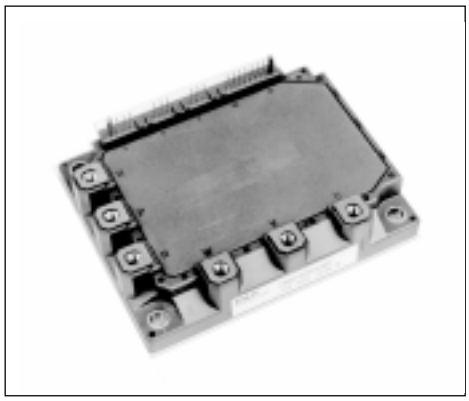
# 6MBP75RA120

## IGBT-IPM R series

**1200V / 75A 6 in one-package**



## Features

- **Temperature protection provided by directly detecting the junction temperature of the IGBTs**
- Low power loss and soft switching
- Compatible with existing IPM-N series packages
- 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 Min. | Rating Max. | Unit |
|---|---|---|---|---|---|---|
| DC bus voltage | | | $V_{DC}$ | 0 | 900 | V |
| DC bus voltage (surge) | | | $V_{DC(surge)}$ | 0 | 1000 | V |
| DC bus voltage (short operating) | | | $V_{SC}$ | 200 | 800 | V |
| Collector-Emitter voltage | | | $V_{CES}$ | 0 | 1200 | V |
| INV | Collector current | DC | $I_C$ | - | 75 | A |
| | | 1ms | $I_{CP}$ | - | 150 | A |
| | | DC | $-I_C$ | - | 75 | A |
| | Collector power dissipation | One transistor | $P_C$ | - | 500 | W |
| Junction temperature | | | $T_j$ | - | 150 | °C |
| Input voltage of power supply for Pre-Driver | | | $V_{CC}$ *1 | 0 | 20 | V |
| Input signal voltage | | | $V_{in}$ *2 | 0 | Vz | V |
| Input signal current | | | $I_{in}$ | - | 1 | mA |
| Alarm signal voltage | | | $V_{ALM}$ *3 | 0 | Vcc | V |
| Alarm signal current | | | $I_{ALM}$ *4 | - | 15 | mA |
| Storage temperature | | | $T_{stg}$ | -40 | 125 | °C |
| Operating case temperature | | | $T_{op}$ | -20 | 100 | °C |
| Isolating voltage (Case-Terminal) | | | $V_{iso}$ *5 | - | AC2.5 | kV |
| Screw torque | | Mounting (M5) | | - | 3.5 *6 | N·m |
| | | Terminal (M5) | | - | 3.5 *6 | N·m |

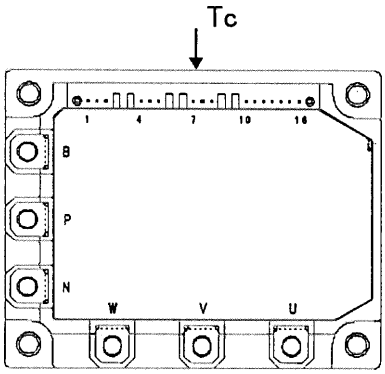



Fig.1 Measurement of case temperature

*1 Apply Vcc between terminal No. 3 and 1, 6 and 4, 9 and 7, 11 and 10.
*2 Apply Vin between terminal No. 2 and 1, 5 and 4, 8 and 7, 13,14,15 and 10.
*3 Apply $V_{ALM}$ between terminal No. 16 and 10.
*4 Apply $I_{ALM}$ to terminal No. 16.
*5 50Hz/60Hz sine wave 1 minute.
*6 Recommendable Value : 2.5 to 3.0 N·m

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

| Item | | Symbol | Condtion | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|---|
| INV | Collector current at off signal input | $I_{CES}$ | $V_{CE}$=1200V input terminal open | – | – | 1.0 | mA |
| | Collector-Emitter saturation voltage | $V_{CE(sat)}$ | Ic=75A | – | – | 2.6 | V |
| | Forward voltage of FWD | $V_F$ | -Ic=75A | – | – | 3.0 | V |

