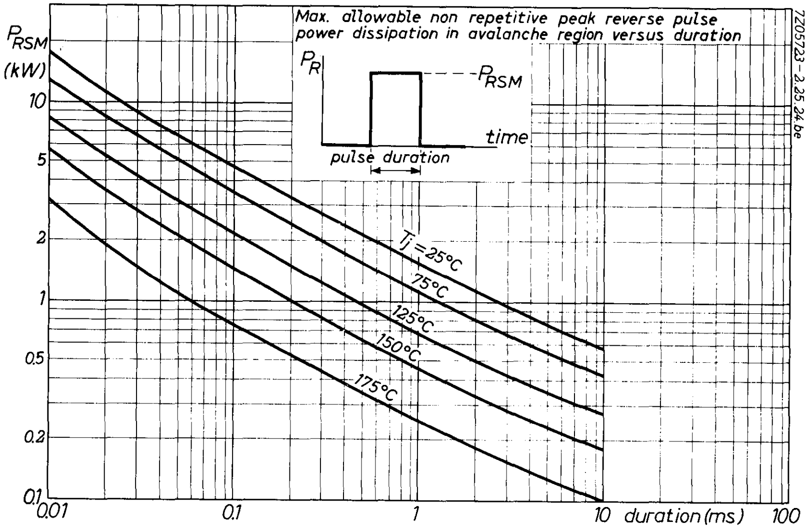

Max. allowable non repetitive peak reverse pulse power dissipation in avalanche region versus duration
P_R
P_{RSM}
time
pulse duration
P_{RSM} (kW)
10
5
2
1
0.5
0.2
0.1
0.01
0.1
1
10
duration (ms)
100
T_j = 25°C
75°C
125°C
150°C
175°C
7Z05723-2.25.24.be

Fig.4

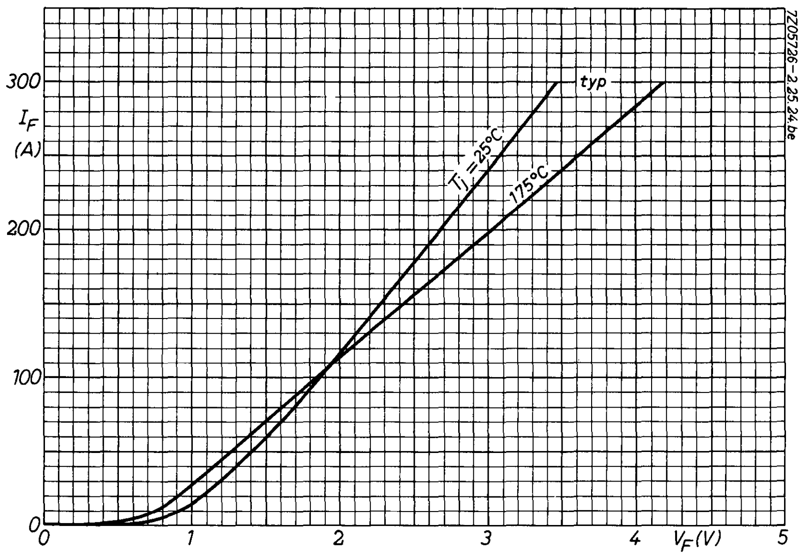

300
I_F (A)
200
100
0
0
1
2
3
4
V_F (V)
5
typ
T_j = 25°C
175°C
7Z05726-2.25.24.be

Fig.5

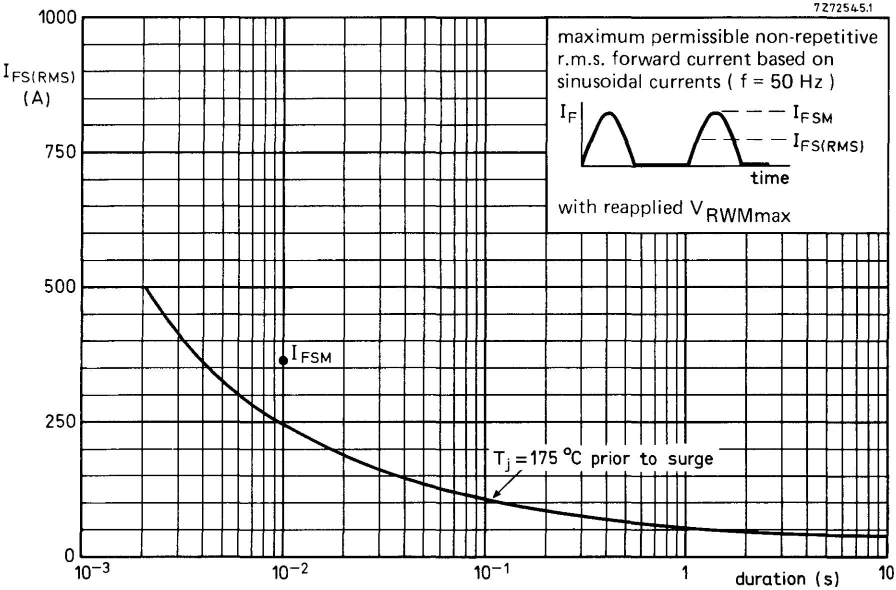

7Z72545.1
1000
$I_{FS(RMS)}$
(A)
750
500
250
0
10^{-3}
10^{-2}
10^{-1}
1
duration (s)
10
maximum permissible non-repetitive r.m.s. forward current based on sinusoidal currents (f = 50 Hz)
I_F
I_{FSM}
$I_{FS(RMS)}$
time
with reapplied V_{RWMmax}
I_{FSM}
$T_j = 175\ ^\circ C$ prior to surge

Fig.6

FAST SOFT-RECOVERY RECTIFIER DIODES

- **With controlled avalanche**

Also available to BS9333-F002

Diffused silicon diodes in DO-4 metal envelopes, capable of absorbing transients. They are primarily intended for use in high-frequency power supplies, thyristor inverters and multi-phase power rectifier applications.
The series consists of the following types:
Normal polarity (cathode to stud): BYX30-200 to BYX30-600
Reverse polarity (anode to stud): BYX30-200R to BYX30-600R.

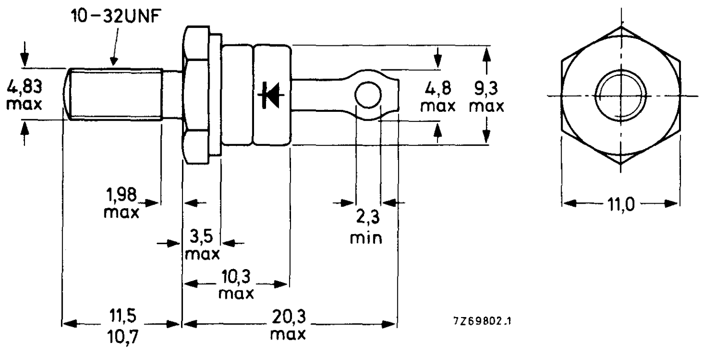
QUICK REFERENCE DATA

			BYX30-200(R)	300(R)	400(R)	500(R)	600(R)	
Crest working reverse voltage	V_{RWM}	max.	200	300	400	500	600	V
Reverse avalanche breakdown voltage	$V_{(BR)R}$	>	250	375	500	625	750	V
Average forward current	$I_{F(AV)}$	max.			14			A
Non-repetitive peak forward current	I_{FSM}	max.			250			A
Non-repetitive peak reverse power	P_{RSM}	max.			18			kW
Reverse recovery time	t_{rr}	<			200			ns

MECHANICAL DATA

Dimensions in mm

DO-4; Supplied with device: 1 nut, 1 lock-washer
Nut dimensions across the flats: 9.5 mm



Net mass: 7 g
Diameter of clearance hole: max. 5.2 mm
Accessories supplied on request:
56295 (PTFE bush, 2 mica washers, plain washer, tag)

Torque on nut: min. 0.9 Nm (9 kg cm)
max. 1.7 Nm (17 kg cm)

The mark shown applies to the normal polarity types.

RATINGS Limiting values in accordance with the Absolute Maximum System (IEC134)

Voltages [1]		BYX30-200(R)	300(R)	400(R)	500(R)	600(R)	
Crest working reverse voltage	V_{RWM}	max. 200	300	400	500	600	V
Continuous reverse voltage	V_R	max. 200	300	400	500	600	V

Currents

Average forward current (averaged over any 20 ms period) up to T_{mb} = 100 °C	$I_{F(AV)}$	max.	14	A
at T_{mb} = 125 °C	$I_{F(AV)}$	max.	7.5	A
R.M.S. forward current	$I_{F(RMS)}$	max.	22	A
Repetitive peak forward current	I_{FRM}	max.	310	A
Non-repetitive peak forward current (t = 10 ms; half-sinewave) T_j = 150 °C prior to surge; with reapplied V_{RWM} max.	I_{FSM}	max.	250	A
I^2t for fusing (t = 10 ms)	I^2t	max.	312	A^2s

Reverse power dissipation

Repetitive peak reverse power dissipation t = 10 µs (square wave; f = 50 Hz) T_j = 150 °C	P_{RRM}	max.	5.5	kW
Non-repetitive peak reverse power dissipation t = 10 µs (square wave) T_j = 25 °C prior to surge	P_{RSM}	max.	18	kW
T_j = 150 °C prior to surge	P_{RSM}	max.	5.5	kW

Temperatures

Storage temperature	T_{stg}	-55 to +150		°C
Junction temperature	T_j	max.	150	°C

THERMAL RESISTANCE

From junction to ambient in free air	$R_{th\ j-a}$	=	50	°C/W
From junction to mounting base	$R_{th\ j-mb}$	=	1.3	°C/W
From mounting base to heatsink	$R_{th\ mb-h}$	=	0.5	°C/W

---

1) To ensure thermal stability: $R_{th\ j-a}$ < 2.5 °C/W (continuous reverse voltage) or < 5 °C/W (a.c.).
For smaller heatsinks T_j max should be derated. For a.c. see page 5.
For continuous reverse voltage: if $R_{th\ j-a}$ = 5 °C/W, then T_j max = 135 °C.
if $R_{th\ j-a}$ = 10 °C/W, then T_j max = 120 °C.

CHARACTERISTICS

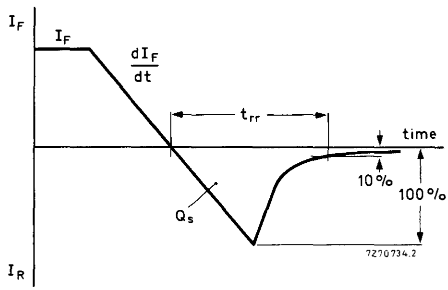
			BYX30-200(R)	300(R)	400(R)	500(R)	600(R)	
Forward voltage								
$I_F = 50$ A; $T_j = 25\ ^oC$	V_F	<	3.2	3.2	3.2	3.2	3.2	V [1]
Reverse breakdown voltage								
$I_R = 5$ mA; $T_j = 25\ ^oC$	$V_{(BR)R}$	>	250	375	500	625	750	V
		<	1050	1050	1050	1050	1050	V
Reverse current								
$V_R = V_{RWMmax}$; $T_j = 125\ ^oC$	I_R	<	4.0	4.0	4.0	4.0	4.0	mA

Reverse recovery charge when switched from

$I_F = 2$ A to $V_R \geq 30$ V; with $-dI_F/dt = 100$ A/μs; $T_j = 25\ ^oC$	Q_s	<	0.70	μC

Reverse recovery time when switched from

$I_F = 1$ A to $V_R \geq 30$ V; $-dI_F/dt = 50$ A/μs; $T_j = 25\ ^oC$	t_{rr}	<	200	ns



OPERATING NOTES

1. Square-wave operation

When I_F has been flowing sufficiently long for the steady state to be established, there will be a charge due to minority carriers present. Before the device can block in the reverse direction this charge must be extracted. This extraction takes the form of a reverse transient (see figure above). The majority of the power dissipation due to the reverse transient occurs during fall time as the rectifier gradually becomes reverse biased, and the mean power will be proportional to the operating frequency. The mean value of this power loss can be derived from the graphs on page 10.

[1]) Measured under pulse conditions to avoid excessive dissipation.

OPERATING NOTES (continued)

2. Sine wave operation

Power loss in sine wave operation will be considerably less owing to the much slower rate of change of the applied voltage (and consequently lower values of I_{RRM}), so that power loss due to reverse recovery may be safely ignored for frequencies up to 20 kHz.

3. Determination of the heatsink thermal resistance

Example:
Assume a diode, used in an inverter.

frequency	f	=	20	kHz
duty cycle	δ	=	0.5	
ambient temperature	T_{amb}	=	45	^oC
switched from	I_F	=	12	A
to	V_R	=	400	V
at a rate	$-\frac{dI}{dt}$	=	20	A/μs

At a duty cycle δ = 0.5 the average forward current I_{FAV} = 6 A.
From the upper graph on page 5 it follows, that at I_{FAV} = 6 A the average forward power + average leakage power = 15 W (point A).
The additional power losses due to switching-off can be read from the nomogram on page 10 (the example being based on optimum use, i.e. T_j = 150 ^oC). Starting from I_F = 12 A on the horizontal scale trace upwards until the appropriate line $-\frac{dI}{dt}$ = 20 A/μs. From the intersection trace horizontally to the right until the line for f = 20 kHz. Then trace downwards to the line V_R = 400 V and ultimately trace horizontally to the left and on the vertical axis read the additional average power dissipation P_{RAV} = 4 W.
Therefore the total power dissipation P_{tot} = 15 W + 4 W = 19 W (point B of the upper graph on page 5). From the right hand part follows the thermal resistance, required at T_{amb} = 45 ^oC.

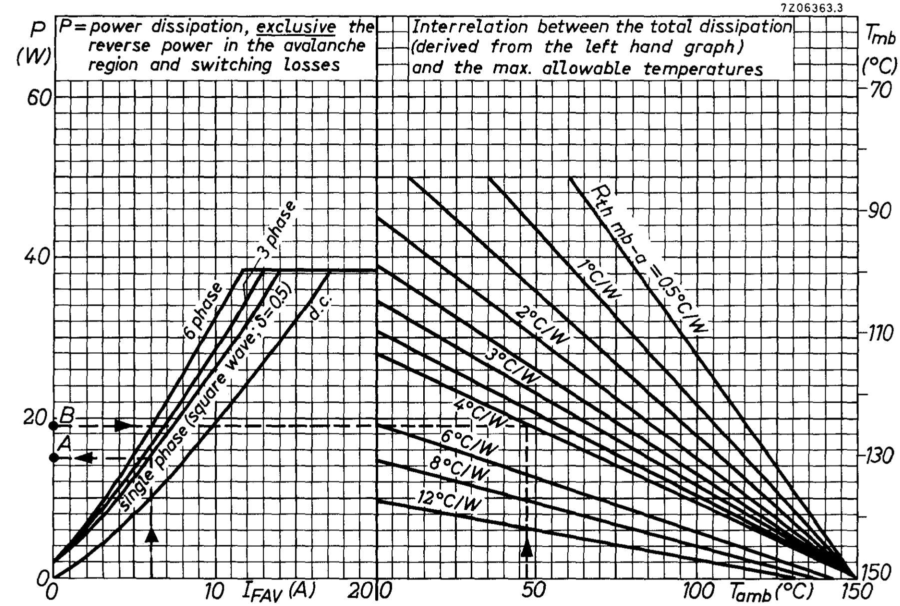
$$R_{th\ mb\text{-}a} \approx 4\ ^oC/W$$

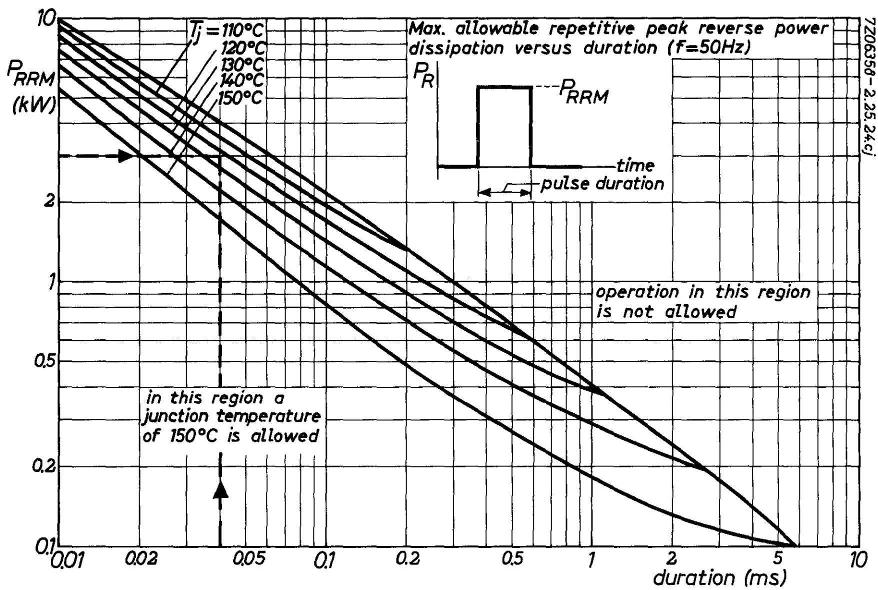
The contact thermal resistance $R_{th\ mb\text{-}h}$ = 0.5 ^oC/W.

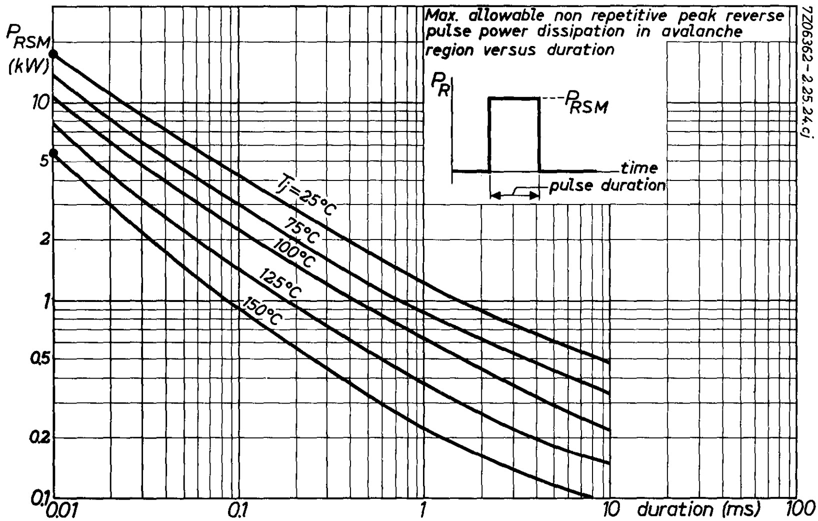
Hence the heatsink thermal resistance should be:

$$R_{th\ h\text{-}a} = R_{th\ mb\text{-}a} - R_{th\ mb\text{-}h} = (4 - 0.5)\ ^oC/W = 3.5\ ^oC/W.$$

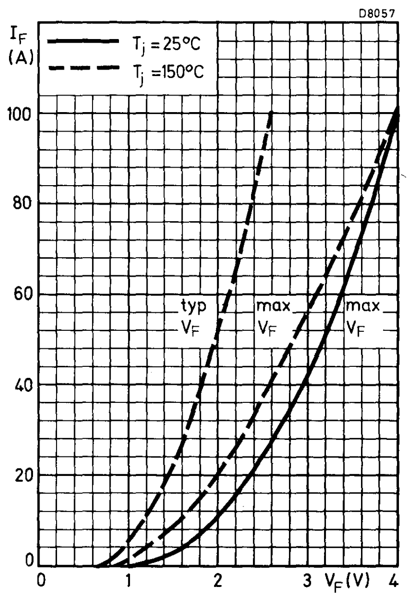
The applicable heatsink(s) may then be found in the Section HEATSINKS.


7Z06363.3
P (W)
P = power dissipation, exclusive the reverse power in the avalanche region and switching losses
Interrelation between the total dissipation (derived from the left hand graph) and the max. allowable temperatures
6 phase
3 phase
single phase (square wave; δ=0.5)
d.c.
B
A
I_{FAV} (A)
$R_{th\ mb-a}$ = 0.5°C/W
1°C/W
2°C/W
3°C/W
4°C/W
6°C/W
8°C/W
12°C/W
T_{amb} (°C)
T_{mb} (°C)

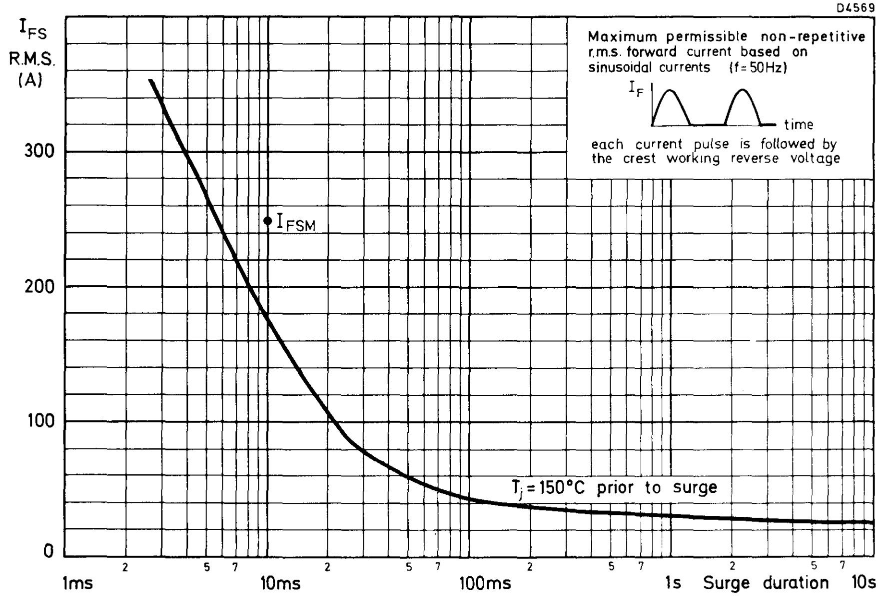

P_{RRM} (kW)
T_j = 110°C
120°C
130°C
140°C
150°C
Max. allowable repetitive peak reverse power dissipation versus duration (f=50Hz)
P_R
P_{RRM}
time
pulse duration
operation in this region is not allowed
in this region a junction temperature of 150°C is allowed
duration (ms)
7Z06356-2.25.24.cj

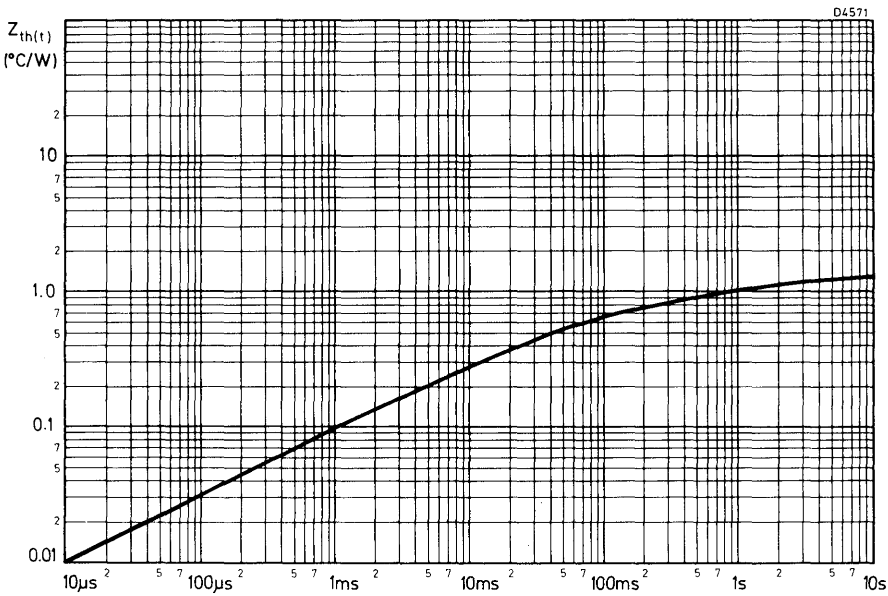


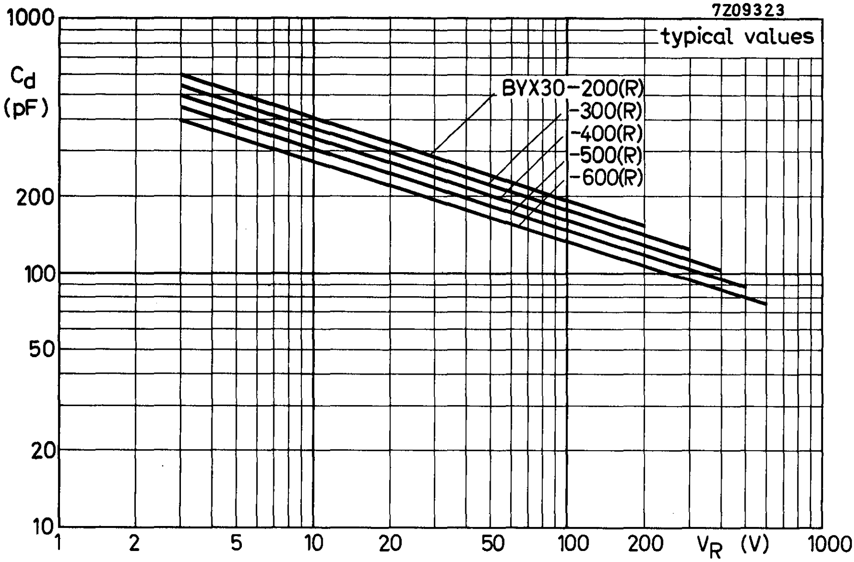
P_{RSM} (kW)
Max. allowable non repetitive peak reverse pulse power dissipation in avalanche region versus duration
P_R
P_{RSM}
time
pulse duration
7Z06362-2.25.24.cj
T_j=25°C
75°C
100°C
125°C
150°C
10
5
2
1
0.5
0.2
0.1
0.01
0.1
1
10
duration (ms)
100

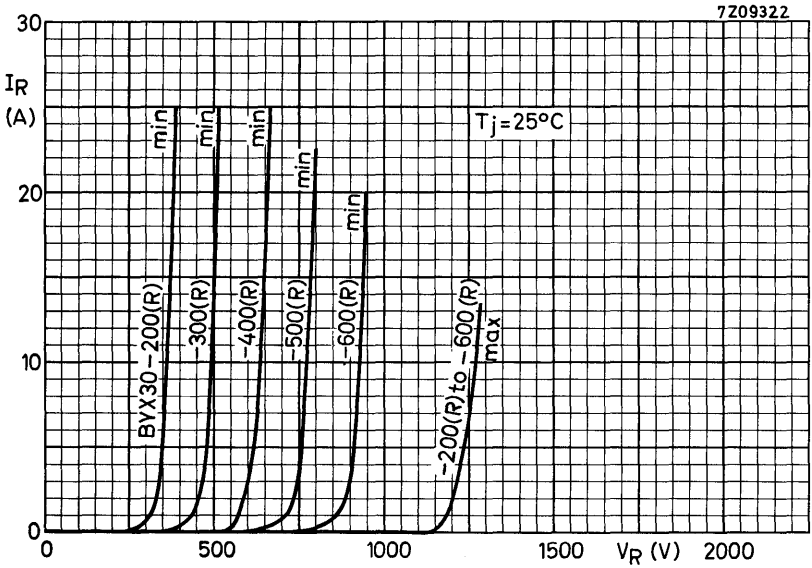


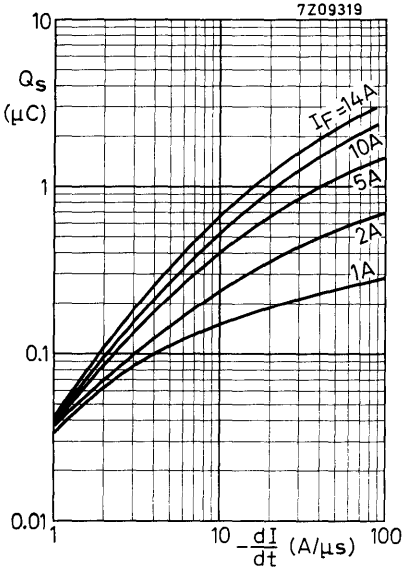
D8057
I_F (A)
T_j = 25°C
T_j = 150°C
typ V_F
max V_F
max V_F
100
80
60
40
20
0
0
1
2
3
V_F (V)
4


D4569
I_{FS}
R.M.S.
(A)
300
200
100
0
Maximum permissible non-repetitive r.m.s. forward current based on sinusoidal currents (f = 50Hz)
I_F
time
each current pulse is followed by the crest working reverse voltage
I_{FSM}
T_j = 150°C prior to surge
1ms
10ms
100ms
1s
Surge duration
10s

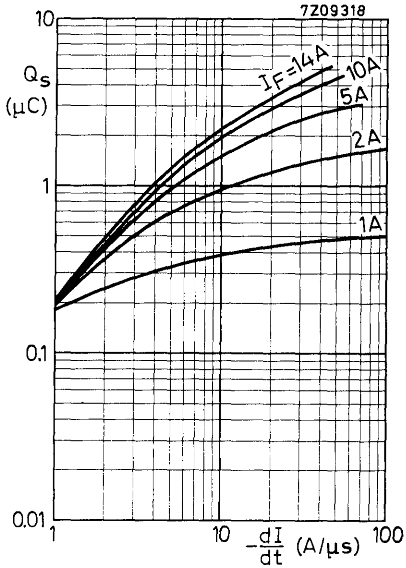

D4571
$Z_{th(t)}$
(°C/W)
10
1.0
0.1
0.01
10µs
100µs
1ms
10ms
100ms
1s
10s


7Z09323
typical values
C_d
(pF)
1000
200
100
50
20
10
BYX30-200(R)
-300(R)
-400(R)
-500(R)
-600(R)
1
2
5
10
20
50
100
200
V_R (V)
1000

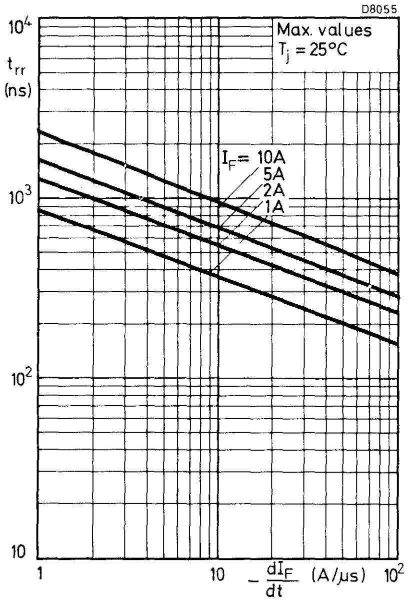

7Z09322
I_R
(A)
30
20
10
0
T_j=25°C
min
min
min
min
min
BYX30-200(R)
-300(R)
-400(R)
-500(R)
-600(R)
-200(R) to -600(R)
max
0
500
1000
1500
V_R (V)
2000

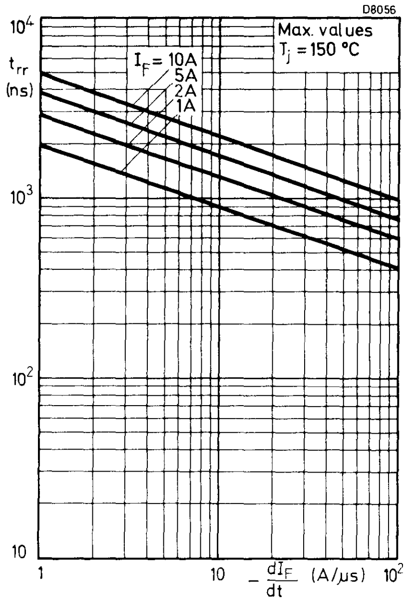


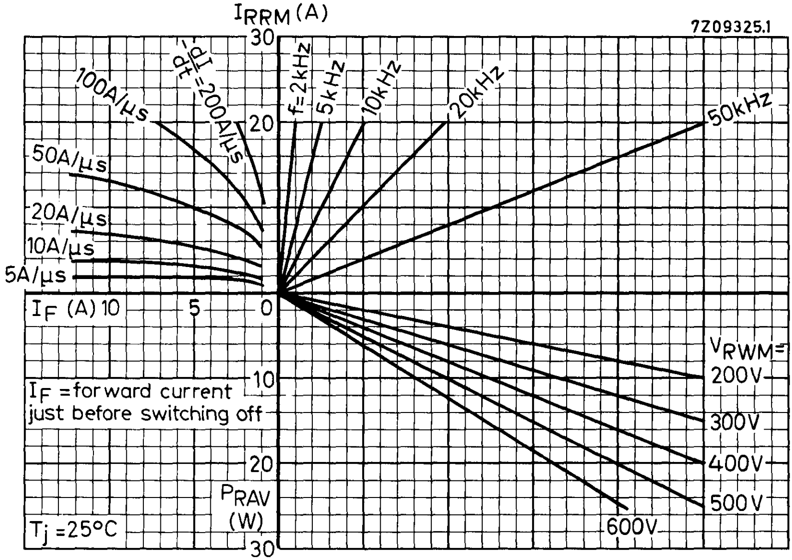
Maximum values; T_j = 25 °C; switched from I_F to $V_R \geqslant 30$ V.

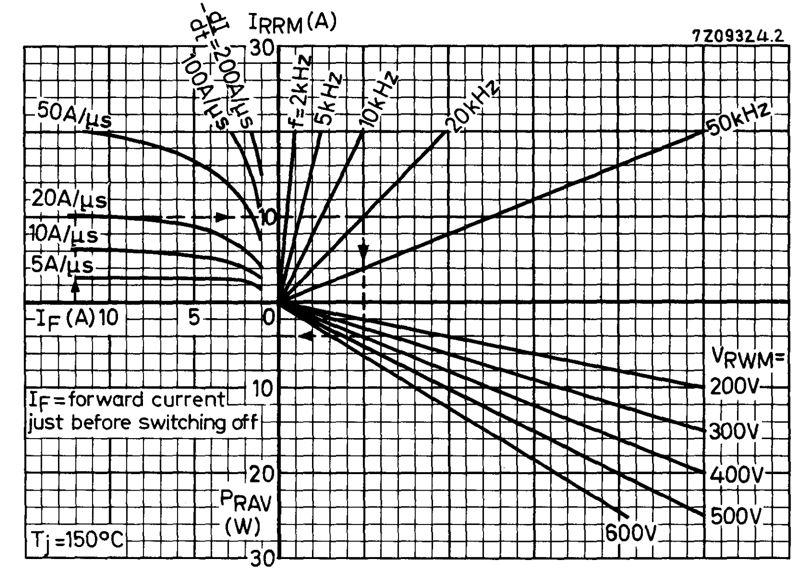


Maximum values; T_j = 150 °C; switched from I_F to $V_R \geqslant 30$ V.









Nomogram: Power loss P_{RAV} due to switching only (square wave operation)

SILICON RECTIFIER DIODES

Diffused silicon diodes in metal envelopes with ceramic insulation, intended for power rectifier application. The series consists of the following types:
Normal polarity (cathode to stud): BYX32–600 to BYX32–1600
Reverse polarity (anode to stud): BYX32–600R to BYX32–1600R

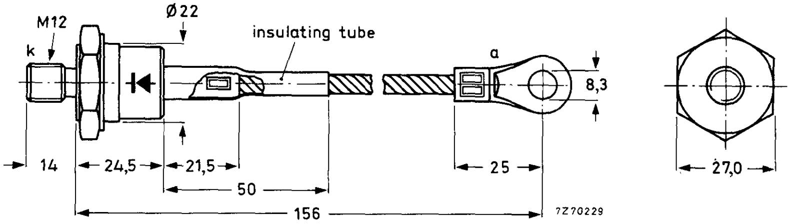
QUICK REFERENCE DATA

			BYX32–	600 600R	800 800R	1000 1000R	1200 1200R	1600 1600R	
Crest working reverse voltage	V_{RWM}	max.		600	800	1000	1200	1200	V
Repetitive peak reverse voltage	V_{RRM}	max.		600	800	1000	1200	1600	V

Average forward current	$I_{F(AV)}$	max.	150	A
Non-repetitive peak forward current	I_{FSM}	max.	1600	A

MECHANICAL DATA

Dimensions in mm



Normal polarity (–|◄–): blue cable. Reverse polarity (–►|–): red cable.

Net mass: 115 g

Diameter of clearance hole: max. 13.0 mm

Torque on nut: min. 10 Nm (100 kg cm)
max. 25 Nm (250 kg cm)

All information applies to frequencies up to 400 Hz.

RATINGS Limiting values in accordance with the Absolute Maximum System (IEC 134)

Voltages [1]			BYX32-	600 600R	800 800R	1000 1000R	1200 1200R	1600 1600R	
Continuous reverse voltage	V_R	max.		600	800	1000	1200	1200	V
Crest working reverse voltage	V_{RWM}	max.		600	800	1000	1200	1200	V
Repetitive peak reverse voltage	V_{RRM}	max.		600	800	1000	1200	1600	V
Non-repetitive peak reverse voltage ($t \leq 10$ ms)	V_{RSM}	max.		650	900	1100	1300	1600	V

Currents

Average forward current (averaged over any 20 ms period) up to T_{mb} = 100 °C	$I_{F(AV)}$	max.	150 A
at T_{mb} = 125 °C	$I_{F(AV)}$	max.	115 A
Forward current (d.c.)	I_F	max.	240 A
R.M.S. forward current	$I_{F(RMS)}$	max.	240 A
Repetitive peak forward current	I_{FRM}	max.	750 A
Non-repetitive peak forward current (t = 10 ms; half sine wave) T_j = 190 °C prior to surge	I_{FSM}	max.	1600 A
I squared t for fusing (t = 10 ms)	I^2t	max.	12800 A^2s

Temperatures

Storage temperature	T_{stg}		-55 to +200 °C
Operating junction temperature	T_j	max.	190 °C

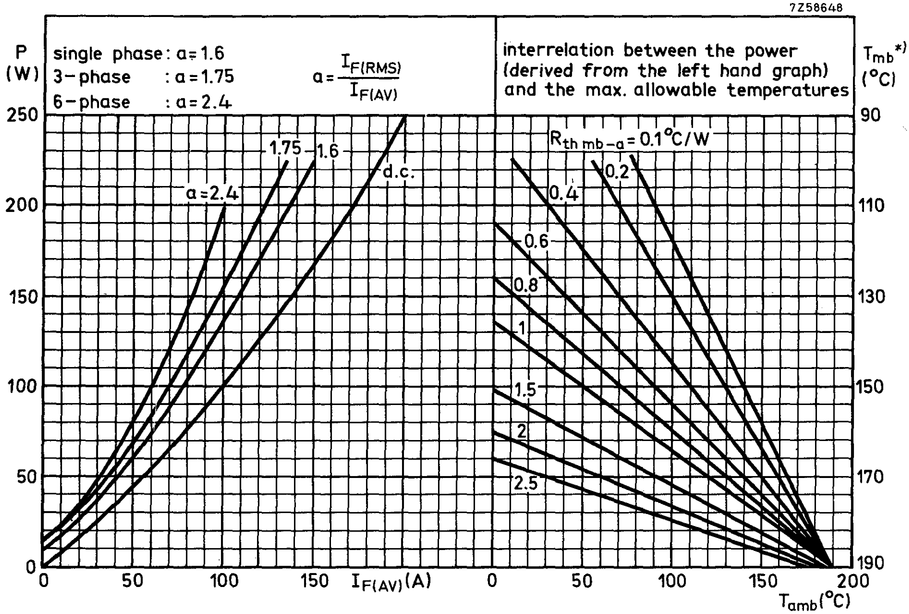
THERMAL RESISTANCE

From junction to mounting base	$R_{th\ j\text{-}mb}$	=	0.4 °C/W
From mounting base to heatsink without heatsink compound	$R_{th\ mb\text{-}h}$	=	0.1 °C/W
From mounting base to heatsink with heatsink compound (Dow Corning 340)	$R_{th\ mb\text{-}h}$	=	0.04 °C/W
Transient thermal impedance; t = 1 ms	$Z_{th\ j\text{-}mb}$	=	0.025 °C/W

[1]) **To ensure thermal stability: $R_{th\ j\text{-}a}$ < 0.75 °C/W (continuous reverse voltage) or < 1.5 °C/W (a.c.)**
For smaller heatsinks T_j should be derated. For a.c. see **graph on page 3.**
For continuous reverse voltage: $R_{th\ j\text{-}a}$ = 1 °C/W, then T_{jmax} = 184 °C
$R_{th\ j\text{-}a}$ = 1.2 °C/W, then T_{jmax} = 180 °C
$R_{th\ j\text{-}a}$ = 1.5 °C/W, then T_{jmax} = 175 °C

CHARACTERISTICS

			BYX32- 600(R)	800(R)	1000(R)	1200(R)	1600(R)	
Forward voltage I_F = 500 A; T_j = 25 °C	V_F	<	1,6	1,6	1,6	1,6	1,6	V [1]
Peak reverse current $V_{RM} = V_{RWMmax}$ T_j = 175 °C	I_{RM}	<	24	18	15	12	12	mA

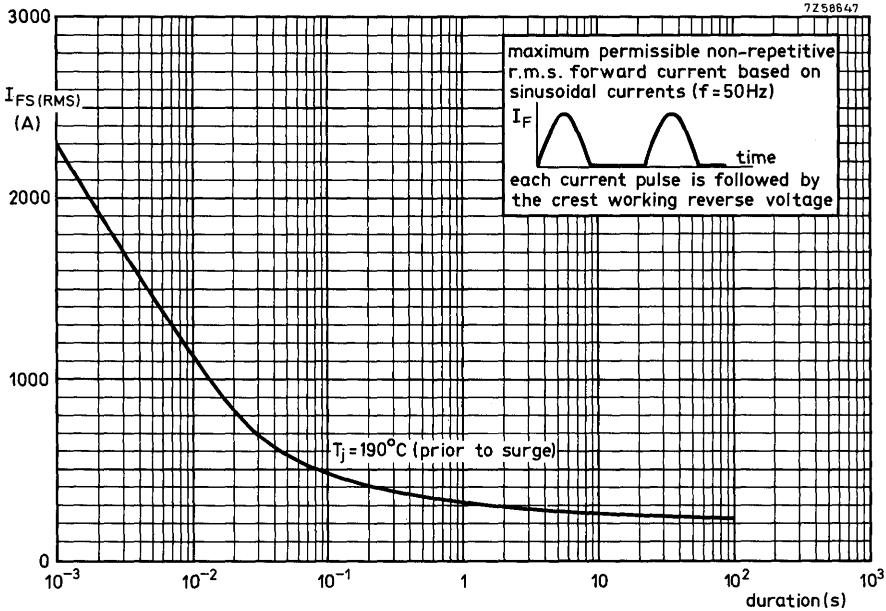


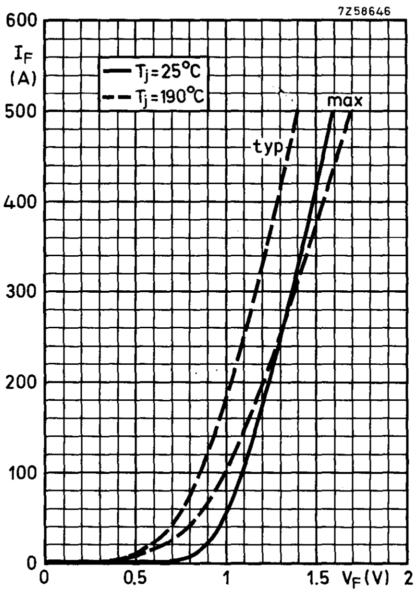
*) T_{mb}-scale is for comparison purposes only and is correct only for $R_{th\ mb-a} \leq 1.1$ °C/W

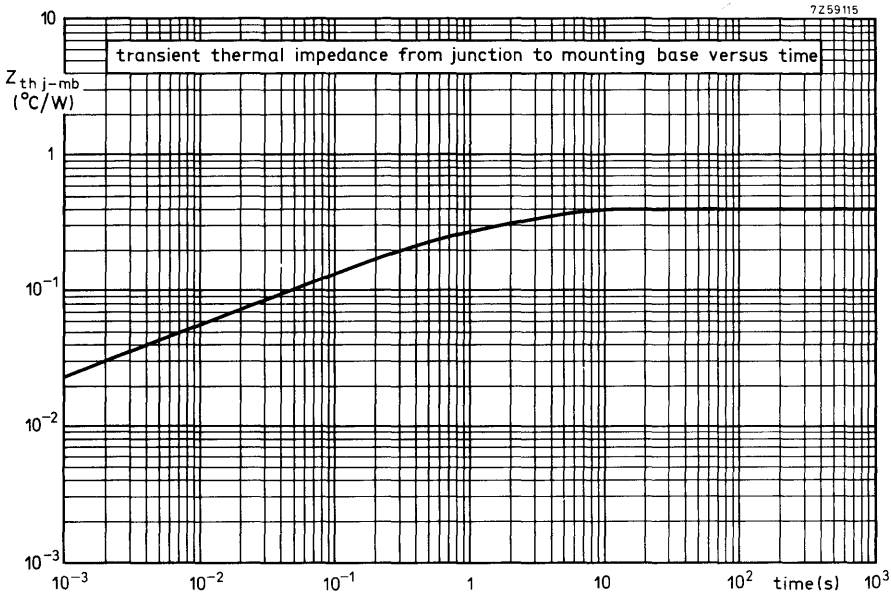
APPLICATION INFORMATION AND OPERATING NOTES

See general pages at the beginning of this section.

[1]) Measured under pulse conditions to avoid excessive dissipation.


7Z58647
3000
2000
1000
0
$I_{FS(RMS)}$
(A)
maximum permissible non-repetitive r.m.s. forward current based on sinusoidal currents (f = 50Hz)
I_F
time
each current pulse is followed by the crest working reverse voltage
T_j = 190°C (prior to surge)
10^{-3}
10^{-2}
10^{-1}
1
10
10^2
10^3
duration (s)


7Z58646
600
I_F
(A)
500
400
300
200
100
0
T_j = 25°C
T_j = 190°C
max
typ
0
0.5
1
1.5
V_F (V)
2


7Z59115
transient thermal impedance from junction to mounting base versus time
Z th j-mb
(°C/W)
10
1
10⁻¹
10⁻²
10⁻³
10⁻³
10⁻²
10⁻¹
1
10
10²
time (s)
10³

SILICON RECTIFIER DIODES

Also available to BS9331-F127

Silicon rectifier diodes in DO-4 metal envelopes, intended for use in power rectifier applications. The series consists of the following types:
Normal polarity (cathode to stud): BYX38-300 to 1200.
Reverse polarity (anode to stud): BYX38-300R to 1200R.

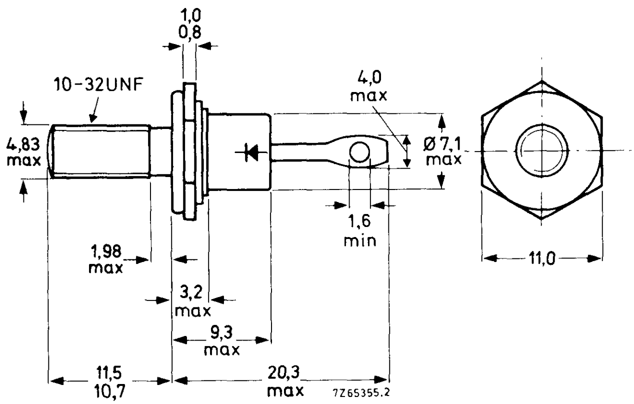
QUICK REFERENCE DATA

			BYX38-300(R)	600(R)	1200(R)	
Repetitive peak reverse voltage	V_{RRM}	max.	300	600	1200	V
Average forward current	$I_{F(AV)}$	max.		6		A
Non-repetitive peak forward current	I_{FSM}	max.		50		A

MECHANICAL DATA

Dimensions in mm

DO-4



Net mass: 6 g

Diameter of clearance hole: max. 5,2 mm

Accessories supplied on request:
56295 (PTFE bush, 2 mica washers, plain washer, tag)
56262A (mica washer, insulating ring, plain washer)

Supplied with device: 1 nut, 1 lock washer
Nut dimensions across the flats: 9,5 mm

The mark shown applies to normal polarity types.

Torque on nut: min. 0,9 Nm
(9 kg cm)
max. 1,7 Nm
(17 kg cm)

RATINGS Limiting values in accordance with the Absolute Maximum System (IEC 134)

Voltages

			BYX38-300(R)	600(R)	1200(R)	
Non-repetitive peak reverse voltage ($t \leq 10$ ms)	V_{RSM}	max.	300	600	1200	V
Repetitive peak reverse voltage ($\delta \leq 0,01$)	V_{RRM}	max.	300	600	1200	V
Crest working reverse voltage	V_{RWM}	max.	200	400	800	V
Continuous reverse voltage	V_R	max.	200	400	800	V

Currents

Average forward current (averaged over any 20 ms period) up to T_{mb} = 110 °C	$I_{F(AV)}$	max.	6	A
at T_{mb} = 125 °C	$I_{F(AV)}$	max.	4	A
R.M.S. forward current	$I_{F(RMS)}$	max.	10	A
Repetitive peak forward current	I_{FRM}	max.	50	A
Non-repetitive peak forward current (t = 10 ms; half sine-wave) T_j = 150 °C prior to surge; with reapplied V_{RWMmax}	I_{FSM}	max.	50	A
I^2t for fusing (t = 10 ms)	I^2t	max.	13	A^2s

Temperatures

Storage temperature	T_{stg}		-55 to +150	°C
Junction temperature	T_j	max.	150	°C

THERMAL RESISTANCE

From junction to ambient in free air	$R_{th\ j-a}$	=	50	°C/W
From junction to mounting base	$R_{th\ j-mb}$	=	4	°C/W
From mounting base to heatsink with heatsink compound	$R_{th\ mb-h}$	=	0,5	°C/W
without heatsink compound	$R_{th\ mb-h}$	=	0,6	°C/W
Transient thermal impedance; t = 1 ms	$Z_{th\ j-mb}$	=	0,3	°C/W

CHARACTERISTICS

Forward voltage

I_F = 20 A; T_j = 25 °C	V_F	<	1,7	V [1]

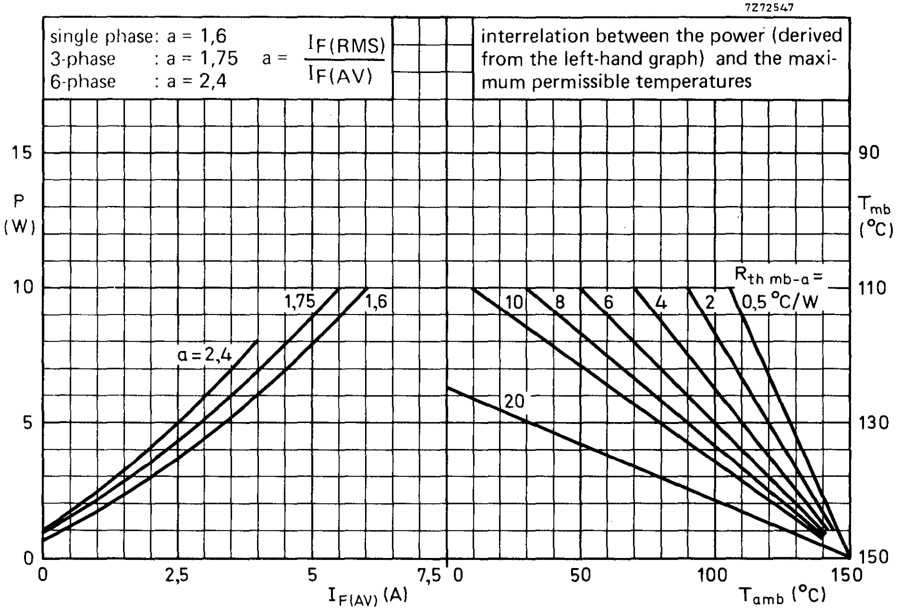
Reverse current

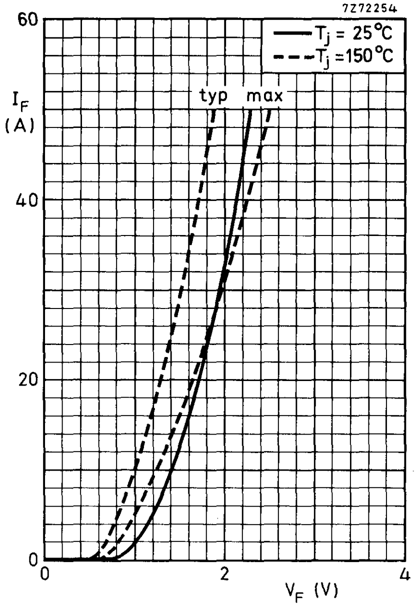
$V_R = V_{RWMmax}$; T_j = 125 °C	I_R	<	200	μA

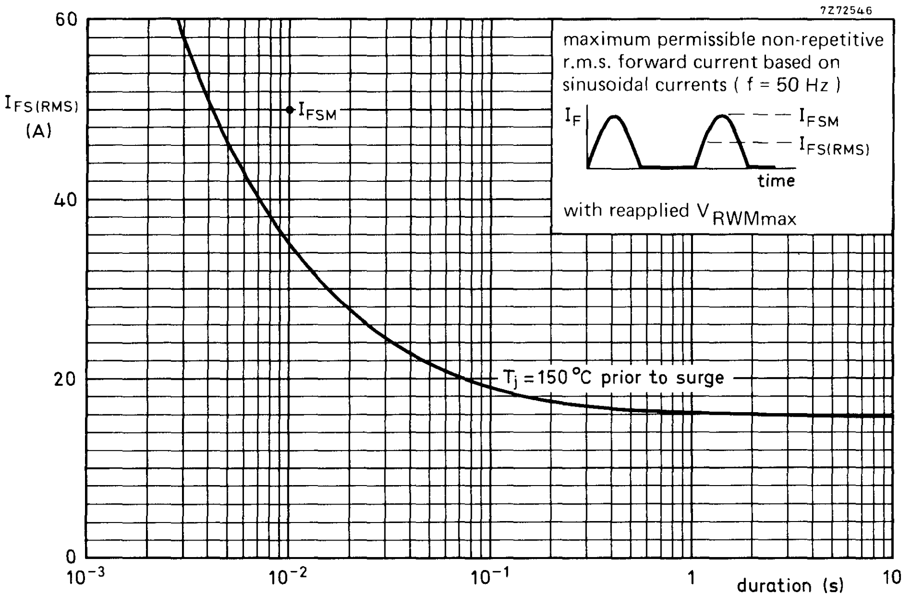
OPERATING NOTES

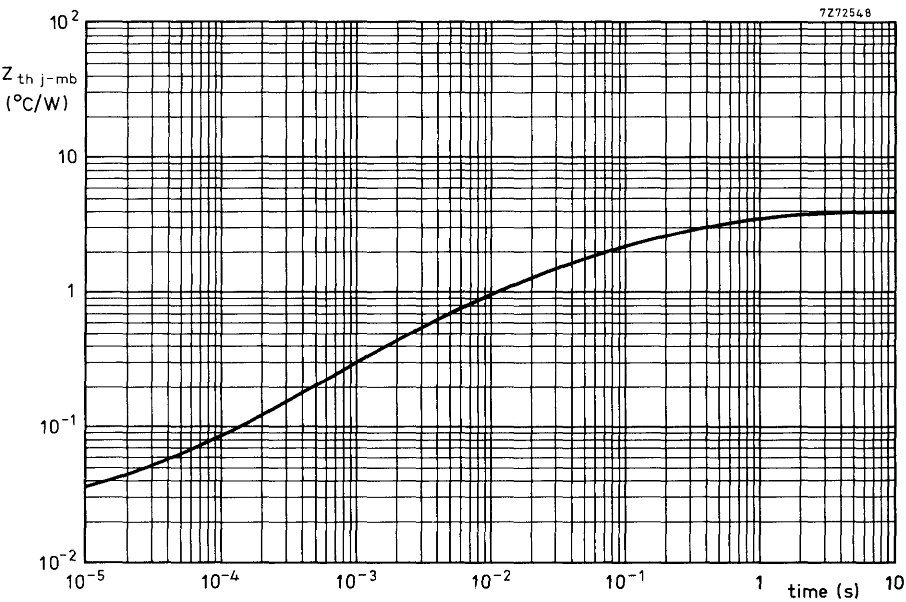
1. The top connector should neither be bent nor twisted; it should be soldered into the circuit so that there is no strain on it.
   During soldering the heat conduction to the junction should be kept to a minimum.
2. Where there is a possibility that transients, due to the energy stored in the transformer, will exceed the maximum permissible non-repetitive peak reverse voltage, see General Section for information on damping circuits in Data Handbook Part SC 1a.

[1]) Measured under pulse conductions to avoid excessive dissipation.


7Z72547
single phase: a = 1,6
3-phase : a = 1,75
6-phase : a = 2,4
a = IF(RMS) / IF(AV)
interrelation between the power (derived from the left-hand graph) and the maximum permissible temperatures
P (W)
15
10
5
0
0
2,5
5
7,5
IF(AV) (A)
a=2,4
1,75
1,6
Tmb (°C)
90
110
130
150
0
50
100
150
Tamb (°C)
Rth mb-a = 0,5 °C/W
10
8
6
4
2
20


7Z72254
Tj = 25°C
Tj =150°C
typ
max
IF (A)
60
40
20
0
0
2
4
VF (V)


7Z72546
maximum permissible non-repetitive r.m.s. forward current based on sinusoidal currents (f = 50 Hz)
I_F
I_{FSM}
$I_{FS(RMS)}$
time
with reapplied V_{RWMmax}
$I_{FS(RMS)}$ (A)
60
40
20
0
I_{FSM}
$T_j = 150\,^{\circ}C$ prior to surge
10^{-3}
10^{-2}
10^{-1}
1
duration (s)
10


7Z72548
$Z_{th\ j-mb}$ (°C/W)
10^2
10
1
10^{-1}
10^{-2}
10^{-5}
10^{-4}
10^{-3}
10^{-2}
10^{-1}
1
time (s)
10

CONTROLLED AVALANCHE RECTIFIER DIODES

Also available to BS9333–F005

Silicon diodes in a DO–4 metal envelope, capable of absorbing transients and intended for use in power rectifier application.
The series consists of the following types:
Normal polarity (cathode to stud): BYX39–600 to BYX39–1400. ←
Reverse polarity (anode to stud): BYX39–600R to BYX39–1400R.

QUICK REFERENCE DATA

			BYX39–600(R)	800(R)	1000(R)	1200(R)	1400(R)	
Crest working reverse voltage	V_{RWM}	max.	600	800	1000	1200	1400	V
Reverse avalanche breakdown voltage	$V_{(BR)R}$	>	750	1000	1250	1450	1650	V

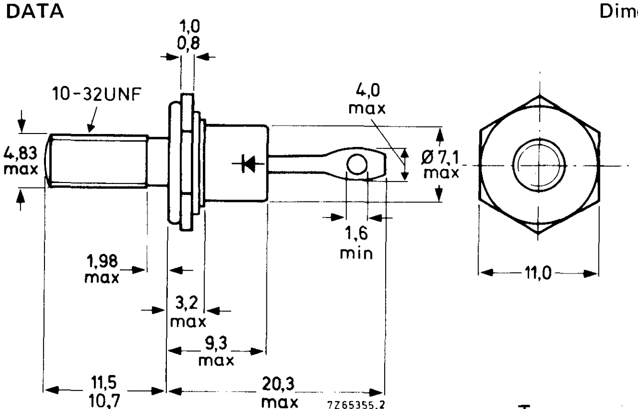
←

Average forward current	$I_{F(AV)}$	max.	9.5	A
Non-repetitive peak forward current	I_{FSM}	max.	125	A
Non-repetitive peak reverse power dissipation	P_{RSM}	max.	4	kW

MECHANICAL DATA

Dimensions in mm

Fig. 1 DO–4



Net mass: 6 g
Diameter of clearance hole: max. 5.2 mm
Accessories supplied on request:
56295 (PTFE bush, 2 mica washers, plain washer, tag).

Supplied with device: 1 nut, 1 lock-washer.

Nut dimensions across the flats: 9.5 mm.

The mark shown applies to normal polarity types.

Torque on nut:
min. 0.9 Nm (9 kg cm),
max. 1.7 Nm (17 kg cm).

RATINGS

Limiting values in accordance with the Absolute Maximum System (IEC134)

→ **Voltages***

			BYX39–600(R)	800(R)	1000(R)	1200(R)	1400(R)	
Continuous reverse voltage	V_R	max.	600	800	1000	1200	1400	V
Crest working reverse voltage	V_{RWM}	max.	600	800	1000	1200	1400	V

Currents

Average forward current (averaged over any 20 ms period) up to T_{mb} = 85 °C	$I_{F(AV)}$	max.	9.5	A
at T_{mb} = 125 °C	$I_{F(AV)}$	max.	6.0	A
R.M.S. forward current	$I_{F(RMS)}$	max.	15	A
Repetitive peak forward current	I_{FRM}	max.	100	A
Non-repetitive peak forward current t = 10 ms (half sine-wave); T_j = 175 °C prior to surge; with reapplied V_{RWMmax}	I_{FSM}	max.	125	A
I^2t for fusing (t = 10 ms)	I^2t	max.	78	A^2s

Reverse power dissipation

Average reverse power dissipation (averaged over any 20 ms period); T_j = 125 °C	$P_{R(AV)}$	max.	10	W
Repetitive peak reverse power dissipation t = 10 μs (square-wave; f = 50 Hz); T_j = 125 °C	P_{RRM}	max.	2	kW
Non-repetitive peak reverse power dissipation t = 10 μs (square-wave) T_j = 25 °C prior to surge	P_{RSM}	max.	4	kW
T_j = 175 °C prior to surge	P_{RSM}	max.	0.8	kW

Temperatures

Storage temperature	T_{stg}		–55 to +175	°C
Junction temperature	T_j	max.	175	°C

*To ensure thermal stability: $R_{th\ j\text{-}a} \leqslant 5$ °C/W (continuouse reverse voltage) or $\leqslant 20$ °C/W (a.c.)

THERMAL RESISTANCE

From junction to ambient in free air	$R_{th\ j\text{-}a}$	=	50	$^oC/W$
From junction to mounting base	$R_{th\ j\text{-}mb}$	=	4.5	$^oC/W$
From mounting base to heatsink				
without heatsink compound	$R_{th\ mb\text{-}h}$	=	1.0	$^oC/W$
with heatsink compound	$R_{th\ mb\text{-}h}$	=	0.5	$^oC/W$
with mica washer	$R_{th\ mb\text{-}h}$	=	2.0	$^oC/W$
Transient thermal impedance; t = 1 ms	$Z_{th\ j\text{-}mb}$	=	0.35	$^oC/W$

CHARACTERISTICS

			BYX39–600(R)	800(R)	1000(R)	1200(R)	1400(R)	
Forward voltage I_F = 20 A; T_j = 25 ^oC	V_F	<	1.7	1.7	1.7	1.7	1.7	V*
Reverse avalanche breakdown voltage I_R = 5 mA; T_j = 25 ^oC	$V_{(BR)R}$	>	750	1000	1250	1450	1650	V
		<	2000	2000	2000	2200	2400	V
Reverse current $V_R = V_{RWMmax}$; T_j = 125 ^oC	I_R	<	200	200	200	200	200	µA

OPERATING NOTES

The top connector should neither be bent nor twisted; it should be soldered into the circuit so that there is no strain on it.
During soldering the heat conduction to the junction should be kept to a minimum.

*Measured under pulse conditions to avoid excessive dissipation.

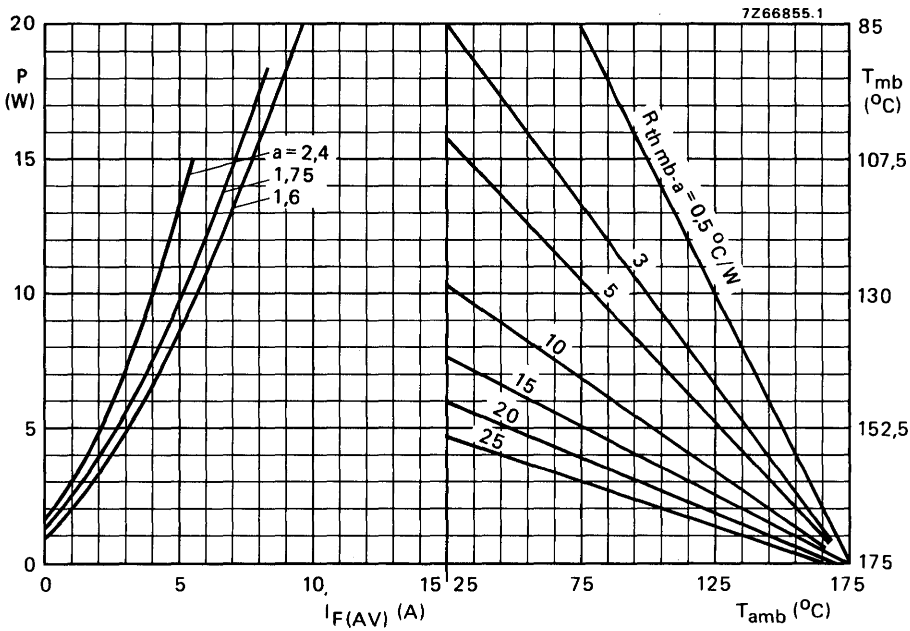


Fig.2

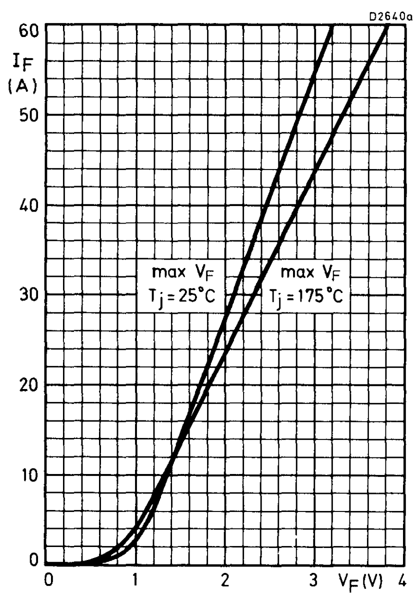


Fig.3

The right-hand part shows the interrelationship between the power (derived from the left-hand part) and the maximum permissible temperatures.
P = dissipation excluding power in the avalanche region.
single phase: a = 1.6
3-phase : a = 1.75
6-phase : a = 2.4

$a = I_{F(RMS)}/I_{F(AV)}$

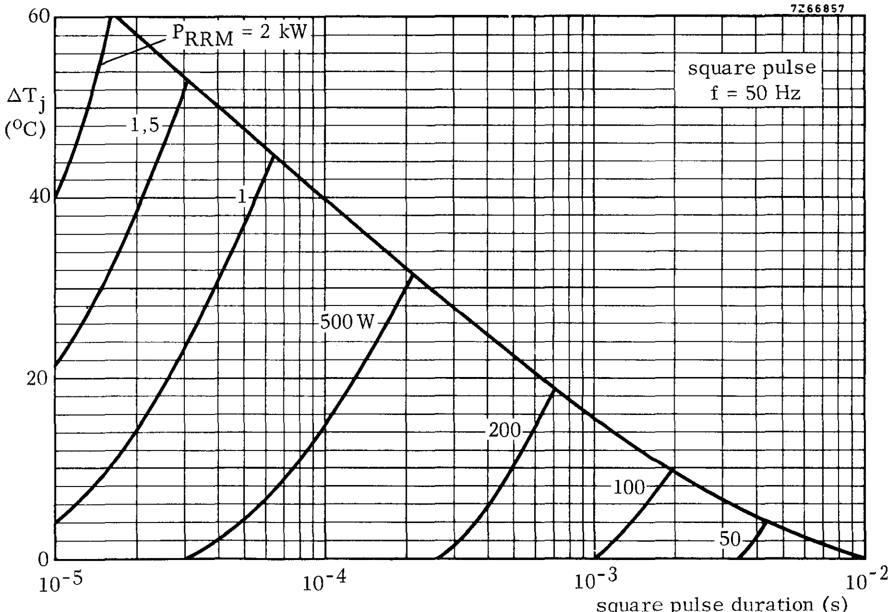

7Z66857
60
40
20
0
ΔTj
(°C)
PRRM = 2 kW
1,5
1
500 W
200
100
50
square pulse
f = 50 Hz
10-5
10-4
10-3
10-2
square pulse duration (s)

Fig.4

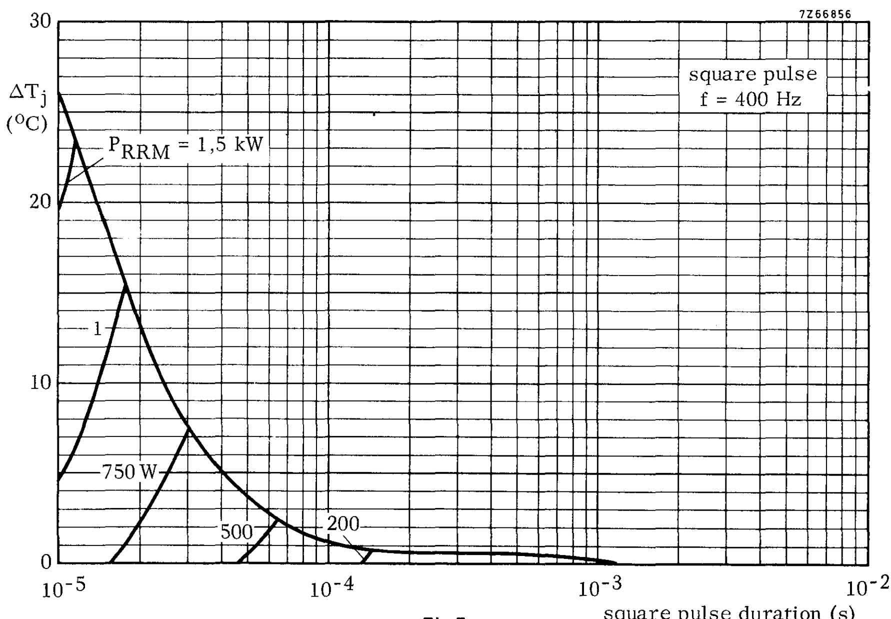

7Z66856
30
20
10
0
ΔTj
(°C)
PRRM = 1,5 kW
1
750 W
500
200
square pulse
f = 400 Hz
10-5
10-4
10-3
10-2
square pulse duration (s)

Fig.5

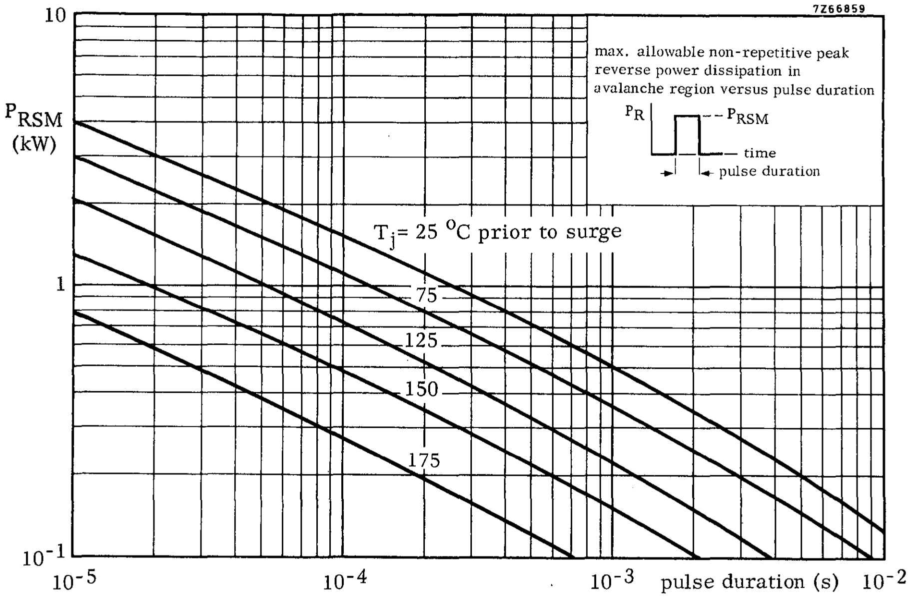

7Z66859
max. allowable non-repetitive peak reverse power dissipation in avalanche region versus pulse duration
P_R
P_RSM
time
pulse duration
P_RSM (kW)
10
1
10^-1
T_j = 25 °C prior to surge
75
125
150
175
10^-5
10^-4
10^-3
pulse duration (s)
10^-2

Fig.6

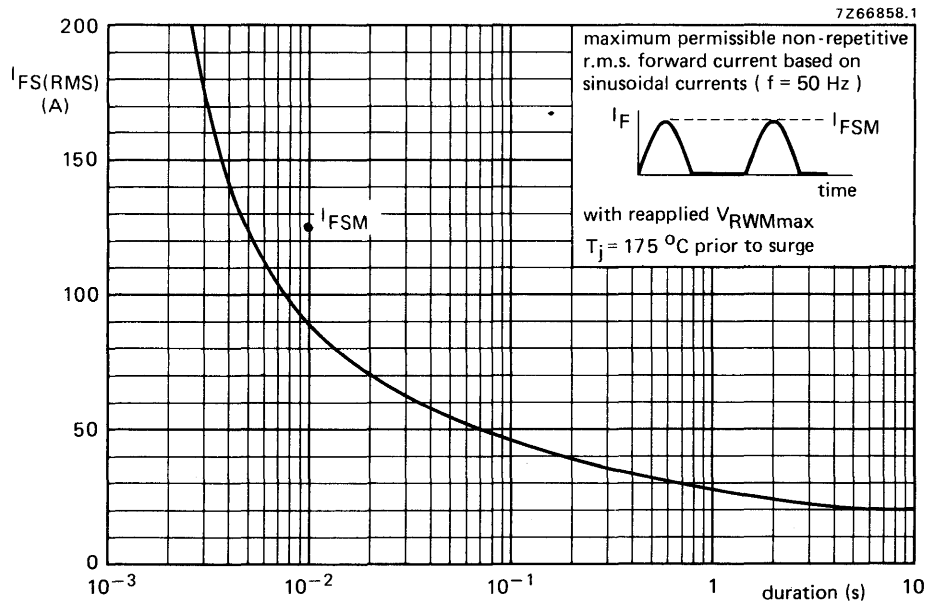

7Z66858.1
maximum permissible non-repetitive r.m.s. forward current based on sinusoidal currents (f = 50 Hz)
I_F
I_FSM
time
with reapplied V_RWMmax
T_j = 175 °C prior to surge
I_FS(RMS) (A)
200
150
100
50
0
I_FSM
10^-3
10^-2
10^-1
1
duration (s)
10

Fig.7

SILICON RECTIFIER DIODES

Also available to BS9331-F128

Diffused silicon rectifier diodes in DO-4 metal envelopes, intended for power rectifier applications.
The series consists of the following types:
Normal polarity (cathode to stud): BYX42-300 to 1200.
Reserve polarity (anode to stud): BYX42-300R to 1200R.

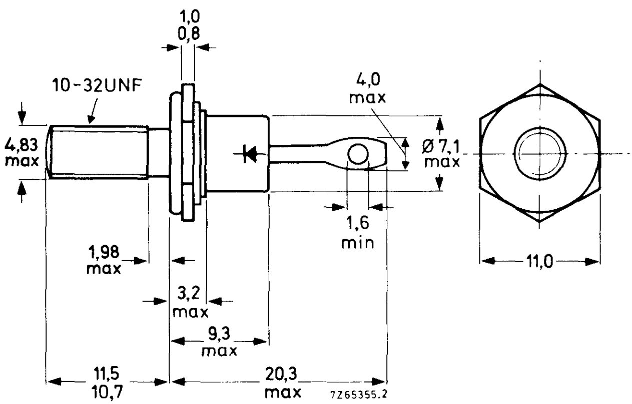
QUICK REFERENCE DATA

			BYX42-300(R)	600(R)	1200(R)	
Repetitive peak reverse voltage	V_{RRM}	max.	300	600	1200	V
Average forward current	$I_{F(AV)}$	max.		12		A
Non-repetitive peak forward current	I_{FSM}	max.		125		A

MECHANICAL DATA

Dimensions in mm

DO-4



Net mass: 6 g

Diameter of clearance hole: 5,2 mm

Accessories supplied on request:
56295 (PTFE bush, 2 mica washers, plain washer, tag)
56262A (mica washer, insulating ring, plain washer)

Supplied with device: 1 nut, 1 lock washer
Nut dimensions accross the flats: 9,5 mm

The mark shown applies to normal polarity types.

Torque on nut: min. 0,9 Nm
(9 kg cm)
max. 1,7 Nm
(17 kg cm)

RATINGS Limiting values in accordance with the Absolute Maximum System (IEC 134)

Voltages			BYX42-300(R)	600(R)	1200(R)	
Non-repetitive peak reverse voltage ($t \leq 10$ ms)	V_{RSM}	max.	300	600	1200	V
Repetitive peak reverse voltage ($\delta \leq 0,01$)	V_{RRM}	max.	300	600	1200	V
Crest working reverse voltage	V_{RWM}	max.	200	400	800	V
Continuous reverse voltage	V_R	max.	200	400	800	V

Currents				
Average forward current (averaged over any 20 ms period) up to T_{mb} = 115 °C	$I_{F(AV)}$	max.	12	A
at T_{mb} = 125 °C	$I_{F(AV)}$	max.	10	A
R.M.S. forward current	$I_{F(RMS)}$	max.	20	A
Repetitive peak forward current	I_{FRM}	max.	60	A
Non-repetitive peak forward current (t = 10 ms; half sine-wave) T_j = 175 °C prior to surge; with reapplied V_{RWMmax}	I_{FSM}	max.	125	A

Temperatures				
Storage temperature	T_{stg}		−55 to +175	°C
Junction temperature	T_j	max.	175	°C

THERMAL RESISTANCE

From junction to ambient in free air	$R_{th\ j\text{-}a}$	=	50	°C/W
From junction to mounting base	$R_{th\ j\text{-}mb}$	=	3	°C/W
From mounting base to heatsink	$R_{th\ mb\text{-}h}$	=	0,5	°C/W

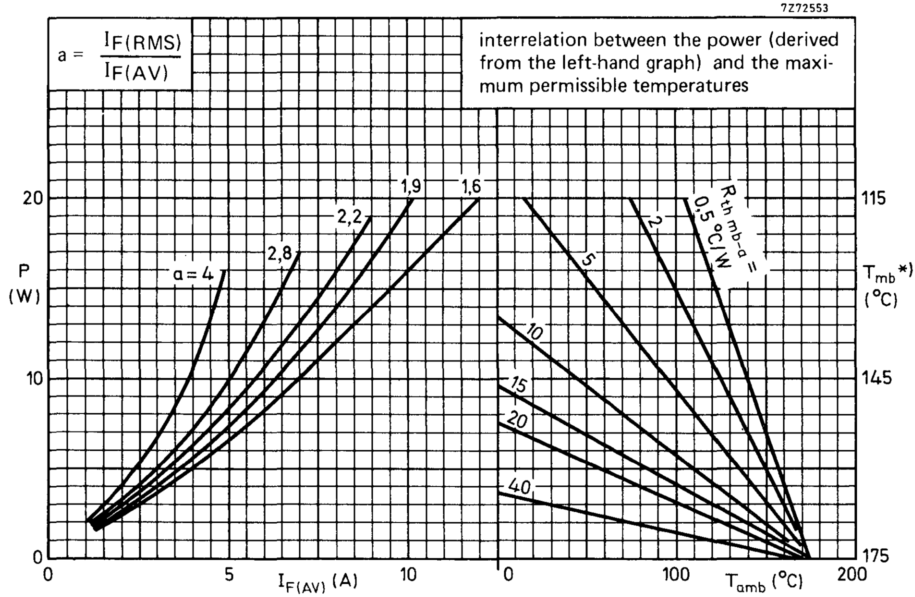
CHARACTERISTICS

Forward voltage at I_F = 15 A; T_j = 25 °C	V_F	<	1,4	V [1]
Reverse current at $V_R = V_{RWMmax}$; T_j = 125 °C	I_R	<	200	µA

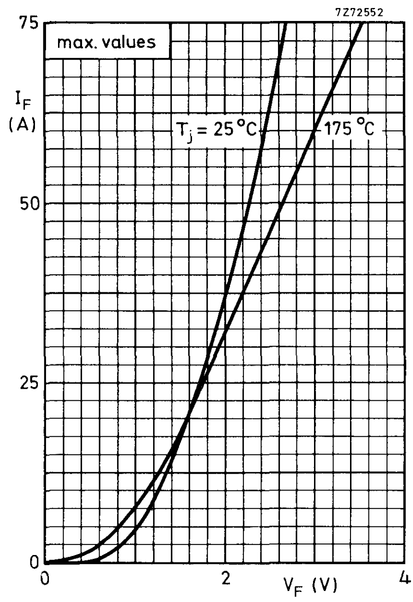
MOUNTING INSTRUCTIONS

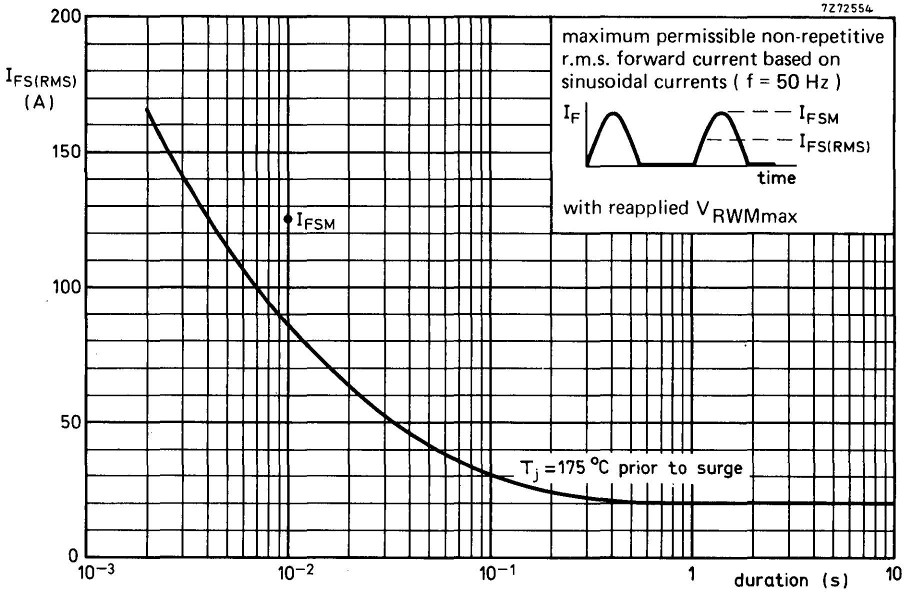
The top connector should neither be bent nor twisted; it should be soldered into the circuit so that there is no strain on it.
During soldering the heat conduction to the junction should be kept to a minimum.

[1]) Measured under pulse conditions to avoid excessive dissipation.



*) T_{mb}-scale is for comparison purposes only and is correct only for $R_{th\ mb-a} \leq 22$ °C/W




7Z72554
maximum permissible non-repetitive r.m.s. forward current based on sinusoidal currents (f = 50 Hz)
I_F
I_{FSM}
$I_{FS(RMS)}$
time
with reapplied V_{RWMmax}
$I_{FS(RMS)}$ (A)
200
150
100
50
0
I_{FSM}
$T_j = 175\ ^\circ C$ prior to surge
10^{-3}
10^{-2}
10^{-1}
1
10
duration (s)

CONTROLLED AVALANCHE RECTIFIER DIODES

Also available to BS9333–F004

Diffused silicon diodes in a DO–1 metal envelope, capable of absorbing transients. They are intended for rectifier applications and particularly suited for series operation.
The series consists of the following reverse polarity types (anode to case):
BYX45–600R, BYX45–800R, BYX45–1000R, BYX45–1200R and BYX45–1400R. ←

QUICK REFERENCE DATA

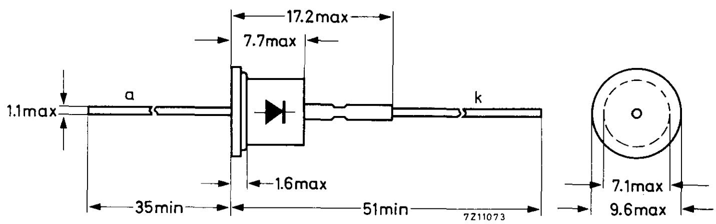
			BYX45–600R	800R	1000R	1200R	1400R	
Crest working reverse voltage	V_{RWM}	max.	600	800	1000	1200	1400	V
Reverse breakdown voltage	$V_{(BR)R}$	>	750	1000	1250	1450	1650	V
Average forward current	$I_{F(AV)}$	max.	1.5					A
Non repetitive peak forward current	I_{FSM}	max.	40					A
Non repetitive peak reverse power	P_{RSM}	max.	2.5					kW

←

MECHANICAL DATA

Dimensions in mm

Fig. 1 DO–1



RATINGS

Limiting values in accordance with the Absolute Maximum System (IEC134)

→ **Voltages**

			BYX45–600R	800R	1000R	1200R	1400R	
Crest working reverse voltage	V_{RWM}	max.	600	800	1000	1200	1400	V
Continuous reverse voltage	V_R	max.	600	800	1000	1200	1400	V

Currents

Average forward current (averaged over any 20 ms period)	$I_{F(AV)}$	max.	1.5	A
R.M.S. forward current	$I_{F(RMS)}$	max.	2.4	A
Repetitive peak forward current	I_{FRM}	max.	15	A
Non-repetitive peak forward current t = 10 ms (half sine-wave); T_j = 150 °C prior to surge; with reapplied V_{RWMmax}.	I_{FSM}	max.	40	A
I^2t for fusing (t = 10 ms)	I^2t	max.	8	A^2s

Reverse power dissipation

Repetitive peak reverse power dissipation t = 10 µs (square-wave; f = 50 Hz); T_j = 125 °C	P_{RRM}	max.	800	W
Non-repetitive peak reverse power dissipation t = 10 µs (square-wave)				
T_j = 25 °C prior to surge	P_{RSM}	max.	2.5	kW
T_j = 150 °C prior to surge	P_{RSM}	max.	800	W

Temperatures

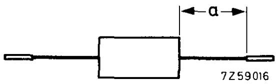
Storage temperature	T_{stg}		−55 to +150	°C
Junction temperature	T_j	max.	150	°C

THERMAL RESISTANCE

Effect of mounting on thermal resistance $R_{th\ j\text{-}a}$

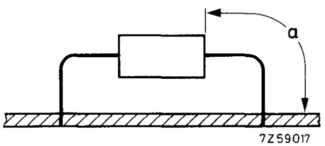
The quoted values apply when no other leads run to the tie-points. If leads of other dissipating components share the same tie-points, the thermal resistance will be higher than that quoted.

1. Mounted on solder tags at a lead-length a = 10 mm. $R_{th\ j\text{-}a}$ = 60 °C/W



2. Mounted on solder tags at a = maximum lead-length. $R_{th\ j\text{-}a}$ = 70 °C/W

3. Mounted on printed-wiring board at a = maximum lead-length. $R_{th\ j\text{-}a}$ = 80 °C/W



4. Mounted on printed-wiring board at a lead-length a = 10 mm. $R_{th\ j\text{-}a}$ = 90 °C/W

SOLDERING AND MOUNTING NOTES

1. At a soldering iron or bath temperature of up to 245 °C, the maximum permissible soldering time is 10 s if the joint is 5 mm from the seal, 3 s if it is 1.5 mm from the seal.

2. At a temperature between 245 °C and 400 °C (max.), the joint must be more than 5 mm from the seal and soldering time must not exceed 5 s.

3. Leads should not be bent less than 1.5 mm from the seal; exert no axial pull when bending.

CHARACTERISTICS

→

			BYX45–600R	800R	1000R	1200R	1400R	
Forward voltage $I_F = 5$ A; $T_j = 25$ °C	V_F	<	1.45	1.45	1.45	1.45	1.45	V*
Reverse avalanche breakdown voltage $I_R = 1$ mA; $T_j = 25$ °C	$V_{(BR)R}$	>	750	1000	1250	1450	1650	V
		<	2000	2000	2000	2200	2400	V
Reverse current $V_R = V_{RWMmax}$; $T_j = 125$ °C	I_R	<	100	100	100	100	100	µA

*Measured under pulse conditions to avoid excessive dissipation.

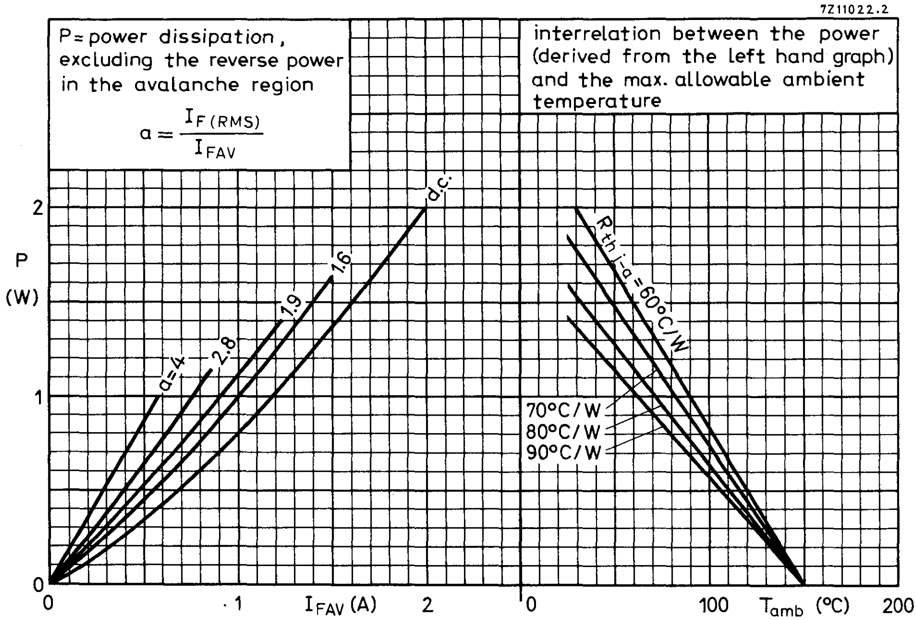

7Z11022.2
P = power dissipation, excluding the reverse power in the avalanche region
$a = \frac{I_{F(RMS)}}{I_{FAV}}$
interrelation between the power (derived from the left hand graph) and the max. allowable ambient temperature
a=4
2.8
1.9
1.6
d.c.
$R_{th\ j-a}$ = 60°C/W
70°C/W
80°C/W
90°C/W
P
(W)
0
1
2
I_{FAV} (A)
T_{amb} (°C)
100
200

Fig.2

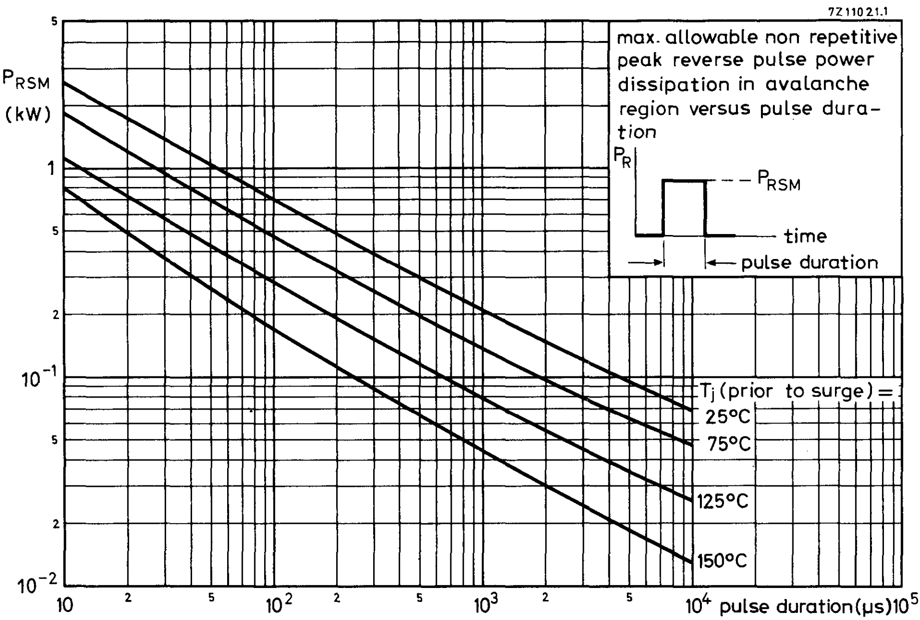

7Z11021.1
max. allowable non repetitive peak reverse pulse power dissipation in avalanche region versus pulse duration
P_R
P_{RSM}
time
pulse duration
P_{RSM}
(kW)
1
5
2
10^{-1}
10^{-2}
10
10^2
10^3
10^4
10^5
pulse duration (μs)
T_j (prior to surge) =
25°C
75°C
125°C
150°C

Fig.3

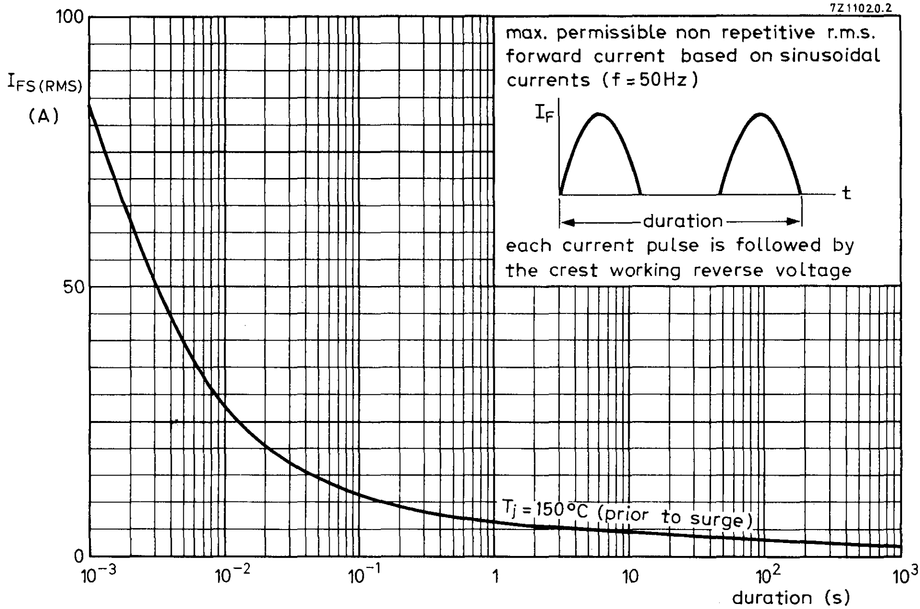

7Z11020.2
max. permissible non repetitive r.m.s. forward current based on sinusoidal currents (f = 50Hz)
I_F
t
duration
each current pulse is followed by the crest working reverse voltage
$I_{FS(RMS)}$ (A)
100
50
0
T_j = 150 °C (prior to surge)
10^{-3}
10^{-2}
10^{-1}
1
10
10^2
10^3
duration (s)

Fig.4

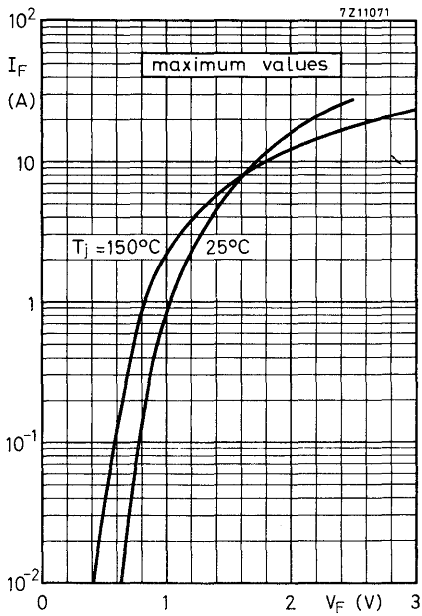

7Z11071
maximum values
I_F (A)
10^2
10
1
10^{-1}
10^{-2}
T_j =150°C
25°C
0
1
2
V_F (V)
3

Fig.5

FAST SOFT-RECOVERY RECTIFIER DIODES

- With controlled avalanche

Diffused silicon diodes in DO-4 metal envelopes, capable of absorbing transients. They are primarily intended for use in high-frequency power supplies, thyristor inverters and multi-phase power rectifier applications.

The series consists of the following types:
Normal polarity (cathode to stud): BYX46-200 to BYX46-600.
Reverse polarity (anode to stud): BYX46-200R to BYX46-600R

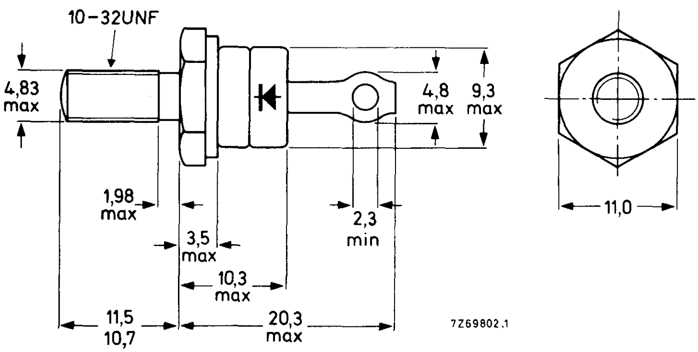
QUICK REFERENCE DATA

			BYX46-200(R)	300(R)	400(R)	500(R)	600(R)	
Crest working reverse voltage	V_{RWM}	max.	200	300	400	500	600	V
Reverse avalanche breakdown voltage	$V_{(BR)R}$	>	250	375	500	625	750	V
Average forward current	$I_{F(AV)}$	max.			22			A
Non-repetitive peak forward current	I_{FSM}	max.			300			A
Non-repetitive peak reverse power	P_{RSM}	max.			18			kW
Reverse recovery time	t_{rr}	<			200			ns

MECHANICAL DATA

Dimensions in mm

DO-4 Supplied with device: 1 nut, 1 lock-washer
Nut dimensions across the flats: 9,5 mm



Net mass: 7 g
Diameter of clearance hole: max. 5,2 mm
Accessories supplied on request: 56295
(PTFE bush, 2 mica washers, plain washer, tag)

Torque on nut: min. 0,9 Nm
(9 kg cm)
max. 1,7 Nm
(17 kg cm)

The mark shown applies to the normal polarity types.

RATINGS

Limiting values in accordance with the Absolute Maximum System (IEC 134)

Voltages *			BYX46-200(R)	300(R)	400(R)	500(R)	600(R)	
Crest working reverse voltage	V_{RWM}	max.	200	300	400	500	600	V
Continuous reverse voltage	V_R	max.	200	300	400	500	600	V

Currents				
Average forward current (averaged over any 20 ms period)				
up to T_{mb} = 100 °C	$I_{F(AV)}$	max.	22	A
at T_{mb} = 125 °C	$I_{F(AV)}$	max.	15	A
R.M.S. forward current	$I_{F(RMS)}$	max.	35	A
Repetitive peak forward current	I_{FRM}	max.	400	A
Non-repetitive peak forward current (t = 10 ms; half-sinewave) T_j = 165 °C prior to surge; with reapplied V_{RWMmax}	I_{FSM}	max.	300	A
I^2t for fusing (t = 10 ms)	I^2t	max.	450	A^2s
Reverse power dissipation				
Repetitive peak reverse power dissipation t = 10 μs (square wave; f = 50 Hz) T_j = 100 °C	P_{RRM}	max.	9,5	kW
Non-repetitive peak reverse power dissipation t = 10 μs (square wave)				
T_j = 25 °C prior to surge	P_{RSM}	max.	18	kW
T_j = 165 °C prior to surge	P_{RSM}	max.	4	kW
Temperatures				
Storage temperature	T_{stg}		−55 to +165	°C
Junction temperature	T_j	max.	165	°C

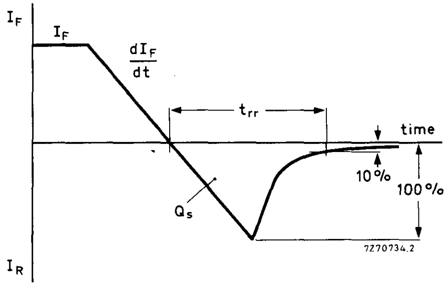
THERMAL RESISTANCE

From junction to ambient in free air	$R_{th\ j\text{-}a}$	=	50	°C/W
From junction to mounting base	$R_{th\ j\text{-}mb}$	=	1,3	°C/W
From mounting base to heatsink	$R_{th\ mb\text{-}h}$	=	0,5	°C/W

* To ensure thermal stability: $R_{th\ j\text{-}a} < 2{,}5$ °C/W (continuous reverse voltage) or < 5 °C/W (a.c.). For smaller heatsinks $T_{j\ max}$ should be derated. For a.c. see page 5. For continuous reverse voltage: if $R_{th\ j\text{-}a}$ = 5 °C/W, then $T_{j\ max}$ = 135 °C; if $R_{th\ j\text{-}a}$ = 10 °C/W, then $T_{j\ max}$ = 125 °C.

CHARACTERISTICS

			BYX46-200(R)	300(R)	400(R)	500(R)	600(R)	
Forward voltage I_F = 50 A; T_j = 25 °C	V_F	<	2,0	2,0	2,0	2,0	2,0	V *
Reverse breakdown voltage I_R = 5 mA; T_j = 25 °C	$V_{(BR)R}$	>	250	375	500	625	750	V
		<	1050	1050	1050	1050	1050	V
Reverse current $V_R = V_{RWMmax}$; T_j = 125 °C	I_R	<	4,0	4,0	4,0	4,0	4,0	mA
Reverse recovery charge when switched from I_F = 2 A to $V_R \geq 30$ V; $-dI_F/dt$ = 100 A/µs; T_j = 25 °C	Q_s	<			0,70			µC
Reverse recovery time when switched from I_F = 1 A to $V_R \geq 30$ V; $-dI_F/dt$ = 50 A/µs; T_j = 25 °C	t_{rr}	<			200			ns



OPERATING NOTES

1. Square-wave operation

When I_F has been flowing sufficiently long for the steady state to be established, there will be a charge due to minority carriers present. Before the device can block in the reverse direction this charge must be extracted. This extraction takes the form of a reverse transient (see figure above). The majority of the power dissipation due to the reverse transient occurs during fall time as the rectifier gradually becomes reverse biased, and the mean power will be proportional to the operating frequency. The mean value of this power loss can be derived from the graphs on page 10.

* Measured under pulse conditions to avoid excessive dissipation.

OPERATING NOTES (continued)

2. Sine wave operation

Power loss in sine wave operation will be considerably less owing to the much slower rate of change of the applied voltage (and consequently lower values of I_{RRM}), so that power loss due to reverse recovery may be safely ignored for frequencies up to 50 kHz.

3. Determination of the heatsink thermal resistance

Example:

Assume a diode, used in an inverter.

frequency	f	=	20	kHz
duty cycle	δ	=	0.5	
ambient temperature	T_{amb}	=	40	^{o}C
switched from	I_F	=	12	A
to	V_R	=	300	V
at a rate	$-\frac{dI}{dt}$	=	50	A/μs

At a duty cycle $\delta = 0.5$ the average forward current $I_{FAV} = 6$ A.
From the upper graph on page 5 it follows, that at $I_{FAV} = 6$ A the average forward power + average leakage power = 13 W (point A).
The additional power losses due to switching-off can be read from the nomogram on page 10 (the example being based on optimum use, i.e. $T_j = 165\ ^{o}C$). Starting from $I_F = 12$ A on the horizontal scale trace upwards until the appropriate line $-\frac{dI}{dt} = 50$ A/μs. From the intersection trace horizontally to the right until the line for f = 20 kHz. Then trace downwards to the line $V_R = 300$ V and ultimately trace horizontally to the left and on the vertical axis read the additional average power dissipation $P_{RAV} = 6$ W.
Therefore the total power dissipation $P_{tot} = 13\ W + 6\ W = 19\ W$ (point B of the upper graph on page 5).

From the right hand part of the upper graph on page 5 follows the thermal resistance, required at $T_{amb} = 40\ ^{o}C$.

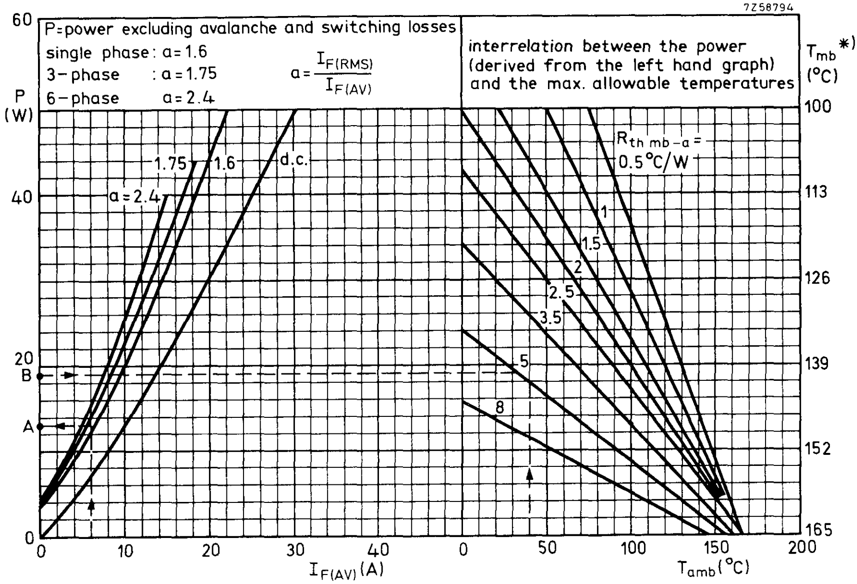
$$R_{th\ mb\text{-}a} \approx 5\ ^{o}C/W$$

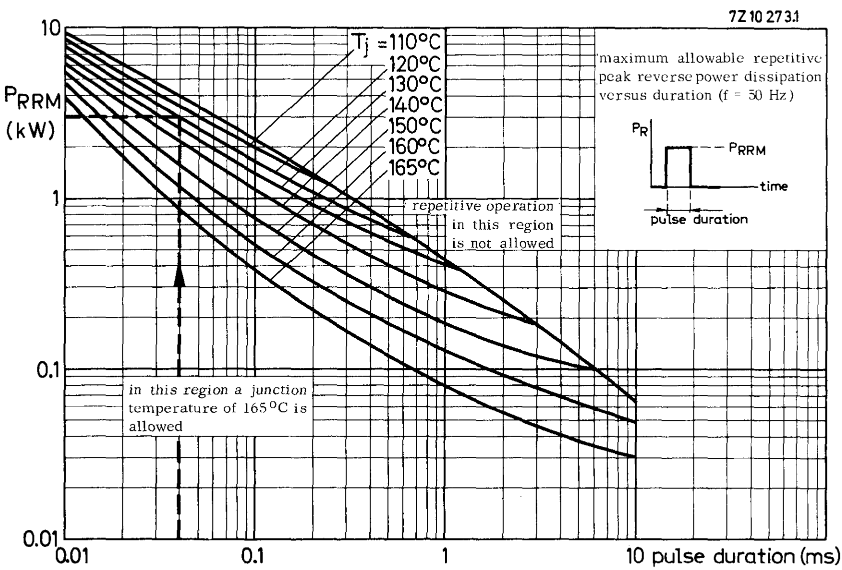
The contact thermal resistance $R_{th\ mb\text{-}h} = 0.5\ ^{o}C/W$.

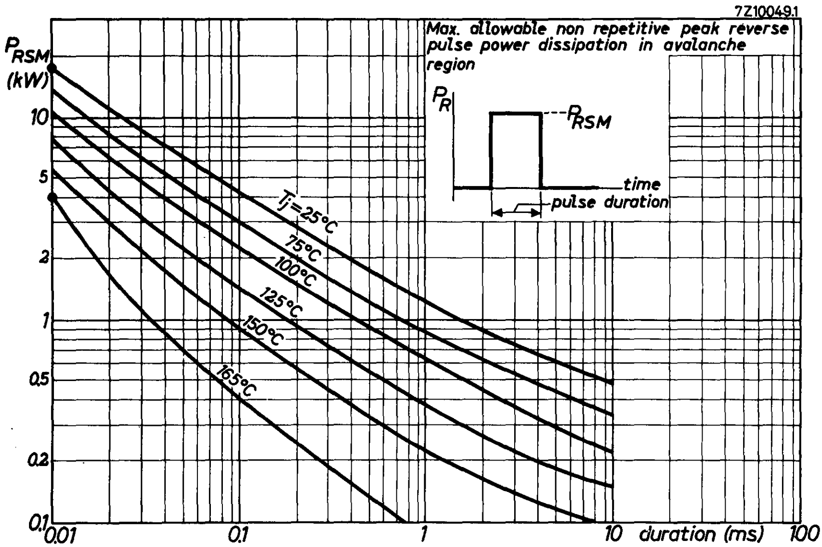
Hence the heatsink thermal resistance should be:

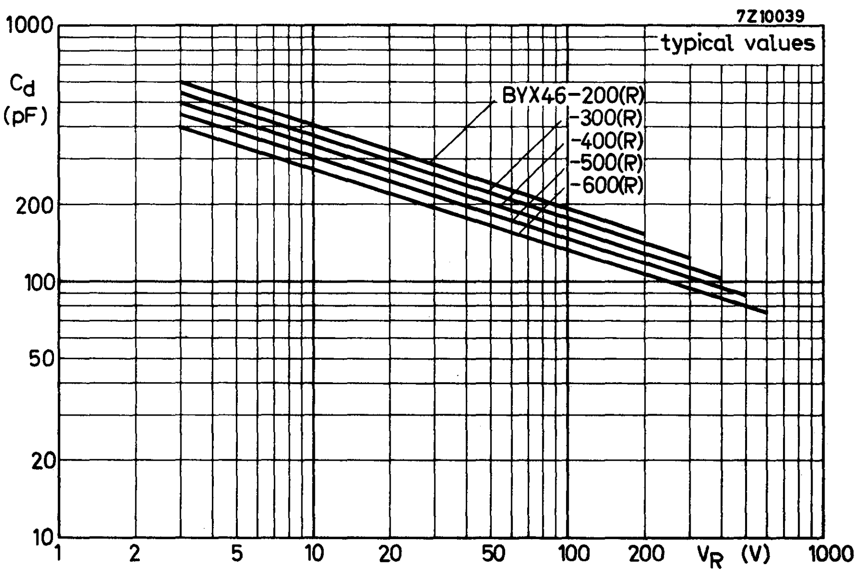
$$R_{th\ h\text{-}a} = R_{th\ mb\text{-}a} - R_{th\ mb\text{-}h} = (5 - 0.5)\ ^{o}C/W = 4.5\ ^{o}C/W.$$

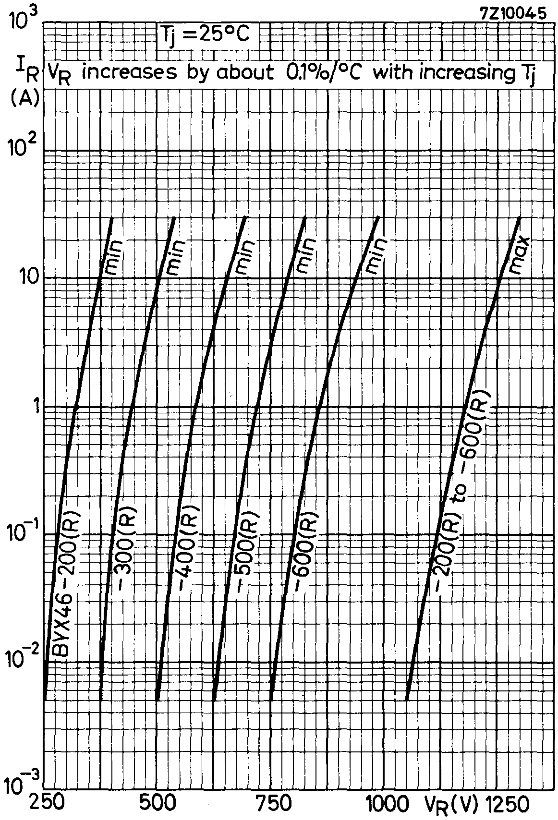
The applicable heatsink(s) may then be found in the Section HEATSINKS.

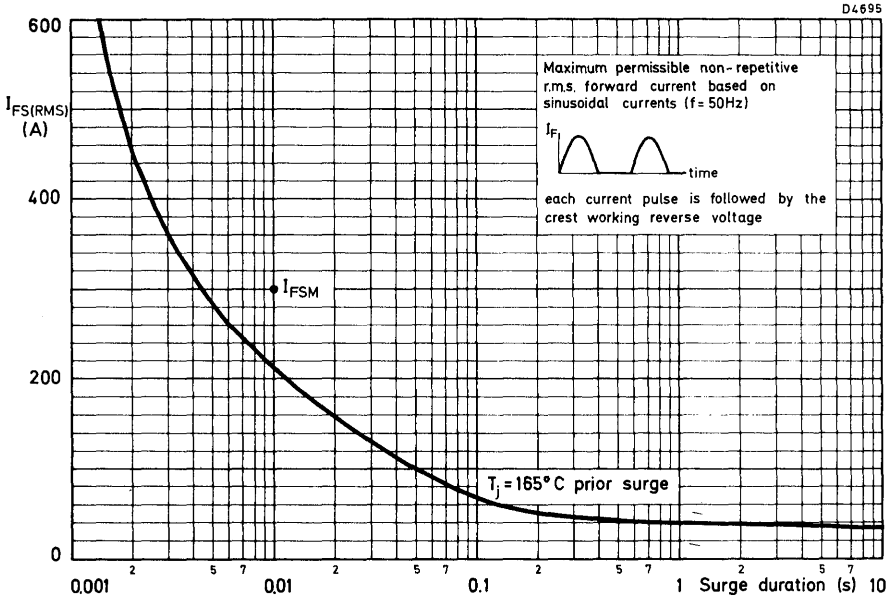

7Z58794
P=power excluding avalanche and switching losses
single phase: a=1.6
3-phase : a=1.75
6-phase a=2.4
a = I F(RMS) / I F(AV)
P (W)
1.75
1.6
d.c.
a=2.4
B
A
I F(AV) (A)
interrelation between the power (derived from the left hand graph) and the max. allowable temperatures
T mb *) (°C)
R th mb-a = 0.5°C/W
1
1.5
2
2.5
3.5
5
8
T amb (°C)

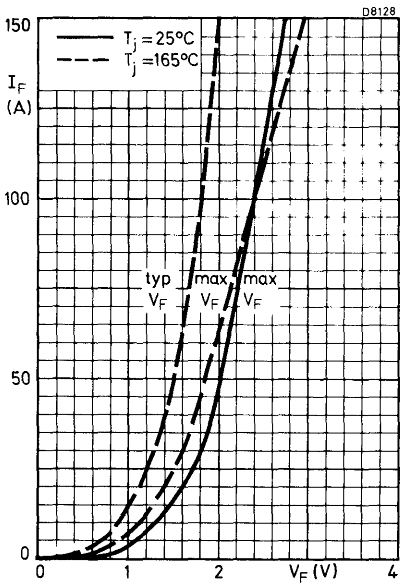

7Z10273.1
P RRM (kW)
Tj =110°C
120°C
130°C
140°C
150°C
160°C
165°C
maximum allowable repetitive peak reverse power dissipation versus duration (f = 50 Hz)
P R
P RRM
time
pulse duration
repetitive operation in this region is not allowed
in this region a junction temperature of 165°C is allowed
pulse duration (ms)

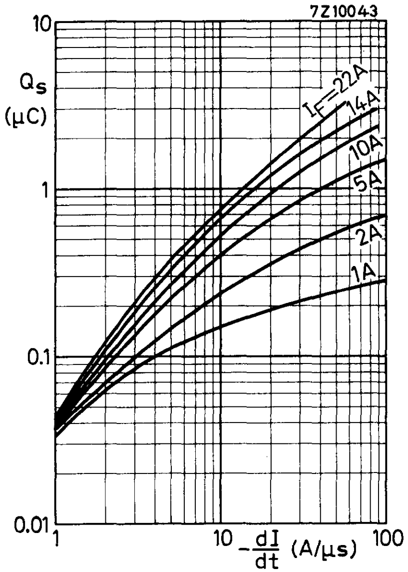

7Z10049.1
P_{RSM} (kW)
10
5
2
1
0.5
0.2
0.1
0.01
0.1
1
10
duration (ms)
100
Max. allowable non repetitive peak reverse pulse power dissipation in avalanche region
P_R
P_{RSM}
time
pulse duration
T_j=25°C
75°C
100°C
125°C
150°C
165°C

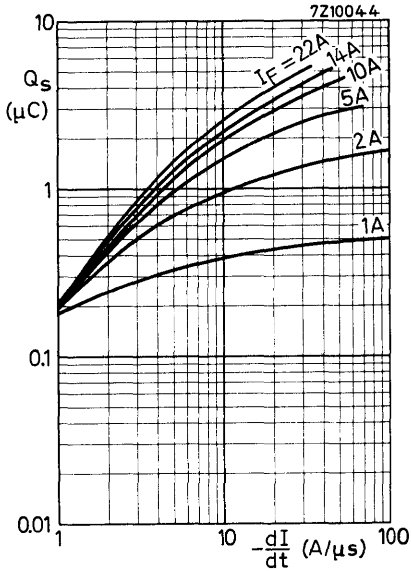

7Z10039
typical values
1000
C_d (pF)
200
100
50
20
10
1
2
5
10
20
50
100
200
V_R (V)
1000
BYX46–200(R)
–300(R)
–400(R)
–500(R)
–600(R)

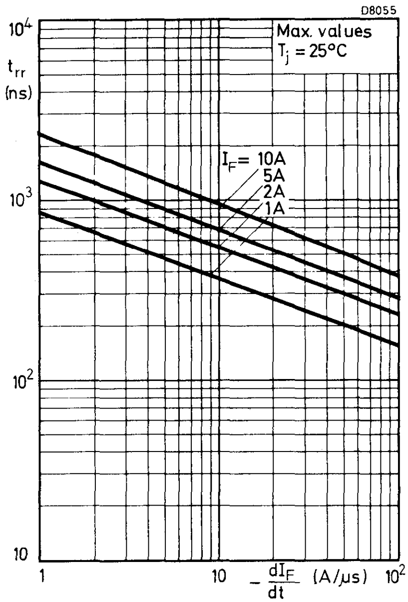

7Z10045
$T_j = 25^\circ C$
V_R increases by about 0.1%/°C with increasing T_j
I_R
(A)
10^3
10^2
10
1
10^{-1}
10^{-2}
10^{-3}
250
500
750
1000
V_R (V)
1250
BYX46−200(R)
−300(R)
−400(R)
−500(R)
−600(R)
min
min
min
min
min
−200(R) to −600(R)
max

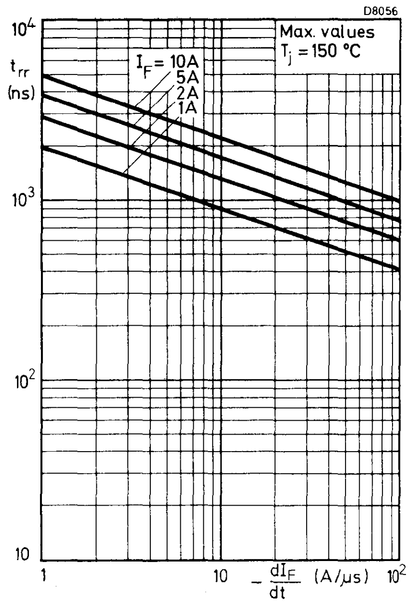

D4695
600
400
200
0
IFS(RMS)
(A)
Maximum permissible non-repetitive r.m.s. forward current based on sinusoidal currents (f = 50Hz)
IF
time
each current pulse is followed by the crest working reverse voltage
IFSM
Tj = 165° C prior surge
0.001
0.01
0.1
1
Surge duration (s)
10

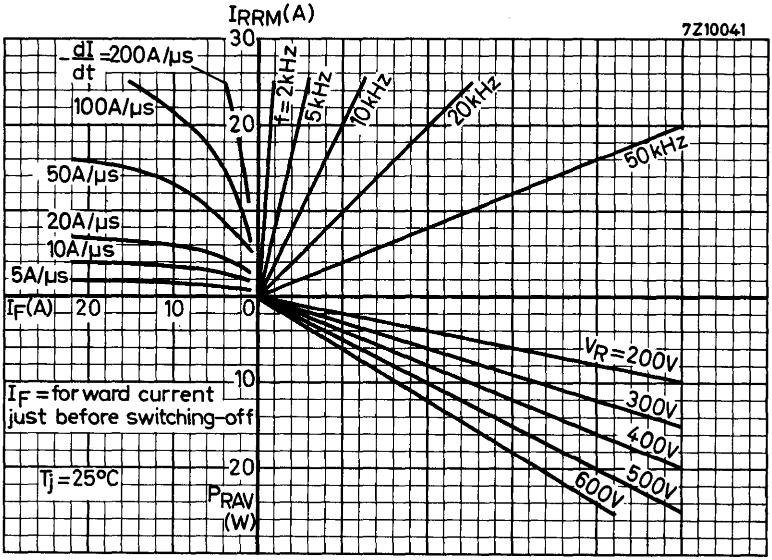

D8128
150
100
50
0
IF
(A)
Tj = 25°C
Tj = 165°C
typ
VF
max
VF
max
VF
0
1
2
VF (V)
4

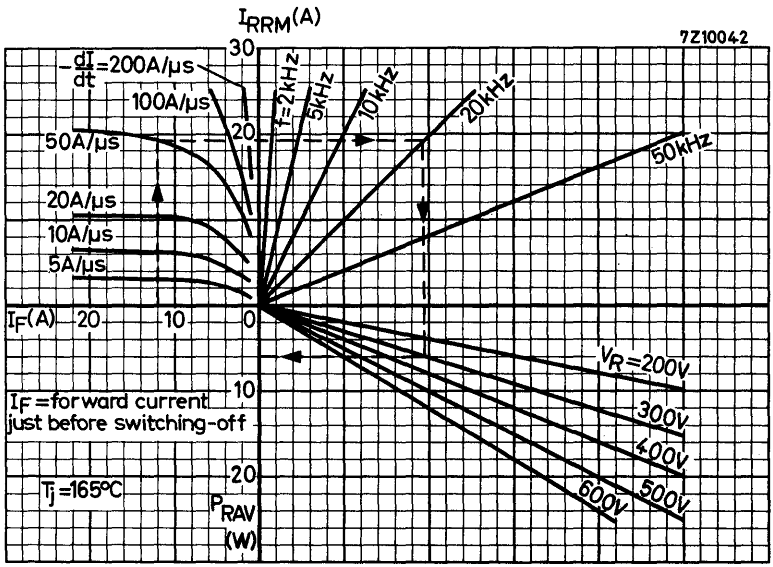

7Z10043
10
Q_s
(µC)
1
0.1
0.01
I_F=22A
14A
10A
5A
2A
1A
1
10
100
$-\frac{dI}{dt}$ (A/µs)


7Z10044
10
Q_s
(µC)
1
0.1
0.01
I_F=22A
14A
10A
5A
2A
1A
1
10
100
$-\frac{dI}{dt}$ (A/µs)

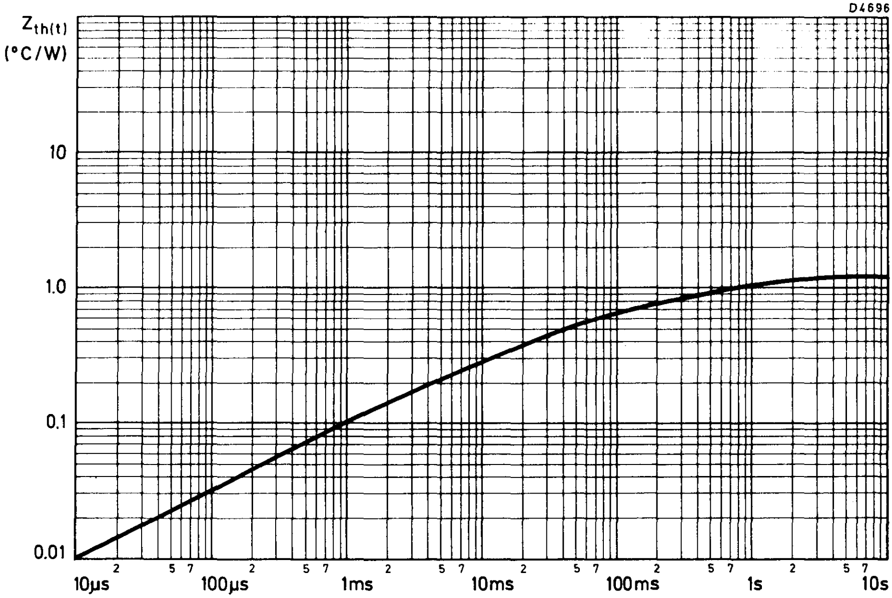

D8055
Max. values
T_j = 25°C
t_{rr}
(ns)
10^4
10^3
10^2
10
I_F= 10A
5A
2A
1A
1
10
10^2
$-\frac{dI_F}{dt}$ (A/µs)


D8056
Max. values
T_j = 150 °C
t_{rr}
(ns)
10^4
10^3
10^2
10
I_F= 10A
5A
2A
1A
1
10
10^2
$-\frac{dI_F}{dt}$ (A/µs)





Nomogram: Power loss P_{RAV} due to switching only (square wave operation)


D4696
Z th(t) (°C/W)
10
1.0
0.1
0.01
10µs
100µs
1ms
10ms
100ms
1s
10s

SILICON RECTIFIER DIODES

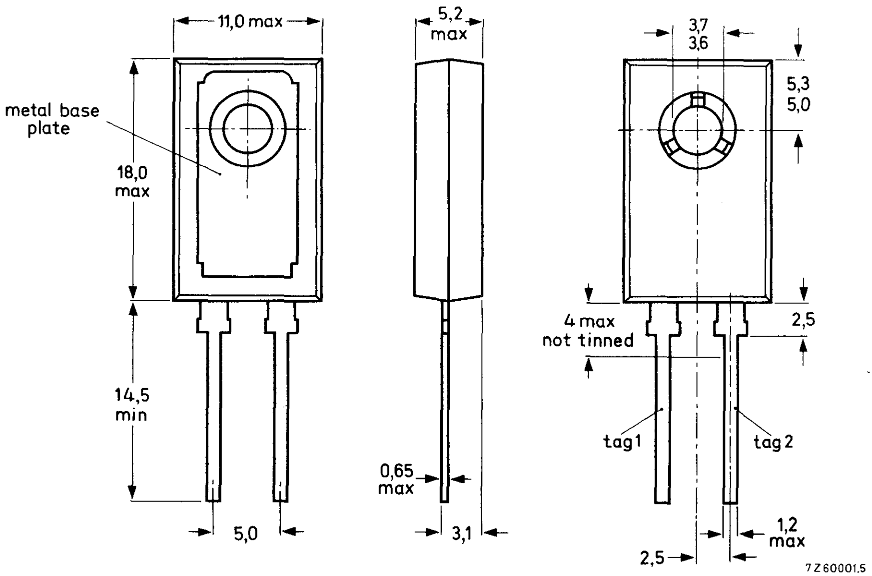
Plastic-encapsulated rectifier diodes intended for power rectifier applications.
Normal and reverse polarity types are available.

QUICK REFERENCE DATA

			BYX49-300(R)	600(R)	1200(R)	
Repetitive peak reverse voltage	V_{RRM}	max.	300	600	1200	V
Average forward current	$I_{F(AV)}$	max.		6		A
Non-repetitive peak forward current	I_{FSM}	max.		40		A

MECHANICAL DATA (see also page 2) Dimensions in mm

SOD-38



The exposed metal base-plate is directly connected to tag 1.

Products approved to CECC 50 009-011, available on request

MECHANICAL DATA (continued)

Net mass: 2,5 g

Recommended diameter of fixing screw: 3,5 mm

Torque on screw
when using washer and heatsink compound: min. 0,95 Nm (9,5 kg cm)
max. 1,5 Nm (15 kg cm)

Accessories:
supplied with device: washer
available on request: 56316 (mica insulating washer)

POLARITY OF CONNECTIONS

	BYX49-300 to BYX49-1200	BYX49-300R to BYX49-1200R
Base-plate:	cathode	anode
Tag 1 :	cathode	anode
Tag 2 :	anode	cathode

All information applies to frequencies up to 400 Hz.

RATINGS Limiting values in accordance with the Absolute Maximum System (IEC134)

Voltages			BYX49-300(R)	600(R)	1200(R)	
Continuous reverse voltage	V_R	max.	200	400	800	V
Crest working reverse voltage	V_{RWM}	max.	200	400	800	V
Repetitive peak reverse voltage (δ = 0,01)	V_{RRM}	max.	300	600	1200	V
Non-repetitive peak reverse voltage ($t \leq 10$ ms)	V_{RSM}	max.	300	600	1200	V

Currents

Average forward current (averaged over any 20 ms period) up to T_{mb} = 85 °C	$I_{F(AV)}$	max.	6,0	A
at T_{mb} = 120 °C	$I_{F(AV)}$	max.	3,0	A
without heatsink; at T_{amb} = 50 °C	$I_{F(AV)}$	max.	1,1	A
Forward current (d.c.)	I_F	max.	9,5	A
R.M.S. forward current	$I_{F(RMS)}$	max.	9,5	A
Repetitive peak forward current	I_{FRM}	max.	20	A
Non-repetitive peak forward current (t = 10 ms; half sine wave) T_j = 150 °C prior to surge	I_{FSM}	max.	40	A
I^2t for fusing (t = 10 ms)	I^2t	max.	8,0	A^2s

Temperatures

Storage temperature	T_{stg}		−55 to +125	°C
Junction temperature	T_j	max.	150	°C

THERMAL RESISTANCE

From junction to mounting base	$R_{th\ j\text{-}mb}$	= 4,5	$^oC/W$
Transient thermal impedance; t = 1 ms	$Z_{th\ j\text{-}mb}$	= 0,3	$^oC/W$

Influence of mounting method :

1. Heatsink mounted

From mounting base to heatsink

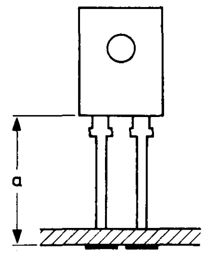
a. with heatsink compound	$R_{th\ mb\text{-}h}$	= 1,5	$^oC/W$
b. with heatsink compound and 56316 mica washer	$R_{th\ mb\text{-}h}$	= 2,7	$^oC/W$
c. without heatsink compound	$R_{th\ mb\text{-}h}$	= 2,7	$^oC/W$
d. without heatsink compound; with 56316 mica washer	$R_{th\ mb\text{-}h}$	= 5	$^oC/W$

2. Free air operation

The quoted values of $R_{th\ j\text{-}a}$ should be used only when no other leads run to the tie-points.

From junction to ambient in free air mounted on a printed circuit board at a = maximum lead length and with a copper laminate

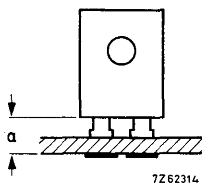
a. > 1 cm^2 — $R_{th\ j\text{-}a}$ = 50 $^oC/W$
b. < 1 cm^2 — $R_{th\ j\text{-}a}$ = 55 $^oC/W$



7Z62315.1

at a lead-length a = 3 mm and with a copper laminate

c. > 1 cm^2 — $R_{th\ j\text{-}a}$ = 55 $^oC/W$
d. < 1 cm^2 — $R_{th\ j\text{-}a}$ = 60 $^oC/W$



7Z62314

CHARACTERISTICS

Forward voltage

$I_F = 20$ A; $T_j = 25$ °C	V_F	<	2,3	V [1]

Reverse current

$V_R = V_{RWMmax}$; $T_j = 125$ °C	I_R	<	200	µA

SOLDERING AND MOUNTING NOTES

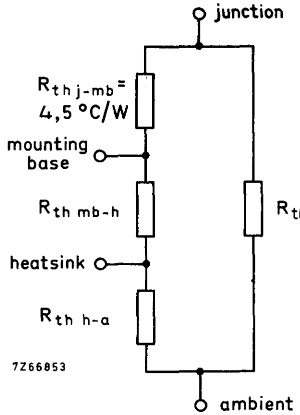
1. Soldered joints must be at least 2,5 mm from the seal.
2. The maximum permissible temperature of the soldering iron or bath is 270 °C; contact with the joint must not exceed 3 seconds.
3. The devices should not be immersed in oil, and few potting resins are suitable for re-encapsulation. Advice on these materials is available on request.
4. Leads should not be bent less than 2,5 mm from the seal; exert no axial pull when bending.
5. For good thermal contact heatsink compound should be used between base-plate and heatsink.

[1]) Measured under pulse conditions to avoid excessive dissipation.

OPERATING NOTES

Dissipation and heatsink considerations:

a. The various components of junction temperature rise above ambient are illustrated below:

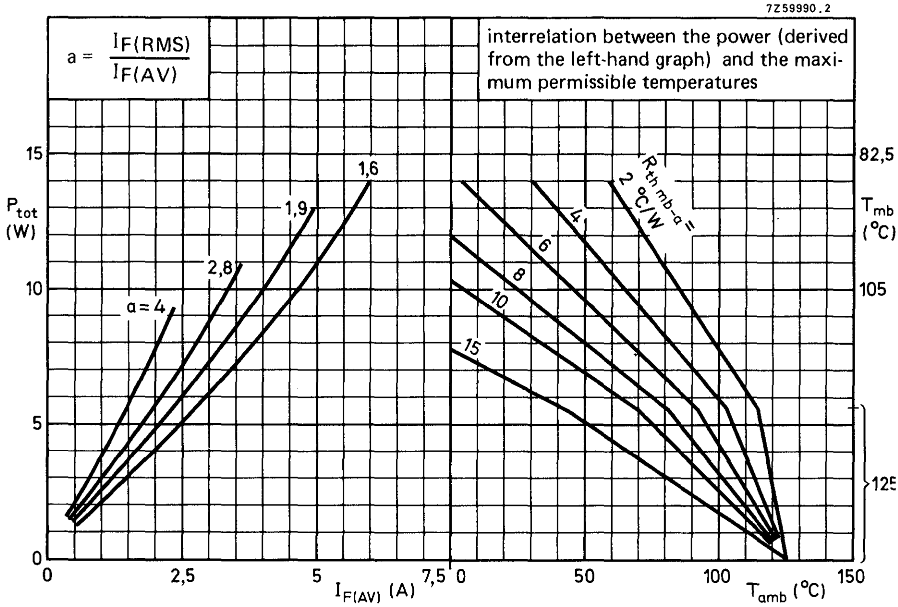


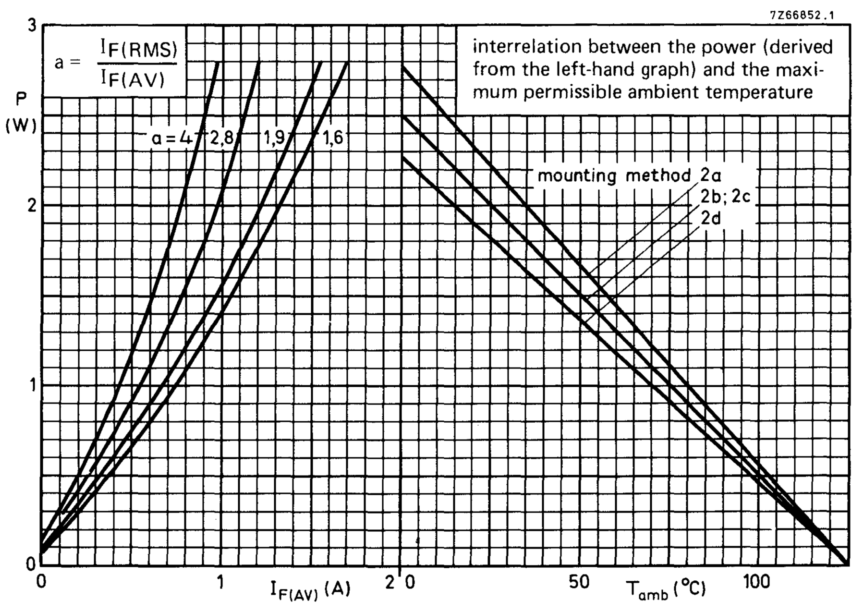
b. The method of using the graph on page 7 is as follows:
Starting with the curve of maximum dissipation as a function of $I_{F(AV)}$, for a particular current value trace upwards to meet the appropriate form factor curve. Trace horizontally until the $R_{th\,mb\text{-}a}$ curve is reached.
Finally trace upwards from the T_{amb} scale. The intersection determines the $R_{th\,mb\text{-}a}$ required.
The heatsink thermal resistance value ($R_{th\,h\text{-}a}$) can now be calculated from:

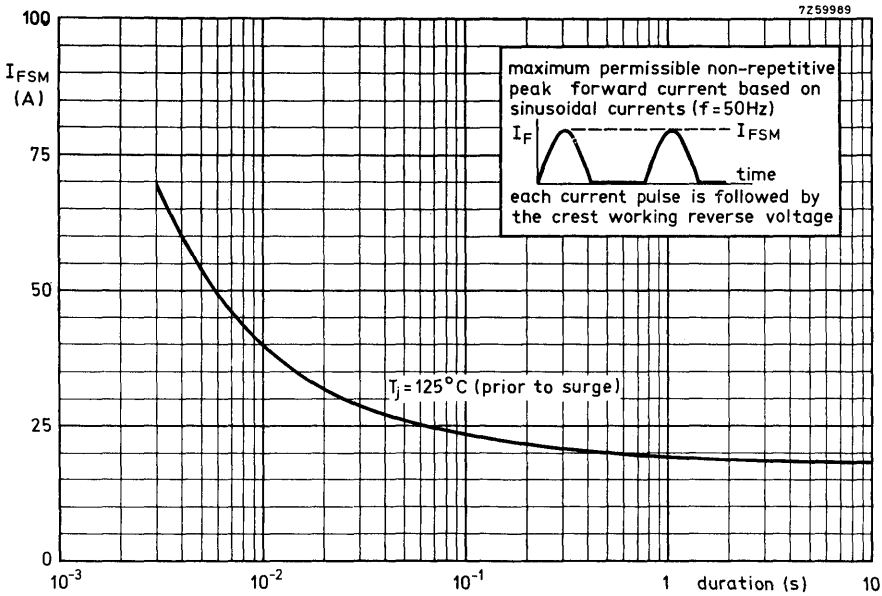
$$R_{th\,h\text{-}a} = R_{th\,mb\text{-}a} - R_{th\,mb\text{-}h}$$

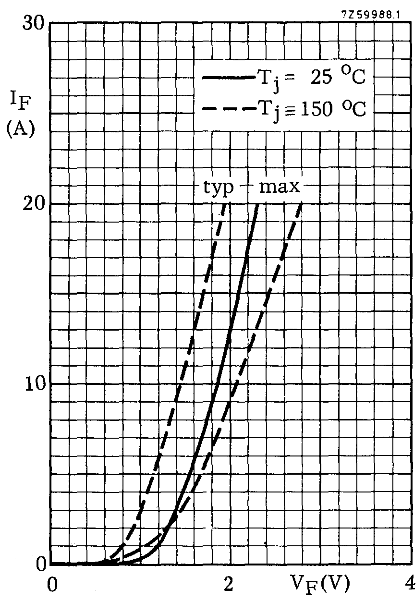
Any measurement of heatsink temperature should be made immediately adjacent to the device.

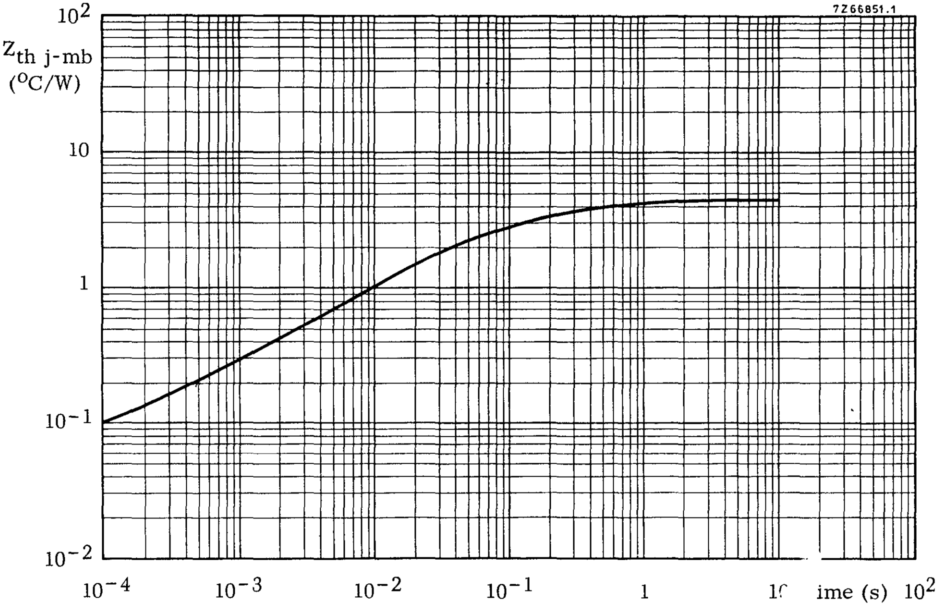
c. The heatsink curves are optimised to allow the junction temperature to run up to 150 °C ($T_{j\,max}$) whilst limiting T_{mb} to 125 °C (or less).


7Z59990.2
a = IF(RMS) / IF(AV)
interrelation between the power (derived from the left-hand graph) and the maximum permissible temperatures
Ptot (W)
15
10
5
0
1,6
1,9
2,8
a = 4
0
2,5
5
7,5
IF(AV) (A)
0
50
100
150
Tamb (°C)
Rth mb-a = 2 °C/W
4
6
8
10
15
82,5
Tmb (°C)
105
125


7Z66852.1
a = IF(RMS) / IF(AV)
interrelation between the power (derived from the left-hand graph) and the maximum permissible ambient temperature
P (W)
3
2
1
0
a = 4
2,8
1,9
1,6
0
1
IF(AV) (A)
2
0
50
Tamb (°C)
100
mounting method 2a
2b; 2c
2d


7Z59989
100
I_{FSM}
(A)
75
50
25
0
10^{-3}
10^{-2}
10^{-1}
1
duration (s)
10
maximum permissible non-repetitive peak forward current based on sinusoidal currents (f = 50Hz)
I_F
I_{FSM}
time
each current pulse is followed by the crest working reverse voltage
T_j = 125 °C (prior to surge)


7Z59988.1
30
I_F
(A)
20
10
0
0
2
V_F(V)
4
T_j = 25 °C
T_j ≡ 150 °C
typ
max


7Z66851.1
10^2
$Z_{th\ j\text{-}mb}$ (°C/W)
10
1
10^{-1}
10^{-2}
10^{-4}
10^{-3}
10^{-2}
10^{-1}
1
time (s)
10^2

FAST SOFT-RECOVERY RECTIFIER DIODES

Also available to BS9331-F028

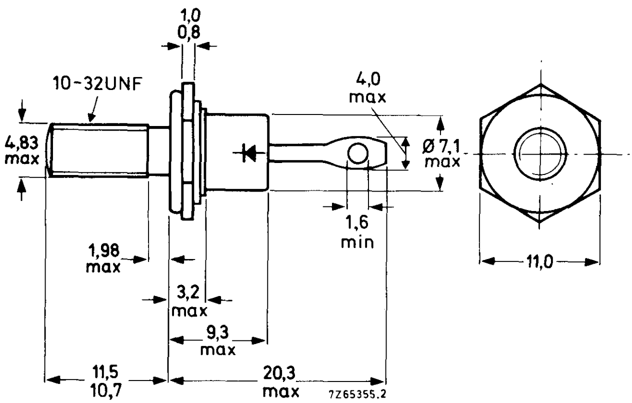
Silicon diodes in DO-4 metal envelopes, intended for use in high-frequency power supplies, thyristor inverters and multi-phase power rectifier applications. The series consists of the following types:
Normal polarity (cathode to stud): BYX50-200, 300
Reverse polarity (anode to stud): BYX50-200R, 300R
These devices feature non-snap-off characteristics.

QUICK REFERENCE DATA

			BYX50-200(R)	300(R)	
Repetitive peak reverse voltage	V_{RRM}	max.	200	300	V
Average forward current	$I_{F(AV)}$	max.	7		A
Non-repetitive peak forward current	I_{FSM}	max.	80		A
Reverse recovery time	t_{rr}	<	100		ns

MECHANICAL DATA Dimensions in mm

DO-4, Supplied with device: 1 nut, 1 lock washer
Nut dimensions across the flats: 9.5 mm



Net mass: 6 g
Diameter of clearance hole: max. 5.2 mm
Accessories supplied on request:
56295 (PTFE bush, 2 mica washers, plain washer, tag)

Torque on nut: min. 0.9 Nm (9 kg cm)
max. 1.7 Nm (17 kg cm)

The mark shown applies to the normal polarity types.

RATINGS Limiting values in accordance with the Absolute Maximum System (IEC 134)

Voltages

			BYX50-200(R)	300(R)	
Non-repetitive peak reverse voltage; $t \leq 10$ ms	V_{RSM}	max.	250	350	V
Repetitive peak reverse voltage	V_{RRM}	max.	200	300	V
Crest working reverse voltage	V_{RWM}	max.	200	300	V
Continuous reverse voltage	V_R	max.	200	300	V

Currents

Average on-state current assuming zero switching losses (averaged over any 20 ms period) up to T_{mb} = 103 °C	$I_{F(AV)}$	max.	7	A
at T_{mb} = 125 °C	$I_{F(AV)}$	max.	4	A
R.M.S. forward current	$I_{F(RMS)}$	max.	11	A
Repetitive peak forward current	I_{FRM}	max.	80	A
Non-repetitive peak forward current t = 10 ms; T_j = 150 °C prior to surge with reapplied V_{RWMmax}	I_{FSM}	max.	80	A
I^2t for fusing (t = 10 ms)	I^2t	max.	32	A^2s
Rate of change of commutation current	See nomogram on page 5			

Temperatures

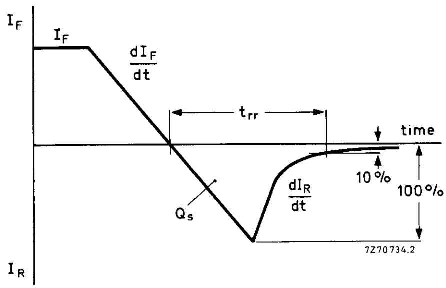
Storage temperature	T_{stg}	−55 to +150		°C
Junction temperature	T_j	max.	150	°C

THERMAL RESISTANCE

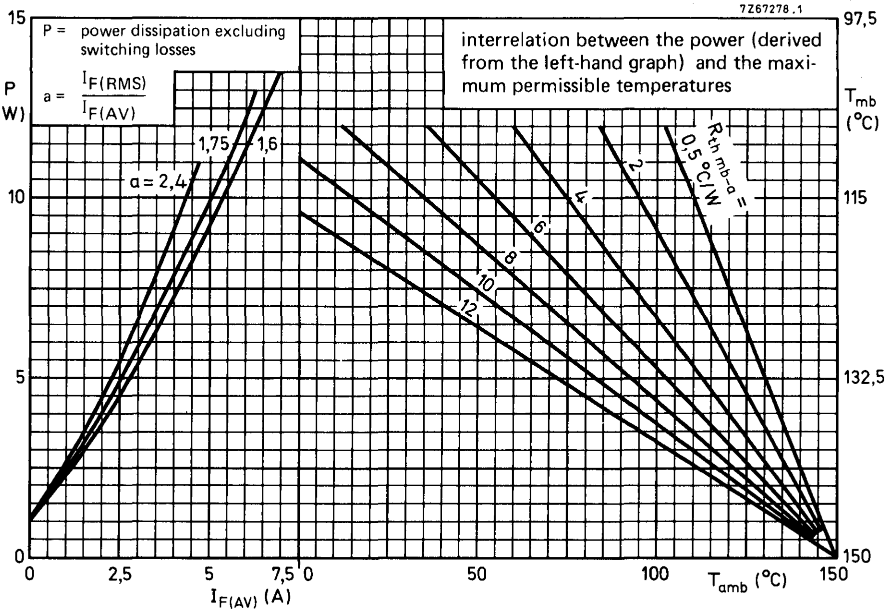
From junction to ambient in free air	$R_{th\ j-a}$	=	50	°C/W
From junction to mounting base	$R_{th\ j-mb}$	=	3,5	°C/W
From mounting base to heatsink	$R_{th\ mb-h}$	=	0,5	°C/W
Transient thermal impedance; t = 1 ms	$Z_{th\ j-mb}$	=	1	°C/W

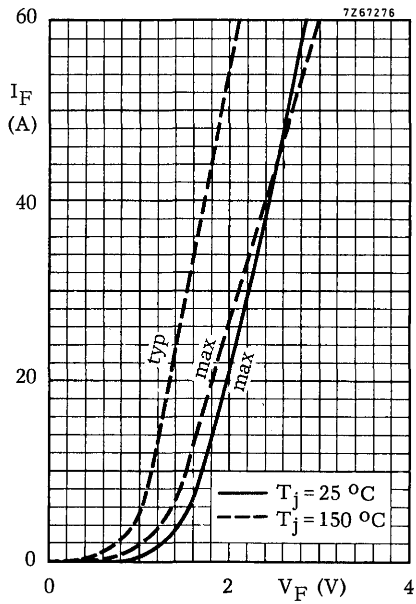
CHARACTERISTICS

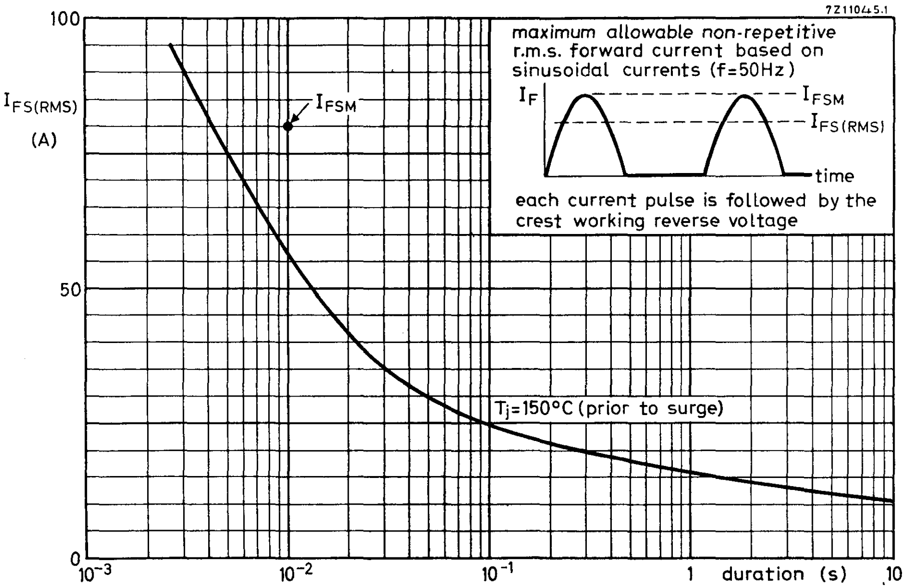
Forward voltage				
I_F = 20 A; T_j = 25 °C	V_F	<	1,95	V [1]
Reverse current				
$V_R = V_{RWMmax}$; T_j = 125 °C	I_R	<	3	mA
Reverse recovery when switched from				
I_F = 1 A to V_R = 30 V; $-dI_F/dt$ = 100 A/µs; T_j = 25 °C Recovery time	t_{rr}	<	100	ns
I_F = 1 A to V_R = 30 V; $-dI_F/dt$ = 35 A/µs; T_j = 25 °C Recovery time	t_{rr}	<	150	ns
I_F = 2 A to V_R = 30 V; $-dI_F/dt$ = 20 A/µs; T_j = 25 °C Recovered charge	Q_s	<	250	nC
I_F = 2 A to V_R = 50 V; $-dI_F/dt$ = 2 A/µs; T_j = 25 °C Max. slope of the reverse recovery current	$\|dI_R/dt\|$	<	5	A/µs

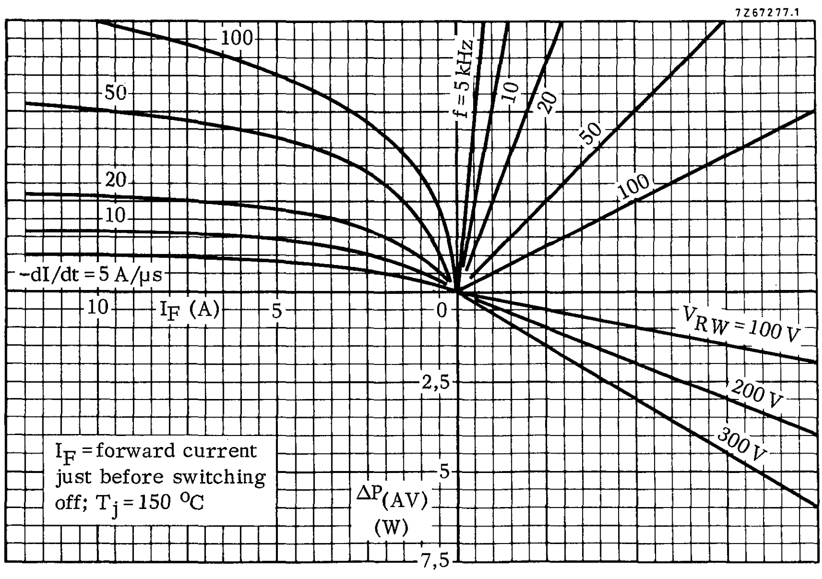


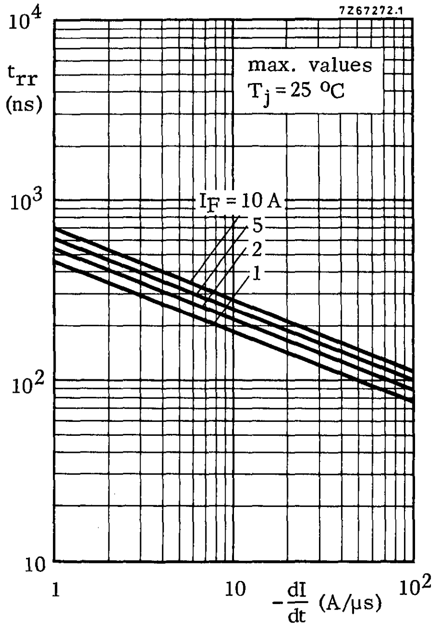
1) Measured under pulse conditions to avoid excessive dissipation.

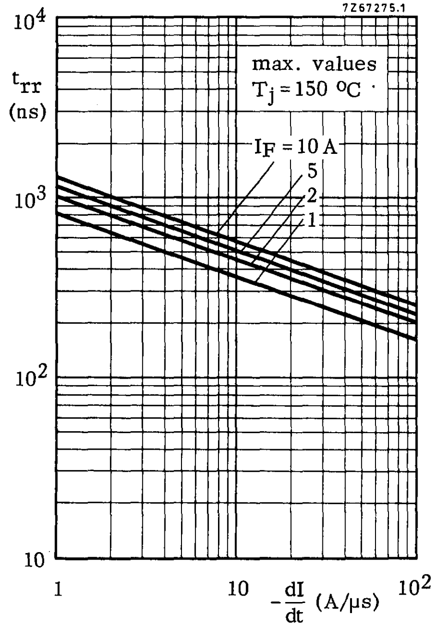

7Z67278.1
P = power dissipation excluding switching losses
a = $\frac{I_{F(RMS)}}{I_{F(AV)}}$
interrelation between the power (derived from the left-hand graph) and the maximum permissible temperatures
P (W)
15
10
5
0
a = 2,4
1,75
1,6
$R_{th\ mb-a}$ = 0,5 °C/W
2
4
6
8
10
12
0
2,5
5
7,5
$I_{F(AV)}$ (A)
0
50
100
150
T_{amb} (°C)
97,5
115
132,5
150
T_{mb} (°C)

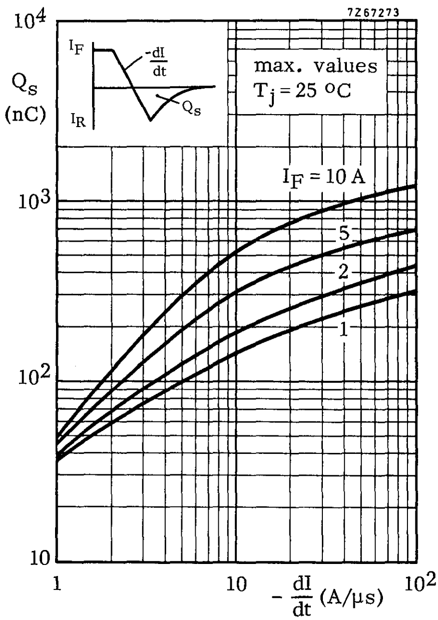

7Z67276
I_F (A)
60
40
20
0
typ
max
max
T_j = 25 °C
T_j = 150 °C
0
2
4
V_F (V)

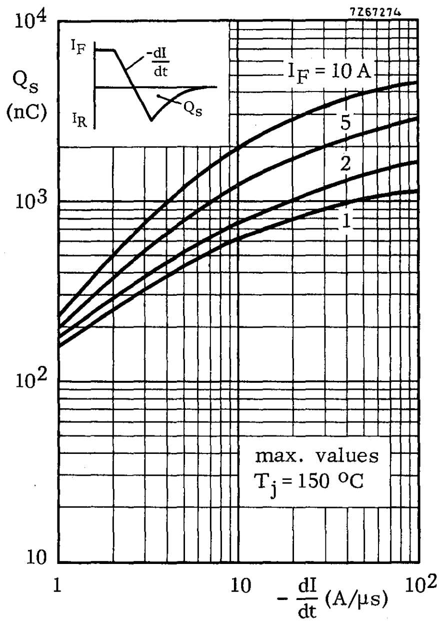

7Z11045.1
maximum allowable non-repetitive r.m.s. forward current based on sinusoidal currents (f=50Hz)
I_F
I_{FSM}
$I_{FS(RMS)}$
time
each current pulse is followed by the crest working reverse voltage
$I_{FS(RMS)}$ (A)
100
50
0
I_{FSM}
T_j=150°C (prior to surge)
10^{-3}
10^{-2}
10^{-1}
1
duration (s)
10

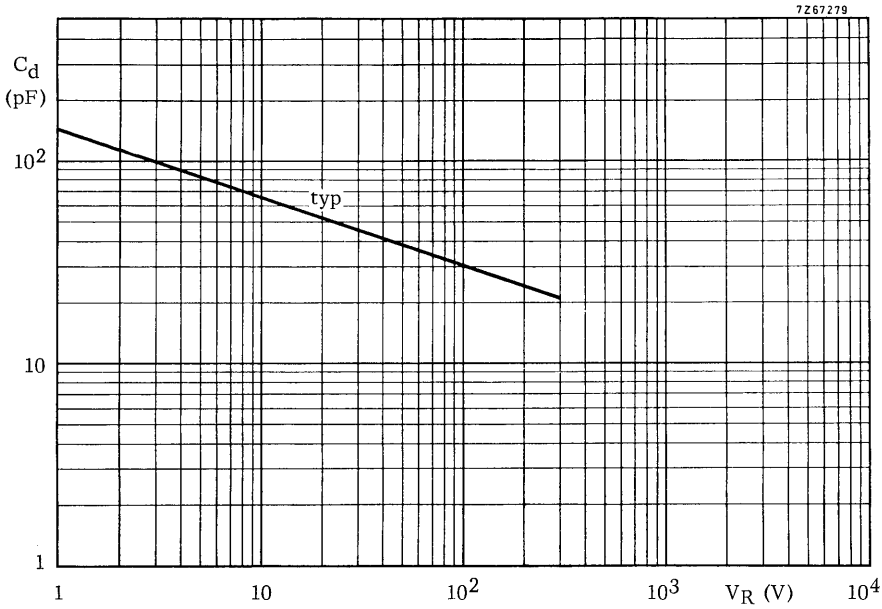

7Z67277.1
100
50
20
10
−dI/dt = 5 A/μs
f = 5 kHz
10
20
50
100
10
I_F (A)
5
0
V_{RW} = 100 V
200 V
300 V
2,5
5
7,5
$\Delta P_{(AV)}$ (W)
I_F = forward current just before switching off; T_j = 150 °C

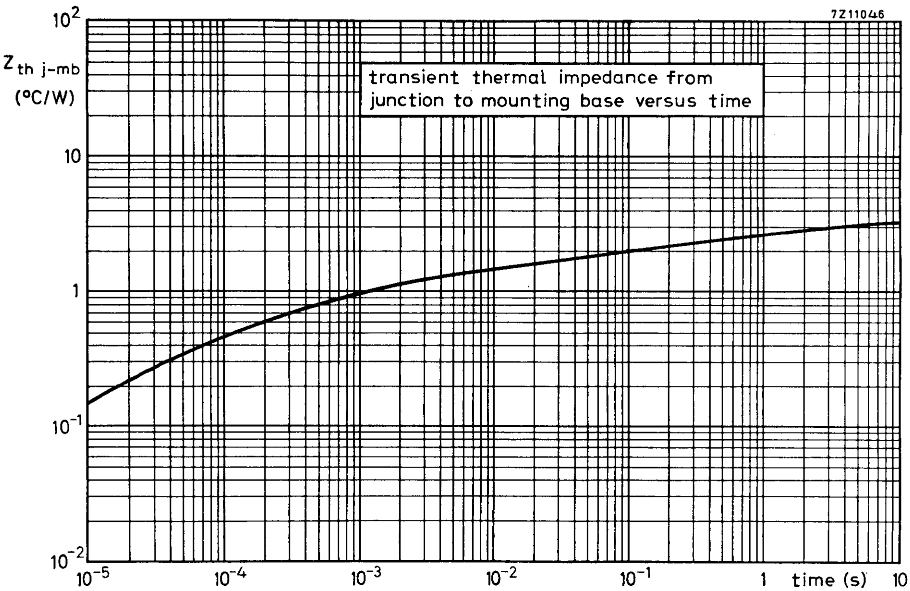

7Z67272.1
10^4
t_{rr}
(ns)
max. values
$T_j = 25\ ^oC$
10^3
$I_F = 10$ A
5
2
1
10^2
10
1
10
$-\frac{dI}{dt}$ (A/μs)
10^2


7Z67275.1
10^4
t_{rr}
(ns)
max. values
$T_j = 150\ ^oC$
$I_F = 10$ A
5
2
1
10^3
10^2
10
1
10
$-\frac{dI}{dt}$ (A/μs)
10^2


7Z67273
10^4
I_F
$-\frac{dI}{dt}$
Q_s
I_R
Q_s
(nC)
max. values
$T_j = 25\ ^oC$
$I_F = 10$ A
10^3
5
2
1
10^2
10
1
10
$-\frac{dI}{dt}$ (A/μs)
10^2


7Z67274
10^4
I_F
$-\frac{dI}{dt}$
Q_s
I_R
Q_s
(nC)
$I_F = 10$ A
5
2
10^3
1
10^2
max. values
$T_j = 150\ ^oC$
10
1
10
$-\frac{dI}{dt}$ (A/μs)
10^2


7Z67279
C_d
(pF)
10^2
typ
10
1
1
10
10^2
10^3
V_R (V)
10^4


7Z11046
10^2
$Z_{th\ j\text{-}mb}$
(°C/W)
transient thermal impedance from
junction to mounting base versus time
10
1
10^{-1}
10^{-2}
10^{-5}
10^{-4}
10^{-3}
10^{-2}
10^{-1}
1
time (s)
10

RECTIFIER DIODES

Also available to BS9331-F026

Silicon rectifier diodes in DO-5 metal envelopes, intended for use in power rectifier applications.
The series consists of the following types:
Normal polarity (cathode to stud): BYX52-300, BYX52-600, BYX52-1200.
Reverse polarity (anode to stud): BYX52-300R, BYX52-600R, BYX52-1200R.

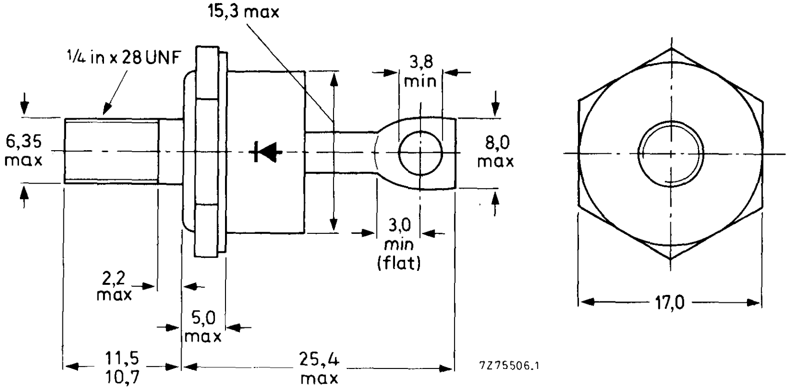
QUICK REFERENCE DATA

			BYX52-300(R)	600(R)	1200(R)	
Repetitive peak reverse voltage	V_{RRM}	max.	300	600	1200	V
Average forward current	$I_{F(AV)}$	max.	48			A
Non-repetitive peak forward current	I_{FSM}	max.	800			A

MECHANICAL DATA

Dimensions in mm

DO-5; Supplied with device: 1 nut, 1 lock-washer
Nut dimensions across the flats: 11,1 mm



Net mass: 22 g
Diameter of clearance hole: max. 6,5 mm
Accessories supplied on request:
56264A (mica washer, insulating ring, tag)

Torque on nut: min. 1,7 Nm
(17 kg cm)
max. 3,5 Nm
(35 kg cm)

The mark shown applies to the normal polarity types.

RATINGS Limiting values in accordance with the Absolute Maximum System (IEC 134)

Voltages

			BYX52-300(R)	600(R)	1200(R)	
Non-repetitive peak reverse voltage ($t \leq 10$ ms)	V_{RSM}	max.	300	600	1200	V
Repetitive peak reverse voltage ($\delta = 0.01$)	V_{RRM}	max.	300	600	1200	V
Crest working reverse voltage	V_{RWM}	max.	200	400	800	V

Currents

Average forward current (averaged over any 20 ms period) up to $T_{mb} = 112\ ^{\circ}C$	$I_{F(AV)}$	max.	48	A
at $T_{mb} = 125\ ^{\circ}C$	$I_{F(AV)}$	max.	40	A
R.M.S. forward current	$I_{F(RMS)}$	max.	75	A
Repetitive peak forward current	I_{FRM}	max.	450	A
Non-repetitive peak forward current ($t = 10$ ms; half-sinewave) $T_j = 175\ ^{\circ}C$ prior to surge	I_{FSM}	max.	800	A
I^2t for fusing ($t = 10$ ms)	I^2t	max.	3200	A^2s

Temperatures

Storage temperature	T_{stg}	-55 to +175		$^{\circ}C$
Junction temperature	T_j	max.	175	$^{\circ}C$

THERMAL RESISTANCE

From junction to mounting base	$R_{th\ j-mb}$	=	0.8	$^{\circ}C/W$
From mounting base to heatsink	$R_{th\ mb-h}$	=	0.2	$^{\circ}C/W$

CHARACTERISTICS

Forward voltage

$I_F = 150$ A; $T_j = 25\ ^{\circ}C$	V_F	<	1.8	V [1]

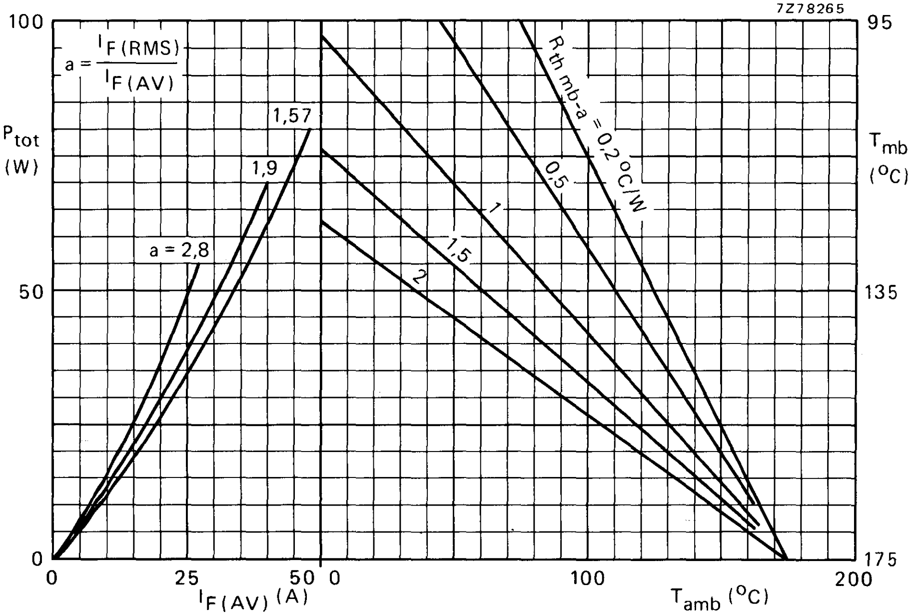
Reverse current

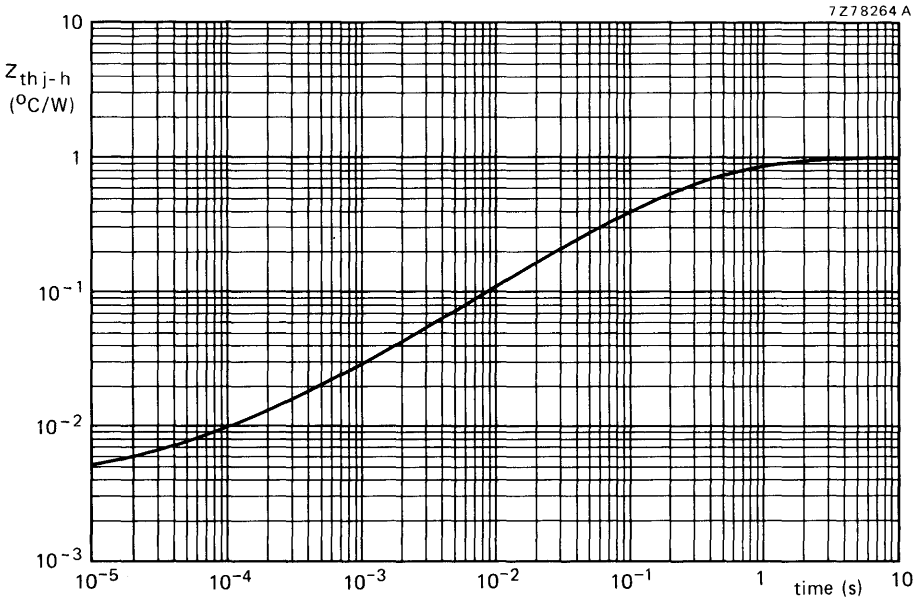
$V_R = V_{RWM}max$; $T_j = 125\ ^{\circ}C$	I_R	<	1.6	mA

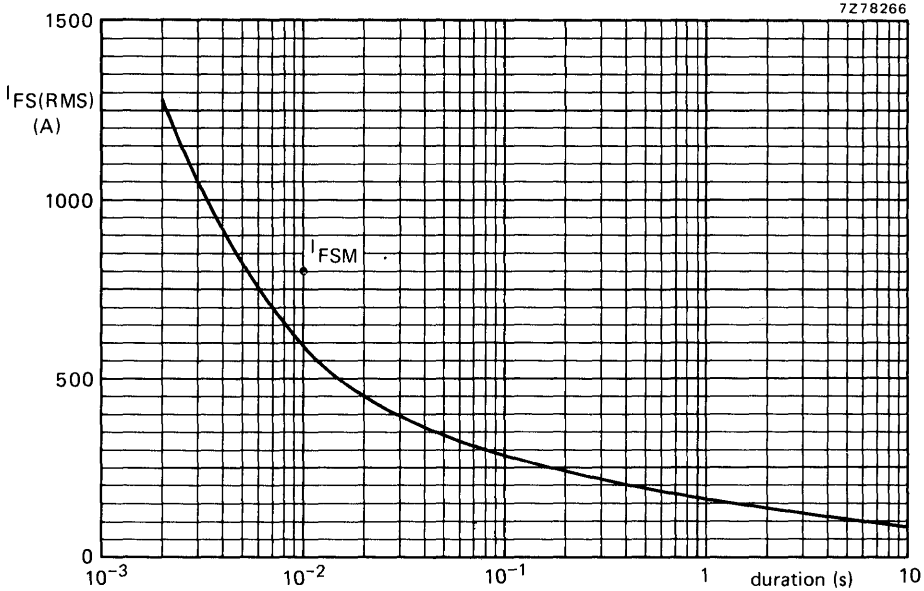
OPERATING NOTES

The top connector should neither be bent nor twisted; it should be soldered into the circuit so there is no strain on it.

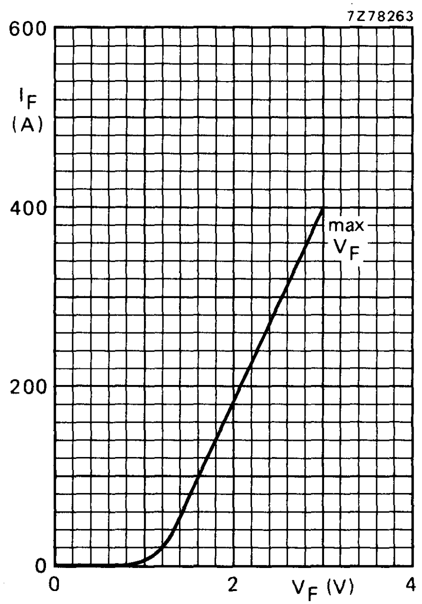
[1]) Measured under pulse conditions to avoid excessive dissipation.


7Z78265
$a = \frac{I_{F(RMS)}}{I_{F(AV)}}$
P_{tot} (W)
100
50
0
a = 2,8
1,9
1,57
0
25
50
$I_{F(AV)}$ (A)
0
100
200
T_{amb} (°C)
$R_{th\ mb\text{-}a}$ = 0,2 °C/W
0,5
1
1,5
2
95
135
175
T_{mb} (°C)


7Z78264 A
$Z_{th\ j\text{-}h}$ (°C/W)
10
1
10^{-1}
10^{-2}
10^{-3}
10^{-5}
10^{-4}
10^{-3}
10^{-2}
10^{-1}
1
time (s)
10



Maximum permissible non-repetitive r.m.s. forward current based on sinusoidal currents (f = 50 Hz); T_j = 175 °C prior to surge; with reapplied V_{RWMmax}.



CONTROLLED AVALANCHE RECTIFIER DIODES

Silicon diodes in a DO–5 metal envelope, capable of absorbing transients and intended for power rectifier applications.
The series consists of the following types:
Normal polarity (cathode to stud): BYX56–600 to BYX56–1400. ←
Reverse polarity (anode to stud): BYX56–600R to BYX56–1400R.

QUICK REFERENCE DATA

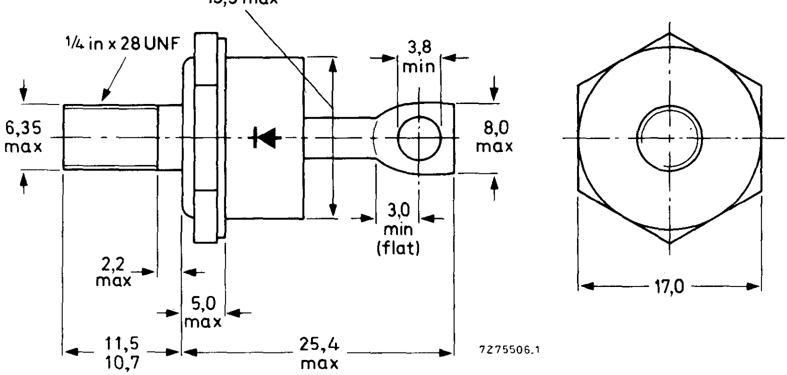
			BYX56–600(R)	800(R)	1000(R)	1200(R)	1400(R)	
Crest working reverse voltage	V_{RWM}	max.	600	800	1000	1200	1400	V
Reverse avalanche breakdown voltage	$V_{(BR)R}$	>	750	1000	1250	1450	1650	V
Average forward current	$I_{F(AV)}$	max.			48			A
Non-repetitive peak forward current	I_{FSM}	max.			800			A
Non-repetitive peak reverse power dissipation	P_{RSM}	max.			40			kW

←

MECHANICAL DATA

Dimensions in mm

Fig. 1 DO–5



Net mass: 22 g
Diameter of clearance hole: max. 6.5 mm
Accessories supplied on request:
56264A (mica washer, insulating ring, tag).

Supplied with device: 1 nut, 1 lock washer.

Nut dimensions across the flats: 11.1 mm.

The mark shown applies to normal polarity types.

Torque on nut:
min. 1.7 Nm (17 kg cm),
max. 2.5 Nm (25 kg cm). ←

RATINGS

Limiting values in accordance with the Absolute Maximum System (IEC134)

→ **Voltages***

			BYX56–600(R)	800(R)	1000(R)	1200(R)	1400(R)	
Crest working reverse voltage	V_{RWM}	max.	600	800	1000	1200	1400	V
Continuous reverse voltage	V_R	max.	600	800	1000	1200	1400	V

Currents

Average forward current (averaged over any 20 ms period) up to T_{mb} = 112 °C	$I_{F(AV)}$	max.	48	A
at T_{mb} = 125 °C	$I_{F(AV)}$	max.	40	A
R.M.S. forward current	$I_{F(RMS)}$	max.	75	A
Repetitive peak forward current	I_{FRM}	max.	450	A
Non-repetitive peak forward current t = 10 ms (half sine-wave); T_j = 175 °C prior to surge; with reapplied V_{RWMmax}	I_{FSM}	max.	800	A
I^2t for fusing (t ⩽ 10 ms)	I^2t	max.	3200	A^2s

Reverse power dissipation

Repetitive peak reverse power dissipation t = 10 μs (square-wave; f = 50 Hz); T_j = 175 °C	P_{RRM}	max.	6.5	kW
Non-repetitive peak reverse power dissipation t = 10 μs (square-wave) T_j = 25 °C prior to surge	P_{RSM}	max.	40	kW
T_j = 175 °C prior to surge	P_{RSM}	max.	6.5	kW

Temperatures

Storage temperature	T_{stg}		−55 to +175	°C
Junction temperature	T_j	max.	175	°C

THERMAL RESISTANCE

From junction to mounting base	$R_{th\ j\text{-}mb}$	=	0.8	°C/W
From mounting base to heatsink	$R_{th\ mb\text{-}h}$	=	0.2	°C/W
Transient thermal impedance; t = 1 ms	$Z_{th\ j\text{-}h}$	=	0.03	°C/W

*To ensure thermal stability: $R_{th\ j\text{-}a}$ < 2.2 °C/W (a.c.)

CHARACTERISTICS

			BYX56–600(R)	800(R)	1000(R)	1200(R)	1400(R)	
Forward voltage I_F = 150 A; T_j = 25 °C	V_F	<	1.8	1.8	1.8	1.8	1.8	V*
Reverse avalanche breakdown voltage I_R = 5 mA; T_j = 25 °C	$V_{(BR)R}$	>	750	1000	1250	1450	1650	V
		<	2000	2000	2000	2200	2400	V
Reverse current $V_R = V_{RWMmax}$; T_j = 125 °C	I_R	<	1.6	1.6	1.6	1.6	1.6	mA

OPERATING NOTES

The top connector should neither be bent nor twisted; it should be soldered into the circuit so that there is no strain on it.
During soldering the heat conduction to the junction should be kept to a minimum by using a thermal shunt.

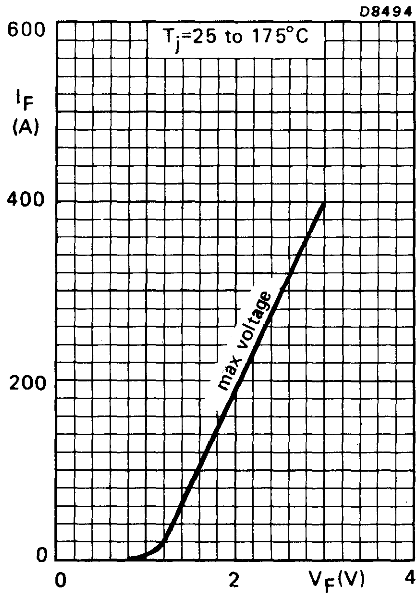


Fig.2

*Measured under pulsed conditions to avoid excessive dissipation.

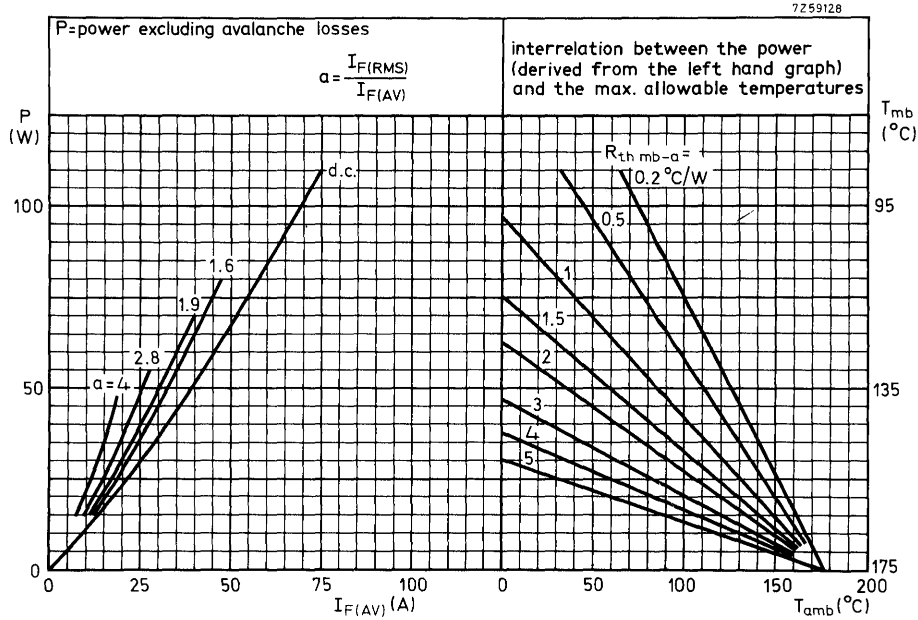

7Z59128
P=power excluding avalanche losses
a = I F(RMS) / I F(AV)
interrelation between the power (derived from the left hand graph) and the max. allowable temperatures
P (W)
100
50
0
d.c.
1.6
1.9
2.8
a=4
0
25
50
75
100
I F(AV) (A)
R th mb-a = 0.2 °C/W
0.5
1
1.5
2
3
4
5
0
50
100
150
200
T amb (°C)
T mb (°C)
95
135
175

Fig.3

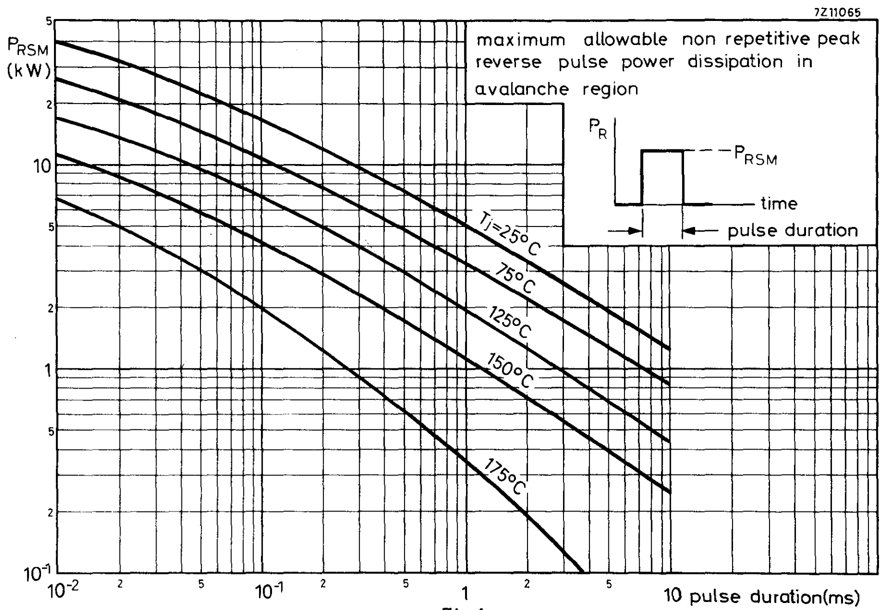

7Z11065
maximum allowable non repetitive peak reverse pulse power dissipation in avalanche region
P RSM (kW)
10
1
10^-1
Tj=25°C
75°C
125°C
150°C
175°C
P R
P RSM
time
pulse duration
10^-2
10^-1
1
10 pulse duration(ms)

Fig.4

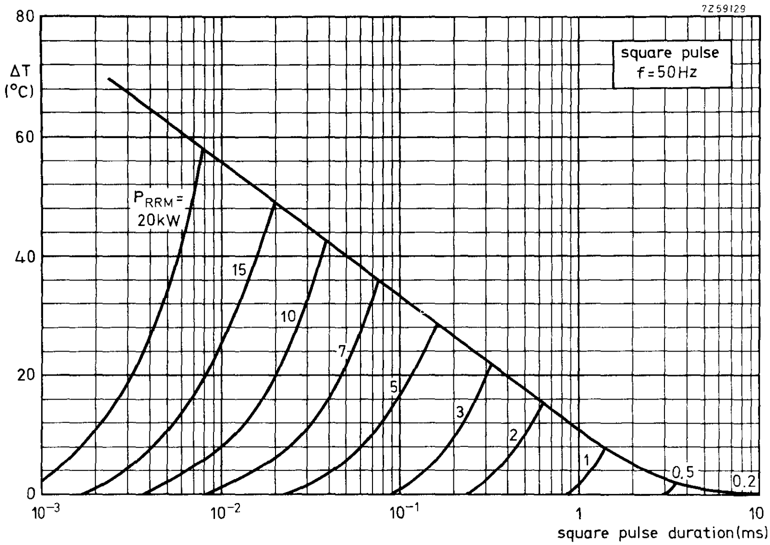


Fig.5

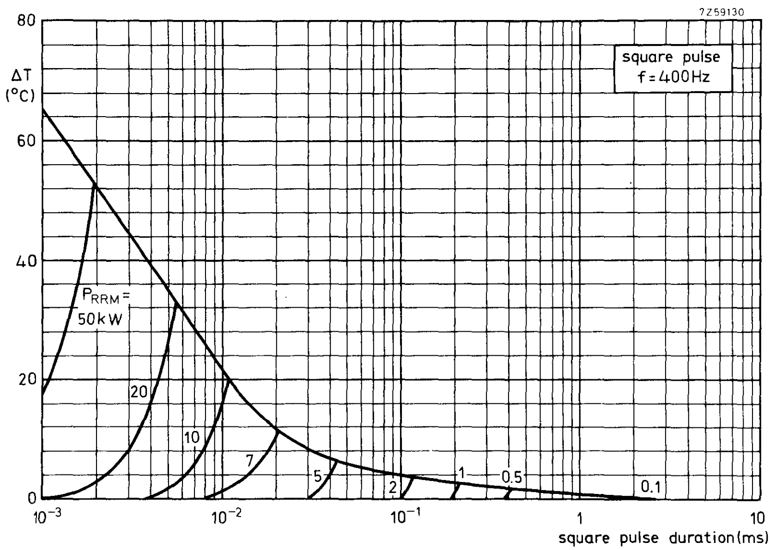


Fig.6

ΔT = neccessary derating of T_{jmax} to accommodate repetitive transients in the reverse direction. Allowance can be made for this by assuming the ambient temperature ΔT higher.

