

# PM200CBS060

FLAT-BASE TYPE  
INSULATED PACKAGE

## PM200CBS060



### FEATURE

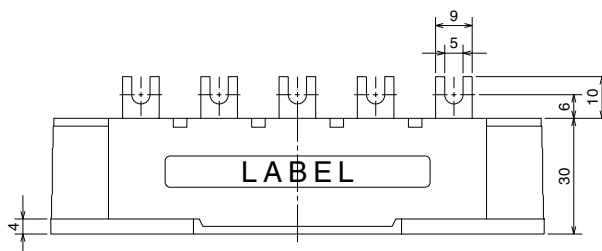
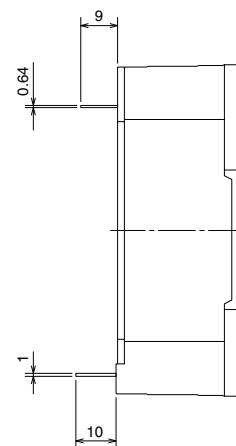
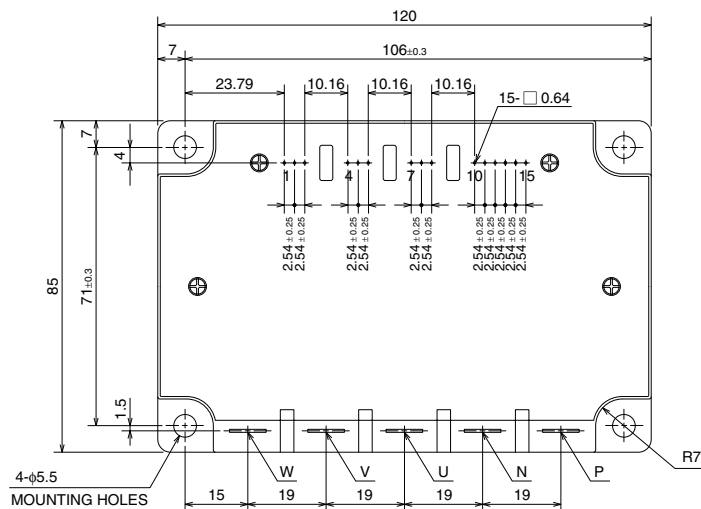
- a) Adopting 4th generation IGBT chip, which performance is improved by 1μm fine rule process.  
For example, typical  $V_{ce(sat)}$ =1.7V
- b) Using new Diode which is designed to get soft reverse recovery characteristics.
- c) Over-temperature protection by detecting  $T_j$  of the IGBT chips
  - 3φ 200A, 600V Current-sense IGBT type inverter
  - Monolithic gate drive & protection logic
  - Detection, protection & status indication circuits for over-current, short-circuit, over-temperature & under-voltage
  - Acoustic noise-less 18.5/22kW class inverter application

