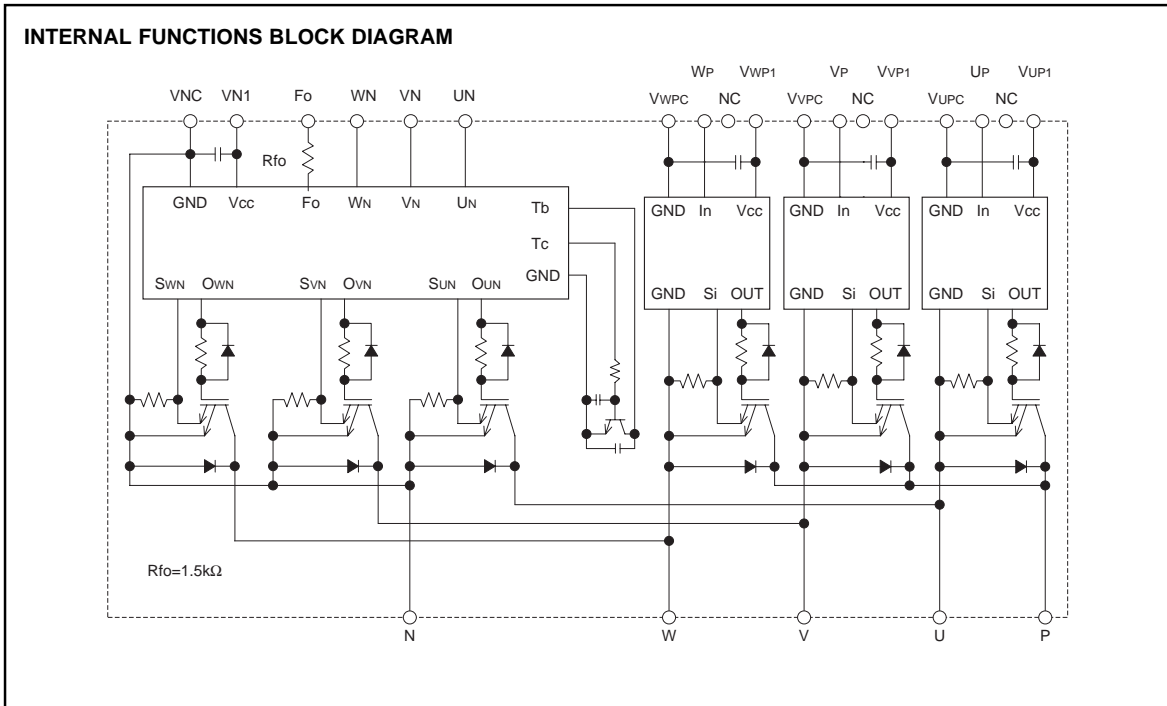




# PM10CNJ060

FLAT-BASE TYPE  
INSULATED PACKAGE

## INTERNAL FUNCTIONS BLOCK DIAGRAM



### MAXIMUM RATINGS (T<sub>j</sub> = 25°C, unless otherwise noted)

#### INVERTER PART

Symbol	Parameter	Condition	Ratings	Unit
V <sub>CES</sub>	Collector-Emitter Voltage	V <sub>D</sub> = 15V, V <sub>CI</sub> N = 15V	600	V
±I <sub>C</sub>	Collector Current	T <sub>C</sub> = 25°C	10	A
±I <sub>CP</sub>	Collector Current (Peak)	T <sub>C</sub> = 25°C	20	A
P <sub>C</sub>	Collector Dissipation	T <sub>C</sub> = 25°C	39	W
T <sub>j</sub>	Junction Temperature		-20 ~ +125*	°C

\*The item defines the maximum junction temperature for the power elements (IGBT/Diode) of the IPM to ensure safe operation. However, these power elements can endure junction temperature as high as 150°C instantaneously. To make use of this additional temperature allowance, a detailed study of the exact application conditions is required and, accordingly, necessary information is requested to be provided before use.

