BREAKOVER DIODES

A range of bidirectional diodes in hermetically sealed axial-leaded implosion-diode glass outlines with a +/– 12% tolerance of breakover voltage. These devices feature controlled breakover voltage and high holding current together with a good peak current handling capability. Typical applications include transient overvoltage in telephony equipment, data transmission and remote instrumentation lines.

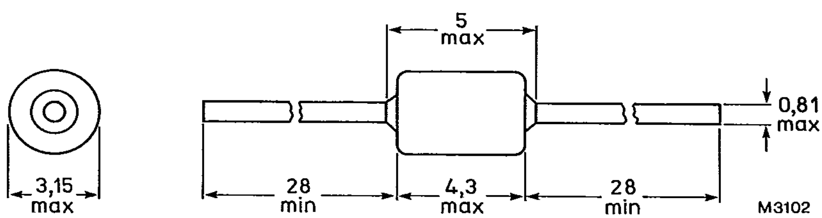
QUICK REFERENCE DATA

			BR211–100 to 280	
Breakover voltage	$V_{(BO)}$	nom.	100 to 280	V
Holding current	I_H	>	150	mA
Transient peak current (10/320 µs impulse)	I_{TSM}	max.	40	A

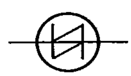
MECHANICAL DATA

Dimensions in mm

Fig.1 SOD-84.



Circuit symbol:



Net mass: 0.35 g.

For packing details see data sheet Bandolier and reel specification for axial-leaded devices.

RATINGS

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

Voltages

(in either direction)			BR211–100 to 280	
Continuous voltages	V_D	max.	75% of nom. voltage	

Currents

(in either direction)				
Transient peak current (10/320 μs impulse) equivalent to 10/700 μs 1.6 kV voltage impulse (CCITT K17); (see Fig.5)	I_{TSM1}	max.	40	A
Non-repetitive peak on-state current, T_j = 70 °C prior to surge; t = 10 ms; half sinewave	I_{TSM2}	max.	15	A
I^2t for fusing (t = 10 ms)	I^2t	max.	1.1	A^2s
Rate of rise of on-state current after $V_{(BO)}$ turn-on (t_p = 10 μs)	dI_T/dt	max.	50	A/μs

Power dissipation

Continuous dissipation; unidirectional operation, device mounted as Fig.3, T_{amb} = 25 °C	P_{tot}	max.	1.2	W
Peak dissipation; t = 1 ms, free-air mounting, T_{amb} = 25 °C	P_{TM}	max.	50	W

Temperatures

Storage temperature	T_{stg}		−65 to +150	°C
Operating temperature (off-state)	T_{amb}	max.	70	°C
Overload temperature (on-state)	T_{vj}	max.	150	°C

DEVELOPMENT DATA

THERMAL RESISTANCE

From junction to envelope	$R_{th\ j\text{-}e}$	=	22	K/W
From envelope to tie point				
lead length = 5 mm	$R_{th\ e\text{-}tp}$	=	15	K/W
lead length = 10 mm	$R_{th\ e\text{-}tp}$	=	30	K/W
From envelope to ambient				
lead length = 5 mm	$R_{th\ e\text{-}a}$	=	440	K/W
lead length = 10 mm	$R_{th\ e\text{-}a}$	=	350	K/W
Transient thermal impedance				
t = 1 ms;	$Z_{th\ j\text{-}a}$	=	2.62	K/W

Influence of mounting method

Device mounted on a 1.5 mm thick epoxy-glass pcb with a copper thickness ⩾ 40 μm

1. Tie point to ambient thermal resistance				
a. mounted as Fig.3	$R_{th\ tp\text{-}a}$	=	70	K/W
b. mounted with 1 cm² copper laminate per lead	$R_{th\ tp\text{-}a}$	=	55	K/W
c. mounted with 2.25 cm² copper laminate per lead	$R_{th\ tp\text{-}a}$	=	45	K/W
2. Junction to ambient thermal resistance, mounted as Fig.3	$R_{th\ j\text{-}a}$	=	105	K/W

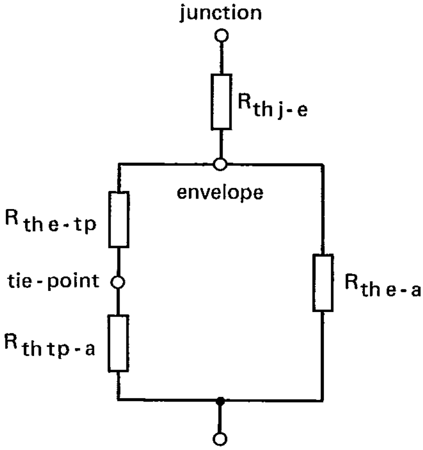


Fig.2 Components of thermal resistance.

