

# High Voltage Thyristor Module

$$V_{RRM} = 2 \times 2000 \text{ V}$$

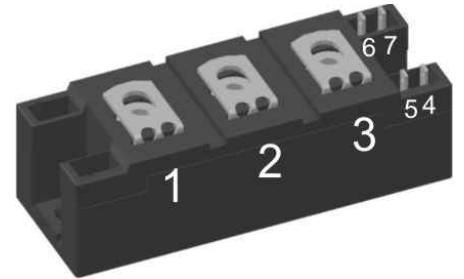
$$I_{TAV} = 165 \text{ A}$$

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

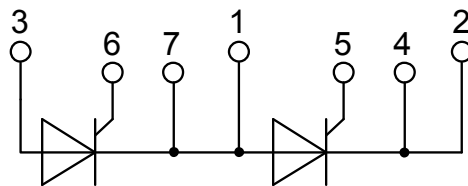
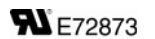
Phase leg

Part number

**MCC161-20io1**



Backside: isolated



**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:**

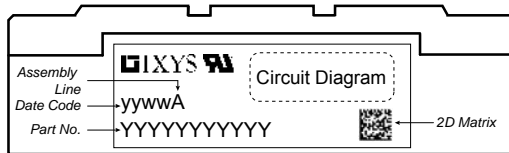
- Line rectifying 50/60 Hz
- Softstart AC motor control
- DC Motor control
- Power converter
- AC power control
- Lighting and temperature control

**Package: Y4**

- Isolation Voltage: 3600 V~
- Industry standard outline
- RoHS compliant
- Soldering pins for PCB mounting
- Base plate: DCB ceramic
- Reduced weight
- Advanced power cycling

