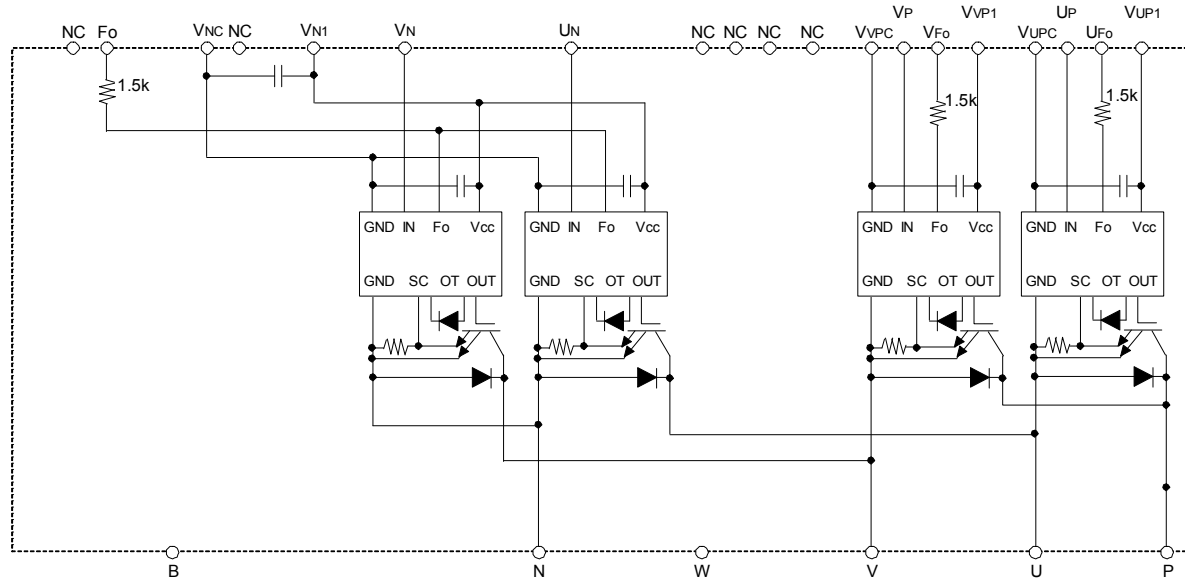




# PM75B4L1C060

FLAT-BASE TYPE  
INSULATED PACKAGE

## 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                |
| $I_C$     | Collector Current                                        | $T_c=25^\circ\text{C}$                  | 75         | A                |
| $I_{CRM}$ |                                                          | Pulse                                   | 150        |                  |
| $P_{tot}$ | Total Power Dissipation                                  | $T_c=25^\circ\text{C}$                  | 201        | W                |
| $I_E$     | Emitter Current<br>(Free wheeling Diode Forward current) | $T_c=25^\circ\text{C}$                  | 75         | A                |
| $I_{ERM}$ |                                                          | Pulse                                   | 150        |                  |
| $T_j$     | Junction Temperature                                     |                                         | -20 ~ +150 | $^\circ\text{C}$ |

\*:  $T_c$  measurement point is just under the chip.

### CONTROL PART

| Symbol    | Parameter                   | Conditions                                                                | Ratings | Unit |
|-----------|-----------------------------|---------------------------------------------------------------------------|---------|------|
| $V_D$     | Supply Voltage              | Applied between : $V_{UP1}-V_{UPC}$ , $V_{VP1}-V_{VPC}$ , $V_{N1}-V_{NC}$ | 20      | V    |
| $V_{CIN}$ | Input Voltage               | Applied between : $UP-V_{UPC}$ , $VP-V_{VPC}$ , $UN-V_{NC}$               | 20      | V    |
| $V_{FO}$  | Fault Output Supply Voltage | Applied between : $U_{FO}-V_{UPC}$ , $V_{FO}-V_{VPC}$ , $Fo-V_{NC}$       | 20      | V    |
| $I_{FO}$  | Fault Output Current        | Sink current at $U_{FO}$ , $V_{FO}$ , $Fo$ terminals                      | 20      | mA   |

