

# 6MBP200VEA060-50

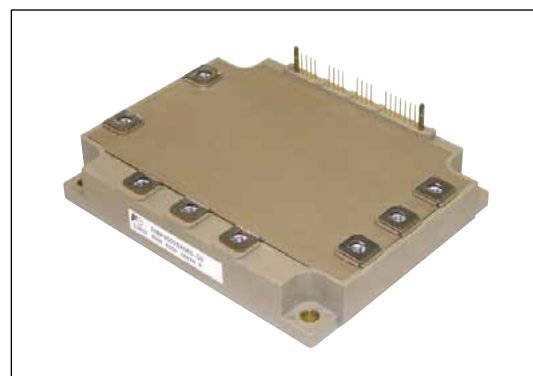
IGBT Modules

## IGBT MODULE (V series)

**600V / 200A / IPM**

### ■ 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 ( $T_c=25^{\circ}\text{C}$ , $V_{cc}=15\text{V}$ unless otherwise specified)

| Items                             |                             |                 | Symbol           | Min. | Max.                 | Units |
|-----------------------------------|-----------------------------|-----------------|------------------|------|----------------------|-------|
| Collector-Emitter Voltage (*1)    |                             |                 | V <sub>CES</sub> | 0    | 600                  | V     |
| Short Circuit Voltage             |                             |                 | V <sub>SC</sub>  | 200  | 400                  | V     |
| Inverter                          | Collector Current           | DC              | I <sub>C</sub>   | -    | 200                  | A     |
|                                   |                             | 1ms             | I <sub>CP</sub>  | -    | 400                  | A     |
|                                   |                             | Duty=88.6% (*2) | -I <sub>C</sub>  | -    | 200                  | A     |
|                                   | Collector Power Dissipation | 1 device (*3)   | P <sub>C</sub>   | -    | 714                  | W     |
| Brake                             | Collector Current           | DC              | I <sub>C</sub>   | -    | -                    | A     |
|                                   |                             | 1ms             | I <sub>CP</sub>  | -    | -                    | A     |
|                                   | Forward Current of Diode    |                 | I <sub>F</sub>   | -    | -                    | A     |
|                                   | Collector Power Dissipation | 1 device (*3)   | P <sub>C</sub>   | -    | -                    | W     |
| Supply Voltage of Pre-Driver (*4) |                             |                 | V <sub>CC</sub>  | -0.5 | 20                   | V     |
| Input Signal Voltage (*5)         |                             |                 | V <sub>in</sub>  | -0.5 | V <sub>CC</sub> +0.5 | V     |
| Alarm Signal Voltage (*6)         |                             |                 | V <sub>ALM</sub> | -0.5 | V <sub>CC</sub>      | V     |
| Alarm Signal Current (*7)         |                             |                 | I <sub>ALM</sub> | -    | 20                   | mA    |
| Junction Temperature              |                             |                 | T <sub>j</sub>   | -    | 150                  | °C    |
| Operating Case Temperature        |                             |                 | T <sub>opr</sub> | -20  | 110                  | °C    |
| Storage Temperature               |                             |                 | T <sub>stg</sub> | -40  | 125                  | °C    |
| Solder Temperature (*8)           |                             |                 | T <sub>sol</sub> | -    | 260                  | °C    |
| Isolating Voltage (*9)            |                             |                 | V <sub>iso</sub> | -    | AC2500               | Vrms  |
| Screw Torque                      |                             | Terminal (M5)   | -                | -    | 3.5                  | Nm    |
|                                   |                             | Mounting (M5)   |                  |      |                      |       |

Note \*1:  $V_{CES}$  shall be applied to the input voltage between all Collector and Emitter.

[ P1-(U,V,W,B) , P2-(U,V,W,B) , (U,V,W,B)-N1 , (U,V,W,B)-N2 ]

Note \*2: Duty=125 $^{\circ}\text{C}/R_{th(j-c)D}/(I_F \times V_F \text{ Max.}) \times 100$

Note \*3:  $P_C=125^{\circ}\text{C}/R_{th(j-c)Q}$  (Inverter & Brake)

Note \*4:  $V_{CC}$  shall be applied to the input voltage between terminal No.3 and 1, 7 and 5, 11 and 9, 14 and 13.

Note \*5:  $V_{in}$  shall be applied to the input voltage between terminal No.2 and 1, 6 and 5, 10 and 9, 15~18 and 13.

Note \*6:  $V_{ALM}$  shall be applied to the voltage between terminal No.4 and 1, 8 and 5, 12 and 9, 19 and 13.

Note \*7:  $I_{ALM}$  shall be applied to the input current to terminal No.4, 8, 12 and 19.

Note \*8: Immersion time 10 $\pm$ 1sec. 1 time

Note \*9: Terminal to base, 50/60Hz sine wave 1min. All terminals should be connected together during the test.

● Electrical Characteristics ( $T_J=25^\circ\text{C}$ ,  $V_{CC}=15\text{V}$  unless otherwise specified)

