

# High Voltage Thyristor Module

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

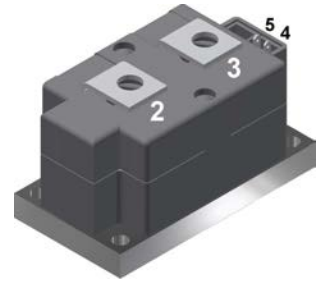
$$I_{TAV} = 464 \text{ A}$$

$$V_T = 1,01 \text{ V}$$

## Single Thyristor

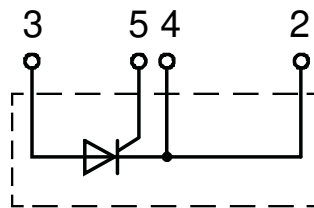
Part number

**MCO450-20io1**



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: Y1

- Isolation Voltage: 4800 V~
- Industry standard outline
- RoHS compliant
- Soldering pins for PCB mounting
- Base plate: Copper internally DCB isolated
- Advanced power cycling

### Disclaimer Notice

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Thyristor			Ratings			
Symbol	Definition	Conditions	min.	typ.	max.	Unit
$V_{RSM/DSM}$	max. non-repetitive reverse/forward blocking voltage	$T_{VJ} = 25^{\circ}C$			2100	V
$V_{RRM/DRM}$	max. repetitive reverse/forward blocking voltage	$T_{VJ} = 25^{\circ}C$			2000	V
$I_{RD}$	reverse current, drain current	$V_{R/D} = 2000\text{ V}$	$T_{VJ} = 25^{\circ}C$		2	mA
		$V_{R/D} = 2000\text{ V}$	$T_{VJ} = 125^{\circ}C$		40	mA
$V_T$	forward voltage drop	$I_T = 450\text{ A}$	$T_{VJ} = 25^{\circ}C$		1,07	V
		$I_T = 900\text{ A}$			1,32	V
		$I_T = 450\text{ A}$	$T_{VJ} = 125^{\circ}C$		1,01	V
		$I_T = 900\text{ A}$			1,33	V
$I_{TAV}$	average forward current	$T_C = 85^{\circ}C$	$T_{VJ} = 140^{\circ}C$		464	A
$I_{T(RMS)}$	RMS forward current	180° sine			750	A
$V_{T0}$	threshold voltage	} for power loss calculation only	$T_{VJ} = 140^{\circ}C$		0,77	V
$r_T$	slope resistance				0,42	mΩ
$R_{thJC}$	thermal resistance junction to case				0,072	K/W
$R_{thCH}$	thermal resistance case to heatsink			0,024		K/W
$P_{tot}$	total power dissipation		$T_C = 25^{\circ}C$		1600	W
$I_{TSM}$	max. forward surge current	$t = 10\text{ ms}; (50\text{ Hz}), \text{ sine}$	$T_{VJ} = 45^{\circ}C$		15,0	kA
		$t = 8,3\text{ ms}; (60\text{ Hz}), \text{ sine}$	$V_R = 0\text{ V}$		16,2	kA
		$t = 10\text{ ms}; (50\text{ Hz}), \text{ sine}$	$T_{VJ} = 140^{\circ}C$		12,8	kA
		$t = 8,3\text{ ms}; (60\text{ Hz}), \text{ sine}$	$V_R = 0\text{ V}$		13,8	kA
$I^2t$	value for fusing	$t = 10\text{ ms}; (50\text{ Hz}), \text{ sine}$	$T_{VJ} = 45^{\circ}C$		1,13	MA <sup>2</sup> s
		$t = 8,3\text{ ms}; (60\text{ Hz}), \text{ sine}$	$V_R = 0\text{ V}$		1,09	MA <sup>2</sup> s
		$t = 10\text{ ms}; (50\text{ Hz}), \text{ sine}$	$T_{VJ} = 140^{\circ}C$		812,8	kA <sup>2</sup> s
		$t = 8,3\text{ ms}; (60\text{ Hz}), \text{ sine}$	$V_R = 0\text{ V}$		788,8	kA <sup>2</sup> s
$C_J$	junction capacitance	$V_R = 700\text{ V}$ $f = 1\text{ MHz}$	$T_{VJ} = 25^{\circ}C$		469	pF
$P_{GM}$	max. gate power dissipation	$t_p = 30\text{ }\mu\text{s}$	$T_C = 140^{\circ}C$		120	W
		$t_p = 300\text{ }\mu\text{s}$			60	W
$P_{GAV}$	average gate power dissipation				20	W
$(di/dt)_{cr}$	critical rate of rise of current	$T_{VJ} = 140^{\circ}C; f = 50\text{ Hz}$ repetitive, $I_T = 1350\text{ A}$			100	A/ $\mu\text{s}$
		$t_p = 200\text{ }\mu\text{s}; di_G/dt = 1\text{ A}/\mu\text{s};$ $I_G = 1\text{ A}; V_D = \frac{2}{3} V_{DRM}$ non-repet., $I_T = 450\text{ A}$			500	A/ $\mu\text{s}$
$(dv/dt)_{cr}$	critical rate of rise of voltage	$V_D = \frac{2}{3} V_{DRM}$ $R_{GK} = \infty$ ; method 1 (linear voltage rise)	$T_{VJ} = 140^{\circ}C$		1000	V/ $\mu\text{s}$
$V_{GT}$	gate trigger voltage	$V_D = 6\text{ V}$	$T_{VJ} = 25^{\circ}C$		2	V
			$T_{VJ} = -40^{\circ}C$		3	V
$I_{GT}$	gate trigger current	$V_D = 6\text{ V}$	$T_{VJ} = 25^{\circ}C$		300	mA
			$T_{VJ} = -40^{\circ}C$		400	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	$t_p = 30\text{ }\mu\text{s}$	$T_{VJ} = 25^{\circ}C$		400	mA
		$I_G = 1\text{ A}; di_G/dt = 1\text{ A}/\mu\text{s}$				
$I_H$	holding current	$V_D = 6\text{ V}$ $R_{GK} = \infty$	$T_{VJ} = 25^{\circ}C$		300	mA
$t_{gd}$	gate controlled delay time	$V_D = \frac{1}{2} V_{DRM}$	$T_{VJ} = 25^{\circ}C$		2	$\mu\text{s}$
		$I_G = 1\text{ A}; di_G/dt = 1\text{ A}/\mu\text{s}$				
$t_q$	turn-off time	$V_R = 100\text{ V}; I_T = 450\text{ A}; V_D = \frac{2}{3} V_{DRM}$ $di/dt = 10\text{ A}/\mu\text{s}; dv/dt = 50\text{ V}/\mu\text{s}; t_p = 200\text{ }\mu\text{s}$	$T_{VJ} = 125^{\circ}C$		350	$\mu\text{s}$



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
<b>Weight</b>				650		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	25,0			mm
$V_{ISOL}$	isolation voltage	t = 1 second	4800			V
		t = 1 minute	4000			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	MCO450-20io1	MCO450-20io1	Box	2	467170

**Equivalent Circuits for Simulation**

\* on die level

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



**Thyristor**

$V_{0\ max}$	threshold voltage	0,77	V
$R_{0\ max}$	slope resistance *	0,22	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



