

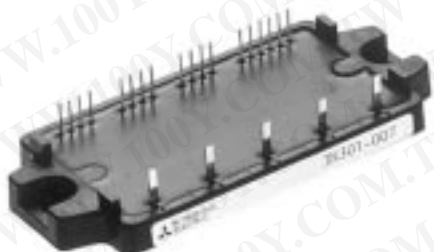
勝特力材料 886-3-5753170  
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MITSUBISHI <INTELLIGENT POWER MODULES>

# PM10CNJ060

FLAT-BASE TYPE  
 INSULATED PACKAGE

## PM10CNJ060



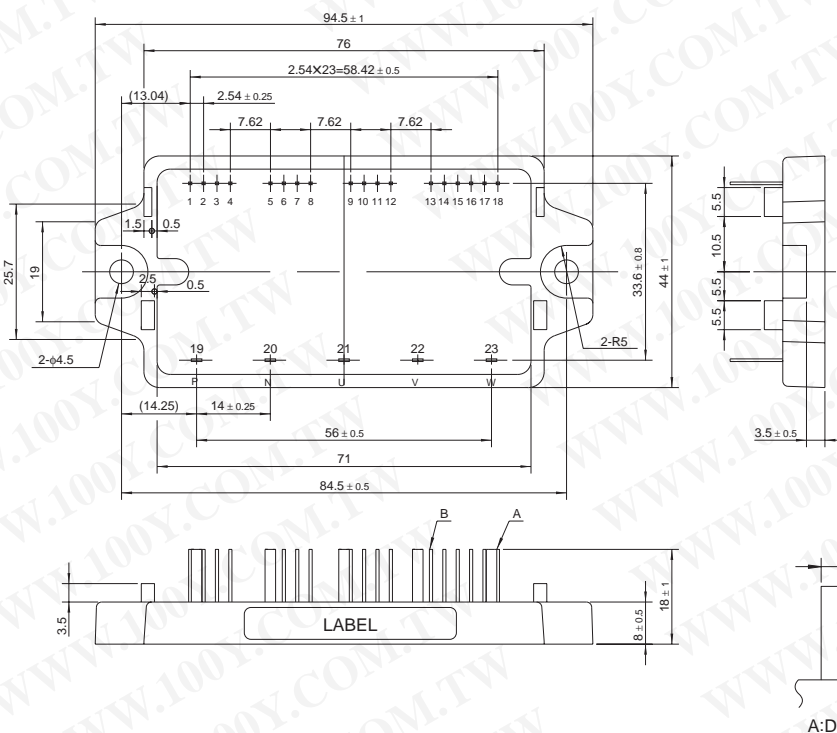
- 3 phase IGBT (10A/600V) inverter output
- Monolithic gate drive & protection logic circuit
- Protection logic
  - Over circuit (OC)
  - Short circuit (SC)
  - Over temperature (OT)
  - Under voltage lock-out (UV)
- UL Recognized File No. E80271  
Yellow Card No. E80276