#### CONTROL PART

Symbol	Parameter	Condition	Ratings	Unit
V <sub>D</sub>	Supply Voltage	Applied between : V <sub>UP1</sub> -V <sub>UPC</sub> V <sub>Vp1</sub> -V <sub>VPC</sub> , V <sub>WP1</sub> -V <sub>WPC</sub> , V <sub>N1</sub> -V <sub>Nc</sub>	20	V
V <sub>CI</sub> N	Input Voltage	Applied between : U <sub>P</sub> -V <sub>UPC</sub> , V <sub>P</sub> -V <sub>VPC</sub> W <sub>P</sub> -V <sub>WPC</sub> , U <sub>N</sub> • V <sub>N</sub> • W <sub>N</sub> -V <sub>Nc</sub>	20	V
V <sub>FO</sub>	Fault Output Supply Voltage	Applied between : F <sub>O</sub> -V <sub>Nc</sub>	20	V
I <sub>FO</sub>	Fault Output Current	Sink current at F <sub>O</sub> terminals	20	mA

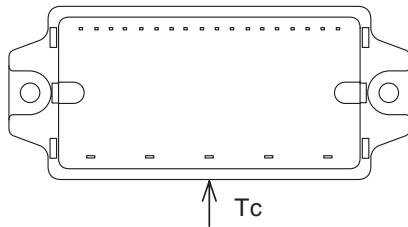
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## TOTAL SYSTEM

Symbol	Parameter	Condition	Ratings	Unit
V <sub>CC(Prot)</sub>	Supply Voltage Protected by SC	V <sub>D</sub> = 13.5 ~ 16.5V, Inverter Part, T <sub>J</sub> = 125°C Start	400	V
V <sub>CC(surge)</sub>	Supply Voltage	Applied between : P-N, Surge value	500	V
T <sub>C</sub>	Module Case Operating Temperature	(Note-1)	-20 ~ +100	°C
T <sub>stg</sub>	Storage Temperature		-40 ~ +125	°C
V <sub>iso</sub>	Isolation Voltage	60Hz, Sinusoidal Charged part to Base, AC 1 min.	2500	V <sub>rms</sub>

(Note-1) T<sub>c</sub> measurement point



## ELECTRICAL CHARACTERISTICS (T<sub>J</sub> = 25°C, unless otherwise noted)

### INVERTER PART

Symbol	Parameter	Test Condition	Limits			Unit	
			Min.	Typ.	Max.		
V <sub>CE(sat)</sub>	Collector-Emitter Saturation Voltage	V <sub>D</sub> = 15V, I <sub>C</sub> = 10A V <sub>CIN</sub> = 0V, Pulsed (Fig. 1)	T <sub>J</sub> = 25°C	—	1.8	2.5	V
			T <sub>J</sub> = 125°C	—	1.9	2.6	
V <sub>EC</sub>	FWDi Forward Voltage	-I <sub>C</sub> = 10A, V <sub>D</sub> = 15V, V <sub>CIN</sub> = 15V (Fig. 2)	—	1.8	3.0	V	
t <sub>on</sub>	Switching Time	V <sub>D</sub> = 15V, V <sub>CIN</sub> = 0V↔15V V <sub>CC</sub> = 300V, I <sub>C</sub> = 10A T <sub>J</sub> = 125°C, Inductive Load (Upper-Lower Arm) (Fig. 3)	—	0.3	0.7	1.6	μs
t <sub>rr</sub>			—	0.15	0.5	μs	
t <sub>c(on)</sub>			—	0.3	1.0	μs	
t <sub>off</sub>			—	1.5	2.3	μs	
t <sub>c(off)</sub>			—	0.4	1.2	μs	
I <sub>CES</sub>	Collector-Emitter Cutoff Current	V <sub>CE</sub> = V <sub>CES</sub> , V <sub>D</sub> = 15V (Fig. 4)	T <sub>J</sub> = 25°C	—	—	1	mA
			T <sub>J</sub> = 125°C	—	—	10	

