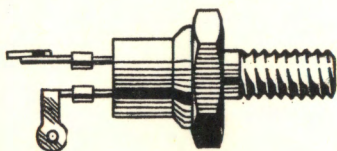
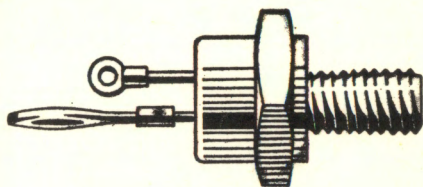


CONTROLLED RECTIFIERS



PHILIPS SEMICONDUCTORS

CONTROLLED RECTIFIERS
 REDRESSEURS COMMANDÉS
 GEREGELTE GLEICHRICHTER

The inclusion of a type number in this list does not necessarily imply its availability
 La figuration d'un numéro de type sur cette liste n'implique pas nécessairement qu'il est livrable
 Das Vorkommen einer Typennummer in dieser Liste bedeutet nicht dass sie tatsächlich lieferbar ist

Type Typ	Page Seite	Date Datum	Type Typ	Page Seite	Date Datum	
BTY79	1,2	5. 5.1963				
	3	5. 5.1963				
	A,B	5. 5.1963				
	C,D	5. 5.1963				
	E,F	5. 5.1963				
	G,H	5. 5.1963				
	I	5. 5.1963				
	BTY84 BTY85 BTY86 BTY87	1,2	5. 5.1963			
		3	5. 5.1963			
A,B		5. 5.1963				
C,D		5. 5.1963				
E,F		5. 5.1963				
G,H		5. 5.1963				
I,J		5. 5.1963				
BTY88 BTY89 BTY90 BTY91		1,2	5. 5.1963			
		3	5. 5.1963			
	A,B	5. 5.1963				
	C,D	5. 5.1963				
	E,F	5. 5.1963				
	G,H	5. 5.1963				
	I,J	5. 5.1963				

n-p-n-p SILICON CONTROLLED RECTIFIER for power control applications

LIMITING VALUES (Absolute max. values)

Anode to cathode

Repetitive peak inverse voltage	$-V_{DM}$	= max. 150 V
Transient peak inverse voltage (non repetitive; $t < 5$ msec)	$-V_{DM}$ (t)	= max. 225 V = max. 5 msec)
Forward blocking voltage	V_D	= max. 150 V
Repetitive peak forward blocking voltage	V_{DM}	= max. 480 V ¹⁾
Average forward current (aver- aging time max. 20 msec)	I_D (t_{av})	= max. 4.7 A ²⁾ = max. 20 msec)
Repetitive peak forward current	I_{DM}	= max. 20 A
Sinusoidal peak forward surge current ($t < 10$ msec)	I_{Dsurge}	= max. 60 A
Repetitive peak reverse current during turn-off	$-I_{Dsurge}$	= max. 5 A

Gate to cathode

Peak power	P_{GM}	= max. 5 W
Average power (averaging time max. 20 msec)	P_G (t_{av})	= max. 0.5 W = max. 20 msec)
Peak forward voltage	V_{GM}	= max. 10 V ³⁾
Peak inverse voltage	$-V_{GM}$	= max. 5 V
Peak current	I_{GM}	= max. 2 A

Temperatures

Junction temperature	T_j	= -55°C to +125°C
Storage temperature	T_s	= -55°C to +125°C

- 1) This voltage may be applied without damage but the controlled rectifier may fire at any voltage over the minimum forward breakover voltage
- 2) At a temperature of the base of the device of 60 °C in single-phase, half-wave circuits with a resistive load and 180° conduction angle. For other conditions see page H.
- 3) A positive voltage greater than 250 μ V must not be applied to the gate when the anode is negative with respect to the cathode

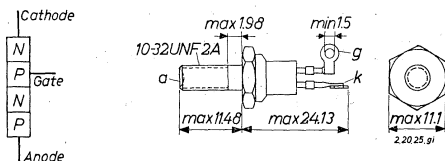
THERMAL DATA

Thermal resistance from junction
to free air (without heat sink) $K_{j-amb} = \text{max. } 70 \text{ } ^\circ\text{C/W}$
to base of the device $K_{j-m} = \text{max. } 3.1 \text{ } ^\circ\text{C/W}$
Contact thermal resistance for a
min. torque of 8 cm kg $K_{m-h} = \text{max. } 0.75 \text{ } ^\circ\text{C/W}$

The figures above are intended as calculating figures

To ensure that no device will thermally run away at full ratings, the thermal resistance between the base of the device and ambience must be $< 18 \text{ } ^\circ\text{C/W}$

Dimensions in mm



The controlled rectifier is supplied with nut, metal washer and metal lock washer

Min. torque on nut for good thermal contact 8 cm kg
Max. torque on nut 17 cm kg

Net weight 7.6 g

OPERATING NOTES

1. Controlled rectifiers may be soldered directly into the circuit, but the heat conducted to the junction should be kept to a minimum by the use of a thermal shunt.
2. The connecting lugs should not be bent or twisted
3. Care must be taken to ensure good thermal contact between the controlled rectifier and the heat sink. The controlled rectifier should be bolted down on a plane surface

CHARACTERISTICS at $T_j = 125\text{ }^\circ\text{C}$ unless otherwise specified

Anode to cathode

Forward breakover voltage	$V_D \text{ b.o.}$	$> 150\text{ V}^1)$
Forward voltage drop	V_D	$(I_D = 20\text{ A}; T_j = 25\text{ }^\circ\text{C})$
		$< 2.3\text{ V}^2)$
Forward leakage current	I_D	$(V_D = 150\text{ V})$
		$< 8.0\text{ mA}$
Reverse leakage current	$-I_D$	$(-V_D = 150\text{ V})$
		$< 8.0\text{ mA}$
Holding current (typical value)	I_{DH}	$= 15\text{ mA}$

Gate to cathode

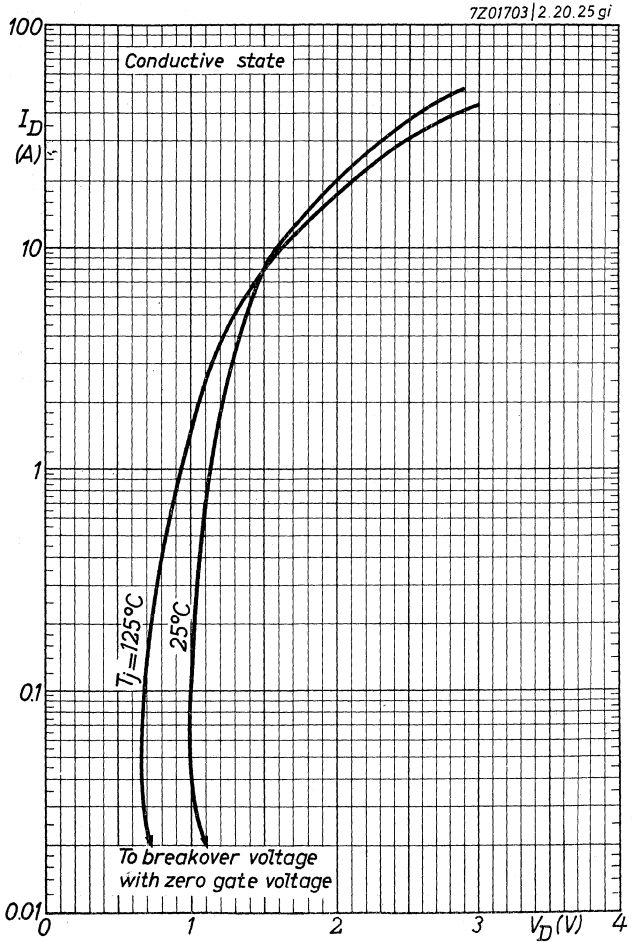
Voltage to fire all units	V_G	$(T_j = 25\text{ }^\circ\text{C})$
		$> 2.0\text{ V}$
Voltage not to fire any unit	V_G	
		$< 0.25\text{ V}$
Current to fire all units	I_G	$(T_j = 25\text{ }^\circ\text{C})$
		$> 25\text{ mA}$

Switching characteristics (See also pages F and G)

Turn-on time ($t_d + t_r$)	t_{on}	$(I_D = 10\text{ A}; I_G = 30\text{ mA})$
		$= 5.0\text{ } \mu\text{sec}$
Turn-off time	t_{off}	$(I_D = 10\text{ A}; -I_D = 4\text{ A})$
		$= 15\text{ } \mu\text{sec}$
		$< 25\text{ } \mu\text{sec}$
Recovered charge from 10 A forward current	Q_{rec}	$= 5\text{ } \mu\text{C}$

