

High Voltage Thyristor \ Diode Module

$$V_{RRM} = 2 \times 2200 \text{ V}$$

$$I_{TAV} = 250 \text{ A}$$

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

Phase leg

Part number

MCD224-22io1



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: Y1

- Isolation Voltage: 3600 V~
- Industry standard outline
- RoHS compliant
- Soldering pins for PCB mounting
- Base plate: Copper internally DCB isolated
- Advanced power cycling

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Rectifier			Ratings			
Symbol	Definition	Conditions	min.	typ.	max.	Unit
$V_{RSM/DSM}$	max. non-repetitive reverse/forward blocking voltage	$T_{VJ} = 25^{\circ}C$			2300	V
$V_{RRM/DRM}$	max. repetitive reverse/forward blocking voltage	$T_{VJ} = 25^{\circ}C$			2200	V
I_{RD}	reverse current, drain current	$V_{R/D} = 2200 V$	$T_{VJ} = 25^{\circ}C$		1	mA
		$V_{R/D} = 2200 V$	$T_{VJ} = 140^{\circ}C$		40	mA
V_T	forward voltage drop	$I_T = 250 A$	$T_{VJ} = 25^{\circ}C$		1.08	V
		$I_T = 500 A$			1.31	V
		$I_T = 250 A$	$T_{VJ} = 125^{\circ}C$		1.03	V
		$I_T = 500 A$			1.33	V
I_{TAV}	average forward current	$T_C = 85^{\circ}C$	$T_{VJ} = 140^{\circ}C$		250	A
$I_{T(RMS)}$	RMS forward current	180° sine			390	A
V_{T0}	threshold voltage	} for power loss calculation only	$T_{VJ} = 140^{\circ}C$		0.72	V
r_T	slope resistance				1.2	mΩ
R_{thJC}	thermal resistance junction to case				0.139	K/W
R_{thCH}	thermal resistance case to heatsink			0.04		K/W
P_{tot}	total power dissipation		$T_C = 25^{\circ}C$		820	W
I_{TSM}	max. forward surge current	$t = 10 \text{ ms}; (50 \text{ Hz}), \text{ sine}$	$T_{VJ} = 45^{\circ}C$		8.00	kA
		$t = 8,3 \text{ ms}; (60 \text{ Hz}), \text{ sine}$	$V_R = 0 V$		8.64	kA
		$t = 10 \text{ ms}; (50 \text{ Hz}), \text{ sine}$	$T_{VJ} = 140^{\circ}C$		6.80	kA
		$t = 8,3 \text{ ms}; (60 \text{ Hz}), \text{ sine}$	$V_R = 0 V$		7.35	kA
I^2t	value for fusing	$t = 10 \text{ ms}; (50 \text{ Hz}), \text{ sine}$	$T_{VJ} = 45^{\circ}C$		320.0	kA ² s
		$t = 8,3 \text{ ms}; (60 \text{ Hz}), \text{ sine}$	$V_R = 0 V$		310.5	kA ² s
		$t = 10 \text{ ms}; (50 \text{ Hz}), \text{ sine}$	$T_{VJ} = 140^{\circ}C$		231.2	kA ² s
		$t = 8,3 \text{ ms}; (60 \text{ Hz}), \text{ sine}$	$V_R = 0 V$		224.4	kA ² s
C_J	junction capacitance	$V_R = 700 V \quad f = 1 \text{ MHz}$	$T_{VJ} = 25^{\circ}C$		235	pF
P_{GM}	max. gate power dissipation	$t_p = 30 \mu s$	$T_C = 140^{\circ}C$		120	W
		$t_p = 500 \mu s$			60	W
P_{GAV}	average gate power dissipation				20	W
$(di/dt)_{cr}$	critical rate of rise of current	$T_{VJ} = 125^{\circ}C; f = 50 \text{ Hz}$	repetitive, $I_T = 750 A$		100	A/μs
		$t_p = 200 \mu s; di_G/dt = 1 A/\mu s;$	non-repet., $I_T = 250 A$		500	A/μs
$(dv/dt)_{cr}$	critical rate of rise of voltage	$V = \frac{2}{3} V_{DRM}$	$T_{VJ} = 125^{\circ}C$		1000	V/μs
		$R_{GK} = \infty; \text{method 1 (linear voltage rise)}$				
V_{GT}	gate trigger voltage	$V_D = 6 V$	$T_{VJ} = 25^{\circ}C$		2	V
			$T_{VJ} = -40^{\circ}C$		3	V
I_{GT}	gate trigger current	$V_D = 6 V$	$T_{VJ} = 25^{\circ}C$		150	mA
			$T_{VJ} = -40^{\circ}C$		220	mA
V_{GD}	gate non-trigger voltage	$V_D = \frac{2}{3} V_{DRM}$	$T_{VJ} = 140^{\circ}C$		0.25	V
I_{GD}	gate non-trigger current				10	mA
I_L	latching current	$t_p = 30 \mu s$	$T_{VJ} = 25^{\circ}C$		200	mA
		$I_G = 0.45 A; di_G/dt = 0.45 A/\mu s$				
I_H	holding current	$V_D = 6 V \quad R_{GK} = \infty$	$T_{VJ} = 25^{\circ}C$		150	mA
t_{gd}	gate controlled delay time	$V_D = \frac{1}{2} V_{DRM}$	$T_{VJ} = 25^{\circ}C$		2	μs
		$I_G = 0.5 A; di_G/dt = 0.5 A/\mu s$				
t_q	turn-off time	$V_R = 100 V; I_T = 250 A; V = \frac{2}{3} V_{DRM}$	$T_{VJ} = 125^{\circ}C$		350	μs
		$di/dt = 10 A/\mu s \quad dv/dt = 50 V/\mu s \quad t_p = 200 \mu s$				



