# 7MBP50RJ120

e-Front runners

## IGBT IPM R-series 1200V class

**1200V / 50A 7 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.
- Both P-side and N-side alarm output available.
- 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 |
|---|---|---|---|---|---|---|
| Bus voltage | | DC | $V_{DC}$ | 0 | 900 | V |
| | | Surge | $V_{DC(surge)}$ | 0 | 1000 | V |
| | | Short operating | $V_{SC}$ | 200 | 800 | V |
| Collector-Emitter voltage *1 | | | $V_{CES}$ | 0 | 1200 | V |
| Inverter | Collector current | DC | $I_C$ | - | 50 | A |
| | | 1ms | $I_{CP}$ | - | 100 | A |
| | | Duty=98.0% *2 | $-I_C$ | - | 50 | A |
| | Collector power dissipation | One transistor *3 | $P_C$ | - | 357 | W |
| Brake | Collector current | DC | $I_C$ | - | 25 | A |
| | | 1ms | $I_{CP}$ | - | 50 | A |
| | Forward Current of Diode | | $I_F$ | - | 25 | A |
| | Collector power dissipation | One transistor *3 | $P_C$ | | 198 | W |
| Supply voltage of Pre-Driver *4 | | | $V_{CC}$ | -0.5 | 20 | V |
| Input signal voltage *5 | | | $V_{in}$ | -0.5 | Vcc+0.5 | V |
| Input signal current | | | $I_{in}$ | - | 3 | mA |
| Alarm signal voltage *6 | | | $V_{ALM}$ | -0.5 | Vcc | V |
| Alarm signal current *7 | | | $I_{ALM}$ | - | 20 | mA |
| Junction temperature | | | $T_j$ | - | 150 | °C |
| Operating case temperature | | | $T_{opr}$ | -20 | 100 | °C |
| Storage temperature | | | $T_{stg}$ | -40 | 125 | °C |
| Isolating voltage (Terminal to base, 50/60Hz sine wave 1min.) | | | $V_{iso}$ | - | AC2500 | V |
| Screw torque | | Terminal (M5) | | - | 3.5 | N·m |
| | | Mounting (M5) | | - | 3.5 | N·m |

Note

*1 : Vces shall be applied to the input voltage between terminal P and U or V or W or DB, N and U or V or W or DB.

*2 : 125°C/FRD Rth(j-c)/(Ic x VF Max.)=125/0.85(50x3.0)x100=98.0%

*3 : Pc=125°C/IGBT Rth(j-c)=125/0.35=357W [Inverter]

Pc=125°C/IGBT Rth(j-c)=125/0.63=198W [Inverter]

*4 : VCC shall be applied to the input voltage between terminal No.4 and 1, 8 and 5, 12 and 9, 14 and 13

*5 : Vin shall be applied to the input voltage between terminal No.3 and 1, 7 and 5, 11 and 9, 15,16,17,18 and 13.

*6 :VALM shall be applied to the voltage between terminal No.2 and 1, No6 and 5, No10 and 9, No.19 and 13.

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

● **Main circuit**

| | Item | Symbol | Condition | | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|---|---|
| Inverter | Collector current at off signal input | $I_{CES}$ | $V_{CE}$=1200V Vin terminal open. | | - | - | 1.0 | mA |
| | Collector-Emitter saturation voltage | $V_{CE(sat)}$ | Ic=50A | Terminal | - | - | 2.6 | V |
| | | | | Chip | - | - | - | |
| | Forward voltage of FWD | $V_F$ | -Ic=50A | Terminal | - | - | 3.0 | V |
| | | | | Chip | - | - | - | |
| Brake | Collector current at off signal input | $I_{CES}$ | $V_{CE}$=1200V Vin terminal open. | | - | - | 1.0 | mA |
| | Collector-Emitter saturation voltage | $V_{CE(sat)}$ | Ic=25A | Terminal | - | - | 2.6 | V |
| | Forward voltage of Diode | $V_F$ | -Ic=25A | Terminal | - | - | 3.3 | |
| Turn-on time | | ton | VDC=600V,Tj=125°C | | 1.2 | - | - | µs |
| Turn-off time | | toff | IC=50A Fig.1, Fig.6 | | - | - | 3.6 | |
| Reverse recovery time | | trr | VDC=600V, IF=50A Fig.1, Fig.6 | | - | - | 0.3 | |

● **Control circuit**

| Item | Symbol | Condition | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| Supply current of P-line side pre-driver(one unit) | $I_{CCP}$ | Switching Trequency : 0 to 15kHz | - | - | 18 | mA |
| Supply current of N-line side pre-driver | $I_{CCN}$ | Tc=-20 to 125°C Fig.7 | - | - | 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 |
| Alarm signal hold time | $t_{ALM}$ | 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 | $R_{ALM}$ | | 1425 | 1500 | 1575 | ohm |