● **Electrical characteristics of control circuit**(at Tc=Tj=25°C, Vcc=15V)

| Item | Symbol | Condition | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| Power supply current of P-line side Pre-driver(one unit) | $I_{CCP}$ | fsw=0 to 15kHz Tc=-20 to 100°C *7 | 3 | - | 18 | mA |
| Power supply current of N-line side three Pre-driver | $I_{CCN}$ | fsw=0 to 15kHz Tc=-20 to 100°C *7 | 10 | - | 65 | mA |
| Input signal threshold voltage (on/off) | $V_{in(th)}$ | ON | 1.00 | 1.35 | 1.70 | V |
| | | OFF | 1.25 | 1.60 | 1.95 | V |
| Input zener voltage | $V_Z$ | Rin=20k ohm | - | 8.0 | - | V |
| Over heating protection temperature level | $T_{COH}$ | VDC=0V, Ic=0A, Case temperature | 110 | - | 125 | °C |
| Hysteresis | $T_{CH}$ | | - | 20 | - | °C |
| IGBT chips over heating protection temperature level | $T_{jOH}$ | surface of IGBT chips | 150 | - | - | °C |
| Hysteresis | $T_{jH}$ | | - | 20 | - | °C |
| Collector current protection level INV | $I_{OC}$ | Tj=125°C | 113 | - | - | A |
| Over current protection delay time (Fig.2) | $t_{DOC}$ | Tj=25°C Fig.2 | - | 10 | - | µs |
| Under voltage protection level | $V_{UV}$ | | 11.0 | - | 12.5 | V |
| Hysteresis | $V_H$ | | 0.2 | - | - | V |
| Alarm signal hold time | $t_{ALM}$ | | 1.5 | 2 | - | ms |
| SC protection delay time | $t_{SC}$ | Tj=25°C Fig.3 | - | - | 12 | µs |
| Limiting resistor for alarm | $R_{ALM}$ | | 1425 | 1500 | 1575 | ohm |

*7 Switching frequency of IGBT

● **Dynamic characteristics**(at Tc=Tj=125°C, Vcc=15V)

| Item | Symbol | Condition | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| Switching time (IGBT) | ton | IC=75A, VDC=600V | 0.3 | - | - | µs |
| | toff | | - | - | 3.6 | µs |
| Switching time (FWD) | trr | IF=75A, VDC=600V | - | - | 0.4 | µs |