Package Y1			Ratings			
Symbol	Definition	Conditions	min.	typ.	max.	Unit
I_{RMS}	RMS current	per terminal			600	A
T_{VJ}	virtual junction temperature		-40		140	°C
T_{op}	operation temperature		-40		125	°C
T_{stg}	storage temperature		-40		125	°C
Weight				680		g
M_D	mounting torque		4.5		7	Nm
M_T	terminal torque		11		13	Nm
$d_{Spp/App}$	creepage distance on surface striking distance through air	terminal to terminal	16.0			mm
$d_{Spb/Apb}$		terminal to backside	16.0			mm
V_{ISOL}	isolation voltage	t = 1 second	3600			V
		t = 1 minute	3000			V



Data Matrix: part no. (1-19), DC + PI (20-25), lot.no.# (26-31), blank (32), serial no.# (33-36)

Ordering	Ordering Number	Marking on Product	Delivery Mode	Quantity	Code No.
Standard	MCD224-22io1	MCD224-22io1	Box	3	479101

Equivalent Circuits for Simulation

* on die level

$T_{VJ} = 140^{\circ}C$

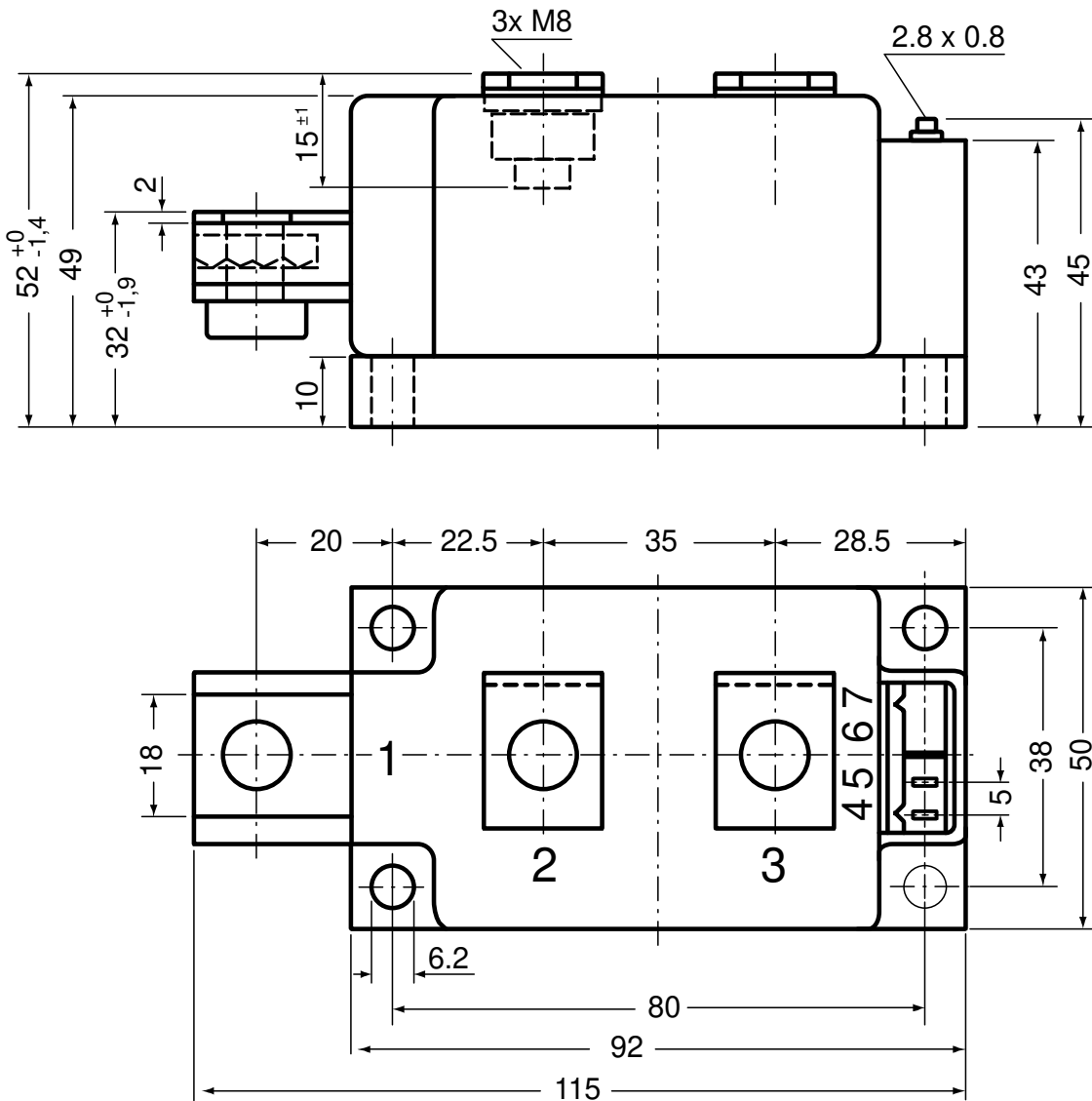


Thyristor

$V_{0\ max}$	threshold voltage	0.72	V
$R_{0\ max}$	slope resistance *	1.01	mΩ

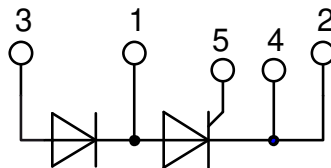


Outlines Y1



Optional accessories for modules

Keyed gate/cathode twin plugs with wire length = 350 mm, gate = white, cathode = red
Type ZY 180L (L = Left for pin pair 4/5) UL 758, style 3751



Thyristor

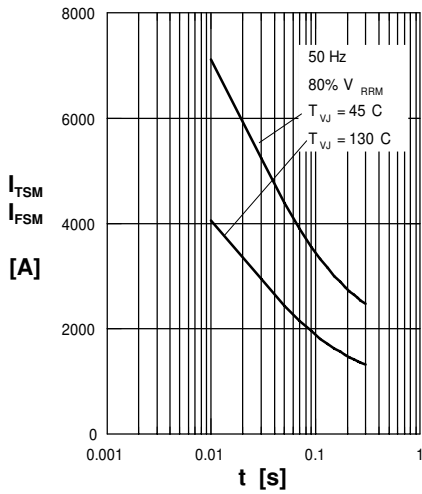


Fig. 1 Surge overload current
 $I_{T(F)SM}$: crest value, t: duration

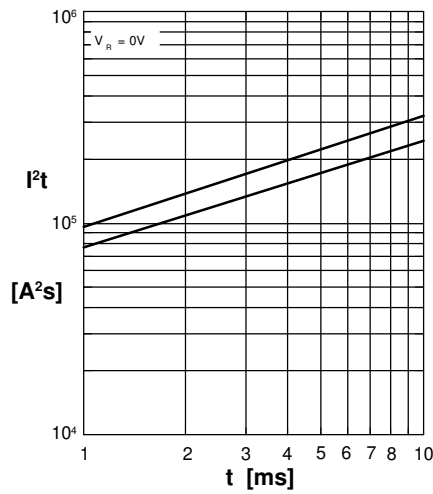


Fig. 2 I^2t versus time (1-10 ms)

