

## IGBT-IPM R series

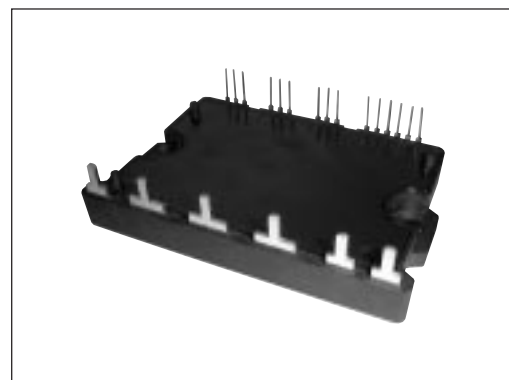
600V / 15A / 6 in one-package

## ■ Features

- Low power loss and soft switching
- High performance and high reliability IGBT with overheating protection
- Higher reliability because of a big decrease in number of parts in built-in control circuit

## ■ Applications

- Inverter for motor drive
- AC and DC servo drive amplifier
- UPS (Uninterruptible power supply)



## ■ Maximum ratings and characteristics

## ● Absolute maximum ratings (Tc=25°C unless otherwise specified)

| Item                                                          | Symbol                  | Rating          | Unit  |
|---------------------------------------------------------------|-------------------------|-----------------|-------|
| DC bus voltage                                                | V <sub>DC</sub>         | 450             | V     |
| DC bus voltage (Surge)                                        | V <sub>DC (surge)</sub> | 500             | V     |
| DC bus voltage (Short operating)                              | V <sub>SC</sub>         | 400             | V     |
| Collector-Emitter voltage                                     | V <sub>CES</sub>        | 600             | V     |
| Collector current                                             | DC                      | I <sub>C</sub>  | 15    |
|                                                               | 1ms                     | I <sub>CP</sub> | 30    |
|                                                               | Duty=44.1%              | –I <sub>C</sub> | 15    |
| Collector power dissipation                                   | One transistor          | P <sub>C</sub>  | 40    |
| Junction temperature                                          | T <sub>j</sub>          | 150             | °C    |
| Input voltage of power supply for pre-driver                  | V <sub>CC</sub>         | –0.3 to 20      | V     |
| Input signal voltage                                          | V <sub>in</sub>         | V <sub>Z</sub>  | V     |
| Input singal current                                          | I <sub>in</sub>         | 1               | mA    |
| Alarm signal voltage                                          | V <sub>ALM</sub>        | V <sub>CC</sub> | V     |
| Alarm signal current                                          | I <sub>ALM</sub>        | 15              | mA    |
| Storage temperature                                           | T <sub>stg</sub>        | –40 to 125      | °C    |
| Operating case temperature                                    | T <sub>cop</sub>        | –20 to 100      | °C    |
| Isolating voltage (Terminal to base, 50/60Hz sine wave 1min.) | V <sub>iso</sub>        | AC 2500         | V     |
| Screw torque                                                  | Mounting (M4)           | 2.0             | N • m |

## ● Electrical characteristics of power circuit (Tc=Tj=25°C, Vcc=15V)

| Item                                  | Symbol                | Condition                                   | Min. | Typ. | Max. | Unit |
|---------------------------------------|-----------------------|---------------------------------------------|------|------|------|------|
| Collector current at off signal input | I <sub>CES</sub>      | V <sub>CE</sub> =600V, V <sub>in</sub> open | –    | –    | 1.0  | mA   |
| Collector-Emitter saturation voltage  | V <sub>CE (sat)</sub> | I <sub>C</sub> =15A                         | –    | –    | 2.7  | V    |
| Forward voltage of FWD                | V <sub>F</sub>        | –I <sub>C</sub> =15A                        | –    | –    | 3.5  | V    |