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## CONTROL PART

Symbol	Parameter	Test Condition	Limits			Unit	
			Min.	Typ.	Max.		
I <sub>D</sub>	Circuit Current	V <sub>D</sub> = 15V, V <sub>CI</sub> N = 15V	V <sub>N1</sub> -V <sub>NC</sub>	—	18	25	mA
			V <sub>XP1</sub> -V <sub>XPC</sub>	—	7	10	
V <sub>th(ON)</sub>	Input ON Voltage	Applied between : UP-V <sub>UPC</sub> , VP-V <sub>VPC</sub> , WP-V <sub>WPC</sub>	1.2	1.5	1.8	V	
V <sub>th(OFF)</sub>	Input OFF Voltage	U <sub>N</sub> • V <sub>N</sub> • W <sub>N</sub> -V <sub>NC</sub>	1.7	2.0	2.3	V	
OC	Over Current Trip Level	-20 ≤ T <sub>J</sub> ≤ 125°C, V <sub>D</sub> = 15V (Fig. 5,6)	12	18	—	A	
SC	Short Circuit Trip Level	-20 ≤ T <sub>J</sub> ≤ 125°C, V <sub>D</sub> = 15V (Fig. 5,6)	—	27	—	A	
t <sub>off(OC)</sub>	Over Current Delay Time	V <sub>D</sub> = 15V (Fig. 5,6)	—	10	—	μs	
OT	Over Temperature protection	V <sub>D</sub> = 15V	Trip level	100	110	120	°C
			Reset level	—	90	—	°C
UV	Supply Circuit Under-Voltage	-20 ≤ T <sub>J</sub> ≤ 125°C	Trip level	11.5	12.0	12.5	V
UV <sub>r</sub>	Protection		Reset level	—	12.5	—	V
I <sub>FO(H)</sub>	Fault Output Current	V <sub>D</sub> = 15V, V <sub>CI</sub> N = 15V (Note-2)	—	—	0.01	mA	
I <sub>FO(L)</sub>			—	10	15	mA	
t <sub>FO</sub>	Minimum Fault Output Pulse Width	V <sub>D</sub> = 15V (Note-2)	1.0	1.8	—	ms	

(Note-2) Fault output is given only when the internal SC, OT & UV protections schemes of either upper or lower arm device operate to protect it.

## THERMAL RESISTANCES

Symbol	Parameter	Test Condition	Limits			Unit
			Min.	Typ.	Max.	
R <sub>th(j-c)Q</sub>	Junction to case Thermal	Inverter IGBT part (per 1/6 module)	—	—	3.2	°C/W
R <sub>th(j-c)F</sub>	Resistances	Inverter FWDi part (per 1/6 module)	—	—	4.5	°C/W
R <sub>th(c-f)</sub>	Contact Thermal Resistance	Case to fin, (per 1 module) Thermal grease applied	—	—	0.5	°C/W

## MECHANICAL RATINGS AND CHARACTERISTICS

Symbol	Parameter	Test Condition	Limits			Unit
			Min.	Typ.	Max.	
—	Mounting torque	Mounting part screw : M4	0.98	1.18	1.47	N • m
—	Weight	—	10	12	15	kg • cm
—	Weight	—	—	60	—	g

## RECOMMENDED CONDITIONS FOR USE

Symbol	Parameter	Test Condition	Recommended value	Unit
V <sub>CC</sub>	Supply Voltage	Applied across P-N terminals (Fig. 3)	≤ 400	V
V <sub>D</sub>	Control Supply Voltage	Applied between : V <sub>UP1</sub> -V <sub>UPC</sub> , V <sub>VP1</sub> -V <sub>VPC</sub> V <sub>WP1</sub> -V <sub>WPC</sub> , V <sub>N1</sub> -V <sub>NC</sub> (Note-3)	15 ± 1.5	V
V <sub>CI</sub> (ON)	Input ON Voltage	Applied between : UP-V <sub>UPC</sub> , VP-V <sub>VPC</sub> , WP-V <sub>WPC</sub>	≤ 0.8	V
V <sub>CI</sub> (OFF)	Input OFF Voltage	U <sub>N</sub> • V <sub>N</sub> • W <sub>N</sub> -V <sub>NC</sub>	≥ 4.0	
f <sub>PWM</sub>	PWM Input Frequency	Using Application Circuit of Fig. 8	≤ 15	kHz
t <sub>dead</sub>	Arm Shoot-through Blocking Time	For IPM's each input signals (Fig. 7)	≥ 2	μs

(Note-3) With ripple satisfying the following conditions  
dv/dt swing ≤ ±5V/μs, Variation ≤ 2V peak to peak

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## PRECAUTIONS FOR TESTING

1. Before applying any control supply voltage ( $V_D$ ), the input signals should be low level.  
After this, each input signal should be set to the specified ON and OFF level.
2. When performing "SC" tests, the turn-off surge voltage spike at the corresponding protection operation should not be allowed to rise above  $V_{CC(surge)}$  rating of the device.  
(These test should not be done by using a curve tracer or its equivalent.)

