FULL-PACK TRIACS

Glass-passivated 12 ampere triacs in SOT-186 envelopes, which feature an electrically isolated mounting base. They are intended for use in applications requiring high bidirectional transient and blocking voltage capability. Typical applications include AC power control circuits such as lighting, industrial and domestic heating, motor control and switching systems.

QUICK REFERENCE DATA

			BT138F–500	600	700	800	
Repetitive peak off-state voltage	V_{DRM}	max.	500	600	700	800	V
RMS on-state current	$I_{T(RMS)}$	max.		12			A
Non-repetitive peak on-state current							
at 50 Hz	I_{TSM}	max.		90			A
at 60 Hz	I_{TSM}	max.		100			A

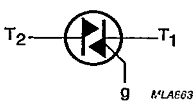
MECHANICAL DATA

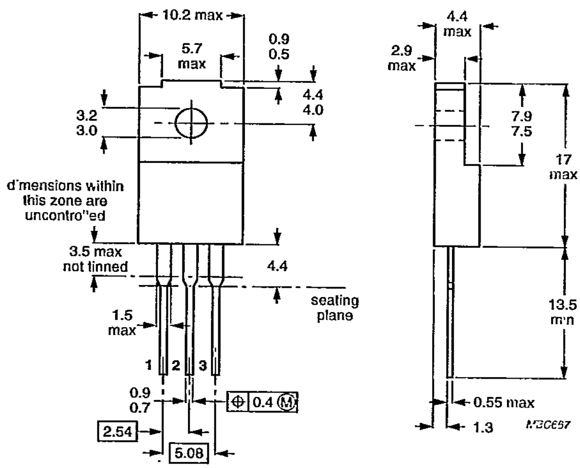
Dimensions in mm

Fig.1 SOT-186

Pinning:

1 = Terminal 1
2 = Terminal 2
3 = Gate





Net mass: 2 g.
The mounting base is electrically isolated from all terminals.
Accessories supplied on request (see data sheets Mounting instructions for F-pack devices and Accessories for SOT-186 envelopes).

RATINGS

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

Voltages (in either direction)			BT138F–500	600	700	800	
Non-repetitive peak off-state voltage ($t \leq 10$ ms)	V_{DSM}	max.	500*	600*	700*	800	V
Repetitive peak off-state voltage ($\delta \leq 0.01$)	V_{DRM}	max.	500	600	700	800	V
Crest working off-state voltage	V_{DWM}	max.	400	400	400	400	V

Currents (in either direction)

RMS on-state current (conduction angle 360°) up to $T_h = 52$ °C	$I_{T(RMS)}$	max.	12	A
Repetitive peak on-state current	I_{TRM}	max.	90	A
Non-repetitive peak on-state current; $T_j = 120$ °C prior to surge; full sinewave				
t = 20 ms	I_{TSM}	max.	90	A
t = 16.7 ms	I_{TSM}	max.	100	A
I^2t for fusing (t = 10 ms)	I^2t	max.	40	A^2s
Rate of rise of on-state current after triggering with $I_G = 200$ mA to $I_T = 20$ A; $dI_G/dt = 0.2$ A/µs	dI_T/dt	max.	30	A/µs

Gate to terminal 1

Power dissipation

Average power dissipation (averaged over any 20 ms period)	$P_{G(AV)}$	max.	0.5	W
Peak power dissipation	P_{GM}	max.	5.0	W

Temperatures

Storage temperature	T_{stg}		–40 to +125	°C
Operating junction temperature				
full-cycle operation	T_j	max.	120	°C
half-cycle operation	T_j	max.	110	°C

ISOLATION

From all three terminals to external heatsink (peak)**	$V_{(isol)M}$	min.	1500	V
Capacitance from T_2 to external heatsink	$C_{(isol)}$	typ.	12	pF

*Although not recommended, off-state voltages up to 800 V may be applied without damage, but the triac may switch into the on-state. The rate of rise of on-state current should not exceed 15 A/µs.