**● Electrical characteristics of control circuit** ( $T_c=T_j=25^{\circ}\text{C}$ ,  $V_{cc}=15\text{V}$ )

| Item                                                 | Symbol       | Condition                               | Min. | Typ. | Max. | Unit               |
|------------------------------------------------------|--------------|-----------------------------------------|------|------|------|--------------------|
| Power supply current of P-line pre-driver (one unit) | $I_{CCP}$    | $V_{in}=H$                              | —    | 2.0  | 5.0  | mA                 |
| Power supply current of N-line pre-driver            | $I_{CCN}$    | $V_{in}=H$                              | —    | 4.0  | 10.0 | mA                 |
| Input signal threshold voltage                       | $V_{in(th)}$ | Turn-on                                 | 1.00 | 1.35 | 1.70 | V                  |
|                                                      |              | Turn-off                                | 1.25 | 1.60 | 1.95 | V                  |
| Input zener voltage                                  | $V_Z$        | $R_{in}=20\text{k}\Omega$               | —    | 8.0  | —    | V                  |
| IGBT chips overheat protection temperature level     | $T_{joH}$    | Surface of IGBT                         | 150  | —    | —    | $^{\circ}\text{C}$ |
| Hysteresis                                           | $T_{jH}$     |                                         | —    | 20   | —    | $^{\circ}\text{C}$ |
| Collector current protection level                   | $I_{OC}$     | N-side, (N1-N2 open)                    | 21   | 27   | 33   | A                  |
|                                                      | $V_{OC}$     | Between N1 and N2                       | 190  | 200  | 210  | mV                 |
| OC detecting resistance value                        | $R_{OC}$     |                                         | —    | 7.5  | —    | $\text{m}\Omega$   |
| Protection delay time                                | $t_{DOC}$    | $T_j=25^{\circ}\text{C}$ Fig. 1, Fig. 2 | —    | 5.0  | 7.0  | $\mu\text{s}$      |
| Undervoltage protection level                        | $V_{UV}$     |                                         | 11.0 | —    | 12.5 | V                  |
| Hysteresis                                           | $V_H$        |                                         | 0.2  | —    | 0.8  | V                  |
| Alarm signal hold time                               | $t_{ALM}$    |                                         | 1.0  | 2.0  | —    | ms                 |

**● Switching characteristics** ( $T_c=T_j=25^{\circ}\text{C}$ ,  $V_{cc}=15\text{V}$ )

| Item                             | Symbol    | Condition                               | Min. | Typ. | Max. | Unit          |
|----------------------------------|-----------|-----------------------------------------|------|------|------|---------------|
| Switching time (IGBT) See Fig. 3 | $t_{on}$  | $I_c=15\text{A}$ , $V_{DC}=300\text{V}$ | 0.5  | —    | —    | $\mu\text{s}$ |
|                                  | $t_{off}$ | Inductive-Load                          | —    | —    | 3.5  | $\mu\text{s}$ |
| Switching time (FWD)             | $t_{rr}$  |                                         | —    | —    | 0.5  | $\mu\text{s}$ |

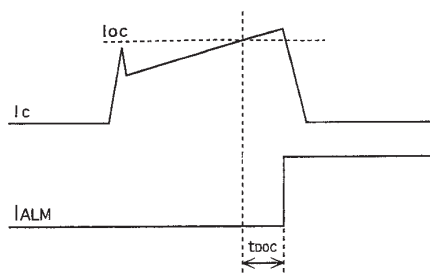


Fig.1 Definition of OC delay time

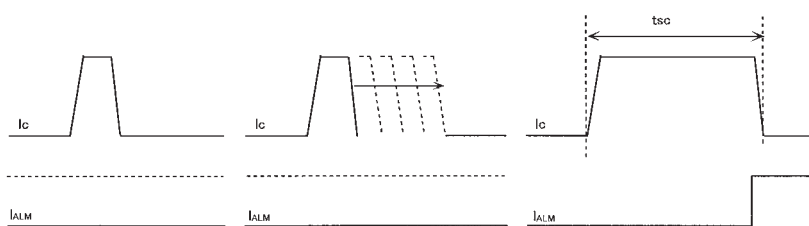
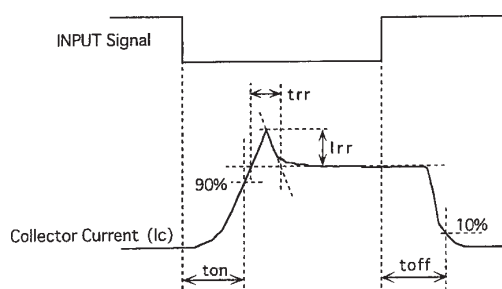
Fig.2 Definition of  $t_{sc}$ 

