

# Thyristor Module

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

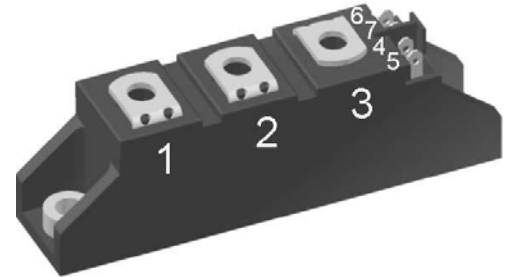
$$I_{TAV} = 85 \text{ A}$$

$$V_T = 1.34 \text{ V}$$

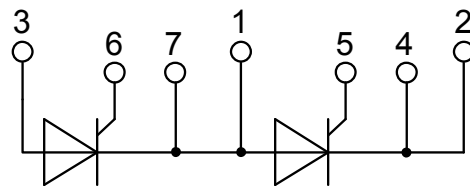
Phase leg

Part number

**MCC72-16io1B**



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:

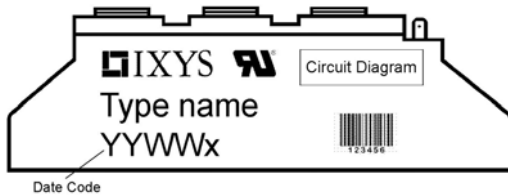
- Line rectifying 50/60 Hz
- Softstart AC motor control
- DC Motor control
- Power converter
- AC power control
- Lighting and temperature control

### Package: 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

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	$V_{RD} = 1600\text{ V}$	$T_{VJ} = 25^{\circ}\text{C}$		200	$\mu\text{A}$	
		$V_{RD} = 1600\text{ V}$	$T_{VJ} = 125^{\circ}\text{C}$		5	mA	
$V_T$	forward voltage drop	$I_T = 150\text{ A}$	$T_{VJ} = 25^{\circ}\text{C}$		1.34	V	
					1.74	V	
		$I_T = 300\text{ A}$	$T_{VJ} = 125^{\circ}\text{C}$		1.34	V	
					1.82	V	
$I_{TAV}$	average forward current	$T_C = 85^{\circ}\text{C}$	$T_{VJ} = 125^{\circ}\text{C}$		85	A	
$I_{T(RMS)}$	RMS forward current	180° sine			180	A	
$V_{T0}$	threshold voltage	} for power loss calculation only	$T_{VJ} = 125^{\circ}\text{C}$		0.85	V	
$r_T$	slope resistance				3.2	m $\Omega$	
$R_{thJC}$	thermal resistance junction to case				0.3	K/W	
$R_{thCH}$	thermal resistance case to heatsink			0.20		K/W	
$P_{tot}$	total power dissipation		$T_C = 25^{\circ}\text{C}$		333	W	
$I_{TSM}$	max. forward surge current	$t = 10\text{ ms}; (50\text{ Hz}), \text{ sine}$	$T_{VJ} = 45^{\circ}\text{C}$		1.70	kA	
			$V_R = 0\text{ V}$		1.84	kA	
		$t = 8,3\text{ ms}; (60\text{ Hz}), \text{ sine}$	$T_{VJ} = 125^{\circ}\text{C}$		1.45	kA	
			$V_R = 0\text{ V}$		1.56	kA	
$I^2t$	value for fusing	$t = 10\text{ ms}; (50\text{ Hz}), \text{ sine}$	$T_{VJ} = 45^{\circ}\text{C}$		14.5	kA <sup>2</sup> s	
			$V_R = 0\text{ V}$		14.0	kA <sup>2</sup> s	
		$t = 8,3\text{ ms}; (60\text{ Hz}), \text{ sine}$	$T_{VJ} = 125^{\circ}\text{C}$		10.4	kA <sup>2</sup> s	
			$V_R = 0\text{ V}$		10.1	kA <sup>2</sup> s	
$C_J$	junction capacitance	$V_R = 400\text{ V}$ $f = 1\text{ MHz}$	$T_{VJ} = 25^{\circ}\text{C}$		119	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, $I_T = 250\text{ A}$		150	A/ $\mu\text{s}$	
			$t_p = 200\text{ }\mu\text{s}; di_G/dt = 0.45\text{ A}/\mu\text{s};$				
			$I_G = 0.45\text{ A}; V_D = \frac{2}{3} V_{DRM}$ non-repet., $I_T = 85\text{ A}$		500	A/ $\mu\text{s}$	
$(dv/dt)_{cr}$	critical rate of rise of voltage	$V_D = \frac{2}{3} V_{DRM}$	$T_{VJ} = 125^{\circ}\text{C}$		1000	V/ $\mu\text{s}$	
			$R_{GK} = \infty$ ; method 1 (linear voltage rise)				
$V_{GT}$	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	$t_p = 10\text{ }\mu\text{s}$	$T_{VJ} = 25^{\circ}\text{C}$		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	$\mu\text{s}$	
		$I_G = 0.45\text{ A}; di_G/dt = 0.45\text{ A}/\mu\text{s}$					
$t_q$	turn-off time	$V_R = 100\text{ V}; I_T = 150\text{ A}; V_D = \frac{2}{3} V_{DRM}$	$T_{VJ} = 125^{\circ}\text{C}$		185	$\mu\text{s}$	
		$di/dt = 10\text{ A}/\mu\text{s}; dv/dt = 20\text{ V}/\mu\text{s}; t_p = 200\text{ }\mu\text{s}$					