**Measured with relative humidity <65% under clean and dust-free conditions.

THERMAL RESISTANCE

1. Heatsink mounted with clip (see mounting instructions)

Thermal resistance from junction to external heatsink

With heatsink compound	$R_{th\ j\text{-}h}$	=	4.0	K/W
Without heatsink compound	$R_{th\ j\text{-}h}$	=	5.5	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	$R_{th\ j\text{-}a}$	=	55	K/W

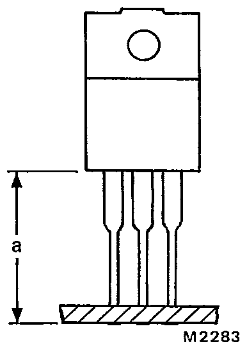


Fig.2.

CHARACTERISTICS (T_j = 25 °C unless otherwise stated)

Polarities, positive or negative, are identified with respect to T_1.

Voltage and currents (in either direction)

On-state voltage (measured under pulse conditions to prevent excessive dissipation)				
I_T = 15 A	V_T	<	1.65	V
Rate of rise of off-state voltage that will not trigger any device; T_j = 120 °C; gate open circuit				
BT138F series	dV_D/dt	<	100	V/µs
BT138F series G	dV_D/dt	<	200	V/µs
BT138F series F	dV_D/dt	<	50	V/µs
BT138F series E	dV_D/dt	typ.	50	V/µs
Rate of change of commutating voltage that will not trigger any device when $-dI_{com}/dt$ = 5.4 A/ms; $I_{T(RMS)}$ = 12 A; T_h = 40 °C; gate open circuit; $V_D = V_{DWMmax}$				
BT138F series	dV_{com}/dt	typ.	10	V/µs
BT138F series G	dV_{com}/dt	<	10	V/µs
BT138F series F	dV_{com}/dt	typ.	10	V/µs
Off-state current				
$V_D = V_{DWMmax}$; T_j = 120 °C;	I_D	<	0.5	mA
Gate voltage that will trigger all devices	V_{GT}	>	1.5	V
Gate voltage that will not trigger any device $V_D = V_{DWMmax}$; T_j = 120 °C; T_2 and G positive or negative	V_{GD}	<	250	mV

Gate current that will trigger all devices (I_{GT}); G to T_1

Holding current (I_H)

Latching current (I_L); V_D = 12 V

			T_2+ G+	T_2+ G−	T_2− G−	T_2− G+	
BT138F series	I_{GT}	>	35	35	35	70	mA
	I_H	<	30	30	30	30	mA
	I_L	<	40	60	40	60	mA
BT138F series G	I_{GT}	>	50	50	50	100	mA
	I_H	<	60	60	60	60	mA
	I_L	<	60	90	60	90	mA
BT138F series F	I_{GT}	>	25	25	25	70	mA
	I_H	<	30	30	30	30	mA
	I_L	<	40	60	40	60	mA
BT138F series E	I_{GT}	>	10	10	10	25	mA
	I_H	<	30	30	30	30	mA
	I_L	<	30	40	30	40	mA

MOUNTING INSTRUCTIONS

1. The triac may be soldered directly into the circuit, but the maximum permissible temperature of the soldering iron or bath is 275 °C; it must not be in contact with the joint for more than 5 seconds. Soldered joints must be at least 4.7 mm from the seal.
2. The leads should not be bent less than 2.4 mm from the seal, and should be supported during bending. The leads can be bent, twisted or straightened by 90° maximum. The minimum bending radius is 1 mm.
3. Mounting by means of a spring clip is the best mounting method because it offers good thermal contact under the crystal area and slightly lower $R_{th\ j\text{-}h}$ values than screw mounting. 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 mounting base and heatsink. Values of $R_{th\ j\text{-}h}$ 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 is not recommended.
6. The heatsink must have a flatness in the mounting area of 0.02 mm maximum per 10 mm. Mounting holes must be deburred.

OPERATING NOTES

Dissipation and heatsink considerations:

a. The various components of junction temperature rise above ambient are illustrated in Fig.3.

