

# 7MBP150RA120

## IGBT-IPM R series

1200V / 150A 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
- Higher reliability because of a big decrease in number of parts in built-in control circuit



### Maximum ratings and characteristics

- Absolute maximum ratings(at  $T_c=25^\circ\text{C}$  unless otherwise specified)

| Item   | Symbol                      | Rating         |          | Unit       |                  |   |
|--|-----------------------------|----------------|----------|------------|------------------|---|
|  |                             | Min.           | Max.     |            |                  |   |
| 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          |                  |   |
| DB Reverse voltage                           | $V_R$                       | -              | 1200     | V          |                  |   |
| INV  | Collector current           | DC             | $I_C$    | -          | 150              | A |
|  |                             | 1ms            | $I_{CP}$ | -          | 300              | A |
|  |                             | DC             | $-I_C$   | -          | 150              | A |
|  | Collector power dissipation | One transistor | $P_C$    | -          | 1040             | W |
| DB   | Collector current           | DC             | $I_C$    | -          | 50               | A |
|  |                             | 1ms            | $I_{CP}$ | -          | 100              | A |
|  | Forward current of Diode    |                | $I_F$    | -          | 50               | A |
|  | Collector power dissipation | One transistor | $P_C$    | -          | 400              | W |
| Junction temperature                         |                             | $T_j$          | -        | 150        | $^\circ\text{C}$ |   |
| Input voltage of power supply for Pre-Driver |                             | $V_{CC}^{*1}$  | 0        | 20         | V                |   |
| Input signal voltage                         |                             | $V_{in}^{*2}$  | 0        | $V_Z$      | V                |   |
| Input signal current                         |                             | $I_{in}$       | -        | 1          | mA               |   |
| Alarm signal voltage                         |                             | $V_{ALM}^{*3}$ | 0        | $V_{CC}$   | V                |   |
| Alarm signal current                         |                             | $I_{ALM}^{*4}$ | -        | 15         | mA               |   |
| Storage temperature                          |                             | $T_{stg}$      | -40      | 125        | $^\circ\text{C}$ |   |
| Operating case temperature                   |                             | $T_{op}$       | -20      | 100        | $^\circ\text{C}$ |   |
| 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              |   |

\*1 Apply  $V_{CC}$  between terminal No. 3 and 1, 6 and 4, 9 and 7, 11 and 10.

\*2 Apply  $V_{in}$  between terminal No. 2 and 1, 5 and 4, 8 and 7, 12,13,14,15 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  $T_c=T_j=25^\circ\text{C}$ ,  $V_{CC}=15\text{V}$ )

| Item | Symbol                                | Condition     | Min.                                      | Typ. | Max. | Unit |    |
|------|---------------------------------------|---------------|---|------|------|------|----|
| INV  | Collector current at off signal input | $I_{CES}$     | $V_{CE}=1200\text{V}$ input terminal open | -    | -    | 1.0  | mA |
|      | Collector-Emitter saturation voltage  | $V_{CE(sat)}$ | $I_C=150\text{A}$                         | -    | -    | 2.6  | V  |
|      | Forward voltage of FWD                | $V_F$         | $-I_C=150\text{A}$                        | -    | -    | 3.0  | V  |
| DB   | Collector current at off signal input | $I_{CES}$     | $V_{CE}=1200\text{V}$ input terminal open | -    | -    | 1.0  | mA |
|      | Collector-Emitter saturation voltage  | $V_{CE(sat)}$ | $I_C=50\text{A}$                          | -    | -    | 2.6  | V  |
|      | Forward voltage of Diode              | $V_F$         | $-I_C=50\text{A}$                         | -    | -    | 3.3  | V  |

