

# Thyristor Module

$$V_{RRM} = 2 \times 1400 \text{ V}$$

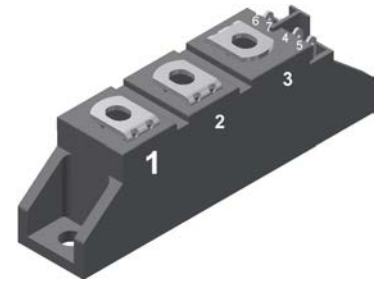
$$I_{TAV} = 60 \text{ A}$$

$$V_T = 1,24 \text{ V}$$

Phase leg

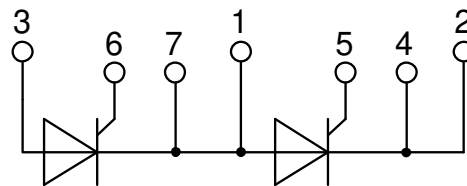
Part number

**MCC56-14io1**



Backside: isolated

 E72873



### 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: 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

### Disclaimer Notice

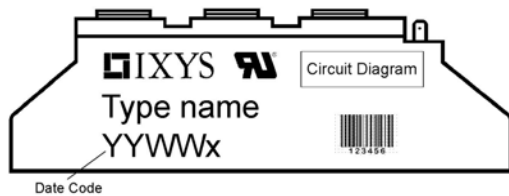
Information furnished is believed to be accurate and reliable. However, users should independently evaluate the suitability of and test each product selected for their own applications. Littelfuse products are not designed for, and may not be used in, all applications. Read complete Disclaimer Notice at [www.littelfuse.com/disclaimer-electronics](http://www.littelfuse.com/disclaimer-electronics).



