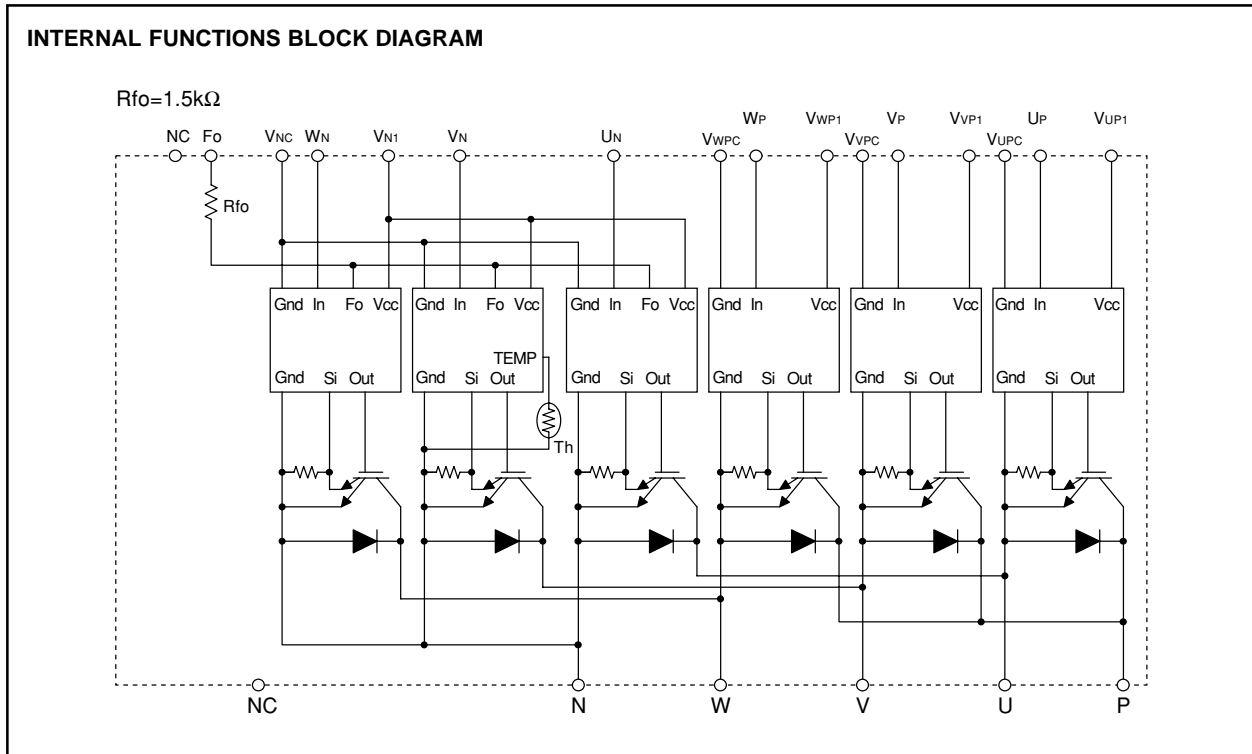




# PM50CSE120

FLAT-BASE TYPE  
INSULATED PACKAGE



**MAXIMUM RATINGS** (Tj = 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>CIN</sub> = 15V | 1200       | V    |
| ±I <sub>C</sub>  | Collector Current         | T <sub>C</sub> = 25°C                        | 50         | A    |
| ±I <sub>CP</sub> | Collector Current (Peak)  | T <sub>C</sub> = 25°C                        | 100        | A    |
| P <sub>C</sub>   | Collector Dissipation     | T <sub>C</sub> = 25°C                        | 328        | W    |
| T <sub>j</sub>   | Junction Temperature      |  | -20 ~ +150 | °C   |

**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>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>CIN</sub> | Input Voltage               | Applied between : U <sub>P</sub> -V <sub>UPC</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>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> terminal   | 20      | mA   |