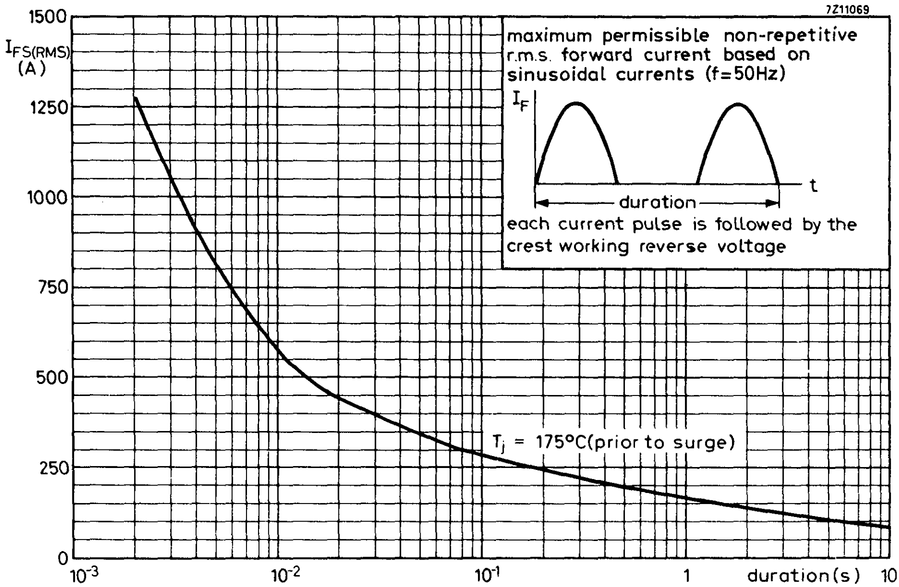

7Z11069
1500
I FS(RMS) (A)
1250
1000
750
500
250
0
10-3
10-2
10-1
1
duration (s)
10
maximum permissible non-repetitive r.m.s. forward current based on sinusoidal currents (f=50Hz)
IF
t
duration
each current pulse is followed by the crest working reverse voltage
Tj = 175°C(prior to surge)

Fig. 7

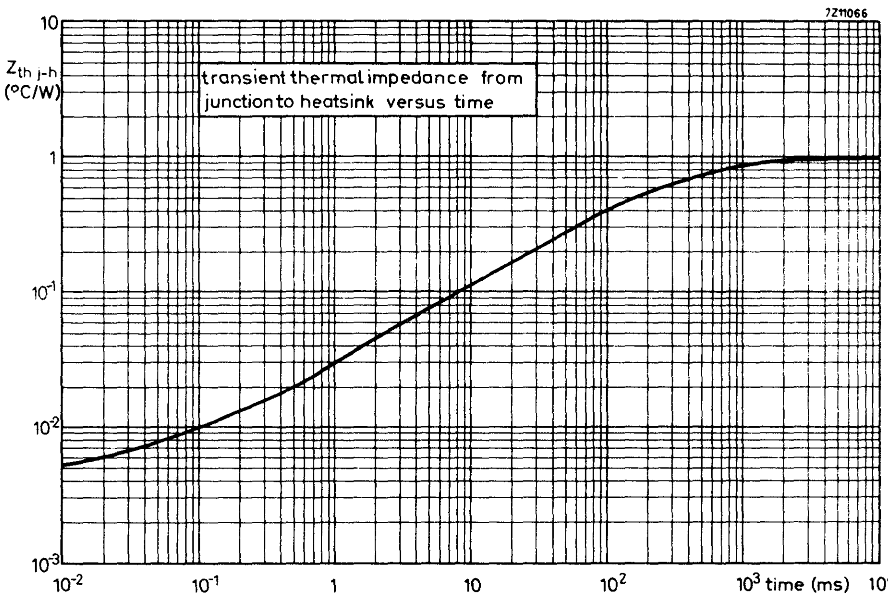

7Z11066
10
Zth j-h (°C/W)
1
10-1
10-2
10-3
transient thermal impedance from junction to heatsink versus time
10-2
10-1
1
10
10^2
10^3 time (ms)
10^4

Fig. 8

FAST SOFT-RECOVERY RECTIFIER DIODES

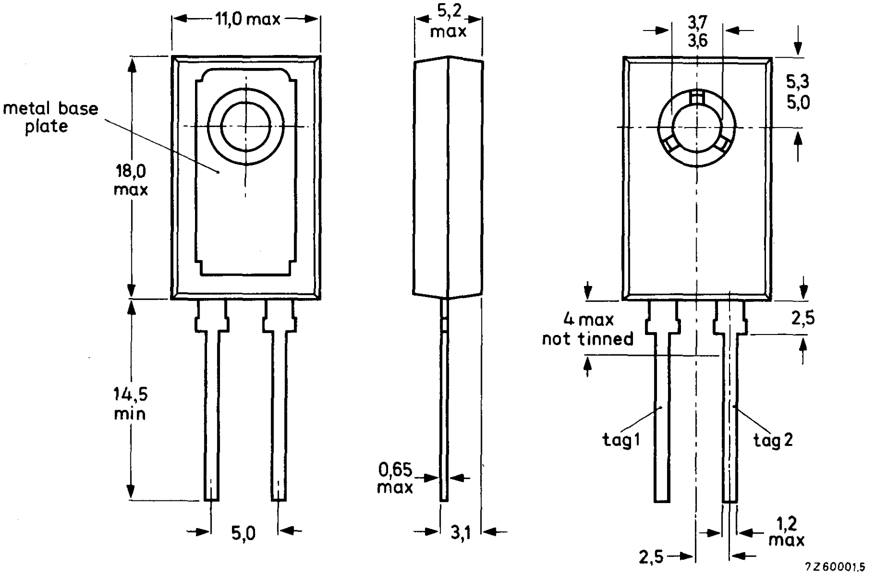
Silicon double-diffused rectifier diodes in plastic envelopes. They are intended for use in chopper applications as well as in switched-mode power supplies, as efficiency diodes and scan rectifiers in television receivers. The devices feature non-snap-off characteristics. Normal and reverse polarity types are available.

QUICK REFERENCE DATA

			BYX71-350(R)	600(R)	
Repetitive peak reverse voltage	V_{RRM}	max.	350	600	V
Average forward current	$I_{F(AV)}$	max.	7		A
Non-repetitive peak forward current	I_{FSM}	max.	60		A
Reverse recovery time	t_{rr}	<	450		ns

MECHANICAL DATA (see also page 2) Dimensions in mm

SOD-38



The exposed metal base-plate is directly connected to tag 1.

MECHANICAL DATA (continued)

Net mass: 2,5 g

Recommended diameter of fixing screw: 3,5 mm

Torque on screw
when using washer and heatsink compound: min. 0,95 Nm (9,5 kg cm)
max. 1,5 Nm (15 kg cm)

Accessories:
supplied with the device: 56355 (washer)
available on request: 56316 (mica insulating washer)

POLARITY OF CONNECTIONS

	BYX71-350 and BYX71-600	BYX71-350R and BYX71-600R
Base-plate:	cathode	anode
Tag 1 :	cathode	anode
Tag 2 :	anode	cathode

RATINGS Limiting values in accordance with the Absolute Maximum System (IEC134)

Voltages

			BYX71-350(R)	600(R)	
Continuous reverse voltage	V_R	max.	300	500	V
Working reverse voltage	V_{RW}	max.	300	500	V
Repetitive peak reverse voltage ($\delta \leq 0,01$)	V_{RRM}	max.	350	600	V
Non-repetitive peak reverse voltage ($t \leq 10$ ms)	V_{RSM}	max.	350	600	V

Currents

Average on-state current assuming zero switching losses (averaged over any 20 ms period)				
square wave: $\delta = 0,5$; up to $T_{mb} = 85\ ^oC$	$I_{F(AV)}$	max.	7	A
without heatsink at $T_{amb} = 50\ ^oC$	$I_{F(AV)}$	max.	1,4	A
sinusoidal: at $T_{mb} = 85\ ^oC$	$I_{F(AV)}$	max.	6,5	A
R.M.S. forward current	$I_{F(RMS)}$	max.	10	A
Repetitive peak forward current	I_{FRM}	max.	25	A
Non-repetitive peak forward current half sine wave; $t = 10$ ms; $T_j = 150\ ^oC$ prior to surge	I_{FSM}	max.	60	A
square pulse; $t = 5$ ms; $T_j = 150\ ^oC$ prior to surge	I_{FSM}	max.	60	A
Rate of change of commutation current	$-\frac{dI}{dt}$	max.	50	A/µs

Temperatures

Storage temperature	T_{stg}		-55 to +125	^oC
Junction temperature	T_j	max.	150	^oC

THERMAL RESISTANCE

From junction to mounting base	$R_{th\ j\text{-}mb}$	=	6,5	$^oC/W$
Transient thermal impedance; t = 1 ms	$Z_{th\ j\text{-}mb}$	=	0,3	$^oC/W$

Influence of mounting method

1. Heatsink mounted

From mounting base to heatsink

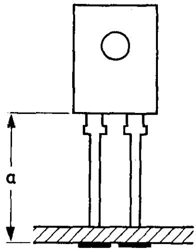
a. with heatsink compound	$R_{th\ mb\text{-}h}$	=	1,5	$^oC/W$
b. with heatsink compound and 56316 mica washer	$R_{th\ mb\text{-}h}$	=	2,7	$^oC/W$
c. without heatsink compound	$R_{th\ mb\text{-}h}$	=	2,7	$^oC/W$
d. without heatsink compound; with 56316 mica washer	$R_{th\ mb\text{-}h}$	=	5	$^oC/W$

2. Free air operation

The quoted values of $R_{th\ j\text{-}a}$ should be used only when no other leads run to the tie-points.

From junction to ambient in free air mounted on a printed circuit board
at a = maximum lead length
and with a copper laminate

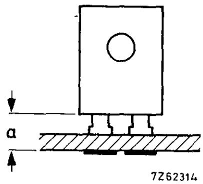
a. > 1 cm^2 — $R_{th\ j\text{-}a}$ = 50 $^oC/W$
b. < 1 cm^2 — $R_{th\ j\text{-}a}$ = 55 $^oC/W$



7Z62315.1

at a lead-length a = 3 mm
and with a copper laminate

c. > 1 cm^2 — $R_{th\ j\text{-}a}$ = 55 $^oC/W$
d. < 1 cm^2 — $R_{th\ j\text{-}a}$ = 60 $^oC/W$



7Z62314

SOLDERING AND MOUNTING NOTES

1. Soldered joints must be at least 2,5 mm from the seal.
2. The maximum permissible temperature of the soldering iron or bath is 270 °C; contact with the joint must not exceed 3 seconds.
3. The device should not be immersed in oil, and few potting resins are suitable for re-encapsulation. Advice on these materials is available on request.
4. Leads should not be bent less than 2,5 mm from the seal; exert no axial pull when bending.
5. For good thermal contact heatsink compound should be used between base-plate and heatsink.

CHARACTERISTICS

Forward voltage

I_F = 5 A; T_j = 25 °C	V_F	<	1,25	V [1]

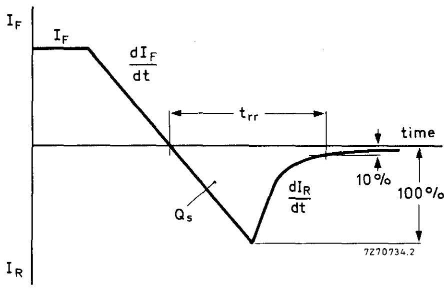
Reverse current

$V_R = V_{RWmax}$; T_j = 125 °C	I_R	<	0,4	mA

Reverse recovery when switched from

I_F = 2 A to V_R = 30 V with
$-dI_F/dt$ = 20 A/µs; T_j = 25 °C

Recovery charge	Q_s	<	700	nC
Recovery time	t_{rr}	<	450	ns
Max. slope of the reverse recovery current with $-dI_F/dt$ = 2 A/µs	$\lvert dI_R/dt \rvert$	<	5	A/µs



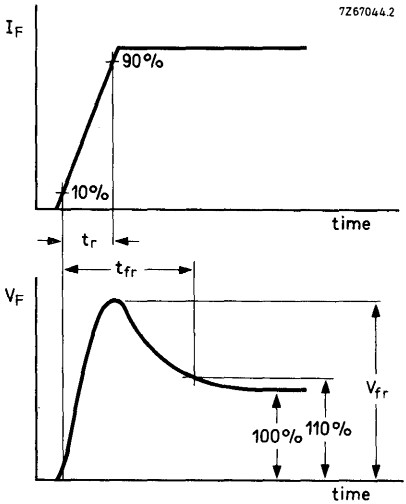
[1] Measured under pulse conditions to avoid excessive dissipation.

CHARACTERISTICS (continued)

Forward recovery when switched to

I_F = 25 A with t_r = 0, 5 μs at T_j = 25 °C

Recovery time	t_{fr}	<	0, 8	μs
Recovery voltage	V_{fr}	<	3, 5	V

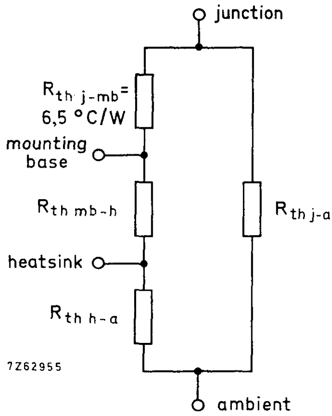


Forward output waveform

OPERATING NOTES

Dissipation and heatsink considerations:

a. The various components of junction temperature rise above ambient are illustrated below:



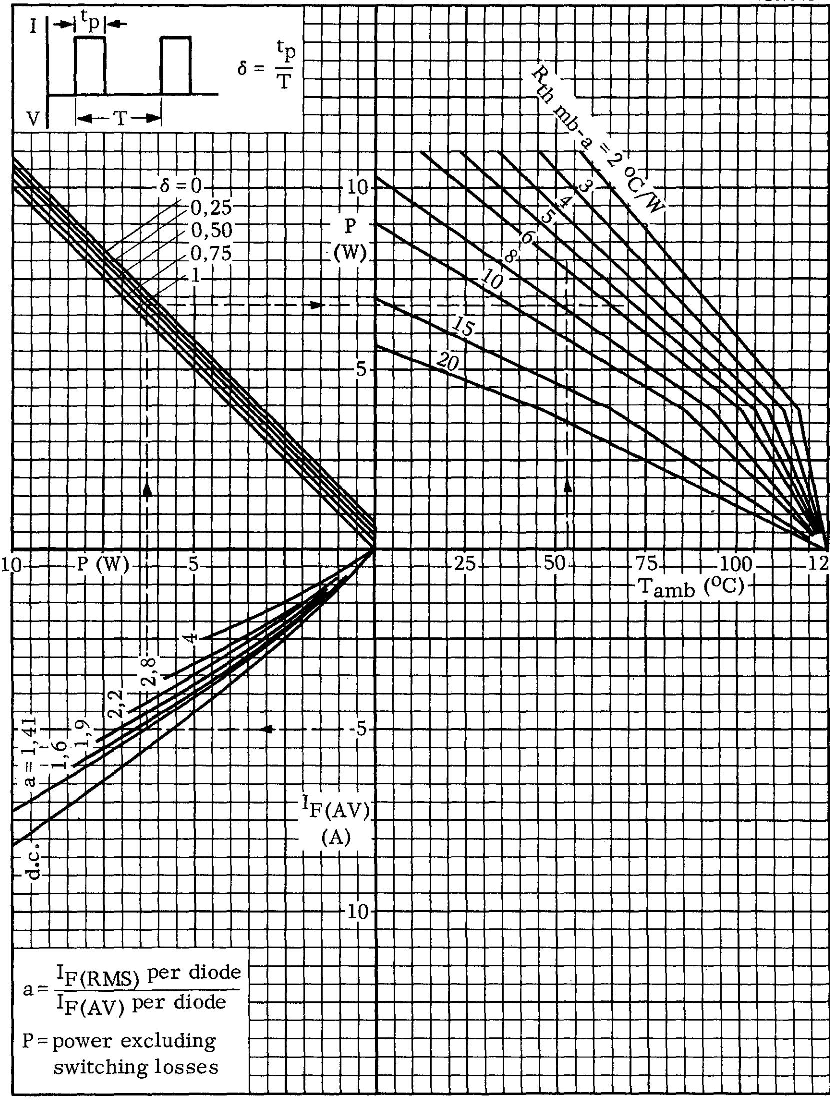
b. The method of using the graph on page 8 is as follows:
Starting with the curve of maximum dissipation as a function of $I_{F(AV)}$, for a particular current trace horizontally to meet the appropriate form factor; upwards to the operating duty cycle (δ) line; horizontally until the $R_{th\ mb\text{-}a}$ curve is reached. Finally trace upwards from the T_{amb} scale. The intersection determines the $R_{th\ mb\text{-}a}$ required.
The heatsink thermal resistance value ($R_{th\ h\text{-}a}$) can now be calculated from:

$$R_{th\ h\text{-}a} = R_{th\ mb\text{-}a} - R_{th\ mb\text{-}h}$$

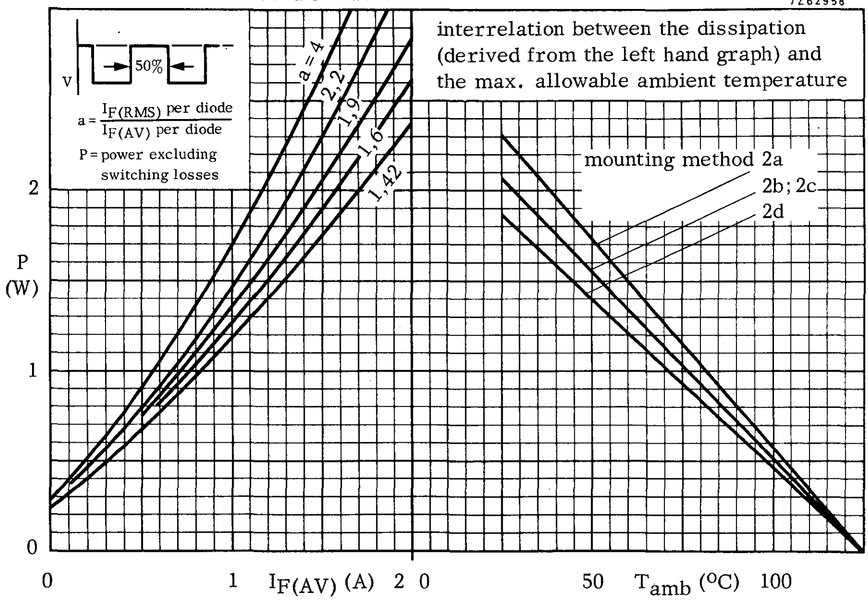
Any measurement of heatsink temperature should be made immediately adjacent to the device.

c. The heatsink curves are optimised to allow the junction temperature to run up to 150 °C ($T_{j\ max}$) whilst limiting T_{mb} to 125 °C (or less).

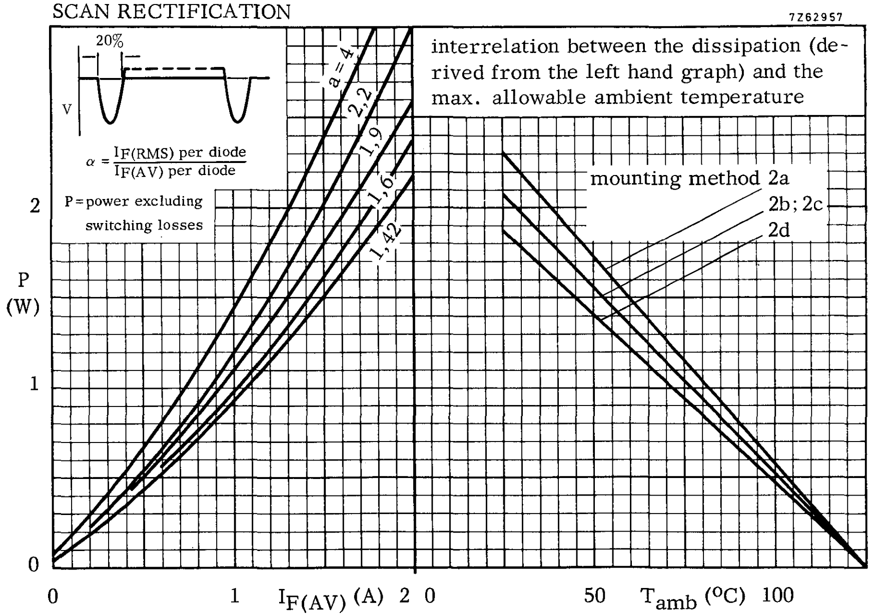
CHOPPER APPLICATIONS

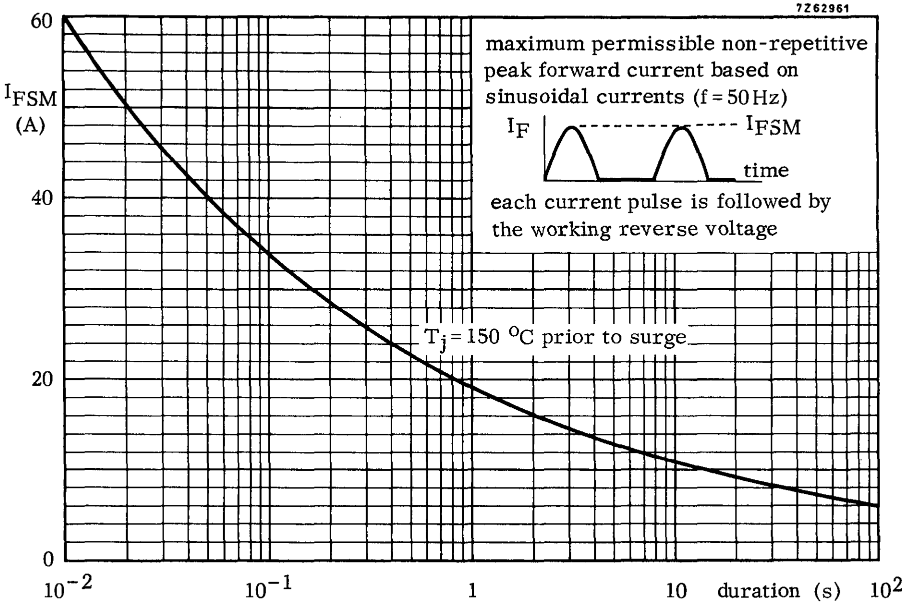


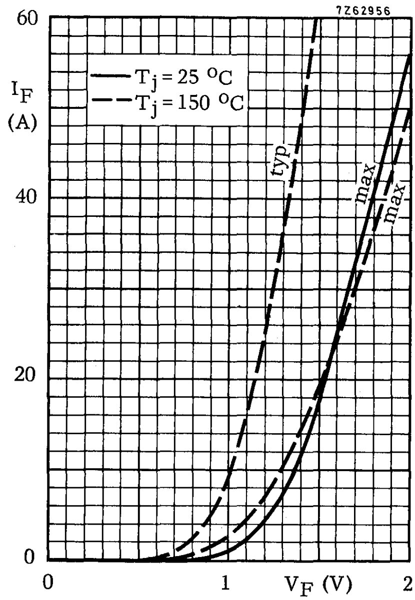
SWITCHED-MODE APPLICATION

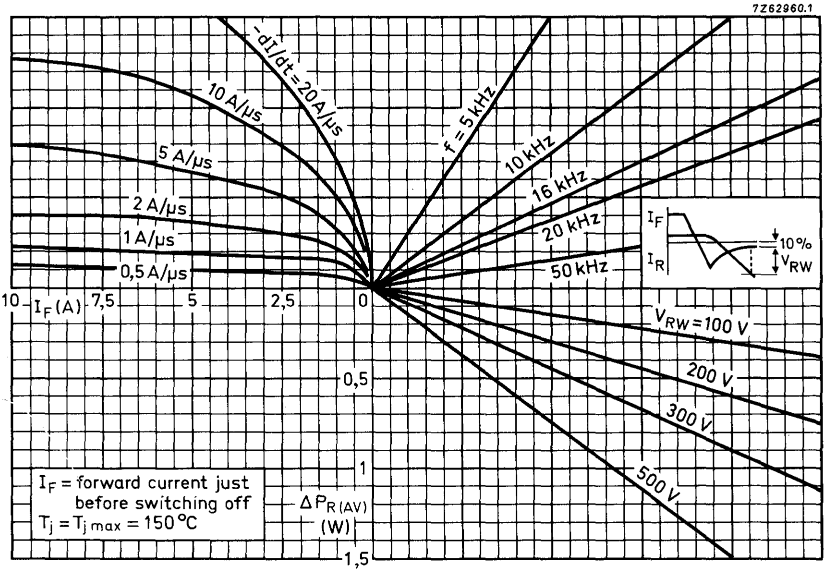


SCAN RECTIFICATION

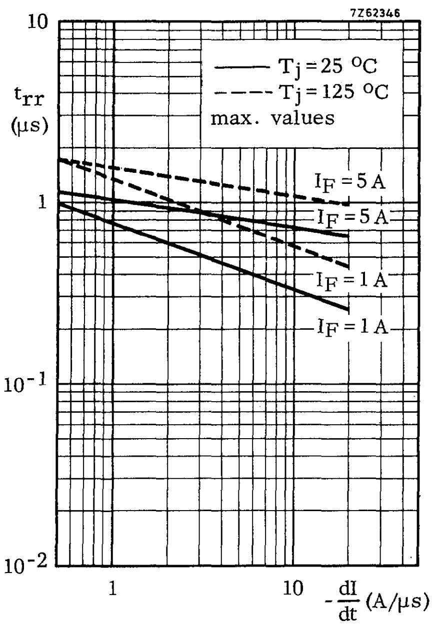


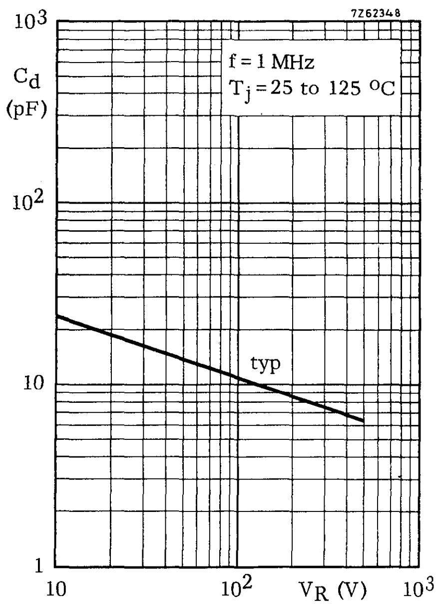

7Z62961
60
I FSM
(A)
40
20
0
10^−2
10^−1
1
10
duration (s)
10^2
maximum permissible non-repetitive peak forward current based on sinusoidal currents (f = 50 Hz)
I F
I FSM
time
each current pulse is followed by the working reverse voltage
T j = 150 °C prior to surge

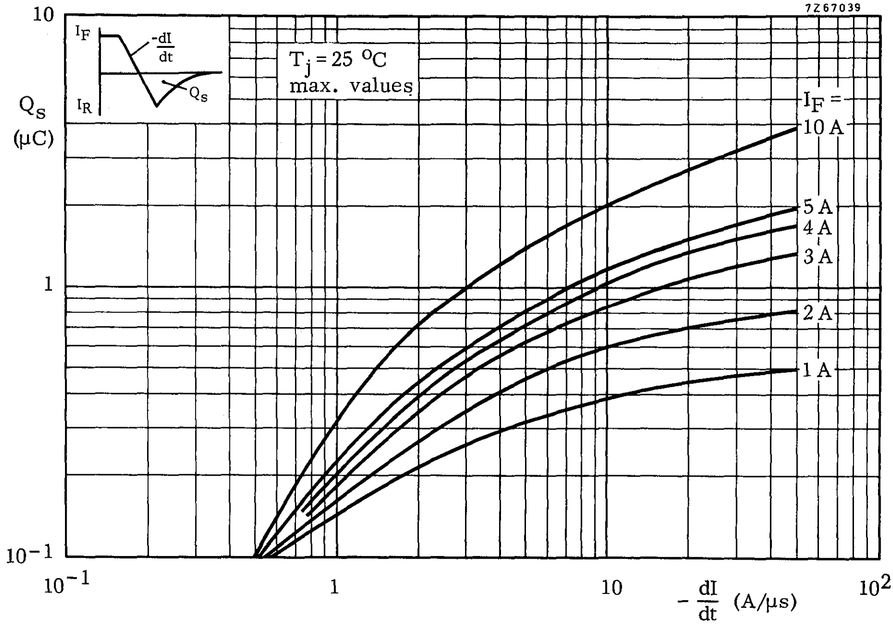

7Z62956
60
I F
(A)
40
20
0
0
1
V F (V)
2
T j = 25 °C
T j = 150 °C
typ
max
max

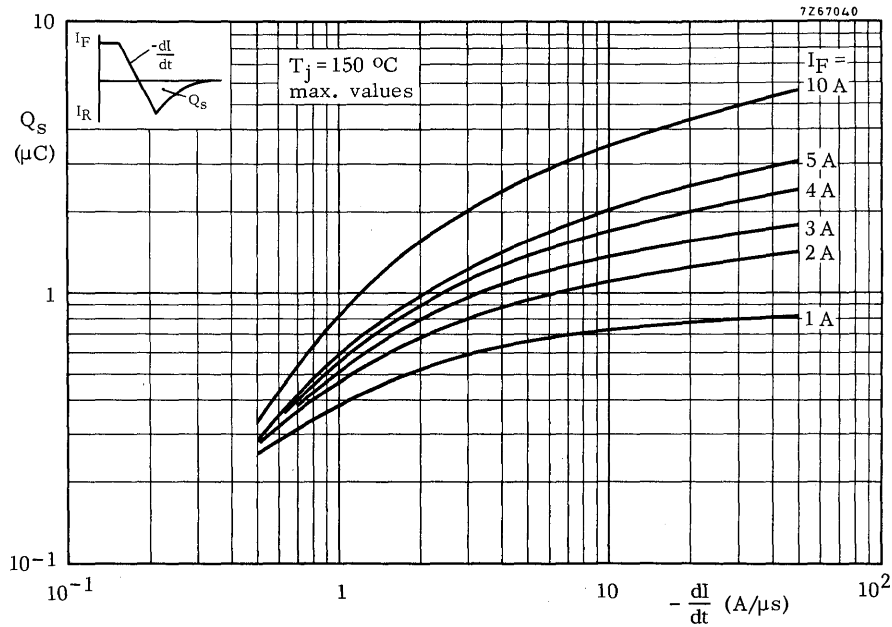


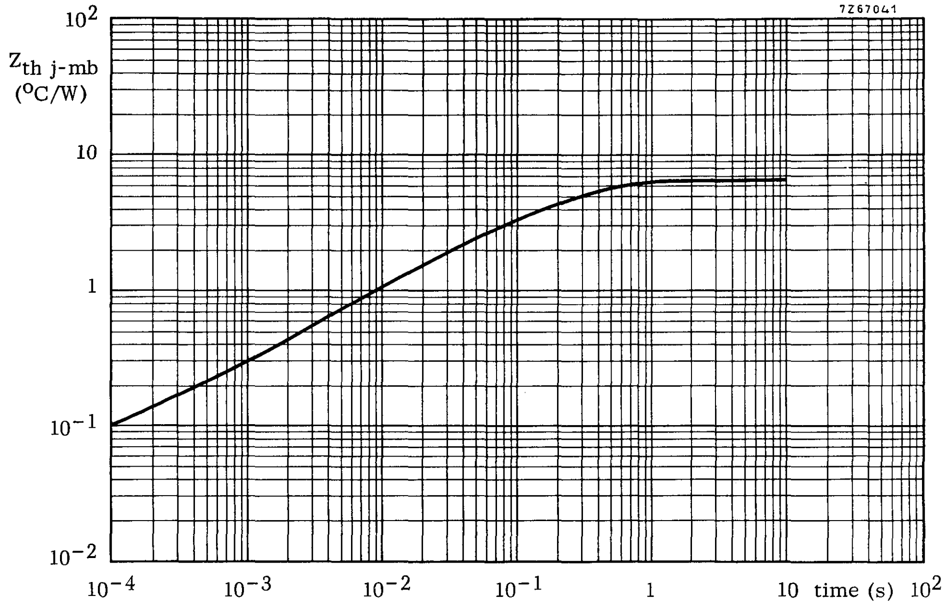
Nomogram: power loss $\Delta P_{R(AV)}$ due to switching only (to be added to forward and reverse power losses).






7Z67039
I_F
$-\frac{dI}{dt}$
I_R
Q_s
$T_j = 25\ ^oC$
max. values
Q_s
(μC)
I_F =
10 A
5 A
4 A
3 A
2 A
1 A
10
1
10^{-1}
1
10
10^2
$-\frac{dI}{dt}$ (A/μs)


7Z67040
I_F
$-\frac{dI}{dt}$
I_R
Q_s
$T_j = 150\ ^oC$
max. values
Q_s
(μC)
I_F =
10 A
5 A
4 A
3 A
2 A
1 A
10
1
10^{-1}
1
10
10^2
$-\frac{dI}{dt}$ (A/μs)


7Z67041
10^2
$Z_{th\ j-mb}$
(°C/W)
10
1
10^{-1}
10^{-2}
10^{-4}
10^{-3}
10^{-2}
10^{-1}
1
10
time (s)
10^2

RECTIFIER DIODES

Also available to BS9331-F129

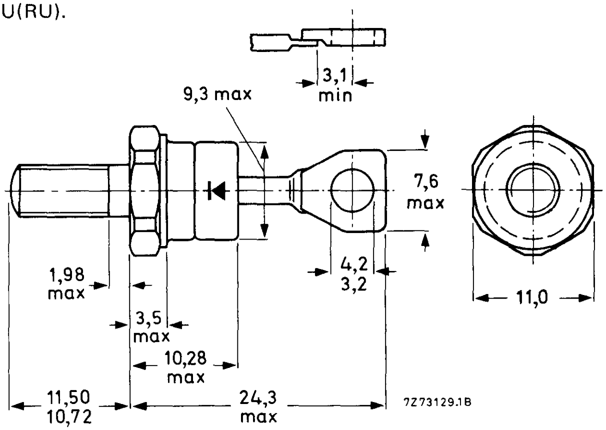
Silicon rectifier diodes in metal envelopes similar to DO-4, intended for use in power rectifier applications.
The series consists of the following types:
Normal polarity (cathode to stud): BYX96-300 to 1600.
Reverse polarity (anode to stud): BYX96-300R to 1600R.

QUICK REFERENCE DATA

		BYX96-300	600	1200	1600	
		BYX96-300R	600R	1200R	1600R	
Repetitive peak reverse voltage	V_{RRM}	max. 300	600	1200	1600	V
Average forward current	$I_{F(AV)}$	max.		30		A
Non-repetitive peak forward current	I_{FSM}	max.		400		A

MECHANICAL DATA Dimensions in mm

Fig. 1 DO-4: with metric M5 stud (ϕ 5 mm); e.g. BYX96-300(R).
Types with 10-32 UNF stud (ϕ 4,83 mm) are available on request. These are indicated by the suffix U; e.g. BYX96-300U(RU).



Supplied with device: 1 nut, 1 lock-washer
Nut dimensions across the flats, M5 thread: 8 mm, 10-32 UNF thread: 9.5 mm

Net mass: 7 g
Diameter of clearance hole: max. 5.2 mm
Supplied on request: accessories 56295
(PTFE bush, 2 mica washers, plain washer, tag)
a version with insulated flying leads
The mark shown applies to normal polarity types

Torque on nut: min. 0.9 Nm (9 kg cm)
max. 1.7 Nm (17 kg cm)

RATINGS Limiting values in accordance with the Absolute Maximum System (IEC 134)

Voltages [1]			BYX96-300(R)	600(R)	1200(R)	1600(R)	
Non-repetitive peak reverse voltage ($t \leq 10$ ms)	V_{RSM}	max.	300	600	1200	1600	V
Repetitive peak reverse voltage ($\delta \leq 0,01$)	V_{RRM}	max.	300	600	1200	1600	V
Crest working reverse voltage	V_{RWM}	max.	200	400	800	800	V
Continuous reverse voltage	V_R	max.	200	400	800	800	V

Currents

Average forward current (averaged over any 20 ms period) up to $T_{mb} = 125$ °C	$I_{F(AV)}$	max.	30	A
R.M.S. forward current	$I_{F(RMS)}$	max.	48	A
Repetitive peak forward current	I_{FRM}	max.	400	A
Non-repetitive peak forward current ($t = 10$ ms; half sine-wave) $T_j = 175$ °C prior to surge; with reapplied V_{RWMmax}	I_{FSM}	max.	400	A
I^2t for fusing ($t = 10$ ms)	I^2t	max.	800	A^2s

Temperatures

Storage temperature	T_{stg}		−55 to +175	°C
Junction temperature	T_j	max.	175	°C

THERMAL RESISTANCE

From junction to mounting base	$R_{th\ j\text{-}mb}$	=	1,0	°C/W
From mounting base to heatsink without heatsink compound	$R_{th\ mb\text{-}h}$	=	0,5	°C/W
with heatsink compound	$R_{th\ mb\text{-}h}$	=	0,3	°C/W
Transient thermal impedance; $t = 1$ ms	$Z_{th\ j\text{-}mb}$	=	0,2	°C/W

[1]) To ensure thermal stability: $R_{th\ j\text{-}a} \leq 2$ °C/W (continuous reverse voltage) or ≤ 8 °C/W (a.c.)
For smaller heatsinks $T_{j\,max}$ should be derated. For a.c. see page 4.
For continuous reverse voltage: if $R_{th\ j\text{-}a} = 4$ °C/W, then $T_{j\,max} = 138$ °C,
if $R_{th\ j\text{-}a} = 6$ °C/W, then $T_{j\,max} = 125$ °C.

CHARACTERISTICS

Forward voltage

I_F = 100 A; T_j = 25 °C	V_F	<	1,7	V [1]

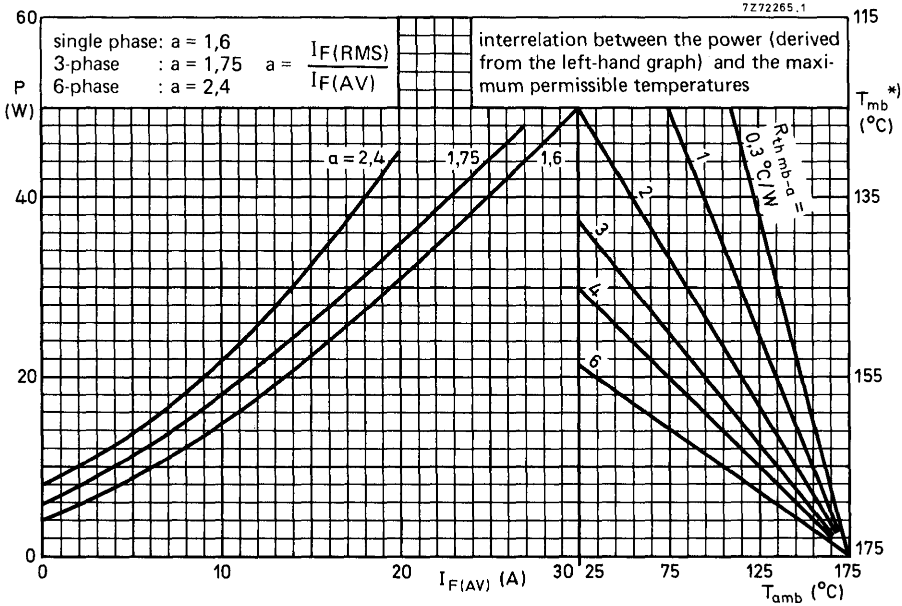
Reverse current

$V_R = V_{RWMmax}$; T_j = 125 °C	I_R	<	1	mA

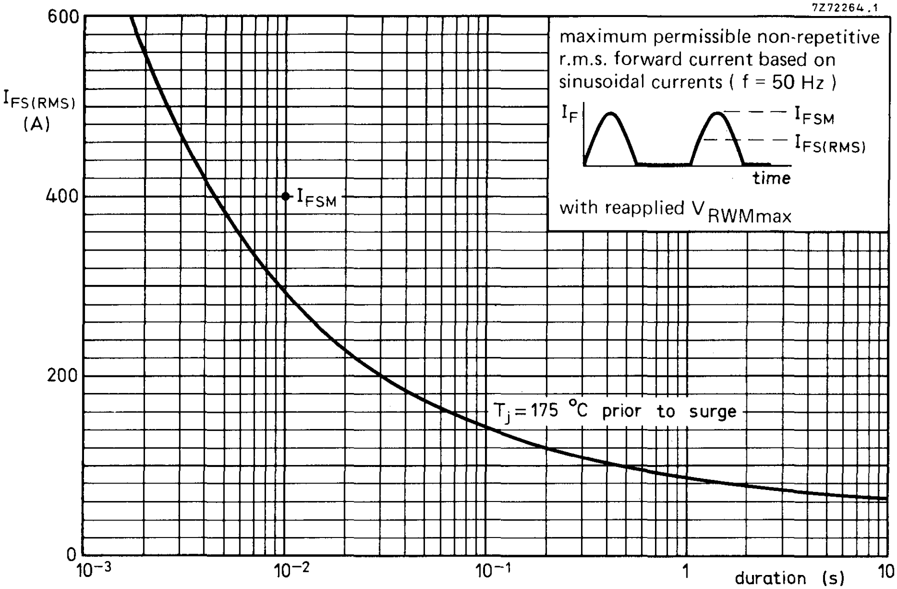
OPERATING NOTES

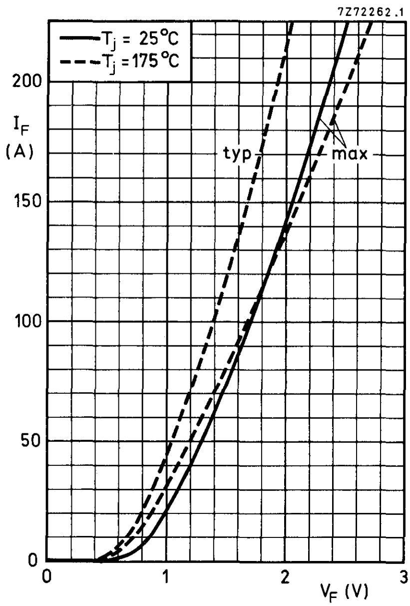
1. The top connector should neither be bent nor twisted; it should be soldered into the circuit so that there is no strain on it.
   During soldering the heat conduction to the junction should be kept to a minimum.
2. Where there is a possibility that transients, due to the energy stored in the transformer, will exceed the maximum permissible non-repetitive peak reverse voltage, see General Section for information on damping circuits in Data Handbook Part SC1a.

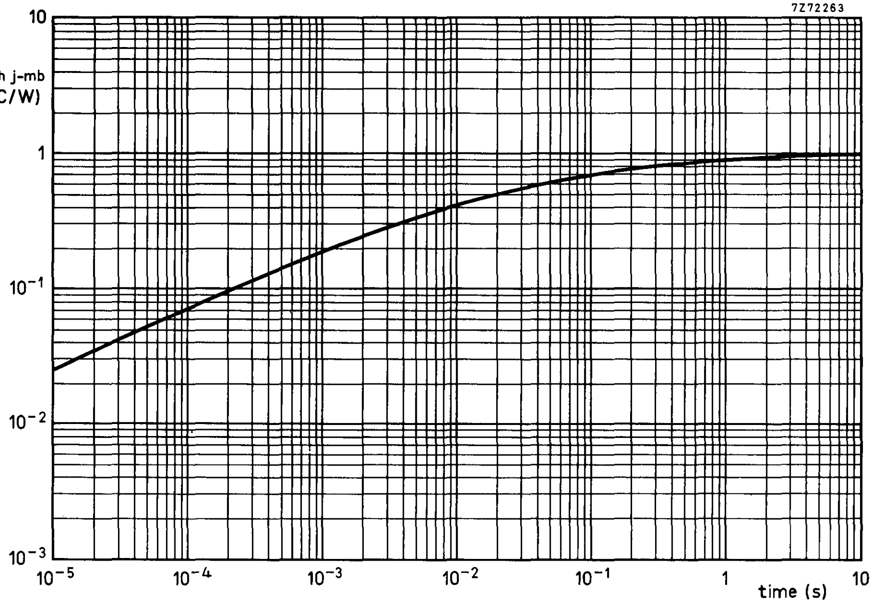
[1]) Measured under pulse conditions to avoid excessive dissipation.



*) T_{mb}-scale is for comparison purposes only and is correct only for $R_{th\ mb-a} \leq 6,5$ °C/W


7Z72264.1
600
400
200
0
$I_{FS(RMS)}$
(A)
I_{FSM}
maximum permissible non-repetitive r.m.s. forward current based on sinusoidal currents (f = 50 Hz)
I_F
I_{FSM}
$I_{FS(RMS)}$
time
with reapplied V_{RWMmax}
$T_j = 175\ °C$ prior to surge
10^{-3}
10^{-2}
10^{-1}
1
duration (s)
10


7Z72262.1
T_j = 25°C
T_j = 175°C
200
150
100
50
0
I_F
(A)
typ
max
0
1
2
3
V_F (V)



7Z72263
$Z_{th\ j\text{-}mb}$ (°C/W)
10
1
10^{-1}
10^{-2}
10^{-3}
10^{-5}
10^{-4}
10^{-3}
10^{-2}
10^{-1}
1
10
time (s)

RECTIFIER DIODES

Also available to BS9331-F130

Silicon rectifier diodes in metal envelopes similar to DO-5, intended for use in power rectifier applications.
The series consists of the following types:
Normal polarity (cathode to stud): BYX97-300 to 1600.
Reverse polarity (anode to stud): BYX97-300R to 1600R.

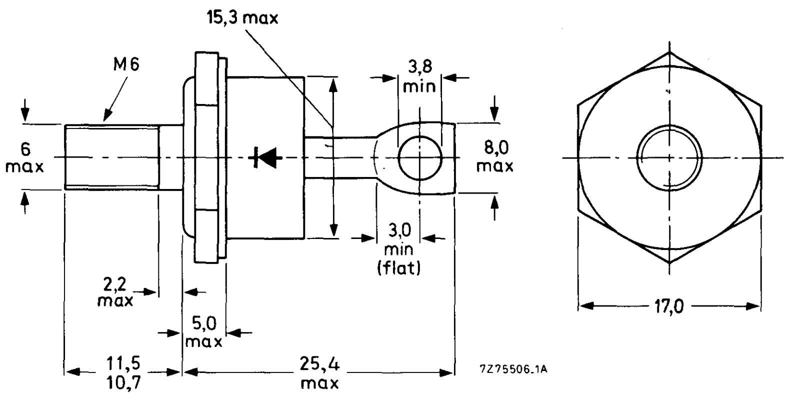
QUICK REFERENCE DATA

			BYX97-300 BYX97-300R	600 600R	1200 1200R	1600 1600R	
Repetitive peak reverse voltage	V_{RRM}	max.	300	600	1200	1600	V
Average forward current	$I_{F(AV)}$	max.	47				A
Non-repetitive peak forward current	I_{FSM}	max.	800				A

MECHANICAL DATA

Dimensions in mm

DO-5 (except for M6 stud); Supplied with device: 1 nut, 1 lock-washer
Nut dimensions across the flats: 10 mm



Net mass: 22 g
Diameter of clearance hole: max. 6.5 mm
Supplied on request: accessories 56264A
(mica washer, insulating ring, tag)
a version with insulated flying leads
The mark shown applies to normal polarity types

Torque on nut: min. 1.7 Nm
(17 kg cm)
max. 3.5 Nm
(35 kg cm)

RATINGS Limiting values in accordance with the Absolute Maximum System (IEC 134)

Voltages [1]			BYX97-300(R)	600(R)	1200(R)	1600(R)	
Non-repetitive peak reverse voltage ($t \leq 10$ ms)	V_{RSM}	max.	300	600	1200	1600	V
Repetitive peak reverse voltage ($\delta \leq 0,01$)	V_{RRM}	max.	300	600	1200	1600	V
Crest working reverse voltage	V_{RWM}	max.	200	400	800	800	V
Continuous reverse voltage	V_R	max.	200	400	800	800	V

Currents

Average forward current (averaged over any 20 ms period) up to T_{mb} = 120 °C	$I_{F(AV)}$	max.	47	A
at T_{mb} = 125 °C	$I_{F(AV)}$	max.	40	A
R.M.S. forward current	$I_{F(RMS)}$	max.	75	A
Repetitive peak forward current	I_{FRM}	max.	550	A
Non-repetitive peak forward current (t = 10 ms; half sine-wave) T_j = 150 °C prior to surge; with reapplied V_{RWMmax}	I_{FSM}	max.	800	A
I^2t for fusing (t = 10 ms)	I^2t	max.	3200	A^2s

Temperatures

Storage temperature	T_{stg}		−55 to +150	°C
Junction temperature	T_j	max.	150	°C

THERMAL RESISTANCE

From junction to mounting base	$R_{th\ j\text{-}mb}$	=	0,6	°C/W
From mounting base to heatsink without heatsink compound	$R_{th\ mb\text{-}h}$	=	0,3	°C/W
with heatsink compound	$R_{th\ mb\text{-}h}$	=	0,2	°C/W
Transient thermal impedance; t = 1 ms	$Z_{th\ j\text{-}mb}$	=	0,1	°C/W

[1]) To ensure thermal stability: $R_{th\ j\text{-}a} \leq 1$ °C/W (continuous reverse voltage) or ≤ 4 °C/W (a.c.)
For smaller heatsinks $T_{j\ max}$ should be derated. For a.c. see page 4.
For continuous reverse voltage: if $R_{th\ j\text{-}a}$ = 2 °C/W, then $T_{j\ max}$ = 138 °C,
if $R_{th\ j\text{-}a}$ = 3 °C/W, then $T_{j\ max}$ = 125 °C.

CHARACTERISTICS

Forward voltage

I_F = 150 A; T_j = 25 °C	V_F	<	1,45	V [1]

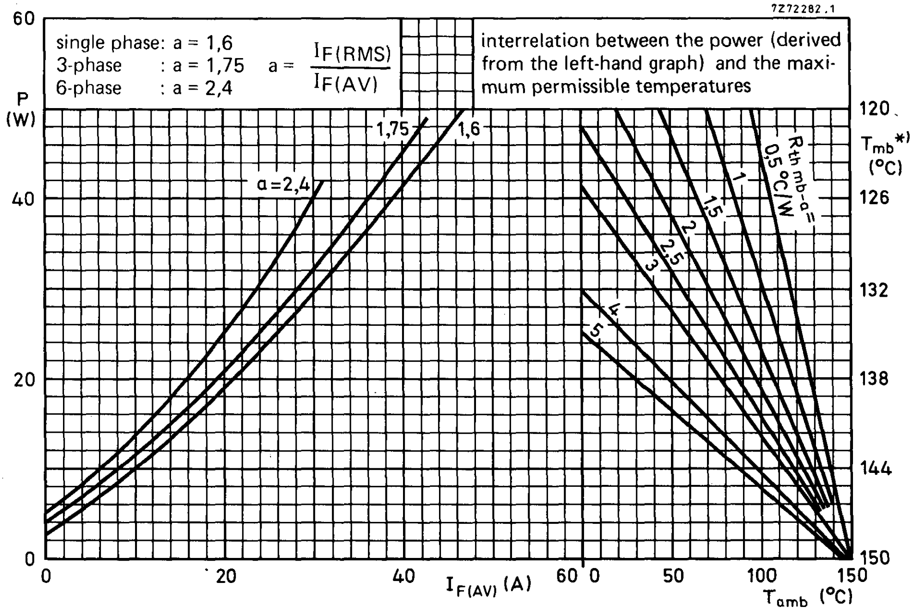
Reverse current

$V_R = V_{RWMmax}$; T_j = 125 °C	I_R	<	4	mA

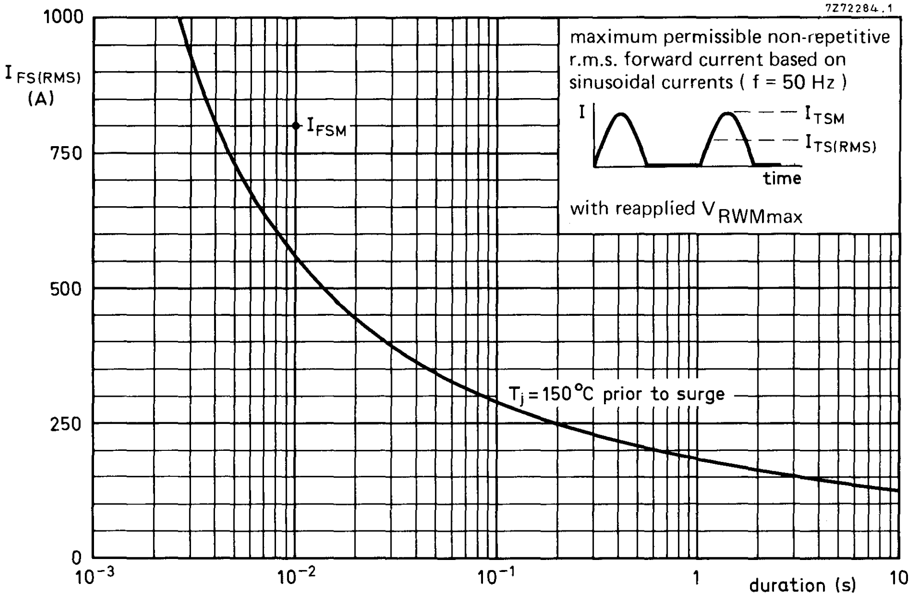
OPERATING NOTES

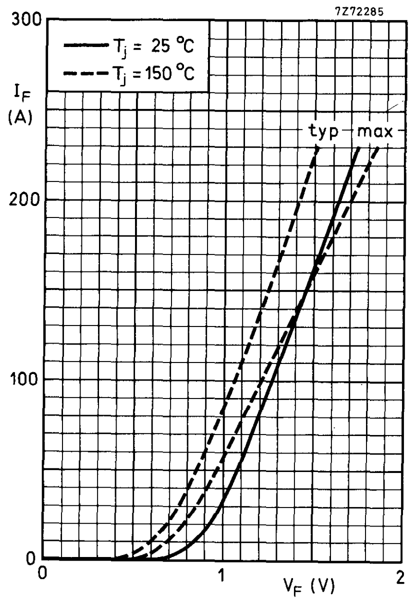
1. The top connector should neither be bent nor twisted; it should be soldered into the circuit so that there is no strain on it.
   During soldering the heat conduction to the junction should be kept to a minimum.
2. Where there is a possibility that transients, due to the energy stored in the transformer, will exceed the maximum permissible non-repetitive peak reverse voltage, see General Section for information on damping circuits in Data Handbook Part SC1a.

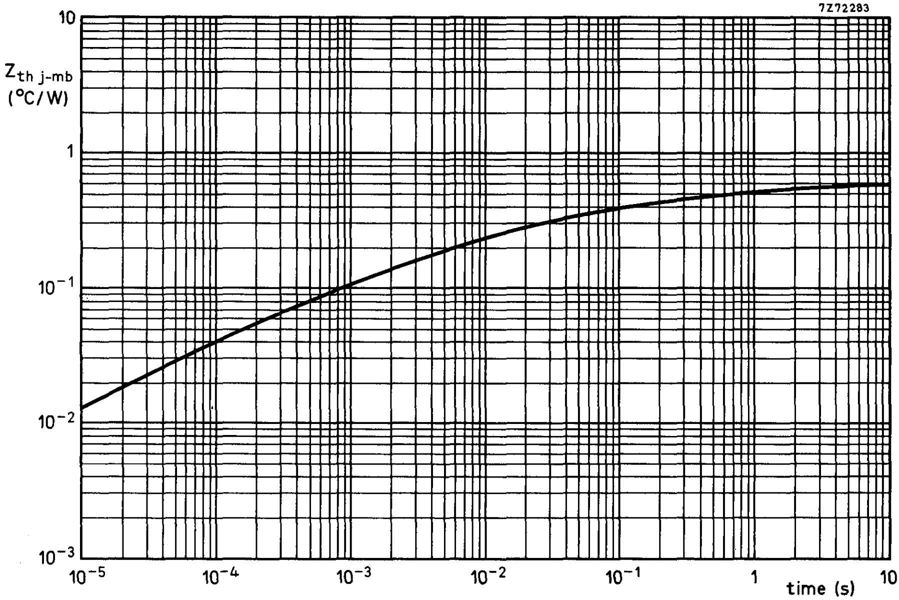
[1]) Measured under pulse conditions to avoid excessive dissipation.



*) T_{mb}-scale is for comparison purposes only and is correct only for $R_{th\ mb-a} \leq 3{,}4\ ^{o}C/W$


7Z72284.1
1000
I FS(RMS)
(A)
750
500
250
0
10^{-3}
10^{-2}
10^{-1}
1
10
duration (s)
I FSM
maximum permissible non-repetitive r.m.s. forward current based on sinusoidal currents (f = 50 Hz)
I
I TSM
I TS(RMS)
time
with reapplied V RWMmax
Tj = 150 °C prior to surge


7Z72285
300
200
100
0
I F
(A)
Tj = 25 °C
Tj = 150 °C
typ
max
0
1
2
VF (V)


7Z72283
$Z_{th\ j\text{-}mb}$ (°C/W)
10
1
10^{-1}
10^{-2}
10^{-3}
10^{-5}
10^{-4}
10^{-3}
10^{-2}
10^{-1}
1
time (s)
10

RECTIFIER DIODES

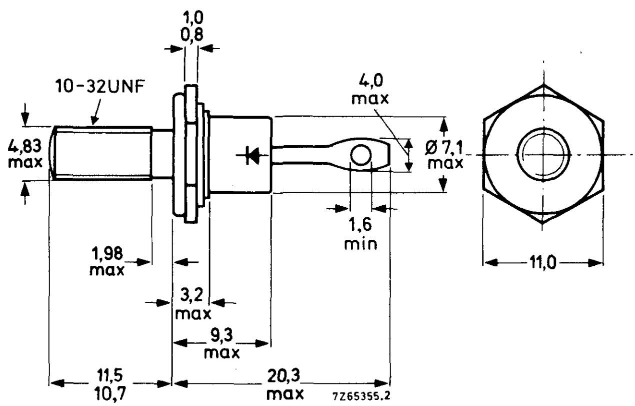
Silicon rectifier diodes in DO-4 metal envelopes, intended for use in power rectifier applications.
The series consists of the following types:
Normal polarity (cathode to stud): BYX98-300 to 1200.
Reverse polarity (anode to stud): BYX98-300R to 1200R.

QUICK REFERENCE DATA

			BYX98-300 BYX98-300R	600 600R	1200 1200R	
Repetitive peak reverse voltage	V_{RRM}	max.	300	600	1200	V
Average forward current	$I_{F(AV)}$	max.		10		A
Non-repetitive peak forward current	I_{FSM}	max.		75		A

MECHANICAL DATA Dimensions in mm

DO-4: Supplied with device: 1 nut, 1 lock-washer
Nut dimensions across the flats: 9.5 mm



Net mass: 6 g
Diameter of clearance hole: max. 5.2 mm
Accessories supplied on request:
56295 (PTFE bush, 2 mica washers, plain washer, tag)
The mark shown applies to the normal polarity types.

Torque on nut: min. 0.9 Nm (9 kg cm)
max. 1.7 Nm (17 kg cm)

Products approved to CECC 50 009-004, available on request

RATINGS Limiting values in accordance with the Absolute Maximum System (IEC 134)

Voltages

			BYX98-300(R)	600(R)	1200(R)	
Non-repetitive peak reverse voltage ($t \leq 10$ ms)	V_{RSM}	max.	300	600	1200	V
Repetitive peak reverse voltage ($\delta \leq 0,01$)	V_{RRM}	max.	300	600	1200	V
Crest working reverse voltage	V_{RWM}	max.	200	400	800	V
Continuous reverse voltage	V_R	max.	200	400	800	V

Currents

Average forward current (averaged over any 20 ms period) up to T_{mb} = 97 °C	$I_{F(AV)}$	max.	10	A
at T_{mb} = 125 °C	$I_{F(AV)}$	max.	6	A
R.M.S. forward current	$I_{F(RMS)}$	max.	16	A
Repetitive peak forward current	I_{FRM}	max.	75	A
Non-repetitive peak forward current (t = 10 ms; half sine-wave) T_j = 150 °C prior to surge; with reapplied V_{RWMmax}	I_{FSM}	max.	75	A
I^2t for fusing (t = 10 ms)	I^2t	max.	28	A^2s

Temperatures

Storage temperature	T_{stg}		−55 to + 150	°C
Junction temperature	T_j	max.	150	°C

THERMAL RESISTANCE

From junction to ambient in free air	$R_{th\ j\text{-}a}$	=	50	°C/W
From junction to mounting base	$R_{th\ j\text{-}mb}$	=	3	°C/W
From mounting base to heatsink with heatsink compound	$R_{th\ mb\text{-}h}$	=	0, 5	°C/W
without heatsink compound	$R_{th\ mb\text{-}h}$	=	0, 6	°C/W
Transient thermal impedance; t = 1 ms	$Z_{th\ j\text{-}mb}$	=	0, 3	°C/W

CHARACTERISTICS

Forward voltage

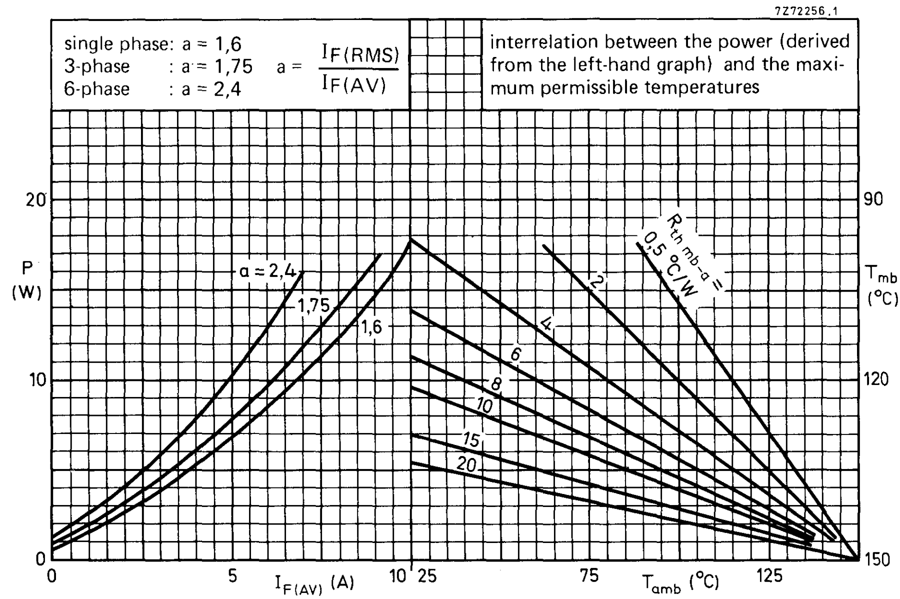
$I_F = 20$ A; $T_j = 25$ °C	V_F	<	1,7	V [1]

Reverse current

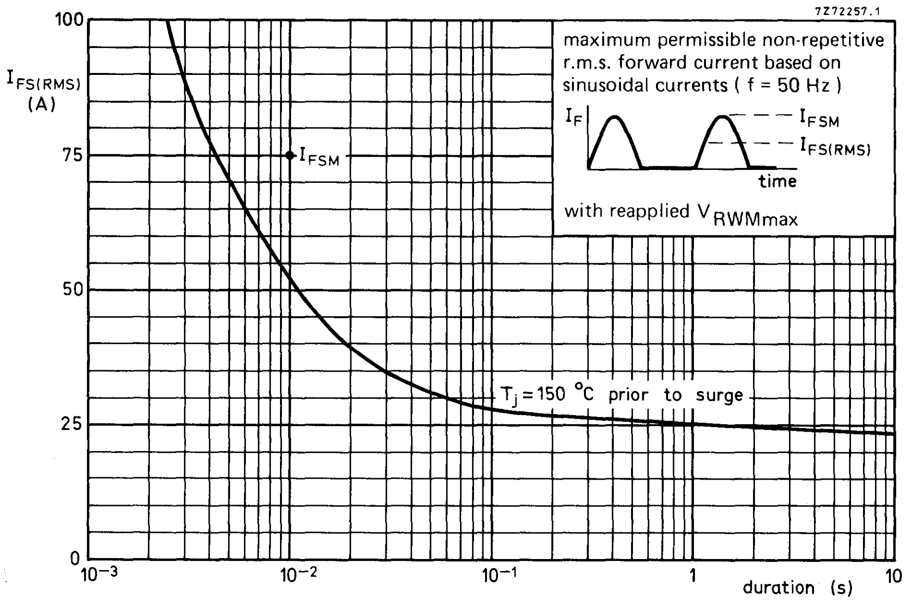
$V_R = V_{RWMmax}$; $T_j = 125$ °C	I_R	<	200	μA

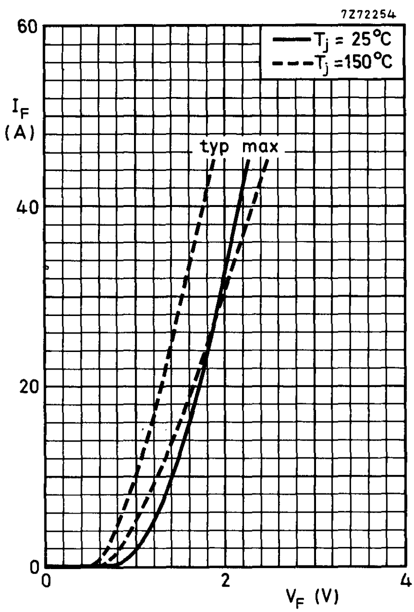
OPERATING NOTES

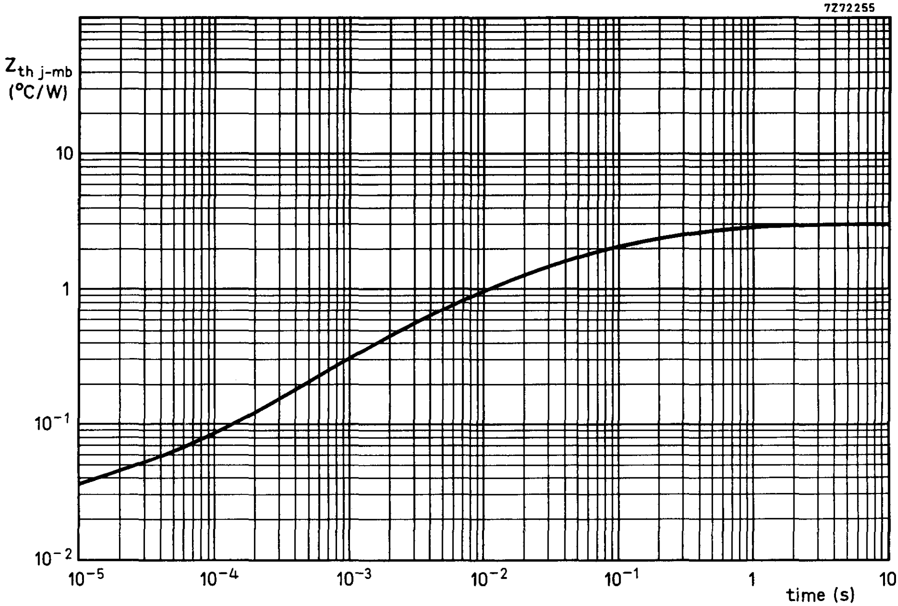
1. The top connector should neither be bent nor twisted; it should be soldered into the circuit so that there is no strain on it.
   During soldering the heat conduction to the junction should be kept to a minimum.
2. Where there is a possibility that transients, due to the energy stored in the transformer, will exceed the maximum permissible non-repetitive peak reverse voltage, see General Section for information on damping circuits in Data Handbook Part SC1a.



[1] Measured under pulse conditions to avoid excessive dissipation.


7Z72257.1
maximum permissible non-repetitive r.m.s. forward current based on sinusoidal currents (f = 50 Hz)
I_F
I_{FSM}
$I_{FS(RMS)}$
time
with reapplied V_{RWMmax}
$I_{FS(RMS)}$ (A)
100
75
50
25
0
I_{FSM}
$T_j = 150\ ^\circ C$ prior to surge
10^{-3}
10^{-2}
10^{-1}
1
10
duration (s)


7Z72254
$T_j = 25^\circ C$
$T_j = 150^\circ C$
I_F (A)
60
40
20
0
typ
max
0
2
4
V_F (V)


7Z72255
$Z_{th\ j\text{-}mb}$ (°C/W)
10
1
10^{-1}
10^{-2}
10^{-5}
10^{-4}
10^{-3}
10^{-2}
10^{-1}
1
10
time (s)

RECTIFIER DIODES

Silicon rectifier diodes in DO-4 metal envelopes, intended for use in power rectifier applications.
The series consists of the following types:
Normal polarity (cathode to stud): BYX99-300 to 1200.
Reverse polarity (anode to stud): BYX99-300R to 1200R.

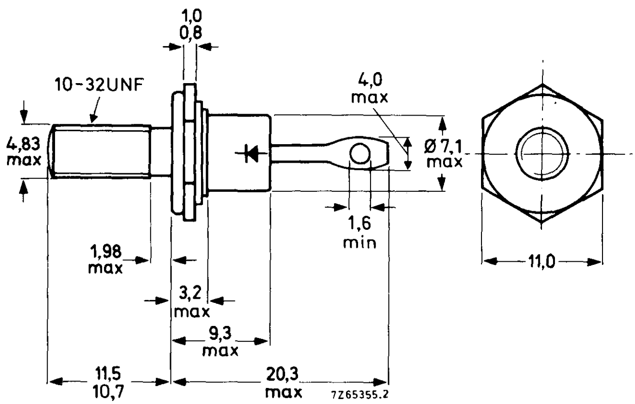
QUICK REFERENCE DATA

			BYX99-300 BYX99-300R	600 600R	1200 1200R	
Repetitive peak reverse voltage	V_{RRM}	max.	300	600	1200	V
Average forward current	$I_{F(AV)}$	max.		15		A
Non-repetitive peak forward current	I_{FSM}	max.		180		A

MECHANICAL DATA

Dimensions in mm

DO-4; Supplied with device: 1 nut, 1 lock-washer
Nut dimensions across the flats: 9.5 mm



Net mass: 6 g
Diameter of clearance hole: 5.2 mm
Accessories supplied on request:
56295 (PTFE bush, 2 mica washers, plain washer, tag)

Torque on nut: min. 0.9 Nm (9 kg cm)
max. 1.7 Nm (17 kg cm)

The mark shown applies to the normal polarity types

Products approved to CECC 50 009-005, available on request

RATINGS Limiting values in accordance with the Absolute Maximum System (IEC 134)

Voltages

			BYX99-300(R)	600(R)	1200(R)	
Non-repetitive peak reverse voltage ($t \leq 10$ ms)	V_{RSM}	max.	300	600	1200	V
Repetitive peak reverse voltage ($\delta \leq 0,01$)	V_{RRM}	max.	300	600	1200	V
Crest working reverse voltage	V_{RWM}	max.	200	400	800	V
Continuous reverse voltage	V_R	max.	200	400	800	V

Currents

Average forward current (averaged over any 20 ms period) up to T_{mb} = 129 °C	$I_{F(AV)}$	max.	15	A
R.M.S. forward current	$I_{F(RMS)}$	max.	24	A
Repetitive peak forward current	I_{FRM}	max.	180	A
Non-repetitive peak forward current (t = 10 ms; half sine-wave) T_j = 175 °C prior to surge; with reapplied V_{RWMmax}	I_{FSM}	max.	180	A
I^2t for fusing (t = 10 ms)	I^2t	max.	162	A^2s

Temperatures

Storage temperature	T_{stg}		−55 to + 175	°C
Junction temperature	T_j	max.	175	°C

THERMAL RESISTANCE

From junction to ambient in free air	$R_{th\ j\text{-}a}$	=	50	°C/W
From junction to mounting base	$R_{th\ j\text{-}mb}$	=	2,3	°C/W
From mounting base to heatsink with heatsink compound	$R_{th\ mb\text{-}h}$	=	0,5	°C/W
without heatsink compound	$R_{th\ mb\text{-}h}$	=	0,6	°C/W
Transient thermal impedance; t = 1 ms	$Z_{th\ j\text{-}mb}$	=	0,13	°C/W

CHARACTERISTICS

Forward voltage

I_F = 50 A; T_j = 25 °C	V_F	<	1,55	V [1]

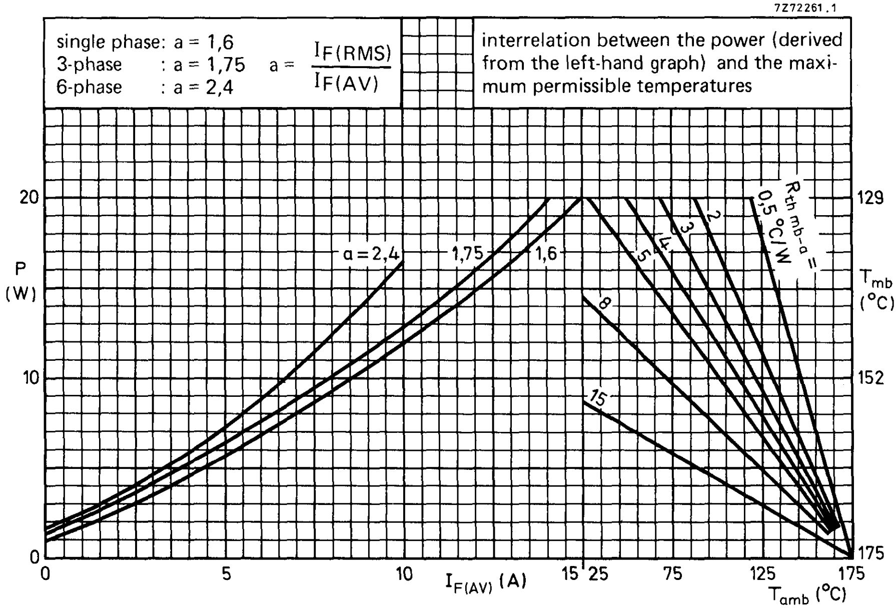
Reverse current

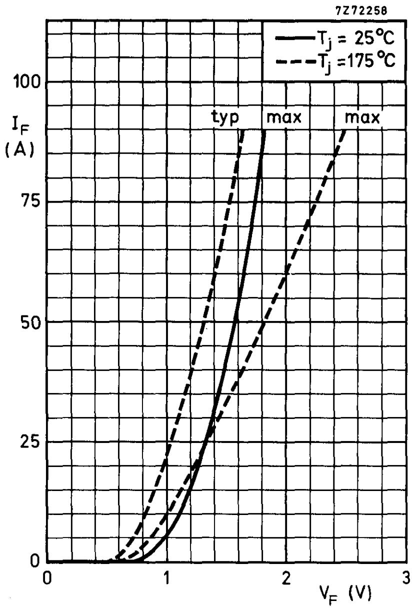
$V_R = V_{RWMmax}$; T_j = 125 °C	I_R	<	200	µA

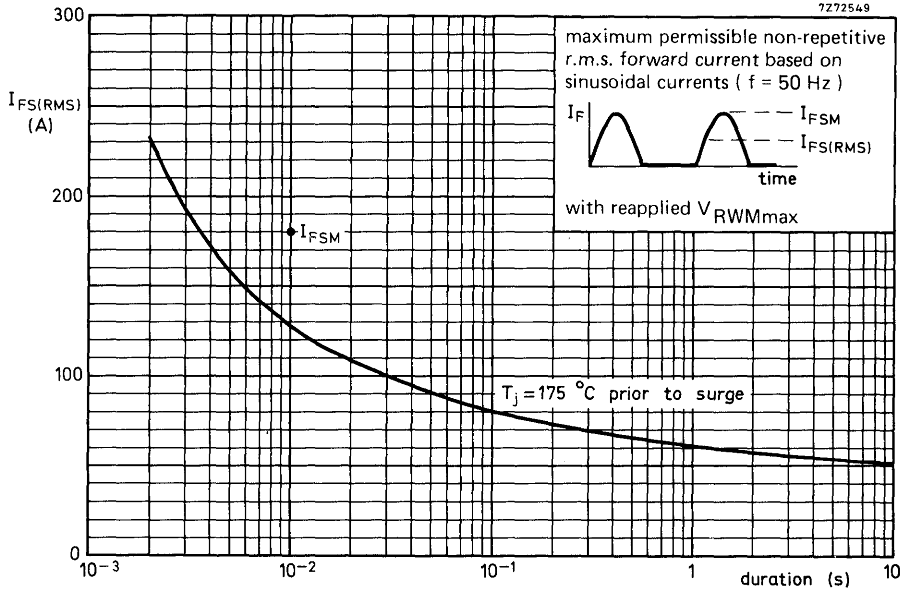
OPERATING NOTES

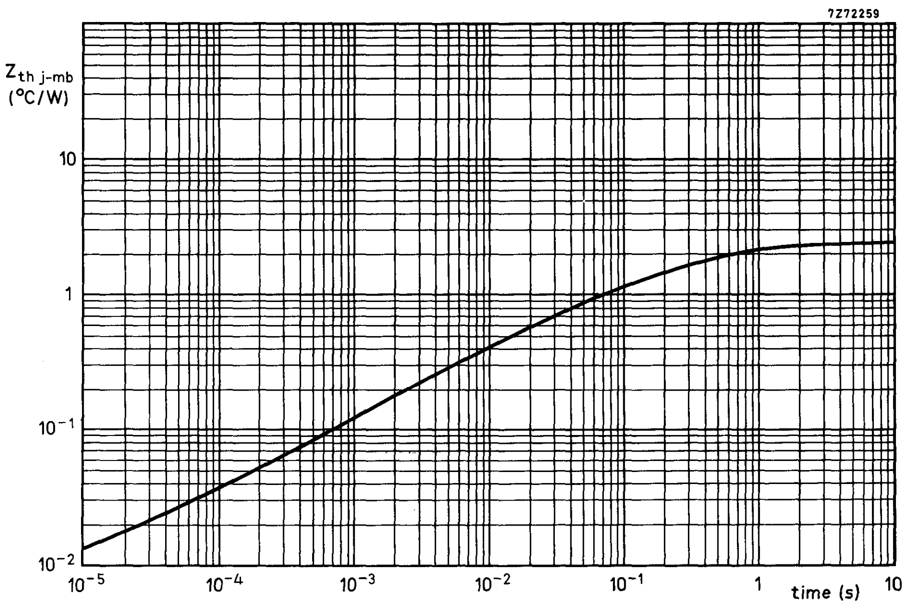
1. The top connector should neither be bent nor twisted; it should be soldered into the circuit so that there is no strain on it.
   During soldering the heat conduction to the junction should be kept to a minimum.
2. Where there is a possibility that transients, due to the energy stored in the transformer, will exceed the maximum permissible non-repetitive peak reverse voltage, see General Section for information on damping circuits in Data Handbook Part SC1a.

[1]) Measured under pulse conductions to avoid excessive dissipation.


7Z72261.1
single phase: a = 1,6
3-phase : a = 1,75
6-phase : a = 2,4
a = IF(RMS) / IF(AV)
interrelation between the power (derived from the left-hand graph) and the maximum permissible temperatures
a = 2,4
1,75
1,6
P (W)
IF(AV) (A)
Tamb (°C)
Tmb (°C)
Rth mb-a = 0,5 °C/W
2
3
4
5
8
15
129
152
175


7Z72258
Tj = 25°C
Tj = 175 °C
typ
max
max
IF (A)
VF (V)


7Z72549
maximum permissible non-repetitive r.m.s. forward current based on sinusoidal currents (f = 50 Hz)
I_F
I_FSM
I_FS(RMS)
time
with reapplied V_RWMmax
I_FS(RMS) (A)
300
200
100
0
I_FSM
T_j = 175 °C prior to surge
10^-3
10^-2
10^-1
1
10
duration (s)


7Z72259
Z_th j-mb (°C/W)
10
1
10^-1
10^-2
10^-5
10^-4
10^-3
10^-2
10^-1
1
10
time (s)

FAST SOFT-RECOVERY RECTIFIER DIODES

Silicon diodes, each in a DO-4 metal envelope, featuring non-snap-off characteristics, and intended for use in high-frequency power supplies, thyristor inverters and multi-phase power rectifier applications.
The series consists of the following types:
Normal polarity (cathode to stud): 1N3879, 1N3880, 1N3881 and 1N3882.
Reverse polarity (anode to stud): 1N3879R, 1N3880R, 1N3881R and 1N3882R.

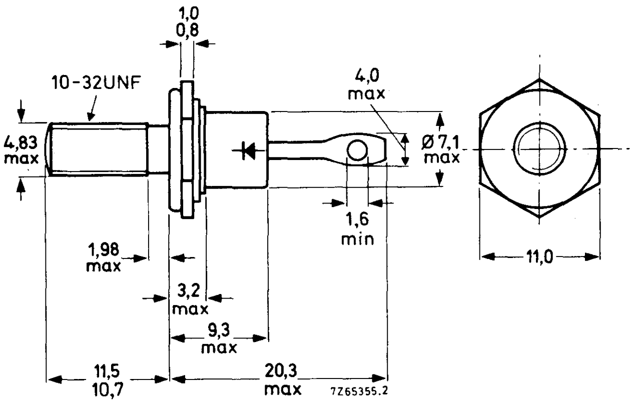
QUICK REFERENCE DATA

			1N3879(R)	1N3880(R)	1N3881(R)	1N3882(R)	
Repetitive peak reverse voltage	V_{RRM}	max.	50	100	200	300	V
Average forward current				$I_{F(AV)}$	max.	6	A
Non-repetitive peak forward current				I_{FSM}	max.	80	A
Reverse recovery time				t_{rr}	<	200	ns

MECHANICAL DATA

Dimensions in mm

DO-4



Net mass: 6 g

Diameter of clearance hole: max. 5,2 mm

Accessories supplied on request:
56295 (PTFE bush, 2 mica washers, plain washer, tag)

Supplied with device: 1 nut, 1 lock washer
Nut dimensions across the flats: 9,5 mm

The mark shown applies to the normal polarity types.

Torque on nut: min. 0,9 Nm
(9 kg cm)
max. 1,7 Nm
(17 kg cm)

Products approved to CECC 50 009-006, available on request.

RATINGS Limiting values in accordance with the Absolute Maximum System (IEC 134)

Voltages

			1N3879(R)	1N3880(R)	1N3881(R)	1N3882(R)	
Non-repetitive peak reverse voltage (t ≤ 10 ms)	V_{RSM}	max.	100	150	250	350	V
Repetitive peak reverse voltage (δ ≤ 0,01)	V_{RRM}	max.	50	100	200	300	V
Crest working reverse voltage	V_{RWM}	max.	50	100	200	300	V

Currents

Average on-state current assuming zero switching losses (averaged over any 20 ms period)				
up to T_{mb} = 100 °C	$I_{F(AV)}$	max.	6	A
at T_{mb} = 125 °C	$I_{F(AV)}$	max.	3,5	A
R.M.S. forward current	$I_{F(RMS)}$	max.	10	A
Repetitive peak forward current	I_{FRM}	max.	75	A
Non-repetitive peak forward current T_j = 150 °C prior to surge; half sine-wave with reapplied V_{RWMmax};				
t = 10 ms	I_{FSM}	max.	75	A
t = 8,3 ms	I_{FSM}	max.	80	A
I^2t for fusing (t = 10 ms)	I^2t	max.	28	A^2s

Temperatures

Storage temperature	T_{stg}	−65 to +175		°C
Operating junction temperature	T_j	max.	150	°C

THERMAL RESISTANCE

From junction to ambient in free air	$R_{th\ j\text{-}a}$	=	50	°C/W
From junction to mounting base	$R_{th\ j\text{-}mb}$	=	4,4	°C/W
From mounting base to heatsink	$R_{th\ mb\text{-}h}$	=	0,5	°C/W
Transient thermal impedance; t = 1 ms; δ = 0	$Z_{th\ j\text{-}mb}$	=	1	°C/W

CHARACTERISTICS

Forward voltage [1]

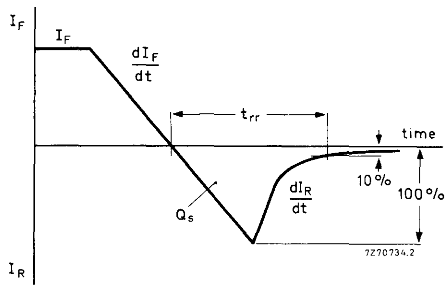
I_F = 6 A; T_j = 25 °C	V_F	<	1,4	V

Reverse current

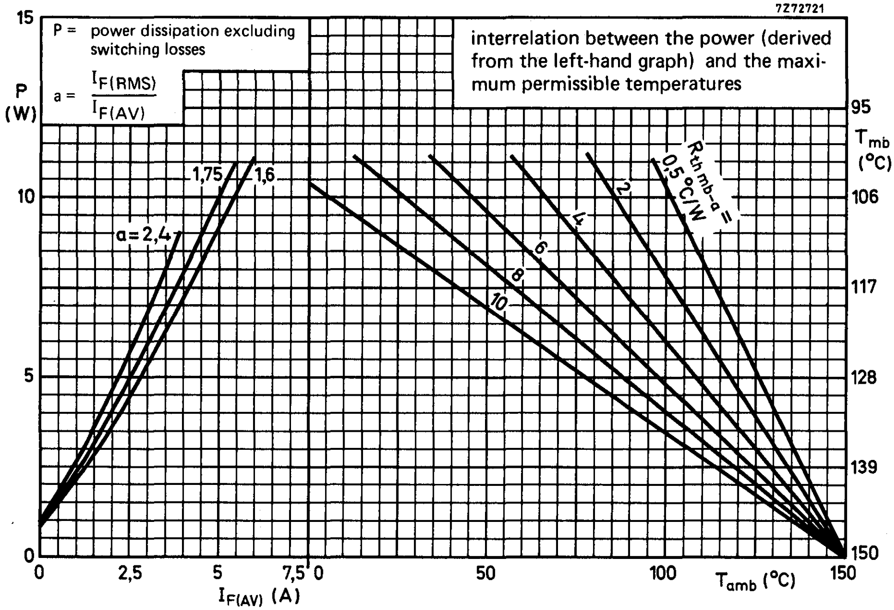
$V_R = V_{RWMmax}$; T_j = 125 °C	I_R	<	3	mA

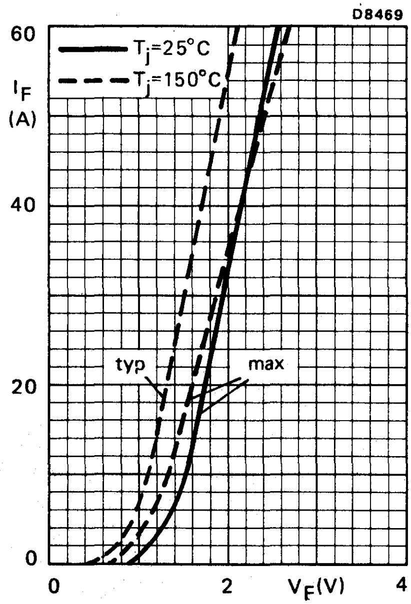
Reverse recovery when switched from

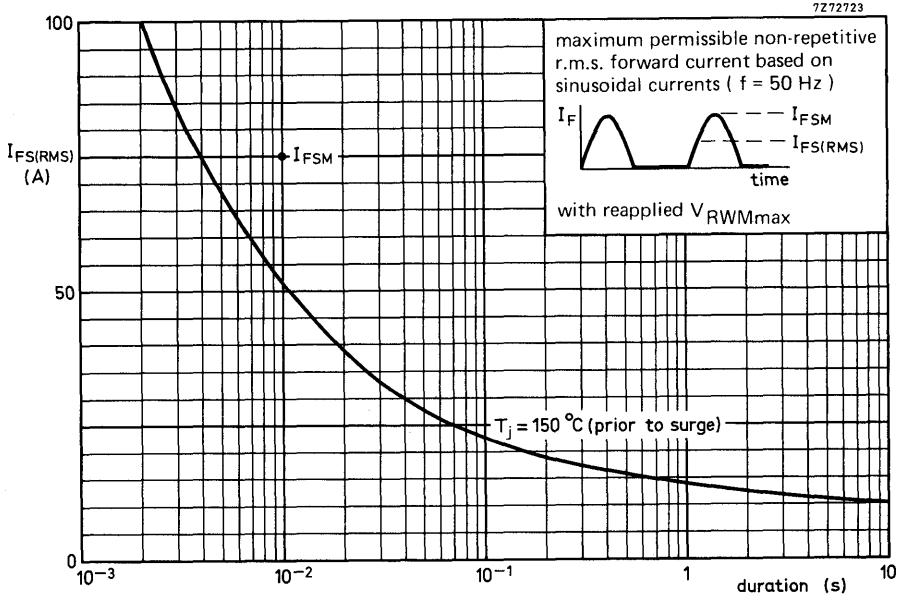
I_F = 1 A to V_R = 30 V; $-dI_F/dt$ = 35 A/µs; T_j = 25 °C Recovery time	t_{rr}	<	200	ns
I_F = 2 A to V_R = 30 V; $-dI_F/dt$ = 20 A/µs; T_j = 25 °C Recovery charge	Q_s	<	250	nC
I_F = 1 A to V_R = 30 V; $-dI_F/dt$ = 2 A/µs; T_j = 25 °C Max. slope of the reverse recovery current	$\|dI_R/dt\|$	<	5	A/µs

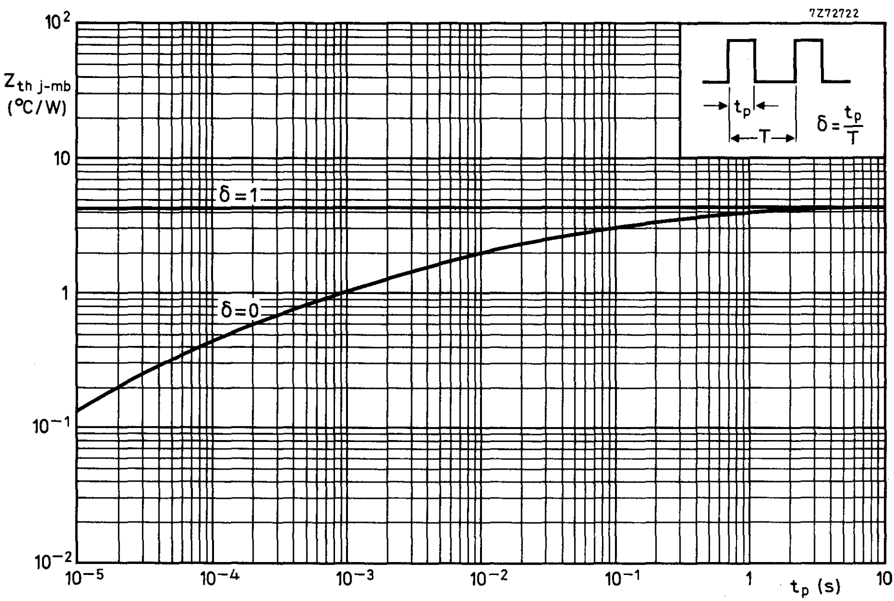


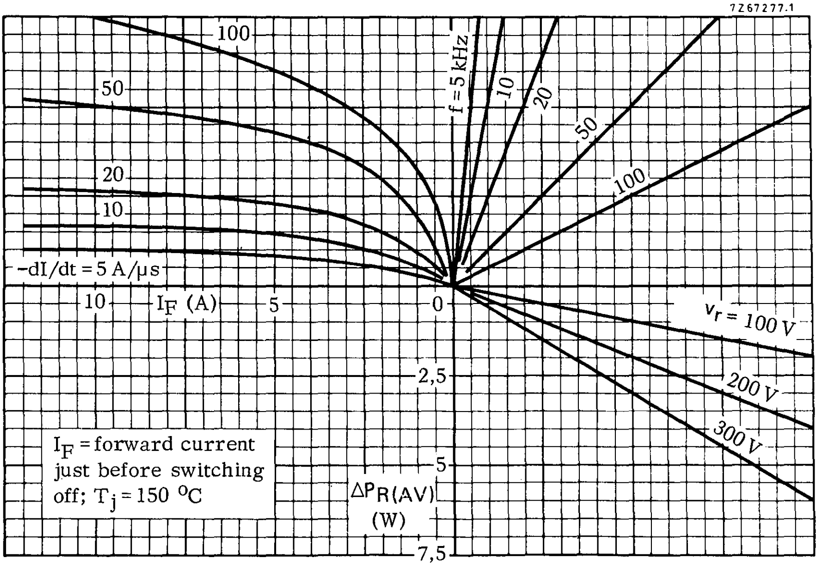
[1]) Measured under pulse conditions to avoid excessive dissipation.


7Z72721
P = power dissipation excluding switching losses
a = $\frac{I_{F(RMS)}}{I_{F(AV)}}$
interrelation between the power (derived from the left-hand graph) and the maximum permissible temperatures
P (W)
15
10
5
0
a=2,4
1,75
1,6
0
2,5
5
7,5
$I_{F(AV)}$ (A)
0
50
100
150
T_{amb} (°C)
$R_{th\ mb-a}$ = 0,5 °C/W
2
4
6
8
10
T_{mb} (°C)
95
106
117
128
139
150


D8469
T_j=25°C
T_j=150°C
I_F (A)
60
40
20
0
typ
max
0
2
V_F(V)
4

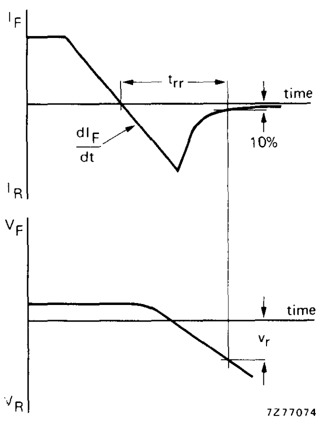

7Z72723
maximum permissible non-repetitive r.m.s. forward current based on sinusoidal currents (f = 50 Hz)
I_F
I_{FSM}
$I_{FS(RMS)}$
time
with reapplied V_{RWMmax}
$I_{FS(RMS)}$ (A)
I_{FSM}
$T_j = 150\,^\circ C$ (prior to surge)
100
50
0
10^{-3}
10^{-2}
10^{-1}
1
10
duration (s)


7Z72722
t_p
T
$\delta = \frac{t_p}{T}$
$Z_{th\ j\text{-}mb}$ (°C/W)
10^2
10
1
10^{-1}
10^{-2}
δ = 1
δ = 0
10^{-5}
10^{-4}
10^{-3}
10^{-2}
10^{-1}
1
10
t_p (s)



NOMOGRAM

Power loss $\Delta P_{R(AV)}$ due to switching only (to be added to steady state power losses).



FAST SOFT-RECOVERY RECTIFIER DIODES

Silicon diodes, each in a DO-4 metal envelope, featuring non-snap-off characteristics, and intended for use in high-frequency power supplies, thyristor inverters and multi-phase power rectifier applications.
The series consists of the following types:
Normal polarity (cathode to stud): 1N3889, 1N3890, 1N3891 and 1N3892.
Reverse polarity (anode to stud): 1N3889R, 1N3890R, 1N3891R and 1N3892R.

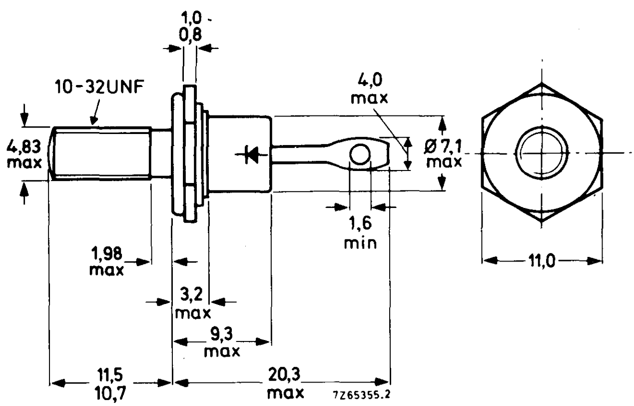
QUICK REFERENCE DATA

			1N3889(R)	1N3890(R)	1N3891(R)	1N3892(R)	
Repetitive peak reverse voltage	V_{RRM}	max.	50	100	200	300	V
Average forward current				$I_{F(AV)}$	max.	12	A
Non-repetitive peak forward current				I_{FSM}	max.	150	A
Reverse recovery time				t_{rr}	<	200	ns

MECHANICAL DATA

Dimensions in mm

DO-4



Net mass: 6 g
Diameter of clearance hole: max. 5,2 mm

Accessories supplied on request:
56295 (PTFE bush, 2 mica washers, plain washer, tag)

Supplied with device: 1 nut, 1 lock washer
Nut dimensions across the flats: 9,5 mm

The mark shown applies to the normal polarity types.

Torque on nut: min. 0,9 Nm
(9 kg cm)
max. 1,7 Nm
(17 kg cm)

Products approved to CECC 50 009-007, available on request

RATINGS Limiting values in accordance with the Absolute Maximum System (IEC134)

Voltages

			1N3889(R)	1N3890(R)	1N3891(R)	1N3892(R)
Non-repetitive peak reverse voltage ($t \leq 10$ ms)	V_{RSM}	max.	100	150	250	350 V
Repetitive peak reverse voltage ($\delta \leq 0,01$)	V_{RRM}	max.	50	100	200	300 V
Crest working reverse voltage	V_{RWM}	max.	50	100	200	300 V

Currents

Average on-state current assuming zero switching losses (averaged over any 20 ms period)				
up to $T_{mb} = 100$ °C	$I_{F(AV)}$	max.	12	A
at $T_{mb} = 125$ °C	$I_{F(AV)}$	max.	7	A
R.M.S. forward current	$I_{F(RMS)}$	max.	20	A
Repetitive peak forward current	I_{FRM}	max.	140	A
Non-repetitive peak forward current $T_j = 150$ °C prior to surge; half sine-wave with reapplied V_{RWMmax};				
$t = 10$ ms	I_{FSM}	max.	140	A
$t = 8,3$ ms	I_{FSM}	max.	150	A
I^2t for fusing ($t = 10$ ms)	I^2t	max.	100	A^2s

Temperatures

Storage temperature	T_{stg}		−65 to +175	°C
Operating junction temperature	T_j	max.	150	°C

THERMAL RESISTANCE

From junction to ambient in free air	$R_{th\ j\text{-}a}$	=	50	°C/W
From junction to mounting base	$R_{th\ j\text{-}mb}$	=	2,2	°C/W
From mounting base to heatsink	$R_{th\ mb\text{-}h}$	=	0,5	°C/W
Transient thermal impedance; $t = 1$ ms; $\delta = 0$	$Z_{th\ j\text{-}mb}$	=	0,8	°C/W

CHARACTERISTICS

Forward voltage [1]

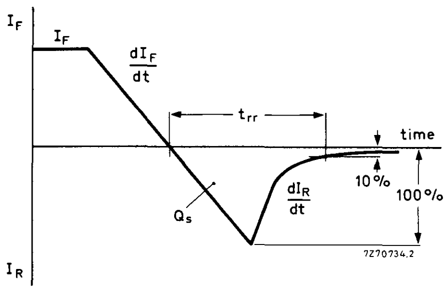
I_F = 12 A; T_j = 25 °C	V_F	<	1,4	V

Reverse current

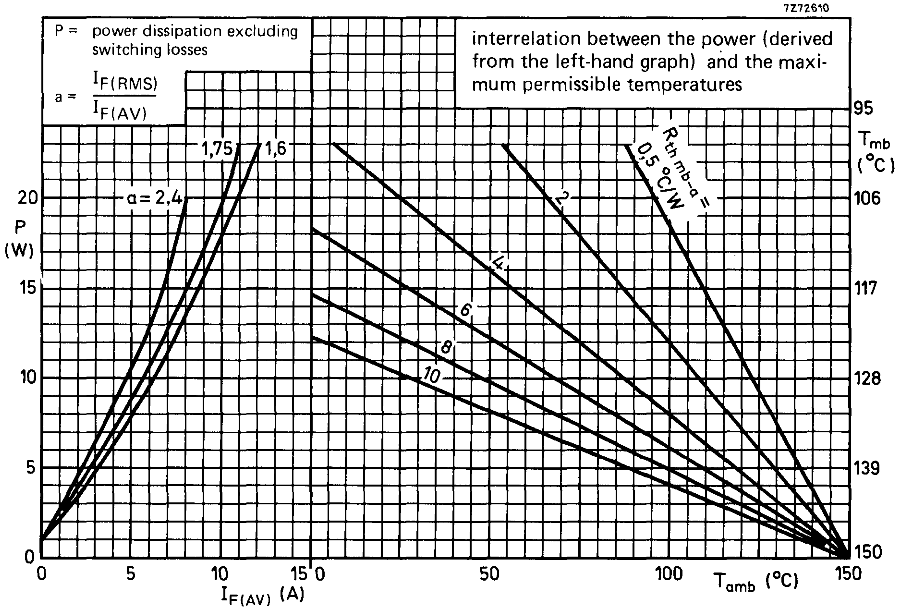
$V_R = V_{RWMmax}$; T_j = 125 °C	I_R	<	3	mA

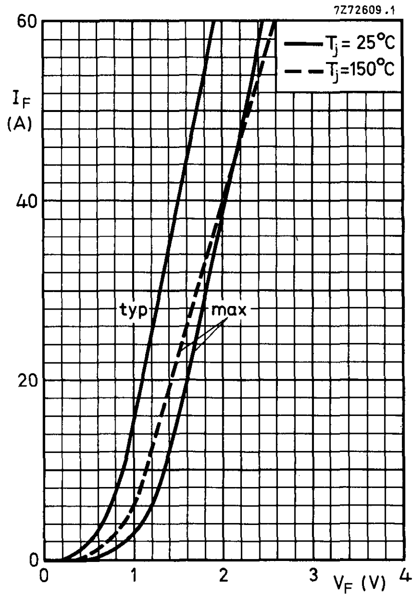
Reverse recovery when switched from

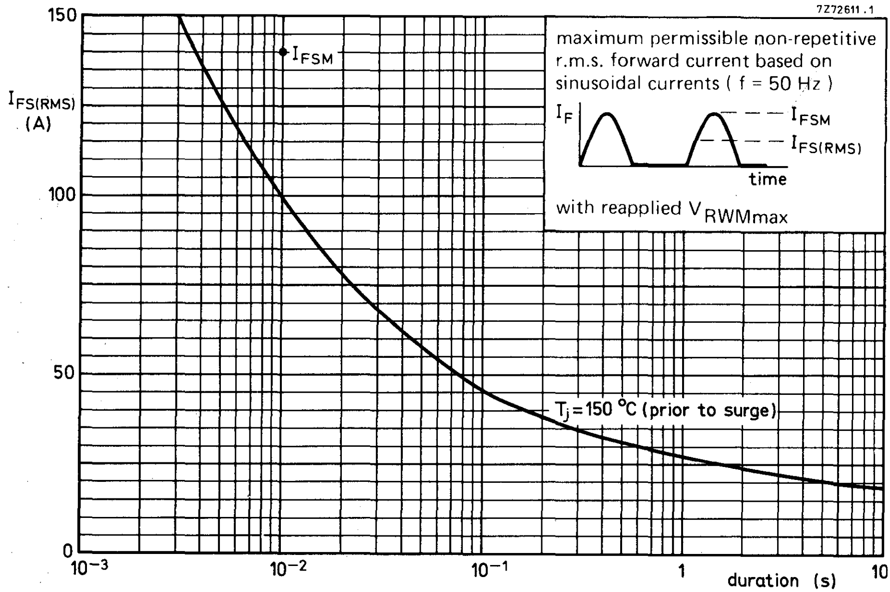
I_F = 1 A to V_R = 30 V; $-dI_F/dt$ = 35 A/µs; T_j = 25 °C Recovery time	t_{rr}	<	200	ns
I_F = 2 A to V_R = 30 V; $-dI_F/dt$ = 20 A/µs; T_j = 25 °C Recovery charge	Q_s	<	250	nC
I_F = 1 A to V_R = 30 V; $-dI_F/dt$ = 2 A/µs; T_j = 25 °C Max. slope of the reverse recovery current	$\|dI_R/dt\|$	<	5	A/µ

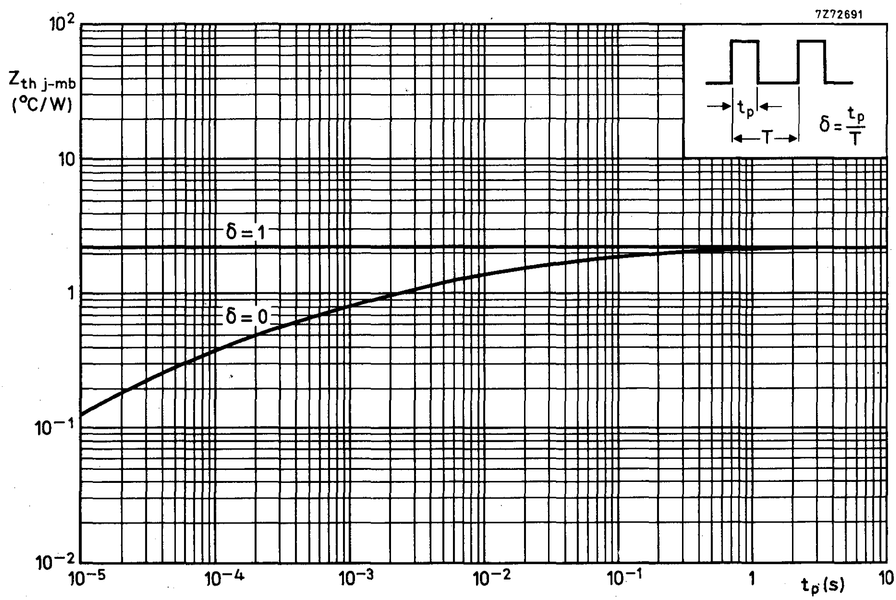


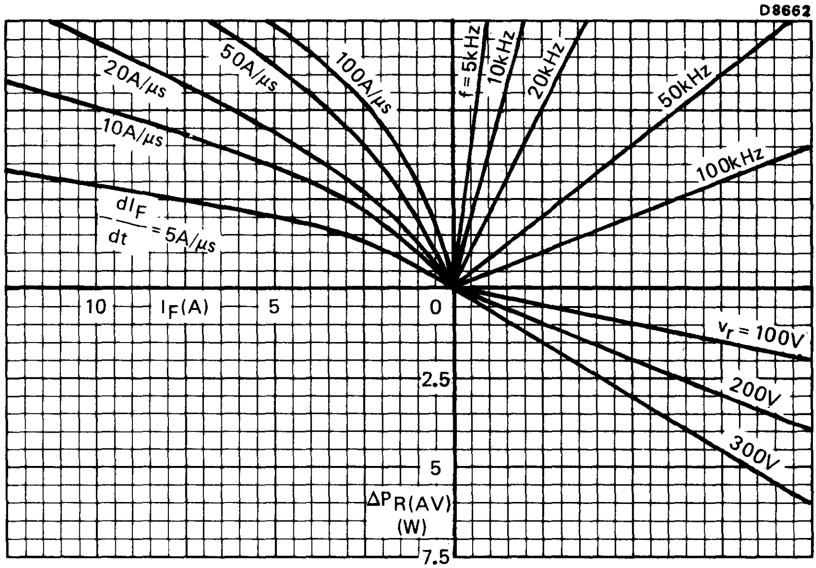
[1]) Measured under pulse conditions to avoid excessive dissipation.


7Z72610
P = power dissipation excluding switching losses
a = IF(RMS) / IF(AV)
interrelation between the power (derived from the left-hand graph) and the maximum permissible temperatures
P (W)
a = 2,4
1,75
1,6
Rth mb-a = 0,5 °C/W
2
4
6
8
10
Tmb (°C)
95
106
117
128
139
150
IF(AV) (A)
Tamb (°C)
0
5
10
15
20
50
100


7Z72609.1
IF (A)
Tj = 25°C
Tj = 150°C
typ
max
VF (V)
0
20
40
60
1
2
3
4


7Z72611.1
maximum permissible non-repetitive r.m.s. forward current based on sinusoidal currents (f = 50 Hz)
I_F
I_{FSM}
$I_{FS(RMS)}$
time
with reapplied V_{RWMmax}
$I_{FS(RMS)}$ (A)
150
100
50
0
I_{FSM}
$T_j = 150\ ^{\circ}C$ (prior to surge)
10^{-3}
10^{-2}
10^{-1}
1
10
duration (s)

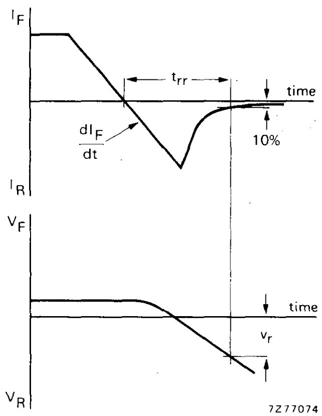

7Z72691
$Z_{th\ j\text{-}mb}$ (°C/W)
10^2
10
1
10^{-1}
10^{-2}
t_p
T
$\delta = \frac{t_p}{T}$
$\delta = 1$
$\delta = 0$
10^{-5}
10^{-4}
10^{-3}
10^{-2}
10^{-1}
1
10
t_p (s)



NOMOGRAM

Power loss $\Delta P_{R(AV)}$ due to switching only (to be added to steady state power losses).

I_F = forward current just before switching off; T_j = 150 °C



FAST SOFT-RECOVERY RECTIFIER DIODES

Silicon diodes in DO–5 metal envelopes, featuring non-snap-off characteristics. They are intended for use in high-frequency power supplies, thyristor inverters and multi-phase power rectifier applications.
The series consists of the following types:
Normal polarity (cathode to stud): 1N3899, 1N3900, 1N3901, 1N3902, 1N3903.
Reverse polarity (anode to stud), 1N3899R, 1N3900R, 1N3901R, 1N3902R, 1N3903R.

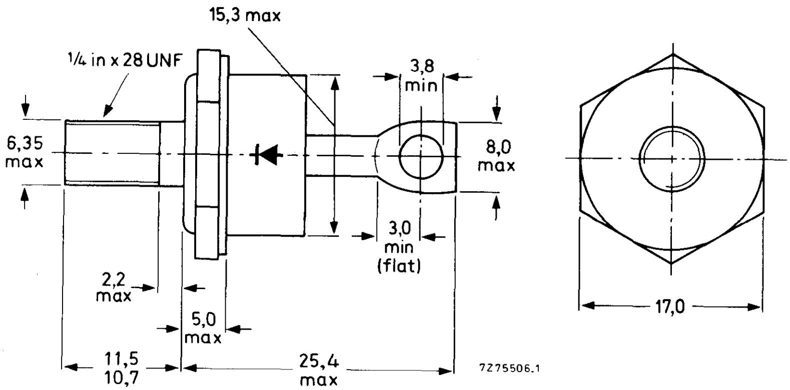
QUICK REFERENCE DATA

			1N3899(R)	3900(R)	3901(R)	3902(R)	3903(R)	
Repetitive peak reverse voltage	V_{RRM}	max.	50	100	200	300	400	V
Average forward current	$I_{F(AV)}$	max.			20			A
Non-repetitive peak forward current	I_{FSM}	max.			225			A
Reverse recovery time	t_{rr}	<			200			ns

MECHANICAL DATA

Dimensions in mm

Fig.1 DO–5; Supplied with device: 1 nut, 1 lock washer
Nut dimensions across the flats: 11.1 mm



Net mass: 22 g
Diameter of clearance hole: max. 6.5 mm
Accessories supplied on request:
56264A (mica washer, insulating ring, tag)
The mark shown applies to normal polarity types.

Torque on nut:
min. 1.7 Nm (17 kg cm)
max. 2.5 Nm (25 kg cm)

RATINGS

Limiting values in accordance with the Absolute Maximum System (IEC 134)

Voltages

			1N3899(R)	3900(R)	3901(R)	3902(R)	3903(R)	
Non-repetitive peak reverse voltage ($t \leq 10$ ms)	V_{RSM}	max.	75	200	300	400	500	V
Repetitive peak reverse voltage ($\delta \leq 0.01$)	V_{RRM}	max.	50	100	200	300	400	V
Crest working voltage	V_{RWM}	max.	50	100	200	300	400	V

Currents

Average on-state current assuming zero switching losses (averaged over any 20 ms period)				
up to T_{mb} = 100 °C	$I_{F(AV)}$	max.	20	A
at T_{mb} = 125 °C	$I_{F(AV)}$	max.	10	A
R.M.S. forward current	$I_{F(RMS)}$	max.	30	A
Repetitive peak forward current	I_{FRM}	max.	100	A
Non-repetitive peak forward current T_j = 150 °C prior to surge; half sine-wave; with reapplied V_{RWMmax};				
t = 10 ms	I_{FSM}	max.	200	A
t = 8.3 ms	I_{FSM}	max.	225	A
I^2t for fusing (t = 10 ms)	I^2t	max.	210	A^2s

Temperatures

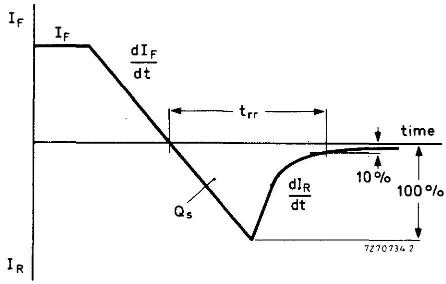
Storage temperature	T_{stg}		−65 to 175	°C
Operating junction temperature	T_j	max.	150	°C

THERMAL RESISTANCE

From junction to mounting base	$R_{th\ j\text{-}mb}$	=	1.5	°C/W
From mounting base to heatsink with heatsink compound	$R_{th\ mb\text{-}h}$	=	0.3	°C/W
Transient thermal impeadance; t = 1 ms	$Z_{th\ j\text{-}mb}$	=	0.3	°C/W

CHARACTERISTICS

Forward voltage				
I_F = 20 A; T_j = 25 °C	V_F	<	1.4	V*
Reverse current				
$V_R = V_{RWMmax}$; T_j = 100 °C	I_R	<	6	mA
Reverse recovery when switched from				
I_F = 1A to $V_R \geqslant$ 30 V; $-dI_F/dt$ = 35 A/μs; T_j = 25 °C				
Recovery time	t_{rr}	<	200	ns
I_F = 2 A to $V_R \geqslant$ 30 V; $-dI_F/dt$ = 20 A/μs; T_j = 25 °C				
Recovered charge	Q_s	<	250	nC
Maximum slope of the reverse recovery current when switched from I_F = 1 A to $V_R \geqslant$ 30 V; $-dI_F/dt$ = 2 A/μs; T_j = 25 °C	$\lvert dI_R/dt \rvert$	<	5	A/μs



D8403

Fig.2 Definitions of t_{rr} and Q_s.

*Measured under pulse conditions to avoid excessive dissipation.

SINUSOIDAL OPERATION

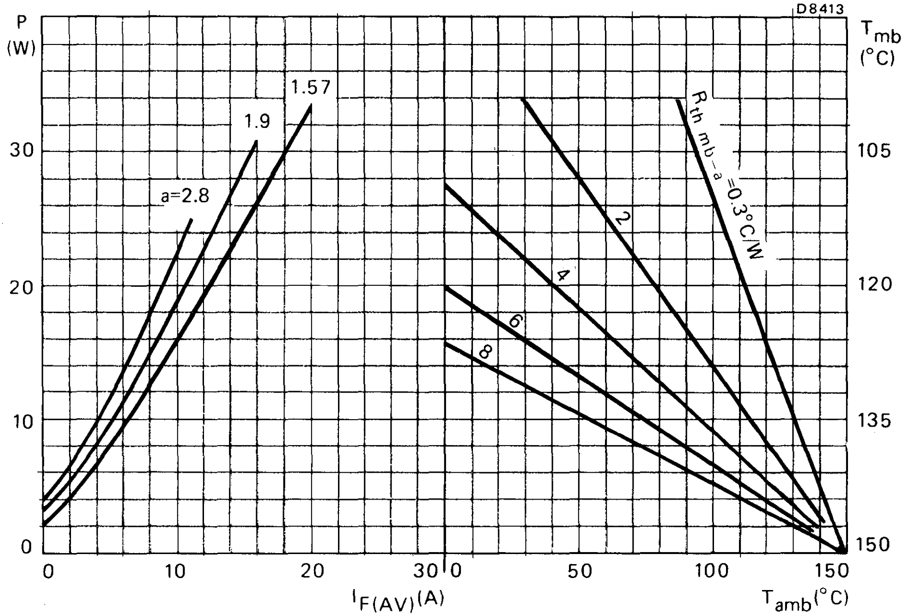


Fig.3 The right-hand part shows the interrelationship between the power (derived from the left-hand part) and the maximum permissible temperatures.
P = power dissipation excluding switching losses.
a = form factor = $I_{F(RMS)}/I_{F(AV)}$.

SQUARE WAVE OPERATION

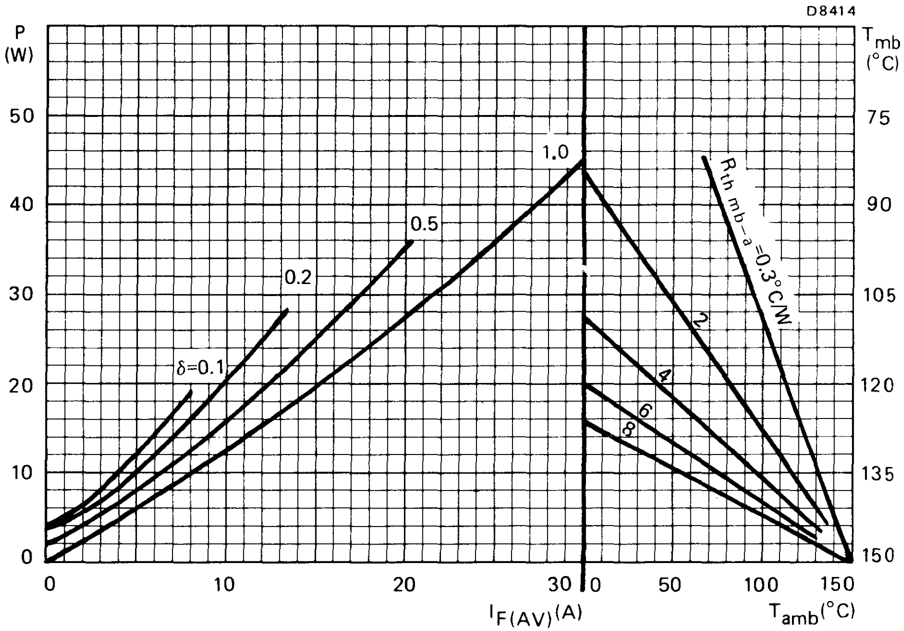
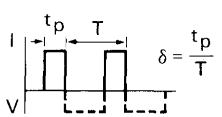


Fig.4 The right-hand part shows the interrelationship between the power (derived from the left-hand part) and the maximum permissible temperatures.
P = power dissipation excluding switching losses.



$I_{F(AV)} = I_{F(RMS)} \times \sqrt{\delta}$

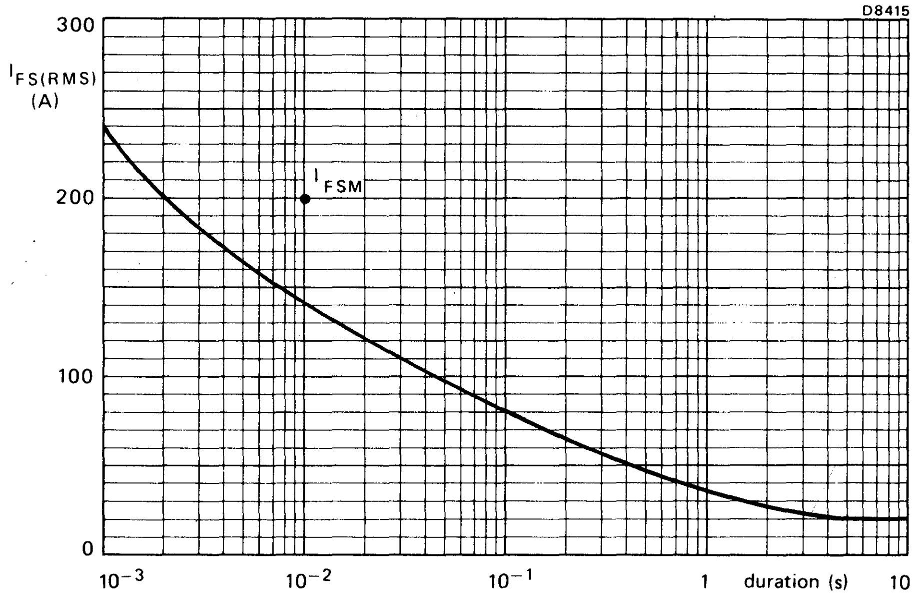


Fig.5 Maximum permissible non-repetitive r.m.s. forward current based on sinusoidal currents (f = 50 Hz); T_j = 150 °C prior to surge; with reapplied V_{RWMmax}.

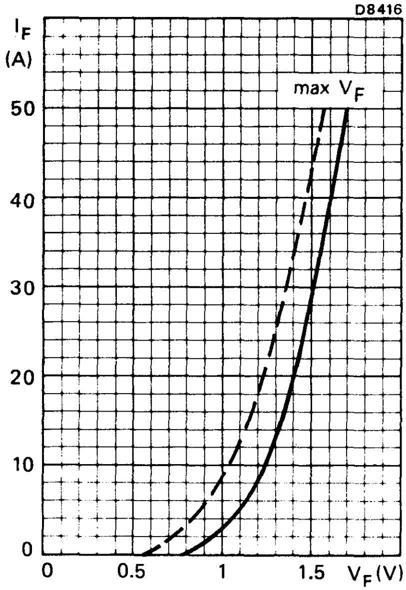


Fig.6 ——— Tj = 25 °C; – – – T_j = 150 °C

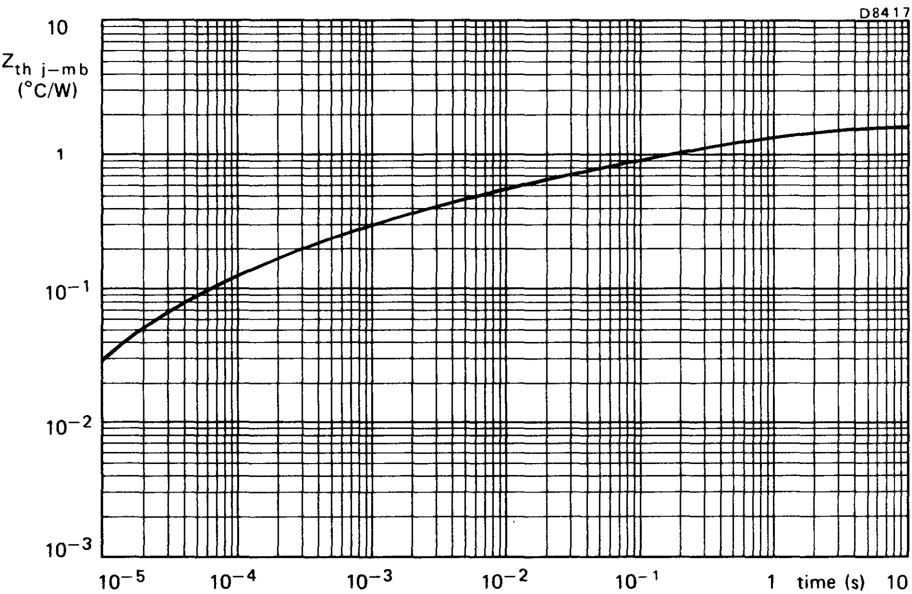


Fig.7

FAST SOFT-RECOVERY RECTIFIER DIODES

Silicon diodes in DO–5 metal envelopes, featuring non-snap-off characteristics. They are intended for use in high-frequency power supplies, thyristor inverters and multi-phase power rectifier applications.
The series consists of the following types:
Normal polarity (cathode to stud): 1N3909, 1N3910, 1N3911, 1N3912, 1N3913.
Reverse polarity (anode to stud): 1N3909R, 1N3910R, 1N3911R, 1N3912R, 1N3913R.

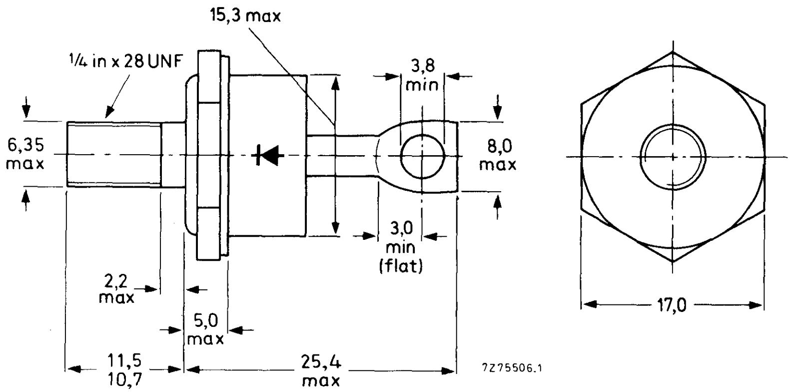
QUICK REFERENCE DATA

			1N3909(R)	3910(R)	3911(R)	3912(R)	3913(R)	
Repetitive peak reverse voltage	V_{RRM}	max.	50	100	200	300	400	V
Average forward current	$I_{F(AV)}$	max.			30			A
Non-repetitive peak forward current	I_{FSM}	max.			300			A
Reverse recovery time	t_{rr}	<			200			ns

MECHANICAL DATA

Dimensions in mm

Fig.1 DO–5; Supplied with device: 1 nut, 1 lock-washer
Nut dimensions across the flats: 11.1 mm



Net mass: 22 g
Diameter of clearance hole: max. 6.5 mm
Accessories supplied on request:
56264A (mica washer, insulating ring, tag)
The mark shown applies to normal polarity types.

Torque on nut:
min. 1.7 Nm (17 kg cm)
max. 2.5 Nm (25 kg cm)

RATINGS

Limiting values in accordance with the Absolute Maximum System (IEC 134)

Voltages

			1N3909(R)	3910(R)	3911(R)	3912(R)	3913(R)	
Non-repetitive peak reverse voltage (t = 10 ms)	V_{RSM}	max.	75	200	300	400	500	V
Repetitive peak reverse voltage ($\delta \leqslant 0.01$)	V_{RRM}	max.	50	100	200	300	400	V
Crest working voltage	V_{RWM}	max.	50	100	200	300	400	V

Currents

Average on-state current assuming zero switching losses (averaged over any 20 ms period)				
up to T_{mb} = 100 °C	$I_{F(AV)}$	max.	30	A
at T_{mb} = 125 °C	$I_{F(AV)}$	max.	15	A
R.M.S. forward current	$I_{F(RMS)}$	max.	45	A
Repetitive peak forward current	I_{FRM}	max.	125	A
Non-repetitive peak forward current T_j = 150 °C prior to surge; half sine-wave with reapplied V_{RWMmax};				
t = 10 ms	I_{FSM}	max.	275	A
t = 8.3 ms	I_{FSM}	max.	300	A
I^2t for fusing (t = 10 ms)	I^2t	max.	375	A^2s

Temperatures

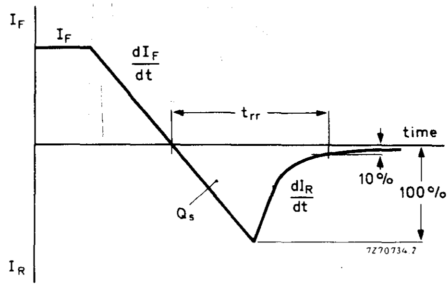
Storage temperature	T_{stg}		−65 to 175	°C
Operating junction temperature	T_j	max.	150	°C

THERMAL RESISTANCE

From junction to mounting base	$R_{th\ j\text{-}mb}$	=	1.0	°C/W
From mounting base to heatsink with heatsink compound	$R_{th\ mb\text{-}h}$	=	0.3	°C/W
Transient thermal impedance; t = 1 ms	$Z_{th\ j\text{-}mb}$	=	0.2	°C/W

CHARACTERISTICS

Forward voltage				
I_F = 30 A; T_j = 25 °C	V_F	<	1.4	V*
Reverse current				
$V_R = V_{RWMmax}$; T_j = 100 °C	I_R	<	10	mA
Reverse recovery when switched from				
I_F = 1 A to $V_R \geq$ 30 V; $-dI_F/dt$ = 35 A/µs; T_j = 25 °C				
Recovery time	t_{rr}	<	200	ns
I_F = 2 A to $V_R \geq$ 30 V; $-dI_F/dt$ = 20 A/µs; T_j = 25 °C				
Recovered charge	Q_s	<	250	nC
Maximum slope of the reverse recovery current when switched from I_F = 1 A to $V_R \geq$ 30 V; $-dI_F/dt$ = 2 A/µs; T_j = 25 °C	$\lvert dI_R/dt \rvert$	<	5	A/µs



D8403

Fig. 2 Definitions of t_{rr} and Q_s.

*Measured under pulse conditions to avoid excessive dissipation.

SINUSOIDAL OPERATION

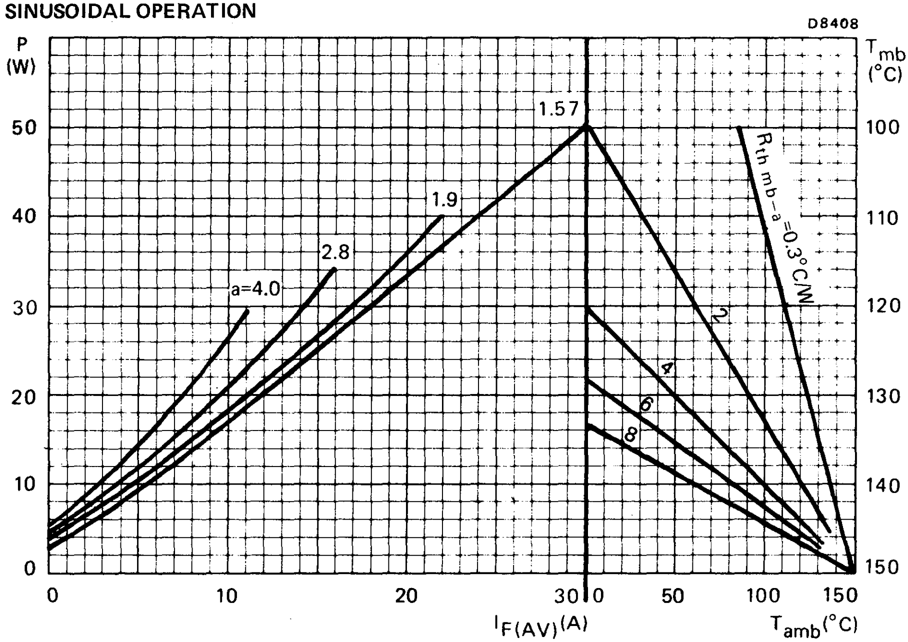


Fig. 3 The right-hand part shows the interrelationship between the power (derived from the left-hand part) and the maximum permissible temperatures.
P = power dissipation excluding switching losses.
a = form factor = $I_{F(RMS)}/I_{F(AV)}$.

SQUARE-WAVE OPERATION

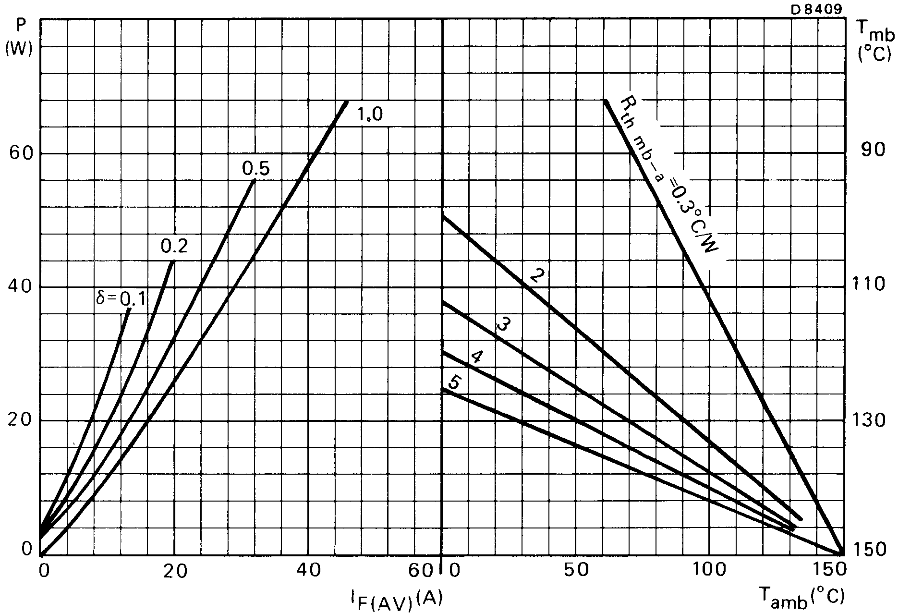
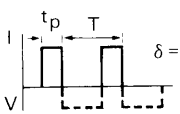


Fig. 4 The right-hand part shows the interrelationship between the power (derived from the left-hand part) and the maximum permissible temperatures.
P = power dissipation excluding switching losses.



$\delta = \frac{t_p}{T}$

$I_{F(AV)} = I_{F(RMS)} \times \sqrt{\delta}$

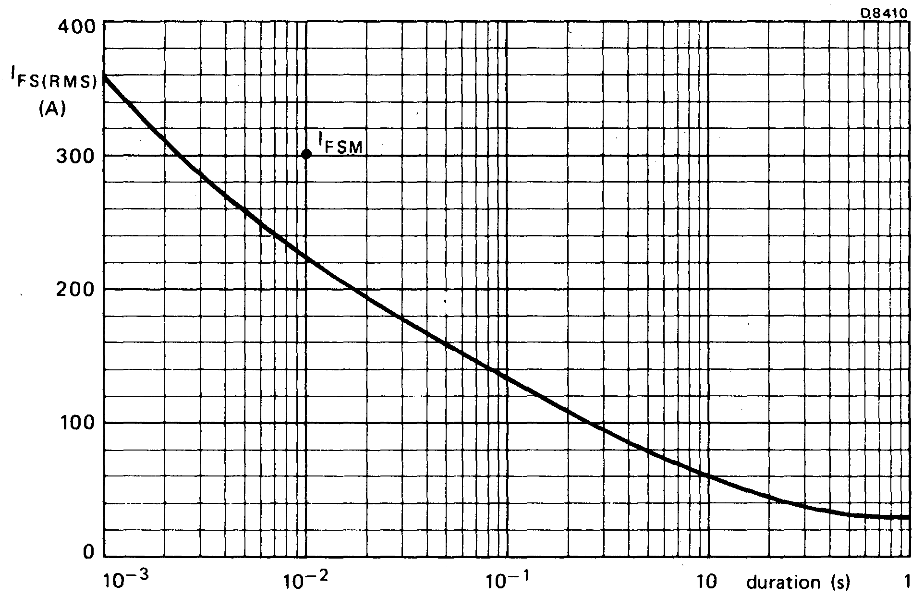


Fig.5 Maximum permissible non-repetitive r.m.s. forward current based on sinusoidal currents (f = 50 Hz); T_j = 150 °C prior to surge; with reapplied V_{RWMmax}.

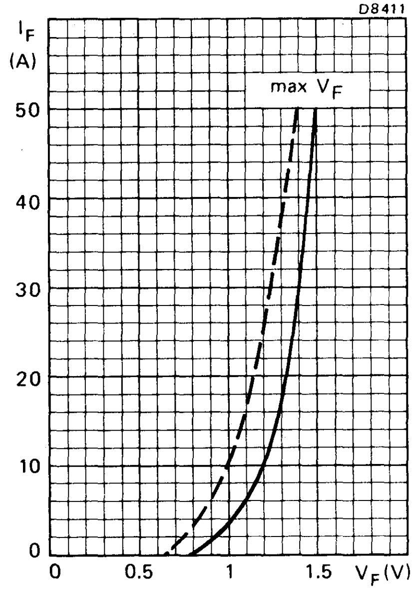


Fig. 6 —— T_j = 25 °C; – – – T_j = 150 °C

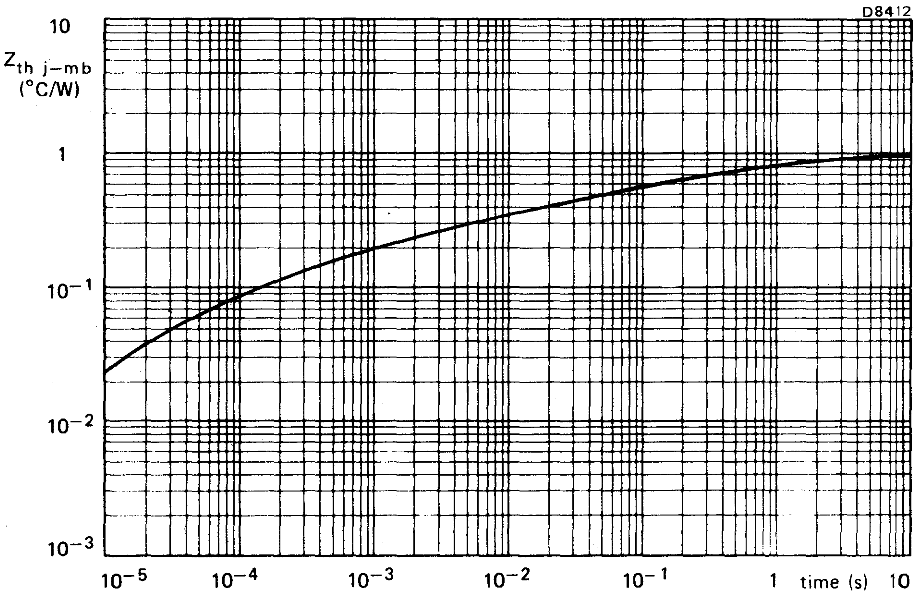


Fig. 7

REGULATOR DIODES

C

C

VOLTAGE REGULATOR DIODES

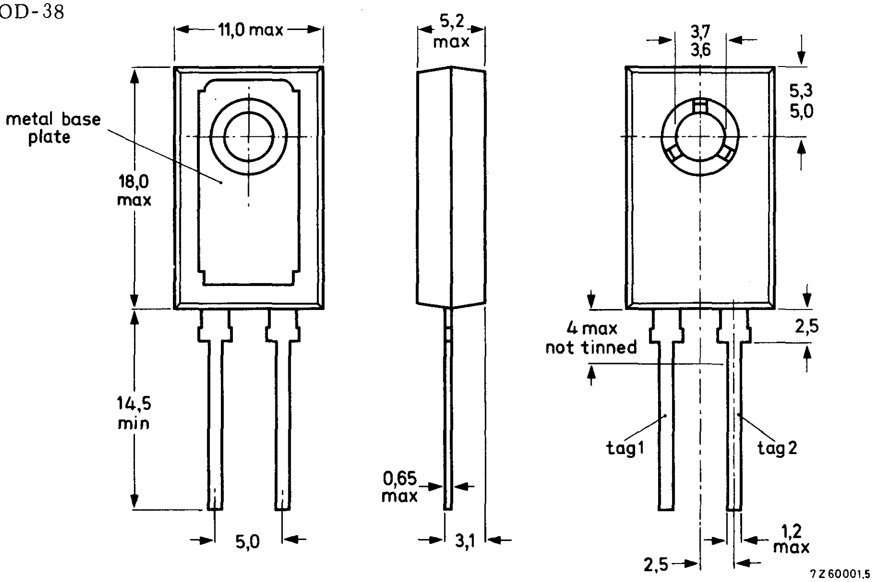
A range of voltage regulator diodes in plastic envelopes intended for use as voltage stabilizers in power supply circuits.
Normal and reverse polarity types are available: BZV15-C10(R) to C75(R).

QUICK REFERENCE DATA				
Working voltage range (5% range)	V_Z	nom.	10 to 75	V
Total power dissipation at T_{amb} = 25 °C	P_{tot}	max.	2,2	W
at T_{mb} = 82 °C	P_{tot}	max.	15	W
Junction temperature	T_j	max.	150	°C

MECHANICAL DATA

Dimensions in mm

SOD-38



Net mass; 2,5 g
Accessories:
supplied with device : washer
available on request : 56316 (mica insulating washer)

Torque on screw: min. 0,95 Nm (9,5 kg cm)
max. 1,5 Nm (15 kg cm)

Tag 1 is connected to the metal base-plate, which should be mounted in contact with the heatsink used.

POLARITY OF CONNECTIONS

	BZV15-C10 to C75	BZV15-C10R to C75R
Base-plate :	cathode	anode
Tag 1 :	cathode	anode
Tag 2 :	anode	cathode

RATINGS Limiting values in accordance with the Absolute Maximum System (IEC 134)

Currents

Average forward current (averaged over any 20 ms period) at T_{mb} = 82 °C	$I_{F(AV)}$	max.	7,5	A
Repetitive peak forward current	I_{FRM}	max.	50	A

Power dissipation

Total power dissipation at T_{amb} = 25 °C (method a)	P_{tot}	max.	2,2	W
at T_{mb} = 82 °C	P_{tot}	max.	15	W
Non-repetitive peak reverse power dissipation T_{amb} = 25 °C; t = 1 ms (square pulse)	P_{ZSM}	max.	400	W

Temperatures

Storage temperature	T_{stg}	−55 to + 125		°C
Junction temperature	T_j	max.	150	°C

SOLDERING AND MOUNTING NOTES

1. The devices may be soldered directly into the circuit.
2. The maximum permissible temperature of the soldering iron or bath is 270 °C; contact with the joint must not exceed 3 seconds.
3. The devices should not be immersed in oil, and few potting resins are suitable for re-encapsulation. Advice on these materials is available on request.
4. Leads should not be bent less than 2,5 mm from the seal; exert no axial pull when bending.
5. Soldered joints must be at least 2,5 mm from the seal.
6. For good thermal contact heatsink compound should be used between base-plate and heatsink.

THERMAL RESISTANCE

From junction to mounting base	$R_{th\ j\text{-}mb}$	=	4,5 °C/W
Transient thermal impedance; t = 1 ms	$Z_{th\ j\text{-}mb}$	=	0,3 °C/W

Influence of mounting method

1. Heatsink operation

From mounting base to heatsink

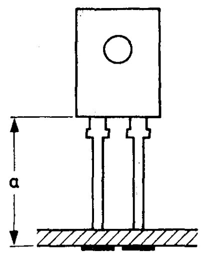
a. With heatsink compound	$R_{th\ mb\text{-}h}$	=	1,5 °C/W
b. With heatsink compound and 56316 mica washer	$R_{th\ mb\text{-}h}$	=	2,7 °C/W
c. Without heatsink compound	$R_{th\ mb\text{-}h}$	=	2,7 °C/W
d. Without heatsink compound with 56316 mica washer	$R_{th\ mb\text{-}h}$	=	5 °C/W

2. Free air operation

The quoted values of $R_{th\ j\text{-}a}$ should be used only when no other leads run to the tie-points.

From junction to ambient in free air mounted on a printed circuit board at a = maximum lead length and with a copper laminate

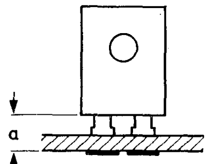
a. > 1 cm^2 — $R_{th\ j\text{-}a}$ = 50 °C/W
b. < 1 cm^2 — $R_{th\ j\text{-}a}$ = 55 °C/W



7Z62315.1

at a lead-length a = 3 mm and with a copper laminate

c. > 1 cm^2 — $R_{th\ j\text{-}a}$ = 55 °C/W
d. < 1 cm^2 — $R_{th\ j\text{-}a}$ = 60 °C/W



7Z62314

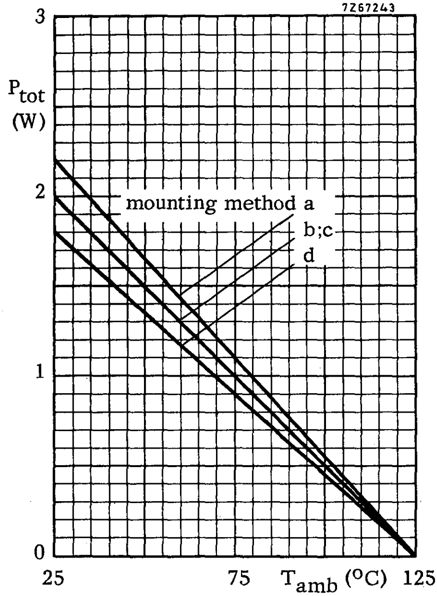
CHARACTERISTICS

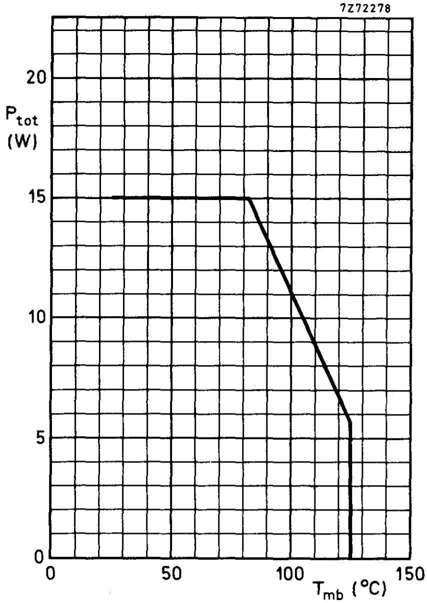
T_j = 25 °C unless otherwise specified

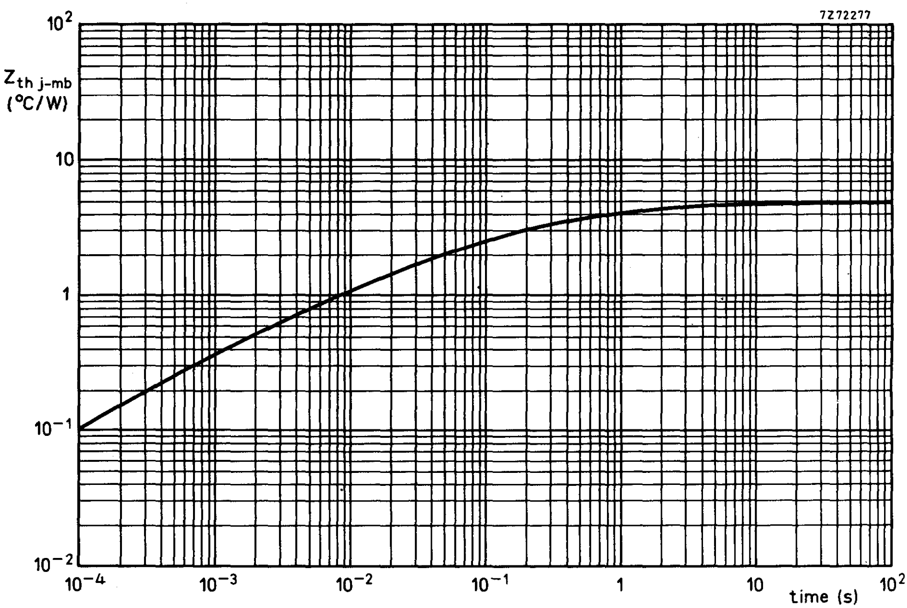
Forward voltage at I_F = 10 A	V_F	< 1,5	V
Reverse current at $V_R = \frac{2}{3} V_{Znom}$	I_R	< 50	µA

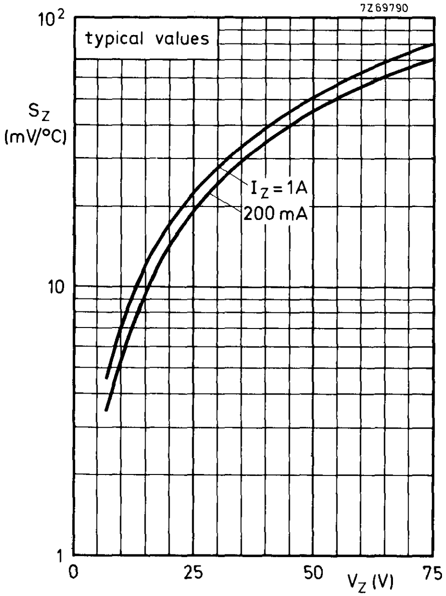
	Working voltage V_Z (V) 1)		Differential resistance r_{diff} (Ω) 1)	Temperature coefficient S_Z (mV/°C) 1)
	at I_Z = 1 A		at I_Z = 1 A	at I_Z = 1 A
BZV15-..	min.	max.	max.	typ.
C10(R)	9,4	10,6	0,5	9
C11(R)	10,4	11,6	1,0	9,9
C12(R)	11,4	12,7	1,0	10,8
C13(R)	12,4	14,1	1,0	11,7
C15(R)	13,8	15,6	1,2	13,5
	at I_Z = 0,5 A		at I_Z = 0,5 A	at I_Z = 0,5 A
C16(R)	15,3	17,1	1,2	14,4
C18(R)	16,8	19,1	1,5	16,2
C20(R)	18,8	21,2	1,5	15
C22(R)	20,8	23,3	1,8	16,5
C24(R)	22,7	25,9	2,0	19,2
C27(R)	25,1	28,9	2,0	22,1
C30(R)	28	32	2,5	25,5
C33(R)	31	35	3,0	29
	at I_Z = 0,2 A		at I_Z = 0,2 A	at I_Z = 0,2 A
C36(R)	34	38	4,0	32,4
C39(R)	37	41	5,0	35,1
C43(R)	40	46	6,5	39,6
C47(R)	44	50	7,0	43,7
C51(R)	48	54	7,5	47,4
C56(R)	52	60	8,0	52,6
C62(R)	58	66	9,0	58,3
C68(R)	64	72	10,0	63,9
C75(R)	70	79	10,5	71,3

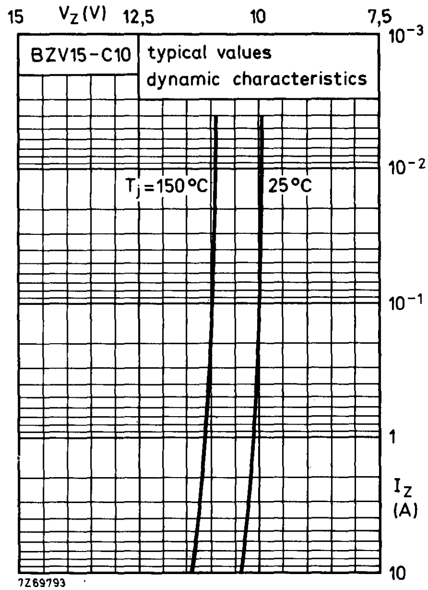
1) Measured by a pulse method with $t_p \leq 100$ µs, duty cycle $\delta \leq 0,001$ and $T_j \approx 25$ °C.

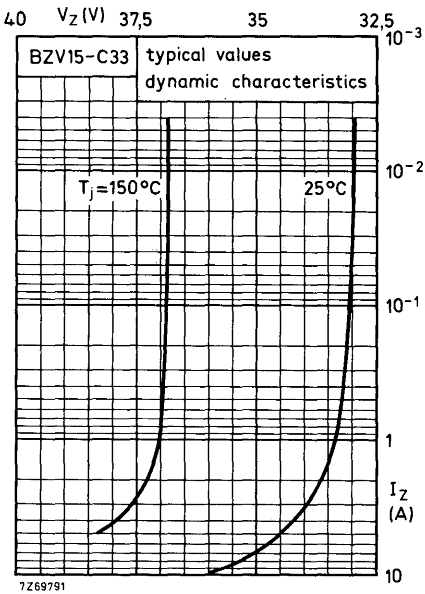

7Z67243
3
2
1
0
P_{tot}
(W)
mounting method a
b;c
d
25
75
T_{amb} (°C)
125

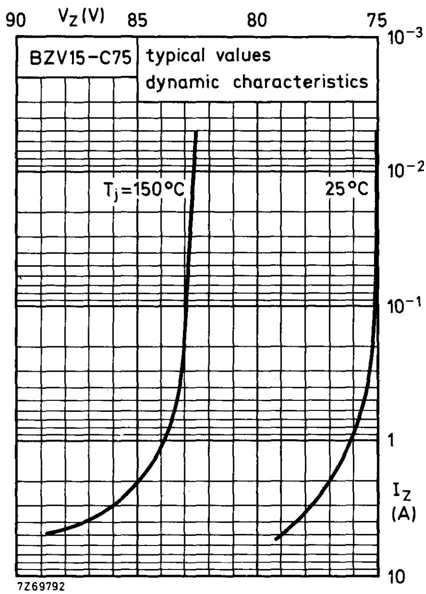

7Z72278
20
15
10
5
0
P_{tot}
(W)
0
50
100
150
T_{mb} (°C)


7Z72277
10^2
$Z_{th\ j\text{-}mb}$
(°C/W)
10
1
10^{-1}
10^{-2}
10^{-4}
10^{-3}
10^{-2}
10^{-1}
1
10
time (s)
10^2


7Z69790
typical values
S_Z (mV/°C)
10^2
10
1
$I_Z = 1A$
200 mA
0
25
50
75
V_Z (V)


15
V_Z (V)
12,5
10
7,5
BZV15-C10
typical values
dynamic characteristics
$T_j = 150\,°C$
25 °C
10^{-3}
10^{-2}
10^{-1}
1
10
I_Z (A)
7Z69793


40
V_Z (V)
37,5
35
32,5
BZV15-C33
typical values
dynamic characteristics
$T_j = 150\,°C$
25 °C
10^{-3}
10^{-2}
10^{-1}
1
10
I_Z (A)
7Z69791


90
V_Z (V)
85
80
75
BZV15-C75
typical values
dynamic characteristics
$T_j = 150\,°C$
25 °C
10^{-3}
10^{-2}
10^{-1}
1
10
I_Z (A)
7Z69792

TRANSIENT SUPPRESSOR BRIDGES

Plastic encapsulated bridge assembly comprising four silicon double diffused transient suppressor diodes. It is specifically intended for use as line polarity guard and transient protection element in telephony equipment, and as suppressor element in electrical and electronic equipment in general.

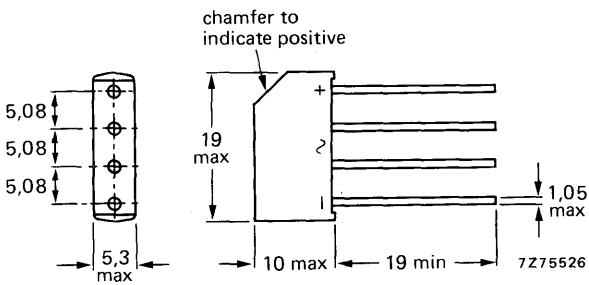
QUICK REFERENCE DATA

			BZW10–12	15	
Input stand-off voltage	V_I	max.	12	15	V
Output clamping voltage	$V_{O(CL)}$	<	30	34	V
Non-repetitive peak clamping current	$I_{(CL)SM}$	max.	50	40	A
Output voltage	V_O	>	10	13	V

MECHANICAL DATA

Dimensions in mm

Fig. 1 SOD–28



The sealing of the plastic envelope withstands the accelerated damp heat test of IEC recommendation 68–2 (test D, severity IV, 6 cycles).

RATINGS

Limiting values in accordance with the Absolute Maximum System (IEC134)

			BZW10–12	15	
Input stand-off voltage (note 1)	V_I	max.	12	15	V
Average output current (averaged over any 20 ms period)	$I_{O(AV)}$	max.	150	150	mA
Non-repetitive peak clamping current full load prior to surge (see note 2)	$I_{(CL)SM}$	max.	50	40	A
→ Storage temperature	T_{stg}		−55 to +150		°C
→ Operating ambient temperature	T_{amb}		−25 to +85		°C

THERMAL RESISTANCE

From junction to ambient	$R_{th\ j\text{-}a}$	=	60	°C/W

CHARACTERISTICS

→ T_{amb} = −25 to +85 °C

			BZW10–12	15	
Output voltage $V_I = V_{Imax}$; I_O = 10 mA	V_O	>	10	13	V
Output clamping voltage at $I_{(CL)SM}$ at rated load conditions	$V_{O(CL)}$	<	30	34	V
Leakage current $V_I = V_{Imax}$; at rated load conditions	I_R	<	40	40	μA

MOUNTING INSTRUCTIONS

1. The maximum permissible temperature of the soldering iron or bath is 270 °C; it must not be in contact with the joint for more than 3 seconds.
2. Avoid hot spots due to handling or mounting; the body of the device must not come into contact with or be exposed to a temperature higher than 150 °C.
3. Exert no axial pull when bending the leads.

Notes

1. The stand-off voltage is the maximum bridge input voltage permitted for continuous operation.
2. In accordance with F.T.Z. requirement 10/700 with 2 kV test voltage: BZW10–12 and 1.6 kV: BZW10–15 (see also page 3).

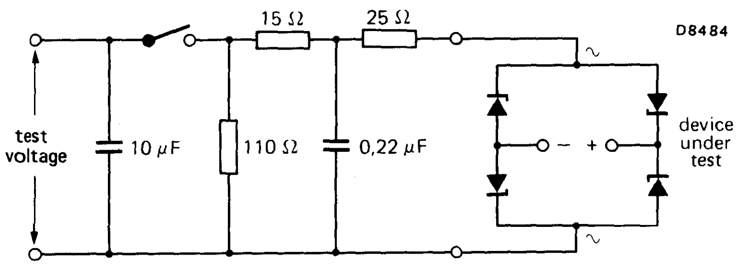


Fig. 2 Test set-up in accordance with F.T.Z. 10/700

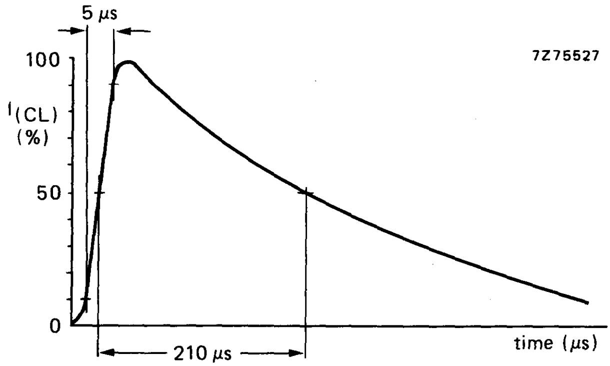


Fig. 3 Output clamping current as a function of time.

TRANSIENT SUPPRESSOR DIODES

A range of diffused silicon diodes in a plastic envelope intended for use in the protection of electrical and electronic equipment against voltage transients.
The series consists of the following types: BZW70-5V6 to BZW70-62.

QUICK REFERENCE DATA

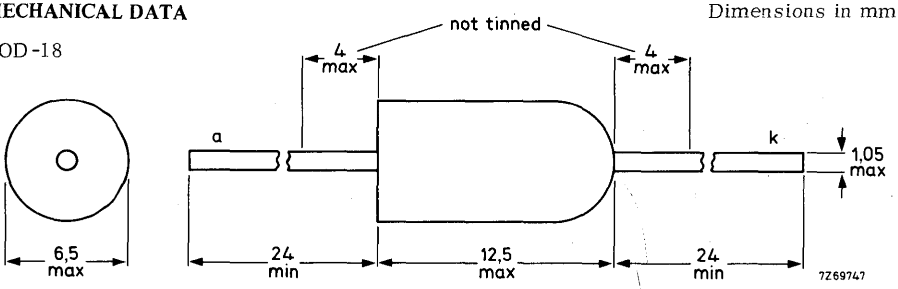
Stand-off voltage (15% range) *	V_R	5,6 to 62	V
Reverse breakdown voltage	$V_{(BR)R}$	6,4 to 70	V
Non-repetitive peak reverse power dissipation; exponential pulse	P_{RSM}	max. 700	W

* The stand-off voltage is the maximum reverse voltage recommended for continuous operation; at this value non-conduction is ensured.

MECHANICAL DATA

Dimensions in mm

SOD-18



The rounded end indicates the cathode

The sealing of the plastic envelope withstands the accelerated damp heat test of IEC recommendation 68-2 (test D, severity IV, 6 cycles).

CHARACTERISTICS – WHEN USED AS TRANSIENT SUPPRESSOR DIODES; T_{amb} = 25 °C

clamping voltage t_p = 500 μs exp. pulse $V_{(CL)R}$ V		at non-repetitive peak reverse current I_{RSM} A	reverse current at recommended stand-off voltage I_R mA	V_R V	BZW70-...
typ.	max.		max.		
9	10	20	0.5	5.6	5V6
10	11.2	20	0.5	6.2	6V2
11	12.5	20	0.5	6.8	6V8
12	14	20	0.1	7.5	7V5
13.5	15.5	20	0.1	8.2	8V2
15	17.5	20	0.1	9.1	9V1
17	19	20	0.1	10	10
19	21	20	0.1	11	11
21	23	20	0.1	12	12
23	26	20	0.1	13	13
22	26	10	0.1	15	15
25	29	10	0.1	16	16
28	33	10	0.1	18	18
32	38	10	0.1	20	20
36	43	10	0.1	22	22
41	48	10	0.1	24	24
47	54	10	0.1	27	27
44	52	5	0.1	30	30
49	58	5	0.1	33	33
56	65	5	0.1	36	36
63	72	5	0.1	39	39
71	82	5	0.1	43	43
80	93	5	0.1	47	47
89	104	5	0.1	51	51
98	116	5	0.1	56	56
104	116	5	0.1	62	62

TRANSIENT SUPPRESSOR DIODES

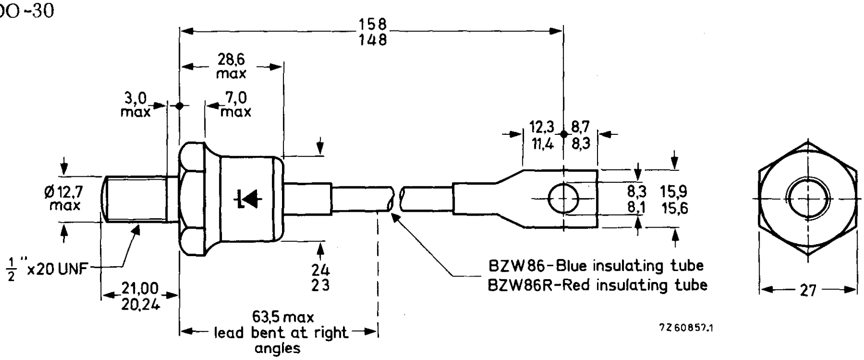
A range of diffused silicon diodes in a DO-30 metal envelope intended for use in the protection of the electrical and electronic equipment against voltage transients.
The series consists of the following types:
Normal polarity (cathode to stud): BZW86-7V5 to 56
Reverse polarity (anode to stud) : BZW86-7V5R to 56R

QUICK REFERENCE DATA				
Stand-off voltage (15% range) *	V_R		7,5 to 56	V
Reverse breakdown voltage	$V_{(BR)R}$		9,4 to 64	V
Non-repetitive peak reverse power dissipation; exponential pulse	P_{RSM}	max.	25	kW

* The stand-off voltage is the maximum reverse voltage recommended for continuous operation; at this value non-conduction is ensured.

MECHANICAL DATA Dimensions in mm

DO-30



Supplied with device: 1 nut, 1 lock washer
Nut dimensions across the flats: 19 mm

Diameter of clearance hole: max. 13 mm
Net weight: 123 g
The mark shown applies to the normal polarity types.

Torque on nut: min. 9 Nm (90 kgcm)
max. 17,5 Nm (175 kgcm)

RATINGS Limiting values in accordance with the Absolute Maximum System (IEC134)

Stand-off voltage *	V_R	equal to type number suffix		
Currents				
Non-repetitive peak reverse current				
T_j = 25 °C prior to surge				
t_p = 10 μs; square pulse				
BZW86-9V1(R)	I_{RSM}	max.	3700	A
BZW86-27(R)	I_{RSM}	max.	1200	A
BZW86-56(R)	I_{RSM}	max.	700	A
t_p = 1 ms; exponential pulse				
BZW86-9V1(R)	I_{RSM}	max.	1200	A
BZW86-27(R)	I_{RSM}	max.	400	A
BZW86-56(R)	I_{RSM}	max.	250	A
Power dissipation				
Repetitive peak reverse power dissipation T_{mb} = 65 °C; f = 50 Hz; t_p = 10 μs (square pulse; see also graphs on page 6)	P_{RRM}	max.	50	kW
Non-repetitive peak reverse power dissipation T_j = 25 °C prior to surge; exponential pulse: see also graph on page 5				
t_p = 100 μs	P_{RSM}	max.	60	kW
t_p = 1 ms	P_{RSM}	max.	25	kW
Temperatures				
Storage temperature	T_{stg}		−55 to +175	°C
Junction temperature	T_j	max.	175	°C

THERMAL RESISTANCE

From junction to mounting base	$R_{th\ j\text{-}mb}$	=	0,3	°C/W
From mounting base to heatsink	$R_{th\ mb\text{-}h}$	=	0,1	°C/W

CHARACTERISTICS

Forward voltage

I_F = 500 A at T_j = 25 °C	V_F	<	1,5	V **

* The stand-off voltage is the maximum reverse voltage recommended for continuous operation; at this value non-conduction is ensured.

** Measured under pulse condition.

CHARACTERISTICS (continued)

	Clamping voltages (exp. pulse) at T_j = 25 °C prior to surge; t_p = 500 μs $V_{(CL)R}$ (V) typ.	max.		Reverse breakdown voltage at T_j = 25 °C $V_{(BR)R}$ (V) min.	
BZW86 -7V5(R)	12	14	I_R = 1000 A	8,5	I_R = 10 A
-8V2(R)	13	15,5		9,4	
-9V1(R)	14	17		10,4	
-10(R)	15,5	18,5		11,4	
-11(R)	17	20		12,4	
-12(R)	18,5	22		13,8	
-13(R)	20	24		15,3	
-15(R)	23	27		16,8	
-16(R)	27	32	I_R = 500 A	18,8	I_R = 5 A
-18(R)	31	36		20,8	
-20(R)	34	40		22,8	
-22(R)	37	43		25,1	
-24(R)	40	47		28	
-27(R)	44	52		31	
-30(R)	47	55	I_R = 250 A	34	
-33(R)	51	60		37	I_R = 2 A
-36(R)	55	65		40	
-39(R)	60	70		44	
-43(R)	66	77		48	
-47(R)	72	84		52	
-51(R)	78	92		58	
-56(R)	85	102		64	

The maximum clamping voltage is the maximum reverse voltage which appear across the diode at the specified pulse duration and junction temperature.
See curves on pages 8 and 9 for square pulses and pages 10 and 11 for exponential pulses.

CHARACTERISTICS (continued) T_j = 25 °C unless otherwise specified

Peak reverse current

V_{RM} = recommended stand-off voltage	I_{RM}	<	2	mA
Temperature coefficient of clamping voltage	S	typ.	+0,1	%/°C

OPERATING NOTES

Heatsink considerations

(a) For non-repetitive transients, the device may be used without a heatsink for pulses up to 10 ms in duration.

(b) For repetitive transients which fall within the permitted operating range shown in the curves on page 6 the required heatsink is found as follows:

$$R_{th\ j\text{-}mb} + R_{th\ mb\text{-}h} + R_{th\ h\text{-}a} = \frac{T_{j\ max} - T_{amb}}{P_S + \delta .\ P_{RRM}}$$

where $T_{j\ max}$ = 175 °C

T_{amb} = ambient temperature

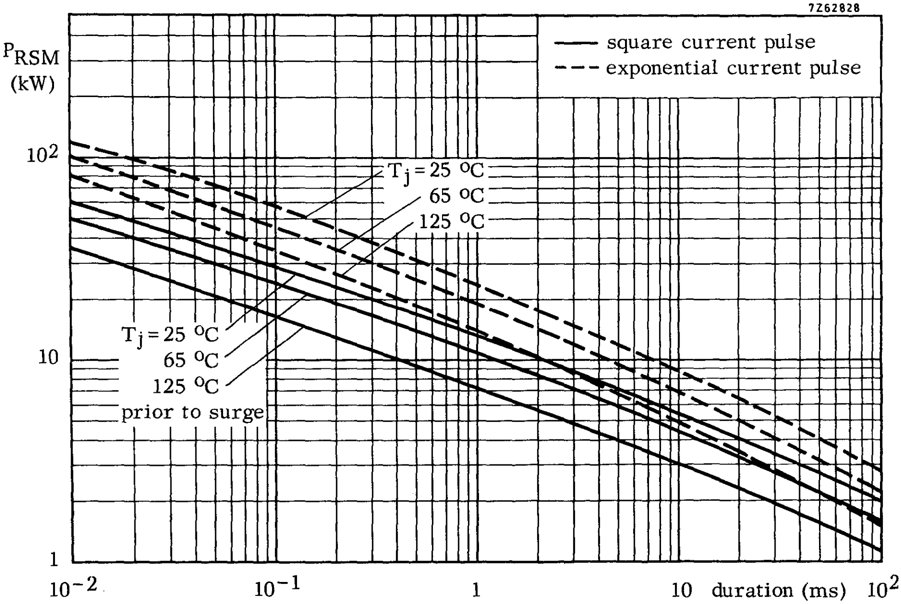
P_S = any steady state dissipation excluding that in pulses

δ = duty factor (t_p/T)

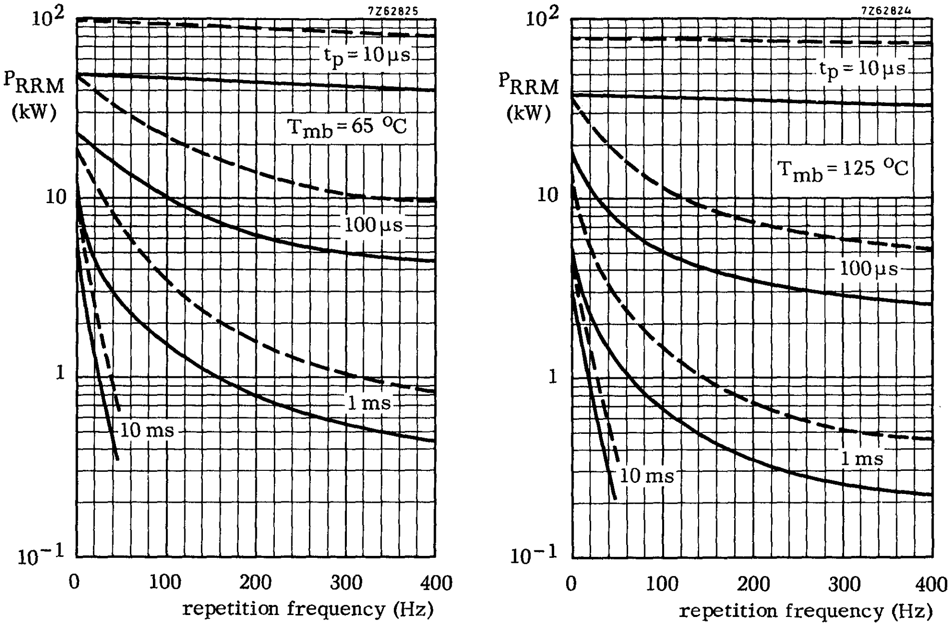
$R_{th\ j\text{-}mb}$ = 0,3 °C/W

$R_{th\ mb\text{-}h}$ = 0,1 °C/W

thus $R_{th\ h\text{-}a}$ can be found.

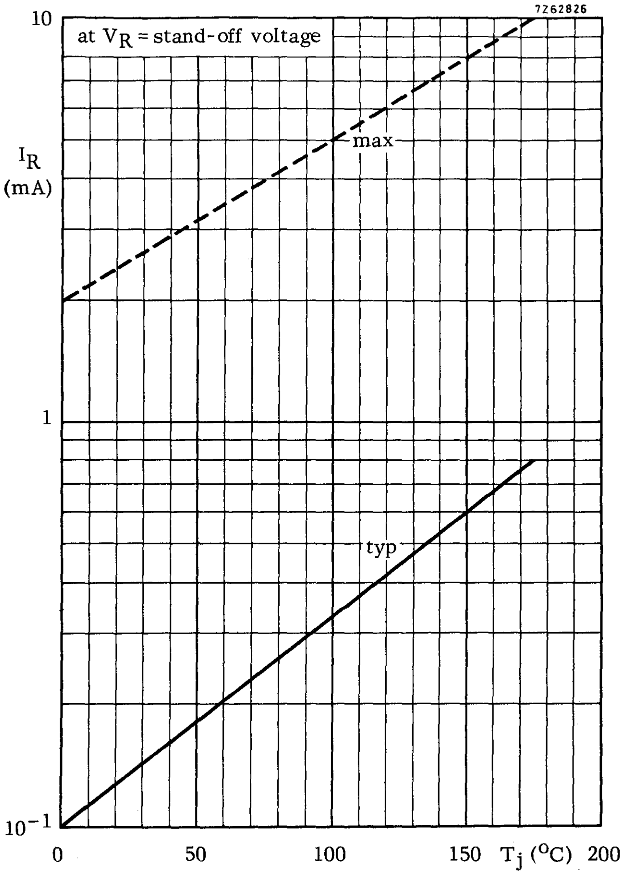


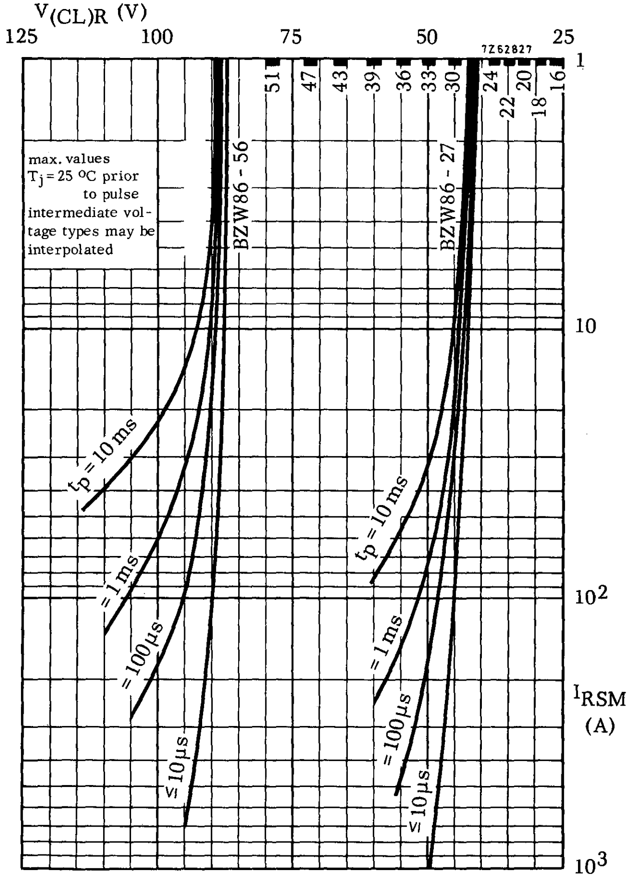
Duration of an exponential pulse is defined as the time taken for the pulse to fall to 37% of its initial value. It is assumed that the energy content does not continue beyond twice this time.



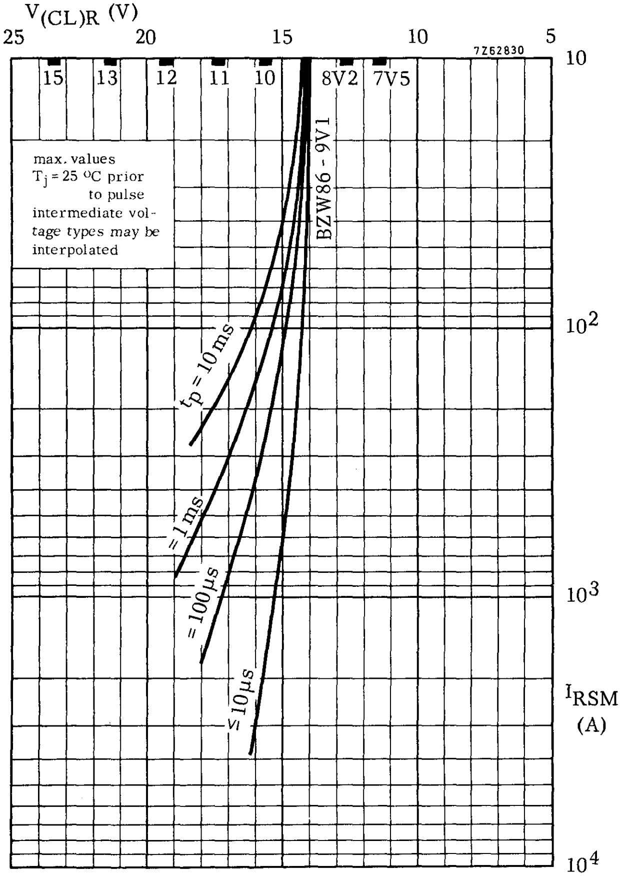
—— square current pulses

- - - exponential current pulses

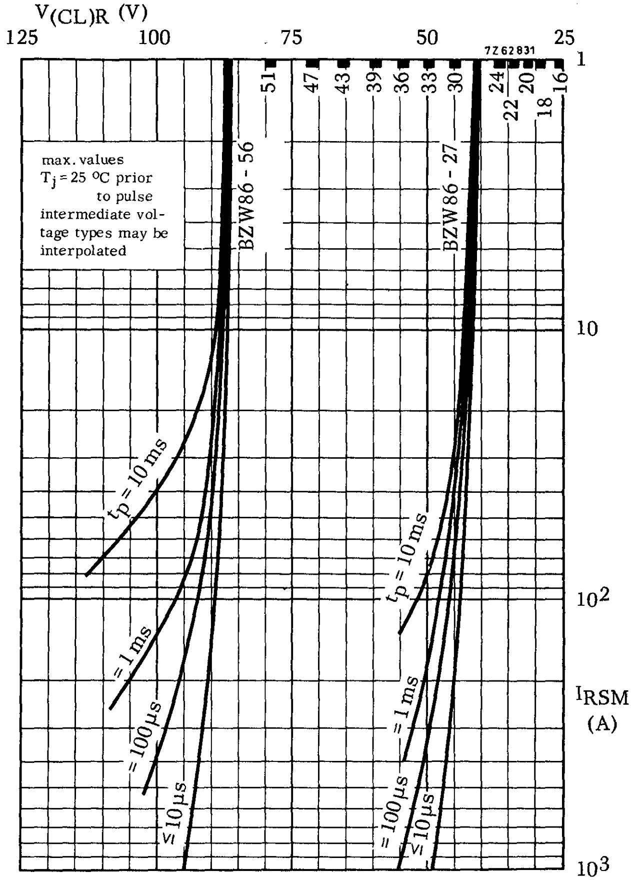

7Z62826
at V_R = stand-off voltage
I_R
(mA)
10
1
10^{-1}
max
typ
0
50
100
150
T_j (°C)
200



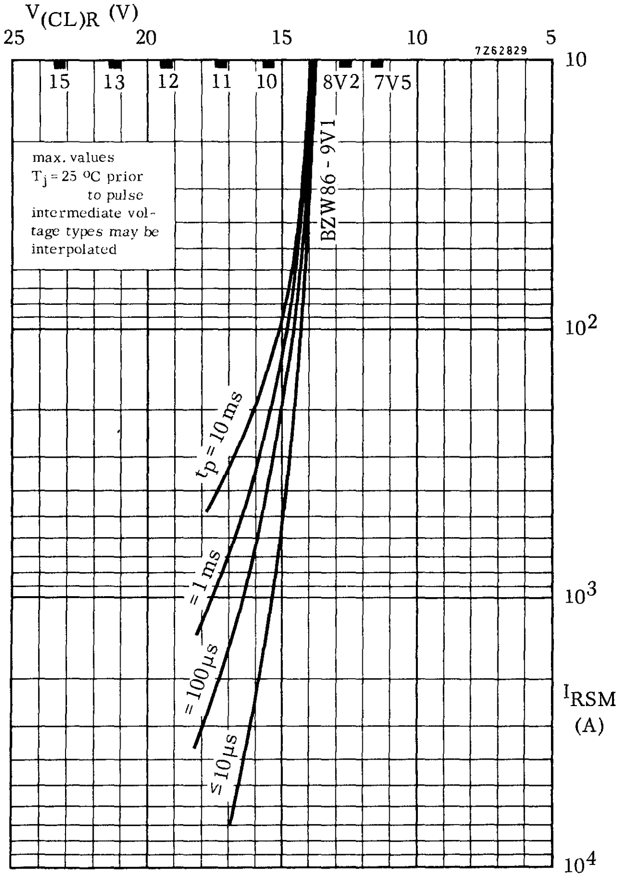
square pulses



square pulses



exponential pulses



exponential pulses

TRANSIENT SUPPRESSOR DIODES

A range of diffused silicon diodes in a DO-5 metal envelope intended for use in the protection of the electrical and electronic equipment against voltage transients.
The series consists of the following types:
Normal polarity (cathode to stuf): BZW91 - 6V2 to 62
Reverse polarity (anode to stud) : BZW91 - 6V2R to 62R

QUICK REFERENCE DATA

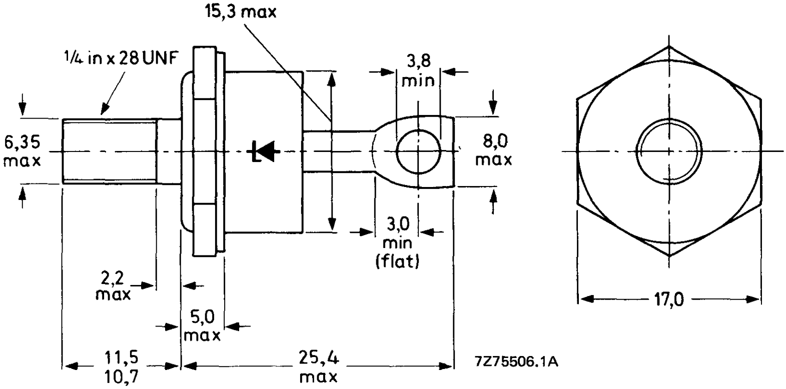
Stand-off voltage (15% range)*	V_R		6,2 to 62	V
Reverse breakdown voltage	$V_{(BR)R}$		7,0 to 70	V
Non-repetitive peak reverse power dissipation; T_j = 25 °C prior to surge; t_p = 100 µs (exponential pulse)	P_{RSM}	max.	27	kW

* The stand-off voltage is the maximum reverse voltage recommended for continuous operation; at this value non-conduction is ensured.

MECHANICAL DATA

Dimensions in mm

DO-5



Supplied with device: 1 nut, 1 lock washer
Nut dimensions across the flats: 11,1 mm
Diameter of clearance hole: max. 6,5 mm
Net mass: 16,5 kg
Accessories available: 56264A; 56309B; 56309R
The mark shown applies to the normal polarity types.

Torque on nut: min. 1,7 Nm. (17 kgcm)
max. 3,5 Nm (35 kgcm)

CHARACTERISTICS – WHEN USED AS TRANSIENT SUPPRESSOR DIODES; T_{mb} = 25 °C

clamping voltage t_p = 500 µs exp. pulse $V_{(CL)R}$ V		at non-repetitive peak reverse current I_{RSM} A	reverse current at recommended stand-off voltage I_R mA	V_R V	BZW91-...
typ.	max.		max.		
9.5	10.5	150	20	6.2	6V2(R)
10	11	150	20	6.8	6V8(R)
11	12.5	150	5	7.5	7V5(R)
12	13.5	150	5	8.2	8V2(R)
13	15	150	5	9.1	9V1(R)
14.5	17	150	5	10	10(R)
16	19	150	5	11	11(R)
17.5	22	150	5	12	12(R)
19	26	150	5	13	13(R)
22	28	100	5	15	15(R)
24	31	100	5	16	16(R)
26	34	100	5	18	18(R)
28	37	100	5	20	20(R)
31	40	100	5	22	22(R)
34	44	100	5	24	24(R)
38	48	100	5	27	27(R)
40	52	50	5	30	30(R)
44	56	50	10	33	33(R)
49	61	50	10	36	36(R)
54	66	50	10	39	39(R)
60	72	50	10	43	43(R)
66	79	50	10	47	47(R)
72	87	50	10	51	51(R)
79	97	50	10	56	56(R)
86	97	50	10	62	62(R)

REGULATOR DIODES

A range of diffused silicon diodes in plastic envelopes, intended for use as voltage regulator and transient suppressor diodes in medium power regulators and transient suppression circuits.