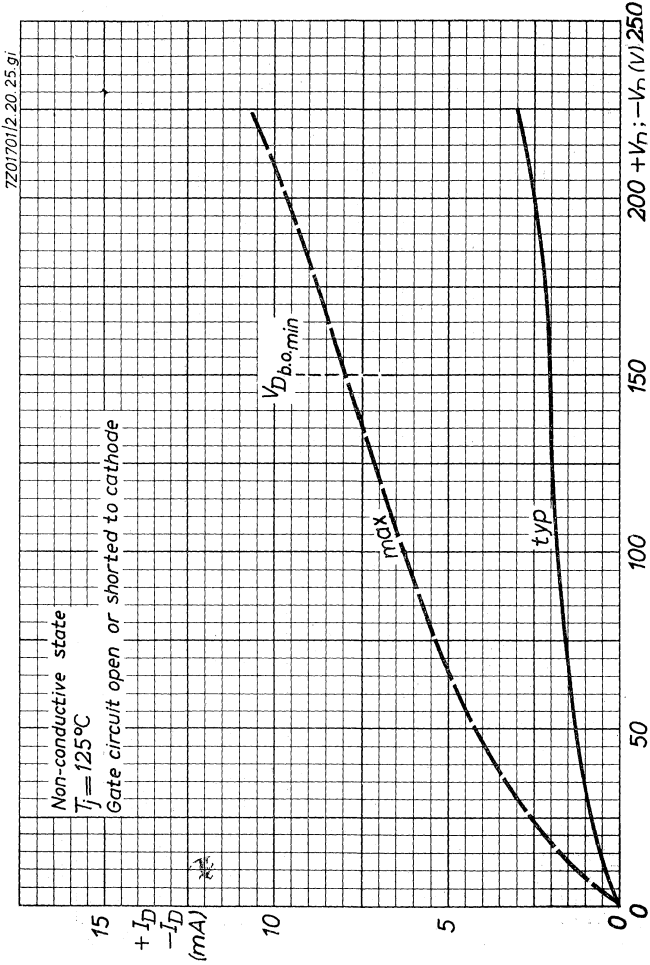
¹⁾ This voltage may be exceeded up to the maximum allowable peak repetitive forward voltage without damage but the controlled rectifier may fire at any voltage over the minimum forward breakover voltage

²⁾ Measured with current pulses to prevent excessive dissipation

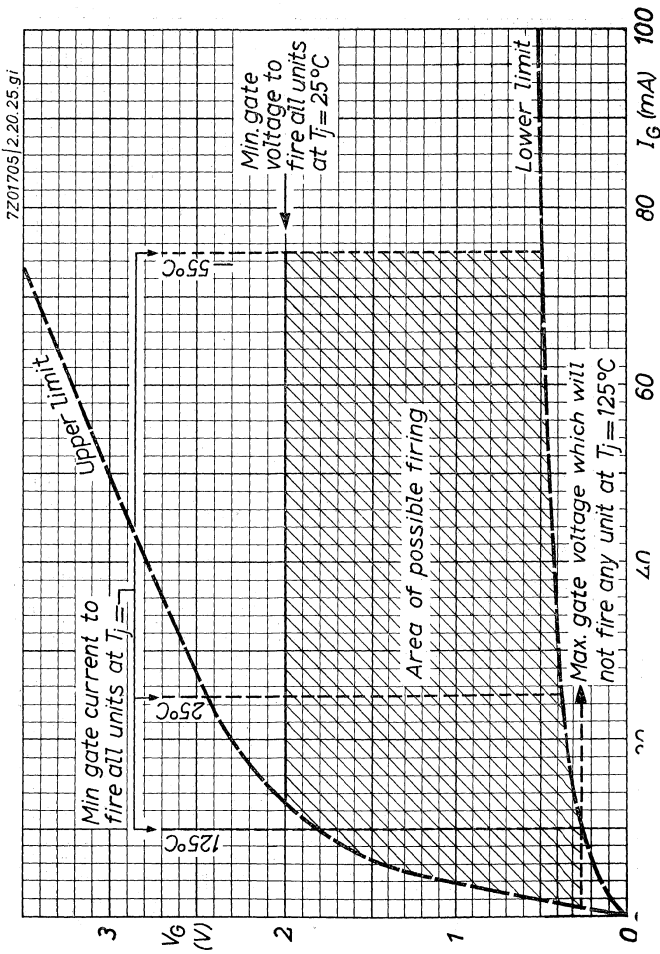


BTY79

PHILIPS



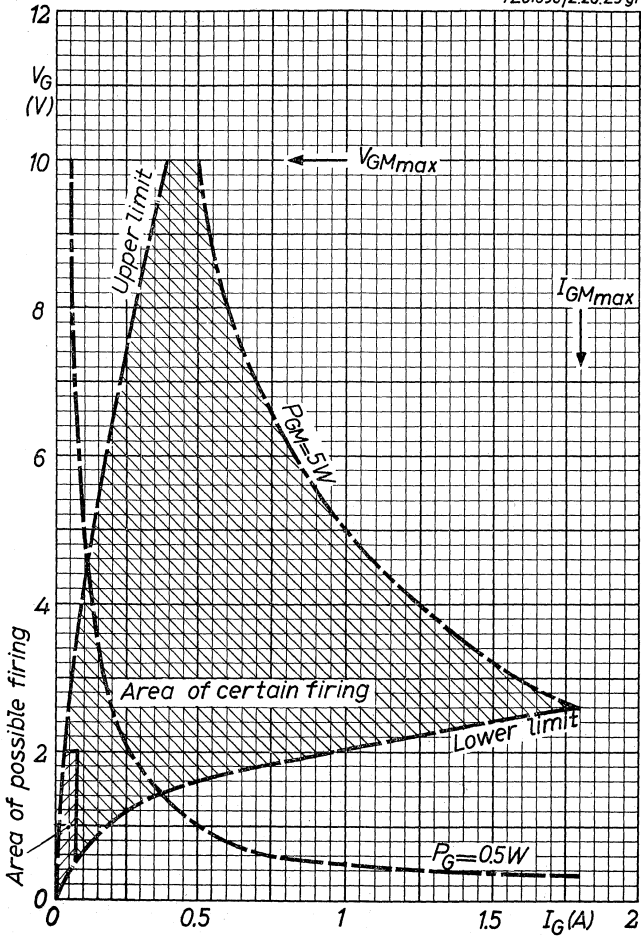
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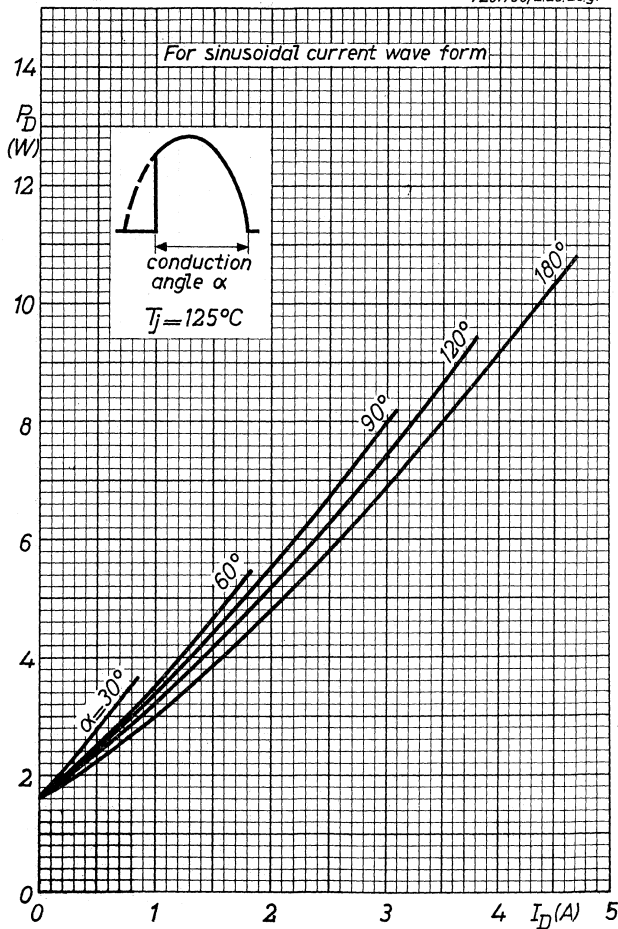
BTY79

PHILIPS

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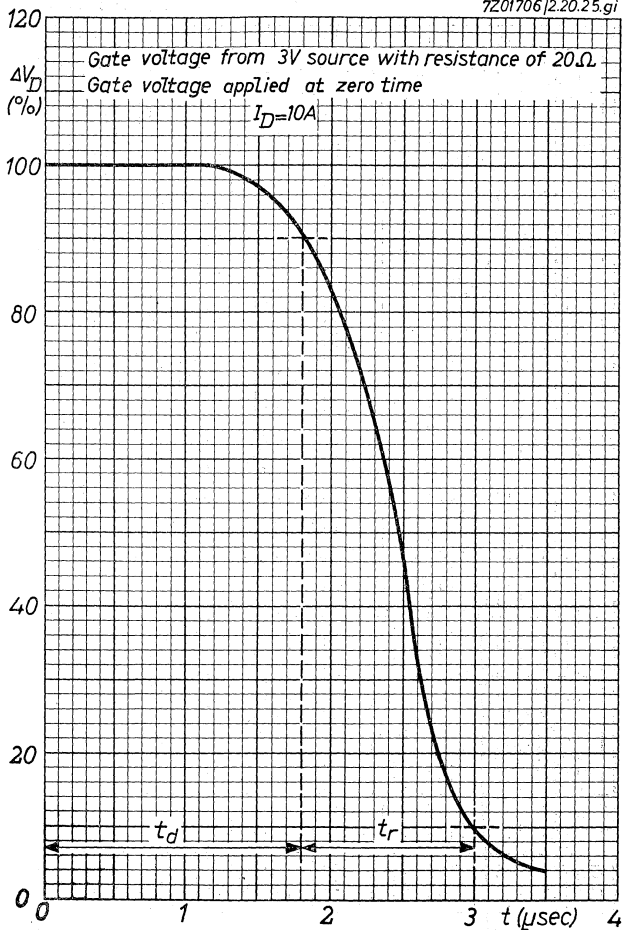