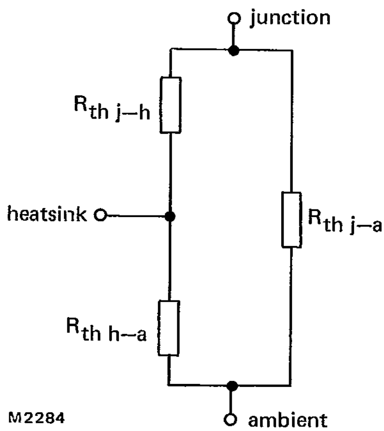


Fig.3.

b. The method of using Figs.4 and 5 is as follows:
Starting with the required current on the $I_{T(RMS)}$ axis (l.h. graph) trace upwards to meet the appropriate conduction angle curve. Trace left from curve to obtain power P. Trace right from curve to obtain T_h (r.h. graph). Trace upwards from T_{amb}, intersect with T_h determines $R_{th\ h\text{-}a}$, required heatsink thermal resistance.

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

FULL-WAVE CONDUCTION (with heatsink compound)

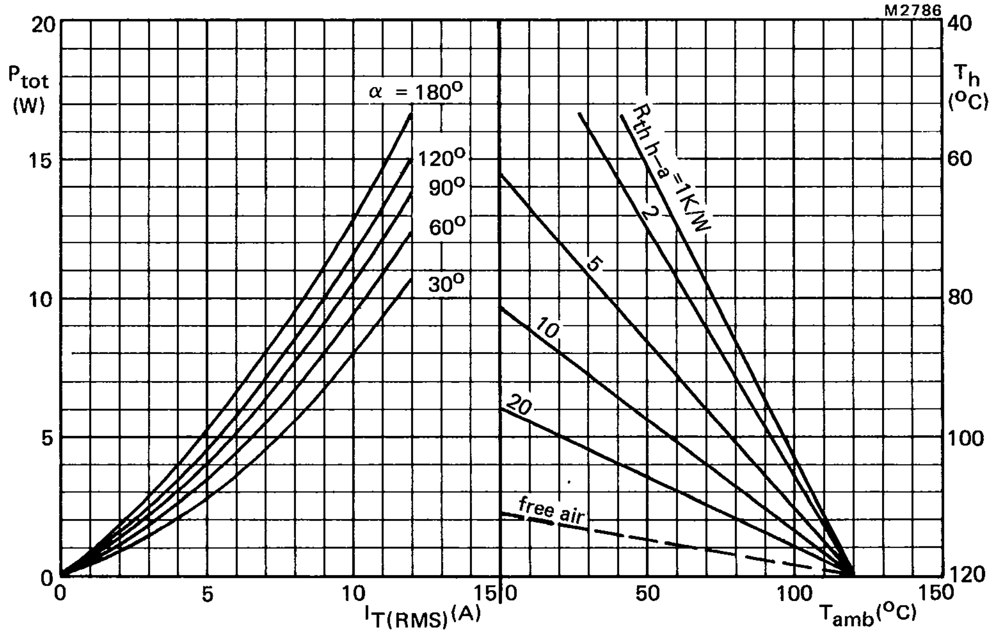
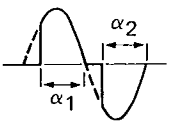


Fig.4 The right-hand part shows the interrelationship between the power (derived from the left-hand part) and the maximum permissible temperatures.



$\alpha = \alpha_1 = \alpha_2$: conduction angle per half cycle

FULL-WAVE CONDUCTION (without heatsink compound)

