

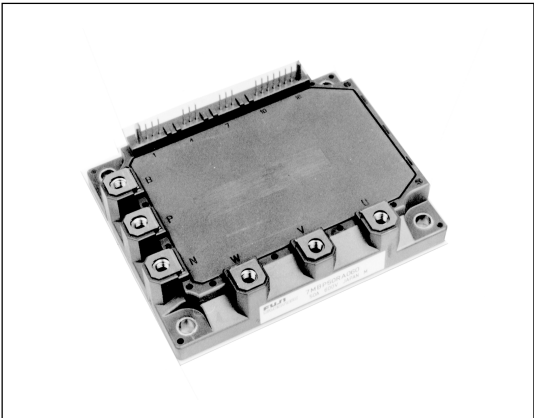
# 6MBP50RTB060

## IPM-R3 series

600V / 50A 6 in one-package

### Features

- Temperature protection provided by directly detecting the junction temperature of the IGBTs
- 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



### Maximum ratings and characteristics

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

| Item                                         |                             |                | Symbol                 | Rating |                      | Unit |
|----------------------------------------------|-----------------------------|----------------|------------------------|--------|----------------------|------|
|                                              |                             |                |                        | Min.   | Max.                 |      |
| DC bus voltage                               |                             |                | V <sub>DC</sub>        | 0      | 450                  | V    |
| DC bus voltage (surge)                       |                             |                | V <sub>DC(surge)</sub> | 0      | 500                  | V    |
| DC bus voltage (short operating)             |                             |                | V <sub>SC</sub>        | 200    | 400                  | V    |
| Collector-Emitter voltage                    |                             |                | V <sub>CES</sub> *1    | 0      | 600                  | V    |
| INV                                          | Collector current           | DC             | I <sub>C</sub>         | -      | 50                   | A    |
|                                              |                             | 1ms            | I <sub>CP</sub>        | -      | 100                  | A    |
|                                              |                             | Duty=76.1%     | -I <sub>C</sub> *2     | -      | 50                   | A    |
|                                              | Collector power dissipation | One transistor | P <sub>C</sub> *3      | -      | 144                  | W    |
| Junction temperature                         |                             |                | T <sub>j</sub>         | -      | 150                  | °C   |
| Input voltage of power supply for Pre-Driver |                             |                | V <sub>CC</sub> *4     | -0.5   | 20                   | V    |
| Input signal voltage                         |                             |                | V <sub>in</sub> *5     | -0.5   | V <sub>CC</sub> +0.5 | V    |
| Input signal current                         |                             |                | I <sub>in</sub>        | -      | 3                    | mA   |
| Alarm signal voltage                         |                             |                | V <sub>ALM</sub> *6    | -0.5   | V <sub>CC</sub>      | V    |
| Alarm signal current                         |                             |                | I <sub>ALM</sub> *7    | -      | 20                   | mA   |
| Storage temperature                          |                             |                | T <sub>stg</sub>       | -40    | 125                  | °C   |
| Operating case temperature                   |                             |                | T <sub>op</sub>        | -20    | 100                  | °C   |
| Isolating voltage (Case-Terminal)            |                             |                | V <sub>iso</sub> *8    | -      | AC2.5                | kV   |
| Screw torque                                 |                             | Mounting (M5)  |                        | -      | 3.5 *9               | N·m  |
|                                              |                             | Terminal (M5)  |                        | -      | 3.5 *9               | N·m  |

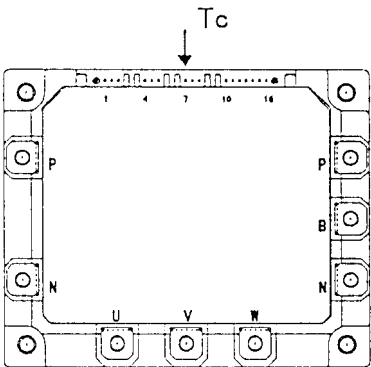


Fig.1 Measurement of case temperature

\*1 : V<sub>CES</sub> shall be applied to the input voltage between terminal P and U or V or W, N and U or V or W.  
\*2 : 125°C/FWD R<sub>th(j-c)</sub>/(I<sub>C</sub> x V<sub>F</sub> MAX)=125/1.263/(50 x 2.6)x100=76.1%  
\*3 : P<sub>C</sub>=125°C/IGBT R<sub>th(j-c)</sub>=125/0.87=144W [Inverter]  
\*4 : V<sub>CC</sub> shall be applied to the input voltage between terminal No. 3 and 1, 6 and 4, 9 and 7, 11 and 10.  
\*5 : V<sub>in</sub> shall be applied to the input voltage between terminal No. 2 and 1, 5 and 4, 8 and 7, 13,14,15 and 10.  
\*6 : V<sub>ALM</sub> shall be applied to the voltage between terminal No. 16 and 10.  
\*7 : I<sub>ALM</sub> shall be applied to the input current to terminal No. 16.  
\*8 : 50Hz/60Hz sine wave 1 minute.  
\*9 : Recommendable Value : 2.5 to 3.0 N·m

● **Electrical characteristics** (at Tc=Tj=25°C, Vcc=15V unless otherwise specified.)