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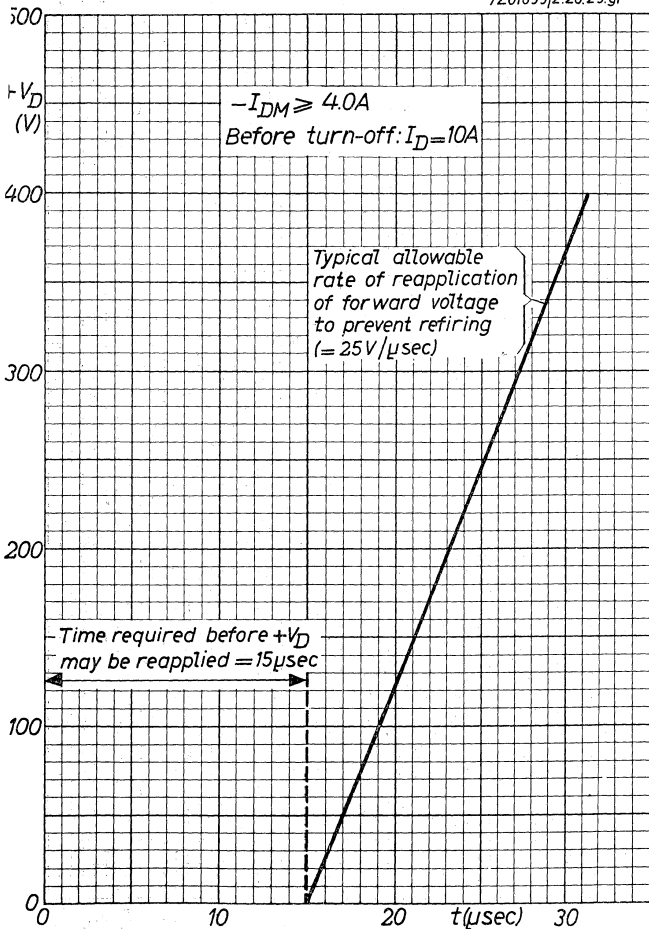
BTY79**PHILIPS**

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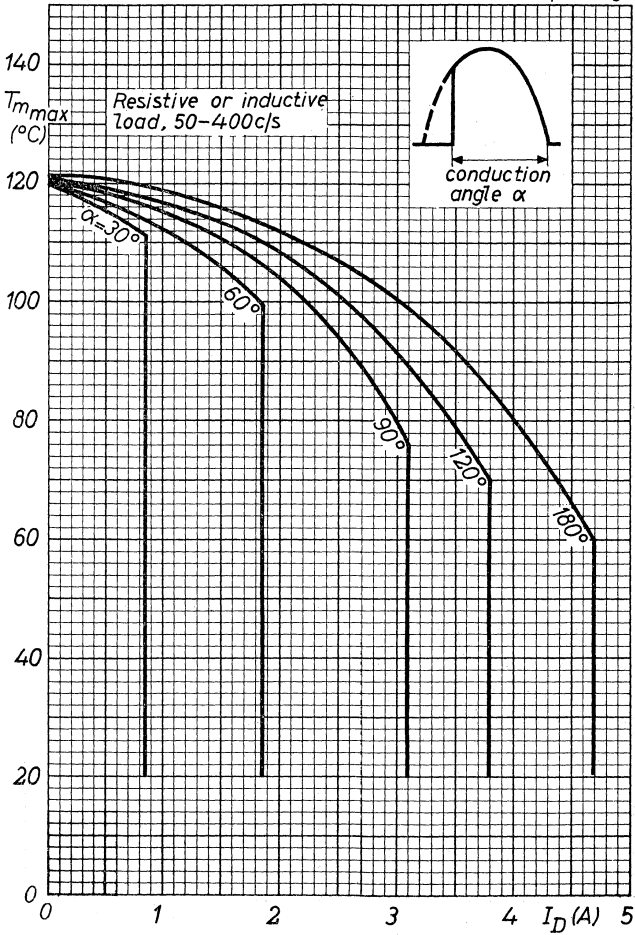
F

7Z01699|2.20.25.gi



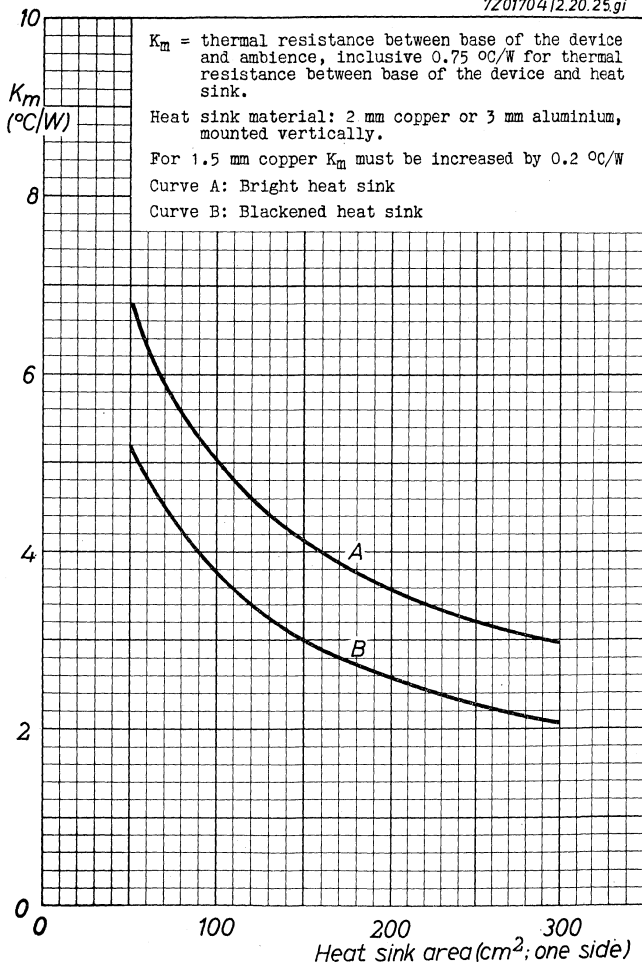
BTY79**PHILIPS**

7Z01702/2.20.25.gi



H

7Z01704|2.20.25.gi



n-p-n-p SILICON CONTROLLED RECTIFIERS for power control and power switching applications

LIMITING VALUES (Absolute max. values)

<u>Anode to cathode</u>		BTY84	BTY85	BTY86	BTY87
Peak inverse voltage	$-V_{DM} = \text{max.}$	100 V	200 V	300 V	400 V ¹⁾
Transient peak inverse voltage (non-repetitive; $t < 5 \text{ msec}$)	$-V_{DM} = \text{max.}$	150 V	300 V	400 V	500 V ¹⁾
Forward blocking voltage	$V_D = \text{max.}$	100 V	200 V	300 V	400 V
Input voltage	$V_i = \text{max.}$	70 V	140 V	210 V	280 V_{RMS}
Repetitive peak forward blocking voltage	$V_{DM} = \text{max.}$	500			V ²⁾
Average forward current	$I_D = \text{max.}$		10		A
One cycle current peak	$I_{Dsurge} = \text{max.}$		120		A
Repetitive peak reverse current during turn-off	$-I_{DM} = \text{max.}$		20		A
<u>Gate to cathode</u>					
Peak power	$P_{GM} = \text{max.}$		5		W
Average power	$P_G = \text{max.}$		0.5		W
Peak forward voltage	$V_{GM} = \text{max.}$		10		V
Peak inverse voltage	$-V_{GM} = \text{max.}$		5		V
Peak current	$I_{GM} = \text{max.}$		2		A
Over current capability for fusing ($t < 10 \text{ msec}$)	$I_G^2 t = \text{max.}$		40		A ² sec
<u>Temperatures</u>					
Operating temperature	T =		-40 °C to +100 °C		
Storage temperature	T _s =		-40 °C to +125 °C		

¹⁾ These limiting values apply for zero or negative gate voltage only and for a total thermal resistance of max. 11 °C/W

²⁾ This voltage may be applied without damage, but the controlled rectifier may fire at any voltage over the minimum forward breaker voltage

BTY84
→ **87**

PHILIPS

THERMAL DATA

Thermal resistance from junction

to base of the device

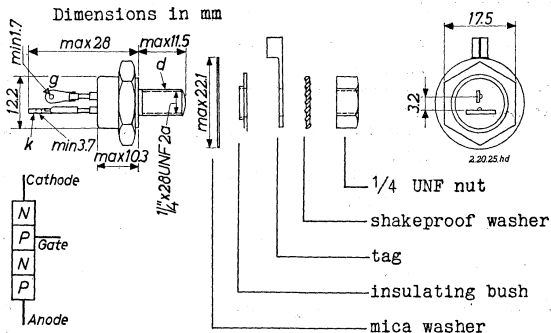
$$K_{j-m} = \text{max. } 2.3 \text{ } ^\circ\text{C/W } ^1)$$

to infinite heat sink, mounted
without insulating bush and
mica washer

$$K_{j-h} = \text{max. } 2.5 \text{ } ^\circ\text{C/W}$$

to infinite heat sink, mounted
with insulating bush and mica
washer

$$K_{j-h} = \text{max. } 3.5 \text{ } ^\circ\text{C/W}$$



Diameter of hole in heat sink

max. 8.5 mm

Min. torque on nut for good thermal contact

17 cm kg

Max. torque on nut

34 cm kg

¹⁾ This value is intended as a calculating figure

CHARACTERISTICS at $T_j = 100\text{ }^\circ\text{C}$

Reverse and forward leakage currents (full cycle average) ¹⁾

$I_D, -I_D$ ($V_{DM}, -V_{DM} = 100\text{ V}$)	< 12.5 mA for the BTY84
$I_D, -I_D$ ($V_{DM}, -V_{DM} = 200\text{ V}$)	< 6 mA for the BTY85
$I_D, -I_D$ ($V_{DM}, -V_{DM} = 300\text{ V}$)	< 5 mA for the BTY86
$I_D, -I_D$ ($V_{DM}, -V_{DM} = 400\text{ V}$)	< 4 mA for the BTY87