## APPLICATION

Servo drives and other motor controls

### PACKAGE OUTLINES

Dimensions in mm

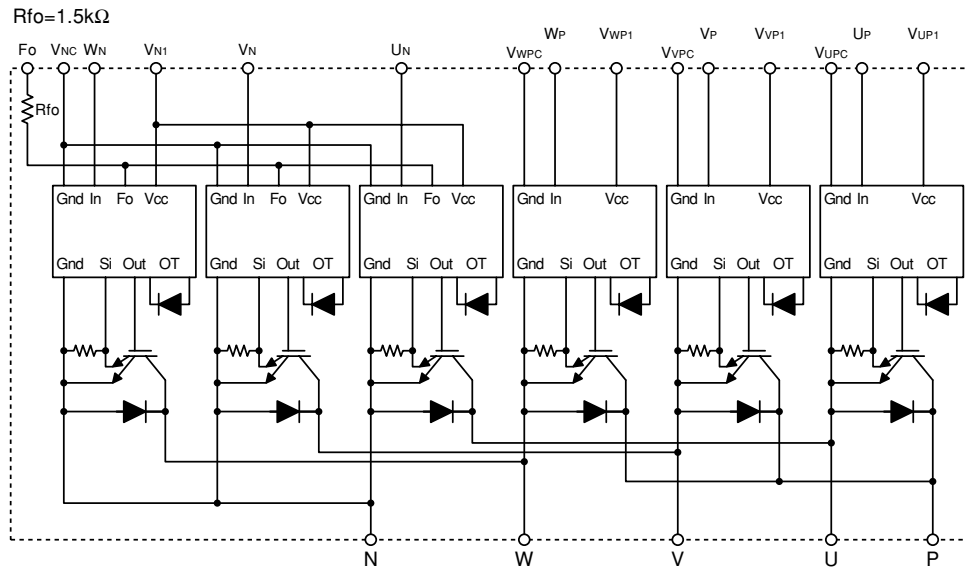


#### Terminal code

- |         |         |
|---------|---------|
| 1. VWPC | 9. VUP1 |
| 2. WP   | 10. VNC |
| 3. VWP1 | 11. VN1 |
| 4. VVPC | 12. WN  |
| 5. VP   | 13. VN  |
| 6. VVP1 | 14. UN  |
| 7. VUPC | 15. Fo  |
| 8. UP   |         |

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**INTERNAL FUNCTIONS BLOCK DIAGRAM****MAXIMUM RATINGS** ( $T_j = 25^\circ\text{C}$ , unless otherwise noted)**INVERTER PART**

| Symbol       | Parameter                 | Conditions                                  | Ratings         | Unit             |
|--------------|---------------------------|---------------------------------------------|-----------------|------------------|
| $V_{CES}$    | Collector-Emitter Voltage | $V_D = 15\text{V}$ , $V_{CIN} = 15\text{V}$ | 600             | V                |
| $\pm I_C$    | Collector Current         | $T_C = 25^\circ\text{C}$                    | 200             | A                |
| $\pm I_{CP}$ | Collector Current (Peak)  | $T_C = 25^\circ\text{C}$                    | 400             | A                |
| $P_C$        | Collector Dissipation     | $T_C = 25^\circ\text{C}$                    | 961             | W                |
| $T_j$        | Junction Temperature      |                                             | $-20 \sim +150$ | $^\circ\text{C}$ |

**CONTROL PART**

| Symbol    | Parameter                   | Conditions                                                                                          | Ratings   | Unit |
|-----------|-----------------------------|-----------------------------------------------------------------------------------------------------|-----------|------|
| $V_D$     | Supply Voltage              | Applied between : $V_{UP1}-V_{UPC}$<br>$V_{VP1}-V_{VPC}$ , $V_{WP1}-V_{WPC}$ , $V_{N1}-V_{NC}$      | 20        | V    |
| $V_{CIN}$ | Input Voltage               | Applied between : $U_P-V_{UPC}$ , $V_P-V_{VPC}$<br>$W_P-V_{WPC}$ , $U_N \cdot V_N \cdot W_N-V_{NC}$ | 20        | V    |
| $V_{FO}$  | Fault Output Supply Voltage | Applied between : $F_O-V_{NC}$                                                                      | $V_D+0.5$ | V    |
| $I_{FO}$  | Fault Output Current        | Sink current at $F_O$ terminal                                                                      | 20        | mA   |

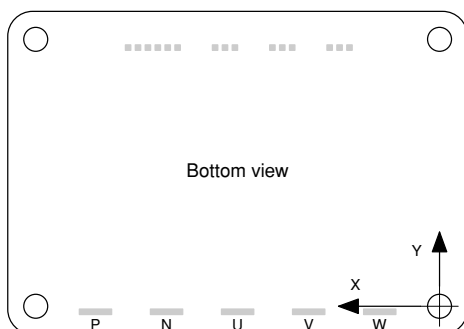
**PM200CBS060****FLAT-BASE TYPE  
INSULATED PACKAGE****TOTAL SYSTEM**

| Symbol           | Parameter                           | Conditions                                                                    | Ratings    | Unit             |
|------------------|-------------------------------------|-------------------------------------------------------------------------------|------------|------------------|
| VCC(Prot)        | Supply Voltage Protected by OC & SC | V <sub>D</sub> = 13.5 ~ 16.5V, Inverter Part,<br>T <sub>j</sub> = 125°C Start | 400        | V                |
| VCC(surge)       | Supply Voltage (Surge)              | Applied between : P-N, Surge value                                            | 500        | V                |
| T <sub>c</sub>   | Module Case Operating Temperature   | (Note-1)                                                                      | -20 ~ +110 | °C               |
| T <sub>stg</sub> | Storage Temperature                 |                                                                               | -40 ~ +125 | °C               |
| V <sub>iso</sub> | Isolation Voltage                   | 60Hz, Sinusoidal<br>Charged part to Base, AC 1 min.                           | 2500       | V <sub>rms</sub> |