Thyristor				Ratings			
Symbol	Definition	Conditions	min.	typ.	max.	Unit	
$V_{RSM/DSM}$	max. non-repetitive reverse/forward blocking voltage	$T_{VJ} = 25^{\circ}C$			1500	V	
$V_{RRM/DRM}$	max. repetitive reverse/forward blocking voltage	$T_{VJ} = 25^{\circ}C$			1400	V	
$I_{RD}$	reverse current, drain current	$V_{R/D} = 1400 V$	$T_{VJ} = 25^{\circ}C$		200	$\mu A$	
		$V_{R/D} = 1400 V$	$T_{VJ} = 125^{\circ}C$		5	mA	
$V_T$	forward voltage drop	$I_T = 100 A$	$T_{VJ} = 25^{\circ}C$		1,26	V	
		$I_T = 200 A$			1,57	V	
		$I_T = 100 A$	$T_{VJ} = 125^{\circ}C$		1,24	V	
		$I_T = 200 A$			1,62	V	
$I_{TAV}$	average forward current	$T_C = 85^{\circ}C$	$T_{VJ} = 125^{\circ}C$		60	A	
$I_{T(RMS)}$	RMS forward current	180° sine			94	A	
$V_{T0}$	threshold voltage	} for power loss calculation only	$T_{VJ} = 125^{\circ}C$		0,85	V	
$r_T$	slope resistance				3,7	m $\Omega$	
$R_{thJC}$	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		$T_C = 25^{\circ}C$		222	W	
$I_{TSM}$	max. forward surge current	$t = 10 ms$ ; (50 Hz), sine	$T_{VJ} = 45^{\circ}C$		1,50	kA	
		$t = 8,3 ms$ ; (60 Hz), sine	$V_R = 0 V$		1,62	kA	
		$t = 10 ms$ ; (50 Hz), sine	$T_{VJ} = 125^{\circ}C$		1,28	kA	
		$t = 8,3 ms$ ; (60 Hz), sine	$V_R = 0 V$		1,38	kA	
$I^2t$	value for fusing	$t = 10 ms$ ; (50 Hz), sine	$T_{VJ} = 45^{\circ}C$		11,3	kA <sup>2</sup> s	
		$t = 8,3 ms$ ; (60 Hz), sine	$V_R = 0 V$		10,9	kA <sup>2</sup> s	
		$t = 10 ms$ ; (50 Hz), sine	$T_{VJ} = 125^{\circ}C$		8,13	kA <sup>2</sup> s	
		$t = 8,3 ms$ ; (60 Hz), sine	$V_R = 0 V$		7,87	kA <sup>2</sup> s	
$C_J$	junction capacitance	$V_R = 400V$ $f = 1 MHz$	$T_{VJ} = 25^{\circ}C$		74	pF	
$P_{GM}$	max. gate power dissipation	$t_p = 30 \mu s$	$T_C = 125^{\circ}C$		10	W	
		$t_p = 300 \mu s$			5	W	
$P_{GAV}$	average gate power dissipation				0,5	W	
$(di/dt)_{cr}$	critical rate of rise of current	$T_{VJ} = 125^{\circ}C$ ; $f = 50 Hz$ repetitive, $I_T = 150 A$			150	A/ $\mu s$	
		$t_p = 200 \mu s$ ; $di_G/dt = 0,45 A/\mu s$ ; $I_G = 0,45A$ ; $V_D = \frac{2}{3} V_{DRM}$ non-repet., $I_T = 60 A$			500	A/ $\mu s$	
$(dv/dt)_{cr}$	critical rate of rise of voltage	$V_D = \frac{2}{3} V_{DRM}$ $R_{GK} = \infty$ ; method 1 (linear voltage rise)	$T_{VJ} = 125^{\circ}C$		1000	V/ $\mu s$	
$V_{GT}$	gate trigger voltage	$V_D = 6 V$	$T_{VJ} = 25^{\circ}C$		1,5	V	
			$T_{VJ} = -40^{\circ}C$		1,6	V	
$I_{GT}$	gate trigger current	$V_D = 6 V$	$T_{VJ} = 25^{\circ}C$		100	mA	
			$T_{VJ} = -40^{\circ}C$		200	mA	
$V_{GD}$	gate non-trigger voltage	$V_D = \frac{2}{3} V_{DRM}$	$T_{VJ} = 125^{\circ}C$		0,2	V	
$I_{GD}$	gate non-trigger current				10	mA	
$I_L$	latching current	$t_p = 10 \mu s$	$T_{VJ} = 25^{\circ}C$		450	mA	
		$I_G = 0,45A$ ; $di_G/dt = 0,45 A/\mu s$					
$I_H$	holding current	$V_D = 6 V$ $R_{GK} = \infty$	$T_{VJ} = 25^{\circ}C$		200	mA	
$t_{gd}$	gate controlled delay time	$V_D = \frac{1}{2} V_{DRM}$ $I_G = 0,45A$ ; $di_G/dt = 0,45 A/\mu s$	$T_{VJ} = 25^{\circ}C$		2	$\mu s$	
$t_q$	turn-off time	$V_R = 100 V$ ; $I_T = 150A$ ; $V_D = \frac{2}{3} V_{DRM}$ $di/dt = 10 A/\mu s$ ; $dv/dt = 20 V/\mu s$ ; $t_p = 200 \mu s$	$T_{VJ} = 100^{\circ}C$	150		$\mu s$	

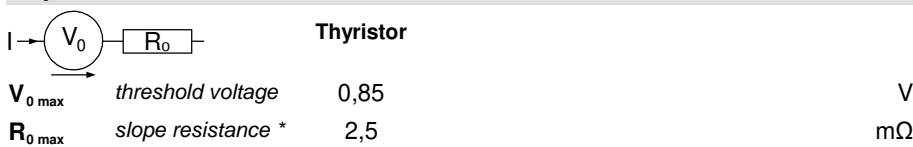


Package TO-240AA				Ratings			
Symbol	Definition	Conditions	min.	typ.	max.	Unit	
$I_{RMS}$	RMS current	per terminal			200	A	
$T_{VJ}$	virtual junction temperature		-40		125	°C	
$T_{op}$	operation temperature		-40		100	°C	
$T_{stg}$	storage temperature		-40		125	°C	
<b>Weight</b>					81	g	
$M_D$	mounting 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			4800	V	
		t = 1 minute	50/60 Hz, RMS; $I_{ISOL} \leq 1$ mA		4000	V	