● **Protection Section** ( Vcc=15V)

| Item | Symbol | Condition | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| Over Current Protection Level of Inverter circuit | $I_{OC}$ | Tj=125°C | 75 | - | - | A |
| Over Current Protection Level of Brake circuit | $I_{OC}$ | Tj=125°C | 38 | - | - | A |
| Over Current Protection Delay time | $t_{DOC}$ | Tj=125°C | - | 10 | - | µs |
| SC Protection Delay time | $t_{SC}$ | Tj=125°C Fig.4 | - | - | 12 | µs |
| IGBT Chip Over Heating Protection Temperature Level | $T_{jOH}$ | Surface of IGBT chips | 150 | | - | ℃ |
| Over Heating Protection Hysteresis | $T_{jH}$ | | - | 20 | - | ℃ |
| Over Heating Protection Protection Temperature Level | $T_{cOH}$ | $V_{DC}$=0V, $I_C$=0A CaseTemperature | 110 | - | 125 | ℃ |
| Over Heating Protection Hysteresis | $T_{cH}$ | | - | 20 | - | ℃ |
| Under Voltage Protection Level | $V_{UV}$ | | 11.0 | - | 12.5 | V |
| Under Voltage Protection Hysteresis | $V_H$ | | 0.2 | 0.5 | - | V |

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

| Item | | | Symbol | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|---|
| Junction to Case thermal resistance *8 | Inverter | IGBT | Rth(j-c) | - | - | 0.35 | °C/W |
| | | FWD | Rth(j-c) | - | - | 0.85 | °C/W |
| | Brake | IGBT | Rth(j-c) | - | - | 0.63 | °C/W |
| Case to fin thermal resistance with compound | | | Rth(c-f) | - | 0.05 | - | |

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

● **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 | $V_{DC}$ | - | - | 800 | V |
| Operating Supply Voltage of Pre-Driver | $V_{CC}$ | 13.5 | 15.0 | 16.5 | V |
| Screw torque (M5) | - | 2.5 | - | 3.0 | Nm |

● **Weight**

| Item | Symbol | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|

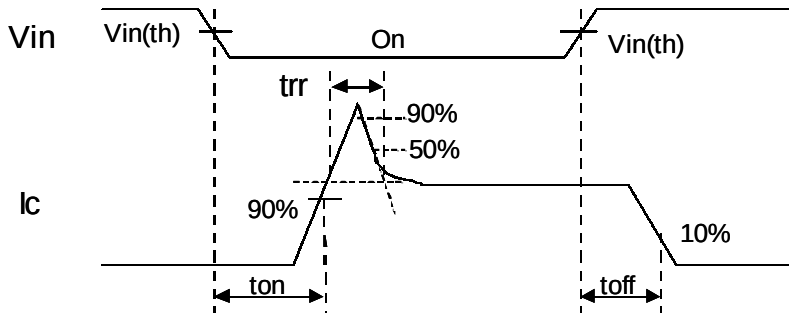
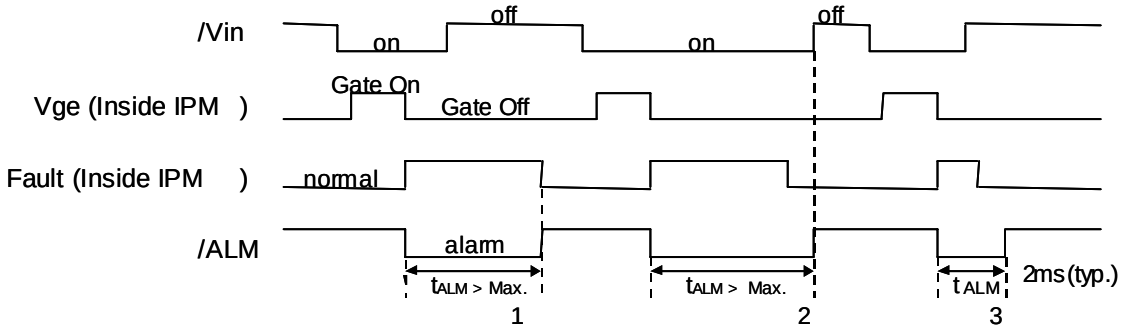



