THYRISTORS

Silicon thyristors in metal envelopes, intended for general purpose single-phase or three-phase mains operation.
The series consists of reverse polarity types (anode to stud) identified by a suffix R: BTW23-600R to 1600R.

QUICK REFERENCE DATA

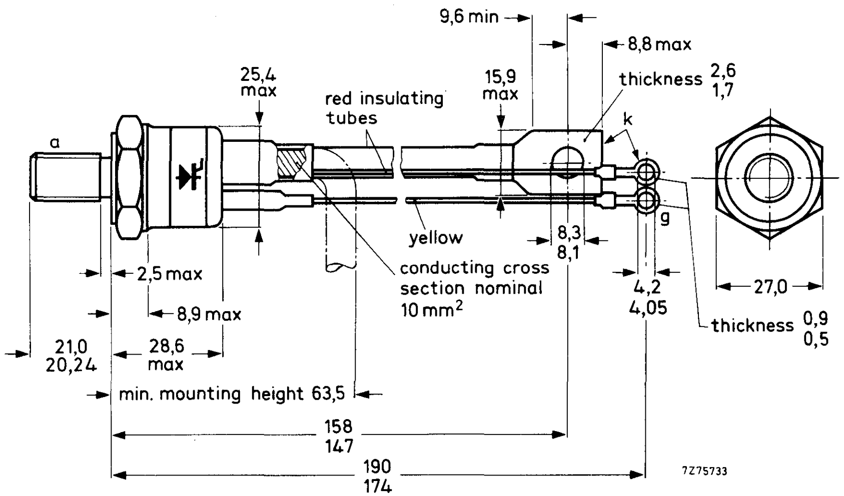
		BTW23-600R	800R	1000R	1200R	1400R	1600R	
Repetitive peak voltages $V_{DRM} = V_{RRM}$	max.	600	800	1000	1200	1400	1600	V

Average on-state current	$I_{T(AV)}$	max.	90	A
R.M.S. on-state current	$I_{T(RMS)}$	max.	140	A
Non-repetitive peak on-state current	I_{TSM}	max.	2000	A
Rate of rise of off-state voltage that will not trigger any device	dV_D/dt	<	200	V/µs
On request (see ordering note on page 4)	dV_D/dt	<	1000	V/µs

MECHANICAL DATA

Dimensions in mm

Fig. 1 TO-94: with metric M12 stud (Ø 12 mm); e.g. BTW23-600R.
Types with ½ in x 20 UNF stud (Ø 12,7 mm) are available on request. These are indicated by the suffix U: e.g. BTW23-600RU.



Net mass: 134 g
Diameter of clearance hole: max. 13,0 mm
Torque on nut: min. 9 Nm (90 kg cm)
max. 17,5 Nm (175 kg cm)

Supplied with device: 1 nut, 1 lock washer
Nut dimensions across the flats;
M12 : 19 mm
½ in x 20 UNF: 19 mm

RATINGS

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

Anode to cathode

			BTW23-600R	800R	1000R	1200R	1400R	1600R	
Non-repetitive peak voltages ($t \leq 10$ ms)	V_{DSM}/V_{RSM}	max.	600	800	1000	1200	1400	1600	V
Repetitive peak voltages	V_{DRM}/V_{RRM}	max.	600	800	1000	1200	1400	1600	V
Crest working voltages	V_{DWM}/V_{RWM}	max.	400	600	700	800	800	800	V*

Average on-state current (averaged over any 20 ms period) up to T_{mb} = 85 °C	$I_{T(AV)}$	max.	90 A
R.M.S. on-state current	$I_{T(RMS)}$	max.	140 A
Repetitive peak on-state current	I_{TRM}	max.	1250 A
Non-repetitive peak on-state current; t = 10 ms; half sine-wave; T_j = 125 °C prior to surge; with reapplied $V_{RWM\,max}$	I_{TSM}	max.	2000 A
I^2t for fusing (t = 10 ms)	I^2t	max.	20 000 A^2s
Rate of rise of on-state current after triggering with I_G = 750 mA to I_T = 300 A; dI_G/dt = 1 A/μs	dI_T/dt	max.	300 A/μs
Rate of change of commutation current	see Fig. 14		

Gate to cathode

Reverse peak voltage	V_{RGM}	max.	10 V
Average power dissipation (averaged over any 20 ms period)	$P_{G(AV)}$	max.	2 W
Peak power dissipation	P_{GM}	max.	10 W