Forward voltage (full cycle average)

V_D ($I_D = 16\text{ A}$; conduction angle = 180°)	< 1.25 V
--	----------

Holding current (typical value)

I_{DH}	= 20 mA
----------	---------

Gate voltage

to fire all units	V_G	> 3.5 V
not to fire any unit	V_G	< 0.3 V

Gate current

to fire all units	I_G	> 50 mA
to fire at $V_G = 1.5\text{ V}$ (typical value)	I_G	= 10 mA

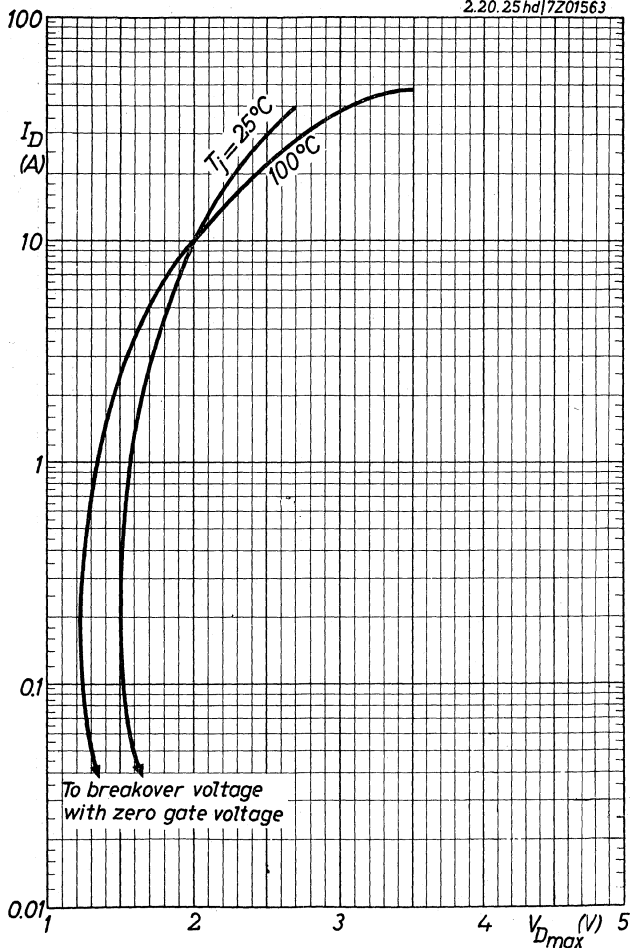
Switching characteristics (See also pages F and G)

The values are dependent upon the circuit

Turn-on time	t_{on}	= 1.0 to 4.5 μsec
Delay time	t_d	= 0.5 to 1.5 μsec
Rise time	t_r	= 0.5 to 3.0 μsec
Turn-off time	t_{off}	= 10 to 20 μsec

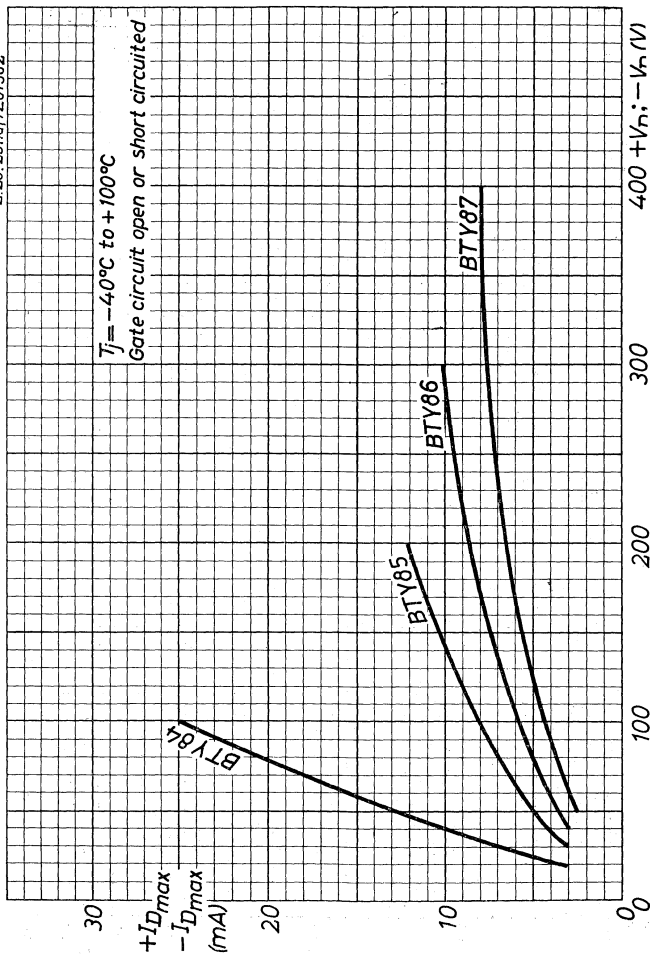
¹⁾ The peak inverse voltages should be applied at zero or negative gate voltage only and with a total thermal resistance of max. 11 $^\circ\text{C/W}$

