

Thyristor \ Diode Module

$$V_{RRM} = 2 \times 1600 \text{ V}$$

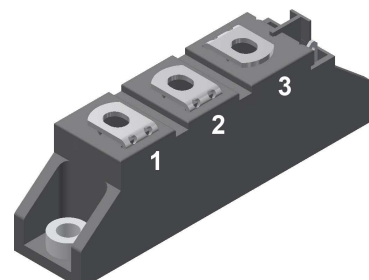
$$I_{TAV} = 49 \text{ A}$$

$$V_T = 1.34 \text{ V}$$

Phase leg

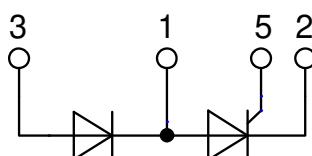
Part number

MCD44-16io8B



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: TO-240AA

- Isolation Voltage: 4800 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.



Rectifier				Ratings			
Symbol	Definition	Conditions		min.	typ.	max.	Unit
$V_{RSM/DSM}$	max. non-repetitive reverse/forward blocking voltage	$T_{VJ} = 25^{\circ}\text{C}$				1700	V
$V_{RRM/DRM}$	max. repetitive reverse/forward blocking voltage	$T_{VJ} = 25^{\circ}\text{C}$				1600	V
$I_{R/D}$	reverse current, drain current	$V_{R/D} = 1600\text{ V}$	$T_{VJ} = 25^{\circ}\text{C}$			100	μA
		$V_{R/D} = 1600\text{ V}$	$T_{VJ} = 125^{\circ}\text{C}$			5	mA
V_T	forward voltage drop	$I_T = 100\text{ A}$	$T_{VJ} = 25^{\circ}\text{C}$			1.34	V
		$I_T = 200\text{ A}$				1.75	V
		$I_T = 100\text{ A}$	$T_{VJ} = 125^{\circ}\text{C}$			1.34	V
		$I_T = 200\text{ A}$				1.80	V
I_{TAV}	average forward current	$T_C = 85^{\circ}\text{C}$	$T_{VJ} = 125^{\circ}\text{C}$			49	A
$I_{T(RMS)}$	RMS forward current	180° sine				77	A
V_{T0}	threshold voltage	for power loss calculation only	$T_{VJ} = 125^{\circ}\text{C}$			0.85	V
r_T	slope resistance					5.3	m Ω
R_{thJC}	thermal resistance junction to case					0.53	K/W
R_{thCH}	thermal resistance case to heatsink				0.2		K/W
P_{tot}	total power dissipation		$T_C = 25^{\circ}\text{C}$			180	W
I_{TSM}	max. forward surge current	$t = 10\text{ ms}; (50\text{ Hz}), \text{ sine}$	$T_{VJ} = 45^{\circ}\text{C}$			1.15	kA
		$t = 8,3\text{ ms}; (60\text{ Hz}), \text{ sine}$	$V_R = 0\text{ V}$			1.24	kA
		$t = 10\text{ ms}; (50\text{ Hz}), \text{ sine}$	$T_{VJ} = 125^{\circ}\text{C}$			980	A
		$t = 8,3\text{ ms}; (60\text{ Hz}), \text{ sine}$	$V_R = 0\text{ V}$			1.06	kA
I^2t	value for fusing	$t = 10\text{ ms}; (50\text{ Hz}), \text{ sine}$	$T_{VJ} = 45^{\circ}\text{C}$			6.62	kA ² s
		$t = 8,3\text{ ms}; (60\text{ Hz}), \text{ sine}$	$V_R = 0\text{ V}$			6.40	kA ² s
		$t = 10\text{ ms}; (50\text{ Hz}), \text{ sine}$	$T_{VJ} = 125^{\circ}\text{C}$			4.80	kA ² s
		$t = 8,3\text{ ms}; (60\text{ Hz}), \text{ sine}$	$V_R = 0\text{ V}$			4.63	kA ² s
C_J	junction capacitance	$V_R = 400\text{ V}$ $f = 1\text{ MHz}$	$T_{VJ} = 25^{\circ}\text{C}$		54		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/ μs
		$t_p = 200\text{ }\mu\text{s}; di_G/dt = 0.45\text{ A}/\mu\text{s};$ $I_G = 0.45\text{ A}; V = \frac{2}{3} V_{DRM}$ non-repet., $I_T = 49\text{ A}$				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	$V_D = 6\text{ V}$	$T_{VJ} = 25^{\circ}\text{C}$			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	μs
		$I_G = 0.45\text{ A}; di_G/dt = 0.45\text{ A}/\mu\text{s}$					
t_q	turn-off time	$V_R = 100\text{ V}; I_T = 120\text{ A}; V = \frac{2}{3} V_{DRM}$ $T_{VJ} = 100^{\circ}\text{C}$ $di/dt = 10\text{ A}/\mu\text{s}$ $dv/dt = 20\text{ V}/\mu\text{s}$ $t_p = 200\text{ }\mu\text{s}$			150		μs