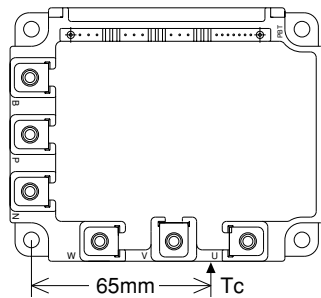
# PM50CSE120

FLAT-BASE TYPE  
INSULATED PACKAGE

## TOTAL SYSTEM

| Symbol                 | Parameter                           | Condition   | Ratings    | Unit             |
|------------------------|-------------------------------------|---|------------|------------------|
| V <sub>CC(PROT)</sub>  | Supply Voltage Protected by OC & SC | V <sub>D</sub> = 13.5 ~ 16.5V, Inverter Part,<br>T <sub>J</sub> = 125°C Start | 800        | V                |
| V <sub>CC(surge)</sub> | Supply Voltage (Surge)              | Applied between : P-N, Surge value or without switching                       | 1000       | 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 is as shown below. (Base plate depth 3mm)



## 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 element), (Note-1)       | —      | —    | 0.38  | °C/W |
| R <sub>th(j-c)F</sub> |                                      | Inverter FWDi part (per 1 element), (Note-1)       | —      | —    | 0.70  |      |
| R <sub>th(j-c)Q</sub> |                                      | Inverter IGBT part (per 1 element), (Note-2)       | —      | —    | 0.23  |      |
| R <sub>th(j-c)F</sub> |                                      | Inverter FWDi part (per 1 element), (Note-2)       | —      | —    | 0.36  |      |
| R <sub>th(c-f)</sub>  | Contact Thermal Resistance           | Case to fin, Thermal grease applied (per 1 module) | —      | —    | 0.027 |      |

(Note-2) T<sub>c</sub> measurement point is just under the chips.  
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 Condition   | Limits                 |      |      | Unit |    |
|----------------------|--------------------------------------|--|------------------------|------|------|------|----|
|                      |                                      |  | Min.                   | Typ. | Max. |      |    |
| V <sub>CE(sat)</sub> | Collector-Emitter Saturation Voltage | V <sub>D</sub> = 15V, I <sub>C</sub> = 50A<br>V <sub>CIN</sub> = 0V, Pulsed (Fig. 1)   | T <sub>J</sub> = 25°C  | —    | 2.4  | 3.2  | V  |
|                      |                                      |  | T <sub>J</sub> = 125°C | —    | 2.1  | 2.8  |    |
| V <sub>EC</sub>      | FWDi Forward Voltage                 | -I <sub>C</sub> = 50A, V <sub>D</sub> = 15V, V <sub>CIN</sub> = 15V (Fig. 2)   | —                      | 2.5  | 3.5  | V    |    |
| t <sub>on</sub>      | Switching Time                       | V <sub>D</sub> = 15V, V <sub>CIN</sub> = 15V↔0V<br>V <sub>CC</sub> = 600V, I <sub>C</sub> = 50A<br>T <sub>J</sub> = 125°C<br>Inductive Load (upper and lower arm) (Fig. 3) | 0.5                    | 1.0  | 2.5  | μs   |    |
| t <sub>rr</sub>      |                                      |  | —                      | 0.15 | 0.3  |      |    |
| t <sub>c(on)</sub>   |                                      |  | —                      | 0.4  | 1.0  |      |    |
| t <sub>off</sub>     |                                      |  | —                      | 2.5  | 3.5  |      |    |
| t <sub>c(off)</sub>  |                                      |  | —                      | 0.7  | 1.2  |      |    |
| I <sub>CES</sub>     | Collector-Emitter Cutoff Current     | V <sub>CE</sub> = V <sub>CE(s)</sub> , V <sub>CIN</sub> = 15V (Fig. 4)   | T <sub>J</sub> = 25°C  | —    | —    | 1    | mA |
|                      |                                      |  | T <sub>J</sub> = 125°C | —    | —    | 10   |    |