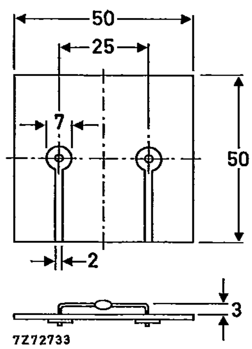


Fig.3 Mounting on pcb used for R_{th} measurement.

$$R_{th\ j\text{-}a} = R_{th\ j\text{-}e} + \frac{R_{th\ e\text{-}a}\,(R_{th\ e\text{-}tp} + R_{th\ tp\text{-}a})}{R_{th\ e\text{-}a} + R_{th\ e\text{-}tp} + R_{th\ tp\text{-}a}}$$

Notes: All figures quoted assume symmetrical lead lengths.
For further information see data sheet Thermal Model of Axial Leaded Devices.

CHARACTERISTICS

T_j = 25 °C unless otherwise stated

Voltages and currents (in either direction)

On-state voltage (note 1) I_{TM} = 2 A	V_{TM}	<	2.5	V

Avalanche voltage $V_{(BR)}$; ($I_{(BR)}$ = 10 mA), and
Breakover voltage $V_{(BO)}$; ($I \leqslant I_S$):
(100 µs pulsed)

	$V_{(BR)}$ min.	$V_{(BO)}$ max.	
BR211–100	88	112	V
–120	105	135	V
–140	123	157	V
–160	140	180	V
–180	158	202	V
–200	176	224	V
–220	193	247	V
–240	211	269	V
–260	228	292	V
–280	246	314	V

Temperature coefficient of $V_{(BR)}$	$S_{(br)}$	typ.	+0.1	%/K
Holding current (note 2)				
T_j = 25 °C	I_H	>	150	mA
T_j = 70 °C	I_H	>	100	mA
Switching current (note 3)	I_S	>	10	mA
(100 µs pulsed)	I_S	typ.	200	mA
	I_S	<	1000	mA
Off-state current; V_D = 85% $V_{(BR)min}$ (note 4) T_j = 70 °C	I_D	<	10	µA
Linear rate of rise of off-state voltage that will not trigger any device; T_j = 70 °C; V_{DM} = 85% $V_{(BR)min}$	dV_D/dt	<	2000	V/µs
Off-state capacitance V_D = 0; f = 1 kHz to 1 MHz	C_j	<	100	pF

Notes:

1. Measured under pulsed conditions to avoid excessive dissipation.
2. The minimum current at which the BOD will remain in the on-state.
3. The avalanche current required to switch the BOD to the on-state.
4. I.e., at maximum recommended continuous voltage. Illuminance ⩽ 500 lux (daylight); relative humidity < 65%.

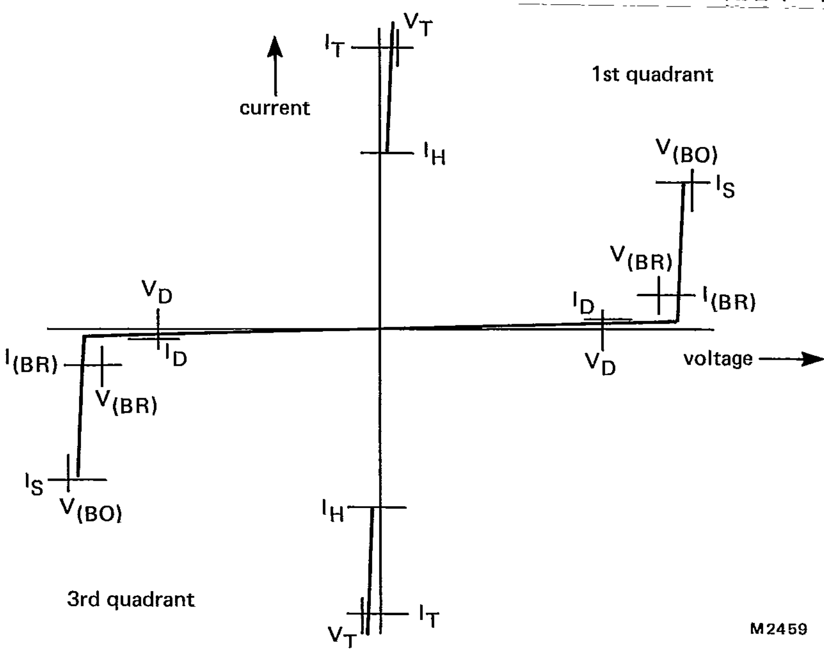


Fig.4 Breakover diode characteristics.