The series consists of the following types: BZX70-C7V5 to BZX70-C75.

QUICK REFERENCE DATA

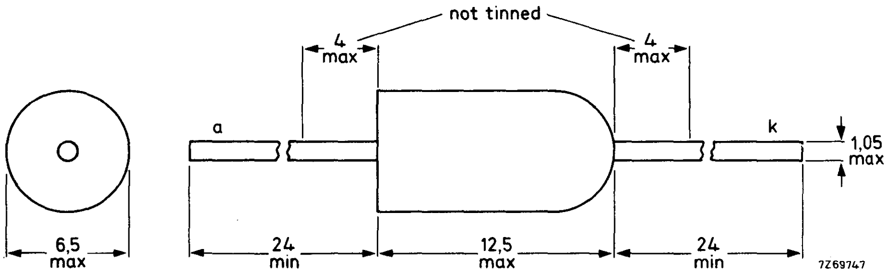
			voltage regulator	transient suppressor	
Working voltage (5% range)	V_Z	nom.	7,5 to 75	–	V
Stand-off voltage	V_R		–	5,6 to 56	V
Total power dissipation	P_{tot}	max.	2,5	–	W
Non-repetitive peak reverse power dissipation	P_{RSM}	max.	–	700	W

MECHANICAL DATA

Dimensions in mm

Fig. 1 SOD-18.

The rounded end indicates the cathode.



RATINGS

Limiting values in accordance with the Absolute Maximum System (IEC 134)

Peak working current	I_{ZM}	max.	5 A
Average forward current (averaged over any 20 ms period)	$I_{F(AV)}$	max.	1 A
Non-repetitive peak reverse current T_j = 25 °C prior to surge; t_p = 1 ms (exponential pulse); BZX70-C7V5 to BZX70-C75	I_{RSM}	max.	44 to 6 A
Total power dissipation at T_{amb} = 25 °C; with 10 mm tie-points; Fig. 5	P_{tot}	max.	2,5 W
Non-repetitive peak reverse power dissipation T_j = 25 °C prior to surge; t_p = 1 ms (exponential pulse)	P_{RSM}	max.	700 W
Storage temperature	T_{stg}		−55 to + 150 °C
Junction temperature	T_j	max.	150 °C

THERMAL RESISTANCE

From junction to ambient in free air — see Figs 4 and 5

CHARACTERISTICS

Forward voltage I_F = 1 A; T_{amb} = 25 °C	V_F	<	1,5 V

OPERATION AS A VOLTAGE REGULATOR (see page 4)

Dissipation and heatsink considerations

a. Steady-state conditions

The maximum permissible steady-state dissipation $P_{s\,max}$ is given by the relationship

$$P_{s\,max} = \frac{T_{j\,max} - T_{amb}}{R_{th\,j\text{-}a}}$$

where: $T_{j\,max}$ is the maximum permissible operating junction temperature
T_{amb} is the ambient temperature
$R_{th\,j\text{-}a}$ is the total thermal resistance from junction to ambient

b. Pulse conditions (see Fig. 2)

The maximum permissible pulse power $P_{p\,max}$ is given by the formula

$$P_{p\,max} = \frac{(T_{j\,max} - T_{amb}) - (P_s \cdot R_{th\,j\text{-}a})}{R_{th\,t}}$$

where: P_s is any steady-state dissipation excluding that in pulses
$R_{th\,t}$ is the effective transient thermal resistance of the device between junction and ambient. It is a function of the pulse duration t_p and duty factor δ.
δ is the duty factor (t_p/T)

The steady-state power P_s when biased in the zener direction at a given zener current can be found from Fig. 3. With the additional pulse power dissipation $P_{p\,max}$ calculated from the above expression, the total peak zener power dissipation $P_{tot} = P_{ZRM} = P_s + P_p$. From Fig. 3 the corresponding maximum repetitive peak zener current at P_{tot} can now be read. This repetitive peak zener current is subject to the absolute maximum rating. For pulse durations longer than the temperature stabilization time of the diode t_{stab}, the maximum permissible repetitive peak dissipation P_{ZRM} is equal to the steady-state power P_s. The temperature stabilization time for the BZX70 is 100 seconds (see Figs 17 and 18).

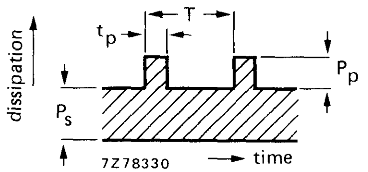


Fig. 2.

NOTES WHEN OPERATING AS A TRANSIENT SUPPRESSOR (see page 5)

1. Recommended stand-off voltage is defined as being the maximum reverse voltage to be applied without causing conduction in the avalanche mode or significant reverse dissipation.
2. Maximum clamping voltage is the maximum reverse avalanche breakdown voltage which will appear across the diode at the specified pulse duration and junction temperature. For square pulses see Figs 19 and 20, for exponential pulses see Figs 21 and 22.
3. Duration of an exponential pulse is defined as the time taken for the pulse to fall to 37% of its initial value. It is assumed that energy content does not continue beyond twice this time.

CHARACTERISTICS – WHEN USED AS VOLTAGE REGULATOR DIODES; T_{amb} = 25 °C

BZX70-. . .	working voltage *V_Z V		differential resistance *r_Z Ω		temperature coefficient *S_Z mV/°C	test I_Z A	reverse current I_R µA	at reverse voltage V_R V
	min.	max.	typ.	max.	typ.		max.	
C7V5	7.0	7.9	0.45	3.5	3.0	50	50	2.0
C8V2	7.7	8.7	0.45	3.5	4.0	50	20	5.6
C9V1	8.5	9.6	0.55	4.0	5.5	50	10	6.2
C10	9.4	10.6	0.75	4.0	7.0	50	10	6.8
C11	10.4	11.6	0.8	4.5	7.5	50	10	7.5
C12	11.4	12.7	0.85	5.0	8.0	50	10	8.2
C13	12.4	14.1	0.9	6.0	8.5	50	10	9.1
C15	13.8	15.6	1.0	8.0	10	50	10	10
C16	15.3	17.1	2.4	9.0	11	20	10	11
C18	16.8	19.1	2.5	11	12	20	10	12
C20	18.8	21.2	2.8	12	14	20	10	13
C22	20.8	23.3	3.0	13	16	20	10	15
C24	22.7	25.9	3.4	14	18	20	10	16
C27	25.1	28.9	3.8	18	20	20	10	18
C30	28	32	4.5	22	25	20	10	20
C33	31	35	5.0	25	30	20	10	22
C36	34	38	5.5	30	32	20	10	24
C39	37	41	12	35	35	10	10	27
C43	40	46	13	40	40	10	10	30
C47	44	50	14	50	45	10	10	33
C51	48	54	15	55	50	10	10	36
C56	52	60	17	63	55	10	10	39
C62	58	66	18	75	60	10	10	43
C68	64	72	18	90	65	10	10	47
C75	70	79	20	100	70	10	10	51

*At test I_Z; measured using a pulse method with $t_p \leqslant 100$ µs and $\delta \leqslant 0.001$ so that the values correspond to a T_j of approximately 25 °C.

CHARACTERISTICS – WHEN USED AS TRANSIENT SUPPRESSOR DIODES; T_{amb} = 25 °C

clamping voltage at t_p = 500 μs exp. pulse $V_{(CL)R}$ V		non-repetitive peak reverse current I_{RSM} A	reverse current at recommended stand-off voltage I_R mA	V_R V	BZX70-. . .
typ.	max.		max.		
9	10	20	0.5	5.6	C7V5
10	11.2	20	0.5	6.2	C8V2
11	12.5	20	0.5	6.8	C9V1
12	14	20	0.1	7.5	C10
13.5	15.5	20	0.1	8.2	C11
15	17.5	20	0.1	9.1	C12
17	19	20	0.1	10	C13
19	21	20	0.1	11	C15
21	23	20	0.1	12	C16
23	26	20	0.1	13	C18
22	26	10	0.1	15	C20
25	29	10	0.1	16	C22
28	33	10	0.1	18	C24
32	38	10	0.1	20	C27
36	43	10	0.1	22	C30
41	48	10	0.1	24	C33
47	54	10	0.1	27	C36
44	52	5	0.1	30	C39
49	58	5	0.1	33	C43
56	65	5	0.1	36	C47
63	72	5	0.1	39	C51
71	82	5	0.1	43	C56
80	93	5	0.1	47	C62
89	104	5	0.1	51	C68
98	116	5	0.1	56	C75

SOLDERING AND MOUNTING INSTRUCTIONS

1. When using a soldering iron, diodes may be soldered directly into the circuit, but heat conducted to the junction should be kept to a minimum.
2. Diodes may be dip-soldered at a solder temperature of 245 °C for a maximum soldering time of 5 seconds. The case temperature during dip-soldering must not at any time exceed the maximum storage temperature. These recommendations apply to a diode with the anode end mounted flush on a printed-circuit board having punched-through holes. For mounting the anode end onto a printed-circuit board, the diode must be spaced at least 5 mm from the underside of the printed-circuit board having punched-through holes, or 5 mm from the top of the printed circuit board having plated-through holes.
3. Care should be taken not to bend the leads nearer than 1,5 mm from the seal; exert no axial pull when bending.

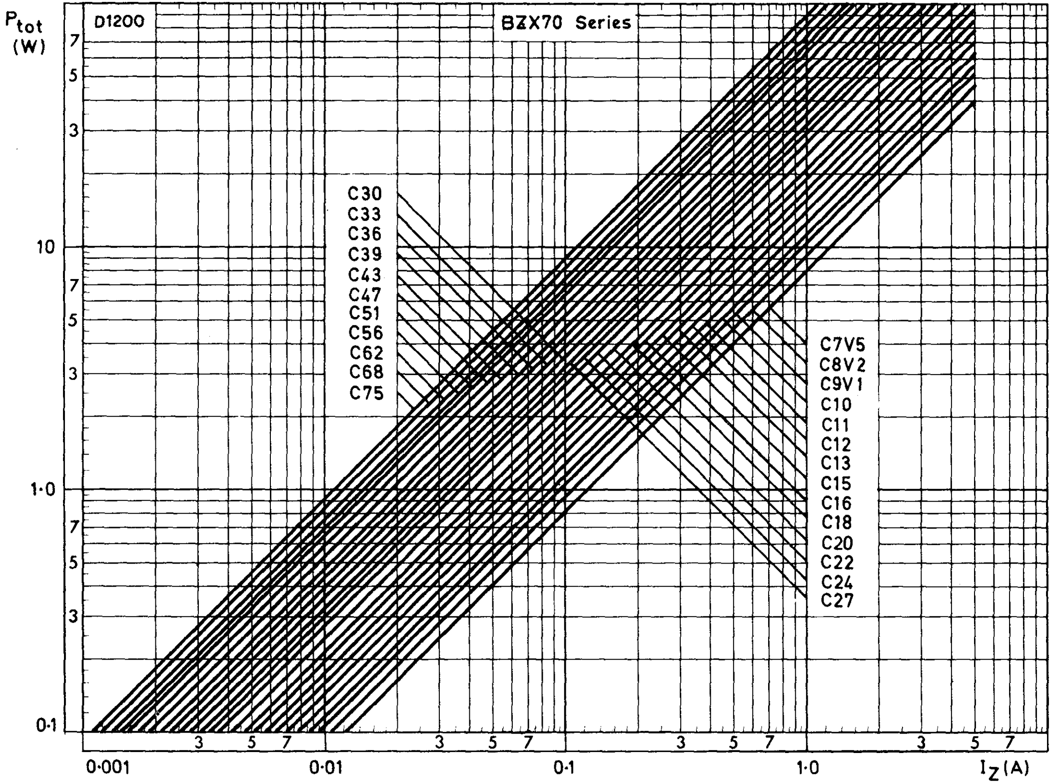


Fig. 3 Maximum permissible repetitive peak dissipation ($P_{tot} = P_{ZRM}$).

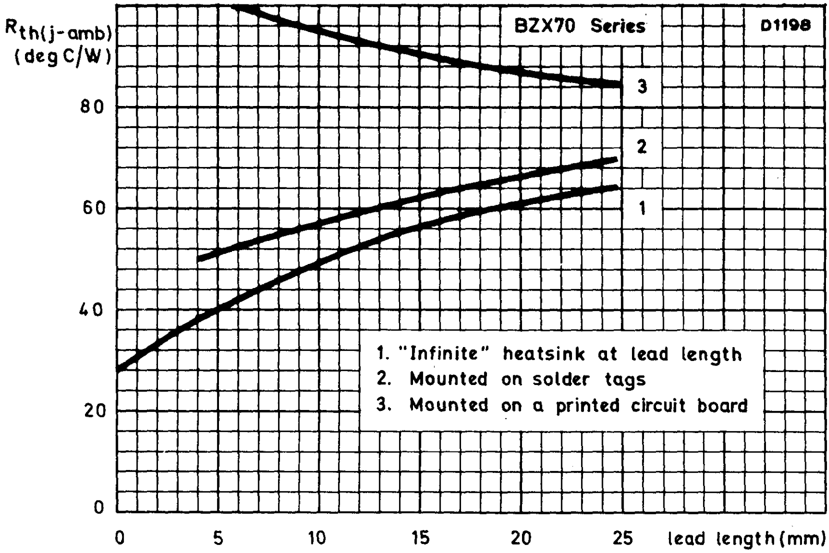


Fig. 4 Thermal resistance as a function of lead length under various mounting conditions.

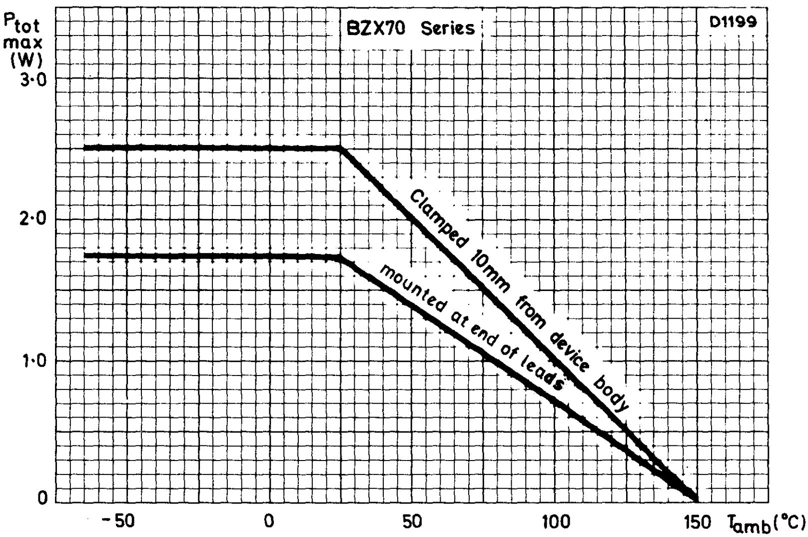


Fig. 5 Maximum permissible power dissipation; the top curve is for mounting method 1 from Fig. 4 at 10 mm lead length.

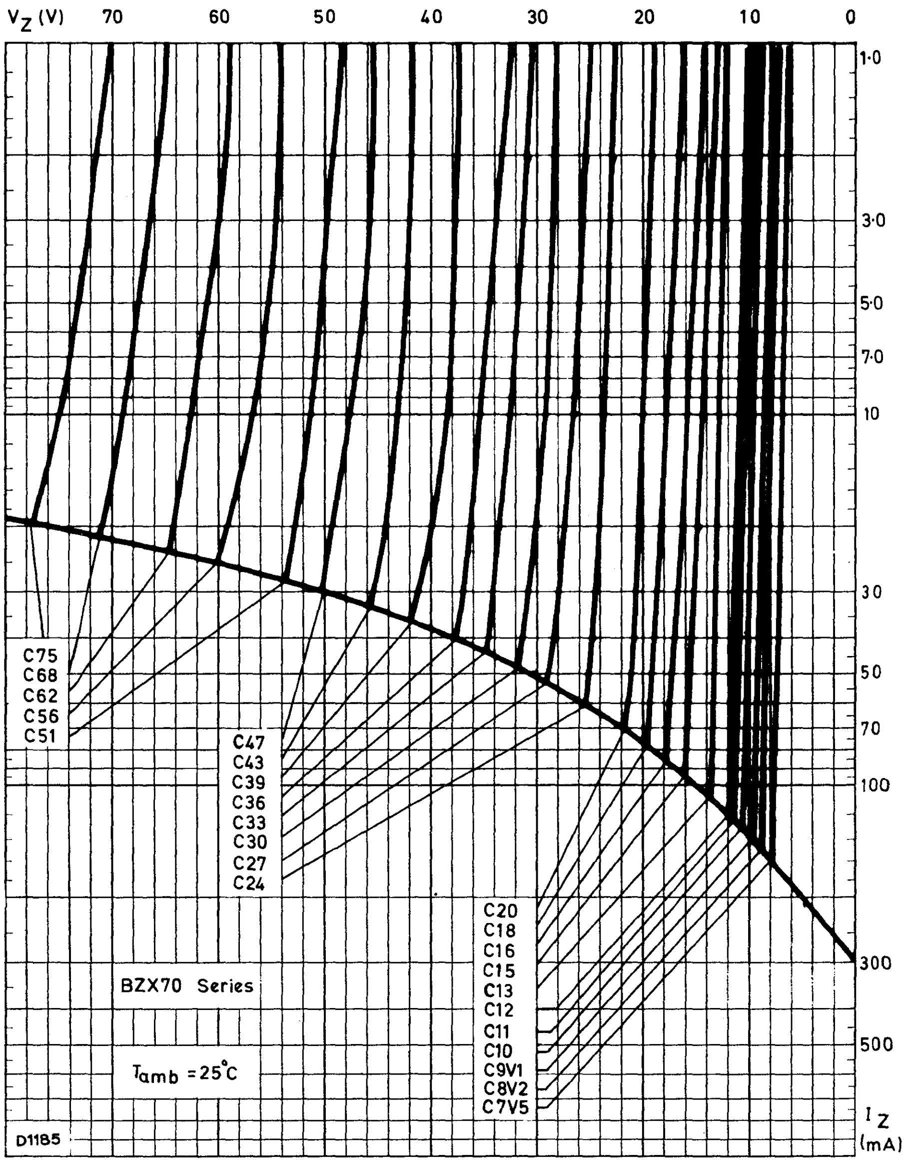


Fig. 6 Typical static zener characteristics.

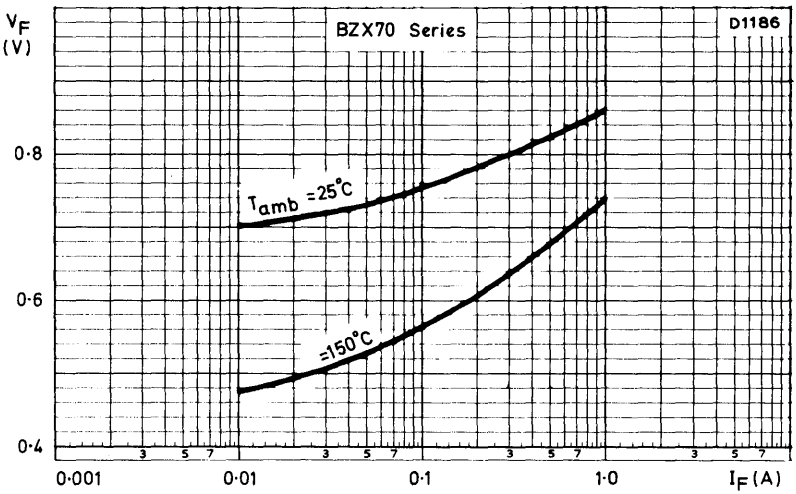


Fig. 7.

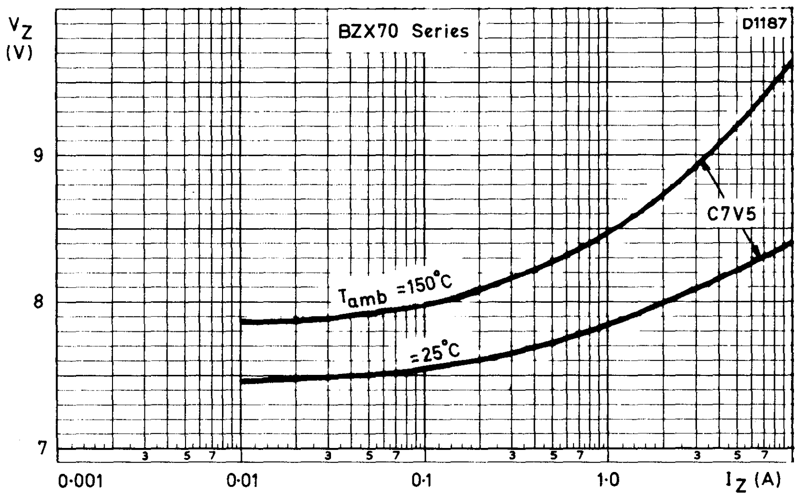


Fig. 8 Typical dynamic zener characteristics for BZX70-C7V5.

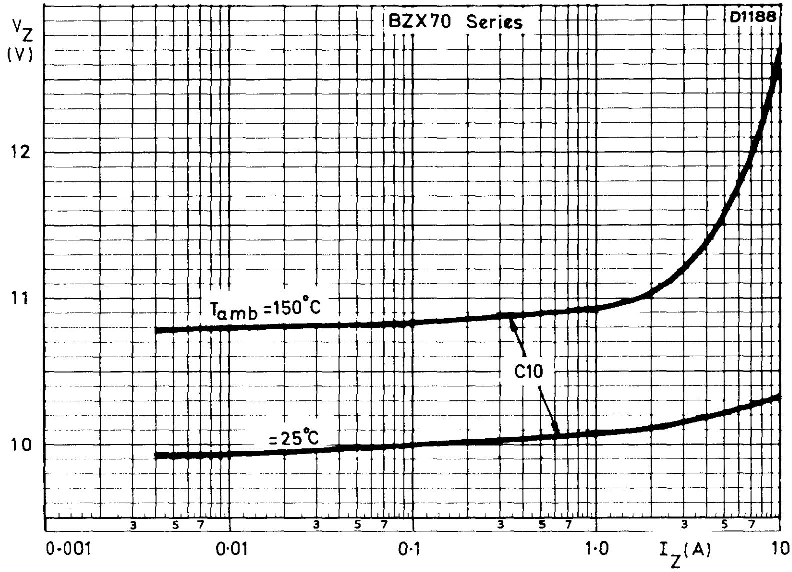


Fig. 9 Typical dynamic zener characteristics for BZX70-C10.

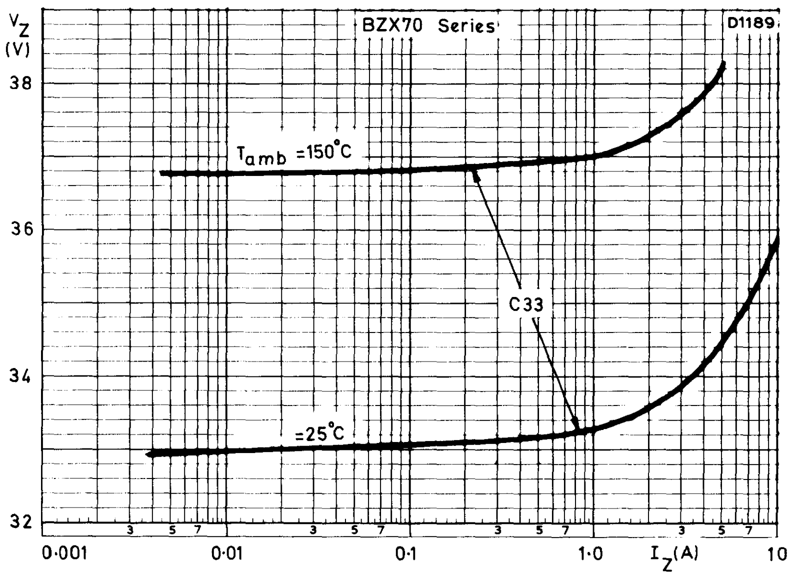


Fig. 10 Typical dynamic zener characteristics for BZX70-C33.

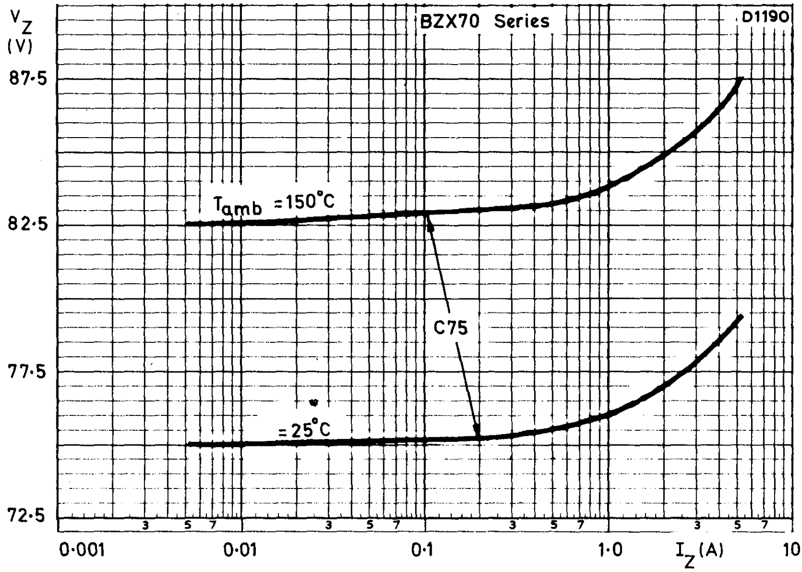


Fig. 11 Typical dynamic zener characteristics for BZX70-C75.

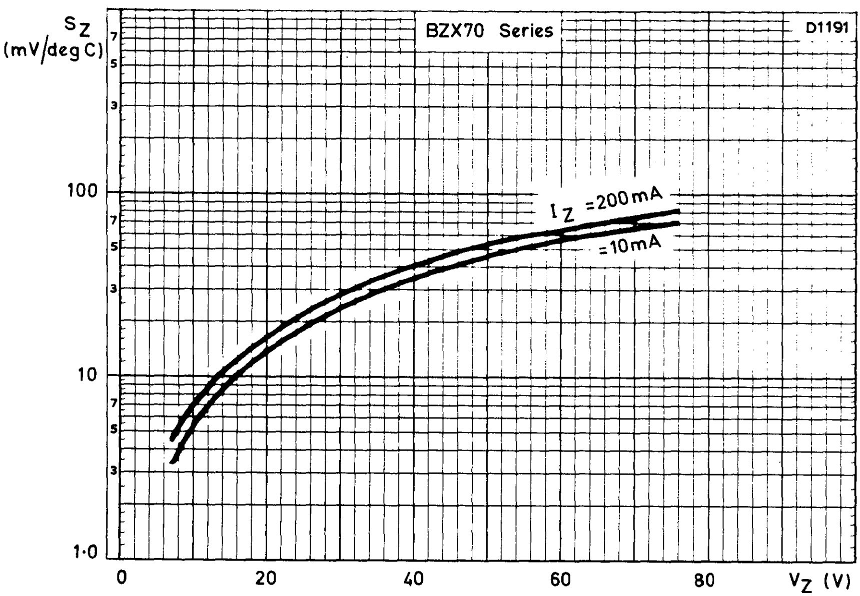


Fig. 12.

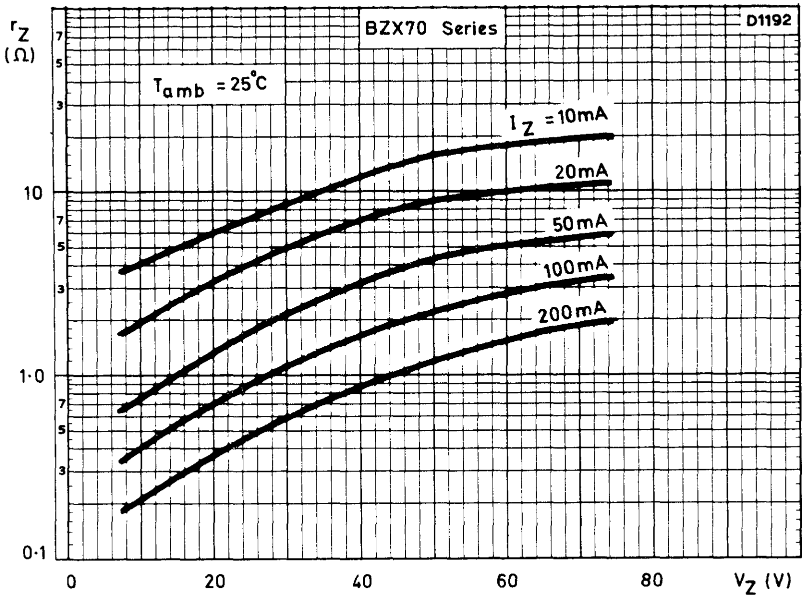

BZX70 Series
D1192
r_Z (Ω)
T_{amb} = 25°C
I_Z = 10mA
20mA
50mA
100mA
200mA
10
1·0
0·1
0
20
40
60
80
V_Z (V)

Fig. 13.

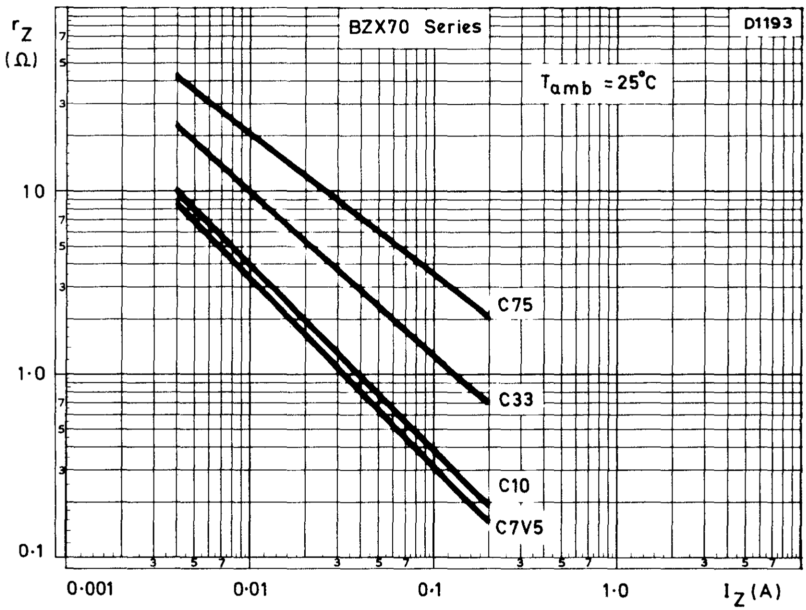

BZX70 Series
D1193
r_Z (Ω)
T_{amb} = 25°C
C75
C33
C10
C7V5
10
1·0
0·1
0·001
0·01
0·1
1·0
I_Z (A)

Fig. 14.

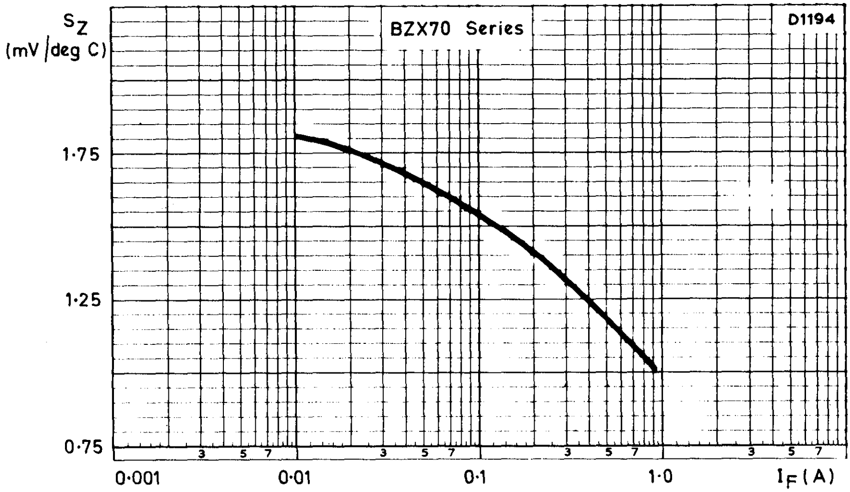


Fig. 15 Typical values.

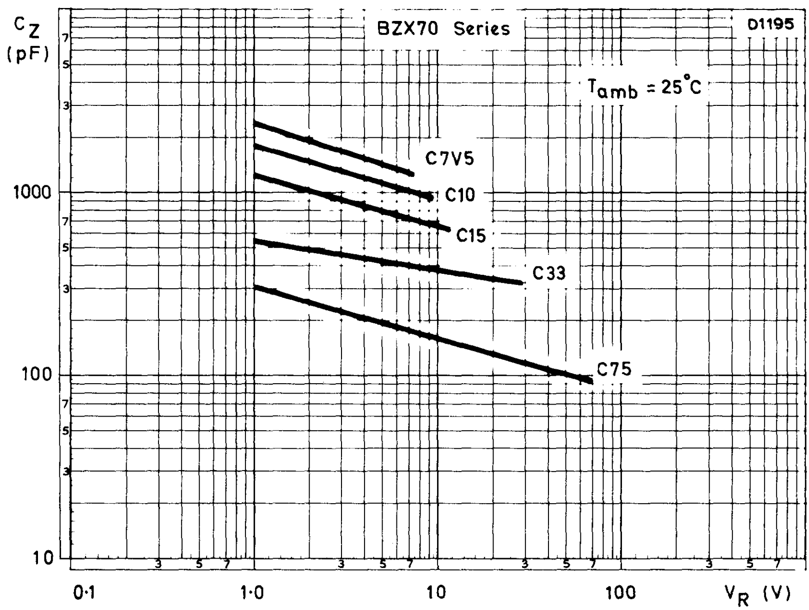


Fig. 16 Typical values.

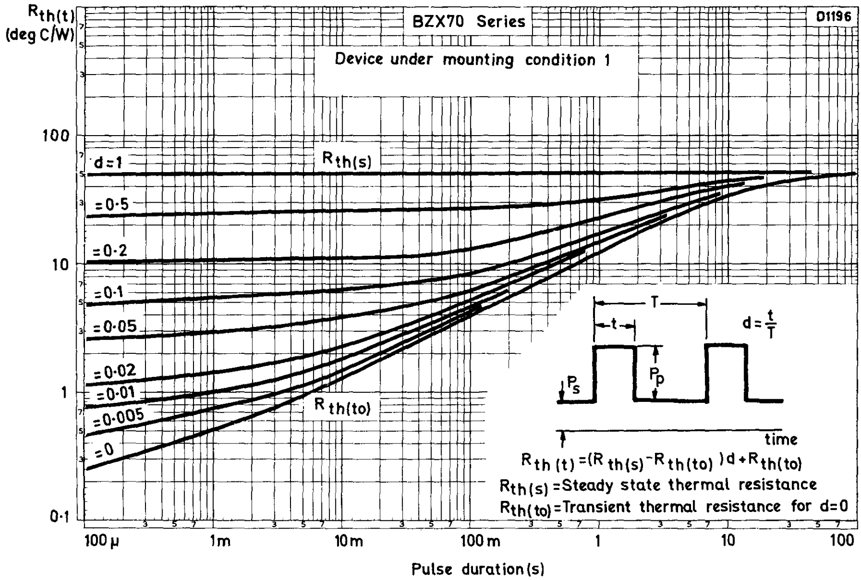


Fig. 17 Device under mounting condition 1 (infinite heatsink); see Fig. 4.

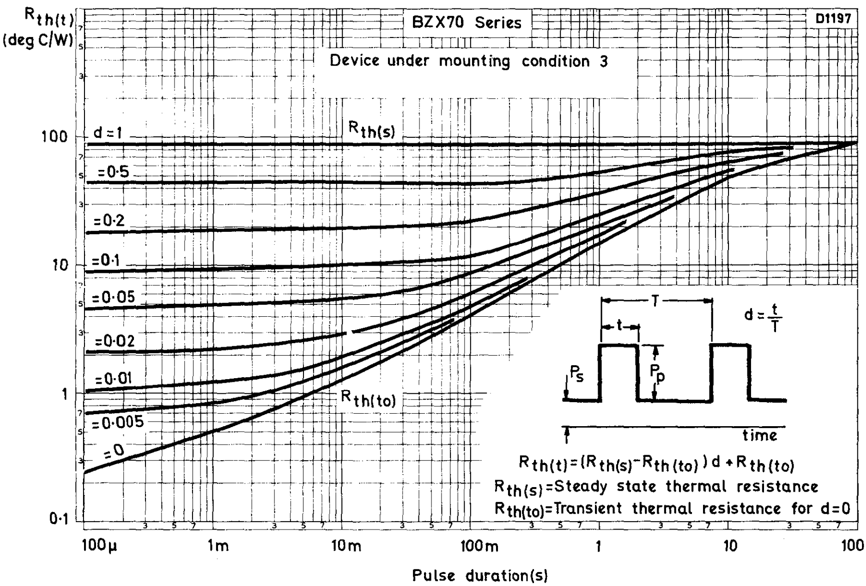


Fig. 18 Device under mounting method 3 (mounted on a printed-circuit board); see Fig. 4.

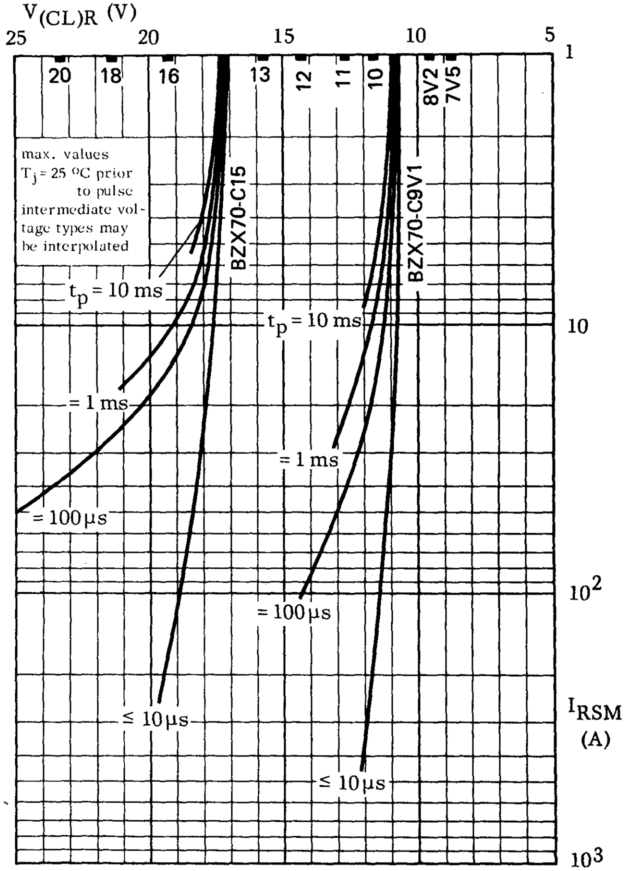


Fig. 19 Square pulses.

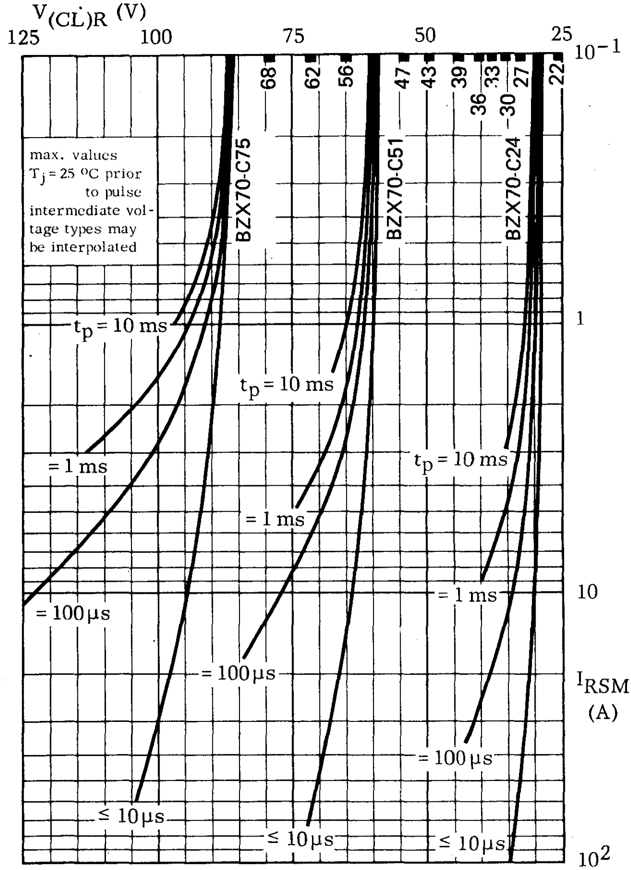


Fig. 20 Square pulses.

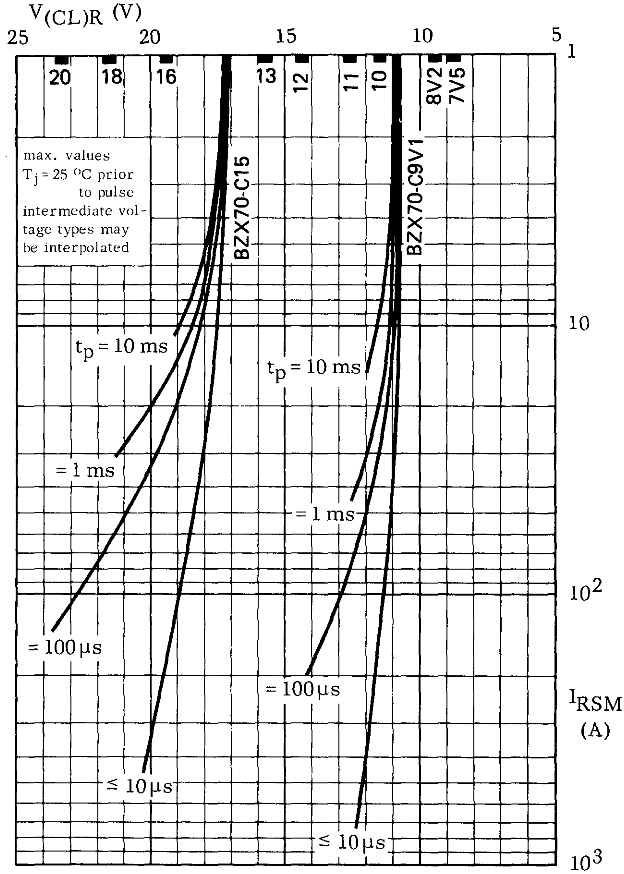


Fig. 21 Exponential pulses.

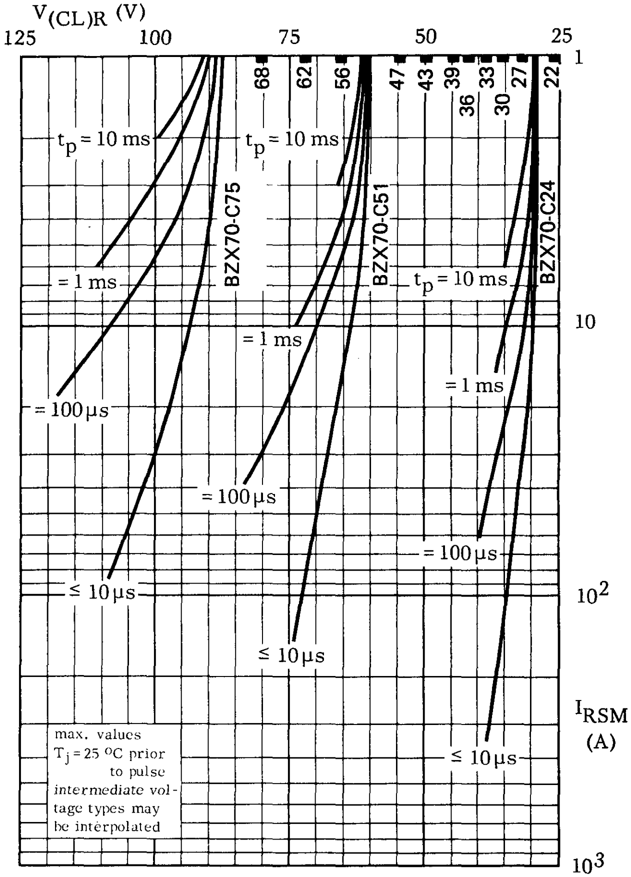


Fig. 22 Exponential pulses.

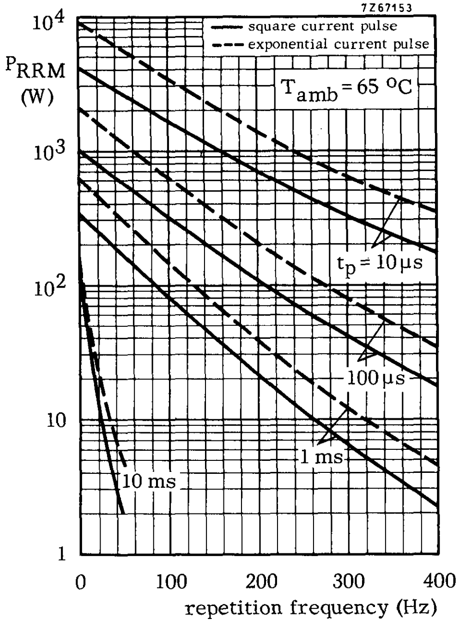


Fig. 23.

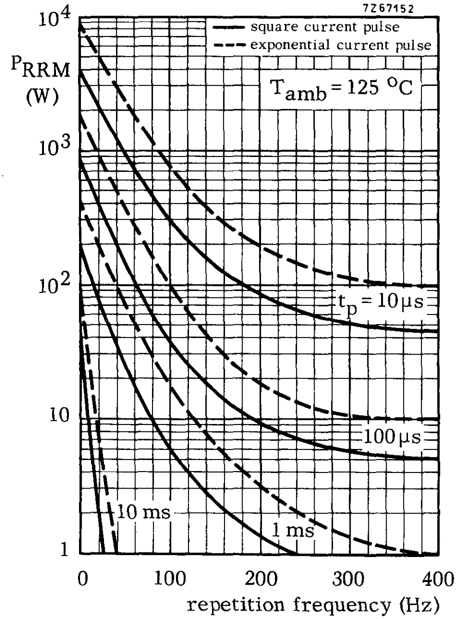


Fig. 24.

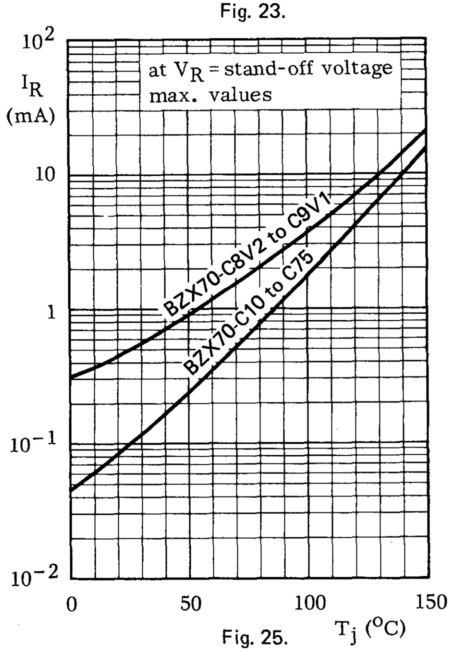


Fig. 25.

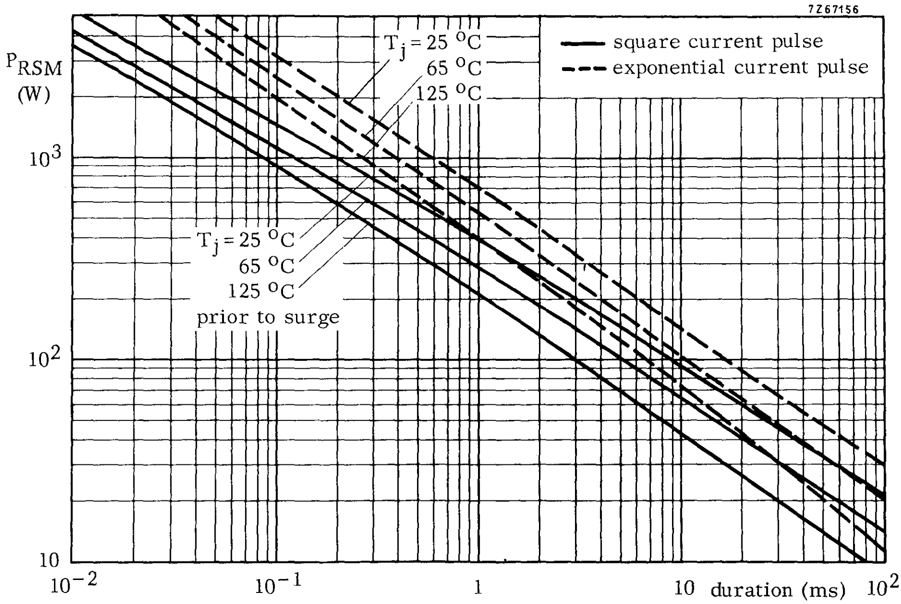

7Z67156
P_{RSM}
(W)
10^3
10^2
10
$T_j = 25\ ^oC$
65 °C
125 °C
square current pulse
exponential current pulse
$T_j = 25\ ^oC$
65 °C
125 °C
prior to surge
10^{-2}
10^{-1}
1
10
duration (ms)
10^2

Fig. 26.

REGULATOR DIODES

Also available to BS9305–F052

A range of diffused silicon diodes in DO-5 metal envelopes, intended for use as voltage regulator and transient suppressor diodes in power stabilization and transient suppression circuits.

The series consists of the following types:
Normal polarity (cathode to stud): BZY91-C7V5 to BZY91-C75.
Reverse polarity (anode to stud): BZY91-C7V5R to BZY91-C75R.

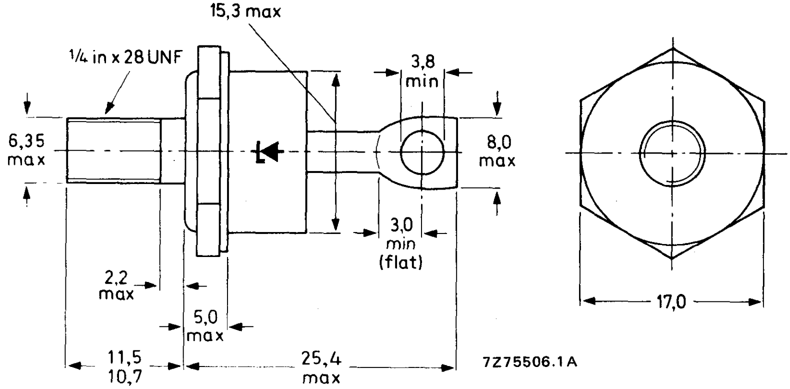
QUICK REFERENCE DATA

			voltage regulator	transient suppressor	
Working voltage (5% range)	V_Z	nom.	7,5 to 75	–	V
Stand-off voltage	V_R		–	5,6 to 56	V
Total power dissipation	P_{tot}	max.	100	–	W
Non-repetitive peak reverse power dissipation	P_{RSM}	max.	–	9,5	kW

MECHANICAL DATA

Dimensions in mm

Fig. 1 DO-5.



Net mass: 22 g

Diameter of clearance hole: max. 6,5 mm

Accessories supplied on request: 56264A (mica washer, insulating ring, tag)

Supplied with device: 1 nut, 1 lock washer
Nut dimensions across the flats: 11,1 mm

Torque on nut: min. 1,7 Nm (17 kg cm)
max. 3,5 Nm (35 kg cm)

RATINGS

Limiting values in accordance with the Absolute Maximum System (IEC 134)

Peak working current	I_{ZM}	max.	400	A
Average forward current (averaged over any 20 ms period)	$I_{F(AV)}$	max.	20	A
Non-repetitive peak reverse current T_j = 25 °C prior to surge; t_p = 1 ms (exponential pulse); BZY91-C7V5(R) to BZY91-C75(R)	I_{RSM}	max.	1000 to 85	A
Total power dissipation up to T_{mb} = 25 °C	P_{tot}	max.	100	W
at T_{mb} = 65 °C	P_{tot}	max.	75	W
Non-repetitive peak reverse power dissipation T_j = 25 °C prior to surge; t_p = 1 ms (exponential pulse)	P_{RSM}	max.	9,5	kW
Storage temperature	T_{stg}		−55 to + 175	°C
Junction temperature	T_j	max.	175	°C

THERMAL RESISTANCE

From junction to mounting base	$R_{th\ j\text{-}mb}$	=	1,5	°C/W
From mounting base to heatsink	$R_{th\ mb\text{-}h}$	=	0,2	°C/W

CHARACTERISTICS

Forward voltage I_F = 10 A; T_{mb} = 25 °C	V_F	<	1,5	V

OPERATION AS A VOLTAGE REGULATOR (see page 4)

Dissipation and heatsink considerations

a. Steady-state conditions

The maximum permissible steady-state dissipation $P_{s\ max}$ is given by the relationship

$$P_{s\ max} = \frac{T_{j\ max} - T_{amb}}{R_{th\ j\text{-}a}}$$

where: $T_{j\ max}$ is the maximum permissible operating junction temperature
T_{amb} is the ambient temperature
$R_{th\ j\text{-}a}$ is the total thermal resistance from junction to ambient

$$R_{th\ j\text{-}a} = R_{th\ j\text{-}mb} + R_{th\ mb\text{-}h} + R_{th\ h\text{-}a}$$

$R_{th\ mb\text{-}h}$ is the thermal resistance from mounting base to heatsink, that is, 0,2 °C/W.
$R_{th\ h\text{-}a}$ is the thermal resistance of the heatsink.

b. Pulse conditions (see Fig. 2)

The heating effect of repetitive power pulses can be found from the curves in Figs 5 and 6 which are given for operation as a transient suppressor at 50 Hz and 400 Hz respectively. This value ΔT is in addition to the mean heating effect. The value of ΔT found from the curves for the particular operating condition should be added to the known value for ambient temperature used in calculating the required heatsink.
The value of the peak power for a given peak zener current is found from the curves in Figs 3 and 4.

The required heatsink is calculated as follows:

$$R_{th\ j\text{-}a} = \frac{T_{j\ max} - T_{amb} - \Delta T}{P_s + \delta \cdot P_p}$$

where: $T_{j\ max}$ = 175 °C
T_{amb} = ambient temperature
ΔT = from Fig. 5 or 6
P_s = any steady-state dissipation excluding that in pulses
P_p = peak pulse power
δ = duty factor (t_p/T)
$R_{th\ j\text{-}a} = R_{th\ j\text{-}mb} + R_{th\ mb\text{-}h} + R_{th\ h\text{-}a} = 1{,}5 + 0{,}2 + R_{th\ h\text{-}a}$ °C/W.

Thus $R_{th\ h\text{-}a}$ can be found.

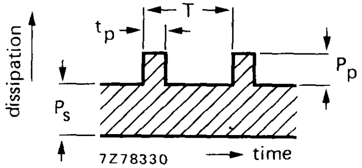


Fig. 2.

OPERATION AS A TRANSIENT SUPPRESSOR (see page 5)

Heatsink considerations

a. For non-repetitive transients, the device may be used without a heatsink for pulses up to 10 ms in duration.
b. For repetitive transients which fall within the permitted operating range shown in Figs 26 and 27 the required heatsink is found as follows:

$$R_{th\ j\text{-}mb} + R_{th\ mb\text{-}h} + R_{th\ h\text{-}a} = \frac{T_{j\ max} - T_{amb}}{P_s + \delta \cdot P_{RRM}}$$

where: $T_{j\ max}$ = 175 °C
T_{amb} = ambient temperature
P_s = any steady-state dissipation excluding that in pulses
δ = duty factor (t_p/T)
$R_{th\ j\text{-}mb}$ = 1,5 °C/W
$R_{th\ mb\text{-}h}$ = 0,2 °C/W

Thus $R_{th\ h\text{-}a}$ can be found.

Notes

1. The stand-off voltage is the maximum reverse voltage recommended for continuous operation; at this value non-conduction is ensured.
2. The maximum clamping voltage is the maximum reverse voltage which appears across the diode at the specified pulse duration and junction temperature. For square pulses see Figs 22 and 23, for exponential pulses see Figs 24 and 25.
3. Duration of an exponential pulse is defined as the time taken for the pulse to fall to 37% of its initial value. It is assumed that the energy content does not continue beyond twice this time.
4. Surge suppressor diodes are extremely fast in clamping, switching on in less than 5 ns.

CHARACTERISTICS – WHEN USED AS VOLTAGE REGULATOR DIODES; T_{mb} = 25 °C

BZY91-...	working voltage *V_Z V		differential resistance *r_Z Ω	temperature coefficient *S_Z %/°C	test I_Z A	reverse current I_R mA at	reverse voltage V_R V
	min.	max.	max.	typ.		max.	
C7V5(R)	7.0	7.9	0.2	0.09	5.0	5.0	2.0
C8V2(R)	7.7	8.7	0.3	0.09	5.0	5.0	5.6
C9V1(R)	8.5	9.6	0.4	0.07	2.0	5.0	6.2
C10(R)	9.4	10.6	0.4	0.07	2.0	1.0	6.8
C11(R)	10.4	11.6	0.4	0.07	2.0	1.0	7.5
C12(R)	11.4	12.7	0.5	0.07	2.0	1.0	8.2
C13(R)	12.4	14.1	0.5	0.07	2.0	1.0	9.1
C15(R)	13.8	15.6	0.6	0.075	2.0	1.0	10
C16(R)	15.3	17.1	0.6	0.075	2.0	1.0	11
C18(R)	16.8	19.1	0.7	0.075	2.0	1.0	12
C20(R)	18.8	21.2	0.8	0.075	1.0	1.0	13
C22(R)	20.8	23.3	0.8	0.075	1.0	1.0	15
C24(R)	22.7	25.9	0.9	0.08	1.0	1.0	16
C27(R)	25.1	28.9	1.0	0.082	1.0	1.0	18
C30(R)	28	32	1.1	0.085	1.0	1.0	20
C33(R)	31	35	1.2	0.088	1.0	1.0	22
C36(R)	34	38	1.3	0.09	1.0	1.0	24
C39(R)	37	41	1.4	0.09	0.5	1.0	27
C43(R)	40	46	1.5	0.092	0.5	1.0	30
C47(R)	44	50	1.7	0.093	0.5	1.0	33
C51(R)	48	54	1.8	0.093	0.5	1.0	36
C56(R)	52	60	2.0	0.094	0.5	1.0	39
C62(R)	58	66	2.2	0.094	0.5	1.0	43
C68(R)	64	72	2.4	0.094	0.5	1.0	47
C75(R)	70	79	2.6	0.095	0.5	1.0	51

*At test I_Z; measured using a pulse method with $t_p \leqslant 100$ μs and $\delta \leqslant 0.001$ so that the values correspond to a T_j of approximately 25 °C.

CHARACTERISTICS – WHEN USED AS TRANSIENT SUPPRESSOR DIODES; $T_{mb} = 25\ ^oC$

clamping voltage $t_p = 500\ \mu s$ exp. pulse $V_{(CL)R}$ V		at non-repetitive peak reverse current I_{RSM} A	reverse current at recommended stand-off voltage I_R mA	V_R V	BZY91-. . .
typ.	max.		max.		
–	–	–	–	–	C7V5(R)
9.5	10.5	150	20	6.2	C8V2(R)
10	11	150	20	6.8	C9V1(R)
11	12.5	150	5	7.5	C10(R)
12	13.5	150	5	8.2	C11(R)
13	15	150	5	9.1	C12(R)
14.5	17	150	5	10	C13(R)
16	19	150	5	11	C15(R)
17.5	22	150	5	12	C16(R)
19	26	150	5	13	C18(R)
22	28	100	5	15	C20(R)
24	31	100	5	16	C22(R)
26	34	100	5	18	C24(R)
28	37	100	5	20	C27(R)
31	40	100	5	22	C30(R)
34	44	100	5	24	C33(R)
38	48	100	5	27	C36(R)
40	52	50	5	30	C39(R)
44	56	50	10	33	C43(R)
49	61	50	10	36	C47(R)
54	66	50	10	39	C51(R)
60	72	50	10	43	C56(R)
66	79	50	10	47	C62(R)
72	87	50	10	51	C68(R)
79	97	50	10	56	C75(R)

MOUNTING INSTRUCTIONS

The top connector should neither be bent not twisted; it should be soldered into the circuit so that there is no strain on it.

During soldering the heat conduction to the junction should be kept to a minimum.

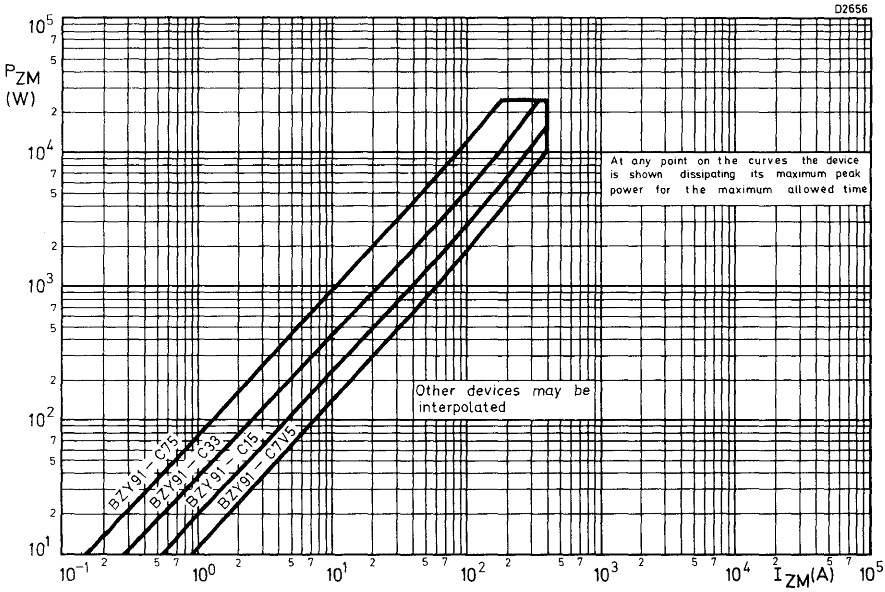

D2656
P_{ZM} (W)
I_{ZM}(A)
At any point on the curves the device is shown dissipating its maximum peak power for the maximum allowed time
Other devices may be interpolated
BZY91 – C75
BZY91 – C33
BZY91 – C15
BZY91 – C7V5

Fig. 3.

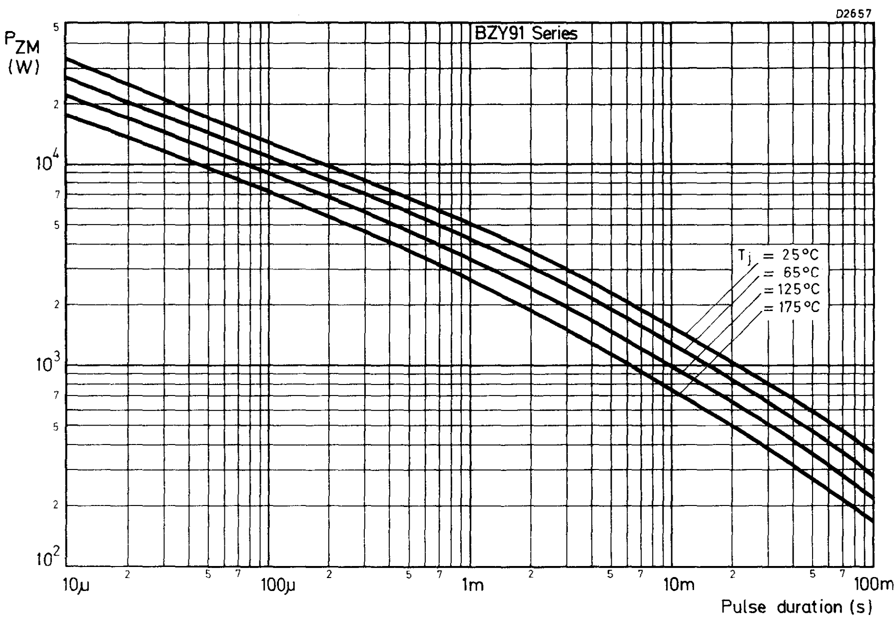

D2657
BZY91 Series
P_{ZM} (W)
T_j = 25 °C
= 65 °C
= 125 °C
= 175 °C
Pulse duration (s)

Fig. 4.

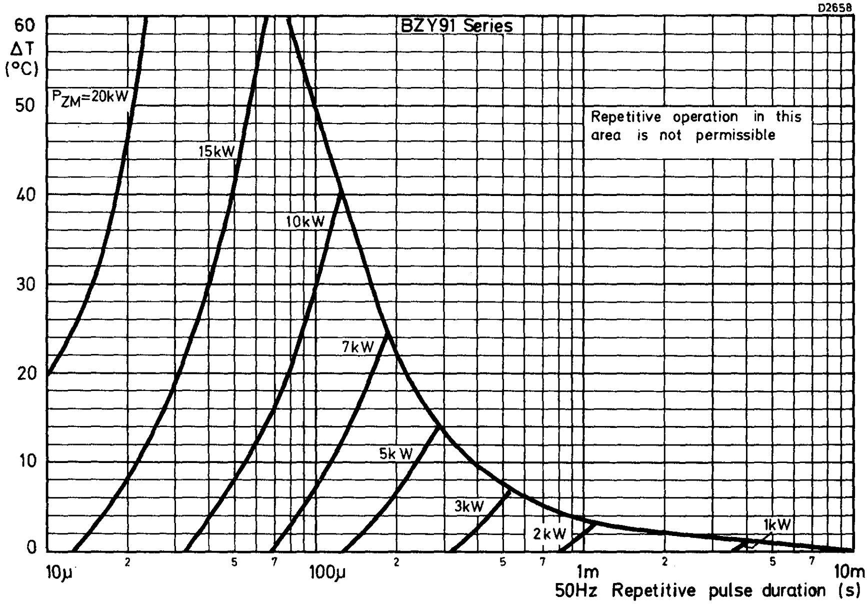

D2658
BZY91 Series
60
ΔT
(°C)
50
40
30
20
10
0
P_{ZM}=20kW
15kW
10kW
7kW
5kW
3kW
2kW
1kW
Repetitive operation in this area is not permissible
10μ
2
5
7
100μ
2
5
7
1m
2
5
7
10m
50Hz Repetitive pulse duration (s)

Fig. 5.

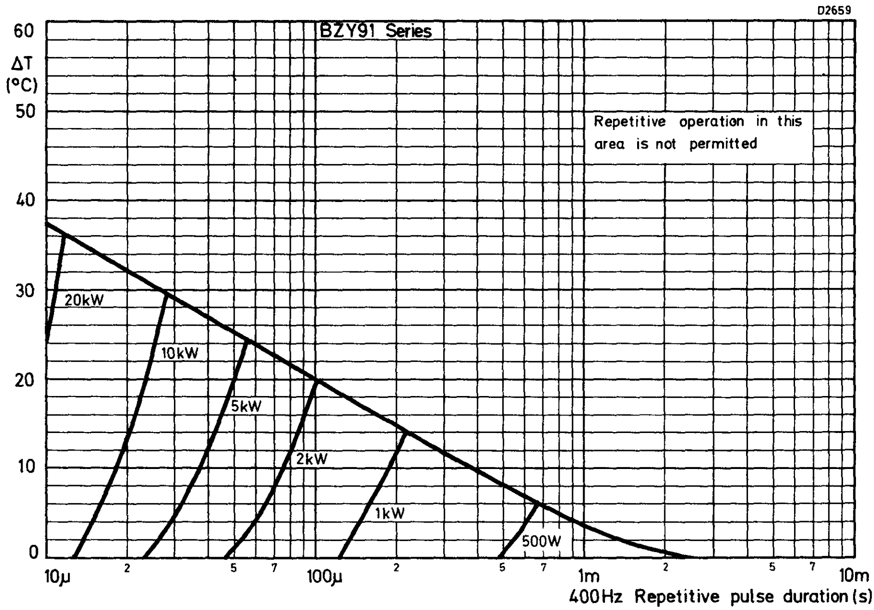

D2659
BZY91 Series
60
ΔT
(°C)
50
40
30
20
10
0
20kW
10kW
5kW
2kW
1kW
500W
Repetitive operation in this area is not permitted
10μ
2
5
7
100μ
2
5
7
1m
2
5
7
10m
400Hz Repetitive pulse duration (s)

Fig. 6.

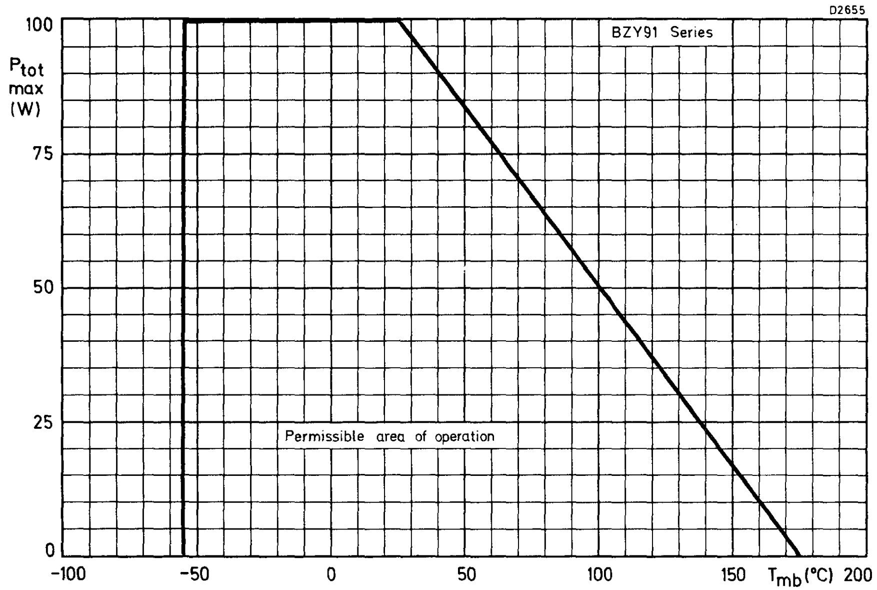


Fig. 7.

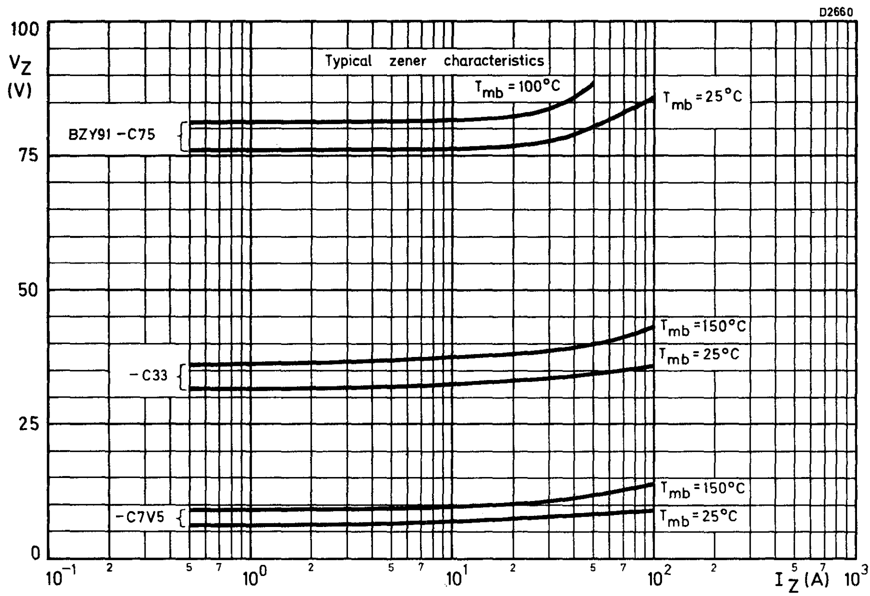


Fig. 8 Typical dynamic zener characteristics.

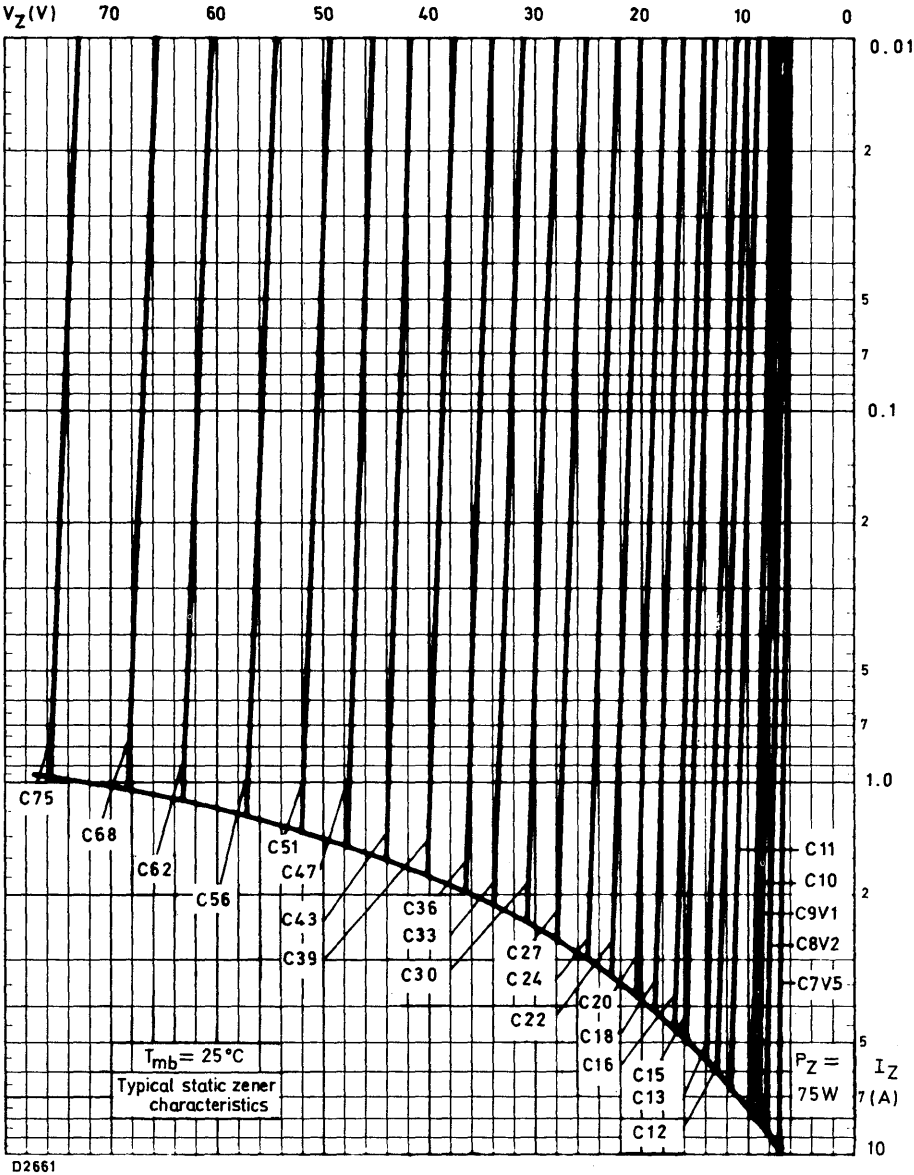


Fig. 9 Typical static zener characteristics.

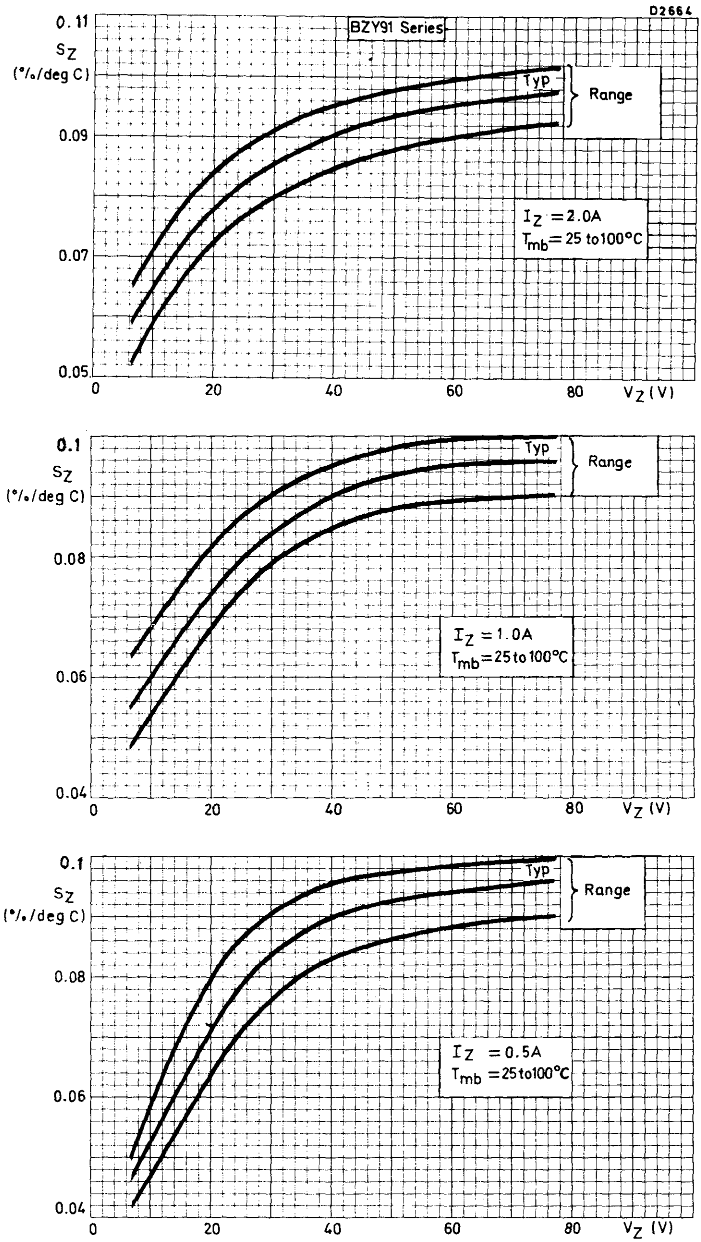

D2664
BZY91 Series
0.11
S_Z
(%/deg C)
0.09
0.07
0.05
0
20
40
60
80
V_Z (V)
Typ
Range
I_Z = 2.0A
T_{mb} = 25 to 100°C
0.1
S_Z
(%/deg C)
0.08
0.06
0.04
0
20
40
60
80
V_Z (V)
Typ
Range
I_Z = 1.0A
T_{mb} = 25 to 100°C
0.1
S_Z
(%/deg C)
0.08
0.06
0.04
0
20
40
60
80
V_Z (V)
Typ
Range
I_Z = 0.5A
T_{mb} = 25 to 100°C

Fig. 10.

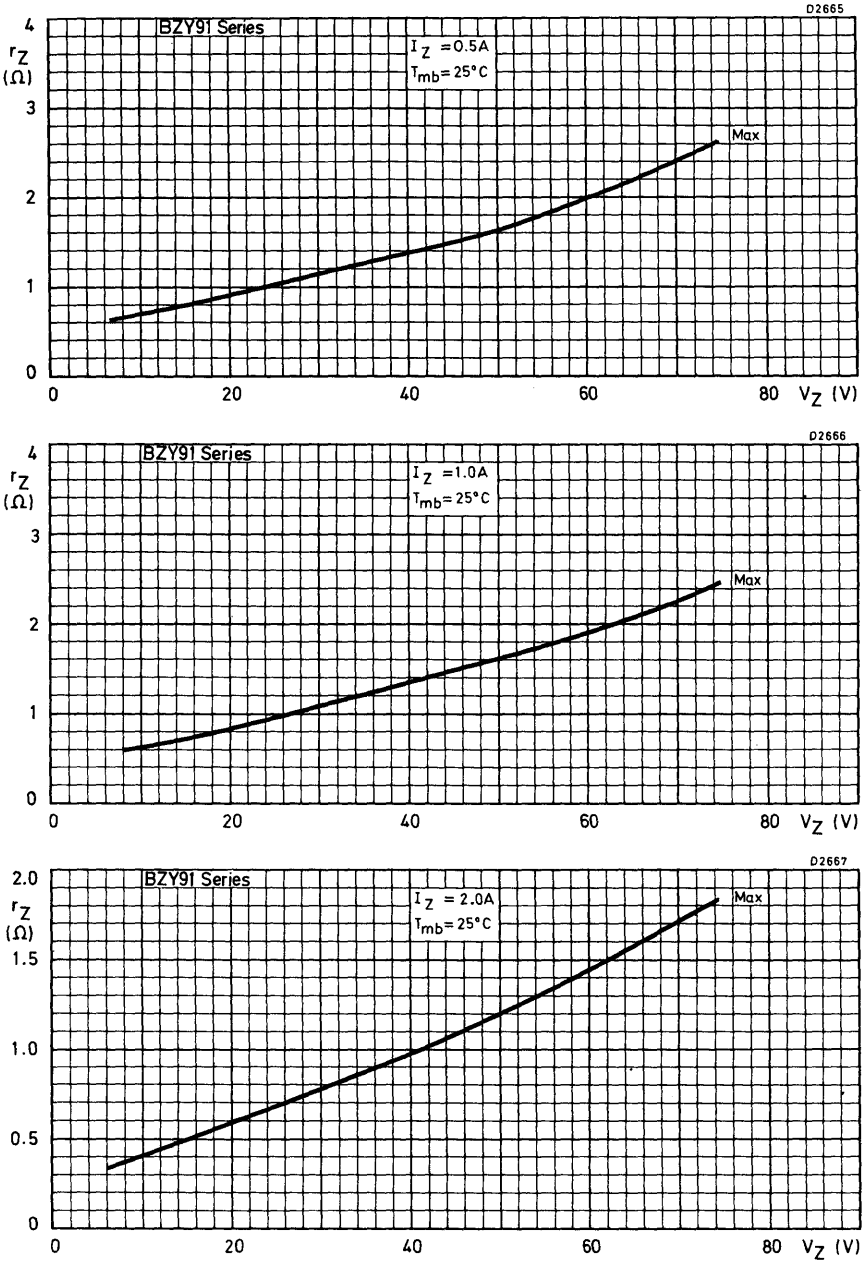

D2665
BZY91 Series
I_Z = 0.5A
T_{mb} = 25°C
Max
r_Z (Ω)
4
3
2
1
0
0
20
40
60
80
V_Z (V)
D2666
BZY91 Series
I_Z = 1.0A
T_{mb} = 25°C
Max
r_Z (Ω)
4
3
2
1
0
0
20
40
60
80
V_Z (V)
D2667
BZY91 Series
I_Z = 2.0A
T_{mb} = 25°C
Max
r_Z (Ω)
2.0
1.5
1.0
0.5
0
0
20
40
60
80
V_Z (V)

Fig. 11.

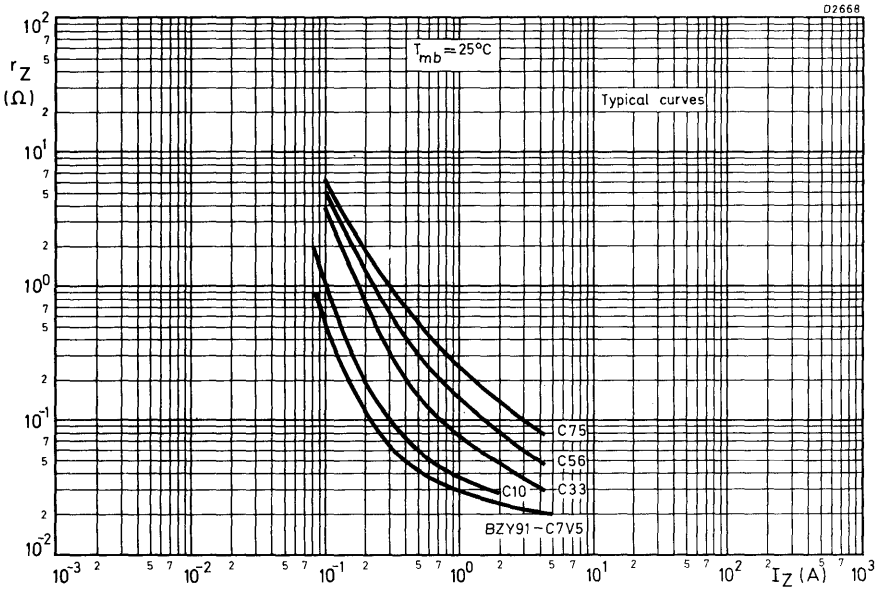

D2668
r_Z (Ω)
T_{mb} = 25°C
Typical curves
C75
C56
C33
C10
BZY91 – C7V5
I_Z (A)

Fig. 12.

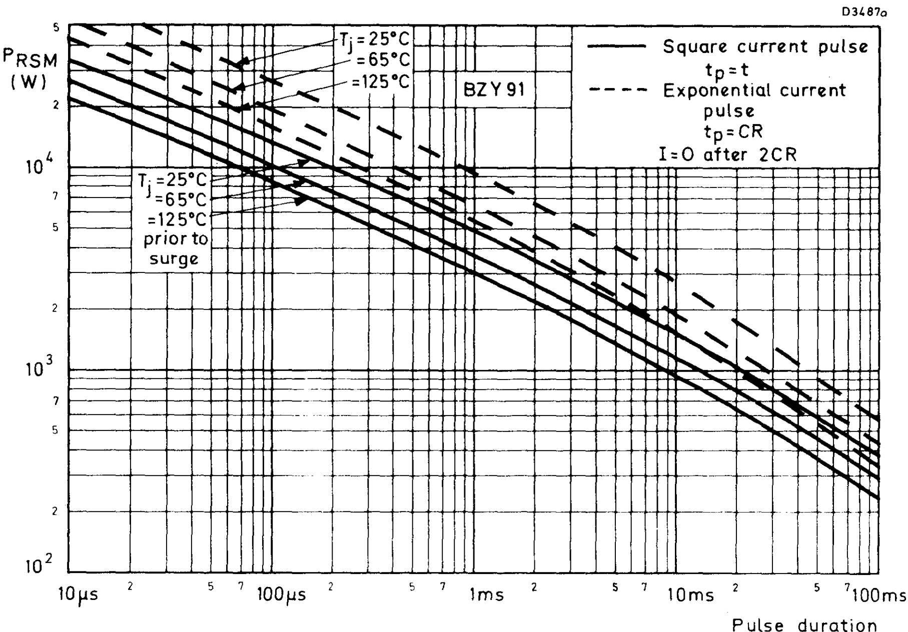

D3487a
P_{RSM} (W)
T_j = 25°C
= 65°C
= 125°C
BZY91
Square current pulse
t_p = t
Exponential current pulse
t_p = CR
I = 0 after 2CR
T_j = 25°C
= 65°C
= 125°C
prior to surge
Pulse duration

Fig. 13.

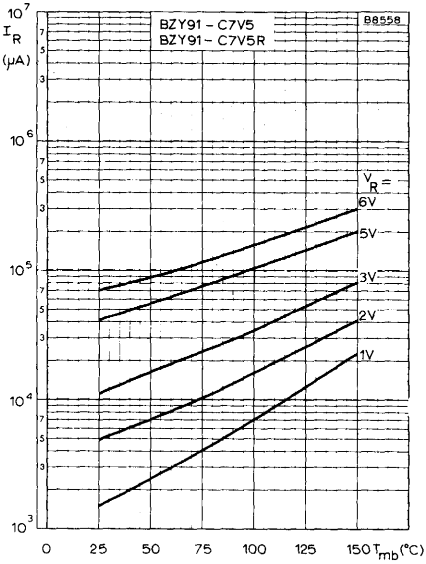


Fig. 14.

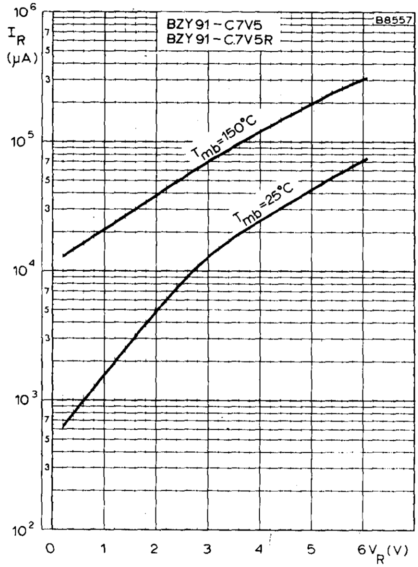


Fig. 15.

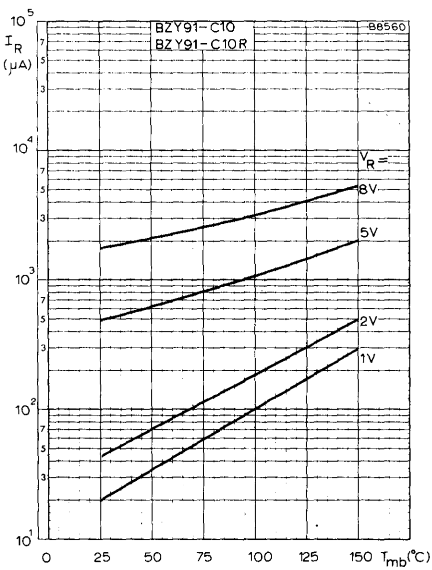


Fig. 16.

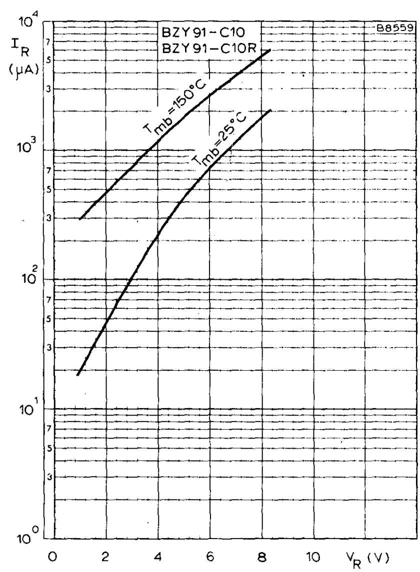


Fig. 17.

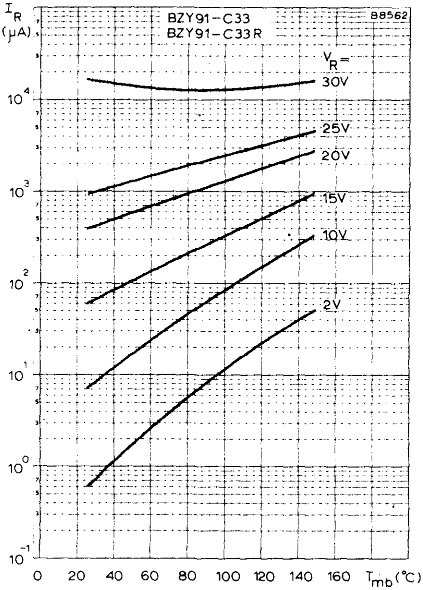


Fig. 18.

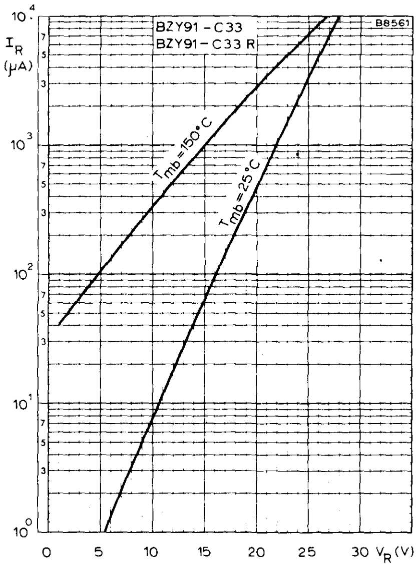


Fig. 19.

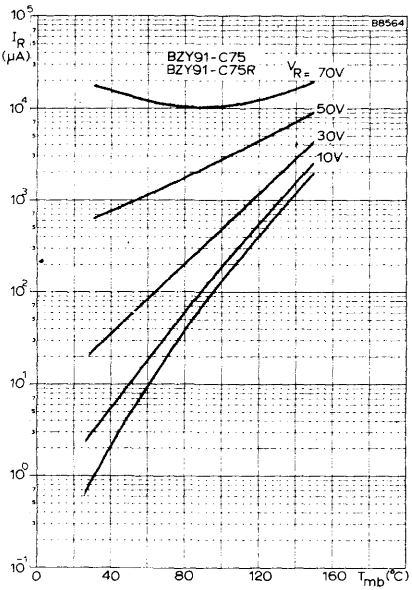


Fig. 20.

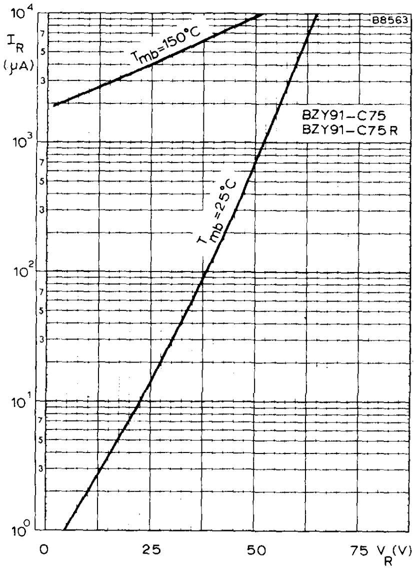


Fig. 21.

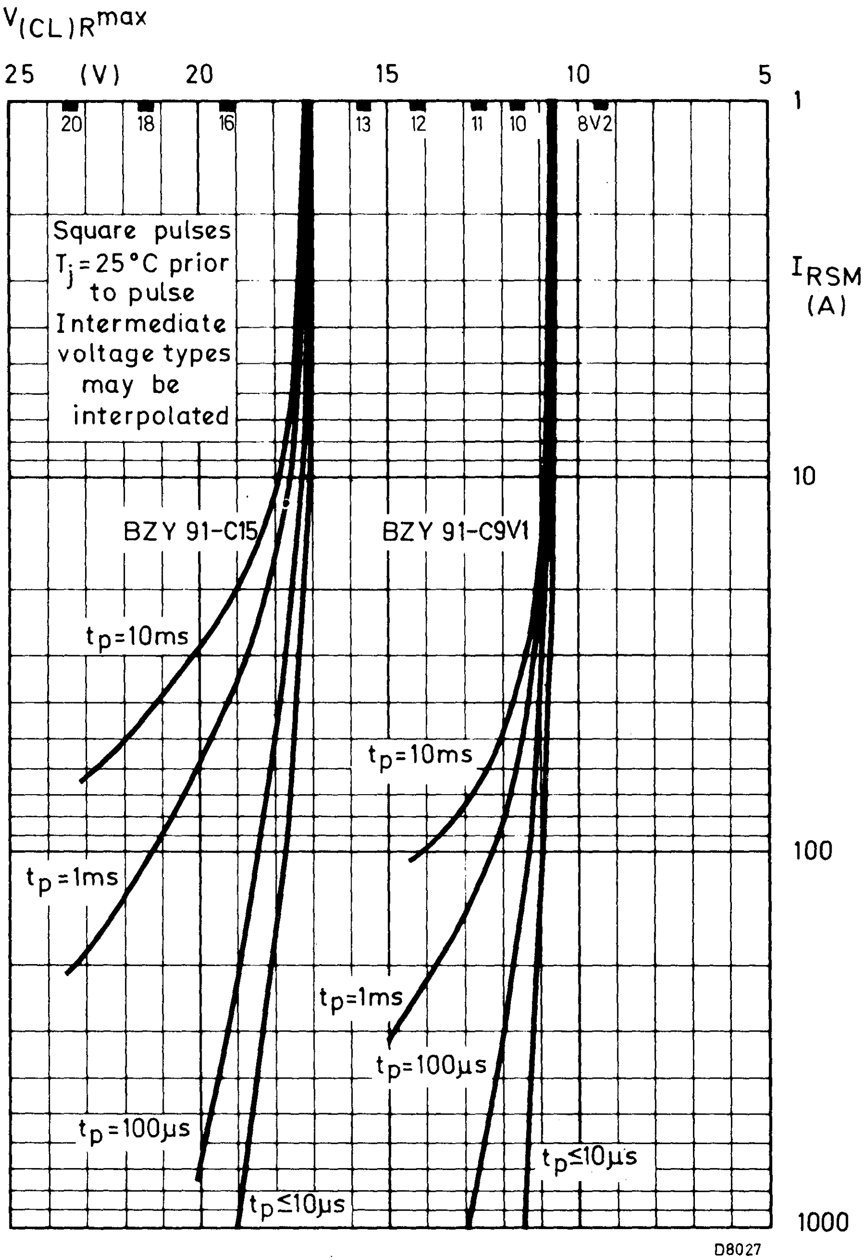

$V_{(CL)R}$max
25
(V)
20
15
10
5
20
18
16
13
12
11
10
8V2
Square pulses
T_j = 25 °C prior to pulse
Intermediate voltage types may be interpolated
I_{RSM} (A)
1
10
100
1000
BZY 91-C15
BZY 91-C9V1
t_p=10ms
t_p=1ms
t_p=100µs
t_p≤10µs
t_p=10ms
t_p=1ms
t_p=100µs
t_p≤10µs
D8027

Fig. 22.

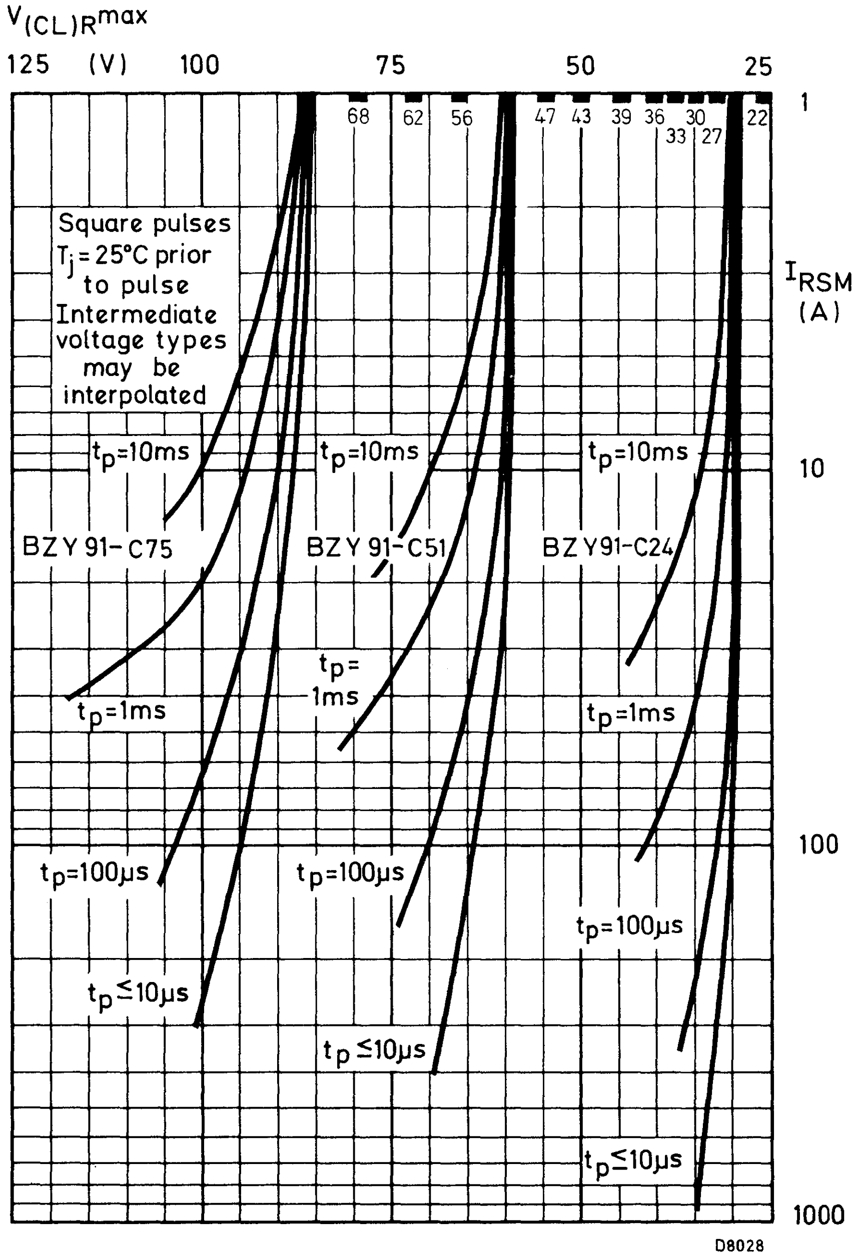
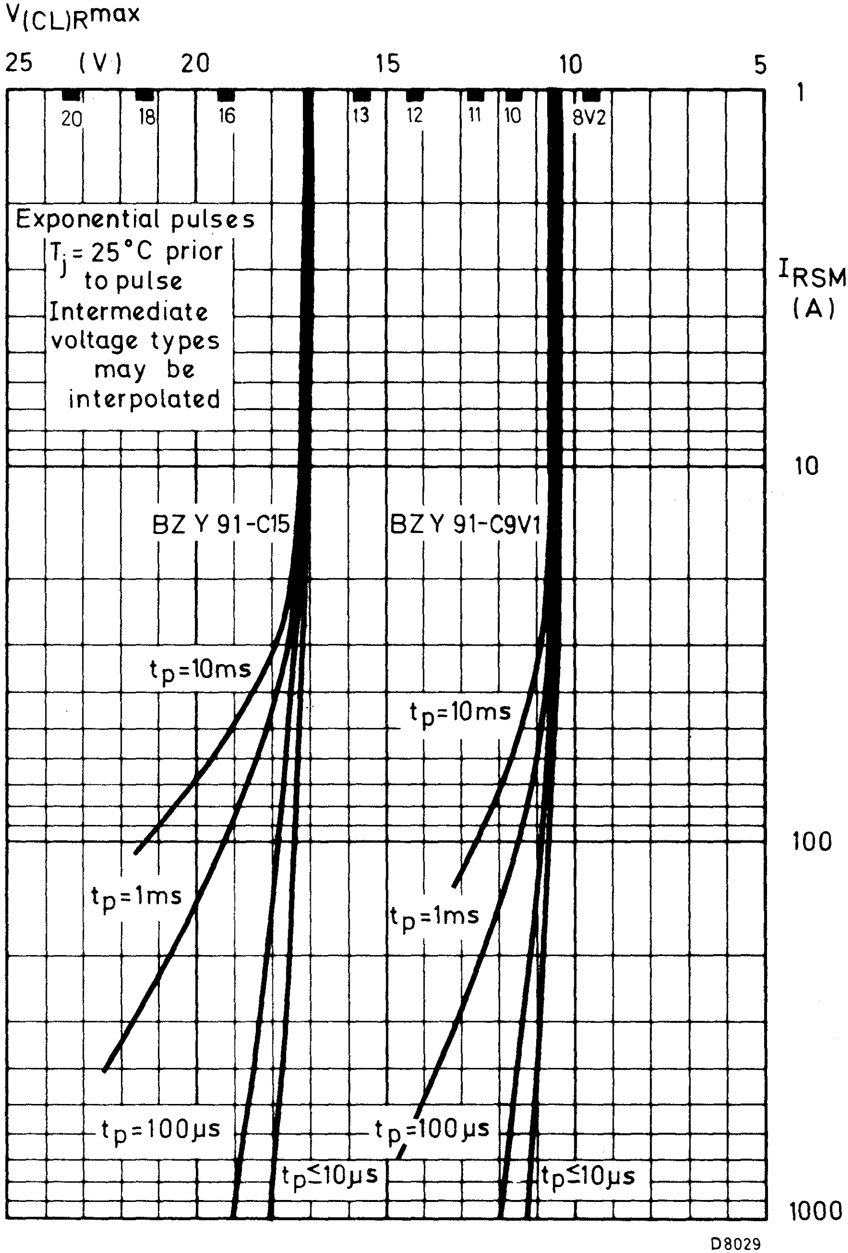

$V_{(CL)R}$max
125 (V) 100 75 50 25
68 62 56 47 43 39 36 33 30 27 22
1 10 100 1000
I_{RSM} (A)
Square pulses
T_j = 25°C prior to pulse
Intermediate voltage types may be interpolated
t_p=10ms
BZY91-C75
t_p=1ms
t_p=100µs
t_p≤10µs
BZY91-C51
t_p= 1ms
BZY91-C24
D8028

Fig. 23.



$V_{(CL)R}$max
(V)
25
20
15
10
5
20
18
16
13
12
11
10
8V2
Exponential pulses
T_j = 25 °C prior to pulse
Intermediate voltage types may be interpolated
I_{RSM} (A)
1
10
100
1000
BZY 91-C15
BZY 91-C9V1
t_p=10ms
t_p=1ms
t_p=100μs
t_p≤10μs
D8029

Fig. 24.

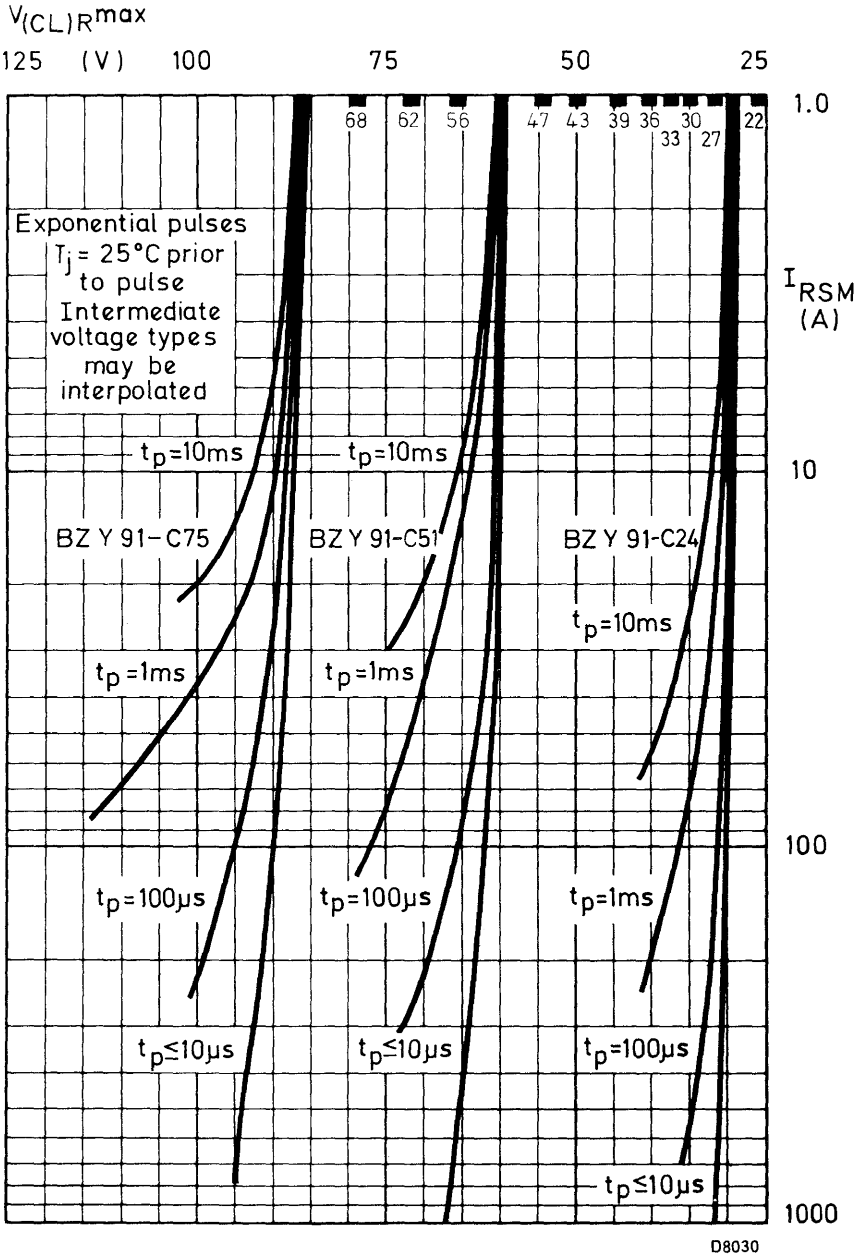

$V_{(CL)R}$max
125 (V) 100 75 50 25
68 62 56 47 43 39 36 30 33 27 22
1.0
10
100
1000
I_{RSM} (A)
Exponential pulses
T_j = 25°C prior to pulse
Intermediate voltage types may be interpolated
t_p=10ms
t_p=10ms
t_p=10ms
BZY91-C75
BZY91-C51
BZY91-C24
t_p=1ms
t_p=1ms
t_p=1ms
t_p=100µs
t_p=100µs
t_p=100µs
t_p≤10µs
t_p≤10µs
t_p≤10µs
D8030

Fig. 25.

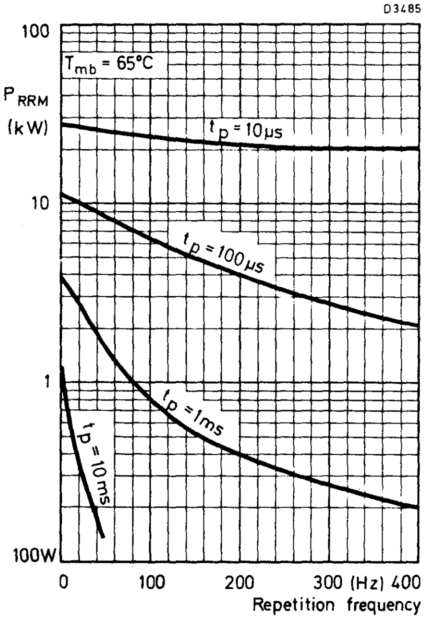


Fig. 26.

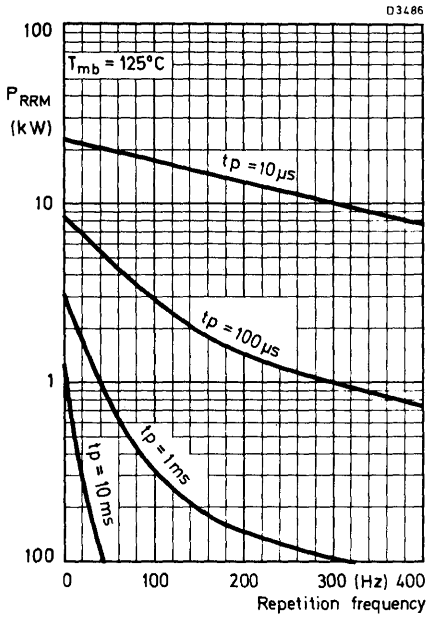


Fig. 27.

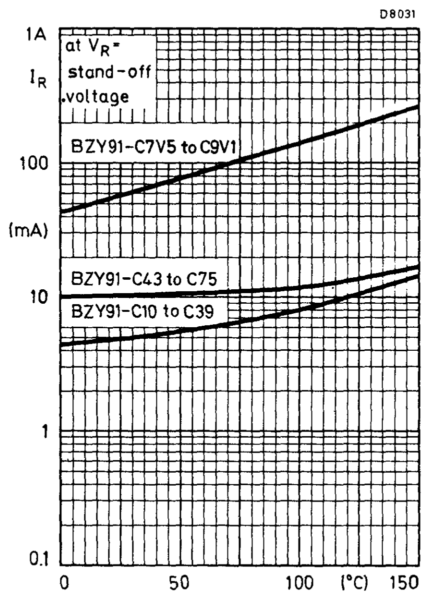


Fig. 28.

REGULATOR DIODES

Also available to BS9305–F051

A range of diffused silicon diodes in DO-4 metal envelopes, intended for use as voltage regulator and transient suppressor diodes in power stabilization and transient suppression circuits.

The series consists of the following types:
Normal polarity (cathode to stud): BZY93-C7V5 to BZY93-C75.
Reverse polarity (anode to stud): BZY93-C7V5R to BZY93-C75R.

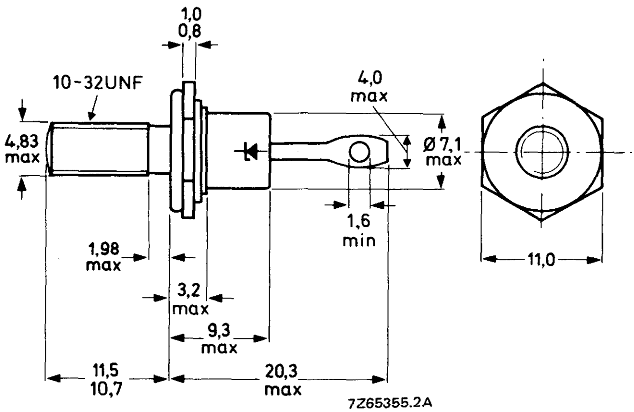
QUICK REFERENCE DATA

			voltage regulator	transient suppressor	
Working voltage (5% range)	V_Z	nom.	7,5 to 75	–	V
Stand-off voltage	V_R		–	5,6 to 56	V
Total power dissipation	P_{tot}	max.	20	–	W
Non-repetitive peak reverse power dissipation	P_{RSM}	max.	–	700	W

MECHANICAL DATA

Dimensions in mm

Fig. 1 DO-4.



Net mass: 6 g
Diameter of clearance hole: max. 5,2 mm

Torque on nut: min. 0,9 Nm (9 kg cm)
max. 1,7 Nm (17 kg cm)

Accessories supplied on request: 56295
(PTFE bush, 2 mica washers, plain washer, tag)

Supplied with device: 1 nut, 1 lock washer
Nut dimensions across the flats: 9,5 mm

RATINGS

Limiting values in accordance with the Absolute Maximum System (IEC 134)

Peak working current	I_{ZM}	max.	20 A
Average forward current (averaged over any 20 ms period)	$I_{F(AV)}$	max.	5 A
Non-repetitive peak reverse current $T_j = 25\ ^oC$ prior to surge; $t_p = 1$ ms (exponential pulse); BZY93-C7V5(R) to BZY93-C75(R)	I_{RSM}	max.	55 to 6 A
Total power dissipation up to $T_{mb} = 75\ ^oC$	P_{tot}	max.	20 W
Non-repetitive peak reverse power dissipation $T_j = 25\ ^oC$ prior to surge; $t_p = 1$ ms (exponential pulse)	P_{RSM}	max.	700 W
Storage temperature	T_{stg}		−55 to + 175 ^oC
Junction temperature	T_j	max.	175 ^oC

THERMAL RESISTANCE

From junction to mounting base	$R_{th\ j\text{-}mb}$	=	5 $^oC/W$
From junction to ambient	$R_{th\ j\text{-}a}$	=	50 $^oC/W$
From mounting base to heatsink (minimum torque: 0,9 Nm)	$R_{th\ mb\text{-}h}$	=	0,6 $^oC/W$

CHARACTERISTICS

Forward voltage $I_F = 5$ A; $T_{mb} = 25\ ^oC$	V_F	<	1,5 V

OPERATION AS A VOLTAGE REGULATOR (see page 4)

Dissipation and heatsink considerations

a. Steady-state conditions

The maximum permissible steady-state dissipation $P_{s\ max}$ is given by the relationship

$$P_{s\ max} = \frac{T_{j\ max} - T_{amb}}{R_{th\ j\text{-}a}}$$

where: $T_{j\ max}$ is the maximum permissible operating junction temperature
T_{amb} is the ambient temperature
$R_{th\ j\text{-}a}$ is the total thermal resistance from junction to ambient

$$R_{th\ j\text{-}a} = R_{th\ j\text{-}mb} + R_{th\ mb\text{-}h} + R_{th\ h\text{-}a}$$

$R_{th\ mb\text{-}h}$ is the thermal resistance from mounting base to heatsink, that is, 0,6 $^oC/W$.
$R_{th\ h\text{-}a}$ is the thermal resistance of the heatsink.

b. Pulse conditions (see Fig. 2)

The maximum permissible pulse power $P_{p\ max}$ is given by the formula

$$P_{p\ max} = \frac{(T_{j\ max} - T_{amb}) - (P_s \cdot R_{th\ j\text{-}a})}{R_{th\ t} + \delta \cdot R_{th\ mb\text{-}a}}$$

where: P_s is any steady-state dissipation excluding that in pulses
$R_{th\ t}$ is the effective transient thermal resistance of the device between junction and mounting base. It is a function of the pulse duration t_p and duty factor δ.
δ is duty factor (t_p/T)
$R_{th\ mb\text{-}a}$ is the total thermal resistance between the mounting base and ambient ($R_{th\ mb\text{-}a} = R_{th\ mb\text{-}h} + R_{th\ h\text{-}a}$).

The steady-state power P_s when biased in the zener direction at a given zener current can be found from Fig. 14. With the additional pulse power dissipation $P_{p\ max}$ calculated from the above expression, the total peak zener power dissipation $P_{tot} = P_{ZRM} = P_s + P_p$. From Fig. 14 the corresponding maximum repetitive peak zener current at P_{ZRM} can now be read. This repetitive peak zener current is subject to the absolute maximum rating. For pulse durations larger than the temperature stabilization time of the diode t_{stab}, the maximum permissible repetitive peak dissipation P_{ZRM} is equal to the steady-state power P_s. The temperature stabilization time for the BZY93 is 5 seconds (see Fig. 9).

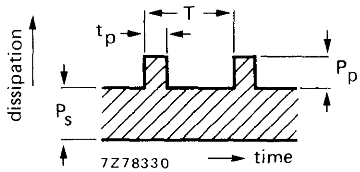


Fig. 2.

OPERATION AS A TRANSIENT SUPPRESSOR (see page 5)

Heatsink considerations

a. For non-repetitive transients, the device may be used without a heatsink for pulses up to 10 ms in duration.
b. For repetitive transients which fall within the permitted operating range shown in Figs 19 and 20 the required heatsink is found as follows:

$$R_{th\ j\text{-}mb} + R_{th\ mb\text{-}h} + R_{th\ h\text{-}a} = \frac{T_{j\ max} - T_{amb}}{P_s + \delta \cdot P_{RRM}}$$

where: $T_{j\ max}$ = 175 °C
T_{amb} = ambient temperature
P_s = any steady-state dissipation excluding that in pulses
δ = duty factor (t_p/T)
$R_{th\ j\text{-}mb}$ = 5 °C/W
$R_{th\ mb\text{-}h}$ = 0,6 °C/W

Thus $R_{th\ h\text{-}a}$ can be found.

Notes

1. The stand-off voltage is the maximum reverse voltage recommended for continuous operation; at this value non-conduction is ensured.
2. The maximum clamping voltage is the maximum reverse voltage which appears across the diode at the specified pulse duration and junction temperature. For square pulses see Figs 15 and 16, for exponential pulses see Figs 17 and 18.
3. Duration of an exponential pulse is defined as the time taken for the pulse to fall to 37% of its initial value. It is assumed that the energy content does not continue beyond twice this time.
4. Surge suppressor diodes are extremely fast in clamping, switching on in less than 5 ns.

CHARACTERISTICS – WHEN USED AS VOLTAGE REGULATOR DIODES; T_{mb} = 25 °C

BZY93-. . .	working voltage $^*V_Z$ V		differential resistance $^*r_Z$ Ω		temperature coefficient $^*S_Z$ mV/°C	test I_Z A	reverse current I_R μA	at reverse voltage V_R V
	min.	max.	typ.	max.	typ.		max.	
C7V5(R)	7.0	7.9	0.04	0.3	3.0	2.0	100	2.0
C8V2(R)	7.7	8.7	0.05	0.3	4.0	2.0	100	5.6
C9V1(R)	8.5	9.6	0.07	0.5	5.0	1.0	50	6.2
C10(R)	9.4	10.6	0.07	0.5	7.0	1.0	50	6.8
C11(R)	10.4	11.6	0.08	1.0	7.5	1.0	50	7.5
C12(R)	11.4	12.7	0.08	1.0	8.0	1.0	50	8.2
C13(R)	12.4	14.1	0.08	1.0	8.5	1.0	50	9.1
C15(R)	13.8	15.6	0.10	1.2	10	1.0	50	10
C16(R)	15.3	17.1	0.18	1.2	11	0.5	50	11
C18(R)	16.8	19.1	0.2	1.5	12	0.5	50	12
C20(R)	18.8	21.2	0.2	1.5	14	0.5	50	13
C22(R)	20.8	23.3	0.21	1.8	16	0.5	50	15
C24(R)	22.7	25.9	0.22	2.0	18	0.5	50	16
C27(R)	25.1	28.9	0.25	2.0	21	0.5	50	18
C30(R)	28	32	0.3	2.5	25	0.5	50	20
C33(R)	31	35	0.32	3.0	30	0.5	50	22
C36(R)	34	38	0.75	4.0	32	0.2	50	24
C39(R)	37	41	0.85	5.0	35	0.2	50	27
C43(R)	40	46	0.90	6.5	40	0.2	50	30
C47(R)	44	50	1.0	7.0	45	0.2	50	33
C51(R)	48	54	1.2	7.5	50	0.2	50	36
C56(R)	52	60	1.3	8.0	55	0.2	50	39
C62(R)	58	66	1.5	9.0	60	0.2	50	43
C68(R)	64	72	1.8	10	65	0.2	50	47
C75(R)	70	79	2.0	10.5	70	0.2	50	51

*At test I_Z; measured using a pulse method with $t_p \leqslant 100\ \mu s$ and $\delta \leqslant 0.001$ so that the values correspond to a T_j of approximately 25 °C.

CHARACTERISTICS – WHEN USED AS TRANSIENT SUPPRESSOR DIODES; T_{mb} = 25 °C

clamping voltage at t_p = 500 µs exp. pulse $V_{(CL)R}$ V		non-repetitive peak reverse current I_{RSM} A	reverse current at recommended stand-off voltage I_R mA	V_R V	BZY93-. . .
typ.	max.		max.		
8	9.2	20	0.5	5.6	C7V5(R)
9	10.2	20	0.5	6.2	C8V2(R)
10	11.5	20	0.5	6.8	C9V1(R)
11	12.5	20	0.1	7.5	C10(R)
12.3	14	20	0.1	8.2	C11(R)
14	16	20	0.1	9.1	C12(R)
15.3	17.5	20	0.1	10	C13(R)
17	19.5	20	0.1	11	C15(R)
19.3	22	20	0.1	12	C16(R)
21	24	20	0.1	13	C18(R)
23	27	10	0.1	15	C20(R)
26	30	10	0.1	16	C22(R)
29	34	10	0.1	18	C24(R)
33	39	10	0.1	20	C27(R)
38	44	10	0.1	22	C30(R)
42	50	10	0.1	24	C33(R)
47	56	10	0.1	27	C36(R)
40	47	5	0.1	30	C39(R)
45	52	5	0.1	33	C43(R)
51	59	5	0.1	36	C47(R)
57	66	5	0.1	39	C51(R)
64	75	5	0.1	43	C56(R)
73	85	5	0.1	47	C62(R)
81	94	5	0.1	51	C68(R)
90	105	5	0.1	56	C75(R)

MOUNTING INSTRUCTIONS

The top connector should neither be bent nor twisted; it should be soldered into the circuit so that there is no strain on it.

During soldering the heat conduction to the junction should be kept to a minimum.

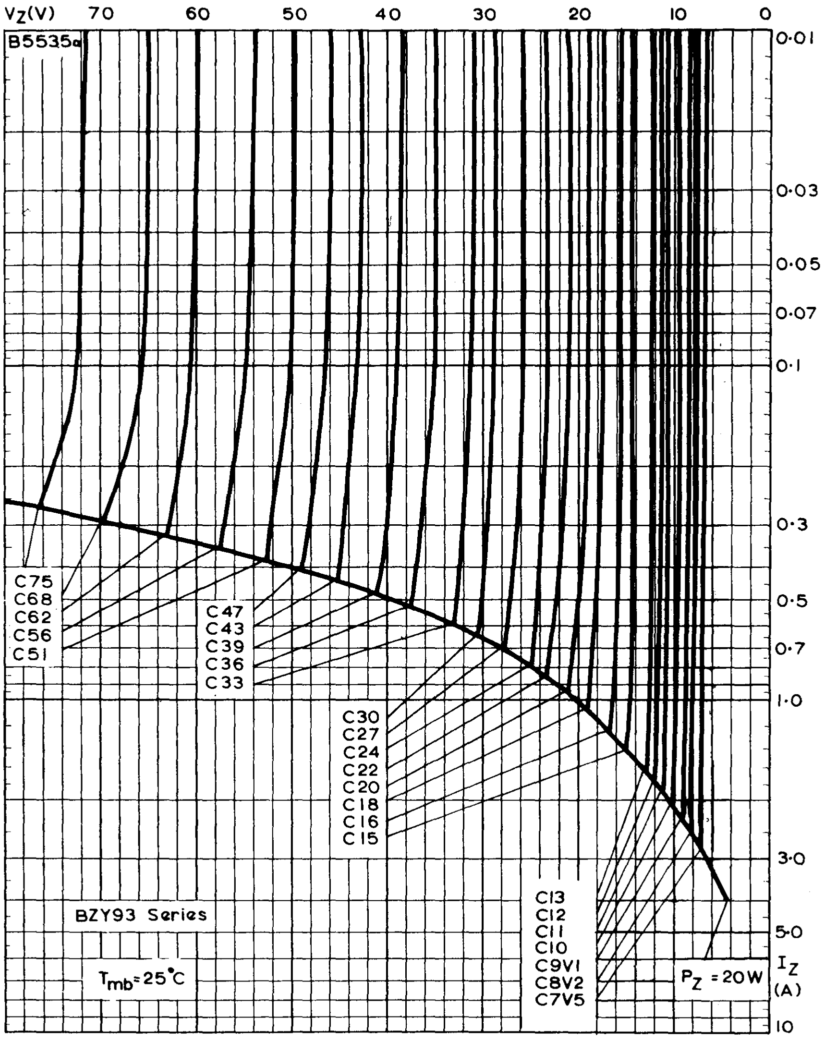


Fig. 3 Typical static zener characteristics.

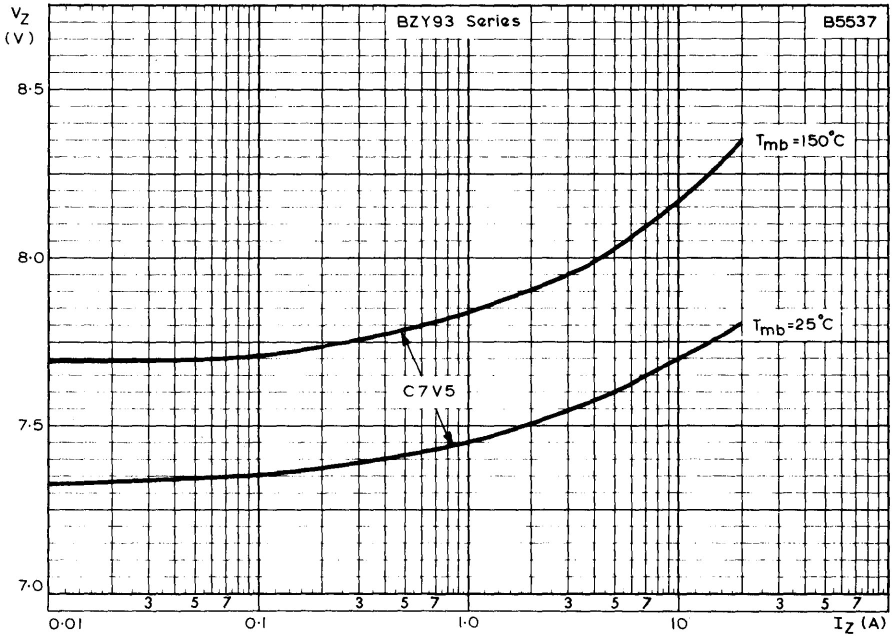


Fig. 4 Typical dynamic zener characteristics for BZY93-C7V5.

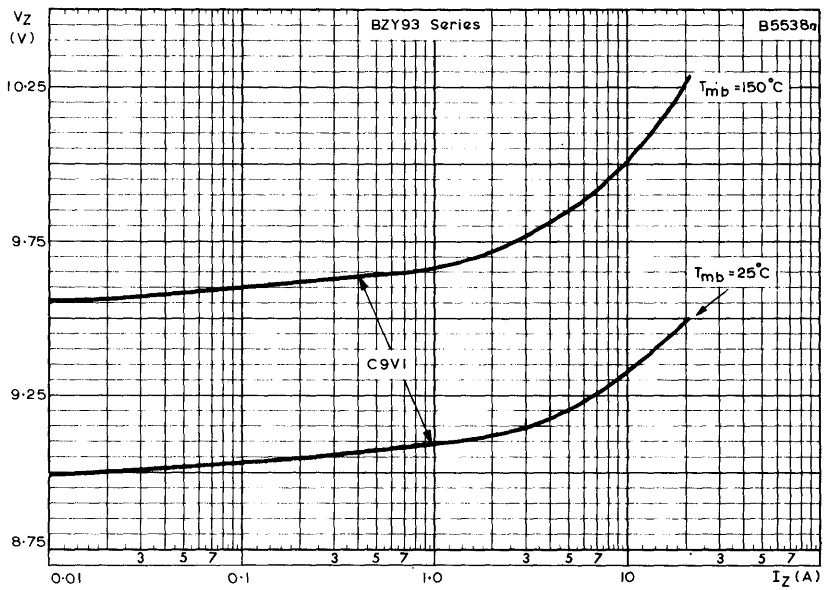


Fig. 5 Typical dynamic zener characteristics for BZY93-C9V1.

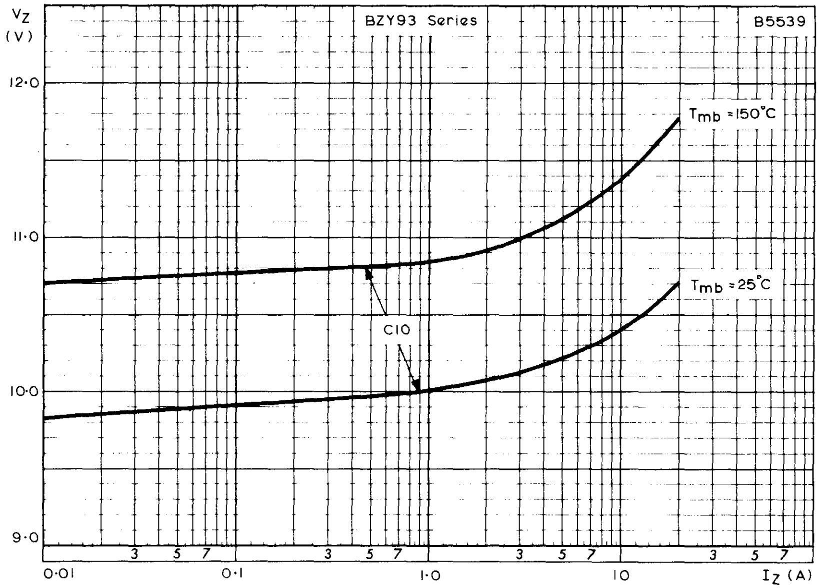


Fig. 6 Typical dynamic zener characteristics for BZY93-C10.

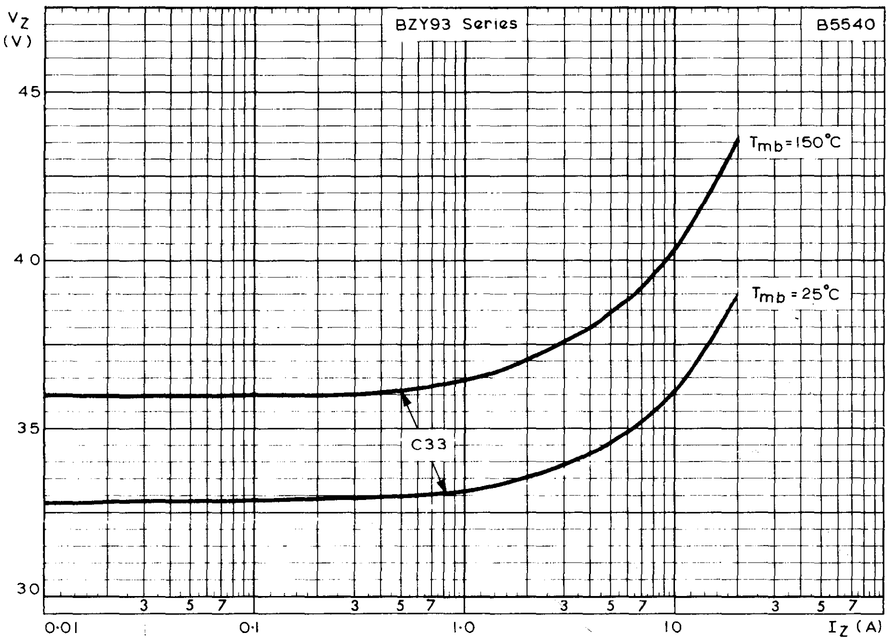


Fig. 7 Typical dynamic zener characteristics for BZY93-C33.

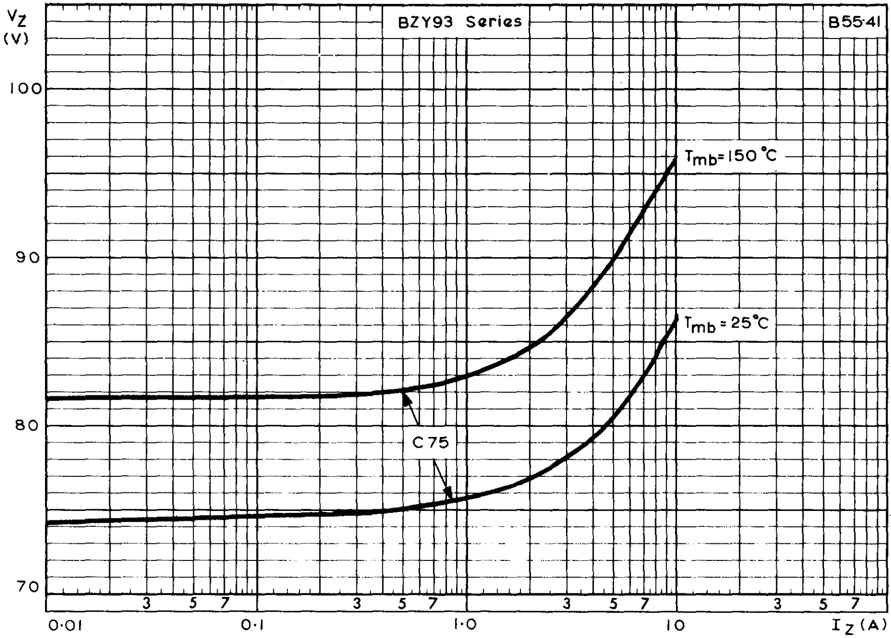


Fig. 8 Typical dynamic zener characteristics for BZY93-C75.

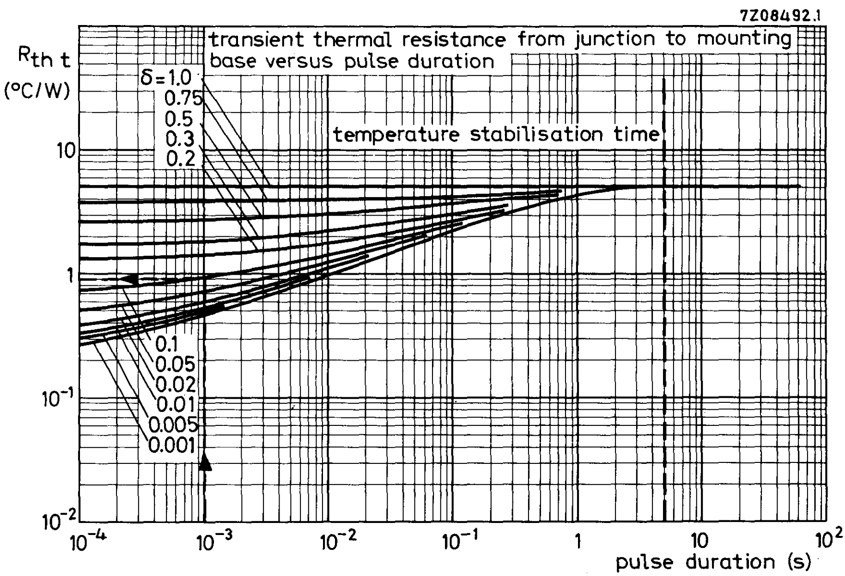


Fig. 9.

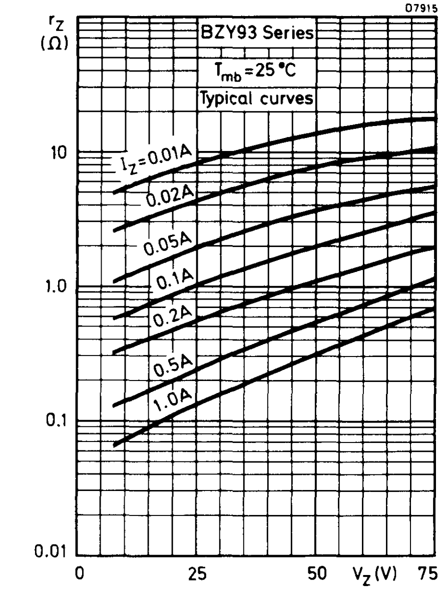


Fig. 10.

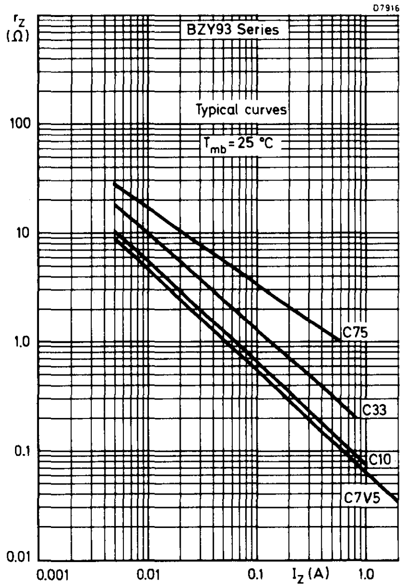


Fig. 11.

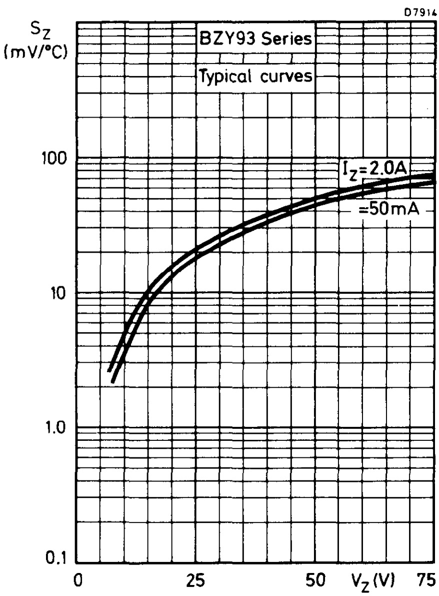


Fig. 12.

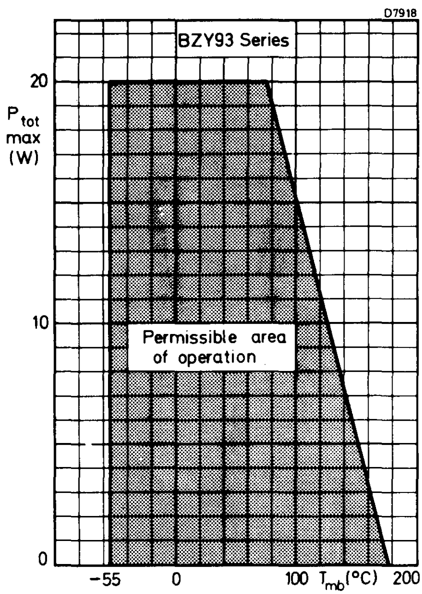


Fig. 13.

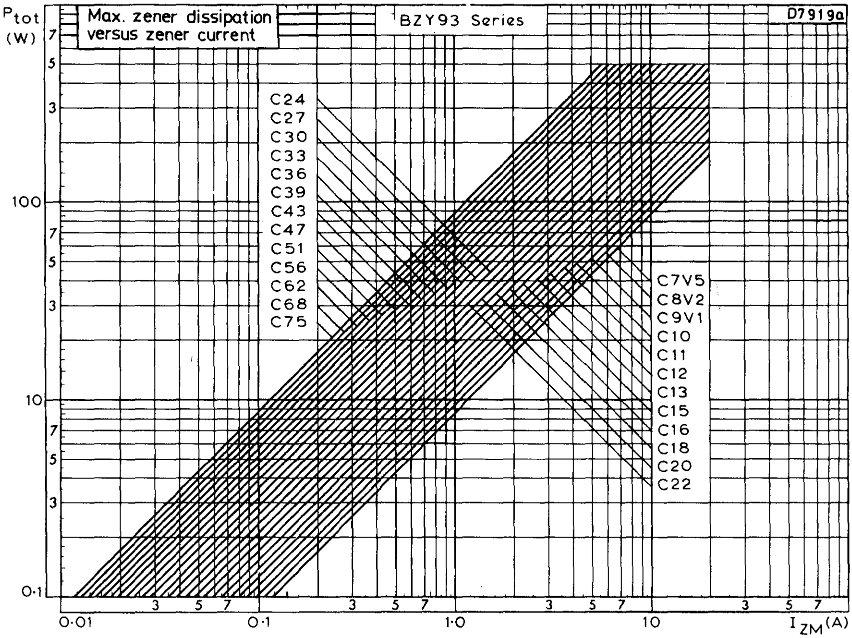


Fig. 14 Maximum permissible repetitive peak dissipation ($P_{tot} = P_{ZRM}$).

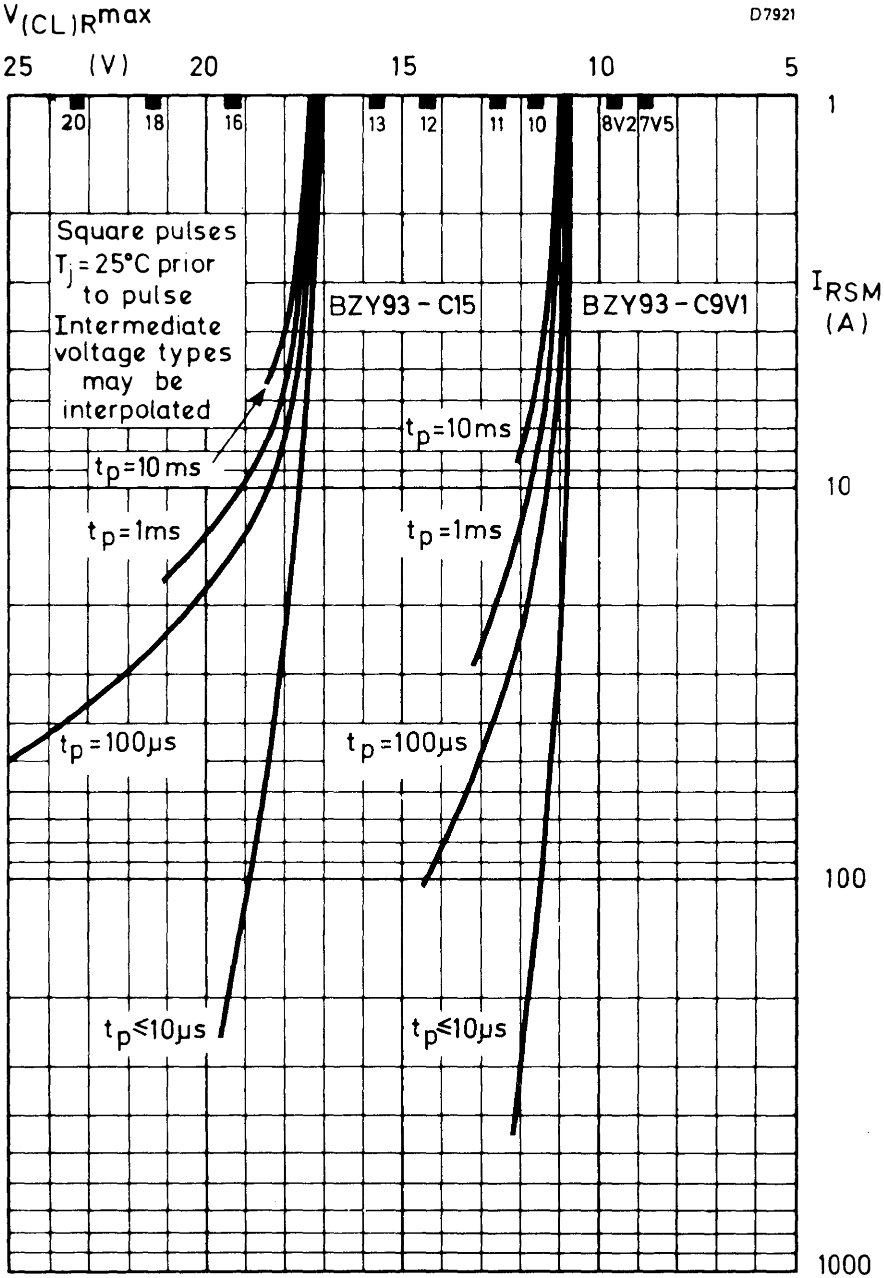
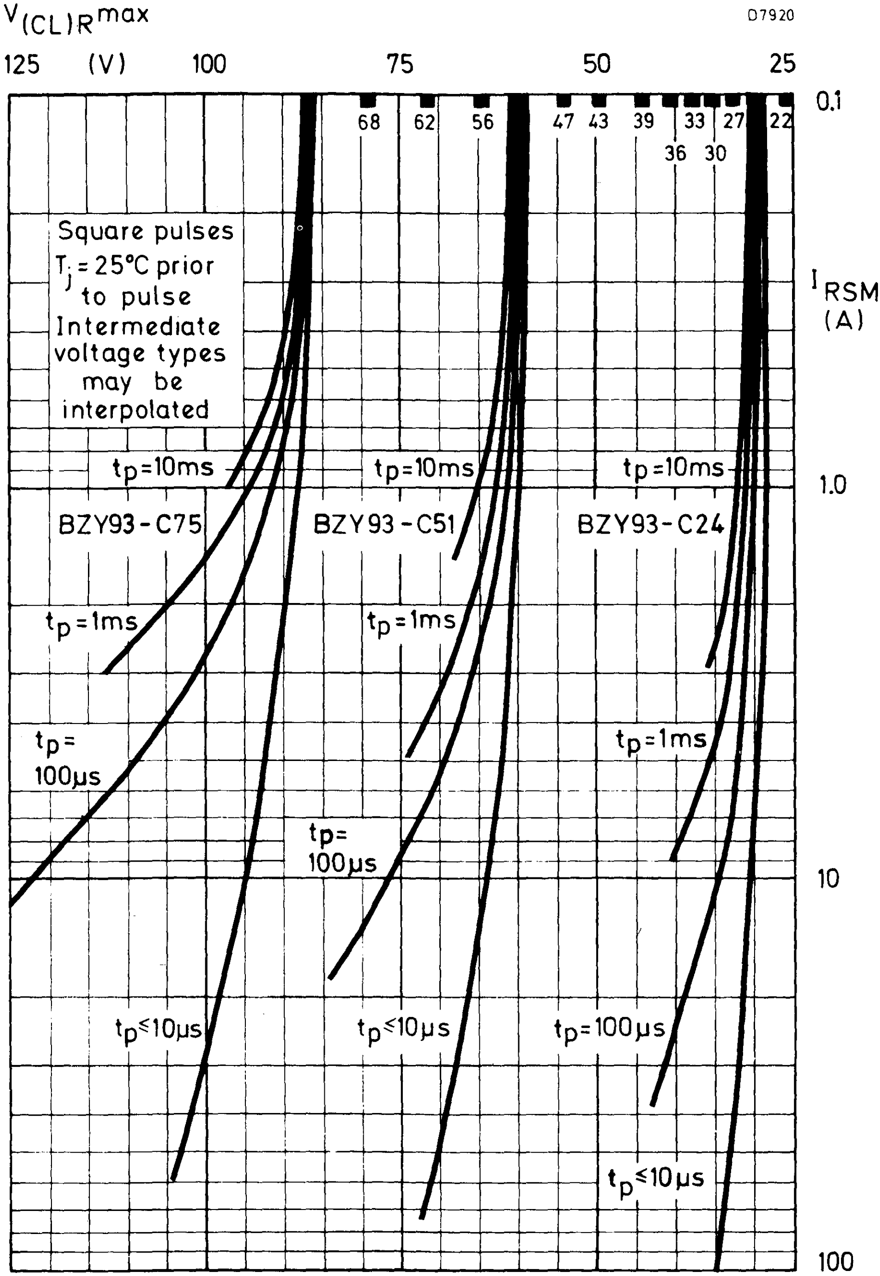

D7921
V(CL)R max
(V)
25
20
15
10
5
20
18
16
13
12
11
10
8V2
7V5
Square pulses
Tj = 25°C prior to pulse
Intermediate voltage types may be interpolated
BZY93 - C15
BZY93 - C9V1
tp=10 ms
tp=1ms
tp=100µs
tp≤10µs
tp=10ms
tp=1ms
tp=100µs
tp≤10µs
IRSM
(A)
1
10
100
1000

Fig. 15.



$V_{(CL)R}$max
D7920
125 (V) 100 75 50 25
68 62 56 47 43 39 36 33 30 27 22
0.1
1.0
10
100
I_{RSM} (A)
Square pulses
T_j = 25°C prior to pulse
Intermediate voltage types may be interpolated
t_p=10ms
t_p=10ms
t_p=10ms
BZY93-C75
BZY93-C51
BZY93-C24
t_p=1ms
t_p=1ms
t_p=1ms
t_p= 100µs
t_p= 100µs
t_p=100µs
t_p≤10µs
t_p≤10µs
t_p≤10µs

Fig. 16.

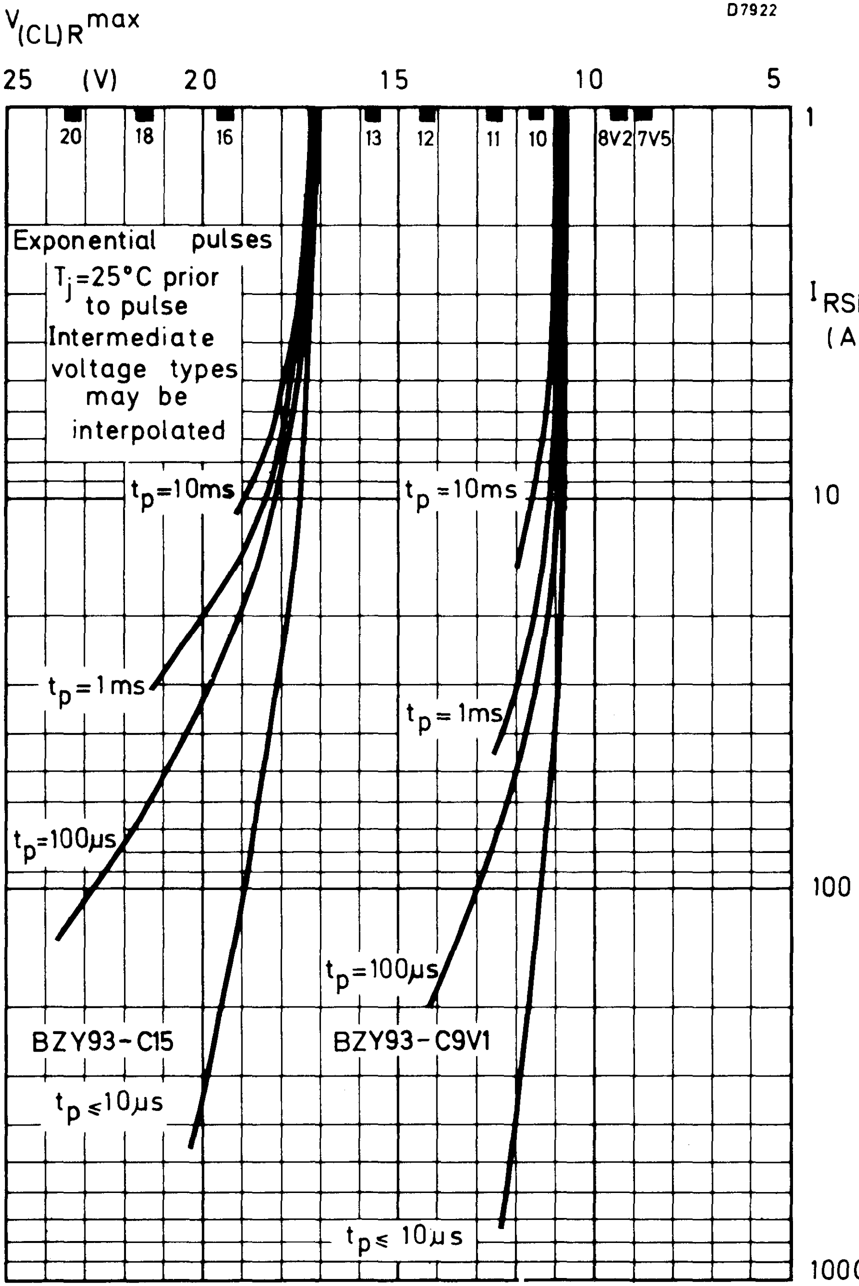
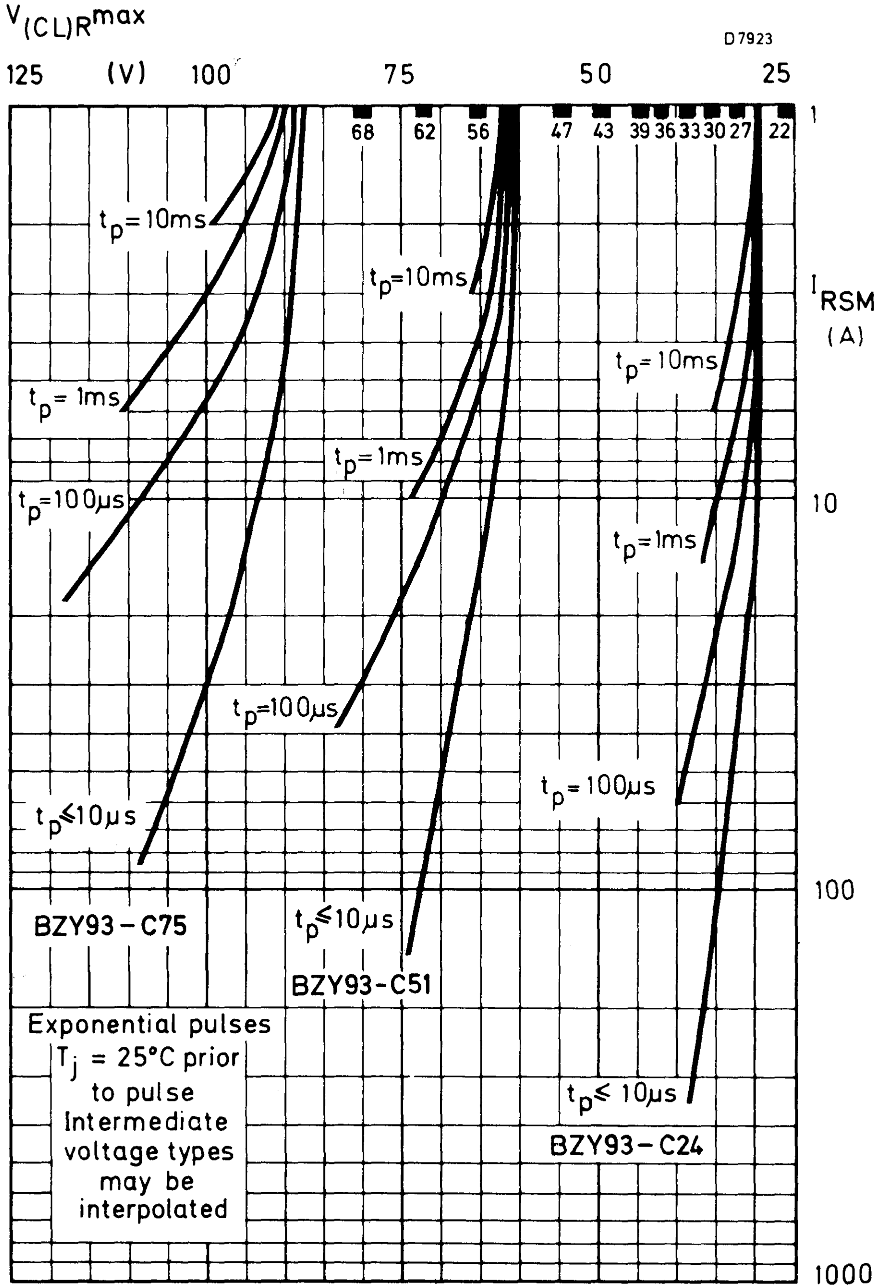

D7922
$V_{(CL)R}$max
25
(V)
20
15
10
5
20
18
16
13
12
11
10
8V2
7V5
1
Exponential pulses
T_j=25°C prior to pulse
Intermediate voltage types may be interpolated
I_{RSM} (A)
t_p=10ms
t_p=10ms
10
t_p=1ms
t_p=1ms
t_p=100µs
100
t_p=100µs
BZY93-C15
BZY93-C9V1
t_p≤10µs
t_p≤10µs
1000

Fig. 17.



V(CL)Rmax
D7923
125
(V)
100
75
50
25
68
62
56
47
43
39
36
33
30
27
22
1
IRSM
(A)
10
100
1000
tp=10ms
tp= 1ms
tp=100µs
tp≤10µs
BZY93-C75
tp=10ms
tp=1ms
tp=100µs
tp≤10µs
BZY93-C51
tp=10ms
tp=1ms
tp=100µs
tp≤10µs
BZY93-C24
Exponential pulses
Tj = 25°C prior to pulse
Intermediate voltage types may be interpolated

Fig. 18.

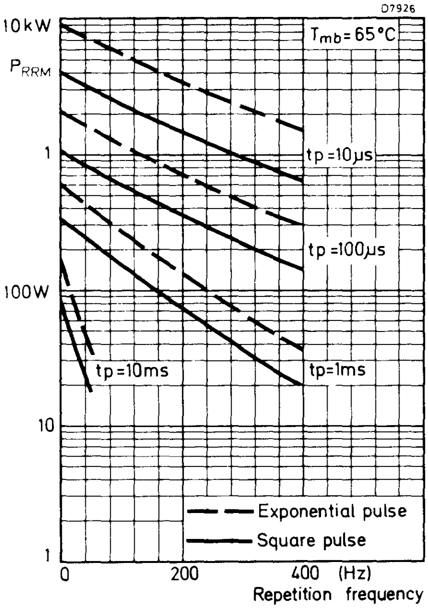


Fig. 19.

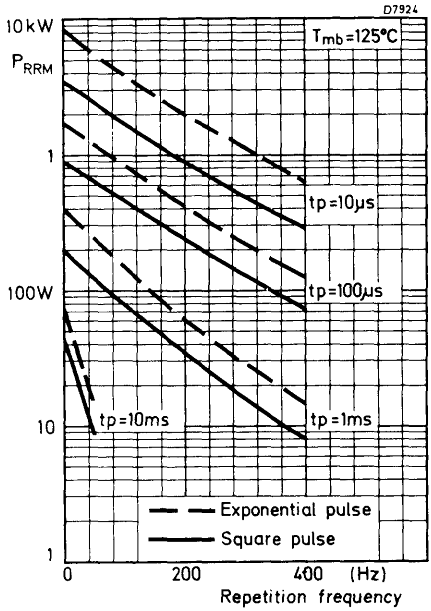


Fig. 20.

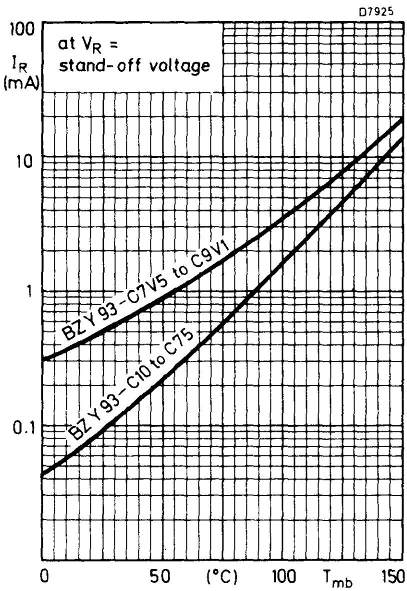


Fig. 21.

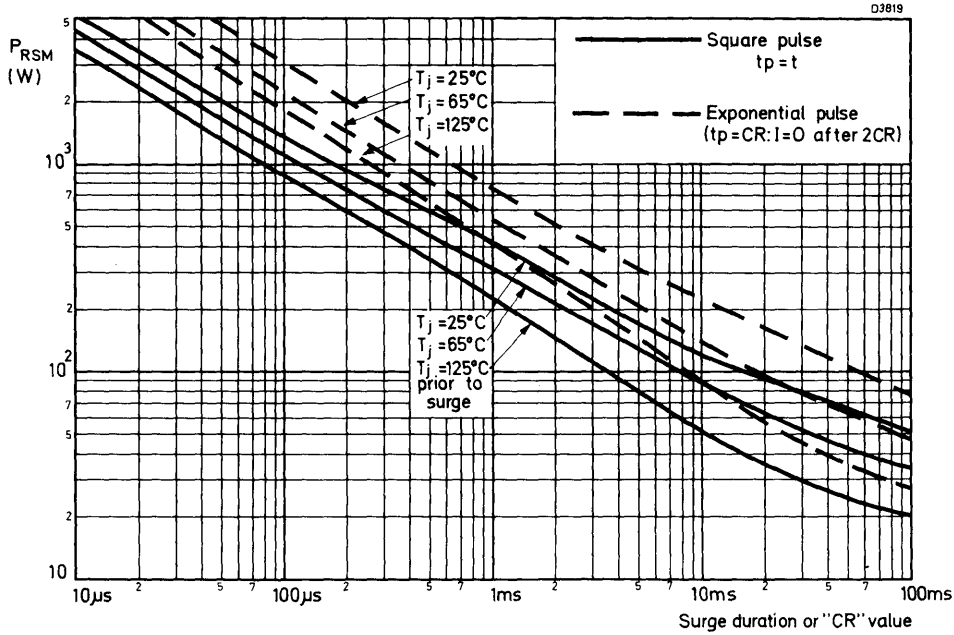

D3819
P_{RSM}
(W)
5
2
10^3
7
5
2
10^2
7
5
2
10
10µs
2
5
7
100µs
2
5
7
1ms
2
5
7
10ms
2
5
7
100ms
Surge duration or "CR" value
Square pulse
tp = t
Exponential pulse
(tp = CR: I = 0 after 2CR)
T_j = 25°C
T_j = 65°C
T_j = 125°C
T_j = 25°C
T_j = 65°C
T_j = 125°C
prior to
surge

Fig. 22.

REGULATOR DIODES

Also available to BS9305–F050

A range of diffused silicon diodes in DO-1 envelopes, intended for use as voltage regulator and transient suppressor diodes in medium power regulators and transient suppression circuits.

The series consists of the following types: BZY95-C10 to BZY95-C75.

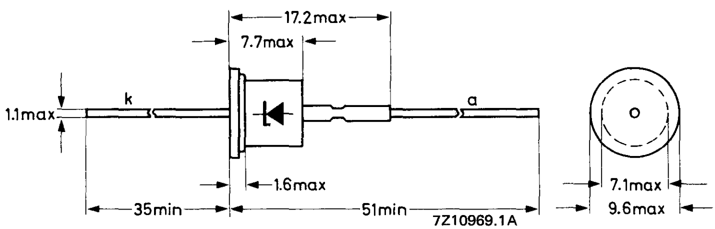
QUICK REFERENCE DATA

			voltage regulator	transient suppressor	
Working voltage (5% range)	V_Z	nom.	10 to 75	–	V
Stand-off voltage	V_R		–	7,5 to 56	V
Total power dissipation	P_{tot}	max.	2,5	–	W
Non-repetitive peak reverse power dissipation	P_{RSM}	max.	–	700	W

MECHANICAL DATA

Dimensions in mm

Fig. 1 DO-1.



RATINGS

Limiting values in accordance with the Absolute Maximum System (IEC 134)

Peak working current	I_{ZM}	max.	5	A
Average forward current (averaged over any 20 ms period)	$I_{F(AV)}$	max.	1	A
Non-repetitive peak reverse current T_j = 25 °C prior to surge; t_p = 1 ms (exponential pulse); BZY95-C10 to BZY95-C75	I_{RSM}	max.	70 to 5	A
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	2,5	W
at T_{amb} = 75 °C	P_{tot}	max.	1,67	W
Non-repetitive peak reverse power dissipation T_j = 25 °C prior to surge; t_p = 1 ms (exponential pulse)	P_{RSM}	max.	700	W
Storage temperature	T_{stg}		−65 to +175	°C
Junction temperature	T_j	max.	175	°C

THERMAL RESISTANCE

The quoted values of $R_{th\ j\text{-}a}$ should be used only when no leads of other dissipating components run to the same tie-points.

Thermal resistance from junction to ambient in free air:

mounted on soldering tags
- at lead length a = 10 mm — $R_{th\ j\text{-}a}$ = 60 °C/W
- at lead length a = maximum — $R_{th\ j\text{-}a}$ = 70 °C/W

mounted on a printed-circuit board
- at lead length a = maximum — $R_{th\ j\text{-}a}$ = 80 °C/W
- at lead length a = 10 mm — $R_{th\ j\text{-}a}$ = 90 °C/W

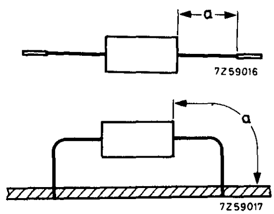


Fig.2

CHARACTERISTICS

Forward voltage

I_F = 1 A; T_{amb} = 25 °C	V_F	<	1,5	V

OPERATION AS A VOLTAGE REGULATOR (see page 4)

Dissipation and heatsink considerations

a. Steady-state conditions

The maximum permissible steady-state dissipation $P_{s\ max}$ is given by the relationship

$$P_{s\ max} = \frac{T_{j\ max} - T_{amb}}{R_{th\ j\text{-}a}}$$

where: $T_{j\ max}$ is the maximum permissible operating junction temperature
T_{amb} is the ambient temperature
$R_{th\ j\text{-}a}$ is the total thermal resistance from junction to ambient

b. Pulse conditions (see Fig.3)

The maximum permissible pulse power $P_{p\ max}$ is given by the formula

$$P_{p\ max} = \frac{(T_{j\ max} - T_{amb}) - (P_s \cdot R_{th\ j\text{-}a})}{R_{th\ t}}$$

where: P_s is any steady-state dissipation excluding that in pulses.
$R_{th\ t}$ is the effective transient thermal resistance of the device between junction and ambient. It is a function of the pulse duration t_p and duty factor δ.
δ is the duty factor (t_p/T).

The steady-state power P_s when biased in the zener direction at a given zener current can be found from Fig. 4. With the additional pulse power dissipation $P_{p\ max}$ calculated from the above expression, the total peak zener power dissipation $P_{tot} = P_{ZRM} = P_s + P_p$. From Fig. 4 the corresponding maximum repetitive peak zener current at P_{tot} can now be read. This repetitive peak zener current is subject to the absolute maximum rating. For pulse durations longer than the temperature stabilization time of the diode t_{stab}, the maximum permissible repetitive peak dissipation P_{ZRM} is equal to the steady-state power P_s. The temperature stabilization time for the BZY95 is 100 seconds (see Fig. 10).

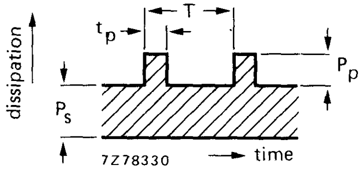


Fig. 3.

NOTES WHEN OPERATING AS A TRANSIENT SUPPRESSOR (see page 5)

1. The stand-off voltage is the maximum reverse voltage recommended for continuous operation; at this value non-conduction is ensured.
2. The maximum clamping voltage is the maximum reverse voltage which appears across the diode at the specified pulse duration and junction temperature. For square pulses see Figs 14 and 15, for exponential pulses see Figs 16 and 17.
3. Duration of an exponential pulse is defined as the time taken for the pulse to fall to 37% of its initial value. It is assumed that the energy content does not continue beyond twice this time.
4. Surge suppressor diodes are extremely fast in clamping, switching on in less than 5 ns.

CHARACTERISTICS – WHEN USED AS VOLTAGE REGULATOR DIODES; T_{mb} = 25 °C

BZY95-. . .	working voltage *V_Z V		differential resistance *r_Z Ω		temperature coefficient *S_Z mV/°C	test I_Z mA	reverse current I_R µA	at reverse voltage V_R V
	min.	max.	typ.	max.	typ.		max.	
C10	9.4	10.6	0.75	4.0	7.0	50	10	6.8
C11	10.4	11.6	0.8	4.5	7.5	50	10	7.5
C12	11.4	12.7	0.85	5.0	8.0	50	10	8.2
C13	12.4	14.1	0.9	6.0	8.5	50	10	9.1
C15	13.8	15.6	1.0	8.0	10	50	10	10
C16	15.3	17.1	2.4	9.0	11	20	10	11
C18	16.8	19.1	2.5	11	12	20	10	12
C20	18.8	21.2	2.8	12	14	20	10	13
C22	20.8	23.3	3.0	13	16	20	10	15
C24	22.7	25.9	3.4	14	18	20	10	16
C27	25.1	28.9	3.8	18	20	20	10	18
C30	28	32	4.5	22	25	20	10	20
C33	31	35	5.0	25	30	20	10	22
C36	34	38	5.5	30	32	20	10	24
C39	37	41	12	35	35	10	10	27
C43	40	46	13	40	40	10	10	30
C47	44	50	14	50	45	10	10	33
C51	48	54	15	55	50	10	10	36
C56	52	60	17	63	55	10	10	39
C62	58	66	18	75	60	10	10	43
C68	64	72	18	90	65	10	10	47
C75	70	79	20	100	70	10	10	51

*At test I_Z; measured using a pulse method with $t_p \leq 100\ \mu s$ and $\delta \leq 0.001$ so that the values correspond to a T_j of approximately 25 °C.

CHARACTERISTICS – WHEN USED AS TRANSIENT SUPPRESSOR DIODES; T_{mb} = 25 °C

clamping voltage t_p = 500 μs exp. pulse $V_{(CL)R}$ V		at non-repetitive peak reverse current I_{RSM} A	reverse current at recommended stand-off voltage I_R mA	V_R V	BZY95-...
typ.	max.		max.		
11	12.5	20	0.1	7.5	C10
12.3	14	20	0.1	8.2	C11
14	16	20	0.1	9.1	C12
15.3	17.5	20	0.1	10	C13
17	19.5	20	0.1	11	C15
19.3	22	20	0.1	12	C16
21	24	20	0.1	13	C18
23	27	10	0.1	15	C20
26	30	10	0.1	16	C22
29	34	10	0.1	18	C24
33	39	10	0.1	20	C27
38	44	10	0.1	22	C30
42	50	10	0.1	24	C33
47	56	10	0.1	27	C36
40	47	5	0.1	30	C39
45	52	5	0.1	33	C43
51	59	5	0.1	36	C47
57	66	5	0.1	39	C51
64	75	5	0.1	43	C56
73	85	5	0.1	47	C62
81	94	5	0.1	51	C68
90	105	5	0.1	56	C75

SOLDERING AND MOUNTING INSTRUCTIONS

1. When using a soldering iron, diodes may be soldered directly into the circuit, but heat conducted to the junction should be kept to a minimum.
2. Diodes may be dip-soldered at a solder temperature of 245 ^{o}C for a maximum soldering time of 5 seconds. The case temperature during dip-soldering must not at any time exceed the maximum storage temperature. These recommendations apply to a diode with the anode end mounted flush on a printed-circuit board having punched-through holes. For mounting the anode end onto a printed-circuit board, the diode must be spaced at least 5 mm from the underside of the printed-circuit board having punched-through holes, or 5 mm from the top of the printed-circuit board having plated-through holes.
3. Care should be taken not to bend the leads nearer than 1,5 mm from the seal; exert no axial pull when bending.

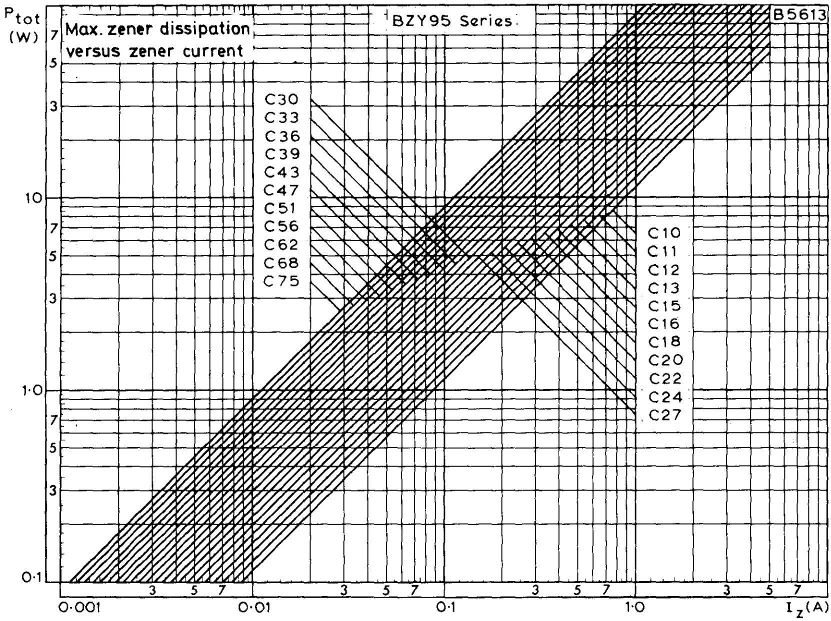


Fig. 4 Maximum permissible repetitive peak dissipation ($P_{tot} = P_{ZRM}$).

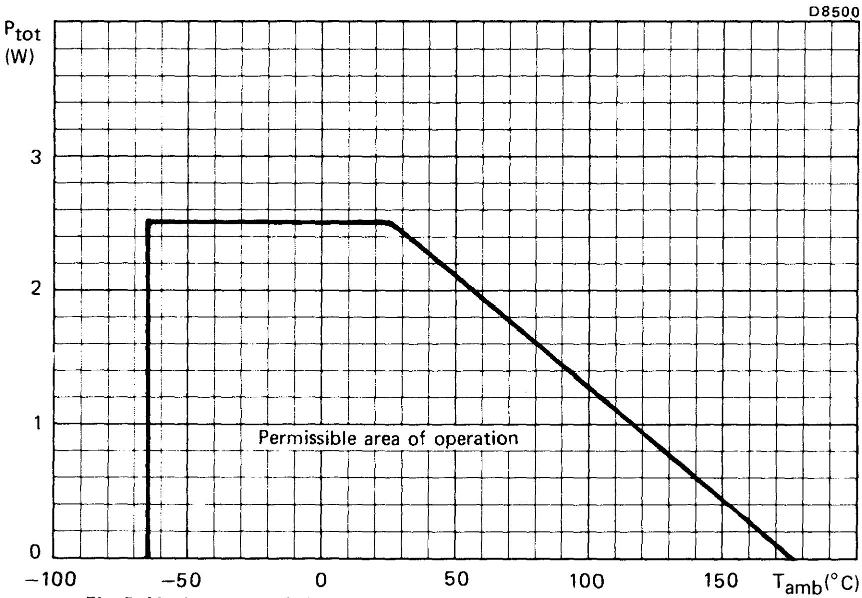


Fig. 5 Maximum permissible total power dissipation versus ambient temperature.

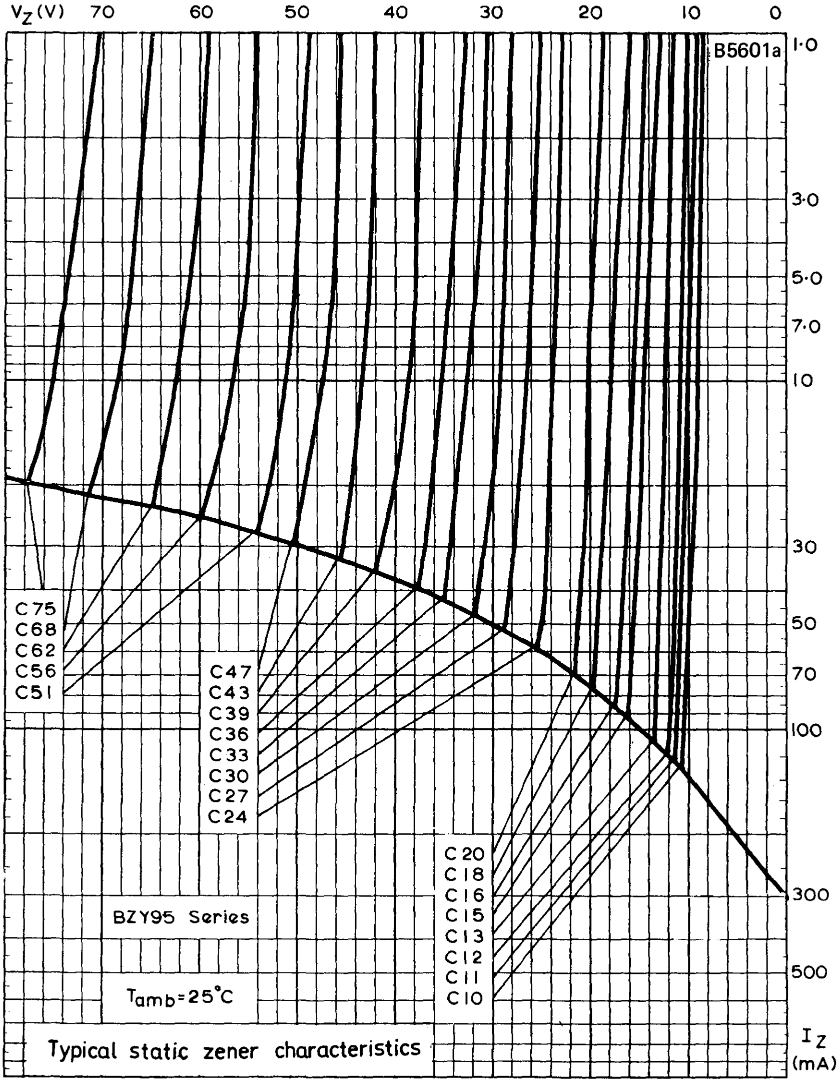


Fig. 6 Typical static zener characteristics.

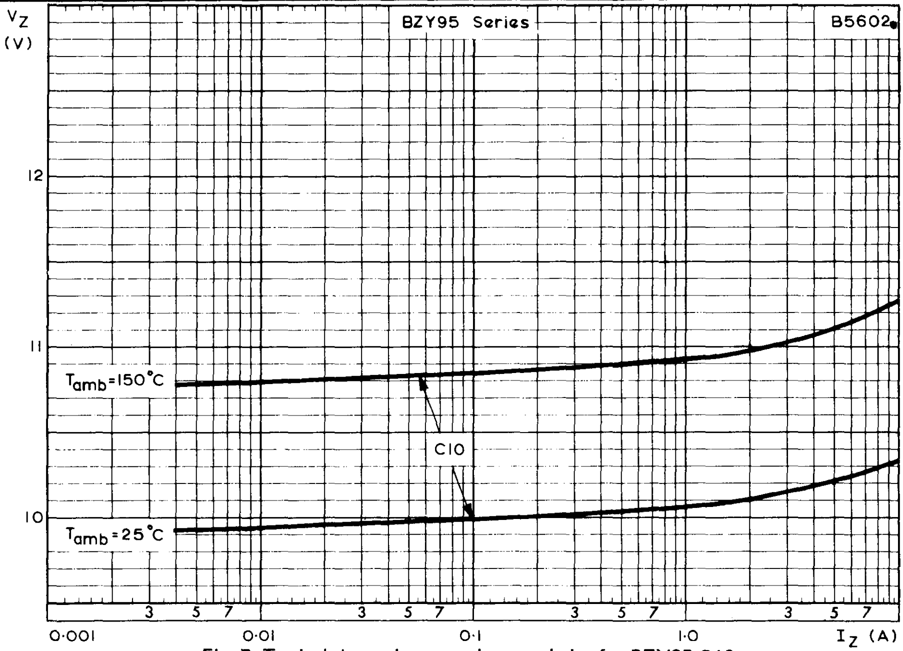


Fig. 7 Typical dynamic zener characteristics for BZY95-C10.

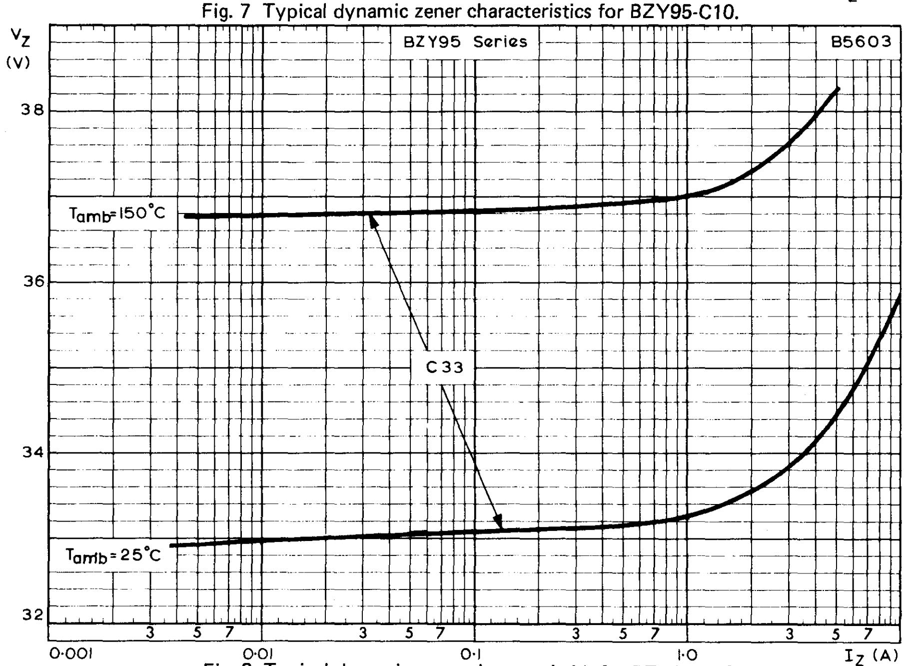


Fig. 8 Typical dynamic zener characteristics for BZY95-C33.

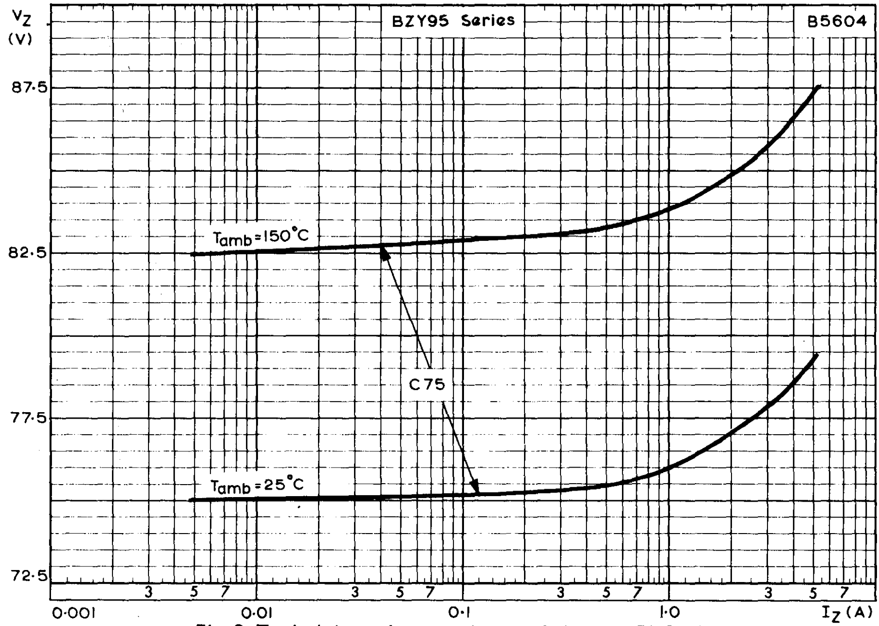


Fig. 9 Typical dynamic zener characteristics for BZY95-C75.

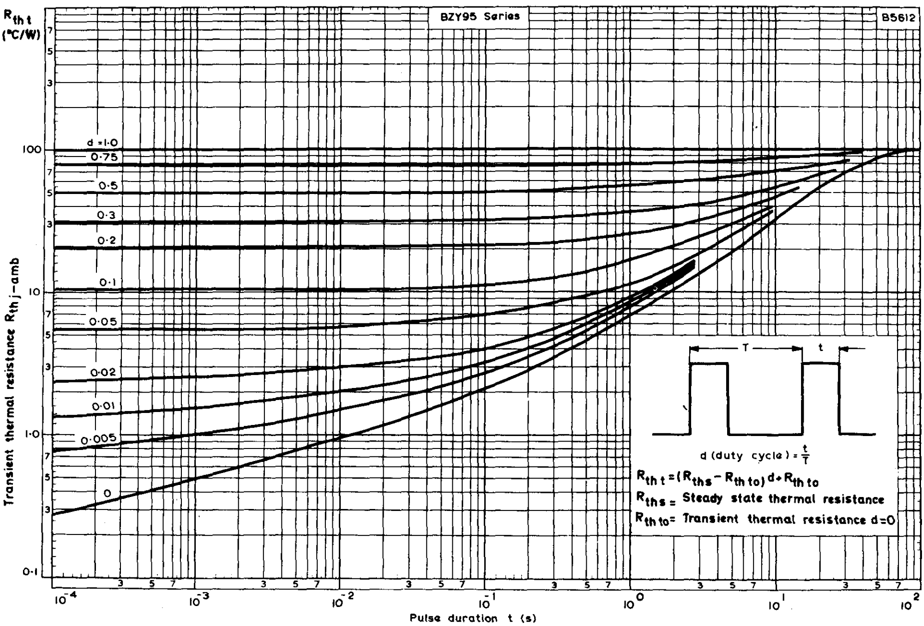


Fig. 10.

