PHILIPS

Data handbook

PHILIPS

Electronic components and materials

Semiconductors

Book S2a 1985

Rectifier diodes

Regulator diodes

High - voltage rectifier stacks

Accessories

POWER DIODES

DATA HANDBOOK SYSTEM

Our Data Handbook System comprises more than 60 books with specifications on electronic components, subassemblies and materials. It is made up of four series of handbooks:

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

The contents of each series are listed on pages iv to viii.

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

When ratings or specifications differ from those published in the preceding edition they are indicated with arrows in the page margin. Where application information is given it is advisory and does not form part of the product specification.

Condensed data on the preferred products of Philips Electronic Components and Materials Division is given in our Preferred Type Range catalogue (issued annually).

Information on current Data Handbooks and on how to obtain a subscription for future issues is available from any of the Organizations listed on the back cover.
Product specialists are at your service and enquiries will be answered promptly.

ELECTRON TUBES (BLUE SERIES)

The blue series of data handbooks is comprises:

T1 **Tubes for r.f. heating**

T2a **Transmitting tubes for communications, glass types**

T2b **Transmitting tubes for communications, ceramic types**

T3 **Klystrons, travelling-wave tubes, microwave diodes**

ET3 **Special Quality tubes, miscellaneous devices** (will not be reprinted)

T4 **Magnetrons**

T5 **Cathode-ray tubes**
Instrument tubes, monitor and display tubes, C.R. tubes for special applications

T6 **Geiger-Müller tubes**

T7 **Gas-filled tubes**
Segment indicator tubes, indicator tubes, dry reed contact units, thyratrons, industrial rectifying tubes, ignitrons, high-voltage rectifying tubes, associated accessories

T8 **Picture tubes and components**
Colour TV picture tubes, black and white TV picture tubes, colour monitor tubes for data graphic display, monochrome monitor tubes for data graphic display, components for colour television, components for black and white television and monochrome data graphic display

T9 **Photo and electron multipliers**
Photomultiplier tubes, phototubes, single channel electron multipliers, channel electron multiplier plates

T10 **Camera tubes and accessories**

T11 **Microwave semiconductors and components**

T12 **Vidicons and Newvicons**

T13 **Image intensifiers**

T14 **Infrared detectors**

SEMICONDUCTORS (RED SERIES)

The red series of data handbooks comprises:

S1 **Diodes**
Small-signal germanium diodes, small-signal silicon diodes, voltage regulator diodes(< 1,5 W), voltage reference diodes, tuner diodes, rectifier diodes

S2 **Power diodes, thyristors, triacs**
Rectifier diodes, voltage regulator diodes (> 1,5 W), rectifier stacks, thyristors, triacs

S3 **Small-signal transistors**

S4a **Low-frequency power transistors and hybrid modules**

S4b **High-voltage and switching power transistors**

S5 **Field-effect transistors**

S6 **R.F. power transistors and modules**

S7 **Microminiature semiconductors for hybrid circuits**

S8 **Devices for optoelectronics**
Photosensitive diodes and transistors, light-emitting diodes, displays, photocouplers, infrared sensitive devices, photoconductive devices.

S9 **Power MOS transistors**

S10 **Wideband transistors and wideband hybrid IC modules**

INTEGRATED CIRCUITS (PURPLE SERIES)

The purple series of data handbooks comprises:

EXISTING SERIES

IC1 **Bipolar ICs for radio and audio equipment**

IC2 **Bipolar ICs for video equipment**

IC3 **ICs for digital systems in radio, audio and video equipment**

IC4 **Digital integrated circuits**
CMOS HE4000B family

IC5 **Digital integrated circuits – ECL**
ECL10 000 (GX family), ECL100 000 (HX family), dedicated designs

IC6 **Professional analogue integrated circuits**

IC7 **Signetics bipolar memories**

IC8 **Signetics analogue circuits**

IC9 **Signetics TTL logic**

IC10 **Signetics Integrated Fuse Logic (IFL)**

IC11 **Microprocessors, microcomputers and peripheral circuitry**

NEW SERIES

IC01N	**Radio, audio and associated systems** Bipolar, MOS	
IC02N	**Video and associated systems** Bipolar, MOS	
IC03N	**Telephony equipment** Bipolar, MOS	
IC04N	**HE4000B logic family** CMOS	
IC05N	**HE4000B logic family uncased integrated circuits** CMOS	(published 1984)
IC06N	**PC54/74HC/HCU/HCT logic families** HCMOS	
IC07N	**PC54/74HC/HCU/HCT uncased integrated circuits** HCMOS	
IC08N	**10K and 100K logic family** ECL	
IC09N	**Logic series** TTL	(published 1984)
IC10N	**Memories** MOS, TTL, ECL	
IC11N	**Analogue - industrial**	
IC12N	**Semi-custom gate arrays & cell libraries** ISL, ECL, CMOS	
IC13N	**Semi-custom integrated fuse logic** IFL series 20/24/28	
IC14N	**Microprocessors, microcontrollers & peripherals** Bipolar, MOS	
IC15N	**Logic series** FAST TTL	(published 1984)

Note

Books available in the new series are shown with their date of publication.

COMPONENTS AND MATERIALS (GREEN SERIES)

The green series of data handbooks comprises:

C1 **Assemblies for industrial use**
PLC modules, PC20 modules, HNIL FZ/30 series, NORbits 60-, 61-, 90-series, input devices, hybrid ICs

C2 **Television tuners, video modulators, surface acoustic wave filters**

C3 **Loudspeakers**

C4 **Ferroxcube potcores, square cores and cross cores**

C5 **Ferroxcube for power, audio/video and accelerators**

C6 **Synchronous motors and gearboxes**

C7 **Variable capacitors**

C8 **Variable mains transformers**

C9 **Piezoelectric quartz devices**
Quartz crystal units, temperature compensated crystal oscillators, compact integrated oscillators, quartz crystal cuts for temperature measurements

C10 **Connectors**

C11 **Non-linear resistors**
Voltage dependent resistors (VDR), light dependent resistors (LDR), negative temperature coefficient thermistors (NTC), positive temperature coefficient thermistors (PTC)

C12 **Variable resistors and test switches**

C13 **Fixed resistors**

C14 **Electrolytic and solid capacitors**

C15 **Film capacitors, ceramic capacitors**

C16 **Permanent magnet materials**

C17 **Stepping motors and associated electronics**

C18 **D.C. motors**

C19 **Piezoelectric ceramics**

C20 **Wire-wound components for TVs and monitors**

SELECTION GUIDE

RECTIFIER DIODES

General purpose

$I_{F(AV)max}$ (A)	Type	V_{RRMmax} (V) 300	600	800	1000	1200	1600	Page
6	BYX38	•	•			•		53
6.5	BY249	•	•					33
10	BYX98	•	•			•		91
12	BYX42	•	•			•		65
15	BYX99	•	•			•		97
30	BYX96	•	•			•	•	79
47	BYX97	•	•			•	•	85
48	BYX52	•	•			•		69
150	BYX32		•	•	•	•	•	47

Avalanche

$I_{F(AV)max}$ (A)	Type	V_{RWMmax} (V) 600	800	1000	1200	1400	Page
9.5	BYX39	•	•	•	•	•	59
20	BYX25	•	•	•	•	•	39
48	BYX56	•	•	•	•	•	73

Bridges (single-phase)

$I_{O(AV)max}$ (A)	Type	$V_{I(RMS)max}$ (V) 50	60	80	140	220	280	420	Page
PCB-mounted types									
4.8	BY224					•	•		109
4.8	BY225	•		•					117
Bolt-down types									
12	BY260				•		•	•	125
25	BY261				•		•	•	131

Bridges (three-phase)

$I_{O(AV)max}$ (A)	Type	$V_{I(RMS)max}$ (V) 340	425	510	Page
25	BGX25	•	•	•	105

FAST RECTIFIER DIODES

Ultra fast (epitaxial) types

$I_{F(AV)max}$ (A)	Type	V_{RRMmax} (V) 50	100	150	200	300	400	500	600	800	Page
2	BYV27	•	•	•	•						209
3.5	BYV28	•	•	•	•						217
7	BYX50				•	•					369
8	BYR29								•	•	181
8	BYW29	•	•	•	•						297
9	BYV29					•	•	•			223
10	BYQ28*	•	•	•	•						171
12	BYV30				•	•	•				233
14	BYT79					•	•	•			191
14	BYV79	•	•	•	•						273
14	BYW30	•	•	•	•						307
20	BYV32*	•	•	•	•						239
20	BYV34*					•	•	•			247
28	BYW31	•	•	•	•						315
30	BYV42*	•	•	•	•						257
30	BYV72*	•	•	•	•						265
35	BYV92				•	•	•				283
40	BYW92	•	•	•	•						323
60	BYW93	•	•	•	•						331
80	BYW94	•	•	•	•						339

*Monolithic dual rectifier diodes

FAST RECTIFIER DIODES (Cont.)

$I_{F(AV)max}$ (A)	Type	V_{RRMmax} (V) 50	100	200	300	400	500	600	800	1000	1200	1300	1500	Page
Very-fast types														
6	1N3879	●												377
6	1N3880		●											377
6	1N3881			●										377
6	1N3882				●									377
12	1N3889	●												383
12	1N3890		●											383
12	1N3891			●										383
12	1N3892				●									383
14	BYX30**			●	●	●	●	●						347
22	BYX46**			●	●	●	●	●						357
30	1N3909	●												389
30	1N3910		●											389
30	1N3911			●										389
30	1N3912				●									389
30	1N3913					●								389
Fast types														
6.5	BY359									●		●	●	163
7	BY229			●		●		●	●					139
8	BY329								●	●	●			151
12	BYV24								●	●				201
40	BYW25								●	●				291

SCHOTTKY RECTIFIER DIODES

$I_{F(AV)max}$ (A)	Type	V_{RRMmax} (V) 30	35	40	40A▲	45	Page
10	BYV19	●	●	●	●	●	399
15	BYV20	●	●	●	●	●	407
16	BYV39	●	●	●	●	●	447
20	BYV33*	●	●	●	●	●	439
28	BYV21	●	●	●	●	●	415
30	BYV43*	●	●	●	●	●	455
30	BYV73*	●	●	●	●	●	463
60	BYV22	●	●	●	●	●	423
60	PHSD51					●	471
80	BYV23	●	●	●	●	●	431

*Monolithic dual rectifier diodes **With avalanche characteristics

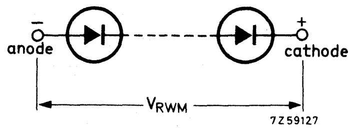
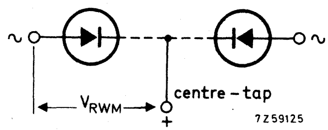
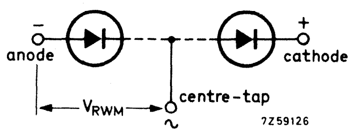
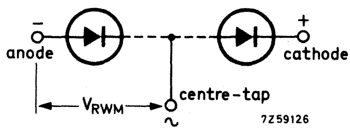
▲With guaranteed reverse surge capability

REGULATOR DIODES

<table>
<tr><th rowspan="4">Regulated voltage</th><th rowspan="4">Suppression stand-off voltage</th><th colspan="5">REGULATOR SERVICE $P_{tot\,max}$</th></tr>
<tr><th>2.5 W</th><th>–</th><th>20 W</th><th>100 W</th><th>–</th></tr>
<tr><th colspan="5">SUPPRESSOR SERVICE $P_{RSM\,max}$</th></tr>
<tr><th>700 W</th><th>700 W</th><th>700 W</th><th>9.5 kW</th><th>25 kW</th></tr>
<tr><td>4.7 V</td><td>3.6 V</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></tr>
<tr><td>5.6 V</td><td>4.3 V</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></tr>
<tr><td>6.8 V</td><td>5.1 V</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 (page 495)</td><td rowspan="26">Type No. BZW70 (page 479)</td><td rowspan="25">Type No. BZY93 (page 537)</td><td rowspan="25">Type No. BZY91 (page 517)</td><td></td></tr>
<tr><td>8.2 V</td><td>6.2 V</td><td></td></tr>
<tr><td>9.1 V</td><td>6.8 V</td><td></td></tr>
<tr><td>10 V</td><td>7.5 V</td><td rowspan="22">Type No. BZW86 (page 481)</td></tr>
<tr><td>11 V</td><td>8.2 V</td></tr>
<tr><td>12 V</td><td>9.1 V</td></tr>
<tr><td>13 V</td><td>10 V</td></tr>
<tr><td>15 V</td><td>11 V</td></tr>
<tr><td>16 V</td><td>12 V</td></tr>
<tr><td>18 V</td><td>13 V</td></tr>
<tr><td>20 V</td><td>15 V</td></tr>
<tr><td>22 V</td><td>16 V</td></tr>
<tr><td>24 V</td><td>18 V</td></tr>
<tr><td>27 V</td><td>20 V</td></tr>
<tr><td>30 V</td><td>22 V</td></tr>
<tr><td>33 V</td><td>24 V</td></tr>
<tr><td>36 V</td><td>27 V</td></tr>
<tr><td>39 V</td><td>30 V</td></tr>
<tr><td>43 V</td><td>33 V</td></tr>
<tr><td>47 V</td><td>36 V</td></tr>
<tr><td>51 V</td><td>39 V</td></tr>
<tr><td>56 V</td><td>43 V</td></tr>
<tr><td>62 V</td><td>47 V</td></tr>
<tr><td>68 V</td><td>51 V</td></tr>
<tr><td>75 V</td><td>56 V</td></tr>
<tr><td>82 V</td><td>62 V</td><td></td><td></td><td></td><td></td></tr>
<tr><td colspan="2">Outline</td><td>SOD-18</td><td>SOD-18</td><td>DO-4</td><td>DO-5</td><td>DO-30</td></tr>
<tr><td colspan="2">Polarity</td><td>normal</td><td>normal</td><td>both</td><td>both</td><td>both</td></tr>
</table>

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.	Page	Configuration
OSS9115–3 to –36	3.5 A (6 A in oil)	4.5 kV to 54 kV	563	
OSS9215–3 to –36	5 A (20 A in oil)		575	
OSS9415–3 to –36	10 A (30 A in oil)		587	
OSB9115–4 to –36	7 A (12 A in oil)	3 kV to 27 kV	563	
OSB9215–4 to –36	10 A (40 A in oil)		575	
OSB9415–4 to –36	20 A (60 A in oil)		587	
OSM9115–4 to –36	3.5 A (6 A in oil)	3 kV to 27 kV	563	
OSM9215–4 to –36	5 A (20 A in oil)		575	
OSM9415–4 to –36	10 A (30 A in oil)		587	
OSM9510–12	1.5 A	6 kV	595	

GENERAL SECTION

Type Designation
Rating Systems
Letter Symbols
Quality Conformance and Reliability
General Explanatory Notes
Heatsinks

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 ($R_{th\ j\text{-}mb} > 15\ ^{o}C/W$)
D. TRANSISTOR; power, audio frequency ($R_{th\ j\text{-}mb} \leq 15\ ^{o}C/W$)
E. DIODE; tunnel
F. TRANSISTOR; low power, high frequency ($R_{th\ j\text{-}mb} > 15\ ^{o}C/W$)
G. MULTIPLE OF DISSIMILAR DEVICES – MISCELLANEOUS; e.g. oscillator
H. DIODE; magnetic sensitive
L. TRANSISTOR; power, high frequency ($R_{th\ j\text{-}mb} \leq 15\ ^{o}C/W$)
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 ($R_{th\ j\text{-}mb} > 15\ ^{o}C/W$)
S. TRANSISTOR; low power, switching ($R_{th\ j\text{-}mb} > 15\ ^{o}C/W$)
T. CONTROL AND SWITCHING DEVICE; e.g. thyristor, power ($R_{th\ j\text{-}mb} \leq 15\ ^{o}C/W$)
U. TRANSISTOR; power, switching ($R_{th\ j\text{-}mb} \leq 15\ ^{o}C/W$)
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.
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 (As used throughout this book) ←

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
C	Controllable
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.

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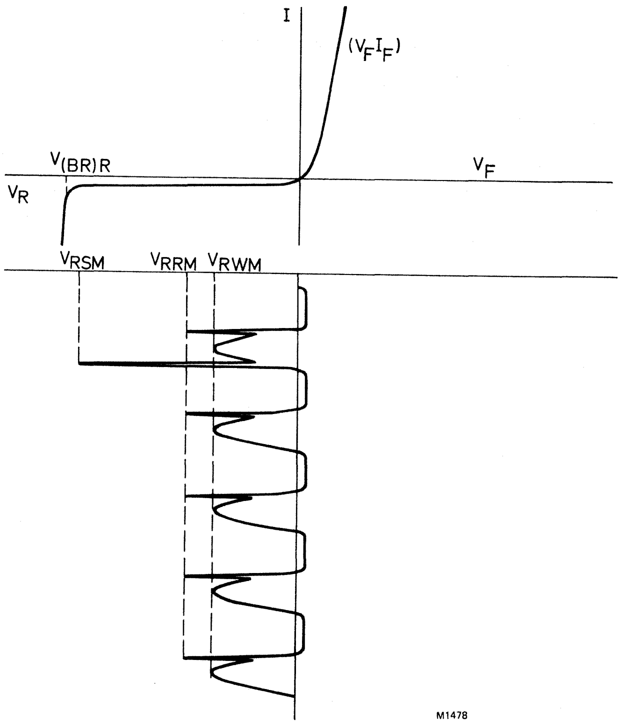
[1]) For the anode-cathode voltage of thyristors and triacs, F is replaced either by D or T, to distinguish between 'off-state' (non-triggered) and 'on-state' (triggered).

Example of the use of letter symbols



Simplified rectifier characteristic together with an anode-cathode voltage as a function of time.

QUALITY CONFORMANCE AND RELIABILITY

In addition to 100% testing of all major device parameters in the 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, IS02859, CA–C–115.

The market demand for a continuously improving product quality is being met by the annual updating of formal quality improvement plans.

The 'Defect free' and 'Right first time' concepts are applied regularly as part of an overall quality programme covering all aspects of device quality from initital design to final production. These concepts, together with the quality assurance requirements, embrace all the principles outlined in DEF STAN 05–21, AQAP–1, and BS5750 Pt1.

CONFORMANCE

The Company actively promote a policy of customer cooperation to determine their quality problems and future requirements. This cooperation is often in the form of a 'ppm' activity. The 'ppm' is a measure of conformance of the outgoing product, and is expressed as the number of reject devices found per million of products delivered (e.g. a process average of 0.01% = 100 ppm). Mutually agreed ppm targets are set, and a programme of quality improvement work initiated.

In addition to the above, special inspection and/or test procedures are available, following consultation with the customer and the agreement of a special specification.

RELIABILITY

'Screening', or 'Burn-in' procedures are also available, based on the requirements of CECC 50 000.

CECC 50 000 offers a choice of four screening sequences: 'A', 'B', 'C', 'D'. The Company's standard 'Hi-rel' procedure offers a combination of 'C' and 'D' sequences.

Sequence 'C'

1. High temperature storage – 24 hours minimum.
2. Rapid change of temperature – as detailed in agreed specification.
3. Sealing – fine leak test.
   – gross leak test.
4. Functional electrical characteristics – within group 'A' limits.

Sequence 'D'

1. 'Burn-in' – high-voltage reverse bias, 48 hours duration. Conditions as specified in CECC 50 000.
2. Post 'Burn-in' measurements – functional electrical characteristics, within group 'A' limits.

Other 'Hi-rel', 'Burn-in', or 'Screening' procedures may be available on request.

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.

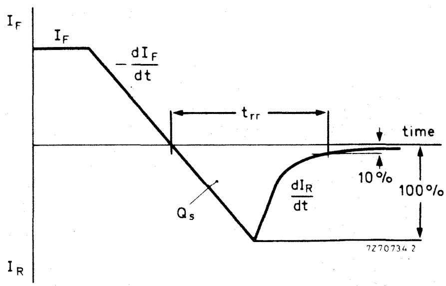


Fig. 1 Waveform showing the reverse recovery aspects.

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 peak value of transient reverse current is known as I_{RRM}.

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.

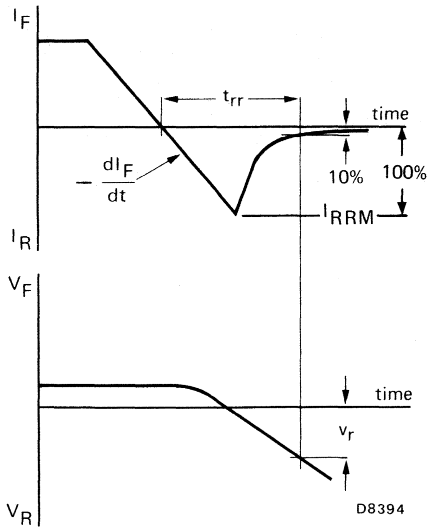


Fig.2 Waveforms showing the reverse switching losses aspects.

SWITCHING LOSSES (continued)

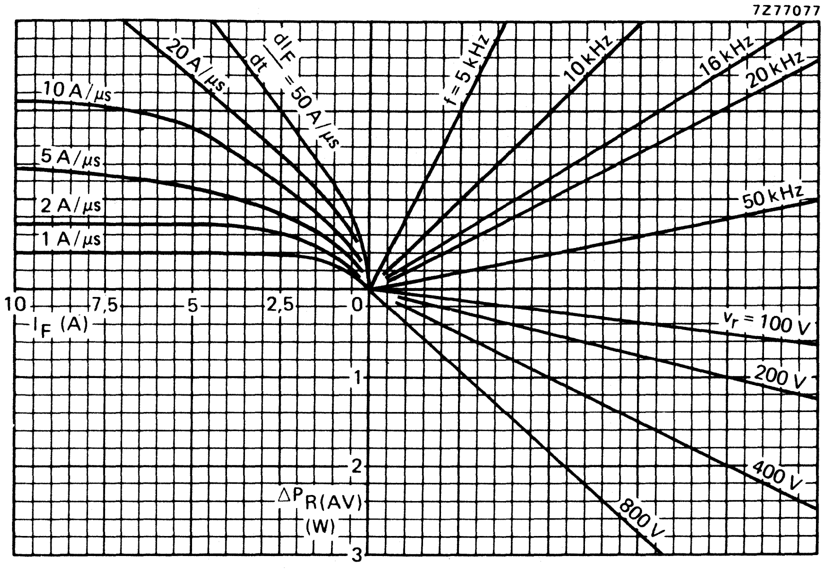


Fig. 3 **Nomogram** (example of reverse switching losses). Power loss $\Delta P_{R(AV)}$ due to switching only (to be added to steady-state power losses). I_F = forward current just before switching off; T_j = 150 °C.

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.

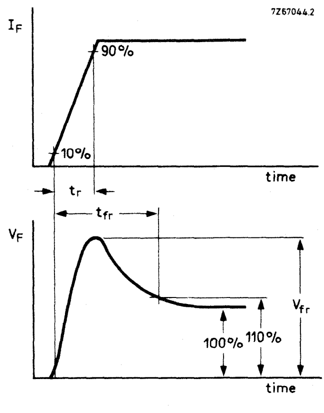


Fig. 4 Waveforms showing the forward recovery aspects.

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.

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: $T_j - T_{amb} = P \times (R_{th\ j\text{-}mb} + R_{th\ mb\text{-}h} + R_{th\ h\text{-}a})$

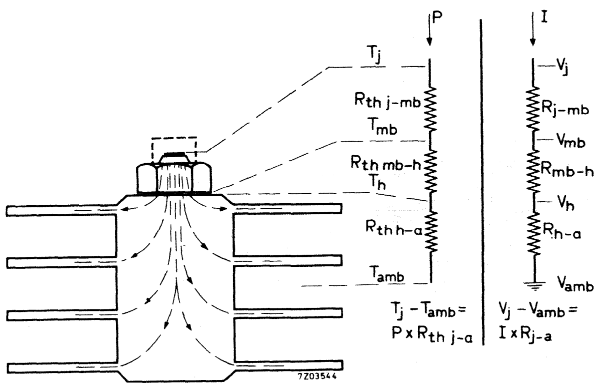


Fig. 1

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.

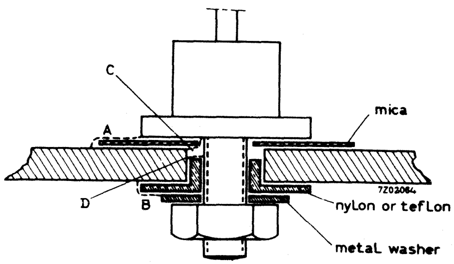


Fig. 2 Creepage distances with an insulated diode

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.

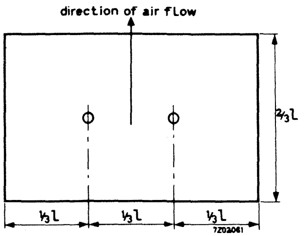


Fig. 3 Plain cooling fin with two diodes

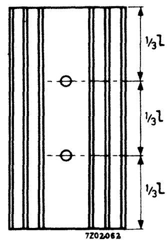


Fig. 4 Extruded aluminium heatsink with two diodes

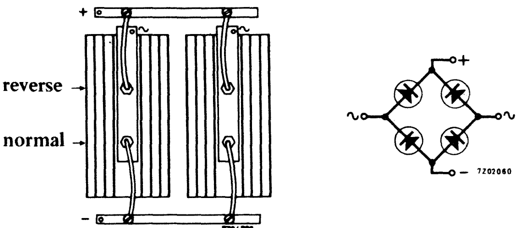


Fig. 5 Single phase full wave rectifier with diodes of different polarity on extruded aluminium heatsinks

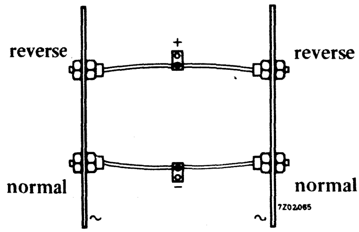


Fig. 6 Single phase full wave rectifier with diodes of different polarity on plain cooling fins (top view)

CONSTRUCTIONS (continued)

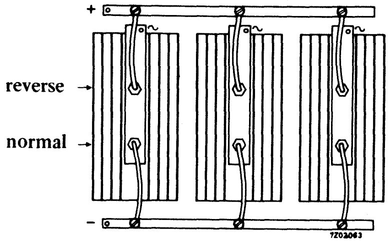
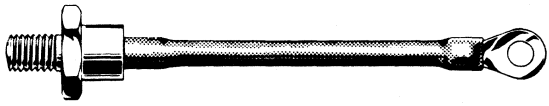


Fig. 7 Three phase full wave rectifier with diodes of different polarity on extruded aluminium heatsinks

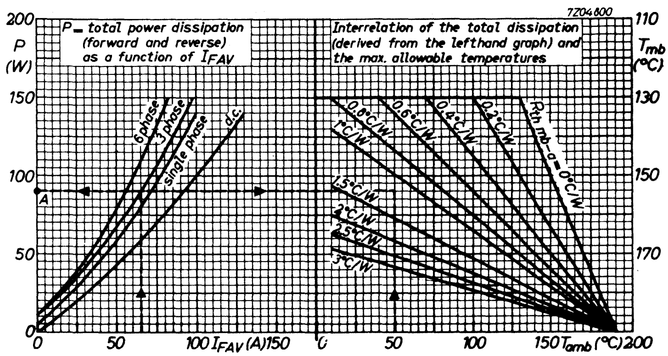
EXAMPLES OF HEATSINK CALCULATION

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 $R_{th\,mb\text{-}a} \approx$ 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 bright	– –	125 cm²; 2 m/s or 300 cm²; 1 m/s 175 cm²; 2 m/s
diecast 56280	applicable	
extrusion 56230 bright blackened 56231 bright blackened	 ℓ = 12 cm ℓ = 8 cm ℓ = 7 cm ℓ = 5 cm [1]	 ℓ = 5 cm [1]; 1 m/s ℓ = 5 cm [1]; 1 m/s

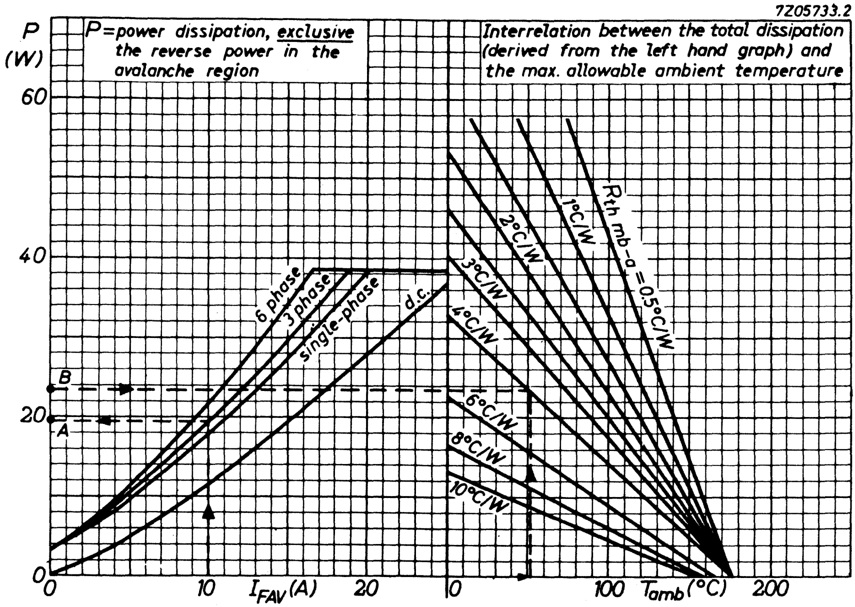
[1]) Practical minimum length

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 $\delta = \frac{40\ \mu s}{20\ ms} = 0,002$.

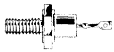
Thus $P_{R(AV)}$ = 0,002 x 2 kW = 4 W.

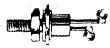
Therefore the total device power dissipation P_{tot} = 19,5 + 4 = 23,5 W (point B). From the righthand graph it follows that $R_{th\ mb\text{-}a}$ = 4 °C/W. Hence the heatsink thermal resistance should be:

$$R_{th\ h\text{-}a} = R_{th\ mb\text{-}a} - R_{th\ mb\text{-}h} = (4 - 0,5)\ ^{\circ}C/W = 3,5\ ^{\circ}C/W.$$

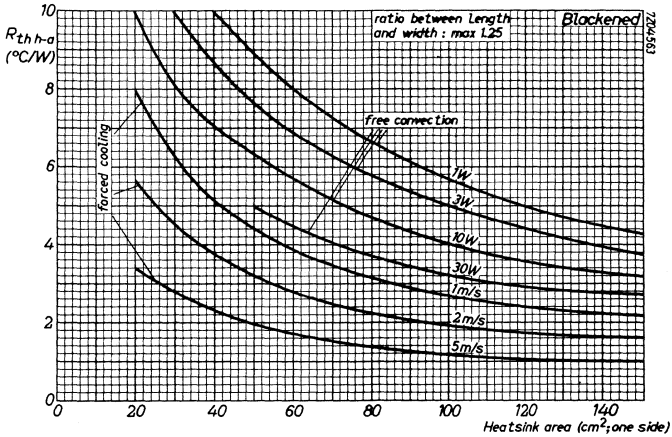
A table of applicable heatsinks, similar to that on the foregoing page, can de derived for this case.

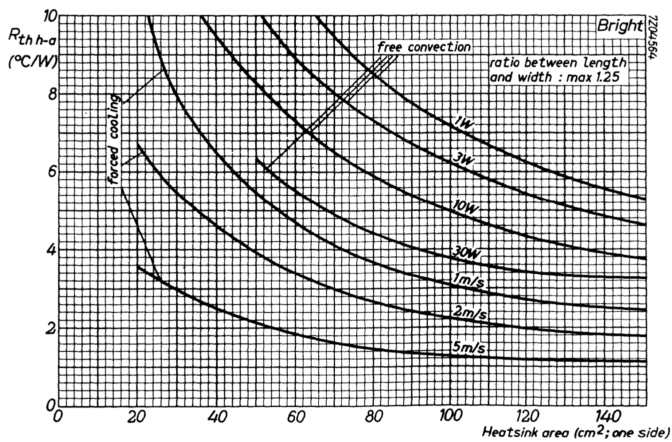
Thermal resistance of flat heatsinks of 2 mm copper or 3 mm aluminium.
The graphs are valid for the combination of device and heatsink.



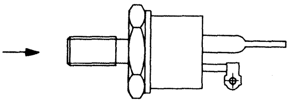


Studs: 10-32UNF
Mounting bases, across the flats: max. 11,0 mm

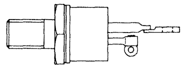




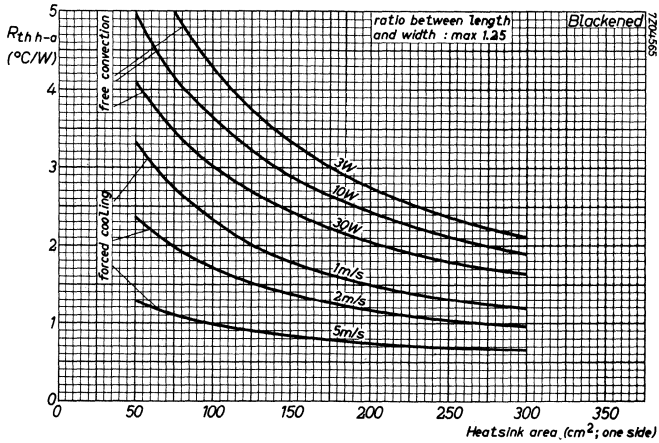
Thermal resistance of flat heatsinks of 2 mm copper or 3 mm aluminium.
The graphs are valid for the combination of device and heatsink.

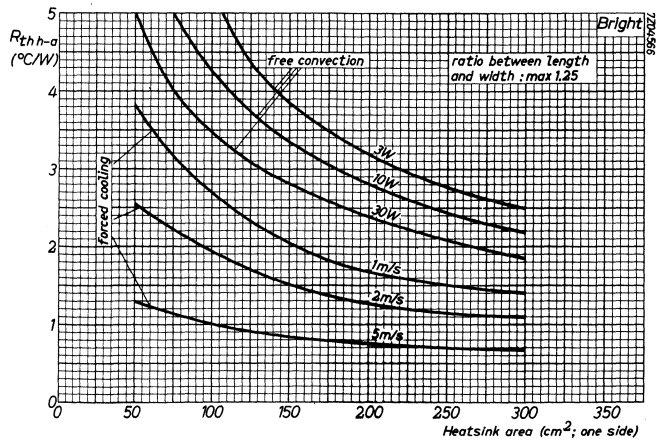


Stud: ¼" x 28 UNF
Mounting base, across the flats: max. 17 mm



Stud: M6
Stud: ¼" x 28 UNF
Mounting base, across the flats: max. 14,0 mm





RECTIFIER DIODES

SILICON RECTIFIER DIODES

Glass-passivated double-diffused rectifier diodes in TO-220 plastic envelopes, intended for power rectifier applications.
The series consists of the following types:
Normal polarity (cathode to base plate): BY249–300 and BY249–600.
Reverse polarity (anode to base plate): BY249–300R and BY249–600R.

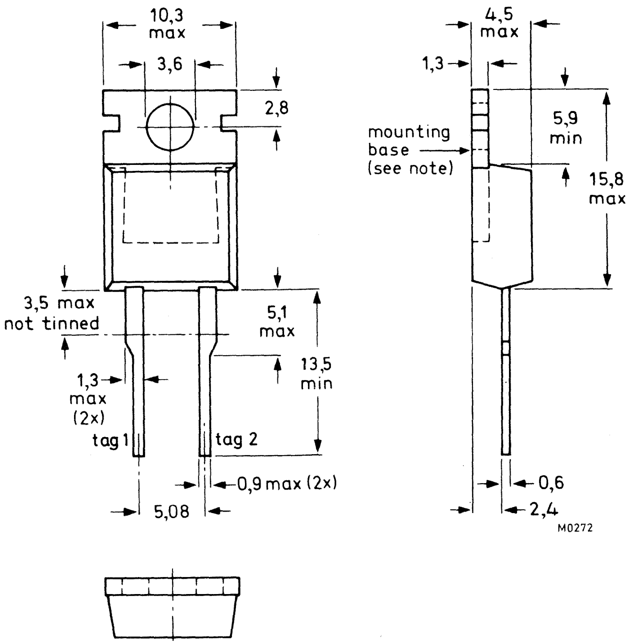
QUICK REFERENCE DATA

			BY249–300(R)	600(R)	
Repetitive peak reverse voltage	V_{RRM}	max.	300	600	V
Average forward current	$I_{F(AV)}$	max.	6.5		A
Non-repetitive peak forward current	I_{FSM}	max.	60		A

MECHANICAL DATA (see next page for polarity of connections)

Dimensions in mm

Fig. 1 TO-220AC



Note: The exposed metal mounting base is directly connected to tag 1.

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

MECHANICAL DATA (continued)

Polarity of connections:

	BY249–300 BY249–600	BY249–300R BY249–600R
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*			BY249–300(R)	600(R)	
Non-repetitive peak reverse voltage	V_{RSM}	max.	300	600	V
Repetitive peak reverse voltage	V_{RRM}	max.	300	600	V
Crest working reverse voltage	V_{RWM}	max.	200	400	V
Continuous reverse voltage	V_R	max.	200	400	V

Currents				
Average forward current;				
sinusoidal; up to T_{mb} = 110 °C	$I_{F(AV)}$	max.	6.5	A
sinusoidal; at T_{mb} = 125 °C	$I_{F(AV)}$	max.	4.0	A
R.M.S. forward current	$I_{F(RMS)}$	max.	9.5	A
Repetitive peak forward current; t = 10 ms; half sine-wave	I_{FRM}	max.	60	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.	60	A
I^2t for fusing; t = 10 ms	I^2t	max.	18	A^2s
Temperatures				
Storage temperature	T_{stg}		−40 to +150	°C
Junction temperature	T_j	max.	150	°C

CHARACTERISTICS

Forward voltage				
I_F = 20 A; T_j = 25 °C	V_F	<	1.6	V**
I_F = 5 A; T_j = 100 °C	V_F	<	1.05	V**
Reverse current				
$V_R = V_{RWMmax}$; T_j = 125 °C	I_R	<	0.4	mA

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

**Measured under pulse conditions to avoid excessive dissipation.

THERMAL RESISTANCE

From junction to mounting base — $R_{th\ j\text{-}mb} = 4.2\ ^{o}C/W$

Transient thermal impedance; t = 1 ms — $Z_{th\ j\text{-}mb} = 0.46\ ^{o}C/W$

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 maximum 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 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.

$$R_{th\ j\text{-}a} = 60\ ^{o}C/W$$

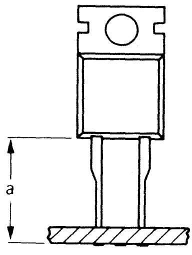


Fig. 2

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 ^{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 1, 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. 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.

SINUSOIDAL OPERATION

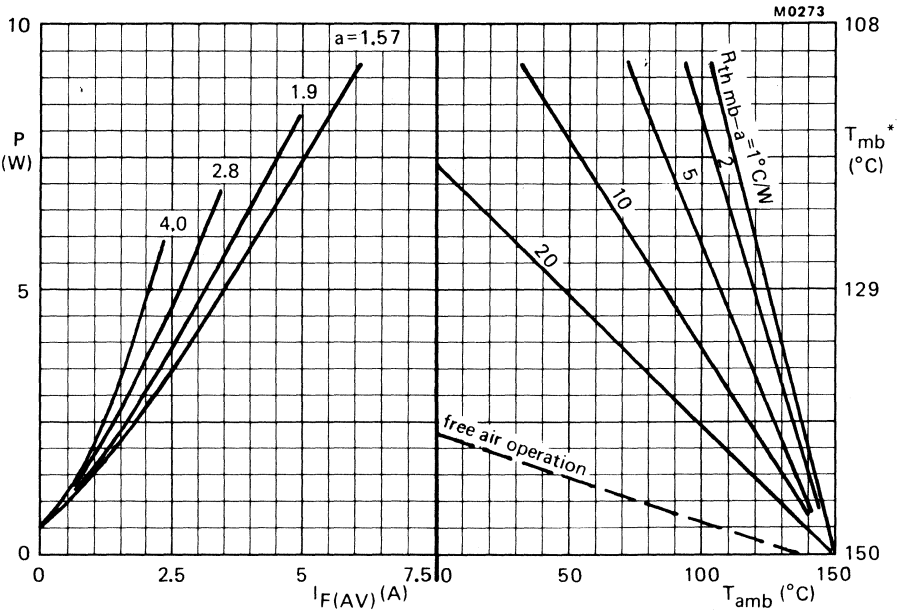


Fig. 3 The right-hand part shows the interrelationship between the power (derived from the left-hand part) and the maximum permissible temperatures.
a = form factor = $I_{F(RMS)}/I_{F(AV)}$.

*T_{mb} scale is for comparison purposes and is correct only for $R_{th\ mb\text{-}a}$ < 19.3 °C/W.

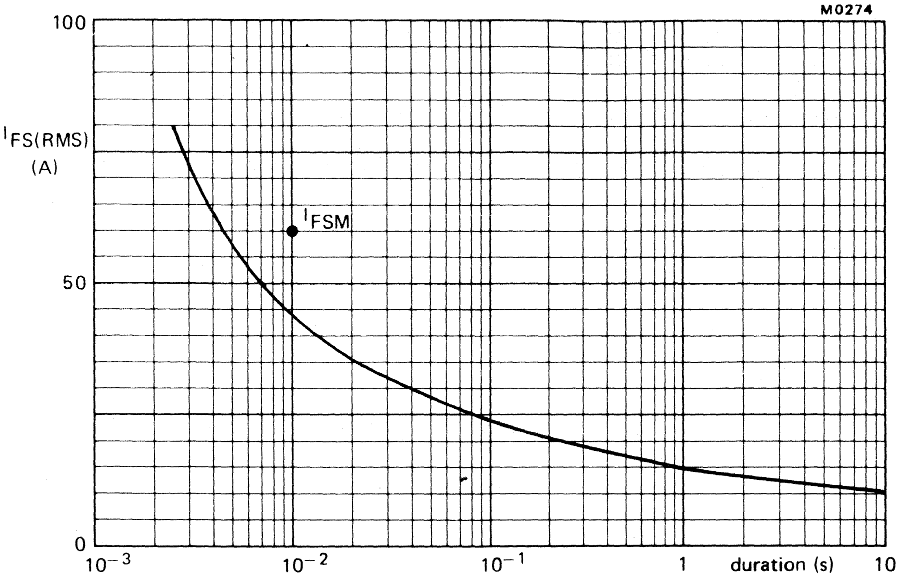
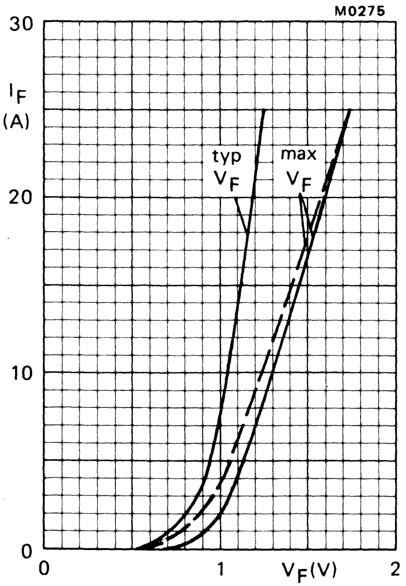


Fig. 4 Maximum permissible non-repetitive r.m.s. forward current based on sinusoidal currents (f = 50 Hz); T_j = 150 °C prior to surge.



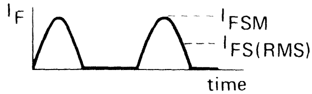


Fig. 5 ——T_j = 25 °C; – – – T_j = 100 °C

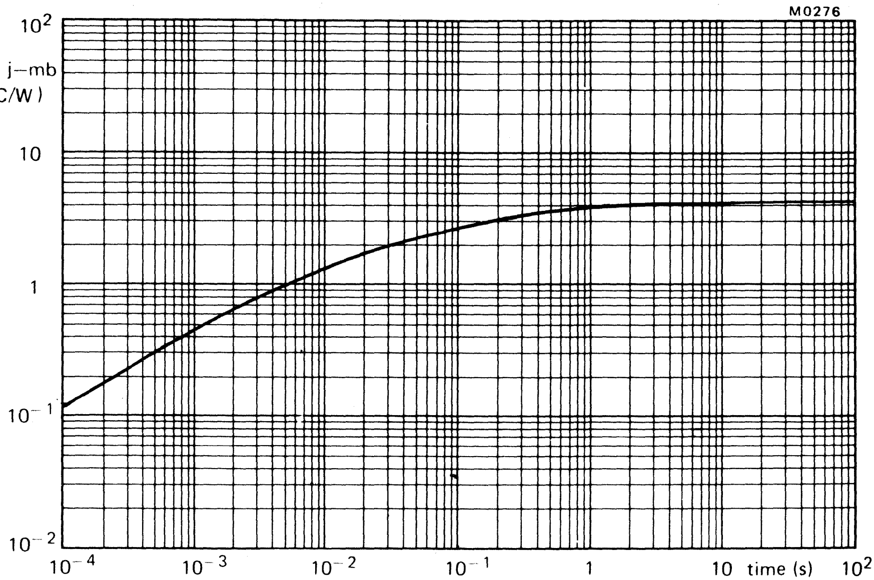


Fig. 6

CONTROLLED AVALANCHE RECTIFIER DIODES

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.

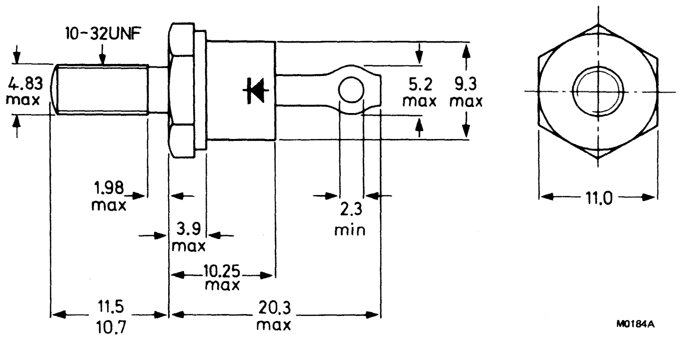
QUICK REFERENCE DATA

			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:
see ACCESSORIES section

Supplied with device: 1 nut, 1 lock washer.

Nut dimensions across the flats: 9.5 mm

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

The mark shown applies to to the normal polarity types.

Products approved to CECC 50 009–022 available on request.

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	$^oC/W$
From junction to mounting base	$R_{th\ j\text{-}mb}$	=	1.3	$^oC/W$
From mounting base to heatsink	$R_{th\ mb\text{-}h}$	=	0.5	$^oC/W$

CHARACTERISTICS

			BYX25–600(R)	800(R)	1000(R)	1200(R)	1400(R)	
Forward voltage $I_F = 50$ A; $T_j = 25\ ^oC$	V_F	<	1.8	1.8	1.8	1.8	1.8	V*
Reverse avalanche breakdown voltage $I_R = 5$ mA; $T_j = 25\ ^oC$	$V_{(BR)R}$	>	750	1000	1250	1450	1650	V
		<	2400	2400	2400	2400	2400	V
Peak reverse current $V_R = V_{RWMmax}$; $T_j = 125\ ^oC$	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 p.43 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 Fig.3).

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

$$R_{th\ mb\text{-}a} \approx 4\ °C/W$$

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

Hence the heatsink thermal resistance should be:

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

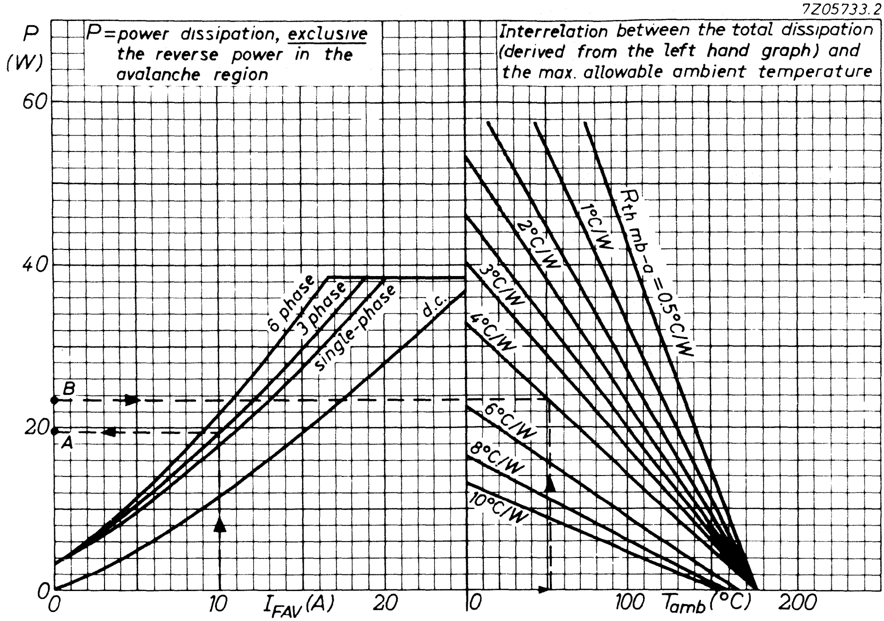

7Z05733.2
P
(W)
P = power dissipation, exclusive the reverse power in the avalanche region
Interrelation between the total dissipation (derived from the left hand graph) and the max. allowable ambient temperature
60
40
20
0
6 phase
3 phase
single-phase
d.c.
B
A
$R_{th\ mb-a}$ = 0,5°C/W
1°C/W
2°C/W
3°C/W
4°C/W
6°C/W
8°C/W
10°C/W
0
10
I_{FAV} (A)
20
0
100
T_{amb} (°C)
200

Fig.2

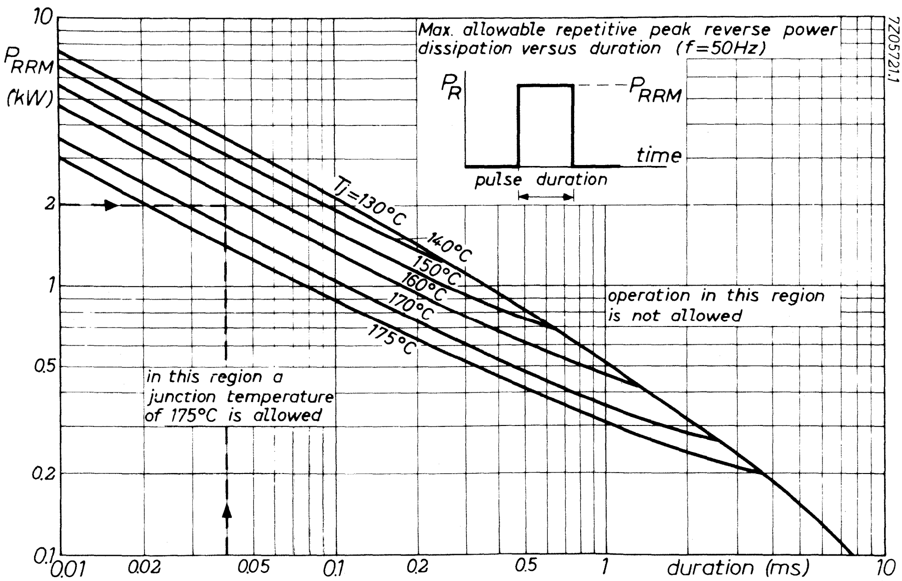

7Z05721.1
10
P_{RRM}
(kW)
2
1
0,5
0,2
0,1
Max. allowable repetitive peak reverse power dissipation versus duration (f = 50Hz)
P_R
P_{RRM}
time
pulse duration
Tj = 130°C
140°C
150°C
160°C
170°C
175°C
operation in this region is not allowed
in this region a junction temperature of 175°C is allowed
0,01
0,02
0,05
0,1
0,2
0,5
1
duration (ms)
10

Fig.3

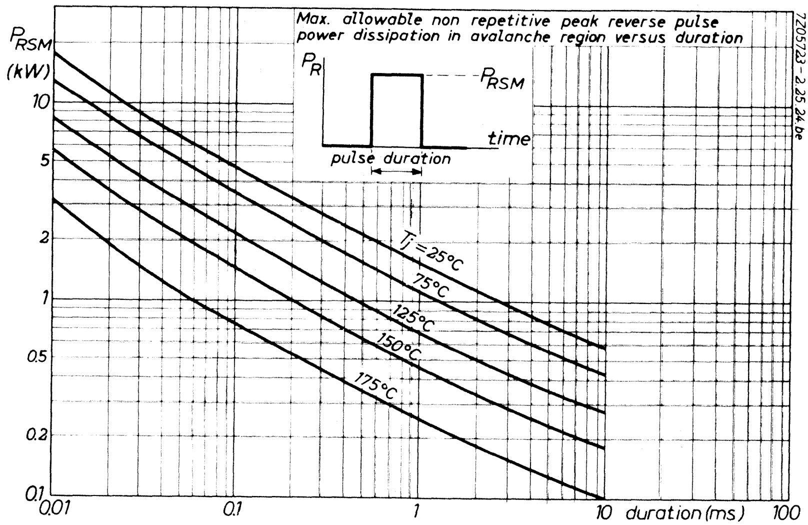

Max. allowable non repetitive peak reverse pulse power dissipation in avalanche region versus duration
P_{RSM} (kW)
P_R
P_{RSM}
time
pulse duration
T_j = 25°C
75°C
125°C
150°C
175°C
10
5
2
1
0.5
0.2
0.1
0.01
0.1
1
10
duration (ms)
100
7Z05723-2.25.24.be

Fig.4

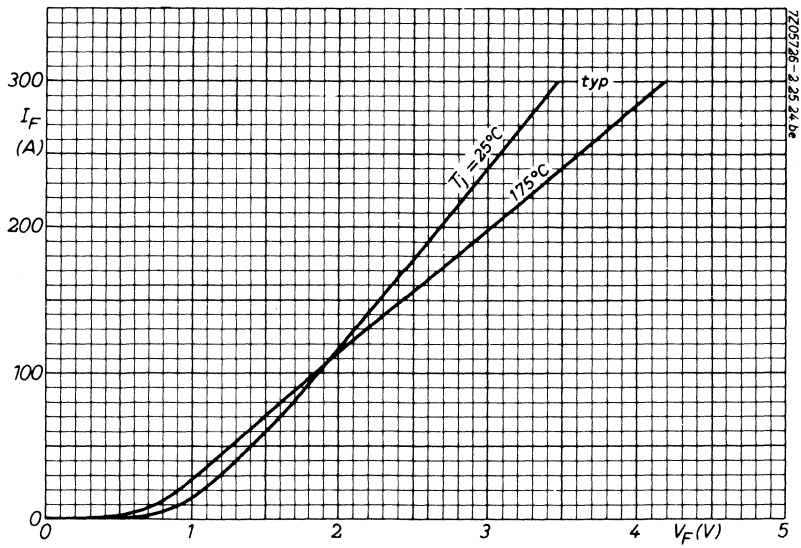

300
I_F (A)
200
100
0
typ
T_j = 25°C
175°C
0
1
2
3
4
V_F (V)
5
7Z05726-2.25.24.be

Fig.5

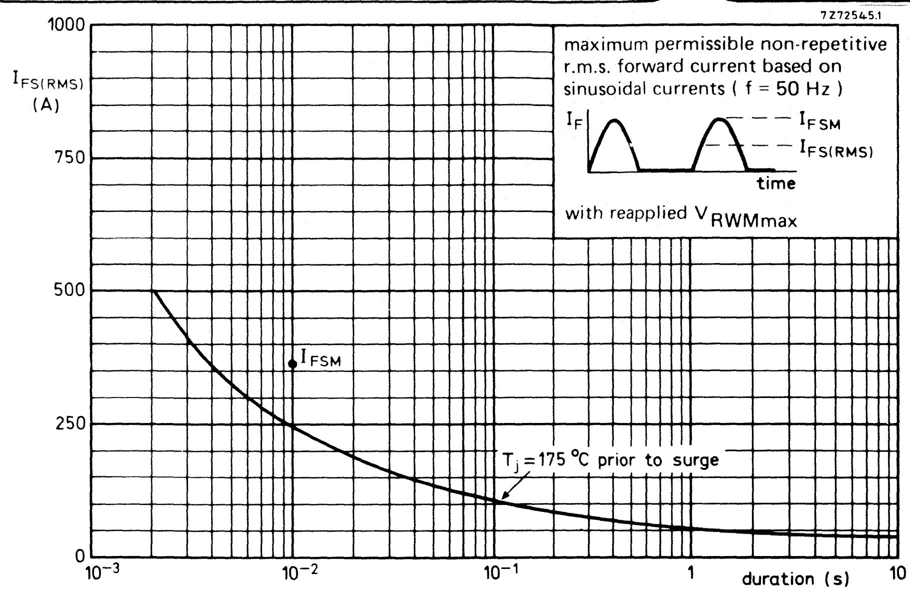

7Z72545.1
1000
$I_{FS(RMS)}$
(A)
750
500
250
0
10^{-3}
10^{-2}
10^{-1}
1
duration (s)
10
maximum permissible non-repetitive
r.m.s. forward current based on
sinusoidal currents (f = 50 Hz)
I_F
I_{FSM}
$I_{FS(RMS)}$
time
with reapplied V_{RWMmax}
I_{FSM}
$T_j = 175\ ^\circ C$ prior to surge

Fig.6

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

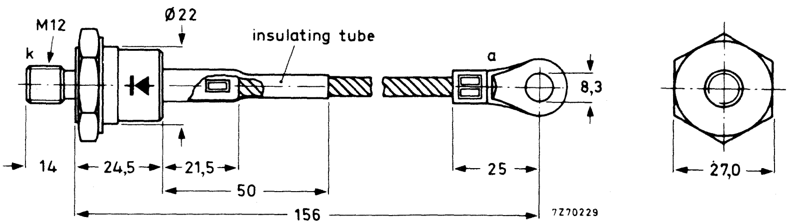
QUICK REFERENCE DATA

			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 ≤ 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

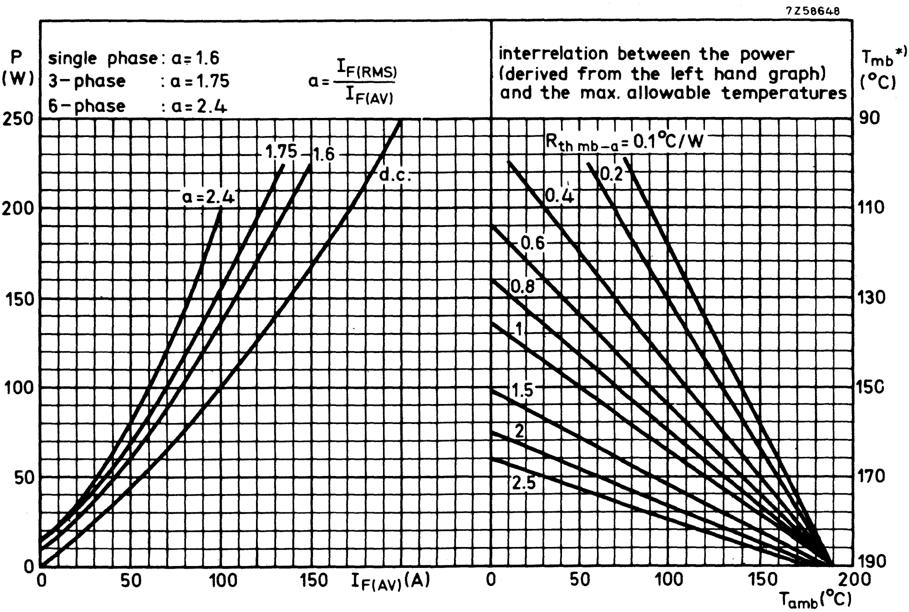
THERMAL RESISTANCE

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

1) **To ensure thermal stability: $R_{th\ j-a}$ < 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** 49.
For continuous reverse voltage: $R_{th\ j-a}$ = 1 °C/W, then T_{jmax} = 184 °C
$R_{th\ j-a}$ = 1.2 °C/W, then T_{jmax} = 180 °C
$R_{th\ j-a}$ = 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

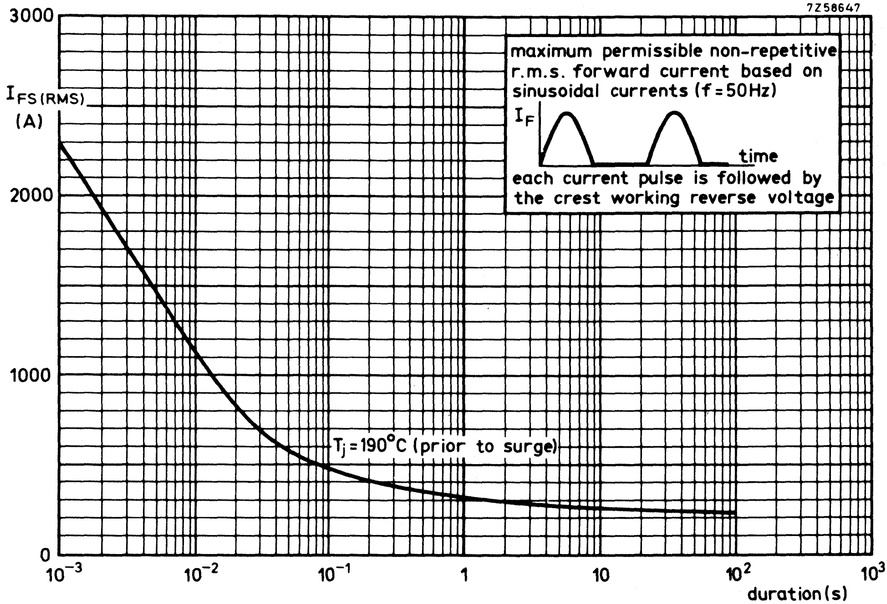


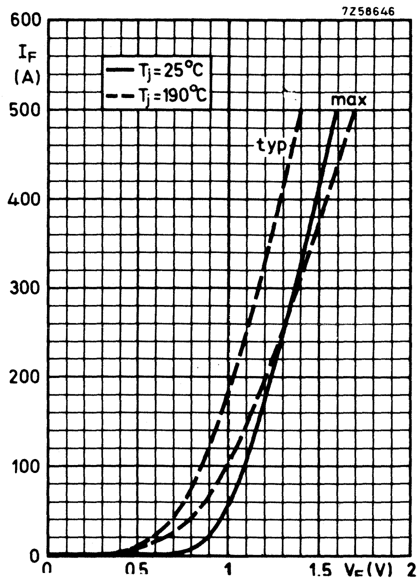
*) T_{mb}-scale is for comparison purposes only and is correct only for $R_{th\ mb-a} \leq 1.1$ °C/W

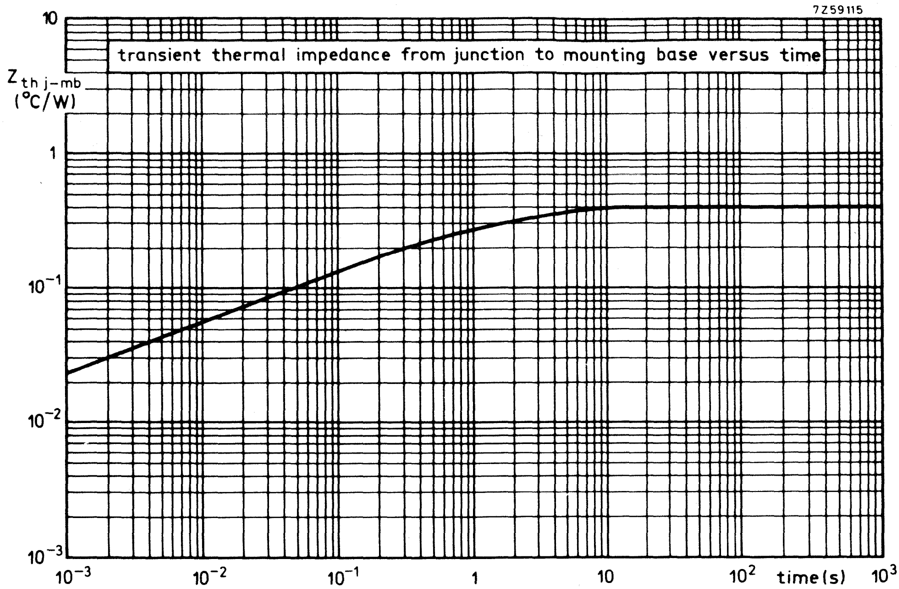
APPLICATION INFORMATION AND OPERATING NOTES

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
500
400
300
200
100
0
I_F
(A)
T_j = 25°C
T_j = 190°C
typ
max
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
10^2
time (s)
10^3

SILICON 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): BYX38-300 to 1200.
Reverse polarity (anode to stud): BYX38-300R to 1200R.

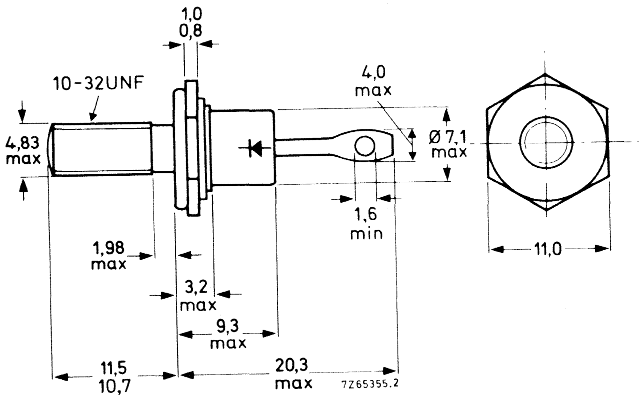
QUICK REFERENCE DATA

			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:
see ACCESSORIES section

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
The mark shown applies to normal polarity types.

Products approved to CECC 50 009-019 available on request.

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	$R_{th\ j\text{-}a}$	=	50	°C/W
From junction to mounting base	$R_{th\ j\text{-}mb}$	=	4	°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]

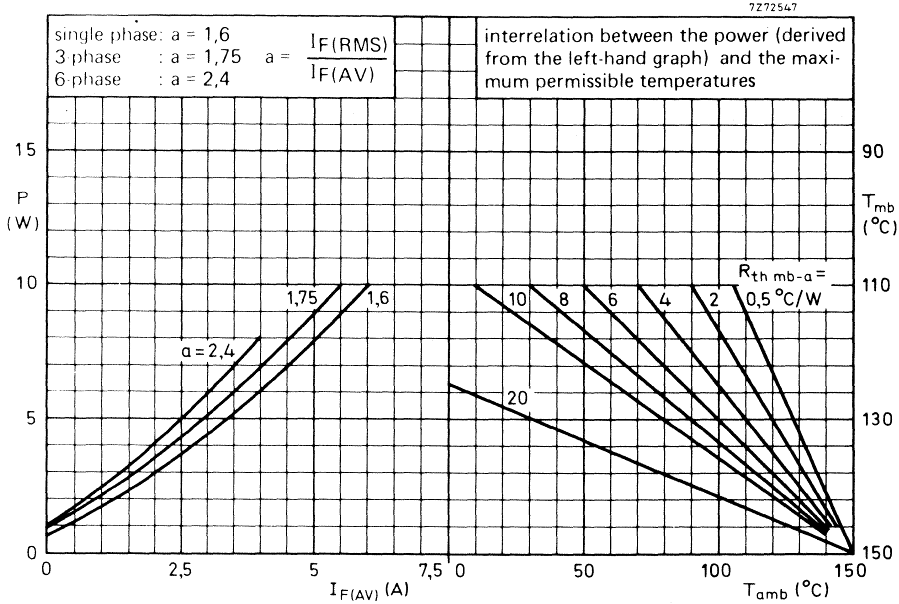
Reverse current

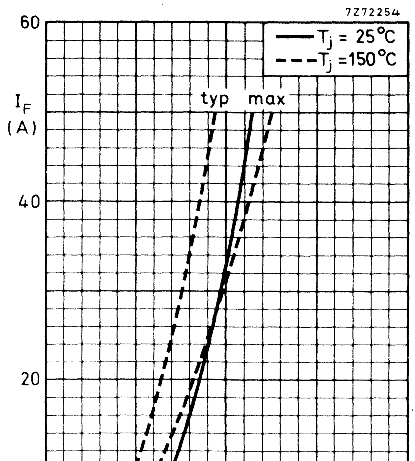
$V_R = V_{RWMmax}$; $T_j = 125$ °C	I_R	<	200	µA

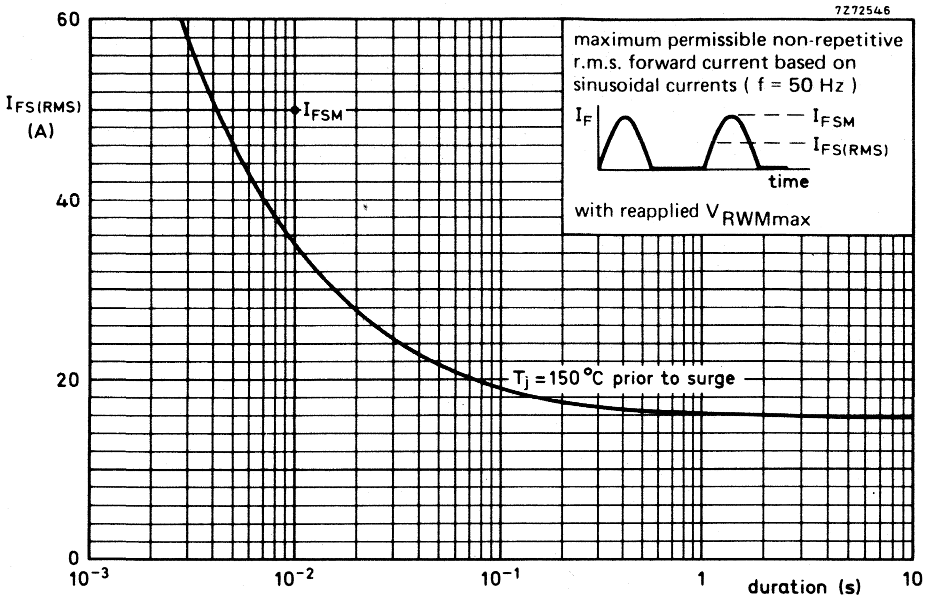
OPERATING NOTES

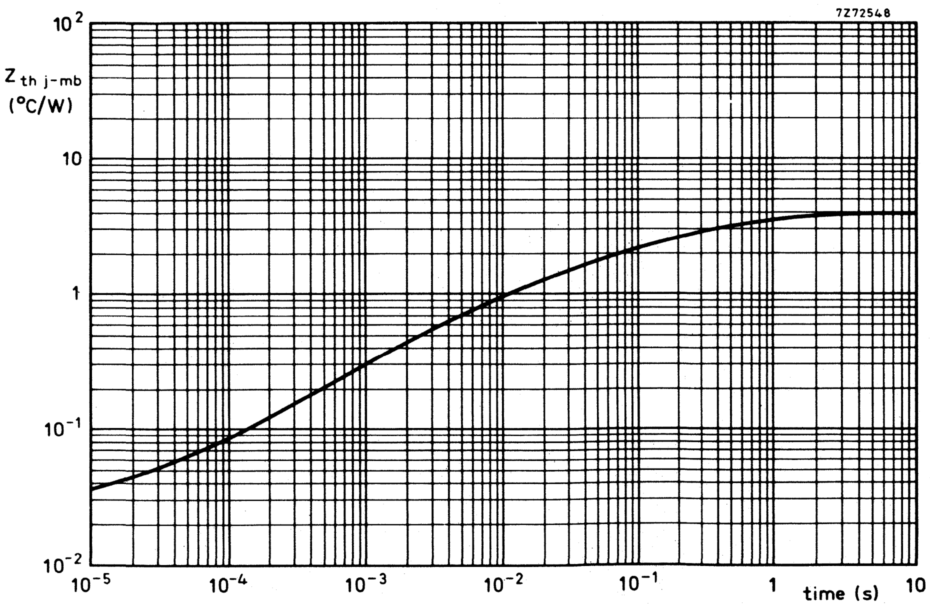
1. The top connector should neither be bent nor twisted; it should be soldered into the circuit so that there is no strain on it.
   During soldering the heat conduction to the junction should be kept to a minimum.
2. Where there is a possibility that transients, due to the energy stored in the transformer,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

[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
a = 2,4
1,75
1,6
0
2,5
5
7,5
IF(AV) (A)
0
50
100
150
Tamb (°C)
Rth mb-a = 0,5 °C/W
10
8
6
4
2
20
Tmb (°C)
90
110
130
150


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


7Z72546
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_{RWMmax}
$T_j = 150\,^{\circ}C$ prior to surge
10^{-3}
10^{-2}
10^{-1}
1
duration (s)
10


7Z72548
10^2
$Z_{th\ j\text{-}mb}$
(°C/W)
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

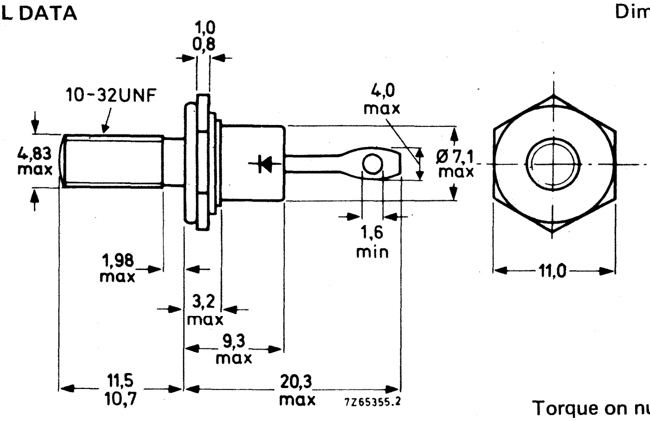
			BYX39–600(R)	800(R)	1000(R)	1200(R)	1400(R)	
Crest working reverse voltage	V_{RWM}	max.	600	800	1000	1200	1400	V
Reverse avalanche breakdown voltage	$V_{(BR)R}$	>	750	1000	1250	1450	1650	V

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:
see ACCESSORIES section

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.

The mark shown applies to normal polarity types.

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	°C/W
From junction to mounting base	$R_{th\ j\text{-}mb}$	=	4.5	°C/W
From mounting base to heatsink				
without heatsink compound	$R_{th\ mb\text{-}h}$	=	1.0	°C/W
with heatsink compound	$R_{th\ mb\text{-}h}$	=	0.5	°C/W
with mica washer	$R_{th\ mb\text{-}h}$	=	2.0	°C/W
Transient thermal impedance; t = 1 ms	$Z_{th\ j\text{-}mb}$	=	0.35	°C/W

CHARACTERISTICS

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

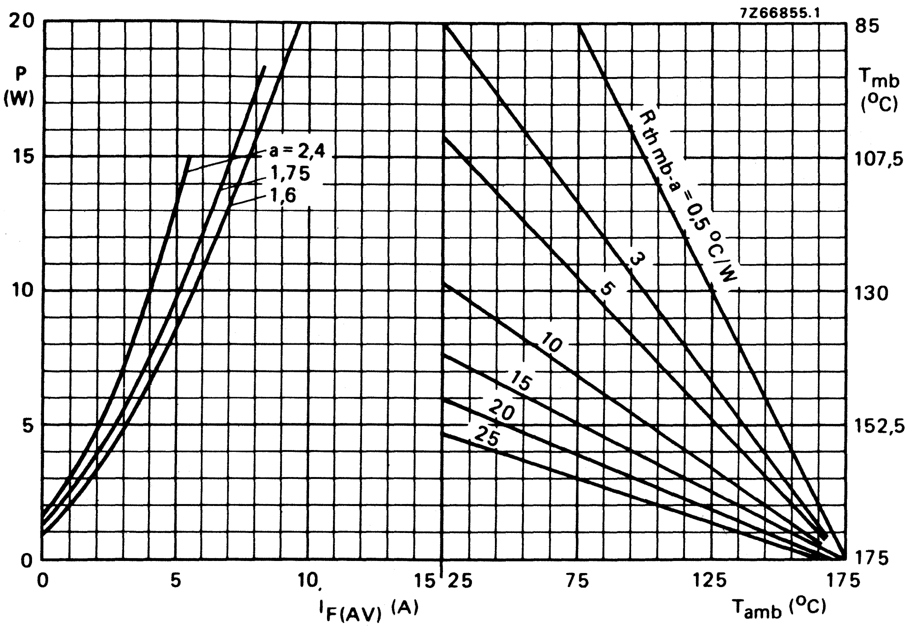


Fig.2

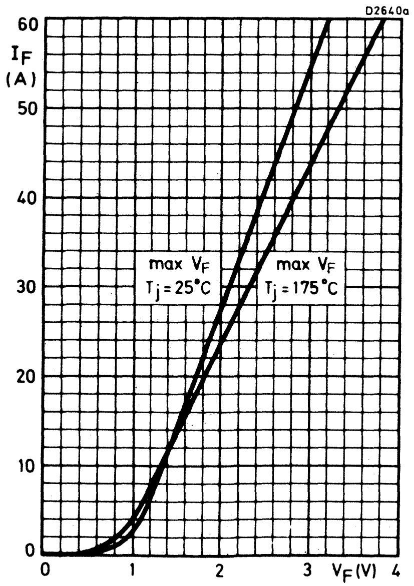


Fig.3

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

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

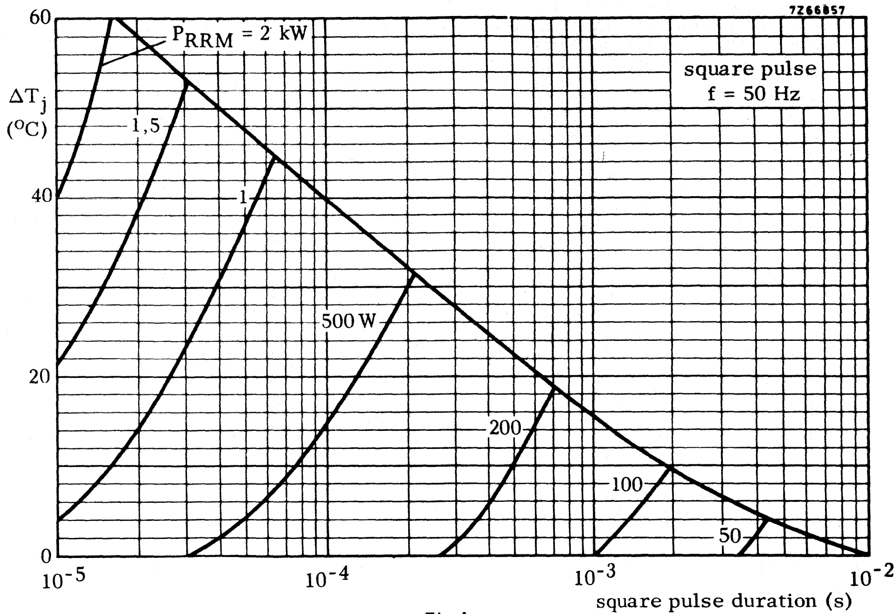

7Z66857
60
40
20
0
ΔT_j
(°C)
P_{RRM} = 2 kW
1,5
1
500 W
200
100
50
square pulse
f = 50 Hz
10^{-5}
10^{-4}
10^{-3}
10^{-2}
square pulse duration (s)

Fig.4

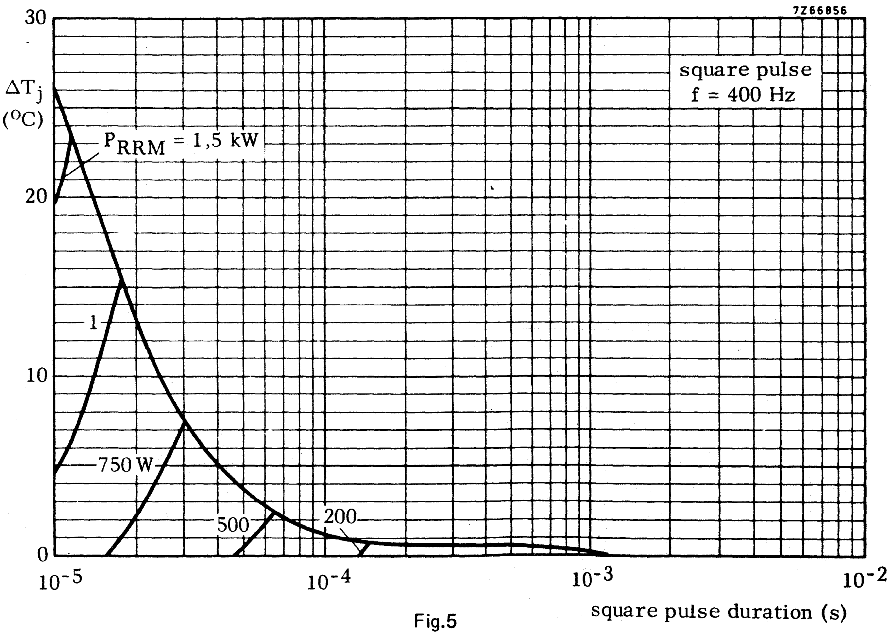

7Z66856
30
20
10
0
ΔT_j
(°C)
P_{RRM} = 1,5 kW
1
750 W
500
200
square pulse
f = 400 Hz
10^{-5}
10^{-4}
10^{-3}
10^{-2}
square pulse duration (s)

Fig.5

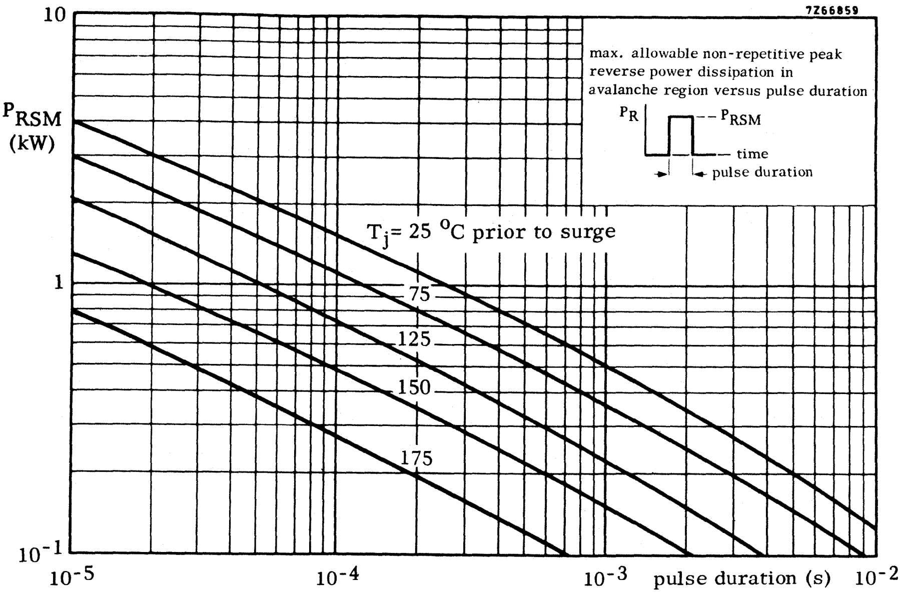

7Z66859
max. allowable non-repetitive peak reverse power dissipation in avalanche region versus pulse duration
P_R
P_RSM
time
pulse duration
T_j = 25 °C prior to surge
75
125
150
175
P_{RSM} (kW)
10
1
10^{-1}
10^{-5}
10^{-4}
10^{-3}
pulse duration (s)
10^{-2}

Fig.6

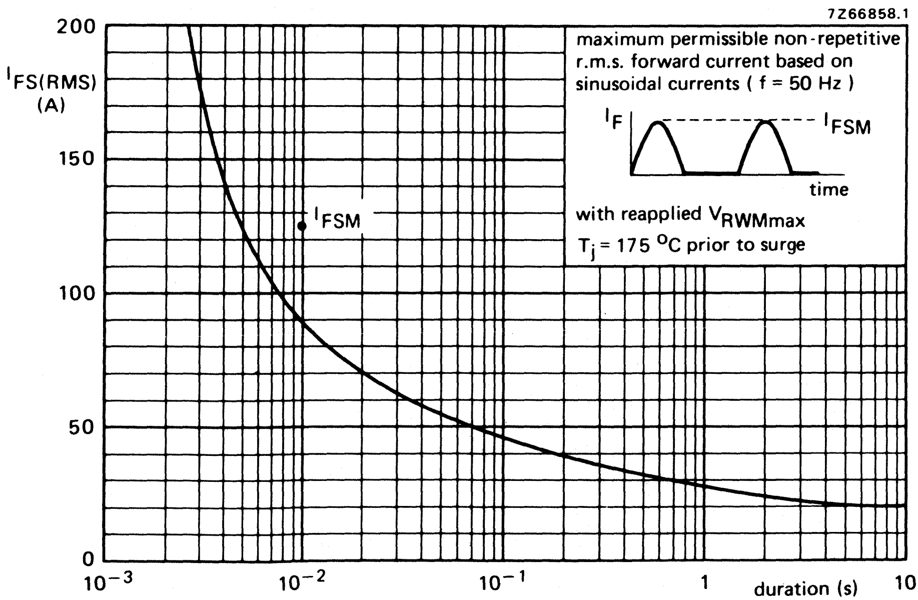

7Z66858.1
maximum permissible non-repetitive r.m.s. forward current based on sinusoidal currents (f = 50 Hz)
I_F
I_FSM
time
with reapplied V_{RWMmax}
T_j = 175 °C prior to surge
I_FSM
$I_{FS(RMS)}$ (A)
200
150
100
50
0
10^{-3}
10^{-2}
10^{-1}
1
duration (s)
10

Fig.7

SILICON RECTIFIER DIODES

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.

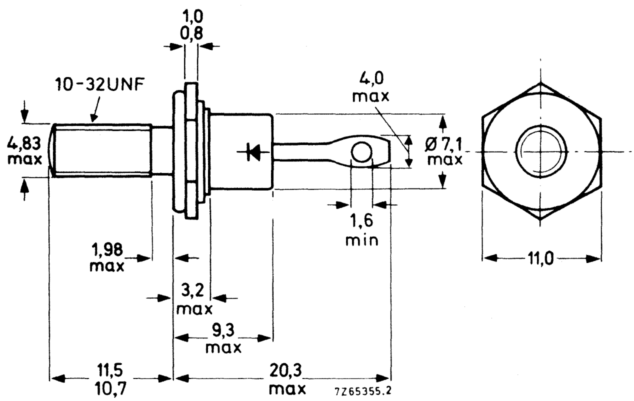
QUICK REFERENCE DATA

			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:
see ACCESSORIES section

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 accross the flats: 9,5 mm

The mark shown applies to normal polarity types.

Products approved to CECC 50 009-020 available on request.

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 ($t \le 10$ ms)	V_{RSM}	max.	300	600	1200	V
Repetitive peak reverse voltage ($\delta \le 0,01$)	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	$R_{th\ j-a}$	=	50	°C/W
From junction to mounting base	$R_{th\ j-mb}$	=	3	°C/W
From mounting base to heatsink	$R_{th\ mb-h}$	=	0,5	°C/W

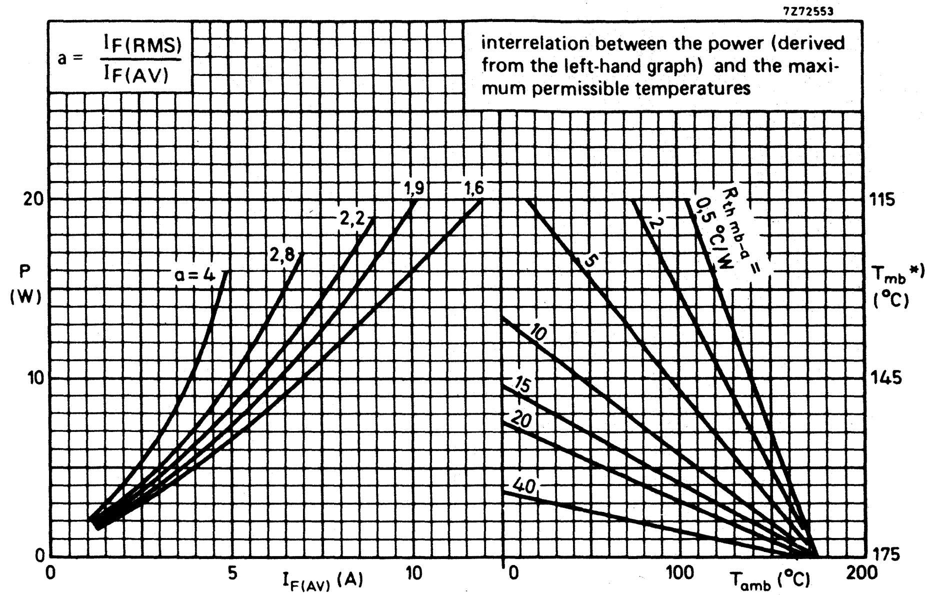
CHARACTERISTICS

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

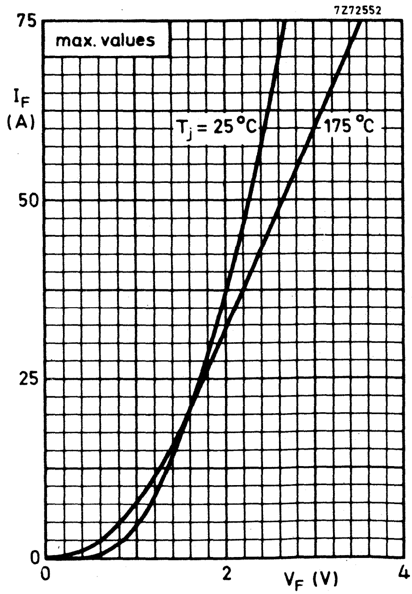
MOUNTING INSTRUCTIONS

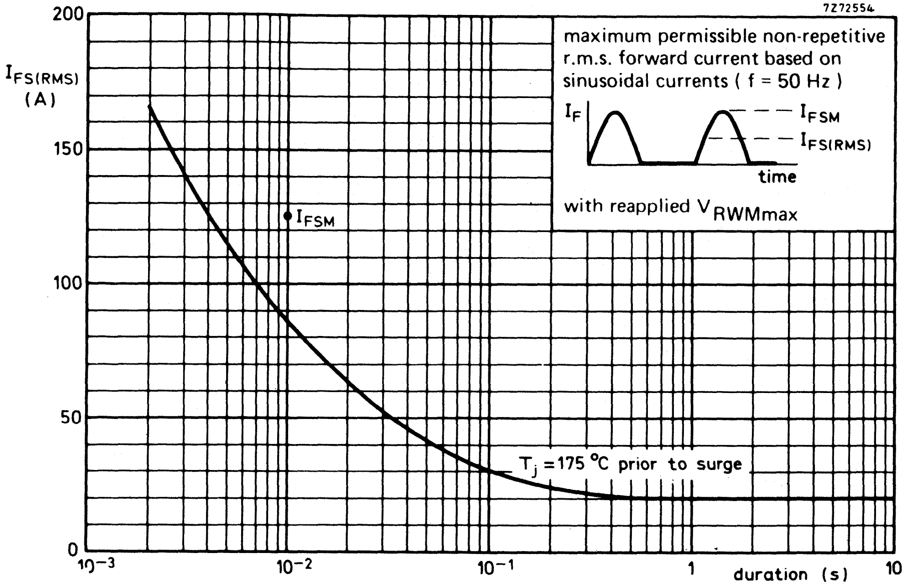
The top connector should neither be bent nor twisted; it should be soldered into the circuit so that there is no strain on it.
During soldering the heat conduction to the junction should be kept to a minimum.

[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
200
150
100
50
0
$I_{FS(RMS)}$ (A)
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 °C prior to surge
10^{-3}
10^{-2}
10^{-1}
1
duration (s)
10

RECTIFIER DIODES

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.

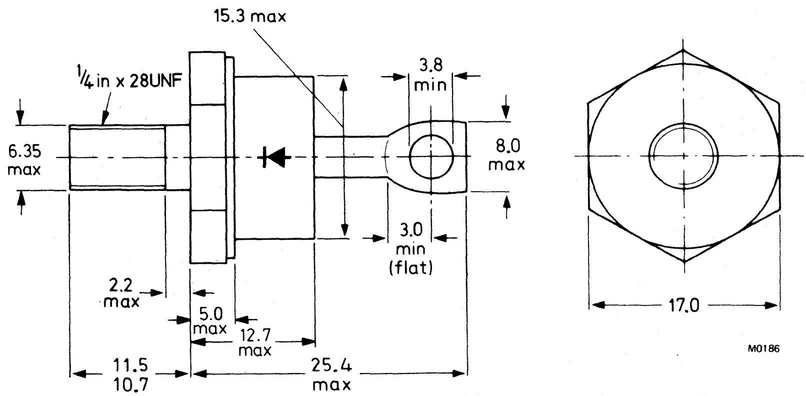
QUICK REFERENCE DATA

			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

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:
see ACCESSORIES section

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

Products approved to CECC 50 009-024 available on request.

RATINGS

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

Voltages

			BYX52–300(R)	600(R)	1200(R)	
Non-repetitive peak reverse voltage ($t \leqslant 10$ 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 $T_{mb} = 112$ °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-sinewave) $T_j = 175$ °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	°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

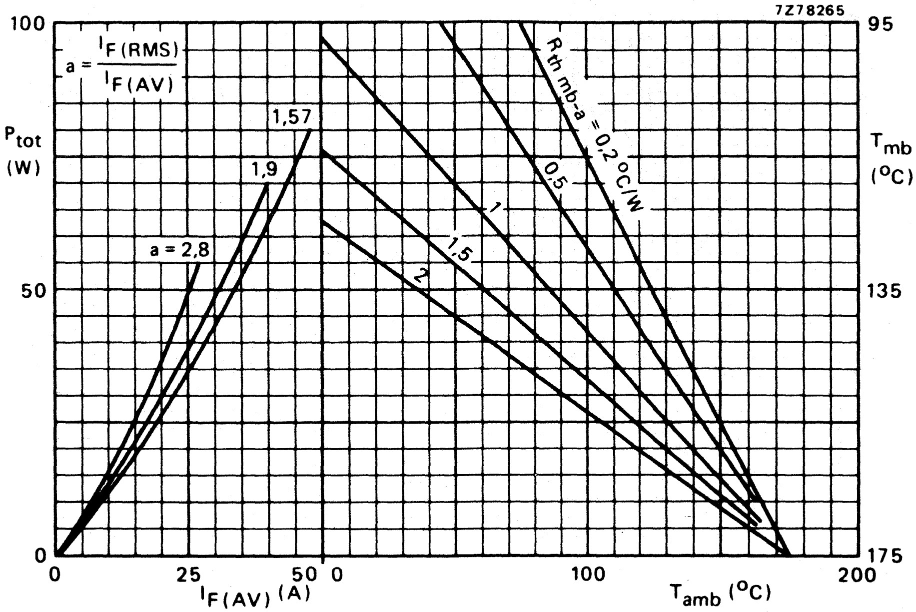
CHARACTERISTICS

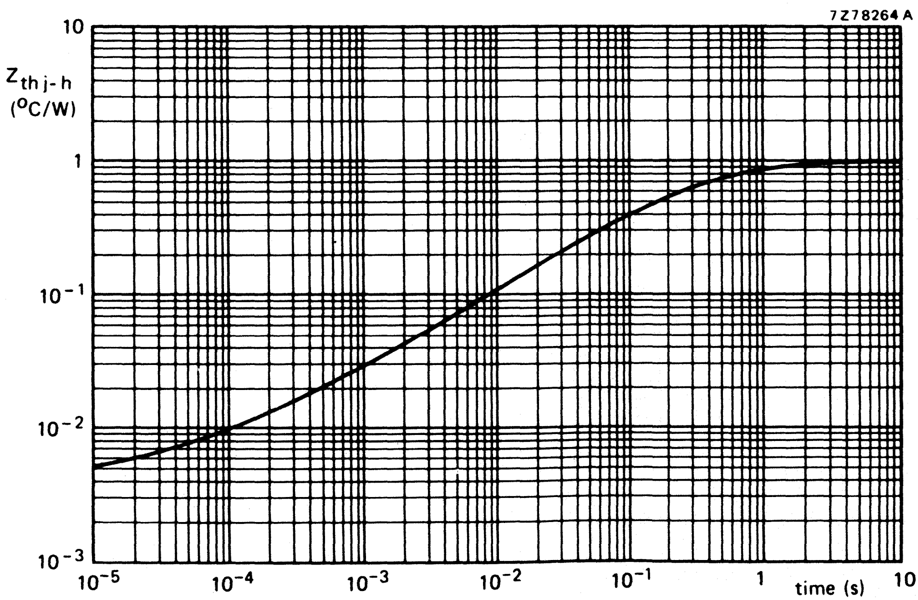
Forward voltage $I_F = 150$ A; $T_j = 25$ °C	V_F	<	1.8	V*
Reverse current $V_R = V_{RWM\ max}$; $T_j = 125$ °C	I_R	<	1.6	mA

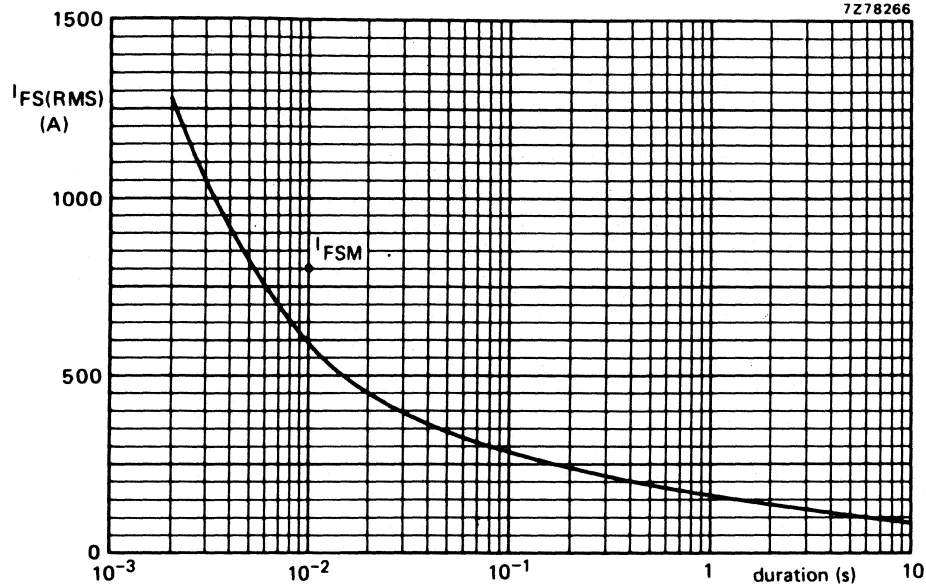
OPERATING NOTE

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

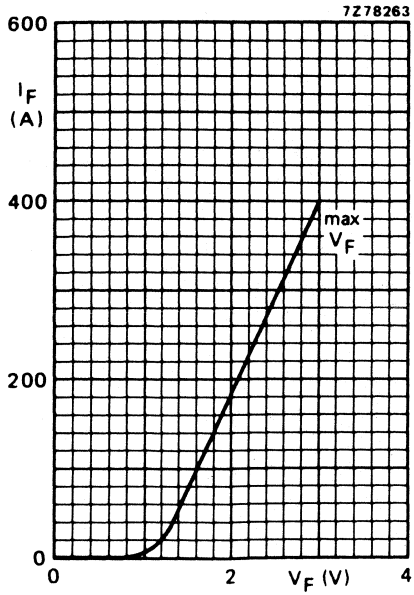
*Measured under pulse conditions to avoid excessive dissipation.

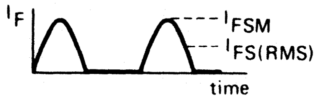

7Z78265
$a = \frac{I_{F(RMS)}}{I_{F(AV)}}$
P_{tot} (W)
100
50
0
a = 2,8
1,9
1,57
0
25
50
$I_{F(AV)}$ (A)
0
100
200
T_{amb} (°C)
$R_{th\ mb-a}$ = 0,2 °C/W
0,5
1
1,5
2
T_{mb} (°C)
95
135
175


7Z78264 A
$Z_{th\ j-h}$ (°C/W)
10
1
10^{-1}
10^{-2}
10^{-3}
10^{-5}
10^{-4}
10^{-3}
10^{-2}
10^{-1}
1
10
time (s)



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.

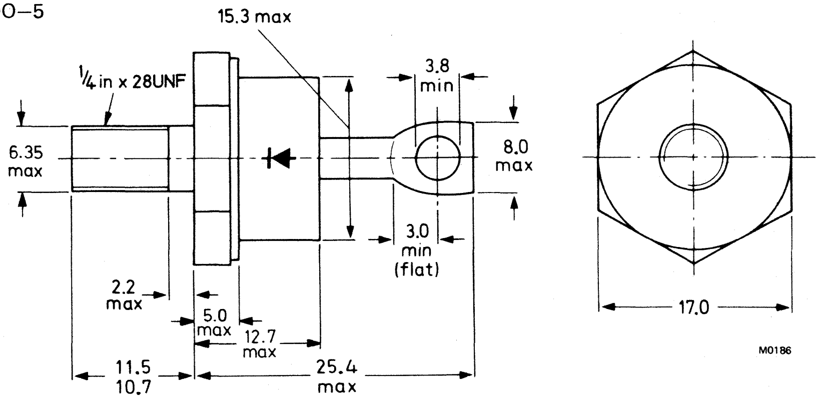
QUICK REFERENCE DATA

			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:
see ACCESSORIES section

Supplied with device: 1 nut, 1 lock washer.

Nut dimensions across the flats: 11.1 mm.

Products approved to CECC 50 009-023 available on request.

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

The mark shown applies to normal polarity types.

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
		<	2400	2400	2400	2400	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.

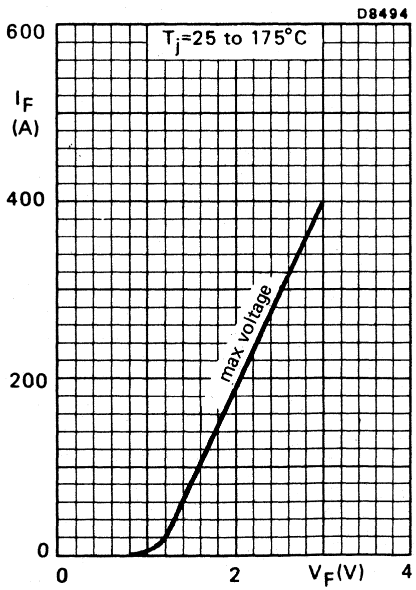


Fig.2

*Measured under pulsed conditions to avoid excessive dissipation.

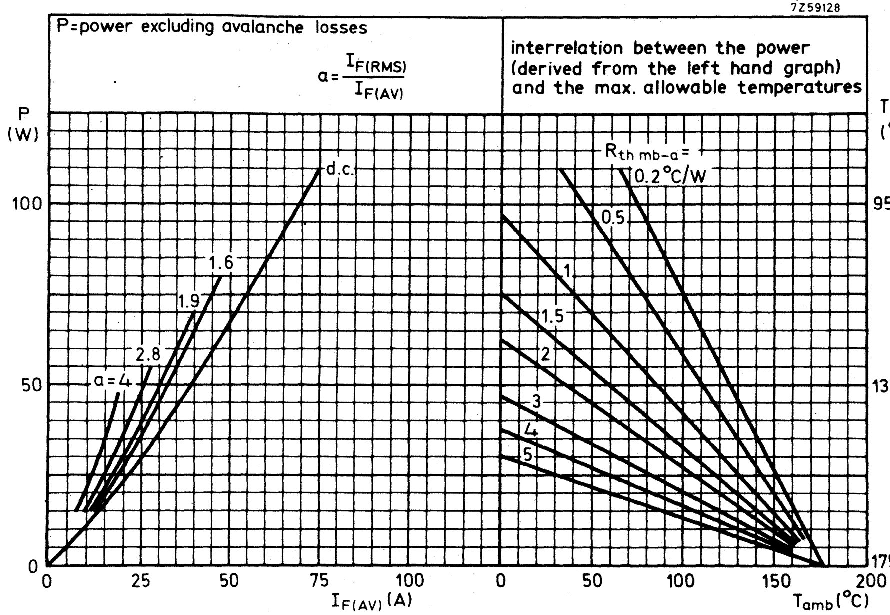

7Z59128
P=power excluding avalanche losses
$a = \frac{I_{F(RMS)}}{I_{F(AV)}}$
interrelation between the power (derived from the left hand graph) and the max. allowable temperatures
P (W)
T_{mb} (°C)
d.c.
1.6
1.9
2.8
a=4
$R_{th\ mb-a}$ = 0.2 °C/W
0.5
1
1.5
2
3
4
5
0
50
100
95
135
175
0
25
50
75
100
0
50
100
150
200
$I_{F(AV)}$ (A)
T_{amb} (°C)

Fig.3

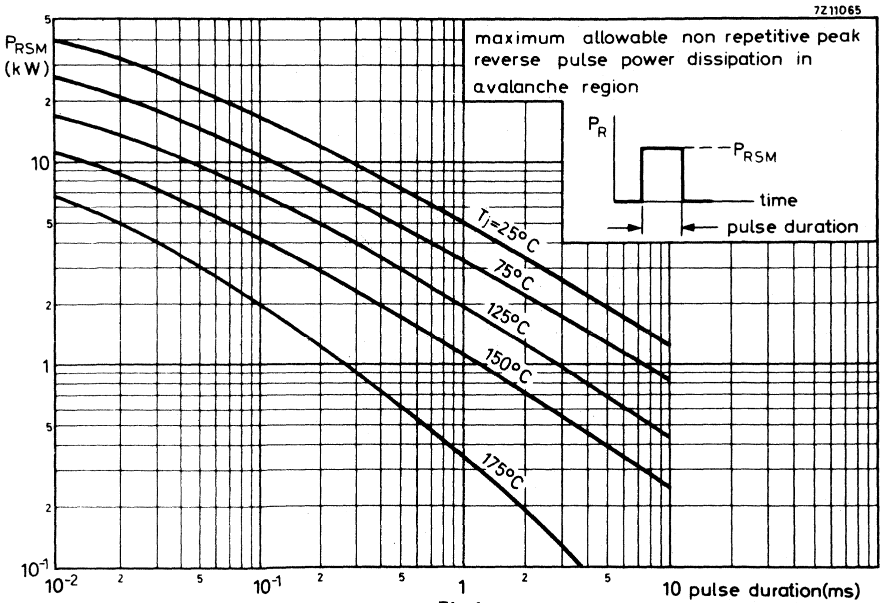

7Z11065
maximum allowable non repetitive peak reverse pulse power dissipation in avalanche region
P_{RSM} (kW)
P_R
P_{RSM}
time
pulse duration
T_j=25°C
75°C
125°C
150°C
175°C
10
1
10^{-1}
10^{-2}
10^{-1}
1
10 pulse duration(ms)

Fig.4

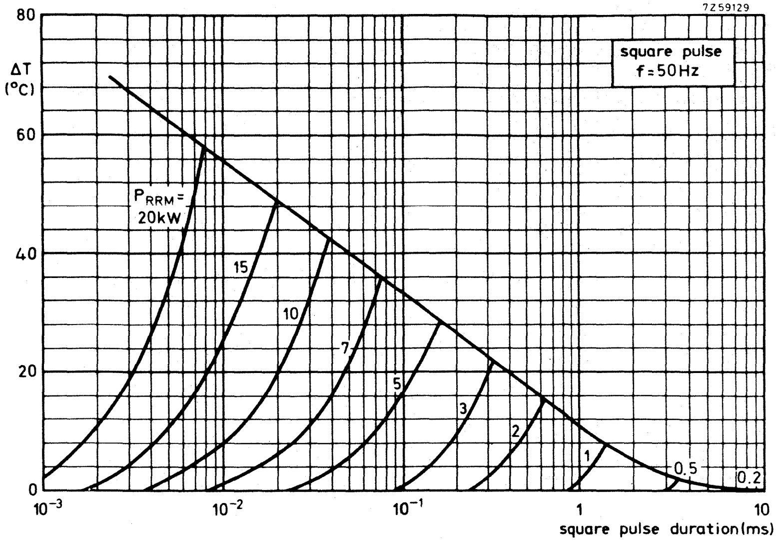


Fig.5

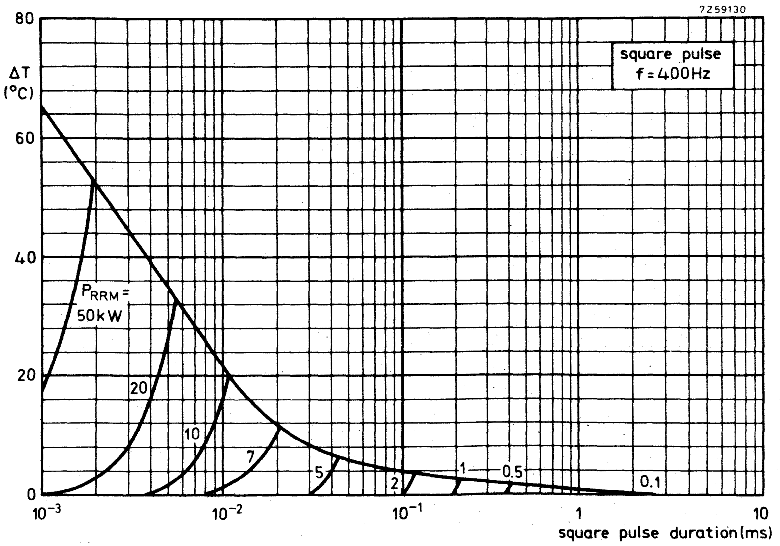


Fig.6

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.

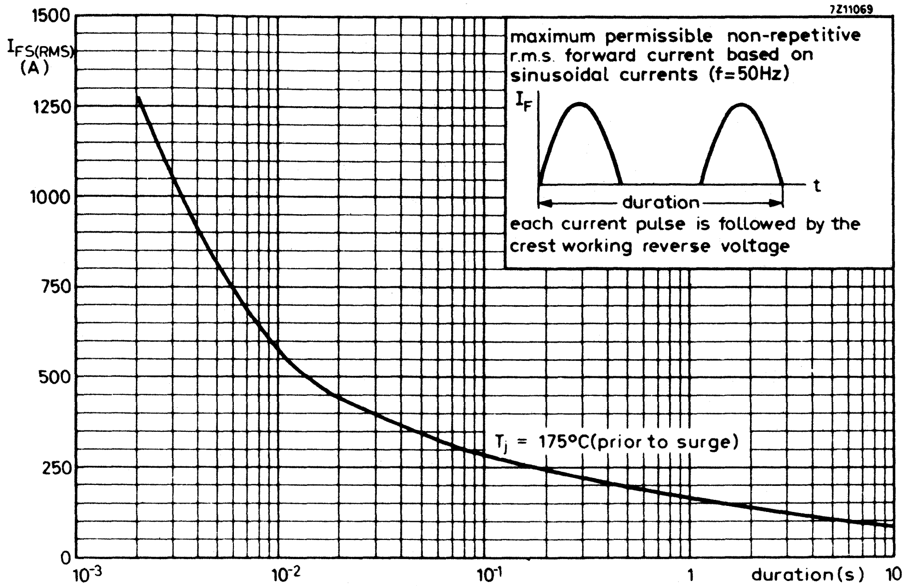

7Z11069
1500
$I_{FS(RMS)}$ (A)
1250
1000
750
500
250
0
10^{-3}
10^{-2}
10^{-1}
1
duration(s)
10
maximum permissible non-repetitive r.m.s. forward current based on sinusoidal currents (f=50Hz)
I_F
t
duration
each current pulse is followed by the crest working reverse voltage
T_j = 175°C(prior to surge)

Fig.7

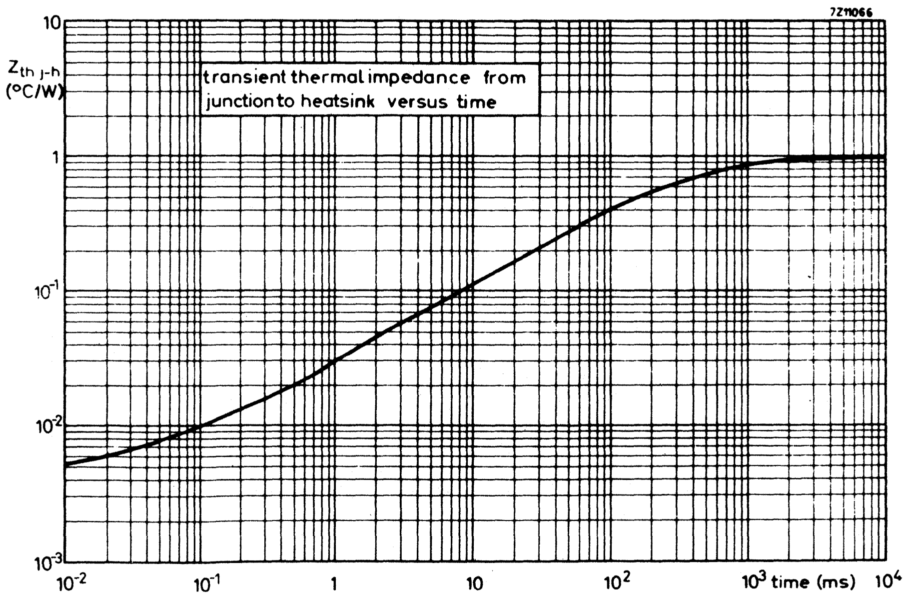

7Z11066
10
$Z_{th\ j\text{-}h}$ (°C/W)
1
10^{-1}
10^{-2}
10^{-3}
10^{-2}
10^{-1}
1
10
10^2
10^3 time (ms)
10^4
transient thermal impedance from junction to heatsink versus time

Fig.8

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.

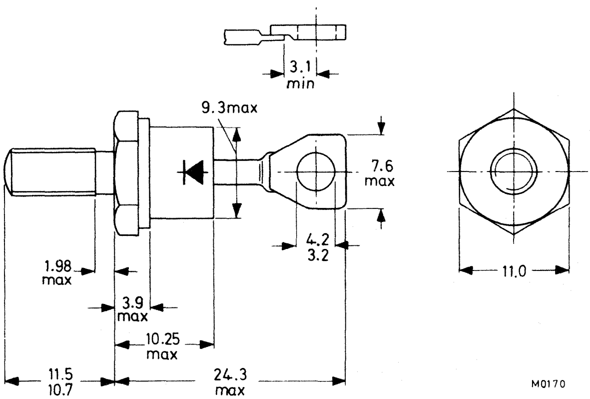
QUICK REFERENCE DATA

			BYX96-300(R)	600(R)	1200(R)	1600(R)	
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: see ACCESSORIES section
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 $T_{mb} = 125\ ^oC$	$I_{F(AV)}$	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) $T_j = 175\ ^oC$ 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	^oC
Junction temperature	T_j	max.	175	^oC

THERMAL RESISTANCE

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

[1] To ensure thermal stability: $R_{th\ j-a} \leq 2\ ^oC/W$ (continuous reverse voltage) or $\leq 8\ ^oC/W$ (a.c.)
For smaller heatsinks $T_{j\ max}$ should be derated. For a.c. see page 82.
For continuous reverse voltage: if $R_{th\ j-a} = 4\ ^oC/W$, then $T_{j\ max} = 138\ ^oC$,
if $R_{th\ j-a} = 6\ ^oC/W$, then $T_{j\ max} = 125\ ^oC$.

CHARACTERISTICS

Forward voltage

I_F = 100 A; T_j = 25 °C	V_F	<	1,7	V [1]

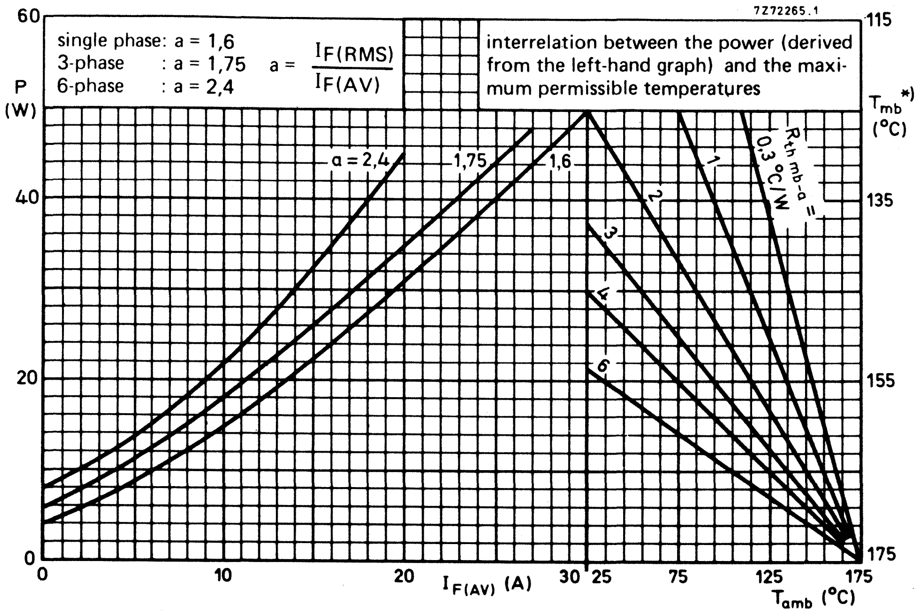
Reverse current

$V_R = V_{RWMmax}$; T_j = 125 °C	I_R	<	1	mA

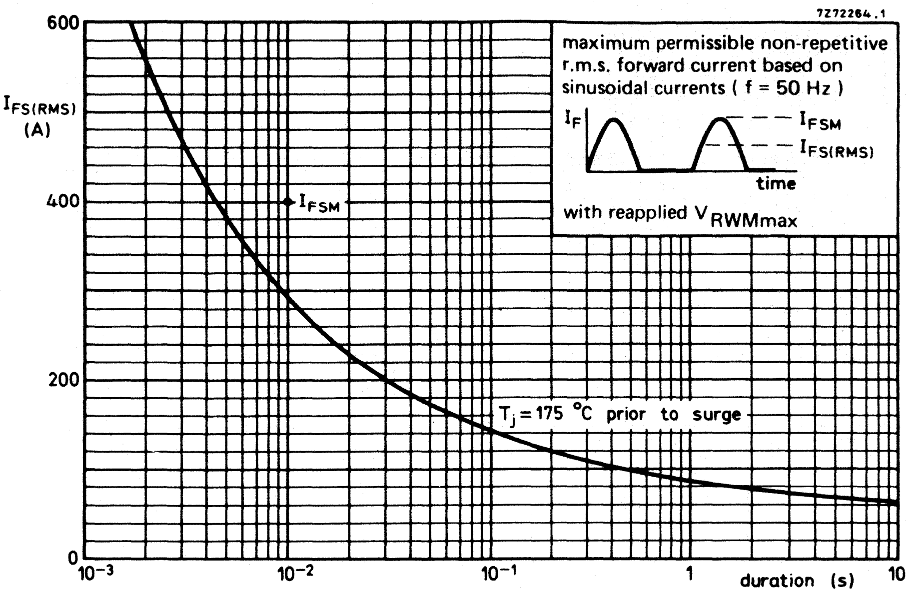
OPERATING NOTES

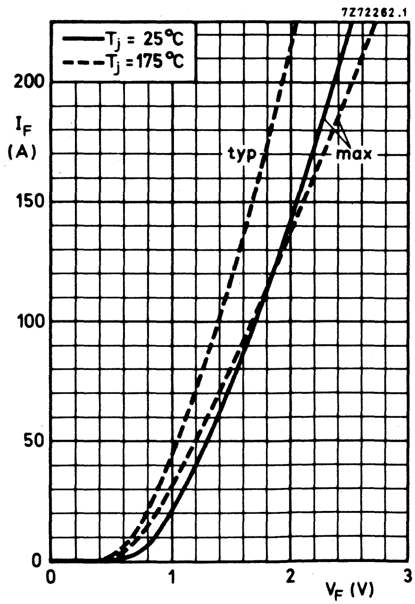
1. The top connector should neither be bent nor twisted; it should be soldered into the circuit so that there is no strain on it.
   During soldering the heat conduction to the junction should be kept to a minimum.
2. Where there is a possibility that transients, due to the energy stored in the transformer,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

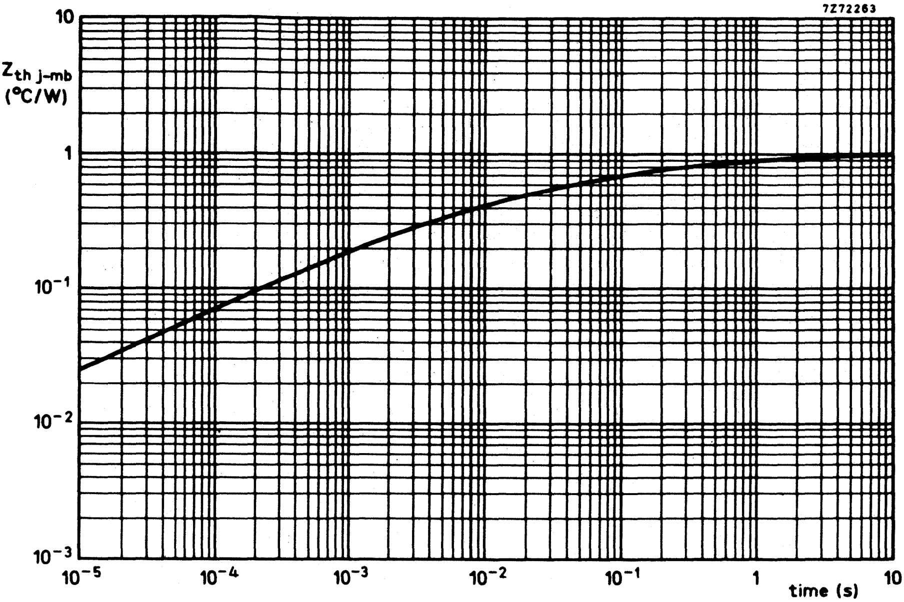
[1]) Measured under pulse conditions to avoid excessive dissipation.



*) T_{mb}-scale is for comparison purposes only and is correct only for $R_{th\ mb\text{-}a} \leq 6,5$ °C/W


7Z72264.1
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)
600
400
200
0
I_FSM
T_j = 175 °C prior to surge
10^-3
10^-2
10^-1
1
10
duration (s)


7Z72262.1
T_j = 25 °C
T_j = 175 °C
I_F (A)
200
150
100
50
0
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.

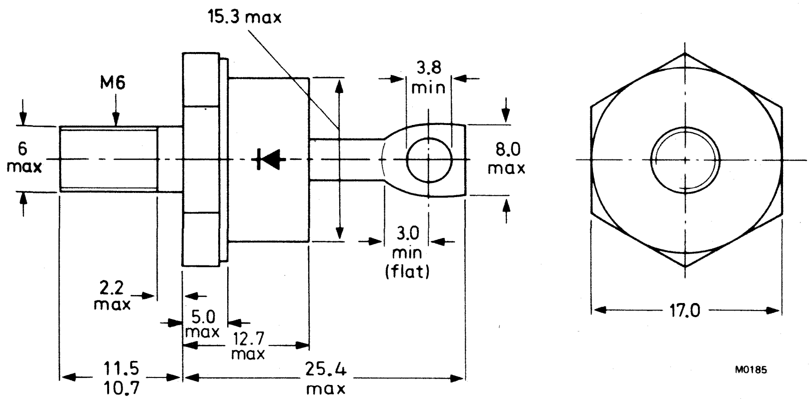
QUICK REFERENCE DATA

			BYX97-300(R)	600(R)	1200(R)	1600(R)	
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: see ACCESSORIES section
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	$R_{th\ j-mb}$	=	0,6	°C/W
From mounting base to heatsink without heatsink compound	$R_{th\ mb-h}$	=	0,3	°C/W
with heatsink compound	$R_{th\ mb-h}$	=	0,2	°C/W
Transient thermal impedance; $t = 1$ ms	$Z_{th\ j-mb}$	=	0,1	°C/W

[1]) To ensure thermal stability: $R_{th\ j-a} \leq 1$ °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 **88**
For continuous reverse voltage: if $R_{th\ j-a} = 2$ °C/W, then $T_{j\ max} = 138$ °C,
if $R_{th\ j-a} = 3$ °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]

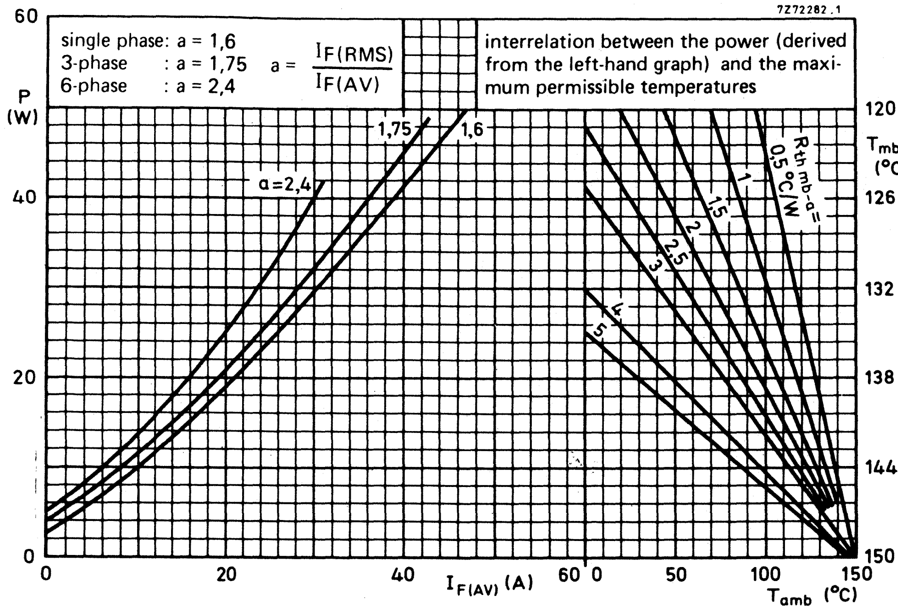
Reverse current

$V_R = V_{RWMmax}$; T_j = 125 °C	I_R	<	4	mA

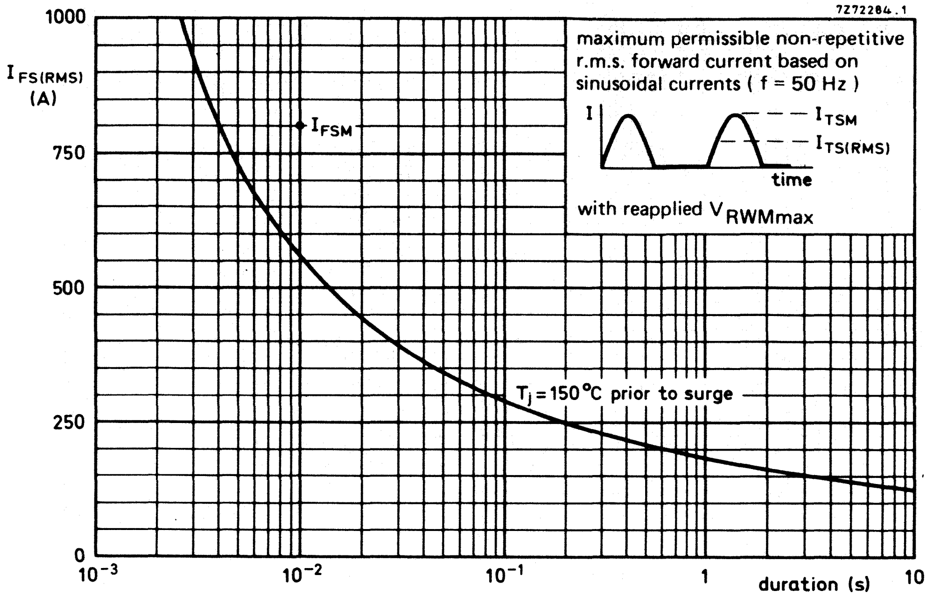
OPERATING NOTES

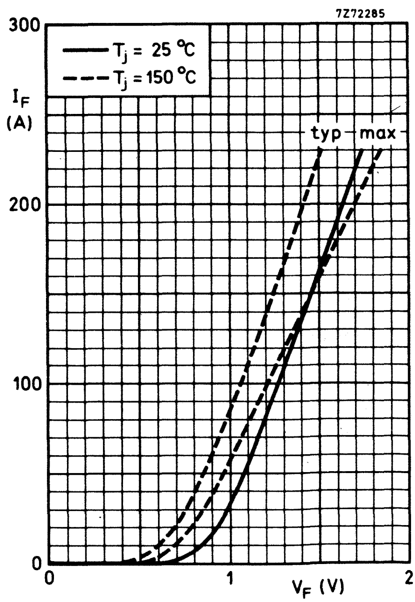
1. The top connector should neither be bent nor twisted; it should be soldered into the circuit so that there is no strain on it.
   During soldering the heat conduction to the junction should be kept to a minimum.
2. Where there is a possibility that transients, due to the energy stored in the transformer,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

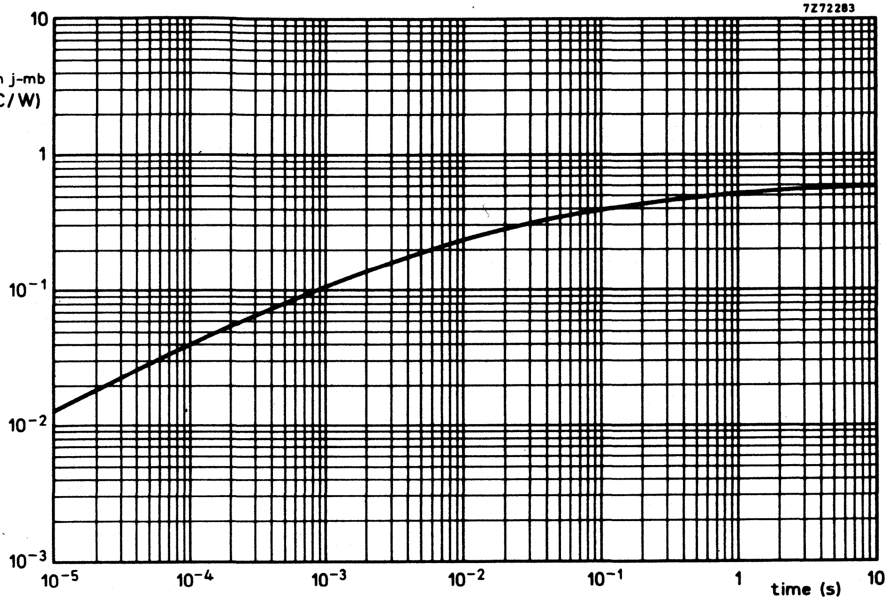
[1] Measured under pulse conditions to avoid excessive dissipation.



*) 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
750
500
250
0
$I_{FS(RMS)}$
(A)
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}
$T_j = 150\,°C$ prior to surge
10^{-3}
10^{-2}
10^{-1}
1
duration (s)
10


7Z72285
300
200
100
0
I_F
(A)
$T_j = 25\,°C$
$T_j = 150\,°C$
typ
max
0
1
2
V_F (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.

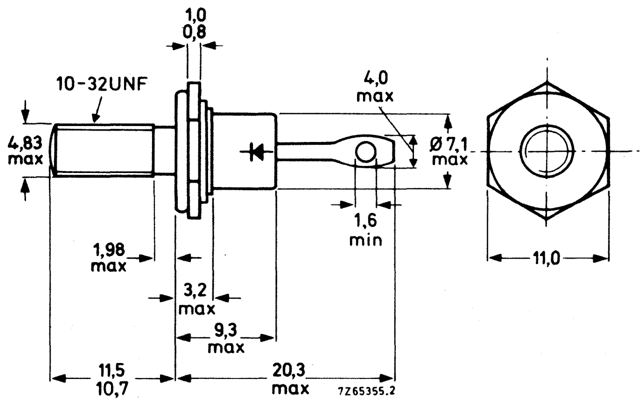
QUICK REFERENCE DATA

			BYX98-300(R)	600(R)	1200(R)	
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:
see ACCESSORIES section
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)

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	$R_{th\ j-a}$	=	50	°C/W
From junction to mounting base	$R_{th\ j-mb}$	=	3	°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

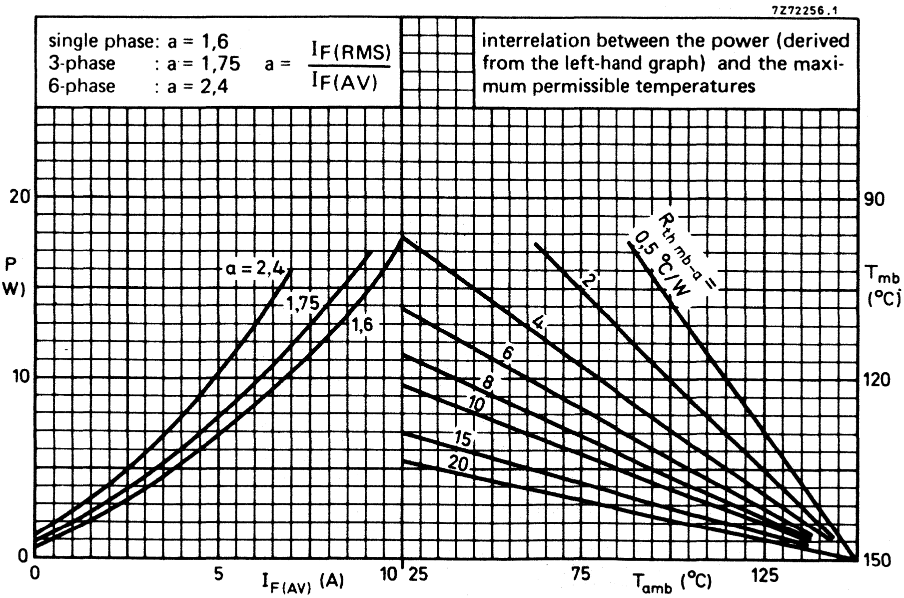
$I_F = 20$ A; $T_j = 25$ °C	V_F	<	1,7	V	1)

Reverse current

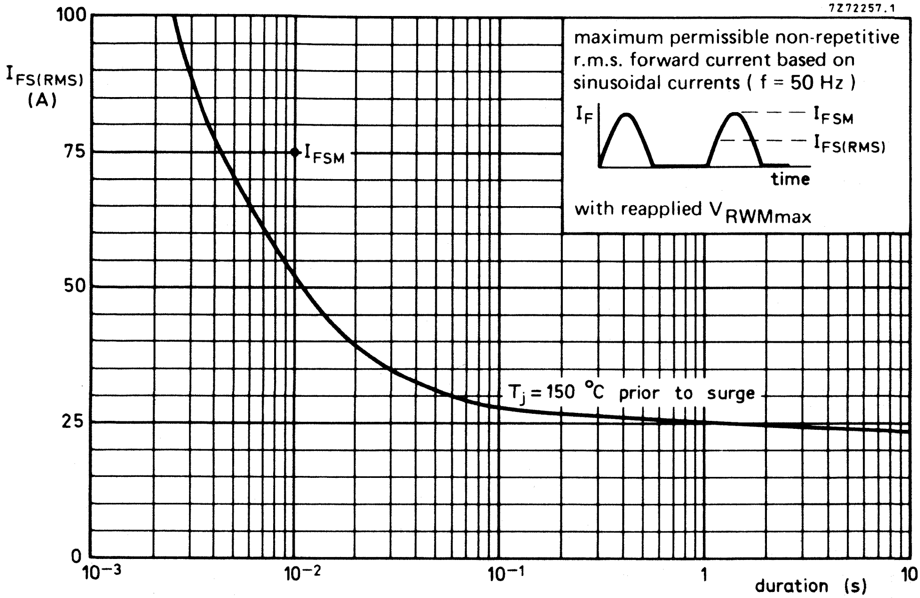
$V_R = V_{RWMmax}$; $T_j = 125$ °C	I_R	<	200	µA

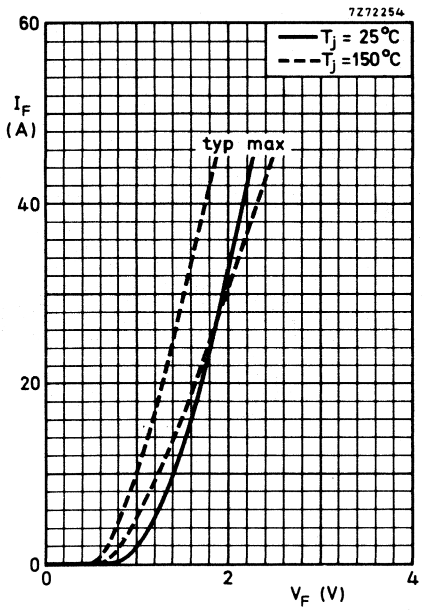
OPERATING NOTES

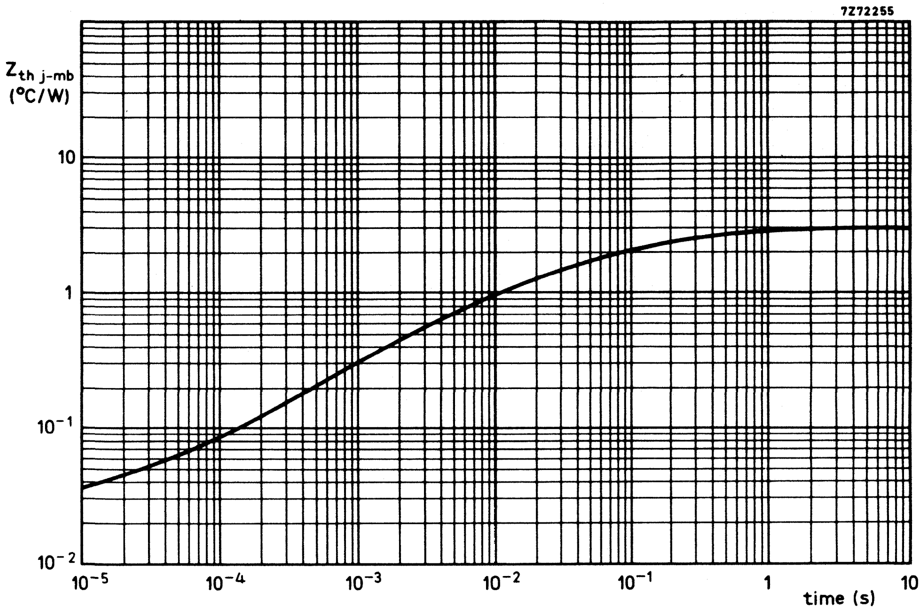
1. The top connector should neither be bent nor twisted; it should be soldered into the circuit so that there is no strain on it.
   During soldering the heat conduction to the junction should be kept to a minimum.
2. Where there is a possibility that transients, due to the energy stored in the transformer,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



1) Measured under pulse conditions to avoid excessive dissipation.


7Z72257.1
100
75
50
25
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}
$T_j = 150$ °C prior to surge
10^{-3}
10^{-2}
10^{-1}
1
10
duration (s)


7Z72254
60
40
20
0
I_F
(A)
T_j = 25°C
T_j =150°C
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.