| Items                                                |                                            | Symbol                   | Conditions                                                         |                       | Min. | Typ. | Max. | Units |
|------------------------------------------------------|--------------------------------------------|--------------------------|--------------------------------------------------------------------|-----------------------|------|------|------|-------|
| Inverter                                             | Collector Current at off signal input      | I <sub>CES</sub>         | V <sub>CE</sub> =600V                                              |                       | -    | -    | 1.0  | mA    |
|                                                      | Collector-Emitter saturation voltage (*10) | V <sub>CE(sat)</sub>     | I <sub>c</sub> =200A                                               | Terminal              | -    | -    | 1.80 | V     |
|                                                      |                                            |                          |                                                                    | Chip                  | -    | 1.25 | -    | V     |
|                                                      | Forward voltage of FWD (*10)               | V <sub>F</sub>           | I <sub>F</sub> =200A                                               | Terminal              | -    | -    | 2.35 | V     |
| Chip                                                 |                                            |                          |                                                                    | -                     | 1.80 | -    | V    |       |
| Brake                                                | Collector Current at off signal input      | I <sub>CES</sub>         | -                                                                  |                       | -    | -    | -    | mA    |
|                                                      | Collector-Emitter saturation voltage (*10) | V <sub>CE(sat)</sub>     | -                                                                  |                       | -    | -    | -    | V     |
|                                                      |                                            |                          |                                                                    |                       | -    | -    | -    | V     |
|                                                      | Forward voltage of FWD (*10)               | V <sub>F</sub>           | -                                                                  |                       | -    | -    | -    | V     |
| -                                                    |                                            |                          |                                                                    |                       | -    | -    | V    |       |
| Switching time                                       |                                            | t <sub>on</sub>          | V <sub>DC</sub> =300V, T <sub>J</sub> =125°C, I <sub>c</sub> =200A |                       | 1.1  | -    | -    | μs    |
|                                                      |                                            | t <sub>off</sub>         |                                                                    |                       | -    | -    | 2.1  | μs    |
|                                                      |                                            | t <sub>rr</sub>          | V <sub>DC</sub> =300V, I <sub>F</sub> =200A                        |                       | -    | -    | 0.3  | μs    |
| Supply current of P-side pre-driver (per one unit)   |                                            | I <sub>ccp</sub>         | Switching Frequency= 0-15kHz<br>T <sub>c</sub> =-20~110°C          |                       | -    | -    | 26   | mA    |
| Supply current of N-side pre-driver                  |                                            | I <sub>ccn</sub>         |                                                                    |                       | -    | -    | 78   | mA    |
| Input signal threshold voltage                       |                                            | V <sub>in(th)(on)</sub>  | V <sub>in</sub> -GND                                               | ON                    | 1.2  | 1.4  | 1.6  | V     |
|                                                      |                                            | V <sub>in(th)(off)</sub> |                                                                    | OFF                   | 1.5  | 1.7  | 1.9  | V     |
| Over Current Protection Level                        | Inverter                                   | I <sub>OC</sub>          | T <sub>J</sub> =125°C                                              |                       | 300  | -    | -    | A     |
|                                                      | Brake                                      |                          |                                                                    |                       | -    | -    | -    | A     |
| Over Current Protection Delay time                   |                                            | t <sub>dOC</sub>         | T <sub>J</sub> =125°C                                              |                       | -    | 5    | -    | μs    |
| Short Circuit Protection Delay time                  |                                            | t <sub>SC</sub>          | T <sub>J</sub> =125°C                                              |                       | -    | 2    | 3    | μs    |
| IGBT Chips Over Heating Protection Temperature Level |                                            | T <sub>JOH</sub>         | Surface of IGBT Chips                                              |                       | 150  | -    | -    | °C    |
| Over Heating Protection Hysteresis                   |                                            | T <sub>JH</sub>          |                                                                    |                       | -    | 20   | -    | °C    |
| Under Voltage Protection Level                       |                                            | V <sub>UV</sub>          |                                                                    |                       | 11.0 | -    | 12.5 | V     |
| Under Voltage Protection Hysteresis                  |                                            | V <sub>H</sub>           |                                                                    |                       | 0.2  | 0.5  | -    | V     |
| Alarm Signal Hold Time                               |                                            | t <sub>ALM(OC)</sub>     | ALM-GND<br>T <sub>c</sub> =-20~110°C                               | V <sub>CC</sub> ≥ 10V | 1.0  | 2.0  | 2.4  | ms    |
|                                                      |                                            | t <sub>ALM(UV)</sub>     |                                                                    |                       | 2.5  | 4.0  | 4.9  | ms    |
|                                                      |                                            | t <sub>ALM(TJOH)</sub>   |                                                                    |                       | 5.0  | 8.0  | 11.0 | ms    |
| Resistance for current limit                         |                                            | R <sub>ALM</sub>         |                                                                    |                       | 960  | 1265 | 1570 | Ω     |

Note \*10: The Max value is a case where it measures from P2-(U,V,W,B) , (U,V,W,B)-N2.

● Thermal Characteristics ( $T_C = 25^\circ\text{C}$ )

| Items                                        |          |      | Symbol                | Min. | Typ. | Max.  | Units |
|----------------------------------------------|----------|------|-----------------------|------|------|-------|-------|
| Junction to Case Thermal Resistance (*11)    | Inverter | IGBT | R <sub>th(j-c)Q</sub> | -    | -    | 0.175 | °C/W  |
|                                              |          | FWD  | R <sub>th(j-c)D</sub> | -    | -    | 0.300 | °C/W  |
|                                              | Brake    | IGBT | R <sub>th(j-c)Q</sub> | -    | -    | -     | °C/W  |
|                                              |          | FWD  | R <sub>th(j-c)D</sub> | -    | -    | -     | °C/W  |
| Case to Fin Thermal Resistance with Compound |          |      | R <sub>th(c-f)</sub>  | -    | 0.05 | -     | °C/W  |

Note \*11: For 1device, the measurement point of the case is just under the chip.