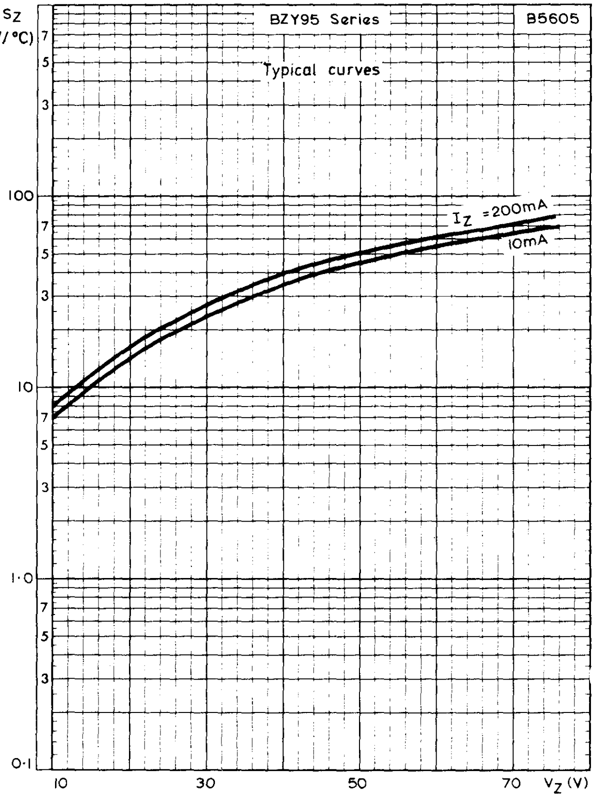

BZY95 Series
B5605
Typical curves
S_Z (mV/°C)
100
10
1·0
0·1
7
5
3
I_Z =200mA
10mA
10
30
50
70
V_Z (V)

Fig. 11.

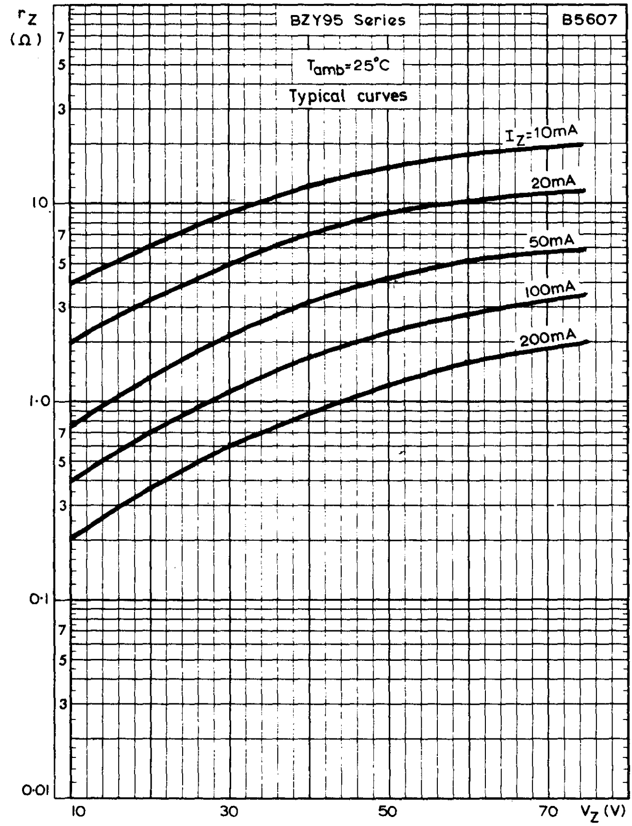

BZY95 Series
B5607
T_{amb}=25°C
Typical curves
r_Z (Ω)
I_Z=10mA
20mA
50mA
100mA
200mA
10
1·0
0·1
0·01
7
5
3
10
30
50
70
V_Z (V)

Fig. 12.

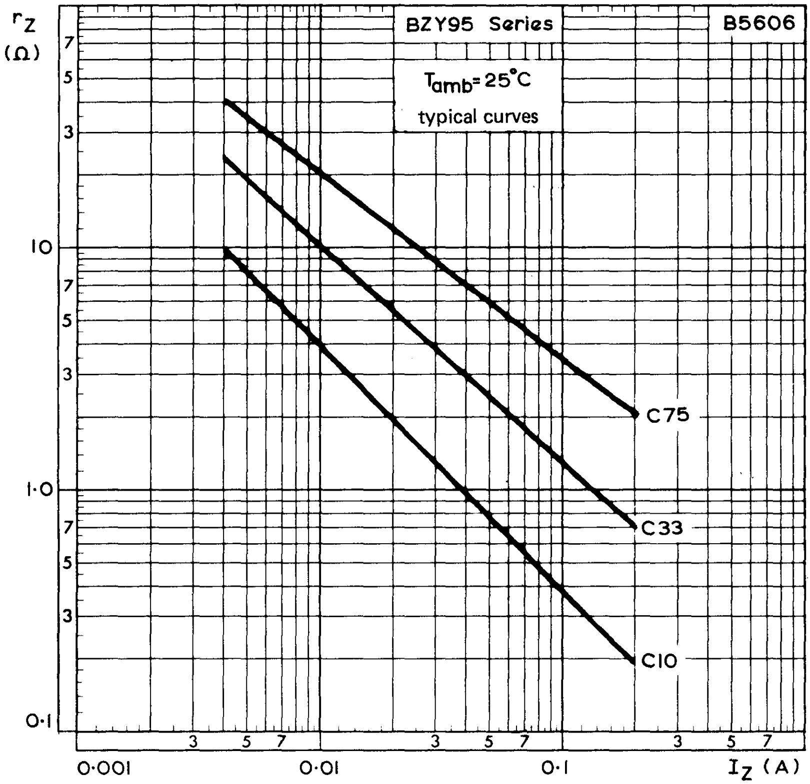
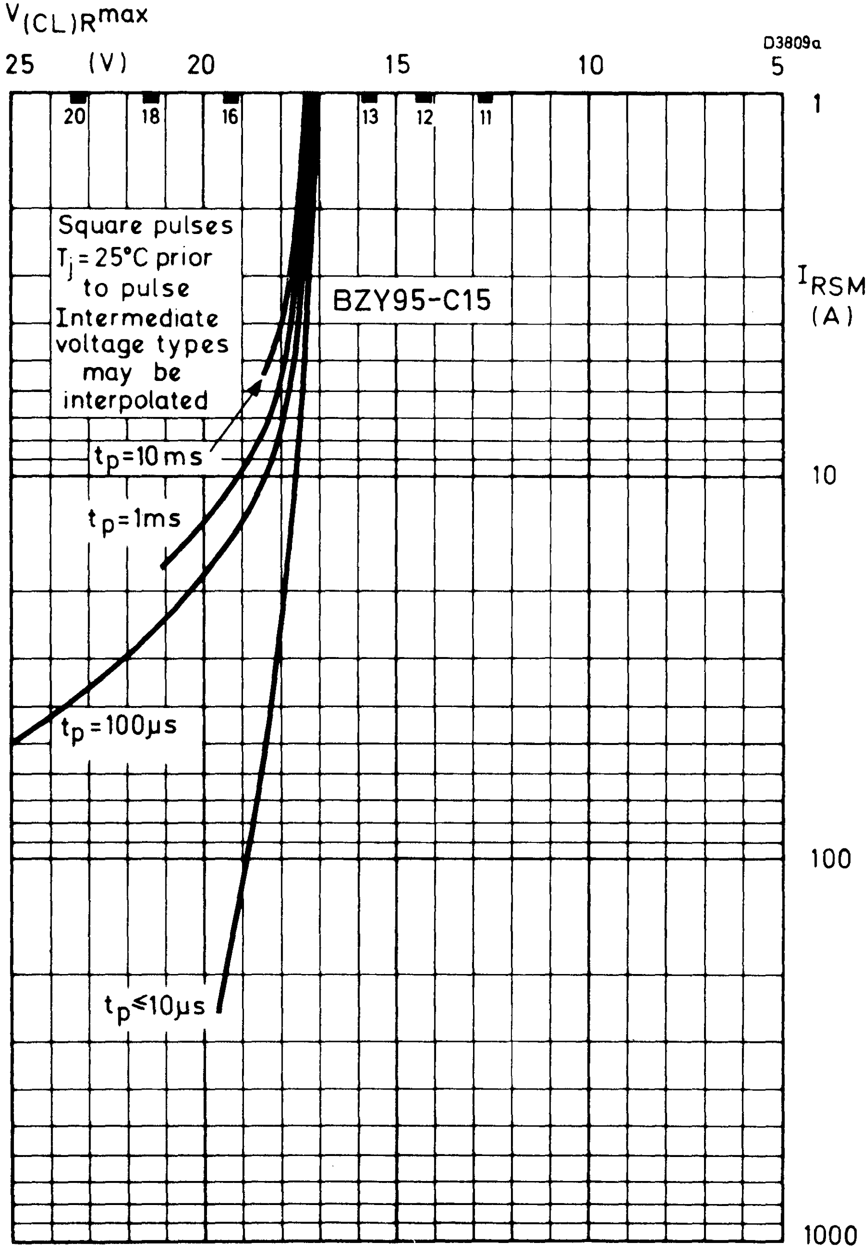

BZY95 Series
B5606
T_{amb} = 25°C
typical curves
r_Z (Ω)
10
1·0
0·1
C75
C33
C10
0·001
0·01
0·1
I_Z (A)

Fig. 13.



D3809a
$V_{(CL)R}$max
(V)
25
20
15
10
5
20
18
16
13
12
11
1
10
100
1000
I_{RSM}
(A)
Square pulses
T_j = 25°C prior
to pulse
Intermediate
voltage types
may be
interpolated
BZY95-C15
t_p=10ms
t_p=1ms
t_p=100μs
t_p≤10μs

Fig. 14.

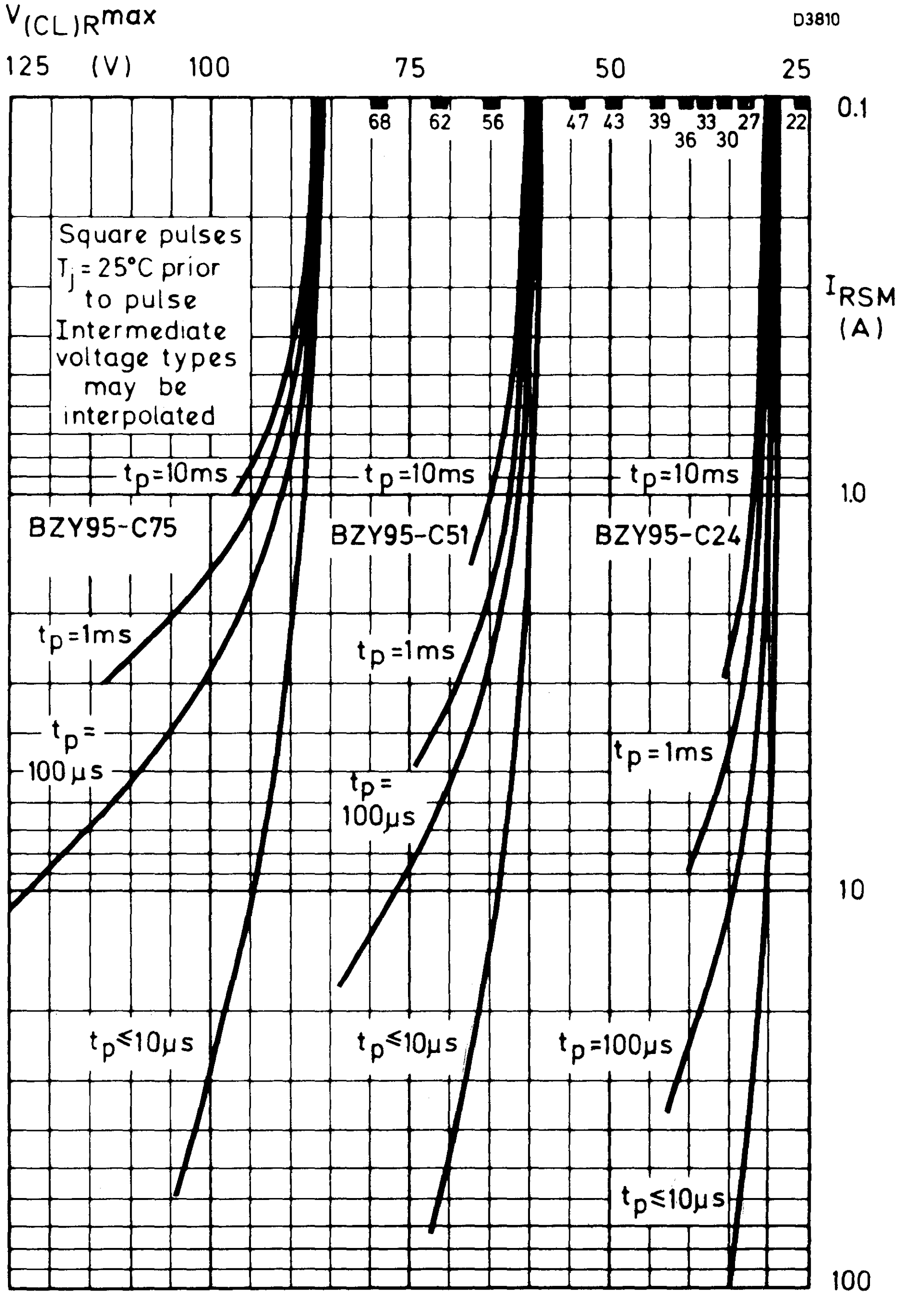

D3810
$V_{(CL)R}max$ (V)
125
100
75
50
25
68
62
56
47
43
39
33
27
22
36
30
0.1
1.0
10
100
I_{RSM} (A)
Square pulses
T_j = 25°C prior to pulse
Intermediate voltage types may be interpolated
t_p=10ms
t_p=10ms
t_p=10ms
BZY95-C75
BZY95-C51
BZY95-C24
t_p=1ms
t_p=1ms
t_p=1ms
t_p= 100µs
t_p= 100µs
t_p=100µs
t_p≤10µs
t_p≤10µs
t_p≤10µs

Fig. 15.

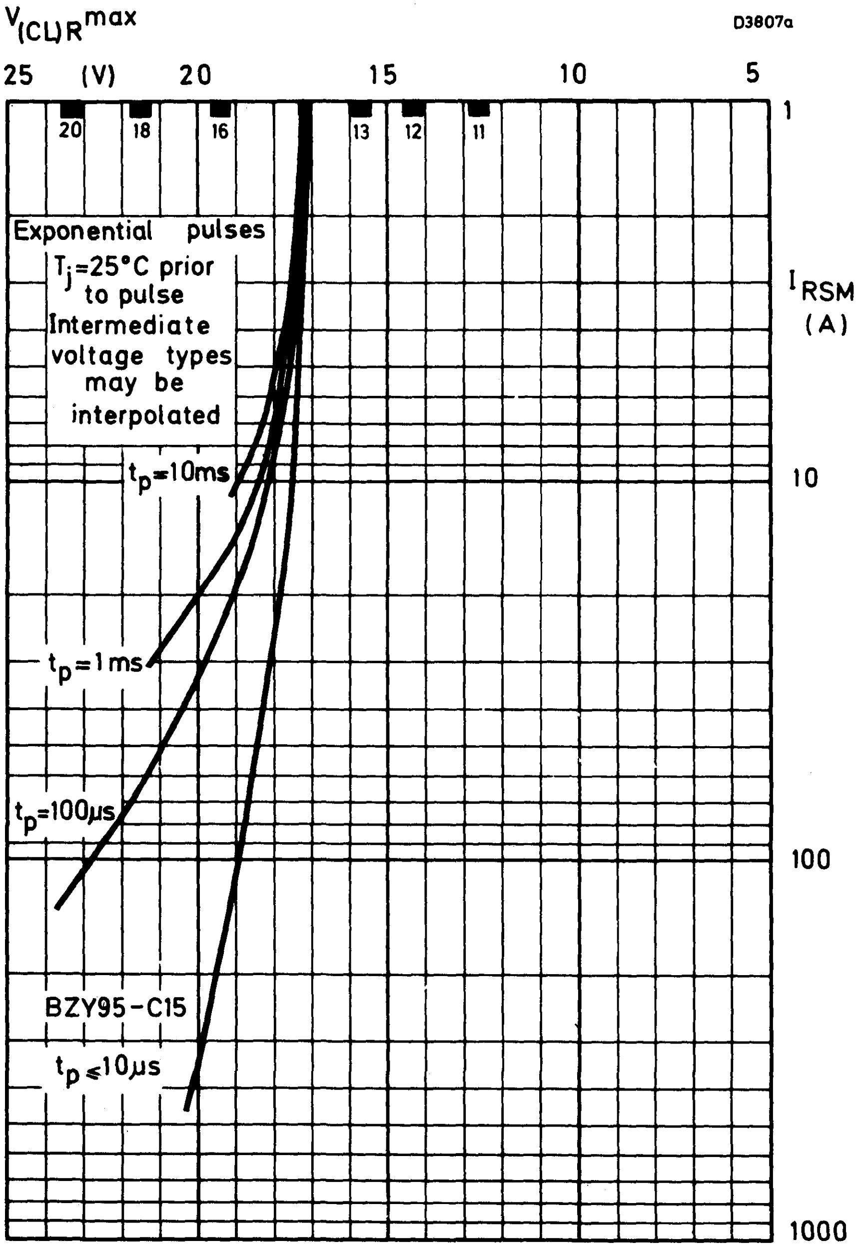

$V_{(CL)R}$ max
D3807a
25
(V)
20
15
10
5
20
18
16
13
12
11
1
10
100
1000
I_{RSM} (A)
Exponential pulses
T_j=25°C prior to pulse
Intermediate voltage types may be interpolated
t_p=10ms
t_p=1ms
t_p=100µs
BZY95-C15
t_p≤10µs

Fig. 16.

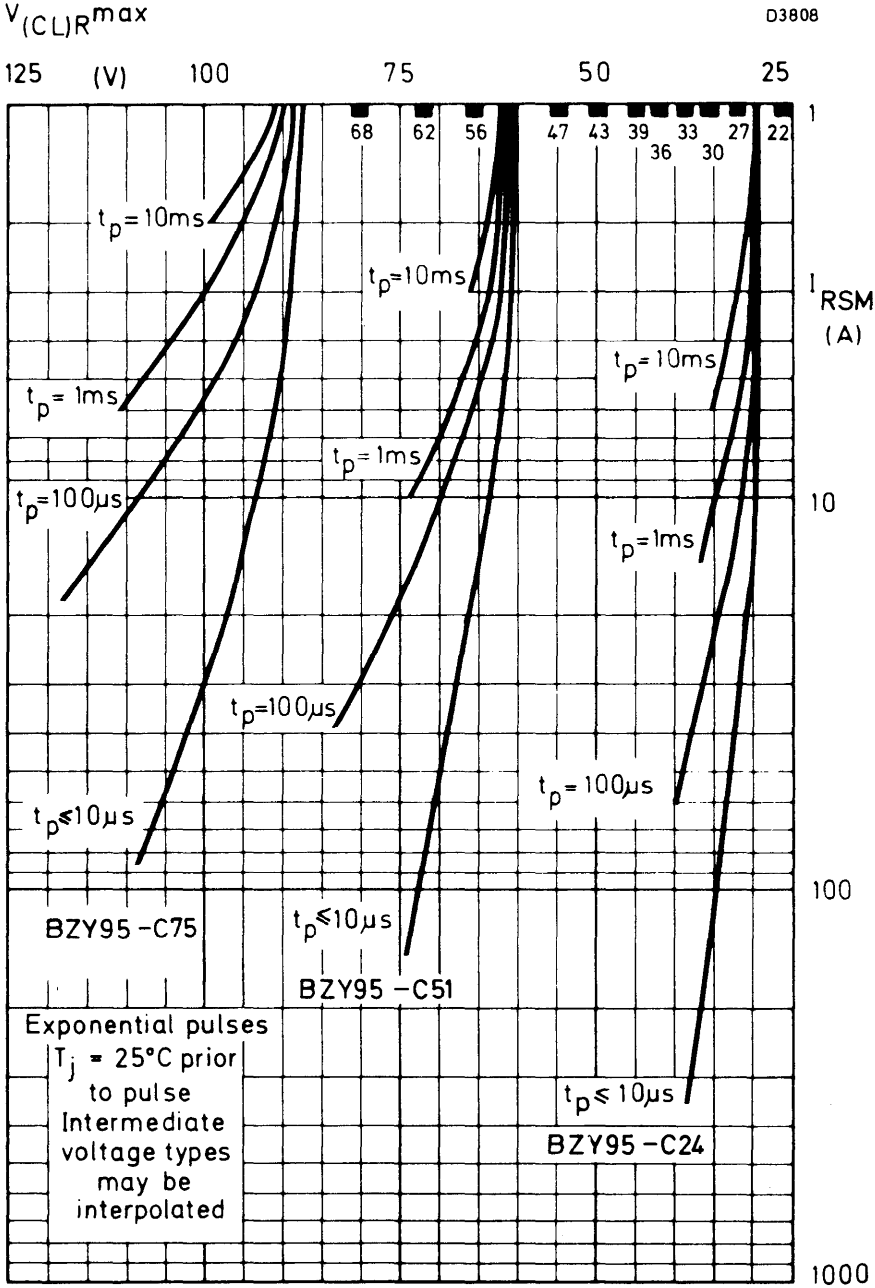

D3808
$V_{(CL)R}$max
(V)
125
100
75
50
25
68
62
56
47
43
39
36
33
30
27
22
1
10
100
1000
I_{RSM}
(A)
t_p=10ms
t_p= 1ms
t_p=100µs
t_p≤10µs
BZY95-C75
t_p=10ms
t_p= 1ms
t_p=100µs
t_p≤10µs
BZY95 -C51
t_p= 10ms
t_p=1ms
t_p= 100µs
t_p≤ 10µs
BZY95 -C24
Exponential pulses
T_j = 25°C prior to pulse
Intermediate voltage types may be interpolated

Fig. 17.

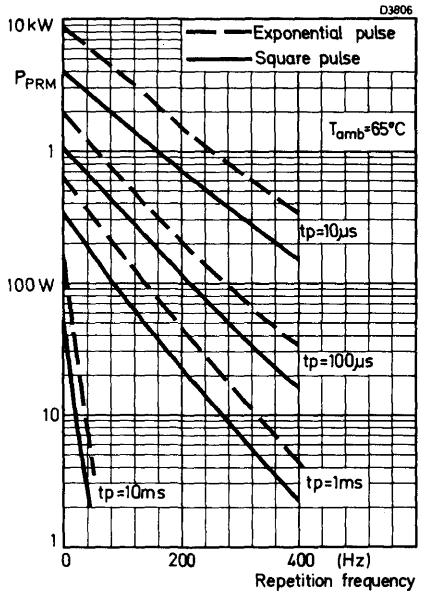


Fig. 18.

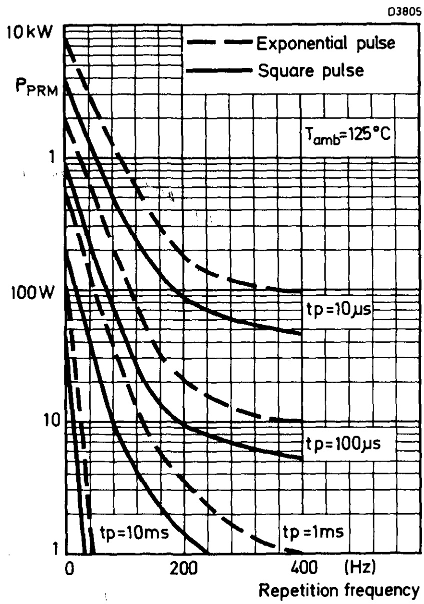


Fig. 19.

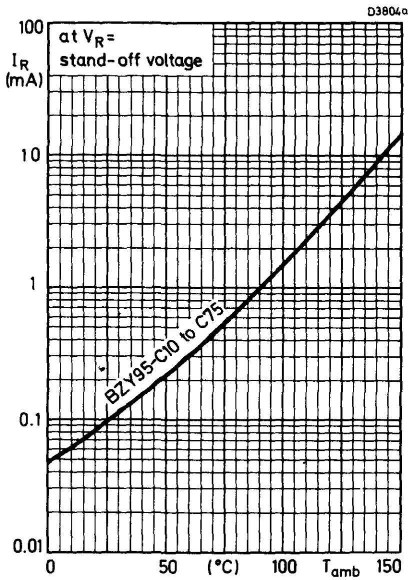


Fig. 20.

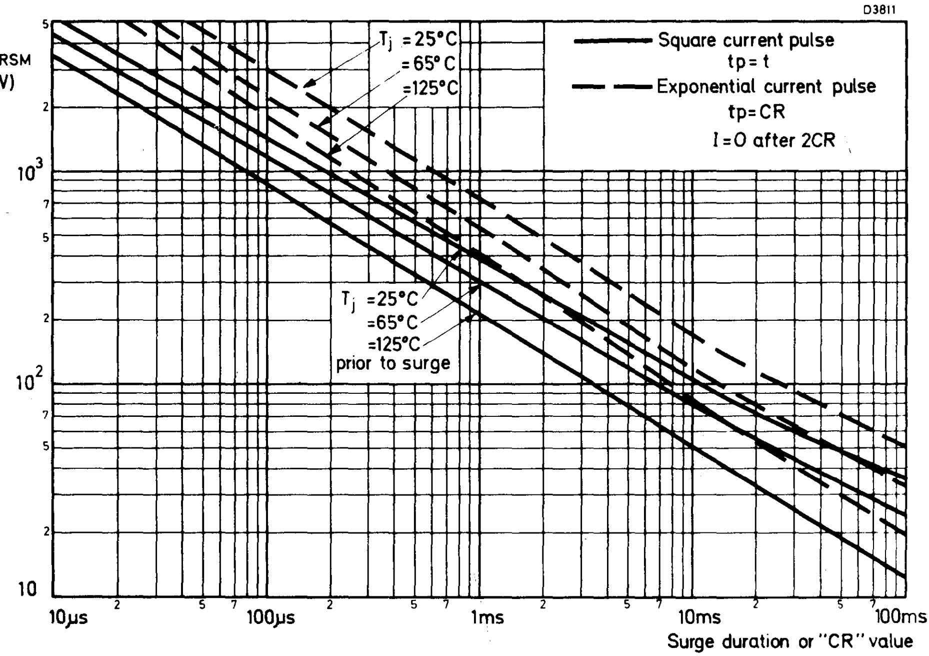

D3811
RSM
V)
10^3
10^2
10
T_j = 25°C
= 65° C
=125°C
T_j =25°C
=65°C
=125°C
prior to surge
Square current pulse
tp = t
Exponential current pulse
tp=CR
I = O after 2CR
10µs
100µs
1ms
10ms
100ms
Surge duration or "CR" value

Fig. 21.

REGULATOR DIODES

Also available to BS9305–F049

A range of alloyed silicon diodes in DO-1 envelopes, intended for use as voltage regulator and transient suppressor diodes in medium power regulators and transient suppression circuits.

The series consists of the following types: BZY96-C4V7 to BZY96-C9V1.

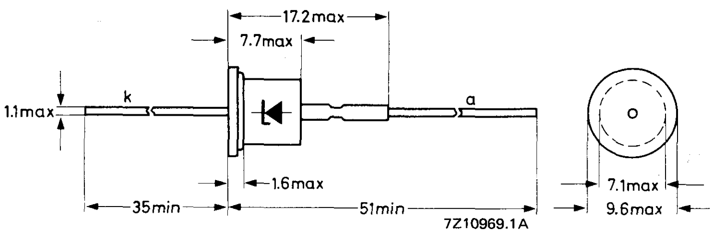
QUICK REFERENCE DATA

			voltage regulator	transient suppressor	
Working voltage (5% range)	V_Z	nom.	4,7 to 9,1	–	V
Stand-off voltage	V_R		–	3,6 to 6,8	V
Total power dissipation	P_{tot}	max.	2,5	–	W
Non-repetitive peak reverse power dissipation	P_{RSM}	max.	–	190	W

MECHANICAL DATA

Dimensions in mm

Fig. 1 DO-1.



RATINGS

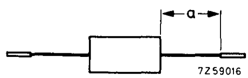
Limiting values in accordance with the Absolute Maximum System (IEC 134)

Peak working current	I_{ZM}	max.	3,5 A
Average forward current (averaged over any 20 ms period)	$I_{F(AV)}$	max.	1 A
Non-repetitive peak reverse current T_j = 25 °C prior to surge; t_p = 1 ms (exponential pulse); BZY96-C4V7 to BZY96-C9V1	I_{RSM}	max.	22 to 12 A
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	2,5 W
at T_{amb} = 75 °C	P_{tot}	max.	1,67 W
Non-repetitive peak reverse power dissipation T_j = 25 °C prior to surge; t_p = 1 ms (exponential pulse)	P_{RSM}	max.	190 W
Storage temperature	T_{stg}		−65 to + 175 °C
Junction temperature	T_j	max.	175 °C

THERMAL RESISTANCE

The quoted values of $R_{th\ j\text{-}a}$ should be used only when no leads of other dissipating components run to the same tie-points.

Thermal resistance from junction to ambient in free air:
mounted on soldering tags
at lead length a = 10 mm $R_{th\ j\text{-}a}$ = 60 °C/W
at lead length a = maximum $R_{th\ j\text{-}a}$ = 70 °C/W



mounted on a printed-circuit board
at lead length a = maximum $R_{th\ j\text{-}a}$ = 80 °C/W
at lead length a = 10 mm $R_{th\ j\text{-}a}$ = 90 °C/W

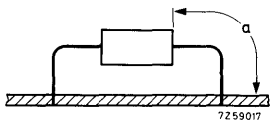


Fig. 2.

CHARACTERISTICS

Forward voltage I_F = 1 A; T_{amb} = 25 °C	V_F	<	1,5 V

CHARACTERISTICS

$T_{amb} = 25\ ^{o}C$

WHEN USED AS VOLTAGE REGULATOR DIODES — WHEN USED AS TRANSIENT SUPPRESSOR DIODES

BZY96-...	working voltage *V_Z V min.	working voltage *V_Z V max.	differential resistance *r_Z Ω typ.	differential resistance *r_Z Ω max.	temperature coefficient *S_Z mV/°C typ.	test I_Z mA	reverse current I_R μA max.	at reverse voltage V_R V	clamping voltage t_p = 500 μs exp. pulse $V_{(CL)R}$ V typ.	clamping voltage $V_{(CL)R}$ V max.	at non-repetitive peak reverse current I_{RSM} A	reverse current at recommended stand-off voltage I_R mA max.	at V_R V	BZY96-...
C4V7	4.4	5.0	2.5	10	−0.6	100	20	1.0	6.5	7.8	10	2.0	3.6	C4V7
C5V1	4.8	5.4	1.0	5.0	−0.4	100	20	1.0	7.0	8.2	10	2.0	3.9	C5V1
C5V6	5.2	6.0	0.7	4.0	+1.0	100	20	1.0	7.5	8.8	10	0.2	4.3	C5V6
C6V2	5.8	6.6	0.6	3.0	+2.0	100	20	2.0	8.0	9.4	10	0.2	4.7	C6V2
C6V8	6.4	7.2	0.6	3.0	+3.0	100	20	2.0	8.5	10	10	0.2	5.1	C6V8
C7V5	7.0	7.9	1.0	3.5	+4.0	50	20	3.0	9.5	11	10	0.2	5.6	C7V5
C8V2	7.7	8.7	1.2	3.5	+5.0	50	20	5.6	11	13	10	0.1	6.2	C8V2
C9V1	8.5	9.6	1.8	4.5	+6.4	50	20	6.2	13	15	10	0.1	6.8	C9V1

*At test I_Z; using a pulse method with $t_p \leqslant 100\ \mu s$ and $\delta \leqslant 0.001$ so that the values correspond to a T_j of approximately 25 °C

OPERATION AS A VOLTAGE REGULATOR

Dissipation and heatsink considerations

a. Steady-state conditions

The maximum permissible steady-state dissipation $P_{s\,max}$ is given by the relationship

$$P_{s\,max} = \frac{T_{j\,max} - T_{amb}}{R_{th\,j\text{-}a}}$$

where: $T_{j\,max}$ is the maximum permissible operating junction temperature
T_{amb} is the ambient temperature
$R_{th\,j\text{-}a}$ is the total thermal resistance from junction to ambient

b. Pulse conditions (see Fig. 3)

The maximum permissible pulse power $P_{p\,max}$ is given by the formula

$$P_{p\,max} = \frac{(T_{j\,max} - T_{amb}) - (P_s \cdot R_{th\,j\text{-}a})}{R_{th\,t}}$$

Where: P_s is any steady-state dissipation excluding that in pulses
$R_{th\,t}$ is the effective transient thermal resistance of the device between junction and ambient. It is a function of the pulse duration t_p and duty factor δ.
δ is the duty factor (t_p/T)

The steady-state power P_s when biased in the zener direction at a given zener current can be found from Fig. 4. With the additional pulse power dissipation $P_{p\,max}$ calculated from the above expression, the total peak zener power dissipation $P_{tot} = P_{ZRM} = P_s + P_p$. From Fig. 4 the corresponding maximum repetitive peak zener current at P_{tot} can now be read. This repetitive peak zener current is subject to the absolute maximum rating. For pulse durations longer than the temperature stabilization time of the diode t_{stab}, the maximum permissible repetitive peak dissipation P_{ZRM} is equal to the steady-state power P_s. The temperature stabilization time for the BZY96 is 100 seconds (see Fig. 10).

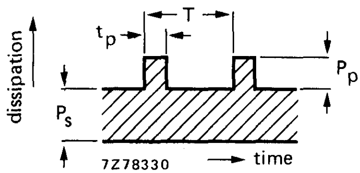


Fig. 3.

NOTES WHEN OPERATING AS A TRANSIENT SUPPRESSOR

1. The stand-off voltage is the maximum reverse voltage recommended for continuous operation; at this value non-conduction is ensured.
2. The maximum clamping voltage is the maximum reverse voltage which appears across the diode at the specified pulse duration and junction temperature. For square pulses see Fig. 13 and for exponential pulses see Fig. 14.
3. Duration of an exponential pulse is defined as the time taken for the pulse to fall to 37% of its initial value. It is assumed that the energy content does not continue beyond twice this time.
4. Surge suppressor diodes are extremely fast in clamping, switching on in less than 5 ns.

SOLDERING AND MOUNTING INSTRUCTIONS

1. When using a soldering iron, diodes may be soldered directly into the circuit, but heat conducted to the junction should be kept to a minimum.
2. Diodes may be dip-soldered at a solder temperature of 245 ^{o}C for a maximum soldering time of 5 seconds. The case temperature during dip-soldering must not at any time exceed the maximum storage temperature. These recommendations apply to a diode with the anode end mounted flush on a printed-circuit board having punched-through holes. For mounting the anode end onto a printed-circuit board, the diode must be spaced at least 5 mm from the underside of the printed-circuit board having punched-through holes, or 5 mm from the top of the printed-circuit board having plated-through holes.
3. Care should be taken not to bend the leads nearer than 1,5 mm from the seal; exert no axial pull when bending.

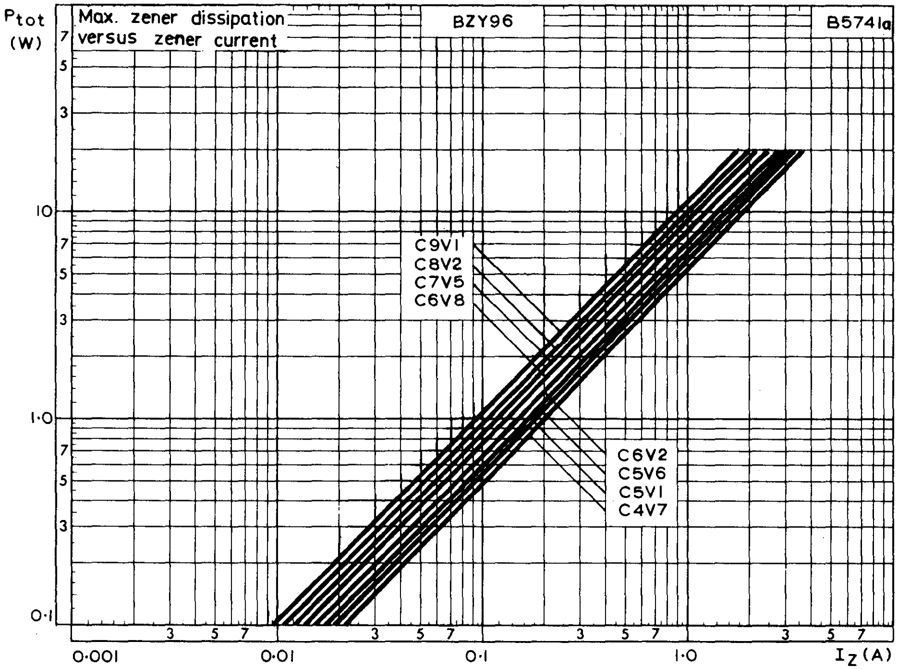


Fig. 4 Maximum permissible repetitive peak dissipation ($P_{tot} = P_{ZRM}$).

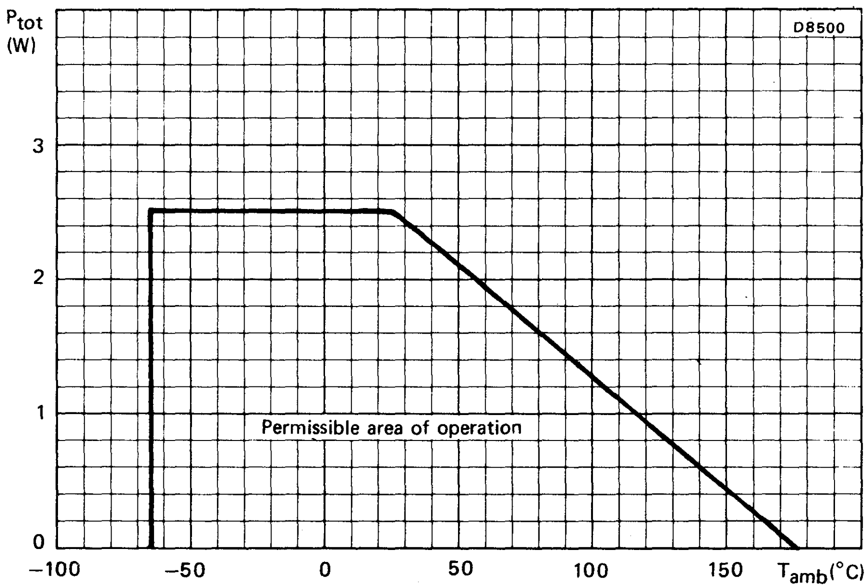


Fig. 5 Maximum permissible total power dissipation versus ambient temperature.

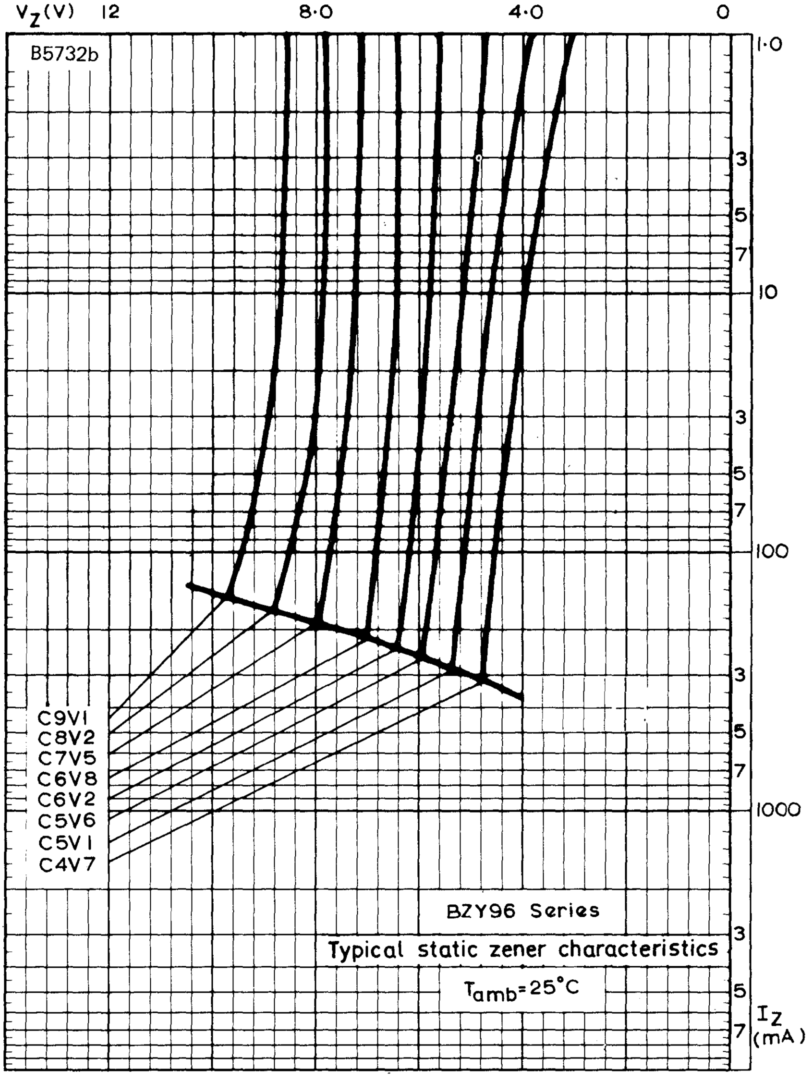


Fig. 6 Typical static zener characteristics.

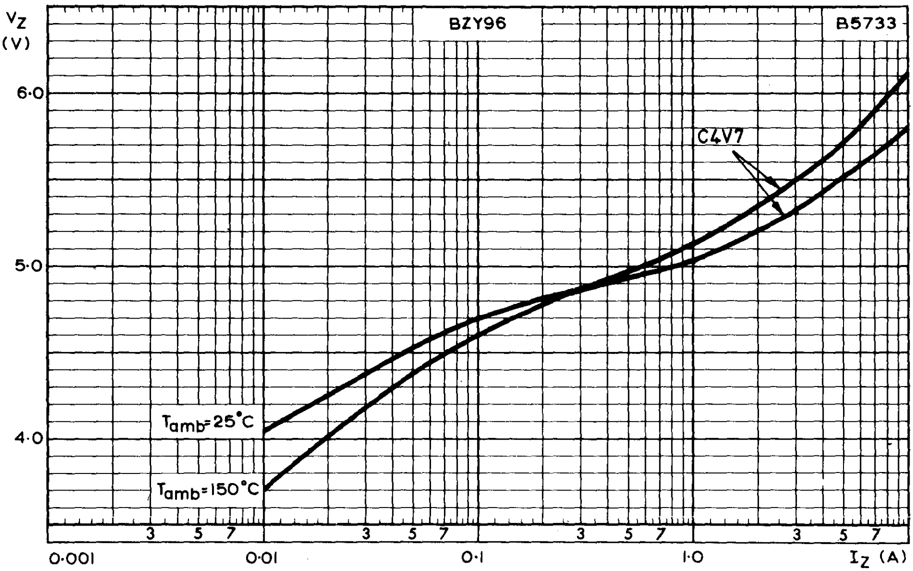


Fig. 7 Typical dynamic zener characteristics for BZY96-C4V7.

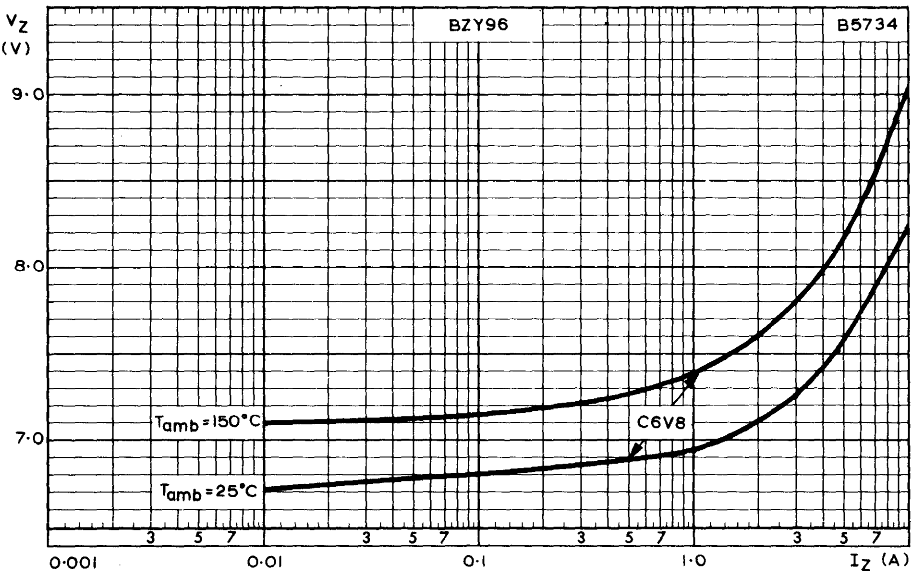


Fig. 8 Typical dynamic zener characteristics for BZY96-C6V8.

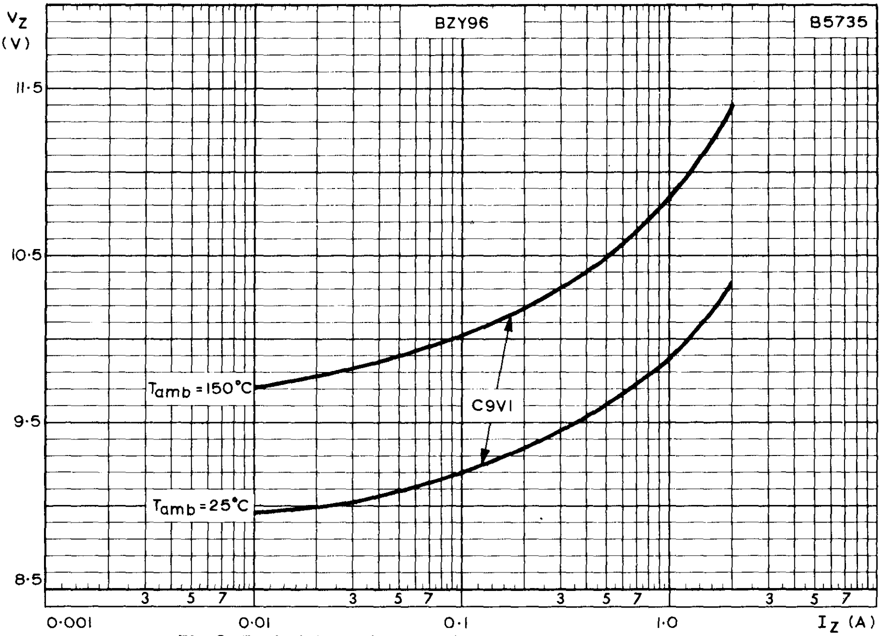


Fig. 9 Typical dynamic zener characteristics for BZY96-C9V1.

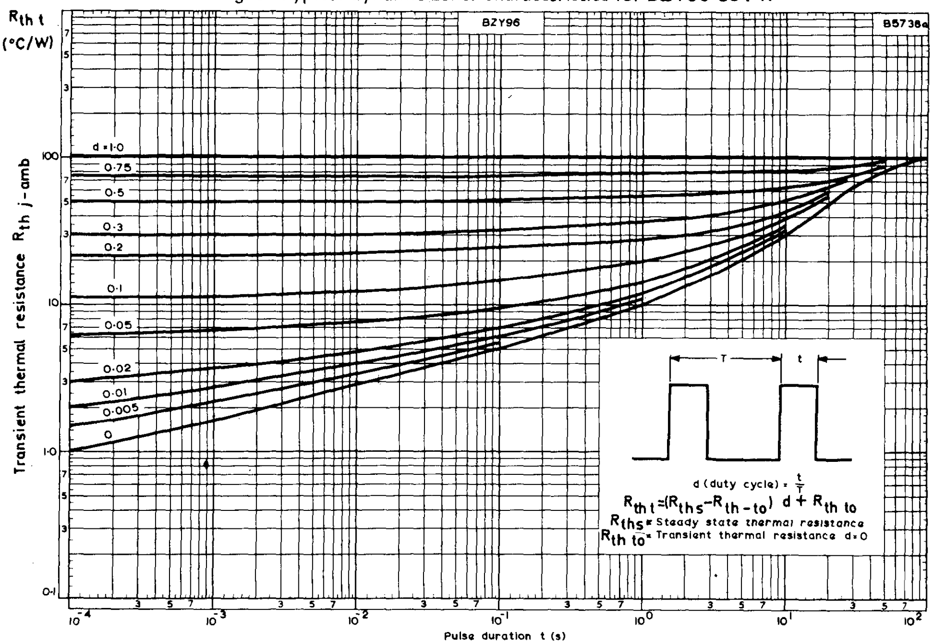


Fig. 10.

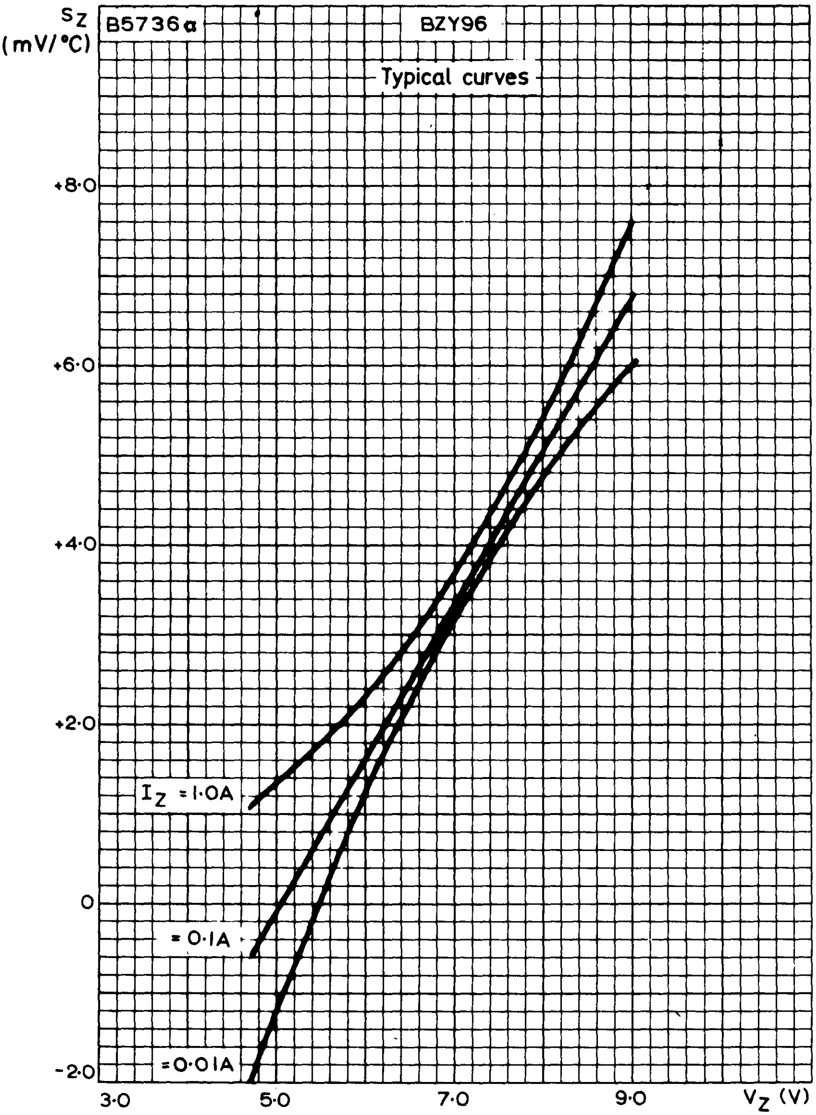

B5736a
BZY96
Typical curves
S_Z (mV/°C)
+8·0
+6·0
+4·0
+2·0
0
-2·0
I_Z = 1·0A
= 0·1A
= 0·01A
3·0
5·0
7·0
9·0
V_Z (V)

Fig. 11.

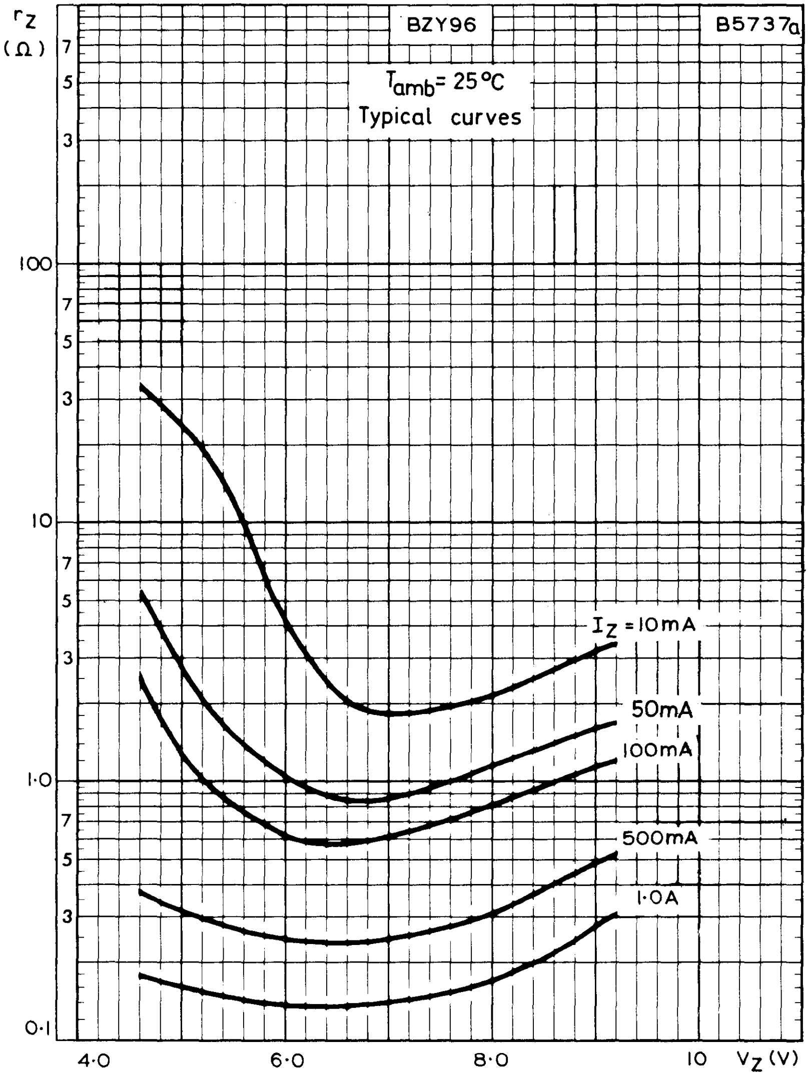
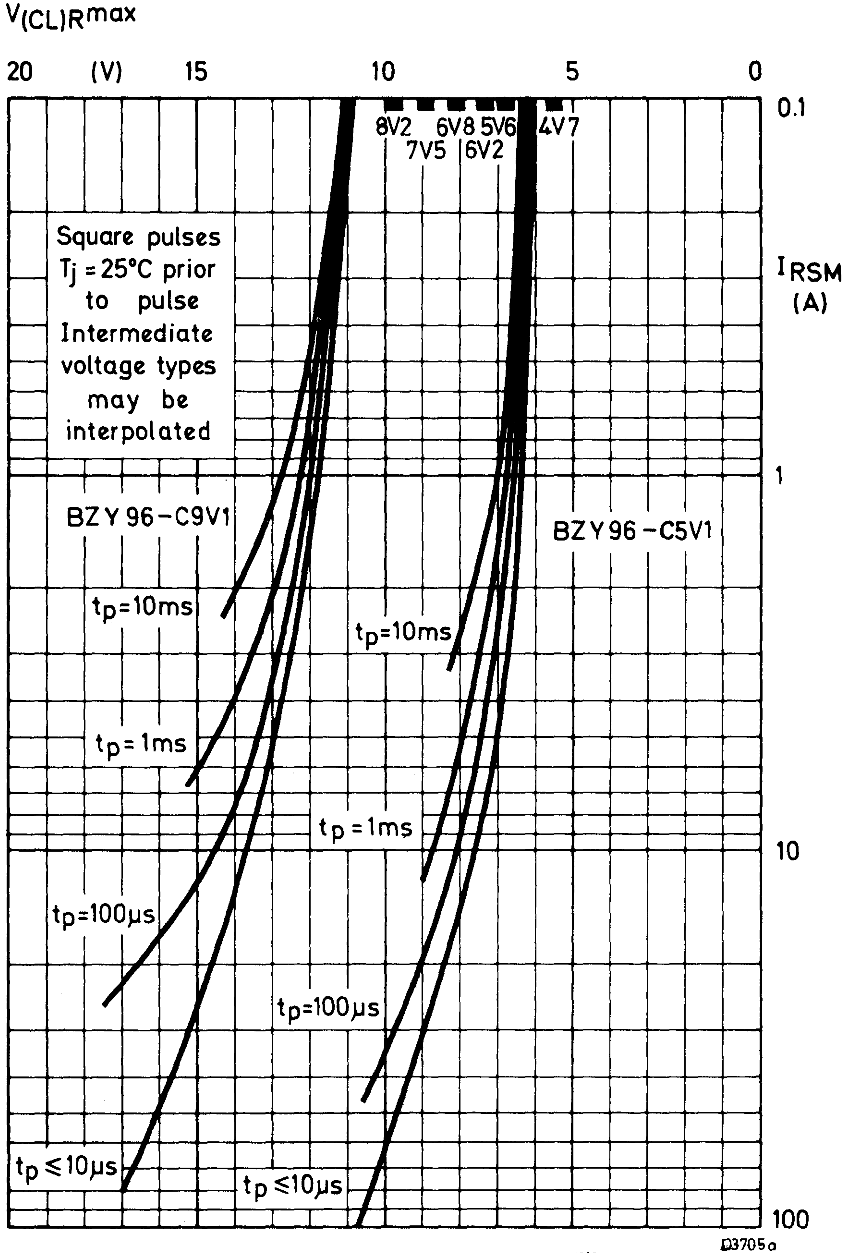

BZY96
B5737a
T_{amb} = 25 °C
Typical curves
r_Z (Ω)
7
5
3
100
7
5
3
10
7
5
3
1·0
7
5
3
0·1
I_Z = 10mA
50mA
100mA
500mA
1·0A
4·0
6·0
8·0
10
V_Z (V)

Fig. 12.



V(CL)Rmax
20
(V)
15
10
5
0
0.1
1
10
100
IRSM (A)
8V2
7V5
6V8
6V2
5V6
4V7
Square pulses Tj = 25°C prior to pulse Intermediate voltage types may be interpolated
BZY96-C9V1
BZY96-C5V1
tp=10ms
tp=1ms
tp=100μs
tp≤10μs
tp=10ms
tp=1ms
tp=100μs
tp≤10μs
D3705a

Fig. 13.

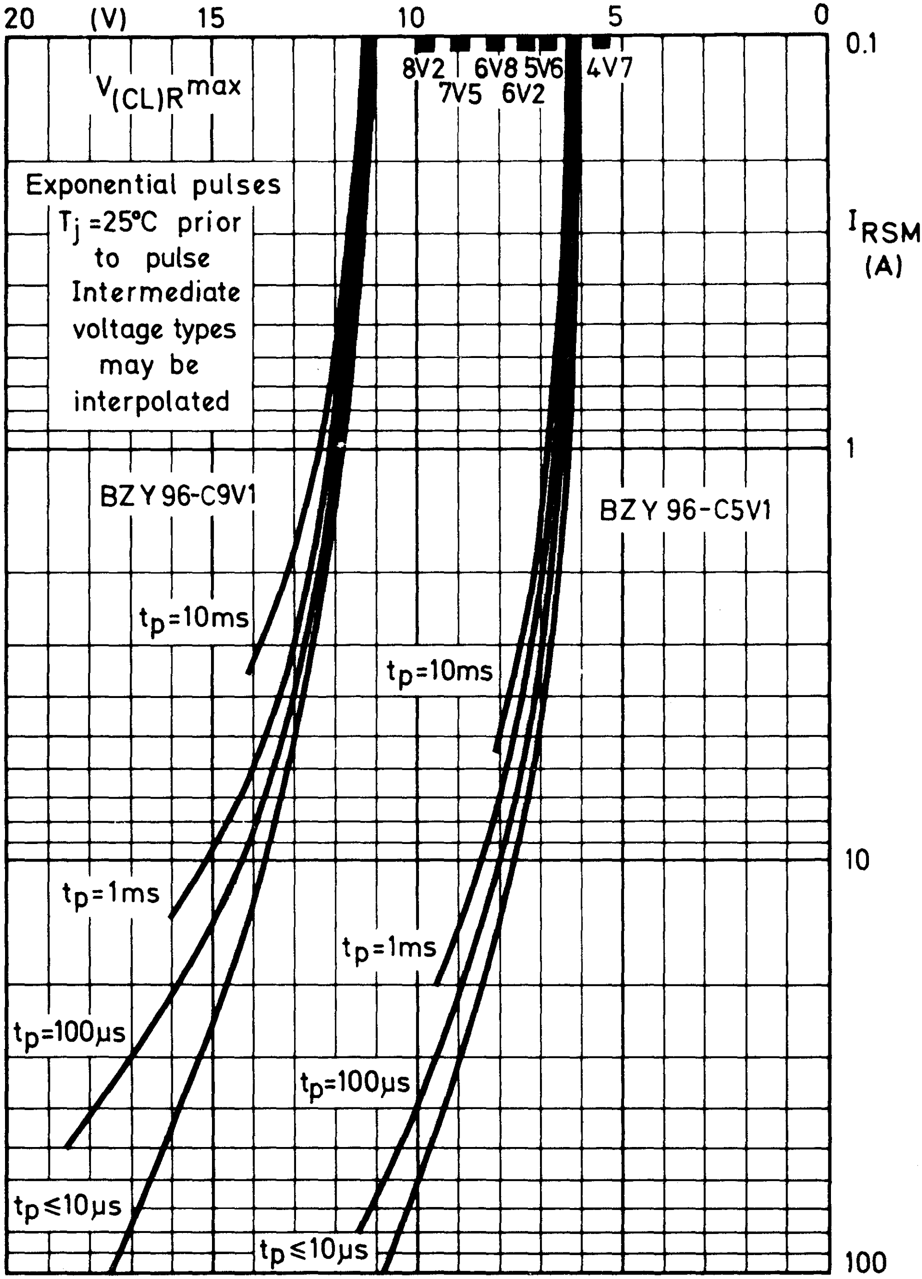

20
(V)
15
10
5
0
0.1
1
10
100
$V_{(CL)R}max$
8V2
7V5
6V8
6V2
5V6
4V7
I_{RSM}
(A)
Exponential pulses
T_j =25°C prior to pulse
Intermediate voltage types may be interpolated
BZY 96-C9V1
BZY 96-C5V1
t_p=10ms
t_p=10ms
t_p=1ms
t_p=1ms
t_p=100μs
t_p=100μs
t_p≤10μs
t_p≤10μs
D3704a

Fig. 14.

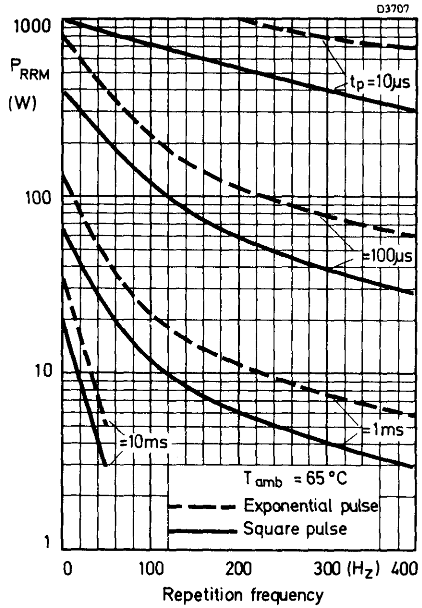


Fig. 15.

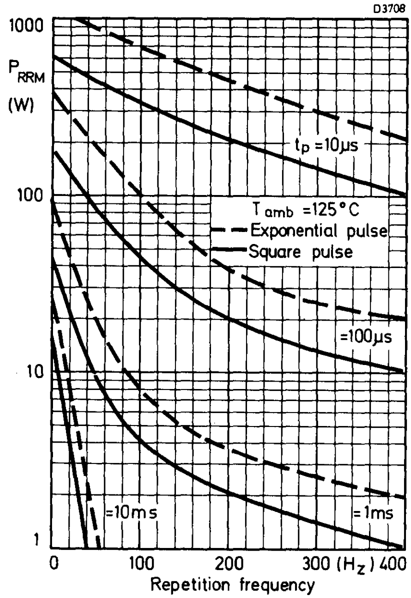


Fig. 16.

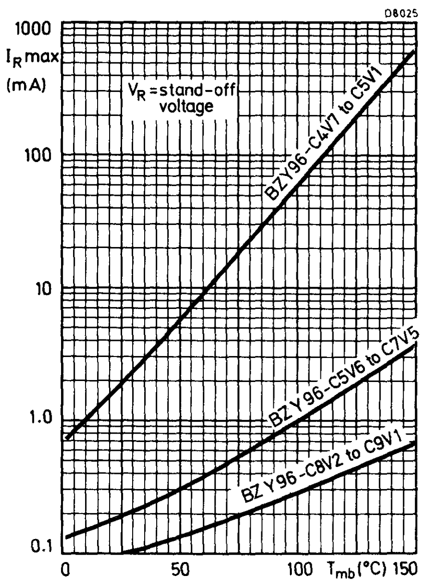


Fig. 17.

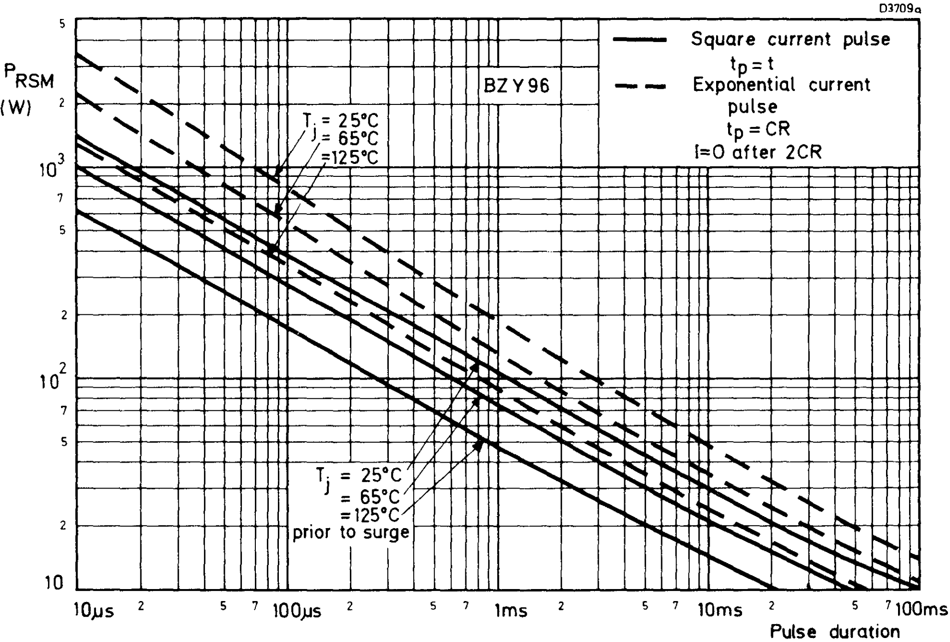

D3709a
P_{RSM} (W)
5
2
10^3
7
5
2
10^2
7
5
2
10
BZY96
Square current pulse
$t_p = t$
Exponential current pulse
$t_p = CR$
I=0 after 2CR
T_j = 25°C
= 65°C
=125°C
T_j = 25°C
= 65°C
=125°C
prior to surge
10µs 2 5 7 100µs 2 5 7 1ms 2 5 7 10ms 2 5 7 100ms
Pulse duration

Fig. 18.

HIGH-VOLTAGE RECTIFIER STACKS

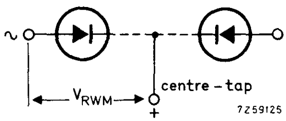
D

D

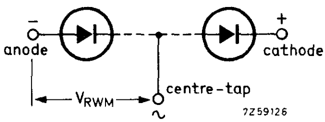
HIGH VOLTAGE RECTIFIER STACKS

The OSB9110, OSM9110 and OSS9110series are ranges of high voltage rectifier assemblies, incorporating controlled avalanche diodes mounted on fire proof triangular formers. The OSB9110series is intended for application in two phase half wave rectifier circuits. The OSM9110series is intended for application in single phase or three phase bridges or in voltage doubler circuits.
The OSS9110series is intended for all kinds of high voltage rectification. The assemblies are supplied with M6 studs or with standard valve bases. The OSB9110-series and OSM9110series are supplied with a centre tap (8-32UNC). The maximum crest working voltages of the OSB9110 and OSM9110series cover the range from 2 kV to 15 kV, and of the OSS9110series the range from 3 kV to 30 kV, in 1 kV steps.

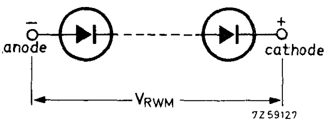
CIRCUIT OSB9110



CIRCUIT OSM9110



CIRCUIT OSS9110



QUICK REFERENCE DATA

Crest working reverse voltage from centre tap to end		OSB9110	−4	−6	. . .	−28	−30	
		OSM9110	−4	−6	. . .	−28	−30	
	V_{RWM}	max.	2	3	. . .	14	15	kV
Crest working reverse voltage		OSS9110	−3	−4	. . .	−29	−30	
	V_{RWM}	max.	3	4	. . .	29	30	kV
Average forward current with R and L load (averaged over any 20 ms period)								
in free air up to T_{amb} = 35 °C	$I_{F(AV)}$	max.					3.5	A
in oil up to T_{oil} = 100 °C	$I_{F(AV)}$	max.					6	A
Non-repetitive peak forward current t = 10 ms; half sine wave; T_j = 175 °C prior to surge	I_{FSM}	max.					125	A

MECHANICAL DATA see pages 4 and 5.

All information applies to frequencies up to 400 Hz

RATINGS Limiting values in accordance with the Absolute Maximum System (IEC 134)

Voltages

			OSB9110 −4 / OSM9110−4	−6	...	−28	−30	
Crest working reverse voltage	V_{RWM}	max.	2	3	...	14	15	kV

			OSS9110 −3	−4	...	−29	−30	
Crest working reverse voltage	V_{RWM}	max.	3	4	...	29	30	kV

Currents

Average forward current (averaged over any 20 ms period) in free air up to T_{amb} = 35 °C	$I_{F(AV)}$	max.	3.5	A
in oil up to T_{oil} = 100 °C	$I_{F(AV)}$	max.	6	A
Repetitive peak forward current	I_{FRM}	max.	120	A
Non-repetitive peak forward current t = 10 ms; half sine wave; T_j = 175 °C prior to surge	I_{FSM}	max.	125	A

Reverse power dissipation

			OSB9110 −4 / OSM9110−4	−6	...	−28	−30	
Repetitive peak reverse power t = 10 μs (square wave; f = 50 Hz) T_j = 175 °C	P_{RRM}	max.	1.2	1.8	...	8.4	9	kW
Non-repetitive peak reverse power t = 10 μs (square wave) T_j = 25 °C prior to surge	P_{RSM}	max.	6	9	...	42	45	kW
T_j = 125 °C prior to surge	P_{RSM}	max.	1.2	1.8	...	8.4	9	kW

			OSS9110 −3	−4	...	−29	−30	
Repetitive peak reverse power dissipation t = 10 μs (square wave; f = 50 Hz) T_j = 175 °C	P_{RRM}	max.	1.8	2.4	...	17.4	18	kW
Non-repetitive peak reverse power dissipation t = 10 μs (square wave) T_j = 25 °C prior to surge	P_{RSM}	max.	9	12	...	87	90	kW
T_j = 175 °C prior to surge	P_{RSM}	max.	1.8	2.4		17.4	18	kW

Temperatures

Storage temperature	T_{stg}		−55 to +175	°C
Junction temperature	T_j	max.	175	°C

CHARACTERISTICS (See note 1)

			OSB9110 -4	-6	...	-28	-30	
			OSM9110-4	-6	...	-28	-30	
Forward voltage								
I_F = 20 A; T_j = 25 °C	V_F	<	4	6	...	28	30	V
Reverse avalanche breakdown voltage [1]								
I_R = 5 mA; T_j = 25 °C	$V_{(BR)R}$	>	2.5	3.75	...	17.5	18.75	kV
		<	3.76	5.64	...	26.32	28.2	kV

			OSS9110 -3	-4	...	-29	-30	
Forward voltage								
I_F = 20 A; T_j = 25 °C	V_F	<	6	8	...	58	60	V
Reverse avalanche breakdown voltage [1]								
I_R = 5 mA; T_j = 25 °C	$V_{(BR)R}$	>	3.75	5.0	...	36.25	37.5	kV
		<	5.64	7.52	...	54.52	56.4	kV

Reverse current				
$V_{RM} = V_{RWMmax}$; T_j = 125 °C	I_{RM}	<	0.6	mA

NOTES

1. The Ratings and Characteristics given apply from centre tap to end. (Not for OSS9110series)
2. Type number suffix

   The suffix consists of a figure indicating the total number of diodes, followed by a letter indicating the base.
   A = M6 studs at the ends
   B = 4 pin Super Jumbo (B4D)
   C = Goliath
   E = 4 pin Jumbo (B4F)
   F = A3-20
3. Operating position

   The rectifier units can be operated at their maximum ratings when mounted in any position.

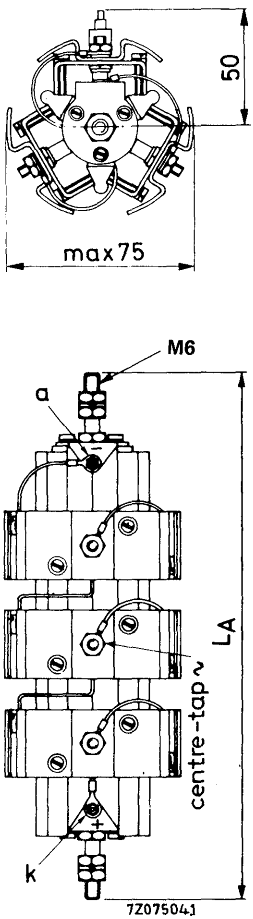
[1] The breakdown voltage increases by approximately 0.1 % per °C with increasing junction temperature.

MECHANICAL DATA

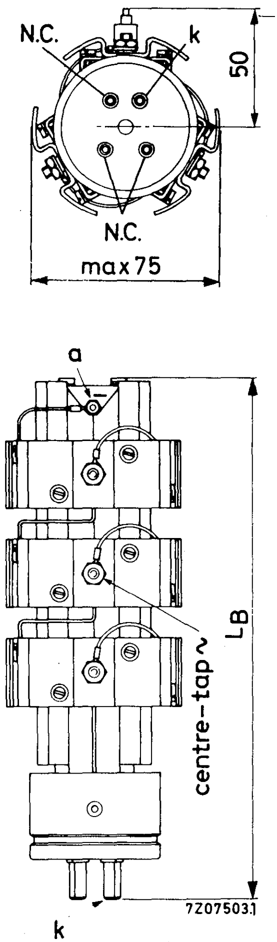
Dimensions in mm

n = total number of diodes

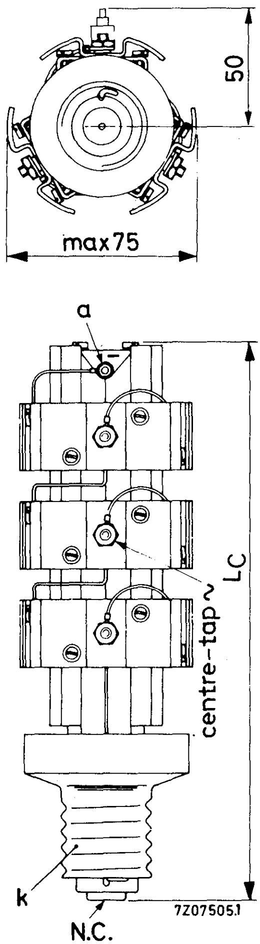
OSM9110-nA



OSM9110-nB



OSM9110-nC



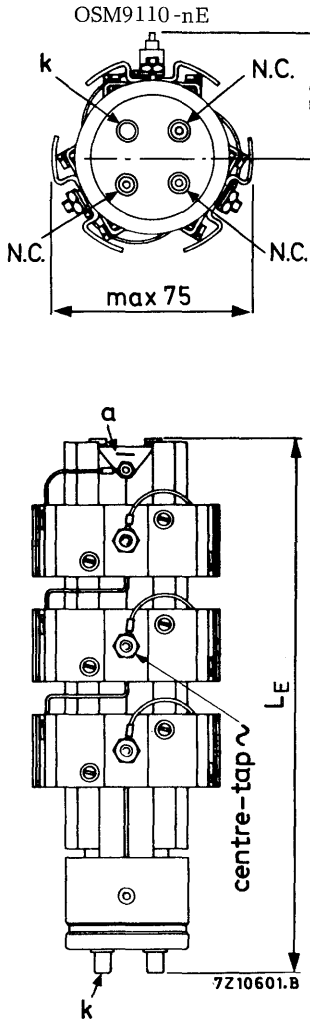
The drawings show the OSM9110series; the OSB9110 and OSS9110series differ in the following respects:

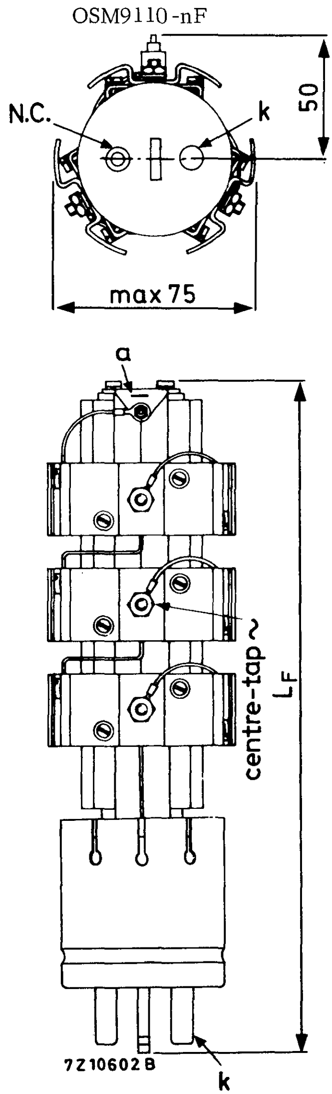
OSB9110series – terminals marked a(-) and k(+) in the drawings are both marked ∿ ; the centre-tap is marked + (instead of ∿ as in the drawings).

OSS9110series – has no centre-tap.

MECHANICAL DATA (continued)

n = total number of diodes.



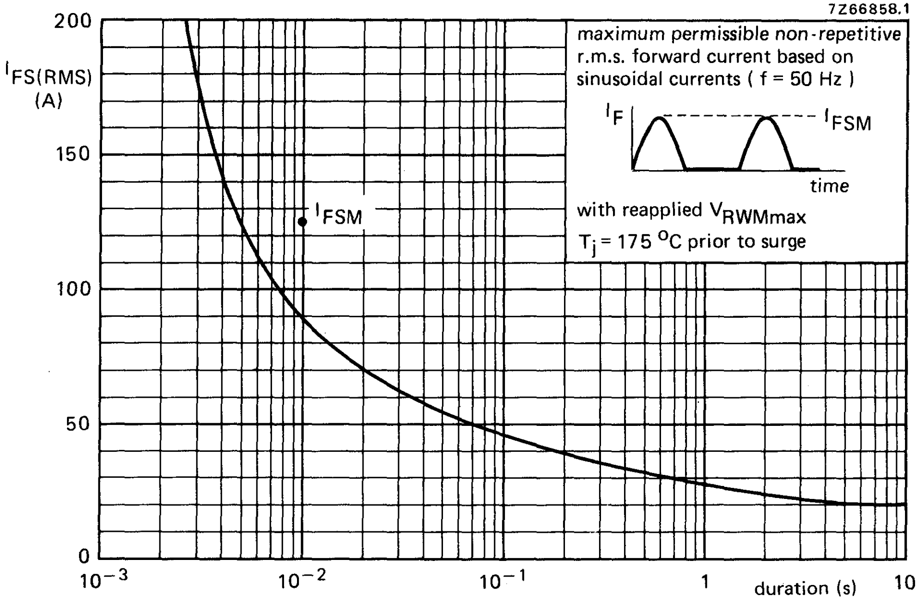


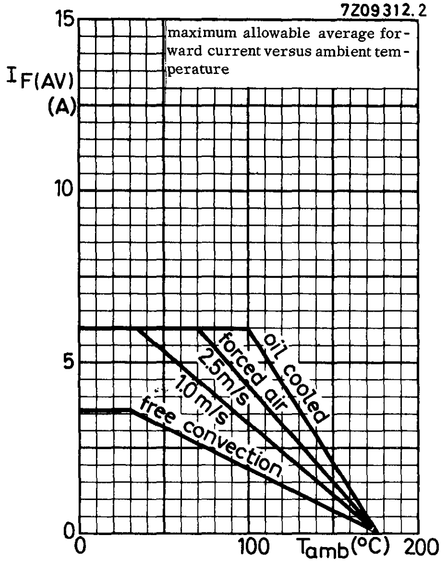
For lengths and weights see table on page 6.

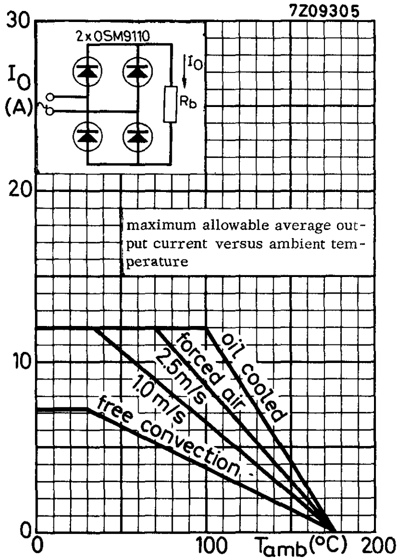
Table of lengths and weights (mm and g)

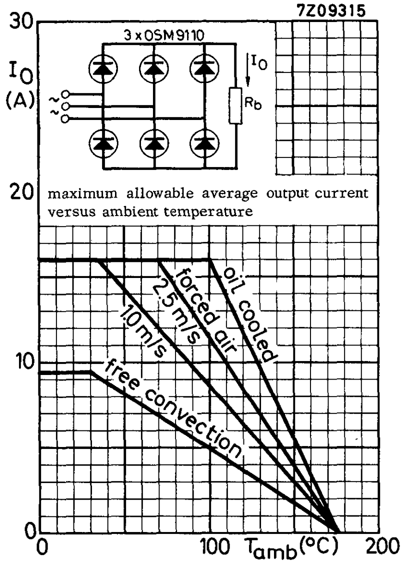
number of diodes	n	3	4 to 6	7 to 9	10 to 12	13 to 15
maximum lengths	L_A	143	184	224	264	305
	L_B	147	188	228	268	309
	L_C	159	199	239	279	320
	L_E	132	173	213	253	294
	L_F	184	225	265	305	346
weights	W_A	153	286	419	552	685
$W_B = W_C =$	W_E	218	351	484	617	750
	W_F	379	512	645	778	911

number of diodes	n	16 to 18	19 to 21	22 to 24	25 to 27	28 to 30
maximum lengths	L_A	345	385	426	466	506
	L_B	349	389	430	470	510
	L_C	360	400	441	481	521
	L_E	334	374	415	455	495
	L_F	386	426	467	507	547
weights	W_A	818	951	1048	1217	1350
$W_B = W_C =$	W_E	883	1016	1149	1282	1415
	W_F	1044	1177	1310	1443	1576


7Z66858.1
$I_{FS(RMS)}$ (A)
200
150
100
50
0
10^{-3}
10^{-2}
10^{-1}
1
10
duration (s)
I_{FSM}
maximum permissible non-repetitive r.m.s. forward current based on sinusoidal currents (f = 50 Hz)
I_F
I_{FSM}
time
with reapplied V_{RWMmax}
T_j = 175 °C prior to surge

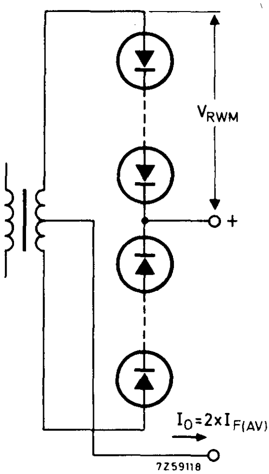

7Z09312.2
maximum allowable average forward current versus ambient temperature
$I_{F(AV)}$ (A)
15
10
5
0
0
100
T_{amb} (°C)
200
oil cooled
forced air
2.5 m/s
1.0 m/s
free convection


7Z09305
2 x OSM9110
I_O
R_b
maximum allowable average output current versus ambient temperature
I_O (A)
30
20
10
0
0
100
T_{amb} (°C)
200
oil cooled
forced air
2.5 m/s
1.0 m/s
free convection

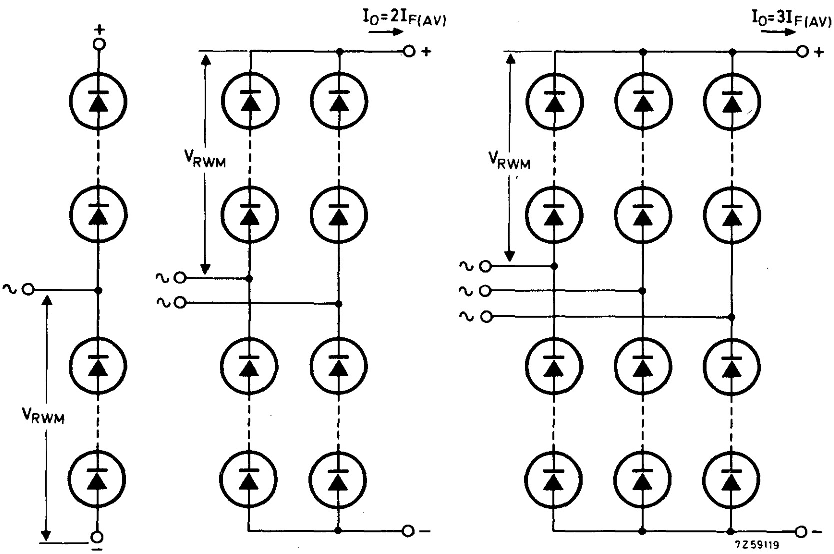

7Z09315
3 x OSM9110
I_O
R_b
maximum allowable average output current versus ambient temperature
I_O (A)
30
20
10
0
0
100
T_{amb} (°C)
200
oil cooled
forced air
2.5 m/s
1.0 m/s
free convection

APPLICATION INFORMATION

OSB9110-4



OSM9110series



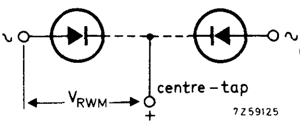
voltage doubler
1x OSM 9110

rectifier circuits with respectively
2x OSM9110 and 3x OSM9110

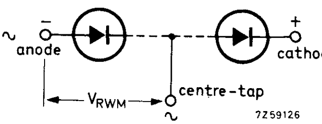
HIGH VOLTAGE RECTIFIER STACKS

The OSB9210, OSM9210 and OSS9210series are ranges of high voltage rectifier assemblies, incorporating controlled avalanche diodes mounted on fireproof triangular formers. The OSB9210series is intended for application in two phase half wave rectifier circuits. The OSM9210series is intended for application in single phase or three phase bridges or in voltage doubler circuits.
The OSS9210series is intended for all kinds of high voltage rectification. The assemblies are supplied with M6 studs or with standard valve bases. The OSB9210-series and OSM9210series are supplied with a centre tap (8-32UNC). The maximum crest working voltages of the OSB9210 and OSM9210series cover the range from 2 kV to 15 kV, and of the OSS9210series the range from 3 kV to 30 kV, in 1 kV steps.

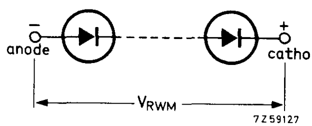
CIRCUIT OSB9210



CIRCUIT OSM9210



CIRCUIT OSS9210



QUICK REFERENCE DATA								
			OSB9210 −4	−6	...	−28	−30	
			OSM9210−4	−6	...	−28	−30	
Crest working reverse voltage from centre tap to end	V_{RWM}	max.	2	3	...	14	15	kV
			OSS9210 −3	−4	...	−29	−30	
Crest working reverse voltage	V_{RWM}	max.	3	4	...	29	30	kV
Average forward current with R and L load (averaged over any 20 ms period)								
in free air up to T_{amb} = 35 °C	$I_{F(AV)}$	max.					5	A
in oil up to T_{oil} = 30 °C	$I_{F(AV)}$	max.					20	A
Non-repetitive peak forward current t = 10 ms; half sine wave; T_j = 175 °C prior to surge	I_{FSM}	max.					360	A

MECHANICAL DATA see page 4 and 5

All information applies to frequencies up to 400 Hz

RATINGS Limiting values in accordance with the Absolute Maximum System (IEC 134)

Voltages

		OSB9210	−4	−6	...	−28	−30	
		OSM9210	−4	−6	...	−28	−30	
Crest working reverse voltage	V_{RWM}	max.	2	3	...	14	15	kV
		OSS9210	−3	−4	...	−29	−30	
Crest working reverse voltage	V_{RWM}	max.	3	4	...	29	30	kV

Currents

Average forward current (averaged over any 20 ms period)				
in free air up to T_{amb} = 35 °C	$I_{F(AV)}$	max.	5	A
in oil up to T_{oil} = 30 °C	$I_{F(AV)}$	max.	20	A
Repetitive peak forward current	I_{FRM}	max.	440	A
Non-repetitive peak forward current t = 10 ms; half sine wave; T_j = 175 °C prior to surge	I_{FSM}	max.	360	A

Reverse power dissipation

		OSB9210	−4	−6	...	−28	−30	
		OSM9210	−4	−6	...	−28	−30	
Repetitive peak reverse power t = 10 µs (square wave; f = 50 Hz) T_j = 175 °C	P_{RRM}	max.	4	6	...	28	30	kW
Non-repetitive peak reverse power t = 10 µs (square wave)								
T_j = 25 °C prior to surge	P_{RSM}	max.	26	39	...	182	195	kW
T_j = 175 °C prior to surge	P_{RSM}	max.	4	6	...	28	30	kW
		OSS9210	−3	−4	...	−29	−30	kW
Repetitive peak reverse power dissipation t = 10 µs (square wave; f = 50 Hz) T_j = 175 °C	P_{RRM}	max.	6	8	...	58	60	kW
Non-repetitive peak reverse power dissipation t = 10 µs (square wave)								
T_j = 25 °C prior to surge	P_{RSM}	max.	39	52	...	377	390	kW
T_j = 175 °C prior to surge	P_{RSM}	max.	6	8		58	60	kW

Temperatures

Storage temperature	T_{stg}		−55 to +175	°C
Junction temperature	T_j	max.	175	°C

CHARACTERISTICS (See note 1)

			OSB9210 -4	-6	...	-28	-30	
			OSM9210-4	-6	...	-28	-30	
Forward voltage								
I_F = 50 A; T_j = 25 °C	V_F	<	3.6	5.4	...	25.2	27	V
Reverse breakdown voltage [1]								
I_R = 5 mA; T_j = 25 °C	$V_{(BR)R}$	>	2.5	3.75	...	17.5	18.75	kV
		<	3.76	5.64	...	26.32	28.2	kV

			OSS9210 -3	-4	...	-29	-30	
Forward voltage								
I_F = 50 A; T_j = 25 °C	V_F	<	5.4	7.2	...	52.2	54	V
Reverse breakdown voltage [1]								
I_R = 5 mA; T_j = 25 °C	$V_{(BR)R}$	>	3.75	5.0	...	36.25	37.5	kV
		<	5.64	7.52	...	54.52	56.4	kV

Reverse current				
$V_{RM} = V_{RWM max}$; T_j = 125 °C	I_{RM}	<	0.6	mA

NOTES

1. The Ratings and Characteristics given apply from centre tap to end. (Not for OSS9210series).

2. Type number suffix

   The suffix sonsists of a figure indicating the total number of diodes, followed by a letter indicating the base.
   A = M6 studs at the ends
   B = 4 pin Super Jumbo (B4D)
   C = Goliath
   E = 4 pin Jumbo (B4F)
   F = A3-20

3. Operating position

   The rectifier units can be operated at their maximum ratings when mounted in any position.

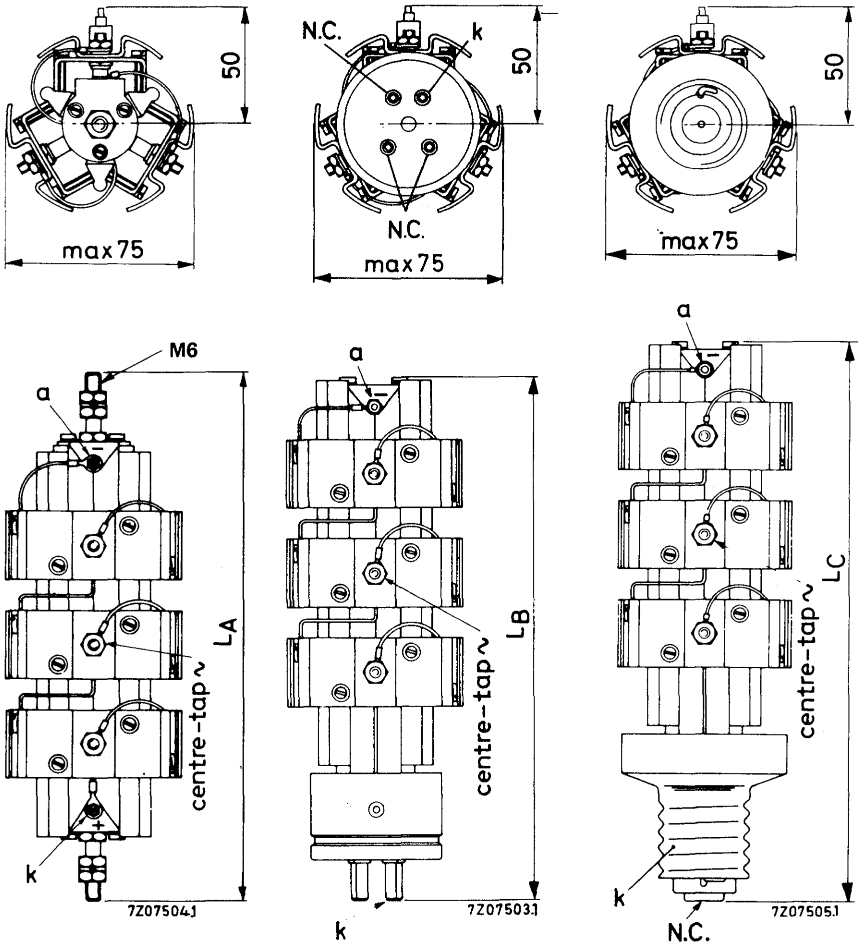
[1] The breakdown voltage increases by approximately 0.1 % per °C with increasing junction temperature.

MECHANICAL DATA

Dimensions in mm

n = total number of diodes

OSM9210-nA | OSM9210-nB | OSM9210-nC



The drawings show the OSM9210series; the OSB9210 and OSS9210series differ in the following respects:

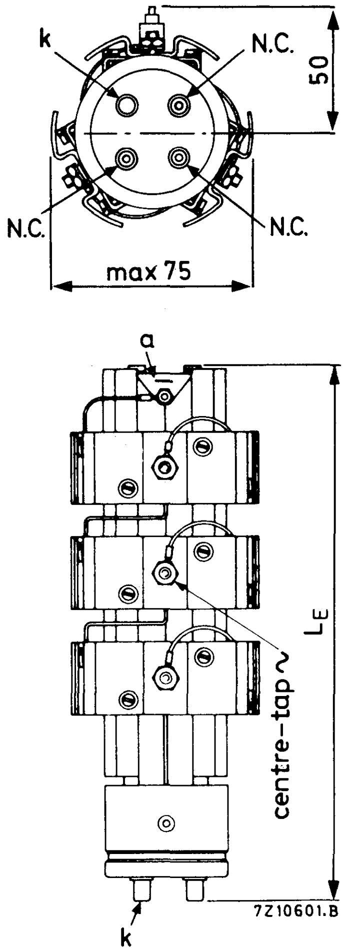
OSB9210series – terminals marked a(-) and k(+) in the drawings are both marked ∿; the centre-tap is marked + (instead of ∿ as in the drawings).

OSS9210series – has no centre-tap.

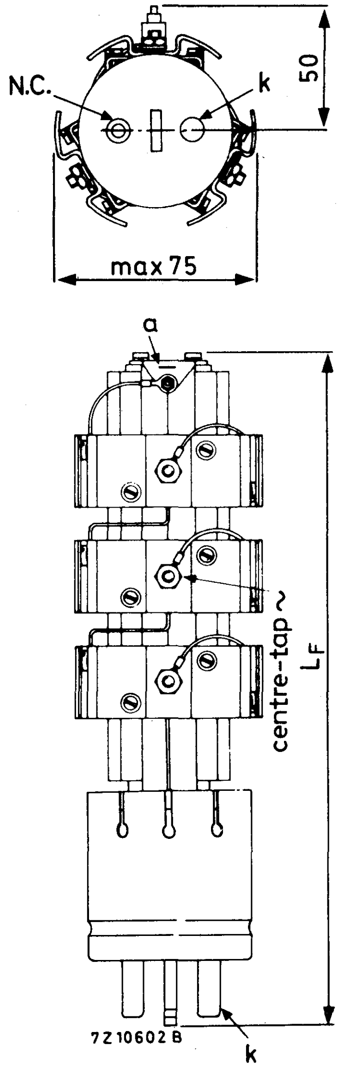
MECHANICAL DATA

n = total number of diodes.

OSM9210-nE



OSM9210-nF

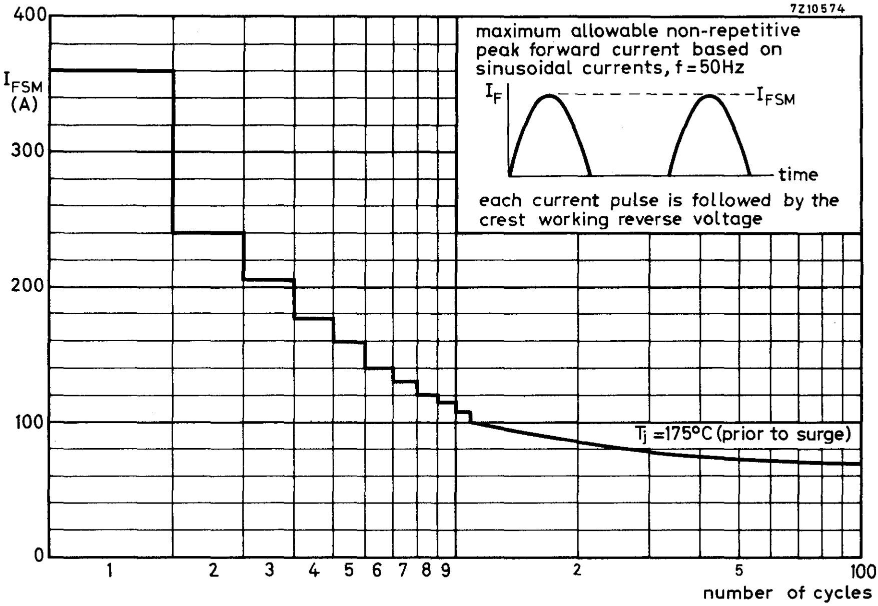


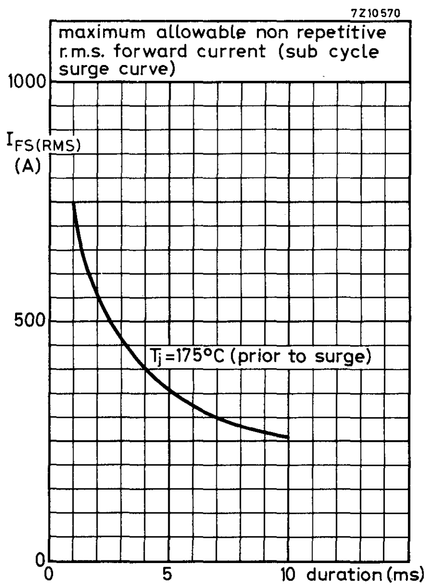
For lengths and weights see table on page 6.

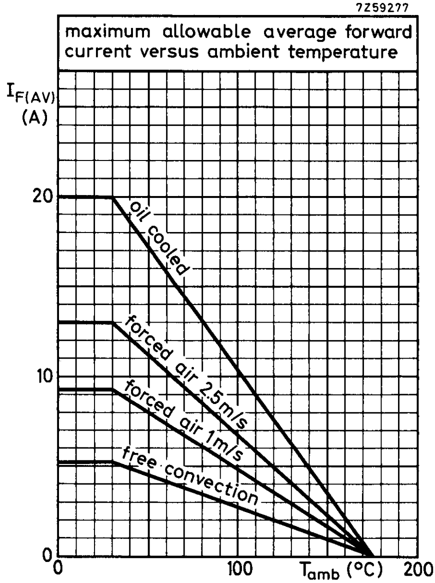
Table of lengths and weights (mm and g)

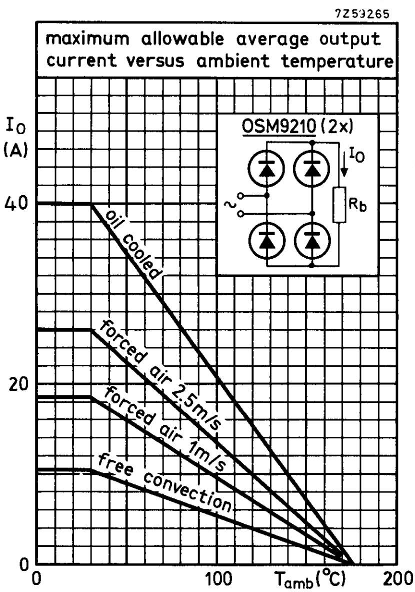
number of diodes	n	3	4 to 6	7 to 9	10 to 12	13 to 15
maximum lengths	L_A	143	184	224	264	305
	L_B	147	188	228	268	309
	L_C	159	199	239	279	320
	L_E	132	173	213	253	294
	L_F	184	225	265	305	346
weight	W_A	153	286	419	552	685
$W_B = W_C =$	W_E	218	351	484	617	750
	W_F	379	512	645	778	911

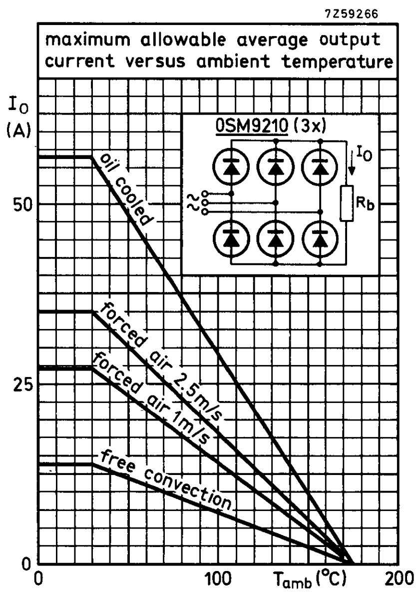
number of diodes	n	16 to 18	19 to 21	22 to 24	25 to 27	28 to 30
maximum lengths	L_A	345	385	426	466	506
	L_B	349	389	430	470	510
	L_C	360	400	441	481	521
	L_E	334	374	415	455	495
	L_F	386	426	467	507	547
weights	W_A	818	951	1084	1217	1350
$W_B = W_C =$	W_E	883	1016	1149	1282	1415
	W_F	1044	1177	1310	1443	1576


7Z10574
maximum allowable non-repetitive peak forward current based on sinusoidal currents, f = 50Hz
I_F
I_FSM
time
each current pulse is followed by the crest working reverse voltage
400
I_FSM (A)
300
200
100
0
1
2
3
4
5
6
7
8
9
2
5
100
number of cycles
Tj =175°C (prior to surge)


7Z10570
maximum allowable non repetitive r.m.s. forward current (sub cycle surge curve)
1000
I_FS(RMS) (A)
500
0
0
5
10
duration (ms)
Tj =175°C (prior to surge)

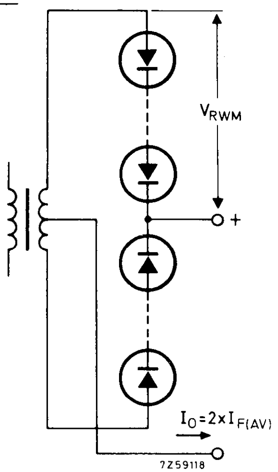

7Z59277
maximum allowable average forward current versus ambient temperature
$I_{F(AV)}$ (A)
20
10
0
0
100
T_{amb} (°C)
200
oil cooled
forced air 2.5m/s
forced air 1m/s
free convection


7Z59265
maximum allowable average output current versus ambient temperature
I_O (A)
40
20
0
0
100
T_{amb}(°C)
200
OSM9210 (2x)
I_O
R_b
~
oil cooled
forced air 2.5m/s
forced air 1m/s
free convection

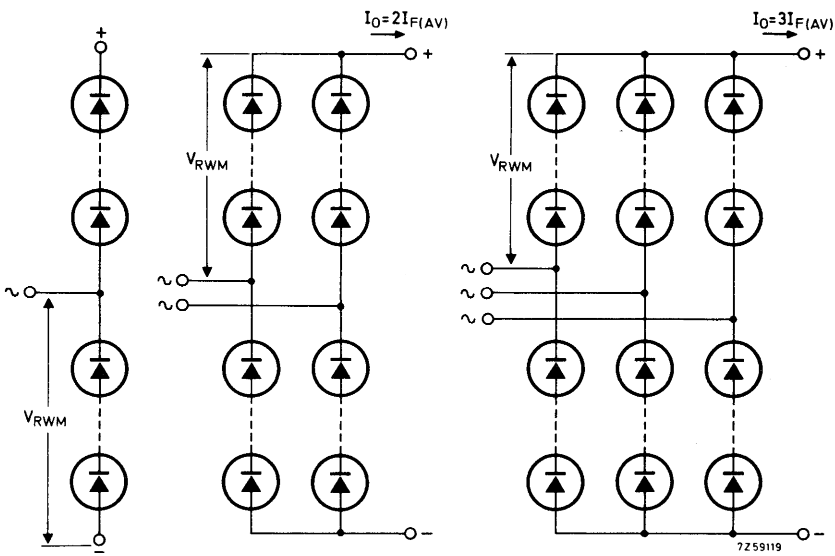

7Z59266
maximum allowable average output current versus ambient temperature
I_O (A)
50
25
0
0
100
T_{amb}(°C)
200
OSM9210 (3x)
I_O
R_b
oil cooled
forced air 2.5m/s
forced air 1m/s
free convection

APPLICATION INFORMATION

OSB9210-4



OSM9210series



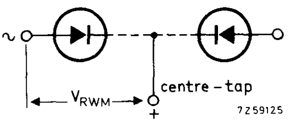
voltage doubler
1x OSM9210

rectifier circuits with respectively
2x OSM9210 and 3x OSM9210

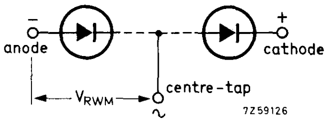
HIGH VOLTAGE RECTIFIER STACKS

The OSB9310, OSM9310 and OSS9310 series are ranges of high voltage rectifier assemblies, incorporating controlled avalanche diodes mounted on fire proof triangular formers. The OSB9310 series is intended for application in two phase half wave rectifier circuits. The OSM9310 series is intended for application in single phase or three phase bridges or in voltage doubler circuits.
The OSS9310 series is intended for all kinds of high voltage rectification. The assemblies are supplied with M6 studs or with standard valve bases. The OSB9310 series and OSM9310 series are supplied with a centre tap (8-32UNC). The maximum crest working voltages of the OSB9310 and OSM9310 series cover the range from 2 kV to 15 kV, and of the OSS9310 series the range from 3 kV to 30 kV, in 1 kV steps.

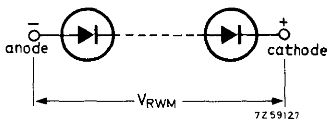
circuit OSB 9310



circuit OSM 9310



circuit OSS 9310



QUICK REFERENCE DATA

		OSB9310	−4	−6	...	−28	−30
		OSM9310	−4	−6	...	−28	−30
Crest working reverse voltage from centre tap to end	V_{RWM}	max.	2	3	...	14	15 kV
		OSS9310	−3	−4	...	−29	−30
Crest working reverse voltage	V_{RWM}	max.	3	4	...	29	30 kV

Average forward current with R and L load (averaged over any 20 ms period)

in free air up to T_{amb} = 35°C	$I_{F(AV)}$	max.	4	A
in oil up to T_{oil} = 65°C	$I_{F(AV)}$	max.	12	A
Non-repetitive peak forward current t = 10 ms: half sinewave: T_j = 175°C prior to surge	I_{FSM}	max.	180	A

MECHANICAL DATA see page 4 and 5

All information applies to frequencies up to 400 Hz

RATINGS Limiting values in accordance with the Absolute Maximum System (IEC 134)

Voltages

		OSB9310	−4	−6	...	−28	−30	
		OSM9310	−4	−6	...	−28	−30	
Crest working reverse voltage	V_{RWM}	max.	2	3	...	14	15	kV
		OSS9310	−3	−4	...	−29	−30	
Crest working reverse voltage	V_{RWM}	max.	3	4	...	29	30	kV

Currents

Average forward current (averaged over any 20 ms period)				
in free air up to T_{amb} = 35 °C	$I_{F(AV)}$	max.	4	A
in oil up to T_{oil} = 65 °C	$I_{F(AV)}$	max.	12	A
Repetitive peak forward current	I_{FRM}	max.	250	A
Non-repetitive peak forward current t = 10 ms; half sine wave; T_j = 175 °C prior to surge	I_{FSM}	max.	180	A

Reverse power dissipation

		OSB9310	−4	−6	...	−28	−30	
		OSM9310	−4	−6	...	−28	−30	
Repetitive peak reverse power dissipation t = 10 μs (square wave; f = 50 Hz) T_j = 175 °C	P_{RRM}	max.	2	3	...	14	15	kW
Non-repetitive peak reverse power dissipation t = 10 μs (square wave)								
T_j = 25 °C prior to surge	P_{RSM}	max.	12	18	...	84	90	kW
T_j = 175 °C prior to surge	P_{RSM}	max.	2	3	...	14	15	kW
		OSS9310	−3	−4		−29	−30	
Repetitive peak reverse power dissipation t = 10 μs (square wave; f = 50 Hz) T_j = 175 °C	P_{RRM}	max.	3	4	...	29	30	kW
Non-repetitive peak reverse power dissipation t = 10 μs (square wave)								
T_j = 25 °C prior to surge	P_{RSM}	max.	18	24	...	174	180	kW
T_j = 175 °C prior to surge	P_{RSM}	max.	3	4		29	30	kW

Temperatures

Storage temperature	T_{stg}	−55 to +175	°C
Junction temperature	T_j	max. 175	°C

CHARACTERISTICS (See note 1)

		OSB9310	-4	-6	...	-28	-30	
		OSM9310	-4	-6	...	-28	-30	
Forward voltage								
I_F = 50 A; T_j = 25 °C	V_F	<	5	7.5	...	35	37.5	V
Reverse breakdown voltage [1]								
I_R = 5 mA; T_j = 25 °C	$V_{(BR)R}$	>	2.5	3.75	...	17.5	18.75	kV
		<	4	6	...	28	30	kV
		OSS9310	-3	-4	...	-29	-30	
Forward voltage								
I_F = 50 A; T_j = 25 °C	V_F	<	7.5	10	...	72.5	75	V
Reverse breakdown voltage [1]								
I_R = 5 mA; T_j = 25 °C	$V_{(BR)R}$	>	3.75	5	...	36.25	37.5	kV
		<	6	8	...	58	60	kV

Reverse current

$V_{RM} = V_{RWMmax}$; T_j = 125 °C $\quad I_{RM} < 0.3$ mA

NOTES

1. The Ratings and Characteristics given apply from centre tap to end. (Not for OSS9310series).

2. Type number suffix

   The suffix consists of a figure indicating the total number of diodes, followed by a letter indicating the base.
   A = M6 studs at the ends
   B = 4 pin Super Jumbo (B4D)
   C = Goliath
   E = 4 pin Jumbo (B4F)
   F = A3-20

3. Operating position

   The rectifier units can be operated at their maximum ratings when mounted in any position.

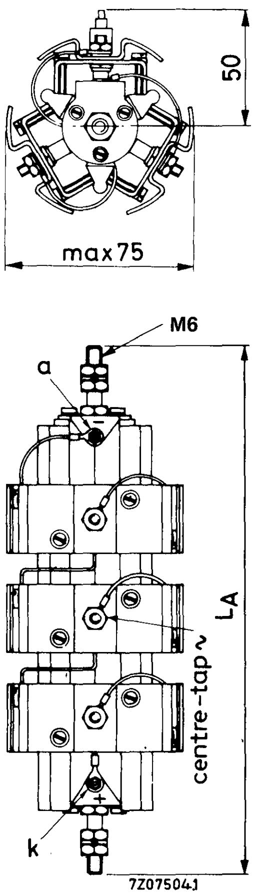
1) The breakdown voltage increases by approximately 0.1% per °C with increasing junction temperature.

MECHANICAL DATA

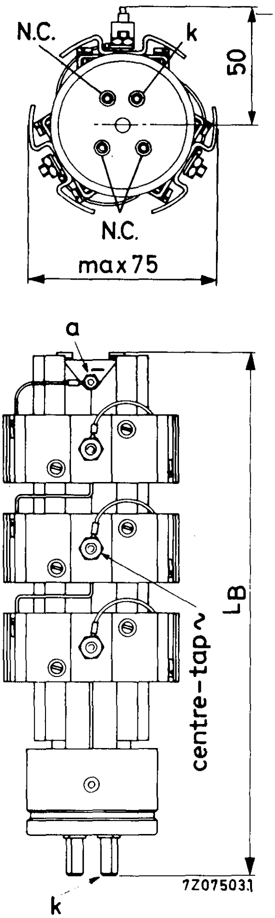
Dimensions in mm

n = total number of diodes

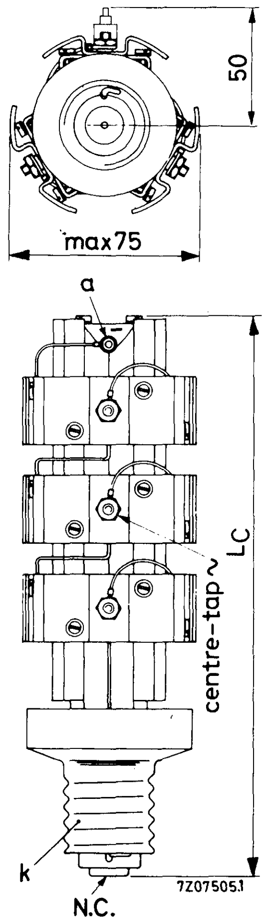
OSM9310-nA



OSM9310-nB



OSM9310-nC



The drawings show the OSM9310series; the OSB9310 and OSS9310series differ in the following respects:

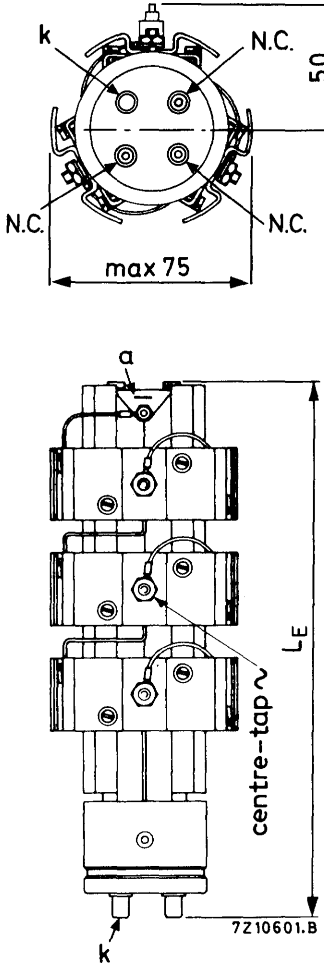
OSB9310series - terminals marked a(-) and k(+) in the drawings are both marked ∿; the centre-tap is marked + (instead of ∿ as in the drawings).

OSS9310series - has no centre-tap.

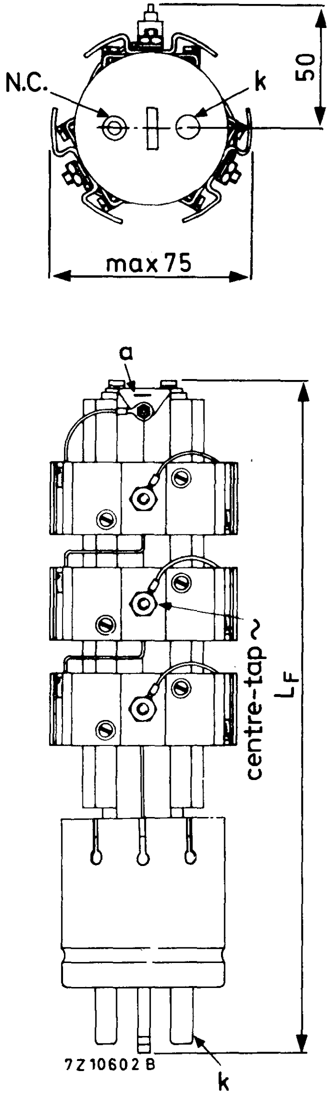
MECHANICAL DATA

n = total number of diodes

OSM9310-nE



OSM9310-nF

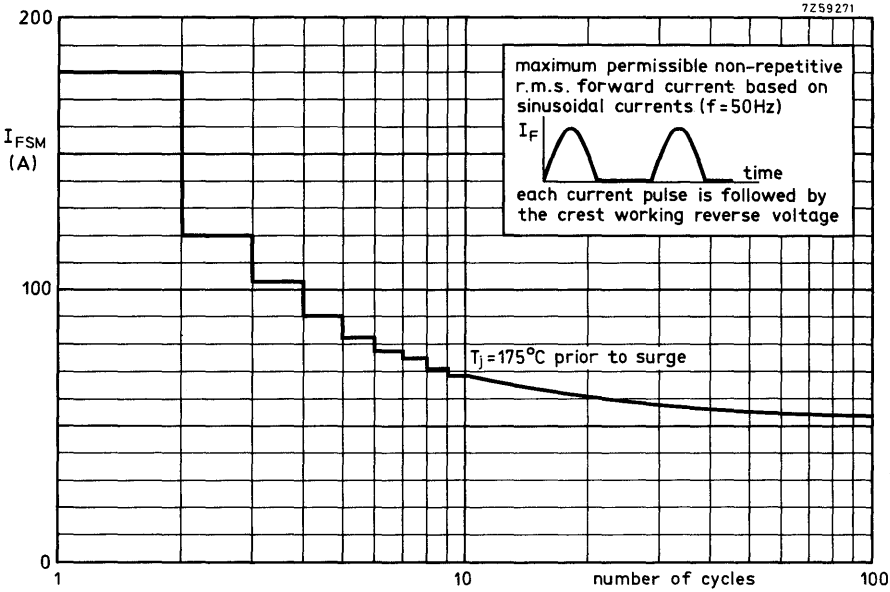


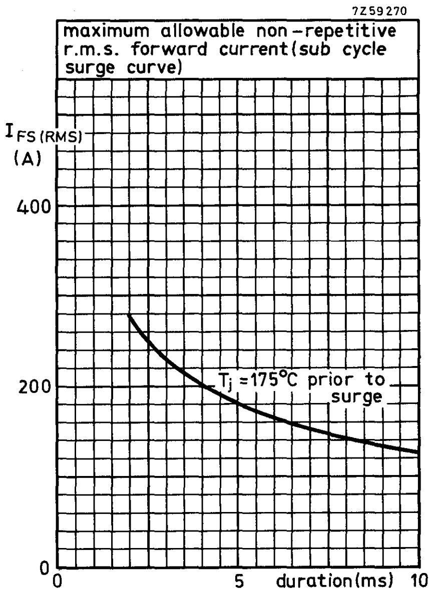
For lengths and weights see table on page 6.

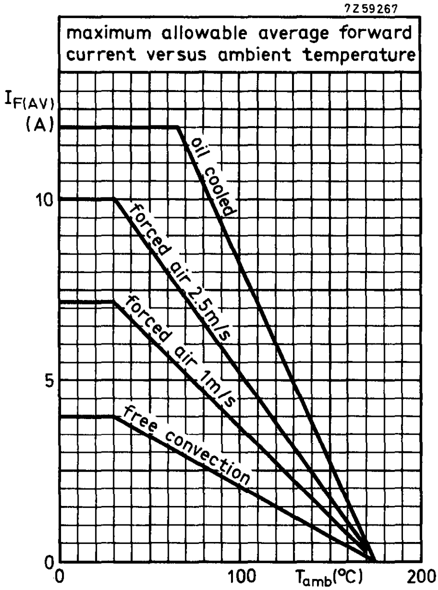
Table of lengths and weights (mm and g)

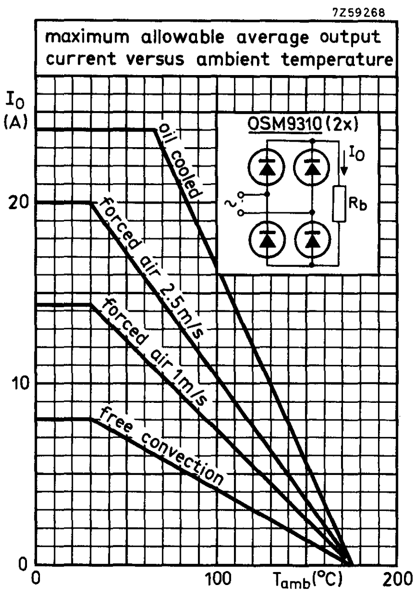
number of diodes	n	3	4 to 6	7 to 9	10 to 12	13 to 15
maximum lengths	L_A	143	184	224	264	305
	L_B	147	188	228	268	309
	L_C	159	199	239	279	320
	L_E	132	173	213	253	294
	L_F	184	225	265	305	346
weight	W_A	153	286	419	552	685
$W_B = W_C =$	W_E	218	351	484	617	750
	W_F	379	512	645	778	911

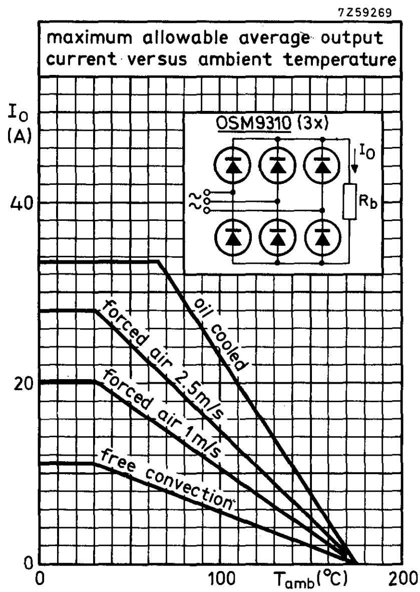
number of diodes	n	16 to 18	19 to 21	22 to 24	25 to 27	28 to 30
maximum lengths	L_A	345	385	426	466	506
	L_B	349	389	430	470	510
	L_C	360	400	441	481	521
	L_E	334	374	415	455	495
	L_F	386	426	467	507	547
weights	W_A	818	951	1084	1217	1350
$W_B = W_C =$	W_E	883	1016	1149	1282	1415
	W_F	1044	1177	1310	1443	1576


7Z59271
maximum permissible non-repetitive r.m.s. forward current based on sinusoidal currents (f = 50Hz)
I_F
time
each current pulse is followed by the crest working reverse voltage
I_FSM (A)
200
100
0
1
10
100
number of cycles
Tj = 175°C prior to surge


7Z59270
maximum allowable non-repetitive r.m.s. forward current (sub cycle surge curve)
I_FS(RMS) (A)
400
200
0
0
5
10
duration (ms)
Tj = 175°C prior to surge

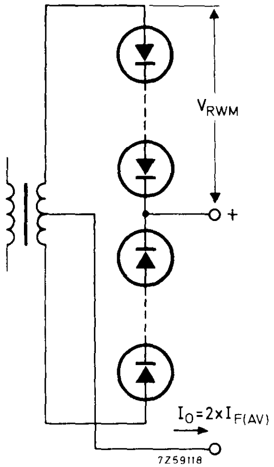

7Z59267
maximum allowable average forward current versus ambient temperature
$I_{F(AV)}$ (A)
10
5
0
oil cooled
forced air 2.5m/s
forced air 1m/s
free convection
0
100
T_{amb} (°C)
200


7Z59268
maximum allowable average output current versus ambient temperature
I_O (A)
20
10
0
OSM9310 (2x)
I_O
R_b
~
oil cooled
forced air 2.5m/s
forced air 1m/s
free convection
0
100
T_{amb} (°C)
200

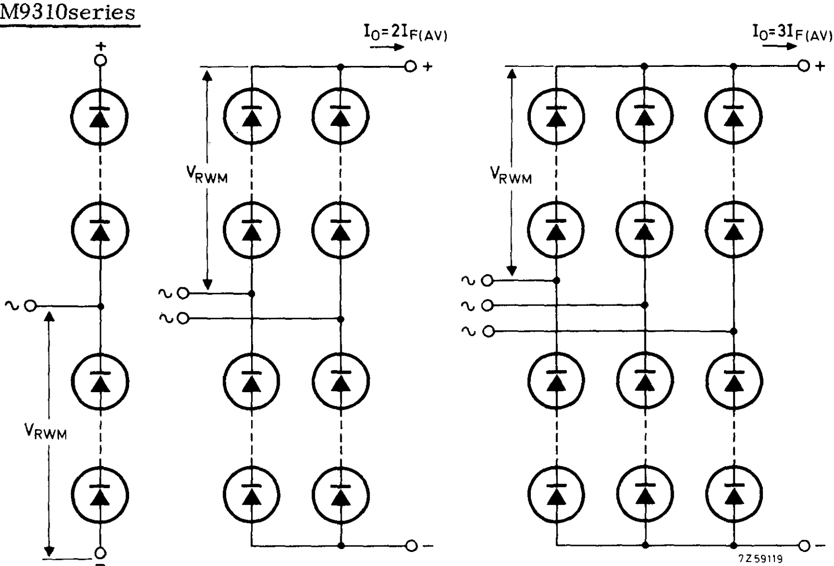

7Z59269
maximum allowable average output current versus ambient temperature
I_O (A)
40
20
0
OSM9310 (3x)
I_O
R_b
oil cooled
forced air 2.5m/s
forced air 1m/s
free convection
0
100
T_{amb} (°C)
200

APPLICATION INFORMATION

OSB9310series



OSM9310series



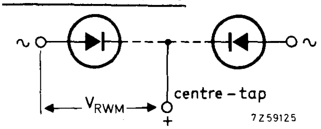
voltage doubler
1x OSM9310

rectifier circuits with respectively
2x OSM9310 and 3x OSM9310

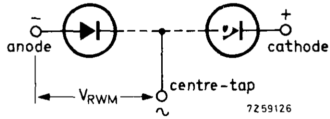
HIGH VOLTAGE RECTIFIER STACKS

Ranges of high voltage rectifier assemblies, incorporating controlled avalanche diodes mounted on fire proof triangular formers. They are supplied with **M6 studs**.
The OSB9410series is intended for application in two phase half wave rectifier circuits.
The OSM9410series is intended for application in single phase or three phase bridges or in voltage doubler circuits.
The OSS9410series is intended for all kinds of high voltage rectification.
The OSB9410series and OSM9410series are supplied with a centre tap (8-32UNC).
The maximum crest working voltages of the OSB9410 and OSM9410series cover the range from 2 kV to 15 kV, and of the OSS9410series the range from 3 kV to 30 kV, in 1 kV steps.

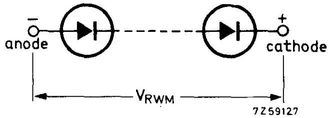
CIRCUIT OSB9410



CIRCUIT OSM9410



CIRCUIT OSS9410



QUICK REFERENCE DATA

		OSB9410	−4	−6	...	−28	−30	
		OSM9410	−4	−6	...	−28	−30	
Crest working reverse voltage from centre tap to end	V_{RWM}	max.	2	3		14	15	kV
		OSS9410	−3	−4	...	−29	−30	
Crest working reverse voltage	V_{RWM}	max.	3	4	...	29	30	kV

Average forward current with R and L load (averaged over any 20 ms period)

in free air up to T_{amb} = 35 °C	$I_{F(AV)}$	max.	10	A
in oil up to T_{oil} = 35 °C	$I_{F(AV)}$	max.	30	A

Non-repetitive peak forward current

t = 10 ms; half sine wave; T_j = 175 °C prior to surge	I_{FSM}	max.	800	A

MECHANICAL DATA see page 4

All information applies to frequencies up to 400 Hz

RATINGS Limiting values in accordance with the Absolute Maximum System (IEC 134)

Voltages

			OSB9410 / OSM9410	-4	-6	...	-28	-30	
Crest working reverse voltage	V_{RWM}		max.	2	3	...	14	15	kV

			OSS9410	-3	-4	...	-29	-30	
Crest working reverse voltage	V_{RWM}		max.	3	4	...	29	30	kV

Currents

Average forward current (averaged over any 20 ms period)

in free air up to T_{amb} = 35 °C	$I_{F(AV)}$	max.	10	A
in oil up to T_{oil} = 35 °C	$I_{F(AV)}$	max.	30	A
Repetitive peak forward current	I_{FRM}	max.	450	A
Non-repetitive peak forward current t = 10 ms; half sine wave; T_j = 175 °C prior to surge	I_{FSM}	max.	800	A

Reverse power dissipation

			OSB9410 / OSM9410	-4	-6	...	-28	-30	
Repetitive peak reverse power dissipation t = 10 μs (square wave; f = 50 Hz) T_j = 175 °C	P_{RRM}		max.	9	13.5	...	63	67.5	kW
Non-repetitive peak reverse power dissipation t = 10 μs (square wave) T_j = 25 °C prior to surge	P_{RSM}		max.	55	80	...	375	400	kW
T_j = 175 °C prior to surge	P_{RSM}		max.	8.5	13	...	60.5	65	kW

			OSS9410	-3	-4	...	-29	-30	
Repetitive peak reverse power dissipation t = 10 μs (square wave; f = 50 Hz) T_j = 175 °C	P_{RRM}		max.	13.5	18	...	130.5	135	kW
Non-repetitive peak reverse power dissipation t = 10 μs (square wave) T_j = 25 °C prior to surge	P_{RSM}		max.	80	105	...	775	800	kW
T_j = 175 °C prior to surge	P_{RSM}		max.	13	17	...	126	130	kW

Temperatures

Storage temperature	T_{stg}		− 55 to + 175	°C
Junction temperature	T_j	max.	175	°C

CHARACTERISTICS (See note 1)

			OSB9410 -4	-6	...	-28	-30
			OSM9410 -4	-6	...	-28	-30
Forward voltage							
I_F = 150 A; T_j = 25 °C	V_F	<	3.6	5.4	...	25.2	27 V
Reverse avalanche breakdown voltage 1)		>	2.5	3.75	...	17.5	18.75 kV
I_R = 5 mA; T_j = 25 °C	$V_{(BR)R}$	<	4	6	...	28	30 kV

			OSS9410 -3	-4	...	-29	-30
Forward voltage							
I_F = 150 A; T_j = 25 °C	V_F	<	5.4	7.2	...	52.2	54 V
Reverse avalanche breakdown voltage 1)		>	3.75	5	...	36.25	37.5 kV
I_R = 5 mA; T_j = 25 °C	$V_{(BR)R}$	<	6	8	...	58	60 kV

Reverse current

$V_{RM} = V_{RWMmax}$; T_j = 125 °C I_{RM} < 1.6 mA

NOTES

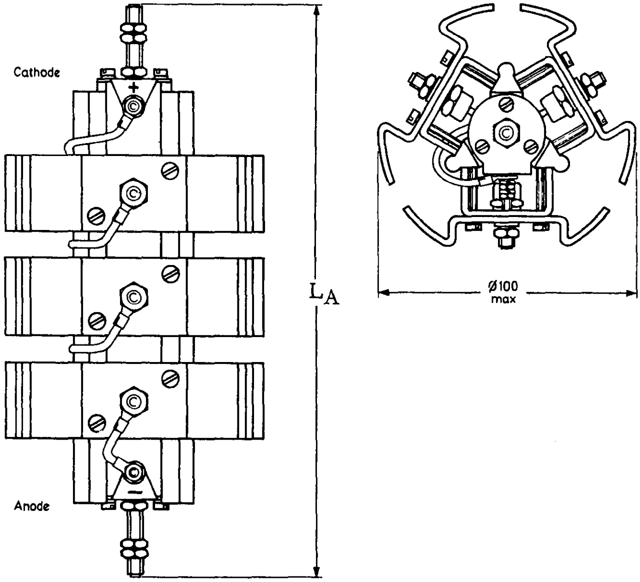
1. The Ratings and Characteristics given apply from centre tap to end. (Not for OSS9410series).
2. Type number suffix
   The suffix consists of a figure indicating the total number of diodes, followed by a letter indicating the base.
   A = M6 studs at the ends.
3. Operating position
   The rectifier units can be operated at their maximum ratings when mounted in any position.

1) The breakdown voltage increases, by approximately 0.1% per °C with increasing junction temperature.

MECHANICAL DATA Dimensions in mm

n = total number of diodes.

OSS9410-nA

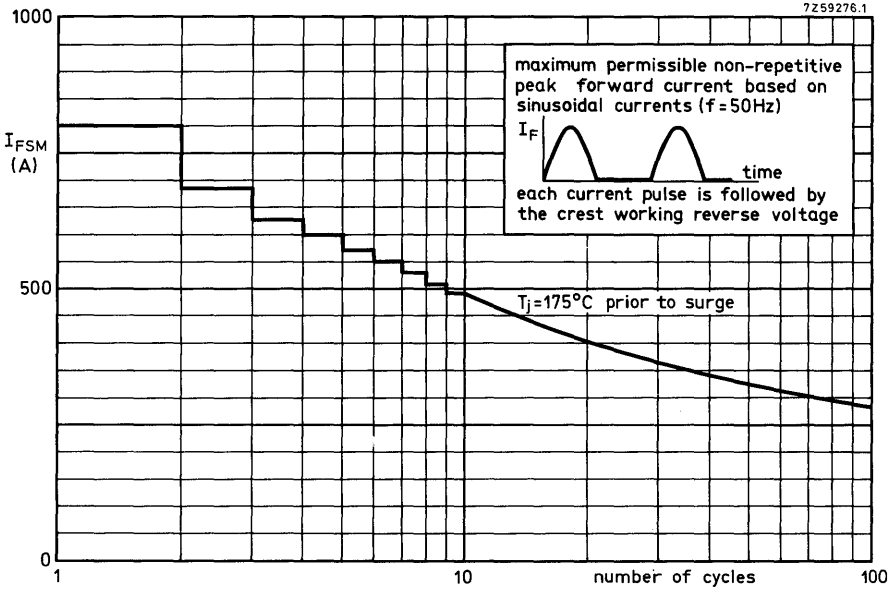


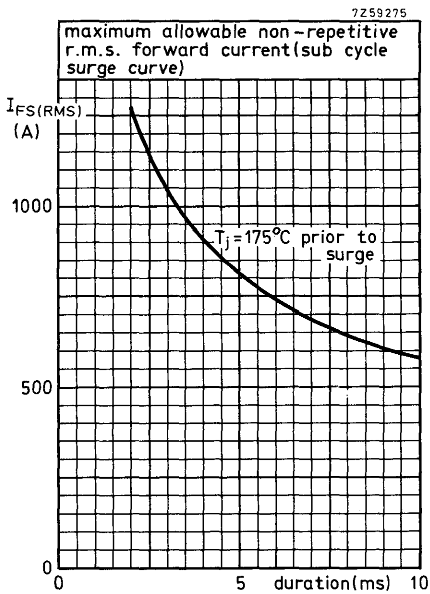
The drawing shows the OSS9410series.
The OSB9410 and OSM9410series differ in the following respects:
OSB9410 series – has a centre tap marked +; anode and cathode terminals are both marked∿.
OSM9410series – has a centre tap marked∿.

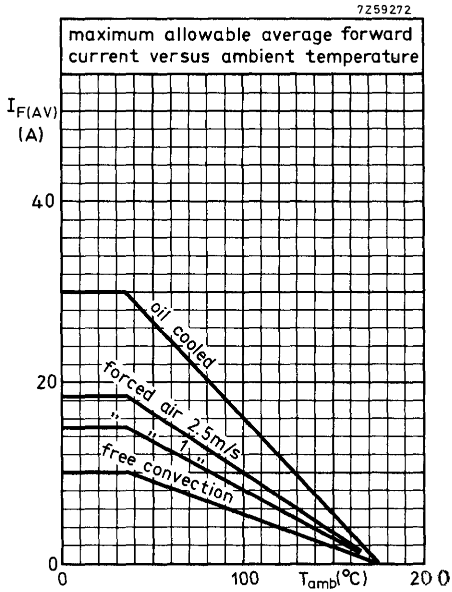
Table of lengths and weights (mm and g)

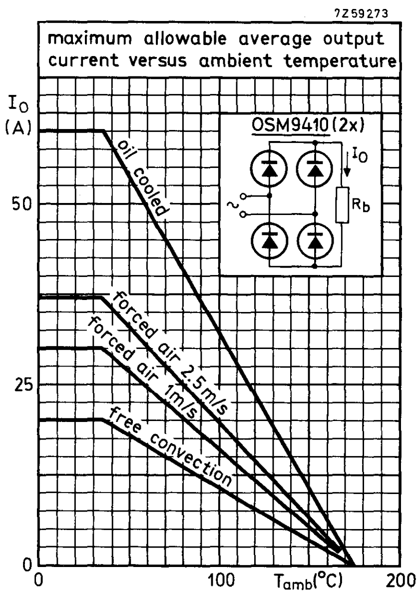
number of diodes n	3	4 to 6	7 to 9	10 to 12	13 to 15
maximum lengths L_A	143	184	224	264	305
weights W_A	215	413	611	809	1007

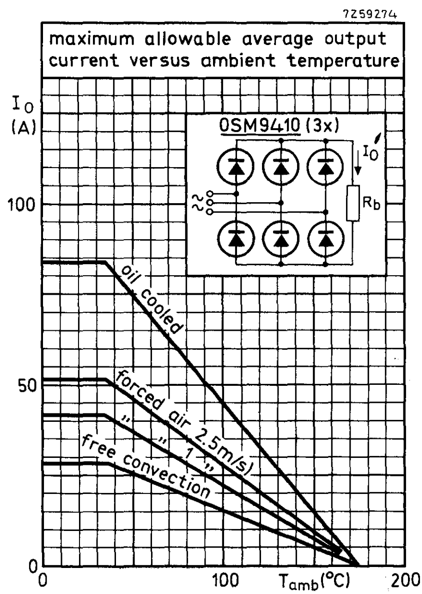
number of diodes n	16 to 18	19 to 21	22 to 24	25 to 27	28 to 30
maximum lengths L_A	345	385	426	466	506
weights W_A	1208	1406	1604	1802	2000


7Z59276.1
maximum permissible non-repetitive peak forward current based on sinusoidal currents (f = 50Hz)
I_F
time
each current pulse is followed by the crest working reverse voltage
I_FSM (A)
1000
500
0
1
10
100
number of cycles
Tj = 175°C prior to surge


7Z59275
maximum allowable non-repetitive r.m.s. forward current (sub cycle surge curve)
I_FS(RMS) (A)
1000
500
0
5
10
duration (ms)
Tj = 175°C prior to surge

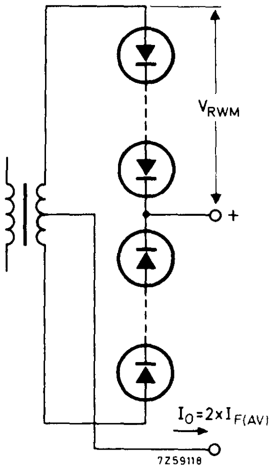

7Z59272
maximum allowable average forward current versus ambient temperature
$I_{F(AV)}$ (A)
40
20
0
oil cooled
forced air 2.5m/s
" " 1 "
free convection
0
100
T_{amb}(°C)
200


7Z59273
maximum allowable average output current versus ambient temperature
I_O (A)
50
25
0
OSM9410 (2x)
I_O
R_b
oil cooled
forced air 2.5m/s
forced air 1m/s
free convection
0
100
T_{amb}(°C)
200

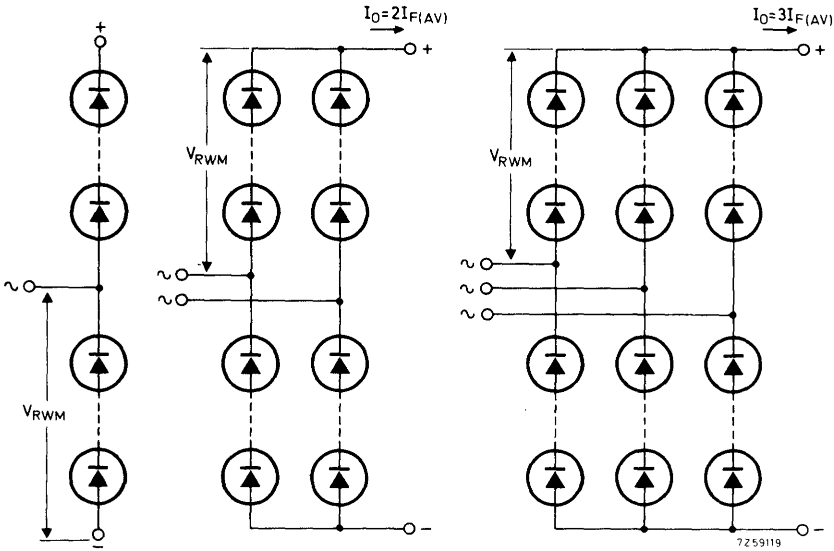

7Z59274
maximum allowable average output current versus ambient temperature
I_O (A)
100
50
0
OSM9410 (3x)
I_O
R_b
oil cooled
forced air 2.5m/s)
" " 1 "
free convection
0
100
T_{amb}(°C)
200

APPLICATION INFORMATION

OSB9410series



OSM9410series



voltage doubler — 1x OSM9410

rectifier circuits with respectively 2x OSM9410 and 3x OSM9410

HIGH-VOLTAGE RECTIFIER STACK

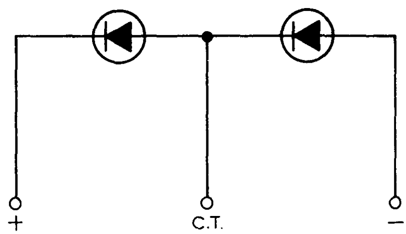
The OSM9510-12 is a silicon rectifier stack for high voltage applications; up to 12kV in half-wave circuits, or up to 6kV as one of the arms of a bridge configuration, where the centre-tap is utilised. Because of its controlled avalanche characteristics it is capable of withstanding reverse transients generated in the circuit.

QUICK REFERENCE DATA		
V_{RWM} max.	12	kV
$V_{(BR)R}$ min.	15	kV
$I_{F(AV)}$ max., in free air, $T_{amb} = 50^{o}C$	1.5	A
P_{RSM} max., $t = 10\mu s$, $T_{amb} = 25^{o}C$	20	kW

OUTLINE AND DIMENSIONS

For details see page 3

CIRCUIT DIAGRAM



Also available: 8 kV type with $V_{(BR)R\ min} = 12.5$ kV

RATINGS

Limiting values of operation according to the absolute maximum system.
These ratings apply for the frequency range 50 to 400Hz.
Simultaneous application of all ratings is inferred unless otherwise stated.

Electrical

V_{RWM} max.	Crest working reverse voltage	12	kV
$I_{F(AV)}$ max.	Mean forward current in free air, $T_{amb} \leq 50^{o}C$, 180^{o} conduction	1.5	A
	See derating curves on page 4		
I_{FRM} max.	Repetitive peak forward current, 30^{o} conduction	15	A
I_{FSM} max.	Surge forward current, 1 cycle (10ms peak of half sinewave)	35	A
P_{RSM} max.	Non-repetitive peak reverse power (10μs square wave, $T_j = 25^{o}C$)	20	kW
P_{RRM} max.	50Hz repetitive peak reverse transient power (10μs square wave, $T_j = 150^{o}C$)	5.0	kW

Temperature

T_{stg}	Storage temperature	-55 to 150	^{o}C
T_j	Junction temperature	-55 to 150	^{o}C

ELECTRICAL CHARACTERISTICS ($T_j = 25^{o}C$ unless otherwise stated)

		Min.	Max.	
*V_F	Forward voltage at $I_F = 5A$	-	17.5	V
I_R	Reverse current at V_{RWM}, $T_j = 125^{o}C$	-	100	μA
$V_{(BR)R}$	**Avalanche breakdown voltage, $I_{(BR)R} = 1mA$	15	25	kV

*Measured under pulsed conditions so that T_j is at, or near, the stated value.

**The avalanche voltage increases by approximately 0.1%/degC with increasing T_j.

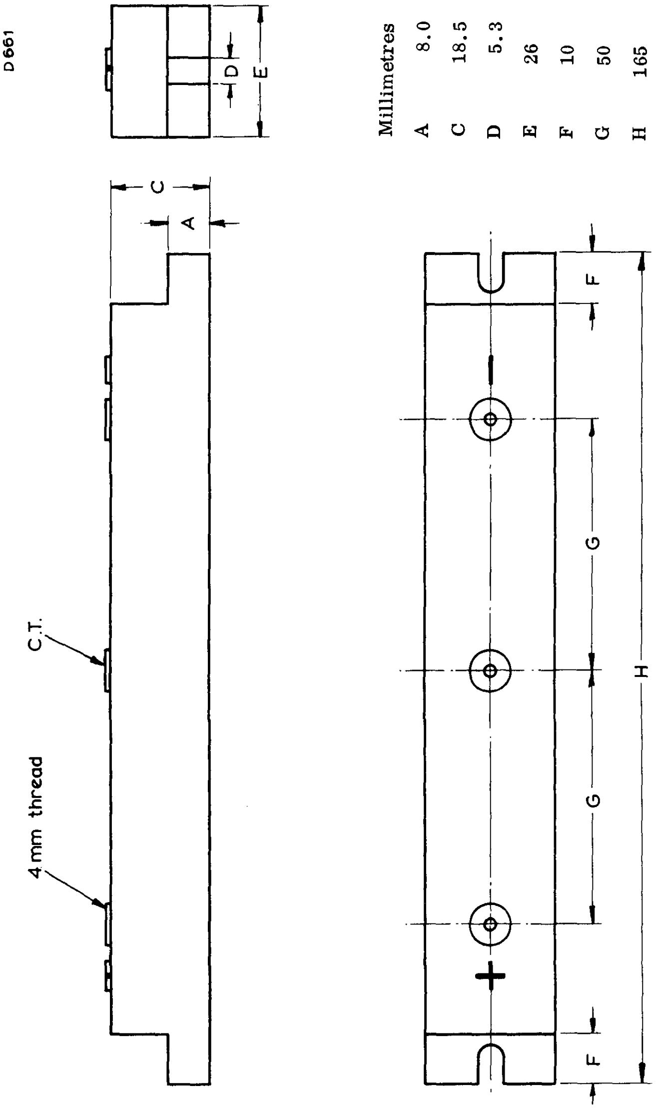
MECHANICAL DATA

Weight	130	g

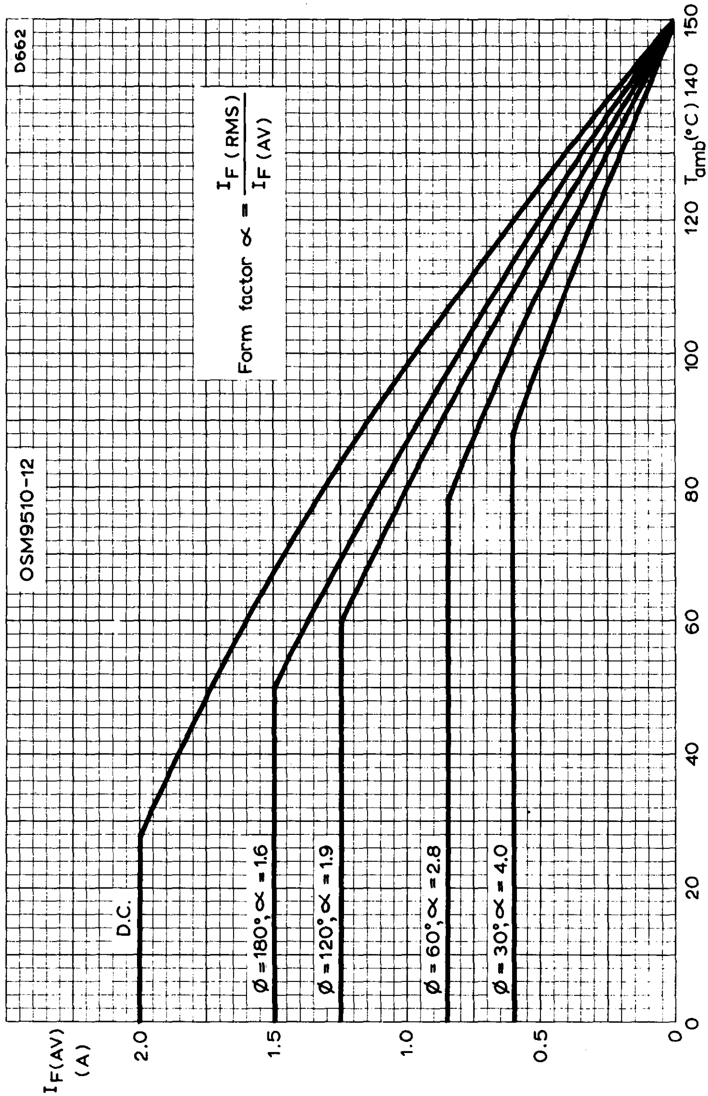
MOUNTING POSITION

The rectifier units can be operated at their maximum ratings when mounted in any position.

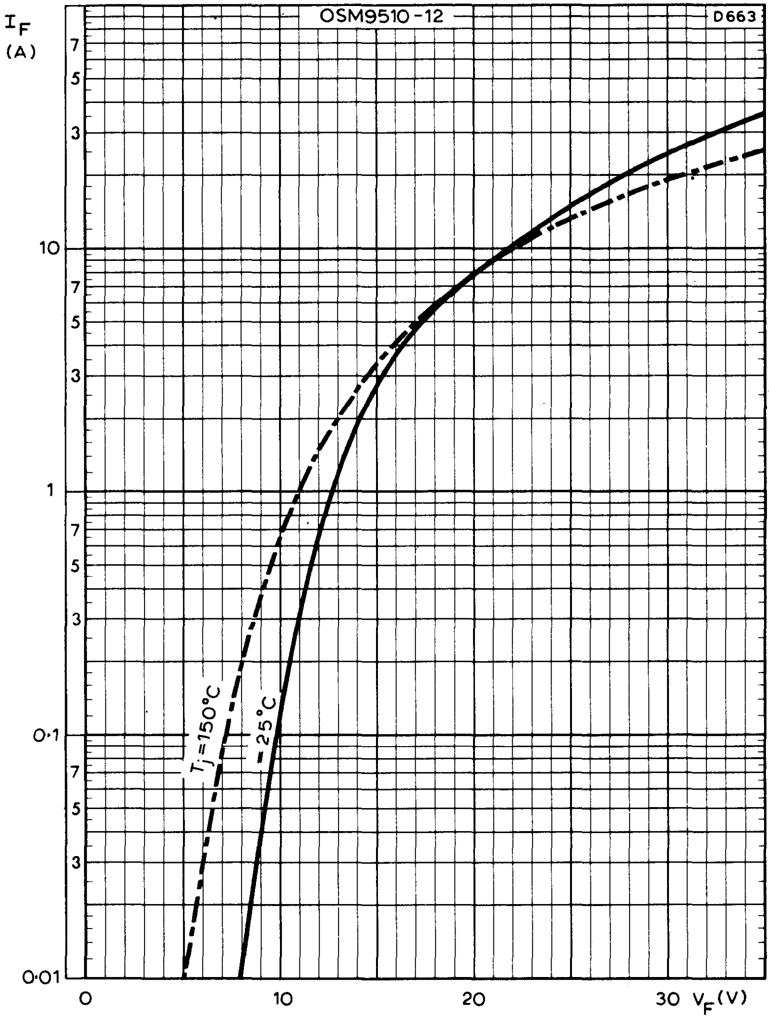
OUTLINE AND DIMENSIONS



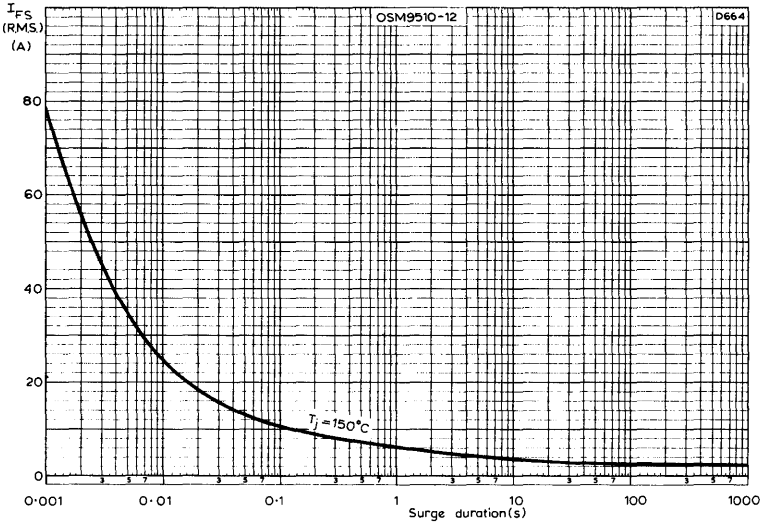
	Millimetres
A	8.0
C	18.5
D	5.3
E	26
F	10
G	50
H	165



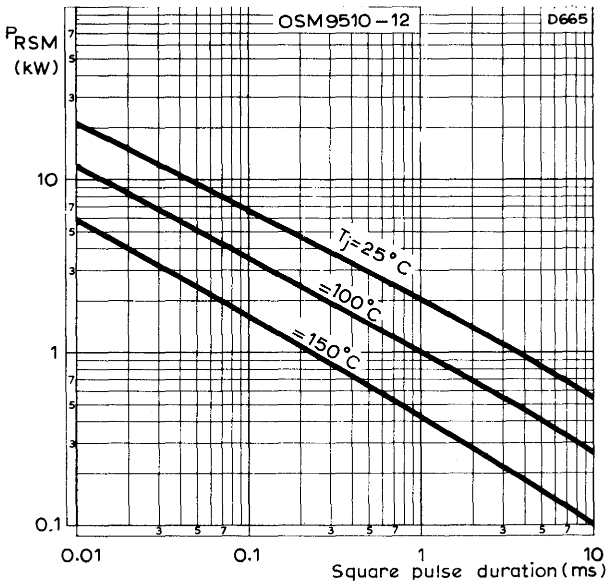
MAXIMUM MEAN FORWARD CURRENT AS A FUNCTION OF AMBIENT TEMPERATURE AND CONDUCTION ANGLE



MAXIMUM FORWARD CONDUCTION CHARACTERISTICS



MAXIMUM R.M.S. SURGE CURRENT PLOTTED AGAINST SURGE DURATION



NON-REPETITIVE PEAK REVERSE POWER PLOTTED AGAINST SQUARE PULSE DURATION

THYRISTORS

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THYRISTORS

SWITCHING CHARACTERISTICS

Thyristors are not perfect switches. They take a finite time to go from the off to the on-state and vice-versa. At frequencies up to about 400 Hz these effects can often be ignored, but in many applications involving fast switching action the departure from the ideal is important.

Gate-controlled turn-on time

Anode current does not commence flowing at the instant the gate current is applied.
There is a period which elapses between the application of gate current and the onset of anode current known as delay time (t_d). The rise time of anode current is known as t_r and is measured as the time taken for the anode voltage to fall from 90% to 10% of its initial value.
The conditions which need to be specified are:

a) Off-state voltage (V_D).

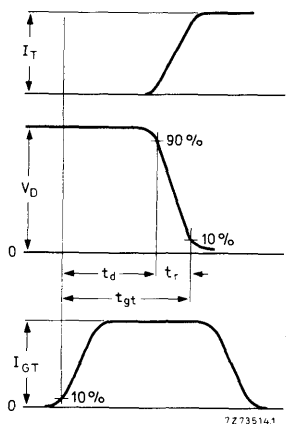
b) On-state current (I_T).

c) Gate trigger current (I_G) – high gate currents reduce turn-on time.

d) Rate of rise of gate trigger current (dI_G/dt) – high values reduce turn-on time.

e) Junction temperature (T_j) – high temperatures reduce turn-on time.

The waveforms are shown in the following diagram:



CIRCUIT-COMMUTATED TURN-OFF TIME

When a thyristor has been conducting and is reverse biased it cannot go immediately into the forward blocking state. Thyristors exhibit a stored charge in a similar fashion to rectifiers; it is only after this charge has been recombined or been swept out that the device can block reapplied off-state voltage. The turn-off time (t_q) is measured from the instant the anode current passes through zero to the instant the thyristor is capable of blocking reapplied off-state voltage.

The conditions which need to be specified are:

a) On-state current (I_T) – high peak currents mean longer turn-off times.

b) Reverse voltage (V_R) – low reverse voltages mean longer turn-off times.
An example of this is when the thyristor is in anti-parallel with a diode, limiting the reverse voltage to a volt or so.

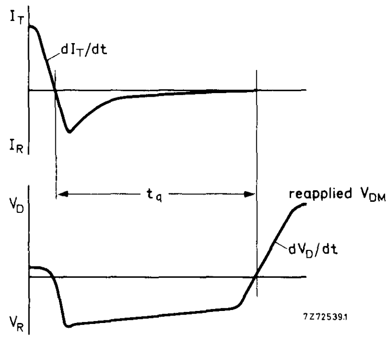
c) Rate of fall of anode current (dI/dt) – high rates mean shorter turn-off times.

d) Rate of rise of reapplied off-state voltage (dV_D/dt) – high rates mean longer turn-off times.

e) Temperature (T_j or T_{mb}) – high temperatures mean longer turn-off times.

f) Gate conditions ($-V_{GG}$, R_{tot}) – the application of a negative gate voltage during reverse recovery can be used to reduce the turn-off time. Care must be taken not to exceed the reverse gate voltage rating (V_{RGMmax}).

The waveforms are shown in the following diagram:



MOUNTING INSTRUCTIONS FOR TO-220 ENVELOPES

GENERAL DATA AND INSTRUCTIONS FOR HEATSINK OPERATION

General rules

1. First fasten the devices to the heatsink before soldering the leads.
2. Use of heatsink compound is recommended.
3. Avoid axial stress to the leads.
4. Keep mounting tool (e.g. screwdriver) clear of the plastic body.
5. It is recommended that the circuit connections be made to the leads rather than direct to the heatsink.

Heatsink requirements

Flatness in the mounting area: 0,02 mm maximum per 10 mm.
Mounting holes must be deburred.

Heatsink compound

Values of the thermal resistance from mounting base to heatsink ($R_{th\ mb-h}$) given for mounting with heatsink compound refer to the use of a metallic oxide-loaded compound. The compound should be an electrical insulator and be applied sparingly and evenly to both interfaces. Ordinary silicone grease is not recommended.

For insulated mounting, the compound should be applied to the bottom of both device and insulator.

Mounting methods for thyristors and triacs

1. Clip mounting.

   Mounting by means of spring clip offers:

   a. A good thermal contact under the crystal area, and slightly lower $R_{th\ mb-h}$ values than screw mounting.

   b. Safe insulation for mains operation.

   Recommended force of clip on device is 120 N (12 kgf).

2. M3 screw mounting.

   Care should be taken to avoid damage to the plastic body. It is therefore recommended that a cross-recess pan-headed screw be used. Do not use self-tapping screws.

   Mounting torque for screw mounting:

Minimum torque (for good heat transfer)	0,55 Nm (5,5 kgcm)
Maximum torque (to avoid damaging the device)	0,80 Nm (8,0 kgcm)

   N.B.: When a nut or screw is not driven direct against a curved spring washer or lock washer, the torques are as follows:

Minimum torque (for good heat transfer)	0,4 Nm (4 kgcm)
Maximum torque (to avoid damaging the device)	0,6 Nm (6 kgcm)

   N.B.: Data on accessories are given in separate data sheets.

3. Rivet mounting (only possible for non-insulated mounting)

   Devices may be rivetted to flat heatsinks; such a process **must neither** deform the mounting tab, **nor** enlarge the mounting hole.

GENERAL DATA AND INSTRUCTIONS FOR HEATSINK OPERATION (continued)

Thermal data

			clip mounting	screw mounting	
Thermal resistance from mounting base to heatsink					
with heatsink compound, direct mounting	$R_{th\ mb\text{-}h}$	=	0,3	0,5	°C/W
without heatsink compound, direct mounting	$R_{th\ mb\text{-}h}$	=	1,4	1,4	°C/W
with heatsink compound and mica insulator 56369	$R_{th\ mb\text{-}h}$	=	2,2	–	°C/W
with heatsink compound and alumina insulator 56367	$R_{th\ mb\text{-}h}$	=	0,8	–	°C/W

Lead bending

Maximum permissible tensile force on the body, for 5 seconds is 5 N (0,5 kgf).

The leads can be bent through 90° maximum, twisted or straightened. To keep forces within the above-mentioned limits, the leads are generally clamped near the body. The leads should neither be bent nor twisted less than 2,4 mm from the body.

Soldering

Lead soldering temperature at 4,7 mm from the body; $t_{sld} < 5$ s: $T_{sld\ max} = 275$ °C.

Avoid any force on body and leads during or after soldering: do not move the device or leads after soldering.

It is not permitted to solder the metal tab of the device to a heatsink, otherwise its junction temperature rating will be exceeded.

INSTRUCTIONS FOR CLIP MOUNTING (TO-220 envelopes)

Direct mounting with clip 56363

1. Place the device on the heatsink, applying heatsink compound to the mounting base.
2. Push the short end of the clip into the narrow slot in the heatsink with the clip at an angle of 10° to 30° to the vertical (see Fig. 1).
3. Push down the clip over the device until the long end of the clip snaps into the wide slot in the heatsink. The clip should bear on the plastic body, not on the tab (see Fig. 1(c)).

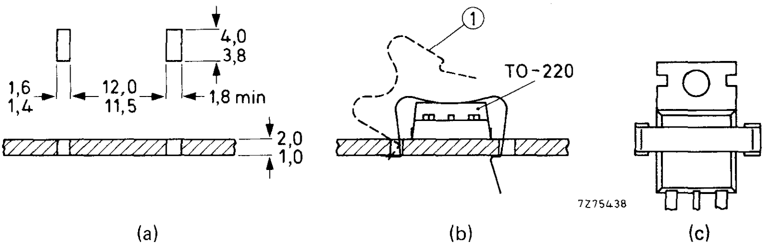


Fig. 1 (a) Heatsink requirements; (b) mounting (1 = spring clip); (c) position of the device (top view).

Insulated mounting with clip 56364

With the insulators 56367 or 56369 insulation up to 2 kV is obtained.

1. Place the device with the insulator on the heatsink, applying heatsink compound to the bottom of both device and insulator.
2. Push the short end of the clip into the narrow slot in the heatsink with the clip at an angle of 10° to 30° to the vertical (see Fig. 2).
3. Push down the clip over the device until the long end of the clip snaps into the wide slot in the heatsink. The clip should bear on the plastic body, not on the tab (see Fig. 2(c)). There should be minimum 3 mm distance between the device and the edge of the insulator for adequate creepage.

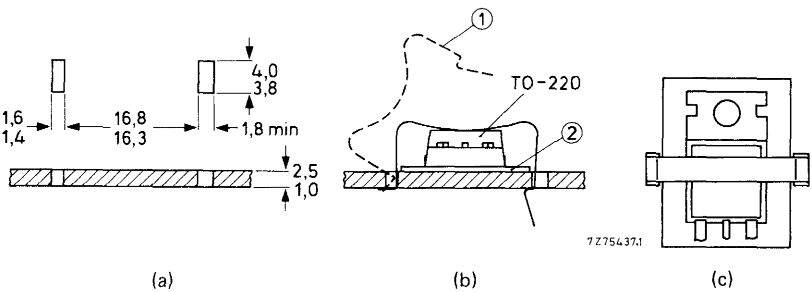
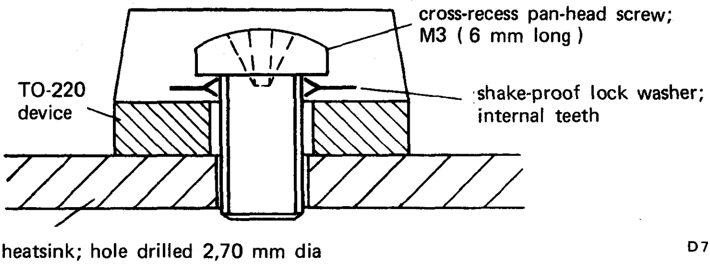


Fig. 2 (a) Heatsink requirements; (b) mounting (1 = spring clip, 2 = insulator 56369 or 56367); (c) position of the device (top view).

INSTRUCTIONS FOR SCREW MOUNTING (TO-220 envelopes)

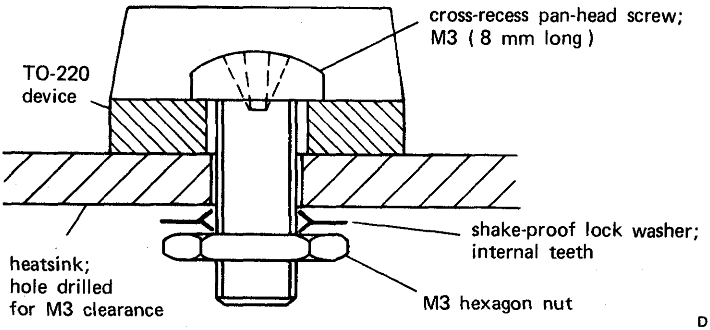
Direct mounting with screw

- *into tapped heatsink*



D7509A

- *through heatsink with nut*



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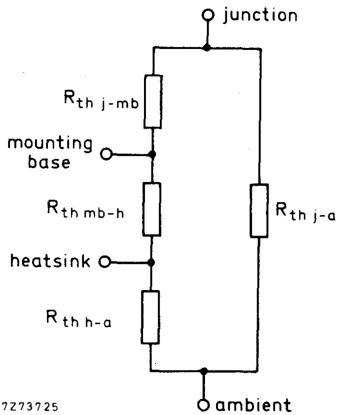
MOUNTING CONSIDERATIONS FOR STUD-MOUNTED THYRISTORS

Losses generated in a silicon device must flow through the case and to a lesser extent the leads. The greatest proportion of the losses flow out through the case into a heat exchanger which can be either free convection cooled, forced convection or even liquid cooled. For the majority of devices in our range natural convection is generally adequate, however, where other considerations such as space saving must be taken into account then methods such as forced convection etc. can be considered. The thermal path from junction to ambient may be considered as a number of resistances in series. The first thermal resistance will be that of junction to mounting base, usually denoted by $R_{th\ j\text{-}mb}$. The second is the contact thermal resistance $R_{th\ mb\text{-}h}$ and finally there is the thermal resistance of the heatsink $R_{th\ h\text{-}a}$.

In the rating curves, the contact thermal resistance and heatsink thermal resistances are combined as a single figure - $R_{th\ mb\text{-}a}$.

In addition to the steady state thermal conditions of the system, consideration should also be given to the possibility of any transient thermal excursions. These can be caused for example by starting conditions or overloads and in order to calculate the effect on the device, a graph of transient thermal resistance $Z_{th\ j\text{-}mb}$ as a function of time is given in each data sheet.



7Z73725

When mounting the device on the heatsink, care should be taken that the contact surfaces are free from burrs or projections of any kind and must be thoroughly clean.

In the case where an anodised heatsink is used, the anodising should be removed from the contact surface ensuring good electrical and thermal contact.

The contact surfaces should be smeared with a metallic oxide-loaded grease to ensure good heat transfer. Where the device is mounted in a tapped hole, care should be taken that the hole is perpendicular to the surface of the heatsink. When mounting the device to the heatsink, it is essential that a proper torque wrench is used, applying the correct amount of torque as specified in the published data.

Excessive torque can distort the threads of the device and may even cause mechanical stress on the wafer, leading to the possible failure.

Where isolation of the device from the heatsink is required, it is common practice to use a mica washer between contact surfaces, and where a clearance hole is used, a p.t.f.e. insulating bush is inserted. A metallic oxide-loaded heatsink compound should be smeared on all contact surfaces, including the mica washer, to ensure optimum heat transfer. The use of ordinary silicone grease is not recommended.

OPERATING NOTES

When there is a possibility that transients, due to the energy stored in the transformer, will exceed the maximum permissible non-repetitive peak reverse voltage, a damping circuit should be connected across the transformer.
Either a series RC circuit or a voltage dependent resistor may be used. Suitable component values for an RC circuit across the transformer primary or secondary may be calculated as follows:

$\frac{V_{RSM}}{V_{RWM}}$	RC across primary of transformer		RC across secondary of transformer	
	C (μF)	R (Ω)	C (μF)	R (Ω)
2.0	$200 \frac{I_{mag}}{V_1}$	$\frac{150}{C}$	$225 \frac{I_{mag} T^2}{V_1}$	$\frac{200}{C}$
1.5	$400 \frac{I_{mag}}{V_1}$	$\frac{225}{C}$	$450 \frac{I_{mag} T^2}{V_1}$	$\frac{275}{C}$
1.25	$550 \frac{I_{mag}}{V_1}$	$\frac{260}{C}$	$620 \frac{I_{mag} T^2}{V_1}$	$\frac{310}{C}$
1.0	$800 \frac{I_{mag}}{V_1}$	$\frac{300}{C}$	$900 \frac{I_{mag} T^2}{V_1}$	$\frac{350}{C}$

where I_{mag} = magnetising primary r.m.s. current (A)

V_1 = transformer primary r.m.s. voltage (V)

V_2 = transformer secondary r.m.s. voltage (V)

T = V_1/V_2

V_{RSM} = the transient voltage peak produced by the transformer

V_{RWM} = the actually applied crest working reverse voltage

The capacitance values calculated from the above table are minimum values; to allow for circuit variations and component tolerances, larger values should be used.

SILICON BI-DIRECTIONAL TRIGGER DEVICE

Silicon bi-directional trigger device intended for use in triac and thyristor trigger circuits.

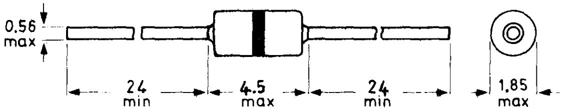
QUICK REFERENCE DATA

Breakover voltage	$V_{(BO)}$		28 to 36	V
Output voltage	V_O	>	5	V
Repetitive peak current	I_{FRM}	max.	2	A

MECHANICAL DATA

Dimensions in mm

Fig. 1



RATINGS

Limiting values in accordance with the Absolute Maximum System (IEC134)

Total power dissipation up to T_{amb} = 50 °C	P_{tot}	max.	150	mW
Repetitive peak current ($t \leq 20\ \mu s$)	I_{FRM}	max.	2	A
Storage temperature	T_{stg}		−55 to +125	°C
Junction temperature	T_j	max.	100	°C

THERMAL RESISTANCE

From junction to ambient in free air	$R_{th\ j\text{-}a}$	=	0.33	K/mW

CHARACTERISTICS

$T_j = 25\ ^oC$

Breakover voltage at $\frac{dV}{dt} = 10$ V/ms	$V_{(BO)}$		28 to 36	V
Breakover voltage symmetry	$\lvert V_{(BO)I} - V_{(BO)III} \rvert$	<	3	V
Output voltage at $\frac{dV}{dt} = 10$ V/ms	V_O	>	5	V
Breakover current at V = 0.98 $V_{(BO)}$	$I_{(BO)}$	<	100	μA

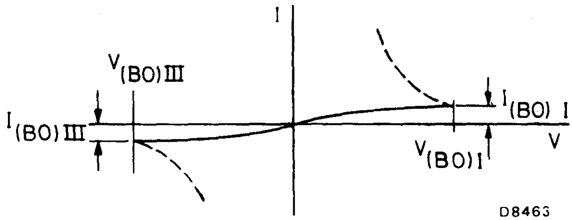


Fig.2

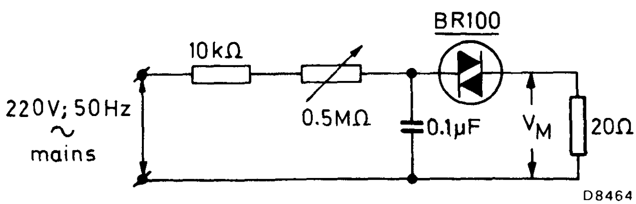


Fig. 3 Test circuit for output voltage

THYRISTOR TETRODE

The BRY39T is a planar p-n-p-n trigger device in a TO—72 metal envelope, intended for use in low-power switching applications such as relay and lamp drivers, sensing network for temperature and as a trigger device for thyristors and triacs.
For BRY39P and BRY39S see 'Small signal transistors' handbook.

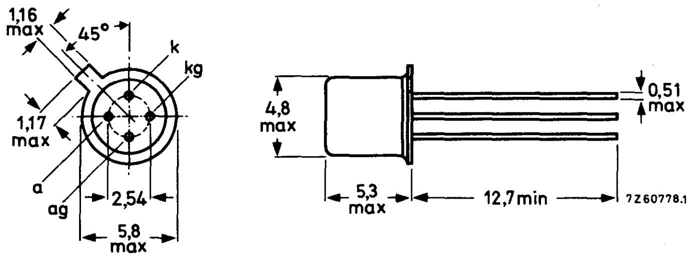
QUICK REFERENCE DATA

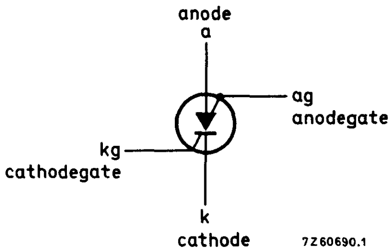
Repetitive peak voltages	$V_{DRM} = V_{RRM}$	max.	70	V
Average on-state current	$I_{T(AV)}$	max.	250	mA
Non-repetitive peak on-state current	I_{TSM}	max.	3	A

MECHANICAL DATA

Dimensions in mm

Fig.1 TO—72; Anode gate connected to case.





Accessories supplied on request: 56246 (distance disc)

RATINGS

Limiting values in accordance with the Absolute Maximum System (IEC 134)

Anode to cathode

Non-repetitive peak voltages	$V_{DSM} = V_{RSM}$	max.	70	V*
Repetitive peak voltages	$V_{DRM} = V_{RRM}$	max.	70	V*
Continuous voltages	$V_D = V_R$	max.	70	V*
Average on-state current up to T_{case} = 85 °C	$I_{T(AV)}$	max.	250	mA
in free air up to T_{amb} = 25 °C	$I_{T(AV)}$	max.	175	mA
Repetitive peak on-state current t = 10 μs; δ = 0.01	I_{TRM}	max.	2.5	A
Non-repetitive peak on-state current t = 10 μs; T_j = 150 °C prior to surge	I_{TSM}	max.	3	A
Rate of rise of on-state current after triggering to I_T = 2.5 A	$\frac{dI_T}{dt}$	max.	20	A/μs

Cathode gate to cathode

Peak reverse voltage	V_{RGKM}	max.	5	V
Peak forward current	I_{FGKM}	max.	100	mA

Anode gate to anode

Peak reverse voltage	V_{RGAM}	max.	70	V
Peak forward current	I_{FGAM}	max.	100	mA

Temperatures

Storage temperature	T_{stg}		−65 to +200	°C
Junction temperature	T_j	max.	150	°C

THERMAL RESISTANCE

From junction to ambient in free air	$R_{th\ j\text{-}a}$	=	0.45	°C/mW
From junction to case	$R_{th\ j\text{-}c}$	=	0.15	°C/mW

*These ratings apply for zero or negative bias on the cathode gate with respect to the cathode, and when a resistor R ⩽ 10 kΩ is connected between cathode gate and cathode.

CHARACTERISTICS

Anode to cathode

On-state voltage I_T = 100 mA; T_j = 25 °C	V_T	<	1.4	V*
Rate of rise of off-state voltage that will not trigger any device	$\frac{dV_D}{dt}$**			
Reverse current V_R = 70 V; T_j = 25 °C	I_R	typ.	1	nA
		<	100	nA
T_j = 150 °C	I_R	<	2	µA
Off-state current V_D = 70 V; T_j = 25 °C	I_D	typ.	1	nA
		<	100	nA
T_j = 150 °C	I_D	<	2	µA
Holding current R_{GK} = 10 kΩ; R_{GA} = 220 kΩ; T_j = 25 °C	I_H	<	250	µA

Cathode gate to cathode

Voltage that will trigger all devices V_D = 6 V; T_j = 25 °C	V_{GKT}	>	0.5	V
Current that will trigger all devices V_D = 6 V; T_j = 25 °C	I_{GKT}	>	1	µA

Anode gate to anode

Voltage that will trigger all devices V_D = 6 V; T_j = 25 °C	$-V_{GAT}$	>	1	V
Current that will trigger all devices V_D = 6 V; R_{GK} = 10 kΩ; T_j = 25 °C	$-I_{GAT}$	>	100	µA

*Measured under pulse conditions to avoid excessive dissipation.
**The dV_D/dt is unlimited when the anode gate lead is returned to the supply voltage through a current limiting resistor.

Switching characteristics

Gate-controlled turn-on time ($t_{gt} = t_d + t_r$) when switched from V_D = 15 V to I_T = 150 mA; I_{GK} = 5 μA; dI_{GK}/dt = 5 μA/μs; T_j = 25 °C	t_{gt}	<	300	ns
Circuit-commutated turn-off time when switched from I_T = 150 mA to V_R = 15 V; $-dI_T/dt$ = 3 A/μs; dV_D/dt = 70 V/μs; V_D = 15 V	t_q	<	3	μs

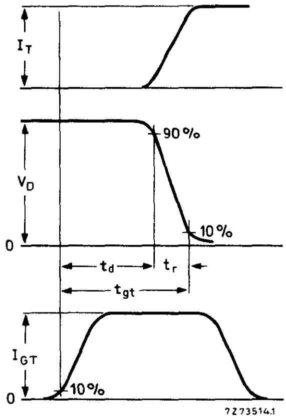


Fig.2 Gate-controlled turn-on time definition.

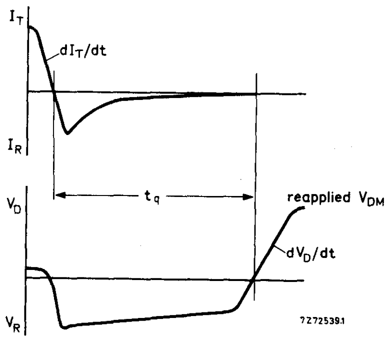


Fig.3 Circuit-commutated turn-off time definition.

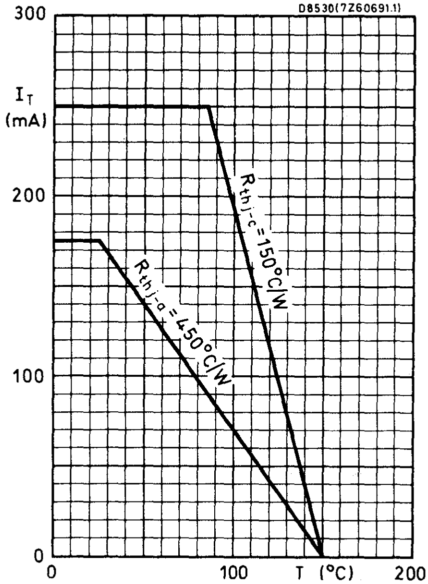


Fig.4

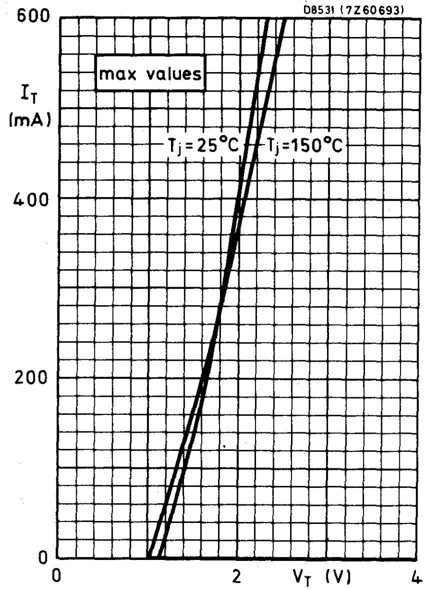


Fig.5

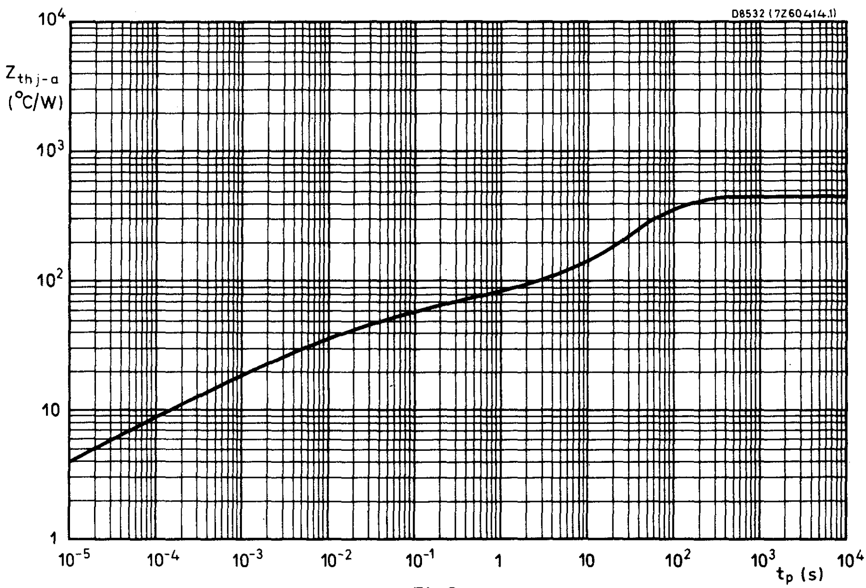


Fig.6

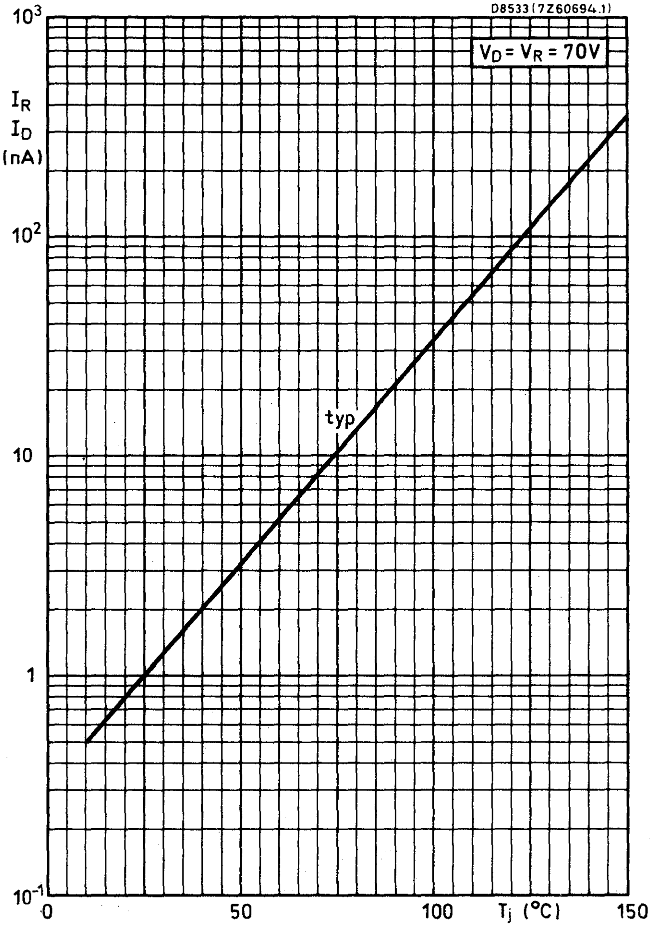

D8533 (7Z60694.1)
$V_D = V_R = 70V$
I_R
I_D
(nA)
10^3
10^2
10
1
10^{-1}
typ
0
50
100
150
T_j (°C)

Fig.7

APPLICATION INFORMATION

Sensing network

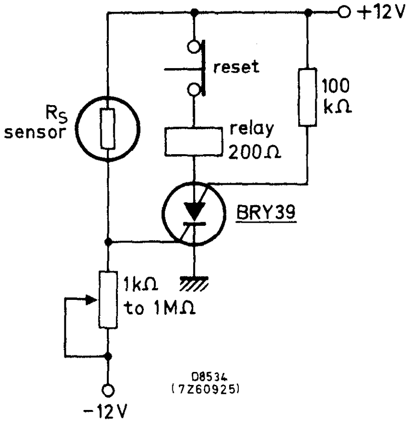


Fig.8

R_S must be chosen in accordance with the light, temperature, or radiation intensity to be sensed; its resistance should be of the same order as that of the potentiometer.
In the arrangement shown, a decline in resistance of R_S triggers the thyristor, closing the relay that activates the warning system. If the positions of R_S and the potentiometer are interchanged, an increase in the resistance of R_S triggers the thyristor.

