

# PM30CNJ060

FLAT-BASE TYPE  
INSULATED PACKAGE

## PM30CNJ060



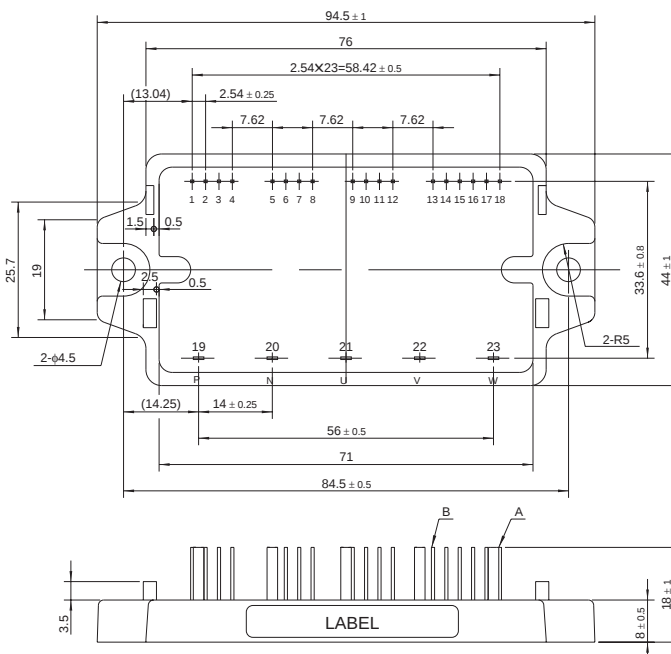
- 3 phase IGBT (30A/600V) inverter output
  - Monolithic gate drive & protection logic circuit
  - Protection logic
    - Over circuit (OC)
    - Short circuit (SC)
    - Over temperature (OT)
    - Under voltage lock-out (UV)
  - UL Recognized
- File No. E80271  
Yellow Card No. E80276

## APPLICATION

General purpose inverter, servo drives and other motor controllers

## PACKAGE OUTLINES

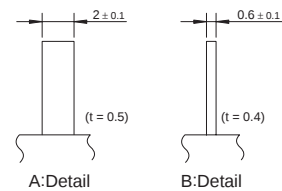
Dimensions in mm



### 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 |         |

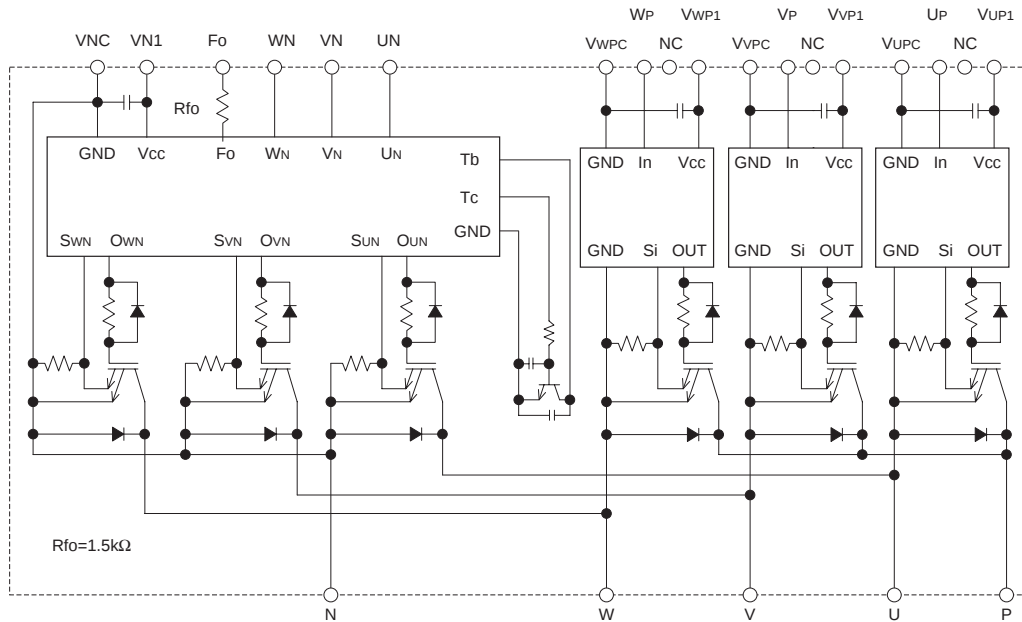
NC : No Connect



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INTERNAL FUNCTIONS BLOCK DIAGRAM