● Noise Immunity ( $V_{DC}=300\text{V}$ ,  $V_{CC}=15\text{V}$ )

| Items                         | Conditions                                                                                         | Min.      | Typ. | Max. | Units |
|-------------------------------|----------------------------------------------------------------------------------------------------|-----------|------|------|-------|
| Common mode rectangular noise | Pulse width 1 $\mu\text{s}$ , polarity $\pm 10$ min.<br>Judge : no over-current, no miss operating | $\pm 2.0$ | -    | -    | kV    |

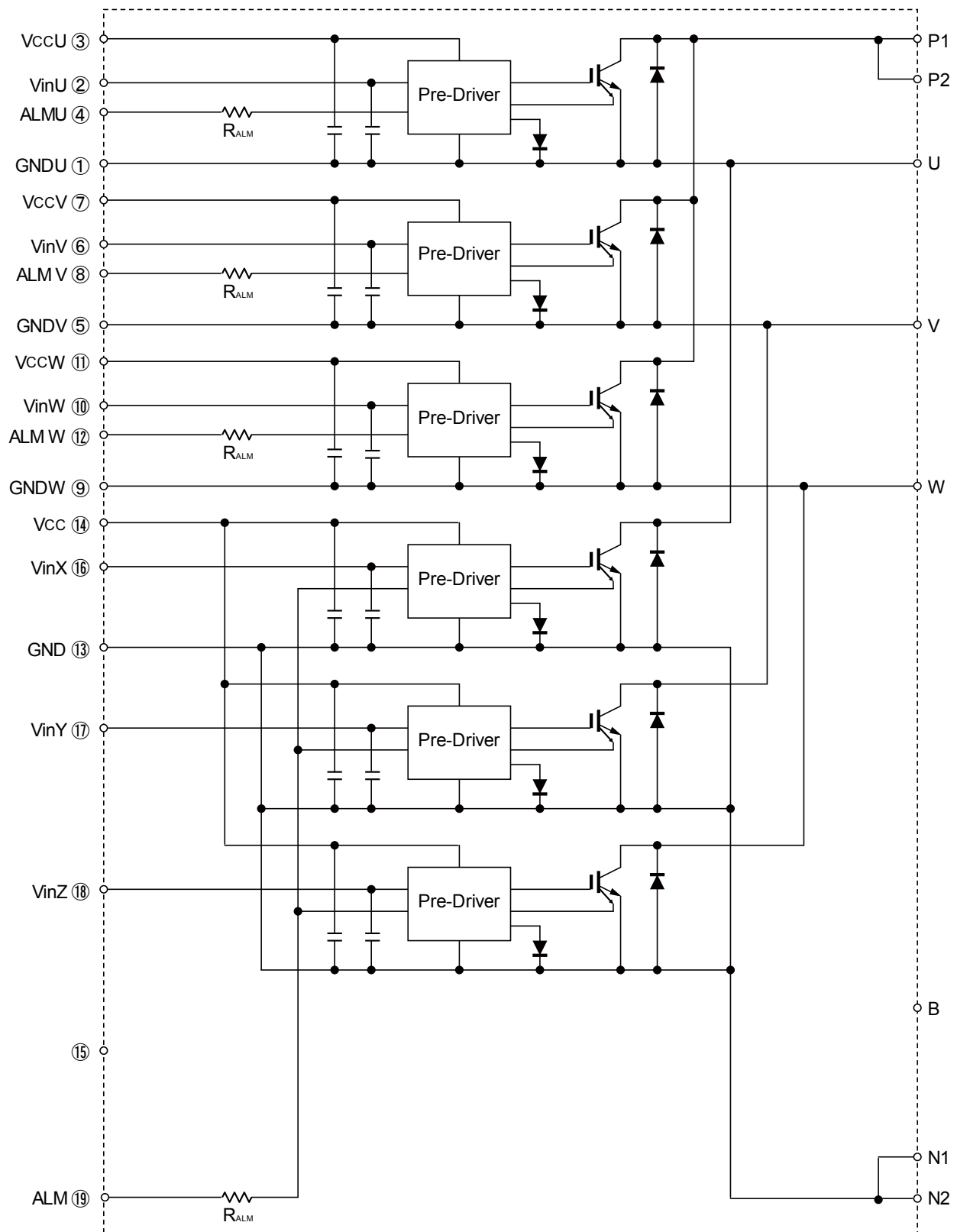
● Recommended Operating Conditions

| Items                                                  | Symbol     | Min. | Typ. | Max. | Units         |
|--------------------------------------------------------|------------|------|------|------|---------------|
| DC Bus Voltage                                         | $V_{DC}$   | -    | -    | 400  | V             |
| Power Supply Voltage of Pre-Driver                     | $V_{CC}$   | 13.5 | 15.0 | 16.5 | V             |
| Switching frequency of IPM                             | $f_{SW}$   | -    | -    | 20   | kHz           |
| Arm shoot through blocking time for IPM's input signal | $t_{dead}$ | 1.0  | -    | -    | $\mu\text{s}$ |
| Screw Torque (M5)                                      | -          | 2.5  | -    | 3.5  | Nm            |

● Weight

| Items  | Symbol | Min. | Typ. | Max. | Units |
|--------|--------|------|------|------|-------|
| Weight | $W_i$  | -    | 940  | -    | g     |

