

# Thyristor \ Diode Module

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

$$I_{TAV} = 60 \text{ A}$$

$$V_T = 1.24 \text{ V}$$

Phase leg

Part number

**MCD56-12io1B**



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: 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

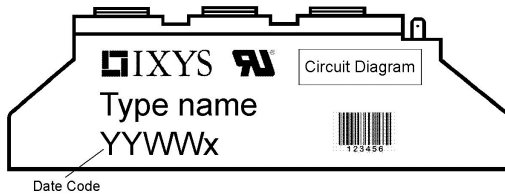
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Rectifier			Ratings			
Symbol	Definition	Conditions	min.	typ.	max.	Unit
$V_{RSM/DSM}$	max. non-repetitive reverse/forward blocking voltage	$T_{VJ} = 25^{\circ}\text{C}$			1300	V
$V_{RRM/DRM}$	max. repetitive reverse/forward blocking voltage	$T_{VJ} = 25^{\circ}\text{C}$			1200	V
$I_{RD}$	reverse current, drain current	$V_{R/D} = 1200\text{ V}$	$T_{VJ} = 25^{\circ}\text{C}$		200	$\mu\text{A}$
		$V_{R/D} = 1200\text{ V}$	$T_{VJ} = 125^{\circ}\text{C}$		5	mA
$V_T$	forward voltage drop	$I_T = 100\text{ A}$	$T_{VJ} = 25^{\circ}\text{C}$		1.26	V
		$I_T = 200\text{ A}$			1.57	V
		$I_T = 100\text{ A}$	$T_{VJ} = 125^{\circ}\text{C}$		1.24	V
		$I_T = 200\text{ A}$			1.62	V
$I_{TAV}$	average forward current	$T_C = 85^{\circ}\text{C}$	$T_{VJ} = 125^{\circ}\text{C}$		60	A
$I_{T(RMS)}$	RMS forward current	180° sine			94	A
$V_{T0}$	threshold voltage	} for power loss calculation only	$T_{VJ} = 125^{\circ}\text{C}$		0.85	V
$r_T$	slope resistance				3.7	m $\Omega$
$R_{thJC}$	thermal resistance junction to case				0.45	K/W
$R_{thCH}$	thermal resistance case to heatsink			0.20		K/W
$P_{tot}$	total power dissipation		$T_C = 25^{\circ}\text{C}$		222	W
$I_{TSM}$	max. forward surge current	$t = 10\text{ ms}; (50\text{ Hz}), \text{ sine}$	$T_{VJ} = 45^{\circ}\text{C}$		1.50	kA
		$t = 8,3\text{ ms}; (60\text{ Hz}), \text{ sine}$	$V_R = 0\text{ V}$		1.62	kA
		$t = 10\text{ ms}; (50\text{ Hz}), \text{ sine}$	$T_{VJ} = 125^{\circ}\text{C}$		1.28	kA
		$t = 8,3\text{ ms}; (60\text{ Hz}), \text{ sine}$	$V_R = 0\text{ V}$		1.38	kA
$I^2t$	value for fusing	$t = 10\text{ ms}; (50\text{ Hz}), \text{ sine}$	$T_{VJ} = 45^{\circ}\text{C}$		11.3	kA <sup>2</sup> s
		$t = 8,3\text{ ms}; (60\text{ Hz}), \text{ sine}$	$V_R = 0\text{ V}$		10.9	kA <sup>2</sup> s
		$t = 10\text{ ms}; (50\text{ Hz}), \text{ sine}$	$T_{VJ} = 125^{\circ}\text{C}$		8.13	kA <sup>2</sup> s
		$t = 8,3\text{ ms}; (60\text{ Hz}), \text{ sine}$	$V_R = 0\text{ V}$		7.87	kA <sup>2</sup> s
$C_J$	junction capacitance	$V_R = 400\text{ V } f = 1\text{ MHz}$	$T_{VJ} = 25^{\circ}\text{C}$		74	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, $I_T = 150\text{ A}$			150	A/ $\mu\text{s}$
		$t_p = 200\text{ }\mu\text{s}; di_G/dt = 0.45\text{ A}/\mu\text{s};$ $I_G = 0.45\text{ A}; V = \frac{2}{3} V_{DRM}$ non-repet., $I_T = 60\text{ A}$			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)	$T_{VJ} = 125^{\circ}\text{C}$		1000	V/ $\mu\text{s}$
$V_{GT}$	gate trigger voltage	$V_D = 6\text{ V}$	$T_{VJ} = 25^{\circ}\text{C}$		1.5	V
			$T_{VJ} = -40^{\circ}\text{C}$		1.6	V
$I_{GT}$	gate trigger current	$V_D = 6\text{ V}$	$T_{VJ} = 25^{\circ}\text{C}$		100	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	$V_R = 100\text{ V}; I_T = 150\text{ A}; V = \frac{2}{3} V_{DRM}$ $di/dt = 10\text{ A}/\mu\text{s } dv/dt = 20\text{ V}/\mu\text{s } t_p = 200\text{ }\mu\text{s}$	$T_{VJ} = 100^{\circ}\text{C}$		150	$\mu\text{s}$