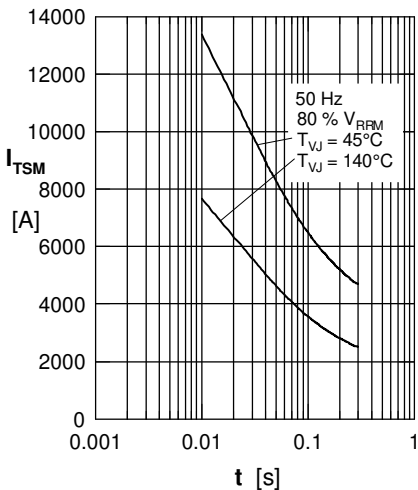
**Thyristor**


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

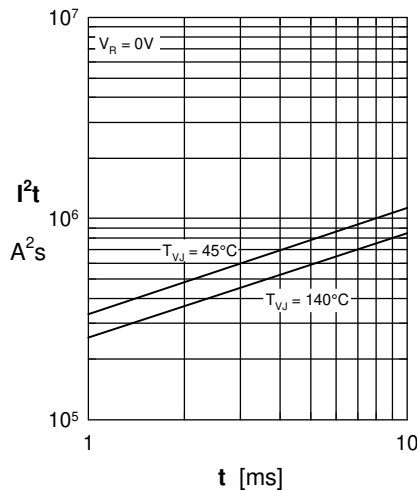


Fig. 2  $I^2t$  versus time (1-10 ms)