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	$V_{R/D} = 2000 V$	$T_{VJ} = 25^{\circ}C$		400	$\mu A$	
		$V_{R/D} = 2000 V$	$T_{VJ} = 125^{\circ}C$		40	mA	
$V_T$	forward voltage drop	$I_T = 150 A$	$T_{VJ} = 25^{\circ}C$		1.14	V	
		$I_T = 300 A$			1.36	V	
		$I_T = 150 A$	$T_{VJ} = 125^{\circ}C$		1.08	V	
		$I_T = 300 A$			1.36	V	
$I_{TAV}$	average forward current	$T_C = 85^{\circ}C$	$T_{VJ} = 125^{\circ}C$		165	A	
$I_{T(RMS)}$	RMS forward current	180° sine			300	A	
$V_{T0}$	threshold voltage	} for power loss calculation only	$T_{VJ} = 125^{\circ}C$		0.80	V	
$r_T$	slope resistance				1.6	m $\Omega$	
$R_{thJC}$	thermal resistance junction to case				0.155	K/W	
$R_{thCH}$	thermal resistance case to heatsink			0.07		K/W	
$P_{tot}$	total power dissipation		$T_C = 25^{\circ}C$		645	W	
$I_{TSM}$	max. forward surge current	$t = 10 \text{ ms}; (50 \text{ Hz}), \text{ sine}$	$T_{VJ} = 45^{\circ}C$		6.00	kA	
		$t = 8,3 \text{ ms}; (60 \text{ Hz}), \text{ sine}$	$V_R = 0 V$		6.48	kA	
		$t = 10 \text{ ms}; (50 \text{ Hz}), \text{ sine}$	$T_{VJ} = 125^{\circ}C$		5.10	kA	
		$t = 8,3 \text{ ms}; (60 \text{ Hz}), \text{ sine}$	$V_R = 0 V$		5.51	kA	
$I^2t$	value for fusing	$t = 10 \text{ ms}; (50 \text{ Hz}), \text{ sine}$	$T_{VJ} = 45^{\circ}C$		180.0	kA <sup>2</sup> s	
		$t = 8,3 \text{ ms}; (60 \text{ Hz}), \text{ sine}$	$V_R = 0 V$		174.7	kA <sup>2</sup> s	
		$t = 10 \text{ ms}; (50 \text{ Hz}), \text{ sine}$	$T_{VJ} = 125^{\circ}C$		130.1	kA <sup>2</sup> s	
		$t = 8,3 \text{ ms}; (60 \text{ Hz}), \text{ sine}$	$V_R = 0 V$		126.3	kA <sup>2</sup> s	
$C_J$	junction capacitance	$V_R = 700 V \quad f = 1 \text{ MHz}$	$T_{VJ} = 25^{\circ}C$		195	pF	
$P_{GM}$	max. gate power dissipation	$t_p = 30 \mu s$	$T_C = 125^{\circ}C$		120	W	
		$t_p = 500 \mu s$			60	W	
$P_{GAV}$	average gate power dissipation				8	W	
$(di/dt)_{cr}$	critical rate of rise of current	$T_{VJ} = 125^{\circ}C; f = 50 \text{ Hz}$	repetitive, $I_T = 500 A$		150	A/ $\mu s$	
		$t_p = 200 \mu s; di_G/dt = 0.5 A/\mu s;$ $I_G = 0.5 A; V_D = \frac{2}{3} V_{DRM}$	non-repet., $I_T = 160 A$		500	A/ $\mu s$	
$(dv/dt)_{cr}$	critical rate of rise of voltage	$V_D = \frac{2}{3} V_{DRM}$ $R_{GK} = \infty; \text{ method 1 (linear voltage rise)}$	$T_{VJ} = 125^{\circ}C$		1000	V/ $\mu s$	
$V_{GT}$	gate trigger voltage	$V_D = 6 V$	$T_{VJ} = 25^{\circ}C$		2	V	
			$T_{VJ} = -40^{\circ}C$		2.6	V	
$I_{GT}$	gate trigger current	$V_D = 6 V$	$T_{VJ} = 25^{\circ}C$		150	mA	
			$T_{VJ} = -40^{\circ}C$		200	mA	
$V_{GD}$	gate non-trigger voltage	$V_D = \frac{2}{3} V_{DRM}$	$T_{VJ} = 125^{\circ}C$		0.25	V	
$I_{GD}$	gate non-trigger current				10	mA	
$I_L$	latching current	$t_p = 30 \mu s$	$T_{VJ} = 25^{\circ}C$		200	mA	
		$I_G = 0.45 A; di_G/dt = 0.45 A/\mu s$					
$I_H$	holding current	$V_D = 6 V \quad R_{GK} = \infty$	$T_{VJ} = 25^{\circ}C$		200	mA	
$t_{gd}$	gate controlled delay time	$V_D = \frac{1}{2} V_{DRM}$	$T_{VJ} = 25^{\circ}C$		2	$\mu s$	
		$I_G = 0.5 A; di_G/dt = 0.5 A/\mu s$					
$t_q$	turn-off time	$V_R = 100 V; I_T = 160 A; V_D = \frac{2}{3} V_{DRM}$ $di/dt = 10 A/\mu s; dv/dt = 20 V/\mu s; t_p = 200 \mu s$	$T_{VJ} = 125^{\circ}C$		150	$\mu s$	

Package Y4				Ratings		
Symbol	Definition	Conditions	min.	typ.	max.	Unit
$I_{RMS}$	RMS current	per terminal			300	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>					150	g
$M_D$	mounting torque		2.25		2.75	Nm
$M_T$	terminal torque		4.5		5.5	Nm
$d_{Spp/App}$	creepage distance on surface   striking distance through air	terminal to terminal	14.0	10.0		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

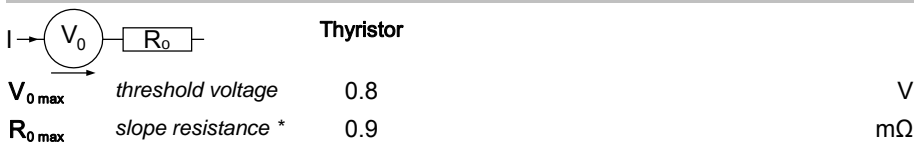


Ordering	Part Number	Marking on Product	Delivery Mode	Quantity	Code No.
Standard	MCC161-20io1	MCC161-20io1	Box	6	463507