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>					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		3600		V
		t = 1 minute	50/60 Hz, RMS; $I_{ISOL} \leq 1$ mA	3000		V



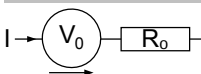
Ordering	Part Number	Marking on Product	Delivery Mode	Quantity	Code No.
Standard	MCC72-16io1B	MCC72-16io1B	Box	6	452718

Similar Part	Package	Voltage class
MCMA85P1600TA	TO-240AA-1B	1600
MCMA110P1600TA	TO-240AA-1B	1600

### Equivalent Circuits for Simulation

\* on die level

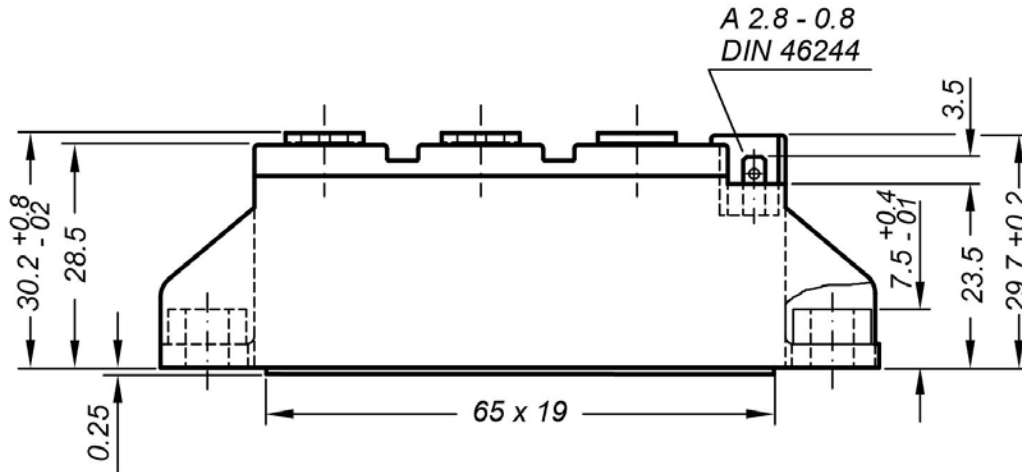
$T_{VJ} = 125^\circ\text{C}$



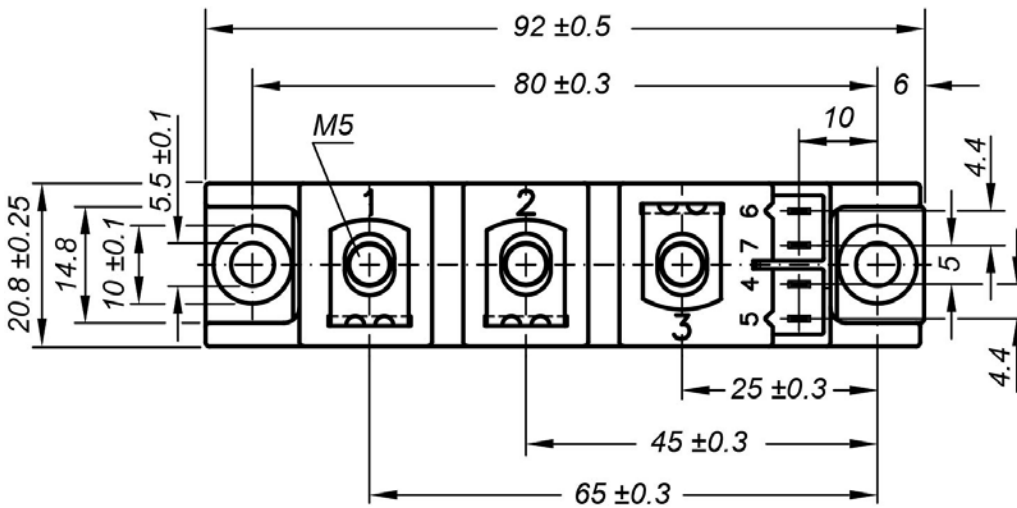
Thyristor

$V_{0\ max}$	threshold voltage	0.85	V
$R_{0\ max}$	slope resistance *	2	mΩ