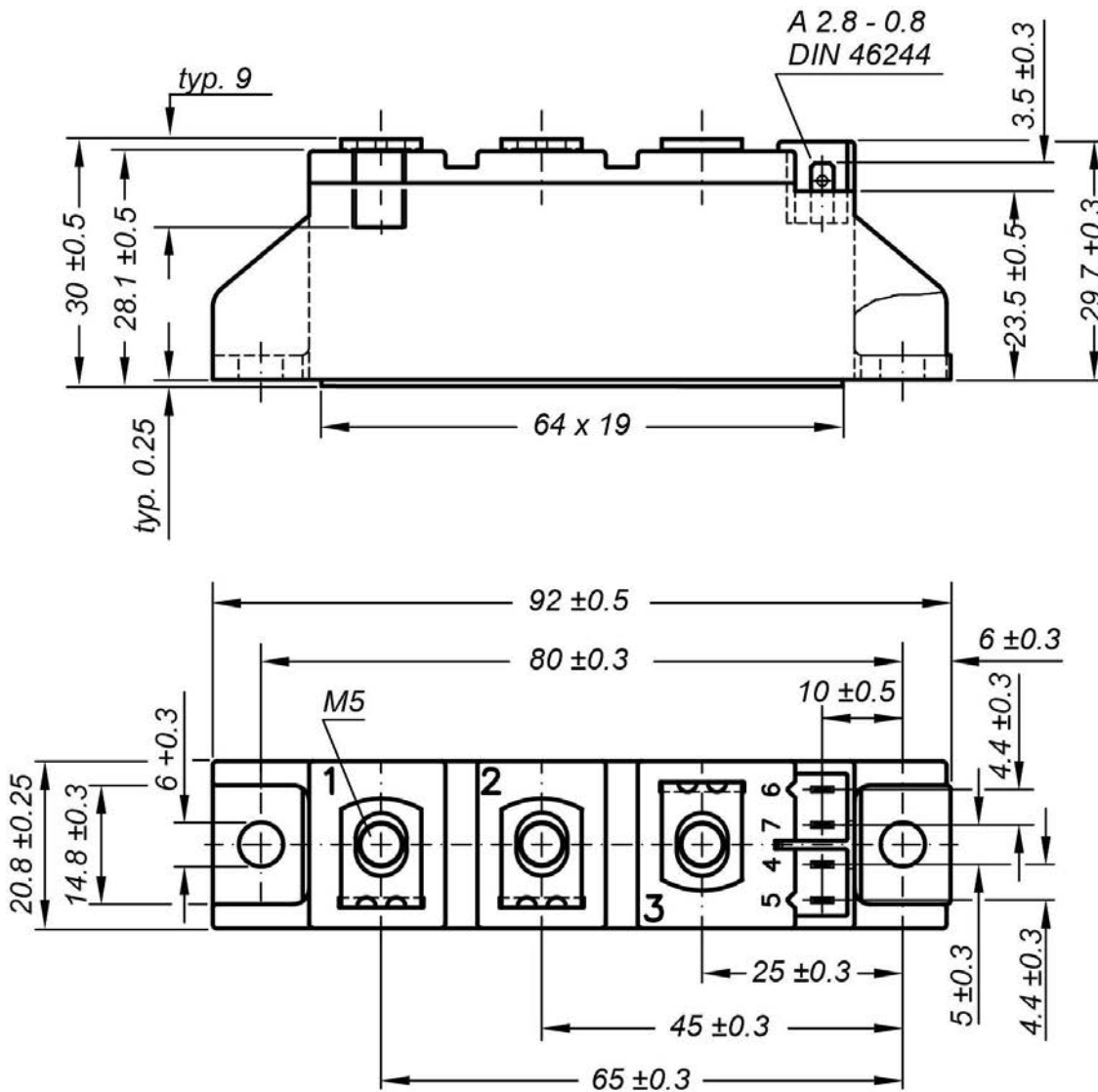
Ordering	Ordering Number	Marking on Product	Delivery Mode	Quantity	Code No.
Standard	MCC56-14IO1	MCC56-14IO1	Box	36	442445