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>					81	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	



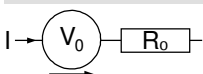
Ordering	Ordering Number	Marking on Product	Delivery Mode	Quantity	Code No.
Standard	MCD56-12io1B	MCD56-12io1B	Box	36	469459

Similar Part	Package	Voltage class
MCMA65PD1200TB	TO-240AA-1B	1200
MCMA85PD1200TB	TO-240AA-1B	1200

**Equivalent Circuits for Simulation**

\* on die level

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

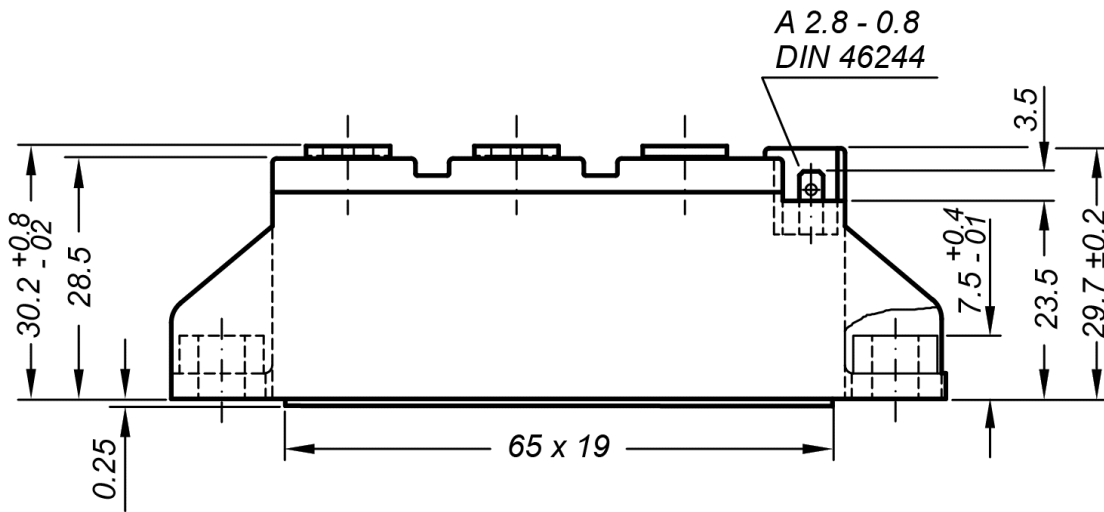


Thyristor

$V_{0\ max}$	threshold voltage	0.85	V
$R_{0\ max}$	slope resistance *	2.5	mΩ



**Outlines TO-240AA**



General tolerance: DIN ISO 2768 class „c“



**Optional accessories for modules**

Keyed gate/cathode twin plugs with wire length = 350 mm, gate = white, cathode = red  
Type ZY 200L (L = Left for pin pair 4/5) UL 758, style 3751