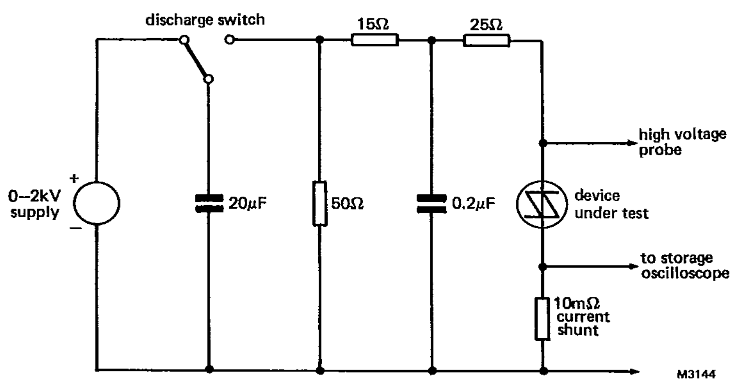


Fig.5 Test circuit for high voltage impulse (I_{TSM1})
(according to CCITT vol IX-Rec. K17)

Notes:
The 10/700 μs Impulse Waveform is defined for the voltage across the test fixture when the device under test is replaced with an open circuit. Clearly, once a breakover device has switched on to a low voltage, the current waveform will have a shorter fall-time, since the 15 Ω + 25 Ω output impedance becomes effectively in parallel with the 50 Ω.

DEVELOPMENT DATA

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MOUNTING INSTRUCTIONS

1. The device may be soldered directly onto a circuit board. The maximum permissible soldering temperature is 300 °C. Heat must not be applied for more than 5 seconds. Soldered joints must be at least 0.5 mm from the body of the device.
2. If the device is soldered in any way other than directly on a printed circuit board then heat must not be applied for more than 3 seconds at a point at least 0.5 mm from the body. The maximum permissible soldering temperature is 300 °C.
3. Avoid any force on the body or leads during or just after soldering. The position of an already soldered device must not be corrected by pushing, pulling or twisting the body.
4. The leads may only be bent without supporting the leads if the bending radius is greater than 0.5 mm. The leads may be bent by 90° maximum. Axial forces on the body during bending, twisting or straightening of the leads must not exceed 20 N.
5. For complete mounting instructions see data sheet Rules for Mounting and Soldering of Axial-Leaded Devices.
   Provided that the device is soldered and mounted correctly it can be flat-mounted with the body in direct contact with hot spots or hot tracks during soldering. The device can also be mounted upright with the body in direct contact with the printed circuit board provided that it is not in contact with metal tracks or plated through holes.

OPERATING NOTES

1. For most applications involving transient overvoltage protection only the device will be adequately rated. The rating of the device may be considerably reduced for repetitive transients.
2. During mains contact fault, excessive dissipation can occur with the device in its avalanche state. The following figures illustrate how power dissipation can be calculated during a mains contact fault. In general, if the fault resistance is about 500 Ω — 5 kΩ, there may be excessive dissipation.

MAINS CONTACT

Calculation of power dissipation during mains contact fault.

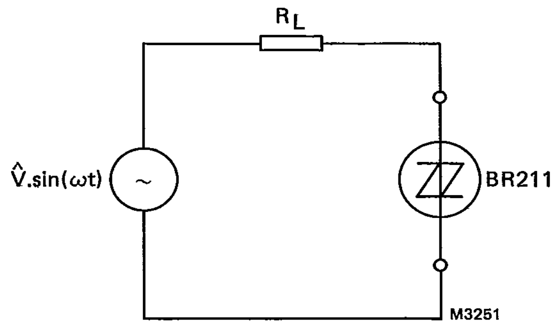

Fig.6 Equivalent circuit of BOD during mains contact fault;
R_L = total fault resistance.

