

Thyristor Module

$$V_{RRM} = 2 \times 1600 \text{ V}$$

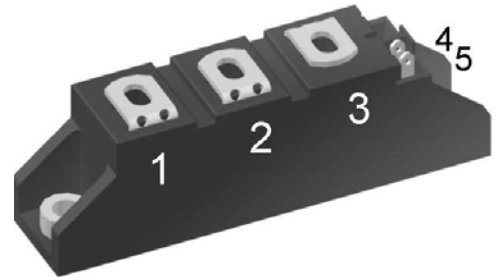
$$I_{TAV} = 60 \text{ A}$$

$$V_T = 1.24 \text{ V}$$

Phase leg

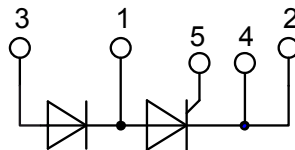
Part number

MCD56-16io1B



Backside: isolated

 E72873



Features / Advantages:

- Thyristor for line frequency
- Planar passivated chip
- Long-term stability
- Direct Copper Bonded Al₂O₃-ceramic

Applications:

- Line rectifying 50/60 Hz
- Softstart AC motor control
- DC Motor control
- Power converter
- AC power control
- Lighting and temperature control

Package: TO-240AA

- Isolation Voltage: 3600 V~
- Industry standard outline
- RoHS compliant
- Soldering pins for PCB mounting
- Base plate: DCB ceramic
- Reduced weight
- Advanced power cycling