# PM75B4L1C060

FLAT-BASE TYPE  
INSULATED PACKAGE

## TOTAL SYSTEM

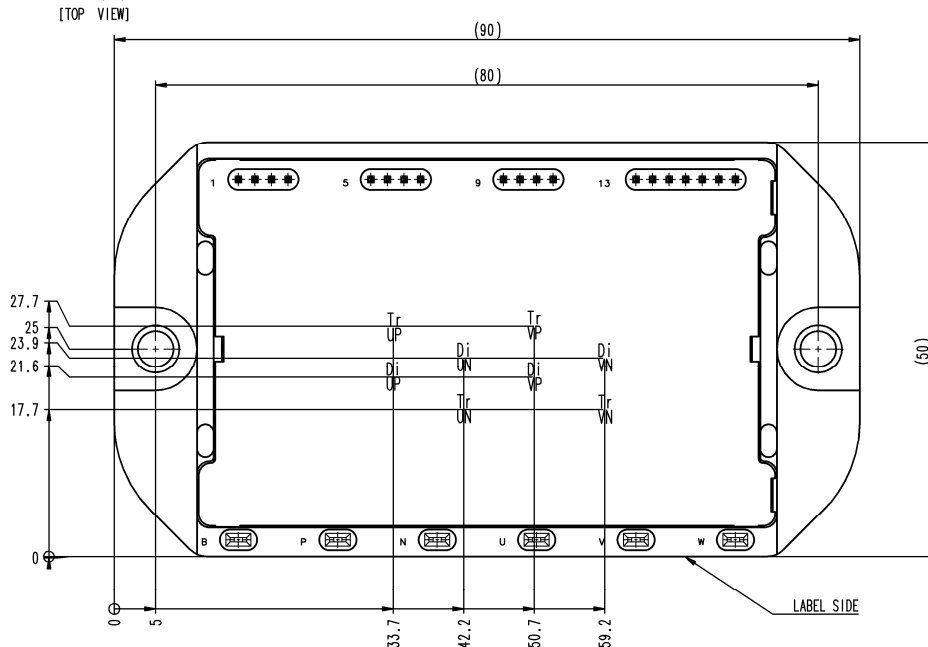
| Symbol          | Parameter                      | Conditions                                                            | Ratings    | Unit       |
|-----------------|--------------------------------|-----------------------------------------------------------------------|------------|------------|
| $V_{CC(Prot)}$  | Supply Voltage Protected by SC | $V_D = 13.5V \sim 16.5V$<br>Inverter Part, $T_j = +125^\circ C$ Start | 450        | V          |
| $V_{CC(surge)}$ | Supply Voltage (Surge)         | Applied between : P-N, Surge value                                    | 500        | V          |
| $T_{stg}$       | Storage Temperature            |                                                                       | -40 ~ +125 | $^\circ C$ |
| $V_{isol}$      | Isolation Voltage              | 60Hz, Sinusoidal, RMS, Charged part to Base, AC 1min.                 | 2500       | V          |

\*:  $T_C$  measurement point is just under the chip.

## THERMAL RESISTANCE

| Symbol         | Parameter                  | Conditions                                                           | Limits |      |      | Unit |
|----------------|----------------------------|----------------------------------------------------------------------|--------|------|------|------|
|                |                            |                                                                      | Min.   | Typ. | Max. |      |
| $R_{th(j-c)Q}$ | Thermal Resistance         | Junction to case, IGBT (per 1 element) (Note.1)                      | -      | -    | 0.62 | K/W  |
| $R_{th(j-c)D}$ |                            | Junction to case, FWDi (per 1 element) (Note.1)                      | -      | -    | 1.06 |      |
| $R_{th(c-s)}$  | Contact Thermal Resistance | Case to heat sink, (per 1 module)<br>Thermal grease applied (Note.1) | -      | 0.06 | -    |      |

Note.1: If you use this value,  $R_{th(s-a)}$  should be measured just under the chips.