2.20.25hd/7Z01563

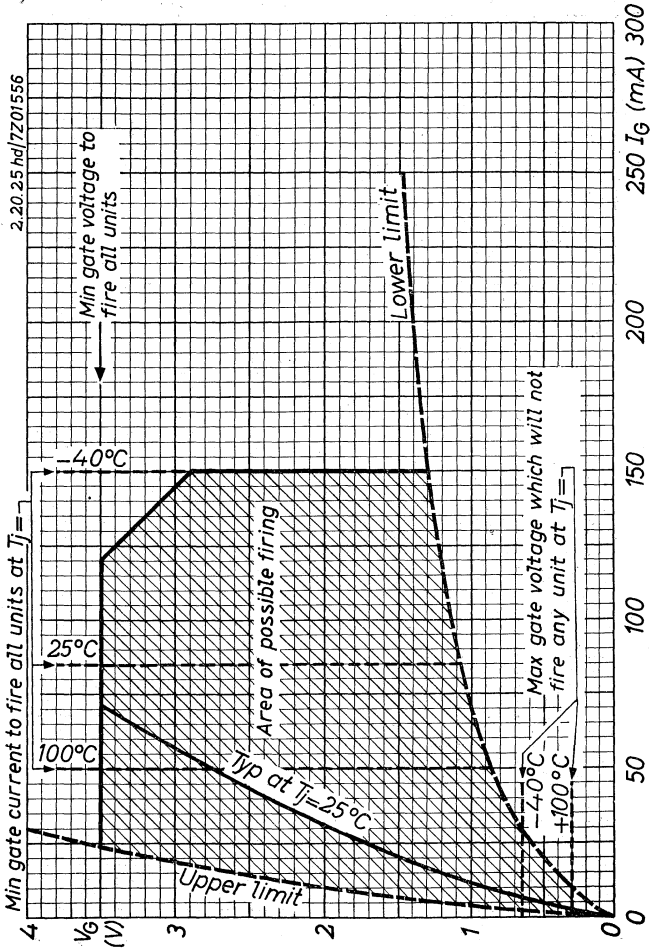


BTY84→ **87****PHILIPS**

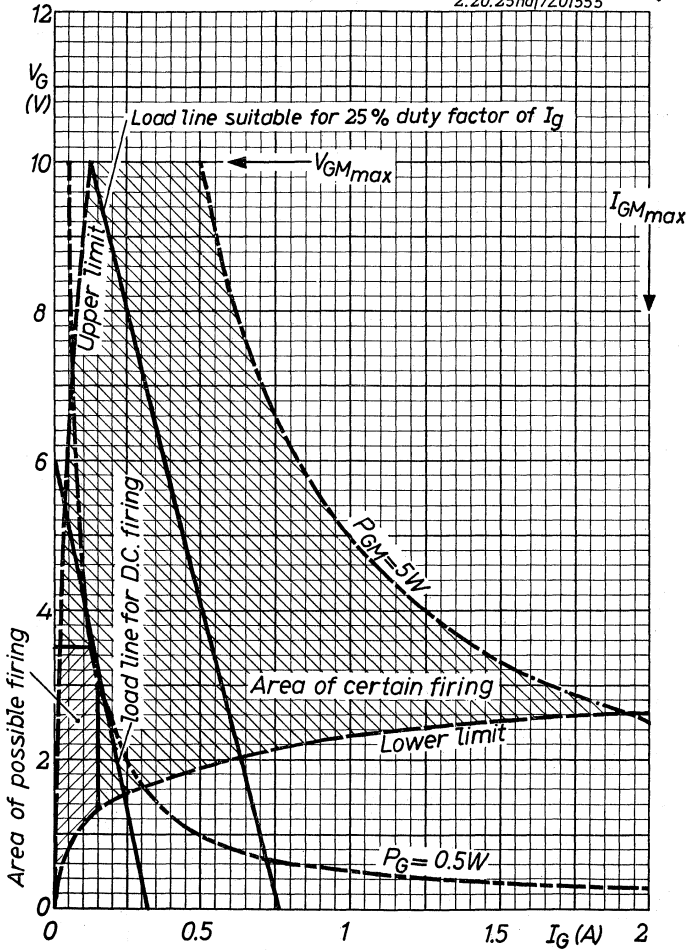
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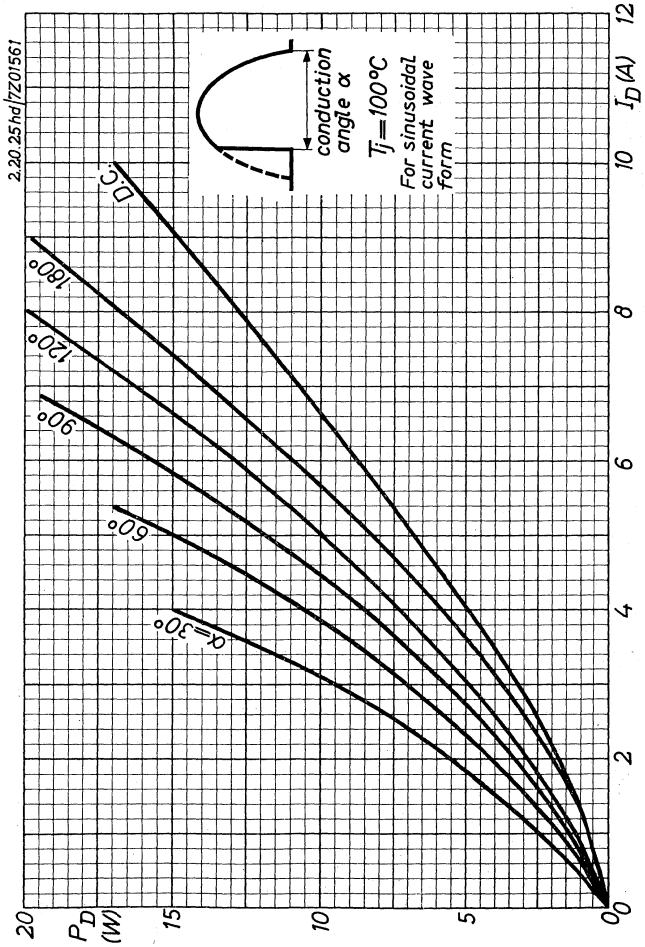


