FAST TURN-OFF THYRISTOR

Glass-passivated, eutectically bonded, fast turn-off forward blocking thyristor in a TO-220AB envelope, intended for use in high-frequency inverters, power supply, motor control, electronic flash systems and for horizontal deflection circuits of colour television receivers.
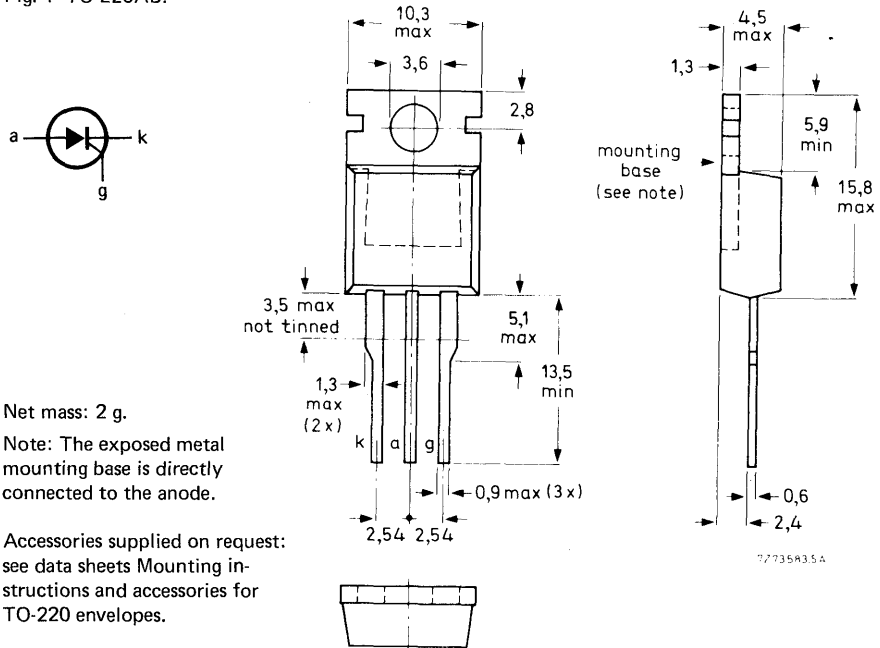
QUICK REFERENCE DATA

Repetitive peak off-state voltage	V_{DRM}	max.	750	V
Average on-state current	$I_{T(AV)}$	max.	5	A
R.M.S. on-state current	$I_{T(RMS)}$	max.	8	A
Repetitive peak on-state current	I_{TRM}	max.	60	A
Circuit-commutated turn-off time	t_q	<	2,4	μs

MECHANICAL DATA

Dimensions in mm

Fig. 1 TO-220AB.

Net mass: 2 g.

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

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

RATINGS

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

Anode to cathode

Non-repetitive peak off-state voltage; $t \leqslant 10$ ms	V_{DSM}	max.	800	V
Repetitive peak off-state voltage	V_{DRM}	max.	750	V
Working off-state voltage $t_p \leqslant 20 \, \mu s; \delta = t_p/T \leqslant 0,25$	V_{DW}	max.	600	V
Average on-state current (averaged over any 20 ms period) up to $T_{mb} = 77$ °C;	$I_{T(AV)}$	max.	5	A
at $T_{mb} = 85$ °C	$I_{T(AV)}$	max.	4	A
R.M.S. on-state current	$I_{T(RMS)}$	max.	8	A
Working peak on-state current (horizontal deflection application)	I_{TWM}	max.	10	A
Repetitive peak on-state current	I_{TRM}	max.	60	A
Peak pulse on-state current	I_{TM}	max.	240	A
$I^2 t$ for fusing; $t = 10$ ms; $T_j = 25$ °C	$I^2 t$	max.	18	$A^2 s$
Rate of rise of on-state current after triggering up to $f = 20$ kHz	dI_T/dt	max.	60	$A/\mu s$

Gate to cathode

Peak power dissipation	P_{GM}	max.	25	W

Temperatures

Storage temperature	T_{stg}		−40 to +125	°C
Operating junction temperature	T_j	max.	110	°C

THERMAL RESISTANCE

From junction to mounting base	$R_{th\ j\text{-}mb}$	=	2,5 °C/W
Transient thermal impedance; t = 1 ms	$Z_{th\ j\text{-}mb}$	=	0,24 °C/W

Influence of mounting method

1. Heatsink mounted with clip (see mounting instructions)

Thermal resistance from mounting base to heatsink

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

2. Free-air operation

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

Thermal resistance from junction to ambient in free air:
mounted on a printed-circuit board at a = any lead length
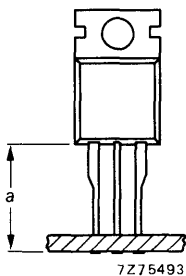and with copper laminate $R_{th\ j\text{-}a}$ =   60 °C/W

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Fig. 2.

