

# 7MBR50VR120-50

**IGBT Modules**

## IGBT MODULE (V series)

### 1200V / 50A / PIM

#### ■ Features

- Low  $V_{CE(sat)}$
- Compact Package
- P.C.Board Mount Module
- Converter Diode Bridge Dynamic Brake Circuit
- RoHS compliant product

#### ■ Applications

- Inverter for Motor Drive
- AC and DC Servo Drive Amplifier
- Uninterruptible Power Supply



#### ■ Maximum Ratings and Characteristics

##### ● Absolute Maximum Ratings (at $T_c=25^\circ\text{C}$ unless otherwise specified)

| Items                                                       |                                                                             | Symbols         | Conditions                    | Maximum ratings         | Units                |   |
|-------------------------------------------------------------|-----------------------------------------------------------------------------|-----------------|-------------------------------|-------------------------|----------------------|---|
| Inverter                                                    | Collector-Emitter voltage                                                   | $V_{CES}$       |                               | 1200                    | V                    |   |
|                                                             | Gate-Emitter voltage                                                        | $V_{GES}$       |                               | $\pm 20$                | V                    |   |
|                                                             | Collector current                                                           | $I_c$           | Continuous                    | $T_c=100^\circ\text{C}$ | 50                   | A |
|                                                             |                                                                             | $I_{cp}$        | 1ms                           | $T_c=80^\circ\text{C}$  | 100                  |   |
|                                                             |                                                                             | $-I_c$          |                               |                         | 50                   |   |
| $-I_c$ pulse                                                |                                                                             | 1ms             |                               | 100                     |                      |   |
| Collector power dissipation                                 | $P_c$                                                                       | 1 device        |                               | 280                     | W                    |   |
| Brake                                                       | Collector-Emitter voltage                                                   | $V_{CES}$       |                               | 1200                    | V                    |   |
|                                                             | Gate-Emitter voltage                                                        | $V_{GES}$       |                               | $\pm 20$                | V                    |   |
|                                                             | Collector current                                                           | $I_c$           | Continuous                    | $T_c=80^\circ\text{C}$  | 35                   | A |
|                                                             |                                                                             | $I_{cp}$        | 1ms                           | $T_c=80^\circ\text{C}$  | 70                   |   |
|                                                             | Collector power dissipation                                                 | $P_c$           | 1 device                      |                         | 210                  | W |
| Repetitive peak reverse voltage (Diode)                     | $V_{RRM}$                                                                   |                 |                               | 1200                    | V                    |   |
| Converter                                                   | Repetitive peak reverse voltage                                             | $V_{RRM}$       |                               | 1600                    | V                    |   |
|                                                             | Average output current                                                      | $I_o$           | 50Hz/60Hz, sine wave          | 50                      | A                    |   |
|                                                             | Surge current (Non-Repetitive)                                              | $I_{FSM}$       | 10ms, $T_j=150^\circ\text{C}$ | 360                     | A                    |   |
|                                                             | $I^2t$ (Non-Repetitive)                                                     | $I^2t$          | half sine wave                | 648                     | $\text{A}^2\text{s}$ |   |
| Junction temperature                                        | $T_j$                                                                       | Inverter, Brake |                               | 175                     | $^\circ\text{C}$     |   |
|                                                             |                                                                             | Converter       |                               | 150                     |                      |   |
| Operating junction temperature (under switching conditions) | $T_{jop}$                                                                   | Inverter, Brake |                               | 150                     |                      |   |
|                                                             |                                                                             | Converter       |                               | 150                     |                      |   |
| Case temperature                                            | $T_c$                                                                       |                 |                               | 125                     |                      |   |
| Storage temperature                                         | $T_{stg}$                                                                   |                 |                               | -40~+125                |                      |   |
| Isolation voltage                                           | between terminal and copper base (*1)<br>between thermistor and others (*2) | $V_{iso}$       | AC : 1min.                    | 2500                    | VAC                  |   |
| Screw torque                                                | Mounting (*3)                                                               | -               | M5                            | 3.5                     | N m                  |   |

Note \*1: All terminals should be connected together during the test.

Note \*2: Two thermistor terminals should be connected together, other terminals should be connected together and shorted to base plate during the test.

Note \*3: Recommendable value : 2.5-3.5 Nm (M5)

● Electrical characteristics (at Tj= 25°C unless otherwise specified)