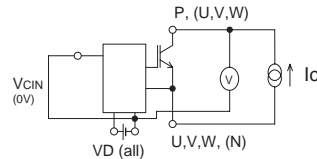


Fig. 1  $V_{ce(sat)}$  Test

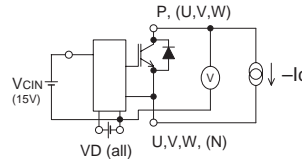
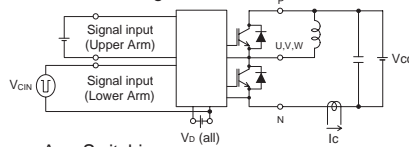


Fig. 2  $V_{ec}$  Test

### a) Lower Arm Switching



### b) Upper Arm Switching

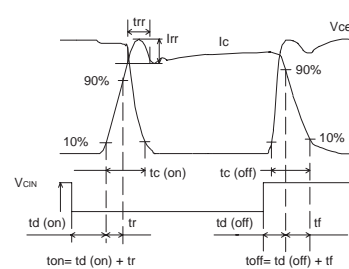
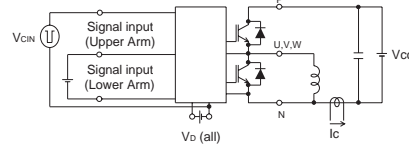


Fig. 3 Switching time Test circuit and waveform

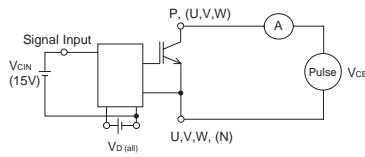


Fig. 4  $I_{ces}$  Test

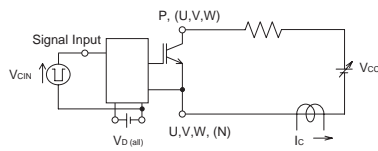
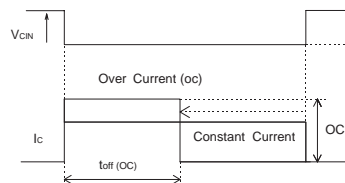


