

# 6MBI225V-120-50

**IGBT Modules**

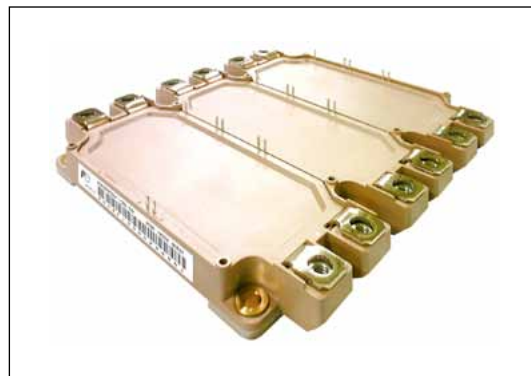
## IGBT MODULE (V series) 1200V / 225A / 6 in one package

### ■ Features

- Compact Package
- P.C.Board Mount
- Low  $V_{CE(sat)}$
- RoHS Compliant product

### ■ Applications

- Inverter for Motor Drive
- AC and DC Servo Drive Amplifier
- Uninterruptible Power Supply
- Industrial machines, such as welding machines



### ■ 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 | $T_c=25^\circ\text{C}$  | 300             | A                |
|                                                    |                                       | $I_{cp}$        |            | $T_c=100^\circ\text{C}$ | 225             |                  |
|                                                    |                                       | $I_{c\ pulse}$  | 1ms        |                         | 450             |                  |
|                                                    |                                       | $-I_c$          |            |                         | 225             |                  |
|                                                    |                                       | $-I_{c\ pulse}$ | 1ms        |                         | 450             |                  |
|                                                    | Collector power dissipation           | $P_c$           | 1 device   |                         | 1070            | W                |
| Junction temperature                               |                                       | $T_j$           |            |                         | 175             | $^\circ\text{C}$ |
| Operation temperature (under switching conditions) |                                       | $T_{jop}$       |            |                         | 150             |                  |
| Case temperature                                   |                                       | $T_c$           |            |                         | 125             |                  |
| Storage temperature                                |                                       | $T_{stg}$       |            |                         | -40 to +125     |                  |
| Isolation voltage                                  | between terminal and copper base (*1) | $V_{iso}$       | AC : 1min. |                         | 2500            | VAC              |
|                                                    | between thermistor and others (*2)    |                 |            |                         |                 |                  |
| Screw torque                                       | Mounting (*3)                         | -               |            |                         | 3.5             | N m              |
|                                                    | Terminals (*4)                        | -               |            |                         | 4.5             |                  |

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)

Note \*4: Recommendable value : 3.5-4.5 Nm (M6)

● Electrical characteristics (at T<sub>j</sub> = 25°C unless otherwise specified)

