THYRISTORS

Glass-passivated thyristors in TO-220AB envelopes, which are particularly suitable in situations creating high fatigue stresses involved in thermal cycling and repeated switching. Applications include temperature control, motor control, regulators in transformerless power supply applications, relay and coil pulsing and power supply crowbar protection circuits.

QUICK REFERENCE DATA

			BT151-500R	650R	800R	
Repetitive peak voltages	V_{DRM}/V_{RRM}	max.	500	650	800	V
Average on-state current	$I_{T(AV)}$	max.		7.5		A
R.M.S. on-state current	$I_{T(RMS)}$	max.		12		A
Non-repetitive peak on-state current	I_{TSM}	max.		100		A

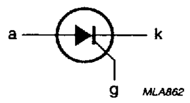
MECHANICAL DATA

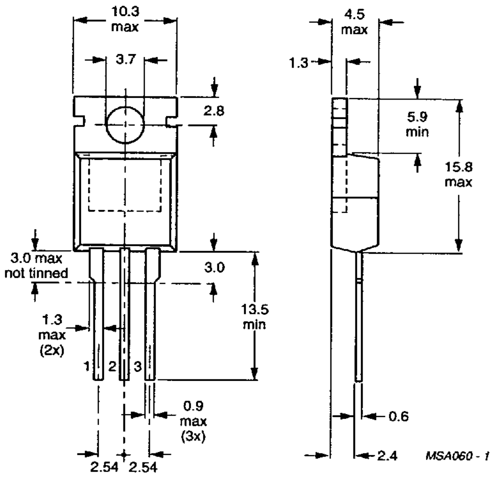
Fig.1 TO-220AB.

Dimensions in mm

Pinning:

1 = Cathode
2 = Anode
3 = Gate





Net mass: 2 g

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

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

Qualification approved to CECC 50 011-003.

RATINGS

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

Anode to cathode			BT151-500R	650R	800R	
Non-repetitive peak voltages ($t \leq 10$ ms)	V_{DSM}/V_{RSM}	max.	500	650	800	V*
Repetitive peak voltages ($\delta \leq 0.01$)	V_{DRM}/V_{RRM}	max.	500	650	800	V
Crest working voltages	V_{DWM}/V_{RWM}	max.	400	400	400	V
Continuous voltages	V_D/V_R	max.	400	400	400	V
Average on-state current (averaged over any 20 ms period) up to $T_{mb} = 95$ °C	$I_{T(AV)}$	max.		7.5		A
R.M.S. on-state current	$I_{T(RMS)}$	max.		12		A
Repetitive peak on-state current	I_{TRM}	max.		65		A
Non-repetitive peak on-state current; t = 10 ms; half sine-wave; $T_j = 110$ °C prior to surge; with reapplied V_{RWMmax}	I_{TSM}	max.		100		A
I^2t for fusing (t = 10 ms)	I^2t	max.		50		A^2s
Rate of rise of on-state current after triggering with $I_G = 50$ mA to $I_T = 20$ A; $dI_G/dt = 50$ mA/μs	dI_T/dt	max.		50		A/μs
Gate to cathode						
Reverse peak voltage	V_{RGM}	max.		5		V
Average power dissipation (averaged over any 20 ms period)	$P_{G(AV)}$	max.		0.5		W
Peak power dissipation	P_{GM}	max.		5		W
Temperatures						
Storage temperature	T_{stg}			−40 to +125		°C
Operating junction temperature	T_j	max.		110		°C

*Although not recommended, higher off-state voltages may be applied without damage, but the thyristor may switch into the on-state. The rate of rise of on-state current should not exceed 15 A/μs.