CHARACTERISTICS

Anode to cathode

On-state voltage
$I_T = 20$ A; $T_j = 25$ °C V_T $<$ 3 V*

Rate of rise of off-state voltage that will
   not trigger any device; exponential method;
   $V_D = 2/3$ V_{DRMmax}; $T_j \leqslant 110$ °C
   $V_{GK} = 0$ V dV_D/dt $<$ 200 V/μs
   $-V_{GK} = 6$ V dV_D/dt $<$ 1000 V/μs

Off-state current
   $V_D = V_{DRMmax}$; $T_j = 110$ °C I_D $<$ 1,5 mA

Gate to cathode

Voltage that will trigger all devices
   $V_D = 6$ V; $T_j = 25$ °C V_{GT} $>$ 2,5 V

Current that will trigger all devices
   $V_D = 6$ V; $T_j = 25$ °C I_{GT} $>$ 40 mA

Switching characteristics

Circuit-commutated turn-off time (in horizontal
   deflection trace switch) when switched from
   $I_T = 8$ A to $V_R = 0,8$ V; $V_{DM} = 700$ V; $-V_{GG} = 25$ V
   from $R_{tot} = 62$ Ω**; $T_{mb} = 80$ °C; see also Fig. 11
   $t_p \leqslant 30$ μs t_q $<$ 2,4 μs
   $t_p \leqslant 150$ μs t_q $<$ 4,8 μs
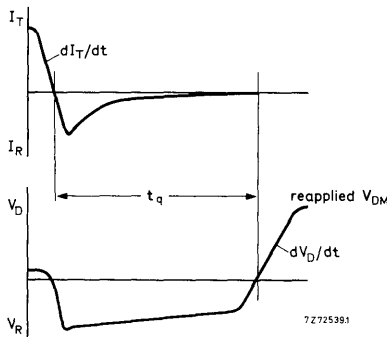

Fig. 3 Circuit-commutated turn-off time definition.

* Measured under pulse conditions to avoid excessive dissipation.
** R_{tot} is the total series resistance including source resistance.

MOUNTING INSTRUCTIONS

1. The device may be soldered directly into the circuit, but the maximum permissible temperature of the soldering iron or bath is 275 °C; it must not be in contact with the joint for more than 5 seconds. Soldered joints must be at least 4,7 mm from the seal.

2. The leads should not be bent less than 2,4 mm from the seal, and should be supported during bending.

3. It is recommended that the circuit connection be made to the anode tag, rather than direct to the heatsink.

4. Mounting by means of a spring clip is the best mounting method because it offers:
   a. a good thermal contact under the crystal area and slightly lower $R_{th\ mb\text{-}h}$ values than screw mounting.
   b. safe isolation for mains operation.
   However, if a screw is used, it should be M3 cross-recess pan-head. Care should be taken to avoid damage to the plastic body.

5. For good thermal contact heatsink compound should be used between mounting base and heatsink. Values of $R_{th\ mb\text{-}h}$ given for mounting with heatsink compound refer to the use of a metallic-oxide loaded compound. Ordinary silicone grease is not recommended.

6. The device should not be pop-rivetted to the heatsink. However, it is permissible to press-rivet providing that rivets of soft material are used, and the press forces are slowly and carefully controlled so as to avoid shock and deformation of either heatsink or mounting tab.

OPERATING NOTES

Dissipation and heatsink considerations:

a. The various components of junction temperature rise above ambient are illustrated in Fig. 4.
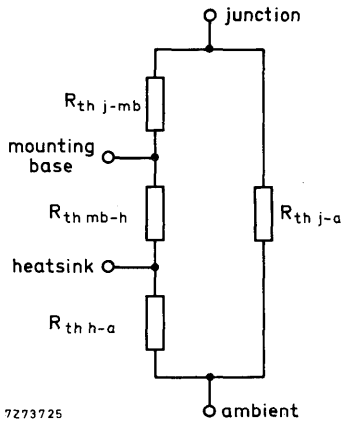

Fig. 4.