**Equivalent Circuits for Simulation** \* on die level  $T_{VJ} = 125^{\circ}C$





**Outlines TO-240AA**

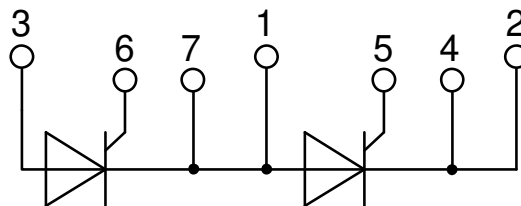


**Optional accessories for modules**

Keyed gate/cathode twin plugs with wire length = 350 mm, gate = white, cathode = red

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**

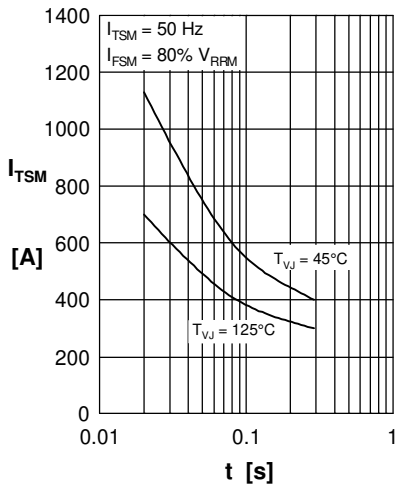


Fig. 1 Surge overload current  $I_{TSM}$ ,  $I_{FSM}$ : Crest value,  $t$ : duration

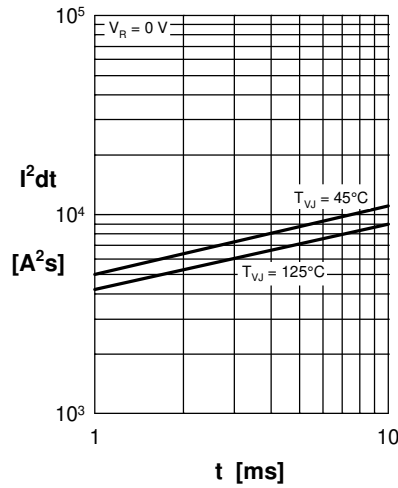


Fig. 2  $I^2dt$  versus time (1-10 ms)

