

Thyristor \ Diode Module

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

$$I_{TAV} = 116 \text{ A}$$

$$V_T = 1.28 \text{ V}$$

Phase leg

Part number

MCD95-16io1B



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

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Rectifier				Ratings			
Symbol	Definition	Conditions		min.	typ.	max.	Unit
$V_{RSM/DSM}$	max. non-repetitive reverse/forward blocking voltage	$T_{VJ} = 25^{\circ}\text{C}$				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	$V_{R/D} = 1600\text{ V}$	$T_{VJ} = 25^{\circ}\text{C}$			200	μA
		$V_{R/D} = 1600\text{ V}$	$T_{VJ} = 125^{\circ}\text{C}$			5	mA
V_T	forward voltage drop	$I_T = 150\text{ A}$	$T_{VJ} = 25^{\circ}\text{C}$			1.29	V
		$I_T = 300\text{ A}$				1.50	V
		$I_T = 150\text{ A}$	$T_{VJ} = 125^{\circ}\text{C}$			1.28	V
		$I_T = 300\text{ A}$				1.70	V
I_{TAV}	average forward current	$T_C = 85^{\circ}\text{C}$	$T_{VJ} = 125^{\circ}\text{C}$			116	A
$I_{T(RMS)}$	RMS forward current	180° sine				182	A
V_{T0}	threshold voltage	for power loss calculation only	$T_{VJ} = 125^{\circ}\text{C}$			0.85	V
r_T	slope resistance					2.4	m Ω
R_{thJC}	thermal resistance junction to case					0.22	K/W
R_{thCH}	thermal resistance case to heatsink				0.2		K/W
P_{tot}	total power dissipation		$T_C = 25^{\circ}\text{C}$			455	W
I_{TSM}	max. forward surge current	$t = 10\text{ ms}; (50\text{ Hz}), \text{ sine}$	$T_{VJ} = 45^{\circ}\text{C}$			2.25	kA
		$t = 8,3\text{ ms}; (60\text{ Hz}), \text{ sine}$	$V_R = 0\text{ V}$			2.43	kA
		$t = 10\text{ ms}; (50\text{ Hz}), \text{ sine}$	$T_{VJ} = 125^{\circ}\text{C}$			1.92	kA
		$t = 8,3\text{ ms}; (60\text{ Hz}), \text{ sine}$	$V_R = 0\text{ V}$			2.07	kA
I^2t	value for fusing	$t = 10\text{ ms}; (50\text{ Hz}), \text{ sine}$	$T_{VJ} = 45^{\circ}\text{C}$			25.3	kA ² s
		$t = 8,3\text{ ms}; (60\text{ Hz}), \text{ sine}$	$V_R = 0\text{ V}$			24.6	kA ² s
		$t = 10\text{ ms}; (50\text{ Hz}), \text{ sine}$	$T_{VJ} = 125^{\circ}\text{C}$			18.3	kA ² s
		$t = 8,3\text{ ms}; (60\text{ Hz}), \text{ sine}$	$V_R = 0\text{ V}$			17.7	kA ² s
C_J	junction capacitance	$V_R = 400\text{ V}$ $f = 1\text{ MHz}$	$T_{VJ} = 25^{\circ}\text{C}$		119		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, $I_T = 250\text{ A}$				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., $I_T = 116\text{ A}$				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	$V_D = 6\text{ V}$	$T_{VJ} = 25^{\circ}\text{C}$			2.5	V
			$T_{VJ} = -40^{\circ}\text{C}$			2.6	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	$V_D = \frac{2}{3} V_{DRM}$	$T_{VJ} = 125^{\circ}\text{C}$			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	$V_R = 100\text{ V}; I_T = 150\text{ A}; V = \frac{2}{3} V_{DRM}$ $T_{VJ} = 100^{\circ}\text{C}$ $di/dt = 10\text{ A}/\mu\text{s}$ $dv/dt = 20\text{ V}/\mu\text{s}$ $t_p = 200\text{ }\mu\text{s}$			185		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} ≤ 1 mA		4800		V
		t = 1 minute			4000		V



Ordering	Ordering Number	Marking on Product	Delivery Mode	Quantity	Code No.
Standard	MCD95-16io1B	MCD95-16io1B	Box	36	472115

Similar Part	Package	Voltage class
MCMA110PD1600TB	TO-240AA-1B	1600
MCMA140PD1600TB	TO-240AA-1B	1600

Equivalent Circuits for Simulation

* on die level

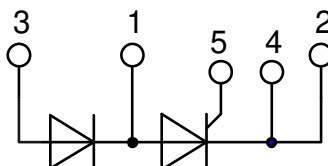
$T_{VJ} = 125^{\circ}\text{C}$

		Thyristor	
$V_{0\max}$	threshold voltage	0.85	V
$R_{0\max}$	slope resistance *	1.2	mΩ