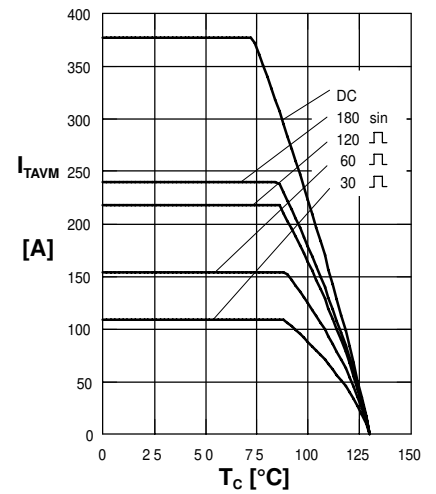


Fig. 3 Max. forward current at case temperature

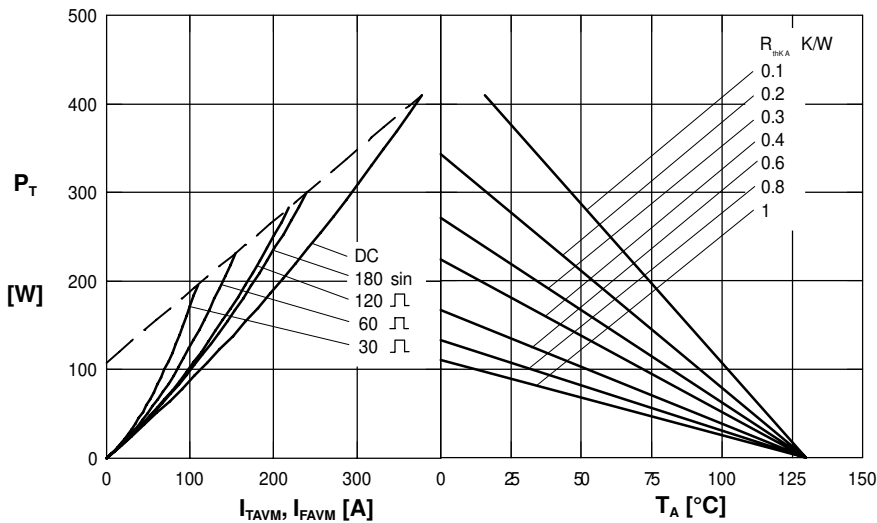


Fig. 4 Power dissipation versus onstate current and ambient temperature (per thyristor/diode)