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

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

c. Any measurement of heatsink temperature should be made immediately adjacent to the device.
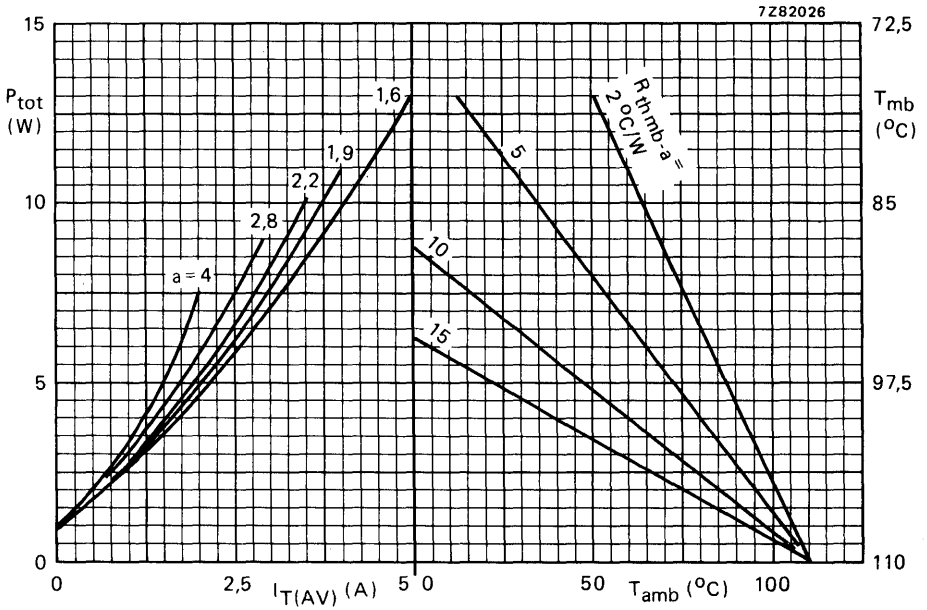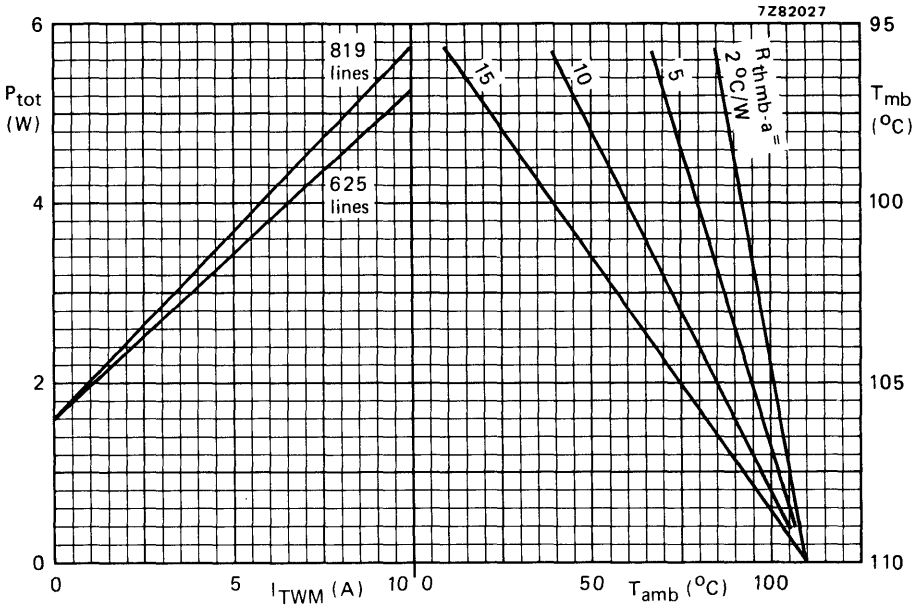
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Fig. 5 The right-hand part shows the interrelationship between the power (derived from the left-hand part) and the maximum permissible temperatures.