THYRISTORS

Glass-passivated thyristors in TO-220AB envelopes, featuring eutectic bonding, thus being particularly suitable in situations creating high fatigue stresses involved in thermal cycling and repeated switching. Applications include temperature control, motor control, regulators in transformerless power supply applications, relay and coil pulsing and power supply crowbar protection circuits.

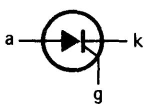
QUICK REFERENCE DATA

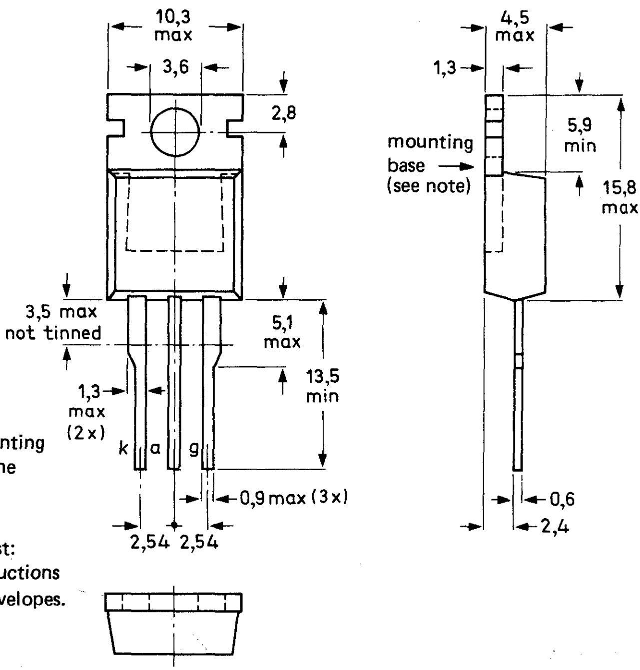
			BT151-500R	650R	
Repetitive peak voltages	V_{DRM}/V_{RRM}	max.	500	650	V
Average on-state current	$I_{T(AV)}$	max.	7,5		A
R.M.S. on-state current	$I_{T(RMS)}$	max.	12		A
Non-repetitive peak on-state current	I_{TSM}	max.	100		A

MECHANICAL DATA

Fig. 1 TO-220AB.

Dimensions in mm





Net mass: 2 g

Note: The exposed metal mounting base is directly connected to the anode.

Accessories supplied on request: see data sheets Mounting instructions and accessories for TO-220 envelopes.

RATINGS

Limiting values in accordance with the Absolute Maximum System (IEC 134)

Anode to cathode			BT151-500R	650R	
Non-repetitive peak voltages ($t \leq 10$ ms)	V_{DSM}/V_{RSM}	max.	500	650	V*
Repetitive peak voltages ($\delta \leq 0{,}01$)	V_{DRM}/V_{RRM}	max.	500	650	V
Crest working voltages	V_{DWM}/V_{RWM}	max.	400	400	V
Continuous voltages	V_{D}/V_{R}	max.	400	400	V
→ Average on-state current (averaged over any 20 ms period) up to T_{mb} = 95 °C	$I_{T(AV)}$	max.		7,5	A
R.M.S. on-state current	$I_{T(RMS)}$	max.		12	A
Repetitive peak on-state current	I_{TRM}	max.		65	A
→ Non-repetitive peak on-state current; t = 10 ms; half sine-wave; T_j = 110 °C prior to surge; with reapplied V_{RWMmax}	I_{TSM}	max.		100	A
I^2t for fusing (t = 10 ms)	I^2t	max.		50	A^2s
Rate of rise of on-state current after triggering with I_G = 50 mA to I_T = 20 A; dI_G/dt = 50 mA/µs	dI_T/dt	max.		50	A/µs
Gate to cathode					
Reverse peak voltage	V_{RGM}	max.		5	V
Average power dissipation (averaged over any 20 ms period)	$P_{G(AV)}$	max.		0,5	W
Peak power dissipation	P_{GM}	max.		5	W
Temperatures					
Storage temperature	T_{stg}			−40 to +125	°C
→ Operating junction temperature	T_j	max.		110	°C

* Although not recommended, higher off-state voltages may be applied without damage, but the thyristor may switch into the on-state. The rate of rise of on-state current should not exceed 15 A/µs.

THERMAL RESISTANCE

From junction to mounting base	$R_{th\ j\text{-}mb}$	= 1,3 ^{o}C/W
Transient thermal impedance; t = 1 ms	$Z_{th\ j\text{-}mb}$	= 0,2 ^{o}C/W

Influence of mounting method

1. Heatsink mounted with clip (see mounting instructions)

Thermal resistance from mounting base to heatsink

a. with heatsink compound	$R_{th\ mb\text{-}h}$	= 0,3 ^{o}C/W
b. with heatsink compound and 0,06 mm maximum mica insulator	$R_{th\ mb\text{-}h}$	= 1,4 ^{o}C/W
c. with heatsink compound and 0,1 mm maximum mica insulator (56369)	$R_{th\ mb\text{-}h}$	= 2,2 ^{o}C/W
d. with heatsink compound and 0,25 mm max. alumina insulator (56367)	$R_{th\ mb\text{-}h}$	= 0,8 ^{o}C/W
e. without heatsink compound	$R_{th\ mb\text{-}h}$	= 1,4 ^{o}C/W

2. Free-air operation

The quoted values of $R_{th\ j\text{-}a}$ should be used only when no leads of other dissipating components run to the same tie-point.

Thermal resistance from junction to ambient in free air:
mounted on a printed-circuit board at a = any lead length
and with copper laminate $R_{th\ j\text{-}a}$ = 60 ^{o}C/W

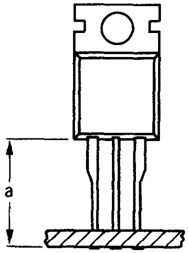


Fig. 2.

→ **CHARACTERISTICS**

Anode to cathode

On-state voltage				
I_T = 23 A; T_j = 25 °C	V_T	<	1,75	V*
Rate of rise of off-state voltage that will not trigger any device; T_j = 110 °C; see Fig.10				
R_{GK} = open circuit	dV_D/dt	<	50	V/µs
R_{GK} = 100 Ω	dV_D/dt	<	200	V/µs
Reverse current				
$V_R = V_{RWMmax}$; T_j = 110 °C	I_R	<	0,5	mA
Off-state current				
$V_D = V_{DWMmax}$; T_j = 110 °C	I_D	<	0,5	mA
Latching current; T_j = 25 °C	I_L	<	40	mA
Holding current; T_j = 25 °C	I_H	<	20	mA

Gate to cathode

Voltage that will trigger all devices				
V_D = 6 V; T_j = 25 °C	V_{GT}	>	1,5	V
V_D = 6 V; T_j = −40 °C	V_{GT}	>	2,3	V
Voltage that will not trigger any device				
$V_D = V_{DRMmax}$; T_j = 110 °C	V_{GD}	<	250	mV
Current that will trigger all devices				
V_D = 6 V; T_j = 25 °C	I_{GT}	>	15	mA
V_D = 6 V; T_j = −40 °C	I_{GT}	>	20	mA

Switching characteristics

Gate-controlled turn-on time ($t_{gt} = t_d + t_r$) when switched from $V_D = V_{DRMmax}$ to I_T = 40 A; I_{GT} = 100 mA; dI_G/dt = 5A/µs; T_j = 25 °C	t_{gt}	typ.	2	µs

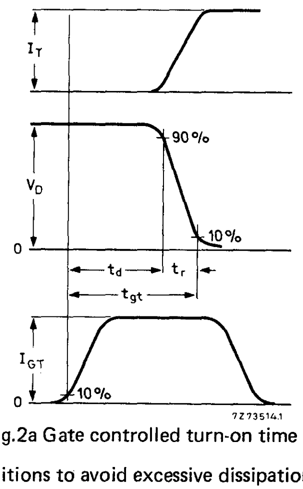


Fig.2a Gate controlled turn-on time definition.

*Measured under pulse conditions to avoid excessive dissipation.

MOUNTING INSTRUCTIONS

1. The device may be soldered directly into the circuit, but the maximum permissible temperature of the soldering iron or bath is 275 °C; it must not be in contact with the joint for more than 5 seconds. Soldered joints must be at least 4,7 mm from the seal.
2. The leads should not be bent less than 2,4 mm from the seal, and should be supported during bending.
3. It is recommended that the circuit connection be made to the anode tag, rather than direct to the heatsink.
4. Mounting by means of a spring clip is the best mounting method because it offers:
   a. a good thermal contact under the crystal area and slightly lower $R_{th\ mb\text{-}h}$ values than screw mounting.
   b. safe isolation for mains operation.
   However, if a screw is used, it should be M3 cross-recess pan-head. Care should be taken to avoid damage to the plastic body.
5. For good thermal contact heatsink compound should be used between mounting base and heatsink. Values of $R_{th\ mb\text{-}h}$ given for mounting with heatsink compound refer to the use of a metallic-oxide loaded compound. Ordinary silicone grease is not recommended.
6. The device should not be pop-rivetted to the heatsink. However, it is permissible to press-rivet providing that rivets of soft material are used, and the press forces are slowly and carefully controlled so as to avoid shock and deformation of either heatsink or mounting tab.

OPERATING NOTES

Dissipation and heatsink considerations:

a. The various components of junction temperature rise above ambient are illustrated in Fig. 3.

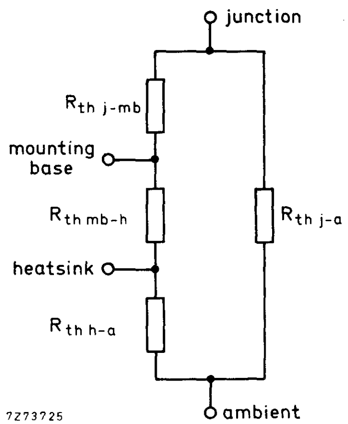


Fig. 3.

b. The method of using Fig. 4 is as follows:
   Starting with the required current on the $I_{T(AV)}$ axis, trace upwards to meet the appropriate form factor curve. Trace right horizontally and upwards from the appropriate value on the T_{amb} scale. The intersection determines the $R_{th\ mb\text{-}a}$. The heatsink thermal resistance value ($R_{th\ h\text{-}a}$) can now be calculated from:

$$R_{th\ h\text{-}a} = R_{th\ mb\text{-}a} - R_{th\ mb\text{-}h}.$$

c. Any measurement of heatsink temperature should be made immediately adjacent to the device.

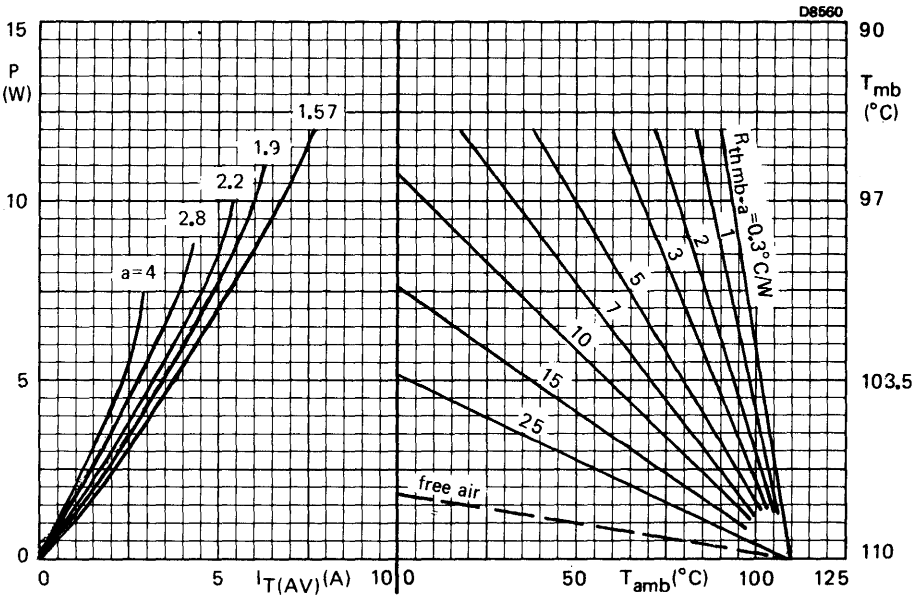
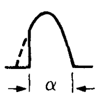


Fig. 4 The right-hand part shows the interrelationship between the power (derived from the left-hand part) and the maximum permissible temperatures.



α = conduction angle per half cycle

a = form factor = $\frac{I_{T(RMS)}}{I_{T(AV)}}$

α	a
30°	4
60°	2,8
90°	2,2
120°	1,9
180°	1,57

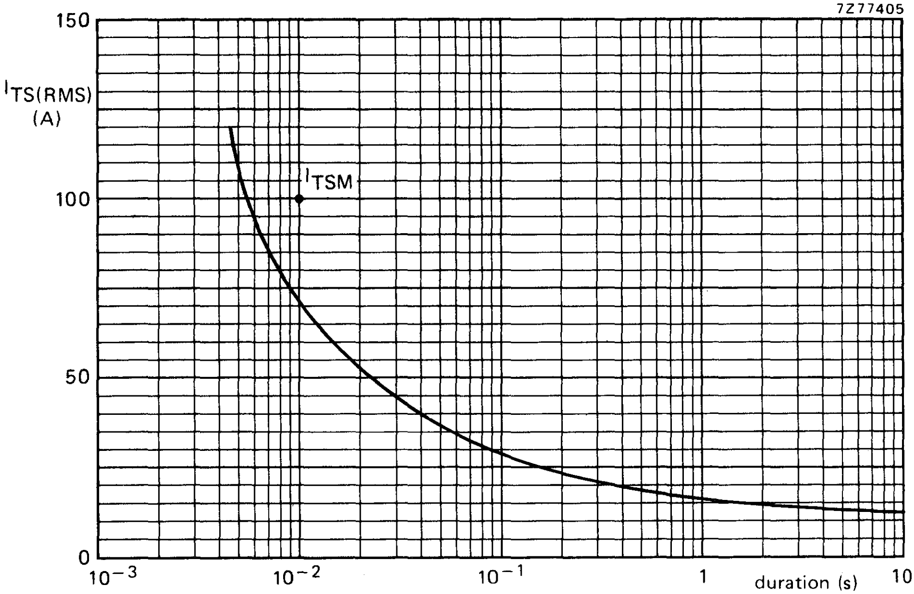
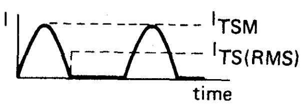


Fig.5 Maximum permissible non-repetitive r.m.s. on-state current based on sinusoidal currents (f = 50 Hz); T_j = 110 °C prior to surge; with reapplied V_{RWMmax}.



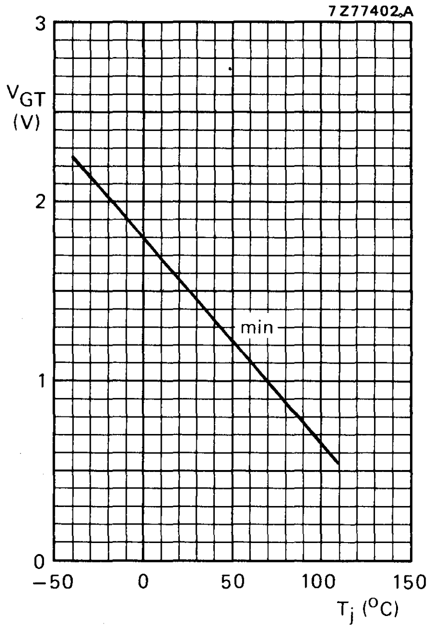


Fig. 6 Minimum gate voltage that will trigger all devices as a function of junction temperature.

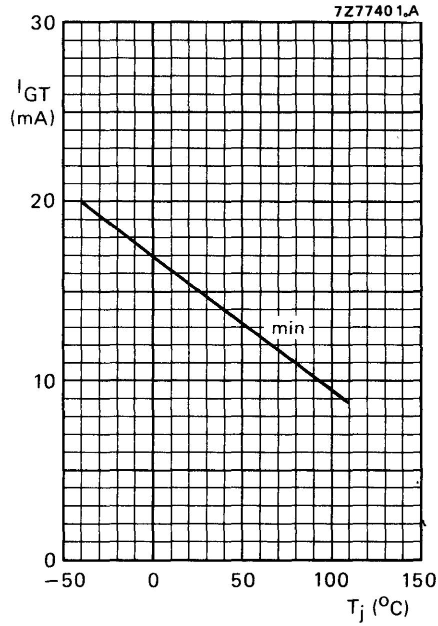


Fig. 7 Minimum gate current that will trigger all devices as a function of junction temperature.

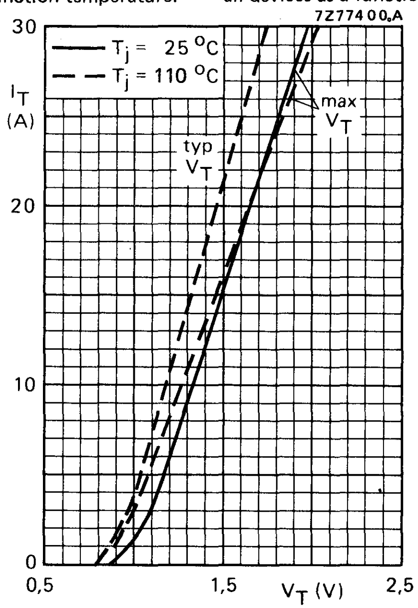


Fig. 8.

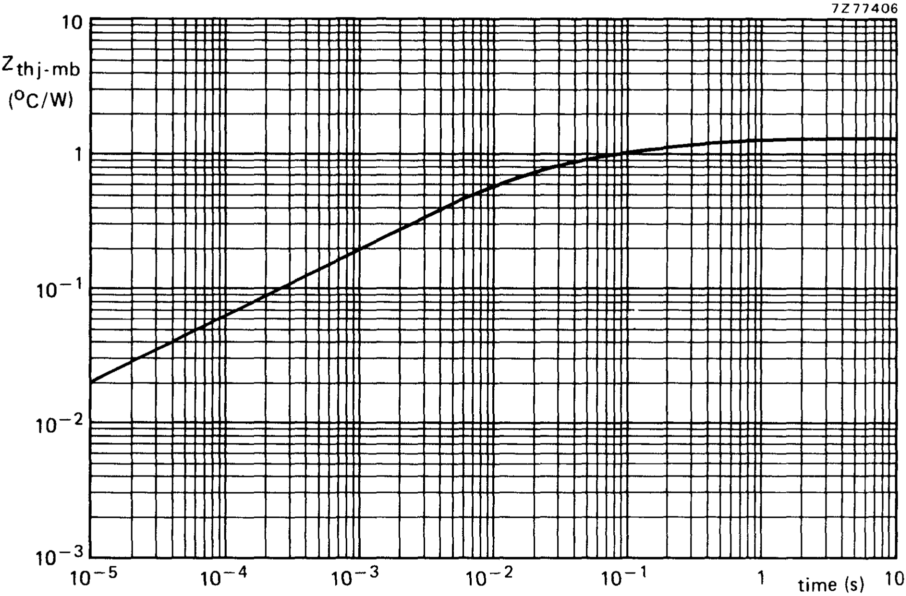


Fig. 9.

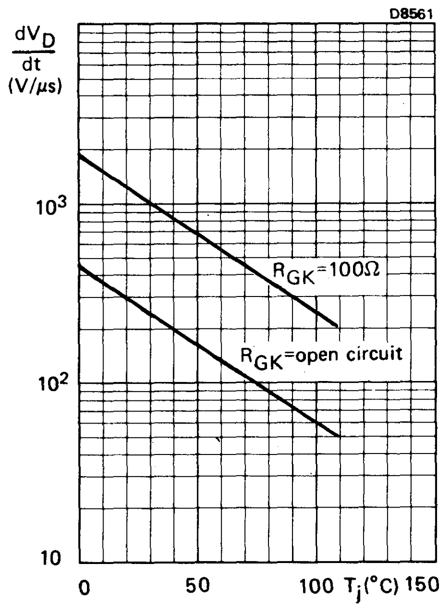


Fig. 10 Maximum rate of rise of off-state voltage that will not trigger any device (exponential method) as a function of junction temperature.

THYRISTORS

Glass-passivated thyristors in TO–220AB envelopes, featuring eutectic bonding, thus being particularly suitable in situations creating high fatigue stresses involved in thermal cycling and repeated switching. Applications include temperature control, motor control, regulators in transformerless power supply applications, relay and coil pulsing and power supply crowbar protection circuits.

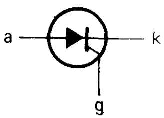
QUICK REFERENCE DATA

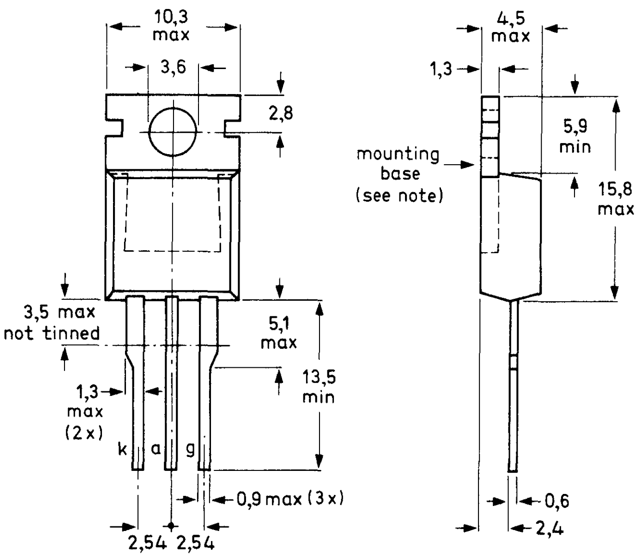
			BT152–400R	600R	800R	
Repetitive peak voltages	V_{DRM}/V_{RRM}	max.	400	600	800	V
Average on-state current	$I_{T(AV)}$	max.		13		A
R.M.S. on-state current	$I_{T(RMS)}$	max.		20		A
Non-repetitive peak on-state current	I_{TSM}	max.		200		A

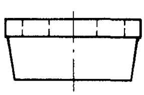
MECHANICAL DATA

Dimensions in mm

Fig.1 TO–220AB







Net mass: 2 g

Note: The exposed metal mounting base is directly connected to the anode.

Accessories supplied on request: see data sheets Mounting instructions and accessories for TO–220 envelopes.

RATINGS

Limiting values in accordance with the Absolute Maximum System (IEC 134)

Anode to cathode

			BT152–400R	600R	800R	
Non-repetitive peak voltages	V_{DSM}/V_{RSM}	max.	450	650	850	V
Repetitive peak voltages	V_{DRM}/V_{RRM}	max.	400	600	800	V
Crest working voltages	V_{DWM}/V_{RWM}	max.	400	400	400	V

Average on-state current (averaged over any 20 ms period) up to $T_{mb} = 93\ ^oC$	$I_{T(AV)}$	max.	13	A
R.M.S. on-state current	$I_{T(RMS)}$	max.	20	A
Repetitive peak on-state current	I_{TRM}	max.	200	A
Non-repetitive peak on-state current; t = 10 ms; half sine-wave; T_j = 115 ^oC prior to surge; with reapplied V_{RWMmax}	I_{TSM}	max.	200	A
I^2t for fusing (t = 10 ms)	I^2t	max.	200	A^2s
Rate of rise of on-state current after triggering with I_G = 160 mA to I_T = 50 A; dI_G/dt = 160 A/ms	dI_T/dt	max.	200	A/μs

Gate to cathode

Reverse peak voltage	V_{RGM}	max.	5	V
Average power dissipation (averaged over any 20 ms period)	$P_{G(AV)}$	max.	0.5	W
Peak power dissipation; t ⩽ 10 μs	P_{GM}	max.	20	W

Temperature

Storage temperature	T_{stg}		−40 to +150	^oC
Junction temperature	T_j	max.	115	^oC

THERMAL RESISTANCE

From junction to mounting base	$R_{th\ j\text{-}mb}$	=	1.1	$^oC/W$
From mounting base to heatsink with heatsink compound	$R_{th\ mb\text{-}h}$	=	0.3	$^oC/W$

CHARACTERISTICS

Anode to cathode

On-state voltage (measured under pulse conditions) I_T = 40 A; T_j = 25 °C	V_T	<	1.75	V
Rate of rise of off-state voltage that will not trigger any device T_j = 115 °C; R_{GK} = open circuit	dV_D/dt	<	200	V/μs
Reverse current $V_R = V_{RWMmax}$; T_j = 115 °C	I_R	<	1.0	mA
Off-state current $V_D = V_{DWMmax}$; T_j = 115 °C	I_D	<	1.0	mA
Latching current; T_j = 25 °C	I_L	<	80	mA
Holding current; T_j = 25 °C	I_H	<	60	mA

Gate to cathode

Voltage that will trigger all devices V_D = 12 V; T_j = −40 °C	V_{GT}	>	1.5	V
V_D = 12 V; T_j = 25 °C	V_{GT}	>	1.0	V
Voltage that will not trigger any device $V_D = V_{DRMmax}$; T_j = 115 °C	V_{GD}	<	0.25	V
Current that will trigger all devices V_D = 12 V; T_j = −40 °C	I_{GT}	>	50	mA
V_D = 12 V; T_j = 25 °C	I_{GT}	>	32	mA

Switching characteristics

Gate-controlled turn-on time ($t_{gt} = t_d + t_r$) when switched from $V_D = V_{DRMmax}$ to I_T = 40 A; I_{GT} = 100 mA; dI_G/dt = 5 A/μs; T_j = 25 °C	t_{gt}	typ.	2	μs
Circuit-commutated turn-off time when switched from I_T = 40 A to V_R > 50 V with $-dI_T/dt$ = 10 A/μs; dV_D/dt = 50 V/μs; T_j = 115 °C	t_q	typ.	35	μs

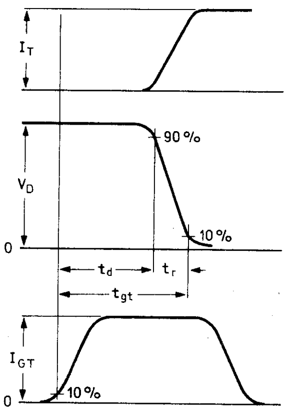


Fig.2 Gate-controlled turn-on time definition.

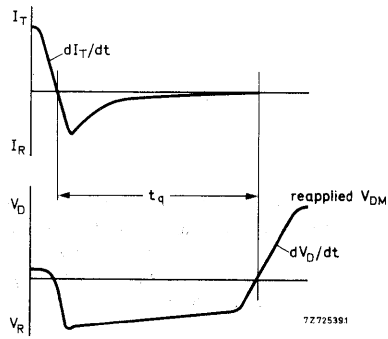


Fig.3 Circuit-commutated turn-off time definition.

MOUNTING INSTRUCTIONS

1. The device may be soldered directly into the circuit, but the maximum permissible temperature of the soldering iron or bath is 275 °C; it must not be in contact with the joint for more than 5 second: Soldered joints must be at least 4.7 mm from the seal.
2. The leads should not be bent less than 2.4 mm from the seal, and should be supported during bendin
3. It is recommended that the circuit connection be made to the anode tag, rather than direct to the heatsink.
4. Mounting by means of a spring clip is the best mounting method because it offers:
   a. a good thermal contact under the crystal area and slightly lower $R_{th\ mb\text{-}h}$ values than screw mounting.
   b. safe isolation for mains operation.
   However, if a screw is used, it should be M3 cross-recess pan-head. Care should be taken to avoid damage to the plastic body.
5. For good thermal contact heatsink compound should be used between mounting base and heatsink. Values of $R_{th\ mb\text{-}h}$ given for mounting with heatsink compound refer to the use of a metallic-oxide loaded compound. Ordinary silicone grease is not recommended.
6. The device should not be pop-rivetted to the heatsink. However, it is permissible to press-rivet providing that rivets of soft material are used, and the press forces are slowly and carefully controlled so as to avoid shock and deformation of either heatsink or mounting tab.

OPERATING NOTES

Dissipation and heatsink considerations:

a. The various components of junction temperature rise above ambient are illustrated in Fig.4.

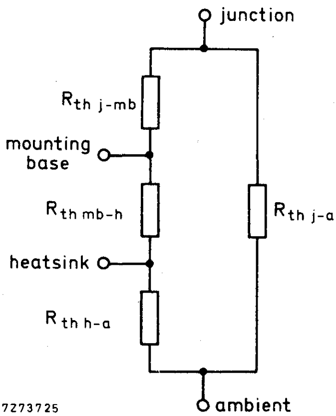


Fig.4

b. The method of using Fig.5 is as follows:
Starting with the required current on the $I_{T(AV)}$ axis, trace upwards to meet the appropriate form factor curve. Trace right horizontally and upwards from the appropriate value on the T_{amb} scale. The intersection determines the $R_{th\ mb\text{-}a}$. The heatsink thermal resistance value ($R_{th\ h\text{-}a}$) can now be calculated from:

$$R_{th\ h\text{-}a} = R_{th\ mb\text{-}a} - R_{th\ mb\text{-}h}.$$

c. Any measurement of heatsink temperature should be made immediately adjacent to the device.

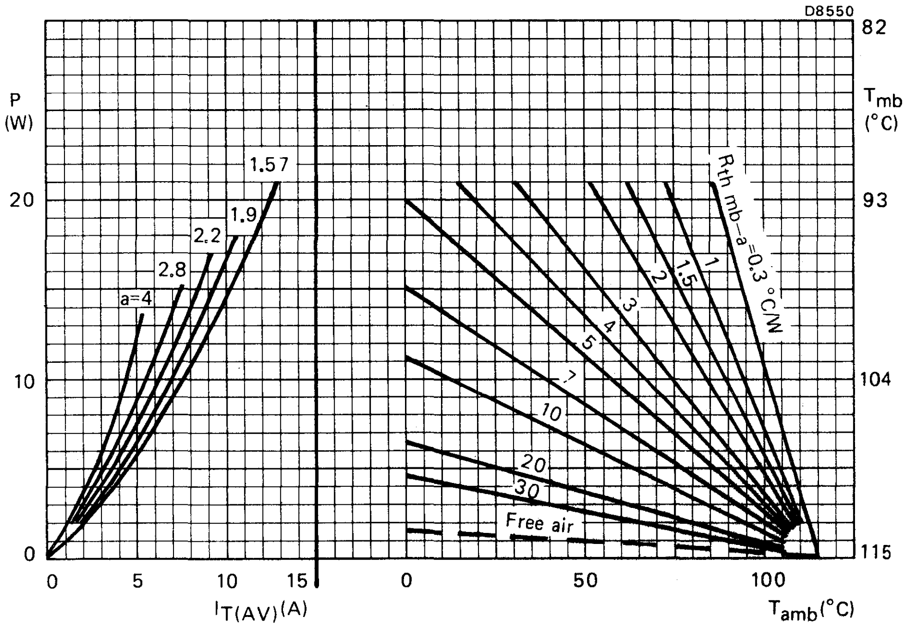
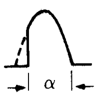


Fig.5 The right-hand part shows the interrelationship between the power (derived from the left-hand part) and the maximum permissible temperatures.



α = conduction angle per half cycle

$$a = \text{form factor} = \frac{I_{T\,(RMS)}}{I_{T(AV)}}$$

α	a
30°	4
60°	2.8
90°	2.2
120°	1.9
180°	1.57

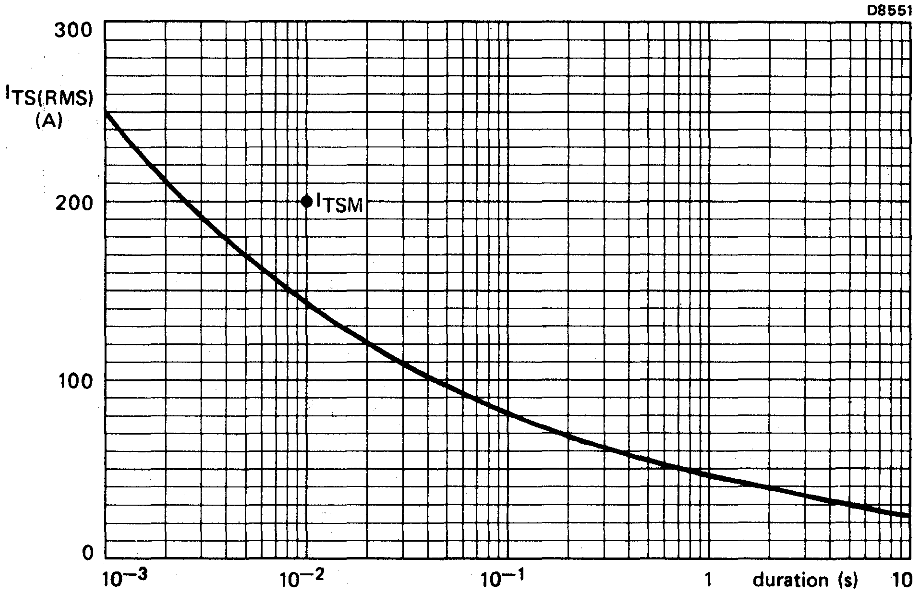
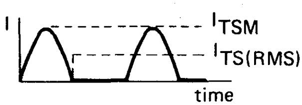


Fig.6 Maximum permissible non-repetitive r.m.s. on-state current based on sinusoidal currents (f = 50 Hz); T_j = 115 °C prior to surge; with reapplied V_{RWMmax}.



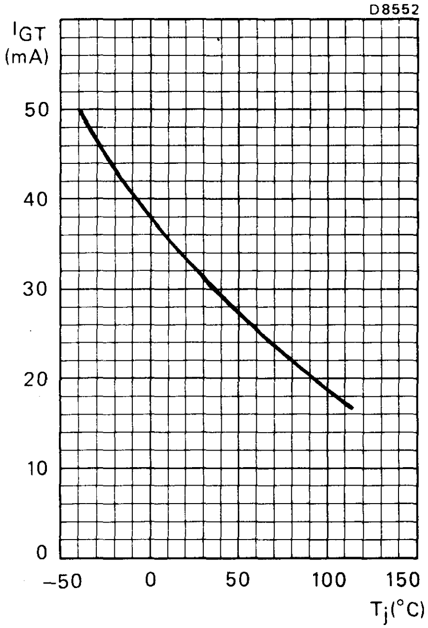


Fig. 7 Minimum gate current that will trigger all devices as a function of junction temperature.

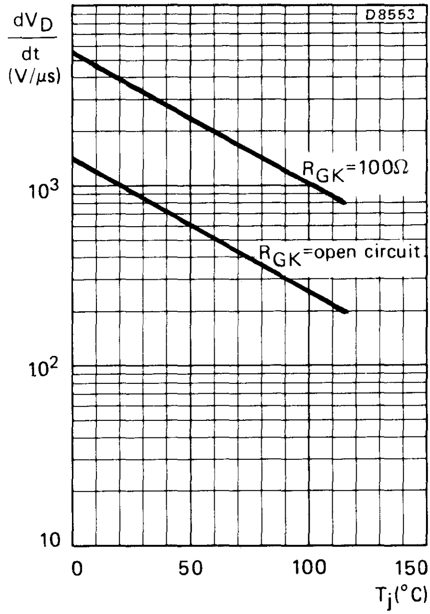


Fig.8 Maximum rate of rise of off-state voltage that will not trigger any device as a function of junction temperature.

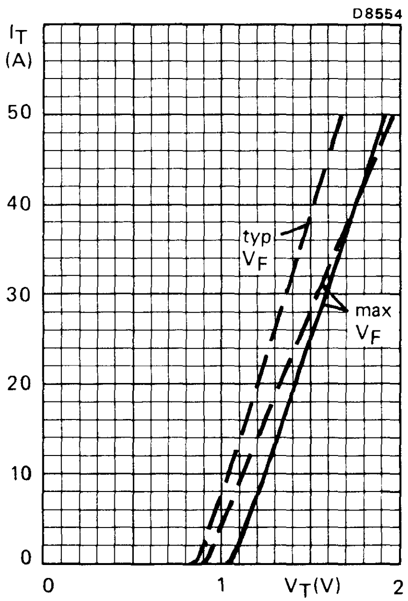


Fig.9 —— T_j = 25 °C; – – – T_j = 115 °C

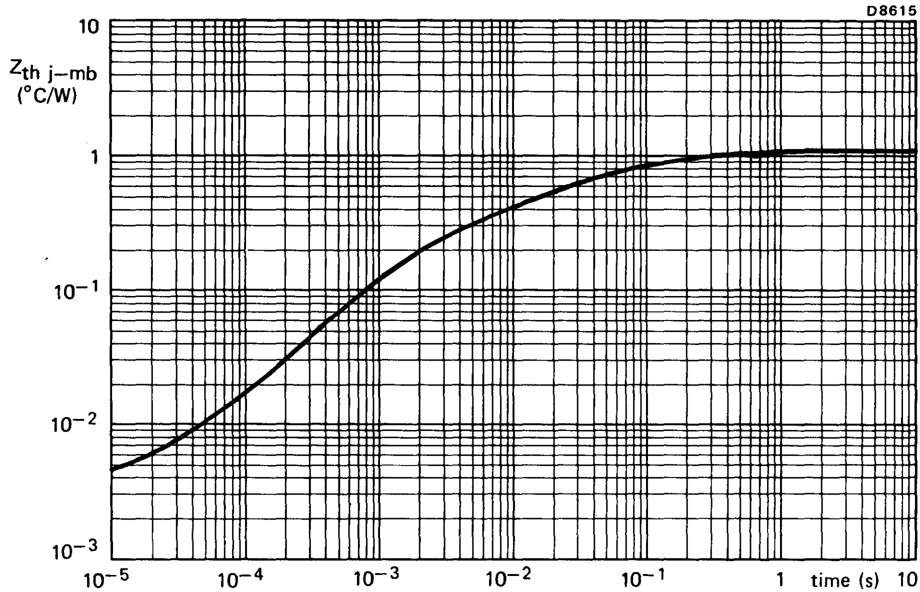


Fig. 10

FAST TURN-OFF THYRISTOR

Glass-passivated, eutectically bonded, fast turn-off thyristor in a TO-220AB envelope, intended for use in inverter, pulse and switching applications. Its characteristics make the device extremely suitable for use in regulator, vertical deflection, and east/west correction circuits of colour television receivers.

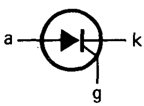
QUICK REFERENCE DATA

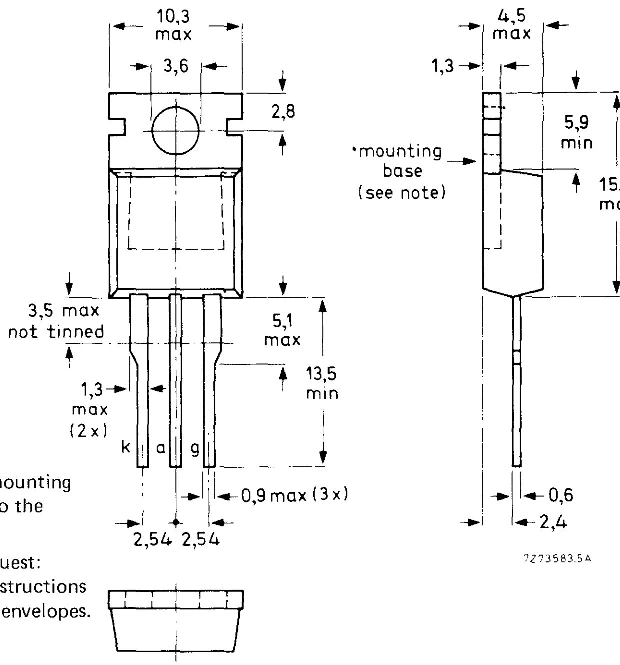
Repetitive peak off-state voltage	V_{DRM}	max.	500	V
Average on-state current	$I_{T(AV)}$	max.	4	A
R.M.S. on-state current	$I_{T(RMS)}$	max.	6	A
Repetitive peak on-state current	I_{TRM}	max.	30	A
Circuit-commutated turn-off time	t_q	<	20	μs

MECHANICAL DATA

Dimensions in mm

Fig. 1 TO-220AB.





Net mass: 2 g

Note: The exposed metal mounting base is directly connected to the anode.

Accessories supplied on request: see data sheets Mounting instructions and accessories for TO-220 envelopes.

RATINGS

Limiting values in accordance with the Absolute Maximum System (IEC 134)

Anode to cathode

Non-repetitive peak voltages ($t \leq 10$ ms)	V_{DSM}/V_{RSM}	max.	550	V
Repetitive peak voltages	V_{DRM}/V_{RRM}	max.	500	V
Working voltages	V_{DW}/V_{RW}	max.	400	V *
Average on-state current (averaged over any 20 ms period) up to T_{mb} = 95 °C	$I_{T(AV)}$	max.	4	A
R.M.S. on-state current	$I_{T(RMS)}$	max.	6	A
Working peak on-state current	I_{TWM}	max.	10	A
Repetitive peak on-state current	I_{TRM}	max.	30	A
Non-repetitive peak on-state current; t = 10 ms; half sine-wave; T_j = 110 °C prior to surge; with reapplied V_{RWMmax}	I_{TSM}	max.	40	A
I^2t for fusing; t = 10 ms; T_j = 25 °C	I^2t	max.	10	A^2s
Rate of rise of on-state current after triggering up to f = 20 kHz; V_{DM} = 300 V to I_{TM} = 6 A	dI_T/dt	max.	200	A/μs

Gate to cathode

Average power dissipation (averaged over any 20 ms period)	$P_{G(AV)}$	max.	1	W
Peak power dissipation; t = 10 μs	P_{GM}	max.	25	W

Temperatures

Storage temperature	T_{stg}	−40 to + 125		°C
Operating junction temperature	T_j	max.	110	°C

* Voltage shapes as occurring in the intended application.

THERMAL RESISTANCE

From junction to mounting base	$R_{th\ j\text{-}mb}$	= 1,5 °C/W
Transient thermal impedance; t = 1 ms	$Z_{th\ j\text{-}mb}$	= 0,2 °C/W

Influence of mounting method

1. Heatsink mounted with clip (see mounting instructions)

Thermal resistance from mounting base to heatsink

a. with heatsink compound	$R_{th\ mb\text{-}h}$	= 0,3 °C/W
b. with heatsink compound and 0,06 mm maximum mica insulator	$R_{th\ mb\text{-}h}$	= 1,4 °C/W
c. with heatsink compound and 0,1 mm maximum mica insulator (56369)	$R_{th\ mb\text{-}h}$	= 2,2 °C/W
d. with heatsink compound and 0,25 mm max. alumina insulator (56367)	$R_{th\ mb\text{-}h}$	= 0,8 °C/W
e. without heatsink compound	$R_{th\ mb\text{-}h}$	= 1,4 °C/W

2. Free-air operation

The quoted values of $R_{th\ j\text{-}a}$ should be used only when no leads of other dissipating components run to the same tie-point.

Thermal resistance from junction to ambient in free air:
mounted on a printed-circuit board at a = any lead length
and with copper laminate $R_{th\ j\text{-}a}$ = 60 °C/W

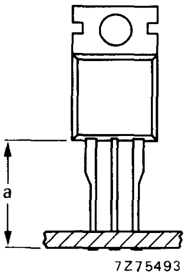


Fig. 2.

CHARACTERISTICS

Anode to cathode

On-state voltage $I_T = 10$ A; $T_j = 25$ °C	V_T	$<$	2,5 V *
Rate of rise of off-state voltage that will not trigger any device; $T_j \leqslant 110$ °C	dV_D/dt	$<$	200 V/μs
Off-state current $V_D = V_{DRMmax}$; $T_j = 110$ °C	I_D	$<$	1,5 mA
Holding current; $T_j = 25$ °C	I_H	$<$	100 mA

Gate to cathode

Voltage that will trigger all devices $V_D = 6$ V; $T_j = 25$ °C; $t_p \geqslant 5$ μs	V_{GT}	$>$	2,5 V
Current that will trigger all devices $V_D = 6$ V; $T_j = 25$ °C; $t_p \geqslant 5$ μs	I_{GT}	$>$	40 mA

Switching characteristics

Circuit-commutated turn-off time (in regulating circuits) when switched from $I_T = 6$ A to $V_R \geqslant 50$ V with $-dI_T/dt = 10$ A/μs; $dV_D/dt = 200$ V/μs; $V_{DM} = 500$ V; $R_{GK} = 68\ \Omega$; $T_{mb} = 80$ °C; $t_p \leqslant 50$ μs	t_q	$<$	20 μs

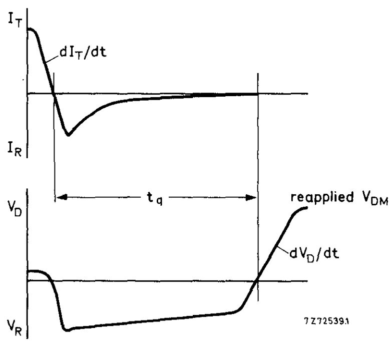


Fig. 3 Circuit-commutated turn-off time definition.

* Measured under pulse conditions to avoid excessive dissipation.

MOUNTING INSTRUCTIONS

1. The device may be soldered directly into the circuit, but the maximum permissible temperature of the soldering iron or bath is 275 ^{o}C; it must not be in contact with the joint for more than 5 seconds. Soldered joints must be at least 4,7 mm from the seal.
2. The leads should not be bent less than 2,4 mm from the seal, and should be supported during bending.
3. It is recommended that the circuit connection be made to the anode tag, rather than direct to the heatsink.
4. Mounting by means of a spring clip is the best mounting method because it offers:
   a. a good thermal contact under the crystal area and slightly lower $R_{th\ mb\text{-}h}$ values than screw mounting.
   b. safe isolation for mains operation.
   However, if a screw is used, it should be M3 cross-recess pan-head. Care should be taken to avoid damage to the plastic body.
5. For good thermal contact heatsink compound should be used between mounting base and heatsink. Values of $R_{th\ mb\text{-}h}$ given for mounting with heatsink compound refer to the use of a metallic-oxide loaded compound. Ordinary silicone grease is not recommended.
6. The device should not be pop-rivetted to the heatsink. However, it is permissible to press-rivet providing that rivets of soft material are used, and the press forces are slowly and carefully controlled so as to avoid shock and deformation of either heatsink or mounting tab.

OPERATING NOTES

Dissipation and heatsink considerations:

a. The various components of junction temperature rise above ambient are illustrated in Fig. 4.

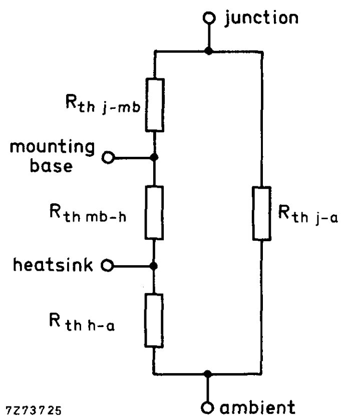


Fig. 4.

b. The method of using Fig. 5 is as follows:
Starting with the required current on the $I_{T(AV)}$ axis, trace upwards to meet the appropriate form factor curve. Trace right horizontally and upwards from the appropriate value on the T_{amb} scale. The intersection determines the $R_{th\ mb\text{-}a}$. The heatsink thermal resistance value ($R_{th\ h\text{-}a}$) can now be calculated from:

$$R_{th\ h\text{-}a} = R_{th\ mb\text{-}a} - R_{th\ mb\text{-}h}.$$

c. Any measurement of heatsink temperature should be made immediately adjacent to the device.

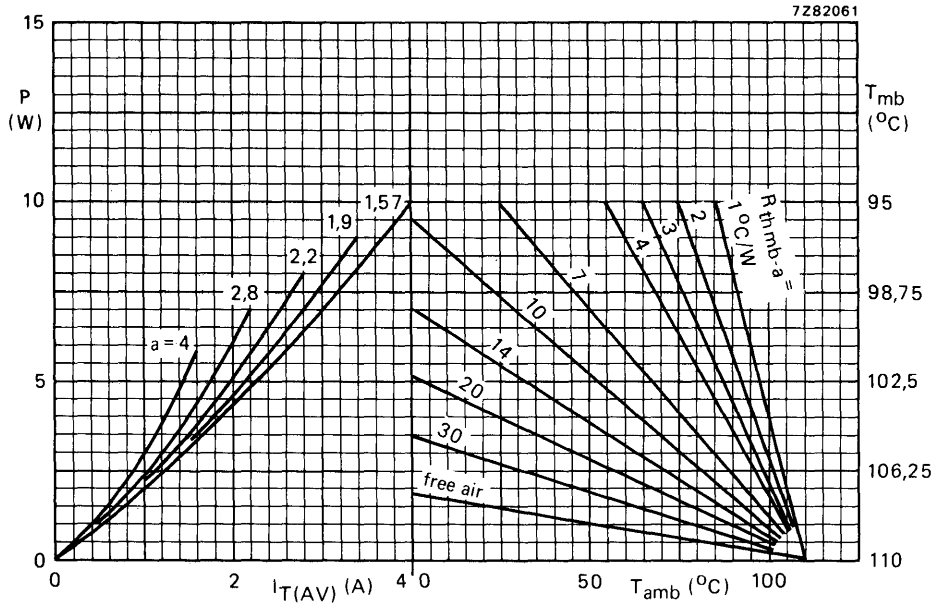


Fig. 5 The right-hand part shows the interrelationship between the power (derived from the left-hand part) and the maximum permissible temperatures.

α = conduction angle per half cycle

$$a = \text{form factor} = \frac{I_{T(RMS)}}{I_{T(AV)}}$$

α	a
30°	4
60°	2,8
90°	2,2
120°	1,9
180°	1,57

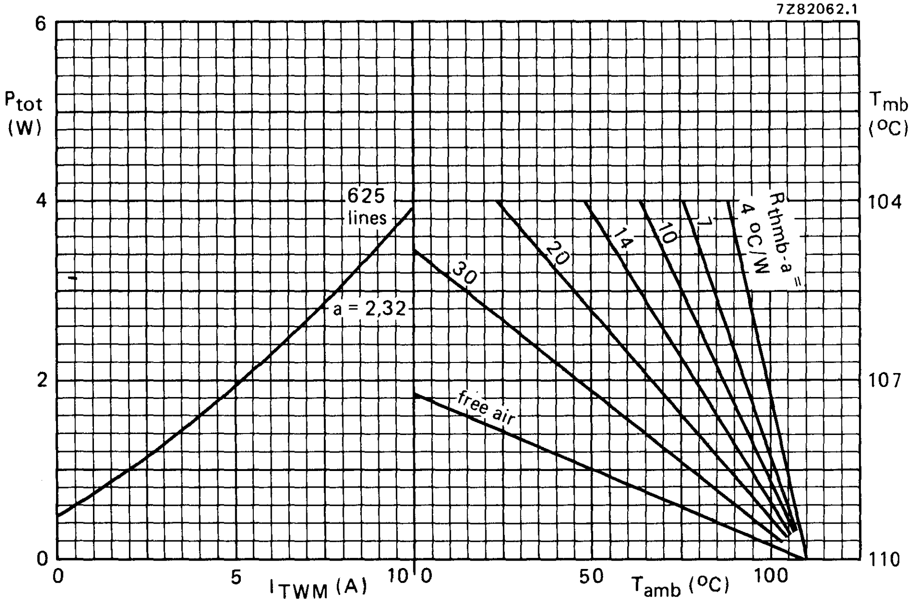


Fig. 6 The right-hand part shows the interrelationship between the power (derived from the left-hand part) and the maximum permissible temperatures.
P_{tot} = maximum power dissipation including gate and switching losses.
I_{TWM} = maximum working peak on-state current.

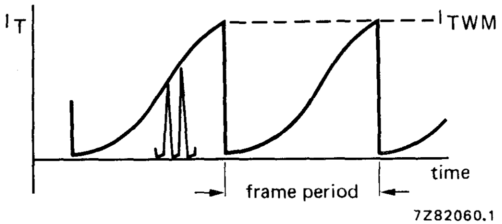


Fig. 7 Waveform defining I_{TWM}.

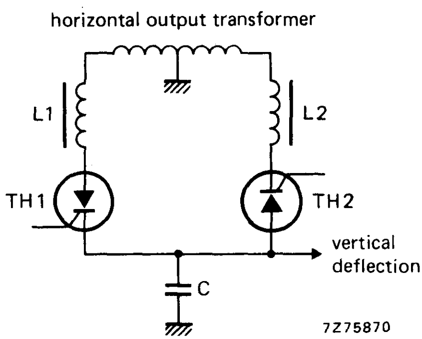


Fig. 8 Basic circuit of a vertical deflection system.

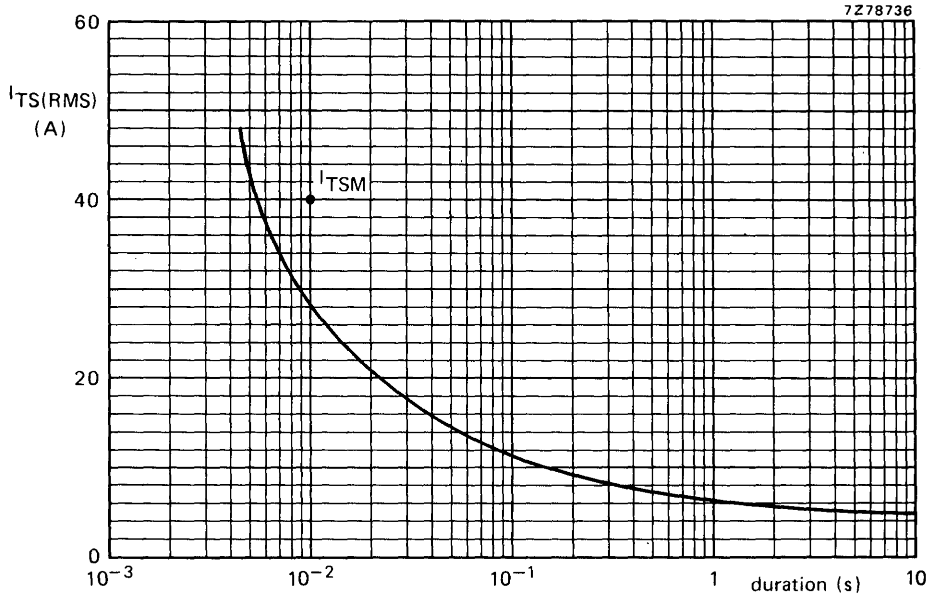
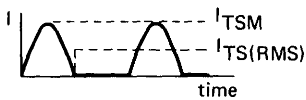


Fig. 9 Maximum permissible non-repetitive r.m.s. on-state current based on sinusoidal currents (f = 50 Hz); T_j = 110 °C prior to surge; with reapplied V_{RWMmax}.



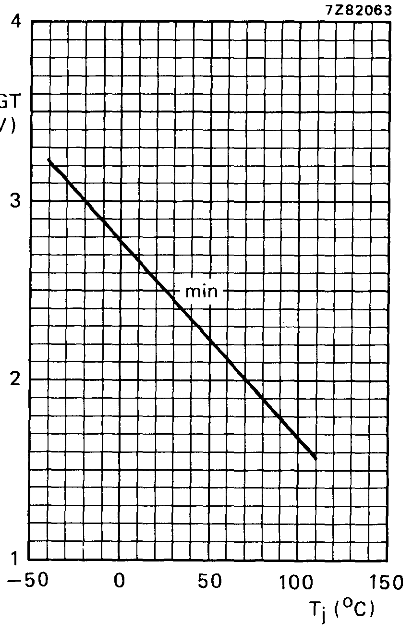


Fig. 10 Minimum gate voltage that will trigger all devices as a function of junction temperature.

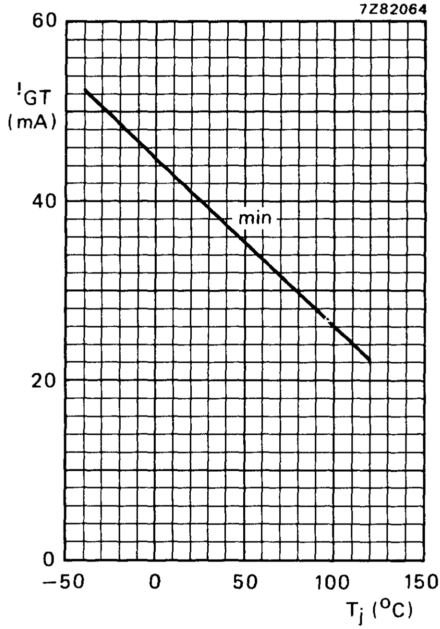


Fig. 11 Minimum gate current that will trigger all devices as a function of junction temperature.

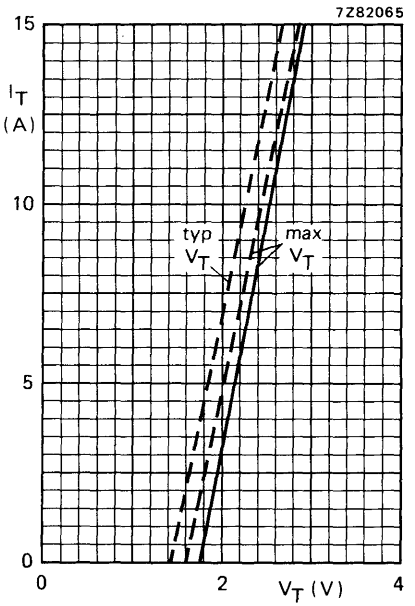


Fig. 12 —— T_j = 25 °C; – – – T_j = 110 °C.

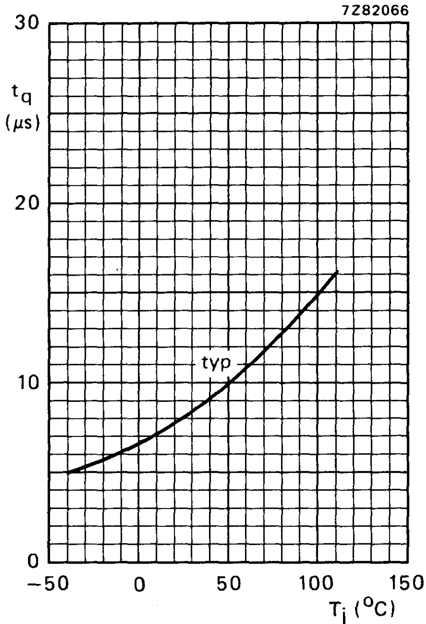


Fig. 13.

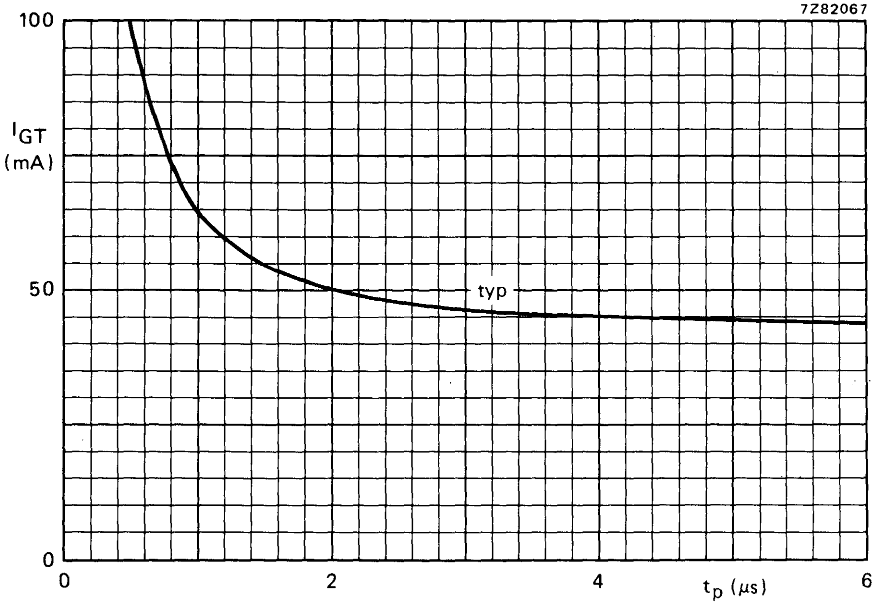
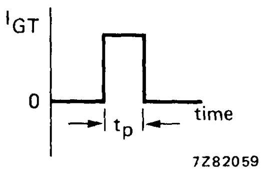


Fig. 14 Gate current that will trigger all devices as a function of rectangular pulse width; $T_j = 25\ ^oC$.



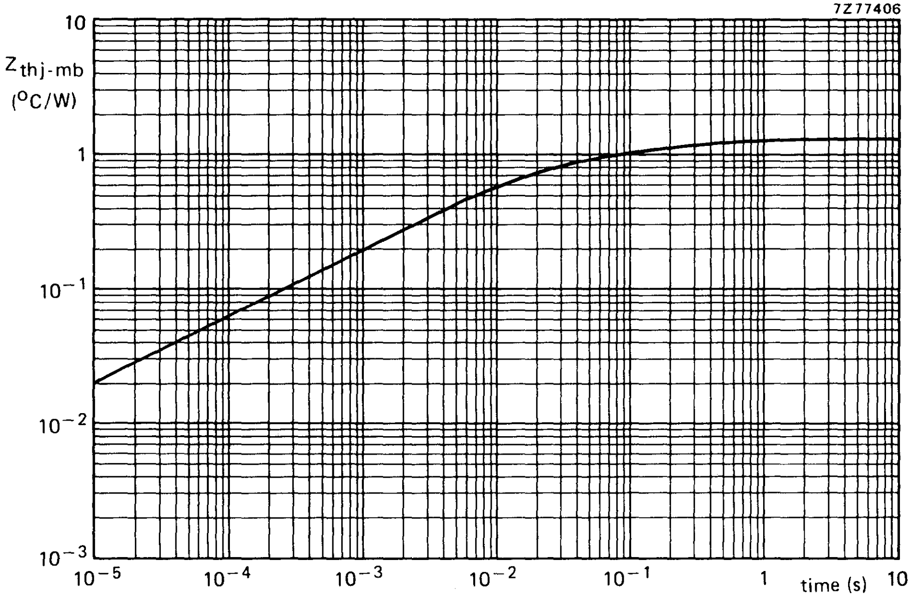

7Z77406
Z_{thj-mb} (°C/W)
10
1
10^{-1}
10^{-2}
10^{-3}
10^{-5}
10^{-4}
10^{-3}
10^{-2}
10^{-1}
1
time (s)
10

Fig. 15.

FAST TURN-OFF THYRISTOR

Glass-passivated, eutectically bonded, fast turn-off forward blocking thyristor in a TO-220AB envelope, intended for use in high-frequency inverters, power supply, motor control, electronic flash systems and for horizontal deflection circuits of colour television receivers.

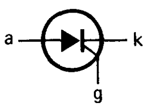
QUICK REFERENCE DATA

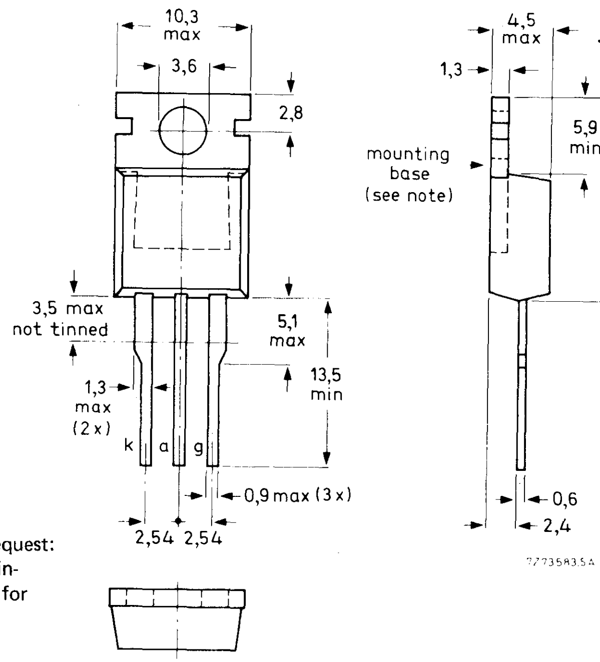
Repetitive peak off-state voltage	V_{DRM}	max.	750	V
Average on-state current	$I_{T(AV)}$	max.	5	A
R.M.S. on-state current	$I_{T(RMS)}$	max.	8	A
Repetitive peak on-state current	I_{TRM}	max.	60	A
Circuit-commutated turn-off time	t_q	<	2,4	μs

MECHANICAL DATA

Dimensions in mm

Fig. 1 TO-220AB.





Net mass: 2 g.

Note: The exposed metal mounting base is directly connected to the anode.

Accessories supplied on request: see data sheets Mounting instructions and accessories for TO-220 envelopes.

RATINGS

Limiting values in accordance with the Absolute Maximum System (IEC 134)

Anode to cathode

Non-repetitive peak off-state voltage; t ≤ 10 ms	V_{DSM}	max.	800	V
Repetitive peak off-state voltage	V_{DRM}	max.	750	V
Working off-state voltage $t_p \leq 20\ \mu s$; $\delta = t_p/T \leq 0{,}25$	V_{DW}	max.	600	V
Average on-state current (averaged over any 20 ms period) up to T_{mb} = 77 °C;	$I_{T(AV)}$	max.	5	A
at T_{mb} = 85 °C	$I_{T(AV)}$	max.	4	A
R.M.S. on-state current	$I_{T(RMS)}$	max.	8	A
Working peak on-state current (horizontal deflection application)	I_{TWM}	max.	10	A
Repetitive peak on-state current	I_{TRM}	max.	60	A
Peak pulse on-state current	I_{TM}	max.	240	A
I^2t for fusing; t = 10 ms; T_j = 25 °C	I^2t	max.	18	A^2s
Rate of rise of on-state current after triggering up to f = 20 kHz	dI_T/dt	max.	60	A/μs

Gate to cathode

Peak power dissipation	P_{GM}	max.	25	W

Temperatures

Storage temperature	T_{stg}		−40 to +125	°C
Operating junction temperature	T_j	max.	110	°C

THERMAL RESISTANCE

From junction to mounting base	$R_{th\ j\text{-}mb}$	=	2,5 °C/W
Transient thermal impedance; t = 1 ms	$Z_{th\ j\text{-}mb}$	=	0,24 °C/W

Influence of mounting method

1. Heatsink mounted with clip (see mounting instructions)

Thermal resistance from mounting base to heatsink

a. with heatsink compound	$R_{th\ mb\text{-}h}$	=	0,3 °C/W
b. with heatsink compound and 0,06 mm maximum mica insulator	$R_{th\ mb\text{-}h}$	=	1,4 °C/W
c. with heatsink compound and 0,1 mm maximum mica insulator (56369)	$R_{th\ mb\text{-}h}$	=	2,2 °C/W
d. with heatsink compound and 0,25 mm max. alumina insulator (56367)	$R_{th\ mb\text{-}h}$	=	0,8 °C/W
e. without heatsink compound	$R_{th\ mb\text{-}h}$	=	1,4 °C/W

2. Free-air operation

The quoted values of $R_{th\ j\text{-}a}$ should be used only when no leads of other dissipating components run to the same tie-point.

Thermal resistance from junction to ambient in free air: mounted on a printed-circuit board at a = any lead length and with copper laminate	$R_{th\ j\text{-}a}$	=	60 °C/W

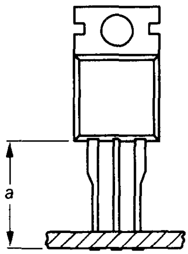


Fig. 2.

CHARACTERISTICS

Anode to cathode

On-state voltage			
$I_T = 20$ A; $T_j = 25\ ^oC$	V_T	<	3 V*
Rate of rise of off-state voltage that will not trigger any device; exponential method; $V_D = 2/3\ V_{DRMmax}$; $T_j \leqslant 110\ ^oC$			
$V_{GK} = 0$ V	dV_D/dt	<	200 V/µs
$-V_{GK} = 6$ V	dV_D/dt	<	1000 V/µs
Off-state current			
$V_D = V_{DRMmax}$; $T_j = 110\ ^oC$	I_D	<	1,5 mA

Gate to cathode

Voltage that will trigger all devices			
$V_D = 6$ V; $T_j = 25\ ^oC$	V_{GT}	>	2,5 V
Current that will trigger all devices			
$V_D = 6$ V; $T_j = 25\ ^oC$	I_{GT}	>	40 mA

Switching characteristics

Circuit-commutated turn-off time (in horizontal deflection trace switch) when switched from $I_T = 8$ A to $V_R = 0,8$ V; $V_{DM} = 700$ V; $-V_{GG} = 25$ V from $R_{tot} = 62\ \Omega$**; $T_{mb} = 80\ ^oC$; see also Fig. 11			
$t_p \leqslant 30$ µs	t_q	<	2,4 µs
$t_p \leqslant 150$ µs	t_q	<	4,8 µs

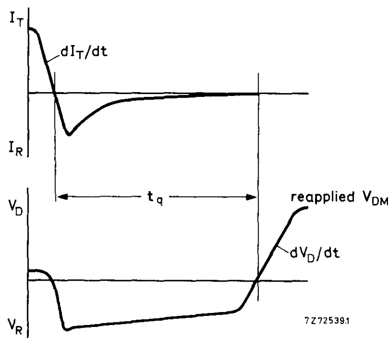


Fig. 3 Circuit-commutated turn-off time definition.

* Measured under pulse conditions to avoid excessive dissipation.

** R_{tot} is the total series resistance including source resistance.

MOUNTING INSTRUCTIONS

1. The device may be soldered directly into the circuit, but the maximum permissible temperature of the soldering iron or bath is 275 °C; it must not be in contact with the joint for more than 5 seconds. Soldered joints must be at least 4,7 mm from the seal.
2. The leads should not be bent less than 2,4 mm from the seal, and should be supported during bending.
3. It is recommended that the circuit connection be made to the anode tag, rather than direct to the heatsink.
4. Mounting by means of a spring clip is the best mounting method because it offers:
   a. a good thermal contact under the crystal area and slightly lower $R_{th\ mb\text{-}h}$ values than screw mounting.
   b. safe isolation for mains operation.
   However, if a screw is used, it should be M3 cross-recess pan-head. Care should be taken to avoid damage to the plastic body.
5. For good thermal contact heatsink compound should be used between mounting base and heatsink. Values of $R_{th\ mb\text{-}h}$ given for mounting with heatsink compound refer to the use of a metallic-oxide loaded compound. Ordinary silicone grease is not recommended.
6. The device should not be pop-rivetted to the heatsink. However, it is permissible to press-rivet providing that rivets of soft material are used, and the press forces are slowly and carefully controlled so as to avoid shock and deformation of either heatsink or mounting tab.

OPERATING NOTES

Dissipation and heatsink considerations:

a. The various components of junction temperature rise above ambient are illustrated in Fig. 4.

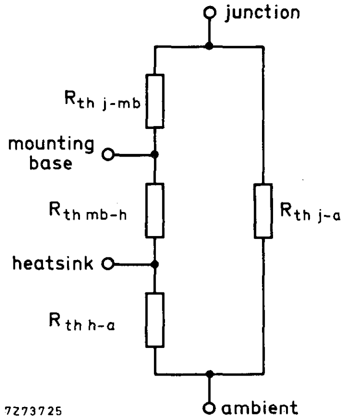


Fig. 4.

b. The method of using Fig. 5 is as follows:
   Starting with the required current on the $I_{T(AV)}$ axis, trace upwards to meet the appropriate form factor curve. Trace right horizontally and upwards from the appropriate value on the T_{amb} scale. The intersection determines the $R_{th\ mb\text{-}a}$. The heatsink thermal resistance value ($R_{th\ h\text{-}a}$) can now be calculated from:

$$R_{th\ h\text{-}a} = R_{th\ mb\text{-}a} - R_{th\ mb\text{-}h}.$$

c. Any measurement of heatsink temperature should be made immediately adjacent to the device.

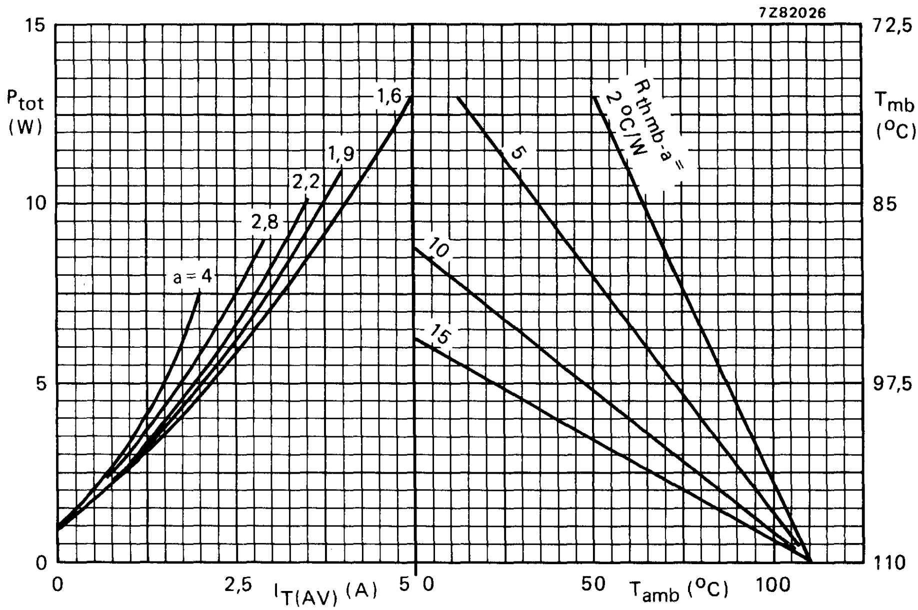
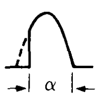


Fig. 5 The right-hand part shows the interrelationship between the power (derived from the left-hand part) and the maximum permissible temperatures.



α = conduction angle per half cycle

$$a = \text{form factor} = \frac{I_{T(RMS)}}{I_{T(AV)}}$$

α	a
30°	4
60°	2,8
90°	2,2
120°	1,9
180°	1,57

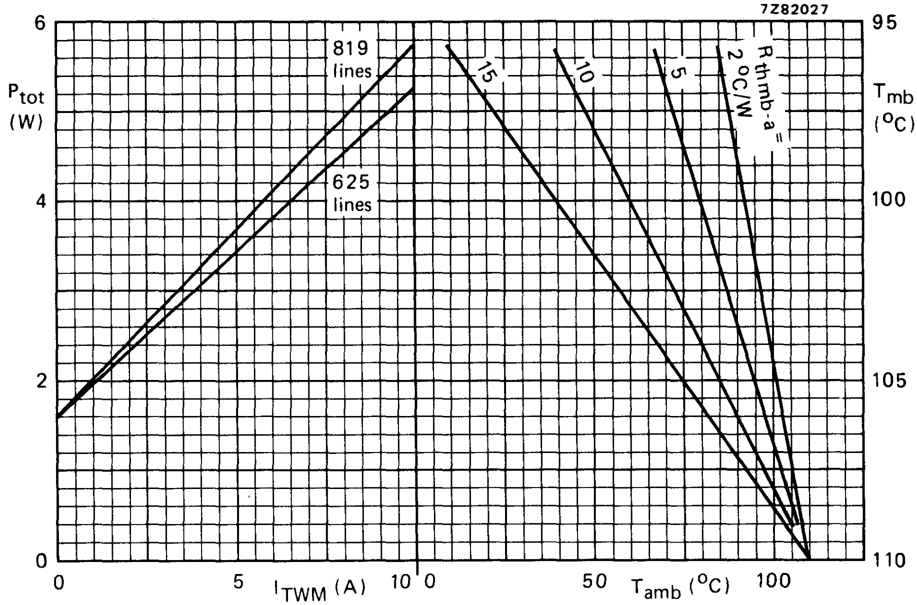


Fig. 6 The right-hand part shows the interrelationship between the power (derived from the left-hand part) and the maximum permissible temperatures (horizontal deflection application).

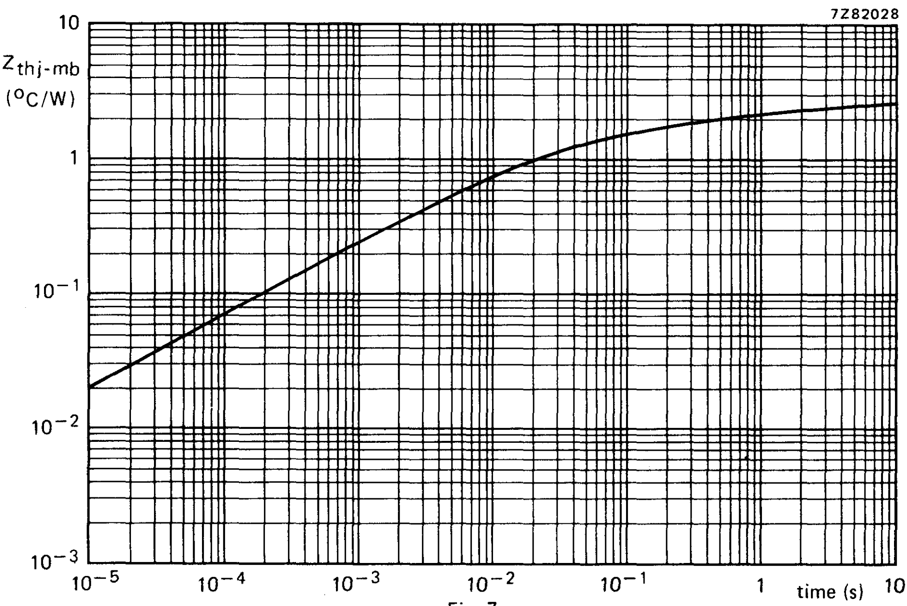


Fig. 7.

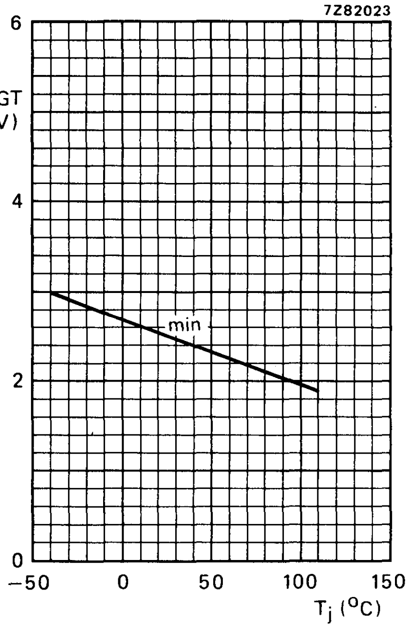


Fig. 8 Minimum gate voltage that will trigger all devices as a function of junction temperature.

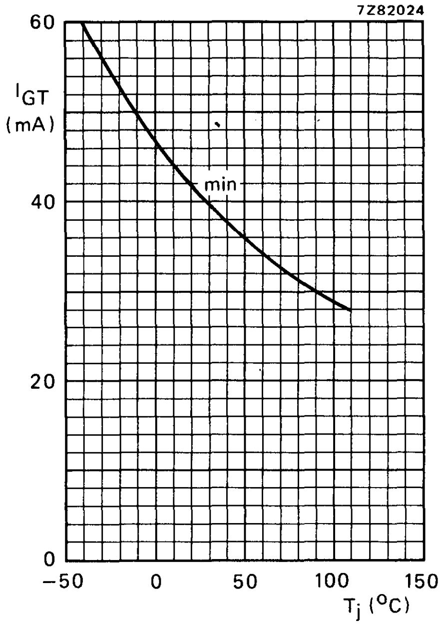


Fig. 9 Minimum gate current that will trigger all devices as a function of junction temperature.

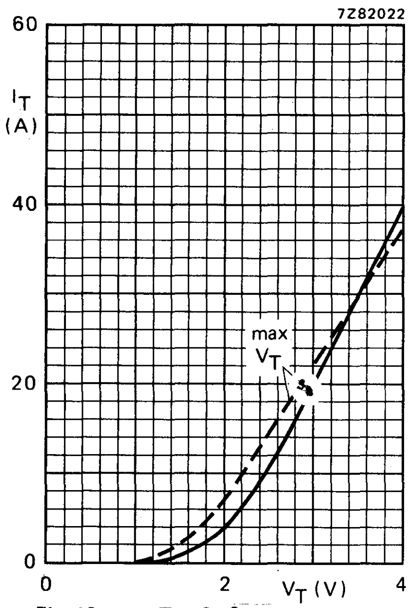
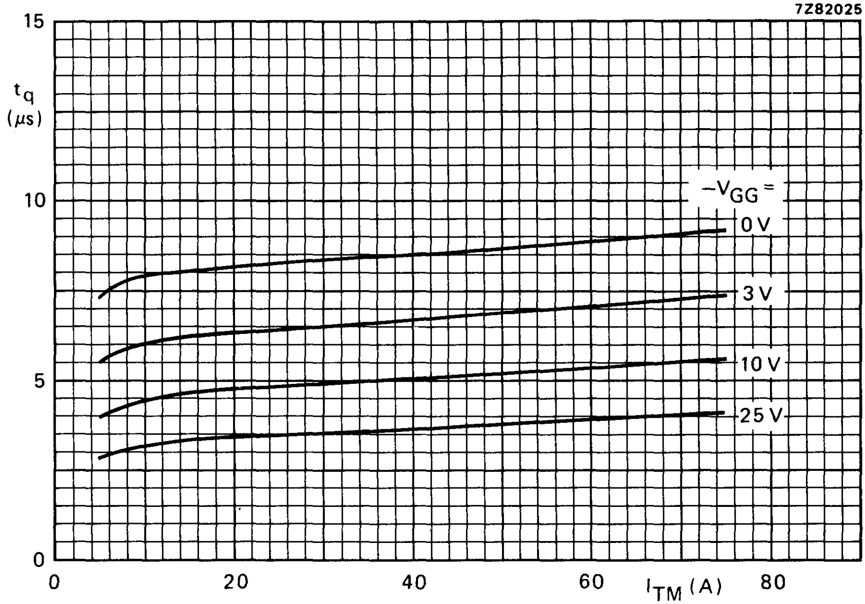


Fig. 10 —— T_j = 25 °C; - - - T_j = 110 °C.



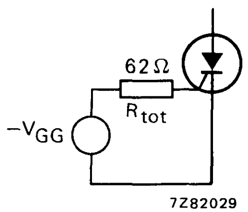


Fig. 11 Typical variation of t_q with I_{TM} and $-V_{GG}$ at $-dI_T/dt$ = 10 A/μs; dV_D/dt = 200 to 700 V/μs; t_p = 150 μs.

APPLICATION INFORMATION

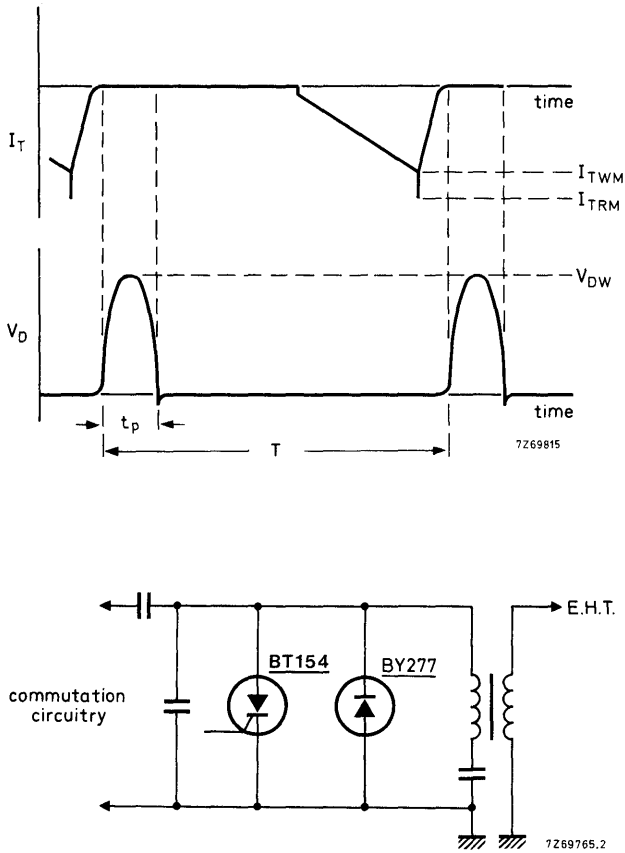


Fig. 12 Basic circuit and waveforms.

Note

For reverse blocking operation use a series diode, for reverse conducting operation use an anti-parallel diode.

THYRISTORS

Silicon thyristors in metal envelopes, intended for general purpose single-phase or three-phase mains operation.
The series consists of reverse polarity types (anode to stud) identified by a suffix R: BTW23-600R to 1600R.

QUICK REFERENCE DATA

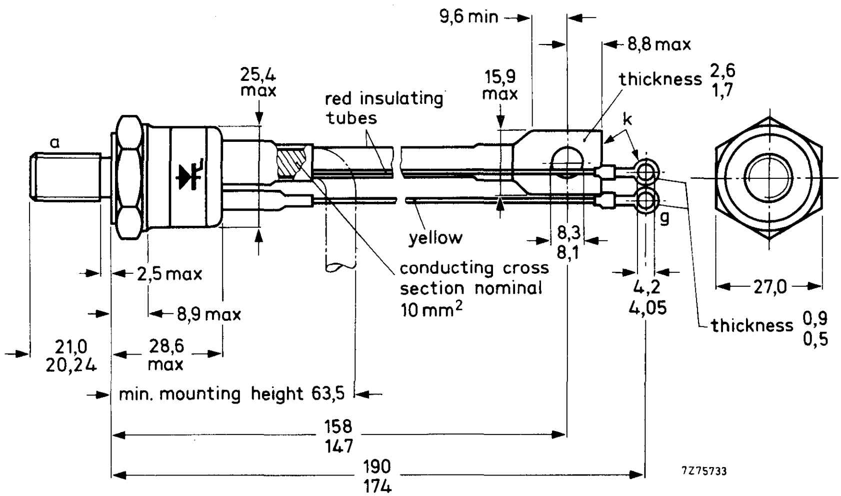
		BTW23-600R	800R	1000R	1200R	1400R	1600R	
Repetitive peak voltages $V_{DRM} = V_{RRM}$	max.	600	800	1000	1200	1400	1600	V

Average on-state current	$I_{T(AV)}$	max.	90	A
R.M.S. on-state current	$I_{T(RMS)}$	max.	140	A
Non-repetitive peak on-state current	I_{TSM}	max.	2000	A
Rate of rise of off-state voltage that will not trigger any device	dV_D/dt	$<$	200	V/µs
On request (see ordering note on page 4)	dV_D/dt	$<$	1000	V/µs

MECHANICAL DATA

Dimensions in mm

Fig. 1 TO-94: with metric M12 stud (Ø 12 mm); e.g. BTW23-600R.
Types with ½ in x 20 UNF stud (Ø 12,7 mm) are available on request. These are indicated by the suffix U: e.g. BTW23-600RU.



Net mass: 134 g
Diameter of clearance hole: max. 13,0 mm
Torque on nut: min. 9 Nm (90 kg cm)
max. 17,5 Nm (175 kg cm)

Supplied with device: 1 nut, 1 lock washer
Nut dimensions across the flats;
M12 : 19 mm
½ in x 20 UNF: 19 mm

RATINGS

Limiting values in accordance with the Absolute Maximum System (IEC 134)

Anode to cathode

			BTW23-600R	800R	1000R	1200R	1400R	1600R	
Non-repetitive peak voltages ($t \leq 10$ ms)	V_{DSM}/V_{RSM}	max.	600	800	1000	1200	1400	1600	V
Repetitive peak voltages	V_{DRM}/V_{RRM}	max.	600	800	1000	1200	1400	1600	V
Crest working voltages	V_{DWM}/V_{RWM}	max.	400	600	700	800	800	800	V*

Average on-state current (averaged over any 20 ms period) up to T_{mb} = 85 °C	$I_{T(AV)}$	max.	90	A
R.M.S. on-state current	$I_{T(RMS)}$	max.	140	A
Repetitive peak on-state current	I_{TRM}	max.	1250	A
Non-repetitive peak on-state current; t = 10 ms; half sine-wave; T_j = 125 °C prior to surge; with reapplied $V_{RWM\,max}$	I_{TSM}	max.	2000	A
I^2t for fusing (t = 10 ms)	I^2t	max.	20 000	A^2s
Rate of rise of on-state current after triggering with I_G = 750 mA to I_T = 300 A; dI_G/dt = 1 A/µs	dI_T/dt	max.	300	A/µs
Rate of change of commutation current	see Fig. 14			

Gate to cathode

Reverse peak voltage	V_{RGM}	max.	10	V
Average power dissipation (averaged over any 20 ms period)	$P_{G(AV)}$	max.	2	W
Peak power dissipation	P_{GM}	max.	10	W

Temperatures

Storage temperature	T_{stg}		−55 to + 125	°C
Junction temperature	T_j	max.	125	°C

THERMAL RESISTANCE

From junction to mounting base	$R_{th\,j\text{-}mb}$	=	0,3	°C/W
From mounting base to heatsink	$R_{th\,mb\text{-}h}$	=	0,1	°C/W
Transient thermal impedance (t = 1 ms)	$Z_{th\,j\text{-}mb}$	=	0,015	°C/W

* To ensure thermal stability: $R_{th\,j\text{-}a} < 0{,}75$ °C/W (d.c. blocking) or $< 1{,}5$ °C/W (a.c.). For smaller heatsinks $T_{j\,max}$ should be derated. For a.c. see Fig. 4.

CHARACTERISTICS

Anode to cathode

On-state voltage I_T = 500 A; T_j = 25 °C	V_T	<	2,2 V*
Rate of rise of off-state voltage that will not trigger any device; exponential method; V_D = 2/3 $V_{DRM\,max}$; T_j = 125 °C	dV_D/dt	<	200 V/µs
Reverse current V_R = $V_{RWM\,max}$; T_j = 125 °C	I_R	<	15 mA
Off-state current V_D = $V_{DWM\,max}$; T_j = 125 °C	I_D	<	15 mA
Holding current; T_j = 25 °C	I_H	<	200 mA

Gate to cathode

Voltage that will trigger all devices V_D = 6 V; T_j = 25 °C	V_{GT}	>	2,5 V
Voltage that will not trigger any device V_D = $V_{DRM\,max}$; T_j = 125 °C	V_{GD}	<	250 mV
Current that will trigger any device V_D = 6 V; T_j = 25 °C	I_{GT}	>	150 mA

Switching characteristics

Gate-controlled turn-on time (t_{gt} = t_d + t_r) when switched from V_D = $V_{DWM\,max}$ to I_T = 100 A; I_{GT} = 200 mA; dI_G/dt = 1 A/µs; T_j = 25 °C	t_{gt}	<	2,5 µs
	t_r	typ.	1 µs

* Measured under pulse conditions to avoid excessive dissipation.

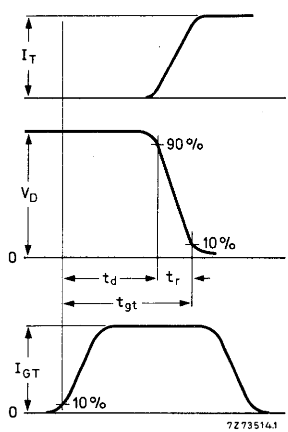


Fig. 2 Gate-controlled turn-on time definitions.

CHARACTERISTICS (continued)

Circuit-commutated turn-off when switched
from I_T = 50 A to $V_R \geqslant 50$ V with $-dI_T/dt$ = 50 A/μs;
dV_D/dt = 200 V/μs;

T_j = 125 °C	t_q	typ.	100	μs
		<	200	μs
T_j = 25 °C	t_q	typ.	60	μs
		<	120	μs

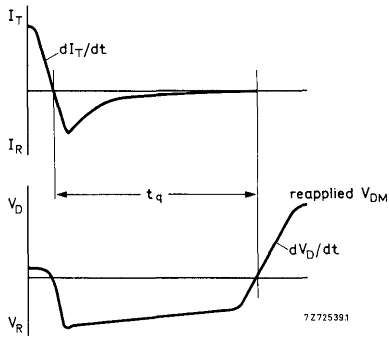


Fig. 3 Circuit-commutated turn-off time definition.

OPERATING NOTE

Switching losses in commutation

For applications in which the thyristor is forced to switch from an on-state current I_{TRM} to a high reverse voltage at a high commutation rate ($-dI_T/dt$), consult Fig. 14 (nomogram) to find the increase in total average power. This increase must be added to the loss from the curves in Fig. 4.

ORDERING NOTE

Types with dV_D/dt of 1000 V/μs are available on request. Add suffix C to the type number when ordering; e.g. BTW23-600RC.

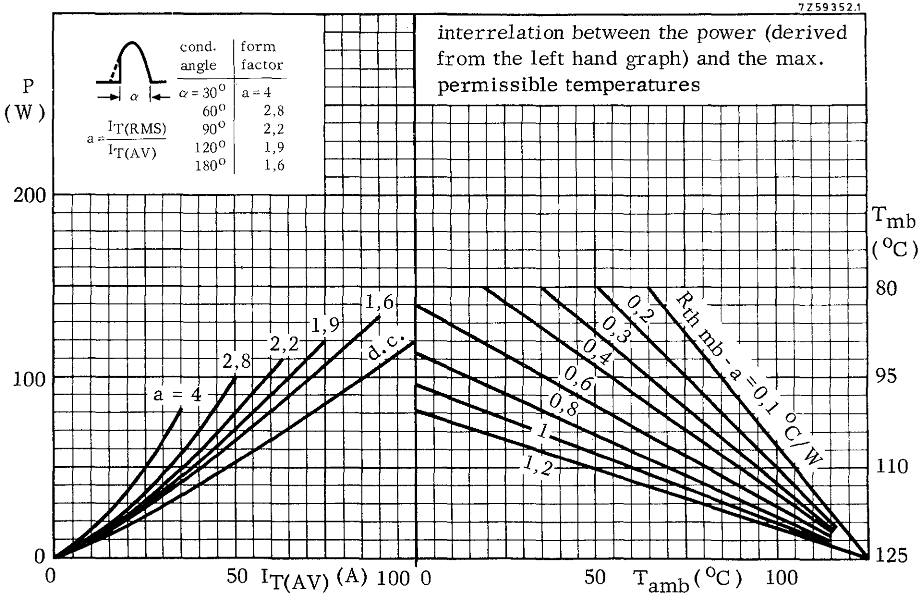

7Z59352.1
P
(W)
cond. angle
form factor
α
α = 30° a = 4
60° 2,8
90° 2,2
120° 1,9
180° 1,6
a = IT(RMS) / IT(AV)
interrelation between the power (derived from the left hand graph) and the max. permissible temperatures
200
100
0
a = 4
2,8
2,2
1,9
1,6
d.c.
0,2
0,3
0,4
0,6
0,8
1
1,2
Rth mb - a = 0,1 °C/W
Tmb (°C)
80
95
110
125
0
50
IT(AV) (A)
100
0
50
Tamb (°C)
100

Fig. 4.

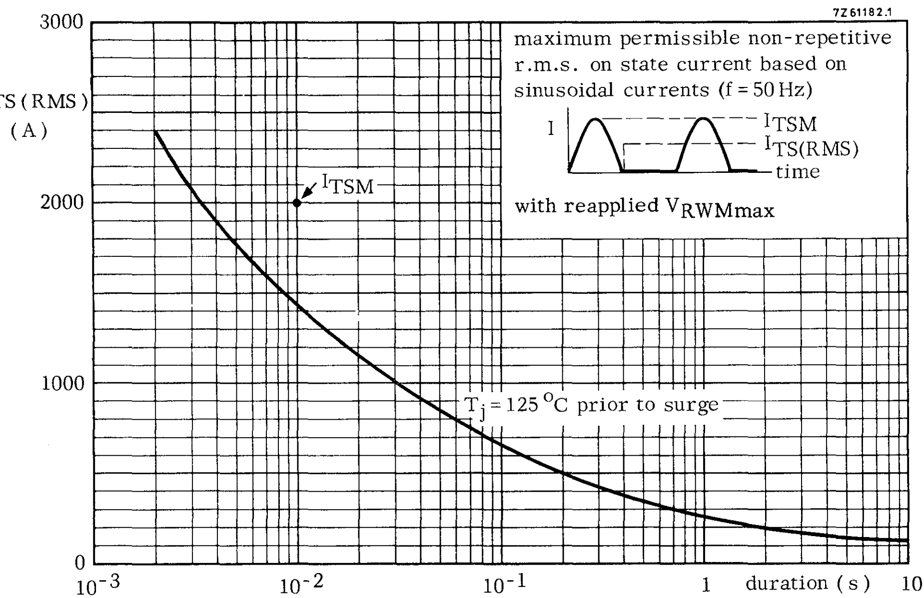

7Z61182.1
3000
2000
1000
0
ITS(RMS) (A)
ITSM
maximum permissible non-repetitive r.m.s. on state current based on sinusoidal currents (f = 50 Hz)
I
ITSM
ITS(RMS)
time
with reapplied VRWMmax
Tj = 125 °C prior to surge
10-3
10-2
10-1
1
duration (s)
10

Fig. 5.

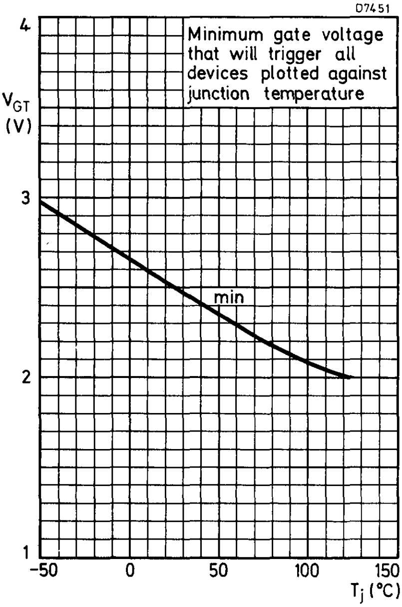


Fig. 6.

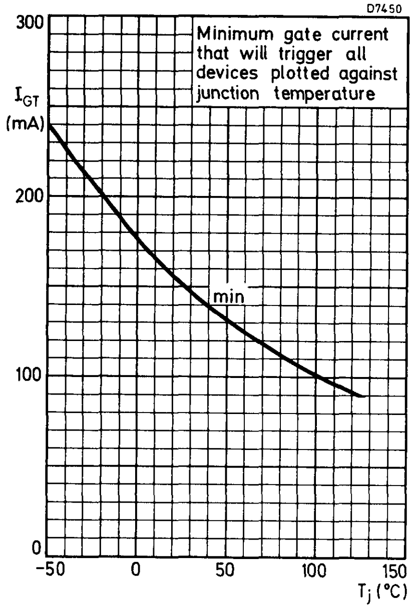


Fig. 7.

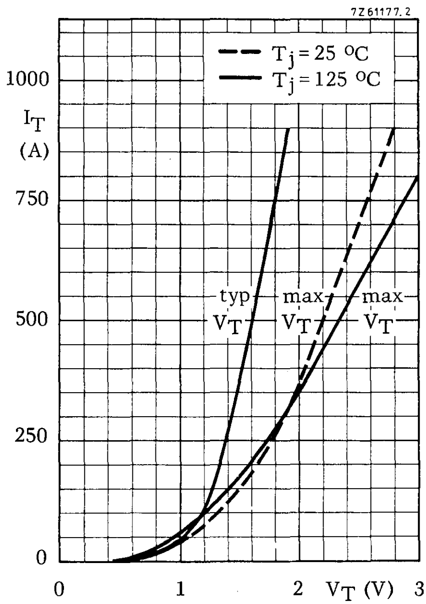


Fig. 8.

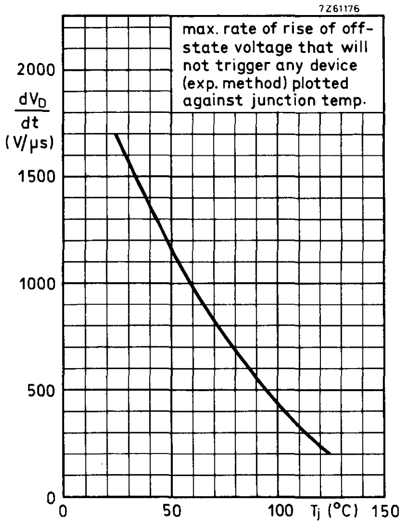


Fig. 9.

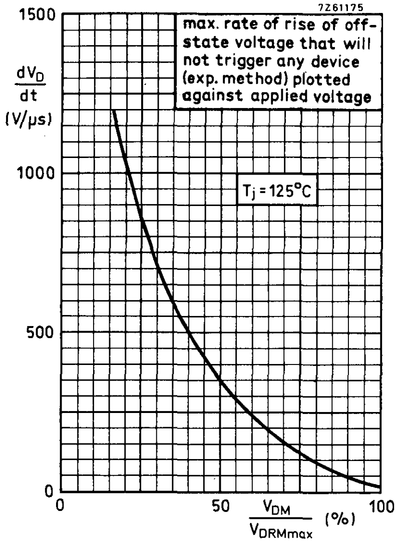


Fig. 10.

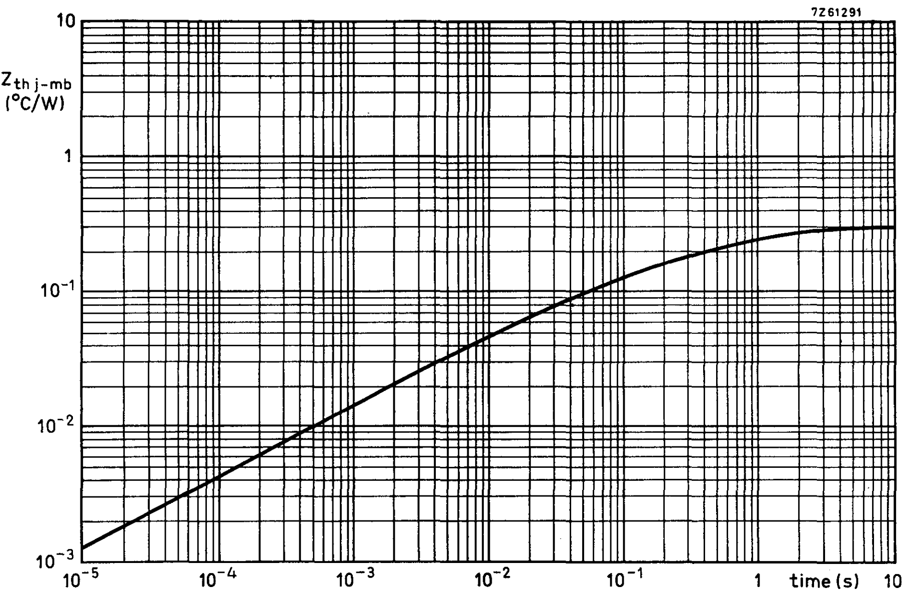
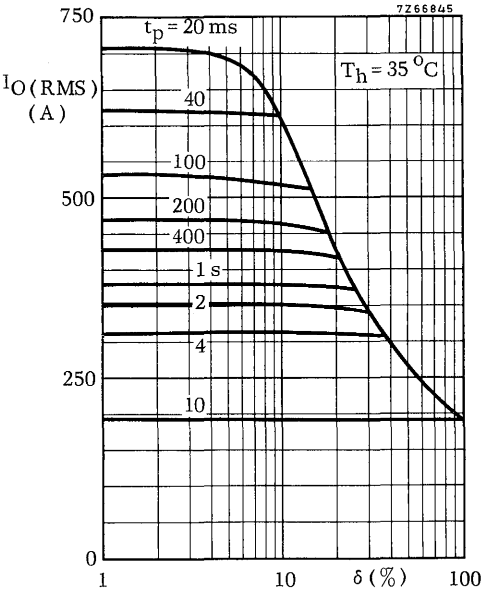
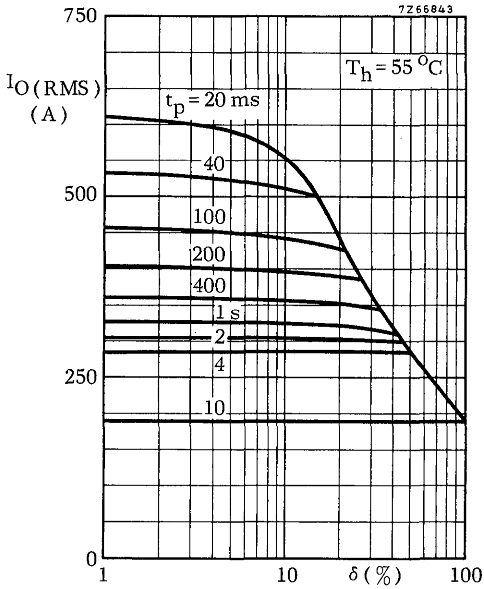
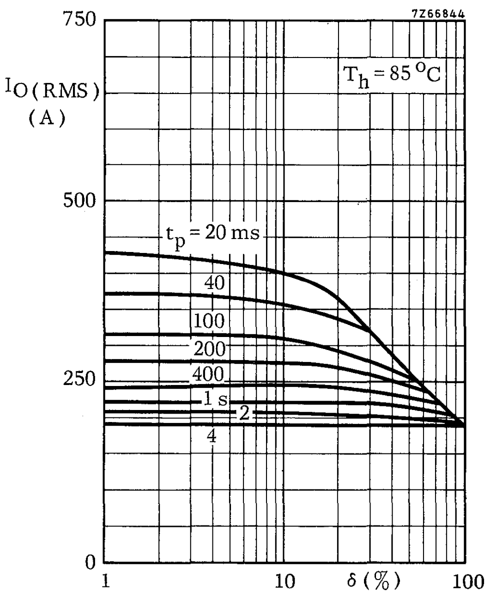
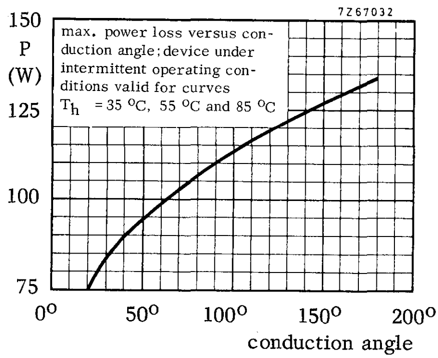


Fig. 11.









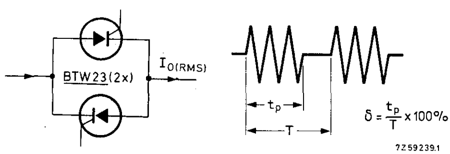


Fig. 12 Intermittent overload capability of two BTW23 thyristors in anti-parallel connection in a single phase a.c. control circuit (e.g. welding); conduction angle 360°.

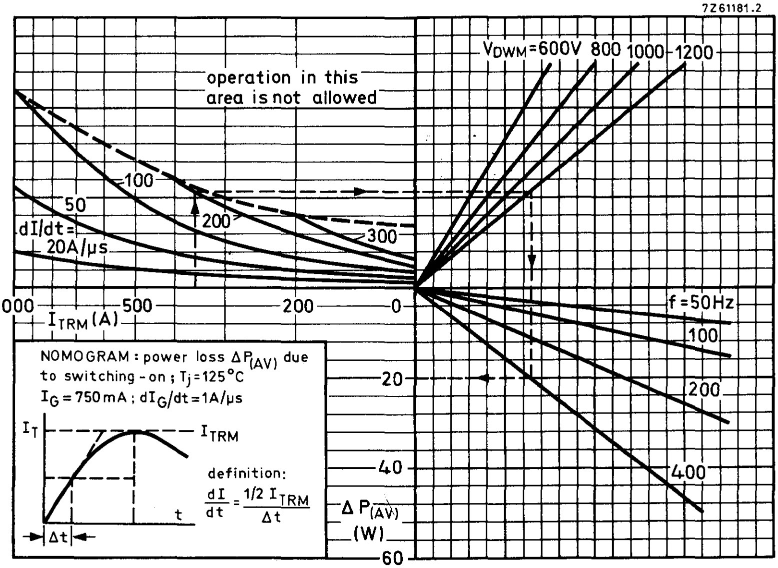

7Z61181.2
operation in this area is not allowed
VDWM=600V
800
1000
1200
100
50
200
300
dI/dt=
20A/μs
1000
500
200
0
ITRM (A)
f=50Hz
100
200
400
20
40
60
ΔP(AV)
(W)
NOMOGRAM: power loss ΔP(AV) due to switching-on; Tj=125°C
IG=750mA; dIG/dt=1A/μs
IT
ITRM
t
Δt
definition:
dI/dt = 1/2 ITRM / Δt

Fig. 13.

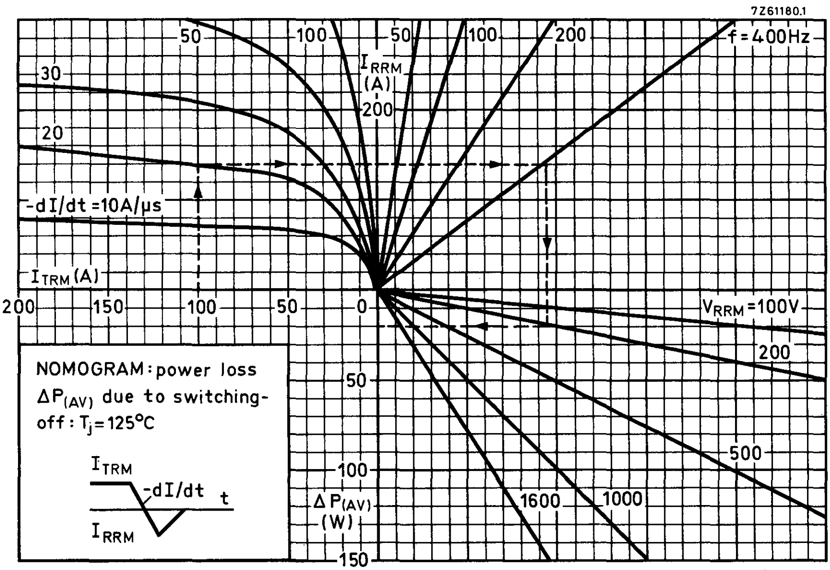
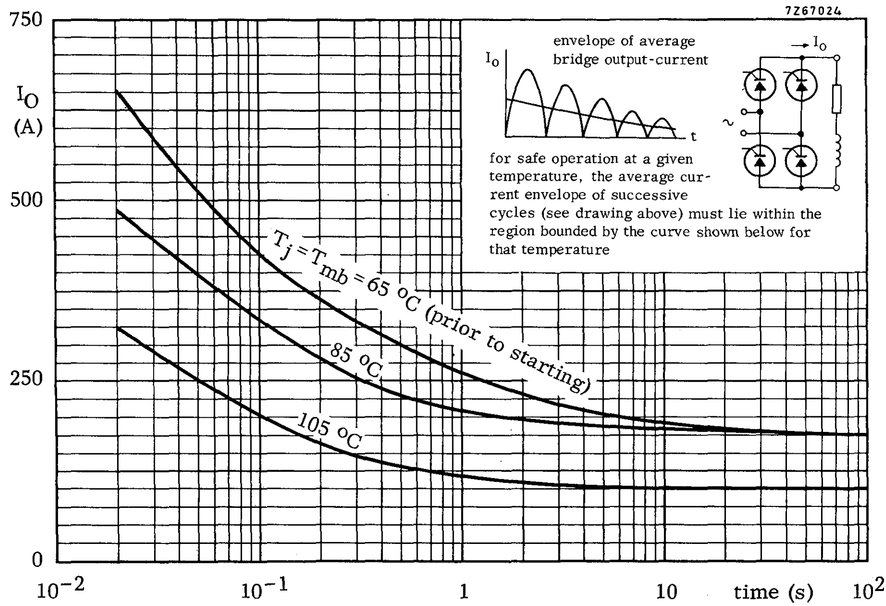

7Z61180.1
50
100
50
100
200
f=400Hz
30
20
IRRM
(A)
200
-dI/dt=10A/μs
ITRM (A)
200
150
100
50
0
VRRM=100V
200
500
1600
1000
50
100
150
ΔP(AV)
(W)
NOMOGRAM: power loss ΔP(AV) due to switching-off: Tj=125°C
ITRM
-dI/dt
t
IRRM

Fig. 14.



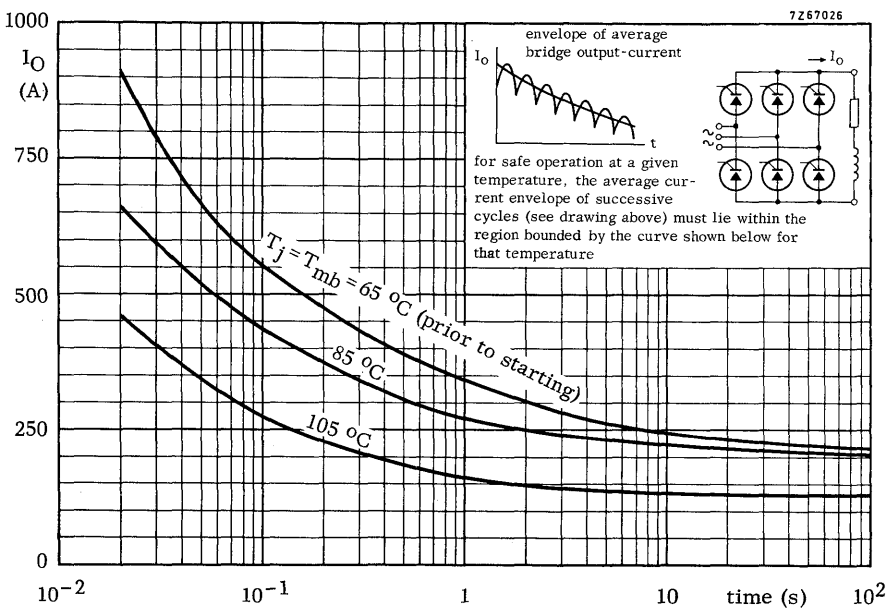


Fig. 15 Limits for starting or inrush currents.

THYRISTORS

Silicon thyristors in metal envelopes, intended for general purpose single-phase or three-phase mains operation.
The series consists of reverse polarity types (anode to stud) identified by a suffix R:
BTW24-600R to 1600R.

QUICK REFERENCE DATA

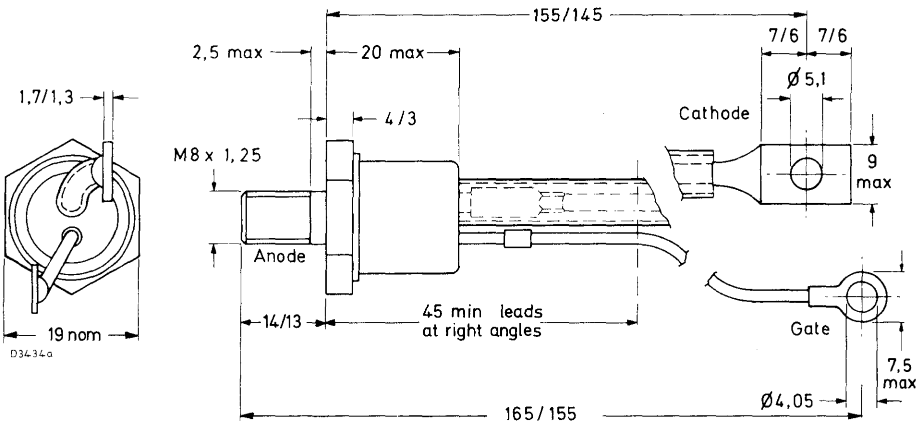
		BTW24-600R	800R	1000R	1200R	1400R	1600R	
Repetitive peak voltages $V_{DRM} = V_{RRM}$	max.	600	800	1000	1200	1400	1600	V

Average on-state current	$I_{T(AV)}$	max.	35	A
R.M.S. on-state current	$I_{T(RMS)}$	max.	55	A
Non-repetitive peak on-state current	I_{TSM}	max.	800	A
Rate of rise of off-state voltage that will not trigger any device	dV_D/dt	$<$	200	V/μs
On request (see ordering note on page 4)	dV_D/dt	$<$	1000	V/μs

MECHANICAL DATA

Dimensions in mm

Fig. 1 TO-103.



Net mass: 46 g
Diameter of clearance hole: 8,5 mm
Torque on nut: min. 4 Nm (40 kg cm)
max. 6 Nm (60 kg cm)

Supplied with device: 1 nut, 1 lock washer
Nut dimensions across the flats: 13 mm

RATINGS

Limiting values in accordance with the Absolute Maximum System (IEC 134)

Anode to cathode

			BTW24-600R	800R	1000R	1200R	1400R	1600R	
Non-repetitive peak voltages ($t \leqslant 10$ ms)	V_{DSM}/V_{RSM}	max.	600	800	1000	1200	1400	1600	V
Repetitive peak voltages	V_{DRM}/V_{RRM}	max.	600	800	1000	1200	1400	1600	V
Crest working voltages	V_{DWM}/V_{RWM}	max.	400	600	700	800	800	800	V *

Average on-state current (averaged over any 20 ms period) up to T_{mb} = 85 °C	$I_{T(AV)}$	max.	35	A
R.M.S. on-state current	$I_{T(RMS)}$	max.	55	A
Repetitive peak on-state current	I_{TRM}	max.	450	A
Non-repetitive peak on-state current; t = 10 ms; half sine-wave; T_j = 125 °C prior to surge; with reapplied V_{RWMmax}	I_{TSM}	max.	800	A
I^2t for fusing (t = 10 ms)	I^2t	max.	3200	A^2s
Rate of rise of on-state current after triggering with I_G = 500 mA to I_T = 100 A; dI_G/dt = 1 A/μs	dI_T/dt	max.	300	A/μs
Rate of change of commutation current	see Fig. 14			

Gate to cathode

Reverse peak voltage	V_{RGM}	max.	10	V
Average power dissipation (averaged over any 20 ms period)	$P_{G(AV)}$	max.	1	W
Peak power dissipation	P_{GM}	max.	5	W

Temperatures

Storage temperature	T_{stg}	−55 to + 125		°C
Junction temperature	T_j	max.	125	°C

THERMAL RESISTANCE

From junction to mounting base	$R_{th\ j\text{-}mb}$	=	0,6	°C/W
From mounting base to heatsink	$R_{th\ mb\text{-}h}$	=	0,2	°C/W
Transient thermal impedance (t = 1 ms)	$Z_{th\ j\text{-}mb}$	=	0,04	°C/W

* To ensure thermal stability: $R_{th\ j\text{-}a} < 1$ °C/W (d.c. blocking) or < 2 °C/W (a.c.). For smaller heatsinks $T_{j\ max}$ should be derated. For a.c. see Fig. 4.

CHARACTERISTICS

Anode to cathode

On-state voltage I_T = 100 A; T_j = 25 °C	V_T	<	1,9 V *
Rate of rise of off-state voltage that will not trigger any device; exponential method; V_D = 2/3 V_{DRMmax}; T_j = 125 °C	dV_D/dt	<	200 V/μs
Reverse current V_R = V_{RWMmax}; T_j = 125 °C	I_R	<	10 mA
Off-state current V_D = V_{DWMmax}; T_j = 125 °C	I_D	<	10 mA
Latching current; T_j = 25 °C	I_L	<	300 mA
Holding current; T_j = 25 °C	I_H	<	200 mA

Gate to cathode

Voltage that will trigger all devices V_D = 6 V; T_j = 25 °C	V_{GT}	>	2,5 V
Voltage that will not trigger any device V_D = V_{DRMmax}; T_j = 125 °C	V_{GD}	<	200 mV
Current that will trigger all devices V_D = 6 V; T_j = 25 °C	I_{GT}	>	100 mA

Switching characteristics

Gate-controlled turn-on time ($t_{gt} = t_d + t_r$) when switched from V_D = V_{DWMmax} to I_T = 100 A; I_{GT} = 150 mA; dI_G/dt = 1 A/μs; T_j = 25 °C	t_{gt}	typ.	2 μs
	t_r	typ.	1 μs

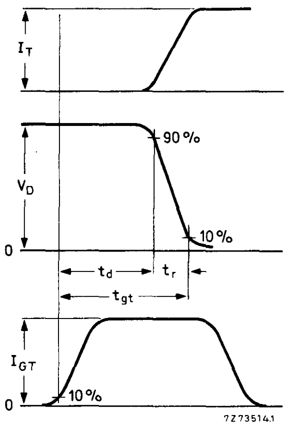


Fig. 2 Gate-controlled turn-on time definitions.

* Measured under pulse conditions to avoid excessive dissipation.

CHARACTERISTICS (continued)

Circuit-commutated turn-off time when switched from I_T = 30 A to $V_R \geqslant$ 50 V with $-dI_T/dt$ = 30 A/μs; dV_D/dt = 100 V/μs;

T_j = 125 °C	t_q	typ.	140 μs
		<	200 μs
T_j = 25 °C	t_q	<	100 μs

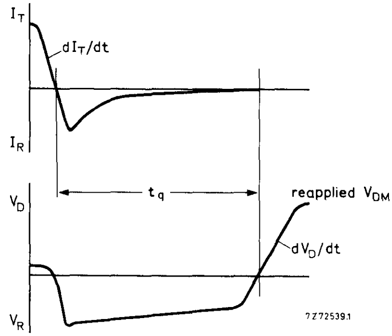


Fig. 3 Circuit-commutated turn-off time definition.

OPERATING NOTE

Switching losses in commutation

For applications in which the thyristor is forced to switch from an on-state current I_{TRM} to a high reverse voltage at a high commutation rate ($-dI_T/dt$), consult Fig. 14 (nomogram) to find the increase in total average power. This increase must be added to the loss from the curves in Fig. 4.

ORDERING NOTE

Types with dV_D/dt of 1000 V/μs are available on request. Add suffix C to the type number when ordering; e.g. BTW24-600RC.

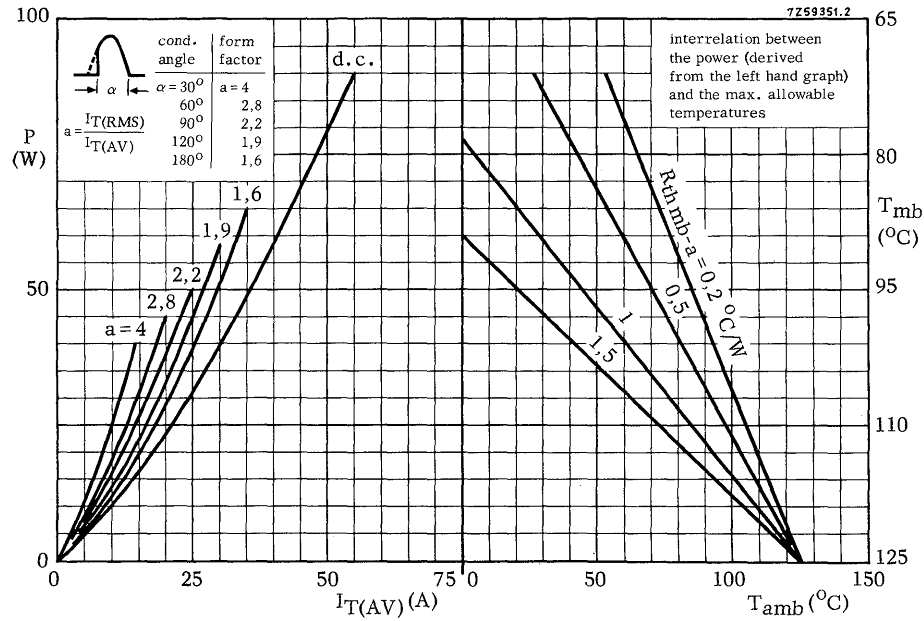

7Z59351.2
cond. angle
form factor
α = 30° a = 4
60° 2,8
90° 2,2
120° 1,9
180° 1,6
a = IT(RMS) / IT(AV)
d.c.
1,6
1,9
2,2
2,8
a = 4
P (W)
100
50
0
25
75
IT(AV) (A)
interrelation between the power (derived from the left hand graph) and the max. allowable temperatures
Rth mb-a = 0,2 °C/W
0,5
1
1,5
65
80
95
110
125
Tmb (°C)
Tamb (°C)
150

Fig. 4.

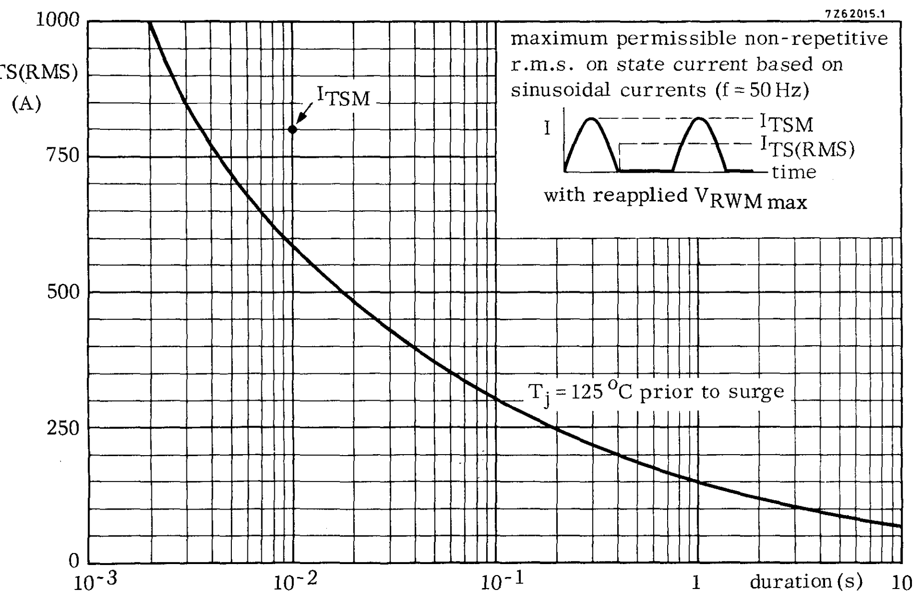

7Z62015.1
1000
750
500
250
0
(A)
ITSM
maximum permissible non-repetitive r.m.s. on state current based on sinusoidal currents (f = 50 Hz)
I
ITSM
ITS(RMS)
time
with reapplied VRWM max
Tj = 125 °C prior to surge
10-3
10-2
10-1
1
duration (s)
10

Fig. 5.

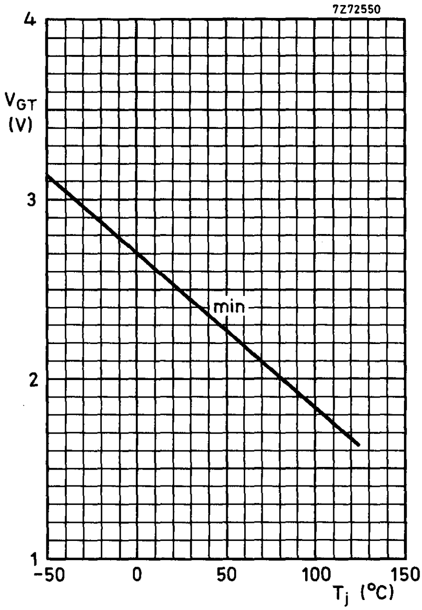


Fig. 6 Minimum gate voltage that will trigger all devices plotted against junction temperature.

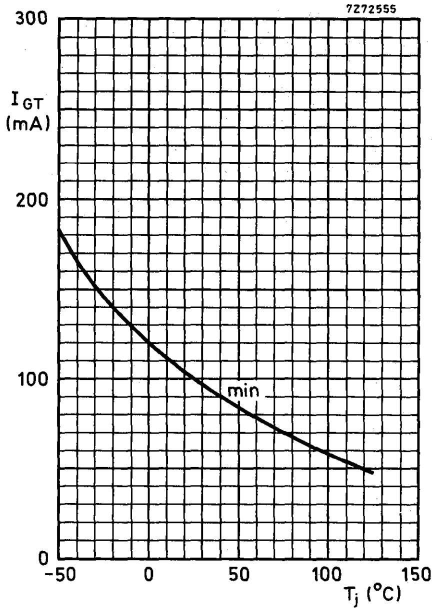


Fig. 7 Minimum gate current that will trigger all devices plotted against junction temperature.

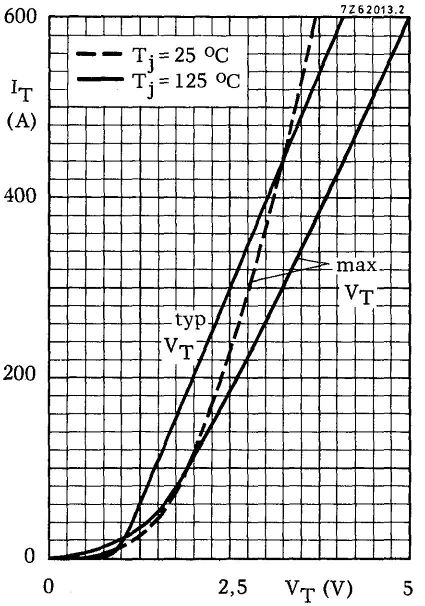


Fig. 8.

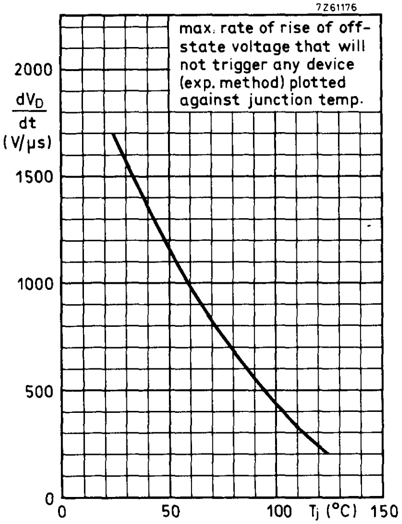


Fig. 9.

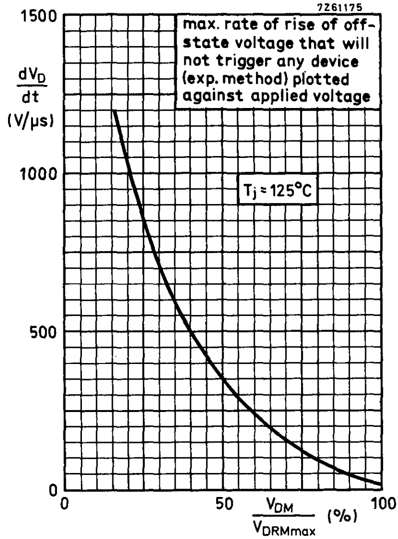


Fig. 10.

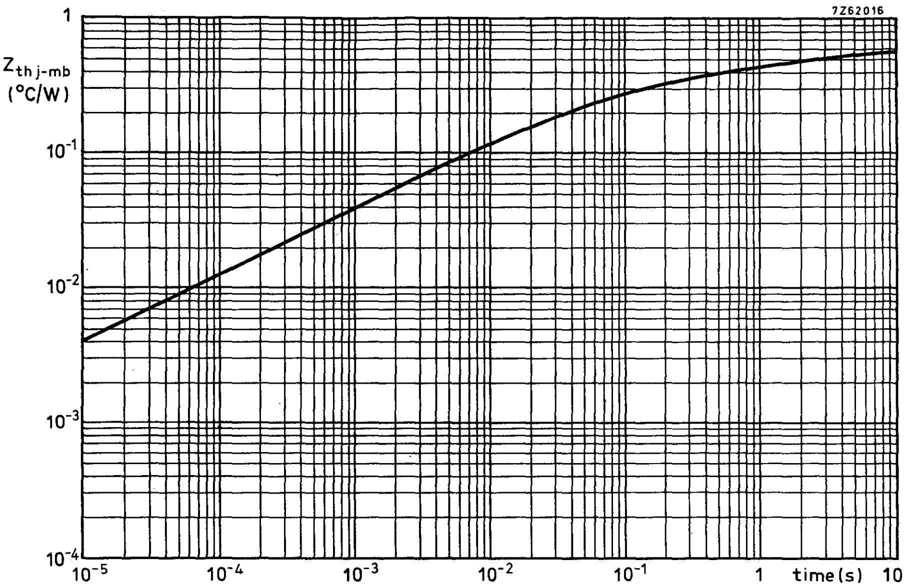
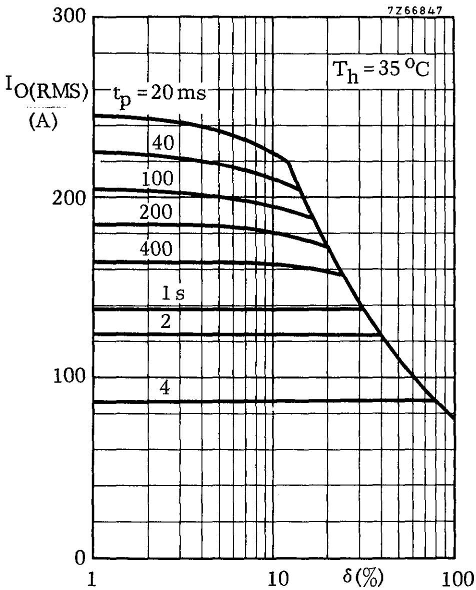
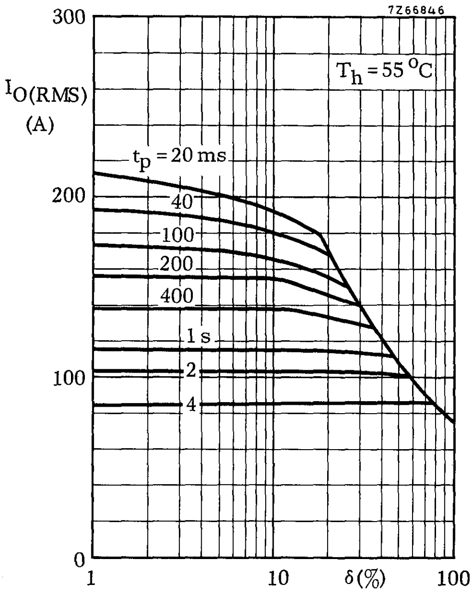
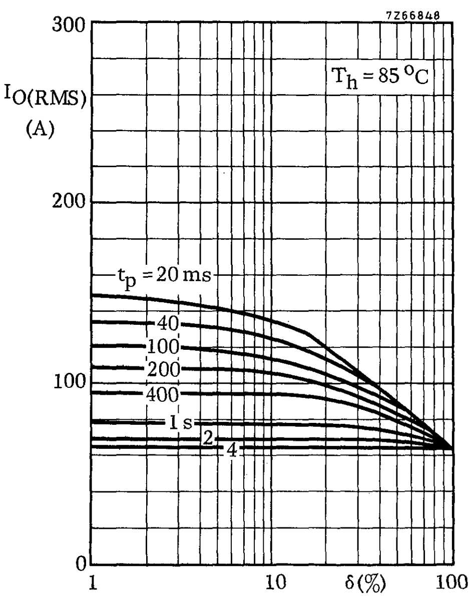
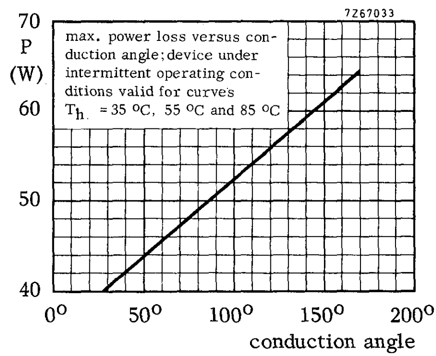


Fig. 11.









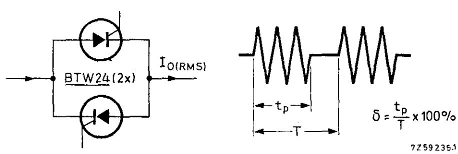


Fig. 12 Intermittent overload capability of two BTW24 thyristors in anti-parallel connection in a single phase a.c. control circuit (e.g. welding); conduction angle: 360°.

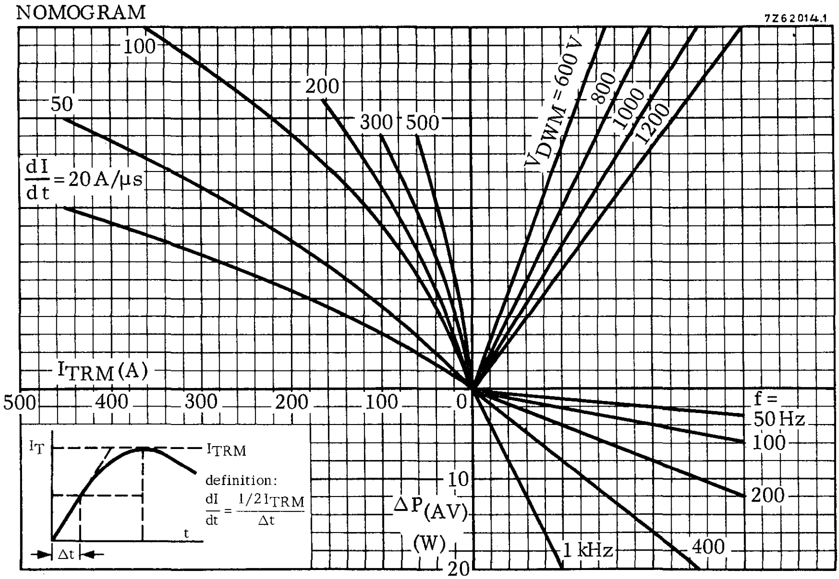


Fig. 13 Power loss $\Delta P_{(AV)}$ due to switching-on; T_j = 125 °C; I_G = 500 mA; dI_G/dt = 1 A/μs.

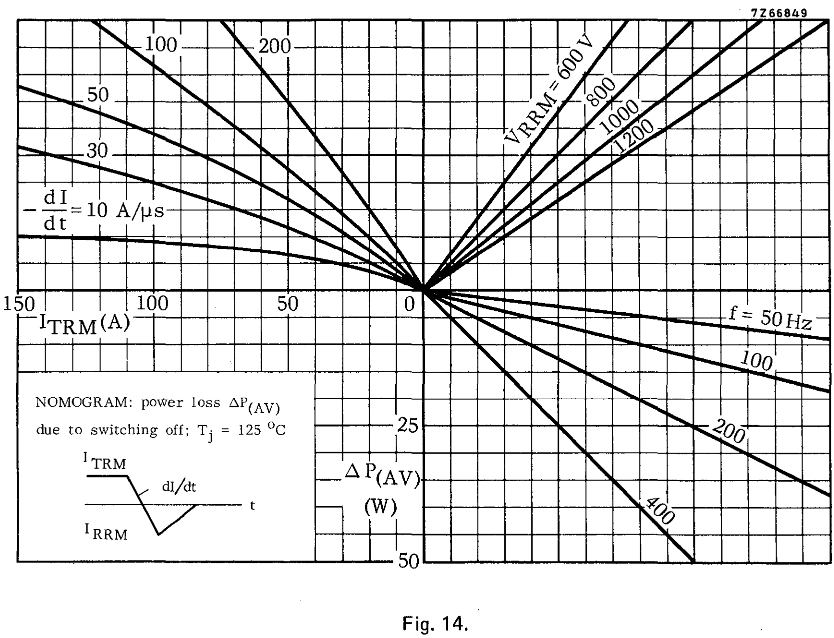
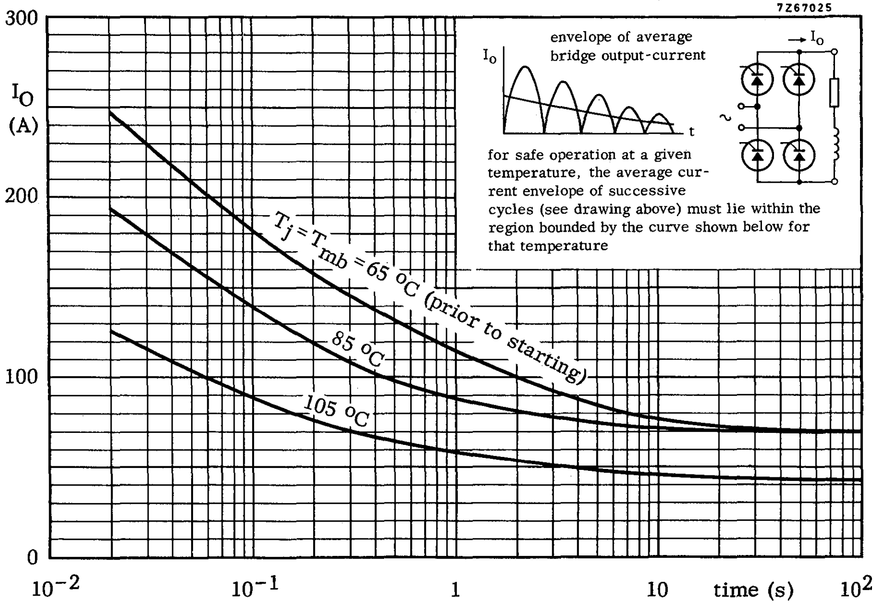


Fig. 14.



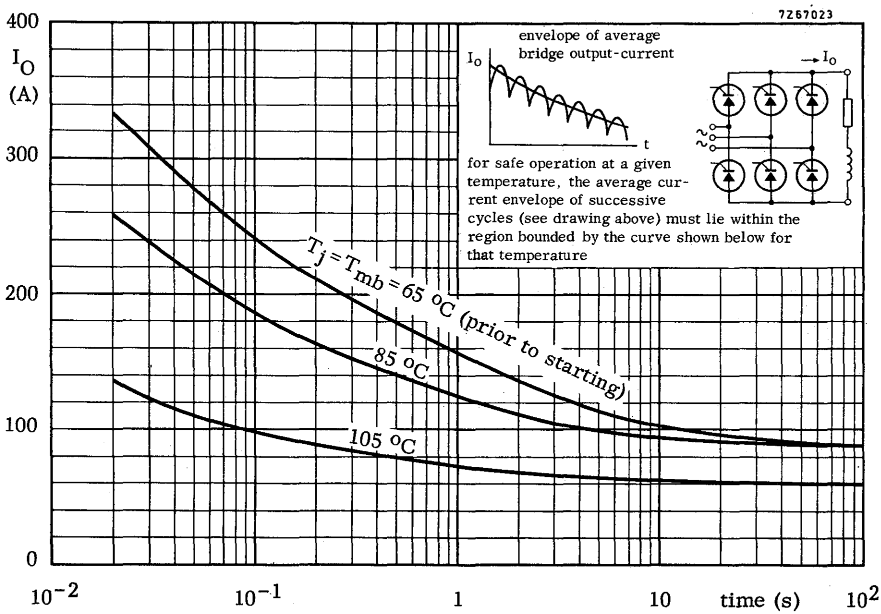


Fig. 15 Limits for starting or inrush currents.

FAST TURN-OFF THYRISTORS

A range of medium current fast turn-off thyristors in metal envelopes, intended for use in inverter applications.
The series consists of reverse polarity types (anode to stud) identified by a suffix R: BTW30-800RS to 1200RS.

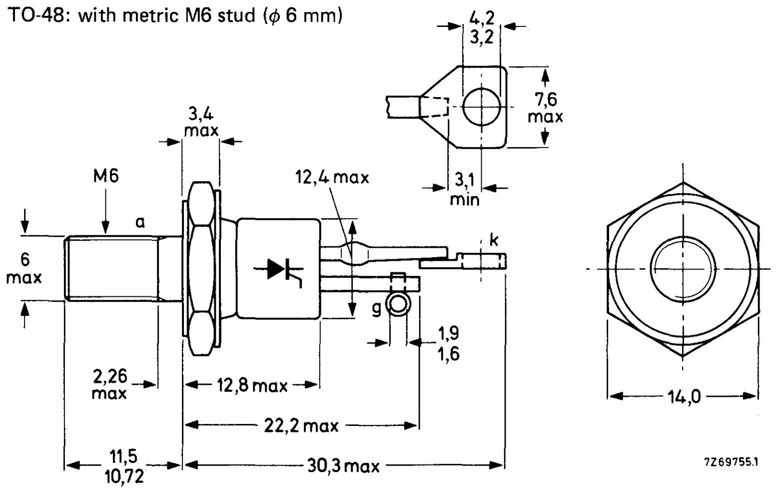
QUICK REFERENCE DATA

			BTW30-800RS	1000RS	1200RS	
Repetitive peak voltages	V_{DRM}/V_{RRM}	max.	800	1000	1200	V
Average on-state current	$I_{T(AV)}$	max.			16	A
R.M.S. on-state current	$I_{T(RMS)}$	max.			24	A
Non-repetitive peak on-state current	I_{TSM}	max.			150	A
Rate of rise of on-state current	dI_T/dt	max.			100	A/µs
Rate of rise of off-state voltage that will not trigger any device	dV_D/dt	<			200	V/µs
Circuit-commutated turn-off time	t_q	<			15	µs

MECHANICAL DATA

Dimensions in mm

Fig. 1 TO-48: with metric M6 stud (ϕ 6 mm)



Net mass: 14 g
Diameter of clearance hole: max. 6,5 mm
Accessories supplied on request: 56264A
(mica washer, insulating ring, soldering tag)

Torque on nut: min. 1,7 Nm (17 kg cm)
max. 3,5 Nm (35 kg cm)
Supplied with device:
1 nut, 1 lock washer
Nut dimensions across the flats: 10 mm

RATINGS

Limiting values in accordance with the Absolute Maximum System (IEC 134)

Anode to cathode

			BTW30-800RS	1000RS	1200RS	
Non-repetitive peak voltages ($t \leqslant 10$ ms)	V_{DSM}**/V_{RSM}	max.	800	1000	1200	V
Repetitive peak voltages	V_{DRM}/V_{RRM}	max.	800	1000	1200	V▲
Crest working off-state voltage square-wave; $\delta = 0,5$	V_{DWM}	max.	600	800	1000	V*

Average on-state current assuming zero switching losses (averaged over any 20 ms period)				
square-wave; $\delta = 0,5$; up to $T_{mb} = 65$ °C	$I_{T(AV)}$	max.	16	A
square-wave; $\delta = 0,5$; at $T_{mb} = 85$ °C	$I_{T(AV)}$	max.	12	A
sinusoidal; at $T_{mb} = 85$ °C	$I_{T(AV)}$	max.	10	A
R.M.S. on-state current	$I_{T(RMS)}$	max.	24	A
Repetitive peak on-state current	I_{TRM}	max.	150	A
Non-repetitive peak on-state current $T_j = 125$ °C prior to surge (see Fig. 6)				
$t = 10$ ms; half sine-wave	I_{TSM}	max.	150	A
$t = 5$ ms; square pulse	I_{TSM}	max.	150	A
I^2t for fusing ($t = 10$ ms)	I^2t	max.	115	A^2s
Rate of rise of on-state current after triggering with $I_G = 1$ A to $I_T = 50$ A; $dI_G/dt = 1$ A/µs	dI_T/dt	max.	100	A/µs

Gate to cathode

Reverse peak voltage	V_{RGM}	max.	10	V
Average power dissipation (averaged over any 20 ms period)	$P_{G(AV)}$	max.	1	W
Peak power dissipation	P_{GM}	max.	5	W

Temperatures

Storage temperature	T_{stg}	−55 to + 125		°C
Junction temperature	T_j	max.	125	°C

THERMAL RESISTANCE

From junction to mounting base	$R_{th\,j\text{-}mb}$	=	1	°C/W
From mounting base to heatsink	$R_{th\,mb\text{-}h}$	=	0,2	°C/W
Transient thermal impedance ($t = 1$ ms)	$Z_{th\,j\text{-}mb}$	=	0,06	°C/W

* To ensure thermal stability: $R_{th\,j\text{-}a} < 3$ °C/W (d.c. blocking) or < 6 °C/W (square-wave; $\delta = 0,5$). For smaller heatsinks $T_{j\,max}$ should be derated. For square-wave see Fig. 5.

** Although not recommended, higher off-state voltages may be applied without damage, but the thyristor may switch into the on-state. The rate of rise of on-state current should not exceed 30 A/µs.

▲ Thermal stability at higher voltage ratings is dependent on duty factor. See Figs 15 and 16.

CHARACTERISTICS

Anode to cathode

On-state voltage I_T = 20 A; T_j = 25 °C	V_T	<	3,5 V*
Rate of rise of off-state voltage that will not trigger any device; exponential method; V_D = 2/3 $V_{DRM\,max}$; T_j = 125 °C	dV_D/dt	<	200 V/μs
Off-state current V_D = $V_{DWM\,max}$; T_j = 125 °C	I_D	<	7 mA
Holding current; T_j = 25 °C	I_H	<	200 mA

Gate to cathode

Voltage that will trigger all devices V_D = 6 V; T_j = 25 °C	V_{GT}	>	2,5 V
Voltage that will not trigger any device V_D = $V_{DRM\,max}$; T_j = 125 °C	V_{GD}	<	0,2 V
Current that will trigger all devices V_D = 6 V; T_j = 25 °C	I_{GT}	>	200 mA

Switching characteristics

Gate-controlled turn-on time ($t_{gt} = t_d + t_r$) when switched from V_D = $V_{DWM\,max}$ to I_T = 50 A; I_{GT} = 200 mA; dI_G/dt = 1 A/μs; T_j = 25 °C	t_d	<	1 μs
	t_r	<	1 μs

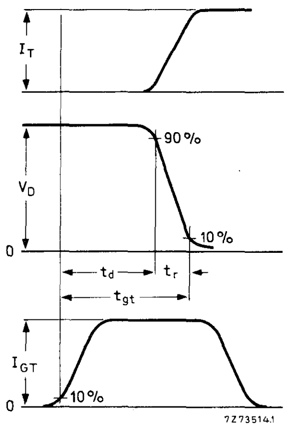


Fig. 2 Gate-controlled turn-on time definitions.

* Measured under pulse conditions to avoid excessive dissipation.

CHARACTERISTICS (continued)

Circuit-commutated turn-off time when switched from I_T = 10 A to $V_R \geqslant$ 50 V with $-dI_T/dt$ = 10 A/μs; dV_D/dt = 50 V/μs; T_j = 125 °C — t_q < 15 μs

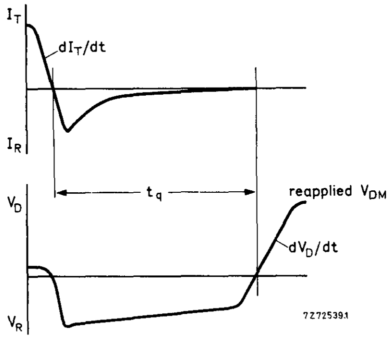
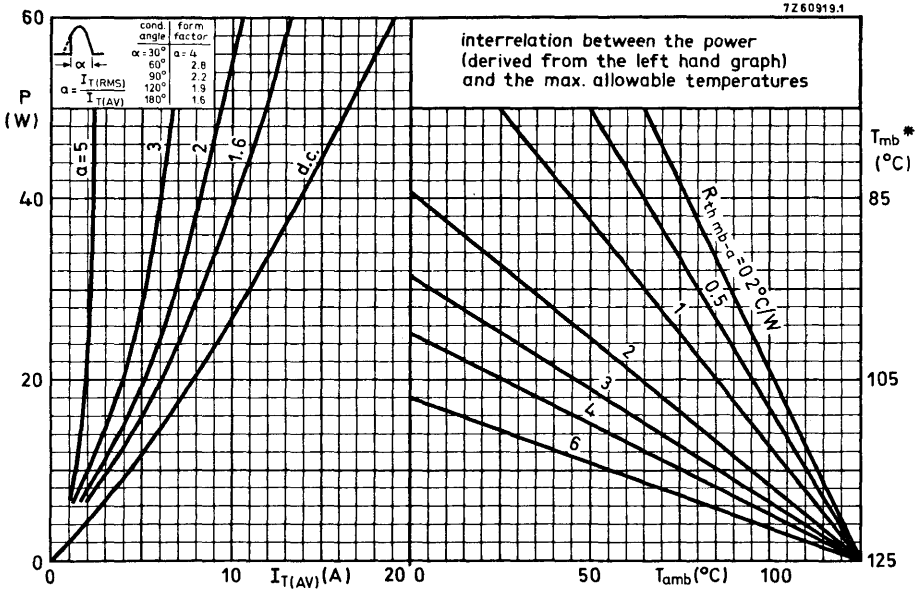


Fig. 3 Circuit-commutated turn-off time definitions.

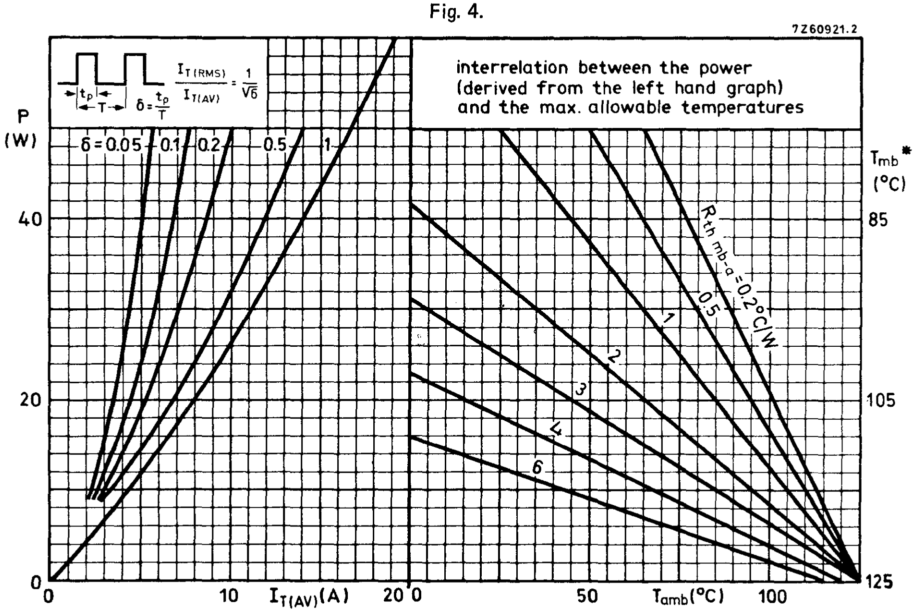
OPERATING NOTES

1. The terminals should neither be bent nor twisted; they should be soldered into the circuit so that there is no strain on them.
   During soldering the heat conduction to the junction should be kept to a minimum.
2. High frequency operation.
   a. The curves in Figs 13 and 14 show the additional average power losses due to turning on and turning off the thyristor in square pulse operation. This power should be added to that derived from the curves in Fig. 5.
   b. Power loss due to turn-off may be discounted if an inverse parallel diode is connected across the thyristor to clip any reverse voltage which may occur following commutation. Note should be taken of the consequent increase in turn-off time (see Fig. 11).



* T_{mb} – scale is for comparison purposes only and is correct only for $R_{th\ mb-a} \leq 6°C/W$

Fig. 4.



* T_{mb} – scale is for comparison purposes only and is correct only for $R_{th\ mb-a} \leq 2°C/W$

Fig. 5.

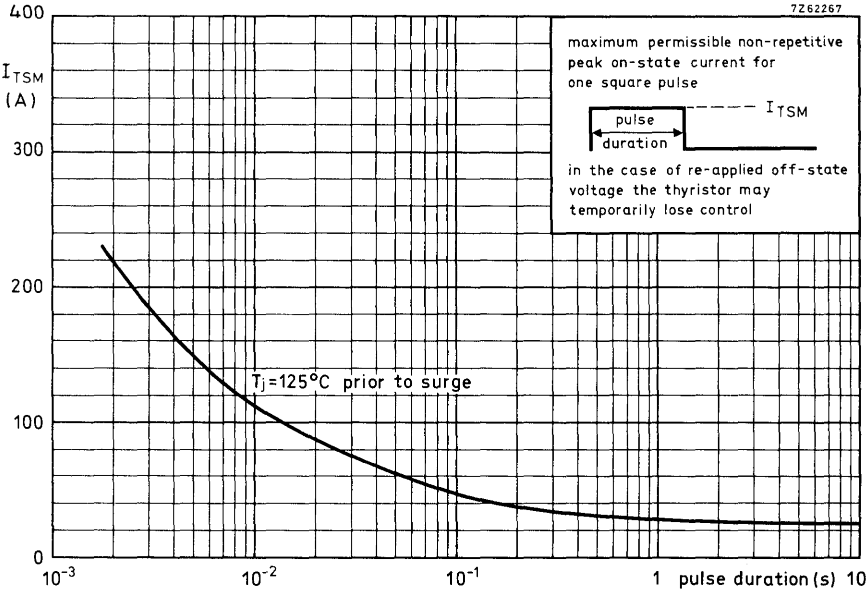


Fig. 6.

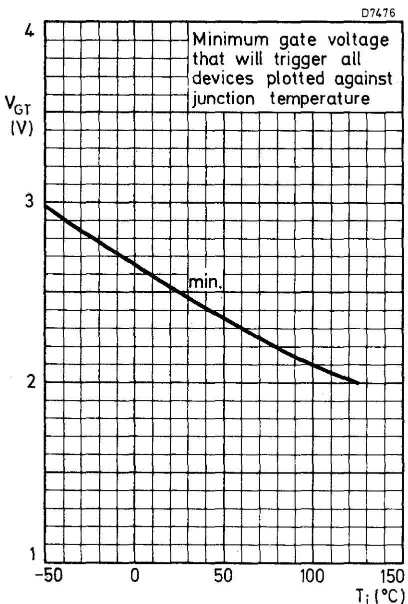


Fig. 7.

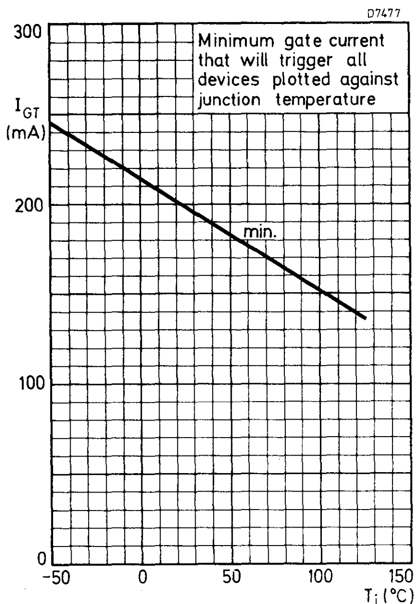


Fig. 8.

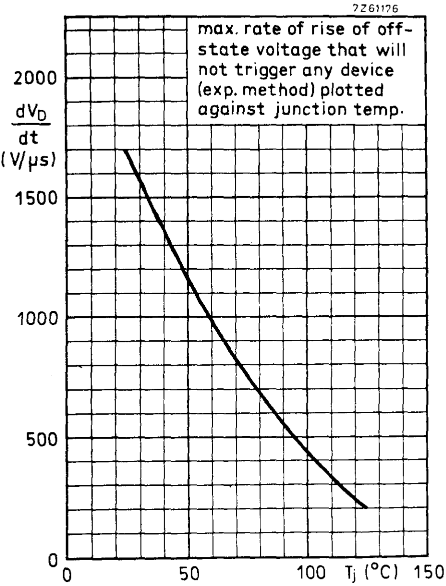


Fig. 9.

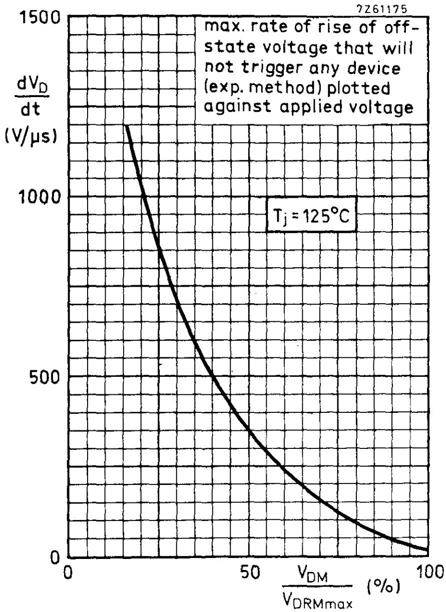


Fig. 10.

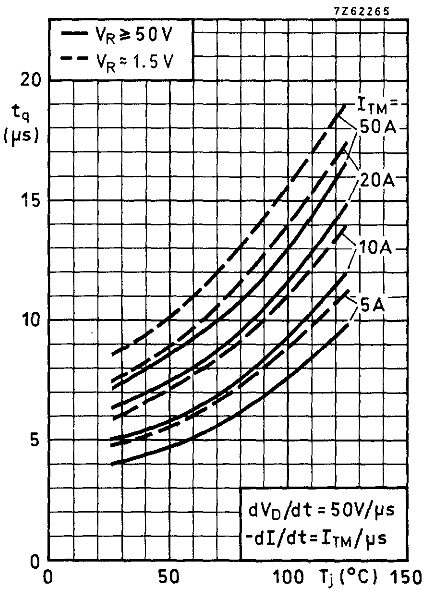


Fig. 11.

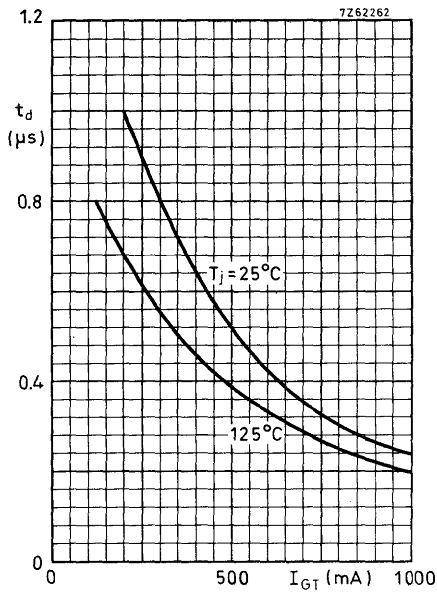


Fig. 12.

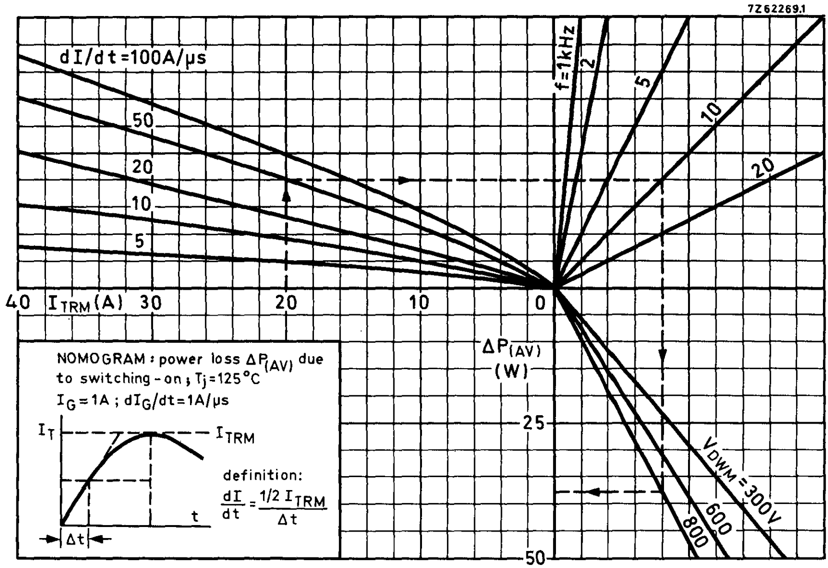
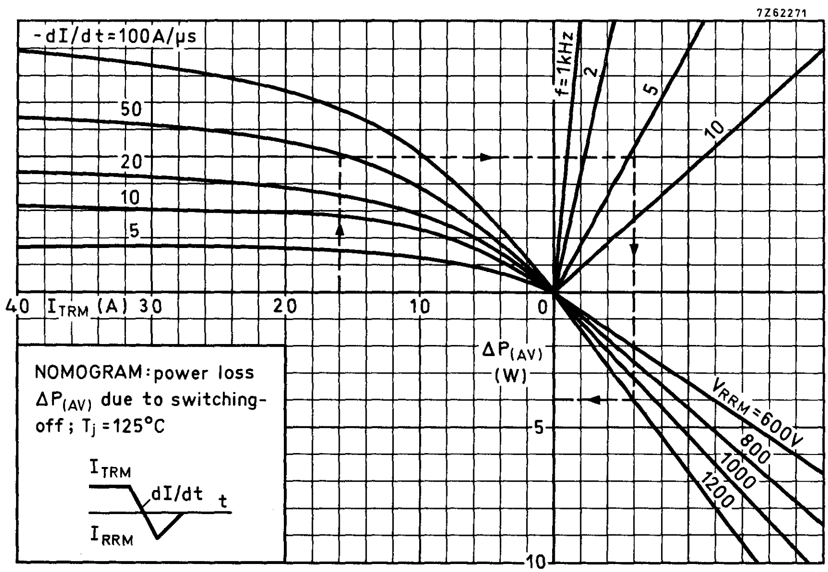

7Z62269.1
dI/dt=100A/μs
50
20
10
5
f=1kHz
2
5
10
20
40 ITRM(A) 30
20
10
0
ΔP(AV)
(W)
25
50
VDWM=300V
600
800
NOMOGRAM: power loss ΔP(AV) due to switching-on; Tj=125°C
IG=1A; dIG/dt=1A/μs
IT
ITRM
t
Δt
definition:
dI/dt = 1/2 ITRM / Δt

Fig. 13.


7Z62271
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50
20
10
5
f=1kHz
2
5
10
40 ITRM (A) 30
20
10
0
ΔP(AV)
(W)
5
10
VRRM=600V
800
1000
1200
NOMOGRAM: power loss ΔP(AV) due to switching-off; Tj=125°C
ITRM
dI/dt
t
IRRM

Fig. 14.

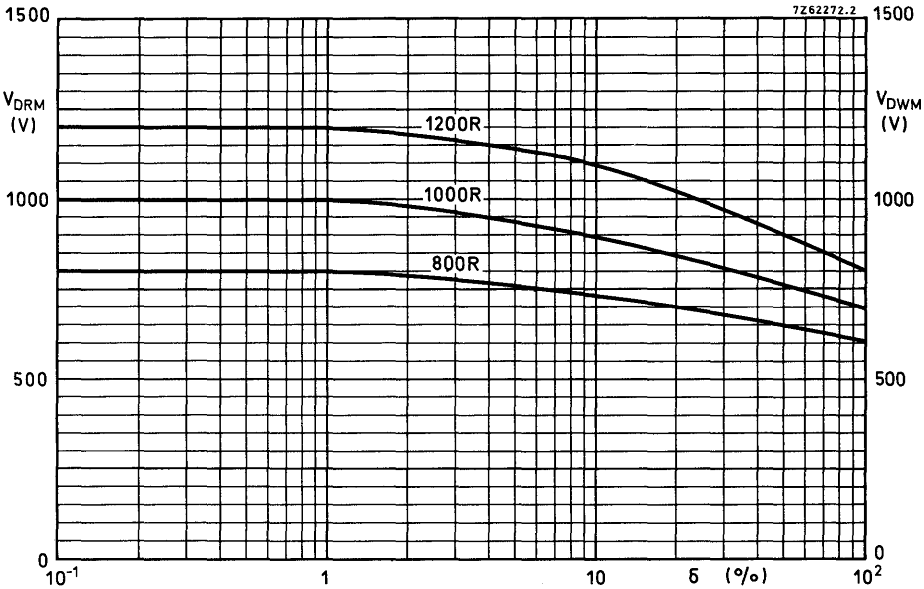

7Z62272.2
1500
1000
500
0
V_{DRM}
(V)
V_{DWM}
(V)
1200R
1000R
800R
10^{-1}
1
10
δ (%)
10^{2}

Fig. 15.

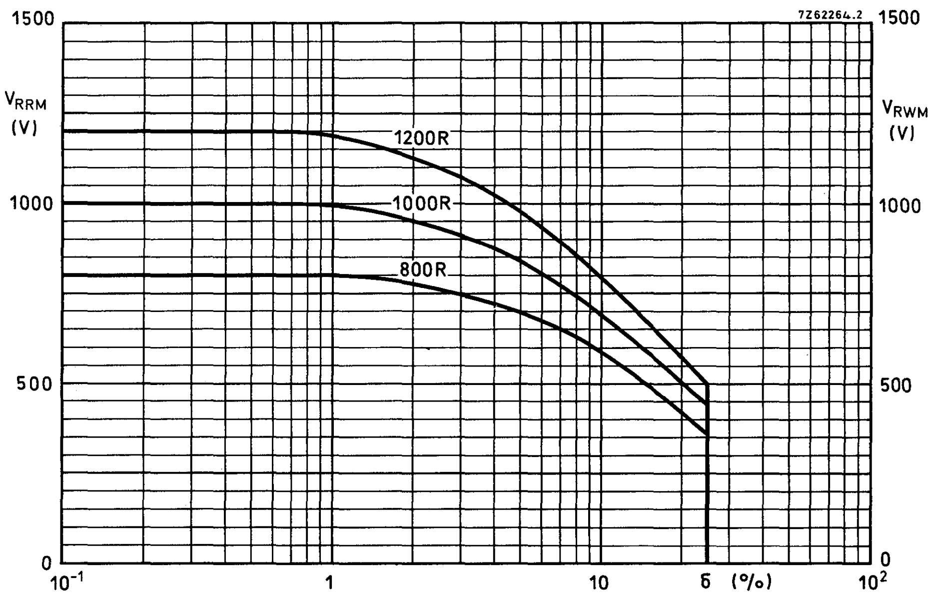

7Z62264.2
1500
1000
500
0
V_{RRM}
(V)
V_{RWM}
(V)
1200R
1000R
800R
10^{-1}
1
10
δ (%)
10^{2}

Fig. 16.

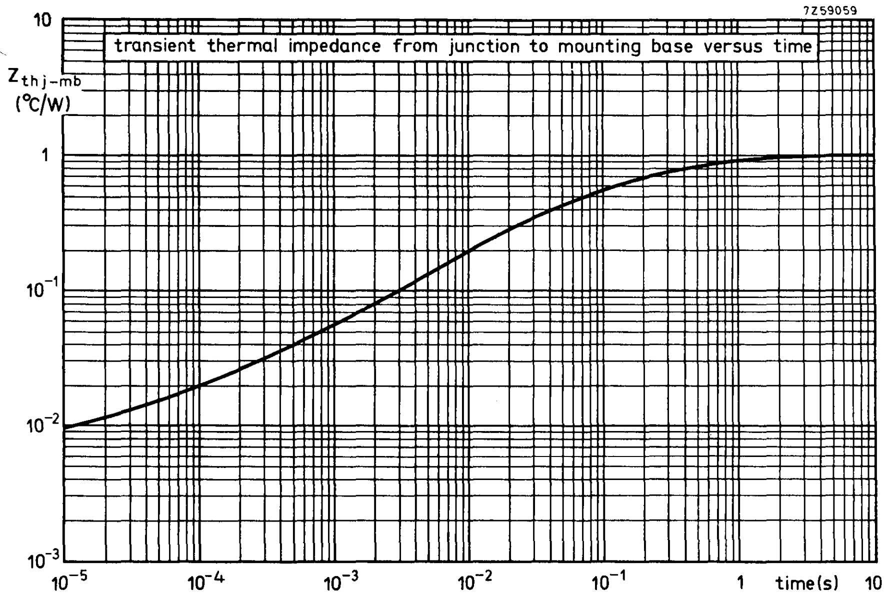

7Z59059
transient thermal impedance from junction to mounting base versus time
$Z_{th\,j-mb}$ (°C/W)
10
1
10^{-1}
10^{-2}
10^{-3}
10^{-5}
10^{-4}
10^{-3}
10^{-2}
10^{-1}
1
time(s)
10

Fig. 17.

FAST TURN-OFF THYRISTORS

A range of medium current fast turn-off thyristors in metal envelopes, intended for use in inverter applications.
The series consists of reverse polarity types (anode to stud) identified by a suffix R: BTW31-800RW to 1200RW.

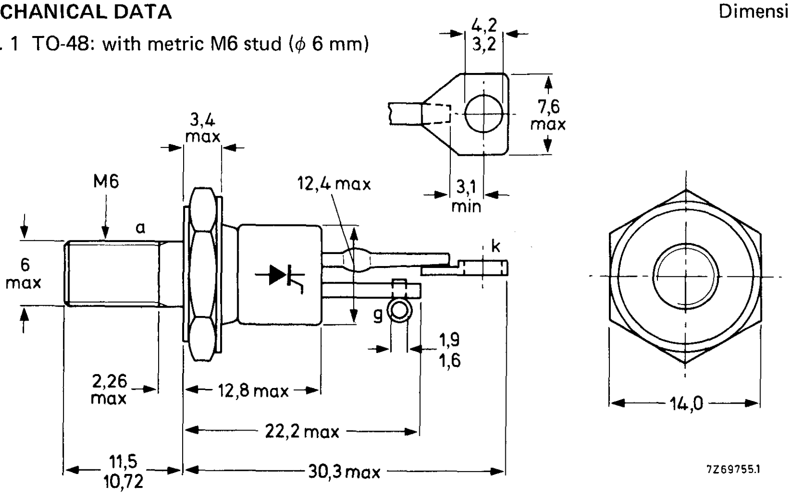
QUICK REFERENCE DATA

			BTW31-800RW	1000RW	1200RW	
Repetitive peak voltages	V_{DRM}/V_{RRM}	max.	800	1000	1200	V
Average on-state current	$I_{T(AV)}$	max.		22		A
R.M.S. on-state current	$I_{T(RMS)}$	max.		31		A
Non-repetitive peak on-state current	I_{TSM}	max.		240		A
Rate of rise of on-state current	dI_T/dt	max.		100		A/μs
Rate of rise of off-state voltage that will not trigger any device	dV_D/dt	<		200		V/μs
Circuit-commutated turn-off time	t_q	<		20		μs

MECHANICAL DATA

Dimensions in mm

Fig. 1 TO-48: with metric M6 stud (ϕ 6 mm)



Net mass: 14 g
Diameter of clearance hole: max. 6,5 mm
Accessories supplied on request: 56264A
(mica washer, insulating ring, soldering tag)

Torque on nut: min. 1,7 Nm (17 kg cm)
max. 3,5 Nm (35 kg cm)
Supplied with device:
1 nut, 1 lock washer
Nut dimensions across the flats: 10 mm

RATINGS

Limiting values in accordance with the Absolute Maximum System (IEC 134)

Anode to cathode

			BTW31-800RW	1000RW	1200RW	
Non-repetitive peak voltages ($t \leqslant 10$ ms)	V_{DSM}**/V_{RSM}	max.	800	1000	1200	V
Repetitive peak voltages	V_{DRM}/V_{RRM}	max.	800	1000	1200	V▲
Crest working off-state voltage square-wave; $\delta = 0,5$	V_{DWM}	max.	600	800	1000	V *

Average on-state current assuming zero switching losses (averaged over any 20 ms period)				
square-wave; $\delta = 0,5$; up to $T_{mb} = 65\ ^oC$	$I_{T(AV)}$	max.	22	A
square-wave; $\delta = 0,5$; at $T_{mb} = 85\ ^oC$	$I_{T(AV)}$	max.	16	A
sinusoidal; at $T_{mb} = 85\ ^oC$	$I_{T(AV)}$	max.	15	A
R.M.S. on-state current	$I_{T(RMS)}$	max.	31	A
Repetitive peak on-state current	I_{TRM}	max.	240	A
Non-repetitive peak on-state current $T_j = 125\ ^oC$ prior to surge (see Fig. 6)				
t = 10 ms; half sine-wave	I_{TSM}	max.	240	A
t = 5 ms; square pulse	I_{TSM}	max.	240	A
I^2t for fusing (t = 10 ms)	I^2t	max.	290	A^2s
Rate of rise of on-state current after triggering with $I_G = 1$ A to $I_T = 50$ A; $dI_G/dt = 1$ A/μs	dI_T/dt	max.	100	A/μs

Gate to cathode

Reverse peak voltage	V_{RGM}	max.	10	V
Average power dissipation (averaged over any 20 ms period)	$P_{G(AV)}$	max.	1	W
Peak power dissipation	P_{GM}	max.	5	W

Temperatures

Storage temperature	T_{stg}		−55 to +125	^oC
Junction temperature	T_j	max.	125	^oC

THERMAL RESISTANCE

From junction to mounting base	$R_{th\ j\text{-}mb}$	=	1	$^oC/W$
From mounting base to heatsink	$R_{th\ mb\text{-}h}$	=	0,2	$^oC/W$
Transient thermal impedance (t = 1 ms)	$Z_{th\ j\text{-}mb}$	=	0,06	$^oC/W$

* To ensure thermal stability: $R_{th\ j\text{-}a} < 3\ ^oC/W$ (d.c. blocking) or $< 6\ ^oC/W$ (square-wave; $\delta = 0,5$). For smaller heatsinks $T_{j\ max}$ should be derated. For square-wave see Fig. 5.

** Although not recommended, higher off-state voltages may be applied without damage, but the thyristor may switch into the on-state. The rate of rise of on-state current should not exceed 30 A/μs.

▲ Thermal stability at higher voltage ratings is dependent on duty factor. See Figs 15 and 16.

CHARACTERISTICS

Anode to cathode

On-state voltage $I_T = 50$ A; $T_j = 25$ °C	V_T	<	2,9 V *
Rate of rise of off-state voltage that will not trigger any device; exponential method; $V_D = 2/3V_{DRMmax}$; $T_j = 125$ °C	dV_D/dt	<	200 V/μs
Off-state current $V_D = V_{DWMmax}$; $T_j = 125$ °C	I_D	<	7 mA
Holding current; $T_j = 25$ °C	I_H	<	200 mA

Gate to cathode

Voltage that will trigger all devices $V_D = 6$ V; $T_j = 25$ °C	V_{GT}	>	2,5 V
Voltage that will not trigger any device $V_D = V_{DRMmax}$; $T_j = 125$ °C	V_{GD}	<	0,2 V
Current that will trigger all devices $V_D = 6$ V; $T_j = 25$ °C	I_{GT}	>	200 mA

Switching characteristics

Gate-controlled turn-on time ($t_{gt} = t_d + t_r$) when switched from $V_D = V_{DWMmax}$ to $I_T = 50$ A; $I_{GT} = 200$ mA; $dI_G/dt = 1$ A/μs; $T_j = 25$ °C	t_d t_r	< <	1 μs 0,7 μs

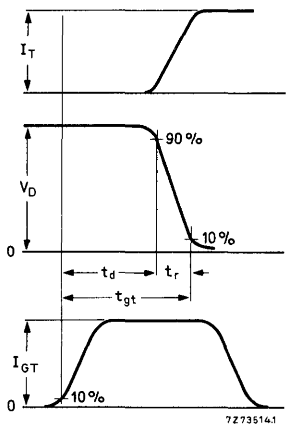


Fig. 2 Gate-controlled turn-on time definitions.

* Measured under pulse conditions to avoid excessive dissipation.

CHARACTERISTICS (continued)

Circuit-commutated turn-off time when switched from I_T = 10 A to $V_R \geqslant$ 50 V with $-dI_T/dt$ = 10 A/μs; dV_D/dt = 50 V/μs; T_j = 125 °C — t_q < 20 μs

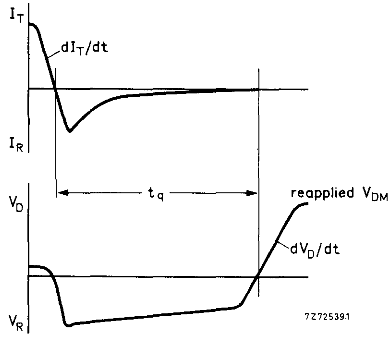
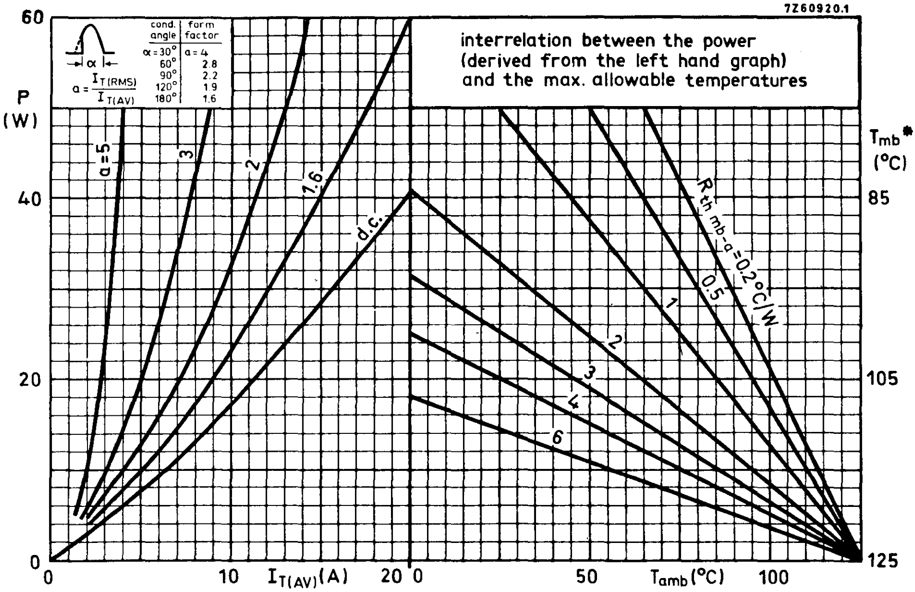


Fig. 3 Circuit-commutated turn-off time definitions.

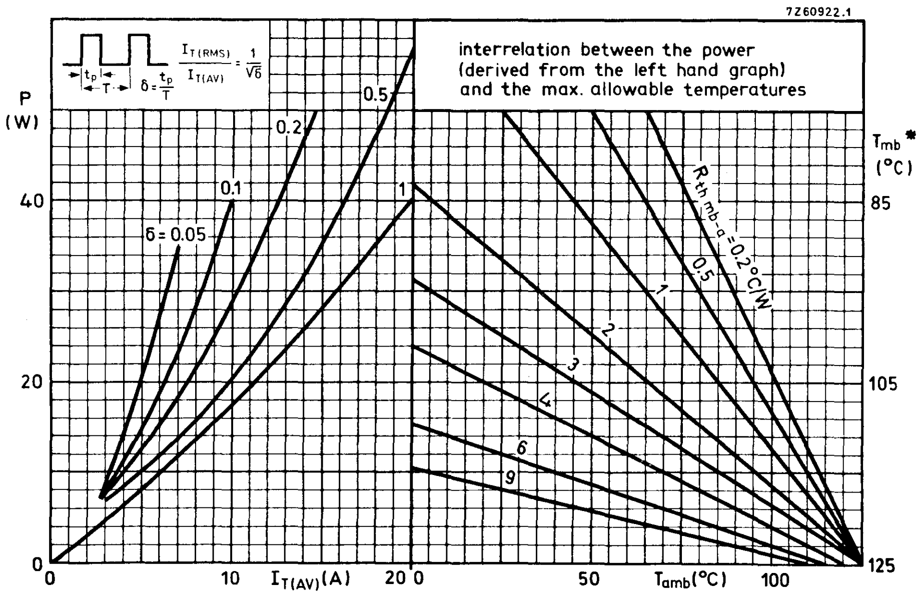
OPERATING NOTES

1. The terminals should neither be bent nor twisted; they should be soldered into the circuit so that there is no strain on them.
   During soldering the heat conduction to the junction should be kept to a minimum.
2. High frequency operation.
   a. The curves in Figs 13 and 14 show the additional average power losses due to turning on and turning off the thyristor in square pulse operation. This power should be added to that derived from the curves in Fig. 5.
   b. Power loss due to turn-off may be discounted if an inverse parallel diode is connected across the thyristor to clip any reverse voltage which may occur following commutation. Note should be taken of the consequent increase in turn-off time (see Fig. 11).



* T_{mb}-scale is for comparison purposes only and is correct only for $R_{th\ mb-a} \leq 6$ °C/W

Fig. 4.



* T_{mb}-scale is for comparison purposes only and is correct only for $R_{th\ mb-a} \leq 2$ °C/W

Fig. 5.

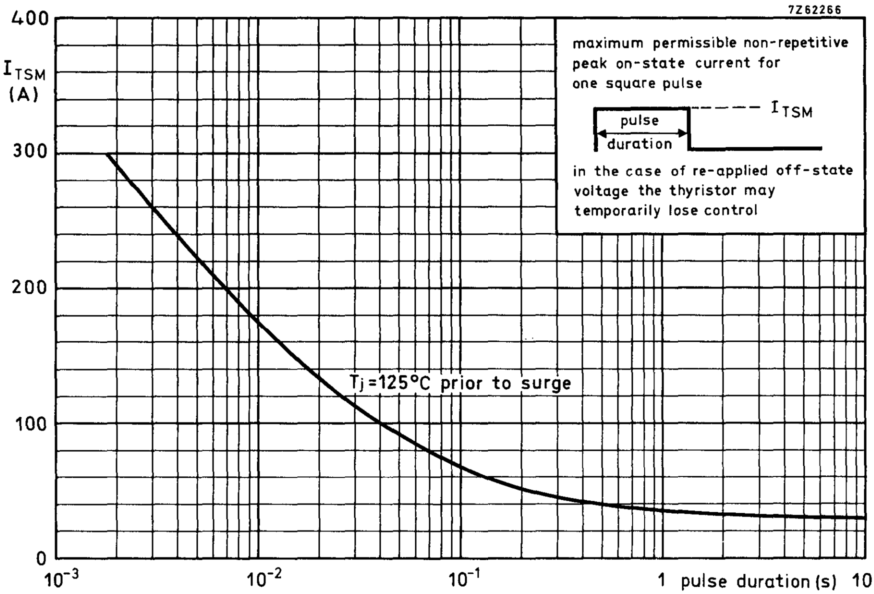


Fig. 6.

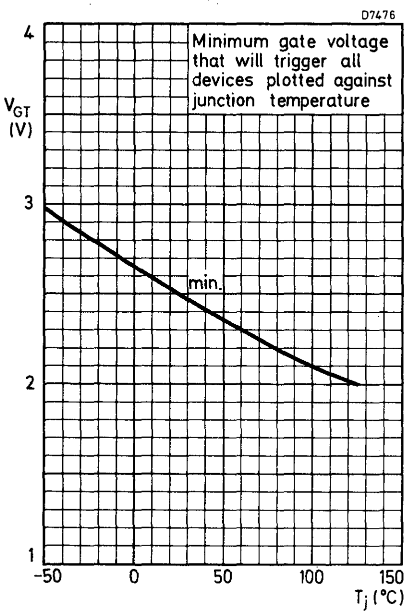


Fig. 7.

