

High Voltage Thyristor \ Diode Module

$$V_{RRM} = 2 \times 2000 \text{ V}$$

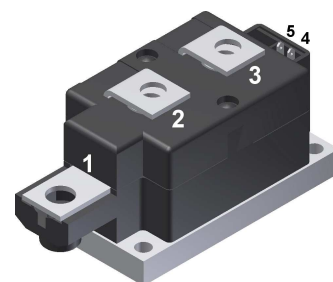
$$I_{TAV} = 250 \text{ A}$$

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

Phase leg

Part number

MCD224-20io1



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

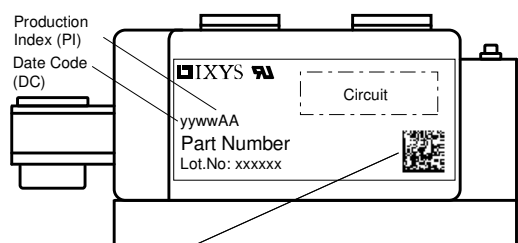
- Isolation Voltage: 3600 V~
- Industry standard outline
- RoHS compliant
- Soldering pins for PCB mounting
- Base plate: Copper internally DCB isolated
- Advanced power cycling

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.

Rectifier				Ratings			
Symbol	Definition	Conditions		min.	typ.	max.	Unit
$V_{RSM/DSM}$	max. non-repetitive reverse/forward blocking voltage	$T_{VJ} = 25^{\circ}\text{C}$				2100	V
$V_{RRM/DRM}$	max. repetitive reverse/forward blocking voltage	$T_{VJ} = 25^{\circ}\text{C}$				2000	V
$I_{R/D}$	reverse current, drain current	$V_{R/D} = 2000\text{ V}$	$T_{VJ} = 25^{\circ}\text{C}$			1	mA
		$V_{R/D} = 2000\text{ V}$	$T_{VJ} = 140^{\circ}\text{C}$			40	mA
V_T	forward voltage drop	$I_T = 250\text{ A}$	$T_{VJ} = 25^{\circ}\text{C}$			1.08	V
		$I_T = 500\text{ A}$				1.31	V
		$I_T = 250\text{ A}$	$T_{VJ} = 125^{\circ}\text{C}$			1.03	V
		$I_T = 500\text{ A}$				1.33	V
I_{TAV}	average forward current	$T_C = 85^{\circ}\text{C}$	$T_{VJ} = 140^{\circ}\text{C}$			250	A
$I_{T(RMS)}$	RMS forward current	180° sine				390	A
V_{T0}	threshold voltage	} for power loss calculation only	$T_{VJ} = 140^{\circ}\text{C}$			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		$T_C = 25^{\circ}\text{C}$			820	W
I_{TSM}	max. forward surge current	$t = 10\text{ ms}; (50\text{ Hz}), \text{ sine}$	$T_{VJ} = 45^{\circ}\text{C}$			8.00	kA
		$t = 8,3\text{ ms}; (60\text{ Hz}), \text{ sine}$	$V_R = 0\text{ V}$			8.64	kA
		$t = 10\text{ ms}; (50\text{ Hz}), \text{ sine}$	$T_{VJ} = 140^{\circ}\text{C}$			6.80	kA
		$t = 8,3\text{ ms}; (60\text{ Hz}), \text{ sine}$	$V_R = 0\text{ V}$			7.35	kA
