

# Thyristor \ Diode Module

$$V_{RRM} = 2 \times 1200 \text{ V}$$

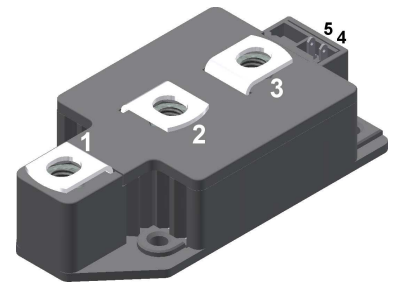
$$I_{TAV} = 320 \text{ A}$$

$$V_T = 1.08 \text{ V}$$

Phase leg

Part number

**MCD310-12io1**



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: Y2

- Isolation Voltage: 3600 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).



Rectifier				Ratings			
Symbol	Definition	Conditions	min.	typ.	max.	Unit	
$V_{RSM/DSM}$	max. non-repetitive reverse/forward blocking voltage				1300	V	
$V_{RRM/DRM}$	max. repetitive reverse/forward blocking voltage				1200	V	
$I_{RD}$	reverse current, drain current	$V_{R/D} = 1200\text{ V}$			1	mA	
		$V_{R/D} = 1200\text{ V}$			40	mA	
$V_T$	forward voltage drop	$I_T = 300\text{ A}$			1.14	V	
		$I_T = 600\text{ A}$			1.32	V	
		$I_T = 300\text{ A}$	$T_{VJ} = 125^\circ\text{C}$			1.08	V
		$I_T = 600\text{ A}$				1.30	V
$I_{TAV}$	average forward current	$T_C = 85^\circ\text{C}$			320	A	
$I_{T(RMS)}$	RMS forward current	180° sine			500	A	
$V_{T0}$	threshold voltage	} for power loss calculation only			0.80	V	
$r_T$	slope resistance				0.82	mΩ	
$R_{thJC}$	thermal resistance junction to case				0.11	K/W	
$R_{thCH}$	thermal resistance case to heatsink			0.04		K/W	
$P_{tot}$	total power dissipation		$T_C = 25^\circ\text{C}$		1030	W	
$I_{TSM}$	max. forward surge current	$t = 10\text{ ms}; (50\text{ Hz}), \text{ sine}$	$T_{VJ} = 45^\circ\text{C}$		9.20	kA	
		$t = 8,3\text{ ms}; (60\text{ Hz}), \text{ sine}$	$V_R = 0\text{ V}$		9.94	kA	
		$t = 10\text{ ms}; (50\text{ Hz}), \text{ sine}$	$T_{VJ} = 140^\circ\text{C}$		7.82	kA	
		$t = 8,3\text{ ms}; (60\text{ Hz}), \text{ sine}$	$V_R = 0\text{ V}$		8.45	kA	
$I^2t$	value for fusing	$t = 10\text{ ms}; (50\text{ Hz}), \text{ sine}$	$T_{VJ} = 45^\circ\text{C}$		423.2	kA <sup>2</sup> s	
		$t = 8,3\text{ ms}; (60\text{ Hz}), \text{ sine}$	$V_R = 0\text{ V}$		410.6	kA <sup>2</sup> s	
		$t = 10\text{ ms}; (50\text{ Hz}), \text{ sine}$	$T_{VJ} = 140^\circ\text{C}$		305.8	kA <sup>2</sup> s	
		$t = 8,3\text{ ms}; (60\text{ Hz}), \text{ sine}$	$V_R = 0\text{ V}$		296.7	kA <sup>2</sup> s	
$C_J$	junction capacitance	$V_R = 400\text{ V}$ $f = 1\text{ MHz}$	$T_{VJ} = 25^\circ\text{C}$		438	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	$T_{VJ} = 140^\circ\text{C}; f = 50\text{ Hz}$ repetitive, $I_T = 960\text{ A}$			100	A/ $\mu\text{s}$	
		$t_p = 200\text{ }\mu\text{s}; di_G/dt = 1\text{ A}/\mu\text{s};$ $I_G = 1\text{ A}; V = \frac{2}{3} V_{DRM}$ non-repet., $I_T = 320\text{ A}$			500	A/ $\mu\text{s}$	
$(dv/dt)_{cr}$	critical rate of rise of voltage	$V = \frac{2}{3} V_{DRM}$ $R_{GK} = \infty$ ; method 1 (linear voltage rise)	$T_{VJ} = 140^\circ\text{C}$		1000	V/ $\mu\text{s}$	
$V_{GT}$	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	
			$T_{VJ} = -40^\circ\text{C}$		200	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	$\mu\text{s}$	
		$I_G = 1\text{ A}; di_G/dt = 1\text{ A}/\mu\text{s}$					
$t_q$	turn-off time	$V_R = 100\text{ V}; I_T = 320\text{ A}; V = \frac{2}{3} V_{DRM}$ $di/dt = 10\text{ A}/\mu\text{s}$ $dv/dt = 50\text{ V}/\mu\text{s}$ $t_p = 200\text{ }\mu\text{s}$	$T_{VJ} = 125^\circ\text{C}$		200	$\mu\text{s}$	



