

# Thyristor Module

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

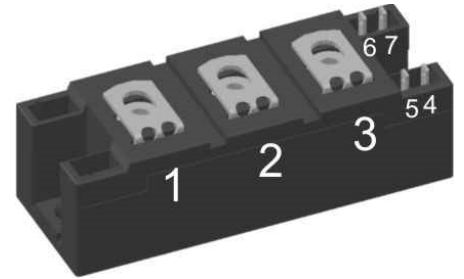
$$I_{TAV} = 181 \text{ A}$$

$$V_T = 1.03 \text{ V}$$

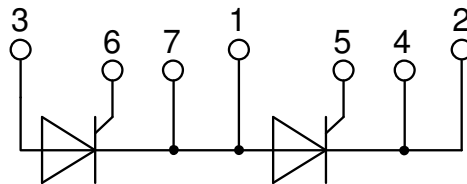
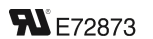
Phase leg

Part number

**MCC162-16io1**



Backside: isolated



### Features / Advantages:

- Thyristor for line frequency
- Planar passivated chip
- Long-term stability
- Direct Copper Bonded Al<sub>2</sub>O<sub>3</sub>-ceramic

### Applications:

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

### Package: Y4

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

### Terms Conditions of usage:

The data contained in this product data sheet is exclusively intended for technically trained staff. The user will have to evaluate the suitability of the product for the intended application and the completeness of the product data with respect to his application. The specifications of our components may not be considered as an assurance of component characteristics. The information in the valid application- and assembly notes must be considered. Should you require product information in excess of the data given in this product data sheet or which concerns the specific application of your product, please contact the sales office, which is responsible for you.

Due to technical requirements our product may contain dangerous substances. For information on the types in question please contact the sales office, which is responsible for you.

Should you intend to use the product in aviation, in health or live endangering or life support applications, please notify. For any such application we urgently recommend

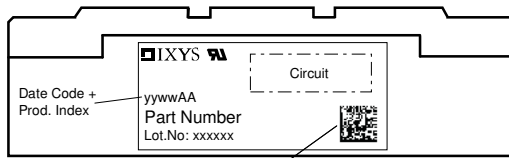
- to perform joint risk and quality assessments;

- the conclusion of quality agreements;

- to establish joint measures of an ongoing product survey, and that we may make delivery dependent on the realization of any such measures.