Figure 1. Switching Time Waveform Definitions




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

Figure 2. Input/Output Timing Diagram

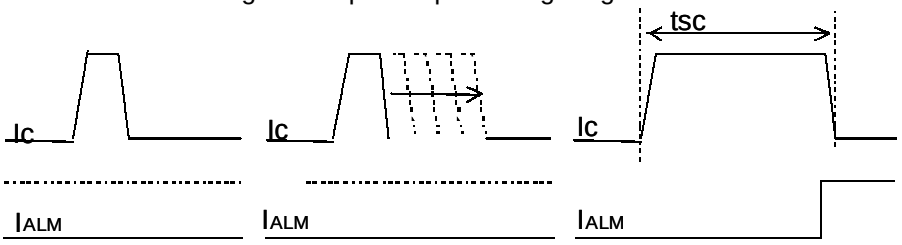



Figure.4 Definition of tsc

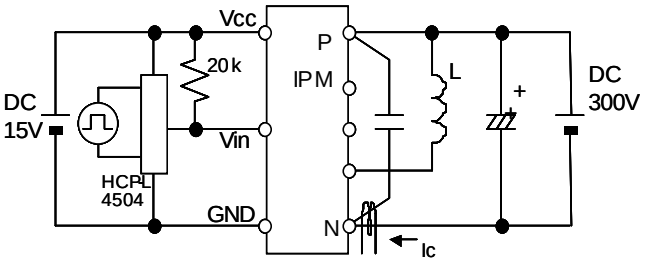



Figure 6. Switching Characteristics Test Circuit

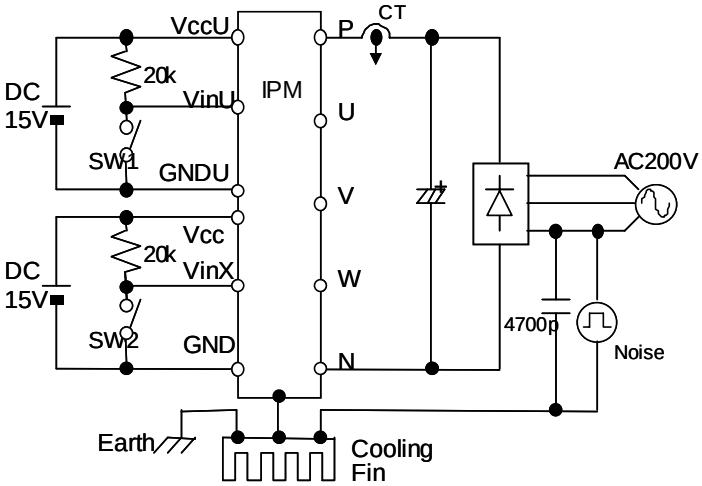



Figure 5. Noise Test Circuit

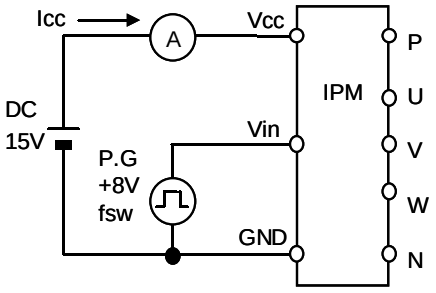
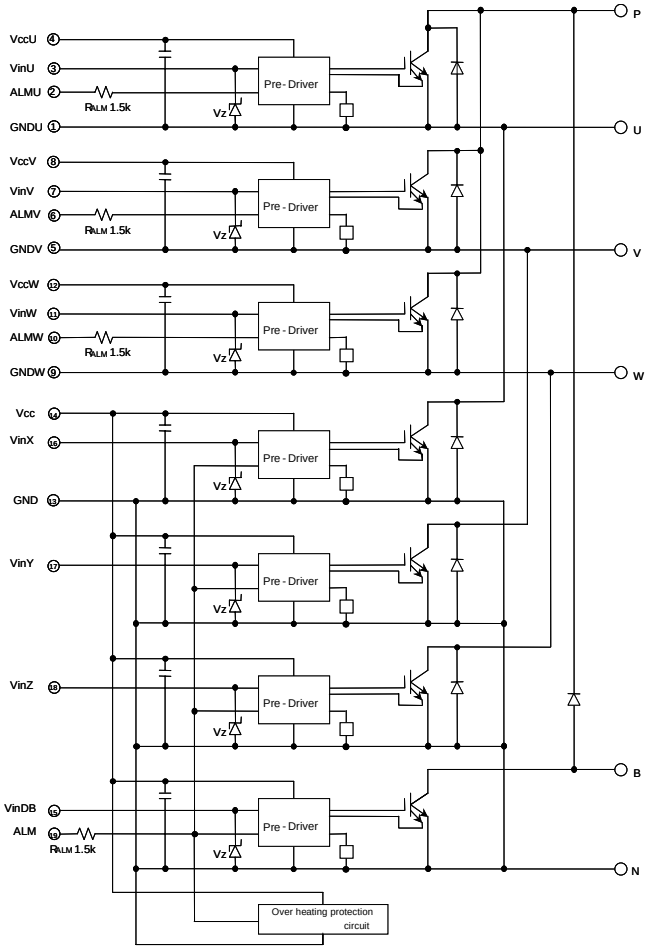