## 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                        | 30          | A    |
| ±ICP   | Collector Current (Peak)  | T <sub>C</sub> = 25°C                        | 60          | A    |
| PC     | Collector Dissipation     | T <sub>C</sub> = 25°C                        | 83          | 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

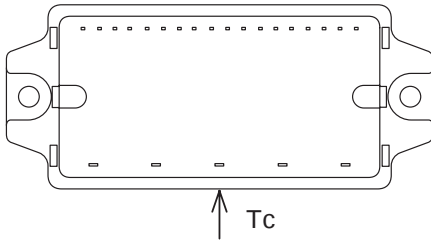
| Symbol           | Parameter                   | Condition                                                                                                                                                                                         | Ratings | Unit |
|------------------|-----------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------|------|
| V <sub>D</sub>   | Supply Voltage              | Applied between : V <sub>UP1</sub> -V <sub>UPC</sub><br>V <sub>VVP1</sub> -V <sub>VVPC</sub> , V <sub>WP1</sub> -V <sub>WPC</sub> , V <sub>N1</sub> -V <sub>N</sub>                               | 20      | V    |
| V <sub>CIN</sub> | Input Voltage               | Applied between : V <sub>UP</sub> -V <sub>UPC</sub> , V <sub>P</sub> -V <sub>VVPC</sub><br>V <sub>WP</sub> -V <sub>WPC</sub> , V <sub>UN</sub> • V <sub>N</sub> • V <sub>WN</sub> -V <sub>N</sub> | 20      | V    |
| V <sub>FO</sub>  | Fault Output Supply Voltage | Applied between : F <sub>O</sub> -V <sub>N</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,<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> = 30A<br>V <sub>CE</sub> = 0V, Pulsed (Fig. 1)                                                                                    | T <sub>J</sub> = 25°C<br>T <sub>J</sub> = 125°C | —      | 1.8<br>1.9 | 2.5<br>2.6 | V    |
| V <sub>EC</sub>      | FWDi Forward Voltage                 | -I <sub>C</sub> = 30A, V <sub>D</sub> = 15V, V <sub>CE</sub> = 15V (Fig. 2)                                                                                            |                                                 | —      | 2.5        | 3.5        | V    |
| t <sub>on</sub>      | Switching Time                       | V <sub>D</sub> = 15V, V <sub>CE</sub> = 0V↔15V<br>V <sub>CC</sub> = 300V, I <sub>C</sub> = 30A<br>T <sub>J</sub> = 125°C, Inductive Load<br>(Upper-Lower Arm) (Fig. 3) |                                                 | 0.3    | 0.85       | 1.7        | μs   |
| t <sub>tr</sub>      |                                      |                                                                                                                                                                        |                                                 | —      | 0.15       | 0.5        | μs   |
| t <sub>c(on)</sub>   |                                      |                                                                                                                                                                        |                                                 | —      | 0.7        | 1.7        | μs   |
| t <sub>off</sub>     |                                      |                                                                                                                                                                        |                                                 | —      | 2.0        | 2.8        | μs   |
| t <sub>c(off)</sub>  |                                      |                                                                                                                                                                        |                                                 | —      | 0.6        | 1.5        | μs   |
| I <sub>CES</sub>     | Collector-Emitter Cutoff Current     | V <sub>CE</sub> = V <sub>CE(sat)</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 Condition                                                  |             | Limits |      |      | Unit |
|----------|-----------------------------------------|-----------------------------------------------------------------|-------------|--------|------|------|------|
|          |                                         |                                                                 |             | Min.   | Typ. | Max. |      |
| Id       | Circuit Current                         | VD = 15V, VCIN = 15V                                            | VN1-VNC     | —      | 18   | 25   | mA   |
|          |                                         |                                                                 | VXP1-VXPC   | —      | 7    | 10   |      |
| Vth(ON)  | Input ON 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 Voltage                       |                                                                 |             | 1.7    | 2.0  | 2.3  | V    |
| OC       | Over Current Trip Level                 | −20 ≤ TJ ≤ 125°C, VD = 15V (Fig. 5,6)                           |             | 39     | 53   | —    | A    |
| SC       | Short Circuit Trip Level                | −20 ≤ TJ ≤ 125°C, VD = 15V (Fig. 5,6)                           |             | —      | 80   | —    | A    |
| toff(OC) | Over Current Delay Time                 | VD = 15V (Fig. 5,6)                                             |             | —      | 10   | —    | μs   |
| OT       | Over Temperature protection             | VD = 15V                                                        | Trip level  | 100    | 110  | 120  | °C   |
| OTr      |                                         |                                                                 | Reset level | —      | 90   | —    | °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, VCIN = 15V (Note-2)                                   | —           | —      | 0.01 | mA   |      |
| IFO(L)   |                                         |                                                                 | —           | 10     | 15   | mA   |      |
| tFO      | Minimum Fault Output Pulse Width        | VD = 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)                   | —      | —    | 1.5  | °C/W |
| R <sub>th(j-c)F</sub> | Resistances                | Inverter FWDi part (per 1/6 module)                   | —      | —    | 3.0  | °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 |
| —      | 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><br>V <sub>WP1</sub> -V <sub>WPC</sub> , V <sub>N1</sub> -V <sub>Nc</sub> (Note-3) | 15 ± 1.5          | V    |
| V <sub>CIN(ON)</sub>  | Input ON Voltage                | Applied between : UP-V <sub>UPC</sub> , VP-V <sub>VPC</sub> , WP-V <sub>WPC</sub><br>UN • VN • WN-V <sub>Nc</sub>                                                           | ≤ 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)                                                                                                                                       | ≥ 2.5             | 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 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.)