| Items                 |                                      | Symbols                                       | Conditions                                                                                                    |                       | Characteristics |      |      | Units |
|-----------------------|--------------------------------------|-----------------------------------------------|---------------------------------------------------------------------------------------------------------------|-----------------------|-----------------|------|------|-------|
|                       |                                      |                                               |                                                                                                               |                       | min.            | typ. | max. |       |
| Inverter              | Zero gate voltage collector current  | I <sub>CES</sub>                              | V <sub>GE</sub> = 0V, V <sub>CE</sub> = 1200V                                                                 |                       | -               | -    | 3.0  | mA    |
|                       | Gate-Emitter leakage current         | I <sub>GES</sub>                              | V <sub>GE</sub> = 0V, V <sub>GE</sub> = ±20V                                                                  |                       | -               | -    | 600  | nA    |
|                       | Gate-Emitter threshold voltage       | V <sub>GE (th)</sub>                          | V <sub>CE</sub> = 20V, I <sub>C</sub> = 225mA                                                                 |                       | 6.0             | 6.5  | 7.0  | V     |
|                       | Collector-Emitter saturation voltage | V <sub>CE (sat)</sub><br>(terminal)           | V <sub>GE</sub> = 15V<br>I <sub>C</sub> = 225A                                                                | T <sub>J</sub> =25°C  | -               | 2.20 | 2.65 | V     |
|                       |                                      |                                               |                                                                                                               | T <sub>J</sub> =125°C | -               | 2.55 | -    |       |
|                       |                                      |                                               |                                                                                                               | T <sub>J</sub> =150°C | -               | 2.60 | -    |       |
|                       |                                      | V <sub>CE (sat)</sub><br>(chip)               | V <sub>GE</sub> = 15V<br>I <sub>C</sub> = 225A                                                                | T <sub>J</sub> =25°C  | -               | 1.85 | 2.30 |       |
|                       |                                      |                                               |                                                                                                               | T <sub>J</sub> =125°C | -               | 2.20 | -    |       |
|                       |                                      |                                               |                                                                                                               | T <sub>J</sub> =150°C | -               | 2.25 | -    |       |
|                       | Internal gate resistance             | R <sub>G(int)</sub>                           | -                                                                                                             |                       | -               | 3.33 | -    | Ω     |
|                       | Input capacitance                    | C <sub>ies</sub>                              | V <sub>CE</sub> = 10V, V <sub>GE</sub> = 0V, f = 1MHz                                                         |                       | -               | 18   | -    | nF    |
|                       | Turn-on time                         | t <sub>on</sub>                               | V <sub>CC</sub> = 600V<br>I <sub>C</sub> = 225A<br>V <sub>GE</sub> = ±15V<br>R <sub>G</sub> = 1.6Ω<br>LS=80nH |                       | -               | 550  | -    | nsec  |
|                       |                                      | t <sub>r</sub>                                |                                                                                                               |                       | -               | 180  | -    |       |
|                       |                                      | t <sub>r (i)</sub>                            |                                                                                                               |                       | -               | 120  | -    |       |
|                       |                                      | Turn-off time                                 | t <sub>off</sub>                                                                                              | -                     | 1050            | -    |      |       |
|                       |                                      |                                               | t <sub>f</sub>                                                                                                | -                     | 110             | -    |      |       |
| Forward on voltage    |                                      | V <sub>F</sub><br>(terminal)                  | V <sub>GE</sub> = 0V<br>I <sub>F</sub> = 225A                                                                 | T <sub>J</sub> =25°C  | -               | 2.05 | 2.50 |       |
|                       | T <sub>J</sub> =125°C                |                                               |                                                                                                               | -                     | 2.20            | -    |      |       |
|                       | T <sub>J</sub> =150°C                |                                               |                                                                                                               | -                     | 2.15            | -    |      |       |
|                       | V <sub>F</sub><br>(chip)             | V <sub>GE</sub> = 0V<br>I <sub>F</sub> = 225A | T <sub>J</sub> =25°C                                                                                          | -                     | 1.70            | 2.15 |      |       |
|                       |                                      |                                               | T <sub>J</sub> =125°C                                                                                         | -                     | 1.85            | -    |      |       |
|                       |                                      |                                               | T <sub>J</sub> =150°C                                                                                         | -                     | 1.80            | -    |      |       |
| Reverse recovery time | t <sub>rr</sub>                      | I <sub>F</sub> = 225A                         |                                                                                                               | -                     | 200             | -    | nsec |       |
| 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

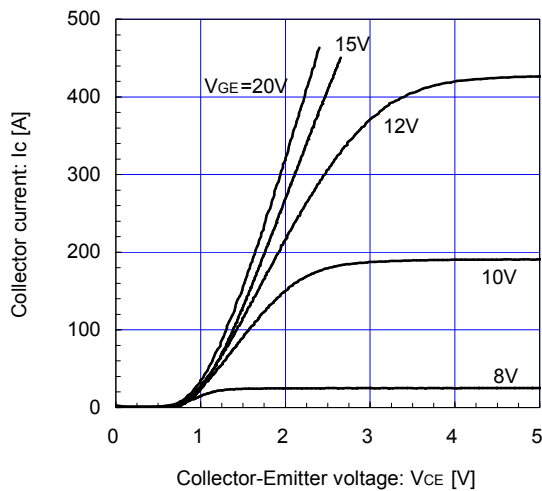
| Items                                            | Symbols              | Conditions            | Characteristics |        |       | Units |
|--------------------------------------------------|----------------------|-----------------------|-----------------|--------|-------|-------|
|                                                  |                      |                       | min.            | typ.   | max.  |       |
| <b>Thermal resistance (1device)</b>              | R <sub>th(j-c)</sub> | Inverter IGBT         | -               | -      | 0.140 | °C/W  |
|                                                  |                      | Inverter FWD          | -               | -      | 0.190 |       |
| <b>Contact thermal resistance (1device) (*5)</b> | R <sub>th(c-f)</sub> | with Thermal Compound | -               | 0.0167 | -     |       |

Note \*5: This is the value which is defined mounting on the additional cooling fin with thermal compound.

