FAST GATE TURN-OFF THYRISTORS

Thyristors in SOT-93 envelopes which are capable of being turned both on and off via the gate, and may be used with gate-assisted turn-off in anode-commutated circuits. They are suitable for use in resonant power supplies, high-frequency inverters, motor control etc. The devices have no reverse blocking capability; for reverse blocking operation use with a series diode, for reverse conducting operation use with an anti-parallel diode. The anode is connected to the mounting base.

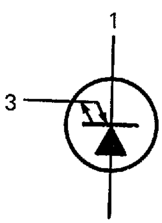
QUICK REFERENCE DATA

			BTR59–800R	1300R	
Repetitive peak off-state voltage	V_{DRM}	max.	800	1300	V
Controllable anode current	I_{TCRM}	max.	50		A
Average on-state current	$I_{T(AV)}$	max.	10		A
Circuit commutated turn-off time	t_q	<	1.0		μs

MECHANICAL DATA

Dimensions in mm

Fig.1 SOT93; anode connected to mounting base.



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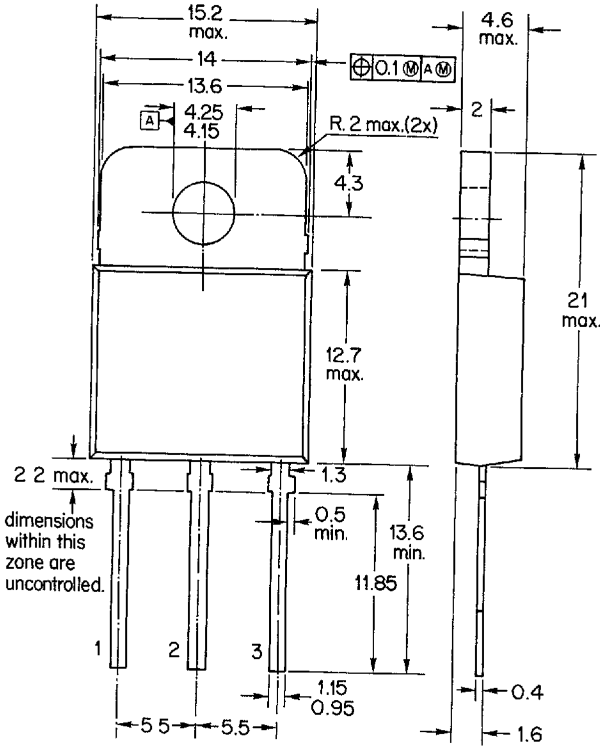

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Accessories supplied on request; see data sheets Mounting instructions and accessories for SOT-93 envelopes.

RATINGS

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

			BTR59–800R	1300R	
Anode to cathode					
Transient off-state voltage	V_{DSM}	max.	800	1300	V*
Repetitive peak off-state voltage	V_{DRM}	max.	800	1300	V*
Working off-state voltage	V_{DW}	max.	600	1000	V*
Continuous off-state voltage	V_D	max.	400	750	V*
Average on-state current (averaged over any 20 ms period) up to T_{mb} = 85 °C	$I_{T(AV)}$	max.	10		A
R.M.S. on-state current	$I_{T(RMS)}$	max.	16.5		A
Controllable anode current	I_{TCRM}	max.	50		A
Non-repetitive peak on-state current t = 10 ms; half-sinewave; T_j = 120 °C prior to surge	I_{TSM}	max.	100		A
I^2t for fusing; t = 10 ms	I^2t	max.	50		A^2s
Total power dissipation up to T_{mb} = 25 °C	P_{tot}	max.	105		W
Gate to cathode					
Repetitive peak current T_j = 120 °C prior to surge gate-cathode forward; t = 10 ms; half-sinewave	I_{GFM}	max.	25		A
gate-cathode reverse; t = 20 µs	I_{GRM}	max.	25		A
Average power dissipation (averaged over any 20 ms period)	$P_{G(AV)}$	max.	5.0		W
Temperatures					
Storage temperature	T_{stg}		−40 to +125		°C
Operating junction temperature	T_j	max.	120		°C

THERMAL RESISTANCE

From mounting base to heatsink; with heatsink compound	$R_{th\ mb\text{-}h}$	=	0.2	K/W
From junction to mounting base	$R_{th\ j\text{-}mb}$	=	0.9	K/W

*Measured with gate-cathode connected together.