Rectifier				Ratings			
Symbol	Definition	Conditions		min.	typ.	max.	Unit
$V_{RSM/DSM}$	max. non-repetitive reverse/forward blocking voltage	$T_{VJ} = 25^{\circ}\text{C}$				1700	V
$V_{RRM/DRM}$	max. repetitive reverse/forward blocking voltage	$T_{VJ} = 25^{\circ}\text{C}$				1600	V
I_{RD}	reverse current, drain current	$V_{R/D} = 1600\text{ V}$	$T_{VJ} = 25^{\circ}\text{C}$			200	μA
		$V_{R/D} = 1600\text{ V}$	$T_{VJ} = 125^{\circ}\text{C}$			5	mA
V_T	forward voltage drop	$I_T = 100\text{ A}$	$T_{VJ} = 25^{\circ}\text{C}$			1.26	V
		$I_T = 200\text{ A}$				1.57	V
		$I_T = 100\text{ A}$	$T_{VJ} = 125^{\circ}\text{C}$			1.24	V
		$I_T = 200\text{ A}$				1.62	V
I_{TAV}	average forward current	$T_C = 85^{\circ}\text{C}$	$T_{VJ} = 125^{\circ}\text{C}$			60	A
$I_{T(RMS)}$	RMS forward current	180° sine				100	A
V_{T0}	threshold voltage	} for power loss calculation only	$T_{VJ} = 125^{\circ}\text{C}$			0.85	V
r_T	slope resistance					3.7	m Ω
R_{thJC}	thermal resistance junction to case					0.45	K/W
R_{thCH}	thermal resistance case to heatsink				0.20		K/W
P_{tot}	total power dissipation		$T_C = 25^{\circ}\text{C}$			222	W
I_{TSM}	max. forward surge current	$t = 10\text{ ms}; (50\text{ Hz}), \text{ sine}$	$T_{VJ} = 45^{\circ}\text{C}$			1.50	kA
		$t = 8,3\text{ ms}; (60\text{ Hz}), \text{ sine}$	$V_R = 0\text{ V}$			1.62	kA
		$t = 10\text{ ms}; (50\text{ Hz}), \text{ sine}$	$T_{VJ} = 125^{\circ}\text{C}$			1.28	kA
		$t = 8,3\text{ ms}; (60\text{ Hz}), \text{ sine}$	$V_R = 0\text{ V}$			1.38	kA
I^2t	value for fusing	$t = 10\text{ ms}; (50\text{ Hz}), \text{ sine}$	$T_{VJ} = 45^{\circ}\text{C}$			11.3	kA ² s
		$t = 8,3\text{ ms}; (60\text{ Hz}), \text{ sine}$	$V_R = 0\text{ V}$			10.9	kA ² s
		$t = 10\text{ ms}; (50\text{ Hz}), \text{ sine}$	$T_{VJ} = 125^{\circ}\text{C}$			8.13	kA ² s
		$t = 8,3\text{ ms}; (60\text{ Hz}), \text{ sine}$	$V_R = 0\text{ V}$			7.87	kA ² s
C_J	junction capacitance	$V_R = 400\text{ V}$ $f = 1\text{ MHz}$	$T_{VJ} = 25^{\circ}\text{C}$		74		pF
P_{GM}	max. gate power dissipation	$t_P = 30\text{ }\mu\text{s}$	$T_C = 125^{\circ}\text{C}$			10	W
		$t_P = 300\text{ }\mu\text{s}$				5	W
P_{GAV}	average gate power dissipation					0.5	W
$(di/dt)_{cr}$	critical rate of rise of current	$T_{VJ} = 125^{\circ}\text{C}; f = 50\text{ Hz}$ repetitive, $I_T = 150\text{ A}$				150	A/ μs
		$t_P = 200\text{ }\mu\text{s}; di_G/dt = 0.45\text{ A}/\mu\text{s};$ $I_G = 0.45\text{ A}; V_D = \frac{2}{3} V_{DRM}$ non-repet., $I_T = 60\text{ A}$				500	A/ μs
$(dv/dt)_{cr}$	critical rate of rise of voltage	$V_D = \frac{2}{3} V_{DRM}$ $R_{GK} = \infty$; method 1 (linear voltage rise)	$T_{VJ} = 125^{\circ}\text{C}$			1000	V/ μs
V_{GT}	gate trigger voltage	$V_D = 6\text{ V}$	$T_{VJ} = 25^{\circ}\text{C}$			1.5	V
			$T_{VJ} = -40^{\circ}\text{C}$			1.6	V
I_{GT}	gate trigger current	$V_D = 6\text{ V}$	$T_{VJ} = 25^{\circ}\text{C}$			100	mA
			$T_{VJ} = -40^{\circ}\text{C}$			200	mA
V_{GD}	gate non-trigger voltage	$V_D = \frac{2}{3} V_{DRM}$	$T_{VJ} = 125^{\circ}\text{C}$			0.2	V
I_{GD}	gate non-trigger current					10	mA
I_L	latching current	$t_P = 10\text{ }\mu\text{s}$	$T_{VJ} = 25^{\circ}\text{C}$			450	mA
		$I_G = 0.45\text{ A}; di_G/dt = 0.45\text{ A}/\mu\text{s}$					
I_H	holding current	$V_D = 6\text{ V}$ $R_{GK} = \infty$	$T_{VJ} = 25^{\circ}\text{C}$			200	mA
t_{gd}	gate controlled delay time	$V_D = \frac{1}{2} V_{DRM}$	$T_{VJ} = 25^{\circ}\text{C}$			2	μs
		$I_G = 0.45\text{ A}; di_G/dt = 0.45\text{ A}/\mu\text{s}$					
t_q	turn-off time	$V_R = 100\text{ V}; I_T = 150\text{ A}; V_D = \frac{2}{3} V_{DRM}$ $T_{VJ} = 125^{\circ}\text{C}$ $di/dt = 10\text{ A}/\mu\text{s}; dv/dt = 20\text{ V}/\mu\text{s}; t_P = 200\text{ }\mu\text{s}$			150		μs

Package TO-240AA				Ratings			
Symbol	Definition	Conditions		min.	typ.	max.	Unit
I_{RMS}	RMS current	per terminal				200	A
T_{VJ}	virtual junction temperature			-40		125	°C
T_{op}	operation temperature			-40		100	°C
T_{stg}	storage temperature			-40		125	°C
Weight					90		g
M_D	mounting torque			2.5		4	Nm
M_T	terminal torque			2.5		4	Nm
$d_{Spp/App}$	creepage distance on surface striking distance through air	terminal to terminal	13.0	9.7			mm
$d_{Spb/Apb}$		terminal to backside	16.0	16.0			mm
V_{ISOL}	isolation voltage	t = 1 second	50/60 Hz, RMS; $I_{ISOL} \leq 1$ mA	3600			V
		t = 1 minute		3000			V



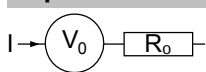
Ordering	Part Number	Marking on Product	Delivery Mode	Quantity	Code No.
Standard	MCD56-16io1B	MCD56-16io1B	Box	6	465984

Similar Part	Package	Voltage class
MCMA65PD1600TB	TO-240AA-1B	1600
MCMA85PD1600TB	TO-240AA-1B	1600