## ■ Block Diagram

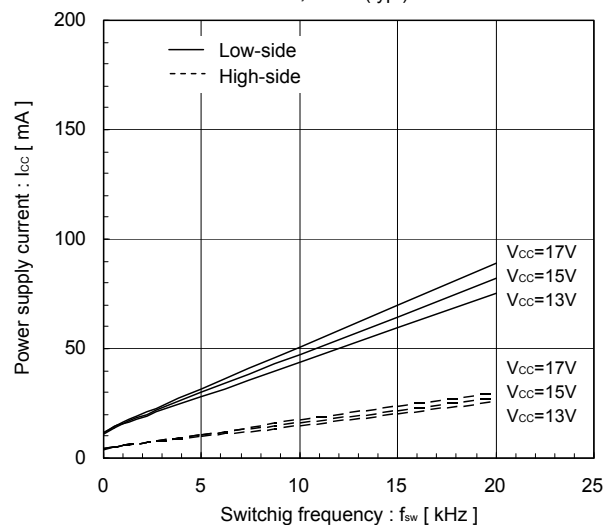


Pre-drivers include following functions

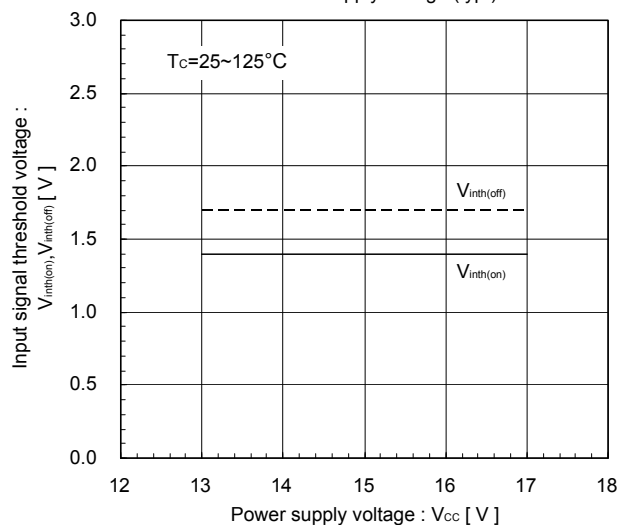
1. Amplifier for driver
2. Short circuit protection
3. Under voltage lockout circuit
4. Over current protection
5. IGBT chip over heating protection

## Characteristics (Representative)

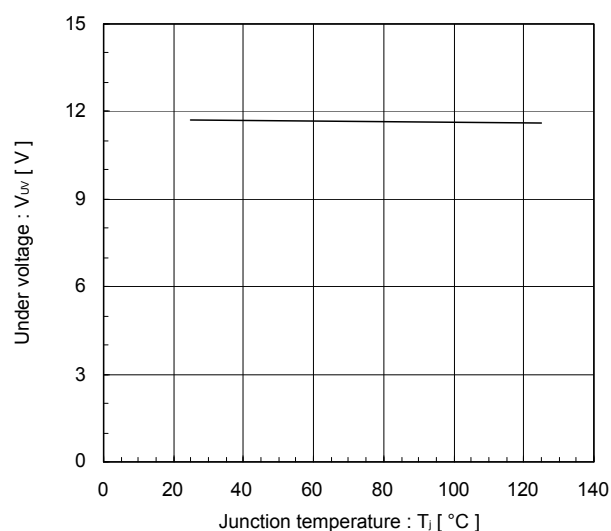
Power supply current vs. Switching frequency  
 $T_J = 25^\circ\text{C}(\text{typ.})$



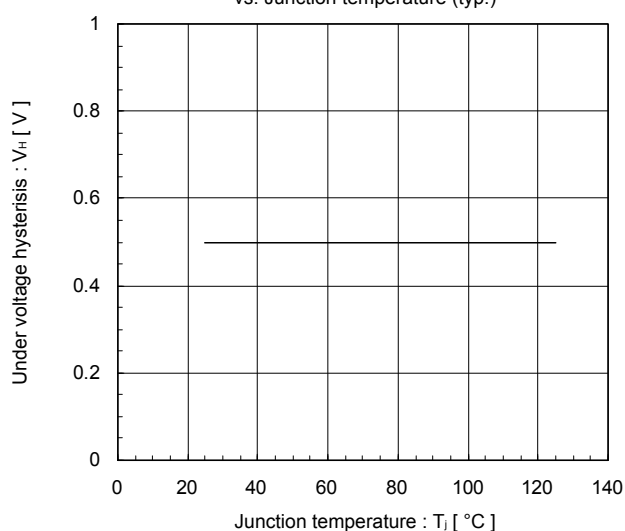
Input signal threshold voltage  
 vs. Power supply voltage (typ.)



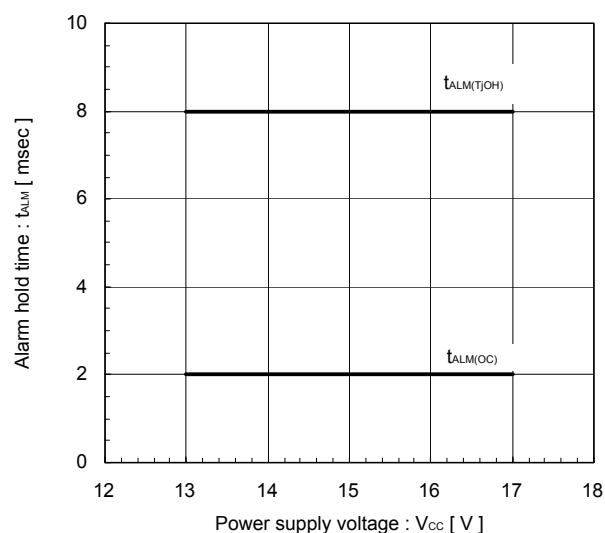
Under voltage vs. Junction temperature (typ.)



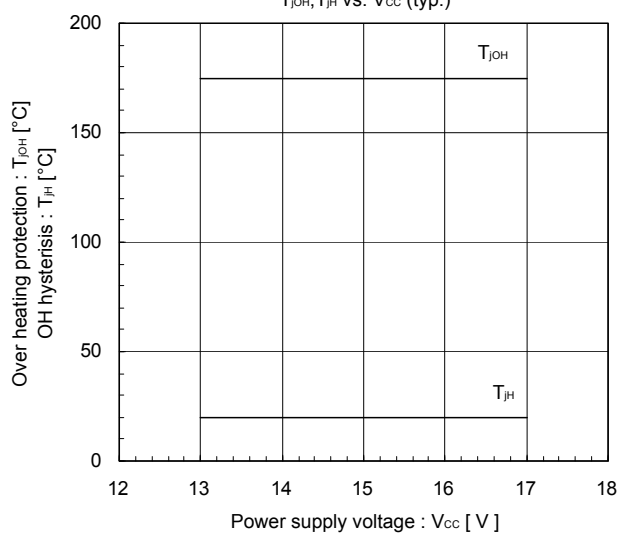
Under voltage hysteresis  
 vs. Junction temperature (typ.)