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FLAT-BASE TYPE  
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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>CIN</sub> = 15V                     | V <sub>N1</sub> -V <sub>Nc</sub>   | —    | 40   | 55   | mA |
|                      |   |  | V <sub>XP1</sub> -V <sub>XPC</sub> | —    | 13   | 18   |    |
| V <sub>th(on)</sub>  | Input ON Threshold Voltage              | Applied between : UP-VUPC, VP-VVPC, WP-VWPC<br>UN • VN • WN-VNC  |                                    | 1.2  | 1.5  | 1.8  | V  |
| V <sub>th(off)</sub> | Input OFF Threshold Voltage             |  |                                    | 1.7  | 2.0  | 2.3  |    |
| OC                   | Over Current Trip Level                 | V <sub>D</sub> = 15V<br>(Fig. 5.6)                               | T <sub>J</sub> = 25°C              | 93   | 157  | —    | A  |
|                      |   |  | T <sub>J</sub> = 125°C             | 59   | —    | —    |    |
| SC                   | Short Circuit Trip Level                | −20 ≤ T <sub>J</sub> ≤ 125°C, V <sub>D</sub> = 15V<br>(Fig. 5.6) |                                    | —    | 183  | —    | A  |
| t <sub>off(OC)</sub> | Over Current Delay Time                 | V <sub>D</sub> = 15V<br>(Fig. 5.6)                               |                                    | —    | 10   | —    | μs |
| OT                   | Over Temperature Protection             | Base-plate<br>Temperature detection, V <sub>D</sub> = 15V        | Trip level                         | 111  | 118  | 125  | °C |
|                      |   |  | Reset level                        | —    | 100  | —    |    |
| UV                   | Supply Circuit Under-Voltage Protection | −20 ≤ T <sub>J</sub> ≤ 125°C                                     | Trip level                         | 11.5 | 12.0 | 12.5 | V  |
|                      |   |  | Reset level                        | —    | 12.5 | —    |    |
| I <sub>FO(H)</sub>   | Fault Output Current                    | V <sub>D</sub> = 15V, V <sub>FO</sub> = 15V<br>(Note-3)          |                                    | —    | —    | 0.01 | mA |
| I <sub>FO(L)</sub>   |   |  |                                    | —    | 10   | 15   |    |
| t <sub>FO</sub>      | Minimum Fault Output Pulse Width        | V <sub>D</sub> = 15V<br>(Note-3)                                 |                                    | 1.0  | 1.8  | —    | ms |

(Note-3) Fault output is given only when the internal OC, SC, OT &amp; UV protection.

Fault output of OT protection operate by lower arm.

Fault output of OC, SC protection given pulse.

Fault output of OT, UV protection given pulse while over level.

## MECHANICAL RATINGS AND CHARACTERISTICS

| Symbol | Parameter       | Test Condition           | 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          | —                        | —      | 560  | —    | g     |

## RECOMMENDED CONDITIONS FOR USE

| Symbol                | Parameter                       | Test Condition  | Recommended value | Unit |
|-----------------------|---------------------------------|---|-------------------|------|
| V <sub>CC</sub>       | Supply Voltage                  | Applied across P-N terminals  | ≤ 800             | 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-4) | 15 ± 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             |      |
| f <sub>PWM</sub>      | PWM Input Frequency             | Using Application Circuit input signal of IPM, 3φ sinusoidal PWM VVVF inverter (Fig. 8)   | ≤ 20              | kHz  |
| t <sub>dead</sub>     | Arm Shoot-through Blocking Time | For IPM's each input signals (Fig. 7)   | ≥ 3.0             | μs   |

(Note-4) Allowable Ripple rating of Control Voltage : dv/dt ≤ ±5V/μs, 2V<sub>p-p</sub>

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FLAT-BASE TYPE  
INSULATED PACKAGE

## PRECAUTIONS FOR TESTING

1. 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.
2. 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.)