Figure 7. Icc Test Circuit

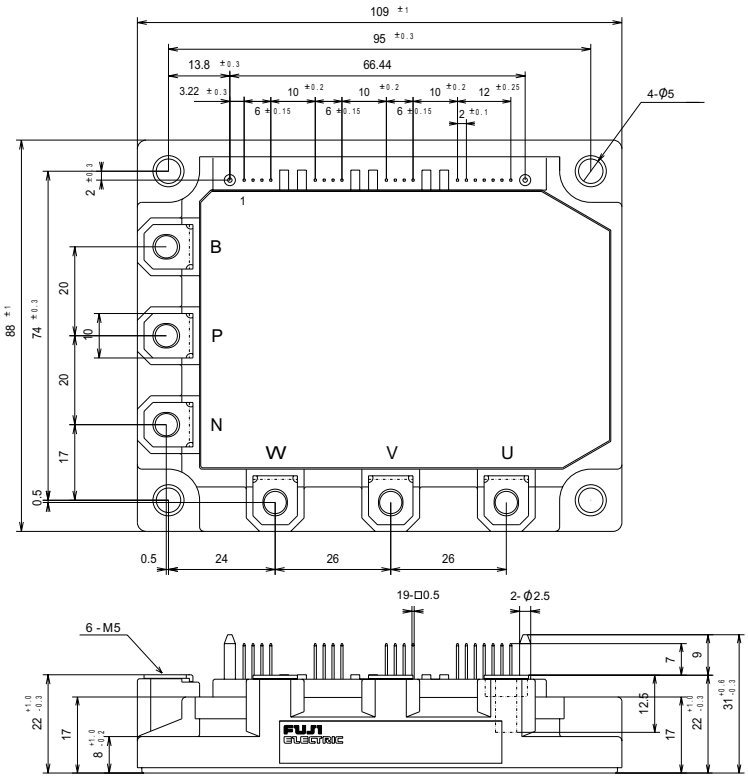
## Block diagram




Pre-drivers include following functions

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

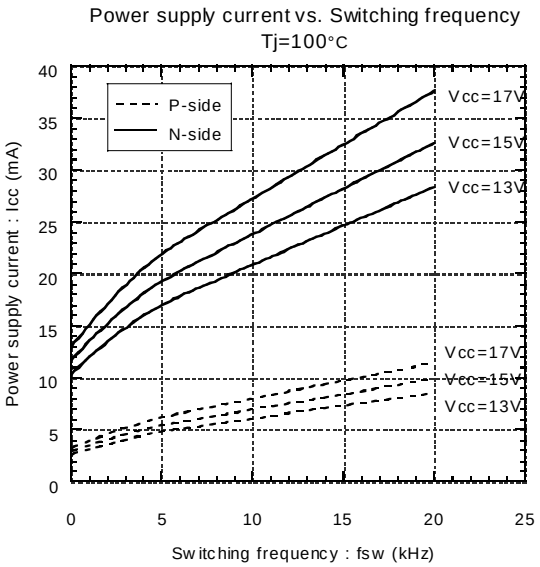
## Outline drawings, mm

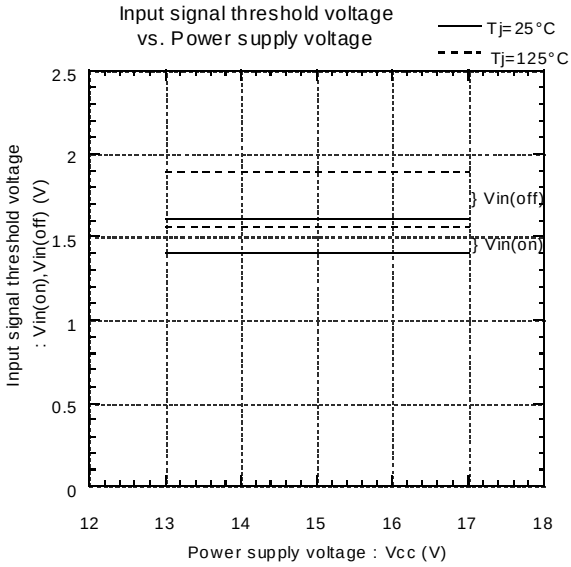


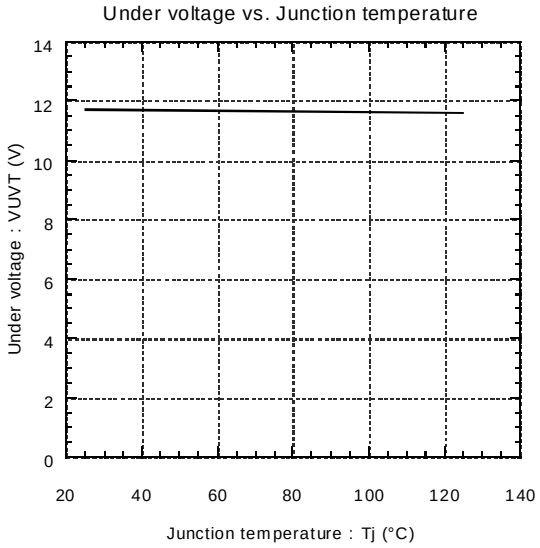

Mass : 450g

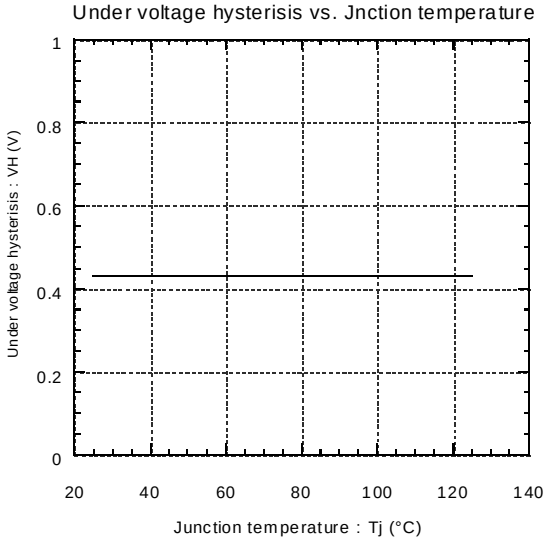
## ■ Characteristics

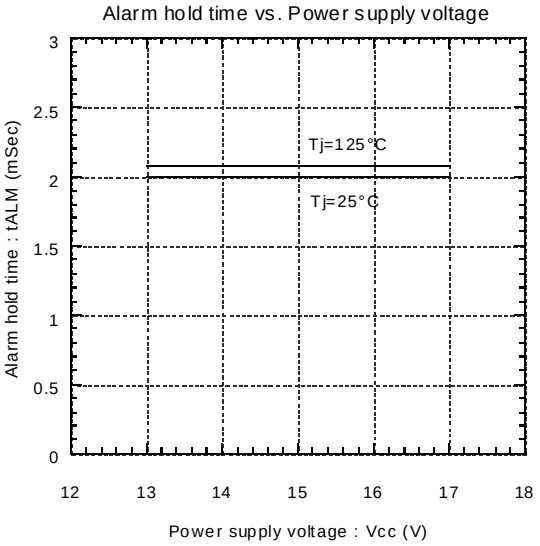
● **Control circuit characteristics (Respresentative)**