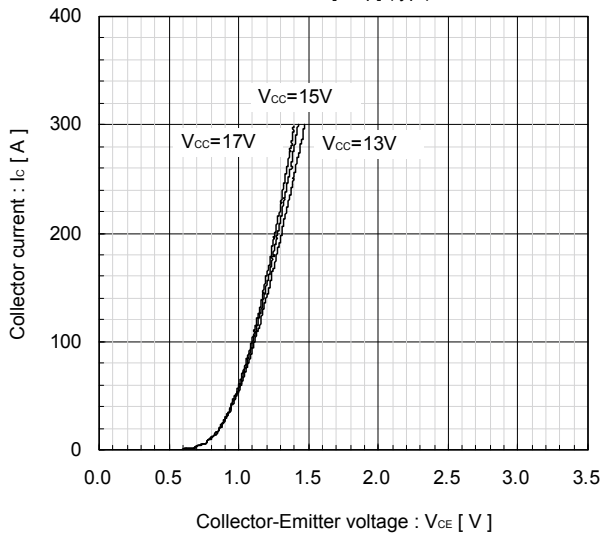
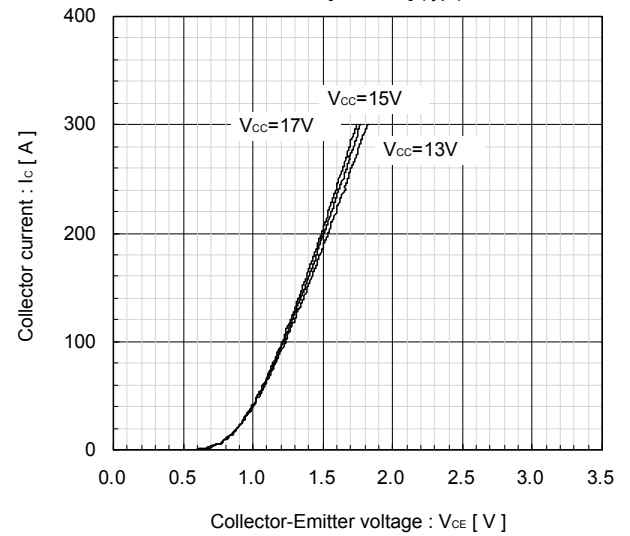
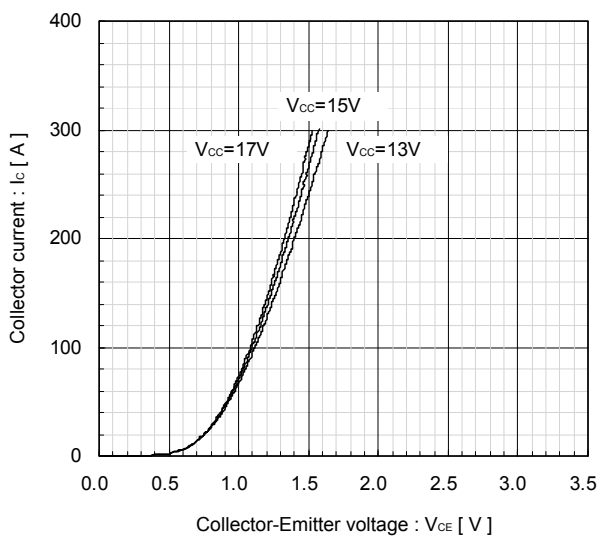
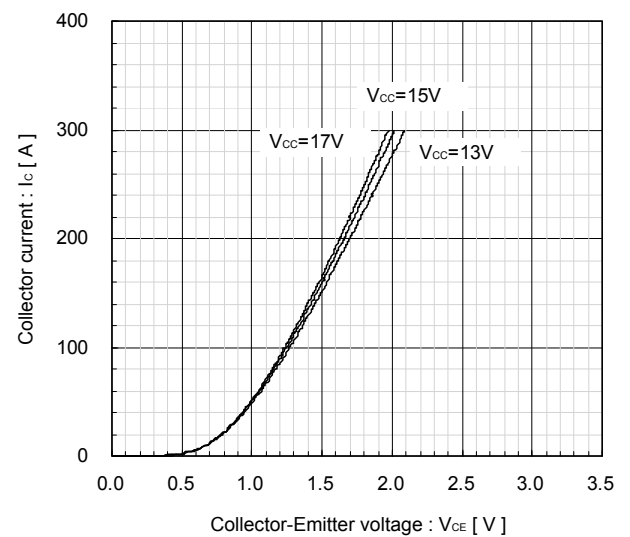
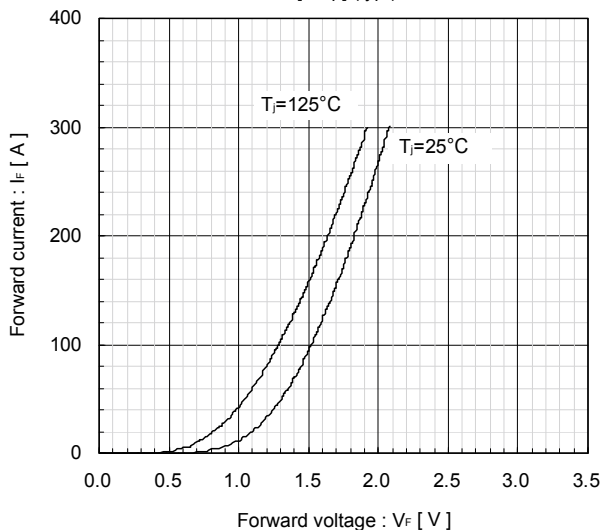
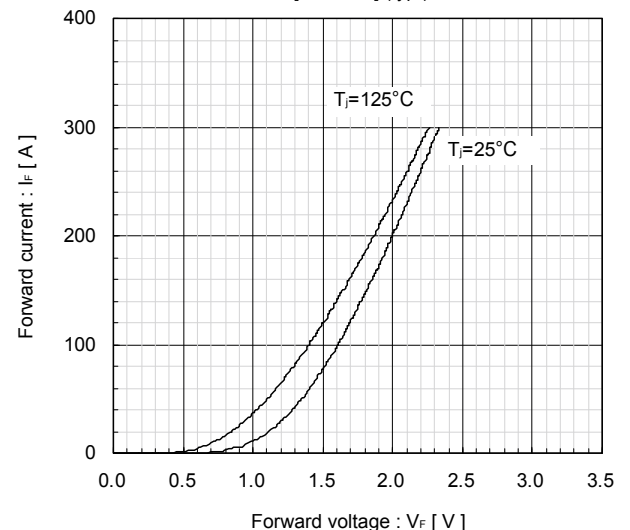
Alarm hold time vs. Power supply voltage (typ.)