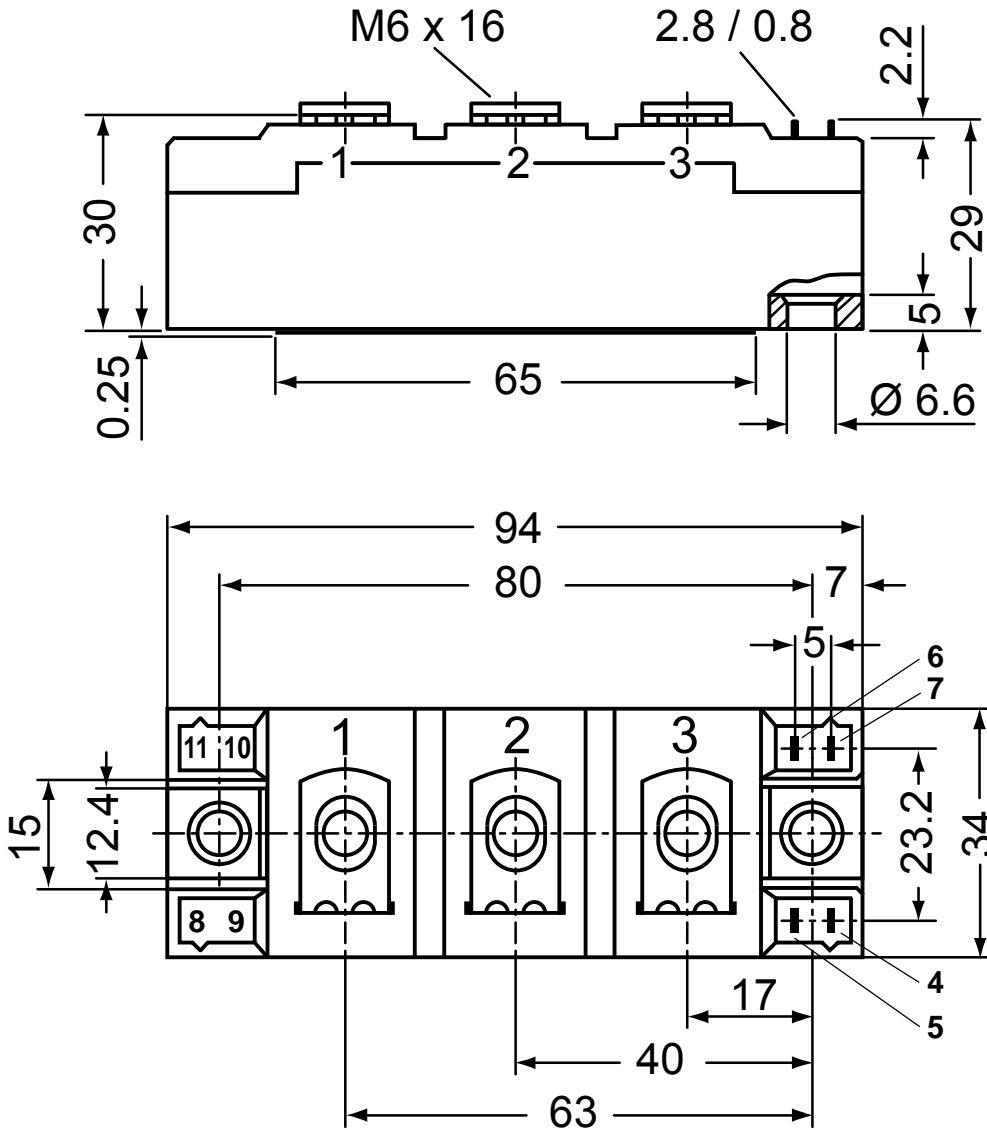
### Equivalent Circuits for Simulation

\* on die level

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



Outlines Y4



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  
 Type ZY 180R (R = Right for pin pair 6/7) }