## ■ Characteristics (Representative)

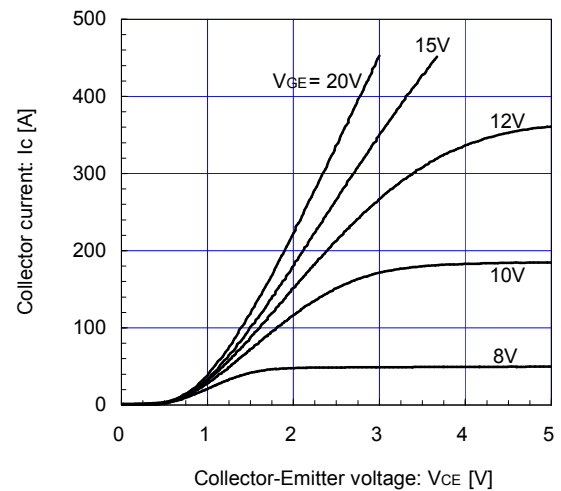
[INVERTER]

Collector current vs. Collector-Emitter voltage (typ.)  
 $T_j = 25^\circ\text{C}$  / chip



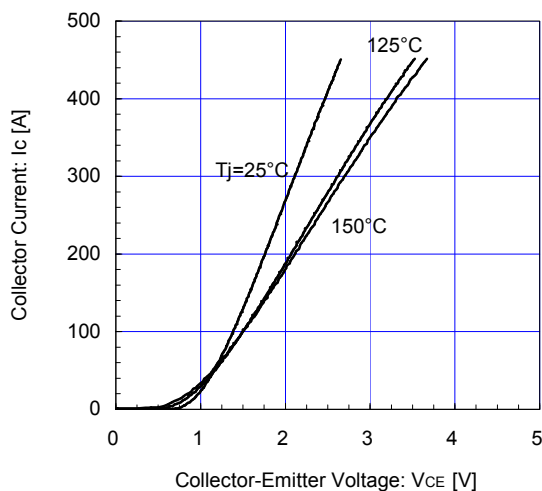
[INVERTER]

Collector current vs. Collector-Emitter voltage (typ.)  
 $T_j = 150^\circ\text{C}$  / chip



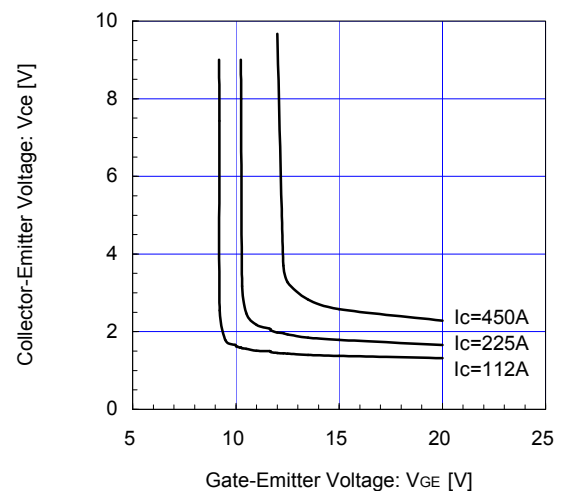
[INVERTER]

Collector current vs. Collector-Emitter voltage (typ.)  
 $V_{GE} = 15\text{V}$  / chip



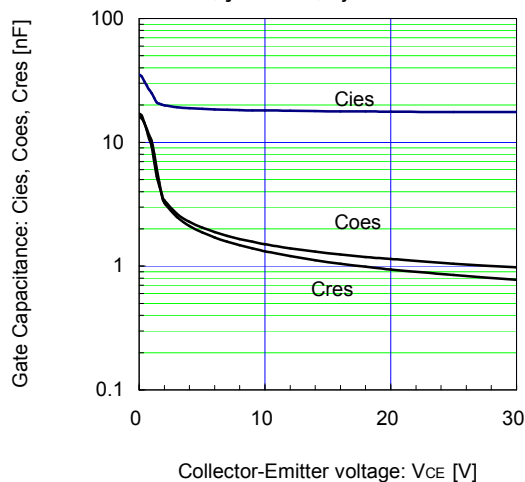
[INVERTER]