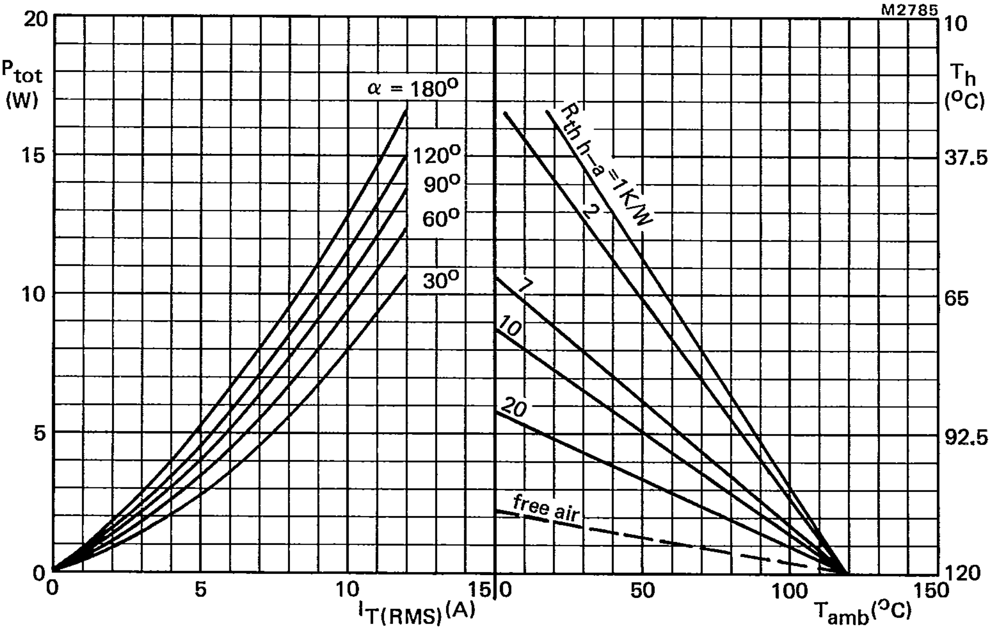
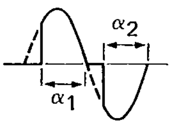


Fig.5 The right-hand part shows the interrelationship between the power (derived from the left-hand part) and the maximum permissible temperatures.



$\alpha = \alpha_1 = \alpha_2$: conduction angle per half cycle

OVERLOAD OPERATION

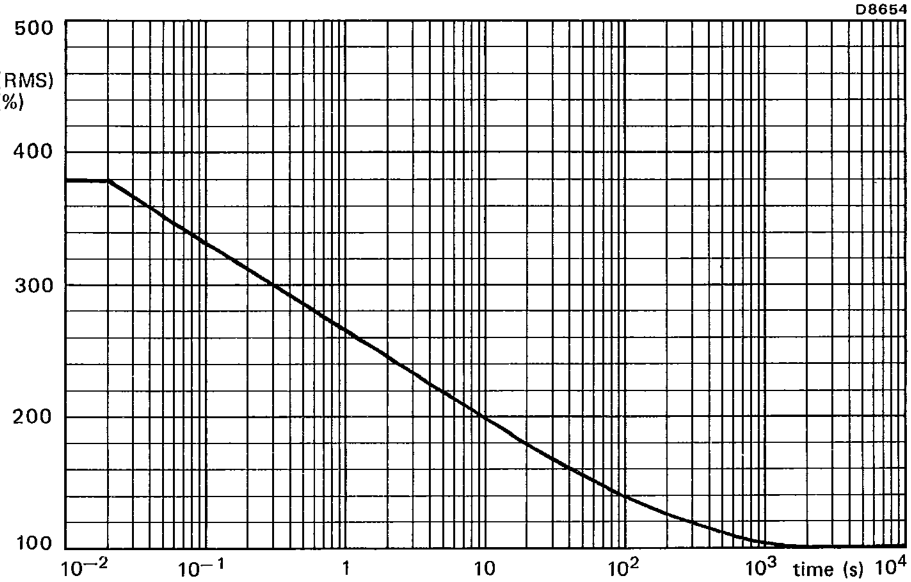


Fig.6 Maximum permissible duration of steady overload (provided that T_h does not exceed 120 °C during and after overload) expressed as a percentage of the steady state r.m.s. rated current. For high r.m.s. overload currents precautions should be taken so that the temperature of the terminals does not exceed 125 °C. During these overload conditions the triac may lose control. Therefore the overload should be terminated by a separate protection device.

