

Thyristor Module

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

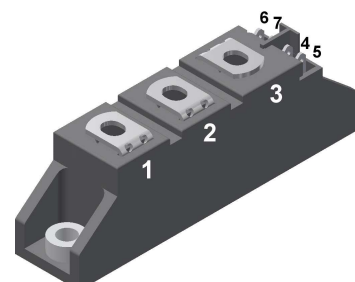
$$I_{TAV} = 60 \text{ A}$$

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

Phase leg

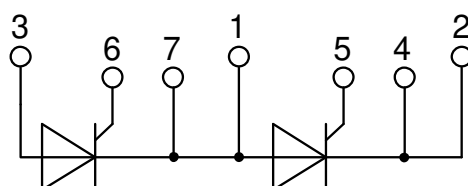
Part number

MCC56-16io1B



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: 4800 V~
- Industry standard outline
- RoHS compliant
- Soldering pins for PCB mounting
- Base plate: DCB ceramic
- Reduced weight
- Advanced power cycling

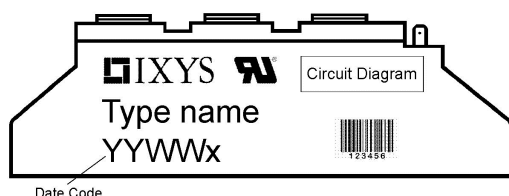
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Thyristor				Ratings			
Symbol	Definition	Conditions		min.	typ.	max.	Unit
$V_{RSM/DSM}$	max. non-repetitive reverse/forward blocking voltage	$T_{VJ} = 25^{\circ}\text{C}$				1700	V
$V_{RRM/DRM}$	max. repetitive reverse/forward blocking voltage	$T_{VJ} = 25^{\circ}\text{C}$				1600	V
$I_{R/D}$	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				94	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				0.2		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
		$t_p = 200\text{ }\mu\text{s}; di_G/dt = 0.45\text{ A}/\mu\text{s};$ $I_G = 0.45\text{ A}; V = \frac{2}{3} V_{DRM}$ non-repet., $I_T = 60\text{ A}$				500	A/ μs
$(dv/dt)_{cr}$	critical rate of rise of voltage	$V = \frac{2}{3} V_{DRM}$	$T_{VJ} = 125^{\circ}\text{C}$			1000	V/ μs
		$R_{GK} = \infty$; method 1 (linear voltage rise)					
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	$V_R = 100\text{ V}; I_T = 150\text{ A}; V = \frac{2}{3} V_{DRM}$ $T_{VJ} = 100^{\circ}\text{C}$ $di/dt = 10\text{ A}/\mu\text{s}$ $dv/dt = 20\text{ V}/\mu\text{s}$ $t_p = 200\text{ }\mu\text{s}$			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					81		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	4800			V
		t = 1 minute		4000			V



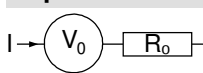
Ordering	Ordering Number	Marking on Product	Delivery Mode	Quantity	Code No.
Standard	MCC56-16io1B	MCC56-16io1B	Box	36	452769

Similar Part	Package	Voltage class
MCMA65P1600TA	TO-240AA-1B	1600
MCMA85P1600TA	TO-240AA-1B	1600

Equivalent Circuits for Simulation

* on die level

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



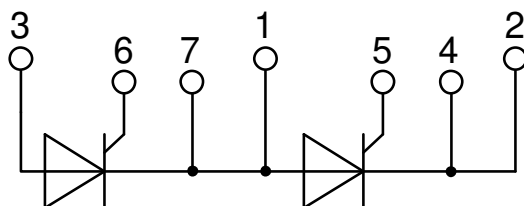
Thyristor

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

Technical drawing of a 5-pin DIN connector. The drawing shows the front and side views with the following dimensions and labels:

- Overall length: 92 ± 0.5
- Distance from front face to center of pin 1: 80 ± 0.3
- Pin 1 thread: M5
- Pin 1 diameter: 5.5 ± 0.1
- Pin 1 height: 10 ± 0.1
- Pin 1 mounting hole diameter: 14.8
- Pin 1 mounting hole offset: 20.8 ± 0.25
- Pin 2 diameter: 4.4
- Pin 2 height: 5
- Pin 2 mounting hole diameter: 4.4
- Pin 3 diameter: 4.4
- Pin 3 height: 5
- Pin 3 mounting hole diameter: 4.4
- Pin 4 diameter: 4.4
- Pin 4 height: 5
- Pin 4 mounting hole diameter: 4.4
- Pin 5 diameter: 4.4
- Pin 5 height: 5
- Pin 5 mounting hole diameter: 4.4
- Pin 6 diameter: 4.4
- Pin 6 height: 5
- Pin 6 mounting hole diameter: 4.4
- Pin 7 diameter: 4.4
- Pin 7 height: 5
- Pin 7 mounting hole diameter: 4.4
- Pin 8 diameter: 4.4
- Pin 8 height: 5
- Pin 8 mounting hole diameter: 4.4
- Pin 9 diameter: 4.4
- Pin 9 height: 5
- Pin 9 mounting hole diameter: 4.4
- Pin 10 diameter: 4.4
- Pin 10 height: 5
- Pin 10 mounting hole diameter: 4.4
- Pin 11 diameter: 4.4
- Pin 11 height: 5
- Pin 11 mounting hole diameter: 4.4
- Pin 12 diameter: 4.4
- Pin 12 height: 5
- Pin 12 mounting hole diameter: 4.4
- Pin 13 diameter: 4.4
- Pin 13 height: 5
- Pin 13 mounting hole diameter: 4.4
- Pin 14 diameter: 4.4
- Pin 14 height: 5
- Pin 14 mounting hole diameter: 4.4
- Pin 15 diameter: 4.4
- Pin 15 height: 5
- Pin 15 mounting hole diameter: 4.4
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- Pin 16 height: 5
- Pin 16 mounting hole diameter: 4.4
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- Pin 18 height: 5
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- Pin 25 height: 5
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- Pin 37 height: 5
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- Pin 38 height: 5
- Pin 38 mounting hole diameter: 4.4
- Pin 39 diameter: 4.4
- Pin 39 height: 5
- Pin 39 mounting hole diameter: 4.4
- Pin 40 diameter: 4.4
- Pin 40 height: 5
- Pin 40 mounting hole diameter: 4.4
- Pin 41 diameter: 4.4
- Pin 41 height: 5
- Pin 41 mounting hole diameter: 4.4
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- Pin 42 height: 5
- Pin 42 mounting hole diameter: 4.4
- Pin 43 diameter: 4.4
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- Pin 44 height: 5
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- Pin 45 height: 5
- Pin 45 mounting hole diameter: 4.4
- Pin 46 diameter: 4.4
- Pin 46 height: 5
- Pin 46 mounting hole diameter: 4.4
- Pin 47 diameter: 4.4
- Pin 47 height: 5
- Pin 47 mounting hole diameter: 4.4
- Pin 48 diameter: 4.4
- Pin 48 height: 5
- Pin 48 mounting hole diameter: 4.4
- Pin 49 diameter: 4.4
- Pin 49 height: 5
- Pin 49 mounting hole diameter: 4.4
- Pin 50 diameter: 4.4
- Pin 50 height: 5
- Pin 50 mounting hole diameter: 4.4
- Pin 51 diameter: 4.4
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- Pin 52 diameter: 4.4
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- Pin 53 height: 5
- Pin 53 mounting hole diameter: 4.4
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- Pin 55 diameter: 4.4
- Pin 55 height: 5
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- Pin 56 diameter: 4.4
- Pin 56 height: 5
- Pin 56 mounting hole diameter: 4.4
- Pin 57 diameter: 4.4
- Pin 57 height: 5
- Pin 57 mounting hole diameter: 4.4
- Pin 58 diameter: 4.4
- Pin 58 height: 5
- Pin 58 mounting hole diameter: 4.4
- Pin 59 diameter: 4.4
- Pin 59 height: 5
- Pin 59 mounting hole diameter: 4.4
- Pin 60 diameter: 4.4
- Pin 60 height: 5
- Pin 60 mounting hole diameter: 4.4
- Pin 61 diameter: 4.4
- Pin 61 height: 5
- Pin 61 mounting hole diameter: 4.4
- Pin 62 diameter: 4.4
- Pin 62 height: 5
- Pin 62 mounting hole diameter: 4.4
- Pin 63 diameter: 4.4
- Pin 63 height: 5
- Pin 63 mounting hole diameter: 4.4
- Pin 64 diameter: 4.4
- Pin 64 height: 5
- Pin 64 mounting hole diameter: 4.4
- Pin 65 diameter: 4.4
- Pin 65 height: 5
- Pin 65 mounting hole diameter: 4.4
- Pin 66 diameter: 4.4
- Pin 66 height: 5
- Pin 66 mounting hole diameter: 4.4
- Pin