THERMAL RESISTANCE

From junction to mounting base	$R_{th\ j\text{-}mb}$	=	1.3	K/W
Transient thermal impedance; t = 1 ms	$Z_{th\ j\text{-}mb}$	=	0.2	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 max. 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 any lead length
and with copper laminate $R_{th\ j\text{-}a}$ = 60 K/W

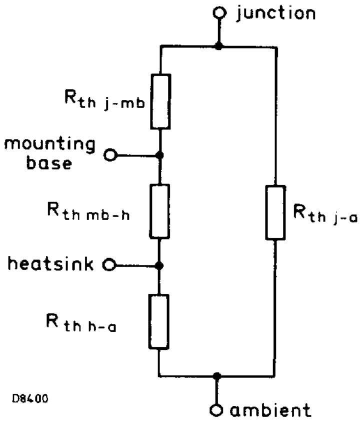


Fig.2 Components of thermal resistance.

CHARACTERISTICS

Anode to cathode

On-state voltage				
I_T = 23 A; T_j = 25 °C	V_T	<	1,75	V*
Rate of rise of off-state voltage that will not trigger any device; T_j = 110 °C; see Fig.10				
R_{GK} = open circuit	dV_D/dt	<	50	V/µs
R_{GK} = 100 Ω	dV_D/dt	<	200	V/µs
Reverse current				
$V_R = V_{RWMmax}$; T_j = 110 °C	I_R	<	0,5	mA
Off-state current				
$V_D = V_{DWMmax}$; T_j = 110 °C	I_D	<	0,5	mA
Latching current; T_j = 25 °C	I_L	<	40	mA
Holding current; T_j = 25 °C	I_H	<	20	mA

Gate to cathode

Voltage that will trigger all devices				
V_D = 12 V; T_j = 25 °C	V_{GT}	>	1,5	V
V_D = 12 V; T_j = −40 °C	V_{GT}	>	2,3	V
Voltage that will not trigger any device				
$V_D = V_{DRMmax}$; T_j = 110 °C	V_{GD}	<	250	mV
Current that will trigger all devices				
V_D = 12 V; T_j = 25 °C	I_{GT}	>	15	mA
V_D = 12 V; T_j = −40 °C	I_{GT}	>	20	mA

Switching characteristics

Gate-controlled turn-on time ($t_{gt} = t_d + t_r$) when switched from $V_D = V_{DRMmax}$ to I_T = 40 A; I_{GT} = 100 mA; dI_G/dt = 5A/µs; T_j = 25 °C	t_{gt}	typ.	2	µs

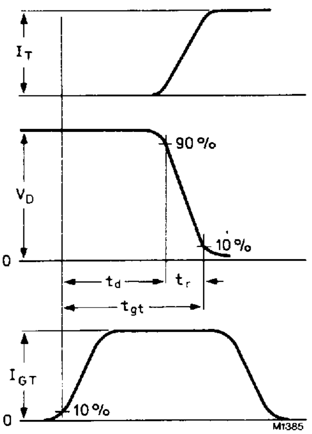


Fig.3 Gate controlled turn-on time definition.

*Measured under pulse conditions to avoid excessive dissipation.

MOUNTING INSTRUCTIONS

1. The device may be soldered directly into the circuit, but the maximum permissible temperature of the soldering iron or bath is 275 ^{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. The leads can be bent, twisted or straightened by 90^{o} maximum. The minimum bending radius is 1 mm.
3. It is recommended that the circuit connection be made to the anode tag, rather than direct to the heatsink.
4. Mounting by means of a spring clip is the best mounting method because it offers:
   a. a good thermal contact under the crystal area and slightly lower $R_{th\ mb\text{-}h}$ values than screw mounting.
   b. safe isolation for mains operation.

   However, if a screw is used, it should be M3 cross-recess pan-head. Care should be taken to avoid damage to the plastic body.
5. For good thermal contact, heatsink compound should be used between mounting base and heatsink. Values of $R_{th\ mb\text{-}h}$ given for mounting with heatsink compound refer to the use of a metallic-oxide loaded compound. Ordinary silicone grease is not recommended.
6. Rivet mounting (only possible for non-insulated mounting)

   Devices may be rivetted to flat heatsink; such a process must neither deform the mounting tab, nor enlarge the mounting hole. The maximum recommended hole size for rivet mounting is 3.5 mm. The pre-formed head of the rivet should be on the device side and any rivet tool used should not damage the plastic body of the device.
7. The heatsink must have a flatness in the mounting area of 0.02 mm maximum per 10 mm. Mounting holes must be deburred.