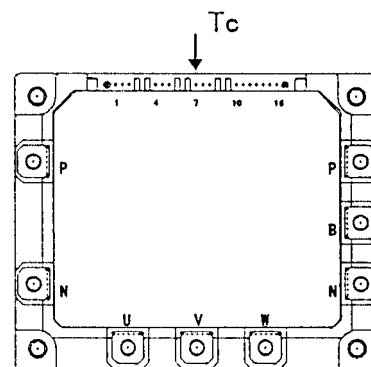


Fig.1 Measurement of case temperature

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

| Item   | Symbol       | Condition  | Min.                      | Typ. | Max. | Unit               |   |
|--|--------------|--|---------------------------|------|------|--------------------|---|
| Power supply current of P-line side Pre-driver(one unit) | $I_{ccp}$    | fsw=0 to 15kHz $T_c=-20$ to $100^{\circ}\text{C}$ *7           | 3                         | -    | 18   | mA                 |   |
| Power supply current of N-line side three Pre-driver     | $I_{CCN}$    | fsw=0 to 15kHz $T_c=-20$ to $100^{\circ}\text{C}$ *7           | 10                        | -    | 65   | mA                 |   |
| Input signal threshold voltage (on/off)                  | $V_{in(th)}$ | ON   | 1.00                      | 1.35 | 1.70 | V                  |   |
|  |              | OFF  | 1.70                      | 2.05 | 2.40 | V                  |   |
| Input zener voltage                                      | $V_Z$        | $R_{in}=20\text{k ohm}$  | -                         | 8.0  | -    | V                  |   |
| Over heating protection temperature level                | $T_{COH}$    | $V_{DC}=0\text{V}$ , $I_c=0\text{A}$ , Case temperature, Fig.1 | 110                       | -    | 125  | $^{\circ}\text{C}$ |   |
| Hysteresis   | $T_{CH}$     |  | -                         | 20   | -    | $^{\circ}\text{C}$ |   |
| IGBT chips over heating protection temperature level     | $T_{JOH}$    | surface of IGBT chips  | 150                       | -    | -    | $^{\circ}\text{C}$ |   |
| Hysteresis   | $T_{JH}$     |  | -                         | 20   | -    | $^{\circ}\text{C}$ |   |
| Collector current protection level                       | INV          | $I_{OC}$   | $T_j=125^{\circ}\text{C}$ | 225  | -    | -                  | A |
|  | DB           | $I_{OC}$   | $T_j=125^{\circ}\text{C}$ | 75   | -    | -                  | A |
| Over current protection delay time (Fig.2)               | $t_{DOC}$    | $T_j=25^{\circ}\text{C}$ Fig.2                                 | -                         | 10   | -    | $\mu\text{s}$      |   |
| 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                                 | $t_{SC}$     | $T_j=25^{\circ}\text{C}$ Fig.3                                 | -                         | -    | 12   | $\mu\text{s}$      |   |
| Limiting resistor for alarm                              | $R_{ALM}$    |  | 1425                      | 1500 | 1575 | ohm                |   |

\*7 Switching frequency of IPM

● Dynamic characteristics(at  $T_c=T_j=125^{\circ}\text{C}$ ,  $V_{cc}=15\text{V}$ )

| Item                  | Symbol    | Condition                                | Min. | Typ. | Max. | Unit          |
|-----------------------|-----------|--|------|------|------|---------------|
| Switching time (IGBT) | $t_{on}$  | $I_C=150\text{A}$ , $V_{DC}=600\text{V}$ | 0.3  | -    | -    | $\mu\text{s}$ |
|                       | $t_{off}$ |  | -    | -    | 3.6  | $\mu\text{s}$ |
| Switching time (FWD)  | $t_{rr}$  | $I_F=150\text{A}$ , $V_{DC}=600\text{V}$ | -    | -    | 0.4  | $\mu\text{s}$ |

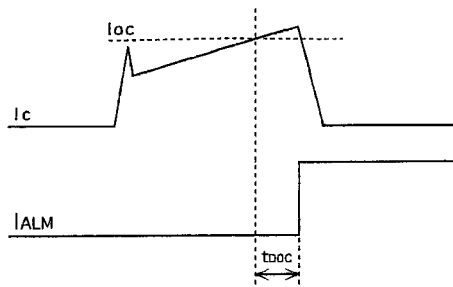


Fig.2 Definition of OC delay time

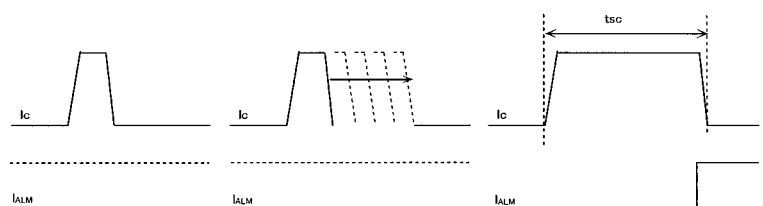


Fig.3 Definition of tsc

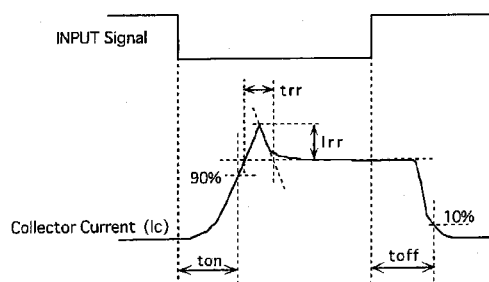


Fig.4 Definition of switching time

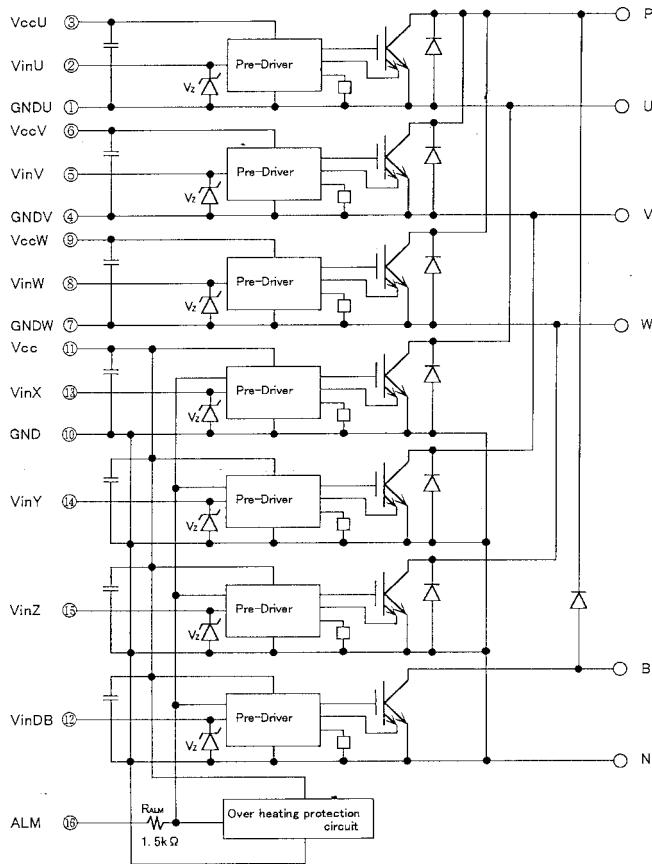
● Thermal characteristics( $T_c=25^{\circ}\text{C}$ )