**Outlines TO-240AA**



General tolerance: DIN ISO 2768 class „c“



Optional accessories: Keyed gate/cathode twin plugs  
 Wire length: 350 mm, gate = white, cathode = red  
 UL 758, style 3751  
 Type **ZY 200L** (L = Left for pin pair 4/5)  
 Type **ZY 200R** (R = Right for pin pair 6/7)



## Thyristor

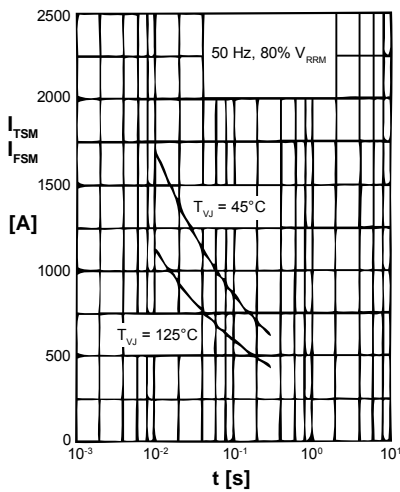


Fig. 1 Surge overload current  
 $I_{TSM}$ ,  $I_{FSM}$ : Crest value, t: duration

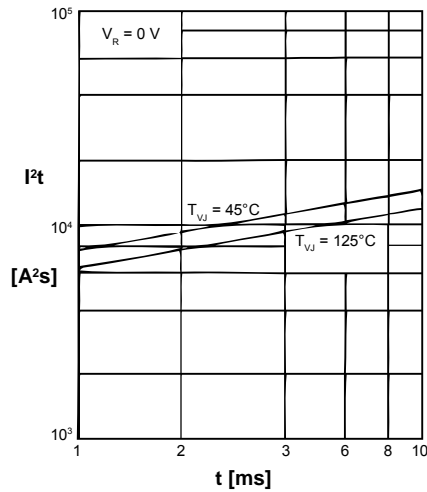


Fig. 2  $I^2t$  versus time (1-10 ms)

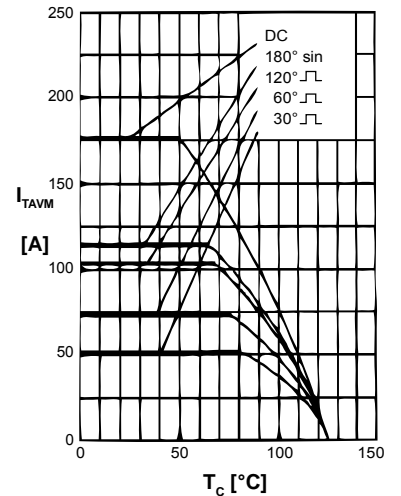


Fig. 3 Maximum forward current at case temperature

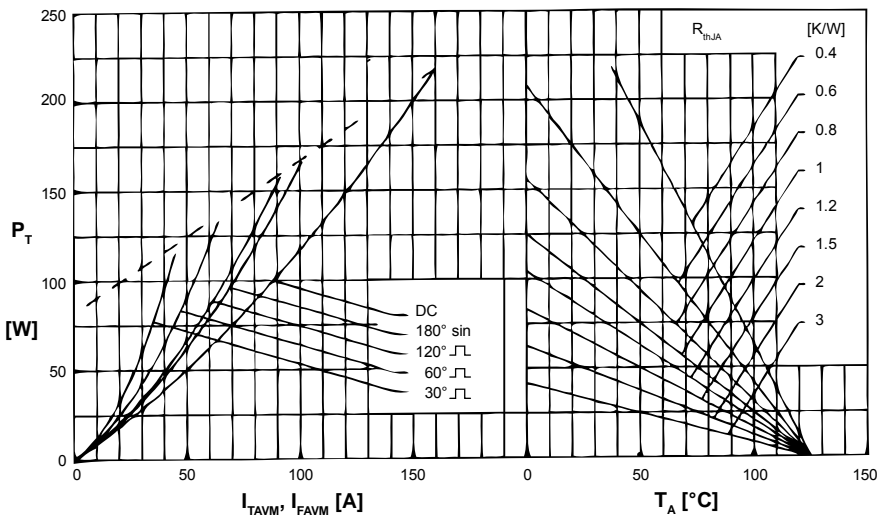


Fig. 4 Power dissipation vs. onstate current and ambient temperature (per thyristor/diode)