## APPLICATION

General purpose inverter, servo drives and other motor controllers

## PACKAGE OUTLINES

Dimensions in mm



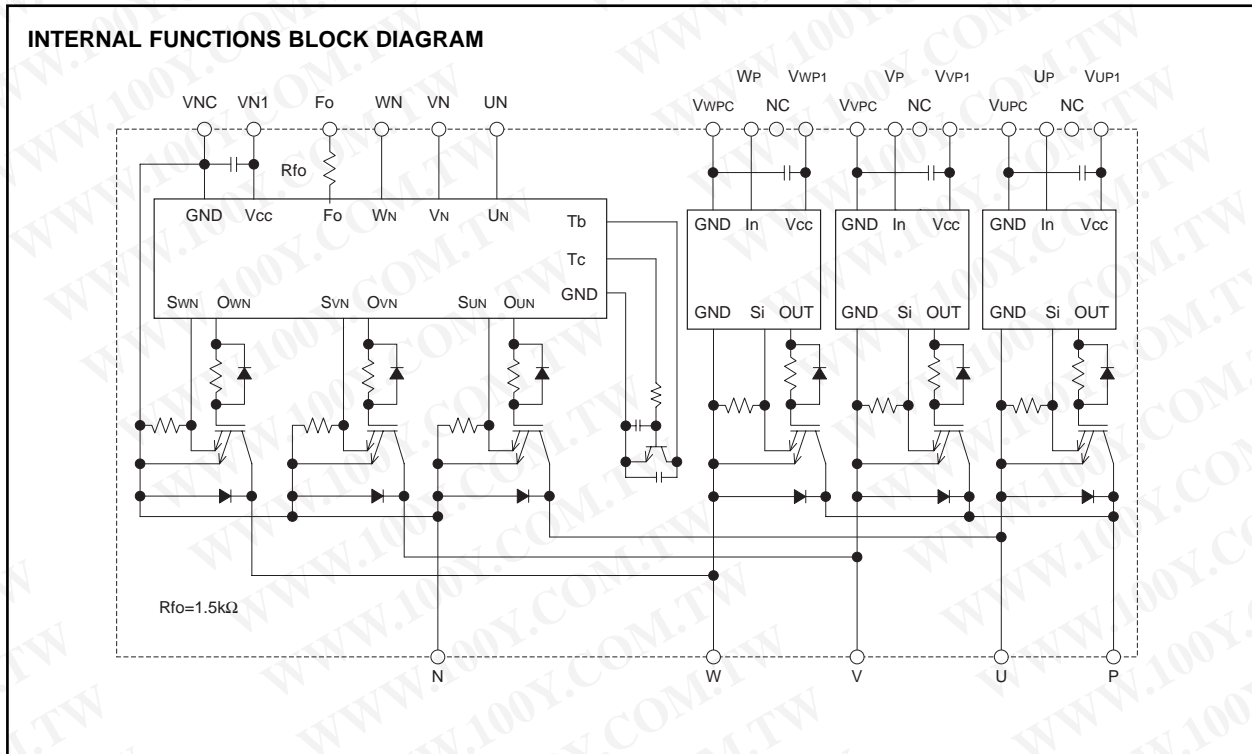
### Terminal code

- |          |         |
|----------|---------|
| 1. VUPC  | 13. VNC |
| 2. NC    | 14. VN1 |
| 3. UP    | 15. UN  |
| 4. VUP1  | 16. VN  |
| 5. VVPC  | 17. WN  |
| 6. NC    | 18. FO  |
| 7. VP    | 19. P   |
| 8. VVP1  | 20. N   |
| 9. VWPC  | 21. U   |
| 10. NC   | 22. V   |
| 11. WP   | 23. W   |
| 12. VWP1 |         |

NC : No Connect

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**MAXIMUM RATINGS** (Tj = 25°C, unless otherwise noted)

**INVERTER PART**

| Symbol | Parameter                 | Condition                                    | Ratings     | Unit |
|--------|---------------------------|--|-------------|------|
| VCES   | Collector-Emitter Voltage | V <sub>D</sub> = 15V, V <sub>CIN</sub> = 15V | 600         | V    |
| ±IC    | Collector Current         | T <sub>C</sub> = 25°C                        | 10          | A    |
| ±ICP   | Collector Current (Peak)  | T <sub>C</sub> = 25°C                        | 20          | A    |
| PC     | Collector Dissipation     | T <sub>C</sub> = 25°C                        | 39          | W    |
| Tj     | Junction Temperature      |  | -20 ~ +125* | °C   |

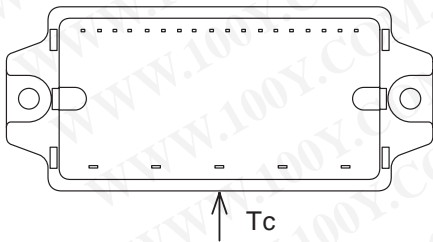
\*The item defines the maximum junction temperature for the power elements (IGBT/Diode) of the IPM to ensure safe operation. However, these power elements can endure junction temperature as high as 150°C instantaneously. To make use of this additional temperature allowance, a detailed study of the exact 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>UVC</sub><br>V <sub>VVP1</sub> -V <sub>VPC</sub> , V <sub>WVP1</sub> -V <sub>WPC</sub> , V <sub>N1</sub> -V <sub>NVC</sub>                          | 20      | V    |
| V <sub>CIN</sub> | Input Voltage               | Applied between : U <sub>P</sub> -V <sub>UVC</sub> , V <sub>P</sub> -V <sub>VPC</sub><br>W <sub>P</sub> -V <sub>WPC</sub> , U <sub>N</sub> • V <sub>N</sub> • W <sub>N</sub> -V <sub>NVC</sub> | 20      | V    |
| V <sub>FO</sub>  | Fault Output Supply Voltage | Applied between : F <sub>O</sub> -V <sub>NVC</sub>   | 20      | V    |
| I <sub>FO</sub>  | Fault Output Current        | Sink current at F <sub>O</sub> terminals   | 20      | mA   |

**PM10CNJ060**FLAT-BASE TYPE  
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| 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,<br>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<br>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<br>V <sub>CIN</sub> = 0V, Pulsed (Fig. 1)  | —      | 1.8  | 2.5  | V    |
|                      |                                      |   | —      | 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<br>V <sub>CC</sub> = 300V, I <sub>C</sub> = 10A<br>T <sub>j</sub> = 125°C, Inductive Load<br>(Upper-Lower Arm) (Fig. 3) | 0.3    | 0.7  | 1.6  | μs   |
| t <sub>tr</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)  | —      | —    | 1    | mA   |
|                      |                                      |   | —      | —    | 10   |      |