| Item   | Symbol        | Typ. | Max.          | Unit |                      |                      |
|--|---------------|------|---------------|------|----------------------|----------------------|
| Junction to Case thermal resistance          | INV           | IGBT | $R_{th(j-c)}$ | -    | 0.12                 | $^{\circ}\text{C/W}$ |
|  |               | FWD  | $R_{th(j-c)}$ | -    | 0.29                 | $^{\circ}\text{C/W}$ |
|  | DB            | IGBT | $R_{th(j-c)}$ | -    | 0.31                 | $^{\circ}\text{C/W}$ |
| Case to fin thermal resistance with compound | $R_{th(c-f)}$ | 0.05 | -             | -    | $^{\circ}\text{C/W}$ |                      |

● Recommendable value

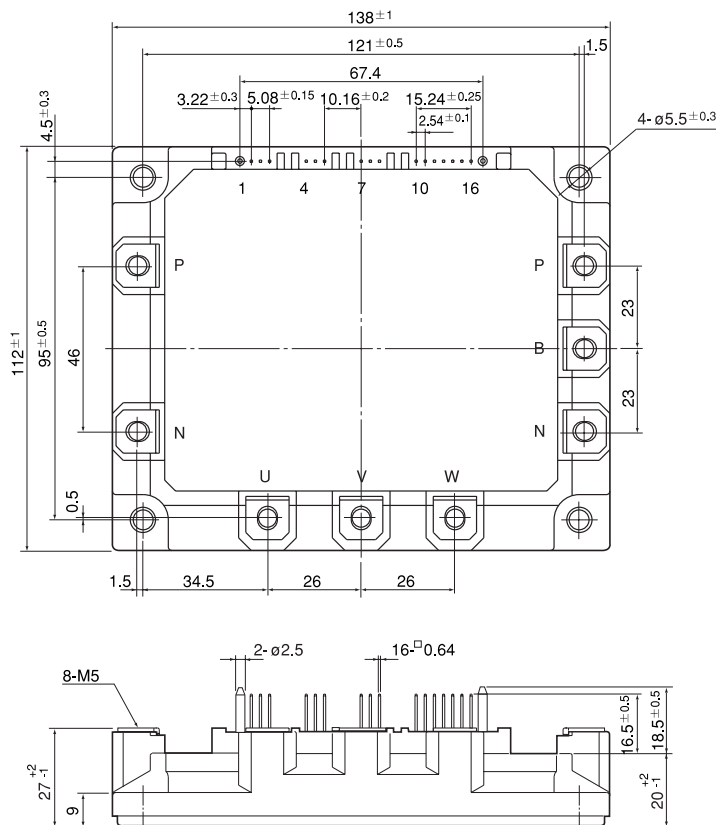
| Item   | Symbol        | Min. | Typ. | Max. | Unit |     |
|--|---------------|------|------|------|------|-----|
| DC bus voltage                                     | $V_{DC}$      | 200  | -    | 800  | V    |     |
| Operating power supply voltage range of Pre-driver | $V_{CC}$      | 13.5 | 15   | 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