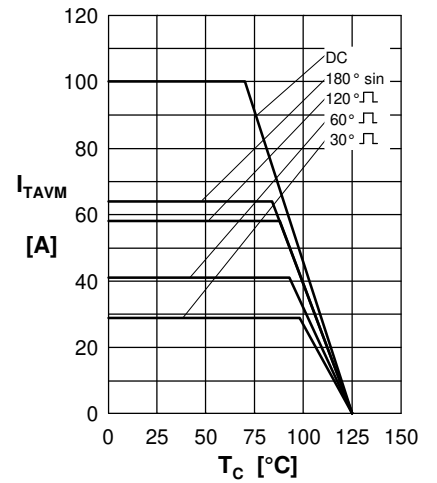


Fig. 3 Max. forward current at case temperature

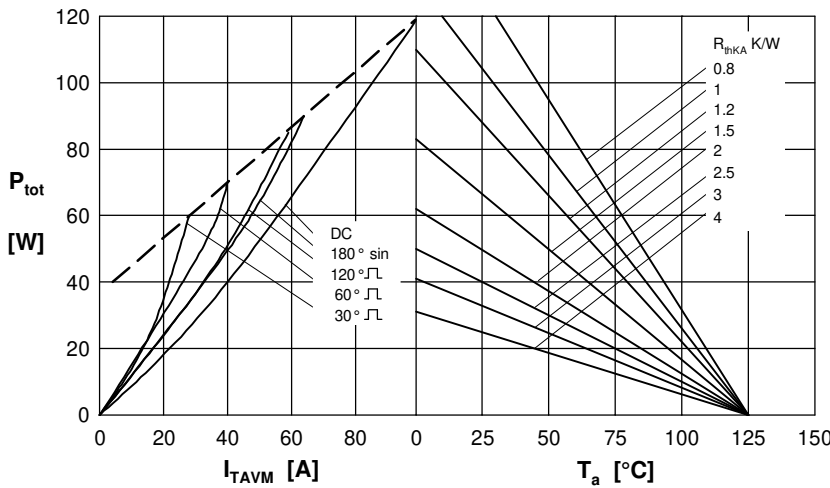


Fig. 4 Power dissipation vs. on-state current & ambient temperature (per thyristor or diode)

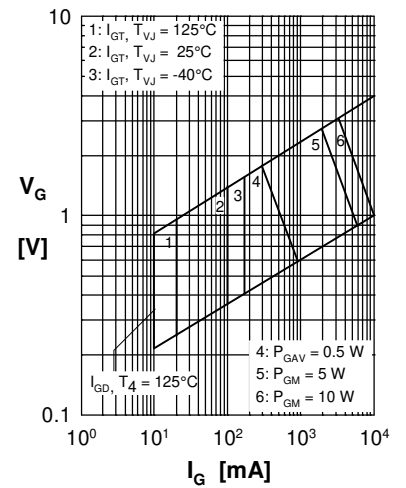


Fig. 5 Gate trigger characteristics

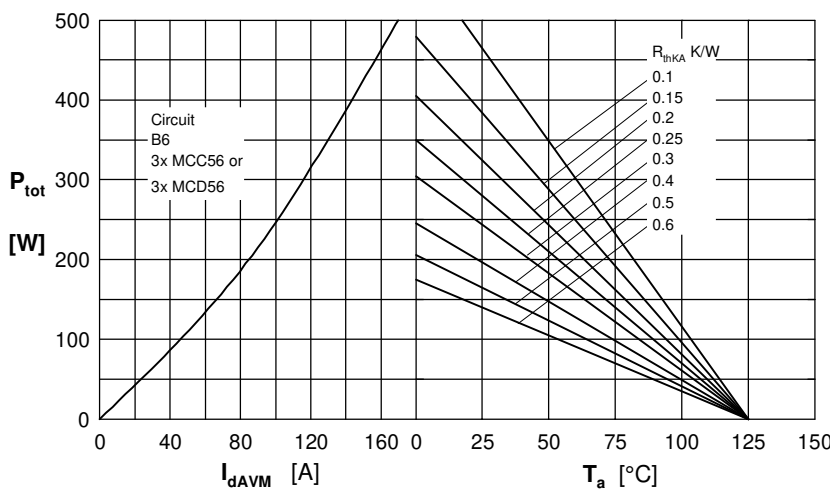


Fig. 6 Three phase rectifier bridge: Power dissipation versus direct output current and ambient temperature