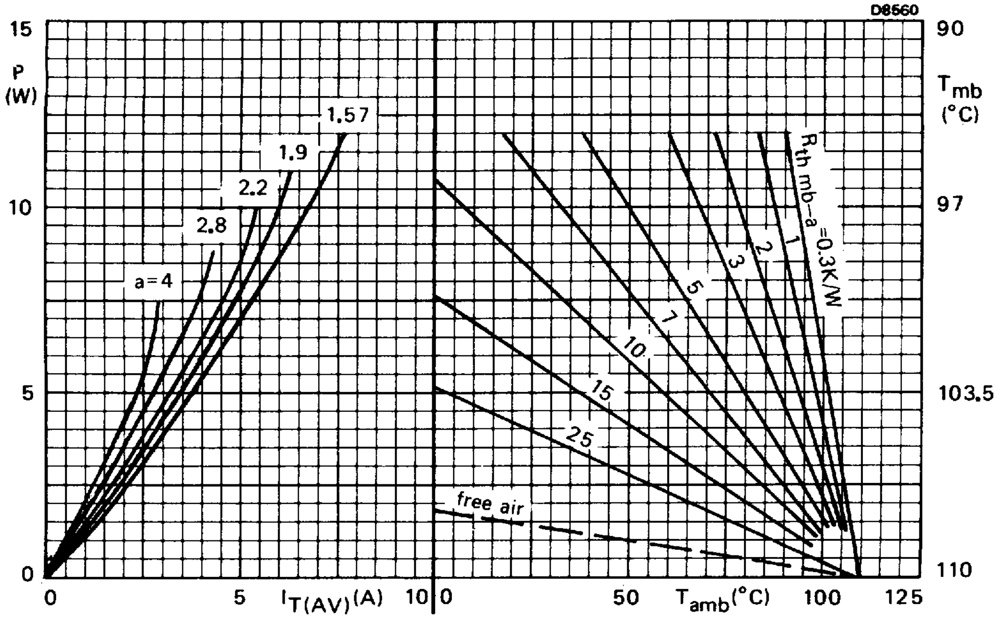
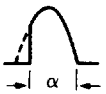


Fig.4 The right-hand part shows the interrelationship between the power (derived from the left-hand part) and the maximum permissible temperatures.



α = conduction angle per half cycle

a = form factor = $\frac{I_{T(RMS)}}{I_{T(AV)}}$

α	a
30°	4
60°	2,8
90°	2,2
120°	1,9
180°	1,57

OPERATING NOTES

Dissipation and heatsink considerations:

a. The method of using Fig.4 is as follows:
Starting with the required current on the $I_{T(AV)}$ or $I_{T(RMS)}$ axis, trace upwards to meet the appropriate form factor or conduction angle curve. Trace 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:

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

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

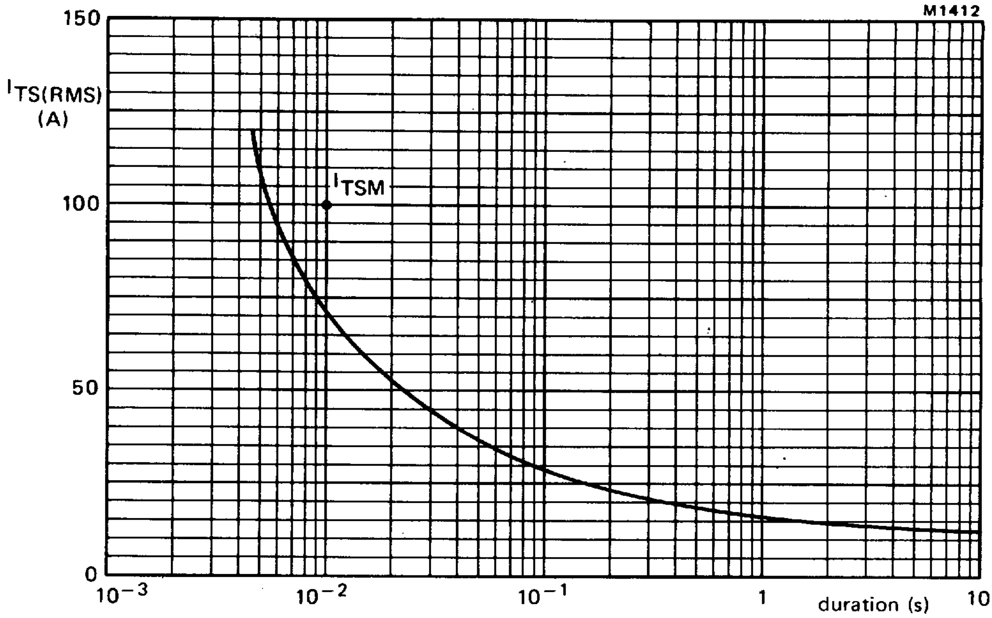
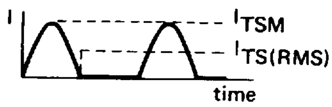


Fig.5 Maximum permissible non-repetitive r.m.s. on-state current based on sinusoidal currents (f = 50 Hz); T_j = 110 °C prior to surge; with reapplied V_{RWMmax}.



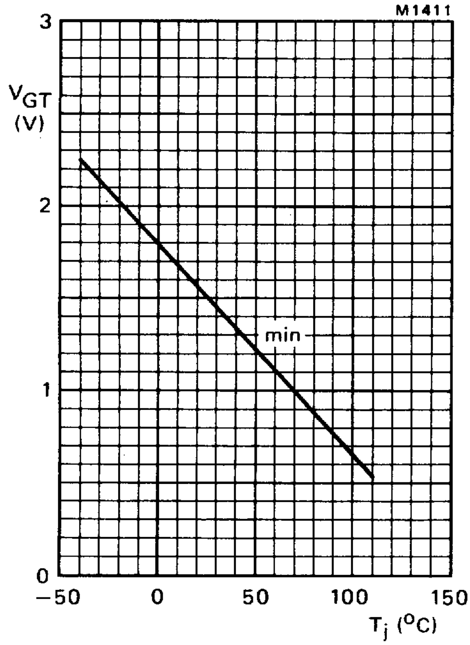


Fig.6 Minimum gate voltage that will trigger all devices as a function of junction temperature.

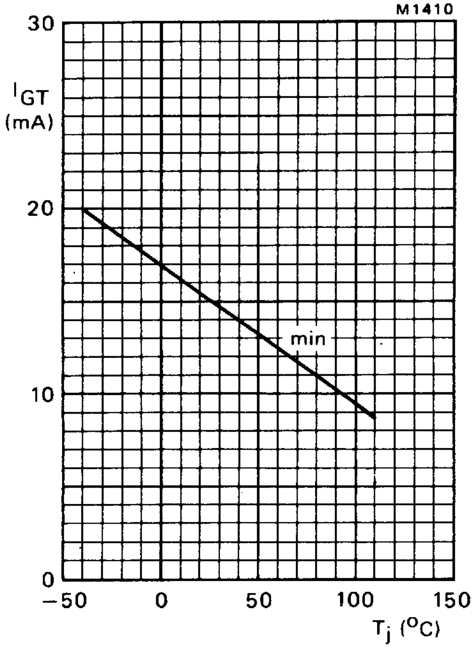


Fig.7 Minimum gate current that will trigger all devices as a function of junction temperature.