Fig.3 Definition of switching time

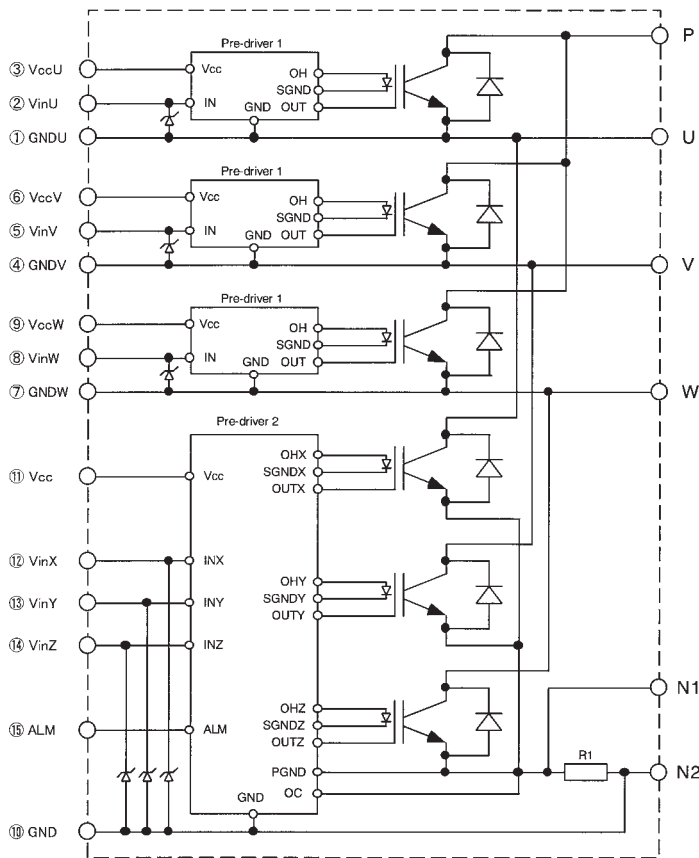
**● Thermal characteristics** ( $T_c=T_j=25^{\circ}\text{C}$ ,  $V_{cc}=15\text{V}$ )

| Item                                         | Symbol             | Min. | Typ. | Max. | Unit                 |
|----------------------------------------------|--------------------|------|------|------|----------------------|
| Junction to case thermal resistance          | IGBT $R_{th(j-c)}$ | —    | —    | 3.1  | $^{\circ}\text{C/W}$ |
|                                              | FWD $R_{th(j-c)}$  | —    | —    | 5.4  | $^{\circ}\text{C/W}$ |
| Case to fin thermal resistance with compound | $R_{th(c-f)}$      | —    | 0.05 | —    | $^{\circ}\text{C/W}$ |

**● Recommendable value**

| Item                                              | Symbol   | Min. | Typ. | Max. | Unit          |
|---------------------------------------------------|----------|------|------|------|---------------|
| DC bus voltage                                    | $V_{DC}$ | 200  | —    | 400  | V             |
| Operating power supply voltage range of pre-drive | $V_{CC}$ | 13.5 | 15   | 16.5 | V             |
| Switching frequency                               | $f_{sw}$ | 1    | —    | 20   | kHz           |
| Flatness of heat sink                             | —        | −100 | —    | 100  | $\mu\text{m}$ |
| Mounting screw torque (M4)                        | —        | 1.3  | —    | 1.7  | N • m         |