DEVELOPMENT DATA

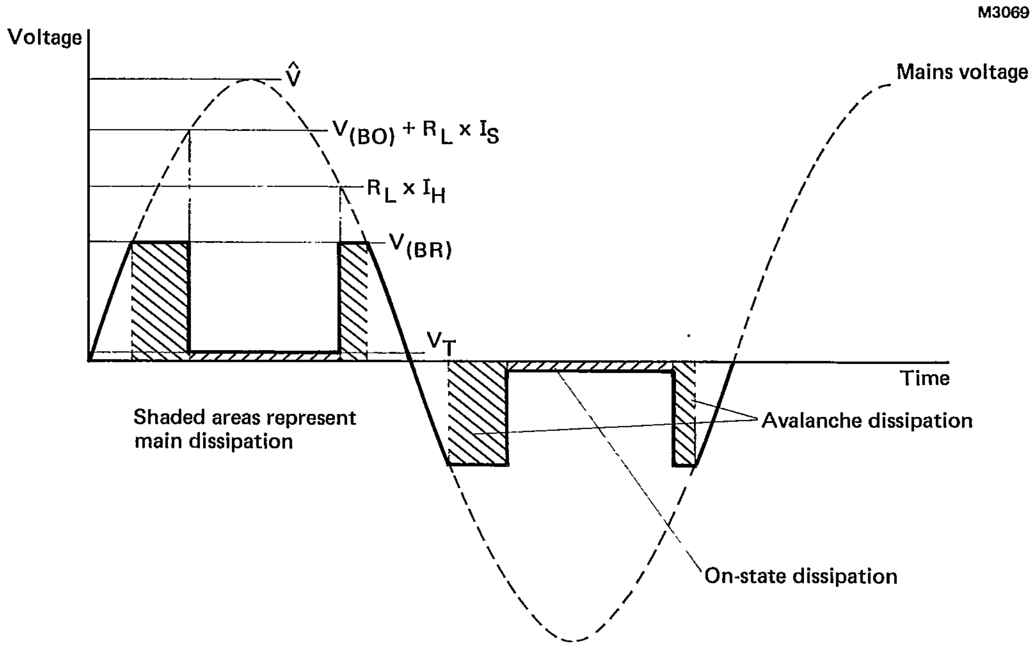

Fig.7 Dissipation during mains contact fault.

Solid line shows voltage across BOD.
Total power generated = avalanche dissipation prior to switching
(per half-cycle) + on-state dissipation
+ avalanche dissipation after on-state.

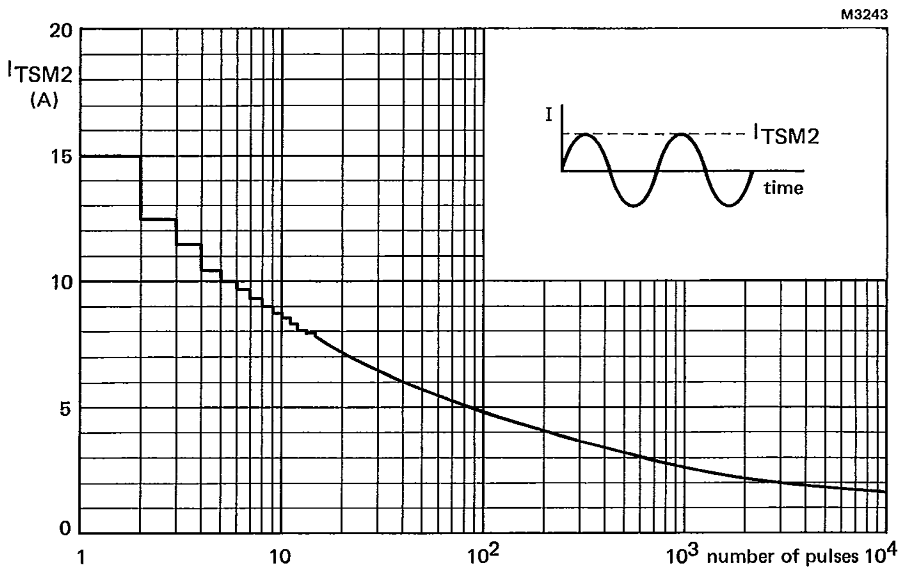

Fig.8 Maximum permissible non-repetitive on-state current based on sinusoidal currents (f = 50 Hz; device triggered at the start of each pulse). T_j = 70 °C prior to surge.