CHARACTERISTICS

Anode to cathode

On-state voltage				
I_T = 10 A; I_G = 0.5 A; T_j = 120 °C	V_T	<	3.0	V*
Rate of rise of off-state voltage that will not trigger any off-state device; exponential method				
V_D = 2/3 V_{Dmax}; V_{GR} = 5 V; T_j = 120 °C	dV_D/dt	<	10	kV/μs
Rate of rise of off-state voltage that will not trigger any device following conduction, linear method				
I_T = 20 A; V_D = V_{DRMmax}; V_{GR} = 10 V; T_j = 120 °C	dV_D/dt	<	1.0	kV/μs
Off-state current				
V_D = V_{Dmax}; T_j = 120 °C	I_D	<	5.0	mA
Latching current; T_j = 25 °C	I_L	typ.	1.5	A**

Gate to cathode

Voltage that will trigger all devices				
V_D = 12 V; T_j = 25 °C	V_{GT}	>	1.5	V
Current that will trigger all devices				
V_D = 12 V; T_j = 25 °C	I_{GT}	>	500	mA
Minimum reverse breakdown voltage				
I_{GR} = 1.0 mA	$V_{(BR)GR}$	>	10	V

Switching characteristics (resistive load)

Turn-on when switched to I_T = 10 A from V_D = 250 V with I_{GF} = 2.5 A; T_j = 25 °C				
delay time	t_d	<	0.3	μs
rise time	t_r	<	1.5	μs

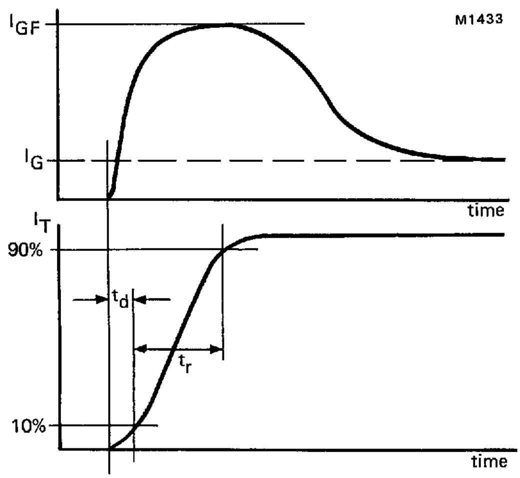

Fig.2 Waveforms.

*Measured under pulse conditions to avoid excessive dissipation.
**Below latching level the device behaves like a transistor with a gain dependent on current.

Switching characteristics (inductive load)

Turn-off when switched from I_T = 10 A to $V_D = V_{Dmax}$;

V_{GR} = 10 V; $L_G \leqslant 0.5\ \mu H$; $L_S \leqslant 0.25\ \mu H$; $C_S \geqslant 20$ nF; T_j = 85 °C

storage time	t_s	<	0.60	μs
fall time	t_f	<	0.25	μs
peak reverse gate current	I_{GR}	<	10	A

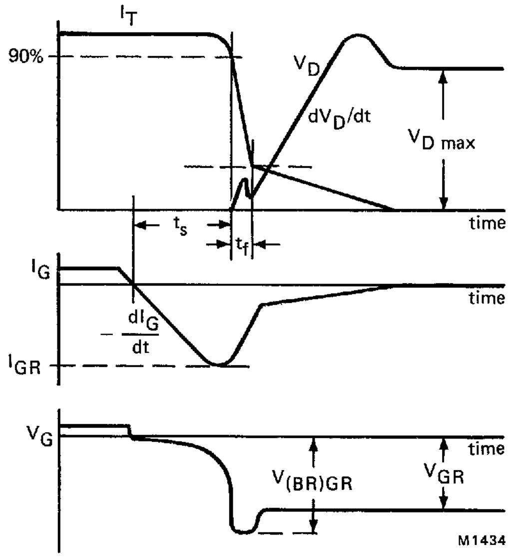

Fig.3 Waveforms.

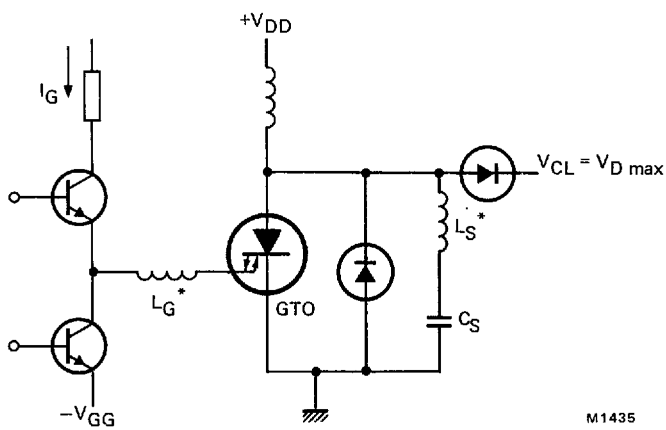

Fig.4 Inductive load test circuit.

*Indicates stray series inductance only.