Equivalent Circuits for Simulation

* on die level

$T_{VJ} = 125^\circ\text{C}$

			Thyristor
$V_{0\max}$	threshold voltage	0.85	V
$R_{0\max}$	slope resistance *	2.5	mΩ

Technical drawing of a 5-pin D-sub connector. The drawing shows the front and side views with the following dimensions in mm:

- Overall width: 92 ± 0.5
- Distance from mounting hole center to pin 1 center: 80 ± 0.3
- Pin 1 diameter: $M5$
- Pin 2 diameter: 25 ± 0.3
- Pin 3 diameter: 45 ± 0.3
- Pin 4 diameter: 65 ± 0.3
- Pin 5 diameter: 25 ± 0.3
- Pin 6 diameter: 45 ± 0.3
- Pin 7 diameter: 65 ± 0.3
- Pin 8 diameter: 25 ± 0.3
- Pin 9 diameter: 45 ± 0.3
- Pin 10 diameter: 65 ± 0.3
- Pin 11 diameter: 25 ± 0.3
- Pin 12 diameter: 45 ± 0.3
- Pin 13 diameter: 65 ± 0.3
- Pin 14 diameter: 25 ± 0.3
- Pin 15 diameter: 45 ± 0.3
- Pin 16 diameter: 65 ± 0.3
- Pin 17 diameter: 25 ± 0.3
- Pin 18 diameter: 45 ± 0.3
- Pin 19 diameter: 65 ± 0.3
- Pin 20 diameter: 25 ± 0.3
- Pin 21 diameter: 45 ± 0.3
- Pin 22 diameter: 65 ± 0.3
- Pin 23 diameter: 25 ± 0.3
- Pin 24 diameter: 45 ± 0.3
- Pin 25 diameter: 65 ± 0.3
- Pin 26 diameter: 25 ± 0.3
- Pin 27 diameter: 45 ± 0.3
- Pin 28 diameter: 65 ± 0.3
- Pin 29 diameter: 25 ± 0.3
- Pin 30 diameter: 45 ± 0.3
- Pin 31 diameter: 65 ± 0.3
- Pin 32 diameter: 25 ± 0.3
- Pin 33 diameter: 45 ± 0.3
- Pin 34 diameter: 65 ± 0.3
- Pin 35 diameter: 25 ± 0.3
- Pin 36 diameter: 45 ± 0.3
- Pin 37 diameter: 65 ± 0.3
- Pin 38 diameter: 25 ± 0.3
- Pin 39 diameter: 45 ± 0.3
- Pin 40 diameter: 65 ± 0.3
- Pin 41 diameter: 25 ± 0.3
- Pin 42 diameter: 45 ± 0.3
- Pin 43 diameter: 65 ± 0.3
- Pin 44 diameter: 25 ± 0.3
- Pin 45 diameter: 45 ± 0.3
- Pin 46 diameter: 65 ± 0.3
- Pin 47 diameter: 25 ± 0.3
- Pin 48 diameter: 45 ± 0.3
- Pin 49 diameter: 65 ± 0.3
- Pin 50 diameter: 25 ± 0.3
- Pin 51 diameter: 45 ± 0.3
- Pin 52 diameter: 65 ± 0.3
- Pin 53 diameter: 25 ± 0.3
- Pin 54 diameter: 45 ± 0.3
- Pin 55 diameter: 65 ± 0.3
- Pin 56 diameter: 25 ± 0.3
- Pin 57 diameter: 45 ± 0.3
- Pin 58 diameter: 65 ± 0.3
- Pin 59 diameter: 25 ± 0.3
- Pin 60 diameter: 45 ± 0.3
- Pin 61 diameter: 65 ± 0.3
- Pin 62 diameter: 25 ± 0.3
- Pin 63 diameter: 45 ± 0.3
- Pin 64 diameter: 65 ± 0.3
- Pin 65 diameter: 25 ± 0.3
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- Pin 72 diameter: 45 ± 0.3
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- Pin 74 diameter: 25 ± 0.3
- Pin 75 diameter: 45 ± 0.3
- Pin 76 diameter: 65 ± 0.3
- Pin 77 diameter: 25 ± 0.3
- Pin 78 diameter: 45 ± 0.3
- Pin 79 diameter: 65 ± 0.3
- Pin 80 diameter: 25 ± 0.3
- Pin 81 diameter: 45 ± 0.3
- Pin 82 diameter: 65 ± 0.3
- Pin 83 diameter: 25 ± 0.3
- Pin 84 diameter: 45 ± 0.3
- Pin 85 diameter: 65 ± 0.3
- Pin 86 diameter: 25 ± 0.3
- Pin 87 diameter: 45 ± 0.3
- Pin 88 diameter: 65 ± 0.3
- Pin 89 diameter: 25 ± 0.3
- Pin 90 diameter: 45 ± 0.3
- Pin 91 diameter: 65 ± 0.3
- Pin 92 diameter: 25 ± 0.3
- Pin 93 diameter: 45 ± 0.3
- Pin 94 diameter: 65 ± 0.3
- Pin 95 diameter: 25 ± 0.3
- Pin 96 diameter: 45 ± 0.3
- Pin 97 diameter: 65 ± 0.3
- Pin 98 diameter: 25 ± 0.3
- Pin 99 diameter: 45 ± 0.3
- Pin 100 diameter: 65 ± 0.3