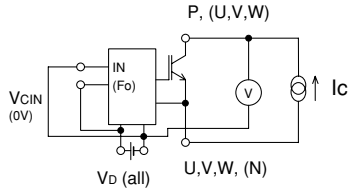


Fig. 1  $V_{CE(sat)}$  Test

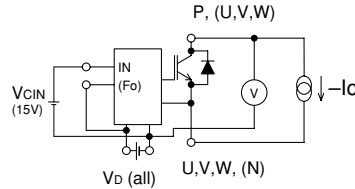
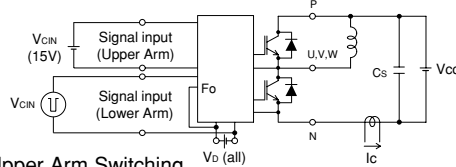


Fig. 2  $V_{EC}$  Test

### a) Lower Arm Switching



### b) Upper Arm Switching

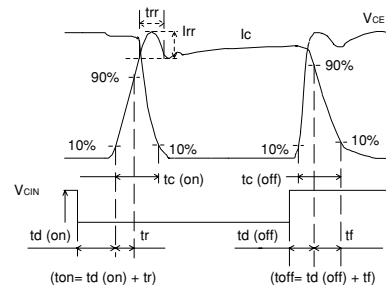
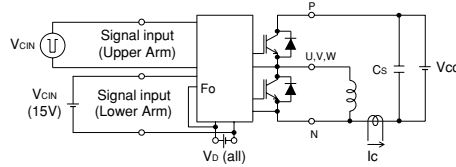


Fig. 3 Switching time Test circuit and waveform

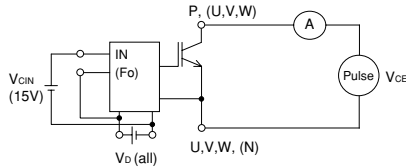


Fig. 4  $I_{ces}$  Test

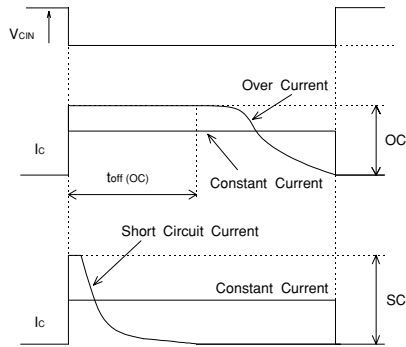


Fig. 6 OC and SC Test waveform

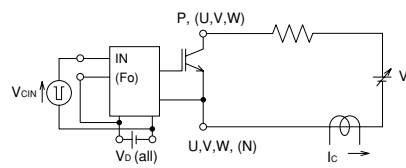


Fig. 5 OC and SC Test

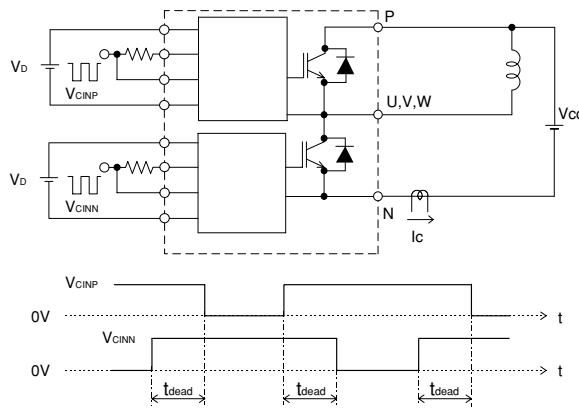


Fig. 7 Dead time measurement point example

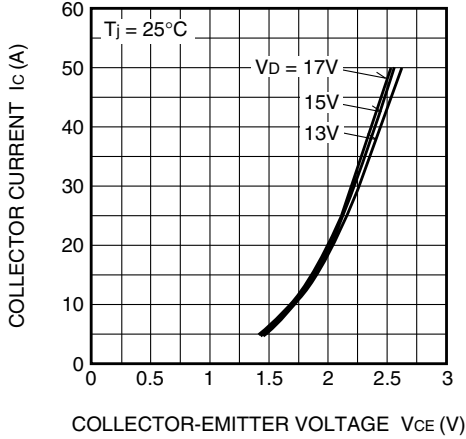


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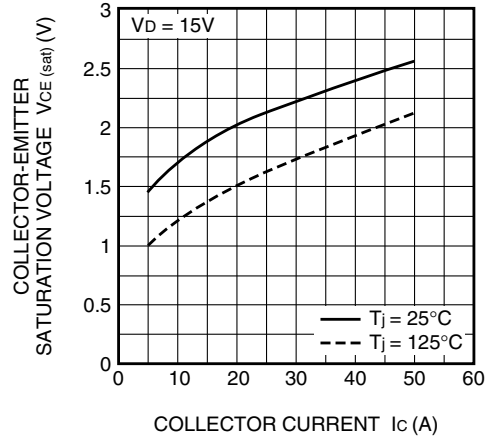
FLAT-BASE TYPE  
INSULATED PACKAGE