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
$I_{RD}$	reverse current, drain current	$V_{R/D} = 1600\text{ V}$	$T_{VJ} = 25^{\circ}\text{C}$		300	$\mu\text{A}$
		$V_{R/D} = 1600\text{ V}$	$T_{VJ} = 125^{\circ}\text{C}$		10	mA
$V_T$	forward voltage drop	$I_T = 150\text{ A}$	$T_{VJ} = 25^{\circ}\text{C}$		1.09	V
		$I_T = 300\text{ A}$			1.25	V
		$I_T = 150\text{ A}$	$T_{VJ} = 125^{\circ}\text{C}$		1.03	V
		$I_T = 300\text{ A}$			1.25	V
$I_{TAV}$	average forward current	$T_C = 85^{\circ}\text{C}$	$T_{VJ} = 125^{\circ}\text{C}$		181	A
$I_{T(RMS)}$	RMS forward current	180° sine			300	A
$V_{T0}$	threshold voltage	} for power loss calculation only	$T_{VJ} = 125^{\circ}\text{C}$		0.88	V
$r_T$	slope resistance				1.15	m $\Omega$
$R_{thJC}$	thermal resistance junction to case				0.155	K/W
$R_{thCH}$	thermal resistance case to heatsink			0.07		K/W
$P_{tot}$	total power dissipation		$T_C = 25^{\circ}\text{C}$		645	W
$I_{TSM}$	max. forward surge current	$t = 10\text{ ms}; (50\text{ Hz}), \text{ sine}$	$T_{VJ} = 45^{\circ}\text{C}$		6.00	kA
		$t = 8,3\text{ ms}; (60\text{ Hz}), \text{ sine}$	$V_R = 0\text{ V}$		6.48	kA
		$t = 10\text{ ms}; (50\text{ Hz}), \text{ sine}$	$T_{VJ} = 125^{\circ}\text{C}$		5.10	kA
		$t = 8,3\text{ ms}; (60\text{ Hz}), \text{ sine}$	$V_R = 0\text{ V}$		5.51	kA
$I^2t$	value for fusing	$t = 10\text{ ms}; (50\text{ Hz}), \text{ sine}$	$T_{VJ} = 45^{\circ}\text{C}$		180.0	kA <sup>2</sup> s
		$t = 8,3\text{ ms}; (60\text{ Hz}), \text{ sine}$	$V_R = 0\text{ V}$		174.7	kA <sup>2</sup> s
		$t = 10\text{ ms}; (50\text{ Hz}), \text{ sine}$	$T_{VJ} = 125^{\circ}\text{C}$		130.1	kA <sup>2</sup> s
		$t = 8,3\text{ ms}; (60\text{ Hz}), \text{ sine}$	$V_R = 0\text{ V}$		126.3	kA <sup>2</sup> s
$C_J$	junction capacitance	$V_R = 400\text{ V } f = 1\text{ MHz}$	$T_{VJ} = 25^{\circ}\text{C}$		273	pF
$P_{GM}$	max. gate power dissipation	$t_p = 30\text{ }\mu\text{s}$	$T_C = 125^{\circ}\text{C}$		120	W
		$t_p = 500\text{ }\mu\text{s}$			60	W
$P_{GAV}$	average gate power dissipation				8	W
$(di/dt)_{cr}$	critical rate of rise of current	$T_{VJ} = 125^{\circ}\text{C}; f = 50\text{ Hz}$ repetitive, $I_T = 540\text{ A}$			150	A/ $\mu\text{s}$
		$t_p = 200\text{ }\mu\text{s}; di_G/dt = 0.5\text{ A}/\mu\text{s};$ $I_G = 0.5\text{ A}; V = \frac{2}{3} V_{DRM}$ non-repet., $I_T = 180\text{ A}$			500	A/ $\mu\text{s}$
$(dv/dt)_{cr}$	critical rate of rise of voltage	$V = \frac{2}{3} V_{DRM}$ $R_{GK} = \infty$ ; method 1 (linear voltage rise)	$T_{VJ} = 125^{\circ}\text{C}$		1000	V/ $\mu\text{s}$
$V_{GT}$	gate trigger voltage	$V_D = 6\text{ V}$	$T_{VJ} = 25^{\circ}\text{C}$		2.5	V
			$T_{VJ} = -40^{\circ}\text{C}$		2.6	V
$I_{GT}$	gate trigger current	$V_D = 6\text{ V}$	$T_{VJ} = 25^{\circ}\text{C}$		150	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	$t_p = 30\text{ }\mu\text{s}$	$T_{VJ} = 25^{\circ}\text{C}$		300	mA
		$I_G = 0.5\text{ A}; di_G/dt = 0.5\text{ A}/\mu\text{s}$				
$I_H$	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	$\mu\text{s}$
		$I_G = 0.5\text{ A}; di_G/dt = 0.5\text{ A}/\mu\text{s}$				
$t_q$	turn-off time	$V_R = 100\text{ V}; I_T = 300\text{ A}; V = \frac{2}{3} V_{DRM}$ $di/dt = 10\text{ A}/\mu\text{s } dv/dt = 20\text{ V}/\mu\text{s } t_p = 200\text{ }\mu\text{s}$	$T_{VJ} = 100^{\circ}\text{C}$		150	$\mu\text{s}$

Package Y4				Ratings			
Symbol	Definition	Conditions	min.	typ.	max.	Unit	
$I_{RMS}$	RMS current	per terminal			300	A	
$T_{VJ}$	virtual junction temperature		-40		125	°C	
$T_{op}$	operation temperature		-40		100	°C	
$T_{stg}$	storage temperature		-40		125	°C	
<b>Weight</b>					150	g	
$M_D$	mounting torque		2.25		2.75	Nm	
$M_T$	terminal torque		4.5		5.5	Nm	
$d_{Spp/App}$	creepage distance on surface   striking distance through air	terminal to terminal	14.0	10.0		mm	
$d_{Spb/Apb}$		terminal to backside	16.0	16.0		mm	
$V_{ISOL}$	isolation voltage	t = 1 second			3600	V	
		t = 1 minute	50/60 Hz, RMS; $I_{ISOL} \leq 1$ mA		3000	V	