**Main circuit**

| Item                                           |                                       | Symbol   | Condition                                                             |          | Min. | Typ. | Max. | Unit |
|------------------------------------------------|---------------------------------------|----------|-----------------------------------------------------------------------|----------|------|------|------|------|
| INV                                            | Collector current at off signal input | ICES     | VCE=600V Vin terminal open.                                           |          | -    | -    | 1.0  | mA   |
|                                                | Collector-Emitter saturation voltage  | VCE(sat) | Ic=50A                                                                | Terminal | -    | -    | 2.5  | V    |
|                                                |                                       |          |                                                                       | Chip     | -    | 2.0  | -    |      |
|                                                | Forward voltage of FWD                | VF       | -Ic=50A                                                               | Terminal | -    | -    | 2.6  | V    |
|                                                |                                       |          |                                                                       | Chip     | -    | 1.6  | -    |      |
| Turn-on time                                   |                                       | ton      | VDC=300V,Tj=125°C                                                     |          | 1.2  | -    | -    | μs   |
| Turn-off time                                  |                                       | toff     | IC=50A Fig.1, Fig.6                                                   |          | -    | -    | 3.6  |      |
| Reverse recovery time                          |                                       | trr      | VDC=300V, IC=50A Fig.1, Fig.6                                         |          | -    | -    | 0.3  |      |
| Maximum Avalanche Energy<br>(A non-repetition) |                                       | PAV      | Internal wiring inductance=50nH<br>Main circuit wiring inductace=54nH |          | 30   | -    | -    | mJ   |

● **Control circuit**

| Item                                               | Symbol  | Condition                                                 | Min. | Typ. | Max. | Unit |
|----------------------------------------------------|---------|-----------------------------------------------------------|------|------|------|------|
| Supply current of P-line side pre-driver(one unit) | Iccp    | Switching Frequency : 0 to 15kHz<br>Tc=-20 to 125°C Fig.7 | -    | -    | 18   | mA   |
| Supply current of N-line side pre-driver           | ICCN    |                                                           | -    | -    | 65   | mA   |
| Input signal threshold voltage (on/off)            | Vin(th) | ON                                                        | 1.00 | 1.35 | 1.70 | V    |
|                                                    |         | OFF                                                       | 1.25 | 1.60 | 1.95 | V    |
| Input zener voltage                                | Vz      | Rin=20k ohm                                               | -    | 8.0  | -    | V    |
| Alarm signal hold time                             | tALM    | Tc=-20°C Fig.2                                            | 1.1  | -    | -    | ms   |
|                                                    |         | Tc=25°C Fig.2                                             | -    | 2.0  | -    | ms   |
|                                                    |         | Tc=125°C Fig.2                                            | -    | -    | 4.0  | ms   |
| Limiting resistor for alarm                        | RALM    |                                                           | 1425 | 1500 | 1575 | ohm  |

● **Protection Section** ( Vcc=15V)

| Item                                              | Symbol | Condition                       | Min. | Typ. | Max. | Unit |
|---------------------------------------------------|--------|---------------------------------|------|------|------|------|
| Over Current Protection Level of Inverter circuit | Ioc    | Tj=125°C                        | 75   | -    | -    | A    |
| Over Current Protection Delay time                | tDOC   | Tj=125°C                        | -    | 5    | -    | μs   |
| SC Protection Delay time                          | tSC    | Tj=125°C Fig.4                  | -    | -    | 8    | μs   |
| IGBT Chip Over Heating                            | TjOH   | surface of IGBT chips           | 150  | -    | -    | °C   |
| Over Heating Protection Hysteresis                | TjH    | VDC=0V, Ic=0A, Case temperature | -    | 20   | -    | °C   |
| Over Heating Protection Temperature Level         | TcoH   |                                 | 110  | -    | 125  | °C   |
| Over Heating Protection Hysteresis                | TCH    |                                 | -    | 20   | -    |      |
| Under Voltage Protection Level                    | VUV    |                                 | 11.0 | -    | 12.5 | V    |
| Under Voltage Protection Hysteresis               | VH     |                                 | 0.2  | 0.5  | -    |      |

