FAST TURN-OFF THYRISTORS

A range of medium current fast turn-off thyristors in metal envelopes, intended for use in inverter applications.
The series consists of reverse polarity types (anode to stud) identified by a suffix R: BTW31-800RW to 1200RW.

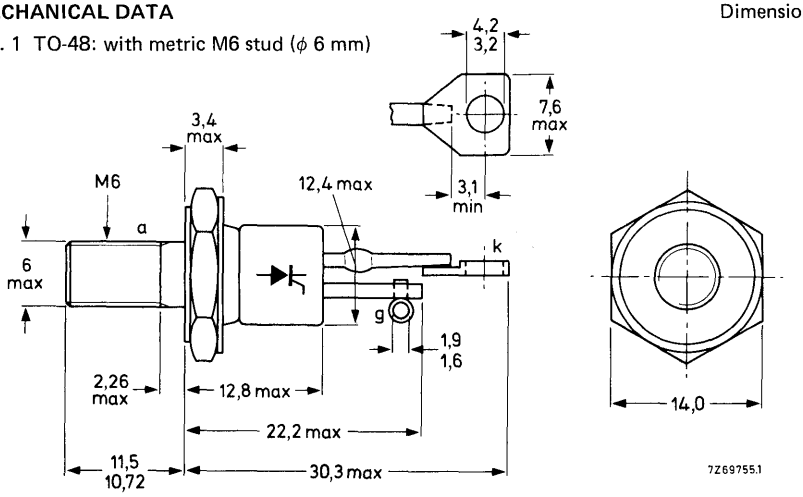
QUICK REFERENCE DATA

			BTW31-800RW	1000RW	1200RW	
Repetitive peak voltages	V_{DRM}/V_{RRM}	max.	800	1000	1200	V
Average on-state current	$I_{T(AV)}$	max.		22		A
R.M.S. on-state current	$I_{T(RMS)}$	max.		31		A
Non-repetitive peak on-state current	I_{TSM}	max.		240		A
Rate of rise of on-state current	dI_T/dt	max.		100		A/μs
Rate of rise of off-state voltage that will not trigger any device	dV_D/dt	<		200		V/μs
Circuit-commutated turn-off time	t_q	<		20		μs

MECHANICAL DATA

Dimensions in mm

Fig. 1 TO-48: with metric M6 stud (ϕ 6 mm)



Net mass: 14 g
Diameter of clearance hole: max. 6,5 mm
Accessories supplied on request: 56264A
(mica washer, insulating ring, soldering tag)

Torque on nut: min. 1,7 Nm (17 kg cm)
max. 3,5 Nm (35 kg cm)
Supplied with device:
1 nut, 1 lock washer
Nut dimensions across the flats: 10 mm

RATINGS

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

Anode to cathode			BTW31-800RW	1000RW	1200RW	
Non-repetitive peak voltages ($t \leqslant 10$ ms)	V_{DSM}**/V_{RSM}	max.	800	1000	1200	V
Repetitive peak voltages	V_{DRM}/V_{RRM}	max.	800	1000	1200	V▲
Crest working off-state voltage square-wave; $\delta = 0{,}5$	V_{DWM}	max.	600	800	1000	V *
Average on-state current assuming zero switching losses (averaged over any 20 ms period)						
square-wave; $\delta = 0{,}5$; up to $T_{mb} = 65$ °C	$I_{T(AV)}$	max.		22		A
square-wave; $\delta = 0{,}5$; at $T_{mb} = 85$ °C	$I_{T(AV)}$	max.		16		A
sinusoidal; at $T_{mb} = 85$ °C	$I_{T(AV)}$	max.		15		A
R.M.S. on-state current	$I_{T(RMS)}$	max.		31		A
Repetitive peak on-state current	I_{TRM}	max.		240		A
Non-repetitive peak on-state current $T_j = 125$ °C prior to surge (see Fig. 6)						
$t = 10$ ms; half sine-wave	I_{TSM}	max.		240		A
$t = 5$ ms; square pulse	I_{TSM}	max.		240		A
I^2t for fusing ($t = 10$ ms)	I^2t	max.		290		A^2s
Rate of rise of on-state current after triggering with $I_G = 1$ A to $I_T = 50$ A; $dI_G/dt = 1$ A/µs	dI_T/dt	max.		100		A/µs
Gate to cathode						
Reverse peak voltage	V_{RGM}	max.		10		V
Average power dissipation (averaged over any 20 ms period)	$P_{G(AV)}$	max.		1		W
Peak power dissipation	P_{GM}	max.		5		W
Temperatures						
Storage temperature	T_{stg}			−55 to +125		°C
Junction temperature	T_j	max.		125		°C