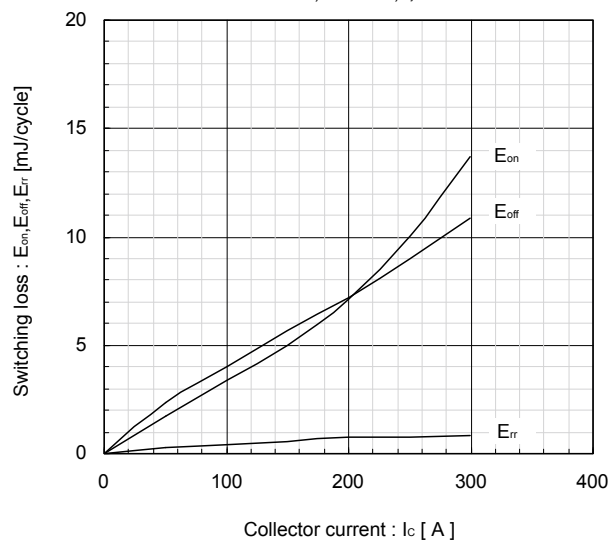
Over heating characteristics  
 $T_{J(OH)}, T_{J(H)}$  vs.  $V_{CC}$  (typ.)



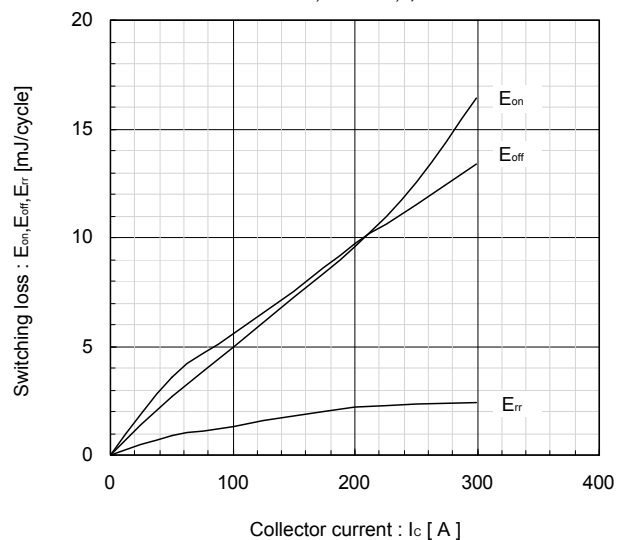
## Inverter

Collector current vs. Collector-Emitter voltage  
 $T_J=25^{\circ}\text{C}$ [Chip] (typ.)Collector current vs. Collector-Emitter voltage  
 $T_J=25^{\circ}\text{C}$ [Terminal] (typ.)Collector current vs. Collector-Emitter voltage  
 $T_J=125^{\circ}\text{C}$ [Chip] (typ.)Collector current vs. Collector-Emitter voltage  
 $T_J=125^{\circ}\text{C}$ [Terminal] (typ.)Forward current vs. Forward voltage  
[Chip] (typ.)Forward current vs. Forward voltage  
[Terminal] (typ.)

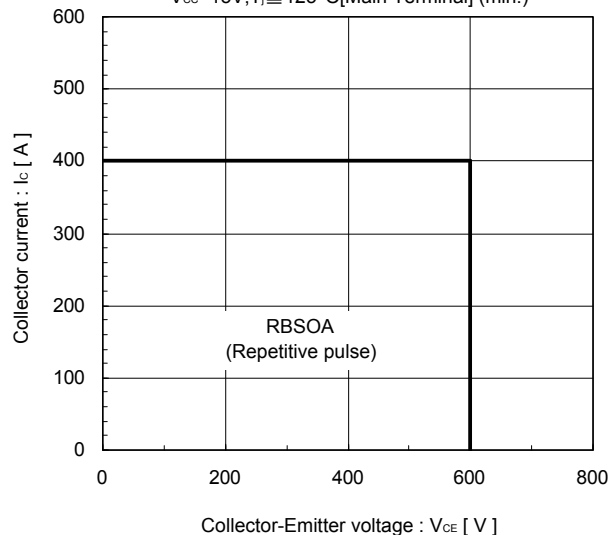
Switching Loss vs. Collector Current (typ.)  
 $V_{DC}=300V, V_{CC}=15V, T_J=25^{\circ}C$