## Thyristor

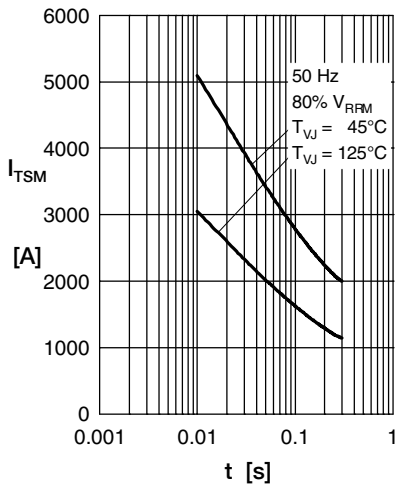


Fig. 1 Surge overload current  $I_{TSM}$ ,  $I_{FSM}$ : Crest value,  $t$ : duration

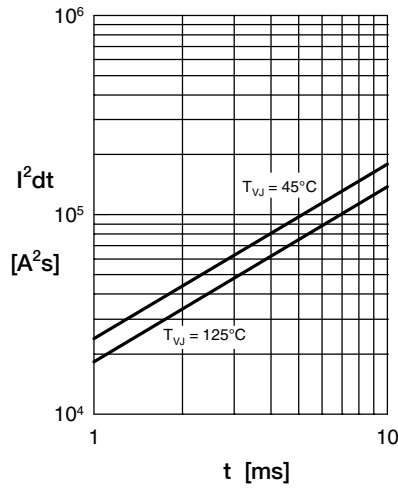


Fig. 2  $I^2t$  versus time (1-10 ms)

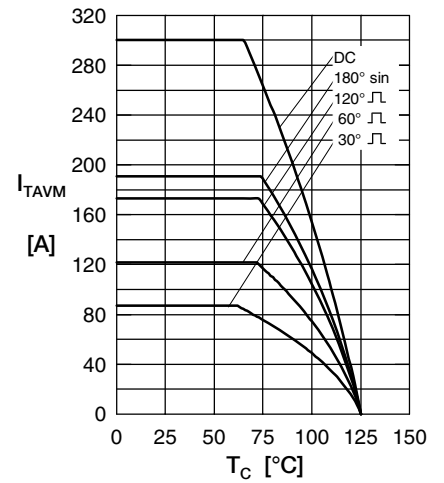


Fig. 3 Max. forward current at case temperature

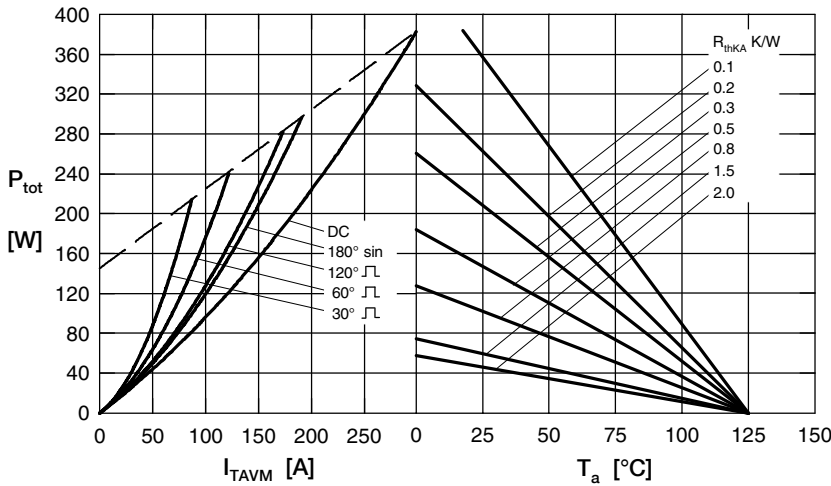


Fig. 4 Power dissipation vs. on-state current & ambient temperature (per thyristor or diode)