### ■ Block diagram



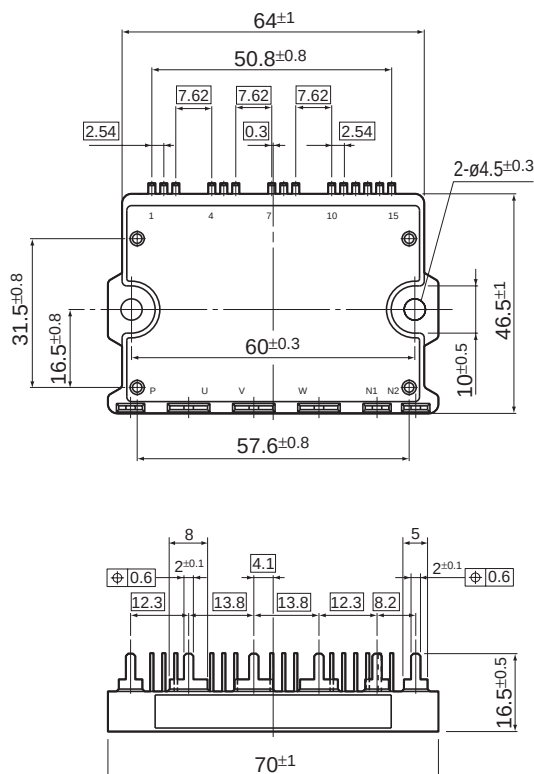
Pre-driver 1 includes following functions. (P-side)

- Amplifier for drive
- Power supply undervoltage protection
- IGBT chip overheating protection

Pre-driver 2 includes following functions. (N-side)

- Amplifier for drive
- Power supply undervoltage protection
- IGBT chip overheating protection
- Overcurrent protection
- Alarm signal output

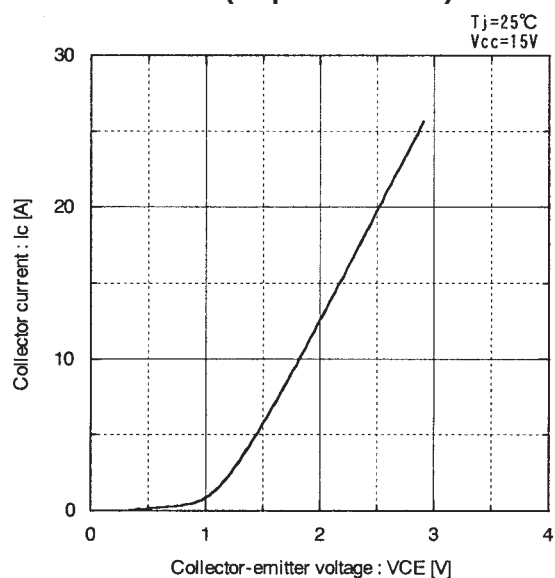
### ■ Outline drawings, mm



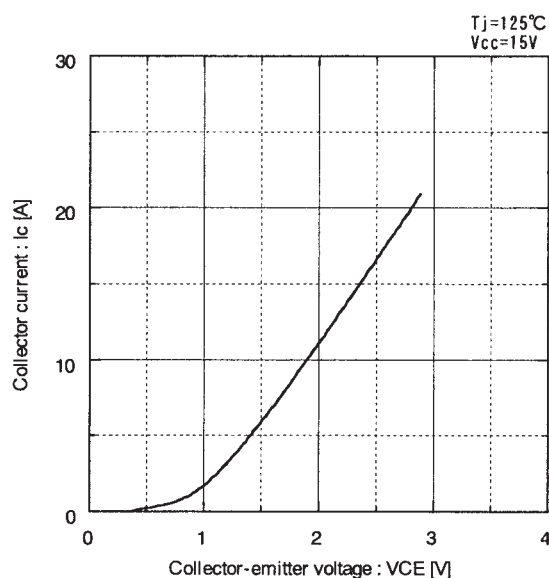
 Shows theory dimensions

Mass: 50g

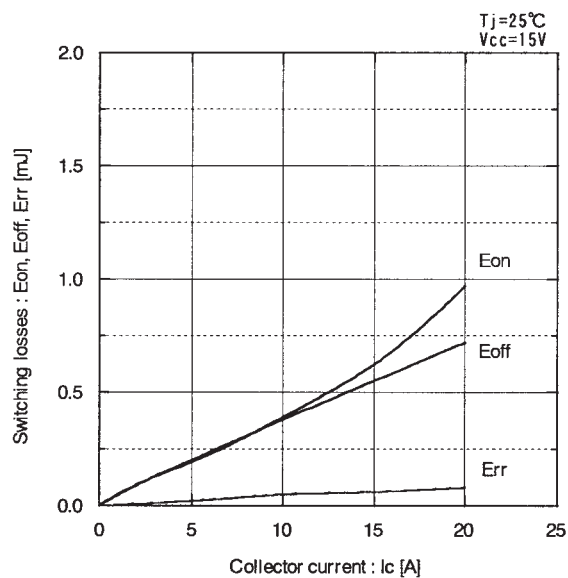
## ■ Characteristics (Representative)