Temperatures

Storage temperature	T_{stg}		−55 to + 125 °C
Junction temperature	T_j	max.	125 °C

THERMAL RESISTANCE

From junction to mounting base	$R_{th\,j\text{-}mb}$	=	0,3 °C/W
From mounting base to heatsink	$R_{th\,mb\text{-}h}$	=	0,1 °C/W
Transient thermal impedance (t = 1 ms)	$Z_{th\,j\text{-}mb}$	=	0,015 °C/W

* To ensure thermal stability: $R_{th\,j\text{-}a} < 0{,}75$ °C/W (d.c. blocking) or $< 1{,}5$ °C/W (a.c.). For smaller heatsinks $T_{j\,max}$ should be derated. For a.c. see Fig. 4.

CHARACTERISTICS

Anode to cathode

On-state voltage I_T = 500 A; T_j = 25 °C	V_T	<	2,2 V*
Rate of rise of off-state voltage that will not trigger any device; exponential method; V_D = 2/3 $V_{DRM\,max}$; T_j = 125 °C	dV_D/dt	<	200 V/μs
Reverse current V_R = $V_{RWM\,max}$; T_j = 125 °C	I_R	<	15 mA
Off-state current V_D = $V_{DWM\,max}$; T_j = 125 °C	I_D	<	15 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 = $V_{DRM\,max}$; T_j = 125 °C	V_{GD}	<	250 mV
Current that will trigger any device V_D = 6 V; T_j = 25 °C	I_{GT}	>	150 mA

Switching characteristics

Gate-controlled turn-on time ($t_{gt} = t_d + t_r$) when switched from V_D = $V_{DWM\,max}$ to I_T = 100 A; I_{GT} = 200 mA; dI_G/dt = 1 A/μs; T_j = 25 °C	t_{gt}	<	2,5 μs
	t_r	typ.	1 μs

* Measured under pulse conditions to avoid excessive dissipation.

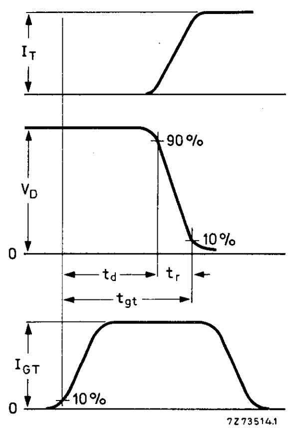


Fig. 2 Gate-controlled turn-on time definitions.

CHARACTERISTICS (continued)

Circuit-commutated turn-off when switched
from I_T = 50 A to $V_R \geqslant$ 50 V with $-dI_T/dt$ = 50 A/μs;
dV_D/dt = 200 V/μs;

T_j = 125 °C	t_q	typ.	100	μs
		<	200	μs
T_j = 25 °C	t_q	typ.	60	μs
		<	120	μs

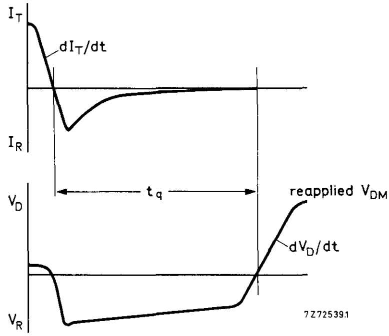


Fig. 3 Circuit-commutated turn-off time definition.

OPERATING NOTE

Switching losses in commutation

For applications in which the thyristor is forced to switch from an on-state current I_{TRM} to a high reverse voltage at a high commutation rate ($-dI_T/dt$), consult Fig. 14 (nomogram) to find the increase in total average power. This increase must be added to the loss from the curves in Fig. 4.

ORDERING NOTE

Types with dV_D/dt of 1000 V/μs are available on request. Add suffix C to the type number when ordering; e.g. BTW23-600RC.