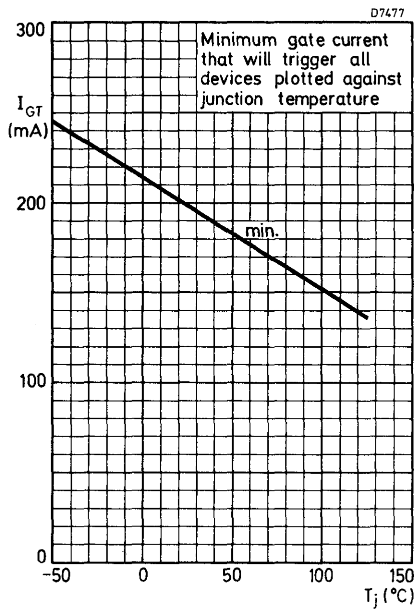


Fig. 8.

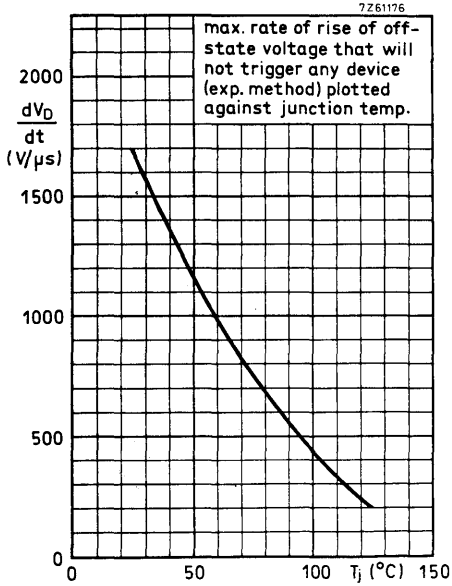


Fig. 9.

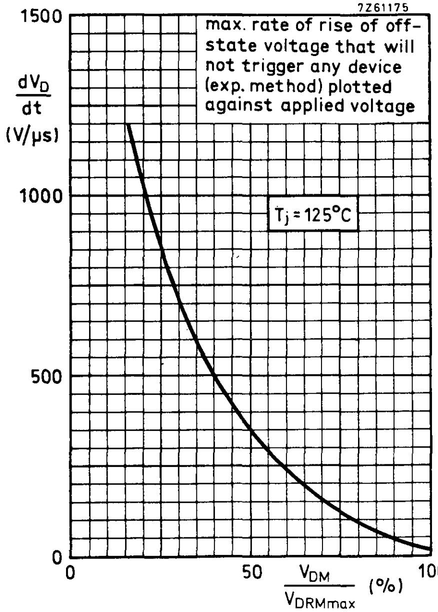


Fig. 10.

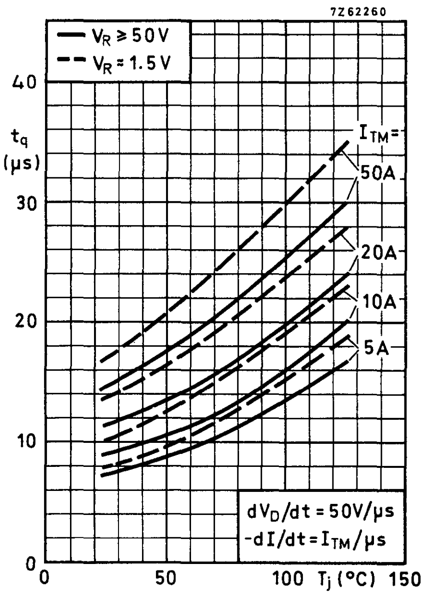


Fig. 11.

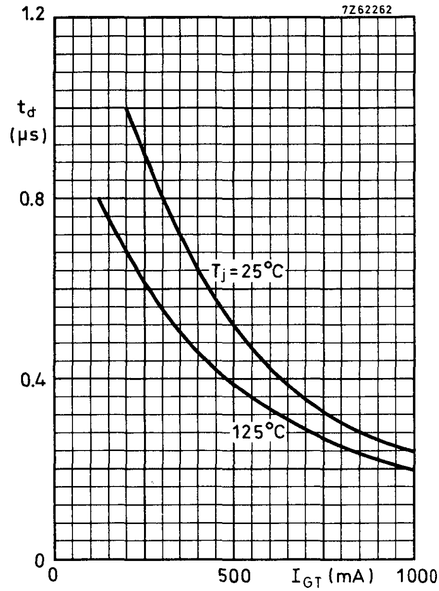


Fig. 12.

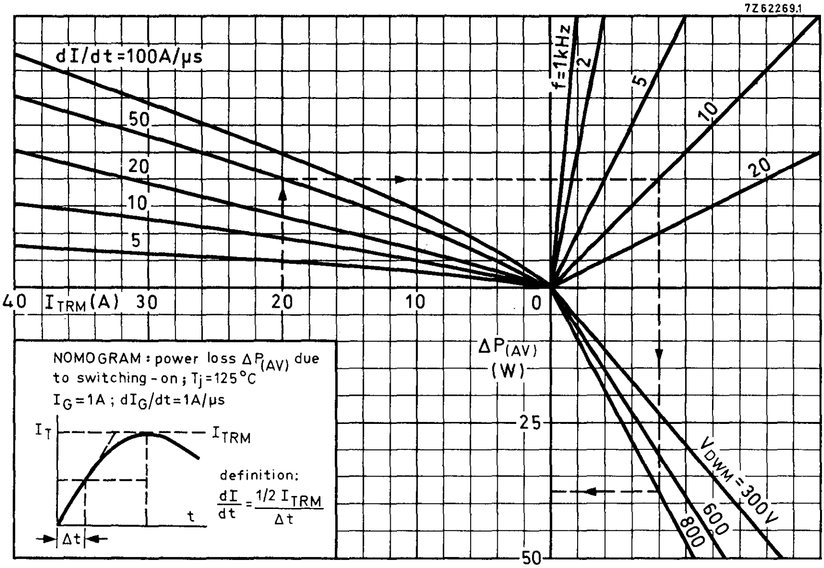

7Z62269.1
dI/dt=100A/μs
50
20
10
5
f=1kHz
2
5
10
20
40 I_{TRM}(A) 30
20
10
0
$\Delta P_{(AV)}$ (W)
25
50
V_{DWM}=300V
600
800
NOMOGRAM: power loss $\Delta P_{(AV)}$ due to switching-on; T_j=125°C
I_G=1A; dI_G/dt=1A/μs
I_T
I_{TRM}
t
Δt
definition:
$\frac{dI}{dt}=\frac{1/2\ I_{TRM}}{\Delta t}$

Fig. 13.

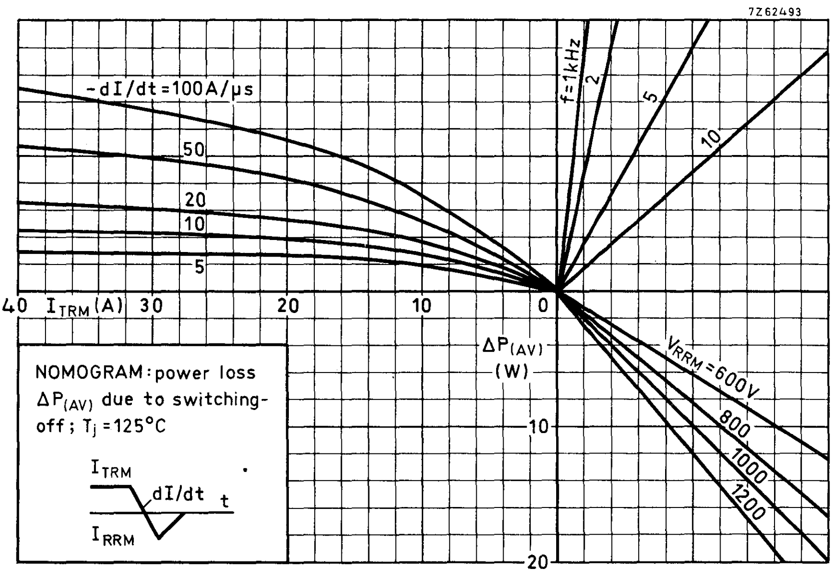

7Z62493
-dI/dt=100A/μs
50
20
10
5
f=1kHz
2
5
10
40 I_{TRM}(A) 30
20
10
0
$\Delta P_{(AV)}$ (W)
10
20
V_{RRM}=600V
800
1000
1200
NOMOGRAM: power loss $\Delta P_{(AV)}$ due to switching-off; T_j=125°C
I_{TRM}
dI/dt
t
I_{RRM}

Fig. 14.

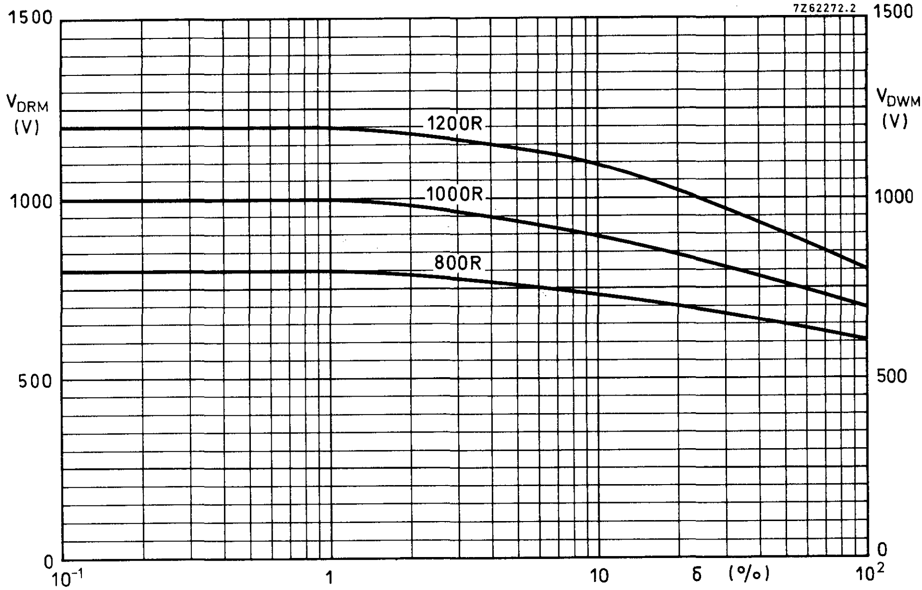

7Z62272.2
1500
1000
500
0
V_{DRM}
(V)
V_{DWM}
(V)
1200R
1000R
800R
10^{-1}
1
10
δ (%)
10^2

Fig. 15.

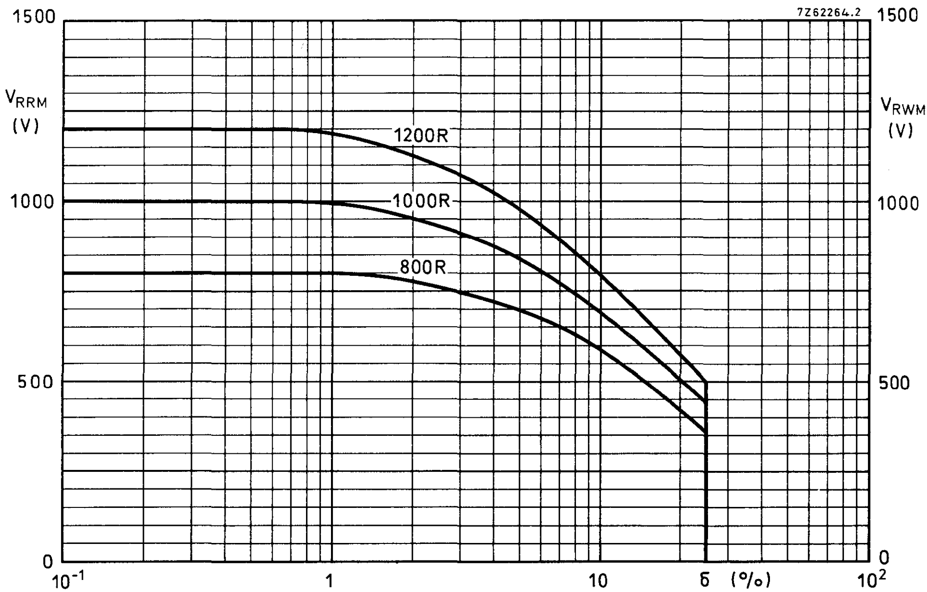

7Z62264.2
1500
1000
500
0
V_{RRM}
(V)
V_{RWM}
(V)
1200R
1000R
800R
10^{-1}
1
10
δ (%)
10^2

Fig. 16.

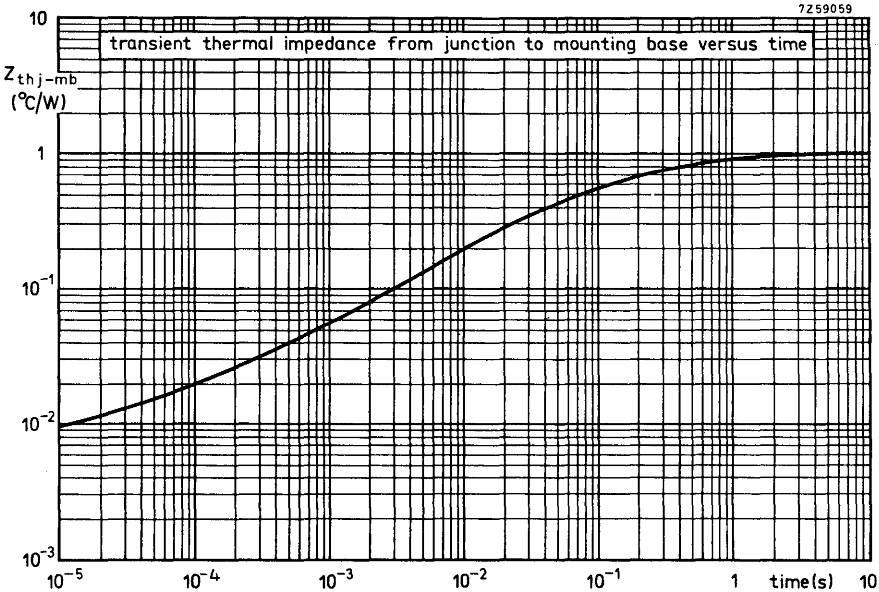

7Z59059
transient thermal impedance from junction to mounting base versus time
Zthj-mb
(°C/W)
10
1
10⁻¹
10⁻²
10⁻³
10⁻⁵
10⁻⁴
10⁻³
10⁻²
10⁻¹
1
time(s)
10

Fig. 17.

FAST TURN-OFF THYRISTORS

A range of fast turn-off thyristors in metal envelopes, intended for use in inverter applications. The series consists of reverse polarity types (anode to stud) identified by a suffix R: BTW33-800R to 1200R.

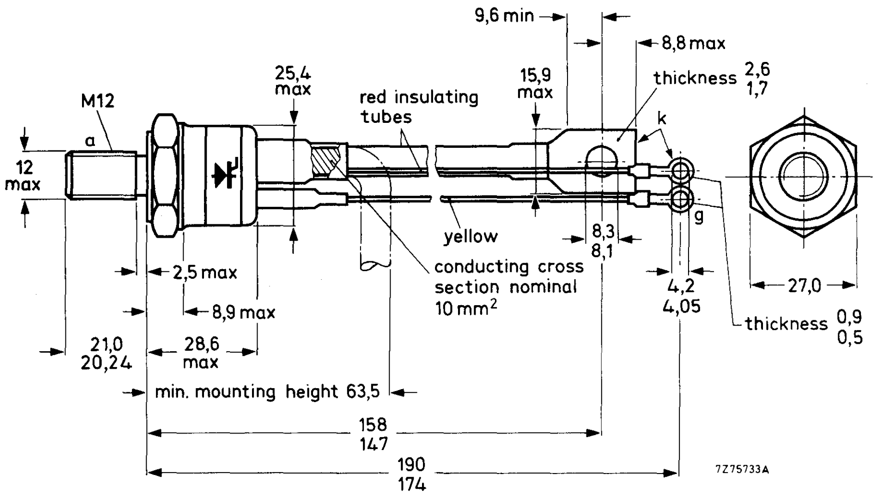
QUICK REFERENCE DATA

			BTW33-800R	1000R	1200R	
Repetitive peak voltages	V_{DRM}/V_{RRM}	max.	800	1000	1200	V
Average on-state current	$I_{T(AV)}$	max.			80	A
R.M.S. on-state current	$I_{T(RMS)}$	max.			110	A
Non-repetitive peak on-state current	I_{TSM}	max.			1500	A
Circuit-commutated turn-off time	t_q	<			25	μs

MECHANICAL DATA

Dimensions in mm

Fig. 1 TO-94; with metric M12 stud (ϕ 12 mm)



Net mass: 108 g
Diameter of clearance hole: max. 13,0 mm
Torque on nut: min. 9 Nm (90 kg cm)
max. 17,5 Nm (175 kg cm)

Supplied with device: 1 nut, 1 lock washer
Nut dimensions across the flats;
M12: 19 mm

RATINGS

Limiting values in accordance with the Absolute Maximum System (IEC 134)

Anode to cathode

			BTW33-800R	1000R	1200R	
Non-repetitive peak voltages (t ⩽ 10 ms)	V_{DSM}**/V_{RSM}	max.	800	1000	1200	V
Repetitive peak voltages	V_{DRM}/V_{RRM}	max.	800	1000	1200	V▲
Crest working off-state voltage square-wave; δ = 0,5	V_{DWM}	max.	600	800	1000	V *

Average on-state current assuming zero switching losses (averaged over any 20 ms period)				
square-wave; δ = 0,5; up to T_{mb} = 70 °C	$I_{T(AV)}$	max.	80	A
square-wave; δ = 0,5; at T_{mb} = 85 °C	$I_{T(AV)}$	max.	65	A
sinusoidal; at T_{mb} = 85 °C	$I_{T(AV)}$	max.	60	A
R.M.S. on-state current	$I_{T(RMS)}$	max.	110	A
Repetitive peak on-state current	I_{TRM}	max.	750	A
Non-repetitive peak on-state current T_j = 125 °C prior to surge				
t = 10 ms; half sine-wave (see Fig. 8)	I_{TSM}	max.	1500	A
t = 5 ms; square pulse (see Fig. 7)	I_{TSM}	max.	1500	A
I^2t for fusing (t = 10 ms)	I^2t	max.	11 250	A^2s
Rate of rise of on-state current after triggering with I_G = 750 mA to I_T = 200 A; dI_G/dt = 1 A/μs	dI_T/dt	max.	100	A/μs

Gate to cathode

Reverse peak voltage	V_{RGM}	max.	10	V
Average power dissipation (averaged over any 20 ms period)	$P_{G(AV)}$	max.	2	W
Peak power dissipation	P_{GM}	max.	10	W
	T_{stg}	−55 to + 125		°C

Temperatures

Storage temperature	T_{stg}	−55 to + 125		°C
Junction temperature	T_j	max.	125	°C

THERMAL RESISTANCE

From junction to mounting base	$R_{th\ j\text{-}mb}$	=	0,3	°C/W
From mounting base to heatsink	$R_{th\ mb\text{-}h}$	=	0,1	°C/W
Transient thermal impedance (t = 1 ms)	$Z_{th\ j\text{-}mb}$	=	0,015	°C/W

* To ensure thermal stability: $R_{th\ j\text{-}a} < 0,75$ °C/W (d.c. blocking) or $< 1,5$ °C/W (square-wave; δ = 0,5). For smaller heatsinks $T_{j\ max}$ should be derated. For square-wave see Fig. 6.

** Although not recommended, higher off-state voltages may be applied without damage, but the thyristor may switch into the on-state. The rate of rise of on-state current should not exceed 20 A/μs.

▲ Thermal stability at higher voltage ratings is dependent on duty factor. See Figs 19 and 20.

CHARACTERISTICS

Anode to cathode

On-state voltage I_T = 200 A; T_j = 25 °C	V_T	<	3 V *
Rate of rise of off-state voltage that will not trigger any device; exponential method; V_D = 2/3 V_{DRMmax}; T_j = 125 °C	dV_D/dt	<	200 V/μs
Off-state current V_D = V_{DWMmax}; T_j = 125 °C	I_D	<	25 mA
Holding current; T_j = 25 °C	I_H	<	200 mA
Latching current; T_j = 25 °C	I_L	<	400 mA

Gate to cathode

Voltage that will trigger all devices V_D = 6 V; T_j = 25 °C	V_{GT}	>	2,5 V
Voltage that will not trigger any device V_D = V_{DRMmax}; T_j = 125 °C	V_{GD}	<	0,2 V
Current that will trigger all devices V_D = 6 V; T_j = 25 °C	I_{GT}	>	150 mA

Switching characteristics

Gate-controlled turn-on time ($t_{gt} = t_d + t_r$) when switched from V_D = V_{DWMmax} to I_T = 200 A; I_{GT} = 200 mA; dI_G/dt = 1 A/μs; T_j = 25 °C	t_d t_r	< <	2 μs 2 μs

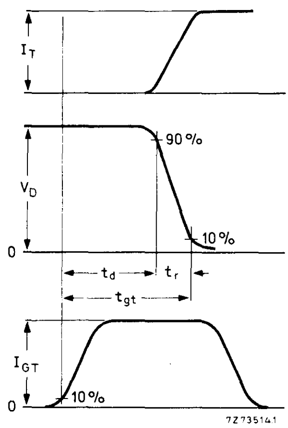


Fig. 2 Gate-controlled turn-on time definitions.

* Measured under pulse conditions to avoid excessive dissipation.

CHARACTERISTICS (continued)

Circuit-commutated turn-off time when switched from I_T = 50 A to $V_R \geqslant$ 50 V with $-dI_T/dt$ = 50 A/μs; dV_D/dt = 25 V/μs; T_j = 125 °C | t_q | < | 25 μs

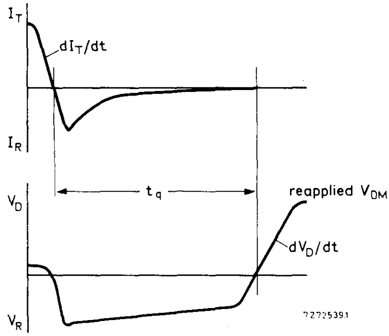


Fig. 3 Circuit-commutated turn-off time definitions.

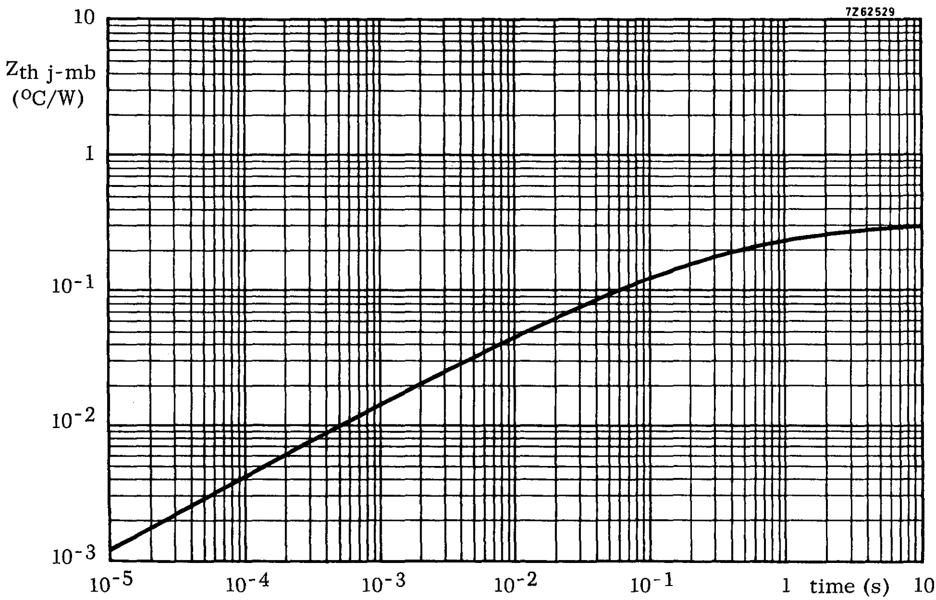


Fig. 4.

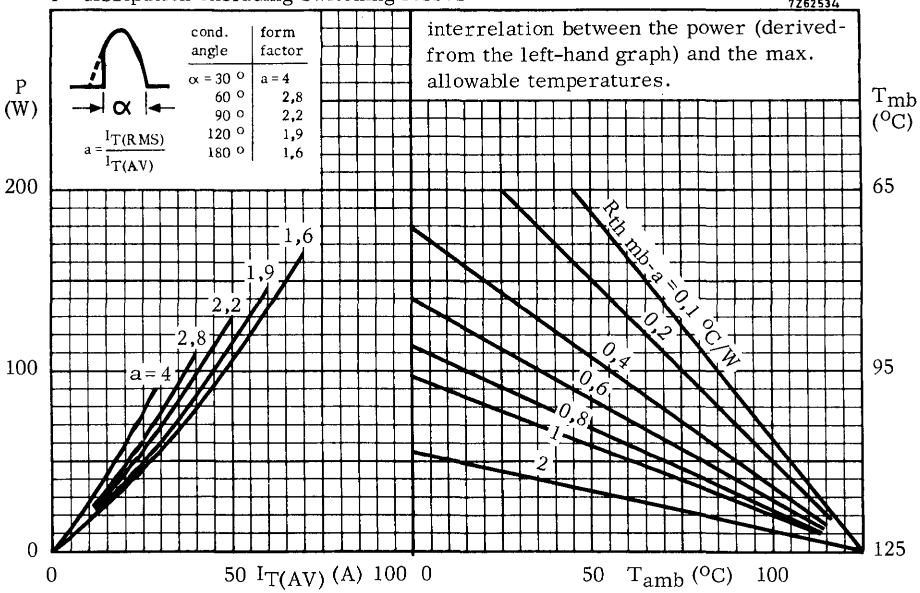
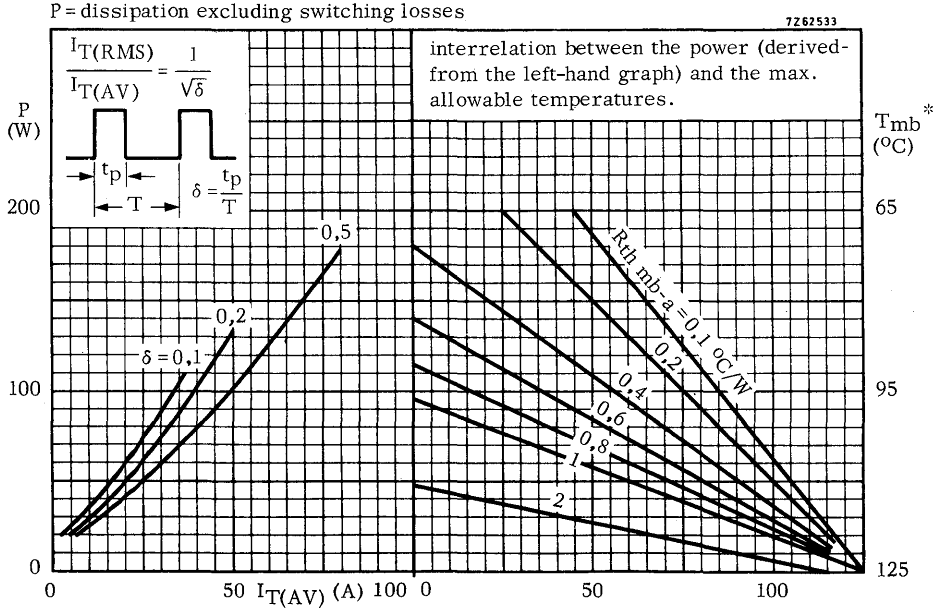


Fig. 5.



* T_{mb}-scale is for comparison purposes only and is correct only for $R_{th\ mb-a} \leq 1{,}0$ °C/W.

Fig. 6.

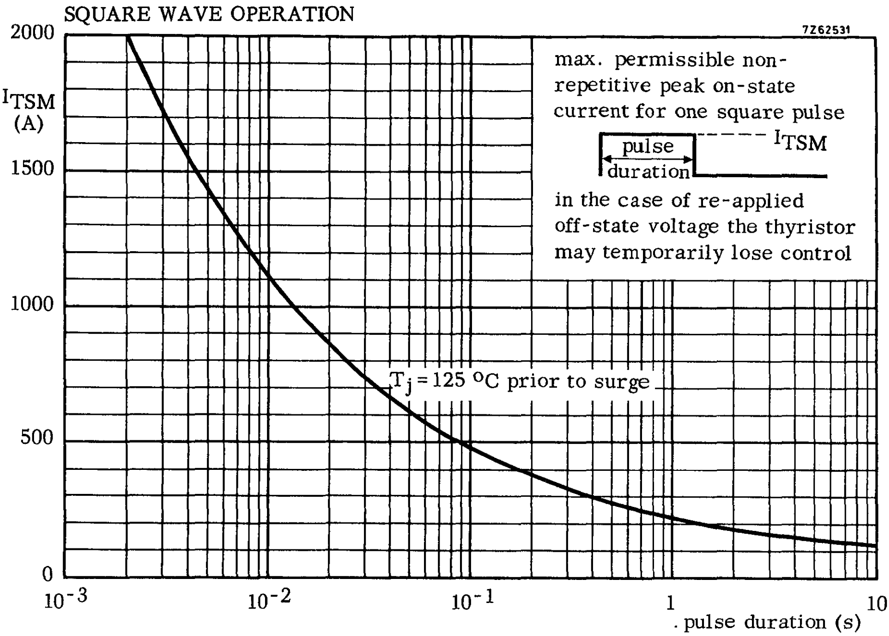

SQUARE WAVE OPERATION
7Z62531
2000
ITSM
(A)
1500
1000
500
0
10-3
10-2
10-1
1
10
pulse duration (s)
max. permissible non-repetitive peak on-state current for one square pulse
pulse
duration
ITSM
in the case of re-applied off-state voltage the thyristor may temporarily lose control
Tj = 125 °C prior to surge

Fig. 7.

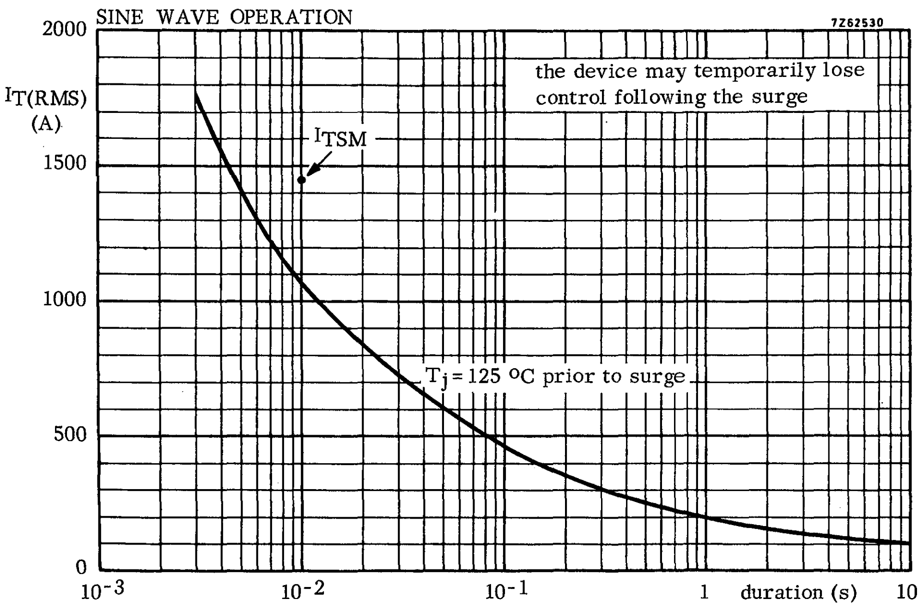

SINE WAVE OPERATION
7Z62530
2000
IT(RMS)
(A)
1500
1000
500
0
10-3
10-2
10-1
1
duration (s)
10
the device may temporarily lose control following the surge
ITSM
Tj = 125 °C prior to surge

Fig. 8.

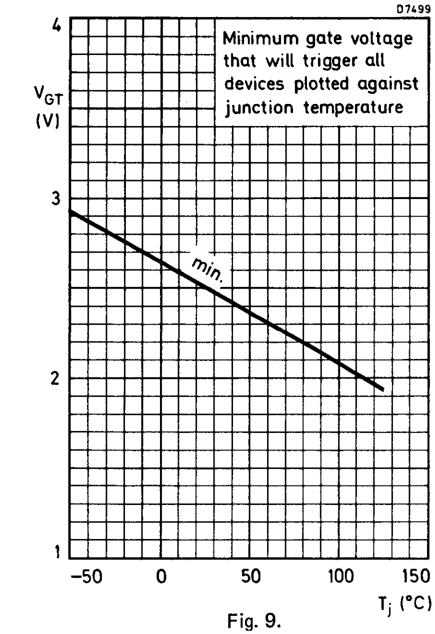


Fig. 9.

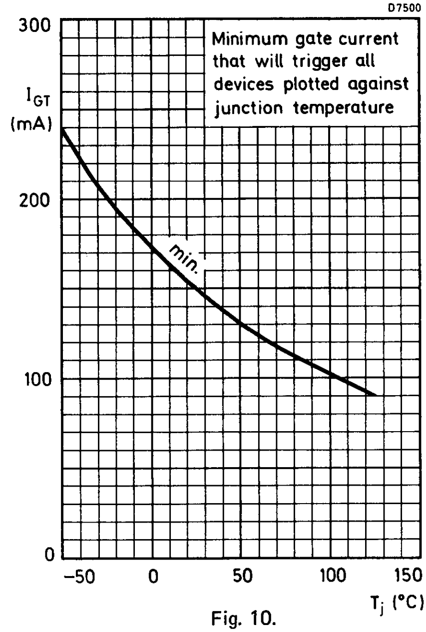


Fig. 10.

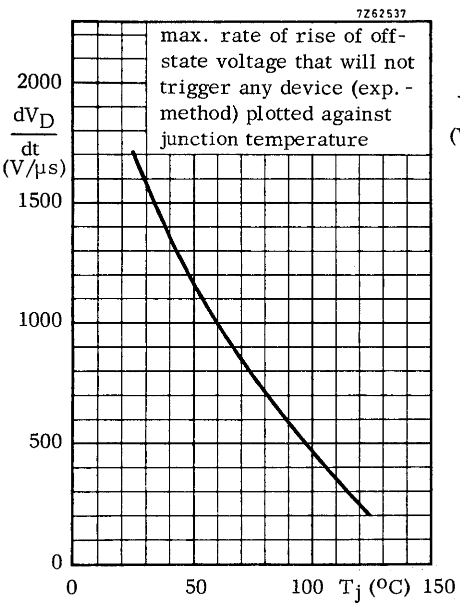


Fig. 11.

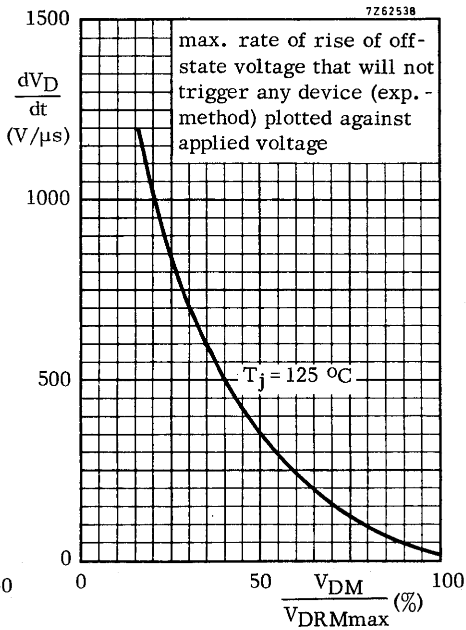


Fig. 12.

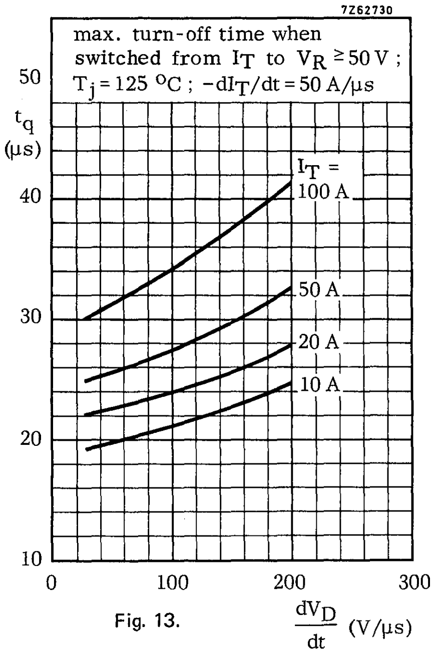


Fig. 13.

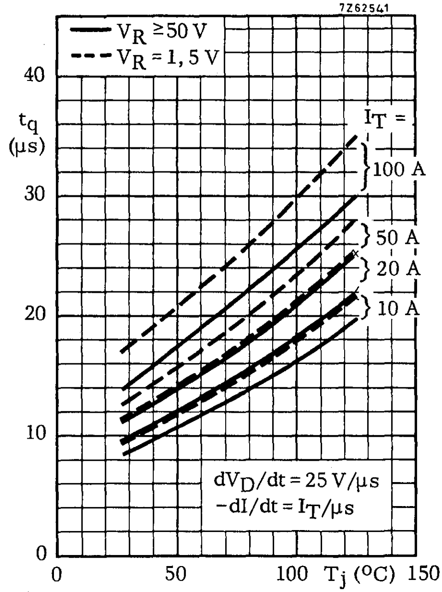


Fig. 14.

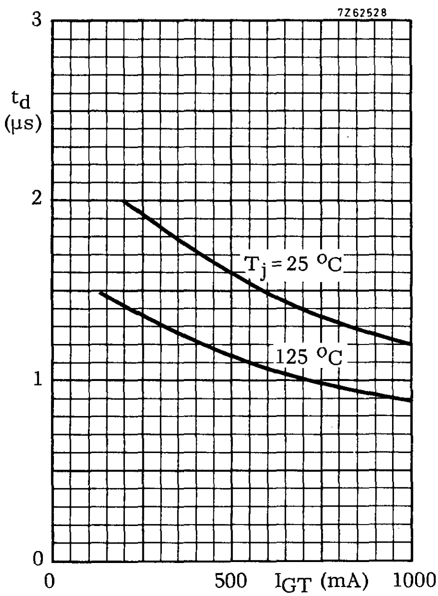


Fig. 15.

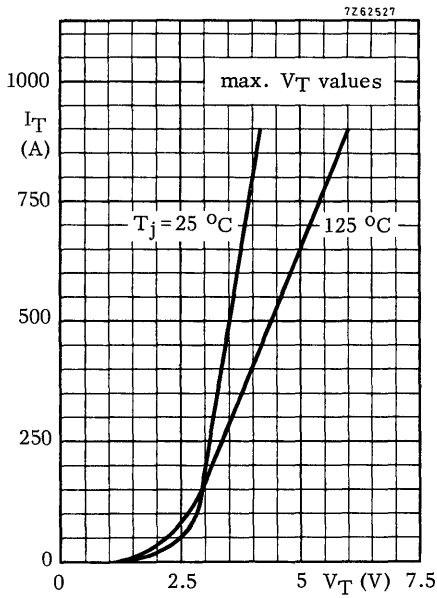


Fig. 16.

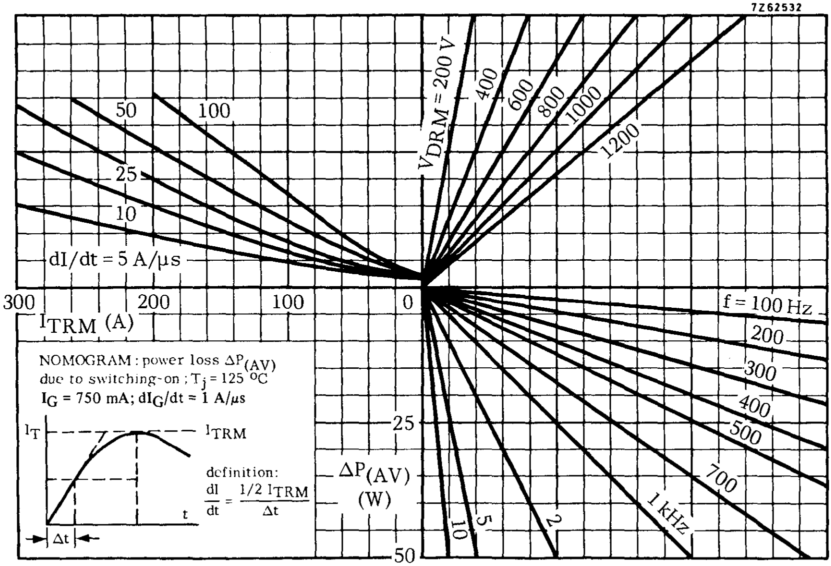

7Z62532
dI/dt = 5 A/µs
10
25
50
100
VDRM = 200 V
400
600
800
1000
1200
300
200
100
0
ITRM (A)
f = 100 Hz
200
300
400
500
700
1 kHz
2
5
10
25
50
ΔP(AV) (W)
NOMOGRAM : power loss ΔP(AV) due to switching-on ; Tj = 125 °C
IG = 750 mA; dIG/dt = 1 A/µs
IT
ITRM
t
Δt
definition:
dI/dt = 1/2 ITRM / Δt

Fig. 17.

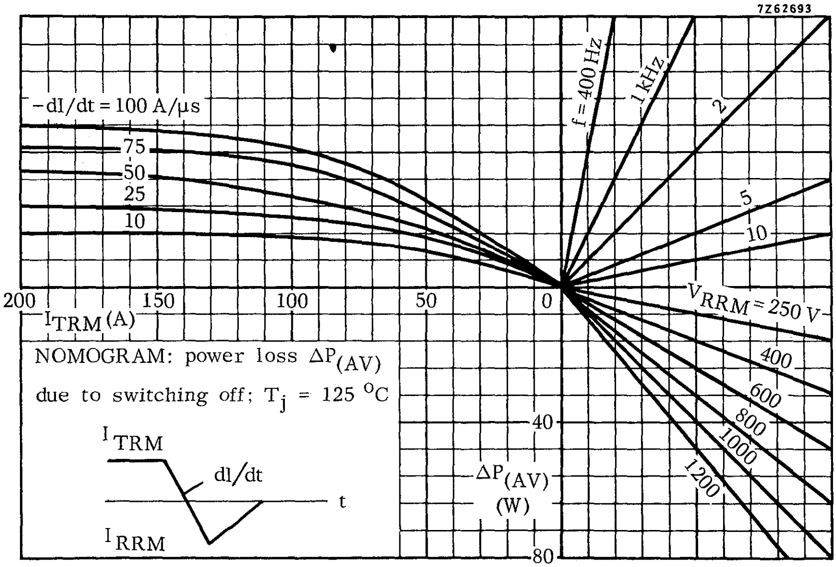
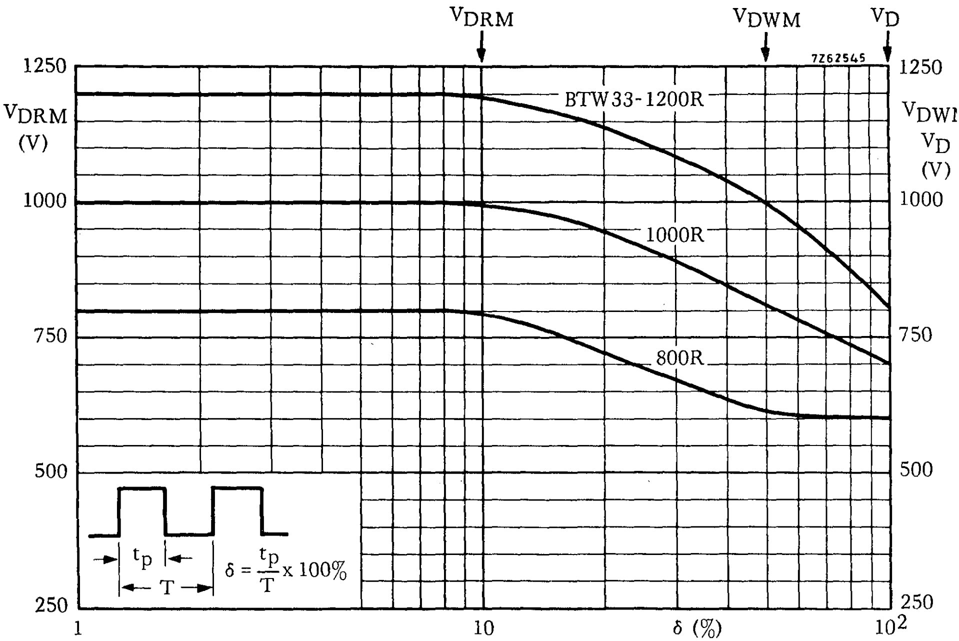
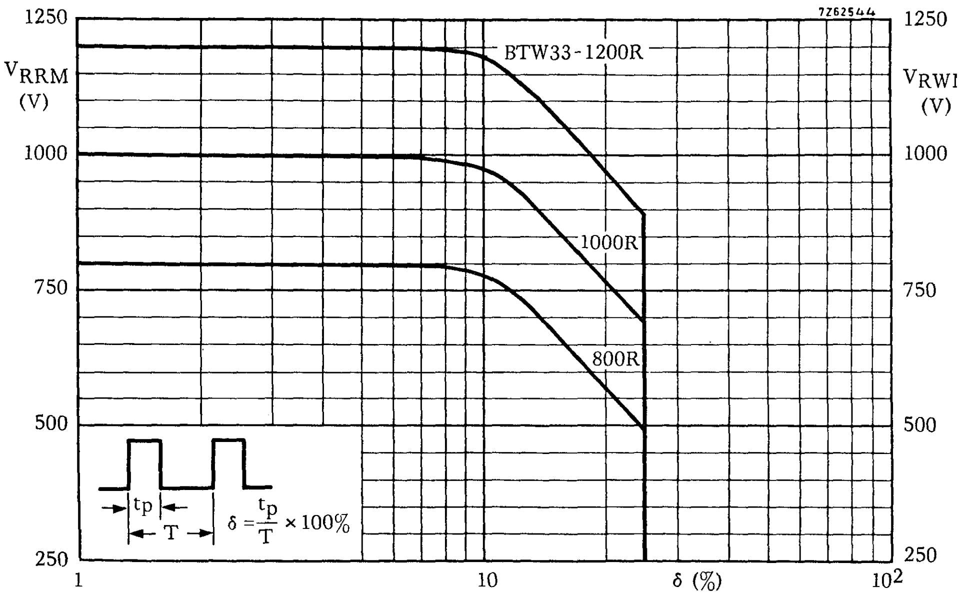

7Z62693
−dI/dt = 100 A/µs
75
50
25
10
f = 400 Hz
1 kHz
2
5
10
VRRM = 250 V
400
600
800
1000
1200
200
150
100
50
0
ITRM (A)
NOMOGRAM: power loss ΔP(AV) due to switching off; Tj = 125 °C
ITRM
dI/dt
t
IRRM
40
ΔP(AV) (W)
80

Fig. 18.



V_{DRM}
V_{DWM}
V_D
7Z62545
1250
1000
750
500
250
V_{DRM} (V)
V_{DWM} V_D (V)
BTW33-1200R
1000R
800R
t_p
T
$\delta = \frac{t_p}{T} \times 100\%$
1
10
δ (%)
10^2

Fig. 19.



7Z62544
1250
1000
750
500
250
V_{RRM} (V)
V_{RWM} (V)
BTW33-1200R
1000R
800R
t_p
T
$\delta = \frac{t_p}{T} \times 100\%$
1
10
δ (%)
10^2

Fig. 20.

THYRISTORS

Also available to BS9341-F082

Silicon thyristors in metal envelopes, intended for use in power control circuits (e.g. light and motor control) and power switching systems.
The series consists of reverse polarity types (anode to stud) identified by a suffix R: BTW38-600R to 1200R.

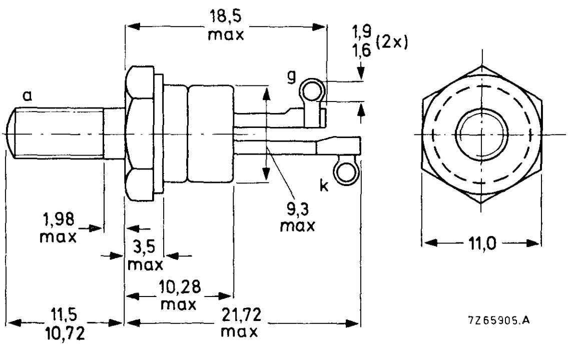
QUICK REFERENCE DATA

			BTW38-600R	800R	1000R	1200R	
Repetitive peak voltages	V_{DRM}/V_{RRM}	max.	600	800	1000	1200	V
Average on-state current	$I_{T(AV)}$	max.				10	A
R.M.S. on-state current	$I_{T(RMS)}$	max.				16	A
Non-repetitive peak on-state current	I_{TSM}	max.				150	A

MECHANICAL DATA

Dimensions in mm

Fig. 1 TO-64: with metric M5 stud (ϕ 5 mm); e.g. BTW38-600R. ←



Net mass: 7 g
Diameter of clearance hole: max. 5,2 mm
Accessories supplied on request:
56295 (PTFE bush, 2 mica washers, plain washer, tag)
56262A (mica washer, insulating ring, plain washer)

Torque on nut: min. 0,9 Nm (9 kg cm)
max. 1,7 Nm (17 kg cm)

Supplied with device: 1 nut, 1 lock washer
Nut dimensions: across the flats; M5: 8,0 mm

RATINGS

Limiting values in accordance with the Absolute Maximum System (IEC 134)

Anode to cathode

			BTW38-600R	800R	1000R	1200R	
Non-repetitive peak voltages ($t \leqslant 10$ ms)	V_{DSM}/V_{RSM}	max.	600	800	1000	1200	V
Repetitive peak voltages	V_{DRM}/V_{RRM}	max.	600	800	1000	1200	V
Crest working voltages	V_{DWM}/V_{RWM}	max.	400	600	700	800	V *

Average on-state current (averaged over any 20 ms period) up to T_{mb} = 85 °C	$I_{T(AV)}$	max.	10	A
R.M.S. on-state current	$I_{T(RMS)}$	max.	16	A
Repetitive peak on-state current	I_{TRM}	max.	75	A
Non-repetitive peak on-state current; t = 10 ms; half sine-wave; T_j = 125 °C prior to surge; with reapplied V_{RWMmax}	I_{TSM}	max.	150	A
I^2t for fusing (t = 10 ms)	I^2t	max.	112	A^2s
Rate of rise of on-state current after triggering with I_G = 250 mA to I_T = 25 A; dI_G/dt = 0,25 A/µs	dI_T/dt	max.	50	A/µs

Gate to cathode

Average power dissipation (averaged over any 20 ms period)	$P_{G(AV)}$	max.	0,5	W
Peak power dissipation	P_{GM}	max.	5	W

Temperatures

Storage temperature	T_{stg}		−55 to +125	°C
Junction temperature	T_j	max.	125	°C

THERMAL RESISTANCE

From junction to mounting base	$R_{th\ j\text{-}mb}$	=	1,8	°C/W
From mounting base to heatsink with heatsink compound	$R_{th\ mb\text{-}h}$	=	0,5	°C/W
From junction to ambient in free air	$R_{th\ j\text{-}a}$	=	45	°C/W
Transient thermal impedance (t = 1 ms)	$Z_{th\ j\text{-}mb}$	=	0,1	°C/W

OPERATING NOTE

The terminals should neither be bent nor twisted; they should be soldered into the circuit so that there is no strain on them.

During soldering the heat conduction to the junction should be kept to a minimum.

* To ensure thermal stability: $R_{th\ j\text{-}a} < 4$ °C/W (d.c. blocking) or < 8 °C/W (a.c.). For smaller heatsinks $T_{j\ max}$ should be derated. For a.c. see Fig. 3.

CHARACTERISTICS

Anode to cathode

On-state voltage $I_T = 20$ A; $T_j = 25$ °C	V_T	<	2 V *
Rate of rise of off-state voltage that will not trigger any device; exponential method; $V_D = 2/3\ V_{DRMmax}$; $T_j = 125$ °C	dV_D/dt	<	50 V/μs
Reverse current $V_R = V_{RWMmax}$; $T_j = 125$ °C	I_R	<	3 mA
Off-state current $V_D = V_{DWMmax}$; $T_j = 125$ °C	I_D	<	3 mA
Latching current; $T_j = 25$ °C	I_L	<	150 mA
Holding current; $T_j = 25$ °C	I_H	<	75 mA

Gate to cathode

Voltage that will trigger all devices $V_D = 6$ V; $T_j = 25$ °C	V_{GT}	>	1,5 V
Voltage that will not trigger any device $V_D = V_{DRMmax}$; $T_j = 125$ °C	V_{GD}	<	200 mV
Current that will trigger all devices $V_D = 6$ V; $T_j = 25$ °C	I_{GT}	>	50 mA

Switching characteristics

Gate-controlled turn-on time ($t_{gt} = t_d + t_r$) when switched from $V_D = 800$ V to $I_T = 25$ A; $I_{GT} = 250$ mA; $dI_G/dt = 0,25$ A/μs; $T_j = 25$ °C	t_{gt}	<	1,5 μs
	t_r	typ.	0,2 μs

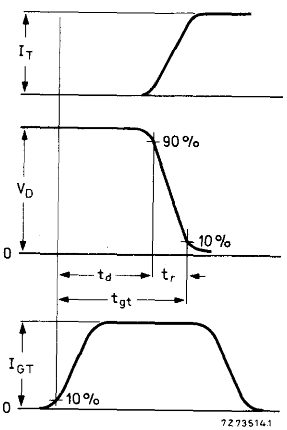


Fig. 2 Gate-controlled turn-on time definitions.

* Measured under pulse conditions to avoid excessive dissipation.

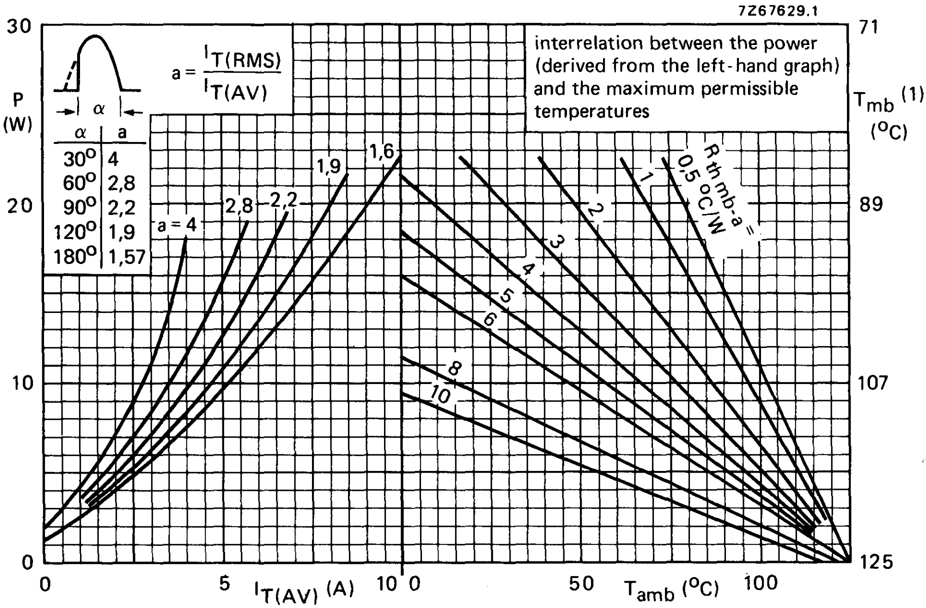


Fig. 3 (1) T_{mb}-scale is for comparison purposes only and is correct only for $R_{th\,mb\text{-}a} \leq 6$ °C/W.

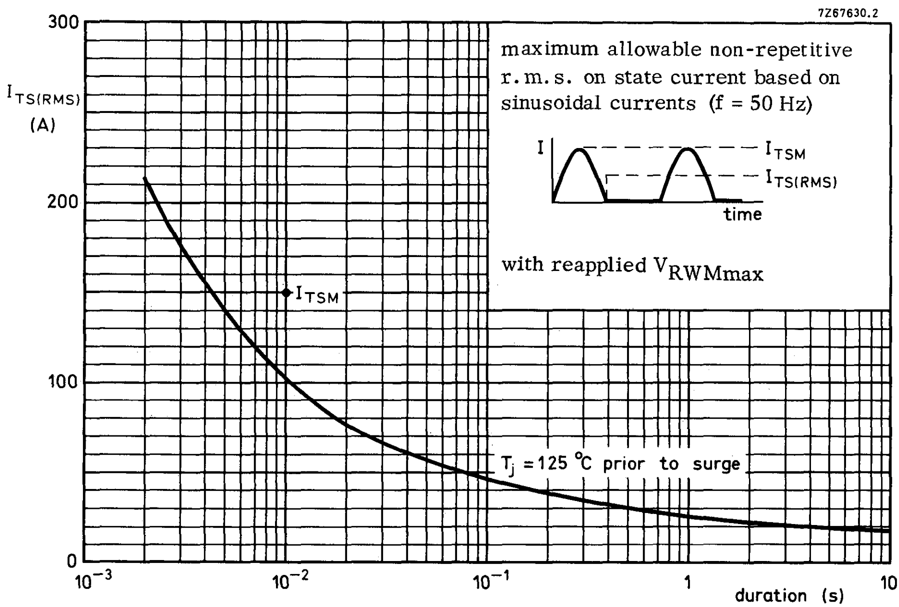


Fig. 4.

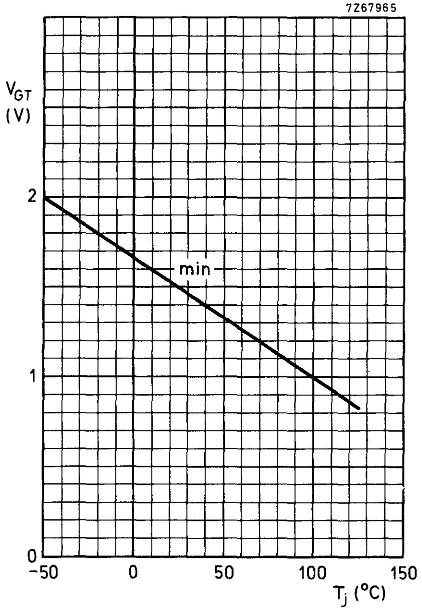


Fig. 5 Minimum gate voltage that will trigger all devices as a function of T_j.

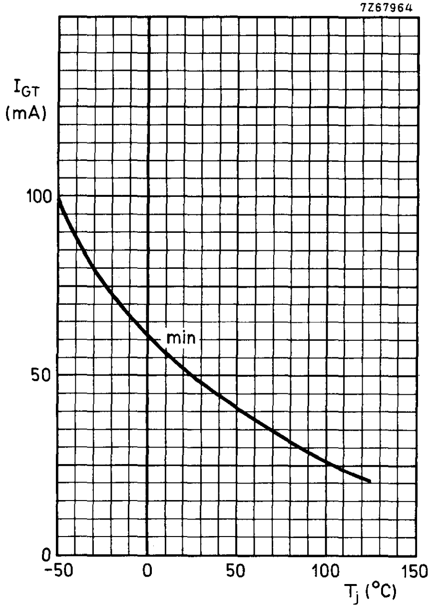


Fig. 6 Minimum gate current that will trigger all devices as a function of T_j.

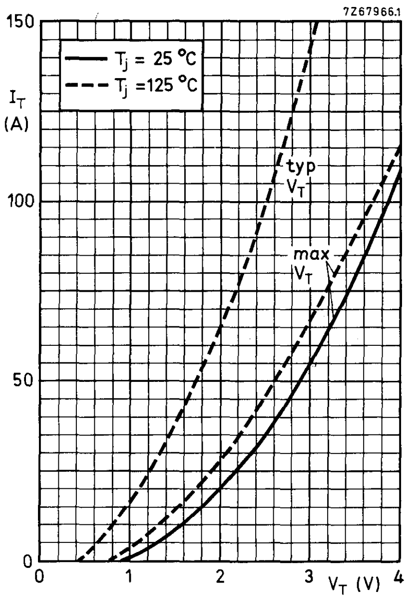


Fig. 7.

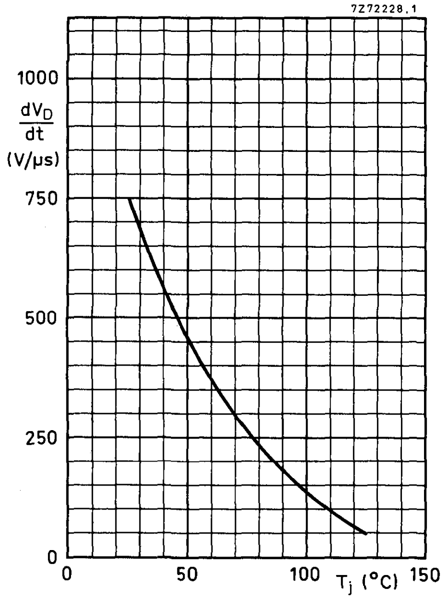


Fig. 8 Maximum rate of rise of off-state voltage that will not trigger any device (exponential method) as a function of T_j.

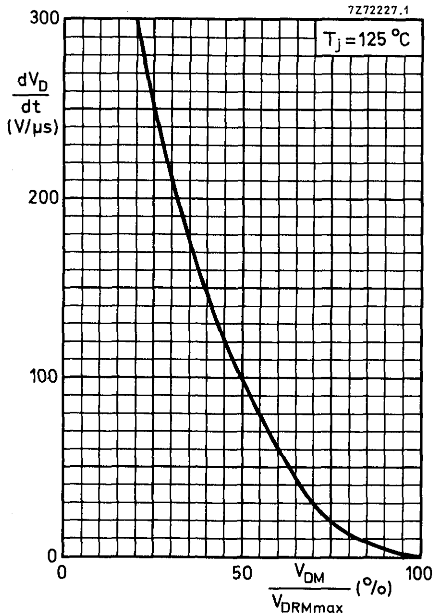
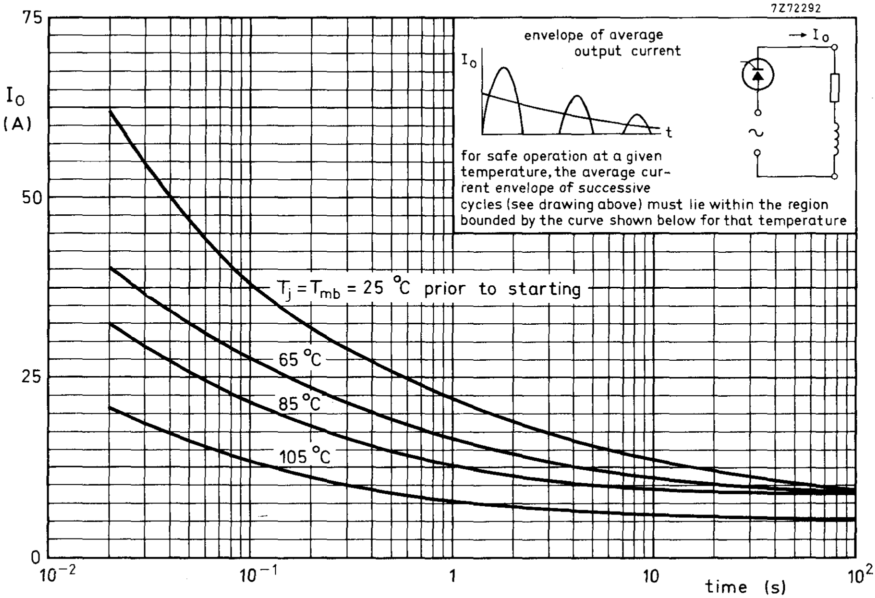


Fig. 9 Maximum rate of rise of off-state voltage that will not trigger any device (exponential method) as a function of applied voltage.



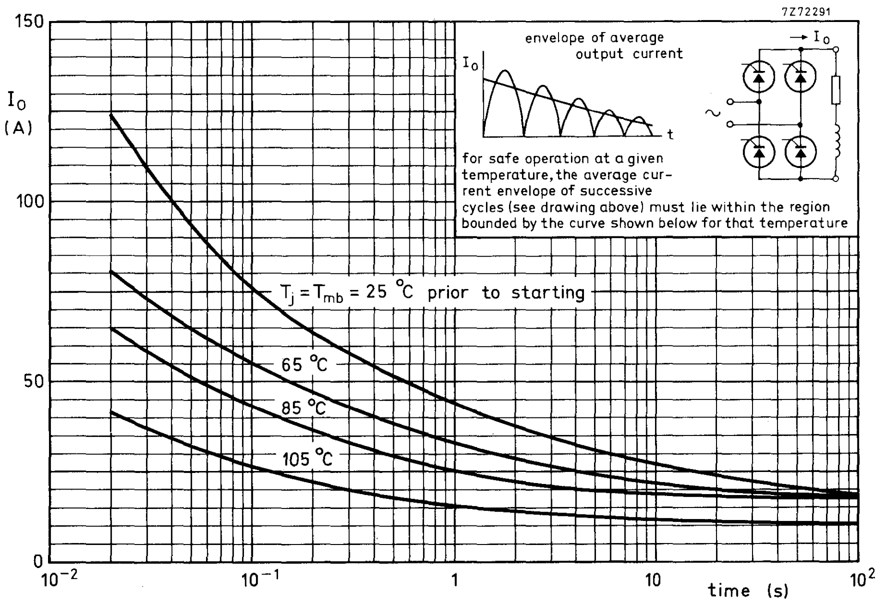


Fig. 10 Limits for starting or inrush currents.

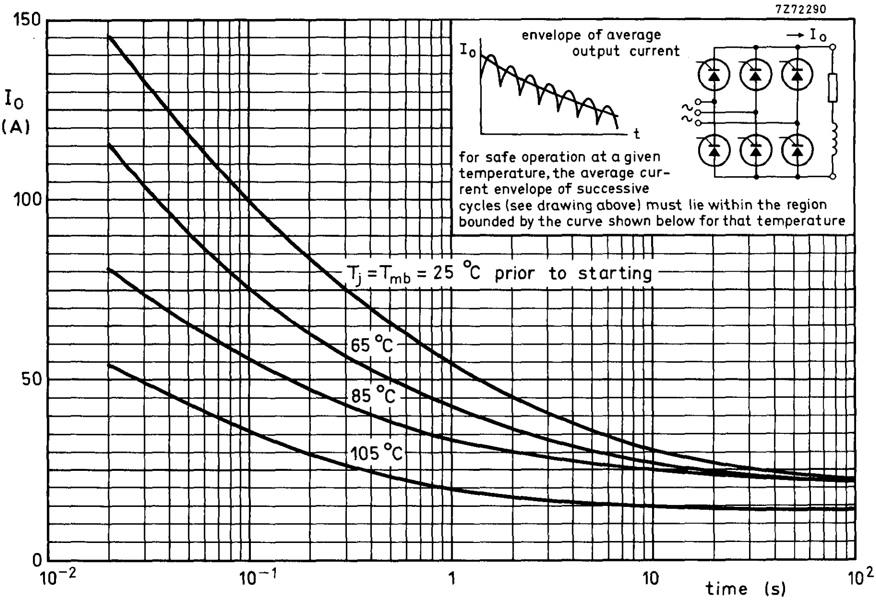


Fig. 11 Limits for starting or inrush currents.

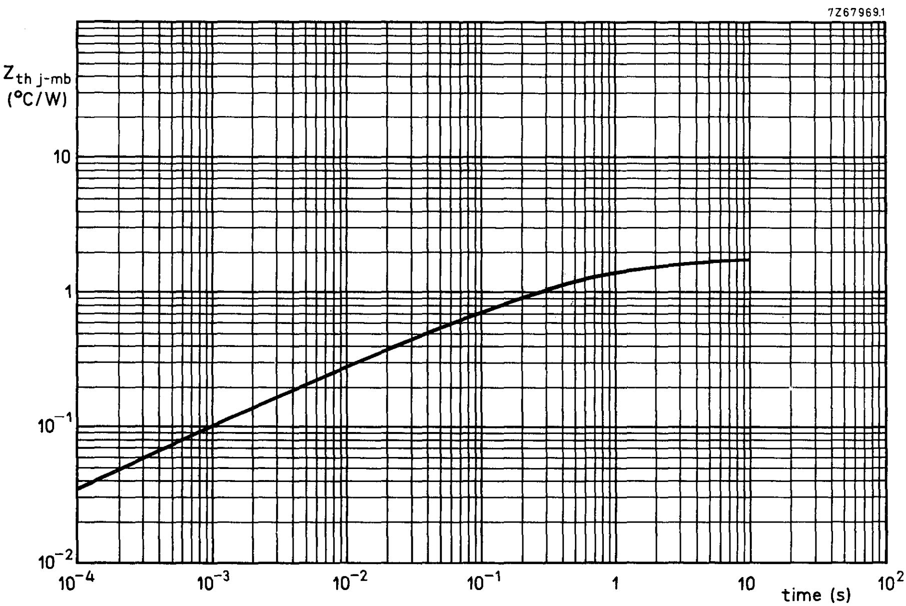


Fig. 12.

THYRISTORS

Also available to BS9341-F083

Silicon thyristors in metal envelopes, intended for use in power control applications in general, and lighting control (in a.c. controller circuit) up to 2,5 kW in particular. A feature of the thyristors is their high surge rating.
The series consists of reverse polarity types (anode to stud) identified by a suffix R: BTW40-400R to 800R.

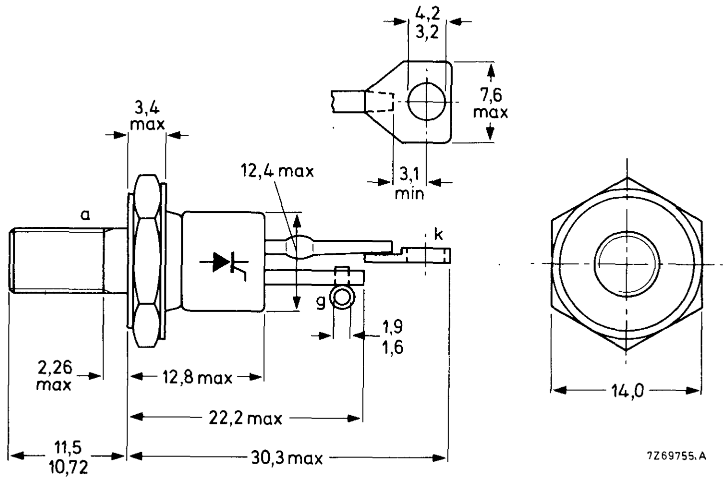
QUICK REFERENCE DATA

			BTW40-400R	600R	800R	
Repetitive peak voltages	V_{DRM}/V_{RRM}	max.	400	600	800	V
Average on-state current	$I_{T(AV)}$	max.			20	A
R.M.S. on-state current	$I_{T(RMS)}$	max.			32	A
Non-repetitive peak on-state current	I_{TSM}	max.			400	A

MECHANICAL DATA

Dimensions in mm

Fig. 1 TO-48: with metric M6 stud (ϕ 6 mm); e.g. BTW40-400R.
Types with ¼ in x 28 UNF stud (ϕ 6,35 mm) are available on request. These are indicated by the suffix U: e.g. BTW40-400RU.



Net mass: 14 g
Diameter of clearance hole: max. 6,5 mm
Accessories supplied on request: 56264A
(mica washer, insulating ring, soldering tag)

Torque on nut: min. 1,7 Nm (17 kg cm)
max. 3,5 Nm (35 kg cm)
Supplied with the device:
1 nut, 1 lock washer
Nut dimensions across the flats;
M6: 10 mm
¼ in x 28 UNF: 11,1 mm

RATINGS

Limiting values in accordance with the Absolute Maximum System (IEC 134)

Anode to cathode

			BTW40-400R	600R	800R	
Non-repetitive peak voltages ($t \leq 10$ ms)	V_{DSM}/V_{RSM}	max.	400	600	800	V
Repetitive peak voltages	V_{DRM}/V_{RRM}	max.	400	600	800	V
Crest working voltages	V_{DWM}/V_{RWM}	max.	300	400	600	V *

Average on-state current (averaged over any 20 ms period) up to T_{mb} = 85 °C	$I_{T(AV)}$	max.	20	A
R.M.S. on-state current	$I_{T(RMS)}$	max.	32	A
Repetitive peak on-state current	I_{TRM}	max.	200	A
Non-repetitive peak on-state current; t = 10 ms; half sine-wave; T_j = 125 °C prior to surge; with reapplied V_{RWMmax}	I_{TSM}	max.	400	A
I^2t for fusing (t = 10 ms)	I^2t	max.	800	A^2s
Rate of rise of on-state current after triggering with I_G = 400 mA to I_T = 60 A; dI_G/dt = 0,4 A/µs	dI_T/dt	max.	100	A/µs

Gate to cathode

Reverse peak voltage	V_{RGM}	max.	10	V
Average power dissipation (averaged over any 20 ms period)	$P_{G(AV)}$	max.	1	W
Peak power dissipation	P_{GM}	max.	5	W

Temperatures

Storage temperature	T_{stg}	−55 to + 125		°C
Junction temperature	T_j	max.	125	°C

THERMAL RESISTANCE

From junction to mounting base	$R_{th\ j\text{-}mb}$	=	1	°C/W
From mounting base to heatsink with heatsink compound	$R_{th\ mb\text{-}h}$	=	0,2	°C/W
Transient thermal impedance (t = 1 ms)	$Z_{th\ j\text{-}mb}$	=	0,1	°C/W

OPERATING NOTE

The terminals should neither be bent not twisted; they should be soldered into the circuit so that there is no strain on them.
During soldering the heat conduction to the junction should be kept to a minimum.

* To ensure thermal stability: $R_{th\ j\text{-}a} < 6{,}5$ °C/W (d.c. blocking) or < 13 °C/W (a.c.). For smaller heatsinks $T_{j\ max}$ should be derated. For a.c. see Fig. 3.

CHARACTERISTICS

Anode to cathode

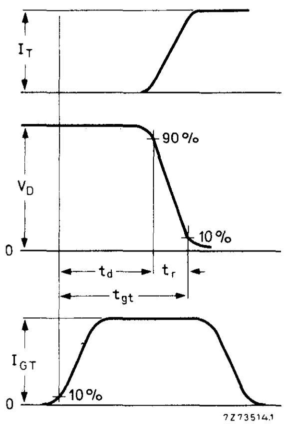
On-state voltage I_T = 50 A; T_j = 25 °C	V_T	<	2,1 V *
Rate of rise of off-state voltage that will not trigger any device; exponential method; V_D = 2/3 V_{DRMmax}; T_j = 125 °C	dV_D/dt	<	100 V/µs
Reverse current $V_R = V_{RWMmax}$; T_j = 125 °C	I_R	<	3 mA
Off-state current $V_D = V_{DWMmax}$; T_j = 125 °C	I_D	<	3 mA
Latching current; T_j = 25 °C	I_L	<	150 mA
Holding current; T_j = 25 °C	I_H	<	75 mA

Gate to cathode

Voltage that will trigger all devices V_D = 6 V; T_j = 25 °C	V_{GT}	>	1,5 V
Voltage that will not trigger any device $V_D = V_{DRMmax}$; T_j = 125 °C	V_{GD}	<	200 mV
Current that will trigger all devices V_D = 6 V; T_j = 25 °C	I_{GT}	>	75 mA

Switching characteristics ←

Gate-controlled turn-on time ($t_{gt} = t_d + t_r$) when switched from $V_D = V_{DWMmax}$ to I_T = 100 A; I_{GT} = 400 mA; dI_G/dt = 1 A/µs; T_j = 25 °C	t_{gt}	<	1 µs
	t_r	<	0,5 µs



Gate-controlled turn-on time definition

*Measured under pulse conditions to avoid excessive dissipation.

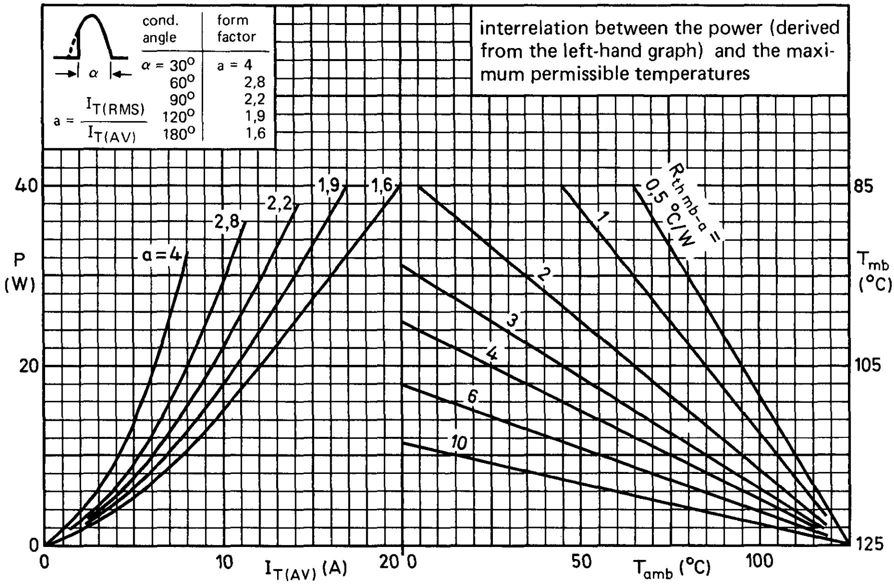

7Z72517
cond. angle
form factor
α = 30° a = 4
60° 2,8
90° 2,2
120° 1,9
180° 1,6
a = I_T(RMS) / I_T(AV)
interrelation between the power (derived from the left-hand graph) and the maximum permissible temperatures
P (W)
a=4
2,8
2,2
1,9
1,6
I_T(AV) (A)
R_th mb-a = 0,5 °C/W
1
2
3
4
6
10
T_mb (°C)
T_amb (°C)
0
10
20
40
50
100
85
105
125

Fig. 2.

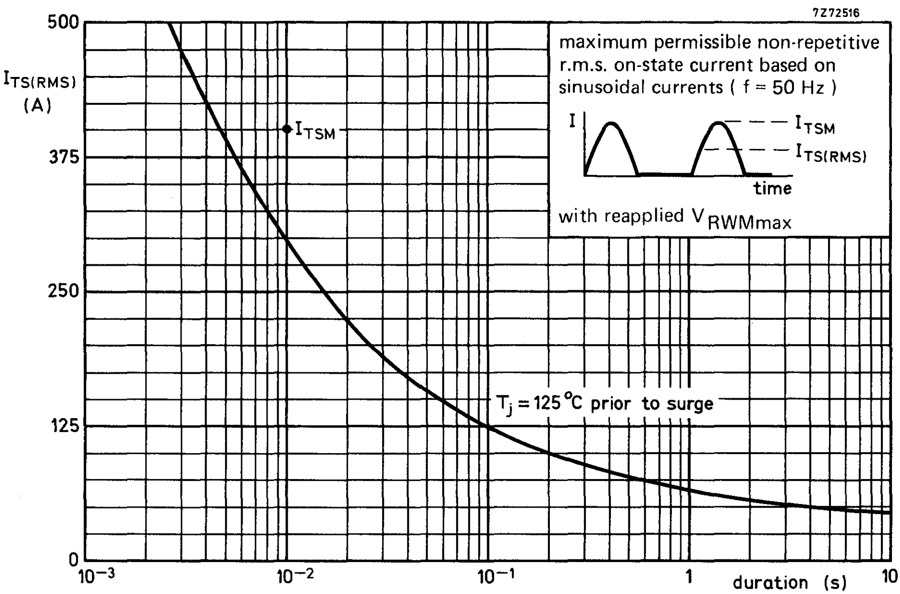

7Z72516
I_TS(RMS) (A)
500
375
250
125
0
I_TSM
maximum permissible non-repetitive r.m.s. on-state current based on sinusoidal currents (f = 50 Hz)
I
I_TSM
I_TS(RMS)
time
with reapplied V_RWMmax
T_j = 125 °C prior to surge
10^-3
10^-2
10^-1
1
10
duration (s)

Fig. 3.

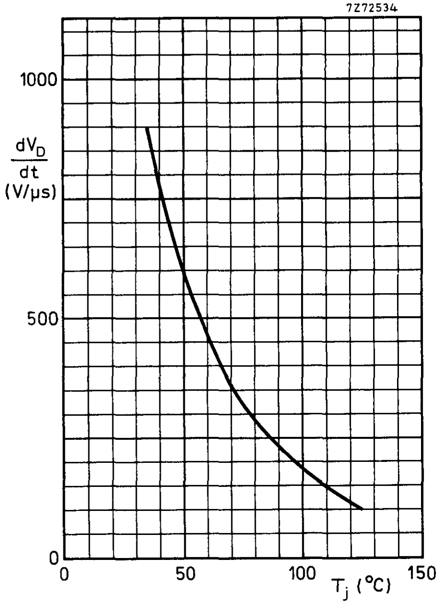


Fig. 4 Maximum rate of rise of off-state voltage that will not trigger any device (exponential method) as a function of T_j.

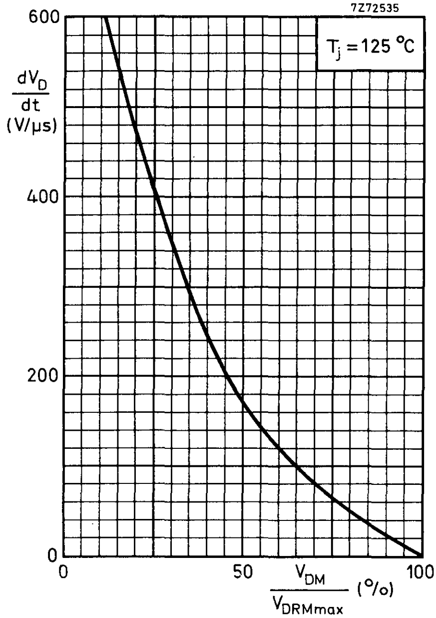


Fig. 5 Maximum rate of rise of off-state voltage that will not trigger any device (exponential method) as a function of applied voltage.

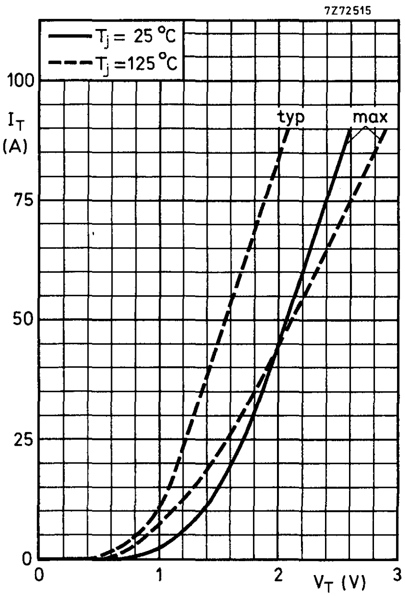


Fig. 6.

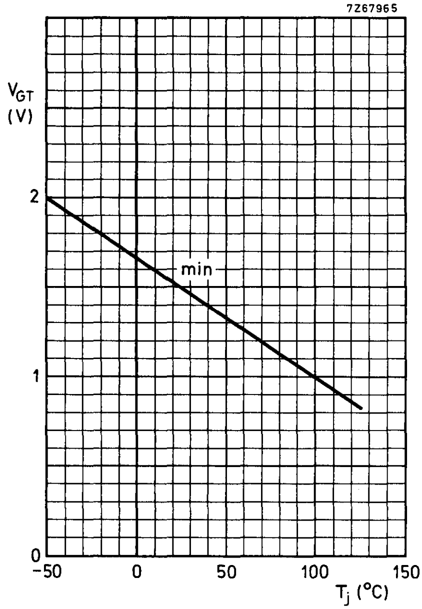


Fig. 7 Minimum gate voltage that will trigger all devices as a function of T_j.

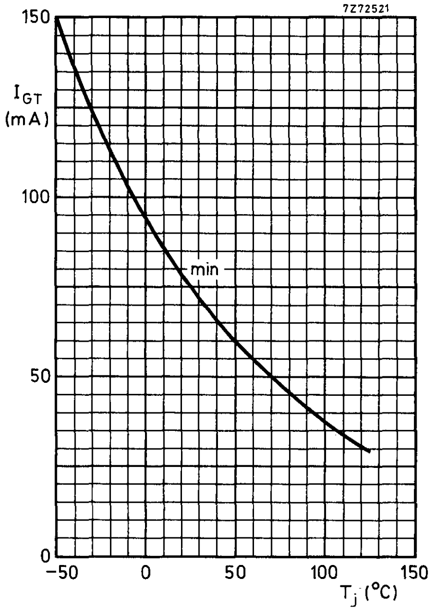


Fig. 8 Minimum gate current that will trigger all devices as a function of T_j.

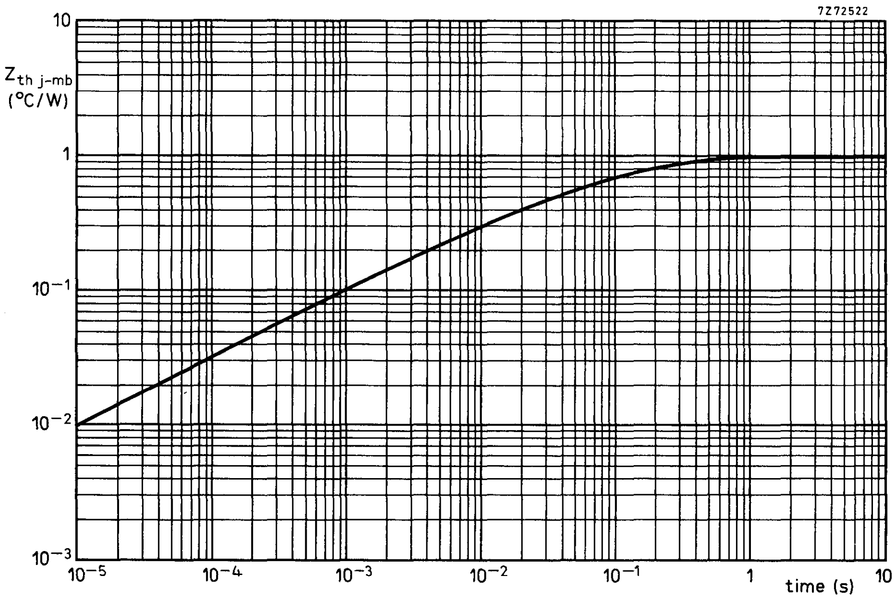


Fig. 9.

THYRISTORS

Also available to BS9341-F084

Silicon thyristors in metal envelopes with high dV_D/dt capabilities. They are intended for use in power control circuits and switching systems where high transients can occur (e.g. phase control in three-phase systems).

The series consists of reverse polarity types (anode to stud) identified by a suffix R: BTW42-600R to 1200R.

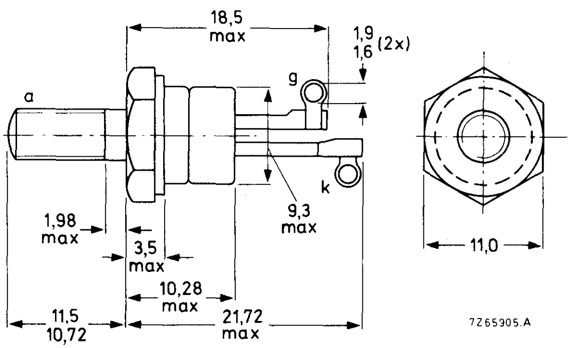
QUICK REFERENCE DATA

			BTW42-600R	800R	1000R	1200R	
Repetitive peak voltages	V_{DRM}/V_{RRM}	max.	600	800	1000	1200	V
Average on-state current			$I_{T(AV)}$		max.	10	A
R.M.S. on-state current			$I_{T(RMS)}$		max.	16	A
Non-repetitive peak on-state current			I_{TSM}		max.	150	A
Rate of rise of off-state voltage that will not trigger any device			dV_D/dt		<	200	V/μs
On request (see ordering note on page 2)			dV_D/dt		<	1000	V/μs

MECHANICAL DATA

Dimensions in mm

Fig. 1 TO-64: with metric M5 stud (ϕ5 mm); e.g. BTW42-600R. ←



Net mass: 7 g
Diameter of clearance hole: max. 5,2 mm
Accessories supplied on request:
56295 (PTFE bush, 2 mica washers, plain washer, tag)
56262A (mica washer, insulating ring, plain washer)

Supplied with device: 1 nut, 1 lock washer
Nut dimensions across the flats; M5: 8,0 mm

Torque on nut: min. 0,9 Nm (9 kg cm)
max. 1,7 Nm (17 kg cm)

RATINGS

Limiting values in accordance with the Absolute Maximum System (IEC 134)

Anode to cathode

			BTW42-600R	800R	1000R	1200R	
Non-repetitive peak voltages ($t \leqslant 10$ ms)	V_{DSM}/V_{RSM}	max.	600	800	1000	1200	V
Repetitive peak voltages	V_{DRM}/V_{RRM}	max.	600	800	1000	1200	V
Crest working voltages	V_{DWM}/V_{RWM}	max.	400	600	700	800	V *

Average on-state current (averaged over any 20 ms period) up to T_{mb} = 85 °C	$I_{T(AV)}$	max.	10	A
R.M.S. on-state current	$I_{T(RMS)}$	max.	16	A
Repetitive peak on-state current	I_{TRM}	max.	75	A
Non-repetitive peak on-state current; t = 10 ms; half sine-wave; T_j = 125 °C prior to surge; with reapplied V_{RWMmax}	I_{TSM}	max.	150	A
I^2t for fusing (t = 10 ms)	I^2t	max.	112	A^2s
Rate of rise of on-state current after triggering with I_G = 250 mA to I_T = 25 A; dI_G/dt = 0,25 A/μs	dI_T/dt	max.	50	A/μs

Gate to cathode

Average power dissipation (averaged over any 20 ms period)	$P_{G(AV)}$	max.	0,5	W
Peak power dissipation	P_{GM}	max.	5	W

Temperatures

Storage temperature	T_{stg}	−55 to + 125		°C
Junction temperature	T_j	max.	125	°C

THERMAL RESISTANCE

From junction to mounting base	$R_{th\ j\text{-}mb}$	=	1,8	°C/W
From mounting base to heatsink with heatsink compound	$R_{th\ mb\text{-}h}$	=	0,5	°C/W
From junction to ambient in free air	$R_{th\ j\text{-}a}$	=	45	°C/W
Transient thermal impedance (t = 1 ms)	$Z_{th\ j\text{-}mb}$	=	0,1	°C/W

OPERATING NOTE

The terminals should neither be bent nor twisted; they should be soldered into the circuit so that there is no strain on them.
During soldering the heat conduction to the junction should be kept to a minimum.

ORDERING NOTE

Types with dV_D/dt of 1000 V/μs are available on request. Add suffix C to the type number when ordering; e.g. BTW42-600RC.

* To ensure thermal stability: $R_{th\ j\text{-}a} < 4$ °C/W (d.c. blocking) or < 8 °C/W (a.c.). For smaller heatsinks $T_{j\ max}$ should be derated. For a.c. see Fig. 3.

CHARACTERISTICS

Anode to cathode

On-state voltage $I_T = 20$ A; $T_j = 25$ °C	V_T	<	2 V *
Rate of rise of off-state voltage that will not trigger any device; exponential method; $V_D = 2/3\ V_{DRMmax}$; $T_j = 125$ °C	dV_D/dt	<	200 V/µs
Reverse current $V_R = V_{RWMmax}$; $T_j = 125$ °C	I_R	<	3 mA
Off-state current $V_D = V_{DWMmax}$; $T_j = 125$ °C	I_D	<	3 mA
Latching current; $T_j = 25$ °C	I_L	<	150 mA
Holding current; $T_j = 25$ °C	I_H	<	75 mA

Gate to cathode

Voltage that will trigger all devices $V_D = 6$ V; $T_j = 25$ °C	V_{GT}	>	1,5 V
Voltage that will not trigger any device $V_D = V_{DRMmax}$; $T_j = 125$ °C	V_{GD}	<	200 mV
Current that will trigger all devices $V_D = 6$ V; $T_j = 25$ °C	I_{GT}	>	50 mA

Switching characteristics

Gate-controlled turn-on time ($t_{gt} = t_d + t_r$) when switched from $V_D = 800$ V to $I_T = 25$ A; $I_{GT} = 250$ mA; $dI_G/dt = 0,25$ A/µs; $T_j = 25$ °C	t_{gt}	<	1,5 µs
	t_r	typ.	0,2 µs

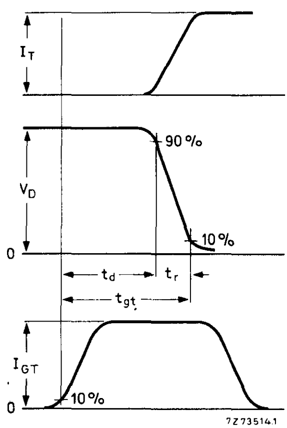
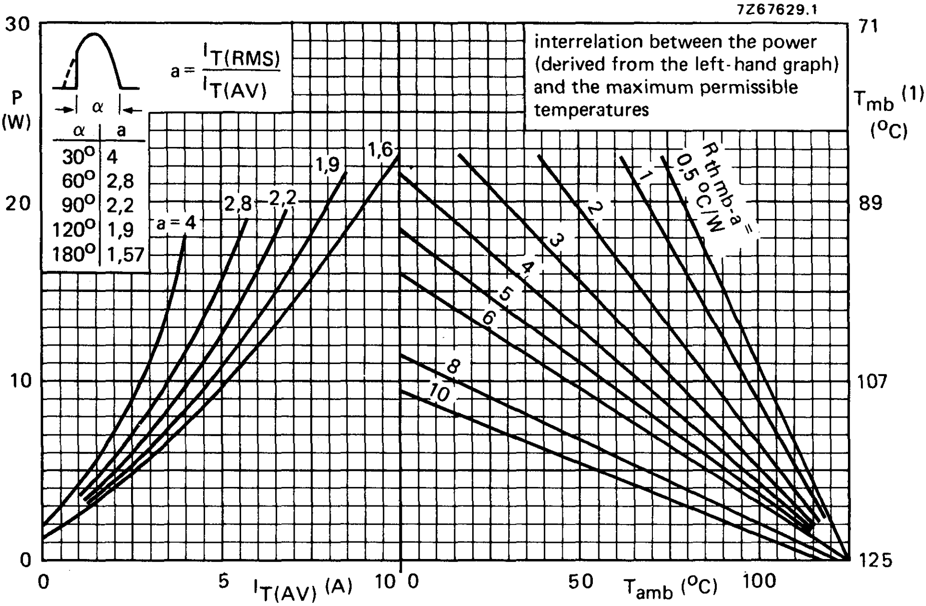


Fig. 2 Gate-controlled turn-on time definitions.

* Measured under pulse conditions to avoid excessive dissipation.



α	a
30°	4
60°	2,8
90°	2,2
120°	1,9
180°	1,57

Fig. 3 (1) T_{mb}-scale is for comparison purposes only and is correct only for $R_{th\ mb-a} \leq 6$ °C/W.

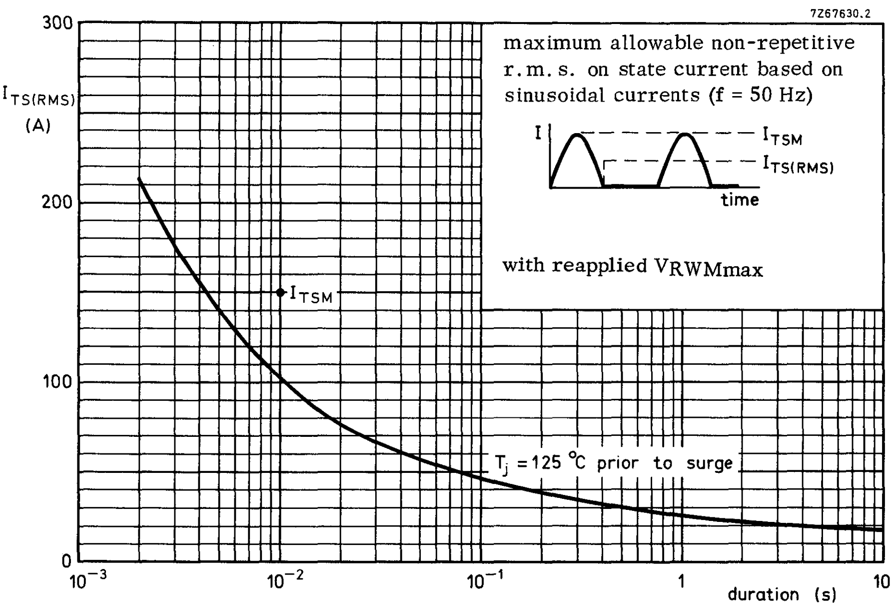


Fig. 4.

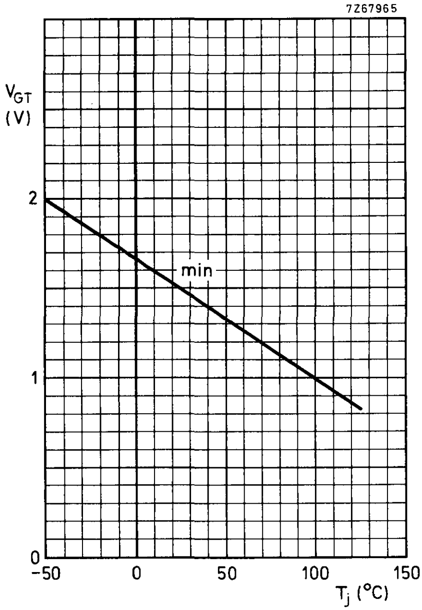


Fig. 5 Minimum gate voltage that will trigger all devices as a function of T_j.

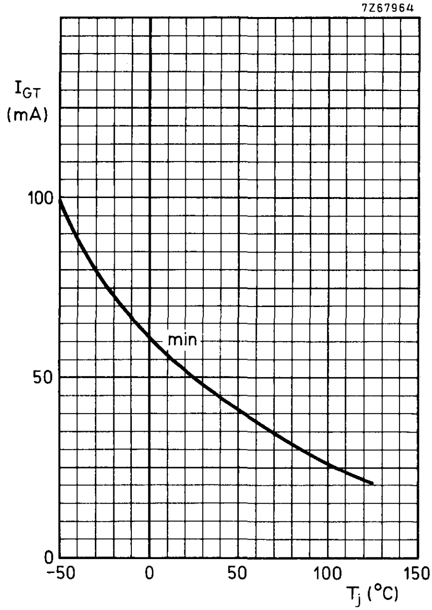


Fig. 6 Minimum gate current that will trigger all devices as a function of T_j.

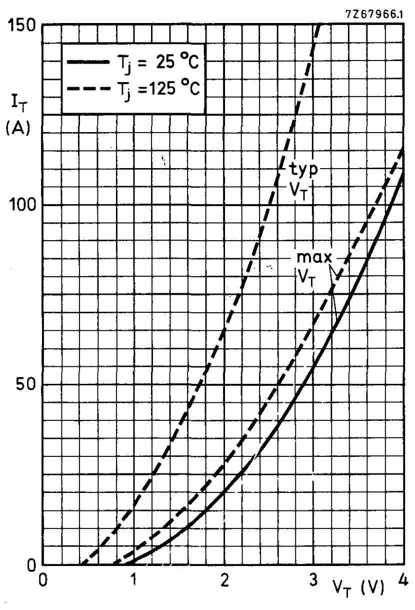


Fig. 7.

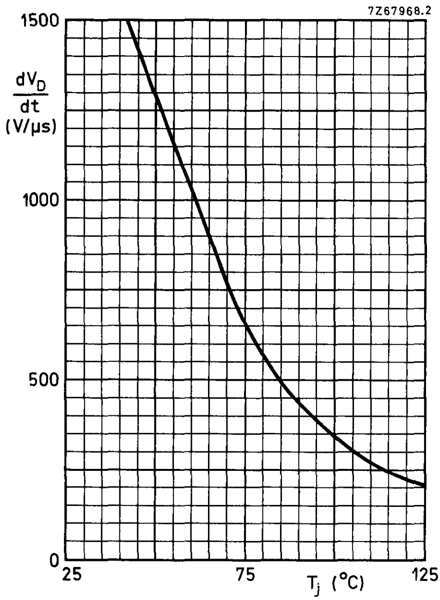


Fig. 8 Maximum rate of rise of off-state voltage that will not trigger any device (exponential method) as a function of T_j.

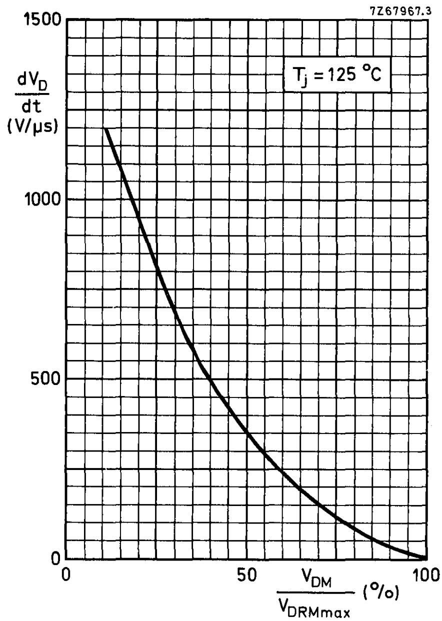
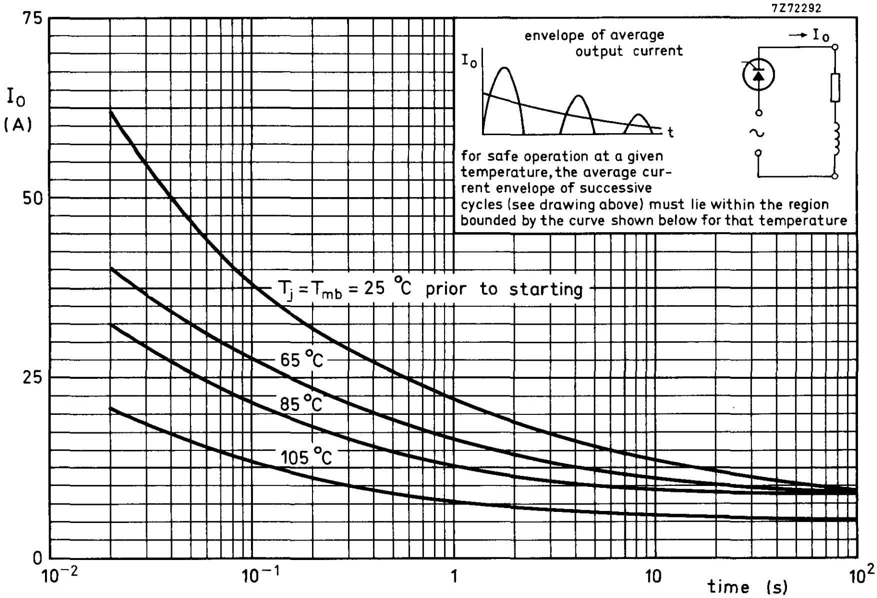


Fig. 9 Maximum rate of rise of off-state voltage that will not trigger any device (exponential method) as a function of applied voltage.



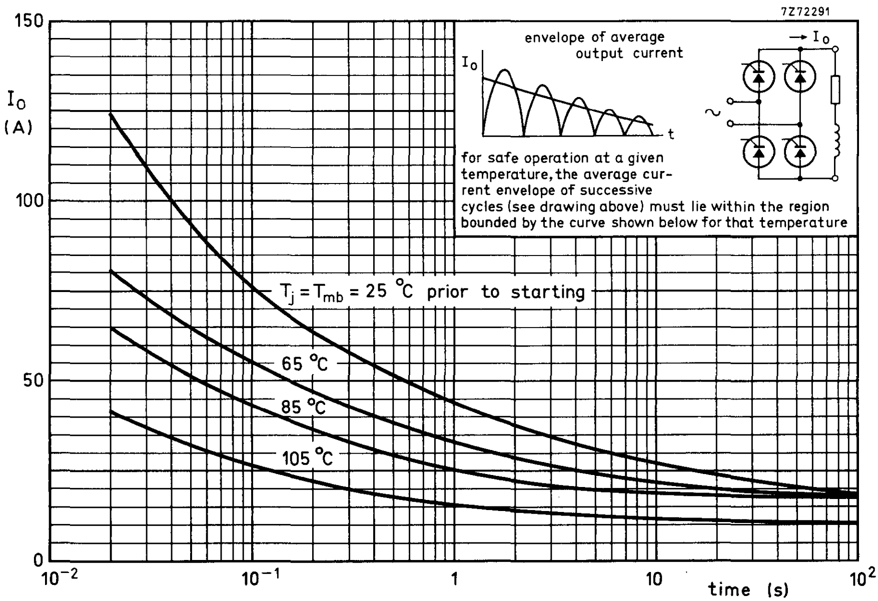


Fig. 10 Limits for starting or inrush currents.

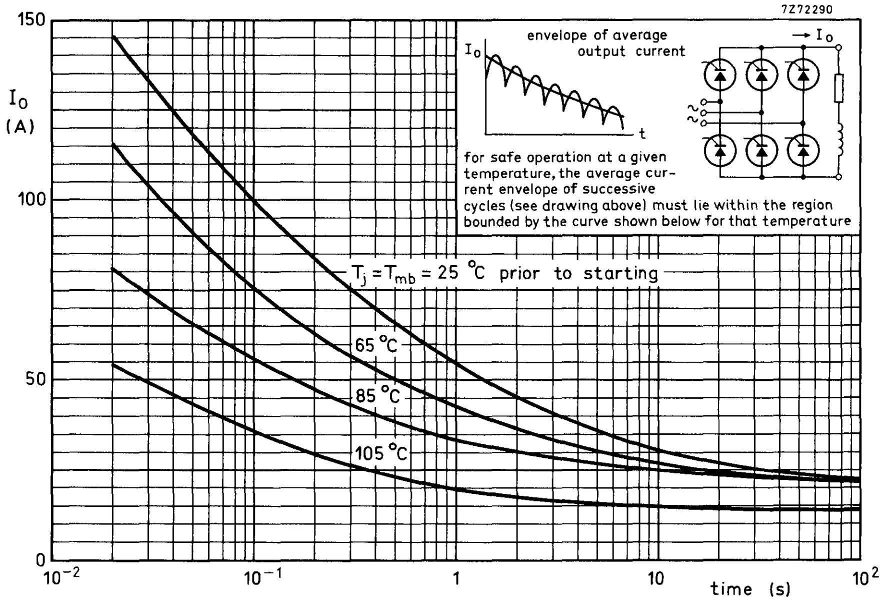


Fig. 11 Limits for starting or inrush currents.

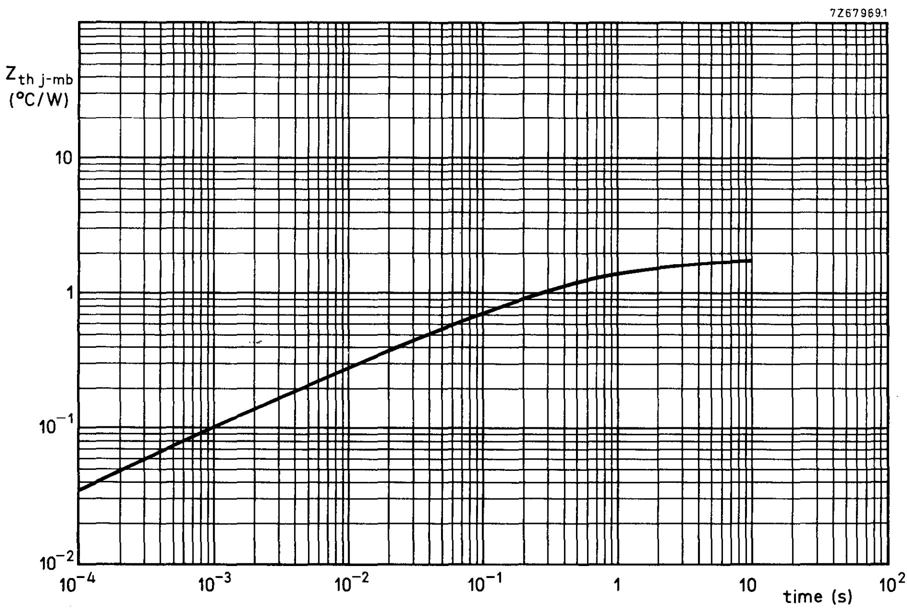


Fig. 12.

THYRISTORS

Silicon thyristors in metal envelopes, intended for power control applications.

The series consists of reverse polarity types (anode to stud) identified by a suffix R: BTW45-400R to 1200R.

QUICK REFERENCE DATA

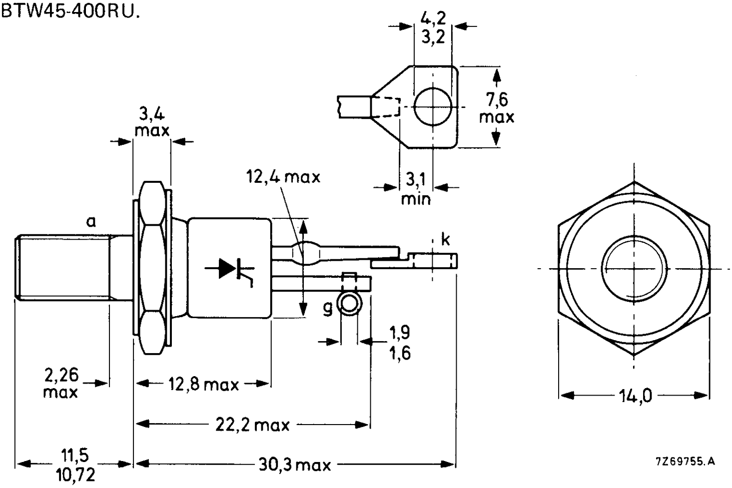
		BTW45-400R	600R	800R	1000R	1200R	
Repetitive peak voltages $V_{DRM} = V_{RRM}$	max.	400	600	800	1000	1200	V

Average on-state current	$I_{T(AV)}$	max.	16	A
R.M.S. on-state current	$I_{T(RMS)}$	max.	25	A
Non-repetitive peak on-state current	I_{TSM}	max.	300	A
Rate of rise of off-state voltage that will not trigger any device	dV_D/dt	<	200	V/μs
On request (see ordering note on page 3)	dV_D/dt	<	1000	V/μs

MECHANICAL DATA

Dimensions in mm

Fig. 1 TO-48: with metric M6 stud (ϕ 6 mm); e.g. BTW45-400R.
Types with ¼ in x 28 UNF stud (ϕ 6,35 mm) are available on request. These are indicated by the suffix U: BTW45-400RU.



Net mass: 14 g
Diameter of clearance hole: max. 6,5 mm
Accessories supplied on request: 56264A
(mica washer, insulating ring, soldering tag)

Torque on nut: min. 1,7 Nm (17 kg cm)
max. 3,5 Nm (35 kg cm)
Supplied with the device:
1 nut, 1 lock washer
Nut dimensions across the flats;
M6: 10 mm
¼ in x 28 UNF: 11,1 mm

Products approved to CECC 50 011-002, available on request

RATINGS

Limiting values in accordance with the Absolute Maximum System (IEC 134)

Anode to cathode

			BTW45-400R	600R	800R	1000R	1200R	
Non-repetitive peak voltages ($t \leqslant 10$ ms)	V_{DSM}/V_{RSM}	max.	400	600	800	1000	1200	V
Repetitive peak voltages	V_{DRM}/V_{RRM}	max.	400	600	800	1000	1200	V
Crest working voltages	V_{DWM}/V_{RWM}	max.	300	400	600	700	800	V*

Average on-state current (averaged over any 20 ms period) up to T_{mb} = 85 °C	$I_{T(AV)}$	max.	16	A
R.M.S. on-state current	$I_{T(RMS)}$	max.	25	A
Repetitive peak on-state current	I_{TRM}	max.	200	A
Non-repetitive peak on-state current; t = 10 ms; half sine-wave; T_j = 125 °C prior to surge; with reapplied $V_{RWM\,max}$	I_{TSM}	max.	300	A
I^2t for fusing (t = 10 ms)	I^2t	max.	450	A^2s
Rate of rise of on-state current after triggering with I_G = 400 mA to I_T = 60 A; dI_G/dt = 0,4 A/µs	dI_T/dt	max.	100	A/µs

Gate to cathode

Reverse peak voltage	V_{RGM}	max.	10	V
Average power dissipation (averaged over any 20 ms period)	$P_{G(AV)}$	max.	1	W
Peak power dissipation	P_{GM}	max.	5	W

Temperatures

Storage temperature	T_{stg}	−55 to +	125	°C
Junction temperature	T_j	max.	125	°C

THERMAL RESISTANCE

From junction to mounting base	$R_{th\,j\text{-}mb}$	=	1,33	°C/W
From mounting base to heatsink; with heatsink compound	$R_{th\,mb\text{-}h}$	=	0,2	°C/W
Transient thermal impedance (t = 1 ms)	$Z_{th\,j\text{-}mb}$	=	0,1	°C/W

OPERATING NOTE

The terminals should neither be bent nor twisted; they should be soldered into the circuit so that there is no strain on them.
During soldering the heat conduction to the junction should be kept to a minimum.

* To ensure thermal stability: $R_{th\,j\text{-}a} < 6,5$ °C/W (d.c. blocking) or < 13 °C/W (a.c.). For smaller heatsinks $T_{j\,max}$ should be derated. For a.c. see Fig. 2.

CHARACTERISTICS

Anode to cathode

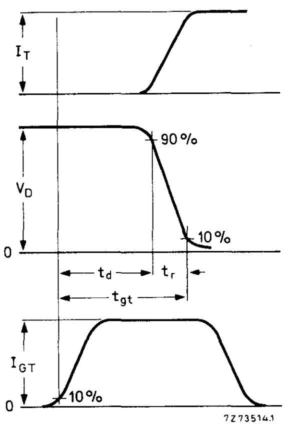
On-state voltage $I_T = 50$ A; $T_j = 25$ °C	V_T	<	2 V*
Rate of rise of off-state voltage that will not trigger any device; exponential method; $V_D = 2/3\ V_{DRM\,max}$; $T_j = 125$ °C	dV_D/dt	<	200 V/µs
Reverse current $V_R = V_{RWM\,max}$; $T_j = 125$ °C	I_R	<	3 mA
Off-state current $V_D = V_{DWM\,max}$; $T_j = 125$ °C	I_D	<	3 mA
Latching current; $T_j = 25$ °C	I_L	<	150 mA
Holding current; $T_j = 25$ °C	I_H	<	75 mA

Gate to cathode

Voltage that will trigger all devices $V_D = 6$ V; $T_j = 25$ °C	V_{GT}	>	1,5 V
Voltage that will not trigger any device $V_D = V_{DRM\,max}$; $T_j = 125$ °C	V_{GD}	<	200 mV
Current that will trigger all devices $V_D = 6$ V; $T_j = 25$ °C	I_{GT}	>	75 mA

Switching characteristics ←

Gate-controlled turn-on time ($t_{gt} = t_d + t_r$) when switched from $V_D = V_{DWM\,max}$ to $I_T = 100$ A; $I_{GT} = 400$ mA; $dI_G/dt = 1$ A/µs; $T_j = 25$ °C	t_{gt} t_r	< <	1 µs 0,5 µs



Gate-controlled turn-on time definition.

ORDERING NOTE

Types with dV_D/dt of 1000 V/µs are available on request. Add suffix C to the type number when ordering; e.g. BTW45-400RC.

*Measured under pulse conditions to avoid excessive dissipation.

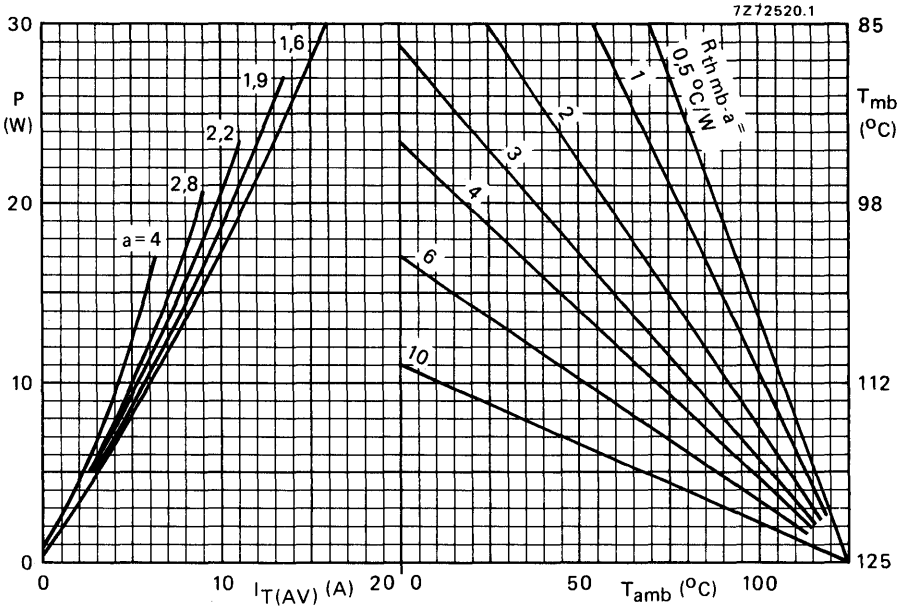

7Z72520.1
P
(W)
30
20
10
0
0
10
$I_{T(AV)}$ (A)
20
0
50
T_{amb} (°C)
100
85
98
112
125
T_{mb}
(°C)
a = 4
2,8
2,2
1,9
1,6
$R_{th\,mb-a}$ =
0,5 °C/W
1
2
3
4
6
10

Fig. 2.

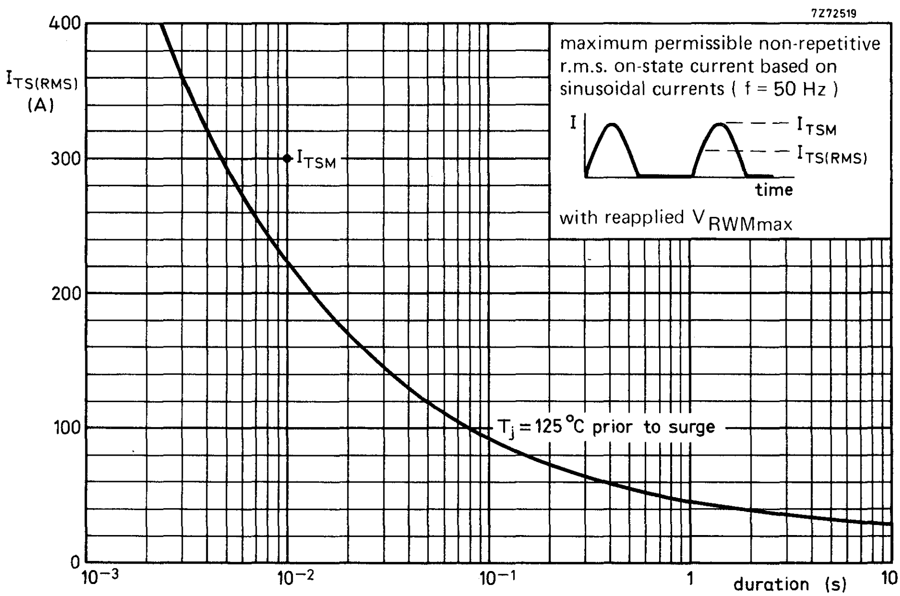

7Z72519
$I_{TS(RMS)}$
(A)
400
300
200
100
0
10^{-3}
10^{-2}
10^{-1}
1
duration (s)
10
I_{TSM}
maximum permissible non-repetitive
r.m.s. on-state current based on
sinusoidal currents (f = 50 Hz)
I
I_{TSM}
$I_{TS(RMS)}$
time
with reapplied V_{RWMmax}
T_j = 125 °C prior to surge

Fig. 3.

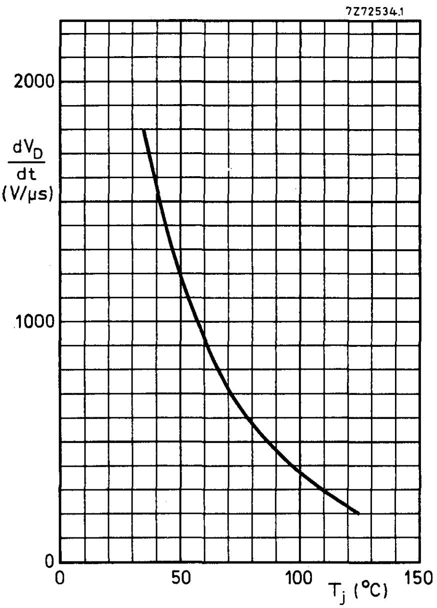


Fig. 4 Maximum rate of rise of off-state voltage that will not trigger any device (exponential method) as a function of T_j.

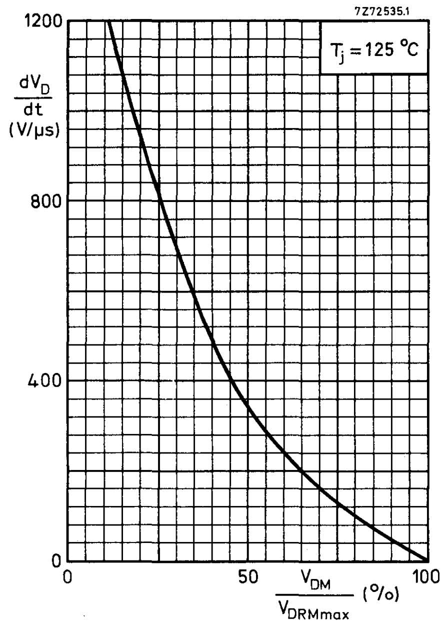


Fig. 5 Maximum rate of rise of off-state voltage that will not trigger any device (exponential method) as a function of applied voltage.

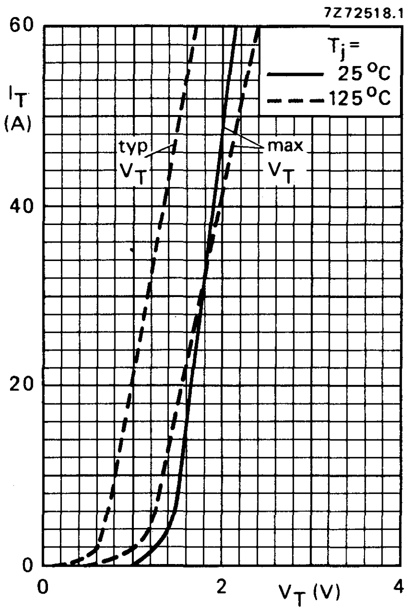


Fig. 6.

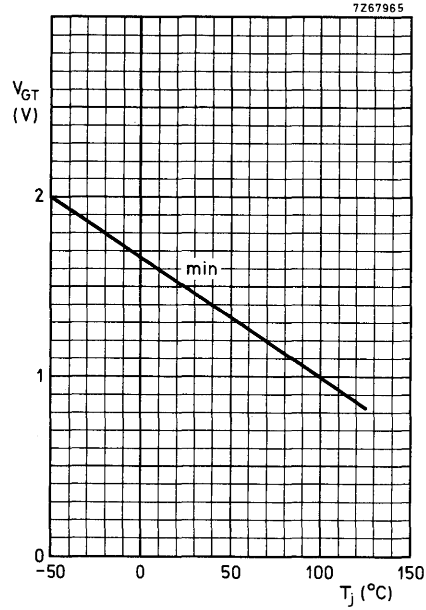


Fig. 7 Minimum gate voltage that will trigger all devices as a function of T_j.

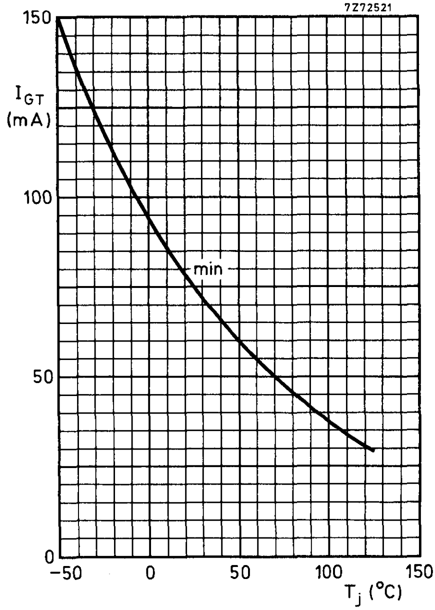


Fig. 8 Minimum gate current that will trigger all devices as a function of T_j.

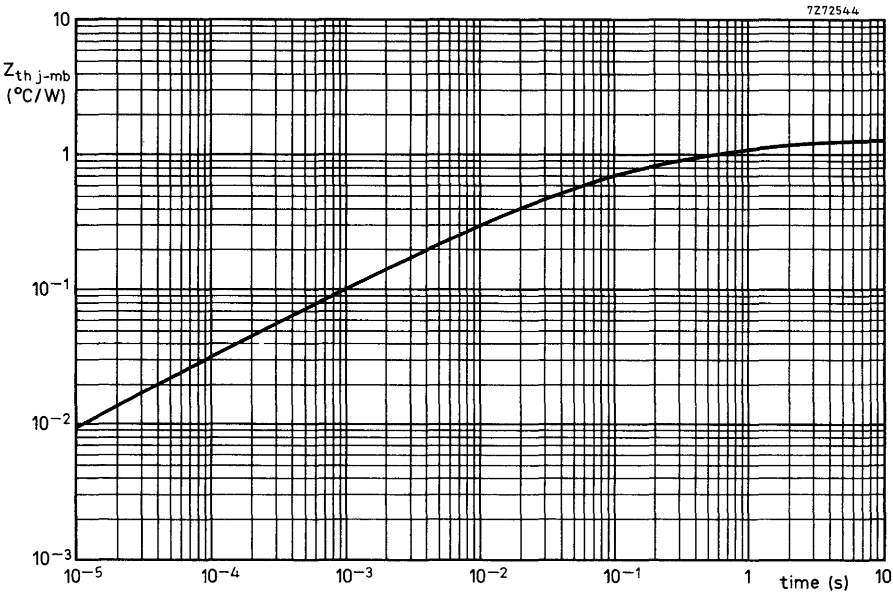


Fig. 9.

THYRISTORS

Silicon thyristors in metal envelopes, primarily intended for three-phase mains operation. The series consists of reverse polarity types (anode to stud) identified by a suffix R: BTW47-800R to 1600R.

QUICK REFERENCE DATA

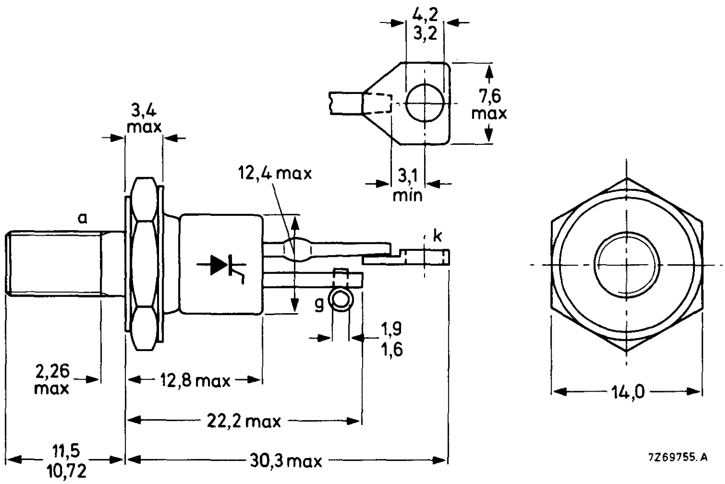
		BTW47-800R	1000R	1200R	1400R	1600R	
Repetitive peak voltages $V_{DRM} = V_{RRM}$	max.	800	1000	1200	1400	1600	V

Average on-state current	$I_{T(AV)}$	max.	16	A
R.M.S. on-state current	$I_{T(RMS)}$	max.	25	A
Non-repetitive peak on-state current	I_{TSM}	max.	300	A
Rate of rise of off-state voltage that will not trigger any device	dV_D/dt	$<$	300	V/µs
On request (see ordering note on page 4)	dV_D/dt	$<$	1000	V/µs

MECHANICAL DATA

Dimensions in mm

Fig. 1 TO-48: with metric M6 stud (ϕ 6 mm); e.g. BTW47-800R.
Types with ¼ in x 28UNF stud (ϕ 6,35 mm) are available on request. These are indicated by the suffix U: BTW47-800RU.



Net mass: 14 g
Diameter of clearance hole: max. 6,5 mm
Accessories supplied on request: 56264A
(mica washer, insulating ring, soldering tag)

Torque on nut: min. 1,7 Nm (17 kg cm)
max. 3,5 Nm (35 kg cm)
Supplied with the device:
1 nut, 1 lock washer
Nut dimensions across the flats;
M6: 10 mm
¼ in x 28 UNF: 11,1 mm

RATINGS

Limiting values in accordance with the Absolute Maximum System (IEC 134)

Anode to cathode

			BTW47-800R	1000R	1200R	1400R	1600R	
Non-repetitive peak voltages ($t \leq 10$ ms)	V_{DSM}/V_{RSM}	max.	800	1000	1200	1400	1600	V
Repetitive peak voltages	V_{DRM}/V_{RRM}	max.	800	1000	1200	1400	1600	V
Crest working voltages	V_{DWM}/V_{RWM}	max.	600	700	800	800	800	V*

Average on-state current (averaged over any 20 ms period) up to T_{mb} = 77 °C	$I_{T(AV)}$	max.	16	A
at T_{mb} = 85 °C	$I_{T(AV)}$	max.	14	A
R.M.S. on-state current	$I_{T(RMS)}$	max.	25	A
Repetitive peak on-state current	I_{TRM}	max.	150	A
Non-repetitive peak on-state current; t = 10 ms; half sine-wave; T_j = 125 °C prior to surge; with reapplied V_{RWMmax}	I_{TSM}	max.	300	A
I^2t for fusing (t = 10 ms)	I^2t	max.	450	A^2s
Rate of rise of on-state current after triggering with I_G = 500 mA to I_T = 50 A	dI_T/dt	max.	200	A/μs
Rate of change of commutation current	see Fig. 9			

Gate to cathode

Reverse peak voltage	V_{RGM}	max.	10	V
Average power dissipation (averaged over any 20 ms period)	$P_{G(AV)}$	max.	1	W
Peak power dissipation	P_{GM}	max.	5	W

Temperatures

Storage temperature	T_{stg}		−55 to +125	°C
Junction temperature	T_j	max.	125	°C

THERMAL RESISTANCE

From junction to mounting base	$R_{th\ j\text{-}mb}$	=	1	°C/W
From mounting base to heatsink	$R_{th\ mb\text{-}h}$	=	0,2	°C/W
Transient thermal impedance (t = 1 ms)	$Z_{th\ j\text{-}mb}$	=	0,06	°C/W

* To ensure thermal stability: $R_{th\ j\text{-}a} < 1{,}5$ °C/W (d.c. blocking) or < 3 °C/W (a.c.). For smaller heatsinks $T_{j\ max}$ should be derated. For a.c. see Fig. 3.

CHARACTERISTICS

Anode to cathode

On-state voltage $I_T = 50$ A; $T_j = 25$ °C	V_T	<	3 V*
Rate of rise of off-state voltage that will not trigger any device; exponential method; $V_D = 2/3\ V_{DRMmax}$; $T_j = 125$ °C	dV_D/dt	<	300 V/µs
Reverse current $V_R = V_{RWMmax}$; $T_j = 125$ °C	I_R	<	5 mA
Off-state current $V_D = V_{DWMmax}$; $T_j = 125$ °C	I_D	<	5 mA
Latching current; $T_j = 25$ °C	I_L	<	200 mA
Holding current; $T_j = 25$ °C	I_H	<	200 mA

Gate to cathode

Voltage that will trigger all devices $V_D = 6$ V; $T_j = 25$ °C	V_{GT}	>	3,5 V
Voltage that will not trigger any device $V_D = V_{DRMmax}$; $T_j = 125$ °C	V_{GD}	<	200 mV
Current that will trigger all devices $V_D = 6$ V; $T_j = 25$ °C	I_{GT}	>	100 mA

Switching characteristics

Gate-controlled turn-on time ($t_{gt} = t_d + t_r$) when switched from $V_D = V_{DWMmax}$ to $I_T = 10$ A; $I_{GT} = 150$ mA; $dI_G/dt = 1$ A/µs; $T_j = 25$ °C	t_{gt} t_r	typ. typ.	2 µs 1,2 µs

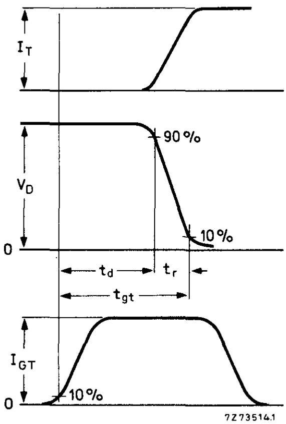


Fig. 2 Gate-controlled turn-on time definitions.

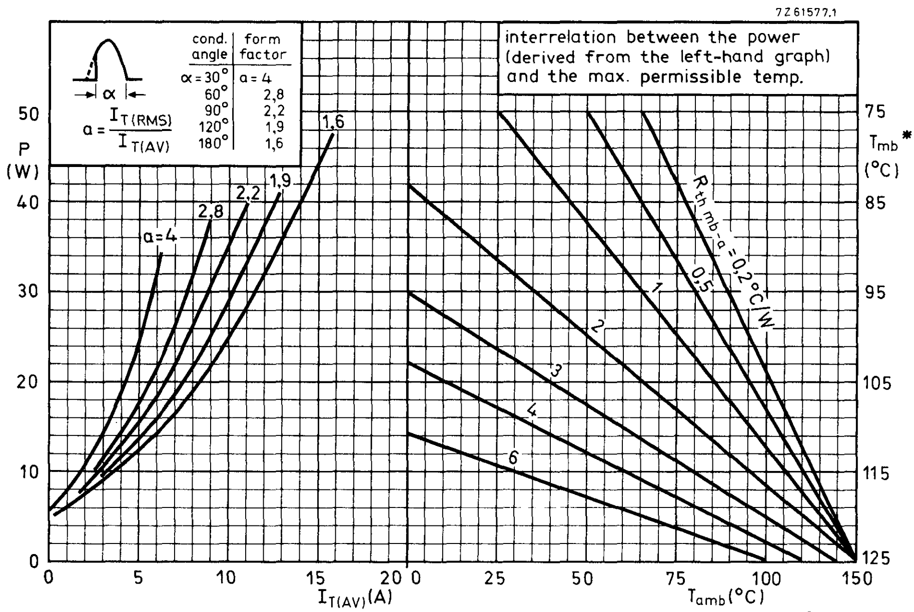
* Measured under pulse conditions to avoid excessive dissipation.

OPERATING NOTES

1. The terminals should neither be bent nor twisted; they should be soldered into the circuit so that there is no strain on them.
   During soldering the heat conduction to the junction should be kept to a minimum.
2. Switching losses in commutation
   For applications in which the thyristor is forced to switch from an on-state current I_{TRM} to a high reverse voltage at a high commutation rate ($-dI_T/dt$), consult Fig. 9 (nomogram) to find the increase in total average power. This increase must be added to the loss from the curves in Fig. 3.

ORDERING NOTE

Types with dV_D/dt of 1000 V/μs are available on request. Add suffix C to the type number when ordering; e.g. BTW47-800RC.



* T_{mb} – scale is for comparison purposes only and is correct only for $R_{th\ mb-a} \leq 2$ °C/W

Fig. 3.

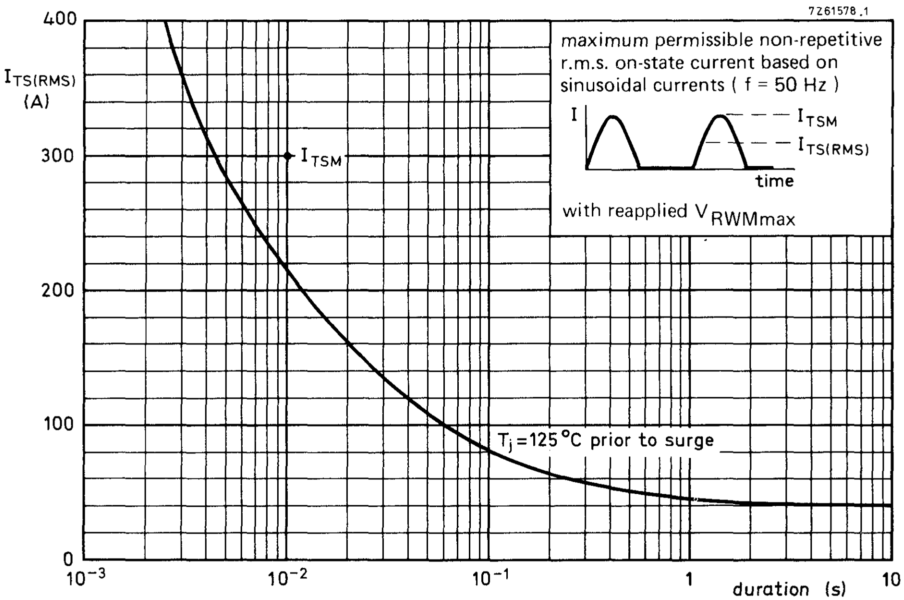


Fig. 4.

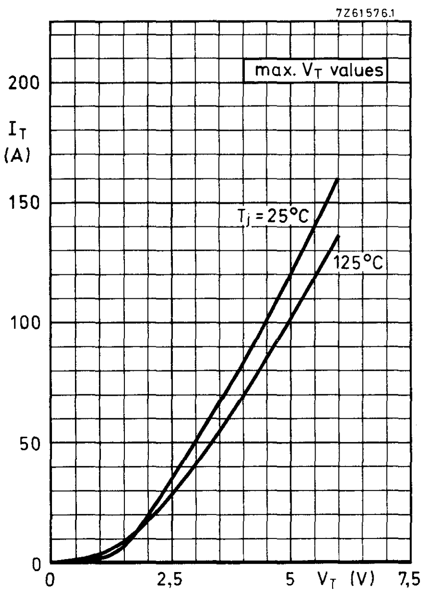


Fig. 5.

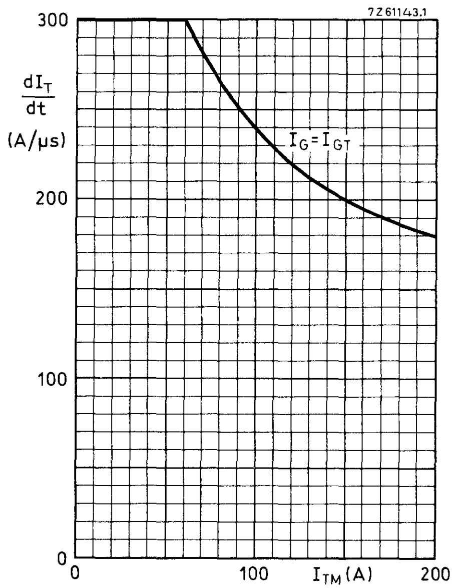


Fig. 6.

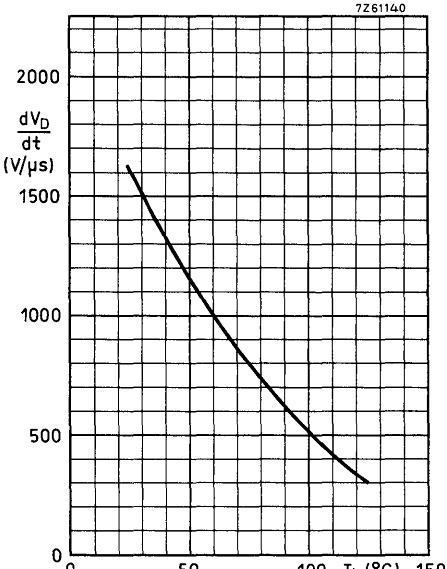


Fig. 7 Maximum rate of rise of off-state voltage that with not trigger any device (exponential method) as a function of T_j.

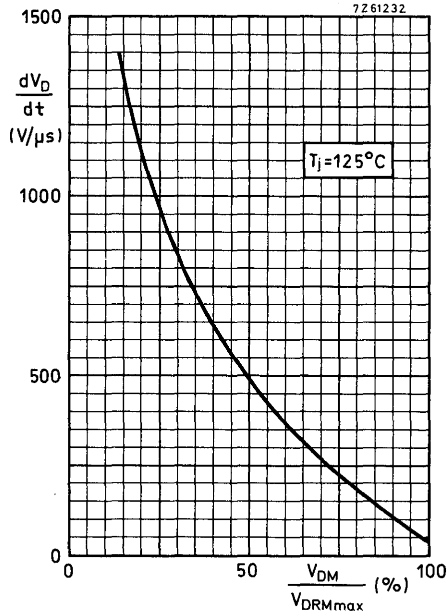


Fig. 8 Maximum rate of rise of off-state voltage that with not trigger any device (exponential method) as a function of applied voltage.

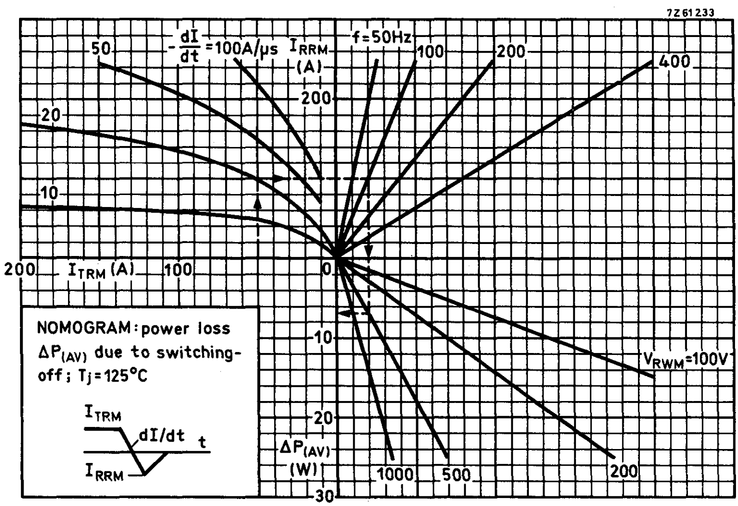


Fig. 9.

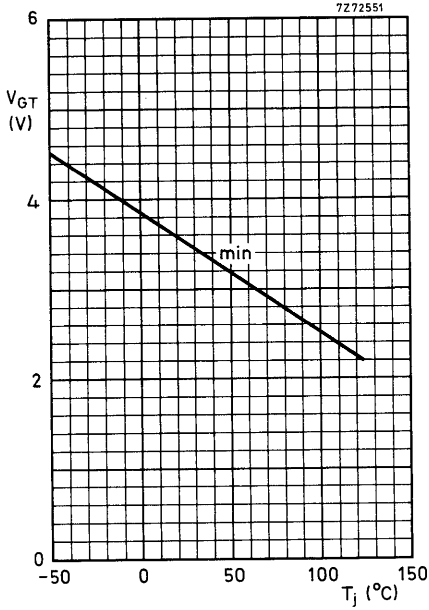


Fig. 10 Minimum gate voltage that will trigger all devices as a function of T_j.

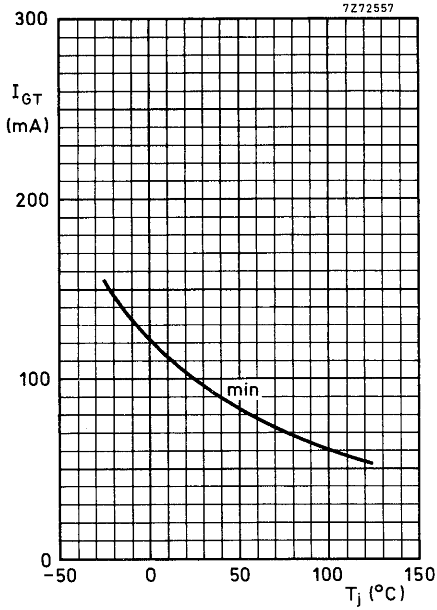


Fig. 11 Minimum gate current that will trigger all devices as a function of T_j.

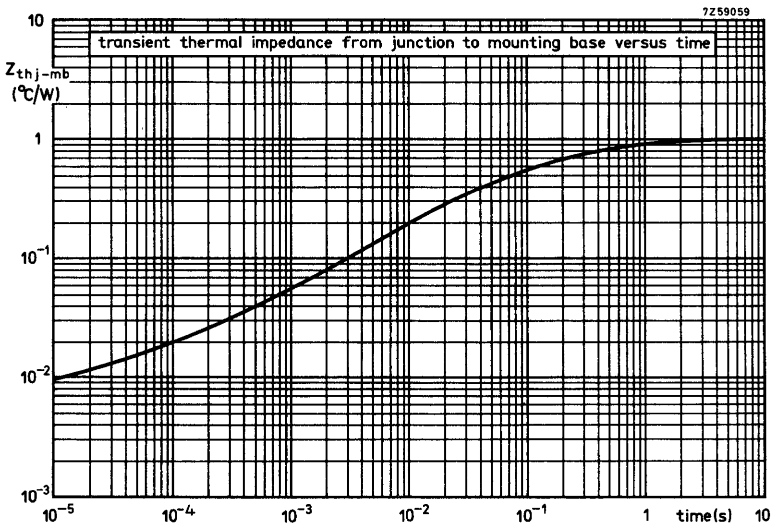
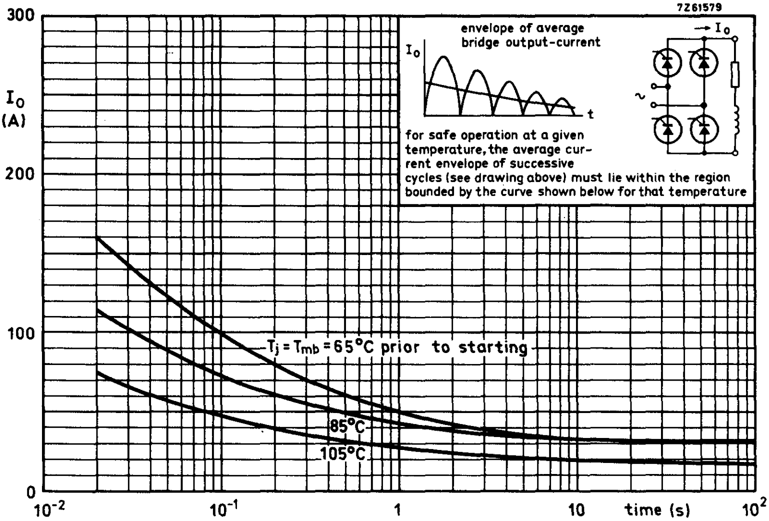


Fig. 12.



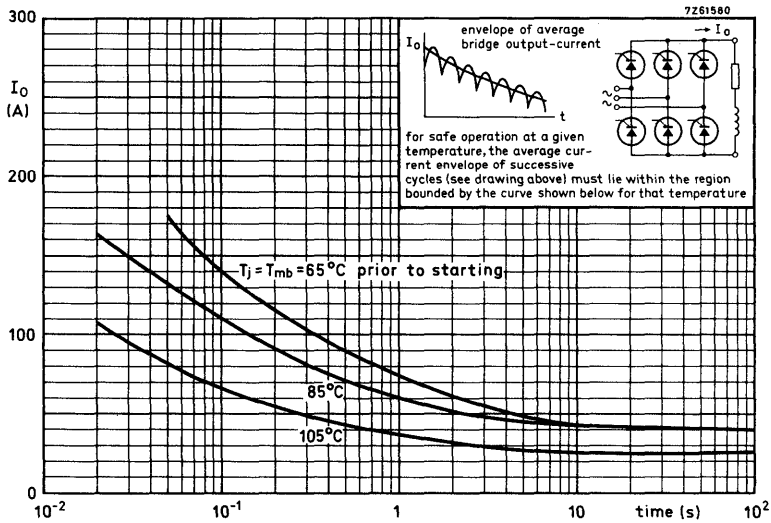


Fig. 13 Limits for starting or inrush currents.

THYRISTORS

Also available to BS9341-F039

Silicon thyristors in metal envelopes, intended for use in general purpose three-phase power control circuits.

The series consists of reverse polarity types (anode to stud) identified by a suffix R: BTW92-800R to 1600R.

QUICK REFERENCE DATA

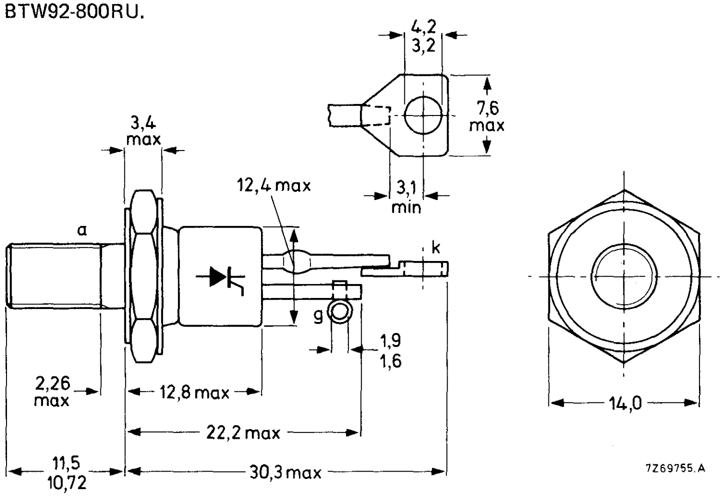
			BTW92-800R	1000R	1200R	1400R	1600R	
Repetitive peak voltages	V_{DRM}/V_{RRM}	max.	800	1000	1200	1400	1600	V

Average on-state current	$I_{T(AV)}$	max.	20	A
R.M.S. on-state current	$I_{T(RMS)}$	max.	31	A
Non-repetitive peak on-state current	I_{TSM}	max.	400	A
Rate of rise of off-state voltage that will not trigger any device	dV_D/dt	<	300	V/μs
On request (see ordering note on page 4)	dV_D/dt	<	1000	V/μs

MECHANICAL DATA

Dimensions in mm

Fig. 1 TO-48: with metric M6 stud (ϕ 6 mm); e.g. BTW92-800R.
Types with ¼ in x 28 UNF stud (ϕ 6,35 mm) are available on request. These are indicated by the suffix U: BTW92-800RU.



Net mass: 14 g
Diameter of clearance hole: max. 6,5 mm
Accessories supplied on request: 56264A
(mica washer, insulating ring, soldering tag)

Torque on nut: min. 1,7 Nm (17 kg cm)
max. 3,5 Nm (35 kg cm)
Supplied with the device:
1 nut, 1 lock washer
Nut dimensions across the flats;
M6: 10 mm
¼ in x 28 UNF: 11,1 mm

RATINGS

Limiting values in accordance with the Absolute Maximum System (IEC 134)

Anode to cathode

			BTW92-800R	1000R	1200R	1400R	1600R	
Non-repetitive peak voltages ($t \leqslant 10$ ms)	V_{DSM}/V_{RSM}	max.	800	1000	1200	1400	1600	V
Repetitive peak voltages	V_{DRM}/V_{RRM}	max.	800	1000	1200	1400	1600	V
Crest working voltages	V_{DWM}/V_{RWM}	max.	600	700	800	800	800	V *

Average on-state current (averaged over any 20 ms period) up to $T_{mb} = 85\ ^{o}C$	$I_{T(AV)}$	max.	20	A
R.M.S. on-state current	$I_{T(RMS)}$	max.	31	A
Repetitive peak on-state current	I_{TRM}	max.	200	A
Non-repetitive peak on-state current; t = 10 ms; half sine-wave; $T_j = 125\ ^{o}C$ prior to surge; with reapplied V_{RWMmax}	I_{TSM}	max.	400	A
I^2t for fusing (t = 10 ms)	I^2t	max.	800	A^2s
Rate of rise of on-state current after triggering with $I_G = 500$ mA to $I_T = 60$ A	dI_T/dt	max.	300	A/µs
Rate of change of commutation current	see Fig. 9			

Gate to cathode

Reverse peak voltage	V_{RGM}	max.	10	V
Average power dissipation (averaged over any 20 ms period)	$P_{G(AV)}$	max.	1	W
Peak power dissipation	P_{GM}	max.	5	W

Temperatures

Storage temperature	T_{stg}	−55 to + 125		°C
Junction temperature	T_j	max.	125	°C

THERMAL RESISTANCE

From junction to mounting base	$R_{th\ j\text{-}mb}$	=	1	°C/W
From mounting base to heatsink	$R_{th\ mb\text{-}h}$	=	0,2	°C/W
Transient thermal impedance (t = 1 ms)	$Z_{th\ j\text{-}mb}$	=	0,06	°C/W

* To ensure thermal stability: $R_{th\ j\text{-}a} < 1{,}5\ ^{o}C/W$ (d.c. blocking) or $< 3\ ^{o}C/W$ (a.c.). For smaller heatsinks $T_{j\ max}$ should be derated. For a.c. see Fig. 3.

CHARACTERISTICS

Anode to cathode

On-state voltage $I_T = 50$ A; $T_j = 25\ ^oC$	V_T	<	2,3 V *
Rate of rise of off-state voltage that will not trigger any device; exponential method; $V_D = 2/3\ V_{DRMmax}$; $T_j = 125\ ^oC$	dV_D/dt	<	300 V/μs
Reverse current $V_R = V_{RWMmax}$; $T_j = 125\ ^oC$	I_R	<	5 mA
Off-state current $V_D = V_{DWMmax}$; $T_j = 125\ ^oC$	I_D	<	5 mA
Latching current; $T_j = 25\ ^oC$	I_L	<	200 mA
Holding current; $T_j = 25\ ^oC$	I_H	<	200 mA

Gate to cathode

Voltage that will trigger all devices $V_D = 6$ V; $T_j = 25\ ^oC$	V_{GT}	>	3,5 V
Voltage that will not trigger any device $V_D = V_{DRMmax}$; $T_j = 125\ ^oC$	V_{GD}	<	200 mV
Current that will trigger all devices $V_D = 6$ V; $T_j = 25\ ^oC$	I_{GT}	>	100 mA

Switching characteristics

Gate-controlled turn-on time ($t_{gt} = t_d + t_r$) when switched from $V_D = V_{DWMmax}$ to $I_T = 10$ A; $I_{GT} = 150$ mA; $dI_G/dt = 1$ A/μs; $T_j = 25\ ^oC$	t_{gt}	typ.	2 μs
	t_r	typ.	1,2 μs

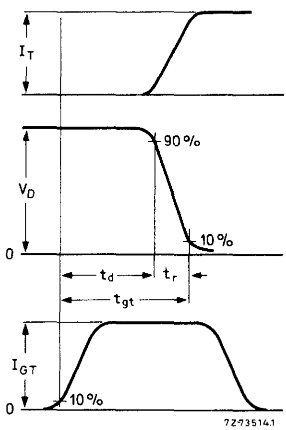


Fig. 2 Gate-controlled turn-on time definitions.

* Measured under pulse conditions to avoid excessive dissipation.

OPERATING NOTES

1. The terminals should neither be bent nor twisted; they should be soldered into the circuit so that there is no strain on them.
   During soldering the heat conduction to the junction should be kept to a minimum.
2. Switching losses in commutation.
   For applications in which the thyristor is forced to switch from an on-state current I_{TRM} to a high reverse voltage at a high commutation rate ($-dI_T/dt$), consult Fig. 9 (nomogram) to find the increase in total average power. This increase must be added to the loss from the curves in Fig. 3.

ORDERING NOTE

Types with dV_D/dt of 1000 V/µs are available on request. Add suffix C to the type number when ordering; e.g. BTW92-800RC.

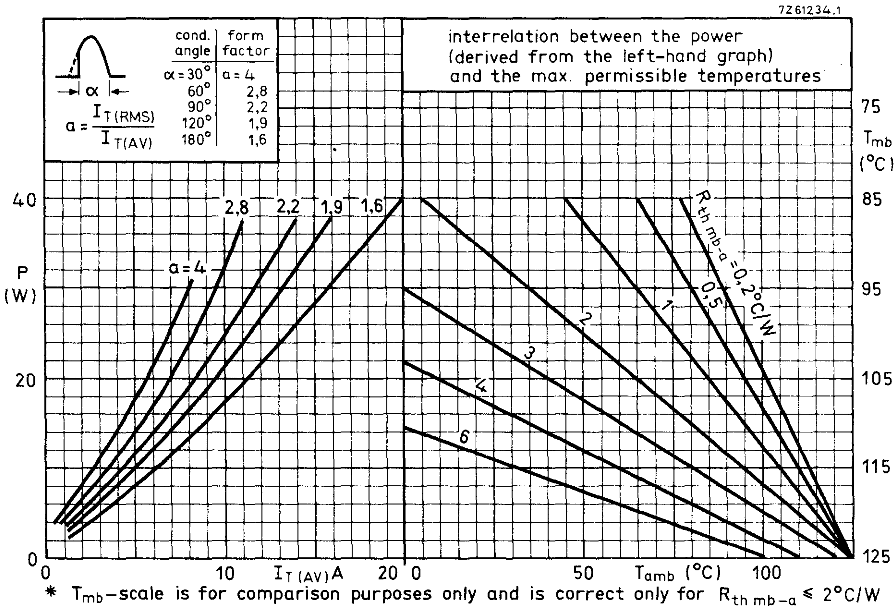


Fig. 3.

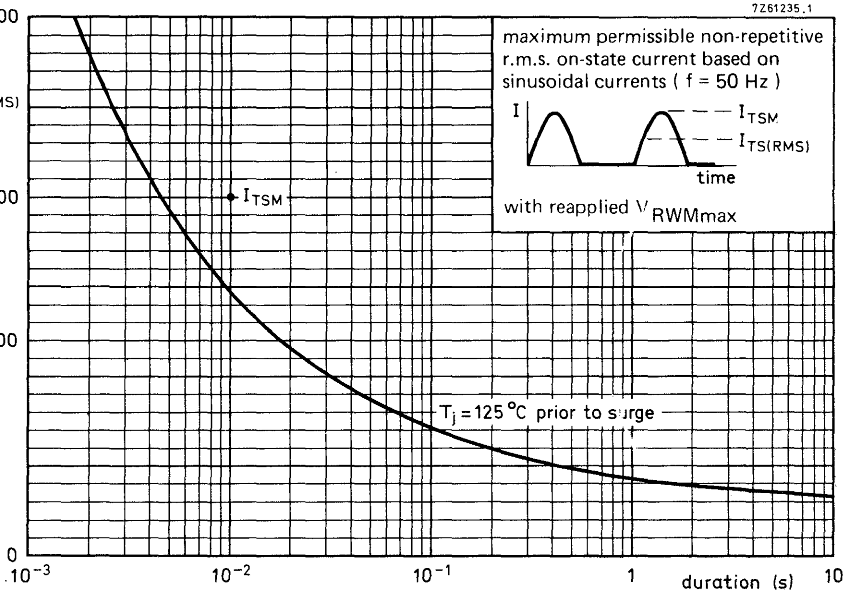


Fig. 4.

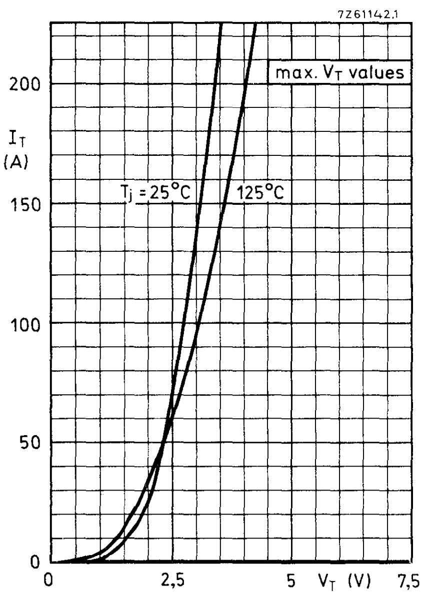


Fig. 5.

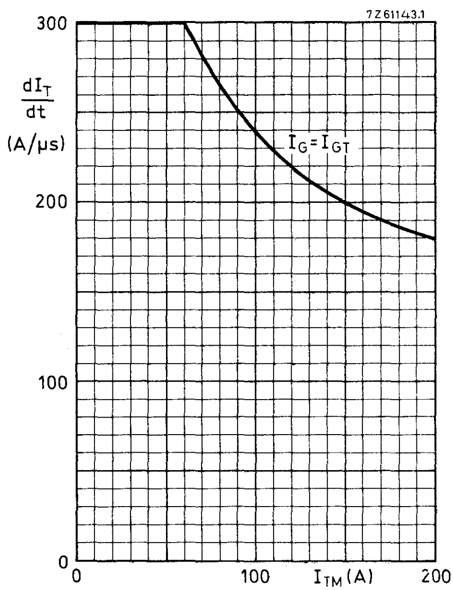


Fig. 6.

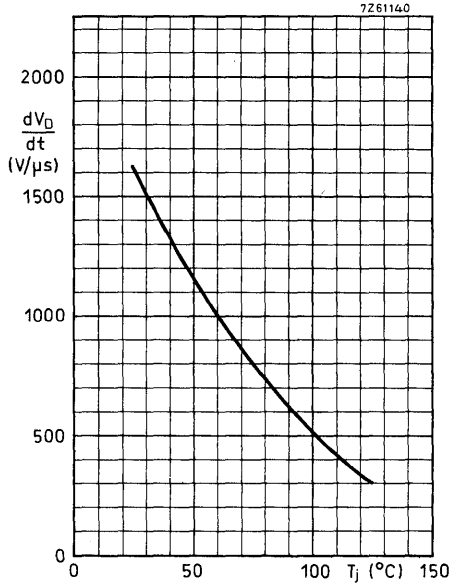


Fig. 7 Maximum rate of rise of off-state voltage that will not trigger any device (exponential method) as a function of T_j.

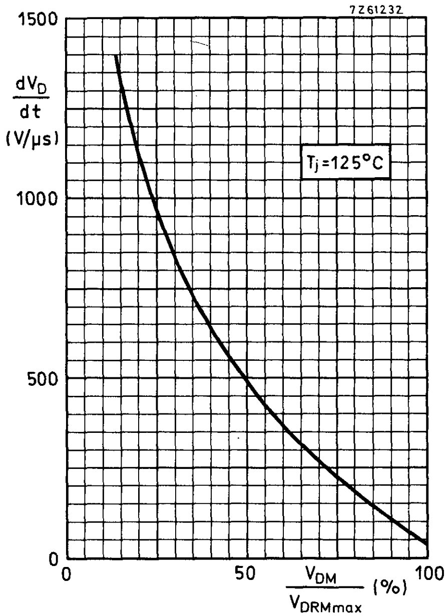


Fig. 8 Maximum rate of rise of off-state voltage that will not trigger any device (exponential method) as a function of applied voltage.

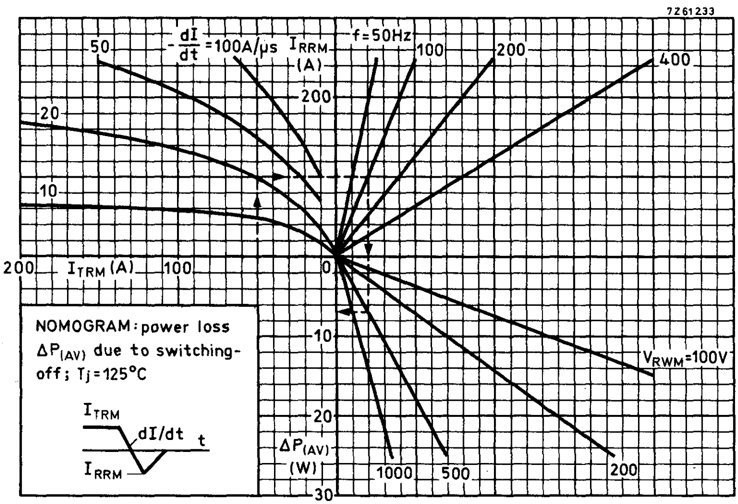


Fig. 9.

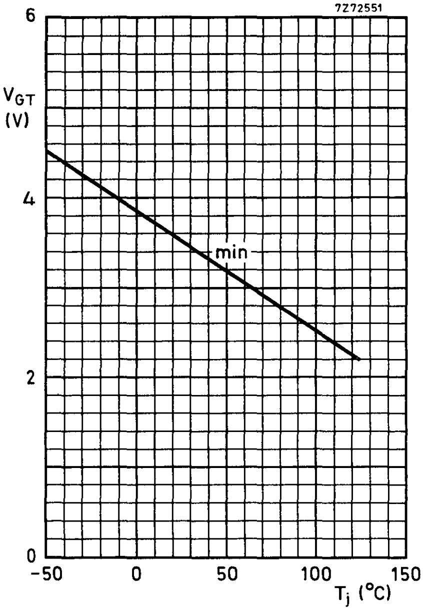


Fig. 10 Minimum gate voltage that will trigger all devices as a function of T_j.

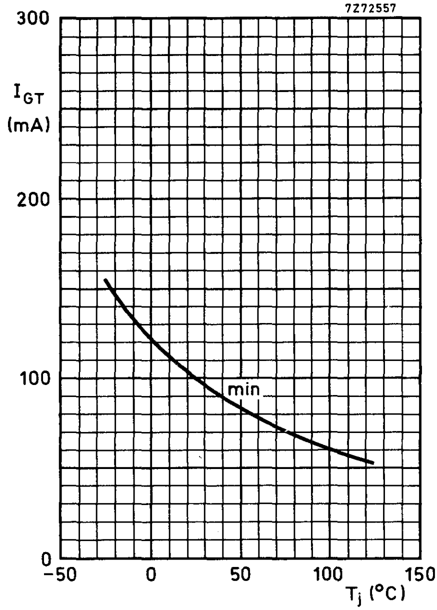


Fig. 11 Minimum gate current that will trigger all devices as a function of T_j.

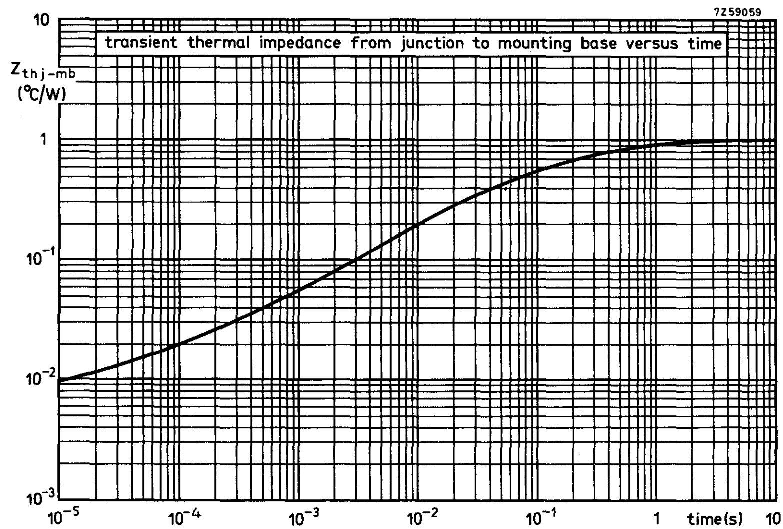
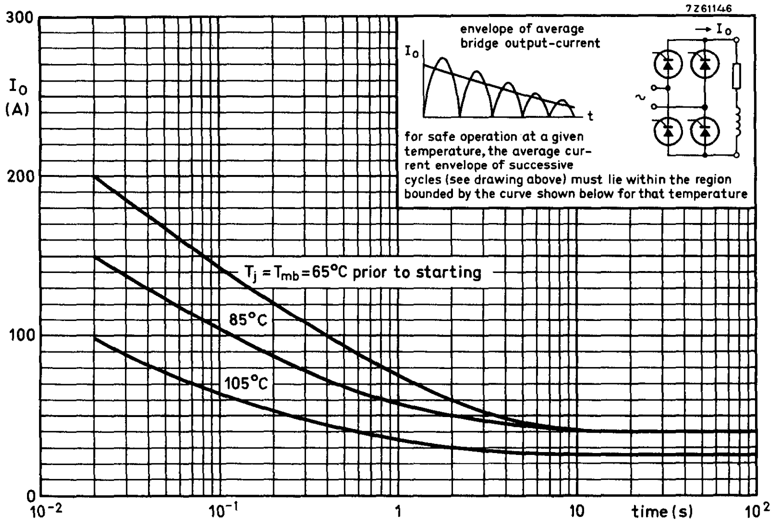


Fig. 12.



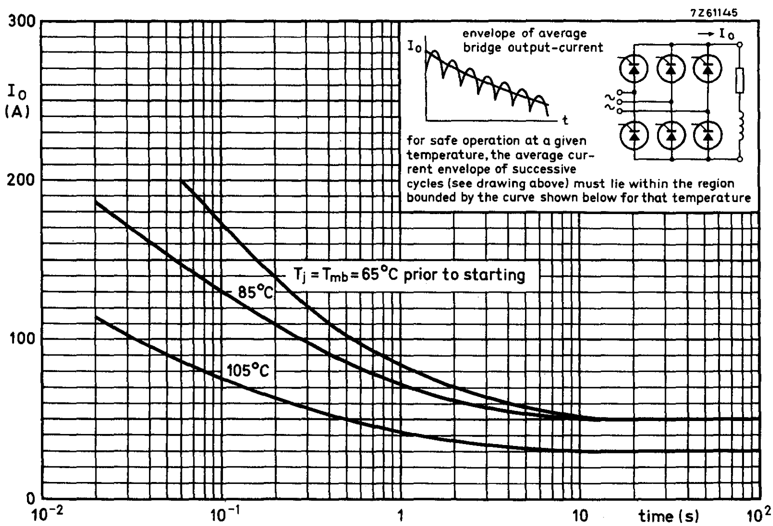


Fig. 13 Limits for starting or inrush currents.

SILICON THYRISTORS

The BTX18series is a range of p-gate reverse blocking thyristors, in a TO-5 metal envelope, intended for use in general low power applications up to 1 A average on-state current

QUICK REFERENCE DATA

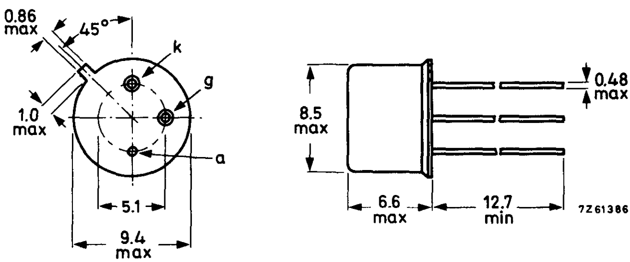
			BTX18-100	200	300	400	500	
Crest working reverse voltage	V_{RWM}	max.	100	200	300	400	500	V
Crest working off-state voltage	V_{DWM}	max.	100	200	300	400	500	V
Average on-state current up to T_{case} = 105 °C	$I_{T(AV)}$	max.			1.0			A
T_{amb} = 60 °C; in free air	$I_{T(AV)}$	max.			250			mA
Non-repetitive peak on-state current t = 10 ms; T_j = 125 °C prior to surge	I_{TSM}	max.			10			A
Junction temperature	T_j	max.			125			°C

MECHANICAL DATA

Dimensions in mm

Anode connected to the case

TO-39



Accessories supplied on request: 56218; 56245.

All information applies to frequencies up to 400 Hz

RATINGS Limiting values in accordance with the Absolute Maximum System (IEC 134)

ANODE TO CATHODE

Voltages [1]			BTX18-100	200	300	400	500	
Continuous reverse voltage	V_R	max.	100	200	300	400	500	V
Crest working reverse voltage	V_{RWM}	max.	100	200	300	400	500	V
Repetitive peak reverse voltage (δ = 0.01; f = 50 Hz)	V_{RRM}	max.	120	240	350	500	600	V
Non-repetitive peak reverse voltage ($t \leq$ 10 ms)	V_{RSM}	max.	120	240	350	500	600	V
Continuous off-state voltage	V_D	max.	100	200	300	400	500	V
Crest working off-state voltage	V_{DWM}	max.	100	200	300	400	500	V
Repetitive peak off-state voltage (δ = 0.01; f = 50 Hz)	V_{DRM}	max.	120	240	350	500	600	V [2]
Non-repetitive peak off-state voltage ($t \leq$ 10 ms)	V_{DSM}	max.	120	240	350	500	600	V [2]

Currents

Average on-state current (averaged over any 20 ms period) up to T_{case} = 105 °C	$I_{T(AV)}$	max.	1.0	A
at T_{amb} = 60 °C	$I_{T(AV)}$	max.	250	mA
On-state current (d.c.) T_{case} = 100 °C	I_T	max.	1.6	A
R.M.S. on-state current	$I_{T(RMS)}$	max.	1.6	A
Repetitive peak on-state current	I_{TRM}	max.	10	A
Non-repetitive peak on-state current (t = 10 ms, half sinewave)	I_{TSM}	max.	10	A

[1]) These ratings apply for zero or negative bias on the gate with respect to the cathode, and when a resistor $R \leq 1$ kΩ is connected between gate and cathode.

[2]) The device is not suitable for operation in the forward breakover mode.

RATINGS

GATE TO CATHODE (with 1 kΩ resistor between gate and cathode)

Voltages

Forward peak voltage	V_{FGM}	max.	10	V
Reverse peak voltage	V_{RGM}	max.	5	V

Current

Forward peak current	I_{FGM}	max.	0.2	A

Power dissipation

Average power dissipation (averaged over any 20 ms period)	$P_{G(AV)}$	max.	0.05	W
Peak power dissipation	P_{GM}	max.	0.5	W

TEMPERATURES

Storage temperature	T_{stg}		-55 to +125	^oC
Junction temperature	T_j	max.	125	^oC

THERMAL RESISTANCE

From junction to case	$R_{th\ j-c}$	=	10	$^oC/W$
From junction to ambient	$R_{th\ j-a}$	=	200	$^oC/W$
Transient thermal resistance (t = 10 ms)	$Z_{th\ j-c}$	=	2.5	$^oC/W$

CHARACTERISTICS

ANODE TO CATHODE

			BTX18-100	200	300	400	500	
Voltages								
On-state voltage I_T = 1.0 A; T_j = 25 ^oC	V_T	<	1.5	1.5	1.5	1.5	1.5	V [1]
Rate of rise of off-state voltage that will not trigger any device R_{GK} = 1 kΩ; T_j = 125 ^oC	$\frac{dV_D}{dt}$		See page 6					
Currents								
Peak reverse current $V_{RM} = V_{RWMmax}$; T_j = 125 ^oC	I_{RM}	<	800	400	275	200	160	μA
Peak off-state current $V_{DM} = V_{DWMmax}$; T_j = 125 ^oC	I_{DM}	<	800	400	275	200	160	μA

[1] V_T is measured along the leads at 1 cm from the case.

CHARACTERISTICS (continued)

Latching current; T_j = 125 °C	I_L	typ.	10	mA
Holding current; T_j = 25 °C	I_H	<	5.0	mA 1)

GATE TO CATHODE

Voltages

Voltage that will trigger all devices; T_j = 25 °C	V_{GT}	>	2.0	V
Voltage that will not trigger any device; T_j = 125 °C	V_{GD}	<	200	mV

Current

Current that will trigger all devices; T_j = 25 °C	I_{GT}	>	5.0	mA

SWITCHING CHARACTERISTICS

Turn off time when switched from

I_T = 300 mA to I_R = 175 mA; T_j = 25 °C	t_q	typ.	20	µs
T_j = 125 °C	t_q	typ.	35	µs

NOTES

1. When using a soldering iron the thyristor may be soldered directly into the circuit, but the heat conduction to the junction should be kept to a minimum by using a thermal shunt.
2. Thyristors may be dip soldered at a solder temperature of 245 °C, for a maximum soldering time of 5 seconds. The case temperature during dip soldering must not at any time exceed the maximum storage temperature. These recommendations apply to a thyristor mounted flush on a board with punched-through holes, or spaced 1.5 mm above a board having plated-through holes.
3. Care should be taken not to bend the leads nearer than 1.5 mm from the seal.

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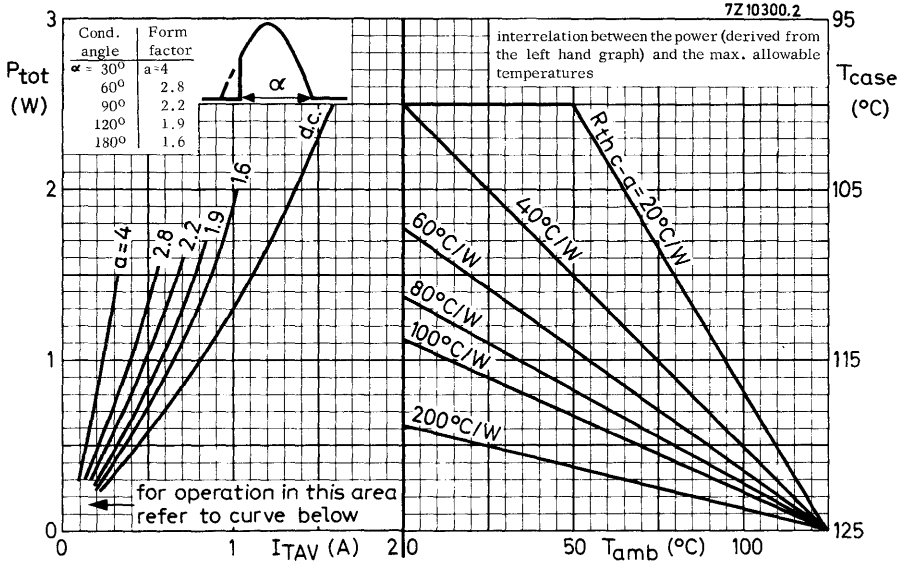
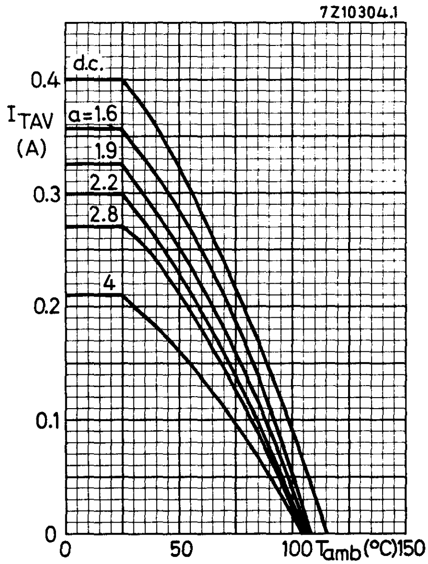
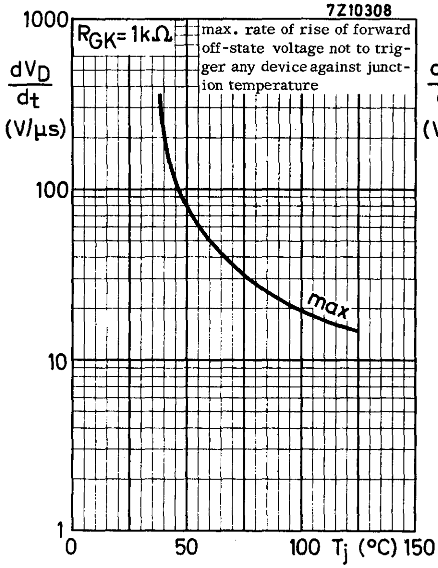
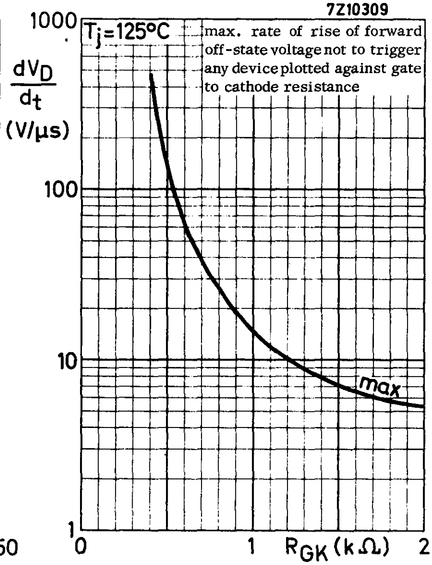
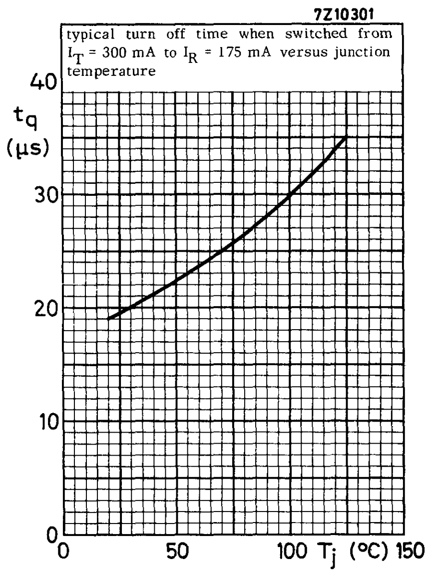
1) Measured under the following conditions: Anode supply voltage = +6.0 V.
Initial on-state current after gate triggering = 50 mA.
The current is reduced until the device turns of.

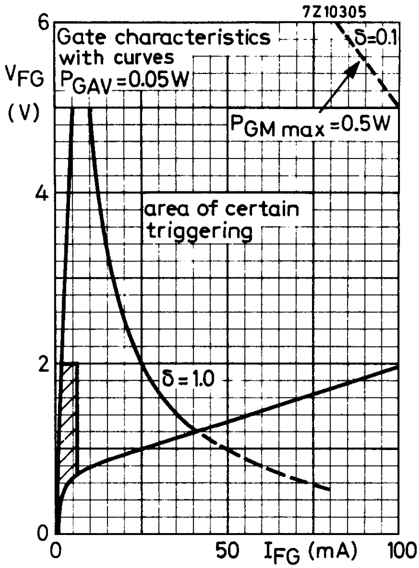

7Z10300.2
Cond. angle
Form factor
α = 30°
a = 4
60°
2.8
90°
2.2
120°
1.9
180°
1.6
α
P_{tot} (W)
a=4
2.8
2.2
1.9
1.6
d.c.
for operation in this area refer to curve below
I_{TAV} (A)
interrelation between the power (derived from the left hand graph) and the max. allowable temperatures
$R_{th\,c-a}$=20°C/W
40°C/W
60°C/W
80°C/W
100°C/W
200°C/W
T_{amb} (°C)
T_{case} (°C)
95
105
115
125
0
1
2
3
0
1
2
0
50
100

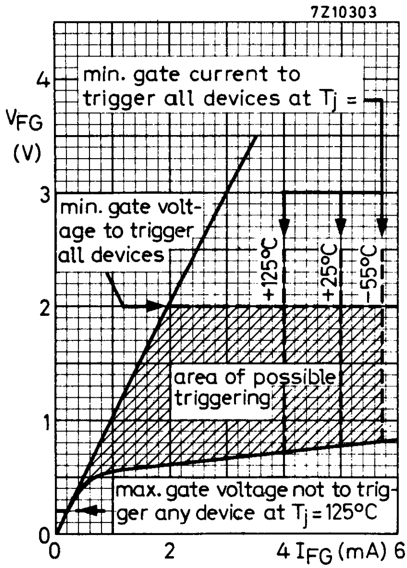

7Z10304.1
I_{TAV} (A)
d.c.
a=1.6
1.9
2.2
2.8
4
0.4
0.3
0.2
0.1
0
0
50
100
T_{amb} (°C)
150

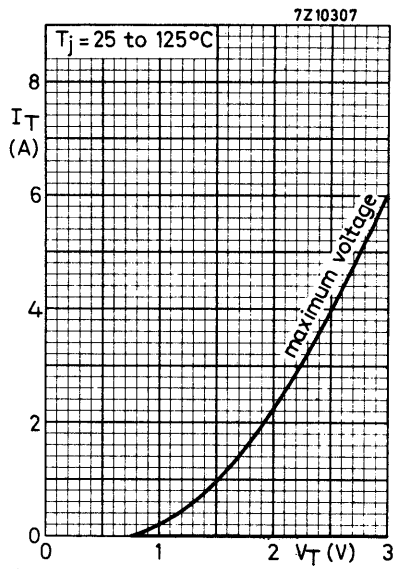

7Z10308
R_{GK}= 1kΩ
max. rate of rise of forward off-state voltage not to trigger any device against junction temperature
$\frac{dV_D}{dt}$ (V/µs)
1000
100
10
1
0
50
100
150
T_j (°C)
max

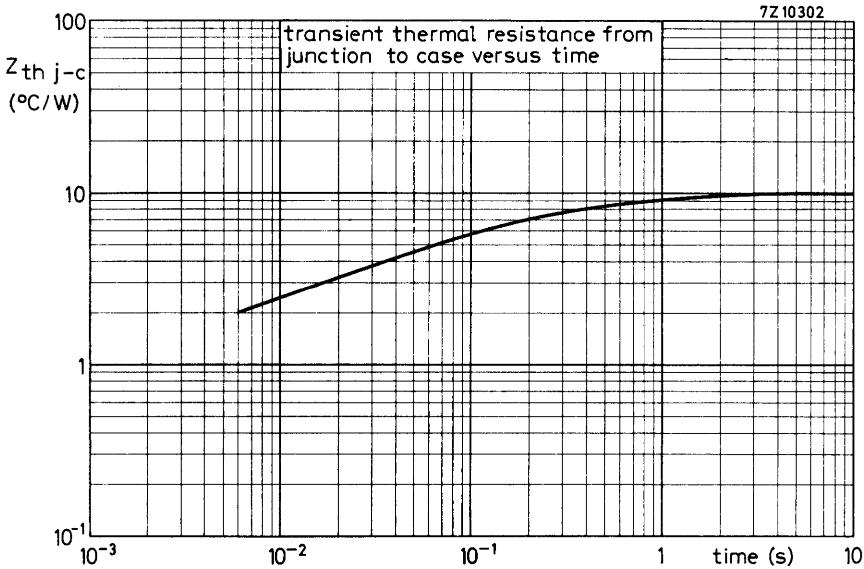

7Z10309
T_j=125°C
max. rate of rise of forward off-state voltage not to trigger any device plotted against gate to cathode resistance
$\frac{dV_D}{dt}$ (V/µs)
1000
100
10
1
0
1
2
R_{GK} (kΩ)
max

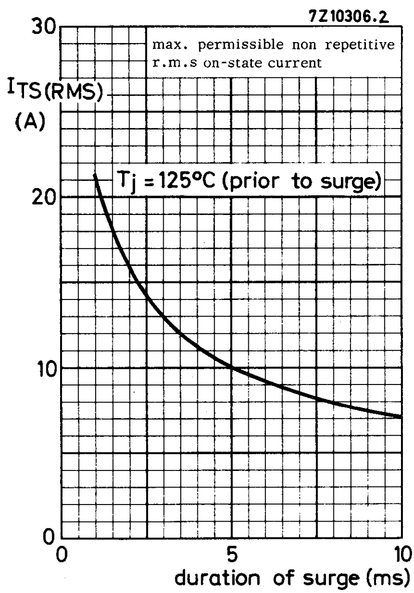

7Z10301
typical turn off time when switched from I_T = 300 mA to I_R = 175 mA versus junction temperature
t_q (µs)
40
30
20
10
0
0
50
100
150
T_j (°C)


7Z10305
Gate characteristics
with curves
PGAV=0.05W
δ=0.1
PGM max =0.5W
area of certain
triggering
δ=1.0
VFG
(V)
IFG (mA)
0
2
4
6
50
100


7Z10303
min. gate current to
trigger all devices at Tj =
min. gate volt-
age to trigger
all devices
+125°C
+25°C
−55°C
area of possible
triggering
max. gate voltage not to trig-
ger any device at Tj=125°C
VFG
(V)
IFG (mA)
0
1
2
3
4
6


7Z10307
Tj=25 to 125°C
maximum voltage
IT
(A)
VT (V)
0
2
4
6
8
1
3


7Z10302
transient thermal resistance from junction to case versus time
$Z_{th\ j-c}$ (°C/W)
100
10
1
10^{-1}
10^{-3}
10^{-2}
10^{-1}
1
time (s)
10


7Z10306.2
max. permissible non repetitive r.m.s on-state current
$I_{TS(RMS)}$ (A)
T_j = 125°C (prior to surge)
30
20
10
0
0
5
10
duration of surge (ms)

THYRISTORS

Also available to BS9341-F001 to F009

Silicon thyristors in metal envelopes, intended for use in power control circuits (e.g. light and motor control) and power switching systems.
The series consists of reverse polarity types (anode to stud) identified by a suffix R: BTY79-400R to 1000R.