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
Weight					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	50/60 Hz, RMS; $I_{ISOL} \leq 1$ mA	4800			V
		t = 1 minute		4000			V



Ordering	Ordering Number	Marking on Product	Delivery Mode	Quantity	Code No.
Standard	MCD44-16io8B	MCD44-16io8B	Box	36	457655

Similar Part	Package	Voltage class
MCMA50PD1600TB	TO-240AA-1B	1600
MCMA65PD1600TB	TO-240AA-1B	1600

Equivalent Circuits for Simulation

* on die level

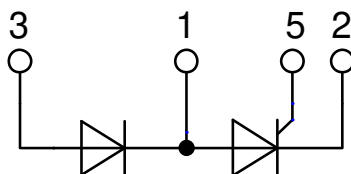
$T_{VJ} = 125^{\circ}\text{C}$

		Thyristor	
$V_{0\max}$	threshold voltage	0.85	V
$R_{0\max}$	slope resistance *	4.1	mΩ

Technical drawing of a 5-pin DIN connector. The drawing shows the front and side views with the following dimensions and labels:

- Overall length: 92 ± 0.5
- Distance from front face to center of pin 1: 80 ± 0.3
- Pin diameter: 6
- Pin 1 diameter: 10
- Pin 2 diameter: 10 ± 0.1
- Pin 3 diameter: 14.8
- Pin 4 diameter: 20.8 ± 0.25
- Pin 5 diameter: 5.5 ± 0.1
- Pin 6 diameter: 6.9
- Pin 7 diameter: 25 ± 0.3
- Pin 8 diameter: 45 ± 0.3
- Pin 9 diameter: 65 ± 0.3
- Pin 10 diameter: 25 ± 0.3
- Pin 11 diameter: 45 ± 0.3
- Pin 12 diameter: 65 ± 0.3
- Pin 13 diameter: 25 ± 0.3
- Pin 14 diameter: 45 ± 0.3
- Pin 15 diameter: 65 ± 0.3
- Pin 16 diameter: 25 ± 0.3
- Pin 17 diameter: 45 ± 0.3
- Pin 18 diameter: 65 ± 0.3
- Pin 19 diameter: 25 ± 0.3
- Pin 20 diameter: 45 ± 0.3
- Pin 21 diameter: 65 ± 0.3
- Pin 22 diameter: 25 ± 0.3
- Pin 23 diameter: 45 ± 0.3
- Pin 24 diameter: 65 ± 0.3
- Pin 25 diameter: 25 ± 0.3
- Pin 26 diameter: 45 ± 0.3
- Pin 27 diameter: 65 ± 0.3
- Pin 28 diameter: 25 ± 0.3
- Pin 29 diameter: 45 ± 0.3
- Pin 30 diameter: 65 ± 0.3
- Pin 31 diameter: 25 ± 0.3
- Pin 32 diameter: 45 ± 0.3
- Pin 33 diameter: 65 ± 0.3
- Pin 34 diameter: 25 ± 0.3
- Pin 35 diameter: 45 ± 0.3
- Pin 36 diameter: 65 ± 0.3
- Pin 37 diameter: 25 ± 0.3
- Pin 38 diameter: 45 ± 0.3
- Pin 39 diameter: 65 ± 0.3
- Pin 40 diameter: 25 ± 0.3
- Pin 41 diameter: 45 ± 0.3
- Pin 42 diameter: 65 ± 0.3
- Pin 43 diameter: 25 ± 0.3
- Pin 44 diameter: 45 ± 0.3
- Pin 45 diameter: 65 ± 0.3
- Pin 46 diameter: 25 ± 0.3
- Pin 47 diameter: 45 ± 0.3
- Pin 48 diameter: 65 ± 0.3
- Pin 49 diameter: 25 ± 0.3
- Pin 50 diameter: 45 ± 0.3
- Pin 51 diameter: 65 ± 0.3
- Pin 52 diameter: 25 ± 0.3
- Pin 53 diameter: 45 ± 0.3
- Pin 54 diameter: 65 ± 0.3
- Pin 55 diameter: 25 ± 0.3
- Pin 56 diameter: 45 ± 0.3
- Pin 57 diameter: 65 ± 0.3
- Pin 58 diameter: 25 ± 0.3
- Pin 59 diameter: 45 ± 0.3
- Pin 60 diameter: 65 ± 0.3
- Pin 61 diameter: 25 ± 0.3
- Pin 62 diameter: 45 ± 0.3
- Pin 63 diameter: 65 ± 0.3
- Pin 64 diameter: 25 ± 0.3
- Pin 65 diameter: 45 ± 0.3