Switching characteristics (circuit-commutated)*

Turn-off time

I_T = 50 A; $-dI_T/dt$ = 10 A/μs; dV_D/dt = 200 V/μs; V_{GR} = 5 V; T_j = 120 °C	t_q	<	1.0	μs

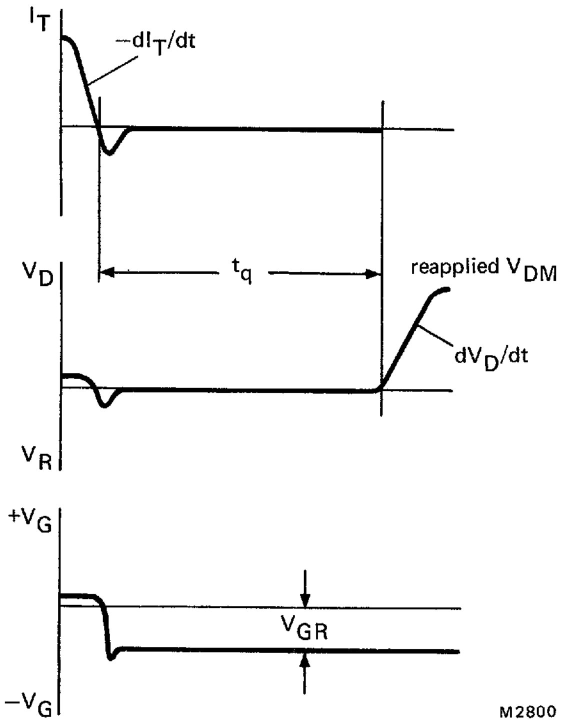

Fig.5 Circuit-commutated turn-off time definition.

*Figs. 7, 11, 12, 13, 15, 16, 17 do not apply to commutated turn-off.

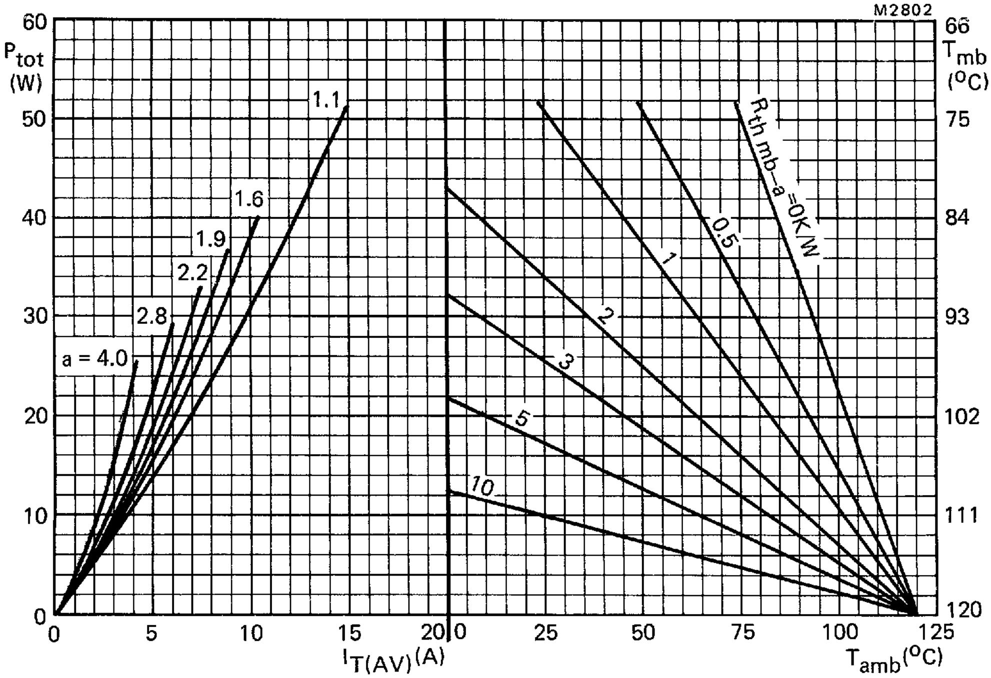

Fig.6 The right hand part shows the interrelationship between the power (derived from the left-hand part) and the maximum permissible temperatures.

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

P = power excluding switching losses.