B



2.20.25hd/7Z01555

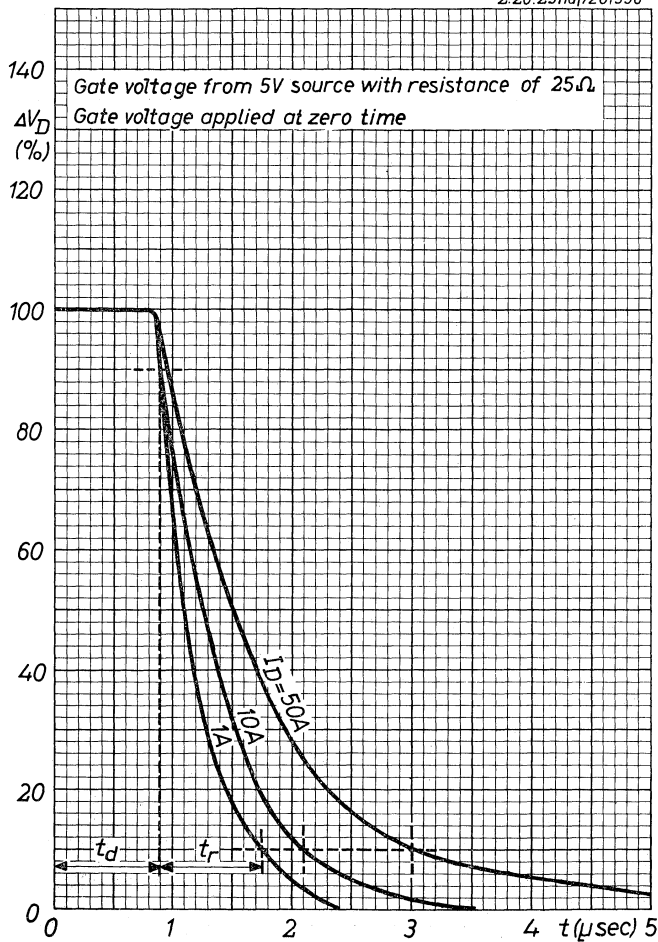




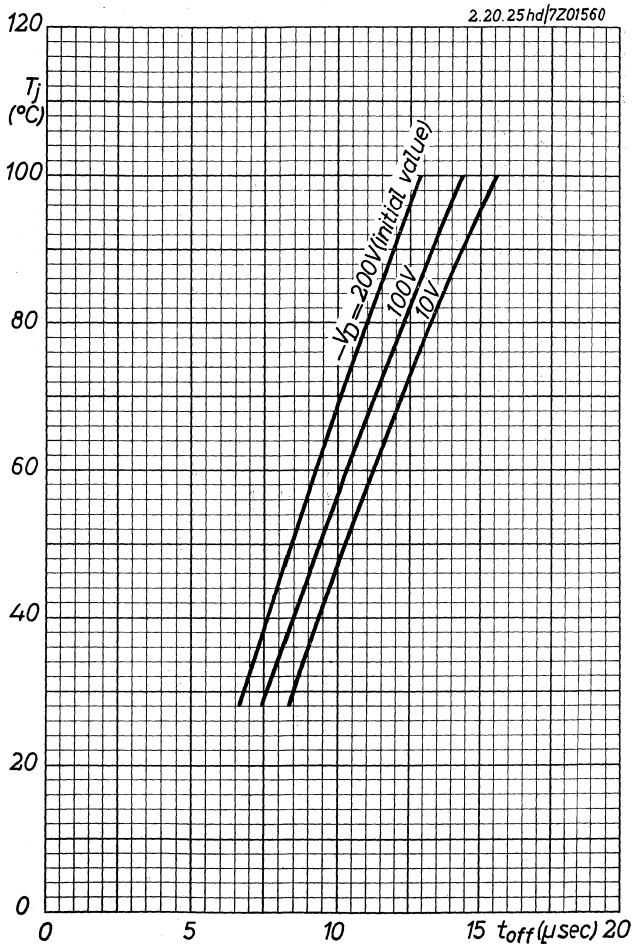
BTY84
→ 87

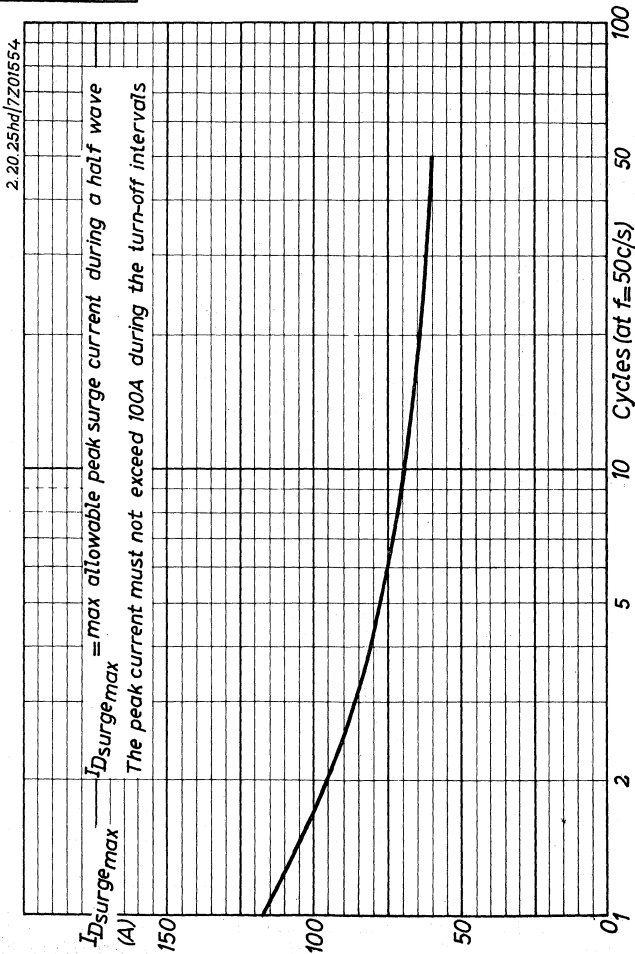
PHILIPS

2.20.25hd/7201558



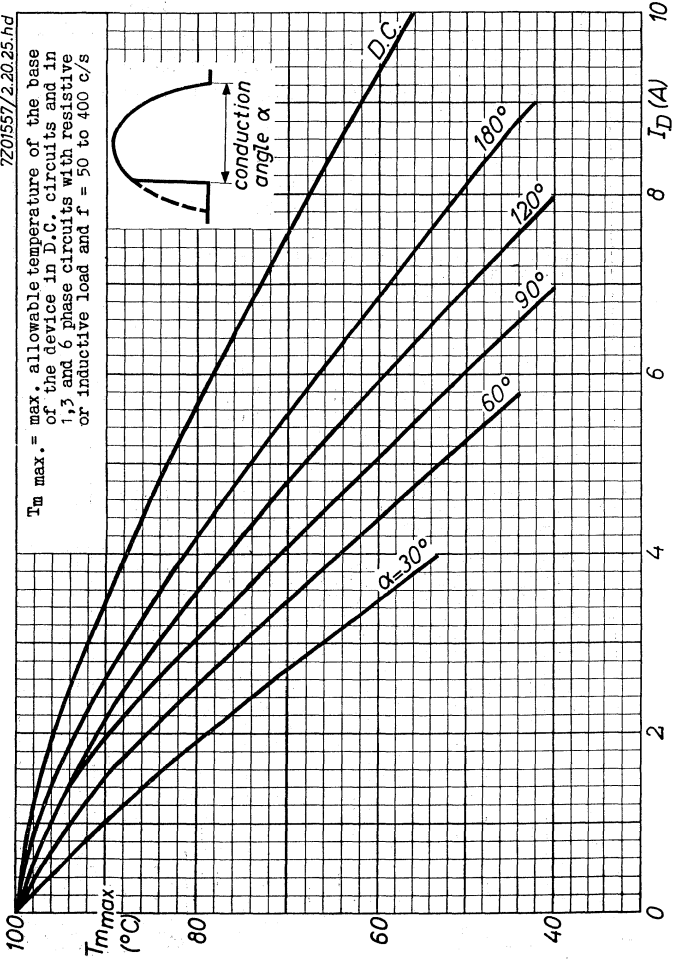
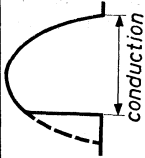
F





7201557/2.20.25.hd

T_m max. = max. allowable temperature of the base of the device in D.C. circuits and in 1,3 and 6 phase circuits with resistive or inductive load and $f = 50$ to 400 c/s



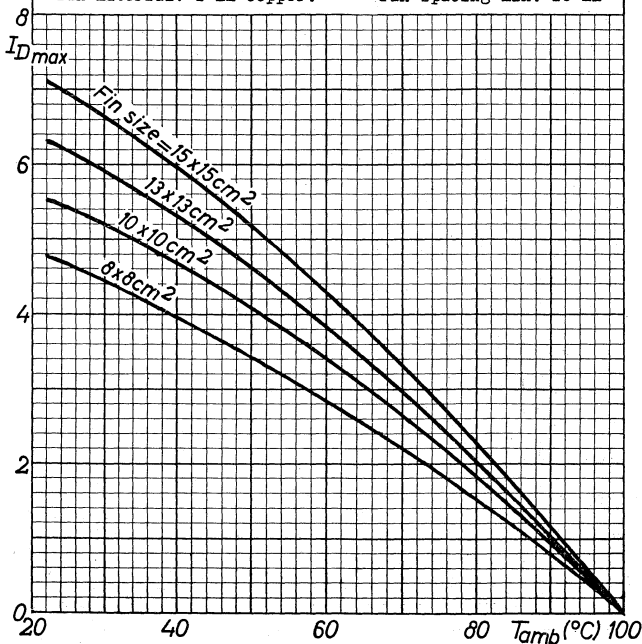
I_{Dmax} = max. allowable average current in circuits with resistive or inductive load, frequency = 50 to 400 c/s and conduction angle of 180 °C

For other conduction angles I_{Dmax} should be multiplied by the following factors:

- D.C. : 1.4
- $\alpha=120^\circ$: 0.91
- 90° : 0.82
- 60° : 0.72
- 30° : 0.58

The device is mounted directly on the fin with free convection cooling

Fin material: 2 mm copper. Fin spacing min. 20 mm



n-p-n-p SILICON CONTROLLED RECTIFIERS for power control and power switching applications

LIMITING VALUES (Absolute max. values)

		BTY88	BTY89	BTY90	BTY91
<u>Anode to cathode</u>					
Peak inverse voltage	$-V_{DM} = \text{max.}$	100 V	200 V	300 V	400 V ¹⁾
Transient peak inverse voltage (non-repetitive; $t < 5$ msec)	$-V_{DM} = \text{max.}$	150 V	300 V	400 V	500 V ¹⁾
Forward blocking voltage	$V_D = \text{max.}$	100 V	200 V	300 V	400 V ²⁾
Input voltage	$V_1 = \text{max.}$	70 V	140 V	210 V	280 V _{RMS}
Repetitive peak forward blocking voltage	$V_{DM} = \text{max.}$	500			V ³⁾
Average forward current	$I_D = \text{max.}$	16			A
One cycle current peak	$I_{D\text{surge}} = \text{max.}$	140			A
Repetitive peak reverse current during turn-off	$-I_{DM} = \text{max.}$	20			A
<u>Gate to cathode</u>					
Peak power	$P_{GM} = \text{max.}$	5			W
Average power	$P_G = \text{max.}$	0.5			W
Peak forward voltage	$V_{GM} = \text{max.}$	10			V
Peak inverse voltage	$-V_{GM} = \text{max.}$	5			V
Peak current	$I_{GM} = \text{max.}$	2			A
Over current capability for fusing ($t < 10$ msec)	$I_G^2 t = \text{max.}$	75			A ² sec
<u>Temperatures</u>					
Operating temperature	T =	-55 °C to +125 °C			
Storage temperature	T _s =	-55 °C to +150 °C			

- 1) These limiting values apply for zero or negative gate voltage only and for a total thermal resistance of max. 11°C/W
- 2) The rate of application of forward voltage must be limited to approximately 10 V/μsec in order to avoid self firing
- 3) This voltage may be applied without damage, but the controlled rectifier may fire at any voltage over the minimum forward breakover voltage

THERMAL DATA

Thermal resistance from junction
to base of the device

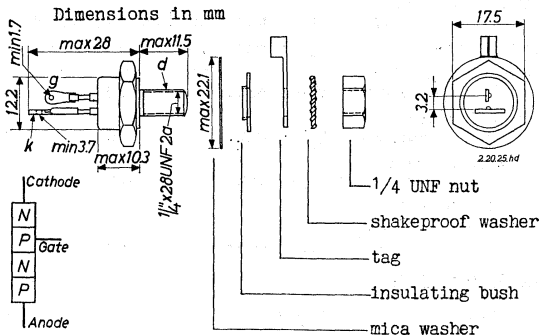
$$K_{j-m} = \text{max. } 1.8 \text{ } ^\circ\text{C/W } ^1)$$

to infinite heat sink, mounted
without insulating bush and
mica washer

$$K_{j-h} = \text{max. } 2 \text{ } ^\circ\text{C/W}$$

to infinite heat sink, mounted
with insulating bush and mica
washer

$$K_{j-h} = \text{max. } 3 \text{ } ^\circ\text{C/W}$$



Diameter of hole in heat sink

max. 8.5 mm

Min. torque on nut for good thermal contact

17 cm kg

Max. torque on nut

34 cm kg

¹⁾ This value is intended as a calculating figure

CHARACTERISTICS at $T_j = 125^\circ\text{C}$ Reverse and forward leakage currents (full cycle average) ¹⁾

$I_D, -I_D$ ($V_{DM}, -V_{DM} = 100\text{ V}$)	< 6.5 mA for the BTY88
$I_D, -I_D$ ($V_{DM}, -V_{DM} = 200\text{ V}$)	< 6 mA for the BTY89
$I_D, -I_D$ ($V_{DM}, -V_{DM} = 300\text{ V}$)	< 5 mA for the BTY90
$I_D, -I_D$ ($V_{DM}, -V_{DM} = 400\text{ V}$)	< 4 mA for the BTY91

Forward voltage (full cycle average)

V_D ($I_D = 16\text{ A}$; conduction angle = 180°)	< 0.86 V
--	----------

Holding current (typical value)

$$I_{DH} = 10\text{ mA}$$

Gate voltage

to fire all units	$V_G > 3.0\text{ V}$
not to fire any unit	$V_G < 0.25\text{ V}$

Gate current

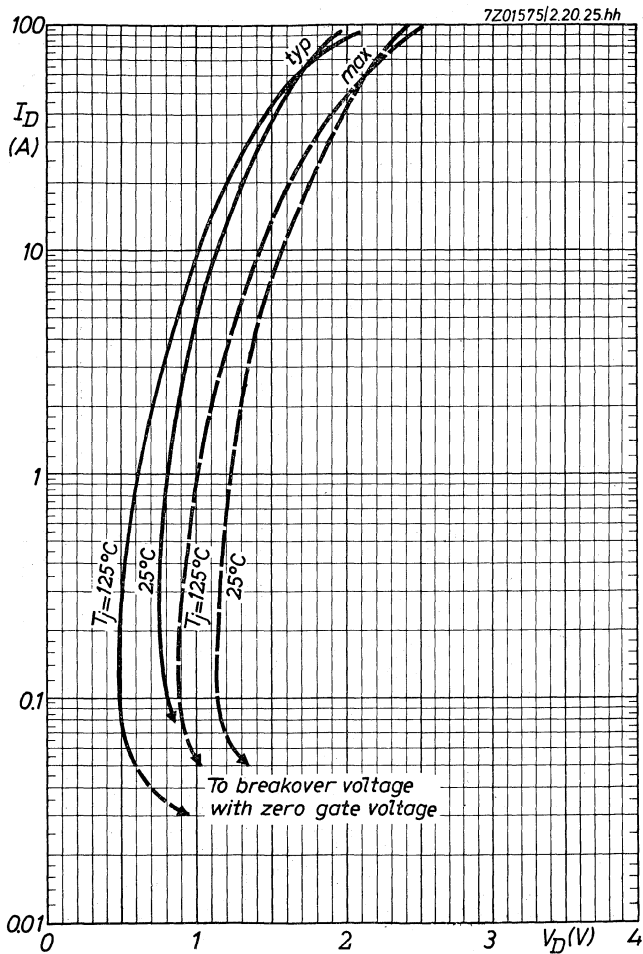
to fire all units	$I_G > 25\text{ mA}$
to fire at $V_G = 1.5\text{ V}$ (typical value)	$I_G = 10\text{ mA}$