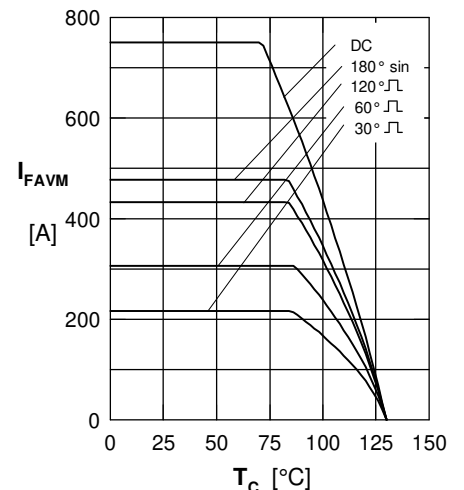


Fig. 3 Maximum forward current at case temperature

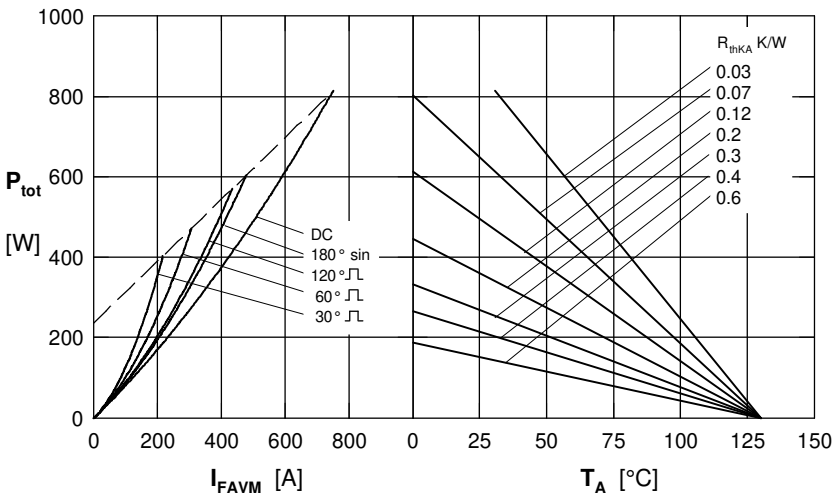


Fig. 4 Power dissipation vs. forward current and ambient temperature

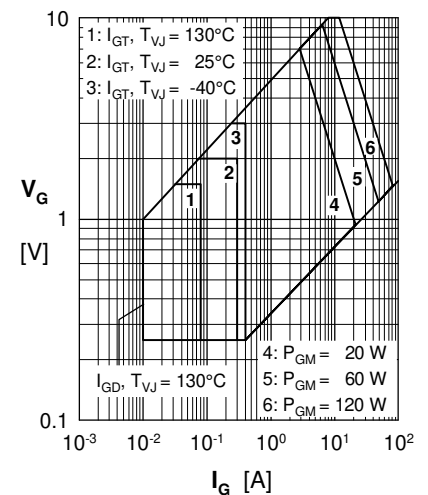


Fig. 5 Gate trigger characteristics

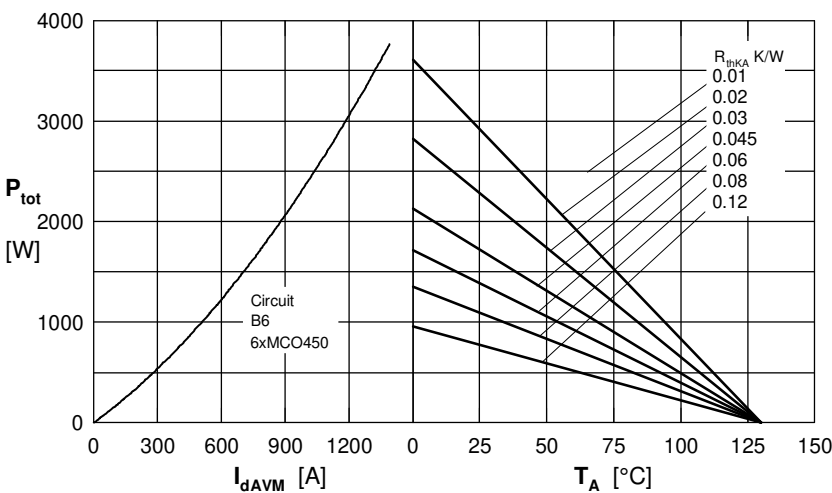