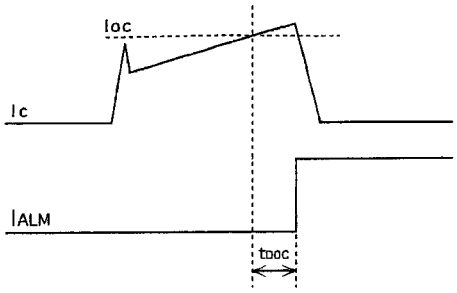



Fig.2 Definition of OC delay time

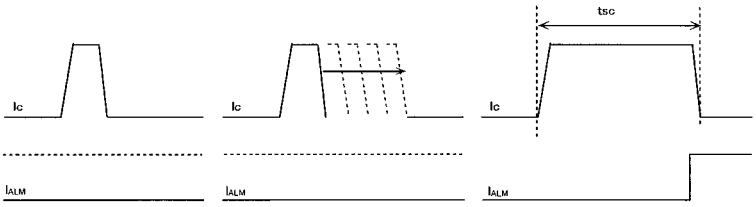



Fig.3 Definition of tsc

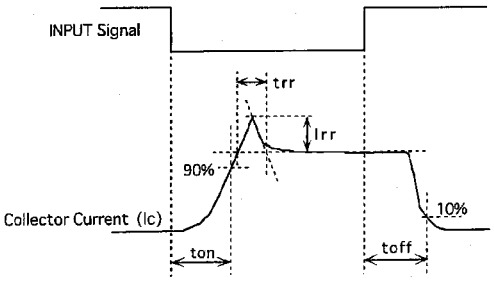



Fig.4 Definition of switching time

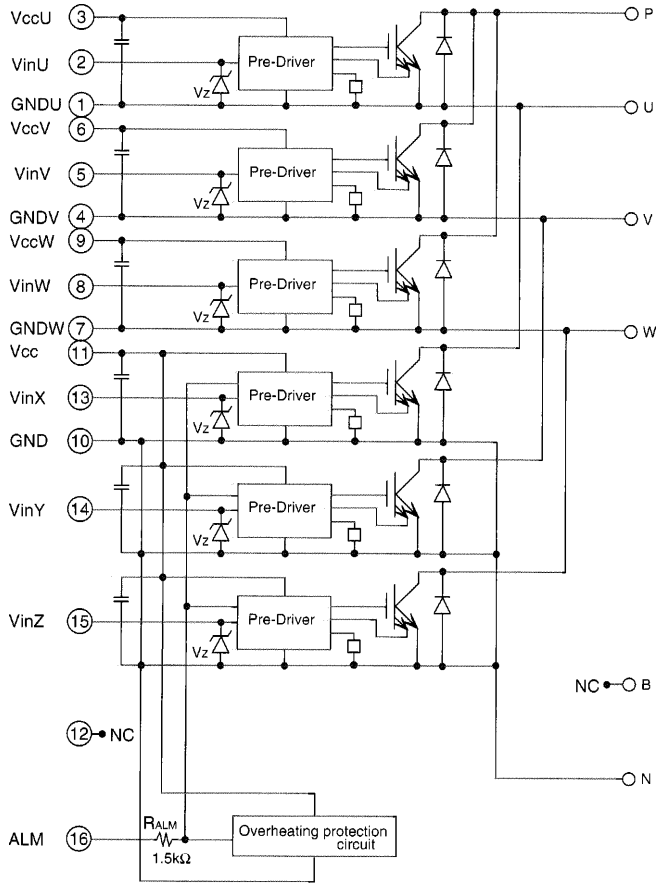
● **Thermal characteristics**(Tc=25°C)

| Item | | | Symbol | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| Junction to Case thermal resistance | INV | IGBT | Rth(j-c) | - | 0.25 | °C/W |
| | | FWD | Rth(j-c) | - | 0.73 | °C/W |