Fig. 5 OC and SC Test

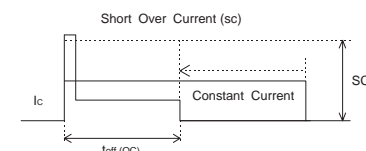


Fig. 6 OC and SC Test waveform

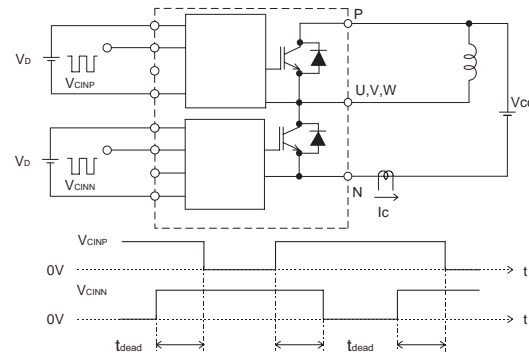


Fig. 7 Dead time measurement point example

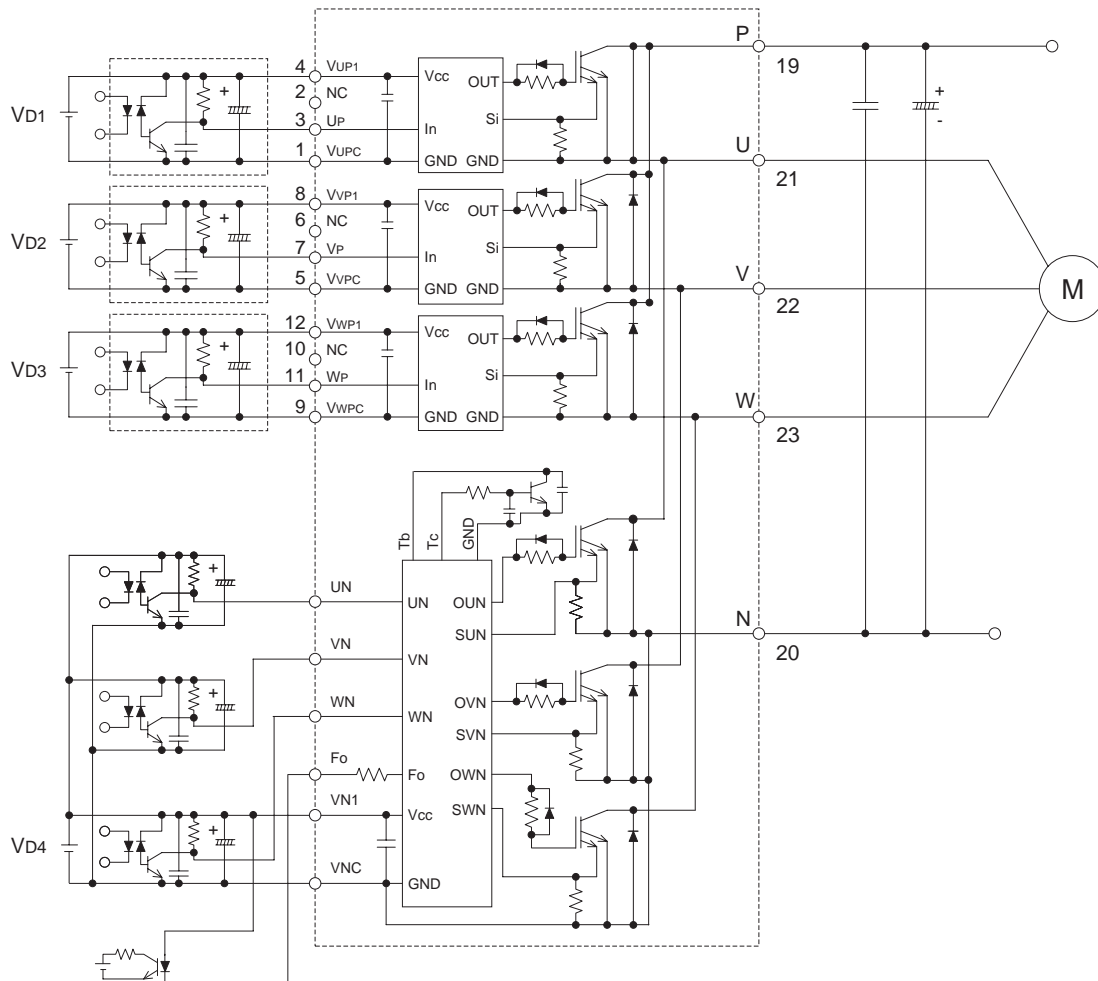
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Fig. 8 Application Example Circuit

**NOTES FOR STABLE AND SAFE OPERATION ;**

- Design the PCB pattern to minimize wiring length between opto-coupler and IPM's input terminal, and also to minimize the stray capacity between the input and output wirings of opto-coupler.
- Connect low impedance capacitor between the Vcc and GND terminal of each fast switching opto-coupler.
- Fast switching opto-couplers :  $t_{PLH}, t_{PHL} \leq 0.8\mu s$ , Use High CMR type.
- Slow switching opto-coupler : CTR > 100%
- Use 4 isolated control power supplies (VD). Also, care should be taken to minimize the instantaneous voltage charge of the power supply.
- Make inductance of DC bus line as small as possible, and minimize surge voltage using snubber capacitor between P and N terminal.
- Use line noise filter capacitor (ex. 4.7nF) between each input AC line and ground to reject common-mode noise from AC line and improve noise immunity of the system.