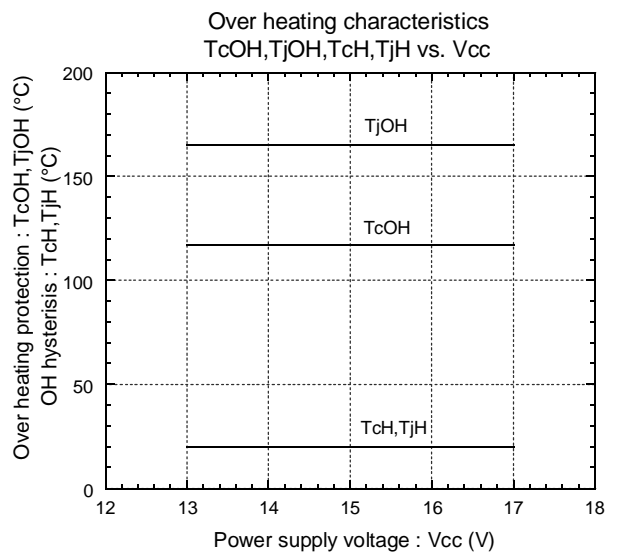
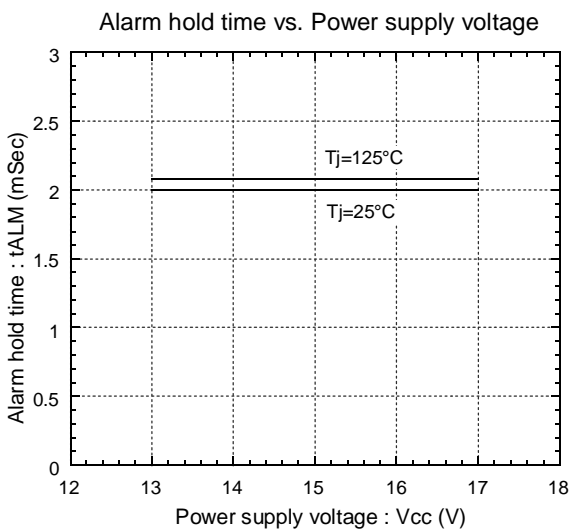
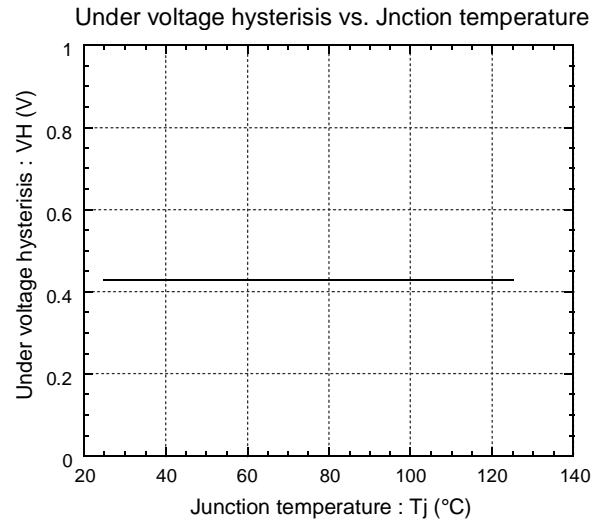
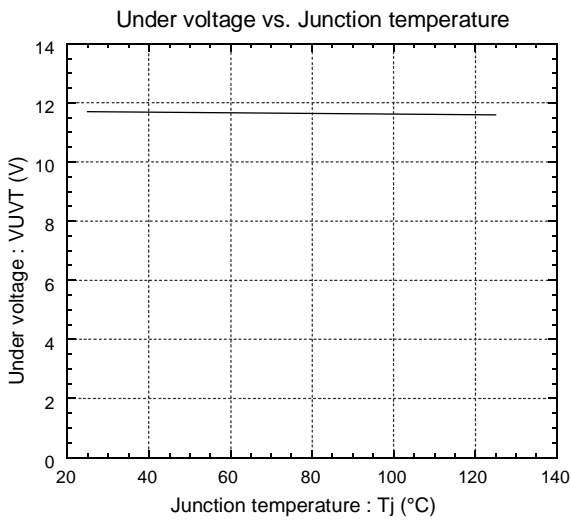
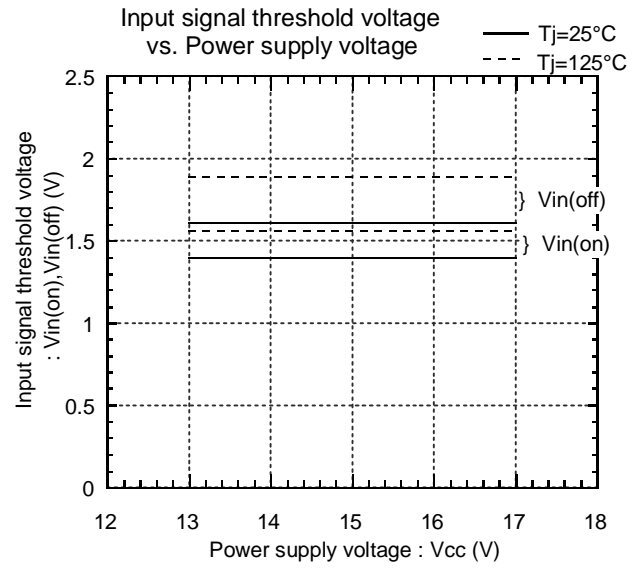
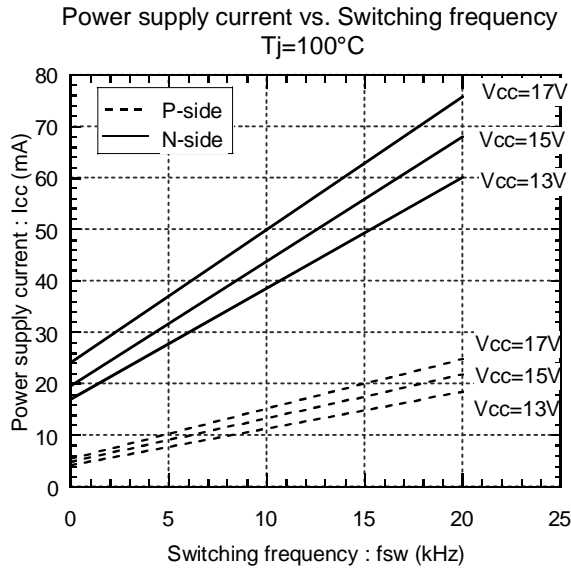
Outline drawings, mm