THERMAL RESISTANCE

From junction to mounting base	$R_{th\ j\text{-}mb}$	=	1	°C/W
From mounting base to heatsink	$R_{th\ mb\text{-}h}$	=	0,2	°C/W
Transient thermal impedance ($t = 1$ ms)	$Z_{th\ j\text{-}mb}$	=	0,06	°C/W

* To ensure thermal stability: $R_{th\ j\text{-}a} < 3$ °C/W (d.c. blocking) or < 6 °C/W (square-wave; $\delta = 0{,}5$). For smaller heatsinks $T_{j\ max}$ should be derated. For square-wave see Fig. 5.

** 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 30 A/µs.

▲ Thermal stability at higher voltage ratings is dependent on duty factor. See Figs 15 and 16.

CHARACTERISTICS

Anode to cathode

On-state voltage I_T = 50 A; T_j = 25 °C	V_T	<	2,9 V *
Rate of rise of off-state voltage that will not trigger any device; exponential method; V_D = 2/3V_{DRMmax}; T_j = 125 °C	dV_D/dt	<	200 V/μs
Off-state current V_D = V_{DWMmax}; T_j = 125 °C	I_D	<	7 mA
Holding current; T_j = 25 °C	I_H	<	200 mA

Gate to cathode

Voltage that will trigger all devices V_D = 6 V; T_j = 25 °C	V_{GT}	>	2,5 V
Voltage that will not trigger any device V_D = V_{DRMmax}; T_j = 125 °C	V_{GD}	<	0,2 V
Current that will trigger all devices V_D = 6 V; T_j = 25 °C	I_{GT}	>	200 mA

Switching characteristics

Gate-controlled turn-on time (t_{gt} = t_d + t_r) when switched from V_D = V_{DWMmax} to I_T = 50 A; I_{GT} = 200 mA; dI_G/dt = 1 A/μs; T_j = 25 °C	t_d	<	1 μs
	t_r	<	0,7 μs

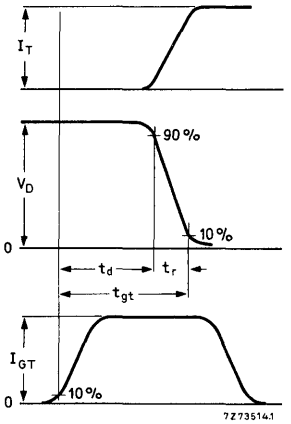


Fig. 2 Gate-controlled turn-on time definitions.

* Measured under pulse conditions to avoid excessive dissipation.

CHARACTERISTICS (continued)

Circuit-commutated turn-off time when switched from I_T = 10 A to $V_R \geqslant 50$ V with $-dI_T/dt$ = 10 A/μs; dV_D/dt = 50 V/μs; T_j = 125 °C

t_q < 20 μs

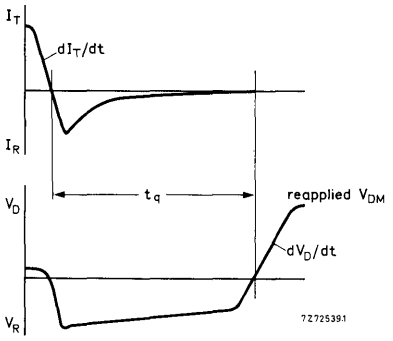
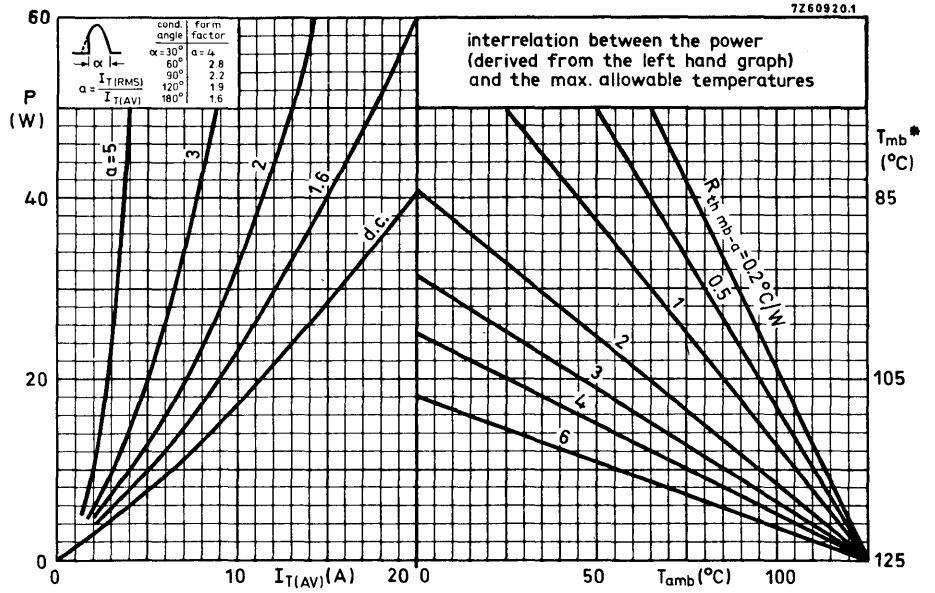