| Items                 | Symbols                              | Conditions                           | Characteristics                        |          |      | Units |      |   |
|-----------------------|--------------------------------------|--------------------------------------|----------------------------------------|----------|------|-------|------|---|
|                       |                                      |                                      | min.                                   | typ.     | max. |       |      |   |
| Inverter              | Zero gate voltage collector current  | $I_{CES}$                            | $V_{GE} = 0V, V_{CE} = 1200V$          | -        | -    | 1.0   | mA   |   |
|                       | Gate-Emitter leakage current         | $I_{GES}$                            | $V_{GE} = 0V, V_{CE} = \pm 20V$        | -        | -    | 200   | nA   |   |
|                       | Gate-Emitter threshold voltage       | $V_{GE(th)}$                         | $V_{CE} = 20V, I_c = 50mA$             | 6.0      | 6.5  | 7.0   | V    |   |
|                       | Collector-Emitter saturation voltage | $V_{CE(sat)}$<br>(terminal)          | $V_{GE} = 15V$<br>$I_c = 50A$          | Tj=25°C  | -    | 2.15  | 2.60 | V |
|                       |                                      |                                      |                                        | Tj=125°C | -    | 2.50  | -    |   |
|                       |                                      |                                      |                                        | Tj=150°C | -    | 2.55  | -    |   |
|                       |                                      | $V_{CE(sat)}$<br>(chip)              | $V_{GE} = 15V$<br>$I_c = 50A$          | Tj=25°C  | -    | 1.85  | 2.30 |   |
|                       |                                      |                                      |                                        | Tj=125°C | -    | 2.20  | -    |   |
|                       | Tj=150°C                             | -                                    | 2.25                                   | -        |      |       |      |   |
|                       | Internal gate resistance             | $R_{g(int)}$                         | -                                      | -        | 4    | -     | Ω    |   |
|                       | Input capacitance                    | $C_{ies}$                            | $V_{CE} = 10V, V_{GE} = 0V, f = 1MHz$  | -        | 4.2  | -     | nF   |   |
|                       | Turn-on time                         | $t_{on}$                             | $V_{CC} = 600V$<br>$I_c = 50A$         | -        | 0.39 | 1.20  | μs   |   |
|                       |                                      | $t_r$                                |                                        | -        | 0.09 | 0.60  |      |   |
|                       |                                      | $t_r(i)$                             |                                        | -        | 0.03 | -     |      |   |
|                       | Turn-off time                        | $t_{off}$                            | $V_{GE} = +15 / -15V$<br>$R_G = 15Ω$   | -        | 0.53 | 1.00  | μs   |   |
| $t_f$                 |                                      | -                                    |                                        | 0.06     | 0.30 |       |      |   |
| Forward on voltage    | $V_F$<br>(terminal)                  | $I_F = 50A$                          | Tj=25°C                                | -        | 2.00 | 2.45  | V    |   |
|                       |                                      |                                      | Tj=125°C                               | -        | 2.15 | -     |      |   |
|                       |                                      |                                      | Tj=150°C                               | -        | 2.10 | -     |      |   |
|                       | $V_F$<br>(chip)                      | $I_F = 50A$                          | Tj=25°C                                | -        | 1.70 | 2.15  |      |   |
|                       |                                      |                                      | Tj=125°C                               | -        | 1.85 | -     |      |   |
| Tj=150°C              | -                                    | 1.80                                 | -                                      |          |      |       |      |   |
| Reverse recovery time | $t_{rr}$                             | $I_F = 50A$                          | -                                      | -        | 0.35 | μs    |      |   |
| Brake                 | Zero gate voltage collector current  | $I_{CES}$                            | $V_{GE} = 0V$<br>$V_{CE} = 1200V$      | -        | -    | 1.0   | mA   |   |
|                       | Gate-Emitter leakage current         | $I_{GES}$                            | $V_{CE} = 0V$<br>$V_{GE} = +20 / -20V$ | -        | -    | 200   | nA   |   |
|                       | Collector-Emitter saturation voltage | $V_{CE(sat)}$<br>(terminal)          | $V_{GE} = 15V$<br>$I_c = 35A$          | Tj=25°C  | -    | 2.10  | 2.55 | V |
|                       |                                      |                                      |                                        | Tj=125°C | -    | 2.45  | -    |   |
|                       |                                      |                                      |                                        | Tj=150°C | -    | 2.50  | -    |   |
|                       |                                      | $V_{CE(sat)}$<br>(chip)              | $V_{GE} = 15V$<br>$I_c = 35A$          | Tj=25°C  | -    | 1.85  | 2.30 |   |
|                       |                                      |                                      |                                        | Tj=125°C | -    | 2.20  | -    |   |
|                       | Tj=150°C                             | -                                    | 2.25                                   | -        |      |       |      |   |
|                       | Internal gate resistance             | $R_{g(int)}$                         | -                                      | -        | 0    | -     | Ω    |   |
|                       | Turn-on time                         | $t_{on}$                             | $V_{CE} = 600V$<br>$I_c = 35A$         | -        | 0.39 | 1.20  | μs   |   |
| $t_r$                 |                                      | -                                    |                                        | 0.09     | 0.60 |       |      |   |
| Turn-off time         | $t_{off}$                            | $V_{GE} = +15 / -15V$<br>$R_G = 27Ω$ | -                                      | 0.53     | 1.00 | μs    |      |   |
|                       | $t_f$                                |                                      | -                                      | 0.06     | 0.30 |       |      |   |
| Reverse current       | $I_{RRM}$                            | $V_R = 1200V$                        | -                                      | -        | 1.00 | mA    |      |   |
| Converter             | Forward on voltage                   | $V_{FM}$<br>(chip)                   | terminal                               | -        | 1.65 | 2.10  | V    |   |
|                       |                                      |                                      | chip                                   | -        | 1.35 | -     |      |   |
| Reverse current       | $I_{RRM}$                            | $V_R = 1600V$                        | -                                      | -        | 1.0  | mA    |      |   |
| Thermistor            | Resistance                           | R                                    | T = 25°C                               | -        | 5000 | -     | Ω    |   |
|                       |                                      |                                      | T = 100°C                              | 465      | 495  | 520   |      |   |
| B value               | B                                    | T = 25 / 50°C                        | 3305                                   | 3375     | 3450 | K     |      |   |