QUICK REFERENCE DATA

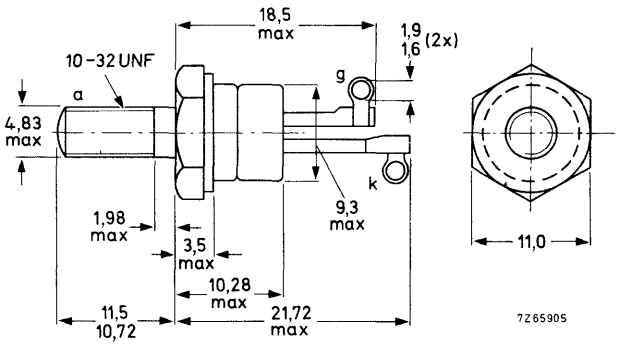
		BTY79-400R	500R	600R	800R	1000R	
Repetitive peak voltages V_{DRM}/V_{RRM}	max.	400	500	600	800	1000	V

Average on-state current	$I_{T(AV)}$	max.	10	A
R.M.S. on-state current	$I_{T(RMS)}$	max.	16	A
Non-repetitive peak on-state current	I_{TSM}	max.	150	A

MECHANICAL DATA

Dimensions in mm

Fig. 1 TO-64: with 10-32 UNF stud (ϕ 4,83 mm).



Net mass: 7 g
Diameter of clearance hole: max. 5,2 mm
Accessories supplied on request:
56295 (PTFE bush, 2 mica washers, plain washer, tag)
56262A (mica washer, insulating ring, plain washer)

Torque on nut: min. 0,9 Nm (9 kg cm)
max. 1,7 Nm (17 kg cm)

Supplied with device: 1 nut, 1 lock washer
Nut dimensions: across the flats: 9,5 mm

RATINGS

Limiting values in accordance with the Absolute Maximum System (IEC 134)

Anode to cathode

			BTY79–400R	500R	600R	800R	1000R	
Non-repetitive peak off-state voltage ($t \leq 10$ ms)	V_{DSM}**	max.	500	1100	1100	1100	1100	V
Non-repetitive peak reverse voltage ($t \leq 5$ ms)	V_{RSM}	max.	500	600	720	960	1100	V
Repetitive peak voltages	V_{DRM}/V_{RRM}	max.	400	500	600	800	1000	V
Crest working voltages	V_{DWM}/V_{RWM}	max.	400	500	600	800	1000	V*

Average on-state current (averaged over any 20 ms period) up to T_{mb} = 85 °C	$I_{T(AV)}$	max.	10	A
R.M.S. on-state current	$I_{T(RMS)}$	max.	16	A
Repetitive peak on-state current	I_{TRM}	max.	75	A
Non-repetitive peak on-state current; t = 10 ms; half sine-wave; T_j = 125 °C prior to surge; with reapplied V_{RWMmax}	I_{TSM}	max.	150	A
I^2t for fusing (t = 10 ms)	I^2t	max.	112	A^2s
Rate of rise of on-state current after triggering with I_G = 150 mA to I_T = 30 A; dI_G/dt = 0,25 A/μs	dI_T/dt	max.	50	A/μs

Gate to cathode

Average power dissipation (averaged over any 20 ms period)	$P_{G(AV)}$	max.	0,5	W
Peak power dissipation	P_{GM}	max.	5	W

Temperatures

Storage temperature	T_{stg}		−55 to +125	°C
Junction temperature	T_j	max.	125	°C

THERMAL RESISTANCE

From junction to mounting base	$R_{th\ j\text{-}mb}$	=	1,8	°C/W
From mounting base to heatsink with heatsink compound	$R_{th\ mb\text{-}h}$	=	0,5	°C/W
From junction to ambient in free air	$R_{th\ j\text{-}a}$	=	45	°C/W
Transient thermal impedance (t = 1 ms)	$Z_{th\ j\text{-}mb}$	=	0,1	°C/W

* To ensure thermal stability: $R_{th\ j\text{-}a} < 4$ °C/W (d.c. blocking) or < 8 °C/W (a.c.). For smaller heatsinks $T_{j\ max}$ should be derated. For a.c. see Fig. 3.

** Although not recommended, higher off-state voltages may be applied without damage, but the thyristor may switch into the on-state. The rate of rise of on-state current should not exceed 100 A/μs.

CHARACTERISTICS

Anode to cathode

On-state voltage $I_T = 20$ A; $T_j = 25$ °C	V_T	<	2 V*
Rate of rise of off-state voltage that will not trigger any device; exponential method; $V_D = 2/3\ V_{DRMmax}$; $T_j = 125$ °C	dV_D/dt	<	50 V/μs
Reverse current $V_R = V_{RWMmax}$; $T_j = 125$ °C	I_R	<	3 mA
Off-state current $V_D = V_{DWMmax}$; $T_j = 125$ °C	I_D	<	3 mA
Latching current; $T_j = 25$ °C	I_L	<	150 mA
Holding current; $T_j = 25$ °C	I_H	<	75 mA

Gate to cathode

Voltage that will trigger all devices $V_D = 6$ V; $T_j = 25$°C	V_{GT}	>	1,5 V
Voltage that will not trigger any device $V_D = V_{DRMmax}$; $T_j = 125$ °C	V_{GD}	<	200 mV
Current that will trigger all devices $V_D = 6$ V; $T_j = 25$ °C	I_{GT}	>	30 mA
On request (see ordering note on page 4)	I_{GT}	>	20 mA

Switching characteristics

Gate-controlled turn-on time ($t_{gt} = t_d + t_r$) when switched from $V_D = 800$ V to $I_T = 25$ A; $I_{GT} = 250$ mA; $dI_G/dt = 0,25$ A/μs; $T_j = 25$ °C	t_{gt}	<	1,5 μs
	t_r	typ.	0,2 μs

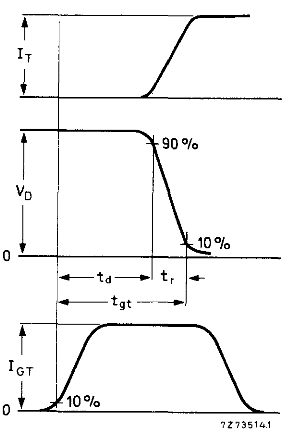


Fig. 2 Gate-controlled turn-on time definitions.

* Measured under pulse conditions to avoid excessive dissipation.

OPERATING NOTE

The terminals should neither be bent nor twisted; they should be soldered into the circuit so that there is no strain on them.
During soldering the heat conduction to the junction should be kept to a minimum.

ORDERING NOTE

Types with low gate trigger current, $I_{GT} > 20$ mA, are available on request. Add suffix A to the type number when ordering: e.g. BTY79A-400R.

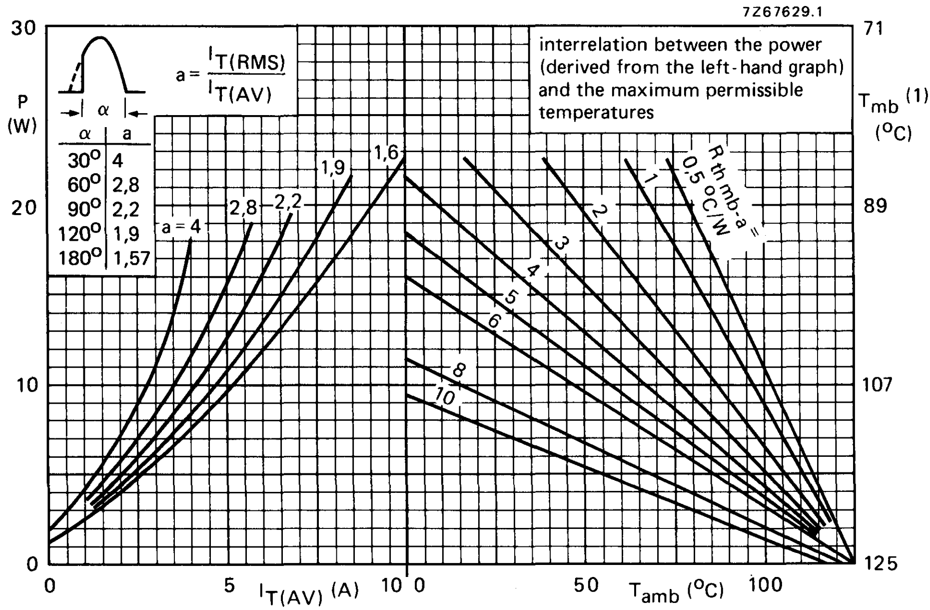


Fig. 3 (1) T_{mb}-scale is for comparison purposes only and is correct only for $R_{th\ mb\text{-}a} \leqslant 6$ °C/W.

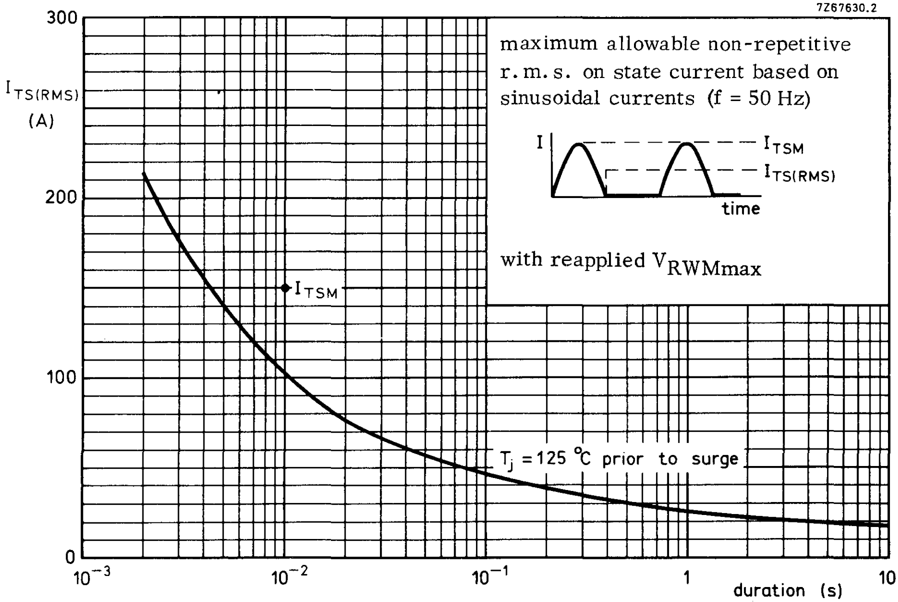

7Z67630.2
$I_{TS(RMS)}$ (A)
300
200
100
0
10^{-3}
10^{-2}
10^{-1}
1
10
duration (s)
maximum allowable non-repetitive r.m.s. on state current based on sinusoidal currents (f = 50 Hz)
I
I_{TSM}
$I_{TS(RMS)}$
time
with reapplied V_{RWMmax}
I_{TSM}
T_j = 125 °C prior to surge

Fig. 4.

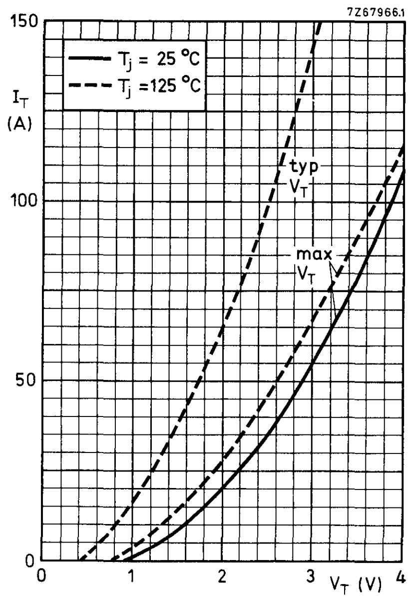

7Z67966.1
I_T (A)
150
100
50
0
0
1
2
3
4
V_T (V)
T_j = 25 °C
T_j =125 °C
typ V_T
max V_T

Fig. 5.

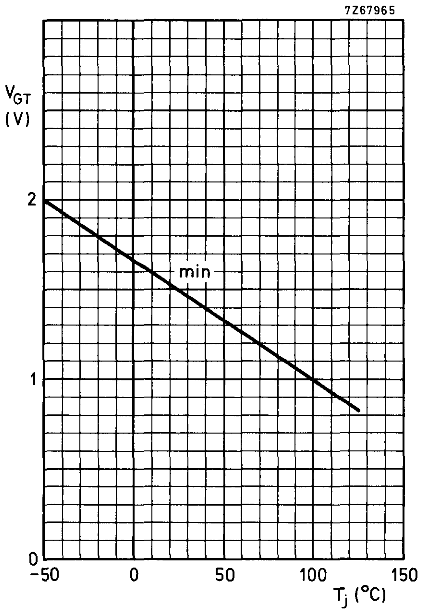


Fig. 6 Minimum gate voltage that will trigger all devices as a function of T_j.

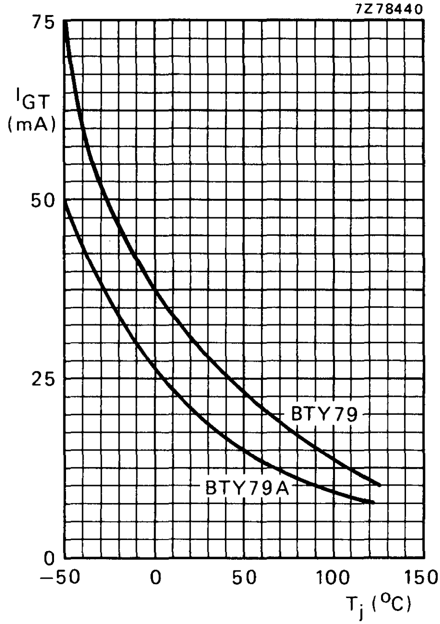


Fig. 7 Minimum gate current that will trigger all devices as a function of T_j.

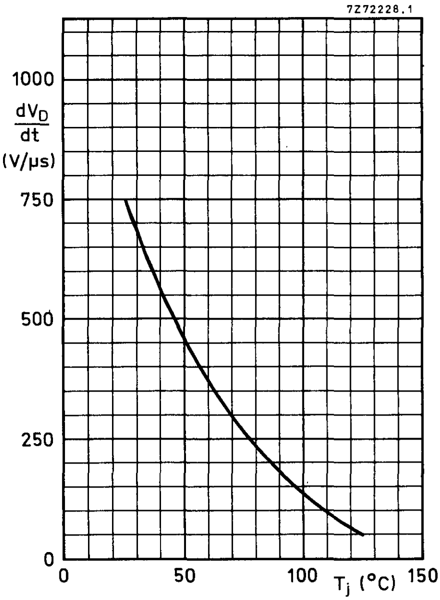


Fig. 8 Maximum rate of rise of off-state voltage that will not trigger any device (exponential method) as a function of T_j.

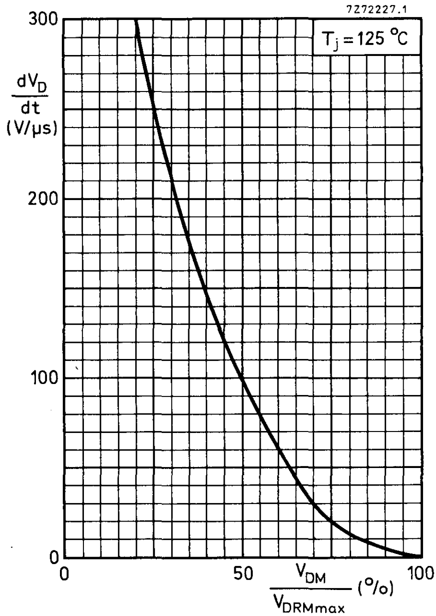
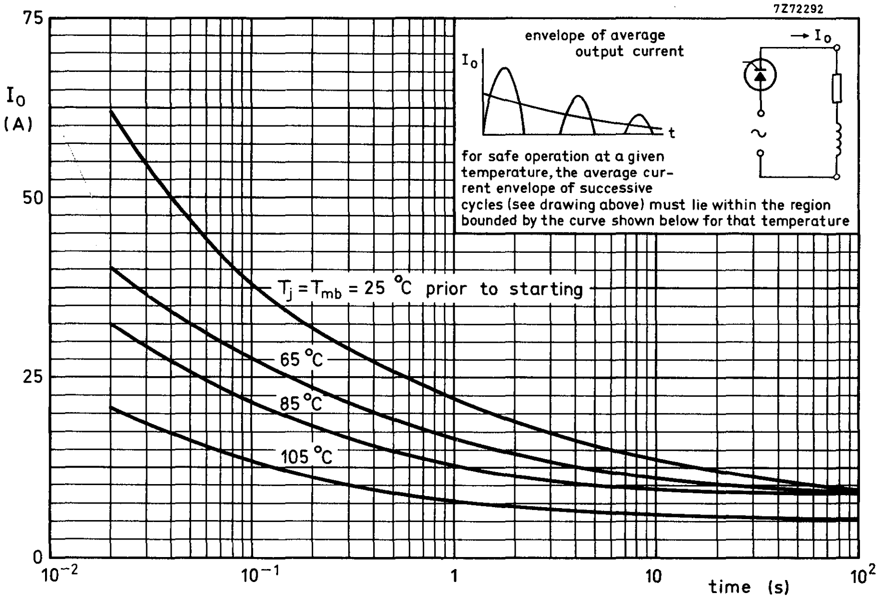


Fig. 9 Maximum rate of rise of off-state voltage that will not trigger any device (exponential method) as a function of applied voltage.



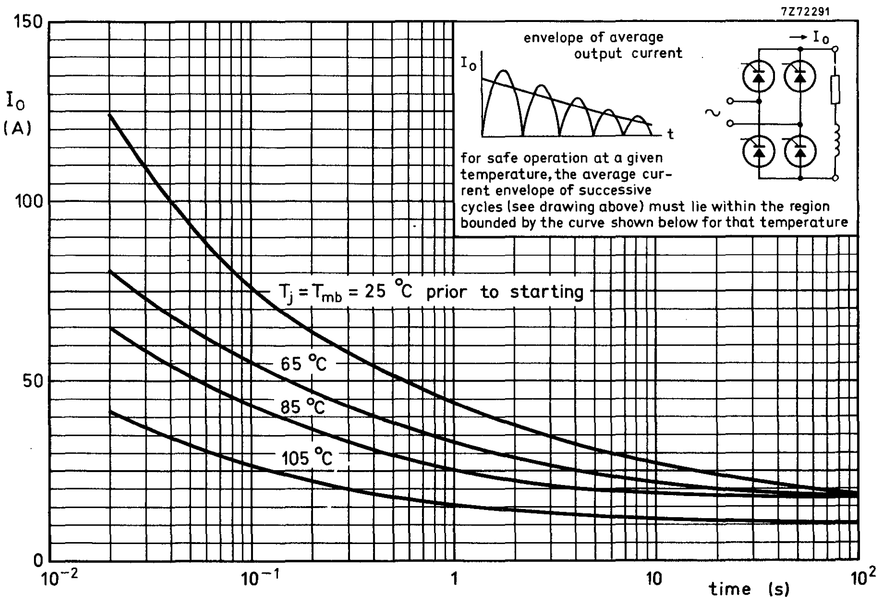


Fig. 10 Limits for starting or inrush currents.

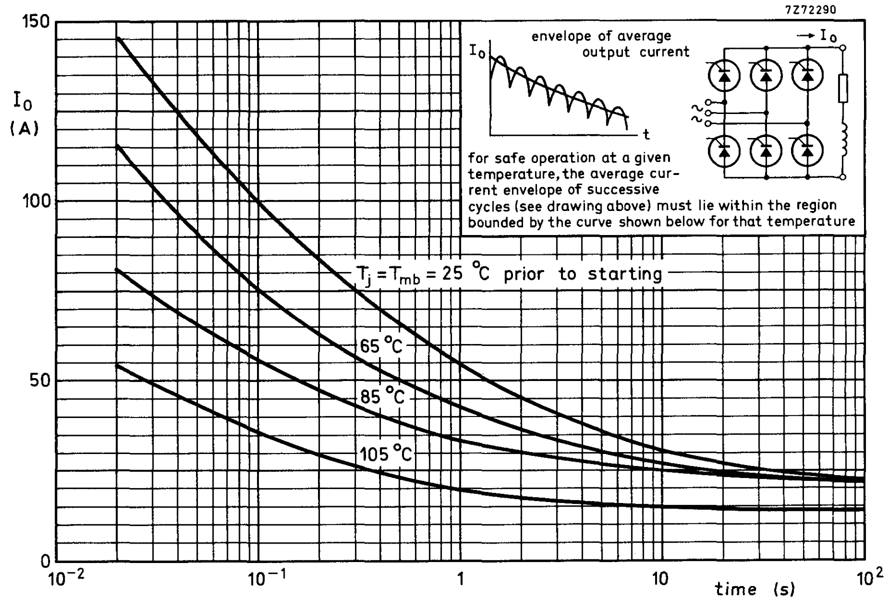


Fig. 11 Limits for starting or inrush currents.

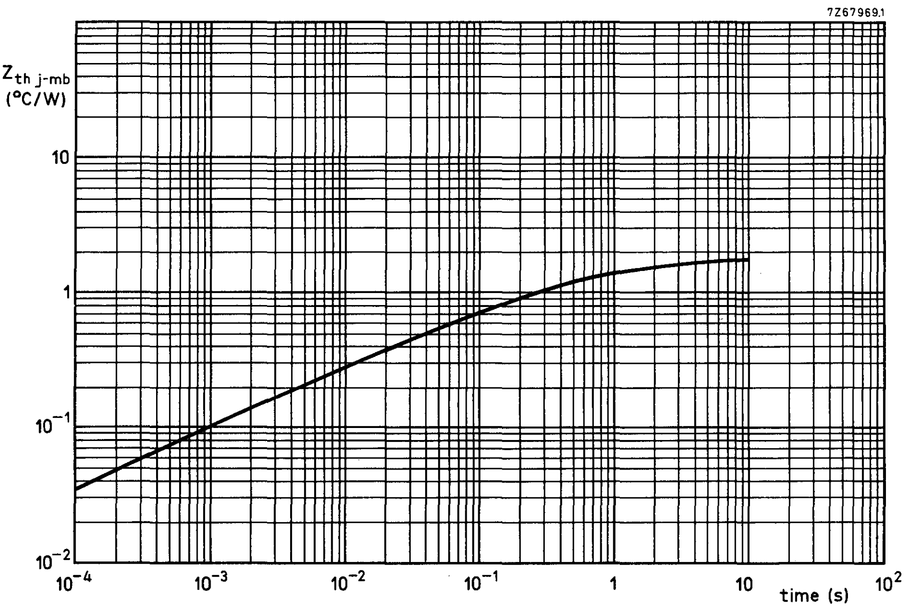


Fig. 12.

THYRISTORS

Silicon thyristors in metal envelopes, intended for power control and power switching applications. The series consists of reverse polarity types (anode to stud) identified by a suffix R: BTY87-400R to 800R.

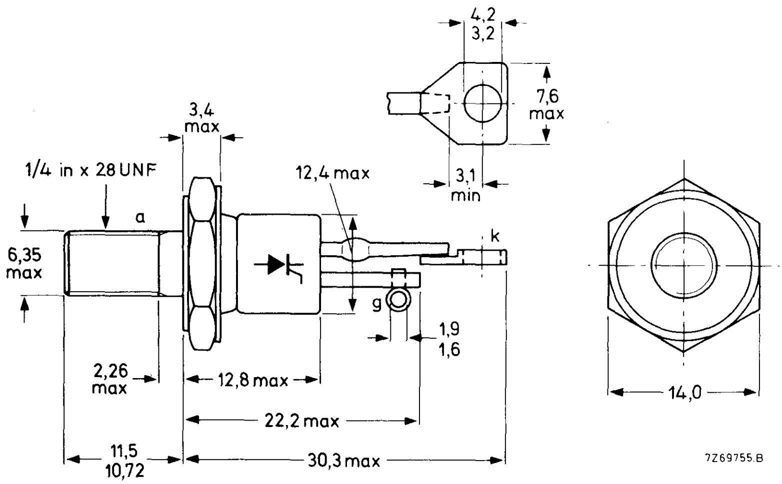
QUICK REFERENCE DATA

			BTY87-400R	500R	600R	800R	
Repetitive peak voltages	V_{DRM}/V_{RRM}	max.	400	500	600	800	V
Average on-state current	$I_{T(AV)}$	max.	16				A
R.M.S. on-state current	$I_{T(RMS)}$	max.	25				A
Non-repetitive peak on-state current	I_{TSM}	max.	140				A

MECHANICAL DATA

Dimensions in mm

Fig. 1 TO-48: with ¼ in x 28 UNF stud (ϕ 6,35 mm).



Net mass: 14 g
Diameter of clearance hole: max. 6,5 mm
Accessories supplied on request: 56264A
(mica washer, insulating ring, soldering tag)

Torque on nut: min. 1,7 Nm (17 kg cm)
max. 3,5 Nm (35 kg cm)
Supplied with the device:
1 nut, 1 lock washer
Nut dimensions across the flats: 11,1 mm

RATINGS

Limiting values in accordance with the Absolute Maximum System (IEC 134)

Anode to cathode

			BTY87-400R	500R	600R	800R	
Non-repetitive peak off-state voltage ($t \leq 10$ ms)	V_{DSM}	max.	500	850	850	850	V
Non-repetitive peak reverse voltage ($t \leq 5$ ms)	V_{RSM}	max.	500	600	850	960	V
Repetitive peak voltages	V_{DRM}/V_{RRM}	max.	400	500	600	800	V
Crest working voltages	V_{DWM}/V_{RWM}	max.	400	500	600	800	V *

Average on-state current (averaged over any 20 ms period) up to T_{mb} = 52 °C	$I_{T(AV)}$	max.	16	A
at T_{mb} = 85 °C	$I_{T(AV)}$	max.	10	A
R.M.S. on-state current	$I_{T(RMS)}$	max.	25	A
Repetitive peak on-state current	I_{TRM}	max.	140	A
Non-repetitive peak on-state current; t = 10 ms; half sine-wave; T_j = 125 °C prior to surge; with reapplied V_{RWMmax}	I_{TSM}	max.	140	A
I^2t for fusing (t = 10 ms)	I^2t	max.	100	A^2s
Rate of rise of on-state current after triggering with I_G = 325 mA to I_T = 50 A	dI_T/dt	max.	20	A/µs

Gate to cathode

Reverse peak voltage	V_{RGM}	max.	5	V
Average power dissipation (averaged over any 20 ms period)	$P_{G(AV)}$	max.	0,5	W
Peak power dissipation	P_{GM}	max.	5	W

Temperatures

Storage temperature	T_{stg}	−55 to + 125		°C
Junction temperature	T_j	max.	125	°C

THERMAL RESISTANCE

From junction to mounting base	$R_{th\ j\text{-}mb}$	=	1,6	°C/W
From mounting base to heatsink with heatsink compound	$R_{th\ mb\text{-}h}$	=	0,2	°C/W
Transient thermal impedance (t = 1 ms)	$Z_{th\ j\text{-}mb}$	=	0,09	°C/W

OPERATING NOTE

The terminals should neither be bent nor twisted; they should be soldered into the circuit so that there is no strain on them.
During soldering the heat conduction to the junction should be kept to a minimum.

* To ensure thermal stability: $R_{th\ j\text{-}a} < 4,5$ °C/W (d.c. blocking) or < 9 °C/W (a.c.). For smaller heatsinks $T_{j\ max}$ should be derated. For a.c. see Fig. 3.

CHARACTERISTICS

Anode to cathode

On-state voltage I_T = 50 A; T_j = 25 °C	V_T	<	3 V *
Rate of rise of off-state voltage that will not trigger any device; exponential method; V_D = 2/3 V_{DRMmax}; T_j = 125 °C	dV_D/dt	<	20 V/µs
Reverse current $V_R = V_{RWMmax}$; T_j = 125 °C	I_R	<	3 mA
Off-state current $V_D = V_{DWMmax}$; T_j = 125 °C	I_D	<	3 mA
Latching current; T_j = 25 °C	I_L	typ.	20 mA
Holding current; T_j = 25 °C	I_H	typ.	10 mA

Gate to cathode

Voltage that will trigger all devices V_D = 6 V; T_j = 25 °C	V_{GT}	>	3,5 V
Voltage that will not trigger any device $V_D = V_{DRMmax}$; T_j = 125 °C	V_{GD}	<	200 mV
Current that will trigger all devices V_D = 6 V; T_j = 25 °C	I_{GT}	>	65 mA

Switching characteristics

Gate-controlled turn-on time ($t_{gt} = t_d + t_r$) when switched from V_D = 400 V to I_T = 50 A; I_{GT} = 200 mA; T_j = 25 °C	t_{gt}	typ.	2 µs

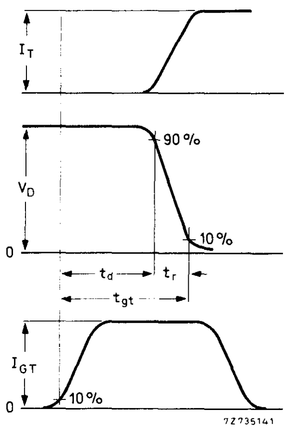


Fig. 2 Gate-controlled turn-on time definitions.

* Measured under pulse conditions to avoid excessive dissipation.

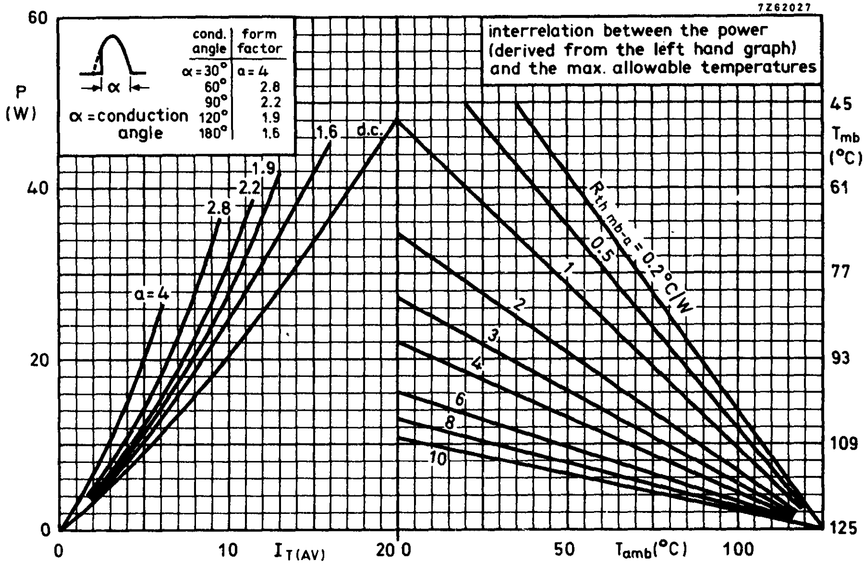

7Z62027
P
(W)
cond. angle | form factor
α = 30° | a = 4
60° | 2.8
90° | 2.2
120° | 1.9
180° | 1.6
α = conduction angle
interrelation between the power (derived from the left hand graph) and the max. allowable temperatures
a = 4
2.8
2.2
1.9
1.6
d.c.
R th mb-a = 0.2°C/W
0.5
1
2
3
4
6
8
10
T mb (°C)
45
61
77
93
109
125
60
40
20
0
0
10
I T(AV)
20
0
50
T amb (°C)
100

Fig. 3.

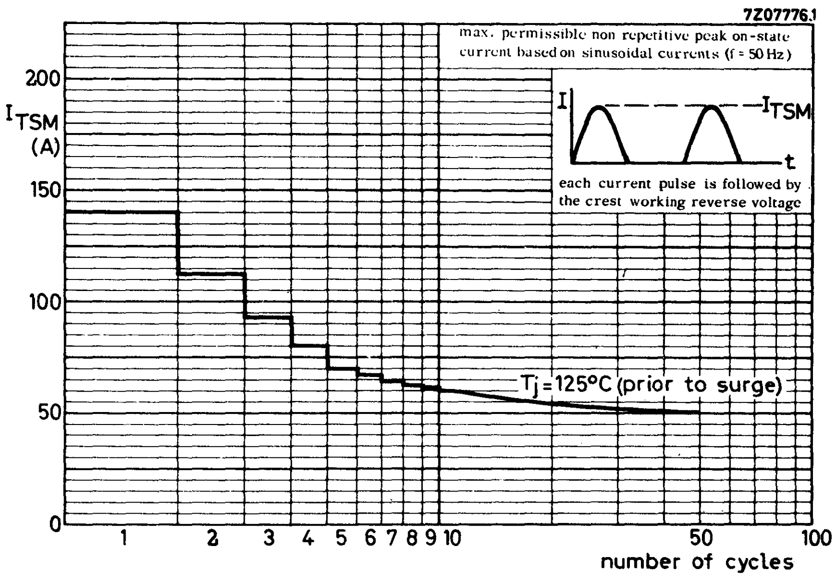

7Z07776.1
max. permissible non repetitive peak on-state current based on sinusoidal currents (f = 50 Hz)
I
I TSM
t
each current pulse is followed by the crest working reverse voltage
I TSM (A)
200
150
100
50
0
Tj = 125°C (prior to surge)
1
2
3
4
5
6
7
8
9
10
50
100
number of cycles

Fig. 4.

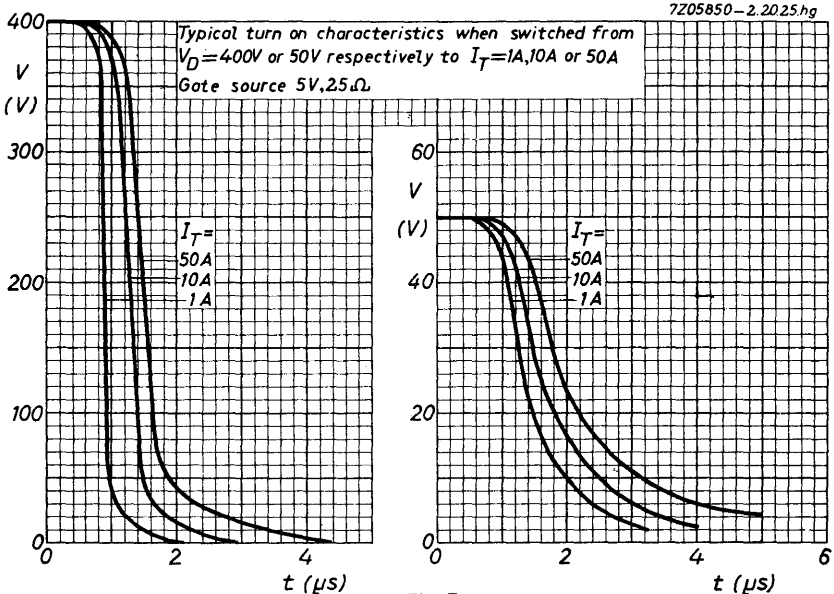

7Z05850–2.20.25.hg
Typical turn on characteristics when switched from
V_D=400V or 50V respectively to I_T=1A,10A or 50A
Gate source 5V,25Ω
400
300
200
100
0
V
(V)
I_T=
50A
10A
1A
0
2
4
t (µs)
60
40
20
0
V
(V)
I_T=
50A
10A
1A
0
2
4
6
t (µs)

Fig. 5.

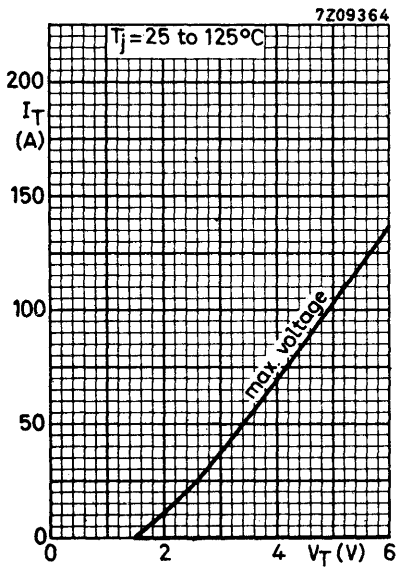
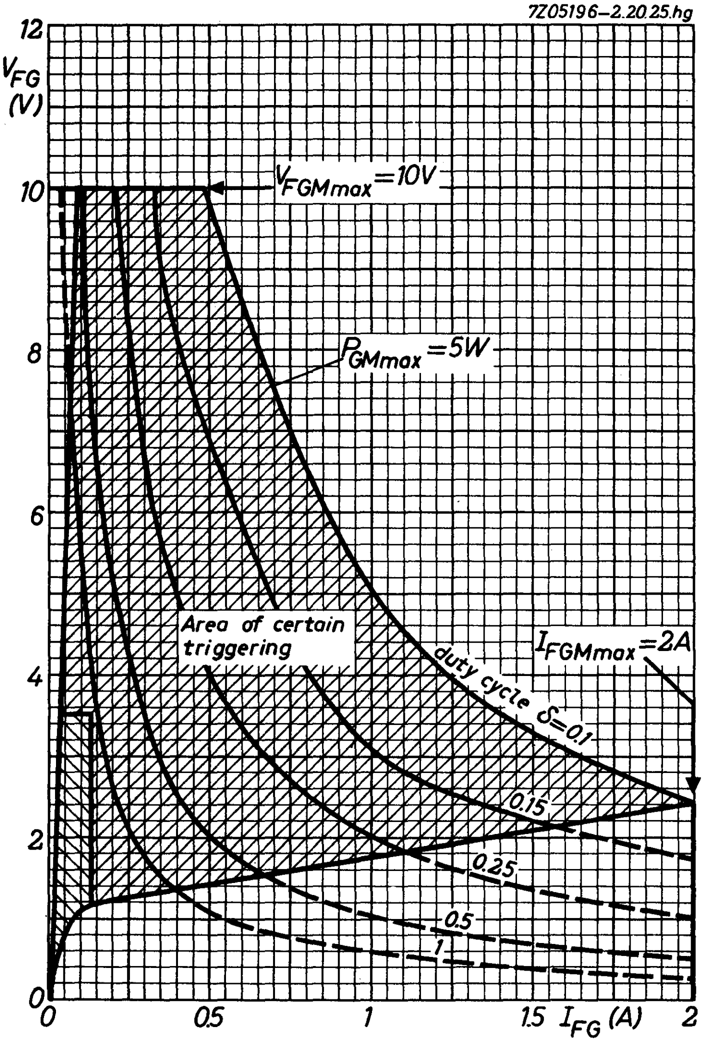

7Z09364
T_j=25 to 125°C
200
150
100
50
0
I_T
(A)
max. voltage
0
2
4
V_T (V)
6

Fig. 6.



Gate characteristics with curves P_{GAV}=0.5W

Fig. 7.

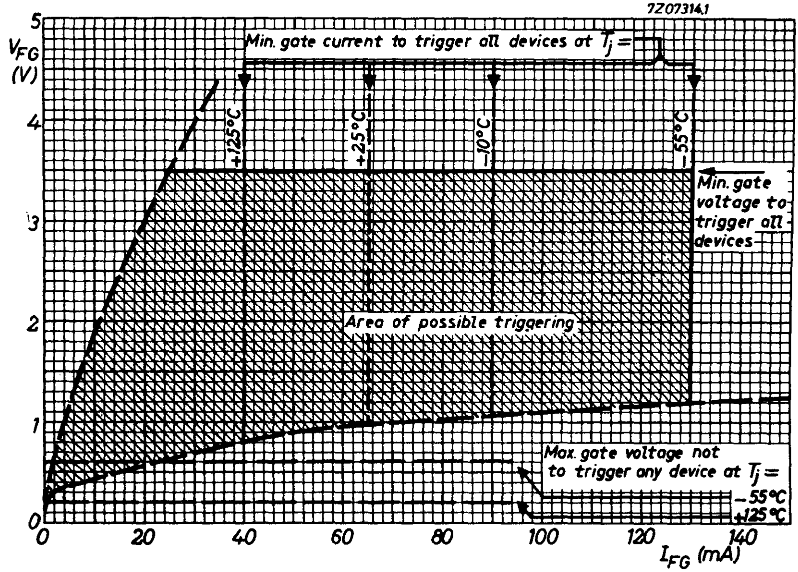

7Z07314.1
V_{FG} (V)
Min. gate current to trigger all devices at T_j =
+125°C
+25°C
−10°C
−55°C
Min. gate voltage to trigger all devices
Area of possible triggering
Max. gate voltage not to trigger any device at T_j =
−55°C
+125°C
I_{FG} (mA)
0
20
40
60
80
100
120
140
1
2
3
4
5

Fig. 8.

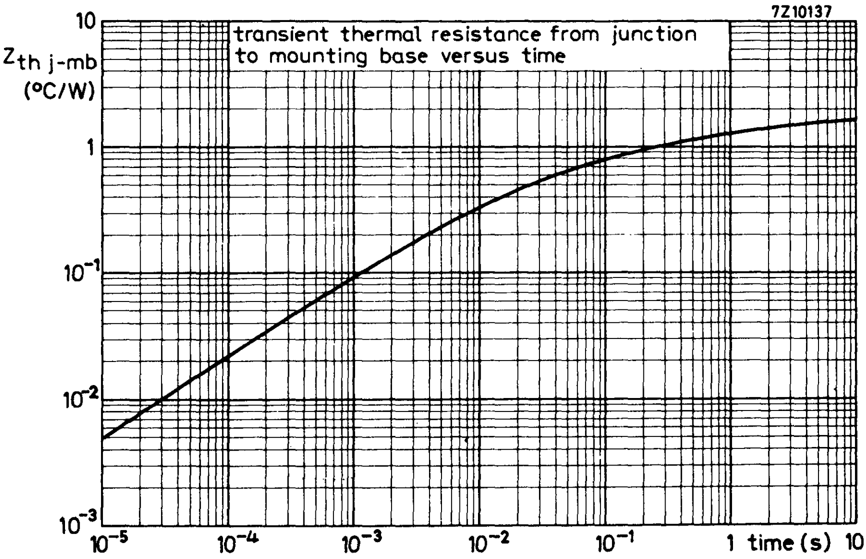

7Z10137
$Z_{th\ j\text{-}mb}$ (°C/W)
transient thermal resistance from junction to mounting base versus time
10
1
10^{-1}
10^{-2}
10^{-3}
10^{-5}
10^{-4}
10^{-3}
10^{-2}
10^{-1}
1
time (s)
10

Fig. 9.

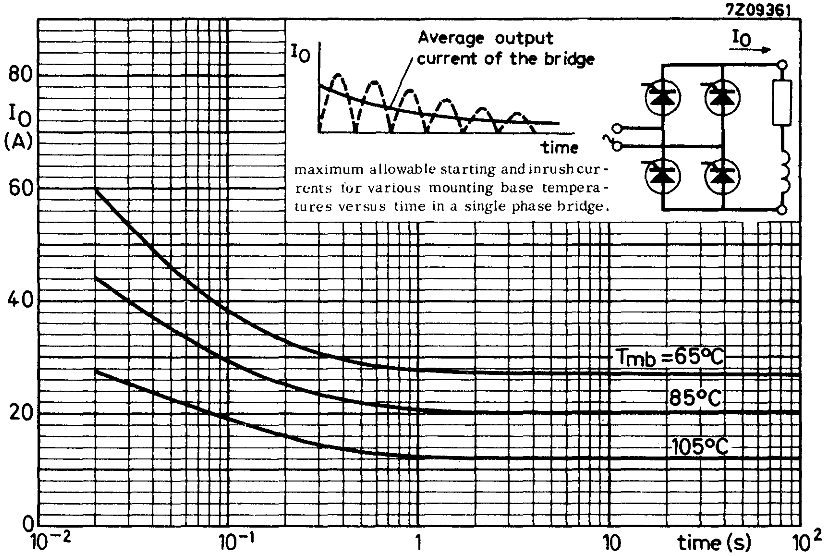

7Z09361
Average output current of the bridge
IO
time
maximum allowable starting and inrush currents for various mounting base temperatures versus time in a single phase bridge.
80
IO
(A)
60
40
20
0
10⁻²
10⁻¹
1
10
time (s)
10²
Tmb = 65°C
85°C
105°C

Fig. 10.

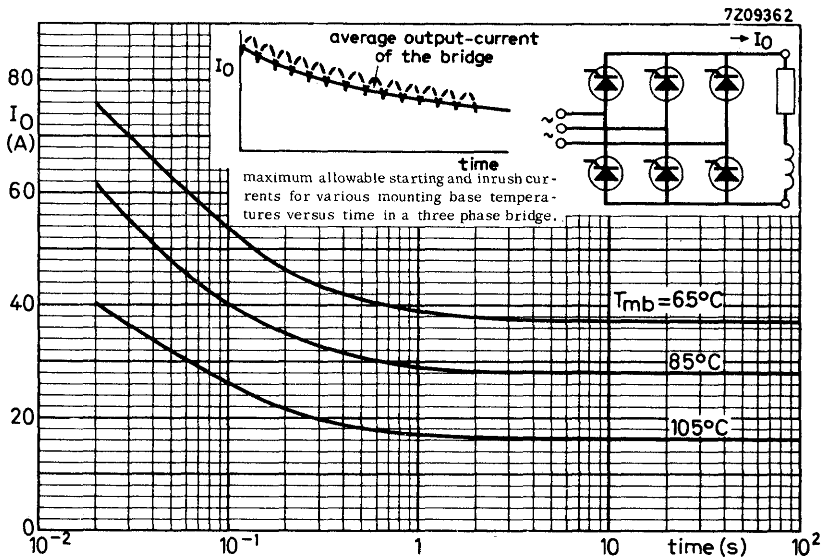

7Z09362
average output-current of the bridge
IO
time
maximum allowable starting and inrush currents for various mounting base temperatures versus time in a three phase bridge.
80
IO
(A)
60
40
20
0
10⁻²
10⁻¹
1
10
time (s)
10²
Tmb = 65°C
85°C
105°C

Fig. 11.

THYRISTORS

Silicon thyristors in metal envelopes, intended for power control and power switching applications. The series consists of reverse polarity types (anode to stud) identified by a suffix R: BTY91-400R to 800R.

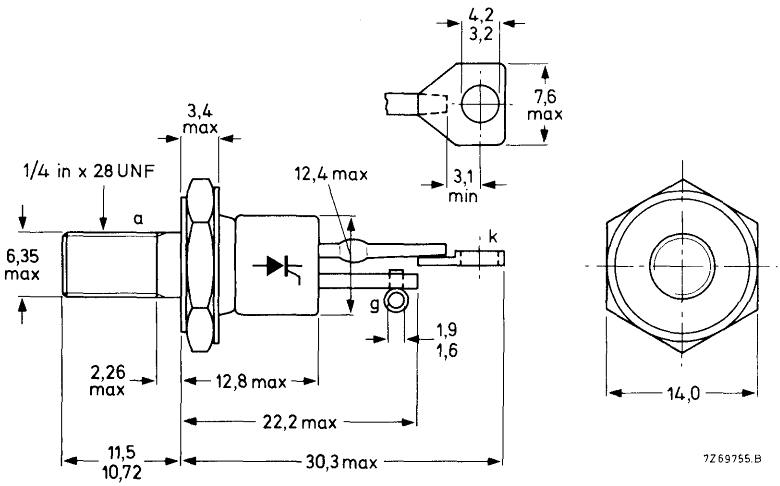
QUICK REFERENCE DATA

			BTY91-400R	500R	600R	800R	
Repetitive peak voltages	V_{DRM}/V_{RRM}	max.	400	500	600	800	V
Average on-state current	$I_{T(AV)}$	max.				16	A
R.M.S. on-state current	$I_{T(RMS)}$	max.				25	A
Non-repetitive peak on-state current	I_{TSM}	max.				200	A

MECHANICAL DATA

Dimensions in mm

Fig. 1 TO-48: with ¼ in x 28 UNF stud (ϕ 6,35 mm).



Net mass: 14 g
Diameter of clearance hole: max. 6,5 mm
Accessories supplied on request: 56264A
(mica washer, insulating ring, soldering tag)

Torque on nut: min. 1,7 Nm (17 kg cm)
max. 3,5 Nm (35 kg cm)
Supplied with the device:
1 nut, 1 lock washer
Nut dimensions across the flats: 11,1 mm

RATINGS

Limiting values in accordance with the Absolute Maximum System (IEC 134)

Anode to cathode			BTY91-400R	500R	600R	800R	
Non-repetitive peak off-state voltage ($t \leqslant 10$ ms)	V_{DSM}	max.	500	850	850	850	V
Non-repetitive peak reverse voltage ($t \leqslant 5$ ms)	V_{RSM}	max.	500	600	720	960	V
Repetitive peak voltages	V_{DRM}/V_{RRM}	max.	400	500	600	800	V
Crest working voltages	V_{DWM}/V_{RWM}	max.	400	500	600	800	V *

Average on-state current (averaged over any 20 ms period) up to T_{mb} = 77 °C	$I_{T(AV)}$	max.	16	A
at T_{mb} = 85 °C	$I_{T(AV)}$	max.	14	A
R.M.S. on-state current	$I_{T(RMS)}$	max.	25	A
Repetitive peak on-state current	I_{TRM}	max.	200	A
Non-repetitive peak on-state current; t = 10 ms; half sine-wave; T_j = 125 °C prior to surge; with reapplied V_{RWMmax}	I_{TSM}	max.	200	A
I^2t for fusing (t = 10 ms)	I^2t	max.	200	A^2s
Rate of rise of on-state current after triggering with I_G = 200 mA to I_T = 50 A	dI_T/dt	max.	20	A/μs

Gate to cathode

Reverse peak voltage	V_{RGM}	max.	5	V
Average power dissipation (averaged over any 20 ms period)	$P_{G(AV)}$	max.	0,5	W
Peak power dissipation	P_{GM}	max.	5	W

Temperatures

Storage temperature	T_{stg}		−55 to + 125	°C
Junction temperature	T_j	max.	125	°C

THERMAL RESISTANCE

From junction to mounting base	$R_{th\ j\text{-}mb}$	=	1,6	°C/W
From mounting base to heatsink with heatsink compound	$R_{th\ mb\text{-}h}$	=	0,2	°C/W
Transient thermal impedance (t = 1 ms)	$Z_{th\ j\text{-}mb}$	=	0,09	°C/W

OPERATING NOTE

The terminals should neither be bent nor twisted; they should be soldered into the circuit so that there is no strain on them.

During soldering the heat conduction to the junction should be kept to a minimum.

* To ensure thermal stability: $R_{th\ j\text{-}a} < 4,5$ °C/W (d.c. blocking) or < 9 °C/W (a.c.). For smaller heatsinks $T_{j\ max}$ should be derated. For a.c. see Fig. 3.

CHARACTERISTICS

Anode to cathode

On-state voltage $I_T = 50$ A; $T_j = 25$ °C	V_T	<	2 V *
Rate of rise of off-state voltage that will not trigger any device; exponential method; $V_D = 2/3\ V_{DRMmax}$; $T_j = 125$ °C	dV_D/dt	<	20 V/μs
Reverse current $V_R = V_{RWMmax}$; $T_j = 125$ °C	I_R	<	3 mA
Off-state current $V_D = V_{DWMmax}$; $T_j = 125$ °C	I_D	<	3 mA
Latching current; $T_j = 25$ °C	I_L	typ.	20 mA
Holding current; $T_j = 25$ °C	I_H	typ.	10 mA

Gate to cathode

Voltage that will trigger all devices $V_D = 6$ V; $T_j = 25$ °C	V_{GT}	>	3 V
Voltage that will not trigger any device $V_D = V_{DRMmax}$; $T_j = 125$ °C	V_{GD}	<	200 mV
Current that will trigger all devices $V_D = 6$ V; $T_j = 25$ °C	I_{GT}	>	40 mA

Switching characteristics

Gate-controlled turn-on time ($t_{gt} = t_d + t_r$) when switched from $V_D = 400$ V to $I_T = 10$ A; $I_{GT} = 200$ mA; $T_j = 25$ °C	t_{gt}	typ.	2 μs

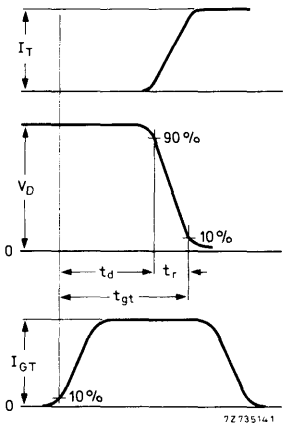


Fig. 2 Gate-controlled turn-on time definitions.

* Measured under pulse conditions to avoid excessive dissipation.

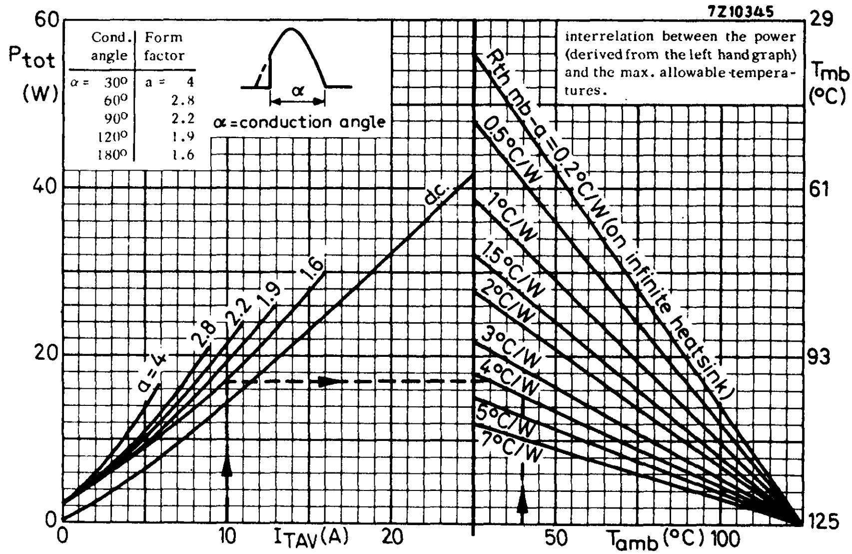

7Z10345
Cond. angle
Form factor
α = 30° a = 4
60° 2.8
90° 2.2
120° 1.9
180° 1.6
α
α = conduction angle
interrelation between the power (derived from the left hand graph) and the max. allowable temperatures.
Ptot (W)
Tmb (°C)
a = 4
2.8
2.2
1.9
1.6
d.c.
Rth mb-a = 0.2°C/W (on infinite heatsink)
0.5°C/W
1°C/W
1.5°C/W
2°C/W
3°C/W
4°C/W
5°C/W
7°C/W
ITAV (A)
Tamb (°C)
0
10
20
40
50
60
100
29
61
93
125

Fig. 3.

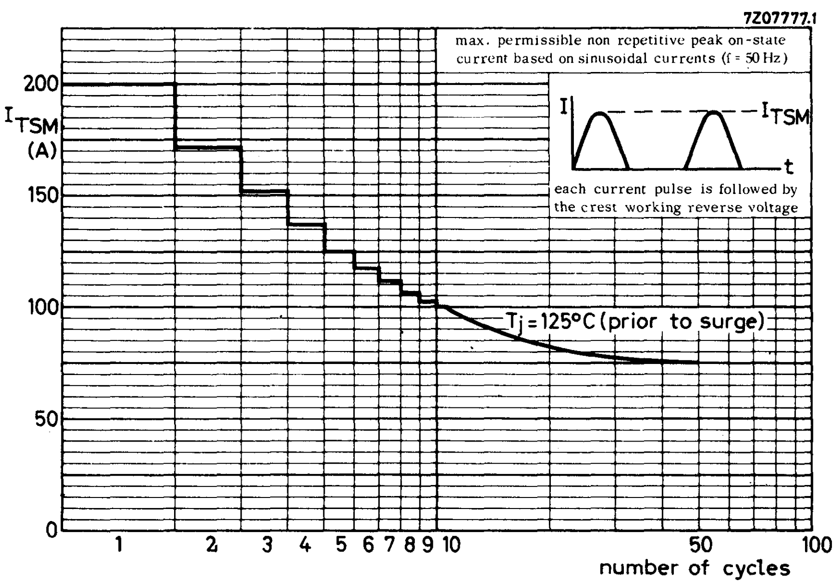

7Z07777.1
max. permissible non repetitive peak on-state current based on sinusoidal currents (f = 50 Hz)
I
ITSM
t
each current pulse is followed by the crest working reverse voltage
ITSM (A)
Tj = 125°C (prior to surge)
0
50
100
150
200
1
2
3
4
5
6
7
8
9
10
50
100
number of cycles

Fig. 4.

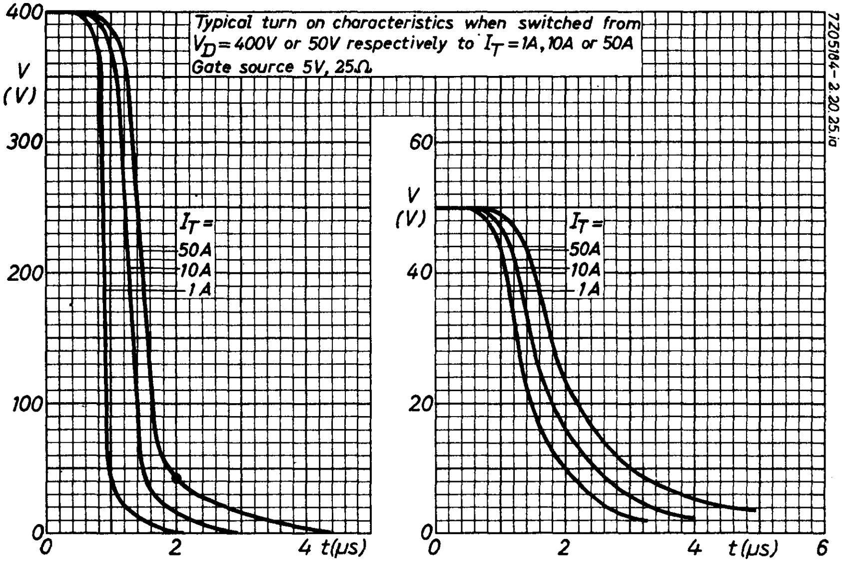

Typical turn on characteristics when switched from V_D = 400V or 50V respectively to I_T = 1A, 10A or 50A
Gate source 5V, 25Ω
7Z05184–2.20.25.ia
V (V)
400
300
200
100
0
I_T =
50A
10A
1A
0
2
4 t(μs)
60
40
20
0
6

Fig. 5.

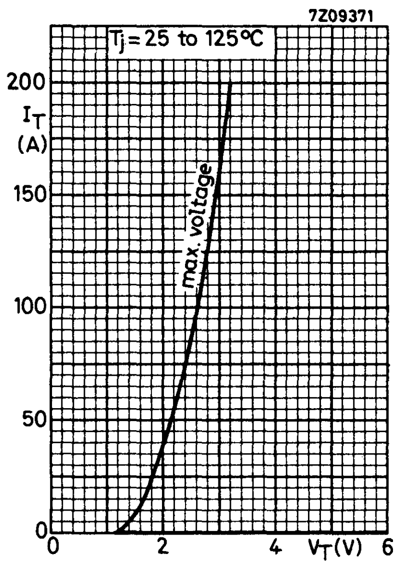

7Z09371
Tj = 25 to 125 °C
I_T (A)
200
150
100
50
0
max. voltage
0
2
4
V_T(V)
6

Fig. 6.

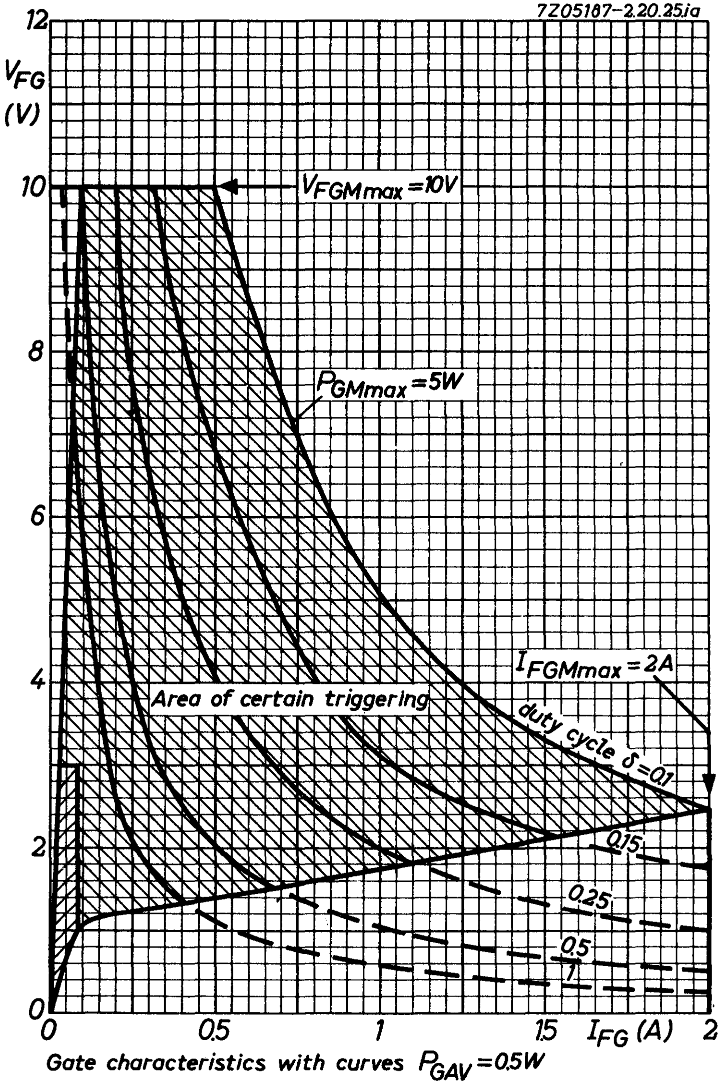

7Z05187-2.20.25.ia
12
V_{FG}
(V)
10
V_{FGMmax} = 10V
8
P_{GMmax} = 5W
6
4
I_{FGMmax} = 2A
Area of certain triggering
duty cycle δ = 0.1
2
0.15
0.25
0.5
1
0
0
0.5
1
1.5
I_{FG} (A)
2
Gate characteristics with curves P_{GAV} = 0.5W

Fig. 7.

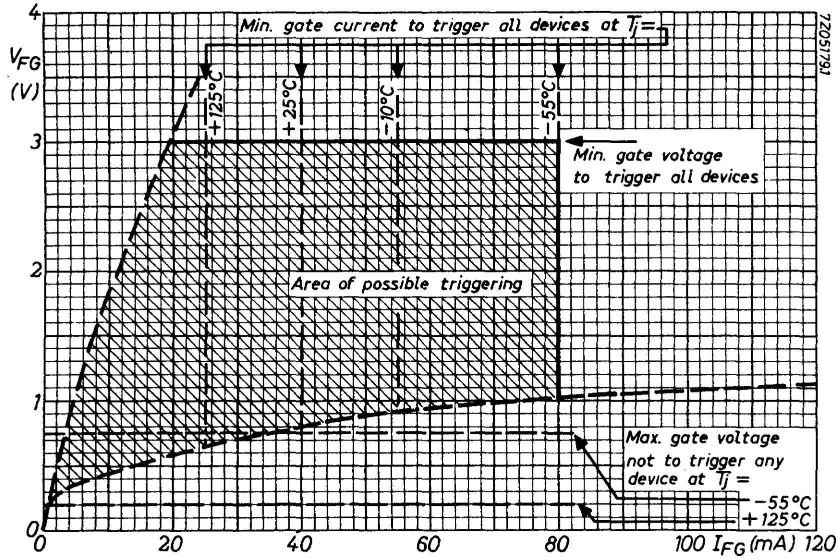

7Z05791
V_{FG} (V)
Min. gate current to trigger all devices at T_j =
+125°C
+25°C
−10°C
−55°C
Min. gate voltage to trigger all devices
Area of possible triggering
Max. gate voltage not to trigger any device at T_j =
−55°C
+125°C
I_{FG} (mA)
0
20
40
60
80
100
120
1
2
3
4

Fig. 8.

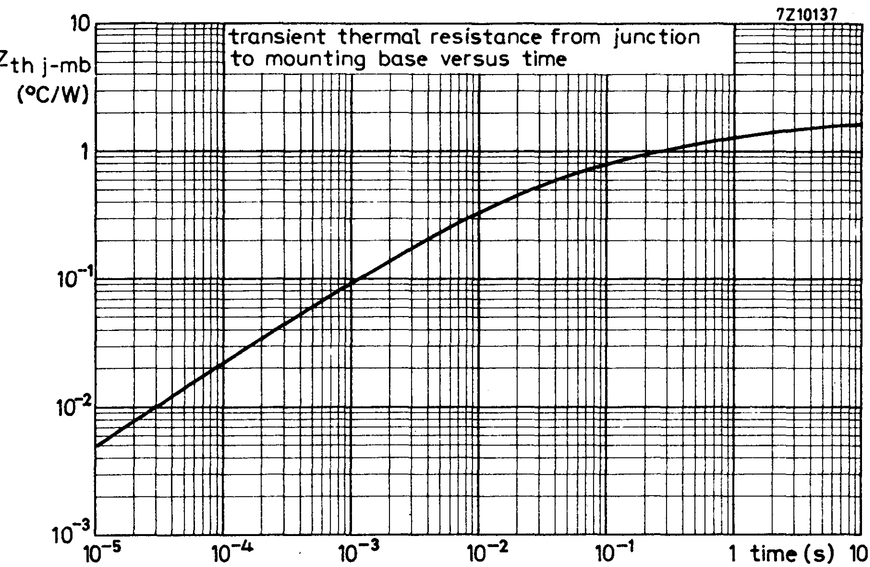

7Z10137
$Z_{th\ j\text{-}mb}$ (°C/W)
transient thermal resistance from junction to mounting base versus time
time (s)
10
1
10^{-1}
10^{-2}
10^{-3}
10^{-5}
10^{-4}
10^{-3}
10^{-2}
10^{-1}
1
10

Fig. 9.

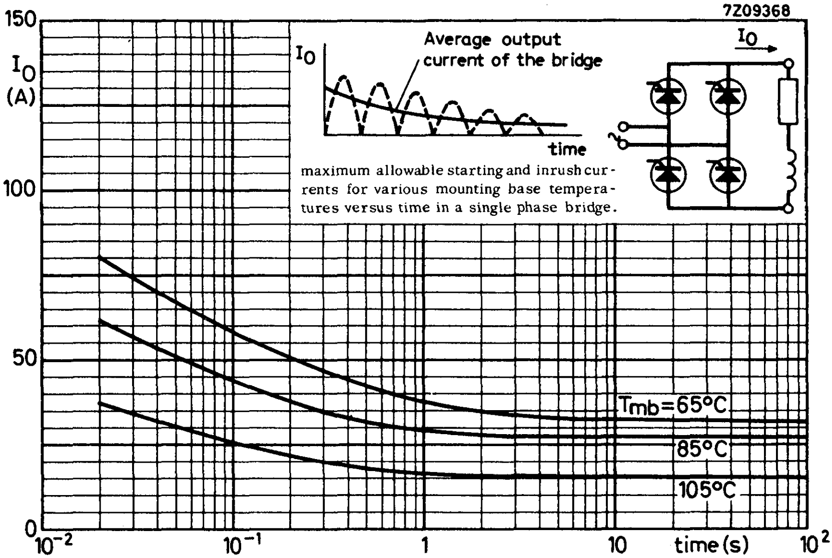

7Z09368
150
I_O
(A)
100
50
0
10^{-2}
10^{-1}
1
10
time (s)
10^2
Average output
current of the bridge
I_O
time
maximum allowable starting and inrush currents for various mounting base temperatures versus time in a single phase bridge.
T_{mb}=65°C
85°C
105°C

Fig. 10.

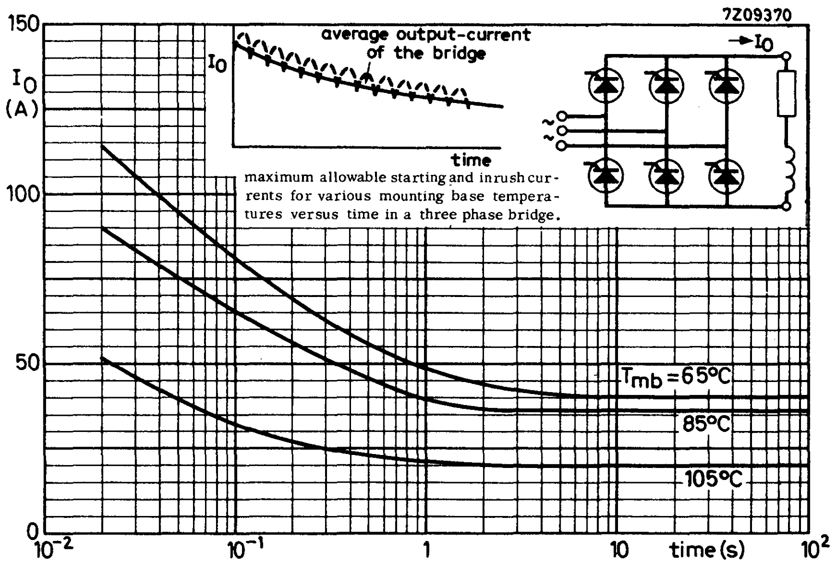

7Z09370
150
I_O
(A)
100
50
0
10^{-2}
10^{-1}
1
10
time (s)
10^2
average output-current
of the bridge
I_O
time
maximum allowable starting and inrush currents for various mounting base temperatures versus time in a three phase bridge.
T_{mb}=65°C
85°C
105°C

Fig. 11.

TRIACS

F

F

TRIACS

SWITCHING CHARACTERISTICS

Triacs are not perfect switches. They take a finite time to go from the off to the on-state and vice-versa. At frequencies up to about 400 Hz these effects can often be ignored, but in many applications involving fast switching action the departure from the ideal is important.

Gate-controlled turn-on time

Anode current does not commence flowing at the instant the gate current is applied.
There is a period which elapses between the application of gate current and the onset of anode current known as delay time (t_d). The rise time of anode current is known as t_r and is measured as the time for the anode voltage to fall from 90% to 10% of its initial value.
The conditions which need to be specified are:

a) Off-state voltage (V_D).

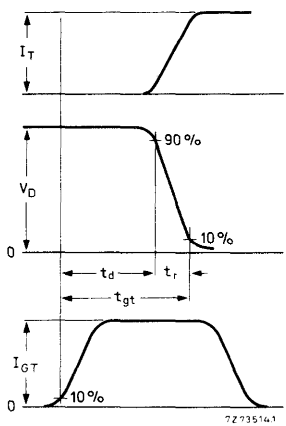
b) On-state current (I_T).

c) Gate trigger current (I_G) – high gate currents reduce turn-on time.

d) Rate of rise of gate trigger current (dI_G/dt) – high values reduce turn-on time.

e) Junction temperature (T_j) – high temperatures reduce turn-on time.

The waveforms are shown in the following diagram:



COMMUTATION dV_{com}/dt

When a triac has been conducting current in one direction and is then required to block voltage in the other, it is faced with a difficult task. Reverse recovery current adds to the capacitive current from the reapplied dV_D/dt in such a fashion that the device's ability to withstand high rates of reapplication of voltage is impaired. For this reason the commutation dV_D/dt is invariably worse than the static dV_D/dt.

The conditions which need to be specified are:

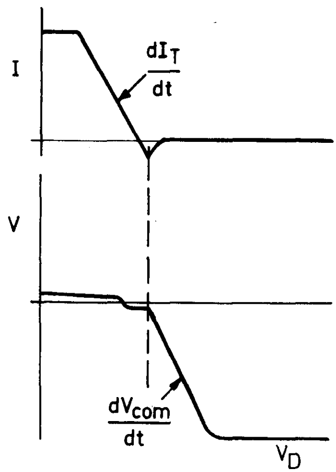
a) R.M.S. current ($I_{T(RMS)}$) – high currents make commutation harder.

b) Re-applied off-state voltage (V_D), normally V_{DRM} max. – high voltage will make commutation harder.

c) Temperature (T_j or T_{mb}) – high temperatures make commutation harder.

d) $-dI/dt$ – high rates of change make commutation harder.

The waveforms are shown in the following diagram:



MOUNTING INSTRUCTIONS FOR TO-220 ENVELOPES

GENERAL DATA AND INSTRUCTIONS FOR HEATSINK OPERATION

General rules

1. First fasten the devices to the heatsink before soldering the leads.
2. Use of heatsink compound is recommended.
3. Avoid axial stress to the leads.
4. Keep mounting tool (e.g. screwdriver) clear of the plastic body.
5. It is recommended that the circuit connections be made to the leads rather than direct to the heatsink.

Heatsink requirements

Flatness in the mounting area: 0,02 mm maximum per 10 mm.
Mounting holes must be deburred.

Heatsink compound

Values of the thermal resistance from mounting base to heatsink ($R_{th\ mb\text{-}h}$) given for mounting with heatsink compound refer to the use of a metallic oxide-loaded compound. The compound should be an electrical insulator and be applied sparingly and evenly to both interfaces. Ordinary silicone grease is not recommended.

For insulated mounting, the compound should be applied to the bottom of both device and insulator.

Mounting methods for thyristors and triacs

1. Clip mounting.

   Mounting by means of spring clip offers:

   a. A good thermal contact under the crystal area, and slightly lower $R_{th\ mb\text{-}h}$ values than screw mounting.

   b. Safe insulation for mains operation.

   Recommended force of clip on device is 120 N (12 kgf).

2. M3 screw mounting.

   Care should be taken to avoid damage to the plastic body. It is therefore recommended that a cross-recess pan-headed screw be used. Do not use self-tapping screws.

   Mounting torque for screw mounting:

Minimum torque (for good heat transfer)	0,55 Nm (5,5 kgcm)
Maximum torque (to avoid damaging the device)	0,80 Nm (8,0 kgcm)

   N.B.: When a nut or screw is not driven direct against a curved spring washer or lock washer, the torques are as follows:

Minimum torque (for good heat transfer)	0,4 Nm (4 kgcm)
Maximum torque (to avoid damaging the device)	0,6 Nm (6 kgcm)

   N.B.: Data on accessories are given in separate data sheets.

3. Rivet mounting (only possible for non-insulated mounting)

   Devices may be rivetted to flat heatsinks; such a process **must neither** deform the mounting tab, **nor** enlarge the mounting hole.

GENERAL DATA AND INSTRUCTIONS FOR HEATSINK OPERATION (continued)

Thermal data

			clip mounting	screw mounting	
Thermal resistance from mounting base to heatsink					
with heatsink compound, direct mounting	$R_{th\ mb\text{-}h}$	=	0,3	0,5	°C/W
without heatsink compound, direct mounting	$R_{th\ mb\text{-}h}$	=	1,4	1,4	°C/W
with heatsink compound and mica insulator 56369	$R_{th\ mb\text{-}h}$	=	2,2	–	°C/W
with heatsink compound and alumina insulator 56367	$R_{th\ mb\text{-}h}$	=	0,8	–	°C/W

Lead bending

Maximum permissible tensile force on the body, for 5 seconds is 5 N (0,5 kgf).

The leads can be bent through 90° maximum, twisted or straightened. To keep forces within the above-mentioned limits, the leads are generally clamped near the body. The leads should neither be bent nor twisted less than 2,4 mm from the body.

Soldering

Lead soldering temperature at 4,7 mm from the body; $t_{sld} < 5$ s: $T_{sld\ max} = 275$ °C.

Avoid any force on body and leads during or after soldering: do not move the device or leads after soldering.

It is not permitted to solder the metal tab of the device to a heatsink, otherwise its junction temperature rating will be exceeded.

INSTRUCTIONS FOR CLIP MOUNTING (TO–220 envelopes)

Direct mounting with clip 56363

1. Place the device on the heatsink, applying heatsink compound to the mounting base.
2. Push the short end of the clip into the narrow slot in the heatsink with the clip at an angle of 10° to 30° to the vertical (see Fig. 1).
3. Push down the clip over the device until the long end of the clip snaps into the wide slot in the heatsink. The clip should bear on the plastic body, not on the tab (see Fig. 1(c)).

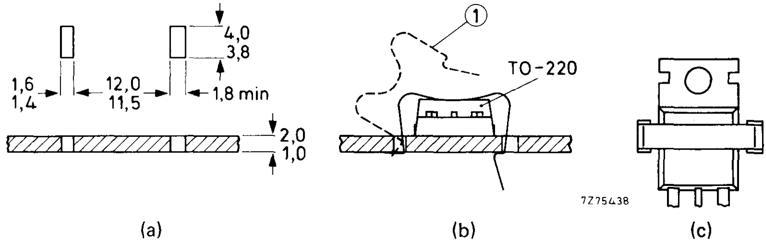


Fig. 1 (a) Heatsink requirements; (b) mounting (1 = spring clip); (c) position of the device (top view).

Insulated mounting with clip 56364

With the insulators 56367 or 56369 insulation up to 2 kV is obtained.

1. Place the device with the insulator on the heatsink, applying heatsink compound to the bottom of both device and insulator.
2. Push the short end of the clip into the narrow slot in the heatsink with the clip at an angle of 10° to 30° to the vertical (see Fig. 2).
3. Push down the clip over the device until the long end of the clip snaps into the wide slot in the heatsink. The clip should bear on the plastic body, not on the tab (see Fig. 2(c)). There should be minimum 3 mm distance between the device and the edge of the insulator for adequate creepage.

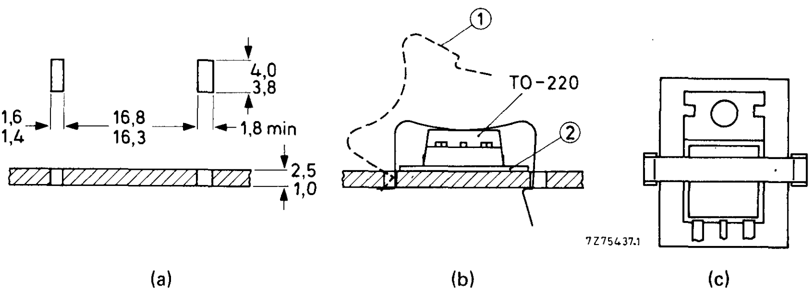
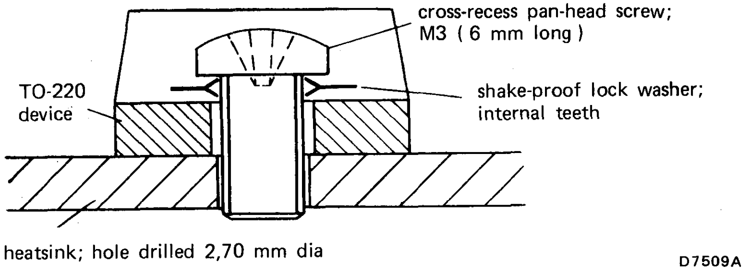


Fig. 2 (a) Heatsink requirements; (b) mounting (1 = spring clip, 2 = insulator 56369 or 56367); (c) position of the device (top view).

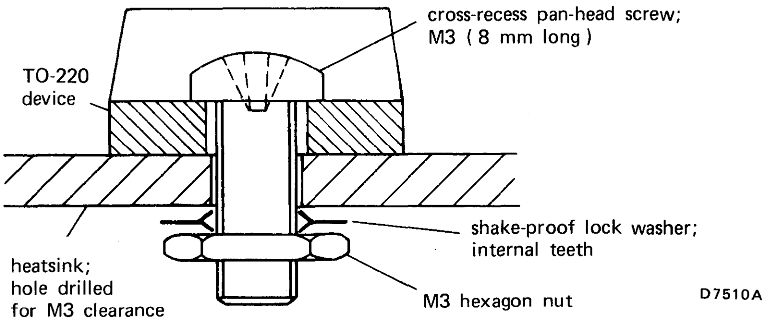
INSTRUCTIONS FOR SCREW MOUNTING (TO–220 envelopes)

Direct mounting with screw

- *into tapped heatsink*

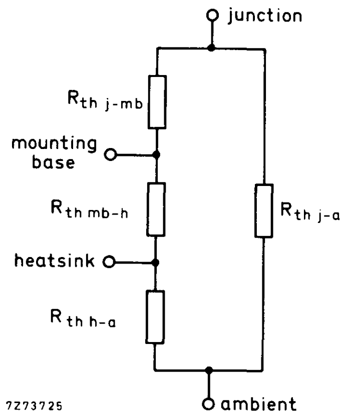


- *through heatsink with nut*



MOUNTING CONSIDERATIONS FOR STUD-MOUNTED TRIACS

Losses generated in a silicon device must flow through the case and to a lesser extent the leads.
The greatest proportion of the losses flow out through the case into a heat exchanger which can be either free convection cooled, forced convection or even liquid cooled. For the majority of devices in our range natural convection is generally adequate, however, where other considerations such as space saving must be taken into account then methods such as forced convection etc. can be considered.
The thermal path from junction to ambient may be considered as a number of resistances in series.
The first thermal resistance will be that of junction to mounting base, usually denoted by $R_{th\ j\text{-}mb}$.
The second is the contact thermal resistance $R_{th\ mb\text{-}h}$ and finally there is the thermal resistance of the heatsink $R_{th\ h\text{-}a}$.
In the rating curves, the contact thermal resistance and heatsink thermal resistances are combined as a single figure - $R_{th\ mb\text{-}a}$.
In addition to the steady state thermal conditions of the system, consideration should also be given to the possibility of any transient thermal excursions. These can be caused for example by starting conditions or overloads and in order to calculate the effect on the device, a graph of transient thermal resistance $Z_{th\ j\text{-}mb}$ as a function of time is given in each data sheet.



When mounting the device on the heatsink, care should be taken that the contact surfaces are free from burrs or projections of any kind and must be thoroughly clean.
In the case where an anodised heatsink is used, the anodising should be removed from the contact surface ensuring good electrical and thermal contact.
The contact surfaces should be smeared with a metallic oxide-loaded grease to ensure good heat transfer.
Where the device is mounted in a tapped hole, care should be taken that the hole is perpendicular to the surface of the heatsink. When mounting the device to the heatsink, it is essential that a proper torque wrench is used, applying the correct amount of torque as specified in the published data.
Excessive torque can distort the threads of the device and may even cause mechanical stress on the wafer, leading to the possible failure.
Where isolation of the device from the heatsink is required, it is common practice to use a mica washer between contact surfaces, and where a clearance hole is used, a p.t.f.e. insulating bush is inserted. A metallic oxide-loaded heatsink compound should be smeared on all contact surfaces, including the mica washer, to ensure optimum heat transfer. The use of ordinary silicone grease is not recommended.

TRIACS

Glass-passivated, eutectic-bonded triacs intended for use in applications requiring high bidirectional transient and blocking voltage capability, and high thermal cycling performance with very low thermal resistances, e.g. a.c. power control applications such as lighting, industrial and domestic heating, motor control and switching systems.

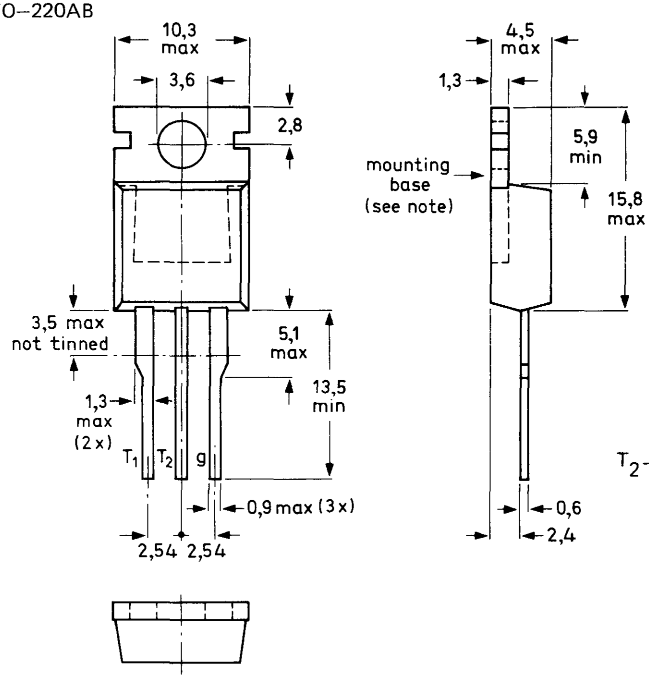
QUICK REFERENCE DATA

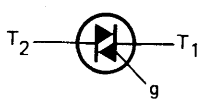
			BT136–500	600	
Repetitive peak off-state voltage	V_{DRM}	max.	500	600	V
R.M.S. on-state current	$I_{T(RMS)}$	max.	4		A
Non-repetitive peak on-state current	I_{TSM}	max.	25		A

MECHANICAL DATA

Dimensions in mm

Fig.1 TO–220AB





Net mass: 2 g

Note: The exposed metal mounting base is directly connected to terminal T_2.

Supplied on request: accessories (see data sheets Mounting instructions and accessories for TO–220 envelopes)

RATINGS

Limiting values in accordance with the Absolute Maximum System (IEC 134)

Voltages (in either direction)			BT136–500	600	
Non-repetitive peak off-state voltage ($t \leqslant 10$ ms)	V_{DSM}	max.	500	600	V*
Repetitive peak off-state voltage ($\delta \leqslant 0.01$)	V_{DRM}	max.	500	600	V
Crest working off-state voltage	V_{DWM}	max.	400	400	V

Currents (in either direction)				
R.M.S. on-state current (conduction angle 360°) up to T_{mb} = 102 °C	$I_{T(RMS)}$	max.	4	A
Average on-state current for half-cycle operation (averaged over any 20 ms period) up to T_{mb} = 92 °C	$I_{T(AV)}$	max.	2.5	A
Repetitive peak on-state current	I_{TRM}	max.	25	A
Non-repetitive peak on-state current; T_j = 120 °C prior to surge; t = 20 ms; full sine-wave	I_{TSM}	max.	25	A
I^2t for fusing (t = 10 ms)	I^2t	max.	4	A^2s
Rate of rise of on-state current after triggering with I_G = 200 mA to I_T = 6 A; dI_G/dt = 0.2 A/μs	dI_T/dt	max.	10	A/μs

Gate to terminal 1

POWER DISSIPATION

Average power dissipation (averaged over any 20 ms period)	$P_{G(AV)}$	max.	0.5	W
Peak power dissipation	P_{GM}	max.	5	W

Temperatures

Storage temperature	T_{stg}		–40 to +125	°C
Operating junction temperature				
full-cycle operation	T_j	max.	120	°C
half-cycle operation	T_j	max.	110	°C

*Although not recommended, off-state voltages up to 800 V may be applied without damage, but the triac may switch into the on-state. The rate of rise of on-state current should not exceed 3 A/μs.

THERMAL RESISTANCE

From junction to mounting base			
full-cycle operation	$R_{th\ j\text{-}mb}$	=	3.0 °C/W
half-cycle operation	$R_{th\ j\text{-}mb}$	=	3.7 °C/W
Transient thermal impedance; t = 1 ms	$Z_{th\ j\text{-}mb}$	=	0.6 °C/W

Influence of mounting method

1. Heatsink mounted with clip (see mounting instructions)

Thermal resistance from mounting base to heatsink

a. with heatsink compound	$R_{th\ mb\text{-}h}$	=	0.3 °C/W
b. with heatsink compound and 0.06 mm maximum mica insulator	$R_{th\ mb\text{-}h}$	=	1.4 °C/W
c. with heatsink compound and 0.1 mm max. mica insulator (56369)	$R_{th\ mb\text{-}h}$	=	2.2 °C/W
d. with heatsink compound and 0.25 mm max. alumina insulator (56367)	$R_{th\ mb\text{-}h}$	=	0.8 °C/W
e. without heatsink compound	$R_{th\ mb\text{-}h}$	=	1.4 °C/W

2. Free-air operation

The quoted value of $R_{th\ j\text{-}a}$ should be used only when no leads of other dissipating components run to the same tie-point.

Thermal resistance from junction to ambient in free air:
mounted on a printed-circuit board at a = any lead length $R_{th\ j\text{-}a}$ = 60 °C/W

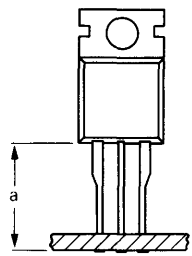


Fig.2.

Notes

1. Values of $R_{th\ mb\text{-}h}$ given for mounting with heatsink compound refer to the use of a zinc-oxide-loaded compound. Ordinary silicone grease is not recommended.
2. Mounting by means of a spring clip is the best mounting method because it offers:
   a. a good thermal contact under the crystal area and slightly lower $R_{th\ mb\text{-}h}$ values than screw mounting.
   b. safe isolation for mains operation.

CHARACTERISTICS

Polarities, positive or negative, are identified with respect to T_1.

Voltages and currents (in either direction)

On-state voltage (Note 1)				
$I_T = 5$ A; $T_j = 25$ °C	V_T	<	1.70	V
Rate of rise of off-state voltage that will not trigger any device; $T_j = 120$ °C; see also Figs.9 and 10; gate open circuit	dV_D/dt	<	50	V/µs
Rate of rise of commutating voltage that will not trigger any device; $I_{T(RMS)} = 4$ A; $V_D = V_{DWM\ max}$; $T_j = 120$ °C; gate open circuit; see also Figs. 9 and 10 BT136 series $-dI_T/dt = 2.5$ A/ms BT136 series F $-dI_T/dt = 2.5$ A/ms BT136 series E $-dI_T/dt = 1.25$ A/ms	dV_{com}/dt	<	6	V/µs
Off-state current				
$V_D = V_{DWM\ max}$; $T_j = 120$ °C	I_D	<	0.5	mA
Holding current; $T_j = 25$ °C				
T_2 and G positive or negative	I_H	<	15	mA

Gate voltage and current that will trigger all devices

Latching current

$V_D = 12$ V; $T_j = 25$ °C

				T_2+ G+	T_2+ G−	T_2- G−	T_2- G+	
BT136 series	G to T_1	V_{GT}	>	1.5	1.5	1.5	1.5	V
		I_{GT}	>	35	35	35	70	mA
		I_L	<	20	30	20	30	mA
BT136 series F e.g. BT136—500F	G to T_1	V_{GT}	>	1.5	1.5	1.5	1.5	V
		I_{GT}	>	25	25	25	70	mA
		I_L	<	20	30	20	30	mA
BT136 series E	G to T_1	V_{GT}	>	1.5	1.5	1.5	1.5	V
		I_{GT}	>	15	15	15	50	mA
		I_L	<	20	20	20	20	mA
BT136 series D (Note 2)	G to T_1	V_{GT}	>	1.5	1.5	1.5	**	V
		I_{GT}	>	8	8	8	**	mA
		I_L	<	15	20	15	**	mA

Gate to terminal 1

Voltage that will not trigger any device $V_D = V_{DRM\ max}$; $T_j = 120$ °C; T_2 and G positive or negative	V_{GD}	<	250	mV

Note 1. Measured under pulse conditions to avoid excessive dissipation.
Note 2. A version with $I_{GT} = 5$ mA max. is available on request.

**Triggerable

MOUNTING INSTRUCTIONS

1. The triac may be soldered directly into the circuit, but the maximum permissible temperature of the soldering iron or bath is 275 ^{o}C; it must not be in contact with the joint for more than 5 seconds. *Soldered joints must be at least 4.7 mm from the seal.*
2. The leads should not be bent less than 2.4 mm from the seal, and should be supported during bending.
3. It is recommended that the circuit connection be made to tag T_2, rather than direct to the heatsink.
4. Clip mounting offers lower thermal resistance than screw mounting. However, if a screw is used, it should be M3. Care should be taken to avoid damage to the plastic body.
5. The device should not be pop-rivetted to the heatsink. However, it is permissible to press-rivet providing that rivets of soft material are used, and the press forces are slowly and carefully controlled so as to avoid shock and deformation of either heatsink or mounting tab.

OPERATING NOTES

Dissipation and heatsink considerations:

a. The various components of junction temperature rise above ambient are illustrated in Fig.3.

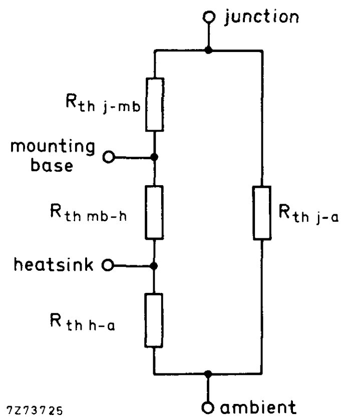


Fig.3

b. The method of using Figs 4 and 5 is as follows:

Starting with the required current on the $I_{T(AV)}$ or $I_{T(RMS)}$ axis, trace upwards to meet the appropriate form factor or conduction angle curve. Trace right horizontally and upwards from the appropriate value on the T_{amb} scale. The intersection determines the $R_{th\ mb\text{-}a}$. The heatsink thermal resistance value ($R_{th\ h\text{-}a}$) can now be calculated from:

$$R_{th\ h\text{-}a} = R_{th\ mb\text{-}a} - R_{th\ mb\text{-}h}.$$

c. Any measurement of heatsink temperature should be made immediately adjacent to the device.

FULL-CYCLE OPERATION

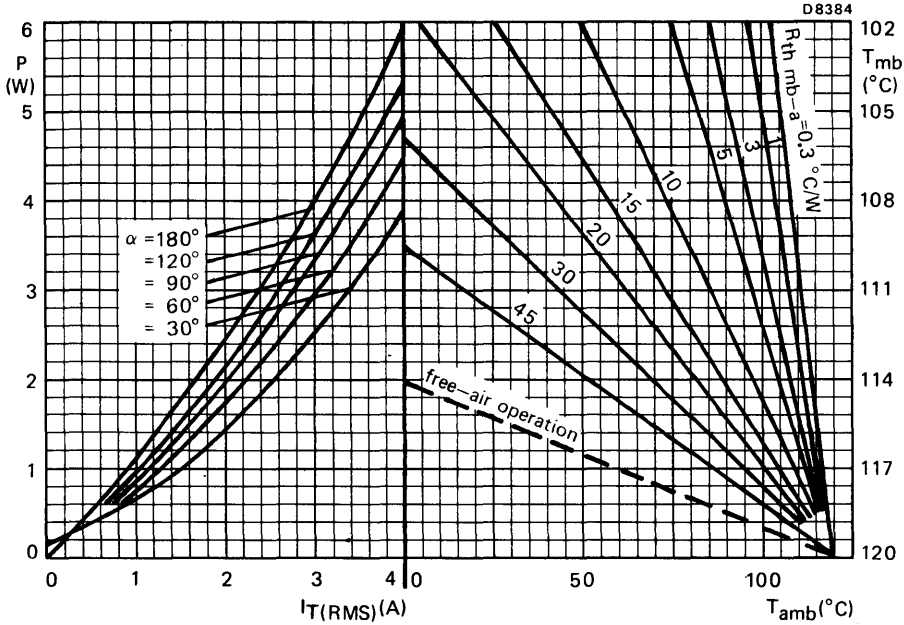
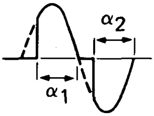


Fig.4 The right-hand part shows the interrelationship between the power (derived from the left-hand part) and the maximum permissible temperatures.



$\alpha = \alpha_1 = \alpha_2$: conduction angle per half cycle

HALF-CYCLE OPERATION

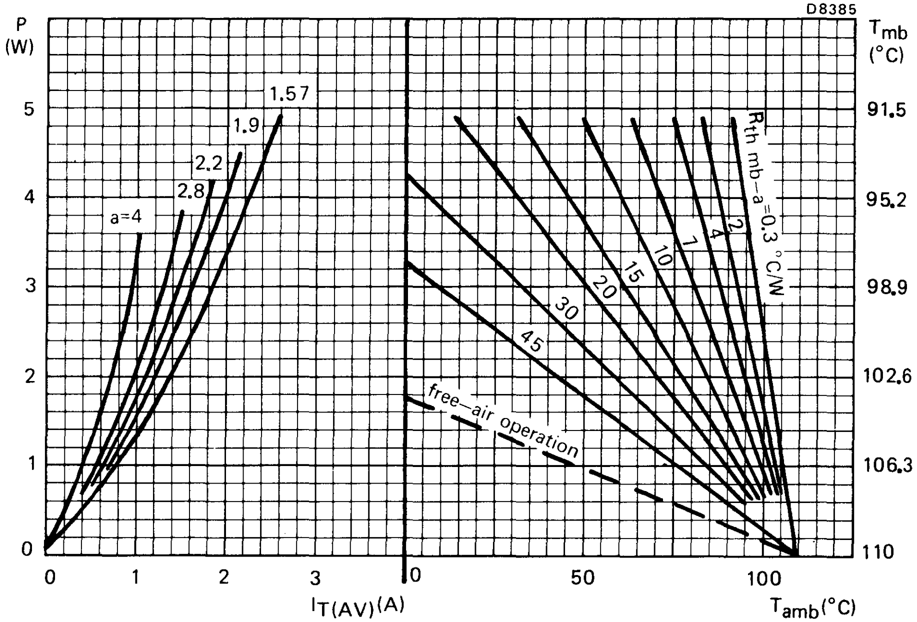
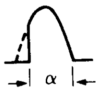


Fig.5 The right-hand part shows the interrelationship between the power (derived from the left-hand part) and the maximum permissible temperatures.



α = conduction angle per half cycle

$$a = \text{form factor} = \frac{I_{T(RMS)}}{I_{T(AV)}}$$

α	a
30°	4
60°	2.8
90°	2.2
120°	1.9
180°	1.57

OVERLOAD OPERATION

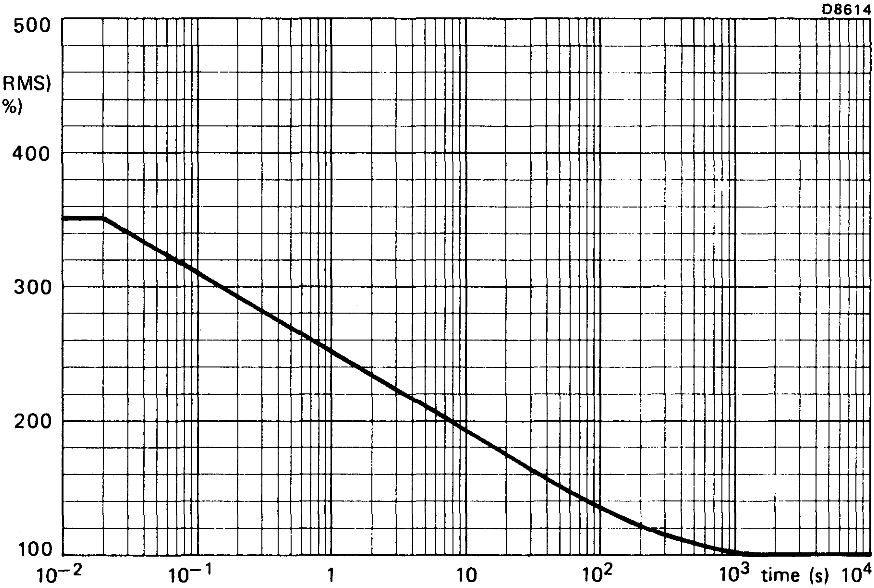


Fig.6 Maximum permissible duration of steady overload (provided that T_{mb} does not exceed 120 °C during and after overload) expressed as a percentage of the steady state r.m.s. rated current. For high r.m.s. overload currents precautions should be taken so that the temperature of the terminals does not exceed 125 °C. During these overload conditions the triac may lose control. Therefore the overload should be terminated by a separate protection device.

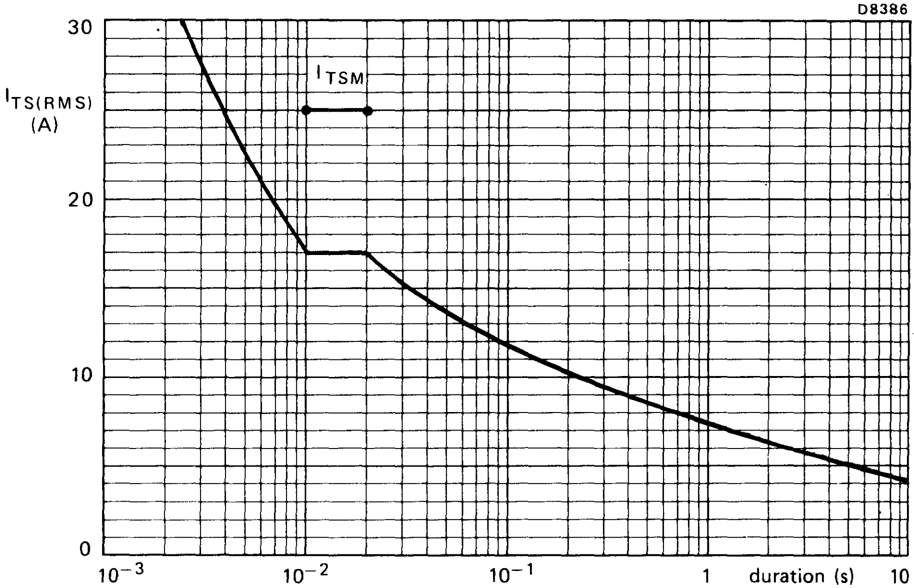


Fig.7 Maximum permissible non-repetitive r.m.s. on-state current based on sinusoidal currents (f = 50 Hz); T_j = 120 °C prior to surge. The triac may temporarily lose control following the surge.

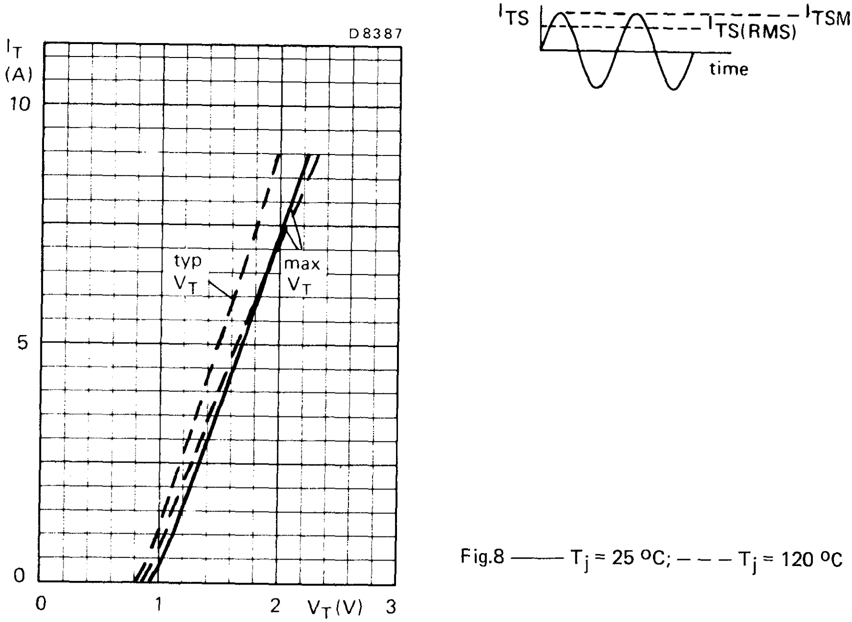


Fig.8 —— T_j = 25 °C; – – – T_j = 120 °C

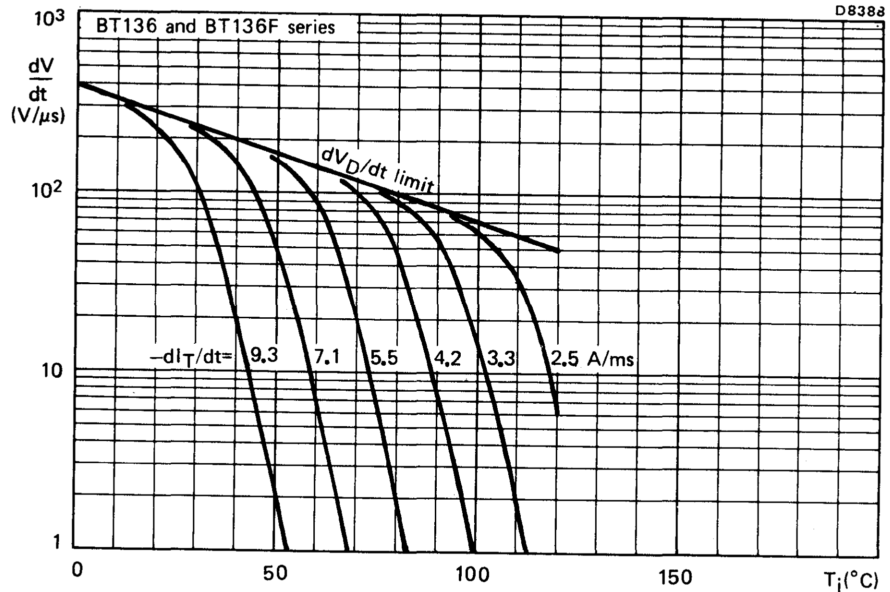


Fig.9 Limit commutation dV/dt for BT136 and F series versus T_j. The triac should commutate when the dV/dt is below the value on the appropriate curve for pre-commutation dI_T/dt.

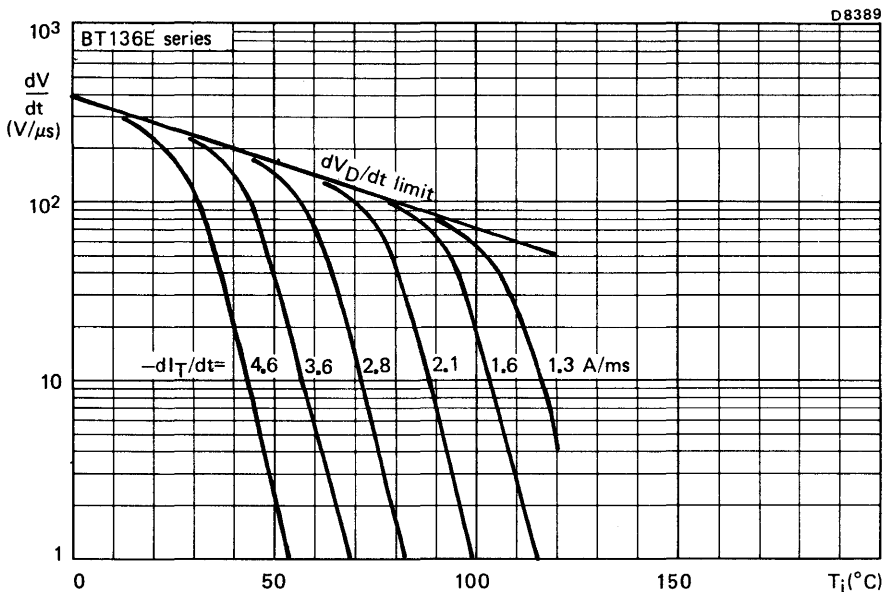


Fig.10 Limit commutation dV/dt for BT136E series versus T_j. The triac should commutate when the dV/dt is below the value on the appropriate curve for pre-commutation dI_T/dt.

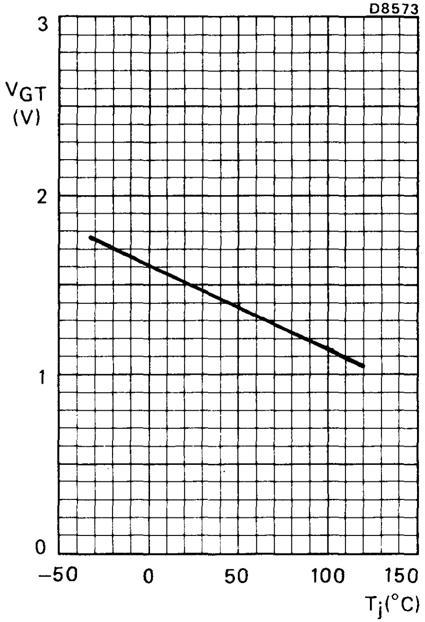


Fig.11 Minimum gate voltage that will trigger all devices; all conditions

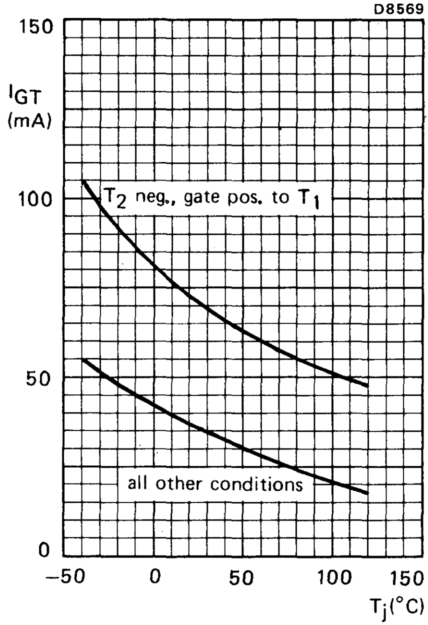


Fig.12 Minimum gate current that will trigger all devices

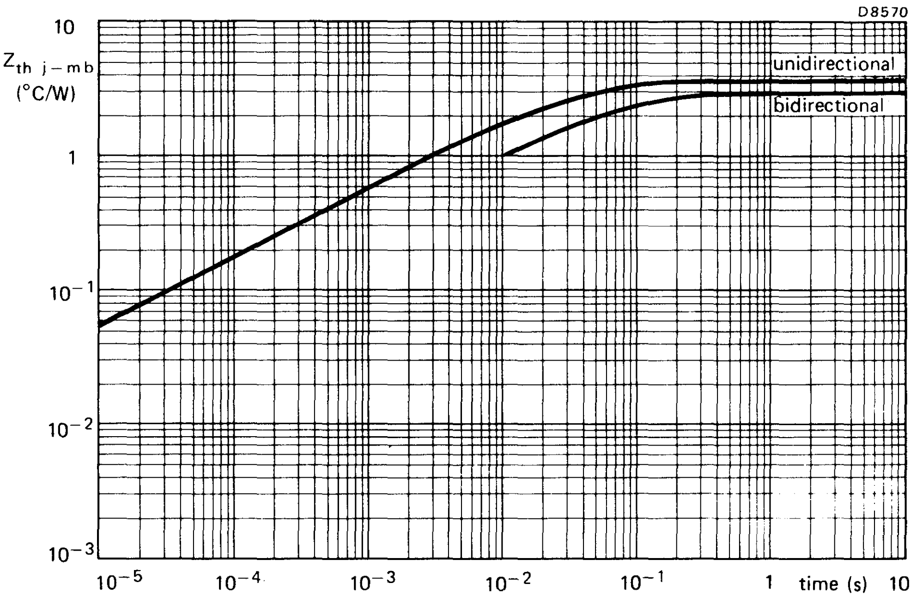


Fig.13

TRIACS

Glass-passivated, eutectic-bonded triacs intended for use in applications requiring high bidirectional transient and blocking voltage capability, and high thermal cycling performance with very low thermal resistances, e.g. a.c. power control applications such as lighting, industrial and domestic heating and motor control and switching systems.

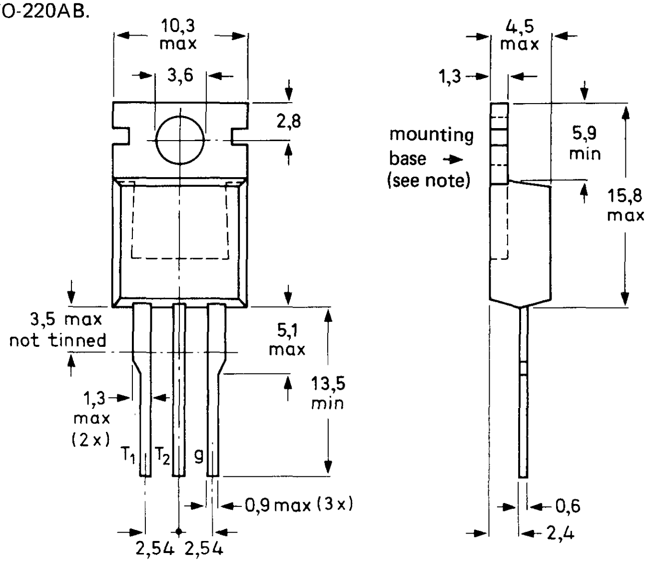
QUICK REFERENCE DATA

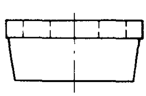
			BT137-500	600	
Repetitive peak off-state voltage	V_{DRM}	max.	500	600	V
R.M.S. on-state current	$I_{T(RMS)}$	max.	8		A
Non-repetitive peak on-state current	I_{TSM}	max.	55		A

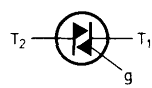
MECHANICAL DATA

Dimensions in mm

Fig. 1 TO-220AB.







Net mass: 2 g

Note: The exposed metal mounting base is directly connected to terminal T_2.

Supplied on request: accessories (see data sheets Mounting instructions and accessories for TO-220 envelopes)

RATINGS

Limiting values in accordance with the Absolute Maximum System (IEC 134)

			BT137-500	600	
Voltages (in either direction)					
Non-repetitive peak off-state voltage ($t \leqslant 10$ ms)	V_{DSM}	max.	500	600	V*
Repetitive peak off-state voltage ($\delta \leqslant 0{,}01$)	V_{DRM}	max.	500	600	V
Crest working off-state voltage	V_{DWM}	max.	400	400	V

→ **Currents** (in either direction)

R.M.S. on-state current (conduction angle 360°) up to T_{mb} = 97 °C	$I_{T(RMS)}$	max.	8	A
Average on-state current for half-cycle operation (averaged over any 20 ms period) up to T_{mb} = 87 °C	$I_{T(AV)}$	max.	5	A
Repetitive peak on-state current	I_{TRM}	max.	55	A
Non-repetitive peak on-state current; T_j = 120 °C prior to surge; t = 20 ms; full sine-wave	I_{TSM}	max.	55	A
I^2t for fusing (t = 10 ms)	I^2t	max.	15	A^2s
Rate of rise of on-state current after triggering with I_G = 200 mA to I_T = 12 A; dI_G/dt = 0,2 A/µs	dI_T/dt	max.	20	A/µs

Gate to terminal 1

POWER DISSIPATION

Average power dissipation (averaged over any 20 ms period)	$P_{G(AV)}$	max.	0,5	W
Peak power dissipation	P_{GM}	max.	5	W

Temperatures

Storage temperature	T_{stg}		−40 to +125	°C
→ Operating junction temperature				
full-cycle operation	T_j	max.	120	°C
half-cycle operation	T_j	max.	110	°C

* Although not recommended, off-state voltages up to 800 V may be applied without damage, but the triac may switch into the on-state. The rate of rise of on-state current should not exceed 6 A/µs.

THERMAL RESISTANCE

From junction to mounting base		
full-cycle operation	$R_{th\ j\text{-}mb}$	= 2,0 $^oC/W$
half-cycle operation	$R_{th\ j\text{-}mb}$	= 2,4 $^oC/W$
Transient thermal impedance; t = 1 ms	$Z_{th\ j\text{-}mb}$	= 0,3 $^oC/W$

Influence of mounting method

1. Heatsink mounted with clip (see mounting instructions)

Thermal resistance from mounting base to heatsink

a. with heatsink compound	$R_{th\ mb\text{-}h}$	= 0,3 $^oC/W$
b. with heatsink compound and 0,06 mm maximum mica insulator	$R_{th\ mb\text{-}h}$	= 1,4 $^oC/W$
c. with heatsink compound and 0,1 mm max. mica insulator (56369)	$R_{th\ mb\text{-}h}$	= 2,2 $^oC/W$
d. with heatsink compound and 0,25 mm max. alumina insulator (56367)	$R_{th\ mb\text{-}h}$	= 0,8 $^oC/W$
e. without heatsink compound	$R_{th\ mb\text{-}h}$	= 1,4 $^oC/W$

2. Free-air operation

The quoted values of $R_{th\ j\text{-}a}$ should be used only when no leads of other dissipating components run to the same tie-point.

Thermal resistance from junction to ambient in free air:
mounted on a printed-circuit board at a = any lead length $R_{th\ j\text{-}a}$ = 60 $^oC/W$

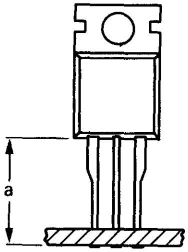


Fig. 2.

CHARACTERISTICS

Polarities, positive or negative, are identified with respect to T_1.

Voltages and currents (in either direction)

On-state voltage (Note 1)

I_T = 10 A; T_j = 25 °C	V_T	<	1,65	V
Rate of rise of off-state voltage that will not trigger any device; T_j = 120 °C; see also Figs. 9 and 10; gate open circuit	dV_D/dt	<	50	V/µs

Rate of rise of commutating voltage that will not trigger any device;

$I_{T(RMS)}$ = 8 A; V_D = V_{DWM} max;
T_j = 120 °C; gate open circuit; see also Figs. 9 and 10

BT137 series	$-dI_T/dt$ = 4,2 A/ms	dV_{com}/dt	<	6	V/µs
BT137 series F	$-dI_T/dt$ = 4,2 A/ms				
BT137 series E	$-dI_T/dt$ = 2,1 A/ms				

Off-state current

V_D = V_{DWM} max; T_j = 120 °C	I_D	<	0,5	mA

Holding current; T_j = 25 °C

T_2 and G positive or negative	BT137, F and E series	I_H	<	20	mA
	BT137 D series	I_H	<	15	mA

Gate voltage and current that will trigger all devices

Latching current

V_D = 12 V; T_j = 25 °C

				T2+ G+	T2+ G−	T2− G−	T2− G+	
BT137 series	G to T_1	V_{GT}	>	1,5	1,5	1,5	1,5	V
		I_{GT}	>	35	35	35	70	mA
		I_L	<	30	45	30	30	mA
BT137 series F e.g. BT137−500F	G to T_1	V_{GT}	>	1,5	1,5	1,5	1,5	V
		I_{GT}	>	25	25	25	70	mA
		I_L	<	30	45	30	30	mA
BT137 series E	G to T_1	V_{GT}	>	1,5	1,5	1,5	1,5	V
		I_{GT}	>	15	15	15	50	mA
		I_L	<	25	35	25	25	mA
BT137 series D (Note 2)	G to T_1	V_{GT}	>	1,5	1,5	1,5	**	V
		I_{GT}	>	8	8	8	**	mA
		I_L	<	15	20	15	**	mA

Gate to terminal 1

Voltage that will not trigger any device V_D = V_{DRM} max; T_j = 120 °C; T_2 and G positive or negative	V_{GD}	<	250	mV

Note 1. Measured under pulse conditions to avoid excessive dissipation.

Note 2. A version with I_{GT} = 5 mA max. is available on request.

**Triggerable

MOUNTING INSTRUCTIONS

1. The triac may be soldered directly into the circuit, but the maximum permissible temperature of the soldering iron or bath is 275 °C; it must not be in contact with the joint for more than 5 seconds. Soldered joints must be at least 4,7 mm from the seal.
2. The leads should not be bent less than 2,4 mm from the seal, and should be supported during bending.
3. It is recommended that the circuit connection be made to tag T_2, rather than direct to the heatsink.
4. Mounting by means of a spring clip is the best mounting method because it offers:
   a. a good thermal contact under the crystal area and slightly lower $R_{th\ mb\text{-}h}$ values than screw mounting.
   b. safe isolation for mains operation.
   However, if a screw is used, it should be M3 cross-recess pan-head. Care should be taken to avoid damage to the plastic body.
5. For good thermal contact heatsink compound should be used between mounting base and heatsink. Values of $R_{th\ mb\text{-}h}$ given for mounting with heatsink compound refer to the use of a metallic-oxide loaded compound. Ordinary silicone grease is not recommended.
6. The device should not be pop-rivetted to the heatsink. However, it is permissible to press-rivet providing that rivets of soft material are used, and the press forces are slowly and carefully controlled so as to avoid shock and deformation of either heatsink or mounting tab.

OPERATING NOTES

Dissipation and heatsink considerations:

a. The various components of junction temperature rise above ambient are illustrated in Fig. 3.

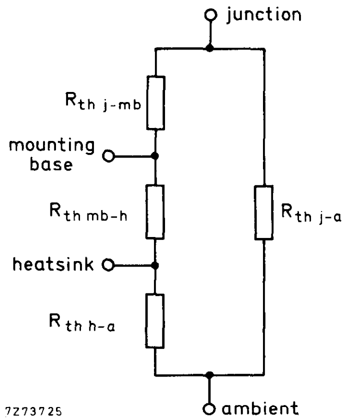


Fig. 3.

b. The method of using Figs 4 and 5 is as follows:
Starting with the required current on the $I_{T(AV)}$ or $I_{T(RMS)}$ axis, trace upwards to meet the appropriate form factor or conduction angle curve. Trace right horizontally and upwards from the appropriate value on the T_{amb} scale. The intersection determines the $R_{th\ mb\text{-}a}$. The heatsink thermal resistance value ($R_{th\ h\text{-}a}$) can now be calculated from:

$R_{th\ h\text{-}a} = R_{th\ mb\text{-}a} - R_{th\ mb\text{-}h}$.

c. Any measurement of heatsink temperature should be made immediately adjacent to the device.

FULL-CYCLE OPERATION

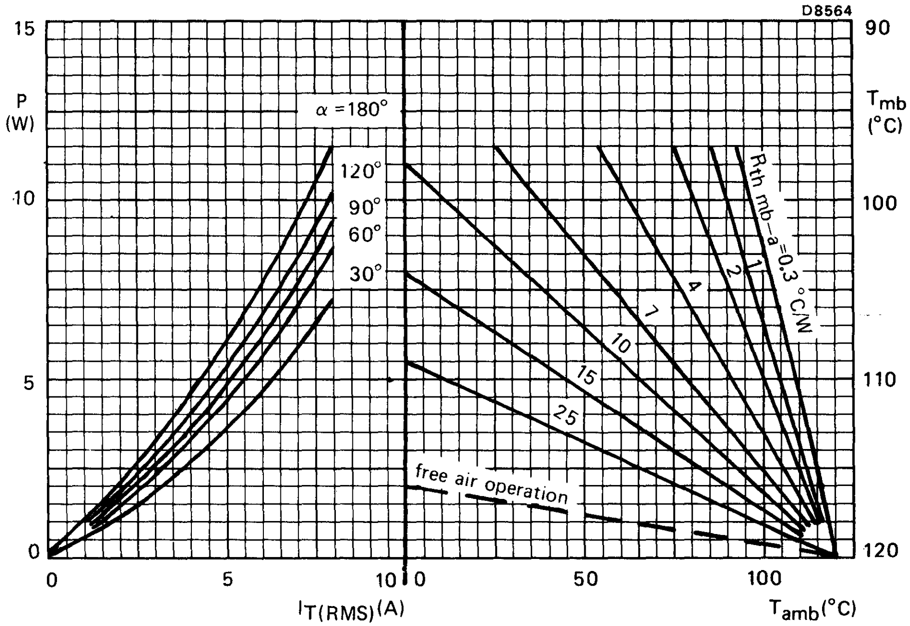
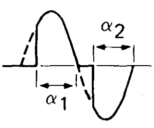


Fig.4 The right-hand part shows the interrelationship between the power (derived from the left-hand part) and the maximum permissible temperatures.



$\alpha = \alpha_1 = \alpha_2$: conduction angle per half cycle

HALF-CYCLE OPERATION

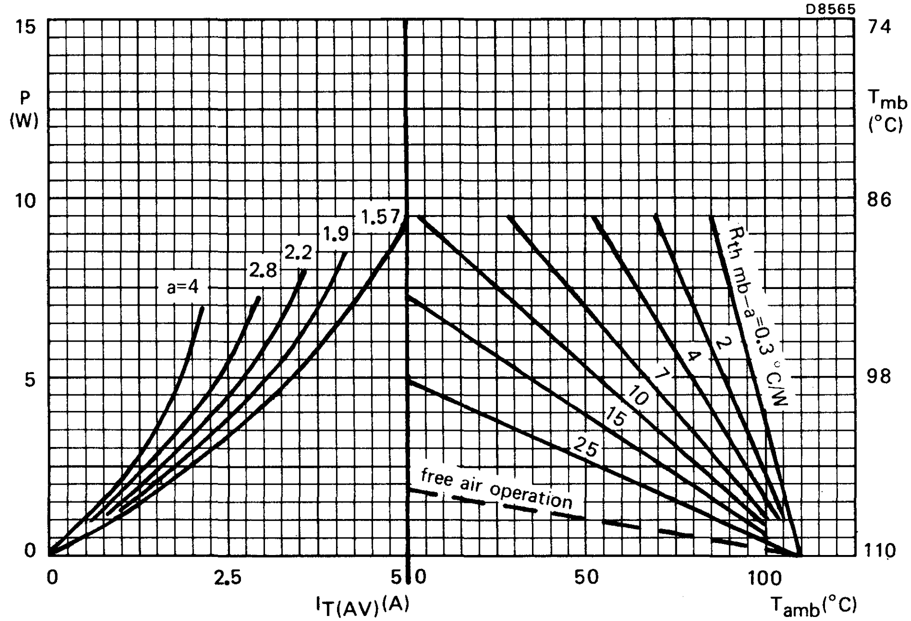
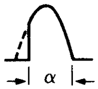


Fig. 5 The right-hand part shows the interrelationship between the power (derived from the left-hand part) and the maximum permissible temperatures.



α = conduction angle per half cycle

a = form factor = $\frac{I_{T(RMS)}}{I_{T(AV)}}$

α	a
30°	4
60°	2,8
90°	2,2
120°	1,9
180°	1,57

OVERLOAD OPERATION

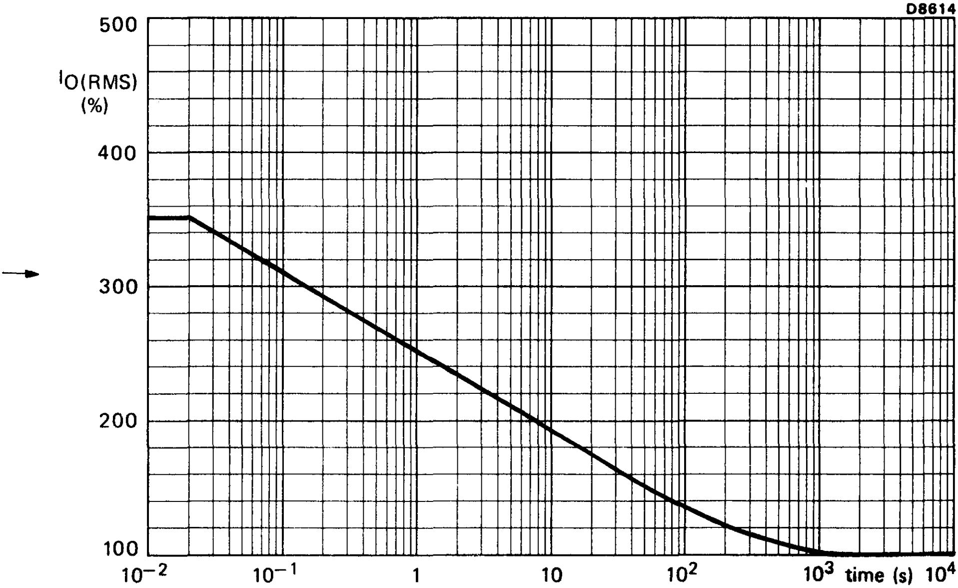


Fig.6 Maximum permissible duration of steady overload (provided that T_{mb} does not exceed 120 °C during and after overload) expressed as a percentage of the steady state r.m.s. rated current. For high r.m.s. overload currents precautions should be taken so that the temperature of the terminals does not exceed 125 °C. During these overload conditions the triac may lose control. Therefore the overload should be terminated by a separate protection device.

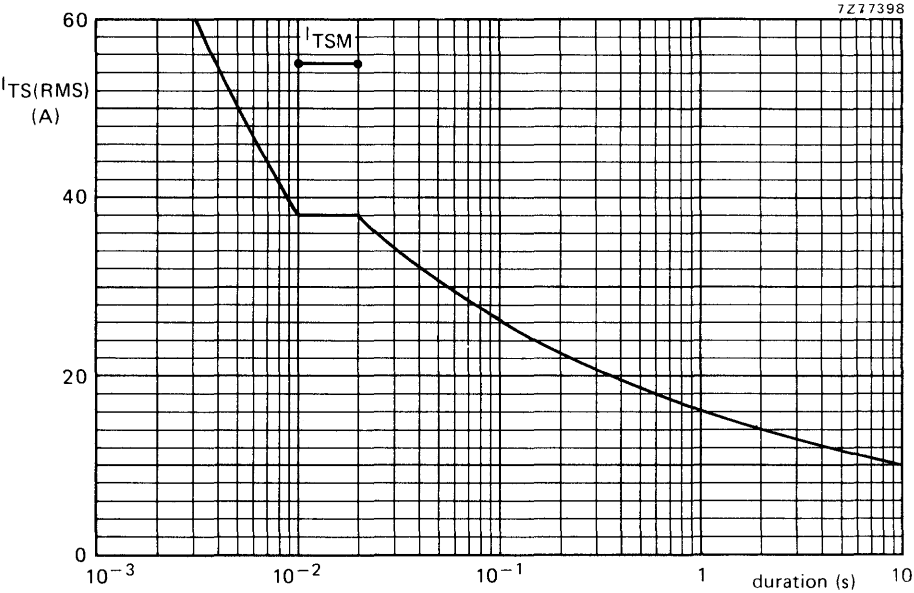
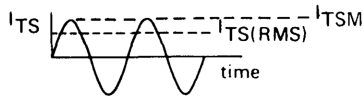


Fig.7 Maximum permissible non-repetitive r.m.s. on-state current based on sinusoidal currents (f = 50 Hz); T_j = 120 °C prior to surge. The triac may temporarily lose control following the surge.



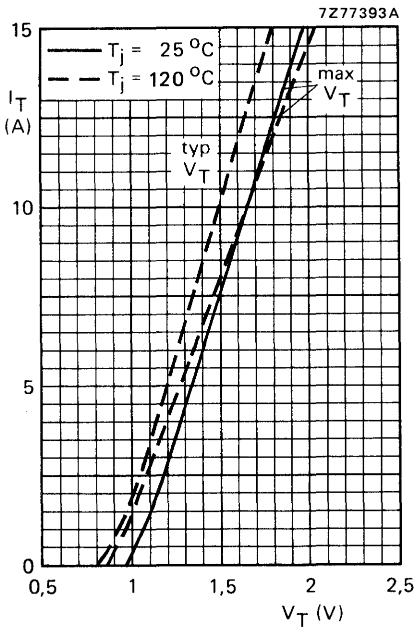


Fig.8

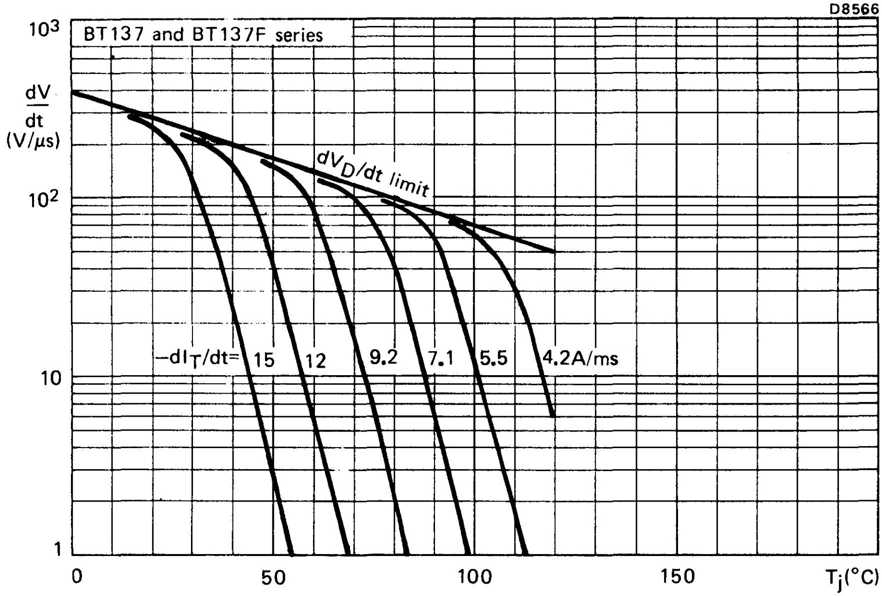


Fig.9 Limit commutation dV/dt for BT137 and F series versus T_j. The triac should commutate when the dV/dt is below the value on the appropriate curve for pre-commutation dI_T/dt.

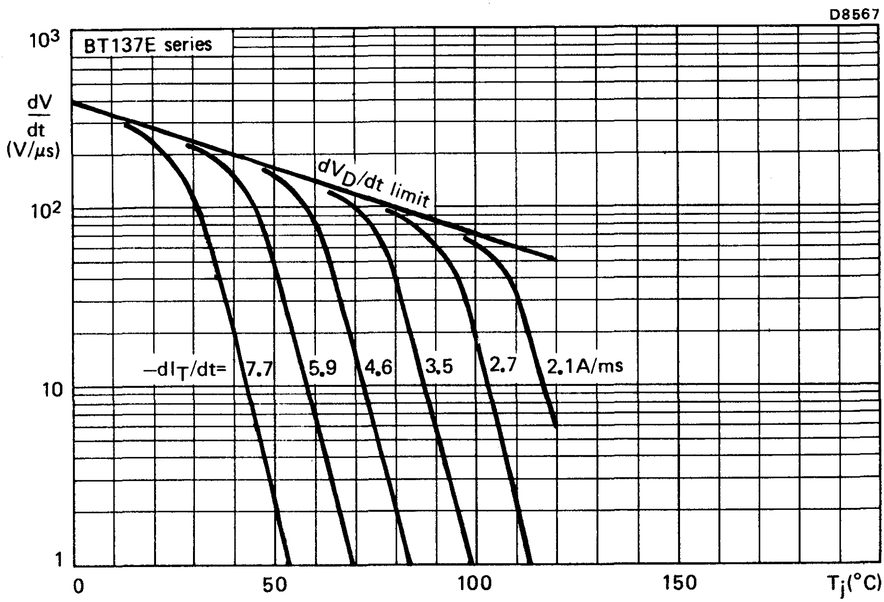


Fig.10 Limit commutation dV/dt for BT137E series versus T_j. The triac should commutate when the dV/dt is below the value on the appropriate curve for pre-commutation dI_T/dt.

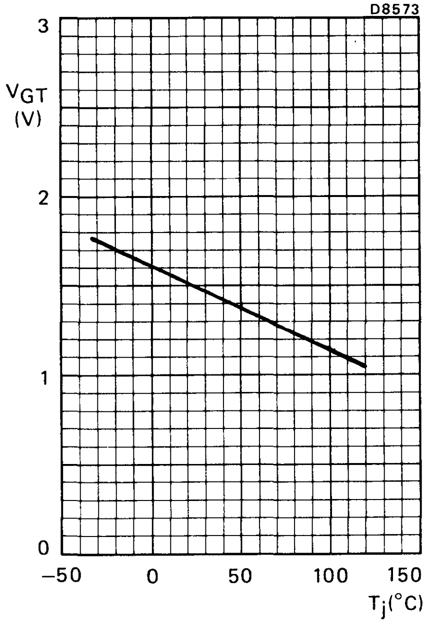


Fig.11 Minimum gate voltage that will trigger all devices; all conditions

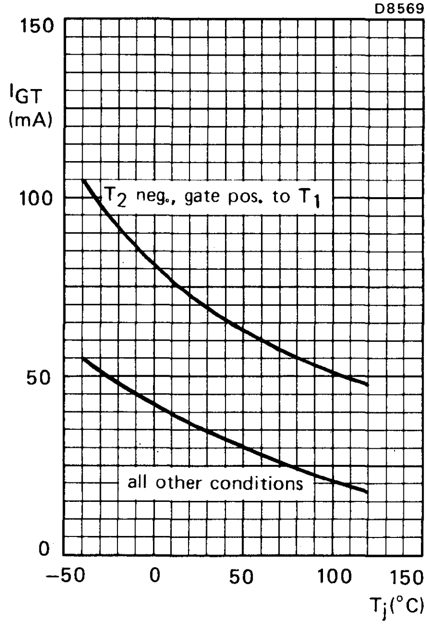


Fig.12 Minimum gate current that will trigger all devices.

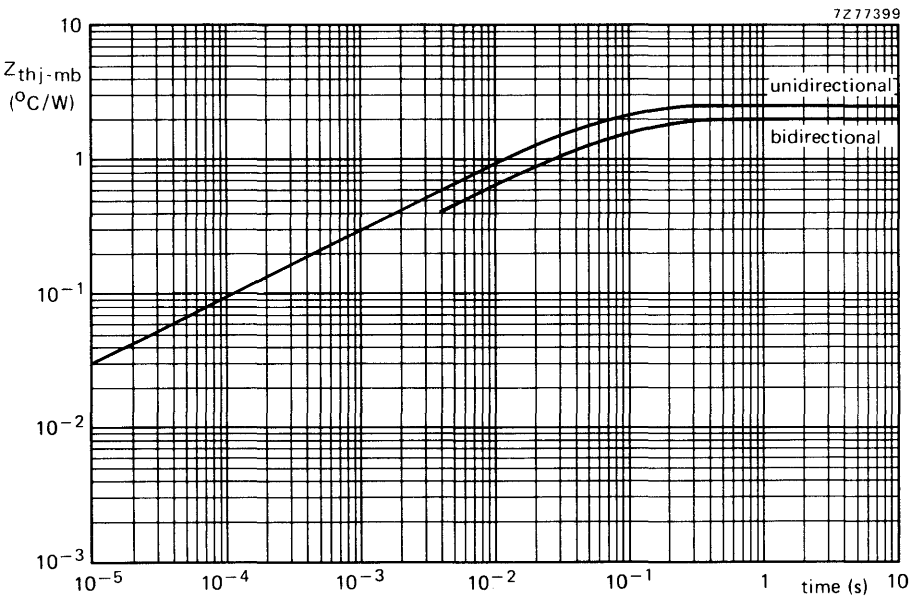


Fig.13

TRIACS

Glass-passivated, eutectic-bonded triacs intended for use in applications requiring high bidirectional transient and blocking voltage capability, and high thermal cycling performance with very low thermal resistances, e.g. a.c. power control applications such as motor, industrial lighting, industrial and domestic heating control and static switching systems.

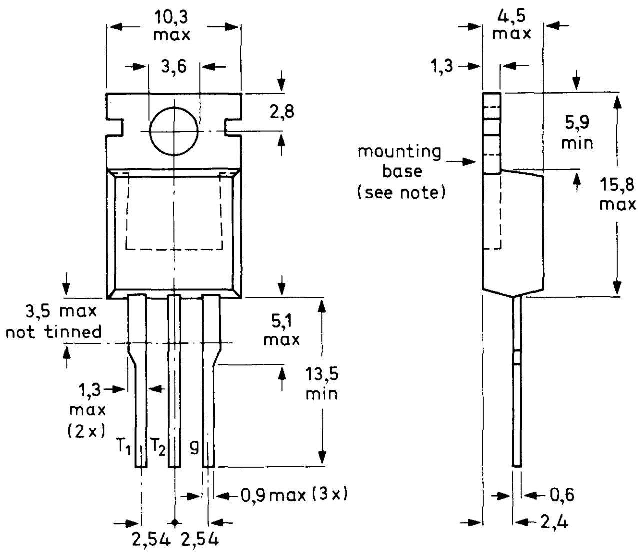
QUICK REFERENCE DATA

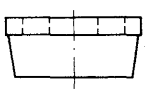
			BT138-500	600	
Repetitive peak off-state voltage	V_{DRM}	max.	500	600	V
R.M.S. on-state current	$I_{T(RMS)}$	max.	12		A ←
Non-repetitive peak on-state current	I_{TSM}	max.	90		A

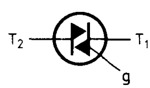
MECHANICAL DATA

Dimensions in mm ←

Fig.1 TO-220AB







Net mass: 2 g

Note: The exposed metal mounting base is directly connected to terminal T_2.

Accessories supplied on request: see data sheet Mounting instructions and accessories for TO-220 envelopes.

RATINGS

Limiting values in accordance with the Absolute Maximum System (IEC134)

Voltages (in either direction)

			BT138-500	600	
Non-repetitive peak off-state voltage ($t \leqslant 10$ ms)	V_{DSM}	max.	500	600	V*
Repetitive peak off-state voltage ($\delta \leqslant 0{,}01$)	V_{DRM}	max.	500	600	V
Crest working off-state voltage	V_{DWM}	max.	400	400	V

→ **Currents** (in either direction)

R.M.S. on-state current (conduction angle 360°) up to $T_{mb} = 95$ °C	$I_{T(RMS)}$	max.	12	A
Average on-state current for half-cycle operation (averaged over any 20 ms period) up to $T_{mb} = 83$ °C	$I_{T(AV)}$	max.	7,5	A
Repetitive peak on-state current	I_{TRM}	max.	90	A
Non-repetitive peak on-state current; $T_j = 120$ °C prior to surge; t = 20 ms; full sine-wave	I_{TSM}	max.	90	A
I^2t for fusing (t = 10 ms)	I^2t	max.	40	A^2s
Rate of rise of on-state current after triggering with $I_G = 200$ mA to $I_T = 20$ A; $dI_G/dt = 0{,}2$ A/μs	dI_T/dt	max.	30	A/μs

Gate to terminal 1

Power dissipation

Average power dissipation (averaged over any 20 ms period)	$P_{G(AV)}$	max.	0,5	W
Peak power dissipation	P_{GM}	max.	5,0	W

Temperatures

Storage temperature	T_{stg}		−40 to +125	°C
→ Operating junction temperature				
full-cycle operation	T_j	max.	120	°C
half-cycle operation	T_j	max.	110	°C

* Although not recommended, off-state voltages up to 800 V may be applied without damage, but the triac may switch into the on-state. The rate of rise of on-state current should not exceed 15 A/μs.

THERMAL RESISTANCE

From junction to mounting base			
full-cycle operation	$R_{th\ j\text{-}mb}$	=	1,5 °C/W ←
half-cycle operation	$R_{th\ j\text{-}mb}$	=	2,0 °C/W ←
Transient thermal impedance; t = 1 ms	$Z_{th\ j\text{-}mb}$	=	0,1 °C/W

Influence of mounting method

1. Heatsink mounted with clip (see mounting instructions)

Thermal resistance from mounting base to heatsink

a. with heatsink compound	$R_{th\ mb\text{-}h}$	=	0,3 °C/W
b. with heatsink compound and 0,06 mm maximum mica insulator	$R_{th\ mb\text{-}h}$	=	1,4 °C/W
c. with heatsink compound and 0,1 mm maximum mica insulator (56369)	$R_{th\ mb\text{-}h}$	=	2,2 °C/W
d. with heatsink compound and 0,25 mm maximum alumina insulator (56367)	$R_{th\ mb\text{-}h}$	=	0,8 °C/W
e. without heatsink compound	$R_{th\ mb\text{-}h}$	=	1,4 °C/W

2. Free-air operation

The quoted values of $R_{th\ j\text{-}a}$ should be used only when no leads of other dissipating components run to the same tie-point.

Thermal resistance from junction to ambient in free air:
mounted on a printed-circuit board at a = any lead length — $R_{th\ j\text{-}a}$ = 60 °C/W

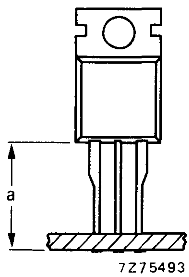


Fig.2

→ CHARACTERISTICS

Polarities, positive or negative, are identified with respect to T_1.

Voltages and currents (in either direction)

On-state voltage (Note 1)

I_T = 15 A; T_j = 25 °C	V_T	<	1,65	V

Rate of rise of off-state voltage that will not trigger any device;

T_j = 120 °C; see also Figs.9 and 10; gate open circuit	dV_D/dt	<	50	V/µs

Rate of rise of commutating voltage that will not trigger any device;

$I_{T(RMS)}$ = 12 A; V_D = $V_{DWM\,max}$;
T_j = 120 °C; gate open circuit; see also Figs.9 and 10

BT138 series	$-dI_T/dt$ = 4,2 A/ms	dV_{com}/dt	<	6	V/µs
BT138 series F	$-dI_T/dt$ = 4,2 A/ms				
BT138 series E	$-dI_T/dt$ = 2,1 A/ms				

Off-state current

V_D = $V_{DWM\,max}$; T_j = 120 °C	I_D	<	0,5	mA

Holding current; T_j = 25 °C

T_2 and G positive or negative	BT138, F and E series	I_H	<	30	mA
	BT138 D series	I_H	<	20	mA

Gate voltage and current that will trigger all devices

Latching current
V_D = 12 V; T_j = 25 °C

				T_2+ G+	T_2+ G−	T_2− G−	T_2− G+	
BT138 series	G to T_1	V_{GT}	>	1,5	1,5	1,5	1,5	V
		I_{GT}	>	35	35	35	70	mA
		I_L	<	40	60	40	40	mA
BT138 series F e.g. BT138–500F	G to T_1	V_{GT}	>	1,5	1,5	1,5	1,5	V
		I_{GT}	>	25	25	25	70	mA
		I_L	<	40	60	40	40	mA
BT138 series E	G to T_1	V_{GT}	>	1,5	1,5	1,5	1,5	V
		I_{GT}	>	15	15	15	50	mA
		I_L	<	30	40	30	30	mA
BT138 series D (Note 2)	G to T_1	V_{GT}	>	1,5	1,5	1,5	**	V
		I_{GT}	>	8	8	8	**	mA
		I_L	<	25	35	25	**	mA

Gate to terminal 1

Voltage that will not trigger any device V_D = $V_{DRM\,max}$;

T_j = 120 °C; T_2 and G positive or negative	V_{GD}	<	250	mV

Note 1. Measured under pulse conditions to avoid excessive dissipation.

Note 2. A version with I_{GT} = 5 mA max. is available on request.

** Triggerable

MOUNTING INSTRUCTIONS

1. The triac may be soldered directly into the circuit, but the maximum permissible temperature of the soldering iron or bath is 275 °C; it must not be in contact with the joint for more than 5 seconds. Soldered joints must be at least 4,7 mm from the seal.
2. The leads should not be bent less than 2,4 mm from the seal, and should be supported during bending.
3. It is recommended that the circuit connection be made to tag T_2, rather than direct to the heatsink.
4. Mounting by means of a spring clip is the best mounting method because it offers:
   a. a good thermal contact under the crystal area and slightly lower $R_{th\ mb\text{-}h}$ values than screw mounting.
   b. safe isolation for mains operation.
   However, if a screw is used, it should be M3 cross-recess pan head. Care should be taken to avoid damage to the plastic body.
5. For good thermal contact heatsink compound should be used between mounting base and heatsink. Values of $R_{th\ mb\text{-}h}$ given for mounting with heatsink compound refer to the use of a metallic-oxide loaded compound. Ordinary silicone grease is not recommended.
6. The device should not be pop-rivetted to the heatsink. However, it is permissible to press-rivet providing that rivets of soft material are used, and the press forces are slowly and carefully controlled so as to avoid shock and deformation of either heatsink or mounting tab.

OPERATING NOTES

Dissipation and heatsink considerations:

a. The various components of junction temperature rise above ambient are illustrated in Fig.3

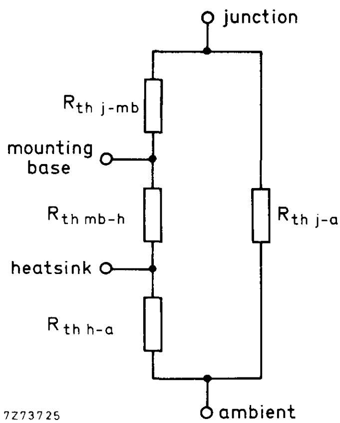


Fig.3

b. The method of using Figs.4 and 5 is as follows:
Starting with the required current on the $I_{T(AV)}$ or $I_{T(RMS)}$ axis, trace upwards to meet the appropriate form factor or conduction angle curve. Trace right horizontally and upwards from the appropriate value on the T_{amb} scale. The intersection determines the $R_{th\ mb\text{-}a}$. The heatsink thermal resistance value ($R_{th\ h\text{-}a}$) can now be calculated from:

$R_{th\ h\text{-}a} = R_{th\ mb\text{-}a} - R_{th\ mb\text{-}h}$.

c. Any measurement of heatsink temperature should be made immediately adjacent to the device.

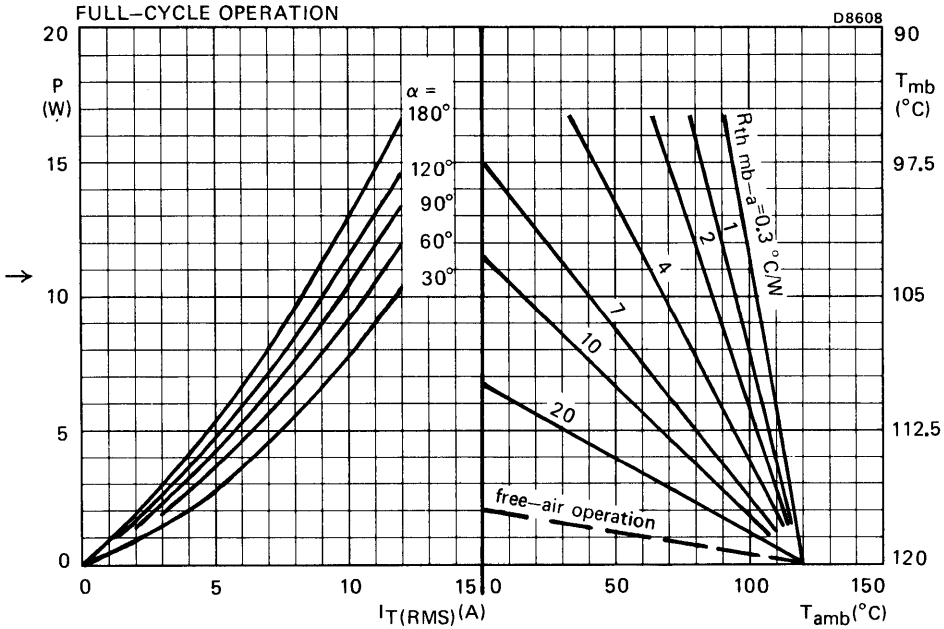
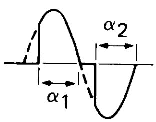


Fig.4 The right-hand part shows the interrelationship between the power (derived from the left-hand part) and the maximum permissible temperatures.



$\alpha = \alpha_1 = \alpha_2$: conduction angle per half cycle

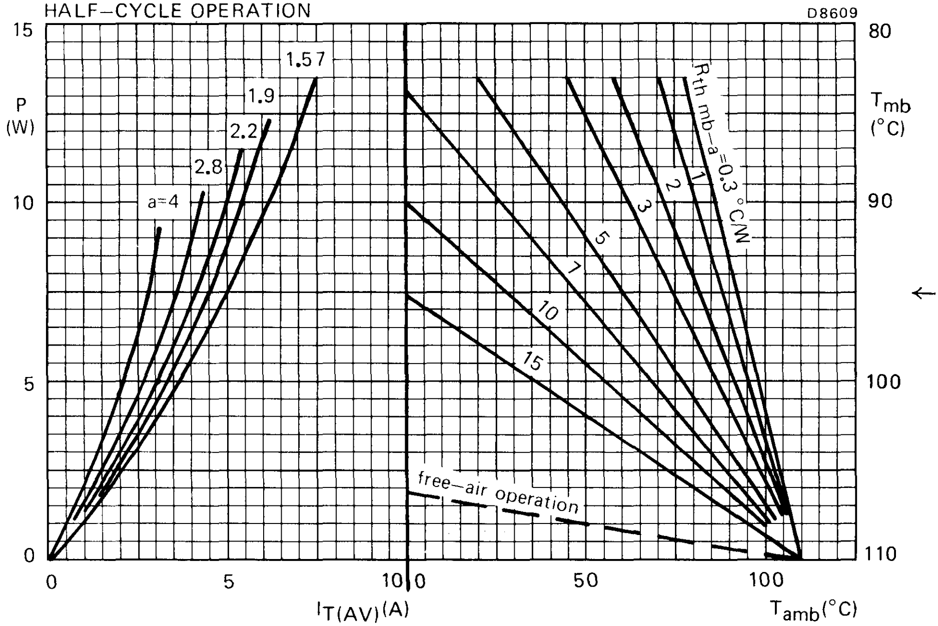
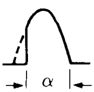


Fig.5 The right-hand part shows the interrelationship between the power (derived from the left-hand part) and the maximum permissible temperatures.

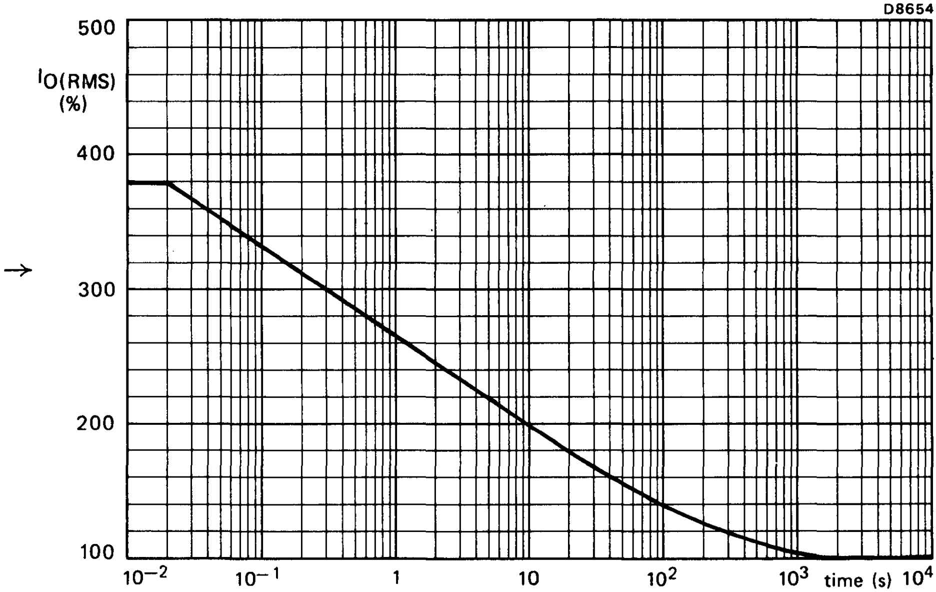


α = conduction angle per half cycle

$$a = \text{form factor} = \frac{I_{T(RMS)}}{I_{T(AV)}}$$

α	a
30°	4
60°	2,8
90°	2,2
120°	1,9
180°	1,57

OVERLOAD OPERATION



→ Fig.6 Maximum permissible duration of steady overload (provided that T_{mb} does not exceed 120 °C during and after overload) expressed as a percentage of the steady state r.m.s. rated current. For high r.m.s. overload currents precautions should be taken so that the temperature of the terminals does not exceed 125 °C. During these overload conditions the triac may lose control. Therefore the overload should be terminated by a separate protection device.

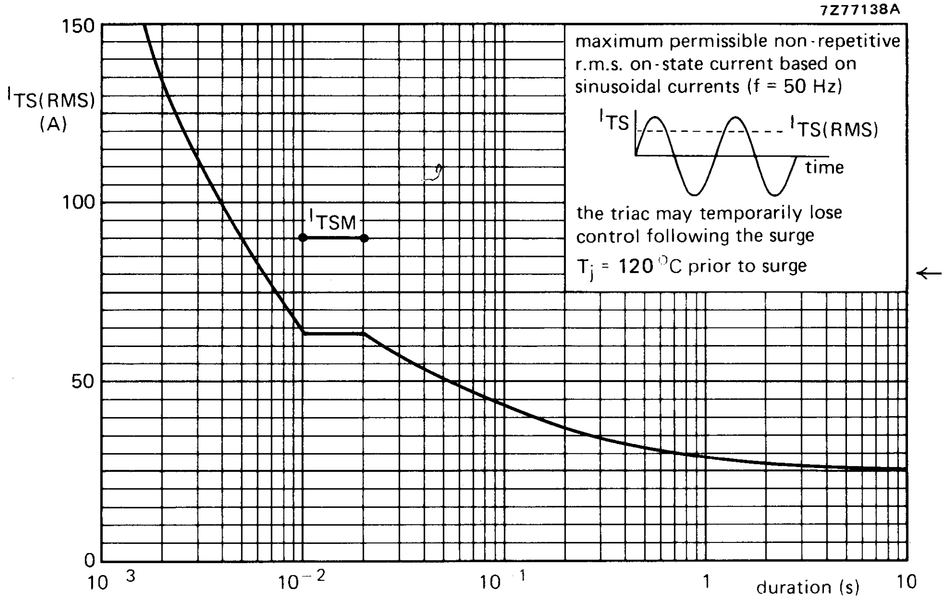

7Z77138A
150
100
50
0
$I_{TS(RMS)}$
(A)
I_{TSM}
maximum permissible non-repetitive r.m.s. on-state current based on sinusoidal currents (f = 50 Hz)
I_{TS}
$I_{TS(RMS)}$
time
the triac may temporarily lose control following the surge
T_j = 120 °C prior to surge
10^{-3}
10^{-2}
10^{-1}
1
duration (s)
10

Fig.7

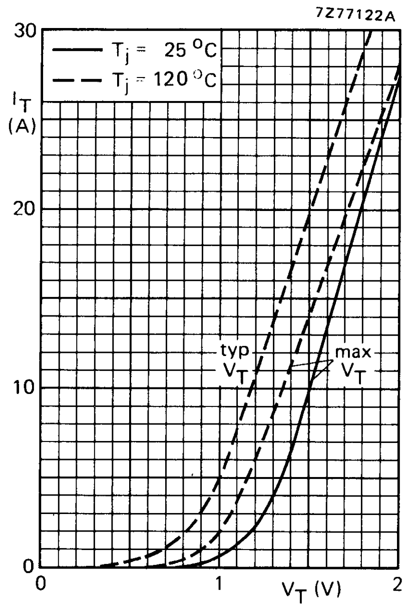

7Z77122A
30
20
10
0
I_T
(A)
T_j = 25 °C
T_j = 120 °C
typ
V_T
max
V_T
0
1
V_T (V)
2

Fig.8

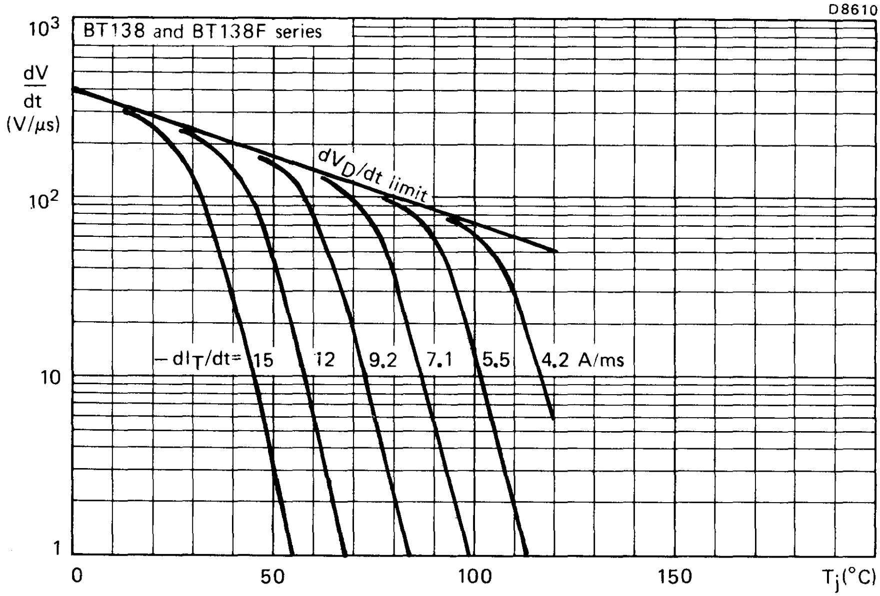


Fig.9 Limit commutation dV/dt for BT138 and F series versus T_j. The triac should commutate when dV/dt is below the value on the appropriate curve for pre-commutation dI_T/dt.

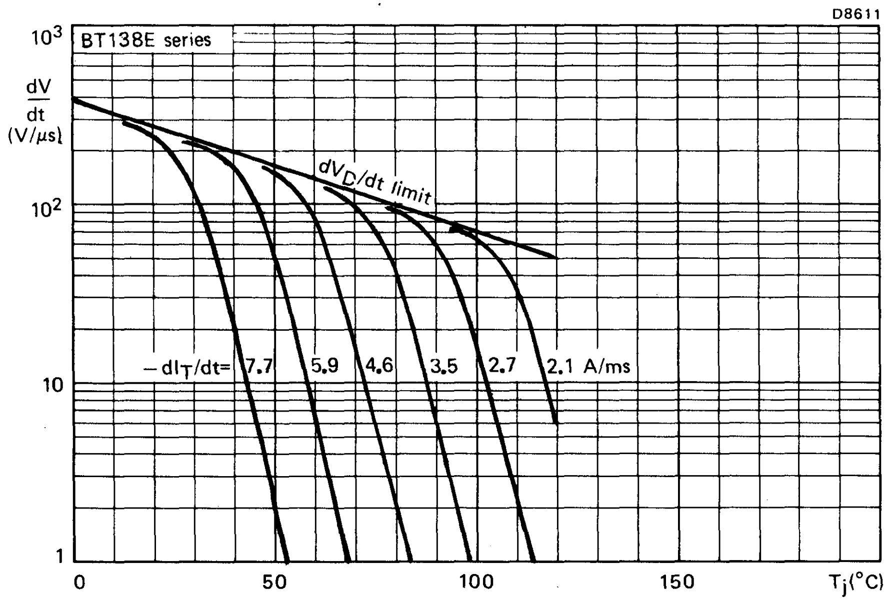


Fig.10 Limit commutation dV/dt for BT138E series versus T_j. The triac should commutate when the dV/dt is below the value on the appropriate curve for pre-commutation dI_T/dt.

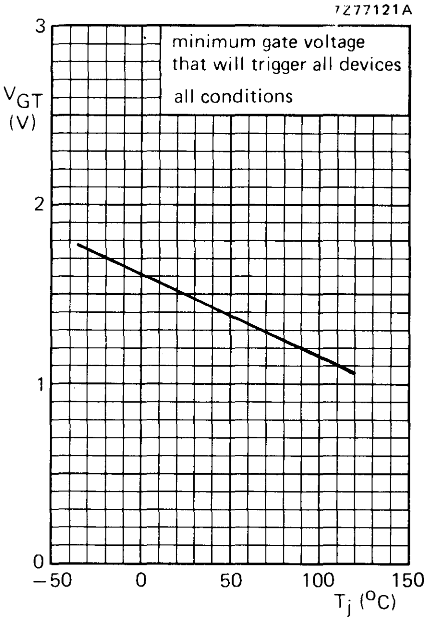


Fig. 11

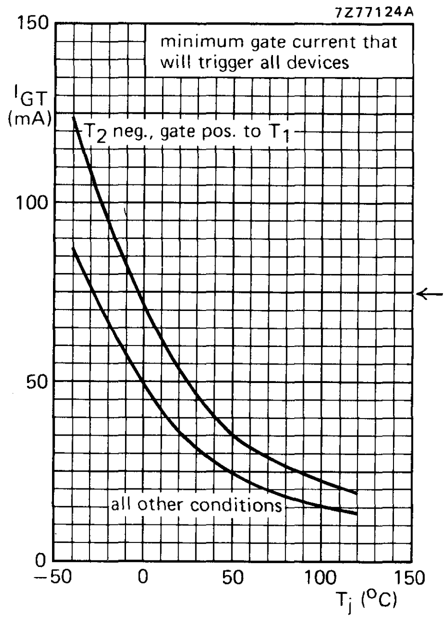


Fig. 12

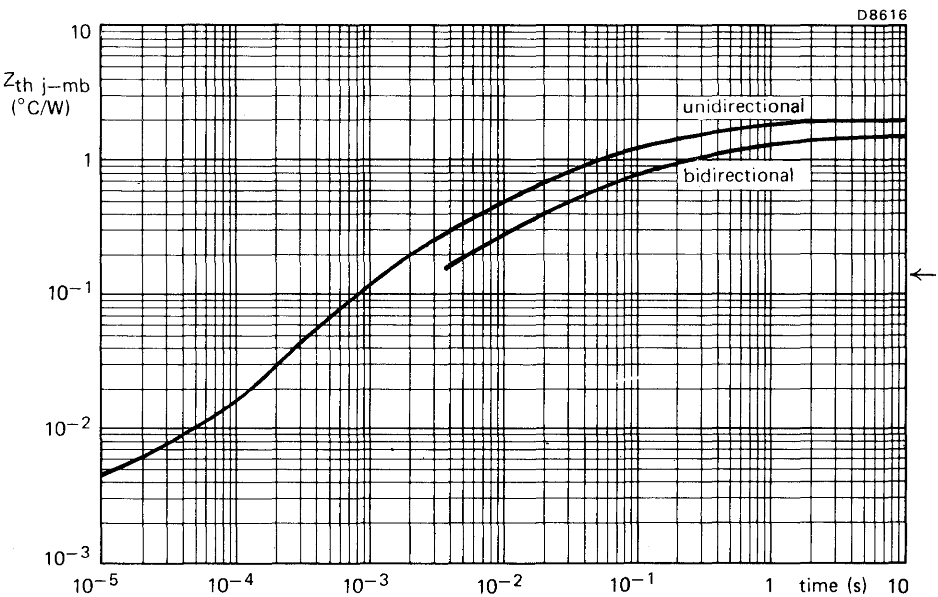


Fig.13

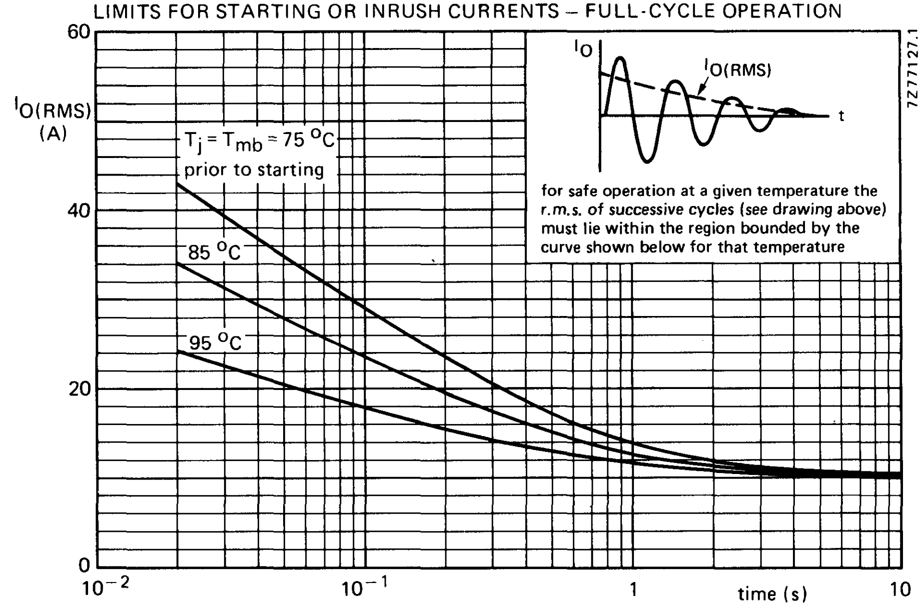

LIMITS FOR STARTING OR INRUSH CURRENTS – FULL-CYCLE OPERATION
7Z77127.1
$I_{O(RMS)}$ (A)
60
40
20
0
$T_j = T_{mb} \approx 75\ ^oC$ prior to starting
85 °C
95 °C
I_O
$I_{O(RMS)}$
t
for safe operation at a given temperature the r.m.s. of successive cycles (see drawing above) must lie within the region bounded by the curve shown below for that temperature
10^{-2}
10^{-1}
1
time (s)
10

Fig.14

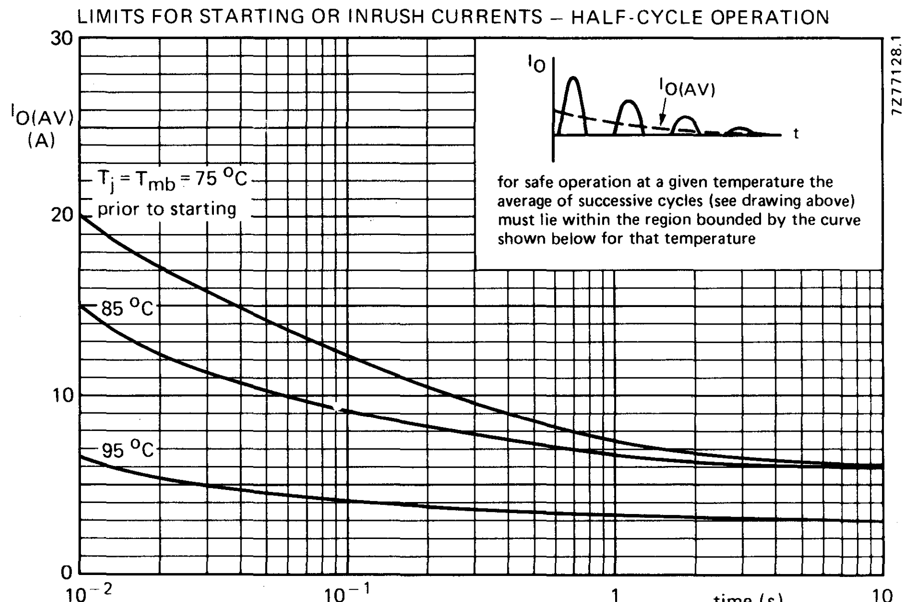

LIMITS FOR STARTING OR INRUSH CURRENTS – HALF-CYCLE OPERATION
7Z77128.1
$I_{O(AV)}$ (A)
30
20
10
0
$T_j = T_{mb} \approx 75\ ^oC$ prior to starting
85 °C
95 °C
I_O
$I_{O(AV)}$
t
for safe operation at a given temperature the average of successive cycles (see drawing above) must lie within the region bounded by the curve shown below for that temperature
10^{-2}
10^{-1}
1
time (s)
10

Fig.15

TRIACS

Glass-passivated eutectic-bonded triacs intended for use in applications requiring high bidirectional transient and blocking voltage capability, and high thermal cycling performance with very low thermal resistances, e.g. a.c. power control applications such as motor, industrial lighting, industrial and domestic heating control and static switching systems.

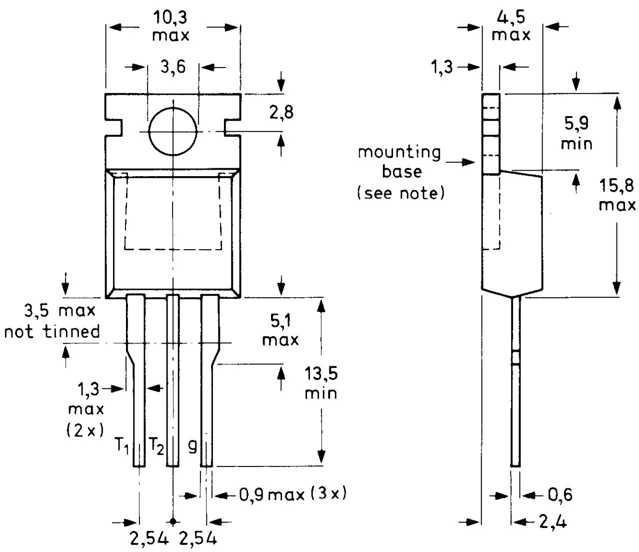
QUICK REFERENCE DATA

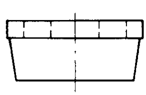
			BT139-500	600	
Repetitive peak off-state voltage	V_{DRM}	max.	500	600	V
R.M.S. on-state current	$I_{T(RMS)}$	max.	16		A ←
Non-repetitive peak on-state current	I_{TSM}	max.	115		A

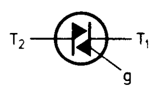
MECHANICAL DATA

Dimensions in mm

Fig.1 TO-220AB







←

Net mass: 2 g

Note: The exposed metal mounting base is directly connected to terminal T_2.

Accessories supplied on request: see data sheet Mounting instructions and accessories for TO-220 envelopes.

RATINGS

Limiting values in accordance with the Absolute Maximum System (IEC 134)

			BT139-500	600	
Voltages (in either direction)					
Non-repetitive peak off-state voltage ($t \leqslant 10$ ms)	V_{DSM}	max.	500	600	V*
Repetitive peak off-state voltage ($\delta \leqslant 0{,}01$)	V_{DRM}	max.	500	600	V
Crest working off-state voltage	V_{DWM}	max.	400	400	V
→ **Currents** (in either direction)					
R.M.S. on-state current (conduction angle 360°) up to T_{mb} = 93 °C	$I_{T(RMS)}$	max.		16	A
Average on-state current for half-cycle operation (averaged over any 20 ms period) up to T_{mb} = 79 °C	$I_{T(AV)}$	max.		10	A
Repetitive peak on-state current	I_{TRM}	max.		115	A
Non-repetitive peak on-state current; T_j = 120 °C prior to surge; t = 20 ms; full sine-wave	I_{TSM}	max.		115	A
I^2t for fusing (t = 10 ms)	I^2t	max.		65	A^2s
Rate of rise of on-state current after triggering with I_G = 200 mA to I_T = 20 A; dI_G/dt = 0,2 A/µs	dI_T/dt	max.		30	A/µs

Gate to terminal 1

Power dissipation				
Average power dissipation (averaged over any 20 ms period)	$P_{G(AV)}$	max.	0,5	W
Peak power dissipation	P_{GM}	max.	5	W
Temperatures				
Storage temperature	T_{stg}		−40 to +125	°C
→ Operating junction temperature				
full-cycle operation	T_j	max.	120	°C
half-cycle operation	T_j	max.	110	°C

* Although not recommended, off-state voltages up to 800 V may be applied without damage, but the triac may switch into the on-state. The rate of rise of on-state current should not exceed 15 A/µs.

THERMAL RESISTANCE

From junction to mounting base			
full-cycle operation	$R_{th\ j\text{-}mb}$	=	1,2 °C/W ←
half-cycle operation	$R_{th\ j\text{-}mb}$	=	1,7 °C/W ←
Transient thermal impedance; t = 1 ms	$Z_{th\ j\text{-}mb}$	=	0,1 °C/W

Influence of mounting method

1. Heatsink mounted with clip (see mounting instructions)

Thermal resistance from mounting base to heatsink

a. with heatsink compound	$R_{th\ mb\text{-}h}$	=	0,3 °C/W
b. with heatsink compound and 0,06 mm maximum mica insulator	$R_{th\ mb\text{-}h}$	=	1,4 °C/W
c. with heatsink compound and 0,1 mm maximum mica insulator (56369)	$R_{th\ mb\text{-}h}$	=	2,2 °C/W
d. with heatsink compound and 0,25 mm maximum alumina insulator (56367)	$R_{th\ mb\text{-}h}$	=	0,8 °C/W
e. without heatsink compound	$R_{th\ mb\text{-}h}$	=	1,4 °C/W

2. Free-air operation

The quoted values of $R_{th\ j\text{-}a}$ should be used only when no leads of other dissipating components run to the same tie-point.

Thermal resistance from junction to ambient in free air:
mounted on a printed-circuit board at a = any lead length $R_{th\ j\text{-}a}$ = 60 °C/W

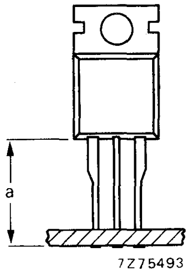


Fig.2

→ CHARACTERISTICS

Polarities, positive or negative, are identified with respect to T_1.

Voltages and currents (in either direction)

On-state voltage (Note 1)

I_T = 20 A; T_j = 25 °C	V_T	<	1,6	V

Rate of rise of off-state voltage that will not trigger any device;

T_j = 120 °C; see also Figs.9 and 10; gate open circuit	dV_D/dt	<	50	V/µs

Rate of rise of commutating voltage that will not trigger any device;

$I_{T(RMS)}$ = 16 A; V_D = $V_{DWM\,max}$;
T_j = 120 °C; gate open circuit; see also Figs.9 and 10

BT139 series	$-dI_T/dt$ = 6,7 A/ms	dV_{com}/dt	<	6	V/µs
BT139 series F	$-dI_T/dt$ = 6,7 A/ms				
BT139 series E	$-dI_T/dt$ = 3,35 A/ms				

Off-state current

V_D = $V_{DWM\,max}$; T_j = 120 °C	I_D	<	0,5	mA

Holding current; T_j = 25 °C

T_2 and G positive or negative	BT139, F and E series	I_H	<	30	mA
	BT139 D series	I_H	<	20	mA

Gate voltage and current that will trigger all devices

Latching current V_D = 12 V; T_j = 25 °C				T_2+ G+	T_2+ G−	T_2− G−	T_2− G+	
BT139 series	G to T_1	V_{GT}	>	1,5	1,5	1,5	1,5	V
		I_{GT}	>	35	35	35	50	mA
		I_L	<	40	60	40	40	mA
BT139 series F e.g. BT139–500F	G to T_1	V_{GT}	>	1,5	1,5	1,5	1,5	V
		I_{GT}	>	25	25	25	50	mA
		I_L	<	40	60	40	40	mA
BT139 series E	G to T_1	V_{GT}	>	1,5	1,5	1,5	1,5	V
		I_{GT}	>	15	15	15	50	mA
		I_L	<	30	40	30	30	mA
BT139 series D (Note 2)	G to T_1	V_{GT}	>	1,5	1,5	1,5	**	V
		I_{GT}	>	8	8	8	**	mA
		I_L	<	25	35	25	**	mA

Gate to terminal 1

Voltage that will not trigger any device V_D = $V_{DRM\,max}$;

T_j = 120 °C; T_2 and G positive or negative	V_{GD}	<	250	mV

Note 1. Measured under pulse conditions to avoid excessive dissipation.

Note 2. A version with I_{GT} = 5 mA max. is available on request.

** Triggerable

MOUNTING INSTRUCTIONS

1. The triac may be soldered directly into the circuit, but the maximum permissible temperature of the soldering iron or bath is 275 °C; it must not be in contact with the joint for more than 5 seconds. Soldered joints must be at least 4,7 mm from the seal.
2. The leads should not be bent less than 2,4 mm from the seal, and should be supported during bending.
3. It is recommended that the circuit connection be made to tag T_2, rather than direct to the heatsink.
4. Mounting by means of a spring clip is the best mounting method because it offers:
   a. a good thermal contact under the crystal area and slightly lower $R_{th\ mb\text{-}h}$ values than screw mounting.
   b. safe isolation for mains operation.
   However, if a screw is used, it should be M3 cross-recess pan head. Care should be taken to avoid damage to the plastic body.
5. For good thermal contact heatsink compound should be used between mounting base and heatsink. Values of $R_{th\ mb\text{-}h}$ given for mounting with heatsink compound refer to the use of a metallic-oxide loaded compound. Ordinary silicone grease is not recommended.
6. The device should not be pop-rivetted to the heatsink. However, it is permissible to press-rivet providing that rivets of soft material are used, and the press forces are slowly and carefully controlled so as to avoid shock and deformation of either heatsink or mounting tab.

OPERATING NOTES

Dissipation and heatsink considerations:

a. The various components of junction temperature rise above ambient are illustrated in Fig.3.

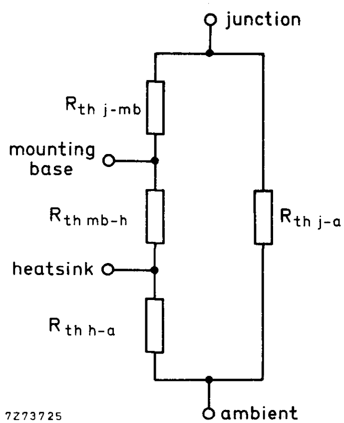


Fig.3

b. The method of using Figs.4 and 5 is as follows:
Starting with the required current on the $I_{T(AV)}$ or $I_{T(RMS)}$ axis, trace upwards to meet the appropriate from factor or conduction angle curve. Trace right horizontally and upwards from the appropriate value on the T_{amb} scale. The intersection determines the $R_{th\ mb\text{-}a}$. The heatsink thermal resistance value ($R_{th\ h\text{-}a}$) can now be calculated from:

$$R_{th\ h\text{-}a} = R_{th\ mb\text{-}a} - R_{th\ mb\text{-}h}.$$

c. Any measurement of heatsink temperature should be made immediately adjacent to the device.

FULL-CYCLE OPERATION

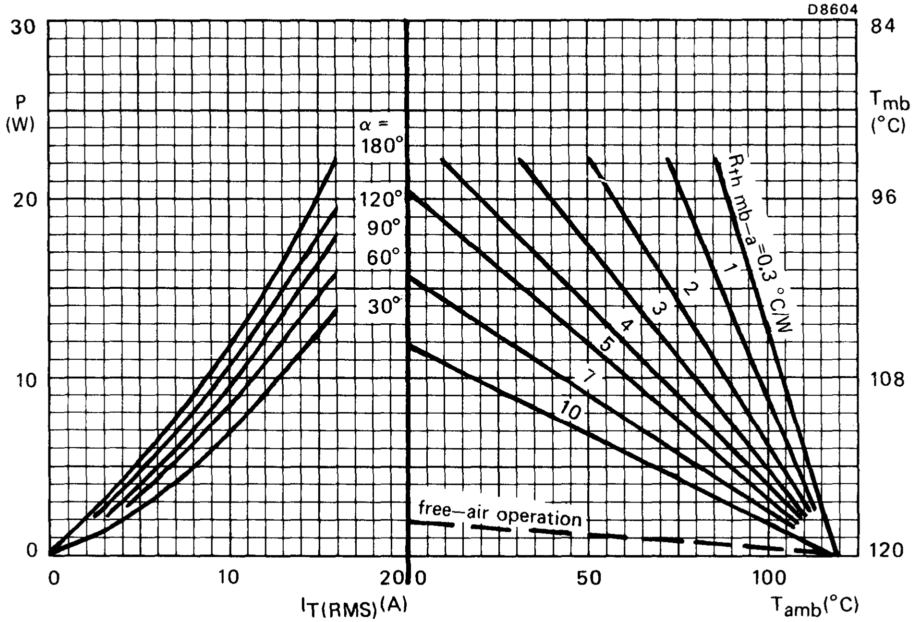
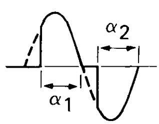


Fig. 4 The right-hand part shows the interrelationship between the power (derived from the left-hand part) and the maximum permissible temperatures.



$\alpha = \alpha_1 = \alpha_2$: conduction angle per half cycle

HALF-CYCLE OPERATION

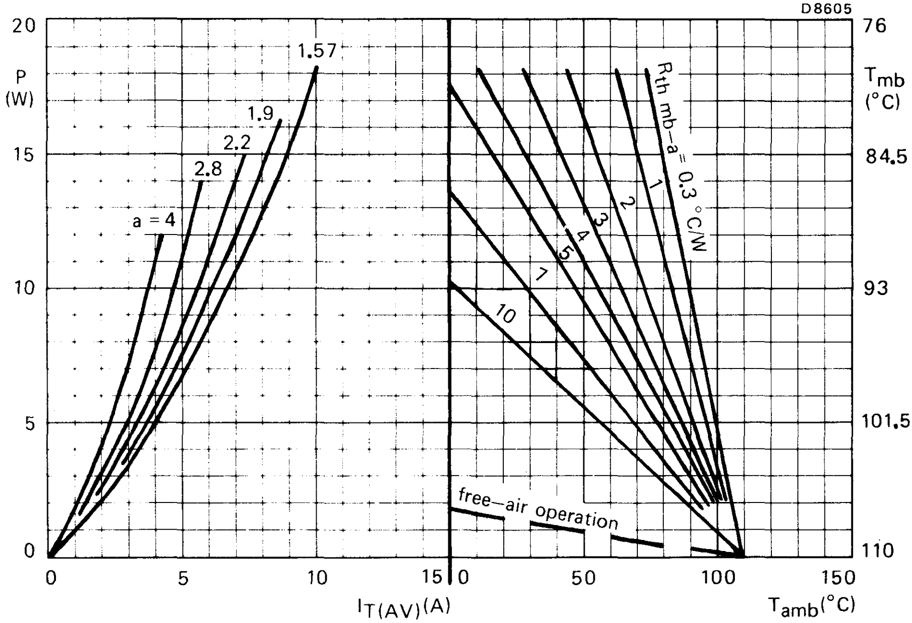
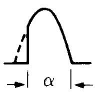


Fig.5 The right-hand part shows the interrelationship between the power (derived from the left-hand part) and the maximum permissible temperatures.