Fig. 6 Single phase rectifier bridge: Power dissipation vs. direct output current and ambient temperature. R = resistive load, L = inductive load

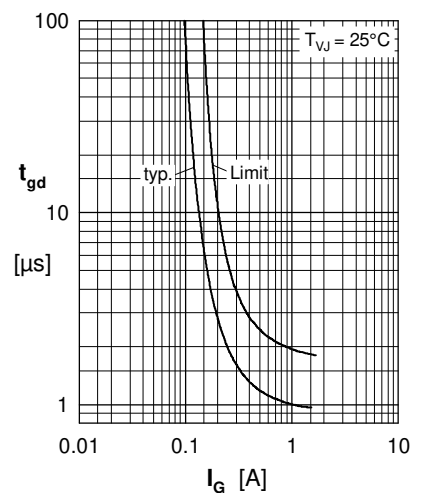


Fig. 7 Gate trigger delay time

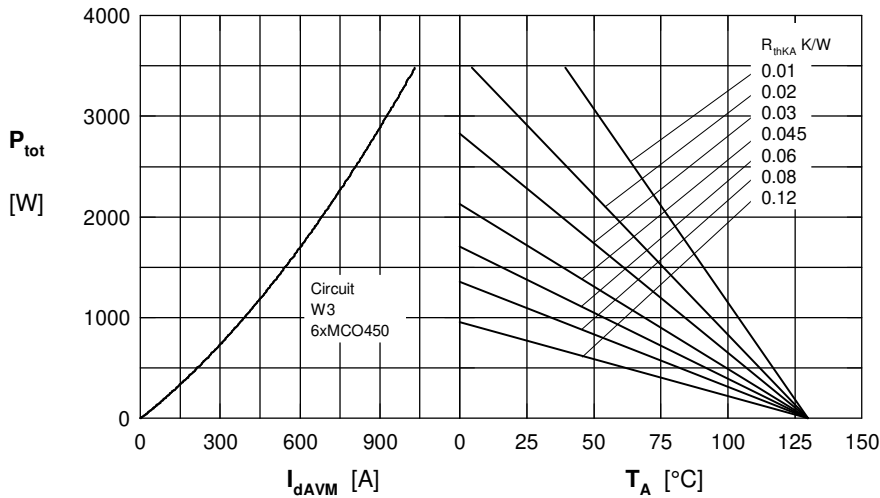
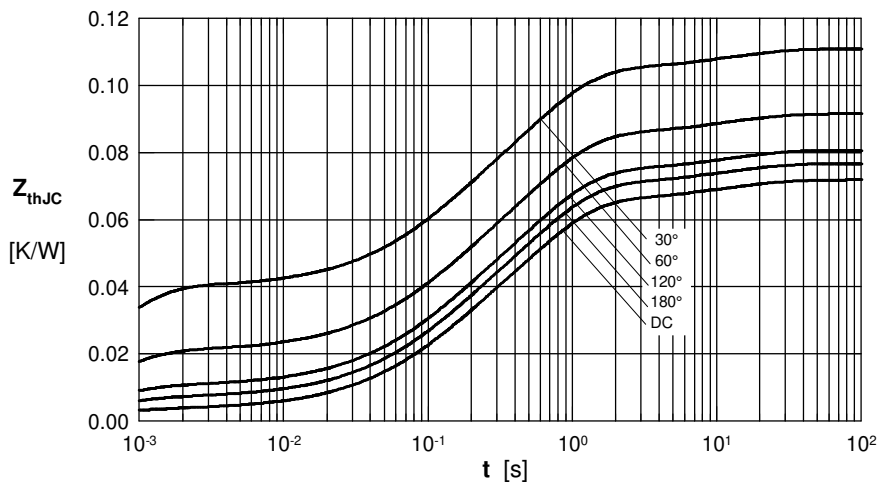
**Thyristor**