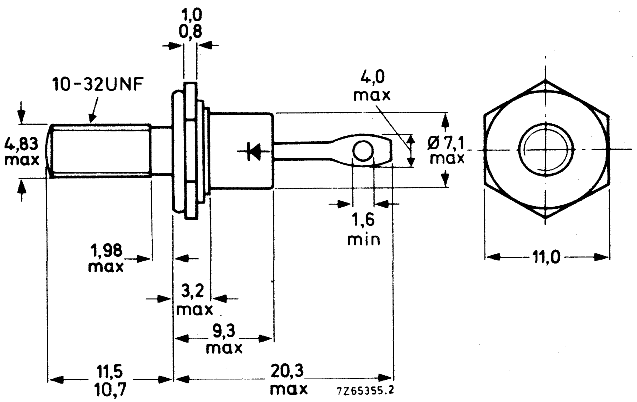
QUICK REFERENCE DATA

			BYX99-300(R)	600(R)	1200(R)	
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:
see ACCESSORIES section
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)

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 $T_{mb} = 129\ ^oC$	$I_{F(AV)}$	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) $T_j = 175\ ^oC$ 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	^oC
Junction temperature	T_j	max.	175	^oC

THERMAL RESISTANCE

From junction to ambient in free air	$R_{th\ j-a}$	=	50	$^oC/W$
From junction to mounting base	$R_{th\ j-mb}$	=	2,3	$^oC/W$
From mounting base to heatsink with heatsink compound	$R_{th\ mb-h}$	=	0,5	$^oC/W$
without heatsink compound	$R_{th\ mb-h}$	=	0,6	$^oC/W$
Transient thermal impedance; t = 1 ms	$Z_{th\ j-mb}$	=	0,13	$^oC/W$

CHARACTERISTICS

Forward voltage

I_F = 50 A; T_j = 25 °C	V_F	<	1,55	V [1]

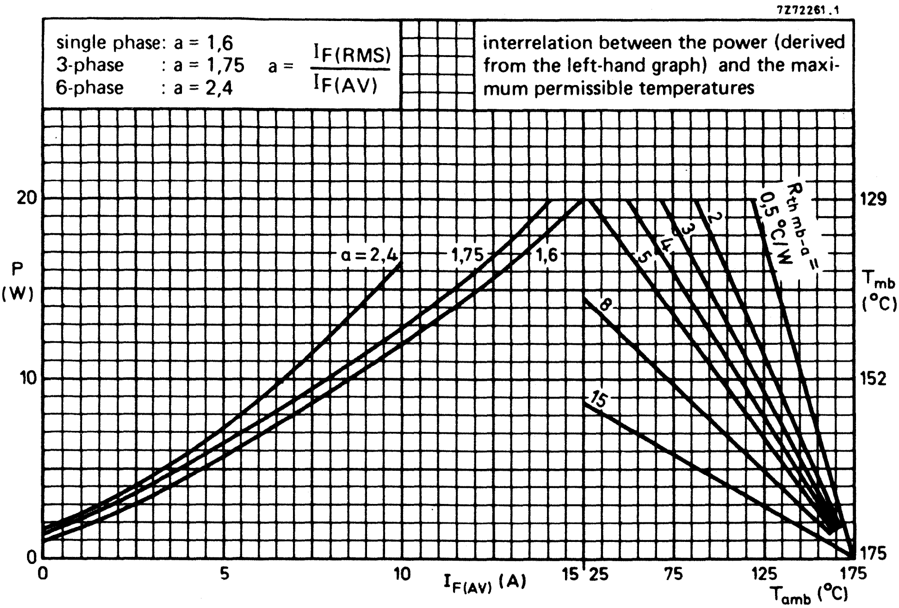
Reverse current

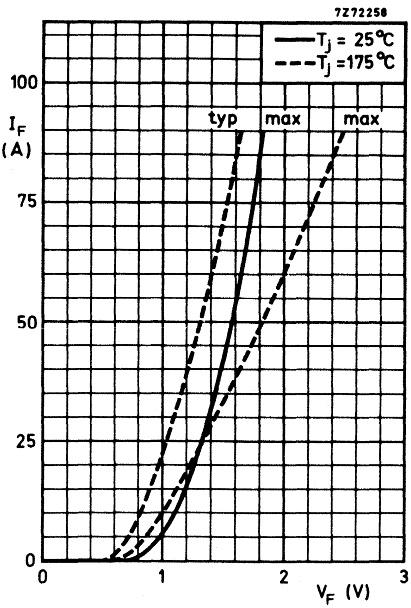
$V_R = V_{RWMmax}$; T_j = 125 °C	I_R	<	200	μA

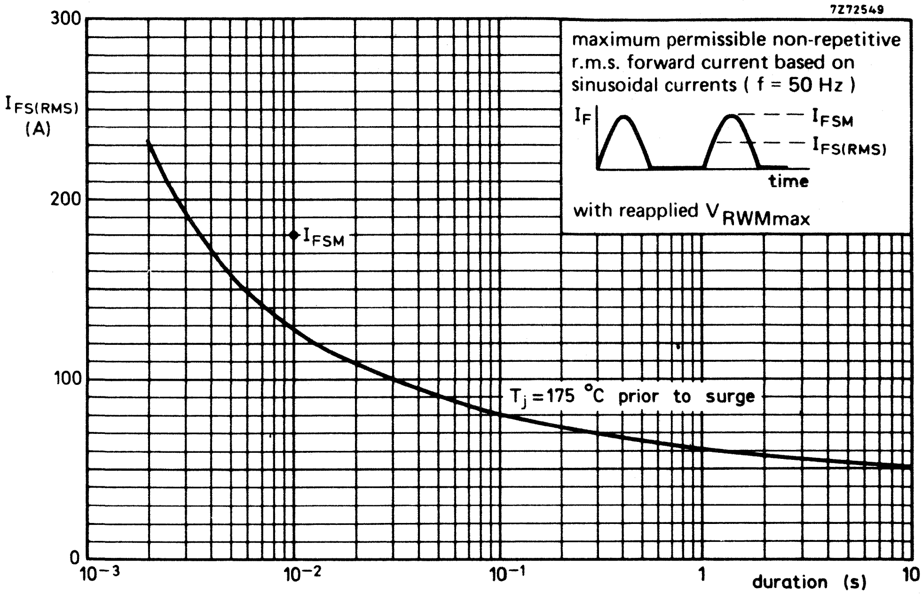
OPERATING NOTES

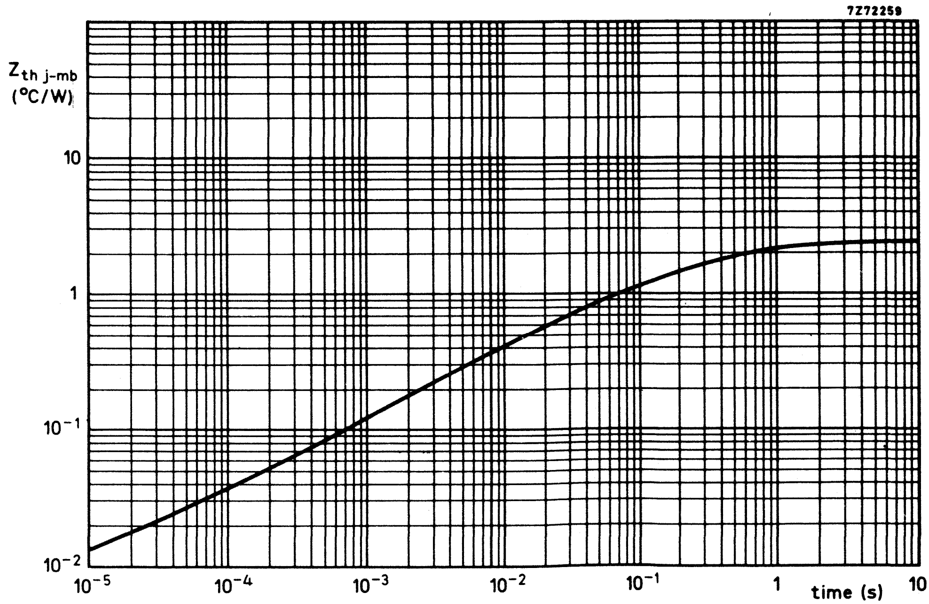
1. The top connector should neither be bent nor twisted; it should be soldered into the circuit so that there is no strain on it.
   During soldering the heat conduction to the junction should be kept to a minimum.
2. Where there is a possibility that transients, due to the energy stored in the transformer,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

[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
P (W)
20
10
0
a = 2,4
1,75
1,6
$R_{th\ mb-a}$ = 0,5 °C/W
2
3
4
5
8
15
0
5
10
15
$I_{F(AV)}$ (A)
25
75
125
175
T_{amb} (°C)
129
152
175
T_{mb} (°C)


7Z72258
—— T_j = 25 °C
- - - T_j = 175 °C
100
75
50
25
0
I_F (A)
typ
max
max
0
1
2
3
V_F (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
duration (s)
10


7Z72259
$Z_{th\ j\text{-}mb}$ (°C/W)
10
1
10^{-1}
10^{-2}
10^{-5}
10^{-4}
10^{-3}
10^{-2}
10^{-1}
1
time (s)
10

RECTIFIER BRIDGES

3–PHASE BRIDGE RECTIFIERS

3-phase full-wave bridge rectifier modules incorporating glass passivated devices in a plastic package, with electrically isolated metal baseplate. Intended for use in equipment supplied from 3-phase a.c. with r.m.s. line voltages up to 510V, they are capable of delivering output currents up to 25 A.

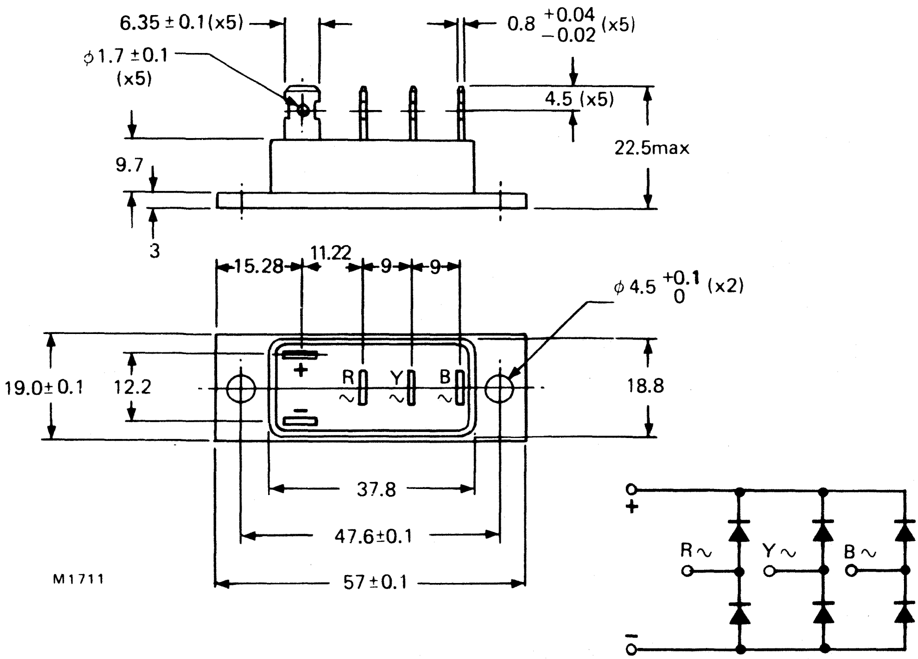
QUICK REFERENCE DATA

Input		BGX25–800	1000	1200	
R.M.S. voltage	$V_{I(RMS)}$	340	425	510	V
Repetitive peak voltage	V_{IRM}	800	1000	1200	V
Non repetitive peak current	I_{ISM}		80		A
Peak inrush current	I_{IIM}		120		A
Output					
Average current	$I_{O(AV)}$		25		A

MECHANICAL DATA

Dimensions in mm

Fig.1



RATINGS

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

INPUT

			BGX25–800	1000	1200	
Non-repetitive peak voltage ($t \leq 10$ ms)	V_{ISM}	max.	800	1000	1200	V
Repetitive peak voltage	V_{IRM}	max.	800	1000	1200	V
Crest working voltage	V_{IWM}	max.	600	800	1000	V
R.M.S. voltage (sine-wave)	$V_{I(RMS)}$	max.	340	425	510	V

Non-repetitive peak current half sine-wave; t = 10 ms; with reapplied V_{IWM}; T_j = 150 °C	I_{ISM}	max.	80	A
Peak inrush current ($a \leq 4$)	I_{IIM}	max.	120	A

OUTPUT

Average current (averaged over any 20 ms period) sinusoidal up to T_{mb} = 85 °C	$I_{O(AV)}$	max.	25	A

TEMPERATURES

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

THERMAL RESISTANCE

From junction to mounting base (total package)	$R_{th\ j\text{-}mb}$	max.	0.75	K/W

CHARACTERISTICS

Forward voltage (per diode) I_F = 25 A; T_j = 25 °C	V_F	max.	1.75	V*
Reverse current $V_R = V_{IWM\ max}$; T_j = 100 °C	I_R	max.	0.8	mA

ISOLATION

From baseplate to all terminals strapped together; r.m.s. isolation voltage	V_{isol}	min.	2500	V

*Measured under pulse conditions to avoid excessive dissipation.

SINUSOIDAL OPERATION

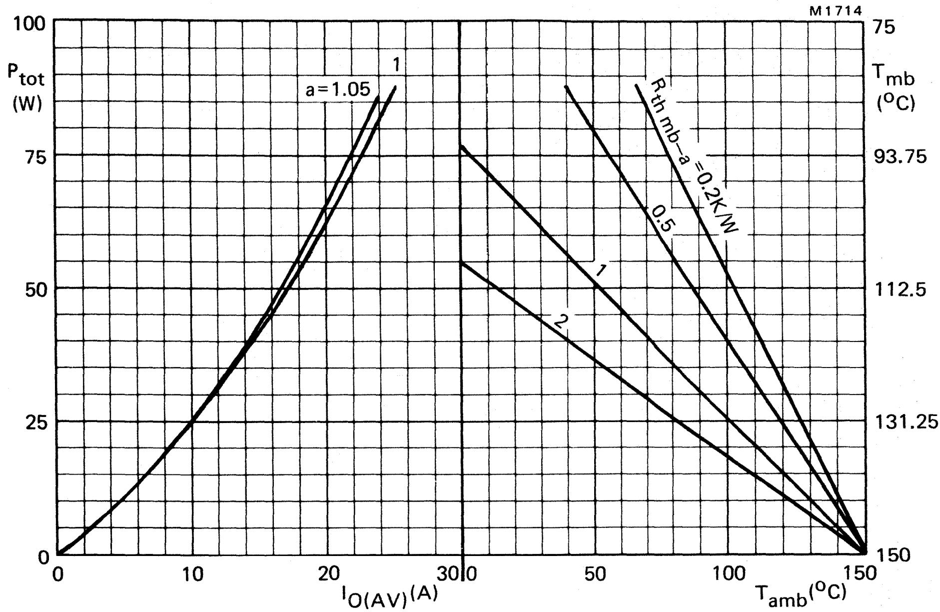


Fig.2 The right-hand part shows the interrelationship between the power (derived from the left-hand part) and the maximum permissible temperatures.
a = form factor = $I_{O(RMS)}/I_{O(AV)}$.

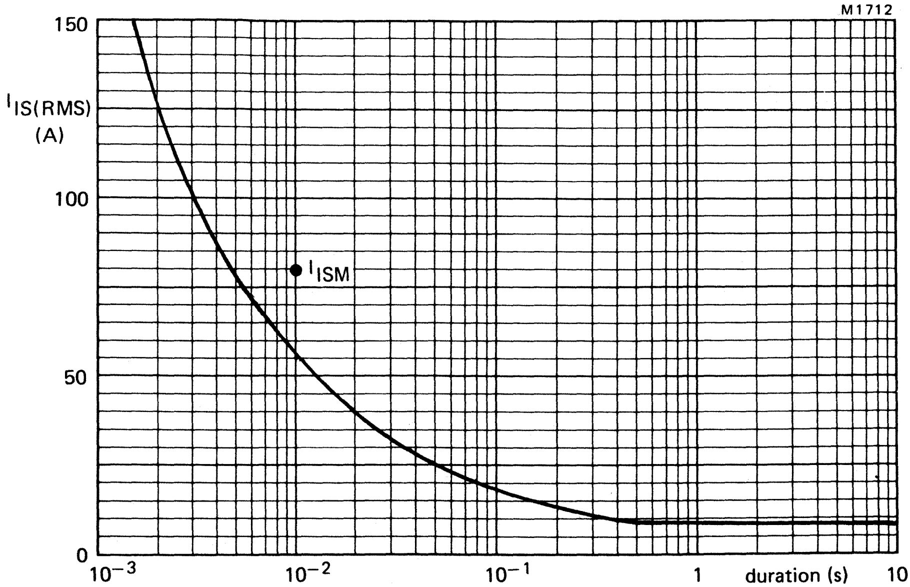
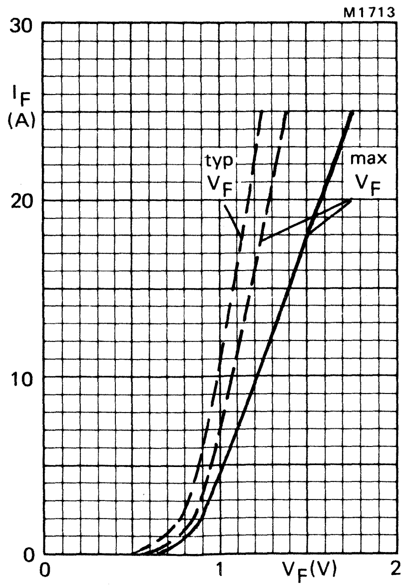


Fig.3 Maximum permissible non-repetitive r.m.s. input current based on sinusoidal currents (f = 50 Hz); T_j = 150 °C prior to surge; with reapplied V_{IWM}.



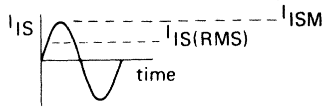


Fig.4 V_F of each diode;
——T_j = 25 °C; – – – T_j = 100 °C.

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.

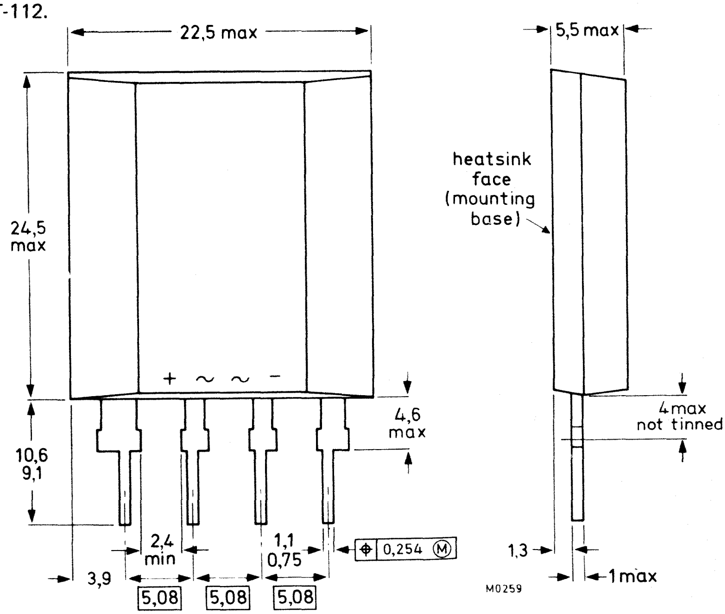
QUICK REFERENCE DATA

			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.



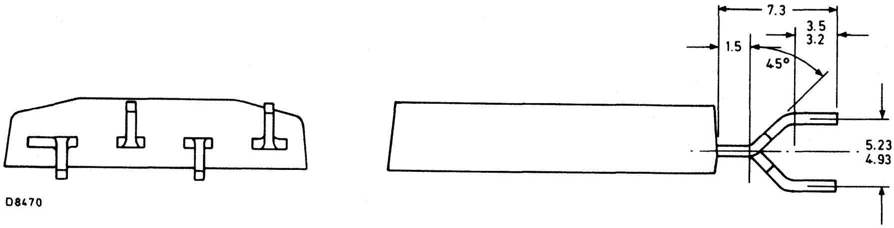
Net mass: 6,8 g

Accessories supplied on request: 56379 (clip); see Accessories and Mounting Instructions.

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 600V version with cranked pins (as shown in figure 1a) is available as type OF432.

RATINGS

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

Input

			BY224–400	600	
Non-repetitive peak voltage ($t \leq 10$ 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	$R_{th\ j\text{-}mb}$	=	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 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	$R_{th\ j\text{-}a}$	=	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.

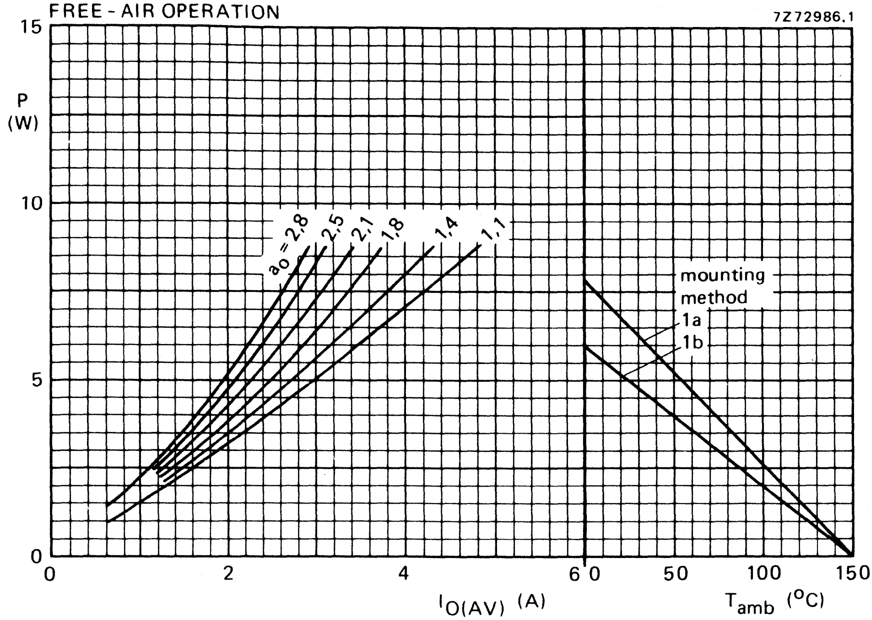


Fig. 2 The right-hand part shows the interrelationship between the power (derived from the left-hand graph) and the maximum permissible ambient temperature.

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

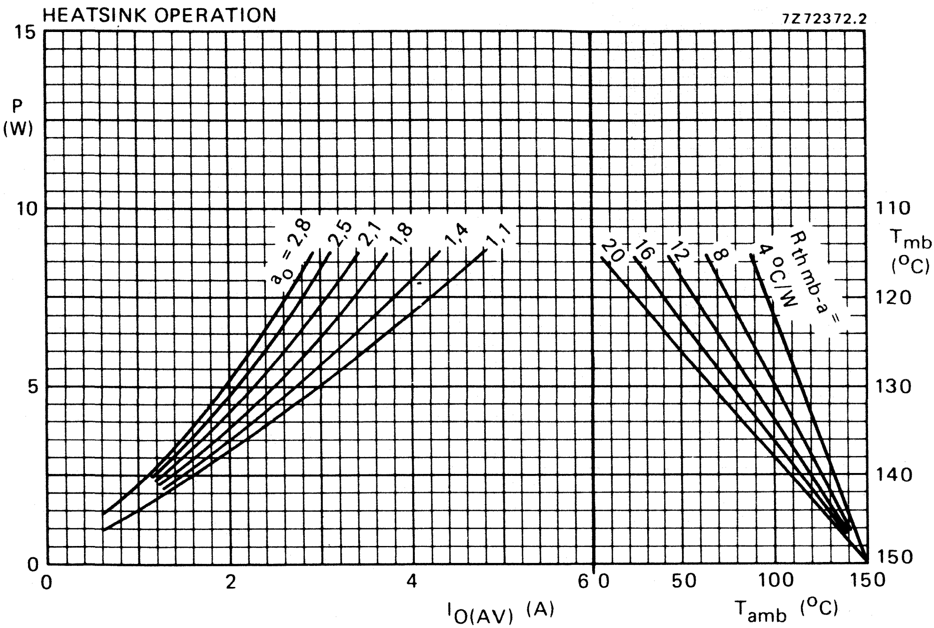


Fig. 3 The right-hand part shows the interrelationship between the power (derived from the left-hand graph) and the maximum permissible temperatures.

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

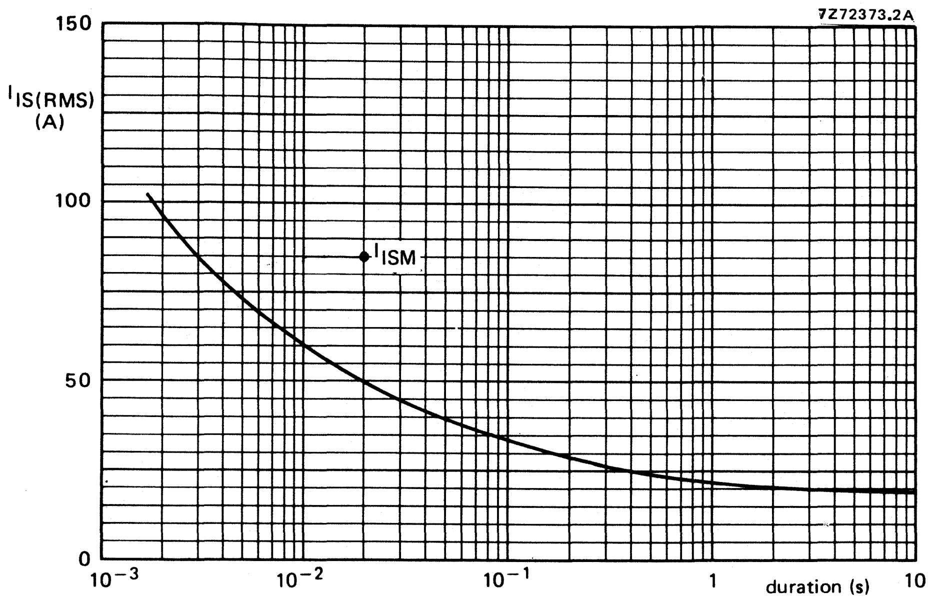
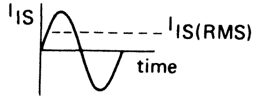


Fig.4 Maximum permissible non-repetitive r.m.s. input current based on sinusoidal currents (f = 50 Hz); T_j = 150 °C prior to surge; with reapplied V_{IWMmax}.



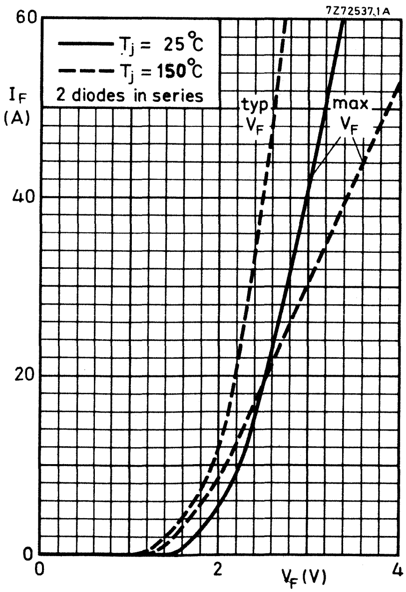
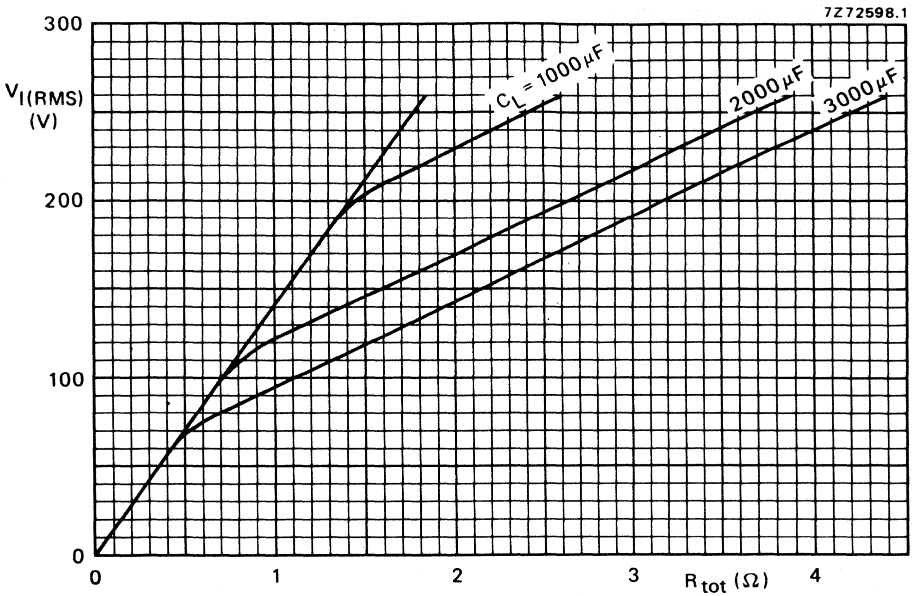
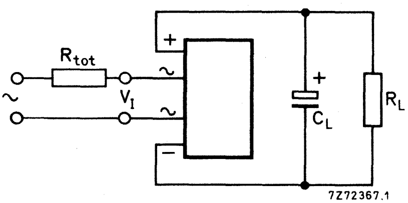


Fig.5



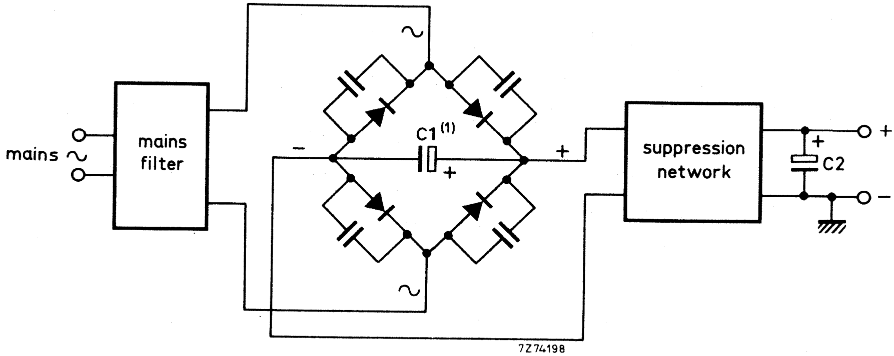


The graph takes the possibility of the following spreads into account:

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.

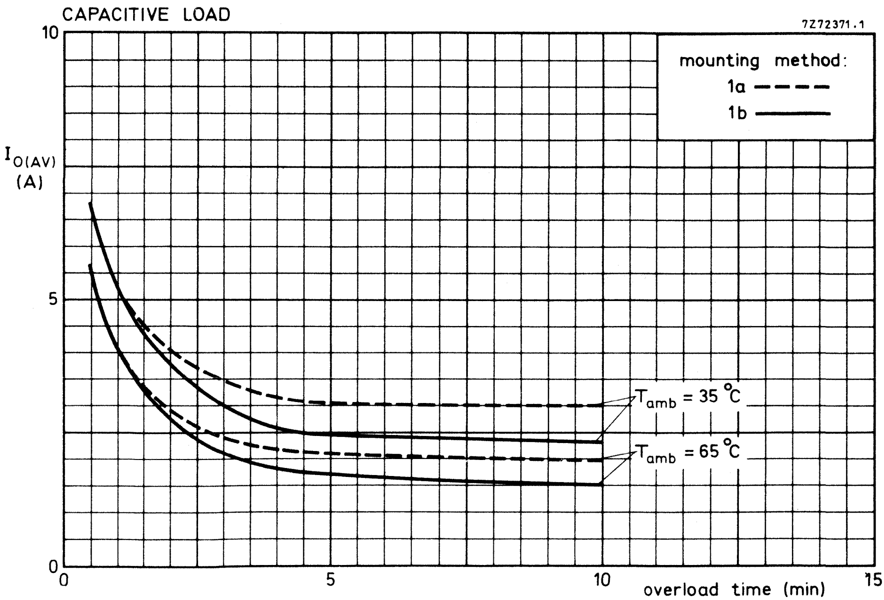


Fig.8

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.

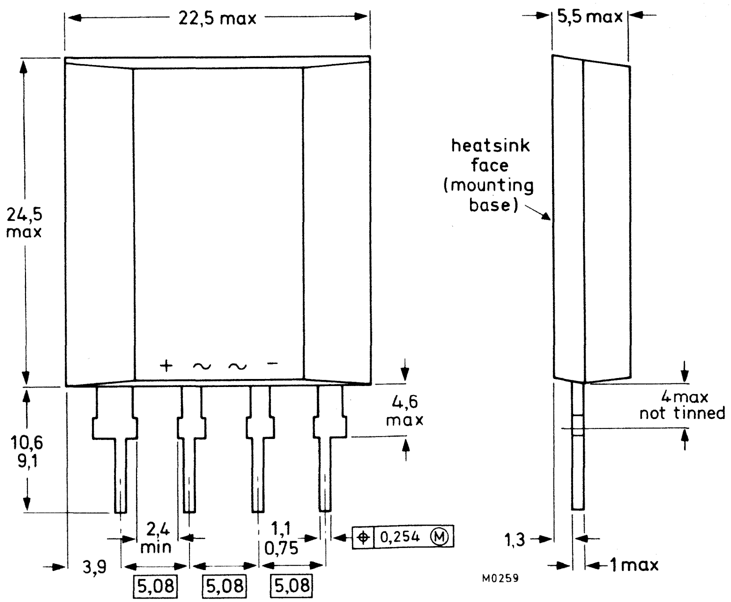
QUICK REFERENCE DATA

Input			BY225–100	200	
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: 56379 (clip); see Accessories and Mounting Instructions.

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.

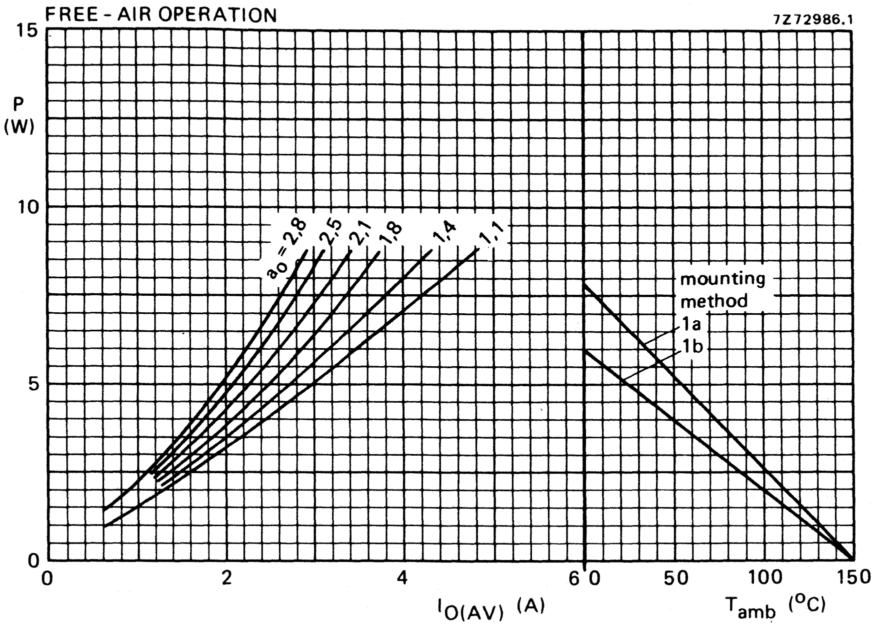


Fig. 2 The right-hand part shows the interrelationship between the power (derived from the left-hand graph) and the maximum permissible ambient temperature.

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

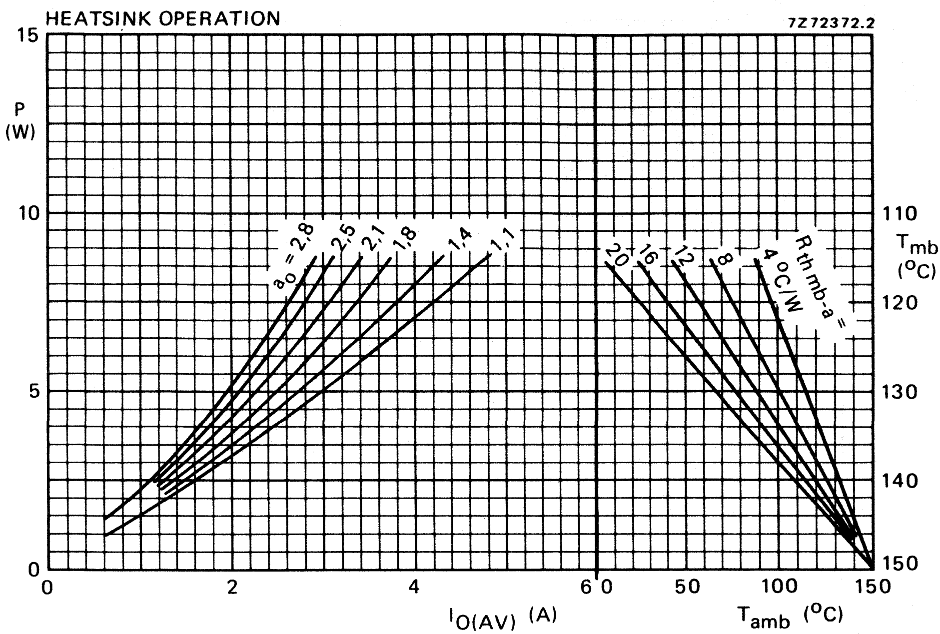


Fig. 3 The right-hand part shows the interrelationship between the power (derived from the left-hand graph) and the maximum permissible temperatures.

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

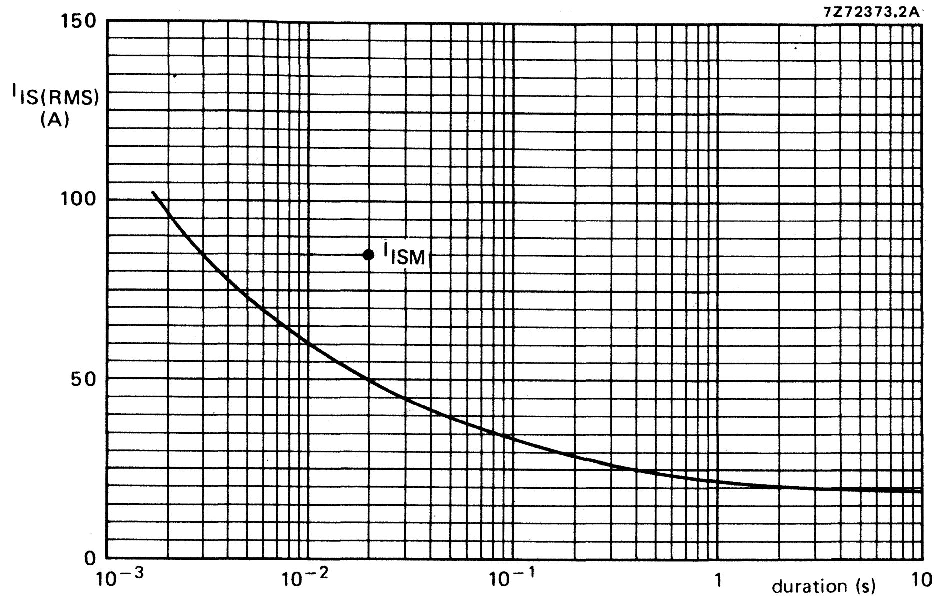
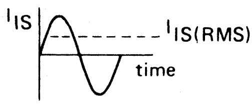


Fig. 4 Maximum permissible non-repetitive r.m.s. input current based on sinusoidal currents (f = 50 Hz); T_j = 150 °C prior to surge; with reapplied V_{IWMmax}.



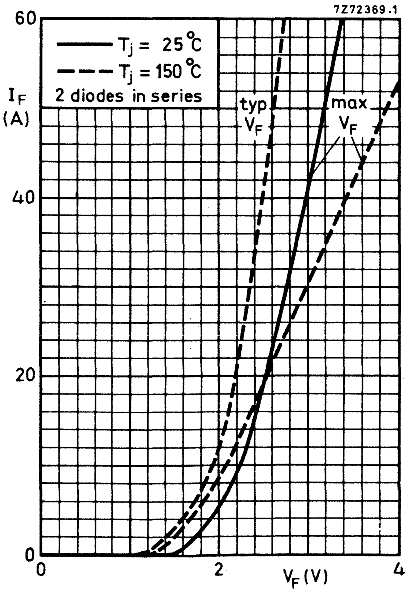
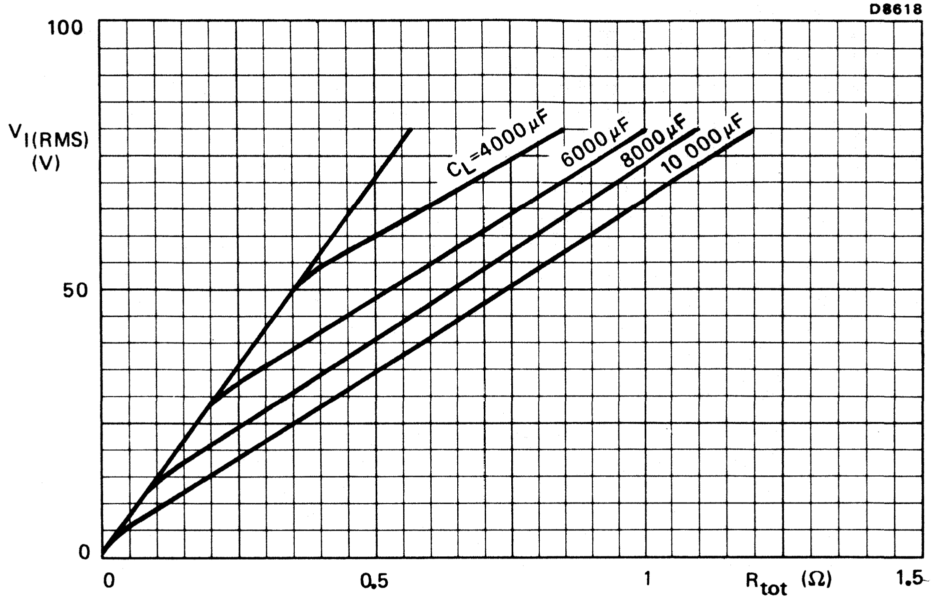
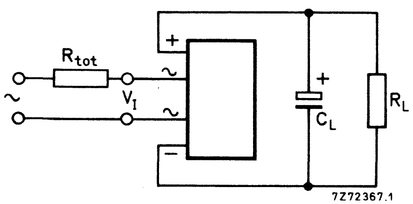


Fig. 5.





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.

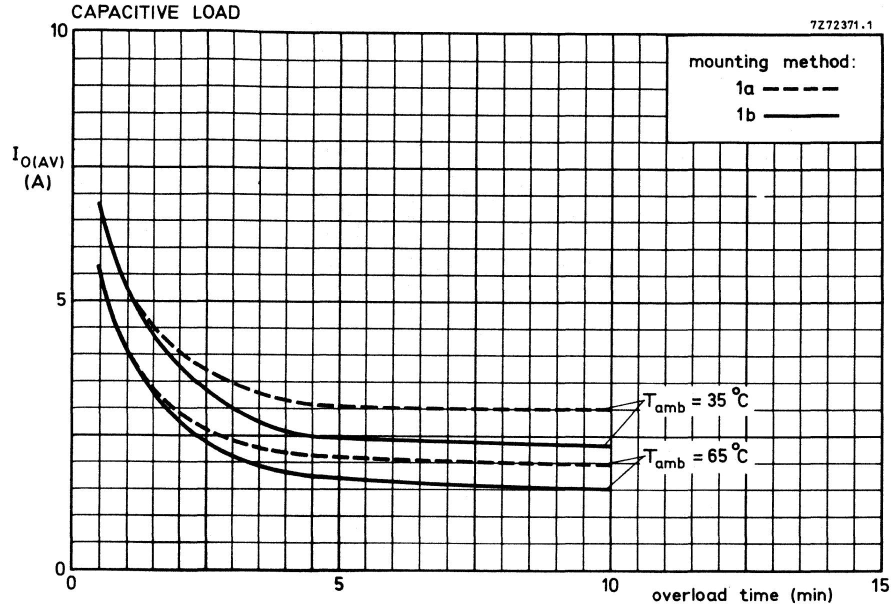

CAPACITIVE LOAD
7Z72371.1
mounting method:
1a
1b
$I_{O(AV)}$
(A)
10
5
0
0
5
10
15
overload time (min)
T_{amb} = 35 °C
T_{amb} = 65 °C

Fig. 7.

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.

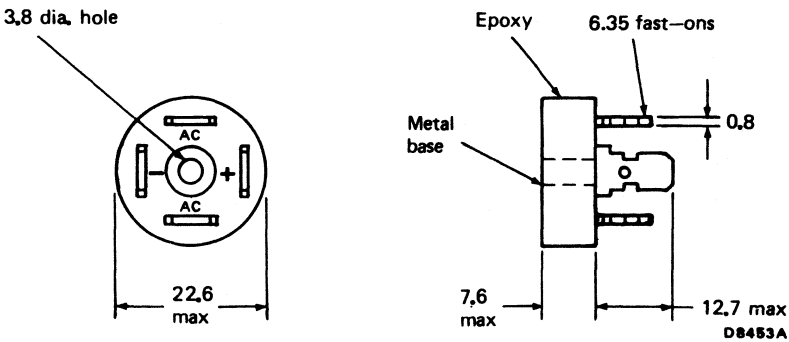
QUICK REFERENCE DATA

			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 °C prior to surge	I_{ISM}	max.	125	A
T_j = 150 °C 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 °C (R-load)	$I_{O(AV)}$	max.	12	A
heatsink operation up to T_{mb} = 60 °C (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	°C
Junction temperature	T_j	max.	150	°C

THERMAL RESISTANCE

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

CHARACTERISTICS

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

*Measured under pulse conditions to avoid excessive dissipation.

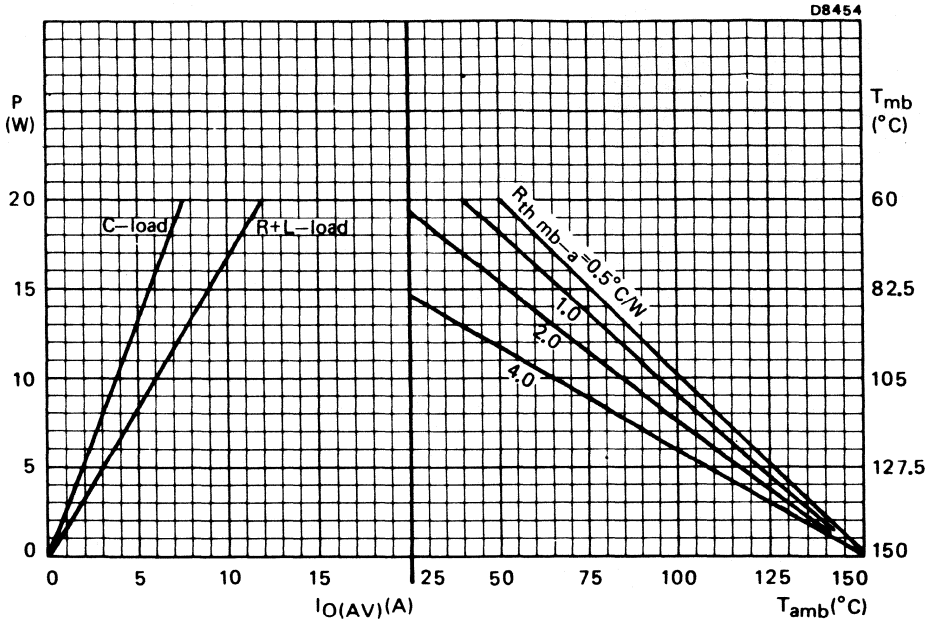


Fig.2 The right-hand part shows the interrelationship between the power (derived from the left-hand graph) and the maximum permissible temperatures.

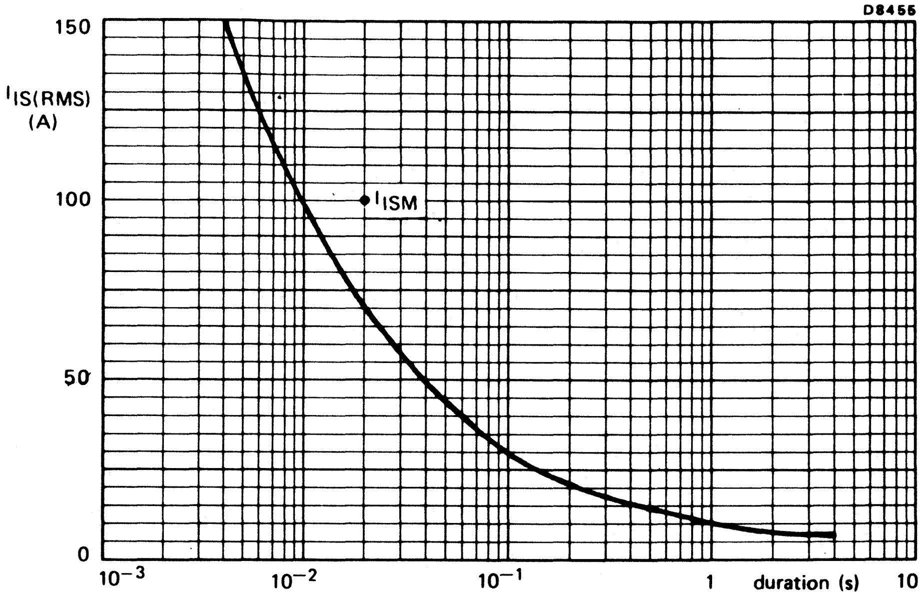
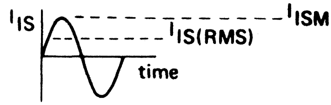


Fig.3 Maximum permissible non-repetitive r.m.s. input current based on sinusoidal currents (f = 50 Hz); T_j = 150 °C prior to surge, with reapplied V_{IWMmax}.



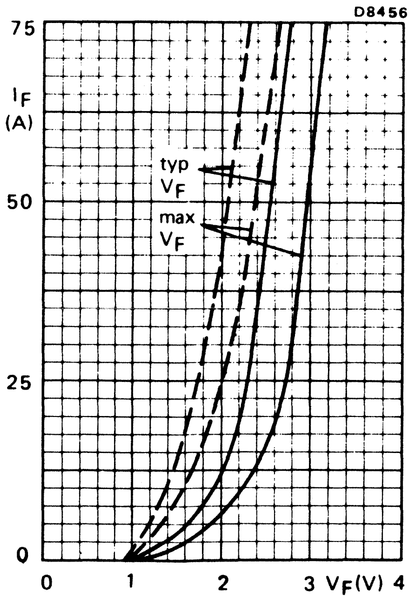
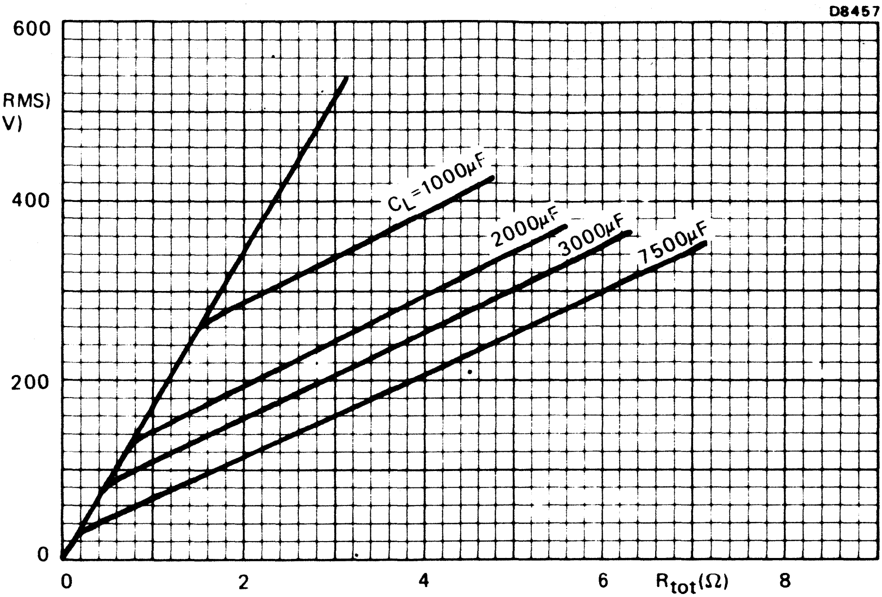
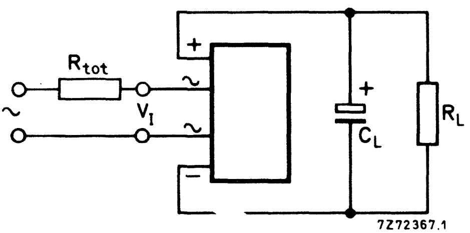


Fig.4 Two diodes in series;
——T_j = 25 °C; – – – –T_j = 150 °C





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.

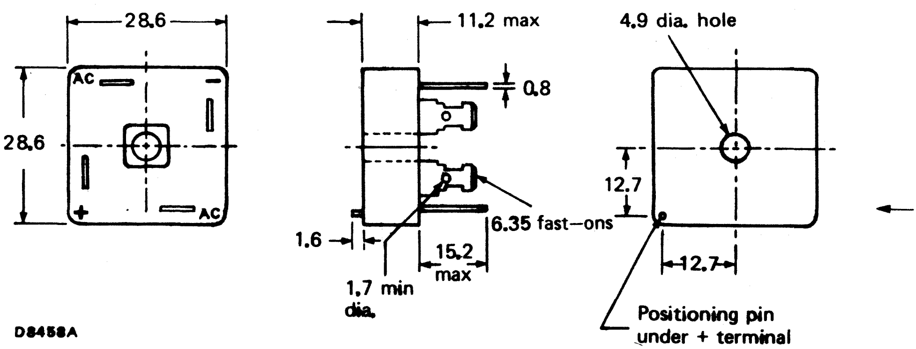
QUICK REFERENCE DATA

			BY261–200	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.		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 ($t \leqslant 10$ 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.

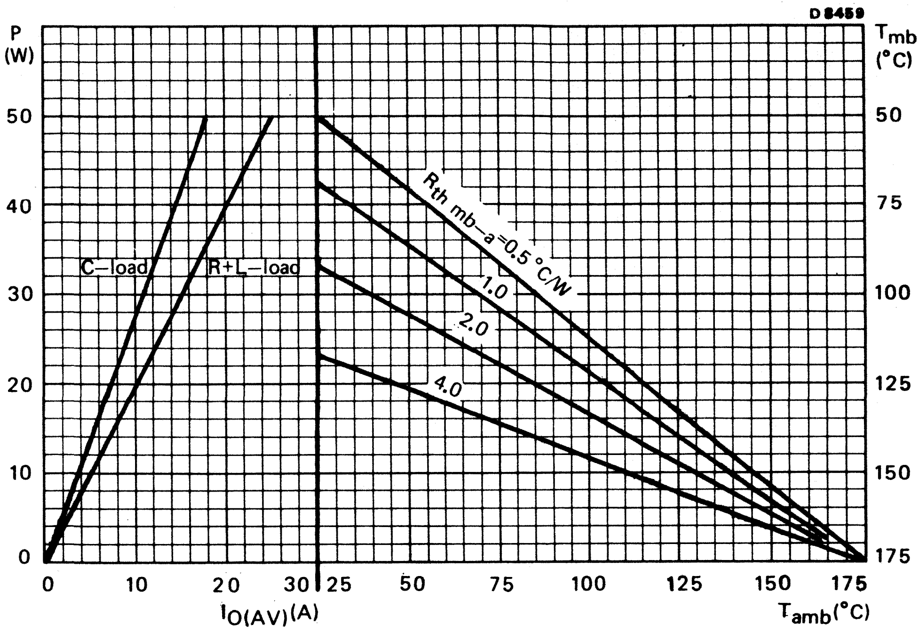


Fig. 2 The right-hand part shows the interrelationship between the power (derived from the left-hand graph) and the maximum permissible temperatures.

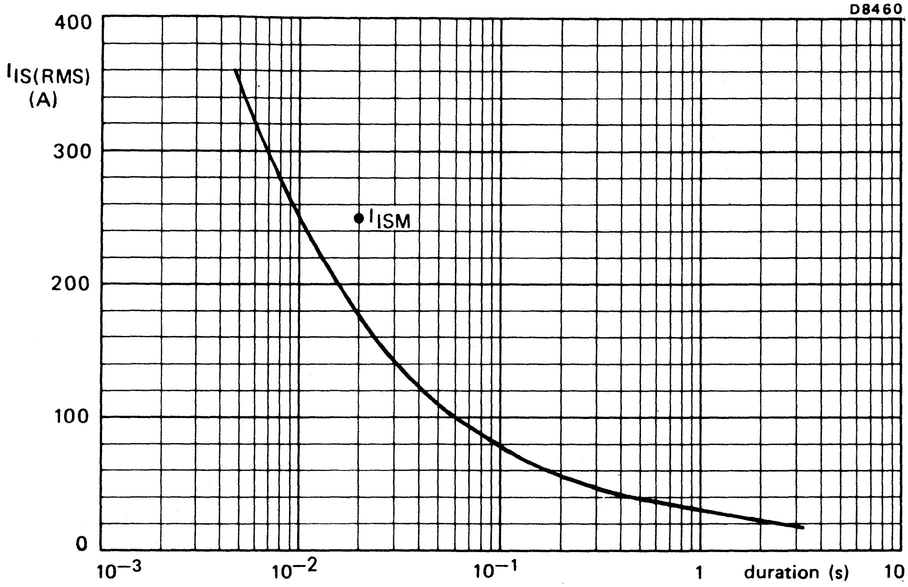
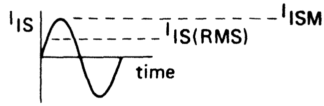


Fig.3 Maximum permissible non-repetitive r.m.s. input current based on sinusoidal currents (f = 50 Hz); T_j = 150 °C prior to surge; with reapplied V_{IWMmax}.



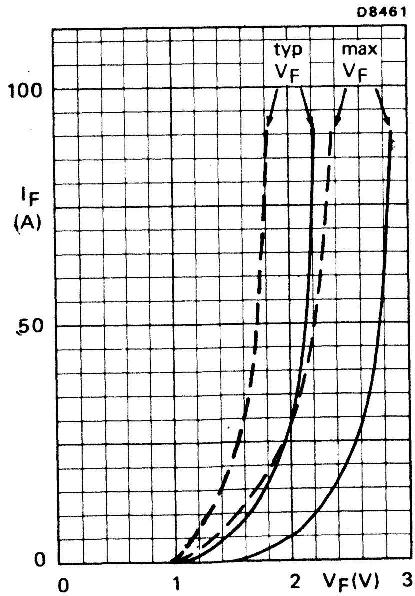
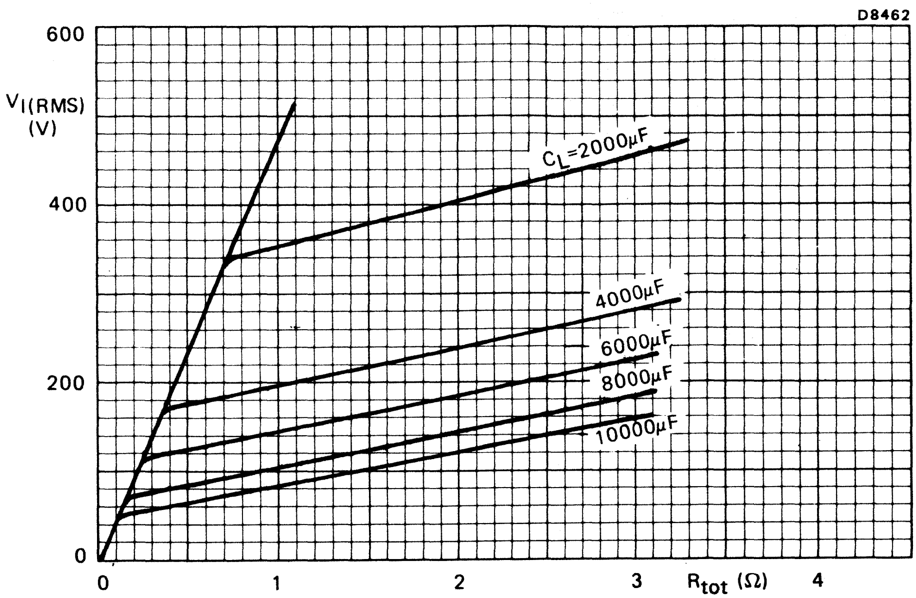
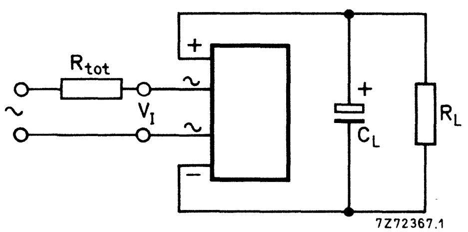


Fig.4 Two diodes in series;
——— T_j = 25 °C; – – – – T_j = 150 °C





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.

FAST RECTIFIER DIODES

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 the following types:
Normal polarity: BY229–200 to 800.
Reverse polarity: BY229–200R to 800R.

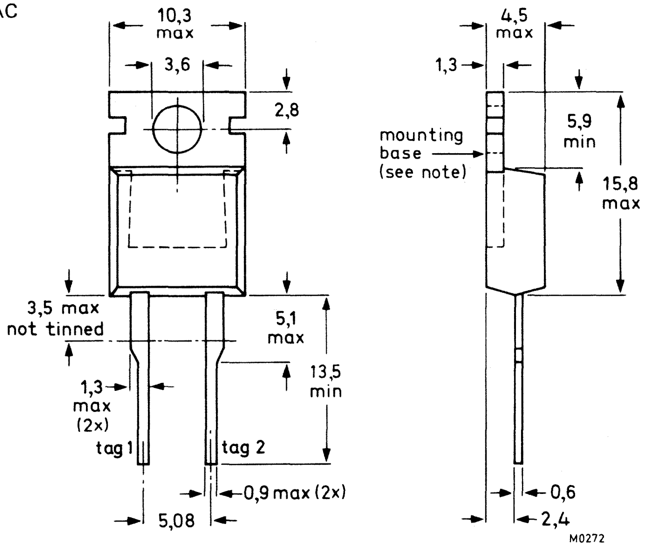
QUICK REFERENCE DATA

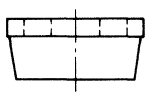
			BY229–200(R)	400(R)	600(R)	800(R)	
Repetitive peak reverse voltage	V_{RRM}	max.	200	400	600	800	V
Average forward current	$I_{F(AV)}$	max.	7				A
Non-repetitive peak forward current	I_{FSM}	max.	60				A
Reverse recovery time	t_{rr}	<	450				ns

MECHANICAL DATA

Dimensions in mm

Fig.1 TO-220AC





	tag 1	tag 2
normal	k	a
reverse	a	k

Note: The exposed metal mounting base is directly connected to tag 1. 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(R)	400(R)	600(R)	800(R)	
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} = 100 °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; $\delta \leq$ 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: $R_{th\ j\text{-}a} \leq$ 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

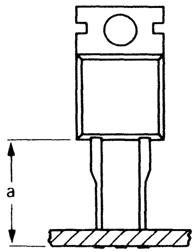


Fig.2

D8397

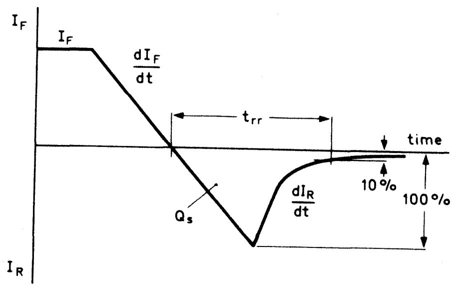
MOUNTING INSTRUCTIONS

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 tag 1, 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. 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.

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	normal polarity	I_R	<	0.4	mA	
	reverse polarity	I_R	<	0.6	mA	←
Reverse recovery when switched from 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	<	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	normal polarity	$\|dI_R/dt\|$	<	60	A/μs	
	reverse polarity	$\|dI_R/dt\|$	<	75	A/μs	←



D8403

Fig.3 Definition of t_{rr} and Q_s

*Measured under pulse conditions to avoid excessive dissipation.

SQUARE-WAVE OPERATION

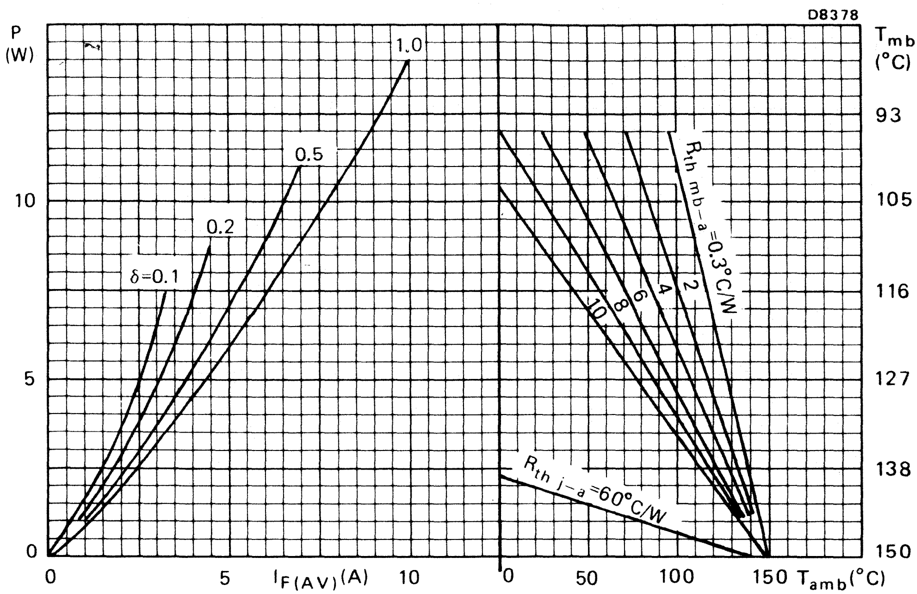
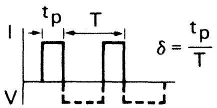


Fig. 4 The right-hand part shows the interrelationship between the power (derived from the left-hand part) and the maximum permissible temperatures.
P = power including reverse current losses but excluding switching losses.



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

SINUSOIDAL OPERATION

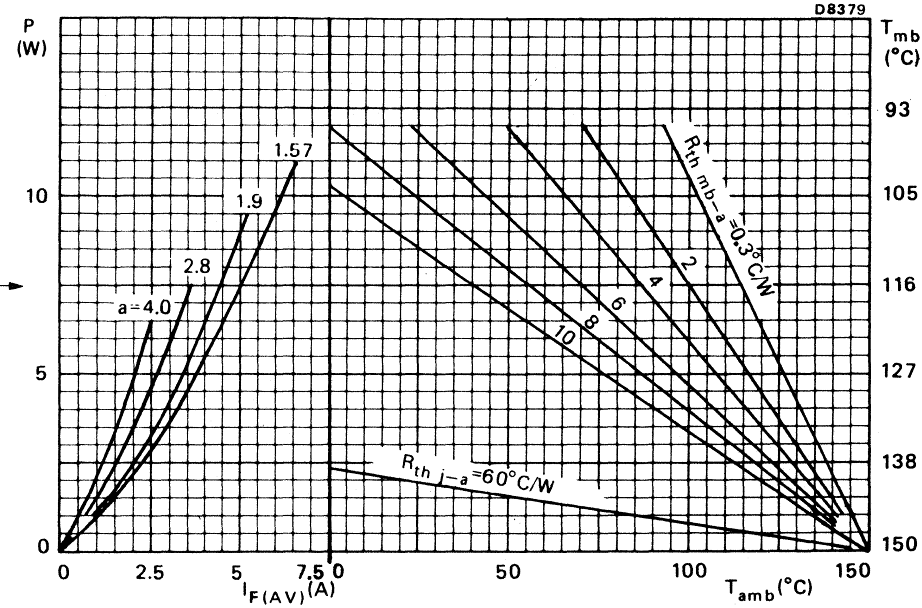


Fig. 5 The right-hand part shows the interrelationship between the power (derived from the left-hand part) and the maximum permissible temperatures.
P = power including reverse current losses but excluding switching losses.
a = form factor = $I_{F(RMS)}/I_{F(AV)}$.

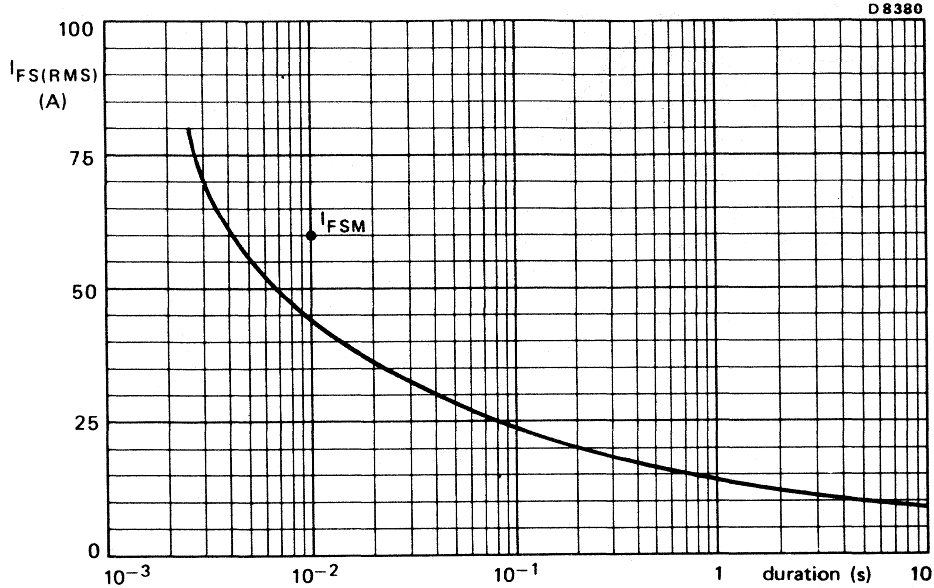
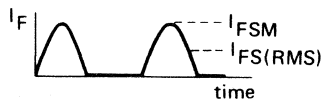


Fig. 6 Maximum permissible non-repetitive r.m.s. forward current based on sinusoidal currents (f = 50 Hz); T_j = 150 °C prior to surge; with reapplied V_{RWMmax}.



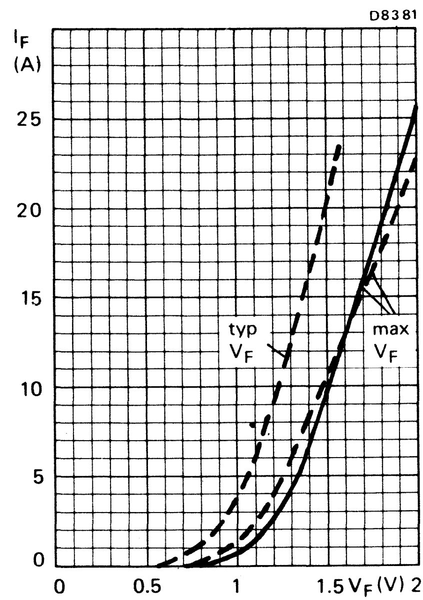


Fig. 7 —— T_j = 25 °C; – – – –T_j = 125 °C

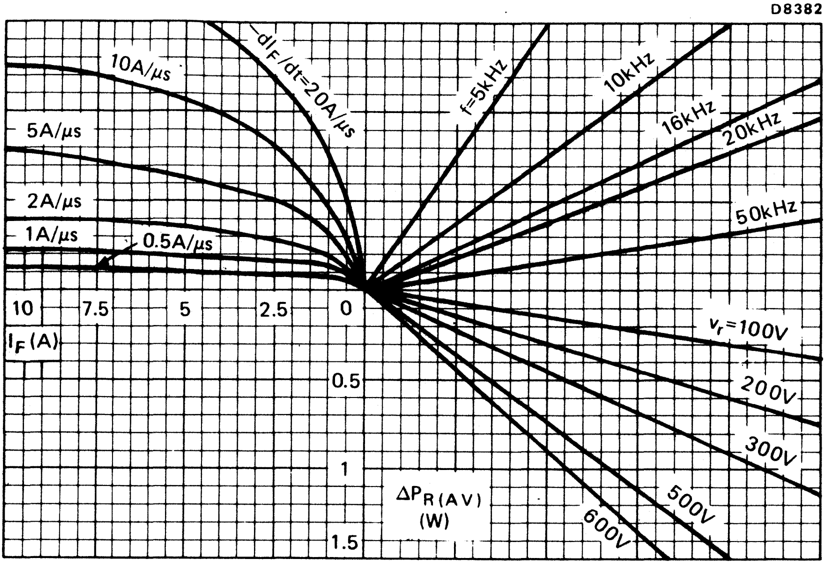
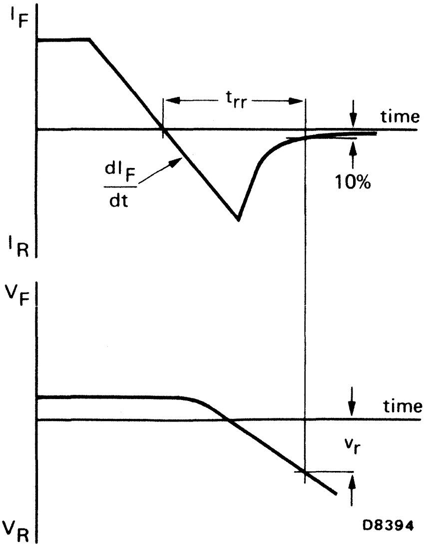


Fig. 8 NOMOGRAM

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



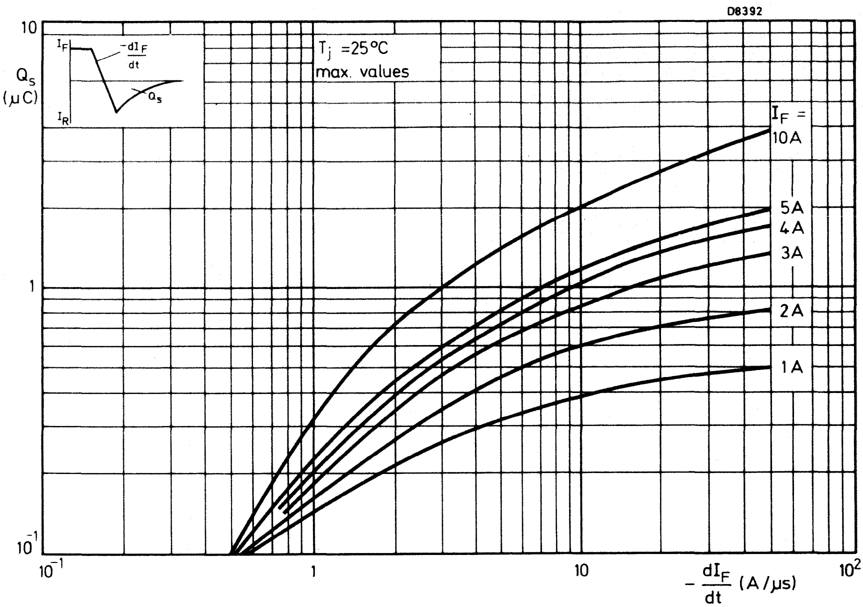

D8392
T_j =25°C
max. values
Q_s (μC)
I_F
$-\frac{dI_F}{dt}$
Q_s
I_R
I_F =
10A
5A
4A
3A
2A
1A
10
1
10^{-1}
1
10
10^2
$-\frac{dI_F}{dt}$ (A/μs)

Fig.9

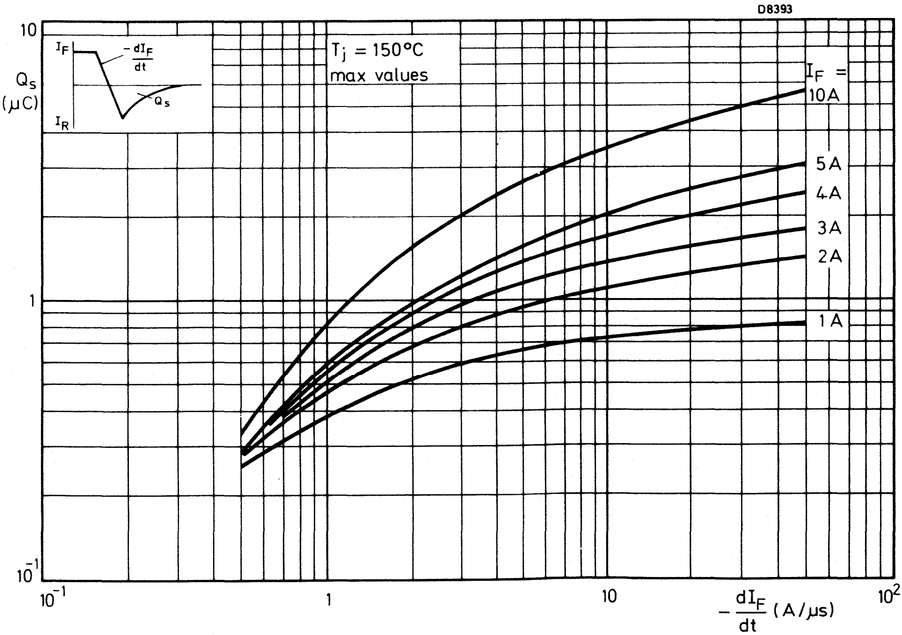

D8393
T_j = 150°C
max values
Q_s (μC)
I_F
$-\frac{dI_F}{dt}$
Q_s
I_R
I_F =
10A
5A
4A
3A
2A
1A
10
1
10^{-1}
1
10
10^2
$-\frac{dI_F}{dt}$ (A/μs)

Fig.10

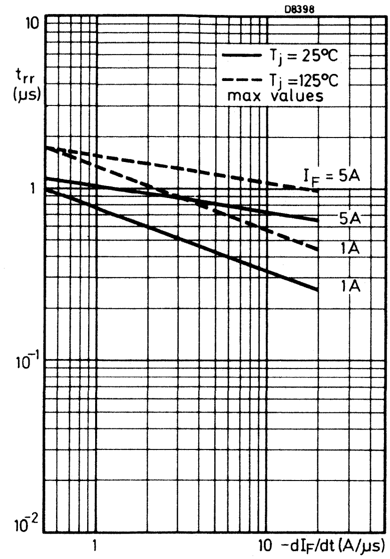


Fig. 11

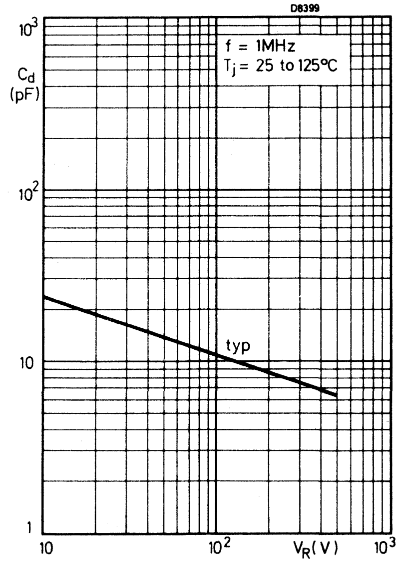


Fig. 12

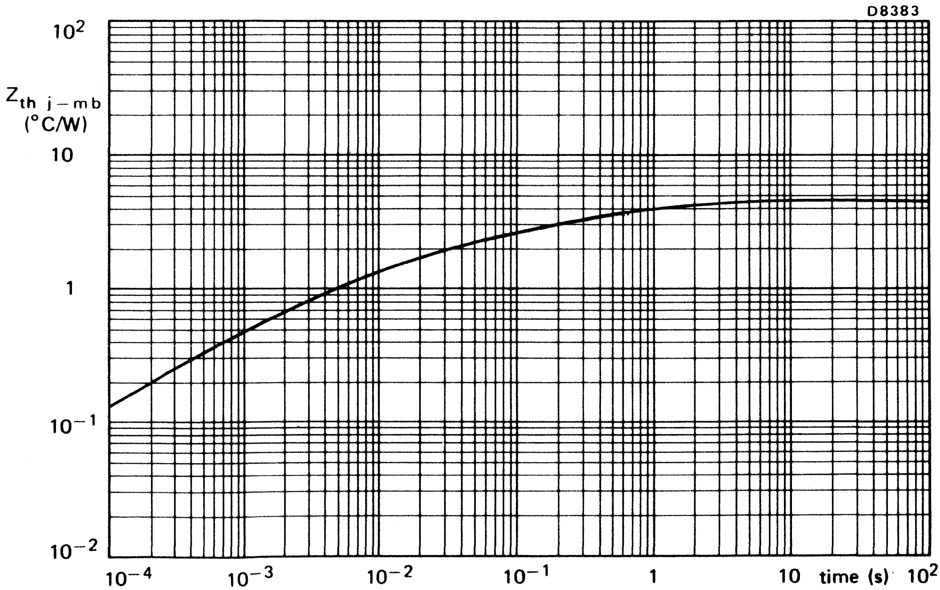


Fig. 13

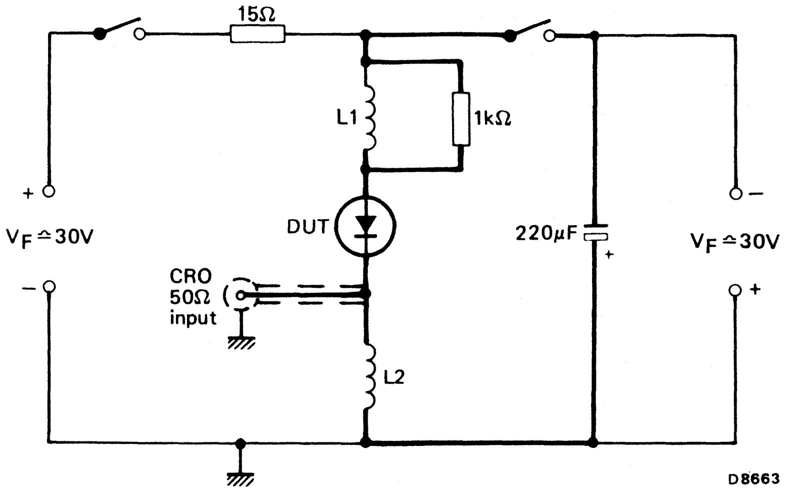


Fig.14 Simplified circuit diagram of practical apparatus to test softness of recovery.

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.

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 types (cathode to mounting base).

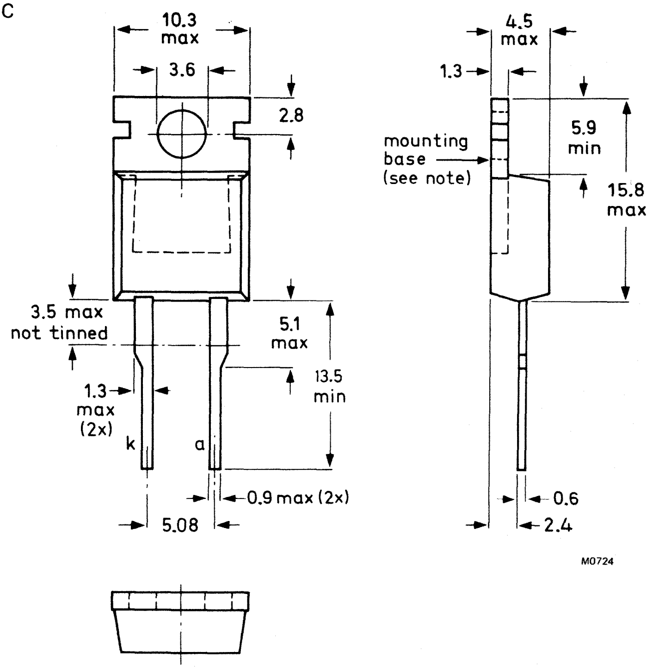
QUICK REFERENCE DATA

			BY329–800	1000	1200	
Repetitive peak reverse voltage	V_{RRM}	max.	800	1000	1200	V
Average forward current	$I_{F(AV)}$	max.		8		A
Non-repetitive peak forward current	I_{FSM}	max.		80		A
Reverse recovery time	t_{rr}	<		150		ns

MECHANICAL DATA

Dimensions in mm

Fig.1 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

			BY329–800	1000	1200	
Non-repetitive peak reverse voltage	V_{RSM}	max.	800	1000	1200	V
Repetitive peak reverse voltage	V_{RRM}	max.	800	1000	1200	V
Crest working reverse voltage	V_{RWM}	max.	600	800	1000	V

Currents

Average forward current assuming zero switching losses				
square-wave; δ = 0.5; up to T_{mb} = 108 °C	$I_{F(AV)}$	max.	8	A
square-wave; δ = 0.5; at T_{mb} = 125 °C	$I_{F(AV)}$	max.	5.3	A
sinusoidal; up to T_{mb} = 113 °C	$I_{F(AV)}$	max.	7	A
sinusoidal; at T_{mb} = 125 °C	$I_{F(AV)}$	max.	5.2	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 half sine-wave; T_j = 150 °C prior to surge; with reapplied $V_{RWM\,max}$	I_{FSM}	max.	80	A

Temperatures

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

THERMAL RESISTANCE

From junction to mounting base	$R_{th\ j\text{-}mb}$	=	3.0	°C/W

Influence of mounting method

1. Heatsink mounted with clip (see mounting instructions)

Thermal resistance from mounting base to heatsink

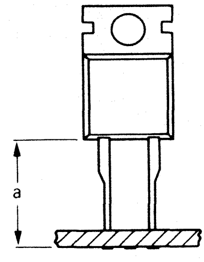
a. with heatsink compound	$R_{th\ mb\text{-}h}$	=	0.3	°C/W
b. with heatsink compound and 0.06 mm maximum mica insulator	$R_{th\ mb\text{-}h}$	=	1.4	°C/W
c. with heatsink compound and 0.1 mm maximum mica insulator (56369)	$R_{th\ mb\text{-}h}$	=	2.2	°C/W
d. with heatsink compound and 0.25 mm maximum alumina insulator (56367)	$R_{th\ mb\text{-}h}$	=	0.8	°C/W
e. without heatsink compound	$R_{th\ mb\text{-}h}$	=	1.4	°C/W

THERMAL RESISTANCE (continued)

2. Free-air operation	$R_{th\ j\text{-}a}$	=	60	°C/W

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.

Fig.2



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	<	1.0	mA
Reverse recovery when switched from 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	<	0.7	μC
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}	<	150	ns
Maximum slope of the reverse recovery current I_F = 2 A; $-dI_F/dt$ = 20 A/μs; T_j = 25 °C	$\lvert dI_R/dt \rvert$	<	60	A/μs

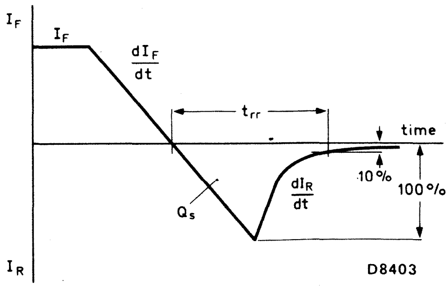


Fig.3 Definition of t_{rr} and Q_s

*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. 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.

SQUARE-WAVE OPERATION

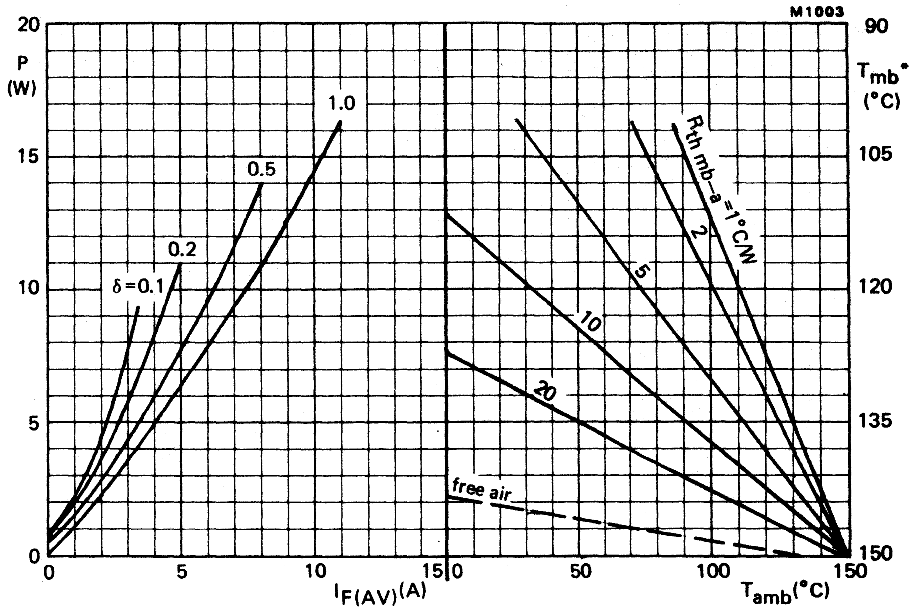
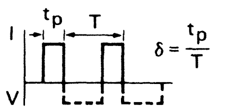


Fig.4 The right-hand part shows the interrelationship between the power (derived from the left-hand part) and the maximum permissible temperatures.
P = power including reverse current losses but excluding switching losses.



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

*T_{mb} scale is for comparison purposes and is correct only for $R_{th\ mb\text{-}a} < 10^oC/W$.

SINUSOIDAL OPERATION

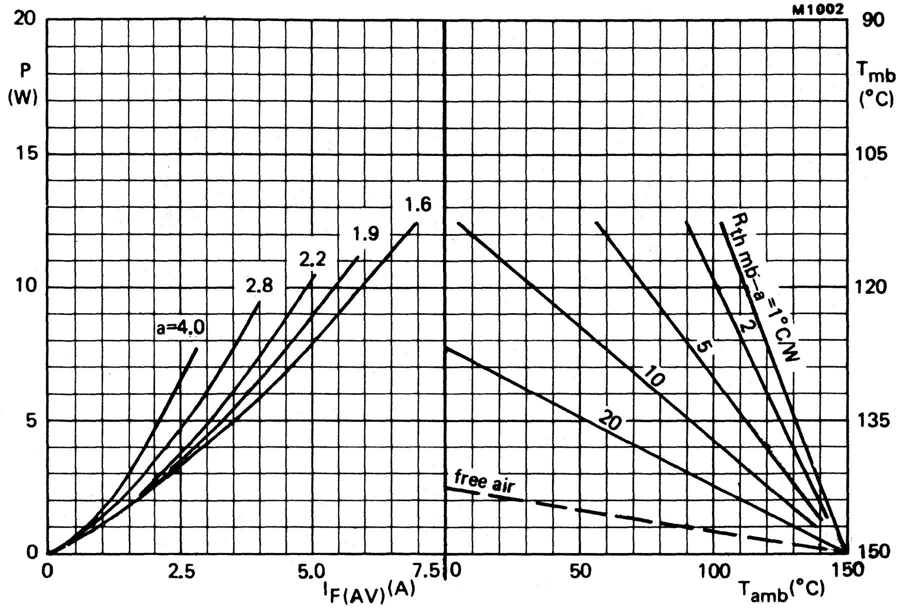


Fig.5 The right-hand part shows the interrelationship between the power (derived from the left-hand part) and the maximum permissible temperatures.
P = power including reverse current losses but excluding switching losses.
a = form factor = $I_{F(RMS)}/I_{F(AV)}$.

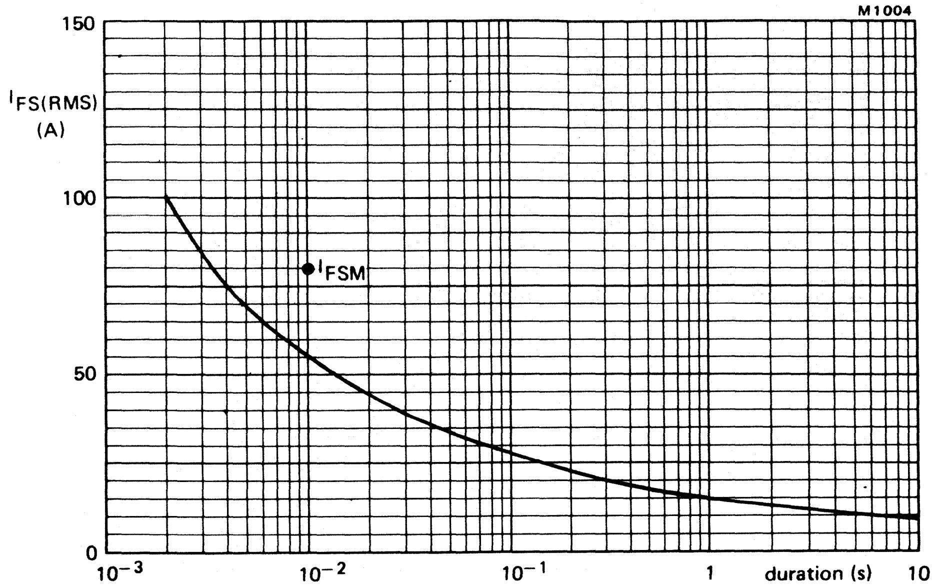
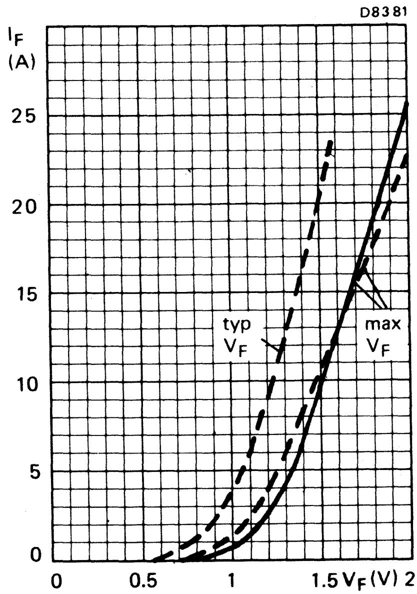


Fig.6 Maximum permissible non-repetitive r.m.s. forward current based on sinusoidal currents (f = 50 Hz); T_j = 150 °C prior to surge; with reapplied V_{RWMmax}.



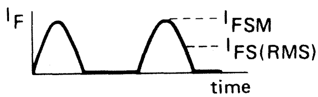


Fig.7 ——— T_j = 25 °C; – – – – T_j = 125 °C

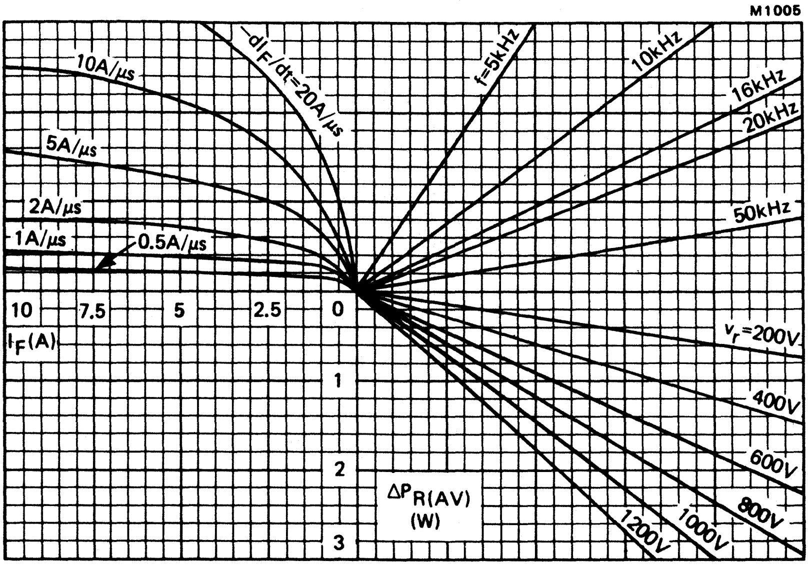
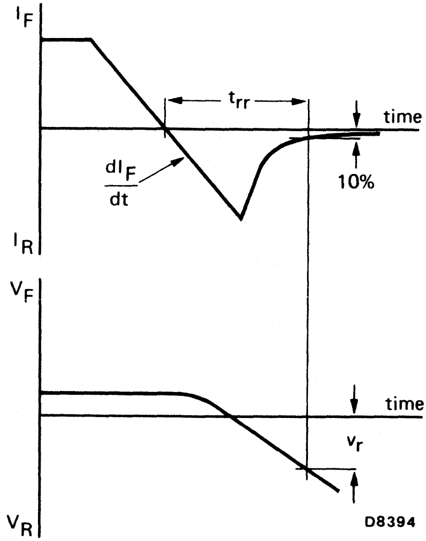


Fig.8 NOMOGRAM

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



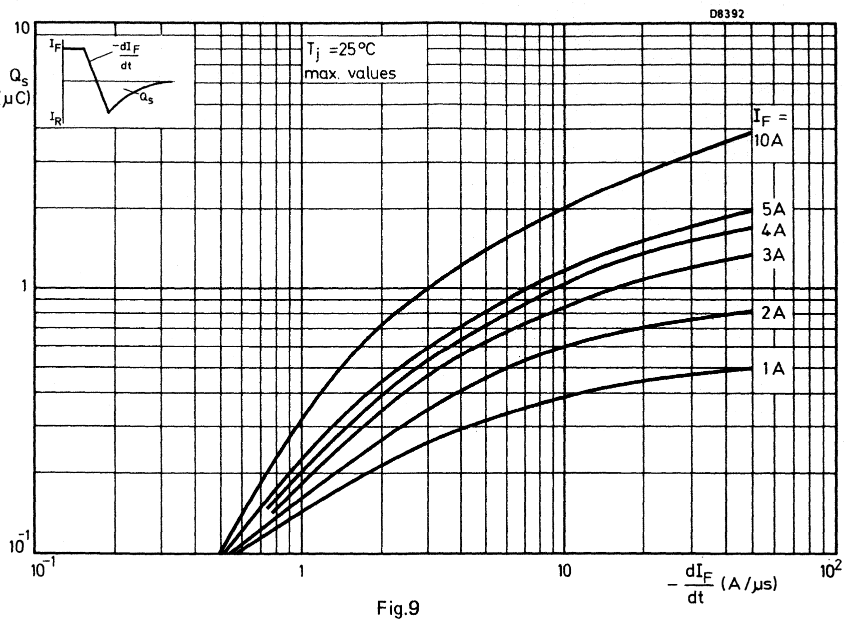

D8392
10
1
10^{-1}
Q_s (μC)
I_F
$-\frac{dI_F}{dt}$
Q_s
I_R
T_j =25°C
max. values
I_F =
10A
5A
4A
3A
2A
1A
10^{-1}
1
10
10^2
$-\frac{dI_F}{dt}$ (A/μs)

Fig.9

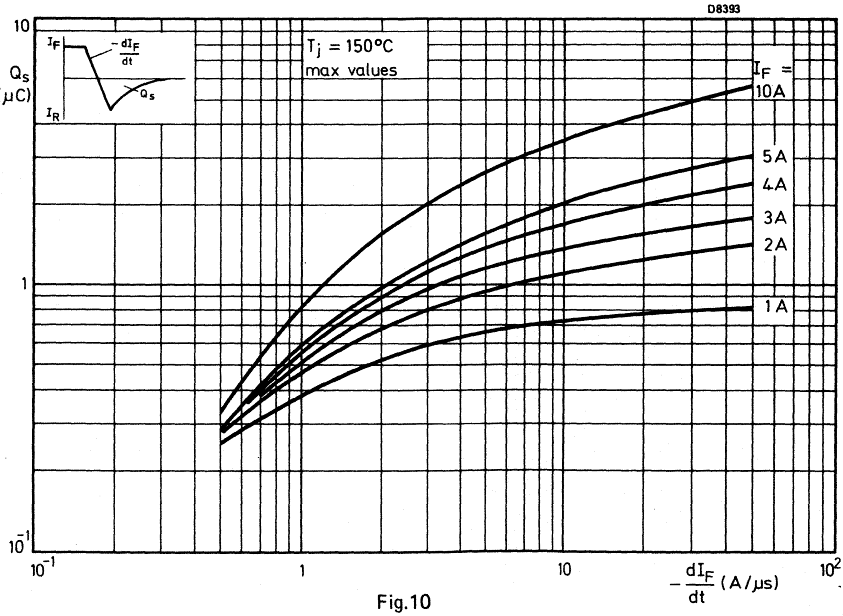

D8393
10
1
10^{-1}
Q_s (μC)
I_F
$-\frac{dI_F}{dt}$
Q_s
I_R
T_j = 150°C
max values
I_F =
10A
5A
4A
3A
2A
1A
10^{-1}
1
10
10^2
$-\frac{dI_F}{dt}$ (A/μs)

Fig.10

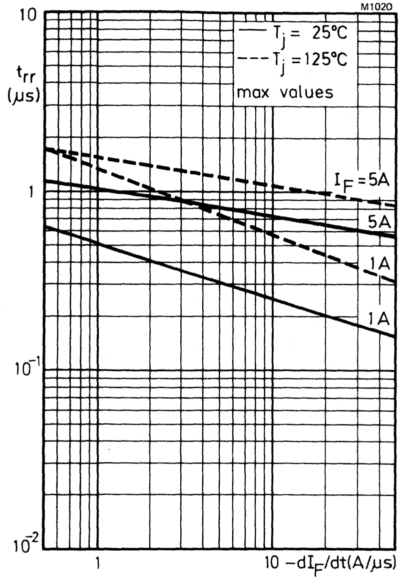


Fig.11

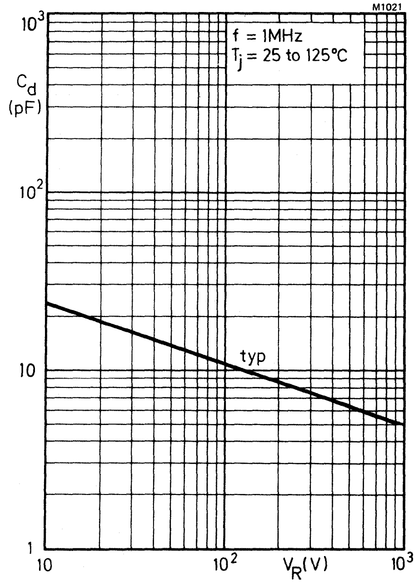


Fig.12

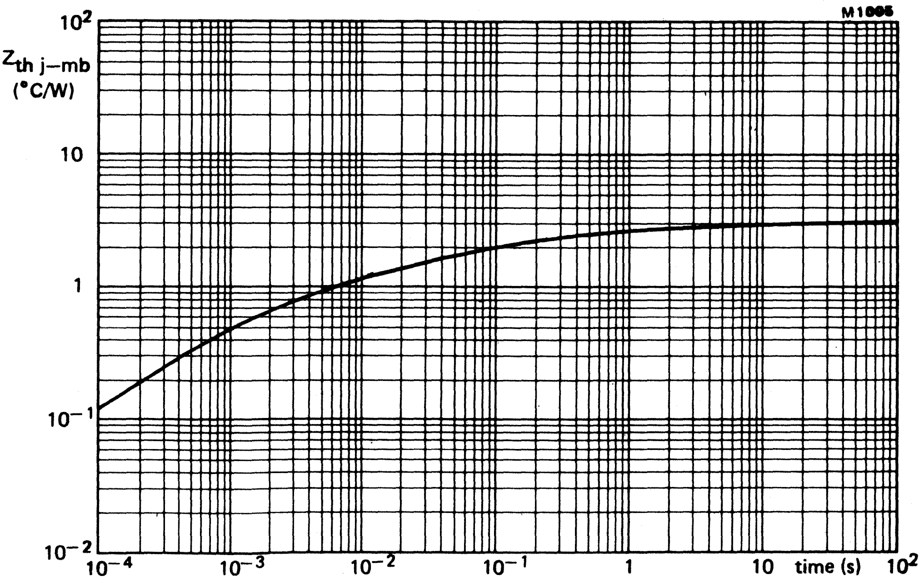


Fig.13

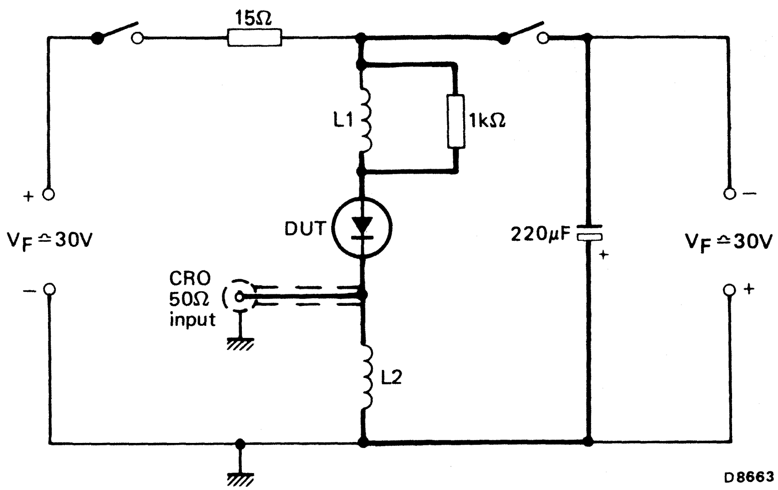


Fig.14 Simplified circuit diagram of practical apparatus to test softness of recovery.

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.

FAST HIGH-VOLTAGE RECTIFIER DIODES

Glass-passivated double-diffused rectifier diodes in TO-220 plastic envelopes, featuring fast recovery times. They are intended for use as an anti-parallel diode to GTOs and similar high-voltage switches, in chopper applications such as Series Resonant Power Supplies (SRPS) and other high-voltage circuits. The series consists of normal polarity types (cathode to mounting base).

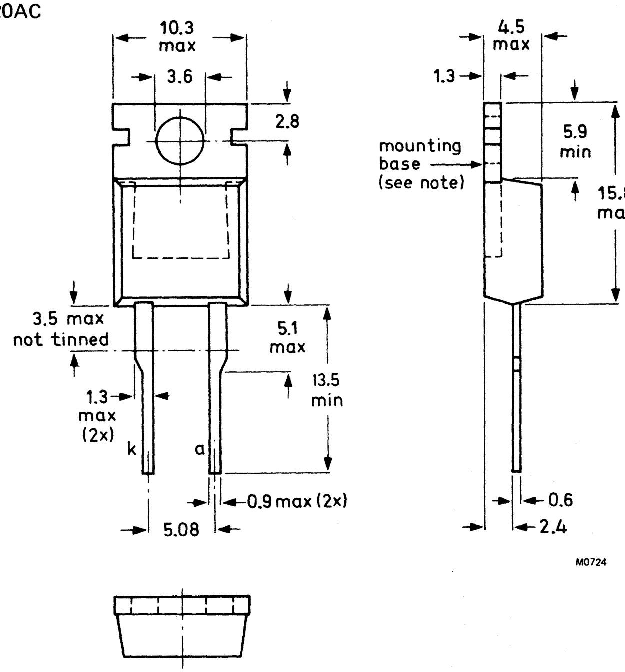
QUICK REFERENCE DATA

			BY359–1000	1300	1500	
Repetitive peak reverse voltage	V_{RRM}	max.	1000	1300	1500	V
Average forward current	$I_{F(AV)}$	max.		6.5		A ←
Non-repetitive peak forward current	I_{FSM}	max.		60		A
Reverse recovery time	t_{rr}	<		0.6		μs

MECHANICAL DATA

Dimensions in mm

Fig.1 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*

			BY359–1000	1300	1500	
Non-repetitive peak reverse voltage	V_{RSM}	max.	1100	1500	1650	
Repetitive peak reverse voltage	V_{RRM}	max.	1000	1300	1500	V
Crest working reverse voltage	V_{RWM}	max.	800	1200	1300	V
Continuous reverse voltage	V_R	max.	600	750	800	V

Currents

Average forward current assuming zero switching losses sinusoidal; → up to T_{mb} = 94 °C	$I_{F(AV)}$	max.	6.5	A
R.M.S. forward current	$I_{F(RMS)}$	max.	10	A
Repetitive peak froward current	I_{FRM}	max.	60	A
Non-repetitive peak forward current: t = 10 ms half sine-wave; T_j = 125 °C prior to surge; with reapplied $V_{RWM\ max}$	I_{FSM}	max.	60	A

Temperatures

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

THERMAL RESISTANCE

From junction to mounting base	$R_{th\ j\text{-}mb}$	=	3.0	°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

*To ensure thermal stability: $R_{th\ j\text{-}a} \leqslant 10.4$ °C/W for continuous reverse voltage.

THERMAL RESISTANCE (continued)

2. Free-air operation $R_{th\ j\text{-}a}$ = 60 °C/W

   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

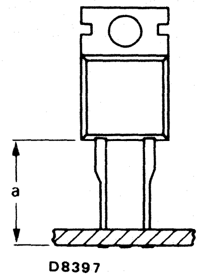


Fig.2

CHARACTERISTICS

Forward voltage				
I_F = 20 A; T_j = 25 °C	V_F	<	2.3	V*
Reverse current				
$V_R = V_{RWMmax}$; T_j = 100 °C	I_R	<	0.6	mA
Reverse recovery when switched from				
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	<	2.0	µC
recovery time	t_{rr}	<	0.6	µs
Forward recovery when switched to				
I_F = 5 A with t_r = 0.1 µs; T_j = 25 °C				
recovery time	t_{fr}	<	1.0	µs

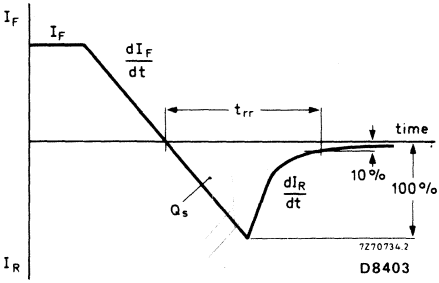


Fig.3 Definition of t_{rr} and Q_s.

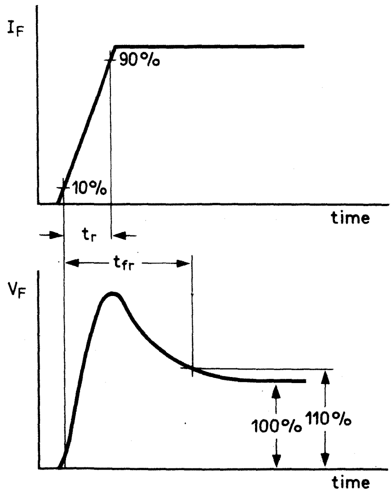


Fig.4 Definition of t_{fr}.

*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. 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.

SINUSOIDAL OPERATION

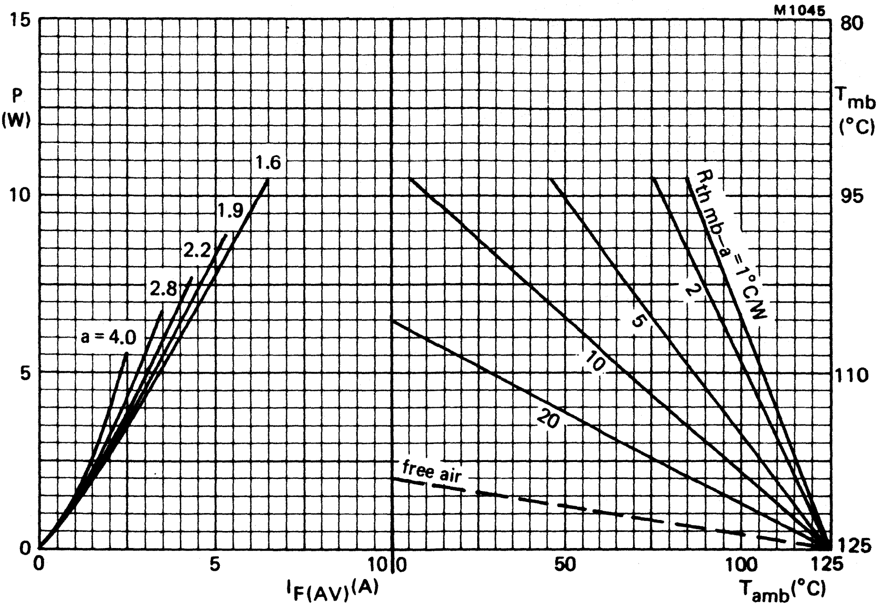


Fig.5 The right-hand part shows the interrelationship between the power (derived from the left-hand part) and the maximum permissible temperatures.
P = power including reverse current losses but excluding switching losses.
a = form factor = $I_{F(RMS)}/I_{F(AV)}$.

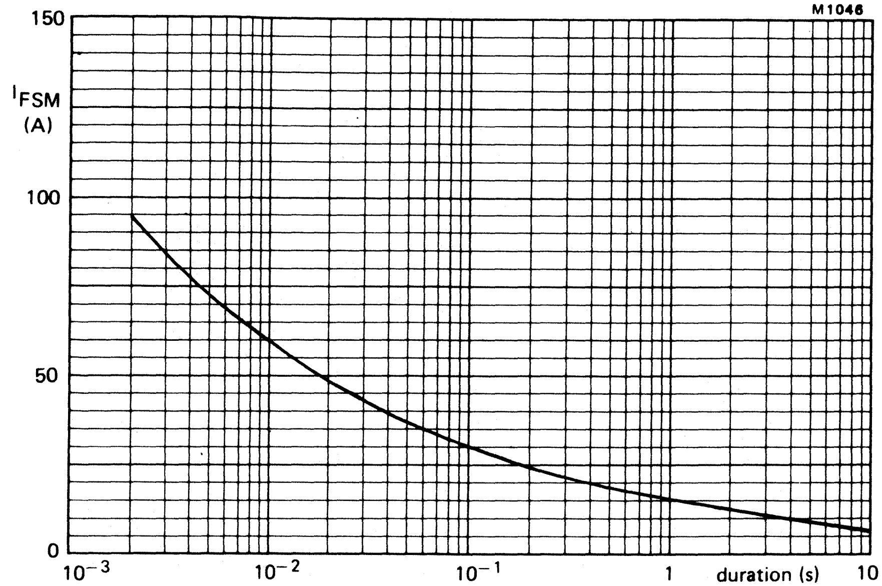
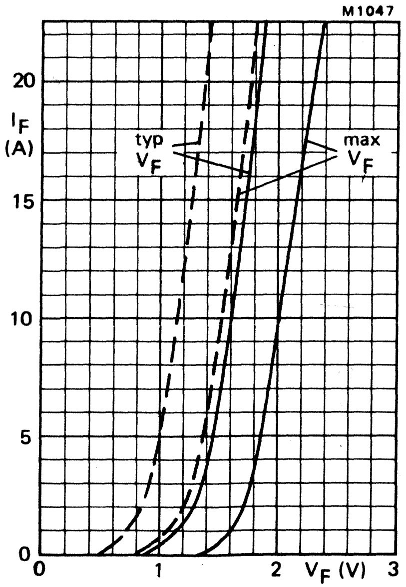


Fig.6 Maximum permissible non-repetitive peak forward current based on sinusoidal currents (f = 50 Hz); T_j = 125 °C prior to surge; with reapplied V_{RWMmax}.



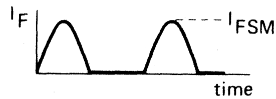


Fig.7 ——— T_j = 25 °C; – – – – T_j = 100 °C.

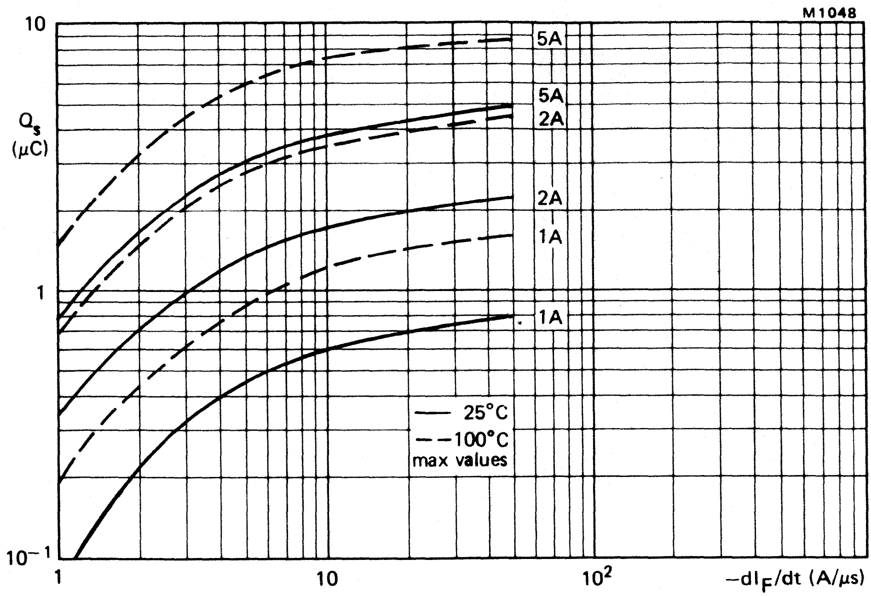

M1048
10
Q_s
(μC)
1
10^{-1}
1
10
10^2
$-dI_F/dt$ (A/μs)
5A
5A
2A
2A
1A
1A
— 25°C
-- 100°C
max values

Fig.8

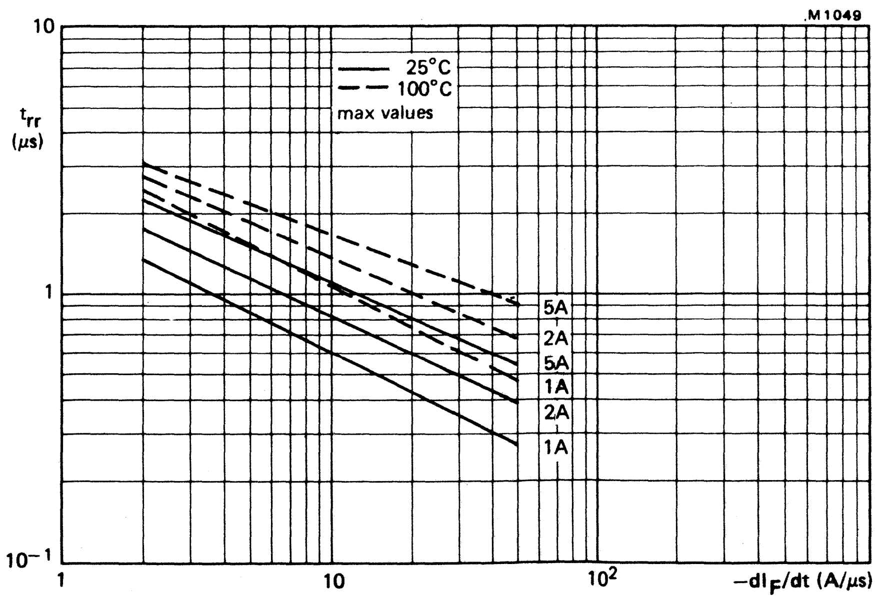

M1049
10
t_{rr}
(μs)
1
10^{-1}
1
10
10^2
$-dI_F/dt$ (A/μs)
25°C
100°C
max values
5A
2A
5A
1A
2A
1A

Fig.9

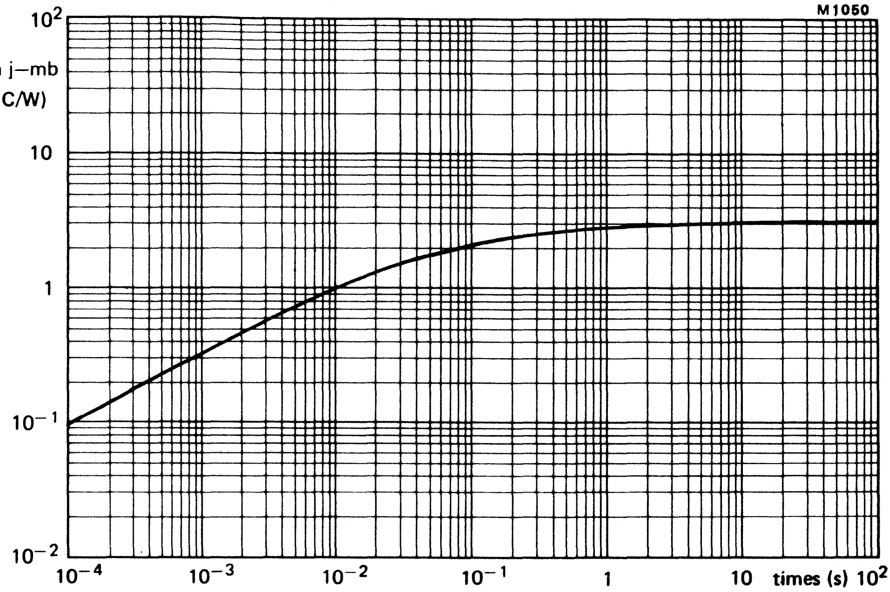


Fig.10

ULTRA FAST RECOVERY DOUBLE RECTIFIER DIODES

Glass-passivated, high-efficiency epitaxial double rectifier diodes in plastic envelopes which feature low forward voltage drop, very fast reverse recovery times and soft recovery characteristic. They are intended for use in switched-mode power supplies, and high-frequency circuits in general, where low conduction and switching losses are essential. Their single chip construction ensures excellent matching of the forward and switching characteristics of the two halves, allowing parallel operation without derating. The series consists of common cathode types.

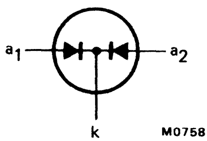
QUICK REFERENCE DATA

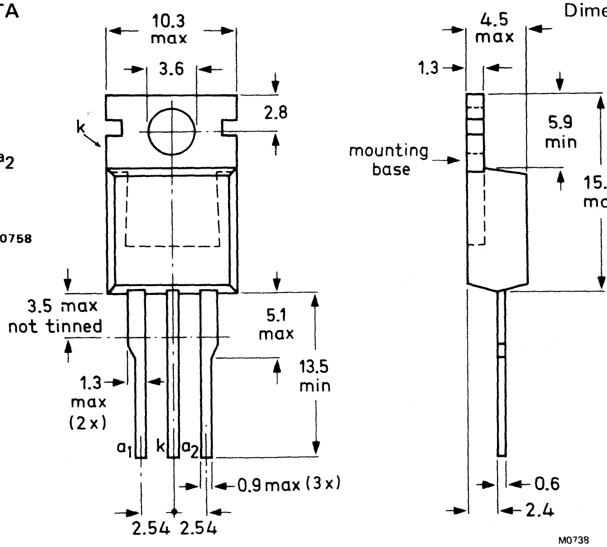
Per diode, unless otherwise stated			BYQ28–50	100	150	200	
Repetitive peak reverse voltage	V_{RRM}	max.	50	100	150	200	V
Output current (both diodes conducting)	I_O	max.		10			A
Forward voltage	V_F	<		0.85			V
Reverse recovery time	t_{rr}	<		20			ns

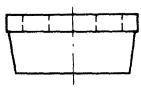
MECHANICAL DATA

Fig.TO-220AB

Dimensions in mm







Net mass: 2 g

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 (IEC134)

Voltages (per diode)

			BYQ28–50	100	150	200	
Repetitive peak reverse voltage	V_{RRM}	max.	50	100	150	200	V
Crest working reverse voltage	V_{RWM}	max.	50	100	150	200	V
Continuous reverse voltage	V_R	max.	50	100	150	200	V

Currents (both diodes conducting; note 1)

Output current				
square wave; δ = 0.5; up to T_{mb} = 128 °C	I_O	max.	10	A
sinusoidal; up to T_{mb} = 130 °C	I_O	max.	10	A
R.M.S. forward current	$I_{F(RMS)}$	max.	10	A
Repetitive peak forward current t_p = 20 μs; δ = 0.02 (note 2)	I_{FRM}	max.	80	A
Non-repetitive peak forward current half sine-wave; T_j = 150 °C prior to surge with re-applied $V_{RWM\ max}$ (note 2)				
t = 10 ms	I_{FSM}	max.	50	A
t = 8.3 ms	I_{FSM}	max.	60	A
I^2t for fusing (t = 10 ms; note 2)	I^2t	max.	12.5	A^2s

Temperatures

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

THERMAL RESISTANCE

From junction to mounting base; total package	$R_{th\ j\text{-}mb}$	=	2.2	K/W
per diode	$R_{th\ j\text{-}mb}$	=	3.0	K/W
From mounting base to heatsink				
a. with heatsink compound	$R_{th\ mb\text{-}h}$	=	0.2	K/W
b. without heatsink compound	$R_{th\ mb\text{-}h}$	=	0.3	K/W

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 any lead length	$R_{th\ j\text{-}a}$	=	60	K/W

Notes:

1. The limits for both diodes apply whether both diodes conduct simultaneously or on alternate half cycles.
2. Figures apply to each diode.

CHARACTERISTICS (per diode)

Forward voltage				
I_F = 5 A; T_j = 150 °C	V_F	<	0.85	V*
I_F = 15 A; T_j = 25 °C	V_F	<	1.3	V*
Reverse current				
$V_R = V_{RWM\,max}$; T_j = 100 °C	I_R	<	0.2	mA
$V_R = V_{RWM\,max}$; T_j = 25 °C	I_R	<	10	μA
Reverse recovery when switched from				
I_F = 1 A to $V_R \geq$ 30 V with $-dI_F/dt$ = 100 A/μs; T_j = 25 °C recovery time	t_{rr}	<	20	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	<	5.5	nC
I_F = 5 A to $V_R \geq$ 30 V with $-dI_F/dt$ = 50 A/μs; T_j = 100 °C peak recovery current	I_{RRM}	<	1.2	A
Forward recovery when switched to I_F = 1 A with dI_F/dt = 10 A/μs; T_j = 25 °C recovery voltage	V_{fr}	typ.	1.0	V

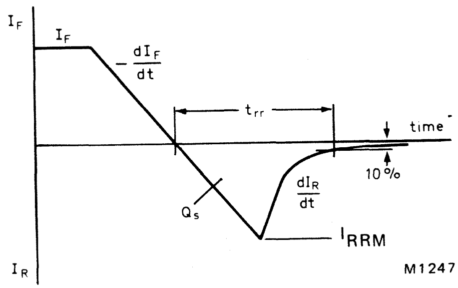


Fig.2 Definition of t_{rr}, Q_s and I_{RRM}.

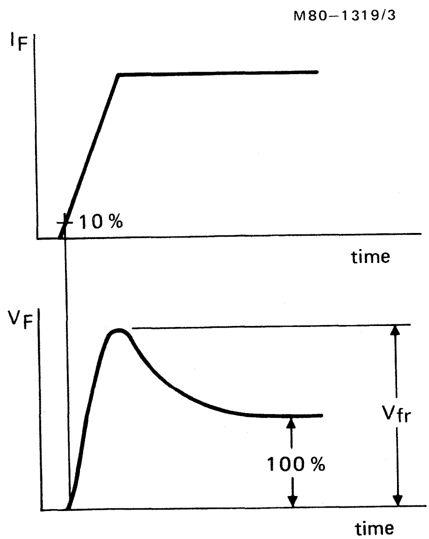


Fig.3 Definition of V_{fr}.

*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 less than 2.4 mm from the seal, and should be supported during bending.
3. 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 the 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.
4. 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.
5. 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.

OPERATING NOTES

Dissipation and heatsink considerations:

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

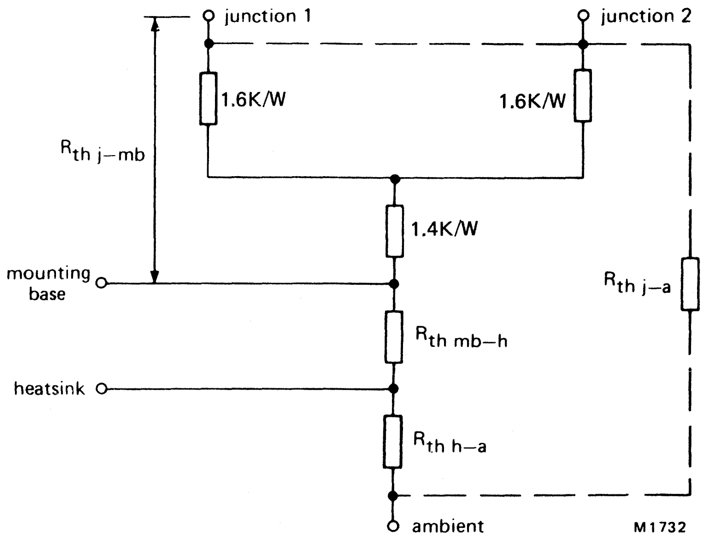


Fig. 4

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

SQUARE-WAVE OPERATION (PER DIODE)

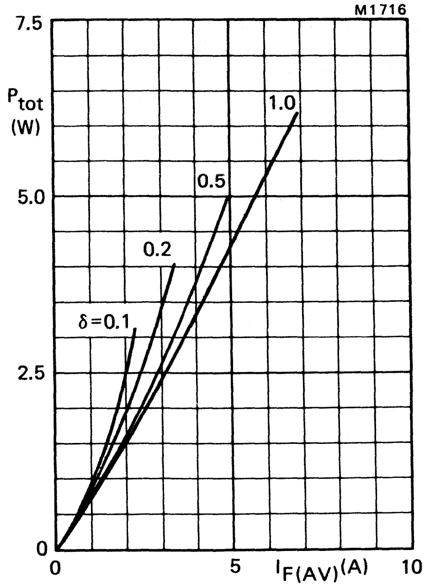
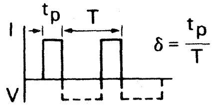


Fig.5 Power rating per diode.
The individual power loss in each diode should first be determined then both added together. The resulting total power loss is then used in conjunction with Fig.6 to determine the heatsink size and corresponding maximum ambient and mounting base temperatures.



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

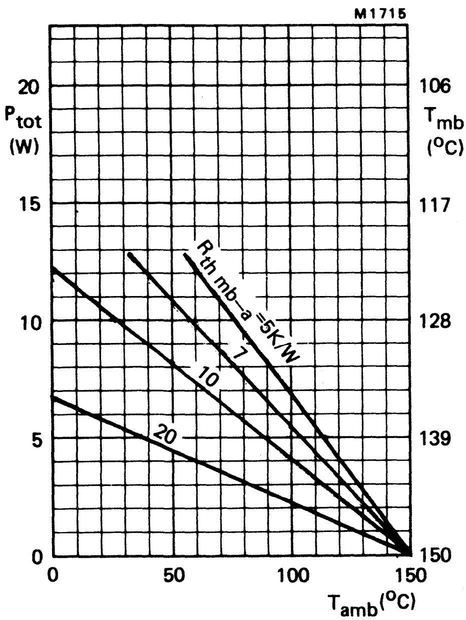


Fig.6

SINUSOIDAL OPERATION (PER DIODE)

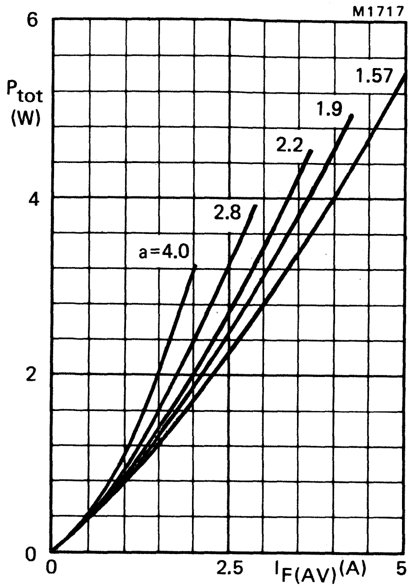


Fig.7 Power rating per diode.
The individual power loss in each diode should first be determined then both added together. The resulting total power loss is then used in conjunction with Fig.6 to determine the heatsink size and corresponding maximum ambient and mounting base temperatures.

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

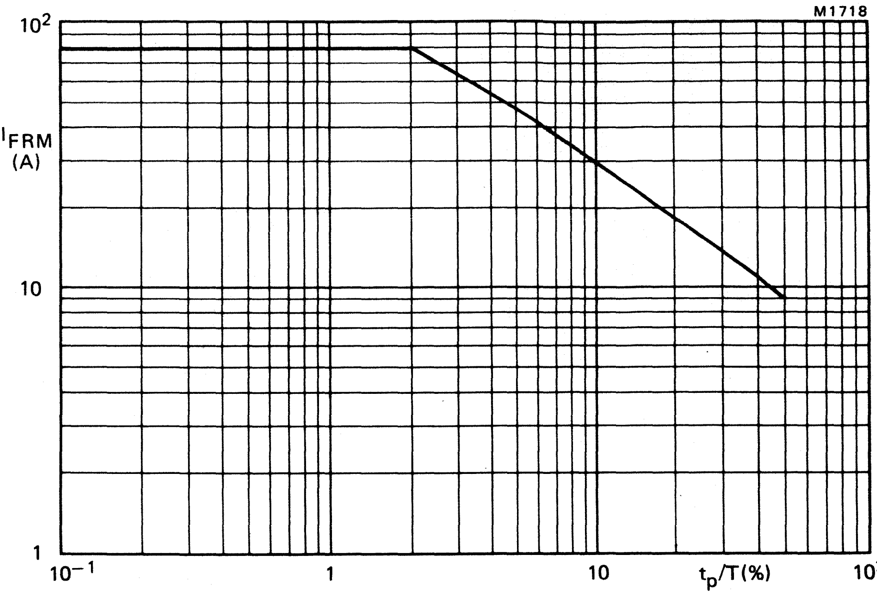
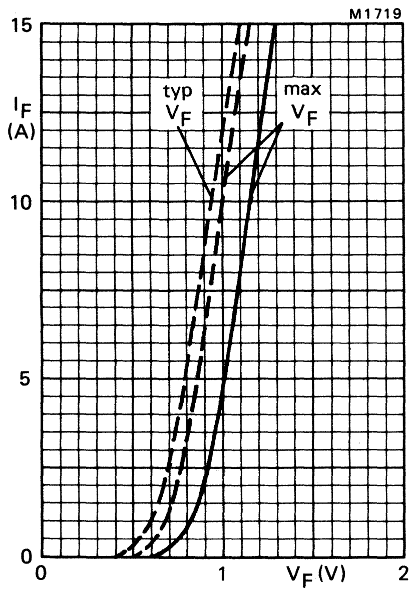
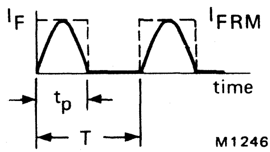


Fig.8 Maximum permissible repetitive peak forward current for either square or sinusoidal currents for 1 $\mu s < t_p < 1$ ms.





Definition of I_{FRM} and t_p/T

Fig.9 —— $T_j = 25\ ^oC$; – – – $T_j = 150\ ^oC$ per diode.

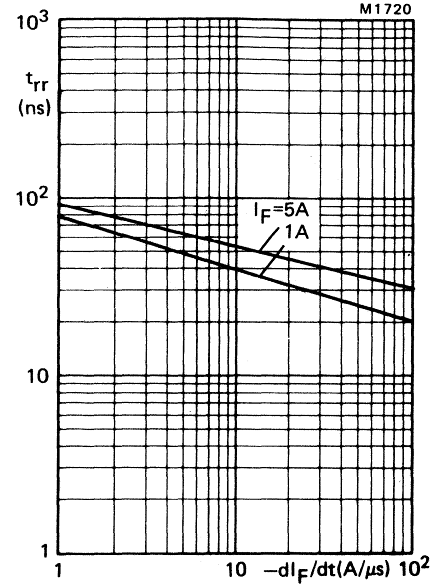


Fig.10 Maximum t_{rr} at T_j = 25 °C.

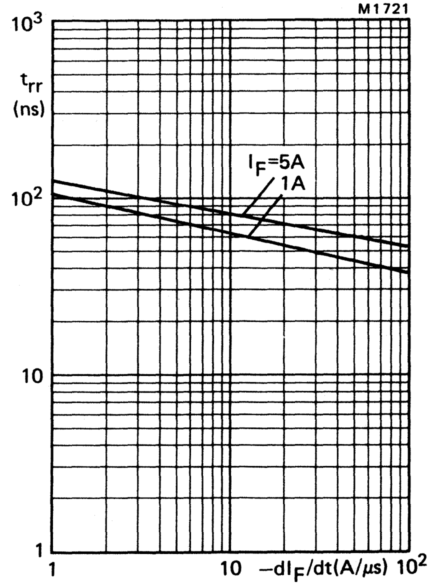


Fig.11 Maximum t_{rr} at T_j = 100 °C.

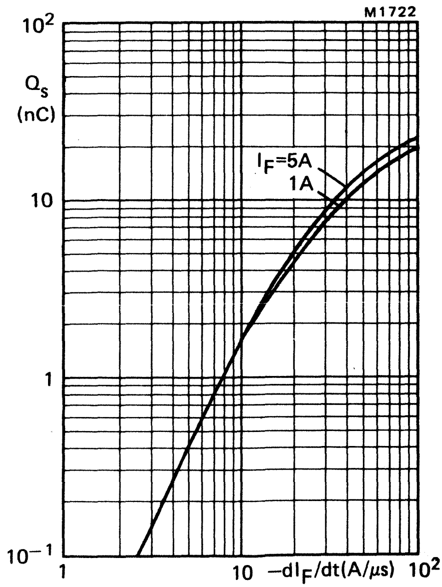


Fig.12 Maximum Q_s at T_j = 25 °C.

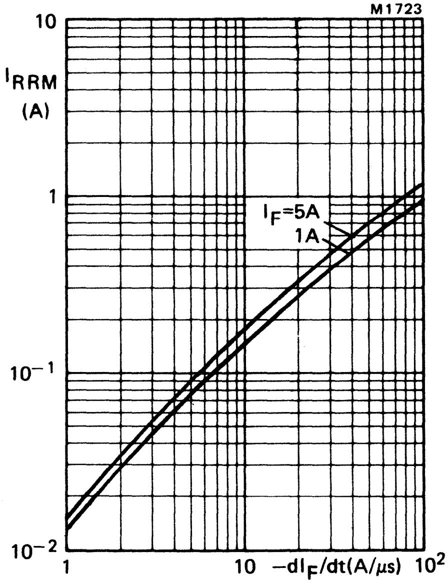


Fig.13 Maximum I_{RRM} at T_j = 25 °C

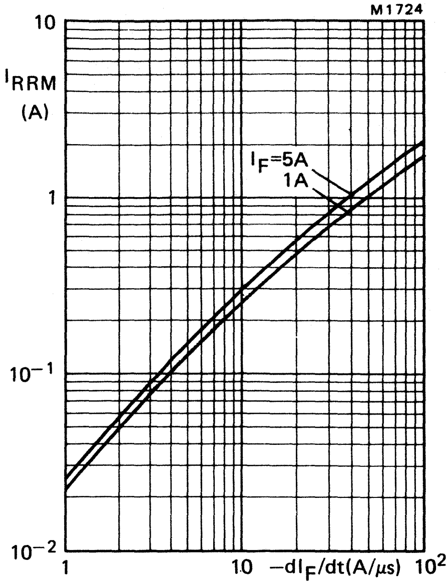


Fig.14 Maximum I_{RRM} at T_j = 100 °C;

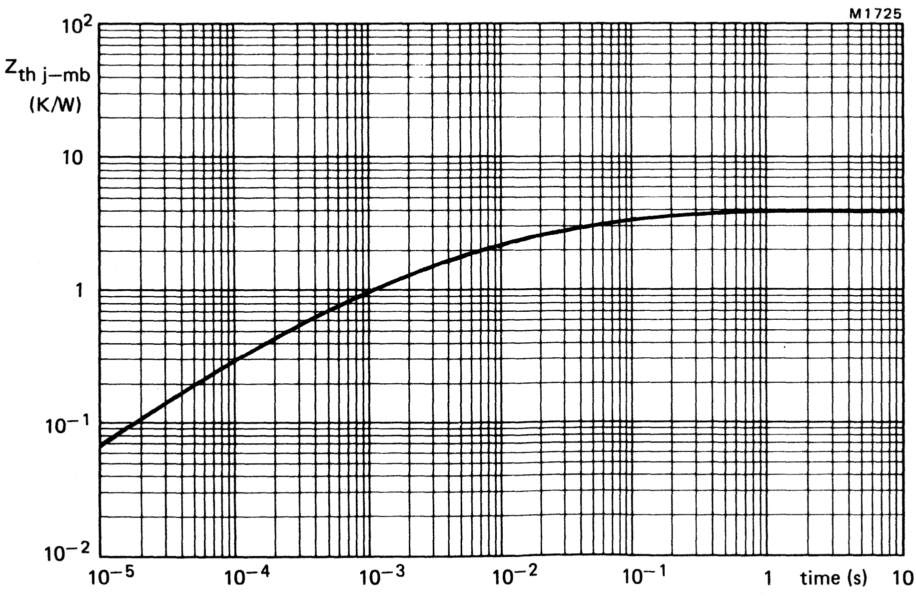


Fig.15 One diode conducting.

ULTRA FAST RECOVERY RECTIFIER DIODES

Glass-passivated, high-efficiency epitaxial rectifier diodes in plastic envelopes, featuring low forward voltage drop, ultra fast reverse recovery times, very low stored charge and soft recovery characteristic. 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.

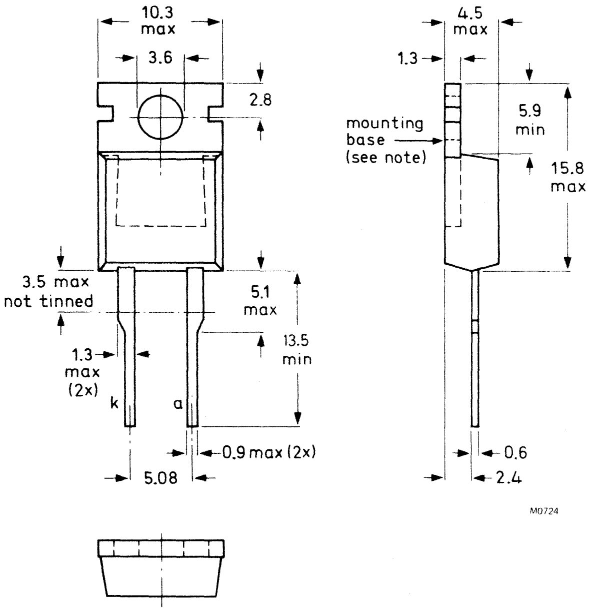
QUICK REFERENCE DATA

			BYR29–600	800	
Repetitive peak reverse voltage	V_{RRM}	max.	600	800	V
Average forward current	$I_{F(AV)}$	max.	8		A
Forward voltage	V_F	$<$	1.3		V
Reverse recovery time	t_{rr}	$<$	75		ns

MECHANICAL DATA

Dimensions in mm

Fig.1 TO-220AC



Net mass: 2 g

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 (IEC134).

Voltages

			BYR29–600	800	
Repetitive peak reverse voltage	V_{RRM}	max.	600	800	V
Crest working reverse voltage	V_{RWM}	max.	500	600	V
Continuous reverse voltage*	V_R	max.	500	600	V

Currents

Average forward current; switching losses negligible up to 100 kHz				
square wave; $\delta = 0.5$; up to $T_{mb} = 117\ ^oC$	$I_{F(AV)}$	max.	8	A
up to $T_{mb} = 125\ ^oC$	$I_{F(AV)}$	max.	6.5	A
sinusoidal; up to $T_{mb} = 120\ ^oC$	$I_{F(AV)}$	max.	7.8	A
up to $T_{mb} = 125\ ^oC$	$I_{F(AV)}$	max.	7.2	A
R.M.S. forward current	$I_{F(RMS)}$	max.	11.5	A
Repetitive peak forward current $t_p = 20\ \mu s$; $\delta = 0.02$	I_{FRM}	max.	130	A
Non-repetitive peak forward current half sine-wave; $T_j = 150\ ^oC$ prior to surge; with reapplied V_{RWMmax};				
t = 10 ms	I_{FSM}	max.	60	A
t = 8.3 ms	I_{FSM}	max.	72	A
I^2t for fusing (t = 10 ms)	I^2t	max.	18	A^2s

Temperatures

Storage temperature	T_{stg}		−40 to +150	^oC
Junction temperature	T_j	max.	150	^oC

*To ensure thermal stability: $R_{th\ j\text{-}a} \leqslant 5.7$ K/W.

CHARACTERISTICS

Forward voltage				
I_F = 10 A; T_j = 150 °C	V_F	<	1.30	V*
I_F = 25 A; T_j = 25 °C	V_F	<	1.75	V*
Reverse current				
$V_R = V_{RWM\,max}$; T_j = 100 °C	I_R	<	0.2	mA
T_j = 25 °C	I_R	<	10	µA
Reverse recovery when switched from				
I_F = 1 A to $V_R \geq 30$ V with $-dI_F/dt$ = 100 A/µs, T_j = 25 °C; recovery time	t_{rr}	<	75	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	<	200	nC
I_F = 10 A to $V_R \geq 30$ V with $-dI_F/dt$ = 50 A/µs; T_j = 100 °C; peak recovery current	I_{RRM}	<	6	A
Forward recovery when switched to I_F = 10 A with dI_F/dt = 10 A/µs; T_j = 25 °C	V_{fr}	typ.	5	V

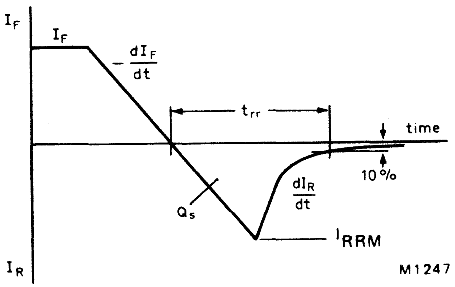


Fig.2 Definition of t_{rr}, Q_s and I_{RRM}.

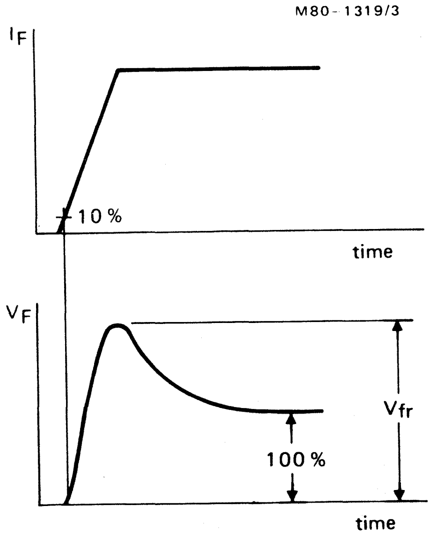


Fig.3 Definition of V_{fr}.

*Measured under pulse conditions to avoid excessive dissipation.

THERMAL RESISTANCE

From junction to mounting base	$R_{th\ j\text{-}mb}$	=	2.5	K/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	K/W
b. with heatsink compound and 0.06 mm maximum mica insulator	$R_{th\ mb\text{-}h}$	=	1.4	K/W
c. with heatsink compound and 0.1 mm maximum mica insulator (56369)	$R_{th\ mb\text{-}h}$	=	2.2	K/W
d. with heatsink compound and 0.25 mm maximum alumina insulator (56367)	$R_{th\ mb\text{-}h}$	=	0.8	K/W
e. without heatsink compound	$R_{th\ mb\text{-}h}$	=	1.4	K/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	K/W

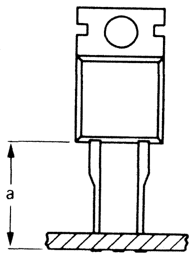


Fig.4

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. 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.