- Pin 66 diameter: 65 ± 0.3
- Pin 67 diameter: 25 ± 0.3
- Pin 68 diameter: 45 ± 0.3
- Pin 69 diameter: 65 ± 0.3
- Pin 70 diameter: 25 ± 0.3
- Pin 71 diameter: 45 ± 0.3
- Pin 72 diameter: 65 ± 0.3
- Pin 73 diameter: 25 ± 0.3
- Pin 74 diameter: 45 ± 0.3
- Pin 75 diameter: 65 ± 0.3
- Pin 76 diameter: 25 ± 0.3
- Pin 77 diameter: 45 ± 0.3
- Pin 78 diameter: 65 ± 0.3
- Pin 79 diameter: 25 ± 0.3
- Pin 80 diameter: 45 ± 0.3
- Pin 81 diameter: 65 ± 0.3
- Pin 82 diameter: 25 ± 0.3
- Pin 83 diameter: 45 ± 0.3
- Pin 84 diameter: 65 ± 0.3
- Pin 85 diameter: 25 ± 0.3
- Pin 86 diameter: 45 ± 0.3
- Pin 87 diameter: 65 ± 0.3
- Pin 88 diameter: 25 ± 0.3
- Pin 89 diameter: 45 ± 0.3
- Pin 90 diameter: 65 ± 0.3
- Pin 91 diameter: 25 ± 0.3
- Pin 92 diameter: 45 ± 0.3
- Pin 93 diameter: 65 ± 0.3
- Pin 94 diameter: 25 ± 0.3
- Pin 95 diameter: 45 ± 0.3
- Pin 96 diameter: 65 ± 0.3
- Pin 97 diameter: 25 ± 0.3
- Pin 98 diameter: 45 ± 0.3
- Pin 99 diameter: 65 ± 0.3
- Pin 100 diameter: 25 ± 0.3
- Pin 101 diameter: 45 ± 0.3
- Pin 102 diameter: 65 ± 0.3
- Pin 103 diameter: 25 ± 0.3
- Pin 104 diameter: 45 ± 0.3
- Pin 105 diameter: 65 ± 0.3
- Pin 106 diameter: 25 ± 0.3
- Pin 107 diameter: 45 ± 0.3
- Pin 108 diameter: 65 ± 0.3
- Pin 109 diameter: 25 ± 0.3
- Pin 110 diameter: 45 ± 0.3
- Pin 111 diameter: 65 ± 0.3
- Pin 112 diameter: 25 ± 0.3
- Pin 113 diameter: 45 ± 0.3
- Pin 114 diameter: 65 ± 0.3
- Pin 115 diameter: 25 ± 0.3
- Pin 116 diameter: 45 ± 0.3
- Pin 117 diameter: 65 ± 0.3
- Pin 118 diameter: 25 ± 0.3
- Pin 119 diameter: 45 ± 0.3
- Pin 120 diameter: 65 ± 0.3
- Pin 121 diameter: 25 ± 0.3
- Pin 122 diameter: 45 ± 0.3
- Pin 123 diameter: 65 ± 0.3
- Pin 124 diameter: 25 ± 0.3
- Pin 125 diameter: 45 ± 0.3
- Pin 126 diameter: 65 ± 0.3
- Pin 127 diameter: 25 ± 0.3
- Pin 128 diameter: 45 ± 0.3
- Pin 129 diameter: 65 ± 0.3
- Pin 130 diameter: 25 ± 0.3
- Pin 131 diameter: 45 ± 0.3
- Pin 132 diameter: 65 ± 0.3
- Pin 133 diameter: 25 ± 0.3
- Pin 134 diameter: 45 ± 0.3
- Pin 135 diameter: 65 ± 0.3
- Pin 136 diameter: 25 ± 0.3
- Pin 137 diameter: 45 ± 0.3
- Pin 138 diameter: 65 ± 0.3
- Pin 139 diameter: 25 ± 0.3
- Pin 140 diameter: 45 ± 0.3
- Pin 141 diameter: 65 ± 0.3
- Pin 142 diameter: 25 ± 0.3
- Pin 143 diameter: 45 ± 0.3
- Pin 144 diameter: 65 ± 0.3
- Pin 145 diameter: 25 ± 0.3
- Pin 146 diameter: 45 ± 0.3
- Pin 147 diameter: 65 ± 0.3
- Pin 148 diameter: 25 ± 0.3
- Pin 149 diameter: 45 ± 0.3
- Pin 150 diameter: 65 ± 0.3
- Pin 151 diameter: 25 ± 0.3
- Pin 152 diameter: 45 ± 0.3
- Pin 153 diameter: 65 ± 0.3
- Pin 154 diameter: 25 ± 0.3
- Pin 155 diameter: 45 ± 0.3
- Pin 156 diameter: 65 ± 0.3
- Pin 157 diameter: 25 ± 0.3
- Pin 158 diameter: 45