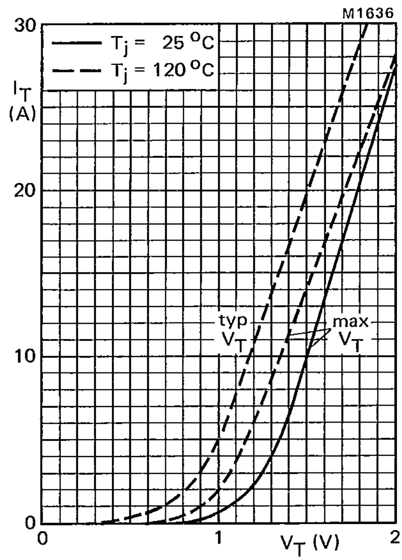


Fig.7.

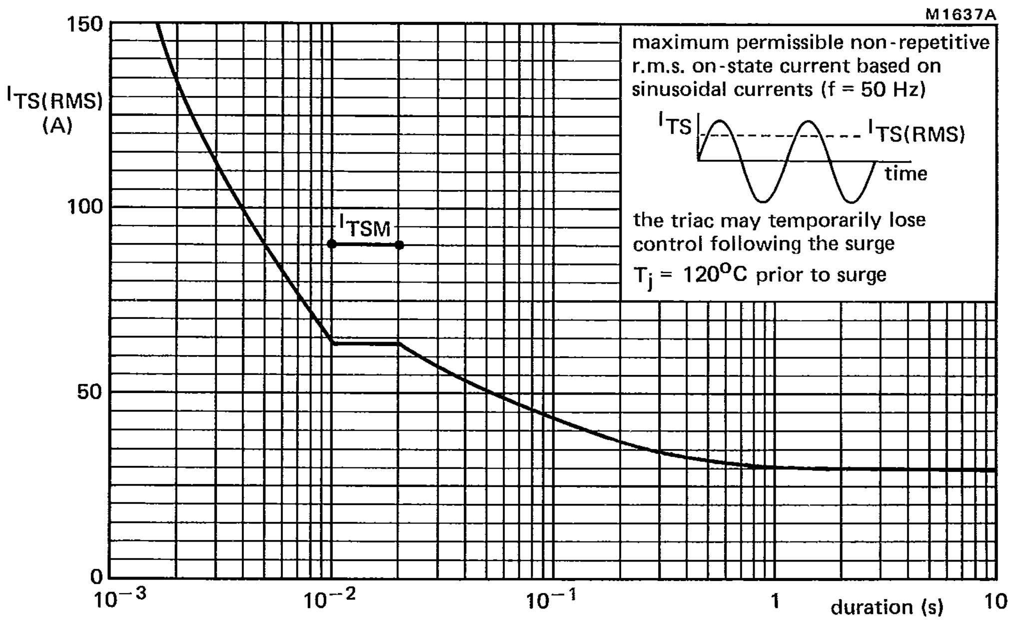


Fig.8.