## ELECTRICAL CHARACTERISTICS ( $T_j = 25^\circ C$ , unless otherwise noted)

### INVERTER PART

| Symbol       | Parameter                            | Conditions                                                                                                                            | Limits |      |      | Unit    |
|--------------|--------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------|--------|------|------|---------|
|              |                                      |                                                                                                                                       | Min.   | Typ. | Max. |         |
| $V_{CEsat}$  | Collector-Emitter Saturation Voltage | $V_D = 15V$ , $I_C = 75A$<br>$V_{CIN} = 0V$ , Pulsed (Fig. 1)                                                                         | -      | 2.2  | 2.7  | V       |
|              |                                      | $T_j = 25^\circ C$<br>$T_j = 125^\circ C$                                                                                             | -      | 2.2  | 2.7  |         |
| $V_{EC}$     | Emitter-Collector Voltage            | $I_E = 75A$ , $V_D = 15V$ , $V_{CIN} = 15V$ (Fig. 2)                                                                                  | -      | 2.4  | 3.3  | V       |
| $t_{on}$     | Switching Time                       | $V_D = 15V$ , $V_{CIN} = 0V \leftrightarrow 15V$<br>$V_{CC} = 300V$ , $I_C = 75A$<br>$T_j = 125^\circ C$<br>Inductive Load (Fig. 3,4) | 0.1    | 0.5  | 1.2  | $\mu s$ |
| $t_{rr}$     |                                      |                                                                                                                                       | -      | 0.1  | 0.2  |         |
| $t_{c(on)}$  |                                      |                                                                                                                                       | -      | 0.15 | 0.3  |         |
| $t_{off}$    |                                      |                                                                                                                                       | -      | 1.1  | 2.0  |         |
| $t_{c(off)}$ |                                      |                                                                                                                                       | -      | 0.2  | 0.4  |         |
| $I_{CES}$    | Collector-Emitter Cut-off Current    | $V_{CE} = V_{CES}$ , $V_D = 15V$ , $V_{CIN} = 15V$ (Fig. 5)                                                                           | -      | -    | 1    | mA      |
|              |                                      | $T_j = 25^\circ C$<br>$T_j = 125^\circ C$                                                                                             | -      | -    | 10   |         |

# PM75B4L1C060

FLAT-BASE TYPE  
INSULATED PACKAGE

## CONTROL PART

| Symbol               | Parameter                               | Conditions                                                                          |                                  | 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> | -      | 6.5  | 12   | mA   |
|                      |                                         |                                                                                     | V <sub>P1</sub> -V <sub>PC</sub> | -      | 1.6  | 4.0  |      |
| V <sub>th(ON)</sub>  | Input ON Threshold Voltage              | Applied between : UP-V <sub>UPC</sub> , VP-V <sub>VPC</sub> , UN·VN-V <sub>NC</sub> |                                  | 1.2    | 1.5  | 1.8  | V    |
| V <sub>th(OFF)</sub> | Input OFF Threshold Voltage             |                                                                                     |                                  | 1.7    | 2.0  | 2.3  |      |
| SC                   | Short Circuit Trip Level                | -20≤T <sub>j</sub> ≤125°C, V <sub>D</sub> =15V (Fig. 3, 6)                          |                                  | 112    | -    | -    | A    |
| t <sub>off(SC)</sub> | Short Circuit Current Delay Time        | V <sub>D</sub> =15V (Fig. 3, 6)                                                     |                                  | -      | 0.2  | -    | μs   |
| OT                   | Over Temperature Protection             | Detect Temperature of IGBT chip                                                     | Trip level                       | 135    | -    | -    | °C   |
| OT <sub>(hys)</sub>  |                                         |                                                                                     | Hysteresis                       | -      | 20   | -    |      |
| UV <sub>t</sub>      | 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 | -    |      |
| I <sub>FO(H)</sub>   | Fault Output Current                    | V <sub>D</sub> =15V, V <sub>FO</sub> =15V (Note.2)                                  | -                                | -      | 0.01 | mA   |      |
| I <sub>FO(L)</sub>   |                                         |                                                                                     | -                                | 10     | 15   |      |      |
| t <sub>FO</sub>      | 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.

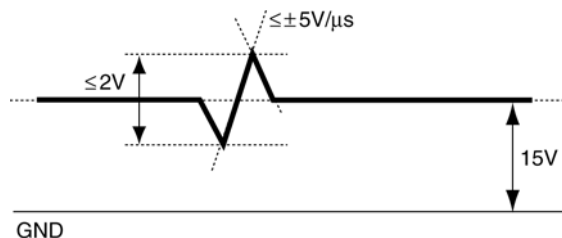
## MECHANICAL RATINGS AND CHARACTERISTICS

| Symbol | Parameter       | Conditions               | Limits |      |      | Unit |
|--------|-----------------|--------------------------|--------|------|------|------|
|        |                 |                          | Min.   | Typ. | Max. |      |
| $M_t$  | Mounting Torque | Mounting part screw : M4 | 1.4    | 1.65 | 1.9  | N·m  |
| m      | Weight          | -                        | -      | 135  | -    | g    |