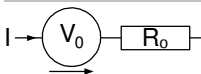
Data Matrix: Typ (1-19), DC+Prod.Index (20-25), FKT# (26-31) Iser (33), IId.# (33-36)

Ordering	Ordering Number	Marking on Product	Delivery Mode	Quantity	Code No.
Standard	MCC162-16io1	MCC162-16io1	Box	6	429619

### Equivalent Circuits for Simulation

\* on die level

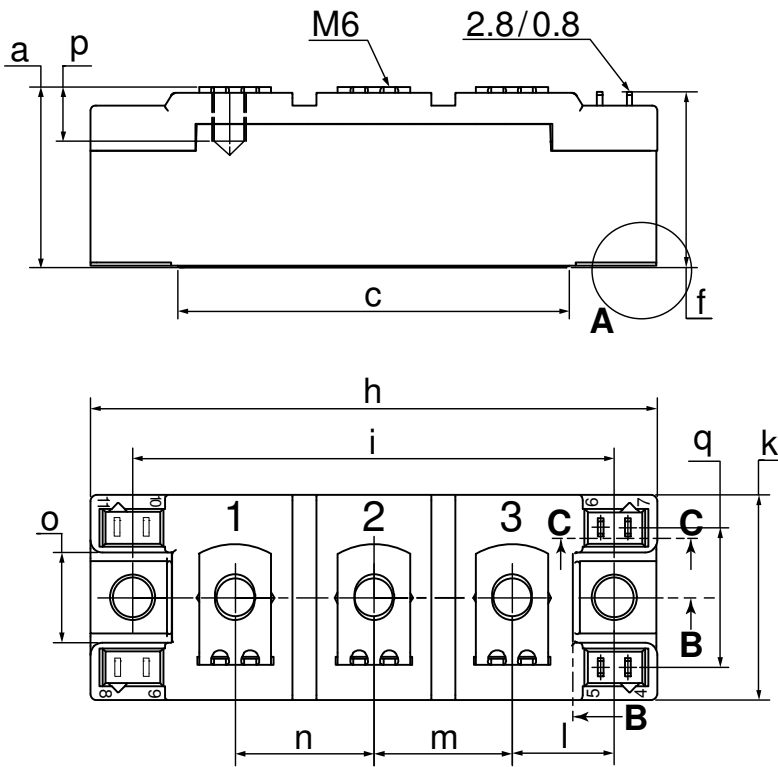
$T_{VJ} = 125^\circ\text{C}$



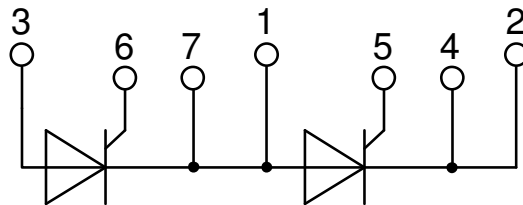
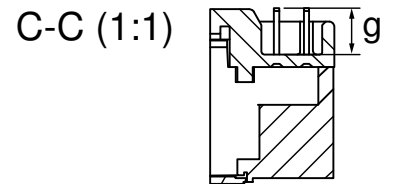
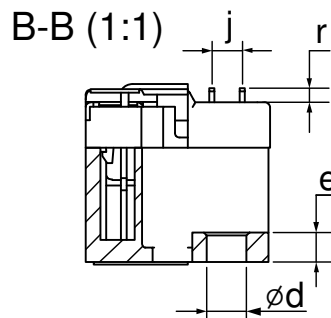
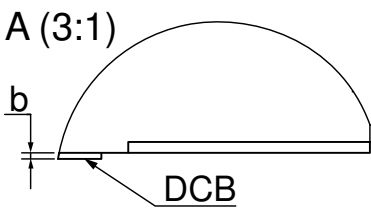
Thyristor