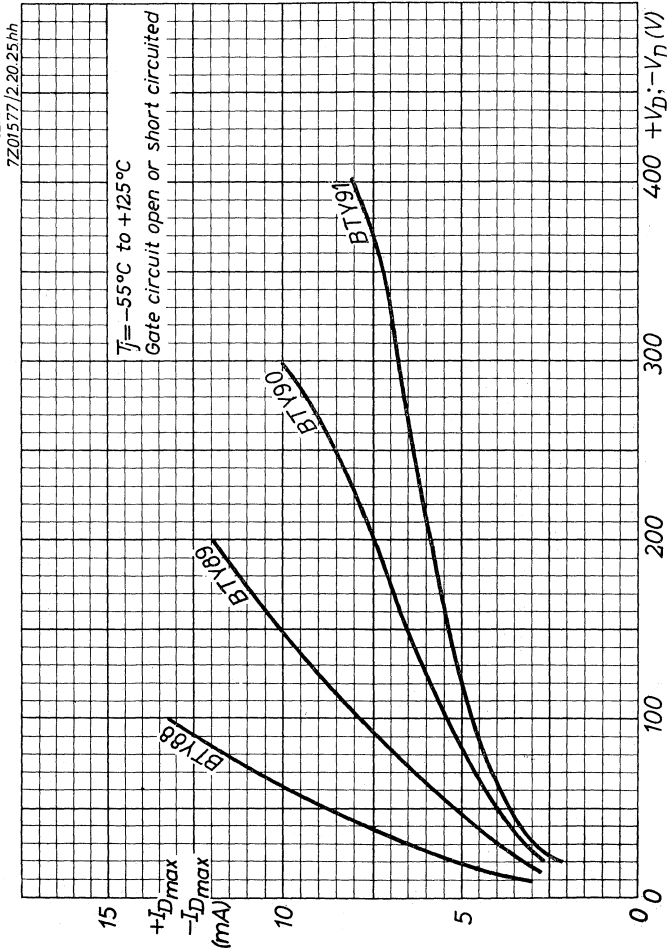
Switching characteristics (See also pages F and G)

The values are dependent upon the circuit

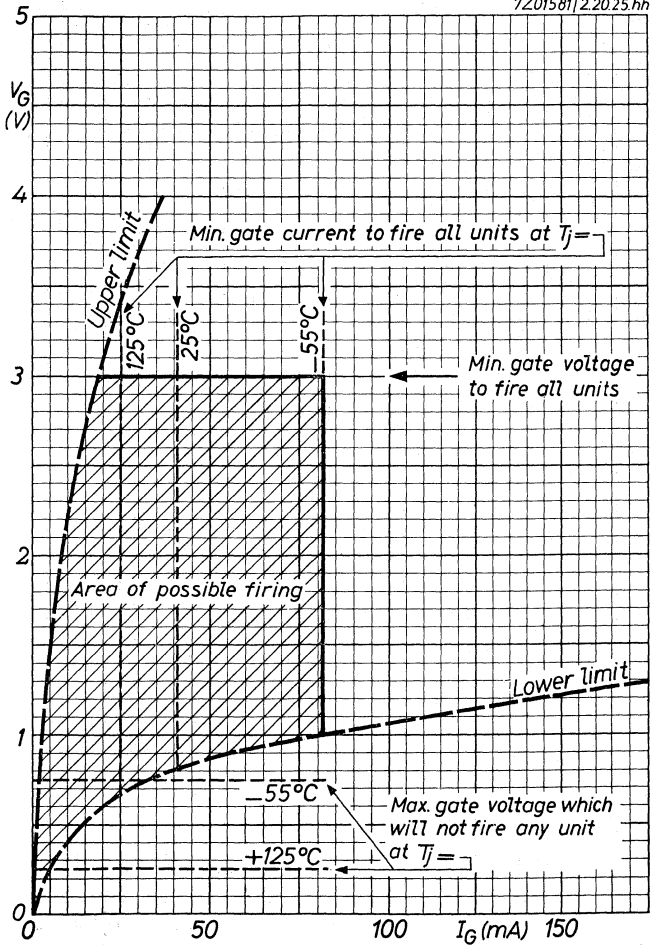
Turn-on time	$t_{on} = 1.0\text{ to }4.5\ \mu\text{sec}$
Delay time	$t_d = 0.5\text{ to }1.5\ \mu\text{sec}$
Rise time	$t_r = 0.5\text{ to }3.0\ \mu\text{sec}$
Turn-off time	$t_{off} = 10\text{ to }20\ \mu\text{sec}$

¹⁾ The peak inverse voltages should be applied at zero or negative gate voltage only and with a total thermal resistance of max. 110°C/W



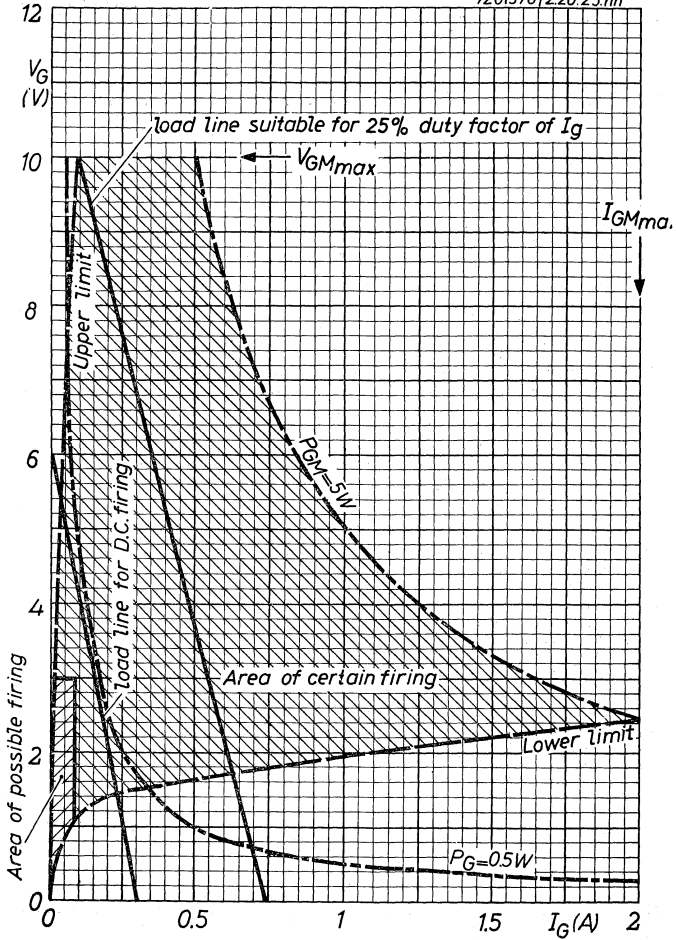
BTY88→ **91****PHILIPS****B**

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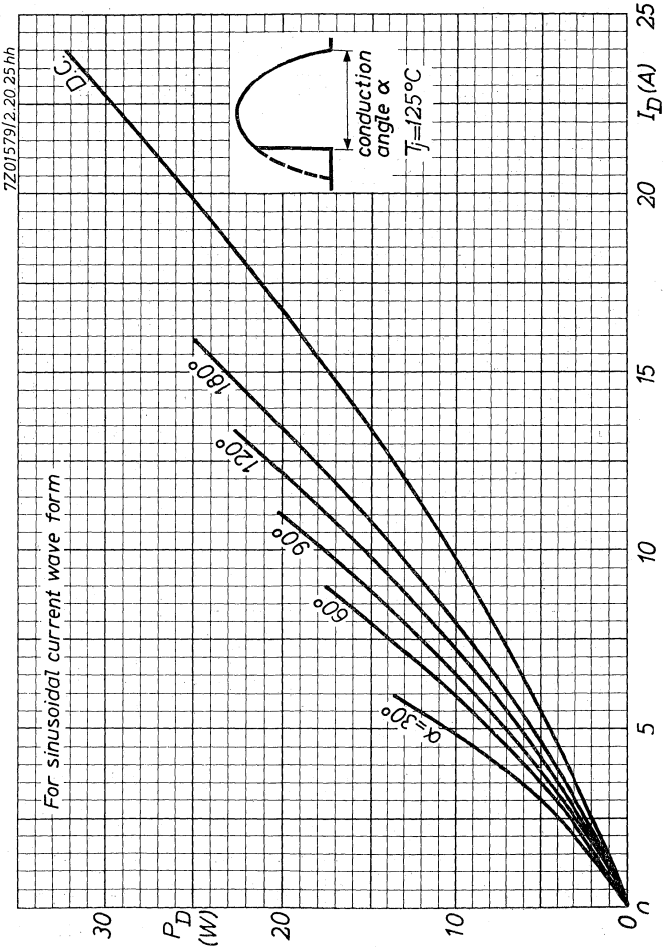