OPERATING NOTES

Dissipation and heatsink considerations:

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

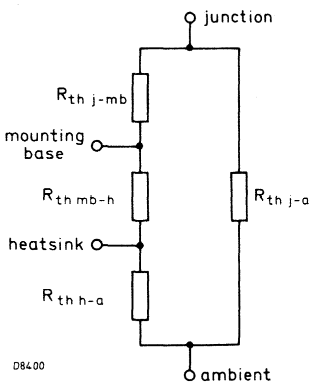


Fig.5

b. The method of using Figs.6 and 7 is as follows:
Starting with the required current on the $I_{F(AV)}$ axis, trace upwards to meet the appropriate duty factor or 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.

SQUARE-WAVE OPERATION

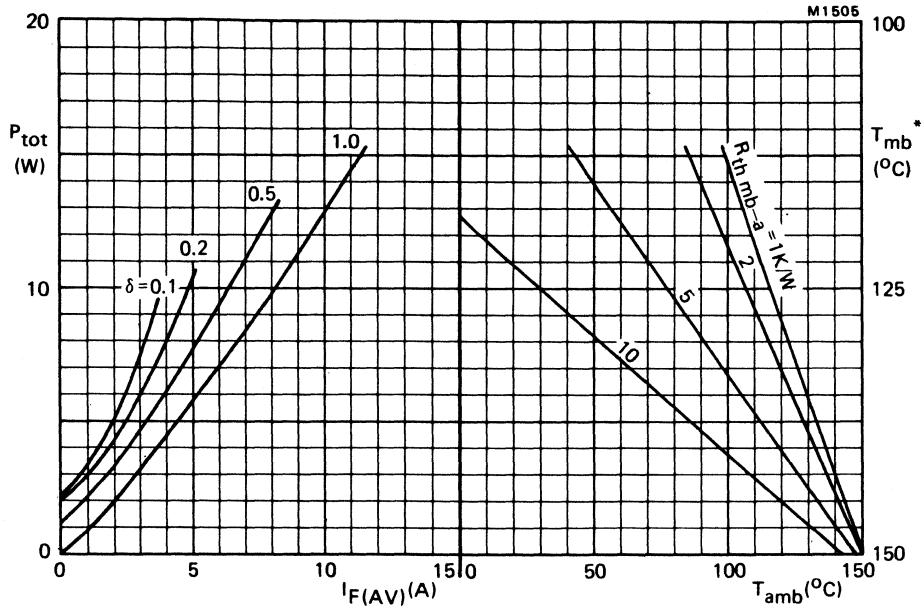
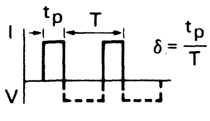


Fig.6 The right-hand part shows the relationship between the power (derived from the left-hand part) and the maximum permissible temperatures. Power includes reverse current losses and switching losses up to f = 100 kHz.



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

*T_{mb} scale is for comparison purposes and is correct only for $R_{th\ mb\text{-}a} < 3.2$ K/W.

SINUSOIDAL OPERATION

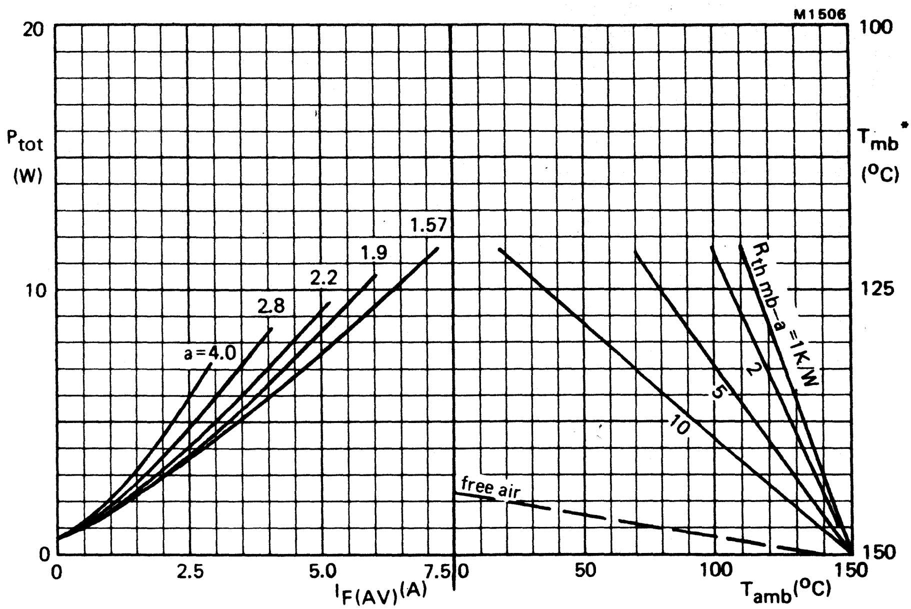


Fig.7 The right-hand part shows the interrelationship between the power (derived from the left-hand part) and the maximum permissible temperatures.
a = form factor = $I_{F(RMS)}/I_{F(AV)}$.

*T_{mb} scale is for comparison purposes and is correct only for $R_{th\ mb-a} < 16$ K/W.

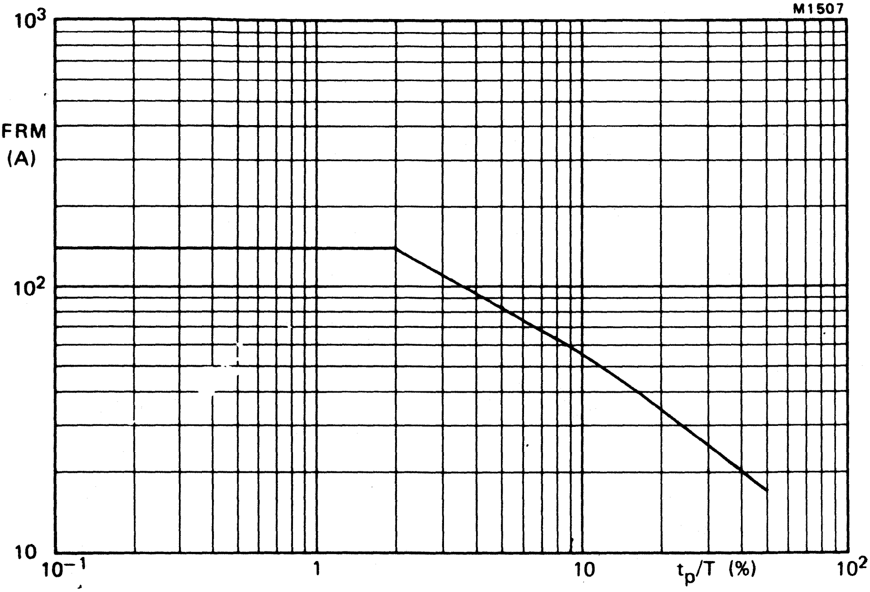
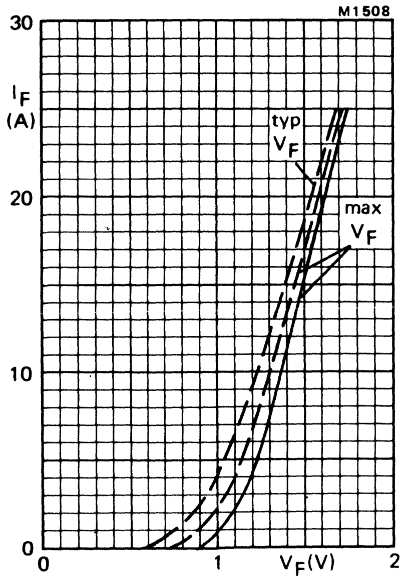
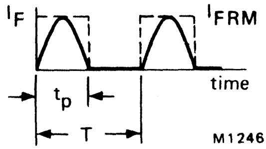


Fig.8 Maximum permissible repetitive peak forward current for square or sinusoidal currents; 1 $\mu s < t_p < 1$ ms.





Definition of I_{FRM} and t_p/T.

Fig.9 —— T_j = 25 °C; – – – T_j = 150 °C.

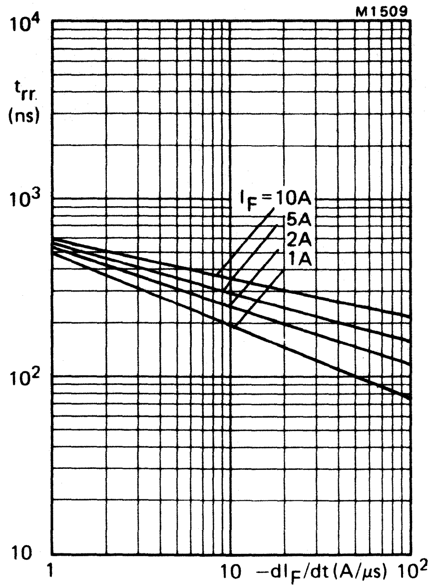


Fig.10 Maximum t_{rr} at T_j = 25 °C.

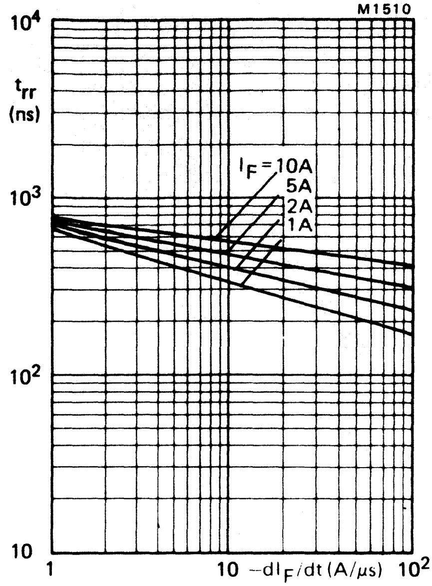


Fig.11 Maximum t_{rr} at T_j = 100 °C.

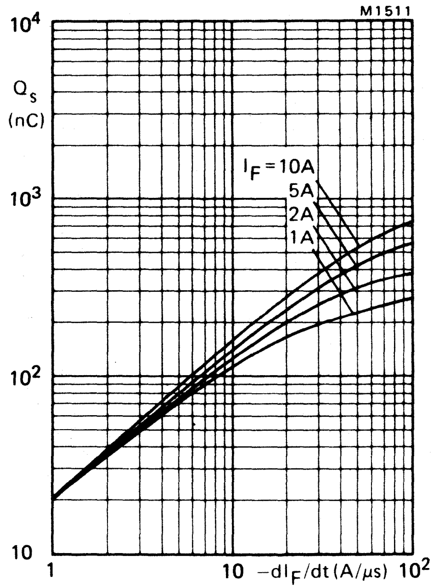


Fig.12 Maximum Q_s at T_j = 25 °C

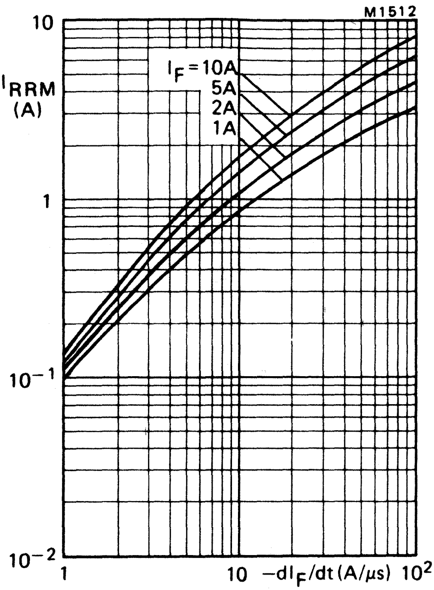


Fig. 13 Maximum I_{RRM} at T_j = 25 °C.

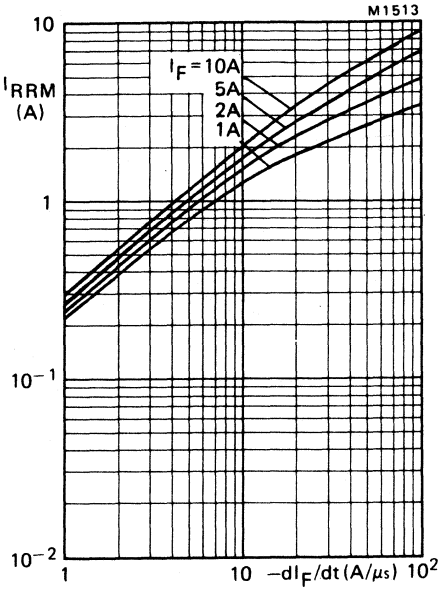


Fig. 14 Maximum I_{RRM} at T_j = 100 °C.

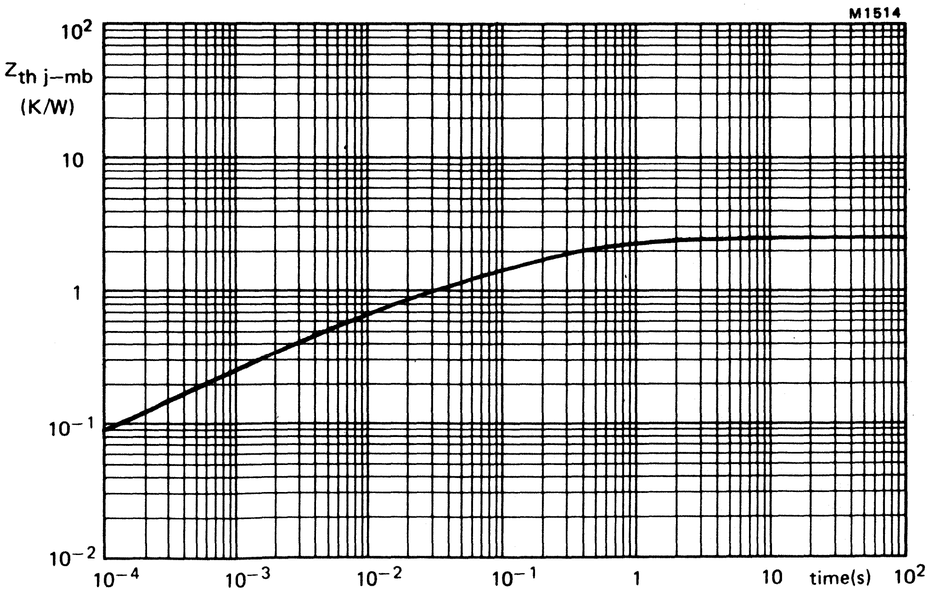


Fig. 15 Transient thermal impedance.

ULTRA FAST RECOVERY RECTIFIER DIODES

Glass-passivated, high-efficiency epitaxial rectifier diodes in plastic envelopes, featuring low forward voltage drop, ultra fast reverse recovery times, very low stored charge and soft recovery characteristic. 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.

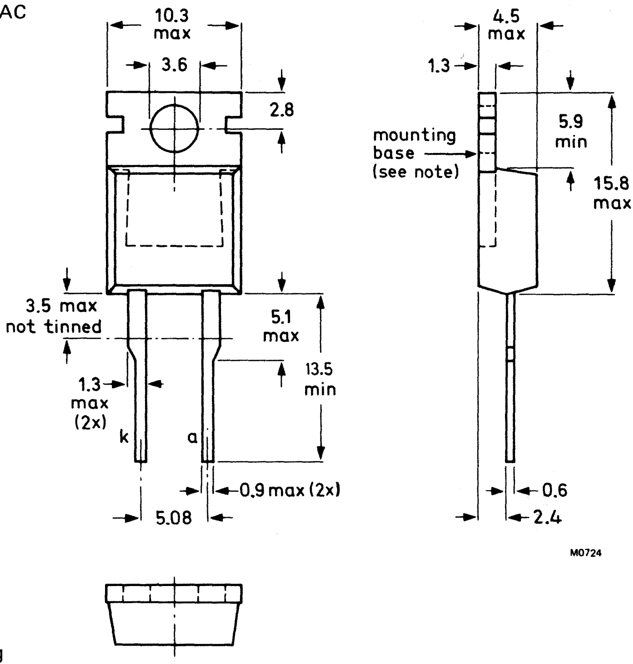
QUICK REFERENCE DATA

			BYT79–300	400	500	
Repetitive peak reverse voltage	V_{RRM}	max.	300	400	500	V
Average forward current	$I_{F(AV)}$	max.		14		A
Forward voltage	V_F	<		1.05		V
Reverse recovery time	t_{rr}	<		50		ns

MECHANICAL DATA

Dimensions in mm

Fig.1 TO-220AC



Net mass: 2 g

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			BYT79–300	400	500	
Repetitive peak reverse voltage	V_{RRM}	max.	300	400	500	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; switching losses negligible up to 100 kHz				
square wave; δ = 0.5; up to T_{mb} = 113 °C	$I_{F(AV)}$	max.	14	A
up to T_{mb} = 125 °C	$I_{F(AV)}$	max.	10	A
sinusoidal; up to T_{mb} = 118 °C	$I_{F(AV)}$	max.	12.5	A
up to 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 t_p = 20 μs; δ = 0.02	I_{FRM}	max.	320	A
Non-repetitive peak forward current half sine-wave; T_j = 150 °C prior to surge; with reapplied V_{RWMmax};				
t = 10 ms	I_{FSM}	max.	150	A
t = 8.3 ms	I_{FSM}	max.	180	A
I^2t for fusing (t = 10 ms)	I^2t	max.	112	A^2s
Temperatures				
Storage temperature	T_{stg}		–40 to +150	°C
Junction temperature	T_j	max.	150	°C

*To ensure thermal stability: $R_{th\ j\text{-}a} \leqslant 4.6$ K/W.

CHARACTERISTICS

Forward voltage				
I_F = 15 A; T_j = 150 °C	V_F	<	1.05	V*
I_F = 50 A; T_j = 25 °C	V_F	<	1.40	V*
Reverse current				
$V_R = V_{RWM\,max}$; T_j = 100 °C	I_R	<	0.8	mA
T_j = 25 °C	I_R	<	50	μA
Reverse recovery when switched from				
I_F = 1 A to $V_R \geqslant$ 30 V with $-dI_F/dt$ = 100 A/μs; T_j = 25 °C; recovery time	t_{rr}	<	50	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	<	50	nC
I_F = 10 A to $V_R \geqslant$ 30 V with $-dI_F/dt$ = 50 A/μs; T_j = 100 °C; peak recovery current	I_{RRM}	<	5.2	A
Forward recovery when switched to I_F = 10 A with dI_F/dt = 10 A/μs; T_j = 25 °C	V_{fr}	typ.	2.5	V

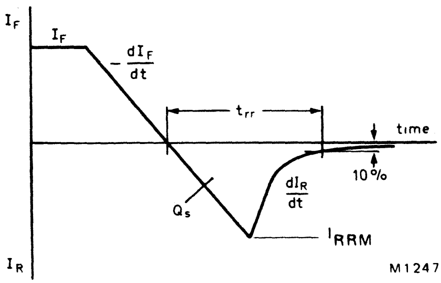


Fig.2 Definition of t_{rr}, Q_s and I_{RRM}.

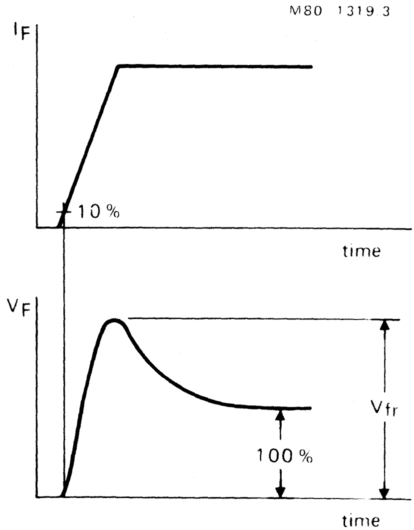


Fig.3 Definition of V_{fr}.

*Measured under pulse conditions to avoid excessive dissipation.

THERMAL RESISTANCE

From junction to mounting base	$R_{th\ j\text{-}mb}$	=	2.0	K/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	K/W
b. with heatsink compound and 0.06 mm maximum mica insulator	$R_{th\ mb\text{-}h}$	=	1.4	K/W
c. with heatsink compound and 0.1 mm maximum mica insulator (56369)	$R_{th\ mb\text{-}h}$	=	2.2	K/W
d. with heatsink compound and 0.25 mm maximum alumina insulator (56367)	$R_{th\ mb\text{-}h}$	=	0.8	K/W
e. without heatsink compound	$R_{th\ mb\text{-}h}$	=	1.4	K/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	K/W

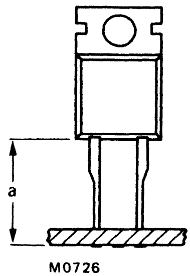


Fig.4

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. 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.

OPERATING NOTES

Dissipation and heatsink considerations:

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

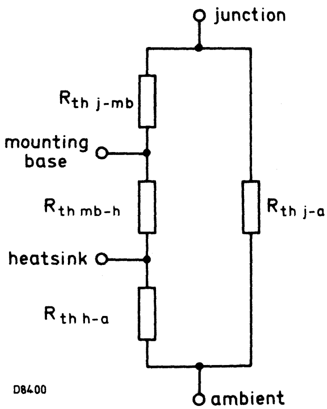


Fig.5

b. The method of using Figs.6 and 7 is as follows:
   Starting with the required current on the $I_{F(AV)}$ axis, trace upwards to meet the appropriate duty factor or 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.

SQUARE-WAVE OPERATION

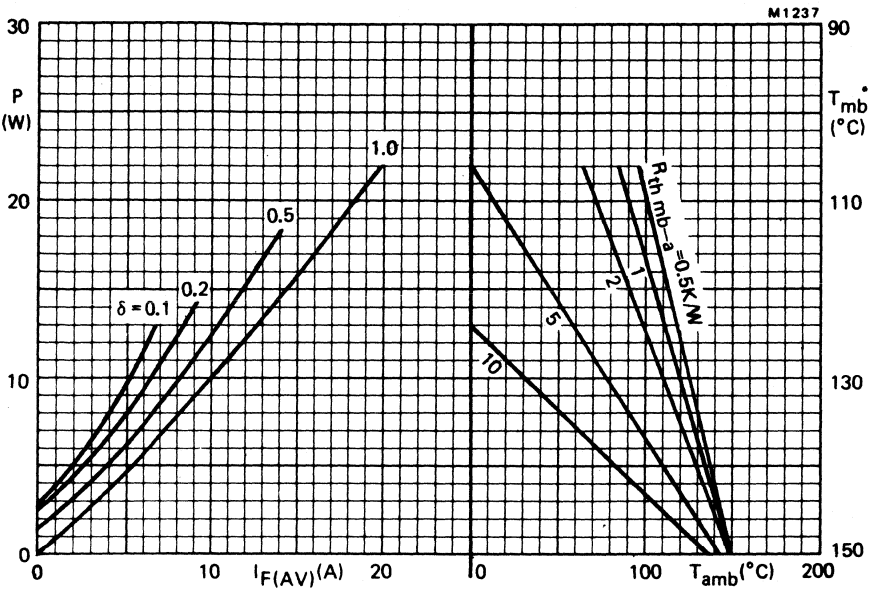
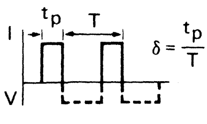


Fig.6 The right-hand part shows the relationship between the power (derived from the left-hand part) and the maximum permissible temperatures. Power includes reverse current losses and switching losses up to f = 100 kHz.



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

*T_{mb} scale is for comparison purposes and is correct only for $R_{th\ mb\text{-}a} < 4.1$ K/W.

SINUSOIDAL OPERATION

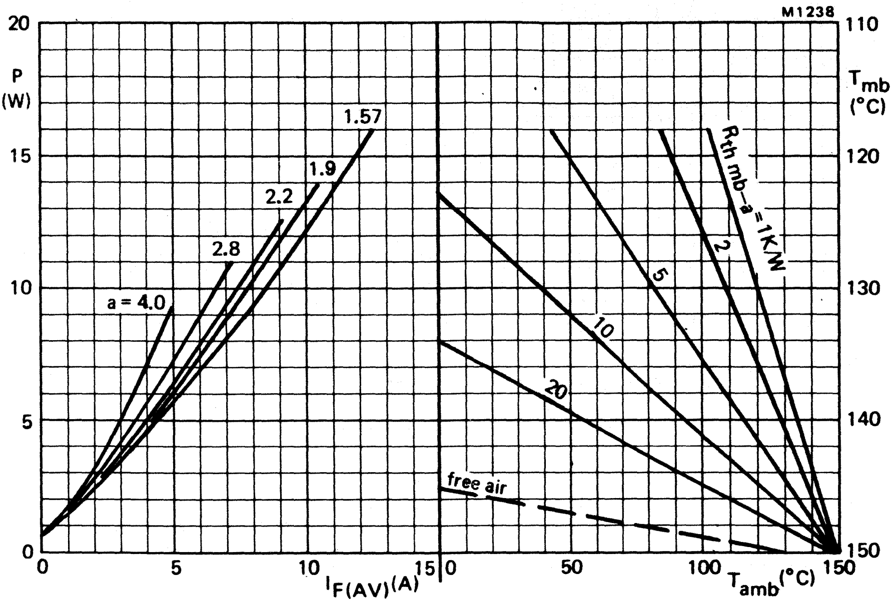


Fig.7 The right-hand part shows the interrelationship between the power (derived from the left-hand part) and the maximum permissible temperatures.
a = form factor = $I_{F(RMS)}/I_{F(AV)}$.

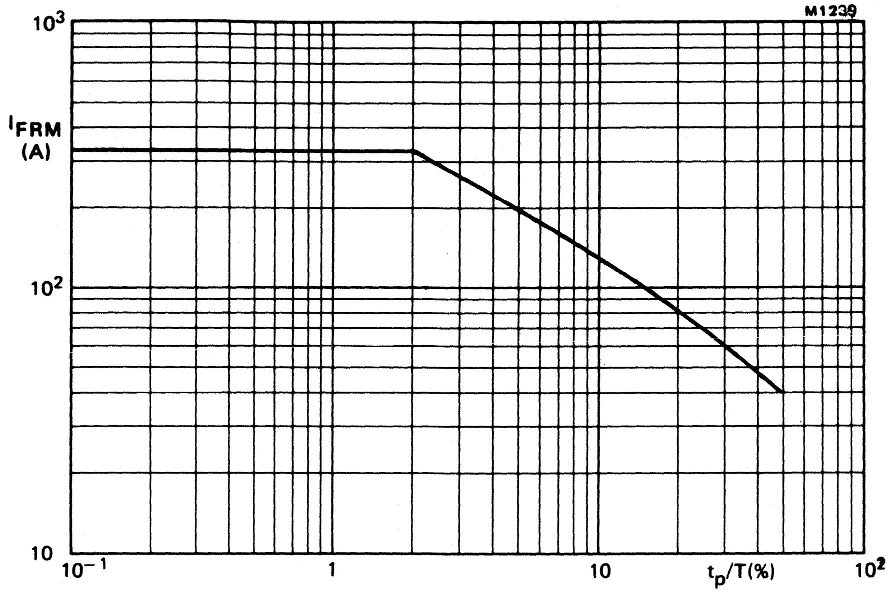
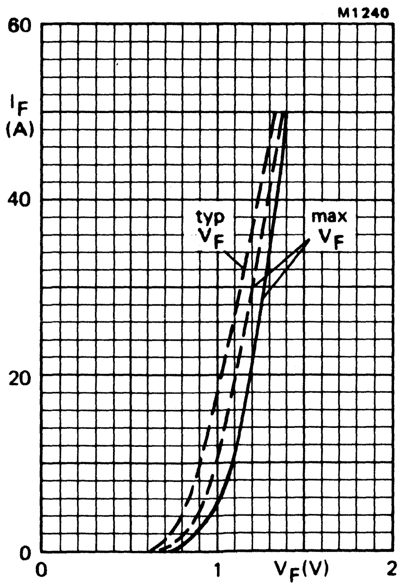
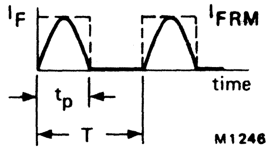


Fig.8 Maximum permissible repetitive peak forward current for square or sinusoidal currents; $1\ \mu s < t_p < 1$ ms.





Definition of I_{FRM} and t_p/T.

Fig.9 —— T_j = 25 °C; – – – T_j = 150 °C.

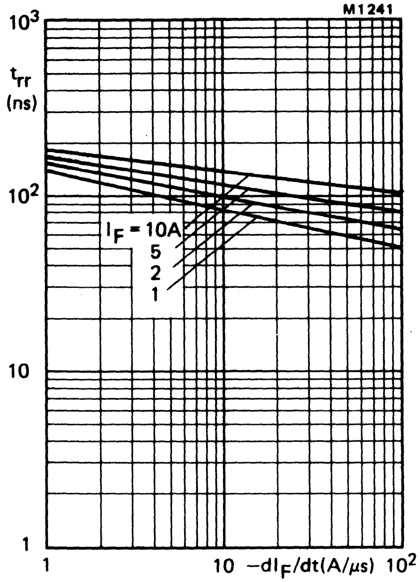


Fig.10 Maximum t_{rr} at T_j = 25 °C.

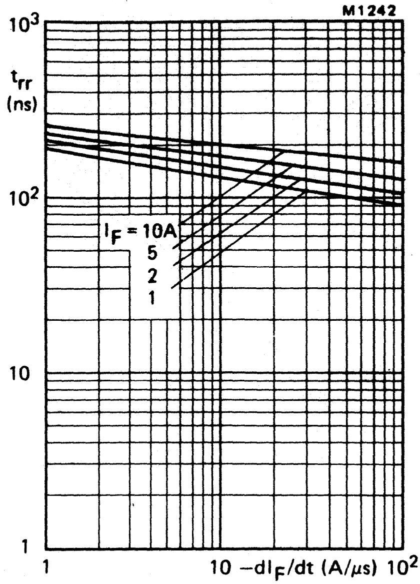


Fig.11 Maximum t_{rr} at T_j = 100 °C.

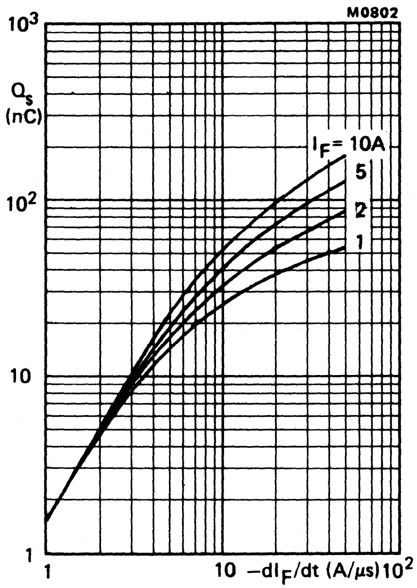


Fig.12 Maximum Q_s at T_j = 25 °C.

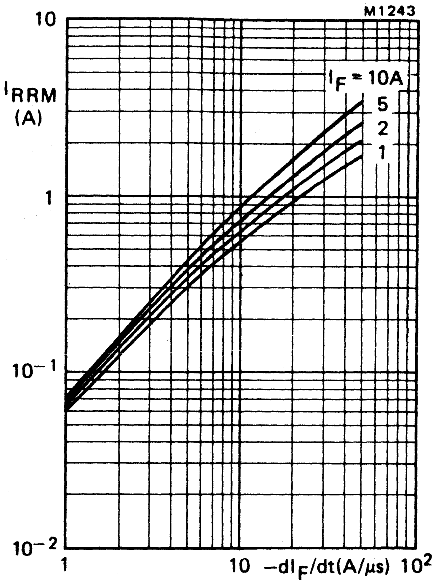


Fig.13 Maximum I_{RRM} at T_j = 25 °C.

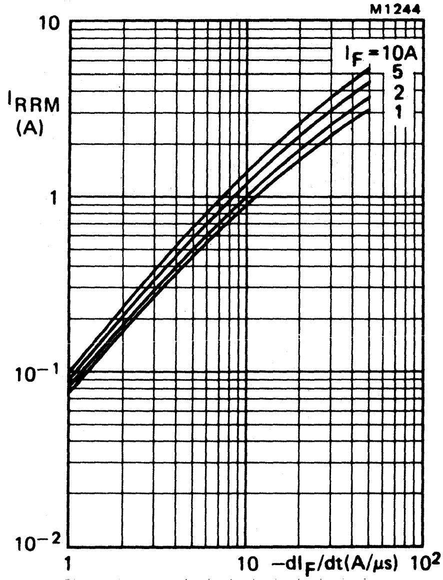


Fig.14 Maximum I_{RRM} at T_j = 100 °C.

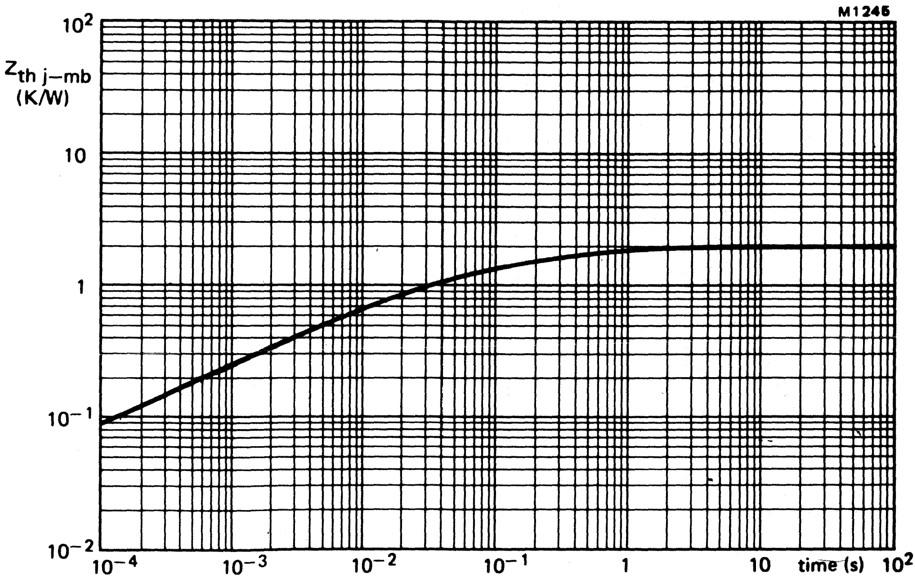


Fig.15 Transient thermal impedance.

FAST SOFT-RECOVERY RECTIFIER DIODES

Fast soft-recovery diodes in DO-4 metal envelopes especially suitable for operation as main and commutating diodes in 3-phase a.c. motor speed control inverters and in high frequency power supplies in general.
The series consists of the following types:
Normal polarity (cathode to stud): BYV24-800 and BYV24-1000.
Reverse polarity (anode to stud): BYV24-800R and BYV24-1000R.

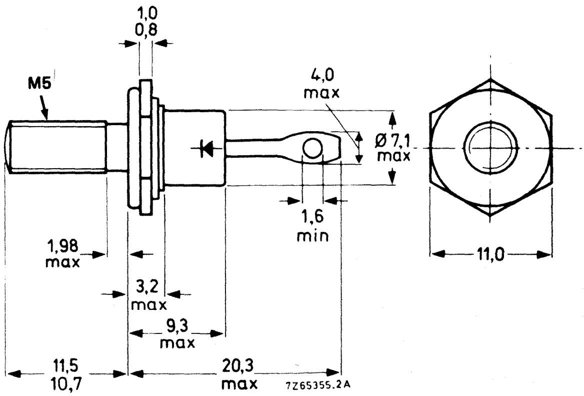
QUICK REFERENCE DATA

			BYV24-800(R)	1000(R)	
Repetitive peak reverse voltage	V_{RRM}	max.	800	1000	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}	<	450		ns

MECHANICAL DATA

Dimensions in mm

Fig. 1 DO—4: with metric M5 stud (ϕ5 mm)



Net mass: 6 g
Diameter of clearance hole: max 5.2 mm
Accessories supplied on request:
see ACCESSORIES section

Supplied with device: 1 nut, 1 lock washer.
Torque on nut: min. 0.9 Nm (9 kg cm)
max. 1.7 Nm (17 kg cm)
Nut dimensions across the flats: 8.0 mm.

The mark shown applies to the normal polarity types.

RATINGS

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

Voltages*

			BYV24–800(R)	1000(R)	
Non-repetitive peak reverse voltage	V_{RSM}	max.	1000	1200	V
Repetitive peak reverse voltage	V_{RRM}	max.	800	1000	V
Crest working reverse voltage	V_{RWM}	max.	650	850	V
Continuous reverse voltage	V_R	max.	650	850	V

Currents

Average forward current				
sinusoidal; up to T_{mb} = 103 °C	$I_{F(AV)}$	max.	12	A
sinusoidal; at T_{mb} = 125 °C	$I_{F(AV)}$	max.	7	A
square-wave; δ = 0.5; up to T_{mb} = 103 °C	$I_{F(AV)}$	max.	14	A
square-wave; δ = 0.5; at T_{mb} = 125 °C	$I_{F(AV)}$	max.	8	A
R.M.S. forward current	$I_{F(RMS)}$	max.	20	A
Repetitive peak forward current	I_{FRM}	max.	120	A
Non-repetitive peak forward current t = 10 ms; half sine-wave; T_j = 150 °C prior to surge;				
without re-applied voltage	I_{FSM}	max.	150	A
with re-applied V_{RWMmax}	I_{FSM}	max.	120	A
I^2t for fusing (t = 10 ms)	I^2t	max.	72	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	$R_{th\ j\text{-}mb}$	=	2.0	°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	$Z_{th\ j\text{-}mb}$	=	0.85	°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: $R_{th\ j\text{-}a} \leqslant 8$ °C/W (continuous reverse voltage).

CHARACTERISTICS

Forward voltage					
I_F = 20 A; T_j = 25 °C	V_F	<	1.7	V*	
Reverse current					
$V_R = V_{RWMmax}$; T_j = 125 °C	I_R	<	1.5	mA	
Reverse recovery when switched from					
I_F = 10 A to $V_R \geq$ 30 V with $-dI_F/dt$ = 10 A/μs; T_j = 25 °C Recovery time	t_{rr}	<	450	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	<	800	nC	
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	$\|dI_R/dt\|$	<	7	A/μs	

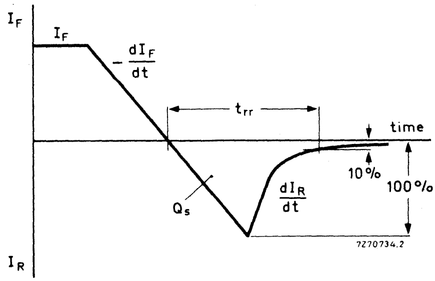


Fig.2 Definition of t_{rr} and Q_s.

*Measured under pulse conditions to avoid excessive dissipation.

SINUSOIDAL OPERATION

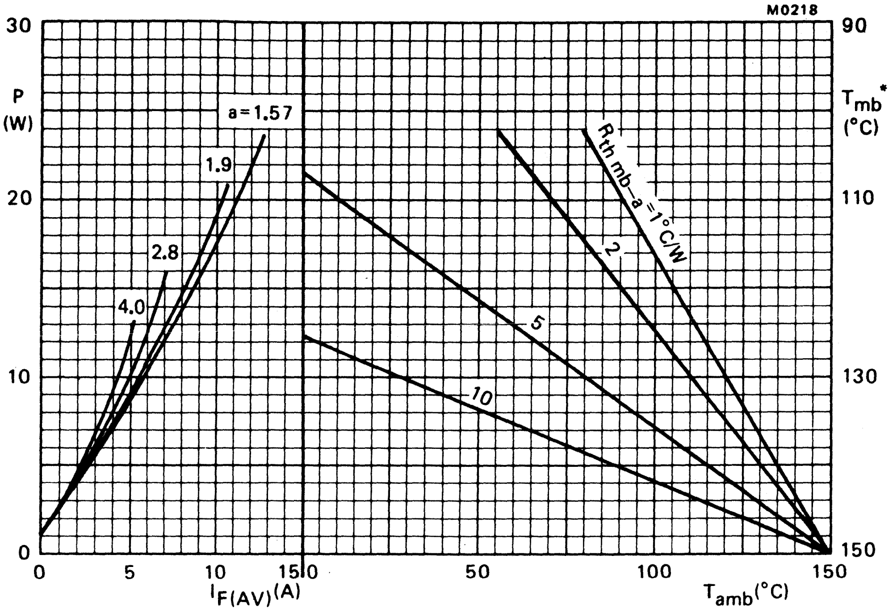


Fig.3 The right-hand part shows the interrelationship between the power (derived from the left-hand part) and the maximum permissible temperatures.
P = power including reverse current losses but excluding switching losses.
a = form factor = $I_{F(RMS)}/I_{F(AV)}$.

*T_{mb} scale is for comparison purposes and is correct only for $R_{th\ mb\text{-}a} < 8\ ^{o}C/W$.

SQUARE–WAVE OPERATION

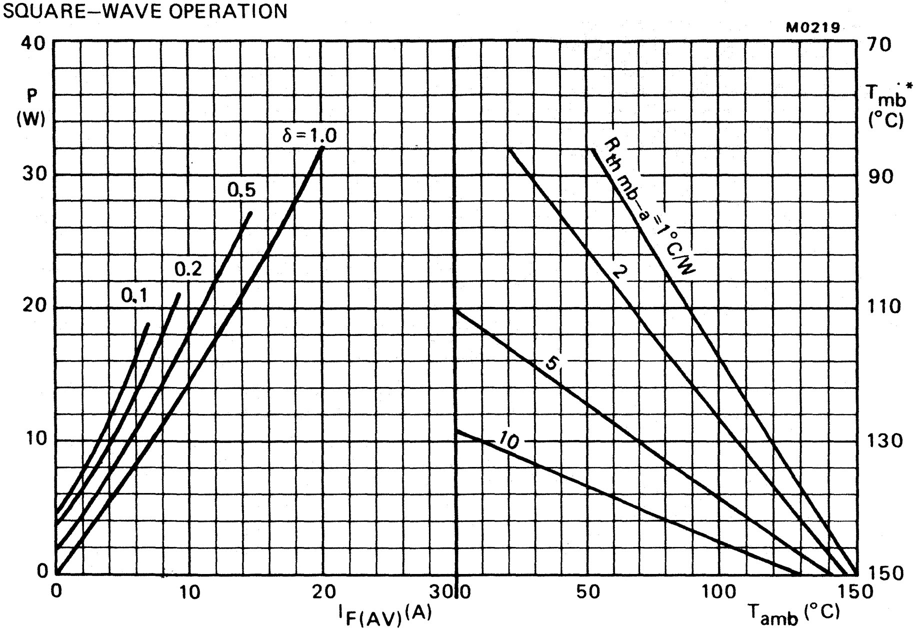
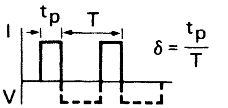


Fig.4 The right-hand part shows the interrelationship between the power (derived from the left-hand part) and the maximum permissible temperatures.
P = power including reverse current losses but excluding switching losses.



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

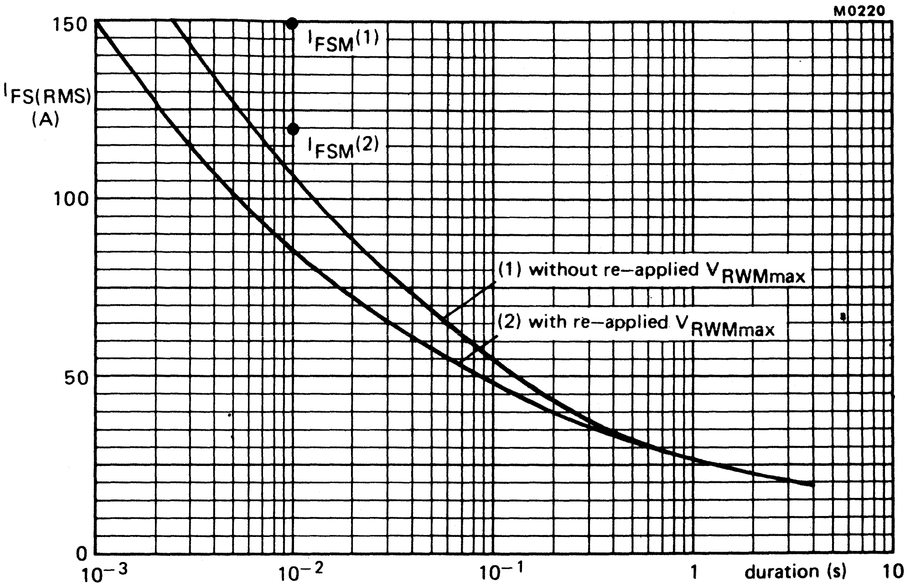
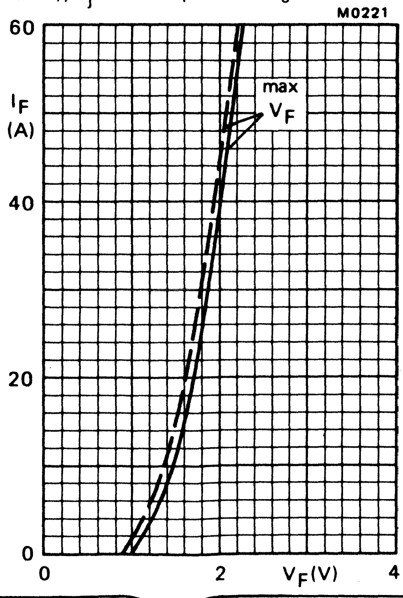


Fig.5 Maximum permissible non-repetitive r.m.s. forward current based on sinusoidal currents (f = 50 Hz); T_j = 150 °C prior to surge.



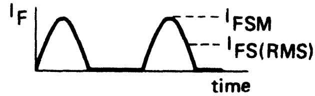


Fig.6 . —— T_j = 25 °C; ––– T_j = 100 °C.

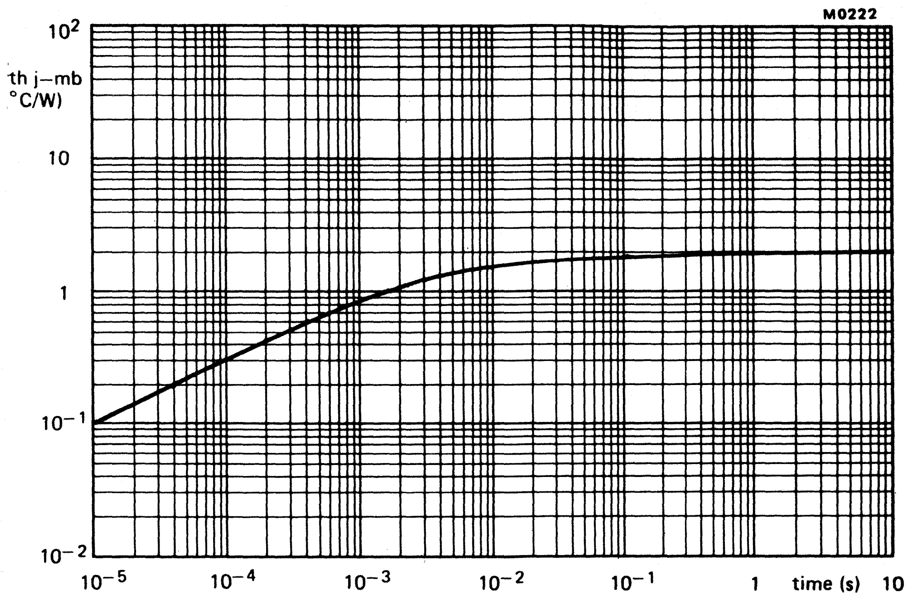


Fig.7

EPITAXIAL AVALANCHE DIODES

Glass passivated epitaxial rectifier diodes in hermetically sealed axial-leaded glass envelopes. They feature low forward voltage drop, very fast recovery, very low stored charge, non-snap-off switching characteristics and are capable of absorbing reverse transient energy (e.g. during flashover in a picture tube). These properties make the diodes very suitable for use in switched-mode power supplies and in general high-frequency circuits, where low conduction and switching losses are essential.

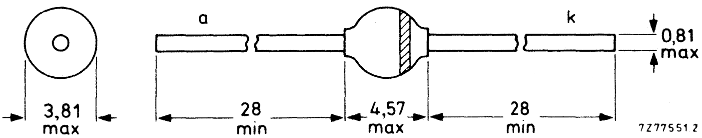
QUICK REFERENCE DATA

			BYV27-50	100	150	200	
Repetitive peak reverse voltage	V_{RRM}	max.	50	100	150	200	V
Continuous reverse voltage	V_R	max.	50	100	150	200	V
Average forward current	$I_{F(AV)}$	max.		2			A
Non-repetitive peak reverse energy	E_{RSM}	max.		40			mJ
Reverse recovery time	t_{rr}	<		25			ns

MECHANICAL DATA

Dimensions in mm

Fig. 1 SOD-57.



The marking band indicates the cathode.

The diodes are type-branded.

RATINGS

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

			BYV27-50	100	150	200	
Repetitive peak reverse voltage	V_{RRM}	max.	50	100	150	200	V
Continuous reverse voltage	V_R	max.	50	100	150	200	V

Average forward current (switching losses negligible up to 200 kHz) square wave; $\delta = 0{,}5$				
$T_{tp} = 85\ ^oC$; lead length = 10 mm	$I_{F(AV)}$	max.	2	A
$T_{amb} = 60\ ^oC$; Fig. 2	$I_{F(AV)}$	max.	1,3	A
Repetitive peak forward current	I_{FRM}	max.	15	A
Non-repetitive peak forward current ($t = 10$ ms; half sine-wave) $T_j = T_{j\,max}$ prior to surge; with reapplied V_{RRM}	I_{FSM}	max.	50	A
Non-repetitive peak reverse avalanche energy; $I_R = 600$ mA; prior to surge; with inductive load switched off:				
at $T_j = 25\ ^oC$	E_{RSM}	max.	40	mJ
at $T_j = T_{j\,max}$	E_{RSM}	max.	20	mJ
Storage temperature	T_{stg}		−65 to + 175	^oC
Junction temperature	T_j	max.	175	^oC

THERMAL RESISTANCE

Influence of mounting method

1. Thermal resistance from junction to tie-point at a lead length of 10 mm	$R_{th\,j\text{-}tp}$	=	46	K/W
2. Thermal resistance from junction to ambient when mounted on a 1,5 mm thick epoxy-glass printed-circuit board; Cu-thickness $\geq 40\ \mu m$; Fig. 2	$R_{th\,j\text{-}a}$	=	100	K/W

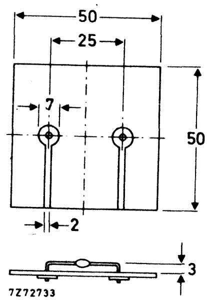


Fig. 2 Mounted on a printed-circuit board.

CHARACTERISTICS

T_j = 25 °C unless otherwise specified

			BYV27-50	100	150	200	
Reverse avalanche breakdown voltage							
I_R = 0,1 mA	$V_{(BR)R}$		55	110	165	220	V
Forward voltage*							
I_F = 3 A; $T_j = T_{j\,max}$	V_F	<	0,88				V
I_F = 3 A	V_F	<	1,07				V
Reverse current							
$V_R = V_{RRMmax}$; T_j = 25 °C	I_R	<	1				µA
$V_R = V_{RRMmax}$; T_j = 165 °C	I_R	<	150				µA
Reverse recovery time when switched from I_F = 0,5 A to I_R = 1 A; measured at I_R = 0,25 A for definition see Figs 3 and 4	t_{rr}	<	25				ns

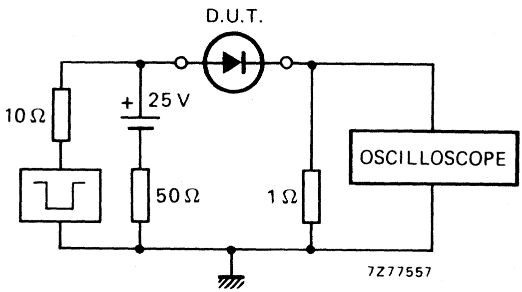


Fig. 3 Test circuit.
Input impedance oscilloscope 1 MΩ; 22 pF. Rise time ⩽ 7 ns.
Source impedance 50 Ω. Rise time ⩽ 15 ns.

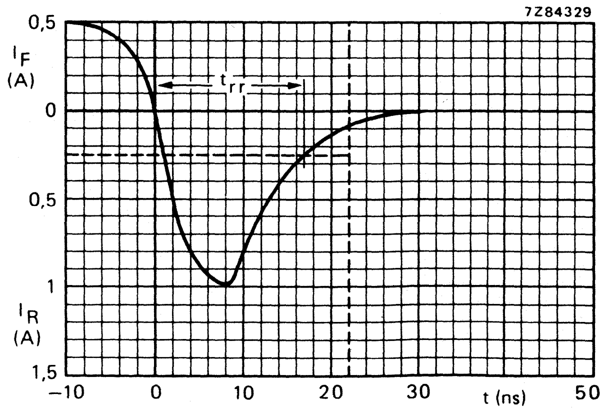


Fig. 4 Reverse recovery time characteristic.

* Measured under pulse conditions to avoid excessive dissipation.

Reverse recovery when switched from
$I_F = 1$ A to $V_R \geqslant 30$ V with
$-dI_F/dt = 20$ A/μs (see Fig. 5)

recovered charge	Q_s	<	15 nC
recovery time	t_{rr}	<	50 ns

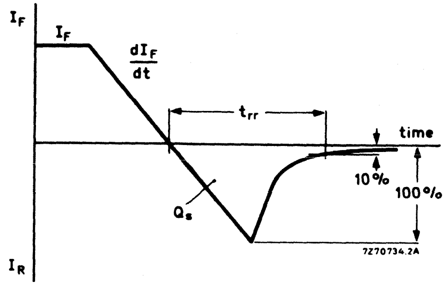


Fig. 5 Definitions of t_{rr} and Q_s.

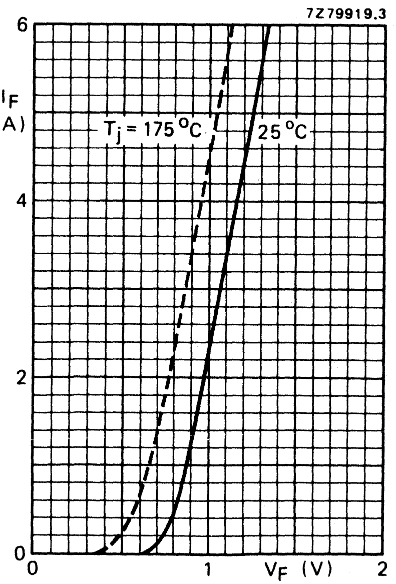


Fig. 6 Forward current as a function of the maximum forward voltage.

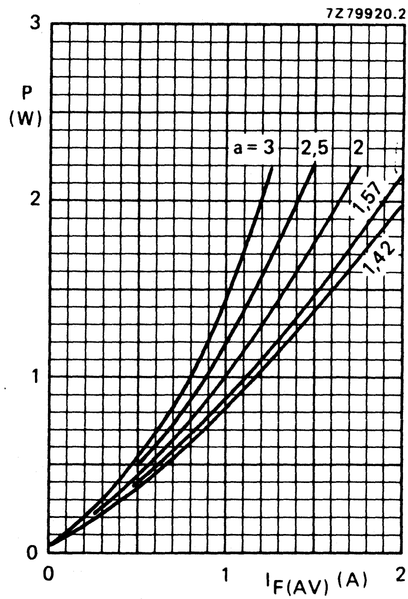


Fig. 7 $a = I_{F(RMS)}/I_{F(AV)}$; $V_R = V_{RRMmax}$.
Pulsed reverse voltage; $\delta = 0{,}5$.
(Including reverse current losses and switching losses up to f = 200 kHz).

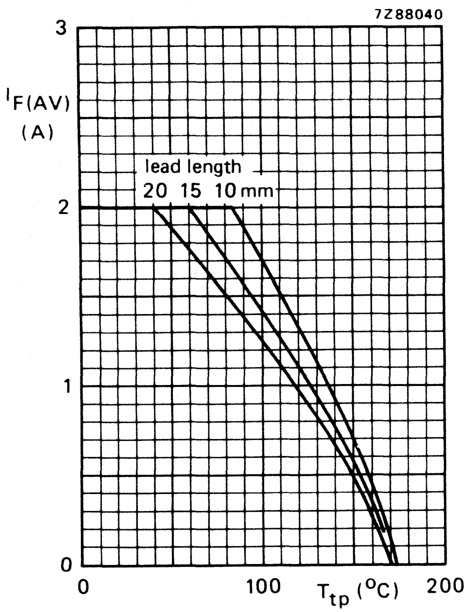


Fig. 8 Maximum average forward current.
The curves include losses due to reverse current and switching up to f = 200 kHz.
Pulsed reverse voltage, δ = 0,5.
$V_R = V_{RRMmax}$.
Square wave current, a = 1,42.

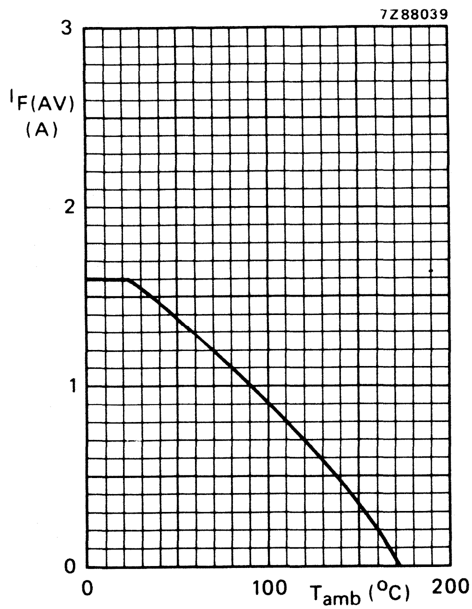


Fig. 9 Maximum average forward current.
The curve includes losses due to reverse current and switching up to f = 200 kHz.
Mounting method see Fig. 2.
Pulsed reverse voltage, δ = 0,5
$V_R = V_{RRMmax}$.
Square wave current, a = 1,42.

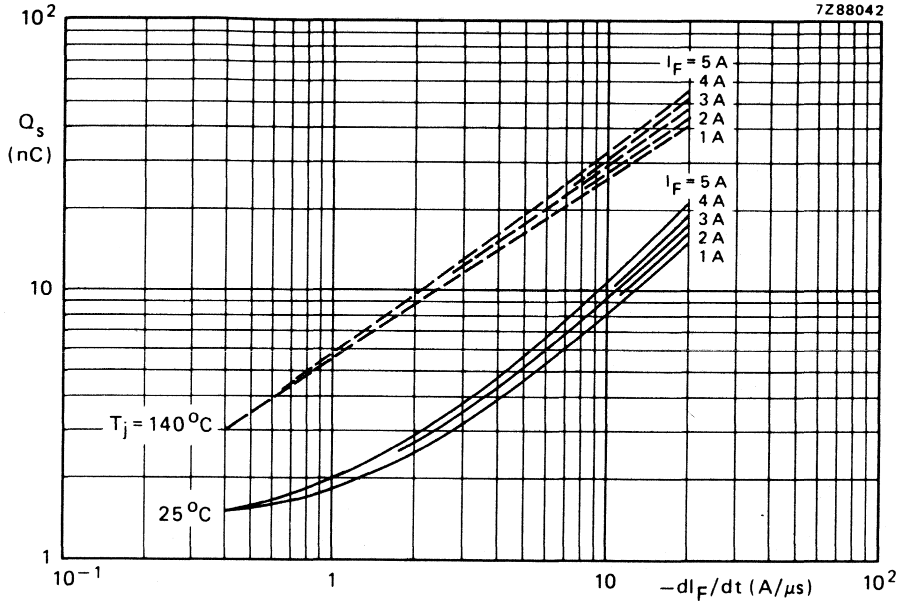


Fig. 10 Maximum values reverse recovery charge. For definition see Fig. 5.

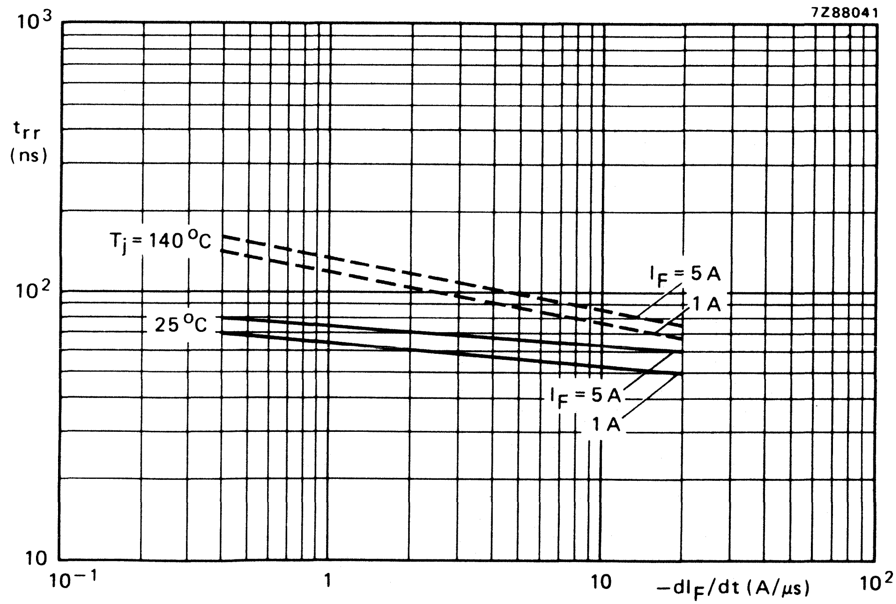


Fig. 11 Maximum values reverse recovery time. For definition see Fig. 5.

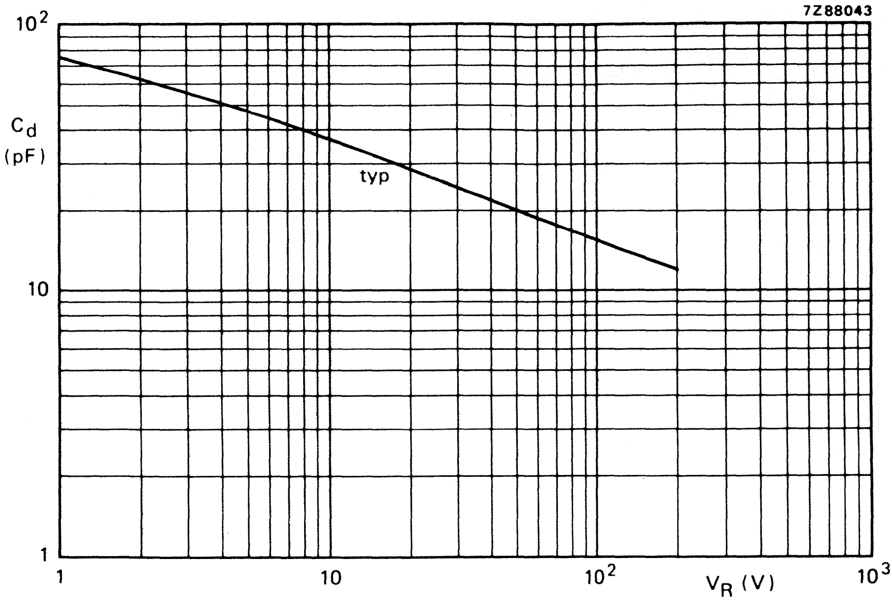


Fig. 12 Typical values diode capacitance at f = 1 MHz; T_j = 25 °C.

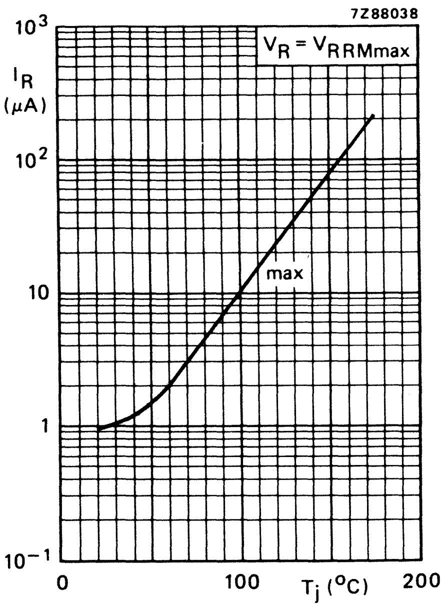


Fig. 13 Maximum values reverse current.

OPERATING NOTES

The various components of junction temperature rise above ambient, for mounting with symmetrical lead length, are illustrated below.

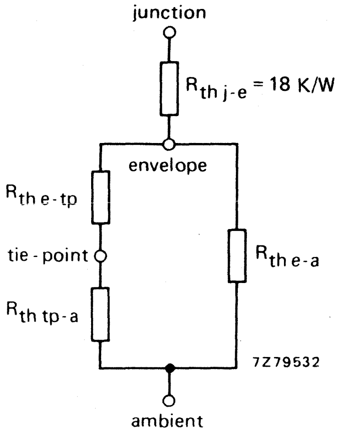


Fig. 14 Thermal model.

By using this thermal model and the dissipation graph (Fig. 7) any temperature can be calculated.

The thermal resistances between envelope and tie-point, and between envelope and ambient depend on lead length.

thermal resistance	lead length					unit
	5	10	15	20	25	mm
$R_{th\ e-tp}$	15	30	45	60	75	K/W
$R_{th\ e-a}$	580	445	350	290	245	K/W

The thermal resistance between tie-point and ambient depends on the mounting method.
For components on a 1,5 mm thick epoxy-glass printed-circuit board with a copper-thickness ⩾40 μm:

1. Mounted as given in Fig. 2 the thermal resistance $R_{th\ tp-a}$ is 70 K/W.
2. Mounted with copper laminate of 1 cm² per lead $R_{th\ tp-a}$ is 55 K/W.
3. Mounted with copper laminate of 2,25 cm² per lead $R_{th\ tp-a}$ is 45 K/W.

EPITAXIAL AVALANCHE DIODES

Glass passivated epitaxial rectifier diodes in hermetically sealed axial-leaded glass envelopes. They feature low forward voltage drop, very fast recovery, very low stored charge, non-snap-off switching characteristics and are capable of absorbing reverse transient energy (e.g. during flashover in a picture tube). These properties make the diodes very suitable for use in switched-mode power supplies and in general in high-frequency circuits, where low conduction and switching losses are essential.

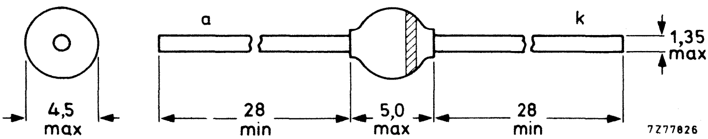
QUICK REFERENCE DATA

			BYV28-50	100	150	200	
Repetitive peak reverse voltage	V_{RRM}	max.	50	100	150	200	V
Continuous reverse voltage	V_R	max.	50	100	150	200	V
Average forward current	$I_{F(AV)}$	max.		3,5			A
Non-repetitive peak reverse energy	E_{RSM}	max.		40			mJ
Reverse recovery time	t_{rr}	<		30			ns

MECHANICAL DATA

Dimensions in mm

Fig. 1 SOD-64.



The marking band indicates the cathode.

The diodes are type-branded.

RATINGS

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

			BYV28-50	100	150	200	
Repetitive peak reverse voltage	V_{RRM}	max.	50	100	150	200	V
Continuous reverse voltage	V_R	max.	50	100	150	200	V

Average forward current (averaged over any 20 ms period)				
T_{tp} = 85 °C; lead length = 10 mm	$I_{F(AV)}$	max.	3,5	A
T_{amb} = 60 °C; p.c.b. mounting (see Fig. 2)	$I_{F(AV)}$	max.	1,9	A
Repetitive peak forward current	I_{FRM}	max.	25	A
Non-repetitive peak forward current (t = 10 ms; half sine-wave) $T_j = T_{j\,max}$ prior to surge; with reapplied V_{RRM}	I_{FSM}	max.	90	A
Non-repetitive peak reverse avalanche energy; I_R = 600 mA; with inductive load switched off				
prior to surge; T_j = 25 °C	E_{RSM}	max.	40	mJ
prior to surge; $T_j = T_{j\,max}$	E_{RSM}	max.	20	mJ
Storage temperature	T_{stg}		−65 to +175	°C
Junction temperature	T_j	max.	175	°C

THERMAL RESISTANCE

Influence of mounting method

1. Thermal resistance from junction to tie-point at a lead length of 10 mm	$R_{th\,j\text{-}tp}$	=	25	K/W
2. Thermal resistance from junction to ambient when mounted on a 1,5 mm thick epoxy-glass printed-circuit board; Cu-thickness ⩾ 40 μm; Fig. 2	$R_{th\,j\text{-}a}$	=	75	K/W

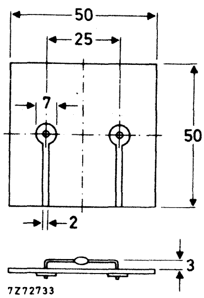


Fig. 2 Mounted on a printed-circuit board.

CHARACTERISTICS

T_j = 25 °C, unless otherwise specified

			BYV28-50	100	150	200	
Reverse avalanche breakdown voltage I_R = 0,1 mA	$V_{(BR)R}$	>	55	110	165	220	V
Forward voltage* I_F = 5 A;	V_F	<		1,10			V
I_F = 5 A; $T_j = T_{j\ max}$	V_F	<		0,89			V
Reverse current $V_R = V_{RRMmax}$; T_j = 25 °C	I_R	<		1			μA
$V_R = V_{RRMmax}$; T_j = 165 °C	I_R	<		150			μA
Reverse recovery time when switched from I_F = 0,5 A to I_R = 1 A; measured at I_R = 0,25 A for definition see Figs 3 and 4	t_{rr}	<		30			ns

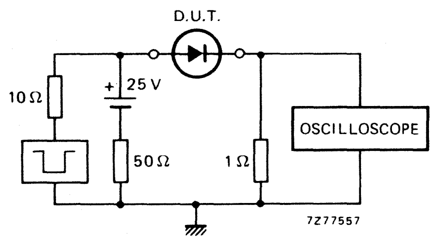


Fig. 3 Test circuit.
Input impedance oscilloscope 1 MΩ; 22 pF; Rise time ≤ 7 ns.
Source impedance 50 Ω. Rise time ≤ 15 ns.

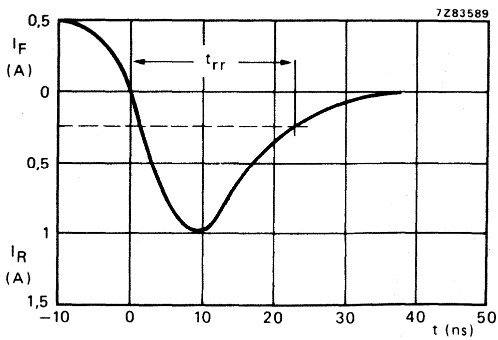


Fig. 4 Reverse recovery time characteristic.

* Measured under pulse conditions to avoid excessive dissipation.

Reverse recovery when switched from
I_F = 1 A to $V_R \geqslant$ 30 V with
$-dI_F/dt$ = 20 A/μs (see Fig. 5)

recovered charge	Q_s	<	20 nC
recovery time	t_{rr}	<	50 ns

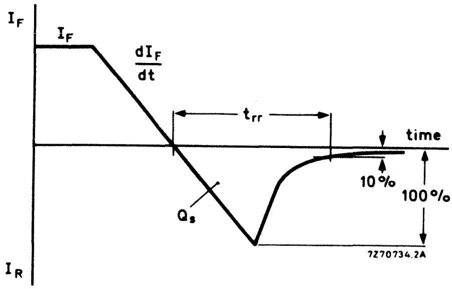


Fig. 5 Definitions of t_{rr} and Q_s.

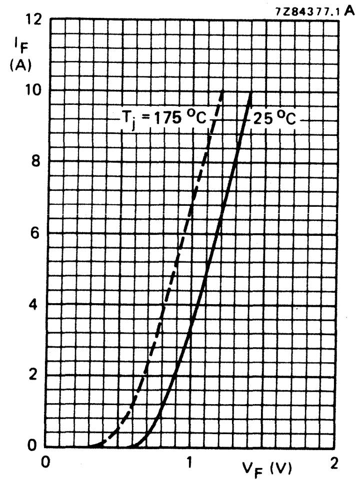


Fig. 6 Forward current as a function of the maximum forward voltage.

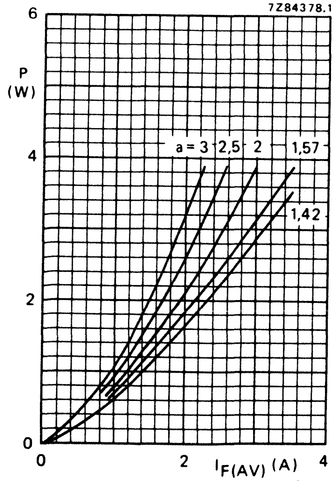


Fig. 7 Power dissipation (forward plus leakage current) as a function of the average forward current. Pulsed reverse voltage; δ = 50%.
$a = I_{F(RMS)}/I_{F(AV)}$; $V_R = V_{RRMmax}$.

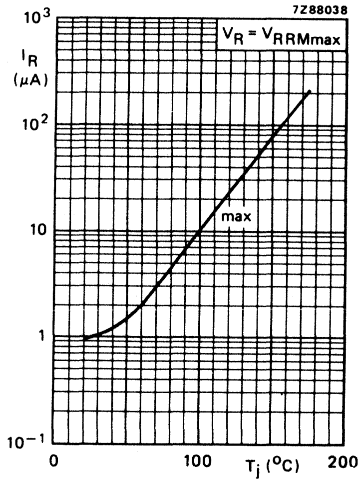


Fig. 8 Reverse current as a function of the junction temperature

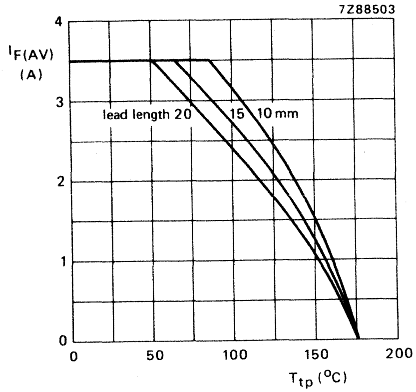


Fig. 9 Maximum average forward current. The curves include losses due to reverse current and switching up to f = 200 kHz.
Pulsed reverse voltage; δ = 0,5 V_R = V_{RRM} max.
Square-wave current; a = 1,42.

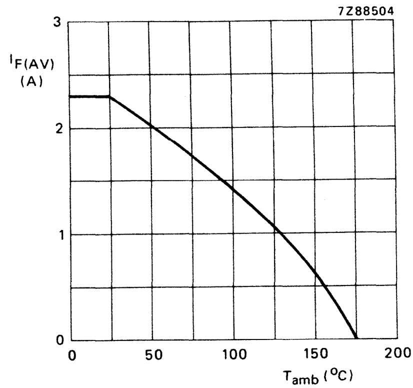


Fig. 10 Maximum average forward current. The curve includes losses due to reverse current and switching up to f = 200 kHz; mounting method see Fig. 2.
Pulsed reverse voltage; δ = 0,5 V_R = V_{RRM} max.
Square-wave current; a = 1,42.

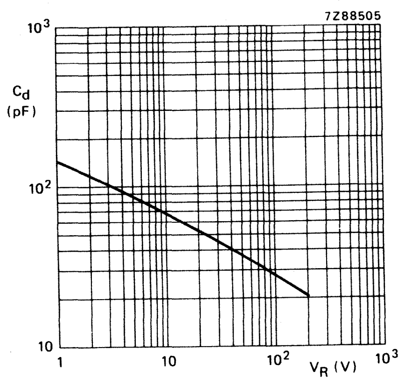


Fig. 11 Typical values diode capacitance at f = 1 MHz. T_j = 25 °C.

OPERATING NOTES

The various components of junction temperature rise above ambient, for mounting with symmetrical lead length, are illustrated below.

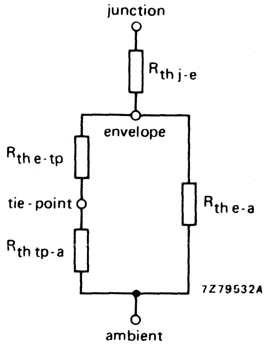


Fig. 12 Thermal model. $R_{th\ j\text{-}e} = 12$ K/W.

The thermal resistances between envelope and tie-point, and between envelope and ambient depend on lead length.

thermal resistance	lead length					unit
	5	10	15	20	25	mm
$R_{th\ e\text{-}tp}$	7	14	21	28	35	K/W
$R_{th\ e\text{-}a}$	410	300	230	185	155	K/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 $\geqslant 40\ \mu m$, the following values apply:

1. Mounted as given in Fig. 2 the thermal resistance $R_{th\ tp\text{-}a}$ is 70 K/W.
2. Mounted with copper laminate of 1 cm^2 per lead $R_{th\ tp\text{-}a}$ is 55 K/W.
3. Mounted with copper laminate of 2,25 cm^2 per lead $R_{th\ tp\text{-}a}$ is 45 K/W.

Note
Any temperature can be calculated by using the dissipation graph (Fig. 7) and the above model.

VERY FAST RECOVERY RECTIFIER DIODES

Glass-passivated, high-efficiency 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.

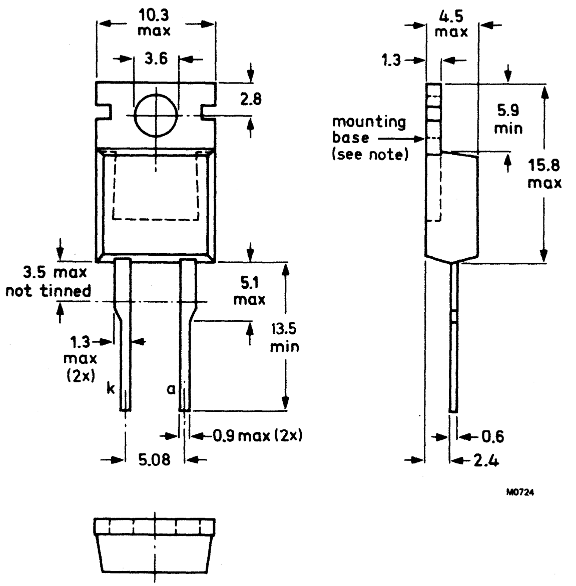
QUICK REFERENCE DATA

			BYV29–300	400	500	
Repetitive peak reverse voltage	V_{RRM}	max.	300	400	500	V
Average forward current	$I_{F(AV)}$	max.		9		A
Forward voltage	V_F	<		1.05		V
Reverse recovery time	t_{rr}	<		50		ns

MECHANICAL DATA

Dimensions in mm

Fig.1 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

			BYV29–300	400	500	
Non-repetitive peak reverse voltage	V_{RSM}	max.	300	400	500	V
Repetitive peak reverse voltage	V_{RRM}	max.	300	400	500	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; switching losses negligible up to 100 kHz				
sinusoidal; up to T_{mb} = 125 °C	$I_{F(AV)}$	max.	7.4	A
square-wave; δ = 0.5; up to T_{mb} = 116 °C*	$I_{F(AV)}$	max.	9	A
R.M.S. forward current	$I_{F(RMS)}$	max.	13	A
Repetitive peak forward current	I_{FRM}	max.	100	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.	100	A
I^2t for fusing (t = 10 ms)	I^2t	max.	50	A^2s

Temperatures

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

*To ensure thermal stability: $R_{th\ j\text{-}a} \leqslant 6.8$ °C/W.

THERMAL RESISTANCE

From junction to mounting base	$R_{th\ j\text{-}mb}$	=	2.5	°C/W
Transient thermal impedance; t = 1 ms	$Z_{th\ j\text{-}mb}$	=	0.26	°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 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

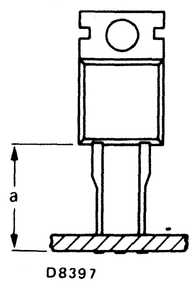


Fig.2

CHARACTERISTICS

Forward voltage				
I_F = 5 A; T_j = 100 °C	V_F	<	1.05	V*
I_F = 20 A; T_j = 25 °C	V_F	<	1.40	V*
Reverse current				
$V_R = V_{RWM\,max}$; T_j = 100 °C	I_R	<	0.35	mA
Reverse recovery when switched from				
I_F = 1 A to $V_R \geqslant$ 30 V with $-dI_F/dt$ = 100 A/μs; T_j = 25 °C;recovery time	t_{rr}	<	50	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	<	55	nC
Forward recovery when switched to I_F = 10 A with dI_F/dt = 10 A/μs; T_j = 25 °C	V_{fr}	typ.	2.5	V

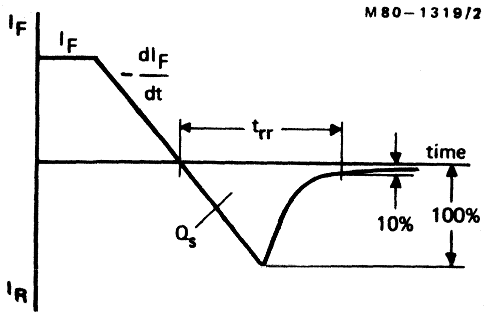


Fig.3 Definition of t_{rr} and Q_s

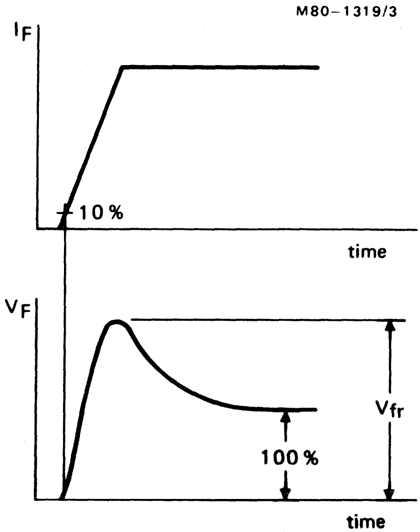


Fig.4 Definition of V_{fr}.

*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. 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.

OPERATING NOTES

Dissipation and heatsink considerations:

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

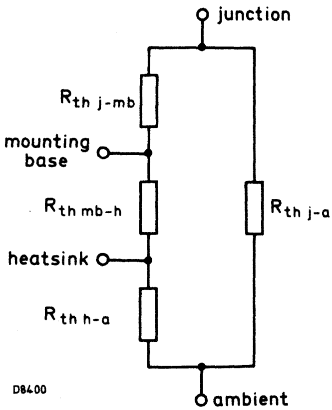


Fig.5

b. The method of using Figs.6 and 7 is as follows:
Starting with the required current on the $I_{F(AV)}$ axis, trace upwards to meet the appropriate duty factor or 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.

SQUARE-WAVE OPERATION

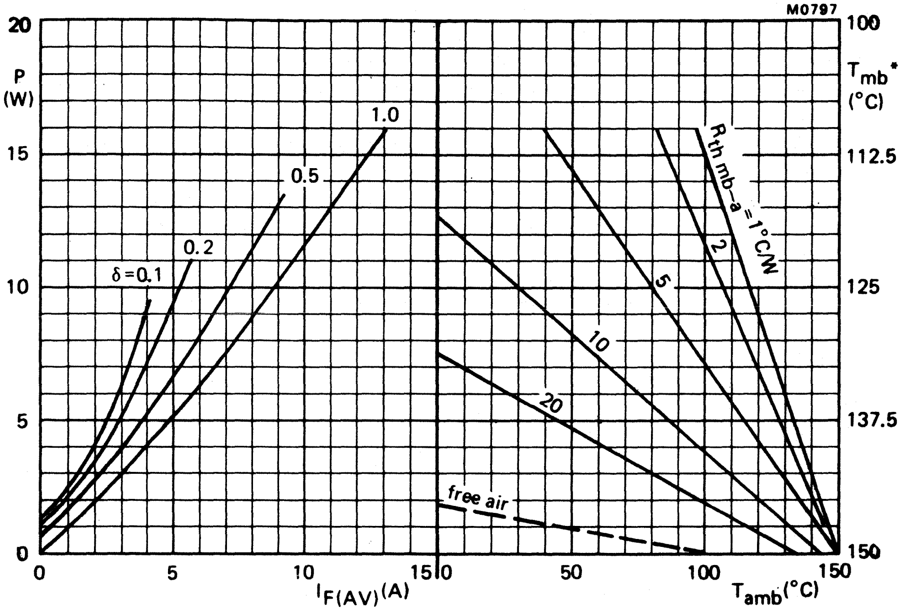
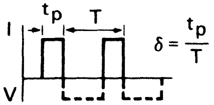


Fig.6 The right-hand part shows the relationship between the power (derived from the left-hand part) and the maximum permissible temperatures.



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

*T_{mb} scale is for comparison purposes and is correct only for $R_{th\ mb\text{-}a} < 4.1$ °C/W

SINUSOIDAL OPERATION

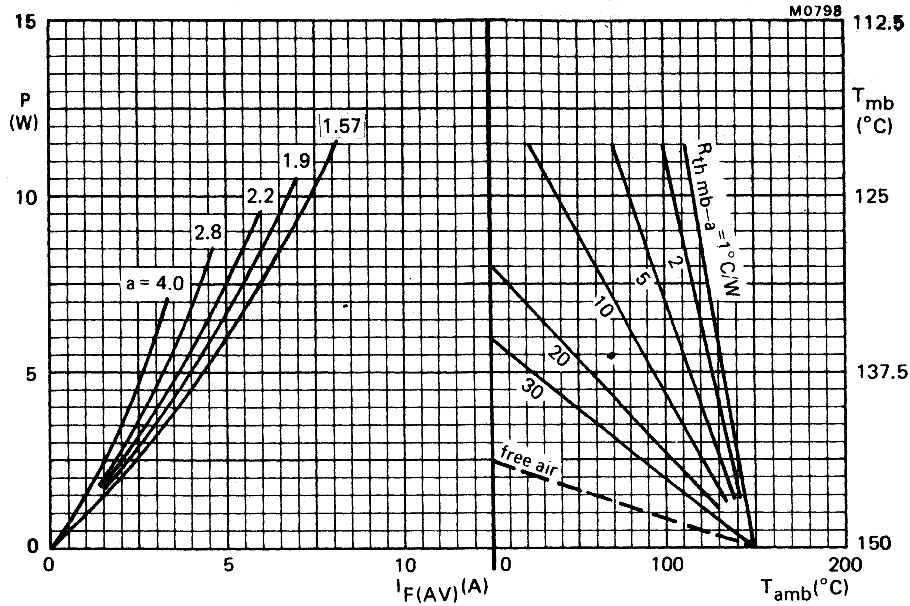


Fig.7 The right-hand part shows the interrelationship between the power (derived from the left-hand part) and the maximum permissible temperatures.
a = form factor = $I_{F(RMS)}/I_{F(AV)}$.

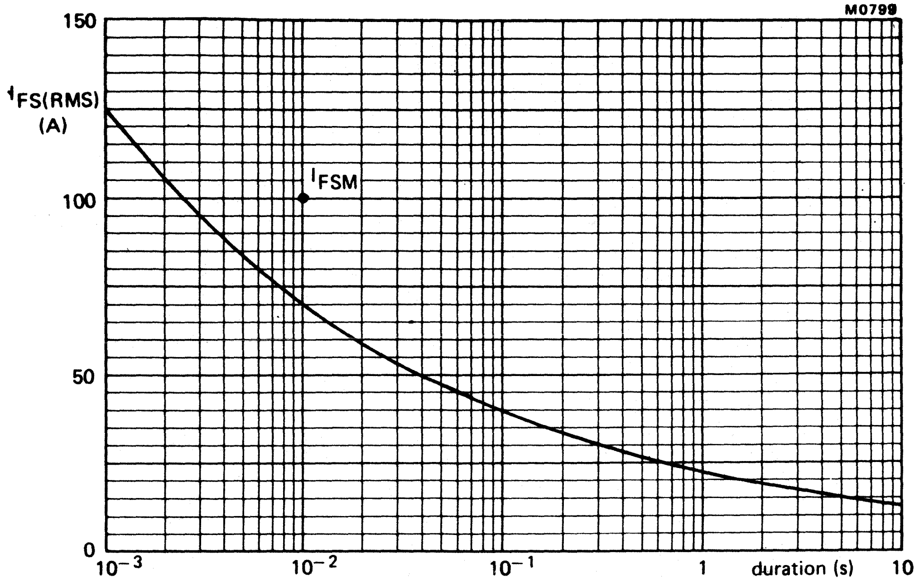
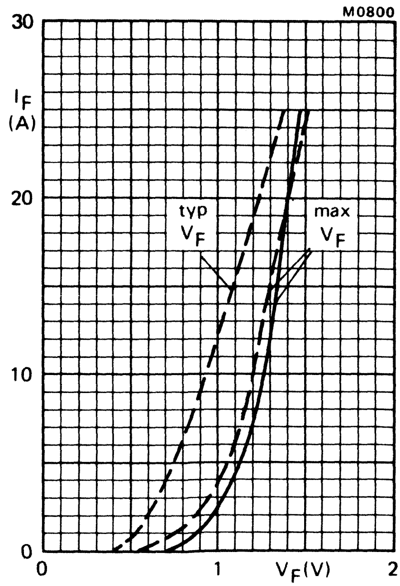


Fig.8 Maximum permissible non-repetitive r.m.s. forward current based on sinusoidal currents (f = 50 Hz); T_j = 150 °C prior to surge; with reapplied V_{RWMmax}.



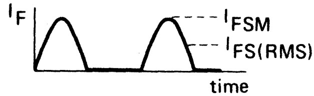


Fig.9 —— T_j = 25 °C; – – – T_j = 100 °C

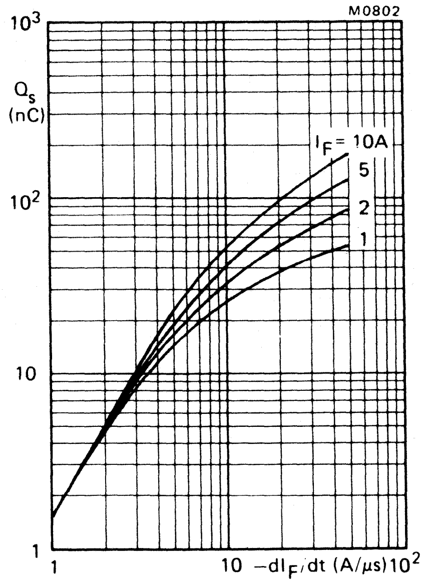


Fig.10 T_j = 25 °C; maximum values.

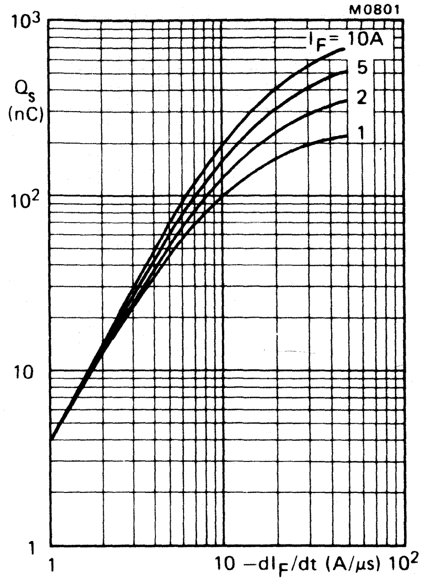
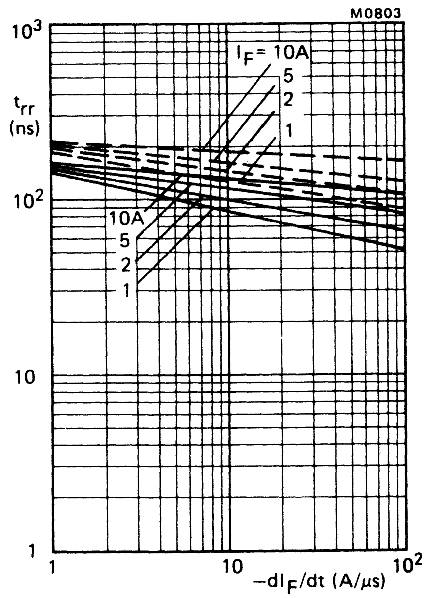
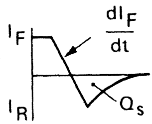


Fig.11 T_j = 100 °C; maximum values.





Definition of Q_s in Figs. 10 and 11

Fig.12 Maximum values; —— T_j = 25 °C; – – – T_j = 100 °C.

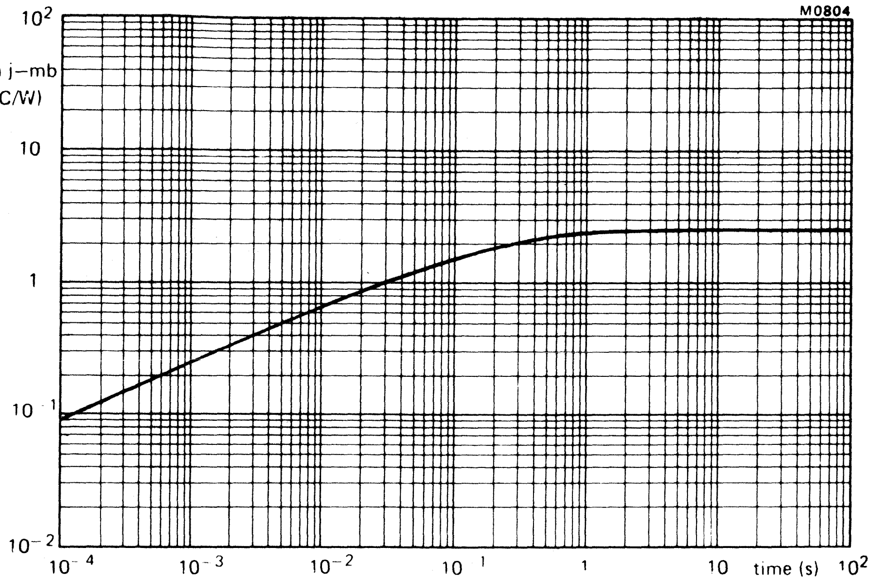


Fig.13

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.

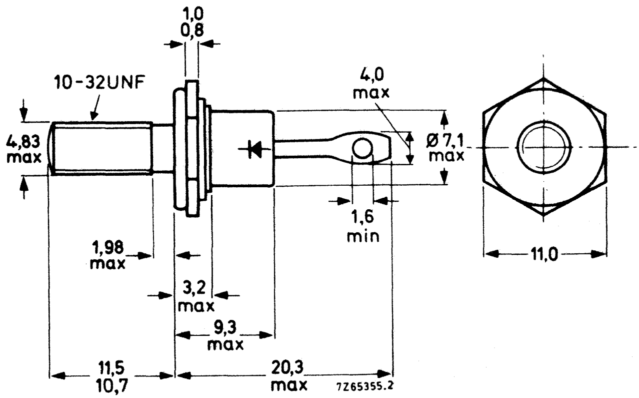
QUICK REFERENCE DATA

			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:
see ACCESSORIES section
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

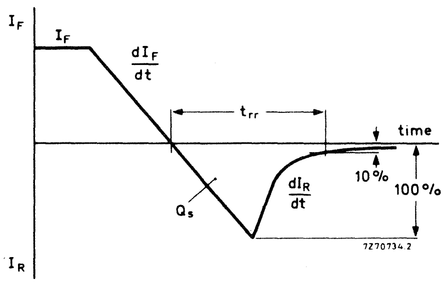
Storage temperature	T_{stg}		−65 to +175	°C
Operating junction temperature	T_j	max.	150	°C

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



D8403

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

*Measured under pulse conditions to avoid excessive dissipation.

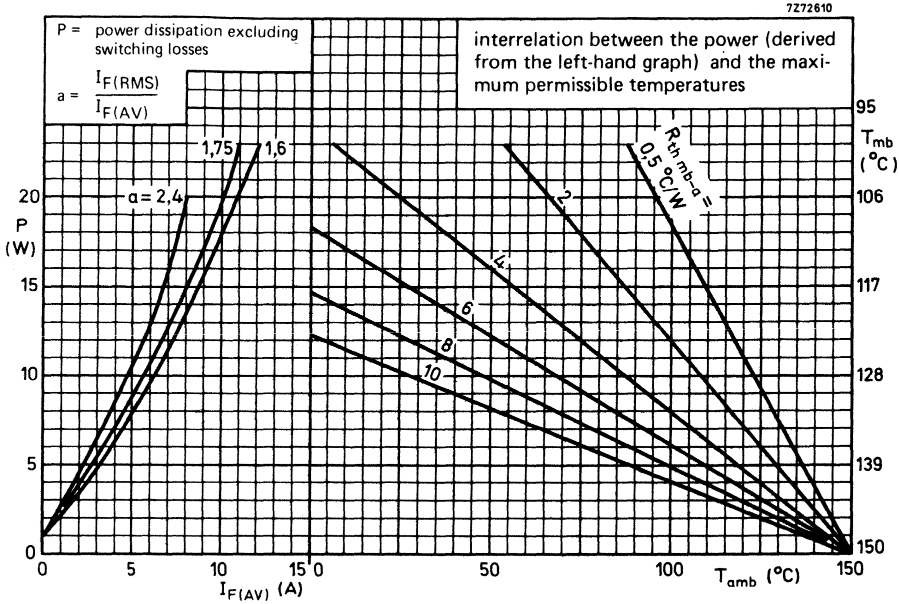

7Z72610
P = power dissipation excluding switching losses
a = IF(RMS) / IF(AV)
interrelation between the power (derived from the left-hand graph) and the maximum permissible temperatures
a = 2,4
1,75
1,6
Rth mb-a = 0,5 °C/W
2
4
6
8
10
P (W)
IF(AV) (A)
Tamb (°C)
Tmb (°C)
0
5
10
15
20
50
100
150
95
106
117
128
139

Fig. 3

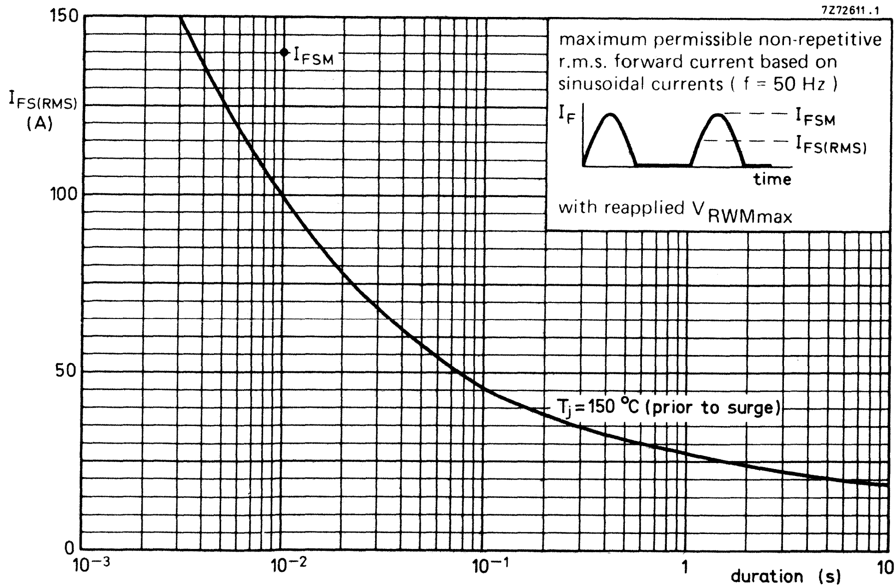

7Z72611.1
maximum permissible non-repetitive r.m.s. forward current based on sinusoidal currents (f = 50 Hz)
IF
IFSM
IFS(RMS)
time
with reapplied VRWMmax
IFS(RMS) (A)
Tj = 150 °C (prior to surge)
duration (s)
0
50
100
150
10−3
10−2
10−1
1
10

Fig. 4

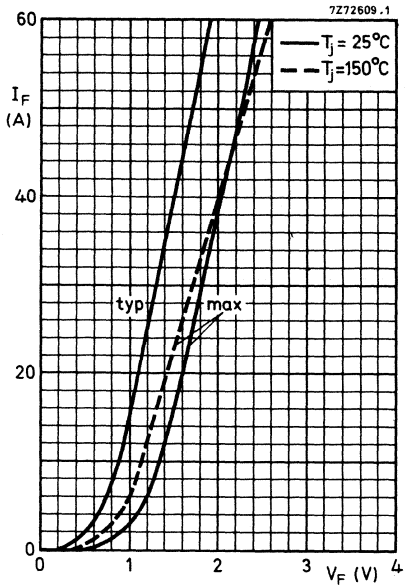


Fig. 5

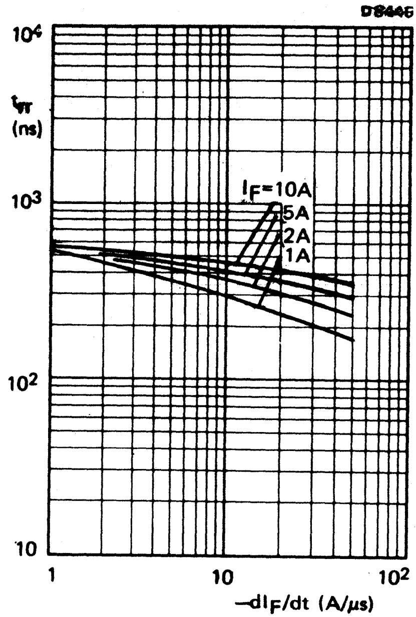


Fig. 6 Maximum values; T_j = 150 °C.

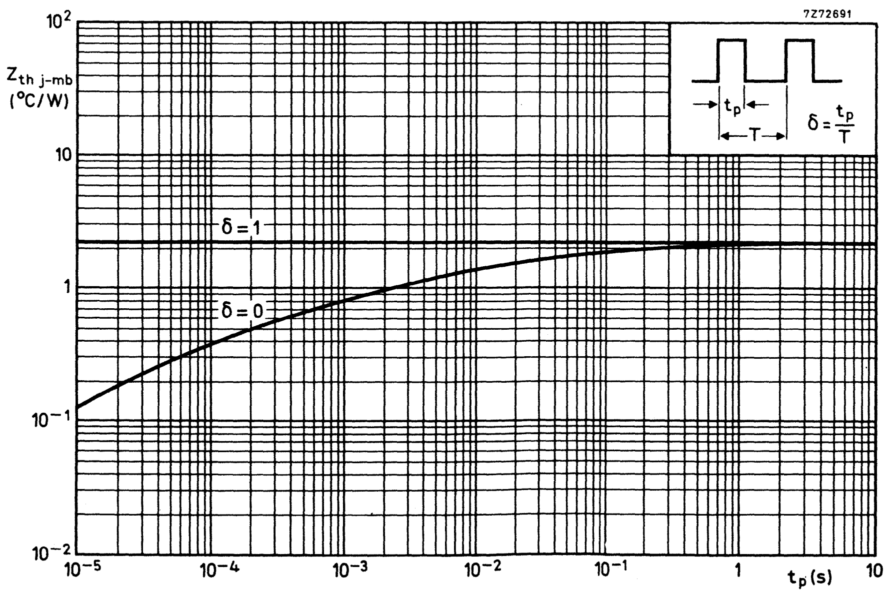


Fig.7

ULTRA FAST RECOVERY DOUBLE RECTIFIER DIODES

Glass-passivated, high-efficiency epitaxial double rectifier diodes in plastic envelopes which feature low forward voltage drop, very fast reverse recovery times and soft recovery characteristic. They are intended for use in switched-mode power supplies, and high-frequency circuits in general, where low conduction and switching losses are essential. Their single chip construction ensures excellent matching of the forward and switching characteristics of the two halves, allowing parallel operation without derating. The series consists of common cathode types.

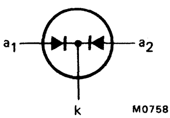
QUICK REFERENCE DATA

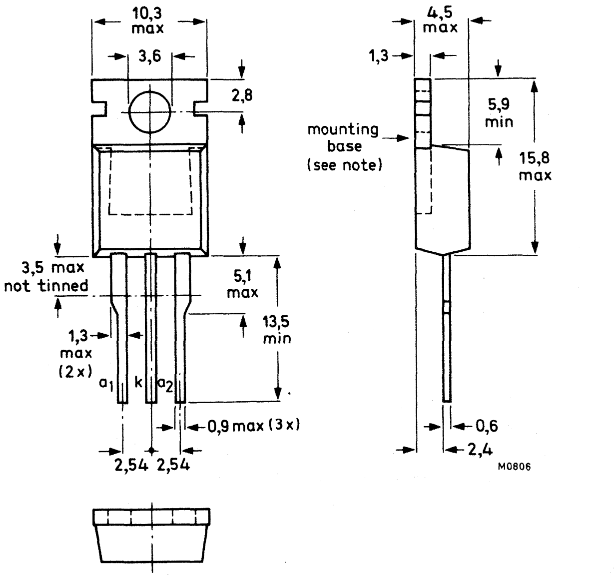
Per diode, unless otherwise stated			BYV32–50	100	150	200	
Repetitive peak reverse voltage	V_{RRM}	max.	50	100	150	200	V
Average forward current (both diodes conducting)	$I_{F(AV)}$	max.		20			A
Non-repetitive peak forward current	I_{FSM}	max.		150			A
Reverse recovery time	t_{rr}	<		35			ns

MECHANICAL DATA

Dimensions in mm

Fig.1 TO-220AB





Net mass: 2 g

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 50 009-026 available on request.

RATINGS

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

Voltages

			BYV32–50	100	150	200	
Non-repetitive peak reverse voltage	V_{RSM}	max.	50	100	150	200	V
Repetitive peak reverse voltage	V_{RRM}	max.	50	100	150	200	V
Crest working reverse voltage	V_{RWM}	max.	50	100	150	200	V
Continuous reverse voltage (note 1)	V_R	max.	50	100	150	200	V

Currents (both diodes conducting; note 2)				
Average forward current				
sinusoidal; up to T_{mb} = 120 °C	$I_{F(AV)}$	max.	18	A
sinusoidal; at T_{mb} = 125 °C	$I_{F(AV)}$	max.	16	A
square-wave; d = 0.5; up to T_{mb} = 120 °C	$I_{F(AV)}$	max.	20	A
square-wave; d = 0.5; at T_{mb} = 125 °C	$I_{F(AV)}$	max.	16.5	A
R.M.S. forward current	$I_{F(RMS)}$	max.	20	A
Repetitive peak forward current	I_{FRM}	max.	300	A
Non-repetitive peak forward current t = 10 ms; half sine-wave; T_j = 150 °C prior to surge; with re-applied $V_{RWM\,max}$ (note 3)	I_{FSM}	max.	150	A
I^2t for fusing (t = 10 ms; note 3)	I^2t	max.	112	A^2s
Temperatures				
Storage temperature	T_{stg}		−40 to +150	°C
Junction temperature	T_j	max.	150	°C
THERMAL RESISTANCE				
From junction to mounting base	$R_{th\ j\text{-}mb}$	=	1.6	°C/W
Transient thermal impedance; t = 1 ms	$Z_{th\ j\text{-}mb}$	=	0.7	°C/W
From mounting base to heatsink				
a. with heatsink compound	$R_{th\ mb\text{-}h}$	=	0.2	°C/W
b. without heatsink compound	$R_{th\ mb\text{-}h}$	=	0.3	°C/W

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 any lead length

$R_{th\ j\text{-}a}$ = 60 °C/W

Notes:

1. To ensure thermal stability: $R_{th\ j\text{-}a} < 6.24$ °C/W
2. The limits for both diodes apply whether both diodes conduct simultaneously or on alternate half cycles.
3. Surge figures apply to each diode.

CHARACTERISTICS (per diode)

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	<	1.15	V*
Reverse current				
$V_R = V_{RWM\ max}$; T_j = 100 °C	I_R	<	0.6	mA
$V_R = V_{RWM\ max}$; T_j = 25 °C	I_R	<	50	μA
Reverse recovery when switched from				
I_F = 1 A to V_R > 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 > 30 V with $-dI_F/dt$ = 20 A/μs; T_j = 25 °C recovered charge	Q_s	<	15	nC
Forward recovery when switched to I_F = 1 A with dI_F/dt = 10 A/μs recovery voltage	V_{fr}	typ.	1	V

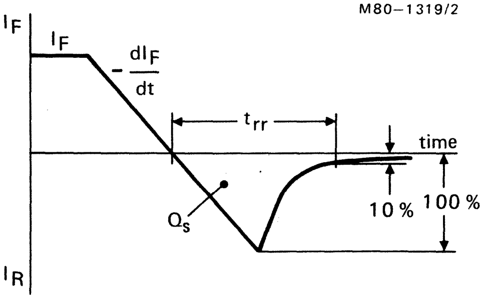


Fig.2 Definition of t_{rr} and Q_s

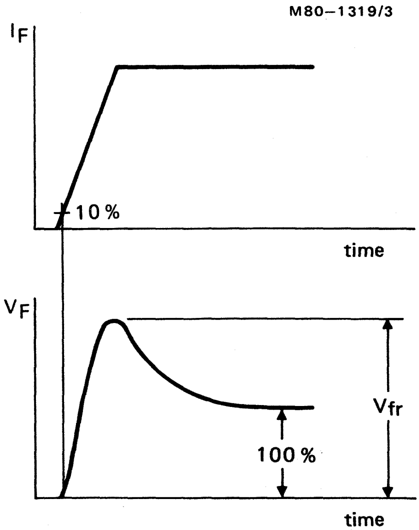


Fig.3 Definition of V_{fr}.

MOUNTING INSTRUCTIONS

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

*Measured under pulse conditions to avoid excessive dissipation.

SINUSOIDAL OPERATION (2-DIODE FULL-WAVE RECTIFICATION)

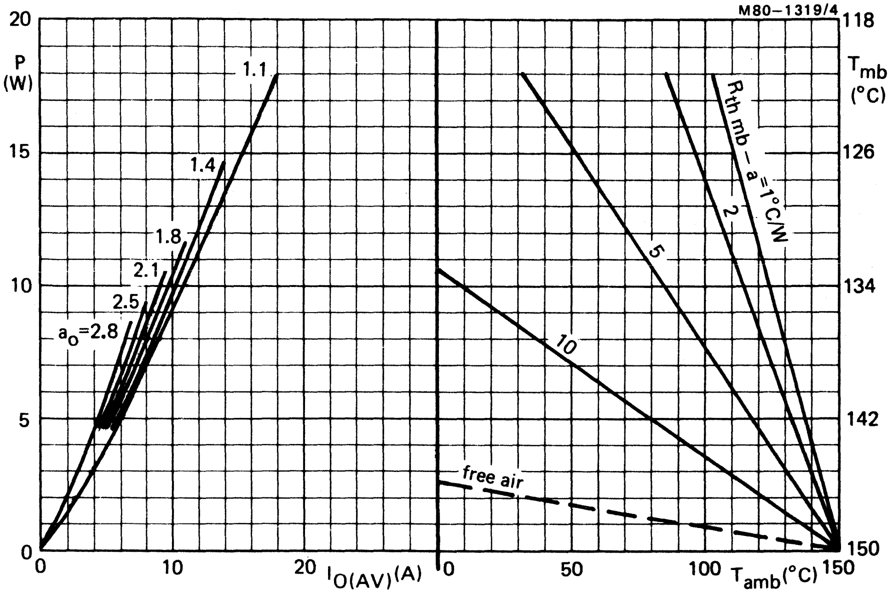


Fig.4 The right-hand part shows the interrelationship between the power (derived from the left-hand part) and the maximum permissible temperatures.
Output form factor $a_o = I_{O(RMS)}/I_{O(AV)} = 0.707 \times I_{F(RMS)}/I_{F(AV)}$ per diode.

SQUARE-WAVE OPERATION (BOTH DIODES)

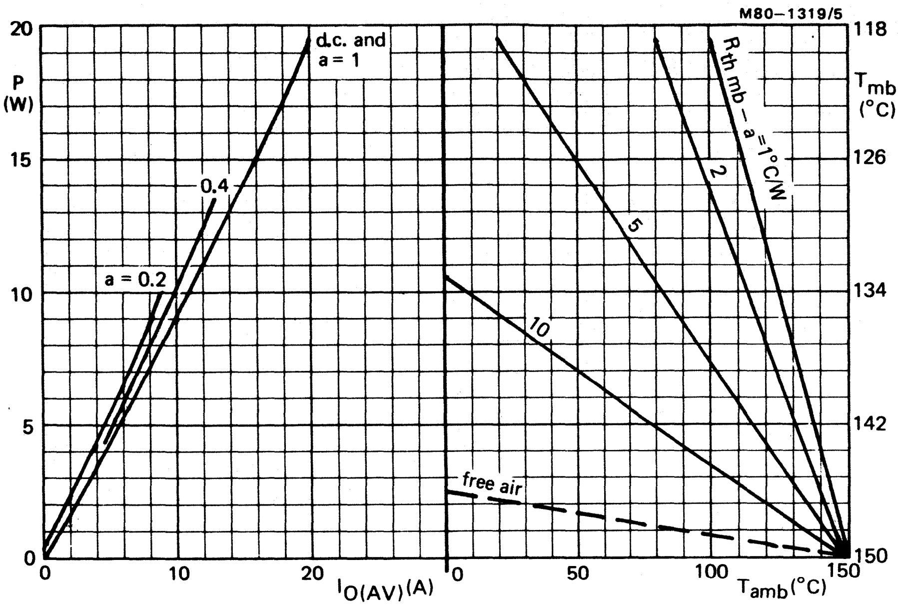
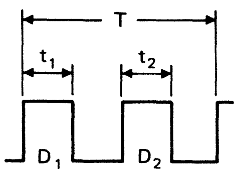


Fig.5 The right-hand part shows the relationship between the power (derived from the left-hand part) and the maximum permissible temperatures.



a = $t_1 + t_2$ = total conduction time of both diodes in one time period.

D_1 = first diode conducting.

D_2 = second diode conducting

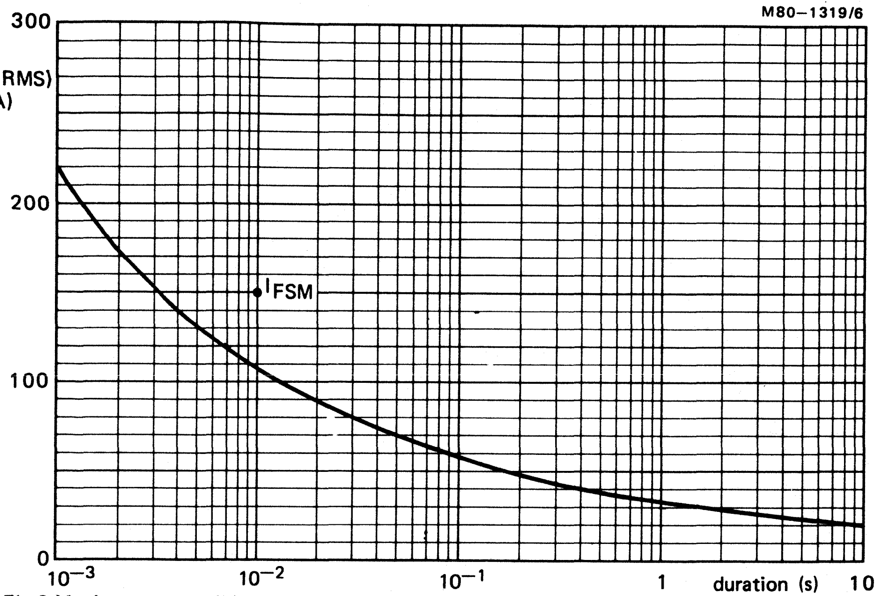
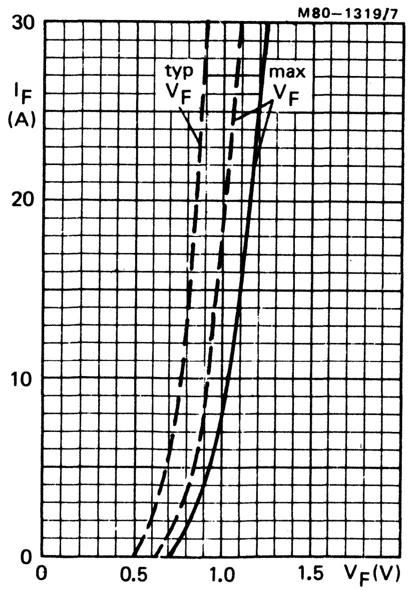


Fig.6 Maximum permissible non-repetitive r.m.s. forward current based on sinusoidal currents (f = 50 Hz); T_j = 150 °C prior to surge; with re-applied $V_{RWM\ max}$; per diode



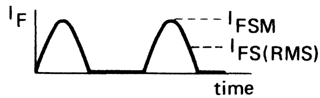


Fig.7 —— T_j = 25 °C; – – – T_j = 100 °C; per diode

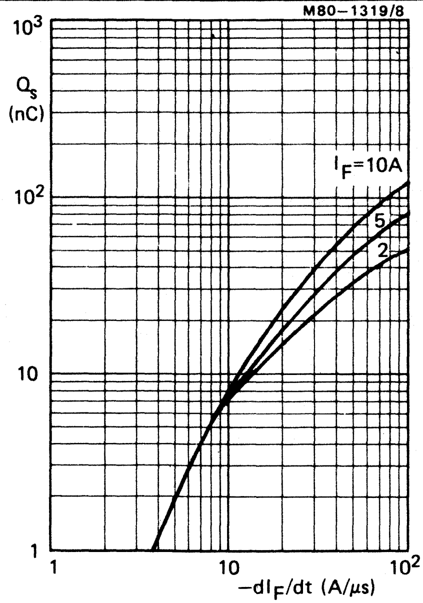


Fig.8 T_j = 25 °C; max. values; per diode

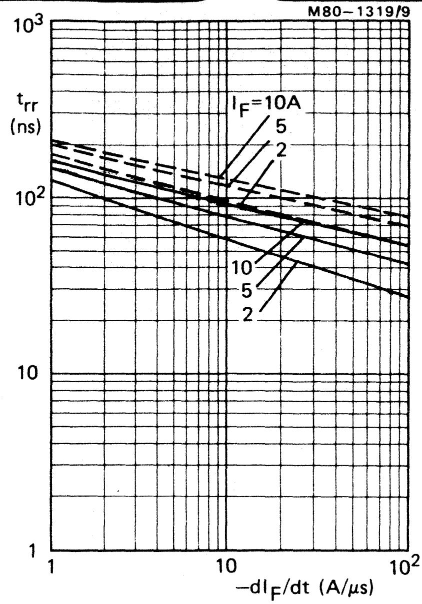


Fig.9 —— T_j = 25 °C; – – – T_j = 100 °C; max. values; per diode

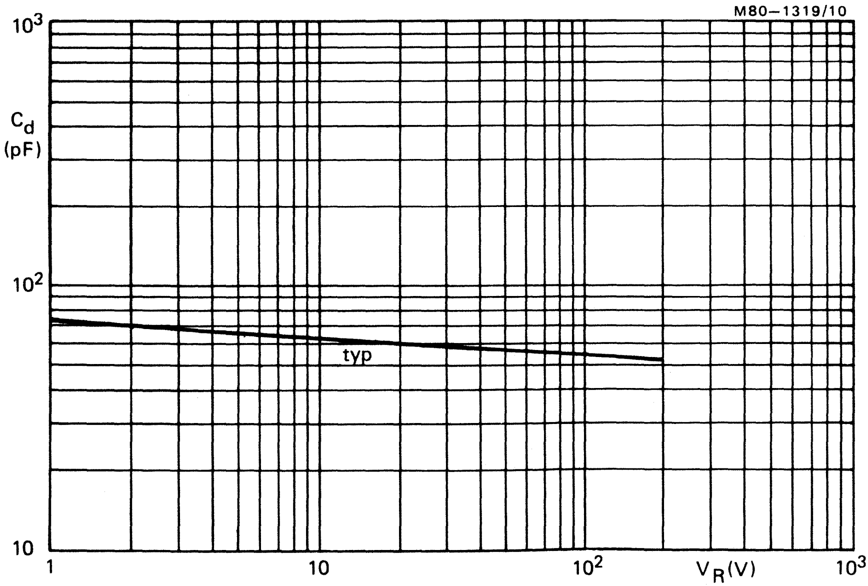


Fig.10 f = 1 MHz; T_j = 25 °C; per diode.

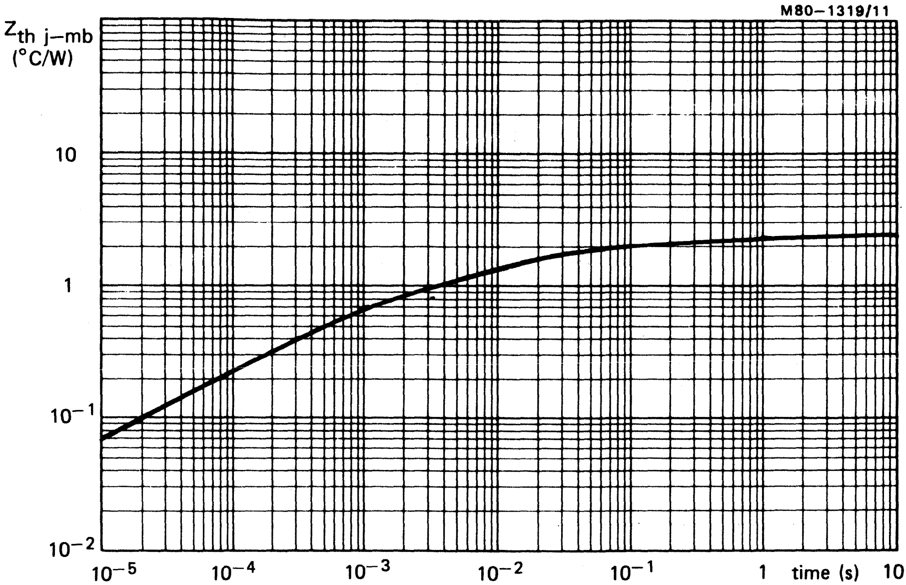


Fig.11 One diode conducting

ULTRA FAST RECOVERY DOUBLE RECTIFIER DIODES

Glass-passivated, high-efficiency epitaxial double rectifier diodes in plastic envelopes which feature low forward voltage drop, very fast reverse recovery times and soft recovery characteristic. They are intended for use in switched-mode power supplies, and high-frequency circuits in general, where low conduction and switching losses are essential. Their single chip construction ensures excellent matching of the forward and switching characteristics of the two halves, allowing parallel operation without derating. The series consists of common cathode types.

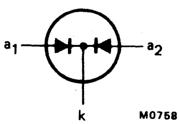
QUICK REFERENCE DATA

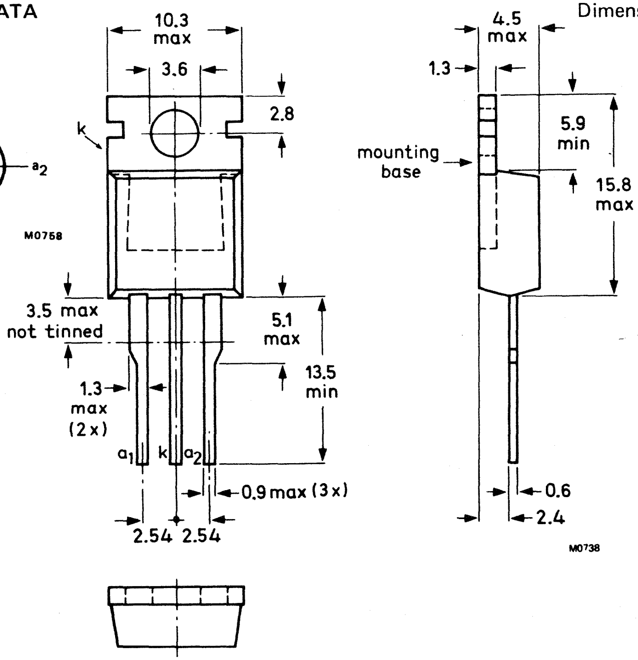
Per diode, unless otherwise stated			BYV34–300	400	500	
Repetitive peak reverse voltage	V_{RRM}	max.	300	400	500	V
Output current (both diodes conducting)	I_O	max.		20		A
Forward voltage	V_F	<		0.93		V
Reverse recovery time	t_{rr}	<		50		ns

MECHANICAL DATA

Dimensions in mm

Fig.1 TO-220AB





Net mass: 2 g

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 (IEC134).

Voltages (per diode)

			BYV34–300	400	500	
Repetitive peak reverse voltage	V_{RRM}	max.	300	400	500	V
Crest working reverse voltage	V_{RWM}	max.	200	300	400	V
Continuous reverse voltage (note 1)	V_R	max.	200	300	400	V

Currents (both diodes conducting; note 2)

Output current				
square wave; $\delta = 0.5$; up to $T_{mb} = 113\ ^oC$	I_O	max.	20	A
up to $T_{mb} = 125\ ^oC$	I_O	max.	14	A
sinusoidal; up to $T_{mb} = 120\ ^oC$	I_O	max.	17.5	A
up to $T_{mb} = 125\ ^oC$	I_O	max.	14	A
R.M.S. forward current	$I_{F(RMS)}$	max.	20	A
Repetitive peak forward current $t_p = 20\ \mu s$; $\delta = 0.02$ (note 3)	I_{FRM}	max.	240	A
Non-repetitive peak forward current half sine-wave; $T_j = 150\ ^oC$ prior to surge with re-applied $V_{RWM\,max}$ (note 3)				
t = 10 ms	I_{FSM}	max.	120	A
t = 8.3 ms	I_{FSM}	max.	150	A
I^2t for fusing (t = 10 ms; note 3)	I^2t	max.	72	A^2s

Temperatures

Storage temperature	T_{stg}		−40 to +150	^oC
Junction temperature	T_j	max.	150	^oC

THERMAL RESISTANCE

From junction to mounting base; total package	$R_{th\ j\text{-}mb}$	=	1.6	K/W
per diode	$R_{th\ j\text{-}mb}$	=	2.3	K/W
From mounting base to heatsink				
a. with heatsink compound	$R_{th\ mb\text{-}h}$	=	0.2	K/W
b. without heatsink compound	$R_{th\ mb\text{-}h}$	=	0.3	K/W

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 any lead length

$R_{th\ j\text{-}a}$ = 60 K/W

Notes

1. To ensure thermal stability: $R_{th\ j\text{-}a} < 4.5$ K/W.
2. The limits for both diodes apply whether both diodes conduct simultaneously or on alternate half cycles.
3. Figures apply to each diode.

CHARACTERISTICS (per diode)

Forward voltage				
I_F = 10 A; T_j = 150 °C	V_F	<	0.93	V*
I_F = 30 A; T_j = 25 °C	V_F	<	1.4	V*
Reverse current				
$V_R = V_{RWM\ max}$; T_j = 100 °C	I_R	<	0.6	mA
$V_R = V_{RWM\ max}$; T_j = 25 °C	I_R	<	50	μA
Reverse recovery when switched from				
I_F = 1 A to $V_R \geq$ 30 V with $-dI_F/dt$ = 100 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	<	45	nC
I_F = 10 A to $V_R \geq$ 30 V with $-dI_F/dt$ = 50 A/μs; T_j = 100 °C peak recovery current	I_{RRM}	<	5.0	A
Forward recovery when switched to I_F = 10 A with dI_F/dt = 10 A/μs; T_j = 25 °C recovery voltage	V_{fr}	typ.	2.5	V

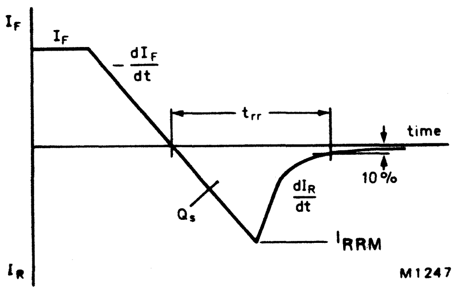


Fig.2 Definition of t_{rr}, Q_s and I_{RRM}.

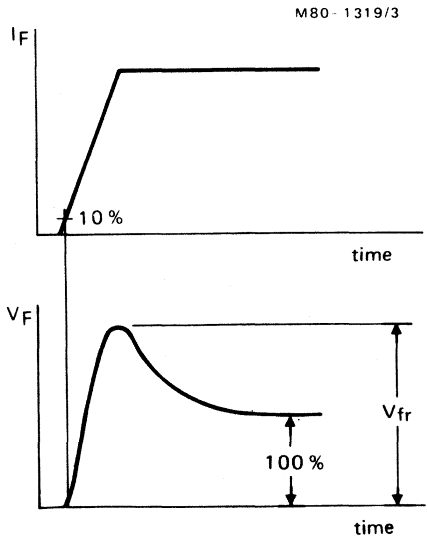


Fig.3 Definition of V_{fr}.

*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. 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 the 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.
4. 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.
5. 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.

OPERATING NOTES

Dissipation and heatsink considerations:

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

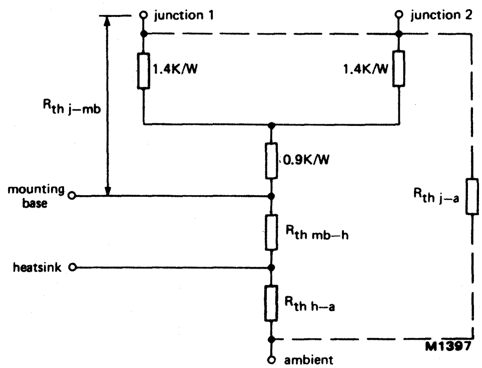


Fig.4

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

SQUARE-WAVE OPERATION (PER DIODE)

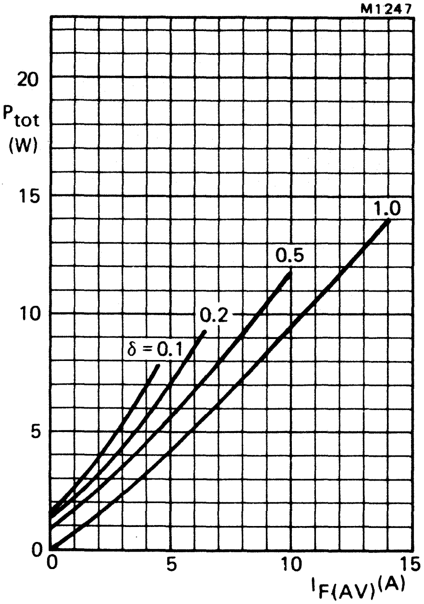
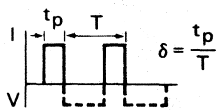


Fig.5 Power rating per diode.
The individual power loss in each diode should first be determined then both added together. The resulting total power loss is then used in conjunction with Fig.6 to determine the heatsink size and corresponding maximum ambient and mounting base temperatures.



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

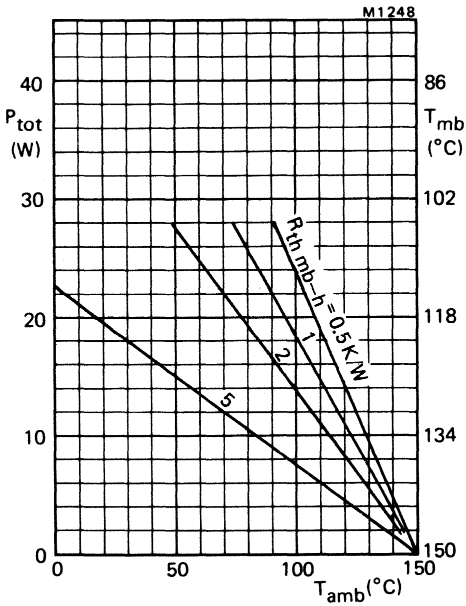


Fig.6

SINUSOIDAL OPERATION (PER DIODE)

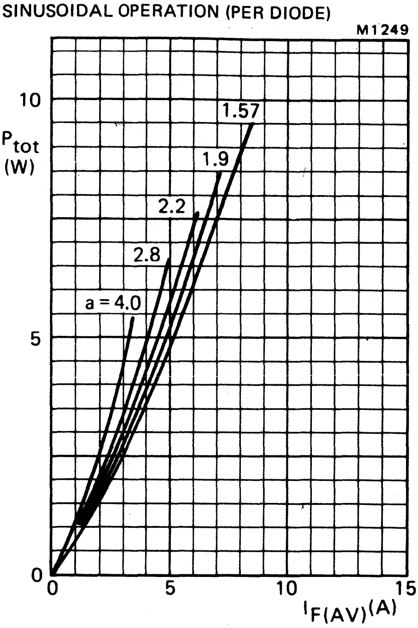


Fig.7 Power rating per diode.
The individual power loss in each diode should first be determined then both added together. The resulting total power loss is then used in conjunction with Fig.6 to determine the heatsink size and corresponding maximum ambient and mounting base temperatures.

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

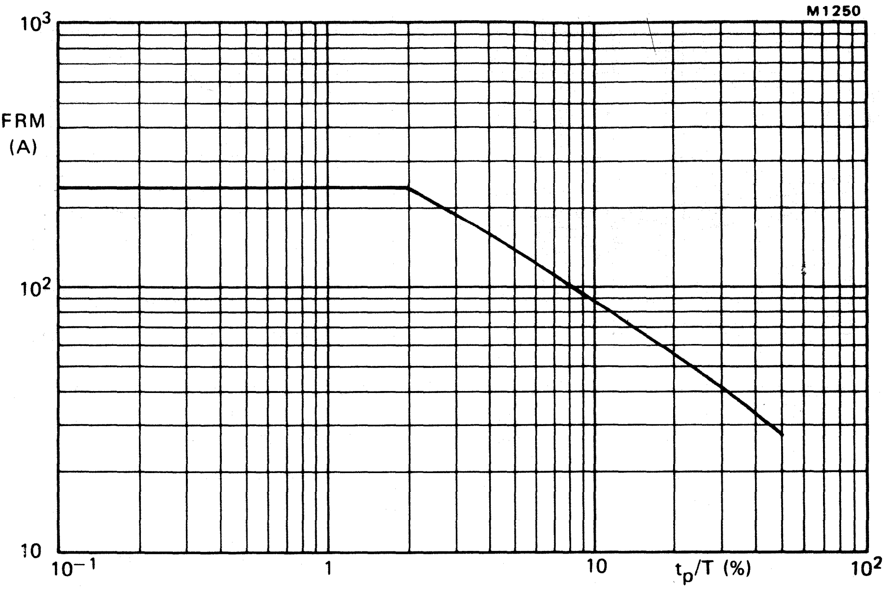
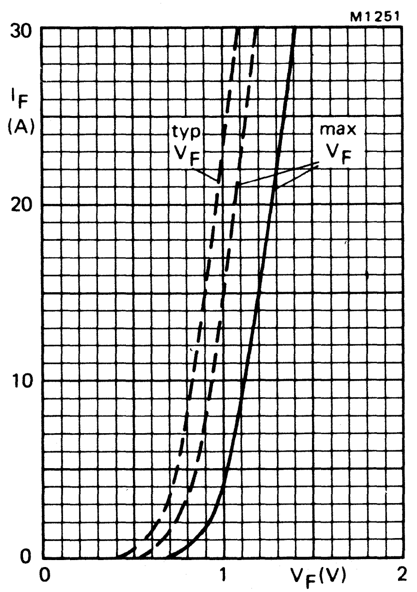
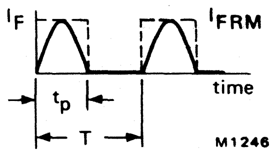


Fig.8 Maximum permissible repetitive peak forward current for either square or sinusoidal currents for 1 $\mu s < t_p < 1$ ms.





Definition of I_{FRM} and t_p/T

Fig. 9 —— $T_j = 25\ ^oC$; – – – $T_j = 150\ ^oC$ per diode.

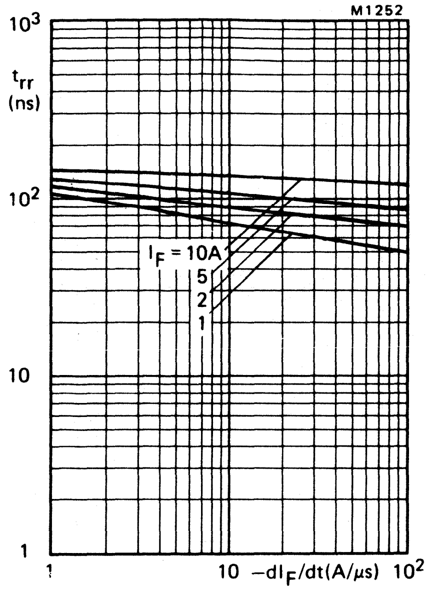


Fig.10 Maximum t_{rr} at T_j = 25 °C.

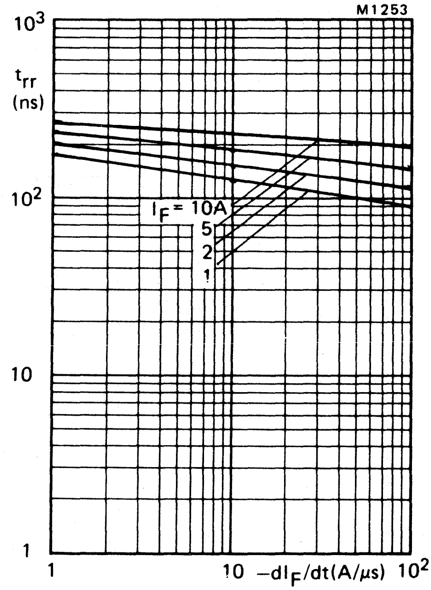


Fig.11 Maximum t_{rr} at T_j = 100 °C.

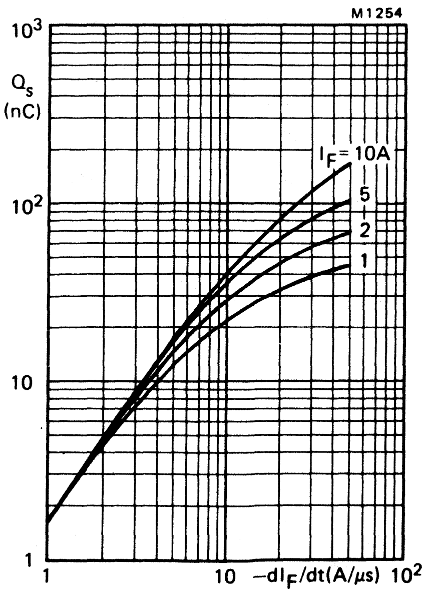


Fig.12 Maximum Q_s at T_j = 25 °C.

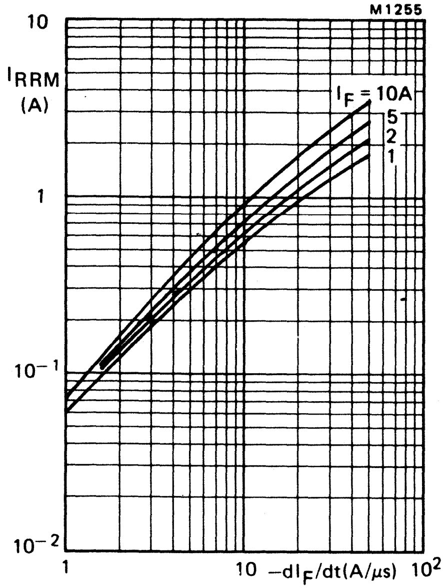


Fig.13 Maximum I_{RRM} at T_j = 25 °C.

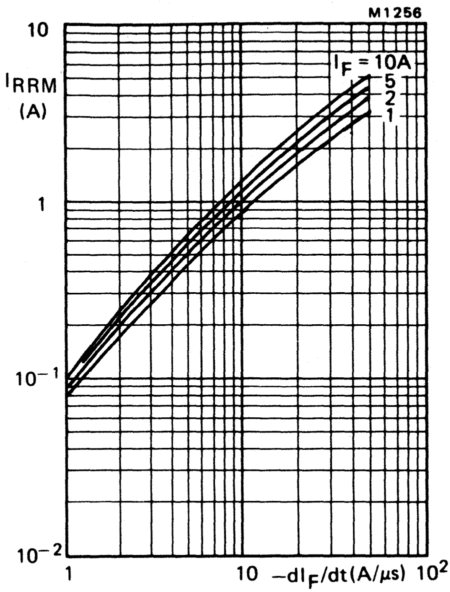


Fig.14 Maximum I_{RRM} at T_j = 100 °C.

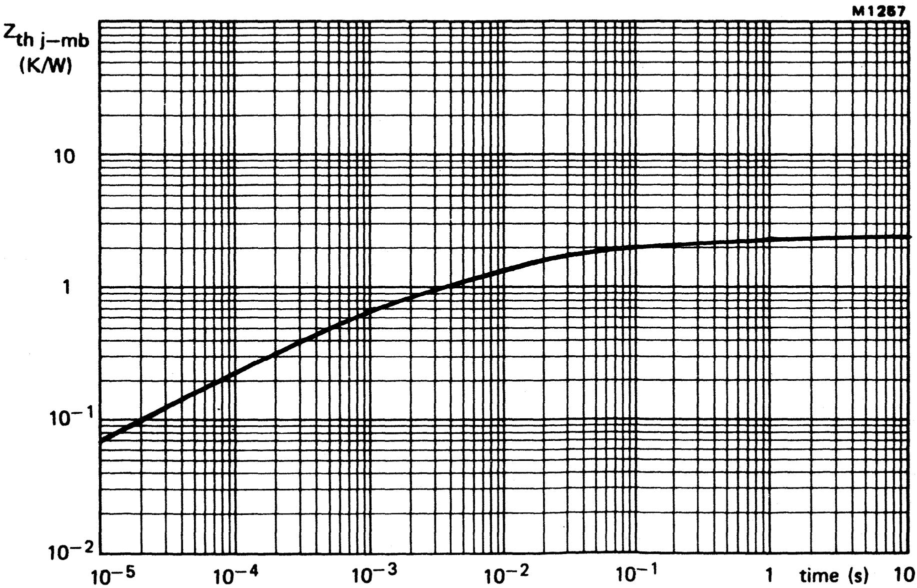


Fig.15 One diode conducting.

VERY FAST RECOVERY DOUBLE RECTIFIER DIODES

Glass-passivated, high-efficiency double rectifier diodes in plastic envelopes which feature low forward voltage drop, very fast reverse recovery times 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. Its single chip construction ensures excellent matching of the forward and switching characteristics of the two halves, allowing parallel operation without derating. The series consists of common-cathode types.