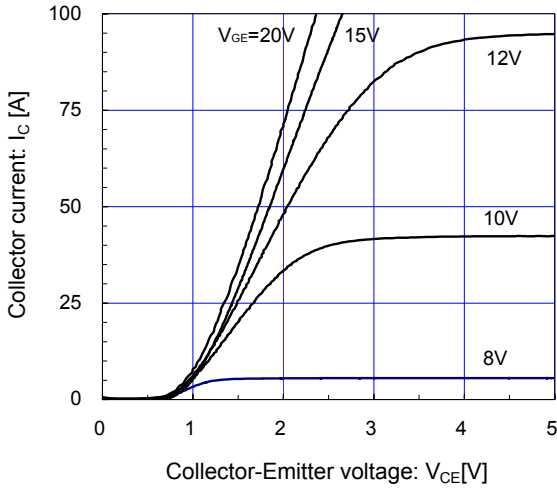
● Thermal resistance characteristics

| Items                                     | Symbols       | Conditions            | Characteristics |      |      | Units |
|-------------------------------------------|---------------|-----------------------|-----------------|------|------|-------|
|                                           |               |                       | min.            | typ. | max. |       |
| Thermal resistance (1device)              | $R_{th(j-c)}$ | Inverter IGBT         | -               | -    | 0.54 | °C/W  |
|                                           |               | Inverter FWD          | -               | -    | 0.73 |       |
|                                           |               | Brake IGBT            | -               | -    | 0.72 |       |
|                                           |               | Converter Diode       | -               | -    | 0.54 |       |
| Contact thermal resistance (1device) (*4) | $R_{th(c-f)}$ | with Thermal Compound | -               | 0.05 | -    |       |

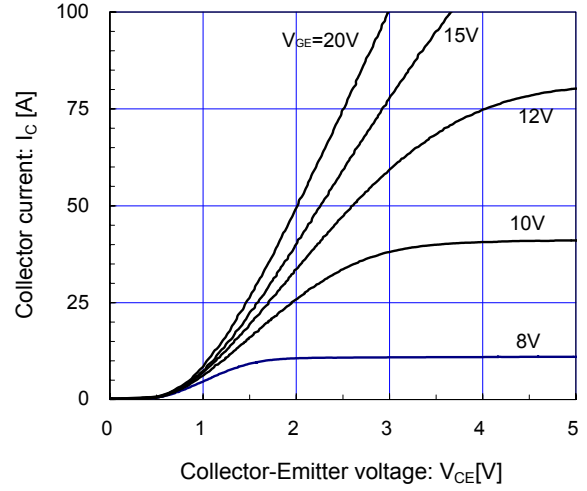
Note \*4: This is the value which is defined mounting on the additional cooling fin with thermal compound.

■ Characteristics (Representative)

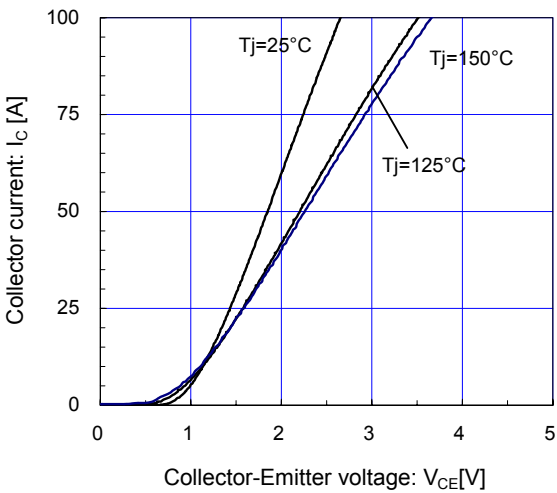
[ Inverter ]  
Collector current vs. Collector-Emittor voltage (typ.)  
T<sub>j</sub> = 25°C / chip



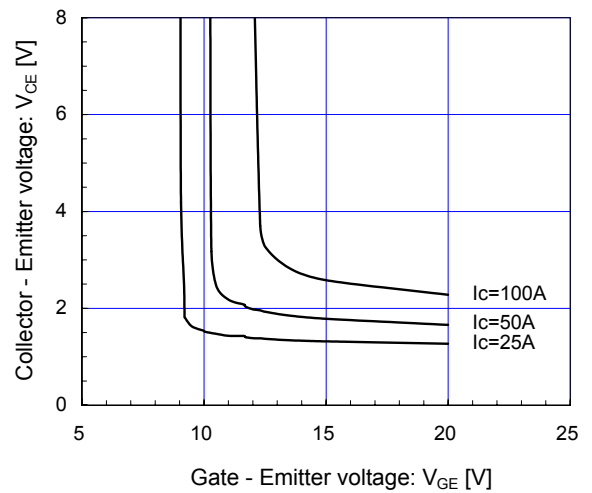
[ Inverter ]  
Collector current vs. Collector-Emittor voltage (typ.)  
T<sub>j</sub> = 150°C / chip