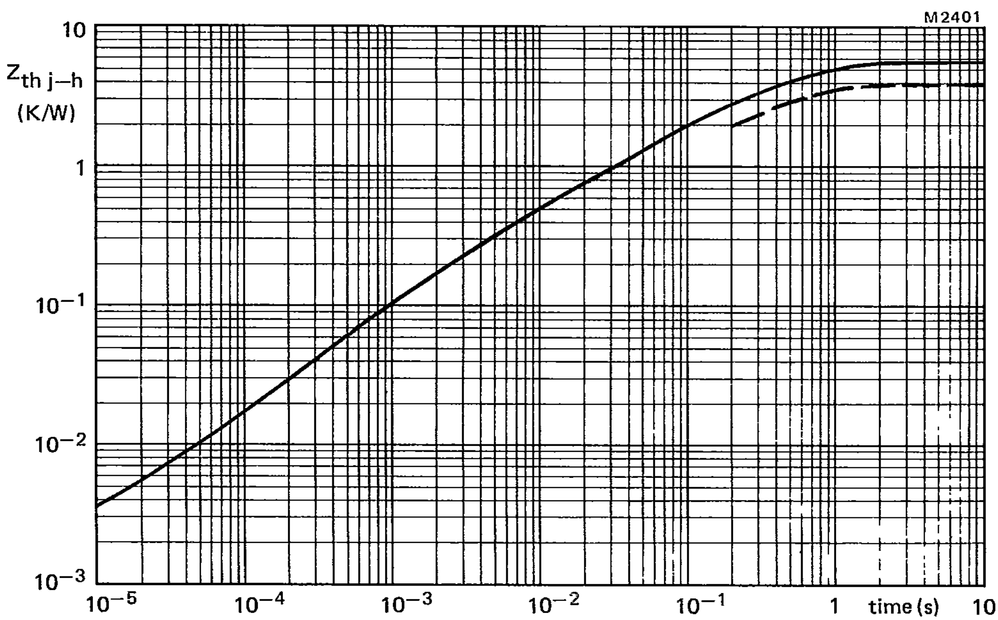


Fig.9 Transient thermal impedance; — — — with heatsink compound; —— without heatsink compound.

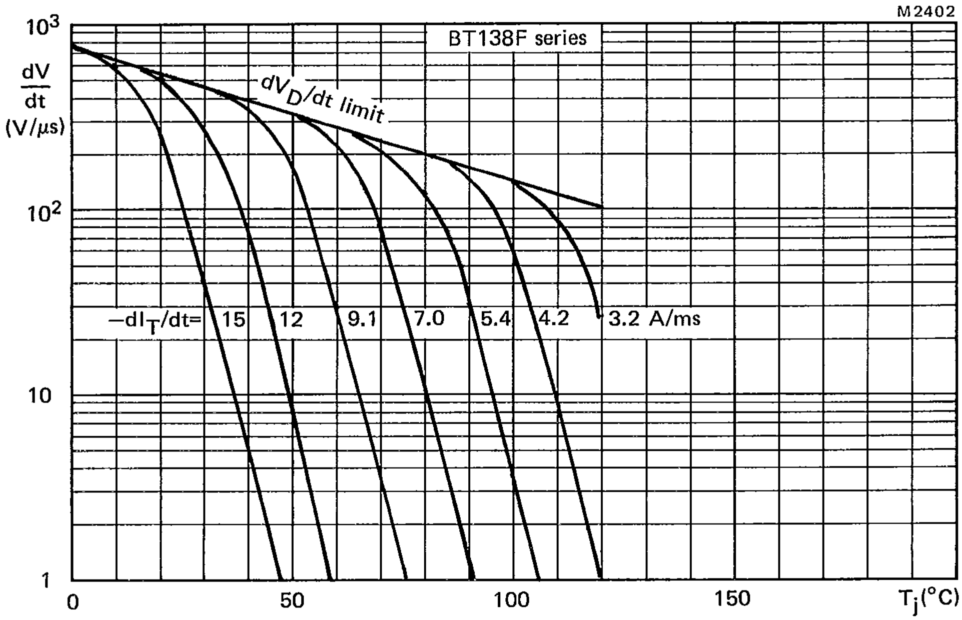


Fig.10 Typical commutation dV/dt for BT138F series versus T_j. The triac should commutate when dV/dt is below the value on the appropriate curve for pre-commutation dI_T/dt.