(Note-1) T<sub>c</sub>(under the chip) measurement point is below.

(Unit : mm)

| Arm<br>Axis | UP   |      | VP   |      | WP   |      | UN   |      | VN   |      | WN   |      |
|-------------|------|------|------|------|------|------|------|------|------|------|------|------|
|             | IGBT | FWDi | IGBT | FWDi | IGBT | FWDi | IGBT | FWDi | IGBT | FWDi | IGBT | FWDi |
| X           | 84.5 | 84.5 | 53.0 | 53.0 | 21.5 | 21.5 | 92.9 | 81.1 | 56.2 | 44.4 | 13.2 | 24.9 |
| Y           | 57.5 | 45.8 | 57.5 | 45.8 | 57.5 | 45.8 | 22.3 | 22.3 | 22.3 | 22.3 | 22.3 | 22.3 |

**THERMAL RESISTANCES**

| Symbol                | Parameter                            | Test Conditions                                                                           | Limits |      |       | Unit |
|-----------------------|--------------------------------------|-------------------------------------------------------------------------------------------|--------|------|-------|------|
|                       |                                      |                                                                                           | Min.   | Typ. | Max.  |      |
| R <sub>th(j-c)Q</sub> | Junction to case Thermal Resistances | T <sub>c</sub> measured point is just under the chips Inverter IGBT part (per 1/6 module) | —      | —    | 0.13* | °C/W |
| R <sub>th(j-c)F</sub> |                                      | T <sub>c</sub> measured point is just under the chips Inverter FWDi part (per 1/6 module) | —      | —    | 0.21* | °C/W |
| R <sub>th(c-f)</sub>  | Contact Thermal Resistance           | Case to fin, (per 1 module)<br>Thermal grease applied                                     | —      | —    | 0.025 | °C/W |

\*: If you use this value, R<sub>th(f-a)</sub> should be measured just under the chips.**ELECTRICAL CHARACTERISTICS (T<sub>j</sub> = 25°C, unless otherwise noted)****INVERTER PART**

| Symbol               | Parameter                            | Test Conditions                                                                                                                                       |                                                 | Limits |      |         | Unit |
|----------------------|--------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------|--------|------|---------|------|
|                      |                                      |                                                                                                                                                       |                                                 | Min.   | Typ. | Max.    |      |
| V <sub>CE(sat)</sub> | Collector-Emitter Saturation Voltage | V <sub>D</sub> = 15V, I <sub>C</sub> = 200A<br>V <sub>CIN</sub> = 0V, Pulsed (Fig. 1)                                                                 | T <sub>j</sub> = 25°C<br>T <sub>j</sub> = 125°C | —      | 1.7  | 2.3     | V    |
| V <sub>EC</sub>      | FWDi Forward Voltage                 | —I <sub>C</sub> = 200A, V <sub>D</sub> = 15V, V <sub>CIN</sub> = 15V (Fig. 2)                                                                         |                                                 | —      | 2.2  | 3.3     | V    |
| t <sub>on</sub>      | Switching Time                       | V <sub>D</sub> = 15V, V <sub>CIN</sub> = 15V↔0V<br>V <sub>CC</sub> = 300V, I <sub>C</sub> = 200A<br>T <sub>j</sub> = 125°C<br>Inductive Load (Fig. 3) |                                                 | 0.8    | 1.2  | 2.4     | μs   |
| t <sub>rr</sub>      |                                      |                                                                                                                                                       |                                                 | —      | 0.15 | 0.3     | μs   |
| t <sub>c(on)</sub>   |                                      |                                                                                                                                                       |                                                 | —      | 0.4  | 1.0     | μs   |
| t <sub>off</sub>     |                                      |                                                                                                                                                       |                                                 | —      | 2.4  | 3.3     | μs   |
| t <sub>c(off)</sub>  |                                      |                                                                                                                                                       |                                                 | —      | 0.5  | 1.0     | 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<br>T <sub>j</sub> = 125°C | —      | —    | 1<br>10 | mA   |