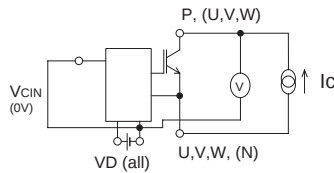


Fig. 1  $V_{CE(sat)}$  Test

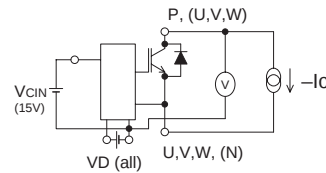
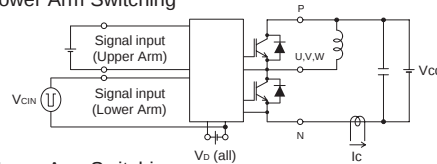


Fig. 2  $V_{EC}$  Test

### a) Lower Arm Switching



### b) Upper Arm Switching

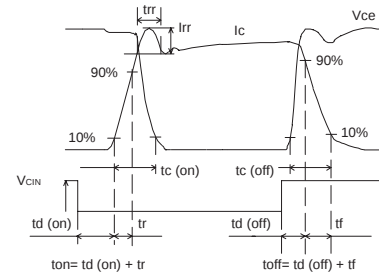
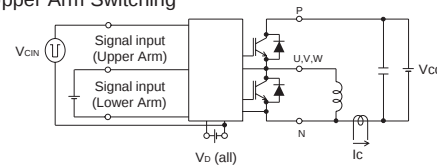


Fig. 3 Switching time Test circuit and waveform

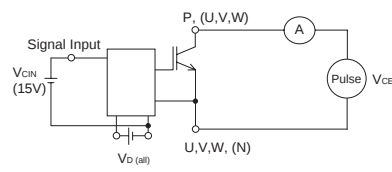


Fig. 4  $I_{CES}$  Test

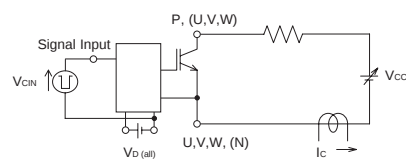
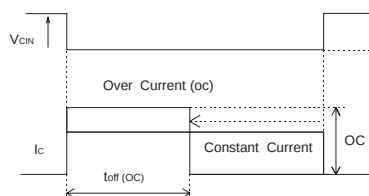