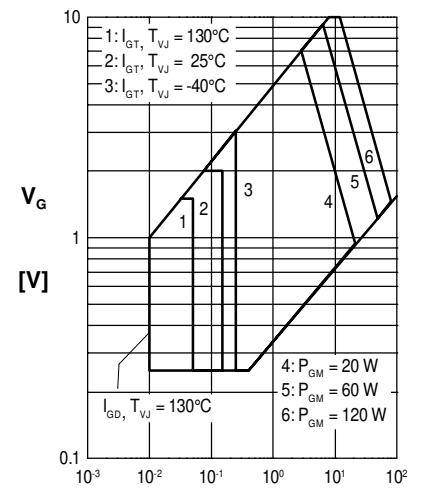


Fig. 5 Gate trigger characteristics

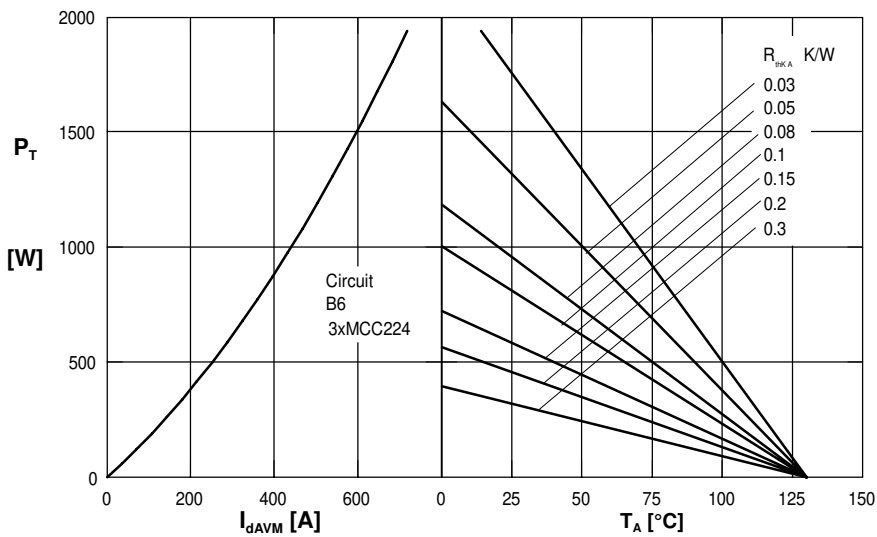


Fig. 6 Three phase rectifier bridge: Power dissipation versus direct output current and ambient temperature

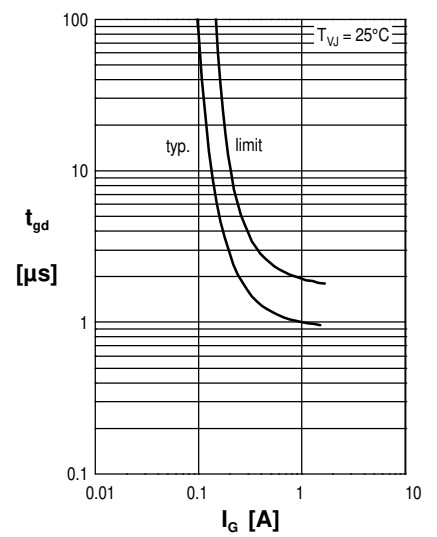


Fig. 7 Gate trigger delay time

Rectifier

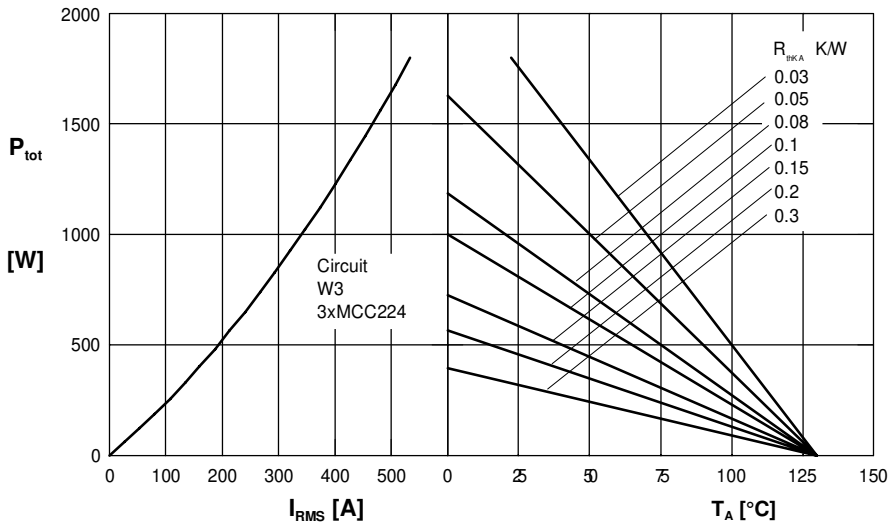


Fig. 7 Three phase AC-controller: Power dissipation versus RMS output current and ambient temperature