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| Symbol   | Parameter                               | Test Conditions                                                 |             | Limits |      |      | Unit |
|----------|-----------------------------------------|-----------------------------------------------------------------|-------------|--------|------|------|------|
|          |                                         |                                                                 |             | Min.   | Typ. | Max. |      |
| Id       | Circuit Current                         | VD = 15V, VCIN = 15V                                            | VN1-VNC     | —      | 40   | 60   | mA   |
|          |                                         |                                                                 | VXP1-VXPC   | —      | 13   | 18   |      |
| Vth(ON)  | Input ON Threshold Voltage              | Applied between : UP-VUPC, VP-VVPC, WP-VWPC<br>UN • VN • WN-VNC |             | 1.2    | 1.5  | 1.8  | V    |
| Vth(OFF) | Input OFF Threshold Voltage             |                                                                 |             | 1.7    | 2.0  | 2.3  | V    |
| OC       | Over Current Trip Level                 | VD = 15V<br>(Fig. 5,6)                                          | Tj = -20°C  | —      | —    | 810  | A    |
|          |                                         |                                                                 | Tj = 25°C   | 400    | 515  | 670  |      |
|          |                                         |                                                                 | Tj = 125°C  | 310    | —    | —    |      |
| SC       | Short Circuit Trip Level                | -20≤ Tj ≤ 125°C, VD = 15V (Fig. 5,6)                            |             | —      | 560  | —    | A    |
| toff(OC) | Over Current Delay Time                 | VD = 15V (Fig. 5,6)                                             |             | —      | 10   | —    | μs   |
| OT       | Over Temperature protection             | Detect Tj of IGBT chip                                          | Trip level  | 135    | 145  | 155  | °C   |
| OTr      |                                         |                                                                 | Reset level | —      | 125  | —    | °C   |
| UV       | Supply Circuit Under-Voltage Protection | -20 ≤ Tj ≤ 125°C                                                | Trip level  | 11.5   | 12.0 | 12.5 | V    |
| UVr      |                                         |                                                                 | Reset level | —      | 12.5 | —    | V    |
| IFO(H)   | Fault Output Current                    | VD = 15V, VFO = 15V<br>(Note-2)                                 |             | —      | —    | 0.01 | mA   |
| IFO(L)   |                                         |                                                                 |             | —      | 10   | 15   | mA   |
| tFO      | Minimum Fault Output Pulse Width        | VD = 15V<br>(Note-2)                                            |             | 1.0    | 1.8  | —    | ms   |

(Note-2) Fault output is given only when the internal OC, SC, OT & UV protection.  
 Fault output of OC, SC, OT & UV protection operate by lower arm.  
 Fault output of OC, SC protection given pulse.  
 Fault output of OT, UV protection given pulse while over trip level.

**MECHANICAL RATINGS AND CHARACTERISTICS**

| Symbol | Parameter       | Test Conditions          | Limits |      |      | Unit  |
|--------|-----------------|--------------------------|--------|------|------|-------|
|        |                 |                          | Min.   | Typ. | Max. |       |
| —      | Mounting torque | Main terminal screw : M5 | 2.5    | 3.0  | 3.5  | N • m |
| —      | Mounting torque | Mounting part screw : M5 | 2.5    | 3.0  | 3.5  | N • m |
| —      | Weight          | —                        | —      | 680  | —    | g     |