Fig. 3 Circuit-commutated turn-off time definitions.

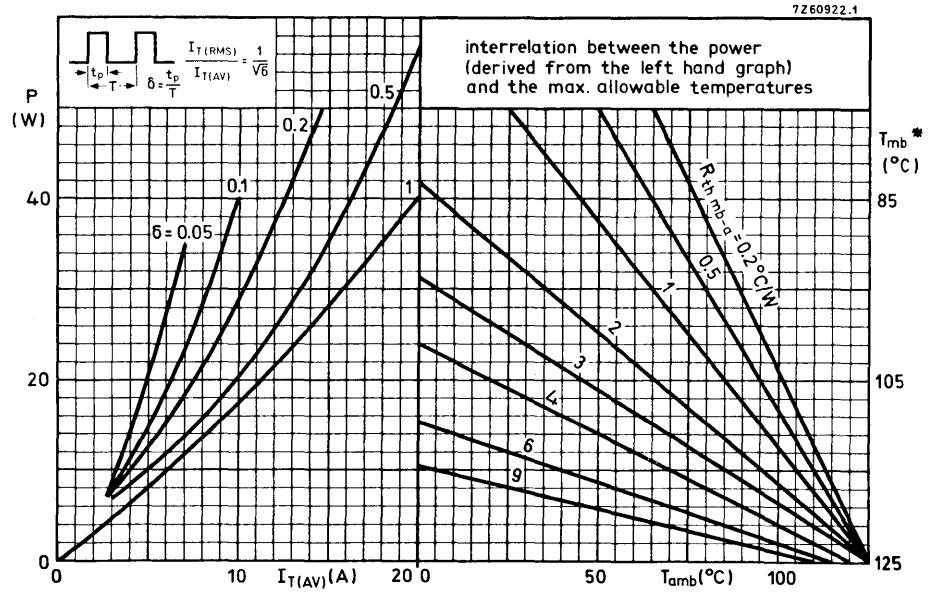
OPERATING NOTES

1. The terminals should neither be bent nor twisted; they should be soldered into the circuit so that there is no strain on them.
   During soldering the heat conduction to the junction should be kept to a minimum.
2. High frequency operation.
   a. The curves in Figs 13 and 14 show the additional average power losses due to turning on and turning off the thyristor in square pulse operation. This power should be added to that derived from the curves in Fig. 5.
   b. Power loss due to turn-off may be discounted if an inverse parallel diode is connected across the thyristor to clip any reverse voltage which may occur following commutation. Note should be taken of the consequent increase in turn-off time (see Fig. 11).



* T_{mb} – scale is for comparison purposes only and is correct only for $R_{th\ mb-a} \leq 6$ °C/W

Fig. 4.



* T_{mb} – scale is for comparison purposes only and is correct only for $R_{th\ mb-a} \leq 2$ °C/W

Fig. 5.