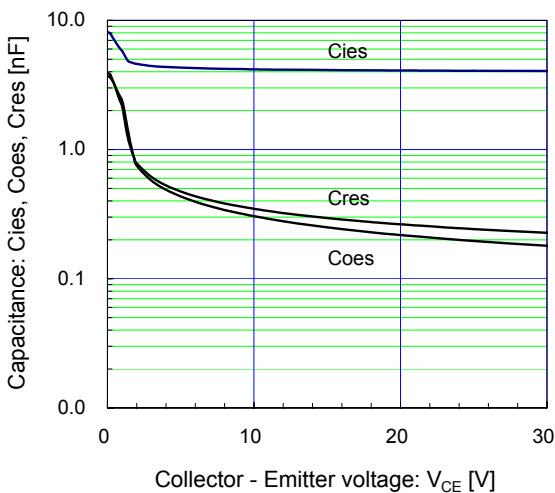
[ Inverter ]  
Collector current vs. Collector-Emittor voltage (typ.)  
V<sub>GE</sub> = 15V / chip



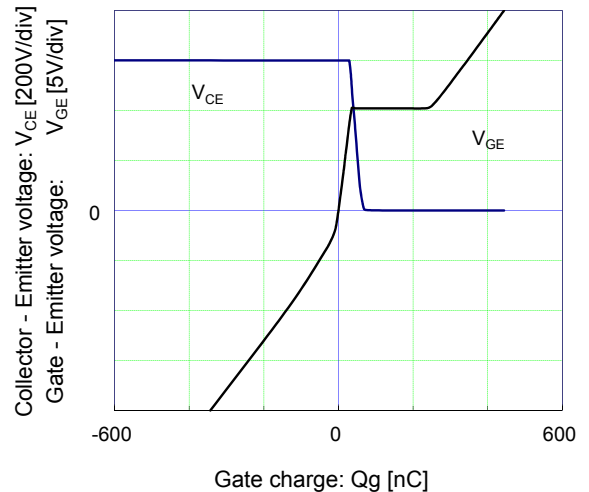
[ Inverter ]  
Collector-Emittor voltage vs. Gate-Emittor voltage (typ.)  
T<sub>j</sub> = 25°C / chip



[ Inverter ]  
Capacitance vs. Collector-Emittor voltage (typ.)  
V<sub>GE</sub> = 0V, f = 1MHz, T<sub>j</sub> = 25°C

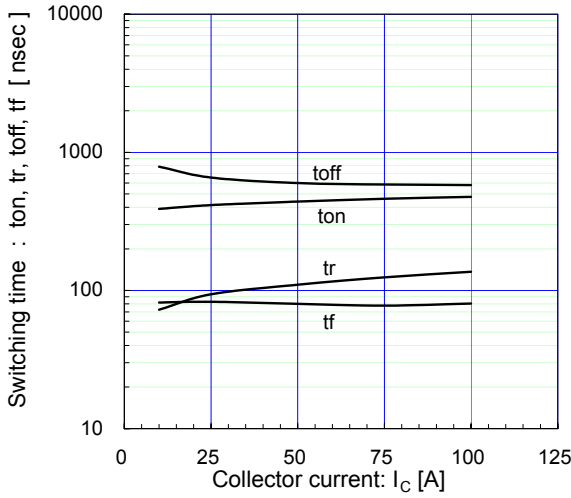


[ Inverter ]  
Dynamic gate charge (typ.)  
V<sub>CC</sub> = 600V, Ic = 50A, T<sub>j</sub> = 25°C



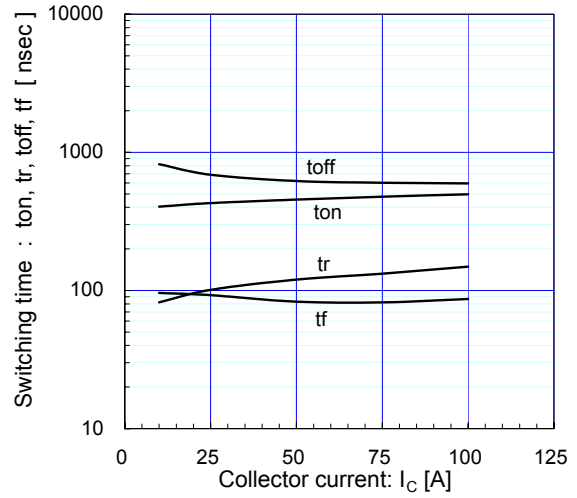
[ Inverter ]

Switching time vs. Collector current (typ.)  
 $V_{CC}=600V, V_{GE}=\pm 15V, R_G=15\Omega, T_j=125^\circ C$



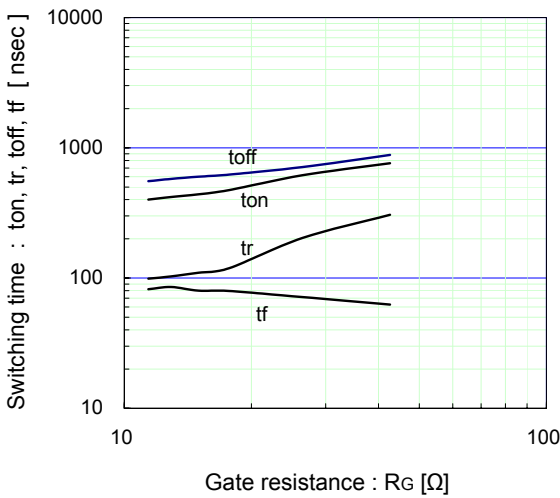
[ Inverter ]