| Case to fin thermal resistance with compound | | | Rth(c-f) | 0.05 | - | °C/W |

● **Recommendable value**

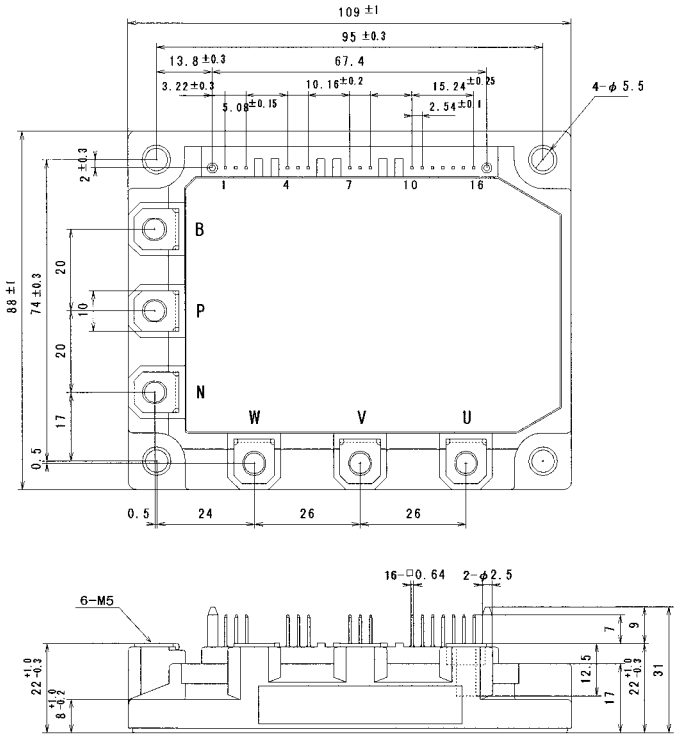
| Item | | Symbol | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| DC bus voltage | | $V_{DC}$ | 200 | - | 800 | V |
| Operating power supply voltage range of Pre-driver | | $V_{CC}$ | 13.5 | 15 | 16.5 | V |
| Switching frequency of IPM | | fsw | 1 | - | 20 | kHz |
| Screw torque | Mounting (M5) | - | 2.5 | - | 3.0 | N·m |
| | Terminal (M5) | - | 2.5 | - | 3.0 | N·m |