$V_{0\ max}$	threshold voltage	0.88	V
$R_{0\ max}$	slope resistance *	0.8	mΩ

## Outlines Y4



Dim.	MIN [mm]	MIN [mm]	MIN [inch]	MIN [inch]
a	30.0	30.6	1.181	1.205
b	typ. 0.25		typ. 0.010	
c	64.0	65.0	2.520	2.559
d	6.5	7.0	0.256	0.275
e	4.9	5.1	0.193	0.201
f	28.6	29.2	1.126	1.150
g	7.3	7.7	0.287	0.303
h	93.5	94.5	3.681	3.720
i	79.5	80.5	3.130	3.169
j	4.8	5.2	0.189	0.205
k	33.4	34.0	1.315	1.339
l	16.7	17.3	0.657	0.681
m	22.7	23.3	0.894	0.917
n	22.7	23.3	0.894	0.917
o	14.0	15.0	0.551	0.591
p	typ. 10.5		typ. 0.413	
q	22.8	23.3	0.898	0.917
r	1.8	2.4	0.071	0.041



Thyristor

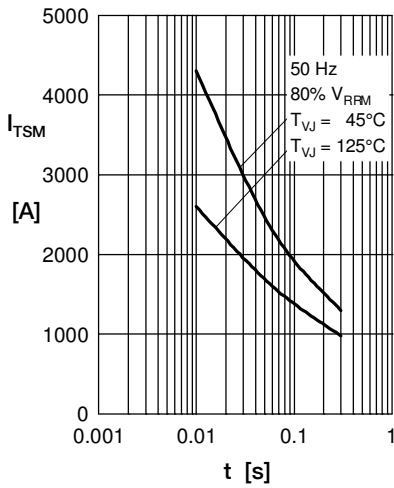


Fig. 1 Surge overload current  $I_{TSM}$ ,  $I_{FSM}$ : Crest value,  $t$ : duration

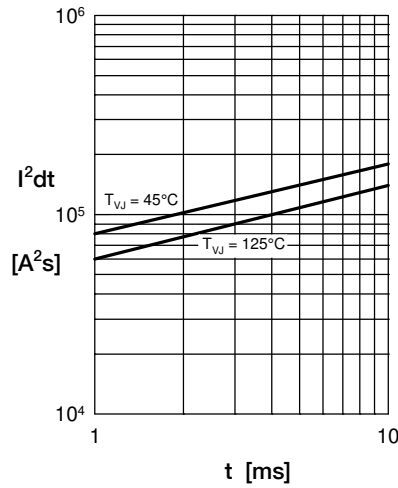


Fig. 2  $I^2dt$  versus time (1-10 ms)

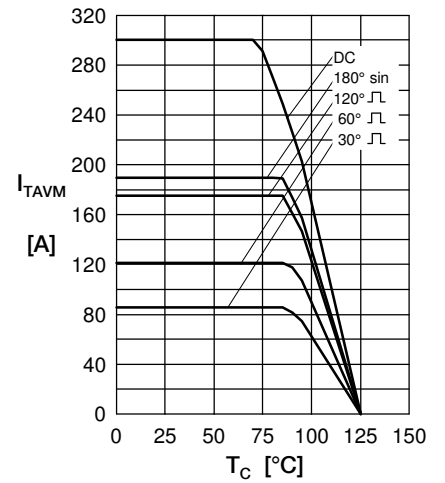


Fig. 3 Max. forward current at case temperature

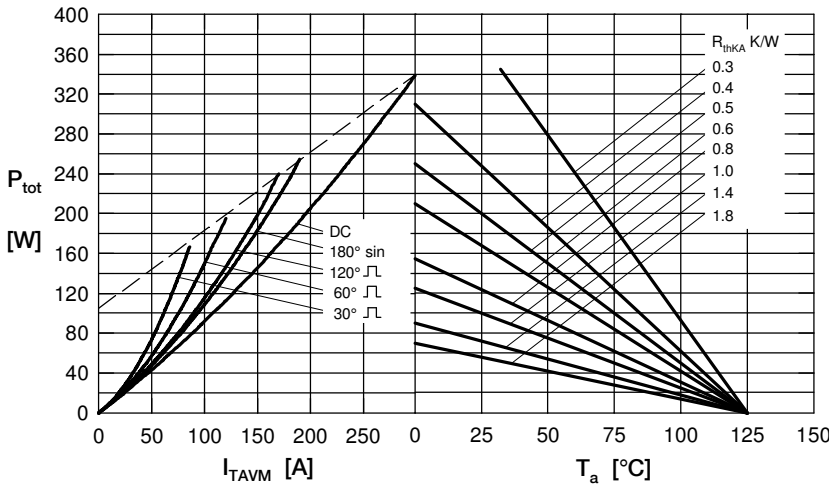


Fig. 4 Power dissipation vs. on-state current & ambient temperature (per thyristor or diode)