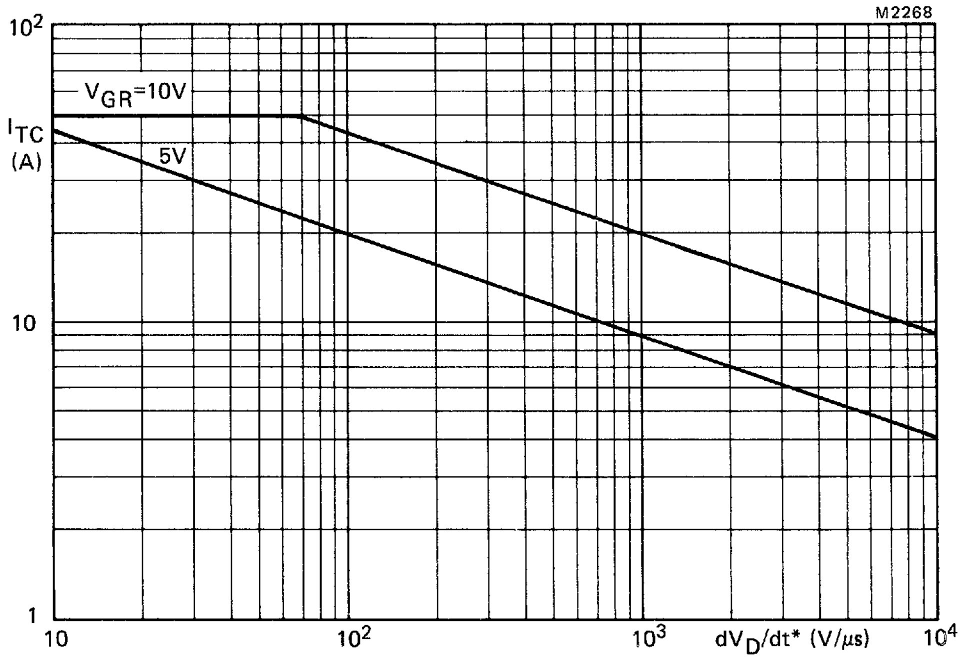

Fig.7 Anode current which can be turned off versus applied dV_D/dt^*; inductive load; $L_G \leqslant 0.5\ \mu H$; $L_S \leqslant 0.25\ \mu H$; $T_j = 120\ ^oC$.

*dV_D/dt is calculated from I_T/C_S.

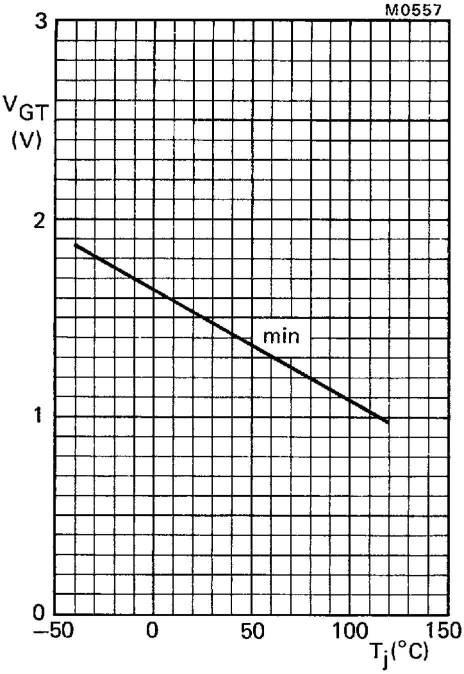

Fig.8 Minimum gate voltage that will trigger all devices as a function of junction temperature; V_D = 12 V.

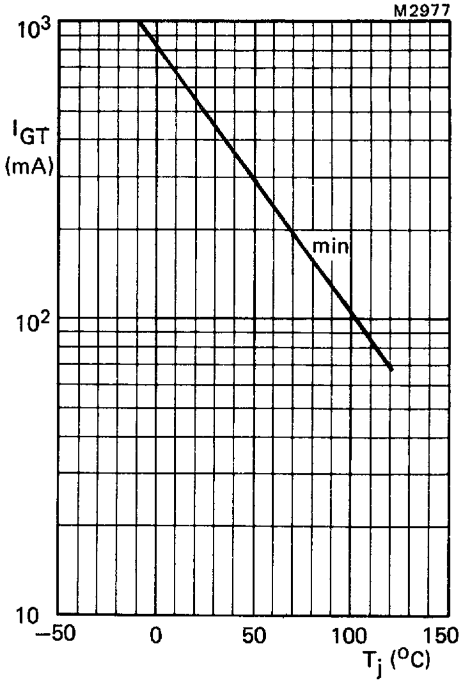

Fig.9 Minimum gate current that will trigger all devices as a function of junction temperature; V_D = 12 V.

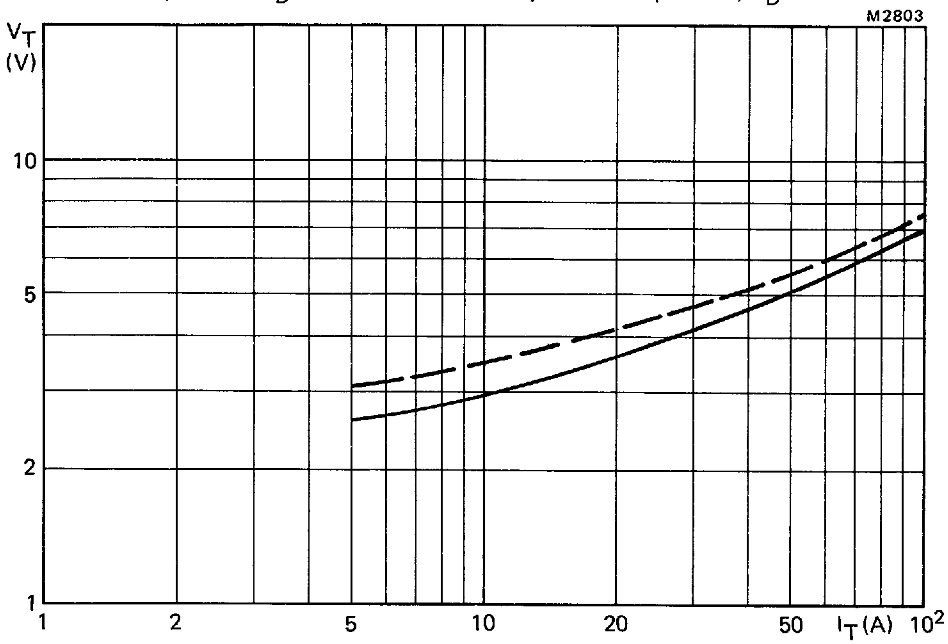

Fig.10 Maximum V_T versus I_T; – – – T_j = 25 °C; —— T_j = 120 °C; I_G = 0.5 A.