Switching time vs. Collector current (typ.)  
 $V_{CC}=600V, V_{GE}=\pm 15V, R_G=15\Omega, T_j=150^\circ C$



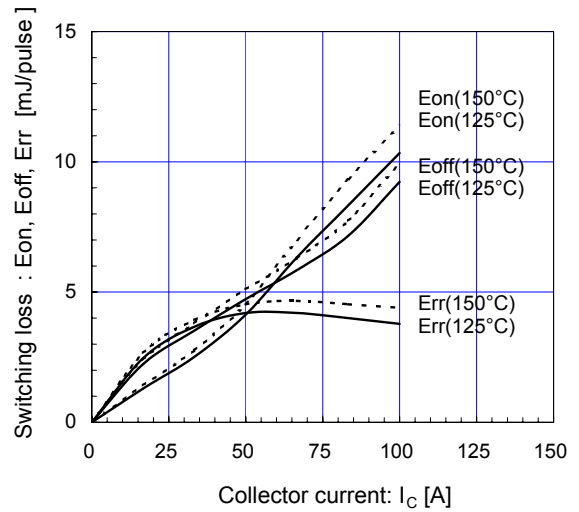
[ Inverter ]

Switching time vs. gate resistance (typ.)  
 $V_{CC}=600V, I_C=50A, V_{GE}=\pm 15V, T_j=125^\circ C$



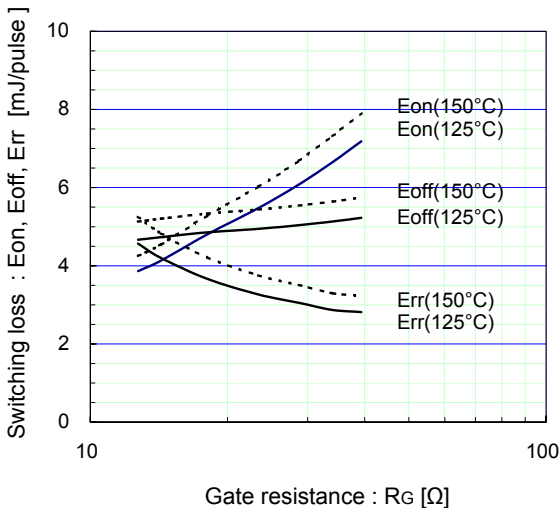
[ Inverter ]

Switching loss vs. Collector current (typ.)  
 $V_{CC}=600V, V_{GE}=\pm 15V, R_G=15\Omega$



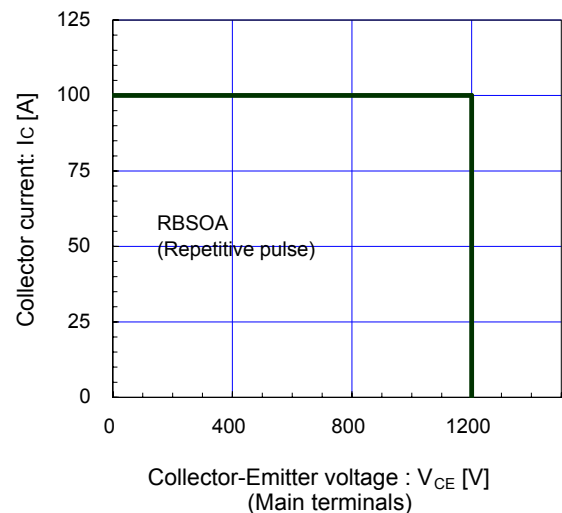
[ Inverter ]