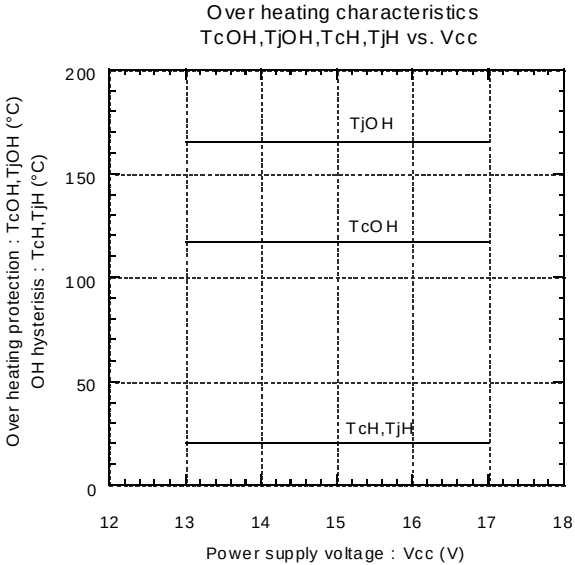


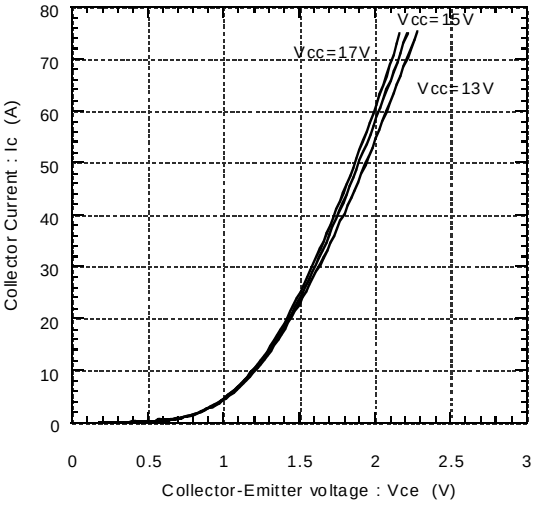



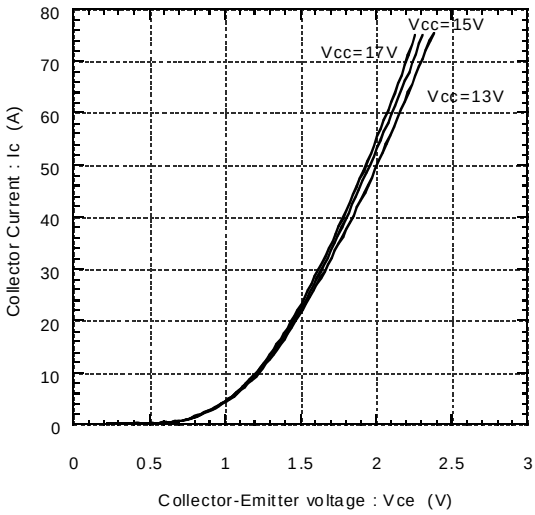



● **Main circuit characteristics (Respresentative)**

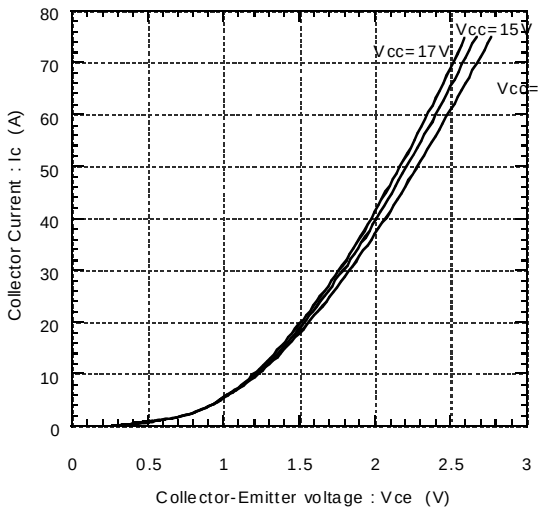
Collector current vs. Collector-Emitter voltage
Tj=25°C(Chip)



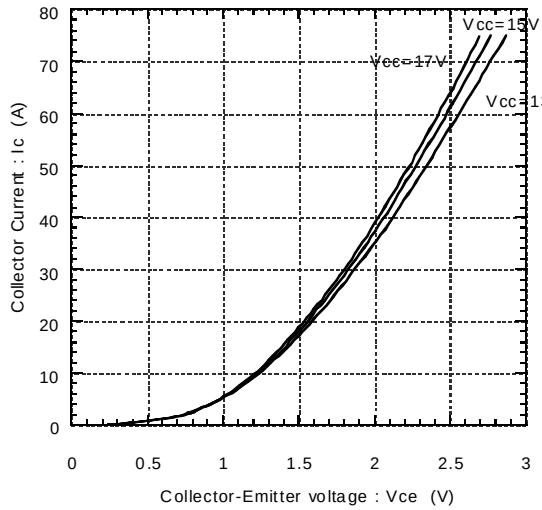

Collector current vs. Collector-Emitter voltage
Tj=25°C (Terminal)