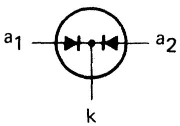
QUICK REFERENCE DATA

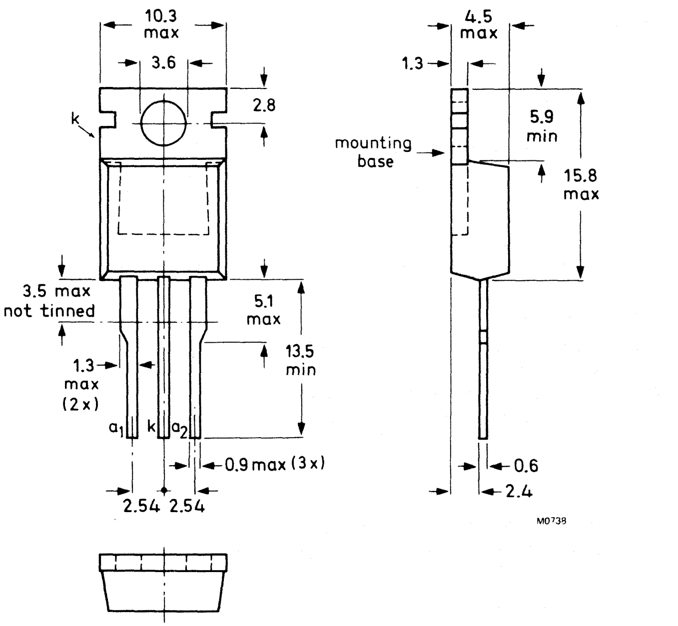
Per diode, unless otherwise stated			BYV42–50	100	150	200	
Crest working reverse voltage	V_{RWM}	max.	50	100	150	200	V
Average forward current (both diodes conducting)	$I_{F(AV)}$	max.		30			A
Non-repetitive peak forward current	I_{FSM}	max.		200			A
Reverse recovery time	t_{rr}	<		35			ns

MECHANICAL DATA

Dimensions in mm

Fig.1 TO-220AB





Net mass: 2 g

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 (IEC134)

Voltages

			BYV42–50	100	150	200	
Non-repetitive peak reverse voltage	V_{RSM}	max.	50	100	150	200	V
Repetitive peak reverse voltage	V_{RRM}	max.	50	100	150	200	V
Crest working reverse voltage	V_{RWM}	max.	50	100	150	200	V
Continuous reverse voltage (note 1)	V_R	max.	50	100	150	200	V

Currents (both diodes conducting; note 2)

Average forward current square-wave; d = 0.5; up to T_{mb} = 104 °C (note 4)	$I_{F(AV)}$	max.	30	A
R.M.S. forward current (note 4)	$I_{F(RMS)}$	max.	30	A
Repetitive peak forward current	I_{FRM}	max.	400	A
Non-repetitive peak forward current t = 10 ms; half sine-wave; T_j = 150 °C prior to surge; with re-applied $V_{RWM\,max}$ (note 3)	I_{FSM}	max.	200	A
I^2t for fusing (t = 10 ms; note 3)	I^2t	max.	200	A^2s

Temperatures

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

THERMAL RESISTANCE

From junction to mounting base	$R_{th\ j\text{-}mb}$	=	1.4	°C/W
Transient thermal impedance; t = 1 ms	$Z_{th\ j\text{-}mb}$	=	0.7	°C/W
From mounting base to heatsink a. with heatsink compound	$R_{th\ mb\text{-}h}$	=	0.2	°C/W
b. without heatsink compound	$R_{th\ mb\text{-}h}$	=	0.3	°C/W

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 any lead length

$R_{th\ j\text{-}a}$	=	60	°C/W

Notes

1. To ensure thermal stability: $R_{th\ j\text{-}a} < 5.6$ °C/W.
2. The limits for both diodes apply whether both diodes conduct simultaneously or on alternate half cycles.
3. Surge figures apply to each diode.
4. For output currents in excess of 20A, connection should be made to the exposed metal mounting base.

CHARACTERISTICS (per diode)

Forward voltage				
I_F = 10 A; T_j = 100 °C	V_F	<	0.85	V*
I_F = 30 A; T_j = 25 °C	V_F	<	1.15	V*
Reverse current				
$V_R = V_{RWM\,max}$; T_j = 100 °C	I_R	<	1.0	mA
$V_R = V_{RWM\,max}$; T_j = 25 °C	I_R	<	100	μA
Reverse recovery when switched from				
I_F = 2 A to V_R > 30 V with $-dI_F/dt$ = 100 A/μs; T_j = 25 °C recovery time	t_{rr}	<	35	ns
I_F = 2 A to V_R > 30 V with $-dI_F/dt$ = 20 A/μs; T_j = 25 °C recovered charge	Q_s	<	15	nC
Forward recovery when switched to I_F = 1 A with dI_F/dt = 10 A/μs recovery voltage	V_{fr}	typ.	1	V

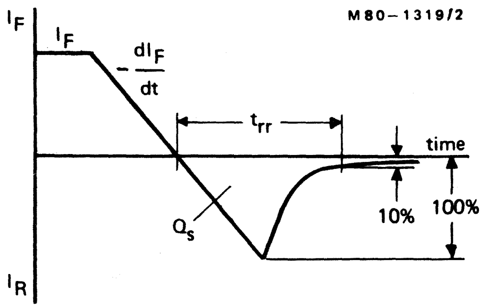


Fig.2 Definition of t_{rr} and Q_s

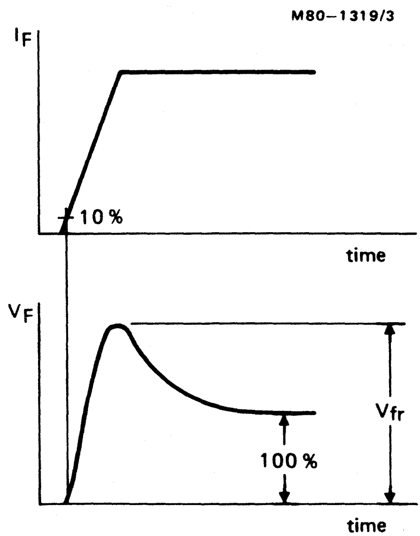


Fig.3 Definition of V_{fr}.

*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 ^{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 for output currents in excess of 20 A, connection be made to the exposed metal mounting base (Fig.1).
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 the 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. 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.

OPERATING NOTES

Dissipation and heatsink considerations:

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

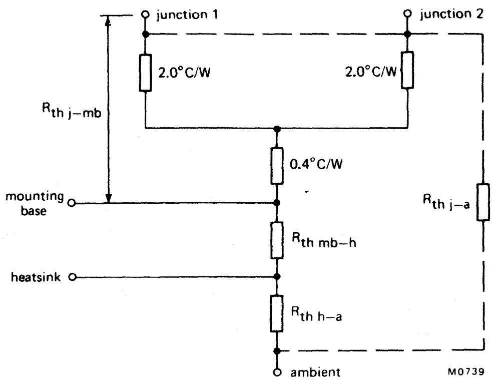


Fig.4

b. The method of using Fig.5 is as follows:
Starting with the required current on the $I_{F(AV)}$ axis, trace upwards to meet the appropriate 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.

SQUARE-WAVE OPERATION (BOTH DIODES)

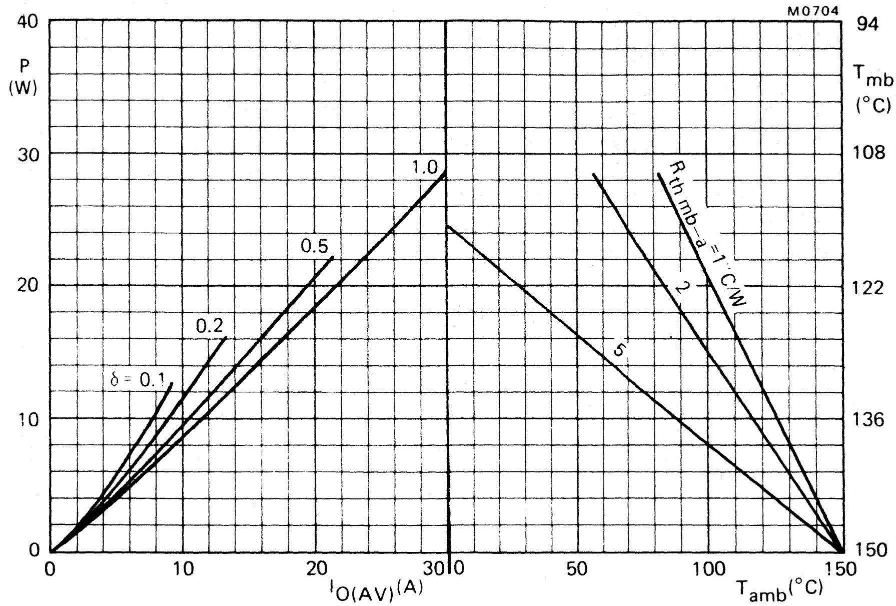
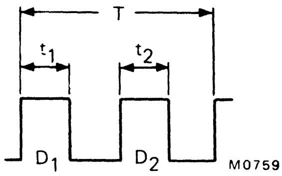


Fig.5 The right-hand part shows the relationship between the power (derived from the left-hand part) and the maximum permissible temperatures.



$\delta = \frac{t_1 + t_2}{T}$ = total conduction time of both diodes in one time period.

D_1 = first diode conducting.

D_2 = second diode conducting.

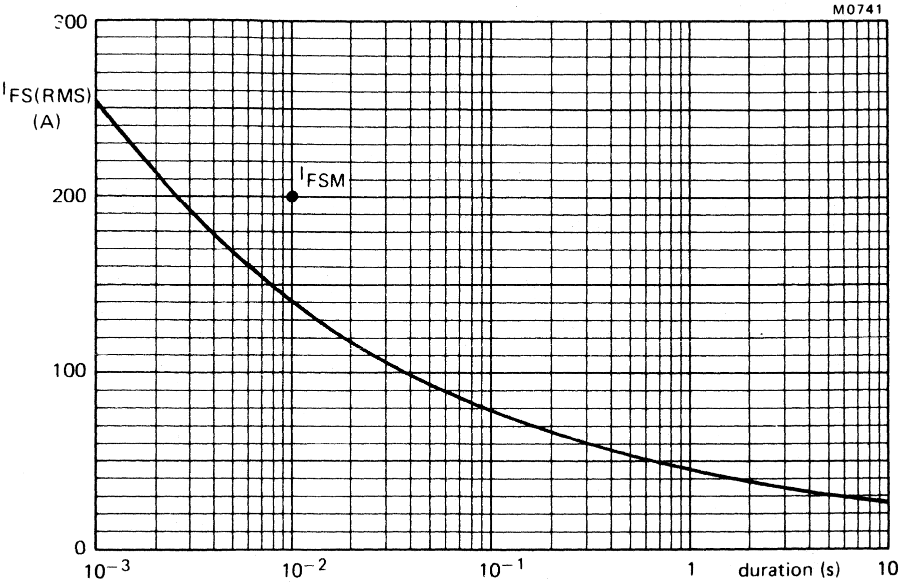


Fig.6 Maximum permissible non-repetitive r.m.s. forward current based on sinusoidal currents (f = 50 Hz); T_j = 150 °C prior to surge; with re-applied $V_{RWM\ max}$; per diode.

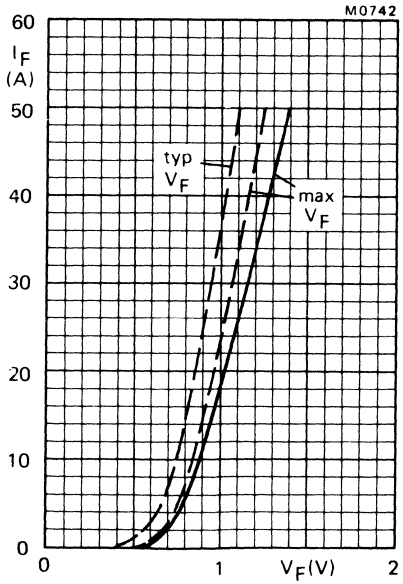


Fig.7 —— T_j = 25 °C; – – – T_j = 100 °C; per diode.

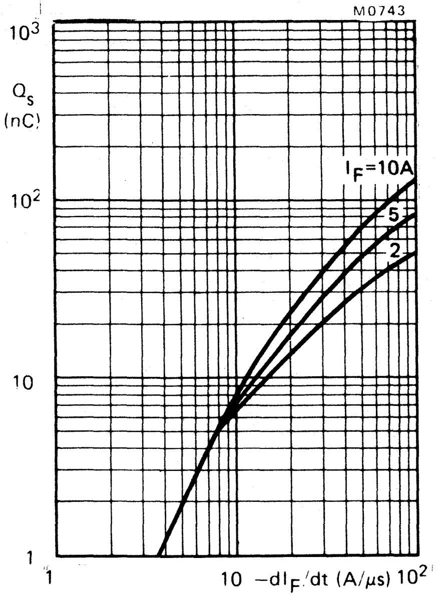


Fig.8 T_j = 25 °C; max. values; per diode.

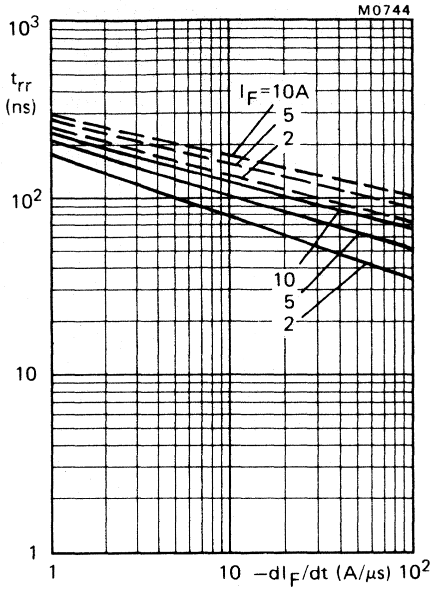


Fig.9 —— T_j = 25 °C; – – – T_j = 100 °C; max. values; per diode.

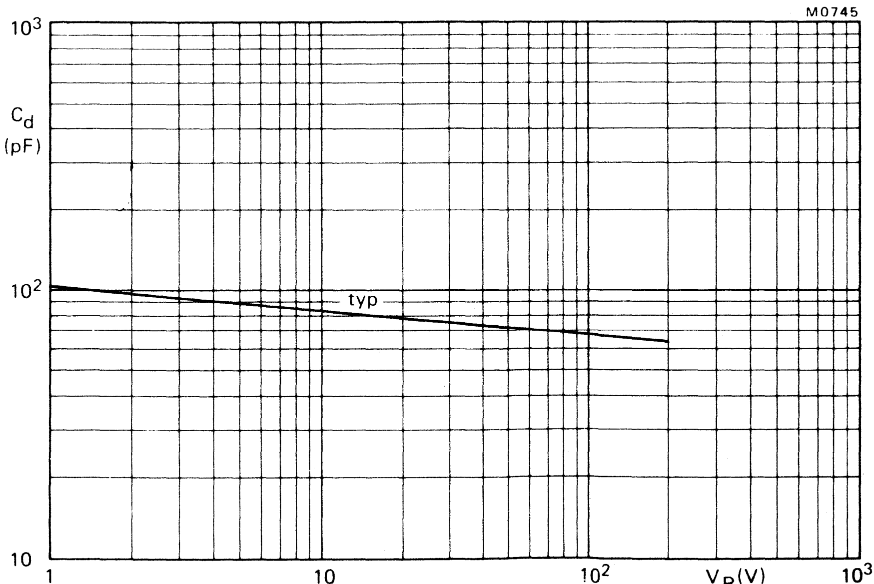


Fig.10 f = 1 MHz; T_j = 25 °C; per diode.

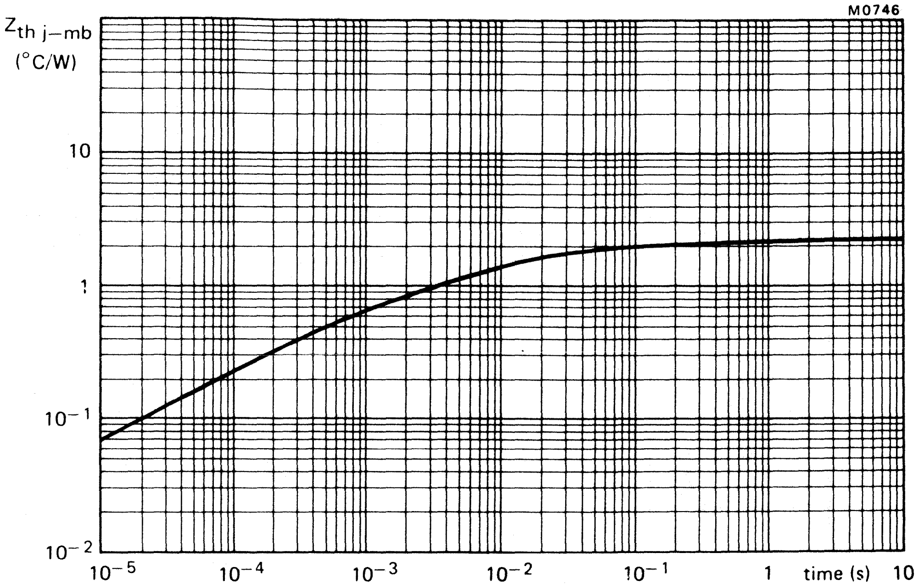


Fig.11 One diode conducting

VERY FAST RECOVERY DOUBLE RECTIFIER DIODES

Glass-passivated, high-efficiency double rectifier diodes in plastic envelopes which feature low forward voltage drop, very fast reverse recovery times 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. Its single chip construction ensures excellent matching of the forward and switching characteristics of the two halves, allowing parallel operation without derating. The series consists of common-cathode types.

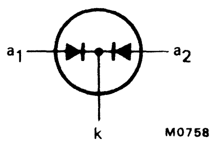
QUICK REFERENCE DATA

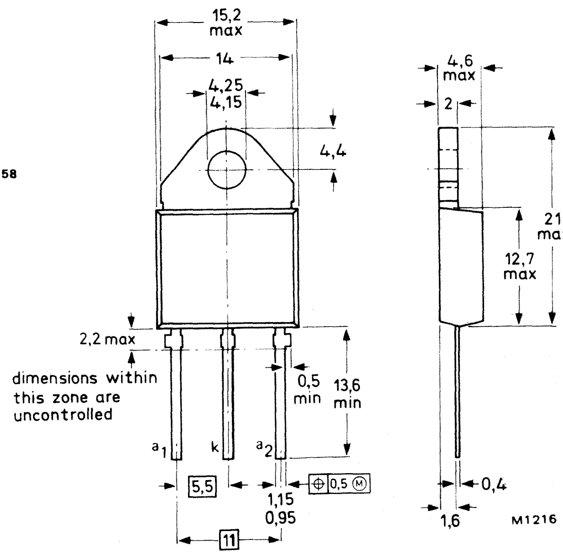
Per diode, unless otherwise stated			BYV72–50	100	150	200	
Crest working reverse voltage	V_{RWM}	max.	50	100	150	200	V
Average forward current (both diodes conducting)	$I_{F(AV)}$	max.		30			A
Non-repetitive peak forward current	I_{FSM}	max.		150			A
Reverse recovery time	t_{rr}	<		35			ns

MECHANICAL DATA

Dimensions in mm

Fig.1 SOT-93; cathode connected to mounting base





Accessories supplied on request: see data sheets Mounting instructions and accessories for SOT-93 envelopes.

RATINGS

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

Voltages

			BYV72--50	100	150	200	
Non-repetitive peak reverse voltage	V_{RSM}	max.	50	100	150	200	V
Repetitive peak reverse voltage	V_{RRM}	max.	50	100	150	200	V
Crest working reverse voltage	V_{RWM}	max.	50	100	150	200	V
Continuous reverse voltage (note 1)	V_R	max.	50	100	150	200	V

Currents (both diodes conducting; note 2)

Average forward current square-wave; d = 0.5; up to T_{mb} = 105 °C (note 4)	$I_{F(AV)}$	max.	30	A
R.M.S. forward current (note 4)	$I_{F(RMS)}$	max.	30	A
Repetitive peak forward current	I_{FRM}	max.	300	A
Non-repetitive peak forward current t = 10 ms; half sine-wave; T_j = 150 °C prior to surge; with re-applied $V_{RWM\,max}$ (note 3)	I_{FSM}	max.	150	A
I^2t for fusing (t = 10 ms; note 3)	I^2t	max.	112	A^2s

Temperatures

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

THERMAL RESISTANCE

From junction to mounting base	$R_{th\ j\text{-}mb}$	=	1.4	K/W
Transient thermal impedance; t = 1 ms	$Z_{th\ j\text{-}mb}$	=	0.7	K/W
From mounting base to heatsink a. with heatsink compound	$R_{th\ mb\text{-}h}$	=	0.2	K/W
b. without heatsink compound	$R_{th\ mb\text{-}h}$	=	0.3	K/W

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 any lead length

	$R_{th\ j\text{-}a}$	=	60	K/W

Notes

1. To ensure thermal stability: $R_{th\ j\text{-}a} < 5.6$ K/W
2. The limits for both diodes apply whether both diodes conduct simultaneously or on alternate half cycles.
3. Surge figures apply to each diode.
4. For output currents in excess of 20 A, connection should be made to the exposed metal mounting base.

CHARACTERISTICS (per diode)

Forward voltage				
I_F = 10 A; T_j = 100 °C	V_F	<	0.85	V*
I_F = 30 A; T_j = 25 °C	V_F	<	1.15	V*
Reverse current				
$V_R = V_{RWM\ max}$; T_j = 100 °C	I_R	<	1.0	mA
$V_R = V_{RWM\ max}$; T_j = 25 °C	I_R	<	25	µA
Reverse recovery when switched from				
I_F = 2 A to V_R > 30 V with $-dI_F/dt$ = 100 A/µs; T_j = 25 °C recovery time	t_{rr}	<	35	ns
I_F = 2 A to V_R > 30 V with $-dI_F/dt$ = 20 A/µs; T_j = 25 °C recovered charge	Q_s	<	15	nC
Forward recovery when switched to I_F = 1 A; T_j = 25 °C with dI_F/dt = 10 A/µs recovery voltage	V_{fr}	typ.	1	V

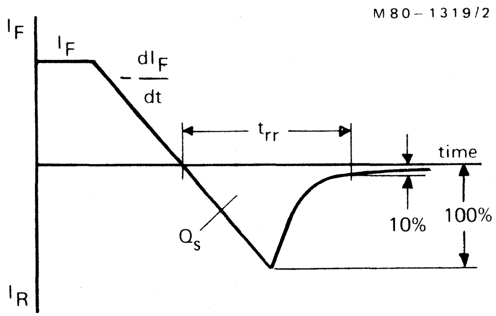


Fig.2 Definition of t_{rr} and Q_s

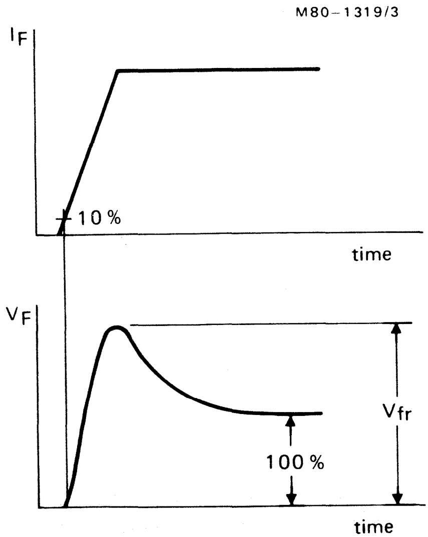


Fig.3 Definition of V_{fr}.

*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 for output currents in excess of 20 A, connection be made to the exposed metal mounting base (Fig.1).
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 the screw mounting.

   b. safe isolation for mains operation.

   However, if a screw is used, it should be M4 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. 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.

OPERATING NOTES

Dissipation and heatsink considerations:

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

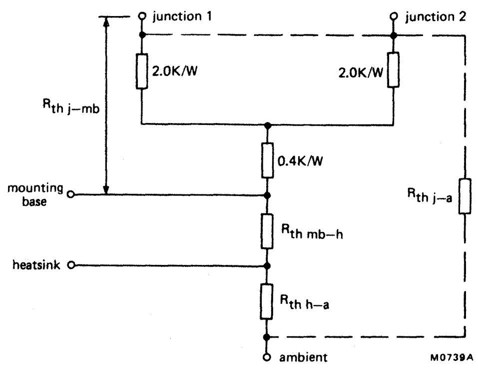


Fig.4

b. The method of using Fig.5 is as follows:
Starting with the required current on the $I_{F(AV)}$ axis, trace upwards to meet the appropriate 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.

SQUARE-WAVE OPERATION (BOTH DIODES)

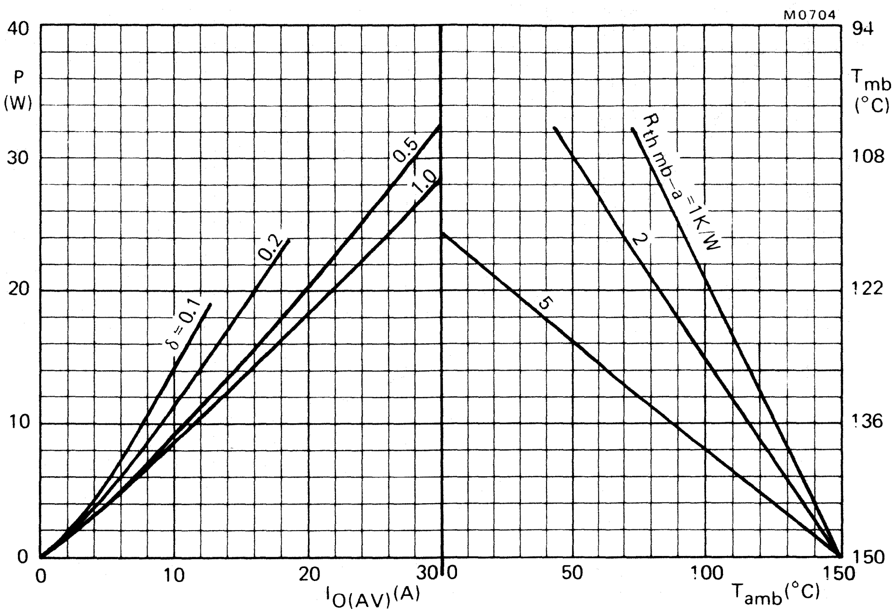
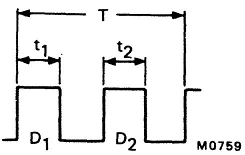


Fig.5 The right-hand part shows the relationship between the power (derived from the left-hand part) and the maximum permissible temperatures.



$\delta = \frac{t_1 + t_2}{T}$ = total conduction time of both diodes in one time period.

D_1 = first diode conducting.

D_2 = second diode conducting.

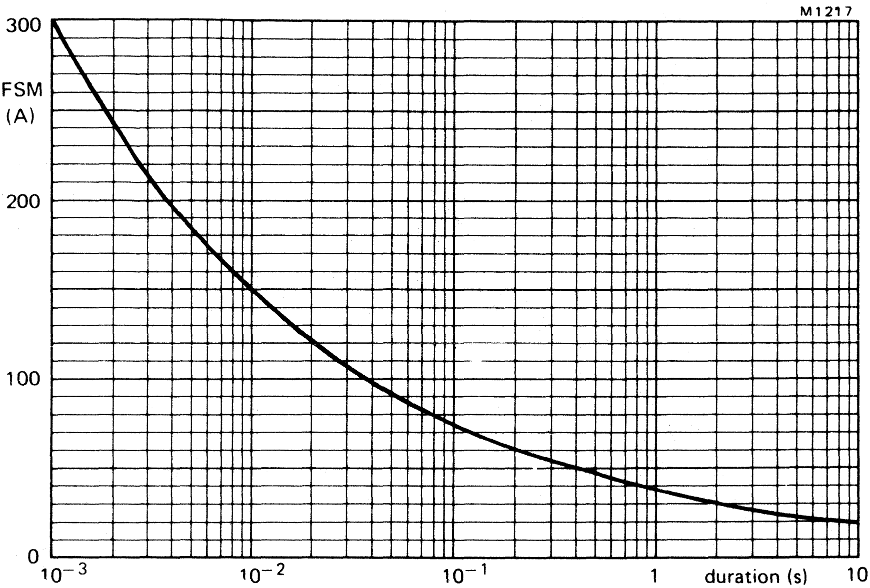
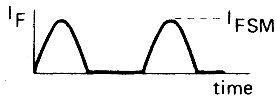


Fig.6 Maximum permissible non-repetitive peak forward current based on sinusoidal currents (f = 50 Hz); T_j = 150 °C prior to surge; with re-applied $V_{RWM\,max}$; per diode.



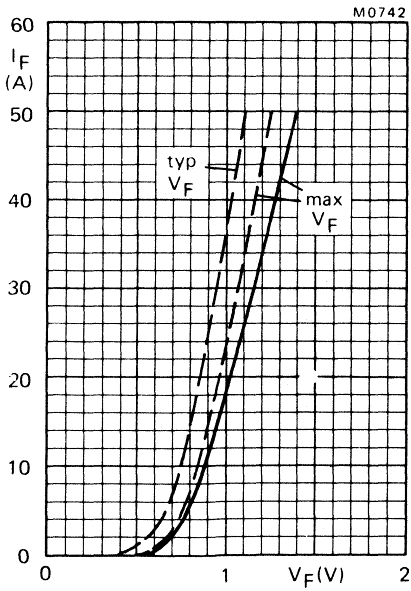


Fig.7 —— T_j = 25 °C; — — - T_j = 100 °C; per diode.

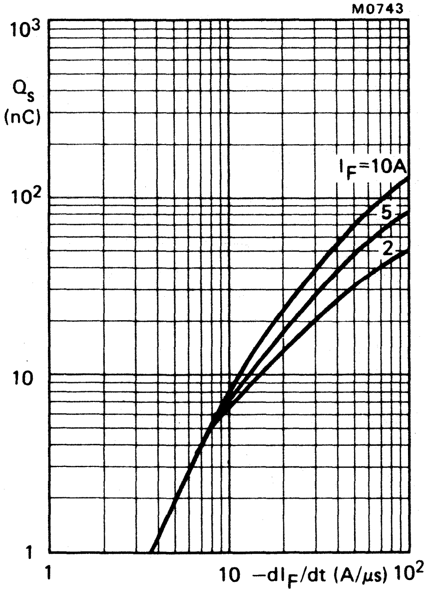


Fig.8 T_j = 25 °C; max. values.

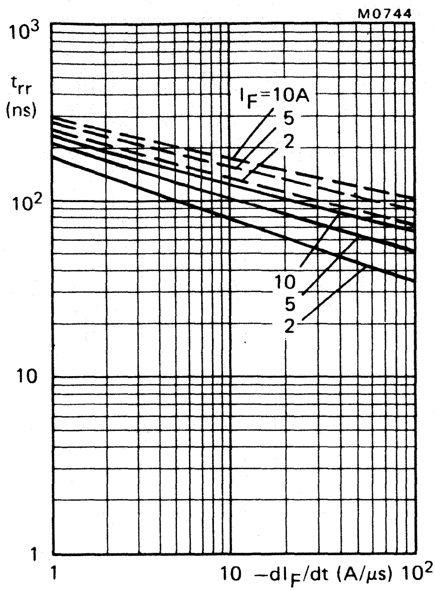


Fig.9 —— T_j = 25 °C; – – – T_j = 100 °C; max. values; per diode.

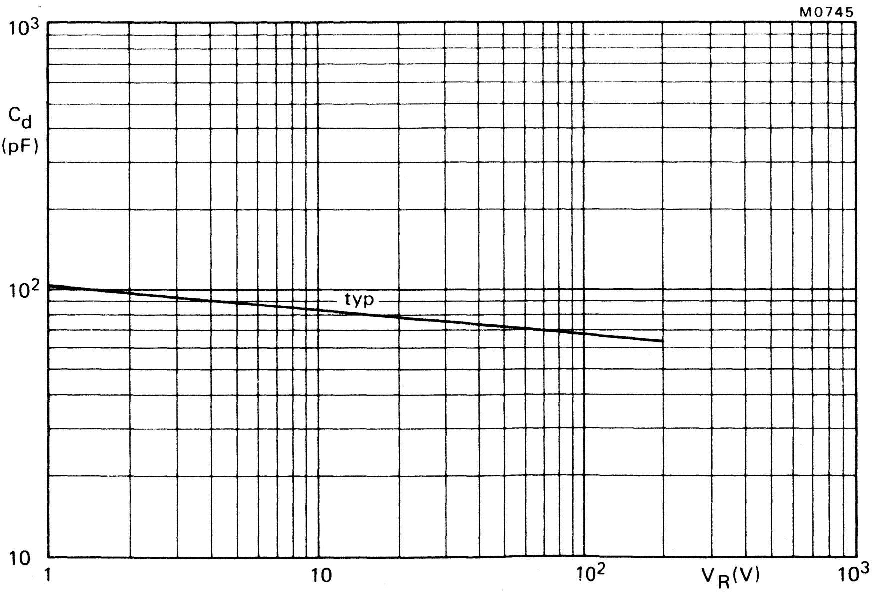


Fig.10 f = 1 MHz; T_j = 25 °C; per diode.

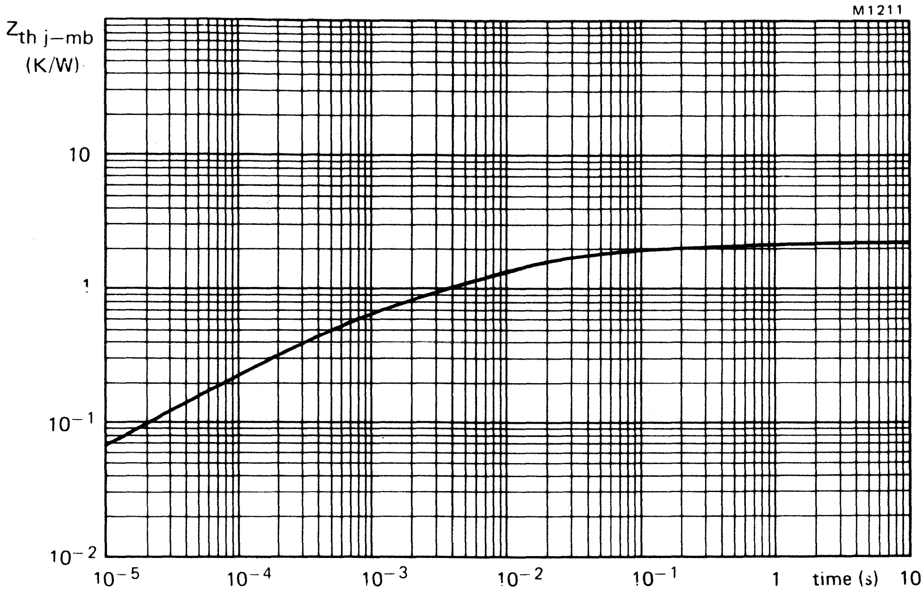


Fig.11 One diode conducting

VERY FAST RECOVERY RECTIFIER DIODES

Glass-passivated, high-efficiency 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.

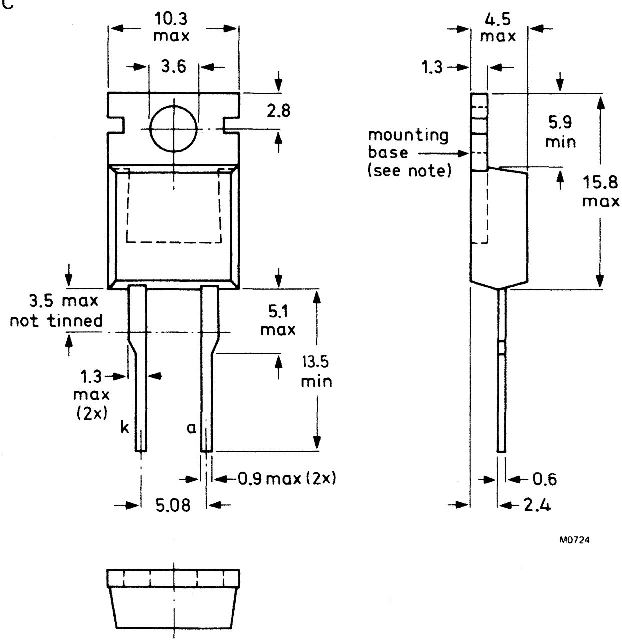
QUICK REFERENCE DATA

			BYV79–50	100	150	200	
Repetitive peak reverse voltage	V_{RRM}	max.	50	100	150	200	V
Average forward current	$I_{F(AV)}$	max.			14		A
Forward voltage	V_F	<			0.85		V
Reverse recovery time	t_{rr}	<			35		ns

MECHANICAL DATA

Dimensions in mm

Fig.1 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*

			BYV79–50	100	150	200	
Non-repetitive peak reverse voltage	V_{RSM}	max.	50	100	150	200	V
Repetitive peak reverse voltage	V_{RRM}	max.	50	100	150	200	V
Crest working reverse voltage	V_{RWM}	max.	50	100	150	200	V
Continuous reverse voltage	V_R	max.	50	100	150	200	V

Currents

Average forward current; switching losses negligible up to 500 kHz				
sinusoidal; up to T_{mb} = 122 °C	$I_{F(AV)}$	max	12	A
square-wave; δ = 0.5; up to T_{mb} = 115 °C	$I_{F(AV)}$	max	14	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}		−40 to +150	°C
Junction temperature	T_j	max.	150	°C

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

THERMAL RESISTANCE

From junction to mounting base	$R_{th\ j\text{-}mb}$	=	2.0	$^oC/W$
Transient thermal impedance; t = 1 ms	$Z_{th\ j\text{-}mb}$	=	0.32	$^oC/W$

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 maximum mica insulator (56369)	$R_{th\ mb\text{-}h}$	=	2.2	$^oC/W$
d. with heatsink compound and 0.25 mm maximum 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 and with copper laminate $R_{th\ j\text{-}a}$ = 60 $^oC/W$

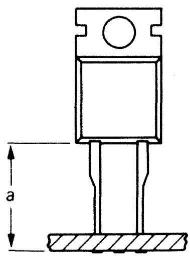


Fig.2

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 $-dI_F/dt$ = 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				
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; T_j = 25 °C	V_{fr}	typ.	1.0	V

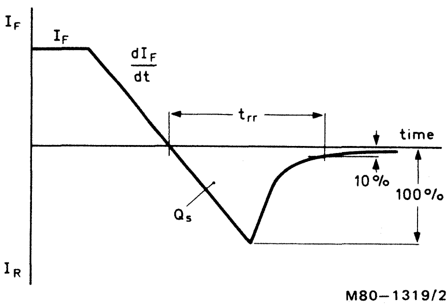


Fig.3 Definition of t_{rr} and Q_s.

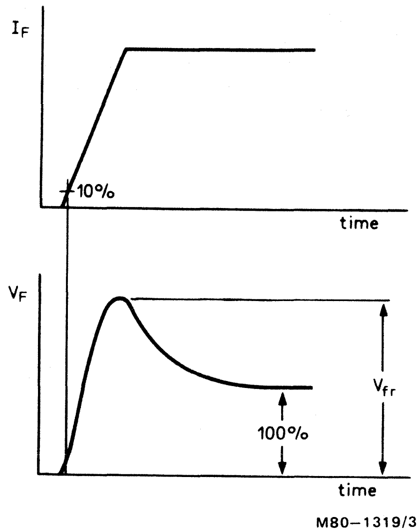


Fig.4 Definition of V_{fr}.

*Measured under pulse conditions to avoid excessive dissipation.

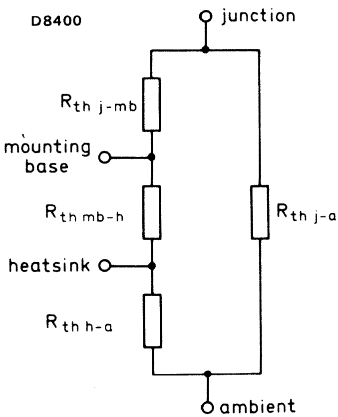
MOUNTING INSTRUCTIONS

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. 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.

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.

SINUSOIDAL OPERATION

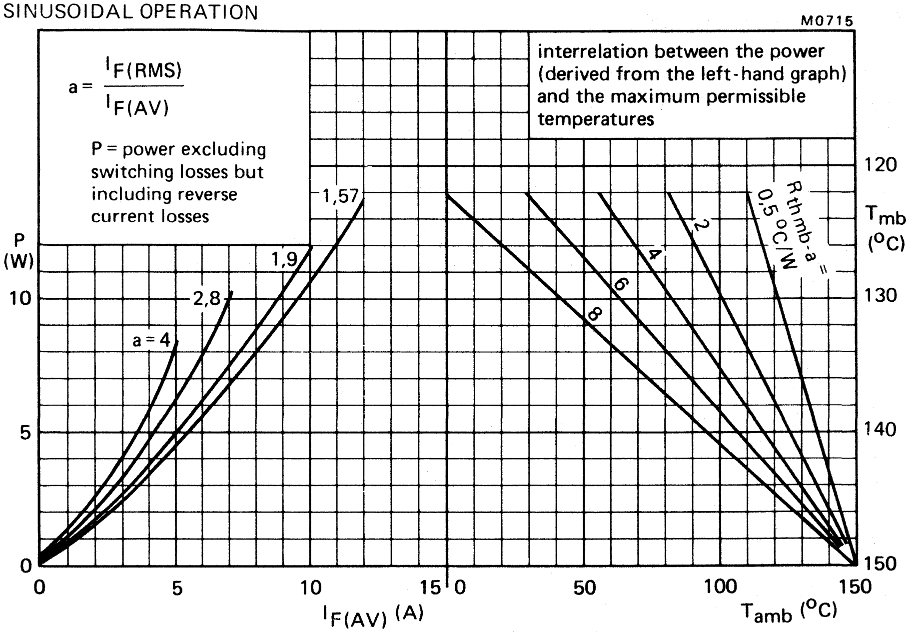


Fig.5

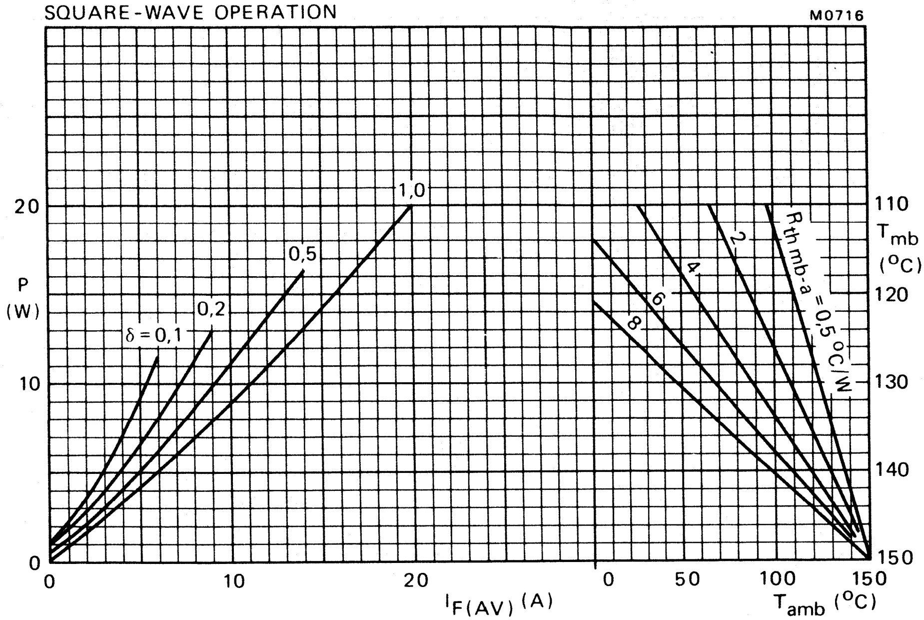
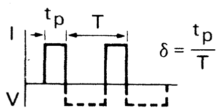


Fig.6 The right-hand part shows the interrelationship between the power (derived from the left-hand part) and the maximum permissible temperatures.
P = power including reverse current losses and switching losses up to f = 500 kHz.



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

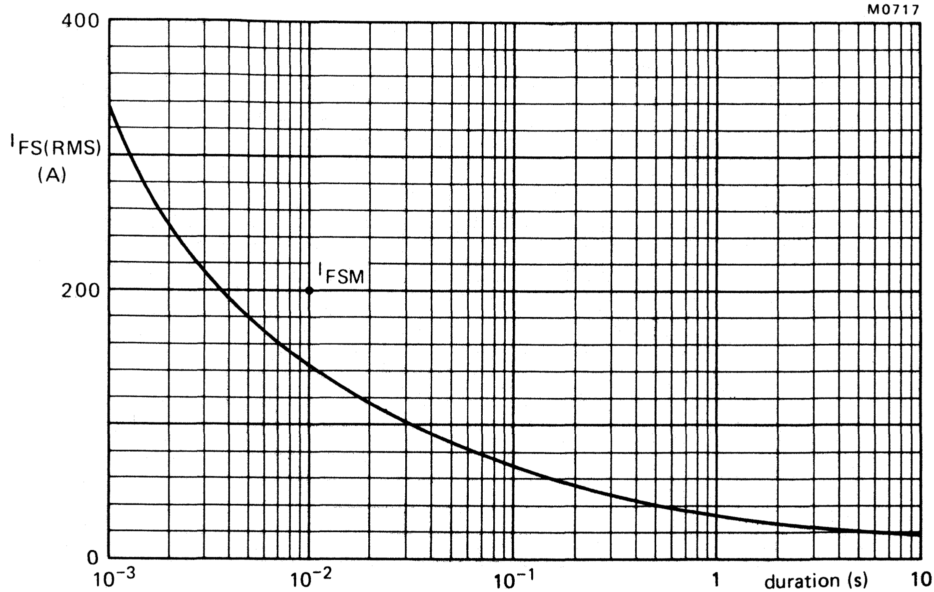
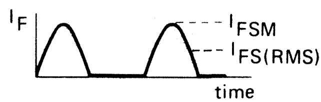


Fig.7 Maximum permissible non-repetitive r.m.s. forward current based on sinusoidal currents (f = 50 Hz); T_j = 150 °C prior to surge; with reapplied V_{RWMmax}.



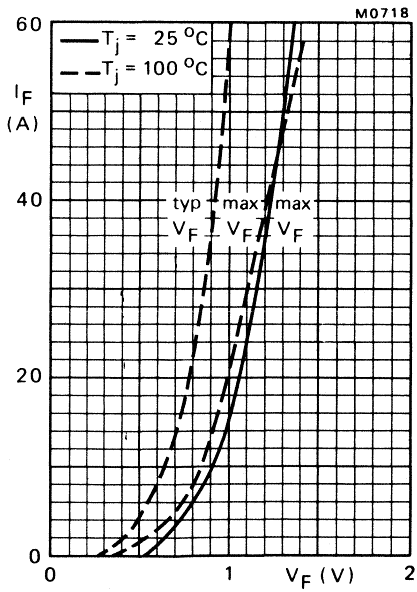


Fig.8

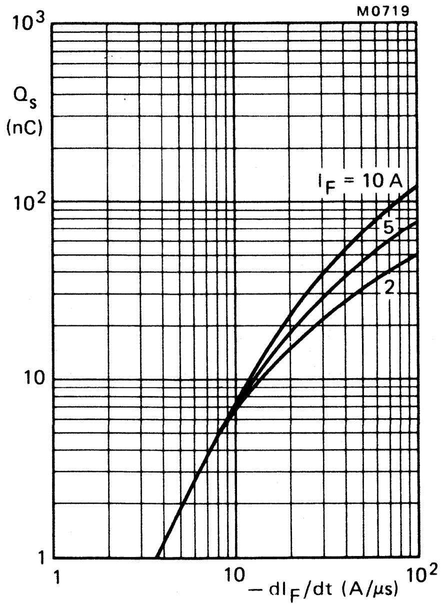


Fig.9 T_j = 25 °C; maximum values.

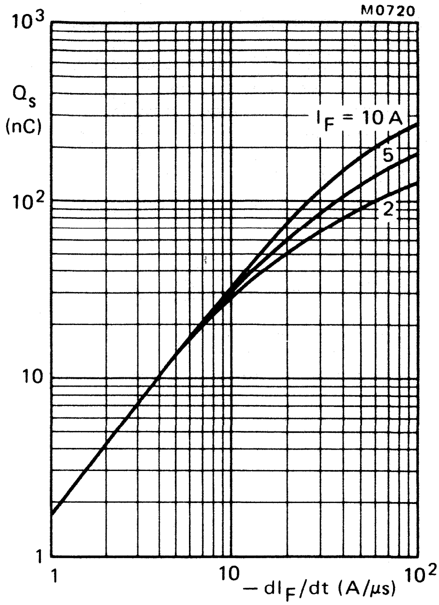
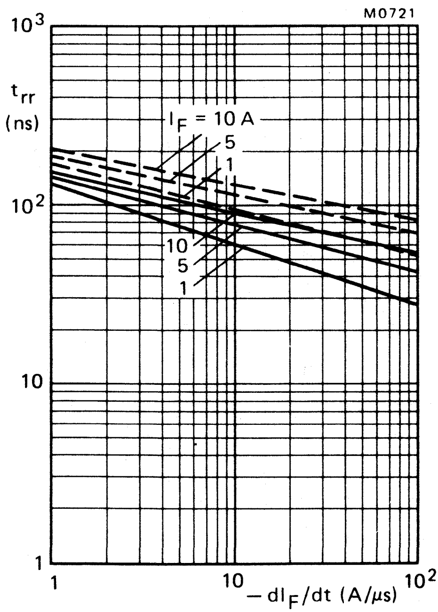
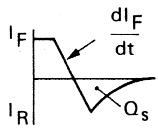


Fig.10 T_j = 100 °C; maximum values.





Definition of Q_s in Figs. 9 and 10.

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

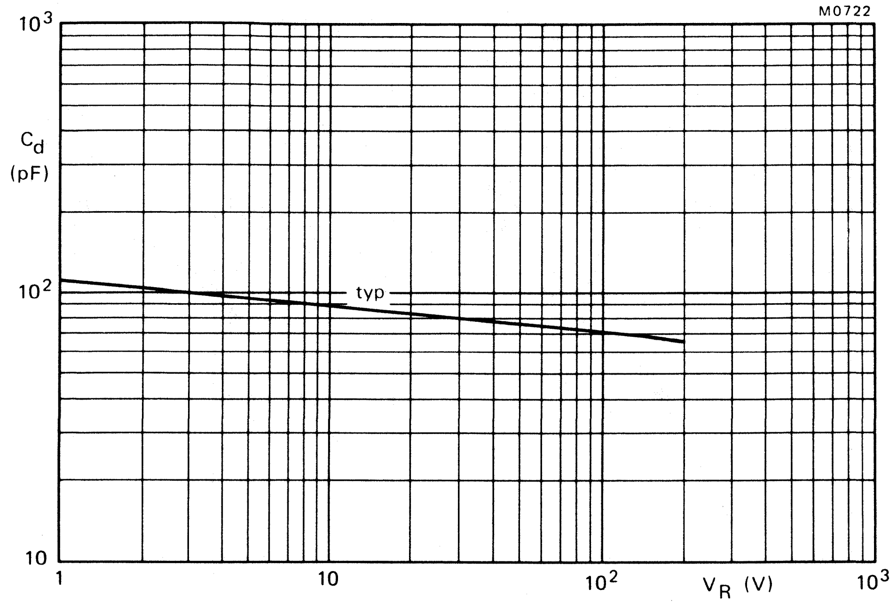


Fig.12 f = 1 MHz; T_j = 25 °C

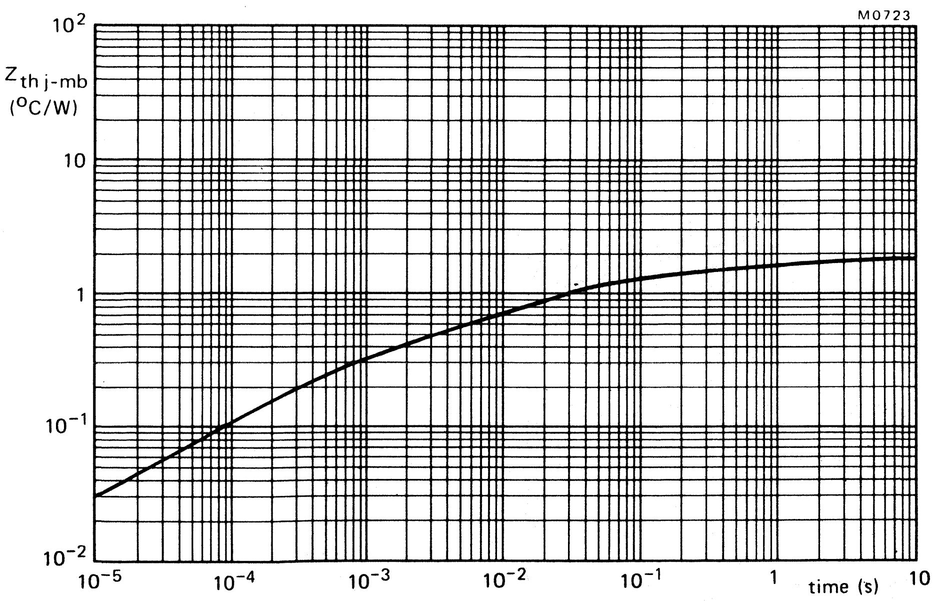


Fig.13

VERY FAST SOFT-RECOVERY DIODES

Glass-passivated high-efficiency epitaxial 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.

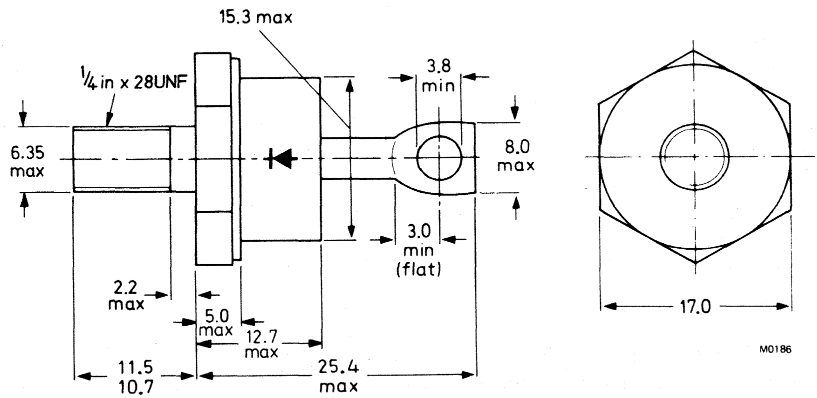
QUICK REFERENCE DATA

			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:
see ACCESSORIES section
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*

			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: $R_{th\ j\text{-}a} \leqslant 6$ °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	$\lvert dI_R/dt \rvert$	<	5	A/µs

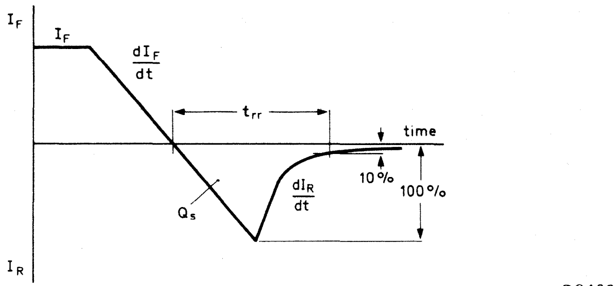


Fig. 2 Definitions of t_{rr} and Q_s.

*Measured under pulse conditions to avoid excessive dissipation.

SQUARE-WAVE OPERATION

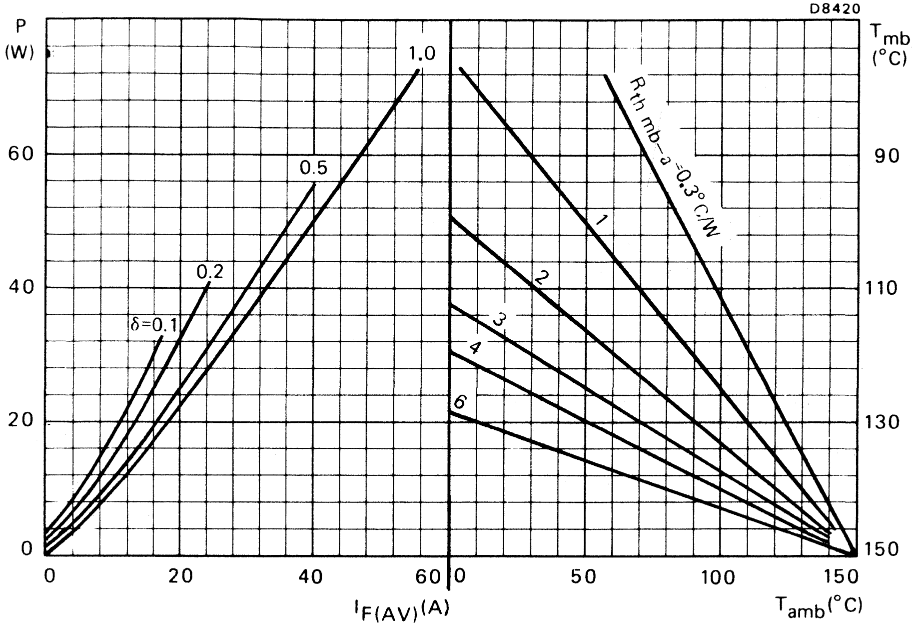
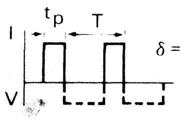


Fig.3 The right-hand part shows the interrelationship between the power (derived from the left-hand part) and the maximum permissible temperatures.
P = power including reverse current losses but excluding switching losses.



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

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

SINUSOIDAL OPERATION

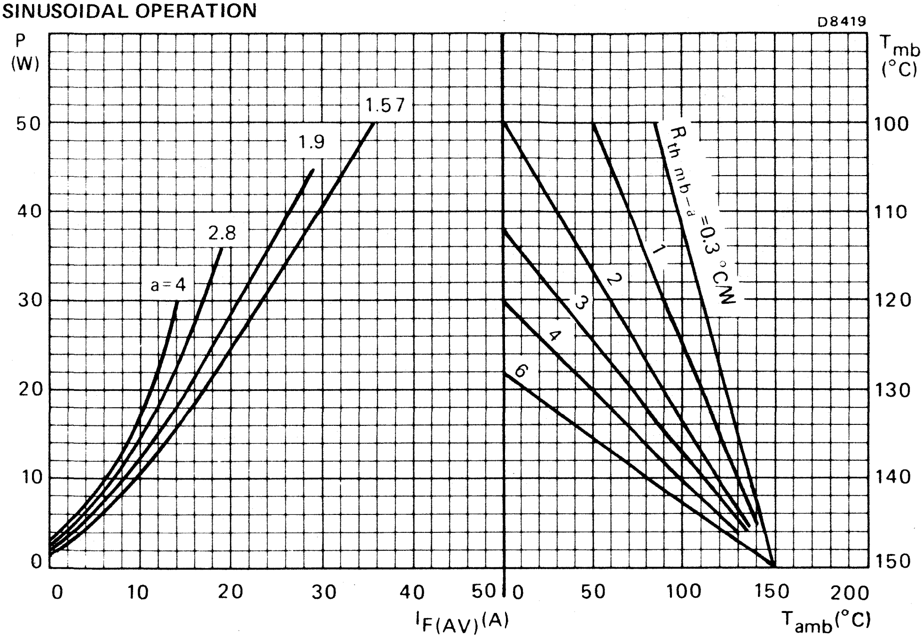


Fig.4 The right-hand part shows the interrelationship between the power (derived from the left-hand part) and the maximum permissible temperatures.
P = power including reverse current losses but excluding switching losses.
a = form factor = $I_{F(RMS)}/I_{F(AV)}$.

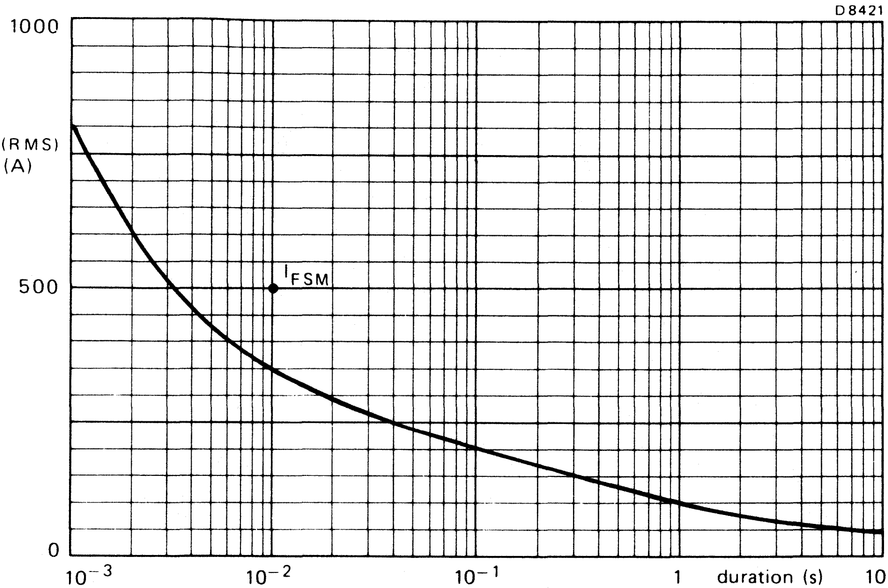
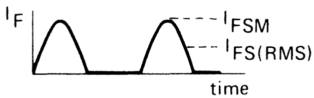


Fig.5 Maximum permissible non-repetitive r.m.s. forward current based on sinusoidal currents (f = 50 Hz); T_j = 150 °C prior to surge; with reapplied V_{RWMmax}.



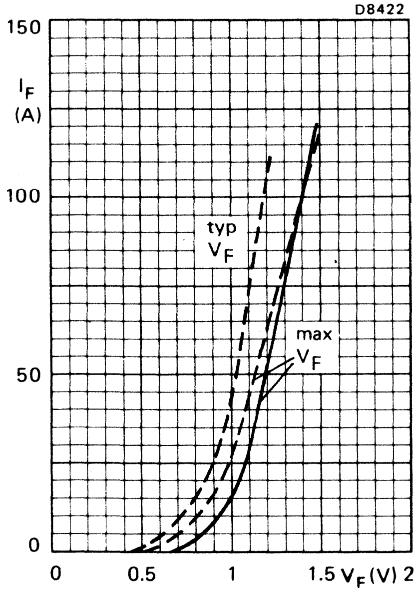


Fig. 6 —— T_j = 25 °C; – – – T_j = 100 °C

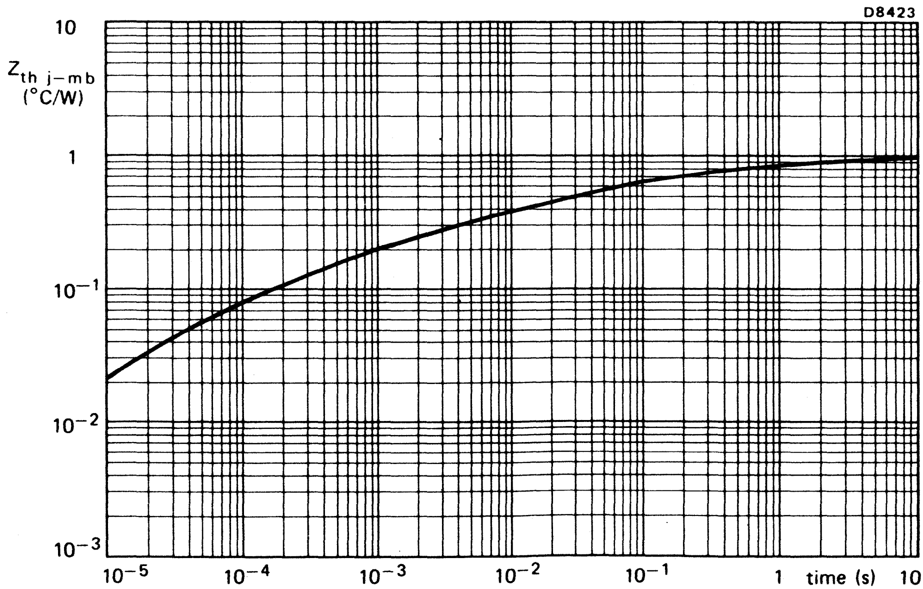


Fig. 7

FAST SOFT-RECOVERY RECTIFIER DIODES

Fast soft-recovery diodes in DO-5 metal envelopes especially suitable for operation as main and commutating diodes in 3-phase a.c. motor speed control inverters and in high frequency power supplies in general.
The series consists of the following types:
Normal polarity (cathode to stud): BYW25–800 and BYW25–1000.
Reverse polarity (anode to stud): BYW25–800R and BYW25–1000R.

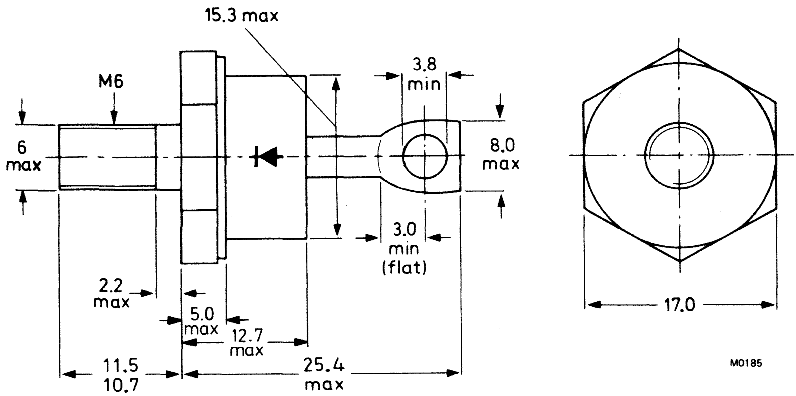
QUICK REFERENCE DATA

			BYW25–800(R)	1000(R)	
Repetitive peak reverse voltage	V_{RRM}	max.	800	1000	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

Dimensions in mm

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



Net mass: 22 g
Diameter of clearance hole: max. 6.5 mm
Accessories supplied on request:
see ACCESSORIES section
The mark shown applies to normal polarity types.

Supplied with device: 1 nut, 1 lock washer
Torque on nut: min. 1.7 Nm (17 kg cm)
max. 3.5 Nm (35 kg cm)
Nut dimensions across the flats: 10 mm

RATINGS

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

Voltages*

			BYW25–800(R)	1000(R)	
Non-repetitive peak reverse voltage	V_{RSM}	max.	1000	1200	V
Repetitive peak reverse voltage	V_{RRM}	max.	800	1000	V
Crest working reverse voltage	V_{RWM}	max.	650	850	V
Continuous reverse voltage	V_R	max.	650	850	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

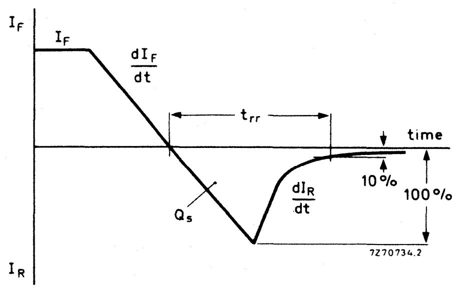


Fig. 2 Definitions of Q_s, t_{rr} and dI_R/dt.

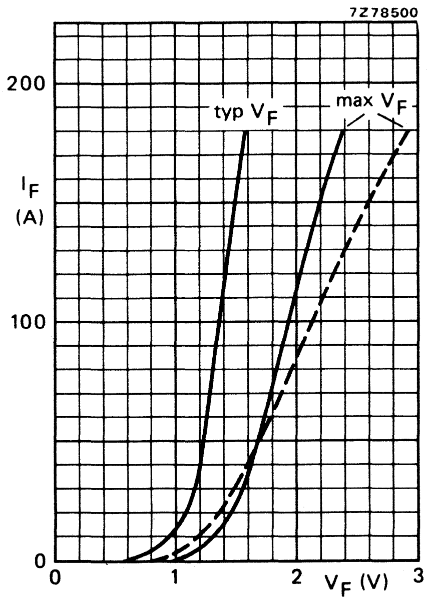


Fig. 3 —— T_j = 25 °C; – – – T_j = 150 °C.

* Measured under pulse conditions to avoid excessive dissipation.

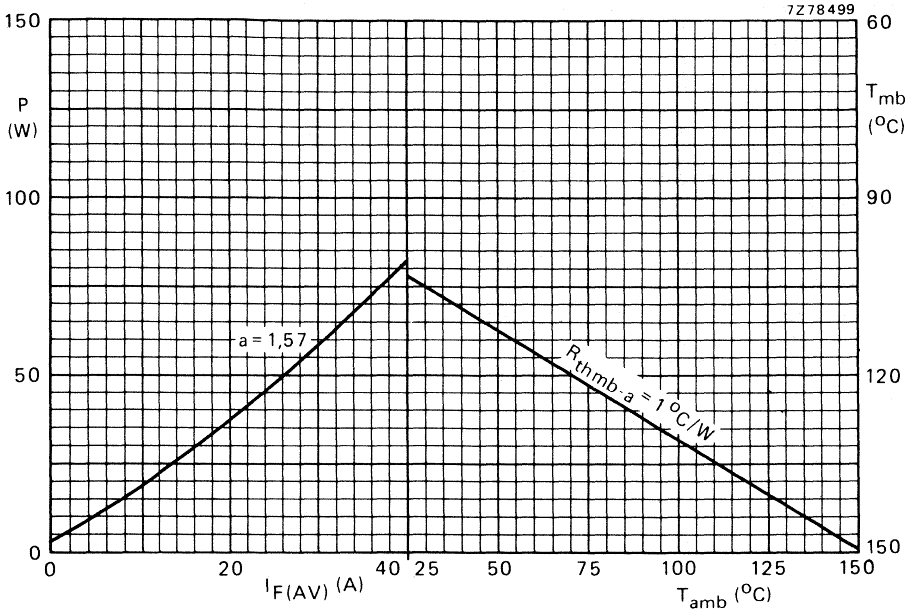


Fig. 4 The right-hand part shows the interrelationship between the power (derived from the left-hand part) and the maximum permissible temperatures.
P = power including reverse current losses and switching losses up to f = 20 kHz.
a = $I_{F(RMS)}/I_{F(AV)}$.

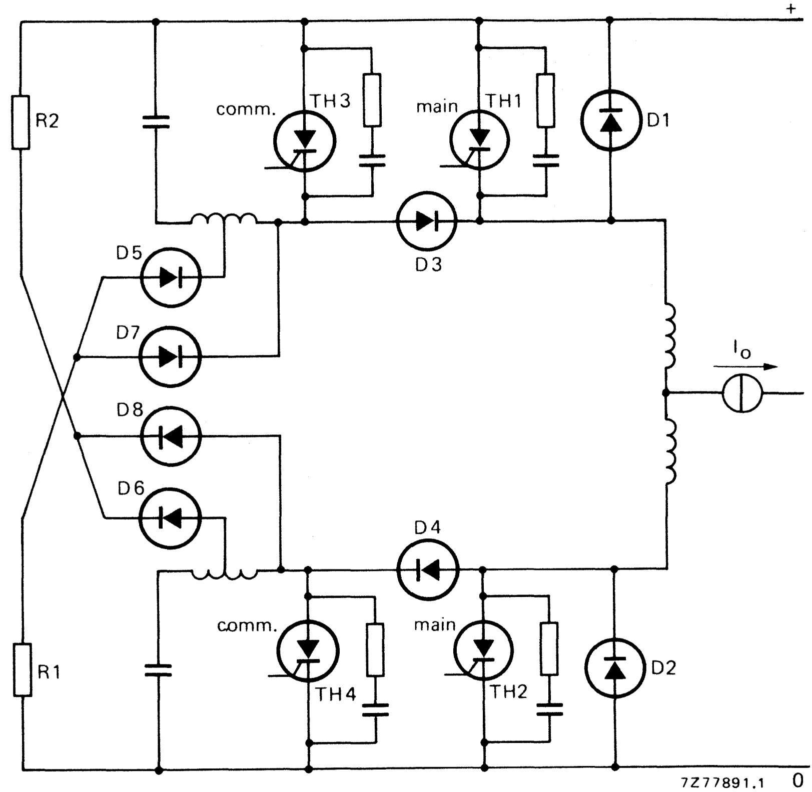


Fig. 5 One phase of a three-phase inverter for a.c. motor speed control.
D1 to D4 are BYW25 types.

ULTRA FAST RECOVERY RECTIFIER DIODES

Glass passivated, high-efficiency epitaxial rectifier diodes in plastic envelopes, featuring low forward voltage drop, ultra fast reverse recovery times, very low stored charge and soft recovery characteristic. 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.

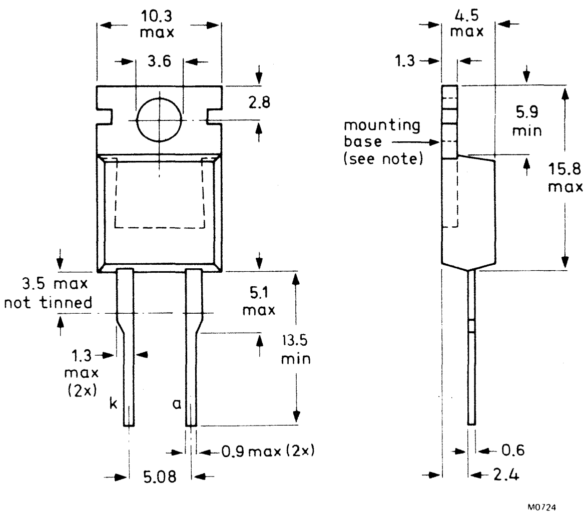
QUICK REFERENCE DATA

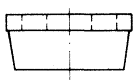
			BYW29–50	100	150	200	
Repetitive peak reverse voltage	V_{RRM}	max.	50	100	150	200	V
Average forward current	$I_{F(AV)}$	max.		8			A
Forward voltage	V_F	<		0.8			V
Reverse recovery time	t_{rr}	<		25			ns

MECHANICAL DATA

Dimensions in mm

Fig.1 TO-220AC





Net mass: 2 g

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	200	
Repetitive peak reverse voltage	V_{RRM}	max.	50	100	150	200	V
Crest working reverse voltage	V_{RWM}	max.	50	100	150	200	V
Continuous reverse voltage*	V_R	max.	50	100	150	200	V

Currents

Average forward current; switching losses negligible up to 500 kHz				
square wave; $\delta = 0.5$; up to $T_{mb} = 125\ ^oC$	$I_{F(AV)}$	max.	8	A
sinusoidal; up to $T_{mb} = 125\ ^oC$	$I_{F(AV)}$	max.	7.2	A
R.M.S. forward current	$I_{F(RMS)}$	max.	11.5	A
Repetitive peak forward current $t_p = 20\ \mu s$; $\delta = 0.02$	I_{FRM}	max.	240	A
Non-repetitive peak forward current half sine-wave; $T_j = 150\ ^oC$ prior to surge; with reapplied V_{RWMmax};				
t = 10 ms	I_{FSM}	max.	80	A
t = 8.3 ms	I_{FSM}	max.	100	A
I^2t for fusing (t = 10 ms)	I^2t	max.	32	A^2s

Temperatures

Storage temperature	T_{stg}		−40 to +150	^oC
Junction temperature	T_j	max.	150	^oC

*To ensure thermal stability: $R_{th\ j\text{-}a} \leqslant 11.6$ K/W

CHARACTERISTICS

Forward voltage				
I_F = 8 A; T_j = 150 °C	V_F	<	0.8	V*
I_F = 20 A; T_j = 25 °C	V_F	<	1.3	V*
Reverse current				
$V_R = V_{RWM\,max}$; T_j = 100 °C	I_R	<	0.6	mA
T_j = 25 °C	I_R	<	10	μA
Reverse recovery when switched from				
I_F = 1 A to $V_R \geq 30$ V with $-dI_F/dt$ = 100 A/μs; T_j = 25 °C; recovery time	t_{rr}	<	25	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	<	15	nC
I_F = 10 A to $V_R \geq 30$ V with $-dI_F/dt$ = 50 A/μs; T_j = 100 °C; peak recovery current	I_{RRM}	<	4	A
Forward recovery when switched to I_F = 1 A with dI_F/dt = 10 A/μs; T_j = 25 °C	V_{fr}	typ.	1	V

M80–1319/3

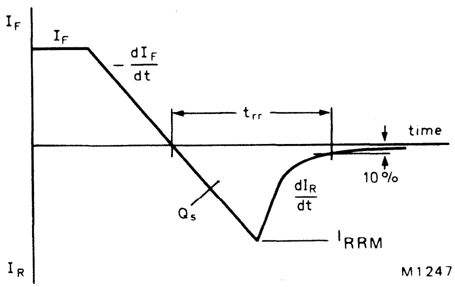


Fig.2 Definition of t_{rr}, Q_s and I_{RRM}.

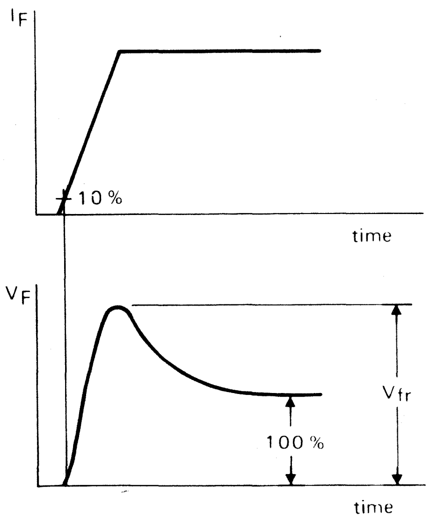


Fig.3 Definition of V_{fr}.

*Measured under pulse conditions to avoid excessive dissipation.

THERMAL RESISTANCE

From junction to mounting base	$R_{th\ j\text{-}mb}$	=	2.7	K/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	K/W
b. with heatsink compound and 0.06 mm maximum mica insulator	$R_{th\ mb\text{-}h}$	=	1.4	K/W
c. with heatsink compound and 0.1 mm maximum mica insulator (56369)	$R_{th\ mb\text{-}h}$	=	2.2	K/W
d. with heatsink compound and 0.25 mm maximum alumina insulator (56367)	$R_{th\ mb\text{-}h}$	=	0.8	K/W
e. without heatsink compound	$R_{th\ mb\text{-}h}$	=	1.4	K/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	K/W

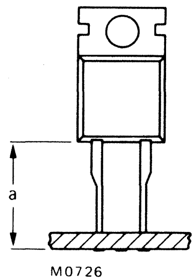


Fig.4

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. Rivet mounting (only possible for non-insulated mounting).
   Devices may be rivetted to flat heatsinl such a process must **neither** deform the mounting tab **nor** enlarge the mounting hole.

OPERATING NOTES

Dissipation and heatsink considerations:

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

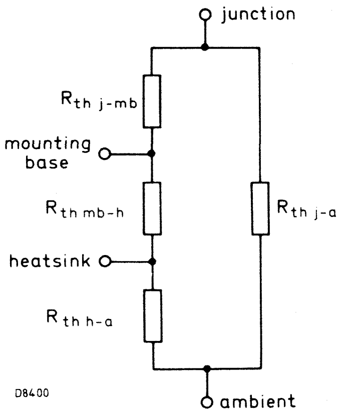


Fig. 5

b. The method of using Figs.6 and 7 is as follows:
Starting with the required current on the $I_{F(AV)}$ axis, trace upwards to meet the appropriate duty factor or 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.

SQUARE-WAVE OPERATION

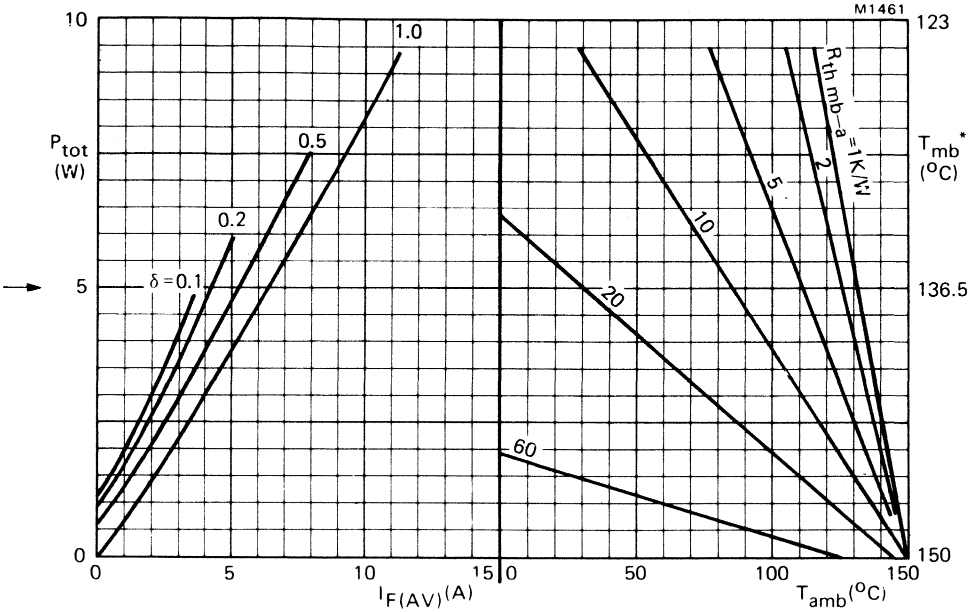
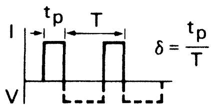


Fig.6 The right-hand part shows the interrelationship between the power (derived from the left-hand part) and the maximum permissible temperatures.
Power includes reverse current losses and switching losses up to f = 500 kHz.



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

*T_{mb} scale is for comparison purposes and is correct only for $R_{th\ mb\text{-}a} < 8.9$ K/W.

SINUSOIDAL OPERATION

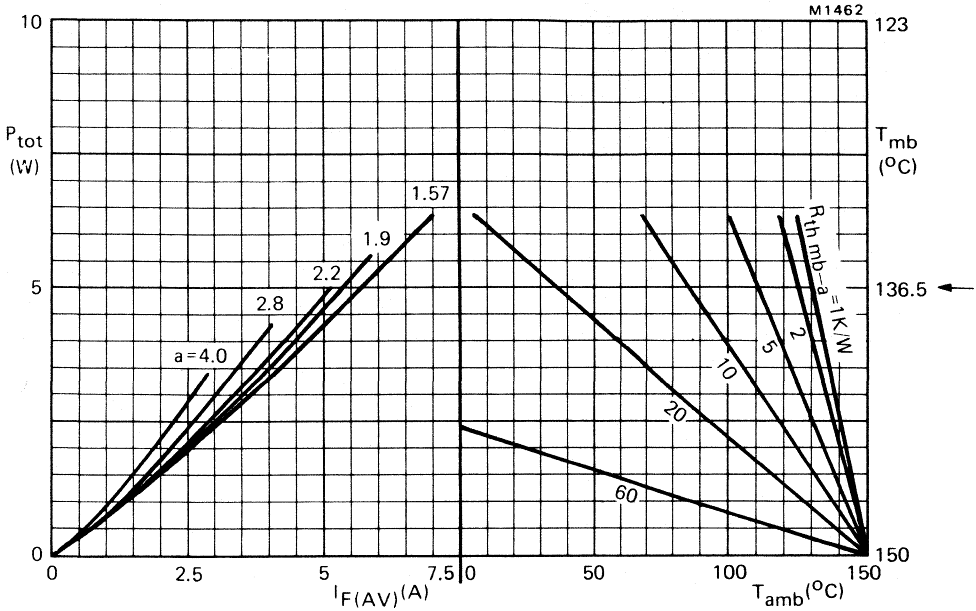


Fig.7 The right-hand part shows the interrelationship between the power (derived from the left-hand part) and the maximum permissible temperatures.
Power includes reverse current losses and switching losses up to f = 500 kHz.
a = form factor = $I_{F(RMS)}/I_{F(AV)}$.

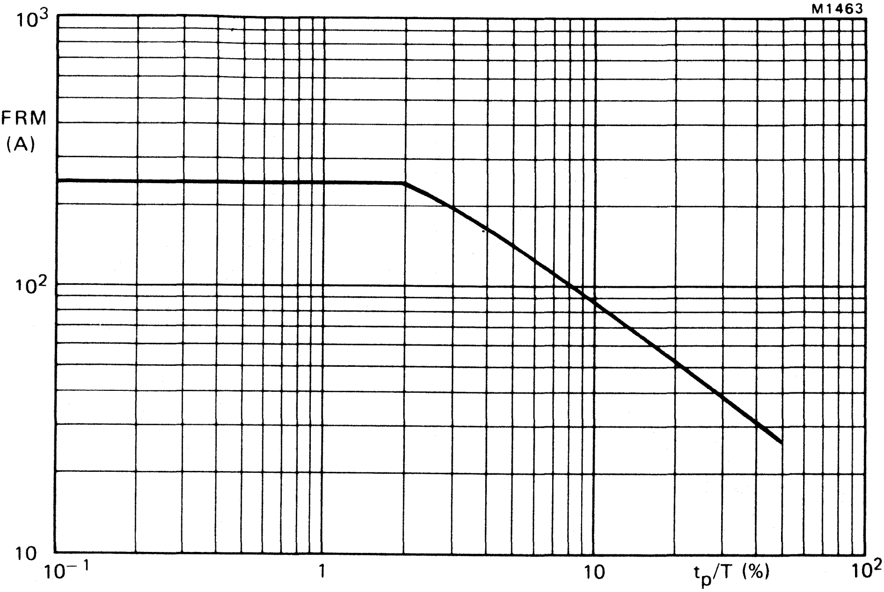
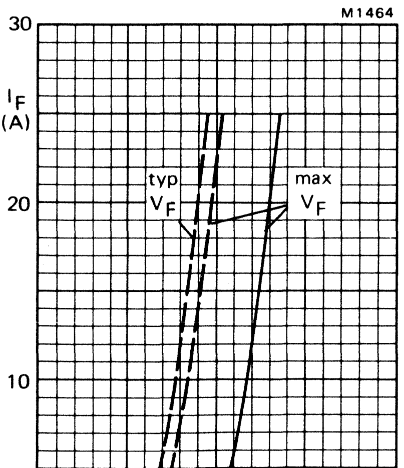
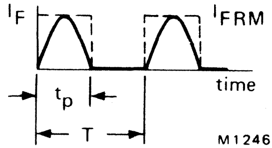


Fig.8 Maximum permissible repetitive peak forward current for square or sinusoidal currents; $1\ \mu s < t_p < 1 ms$.





Definition of I_{FRM} and t_p/T.

Fig.9 —— $T_j = 25\ ^oC$; – – – $T_j = 150\ ^oC$.

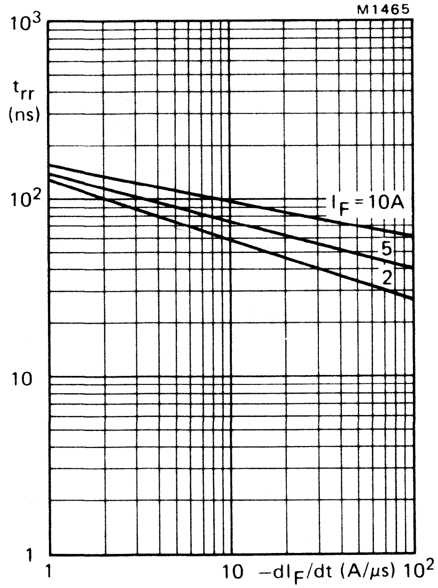


Fig.10 Maximum t_{rr} at $T_j = 25\ ^oC$.

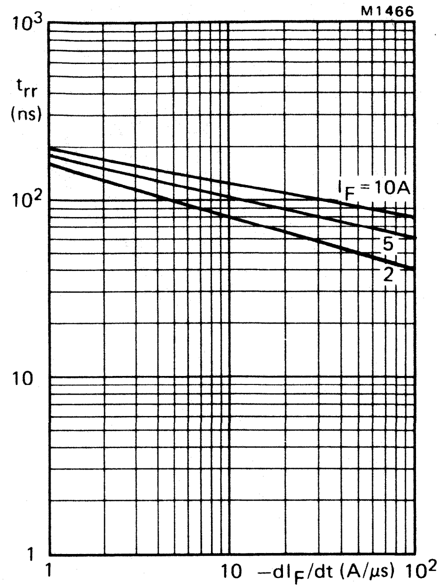


Fig.11 Maximum t_{rr} at $T_j = 100\ ^oC$.

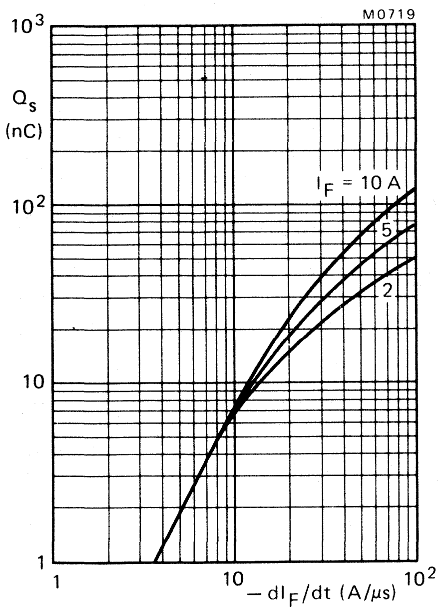


Fig.12 Maximum Q_s at $T_j = 25\ ^oC$.

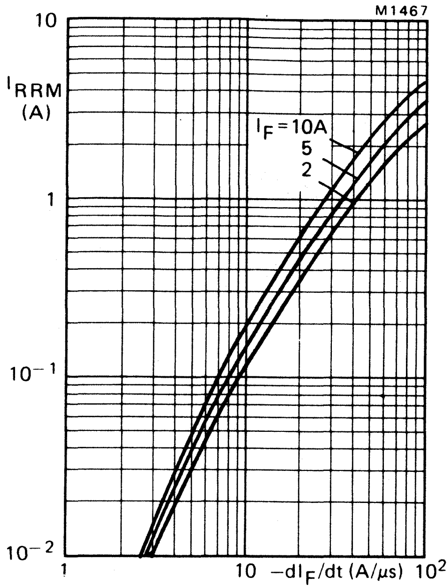


Fig.13 Maximum I_{RRM} at T_j = 25 °C.

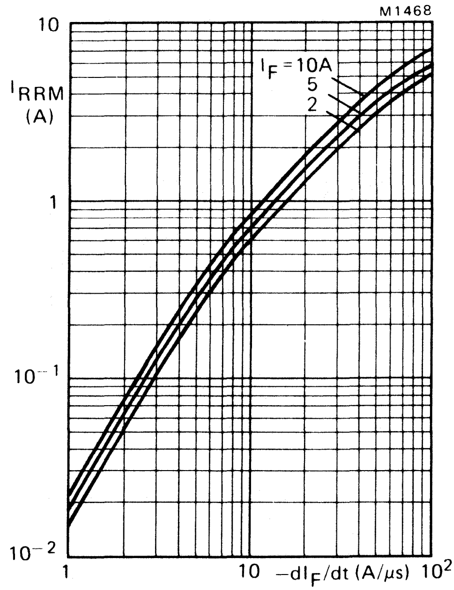


Fig.14 Maximum I_{RRM} at T_j = 100 °C.

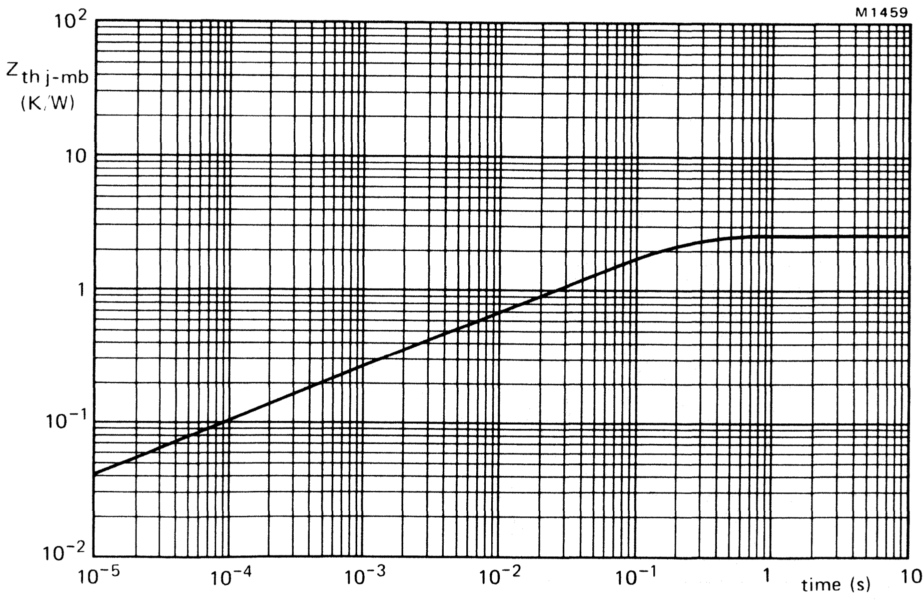


Fig.15 Transient thermal impedance.

ULTRA FAST RECOVERY RECTIFIER DIODES

Glass-passivated, high-efficiency epitaxial rectifier diodes in DO-4 metal envelopes, featuring low forward voltage drop, ultra fast reverse recovery times, very low stored charge and soft recovery characteristic. 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.

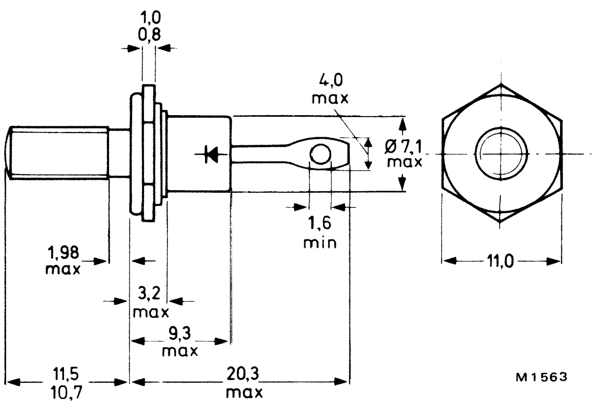
QUICK REFERENCE DATA

			BYW30—50	100	150	200	
Repetitive peak reverse voltage	V_{RRM}	max.	50	100	150	200	V
Average forward current	$I_{F(AV)}$	max.		14			A
Forward voltage	V_F	<		0.8			V
Reverse recovery time	t_{rr}	<		30			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:
see ACCESSORIES section.

Supplied with device: 1 nut, 1 lock washer

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

Nut dimensions across the flats:
M5: 8.0 mm; 10-32 UNF: 9.5 mm.

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	200	
Repetititve peak reverse voltage	V_{RRM}	max.	50	100	150	200	V
Crest working reverse voltage	V_{RWM}	max.	50	100	150	200	V
Continuous reverse voltage	V_R	max.	50	100	150	200	V

Currents

Average forward current; switching losses negligible up to 500 kHz				
square wave; $\delta = 0.5$; up to $T_{mb} = 120\ ^oC$	$I_{F(AV)}$	max.	14	A
up to $T_{mb} = 125\ ^oC$	$I_{F(AV)}$	max.	12	A
sinusoidal; up to $T_{mb} = 125\ ^oC$	$I_{F(AV)}$	max.	12.5	A
R.M.S. forward current	$I_{F(RMS)}$	max.	20	A
Repetitive peak forward current $t_p = 20\ \mu s$; $\delta = 0.02$	I_{FRM}	max.	420	A
Non-repetitive peak forward current half sine-wave; $T_j = 150\ ^oC$ prior to surge; with reapplied V_{RWMmax};				
t = 10 ms	I_{FSM}	max.	200	A
t = 8.3 ms	I_{FSM}	max.	240	A
I^2t for fusing (t = 10 ms)	I^2t	max.	200	A^2s

Temperatures

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

THERMAL RESISTANCE

From junction to mounting base	$R_{th\ j\text{-}mb}$	=	2.2	K/W
From mounting base to heatsink				
a. with heatsink compound	$R_{th\ mb\text{-}h}$	=	0.5	K/W
b. without heatsink compound	$R_{th\ mb\text{-}h}$	=	0.6	K/W
Transient thermal impedance; t = 1 ms	$Z_{th\ j\text{-}mb}$	=	0.3	K/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.

*To ensure thermal stability: $R_{th\ j\text{-}a} \leqslant 5.6$ K/W (continuous reverse voltage).

CHARACTERISTICS

Forward voltage				
I_F = 15 A; T_j = 150 °C	V_F	<	0.8	V*
I_F = 50 A; T_j = 25 °C	V_F	<	1.3	V*
Reverse current				
$V_R = V_{RWM\,max}$; T_j = 100 °C	I_R	<	1.3	mA
T_j = 25 °C	I_R	<	50	μA
Reverse recovery when switched from				
I_F = 1 A to $V_R \geq$ 30 V with $-dI_F/dt$ = 100 A/μs; T_j = 25 °C; recovery time	t_{rr}	<	30	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	<	15	nC
I_F = 10 A to $V_R \geq$ 30 V with $-dI_F/dt$ = 50 A/μs; T_j = 100 °C; peak recovery current	I_{RRM}	<	4	A
Forward recovery when switched to I_F = 10 A with dI_F/dt = 10 A/μs; T_j = 25 °C	V_{fr}	typ.	1.0	V

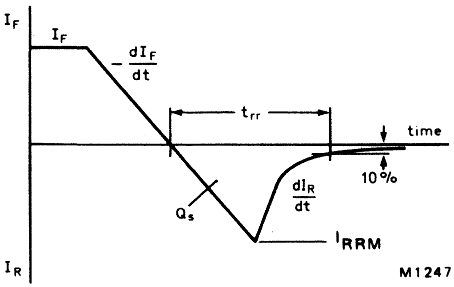


Fig.2 Definition of t_{rr}, Q_s and I_{RRM}.

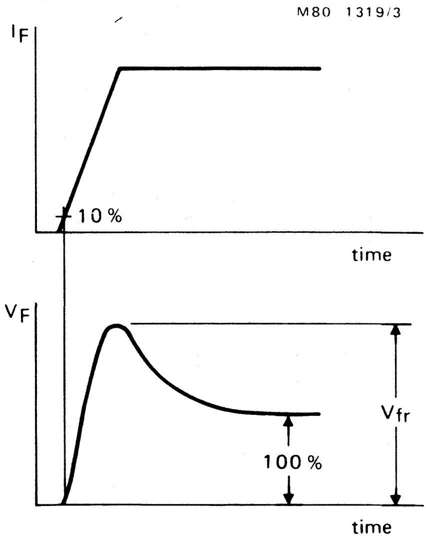


Fig.3 Definition of V_{fr}.

*Measured under pulse conditions to avoid excessive dissipation.

SQUARE-WAVE OPERATION

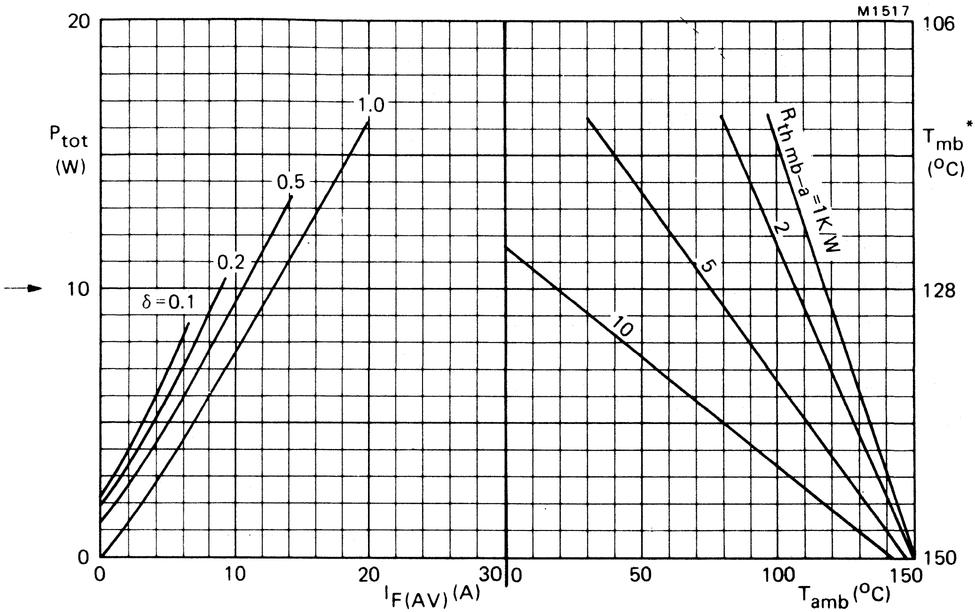
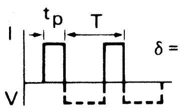


Fig.4 The right-hand part shows the interrelationship between the power (derived from the left-hand part) and the maximum permissible temperatures. Power includes reverse current losses and switching losses up to f = 500 kHz.



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

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

*T_{mb} scale is for comparison purposes and is correct only for $R_{th\ mb\text{-}a} < 3.1$ K/W.

SINUSOIDAL OPERATION

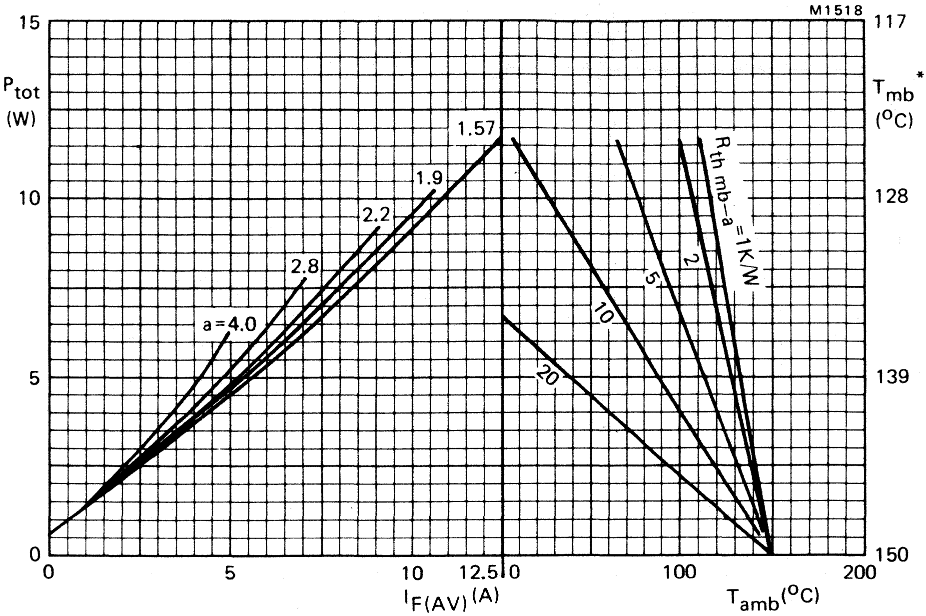


Fig.5 The right-hand part shows the interrelationship between the power (derived from the left-hand part) and the maximum permissible temperatures.
a = form factor = $I_{F(RMS)}/I_{F(AV)}$.

*T_{mb} scale is for comparison purposes and is correct only for $R_{th\ mb-a} < 17$ K/W.

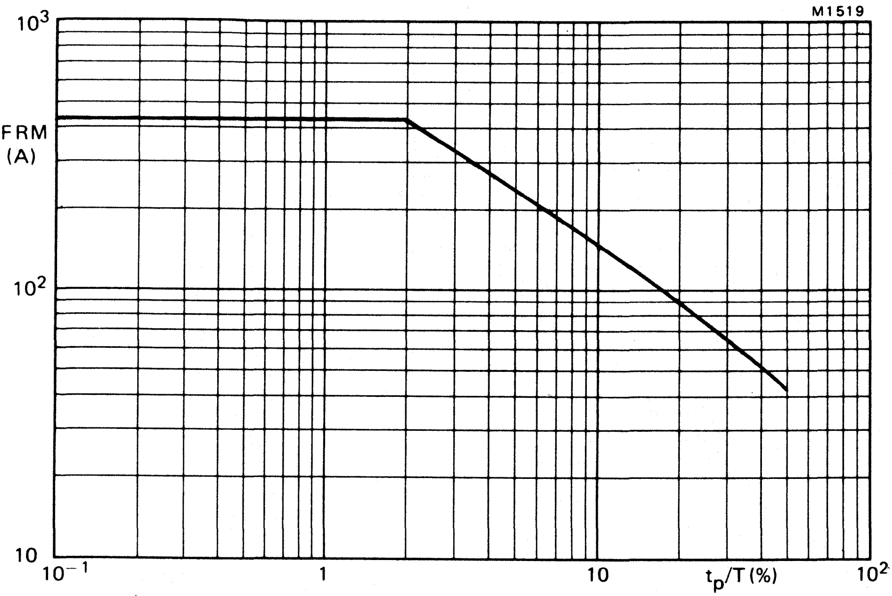
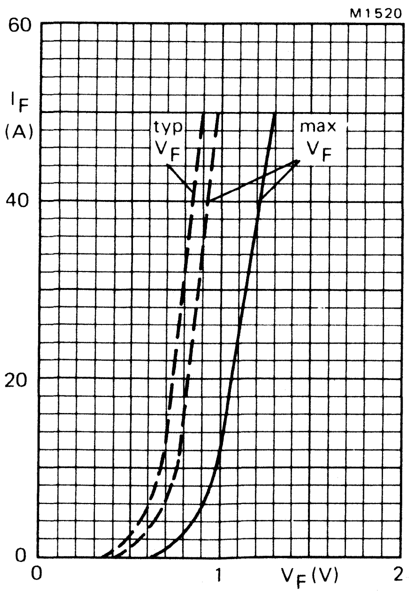
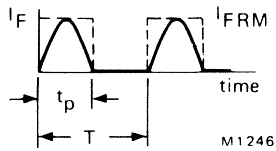


Fig.6 Maximum permissible repetitive peak forward current for square or sinusoidal currents; 1 $\mu s < t_p < 1$ ms.





Definition of I_{FRM} and t_p/T.

Fig.7 —— T_j = 25 °C; – – – T_j = 150 °C.

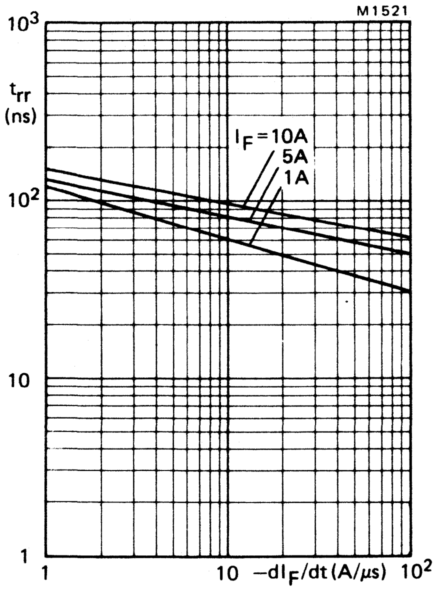


Fig.8 Maximum t_{rr} at T_j = 25 °C.

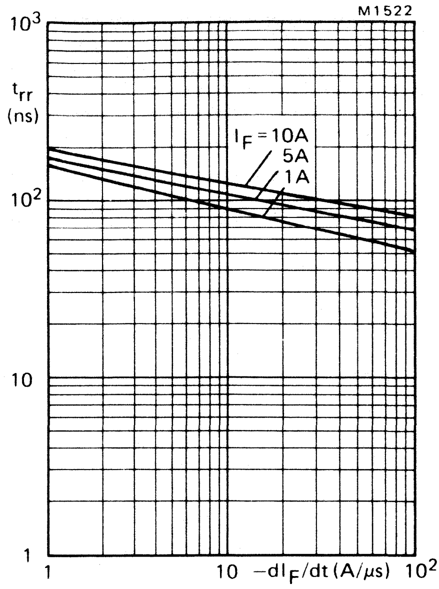


Fig.9 Maximum t_{rr} at T_j = 100 °C.

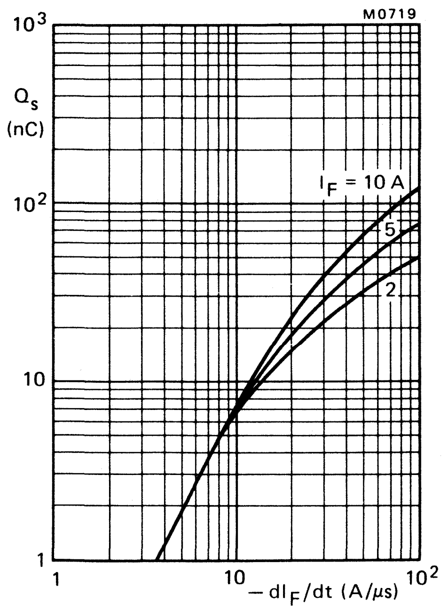


Fig.10 Maximum Q_s at T_j = 25 °C.

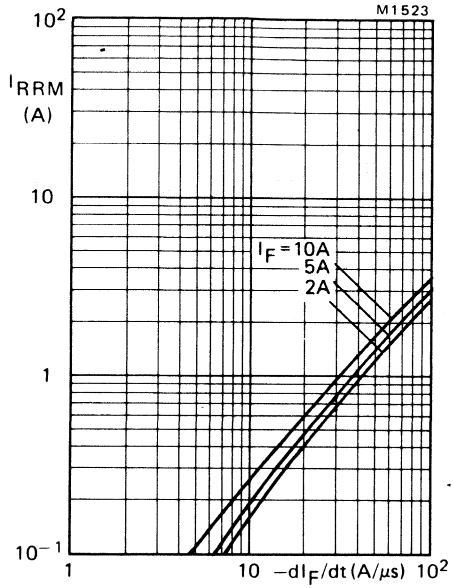


Fig.11 Maximum I_{RRM} at T_j = 25 °C.

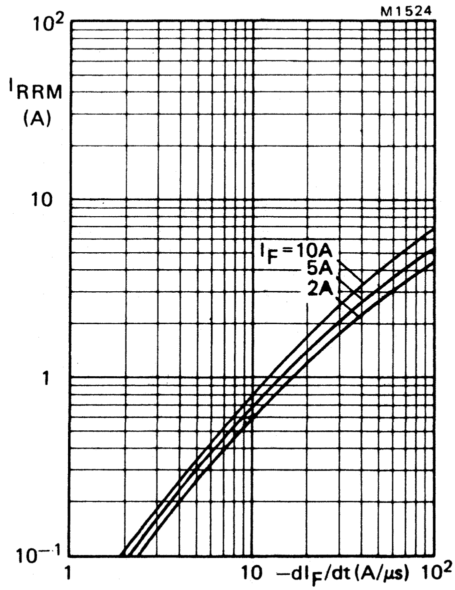


Fig.12 Maximum I_{RRM} at T_j = 100 °C.

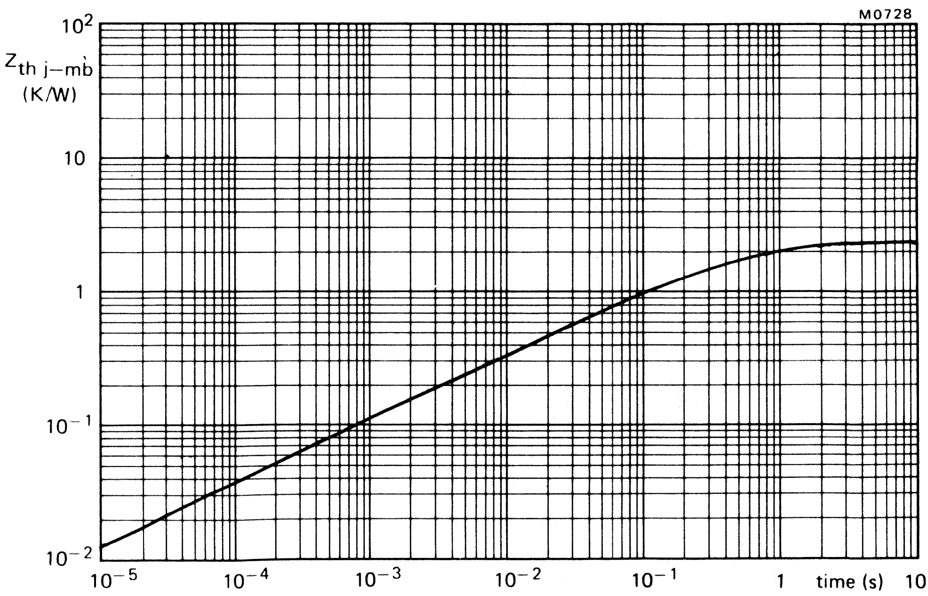


Fig.13 Transient thermal impedance.

ULTRA FAST RECOVERY RECTIFIER DIODES

Glass-passivated, high-efficiency epitaxial rectifier diodes in DO-4 metal envelopes, featuring low forward voltage drop, ultra fast reverse recovery times, very low stored charge and soft recovery characteristic. 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.

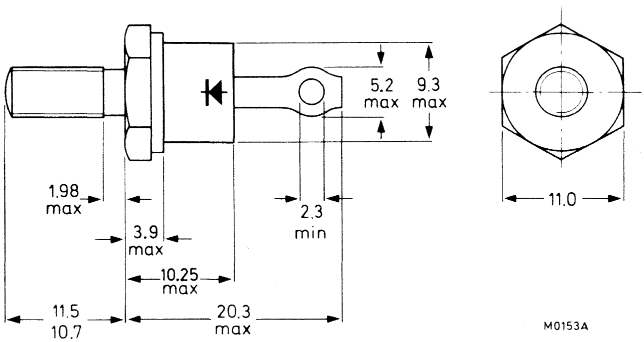
QUICK REFERENCE DATA

			BYW31–50	100	150	200	
Repetitive peak reverse voltage	V_{RRM}	max.	50	100	150	200	V
Average forward current	$I_{F(AV)}$	max.	28				A
Forward voltage	V_F	<	0.8				V
Reverse recovery time	t_{rr}	<	40				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:
see ACCESSORIES section.

Supplied with device: 1 nut, 1 lock washer

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

Nut dimensions across the flats;
M5: 8.0 mm; 10-32 UNF: 9.5 mm

Products approved 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	200	
Repetitive peak reverse voltage	V_{RRM}	max.	50	100	150	200	V
Crest working reverse voltage	V_{RWM}	max.	50	100	150	200	V
Continuous reverse voltage*	V_R	max.	50	100	150	200	V

Currents

Average forward current; switching losses negligible up to 500 kHz				
square wave; δ = 0.5; up to T_{mb} = 122 °C	$I_{F(AV)}$	max.	28	A
up to T_{mb} = 125 °C	$I_{F(AV)}$	max.	26	A
sinsusoidal; up to T_{mb} = 127 °C	$I_{F(AV)}$	max.	25	A
R.M. S. forward current	$I_{F(RMS)}$	max.	40	A
Repetitive peak forward current t_p = 20 μs; δ = 0.02	I_{FRM}	max.	550	A
Non-repetitive peak forward current half sine-wave; T_j = 150 °C prior to surge; with reapplied V_{RWMmax};				
t = 10 ms	I_{FSM}	max.	320	A
t = 8.3 ms	I_{FSM}	max.	380	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	K/W
From mounting base to heatsink				
a. with heatsink compound	$R_{th\ mb\text{-}h}$	=	0.3	K/W
b. without heatsink compound	$R_{th\ mb\text{-}h}$	=	0.5	K/W
Transient thermal impedance: t = 1 ms	$Z_{th\ j\text{-}mb}$	=	0.2	K/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.

*To ensure thermal stability: $R_{th\ j\text{-}a} \leqslant 4.9$ K/W (continuous reverse voltage).

CHARACTERISTICS

Forward voltage				
I_F = 30 A; T_j = 150 °C	V_F	<	0.8	V*
I_F = 100 A; T_j = 25 °C	V_F	<	1.3	V*
Reverse current				
$V_R = V_{RWM\,max}$; T_j = 100 °C	I_R	<	1.5	mA
T_j = 25 °C	I_R	<	100	µA
Reverse recovery when switched from				
I_F = 1 A to $V_R \geq$ 30 V with $-dI_F/dt$ = 100 A/µs; T_j = 25 °C; recovery time	t_{rr}	<	40	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
I_F = 10 A to $V_R \geq$ 30 V with $-dI_F/dt$ = 50 A/µs; T_j = 100 °C; peak recovery current	I_{RRM}	<	4	A
Forward recovery when switched to I_F = 10 A with dI_F/dt = 10 A/µs; T_j = 25 °C	V_{fr}	typ.	1	V

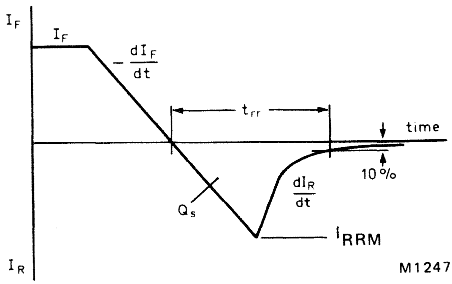


Fig.2 Definition of t_{rr}, Q_s and I_{RRM}.

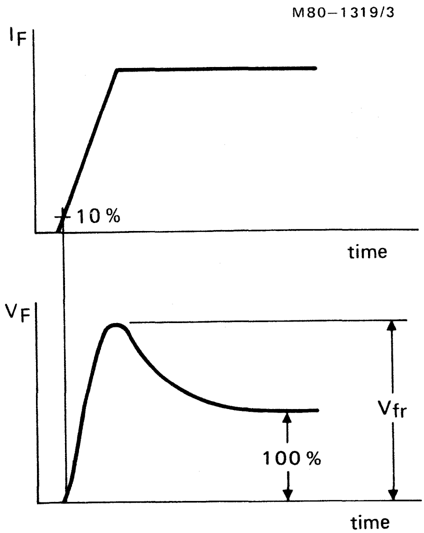


Fig.3 Definition of V_{fr}.

*Measured under pulse conditions to avoid excessive dissipation.

SQUARE-WAVE OPERATION

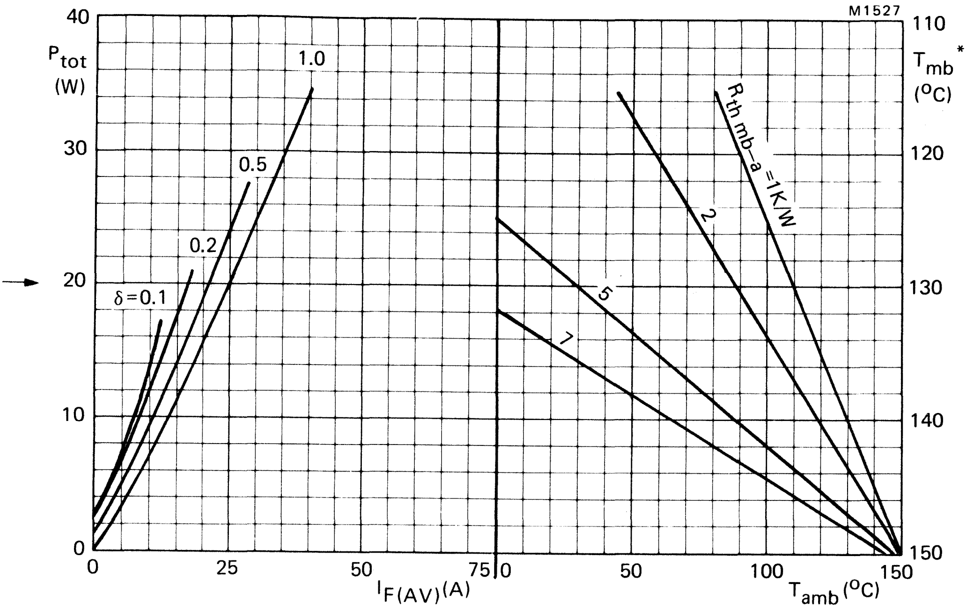
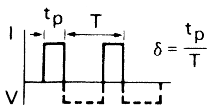


Fig.4 The right-hand part shows the interrelationship between the power (derived from the left-hand part) and the maximum permissible temperatures. Power includes reverse current losses and switching losses up to f = 500 kHz.



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

*T_{mb} scale is for comparison purposes and is correct only for $R_{th\ mb\text{-}a} < 3.6$ K/W.

SINUSOIDAL OPERATION

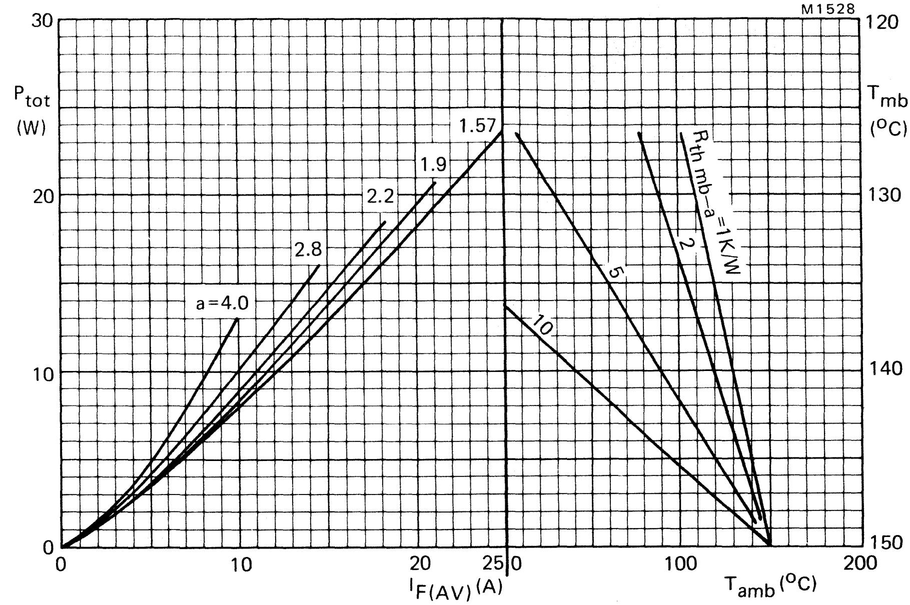


Fig.5 The right-hand part shows the interrelationship between the power (derived from the left-hand part) and the maximum permissible temperatures. Power includes reverse current losses and switching losses up to f = 500 kHz.
a = form factor = $I_{F(RMS)}/I_{F(AV)}$.

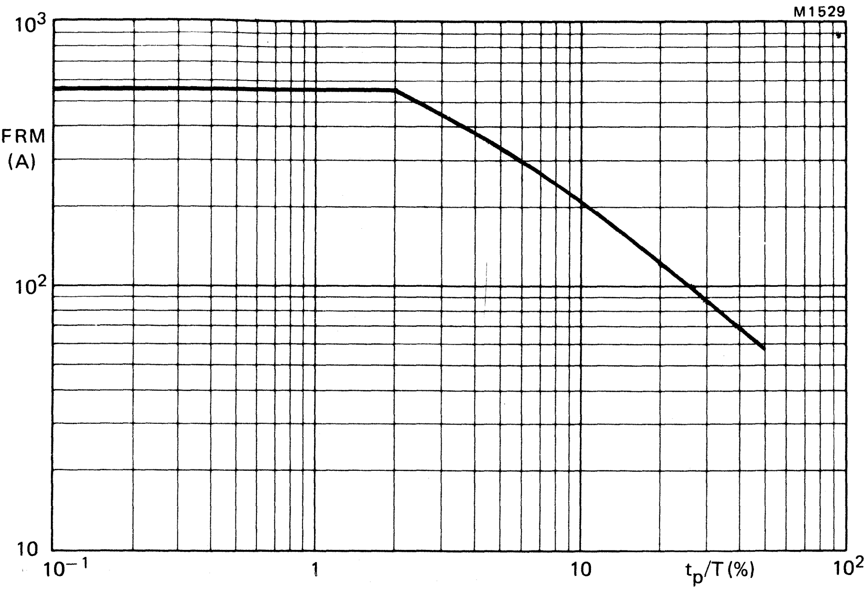
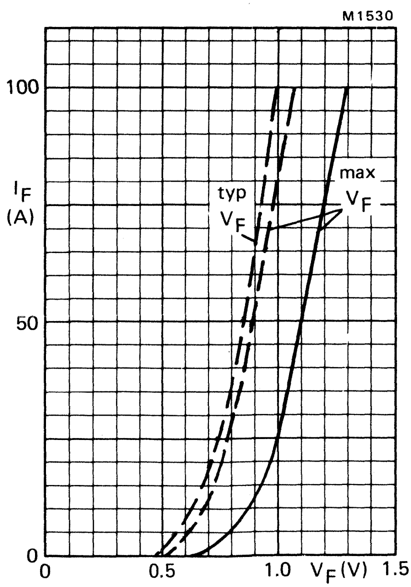
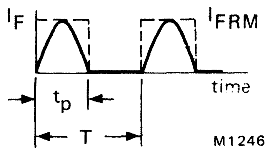


Fig.6 Maximum permissible repetitive peak forward current for square or sinusoidal currents; 1 $\mu s < t_p < 1$ ms.





Definition of I_{FRM} and t_p/T.

Fig.7 ——— T_j = 25 °C; – – – T_j = 150 °C.

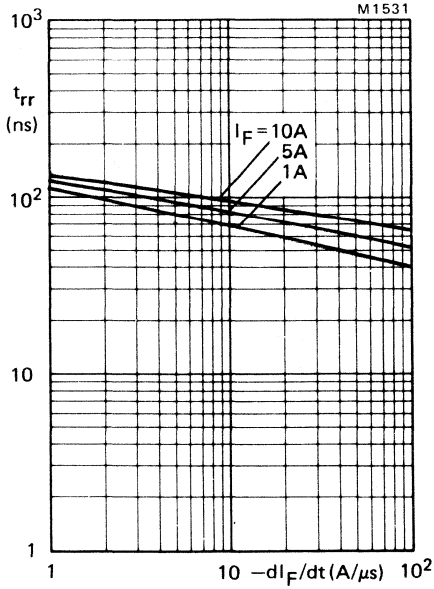


Fig.8 Maximum t_{rr} at T_j = 25 °C.

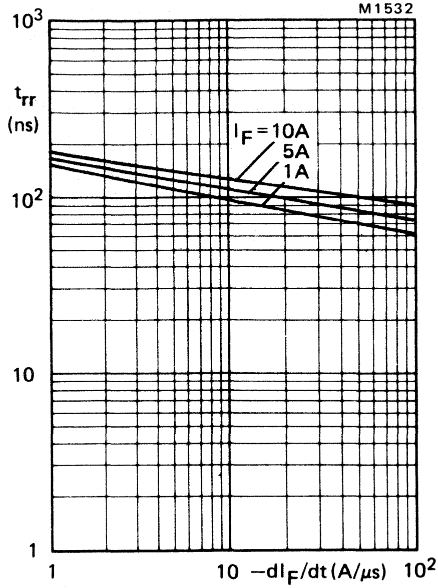


Fig.9 Maximum t_{rr} at T_j = 100 °C.

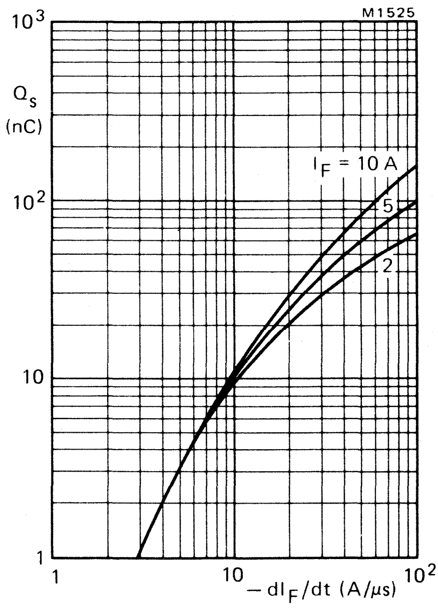


Fig.10 Maximum Q_s at T_j = 25 °C.

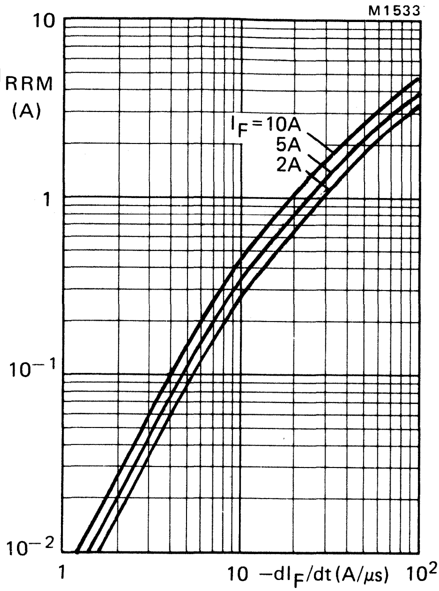


Fig.11 Maximum I_{RRM} at T_j = 25 °C.

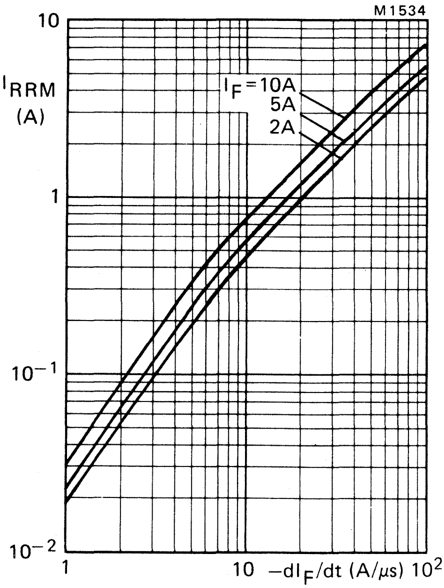


Fig.12 Maximum I_{RRM} at T_j = 100 °C.

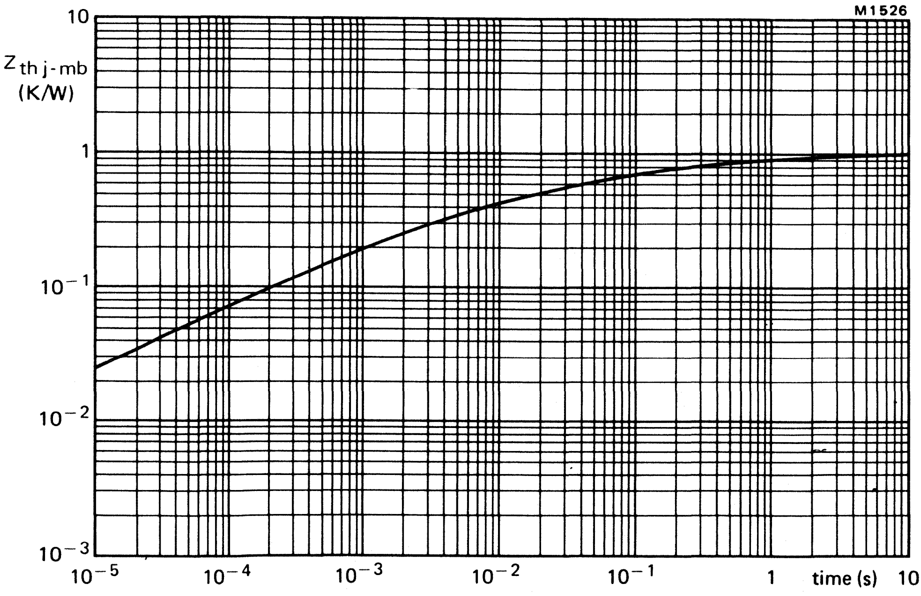


Fig.13 Transient thermal impedance.

ULTRA FAST RECOVERY RECTIFIER DIODES

Glass-passivated, high-efficiency epitaxial rectifier diodes in DO-5 metal envelopes, featuring low forward voltage drop, ultra fast reverse recovery times, very low stored charge and soft recovery characteristic. 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.

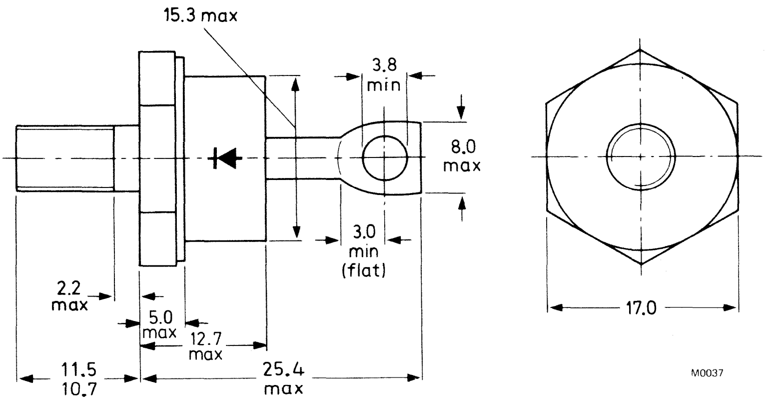
QUICK REFERENCE DATA

			BYW92–50	100	150	200	
Repetitive peak reverse voltage	V_{RRM}	max.	50	100	150	200	V
Average forward current	$I_{F(AV)}$	max.		40			A
Forward voltage	V_F	<		0.8			V
Reverse recovery time	t_{rr}	<		40			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 28 UNF stud (ϕ 6.35 mm); e.g. BYW92–50U.



Net mass: 22 g
Diameter of clearance hole: max. 6.5 mm
Accessories supplied on request:
see ACCESSORIES section.

Supplied with device: 1 nut. 1 lock washer
Torque on nut: min. 1.7 Nm (17 kg cm)
max. 3.5 Nm (35 kg cm)
Nut dimensions across the flats:
M6: 10 mm; ¼ in x 28 UNF: 11.1 mm

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	200	
Repetitive peak reverse voltage	V_{RRM}	max.	50	100	150	200	V
Crest working reverse voltage	V_{RWM}	max.	50	100	150	200	V
Continuous reverse voltage*	V_R	max.	50	100	150	200	V

Currents

Average forward current; switching losses negligible up to 500 kHz				
square wave; $\delta = 0.5$; up to $T_{mb} = 110\ ^oC$	$I_{F(AV)}$	max.	40	A
up to $T_{mb} = 125\ ^oC$	$I_{F(AV)}$	max.	27	A
sinusoidal; up to $T_{mb} = 115\ ^oC$	$I_{F(AV)}$	max.	35	A
up to $T_{mb} = 125\ ^oC$	$I_{F(AV)}$	max.	26	A
R.M.S. forward current	$I_{F(RMS)}$	max.	55	A
Repetitive peak forward current $t_p = 20\ \mu s$; $\delta = 0.02$	I_{FRM}	max.	800	A
Non-repetitive peak forward current half sine-wave; $T_j = 150\ ^oC$ prior to surge; with reapplied V_{RWMmax};				
t = 10 ms	I_{FSM}	max.	500	A
t = 8.3 ms	I_{FSM}	max.	600	A
I^2t for fusing (t = 10 ms)	I^2t	max.	1250	A^2s

Temperatures

Storage temperature	T_{stg}		–40 to +150	^oC
Junction temperature	T_j	max.	150	^oC

THERMAL RESISTANCE

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

*To ensure thermal stability: $R_{th\ j\text{-}a} \leqslant 4.9$ K/W

CHARACTERISTICS

Forward voltage				
I_F = 35 A; T_j = 150 °C	V_F	<	0.8	V*
I_F = 100 A; T_j = 25 °C	V_F	<	1.3	V*
Reverse current				
$V_R = V_{RRMmax}$; T_j = 100 °C	I_R	<	2.5	mA
T_j = 25 °C	I_R	<	100	μA
Reverse recovery when switched from				
I_F = 1 A to $V_R \geq$ 30 V with $-dI_F/dt$ = 100 A/μs; T_j = 25 °C; recovery time	t_{rr}	<	40	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
I_F = 10 A to $V_R \geq$ 30 V with $-dI_F/dt$ = 50 A/μs; T_j = 100 °C; peak recovery current	I_{RRM}	<	4.5	A
Forward recovery when switched to I_F = 10 A with dI_F/dt = 10 A/μs; T_j = 25 °C	V_{fr}	typ.	1.0	V

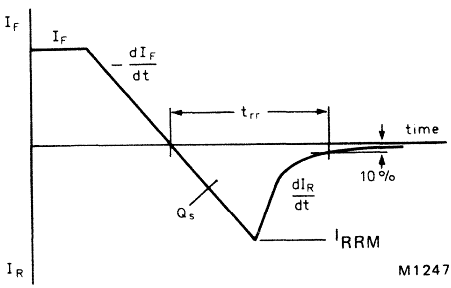


Fig.2 Definition of t_{rr}, Q_s and I_{RRM}.

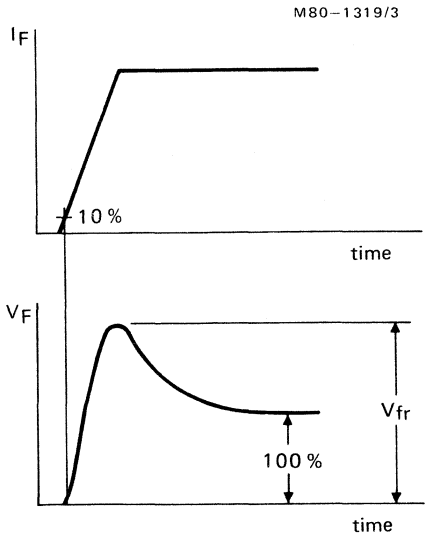


Fig.3 Definition of V_{fr}.

*Measured under pulse conditions to avoid axcessive dissipation.

SQUARE-WAVE OPERATION

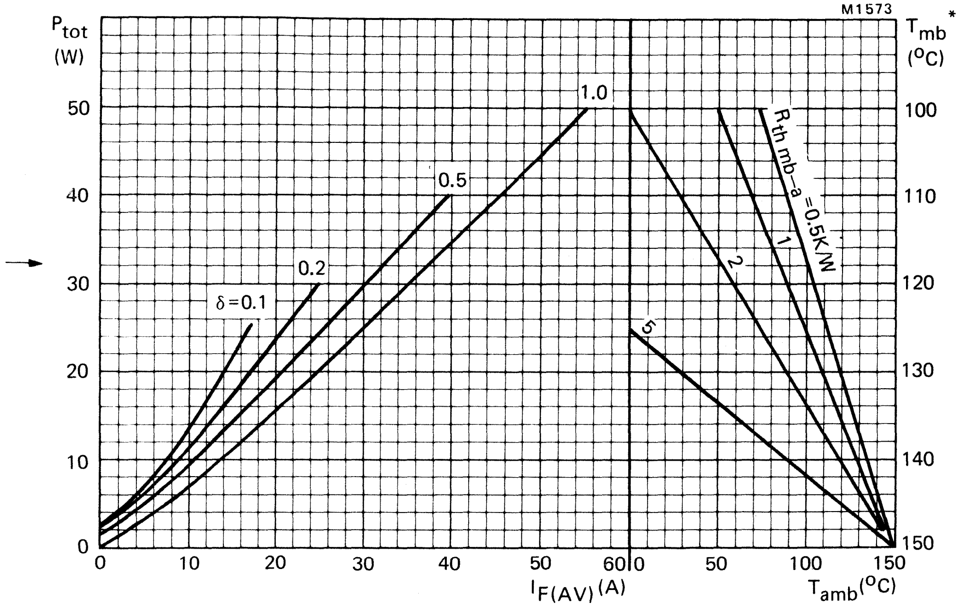
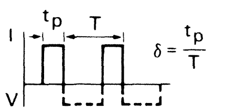


Fig.4 The right-hand part shows the interrelationship between the power (derived from the left-hand part) and the maximum permissible temperatures. Power includes reverse current losses and switching losses up to f = 500 kHz.



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

*T_{mb} scale is for comparison purposes and is correct only for $R_{th\ mb-a} < 3.6$ K/W.

SINUSOIDAL OPERATION

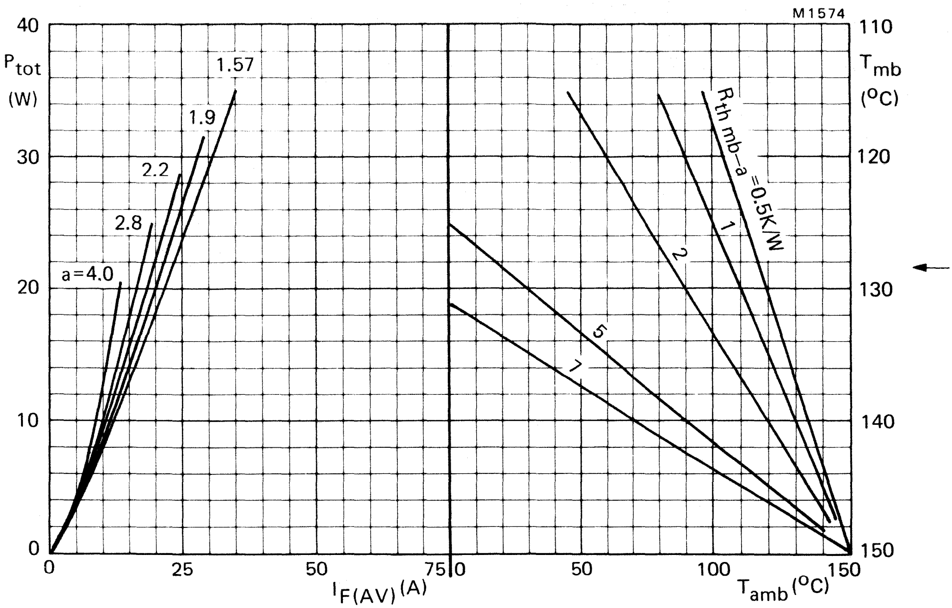


Fig.5 The right-hand part shows the interrelationship between the power (derived from the left-hand part) and the maximum permissible temperatures. Power includes reverse current losses and switching losses up to f = 500 kHz.
a = form factor = $I_{F(RMS)}/I_{F(AV)}$.

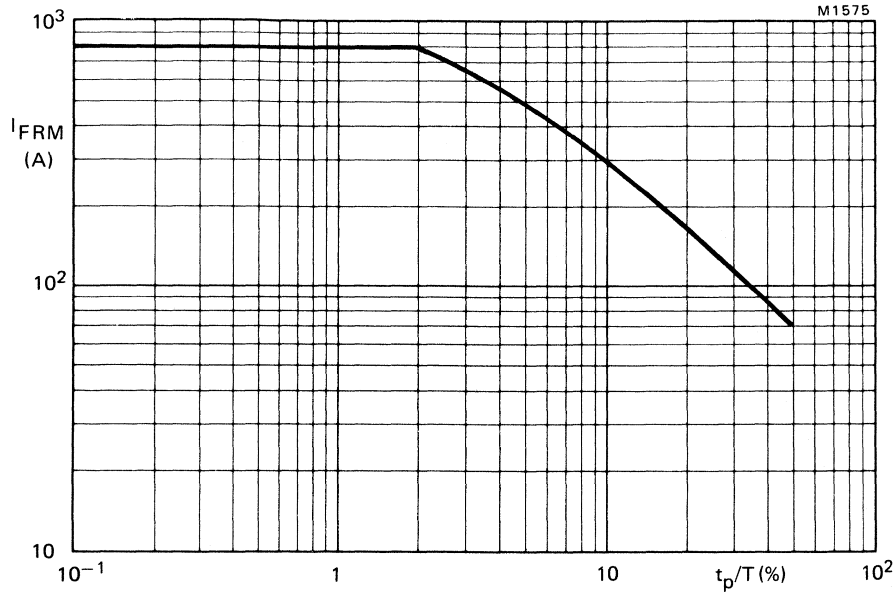
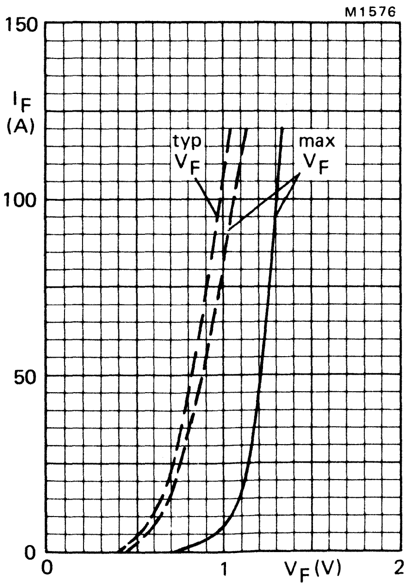
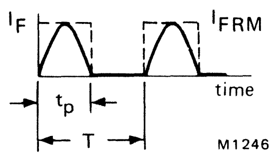


Fig.6 Maximum permissible repetitive peak forward current for square or sinusoidal currents; $1\ \mu s < t_p < 1$ ms.