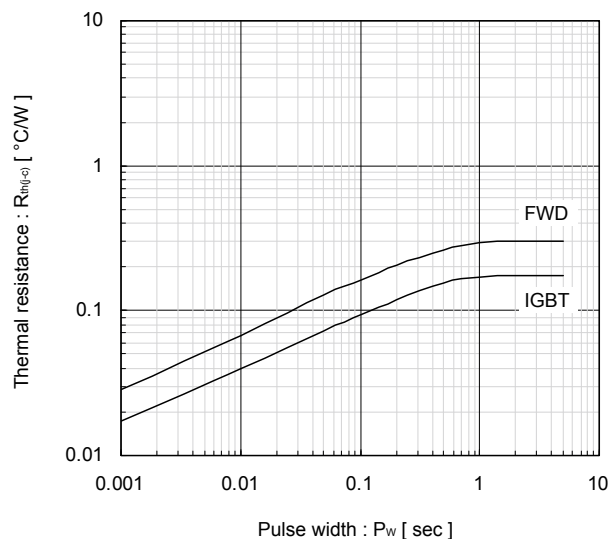
Switching Loss vs. Collector Current (typ.)  
 $V_{DC}=300V, V_{CC}=15V, T_J=125^{\circ}C$



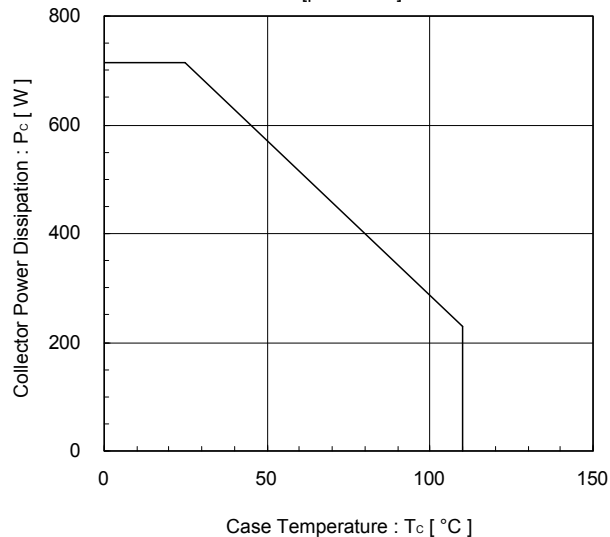
Reversed biased safe operating area  
 $V_{CC}=15V, T_J \leq 125^{\circ}C$  [Main Terminal] (min.)



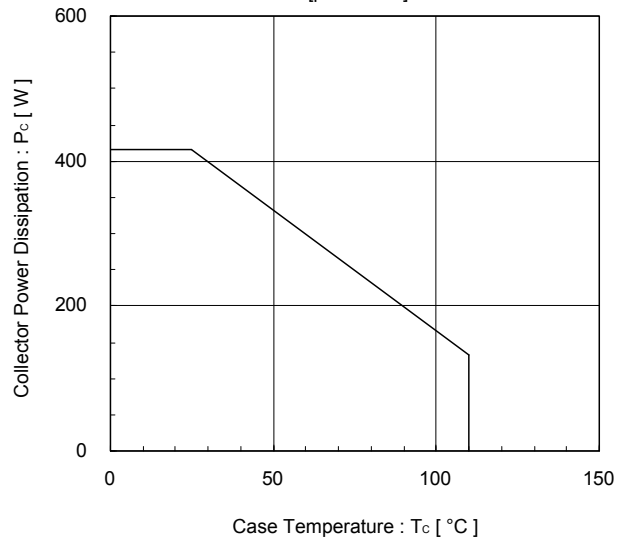
Transient thermal resistance (max.)



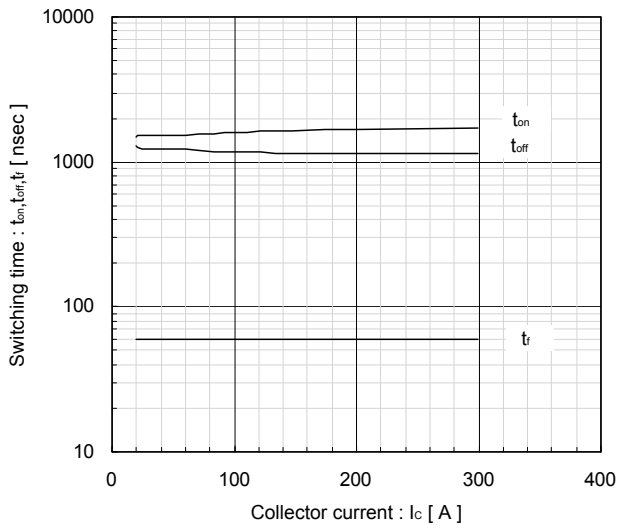
Power derating for IGBT (max.)  
 [per device]



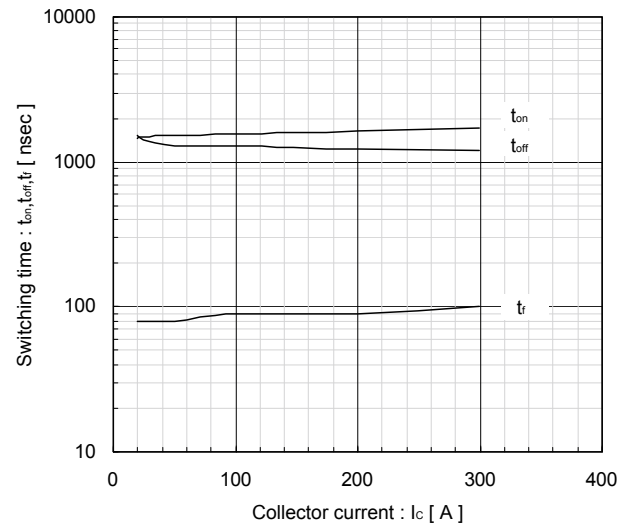
Power derating for FWD (max.)  
 [per device]