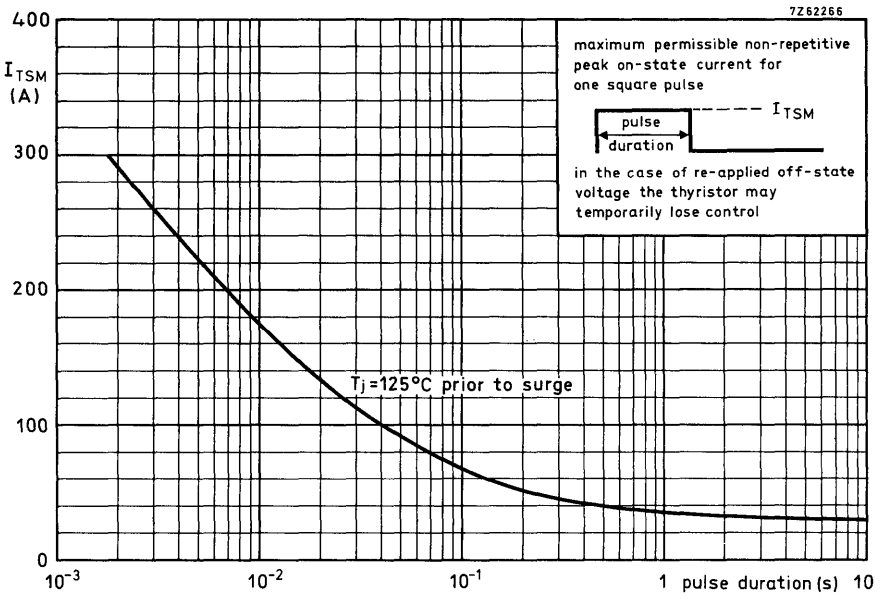


Fig. 6.

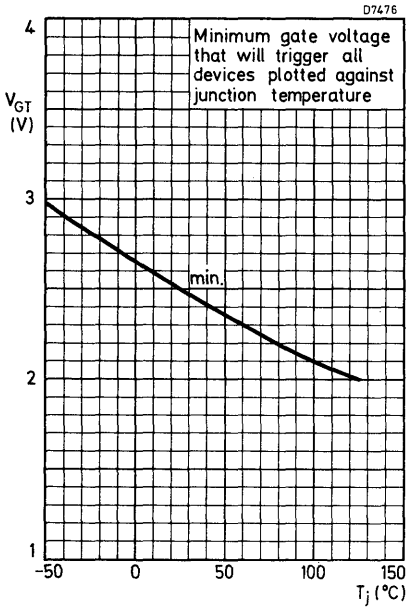


Fig. 7.

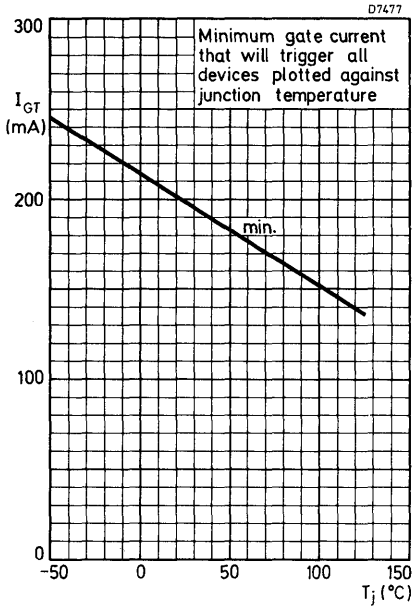


Fig. 8.

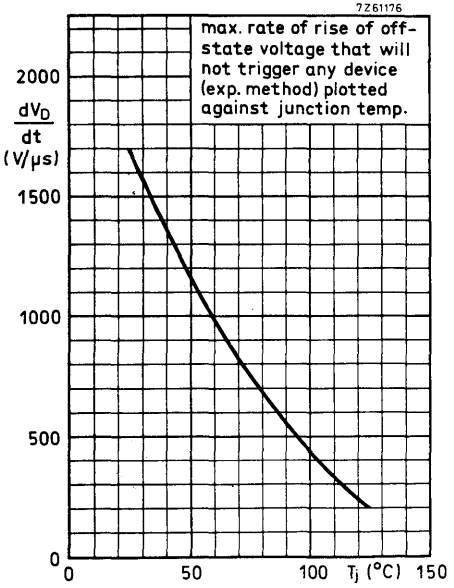


Fig. 9.