● **Thermal characteristics**( Tc=25°C)

| Item                                         |     |      | Symbol   | Min. | Typ. | Max.  | Unit |
|----------------------------------------------|-----|------|----------|------|------|-------|------|
| Junction to Case thermal resistance          | INV | IGBT | Rth(j-c) | -    | -    | 0.87  | °C/W |
|                                              |     | FWD  | Rth(j-c) | -    | -    | 1.263 | °C/W |
| Case to fin thermal resistance with compound |     |      | Rth(c-f) | -    | 0.05 | -     | °C/W |

● **Noise Immunity** ( VDC=300V, Vcc=15V, Test Circuit Fig.5)

| Item                          | Condition                                                                                               | Min. | Typ. | Max. | Unit |
|-------------------------------|---------------------------------------------------------------------------------------------------------|------|------|------|------|
| Common mode rectangular noise | Pulse width 1μs, polarity ±, 10minuets<br>Judge : no over-current, no miss operating                    | ±2.0 | -    | -    | kV   |
| Common mode lightning surge   | Rise time 1.2μs, Fall time 50μs<br>Interval 20s, 10 times<br>Judge : no over-current, no miss operating | ±5.0 | -    | -    | kV   |

● **Recommendable value**

| Item                                   | Symbol | Min. | Typ. | Max. | Unit |
|----------------------------------------|--------|------|------|------|------|
| DC Bus Voltage                         | VDC    | -    | -    | 400  | V    |
| Operating Supply Voltage of Pre-Driver | VCC    | 13.5 | 15.0 | 16.5 | V    |
| Screw torque (M5)                      | -      | 2.5  | -    | 3.0  | Nm   |

● **Weight**

| Item   | Symbol | Min. | Typ. | Max. | Unit |
|--------|--------|------|------|------|------|
| Weight | Wt     | -    | 450  | -    | g    |

\*9 : (For 1 device, Case is under the device)

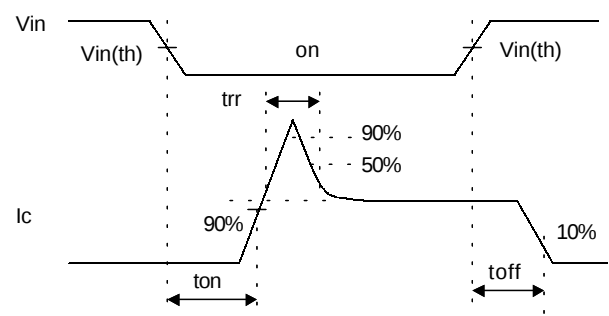
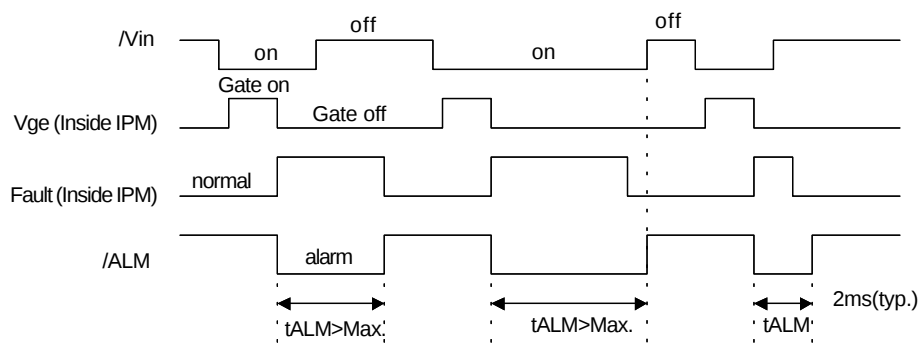