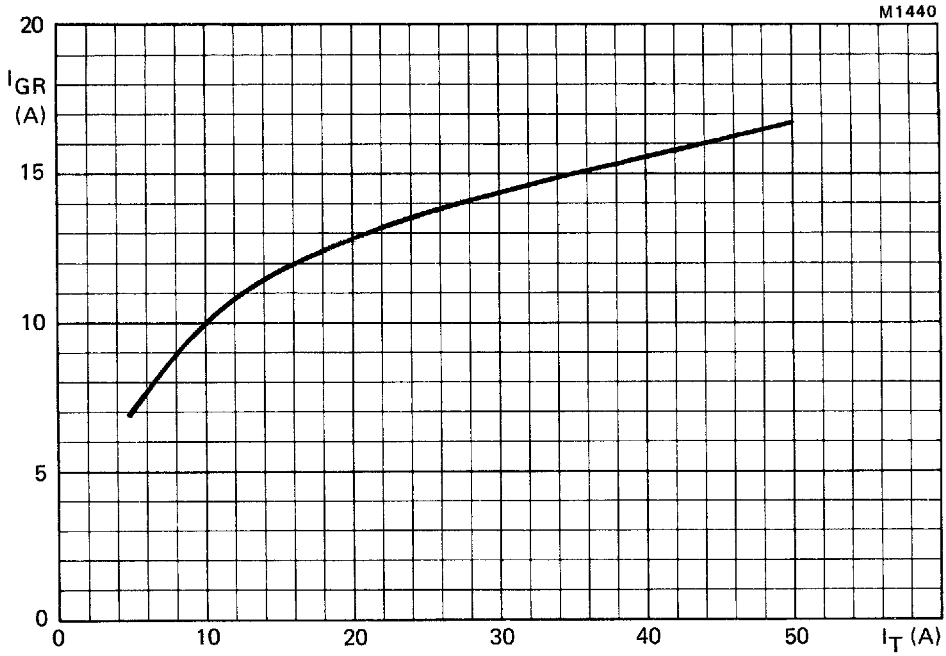

Fig.11 Peak reverse gate current versus anode current at turn-off; inductive load;
V_{GR} = 10 V; I_G = 0.5 A; L_G = 0.4 μH; T_j = 120 ^oC; maximum values.

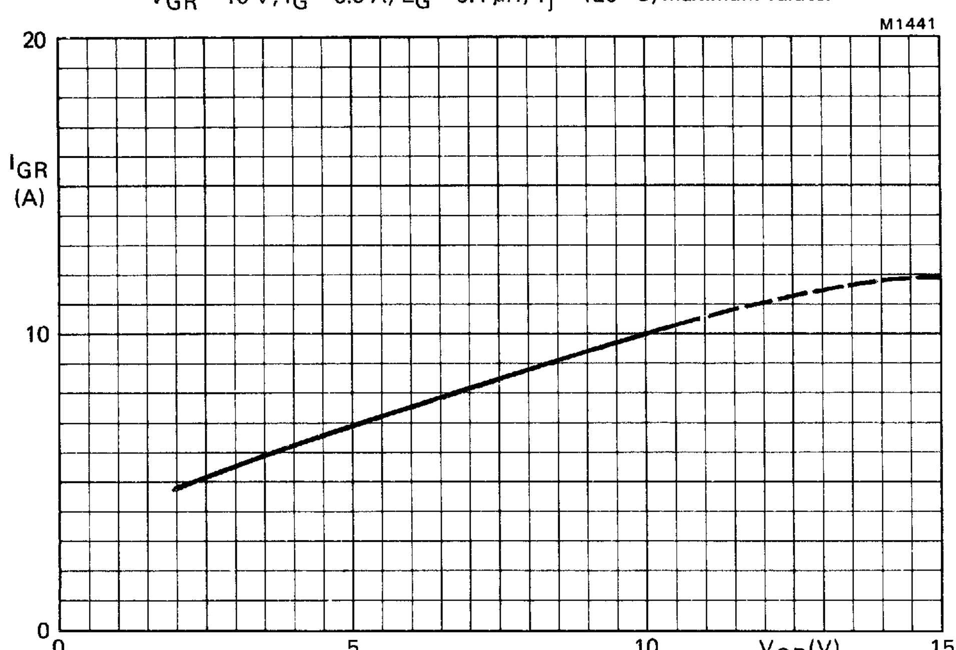

Fig.12 Peak reverse gate current versus applied reverse gate voltage; inductive load;
I_T = 10 A; I_G = 0.5 A; L_G = 0.4 μH; T_j = 120 ^oC; maximum values.