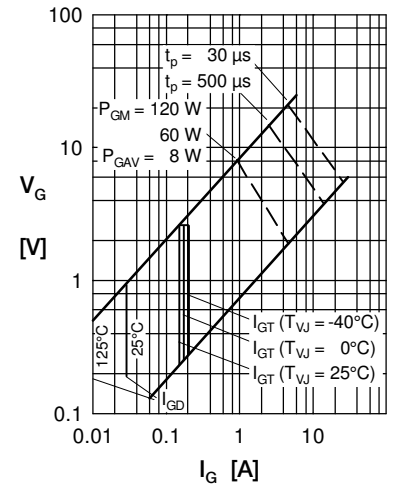


Fig. 5 Gate trigger characteristics

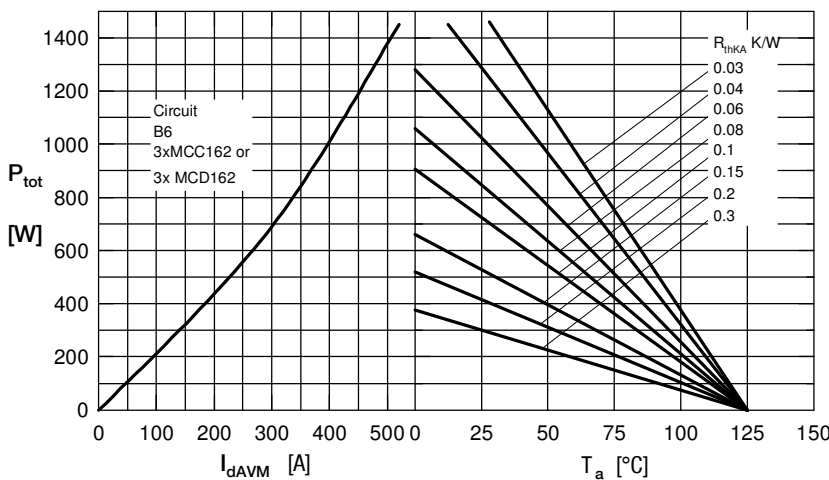


Fig. 6 Three phase rectifier bridge: Power dissipation versus direct output current and ambient temperature