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

- Overall width: 92 ± 0.5
- Distance from mounting hole to first pin: 80 ± 0.3
- Pin diameter: 6
- Pin pitch: 10
- Mounting hole diameter: $M5$
- Pin 1 diameter: 14.8
- Pin 1 to Pin 2 distance: 10 ± 0.1
- Pin 2 to Pin 3 distance: 5.5 ± 0.1
- Pin 3 to Pin 4 distance: 25 ± 0.3
- Pin 4 to Pin 5 distance: 45 ± 0.3
- Pin 5 to Pin 6 distance: 65 ± 0.3
- Pin 6 diameter: 4.4
- Pin 6 to Pin 7 distance: 20.8 ± 0.25
- Pin 7 diameter: 10 ± 0.1
- Pin 7 to Pin 8 distance: 5.5 ± 0.1
- Pin 8 diameter: 6
- Pin 8 to Pin 9 distance: 10
- Pin 9 diameter: 4.4
- Pin 9 to Pin 10 distance: 25 ± 0.3
- Pin 10 diameter: 6
- Pin 10 to Pin 11 distance: 45 ± 0.3
- Pin 11 diameter: 4.4
- Pin 11 to Pin 12 distance: 65 ± 0.3
- Pin 12 diameter: 6
- Pin 12 to Pin 13 distance: 10
- Pin 13 diameter: 4.4
- Pin 13 to Pin 14 distance: 25 ± 0.3
- Pin 14 diameter: 6
- Pin 14 to Pin 15 distance: 45 ± 0.3
- Pin 15 diameter: 4.4
- Pin 15 to Pin 16 distance: 65 ± 0.3
- Pin 16 diameter: 6
- Pin 16 to Pin 17 distance: 10
- Pin 17 diameter: 4.4
- Pin 17 to Pin 18 distance: 25 ± 0.3
- Pin 18 diameter: 6
- Pin 18 to Pin 19 distance: 45 ± 0.3
- Pin 19 diameter: 4.4
- Pin 19 to Pin 20 distance: 65 ± 0.3
- Pin 20 diameter: 6
- Pin 20 to Pin 21 distance: 10
- Pin 21 diameter: 4.4
- Pin 21 to Pin 22 distance: 25 ± 0.3
- Pin 22 diameter: 6
- Pin 22 to Pin 23 distance: 45 ± 0.3
- Pin 23 diameter: 4.4
- Pin 23 to Pin 24 distance: 65 ± 0.3
- Pin 24 diameter: 6
- Pin 24 to Pin 25 distance: 10
- Pin 25 diameter: 4.4
- Pin 25 to Pin 26 distance: 25 ± 0.3
- Pin 26 diameter: 6
- Pin 26 to Pin 27 distance: 45 ± 0.3
- Pin 27 diameter: 4.4
- Pin 27 to Pin 28 distance: 65 ± 0.3
- Pin 28 diameter: 6
- Pin 28 to Pin 29 distance: 10
- Pin 29 diameter: 4.4
- Pin 29 to Pin 30 distance: 25 ± 0.3
- Pin 30 diameter: 6
- Pin 30 to Pin 31 distance: 45 ± 0.3
- Pin 31 diameter: 4.4
- Pin 31 to Pin 32 distance: 65 ± 0.3
- Pin 32 diameter: 6
- Pin 32 to Pin 33 distance: 10
- Pin 33 diameter: 4.4
- Pin 33 to Pin 34 distance: 25 ± 0.3
- Pin 34 diameter: 6
- Pin 34 to Pin 35 distance: 45 ± 0.3
- Pin 35 diameter: 4.4
- Pin 35 to Pin 36 distance: 65 ± 0.3
- Pin 36 diameter: 6
- Pin 36 to Pin 37 distance: 10
- Pin 37 diameter: 4.4
- Pin 37 to Pin 38 distance: 25 ± 0.3
- Pin 38 diameter: 6
- Pin 38 to Pin 39 distance: 45 ± 0.3
- Pin 39 diameter: 4.4
- Pin 39 to Pin 40 distance: 65 ± 0.3
- Pin 40 diameter: 6
- Pin 40 to Pin 41 distance: 10
- Pin 41 diameter: 4.4
- Pin 41 to Pin 42 distance: 25 ± 0.3
- Pin 42 diameter: 6