Package Y2			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>				255		g
$M_D$	mounting torque		2.5		5	Nm
$M_T$	terminal torque		12		15	Nm
$d_{Spp/App}$	creepage distance on surface   striking distance through air	terminal to terminal	13.0			mm
$d_{Spb/Apb}$		terminal to backside	13.0			mm
$V_{ISOL}$	isolation voltage	t = 1 second	3600			V
		t = 1 minute	3000			V



Ordering	Ordering Number	Marking on Product	Delivery Mode	Quantity	Code No.
Standard	MCD310-12io1	MCD310-12io1	Box	2	428787

**Equivalent Circuits for Simulation**

\* on die level

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



Thyristor

$V_{0\ max}$	threshold voltage	0.8	V
$R_{0\ max}$	slope resistance *	0.32	mΩ

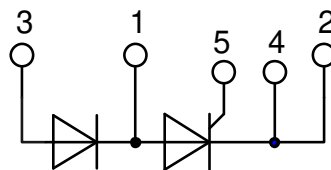


**Outlines Y2**



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)

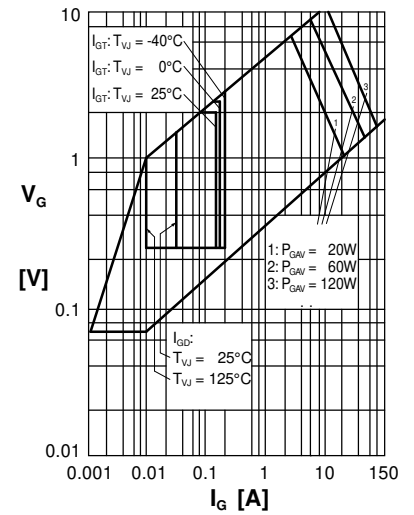


Fig. 5 Gate trigger characteristics

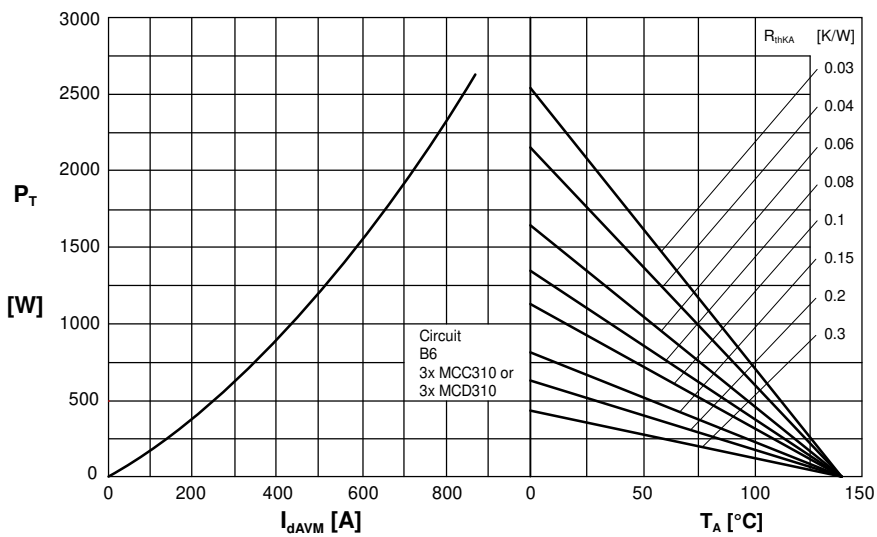


Fig. 6 Three phase rectifier bridge: Power dissipation versus direct output current and ambient temperature

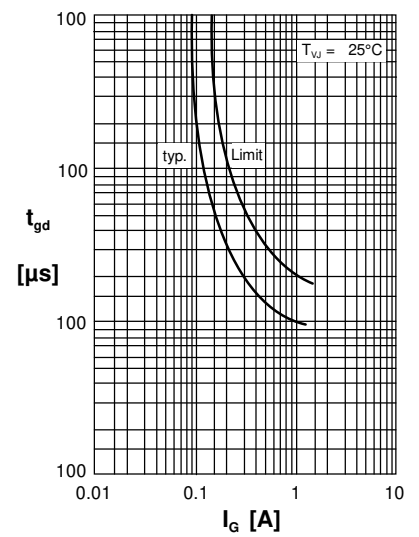


Fig. 7 Gate trigger delay time



**Rectifier**



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



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

$R_{\theta JC}$  for various conduction angles d:

d	$R_{\theta JC}$ (K/W)
DC	0.112
180°C	0.113
120°C	0.114
60°C	0.115
30°C	0.115

Constants for  $Z_{\theta JC}$  calculation:

i	$R_{\theta i}$ [K/W]	$t_i$ [s]
1	0.003	0.099
2	0.0143	0.168
3	0.0947	0.456



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

$R_{\theta JK}$  for various conduction angles d:

d	$R_{\theta JK}$ [K/W]
DC	0.152
180°C	0.154
120°C	0.154
60°C	0.155
30°C	0.155

Constants for  $Z_{\theta JK}$  calculation:

i	$R_{\theta i}$ (K/W)	$t_i$ (s)
1	0.003	0.099
2	0.0143	0.168
3	0.0947	0.456
4	0.04	1.36