## Block diagram




Pre-drivers include following functions
a) Amplifier for driver
b) Short circuit protection
c) Undervoltage lockout circuit
d) Over current protection
e) IGBT chip over heating protection

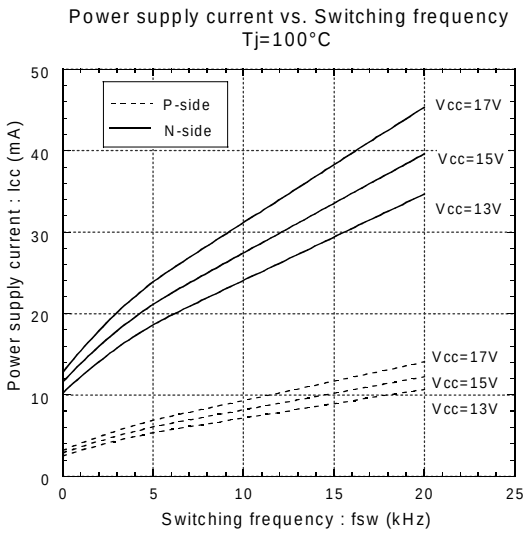
## Outline drawings, mm

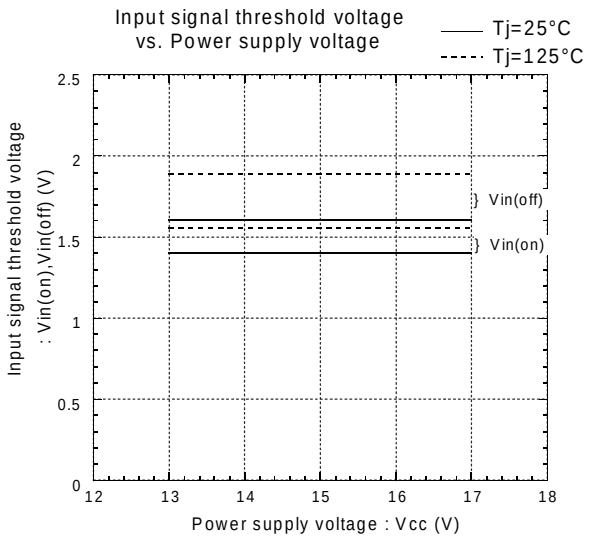


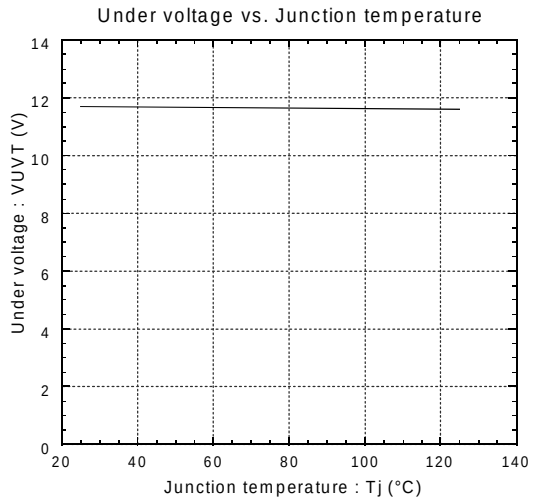

Mass : 440g

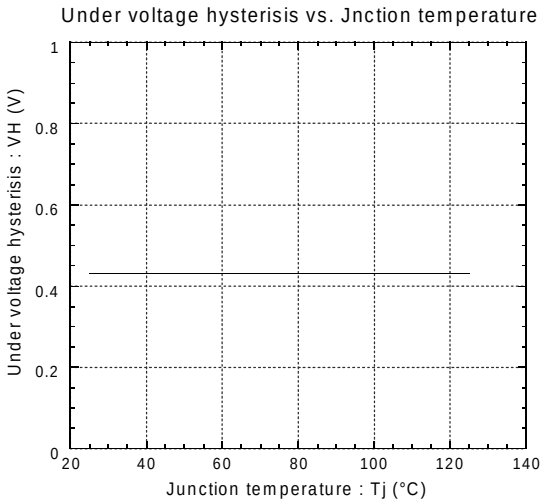
## Characteristics (Representative)