Collector-Emitter voltage vs. Gate-Emitter voltage (typ.)  
 $T_j = 25^\circ\text{C}$  / chip



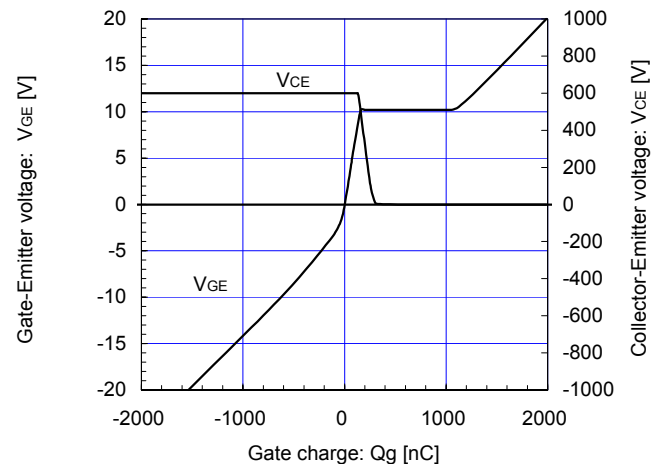
[INVERTER]

Gate Capacitance vs. Collector-Emitter Voltage (typ.)  
 $V_{GE} = 0\text{V}$ ,  $f = 1\text{MHz}$ ,  $T_j = 25^\circ\text{C}$



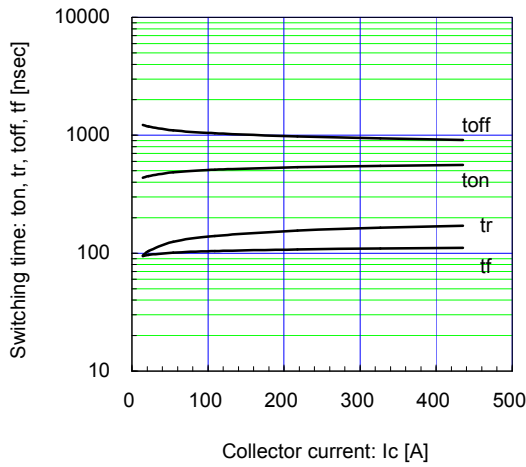
[INVERTER]

Dynamic Gate Charge (typ.)  
 $V_{CC} = 600\text{V}$ ,  $I_c = 225\text{A}$ ,  $T_j = 25^\circ\text{C}$



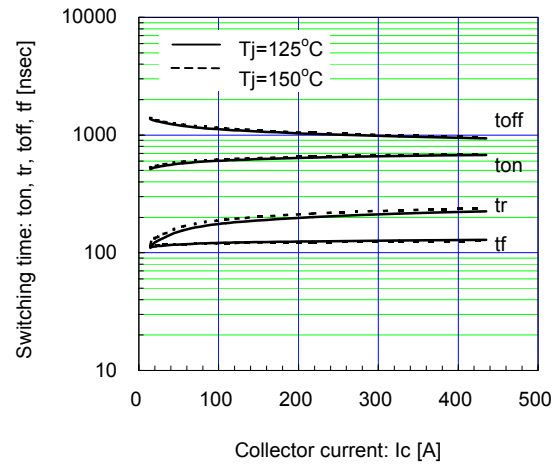
[INVERTER]

Switching time vs. Collector current (typ.)  
 $V_{CC}=600V$ ,  $V_{GE}=\pm 15V$ ,  $R_g=1.6\Omega$ ,  $T_j=25^\circ C$