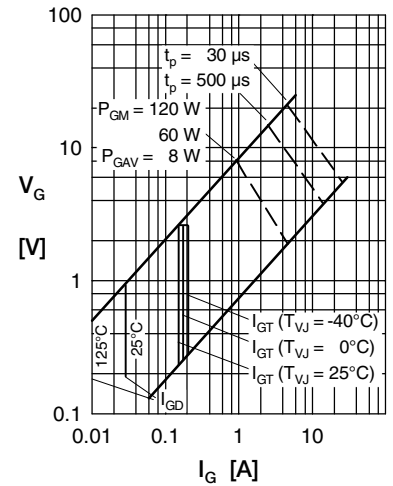


Fig. 5 Gate trigger characteristics

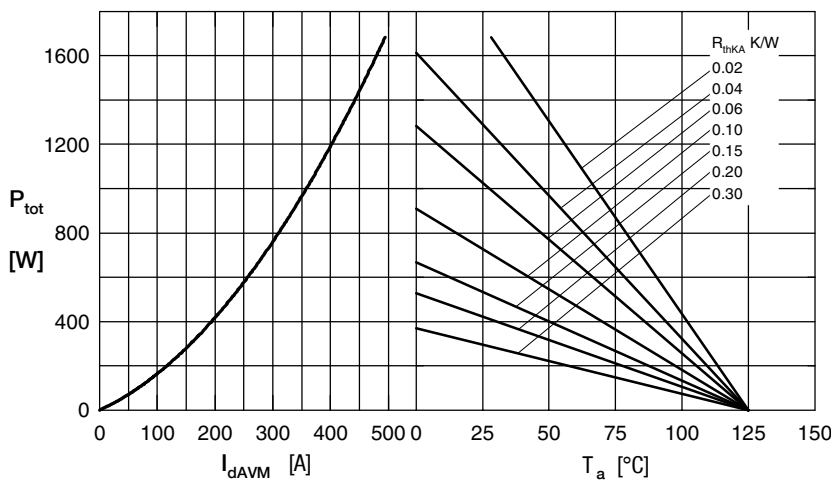


Fig. 6 Three phase rectifier bridge: Power dissipation versus direct output current and ambient temperature

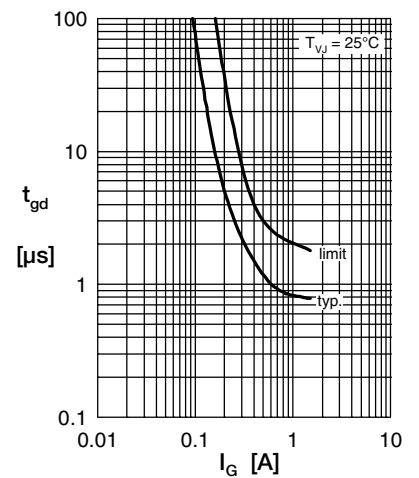
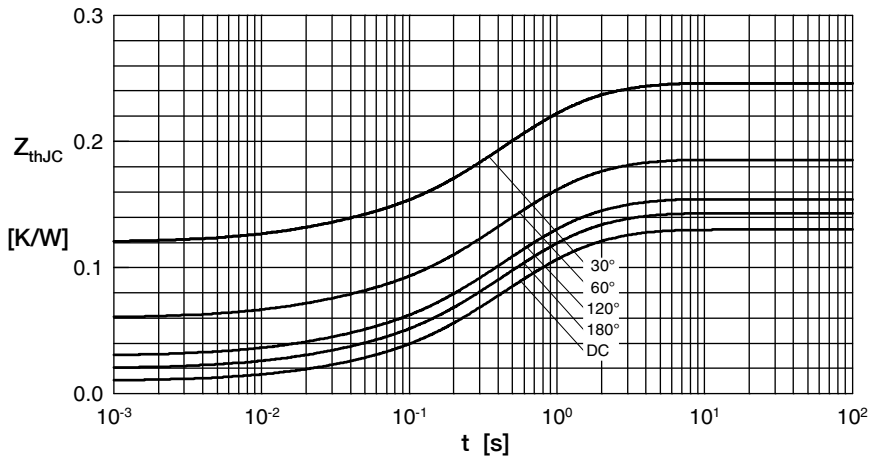


Fig. 7 Gate trigger delay time

**Thyristor**



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

d	$R_{thJC}$ [K/W]
DC	0.155
180°	0.171
120°	0.184
60°	0.222
30°	0.294

Constants for  $Z_{thJC}$  calculation:

i	$R_{thi}$ [K/W]	$t_i$ [s]
1	0.012	0.00014
2	0.008	0.019
3	0.030	0.180
4	0.073	0.520
5	0.032	1.600

Fig. 8 Transient thermal impedance junction to case at various conduction angles