Figure 1. Switching Time Waveform Definitions



Fault : Over-current, Over-heat or Under-voltage

Figure 2. Input / Output Timing Diagram

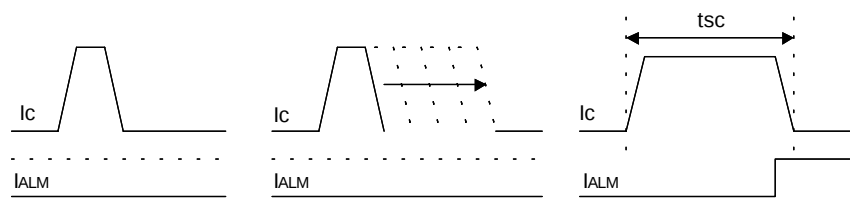


Figure. 4 Definition of tsc

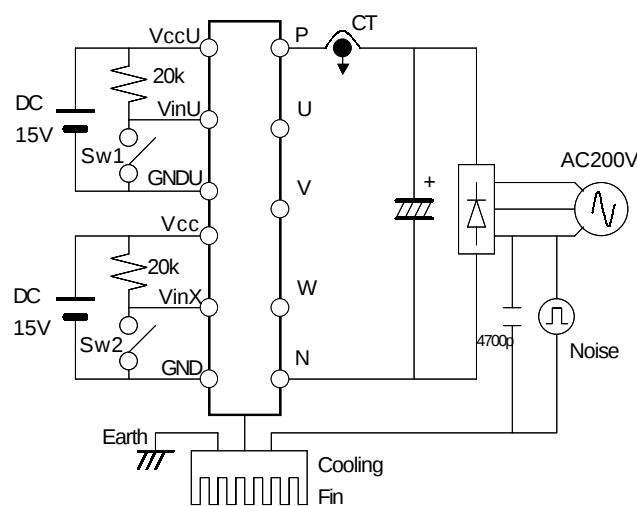


Figure 5. Noise Test Circuit

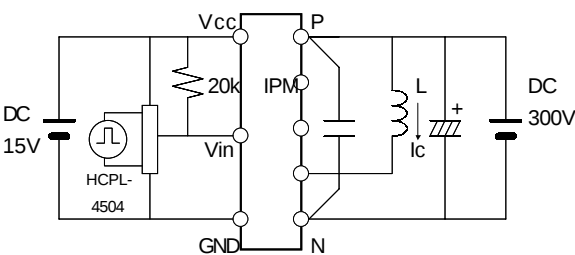


Figure 6. Switching Characteristics Test Circuit

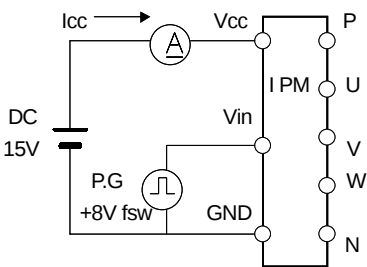
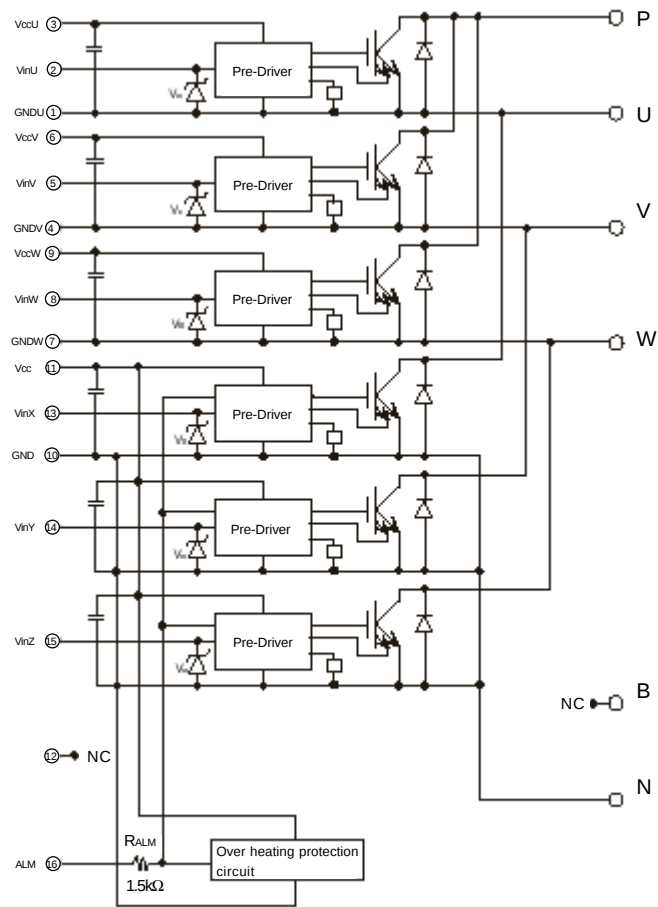