I^2t	value for fusing	$t = 10\text{ ms}; (50\text{ Hz}), \text{ sine}$	$T_{VJ} = 45^{\circ}\text{C}$			320.0	kA ² s
		$t = 8,3\text{ ms}; (60\text{ Hz}), \text{ sine}$	$V_R = 0\text{ V}$			310.5	kA ² s
		$t = 10\text{ ms}; (50\text{ Hz}), \text{ sine}$	$T_{VJ} = 140^{\circ}\text{C}$			231.2	kA ² s
		$t = 8,3\text{ ms}; (60\text{ Hz}), \text{ sine}$	$V_R = 0\text{ V}$			224.4	kA ² s
C_J	junction capacitance	$V_R = 700\text{ V}$ $f = 1\text{ MHz}$	$T_{VJ} = 25^{\circ}\text{C}$		235		pF
P_{GM}	max. gate power dissipation	$t_p = 30\text{ }\mu\text{s}$	$T_C = 140^{\circ}\text{C}$			120	W
		$t_p = 500\text{ }\mu\text{s}$				60	W
P_{GAV}	average gate power dissipation					20	W
$(di/dt)_{cr}$	critical rate of rise of current	$T_{VJ} = 125^{\circ}\text{C}; f = 50\text{ Hz}$ repetitive, $I_T = 750\text{ A}$				100	A/ μs
		$t_p = 200\text{ }\mu\text{s}; di_G/dt = 1\text{ A}/\mu\text{s};$ $I_G = 1\text{ A}; V = \frac{2}{3} V_{DRM}$ non-repet., $I_T = 250\text{ A}$				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	$V_D = 6\text{ V}$	$T_{VJ} = 25^{\circ}\text{C}$			2	V
			$T_{VJ} = -40^{\circ}\text{C}$			3	V
I_{GT}	gate trigger current	$V_D = 6\text{ V}$	$T_{VJ} = 25^{\circ}\text{C}$			150	mA
			$T_{VJ} = -40^{\circ}\text{C}$			220	mA
V_{GD}	gate non-trigger voltage	$V_D = \frac{2}{3} V_{DRM}$	$T_{VJ} = 140^{\circ}\text{C}$			0.25	V
I_{GD}	gate non-trigger current					10	mA
I_L	latching current	$t_p = 30\text{ }\mu\text{s}$	$T_{VJ} = 25^{\circ}\text{C}$			200	mA
		$I_G = 0.45\text{ A}; di_G/dt = 0.45\text{ A}/\mu\text{s}$					
I_H	holding current	$V_D = 6\text{ V}$ $R_{GK} = \infty$	$T_{VJ} = 25^{\circ}\text{C}$			150	mA
t_{gd}	gate controlled delay time	$V_D = \frac{1}{2} V_{DRM}$	$T_{VJ} = 25^{\circ}\text{C}$			2	μs
		$I_G = 0.5\text{ A}; di_G/dt = 0.5\text{ A}/\mu\text{s}$					
t_q	turn-off time	$V_R = 100\text{ V}; I_T = 250\text{ A}; V = \frac{2}{3} V_{DRM}$ $T_{VJ} = 125^{\circ}\text{C}$ $di/dt = 10\text{ A}/\mu\text{s}$ $dv/dt = 50\text{ V}/\mu\text{s}$ $t_p = 200\text{ }\mu\text{s}$			350		μs