- Pin 42 to Pin 43 distance: 45 ± 0.3
- Pin 43 diameter: 4.4
- Pin 43 to Pin 44 distance: 65 ± 0.3
- Pin 44 diameter: 6
- Pin 44 to Pin 45 distance: 10
- Pin 45 diameter: 4.4
- Pin 45 to Pin 46 distance: 25 ± 0.3
- Pin 46 diameter: 6
- Pin 46 to Pin 47 distance: 45 ± 0.3
- Pin 47 diameter: 4.4
- Pin 47 to Pin 48 distance: 65 ± 0.3
- Pin 48 diameter: 6
- Pin 48 to Pin 49 distance: 10
- Pin 49 diameter: 4.4
- Pin 49 to Pin 50 distance: 25 ± 0.3
- Pin 50 diameter: 6
- Pin 50 to Pin 51 distance: 45 ± 0.3
- Pin 51 diameter: 4.4
- Pin 51 to Pin 52 distance: 65 ± 0.3
- Pin 52 diameter: 6
- Pin 52 to Pin 53 distance: 10
- Pin 53 diameter: 4.4
- Pin 53 to Pin 54 distance: 25 ± 0.3
- Pin 54 diameter: 6
- Pin 54 to Pin 55 distance: 45 ± 0.3
- Pin 55 diameter: 4.4
- Pin 55 to Pin 56 distance: 65 ± 0.3
- Pin 56 diameter: 6
- Pin 56 to Pin 57 distance: 10
- Pin 57 diameter: 4.4
- Pin 57 to Pin 58 distance: 25 ± 0.3
- Pin 58 diameter: 6
- Pin 58 to Pin 59 distance: 45 ± 0.3
- Pin 59 diameter: 4.4
- Pin 59 to Pin 60 distance: 65 ± 0.3
- Pin 60 diameter: 6
- Pin 60 to Pin 61 distance: 10
- Pin 61 diameter: 4.4
- Pin 61 to Pin 62 distance: 25 ± 0.3
- Pin 62 diameter: 6
- Pin 62 to Pin 63 distance: 45 ± 0.3
- Pin 63 diameter: 4.4
- Pin 63 to Pin 64 distance: 65 ± 0.3
- Pin 64 diameter: 6
- Pin 64 to Pin 65 distance: 10
- Pin 65 diameter: 4.4
- Pin 65 to Pin 66 distance: 25 ± 0.3
- Pin 66 diameter: 6
- Pin 66 to Pin 67 distance: 45 ± 0.3
- Pin 67 diameter: 4.4
- Pin 67 to Pin 68 distance: 65 ± 0.3
- Pin 68 diameter: 6
- Pin 68 to Pin 69 distance: 10
- Pin 69 diameter: 4.4
- Pin 69 to Pin 70 distance: 25 ± 0.3
- Pin 70 diameter: 6
- Pin 70 to Pin 71 distance: 45 ± 0.3
- Pin 71 diameter: 4.4
- Pin 71 to Pin 72 distance: 65 ± 0.3
- Pin 72 diameter: 6
- Pin 72 to Pin 73 distance: 10
- Pin 73 diameter: 4.4
- Pin 73 to Pin 74 distance: 25 ± 0.3
- Pin 74 diameter: 6
- Pin 74 to Pin 75 distance: 45 ± 0.3
- Pin 75 diameter: 4.4
- Pin 75 to Pin 76 distance: 65 ± 0.3
- Pin 76 diameter: 6
- Pin 76 to Pin 77 distance: 10
- Pin 77 diameter: 4.4
- Pin 77 to Pin 78 distance: 25 ± 0.3
- Pin 78 diameter: 6
- Pin 78 to Pin 79 distance: 45 ± 0.3
- Pin 79 diameter: 4.4
- Pin 79 to Pin 80 distance: 65 ± 0.3
- Pin 80 diameter: 6
- Pin 80 to Pin 81 distance: 10
- Pin 81 diameter: 4.4
- Pin 81 to Pin 82 distance: 25 ± 0.3
- Pin 82 diameter: 6
- Pin 82 to Pin 83 distance: 45 ± 0.3
- Pin 83 diameter: 4.4
- Pin 83 to Pin 84 distance: 65 ± 0.3
- Pin 84 diameter: 6
- Pin 84 to Pin 85 distance: 10
- Pin 85 diameter: 4.4
- Pin 85 to Pin 86 distance: $$