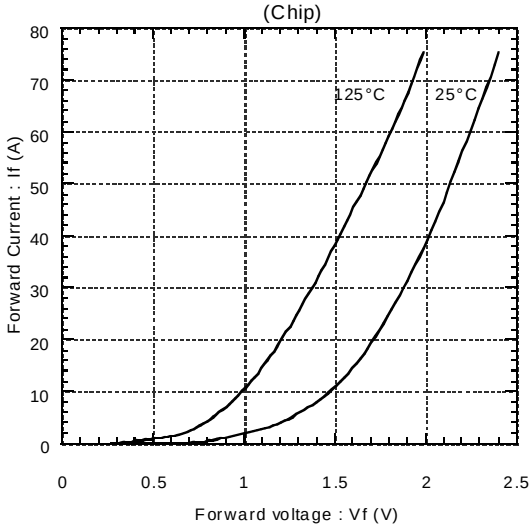

Collector current vs. Collector-Emitter voltage
Tj=125°C(Chip)



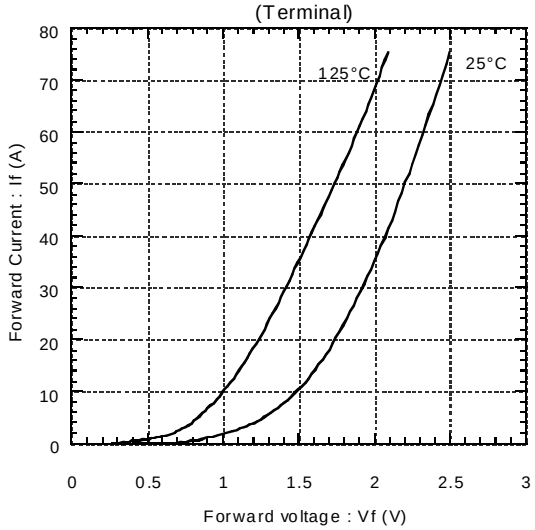

Collector current vs. Collector-Emitter voltage
Tj=125°C (Terminal)



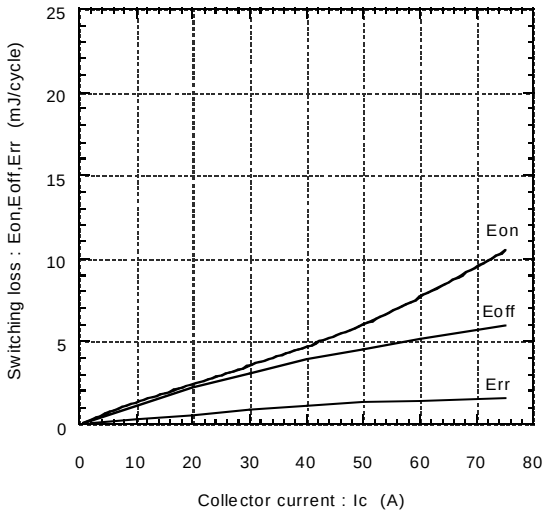

Forward current vs. Forward voltage
(Chip)



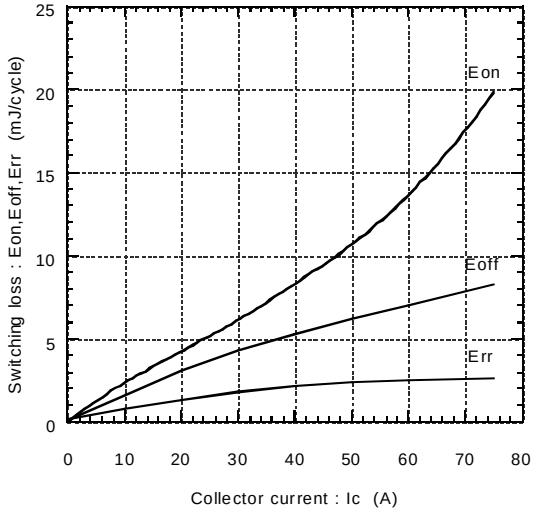

Forward current vs. Forward voltage
(Terminal)



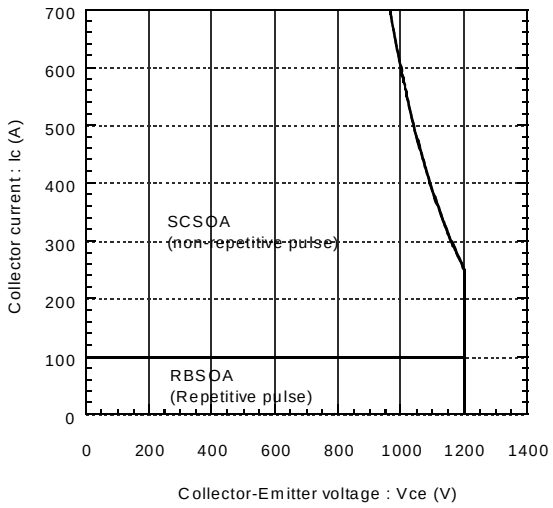
Switching Loss vs. Collector Current
Edc=600V,Vcc=15V,Tj=25°C