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	MCD224-20io1	MCD224-20io1	Box	3	481238

Equivalent Circuits for Simulation

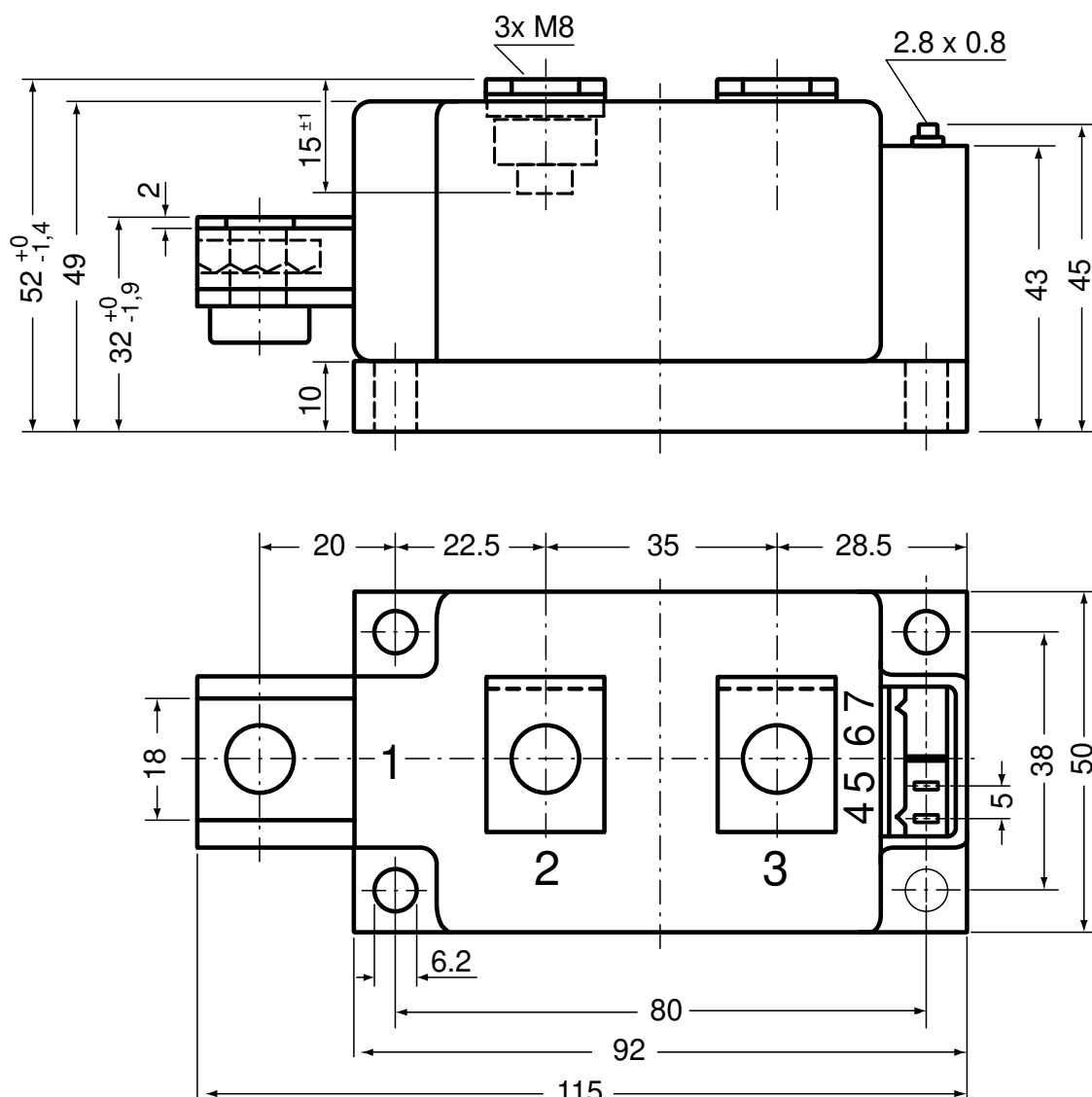
* on die level

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



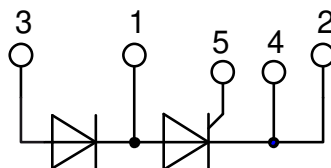
Thyristor

$V_{0\max}$	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

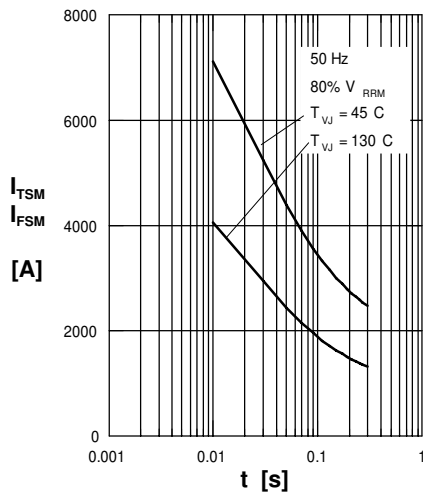


Fig. 1 Surge overload current
 $I_{T(F)SM}$: crest value, t : duration

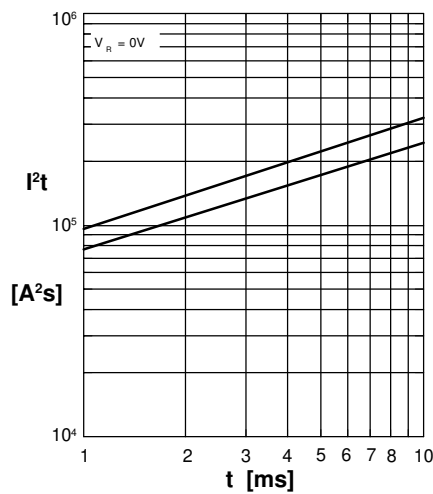


Fig. 2 I^2t versus time (1-10 ms)