Type ZY 200L (L = Left for pin pair 4/5)
Type ZY 200R (R = Right for pin pair 6/7) } UL 758, style 3751



Thyristor

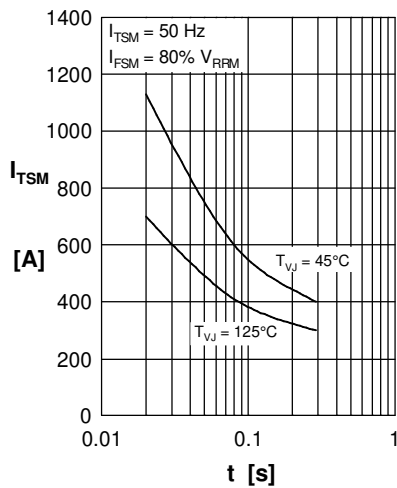


Fig. 1 Surge overload current I_{TSM} ,
 I_{FSM} : Crest value, t : duration

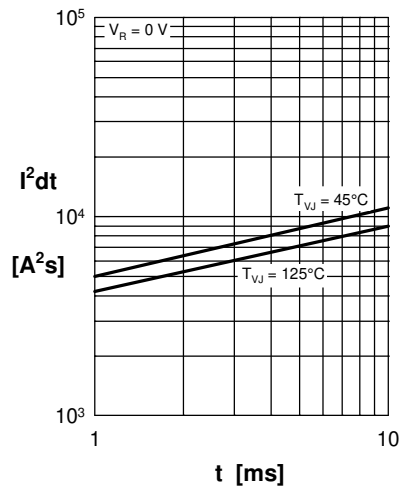


Fig. 2 I^2dt versus time (1-10 ms)