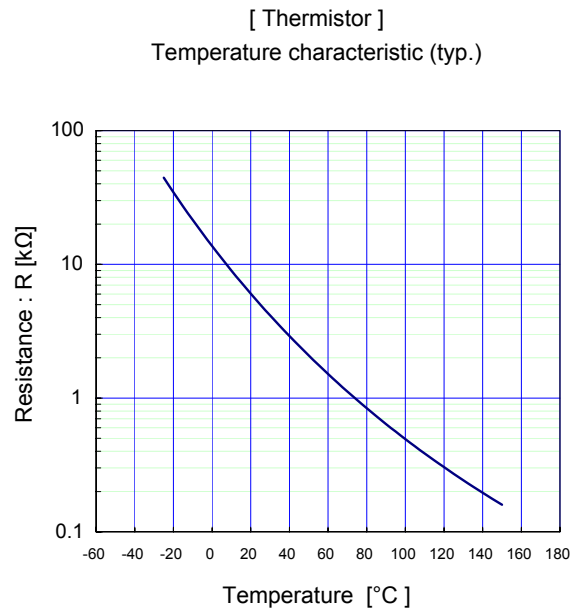
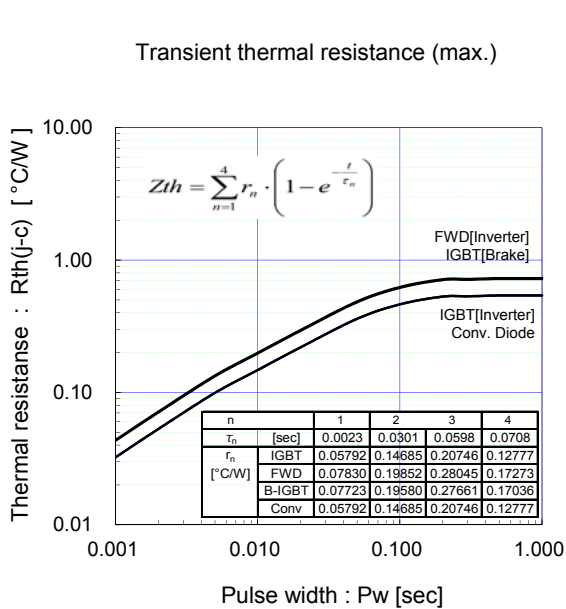
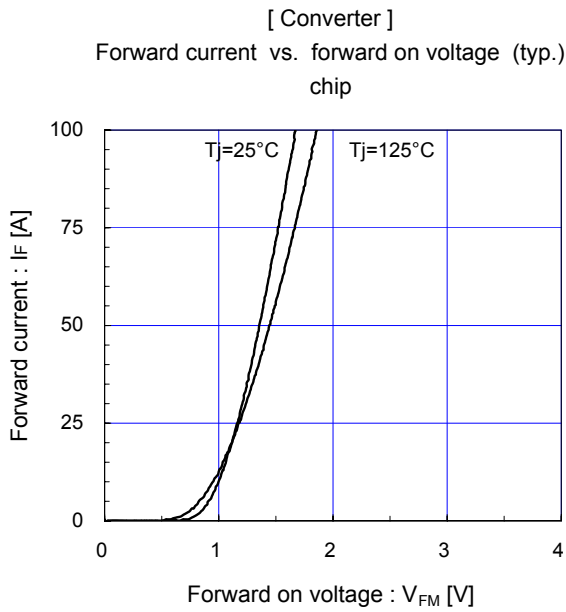
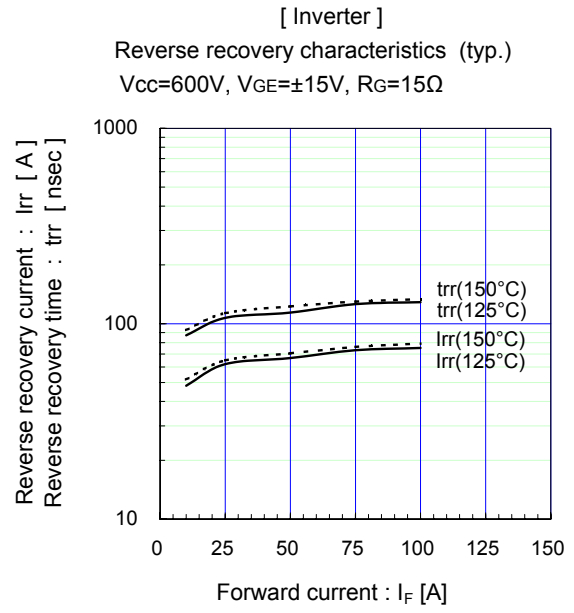
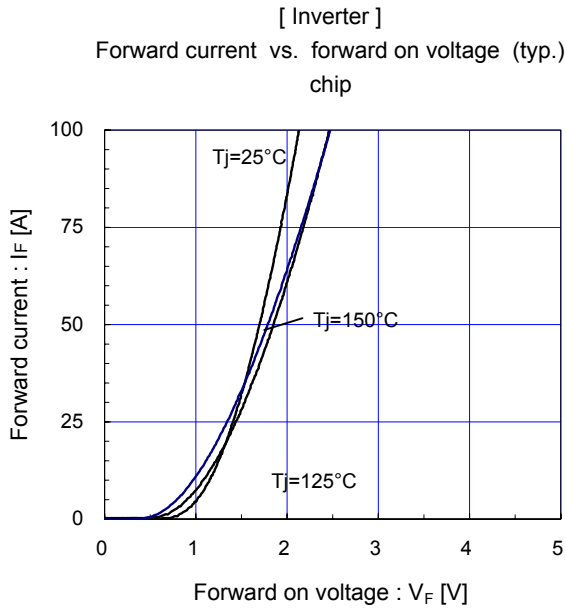
Switching loss vs. gate resistance (typ.)  
 $V_{CC}=600V, I_C=50A, V_{GE}=\pm 15V$