Figure 7. Icc Test Circuit

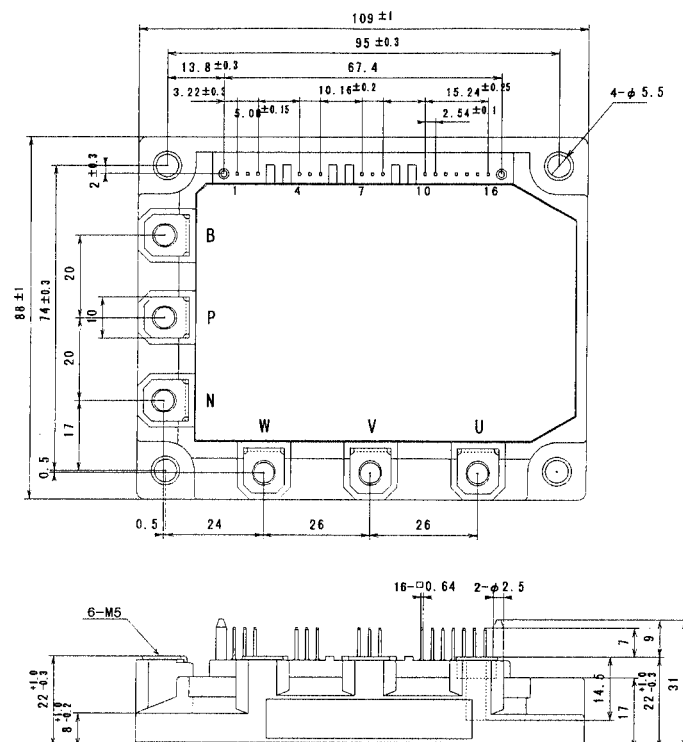
## Block diagram



Pre-driver include following functions

- ① Amplifier for drive
- ② Short circuit protection
- ③ Under voltage lockout circuit
- ④ Over current protection
- ⑤ IGBT chip over heating protection