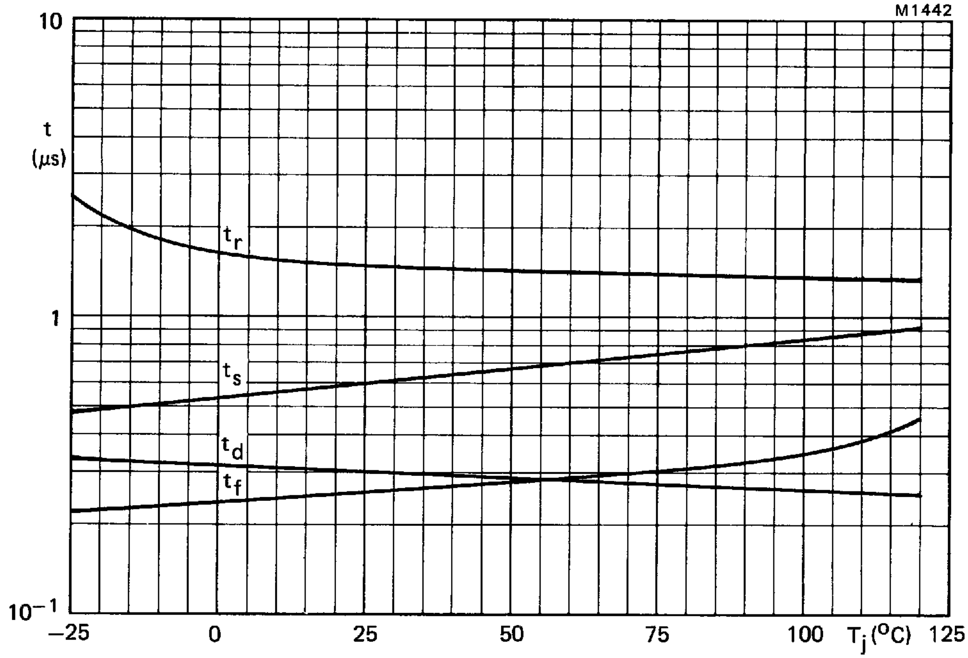

Fig.13 Switching times as a function of junction temperature; $V_D \geqslant 250$ V; $I_T = 10$ A; $I_{GF} = 1.0$ A; $V_{GR} = 10$ V; $I_G = 0.5$ A; $L_G = 0.4$ μH; maximum values.

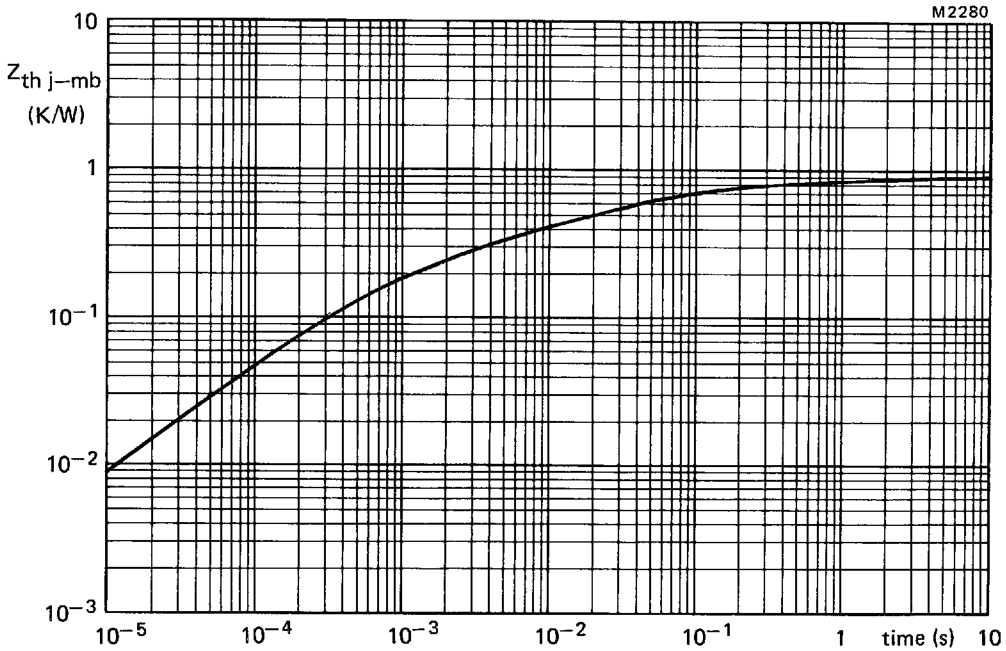

Fig.14 Transient thermal impedance.