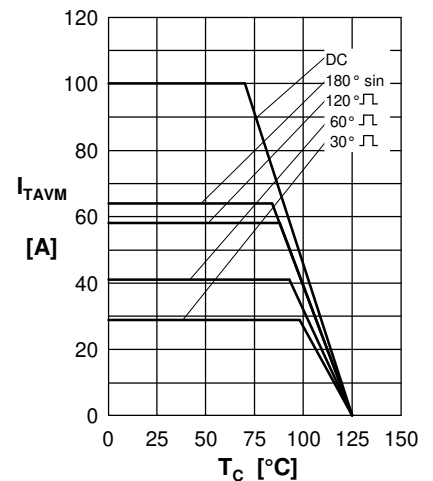


Fig. 3 Max. forward current
 at case temperature

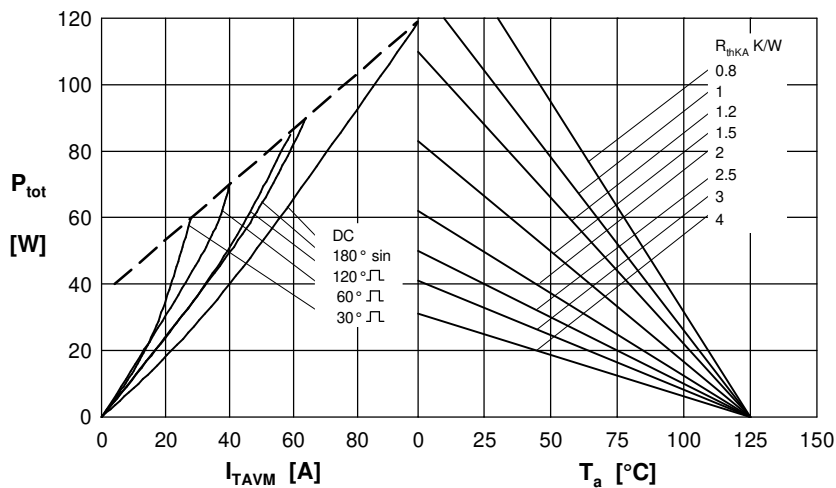


Fig. 4 Power dissipation vs. on-state current & ambient temperature
 (per thyristor or diode)

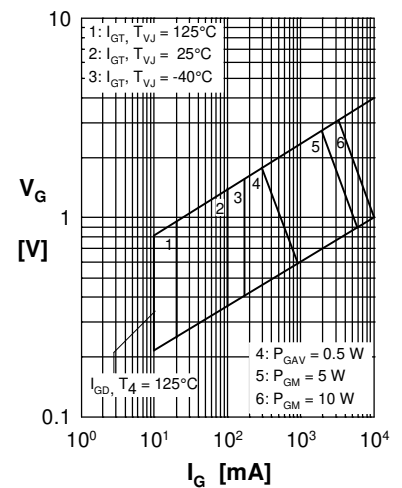


Fig. 5 Gate trigger characteristics

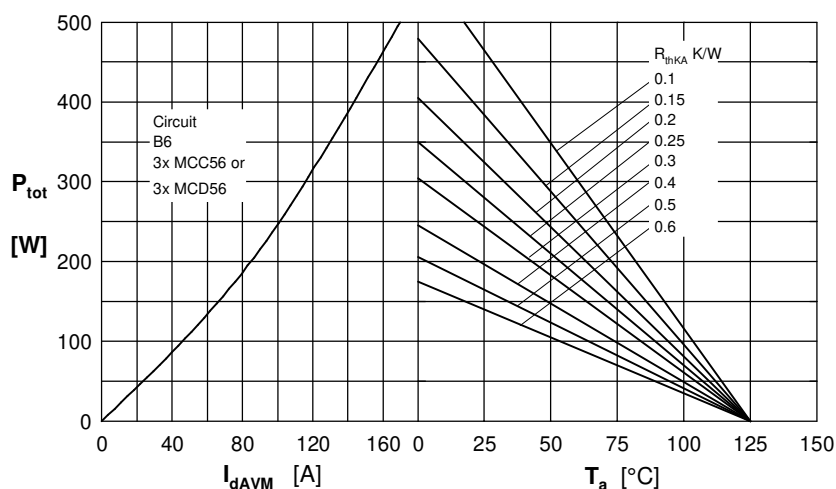


Fig. 6 Three phase rectifier bridge: Power dissipation versus direct
 output current and ambient temperature