**RECOMMENDED CONDITIONS FOR USE**

| Symbol                | Parameter                       | Test Conditions                                                       | Recommended value | Unit |
|-----------------------|---------------------------------|-----------------------------------------------------------------------|-------------------|------|
| V <sub>CC</sub>       | Supply Voltage                  | Applied across P-N terminals                                          | ≤ 400             | V    |
| V <sub>D</sub>        | Control Supply Voltage          | Applied between : VUP1-VUPC, VVP1-VVPC<br>VWP1-VWPC, VN1-VNC (Note-3) | 15.0 ± 1.5        | V    |
| V <sub>CIN(ON)</sub>  | Input ON Voltage                | Applied between : UP-VUPC, VP-VVPC, WP-VWPC<br>UN • VN • WN-VNC       | ≤ 0.8             | V    |
| V <sub>CIN(OFF)</sub> | Input OFF Voltage               |                                                                       | ≥ 4.0             | V    |
| f <sub>PWM</sub>      | PWM Input Frequency             | Using Application Circuit of Fig.8                                    | ≤ 20              | kHz  |
| t <sub>dead</sub>     | Arm Shoot-through Blocking Time | For IPM's each input signals (Fig. 7)                                 | ≥ 2.5             | 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

- Before applying any control supply voltage ( $V_D$ ), the input terminals should be pulled up by resistors, etc. to their corresponding supply voltage and each input signal should be kept off state.  
After this, the specified ON and OFF level setting for each input signal should be done.
- When performing "OC" and "SC" tests, the turn-off surge voltage spike at the corresponding protection operation should not be allowed to rise above  $V_{CES}$  rating of the device.  
(These test should not be done by using a curve tracer or its equivalent.)