Mass : 920g

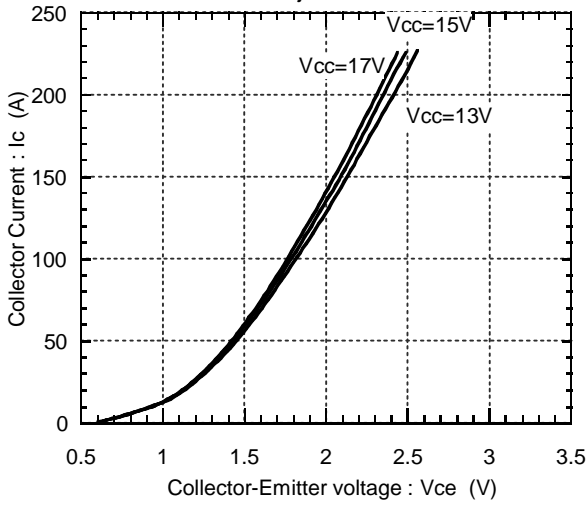
Characteristics (Representative)

Control Circuit

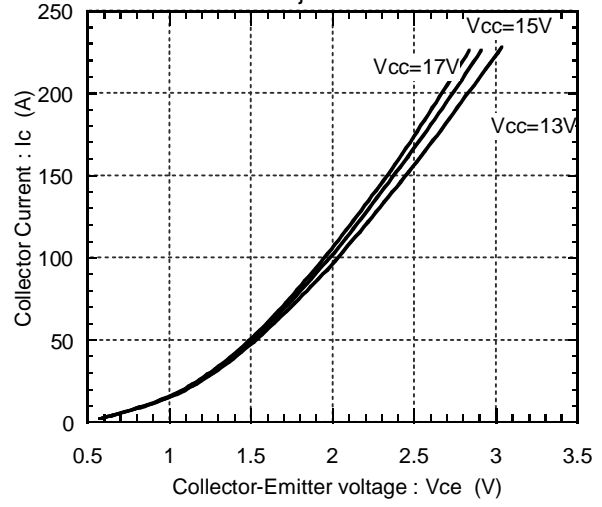


● Inverter

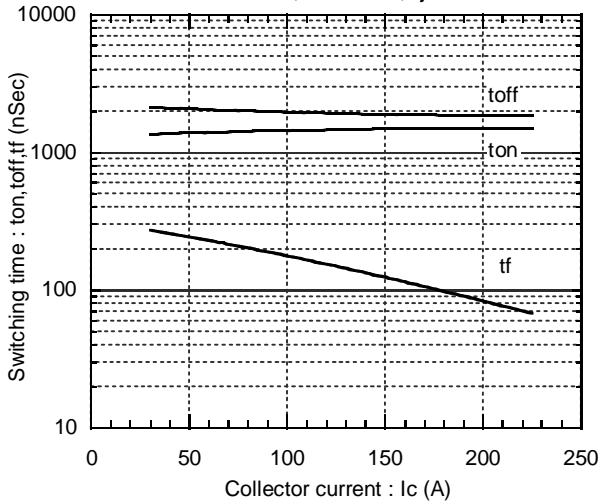
Collector current vs. Collector-Emmitter voltage  
T<sub>j</sub>=25°C



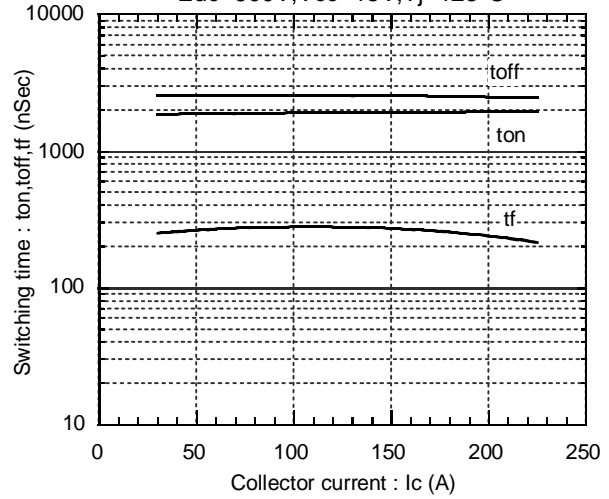
Collector current vs. Collector-Emmitter voltage  
T<sub>j</sub>=125°C