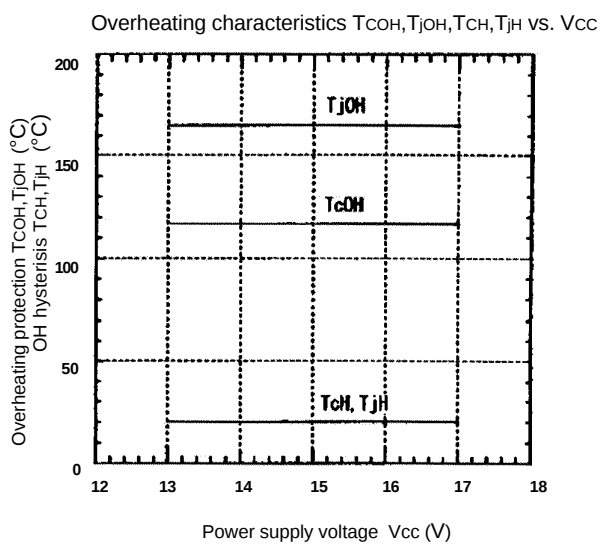
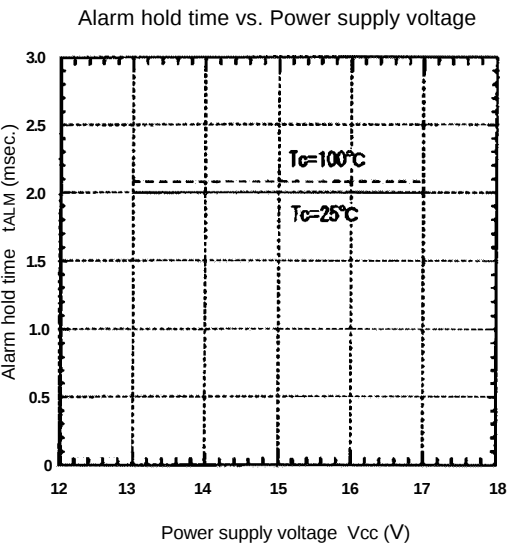
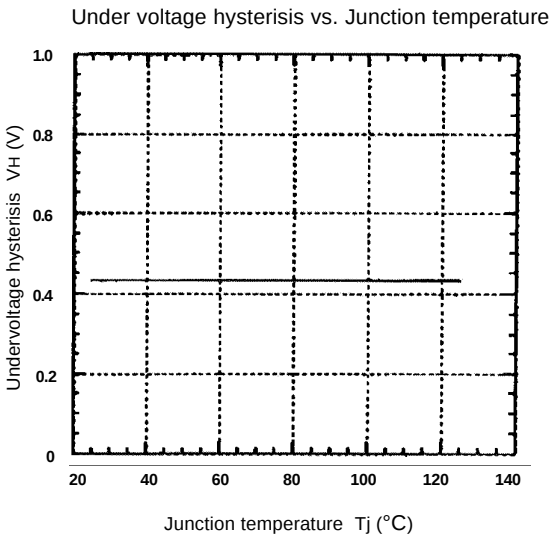
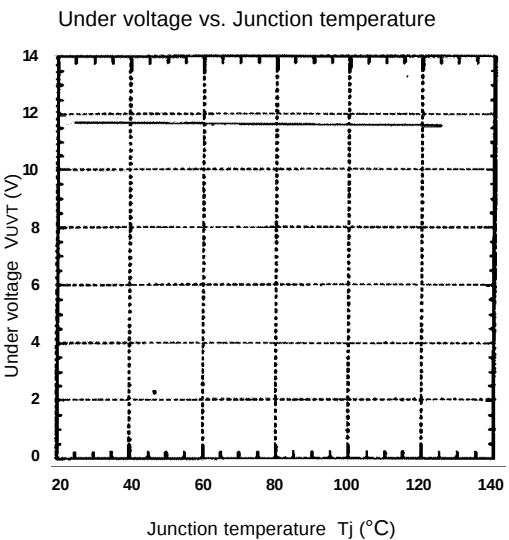
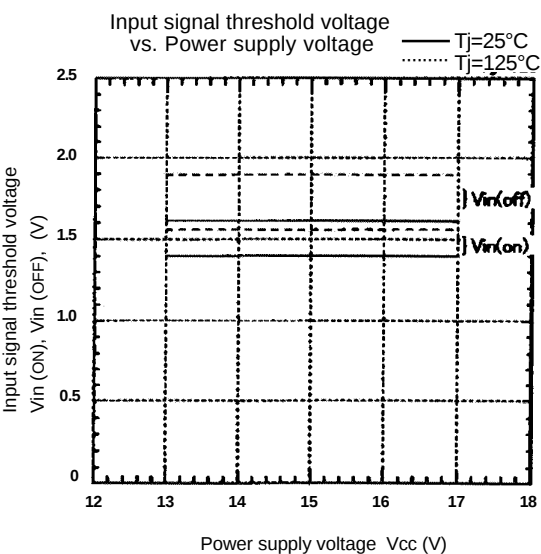
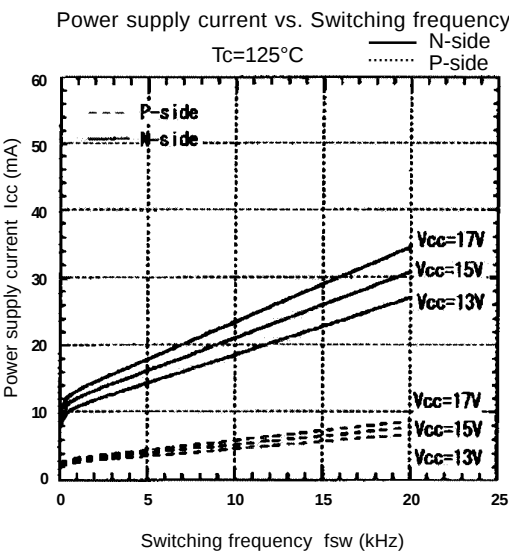
## Outline drawings, mm