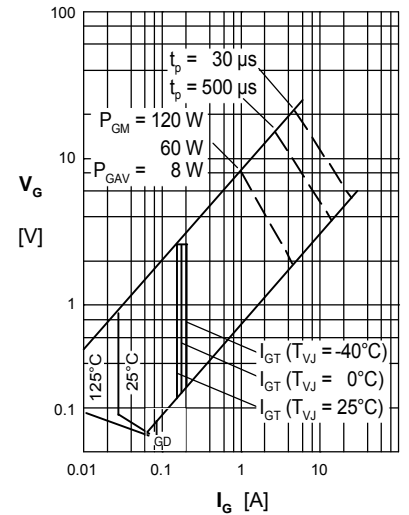


Fig. 5 Gate trigger characteristics

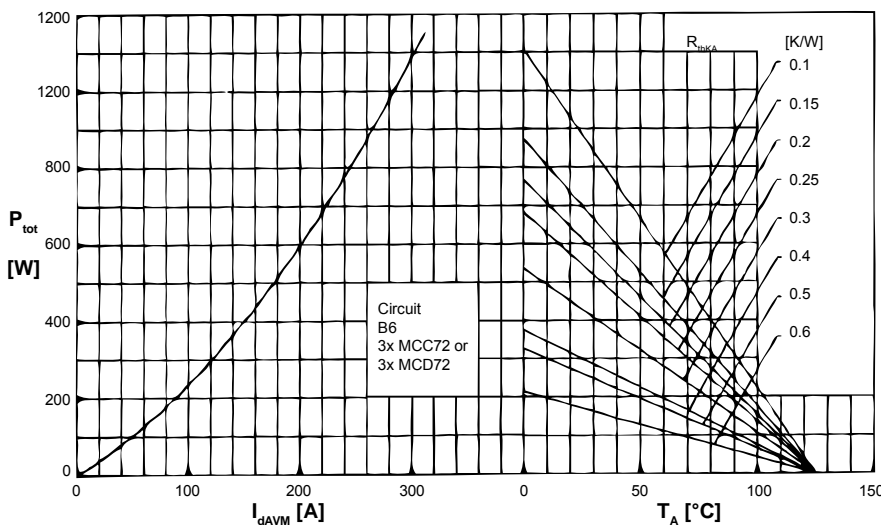


Fig. 6 Three phase rectifier bridge: Power dissipation versus direct output current and ambient temperature