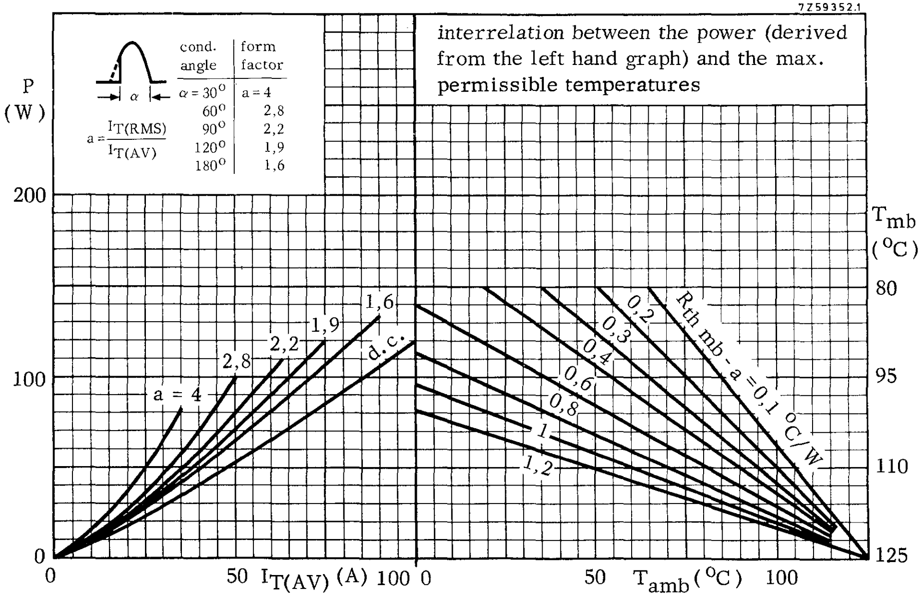

7Z59352.1
interrelation between the power (derived from the left hand graph) and the max. permissible temperatures
P (W)
cond. angle
form factor
α = 30° a = 4
60° 2,8
90° 2,2
120° 1,9
180° 1,6
a = I_T(RMS) / I_T(AV)
a = 4
2,8
2,2
1,9
1,6
d.c.
0
100
200
0
50
I_T(AV) (A)
100
0
50
T_amb (°C)
100
T_mb (°C)
80
95
110
125
R_th mb-a = 0,1 °C/W
0,2
0,3
0,4
0,6
0,8
1
1,2

Fig. 4.

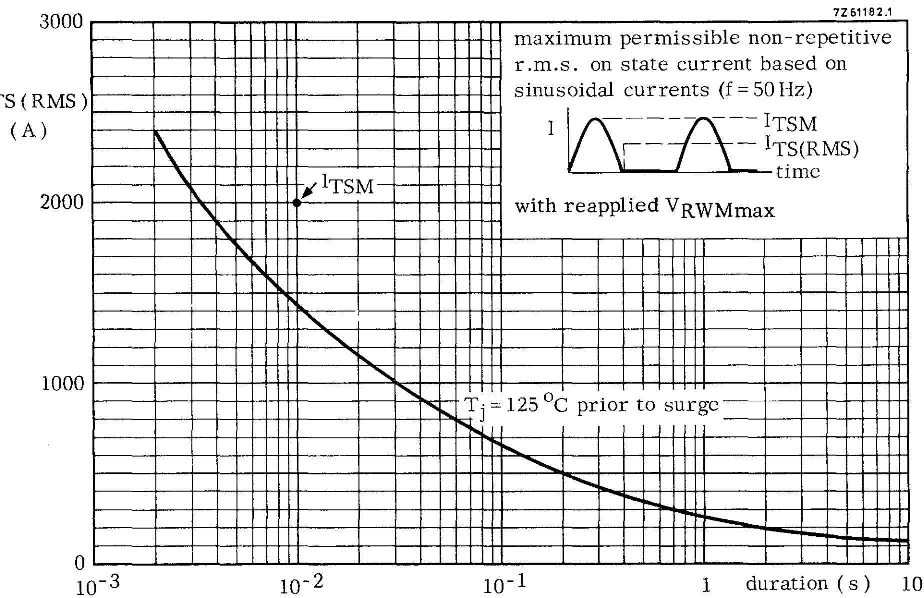

7Z61182.1
maximum permissible non-repetitive r.m.s. on state current based on sinusoidal currents (f = 50 Hz)
I
I_TSM
I_TS(RMS)
time
with reapplied V_RWMmax
I_TSM
T_j = 125 °C prior to surge
TS (RMS) (A)
3000
2000
1000
0
10^-3
10^-2
10^-1
1
duration (s)
10

Fig. 5.