α = conduction angle per half cycle
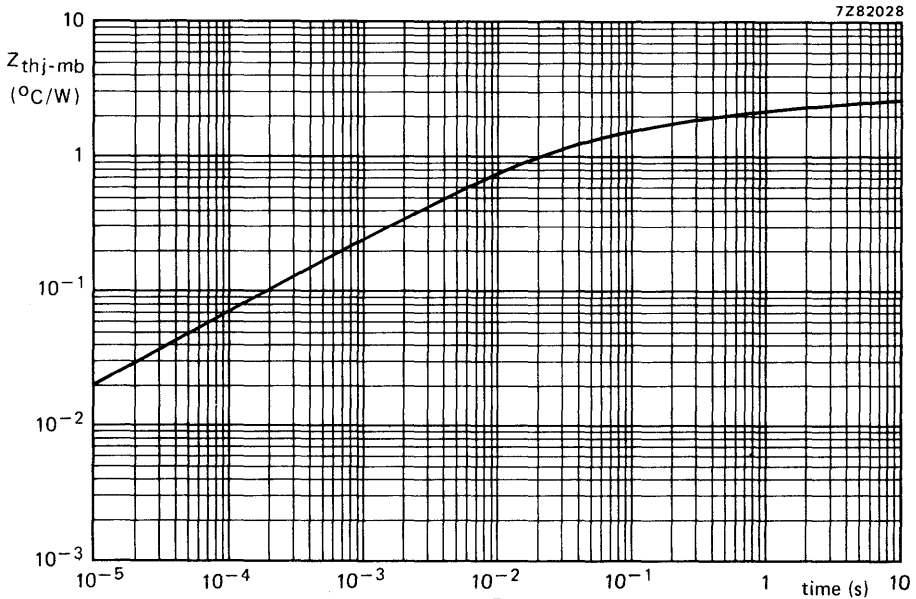
a = form factor = $\dfrac{I_{T(RMS)}}{I_{T(AV)}}$

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

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

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Fig. 7.
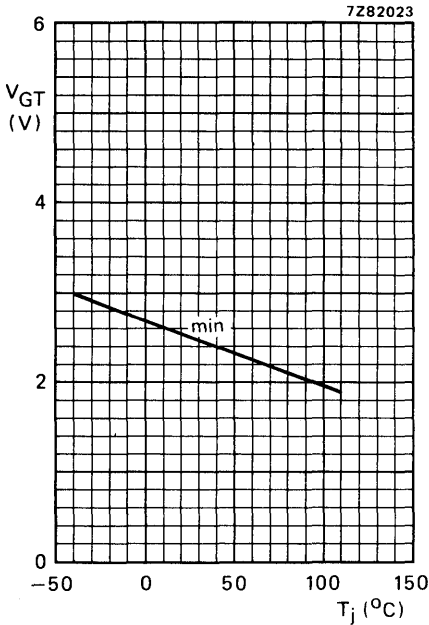
Fig. 8 Minimum gate voltage that will trigger all devices as a function of junction temperature.
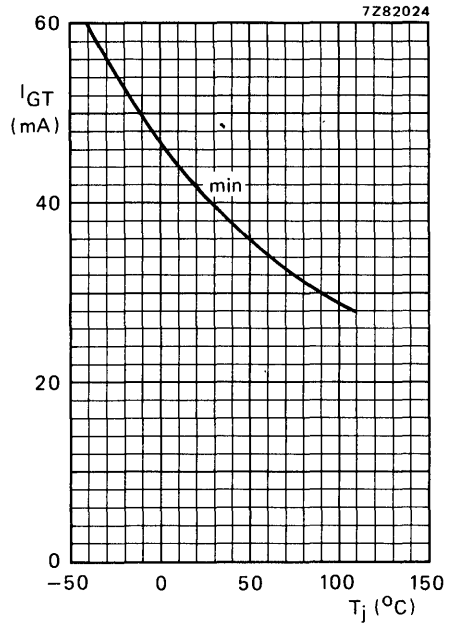
Fig. 9 Minimum gate current that will trigger all devices as a function of junction temperature.
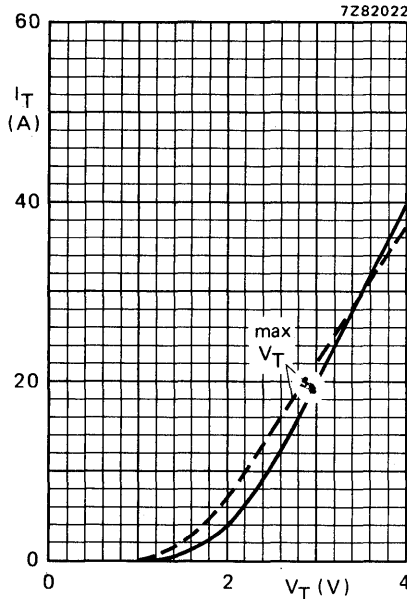