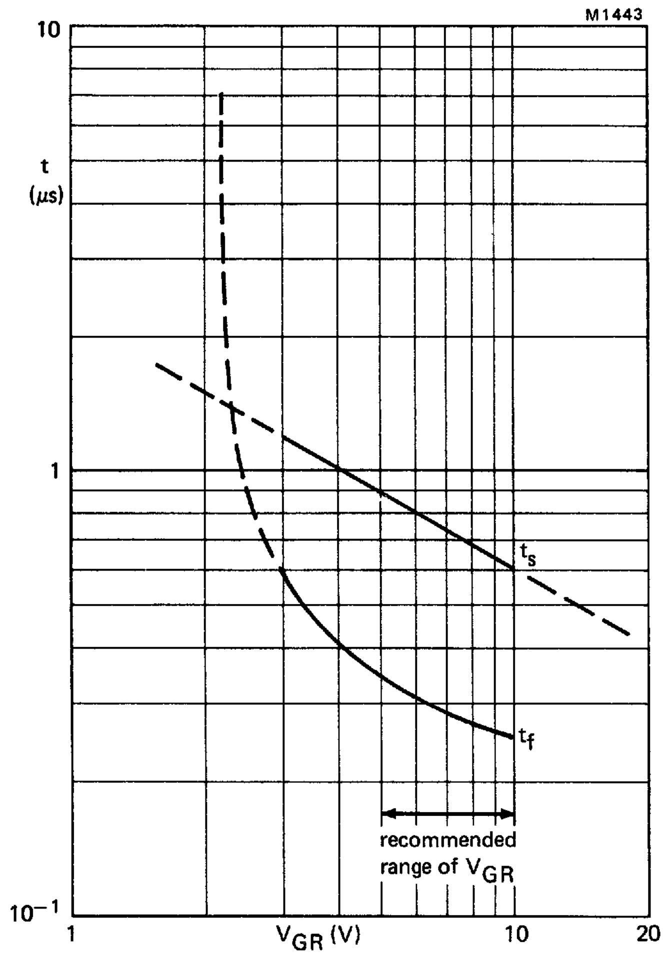

Fig.15 Storage and fall times versus applied reverse gate voltage; inductive load, I_T = 10 A; I_G = 0.5 A; L_G = 0.4 μH; T_j = 25 °C; maximum values.

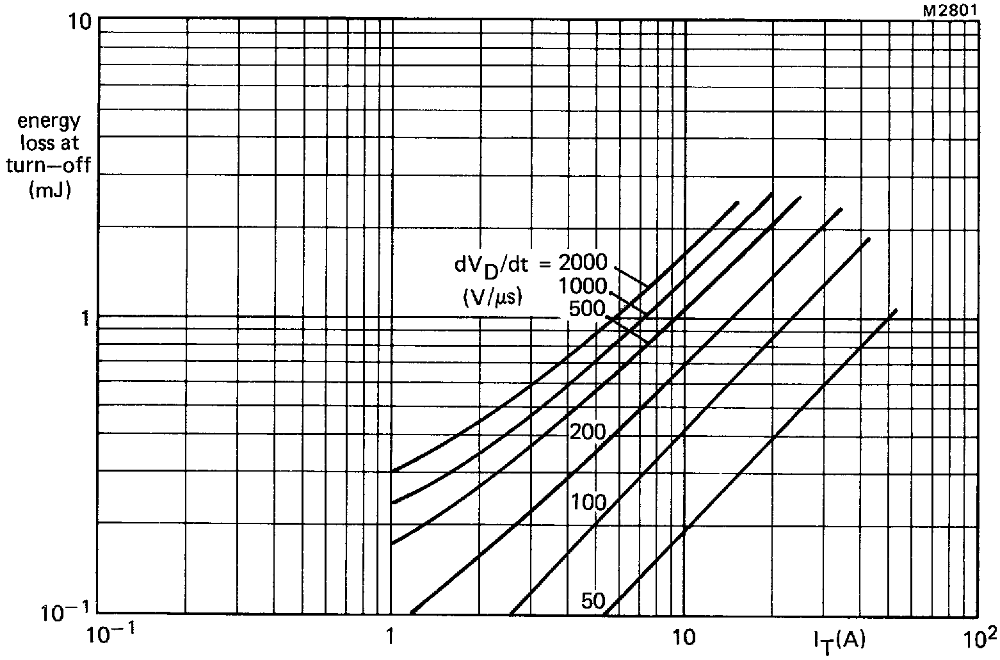

Fig.16 Maximum energy loss at turn-off (per cycle) as a function of anode current and applied dV_D/dt (calculated from I_T/C_S); dV_D/dt linear up to $V_D = V_{DWmax}$; $V_{GR} = 10$ V; $I_G = 0.5$ A; $L_G < 0.5$ μH; $L_S < 0.25$ μH; $T_j = 120$ °C.