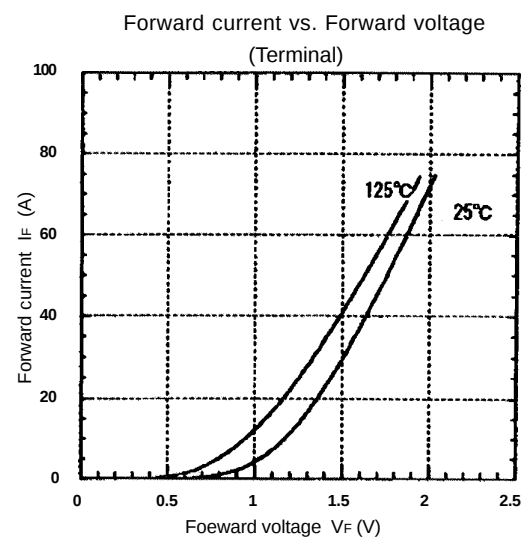
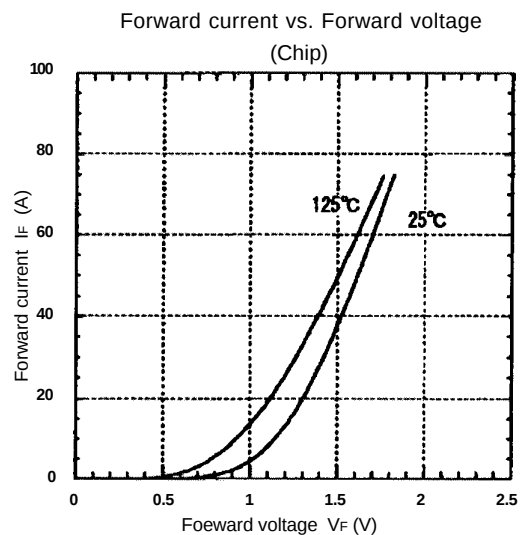
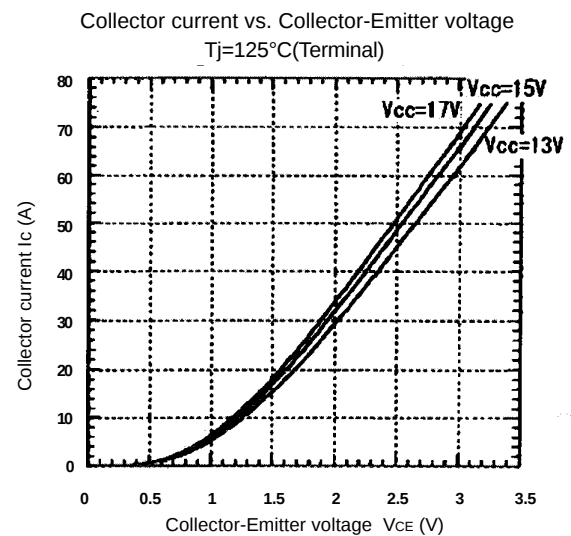
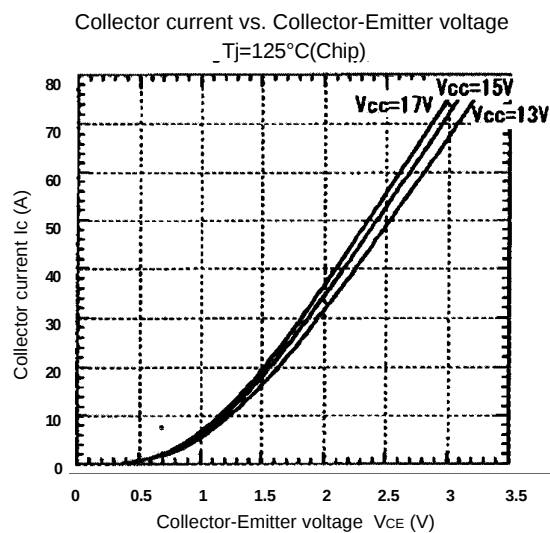
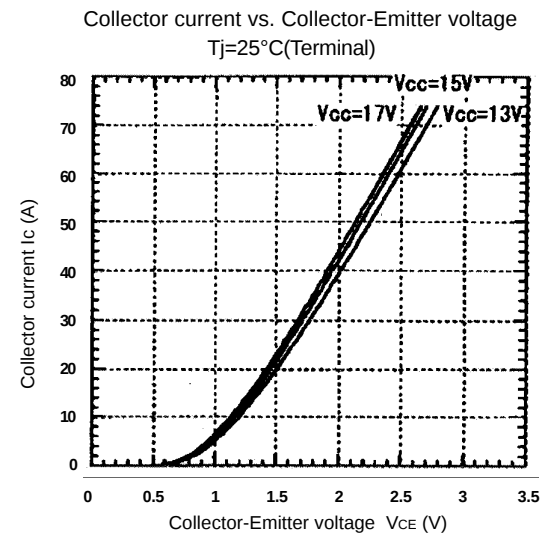
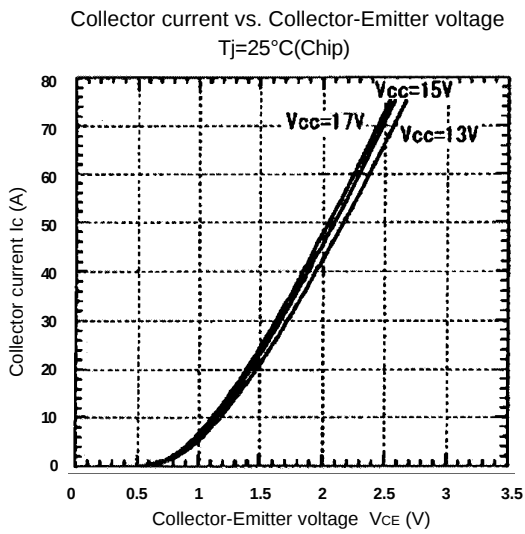
Mass : 450g