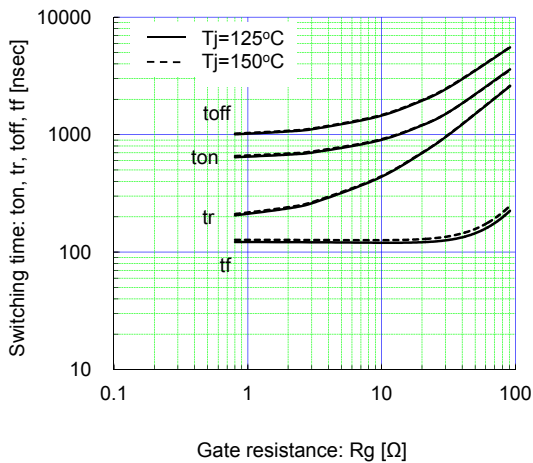
[INVERTER]

Switching time vs. Collector current (typ.)  
 $V_{CC}=600V$ ,  $V_{GE}=\pm 15V$ ,  $R_g=1.6\Omega$ ,  $T_j=125^\circ C, 150^\circ C$



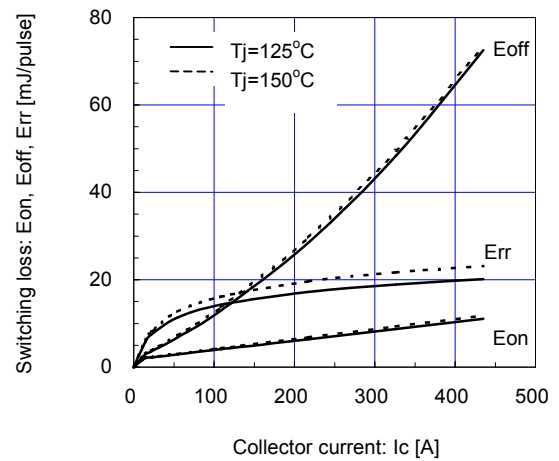
[INVERTER]

Switching time vs. Gate resistance (typ.)  
 $V_{CC}=600V$ ,  $I_c=225A$ ,  $V_{GE}=\pm 15V$ ,  $T_j=125^\circ C, 150^\circ C$



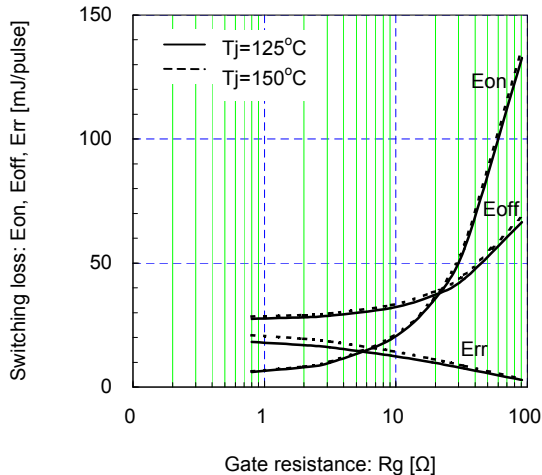
[INVERTER]

Switching loss vs. Collector current (typ.)  
 $V_{CC}=600V$ ,  $V_{GE}=\pm 15V$ ,  $R_g=1.6\Omega$ ,  $T_j=125^\circ C, 150^\circ C$



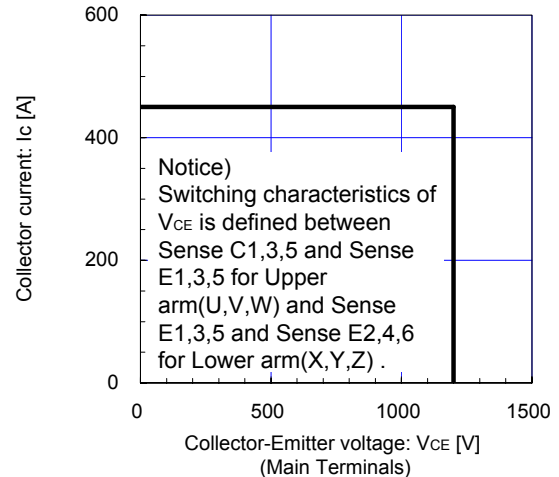
[INVERTER]

Switching loss vs. Gate resistance (typ.)  
 $V_{CC}=600V$ ,  $I_c=225A$ ,  $V_{GE}=\pm 15V$ ,  $T_j=125^\circ C, 150^\circ C$