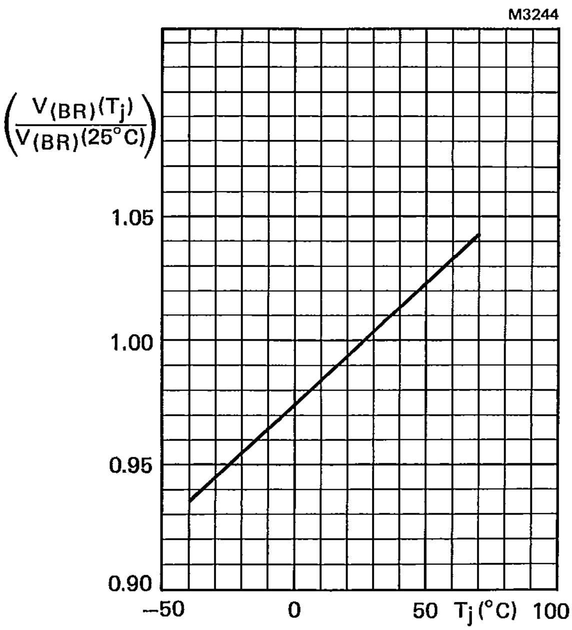

Fig.9 Normalized avalanche breakdown voltage as a function of temperature.
Note: this figure may also be used to derive normalized $V_{(BO)}$.

DEVELOPMENT DATA

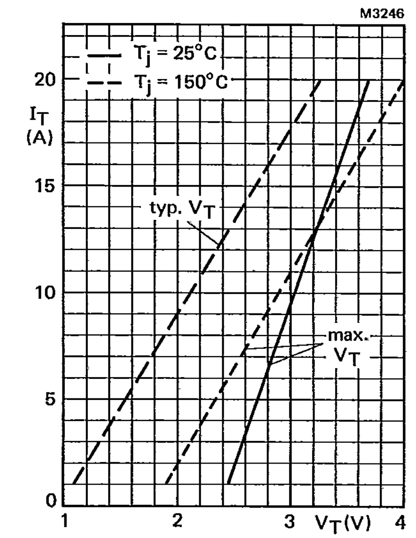

Fig.10 On-state voltage as a function of on-state current. (200 μs pulsed condition to avoid excessive dissipation)

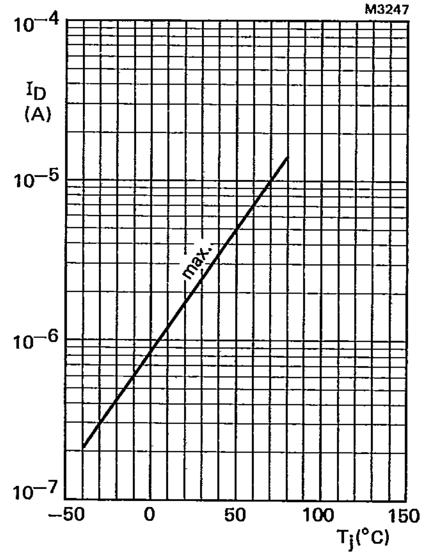

Fig.11 Maximum off-state current as a function of temperature.

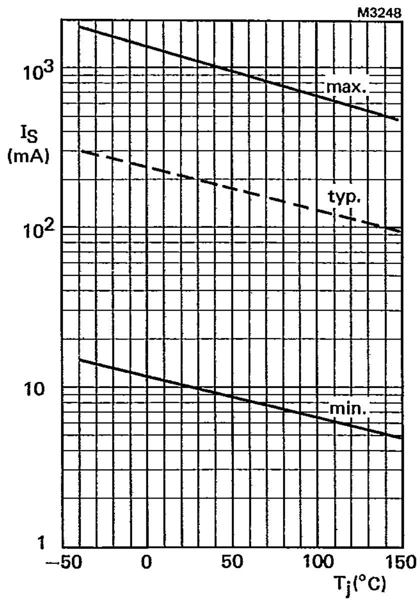

Fig.12 Switching current as a function of junction temperature.