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

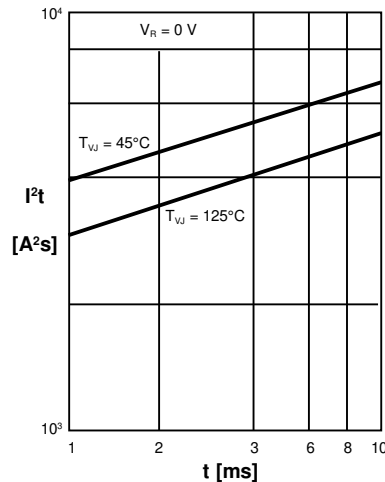


Fig. 2 I^2t versus time (1-10 ms)



Fig. 3 Maximum forward current at case temperature



Fig. 4 Power dissipation vs. 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. 8 Three phase AC-controller: Power dissipation versus RMS output current and ambient temperature



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

R_{thJC} for various conduction angles d:

d	R_{thJC} [KW]
DC	0.53
180°	0.55
120°	0.58
60°	0.60
30°	0.62

Constants for Z_{thJC} calculation:

i	R_{thi} [KW]	t_i [s]
1	0.015	0.0035
2	0.026	0.0200
3	0.489	0.1950



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

R_{thJK} for various conduction angles d:

d	R_{thJK} [KW]
DC	0.73
180°	0.75
120°	0.78
60°	0.80
30°	0.82

Constants for Z_{thJK} calculation:

i	R_{thi} [KW]	t_i [s]
1	0.015	0.0035
2	0.026	0.0200
3	0.489	0.0195
4	0.200	0.6800