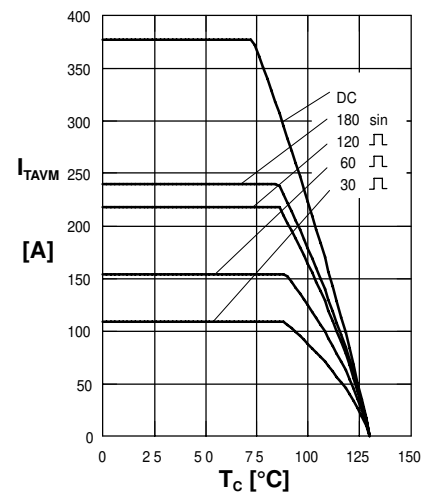


Fig. 3 Max. forward current
at case temperature

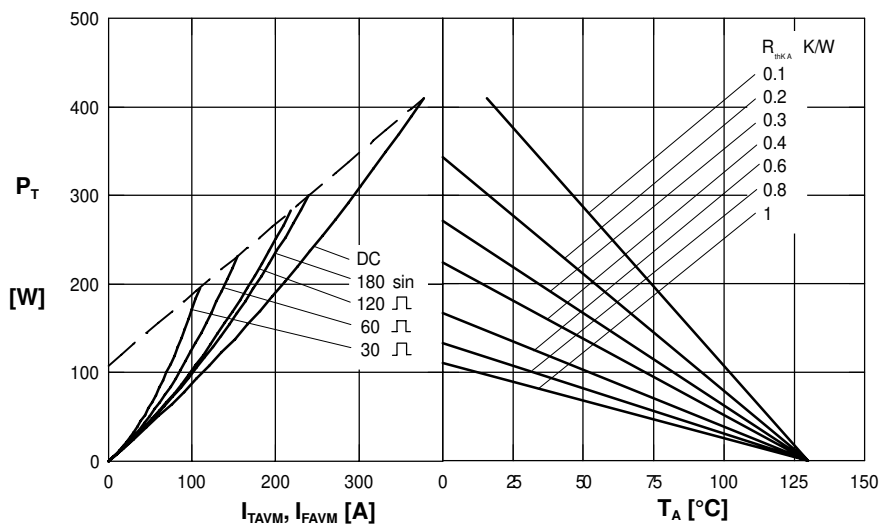


Fig. 4 Power dissipation versus onstate current and
ambient temperature (per thyristor/diode)