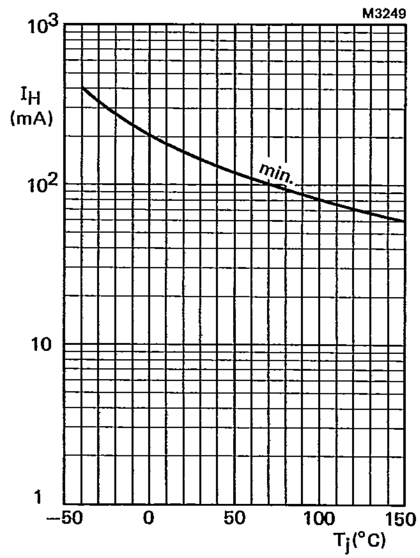

Fig.13 Minimum holding current as a function of temperature.

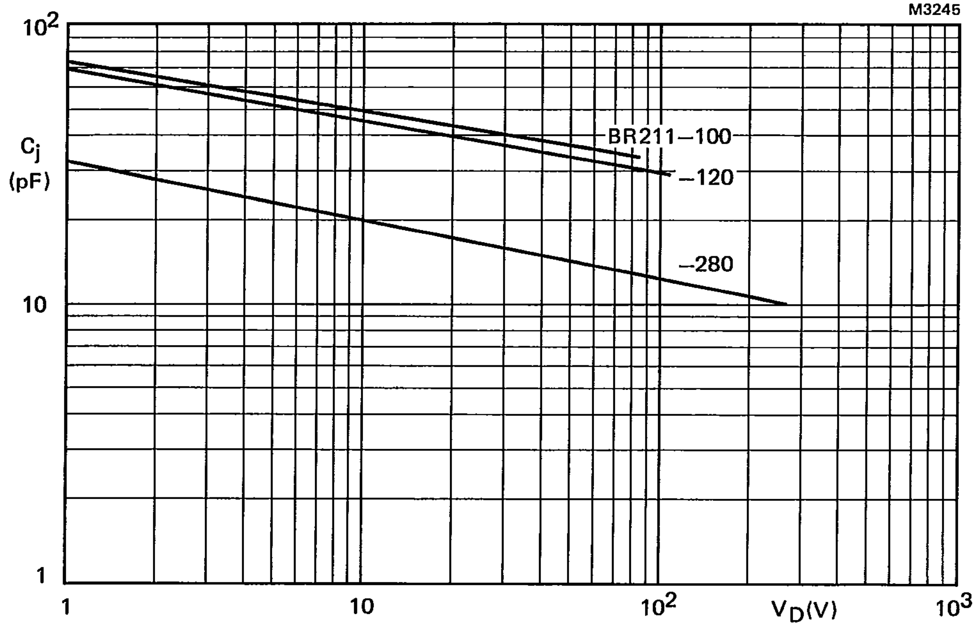

Fig.14 Typical junction capacitance as a function of off-state voltage; T_j = 25 °C; f = 1 MHz.

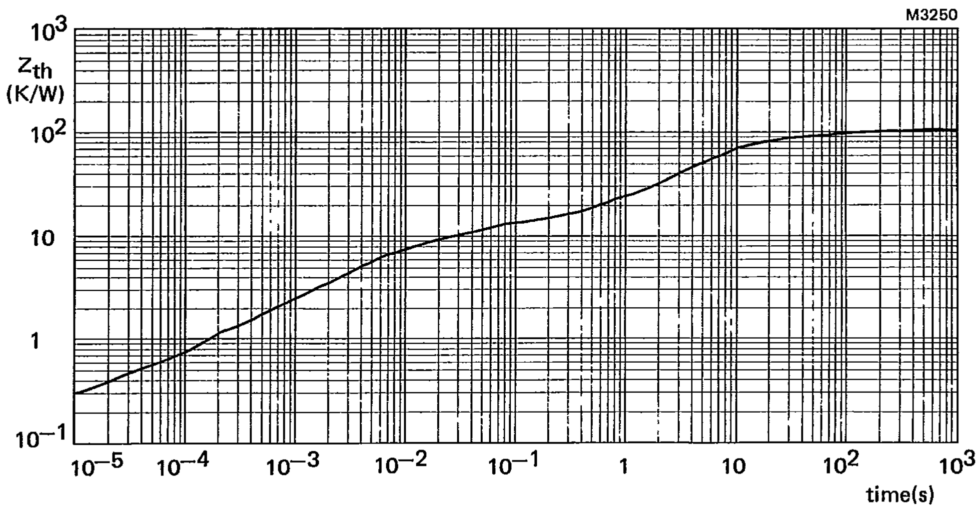

Fig.15 Transient thermal impedance as a function of time (rectangular pulse duration). Mounted as Fig.3.