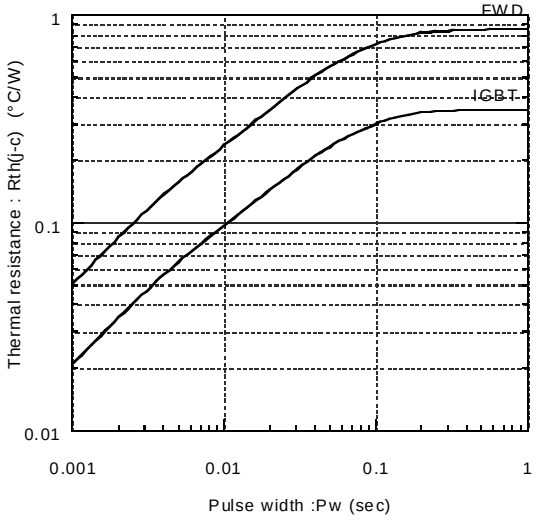

Switching Loss vs. Collector Current
Edc=600V,Vcc=15V,Tj=125°C



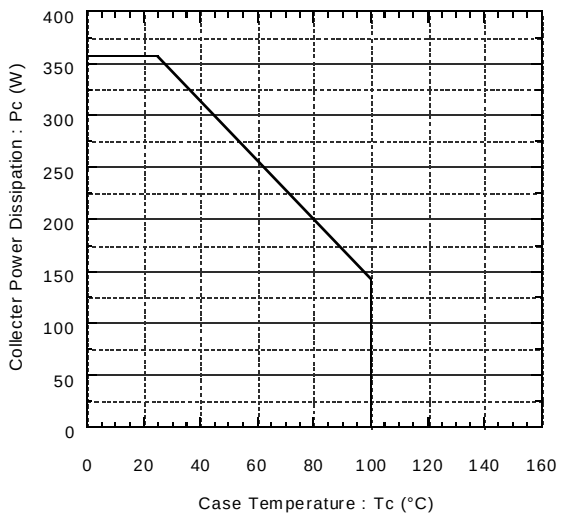

Reversed biased safe operating area
Vcc=15V,Tj≦125°C



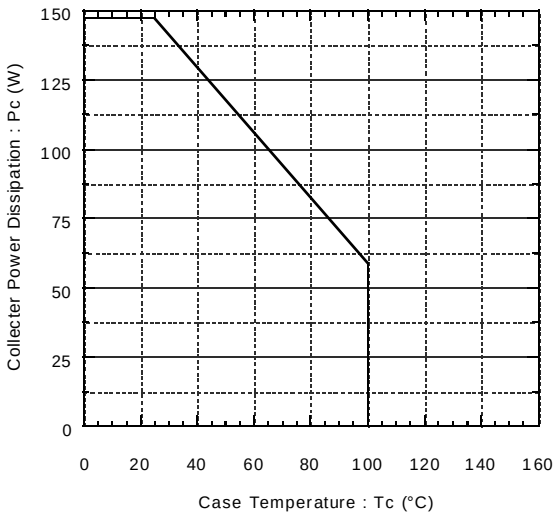

Transient thermal resistance



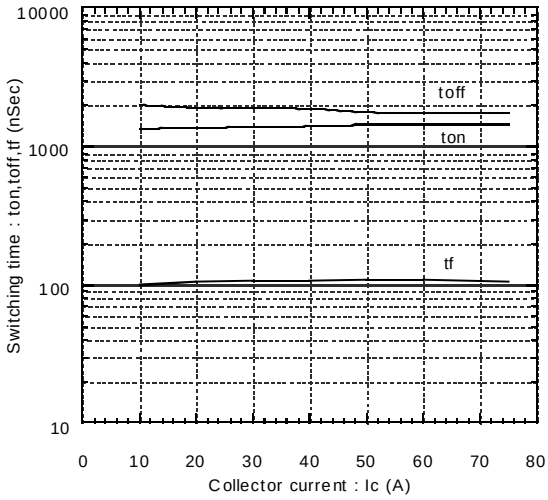

Power derating for IGBT
(per device)



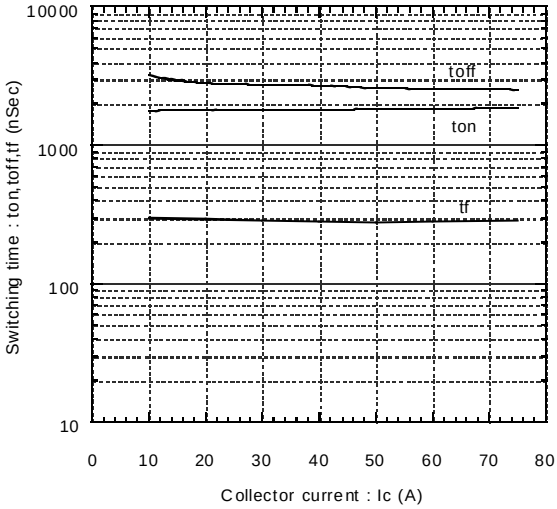

Power derating for FWD
(per device)