## RECOMMENDED CONDITIONS FOR USE

| Symbol         | Parameter                       | Conditions                                                                     | Recommended value | Unit    |
|----------------|---------------------------------|--------------------------------------------------------------------------------|-------------------|---------|
| $V_{CC}$       | Supply Voltage                  | Applied across P-N terminals                                                   | $\leq 450$        | V       |
| $V_D$          | Control Supply Voltage          | Applied between : $V_{UP1}-V_{UPC}, V_{VP1}-V_{VPC}, V_{VN1}-V_{VNC}$ (Note.3) | $15.0 \pm 1.5$    | V       |
| $V_{CIN(ON)}$  | Input ON Voltage                | Applied between : $UP-V_{UPC}, VP-V_{VPC}, UN \cdot VN-V_{NC}$                 | $\leq 0.8$        | V       |
| $V_{CIN(OFF)}$ | Input OFF Voltage               |                                                                                | $\geq 9.0$        |         |
| $f_{PWM}$      | PWM Input Frequency             | Using Application Circuit of Fig. 8                                            | $\leq 20$         | kHz     |
| $t_{dead}$     | Arm Shoot-through Blocking Time | For IPM's each input signals (Fig. 7)                                          | $\geq 2.0$        | $\mu s$ |
| $I_O$          | Module Operating Current        | RMS                                                                            | $\leq 30$         | A       |

Note.3: With ripple satisfying the following conditions:  $dv/dt$  swing  $\leq \pm 5V/\mu s$ , Variation  $\leq 2V$  peak to peak