Definition of I_{FRM} and t_p/T.

Fig.7 —— $T_j = 25\ ^oC$; – – – $T_j = 150\ ^oC$.

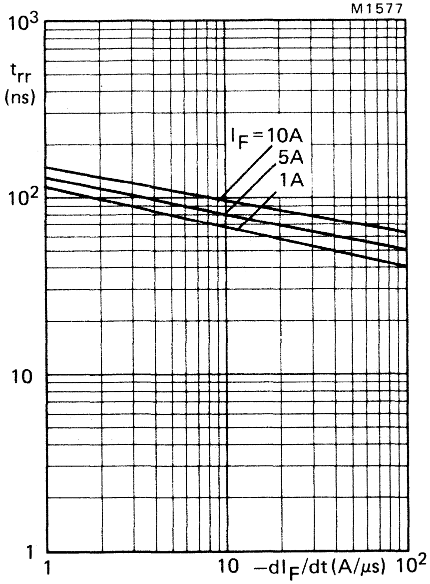


Fig.8 Maximum t_{rr} at T_j = 25 °C.

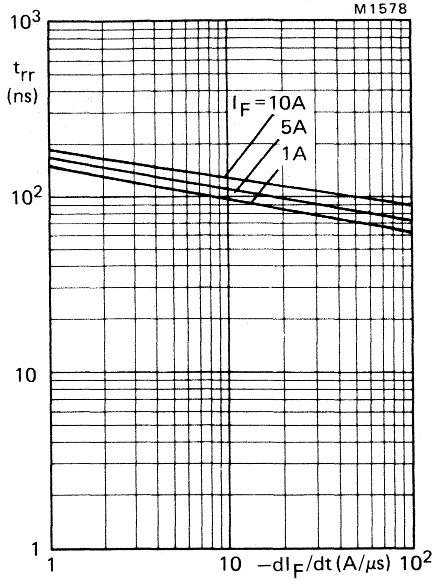


Fig.9 Maximum t_{rr} at T_j = 100 °C.

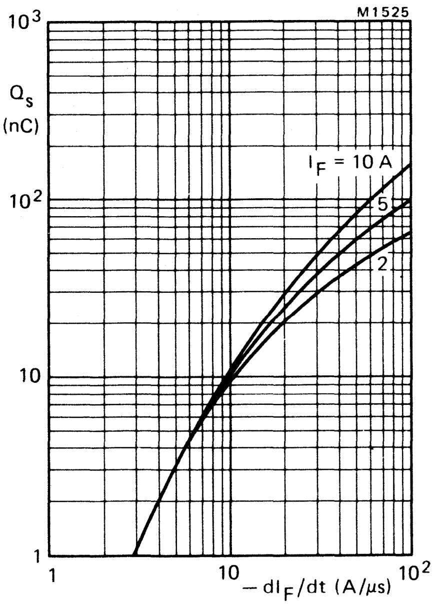


Fig.10 Maximum Q_s at T_j = 25 °C.

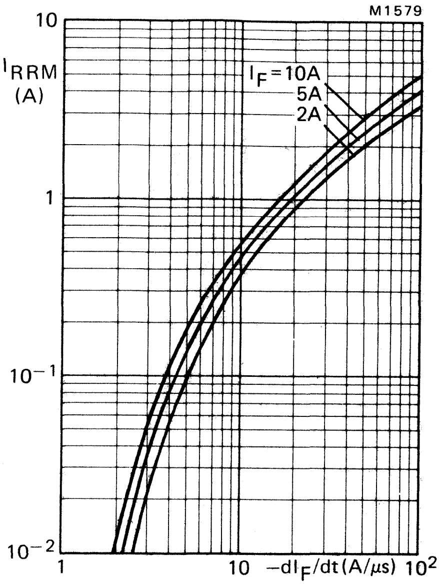


Fig.11 Maximum I_{RRM} at T_j = 25 °C.

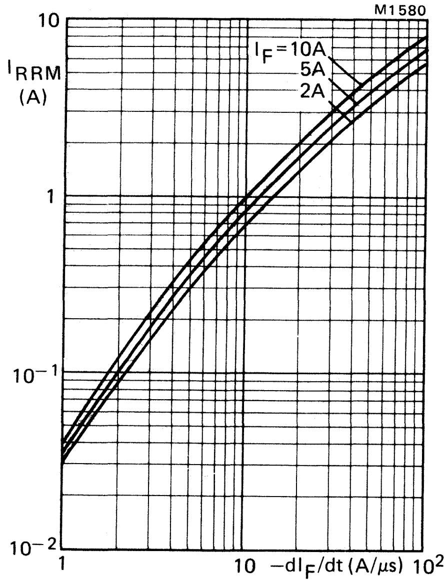


Fig.12 Maximum I_{RRM} at T_j = 100 °C.

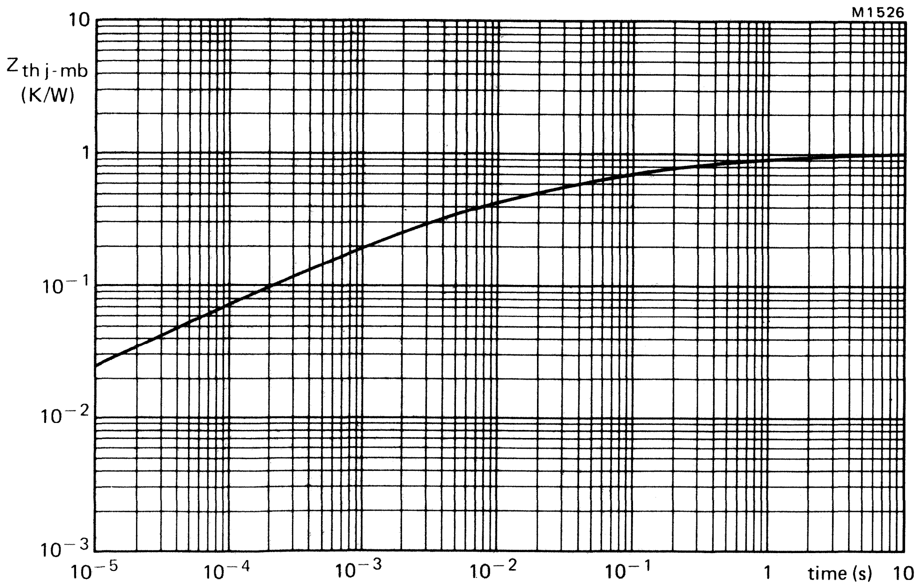


Fig.13 Transient thermal impedance.

ULTRA FAST RECOVERY RECTIFIER DIODES

Glass-passivated, high-efficiency epitaxial rectifier diodes in DO-5 metal envelopes, featuring low forward voltage drop, ultra fast reverse recovery times, very low stored charge and soft recovery characteristic. 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.

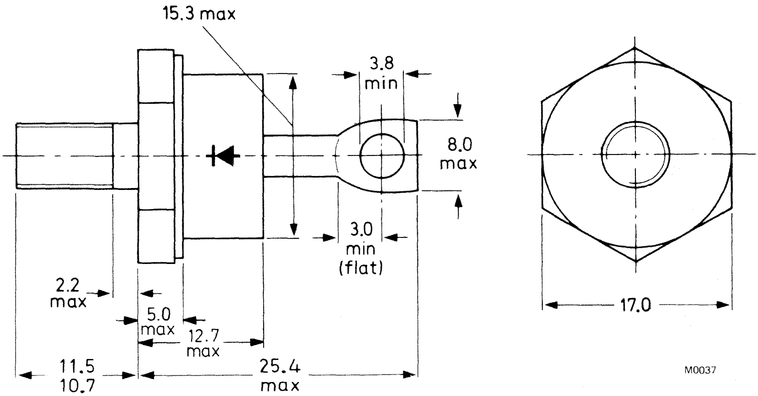
QUICK REFERENCE DATA

			BYW93–50	100	150	200	
Repetitive peak reverse voltage	V_{RRM}	max.	50	100	150	200	V
Average forward current	$I_{F(AV)}$	max.	60				A
Forward voltage	V_F	<	0.8				V
Reverse recovery time	t_{rr}	<	45				ns

MECHANICAL DATA

Dimensions in mm

Fig.1 DO-5; with metric M6 stud (ϕ 6 mm): e.g. BYW93–50
with ¼ in x 28 UNF stud (ϕ 6.35 mm); e.g. BYW93–50U



Net mass: 22 g

Diameter of clearance hole: max. 6.5 mm

Accessories supplied on request:
see ACCESSORIES section.

Supplied with device: 1 nut, 1 lock washer

Torque on nut: min. 1.7 Nm (17 kg cm)
max. 3.5 Nm (35 kg cm)

Nut dimensions across the flats: M6: 10 mm,
¼ in x 28 UNF: 11.1 mm

Products approved to CECC 50 009-028, available on request.

RATINGS

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

Voltages

			BYW93–50	100	150	200	
Repetitive peak reverse voltage	V_{RRM}	max.	50	100	150	200	V
Crest working reverse voltage	V_{RWM}	max.	50	100	150	200	V
Continuous reverse voltage*	V_R	max.	50	100	150	200	V

Currents

Average forward current; switching losses negligible up to 500 kHz				
square wave; δ = 0.5; up to T_{mb} = 110 °C	$I_{F(AV)}$	max.	60	A
up to T_{mb} = 125 °C	$I_{F(AV)}$	max.	40	A
sinusoidal; up to T_{mb} = 115 °C	$I_{F(AV)}$	max.	50	A
up to T_{mb} = 125 °C	$I_{F(AV)}$	max.	38	A
R.M.S. forward current	$I_{F(RMS)}$	max.	85	A
Repetitive peak forward current t_p = 20 μs; δ = 0.02	I_{FRM}	max.	1500	A
Non-repetitive peak forward current half sine-wave; T_j = 150 °C prior to surge; with reapplied V_{RWMmax};				
t = 10 ms	I_{FSM}	max.	800	A
t = 8.3 ms	I_{FSM}	max.	1000	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	$R_{th\ j\text{-}mb}$	=	0.7	K/W
From mounting base to heatsink				
a. with heatsink compound	$R_{th\ mb\text{-}h}$	=	0.2	K/W
b. without heatsink compound	$R_{th\ mb\text{-}h}$	=	0.3	K/W
Transient thermal impedance; t = 1 ms	$Z_{th\ j\text{-}mb}$	=	0.32	K/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.

*To ensure thermal stability: $R_{th\ j\text{-}a} \leq 3.0$ K/W.

CHARACTERISTICS

Forward voltage				
I_F = 50 A; T_j = 150 °C	V_F	<	0.8	V*
I_F = 150 A; T_j = 25 °C	V_F	<	1.3	V*
Reverse current				
$V_R = V_{RWM}$ max; T_j = 100 °C	I_R	<	5	mA
T_j = 25 °C	I_R	<	250	µA
Reverse recovery when switched from				
I_F = 1 A to $V_R \geq$ 30 V with $-dI_F/dt$ = 100 A/µs; T_j = 25 °C; recovery time	t_{rr}	<	45	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	<	35	nC
I_F = 10 A to $V_R \geq$ 30 V with $-dI_F/dt$ = 50 A/µs; T_j = 100 °C; peak recovery current	I_{RRM}	<	6	A
Forward recovery when switched to I_F = 10 A with dI_F/dt = 10 A/µs; T_j = 25 °C	V_{fr}	typ.	1.0	V

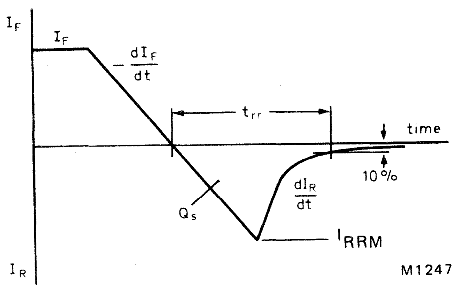


Fig.2 Definition of t_{rr}, Q_s and I_{RRM}.

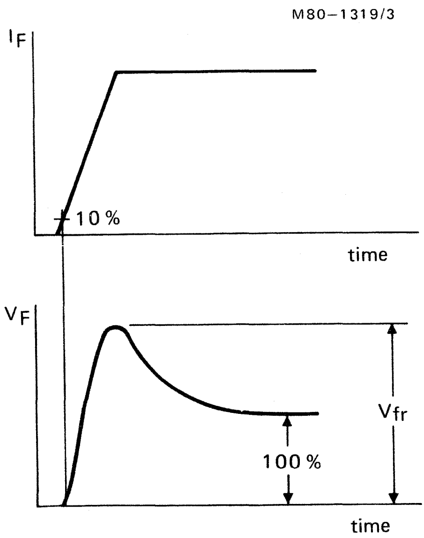


Fig.3 Definition of V_{fr}.

*Measured under pulse conditions to avoid excessive dissipation.

SQUARE-WAVE OPERATION

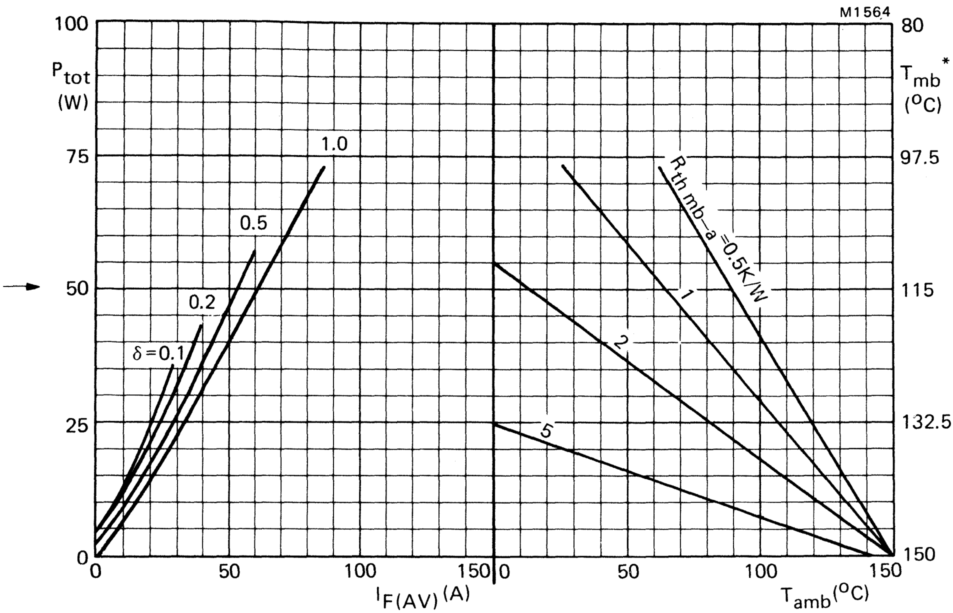
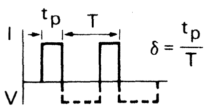


Fig.4 The right-hand part shows the interrelationship between the power (derived from the left-hand part) and the maximum permissible temperatures.
Power includes reverse current losses.



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

*T_{mb} scale is for comparison purposes and is correct only for $R_{th\ mb\text{-}a} < 2.1$ K/W

SINUSOIDAL OPERATION

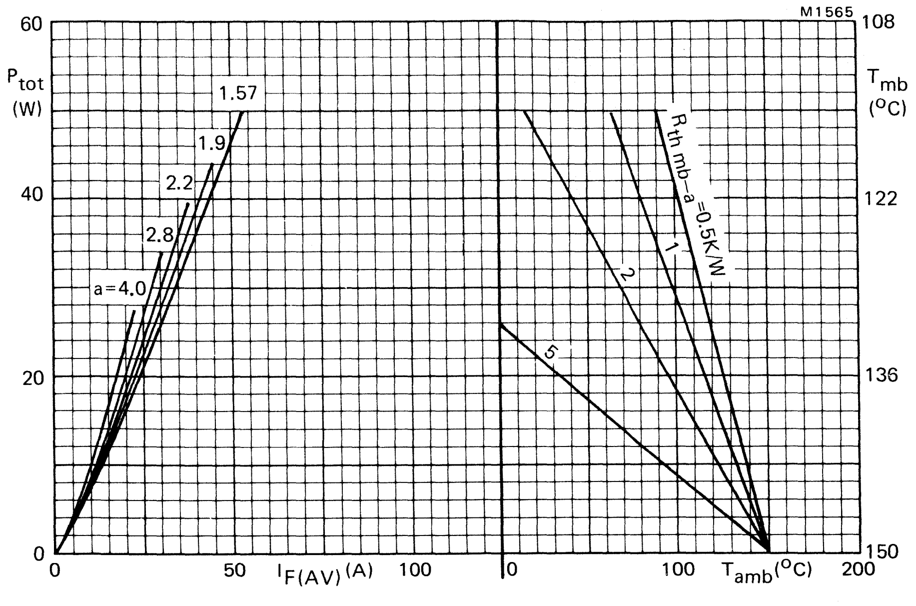


Fig.5 The right-hand part shows the interrelationship between the power (derived from the left-hand part) and the maximum permissible temperatures.
Power includes reverse current losses.
a = form factor = $I_{F(RMS)}/I_{F(AV)}$.

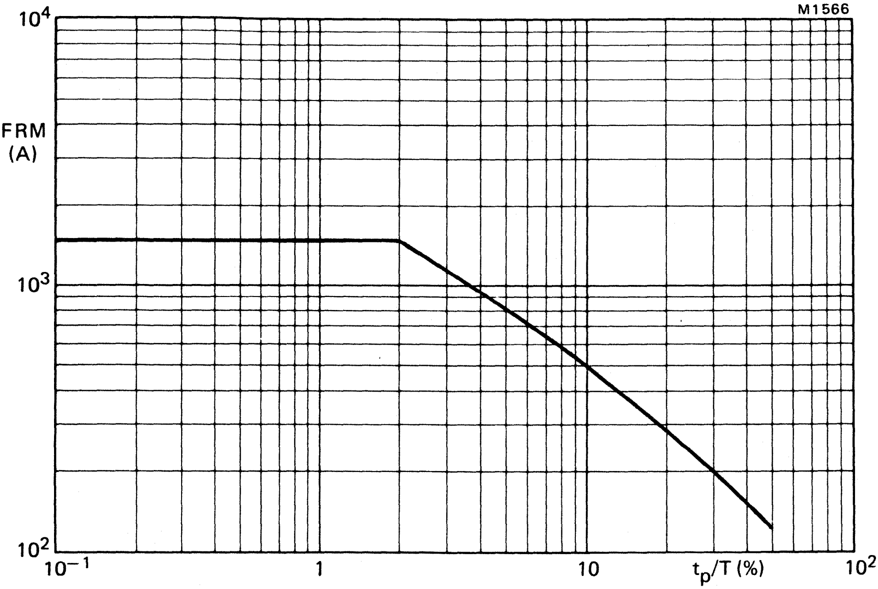
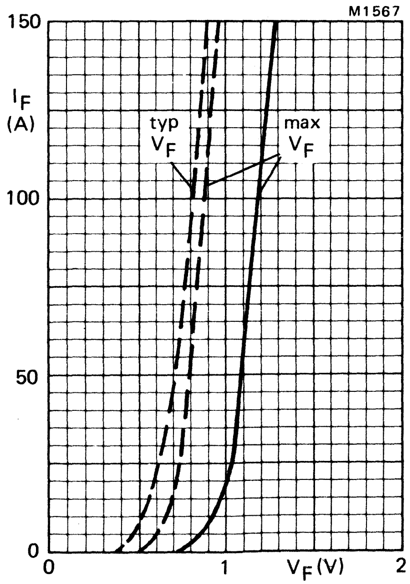
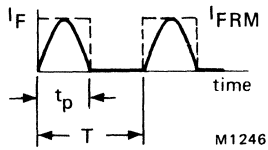


Fig.6 Maximum permissible repetitive peak forward current for square or sinusoidal currents; $1\ \mu s < t_p < 1$ ms.





Definition of I_{FRM} and t_p/T.

Fig.7 —— T_j = 25 °C; – – – T_j = 150 °C.

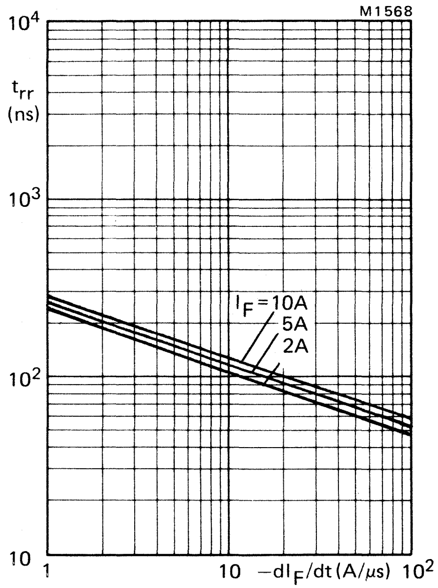


Fig.8 Maximum t_{rr} at T_j = 25 °C.

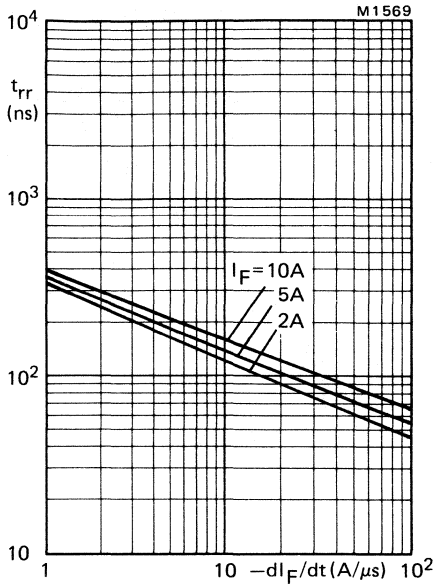


Fig.9 Maximum t_{rr} at T_j = 100 °C.

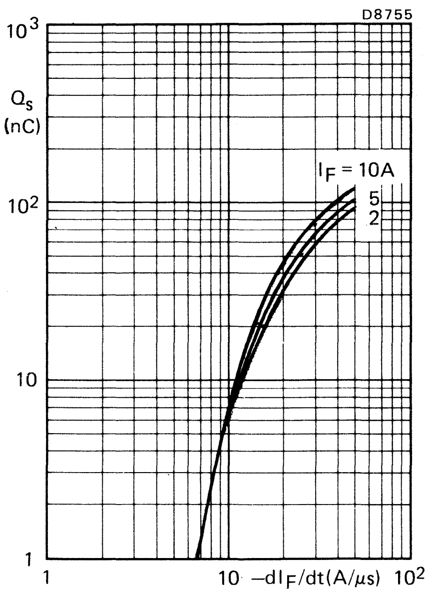


Fig.10 Maximum Q_s at T_j = 25 °C.

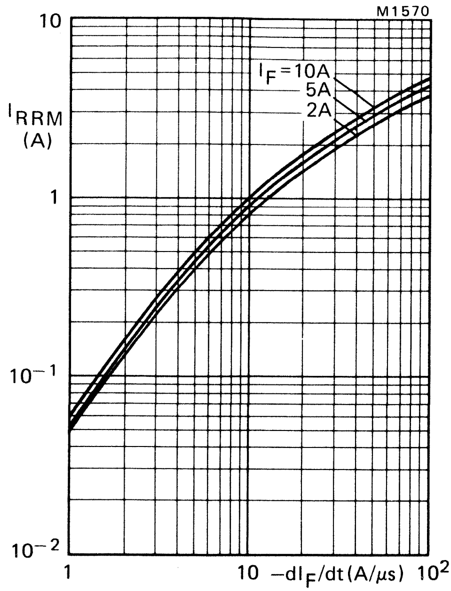


Fig.11 Maximum I_{RRM} at $T_j = 25\ ^oC$.

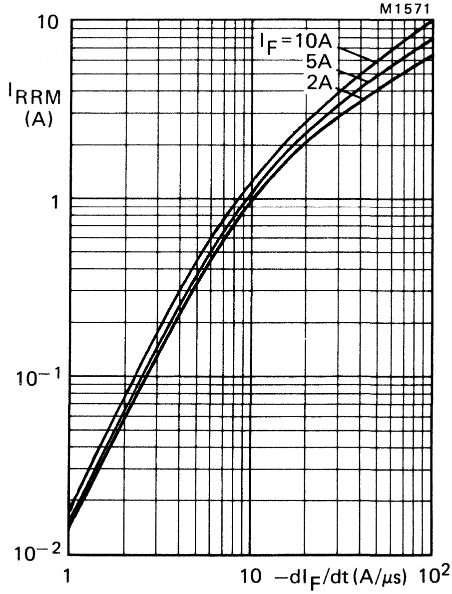


Fig.12 Maximum I_{RRM} at $T_j = 100\ ^oC$.

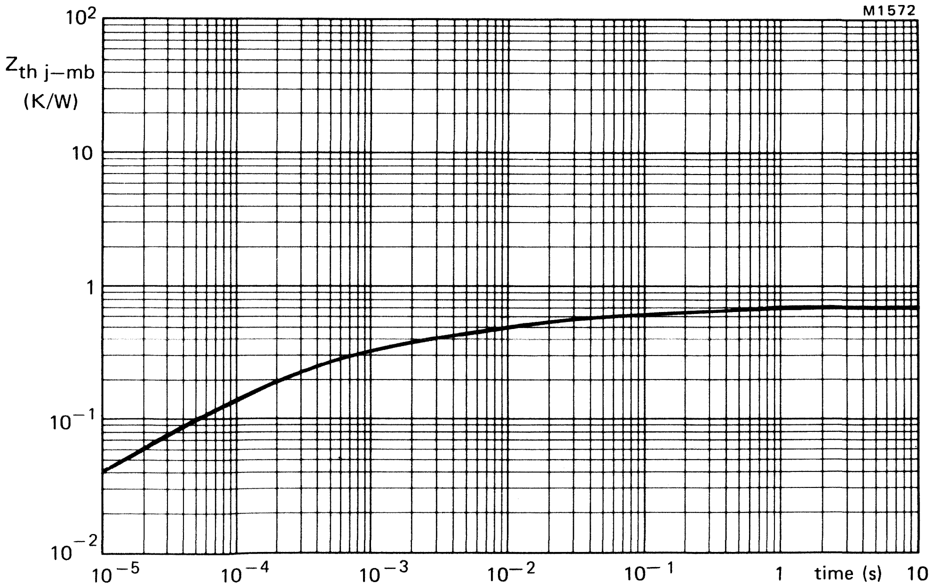


Fig.13 Transient thermal impedance.

ULTRA FAST RECOVERY RECTIFIER DIODES

Glass-passivated, high-efficiency epitaxial rectifier diodes in DO-5 metal envelopes, featuring low forward voltage drop, ultra fast reverse recovery times, very low stored charge and soft recovery characteristic. 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.

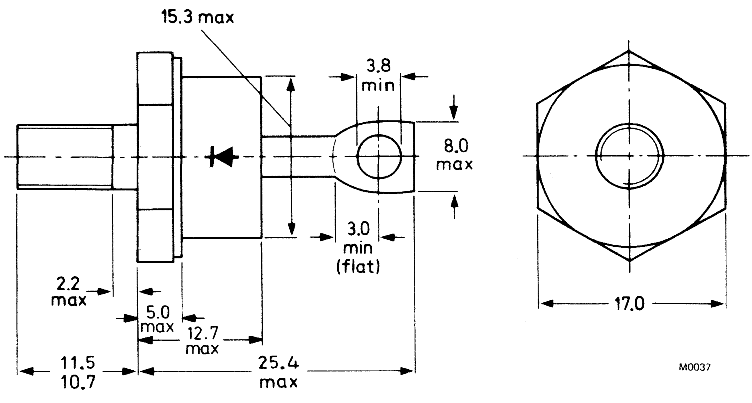
QUICK REFERENCE DATA

			BYW94–50	100	150	200	
Repetitive peak reverse voltage	V_{RRM}	max.	50	100	150	200	V
Average forward current	$I_{F(AV)}$	max.	80				A
Forward voltage	V_F	<	0.8				V
Reverse recovery time	t_{rr}	<	50				ns

MECHANICAL DATA

Dimensions in mm

Fig.1 DO-5; with metric M6 stud (ϕ6 mm): e.g. BYW94–50
with ¼ in x 28 UNF stud (ϕ 6.35 mm); e.g. BYW94–50U



Net mass: 22 g

Diameter of clearance hole: max. 6.5 mm

Accessories supplied on request: see ACCESSORIES section.

Supplied with device: 1 nut, 1 lock washer.
Torque on nut:
min. 1.7 Nm (17 kg cm),
max. 3.5 Nm (35 kg cm)
Nut dimensions across the flats:
M6: 10 mm; ¼" x 28 UNF: 11.1 mm

RATINGS

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

Voltages		BYW94–50		100	150	200	
Repetitive peak reverse voltage	V_{RRM}	max.	50	100	150	200	V
Crest working reverse voltage	V_{RWM}	max.	50	100	150	200	V
Continuous reverse voltage*	V_R	max.	50	100	150	200	V

Currents

Average forward current; switching losses negligible up to 100 kHz				
square wave; δ = 0.5; up to T_{mb} = 98 °C	$I_{F(AV)}$	max.	80	A
sinusoidal; up to T_{mb} = 105 °C	$I_{F(AV)}$	max.	70	A
R.M.S. forward current	$I_{F(RMS)}$	max.	113	A
Repetitive peak forward current t_p = 20 μs; δ = 0.02	I_{FRM}	max.	1800	A
Non-repetitive peak forward current half sine-wave; T_j = 150 °C prior to surge; with reapplied V_{RWMmax};				
t = 10 ms	I_{FSM}	max.	1500	A
t = 8.3 ms	I_{FSM}	max.	1800	A
I^2t for fusing (t = 10 ms)	I^2t	max.	11250	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	$R_{th\ j\text{-}mb}$	=	0.7	K/W
From mounting base to heatsink				
a. with heatsink compound	$R_{th\ mb\text{-}h}$	=	0.2	K/W
b. without heatsink compound	$R_{th\ mb\text{-}h}$	=	0.3	K/W
Transient thermal impedance; t = 1 ms	$Z_{th\ j\text{-}mb}$	=	0.32	K/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.

*To ensure thermal stability: $R_{th\ j\text{-}a} \leq 2.2$ K/W

CHARACTERISTICS

Forward voltage				
I_F = 70 A; T_j = 150 °C	V_F	<	0.8	V*
I_F = 200 A; T_j = 25 °C	V_F	<	1.2	V*
Reverse current				
$V_R = V_{RWM\ max}$; T_j = 100 °C	I_R	<	6.5	mA
T_j = 25 °C	I_R	<	250	μA
Reverse recovery when switched from				
I_F = 1 A to $V_R \geq$ 30 V with $-dI_F/dt$ = 100 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	<	50	nC
I_F = 10 A to $V_R \geq$ 30 V with $-dI_F/dt$ = 50 A/μs; T_j = 100 °C; peak recovery current	I_{RRM}	<	4.0	A
Forward recovery when switched to I_F = 10 A with dI_F/dt = 10 A/μs; T_j = 25 °C	V_{fr}	typ.	1.0	V

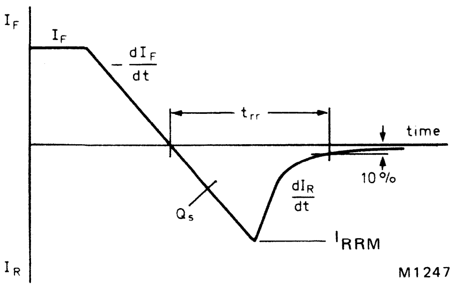


Fig.2 Definition of t_{rr}, Q_s and I_{RRM}.

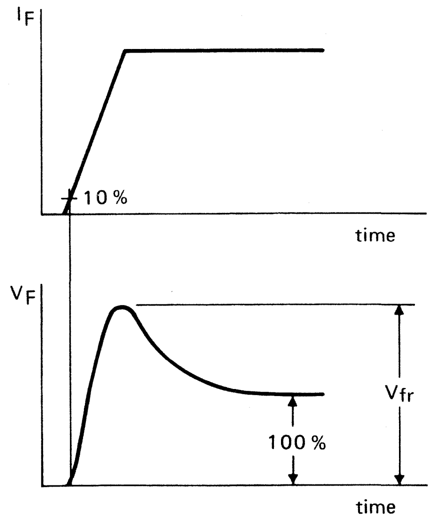


Fig.3 Definition of V_{fr}.

*Measured under pulse conditions to avoid excessive dissipation.

SQUARE-WAVE OPERATION

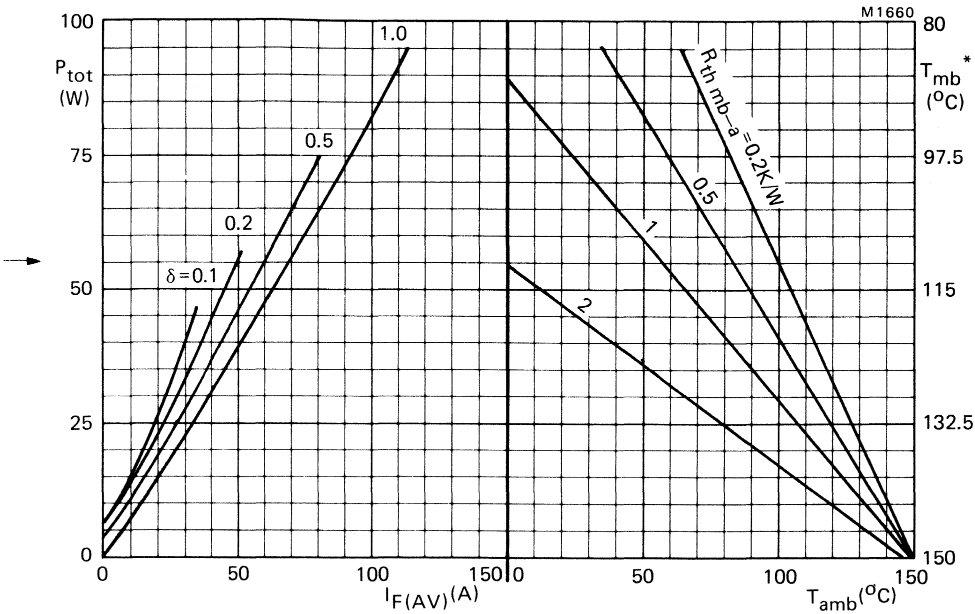
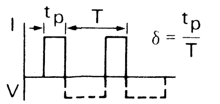


Fig.4 The right-hand part shows the interrelationship between the power (derived from the left-hand part) and the maximum permissible temperatures. Power includes reverse current losses.



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

*T_{mb} scale is for comparison purposes and is correct only for $R_{th\ mb\text{-}a} < 1.3$ K/W.

SINUSOIDAL OPERATION

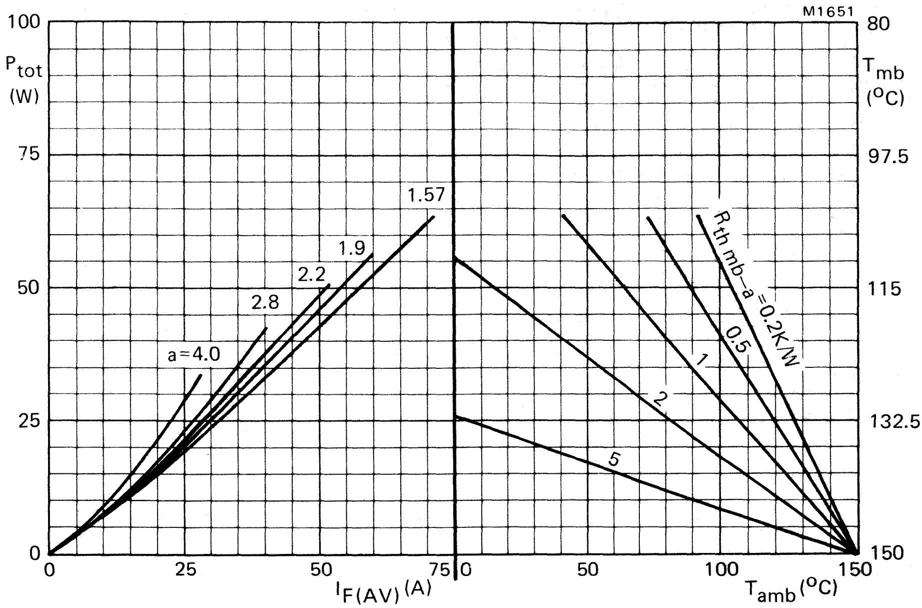


Fig.5 The right-hand part shows the interrelationship between the power (derived from the left-hand part) and the maximum permissible temperatures. Power includes reverse current losses.

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

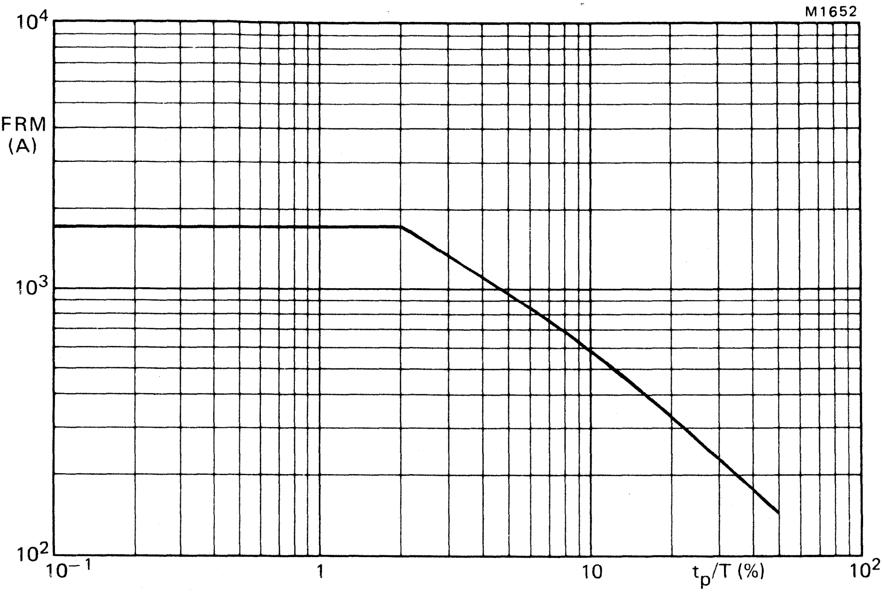
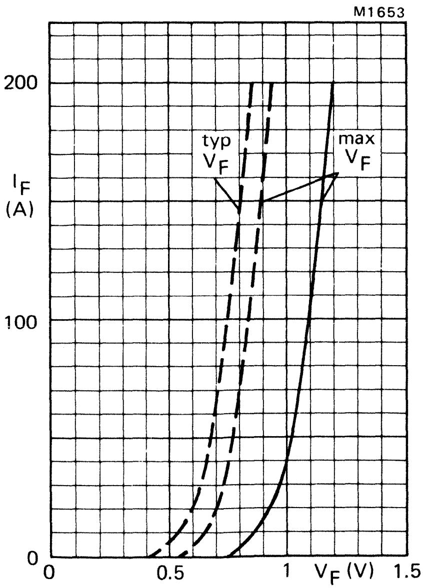
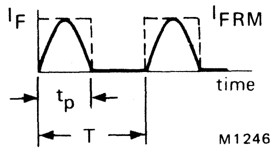


Fig.6 Maximum permissible repetitive peak forward current for square or sinusoidal currents; 1 μs < t_p < 1 ms.





Definition of I_{FRM} and t_p/T.

Fig.7 —— T_j = 25 °C; – – – T_j = 150 °C.

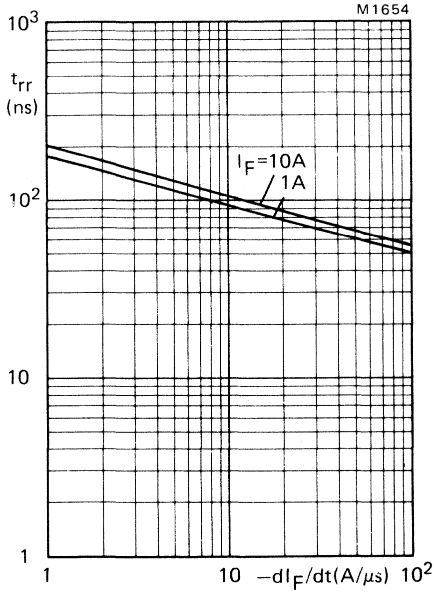


Fig.8 Maximum t_{rr} at T_j = 25 °C.

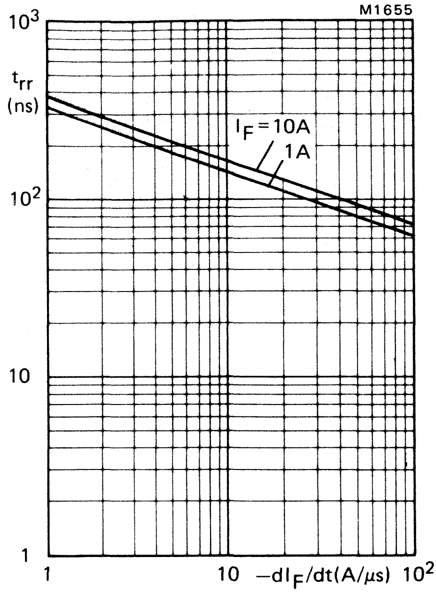


Fig.9 Maximum t_{rr} at T_j = 100 °C.

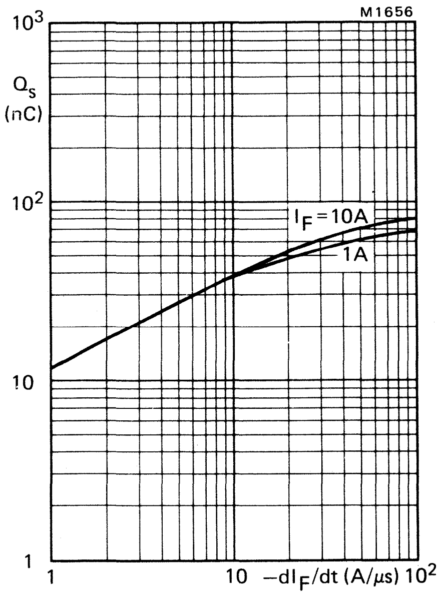


Fig.10 Maximum Q_s at T_j = 25 °C.

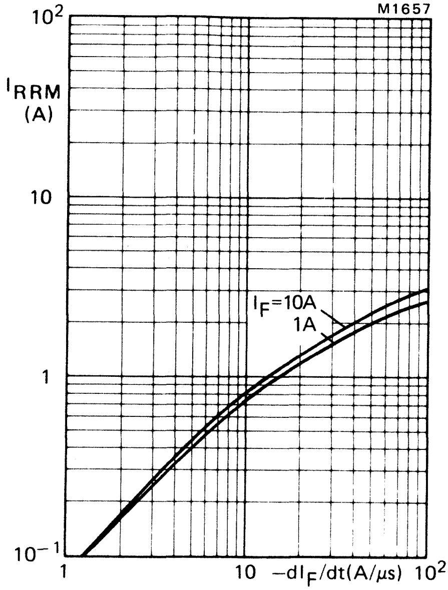


Fig.11 Maximum I_{RRM} at T_j = 25 °C.

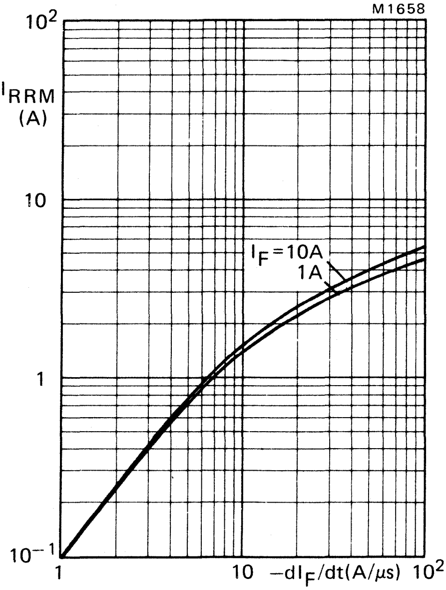


Fig.12 Maximum I_{RRM} at T_j = 100 °C.

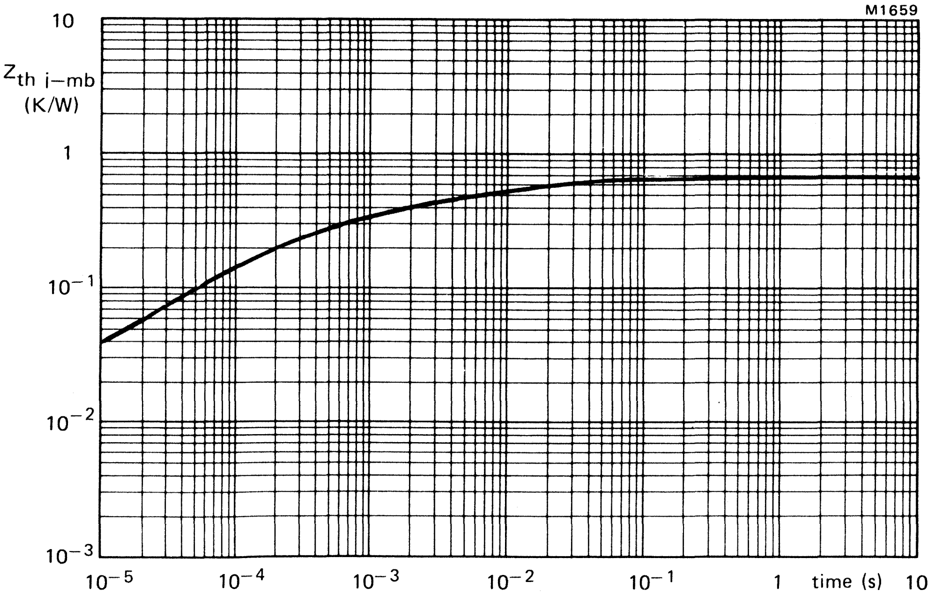


Fig.13 Transient thermal impedance.

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.

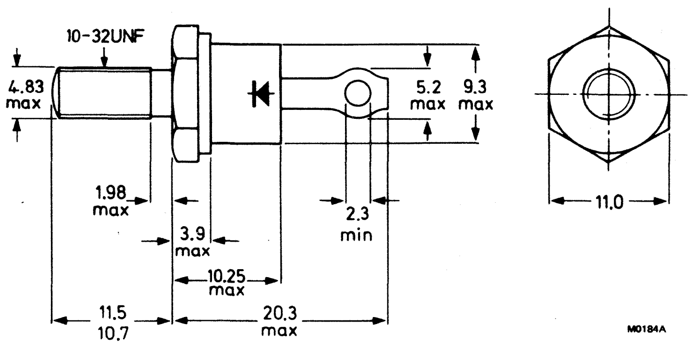
QUICK REFERENCE DATA

			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:
see ACCESSORIES section

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 351.
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

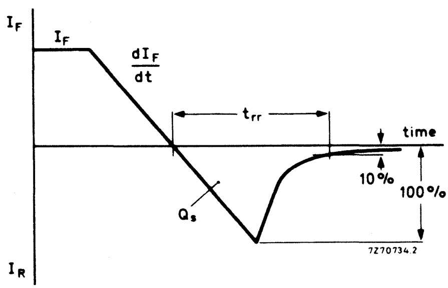
			BYX30-200(R)	300(R)	400(R)	500(R)	600(R)	
Forward voltage								
I_F = 50 A; T_j = 25 °C	V_F	<	3.2	3.2	3.2	3.2	3.2	V [1]
Reverse breakdown voltage								
I_R = 5 mA; T_j = 25 °C	$V_{(BR)R}$	>	250	375	500	625	750	V
		<	1050	1050	1050	1050	1050	V
Reverse current								
$V_R = V_{RWMmax}$; T_j = 125 °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;
with $-dI_F/dt$ = 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 356.

[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	°C
switched from	I_F	=	12	A
to	V_R	=	400	V
at a rate	$-\frac{dI}{dt}$	=	20	A/µs

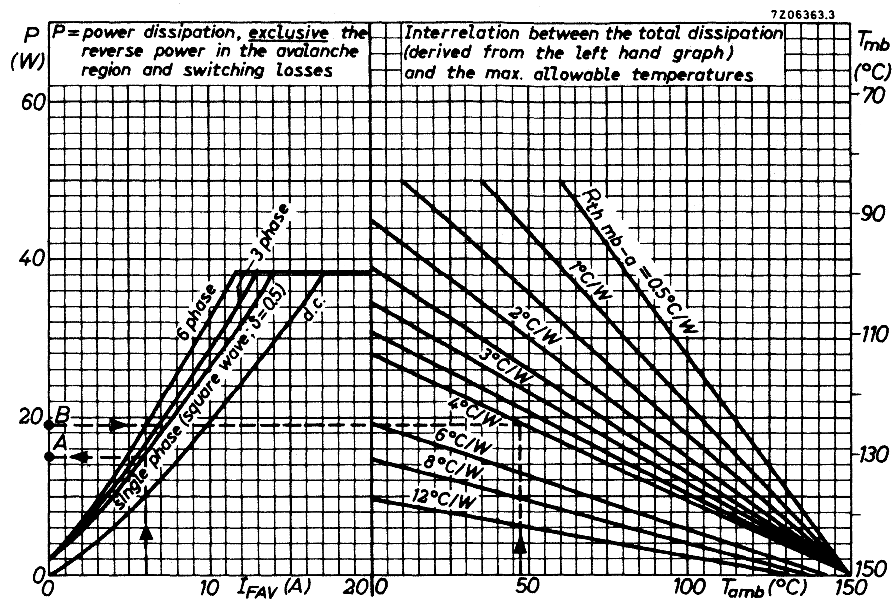
At a duty cycle $\delta = 0.5$ the average forward current $I_{FAV} = 6$ A.
From the upper graph on p.351 it follows, that at $I_{FAV} = 6$ A the average forward power + average leakage power = 15 W (point A).
The additional power losses due to switching-off can be read from the nomogram on p.356 (the example being based on optimum use, i.e. $T_j = 150$ °C). 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 p.351). From the right hand part follows the thermal resistance, required at $T_{amb} = 45$ °C.

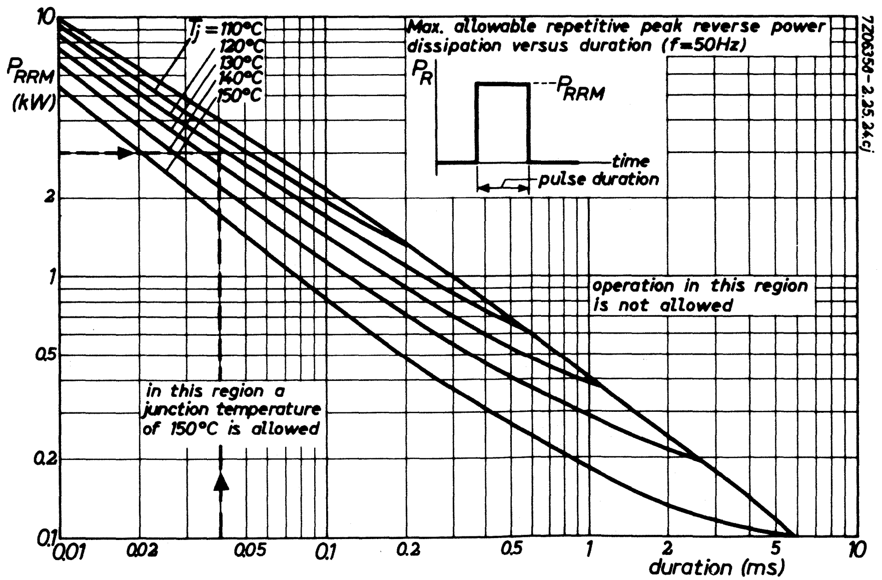
$$R_{th\ mb\text{-}a} \approx 4\ ^{o}C/W$$

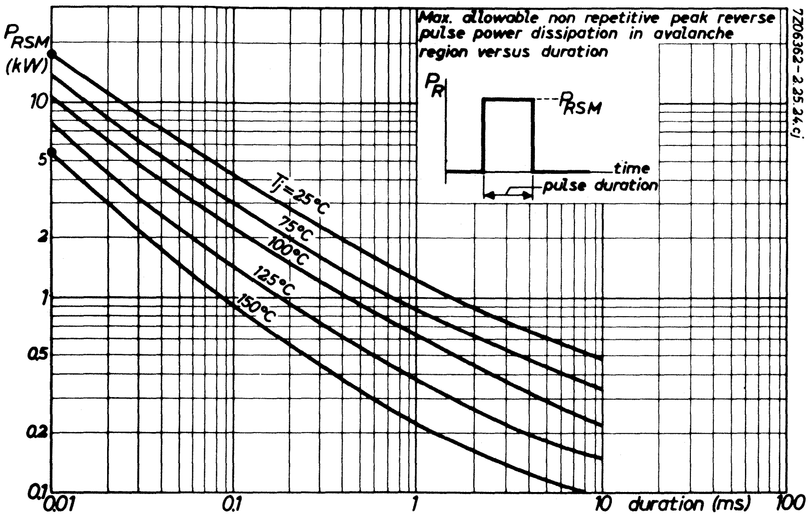
The contact thermal resistance $R_{th\ mb\text{-}h} = 0.5$ °C/W.

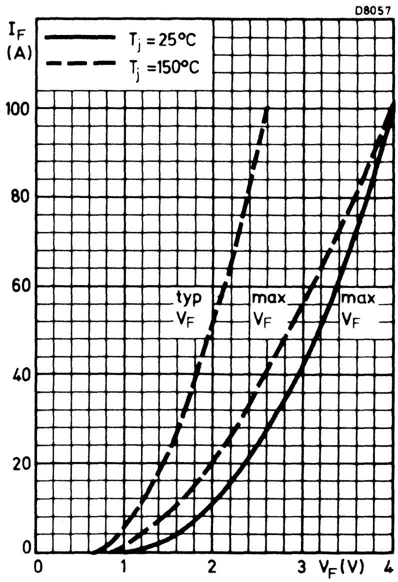
Hence the heatsink thermal resistance should be:

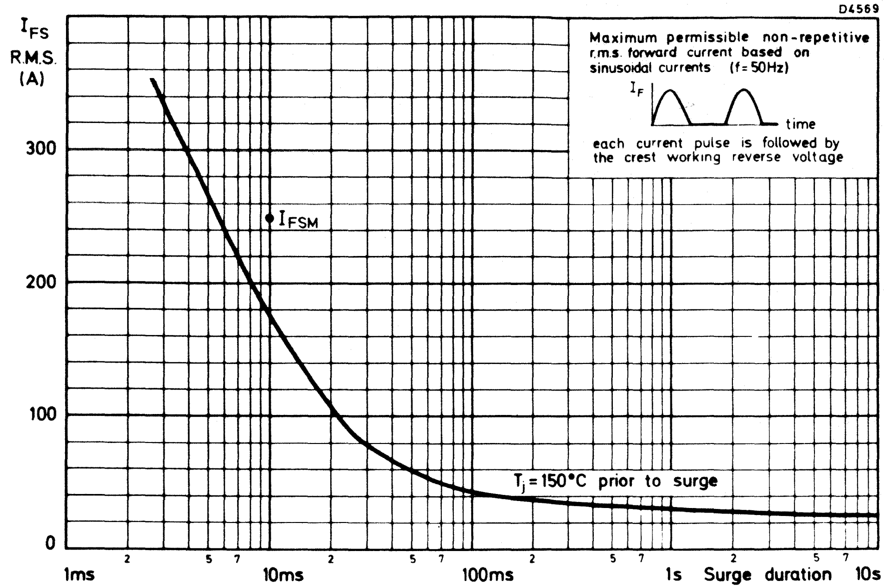
$$R_{th\ h\text{-}a} = R_{th\ mb\text{-}a} - R_{th\ mb\text{-}h} = (4 - 0.5)\ ^{o}C/W = 3.5\ ^{o}C/W.$$

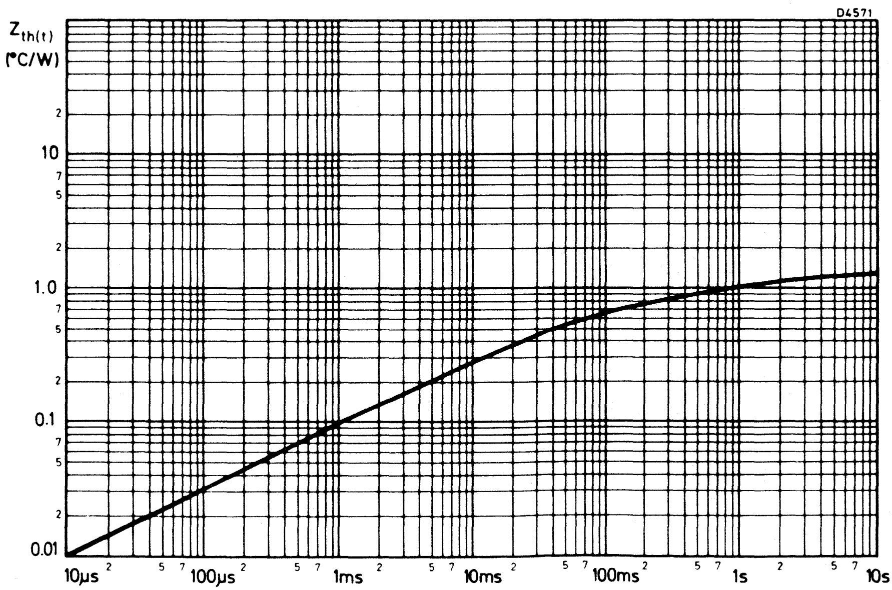

7Z06363.3
P (W)
P = power dissipation, exclusive the reverse power in the avalanche region and switching losses
Interrelation between the total dissipation (derived from the left hand graph) and the max. allowable temperatures
Tmb (°C)
6 phase
3 phase
single phase (square wave; δ=0.5)
d.c.
B
A
Rth mb-a = 0.5°C/W
1°C/W
2°C/W
3°C/W
4°C/W
6°C/W
8°C/W
12°C/W
IFAV (A)
Tamb (°C)
0
10
20
50
100
150
40
60
70
90
110
130

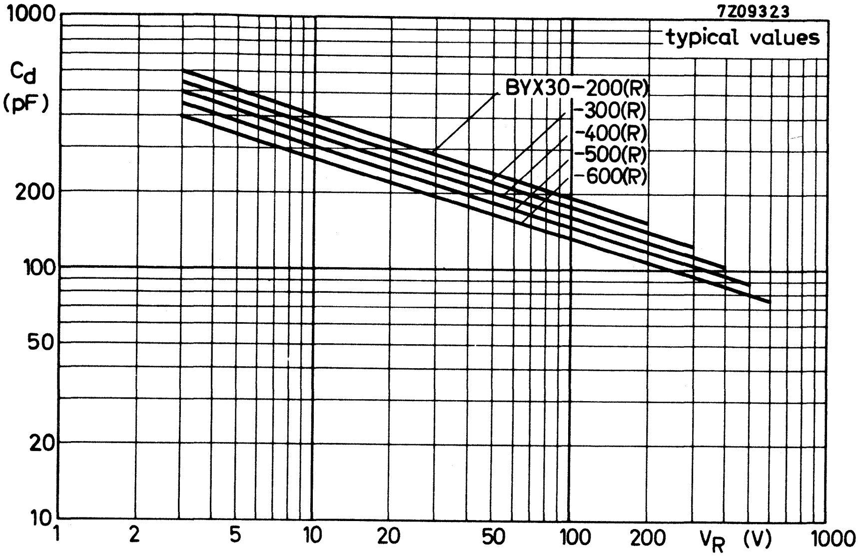

PRRM (kW)
Tj = 110°C
120°C
130°C
140°C
150°C
Max. allowable repetitive peak reverse power dissipation versus duration (f=50Hz)
PR
PRRM
time
pulse duration
operation in this region is not allowed
in this region a junction temperature of 150°C is allowed
duration (ms)
7Z06358-2.25.24.c)
10
2
1
0.5
0.2
0.1
0.01
0.02
0.05
0.2
5

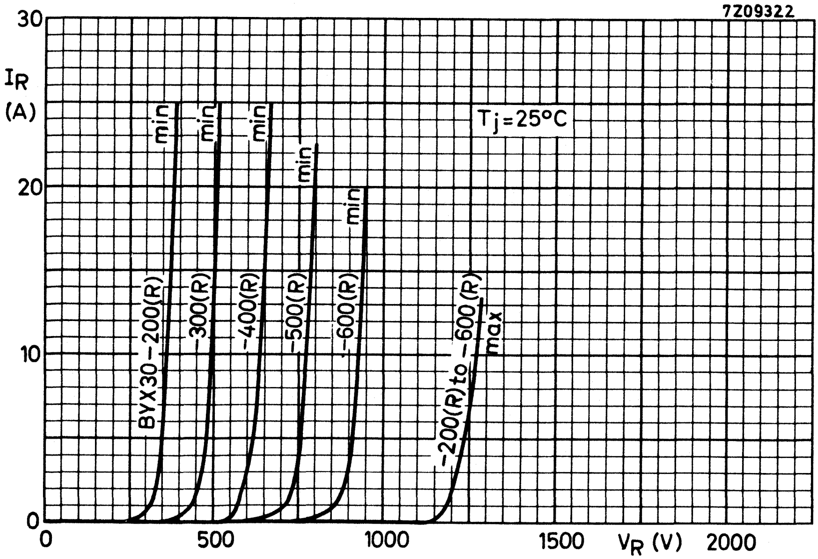

7Z06362-2.25.24.cj
Max. allowable non repetitive peak reverse pulse power dissipation in avalanche region versus duration
P_RSM (kW)
10
5
2
1
0.5
0.2
0.1
0.01
0.1
1
10
duration (ms)
100
Tj = 25 °C
75 °C
100 °C
125 °C
150 °C
P_R
P_RSM
time
pulse duration

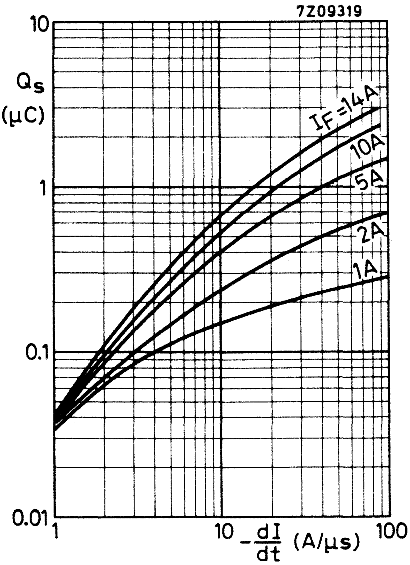

D8057
I_F (A)
Tj = 25 °C
Tj = 150 °C
100
80
60
40
20
0
1
2
3
V_F (V)
4
typ V_F
max V_F
max V_F


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

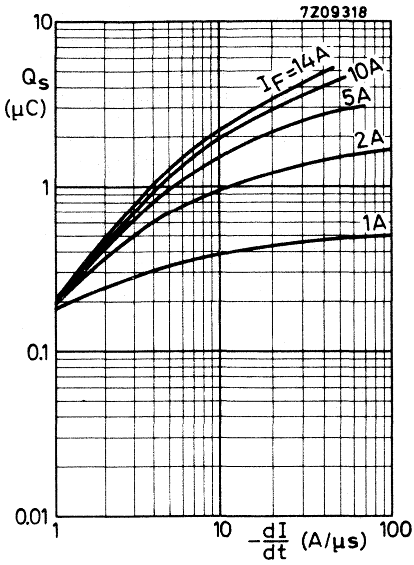

D4571
$Z_{th(t)}$
(°C/W)
10
1.0
0.1
0.01
10µs
100µs
1ms
10ms
100ms
1s
10s


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

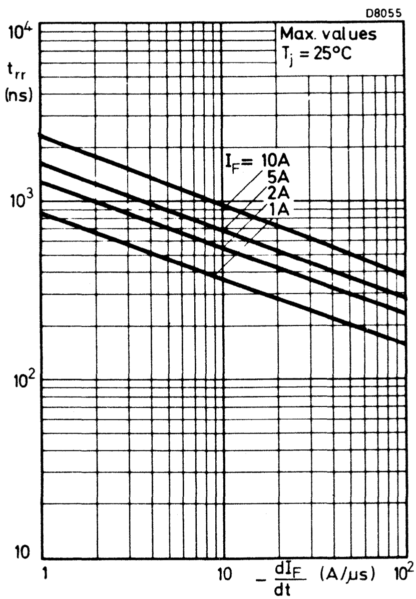

7Z09322
I_R
(A)
30
20
10
0
T_j=25°C
min
min
min
min
min
BYX30-200(R)
-300(R)
-400(R)
-500(R)
-600(R)
-200(R) to -600(R)
max
0
500
1000
1500
V_R (V)
2000

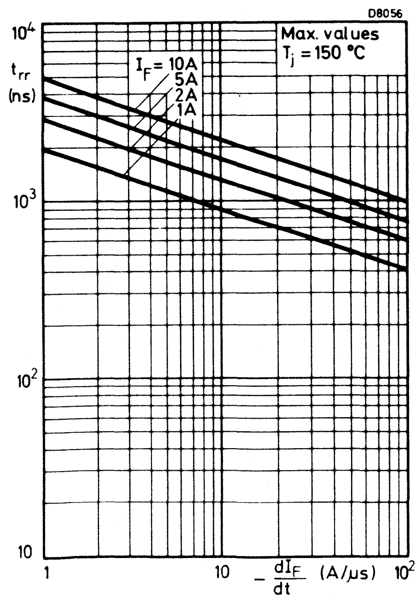


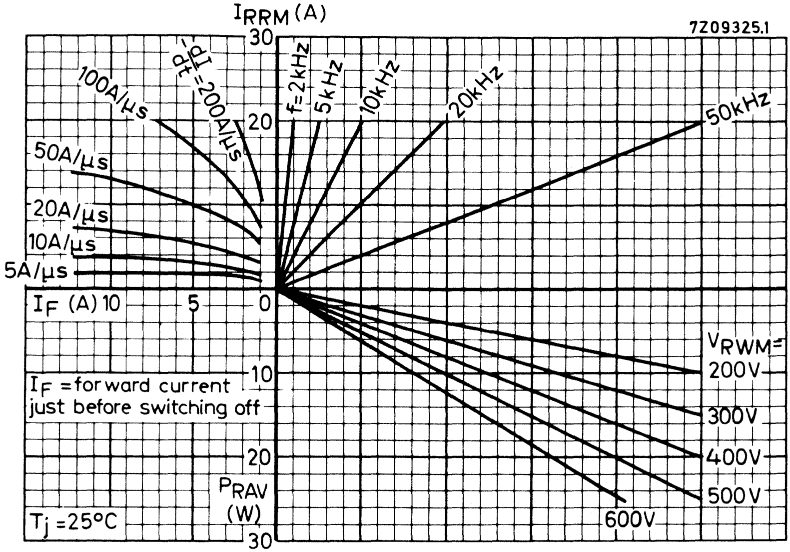
Maximum values; T_j = 25 °C; switched from I_F to $V_R \geqslant 30$ V.

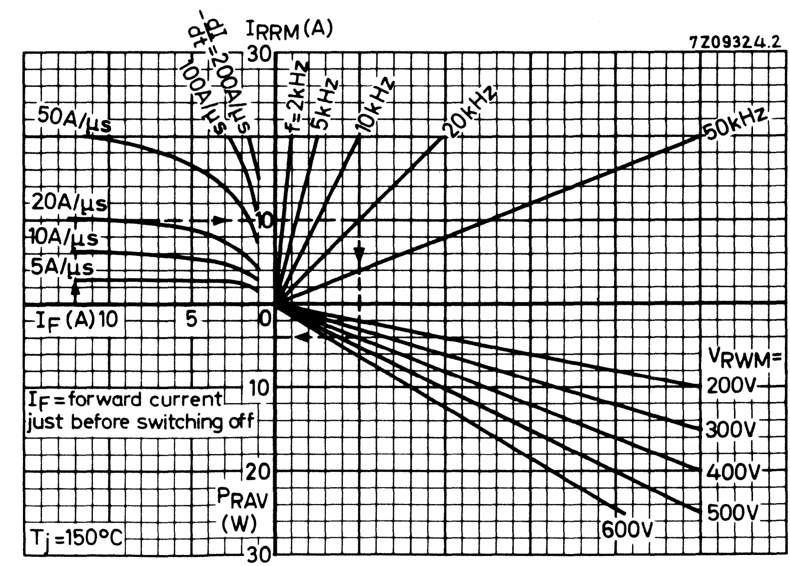


Maximum values; T_j = 150 °C; switched from I_F to $V_R \geqslant 30$ V.









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

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

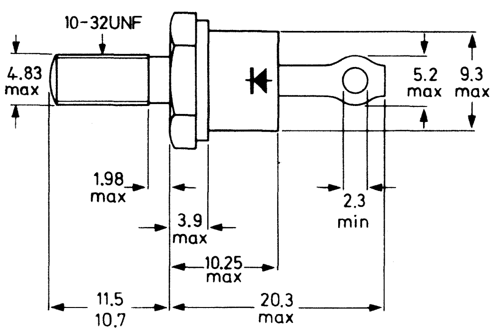
QUICK REFERENCE DATA

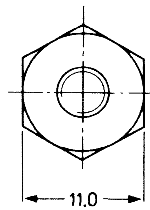
			BYX46-200(R)	300(R)	400(R)	500(R)	600(R)	
Crest working reverse voltage	V_{RWM}	max.	200	300	400	500	600	V
Reverse avalanche breakdown voltage	$V_{(BR)R}$	>	250	375	500	625	750	V
Average forward current	$I_{F(AV)}$	max.			22			A
Non-repetitive peak forward current	I_{FSM}	max.			300			A
Non-repetitive 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:
see ACCESSORIES section

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

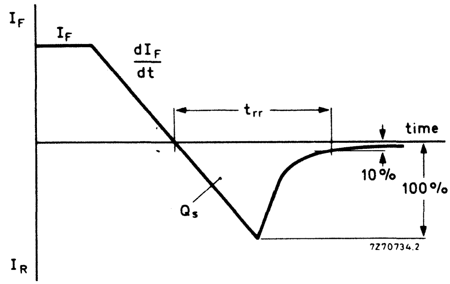
THERMAL RESISTANCE

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 p.361. 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		>	250	375	500	625	750	V
I_R = 5 mA; T_j = 25 °C	$V_{(BR)R}$	<	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 $V_R \geqslant$ 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 $V_R \geqslant$ 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 366.

* 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	^oC
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 p.361 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 p.366 (the example being based on optimum use, i.e. $T_j = 165\ ^oC$). 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 361).

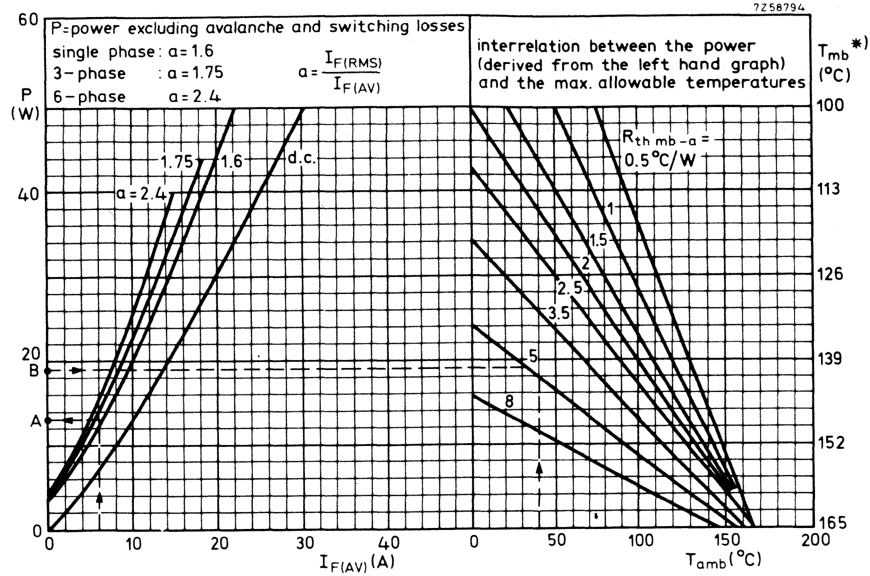
From the right hand part of the upper graph on p.361 follows the thermal resistance, required at $T_{amb} = 40\ ^oC$.

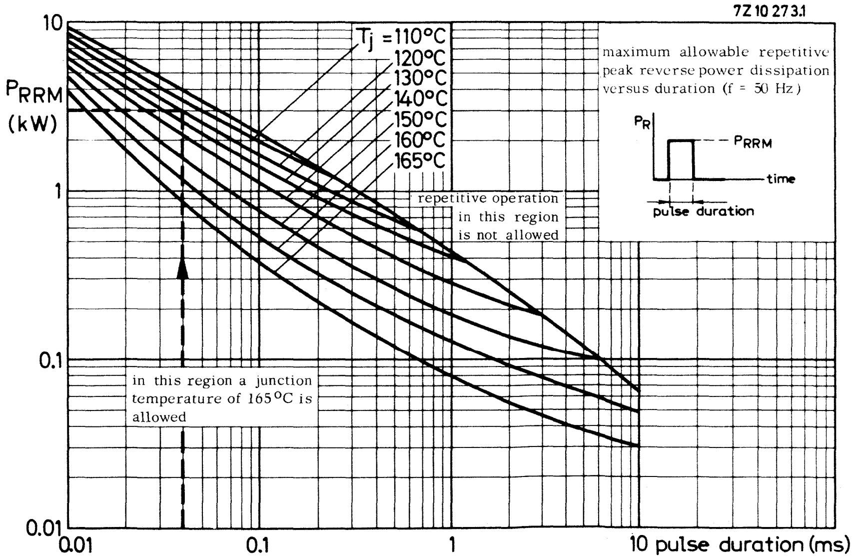
$$R_{th\ mb\text{-}a} \approx 5\ ^oC/W$$

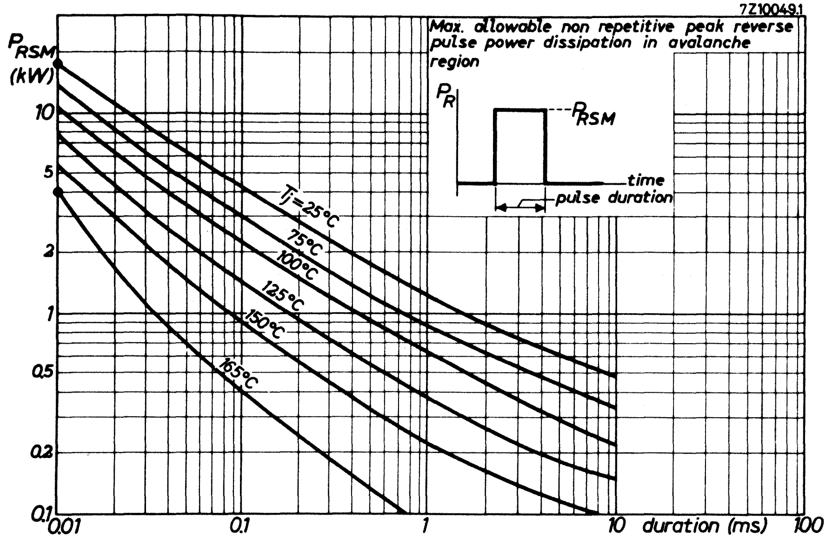
The contact thermal resistance $R_{th\ mb\text{-}h} = 0.5\ ^oC/W$.

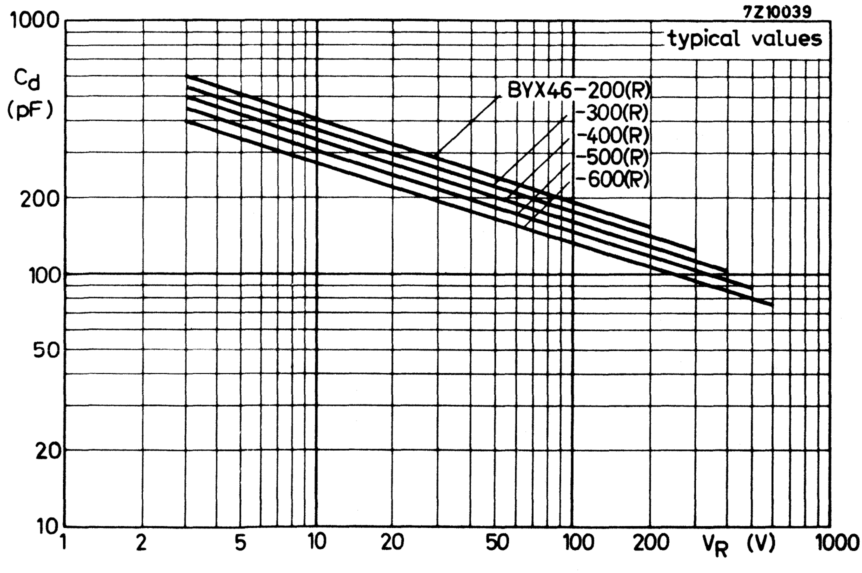
Hence the heatsink thermal resistance should be:

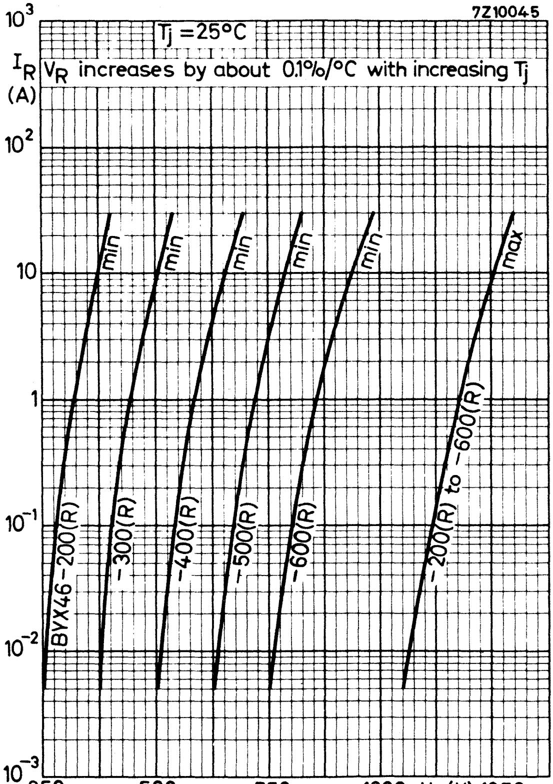
$$R_{th\ h\text{-}a} = R_{th\ mb\text{-}a} - R_{th\ mb\text{-}h} = (5 - 0.5)\ ^oC/W = 4.5\ ^oC/W.$$

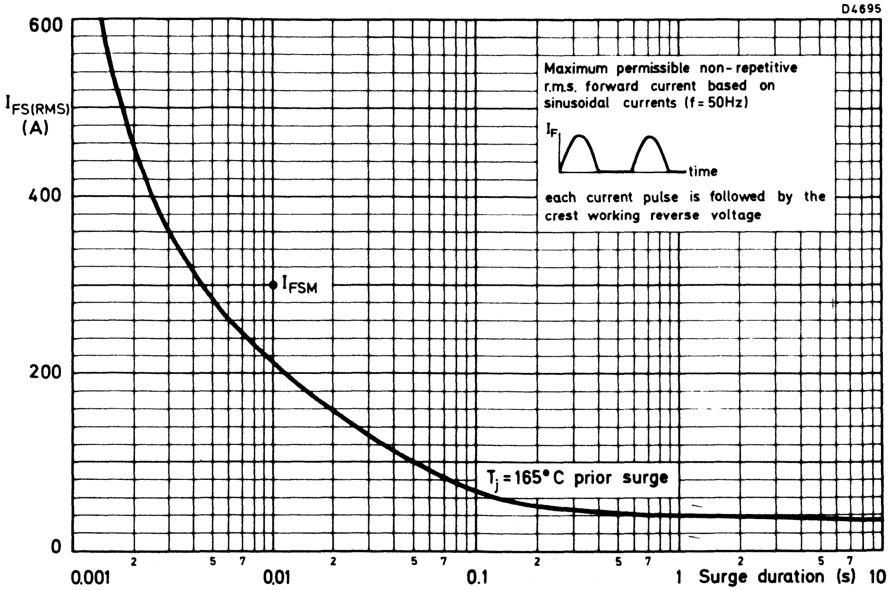

7Z58794
P=power excluding avalanche and switching losses
single phase: a = 1.6
3-phase : a = 1.75
6-phase a = 2.4
a = I_F(RMS) / I_F(AV)
P (W)
interrelation between the power (derived from the left hand graph) and the max. allowable temperatures
T_mb *) (°C)
R_th mb-a = 0.5 °C/W
1
1.5
2
2.5
3.5
5
8
a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

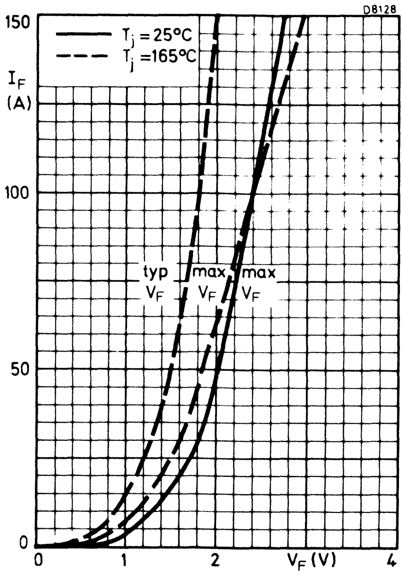

7Z10273.1
P_RRM (kW)
T_j = 110°C
120°C
130°C
140°C
150°C
160°C
165°C
maximum allowable repetitive peak reverse power dissipation versus duration (f = 50 Hz)
P_R
P_RRM
time
pulse duration
repetitive operation in this region is not allowed
in this region a junction temperature of 165 °C is allowed
pulse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

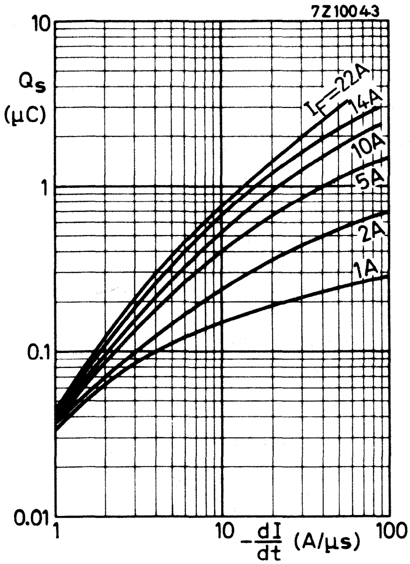

7Z10049.1
Max. allowable non repetitive peak reverse pulse power dissipation in avalanche region
P_RSM (kW)
10
5
2
1
0.5
0.2
0.1
0.01
0.1
1
10
duration (ms)
100
P_R
P_RSM
time
pulse duration
Tj=25°C
75°C
100°C
125°C
150°C
165°C

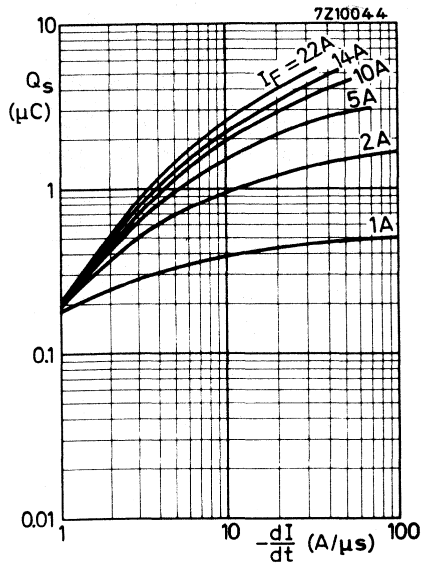

7Z10039
typical values
1000
Cd (pF)
200
100
50
20
10
1
2
5
10
20
50
100
200
V_R (V)
1000
BYX46-200(R)
-300(R)
-400(R)
-500(R)
-600(R)

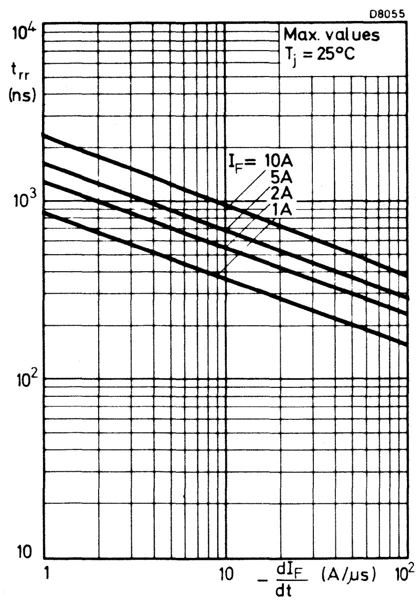

7Z10045
T_j = 25°C
I_R (A)
V_R increases by about 0.1%/°C with increasing T_j
10^3
10^2
10
1
10^{-1}
10^{-2}
10^{-3}
250
500
750
1000
V_R(V)
1250
min
min
min
min
min
max
BYX46−200(R)
−300(R)
−400(R)
−500(R)
−600(R)
−200(R) to −600(R)

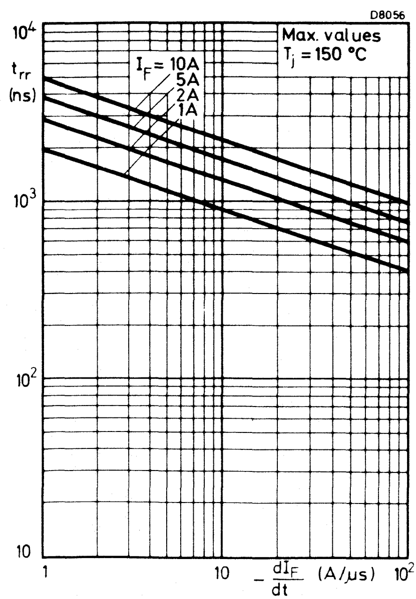

D4695
600
400
200
0
$I_{FS(RMS)}$
(A)
Maximum permissible non-repetitive r.m.s. forward current based on sinusoidal currents (f = 50Hz)
I_F
time
each current pulse is followed by the crest working reverse voltage
I_{FSM}
T_j = 165°C prior surge
0.001
0.01
0.1
1
Surge duration (s)
10

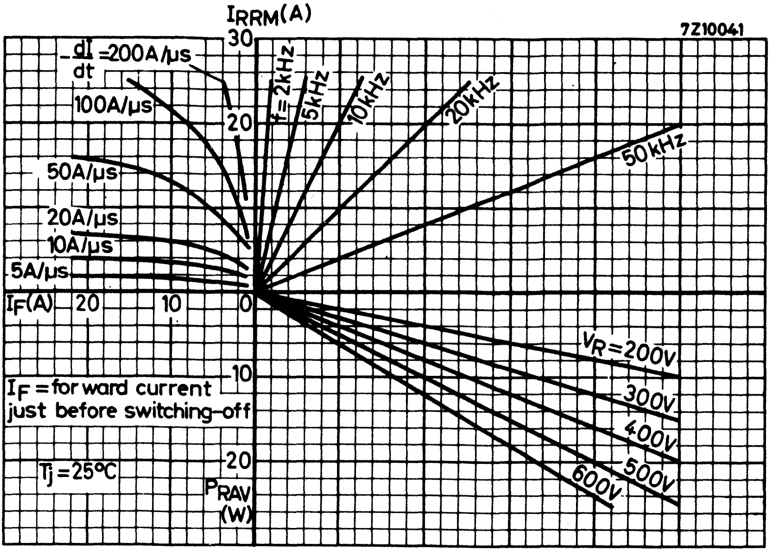

D8128
150
100
50
0
I_F
(A)
T_j = 25°C
T_j = 165°C
typ V_F
max V_F
max V_F
0
1
2
V_F (V)
4

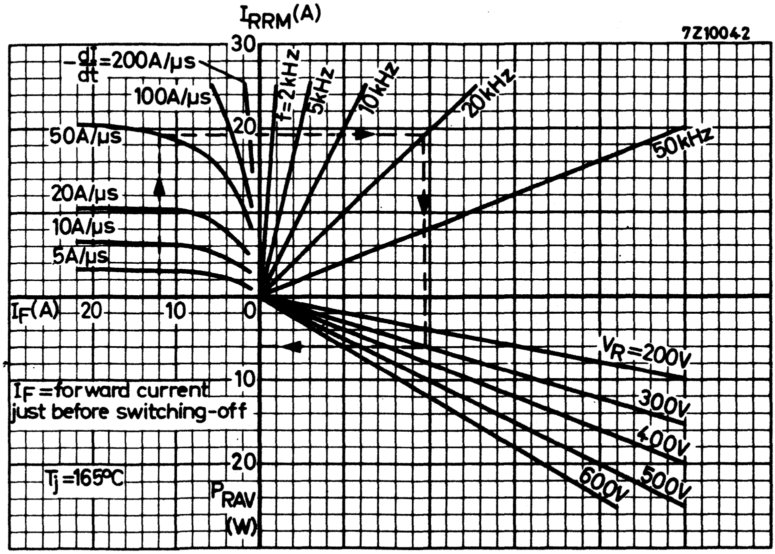

7Z10043
Qs
(μC)
IF = 22A
14A
10A
5A
2A
1A
10
1
0.1
0.01
1
10
100
-dI/dt (A/μs)


7Z10044
Qs
(μC)
IF = 22A
14A
10A
5A
2A
1A
10
1
0.1
0.01
1
10
100
-dI/dt (A/μs)

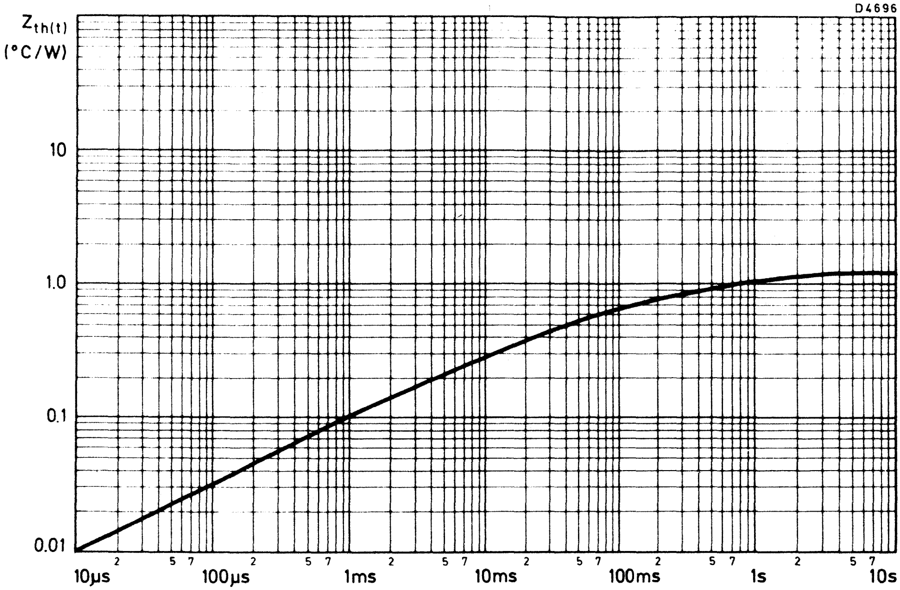

D8055
Max. values
Tj = 25°C
trr
(ns)
IF = 10A
5A
2A
1A
10^4
10^3
10^2
10
1
10
10^2
-dIF/dt (A/μs)


D8056
Max. values
Tj = 150 °C
trr
(ns)
IF = 10A
5A
2A
1A
10^4
10^3
10^2
10
1
10
10^2
-dIF/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

FAST SOFT-RECOVERY RECTIFIER DIODES

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.

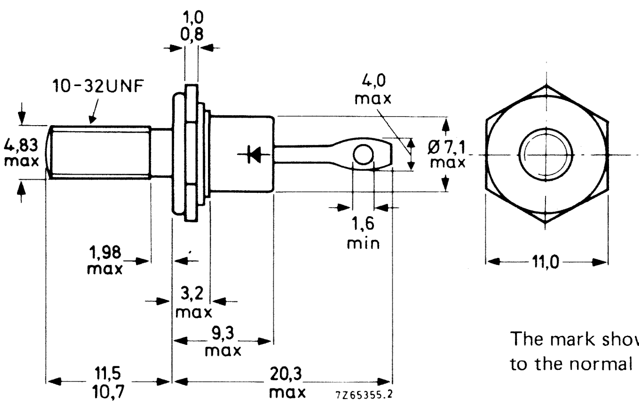
QUICK REFERENCE DATA

			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



The mark shown applies to the normal polarity types.

Net mass : 6 g
Diameter of clearance hole : max. 5.2 mm
Accessories supplied on request :
see ACCESSORIES section

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

			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

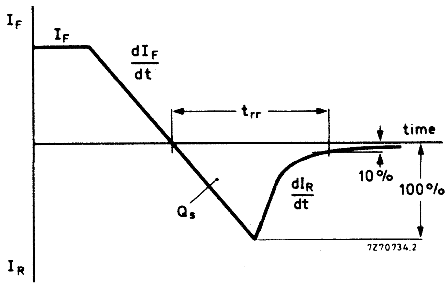
I_F = 20 A; T_j = 25 °C	V_F	<	1,95	V [1]

Reverse current

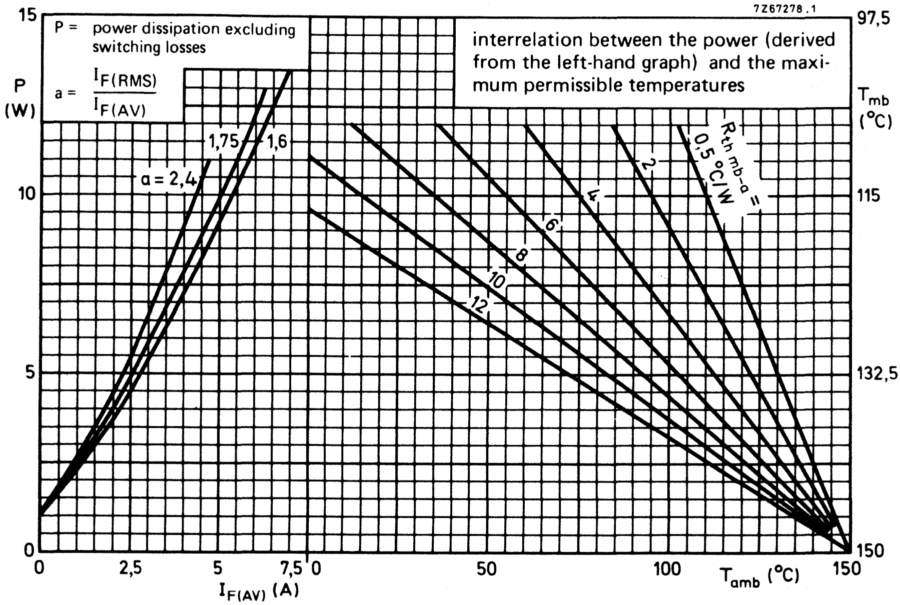
$V_R = V_{RWMmax}$; T_j = 125 °C	I_R	<	3	mA

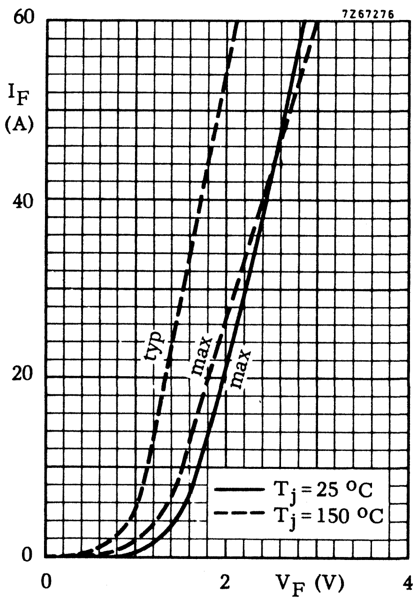
Reverse recovery when switched from

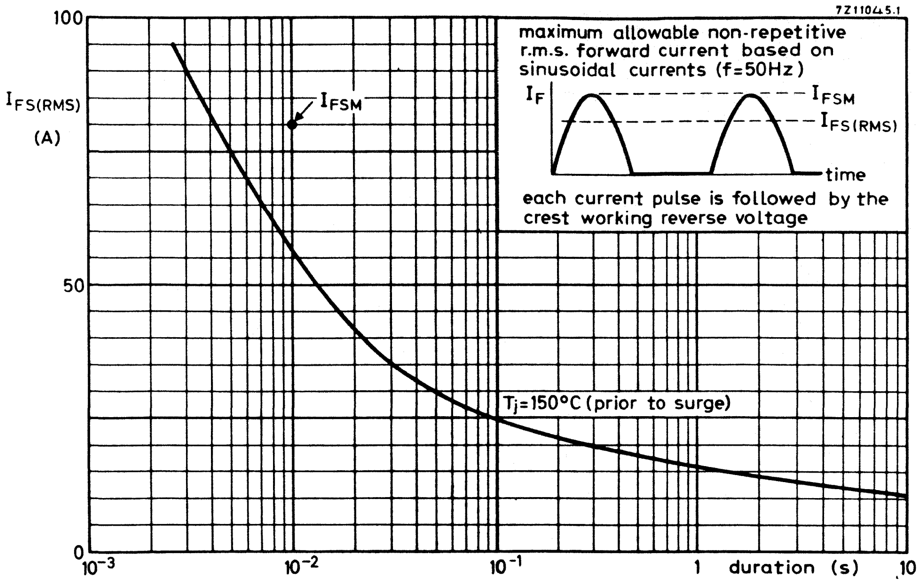
I_F = 1 A to V_R = 30 V; $-dI_F/dt$ = 100 A/µs; T_j = 25 °C Recovery time	t_{rr}	<	100	ns
I_F = 1 A to V_R = 30 V; $-dI_F/dt$ = 35 A/µs; T_j = 25 °C Recovery time	t_{rr}	<	150	ns
I_F = 2 A to V_R = 30 V; $-dI_F/dt$ = 20 A/µs; T_j = 25 °C Recovered charge	Q_s	<	250	nC
I_F = 2 A to V_R = 50 V; $-dI_F/dt$ = 2 A/µs; T_j = 25 °C Max. slope of the reverse recovery current	$\|dI_R/dt\|$	<	5	A/µs

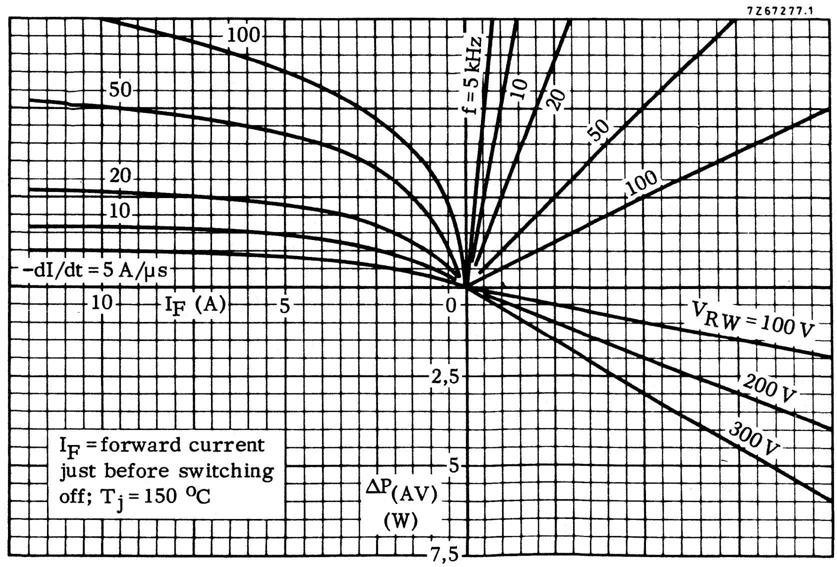


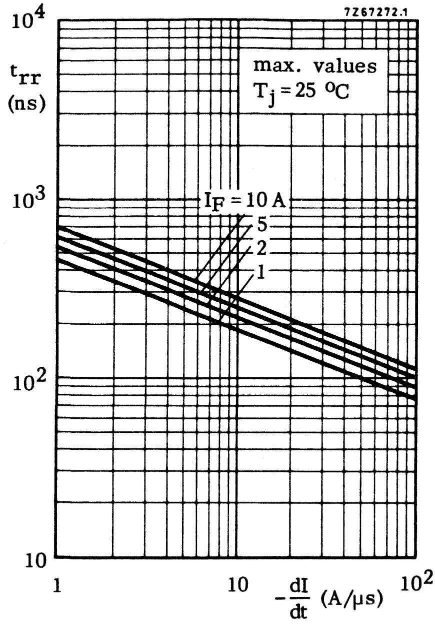
[1] Measured under pulse conditions to avoid excessive dissipation.

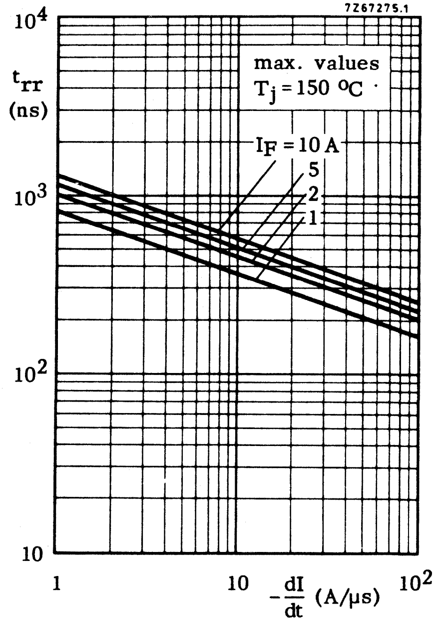

7Z67278.1
P = power dissipation excluding switching losses
a = IF(RMS) / IF(AV)
P (W)
15
10
5
0
a = 2,4
1,75
1,6
interrelation between the power (derived from the left-hand graph) and the maximum permissible temperatures
Rth mb-a = 0,5 °C/W
2
4
6
8
10
12
97,5
115
132,5
150
Tmb (°C)
0
2,5
5
7,5
IF(AV) (A)
0
50
100
150
Tamb (°C)

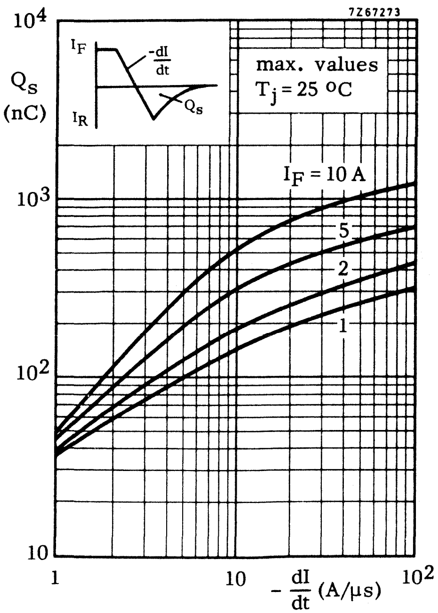

7Z67276
IF (A)
60
40
20
0
typ
max
max
Tj = 25 °C
Tj = 150 °C
0
2
4
VF (V)

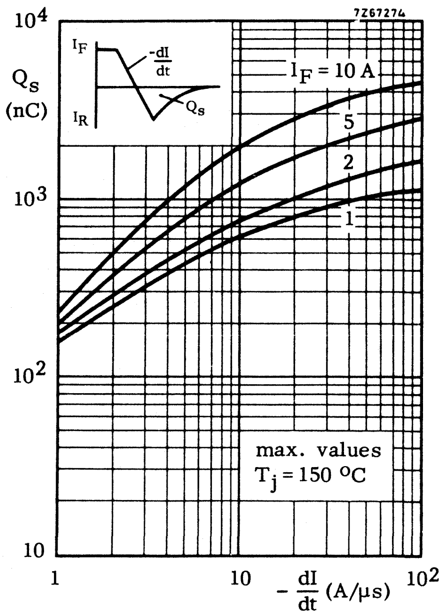

7Z11045.1
maximum allowable non-repetitive r.m.s. forward current based on sinusoidal currents (f=50Hz)
I_F
I_FSM
I_FS(RMS)
time
each current pulse is followed by the crest working reverse voltage
I_FS(RMS)
(A)
100
50
0
I_FSM
T_j=150°C (prior to surge)
10^-3
10^-2
10^-1
1
duration (s)
10

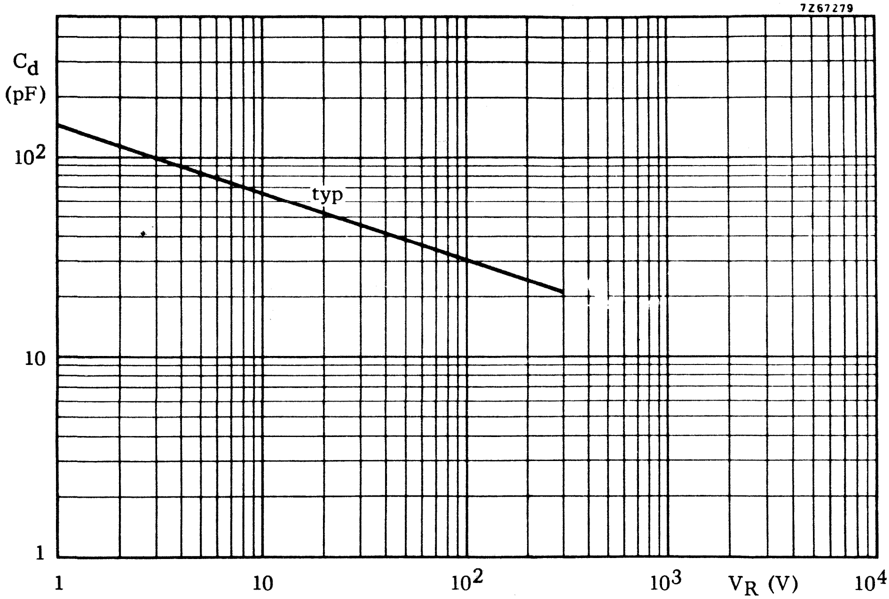

7Z67277.1
100
50
20
10
−dI/dt = 5 A/μs
f = 5 kHz
10
20
50
100
10
I_F (A)
5
0
V_RW = 100 V
200 V
300 V
2,5
5
7,5
ΔP_(AV)
(W)
I_F = forward current just before switching off; T_j = 150 °C

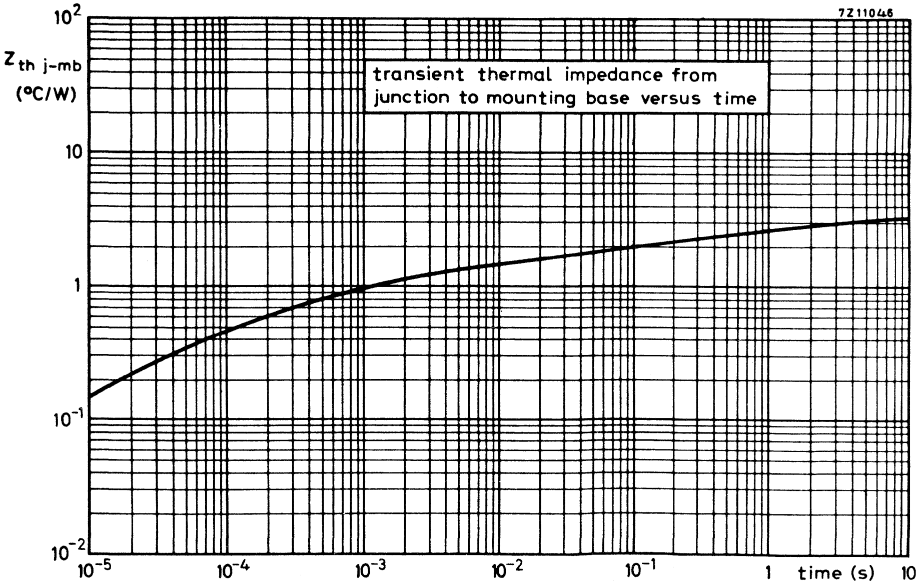

7Z67272.1
max. values
Tj = 25 °C
trr (ns)
IF = 10 A
5
2
1
- dI/dt (A/µs)


7Z67275.1
max. values
Tj = 150 °C
trr (ns)
IF = 10 A
5
2
1
- dI/dt (A/µs)


7Z67273
Qs (nC)
IF
IR
-dI/dt
Qs
max. values
Tj = 25 °C
IF = 10 A
5
2
1
- dI/dt (A/µs)


7Z67274
Qs (nC)
IF
IR
-dI/dt
Qs
IF = 10 A
5
2
1
max. values
Tj = 150 °C
- dI/dt (A/µs)


7Z67279
C_d
(pF)
10^2
10
1
typ
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

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.

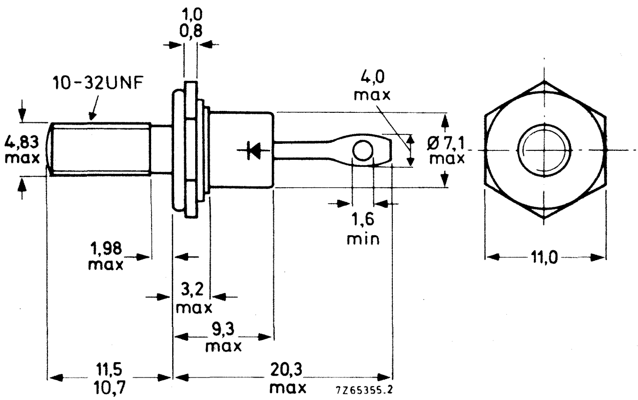
QUICK REFERENCE DATA

			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:
see ACCESSORIES section

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]

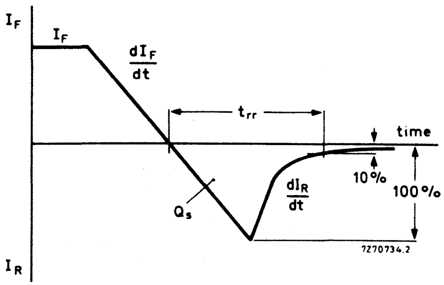
$I_F = 6$ A; $T_j = 25$ °C	V_F	<	1,4	V

Reverse current

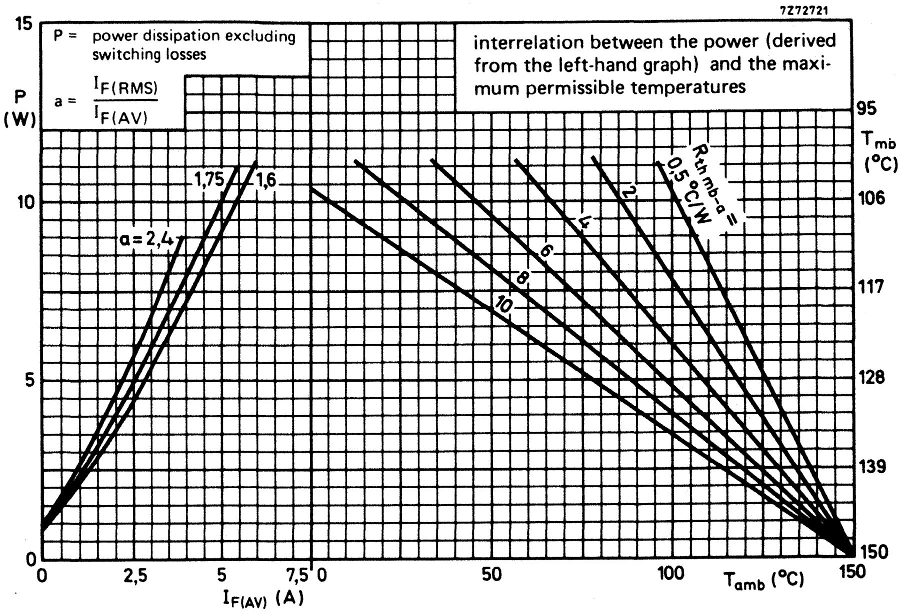
$V_R = V_{RWMmax}$; $T_j = 125$ °C	I_R	<	3	mA

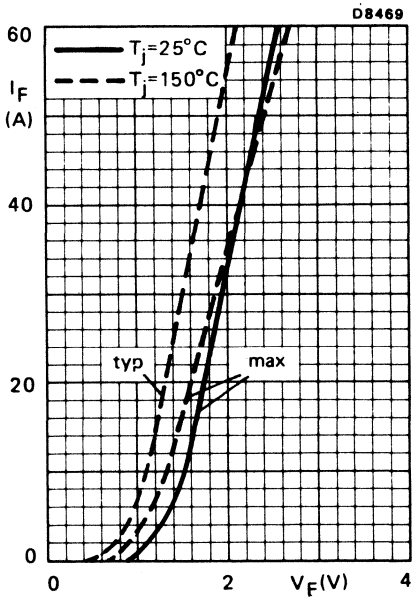
Reverse recovery when switched from

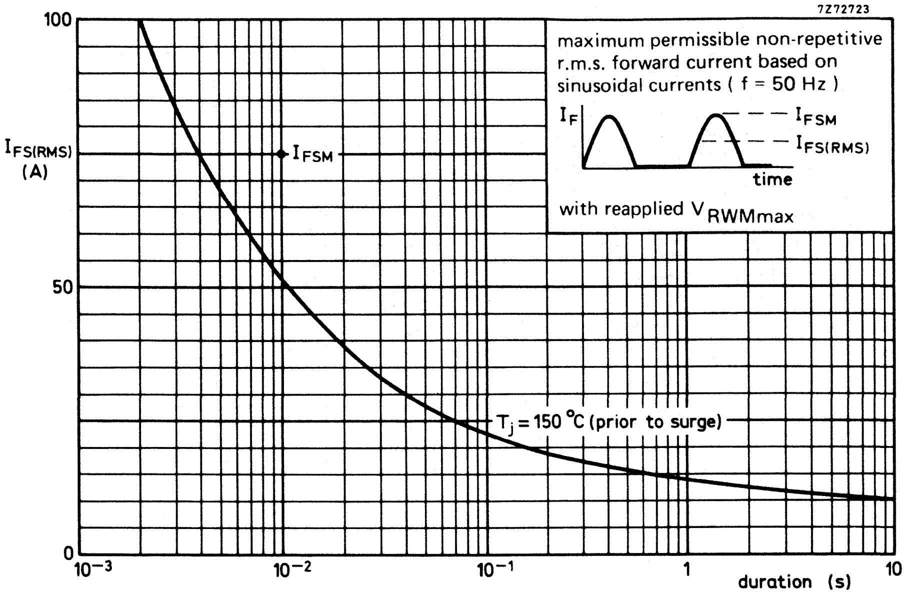
$I_F = 1$ A to $V_R = 30$ V; $-dI_F/dt = 35$ A/µs; $T_j = 25$ °C Recovery time	t_{rr}	<	200	ns
$I_F = 2$ A to $V_R = 30$ V; $-dI_F/dt = 20$ A/µs; $T_j = 25$ °C Recovery charge	Q_s	<	250	nC
$I_F = 1$ A to $V_R = 30$ V; $-dI_F/dt = 2$ A/µs; $T_j = 25$ °C Max. slope of the reverse recovery current	$\lvert dI_R/dt \rvert$	<	5	A/µs

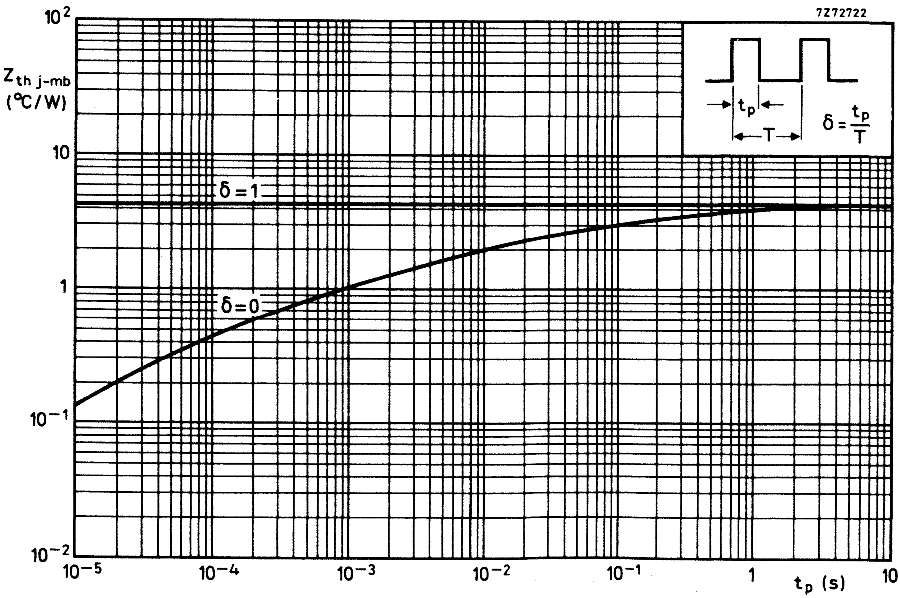


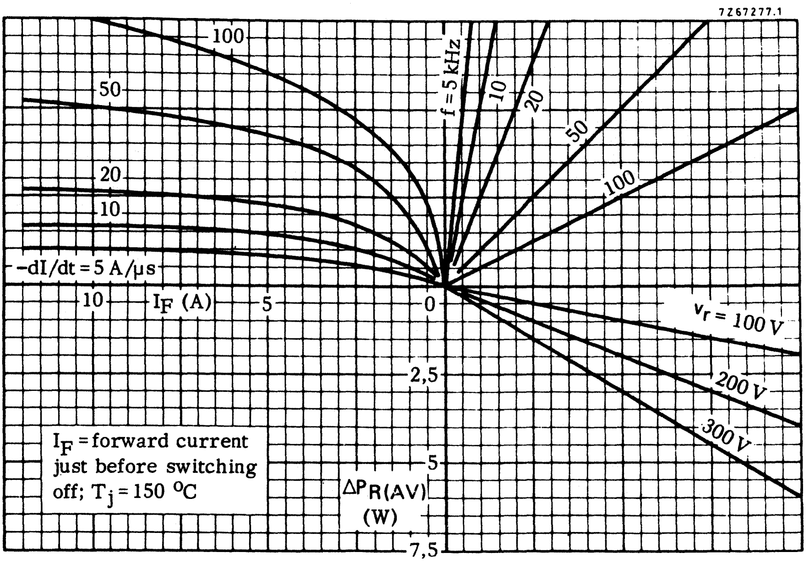
[1] Measured under pulse conditions to avoid excessive dissipation.


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
4
V_F(V)

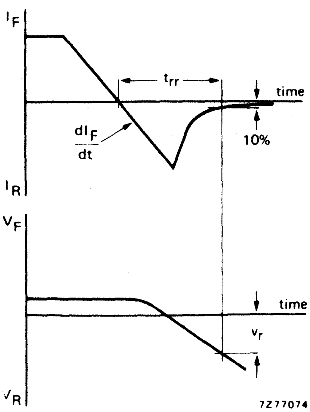

7Z72723
100
50
0
$I_{FS(RMS)}$ (A)
I_{FSM}
maximum permissible non-repetitive r.m.s. forward current based on sinusoidal currents (f = 50 Hz)
I_F
I_{FSM}
$I_{FS(RMS)}$
time
with reapplied V_{RWMmax}
T_j = 150 °C (prior to surge)
10^{-3}
10^{-2}
10^{-1}
1
10
duration (s)


7Z72722
10^2
$Z_{th\ j\text{-}mb}$ (°C/W)
10
1
10^{-1}
10^{-2}
δ = 1
δ = 0
t_p
T
$\delta = \frac{t_p}{T}$
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.

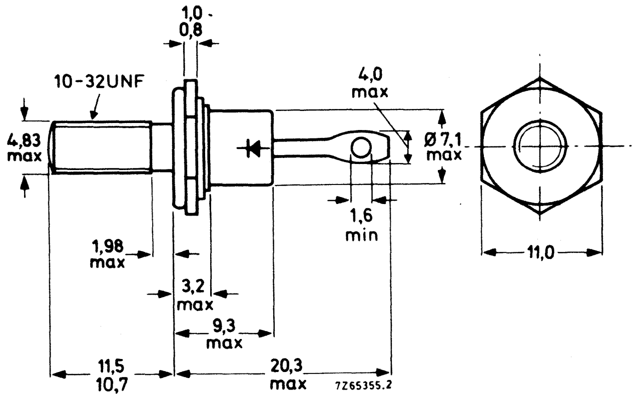
QUICK REFERENCE DATA

			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:
see ACCESSORIES section
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

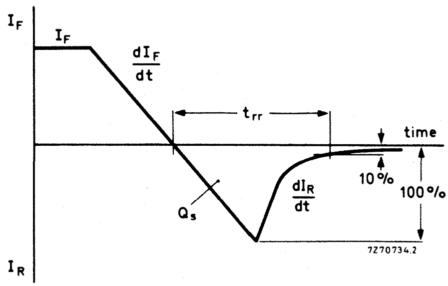
Storage temperature	T_{stg}		−65 to +175	°C
Operating junction temperature	T_j	max.	150	°C

THERMAL RESISTANCE

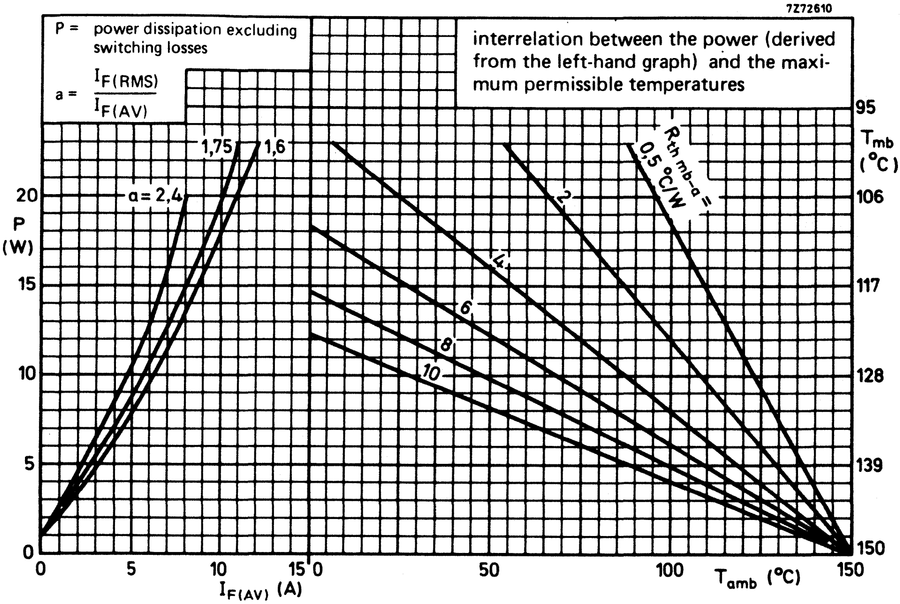
From junction to ambient in free air	$R_{th\ j-a}$	=	50	°C/W
From junction to mounting base	$R_{th\ j-mb}$	=	2,2	°C/W
From mounting base to heatsink	$R_{th\ mb-h}$	=	0,5	°C/W
Transient thermal impedance; t = 1 ms; δ = 0	$Z_{th\ j-mb}$	=	0,8	°C/W

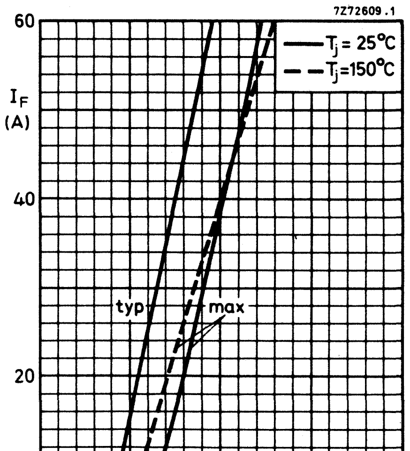
CHARACTERISTICS

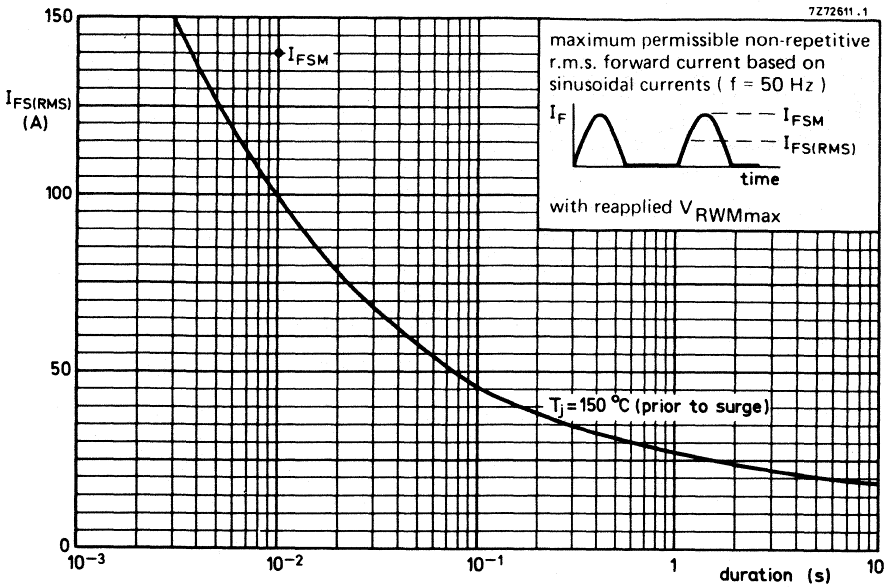
Forward voltage [1]				
I_F = 12 A; T_j = 25 °C	V_F	<	1,4	V
Reverse current				
$V_R = V_{RWMmax}$; T_j = 125 °C	I_R	<	3	mA
Reverse recovery when switched from				
I_F = 1 A to V_R = 30 V; $-dI_F/dt$ = 35 A/µs; T_j = 25 °C Recovery time	t_{rr}	<	200	ns
I_F = 2 A to V_R = 30 V; $-dI_F/dt$ = 20 A/µs; T_j = 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/µs

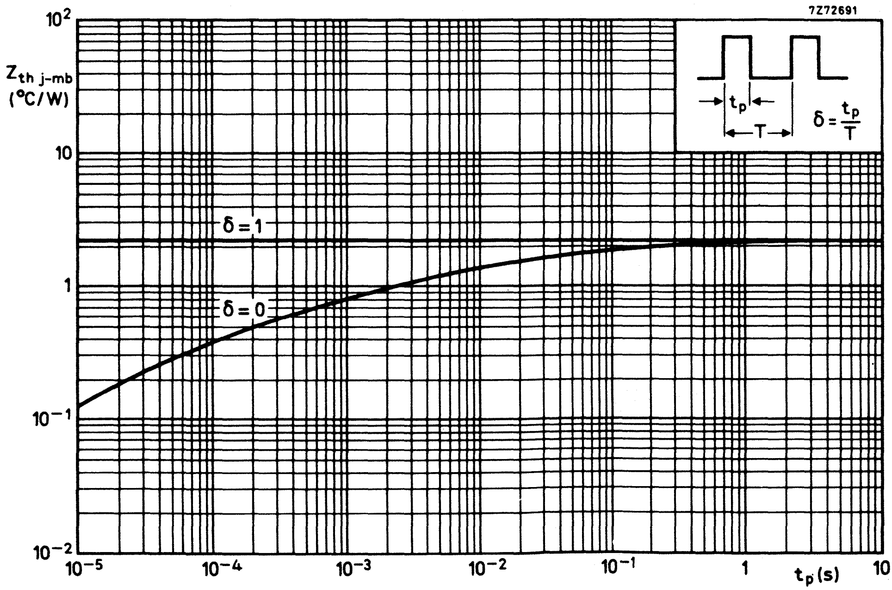


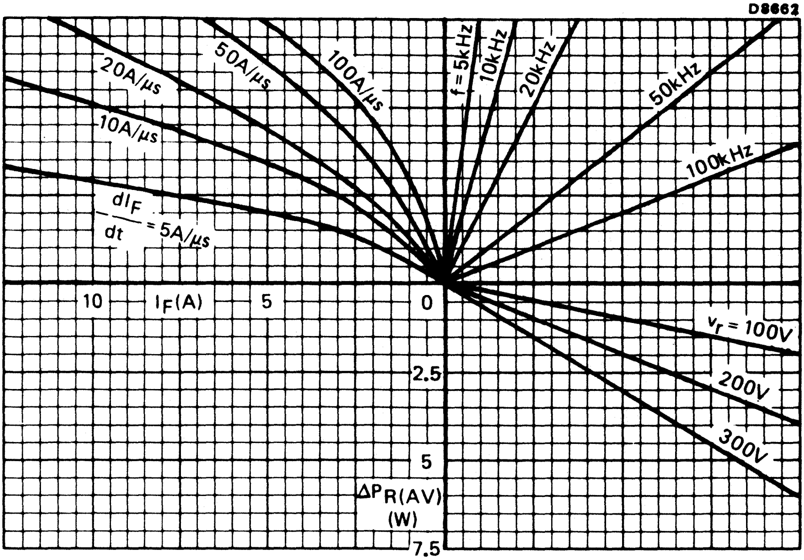
[1] Measured under pulse conditions to avoid excessive dissipation.


7Z72610
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)
$I_{F(AV)}$ (A)
a = 2,4
1,75
1,6
$R_{th\ mb-a}$ = 0,5 °C/W
2
4
6
8
10
T_{mb} (°C)
95
106
117
128
139
150
T_{amb} (°C)
0
50
100
150
0
5
10
15
20


7Z72609.1
I_F (A)
V_F (V)
T_j = 25°C
T_j = 150°C
typ
max
0
20
40
60
1
2
3
4


7Z72611.1
150
100
50
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 = 150 °C (prior to surge)
10^{-3}
10^{-2}
10^{-1}
1
duration (s)
10

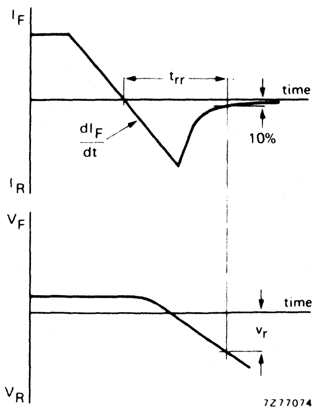

7Z72691
10^2
$Z_{th\ j\text{-}mb}$ (°C/W)
10
1
10^{-1}
10^{-2}
t_p
T
$\delta = \frac{t_p}{T}$
δ = 1
δ = 0
10^{-5}
10^{-4}
10^{-3}
10^{-2}
10^{-1}
1
t_p(s)
10



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): 1N3909, 1N3910, 1N3911, 1N3912, 1N3913.
Reverse polarity (anode to stud): 1N3909R, 1N3910R, 1N3911R, 1N3912R, 1N3913R.

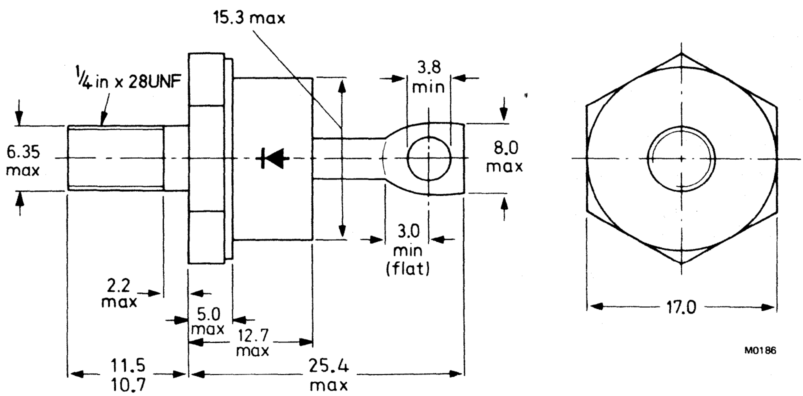
QUICK REFERENCE DATA

			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: see ACCESSORIES section

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

The mark shown applies to normal polarity types.

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 ($\delta \leq 0.01$)	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.	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

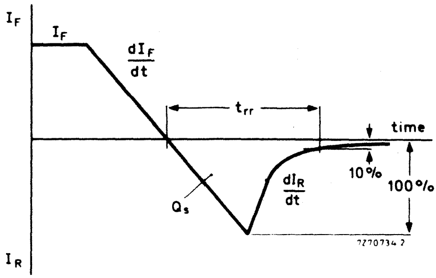
Storage temperature	T_{stg}		−65 to 175	°C
Operating junction temperature	T_j	max.	150	°C

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 $V_R \geqslant 30$ 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

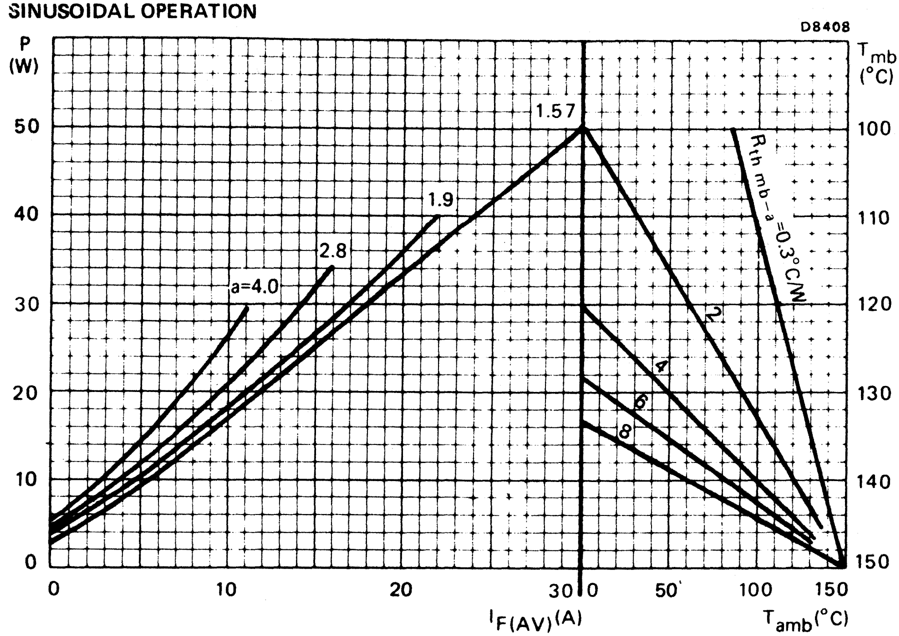


Fig. 3 The right-hand part shows the interrelationship between the power (derived from the left-hand part) and the maximum permissible temperatures.
P = power dissipation excluding switching losses.
a = form factor = $I_{F(RMS)}/I_{F(AV)}$.

SQUARE-WAVE OPERATION

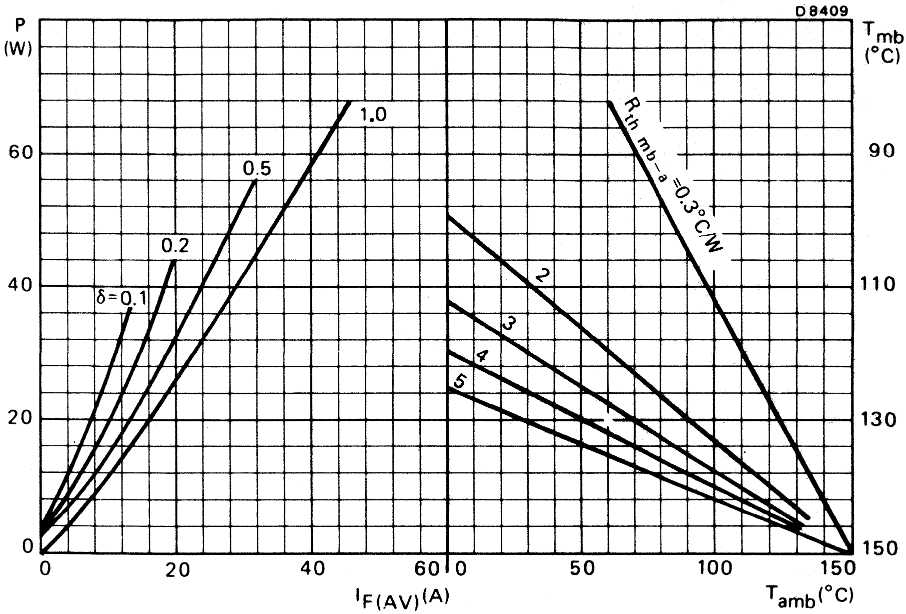
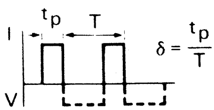


Fig. 4 The right-hand part shows the interrelationship between the power (derived from the left-hand part) and the maximum permissible temperatures.
P = power dissipation excluding switching losses.



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

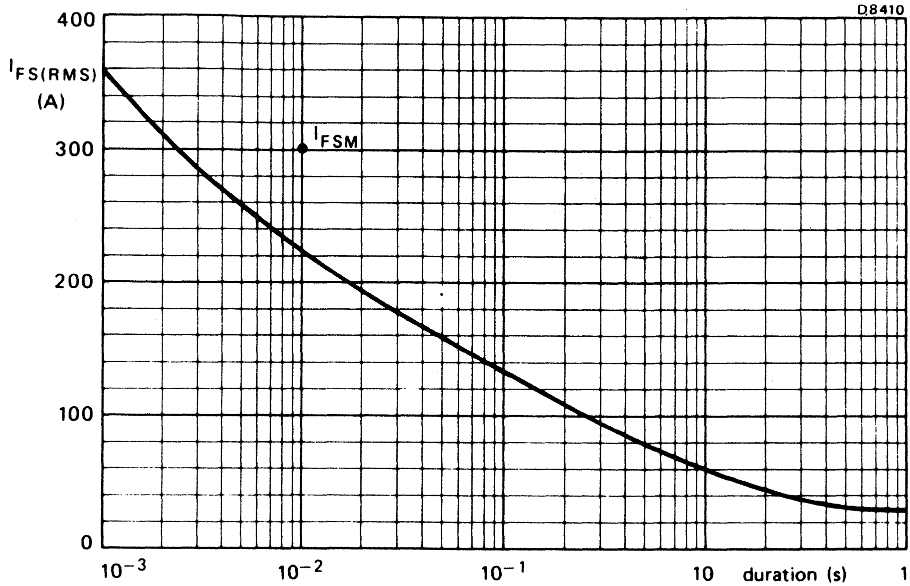
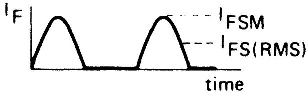


Fig.5 Maximum permissible non-repetitive r.m.s. forward current based on sinusoidal currents (f = 50 Hz); T_j = 150 °C prior to surge; with reapplied V_{RWMmax}.



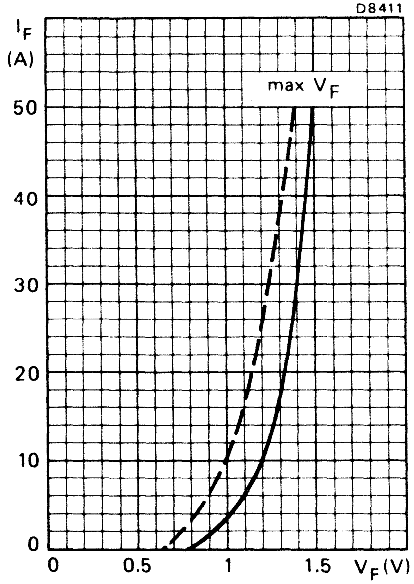


Fig. 6 —— T_j = 25 °C; – – – T_j = 150 °C

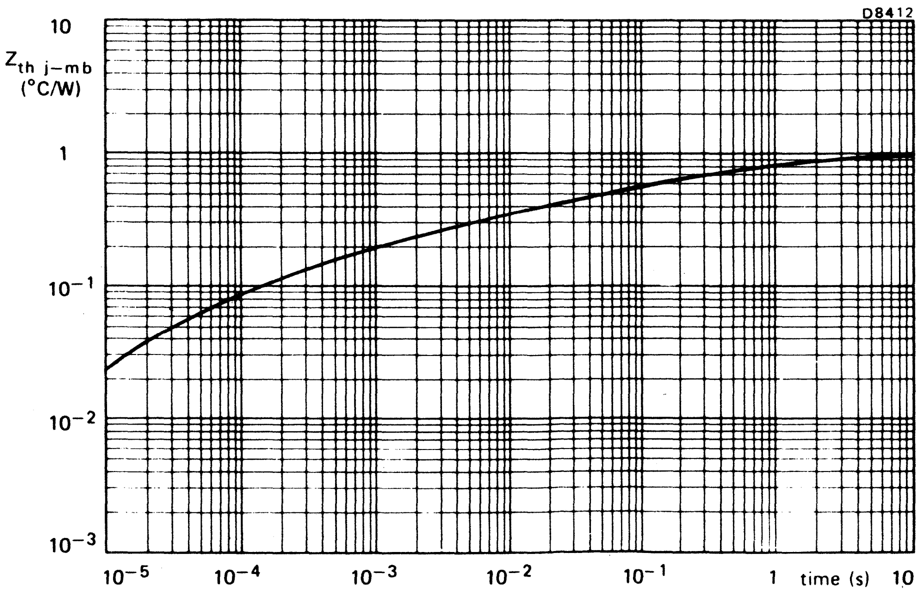


Fig. 7

SCHOTTKY RECTIFIER DIODES

SCHOTTKY–BARRIER RECTIFIER DIODES

High-efficiency rectifier diodes in TO-220AC plastic 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. They can also withstand reverse voltage transients.
The series consists of normal polarity (cathode to mounting base) types.
A version with guaranteed reverse surge capability, BYV19–40A, is also available.

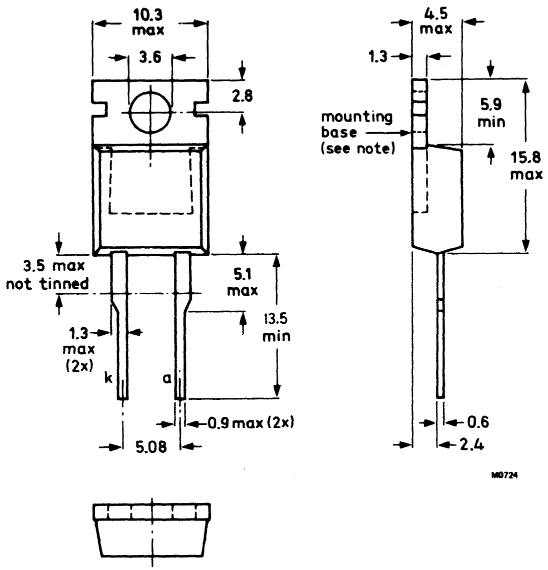
QUICK REFERENCE DATA

			BYV19–30	35	40(A)	45	
Repetitive peak reverse voltage	V_{RRM}	max.	30	35	40	45	V
Average forward current	$I_{F(AV)}$	max.		10			A
Forward voltage	V_F	<		0.6			V
Junction temperature	T_j	max.		150			°C

MECHANICAL DATA

Dimensions in mm

Fig.1 TO-220AC



Note: The exposed metal mounting base is directly connected to 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 (IEC134).