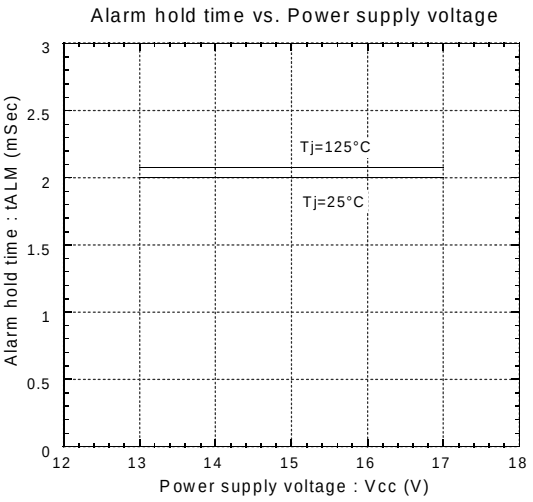
### Control Circuit

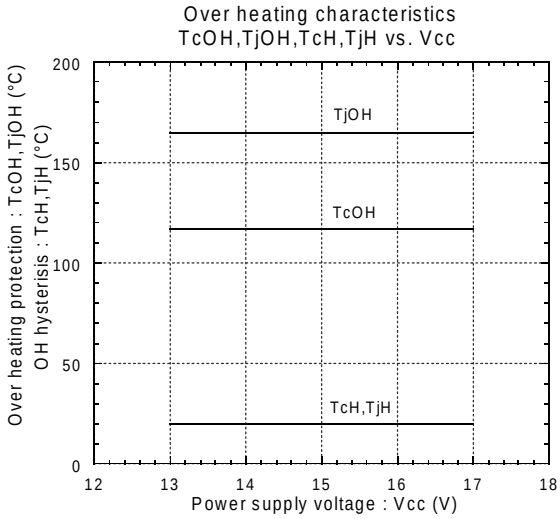


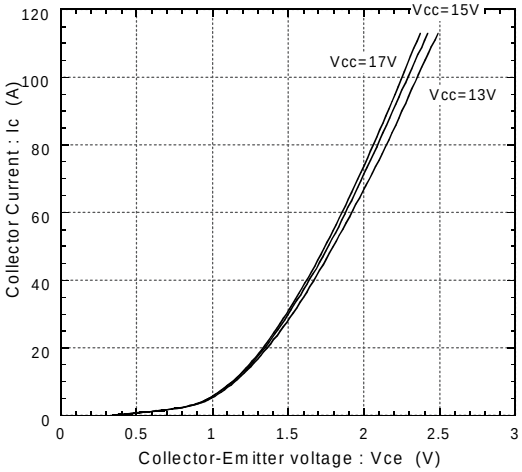



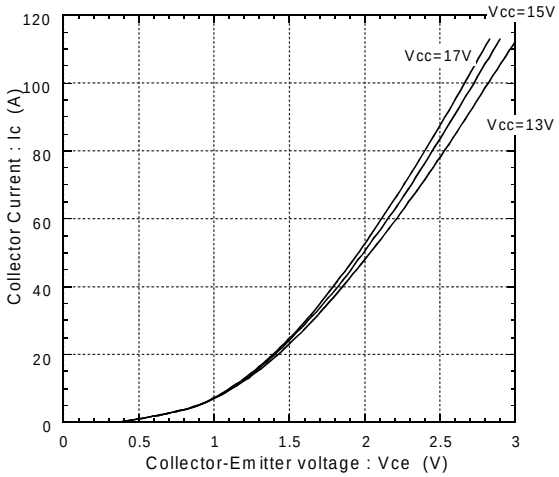



● **Inverter**

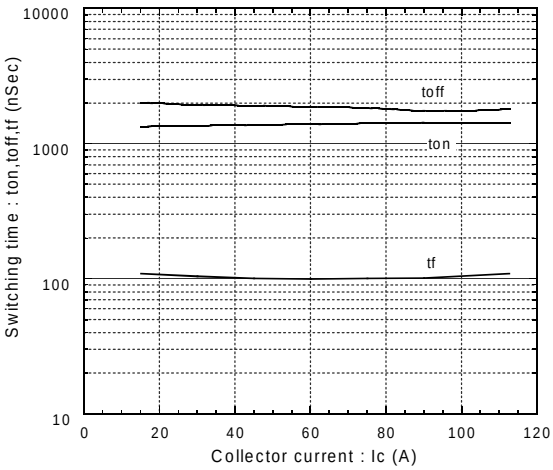
Collector current vs. Collector-Emitter voltage
Tj=25°C