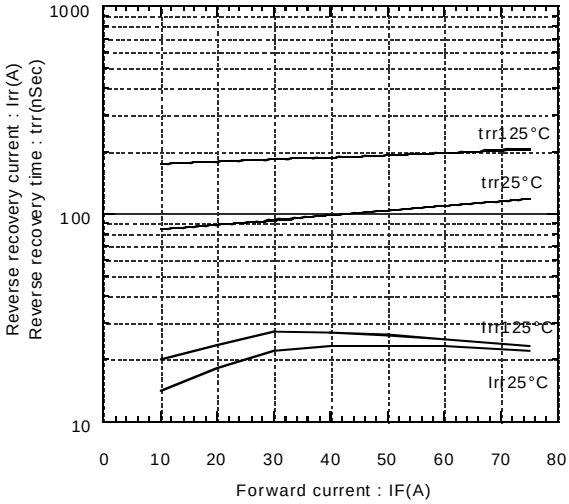
Switching time vs. Collector current
Edc=600V,Vcc=15V,Tj=25°C




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

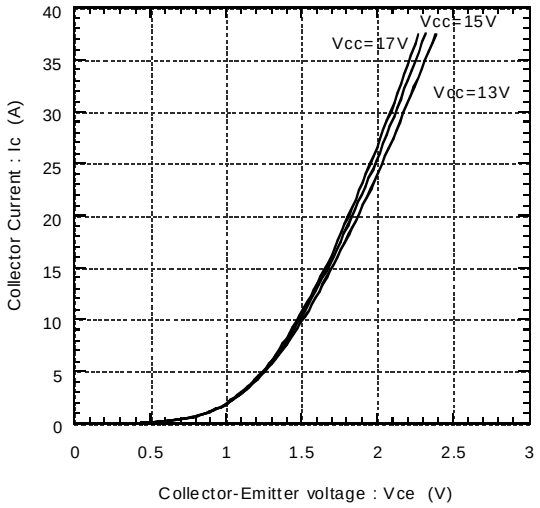



Reverse recovery characteristics
trr,Irr vs. IF

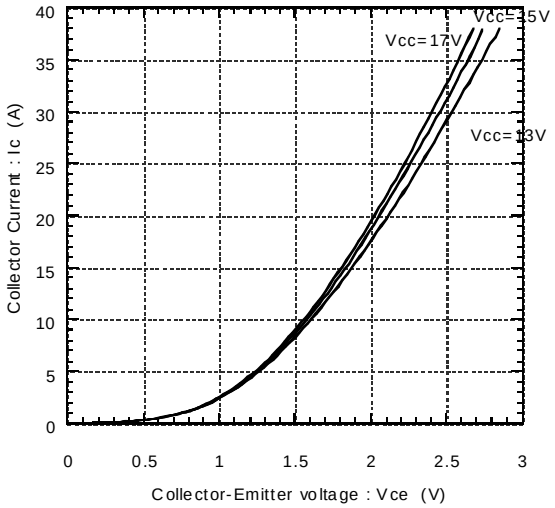


● **Dynamic Brake Characteristics (Representative)**

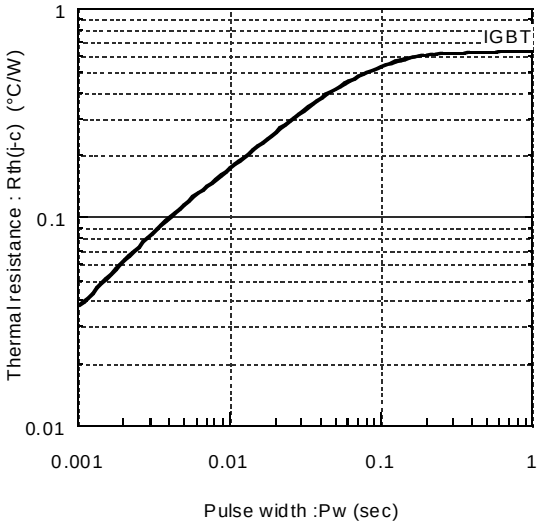
Collector current vs. Collector-Emitter voltage
Tj=25°C (Terminal)



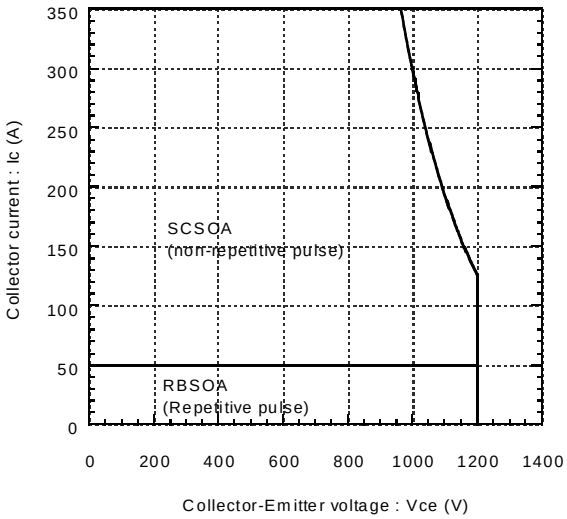

Collector current vs. Collector-Emitter voltage
Tj=125°C(Terminal)




Transient thermal resistance




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




Power derating for IGBT
(per device)