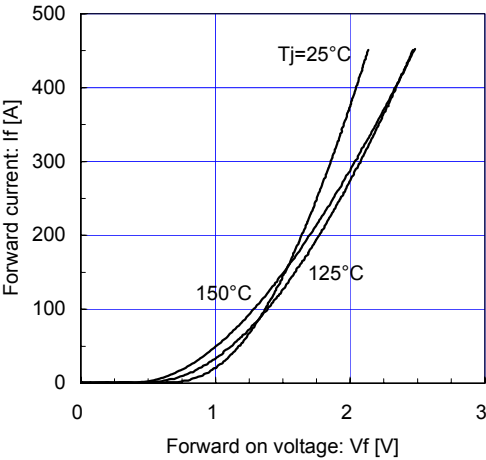
[INVERTER]

Reverse bias safe operating area (max.)  
 $+V_{GE}=15V$ ,  $-V_{GE}\leq 15V$ ,  $R_g\geq 1.6\Omega$ ,  $T_j=150^\circ C$



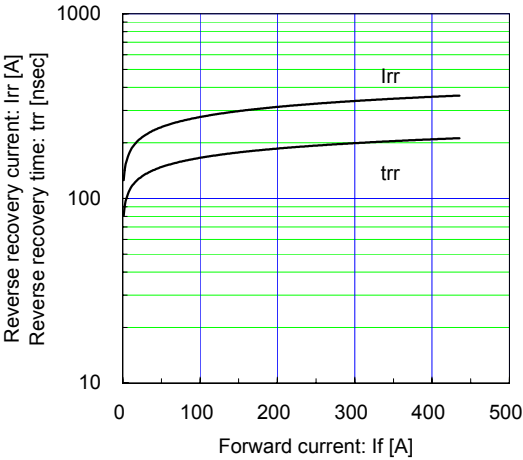
[INVERTER]

Forward Current vs. Forward Voltage (typ.)  
chip



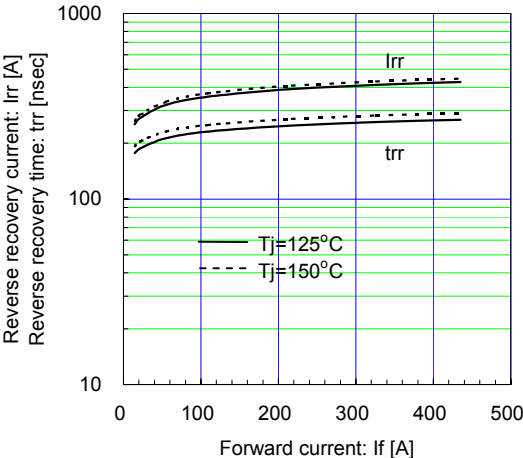
[INVERTER]

Reverse Recovery Characteristics (typ.)  
Vcc=600V, VGE=±15V, Rg=1.6 Ω, Tj=25°C

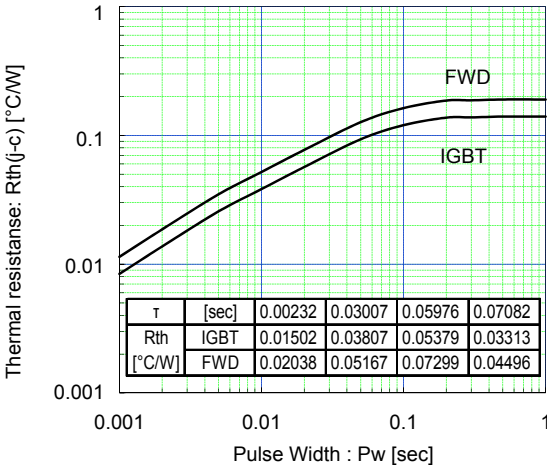


[INVERTER]

Reverse Recovery Characteristics (typ.)  
Vcc=600V, VGE=±15V, Rg=1.6 Ω, Tj=125°C, 150°C

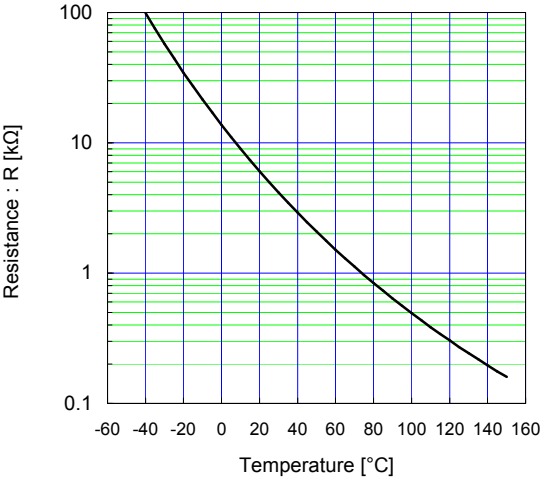


Transient Thermal Resistance (max.)