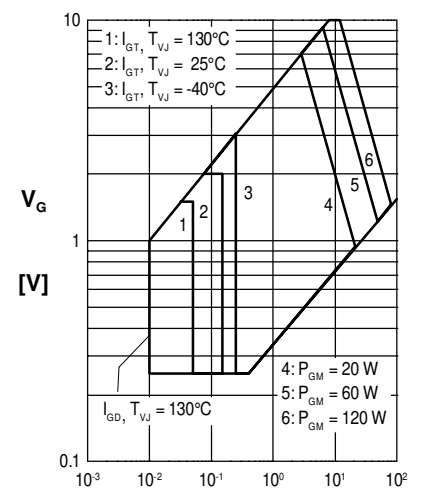


Fig. 5 Gate trigger characteristics

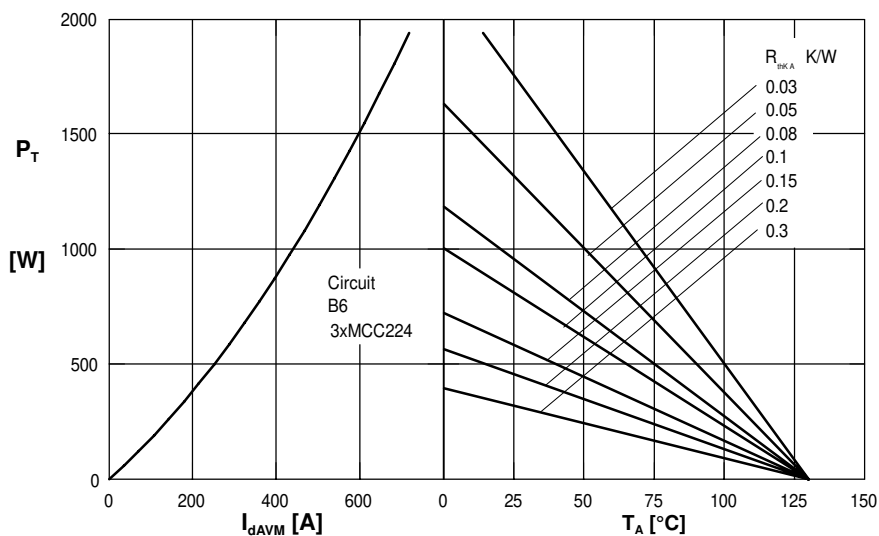


Fig. 6 Three phase rectifier bridge: Power dissipation versus
direct output current and ambient temperature

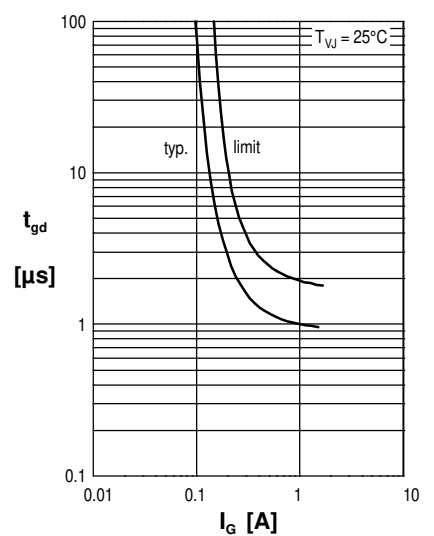


Fig. 7 Gate trigger delay time

Rectifier

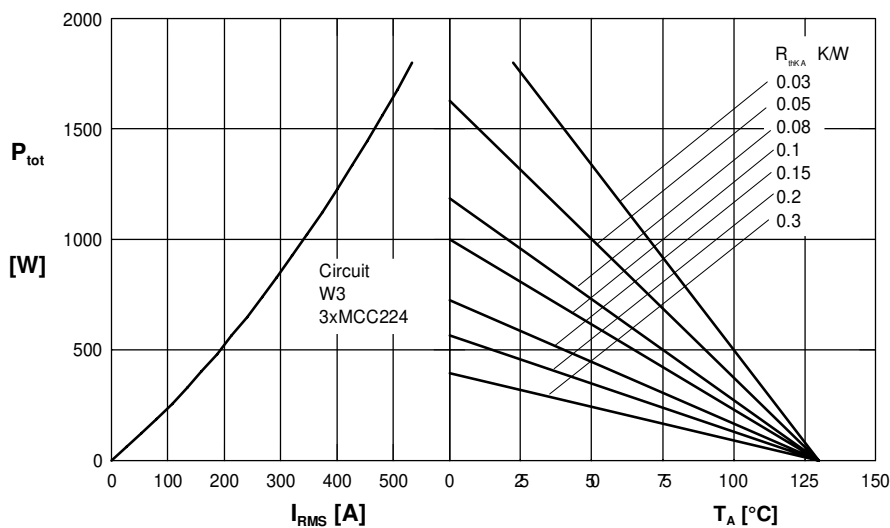


Fig. 7 Three phase AC-controller: Power dissipation versus RMS output current and ambient temperature