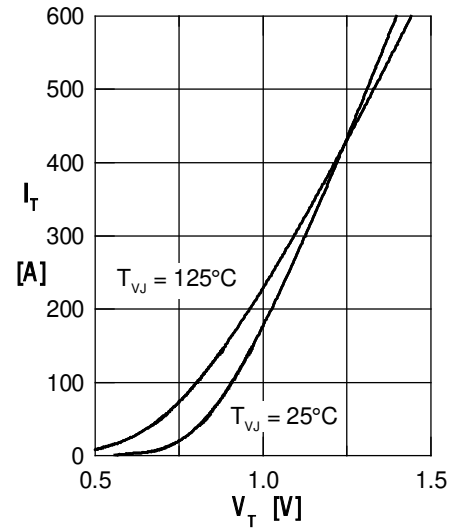


Fig. 10 Forward characteristics

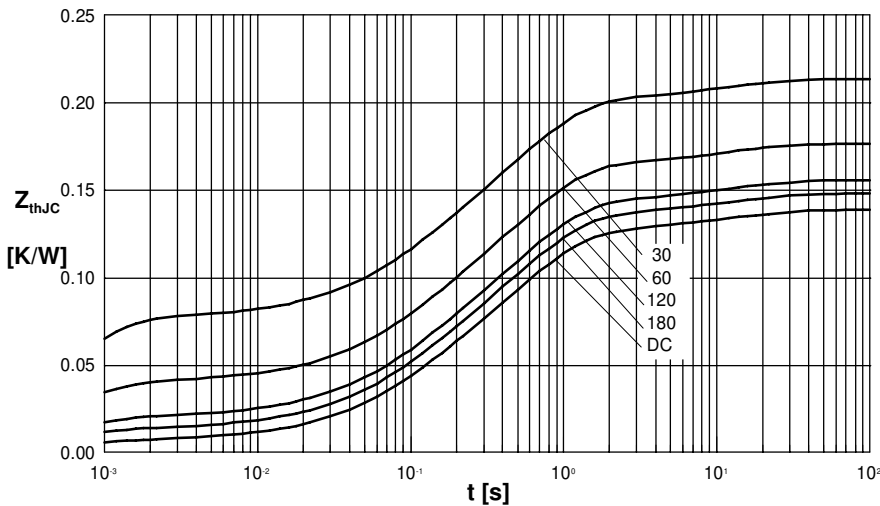


Fig. 8 Transient thermal impedance junction to case (per thyristor/diode)

R_{thJC} for various conduction angles d :

d	R_{thJC} [K/W]
DC	0.139
180°C	0.148
120°C	0.156
60°C	0.176
30°C	0.214

Constants for Z_{thJC} calculation:

i	R_{thi} [K/W]	t_i [s]
1	0.0067	0.00054
2	0.0358	0.098
3	0.0832	0.540
4	0.0129	12.00

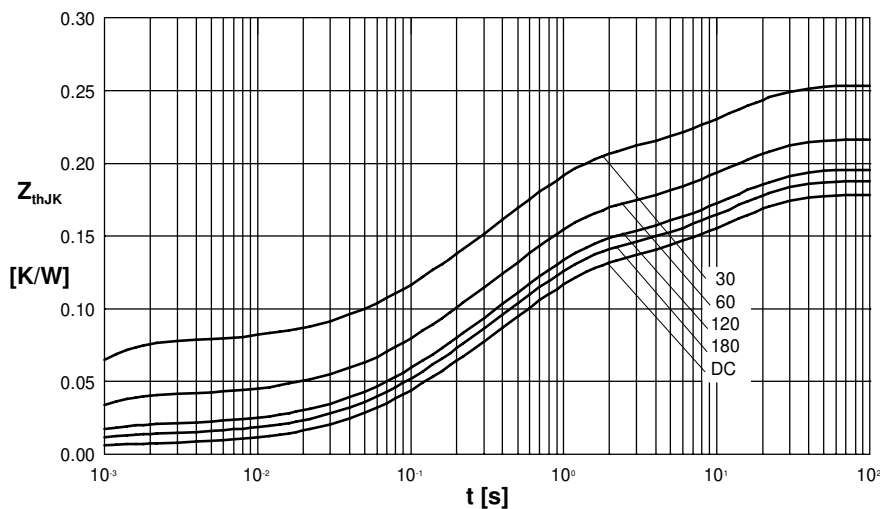


Fig. 9 Transient thermal impedance junction to heatsink (per thyristor/diode)

R_{thJK} for various conduction angles d :

d	R_{thJK} [K/W]
DC	0.179
180°C	0.188
120°C	0.196
60°C	0.216
30°C	0.256

Constants for Z_{thJK} calculation:

i	R_{thi} [K/W]	t_i [s]
1	0.0067	0.001
2	0.0358	0.080
3	0.0832	0.200
4	0.0129	1.000