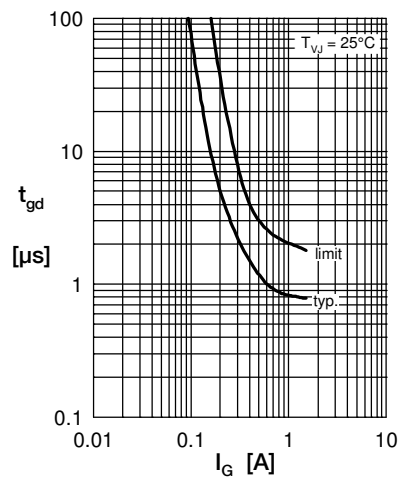


Fig. 7 Gate trigger delay time

**Thyristor**

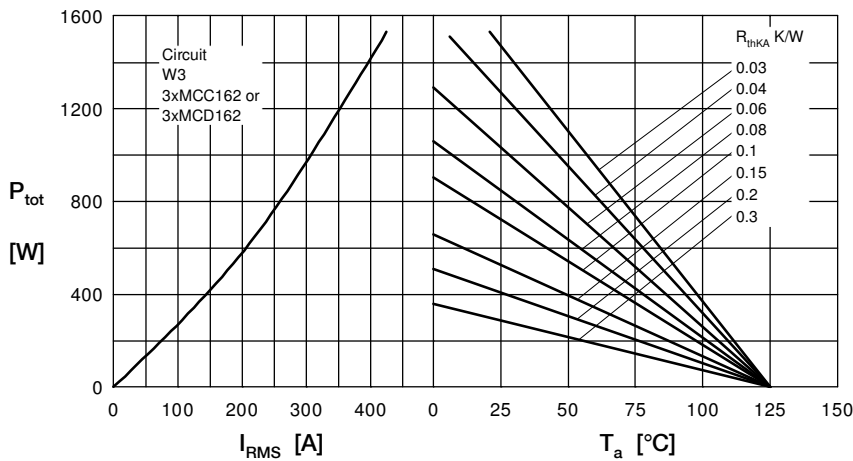
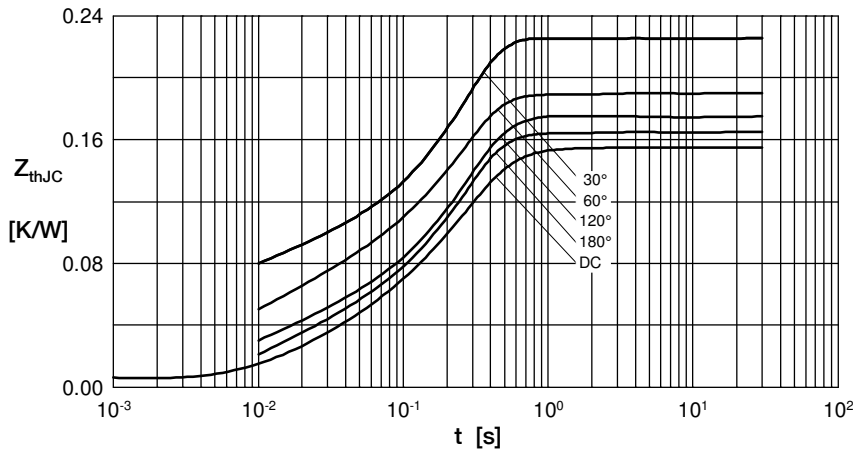


Fig. 8 Three phase AC-controller: Power dissipation versus RMS output current and ambient temperature



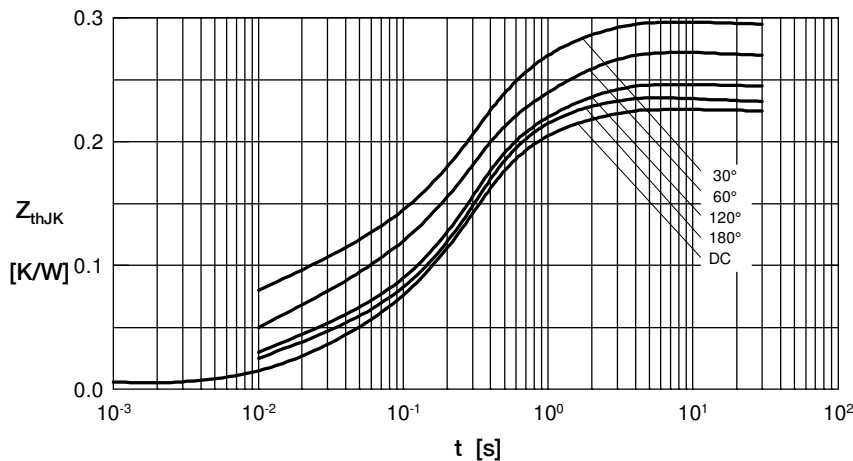
$R_{thJC}$  for various conduction angles d:

d	$R_{thJC}$ [K/W]
DC	0.155
180°	0.167
120°	0.176
60°	0.197
30°	0.227

Constants for  $Z_{thJC}$  calculation:

i	$R_{thi}$ [K/W]	$t_i$ [s]
1	0.0072	0.001
2	0.0188	0.080
3	0.1290	0.200

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



$R_{thJK}$  for various conduction angles d:

d	$R_{thJK}$ [K/W]
DC	0.225
180°	0.237
120°	0.246
60°	0.267
30°	0.297

Constants for  $Z_{thJK}$  calculation:

i	$R_{thi}$ [K/W]	$t_i$ [s]
1	0.0072	0.001
2	0.0188	0.080
3	0.1290	0.200
4	0.0700	1.000

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