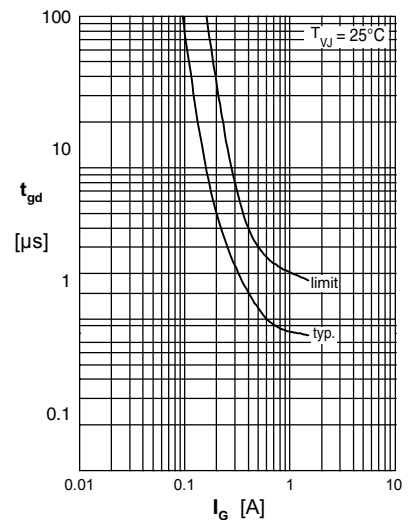


Fig. 7 Gate trigger delay time

Thyristor

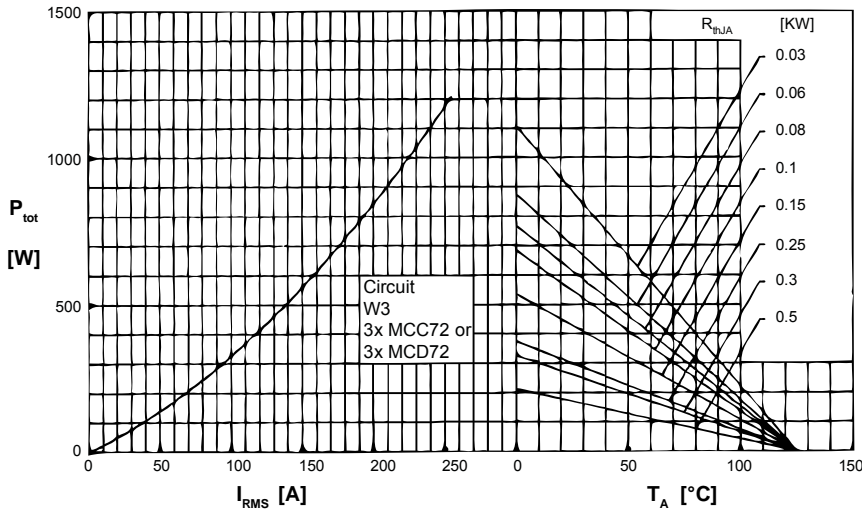


Fig. 8 Three phase AC-controller: Power dissipation versus RMS output current and ambient temperature

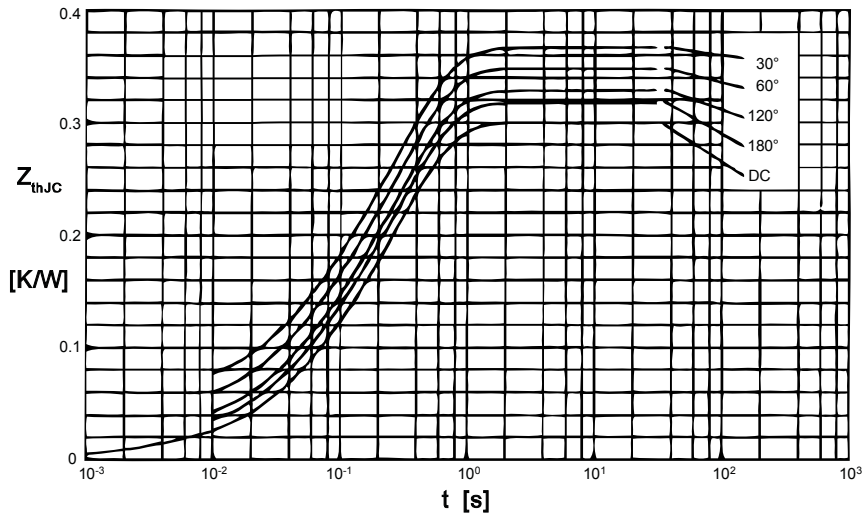


Fig. 9 Transient thermal impedance junction to case (per thyristor)

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

d	$R_{thJC}$ [K/W]
DC	0.30
180°	0.31
120°	0.33
60°	0.35
30°	0.37

Constants for  $Z_{thJC}$  calculation:

i	$R_{thi}$ [K/W]	$t_i$ [s]
1	0.008	0.0019
2	0.054	0.0470
3	0.238	0.3000

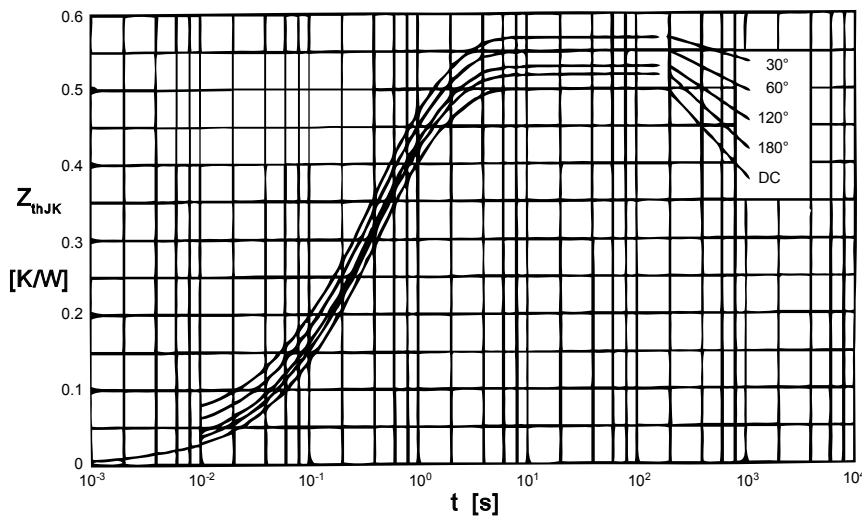


Fig. 10 Transient thermal impedance junction to heatsink (per thyristor)

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

d	$R_{thJK}$ [K/W]
DC	0.50
180°	0.51
120°	0.53
60°	0.55
30°	0.57

Constants for  $Z_{thJK}$  calculation:

i	$R_{thi}$ [K/W]	$t_i$ [s]
1	0.008	0.0019
2	0.054	0.0470
3	0.238	0.3000
4	0.200	1.2500