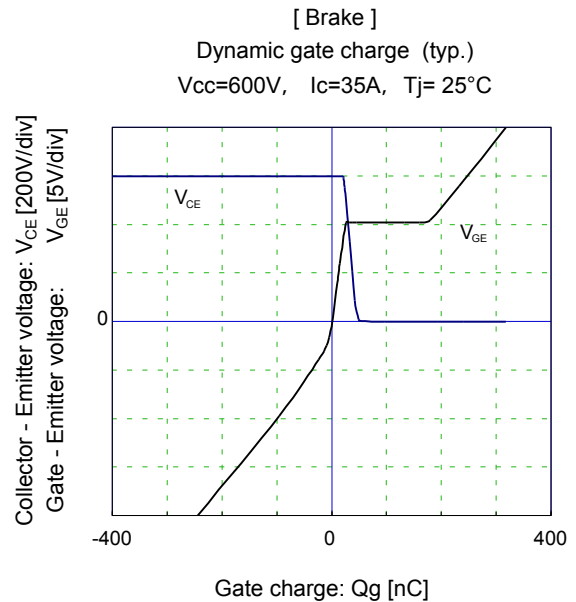
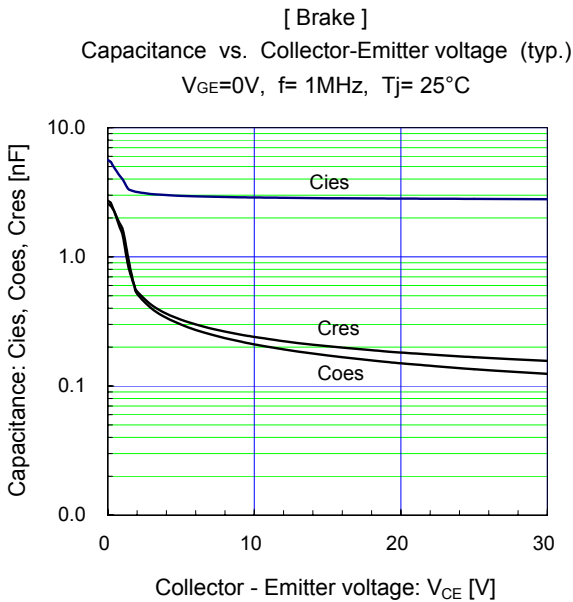
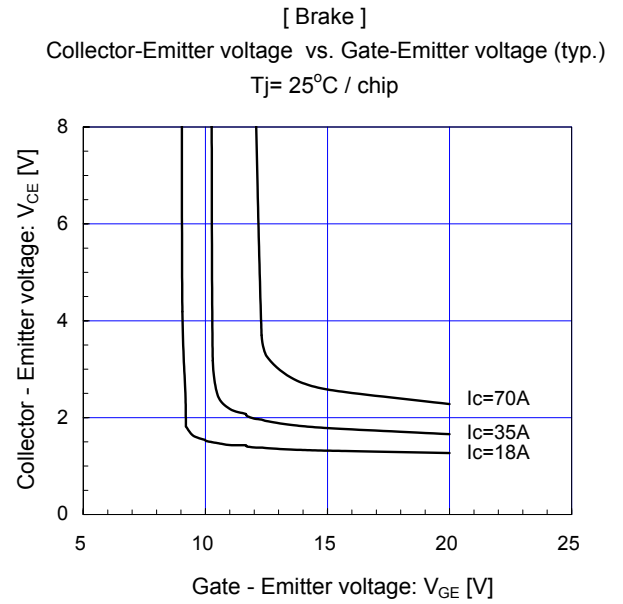
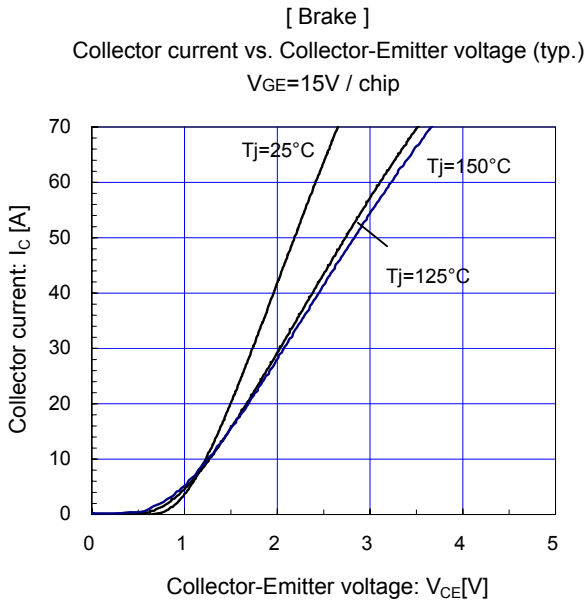
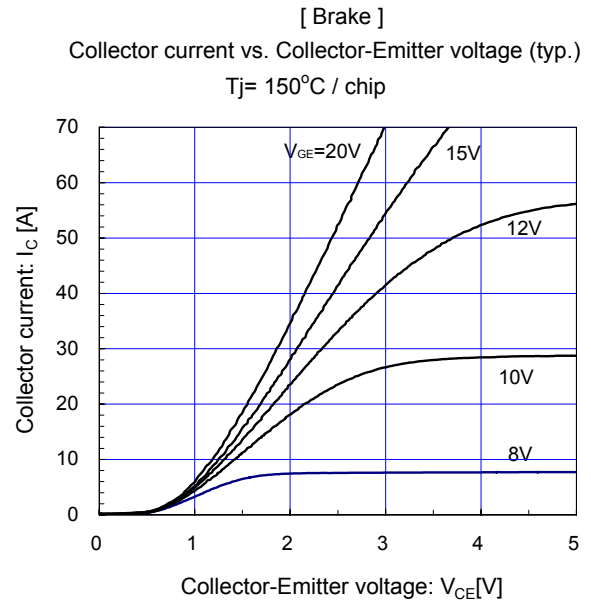
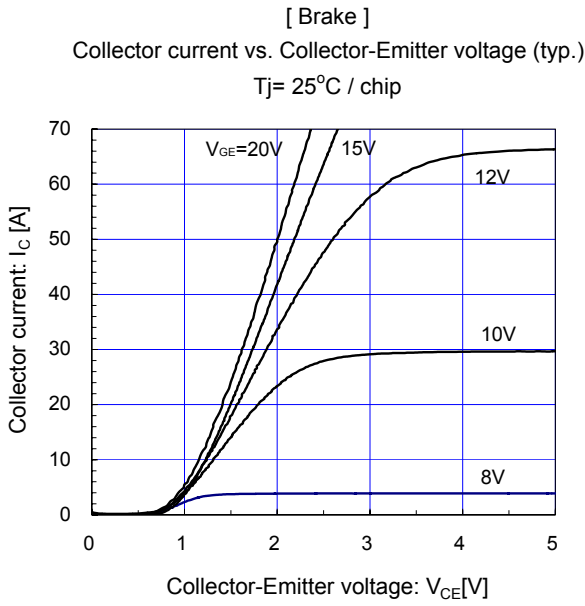