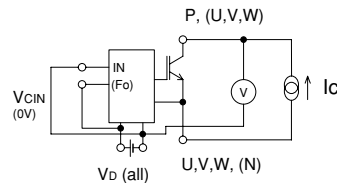


Fig. 1  $V_{CE(sat)}$  Test

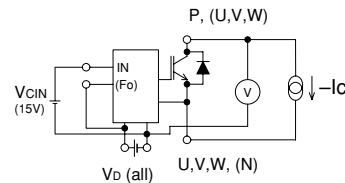


Fig. 2  $V_{EC}$  Test

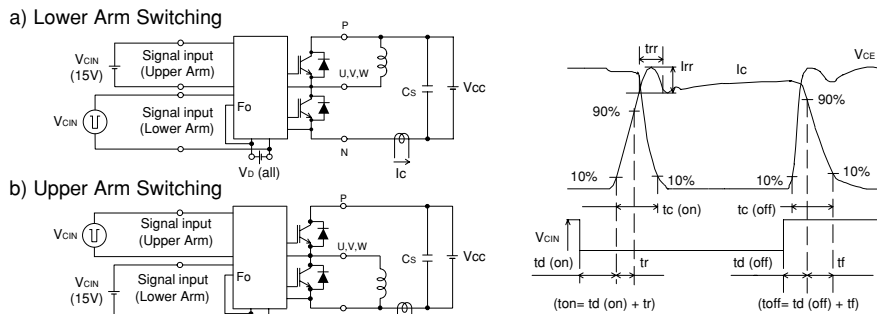


Fig. 3 Switching time Test circuit and waveform

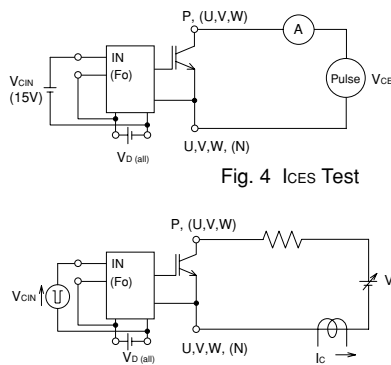


Fig. 4  $I_{CES}$  Test

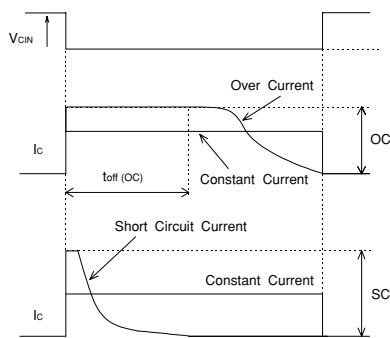


Fig. 6 OC and SC Test waveform

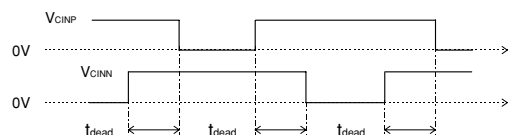


Fig. 7 Dead time measurement point example

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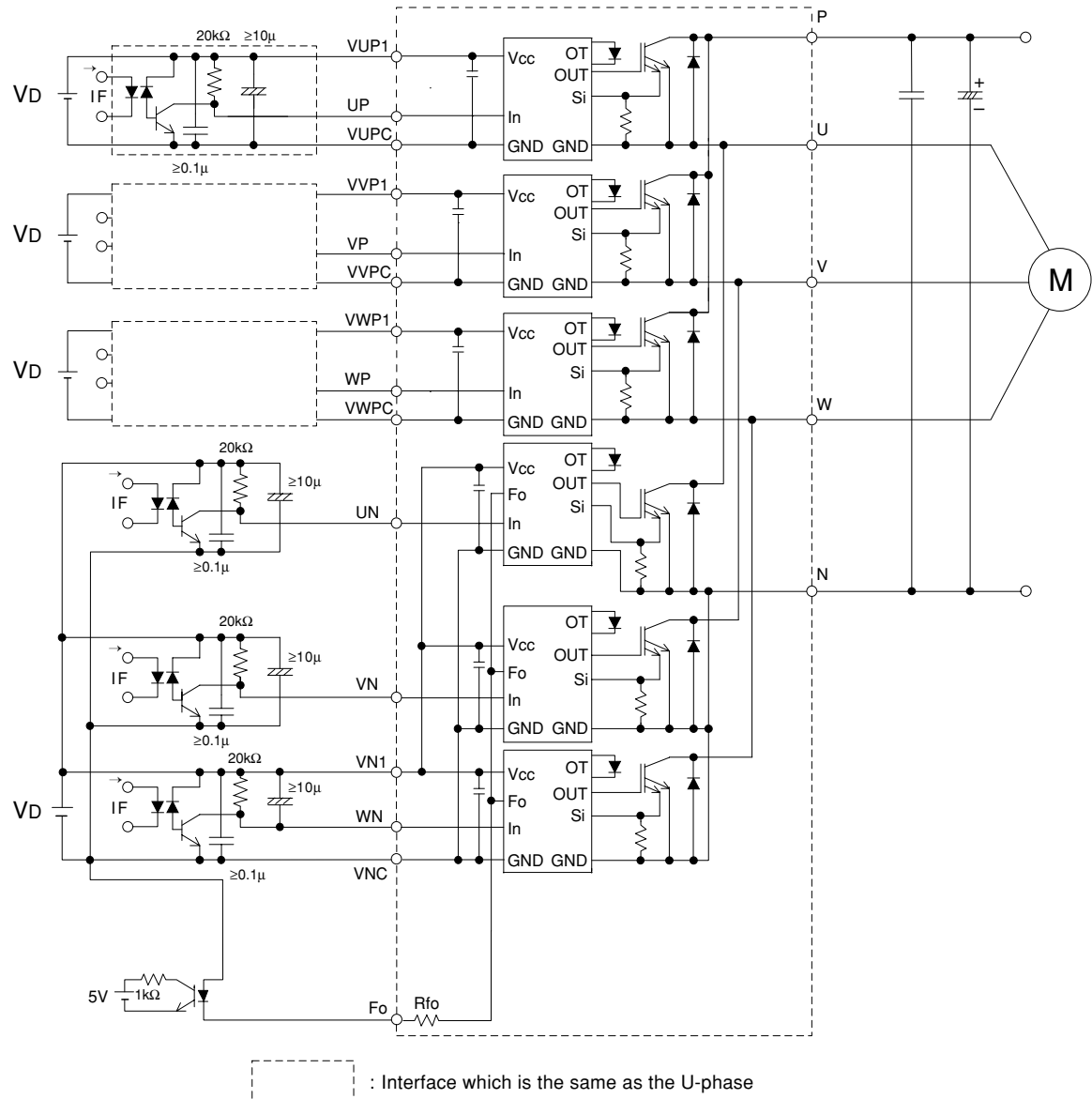


Fig. 8 Application Example Circuit

## 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.