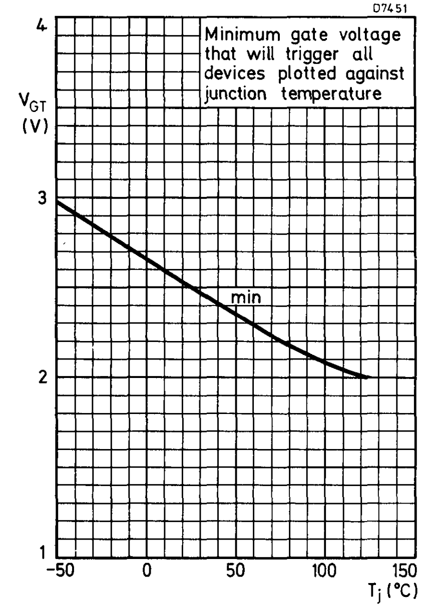


Fig. 6.

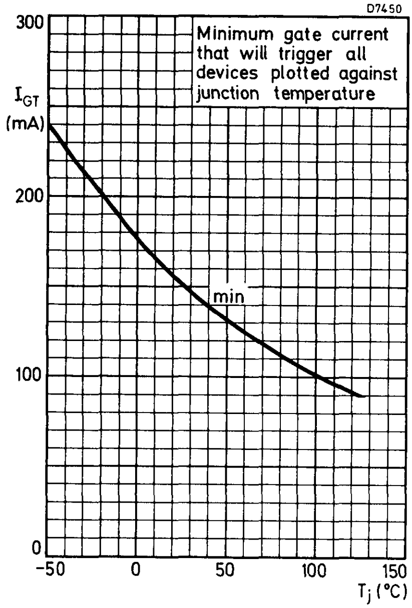


Fig. 7.

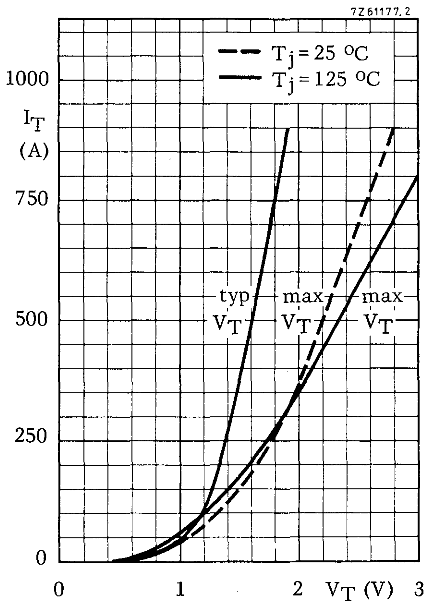


Fig. 8.

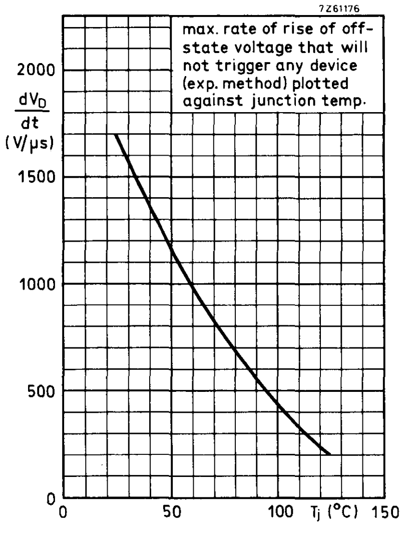


Fig. 9.

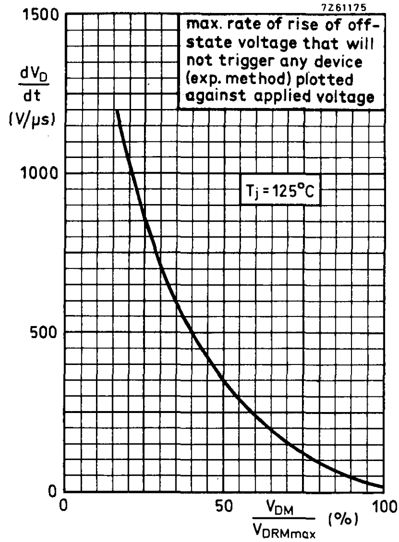


Fig. 10.