→ **Voltages**

			BYV19–30	35	40(A)	45	
Repetitive peak reverse voltage	V_{RRM}	max.	30	35	40	45	V
Crest working reverse voltage (note 1)	V_{RWM}	max.	20	25	30	35	V
Continuous reverse voltage (note 1)	V_R	max.	20	25	30	35	V

Currents

Average forward current square-wave; $\delta = 0.5$; up to $T_{mb} = 97\ ^oC$	$I_{F(AV)}$	max.	10	A
R.M.S. forward current	$I_{F(RMS)}$	max.	14	A
Non-repetitive peak forward current t = 10 ms; half sine-wave; $T_j = 125\ ^oC$ prior to surge; with reapplied V_{RWMmax}	I_{FSM}	max.	150	A
I^2t for fusing	I^2t	max.	112	A^2s
→ Reverse surge current ($t_p = 100\ \mu s$); (note 2)	I_{RSM}	max.	0.5	A

Temperatures

Storage temperature	T_{stg}		−40 to +150	^oC
Junction temperature	T_j	max.	150	^oC

CHARACTERISTICS

Forward voltage				
$I_F = 5$ A; $T_j = 100\ ^oC$ (note 3)	V_F	<	0.6	V
$I_F = 20$ A; $T_j = 25\ ^oC$ (note 3)	V_F	<	1.10	V
Reverse current				
$V_R = V_{RWMmax}$; $T_j = 125\ ^oC$	I_R	<	20	mA
Capacitance at f = 1 MHz				
$V_R = 5$ V; $T_j = 25$ to $125\ ^oC$	C_d	typ.	200	pF

Notes

1. Up to $T_j = 125\ ^oC$; see derating curve (Fig.5) for higher temperature operation.
2. BYV19–40A only.
3. Measured under pulse conditions to avoid excessive dissipation.

THERMAL RESISTANCE

From junction to mounting base	$R_{th\ j\text{-}mb}$	= 2.7	K/W
Transient thermal impedance; t = 1 ms	$Z_{th\ j\text{-}mb}$	= 0.8	K/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	K/W
b. with heatsink compound and 0.06 mm maximum mica insulator	$R_{th\ mb\text{-}h}$	= 1.4	K/W
c. with heatsink compound and 0.1 mm maximum mica insulator (56369)	$R_{th\ mb\text{-}h}$	= 2.2	K/W
d. with heatsink compound and 0.25 mm maximum alumina insulator (56367)	$R_{th\ mb\text{-}h}$	= 0.8	K/W
e. without heatsink compound	$R_{th\ mb\text{-}h}$	= 1.4	K/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 K/W

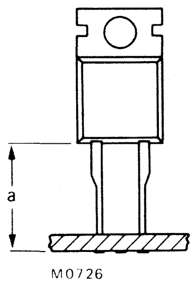


Fig.2

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 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. 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.

OPERATING NOTES

Dissipation and heatsink considerations:

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

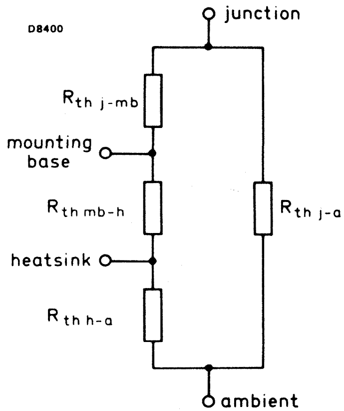


Fig.3

b. The method of using Fig.4 is as follows:
Starting with the required current on the $I_{F(AV)}$ axis, trace upwards to meet the appropriate duty cycle 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.

SQUARE-WAVE OPERATION

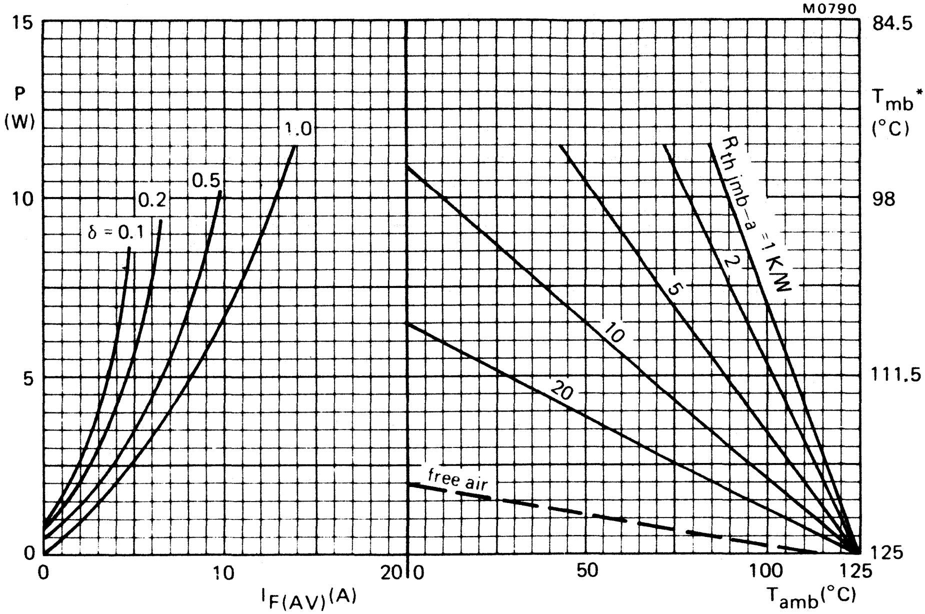
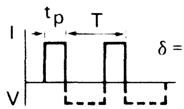


Fig.4 The right-hand part shows the interrelationship between the power (derived from the left-hand part) and the maximum permissible temperatures.



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

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

*T_{mb} scale is for comparison purposes and is correct only for $R_{th\ mb\text{-}a} < 15$ K/W.

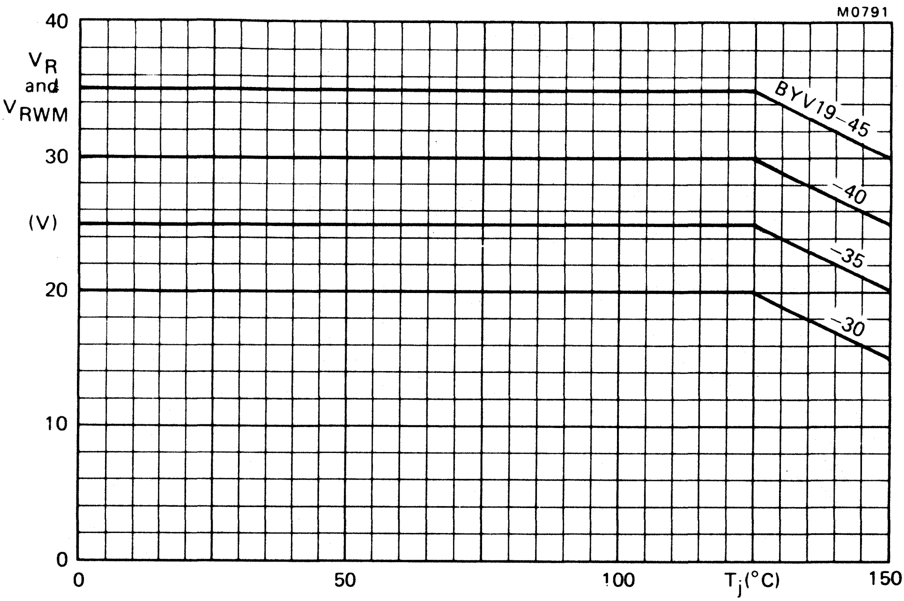


Fig.5 The maximum permissible continuous and crest working reverse voltage as a function of junction temperature.

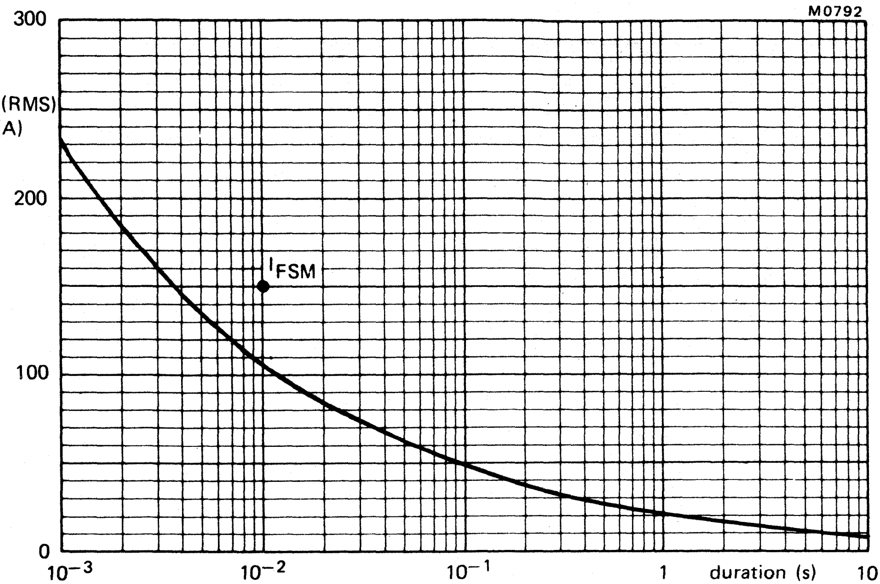
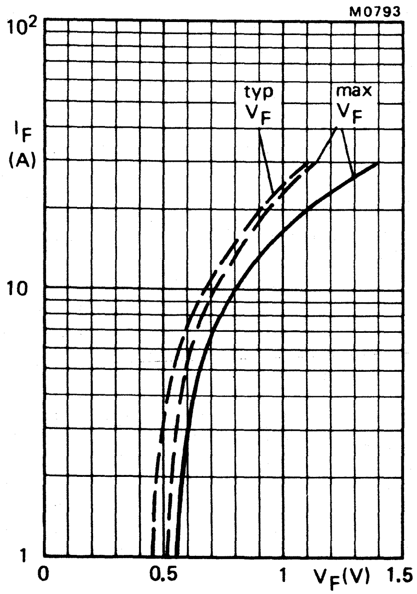


Fig.6 Maximum permissible non-repetitive r.m.s. forward current based on sinusoidal currents (f = 50 Hz); T_j = 125 °C prior to surge; with reapplied V_{RWMmax}.



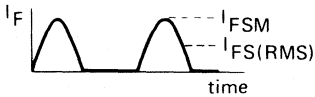


Fig.7 —— T_j = 25 °C; – – – T_j = 100 °C

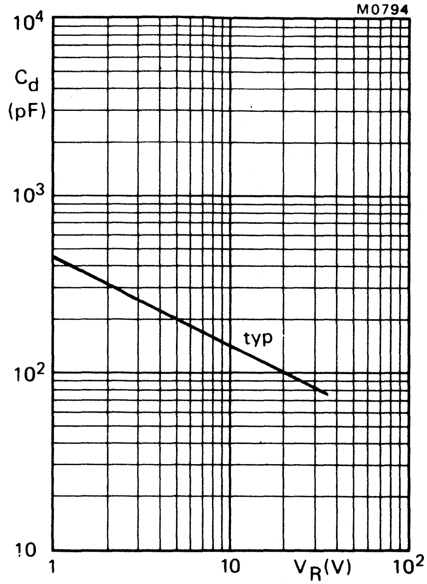


Fig.8 f = 1 MHz; T_j = 25 to 125 ^oC

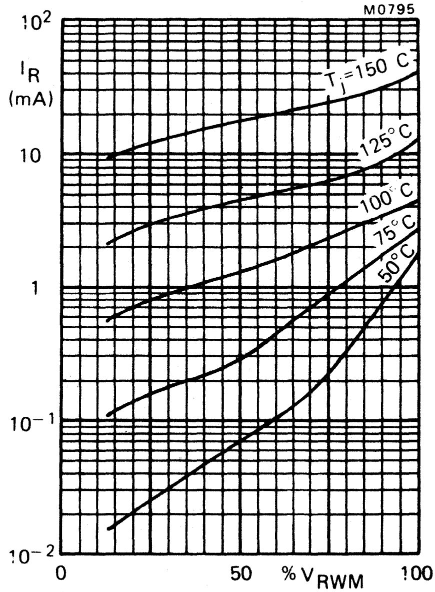


Fig.9 Typical values.

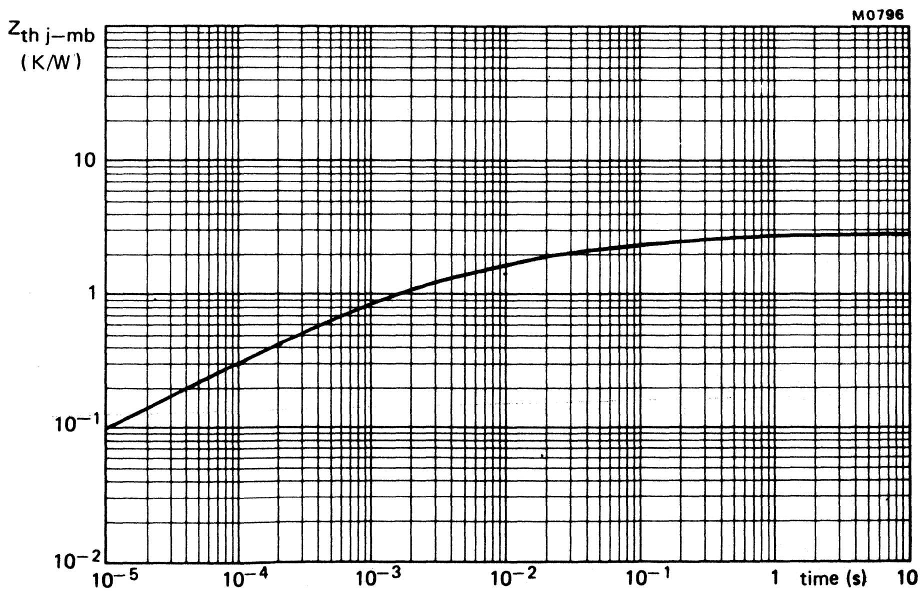


Fig.10

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. They can also withstand reverse voltage transients. The series consists of normal polarity (cathode to stud) types.
A version with guaranteed reverse surge capability, BYV20–40A, is also available.

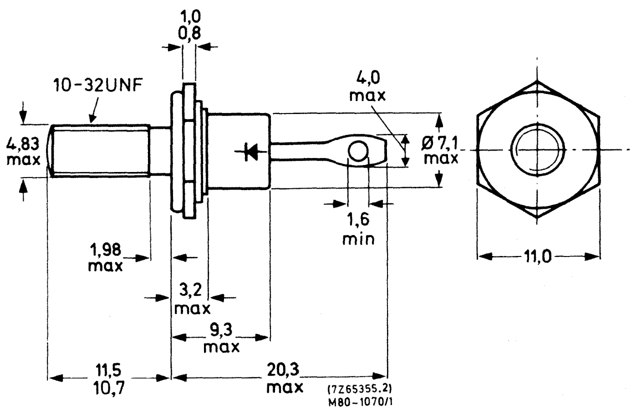
QUICK REFERENCE DATA

			BYV20–30	35	40(A)	45	
Repetitive peak reverse voltage	V_{RRM}	max.	30	35	40	45	V
Average forward current	$I_{F(AV)}$	max.		15			A
Forward voltage	V_F	<		0.6			V
Junction temperature	T_j	max.		150			°C

MECHANICAL DATA

Dimensions in mm

Fig.1 DO–4 with 10–32 UNF stud (ϕ4.83 mm)
Types with metric M5 stud (ϕ 5 mm) are available on request; e.g. BYV20–30M.



Supplied with device: 1 nut, 1 lock washer

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

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

Net mass: 6 g

Diameter of clearance hole: 5.2 mm

Accessories supplied on request:
see ACCESSORIES section

Products approved to CECC 50 009-033 available on request

RATINGS

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

→ **Voltages**

			BYV20–30	35	40(A)	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} = 110 °C	$I_{F(AV)}$	max.	12.5	A
square-wave; up to T_{mb} = 107 °C; $\delta = 0.5$	$I_{F(AV)}$	max.	15	A
R.M.S. forward current	$I_{F(RMS)}$	max.	21	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.	300	A
I^2t for fusing (t = 10 ms)	I^2t	max.	450	A^2s
→ Reverse surge current (t_p = 100 μs)**	I_{RSM}	max.	1.0	A

Temperatures

Storage temperature	T_{stg}		–55 to +150	°C
Junction temperature see also Figs.3 and 5	T_j	max.	150	°C

THERMAL RESISTANCE

From junction to mounting base	$R_{th\ j\text{-}mb}$	=	2.2	K/W
From mounting base to heatsink with heatsink compound	$R_{th\ mb\text{-}h}$	=	0.5	K/W

MOUNTING INSTRUCTIONS

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.

** BYV20–40A only.

CHARACTERISTICS

Forward voltage				
$I_F = 15$ A; $T_j = 100$ °C	V_F	<	0.6	V*
$I_F = 40$ A; $T_j = 25$ °C	V_F	<	1.0	V*
Reverse current				
$V_R = V_{RWMmax}$; $T_j = 125$ °C	I_R	<	70	mA
Capacitance at f = 1 MHz				
$V_R = 5$ V; $T_j = 25$ to 125 °C	C_d	typ.	520	pF

*Measured under pulse conditions to avoid excessive dissipation.

OPERATING NOTES

Dissipation and heatsink calculations

The various components of junction temperature rise above ambient are shown below:

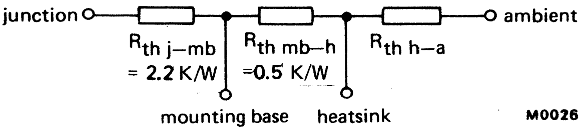


Fig.2

Overall thermal resistance $R_{th\ j\text{-}a} = R_{th\ j\text{-}mb} + R_{th\ mb\text{-}h} + R_{th\ h\text{-}a}$

To choose a suitable heatsink, the following information is required:

(i) Maximum operating ambient temperature
(ii) Duty-cycle or form-factor of forward current (δ or a)
(iii) Average forward current per diode (square or sine-wave)
(iv) Crest working reverse voltage (V_{RWM})

The total power dissipation in the diode has two components:

P_R — reverse leakage dissipation
P_F — forward conduction dissipation

$$P_{tot} = P_R + P_F \quad \ldots\ldots 1)$$

From the above, it can be seen that:

$$R_{th\ h\text{-}a} = \frac{T_{j\ max} - T_{amb}}{P_R + P_F} - (R_{th\ j\text{-}mb} + R_{th\ mb\text{-}h}) \quad \ldots\ldots 2)$$

values for $R_{th\ j\text{-}mb}$ and $R_{th\ mb\text{-}h}$ can be found under Thermal Resistance.

P_R and P_F are derived from Figs.3 and 4 for square-wave operation (and Figs.5 and 6 for sine-wave) as follows:

Starting at the bottom left-hand axis of Fig.3 (or Fig.5), for a particular duty-cycle (or form-factor), δ (or a), trace vertically upwards to meet the required V_{RWM} line. From this point, trace horizontally across to the right-hand $T_{j\ max}$ lines, the resulting reverse leakage power (P_R) at the chosen $T_{j\ max}$ can be read by tracing vertically downwards to the horizontal axis.

Forward conduction dissipation (P_F) for the known average current $I_{F(AV)}$ and duty-cycle (or form-factor) is easily derived from Fig.4 (or Fig.6).

These derived figures for P_R and P_F can now be substituted in equation 2) to calculate the required heatsink.

EXAMPLE: Square-wave operation, using BYV20—30 and heatsink compound;
$T_{amb} = 50\ ^oC$; $\delta = 0.5$; $I_{F(AV)} = 10$ A; $V_{RWM} = 20$ V;
from data, $R_{th\ j\text{-}mb} = 2.2$ K/W and $R_{th\ mb\text{-}h} = 0.5$ K/W;

from Fig.4, it is found that $P_F = 7$ W.

If the desired $T_{j\ max}$ is chosen to be 135 ^oC, then P_R becomes 1 W, leading to:

$$R_{th\ h\text{-}a} = \frac{135\ ^oC - 50\ ^oC}{7\ W + 1\ W} - (2.2\ K/W + 0.5\ K/W) = 7.9\ K/W$$

NOTE: To ensure thermal stability, the overall thermal resistance ($R_{th\ j\text{-}a}$) x P_R must be less than 12 ^oC. If the calculated value of $R_{th\ h\text{-}a}$ does not permit this, then it must be reduced (heatsink size increased) to enable this criterion to be met.

SQUARE-WAVE OPERATION (Figs 3 and 4)

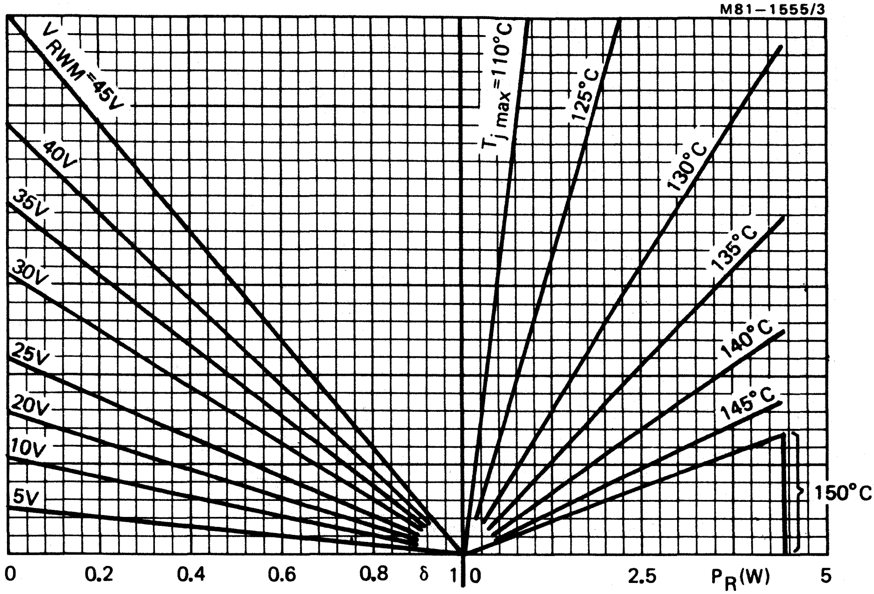


Fig.3 Maximum permissible junction temperature as a function of crest working reverse voltage and duty cycle of forward conduction.

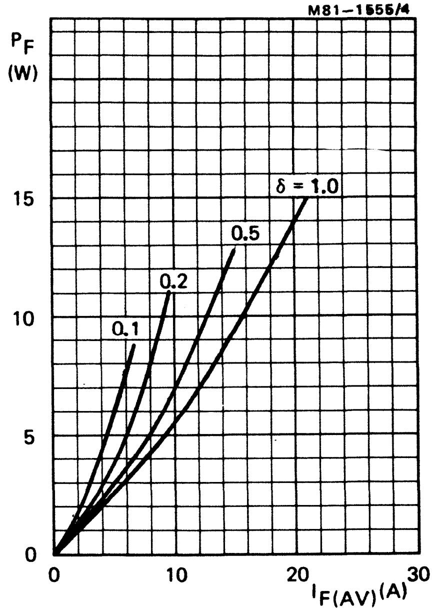
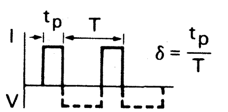


Fig.4



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

SINE-WAVE OPERATION (Figs. 5 and 6)

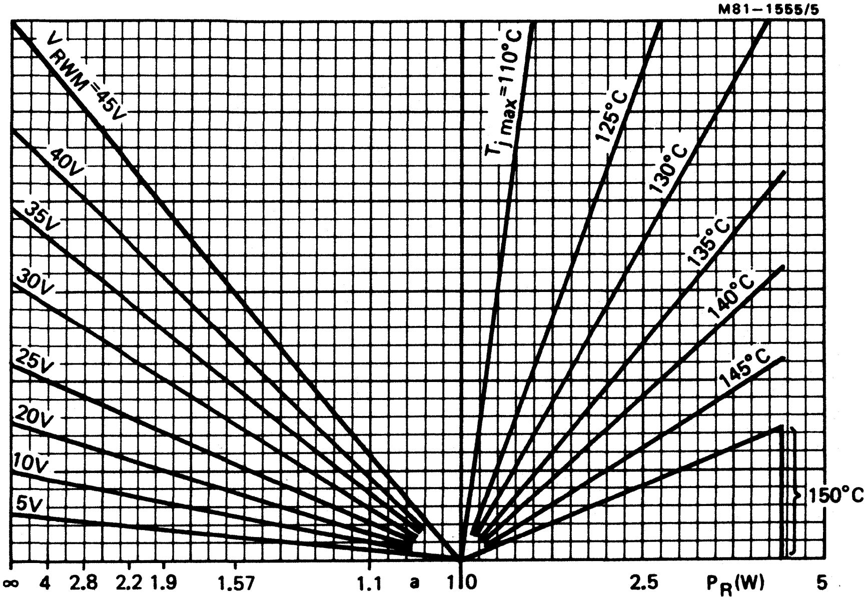


Fig.5 Maximum permissible junction temperature as a function of crest working reverse voltage and form factor of forward conduction. a = form factor = $I_{F(RMS)}/I_{F(AV)}$.

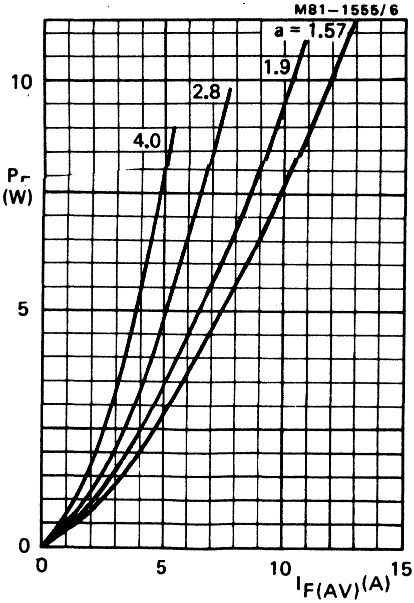


Fig.6

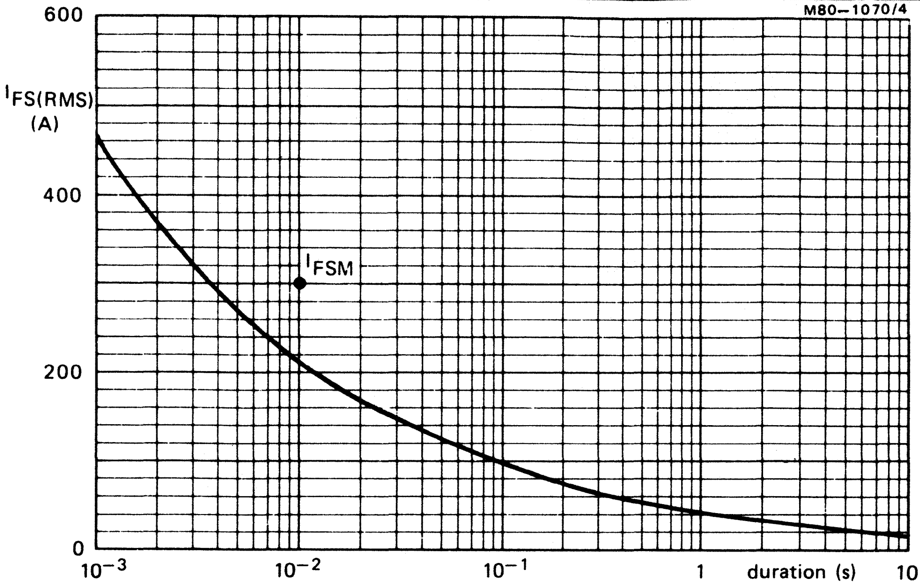
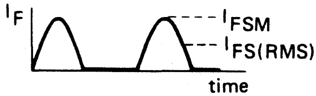


Fig.7 Maximum permissible non-repetitive r.m.s. forward current based on sinusoidal currents (f = 50 Hz); T_j = 125 °C prior to surge; with reapplied V_{RWMmax}.



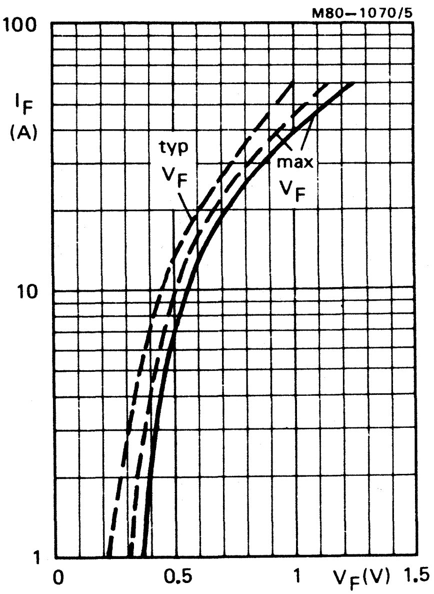


Fig.8 ——— T_j = 25 °C; — — — T_j = 100 °C

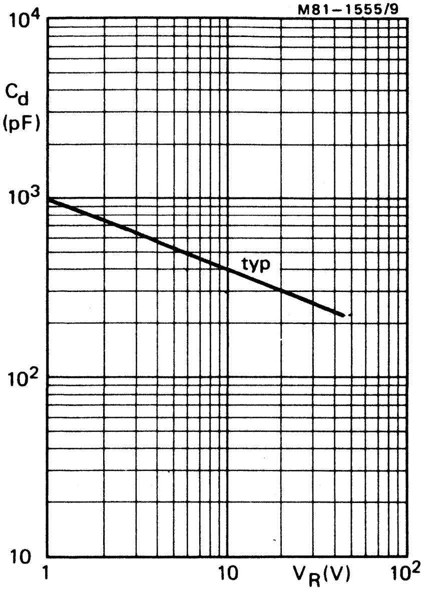


Fig.9 f = 1 MHz; T_j = 25 to 125 °C

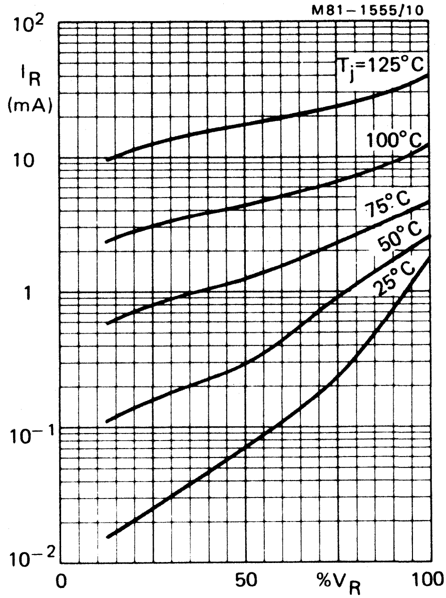


Fig.10 Typical values

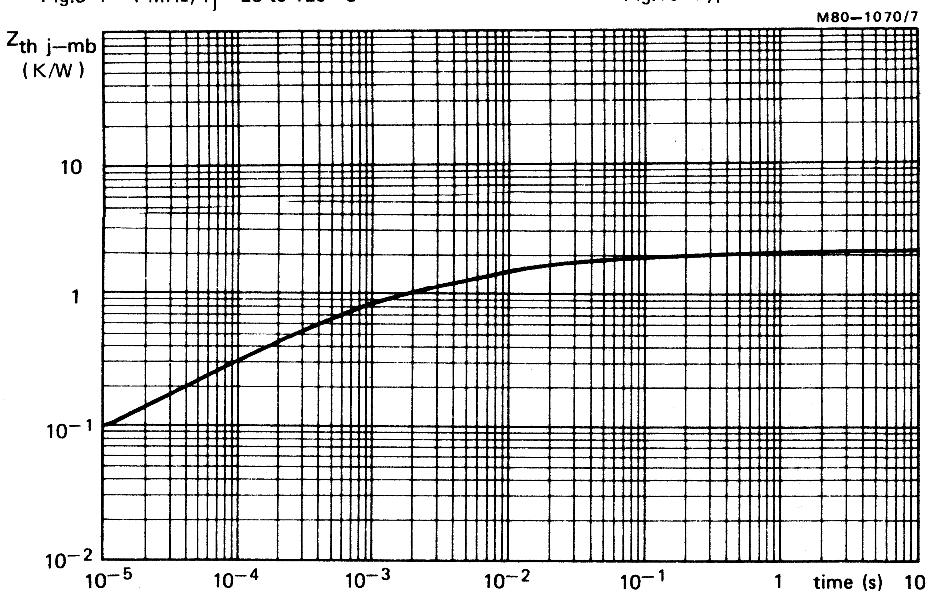


Fig.11

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. They can also withstand reverse voltage transients. The series consists of normal polarity (cathode to stud) types.
A version with guaranteed reverse surge capability, BYV21–40A, is also available.

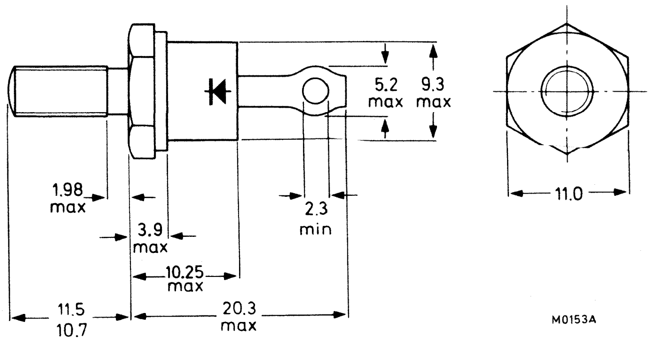
QUICK REFERENCE DATA

			BYV21–30	35	40(A)	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
Junction temperature	T_j	max.	150				°C

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, e.g. BYV21–30M.



Net mass: 7 g

Diameter of clearance hole: 5.2 mm

Accessories supplied on request:
see ACCESSORIES section

Supplied with device: 1 nut, 1 lock washer.
Torque on nut:
min. 0.9 Nm (9 kg cm),
max. 1.7 Nm (17 kg cm).
Nut dimensions across the flats:
10–32 UNF, 9.5 mm; M5, 8.0 mm.

Products approved to CECC 50 009–018 available on request.

RATINGS

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

→ **Voltages**

			BYV21–30	35	40(A)	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 (t = 10 ms)	I^2t	max.	1800	A^2s
→ Reverse surge current (t_p = 100 μs)**	I_{RSM}	max.	1.0	A

Temperatures

Storage temperature	T_{stg}		−55 to +150	°C
Junction temperature; see also Figs.3 and 5	T_j	max.	150	°C

THERMAL RESISTANCE

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

** BYV21–40A only.

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.	1150	pF

*Measured under pulse conditions to avoid excessive dissipation.

OPERATING NOTES

Dissipation and heatsink calculations

The various components of junction temperature rise above ambient are shown below:

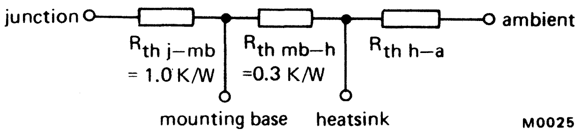


Fig.2

Overall thermal resistance $R_{th\ j\text{-}a} = R_{th\ j\text{-}mb} + R_{th\ mb\text{-}h} + R_{th\ h\text{-}a}$

To choose a suitable heatsink, the following information is required:

(i) Maximum operating ambient temperature
(ii) Duty-cycle or form-factor of forward current (δ or a)
(iii) Average forward current per diode (square or sine-wave)
(iv) Crest working reverse voltage (V_{RWM})

The total power dissipation in the diode has two components:

P_R — reverse leakage dissipation
P_F — forward conduction dissipation

$$P_{tot} = P_R + P_F \quad \text{.......... 1)}$$

From the above, it can be seen that:

$$R_{th\ h\text{-}a} = \frac{T_{j\ max} - T_{amb}}{P_R + P_F} - (R_{th\ j\text{-}mb} + R_{th\ mb\text{-}h}) \quad \text{.......... 2)}$$

values for $R_{th\ j\text{-}mb}$ and $R_{th\ mb\text{-}h}$ can be found under Thermal Resistance.

P_R and P_F are derived from Figs.3 and 4 for square-wave operation (and Figs.5 and 6 for sine-wave) as follows:

Starting at the bottom left-hand axis of Fig.3 (or Fig.5), for a particular duty-cycle (or form-factor), δ (or a), trace vertically upwards to meet the required V_{RWM} line. From this point, trace horizontally across to the right-hand $T_{j\ max}$ lines, the resulting reverse leakage power (P_R) at the chosen $T_{j\ max}$ can be read by tracing vertically downwards to the horizontal axis.
Forward conduction dissipation (P_F) for the known average current $I_{F(AV)}$ and duty-cycle (or form-factor) is easily derived from Fig.4 (or Fig.6).
These derived figures for P_R and P_F can now be substituted in equation 2) to calculate the required heatsink.

EXAMPLE: Square-wave operation, using BYV21—30 and heatsink compound;

$T_{amb} = 50\ ^oC$; $\delta = 0.5$; $I_{F(AV)} = 20$ A; $V_{RWM} = 20$ V;

from data, $R_{th\ j\text{-}mb} = 1.0$ K/W and $R_{th\ mb\text{-}h} = 0.3$ K/W ;

from Fig.4, it is found that $P_F = 14$ W.
If the desired $T_{j\ max}$ is chosen to be 140 °C, then P_R becomes 2 W, leading to:

$$R_{th\ h\text{-}a} = \frac{140\ ^oC - 50\ ^oC}{14\ W + 2\ W} - (1.0\ K/W + 0.3\ K/W) = 4.3\ K/W.$$

NOTE: To ensure thermal stability, the overall thermal resistance ($R_{th\ j\text{-}a}$) x P_R must be less than 12 °C. If the calculated value of $R_{th\ h\text{-}a}$ does not permit this, then it must be reduced (heatsink size increased) to enable this criterion to be met.

SQUARE-WAVE OPERATION (Figs. 3 and 4)

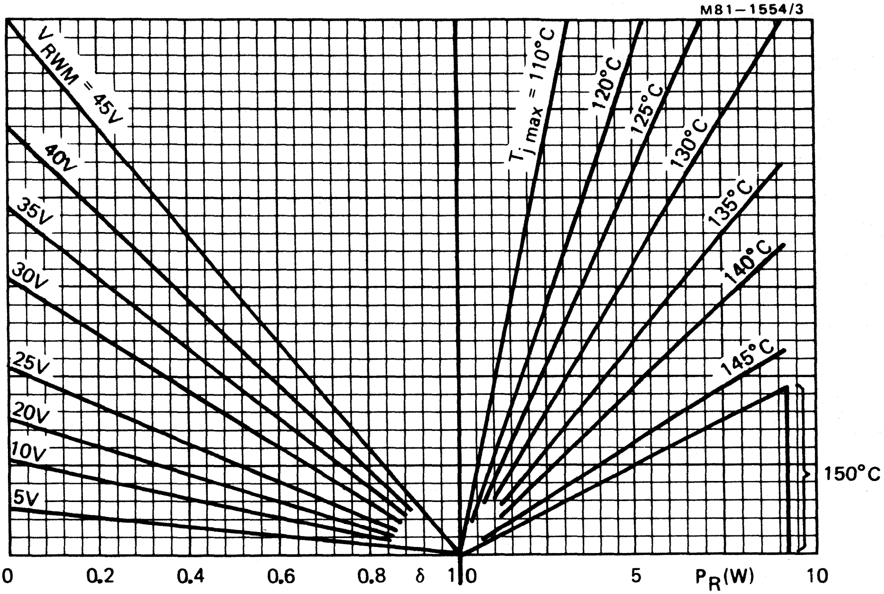


Fig.3 Maximum permissible junction temperature as a function of crest working reverse voltage and duty cycle of forward conduction.

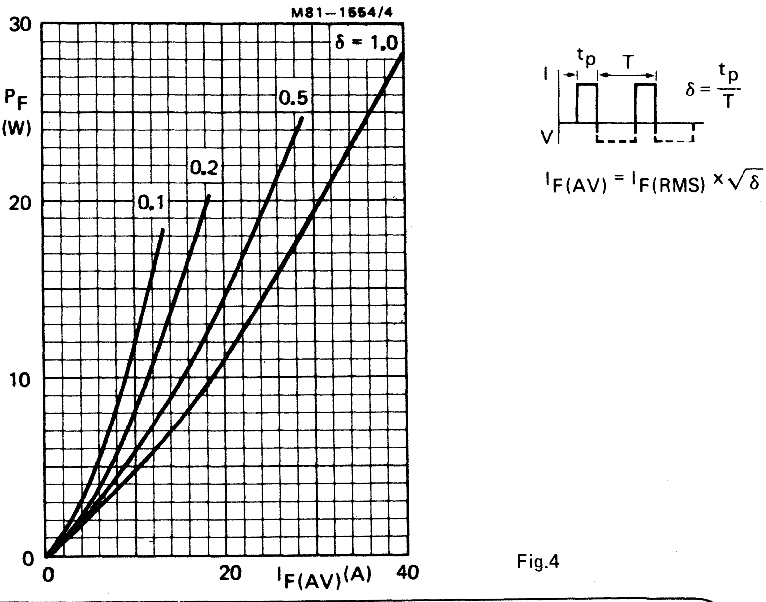


Fig.4

SINE-WAVE OPERATION (Figs. 5 and 6)

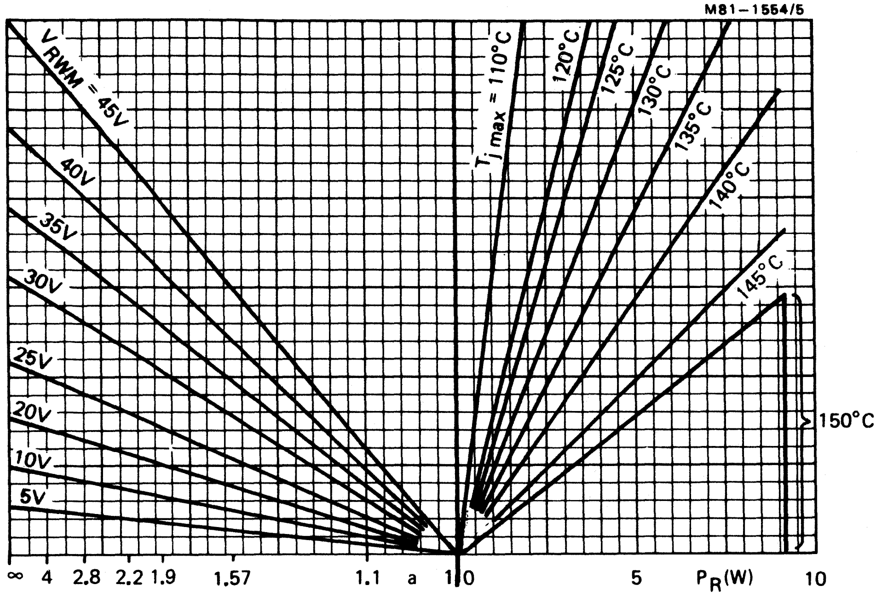


Fig.5 Maximum permissible junction temperature as a function of crest working reverse voltage and form factor of forward conduction.
a = form factor = $I_{F(RMS)}/I_{F(AV)}$.

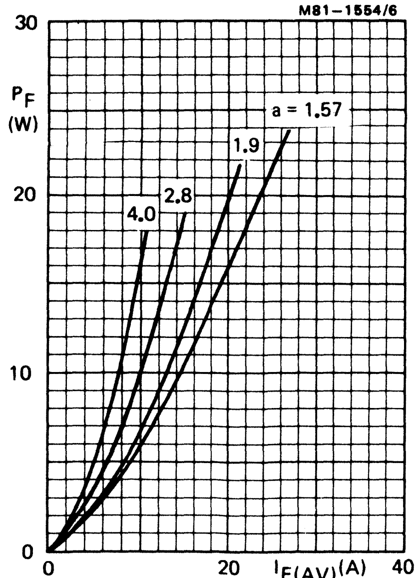


Fig.6

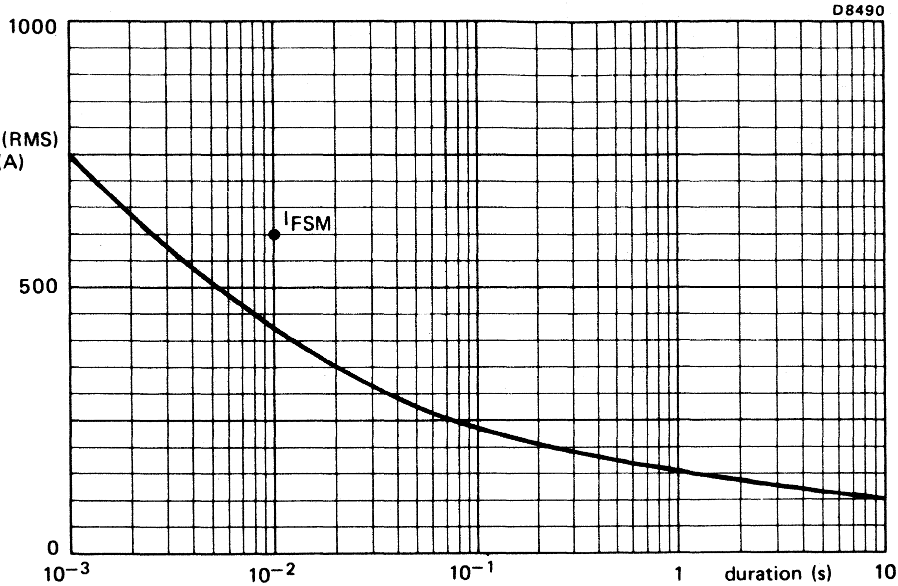


Fig.7 Maximum permissible non-repetitive r.m.s. forward current based on sinusoidal currents (f = 50 Hz); T_j = 125 °C prior to surge; with reapplied V_{RWMmax}.

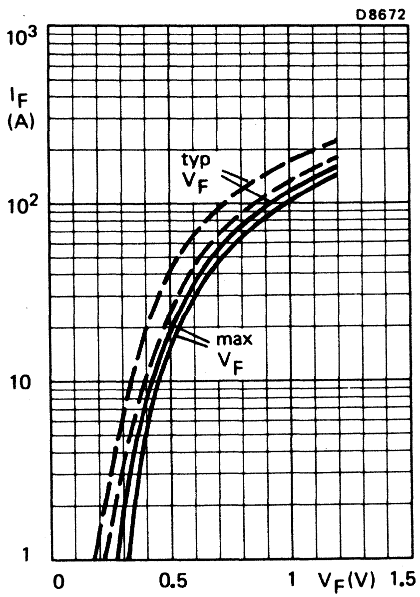


Fig.8 ——— T_j = 25 °C; – – – T_j = 100 °C.

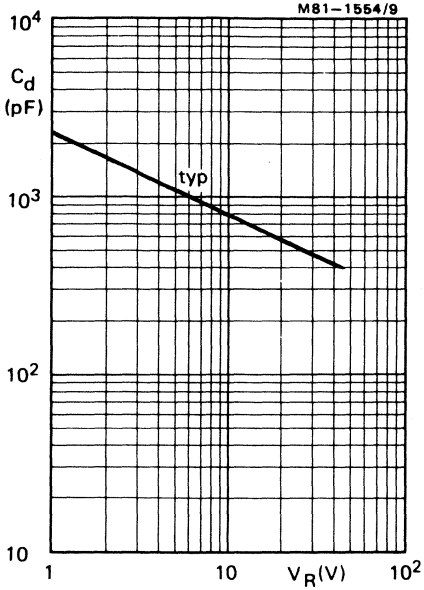


Fig.9 f = 1 MHz; T_j = 25 to 125 °C

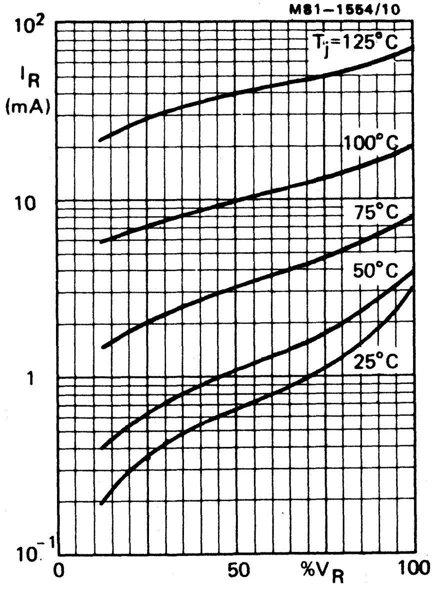


Fig.10 Typical values

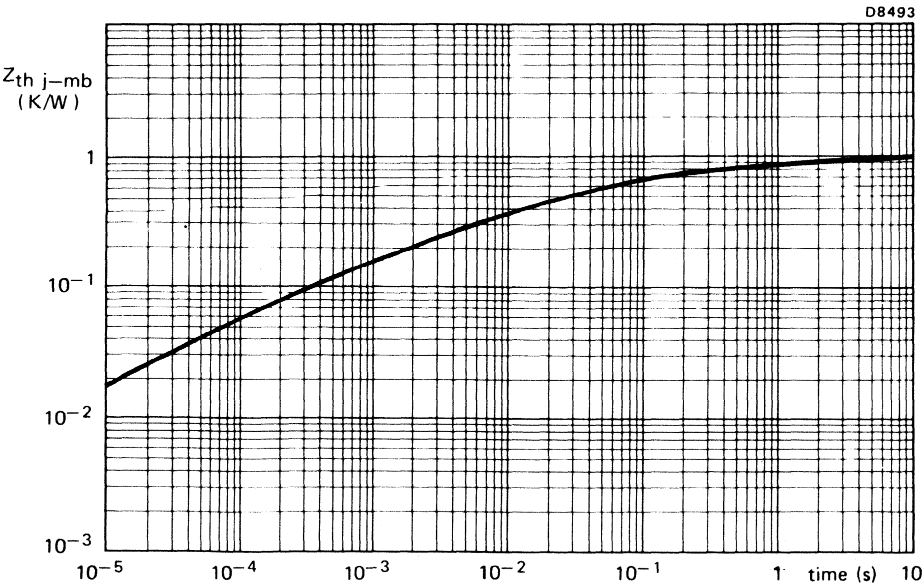


Fig.11

SCHOTTKY-BARRIER RECTIFIER DIODES

High-efficiency rectifier diodes in DO–5 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. They can also withstand reverse voltage transients. The series consists of normal polarity (cathode to stud) types.
A version with guaranteed reverse surge capability, BYV22–40A, is also available.

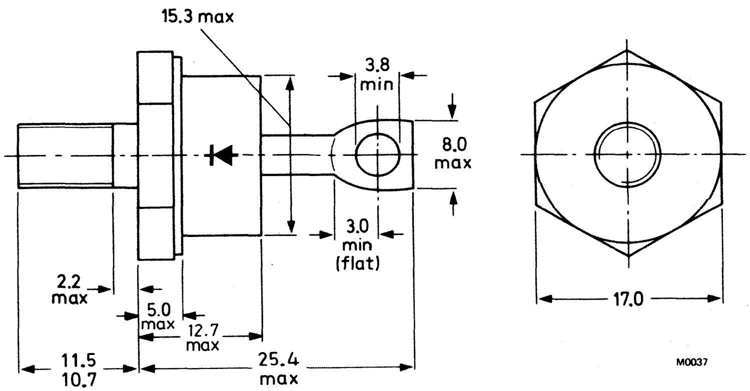
QUICK REFERENCE DATA

			BYV22–30	35	40(A)	45	
Repetitive peak reverse voltage	V_{RRM}	max.	30	35	40	45	V
Average forward current	$I_{F(AV)}$	max.	60				A
Forward voltage	V_F	<	0.55				V
Junction temperature	T_j	max.	150				°C

MECHANICAL DATA

Dimensions in mm

Fig.1 DO–5 with ¼" x 28 UNF stud (ϕ6.35 mm)
Types with metric M6 stud (ϕ6 mm) are available on request; e.g. BYV22–30M.



Net mass: 22 g

Diameter of clearance hole: 6.5 mm

Accessories supplied on request:
see ACCESSORIES section

Supplied with device: 1 nut, 1 lock washer
Torque on nut:
min. 1.7 Nm (17 kg cm),
max. 3.5 Nm (35 kg cm),
Nut dimensions across the flats
¼" x 28 UNF, 11.1 mm; M6, 10 mm.

Products approved to CECC 50 009-034 available on request

RATINGS

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

Voltages			BYV22–30	35	40(A)	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.	50	A
square-wave; up to T_{mb} = 96 °C; δ = 0.5	$I_{F(AV)}$	max.	60	A
R.M.S. forward current	$I_{F(RMS)}$	max.	85	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.	1000	A
I^2t for fusing (t = 10 ms)	I^2t	max.	5000	A^2s
Reverse surge current (t_p = 100 μs) **	I_{RSM}	max.	2.0	A

Temperatures

Storage temperature	T_{stg}		−55 to +150	°C
Junction temperature; see also Figs.3 and 5	T_j	max.	150	°C

THERMAL RESISTANCE

From junction to mounting base	$R_{th\ j\text{-}mb}$	=	0.6	K/W
From mounting base to heatsink				
with heatsink compound	$R_{th\ mb\text{-}h}$	=	0.3	K/W
without heatsink compound	$R_{th\ mb\text{-}h}$	=	0.5	K/W
Transient thermal impedance; t = 1 ms	$Z_{th\ j\text{-}mb}$	=	0.072	K/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.

** BYV22–40A only.

CHARACTERISTICS

Forward voltage				
I_F = 50 A; T_j = 100 °C	V_F	<	0.55	V*
I_F = 150 A; T_j = 25 °C	V_F	<	0.9	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	<	250	mA
Capacitance at f = 1 MHz				
V_R = 5 V; T_j = 25 to 125 °C	C_d	typ.	2100	pF

*Measured under pulse conditions to avoid excessive dissipation

OPERATING NOTES

Dissipation and heatsink calculations

The various components of junction temperature rise above ambient are shown below:

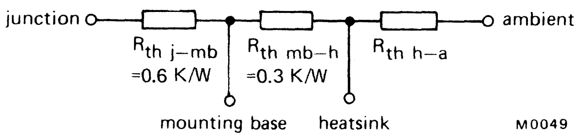


Fig.2

Overall thermal resistance $R_{th\ j\text{-}a} = R_{th\ j\text{-}mb} + R_{th\ mb\text{-}h} + R_{th\ h\text{-}a}$

To choose a suitable heatsink, the following information is required:

(i) Maximum operating ambient temperature
(ii) Duty-cycle or form-factor of forward current (δ or a)
(iii) Average forward current per diode (square or sine-wave)
(iv) Crest working reverse voltage (V_{RWM})

The total power dissipation in the diode has two components:

P_R – reverse leakage dissipation
P_F – forward conduction dissipation

$$P_{tot} = P_R + P_F \qquad \text{1)}$$

From the above, it can be seen that:

$$R_{th\ h\text{-}a} = \frac{T_{j\ max} - T_{amb}}{P_R + P_F} - (R_{th\ j\text{-}mb} + R_{th\ mb\text{-}h}) \qquad \text{2)}$$

values for $R_{th\ j\text{-}mb}$ and $R_{th\ mb\text{-}h}$ can be found under Thermal Resistance.

P_R and P_F are derived from Figs.3 and 4 for square-wave operation (and Figs.5 and 6 for sine-wave) as follows:
Starting at the bottom left-hand axis of Fig.3 (or Fig.5), for a particular duty-cycle (or form-factor), δ (or a), trace vertically upwards to meet the required V_{RWM} line. From this point, trace horizontally across to the right-hand $T_{j\ max}$ lines, the resulting reverse leakage power (P_R) at the chosen $T_{j\ max}$ can be read by tracing vertically downwards to the horizontal axis.
Forward conduction dissipation (P_F) for the known average current $I_{F(AV)}$ and duty-cycle (or form-factor) is easily derived from Fig.4 (or Fig.6).
These derived figures for P_R and P_F can now be substituted in equation 2) to calculate the required heatsink.

EXAMPLE: Square-wave operation, using BYV22—30 and heatsink compound;

$T_{amb} = 50\ ^oC$; $\delta = 0.5$; $I_{F(AV)} = 40$ A; $V_{RWM} = 20$ V;

from data, $R_{th\ j\text{-}mb} = 0.6$ K/W and $R_{th\ mb\text{-}h} = 0.3$ K/W;

from Fig.4, it is found that $P_F = 26$ W.

If the desired $T_{j\ max}$ is chosen to be 140 ^oC, then P_R becomes 3 W, leading to:

$$R_{th\ h\text{-}a} = \frac{140\ ^oC - 50\ ^oC}{26\ W + 3\ W} - (0.6\ K/W + 0.3\ K/W) = 2.2\ K/W$$

NOTE: To ensure thermal stability, the overall thermal resistance ($R_{th\ j\text{-}a}$) x P_R must be less than 12 ^oC. If the calculated value of $R_{th\ h\text{-}a}$ does not permit this, then it must be reduced (heatsink size increased) to enable this criterion to be met.

SQUARE-WAVE OPERATION (Figs.3 and 4)

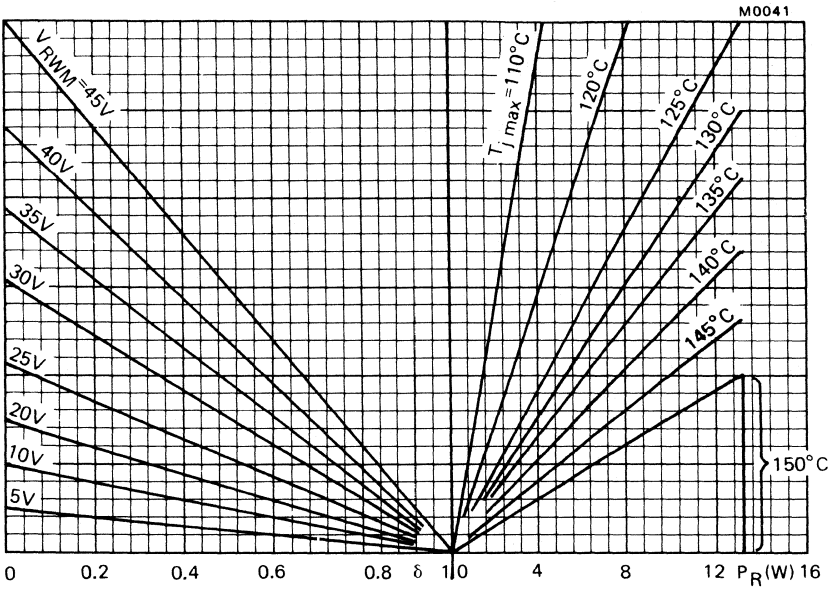
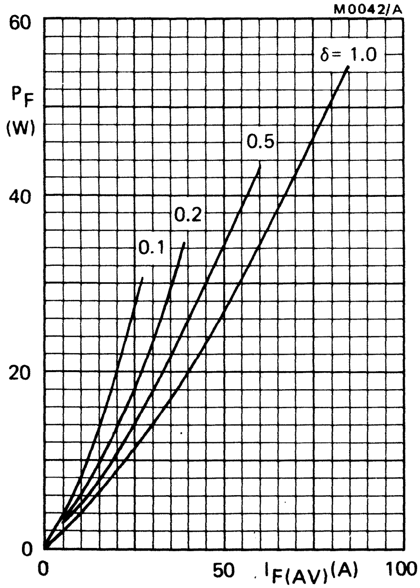
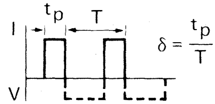


Fig.3 Maximum permissible junction temperature as a function of crest working reverse voltage and duty cycle of forward conduction.





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

Fig.4.

SINE—WAVE OPERATION (Figs.5 and 6)

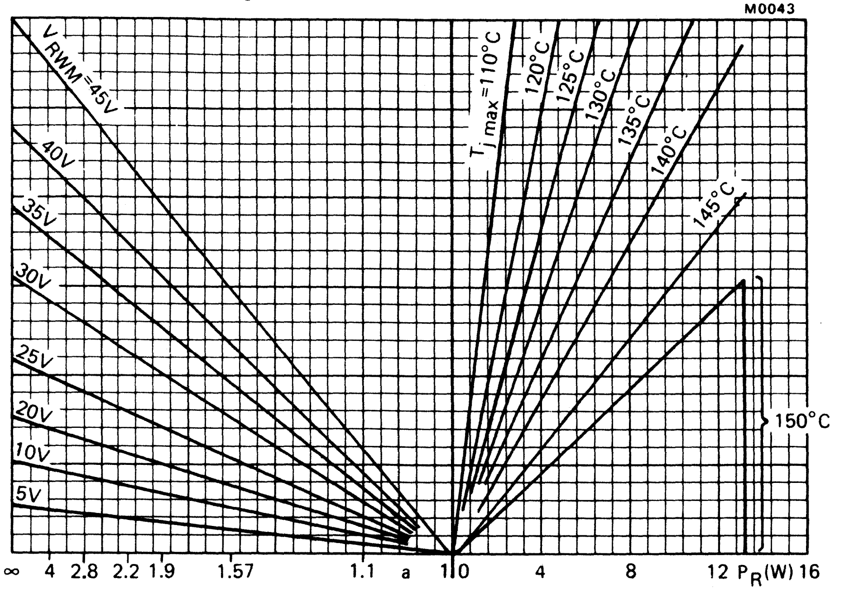


Fig.5 Maximum permissible junction temperature as a function of crest working reverse voltage and form factor of forward conduction; a = form factor = $I_{F(RMS)}/I_{F(AV)}$.

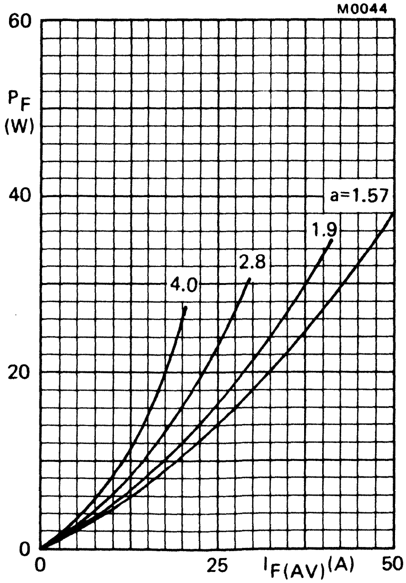


Fig.6

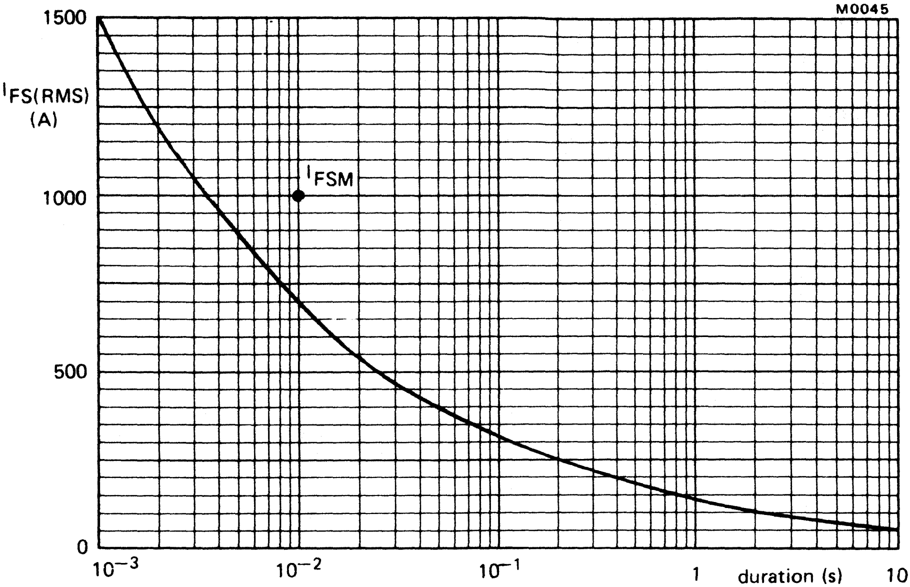
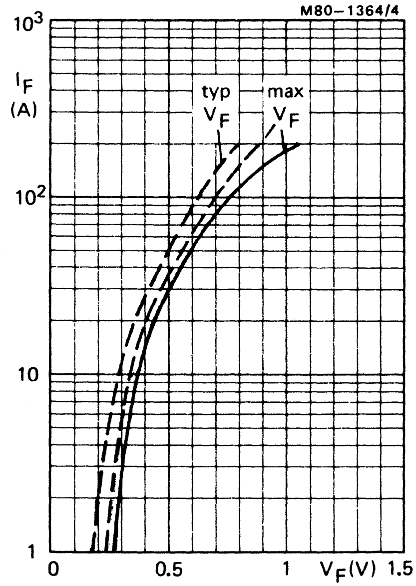


Fig.7 Maximum permissible non-repetitive r.m.s.forward current based on sinusoidal currents (f = 50 Hz); T_j = 125 °C prior to surge; with reapplied V_{RWMmax}.



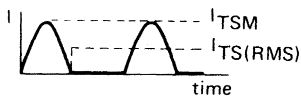


Fig.8 ——— T_j = 25 °C; – – – T_j = 100 °C

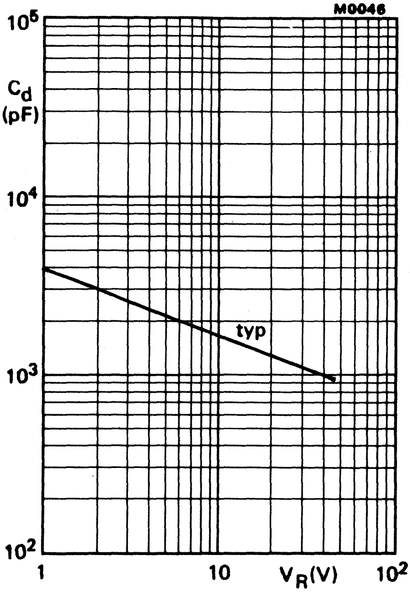


Fig.9 f = 1 MHz; T_j = 25 to 125 °C

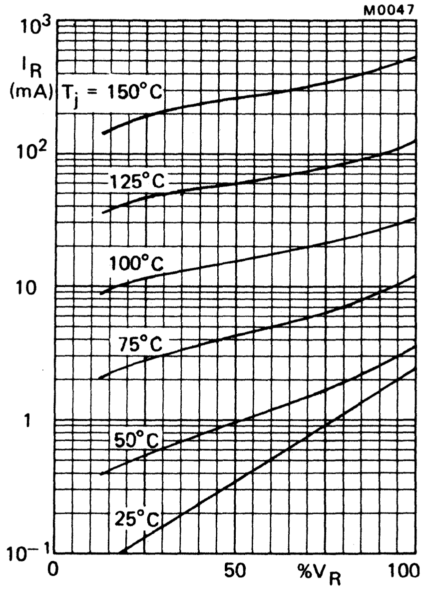


Fig.10 Typical values

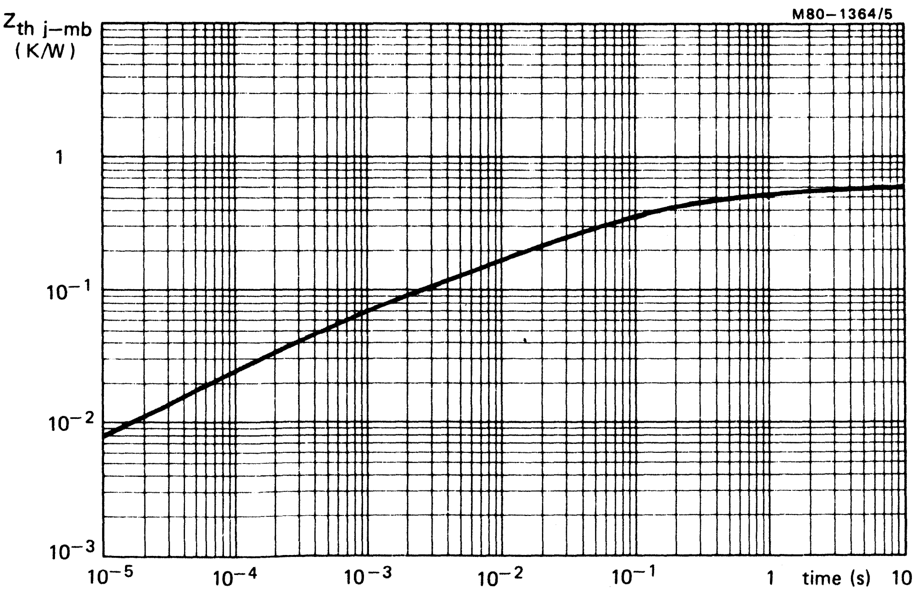


Fig.11

SCHOTTKY-BARRIER RECTIFIER DIODES

High-efficiency rectifier diodes in DO–5 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. They can also withstand reverse voltage transients. The series consists of normal polarity (cathode to stud) types.
A version with guaranteed reverse surge capability, BYV23–40A, is also available.

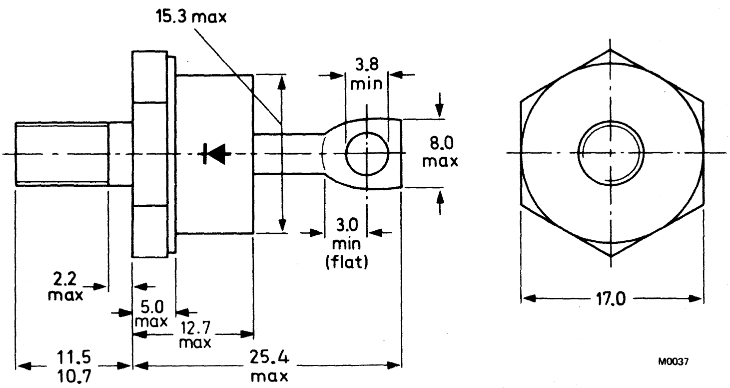
QUICK REFERENCE DATA

			BYV23–30	35	40(A)	45	
Repetitive peak reverse voltage	V_{RRM}	max.	30	35	40	45	V
Average forward current	$I_{F(AV)}$	max.	80				A
Forward voltage	V_F	<	0.55				V
Junction temperature	T_j	max.	150				°C

MECHANICAL DATA

Dimensions in mm

Fig.1 DO–5 with ¼" x 28 UNF stud (ϕ6.35 mm)
Types with metric M6 stud (ϕ6 mm) are available on request; e.g. BYV23–30M.



Net mass: 22 g

Diameter of clearance hole: 6.5 mm

Accessories supplied on request:
see ACCESSORIES section

Supplied with device: 1 nut, 1 lock washer
Torque on nut:
min. 1.7 Nm (17 kg cm),
max. 3.5 Nm (35 kg cm).
Nut dimensions across the flats:
¼" x 28 UNF, 11.1 mm; M6, 10 mm.

Products approved to CECC 50 009-036 available on request

RATINGS

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

Voltages

			BYV23–30	35	40(A)	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} = 90 °C	$I_{F(AV)}$	max.	70	A
square-wave; up to T_{mb} = 85 °C; δ = 0.5	$I_{F(AV)}$	max.	80	A
R.M.S. forward current	$I_{F(RMS)}$	max.	113	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.	1500	A
I^2t for fusing (t = 10 ms)	I^2t	max.	11250	A^2s
Reverse surge current (t_p = 100 µs)**	I_{RSM}	max.	2.0	A

Temperatures

Storage temperature	T_{stg}		−55 to +150	°C
Junction temperature; see also Figs. 3 and 5	T_j	max.	150	°C

THERMAL RESISTANCE

From junction to mounting base	$R_{th\ j\text{-}mb}$	=	0.6	K/W
From mounting base to heatsink				
with heatsink compound	$R_{th\ mb\text{-}h}$	=	0.3	K/W
without heatsink compound	$R_{th\ mb\text{-}h}$	=	0.5	K/W
Transient thermal impedance; t = 1 ms	$Z_{th\ j\text{-}mb}$	=	0.07	K/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.

**BYV23–40A only.

CHARACTERISTICS

Forward voltage				
I_F = 70 A; T_j = 100 °C	V_F	<	0.55	V*
I_F = 200 A; T_j = 25 °C	V_F	<	0.95	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	<	350	mA
Capacitance at f = 1 MHz				
V_R = 5 V; T_j = 25 to 125 °C	C_d	typ.	2500	pF

*Measured under pulse conditions to avoid excessive dissipation

OPERATING NOTES

Dissipation and heatsink calculations

The various components of junction temperature rise above ambient are shown below:

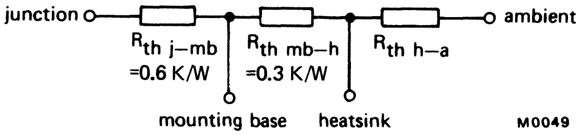


Fig.2

Overall thermal resistance $R_{th\ j\text{-}a} = R_{th\ j\text{-}mb} + R_{th\ mb\text{-}h} + R_{th\ h\text{-}a}$

To choose a suitable heatsink, the following information is required:

(i) Maximum operating ambient temperature
(ii) Duty-cycle or form-factor of forward current (δ or a)
(iii) Average forward current per diode (square or sine-wave)
(iv) Crest working reverse voltage (V_{RWM})

The total power dissipation in the diode has two components:

P_R — reverse leakage dissipation
P_F — forward conduction dissipation

$$P_{tot} = P_R + P_F \qquad \text{1)}$$

From the above, it can be seen that:

$$R_{th\ h\text{-}a} = \frac{T_{jmax} - T_{amb}}{P_R + P_F} - (R_{th\ j\text{-}mb} + R_{th\ mb\text{-}h}) \qquad \text{2)}$$

values for $R_{th\ j\text{-}mb}$ and $R_{th\ mb\text{-}h}$ can be found under Thermal Resistance.

P_R and P_F are derived from Figs.3 and 4 for square-wave operation (and Figs. 5 and 6 for sine-wave) as follows:
Starting at the bottom left-hand axis of Fig.3 (or Fig.5), for a particular duty-cycle (or form-factor), δ (or a), trace vertically upwards to meet the required V_{RWM} line. From this point, trace horizontally across to the right-hand T_{jmax} lines, the resulting reverse leakage power (P_R) at the chosen T_{jmax} can be read by tracing vertically downwards to the horizontal axis.
Forward conduction dissipation (P_F) for the known average current $I_{F(AV)}$ and duty-cycle (or form-factor) is easily derived from Fig.4 (or Fig.6). These derived figures for P_R and P_F can now be substituted in equation 2) to calculate the required heatsink.

EXAMPLE: Square-wave operation, using BYV23—30 and heatsink compound;

$T_{amb} = 50\ ^oC$; $\delta = 0.5$; $I_{F(AV)} = 60$ A; $V_{RWM} = 20$ V;

from data, $R_{th\ j\text{-}mb} = 0.6$ K/W and $R_{th\ mb\text{-}h} = 0.3$ K/W;

from Fig.4, it is found that $P_F = 40$ W.

If the desired T_{jmax} is chosen to be 130 ^oC, then P_R becomes 6 W, leading to:

$$R_{th\ h\text{-}a} = \frac{130\ ^oC - 50\ ^oC}{40\ W + 6\ W} - (0.6\ K/W + 0.3\ K/W) = 0.84\ K/W.$$

NOTE: To ensure thermal stability, the overall thermal resistance ($R_{th\ j\text{-}a}$) x P_R must be less than 12 ^oC. If the calculated value of $R_{th\ h\text{-}a}$ does not permit this, then it must be reduced (heatsink size increased) to enable this criterion to be met.

SQUARE-WAVE OPERATION (Figs.3 and 4)

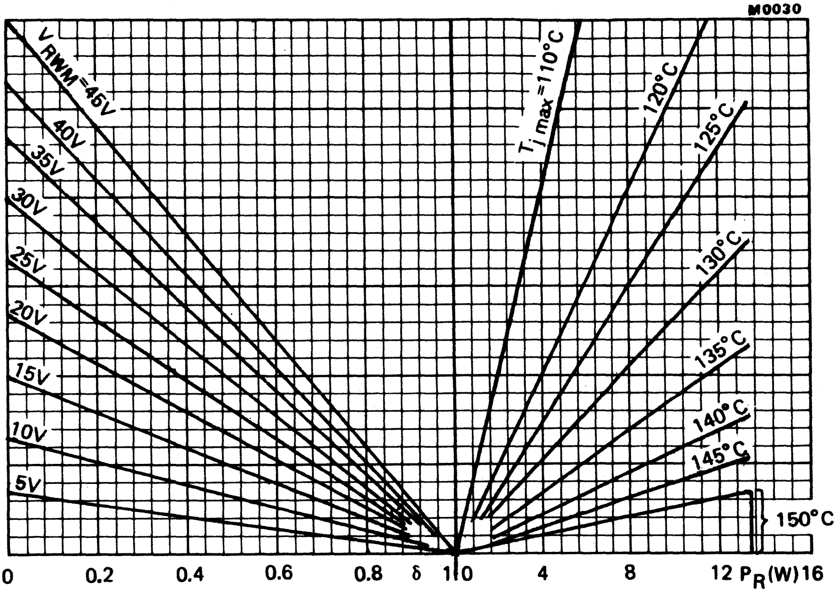
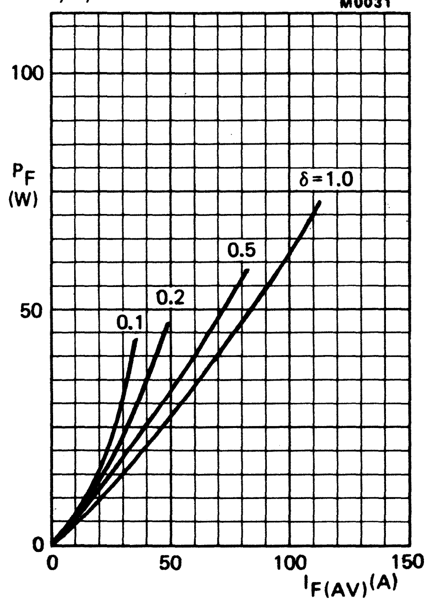
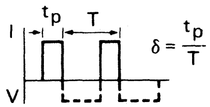


Fig.3 Maximum permissible junction temperature as a function of crest working reverse voltage and duty cycle of forward conduction.





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

Fig.4

SINE-WAVE OPERATION (Figs.5 and 6)

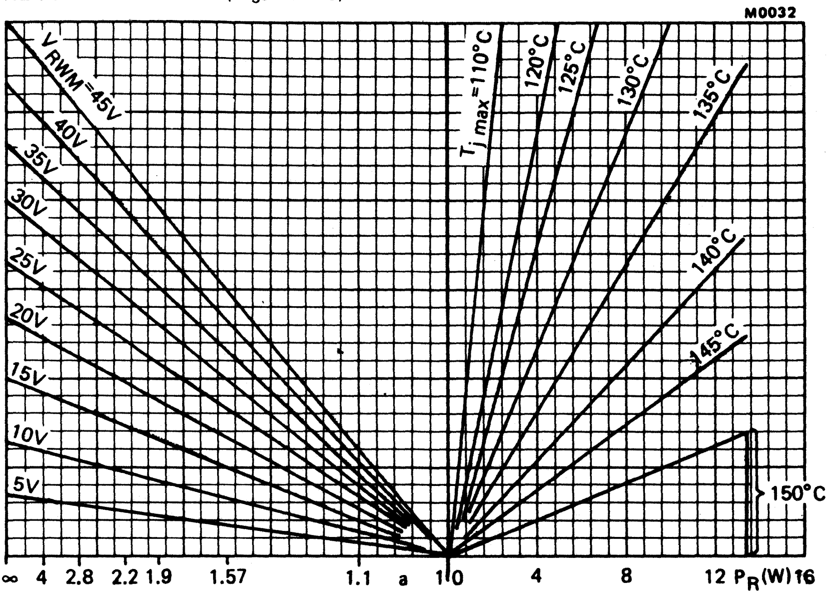


Fig.5 Maximum permissible junction temperature as a function of crest working reverse voltage and form factor of forward conduction; a = form factor = $I_{F(RMS)}/I_{F(AV)}$.

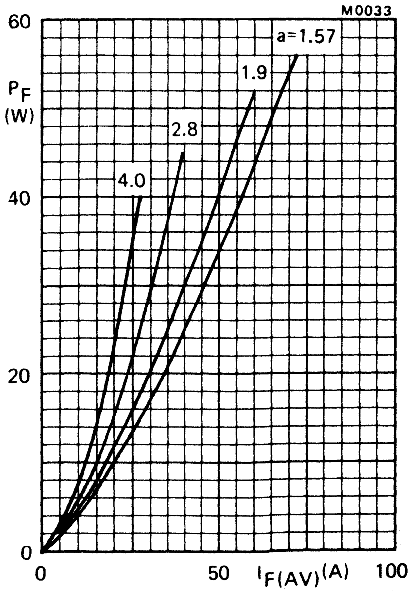


Fig.6

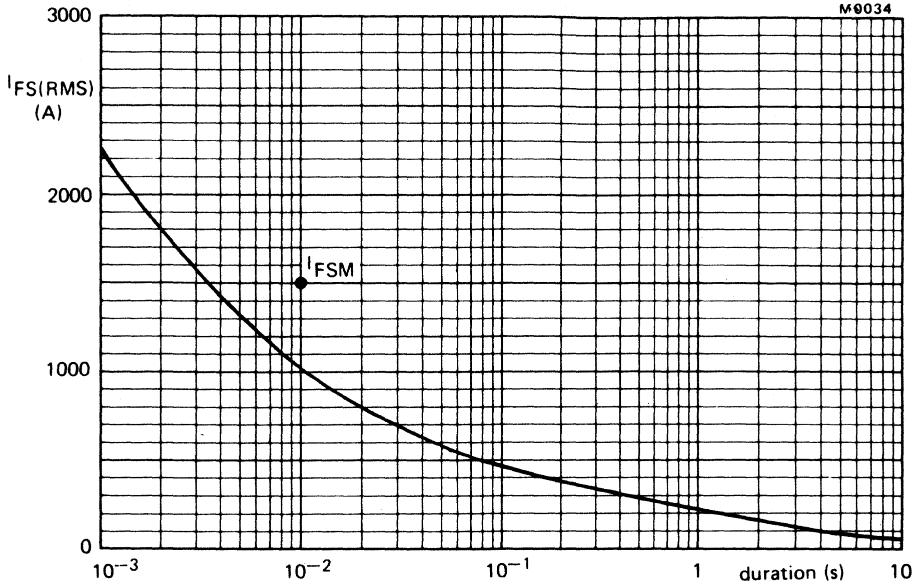
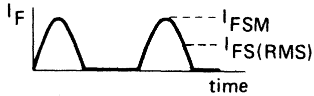


Fig.7 Maximum permissible non-repetitive r.m.s. forward current based on sinusoidal currents (f = 50 Hz); T_j = 125 °C prior to surge; with reapplied V_{RWMmax}.



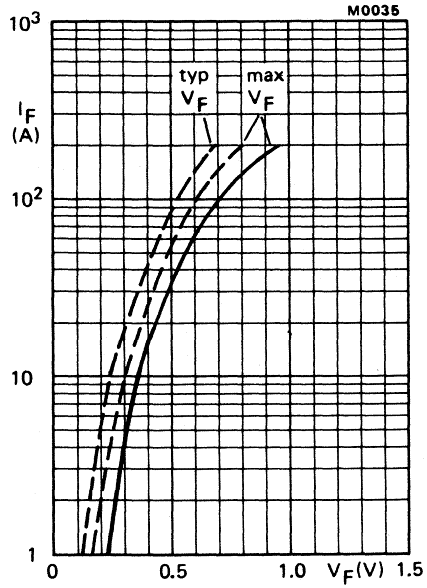


Fig.8 ——— T_j = 25 °C; — — — T_j = 100 °C

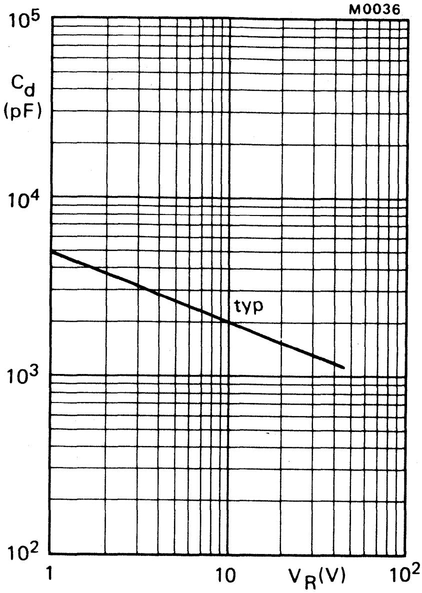


Fig.9 f = 1 MHz; T_j = 25 to 125 °C

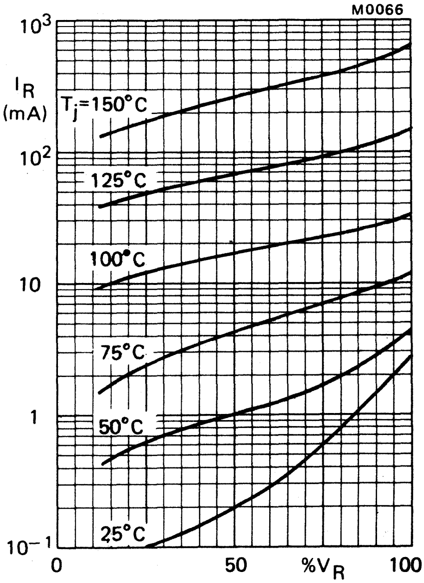


Fig.10 Typical values

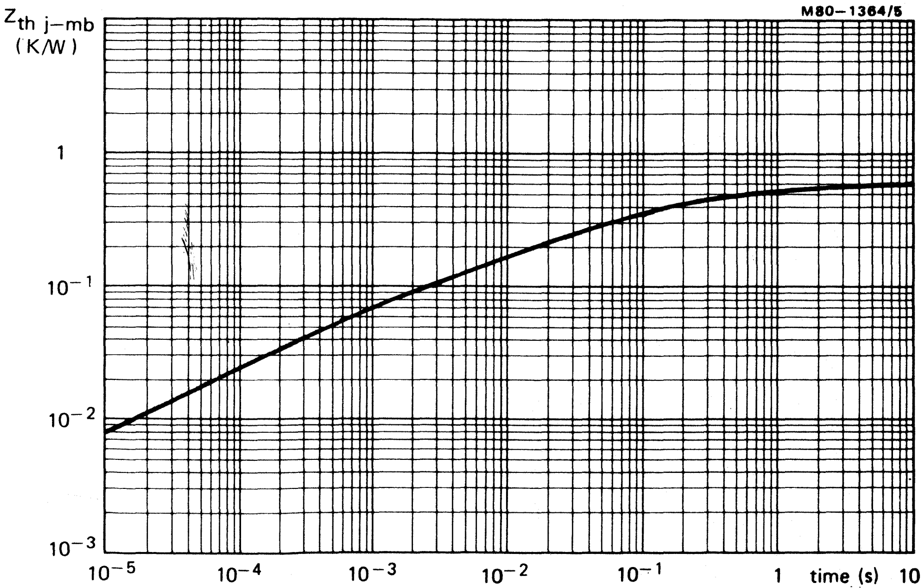


Fig.11

SCHOTTKY–BARRIER DOUBLE RECTIFIER DIODES

High-efficiency double rectifier diodes in plastic envelopes which feature low forward voltage drop, low capacitance and absence of stored charge. 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 monolithic construction allows both diodes to be paralleled without derating. The series consists of common-cathode types.
A version with guaranteed reverse surge capability, BYV33–40A, is also available. ←

QUICK REFERENCE DATA

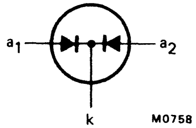
Per diode, unless otherwise stated			BYV33–30	35	40(A)	45	
Repetitive peak reverse voltage	V_{RRM}	max.	30	35	40	45	V
Average forward current (both diodes conducting)	$I_{F(AV)}$	max.	20				A
Forward voltage	V_F	<	0.6				V
Junction temperature	T_j	max.	150				°C

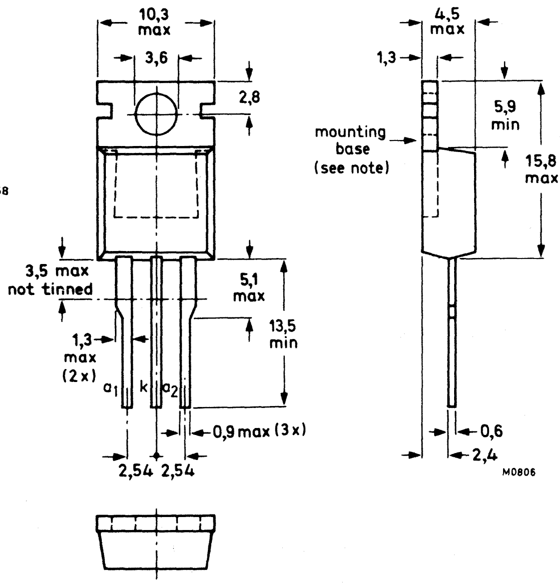
←

MECHANICAL DATA

Dimensions in mm

Fig.1 TO-220AB





Net mass: 2 g
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 (IEC134).

Voltages

			BYV33–30	35	40(A)	45	
Repetitive peak reverse voltage	V_{RRM}	max.	30	35	40	45	V
Crest working reverse voltage (note 1)	V_{RWM}	max.	20	25	30	35	V
Continuous reverse voltage (note 1)	V_R	max.	20	25	30	35	V

Currents (both diodes conducting; note 2)

Average forward current square-wave; d = 0.5; up to T_{mb} = 98 °C	$I_{F(AV)}$	max.	20	A
R.M.S. forward current	$I_{F(RMS)}$	max.	20	A
Repetitive peak forward current	I_{FRM}	max.	300	A
Non-repetitive peak forward current t = 10 ms; half sine-wave; T_j = 125 °C prior to surge; with re-applied V_{RWMmax} (note 3)	I_{FSM}	max.	200	A
I^2t for fusing (t = 10 ms; note 3)	I^2t	max.	200	A^2s
Reverse surge current (t_p = 100 μs; note 5)	I_{RSM}	max.	0.5	A

Temperatures

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

CHARACTERISTICS (per diode)

Forward voltage				
I_F = 7 A; T_j = 100 °C (note 4)	V_F	<	0.6	V
I_F = 20 A; T_j = 25 °C note 4)	V_F	<	1.0	V
Reverse current				
$V_R = V_{RWMmax}$; T_j = 125 °C	I_R	<	30	mA
Capacitance at f = 1 MHz				
V_R = 5 V; T_j = 25 to 125 °C	C_d	typ.	300	pF

Notes

1. Up to T_j = 125 °C; see derating curve for higher temperature operation.
2. The limits for both diodes apply whether both diodes conduct simultaneously or on alternate half cycles.
3. Surge figures apply to each diode.
4. Measured under pulse conditions to avoid excessive dissipation.
5. BYV33–40A only.

THERMAL RESISTANCE

From junction to mounting base (both diodes conducting)	$R_{th\ j\text{-}mb}$	=	1.6	K/W
Transient thermal impedance; t = 1 ms	$Z_{th\ j\text{-}mb}$	=	0.7	K/W

Influence of mounting method

1. Heatsink mounted with clip (see mounting instructions)

Thermal resistance from mounting base to heatsink

a. with heatsink compound	$R_{th\ mb\text{-}h}$	=	0.2	K/W
b. with heatsink compound and 0.06 mm maximum mica insulator	$R_{th\ mb\text{-}h}$	=	1.4	K/W
c. with heatsink compound and 0.1 mm maximum mica insulator (56369)	$R_{th\ mb\text{-}h}$	=	2.2	K/W
d. with heatsink compound and 0.25 mm maximum alumina insulator (56367)	$R_{th\ mb\text{-}h}$	=	0.8	K/W
e. without heatsink compound	$R_{th\ mb\text{-}h}$	=	1.4	K/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 K/W

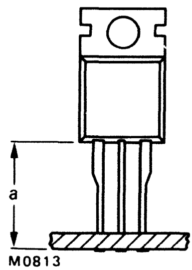


Fig.2

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 method because if offers:
   a. a good thermal contact under the crystal area and slightly lower $R_{th\ mb\text{-}h}$ values than the 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. 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.

OPERATING NOTES

Dissipation and heatsink considerations:

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

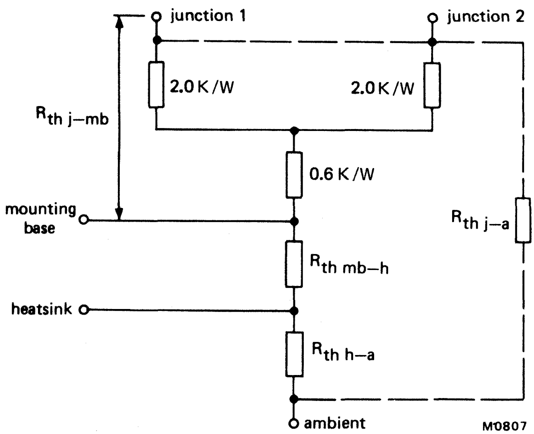


Fig.3

b. The method of using Fig.4 is as follows:
Starting with the required current on the $I_{F(AV)}$ axis, trace upwards to meet the appropriate 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.

SQUARE-WAVE OPERATION (BOTH DIODES)

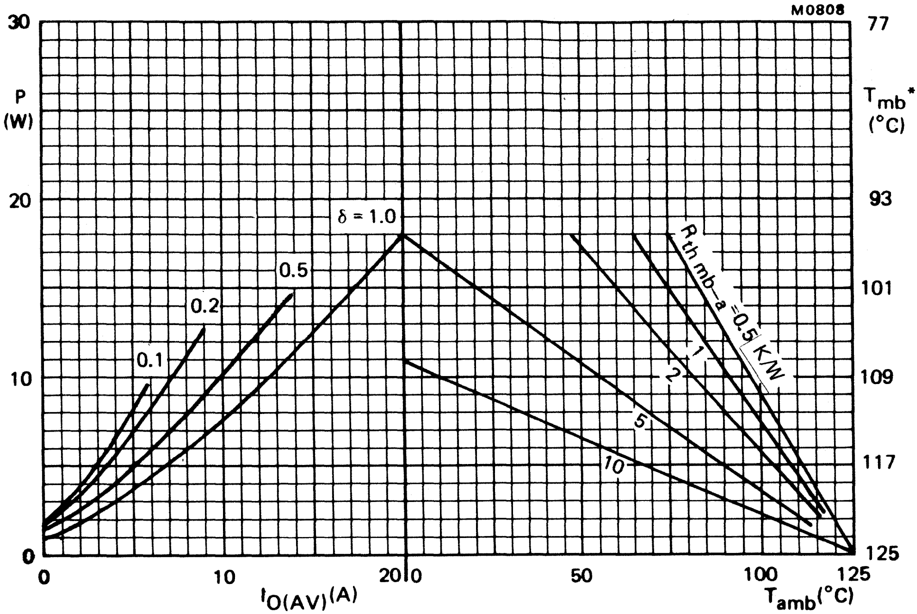
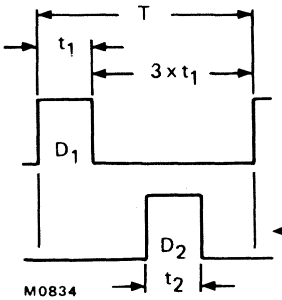


Fig.4 The right-hand part shows the relationship between the power (derived from the left-hand part) and the maximum permissible temperatures.



$\delta = \frac{t_1 + t_2}{T}$ = total conduction time of both diodes in one time period.

D_1 = first diode conducting.

D_2 = second diode conducting.

← e.g. $\delta = 0.5$

*T_{mb} scale is for comparison purposes and is correct only for $R_{th\ mb\text{-}a} < 4.1$ K/W.

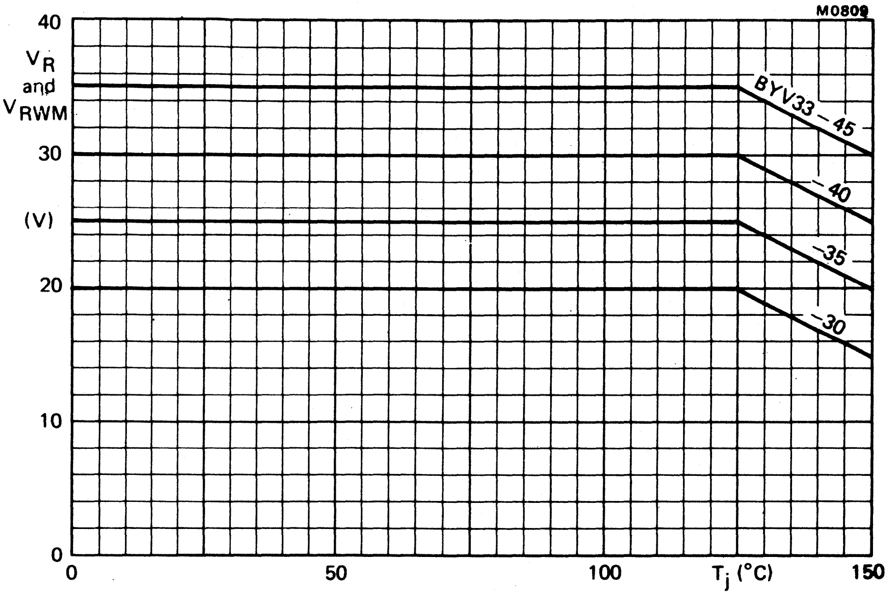


Fig.5 Maximum allowable continuous and crest working voltage as a function of junction temperature.

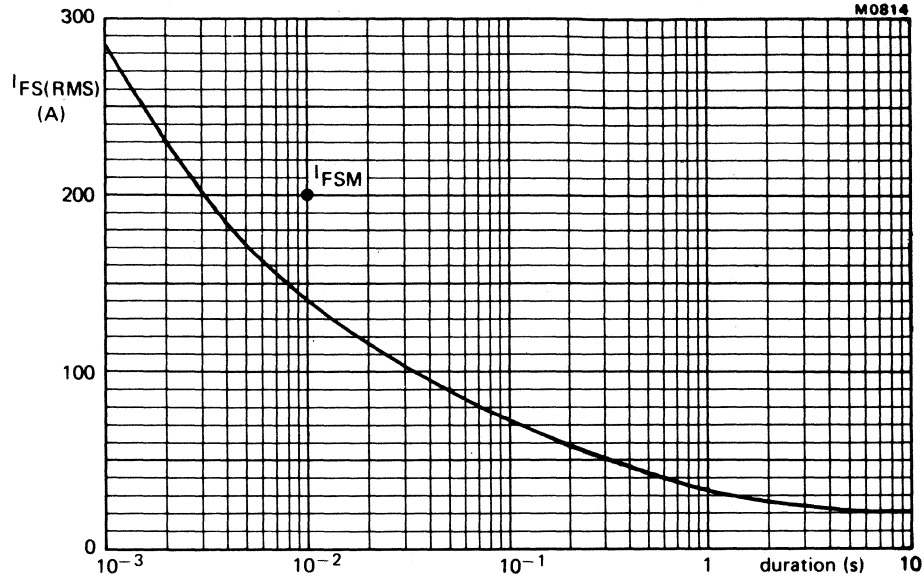
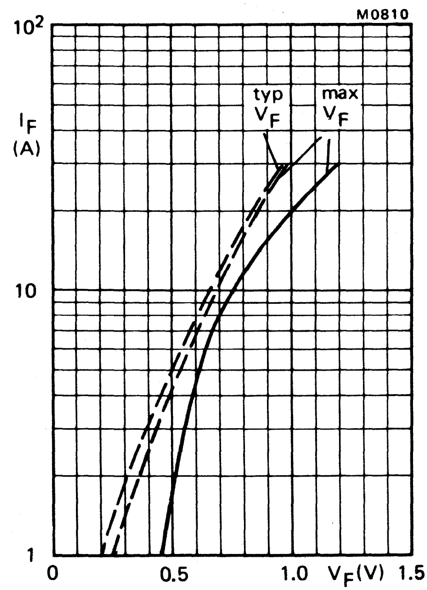


Fig.6 Maximum permissible non-repetitive r.m.s. forward current based on sinusoidal currents (f = 50 Hz); T_j = 125 °C prior to surge; with re-applied $V_{RWM\ max}$; per diode.



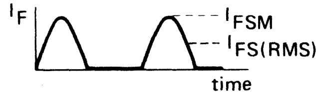


Fig.7 —— T_j = 25 °C; – – – T_j = 100 °C; per diode.

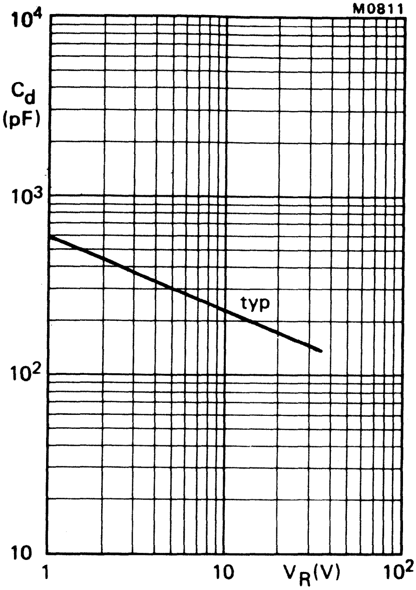


Fig.8 f = 1 MHz; T_j = 25 to 125 °C; per diode

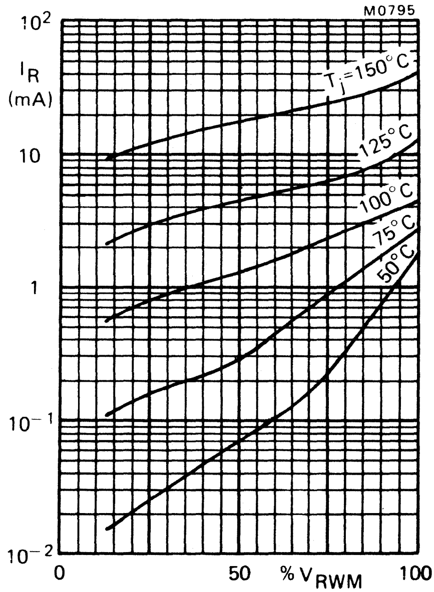


Fig.9 Typical values; per diode.

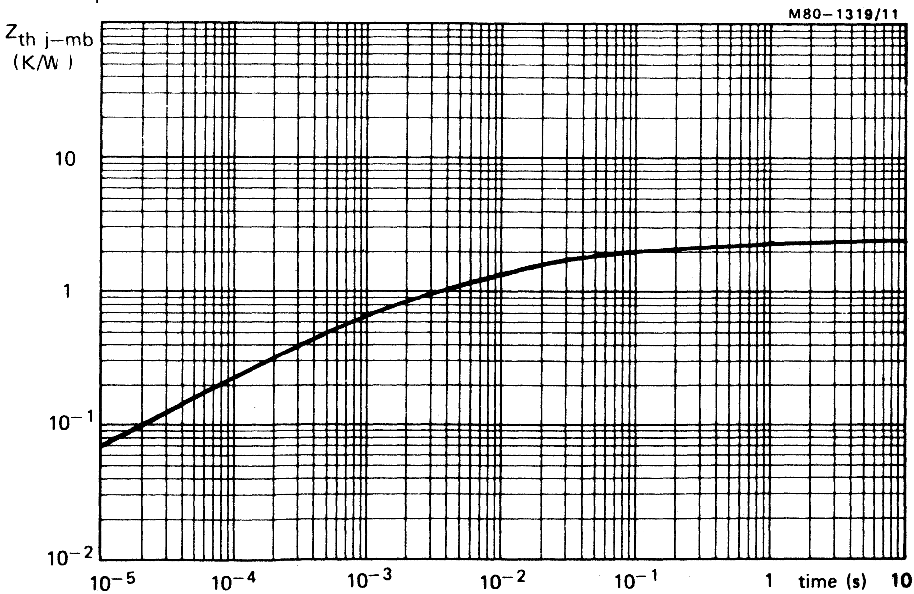


Fig.10 One diode conducting.

SCHOTTKY-BARRIER RECTIFIER DIODES

High-efficiency rectifier diodes in TO–220 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. They can also withstand reverse voltage transients.
The series consists of normal polarity (cathode to mounting-base) types.
A version with guaranteed reverse surge capability, BYV39–40A; is also available.

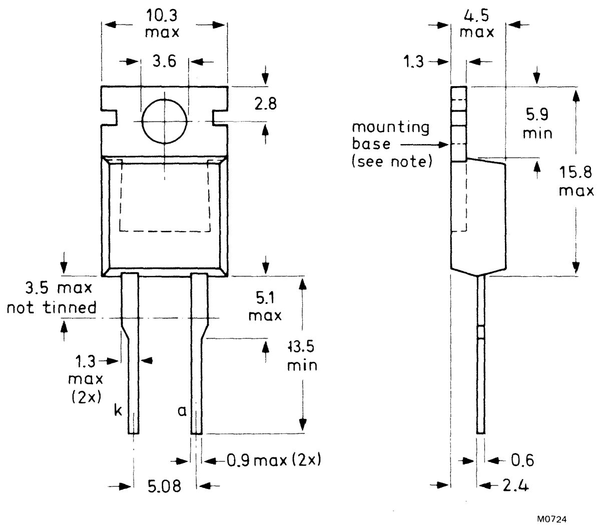
QUICK REFERENCE DATA

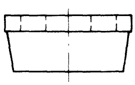
			BYV39–30	35	40(A)	45	
Repetitive peak reverse voltage	V_{RRM}	max.	30	35	40	45	V
Average forward current	$I_{F(AV)}$	max.			16		A
Forward voltage	V_F	<			0.6		V
Junction temperature	T_j	max.			150		°C

MECHANICAL DATA

Dimensions in mm

Fig.1 TO-220AC





Net mass: 2 g

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 (IEC134)

Voltages

			BYV39–30	35	40(A)	45	
Repetitive peak reverse voltage	V_{RRM}	max.	30	35	40	45	V
Crest working reverse voltage	V_{RWM}	max.	20	25	30	35	V
Continuous reverse voltage	V_R	max.	20	25	30	35	V

Currents

Average forward current				
sinusoidal; up to T_{mb} = 110 °C	$I_{F(AV)}$	max.	12.5	A
square-wave, up to T_{mb} = 105 °C; δ = 0.5	$I_{F(AV)}$	max.	16	A
R.M.S. forward current	$I_{F(RMS)}$	max.	22	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.	150	A
I^2t for fusing	I^2t	max.	112	A^2s
Reverse surge current (t_p = 100 μs)*	I_{RSM}	max.	1	A

Temperatures

Storage temperature	T_{stg}		−40 to +150	°C
Junction temperature see also Figs. 3 and 5	T_j	max.	150	°C

THERMAL RESISTANCE

From junction to mounting base	$R_{th\ j\text{-}mb}$	<	2.2	K/W
From mounting base to heatsink with heatsink compound	$R_{th\ mb\text{-}h}$	=	0.5	K/W

*BYV39-40A only.

CHARACTERISTICS

Forward voltage				
I_F = 15 A; T_j = 100 °C	V_F	<	0.6	V*
I_F = 40 A; T_j = 25 °C	V_F	<	1.0	V*
Reverse current				
$V_R = V_{RWMmax}$; T_j = 125 °C	I_R	<	40	mA
Capacitance at f = 1 MHz				
V_R = 5 V; T_j = 25 to 125 °C	C_d	typ.	520	pF

*Measured under pulse conditions to avoid excessive dissipation.

OPERATING NOTES

Dissipation and heatsink calculations

The various components of junction temperature rise above ambient are shown below:

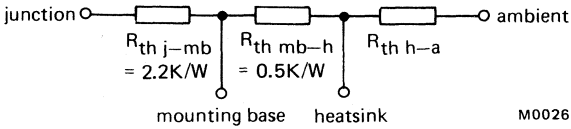


Fig.2

Overall thermal resistance $R_{th\ j\text{-}a} = R_{th\ j\text{-}mb} + R_{th\ mb\text{-}h} + R_{th\ h\text{-}a}$

To choose a suitable heatsink, the following information is required:

(i) Maximum operating ambient temperature
(ii) Duty-cycle or form-factor of forward current (δ or a)
(iii) Average forward current per diode (square or sine-wave)
(iv) Crest working reverse voltage (V_{RWM})

The total power dissipation in the diode has two components:

P_R — reverse leakage dissipation
P_F — forward conduction dissipation

$$P_{tot} = P_R + P_F \quad \text{.......... 1)}$$

From the above, it can be seen that:

$$R_{th\ h\text{-}a} = \frac{T_{j\ max} - T_{amb}}{P_R + P_F} - (R_{th\ j\text{-}mb} + R_{th\ mb\text{-}h}) \quad \text{.......... 2)}$$

values for $R_{th\ j\text{-}mb}$ and $R_{th\ mb\text{-}h}$ can be found under Thermal Resistance.

P_R and P_F are derived from Figs.3 and 4 for square-wave operation (and Figs.5 and 6 for sine-wave) as follows:
Starting at the bottom left-hand axis of Fig.3 (or Fig.5), for a particular duty-cycle (or form-factor), δ (or a), trace vertically upwards to meet the required V_{RWM} line. From this point, trace horizontally across to the right-hand $T_{j\ max}$ lines, the resulting reverse leakage power (P_R) at the chosen $T_{j\ max}$ can be read by tracing vertically downwards to the horizontal axis.
Forward conduction dissipation (P_F) for the known average current $I_{F(AV)}$ and duty-cycle (or form-factor) is easily derived from Fig.4 (or Fig.6).
These derived figures for P_R and P_F can now be substituted in equation 2) to calculate the required heatsink.

EXAMPLE: Square-wave operation, using BYV39—35 and heatsink compound;
$T_{amb} = 50\ ^oC$; $\delta = 0.5$; $I_{F(AV)} = 10$ A; $V_{RWM} = 20$ V;
from data, $R_{th\ j\text{-}mb} = 2.2$ K/W and $R_{th\ mb\text{-}h} = 0.5$ K/W;

from Fig.4, it is found that $P_F = 7$ W.

If the desired $T_{j\ max}$ is chosen to be 135 ^oC, then P_R becomes 1 W, leading to:

$$R_{th\ h\text{-}a} = \frac{135\ ^oC - 50\ ^oC}{7\ W + 1\ W} - 2.2\ K/W + 0.5\ ^oC/W) = 7.9\ K/W$$

NOTE: To ensure thermal stability, the overall thermal resistance ($R_{th\ j\text{-}a}$) x P_R must be less than 12 ^oC. If the calculated value of $R_{th\ h\text{-}a}$ does not permit this, then it must be reduced (heatsink size increased) to enable this criterion to be met.

SQUARE-WAVE OPERATION (Figs 3 and 4)

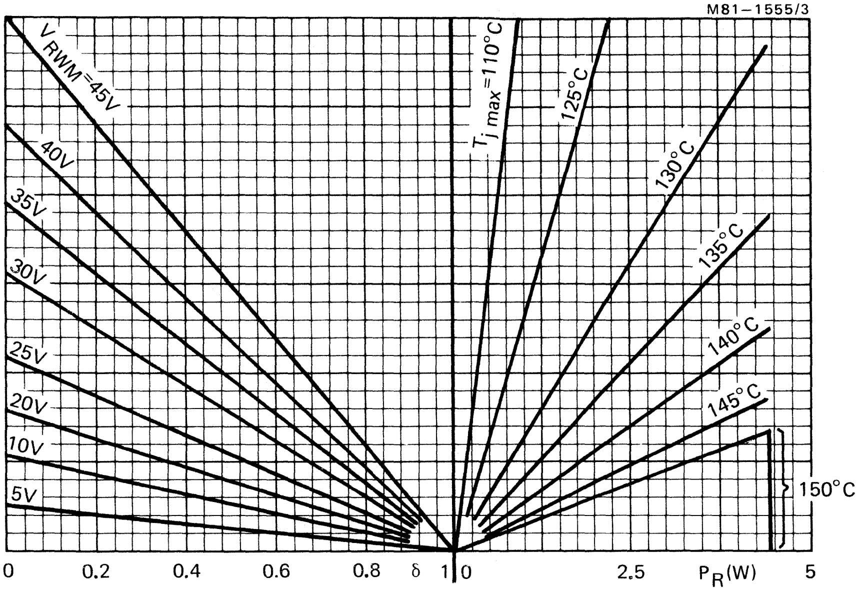
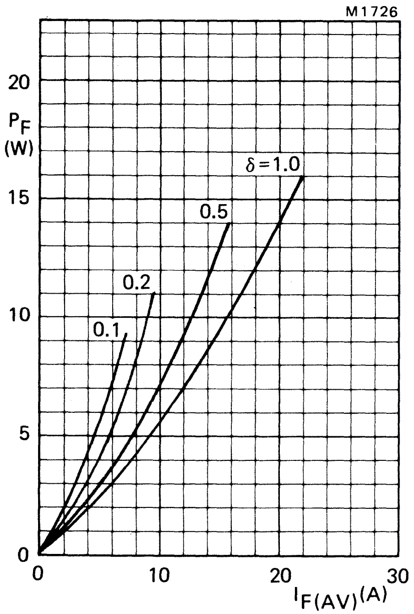


Fig.3 Maximum permissible junction temperature as a function of crest working reverse voltage and duty cycle of forward conduction.



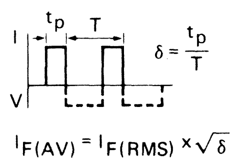


Fig.4

SINUSOIDAL OPERATION (Figs.5 and 6)

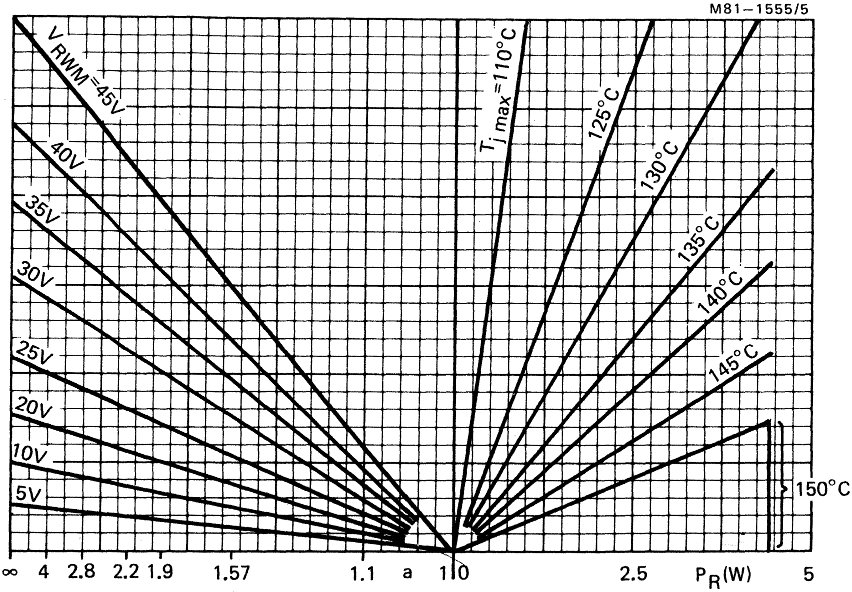


Fig.5 Maximum permissible junction temperature as a function of crest working reverse voltage and form factor of forward conduction. a = form factor = $I_{F(RMS)}/I_{F(AV)}$.

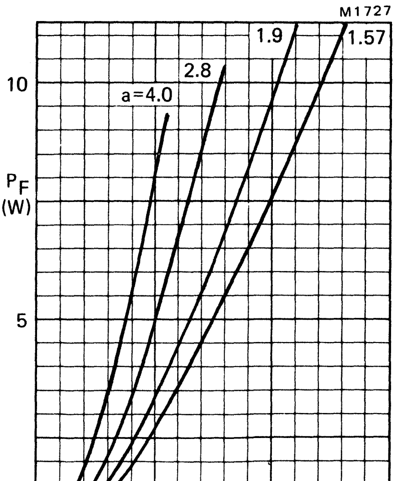


Fig.6

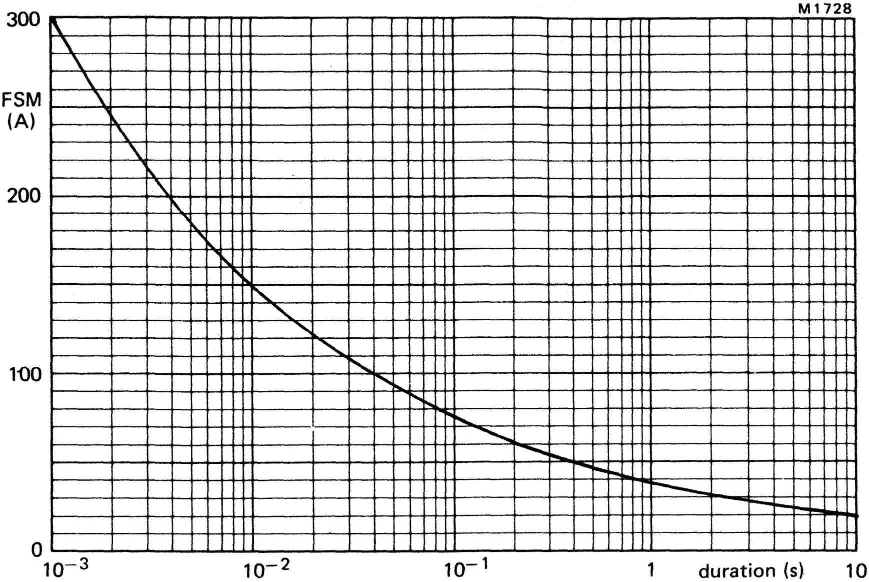
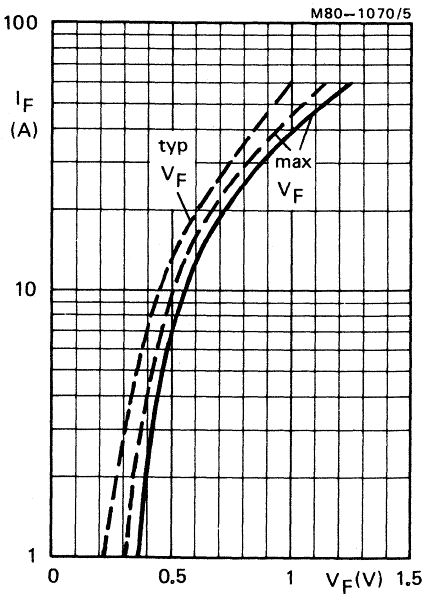


Fig.7 Maximum permissible non-repetitive peak forward current based on sinusoidal currents (f = 50 Hz); T_j = 125 °C prior to surge; with reapplied V_{RWMmax}.



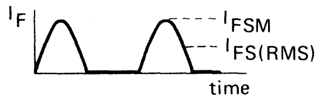


Fig.8 —— T_j = 25 °C; – – – T_j = 100 °C

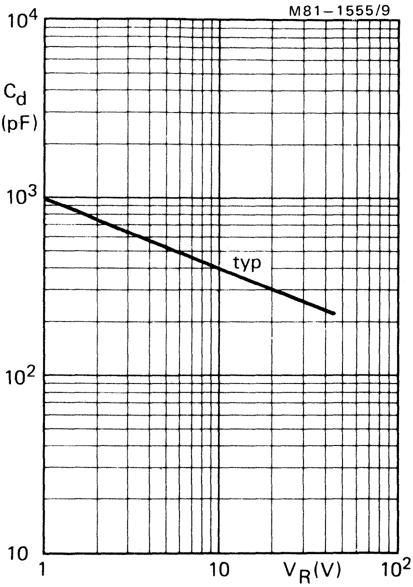


Fig.9 f = 1 MHz; T_j = 25 to 125 °C

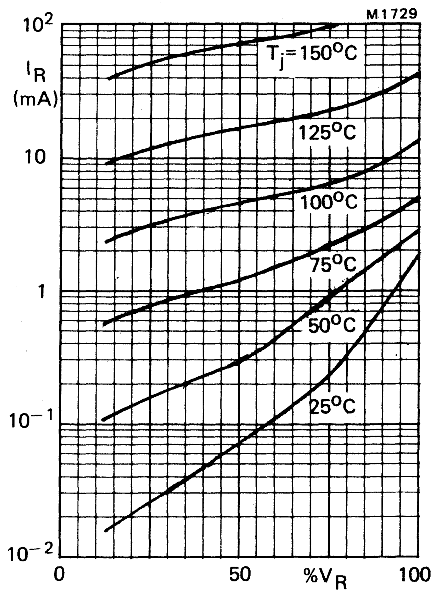


Fig.10 Typical values

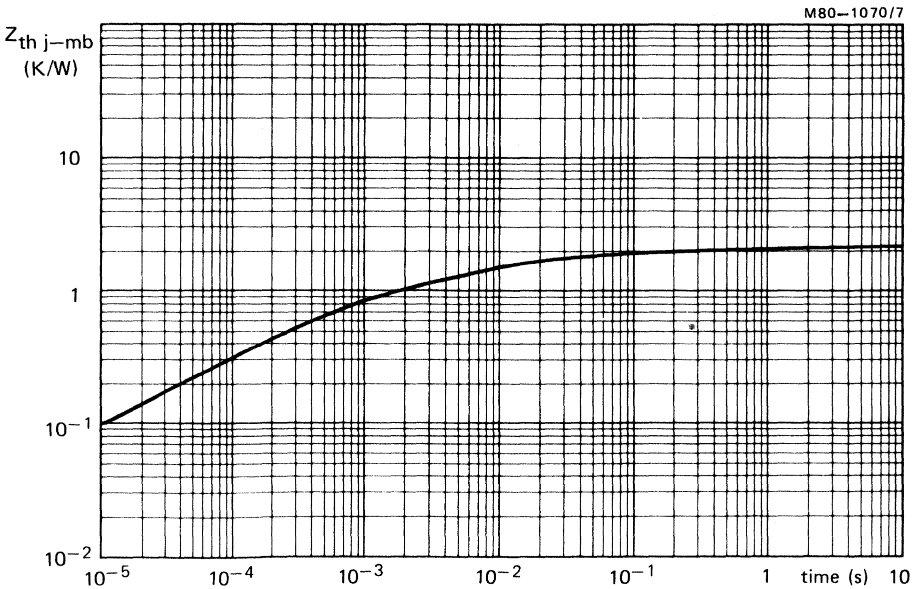


Fig.11 Transient thermal impedance

SCHOTTKY–BARRIER DOUBLE RECTIFIER DIODES

High-efficiency double rectifier diodes in plastic envelopes which feature low forward voltage drop, low capacitance and absence of stored charge. 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 monolithic construction allows both diodes to be paralleled without derating. The series consists of common-cathode types. A version with guaranteed reverse surge capability, BYV43–40A, is also available.

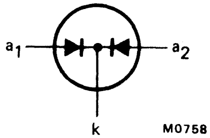
QUICK REFERENCE DATA

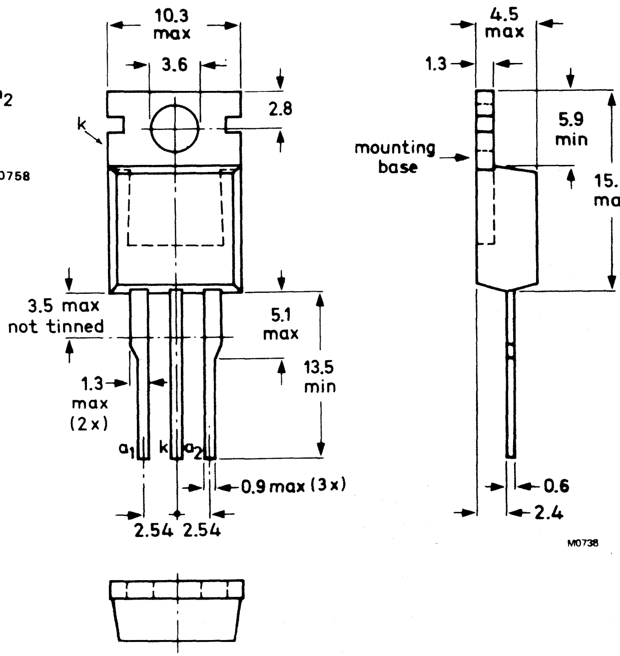
Per diode, unless otherwise stated			BYV43–30	35	40(A)	45	
Repetitive peak reverse voltage	V_{RRM}	max.	30	35	40	45	V
Average forward current (both diodes conducting)	$I_{F(AV)}$	max.		30			A
Forward voltage	V_F	<		0.6			V
Junction temperature	T_j	max.		150			^oC

MECHANICAL DATA

Dimensions in mm

Fig.1 TO-220AB





Net mass: 2 g

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 (IEC134).

Voltages

			BYV43–30	35	40(A)	45	
Repetitive peak reverse voltage	V_{RRM}	max.	30	35	40	45	V
Crest working reverse voltage (note 1)	V_{RWM}	max.	20	25	30	35	V
Continuous reverse voltage (note 1)	V_R	max.	20	25	30	35	V

Currents (both diodes conducting; note 2)

Average forward current square-wave; d = 0.5; up to T_{mb} = 85 °C (note 5)	$I_{F(AV)}$	max.	30	A
R.M.S. forward current	$I_{F(RMS)}$	max.	30	A
Repetitive peak forward current	I_{FRM}	max.	300	A
Non-repetitive peak forward current t = 10 ms; half sine-wave; T_j = 125 °C prior to surge; with re-applied V_{RWMmax} (note 3)	I_{FSM}	max.	200	A
I^2t for fusing (t = 10 ms; note 3)	I^2t	max.	200	A^2s
Reverse surge current (t_p = 100 μs); (note 6)	I_{RSM}	max.	0.5	A

Temperatures

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

CHARACTERISTICS (per diode)

Forward voltage I_F = 15 A; T_j = 100 °C (note 4)	V_F	<	0.6	V
I_F = 30 A; T_j = 25 °C (note 4)	V_F	<	0.87	V
Reverse current V_R = V_{RWMmax}; T_j = 125 °C	I_R	<	75	mA
Capacitance at f = 1 MHz V_R = 5 V; T_j = 25 to 125 °C	C_d	typ.	500	pF

Notes:

1. Up to T_j = 125 °C; see derating curve for higher temperature operation.
2. The limits for both diodes apply whether both diodes conduct simultaneously or on alternate half cycles.
3. Surge figures apply to each diode.
4. Measured under pulse conditions to avoid excessive dissipation.
5. For output currents in excess of 20 A, connection should be made to the exposed metal mounting base.
6. BYV43–40A only.

THERMAL RESISTANCE

From junction to mounting base (both diodes conducting)	$R_{th\ j\text{-}mb}$	=	1.4	K/W
Transient thermal impedance; t = 1 ms	$Z_{th\ j\text{-}mb}$	=	0.65	K/W

Influence of mounting method

1. Heatsink mounted with clip (see mounting instructions)

Thermal resistance from mounting base to heatsink

a. with heatsink compound	$R_{th\ mb\text{-}h}$	=	0.2	K/W
b. with heatsink compound and 0.06 mm maximum mica insulator	$R_{th\ mb\text{-}h}$	=	1.4	K/W
c. with heatsink compound and 0.1 mm maximum mica insulator (56369)	$R_{th\ mb\text{-}h}$	=	2.2	K/W
d. with heatsink compound and 0.25 mm maximum alumina insulator (56367)	$R_{th\ mb\text{-}h}$	=	0.8	K/W
e. without heatsink compound	$R_{th\ mb\text{-}h}$	=	1.4	K/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 K/W

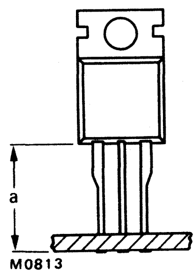


Fig.2

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 ^{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. 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 the 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.
4. 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.
5. 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.

OPERATING NOTES

Dissipation and heatsink considerations:

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

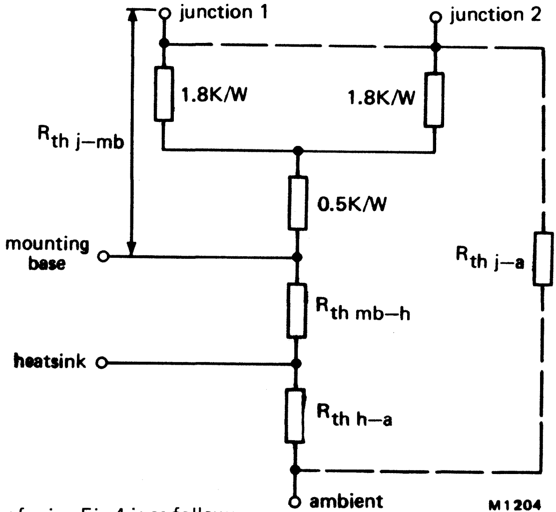


Fig.3

b. The method of using Fig.4 is as follows:
   Starting with the required current on the $I_{F(AV)}$ axis, trace upwards to meet the appropriate 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.

SQUARE-WAVE OPERATION (BOTH DIODES)

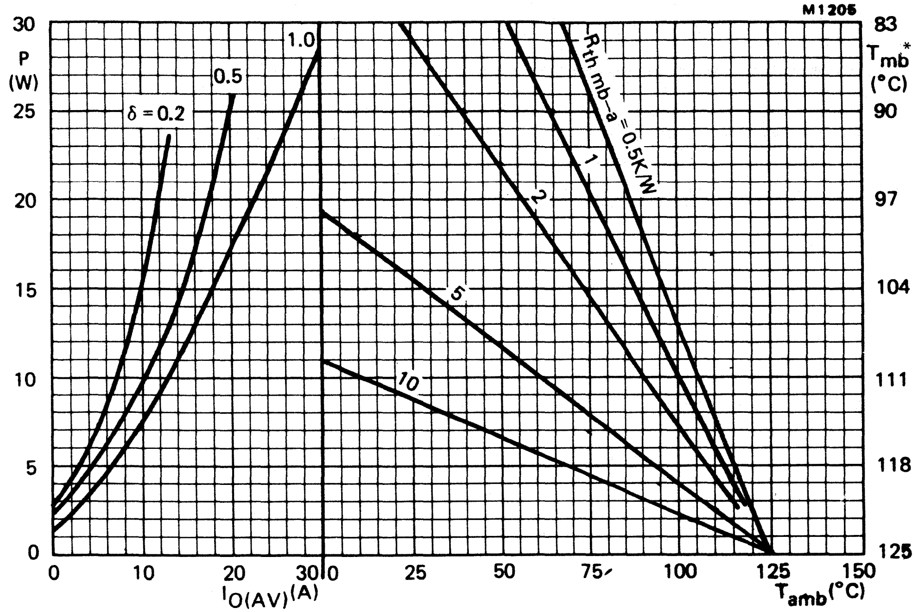
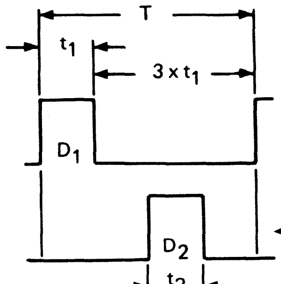


Fig.4 The right-hand part shows the relationship between the power (derived from the left-hand part) and the maximum permissible temperatures.



$\delta = \frac{t_1 + t_2}{T}$ = total conduction time of both diodes in one time period.

D_1 = first diode conducting.

D_2 = second diode conducting.

← e.g. δ = 0.5

*T_{mb} scale is for comparison purposes and is correct only for $R_{th\ mb-a} < 2.7$ K/W

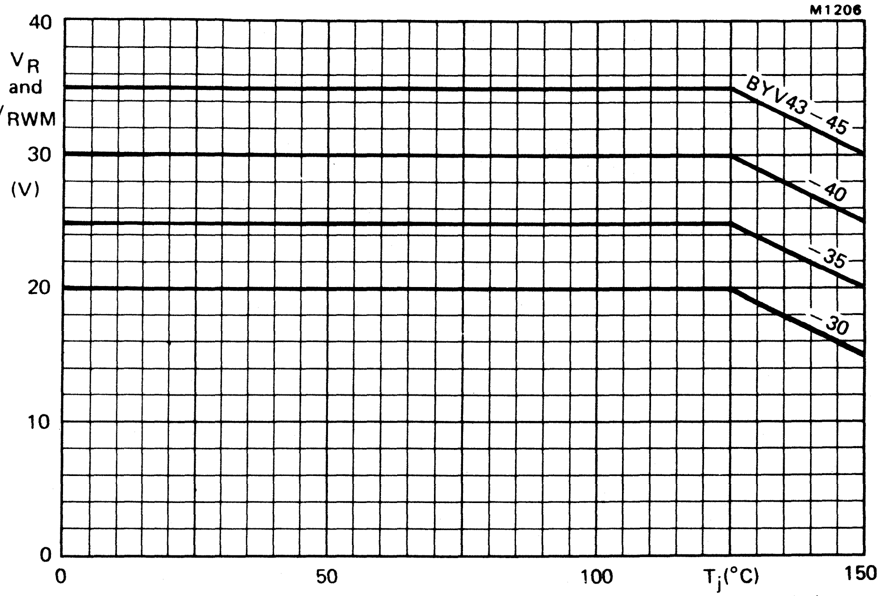


Fig.5 Maximum allowable continuous and crest working voltage as a function of junction temperature.

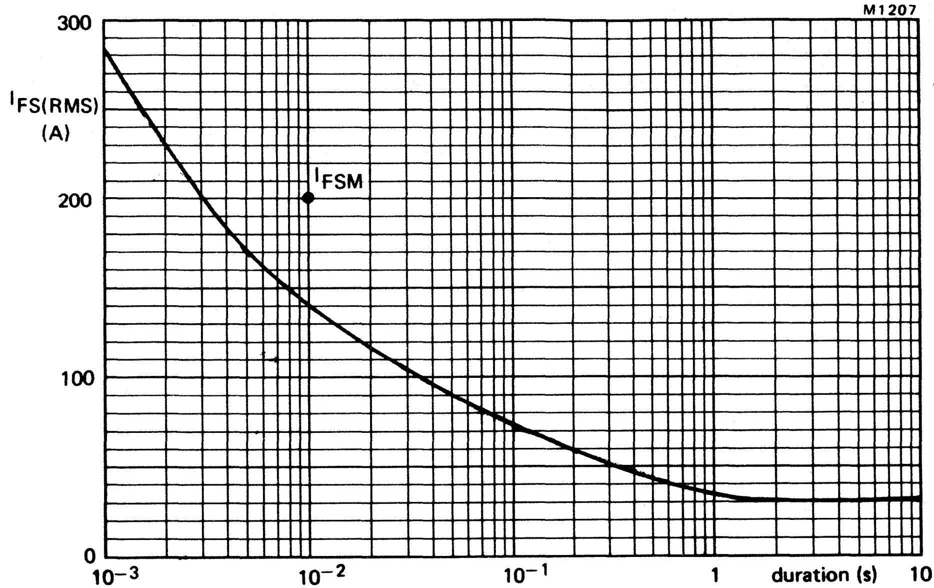
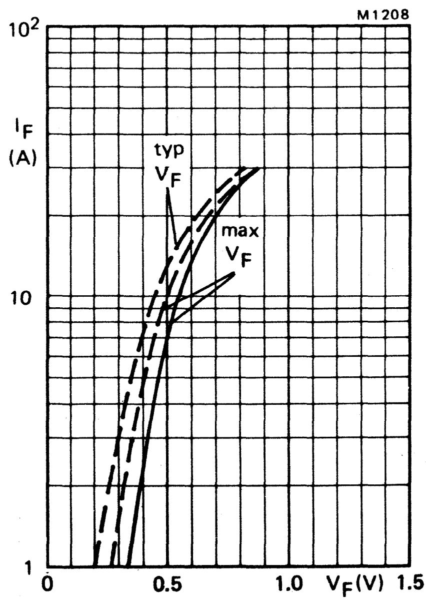


Fig.6 Maximum permissible non-repetitive r.m.s. forward current based on sinusoidal currents (f = 50 Hz); T_j = 125 °C prior to surge; with re-applied $V_{RWM\ max}$; per diode.



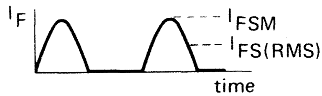


Fig.7 —— T_j = 25 °C; – – – T_j = 100 °C; per diode.

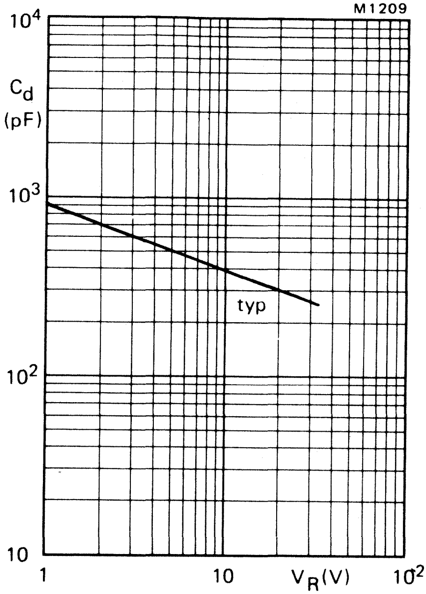


Fig.8 f = 1 MHz; T_j = 25 to 125 °C; per diode.

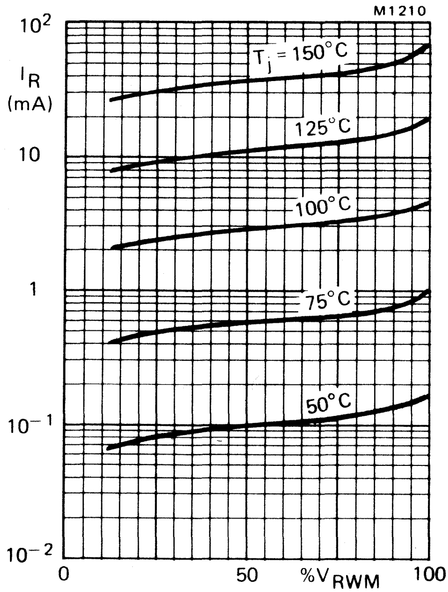


Fig.9 Typical values; per diode.

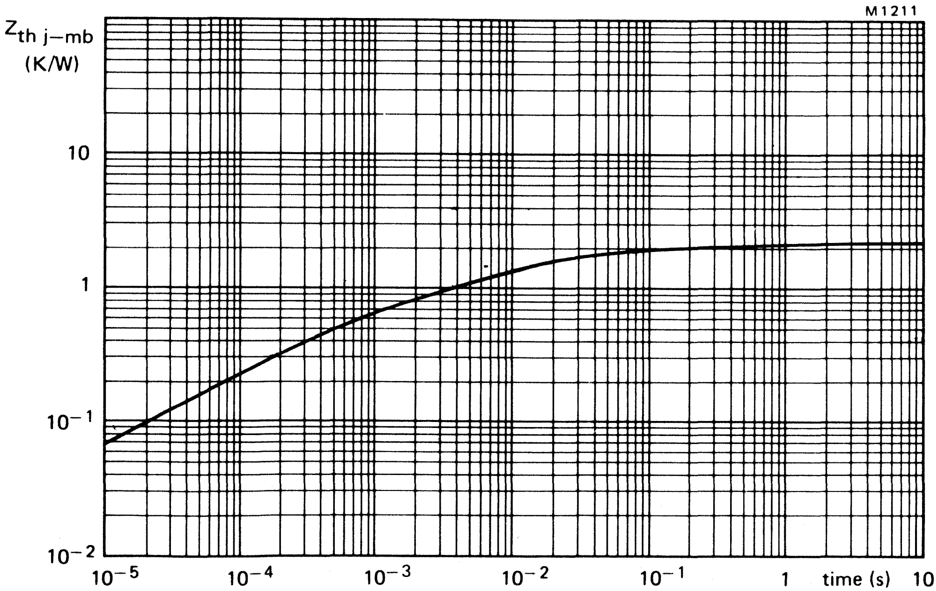


Fig.10 One diode conducting.

SCHOTTKY-BARRIER DOUBLE RECTIFIER DIODES

High-efficiency double rectifier diodes in plastic envelopes which feature low forward voltage drop, low capacitance and absence of stored charge. 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 monolithic construction allows both diodes to be paralleled without derating. The series consists of common-cathode types. A version with guaranteed reverse surge capability, BYV73-40A, is also available.

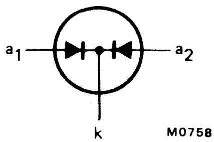
QUICK REFERENCE DATA

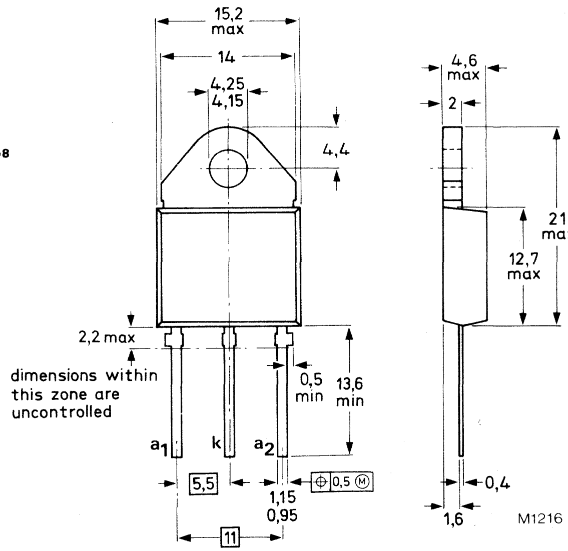
Per diode, unless otherwise stated			BYV73–30	35	40(A)	45	
Repetitive peak reverse voltage	V_{RRM}	max.	30	35	40	45	V
Average forward current (both diodes conducting)	$I_{F(AV)}$	max.			30		A
Forward voltage	V_F	<			0.6		V
Junction temperature	T_j	max.			150		°C

MECHANICAL DATA

Dimensions in mm

Fig.1 SOT-93; cathode connected to mounting base





Accessories supplied on request: see data sheets Mounting instructions and accessories for SOT-93 envelopes.

RATINGS

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

Voltages

			BYV73–30	35	40(A)	45	
Repetitive peak reverse voltage	V_{RRM}	max.	30	35	40	45	V
Crest working reverse voltage (note 1)	V_{RWM}	max.	20	25	30	35	V
Continuous reverse voltage (note 1)	V_R	max.	20	25	30	35	V

Currents (both diodes conducting; note 2)

Average forward current square-wave; d = 0.5; up to T_{mb} = 85 °C (note 3)	$I_{F(AV)}$	max.	30	A
R.M.S. forward current	$I_{F(RMS)}$	max.	30	A
Repetitive peak forward current (t_p = 20 μs; δ ⩽ 0.02	I_{FRM}	max.	300	A
Non-repetitive peak forward current t = 10 ms; half sine-wave; T_j = 125 °C prior to surge; with re-applied V_{RWMmax} (note 4)	I_{FSM}	max.	150	A
I^2t for fusing (t = 10 ms; note 4)	I^2t	max.	112	A^2s
Reverse surge current (t_p = 100 μs); (note 5)	I_{RSM}	max.	0.5	A

Temperatures

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

CHARACTERISTICS (per diode)

Forward voltage I_F = 15 A; T_j = 100 °C (note 6)	V_F	<	0.6	V
I_F = 30 A; T_j = 25 °C (note 6)	V_F	<	0.87	V
Reverse current $V_R = V_{RWMmax}$; T_j = 125 °C	I_R	<	75	mA
Capacitance at f = 1 MHz V_R = 5 V; T_j = 25 to 125 °C	C_d	typ.	500	pF

Notes:

1. Up to T_j = 125 °C; see derating curve for higher temperature operation.
2. The limits for both diodes apply whether both diodes conduct simultaneously or on alternate half cycles.
3. For output currents in excess of 20 A, connection should be made to the exposed metal mounting base.
4. Surge figures apply to each diode.
5. BYV73–40A only.
6. Measured under pulse conditions to avoid excessive dissipation.