# PM75B4L1C060

FLAT-BASE TYPE  
INSULATED PACKAGE

## 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 "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.)

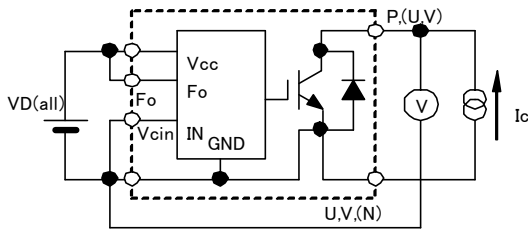


Fig. 1  $V_{CESat}$  Test

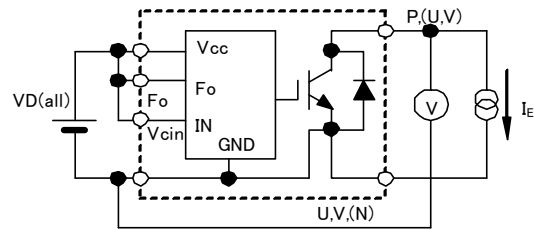


Fig. 2  $V_{EC}$  Test

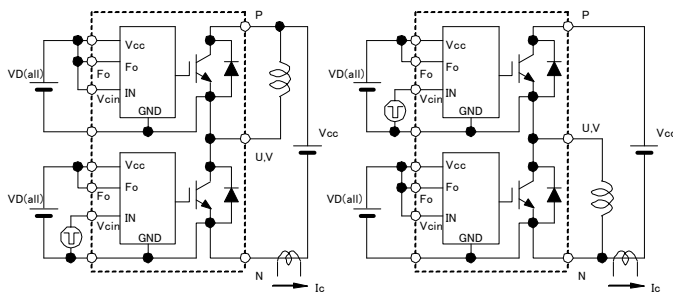


Fig. 3 Switching time and SC test circuit

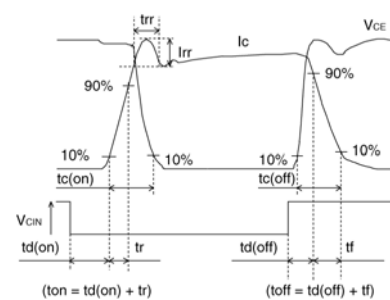


Fig. 4 Switching time test waveform