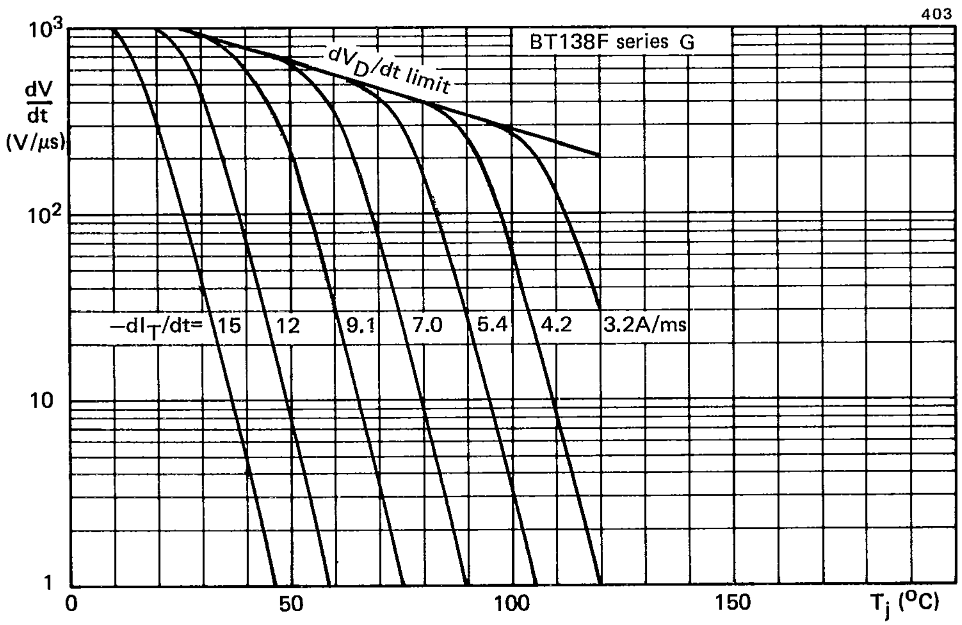


Fig.11 Limit commutation dV/dt for BT138F series G versus T_j. The triac should commutate when the dV/dt is below the value on the appropriate curve for pre-commutation dI_T/dt.

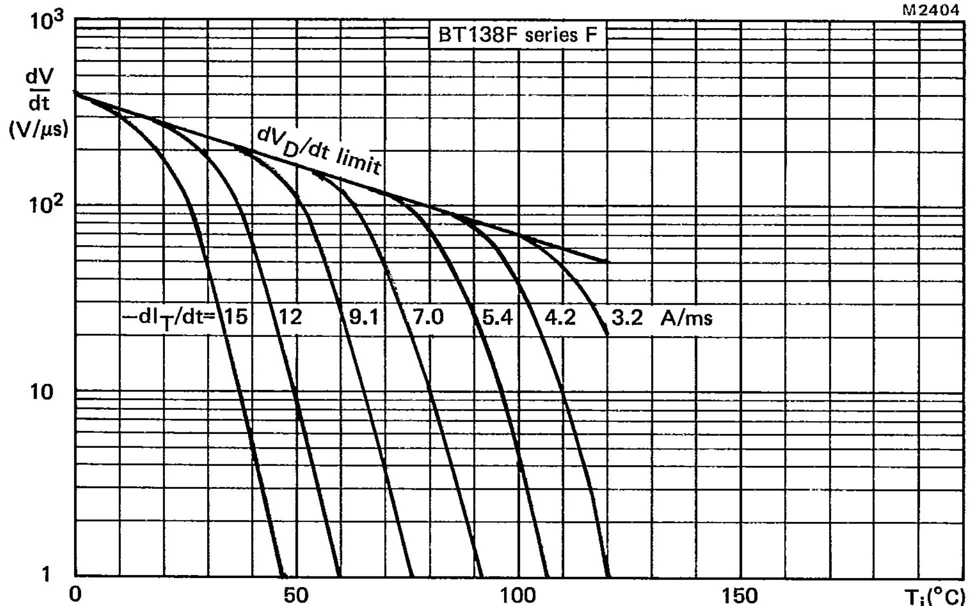


Fig.12 Typical commutation dV/dt for BT138F series F versus T_j. The triac should commutate when the dV/dt is below the value on the appropriate curve for pre-commutation dI_T/dt.

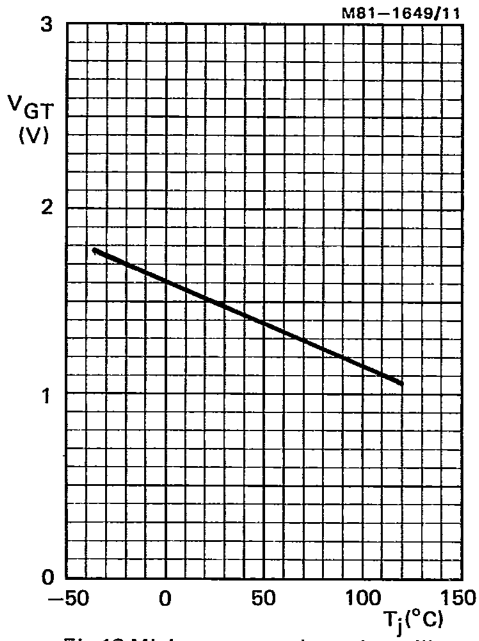


Fig.13 Minimum gate voltage that will trigger all devices; all conditions.