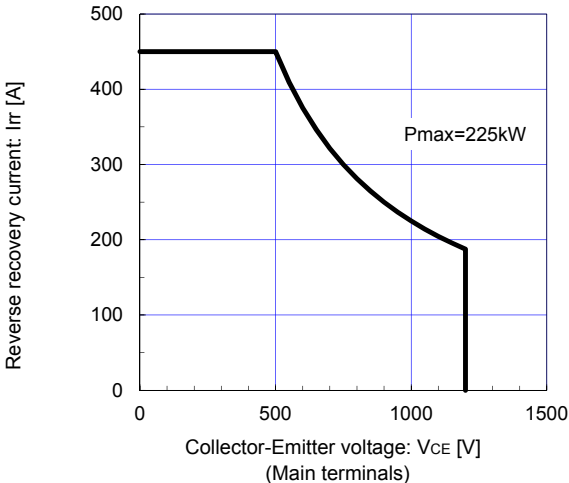


[THERMISTOR]

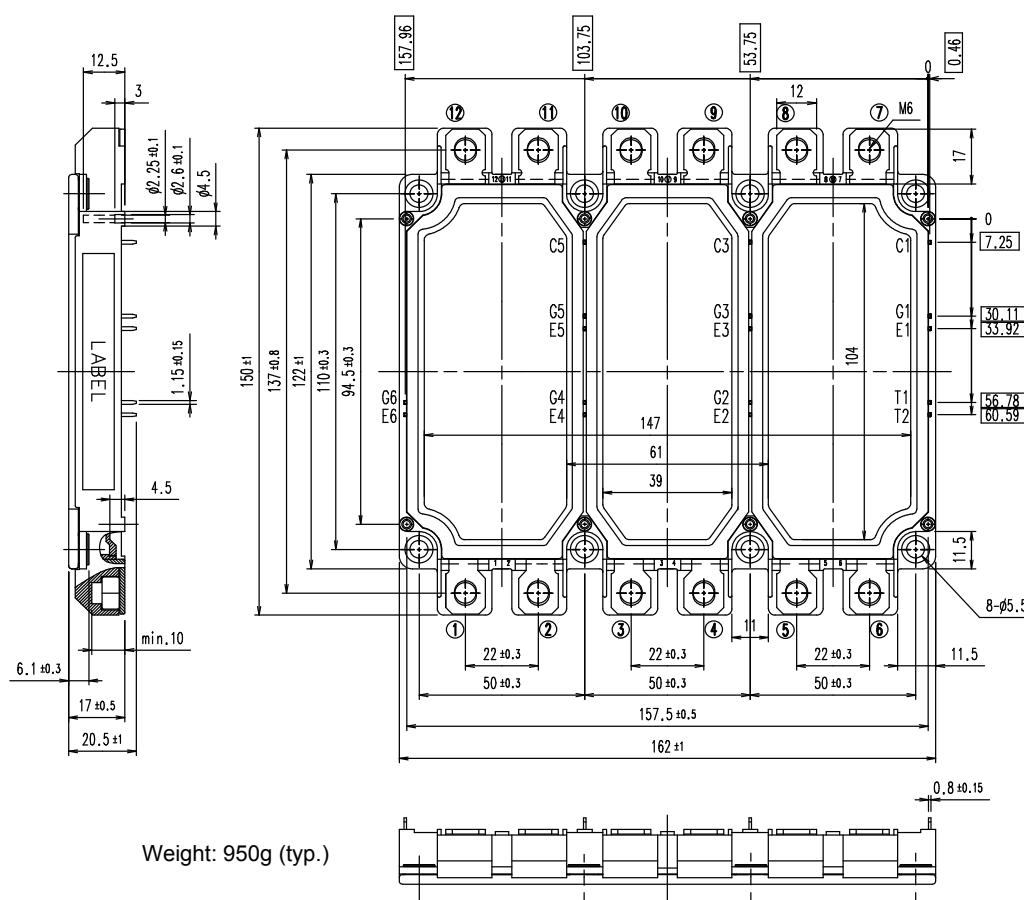
Temperature characteristic (typ.)