Characteristics

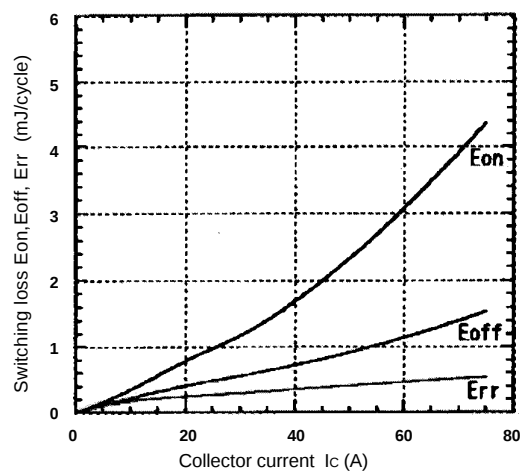
Control circuit characteristics (Representative)



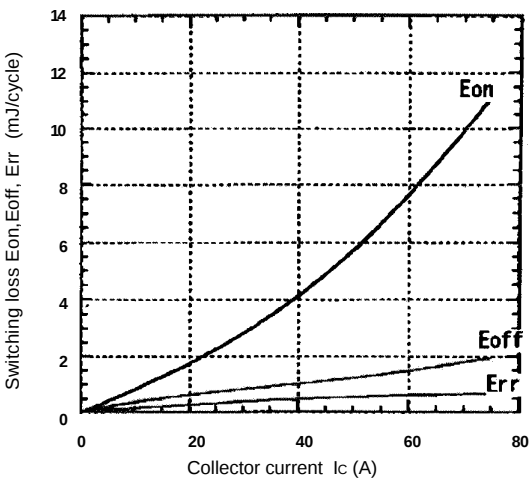
● Main circuit characteristics (Representative)



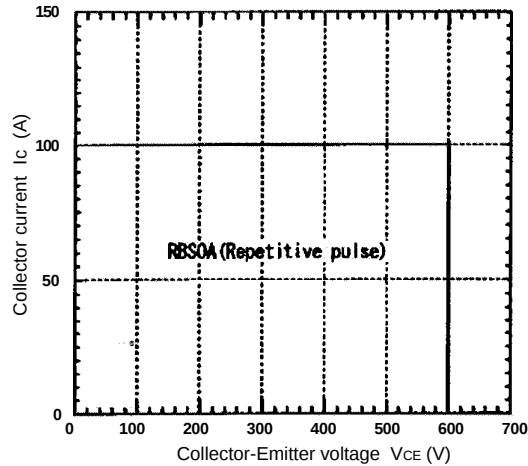
Switching Loss vs. Collector current  
Edc=300V, Vcc=15V, Tj=25°C



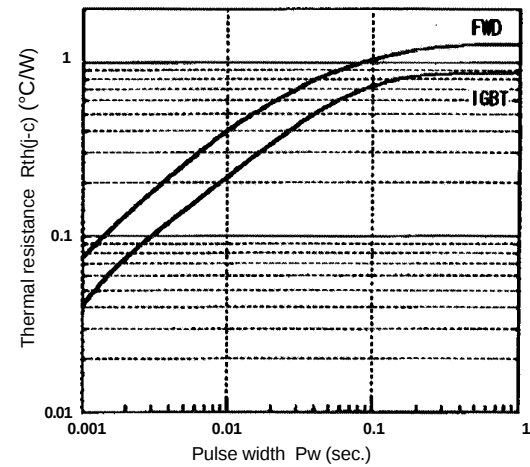
Switching Loss vs. Collector current  
Edc=300V, Vcc=15V, Tj=125°C



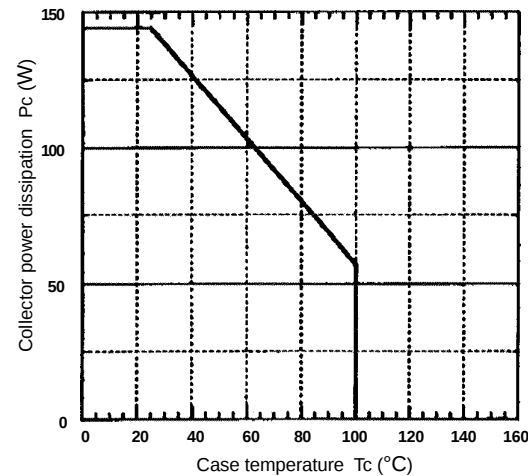
Reverse biased safe operating area  
Vcc=15V, Tj ≤125°C



Transient thermal resistance



Power derating for IGBT (per device)



Power derating for FWD (per device)