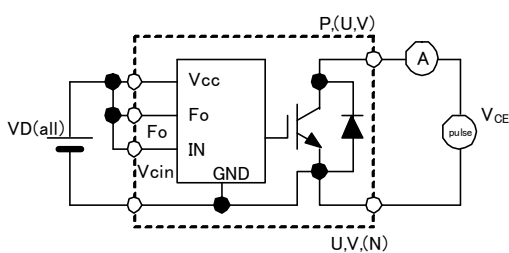


Fig. 5  $I_{CES}$  Test

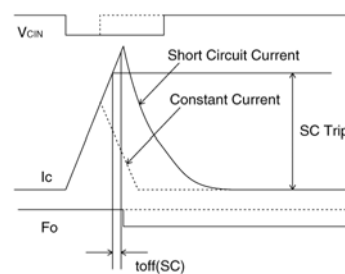
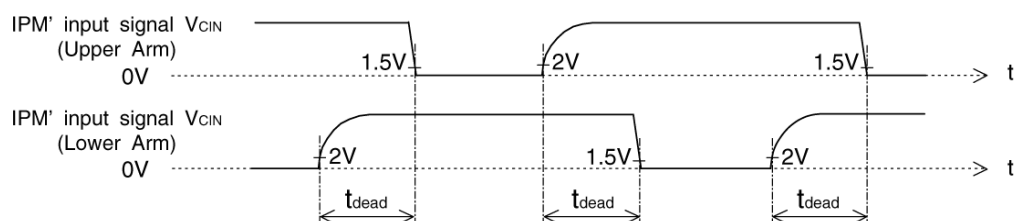


Fig. 6 SC test waveform



1.5V: Input on threshold voltage  $V_{th(on)}$  typical value, 2V: Input off threshold voltage  $V_{th(off)}$  typical value

Fig. 7 Dead time measurement point example

# PM75B4L1C060

FLAT-BASE TYPE  
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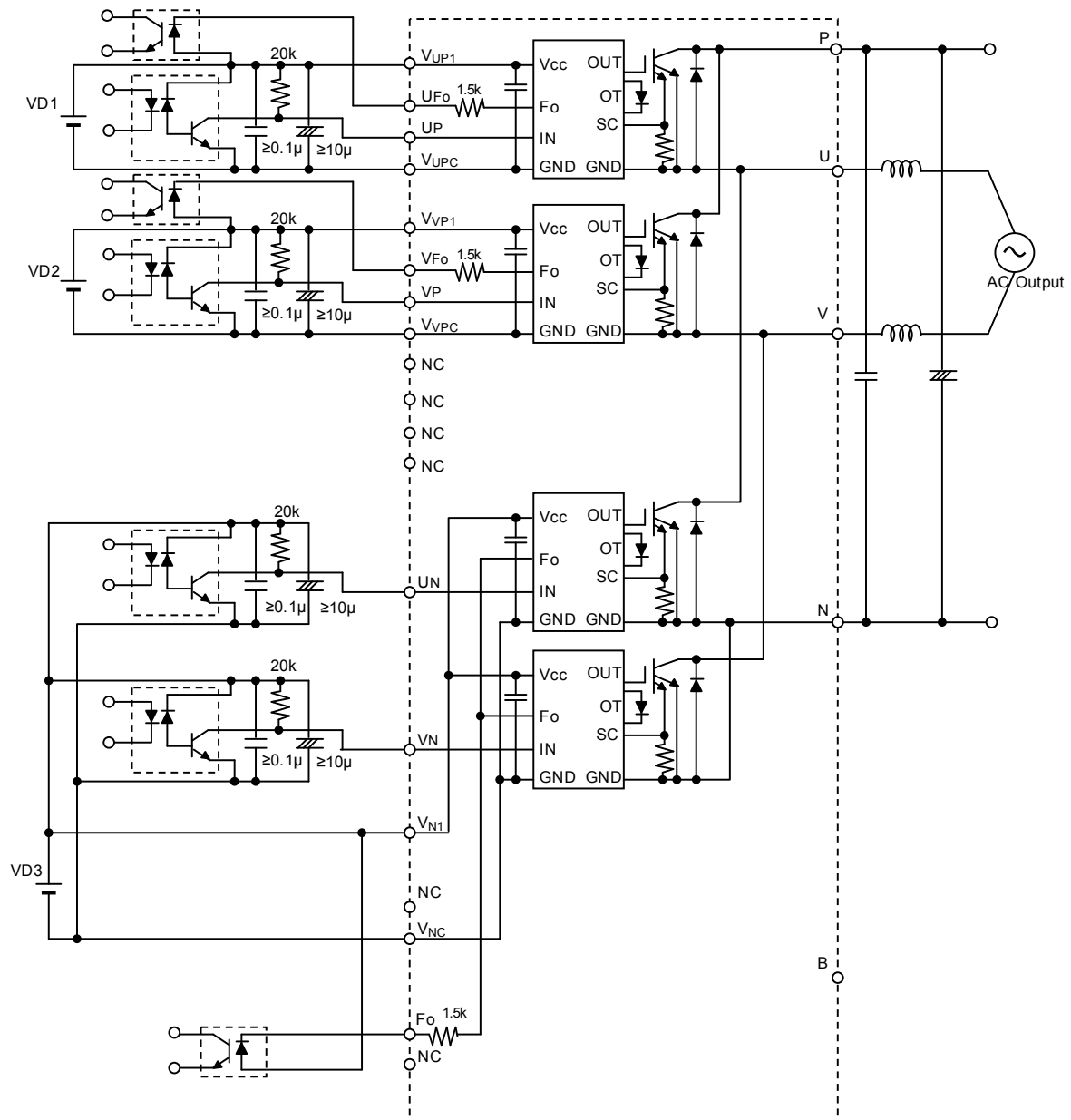