[ Inverter ]

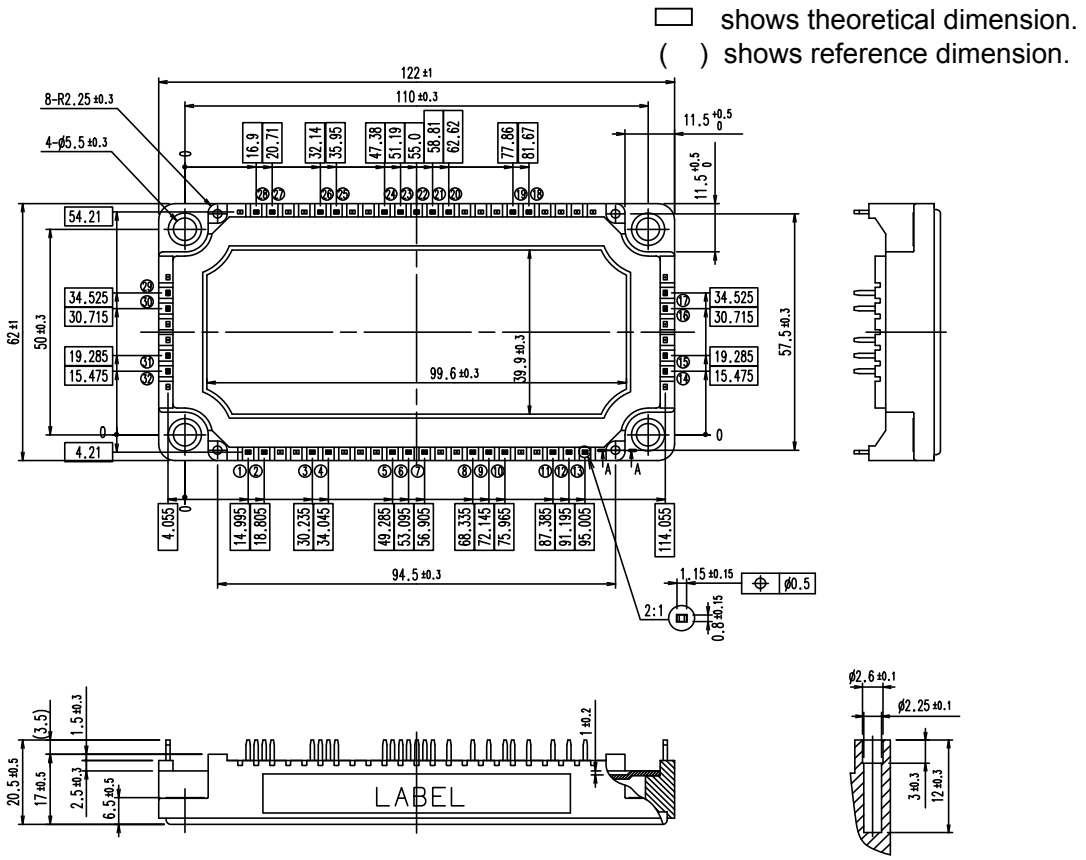
Reverse bias safe operating area (max.)  
 $+V_{GE}=15V, -V_{GE} \leq 15V, R_G \geq 15\Omega, T_j=150^\circ C$







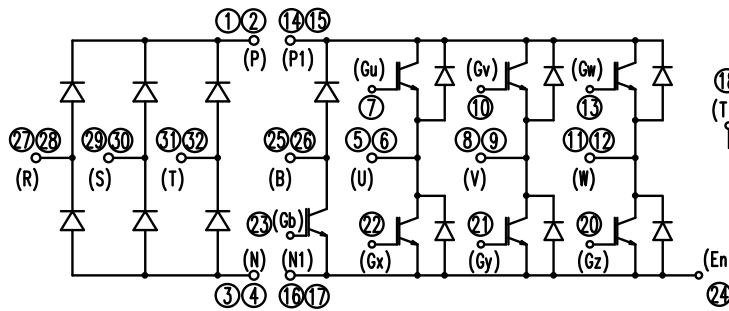
■ Outline Drawings (Unit: mm)



Section A-A  
Weight: 310g (typ.)

■ Equivalent Circuit

[ Converter ]      [ Brake ]      [ Inverter ]      [ Thermistor ]



**WARNING**

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  - Machine tools                      • Audiovisual equipment                      • Electrical home appliances                      • Personal equipment                      • Industrial robots etc.
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  - Medical equipment
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  - Submarine repeater equipment
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