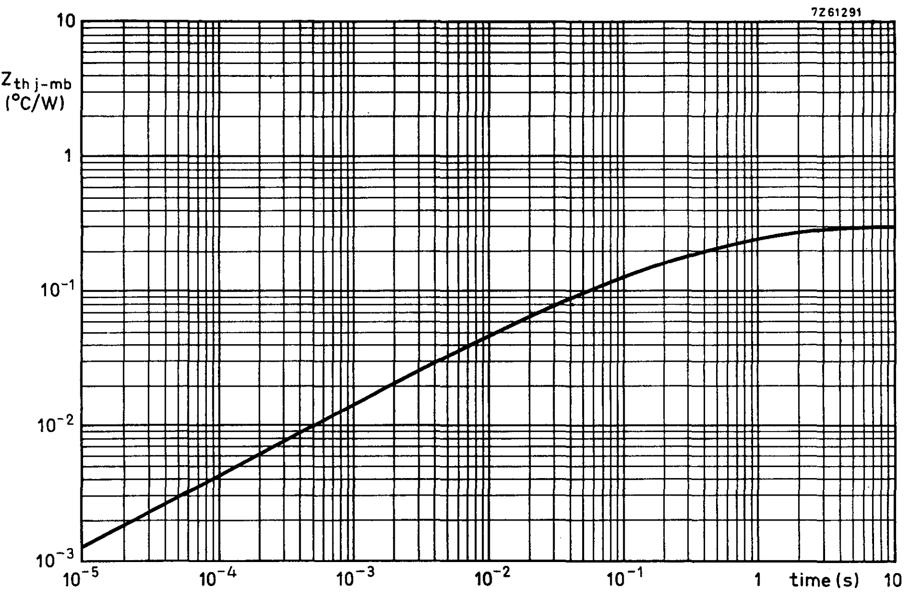
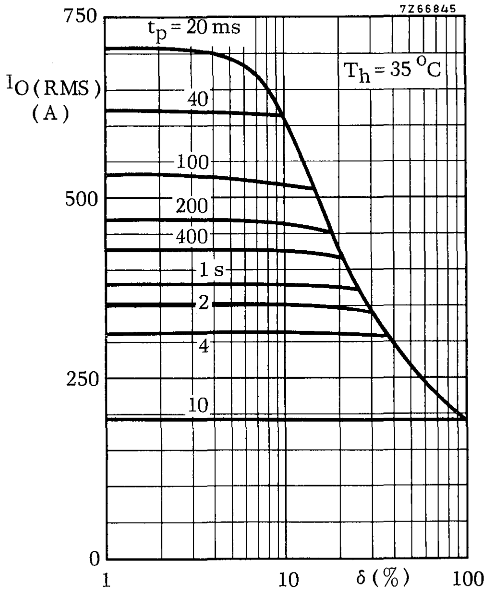
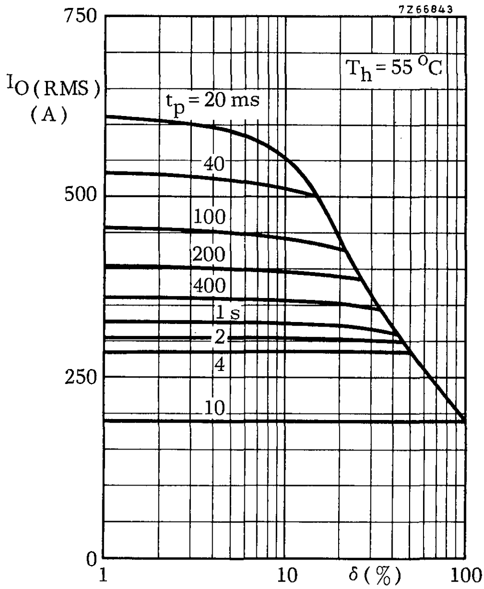
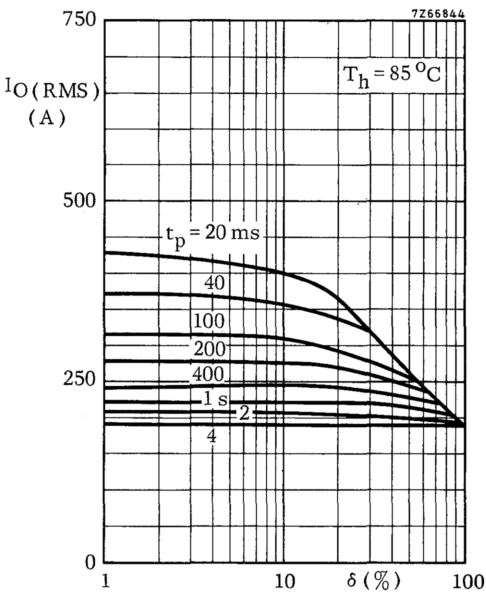
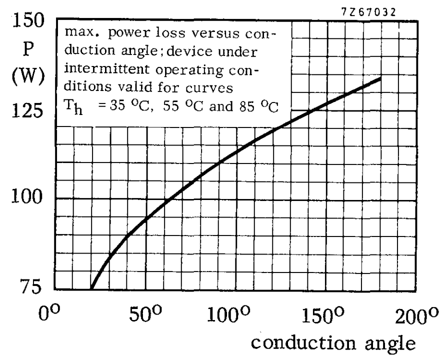