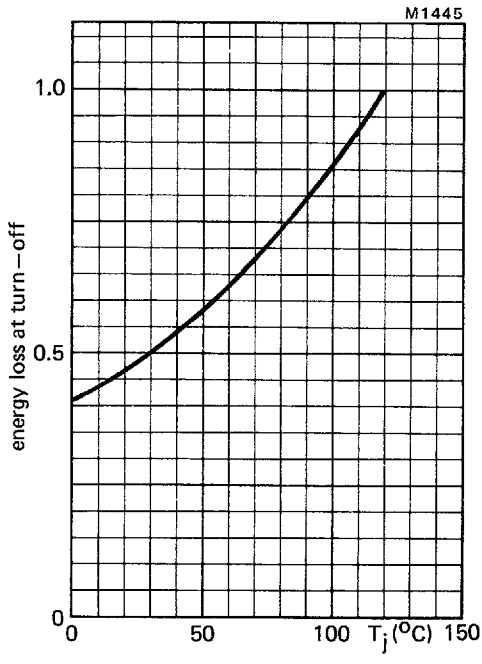

Fig.17 Energy loss at turn-off as a function of junction temperature; $I_G = 0.5$ A; $V_{GR} = 10$ V. Normalised to $T_j = 120$ °C.

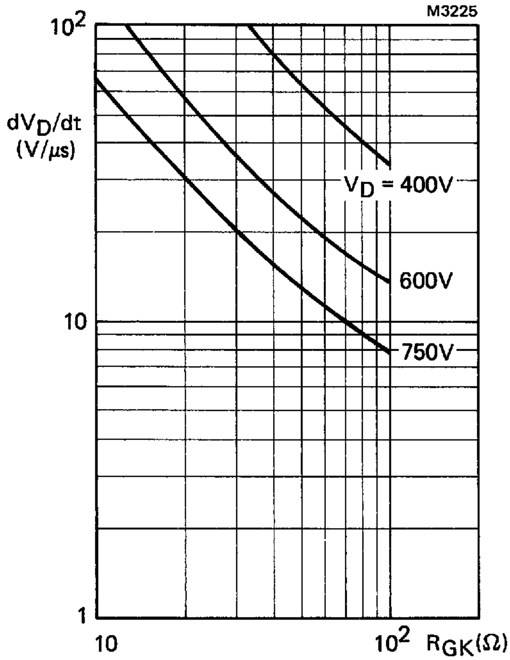

Fig.18 Linear rate of rise of off-state voltage versus gate-cathode resistance; T_j = 25 °C; typical values.

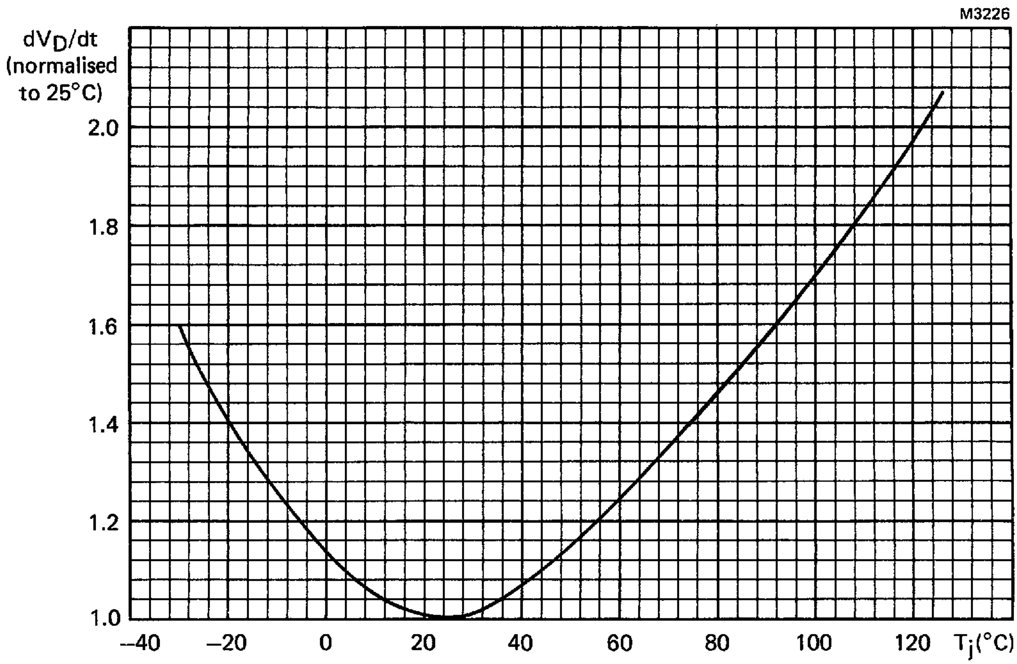

Fig.19 Rate of rise of off-state voltage versus junction temperature, normalised to 25 °C; V_{Dmax} = 750V; R_{GK} = 22 Ω; typical values.