Fig. 8 Application Example Circuit

## 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 3 isolated control power supplies ( $V_D$ ). 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.

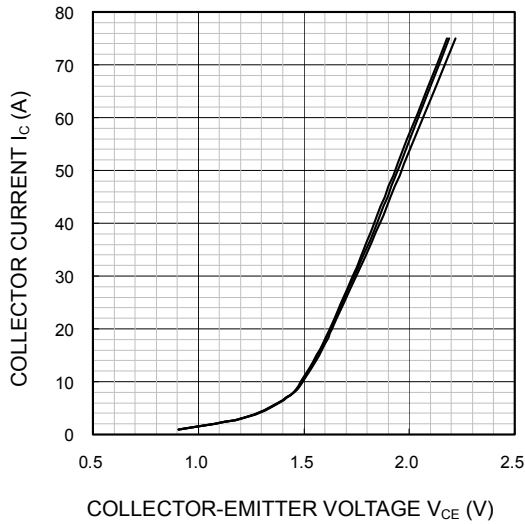
# PM75B4L1C060

FLAT-BASE TYPE  
INSULATED PACKAGE

## PERFORMANCE CURVES

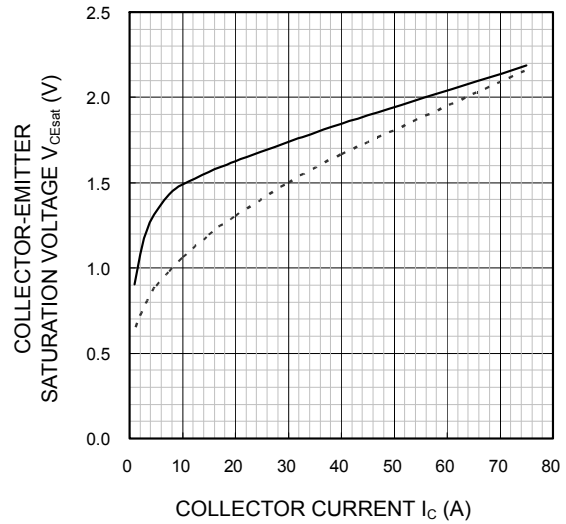
OUTPUT CHARACTERISTICS

(TYPICAL)  
INVERTER PART



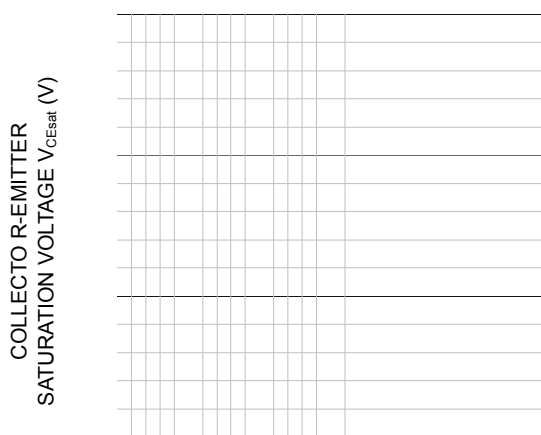
COLLECTOR-EMITTER SATURATION  
VOLTAGE (VS.  $I_C$ ) CHARACTERISTICS

(TYPICAL)  
INVERTER PART



COLLECTOR-EMITTER SATURATION  
VOLTAGE (VS.  $V_D$ ) CHARACTERISTICS

(TYPICAL)  
INVERTER PART



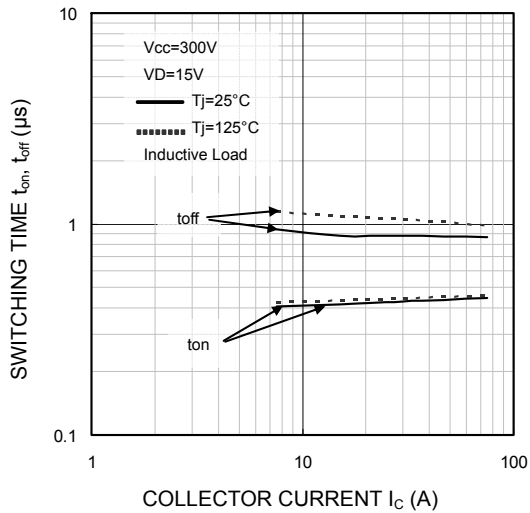
FREE WHEELING DIODE  
FORWARD CHARACTERISTICS

(TYPICAL)  
INVERTER PART

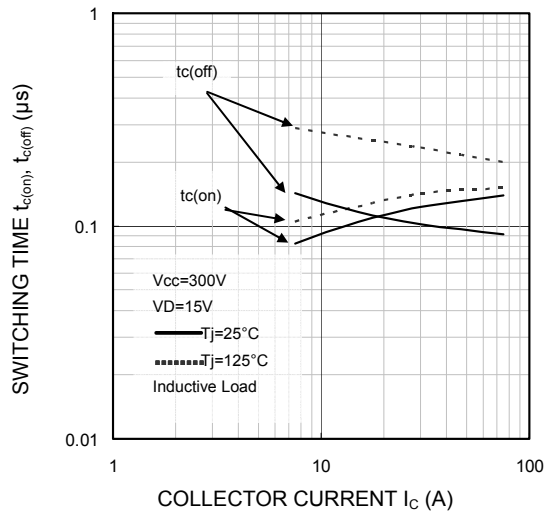
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FLAT-BASE TYPE  
INSULATED PACKAGE

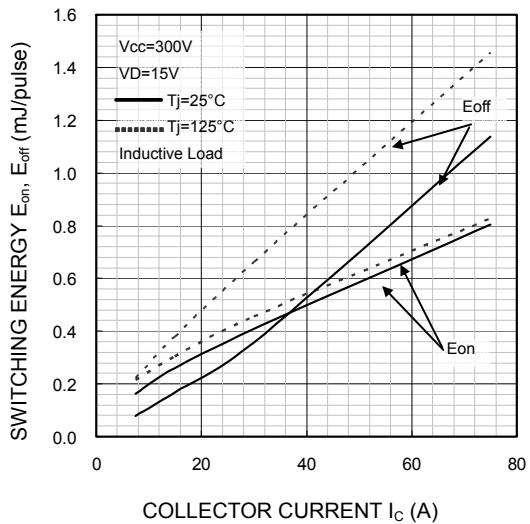
SWITCHING TIME ( $t_{on}$ ,  $t_{off}$ ) CHARACTERISTICS  
(TYPICAL)  
INVERTER PART



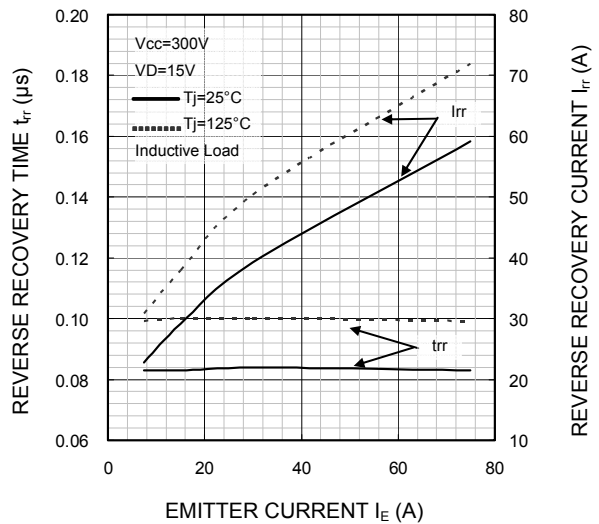
SWITCHING TIME ( $t_{c(on)}$ ,  $t_{c(off)}$ ) CHARACTERISTICS  
(TYPICAL)  
INVERTER PART