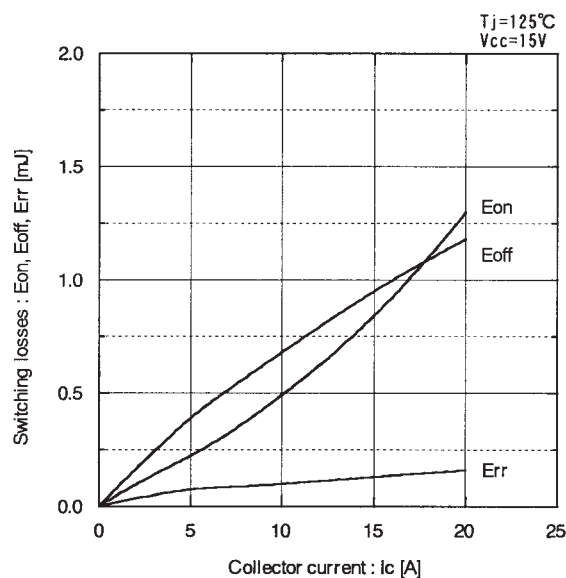
Collector current vs. Collector-emitter voltage



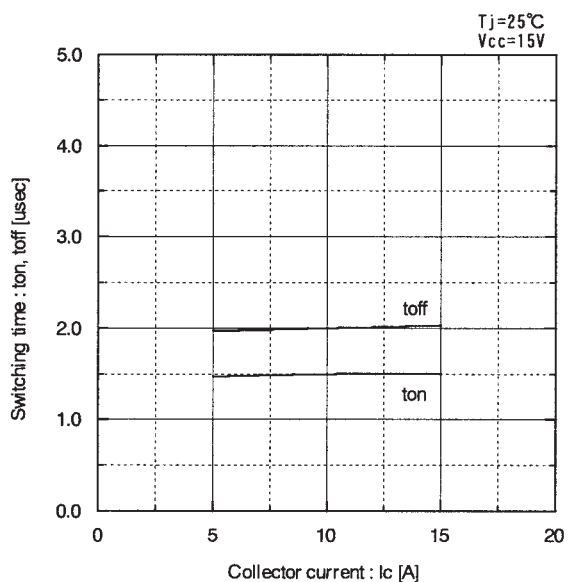
Collector current vs. Collector-emitter voltage



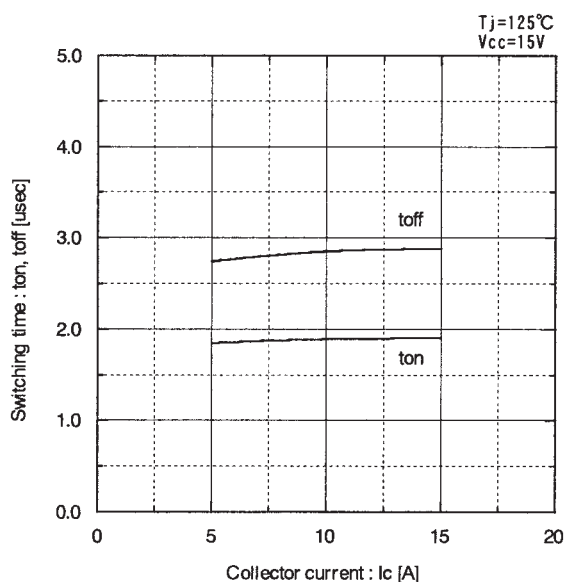
Switching losses vs. Collector current



Switching losses vs. Collector current



Switching time vs. Collector current



Switching time vs. Collector current