Fig. 5 OC and SC Test

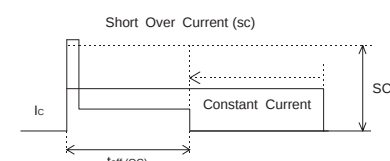


Fig. 6 OC and SC Test waveform

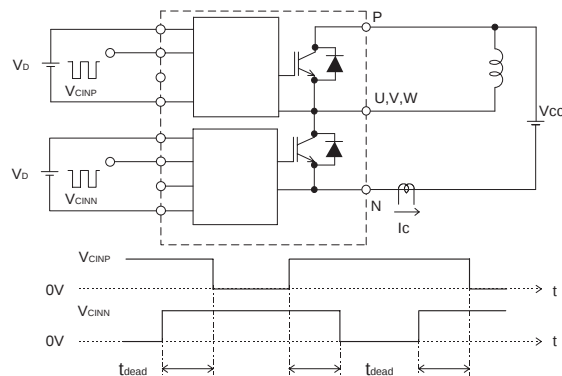


Fig. 7 Dead time measurement point example

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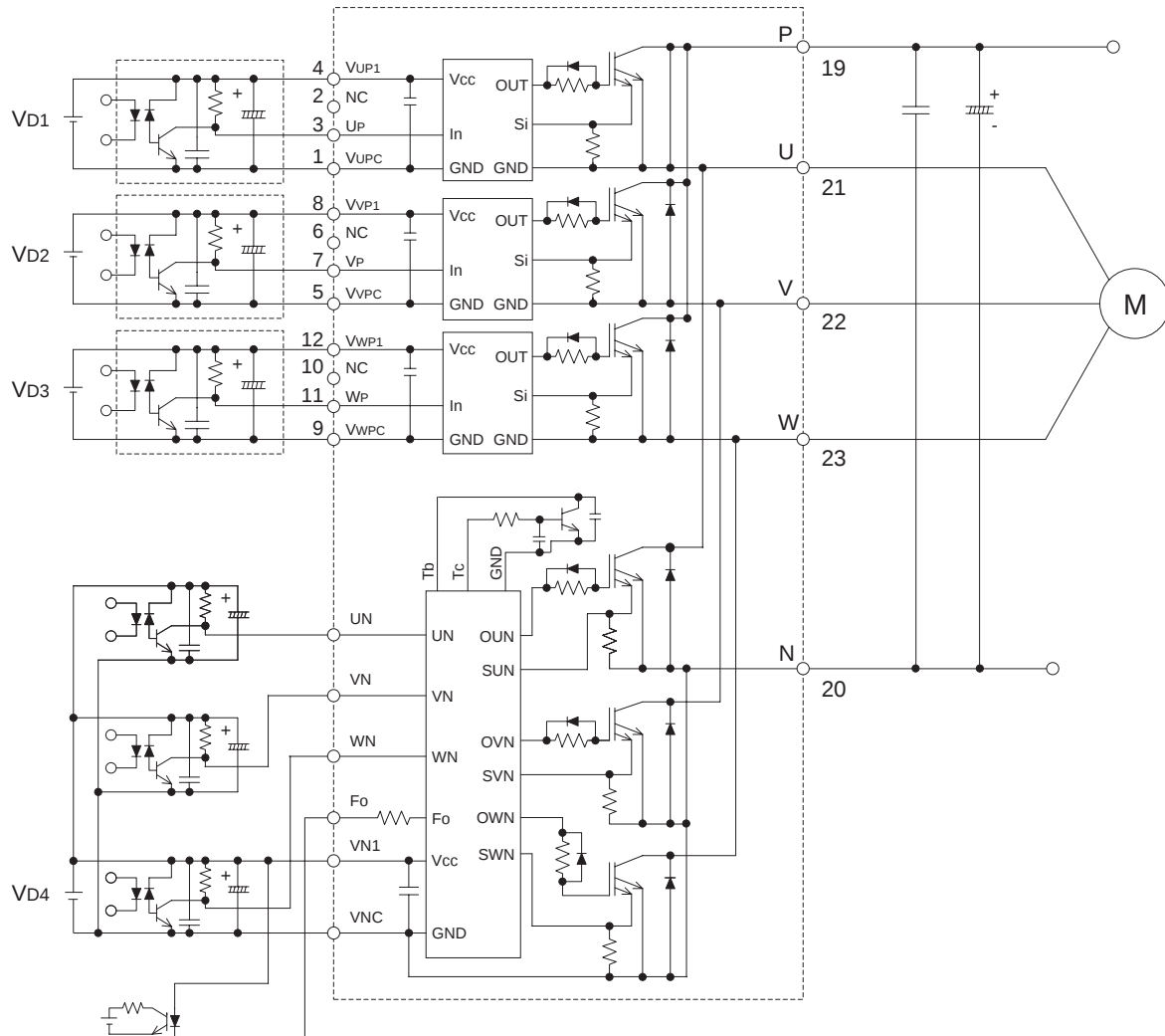


Fig. 8 Application Example Circuit

## 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-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.