THERMAL RESISTANCE

From junction to mounting base (both diodes conducting)	$R_{th\ j\text{-}mb}$	=	1.4	K/W
Transient thermal impedance; t = 1 ms	$Z_{th\ j\text{-}mb}$	=	0.65	K/W

Influence of mounting method

1. Heatsink mounted with clip (see mounting instructions)

Thermal resistance from mounting base to heatsink

a. with heatsink compound	$R_{th\ mb\text{-}h}$	=	0.2	K/W
b. with heatsink compound and 0.06 mm maximum mica insulator (56378)	$R_{th\ mb\text{-}h}$	=	1.4	K/W
c. without heatsink compound	$R_{th\ mb\text{-}h}$	=	1.4	K/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 any lead length and with copper laminate $R_{th\ j\text{-}a}$ = 60 K/W

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 for output currents in excess of 20 A, connection be made to the exposed metal mounting base (Fig.1).
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 the screw mounting.

   b. safe isolation for mains operation.

   However, if a screw is used, it should be M4 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. 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.

OPERATING NOTES

Dissipation and heatsink considerations:

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

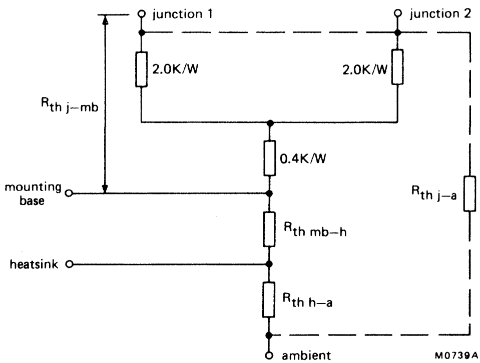


Fig.2

b. The method of using Fig.3 is as follows:
Starting with the required current on the $I_{F(AV)}$ axis, trace upwards to meet the appropriate 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.

SQUARE-WAVE OPERATION (BOTH DIODES)

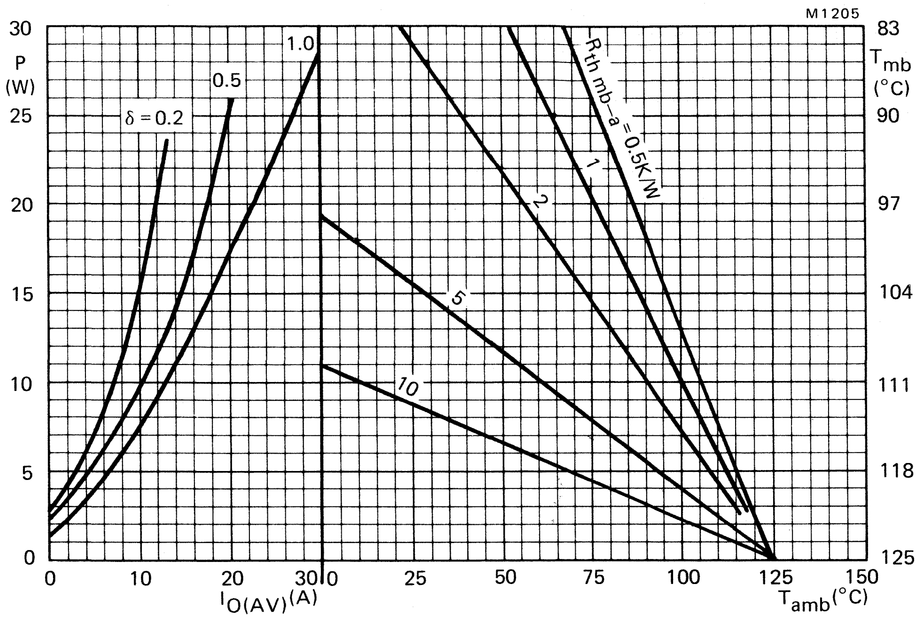
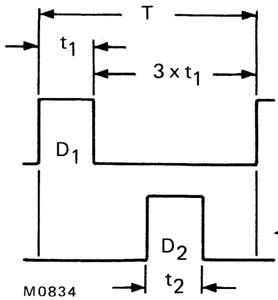


Fig.3 The right-hand part shows the relationship between the power (derived from the left-hand part) and the maximum permissible temperatures.



$\delta = \frac{t_1 + t_2}{T}$ = total conduction time of both diodes in one time period

D_1 = first diode conducting.

D_2 = second diode conducting.

← e.g. $\delta = 0.5$

*T_{mb} scale is for comparison purposes and is correct only for $R_{th\ mb\text{-}a} < 2.7$ K/W

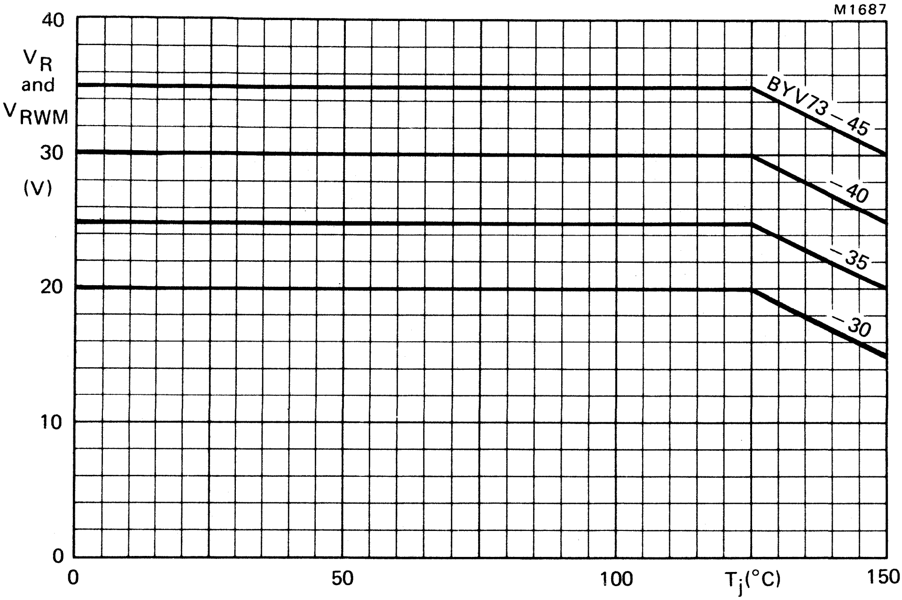


Fig.4 Maximum allowable continuous and crest working voltage as a function of junction temperature.

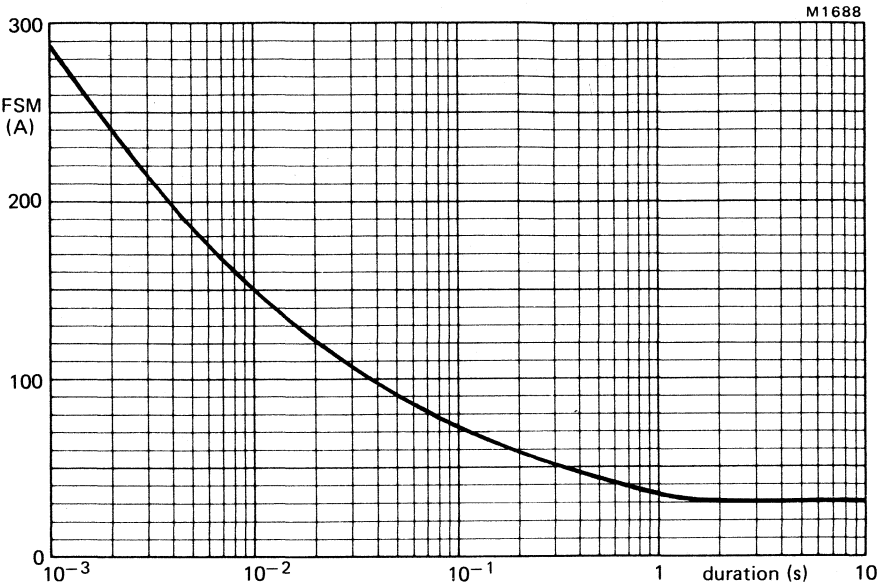
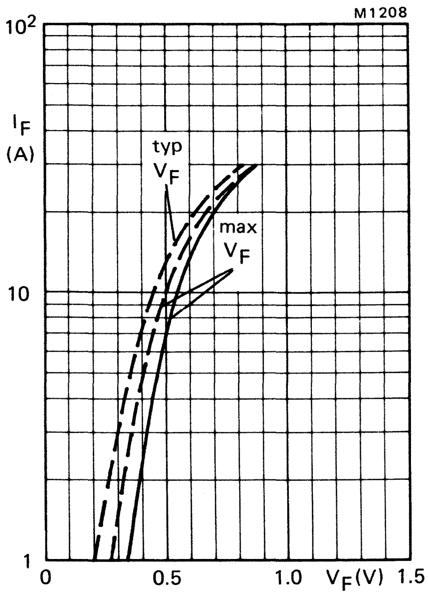


Fig.5 Maximum permissible non-repetitive peak forward current based on sinusoidal currents (f = 50 Hz); T_j = 125 °C prior to surge; with re-applied V_{RWMmax}; per diode.



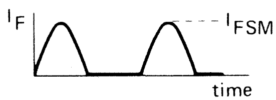


Fig.6 —— T_j = 25 °C; – – – T_j = 100 °C; per diode.

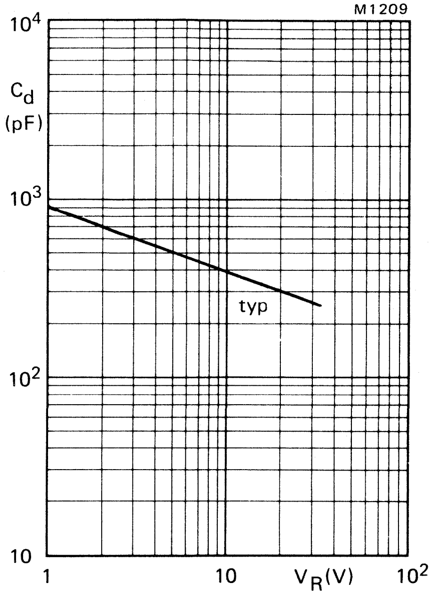


Fig.7 f = 1 MHz; T_j = 25 to 125 °C; per diode.

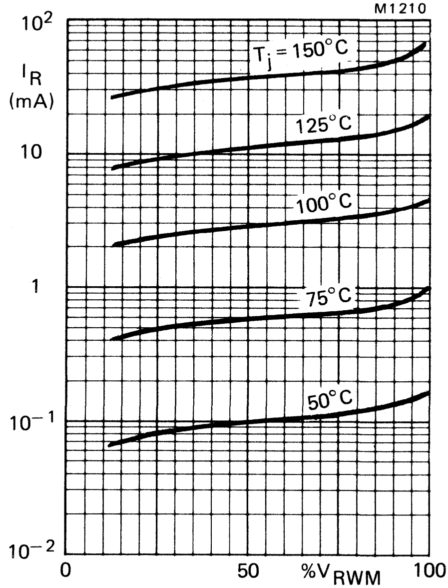


Fig.8 Typical values; per diode.

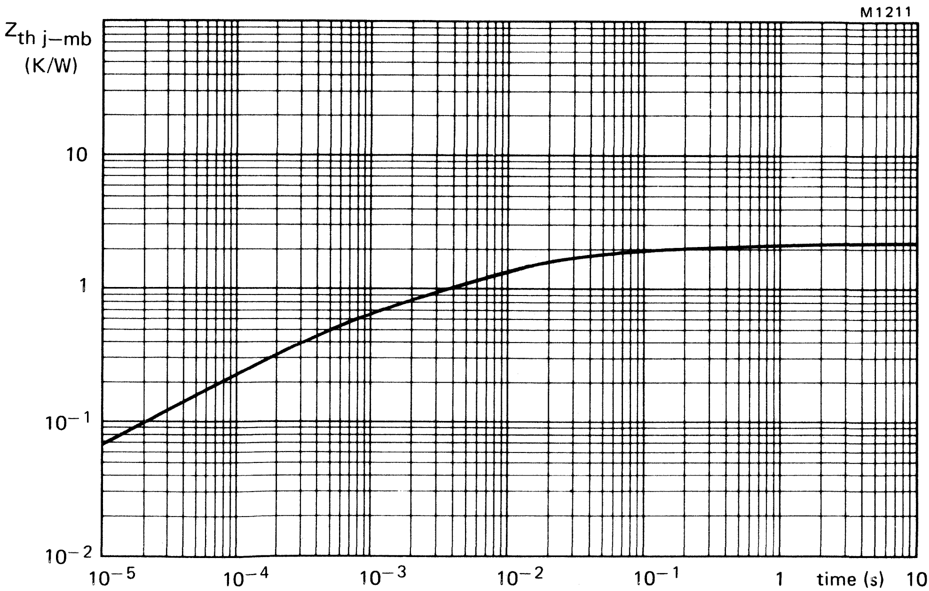


Fig.9 One diode conducting.

SCHOTTKY–BARRIER RECTIFIER DIODE

High-efficiency rectifier diode in a DO–5 metal envelope, featuring low forward voltage drop, low capacitance, absence of stored charge and high temperature stability. It is 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, It can also withstand reverse voltage transients. The diode is of normal polarity (cathode to stud).

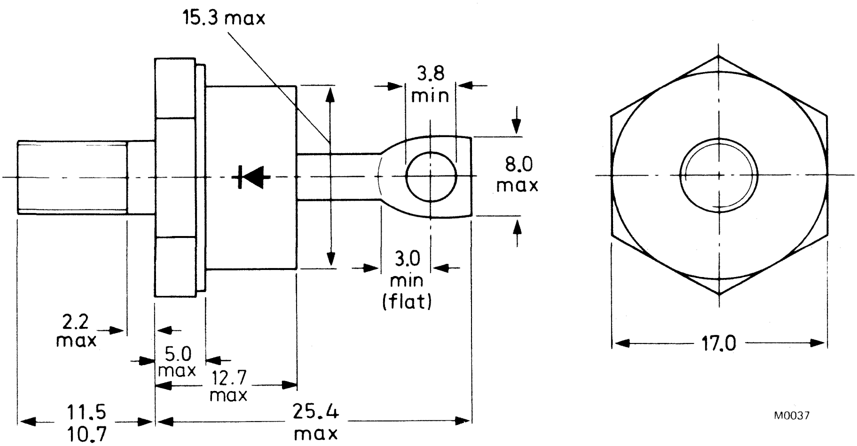
QUICK REFERENCE DATA

Repetitive peak reverse voltage	V_{RRM}	max.	45	V
Average forward current	$I_{F(AV)}$	max.	60	A
Forward voltage	V_F	$<$	0.6	V
Junction temperature	T_j	max.	150	°C

MECHANICAL DATA

Dimensions in mm

Fig.1 DO–5 with ¼″ x 28 UNF stud (ϕ6.35 mm)



Net mass: 22 g

Diameter of clearance hole: 6.5 mm

Accessories supplied on request:
see ACCESSORIES section

Supplied with device: 1 nut, 1 lock washer.
Torque on nut:
min. 1.7 Nm (17 kg cm),
max.3.5 Nm (35 kg cm).
Nut dimensions across the flats:
¼″ x 28 UNF, 11.1 mm

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

Voltages

Repetitive peak reverse voltage	V_{RRM}	max.	45	V
Crest working reverse voltage	V_{RWM}	max.	35	V
Continuous reverse voltage	V_R	max.	35	V

Currents

Average forward current; switching losses negligible square-wave; $\delta = 0.5$; up to $T_{mb} = 90\ ^oC$.	$I_{F(AV)}$	max.	60	A
R.M.S. forward current	$I_{F(RMS)}$	max.	85	A
Non-repetitive peak forward current t = 10 ms; half sine-wave; $T_j = 125\ ^oC$ prior to surge; with reapplied V_{RWMmax}	I_{FSM}	max.	700	A
I^2t for fusing (t = 10 ms)	I^2t	max.	2450	A^2s

Temperatures

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

THERMAL RESISTANCE

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

CHARACTERISTICS

Forward voltage $I_F = 60$ A; $T_j = 125\ ^oC$	V_F	<	0.6	V*
$I_F = 120$ A; $T_j = 125\ ^oC$	V_F	<	0.84	V*
Rate of rise of reverse voltage $V_R = V_{RWMmax}$	$\frac{dV_R}{dt}$	<	1500	V/µs
Reverse current $V_R = V_{RWMmax}$; $T_j = 125\ ^oC$	I_R	<	200	mA
Capacitance at f = 1 MHz $V_R = 5$ V; $T_j = 25$ to $125\ ^oC$	C_d	typ.	2100	pF

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.

*Measured under pulse conditions to avoid excessive dissipation.

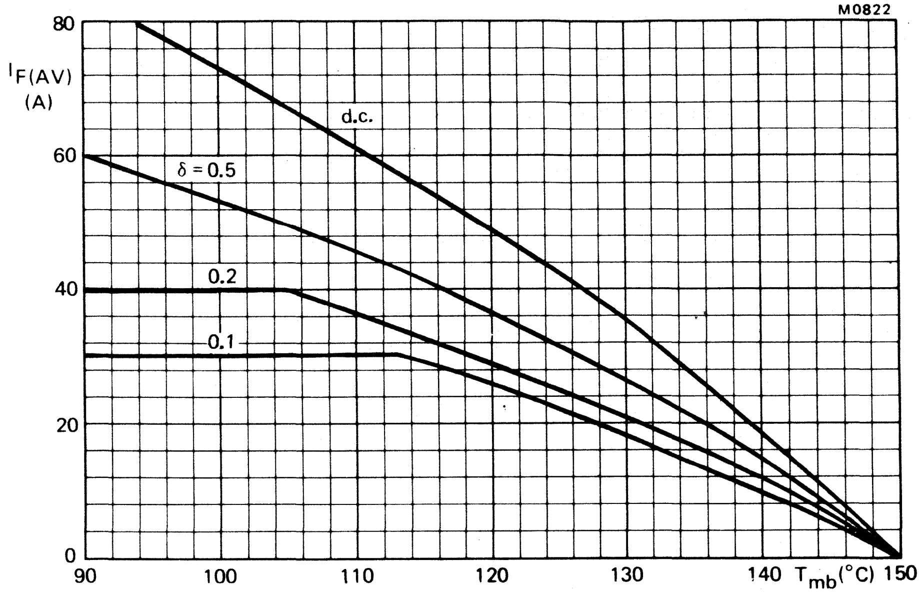
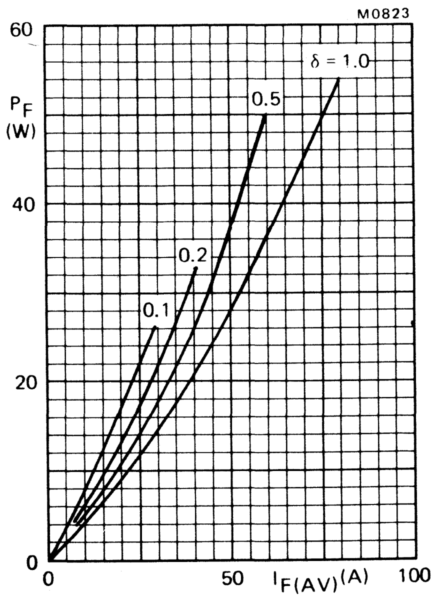


Fig.2 Maximum permissible average forward current versus mounting-base temperature at V_{RWM} = 35 V.



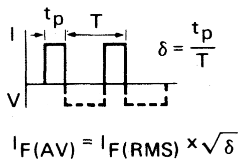


Fig.3 Forward power dissipation versus average forward current.

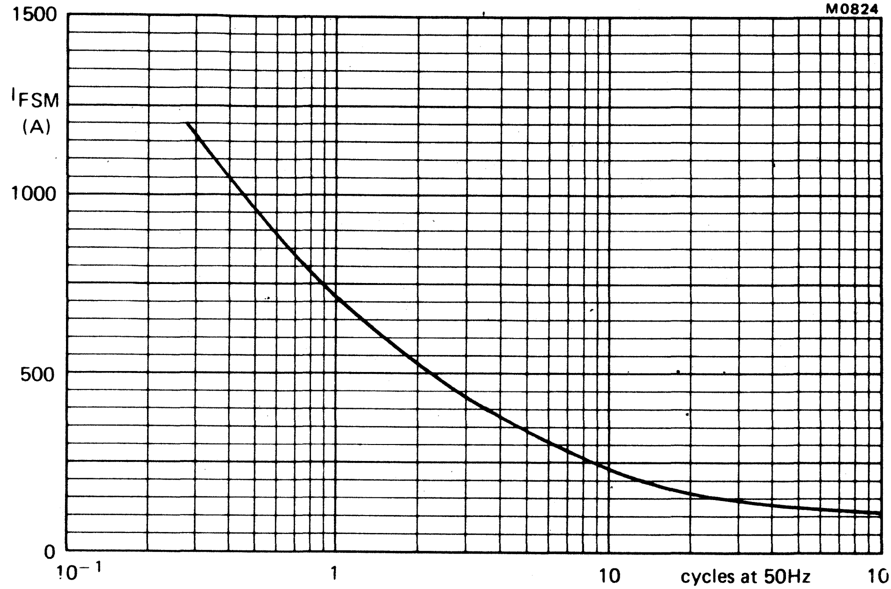


Fig.4 Maximum permissible non-repetitive peak forward current based on sinusoidal currents (f = 50 Hz); T_j = 125 °C prior to surge; with reapplied V_{RWMmax}.

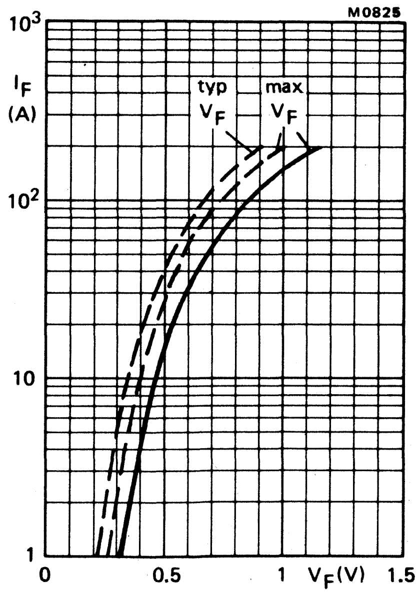


Fig.5 —— T_j = 25 °C; – – – T_j = 125 °C

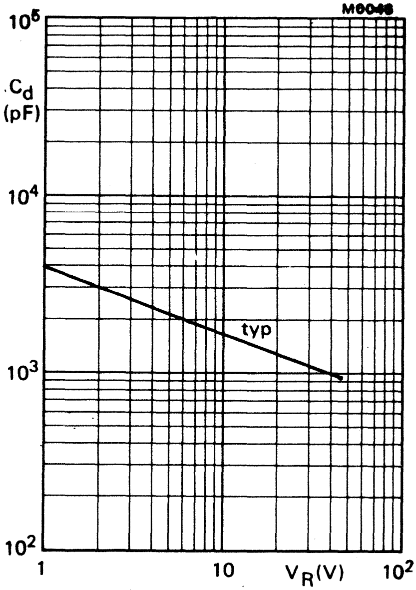


Fig.6 f = 1 MHz; T_j = 25 to 125 °C

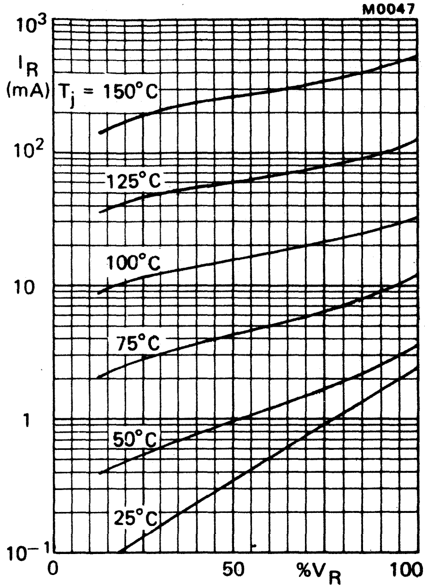


Fig.7 Typical values

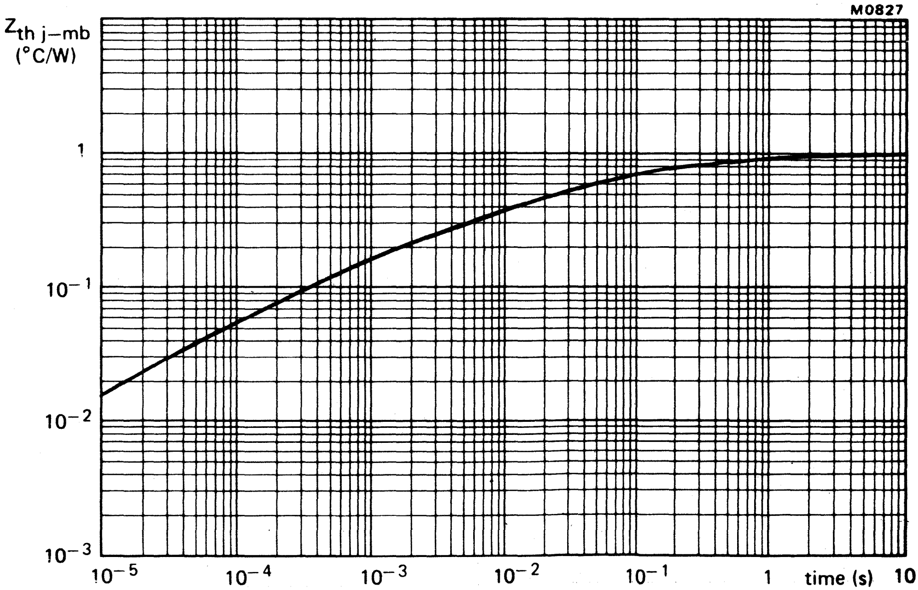


Fig.8

REGULATOR DIODES

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

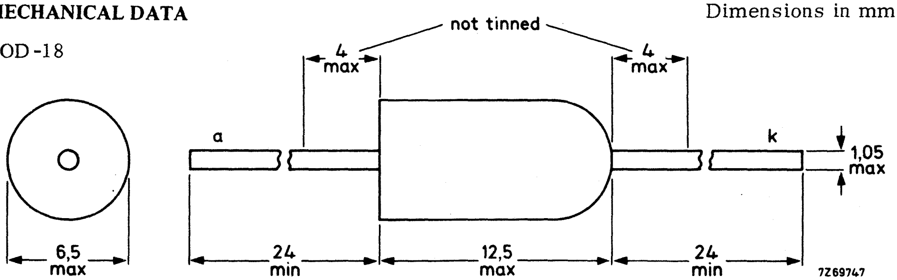
Stand-off voltage (15% range) *	V_R	5,6 to 62	V
Reverse breakdown voltage	$V_{(BR)R}$	6,4 to 70	V
Non-repetitive peak reverse power dissipation; exponential pulse	P_{RSM}	max. 700	W

* 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).

Products approved to CECC 50 005-015 available on request.

CHARACTERISTICS – WHEN USED AS TRANSIENT SUPPRESSOR DIODES; T_{amb} = 25 °C

clamping voltage at t_p = 500 μs exp. pulse $V_{(CL)R}$ V typ.	max.	non-repetitive peak reverse current I_{RSM} A	reverse current at recommended stand-off voltage I_R mA max.	V_R V	BZW70-. . .
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

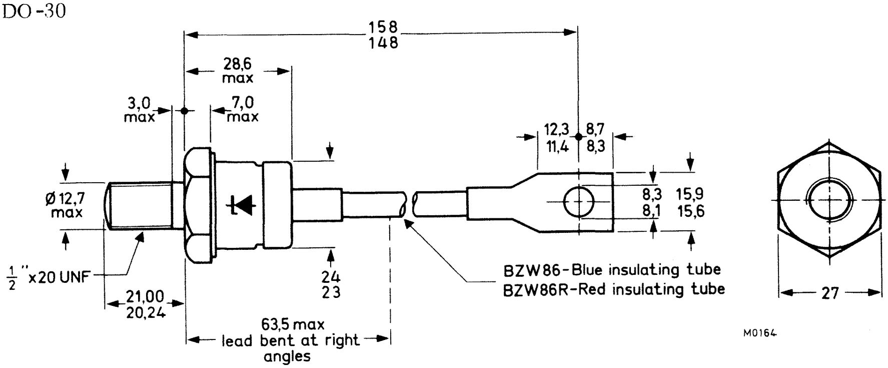
QUICK REFERENCE DATA				
Stand-off voltage (15% range) *	V_R		7,5 to 56	V
Reverse breakdown voltage	$V_{(BR)R}$		9,4 to 64	V
Non-repetitive peak reverse power dissipation; exponential pulse	P_{RSM}	max.	25	kW

* 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 486)	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 485				
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 for square and 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 p.486 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

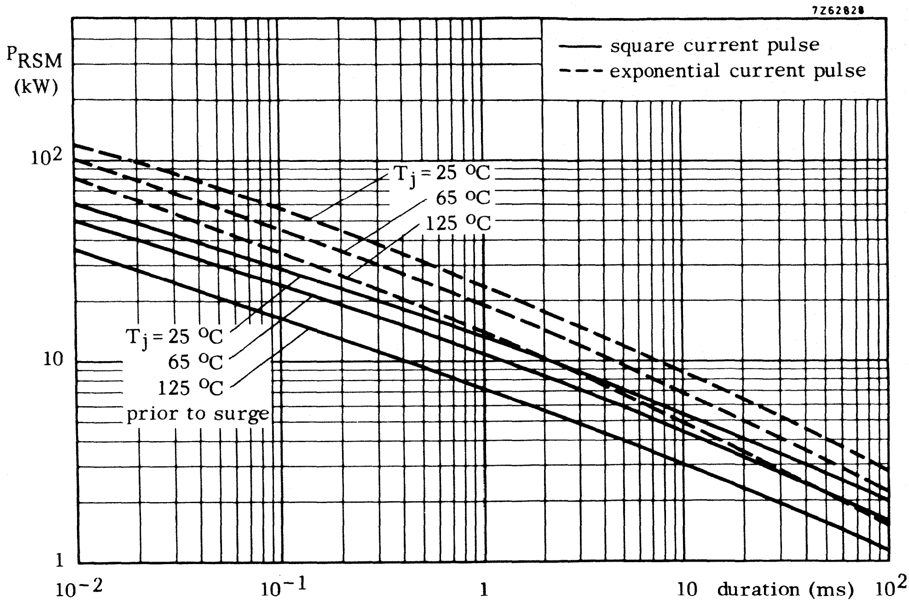
P_S = any steady state dissipation excluding that in pulses

δ = duty factor (t_p/T)

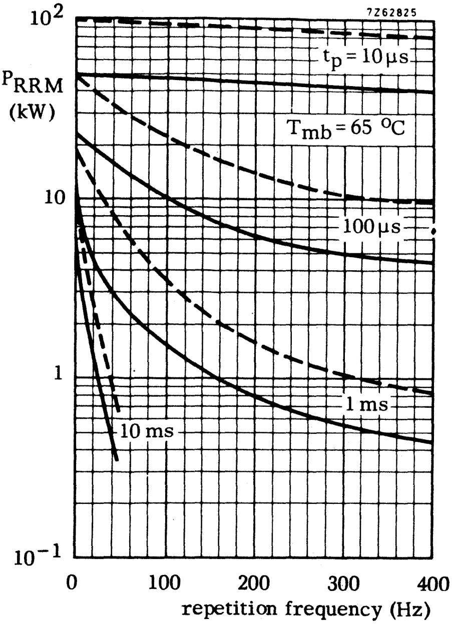
$R_{th\ j\text{-}mb}$ = 0,3 °C/W

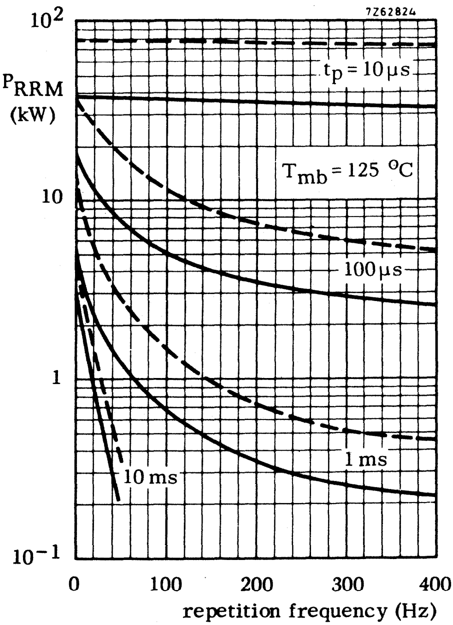
$R_{th\ mb\text{-}h}$ = 0,1 °C/W

thus $R_{th\ h\text{-}a}$ can be found.



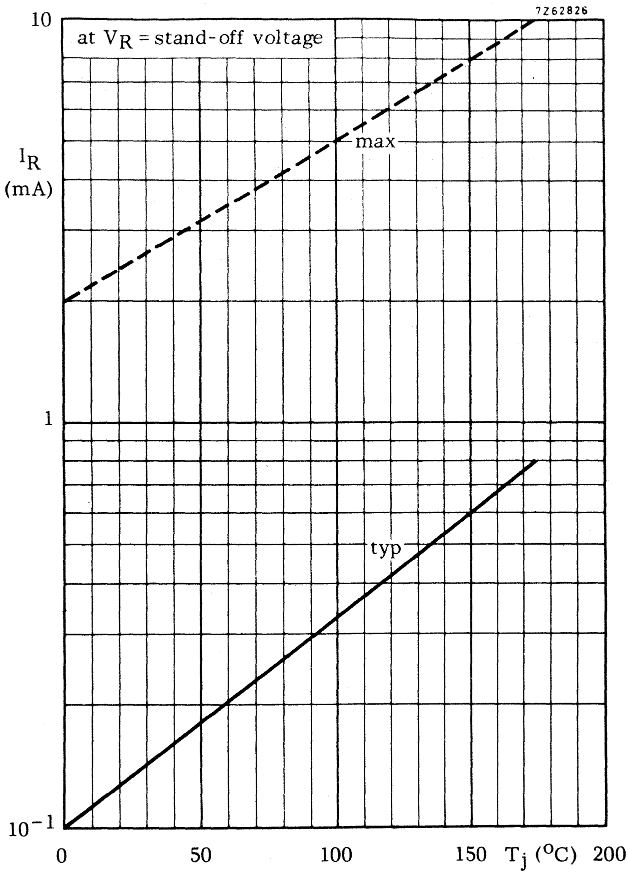
Duration of an exponential pulse is defined as the time taken for the pulse to fall to 37% of its initial value. It is assumed that the energy content does not continue beyond twice this time.

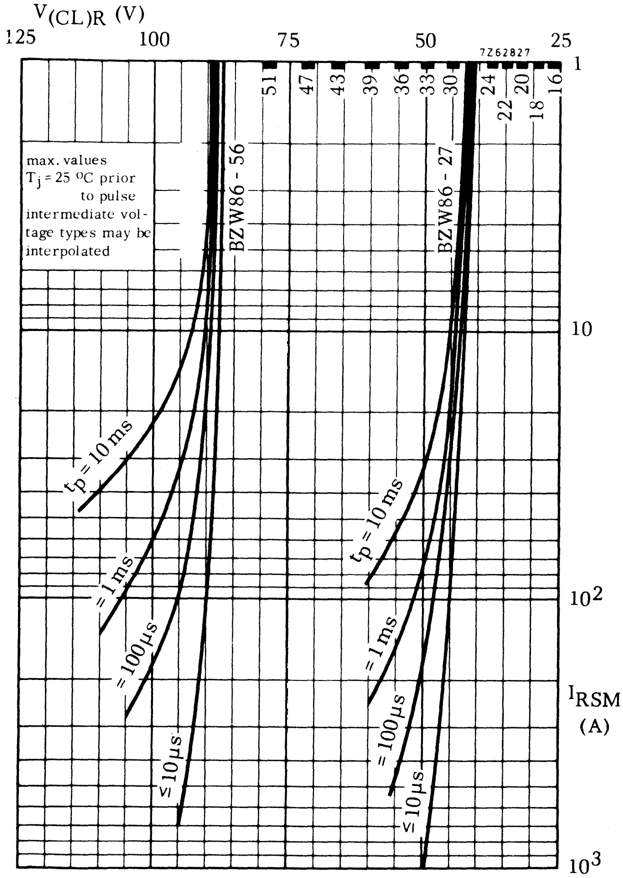




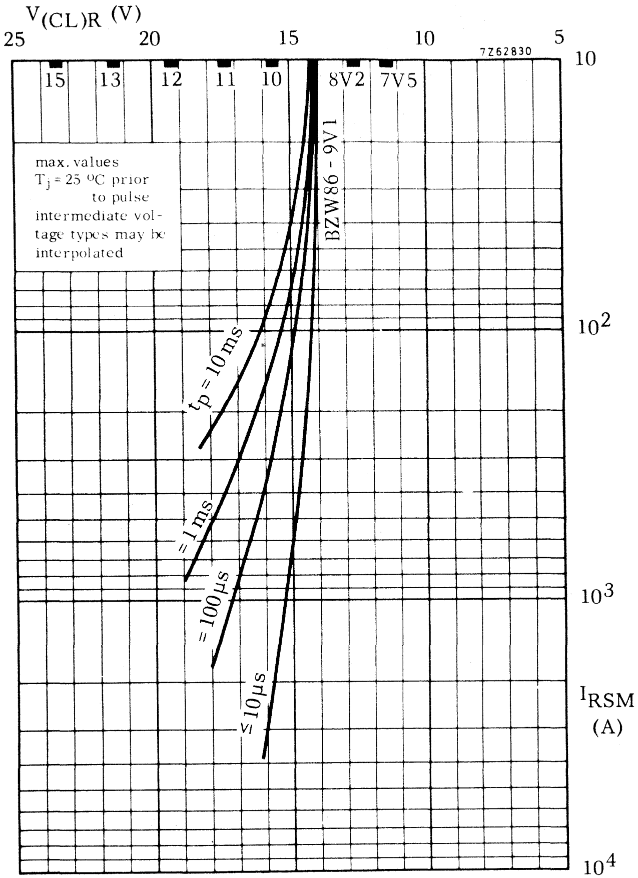
——— square current pulses

– – – exponential current pulses

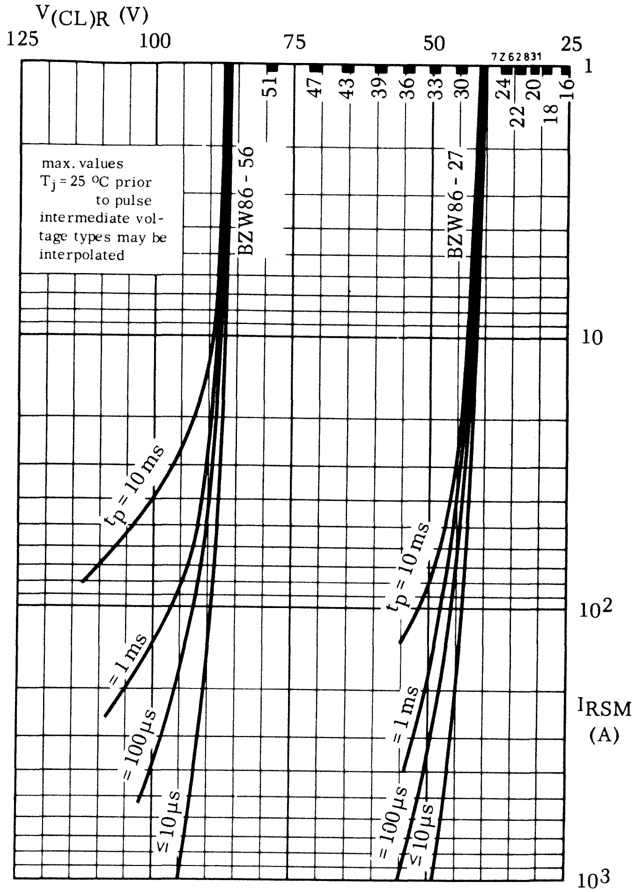

7Z62826
at V_R = stand-off voltage
I_R (mA)
10
1
10^{-1}
max
typ
0
50
100
150
200
T_j (°C)



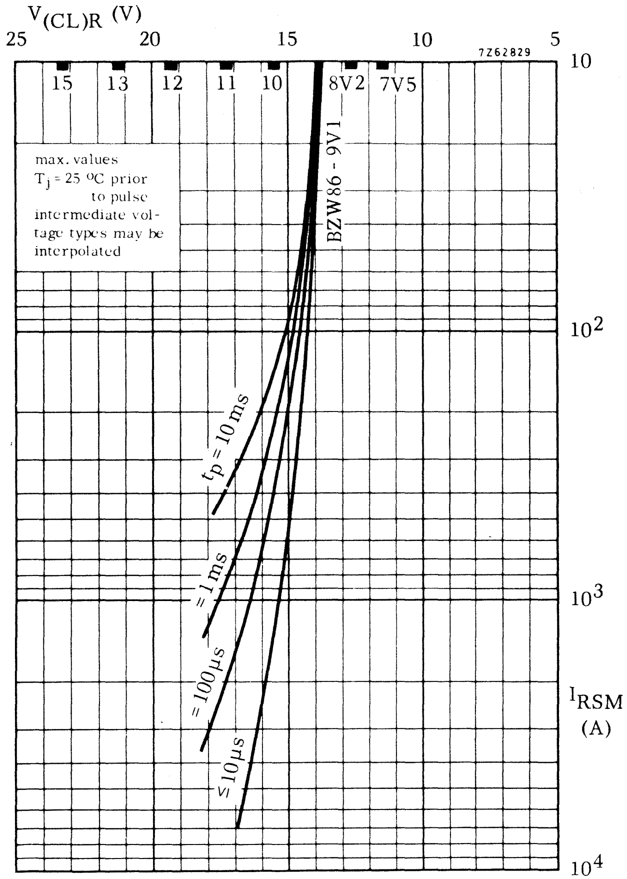
square pulses



square pulses



exponential pulses



exponential pulses

TRANSIENT SUPPRESSOR DIODES

For full information see BZY91 data sheet

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

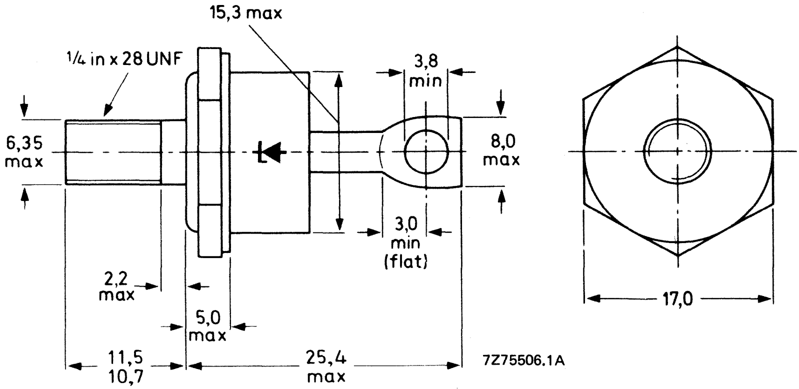
Stand-off voltage (15% range)*	V_R		6,2 to 62	V
Reverse breakdown voltage	$V_{(BR)R}$		7,0 to 70	V
Non-repetitive peak reverse power dissipation; T_j = 25 °C prior to surge; t_p = 100 µs (exponential pulse)	P_{RSM}	max.	27	kW

* 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: 22g
Accessories available: see ACCESSORIES section
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

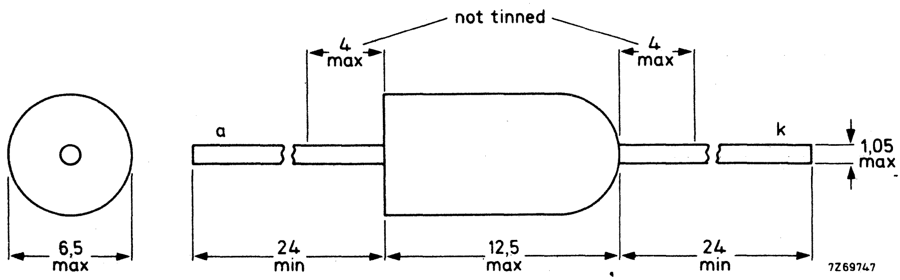
			voltage regulator	transient suppressor	
Working voltage (5% range)	V_Z	nom.	7,5 to 75	–	V
Stand-off voltage	V_R		–	5,6 to 56	V
Total power dissipation	P_{tot}	max.	2,5	–	W
Non-repetitive peak reverse power dissipation	P_{RSM}	max.	–	700	W

MECHANICAL DATA

Dimensions in mm

Fig. 1 SOD-18.

The rounded end indicates the cathode.



Products approved to CECC 50 005-015 available on request.

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 498)

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).

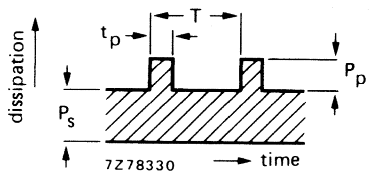


Fig. 2.

NOTES WHEN OPERATING AS A TRANSIENT SUPPRESSOR (see page 499)

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 mA	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.

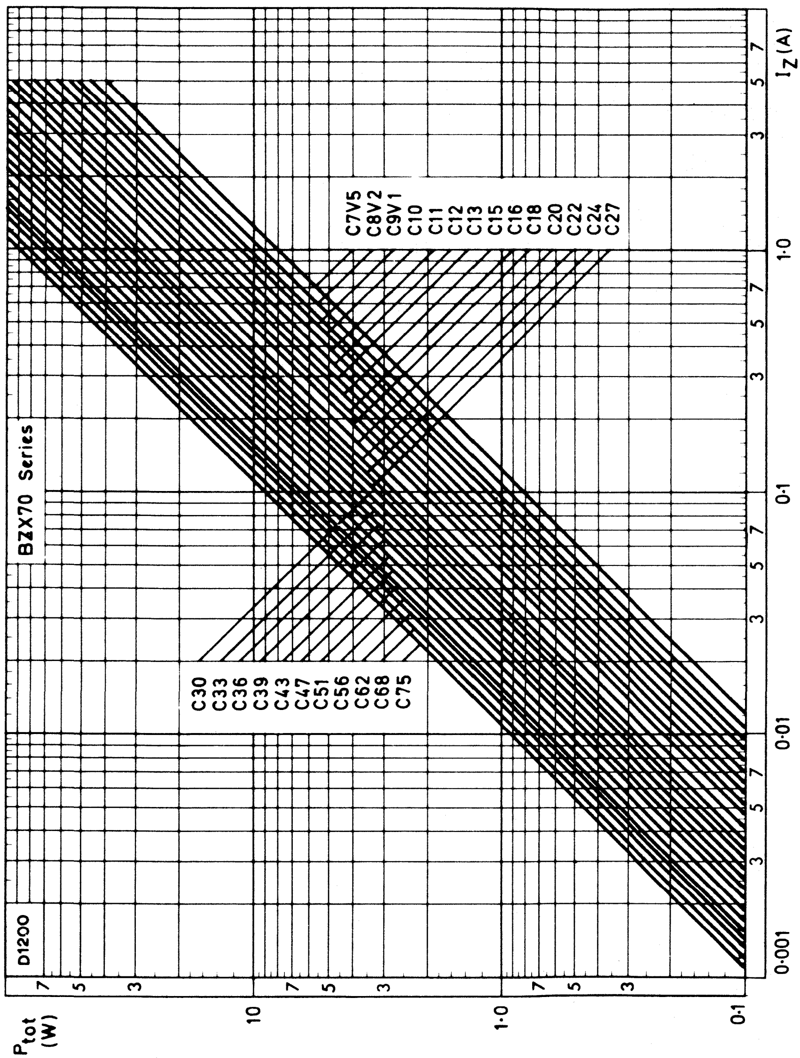


Fig. 3 Maximum permissible repetitive peak dissipation ($P_{tot} = P_{ZRM}$).

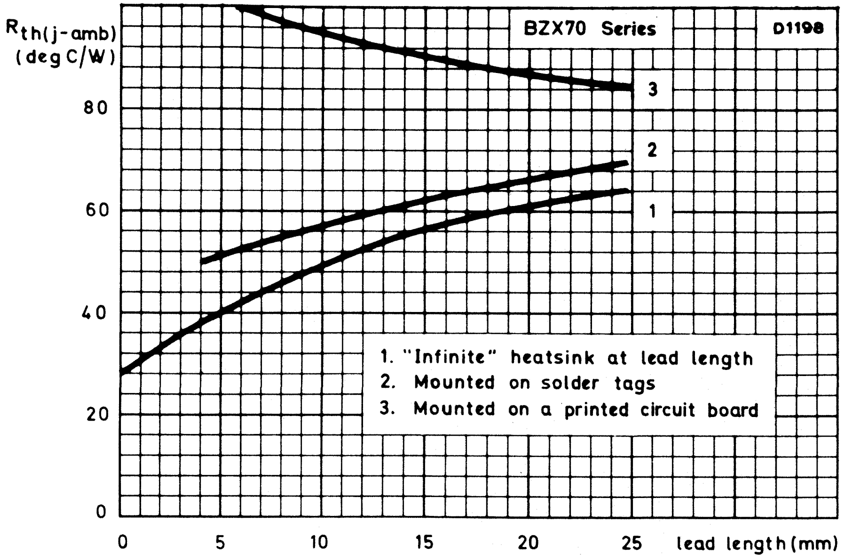


Fig. 4 Thermal resistance as a function of lead length under various mounting conditions.

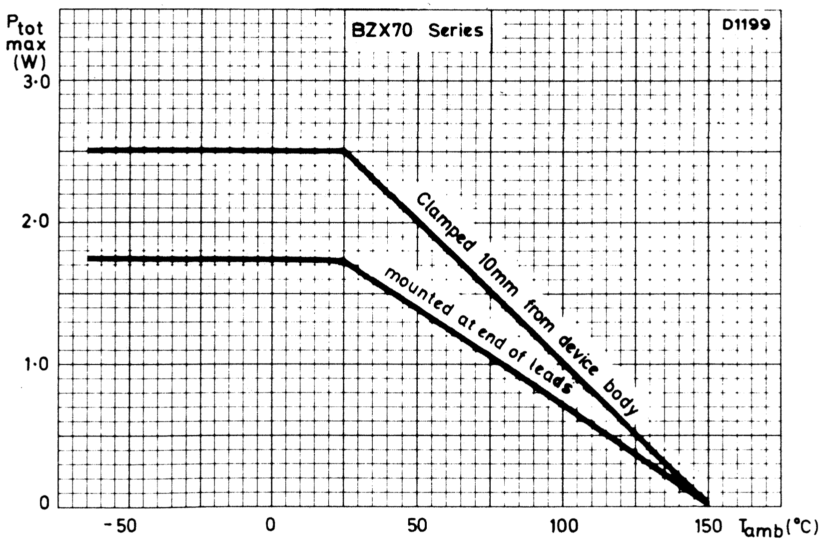


Fig. 5 Maximum permissible power dissipation; the top curve is for mounting method 1 from Fig. 4 at 10 mm lead length.

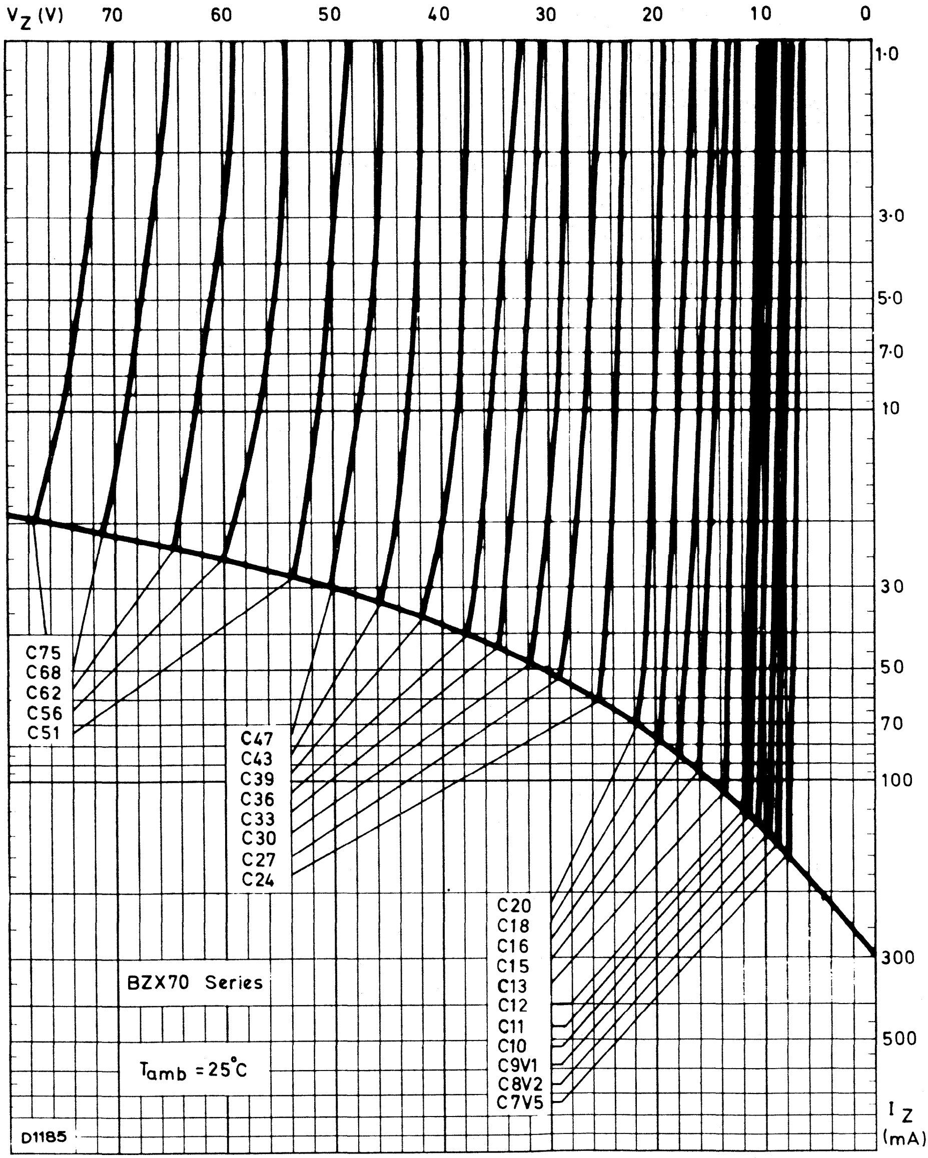


Fig. 6 Typical static zener characteristics.

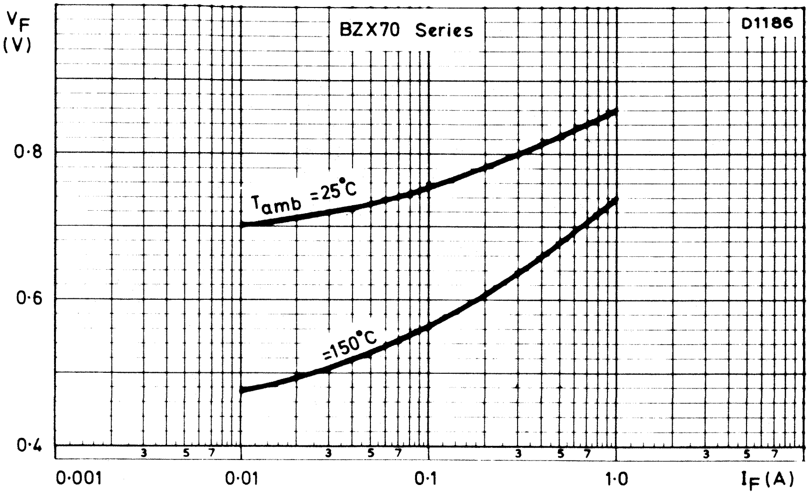


Fig. 7.

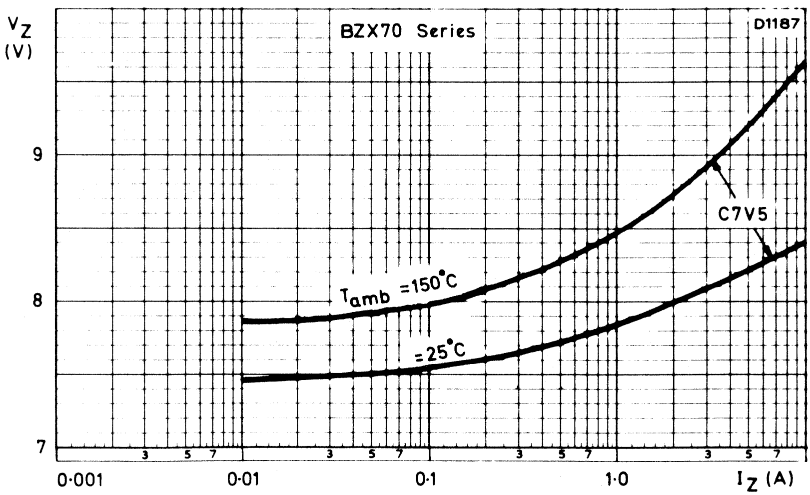


Fig. 8 Typical dynamic zener characteristics for BZX70-C7V5.

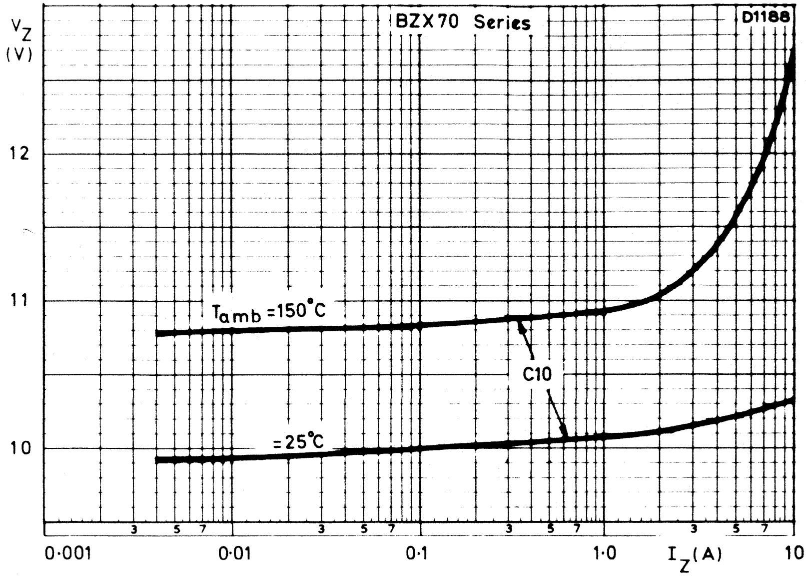


Fig. 9 Typical dynamic zener characteristics for BZX70-C10.

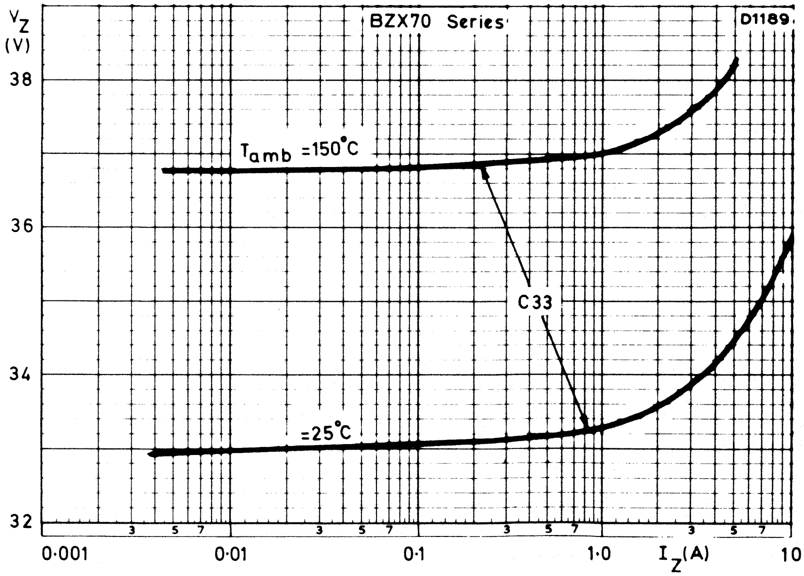


Fig. 10 Typical dynamic zener characteristics for BZX70-C33.

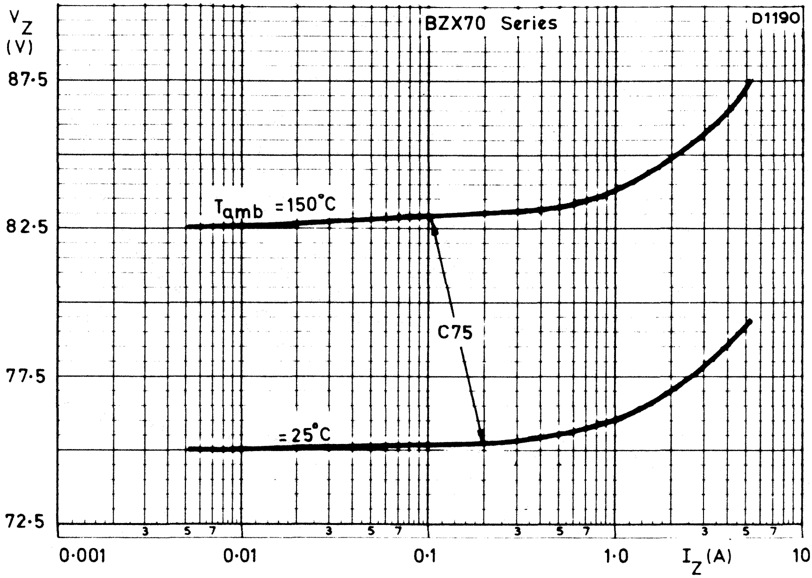


Fig. 11 Typical dynamic zener characteristics for BZX70-C75.

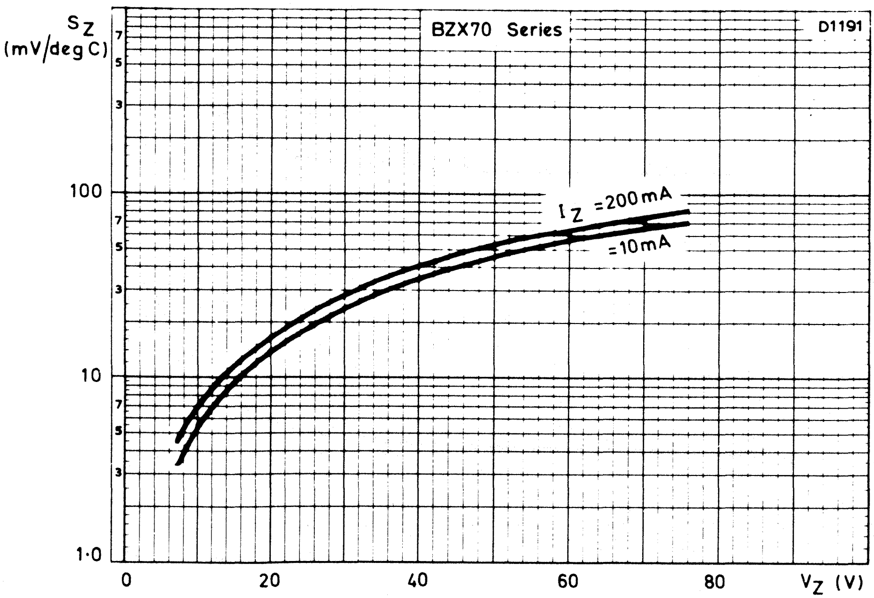


Fig. 12.

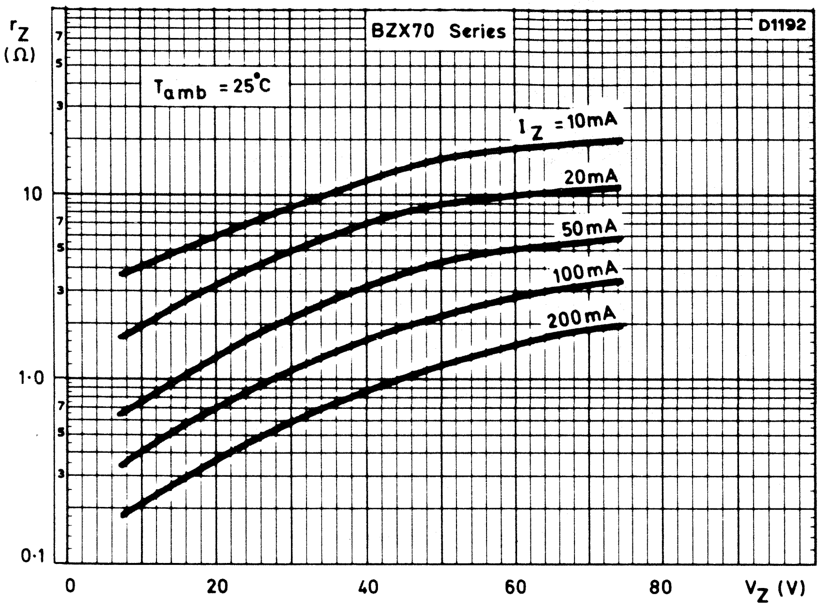

BZX70 Series
D1192
r_Z (Ω)
T_{amb} = 25°C
I_Z = 10mA
20mA
50mA
100mA
200mA
10
1·0
0·1
0
20
40
60
80
V_Z (V)

Fig. 13.

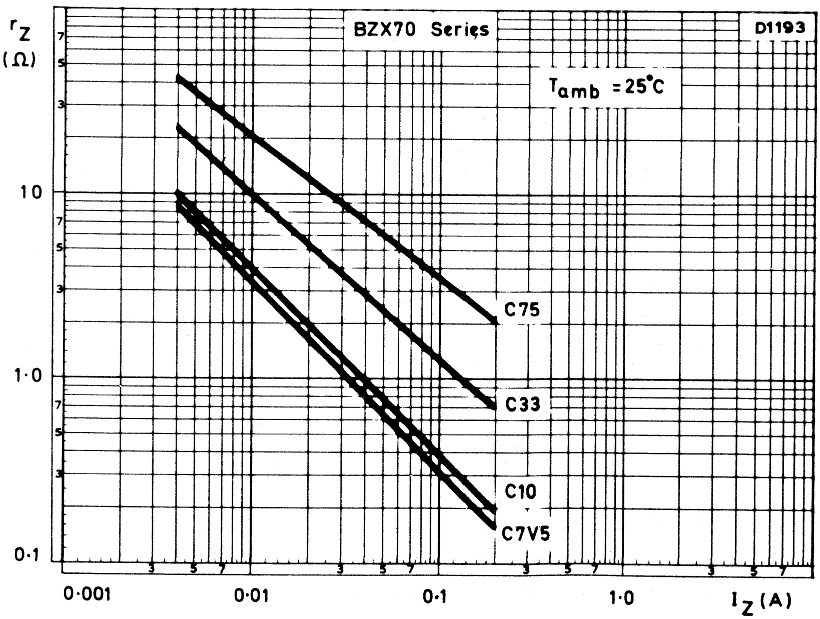

BZX70 Series
D1193
r_Z (Ω)
T_{amb} = 25°C
C75
C33
C10
C7V5
10
1·0
0·1
0·001
0·01
0·1
1·0
I_Z (A)

Fig. 14.

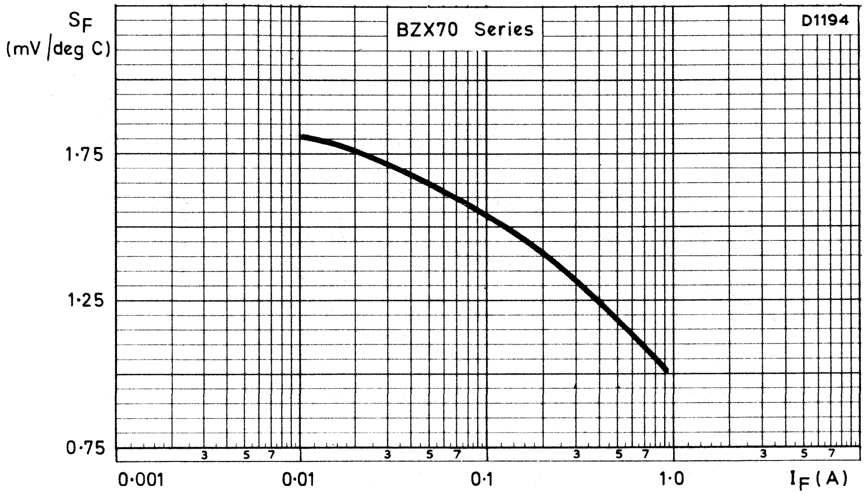


Fig. 15 Typical values.

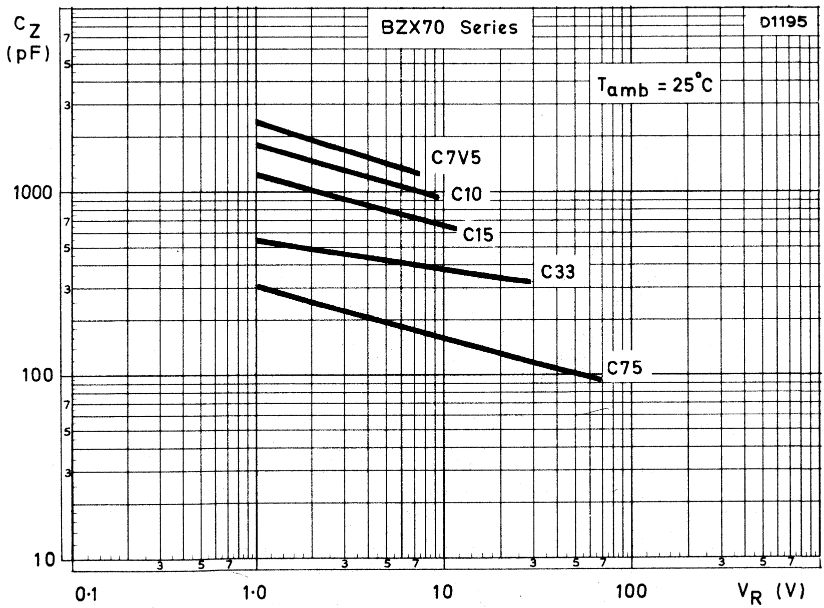


Fig. 16 Typical values.

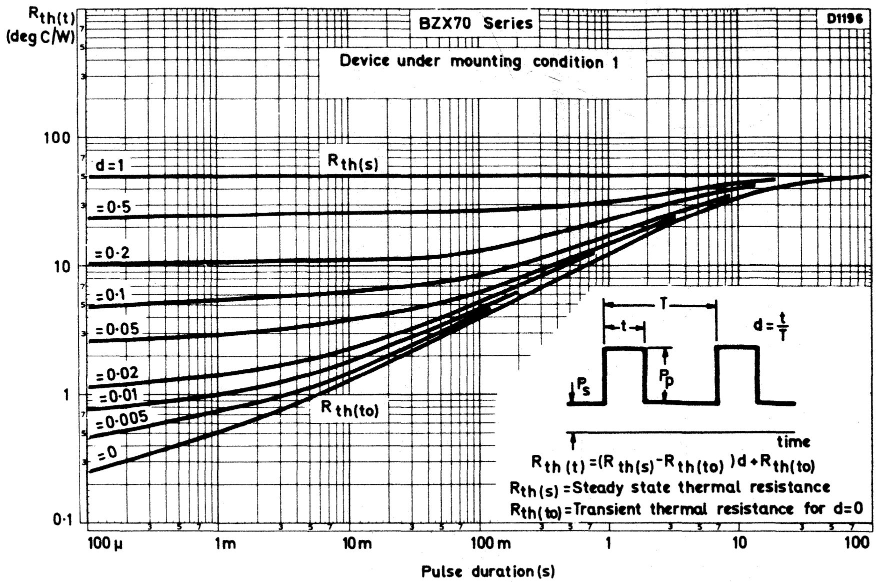


Fig. 17 Device under mounting condition 1 (infinite heatsink); see Fig. 4.

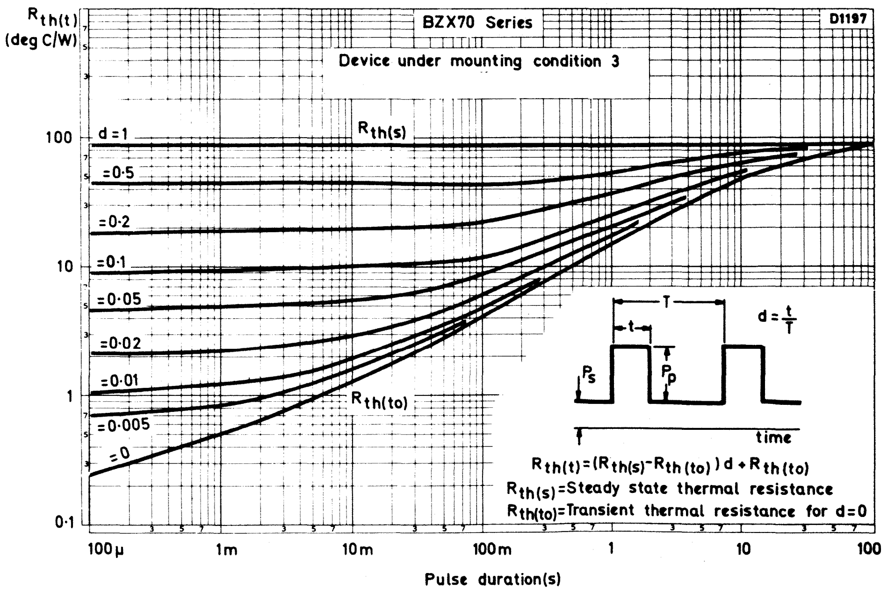


Fig. 18 Device under mounting method 3 (mounted on a printed-circuit board); see Fig. 4.

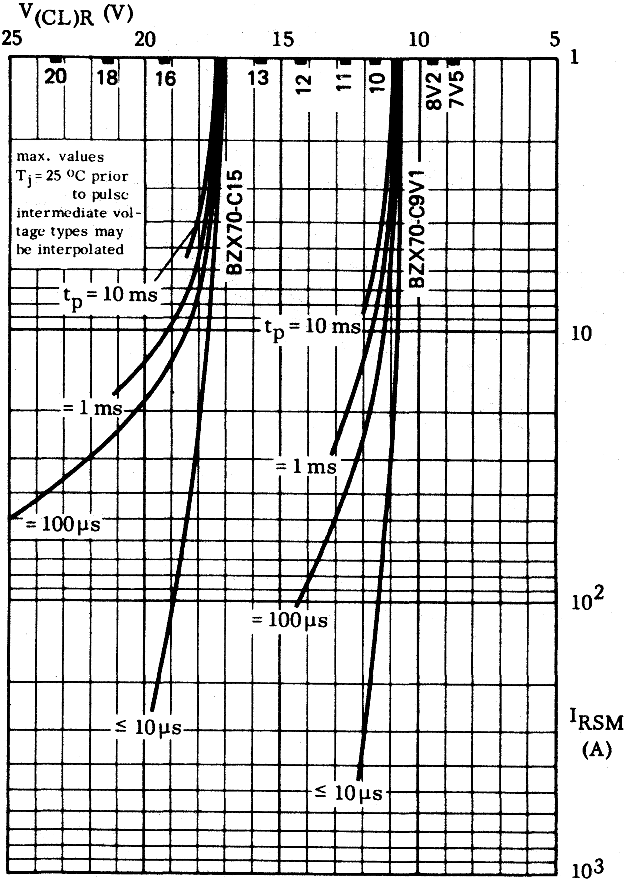


Fig. 19 Square pulses.

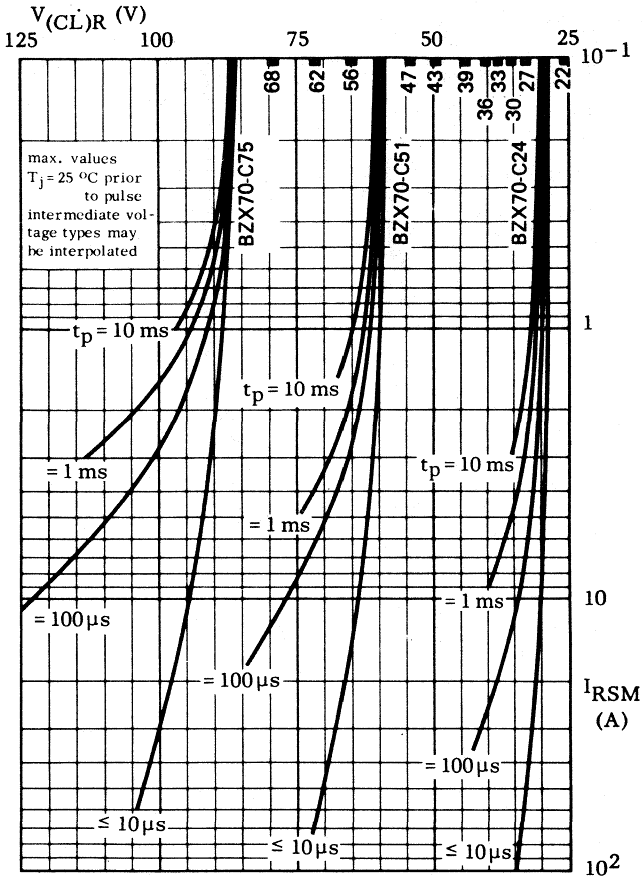


Fig. 20 Square pulses.

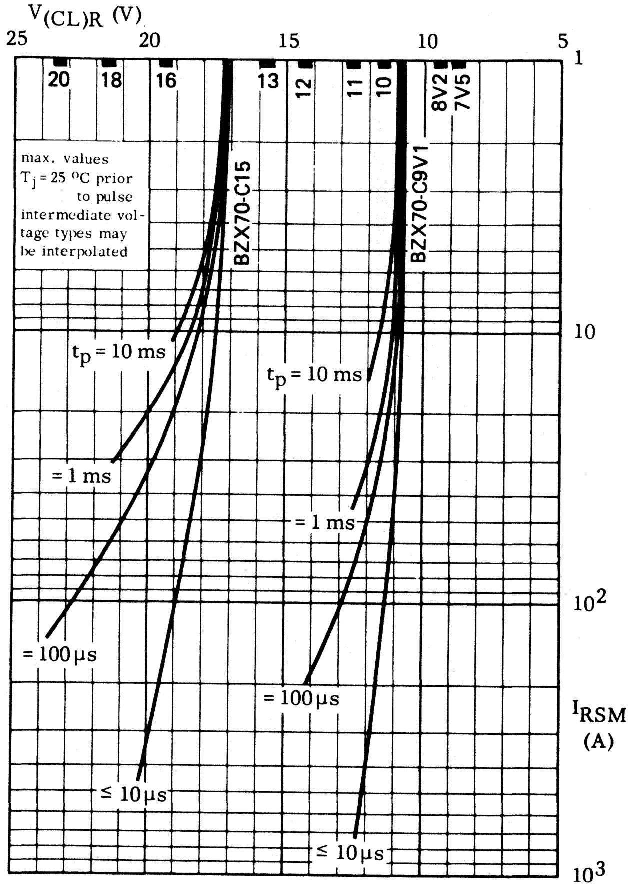


Fig. 21 Exponential pulses.

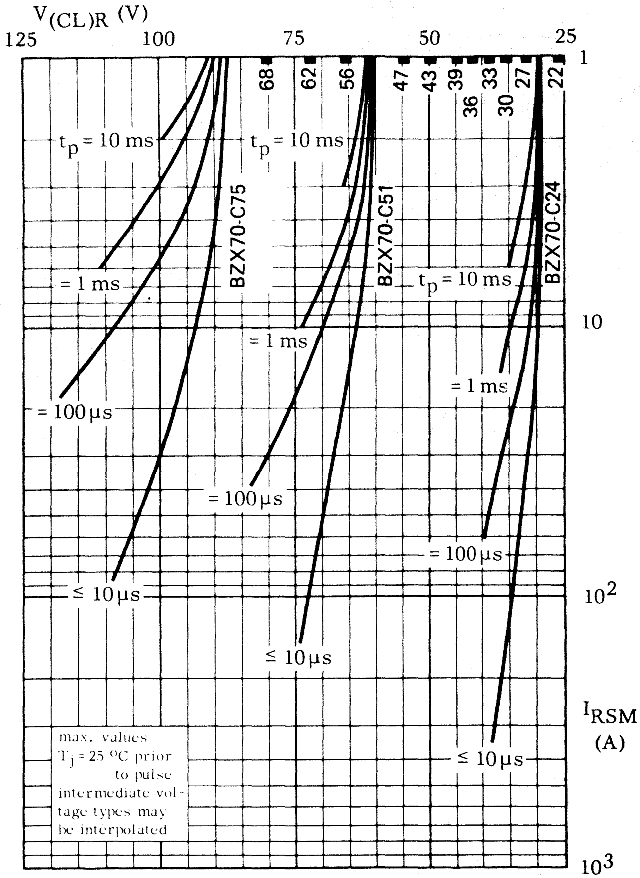


Fig. 22 Exponential pulses.

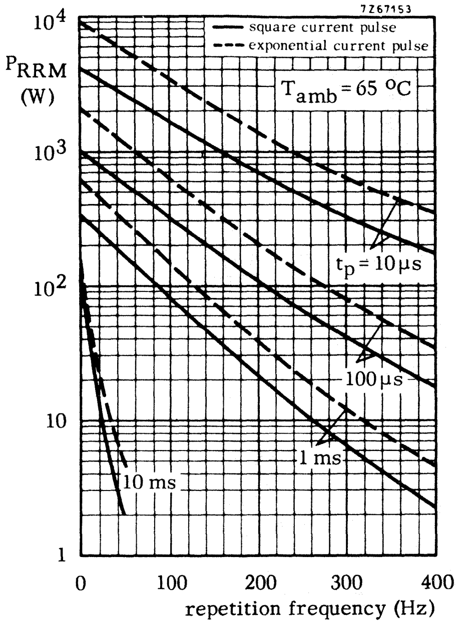


Fig. 23.

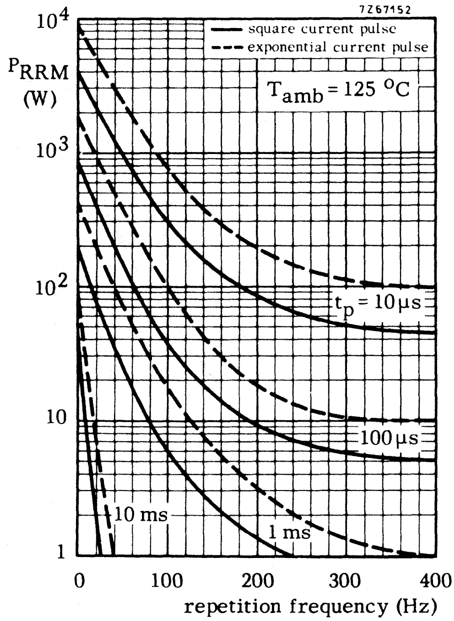


Fig. 24.

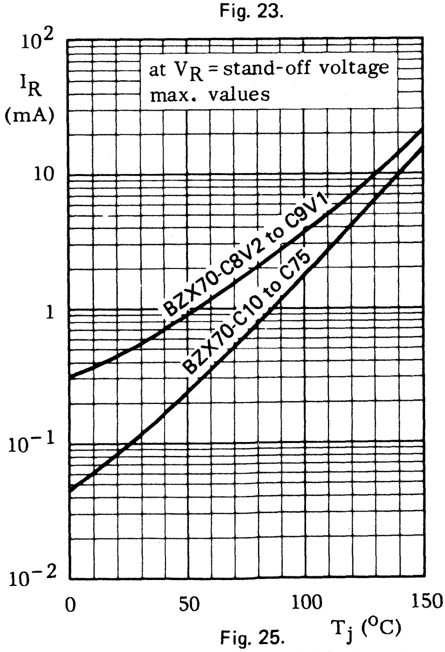


Fig. 25.

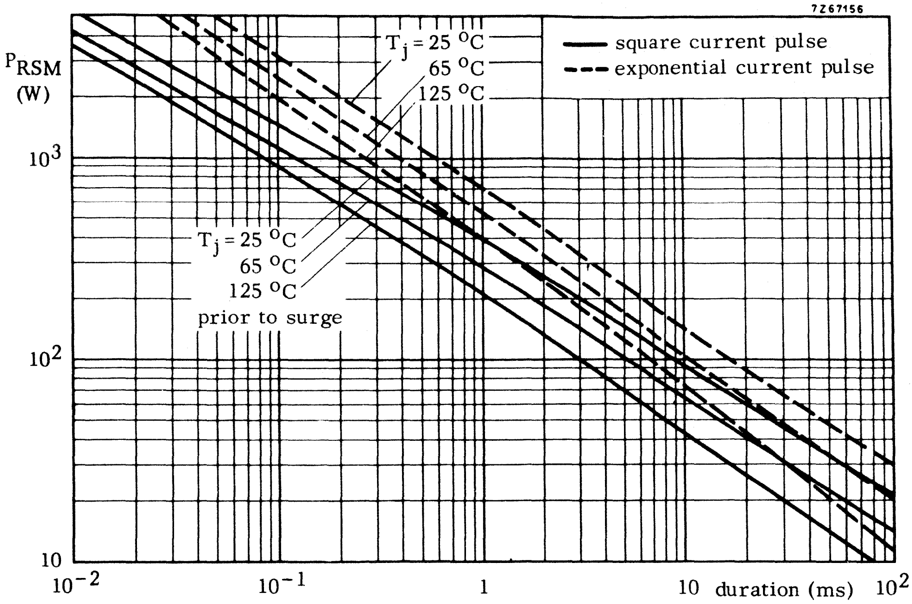

7Z67156
P_{RSM}
(W)
10^3
10^2
10
10^{-2}
10^{-1}
1
10
duration (ms)
10^2
square current pulse
exponential current pulse
T_j = 25 °C
65 °C
125 °C
T_j = 25 °C
65 °C
125 °C
prior to surge

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.

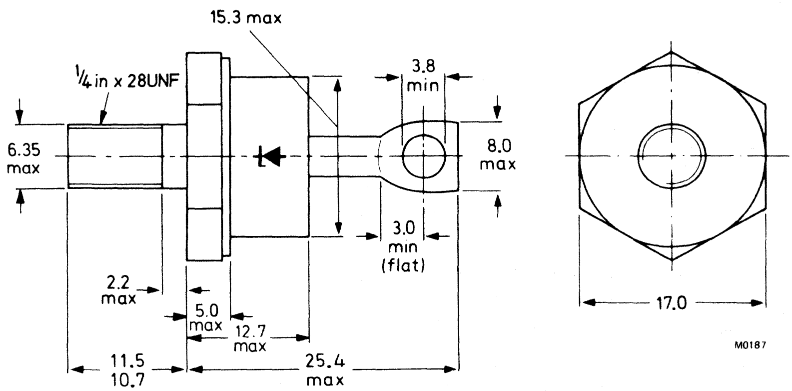
QUICK REFERENCE DATA

			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:
see ACCESSORIES section

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 520)

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.

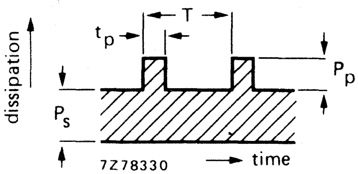


Fig. 2.

OPERATION AS A TRANSIENT SUPPRESSOR (see page 521)

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 $t_p \leqslant 100\ \mu s$ 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	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.

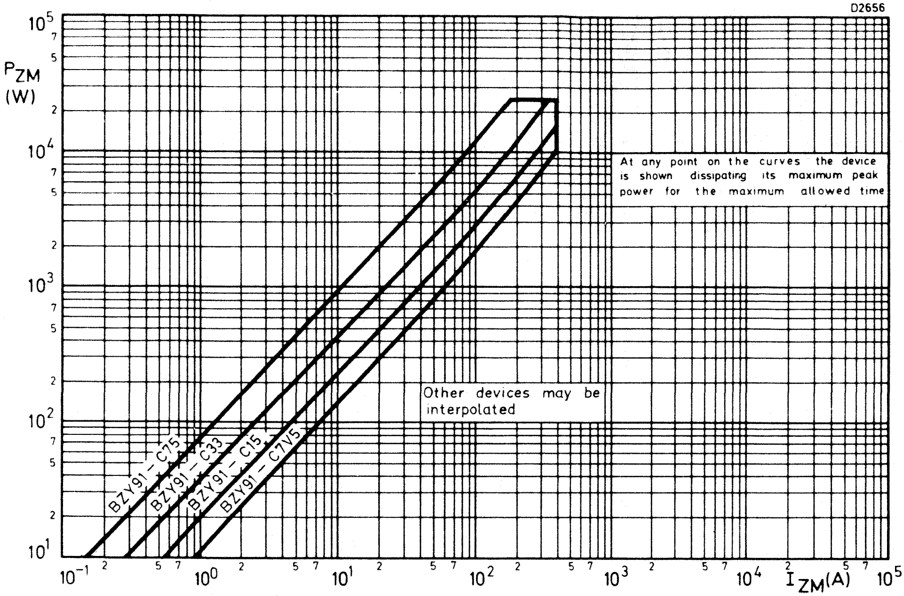

D2656
P_{ZM} (W)
At any point on the curves the device is shown dissipating its maximum peak power for the maximum allowed time
Other devices may be interpolated
BZY91 – C75
BZY91 – C33
BZY91 – C15
BZY91 – C7V5
I_{ZM}(A)

Fig. 3.

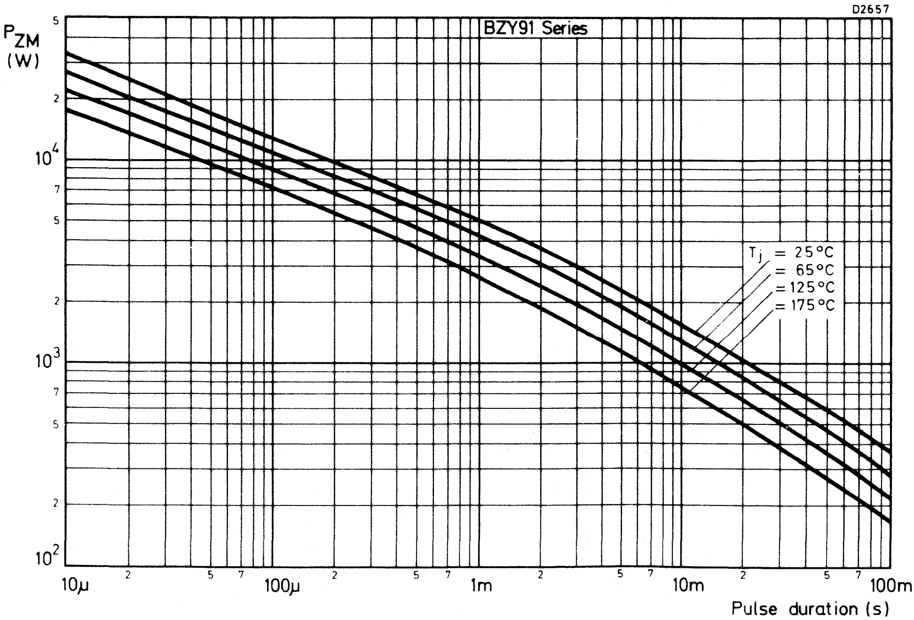

D2657
BZY91 Series
P_{ZM} (W)
T_j = 25 °C
= 65 °C
= 125 °C
= 175 °C
Pulse duration (s)

Fig. 4.

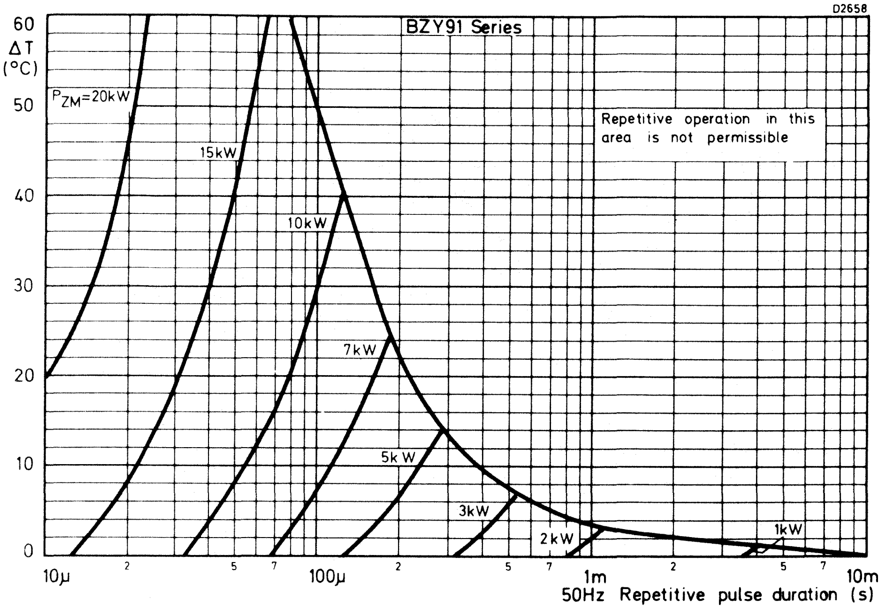

D2658
BZY91 Series
60
ΔT
(°C)
50
40
30
20
10
0
P_{ZM}=20kW
15kW
10kW
7kW
5kW
3kW
2kW
1kW
Repetitive operation in this area is not permissible
10μ
2
5
7
100μ
2
5
7
1m
2
5
7
10m
50Hz Repetitive pulse duration (s)

Fig. 5.

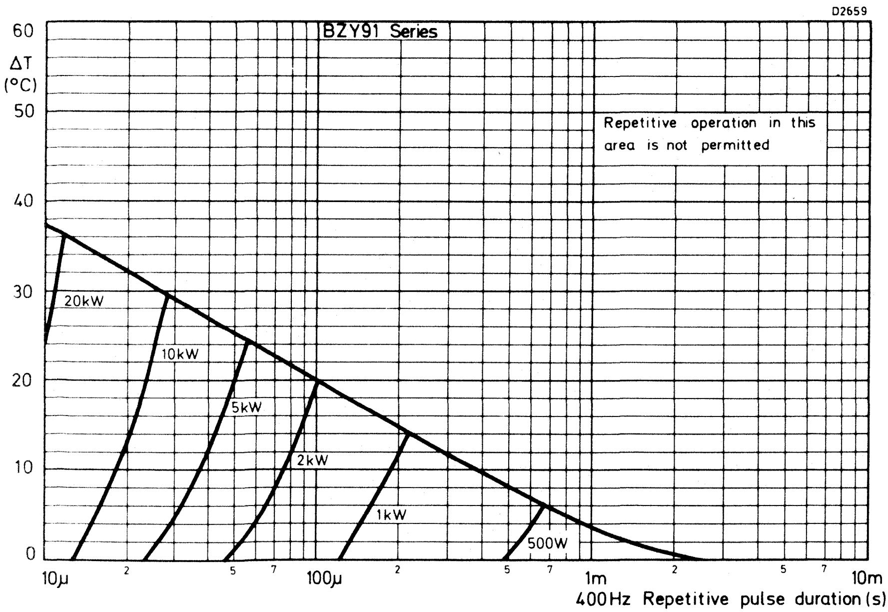

D2659
BZY91 Series
60
ΔT
(°C)
50
40
30
20
10
0
20kW
10kW
5kW
2kW
1kW
500W
Repetitive operation in this area is not permitted
10μ
2
5
7
100μ
2
5
7
1m
2
5
7
10m
400Hz Repetitive pulse duration (s)

Fig. 6.

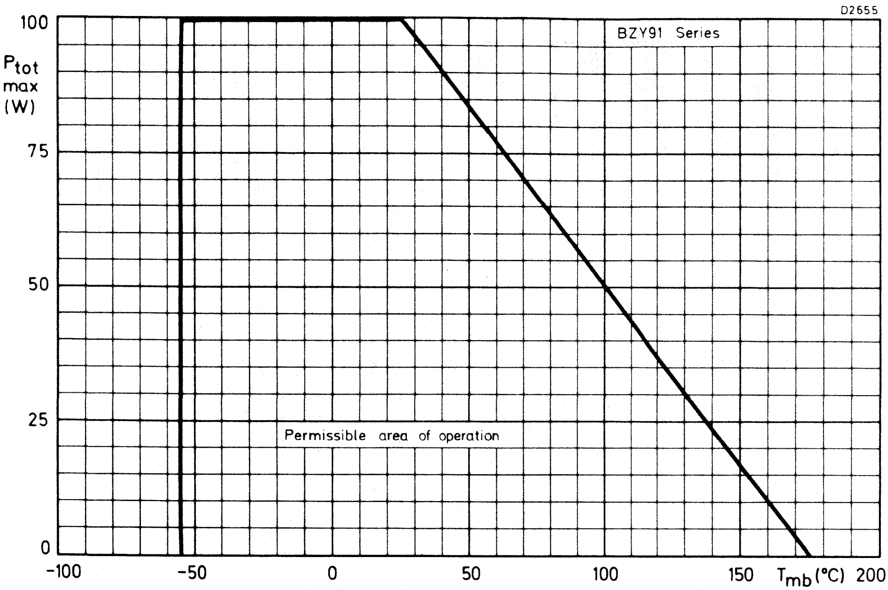


Fig. 7.

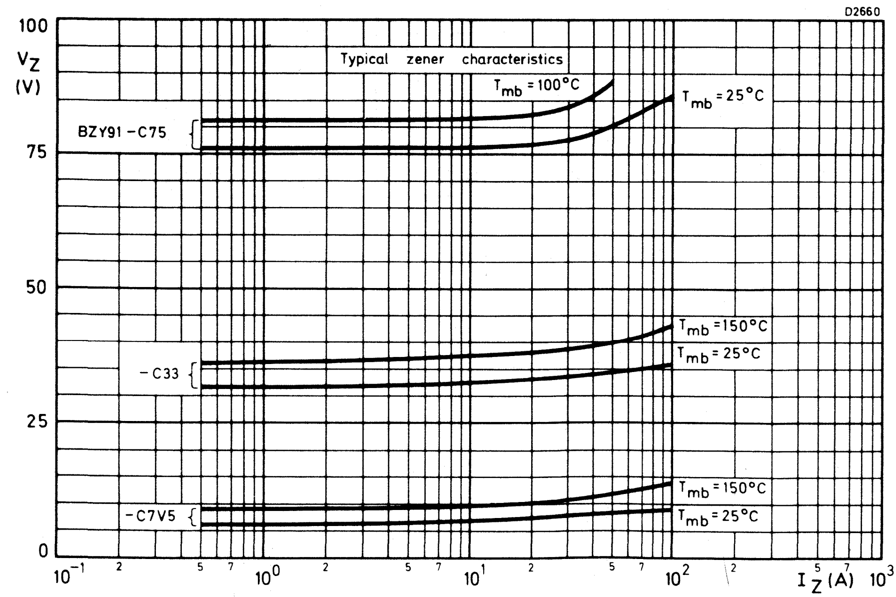


Fig. 8 Typical dynamic zener characteristics.

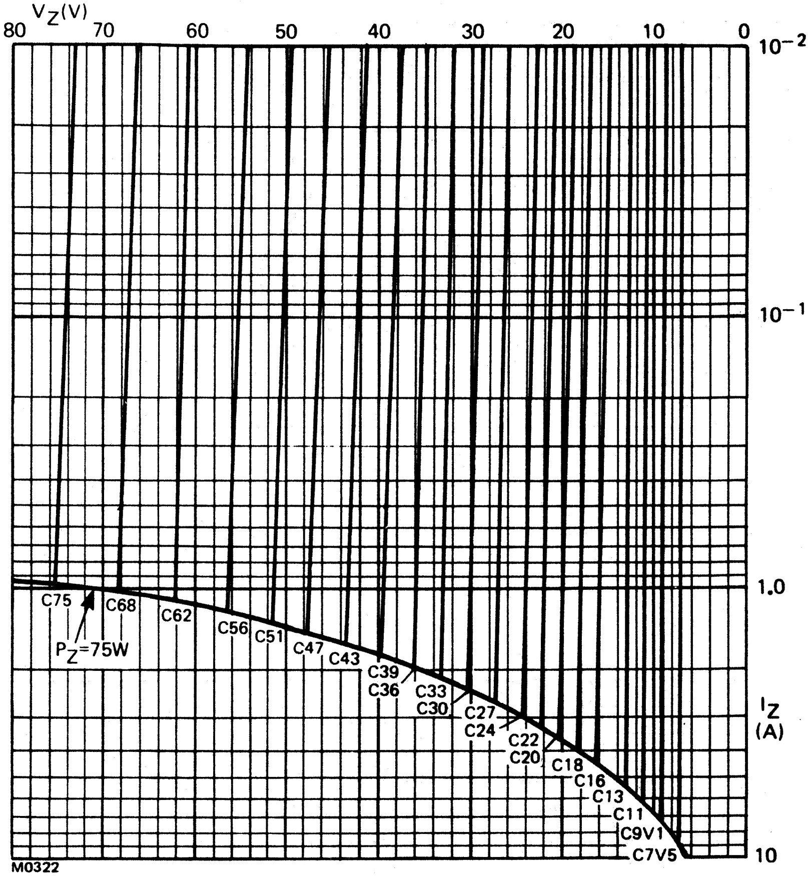


Fig.9 Typical static zener characteristics, T_{mb} = 25 °C

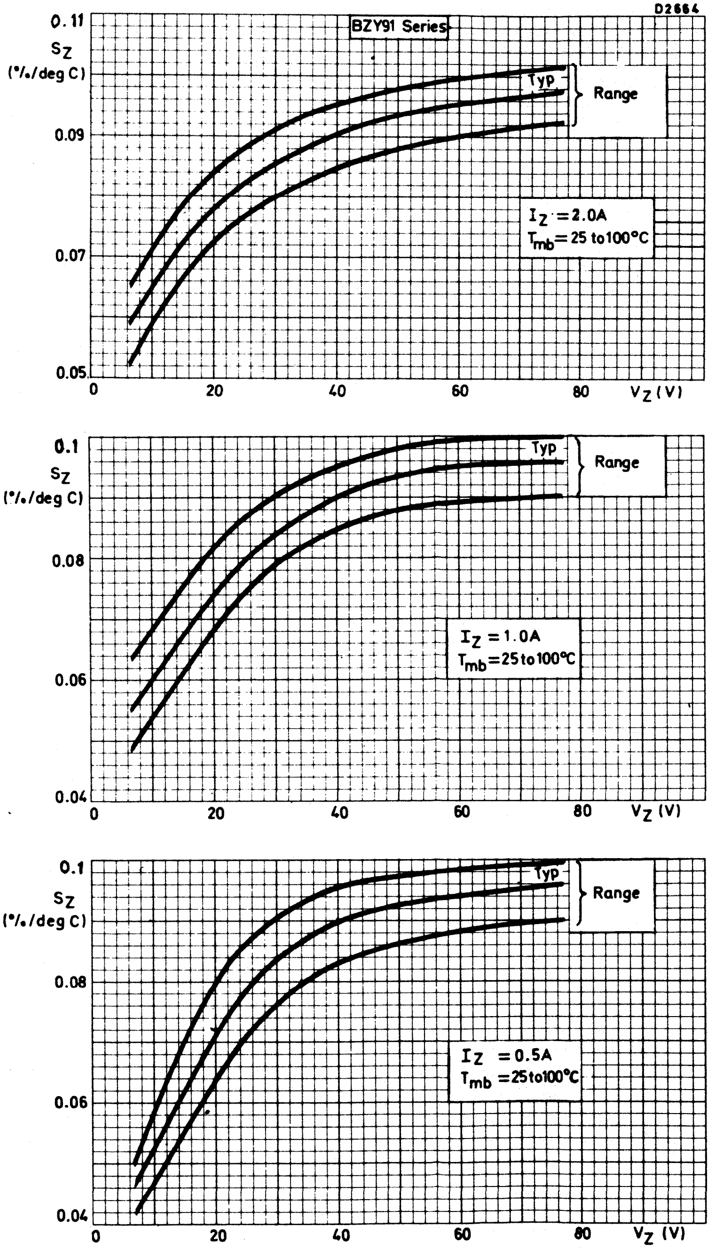
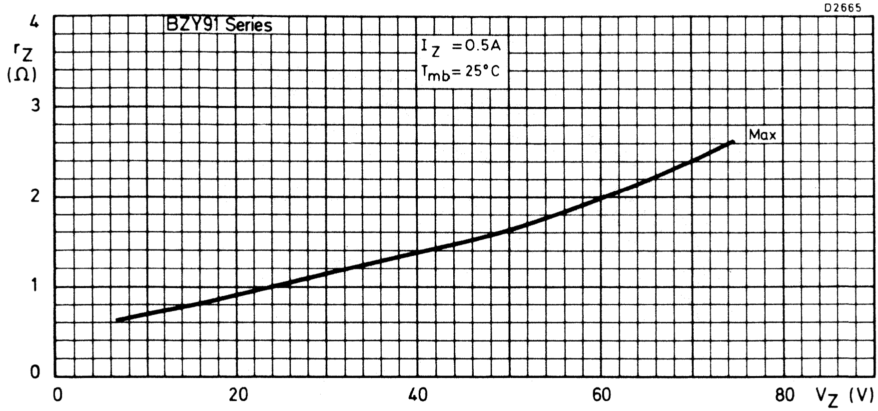
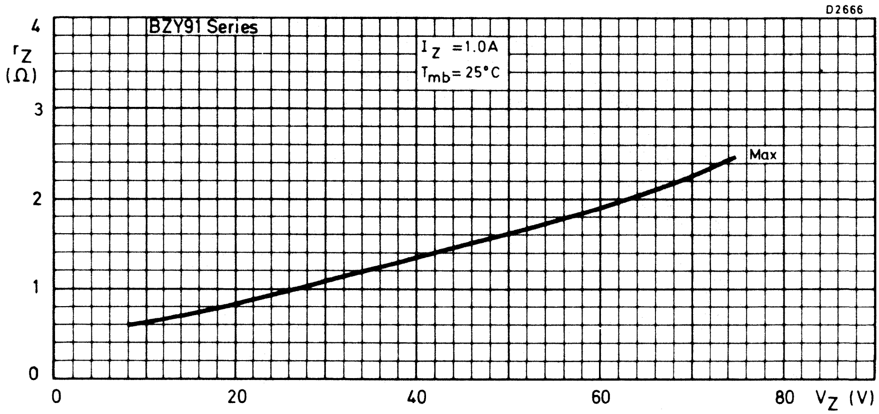

D2664
BZY91 Series
0.11
0.09
0.07
0.05
S_Z
(%/deg C)
Typ
Range
I_Z = 2.0A
T_{mb} = 25 to 100 °C
0
20
40
60
80
V_Z (V)
0.1
0.08
0.06
0.04
S_Z
(%/deg C)
Typ
Range
I_Z = 1.0A
T_{mb} = 25 to 100 °C
0
20
40
60
80
V_Z (V)
0.1
0.08
0.06
0.04
S_Z
(%/deg C)
Typ
Range
I_Z = 0.5A
T_{mb} = 25 to 100 °C
0
20
40
60
80
V_Z (V)

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)

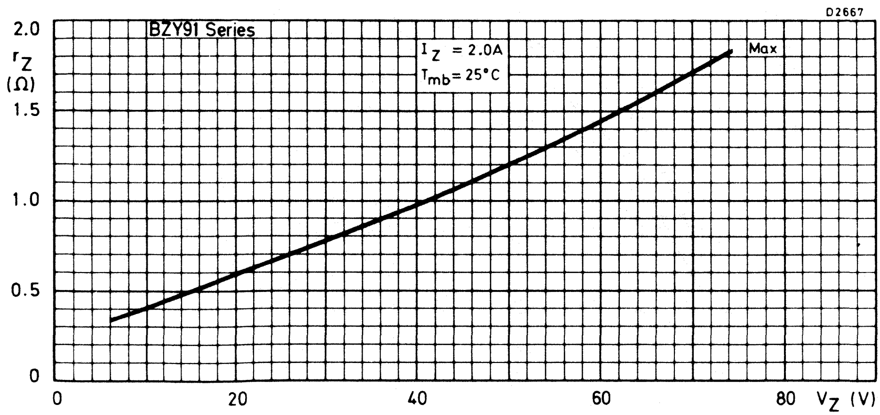

D2667
BZY91 Series
I_Z = 2.0A
T_{mb} = 25°C
Max
r_Z (Ω)
2.0
1.5
1.0
0.5
0
0
20
40
60
80
V_Z (V)

Fig. 11.

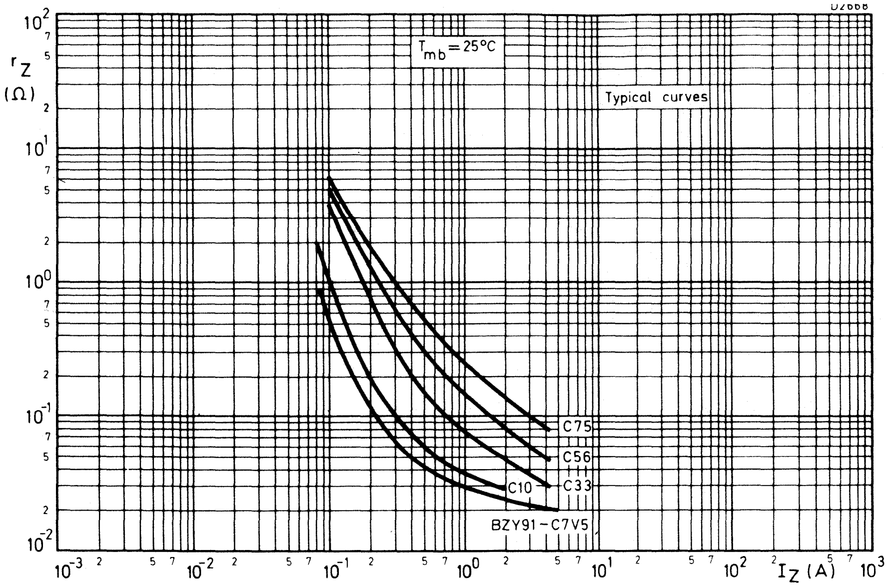

D2668
T_{mb} = 25°C
Typical curves
r_Z (Ω)
C75
C56
C33
C10
BZY91 – C7V5
I_Z (A)

Fig. 12.

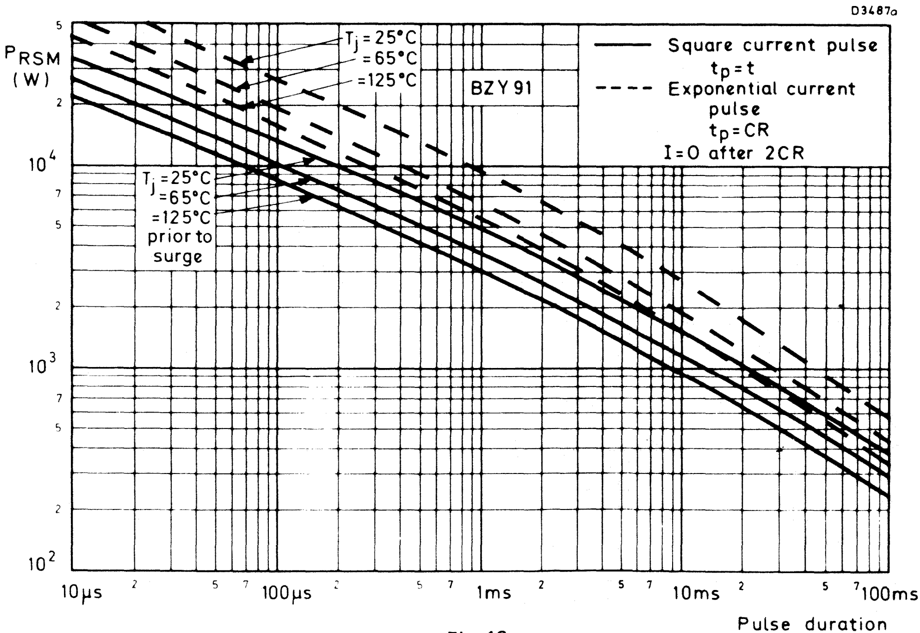

D3487a
P_{RSM} (W)
T_j = 25°C
= 65°C
= 125°C
BZY 91
Square current pulse
$t_p = t$
Exponential current pulse
$t_p = CR$
I = 0 after 2CR
T_j = 25°C
= 65°C
= 125°C
prior to surge
Pulse duration

Fig. 13.

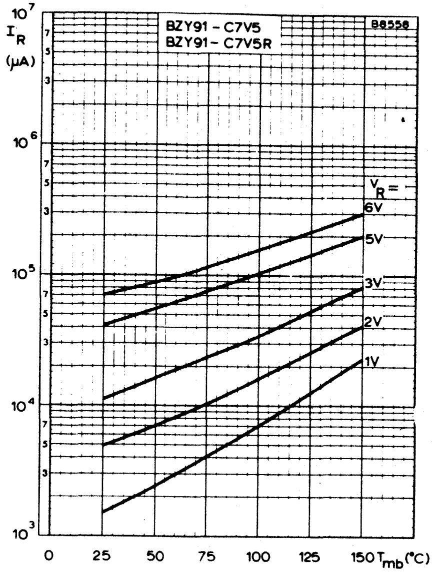


Fig. 14.

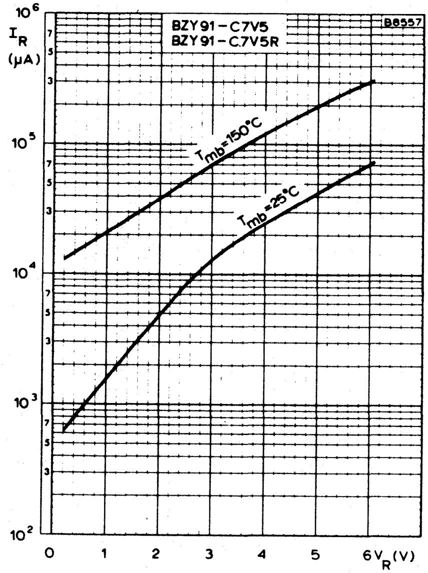


Fig. 15.

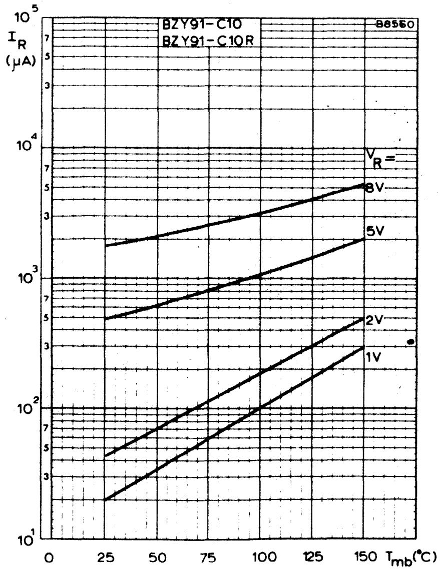


Fig. 16.

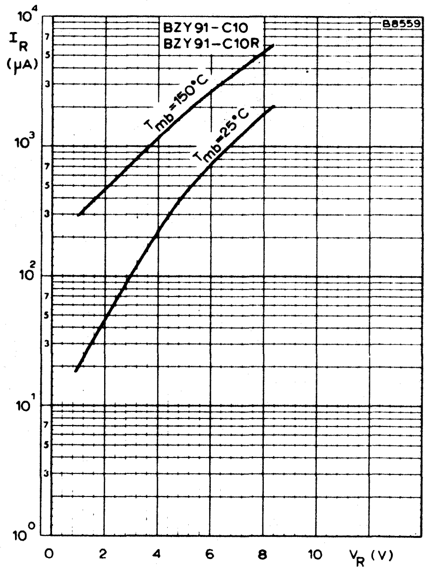


Fig. 17.

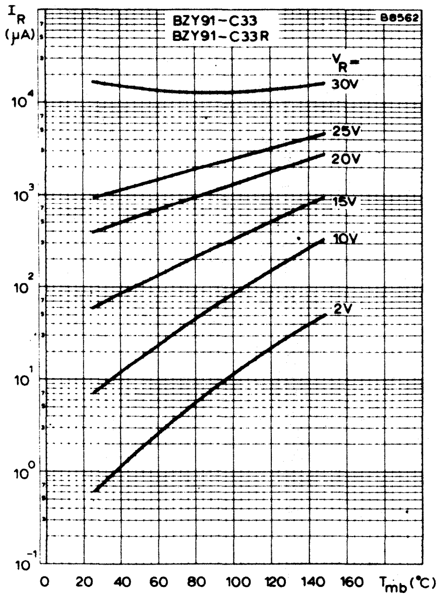


Fig. 18.

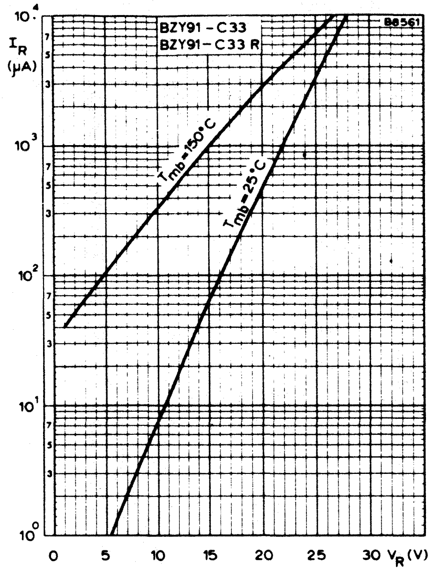


Fig. 19.

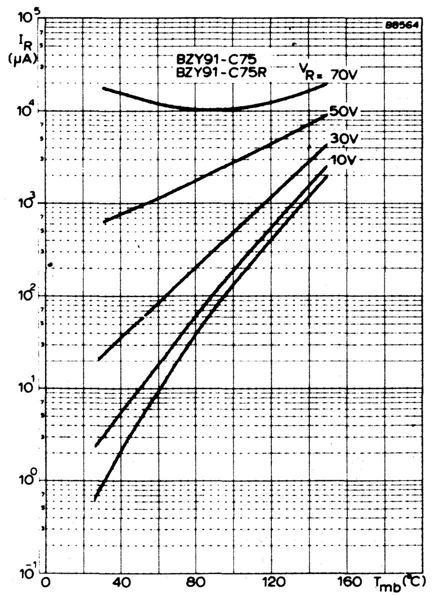


Fig. 20.

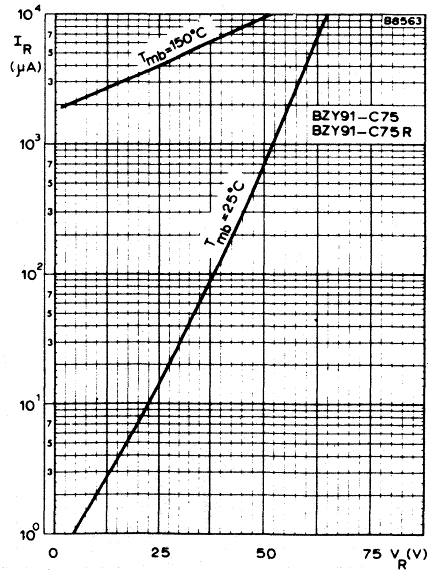
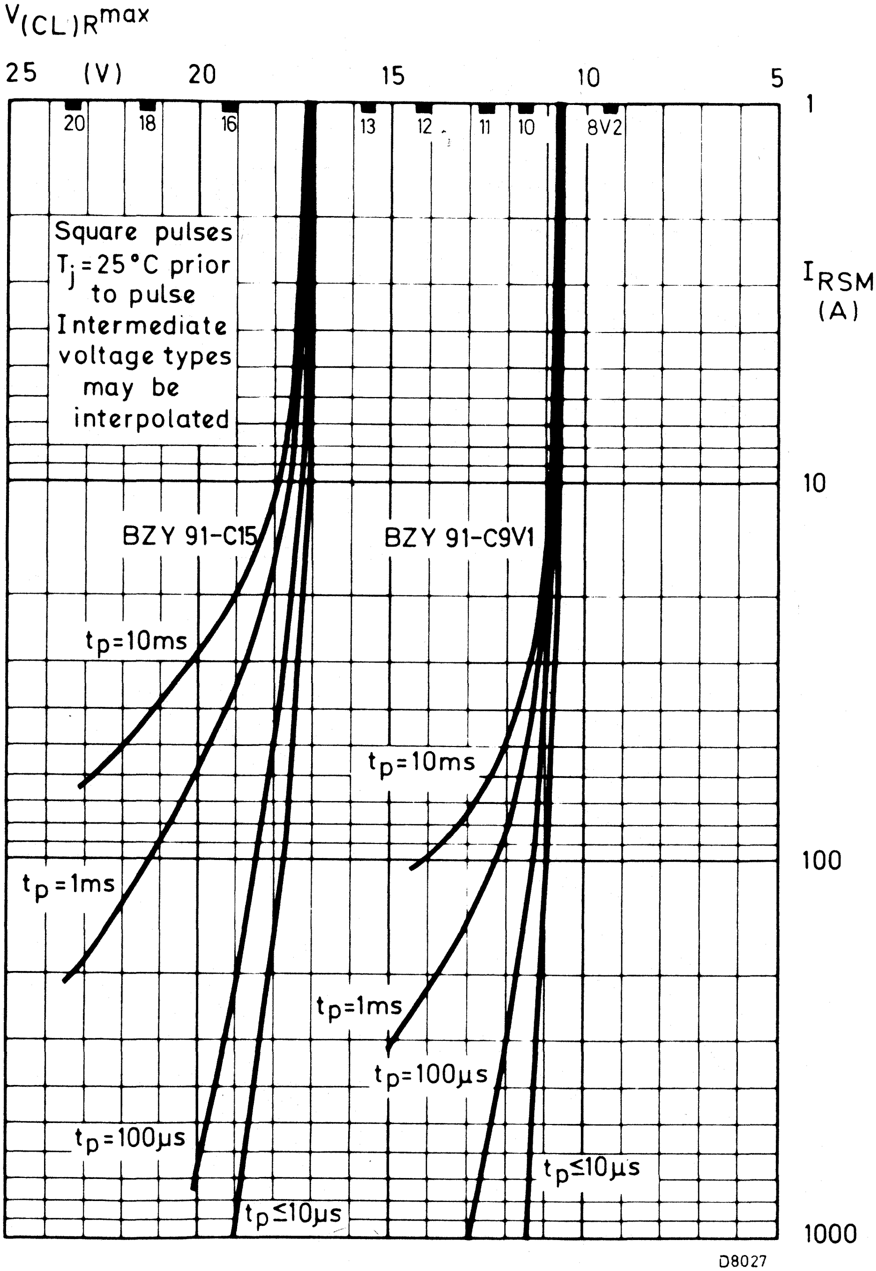


Fig. 21.



$V_{(CL)R}max$
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
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
I_{RSM} (A)
1
10
100
1000
D8027

Fig. 22.

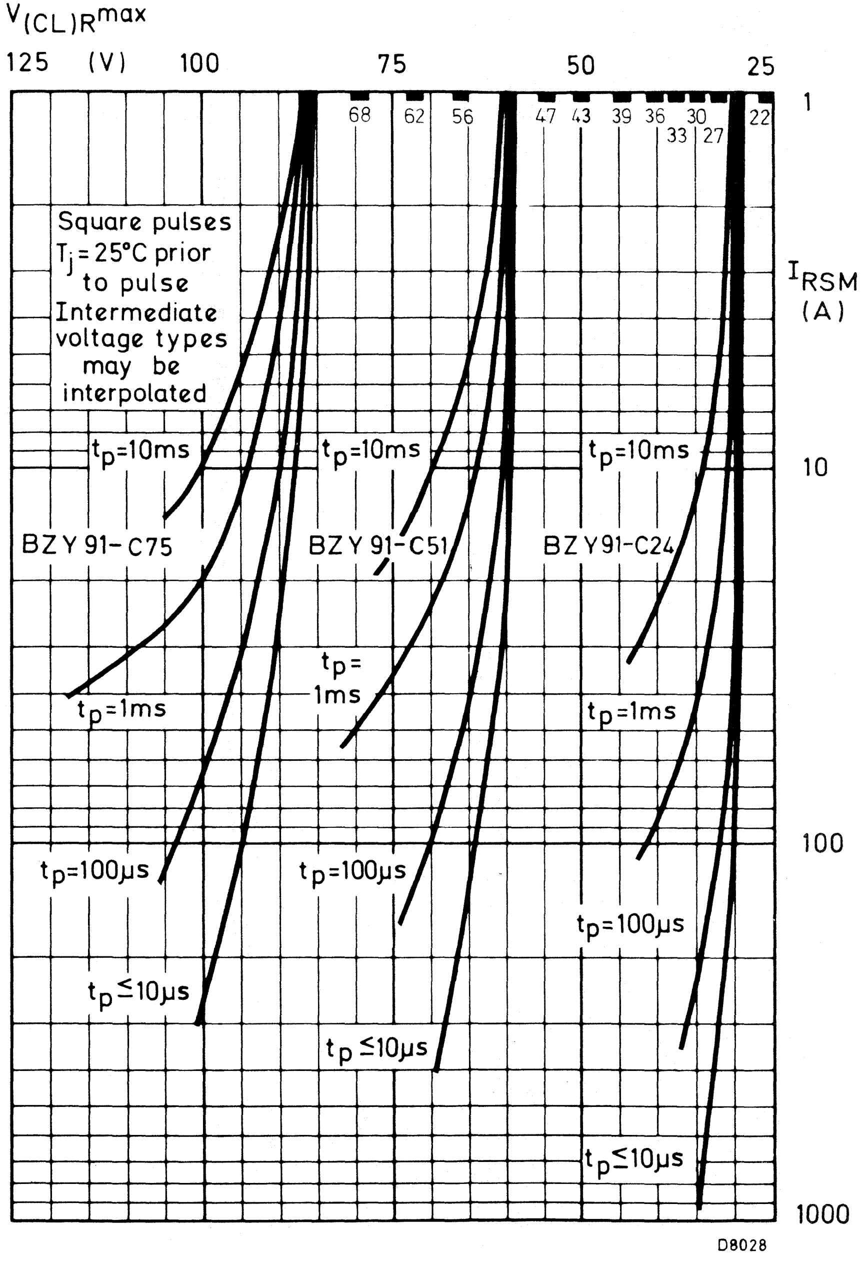
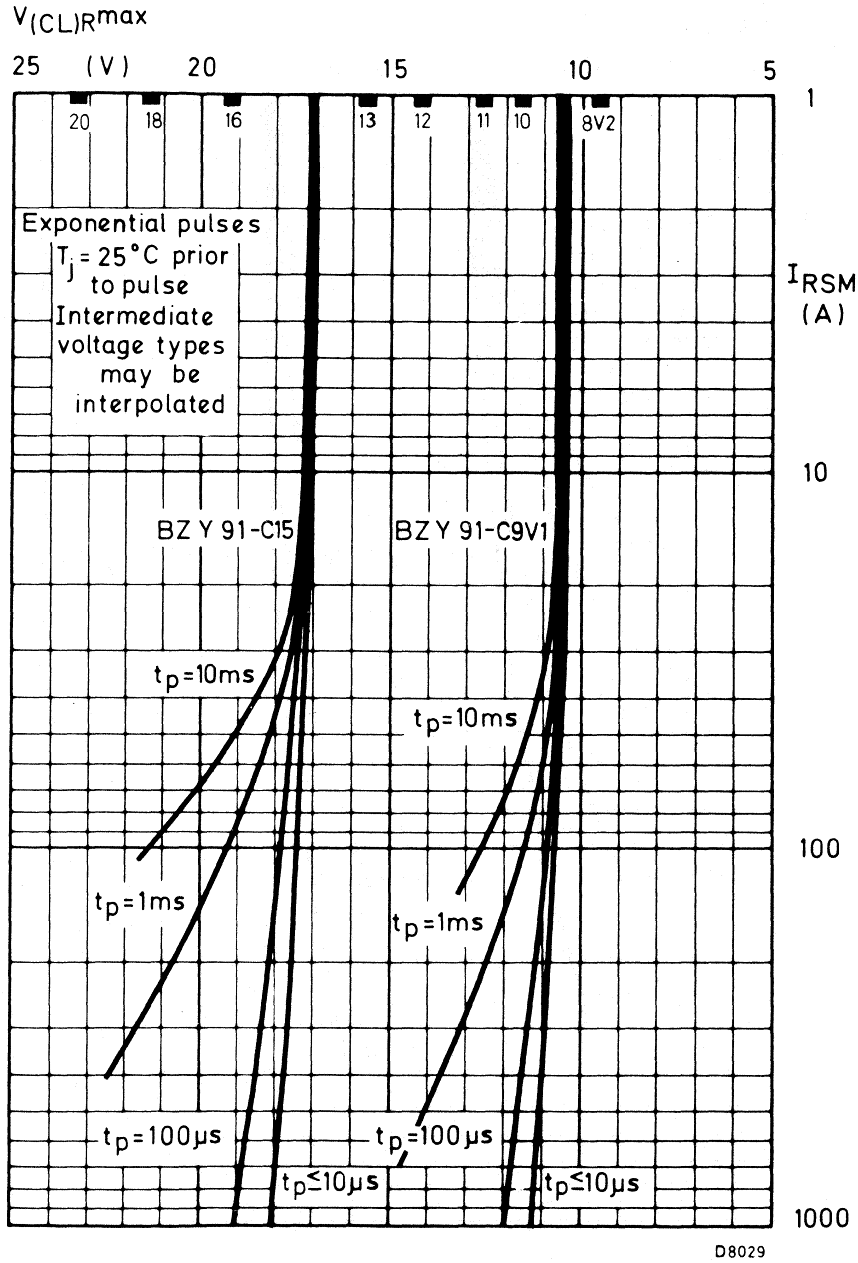

$V_{(CL)R}max$
125 (V) 100
75
50
25
68
62
56
47
43
39
36
30
33
27
22
1
10
100
1000
I_{RSM}
(A)
Square pulses
T_j = 25°C prior to pulse
Intermediate voltage types may be interpolated
t_p=10ms
t_p=10ms
t_p=10ms
BZY 91-C75
BZY 91-C51
BZY91-C24
t_p=1ms
t_p= 1ms
t_p=1ms
t_p=100µs
t_p=100µs
t_p=100µs
t_p≤10µs
t_p≤10µs
t_p≤10µs
D8028

Fig. 23.



V(CL)Rmax
25
(V)
20
15
10
5
20
18
16
13
12
11
10
8V2
1
10
100
1000
IRSM
(A)
Exponential pulses
Tj = 25°C prior to pulse
Intermediate voltage types may be interpolated
BZY 91-C15
BZY 91-C9V1
tp=10ms
tp=1ms
tp=100µs
tp≤10µs
tp=10ms
tp=1ms
tp=100µs
tp≤10µs
D8029

Fig. 24.

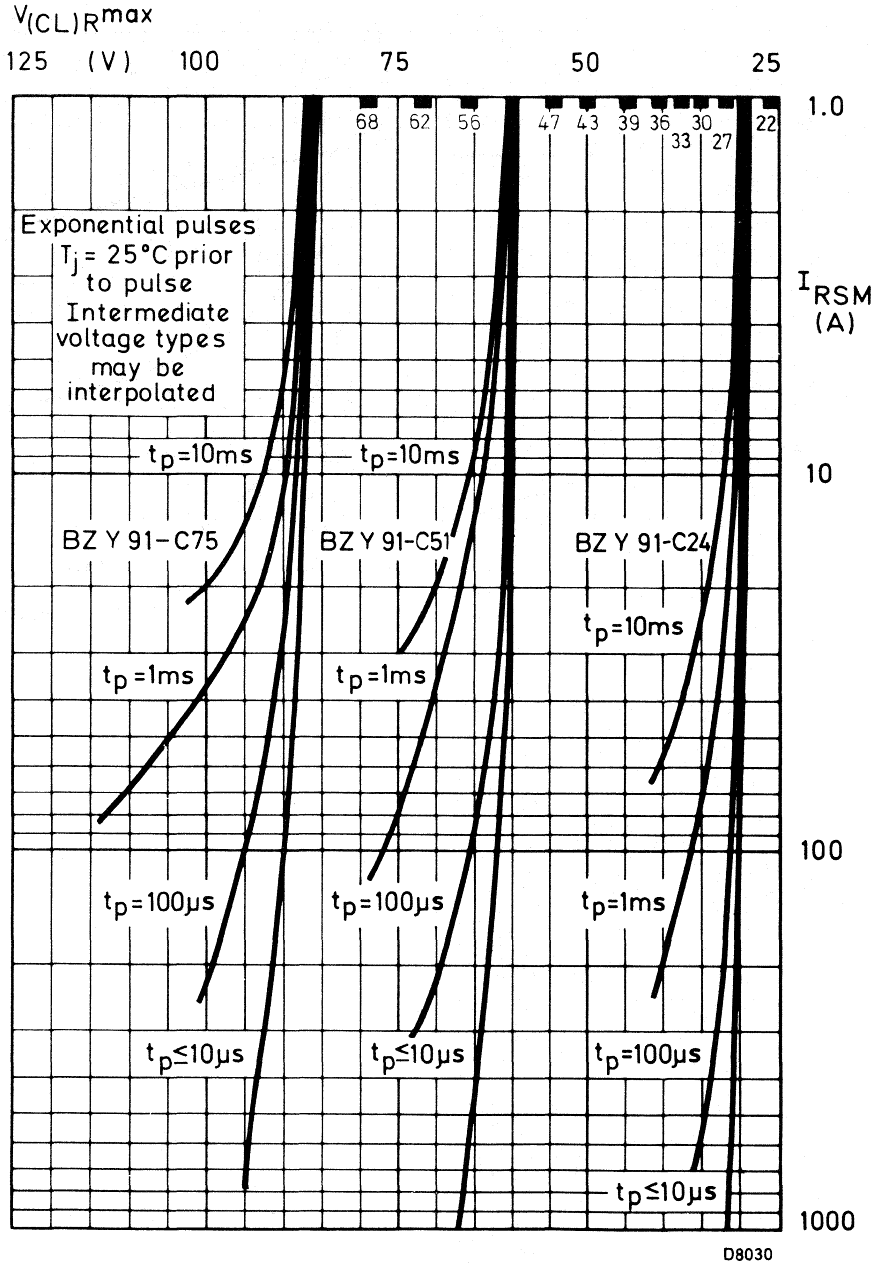

V(CL)R max
125 (V) 100 75 50 25
68 62 56 47 43 39 36 30 22
33 27
1.0
10
100
1000
I RSM
(A)
Exponential pulses
Tj = 25°C prior to pulse
Intermediate voltage types may be interpolated
tp=10ms
tp=10ms
BZ Y 91–C75
BZ Y 91-C51
BZ Y 91-C24
tp=10ms
tp =1ms
tp =1ms
tp=100μs
tp=100μs
tp=1ms
tp≤10μs
tp≤10μs
tp=100μs
tp≤10μs
D8030

Fig. 25.

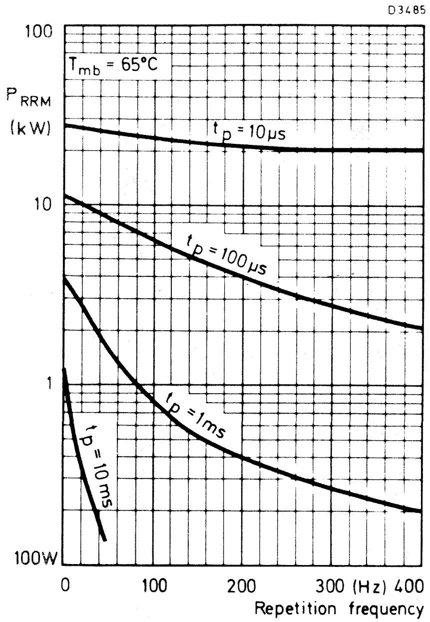


Fig. 26.

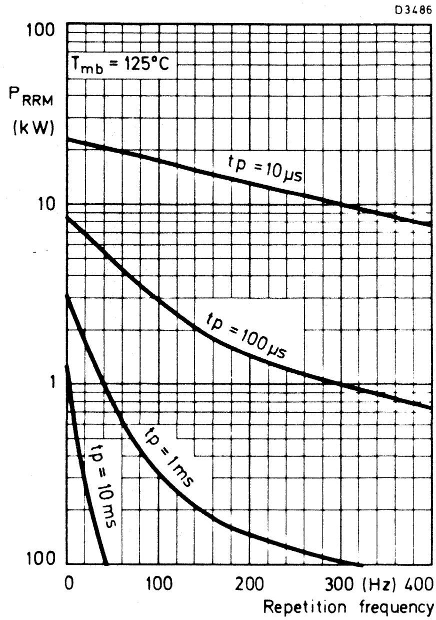


Fig. 27.

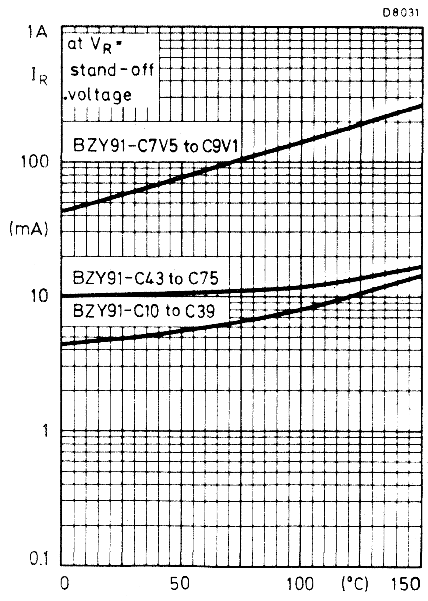


Fig. 28.

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.

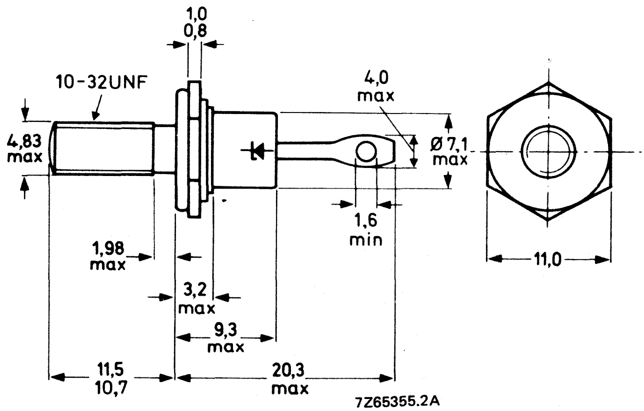
QUICK REFERENCE DATA

			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:
see ACCESSORIES section

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 °C 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 °C	P_{tot}	max.	20	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 + 175	°C
Junction temperature	T_j	max.	175	°C

THERMAL RESISTANCE

From junction to mounting base	$R_{th\ j\text{-}mb}$	=	5	°C/W
From junction to ambient	$R_{th\ j\text{-}a}$	=	50	°C/W
From mounting base to heatsink (minimum torque: 0,9 Nm)	$R_{th\ mb\text{-}h}$	=	0,6	°C/W

CHARACTERISTICS

Forward voltage I_F = 5 A; T_{mb} = 25 °C	V_F	<	1,5	V

OPERATION AS A VOLTAGE REGULATOR (see page 540)

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 °C/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).

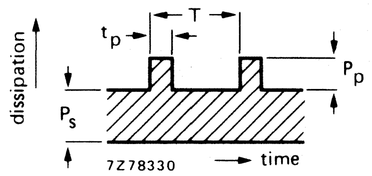


Fig. 2.

OPERATION AS A TRANSIENT SUPPRESSOR (see page 541)

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 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 A	reverse current I_R μA max.	at reverse voltage V_R V
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 $t_p \leqslant 100$ 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 °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	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.

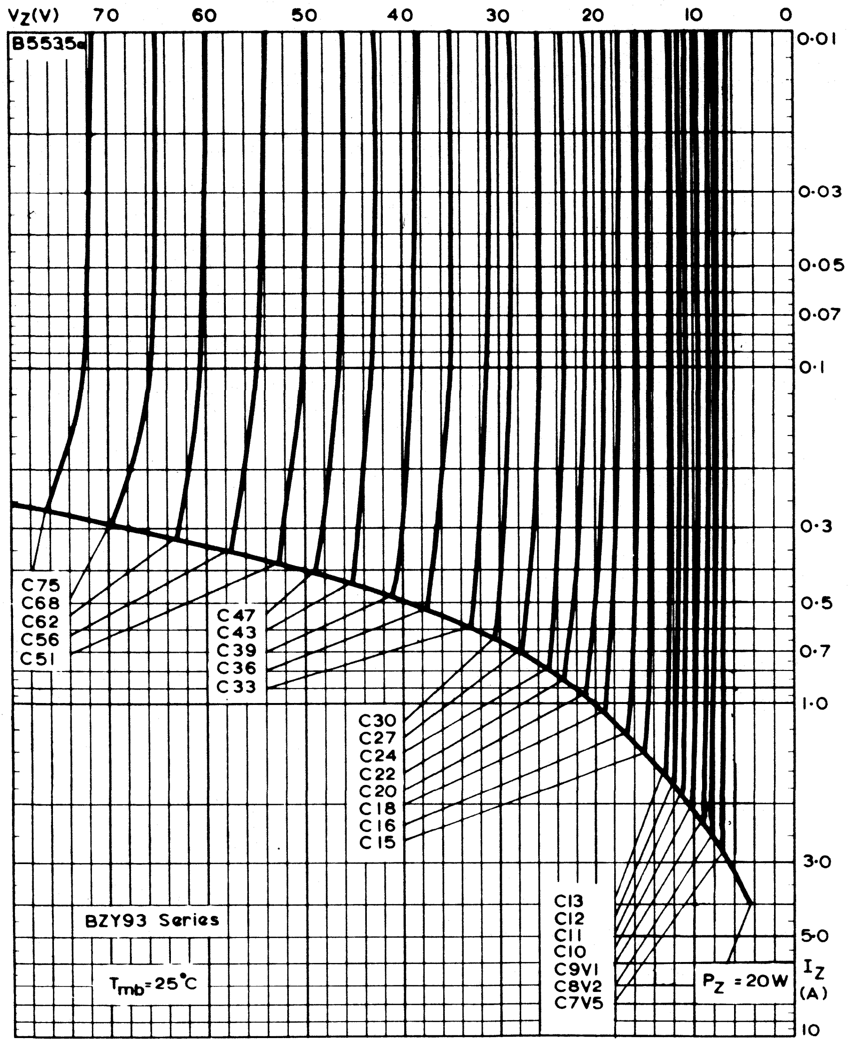


Fig. 3 Typical static zener characteristics.