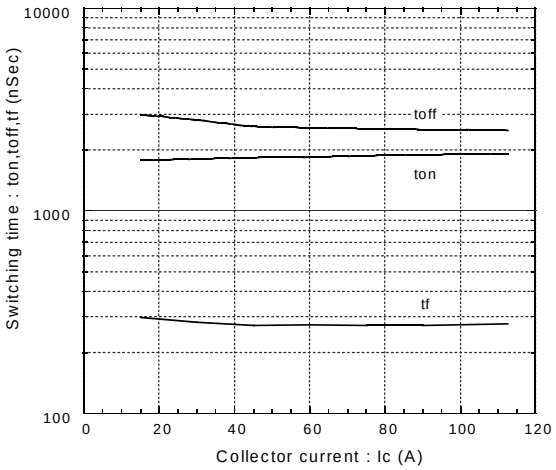

Collector current vs. Collector-Emitter voltage
Tj=125°C



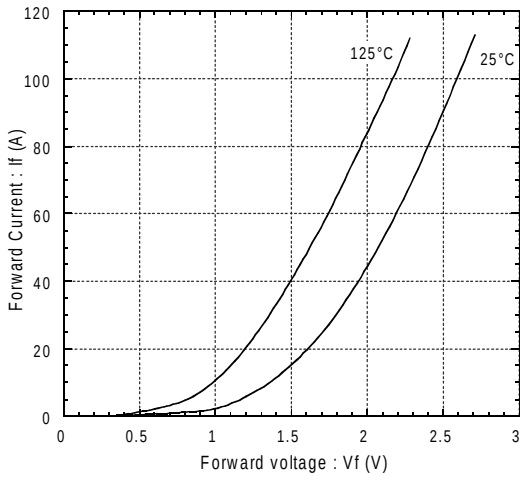

Switching time vs. Collector current
Edc=600V,Vcc=15V,Tj=25°C



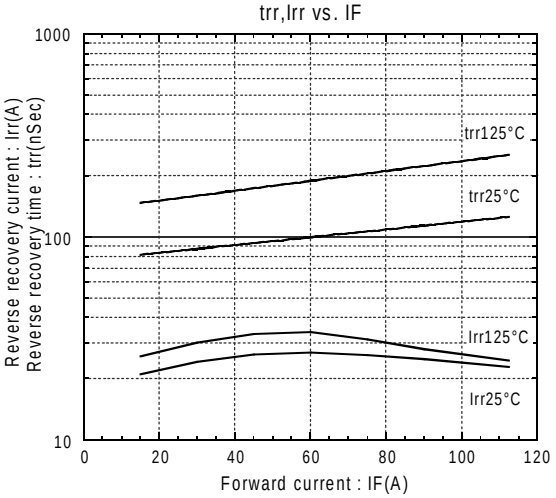

Switching time vs. Collector current
Edc=600V,Vcc=15V,Tj=125°C



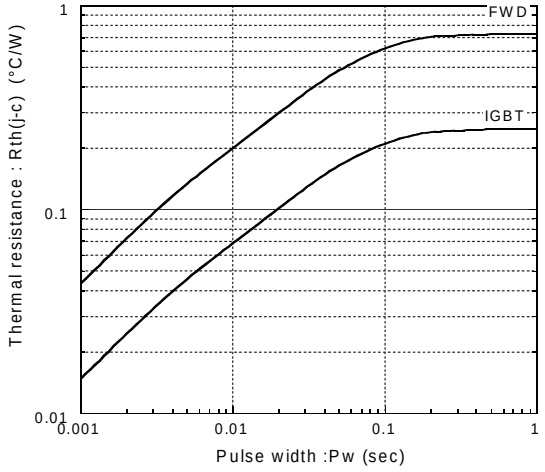

Forward current vs. Forward voltage



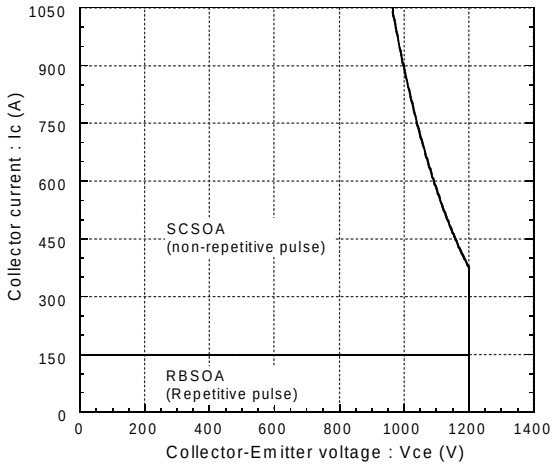

Reverse recovery characteristics
trr,Irr vs. IF



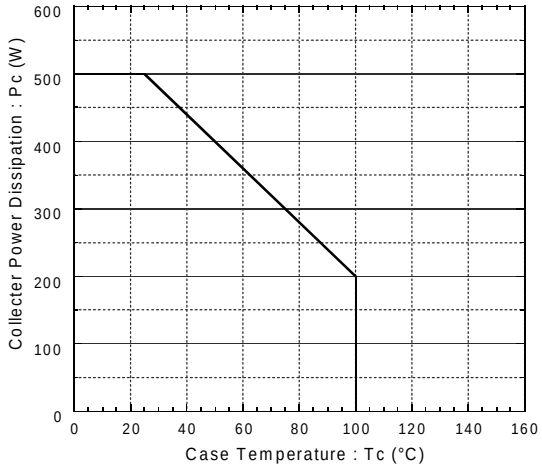
Transient thermal resistance



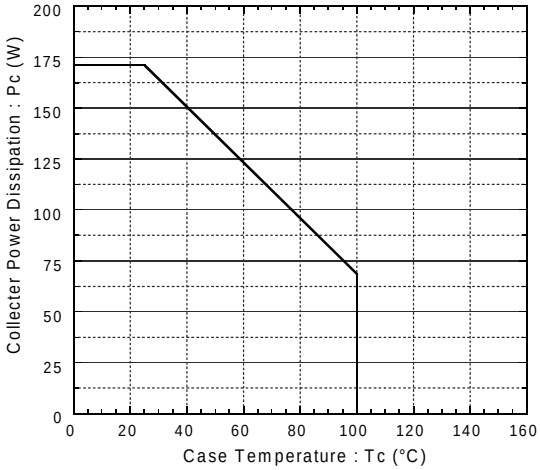