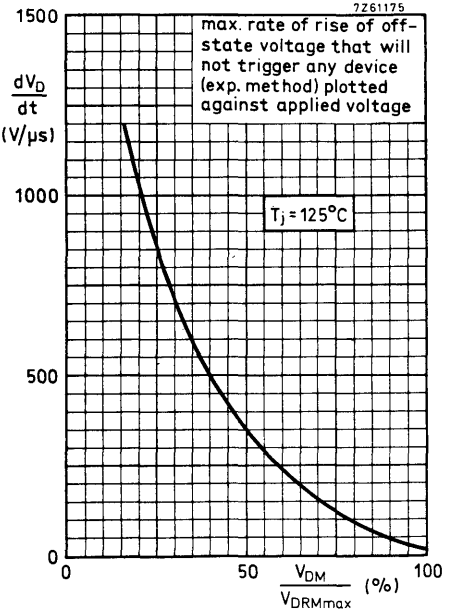


Fig. 10.

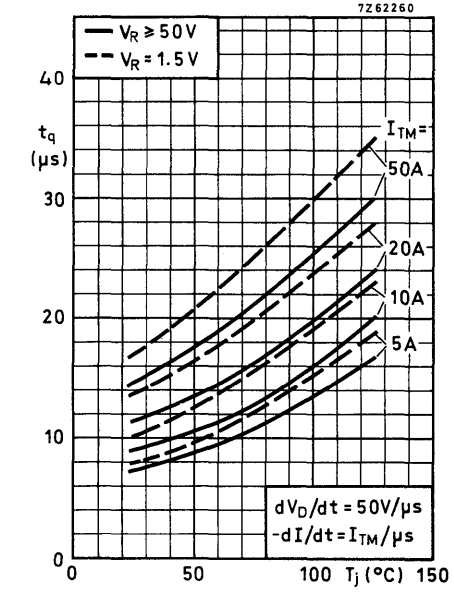


Fig. 11.

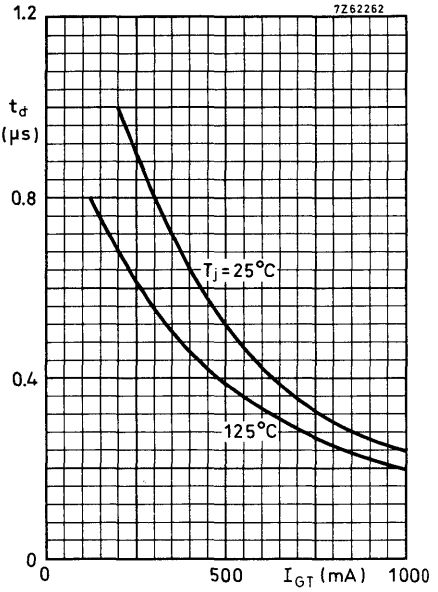


Fig. 12.

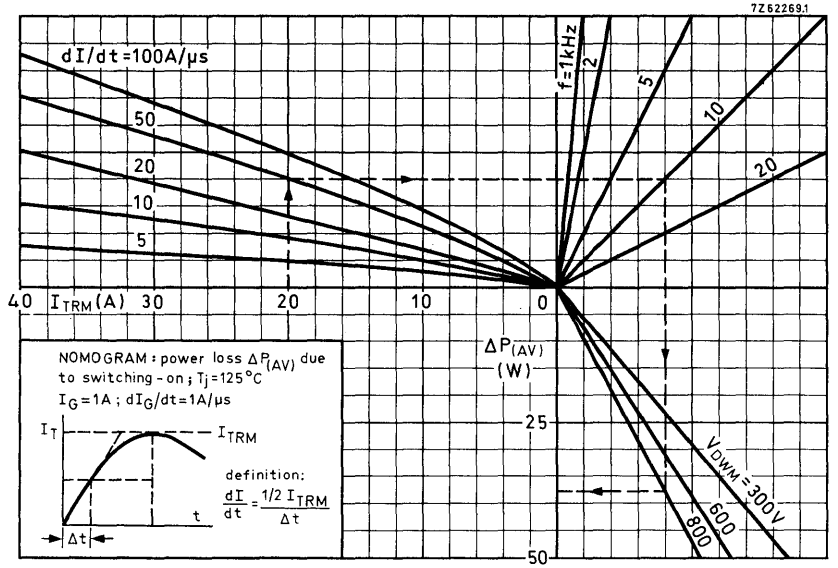

7Z62269.1
dI/dt=100A/μs
50
20
10
5
f=1kHz
2
5
10
20
40 ITRM(A) 30
20
10
0
ΔP(AV) (W)
25
50
VDWM=300V
600
800
NOMOGRAM: power loss ΔP(AV) due to switching-on; Tj=125°C
IG=1A; dIG/dt=1A/μs
IT
ITRM
t
Δt
definition:
dI/dt = 1/2 ITRM / Δt

Fig. 13.