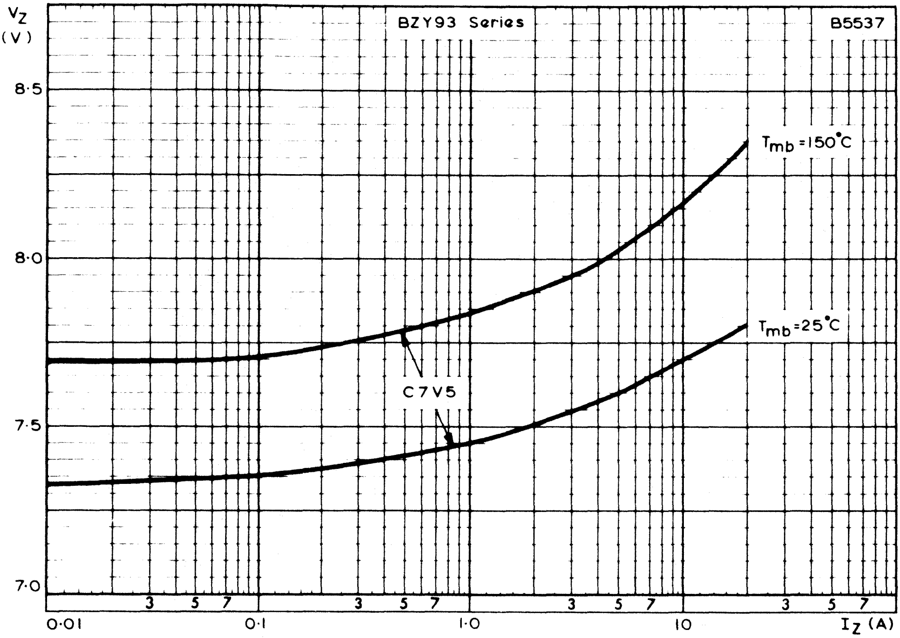


Fig. 4 Typical dynamic zener characteristics for BZY93-C7V5.

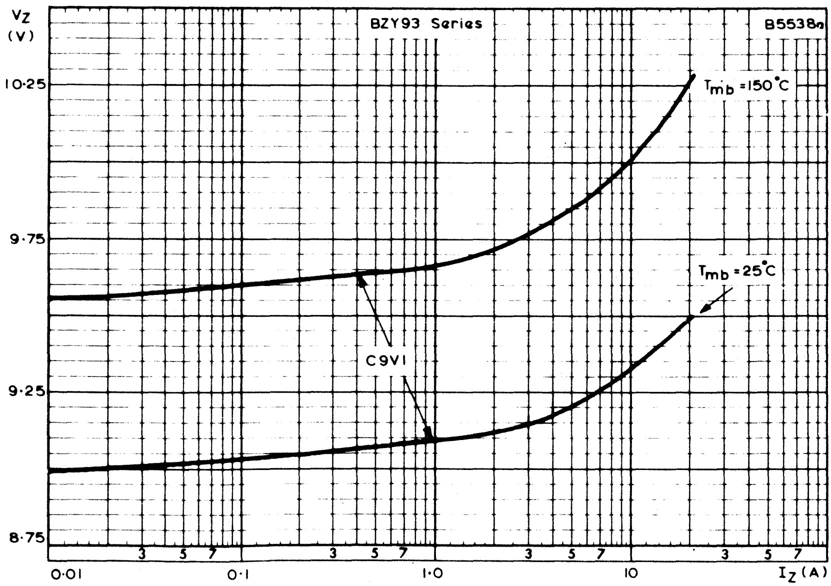


Fig. 5 Typical dynamic zener characteristics for BZY93-C9V1.

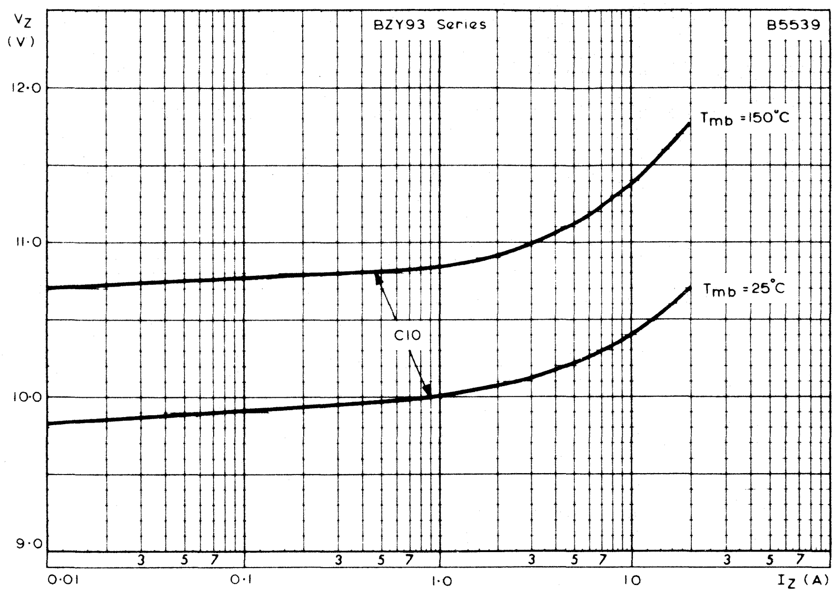


Fig. 6 Typical dynamic zener characteristics for BZY93-C10.

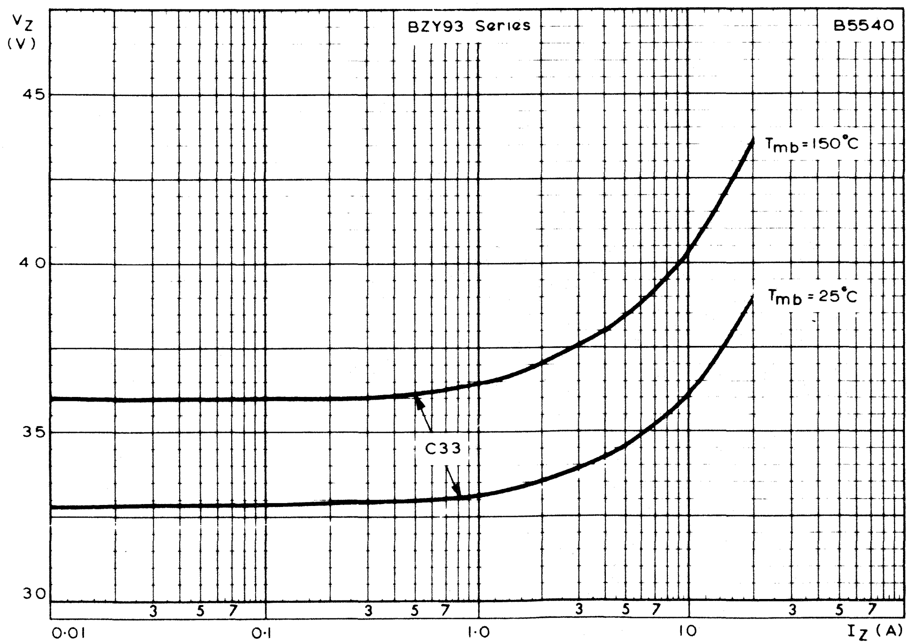


Fig. 7 Typical dynamic zener characteristics for BZY93-C33.

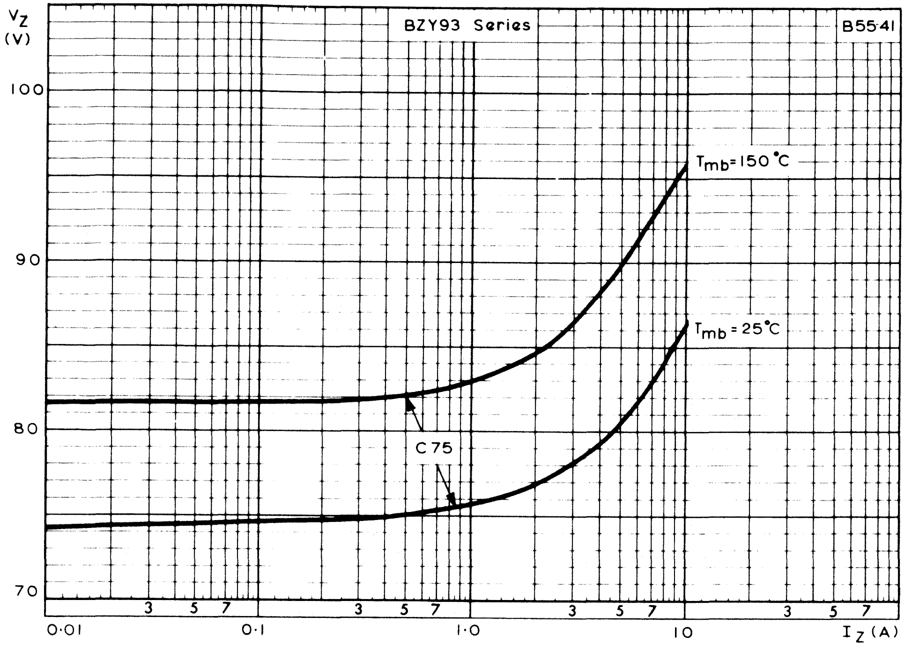


Fig. 8 Typical dynamic zener characteristics for BZY93-C75.

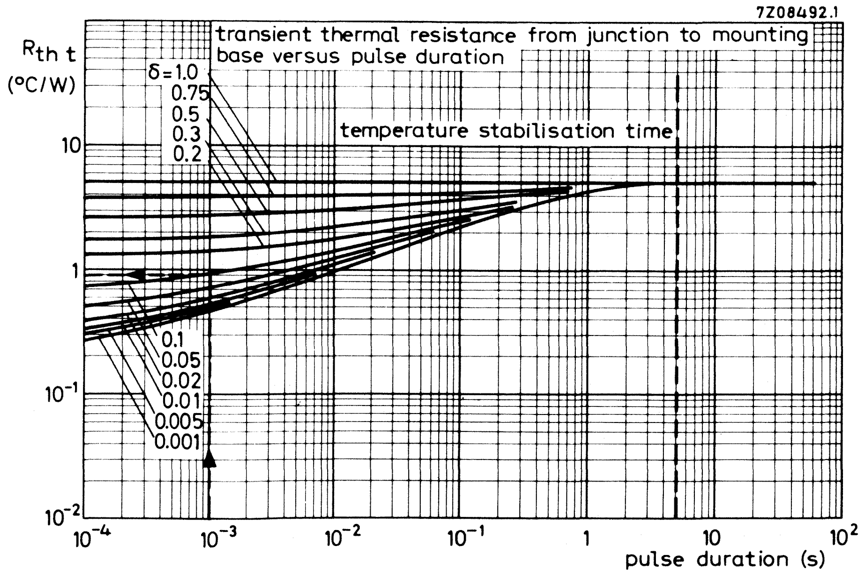


Fig. 9.

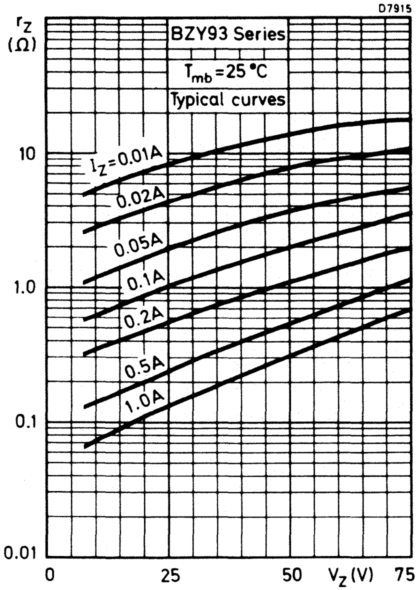


Fig. 10.

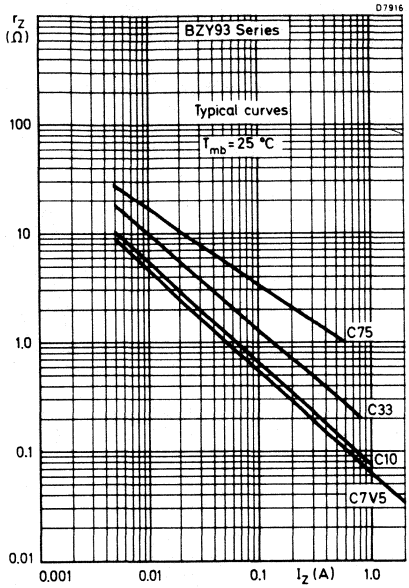


Fig. 11.

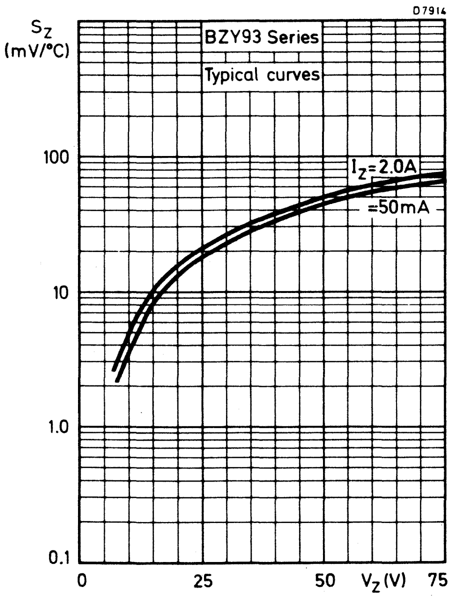


Fig. 12.

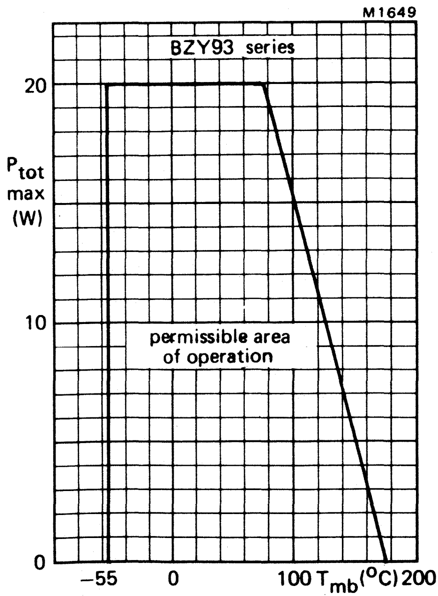


Fig. 13.

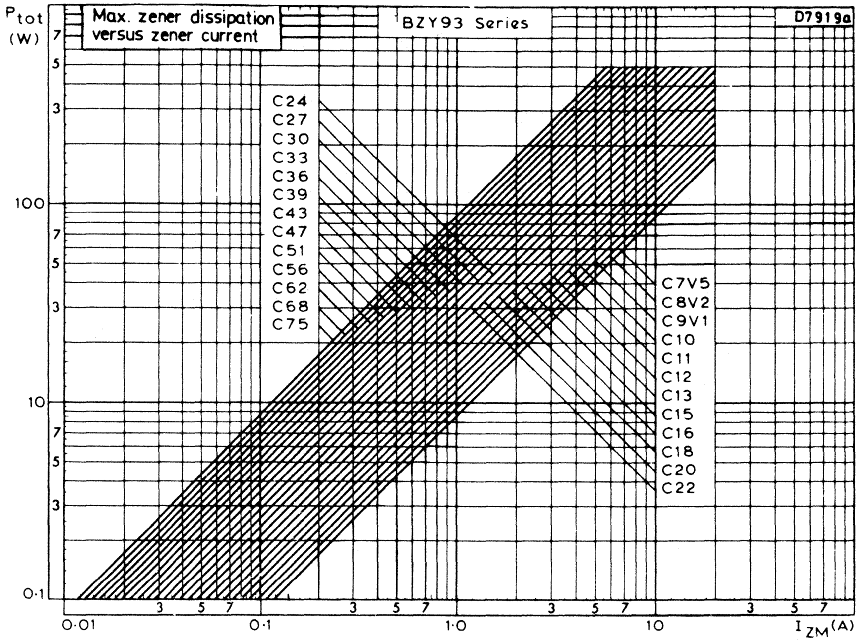


Fig. 14 Maximum permissible repetitive peak dissipation ($P_{tot} = P_{ZRM}$).

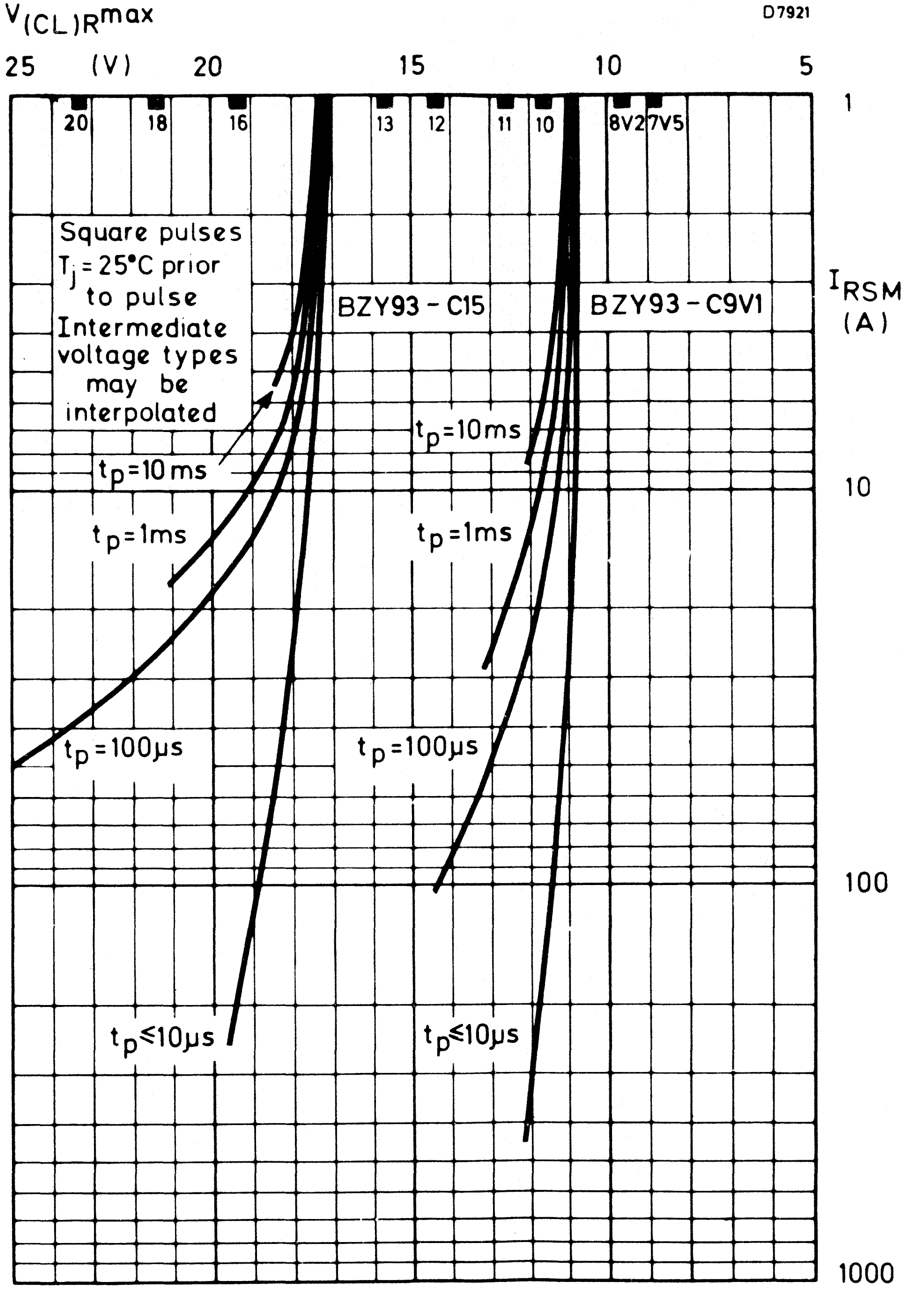
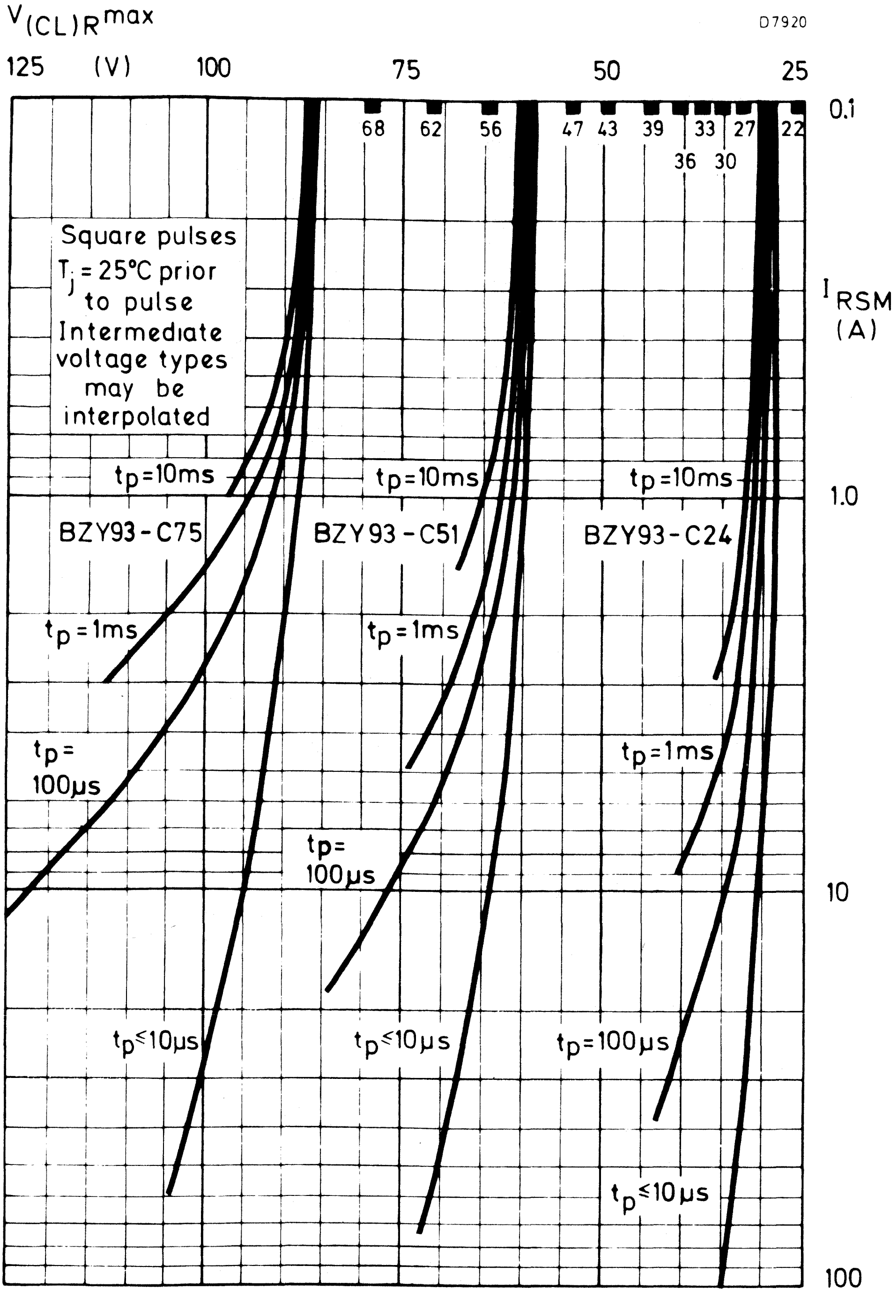

D7921
$V_{(CL)R}max$
(V)
25
20
15
10
5
20
18
16
13
12
11
10
8V2
7V5
1
10
100
1000
I_{RSM} (A)
Square pulses
T_j = 25°C prior to pulse
Intermediate voltage types may be interpolated
BZY93 - C15
BZY93 - C9V1
t_p = 10 ms
t_p = 1ms
t_p = 100µs
t_p ≤ 10µs

Fig. 15.



V(CL)R max
(V)
D7920
125
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
Tj = 25°C prior to pulse
Intermediate voltage types may be interpolated
tp = 10ms
tp = 1ms
tp = 100µs
tp ≤ 10µs
BZY93-C75
BZY93-C51
BZY93-C24

Fig. 16.

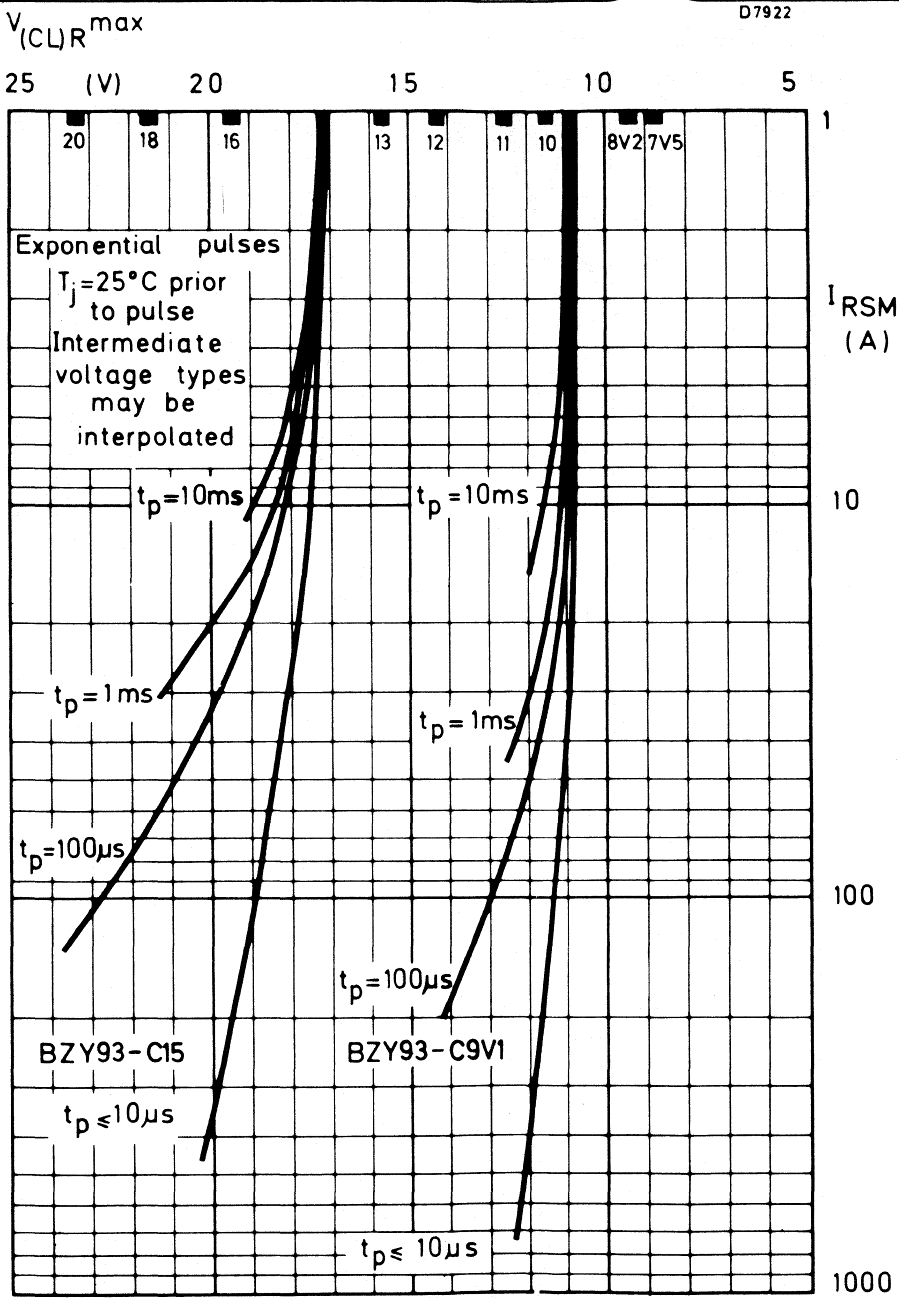
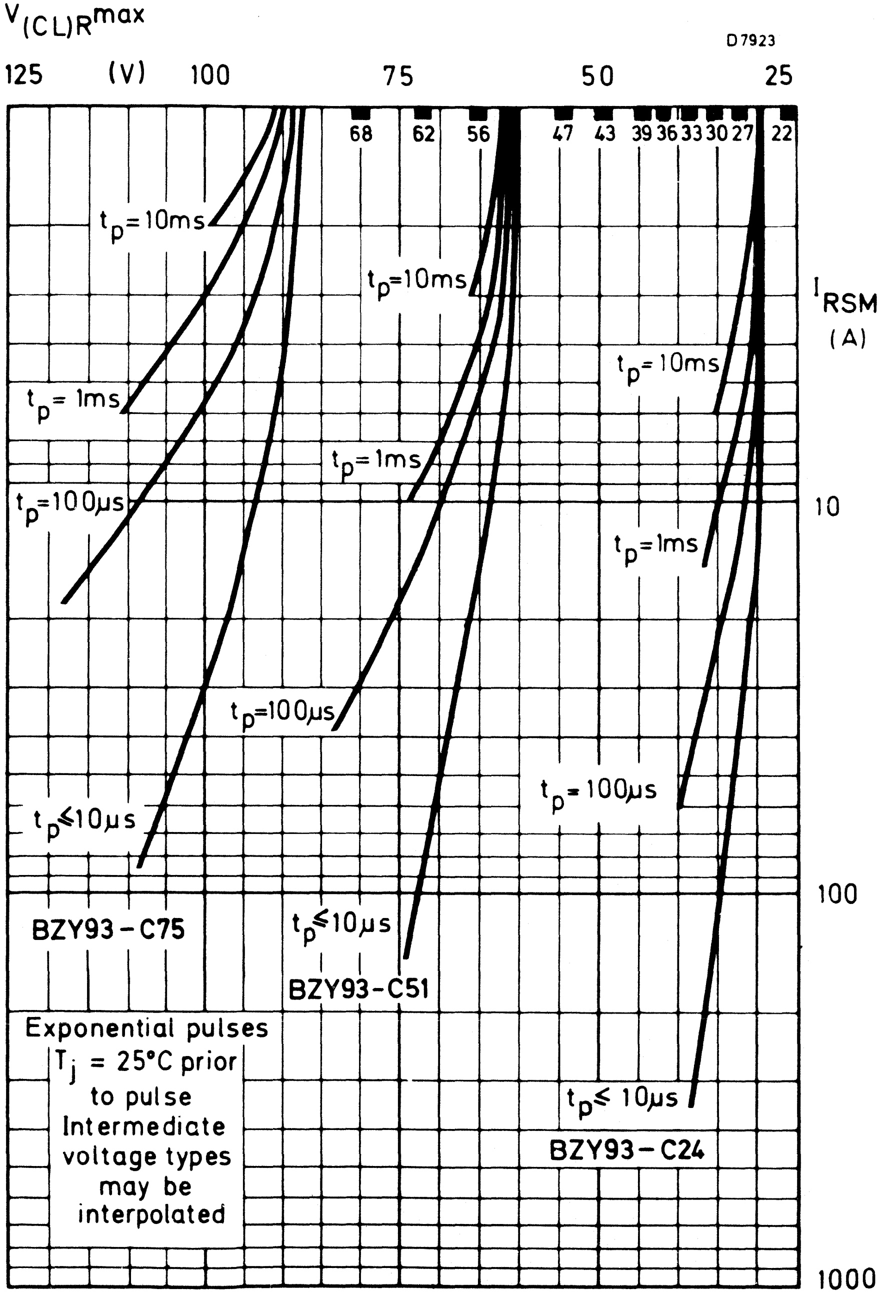

D7922
$V_{(CL)R}$ max
25 (V) 20 15 10 5
20 18 16 13 12 11 10 8V2 7V5
Exponential pulses
T_j=25°C prior to pulse
Intermediate voltage types may be interpolated
t_p=10ms
t_p=1ms
t_p=100μs
t_p≤10μs
BZY93-C15
BZY93-C9V1
I_{RSM} (A)
1
10
100
1000

Fig. 17.



$V_{(CL)R}$max
D7923
125
(V)
100
75
50
25
68
62
56
47
43
39
36
33
30
27
22
I_{RSM}
(A)
10
100
1000
t_p=10ms
t_p= 1ms
t_p=100μs
t_p≤10μs
BZY93-C75
t_p=10ms
t_p=1ms
t_p=100μs
t_p≤10μs
BZY93-C51
t_p= 10ms
t_p=1ms
t_p= 100μs
t_p≤ 10μs
BZY93-C24
Exponential pulses
T_j = 25°C prior to pulse
Intermediate voltage types may be interpolated

Fig. 18.

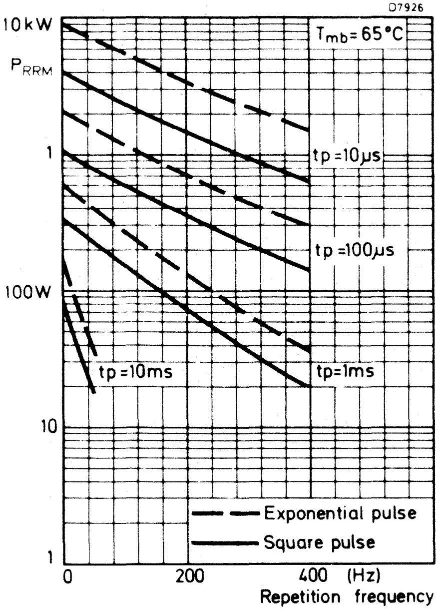


Fig. 19.

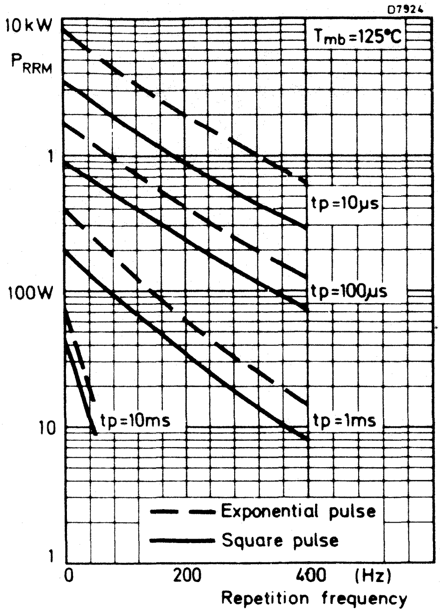


Fig. 20.

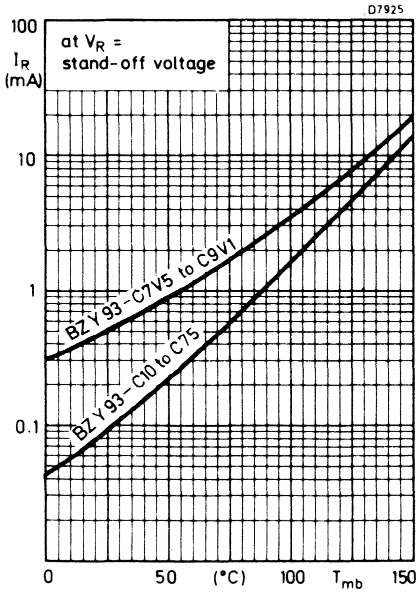


Fig. 21.

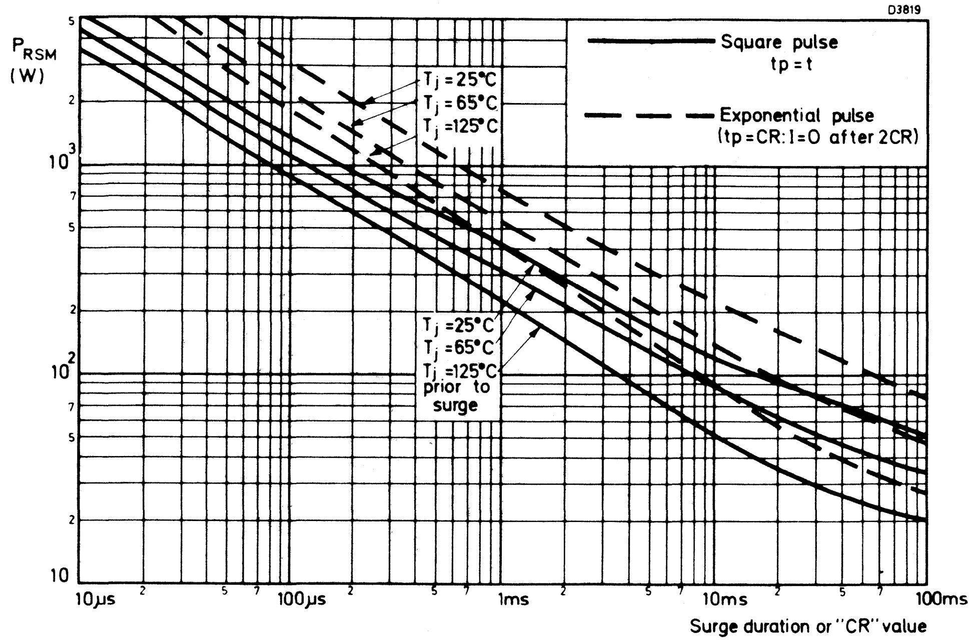

D3819
P_{RSM} (W)
5
2
10^3
7
5
2
10^2
7
5
2
10
10µs
2
5
7
100µs
2
5
7
1ms
2
5
7
10ms
2
5
7
100ms
Surge duration or "CR" value
Square pulse
tp = t
Exponential pulse
(tp = CR: I = O after 2CR)
T_j = 25°C
T_j = 65°C
T_j = 125°C
T_j = 25°C
T_j = 65°C
T_j = 125°C
prior to
surge

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.

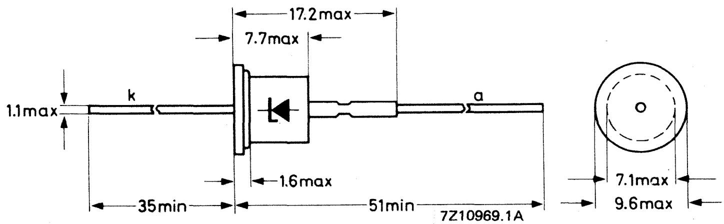
QUICK REFERENCE DATA

			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

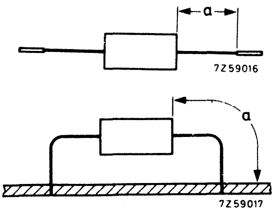


Fig.2

CHARACTERISTICS

Forward voltage

I_F = 1 A; T_{amb} = 25 °C	V_F	$<$	1,5	V

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.

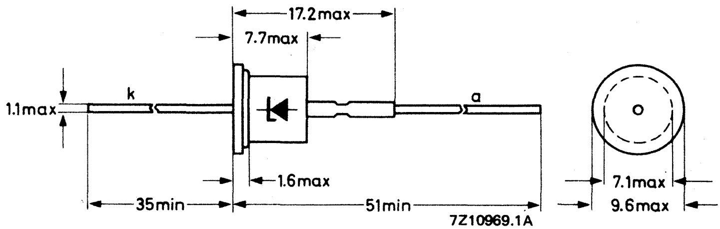
QUICK REFERENCE DATA

			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

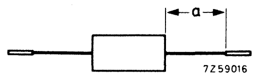
The quoted values of $R_{th\ j\text{-}a}$ should be used only when no leads of other dissipating components run to the same tie-points.

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

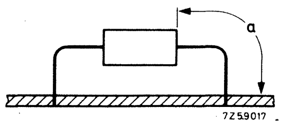


Fig. 2.

CHARACTERISTICS

Forward voltage

I_F = 1 A; T_{amb} = 25 °C V_F < 1,5 V

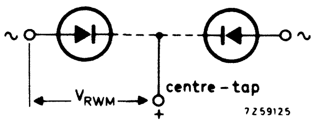
HIGH VOLTAGE
RECTIFIER STACKS

Superseded by OSB/M/S9115 series.

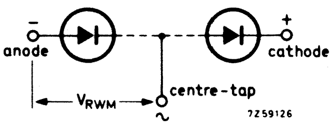
HIGH VOLTAGE RECTIFIER STACKS

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.

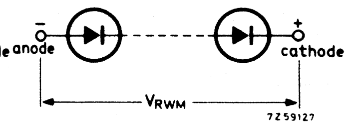
CIRCUIT OSB 9110



CIRCUIT OSM 9110



CIRCUIT OSS 9110



QUICK REFERENCE DATA

		OSB9110	−4	−6	. . .	−28	−30	
		OSM9110	−4	−6	. . .	−28	−30	
Crest working reverse voltage from centre tap to end	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
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

All information applies to frequencies up to 400 Hz

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

Voltages

			OSB9110 / 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 / 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

HIGH-VOLTAGE RECTIFIER STACKS

The OSB9115, OSM9115 and OSS9115 series are ranges of high-voltage rectifier assemblies incorporating controlled avalanche diodes mounted on fire-proof triangular formers. The OSB9115 series is intended for application in two-phase half-wave rectifier circuits. The OSM9115 series is intended for application in single-phase or three-phase bridges or in voltage doubler circuits. The OSS9115 series is intended for all kinds of high-voltage rectification. The assemblies are supplied with M6 studs or with standard valve bases. The OSB9115 series and OSM9115 series are supplied with a centre tap (8-32UNC). The maximum crest working voltages of the OSB9115 and OSM9115 series cover the range from 3 kV to 27 kV, and of the OSS9115 series the range from 4.5 kV to 54 kV in 1.5 kV steps.

Configuration:

Fig.1 OSB9115

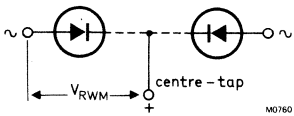


Fig.2 OSM9115

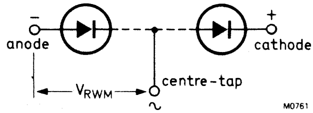
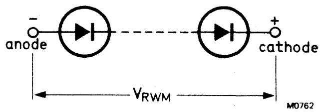


Fig.3 OSS9115



QUICK REFERENCE DATA

		OSB9115	–4	–6	. . .	–34	–36	
		OSM9115	–6	–6	. . .	–34	–36	
Crest working reverse voltage from centre tap to end	V_{RWM}	max.	3	4.5	. . .	25.5	27	kV
		OSS9115	–3	–4	. . .	–35	–36	
Crest working reverse voltage	V_{RWM}	max.	4.5	6	. . .	52.5	54	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 566 and 567

All information applies to frequencies up to 400 Hz

RATINGS

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

Voltages

		OSB9115	–4	–6	. . .	–34	–36	
		OSM9115	–4	–6	. . .	–34	–36	
Crest working reverse voltage	V_{RWM}	max.	3	4.5	. . .	25.5	27	kV
		OSS9115	–3	–4	. . .	–35	–36	
Crest working reverse voltage	V_{RWM}	max.	4.5	6	. . .	52.5	54	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

		OSB9115	–4	–6	. . .	–34	–34	
		OSM9115	–4	–6	. . .	–34	–36	
Repetitive peak reverse power t = 10 μs (square-wave; f = 50 Hz) T_j = 175 °C	P_{RRM}	max.	1.2	1.8	. . .	10.2	10.8	kW
Non-repetitive peak reverse power t = 10 μs (square -wave) T_j = 25 °C prior to surge	P_{RSM}	max.	6	9	. . .	51	54	kW
T_j = 125 °C prior to surge	P_{RSM}	max.	1.2	1.8	. . .	10.2	10.8	kW
		OSS9115	–3	–4	. . .	–35	–36	
Repetitive peak reverse power dissipation t = 10 μs (square-wave; f = 50 Hz) T_j = 175 °C	P_{RRM}	max.	1.8	2.4	. . .	21	21.6	kW
Non-repetitive peak reverse power dissipation t = 10 μs (square-wave) T_j = 25 °C prior to surge	P_{RSM}	max.	9	12	. . .	105	108	kW
T_j = 175 °C prior to surge	P_{RSM}	max.	1.8	2.4	. . .	21	21.6	kW

Temperatures

Storage temperature	T_{stg}		–55 to +150	°C
Junction temperature	T_j	max.	175	°C

CHARACTERISTICS (See note 1)

			OSB9115 –4	–6	. . .	–34	–36	
			OSM9115 –4	–6	. . .	–34	–36	
Forward voltage								
I_F = 20 A; T_j = 25 °C	V_F	<	4	6	. . .	34	36	V
Reverse avalanche breakdown voltage*								
I_R = 5 mA; T_j = 25 °C	$V_{(BR)R}$	>	3.3	4.95	. . .	28	29.7	kV
		<	4.8	7.2	. . .	40.8	43.2	kV

			OSS9115 –3	–4	. . .	–35	–36	
Forward voltage								
I_F = 20 A; T_j = 25 °C	V_F	<	6	8	. . .	70	72	V
Reverse avalanche breakdown voltage*								
I_R = 5 mA; T_j = 25 °C	$V_{(BR)R}$	>	4.95	6.6	. . .	57.8	59.4	kV
		<	7.2	9.6	. . .	84	68.4	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 OSS9115 series).

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.

*The breakdown voltage increases by approximately 0.1% per °C with increasing junction temperature.

MECHANICAL DATA

Dimensions in mm

n = total number of diodes

Fig.4 OSM9115 –nA

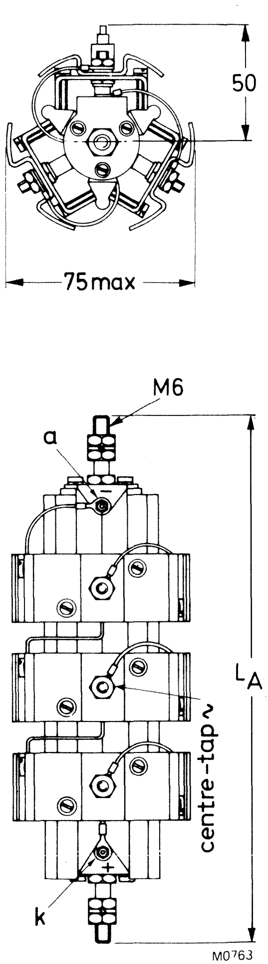


Fig.5 OSM9115 –nB

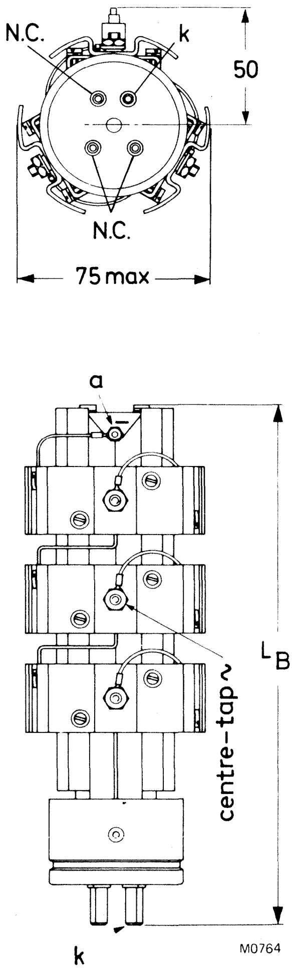
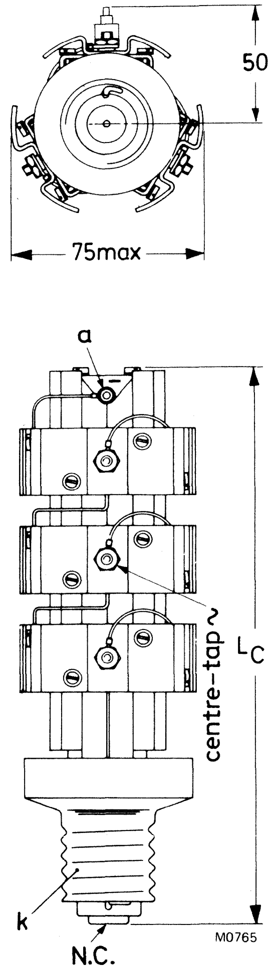


Fig.6 OSM9115 –nC



The drawings show the OSM9115 series; the OSB9115 and OSS9115 series differ in the following respects:

OSB9115 series – terminals marked a (–) and k (+) in the drawings are both marked ∿; the centre-tap is marked + (instead of ∿ as in the drawings).

OSS9115 series – has no centre-tap.

MECHANICAL DATA (continued)

n = total number of diodes.

Fig.7 OSM9115 –nE

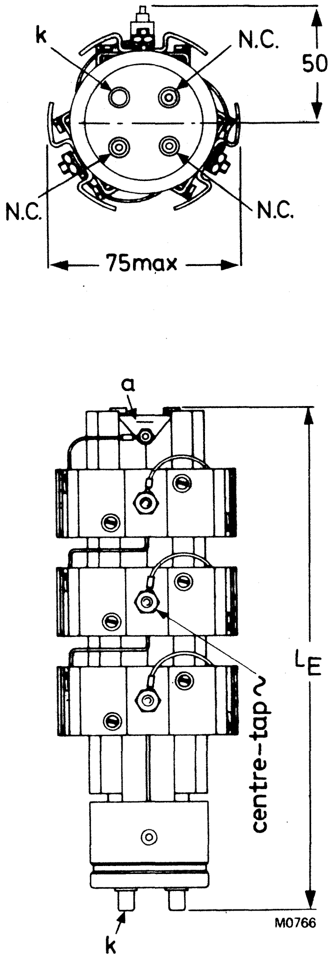
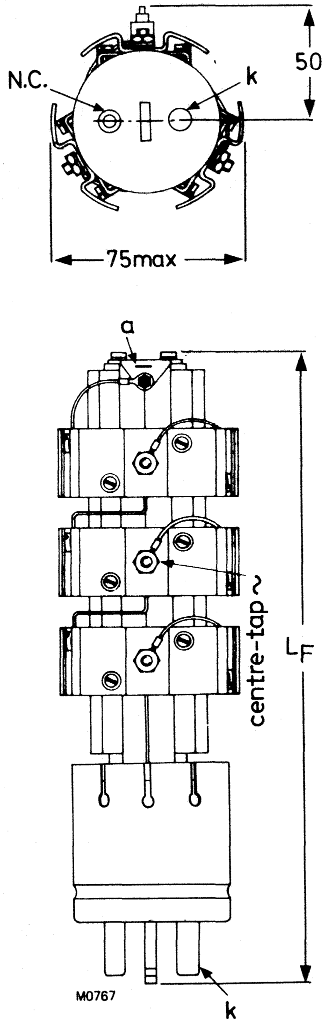


Fig.8 OSM9115 –nF



For lengths and weights see table overleaf.

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

number of diodes	n	31 to 33	34 to 36
	L_A	546	586
	L_B	550	590
	L_C	561	601
	L_E	535	575
	L_F	587	627
weights	W_A	1483	1616
	$W_B = W_C = W_E$	1548	1681
	W_F	1709	1842

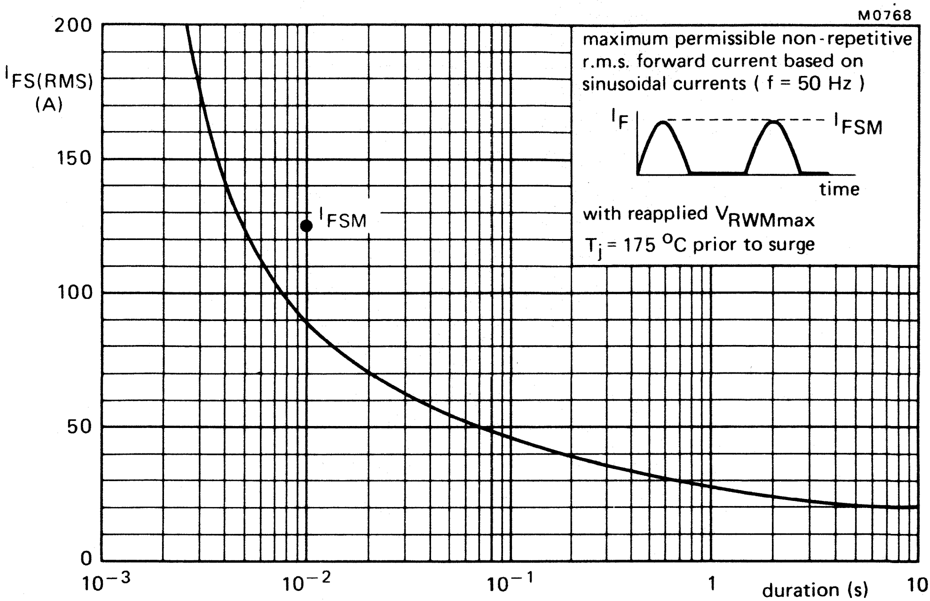

M0768
200
150
100
50
0
$I_{FS(RMS)}$ (A)
I_{FSM}
maximum permissible non-repetitive r.m.s. forward current based on sinusoidal currents (f = 50 Hz)
I_F
I_{FSM}
time
with reapplied V_{RWMmax}
T_j = 175 °C prior to surge
10^{-3}
10^{-2}
10^{-1}
1
duration (s)
10

Fig.9

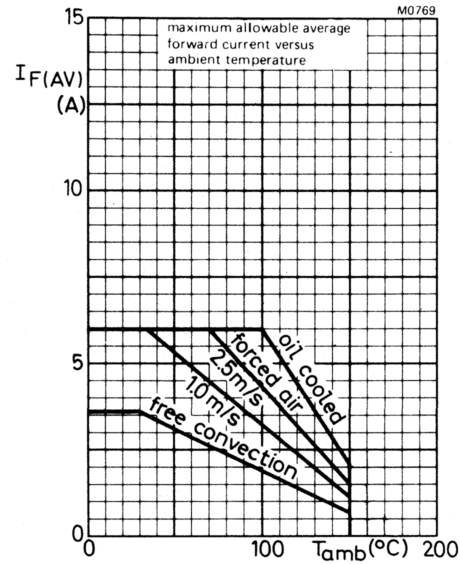


Fig.10

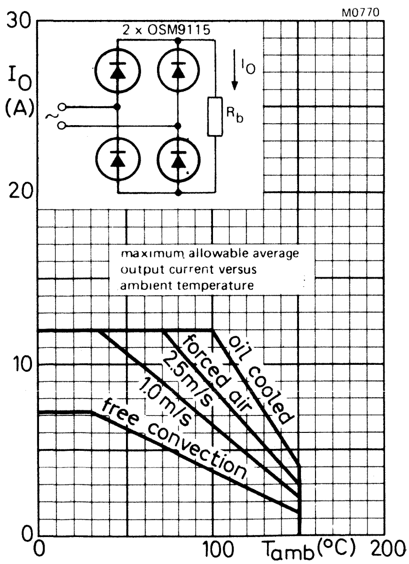


Fig.11

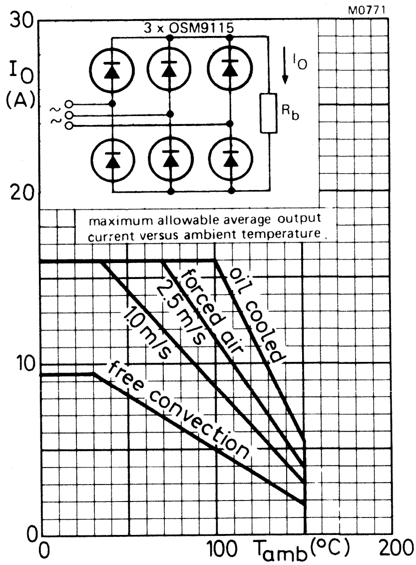


Fig.12

APPLICATION INFORMATION

Fig.13 OSB9115 –4

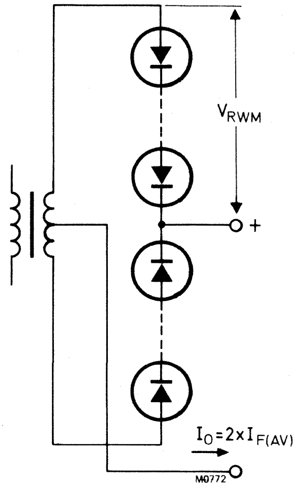
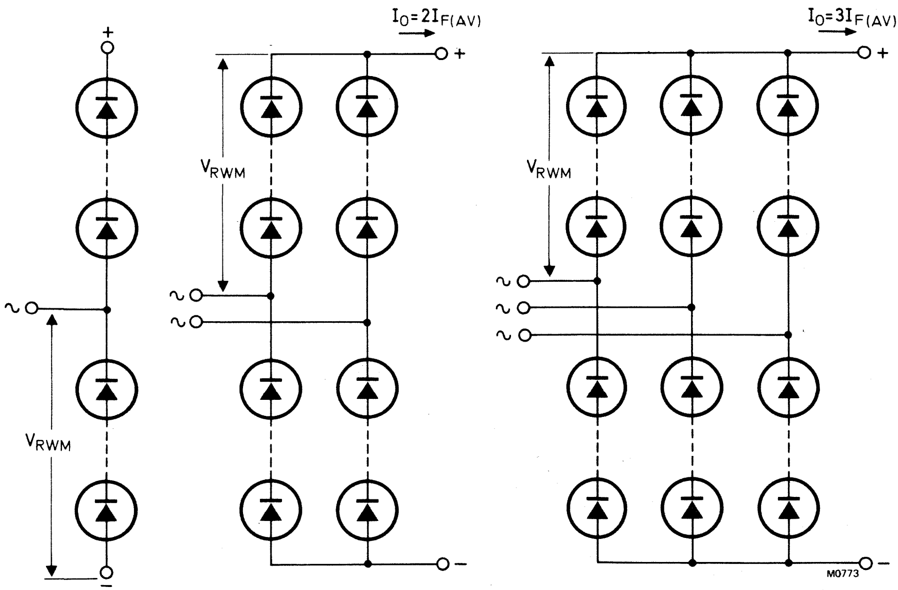


Fig.14 OSM9115 series



voltage doubler
1 x OSM9115

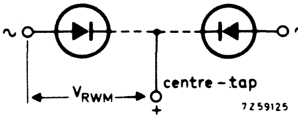
rectifier circuits with respectively
2 x OSM9115 and 3 x OSM9115

Superseded by OSB/M/S9215 series.

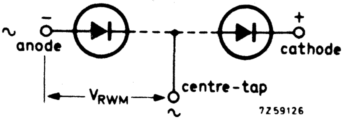
HIGH VOLTAGE RECTIFIER STACKS

The OSB9210, OSM9210 and OSS9210series are ranges of high voltage rectifier assemblies, incorporating controlled avalanche diodes mounted on fire proof 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.

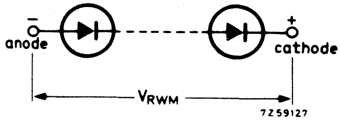
CIRCUIT OSB9210



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

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
Repetitive peak reverse power dissipation		OSS9210	-3	-4	...	-29	-30	kW
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

HIGH-VOLTAGE RECTIFIER STACKS

The OSB9215, OSM9215 and OSS9215 series are ranges of high-voltage rectifier assemblies, incorporating controlled avalanche diodes mounted on fire-proof triangular formers. The OSB9215 series is intended for application in two-phase half-wave rectifier circuits. The OSM9215 series is intended for application in single-phase or three-phase bridges or in voltage doubler circuits.
The OSS9215 series is intended for all kinds of high-voltage rectification. The assemblies are supplied with M6 studs or with standard valve bases. The OSB9215 series and OSM9215 series are supplied with a centre tap (8-32UNC). The maximum crest working voltages of the OSB9215 and OSM9215 series cover the range from 3 kV to 27 kV, and of the OSS9215 series the range from 4.5 kV to 54 kV in 1.5 kV steps.

Configuration:

Fig. 1 OSB9215

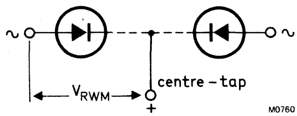


Fig. 2 OSM9215

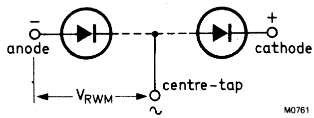
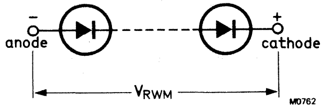


Fig. 3 OSS9215



QUICK REFERENCE DATA

		OSB9215	−4	−6	. . .	−34	−36	
		OSM9215	−4	−6	. . .	−34	−36	
Crest working reverse voltage from centre tap to end	V_{RWM}	max.	3	4.5	. . .	25.5	27	kV
		OSS9215	−3	−4	. . .	−35	−36	
Crest working reverse voltage	V_{RWM}	max.	4.5	6	. . .	52.5	54	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 578 and 579

All information applies to frequencies up to 400 Hz

RATINGS

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

Voltages

		OSB9215	–4	–6	. . .	–34	–36	
		OSM9215	–4	–6	. . .	–34	–36	
Crest working reverse voltage	V_{RWM}	max.	3.0	4.5	. . .	25.5	27	kV
		OSS9215	–3	–4	. . .	–35	–36	
Crest working reverse voltage	V_{RWM}	max.	4.5	6	. . .	52.5	54	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

		OSB9215	–4	–6	. . .	–34	–36	
		OSM9215	–4	–6	. . .	–34	–36	
Repetitive peak reverse power t = 10 μs (square-wave; f = 50 Hz) T_j = 175 °C	P_{RRM}	max.	4	6	. . .	34	36	kW
Non-repetitive peak reverse power t = 10 μs (square-wave)								
T_j = 25 °C prior to surge	P_{RSM}	max.	26	39	. . .	221	234	kW
T_j = 175 °C prior to surge	P_{RSM}	max.	4	6	. . .	34	36	kW
Repetitive peak reverse power dissipation		OSS9215	–3	–4	. . .	–35	–36	kW
t = 10 μs (square-wave; f = 50 Hz) T_j = 175 °C	P_{RRM}	max.	6	8	. . .	70	72	kW
Non-repetitive peak reverse power dissipation t = 10 μs (square-wave)								
T_j = 25 °C prior to surge	P_{RSM}	max.	39	52	. . .	455	468	kW
T_j = 175 °C prior to surge	P_{RSM}	max.	6	8		70	72	kW

Temperatures

Storage temperature	T_{stg}		–55 to +150	°C
Junction temperature	T_j	max.	175	°C

CHARACTERISTICS (see note 1)

			OSB9215	–4	–6	. . .	–34	–36	
			OSM9215	–4	–6	. . .	–34	–36	
Forward voltage I_F = 50 A; T_j = 25 °C	V_F	<		3.6	5.4	. . .	30.6	32.4	V
Reverse breakdown voltage* I_R = 5 mA; T_j = 25 °C	$V_{(BR)R}$	>		3.3	4.95	. . .	28	29.7	kV
		<		4.8	7.2	. . .	40.8	43.2	kV
			OSS9215	–3	–4	. . .	–35	–36	
Forward voltage I_F = 50 A; T_j = 25 °C	V_F	<		5.4	7.2	. . .	63	64.8	V
Reverse breakdown voltage* I_R = 5 mA; T_j = 25 °C	$V_{(BR)R}$	>		4.95	6.6	. . .	57.8	59.4	kV
		<		7.2	9.6	. . .	84	86.4	kV

Reverse current
$V_{RM} = V_{RWMmax}$; T_j = 125 °C $\quad I_{RM}$ < 0.6 mA

Notes

1. The Ratings and Characteristics given apply **from centre tap to end.** (Not for OSS9215 series).

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.

*The breakdown voltage increases by approximately 0.1% per °C with increasing junction temperature.

MECHANICAL DATA

Dimensions in mm

n = total number of diodes

Fig. 4 OSM9215-nA

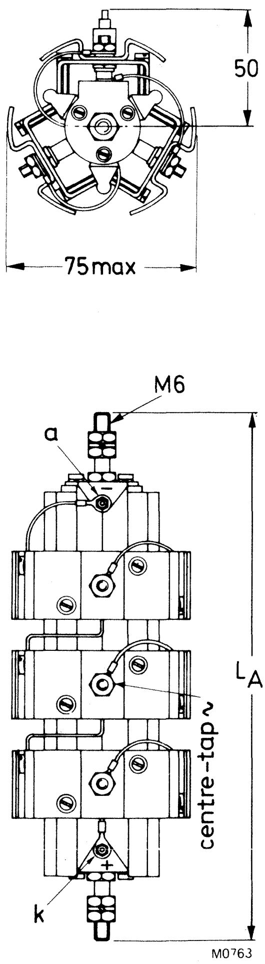


Fig. 5 OSM9215-nB

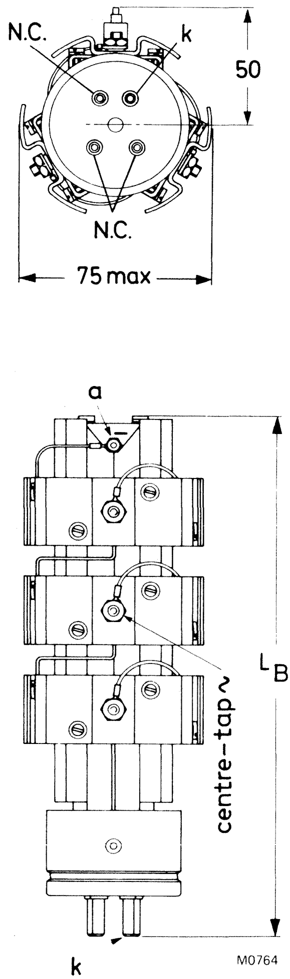
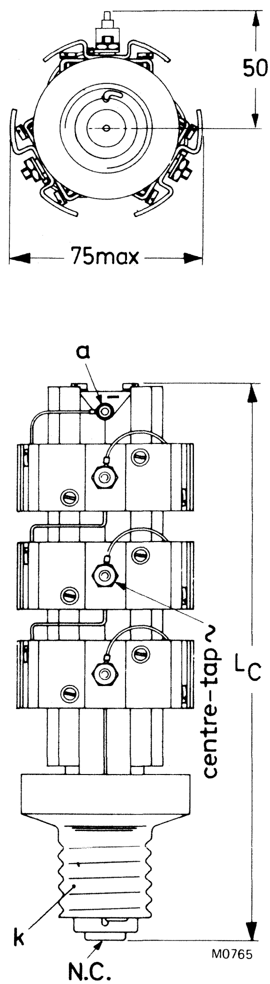


Fig. 6 OSM9215-nC



The drawings show the OSM9215 series; the OSB9215 and OSS9215 series differ in the following respects:

OSB9215 series – terminals marked a(–) and k(+) in the drawings are both marked ∿;
the centre-tap is marked + (instead of ∿ as in the drawings).

OSS9215 series – has no centre-tap.

MECHANICAL DATA (continued)

n = total number of diodes.

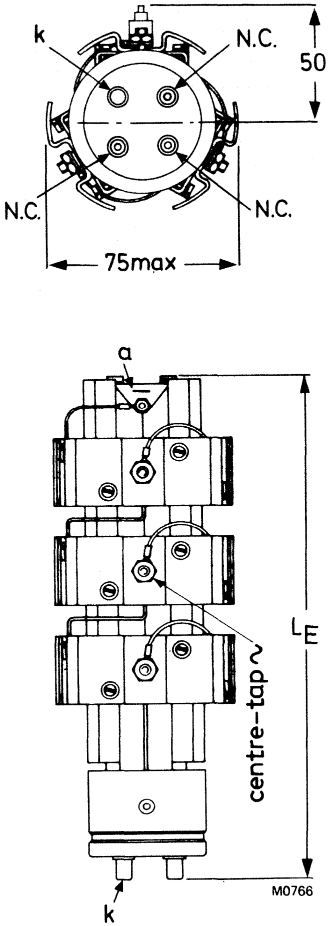


Fig. 7 OSM9215-nE

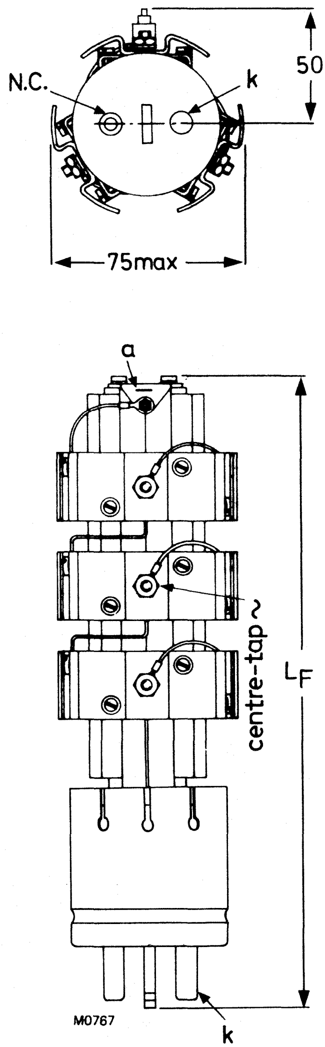


Fig. 8 OSM9215-nF

For lengths and weights see table overleaf.

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

number of diodes	n	31 to 33	34 to 36
maximum lengths	L_A	546	586
	L_B	550	590
	L_C	561	601
	L_E	535	575
	L_F	587	627
weights	W_A	1483	1616
	$W_B = W_C = W_E$	1548	1681
	W_F	1709	1842

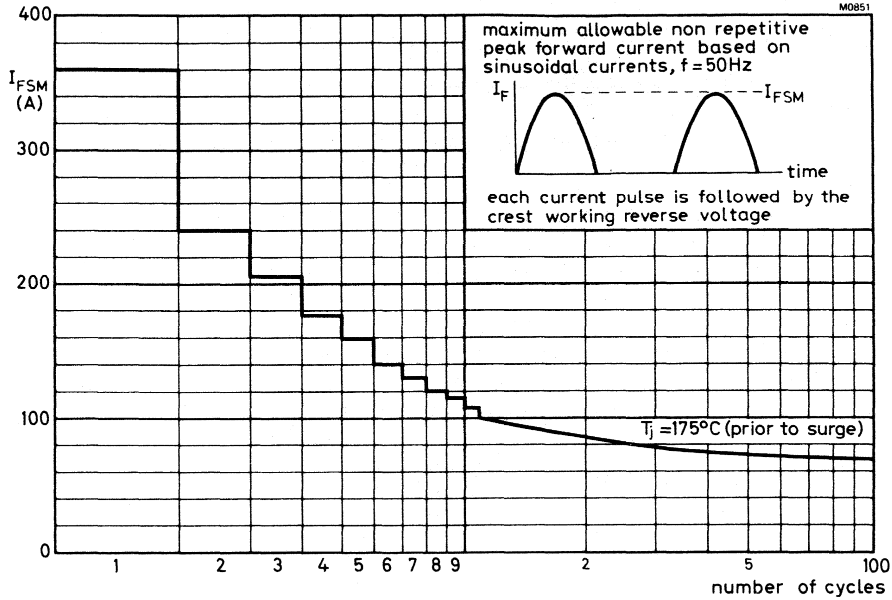

M0851
maximum allowable non repetitive peak forward current based on sinusoidal currents, f = 50Hz
I_F
I_FSM
time
each current pulse is followed by the crest working reverse voltage
I_FSM (A)
400
300
200
100
0
Tj = 175°C (prior to surge)
1
2
3
4
5
6
7
8
9
2
5
100
number of cycles

Fig. 9

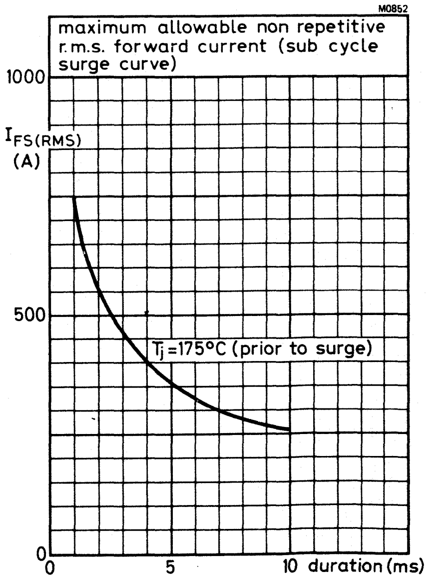

M0852
maximum allowable non repetitive r.m.s. forward current (sub cycle surge curve)
I_FS(RMS) (A)
1000
500
0
Tj = 175°C (prior to surge)
0
5
10
duration (ms)

Fig. 10

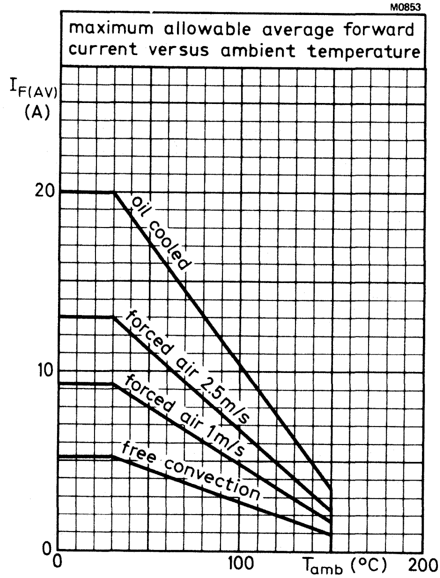


Fig. 11

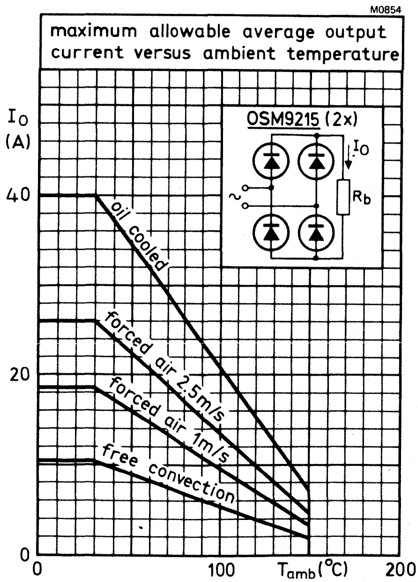


Fig. 12

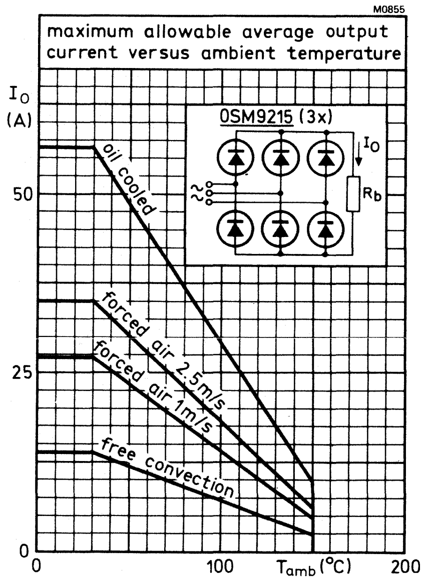


Fig. 13

APPLICATION INFORMATION

Fig. 14 OSB9215–4

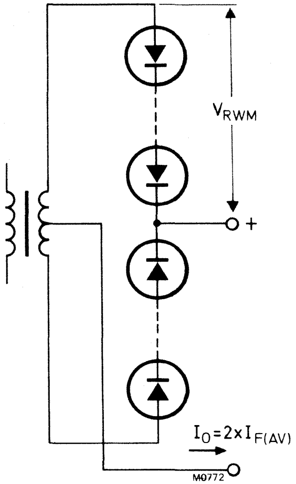
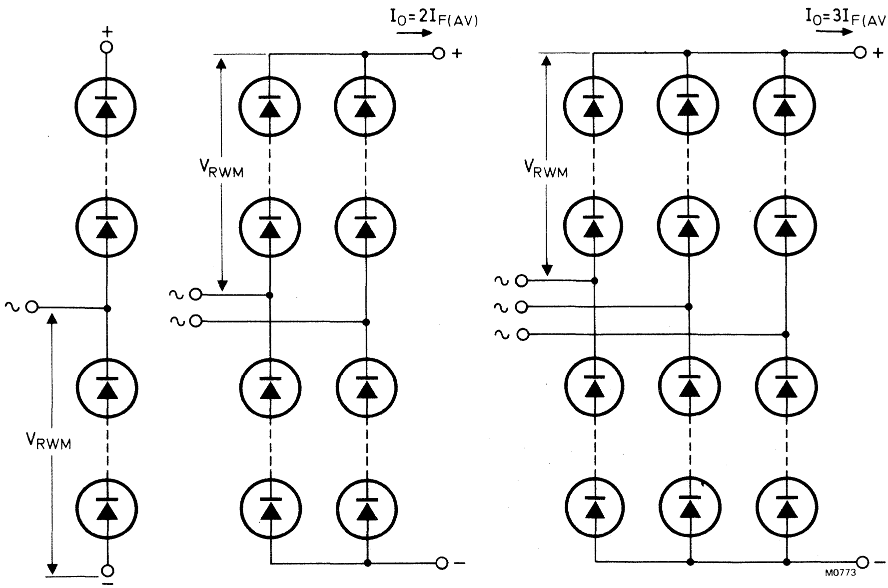


Fig. 15 OSM9215 series



voltage doubler
1x OSM9215

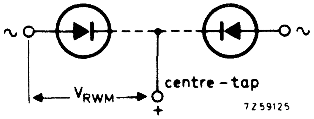
rectifier circuits with respectively
2x OSM9215 and 3x OSM9215

Superseded by OSB/M/S9415 series.

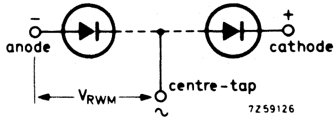
HIGH VOLTAGE RECTIFIER STACKS

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.

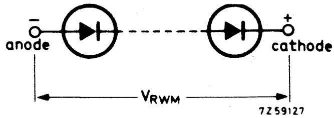
CIRCUIT OSB9410



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

All information applies to frequencies up to 400 Hz

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

Voltages

			OSB9410 -4	-6	...	-28	-30	
			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 -4	-6	...	-28	-30	
Repetitive peak reverse power dissipation			OSM9410 -4	-6	...	-28	-30	
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
Repetitive peak reverse power dissipation			OSS9410 -3	-4	...	-29	-30	
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

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 OSB9415 series is intended for application in two-phase half-wave rectifier circuits.
The OSM9415 series is intended for application in single-phase or three-phase bridges or in voltage doubler circuits.
The OSS9415 series is intended for all kinds of high-voltage rectification.
The OSB9415 series and OSM9415 series are supplied with a centre tap (8–32UNC).
The maximum crest working voltages of the OSB9415 and OSM9415 series cover the range from 3 kV to 27 kV, and of the OSS9415 series the range from 4.5 kV to 54 kV, in 1.5 kV steps.

Configuration:

Fig.1 OSB9415

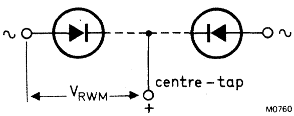


Fig.2 OSM9415

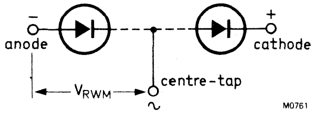
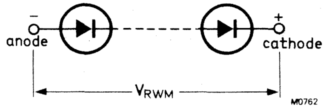


Fig.3 OSS9415



QUICK REFERENCE DATA

		OSB9415	−4	−6	. . .	−34	−36	
		OSM9415	−4	−6	. . .	−34	−36	
Crest working reverse voltage from centre tap to end	V_{RWM}	max.	3	4.5		25.5	27	kV
		OSS9415	−3	−4	. . .	−35	−36	
Crest working reverse voltage	V_{RWM}	max.	4.5	6	. . .	52.5	54	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 590

All information applies to frequencies up to 400 Hz

RATINGS

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

Voltages

		OSB9415 OSM9415	−4 −4	−6 −6	. . .	−34 −34	−36 −36	
Crest working reverse voltage	V_{RWM}	max.	3	4.5	. . .	25.5	27	kV
		OSS9415	−3	−4	. . .	−35	−36	
Crest working reverse voltage	V_{RWM}	max.	4.5	6	. . .	52.5	54	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

		OSB9415 OSM9415	−4 −4	−6 −6	. . . . . .	−34 −34	−36 −36	
Repetitive peak reverse power dissipation t = 10 μs (square-wave; f = 50 Hz) T_j = 175 °C	P_{RRM}	max.	9	13.5	. . .	76.5	81	kW
Non-repetitive peak reverse power dissipation t = 10 μs (square-wave)								
T_j = 25 °C prior to surge	P_{RSM}	max.	55	82	. . .	467	495	kW
T_j = 175 °C prior to surge	P_{RSM}	max.	8.5	13	. . .	72	77	kW
		OSS9415	−3	−4	. . .	−35	−36	
Repetitive peak reverse power dissipation t = 10 μs (square-wave; f = 50 Hz) T_j = 175 °C	P_{RRM}	max.	13.5	18	. . .	157	162	kW
Non-repetitive peak reverse power dissipation t = 10 μs (square-wave)								
T_j = 25 °C prior to surge	P_{RSM}	max.	80	105	. . .	919	945	kW
T_j = 175 °C prior to surge	P_{RSM}	max.	13	17	. . .	149	153	kW

Temperatures

Storage temperature	T_{stg}		−55 to +150	°C
Junction temperature	T_j	max.	175	°C

CHARACTERISTICS (See note 1)

			OSB9415	−4	−6	. . .	−34	−36	
			OSM9415	−4	−6	. . .	−34	−36	
Forward voltage									
I_F = 150 A; T_j = 25 °C	V_F	<		3.6	5.4	. . .	30.6	32.4	V
Reverse avalanche breakdown voltage*									
I_R = 5 mA; T_j = 25 °C	$V_{(BR)R}$	>		3.3	4.95	. . .	28	29.7	kV
		<		4.8	7.2	. . .	40.8	43.2	kV

			OSS9415	−3	−4	. . .	−35	−36	
Forward voltage									
I_F = 150 A; T_j = 25 °C	V_F	<		5.4	7.2	. . .	63	64.8	V
Reverse avalanche breakdown voltage*									
I_R = 5 mA; T_j = 25 °C	$V_{(BR)R}$	>		4.95	6.6	. . .	57.8	59.4	kV
		<		7.2	9.6	. . .	84	86.4	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 OSS9415 series).
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.

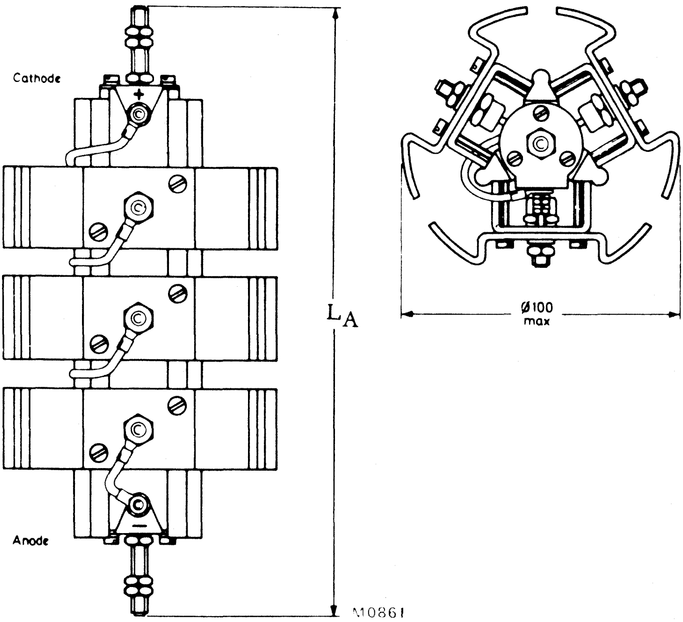
* The breakdown voltage increases, by approximately 0.1% per °C with increasing junction temperature.

MECHANICAL DATA

Dimensions in mm

n = total number of diodes.

Fig.4 OSS9415-nA



The drawing shows the OSS9415 series.
The OSB9415 and OSM9415 series differ in the following respects:
OSB9415 series – has a centre tap marked +; anode and cathode terminals are both marked ∿.
OSM9415 series – 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	31 to 33	34 to 36
maximum lengths	L_A	345	385	426	466	506	546	586
weights	W_A	1208	1406	1604	1802	2000	2198	2396

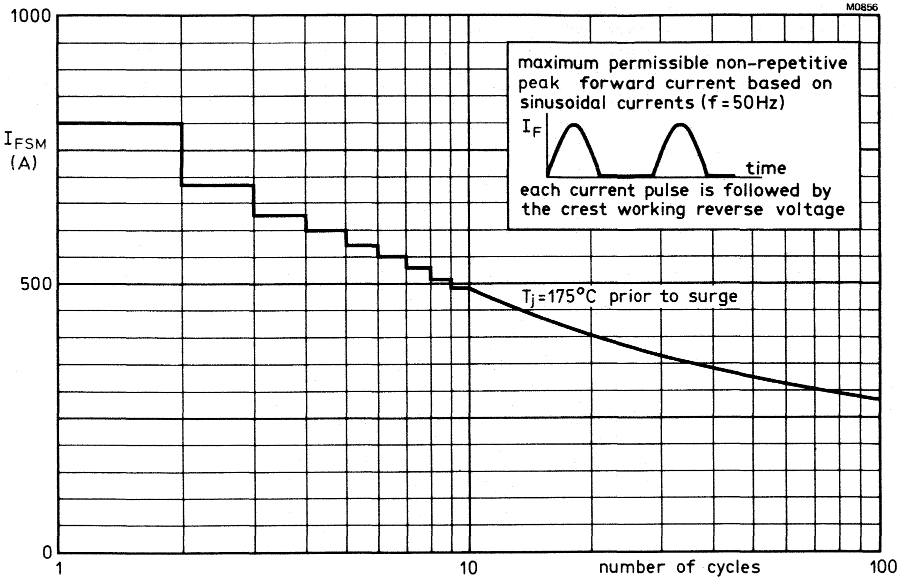

M0856
maximum permissible non-repetitive peak forward current based on sinusoidal currents (f = 50 Hz)
I_F
time
each current pulse is followed by the crest working reverse voltage
T_j = 175 °C prior to surge
I_FSM (A)
1000
500
0
1
10
number of cycles
100

Fig.5

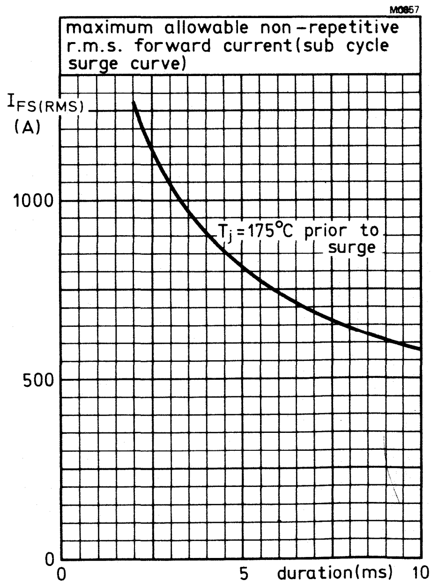

M0857
maximum allowable non-repetitive r.m.s. forward current (sub cycle surge curve)
I_FS(RMS) (A)
1000
500
0
T_j = 175 °C prior to surge
0
5
duration (ms)
10

Fig.6

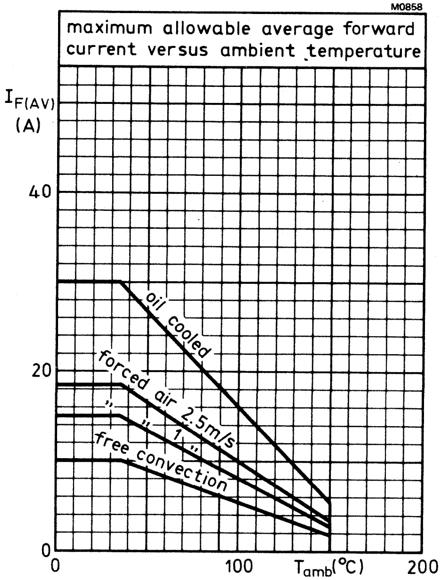


Fig.7

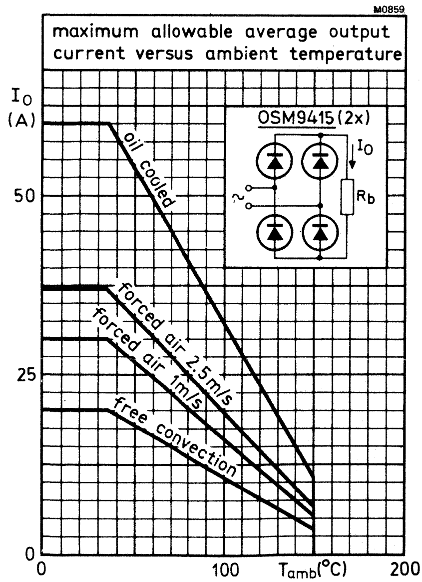


Fig.8

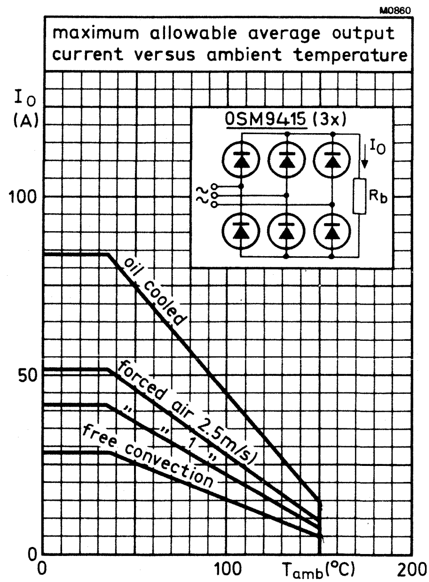


Fig.9

APPLICATION INFORMATION

Fig.10 OSB9415 series

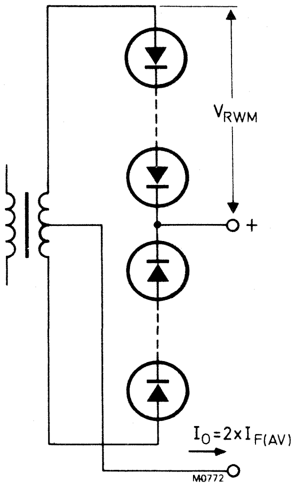
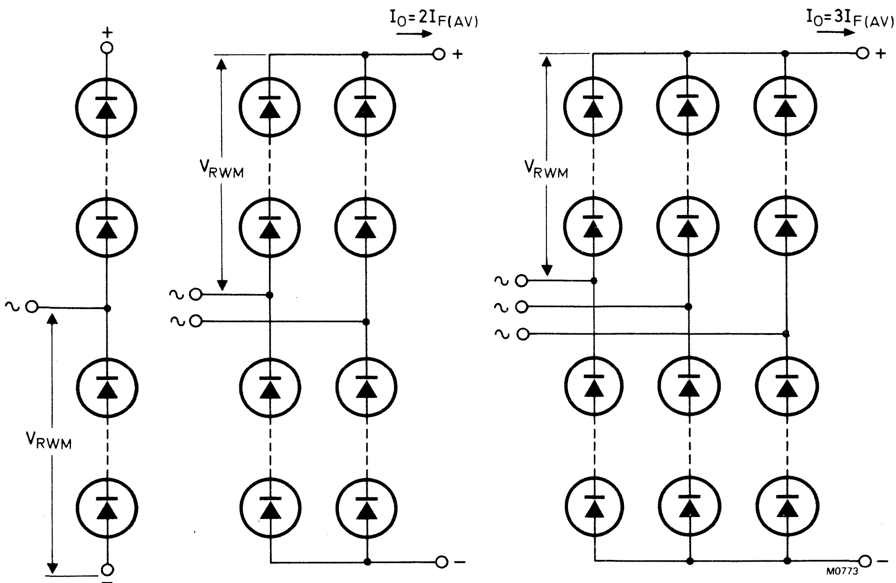


Fig.11 OSM9415 series



voltage doubler
1 x OSM9415

rectifier circuits with respectively
2 x OSM9415 and 3 x OSM9415

HIGH-VOLTAGE RECTIFIER STACK

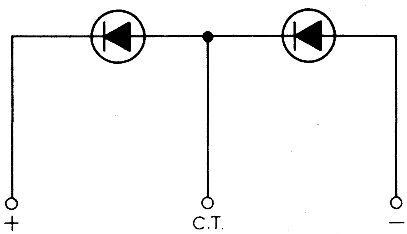
The OSM9510-12 is a silicon rectifier stack for high voltage applications; up to 12kV in half-wave circuits, or up to 6kV as one of the arms of a bridge configuration, where the centre-tap is utilised. Because of its controlled avalanche characteristics it is capable of withstanding reverse transients 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, $T_{amb} = 50^{\circ}C$	1.5	A
P_{RSM} max., $t = 10\mu s$, $T_{amb} = 25^{\circ}C$	20	kW

OUTLINE AND DIMENSIONS

For details see page 597

CIRCUIT DIAGRAM



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 See derating curves	1.5	A
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.

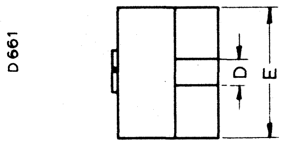
MECHANICAL DATA

Weight	130	g

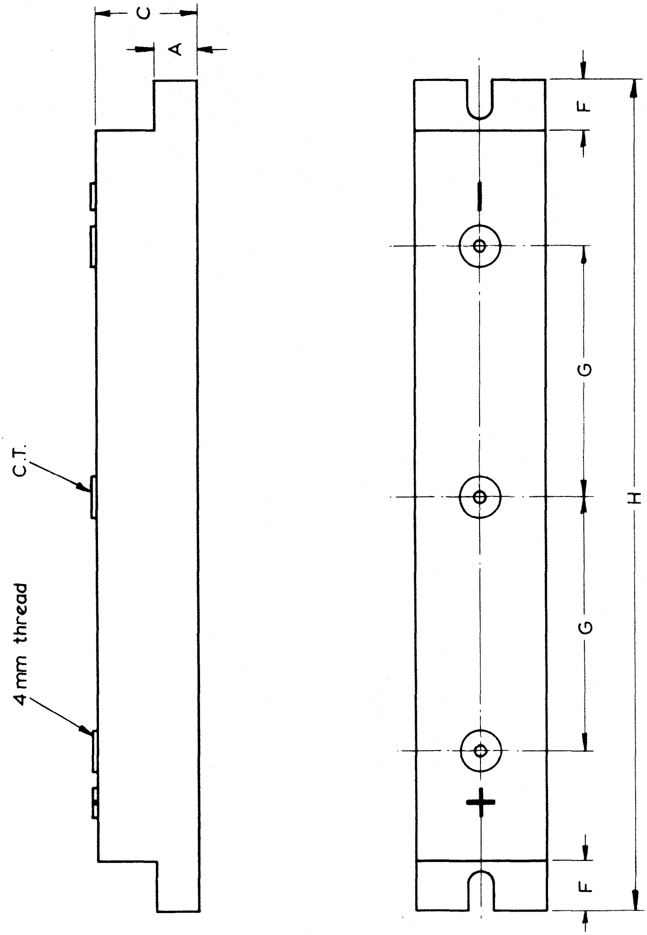
MOUNTING POSITION

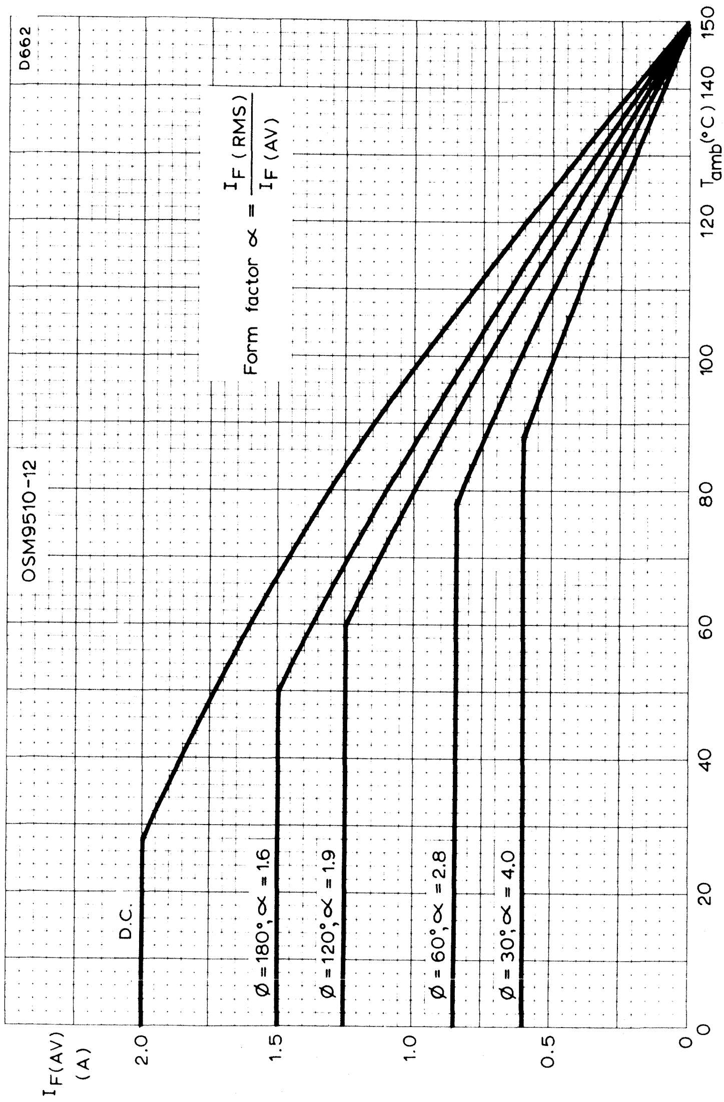
The rectifier units can be operated at their maximum ratings when mounted in any position.

OUTLINE AND DIMENSIONS

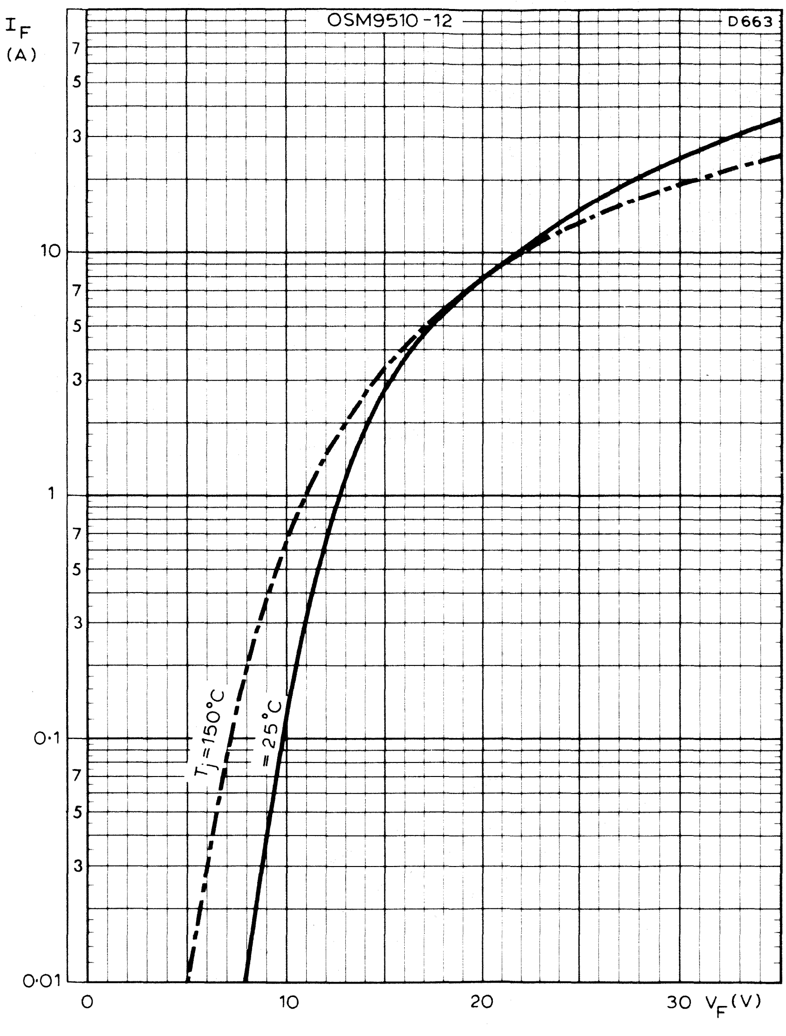


Millimetres	
A	8.0
C	18.5
D	5.3
E	26
F	10
G	50
H	165

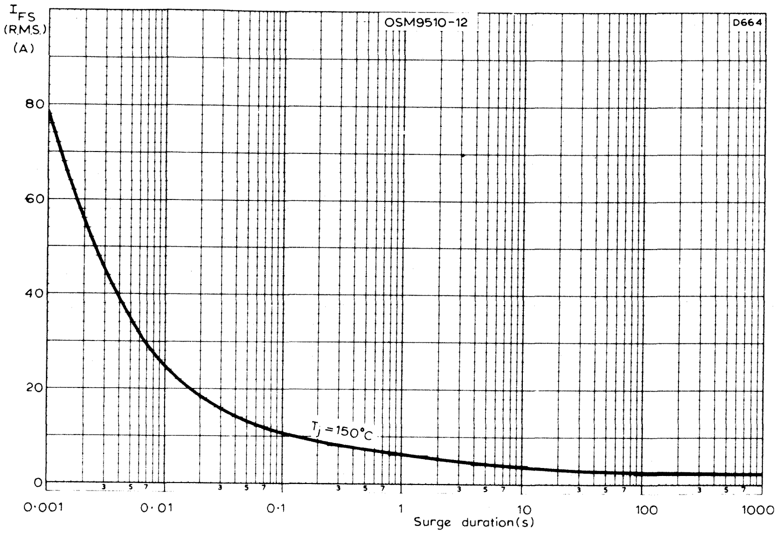




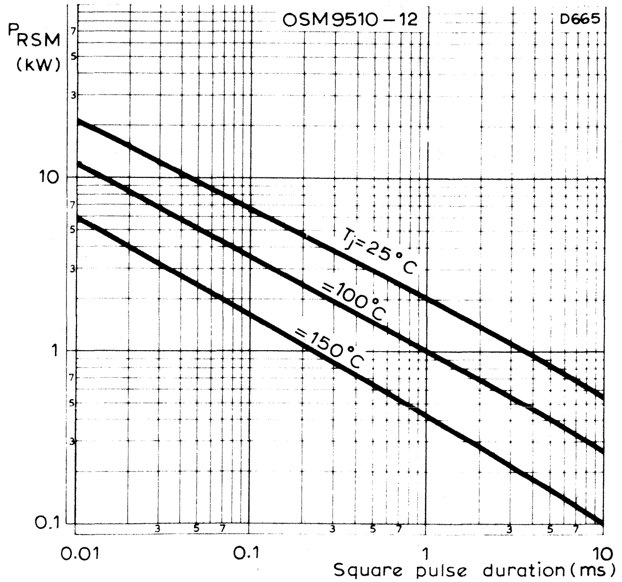
MAXIMUM MEAN FORWARD CURRENT AS A FUNCTION OF AMBIENT TEMPERATURE AND CONDUCTION ANGLE



MAXIMUM FORWARD CONDUCTION CHARACTERISTICS



MAXIMUM R.M.S. SURGE CURRENT PLOTTED AGAINST SURGE DURATION



NON-REPETITIVE PEAK REVERSE POWER PLOTTED AGAINST SQUARE PULSE DURATION

ACCESSORIES

TYPE NUMBER SUMMARY

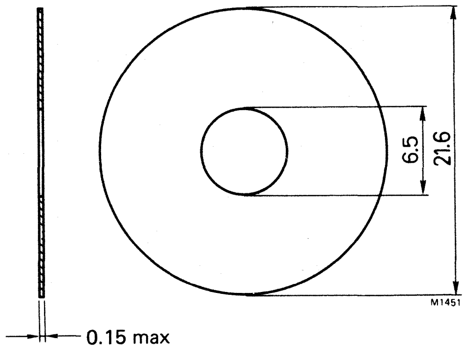
type number	description	envelope
56264a	mica washer (up to 2000 V)	DO-5, TO-48, TO-65
56264b	insulating bush	DO-5, TO-48, TO-65
56295a	mica washer (up to 2000 V)	DO-4, TO-64
56295b	PTFE ring	DO-4, TO-64
56295c	insulating bush	DO-4, TO-64
56359b	mica washer (up to 1000 V)	TO-220
56359c	insulating bush (up to 800 V)	TO-220
56359d	rectangular insulating bush (up to 1000 V)	TO-220
56360a	rectangular washer	TO-220
56363	spring clip (direct mounting)	TO-220
56364	spring clip (insulated mounting)	TO-220
56367	alumina insulator (up to 2000 V)	TO-220
56368a	mica insulator (up to 800 V)	SOT-93
56368b	insulating bush (up to 800 V)	SOT-93
56369	mica insulator (up to 2000 V)	TO-220
56378	mica insulator (up to 1500 V)	SOT-93
56379	spring clip	SOT-93, SOT-112

56264a MICA WASHER

Insulator up to 2000 V

MECHANICAL DATA

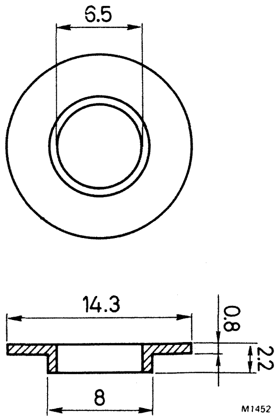
Dimensions in mm



56264b INSULATING BUSH

MECHANICAL DATA

Dimensions in mm



THERMAL RESISTANCE

From mounting base to heatsink				
with mica washer, without heatsink compound	$R_{th\ mb\text{-}h}$	=	5	K/W
with mica washer, with heatsink compound	$R_{th\ mb\text{-}h}$	=	2.5	K/W

TEMPERATURE

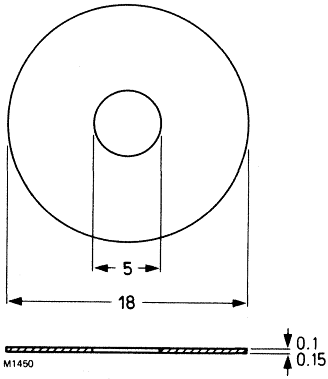
Maximum allowable temperature	T_{max}	=	175	^oC

56295a MICA WASHER

Insulator up to 2 kV.

MECHANICAL DATA

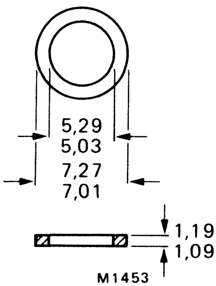
Dimensions in mm



56295b PTFE RING

MECHANICAL DATA

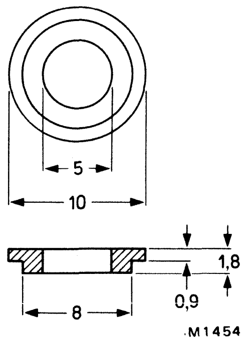
Dimensions in mm



56295c INSULATING BUSH

MECHANICAL DATA

Dimensions in mm



THERMAL RESISTANCE

From mounting base to heatsink				
without heatsink compound	$R_{th\ mb\text{-}h}$	=	5	K/W
with heatsink compound	$R_{th\ mb\text{-}h}$	=	2.5	K/W

TEMPERATURE

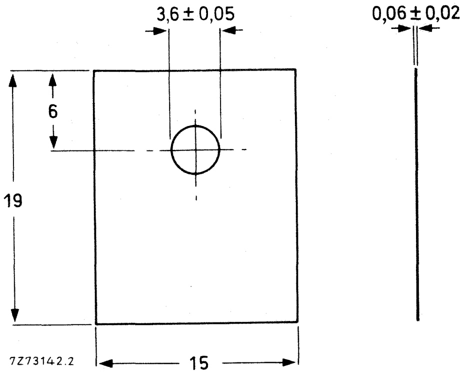
Maximum allowable temperature	T_{max}	=	175	^oC

56359b MICA WASHER

Insulator up to 1000 V.

MECHANICAL DATA

Dimensions in mm



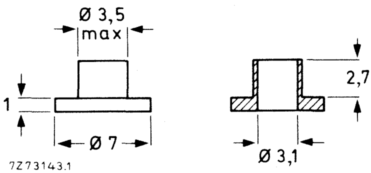
56359c INSULATING BUSH

Insulator up to 800 V.

MECHANICAL DATA

Dimensions in mm

Material: polyester



TEMPERATURE

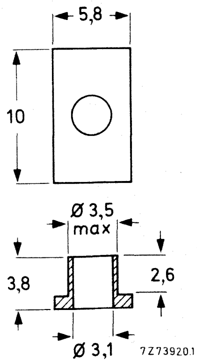
Maximum pemissible temperature T_{max} = 150 °C

56359d RECTANGULAR INSULATING BUSH

Insulator up to 1000 V.

MECHANICAL DATA

Dimensions in mm



TEMPERATURE

Maximum permissible temperature T_{max} = 150 °C

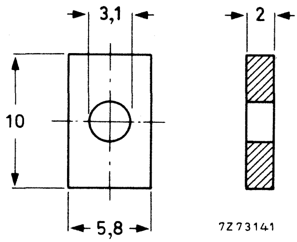
56360a RECTANGULAR WASHER

For direct and insulated mounting.

MECHANICAL DATA

Dimensions in mm

Material: brass; nickel plated.



56363 SPRING CLIP

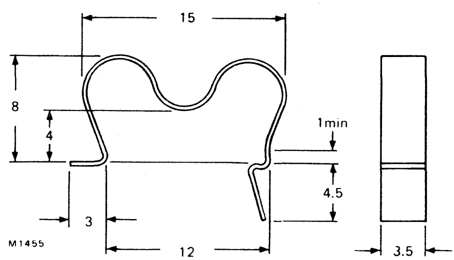
For direct mounting.

MECHANICAL DATA

Dimensions in mm

Material: stainless steel; for mounting on heatsink of 1.0 to 2.0 mm.

Recommended force of clip on device is 20 N (2 kgf).



56364 SPRING CLIP

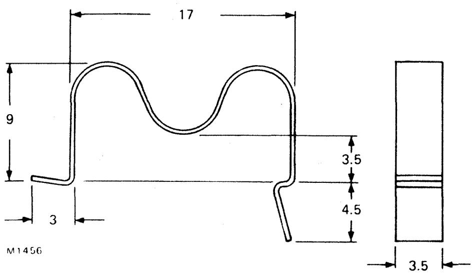
For insulated mounting.

MECHANICAL DATA

Dimensions in mm

Material: stainless steel; for mounting on heatsink of 1.0 to 1.5 mm.

Recommended force of clip on device is 20 N (2 kgf).



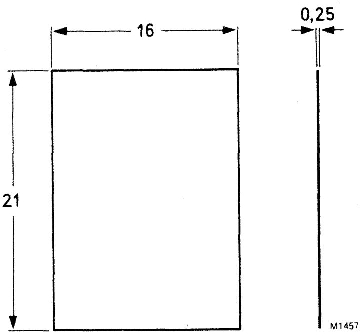
To be used in conjunction with insulators **56367** or **56369**

56367 ALUMINA INSULATOR

For insulated clip mounting up to 2 kV.

MECHANICAL DATA Dimensions in mm

Material: 96-alumina.

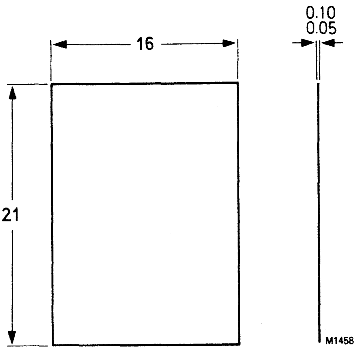


*Because alumina is brittle, extreme care must be taken when mounting devices not to crack the alumina, particularly when used without heatsink compound.

56369 MICA INSULATOR

For insulated clip mounting up to 2 kV.

MECHANICAL DATA Dimensions in mm

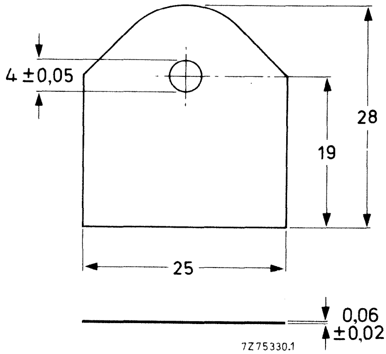


56368a MICA INSULATOR

For insulated screw mounting up to 800 V.

MECHANICAL DATA

Dimensions in mm



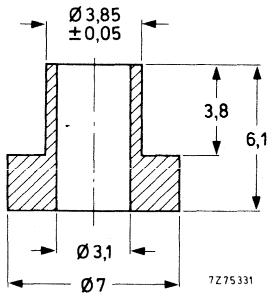
56368b INSULATING BUSH

For insulated screw mounting up to 800 V.

MECHANICAL DATA

Dimensions in mm

Material: polyester



TEMPERATURE

Maximum permissible temperature T_{max} = 150 °C

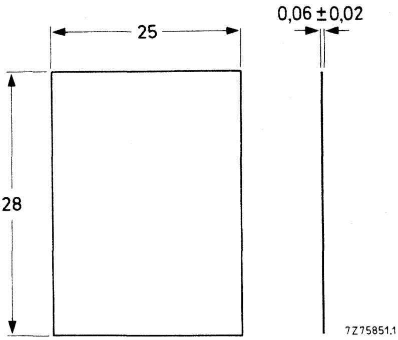
56369: see preceding page.

56378 MICA INSULATOR

For clip mounting up to 1500 V.

MECHANICAL DATA

Dimensions in mm



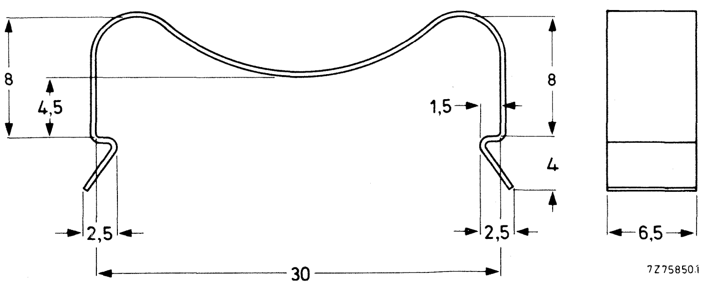
56379 SPRING CLIP

For direct and insulated mounting of SOT-93 and SOT-112 envelopes.

MECHANICAL DATA

Dimensions in mm

Material:
CrNi steel NLN-939;
thickness 0.4 ± 0.04.



MOUNTING INSTRUCTIONS

MOUNTING INSTRUCTIONS FOR TO-220 ENVELOPES

GENERAL DATA AND INSTRUCTIONS

General rules

1. First fasten the device to the heatsink before soldering the leads.
2. Avoid axial stress to the leads.
3. Keep mounting tool (e.g. screwdriver) clear of the plastic body.
4. The rectangular washer may only touch the plastic part of the body; it should not exert any force on that part (screw mounting).

Heatsink requirements

Flatness in the mounting area: 0,02 mm maximum per 10 mm.
Mounting holes must be deburred, see further mounting instructions.

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. 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 power devices

1. Clip mounting

   Mounting with a spring clip gives:

   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.

2. M3 screw mounting

   It is recommended that the rectangular spacing washer is inserted between screw head and mounting tab.

   Mounting torque for screw mounting:

   (For thread-forming screws these are final values. Do not use self-tapping screws.)

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 (not for thread-forming screw), 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 non-insulated

The device should not be pop-rivetted to the heatsink. However, it is permissible to press-rivet providing that eyelet 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.

Thermal data

			clip mounting	screw mounting	
From mounting base to heatsink					
with heatsink compound, direct mounting	$R_{th\ mb\text{-}h}$	=	0,3	0,5	K/W
without heatsink compound, direct mounting	$R_{th\ mb\text{-}h}$	=	1,4	1,4	K/W
with heatsink compound and 0,1 mm maximum mica washer	$R_{th\ mb\text{-}h}$	=	2,2	–	K/W
with heatsink compound and 0,25 mm maximum alumina insulator	$R_{th\ mb\text{-}h}$	=	0,8	–	K/W
with heatsink compound and 0,05 mm mica washer					
insulated up to 500 V	$R_{th\ mb\text{-}h}$	=	–	1,4	K/W
insulated up to 800 V/1000 V	$R_{th\ mb\text{-}h}$	=	–	1,6	K/W
without heatsink compound and 0,05 mm mica washer					
insulated up to 500 V	$R_{th\ mb\text{-}h}$	=	–	3,0	K/W
insulated up to 800 V/1000 V	$R_{th\ mb\text{-}h}$	=	–	4,5	K/W

Lead bending

Maximum permissible tensile force on the body, for 5 seconds is 20 N (2 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, using pliers. The leads should neither be bent nor twisted less than 2,4 mm from the body.

Soldering

Lead soldering temperature at > 3 mm from the body; $t_{sld} < 5$ s:

Devices with $T_{j\ max} \leqslant 175$ °C, soldering temperature $T_{sld\ max} = 275$ °C.
Devices with $T_{j\ max} \leqslant 110$ °C, soldering temperature $T_{sld\ max} = 240$ °C.

Avoid any force on body and leads during or after soldering: do not correct the position of the device or of its 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.

Mounting base soldering

Recommended metal-alloy of solder paste (85% metal weight)
62 Sm/36 Pb/2 Ag or 60 Sn/40 Pb.
Maximum soldering temperature ⩽ 200 °C (tab-temperature).
Soldering cycle duration including pre-heating ⩽ 30 sec.

For good soldering and avoiding damage to the encapsulation pre-heating is recommended to a temperature ⩽ 165 °C at a duration ⩽ 10 s.

INSTRUCTIONS FOR CLIP MOUNTING

Direct mounting with clip 56363

1. Apply heatsink compound to the mounting base, then place the device on the heatsink.
2. Push the short end of the clip into the narrow slot in the heatsink with clip at an angle of 10° to 30° to the vertical (see Figs 1 and 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.2a). Do not insert more than 1 mm beyond final position.

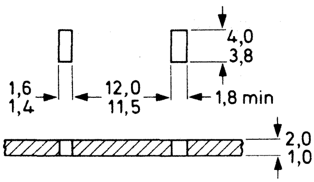


Fig. 1 Heatsink requirements.

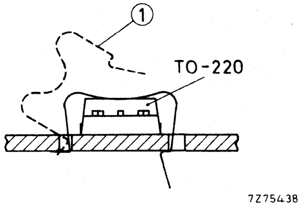


Fig. 2 Mounting.
(1) spring clip 56363.

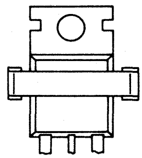


Fig. 2a Position of transistor (top view).

Insulated mounting with clip 56364

With the insulators 56367 or 56369 insulation up to 2 kV is obtained.

1. Apply heatsink compound to the bottom of both device and insulator, then place the device with the insulator on the heatsink.
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 Figs 3 and 4).
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. Ensure that the device is centred on the mica insulator to prevent creepage. Do not insert more than 1 mm beyond final position.

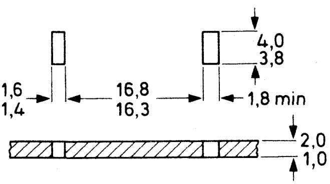


Fig. 3 Heatsink requirements.

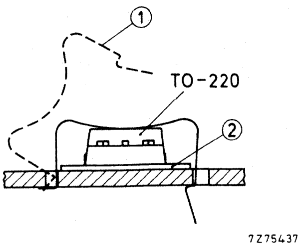


Fig. 4 Mounting.
(1) spring clip 56364.
(2) insulator 56369 or 56367.

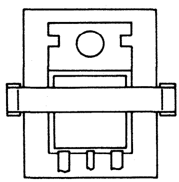


Fig.4a Position of device (top view).

INSTRUCTIONS FOR SCREW MOUNTING

Dimensions in mm

Direct mounting with screw and spacing washer

- *through heatsink with nut*

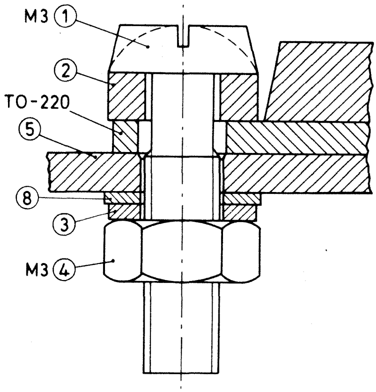


Fig. 5 Assembly.

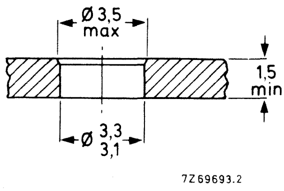


Fig. 6 Heatsink requirements.

(1) M3 screw.
(2) rectangular washer (56360a).
(3) lock washer.
(4) M3 nut.
(5) heatsink.
(8) plain washer.

- *into tapped heatsink*

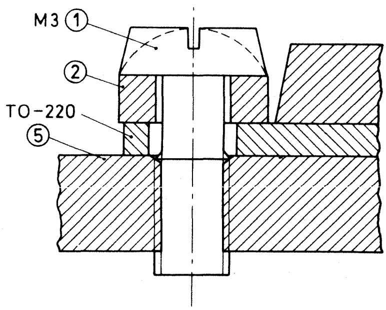


Fig. 7 Assembly.

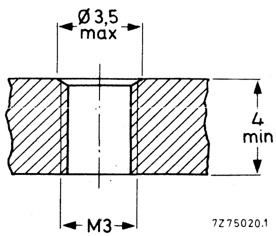


Fig. 8 Heatsink requirements.

(1) M3 screw.
(2) rectangular washer 56360a.
(5) heatsink.

Insulated mounting with screw and spacing washer
(not recommended where mounting tab is on mains voltage)

Dimensions in mm

- *through heatsink with nut*

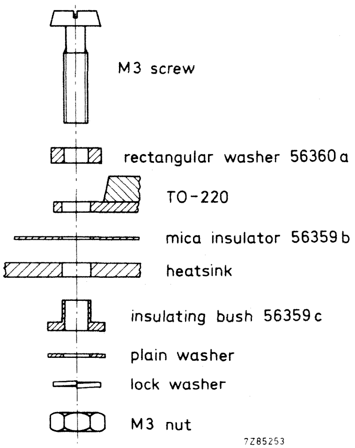


Fig. 9 Insulated screw mounting with rectangular washer. Known as a "bottom mounting".

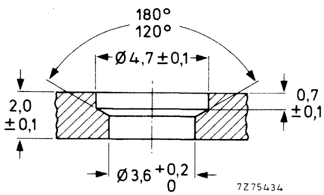


Fig. 10 Heatsink requirements for 500 V insulation.

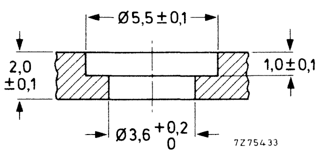


Fig. 11 Heatsink requirements for 800 V insulation.

- *into tapped heatsink*

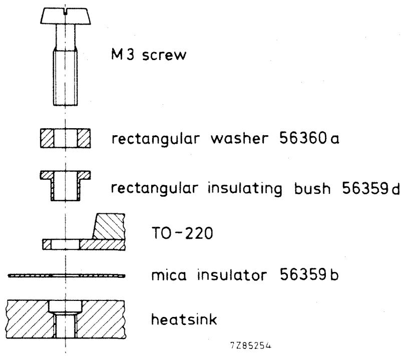


Fig. 12 Insulated screw mounting with rectangular washer into tapped heatsink. Known as a "top mounting".

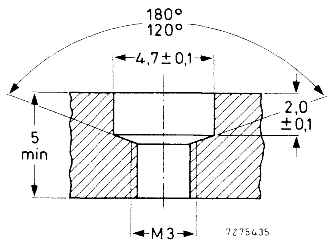


Fig. 13 Heatsink requirements for 500 V insulation.

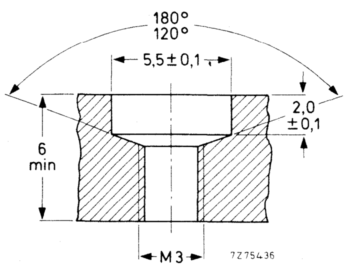


Fig. 14 Heatsink requirements for 1000 V insulation.

MOUNTING INSTRUCTIONS FOR SOT-93 ENVELOPES

GENERAL DATA AND INSTRUCTIONS

General rule

Avoid any sudden forces on leads and body; these forces, such as from falling on a hard surface, are easily underestimated. In the direct screw mounting an M4 screw must be used; an M3 screw in the insulating mounting.

Heatsink requirements

Flatness in the mounting area: 0,02 mm maximum per 10 mm.
The mounting hole must be deburred.

Heatsink compound

The thermal resistance from mounting base to heatsink ($R_{th\ mb\text{-}h}$) can be reduced by applying a metallic-oxide heatsink compound between the contact surfaces. For insulated mounting the compound should be applied to the bottom of both device and insulator.

Maximum play

The bush or the washer may only just touch the plastic part of the body, but should not exert any force on that part. Keep mounting tool (e.g. screwdriver) clear of the plastic body.

Mounting torques

For M3 screw (insulated mounting):	
Minimum torque (for good heat transfer)	0,4 Nm (4 kgcm)
Maximum torque (to avoid damaging the device)	0,6 Nm (6 kgcm)
For M4 screw (direct mounting only):	
Minimum torque (for good heat transfer)	0,4 Nm (4 kgcm)
Maximum torque (to avoid damaging the device)	1,0 Nm (10 kgcm)

Note: The M4 screw head should not touch the plastic part of the envelope.

Lead bending

Maximum permissible tensile force on the body for 5 s — 20 N (2 kgf)

No torsion is permitted at the emergence of the leads.

Bending or twisting is not permitted within a lead length of 0,3 mm.

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.

N.B.: Data on accessories are given in chapter Accessories.

Soldering

Recommendations for devices with a maximum junction temperature rating $\leqslant$ 175 °C:

a. Dip or wave soldering

Maximum permissible solder temperature is 260 °C at a distance from the body of > 5 mm and for a total contact time with soldering bath or waves of < 7 s.

b. Hand soldering

Maximum permissible temperature is 275 °C at a distance from the body of > 3 mm and for a total contact time with the soldering iron of < 5 s.

The body of the device must not touch anything with a temperature > 200 °C.

It is not permitted to solder the metal tab of the device to a heatsink, otherwise the junction temperature rating will be exceeded.

Avoid any force on body and leads during or after soldering; do not correct the position of the device or of its leads after soldering.

Thermal data

			clip mounting	screw mounting
Thermal resistance from mounting base to heatsink				
direct mounting				
with heatsink compound	$R_{th\ mb\text{-}h}$	=	0,3	0,3 K/W
without heatsink compound	$R_{th\ mb\text{-}h}$	=	1,5	0,8 K/W
with 0,05 mm mica washer				
with heatsink compound	$R_{th\ mb\text{-}h}$	=	0,8	0,8 K/W
without heatsink compound	$R_{th\ mb\text{-}h}$	=	3,0	2,2 K/W

INSTRUCTIONS FOR CLIP MOUNTING

Direct mounting with clip 56379

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 20° to the vertical (see Fig. 1b).
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)).

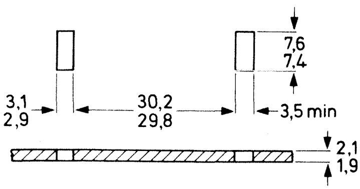


Fig. 1a Heatsink requirements.

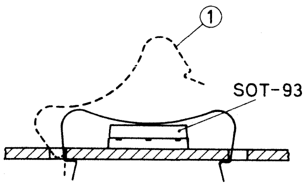


Fig. 1b Mounting.
(1) = spring clip 56379.

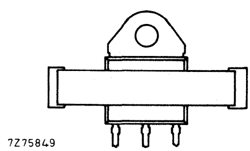


Fig. 1c Position of the device.

Insulated mounting with clip 56379

With the mica 56378 insulation up to 1500 V 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^{o} to 20^{o} to the vertical (see Figs 2a and 2b).
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. 2c). There should be minimum 3 mm distance between the device and the edge of the insulator for adequate creepage.

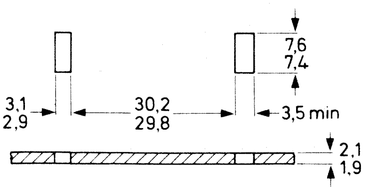


Fig. 2a Heatsink requirements.

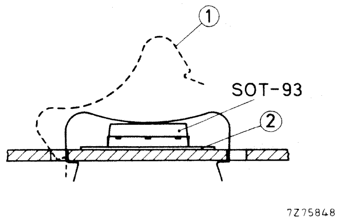


Fig. 2b Mounting.
(1) = spring clip 56379
(2) = insulator 56378

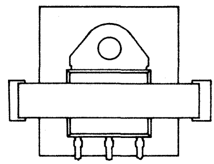


Fig. 2c Position of the device.

INSTRUCTIONS FOR SCREW MOUNTING

Direct mounting

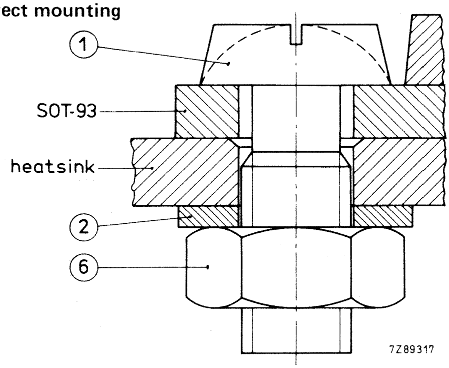


Fig. 3a Assembly through heatsink with nut.

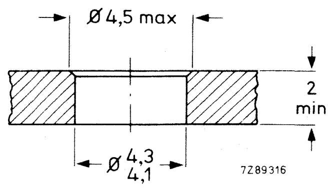


Fig. 3b Heatsink requirements.

When screw mounting the SOT-93 envelope, it is particularly important to apply a thin, even layer of heatsink compound to the mounting base, and to apply torque to the screw slowly so that the compound has time to flow and the mounting base is not deformed. Most SOT-93 envelopes contain a crystal larger than that in the other plastic envelopes, and it is more likely to crack if the mounting base is deformed.

Legend: (1) M4 screw; (2) plain washer; (6) M4 nut.
Where vibrations are to be expected the use of a lock washer or of a curved spring washer is recommended, with a plain washer between aluminium heatsink and spring washer.

Insulated screw mounting with nut; up to 800 V.

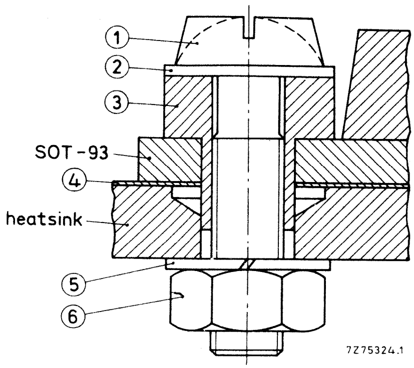


Fig. 4 Assembly.
See also Fig. 9.

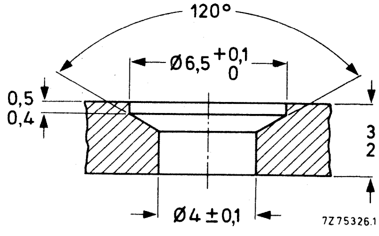


Fig. 5 Heatsink requirements up to 800 V insulation.

(1) M3 screw
(2) plain washer
(3) insulating bush (56368b)
(4) mica insulator (56368a)
(5) lock washer
(6) M3 nut

Insulated screw mounting with tapped hole; up to 800 V.

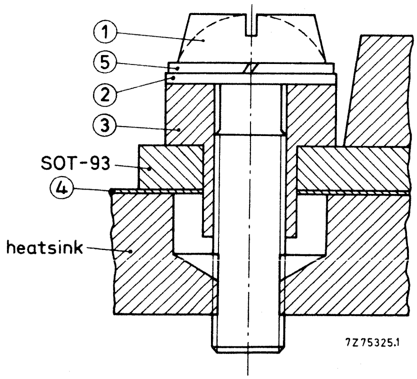


Fig. 6 Assembly.
See also Fig. 9.

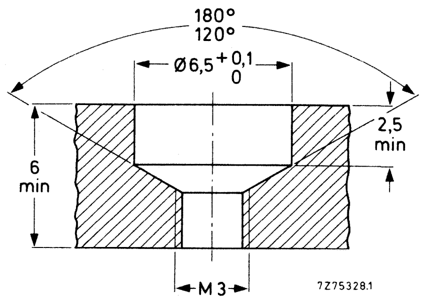


Fig. 7 Heatsink requirements up to 800 V insulation.

(1) M3 screw
(2) plain washer
(3) insulating bush (56368b)
(4) mica insulator (56368a)
(5) lock washer

Insulated screw mounting with insert nut; up to 500 V

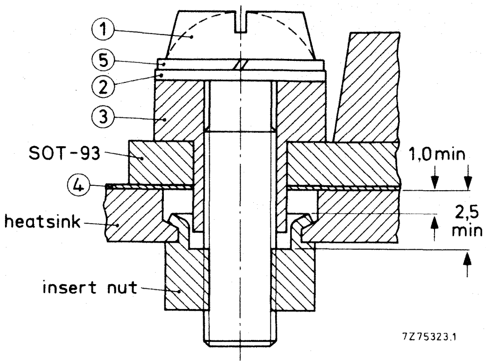


Fig. 8 Assembly and heatsink requirements for 500 V insulation. See also Fig. 3.

(1) M3 screw
(2) plain washer
(3) insulating bush (56368b)
(4) mica insulator (56368a)
(5) lock washer

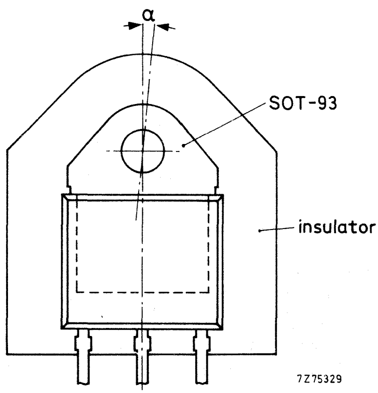
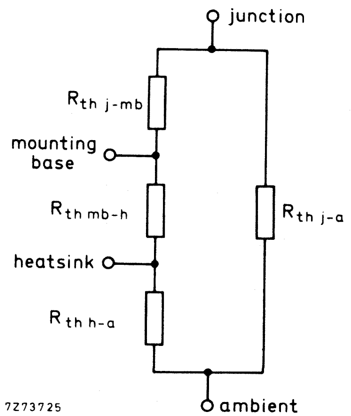


Fig. 9 Mica insulator.

The axial deviation (α) between SOT-93 and mica should not exceed 5^{o}.

MOUNTING CONSIDERATIONS FOR STUD-MOUNTED DEVICES

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.

MOUNTING INSTRUCTIONS FOR DO-4 AND TO-64 ENVELOPES

GENERAL DATA AND INSTRUCTIONS

Mounting instructions for up to 2000 V insulation using 56295c insulating bush and 56295a mica washer.

Mounting instructions for up to 2000 V insulation using 56295b insulating ring and two 56295a mica washers.

HEATSINK REQUIREMENTS

Mounting holes must be deburred.

MOUNTING TORQUES

Minimum torque (for good heat transfer)	0.9 Nm (9 kg cm)
Maximum torque (to avoid damaging device)	1.7 Nm (17 kg cm)

THERMAL DATA

The thermal resistance from mounting base to heatsink ($R_{th\ mb\text{-}h}$) can be reduced by applying a heat conducting compound between device and heatsink. For insulated mounting the compound should be applied to the bottom of both device and insulator.

Thermal resistance from mounting base to heatsink
(insulated mounting using 56295a mica washer)

without heatsink compound	$R_{th\ mb\text{-}h}$	=	5	K/W
with heatsink compound	$R_{th\ mb\text{-}h}$	=	2.5	K/W

MOUNTING INSTRUCTIONS FOR UP TO 2000 V INSULATION

Using 56295c insulating bush and 56295a mica washer.

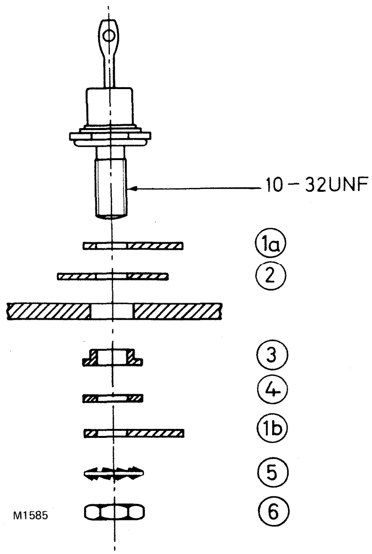


Fig.1

(1a);(1b) tag — alternative positions
(2) mica washer 56295a
(3) insulating bush 56295c
(4) plain washer (may be omitted if tag used in position 1b)
(5) lock washer (supplied with device)
(6) 10-32 UNF nut (supplied with device)

MOUNTING INSTRUCTIONS FOR UP TO 2000 V INSULATION

Using insulating ring 56295b and two mica washers 56295a.

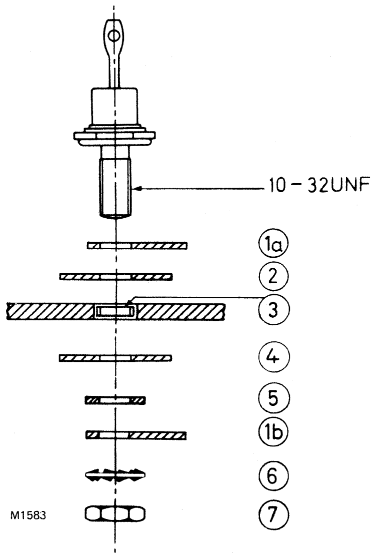


Fig. 2

(1a); (1b)	tag — alternative positions
(2)	mica washer 56295a
(3)	insulating ring 56295b
(4)	mica washer 56295a
(5)	plain washer (may be omitted if tag used in position 1b)
(6)	lock washer (supplied with device)
(7)	10-32 nut (supplied with device)

MOUNTING INSTRUCTIONS FOR DO-5, TO 48 AND TO-65 ENVELOPES

GENERAL DATA AND INSTRUCTIONS

Mounting instructions for up to 2000 V insulation using 56264b insulating bush and 56264a mica washer.

HEATSINK REQUIREMENTS

Mounting holes must be deburred.

MOUNTING TORQUES

Minimum torque (for good heat transfer)	1.7 Nm (17 kg cm)
Maximum torque (to avoid damaging device)	3.5 Nm (35 kg cm)

THERMAL DATA

The thermal resistance from mounting base to heatsink ($R_{th\ mb\text{-}h}$) can be reduced by applying a heat conducting compound between device and heatsink. For insulated mounting the compound should be applied to the bottom of both device and insulator.

Thermal resistance from mounting base
to heatsink (insulated mounting using 56264a mica washer)

without heatsink compound	$R_{th\ mb\text{-}h}$	=	5	K/W
with heatsink compound	$R_{th\ mb\text{-}h}$	=	2.5	K/W

MOUNTING INSTRUCTIONS FOR UP TO 2000 V INSULATION

Using insulating bush 56264b and mica washer 56264a.

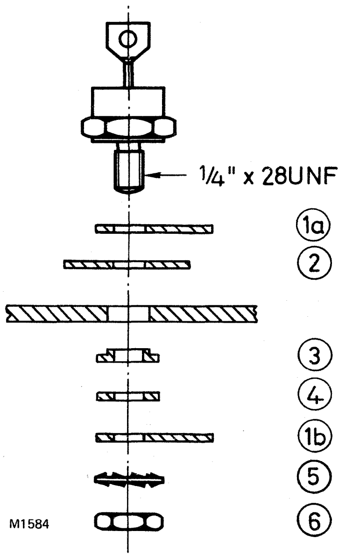


Fig.1

(1a); (1b) tag — alternative positions
(2) mica washer 56264a
(3) insulating bush 56264b
(4) plain washer (may be omitted if tag used in position 1b)
(5) lock washer (supplied with device)
(6) ¼" x 28 UNF nut (supplied with device)

MOUNTING INSTRUCTIONS FOR SOT-112 ENVELOPE

GENERAL DATA AND INSTRUCTIONS

Mounting instructions using 56379 spring clip.

THERMAL DATA

The thermal resistance from mounting base to heatsink ($R_{th\ mb-h}$) can be reduced by applying a metallic oxide heatsink compound between the contact surfaces.

Thermal resistance from mounting base to heatsink				
with a metallic oxide loaded compound	$R_{th\ mb-h}$	=	1.0	K/W
without heatsink compound	$R_{th\ mb-h}$	=	2.0	K/W

INSTRUCTIONS FOR MOUNTING

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 of 10 ^{o} to 30 ^{o} to the vertical (see Fig.1b).
3. Push down the clip over the device until the long end of the clip snaps into the wide slot. The clip should bear down on the middle of the plastic body.

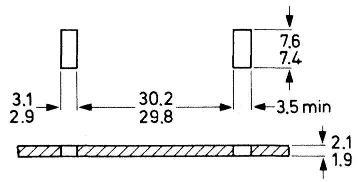


Fig. 1a Heatsink requirements.

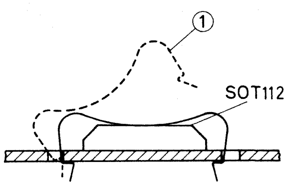


Fig. 1b Mounting.
(1) = spring clip 56379

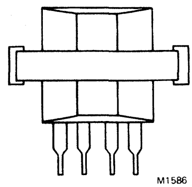


Fig. 1c Position of the device.

INDEX

INDEX OF TYPE NUMBERS

Data Handbooks Semiconductor Devices

FET = Field-effect transistors
GD = Germanium diodes
Mm = Microminiature semiconductors for hybrid circuits
SD = Small-signal diodes
Sm = Small-signal transistors
Sp = Special diodes
T = Tuner diodes
Vrg = Voltage regulator diodes

* = series
FET = Field-effect transistors
Mm = Microminiature semiconductors for hybrid circuits
P = Low-frequency power transistors
Sm = Small-signal transistors

P = Low-frequency power transistors

P = Low-frequency power transistors
Sm = Small-signal transistors

FET = Field-effect transistors
HVP = High-voltage power transistors
Mm = Microminiature semiconductors for hybrid circuits
RFP = R.F. power transistors and modules
Sm = Small-signal transistors
WBT = Wideband hybrid IC transistors

* = series
FET = Field-effect transistors
Mm = Microminiature semiconductors for hybrid circuits
RFP = R.F. power transistors and modules
RT = Tripler
Sm = Small-signal transistors
ThM = Thyristor Modules
WBM = Wideband hybrid IC modules
WBT = Wideband hybrid IC transistors

FET = Field-effect transistors
Mm = Microminiature semiconductors for hybrid circuits
PDT = Photodiodes or transistors
RFP = R.F. power transistors and modules
Sm = Small-signal transistors
Th = Thyristors

* = series
FET = Field-effect transistors
Mm = Microminiature semiconductors for hybrid circuits
Sm = Small-signal transistors
SP = Low-frequency switching power transistors
Th = Thyristors
Tri = Triacs

* = series
PM = Power MOS transistors
R = Rectifier diodes
SP = Low-frequency switching power transistors

* = series
D = Displays
LED = Light-emitting diodes
Mm = Microminiature semiconductors for hybrid circuits
Ph = Photoconductive devices
PhC = Photocouplers
R = Rectifier diodes
TS = Transient suppressor diodes
Vrf = Voltage reference diodes
Vrg = Voltage regulator diodes

GD = Germanium diodes
I = Infrared devices
LED = Light-emitting diodes
P = Low-frequency power transistors
Ph = Photoconductive devices
R = Rectifier diodes
SD = Small-signal diodes
Sm = Small-signal transistors
St = Rectifier stacks
Vrf = Voltage reference diodes
WBM = Wideband hybrid IC modules

A = Accessories
I = Infrared devices
FET = Field-effect transistors
Ph = Photoconductive devices
R = Rectifier diodes
RFP = R.F. power transistors and modules
SD = Small-signal diodes
Sm = Small-signal transistors
WBT = Wideband hybrid IC transistors

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