Reversed biased safe operating area
Vcc=15V,Tj ≦125°C



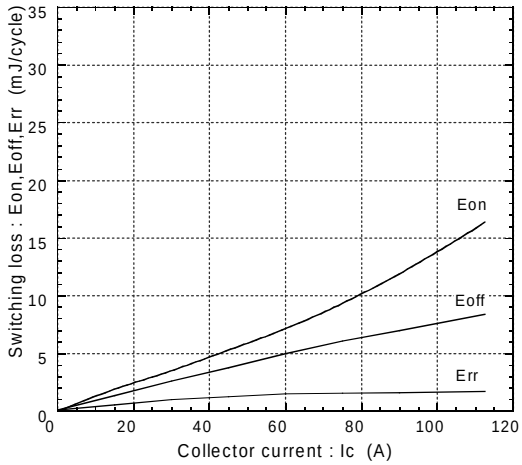

Power derating for IGBT
(per device)



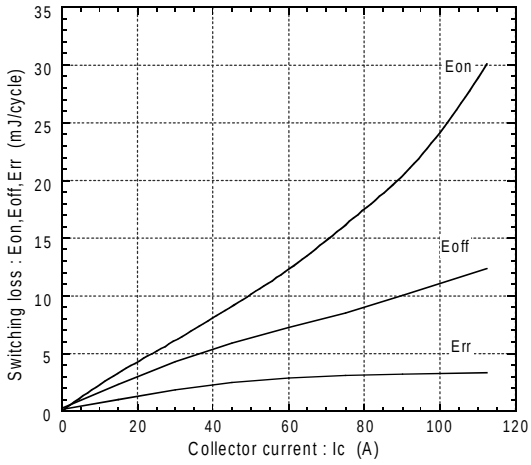

Power derating for FWD
(per device)

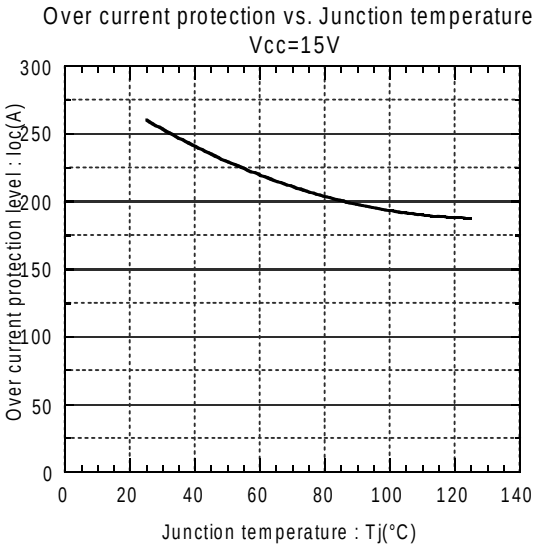



Switching Loss vs. Collector Current
Edc=600V,Vcc=15V,Tj=25°C




Switching Loss vs. Collector Current
Edc=600V,Vcc=15V,Tj=125°C




Over current protection vs. Junction temperature
Vcc=15V
Over current protection level : Ioc(A)
300
250
200
150
100
50
0
0
20
40
60
80
100
120
140
Junction temperature : Tj(°C)