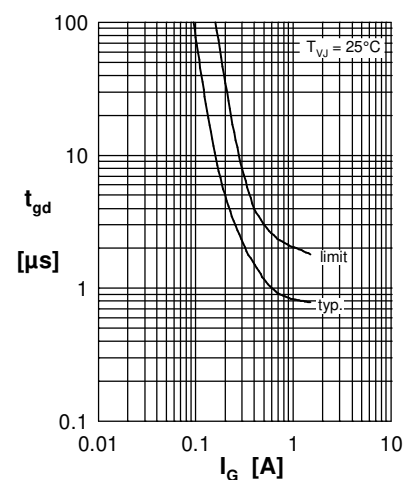


Fig. 7 Gate trigger delay time

Thyristor

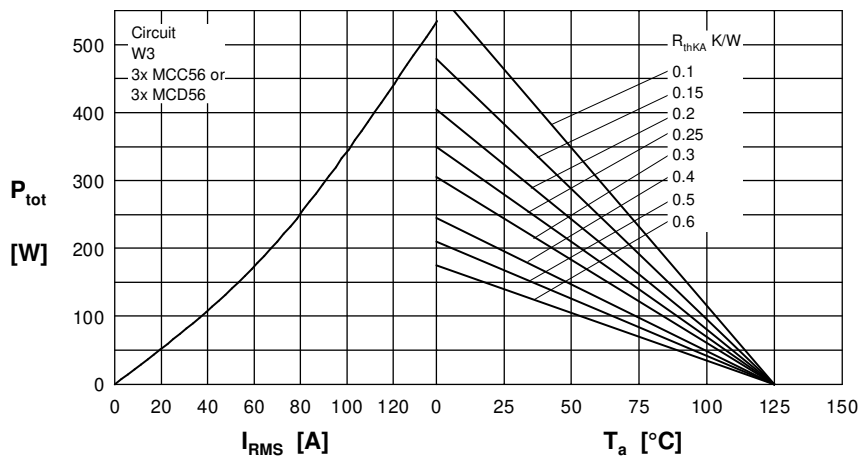


Fig. 8 Three phase AC-controller: Power dissipation versus RMS output current and ambient temperature

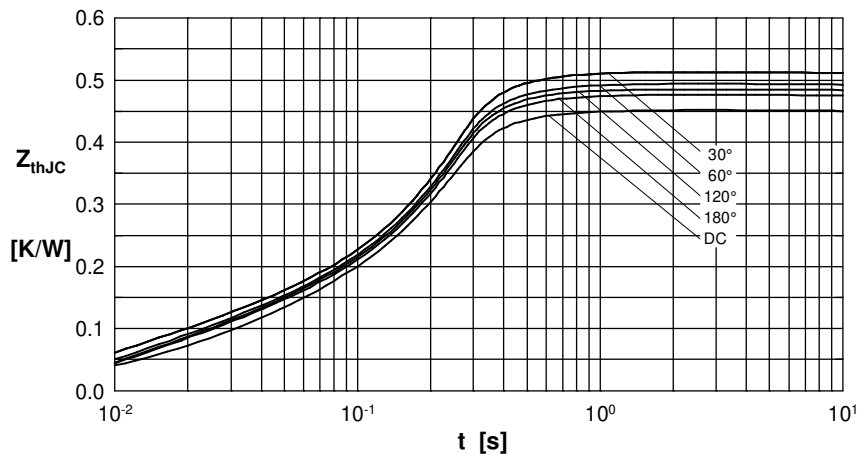


Fig. 9 Transient thermal impedance junction to case (per thyristor/diode)

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

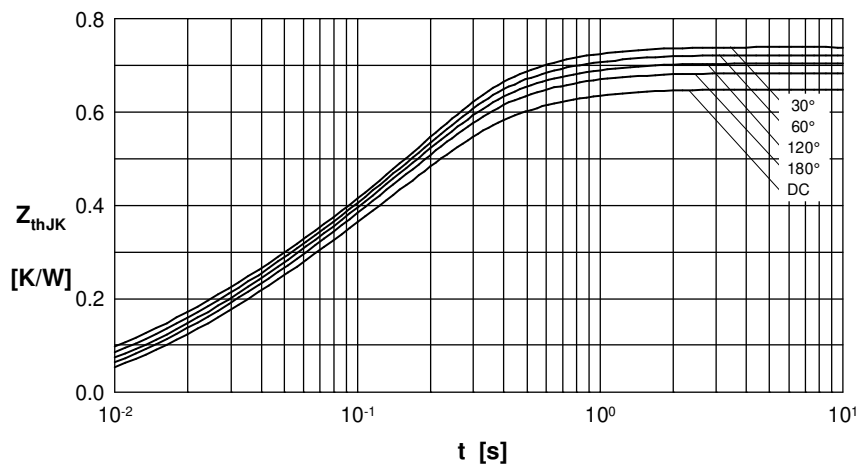


Fig. 10 Transient thermal impedance junction to heatsink (per thyristor/diode)

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