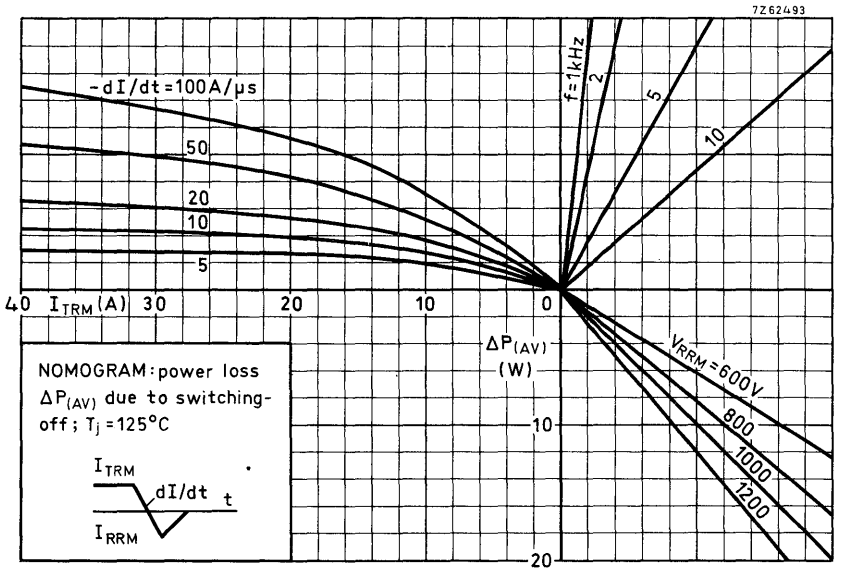

7Z62493
-dI/dt=100A/μs
50
20
10
5
f=1kHz
2
5
10
40 ITRM(A) 30
20
10
0
ΔP(AV) (W)
10
20
VRRM=600V
800
1000
1200
NOMOGRAM: power loss ΔP(AV) due to switching-off; Tj=125°C
ITRM
dI/dt
t
IRRM

Fig. 14.

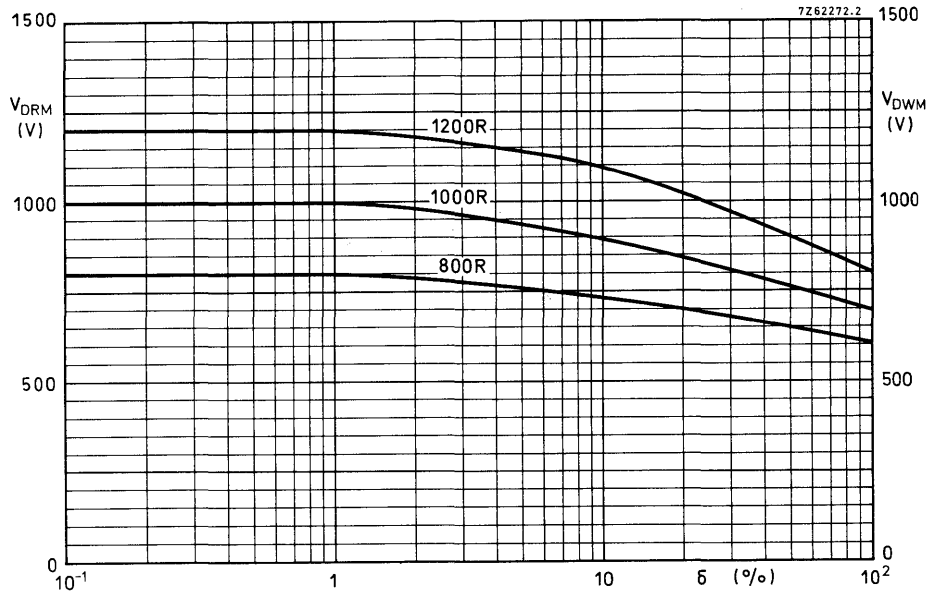

7Z62272.2
1500
V_{DRM} (V)
1000
500
0
1200R
1000R
800R
10^{-1}
1
10
δ (%)
10^2
1500
V_{DWM} (V)
1000
500
0

Fig. 15.