BTY88**→91****PHILIPS**

7Z01576/2.20.25.hh

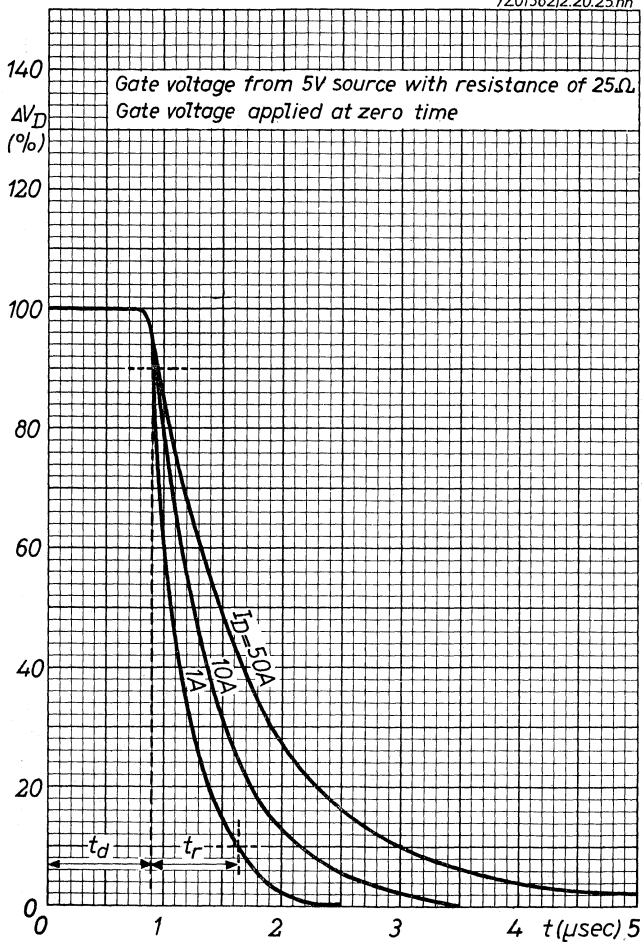


D



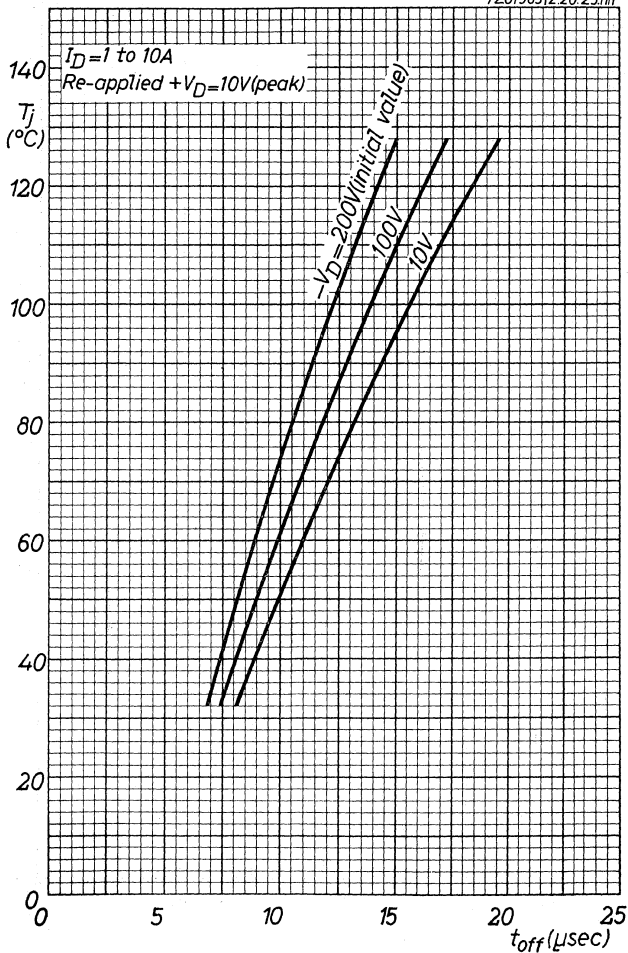
BTY88**→91****PHILIPS**

7201582/2.20.25.hh



F

7Z01583|2.20.25.hh



BTY88→ **91****PHILIPS**

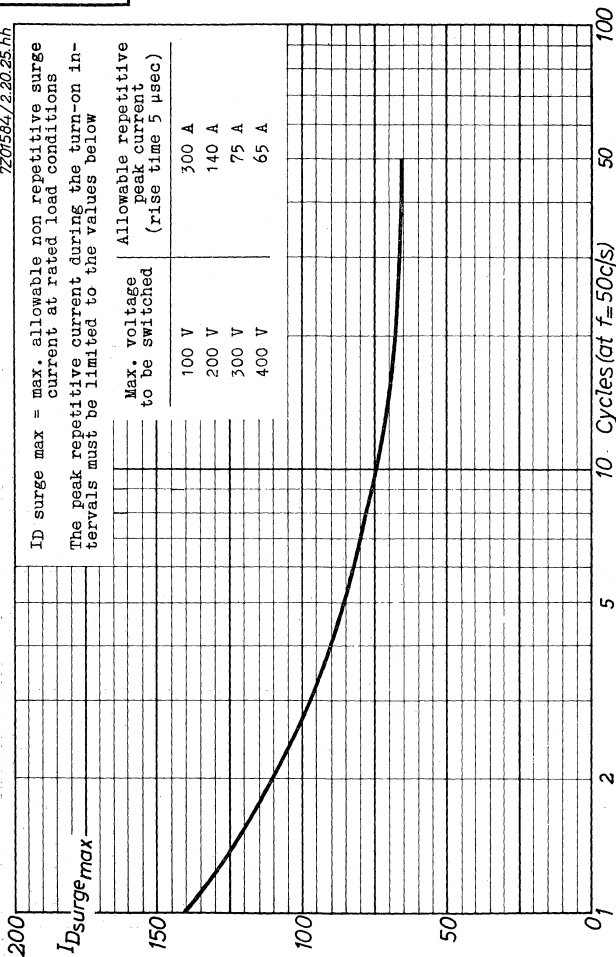
7Z01584/2.20.25.hh

$I_{D\text{surge,max}}$

ID surge max = max. allowable non repetitive surge current at rated load conditions

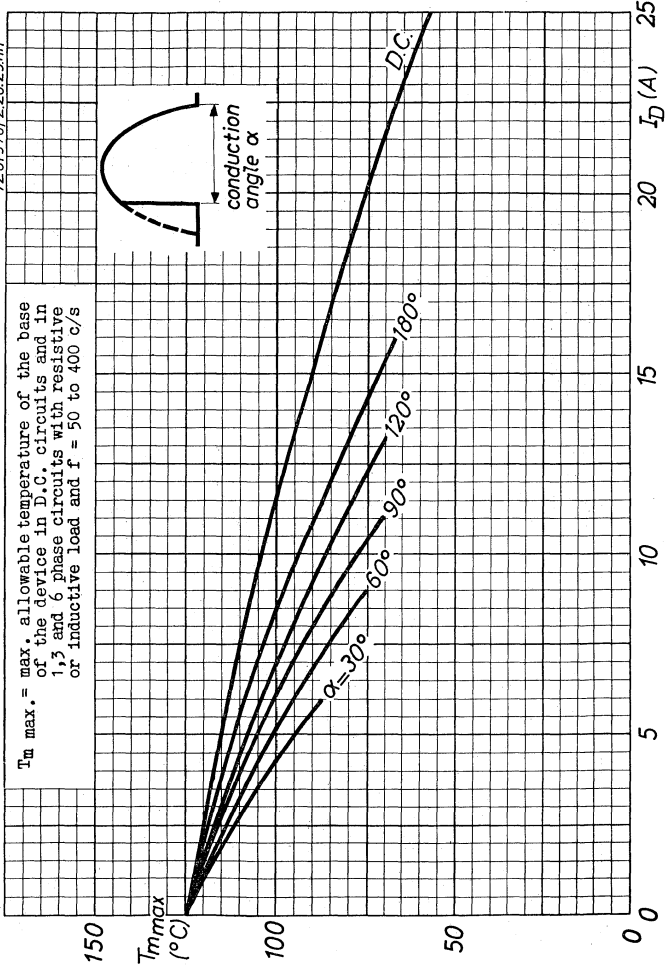
The peak repetitive current during the turn-on intervals must be limited to the values below

Max. voltage to be switched	Allowable repetitive peak current (rise time 5 μ sec)
100 V	300 A
200 V	140 A
300 V	75 A
400 V	65 A



H

7Z01578/2.20.25.hh



7Z01580/2.20.25.hh

I_{Dmax} = max. allowable average current in circuits with resistive or inductive load, frequency = 50 to 400 c/s and conduction angle of 180° OC

For other conduction angles I_{Dmax} should be multiplied by the following factors:

- D.C. : 1.4
- $\alpha = 120^\circ$: 0.91
- 90° : 0.82
- 60° : 0.72
- 30° : 0.58

The device is mounted directly on the fin with free convection cooling

Fin material: 2 mm copper. Fin spacing min. 20 mm