Fig. 8 Three phase rectifier bridge: Power dissipation versus direct output current and ambient temperature



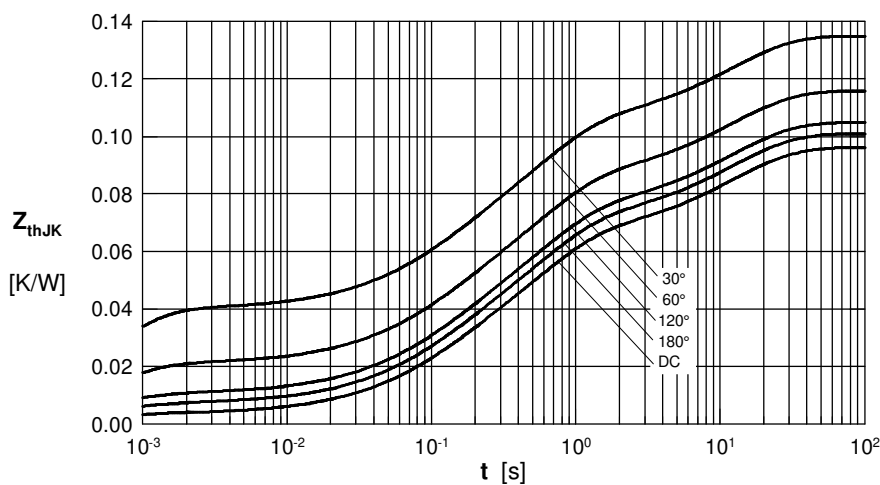
$R_{thJC}$  for various conduction angles d:

d	$R_{thJC}$ (K/W)
DC	0.072
180°	0.0768
120°	0.081
60°	0.092
30°	0.111

Constants for  $Z_{thJC}$  calculation:

i	$R_{thi}$ (K/W)	$t_i$ (s)
1	0.0035	0.0054
2	0.0186	0.098
3	0.0432	0.54
4	0.0067	12

Fig. 9 Transient thermal impedance junction to case



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

d	$R_{thJK}$ (K/W)
DC	0.096
180°	0.1
120°	0.105
60°	0.116
30°	0.135

Constants for  $Z_{thJK}$  calculation:

i	$R_{thi}$ (K/W)	$t_i$ (s)
1	0.0035	0.0054
2	0.0186	0.098
3	0.0432	0.54
4	0.0067	12
5	0.024	12

Fig. 10 Transient thermal impedance junction to heatsink