## PERFORMANCE CURVES

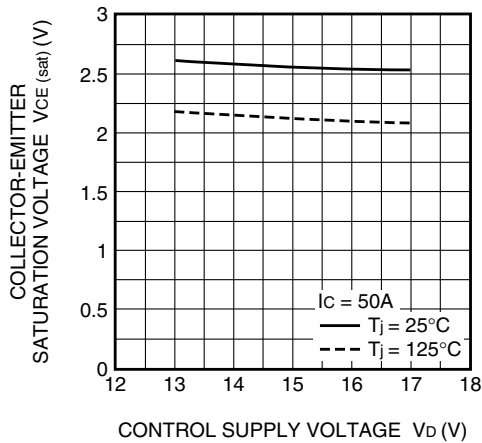
**OUTPUT CHARACTERISTICS (TYPICAL)**



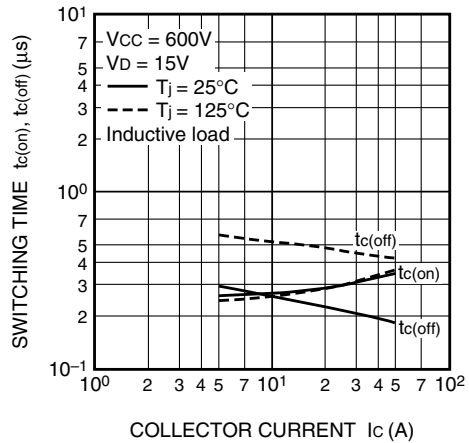
**COLLECTOR-EMITTER SATURATION VOLTAGE (VS.  $I_c$ ) CHARACTERISTICS (TYPICAL)**



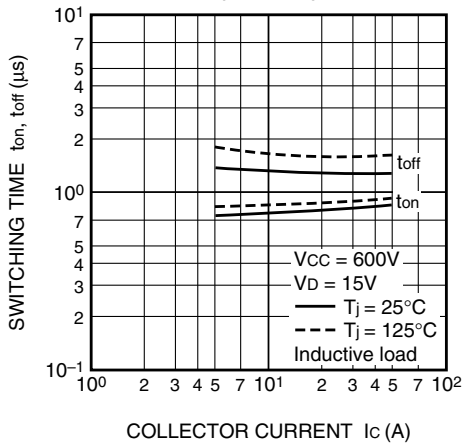
**COLLECTOR-EMITTER SATURATION VOLTAGE (VS.  $V_b$ ) CHARACTERISTICS (TYPICAL)**



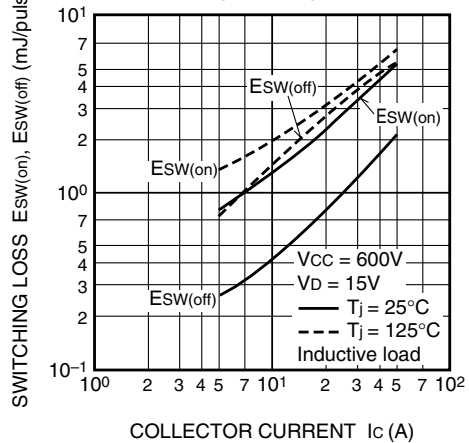
**SWITCHING TIME CHARACTERISTICS (TYPICAL)**



**SWITCHING TIME CHARACTERISTICS (TYPICAL)**



**SWITCHING LOSS CHARACTERISTICS (TYPICAL)**



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FLAT-BASE TYPE  
INSULATED PACKAGE