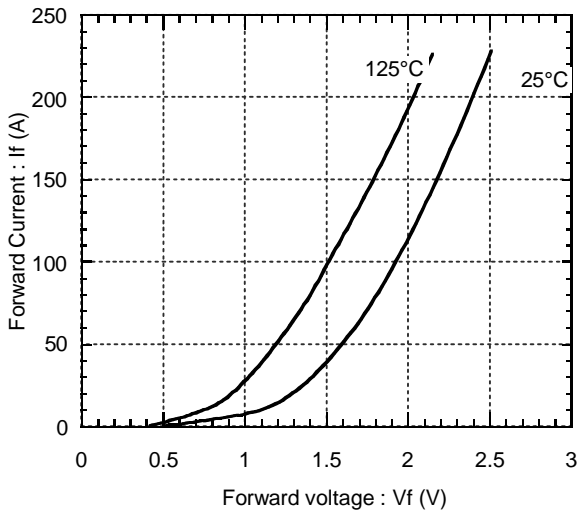
Switching time vs. Collector current  
E<sub>dc</sub>=600V, V<sub>cc</sub>=15V, T<sub>j</sub>=25°C



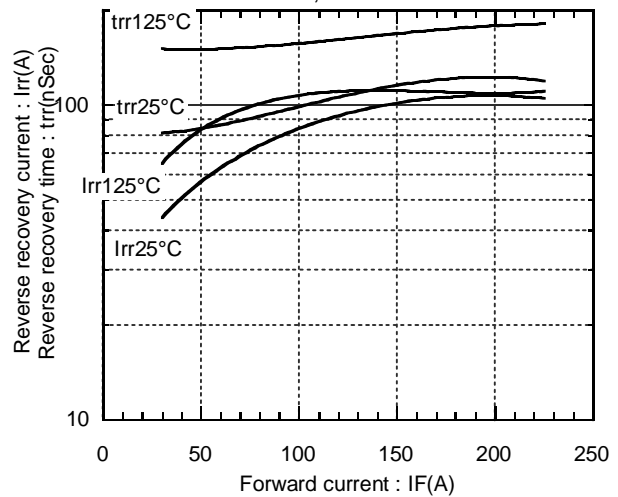
Switching time vs. Collector current  
E<sub>dc</sub>=600V, V<sub>cc</sub>=15V, T<sub>j</sub>=125°C