Thyristor

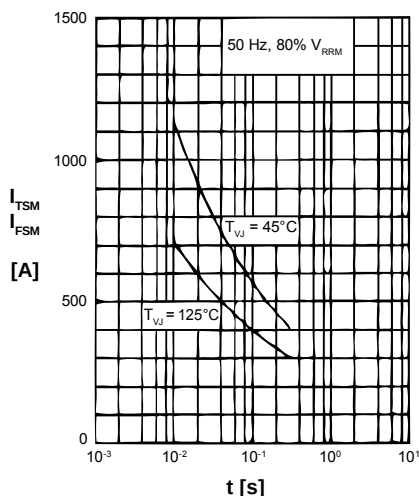


Fig. 1 Surge overload current
 I_{TSM} , I_{FSM} : Crest value, t: duration

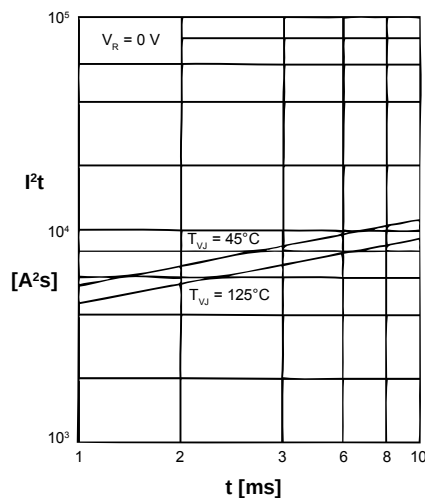


Fig. 2 I^2t versus time (1-10 ms)

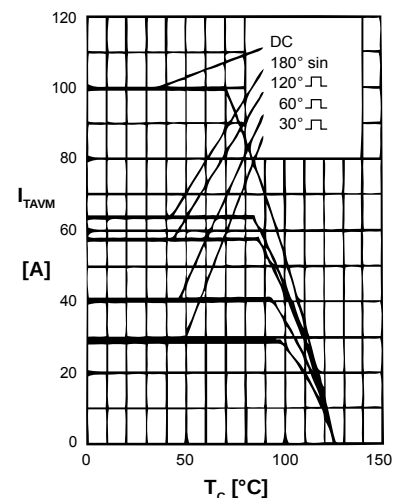


Fig. 3 Maximum forward current at case temperature

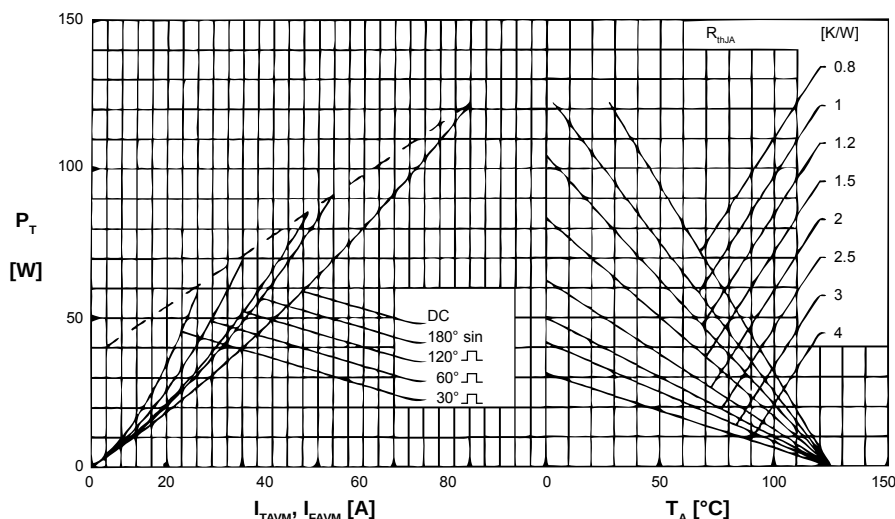


Fig. 4 Power dissipation vs. onstate current and ambient temperature (per thyristor/diode)