FWD safe operating area (max.)  
Tj=150°C

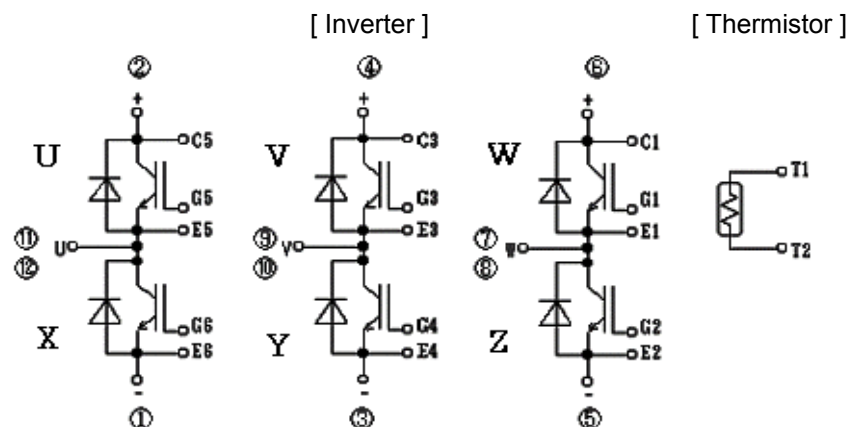


### ■ Outline Drawings(Unit:mm)

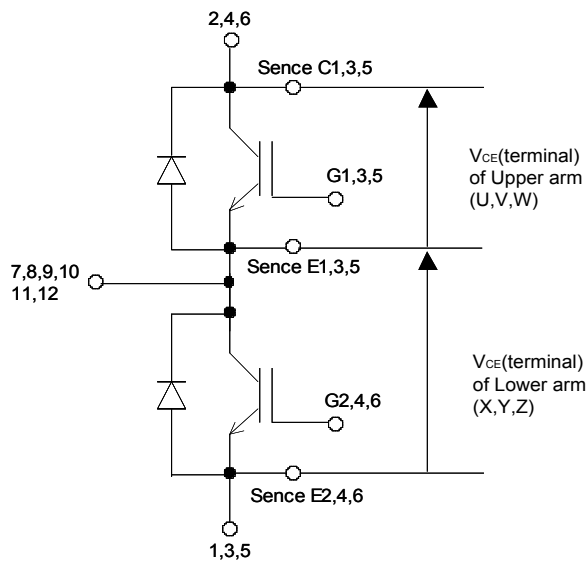


NOTE)  $\boxed{\phantom{00}}$  shows theoretical dimension and tolerance is  $\boxed{\oplus} \boxed{\emptyset 0.5}$ .

### ■ Equivalent Circuit



## ■ Definition of switching characteristics



Switching characteristics of  $V_{CE}$  is defined between Sense C1,3,5 and Sense E1,3,5 for Upper arm(U,V,W) and Sense E1,3,5 and Sense E2,4,6 for Lower arm(X,Y,Z) .

Please use these terminals whenever measure spike voltage.

## WARNING

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|                 |                         |                                               |                          |
|-----------------|-------------------------|-----------------------------------------------|--------------------------|
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| • Machine tools | • Audiovisual equipment | • Electrical home appliances                  | • Personal equipment     |
|                 |                         |                                               | • Industrial robots etc. |
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|                                                                             |                                                       |
|-----------------------------------------------------------------------------|-------------------------------------------------------|
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| • Traffic-signal control equipment                                          | • Gas leakage detectors with an auto-shut-off feature |
| • Emergency equipment for responding to disasters and anti-burglary devices | • Safety devices                                      |
| • Medical equipment                                                         |                                                       |
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|                                |                        |                             |
|--------------------------------|------------------------|-----------------------------|
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| • Submarine repeater equipment |                        |                             |
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