SWITCHING ENERGY CHARACTERISTICS  
(TYPICAL)  
INVERTER PART



FREE WHEELING DIODE  
REVERSE RECOVERY CHARACTERISTICS  
(TYPICAL)  
INVERTER PART

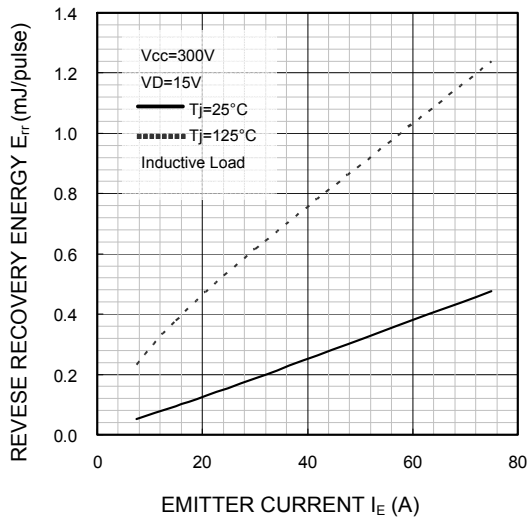




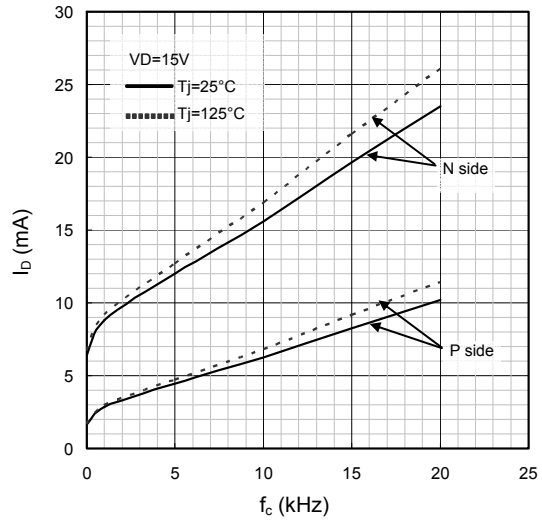
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FLAT-BASE TYPE  
INSULATED PACKAGE

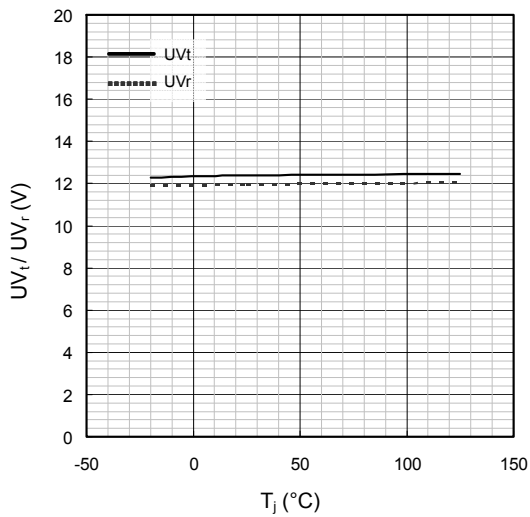
**FREE WHEELING DIODE  
REVERSE RECOVERY ENERGY CHARACTERISTICS  
(TYPICAL)  
INVERTER PART**



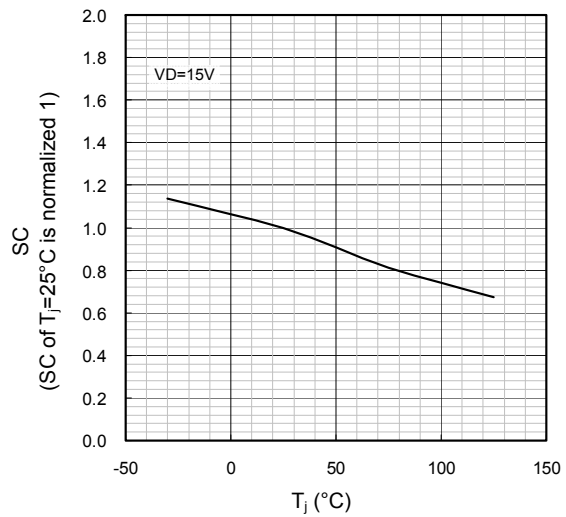
**$I_b$  VS.  $f_c$  CHARACTERISTICS  
(TYPICAL)**



**UV TRIP LEVEL VS.  $T_j$  CHARACTERISTICS  
(TYPICAL)**



**SC TRIP LEVEL VS.  $T_j$  CHARACTERISTICS  
(TYPICAL)  
INVERTER PART**



# PM75B4L1C060

FLAT-BASE TYPE  
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