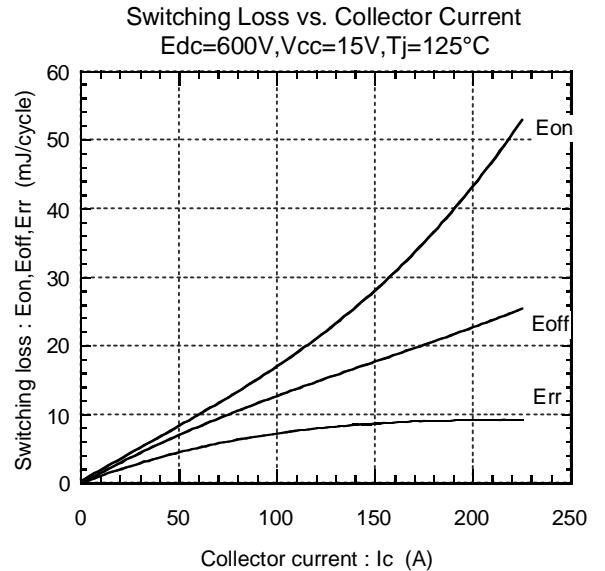
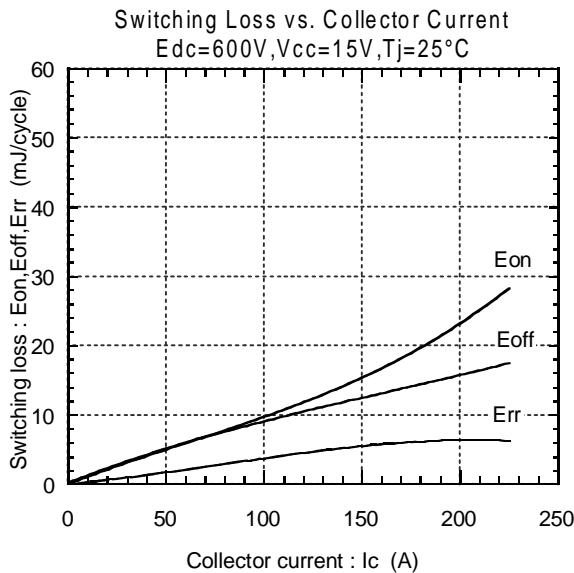
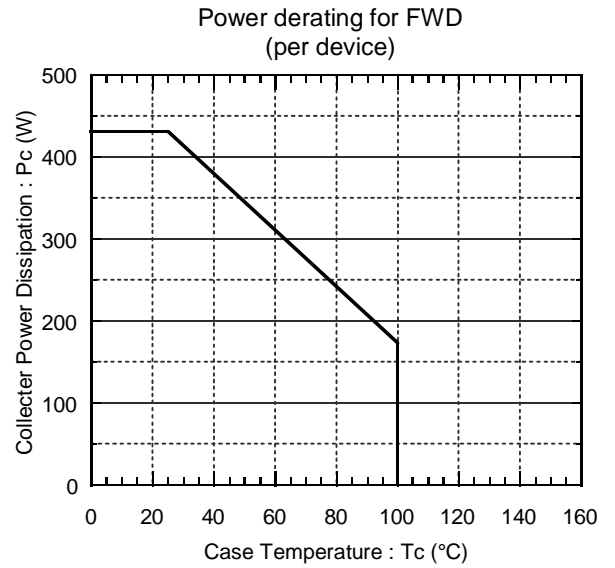
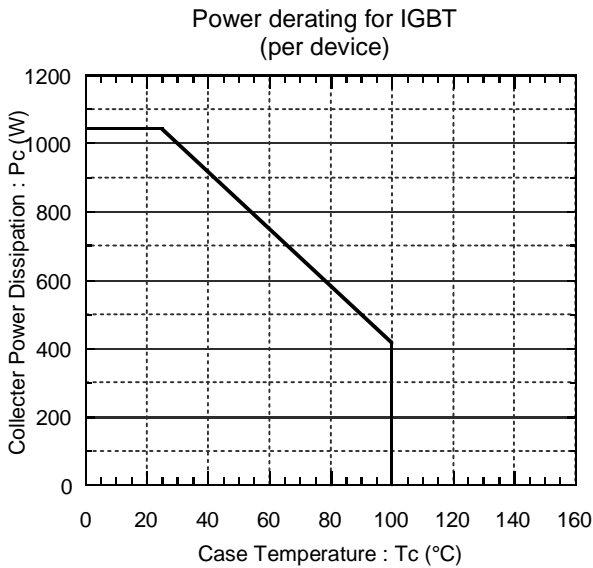
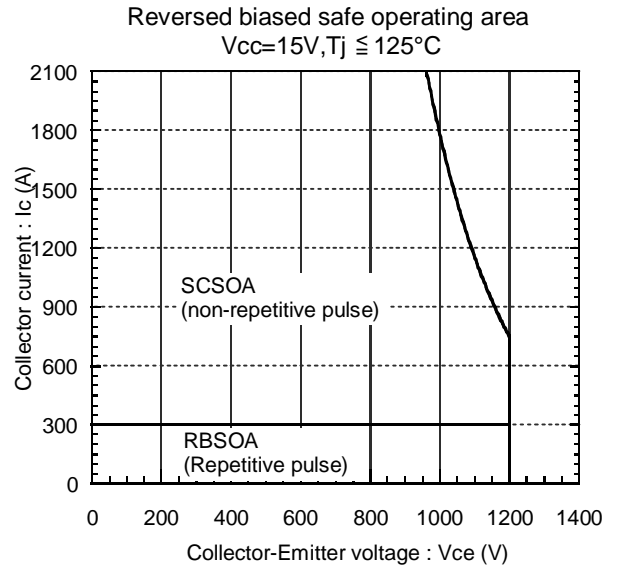
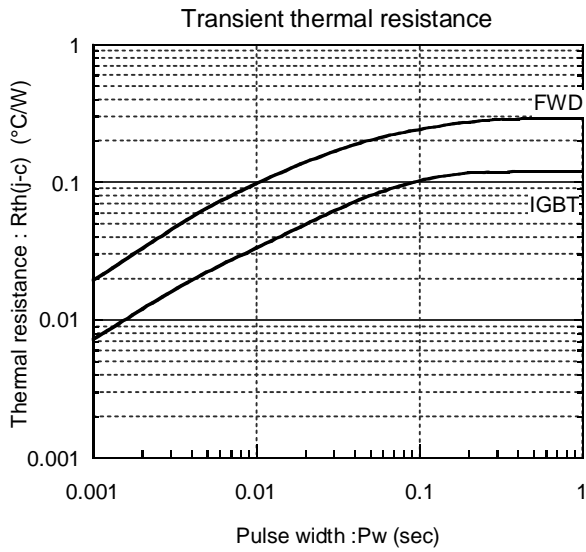