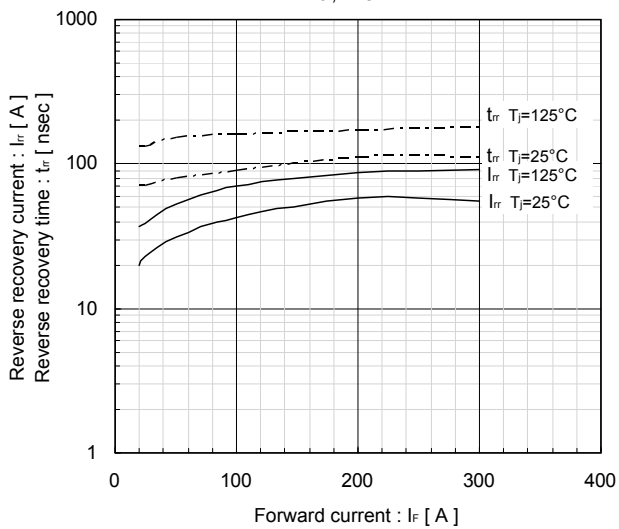
Switching time vs. Collector current (typ.)  
 $V_{DC}=300V, V_{CC}=15V, T_J=25^\circ C$



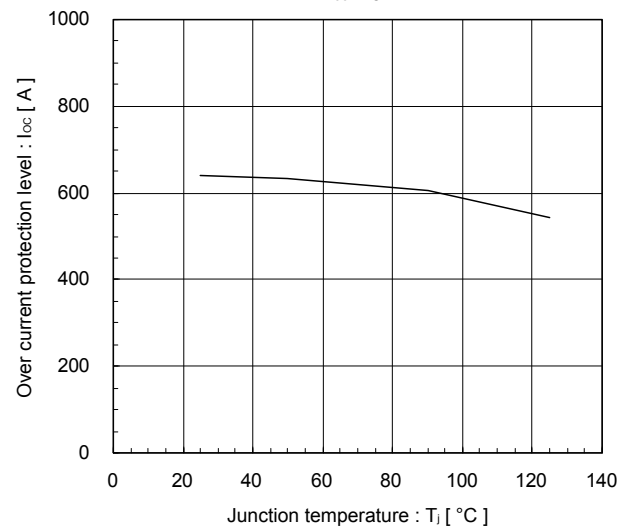
Switching time vs. Collector current (typ.)  
 $V_{DC}=300V, V_{CC}=15V, T_J=125^\circ C$



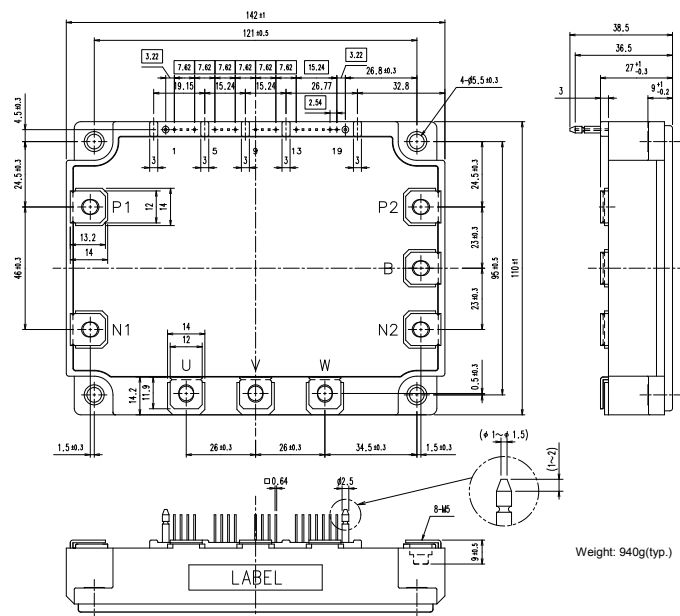
Reverse recovery characteristics (typ.)  
 $t_{rr}, I_{rr}$  vs.  $I_F$



Over current protection vs. Junction temperature (typ.)  
 $V_{CC}=15V$



## Outline Drawings, mm



**WARNING**

1. This Catalog contains the product specifications, characteristics, data, materials, and structures as of March 2014.  
The contents are subject to change without notice for specification changes or other reasons. When using a product listed in this Catalog, be sure to obtain the latest specifications.
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4. The products introduced in this Catalog are intended for use in the following electronic and electrical equipment which has normal reliability requirements.
 

|                 |                         |                                               |                          |
|-----------------|-------------------------|-----------------------------------------------|--------------------------|
| • Computers     | • OA equipment          | • Communications equipment (terminal devices) | • Measurement equipment  |
| • Machine tools | • Audiovisual equipment | • Electrical home appliances                  | • Personal equipment     |
|                 |                         |                                               | • Industrial robots etc. |
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|                                                                             |                                                       |
|-----------------------------------------------------------------------------|-------------------------------------------------------|
| • Transportation equipment (mounted on cars and ships)                      | • Trunk communications equipment                      |
| • 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                                                         |                                                       |
6. Do not use products in this Catalog for the equipment requiring strict reliability such as the following and equivalents to strategic equipment (without limitation).
 

|                                |                        |                             |
|--------------------------------|------------------------|-----------------------------|
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| • Submarine repeater equipment |                        |                             |
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