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

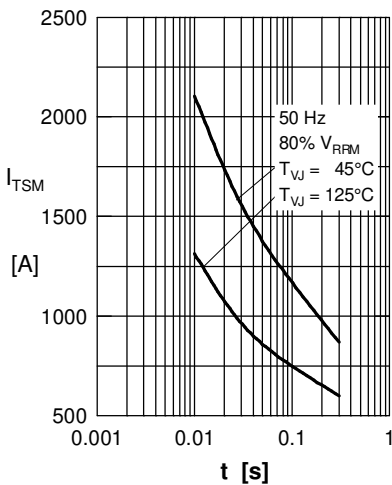


Fig. 1 Surge overload current I_{TSM} ,
 I_{FSM} : Crest value, t : duration



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



Fig. 3 Max. forward current
 at case temperature

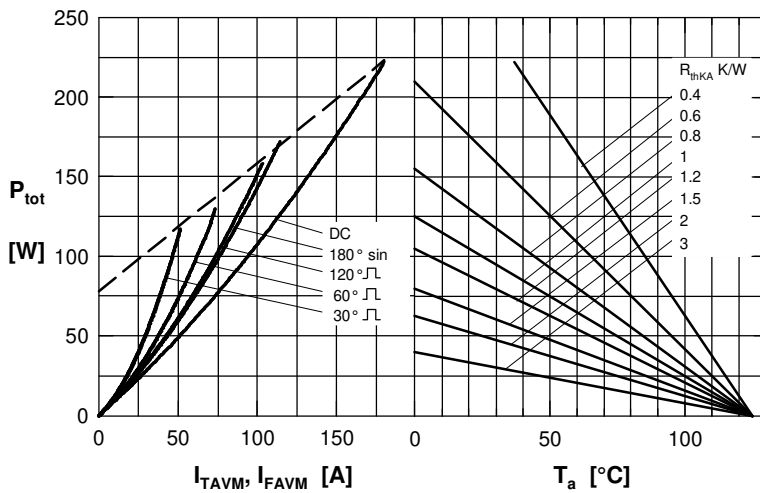


Fig. 4 Power dissipation vs. on-state current & ambient temperature
 (per thyristor or diode)

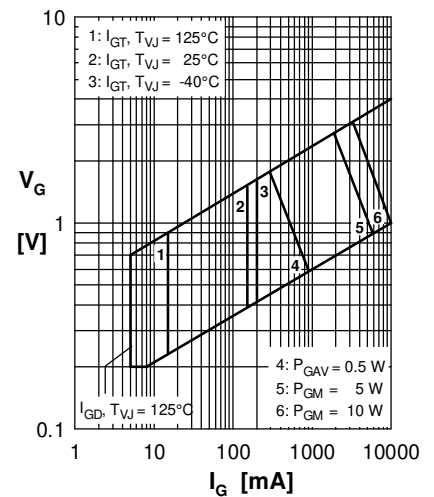


Fig. 5 Gate trigger characteristics

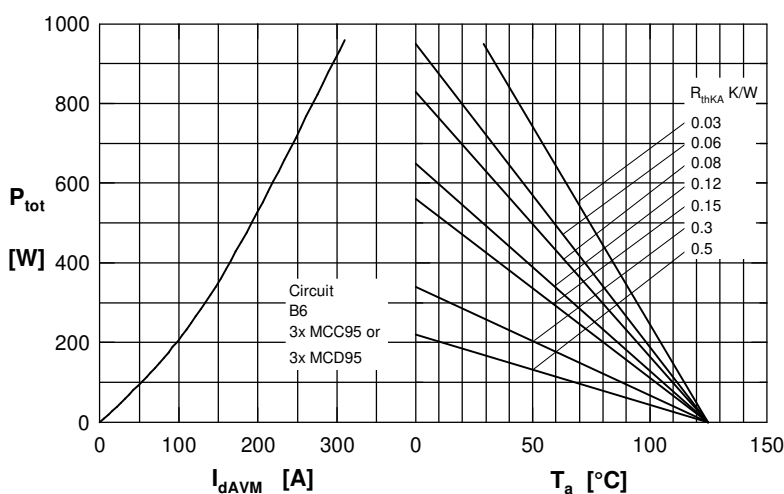


Fig. 6 Three phase rectifier bridge: Power dissipation vs. direct
 output current and ambient temperature



Fig. 7 Gate controlled 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/diode)

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

d	$R_{\theta JC}$ [K/W]
DC	0.22
180°	0.23
120°	0.25
60°	0.27
30°	0.28

Constants for Z_{thJC} calculation:

i	$R_{\theta i}$ [K/W]	t_i [s]
1	0.0066	0.0019
2	0.0678	0.0477
3	0.1456	0.3440



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

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

d	$R_{\theta JK}$ [K/W]
DC	0.42
180°	0.43
120°	0.45
60°	0.47
30°	0.48

Constants for Z_{thJK} calculation:

i	$R_{\theta i}$ [K/W]	t_i [s]
1	0.0066	0.0019
2	0.0678	0.0477
3	0.1456	0.3440
4	0.2000	1.3200