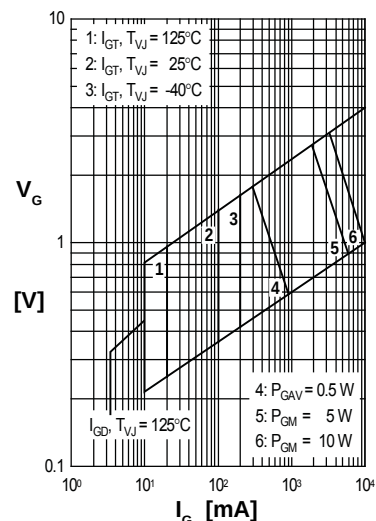


Fig. 5 Gate trigger charact.

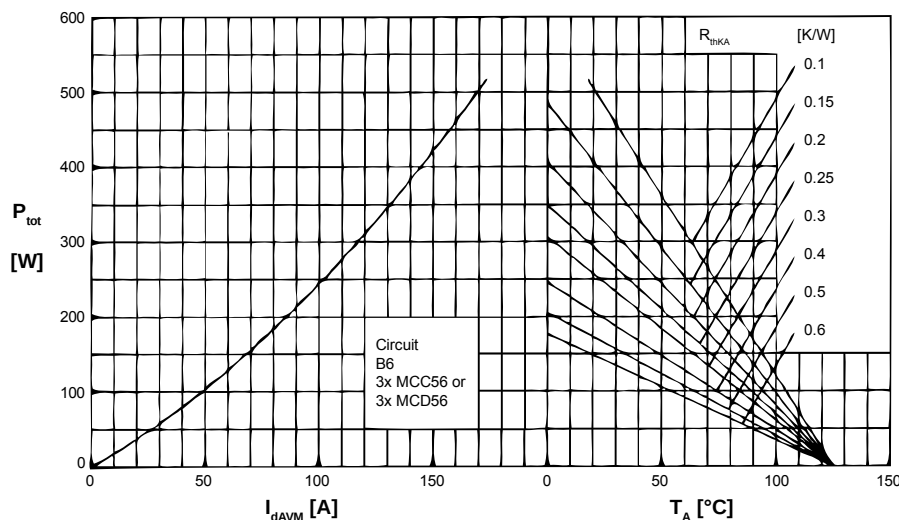


Fig. 6 Three phase rectifier bridge: Power dissipation versus direct output current and ambient temperature

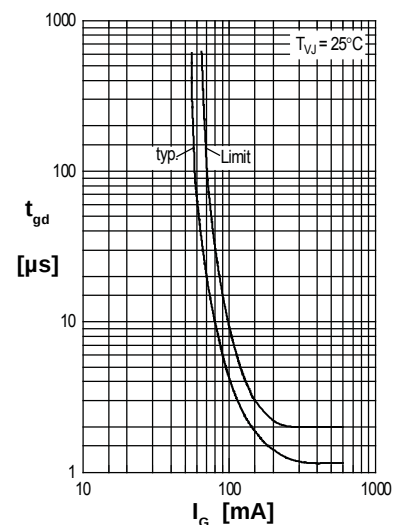


Fig. 7 Gate trigger delay time

Rectifier

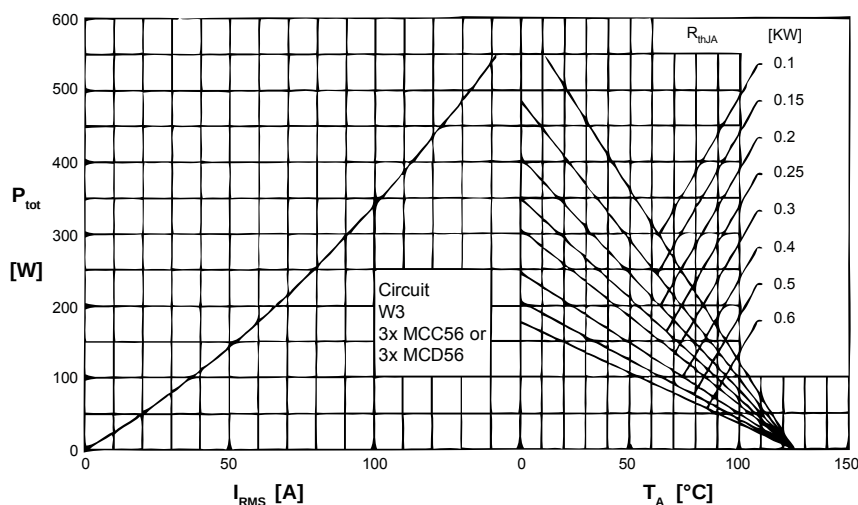


Fig. 8 Three phase AC-controller: Power dissipation vs. RMS output current and ambient temperature