Fig. 10 —— T_j = 25 °C; —— T_j = 110 °C.
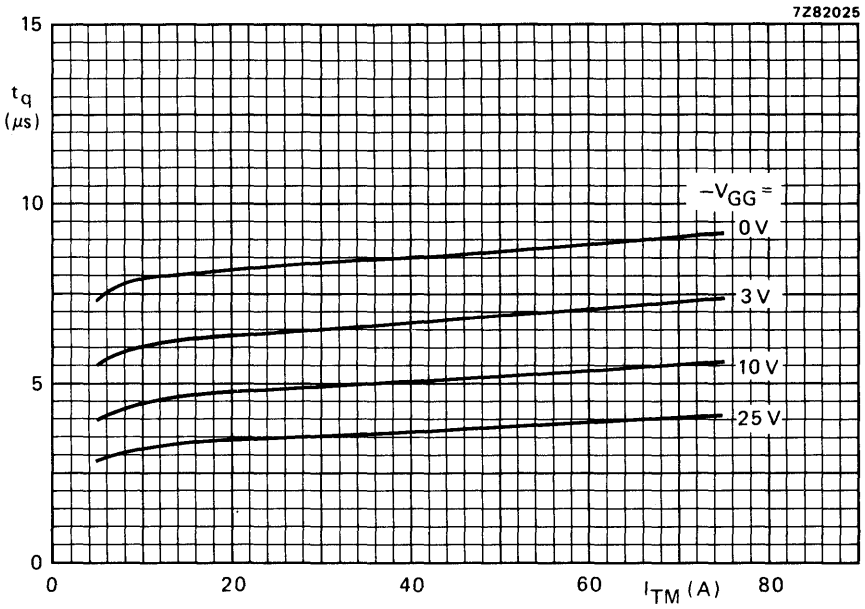
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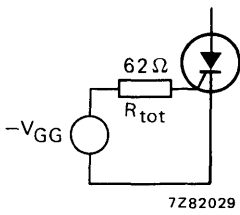
Fig. 11 Typical variation of t_q with I_{TM} and $-V_{GG}$ at $-dI_T/dt = 10$ A/μs; $dV_D/dt = 200$ to 700 V/μs; $t_p = 150$ μs.
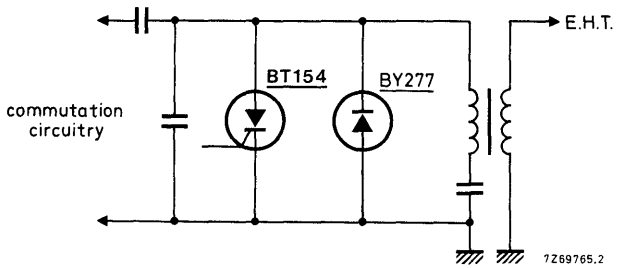
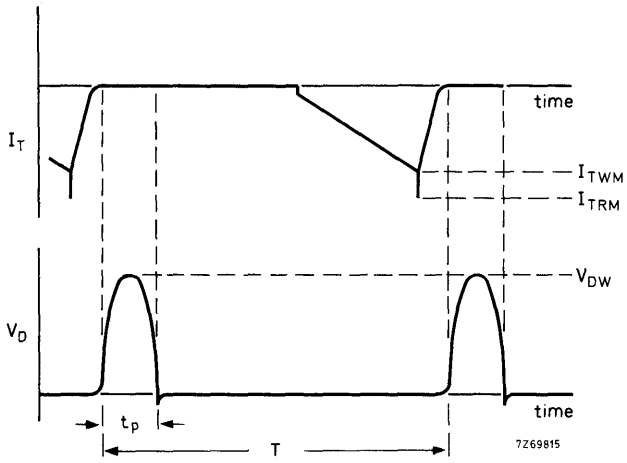**APPLICATION INFORMATION**

Fig. 12 Basic circuit and waveforms.

Note

For reverse blocking operation use a series diode, for reverse conducting operation use an anti-parallel diode.