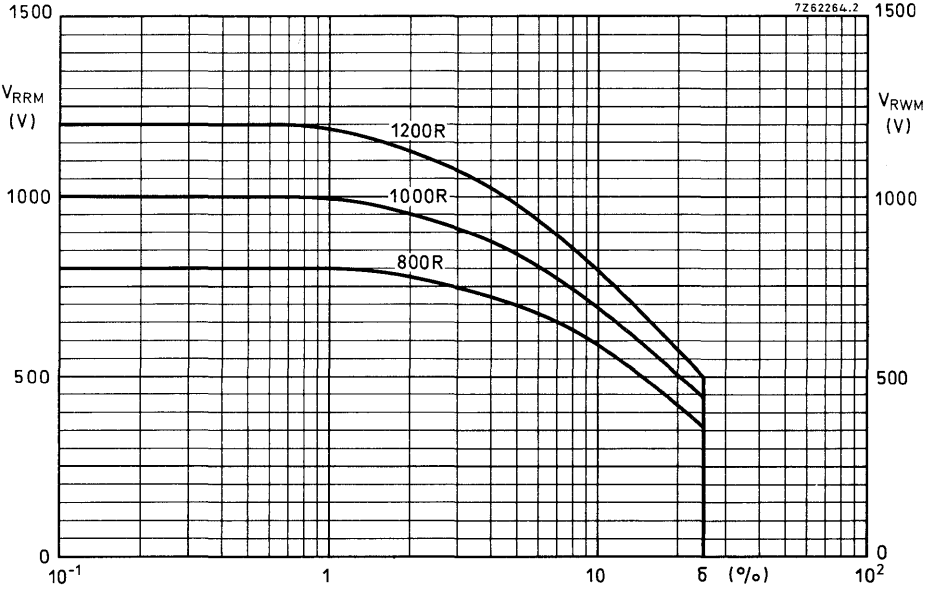

7Z62264.2
1500
V_{RRM} (V)
1000
500
0
1200R
1000R
800R
10^{-1}
1
10
δ (%)
10^2
1500
V_{RWM} (V)
1000
500
0

Fig. 16.

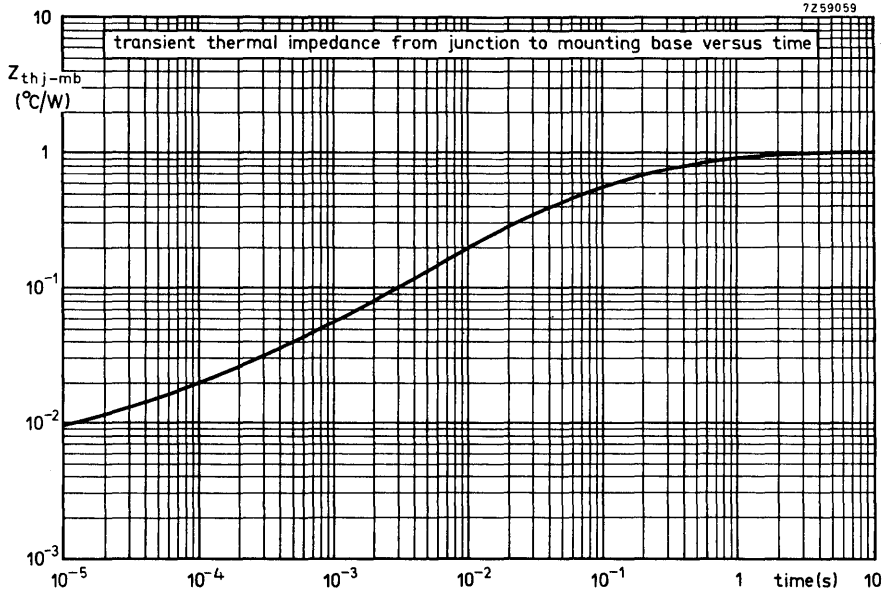

7Z59059
transient thermal impedance from junction to mounting base versus time
Z_{thj-mb} (°C/W)
10
1
10^{-1}
10^{-2}
10^{-3}
10^{-5}
10^{-4}
10^{-3}
10^{-2}
10^{-1}
1
time(s)
10

Fig. 17.