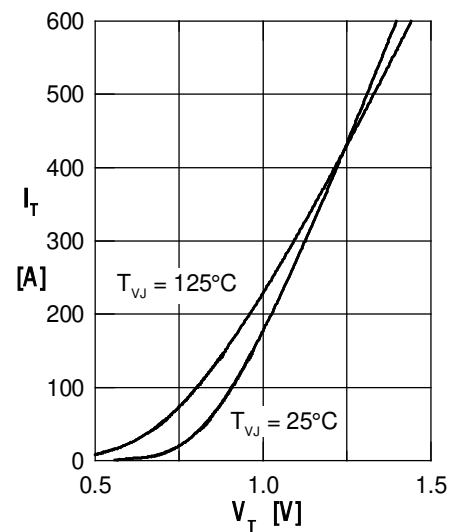


Fig. 10 Forward characteristics

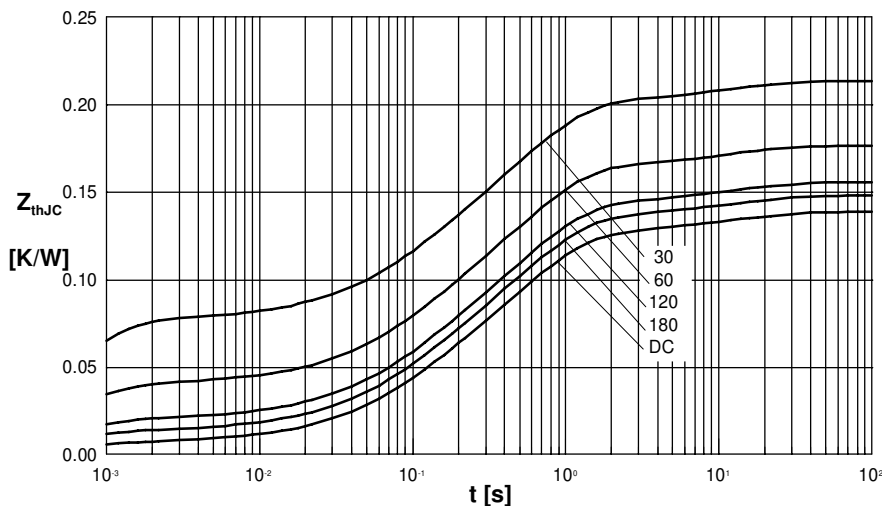


Fig. 8 Transient thermal impedance junction to case (per thyristor/diode)

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

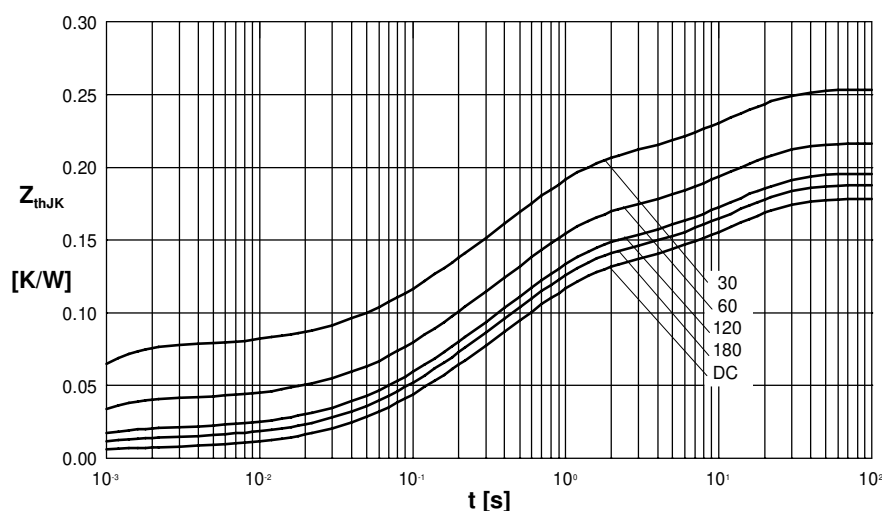


Fig. 9 Transient thermal impedance junction to heatsink (per thyristor/diode)

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