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## CONTROL PART

| Symbol               | Parameter                               | Test Condition  | Limits      |      |      | Unit |    |
|----------------------|---|---|-------------|------|------|------|----|
|                      |   |   | Min.        | Typ. | Max. |      |    |
| Id                   | Circuit Current                         | V <sub>D</sub> = 15V, V <sub>CIN</sub> = 15V                                      | VN1-VNC     | —    | 18   | 25   | mA |
|                      |   |   | VXP1-VXPC   | —    | 7    | 10   |    |
| V <sub>th(ON)</sub>  | Input ON Voltage                        | Applied between : UP-VU <sub>PC</sub> , VP-VV <sub>PC</sub> , WP-VW <sub>PC</sub> | 1.2         | 1.5  | 1.8  | V    |    |
| V <sub>th(OFF)</sub> | Input OFF Voltage                       | UN • VN • WN-VNC  | 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 Protection | -20 ≤ T <sub>j</sub> ≤ 125°C  | Trip level  | 11.5 | 12.0 | 12.5 | V  |
| UV <sub>r</sub>      |   |   | Reset level | —    | 12.5 | —    | V  |
| I <sub>FO(H)</sub>   | Fault Output Current                    | V <sub>D</sub> = 15V, V <sub>CIN</sub> = 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 Resistances | Inverter IGBT part (per 1/6 module)                   | —      | —    | 3.2  | °C/W |
| R <sub>th(j-c)F</sub> |                                      | 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)<br>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 |
| —      |                 |                          | —      | 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 : VUP1-VU <sub>PC</sub> , VVP1-VV <sub>PC</sub><br>VWP1-VW <sub>PC</sub> , VN1-VNC (Note-3) | 15 ± 1.5          | V    |
| V <sub>CIN(ON)</sub>  | Input ON Voltage                | Applied between : UP-VU <sub>PC</sub> , VP-VV <sub>PC</sub> , WP-VW <sub>PC</sub><br>UN • VN • WN-VNC       | ≤ 0.8             | V    |
| V <sub>CIN(OFF)</sub> | Input OFF Voltage               |   | ≥ 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

- 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.
- 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.)

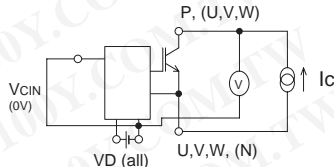


Fig. 1  $V_{CE(sat)}$  Test

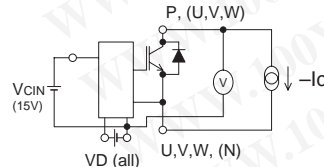
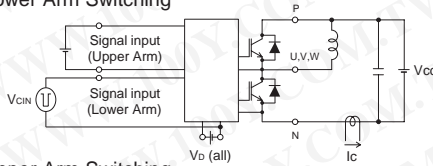


Fig. 2  $V_{EC}$  Test

### a) Lower Arm Switching



### b) Upper Arm Switching

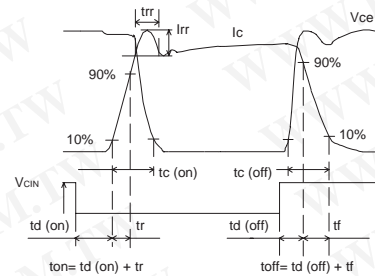
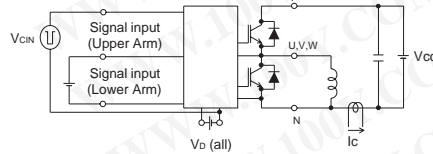


Fig. 3 Switching time Test circuit and waveform

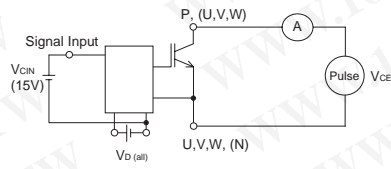


Fig. 4  $I_{CES}$  Test

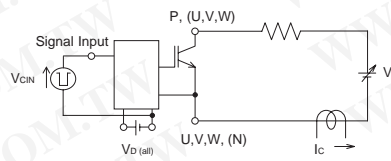
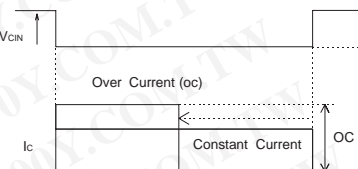