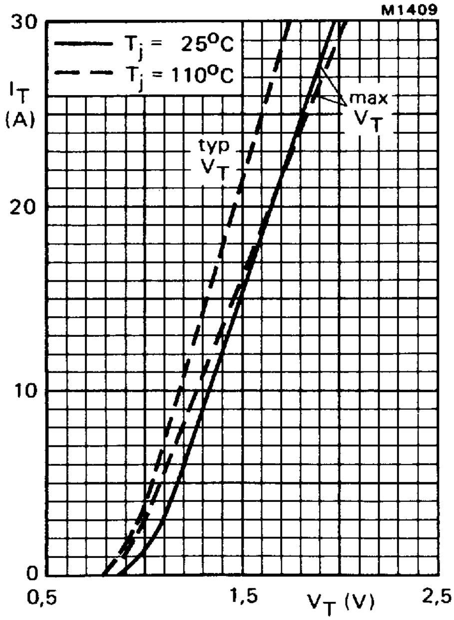


Fig.8 On-state voltage drop versus on-state current.

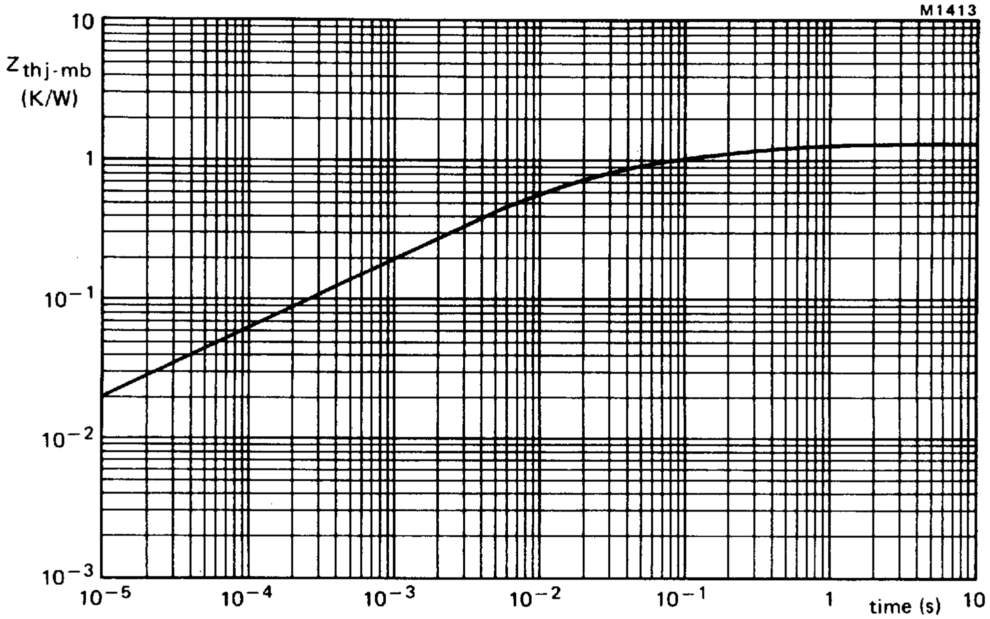


Fig.9 Thermal impedance as a function of dissipation time.

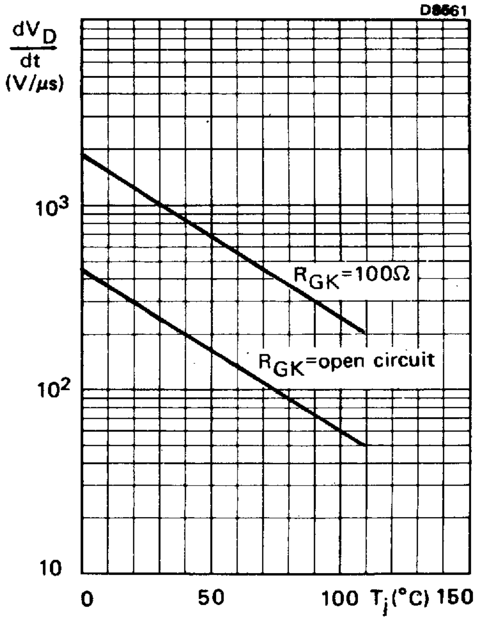


Fig.10 Maximum rate of rise of off-state voltage that will not trigger any device (exponential method) as a function of junction temperature.