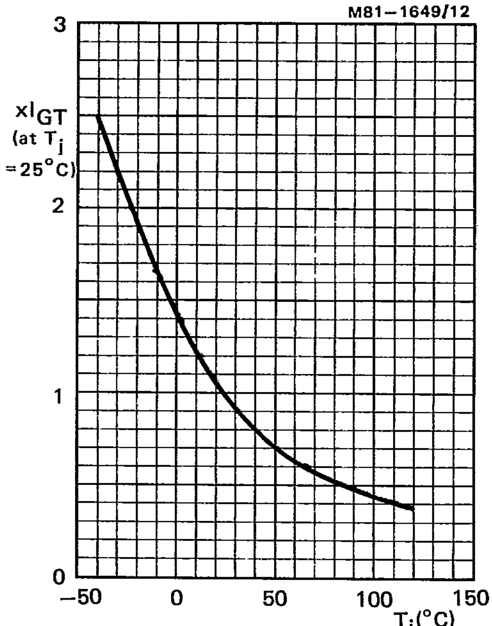


Fig.14 Normalised gate current that will trigger all devices; all conditions.

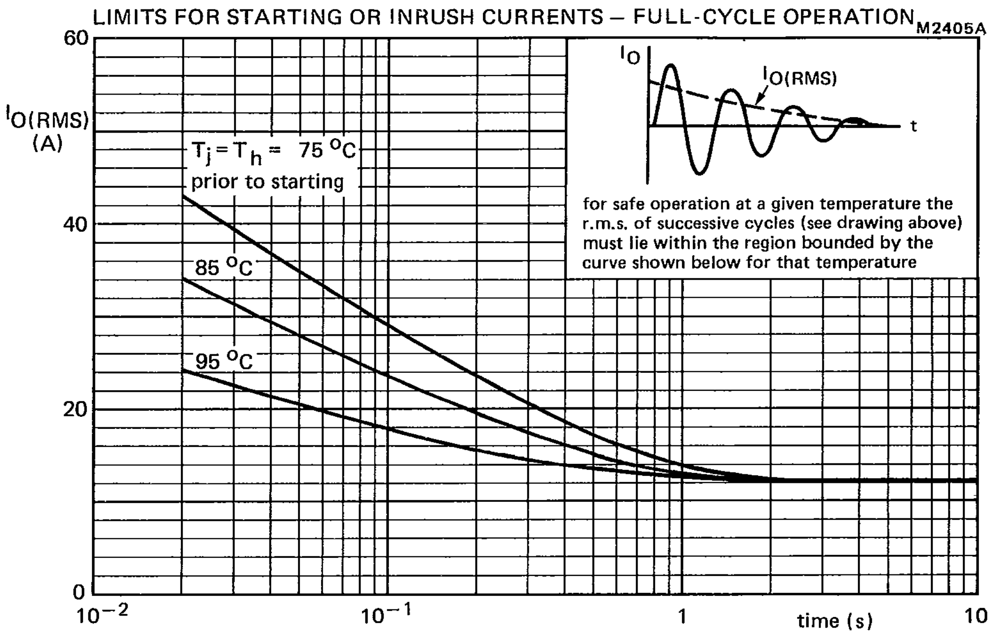

LIMITS FOR STARTING OR INRUSH CURRENTS — FULL-CYCLE OPERATION
M2405A
60
40
20
0
$I_{O(RMS)}$
(A)
$T_j = T_h =$ 75 °C
prior to starting
85 °C
95 °C
I_O
$I_{O(RMS)}$
t
for safe operation at a given temperature the r.m.s. of successive cycles (see drawing above) must lie within the region bounded by the curve shown below for that temperature
10^{-2}
10^{-1}
1
time (s)
10

Fig.15