Fig. 5 OC and SC Test

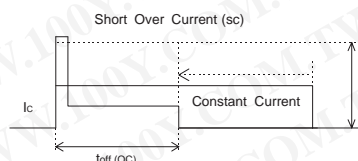


Fig. 6 OC and SC Test waveform

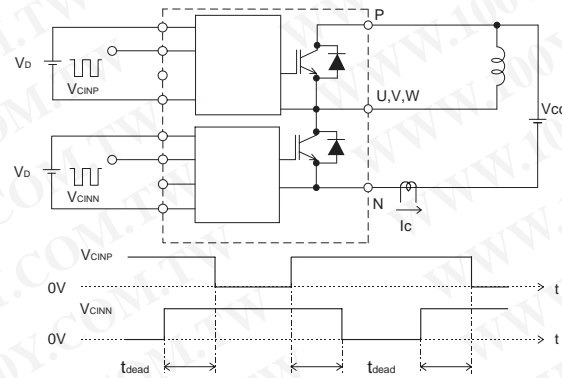


Fig. 7 Dead time measurement point example

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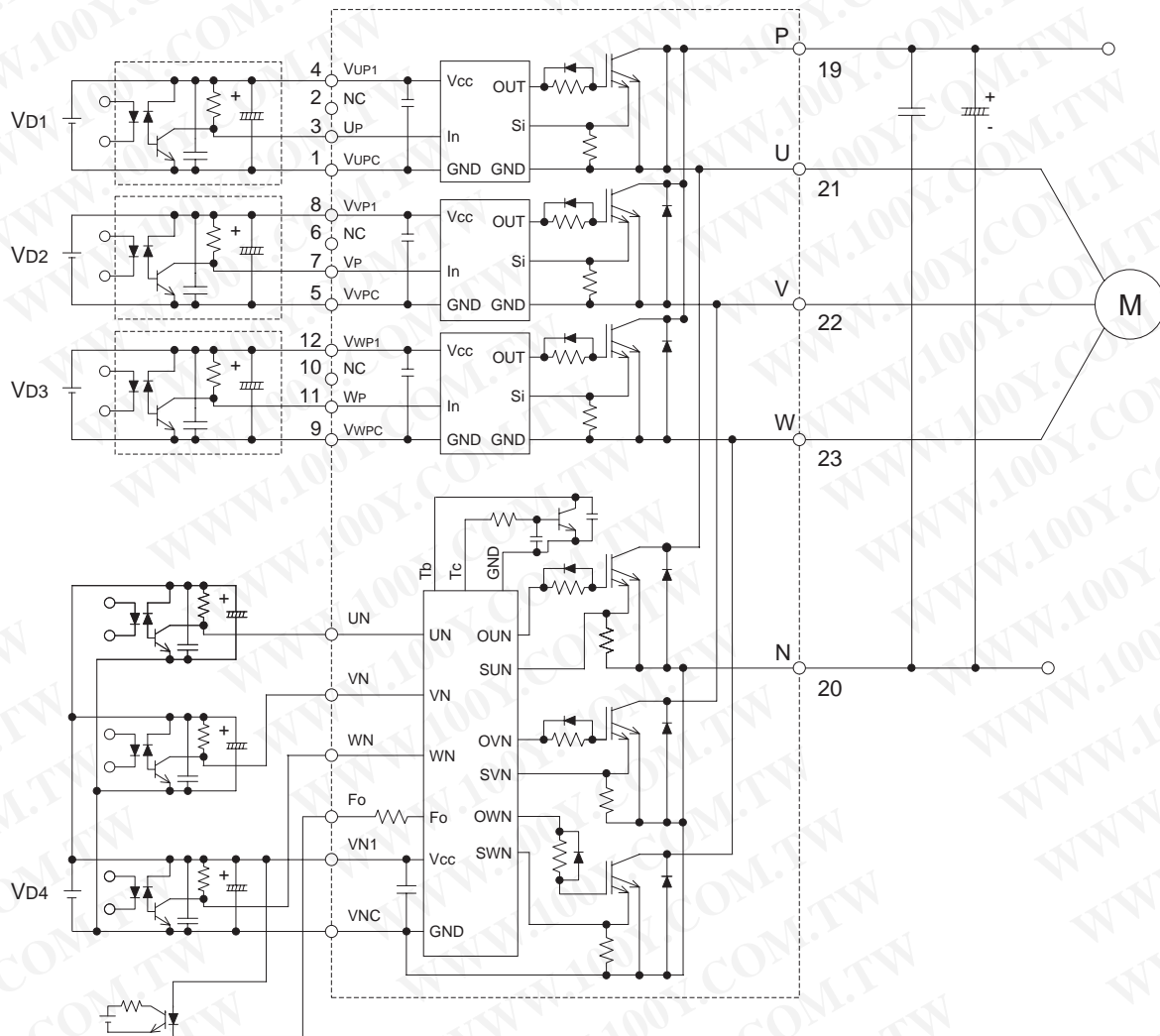


Fig. 8 Application Example Circuit

**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-coupler :  $t_{PLH}, t_{PHL} \leq 0.8\mu s$ , 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.