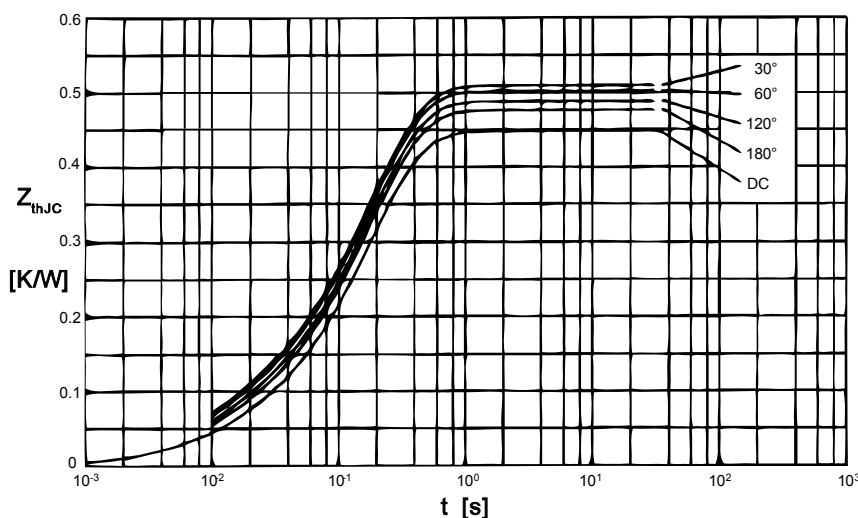


Fig. 9 Transient thermal impedance junction to case (per thyristor)

R_{thJC} for various conduction angles d:

d	R_{thJC} [K/W]
DC	0.450
180°	0.470
120°	0.490
60°	0.505
30°	0.520

Constants for Z_{thJC} calculation:

i	R_{thi} [K/W]	t_i [s]
1	0.014	0.0150
2	0.026	0.0095
3	0.410	0.1750

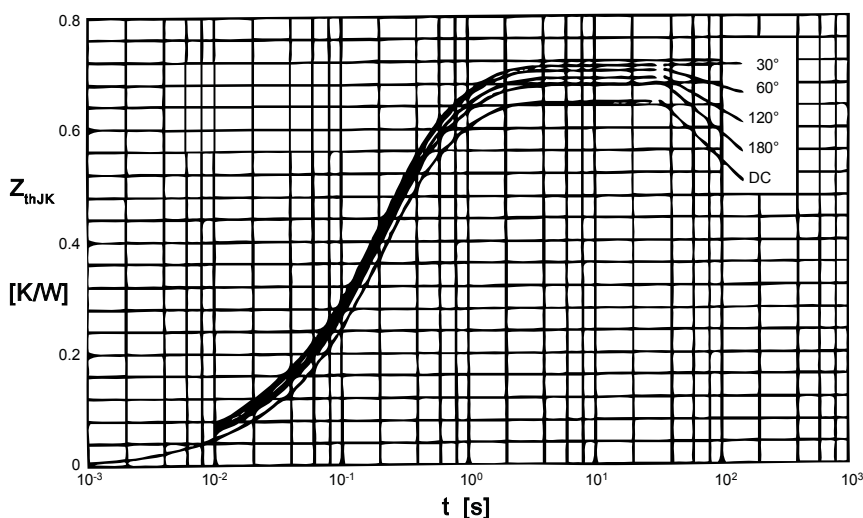


Fig. 10 Transient thermal impedance junction to heatsink (per thyristor)

R_{thJK} for various conduction angles d:

d	R_{thJK} [K/W]
DC	0.650
180°	0.670
120°	0.690
60°	0.705
30°	0.720

Constants for Z_{thJK} calculation:

i	R_{thi} [K/W]	t_i [s]
1	0.014	0.0150
2	0.026	0.0095
3	0.410	0.1750
4	0.200	0.6700