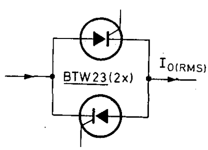
Fig. 11.











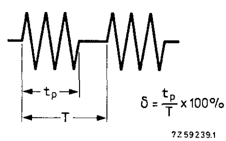


Fig. 12 Intermittent overload capability of two BTW23 thyristors in anti-parallel connection in a single phase a.c. control circuit (e.g. welding); conduction angle 360°.

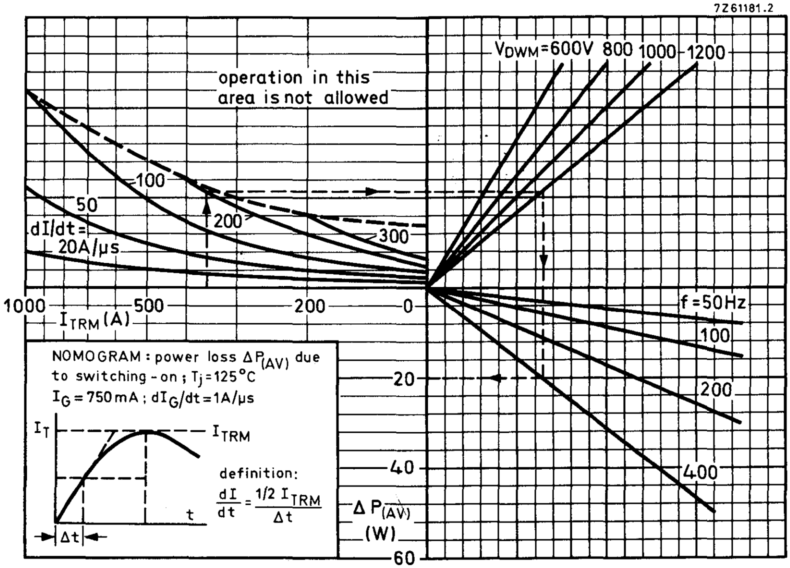

7Z61181.2
VDWM=600V 800 1000 1200
operation in this area is not allowed
100
50
dI/dt= 20A/μs
200
300
1000 500 200 0
ITRM (A)
f=50Hz
100
200
400
20
40
60
Δ P(AV) (W)
NOMOGRAM: power loss ΔP(AV) due to switching-on; Tj=125°C
IG=750 mA; dIG/dt=1A/μs
IT
ITRM
t
Δt
definition:
dI/dt = 1/2 ITRM / Δt

Fig. 13.