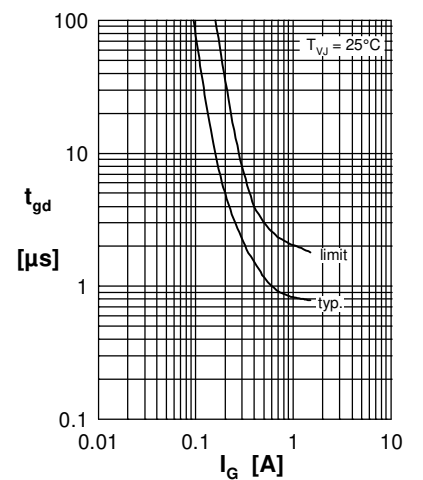


Fig. 7 Gate trigger delay time



**Thyristor**

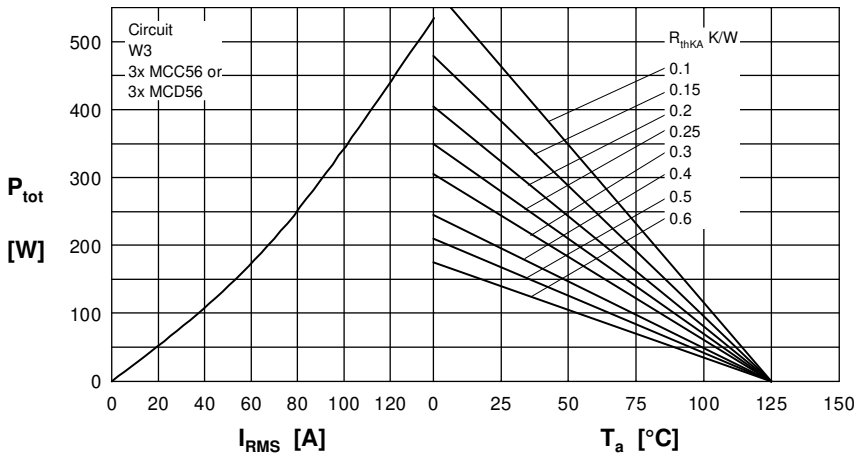
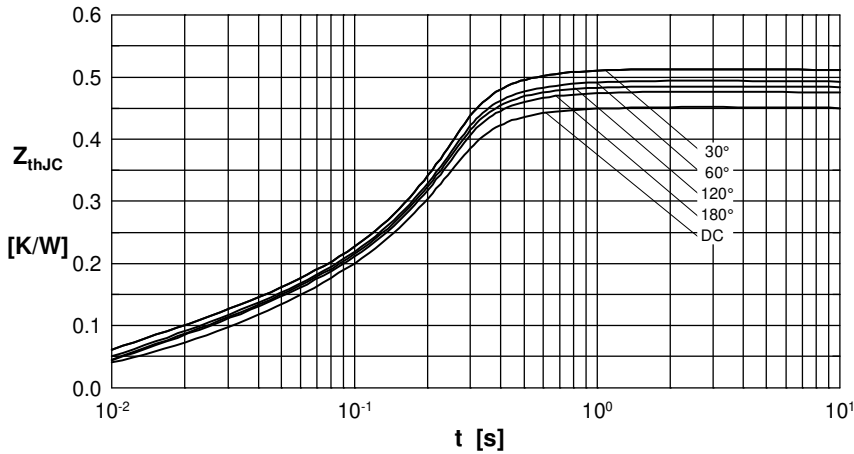


Fig. 8 Three phase AC-controller: Power dissipation versus RMS output current and ambient temperature



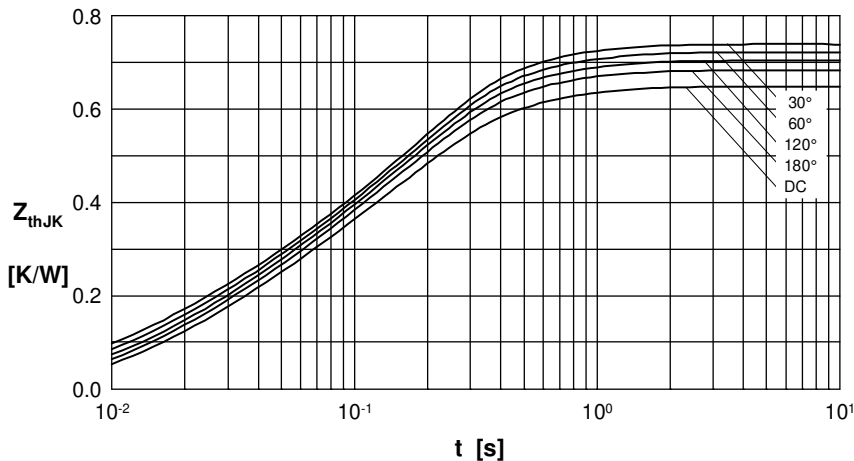
$R_{thJC}$  for various conduction angles d:

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. 9 Transient thermal impedance junction to case (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

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