Forward current vs. Forward voltage

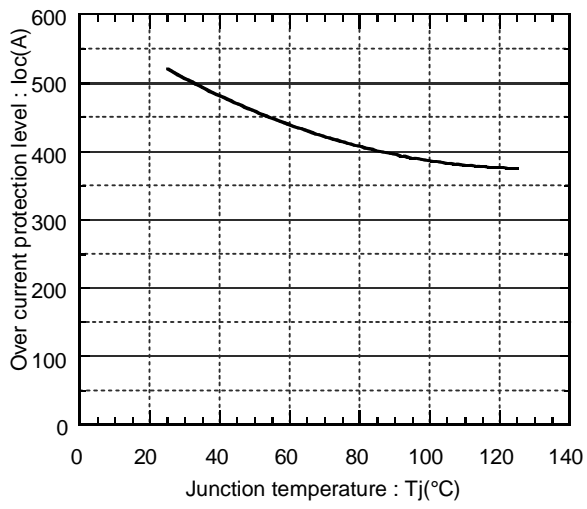


Reverse recovery characteristics  
trr, Irr vs. IF



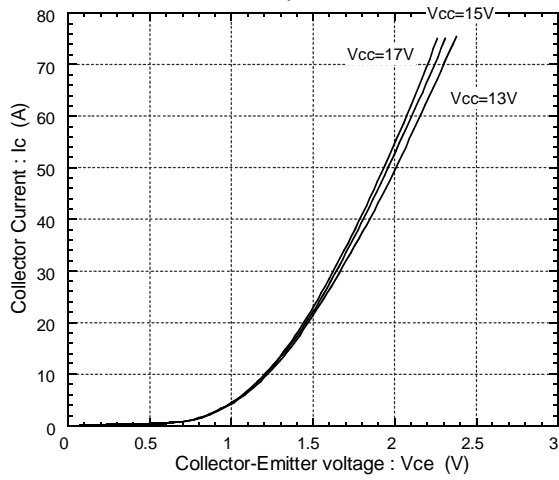


Over current protection vs. Junction temperature  
V<sub>cc</sub>=15V

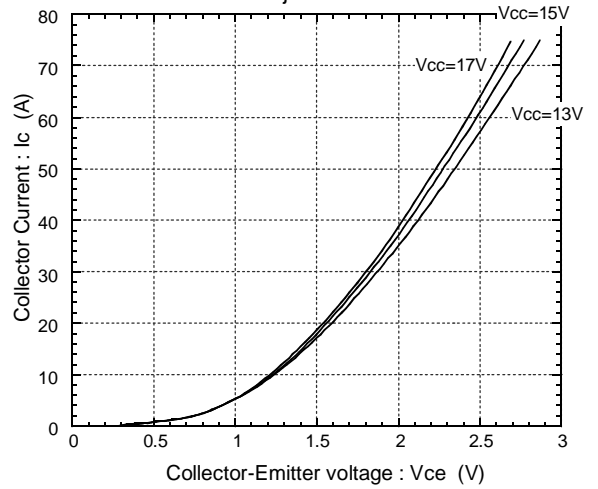


● Brake

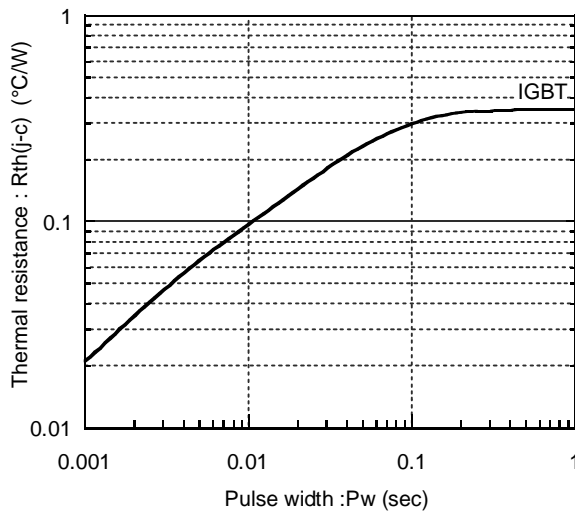
Collector current vs. Collector-Emmitter voltage  
T<sub>j</sub>=25°C



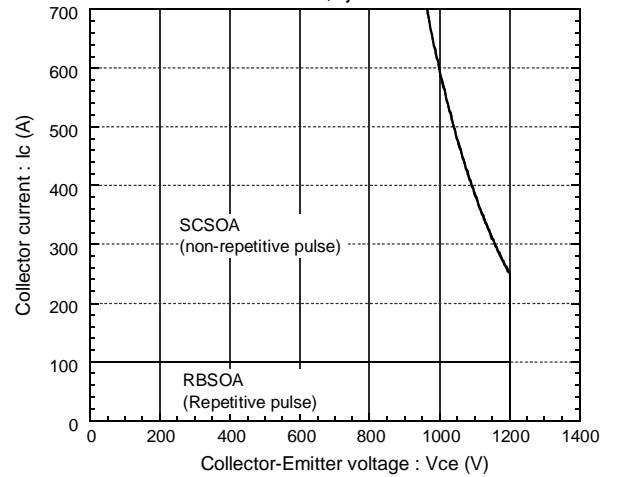
Collector current vs. Collector-Emmitter voltage  
T<sub>j</sub>=125°C



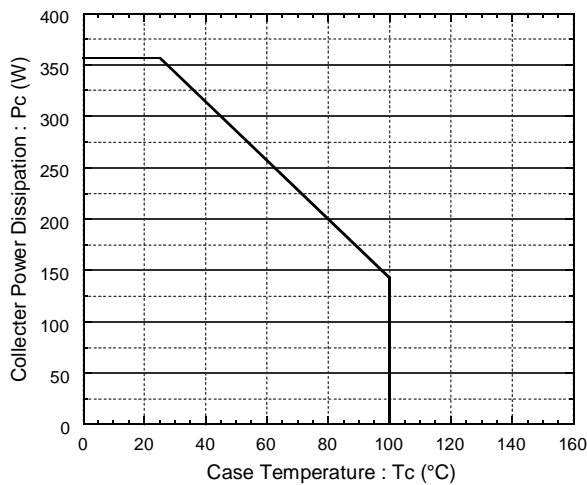
Transient thermal resistance



Reversed biased safe operating area  
V<sub>cc</sub>=15V, T<sub>j</sub> 125°C



Power derating for IGBT  
(per device)



Over current protection vs. Junction temperature  
V<sub>cc</sub>=15V