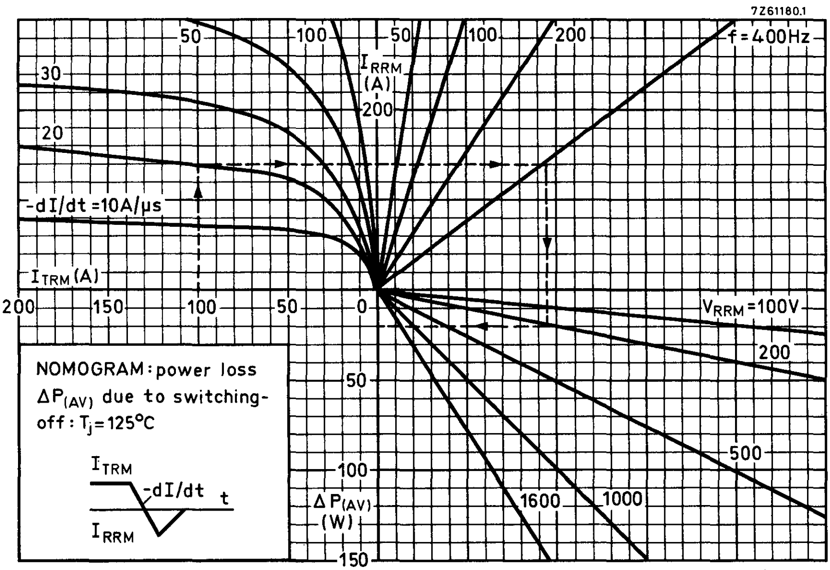
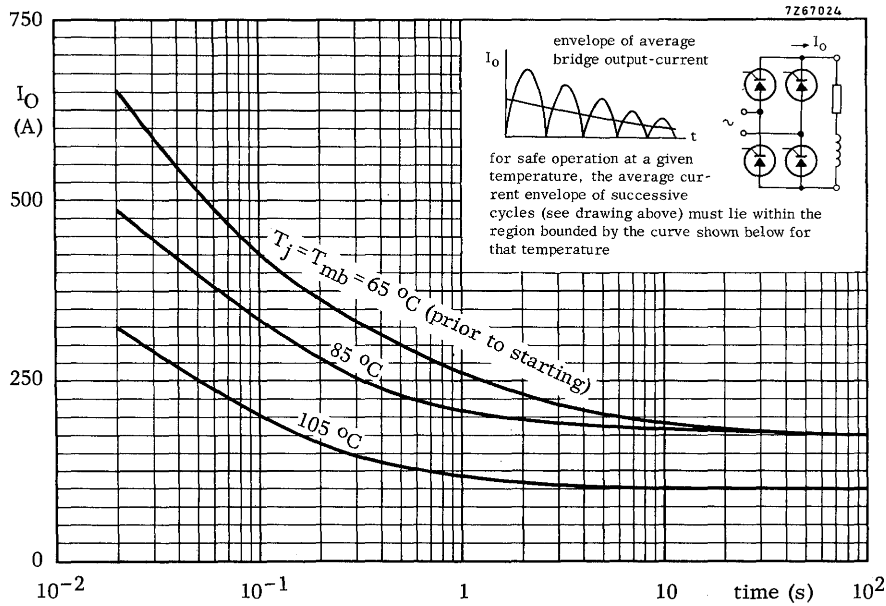

7Z61180.1
50 100 50 100 200 f=400Hz
IRRM (A)
200
30
20
-dI/dt =10A/μs
ITRM (A)
200 150 100 50 0
VRRM=100V
200
500
1600 1000
50
100
150
ΔP(AV) (W)
NOMOGRAM: power loss ΔP(AV) due to switching-off: Tj=125°C
ITRM
-dI/dt
t
IRRM

Fig. 14.



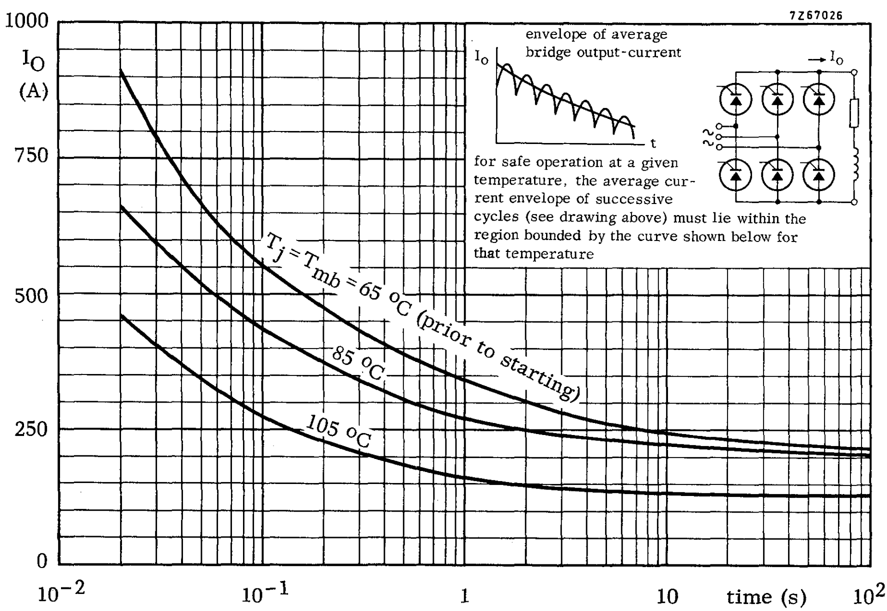


Fig. 15 Limits for starting or inrush currents.