**Thyristor**



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



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

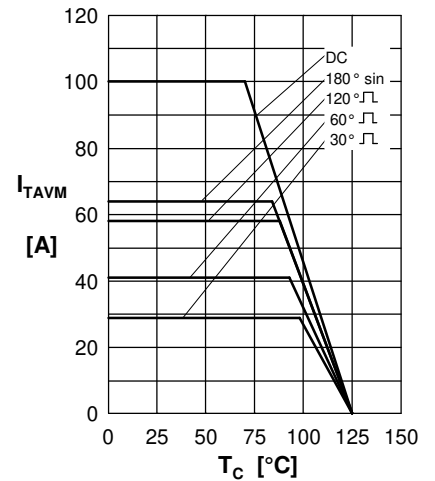


Fig. 3 Max. forward current at case temperature

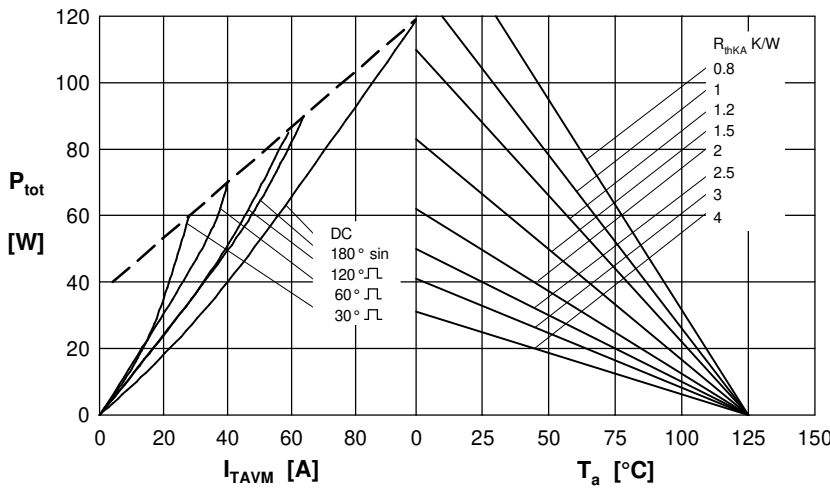


Fig. 4 Power dissipation vs. on-state current & ambient temperature (per thyristor or diode)