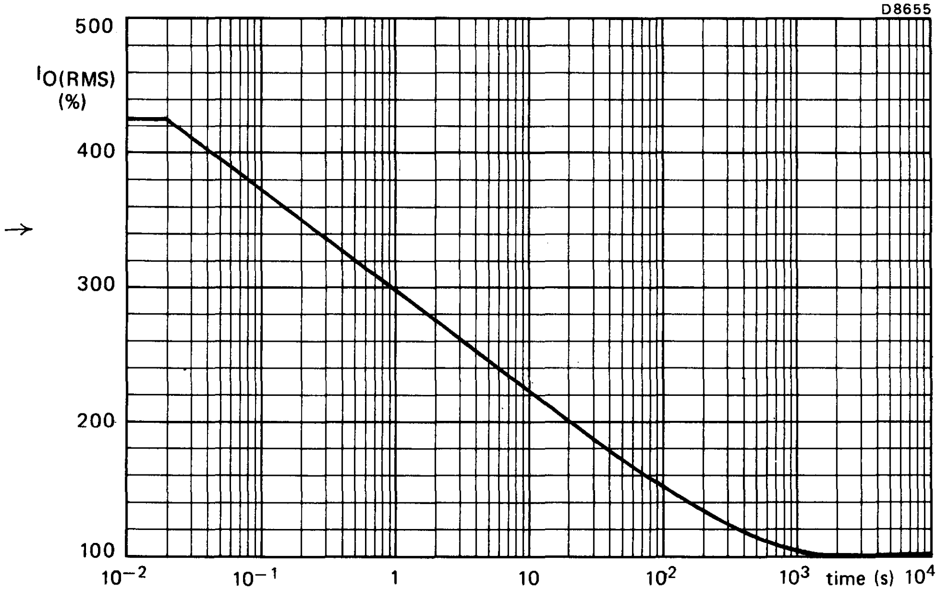


α = conduction angle per half cycle

$$a = \text{form factor} = \frac{I_{T(RMS)}}{I_{T(AV)}}$$

α	a
30°	4
60°	2,8
90°	2,2
120°	1,9
180°	1,57

OVERLOAD OPERATION



→ Fig. 6 Maximum permissible duration of steady overload (provided that T_{mb} does not exceed 120 °C during and after overload) expressed as a percentage of the steady state r.m.s. rated current. For high r.m.s. overload currents precautions should be taken so that the temperature of the terminals does not exceed 125 °C. During these overload conditions the triac may lose control. Therefore the overload should be terminated by a separate protection device.

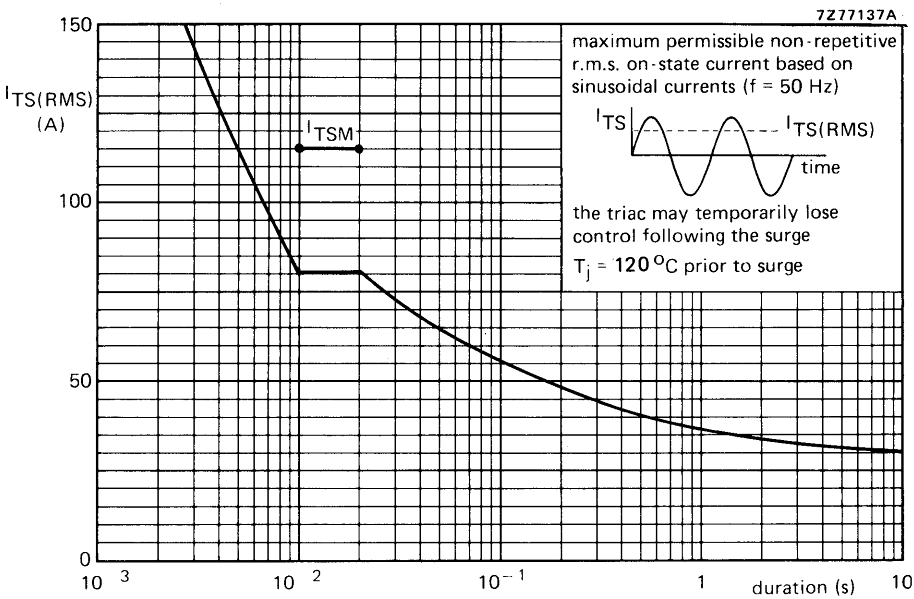

7Z77137A
150
100
50
0
$I_{TS(RMS)}$ (A)
I_{TSM}
maximum permissible non-repetitive r.m.s. on-state current based on sinusoidal currents (f = 50 Hz)
I_{TS}
$I_{TS(RMS)}$
time
the triac may temporarily lose control following the surge
T_j = 120 °C prior to surge
10^{-3}
10^{-2}
10^{-1}
1
duration (s)
10

Fig.7

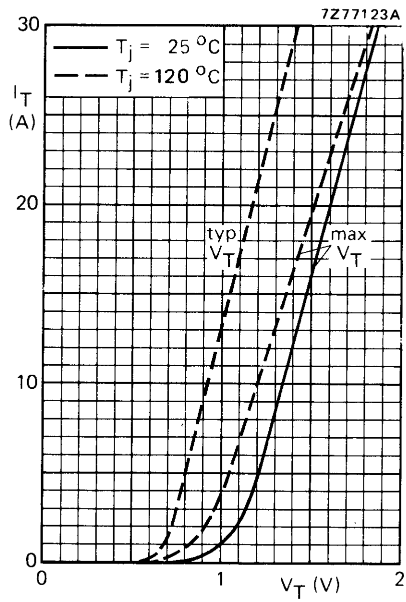

7Z77123A
30
20
10
0
I_T (A)
T_j = 25 °C
T_j = 120 °C
typ V_T
max V_T
0
1
V_T (V)
2

Fig.8

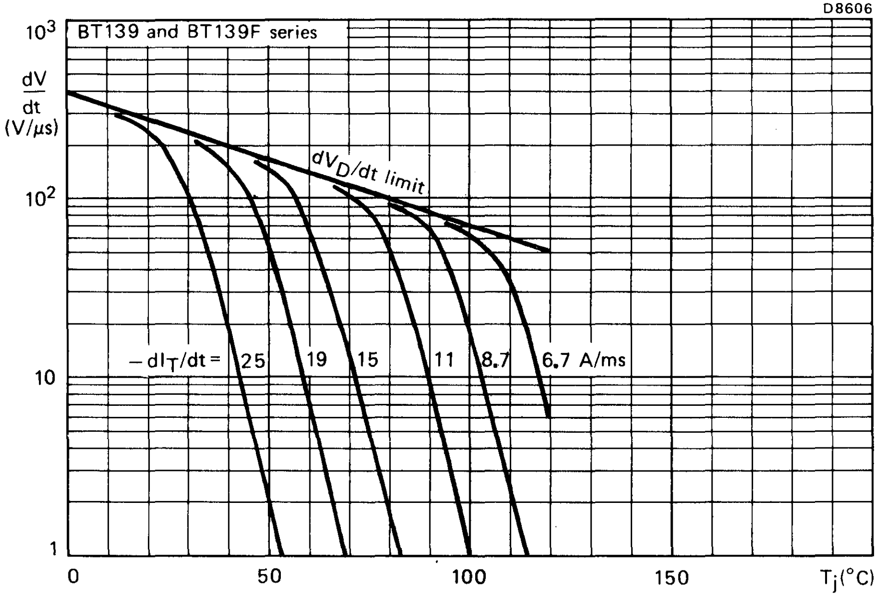


Fig.9 Limit commutation dV/dt for BT139 and F series versus T_j. The triac should commutate when the dV/dt is below the value on the appropriate curve for pre-commutation dI_T/dt.

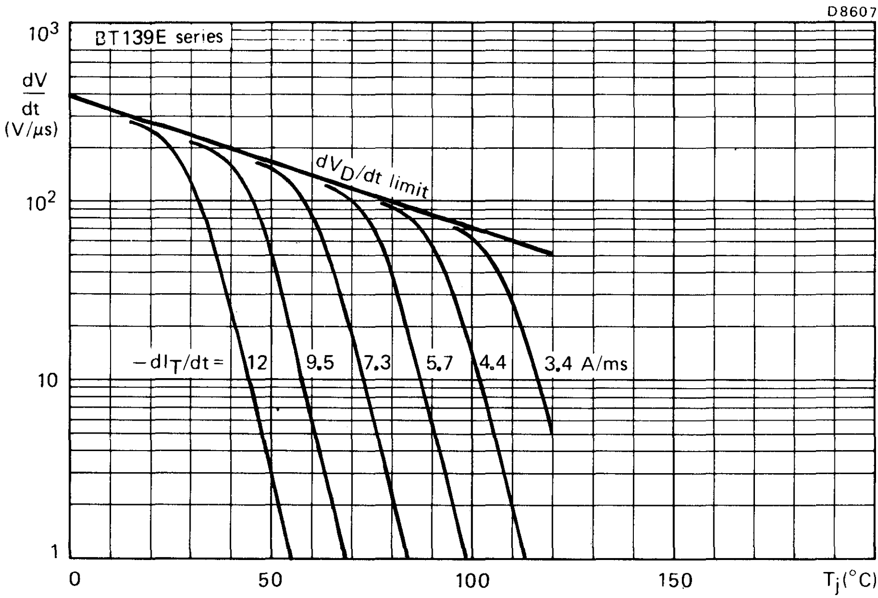


Fig.10 Limit commutation dV/dt for BT139E series versus T_j. The triac should commutate when the dV/dt is below the value on the appropriate curve for pre-commutation dI_T/dt.

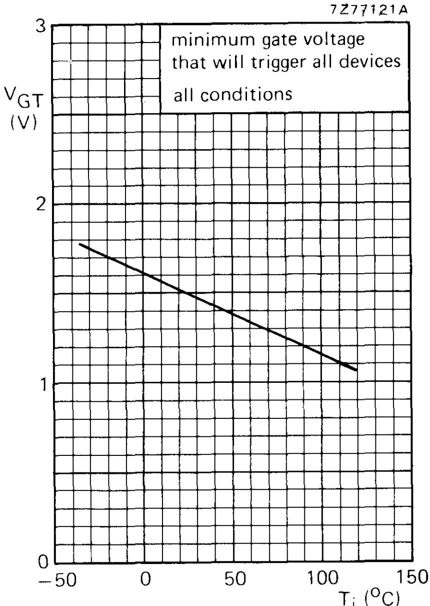


Fig. 11

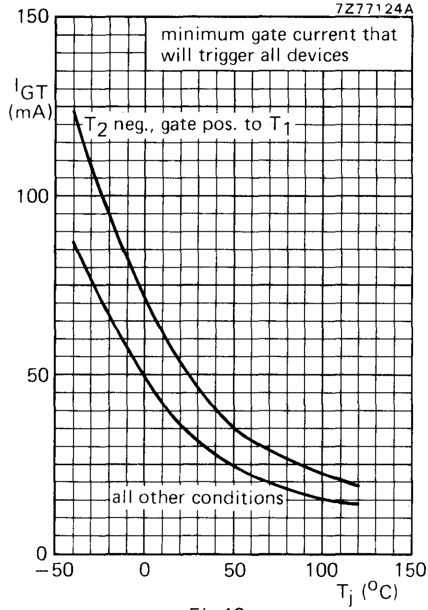


Fig. 12

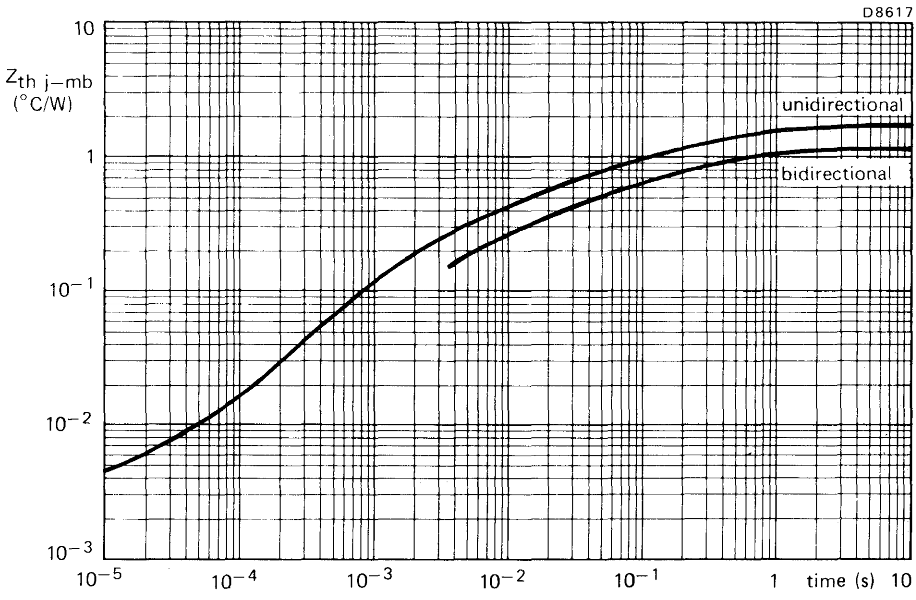


Fig. 13

LIMITS FOR STARTING OR INRUSH CURRENTS — FULL-CYCLE OPERATION

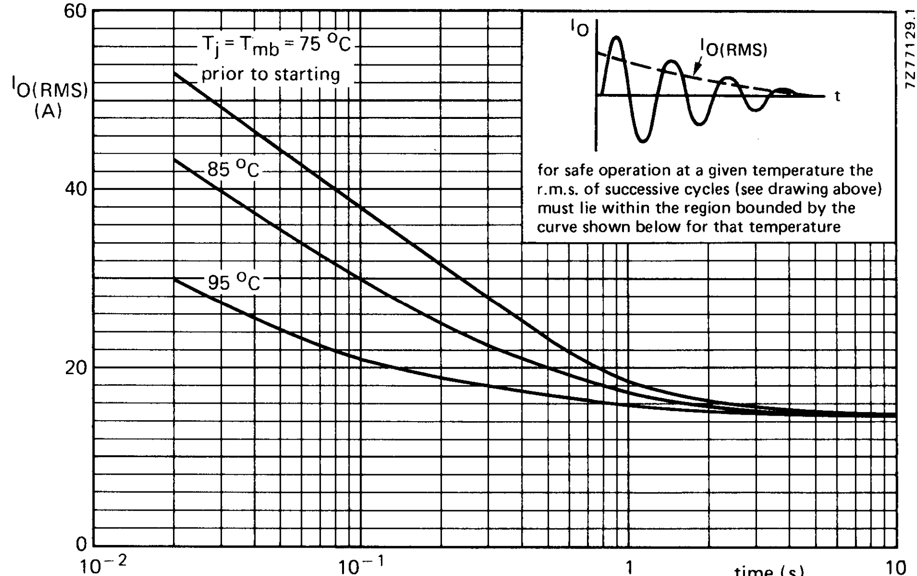


Fig.14

LIMITS FOR STARTING OR INRUSH CURRENTS — HALF-CYCLE OPERATION

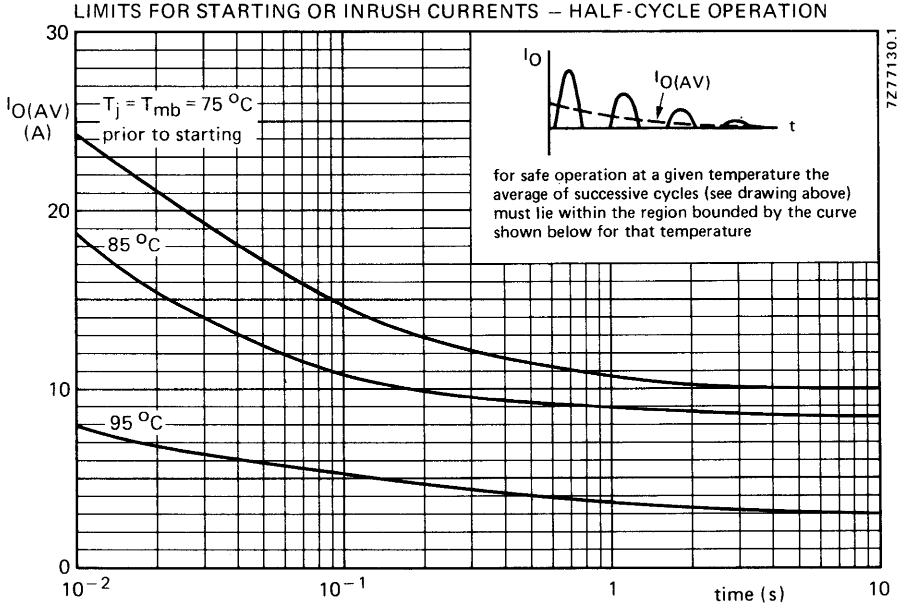


Fig.15

TRIACS

Silicon triacs in metal envelopes, intended for industrial a.c. power control, and are particularly suitable for static switching of 3-phase induction motors. They may also be used for furnace control, lighting control and other static switching applications up to an r.m.s. on-state current of 55 A.

Two grades of commutation performance are available, 30 V/µs at 25 A/ms (suffix G) and 30 V/µs at 50 A/ms (suffix H).

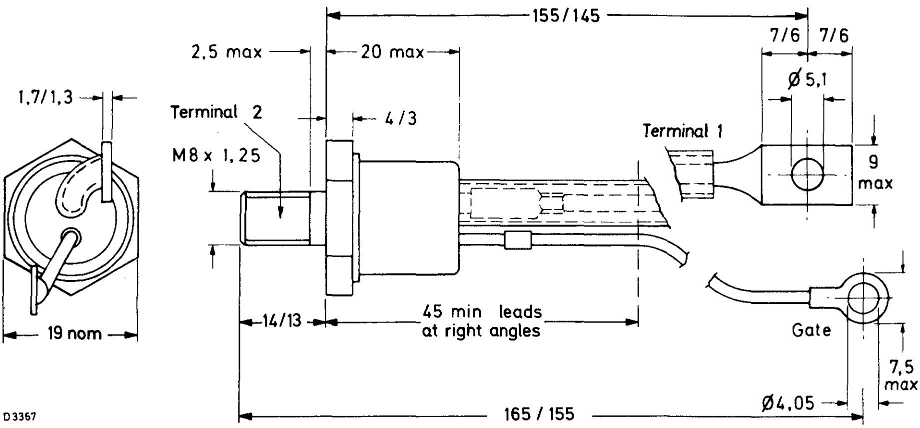
QUICK REFERENCE DATA

			BTW34-600	800	1000	1200	1400	1600	
Repetitive peak off-state voltage	V_{DRM}	max.	600	800	1000	1200	1400	1600	V
R.M.S. on-state current	$I_{T(RMS)}$	max.						55	A
Non-repetitive peak on-state current	I_{TSM}	max.						400	A
Rate of rise of commutating voltage that will not trigger any device (see page 3)	dV_{com}/dt	<						30	V/µs

MECHANICAL DATA

Dimensions in mm

Fig. 1 TO-103.



Net mass: 46 g
Diameter of clearance hole: 8,5 mm
Torque on nut: min. 4 Nm (40 kg cm)
max. 6 Nm (60 kg cm)

Supplied with device: 1 nut, 1 lock washer
Nut dimensions across the flats: 13 mm

RATINGS

Limiting values in accordance with the Absolute Maximum System (IEC 134)

Voltages (in either direction)*

			BTW34-600	800	1000	1200	1400	1600	
Non-repetitive peak off-state voltage ($t \leqslant 10$ ms)	V_{DSM}	max.	700	900	1100	1300	1400	1600	V**
Repetitive peak off-state voltage	V_{DRM}	max.	600	800	1000	1200	1400	1600	V
Crest working off-state voltage	V_{DWM}	max.	400	600	700	800	800	800	V

Currents (in either direction)

R.M.S. on-state current (conduction angle 360°)				
up to $T_{mb} = 75$ °C	$I_{T(RMS)}$	max.	55	A
at $T_{mb} = 85$ °C	$I_{T(RMS)}$	max.	45	A
Average on-state current for half-cycle operation (averaged over any 20 ms period) at $T_{mb} = 85$ °C	$I_{T(AV)}$	max.	21	A
Repetitive peak on-state current	I_{TRM}	max.	300	A
Non-repetitive peak on-state current $T_j = 125$ °C prior to surge; t = 20 ms; full sine-wave	I_{TSM}	max.	400	A
I^2t for fusing (t = 10 ms)	I^2t	max.	800	A^2s
Rate of rise of on-state current after triggering with $I_G = 1$ A to $I_T = 100$ A; $dI_G/dt = 1$ A/µs	dI_T/dt	max.	50	A/µs

Gate to terminal 1

Power dissipation

Average power dissipation (averaged over any 20 ms period)	$P_{G(AV)}$	max.	2	W
Peak power dissipation	P_{GM}	max.	10	W

Temperatures

Storage temperature	T_{stg}	−55 to + 125		°C
Junction temperature	T_j	max.	125	°C

THERMAL RESISTANCE

From junction to mounting base				
full-cycle operation	$R_{th\ j\text{-}mb}$	=	0,6	°C/W
half-cycle operation	$R_{th\ j\text{-}mb}$	=	1,2	°C/W
From mounting base to heatsink with heatsink compound	$R_{th\ mb\text{-}h}$	=	0,2	°C/W
Transient thermal impedance; t = 1 ms	$Z_{th\ j\text{-}mb}$	=	0,08	°C/W

* To ensure thermal stability: $R_{th\ j\text{-}a} < 2$ °C/W (full-cycle or half-cycle operation). For smaller heatsinks $T_{j\ max}$ should be derated (see Figs 2 and 3).

** Although not recommended, higher off-state voltages may be applied without damage, but the triac may switch into the on-state. The rate of rise of on-state current should not exceed 20 A/µs.

CHARACTERISTICS

Polarities, positive or negative, are identified with respect to T_1.

Voltages (in either direction)

On-state voltage			
I_T = 65 A; T_j = 25 °C	V_T	<	2,1 V*
Rate of rise of off-state voltage that will not trigger any device; exponential method; V_D = 2/3 $V_{DRM\,max}$; T_j = 125 °C	dV_D/dt	<	200 V/µs

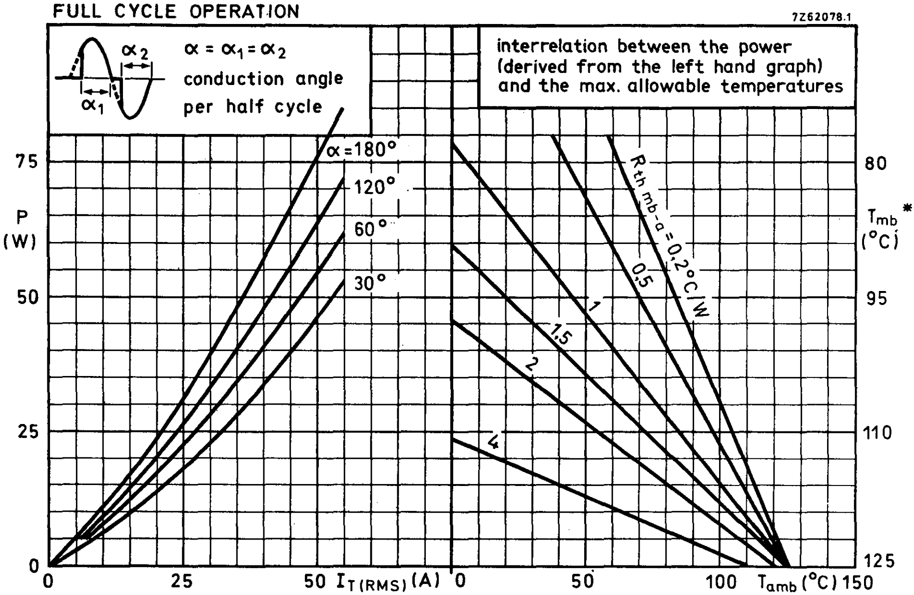
Rate of rise of commutating voltage that will not trigger any device;
$I_{T(RMS)}$ = 45 A; V_D = $V_{DRM\,max}$; T_{mb} = 85 °C

	dV_{com}/dt (V/µs)	$-dI_T/dt$ (A/ms)
BTW34-600G to 1600G	<30	25 ←
BTW34-600H to 1600H	<30	50

Currents (in either direction)

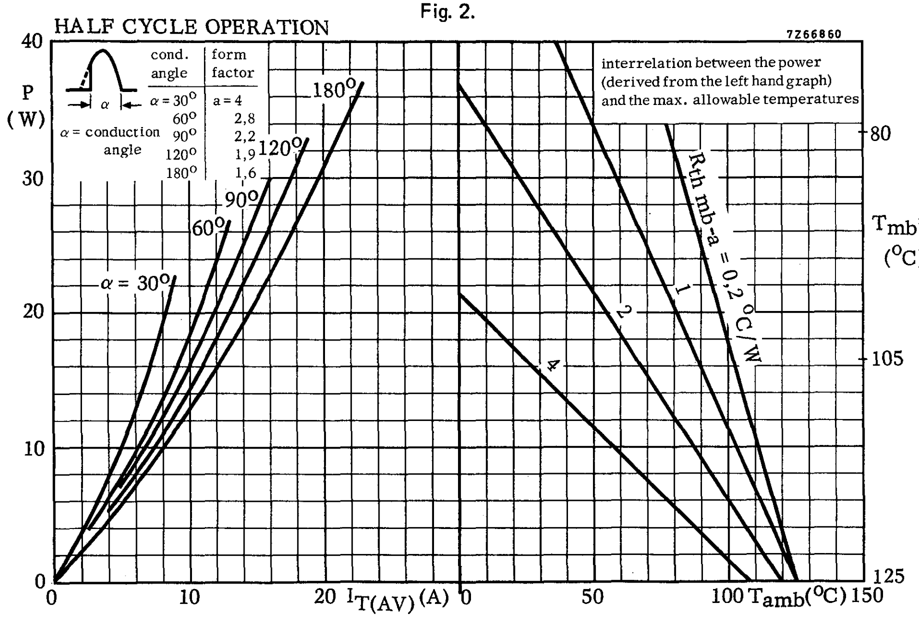
		T2 pos.	T2 neg.	
Off-state current V_D = $V_{DWM\,max}$; T_j = 125 °C	I_D	<	10	mA
Latching current; T_j = 25 °C				
G positive	I_L	<250	–	mA
G negative	I_L	<500	250	mA
Holding current; T_j = 25 °C				
G positive or negative	I_H	<200	200	mA
Gate to terminal 1				
Voltage and current that will trigger all devices V_D = 12 V; T_j = 25 °C				
G positive	V_{GT}	> 2,5	–	V
	I_{GT}	> 200	–	mA
G negative	$-V_{GT}$	> 2,5	2,5	V
	$-I_{GT}$	> 200	200	mA
Voltage that will not trigger any device V_D = $V_{DRM\,max}$; T_j = 125 °C; G positive or negative	V_{GD}	< 0,2	0,2	V

* Measured under pulse conditions to avoid excessive dissipation.



* T_{mb}-scale is for comparison purposes only and is correct only for $R_{th\ mb-a} \leq 1,4\ °C/W$

Fig. 2.



* T_{mb}- scale is for comparison purposes only and is correct only for $R_{th\ mb-a} \leq 0,8\ °C/$

Fig. 3.

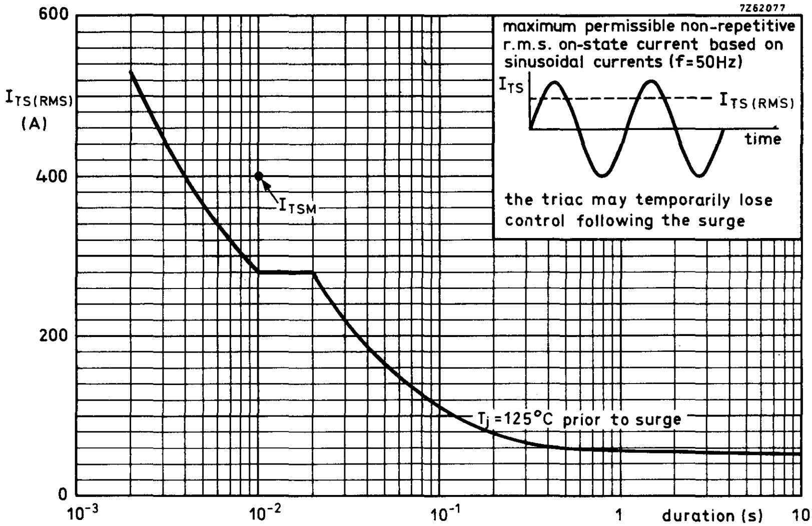

7Z62077
600
400
200
0
$I_{TS(RMS)}$ (A)
I_{TSM}
maximum permissible non-repetitive r.m.s. on-state current based on sinusoidal currents (f=50Hz)
I_{TS}
$I_{TS(RMS)}$
time
the triac may temporarily lose control following the surge
T_j =125°C prior to surge
10^{-3}
10^{-2}
10^{-1}
1
duration (s)
10

Fig. 4.

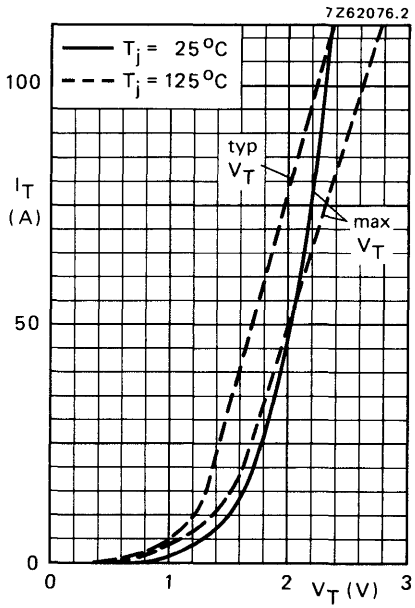

7Z62076.2
T_j = 25°C
T_j = 125°C
100
50
0
I_T (A)
typ V_T
max V_T
0
1
2
V_T (V)
3

Fig. 5.

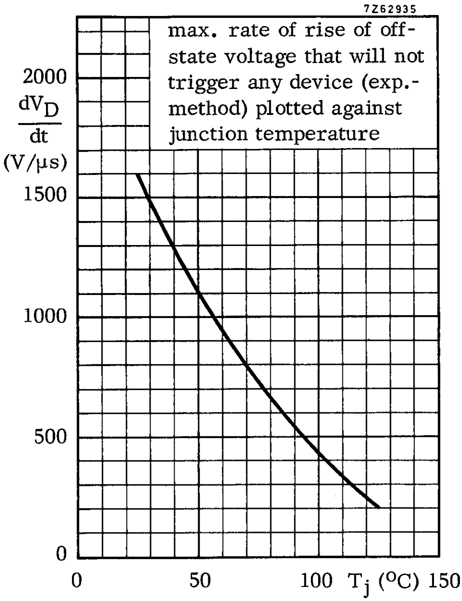


Fig. 6.

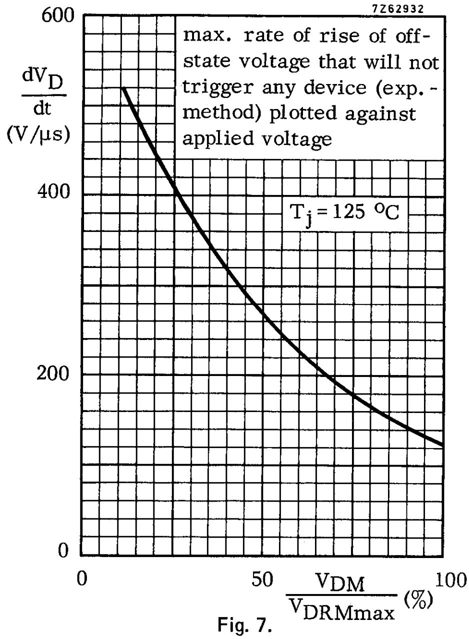


Fig. 7.

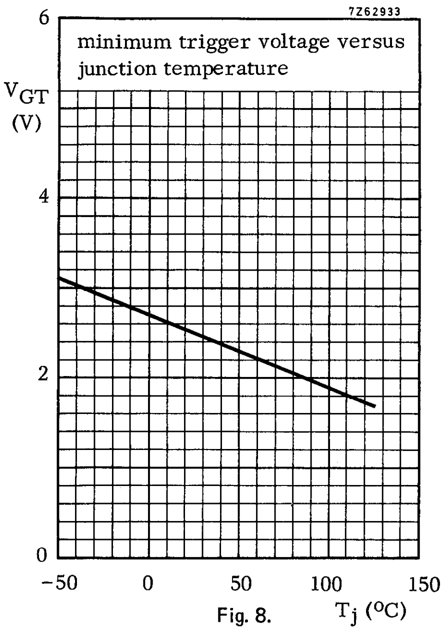


Fig. 8.

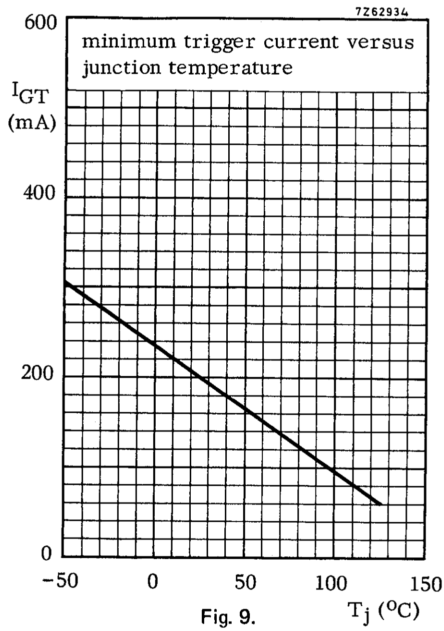


Fig. 9.

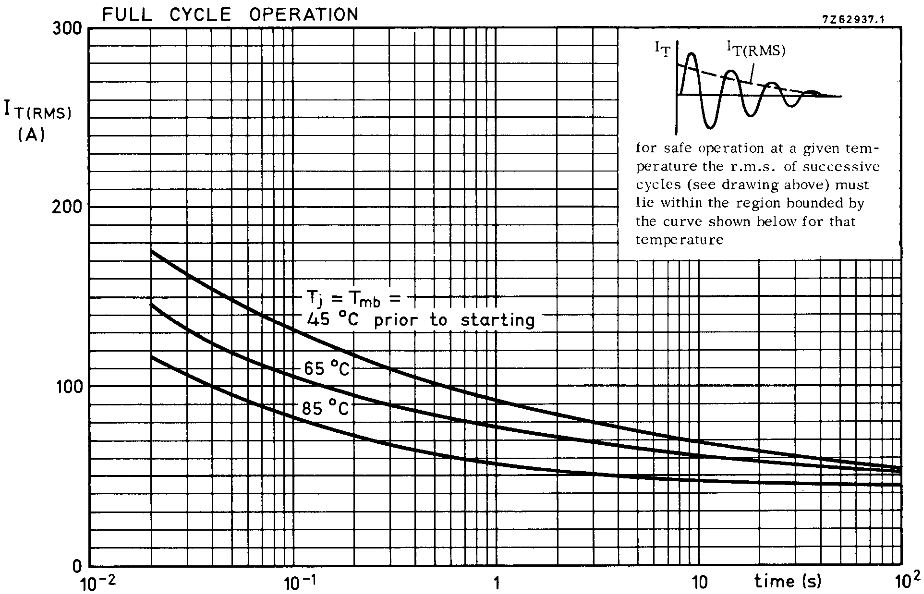

FULL CYCLE OPERATION
7Z62937.1
300
200
100
0
$I_{T(RMS)}$ (A)
I_T
$I_{T(RMS)}$
for safe operation at a given temperature the r.m.s. of successive cycles (see drawing above) must lie within the region bounded by the curve shown below for that temperature
$T_j = T_{mb} =$ 45 °C prior to starting
65 °C
85 °C
10^{-2}
10^{-1}
1
10
time (s)
10^2

Fig. 10.

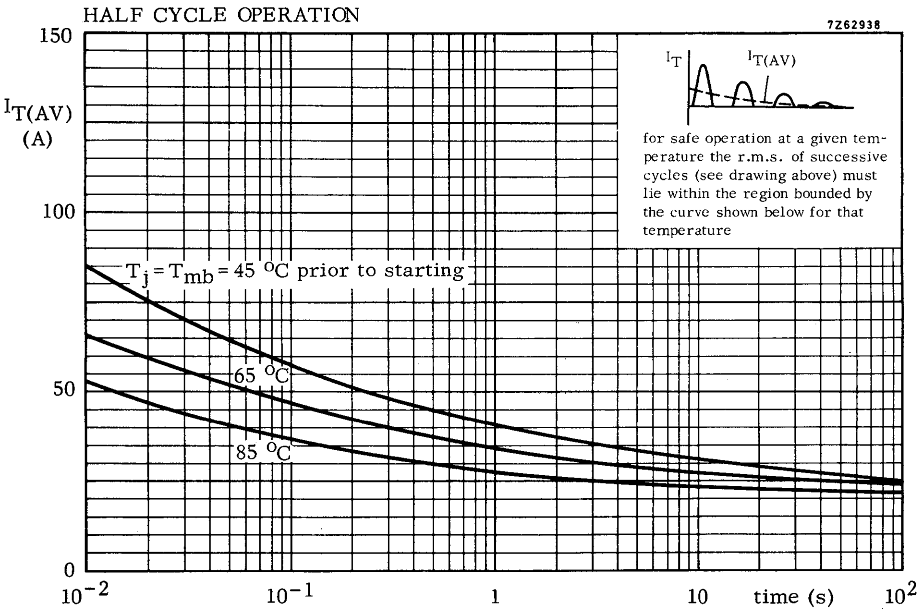
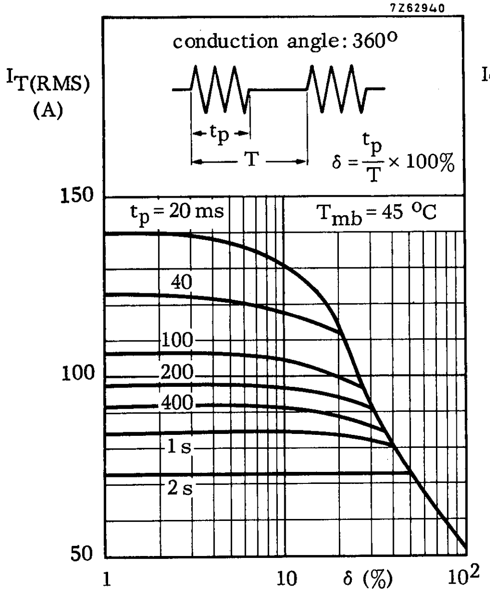

HALF CYCLE OPERATION
7Z62938
150
100
50
0
$I_{T(AV)}$ (A)
I_T
$I_{T(AV)}$
for safe operation at a given temperature the r.m.s. of successive cycles (see drawing above) must lie within the region bounded by the curve shown below for that temperature
$T_j = T_{mb} = 45$ °C prior to starting
65 °C
85 °C
10^{-2}
10^{-1}
1
10
time (s)
10^2

Fig. 11.



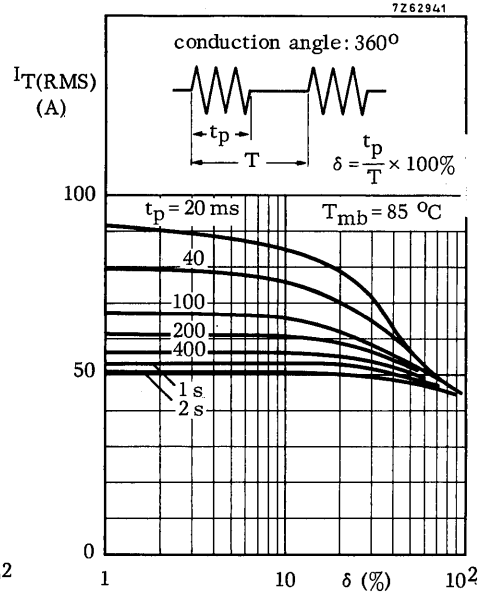


Fig. 12 Intermittent overload capability of one triac in a single phase a.c. control circuit.

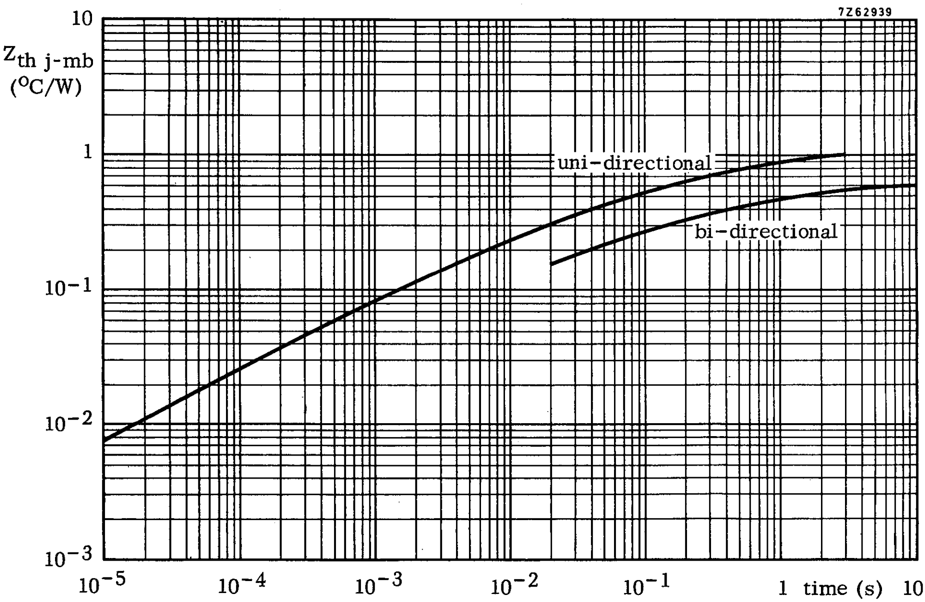


Fig. 13.

TRIACS

A range of glass-passivated triacs in plastic envelopes with push-on connectors. They are intended for use in industrial a.c. power control applications such as motor and heating controls, and switching systems.

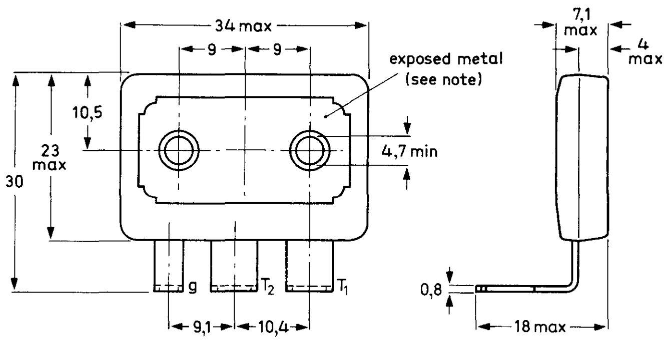
QUICK REFERENCE DATA

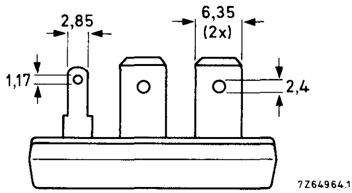
			BTW41–500G	600G	800G	
Repetitive peak off-state voltage	V_{DRM}	max.	500	600	800	V
R.M.S. on-state current	$I_{T(RMS)}$	max.		40		A
Non-repetitive peak on-state vurrent	I_{TSM}	max.		260		A
Rate of rise of commutating voltage that will not trigger any device	dV_{com}/dt	<		5		V/μs

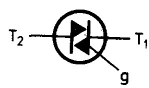
MECHANICAL DATA

Dimensions in mm

Fig.1 SOT-80







T_1 and T_2: AMP250 series
g: AMP110 series
The exposed metal base-plate is electrically connected to main terminal T_2.

Recommended diameter of fixing screws: 4 mm

Net mass: 15 g
Torque on fixing screws:
min. 0,8 Nm (8 kg cm)
max. 1,5 Nm (15 kg cm)

TRIACS

Also available to BS9343-F001

Silicon triacs in metal envelopes, intended for industrial a.c. power control and are particularly suitable for static switching of 3-phase induction motors. They may also be used for furnace control, lighting control and other static switching applications up to an r.m.s. on-state current of 15 A.

Two grades of commutation performance are available, 10 V/μs at 5 A/ms (suffix G) and 10 V/μs at 12 A/ms (suffix H).

QUICK REFERENCE DATA

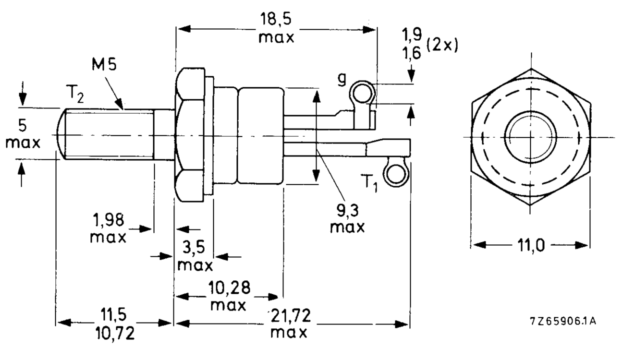
			BTW43–600	800	1000	1200	
Repetitive peak off-state voltage	V_{DRM}	max.	600	800	1000	1200	V

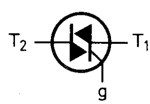
R.M.S. on-state current	$I_{T(RMS)}$	max.	15	A
Non-repetitive peak on-state current	I_{TSM}	max.	120	A
Rate of rise of commutating voltage that will not trigger any device (see page 3)	dV_{com}/dt	<	10	V/μs

MECHANICAL DATA

Dimensions in mm

Fig. 1 TO-64: with metric M5 stud (ϕ 5 mm).





Net mass: 7 g
Diameter of clearance hole: max. 5,2 mm
Accessories supplied on request: 56295
(PTFE bush, 2 mica washers, plain washer, tag)

Torque on nut: min. 0,9 Nm
(9 kg cm)
max. 1,7 Nm
(17 kg cm)

Supplied with the device: 1 nut, 1 lock washer
Nut dimensions across the flats: 8,0 mm

RATINGS

Limiting values in accordance with the Absolute Maximum System (IEC 134)

Voltages (in either direction)*

			BTW43–600	800	1000	1200	
Non-repetitive peak off-state voltage ($t \leq 10$ ms)	V_{DSM}	max.	600	800	1000	1200	V
Repetitive peak off-state voltage	V_{DRM}	max.	600	800	1000	1200	V
Crest working off-state voltage	V_{DWM}	max.	400	600	700	800	V

Currents (in either direction)

R.M.S. on-state current (conduction angle 360°)				
up to T_{mb} = 75 °C	$I_{T(RMS)}$	max.	15	A
at T_{mb} = 85 °C	$I_{T(RMS)}$	max.	12	A
Average on-state current for half-cycle operation (averaged over any 20 ms period)				
up to T_{mb} = 35 °C	$I_{T(AV)}$	max.	9,5	A
at T_{mb} = 85 °C	$I_{T(AV)}$	max.	5,5	A
Repetitive peak on-state current	I_{TRM}	max.	50	A
Non-repetitive peak on-state current T_j = 125 °C prior to surge; t = 20 ms; full sine-wave	I_{TSM}	max.	120	A
I^2t for fusing (t = 10 ms)	I^2t	max.	72	A^2s
Rate of rise of on-state current after triggering with I_G = 0,5 A to I_T = 25 A; dI_G/dt = 0,5 A/μs	dI_T/dt	max.	50	A/μs

Gate to terminal 1

Power dissipation

Average power dissipation (averaged over any 20 ms period)	$P_{G(AV)}$	max.	1	W
Peak power dissipation	P_{GM}	max.	10	W

Temperatures

Storage temperature	T_{stg}		− 55 to + 125	°C
Junction temperature	T_j	max.	125	°C

THERMAL RESISTANCE

From junction to mounting base				
full-cycle operation	$R_{th\ j\text{-}mb}$	=	2,0	°C/W
half-cycle operation	$R_{th\ j\text{-}mb}$	=	4,0	°C/W
From mounting base to heatsink with heatsink compound	$R_{th\ mb\text{-}h}$	=	0,5	°C/W
Transient thermal impedance; t = 1 ms	$Z_{th\ j\text{-}mb}$	=	0,2	°C/W

* To ensure thermal stability: $R_{th\ j\text{-}a} < 6$ °C/W (full-cycle or half-cycle operation). For smaller heatsinks $T_{j\ max}$ should be derated (see Figs 2 and 3).

CHARACTERISTICS

Polarities positive or negative, are identified with respect to T_1.

Voltages (in either direction)

On-state voltage			
I_T = 20 A; T_j = 25 °C	V_T	<	2,2 V*
Rate of rise of off-state voltage that will not trigger any device; exponential method; V_D = 2/3 V_{DRMmax}; T_j = 125 °C	dV_D/dt	<	200 V/μs

Rate of rise of commutating voltage that will not trigger any device;
$I_{T(RMS)}$ = 12 A; V_D = V_{DWMmax}; T_{mb} = 85 °C

	dV_{com}/dt (V/μs)	$-dI_T/dt$ (A/ms)
BTW43-600G to 1200G	< 10	5
BTW43-600H to 1200H	< 10	12 ←

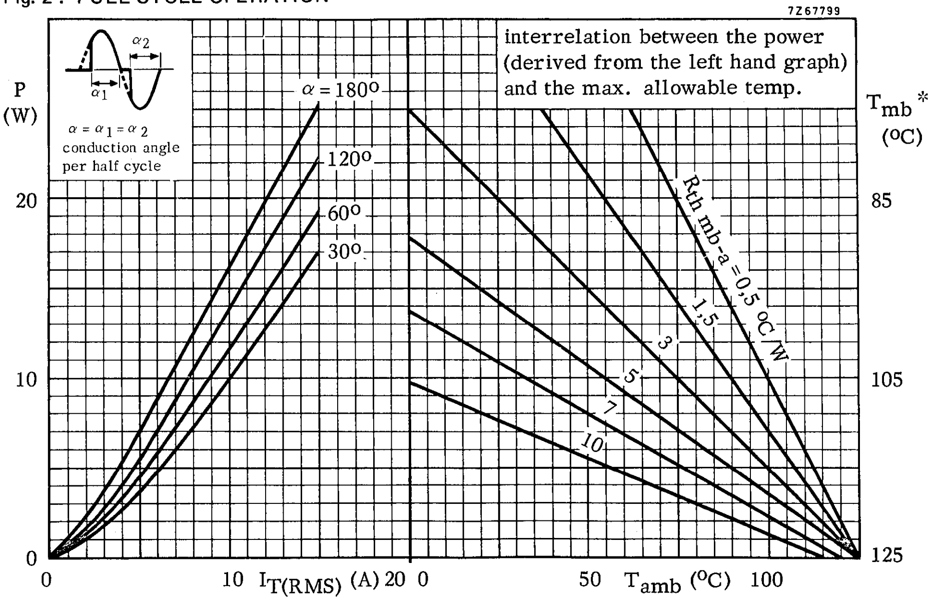
Currents (in either direction)

Off-state current			
V_D = V_{DWMmax}; T_j = 125 °C	I_D	<	5 mA

		T_2 pos.	T_2 neg.
Latching current; T_j = 25 °C			
G positive	I_L	< 200	200 mA
G negative	I_L	< 200	200 mA
Holding current; T_j = 25 °C			
G positive or negative	I_H	< 100	100 mA
Gate to terminal 1			
Voltage and current that will trigger all devices			
V_D = 12 V; T_j = 25 °C			
G positive	V_{GT}	> 2,5	5,0 V
	I_{GT}	> 100	200 mA
G negative	$-V_{GT}$	> 2,5	2,5 V
	$-I_{GT}$	> 100	100 mA
Voltage that will not trigger any device			
V_D = V_{DRMmax}; T_j = 125 °C; G positive or negative	V_{GD}	< 0,2	0,2 V

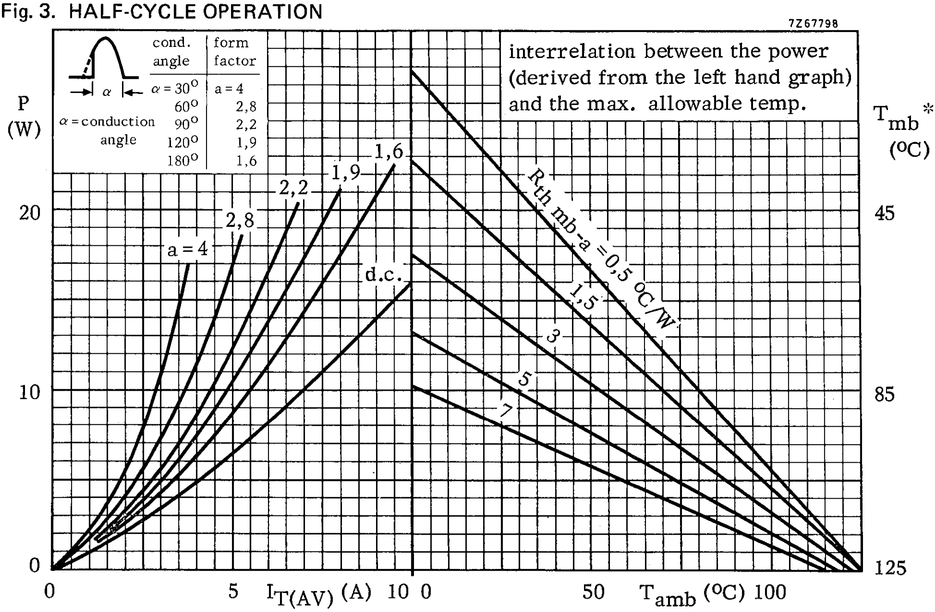
* Measured under pulse conditions to avoid excessive dissipation.

Fig. 2. FULL CYCLE OPERATION



* T_{mb}-scale is for comparison purposes only and is correct only for $R_{th\ mb-a} \leqslant 4\ ^oC/W$.

Fig. 3. HALF-CYCLE OPERATION



* T_{mb}-scale is for comparison purposes only and is correct only for $R_{th\ mb-a} \leqslant 2\ ^oC/W$.

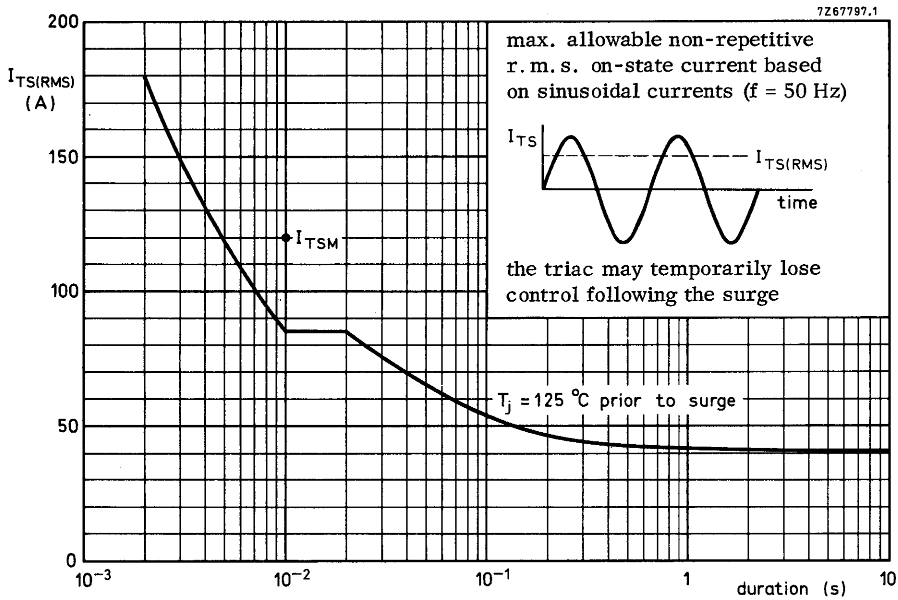

7Z67797.1
200
150
100
50
0
$I_{TS(RMS)}$
(A)
I_{TSM}
max. allowable non-repetitive
r.m.s. on-state current based
on sinusoidal currents (f = 50 Hz)
I_{TS}
$I_{TS(RMS)}$
time
the triac may temporarily lose
control following the surge
T_j = 125 °C prior to surge
10^{-3}
10^{-2}
10^{-1}
1
10
duration (s)

Fig. 4.

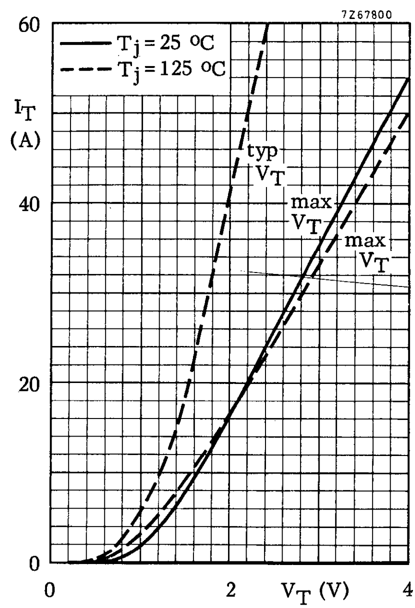

7Z67800
60
40
20
0
I_T
(A)
T_j = 25 °C
T_j = 125 °C
typ
V_T
max
V_T
max
V_T
0
2
V_T (V)
4

Fig. 5.

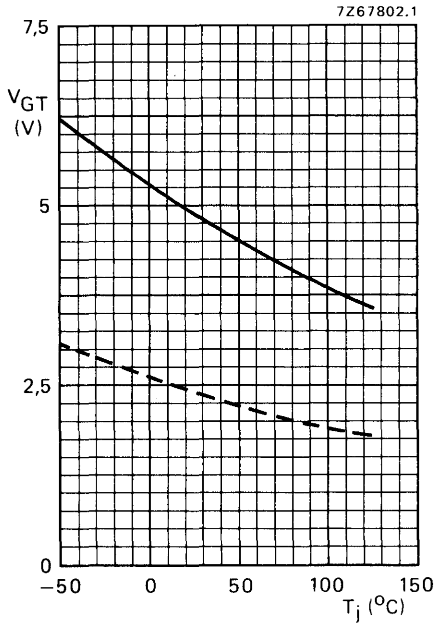


Fig. 6 Minimum gate voltage that will trigger all devices as a function of T_j.

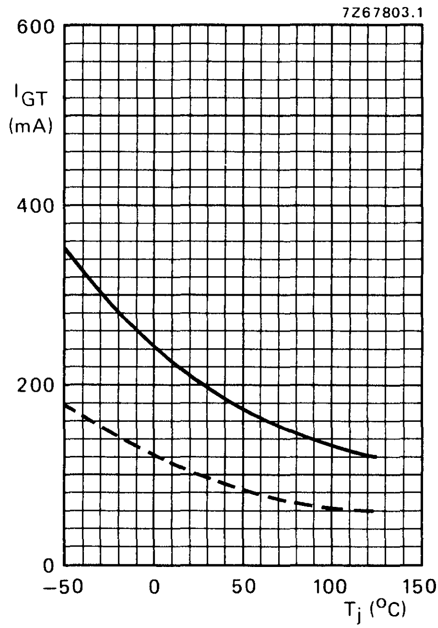
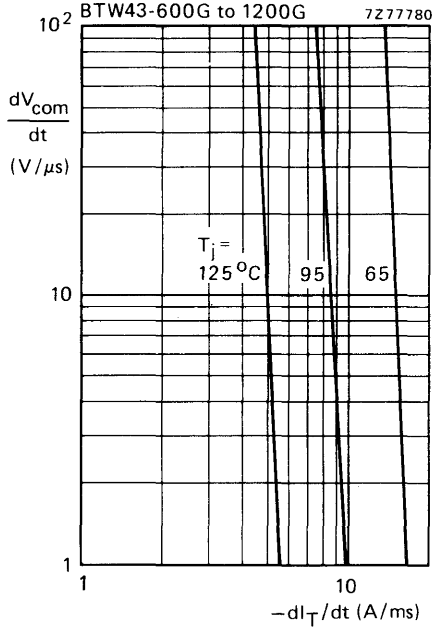


Fig. 7 Minimum gate current that will trigger all devices as a function of T_j.

Conditions for Figs 6 and 7:

——— T_2 negative, gate positive with respect to T_1
– – – – all other conditions



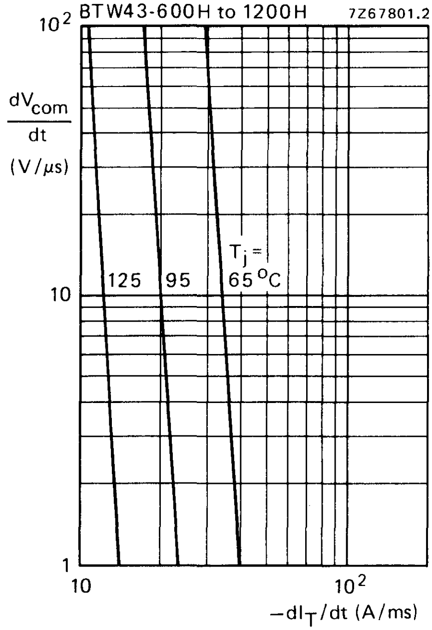


Fig. 8 Maximum rate of rise of commutating voltage that will not trigger any device as a function of rate of fall of on-state current; $I_{T(RMS)}$ = 12 A; $V_D = V_{DWMmax}$.

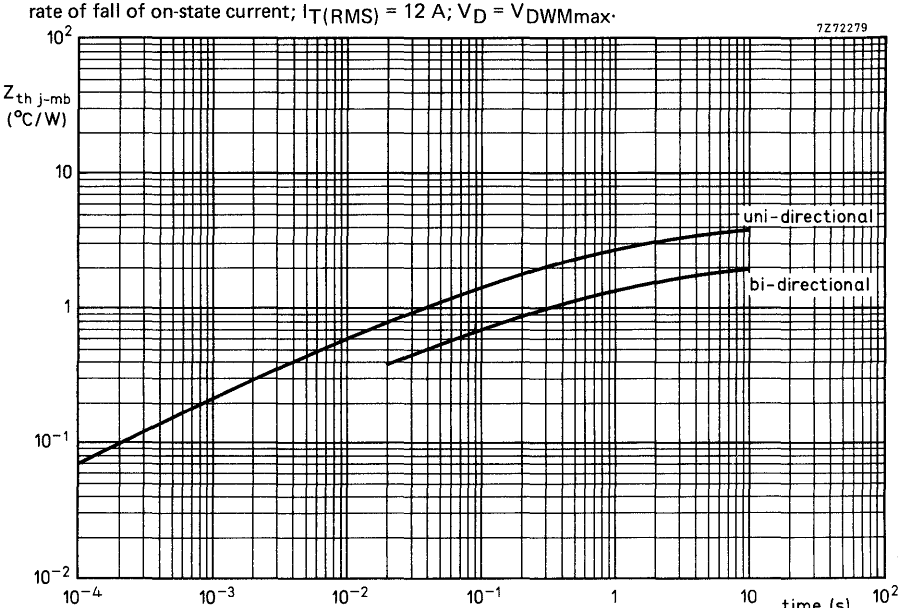


Fig. 9.

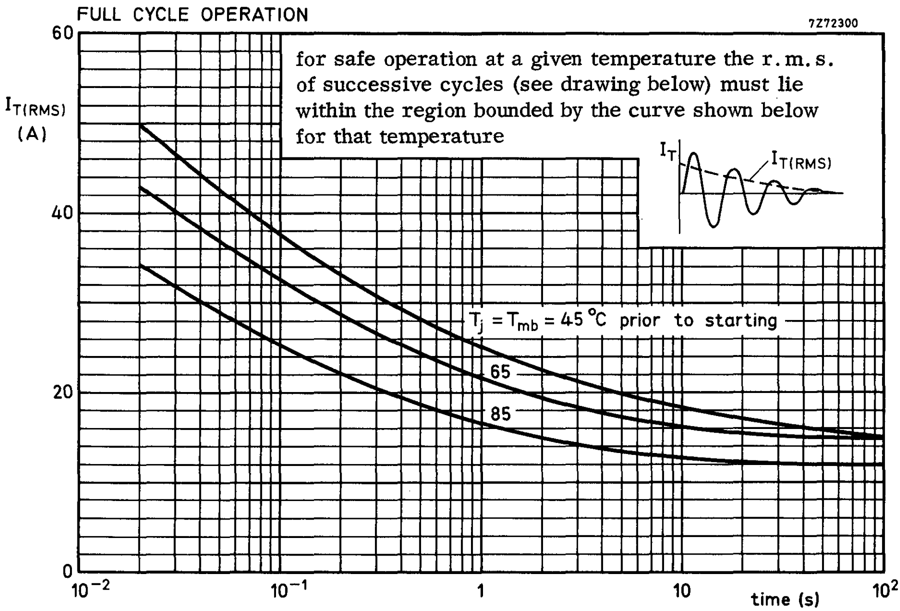

FULL CYCLE OPERATION
7Z72300
for safe operation at a given temperature the r.m.s. of successive cycles (see drawing below) must lie within the region bounded by the curve shown below for that temperature
$I_{T(RMS)}$ (A)
$T_j = T_{mb} = 45\ ^\circ C$ prior to starting
65
85
time (s)

Fig. 10.

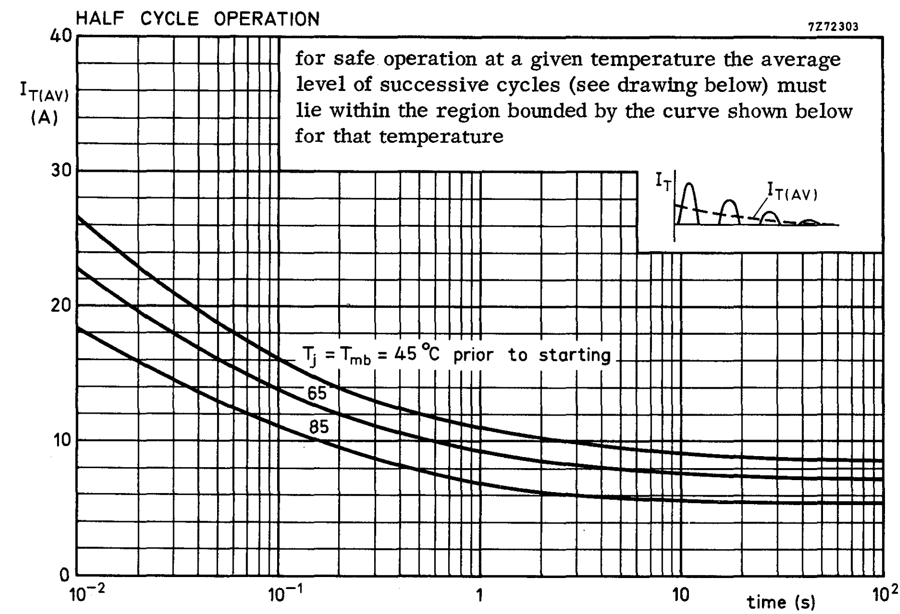

HALF CYCLE OPERATION
7Z72303
for safe operation at a given temperature the average level of successive cycles (see drawing below) must lie within the region bounded by the curve shown below for that temperature
$I_{T(AV)}$ (A)
$T_j = T_{mb} = 45\ ^\circ C$ prior to starting
65
85
time (s)

Fig. 11.

TRIACS

Silicon triacs in metal envelopes, intended for industrial single-phase and three-phase inductive load applications such as regenerative motor control systems. They are also suitable for furnace temperature control and static switching systems.
Two grades of commutation performance are available, 30 V/μs at 25 A/ms (suffix H) and 30 V/μs at 50 A/ms (suffix J).

QUICK REFERENCE DATA

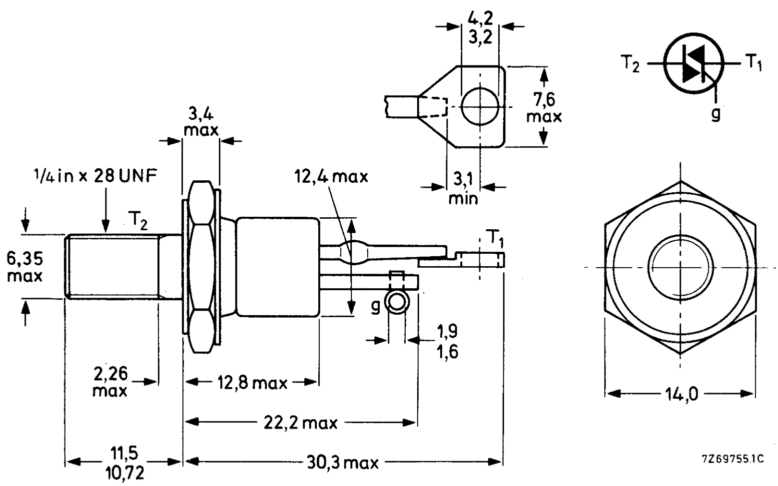
			BTX94-400	600	800	1000	1200	
Repetitive peak off-state voltage	V_{DRM}	max.	400	600	800	1000	1200	V

R.M.S. on-state current	$I_{T(RMS)}$	max.	25	A
Non-repetitive peak on-state current	I_{TSM}	max.	250	A
Rate of rise of commutating voltage that will not trigger any device (see page 3)	dV_{com}/dt	<	30	V/μs

MECHANICAL DATA

Dimensions in mm

Fig. 1 TO-48.



Net mass: 14 g
Diameter of clearance hole: max. 6,5 mm
Accessories supplied on request: 56264A
(mica washer, insulating ring, soldering tag)

Torque on nut: min. 1,7 Nm (17 kg cm)
max. 3,5 Nm (35 kg cm)
Supplied with the device:
1 nut, 1 lock washer
Nut dimensions across the flats; 11,1 mm

RATINGS

Limiting values in accordance with the Absolute Maximum System (IEC 134)

Voltages (in either direction) *

			BTX94-400	600	800	1000	1200	
Non-repetitive peak off-state voltage ($t \leq 10$ ms)	V_{DSM}	max.	400	600	800	1000	1200	V **
Repetitive peak off-state voltage	V_{DRM}	max.	400	600	800	1000	1200	V
Crest working off-state voltage	V_{DWM}	max.	200	400	600	700	800	V

Currents (in either direction)

R.M.S. on-state current (conduction angle 360°) at T_{mb} = 85 °C	$I_{T(RMS)}$	max.	25	A
Repetitive peak on-state current	I_{TRM}	max.	100	A
Non-repetitive peak on-state current T_j = 125 °C prior to surge; t = 20 ms; full sine-wave	I_{TSM}	max.	250	A
I^2t for fusing (t = 10 ms)	I^2t	max.	320	A^2s
Rate of rise of on-state current after triggering with I_G = 750 mA to I_T = 100 A	dI_T/dt	max.	50	A/μs

Gate to terminal 1

Power dissipation

Average power dissipation (averaged over any 20 ms period)	$P_{G(AV)}$	max.	1	W
Peak power dissipation	P_{GM}	max.	5	W

Temperatures

Storage temperature	T_{stg}	−55 to + 125		°C
Junction temperature	T_j	max.	125	°C

THERMAL RESISTANCE

From junction to mounting base full-cycle operation	$R_{th\ j\text{-}mb}$	=	1,0	°C/W
half-cycle operation	$R_{th\ j\text{-}mb}$	=	2,0	°C/W
From mounting base to heatsink with heatsink compound	$R_{th\ mb\text{-}h}$	=	0,2	°C/W
Transient thermal impedance; t = 1 ms	$Z_{th\ j\text{-}mb}$	=	0,12	°C/W

* To ensure thermal stability: $R_{th\ j\text{-}a} < 3,5$ °C/W (full-cycle or half-cycle operation). For smaller heatsinks $T_{j\ max}$ should be derated (see Figs 2 and 3).

** Although not recommended, higher off-state voltages may be applied without damage, but the triac may switch into the on-state. The rate of rise of on-state current should not exceed 50 A/μs.

CHARACTERISTICS

Polarities, positive or negative, are identified with respect to T_1.

Voltages (in either direction)

On-state voltage

I_T = 50 A; T_j = 25 °C — V_T < 2 V *

Rate of rise of off-state voltage that will not trigger any device; exponential method;

V_D = 2/3 V_{DRMmax}; T_j = 125 °C — dV_D/dt < 100 V/μs

Rate of rise of commutating voltage that will not trigger any device;

$I_{T(RMS)}$ = 25 A; V_D = V_{DWMmax}; T_{mb} = 85 °C

	dV_{com}/dt (V/μs)	$-dI_T/dt$ (A/ms)
BTX94-400H to 1200H	< 30	25
BTX94-400J to 1200J	< 30	50 ←

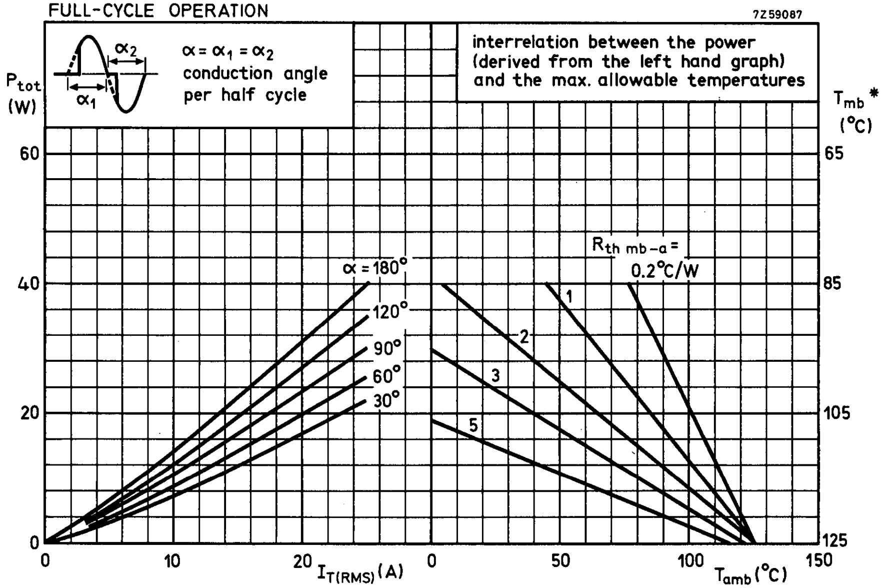
Currents (in either direction)

Off-state current

V_D = V_{DWMmax}; T_j = 125 °C — I_D < 5 mA

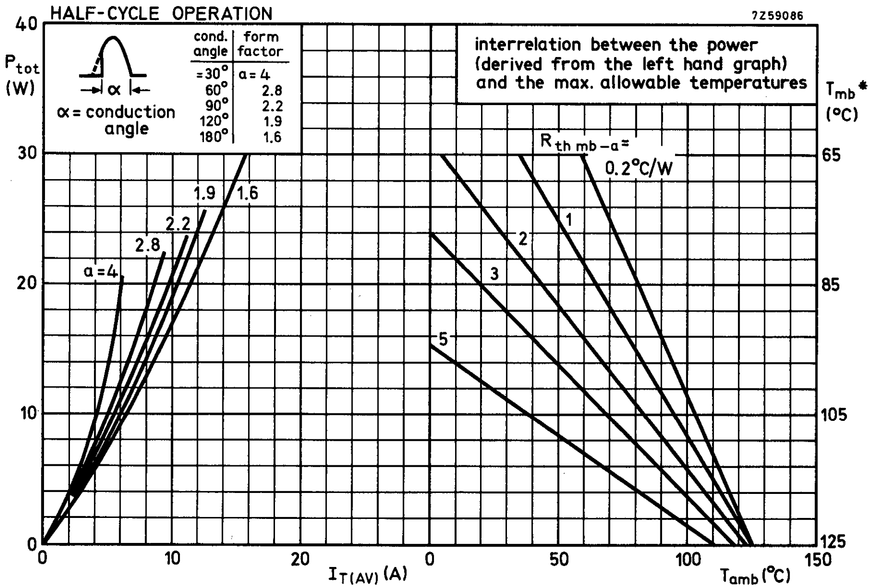
		T_2 pos.	T_2 neg.
Latching current; T_j = 25 °C			
G positive	I_L	< 150	150 mA
G negative	I_L	< 350	150 mA
Gate to terminal 1			
Voltage and current that will trigger all devices V_D = 12 V; T_j = 25 °C			
G positive	V_{GT}	> 3,0	5,0 V
	I_{GT}	> 150	200 mA
G negative	$-V_{GT}$	> 3,0	3,0 V
	$-I_{GT}$	> 150	150 mA

* Measured under pulse conditions to avoid excessive dissipation.



* T_{mb}-scale is for comparison purposes only and is correct only for $R_{th\ mb-a} \leq 2.5\ °C/W$

Fig. 2.



* T_{mb}-scale is for comparison purposes only and is correct only for $R_{th\ mb-a} \leq 1.5\ °C/W$

Fig. 3.

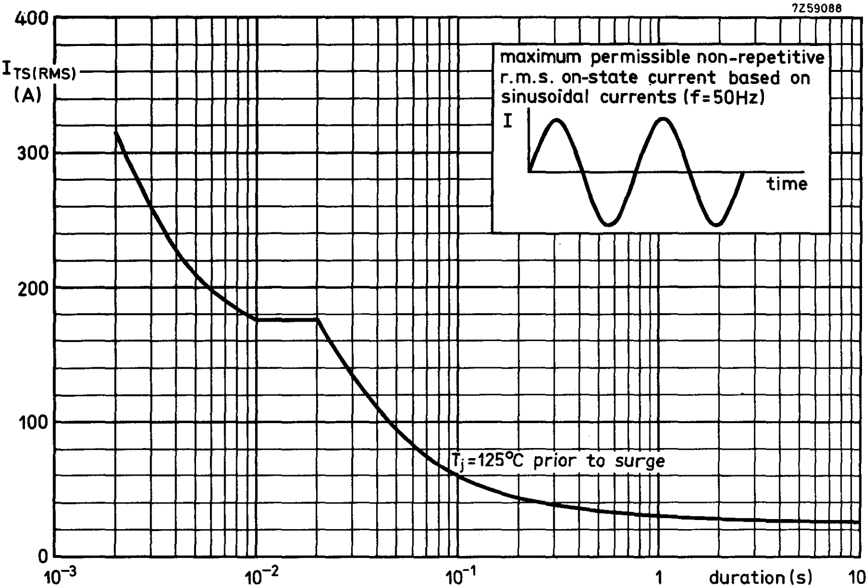

7Z59088
400
$I_{TS(RMS)}$
(A)
300
200
100
0
10^{-3}
10^{-2}
10^{-1}
1
duration (s)
10
maximum permissible non-repetitive r.m.s. on-state current based on sinusoidal currents (f=50Hz)
I
time
T_j=125°C prior to surge

Fig. 4.

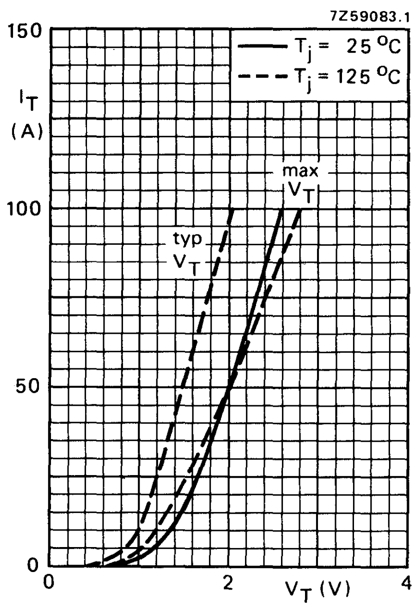

7Z59083.1
150
I_T
(A)
100
50
0
0
2
4
V_T (V)
T_j = 25 °C
T_j = 125 °C
typ
V_T
max
V_T

Fig. 5.

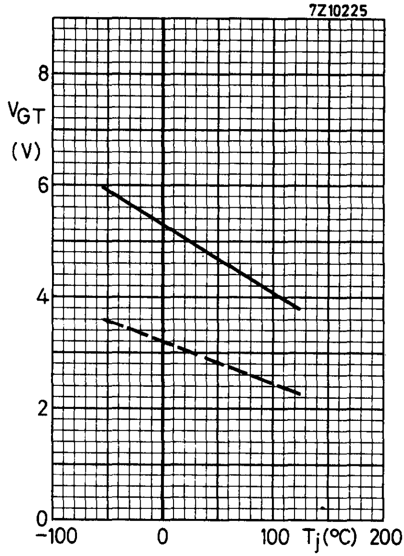


Fig. 6 Minimum gate voltage that will trigger all devices as a function of T_j.

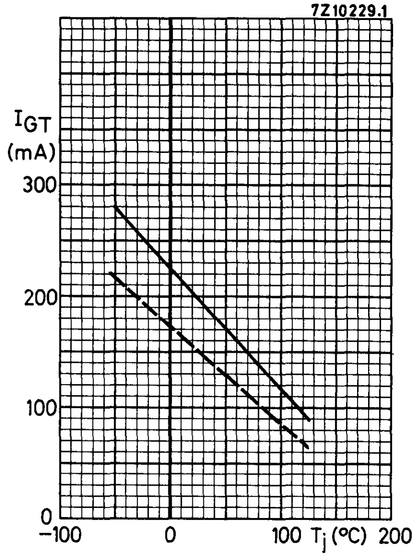


Fig. 7 Minimum gate current that will trigger all devices as a function of T_j.

Conditions for Figs 6 and 7:

—— T_2 negative, gate positive with respect to T_1
– – – all other conditions

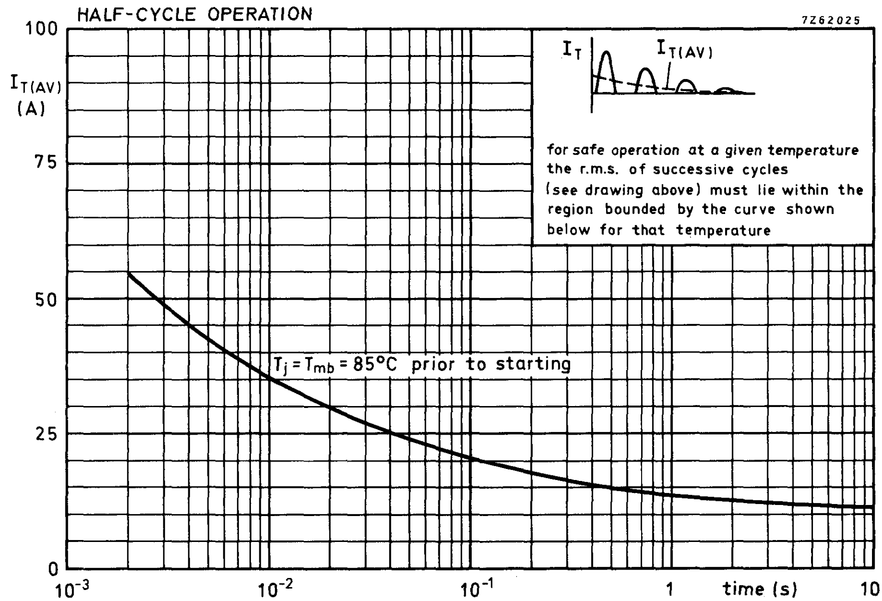

HALF-CYCLE OPERATION
7Z62025
$I_{T(AV)}$ (A)
100
75
50
25
0
I_T
$I_{T(AV)}$
for safe operation at a given temperature the r.m.s. of successive cycles (see drawing above) must lie within the region bounded by the curve shown below for that temperature
$T_j = T_{mb} = 85°C$ prior to starting
10^{-3}
10^{-2}
10^{-1}
1
time (s)
10

Fig. 8.

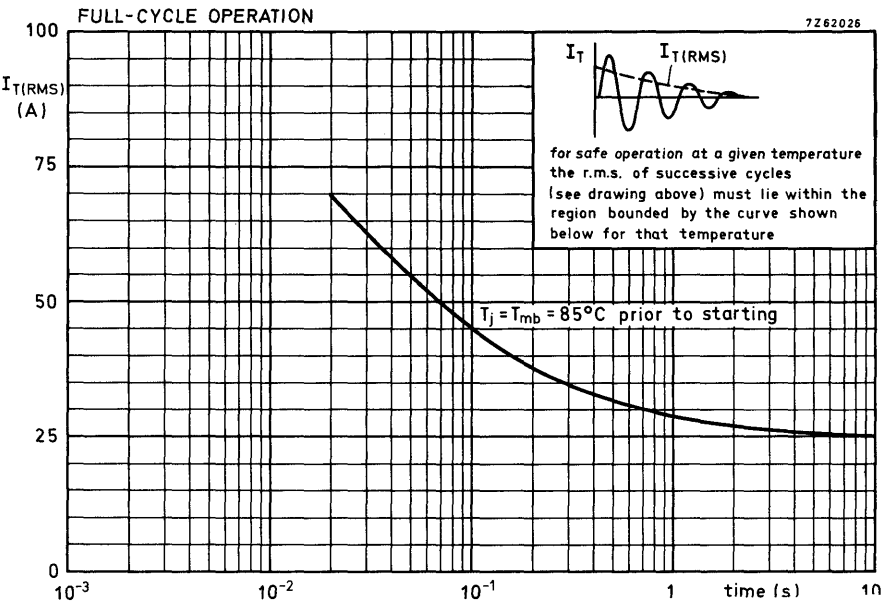

FULL-CYCLE OPERATION
7Z62026
$I_{T(RMS)}$ (A)
100
75
50
25
0
I_T
$I_{T(RMS)}$
for safe operation at a given temperature the r.m.s. of successive cycles (see drawing above) must lie within the region bounded by the curve shown below for that temperature
$T_j = T_{mb} = 85°C$ prior to starting
10^{-3}
10^{-2}
10^{-1}
1
time (s)
10

Fig. 9.

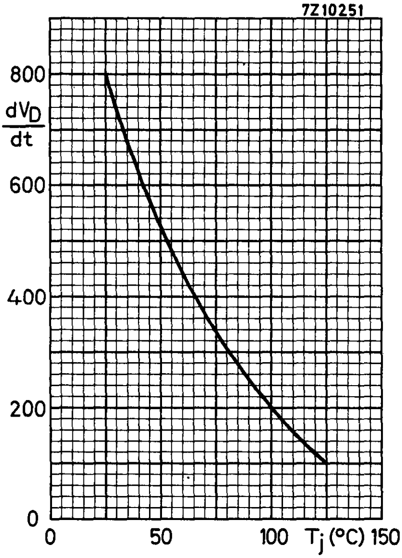


Fig. 10 Maximum rate of rise of off-state voltage that will not trigger any device (exponential method) as a function of T_j.

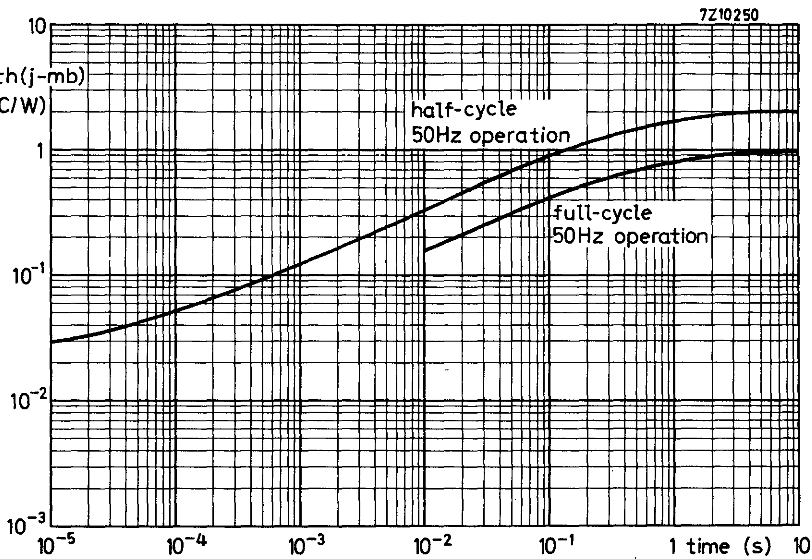


Fig. 11.

ACCESSORIES

G

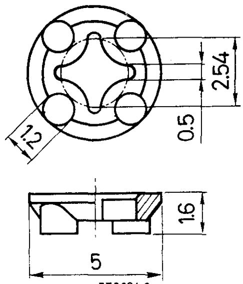
G

DISTANCE DISC

For use with BRY39T

MECHANICAL DATA

Dimensions in mm



Insulating material

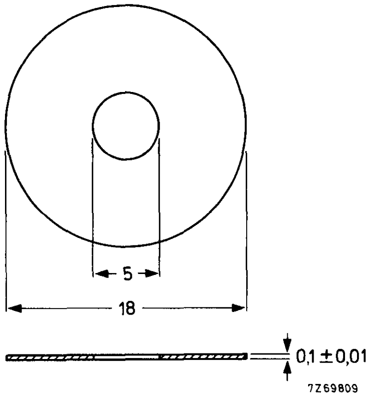
TEMPERATURE

Maximum allowable temperature T_{max} = 100 °C

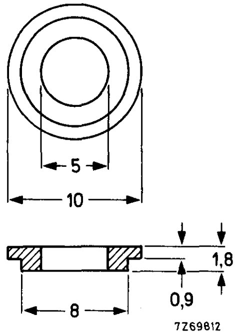
MOUNTING ACCESSORIES

MECHANICAL DATA

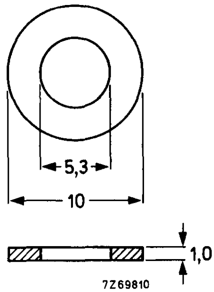
Dimensions in mm



mica washer



insulating ring



plain washer
material: brass, nickel plated

→ THERMAL RESISTANCE

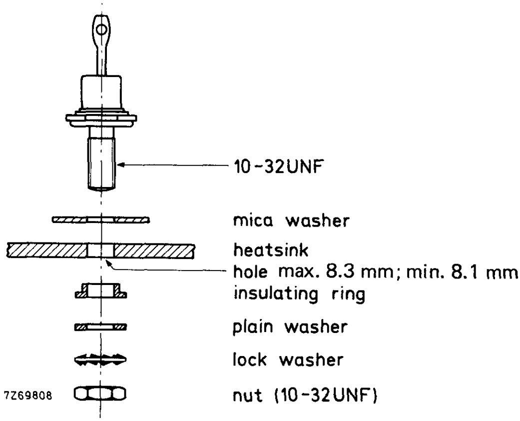
From mounting base to heatsink (with mica washer)

without heatsink compound	$R_{th\ mb\text{-}h}$	=	5	°C/W
with heatsink compound	$R_{th\ mb\text{-}h}$	=	2.5	°C/W

TEMPERATURE

Maximum permissible temperature	$T_{max.}$	=	125	°C

→ MOUNTING INSTRUCTIONS

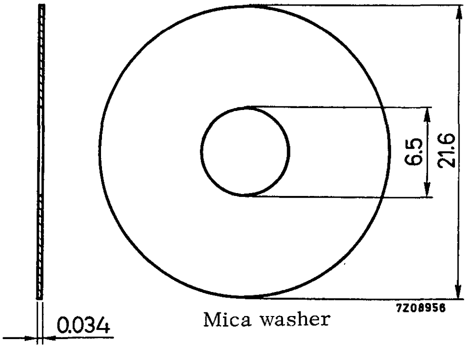


Note: When using a tag for electrical contact, insert tag between nut and plain washer or replace plain washer by tag.

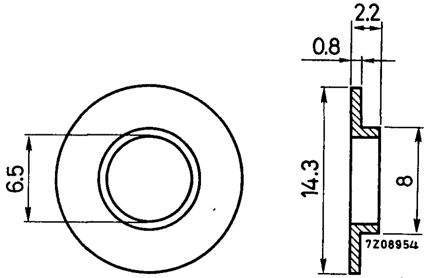
MOUNTING ACCESSORIES

MECHANICAL DATA

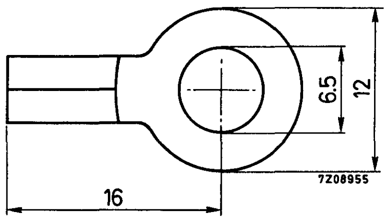
Dimensions in mm



Mica washer



Insulating ring



Soldering tag

THERMAL RESISTANCE

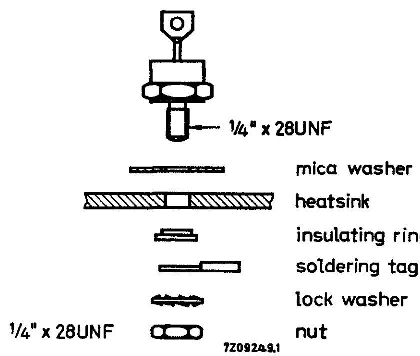
From mounting base to heatsink

with mica washer, without heatsink compound	$R_{th\ mb\text{-}h}$	=	4	$^{o}C/W$	
with mica washer; with heatsink compound	$R_{th\ mb\text{-}h}$	=	1.5	$^{o}C/W$	←

TEMPERATURE

Maximum allowable temperature	T_{max}	=	175	^{o}C

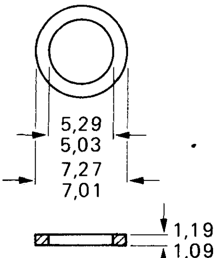
MOUNTING INSTRUCTIONS



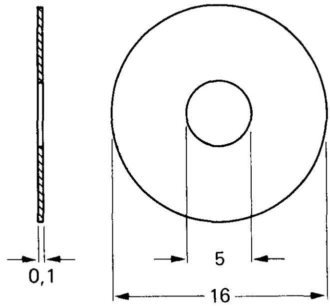
MOUNTING ACCESSORIES

MECHANICAL DATA

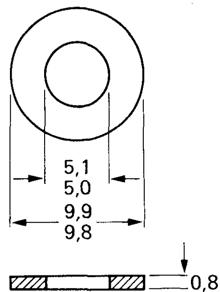
Dimensions in mm



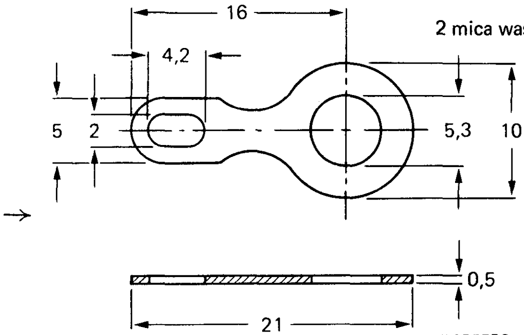
7Z75773
PTFE bush



7Z75775
2 mica washers



7Z75774
plain washer



terminal tag
7Z75772

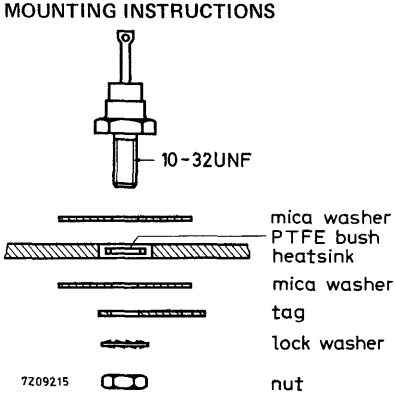
THERMAL RESISTANCE

From mounting base to heatsink
without heatsink compound $R_{th\ mb\text{-}h}$ = 5 °C/W
with heatsink compound $R_{th\ mb\text{-}h}$ = 2.5 °C/W

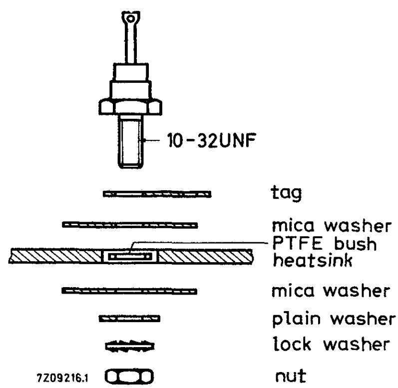
TEMPERATURE

Maximum allowable temperature T_{max} = 175 °C

MOUNTING INSTRUCTIONS



7Z09215

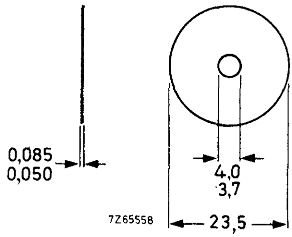


7Z09216.1

MOUNTING ACCESSORIES

MECHANICAL DATA

Dimensions in mm



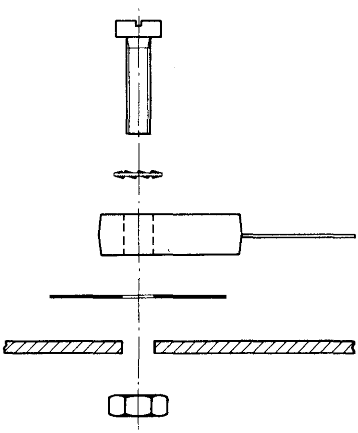
←

THERMAL RESISTANCE

From mounting base to heatsink

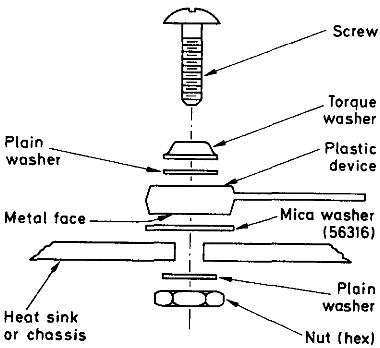
with heatsink compound	$R_{th\ mb\text{-}h}$	=	1.2	$^{o}C/W$
without heatsink compound	$R_{th\ mb\text{-}h}$	=	2.3	$^{o}C/W$

MOUNTING INSTRUCTIONS



MOUNTING ACCESSORIES

QUANTITY	DESCRIPTION
2	Steel washers, cadmium plated, I.D. 4.3 x O.D. 9.0 x 0.8 thick.
1	Hex. full nut, steel, cadmium plated 6-32 UNC.
1	Pan head screw, slotted, steel, cadmium plated, 6-32 UNC x 5/8" long.



Mounting method for plastic devices
(Insulating method illustrated)

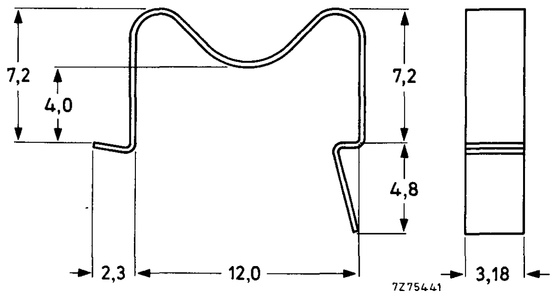
D6179

CLIPS FOR TO-220 ENVELOPES

MECHANICAL DATA

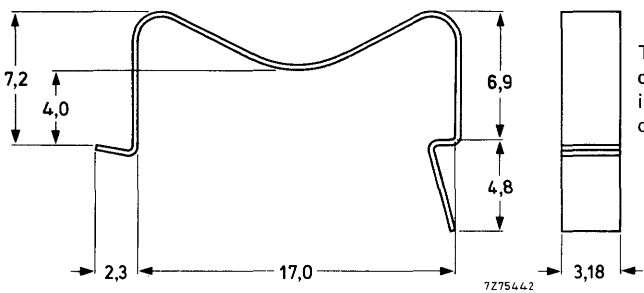
Dimensions in mm

56363



Spring clip for direct mounting on heatsink of 1,0 to 2,0 mm;
material: steel, zinc-chromate passivated.

56364



To be used in conjunction with insulators **56367** or **56369**.

Spring clip for insulated mounting on heatsink of 1,0 to 2,5 mm;
material : steel, zinc-chromate passivated.

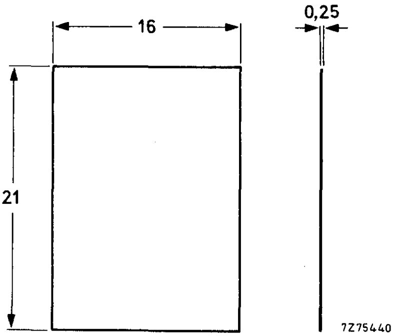
Mounting instructions with R_{th} values are given separately.

INSULATORS FOR TO-220 ENVELOPES

MECHANICAL DATA

Dimensions in mm

56367

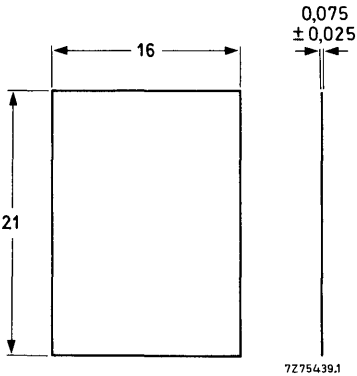


Alumina insulator (up to 2 kV) to be used in conjunction with spring clip **56364**; material: 96-alumina.*

THERMAL RESISTANCE

→ From mounting base to heatsink, with heatsink compound $R_{th\ mb-h}$ = 0.82 °C/W

56369



Mica insulator (up to 2 kV) to be used in conjunction with spring clip **56364**.

THERMAL RESISTANCE

→ From mounting base to heatsink, with heatsink compound $R_{th\ mb-h}$ = 2.2 °C/W

*Because alumina is brittle, extreme care must be taken, when mounting devices, not to crack the alumina, particularly when used without heatsink compound.

CLIP FOR SOT-112 ENVELOPE

MECHANICAL DATA

Dimensions in mm

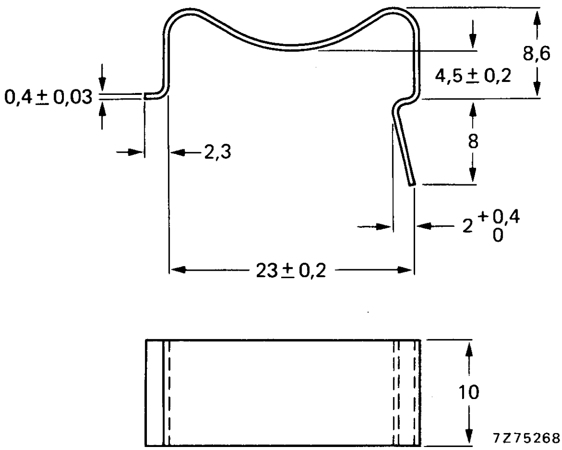


Fig. 1 Clip; material: steel, blackened (zinc-chromate passivated).

THERMAL RESISTANCE

From mounting base to heatsink

with a metallic oxide-loaded compound	$R_{th\ m\text{-}h}$	=	1,0 °C/W
without heatsink compound	$R_{th\ m\text{-}h}$	=	2,0 °C/W

MOUNTING INSTRUCTIONS

1. Place the device on the heatsink, applying a metallic oxide-loaded compound to the mounting base.
2. Push the short end of the clip into the narrow slot of the heatsink with the clip at an angle 10° to 30° to the vertical.
3. Push down the clip over the device until the long end of the clip snaps into the wide slot. The clip should bear on the middle of the plastic body.

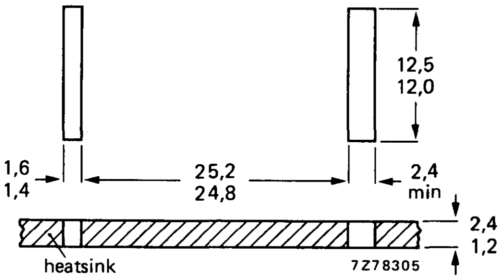


Fig. 2 Hole pattern for clip in heatsink.

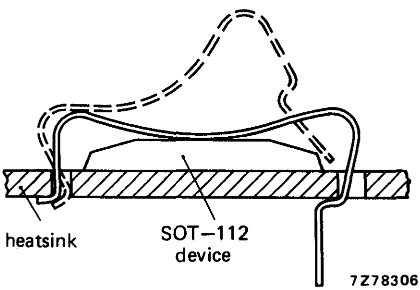


Fig. 3 Mounting of the clip.

HEATSINKS
Selection Guide
General
Flat Heatsinks
Diecast Heatsinks
Heatsink Extrusions

H

Rectifier diodes
Thyristors
Triacs

K-code to DIN-41882

	K15	K9	K9	K3	K3	K3	K1.1	K1.1	Extrusions		
type	**56268**	**56256**	**56350**	**56253**	**56312**	**56348**	**56313**	**56314**	**56230**	**56231**	**56290**
BYX38	●								●		●
BYX39	●	●							●		●
BYX50	●								●		●
1N3879 to 3882	●								●		●
1N3889 to 3892	●	●							●	●	●
BYX98	●	●							●	●	●
BYX42	●	●							●	●	●
BYX99		●							●	●	●
BYX30		●							●	●	●
BYX25		●							●	●	●
BYX46		●							●	●	●
BYW30		●	●								
BYV30		●									
BYW31			●			●					
BYV21		●									
BYX96						●			●	●	
BYW92				●	●		●		●	●	
BYV92				●					●	●	
BYW93				●					●	●	
BYX56				●					●	●	
BYX97					●		●		●	●	
BYX32										●	
BYX52				●					●	●	
1N3899 to 3903				●							
1N3909 to 3913				●							
BYW25					●		●				
BTY79	●	●									●
BTW38	●	●	●			●					●
BTW42	●	●	●			●					●
BTY87				●					●	●	●
BTY91				●					●	●	●
BTW47				●	●		●		●	●	●
BTW30S					●		●		●	●	●
BTW45				●	●		●		●	●	●
BTW40				●	●		●		●	●	●
BTW92				●	●		●		●	●	●
BTW31W					●		●		●	●	●
BTW24								●	●	●	
BTW33										●	
BTW23										●	
BTW43			●								●
BTX94				●					●	●	●
BTW34								●	●	●	

Heatsinks are used where a semiconductor device is unable of itself to dissipate the heat generated by its internal power losses without the junction temperature exceeding its maximum. The simplest form of heatsink is a flat metal plate, but for economy in weight, size, and cost, more complex shapes are usually used.
Apart from information on heat transfer and the construction of assemblies, this Section shows how to take advantage of reverse polarity types, describes three types of heatsink, and gives calculation examples.

HEAT TRANSFER PATH

In, for example, a silicon rectifier the heat is generated inside the wafer and flows mainly by way of the base, through a heatsink to the ambient air.
The heat flow can be likened to the flow of electric current, with thermal resistance (R_{th} in $^oC/W$) analogous to the electric resistance (R in Ω).
Fig. 1 shows the heat path from junction to ambient as three thermal resistances in series:

$R_{th\ j\text{-}mb}$ — The thermal resistance from junction to mounting base. Its value is given in the data sheets of a device.

$R_{th\ mb\text{-}h}$ — The thermal resistance from mounting base to heatsink (contact thermal resistance). It is caused by the imperfect nature and limited size of the contact between the two. Its value is also given in the data sheets.

$R_{th\ h\text{-}a}$ — The thermal resistance between the contact surface mentioned above and the ambient air.

For thermal balance air warmed by the heatsink must be replaced by cool, i.e., there must be an air flow.
From Fig. 1: $T_j - T_{amb} = P \times (R_{th\ j\text{-}mb} + R_{th\ mb\text{-}h} + R_{th\ h\text{-}a})$

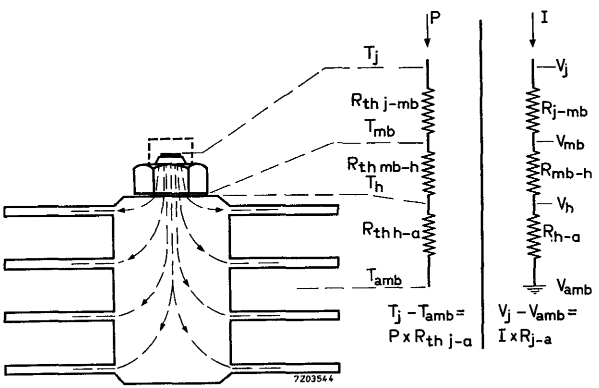


Fig. 1

IMPROVING HEAT TRANSFER

Heat transfer can be improved by reducing the thermal resistance of the contact and the thermal resistance of the heatsink.

Contact thermal resistance

- Make the contact area large
- Make the contact surfaces plane parallel by attention to drilling an punching, and make them burr-free.
- Apply sufficient pressure. Use a torque spanner adjusted to at least the rated minimum torque.
- Use metal oxide-loaded compound to fill air pockets. ←

Heatsink thermal resistance

- Paint or anodise the surface to improve radiation
- Increase the flow of cooling air
- Use a larger heatsink

The simplest form of air flow is natural convection. Mount the fins vertically, make intake and outlet apertures large, avoid obstructions, create a draught (chimney effect). A blower or fan must be used where free convection is not enough or where a smaller heatsink is wanted.

INSULATED MOUNTING

Where a semiconductor must be insulated from its heatsink (e.g., in bridge rectifiers) by a mica or teflon washer, the contact thermal resistance will be about ten times higher than without insulation. This must be compensated by a reduction in $R_{th\,h\text{-}a}$ to keep the total thermal resistance below the maximum given for P and T_{amb}. A larger heatsink may be necessary.

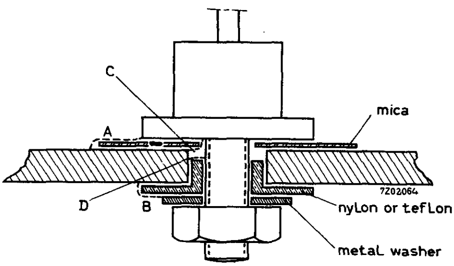


Fig. 2 Creepage distances with an insulated diode

Note: care must be taken that the creepage distances, see Fig. 2, are sufficient for the voltage involved. While A and B can be made large enough, C and D are likely to be the critical ones.

CONSTRUCTIONS

Good thermal coupling is essential to semiconductors connected in parallel to ensure good current sharing in view of the forward characteristics, and semiconductors in series in view of the reverse characteristics.
Mounting the semiconductors on the same heatsink not only saves mounting costs but also provides the needed thermal coupling.
Fig. 3 shows the construction for a plain heatsink, and Fig. 4 the construction for an extruded heatsink. The electrical connection is made with a copper strip at least 1 mm thick. For two diodes a plain heatsink should be twice the area, and an extruded heatsink twice the length needed for a single diode.
Reverse polarity devices are covenient for series connection of two diodes on a common heatsink. Figs. 5, 6 and 7 show how the use of normal polarity and reverse polarity diodes simplifies the construction of single-phase and three-phase bridge rectifiers.

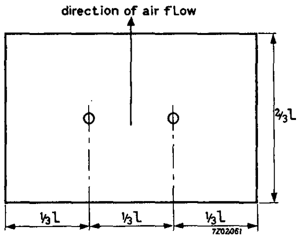


Fig. 3 Plain cooling fin with two diodes

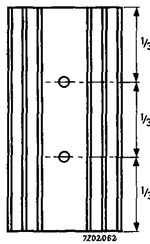


Fig. 4 Extruded aluminium heatsink with two diodes

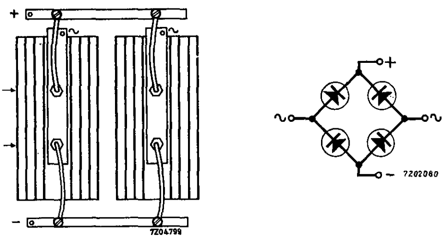


Fig. 5 Single phase full wave rectifier with diodes of different polarity on extruded aluminium heatsinks

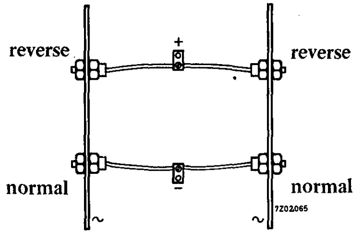


Fig. 6 Single phase full wave rectifier with diodes of different polarity on plain cooling fins (top view)

CONSTRUCTIONS (continued)

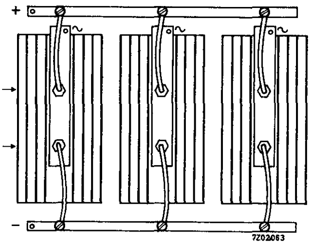


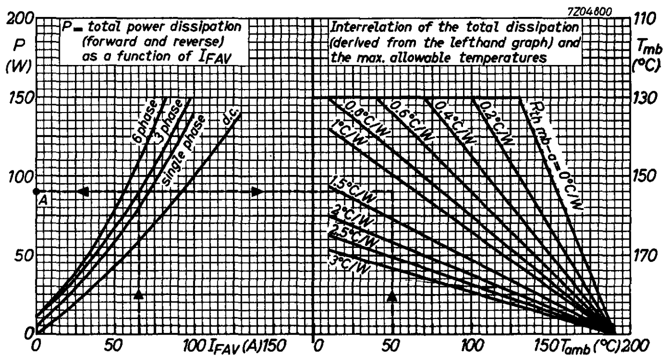
Fig. 7 Three phase full wave rectifier with diodes of different polarity on extruded aluminium heatsinks

EXAMPLES OF HEATSINK CALCULATION

1. Devices without controlled avalanche properties.
Assume that the diode of which the outlines are shown, is used in a three phase 50 Hz rectifier circuit at T_{amb} = 50 °C. Further assume: average forward current per diode $I_{F(AV)}$ = 65 A; contact thermal resistance $R_{th\,mb\text{-}h}$ = 0,1 °C/W.

Stud: M12
Mounting base, across the flats: max. 27 mm

From the data of the diode the graph to be used is shown below.



From the lefthand graph it follows that P_{tot} = 90 W per diode (point A).
From the righthand graph it follows that $R_{th\,mb\text{-}a}$ ≈ 1,2 °C/W.
Thus $R_{th\,h\text{-}a} = R_{th\,mb\text{-}a} - R_{th\,mb\text{-}h}$ = (1,2 − 0,1) °C/W = 1,1 °C/W.
This may be achieved by different types of heatsinks as shown below.

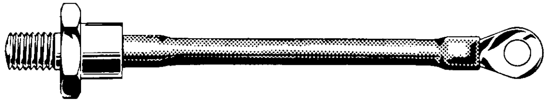
Type	Free convection	Forced cooling
flat, blackened	–	125 cm²; 2 m/s or 300 cm²; 1 m/s
bright	–	175 cm²; 2 m/s
diecast 56280	applicable	
extrusion		
56230 bright	ℓ = 12 cm	ℓ = 5 cm [1]; 1 m/s
blackened	ℓ = 8 cm	ℓ = 5 cm [1]; 1 m/s
56231 bright	ℓ = 7 cm	
blackened	ℓ = 5 cm [1]	

[1]) Practical minimum length

EXAMPLES OF HEATSINK CALCULATION (continued)

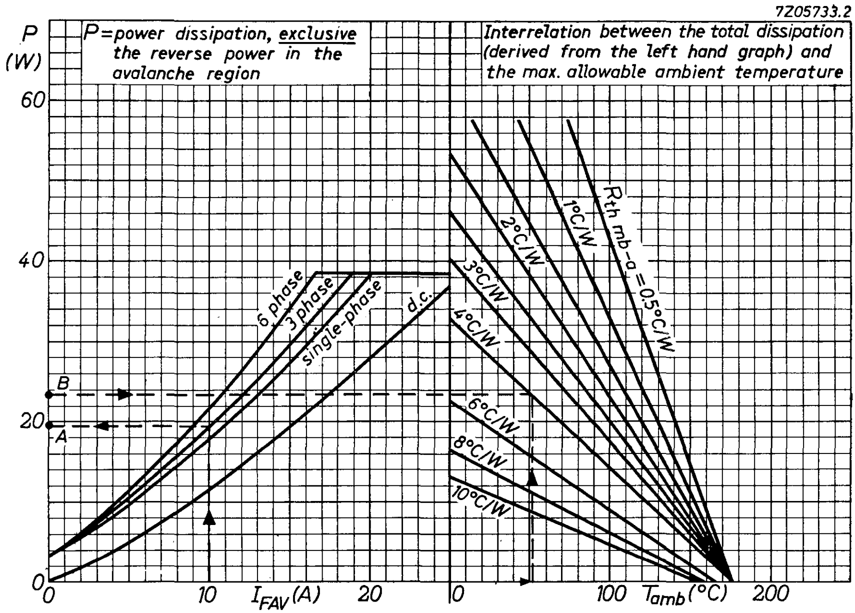
2. Devices with controlled avalanche properties

Assume that the diode of which the outlines are shown, is used in a three phase 50 Hz rectifier circuit at T_{amb} = 40 °C. Further assume: average forward current per diode $I_{F(AV)}$ = 10 A; contact thermal resistance: $R_{th\ mb\text{-}h}$ = 0,5 °C/W; repetitive peak reverse power in the avalanche region (t = 40 µs) P_{RRM} = 2 kW (per diode).



Stud: M12
Mounting base, across the flats: max. 27 mm

From the data of this diode the graph to be used is shown below.



From the lefthand graph it follows that P_{tot} = 19,5 W per diode (point A). The average reverse power in the avalanche region, averaged over any cycle, follows from

$P_{R(AV)} = \delta \times P_{RRM}$, where the duty cycle $\delta = \frac{40\ \mu s}{20\ ms} = 0,002$.

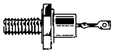
Thus $P_{R(AV)}$ = 0,002 x 2 kW = 4 W.

Therefore the total device power dissipation P_{tot} = 19,5+4 = 23,5 W (point B). From the righthand graph it follows that $R_{th\ mb\text{-}a}$ = 4 °C/W. Hence the heatsink thermal resistance should be:

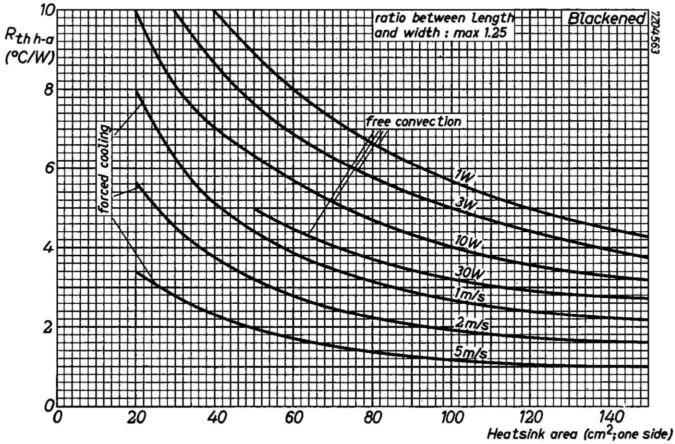
$$R_{th\ h\text{-}a} = R_{th\ mb\text{-}a} - R_{th\ mb\text{-}h} = (4 - 0,5)\ ^{\circ}C/W = 3,5\ ^{\circ}C/W.$$

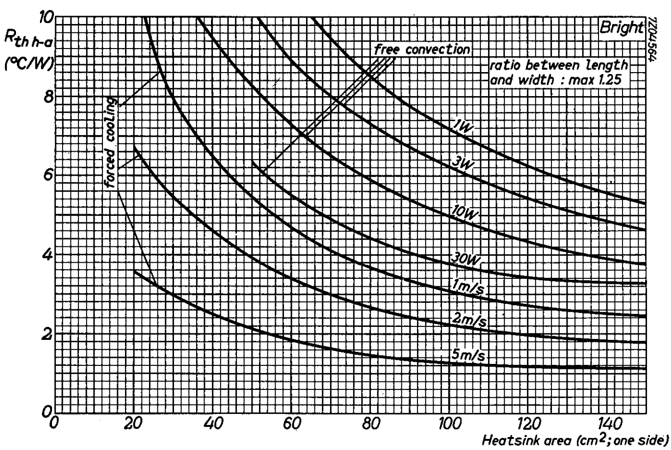
A table of applicable heatsinks, similar to that on the foregoing page, can de derived for this case.

Thermal resistance of flat heatsinks of 2 mm copper or 3 mm aluminium.
The graphs are valid for the combination of device and heatsink.

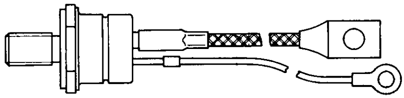


Studs: 10-32UNF
Mounting bases, across the flats: max. 11,0 mm

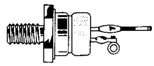




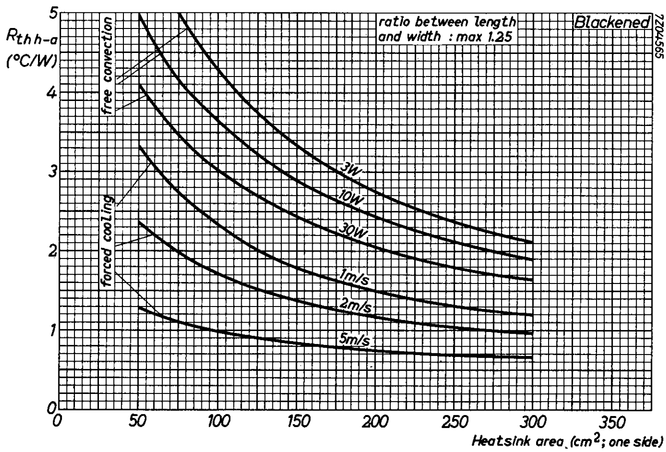
Thermal resistance of flat heatsinks of 2 mm copper or 3 mm aluminium.
The graphs are valid for the combination of device and heatsink.

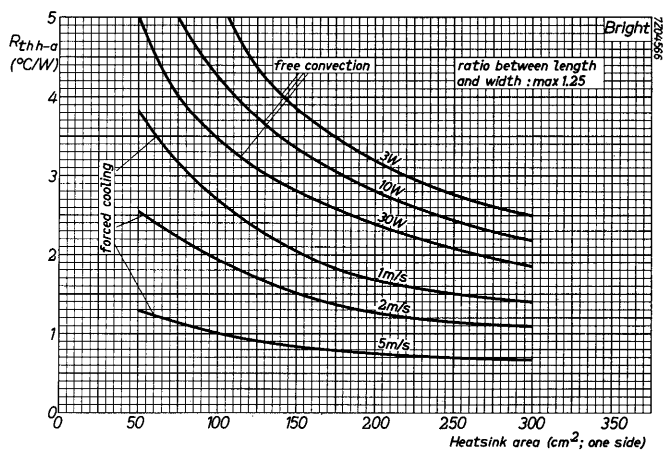


Stud: M8
Mounting base, across the flats: max. 19 mm

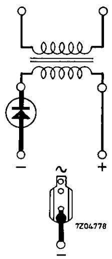
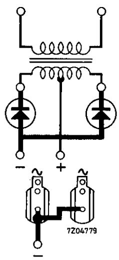
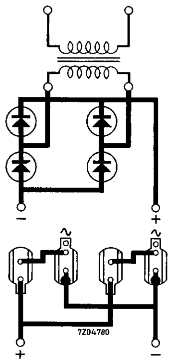
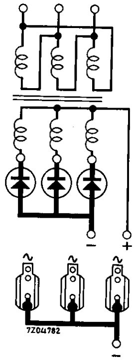


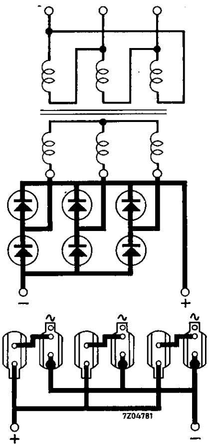
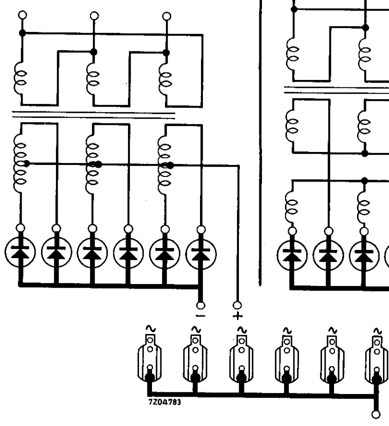
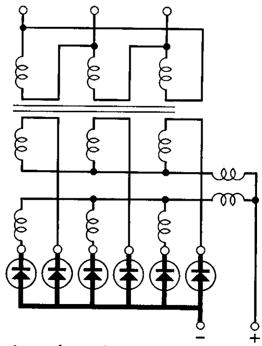
Stud: M6
Stud: $\frac{1}{4}$" x 28 UNF
Mounting base, across the flats: max. 14,0 mm

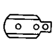




RECTIFIER CIRCUITS ON SINGLE HEATSINKS

Single phase half wave	Two phase half wave	Single phase full wave (Single phase bridge)	Three phase half wave (Three phase star)
			

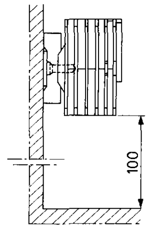
Three phase full wave (Three phase bridge)	Six phase half wave (Six phase star)	Three phase double Y with interphase transformer
		

Diecast heatsink without insulator 

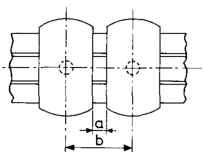
Diecast heatsink with insulator 

MOUNTING INSTRUCTION FOR DIECAST HEATSINKS

1. At free convection cooling or forced air flow < 0,5 m/s the heatsinks should be mounted with the fins vertical and with a distance to the chassis bottom > 100 mm.

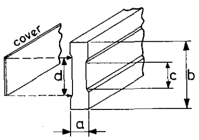


2. At forced air flow > 0,5 m/s the heatsinks may be mounted in any position.
3. Minimum distance between heatsinks in a row.



Heatsink	Distance (mm) a	b
56256/268	> 5,0	> 25,0
56334	> 5,0	> 40,0
56253/334	> 10,0	> 50,0
56271	> 10,0	> 50,0

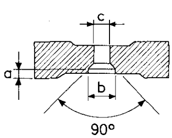
4. The rectifier devices should be fixed to their heatsinks with the torques specified in the relevant published data. Use the torque spanner.
5. For insulated mounting of heatsinks two sizes of mounting strips made of insulating material are available.



Length 750 mm

Strip	Dimensions (mm) a	b	c	d	Weight (g) (with cover)
56233	10,0	36	14,1	22	330
56234	13,5	50	20,1	28	615

6. Mounting holes to be made in the strips:

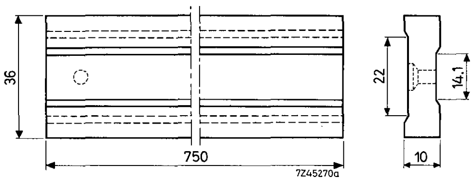


Heatsink	Strip	Dimensions in mm a	b	c
56256/268	56233	< 1,5	7,5	4,3
56253/271	56234	< 1,3	10,2	6,3
56277/334	56234	< 1,3	10,2	6,3

MOUNTING STRIPS

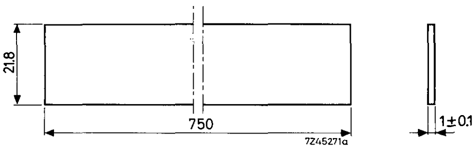
56233

MECHANICAL DATA Dimensions in mm



mounting strip of insulating material

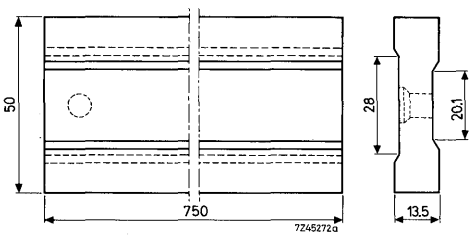
Weight with cover:
330 g



insulating plate (cover)

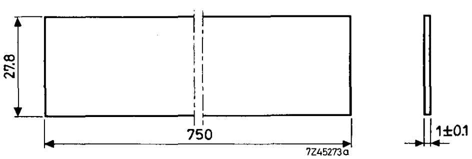
56234

MECHANICAL DATA Dimensions in mm



mounting strip of insulating material

Weight with cover:
615 g



insulating plate (cover)

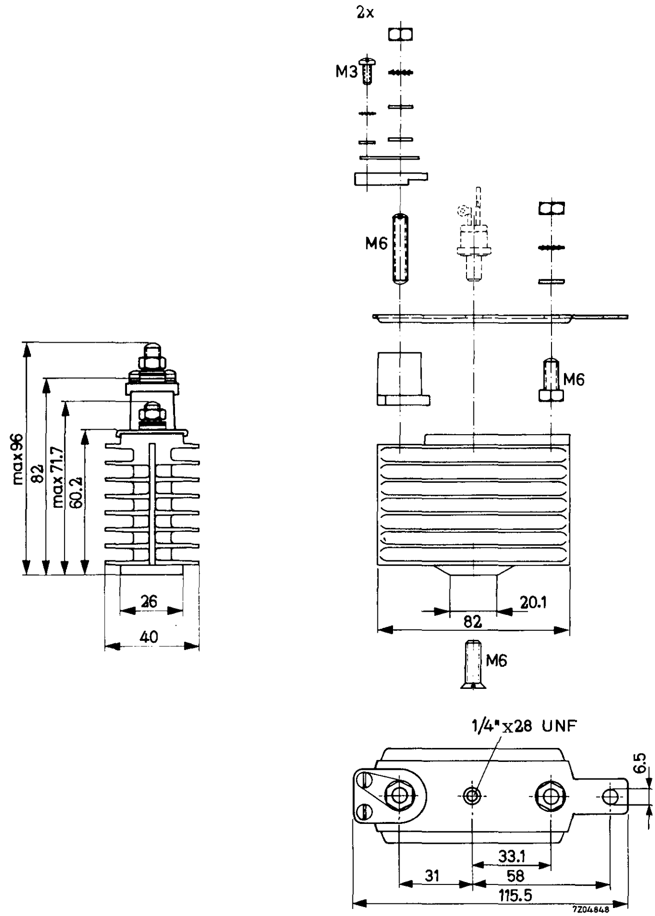
DIECAST HEATSINK

Diecast heatsink of aluminium alloy, painted black, with ¼" x 28 UNF tap hole for devices in DO-5 or TO-48 envelopes.

Weight: 305 g

Dimensions in mm

Fig.1



The graphs are valid for the combination of device and heatsink.

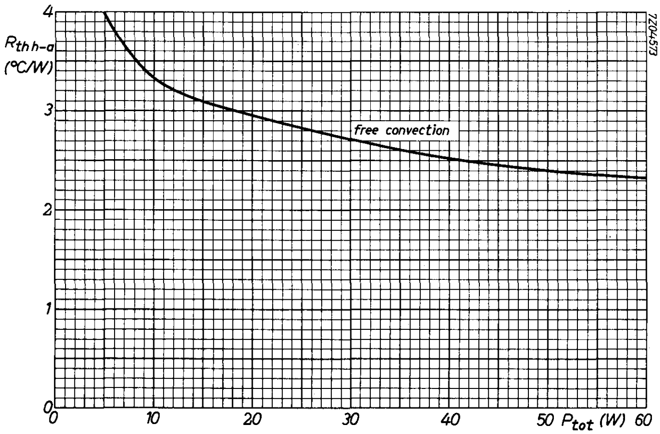


Fig.2

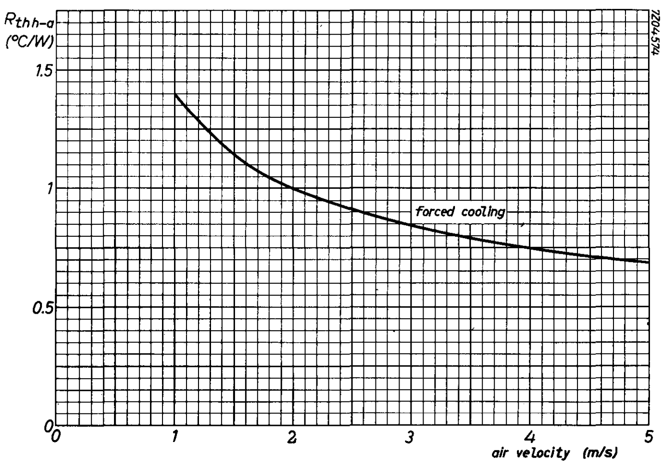


Fig.3

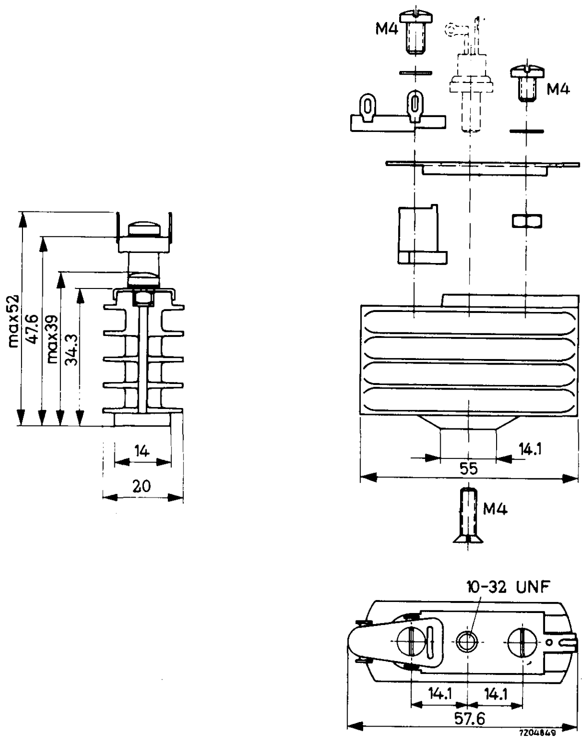
DIECAST HEATSINK

Diecast heatsink of aluminium alloy, painted black, with 10-32 UNF tap hole for devices in DO-4 or TO-64 envelopes.

Weight: 55 g

Dimensions in mm

Fig.1



The graphs are valid for the combination of device and heatsink.

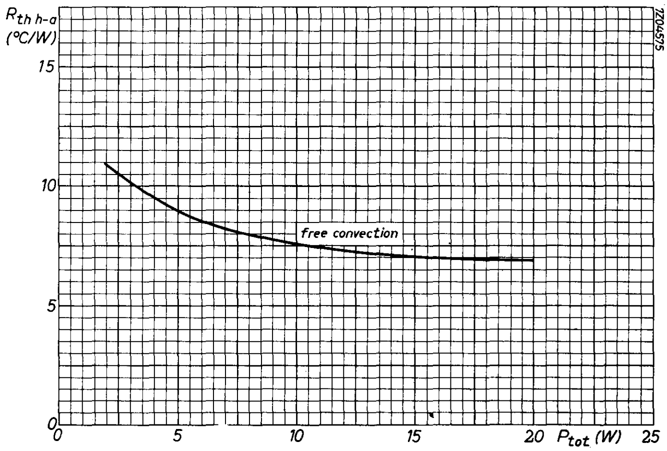


Fig.2

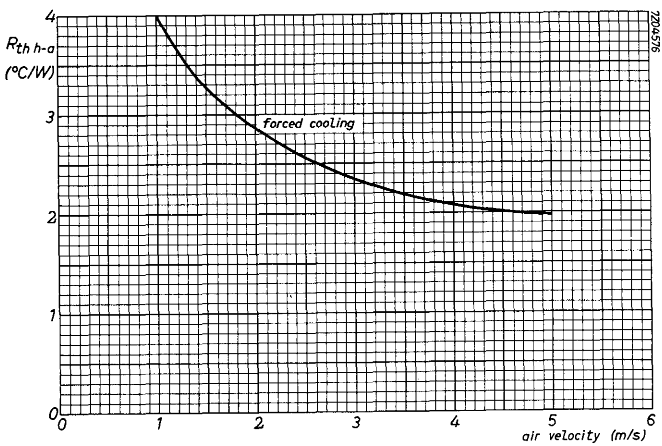


Fig.3

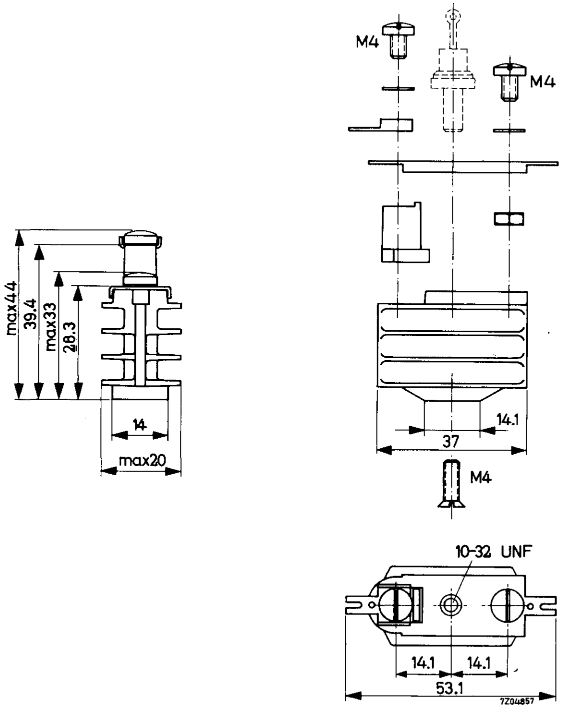
DIECAST HEATSINK

Diecast heatsink of aluminium alloy, painted black, with 10-32 UNF tap hole for devices in DO-4 or TO-64 envelopes.

Weight: 33 g

Dimensions in mm

Fig. 1



The graphs are valid for the combination of device and heatsink

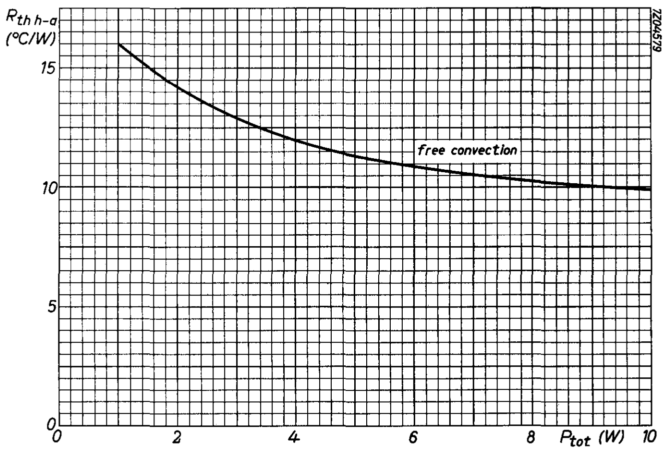


Fig.2

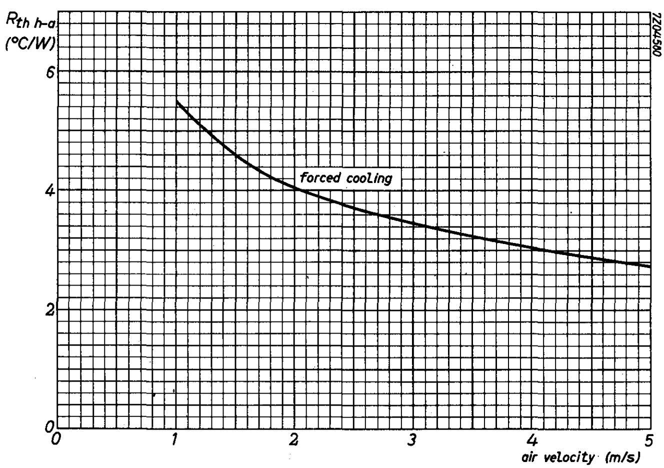


Fig.3

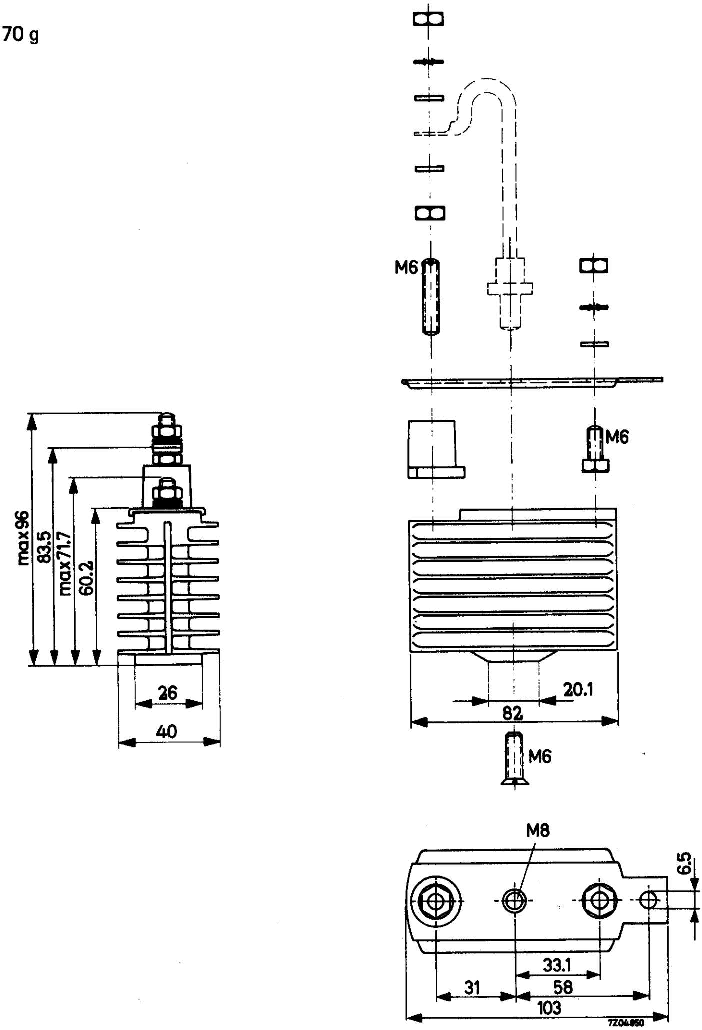
DIECAST HEATSINK

Diecast heatsink of aluminium alloy, painted black, with M8 tap hole for rectifier device.

Dimensions in mm

Weight: 270 g

Fig. 1



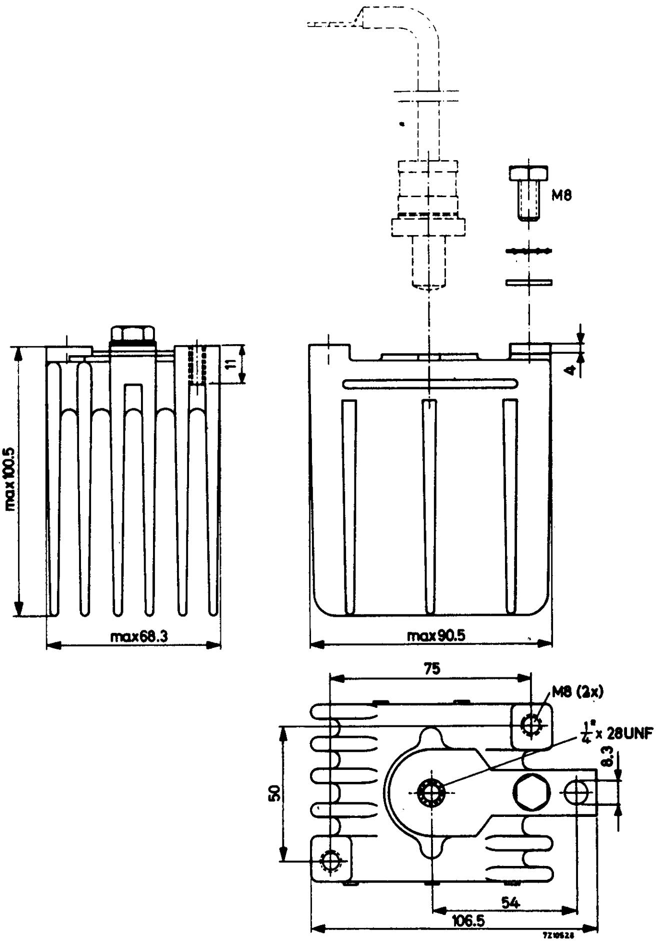
DIECAST HEATSINK

Diecast heatsink of aluminium alloy, painted black, with ¼" x 28 UNF tap hole for rectifier device.

Weight: 690 g

Dimensions in mm

Fig. 1



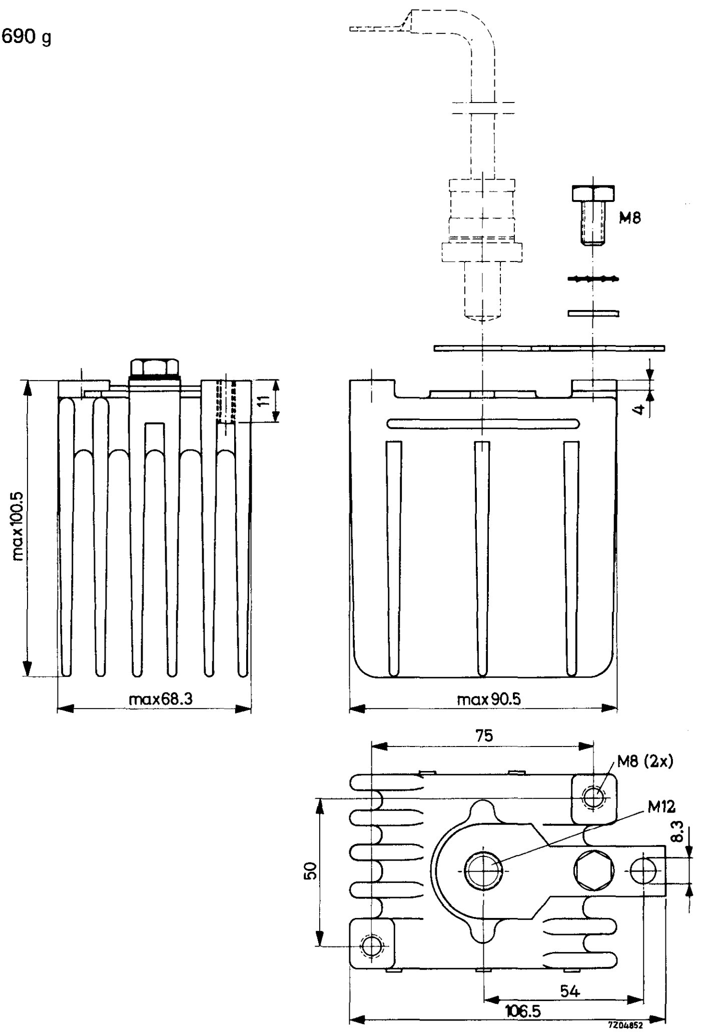
DIECAST HEATSINK

Diecast heatsink of aluminium alloy, painted black, with M12 tap hole for rectifier device.

Weight: 690 g

Dimensions in mm

Fig. 1



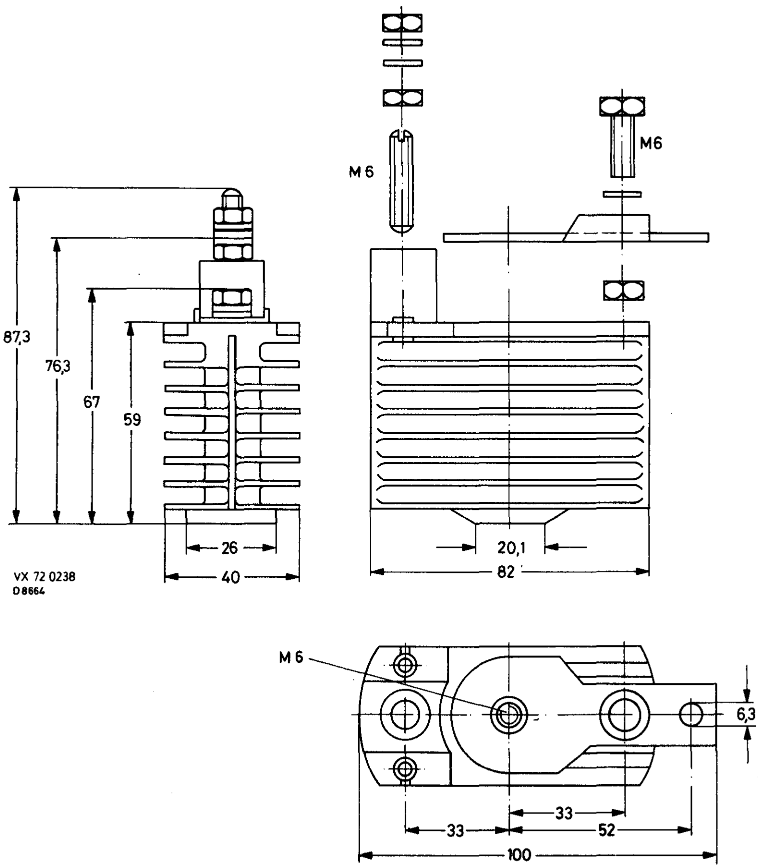
DIECAST HEATSINK

For DO-5 rectifier diodes and TO-48 thyristors and triacs.

Weight: 270 g

Dimensions in mm

Fig.1



Tap hole for fixing the heatsink: M6

The graphs are valid for the combination of device and heatsink.

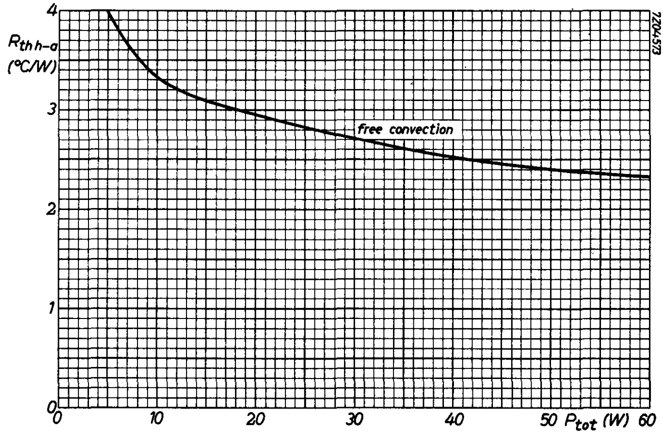


Fig.2

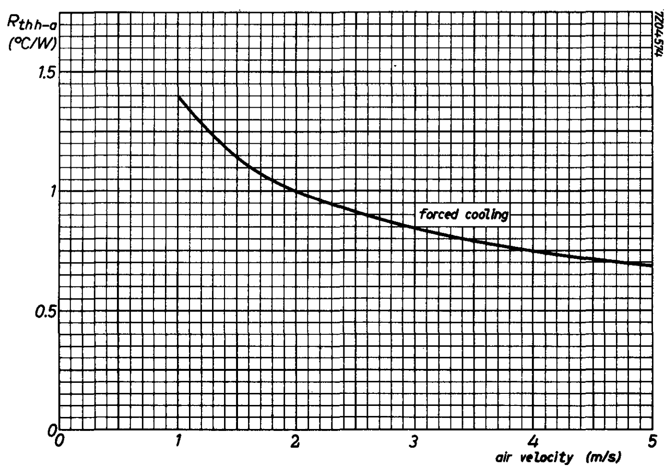


Fig.3

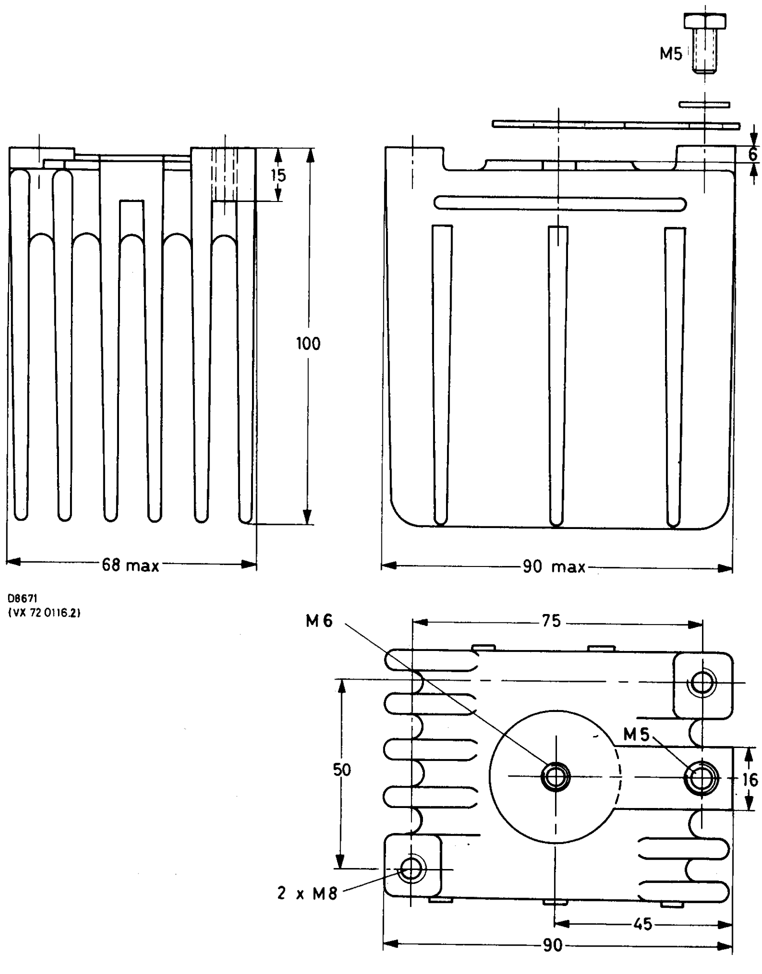
DIECAST HEATSINK

For DO-5 rectifiers and TO-48 thyristors and triacs.

Weight: 690 g

Dimensions in mm

Fig. 1



The graphs are valid for the combination of device and heatsink.

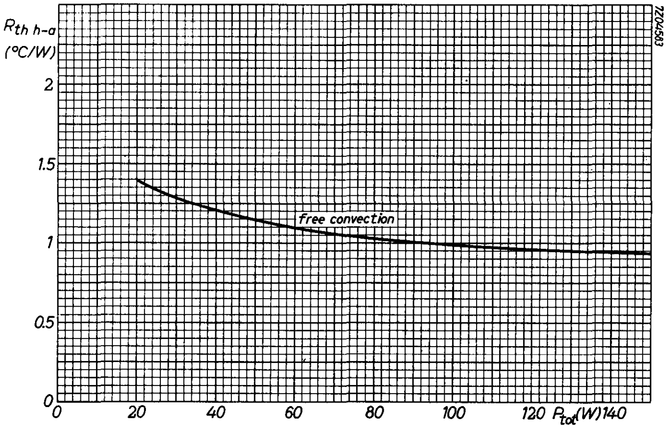


Fig.2

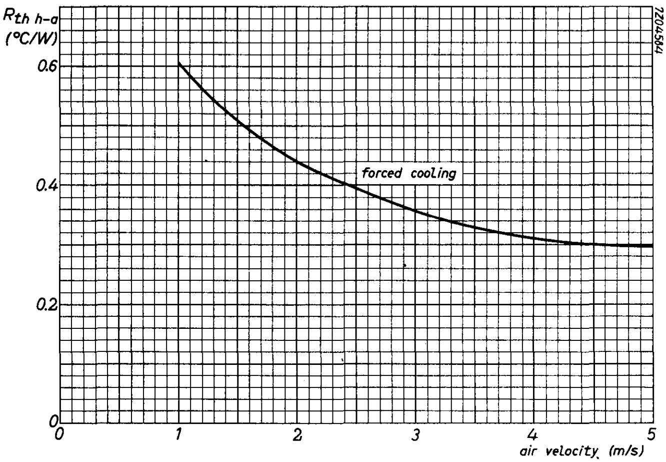


Fig.3

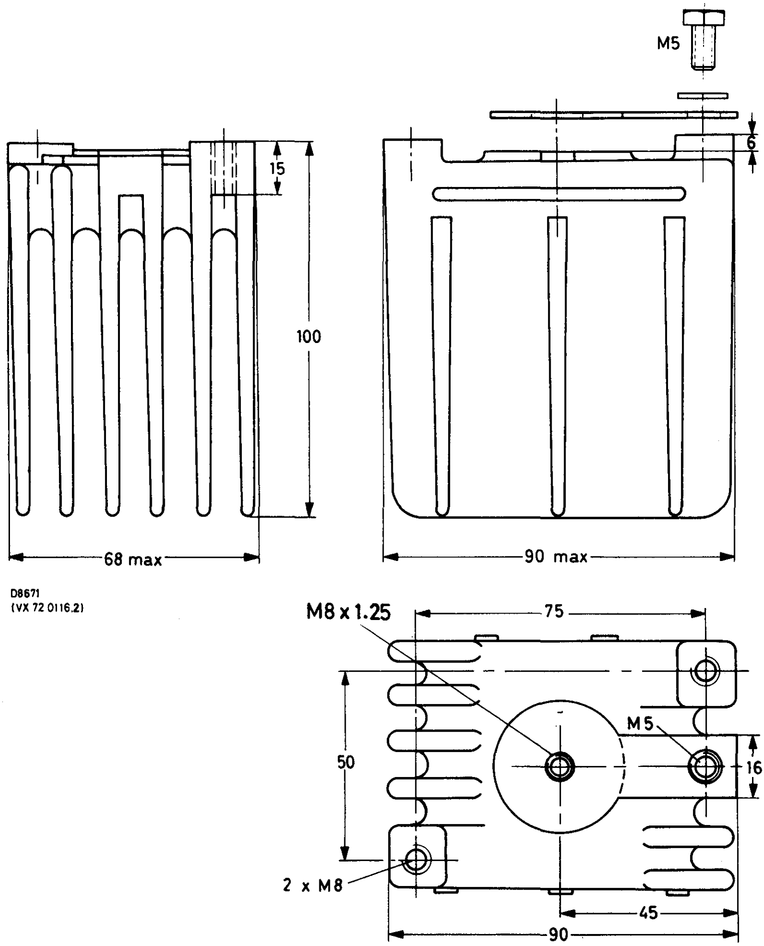
DIECAST HEATSINK

For DO-5 rectifiers and TO-48 thyristors and triacs.

Weight: 690 g

Dimensions in mm

Fig. 1



The graphs are valid for the combination of device and heatsink.

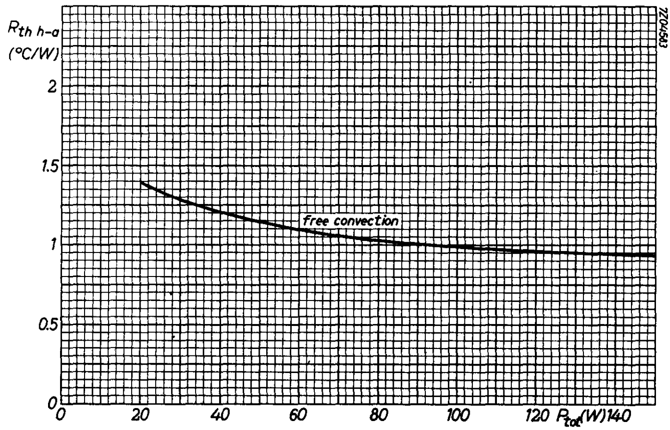


Fig.2

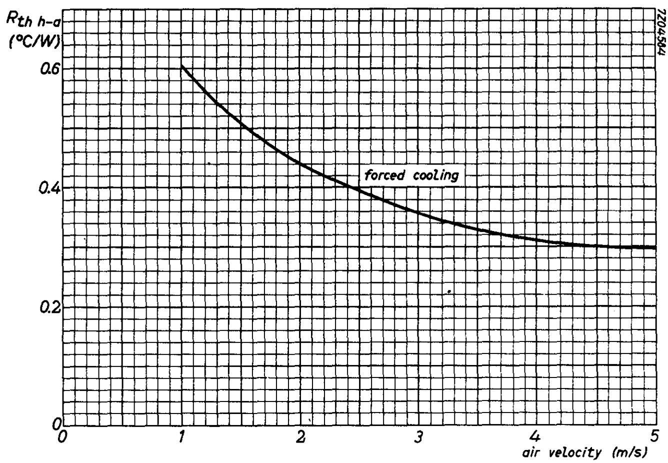


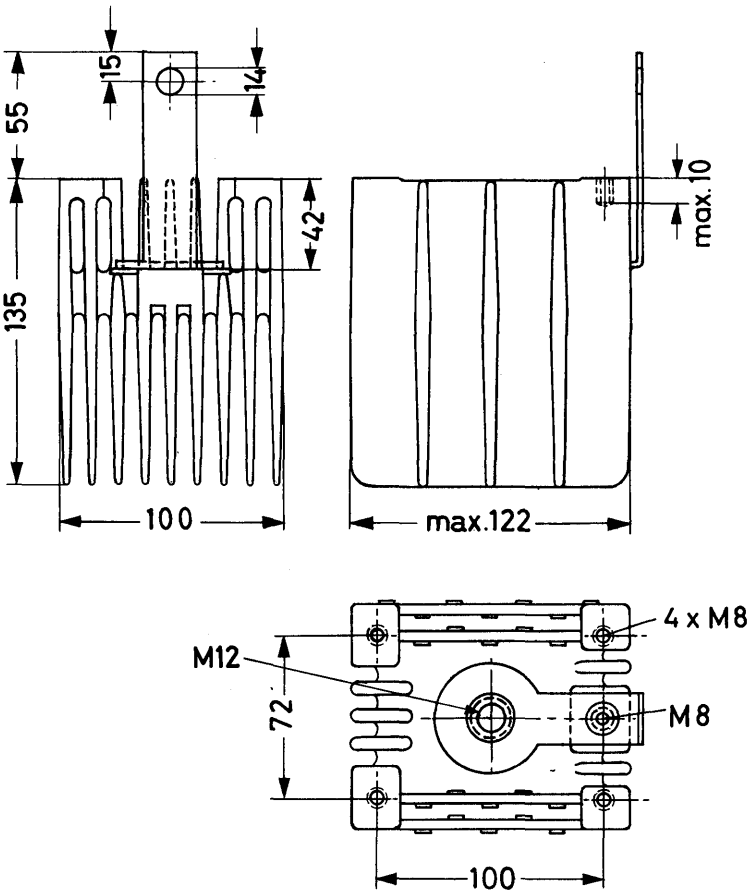
Fig.3

DIECAST HEATSINK

Weight: 1.9 kg

Dimensions in mm

Fig. 1

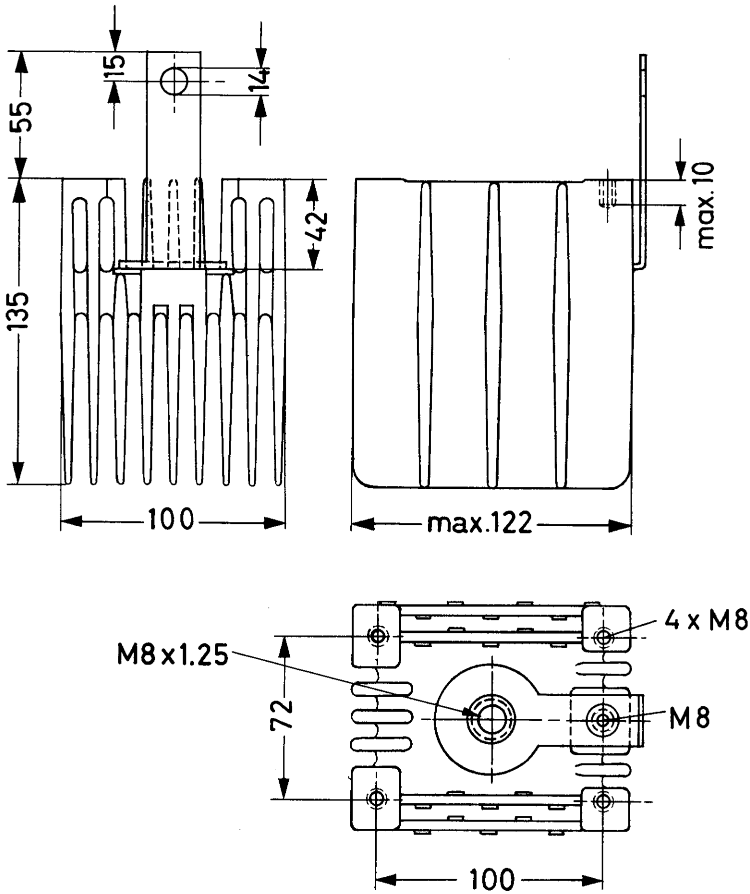


DIECAST HEATSINK

Weight: 1.9 kg

Dimensions in mm

Fig.1

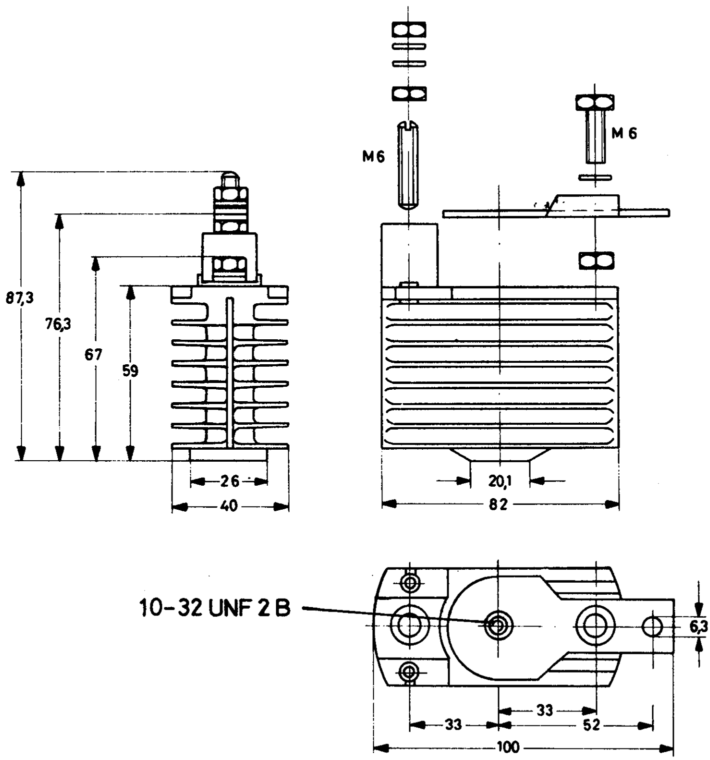


DIECAST HEATSINK

Weight: 270 g

Dimensions in mm

Fig. 1



Tap hole for fixing the heatsink: M8

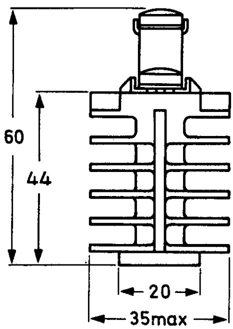
DIECAST HEATSINK

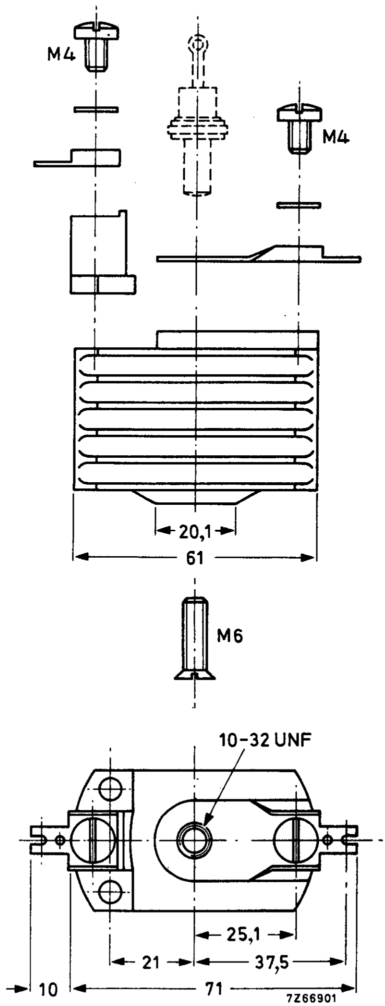
Diecast heatsink of aluminium alloy, painted black, with 10-32 UNF tap hole for rectifier device.

Weight: 135 g

Dimensions in mm

Fig. 1





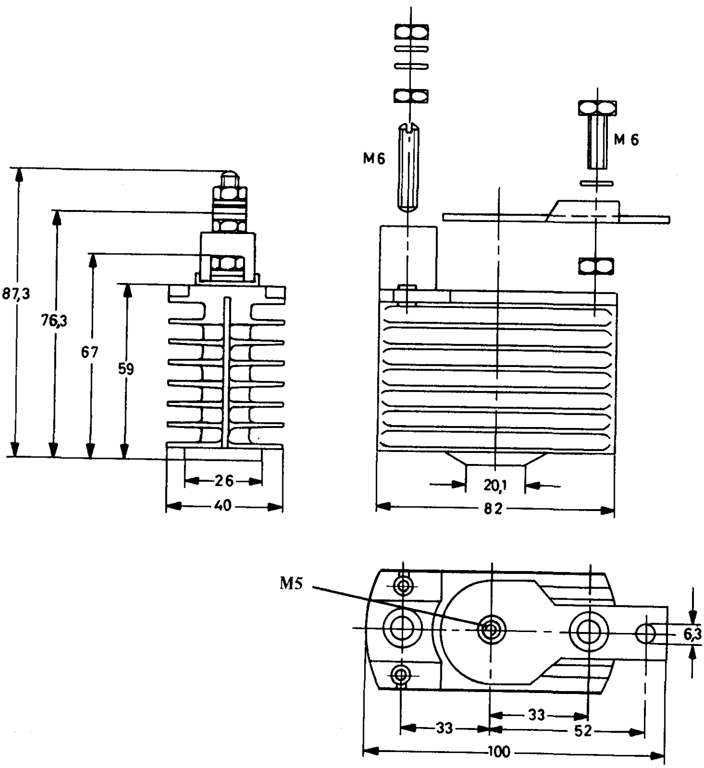
DIECAST HEATSINK

For DO-4 and TO-64 devices with M5 stud

Weight: 270 g

Dimensions in mm

Fig.1



Tap hole for fixing the heatsink: M6

The graphs are valid for the combination of device and heatsink.

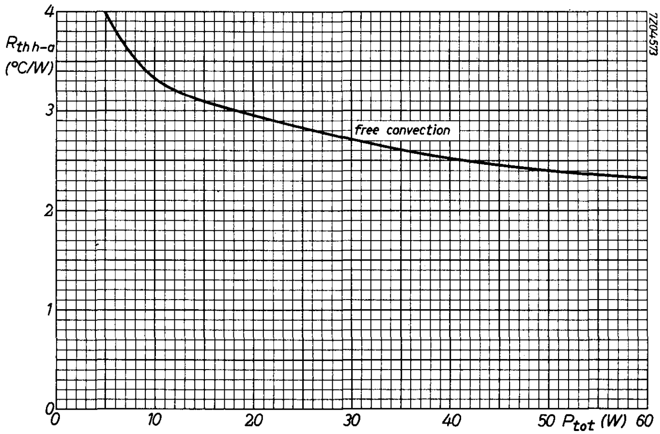


Fig.2

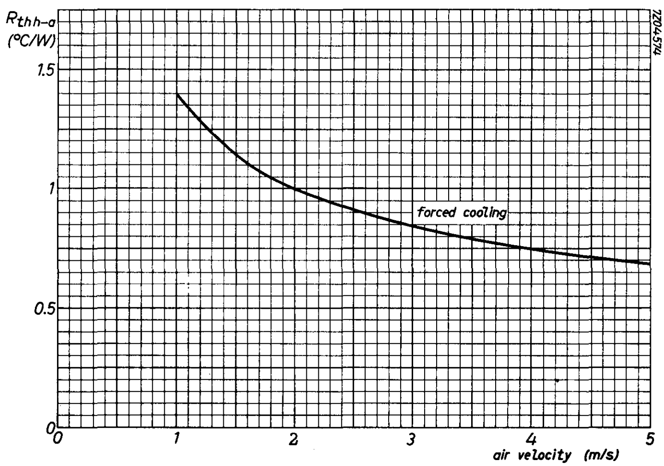


Fig.3

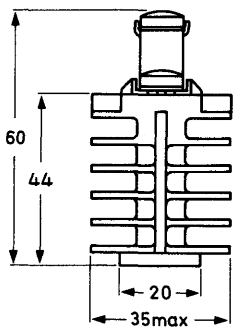
DIECAST HEATSINK

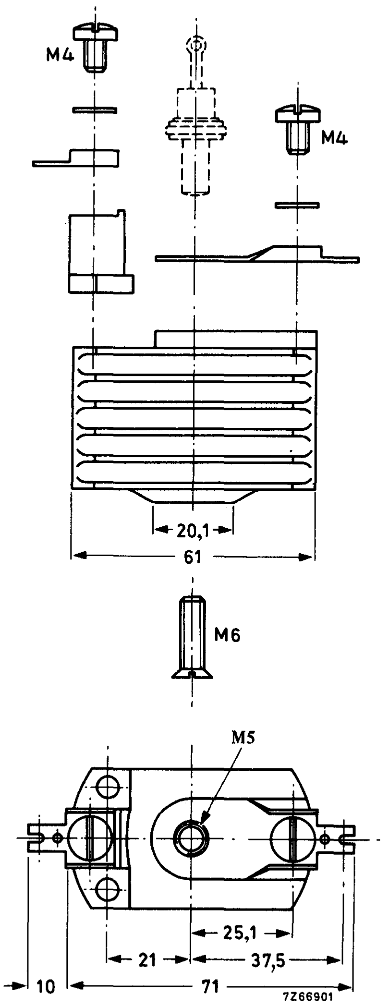
Diecast heatsink of aluminium alloy, painted black, with M5 tap hole for rectifier device.

Weight: 135 g

Dimensions in mm

Fig.1





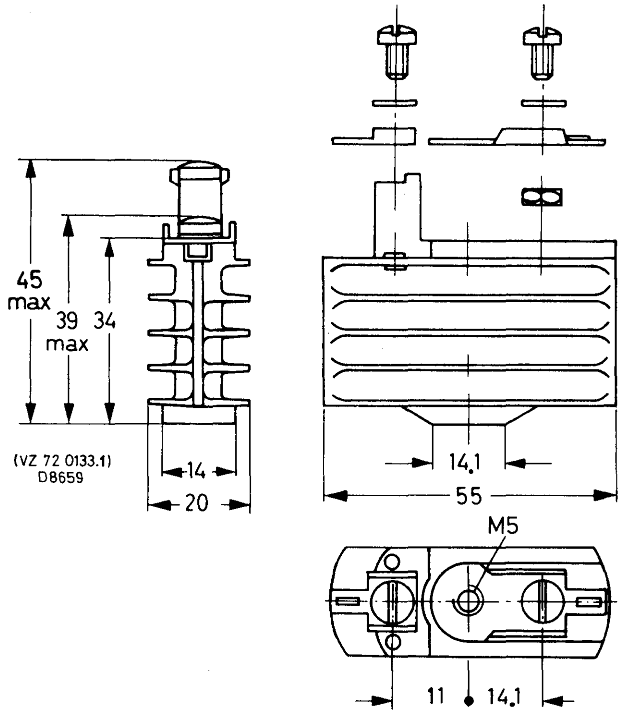
DIECAST HEATSINK

Diecast heatsink of aluminium alloy, painted black, with M5 tap hole for devices in DO-4 and TO-64 envelopes.

Weight: 55 g

Dimensions in mm

Fig.1



Tap hole for fixing the heatsink: M4

The graphs are valid for the combination of device and heatsink.

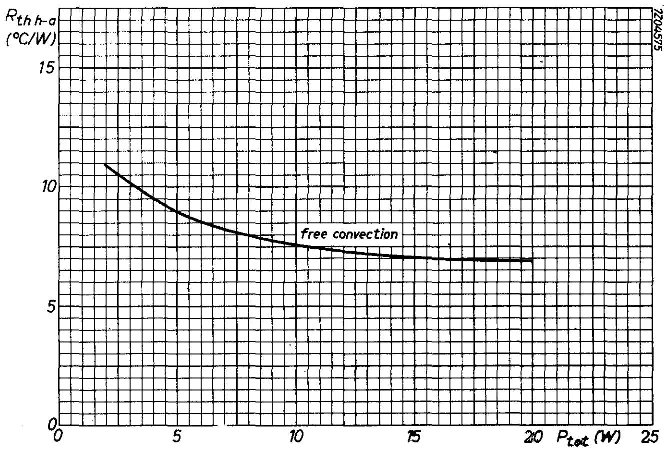


Fig.2

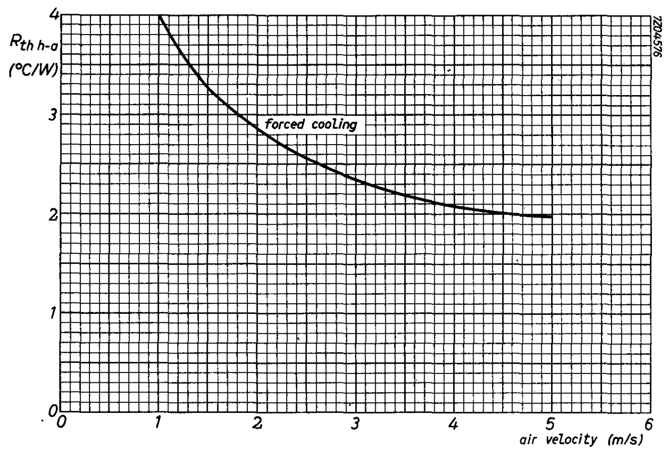
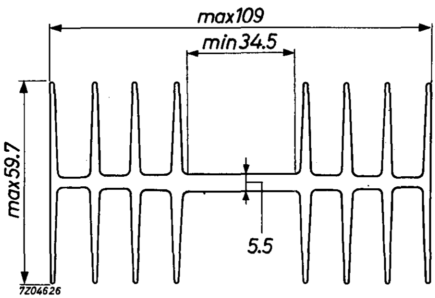


Fig.3

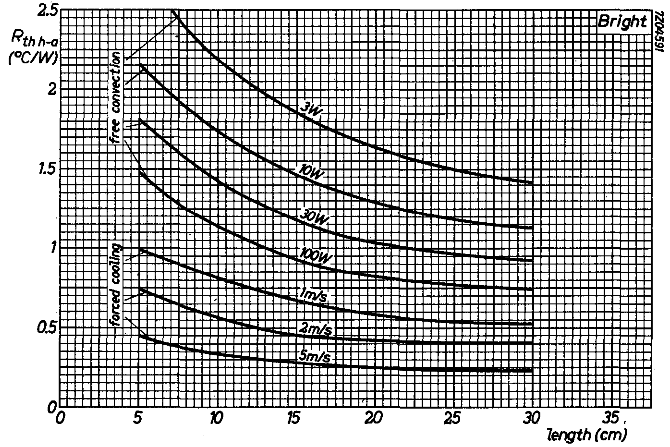
EXTRUDED ALUMINIUM HEATSINK

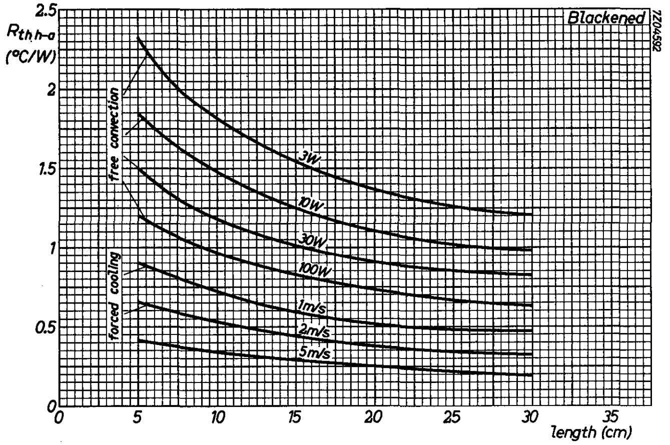
Extruded heatsink of aluminium alloy.
The extrusion is supplied unpainted, in lengths of 1,5 m.

Weight: 4 kg per 1,5 m. Dimensions in mm



The graphs are valid for the combination of device and heatsink.



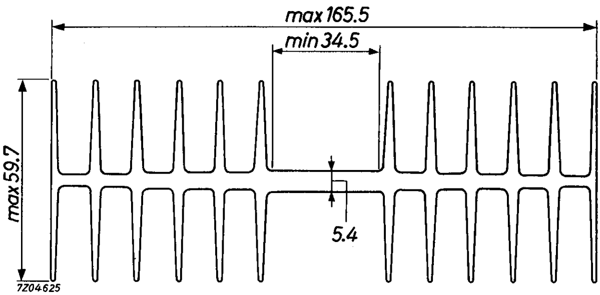


EXTRUDED ALUMINIUM HEATSINK

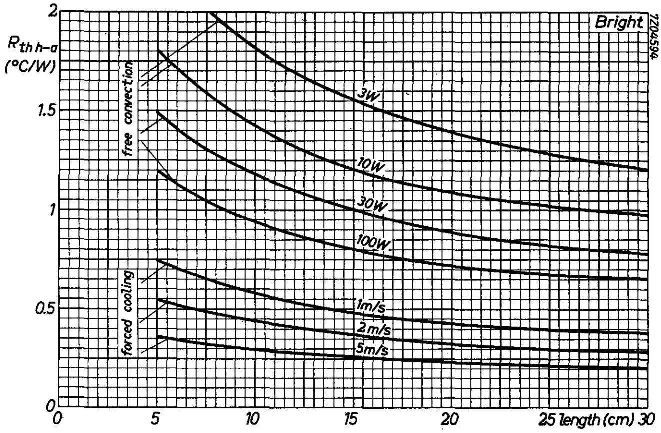
Extruded heatsink of aluminium alloy.
The extrusion is supplied unpainted, in lengths of 1,5 m.

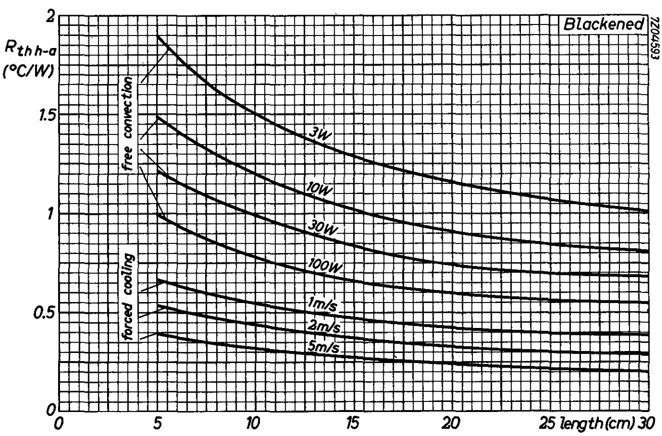
Weight: 6 kg per 1,5 m.

Dimensions in mm



The graphs are valid for the combination of device and heatsink.



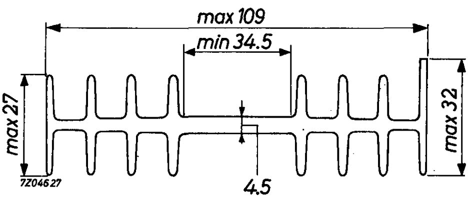


EXTRUDED ALUMINIUM HEATSINK

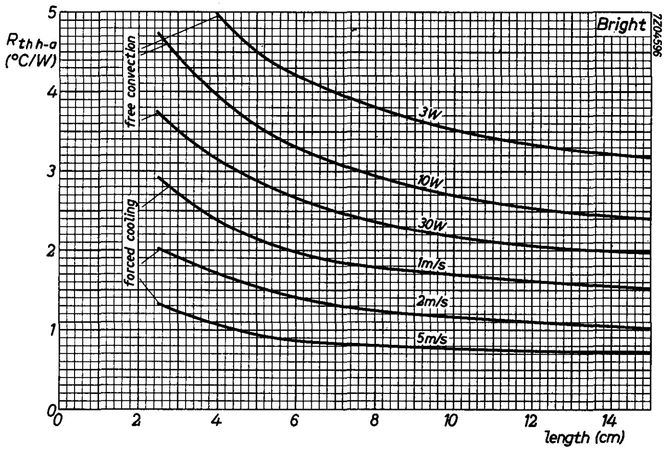
Extruded heatsink of aluminium alloy.
The extrusion is supplied unpainted, in lengths of 1,5 m.

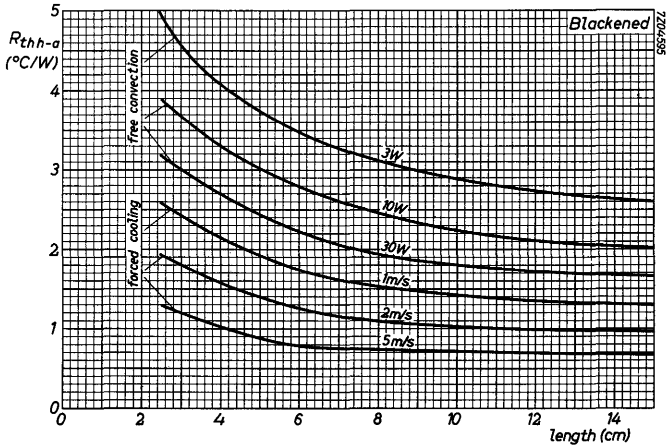
Weight: 2,4 kg per 1,5 m.

Dimensions in mm



The graphs are valid for the combination of device and heatsink.





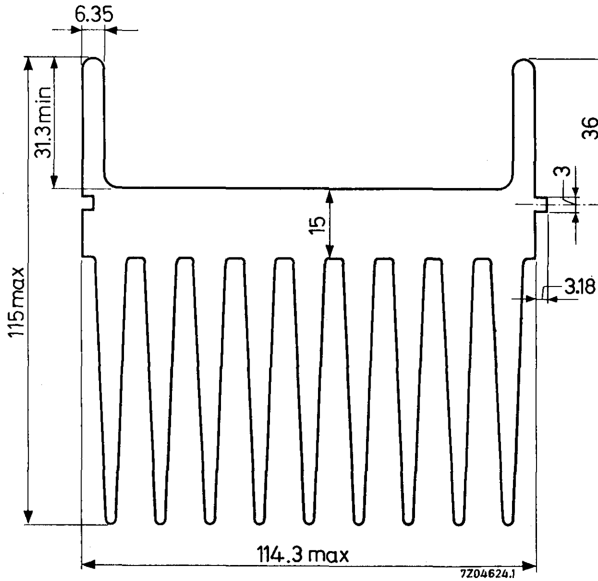
EXTRUDED ALUMINIUM HEATSINK

Extruded heatsink of aluminium alloy.
The extrusion is supplied unpainted, in lengths of 1.5 m.

Weight: 16.2 kg per 1.5 m.

Dimensions in mm

Fig. 1



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