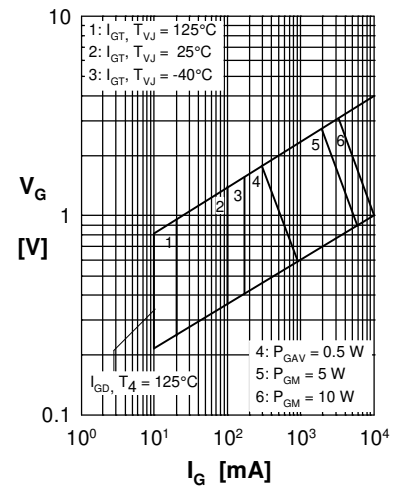


Fig. 5 Gate trigger characteristics



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



Fig. 7 Gate trigger delay time



**Rectifier**

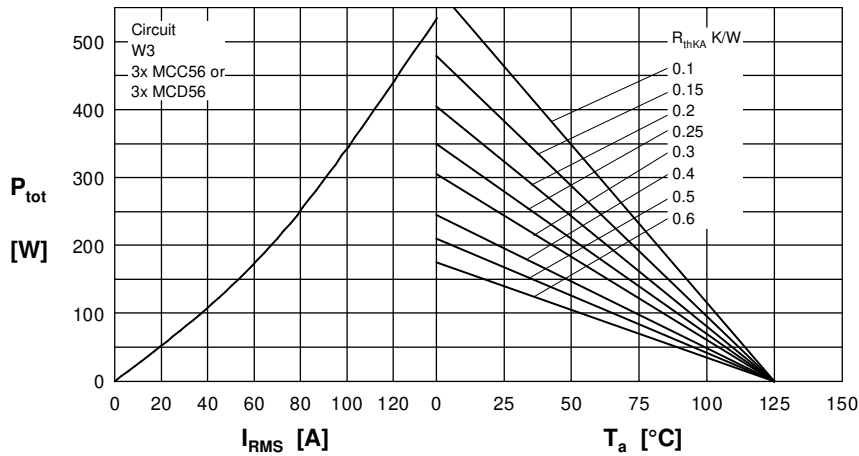
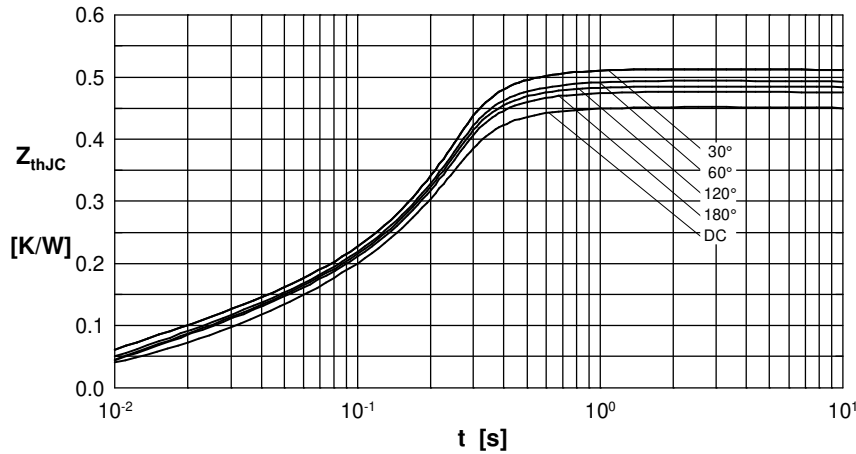


Fig. 8 Three phase AC-controller: Power dissipation versus RMS output current and ambient temperature



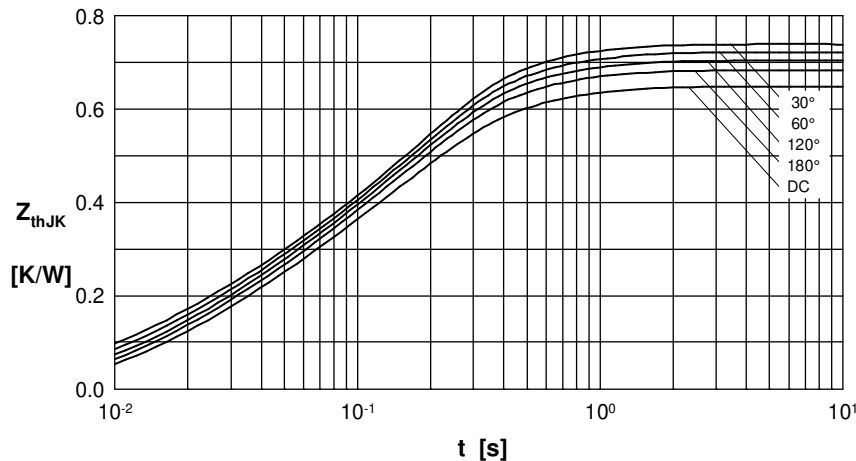
$R_{thJC}$  for various conduction angles d:

d	$R_{thJC}$ [K/W]
DC	0.450
180°	0.470
120°	0.490
60°	0.505
30°	0.520

Constants for  $Z_{thJC}$  calculation:

i	$R_{thi}$ [K/W]	$t_i$ [s]
1	0.014	0.0150
2	0.026	0.0095
3	0.410	0.1750

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



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

d	$R_{thJK}$ [K/W]
DC	0.650
180°	0.670
120°	0.690
60°	0.705
30°	0.720

Constants for  $Z_{thJK}$  calculation:

i	$R_{thi}$ [K/W]	$t_i$ [s]
1	0.014	0.0150
2	0.026	0.0095
3	0.410	0.1750
4	0.200	0.6700

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