

# 6MBP300VEA060-50

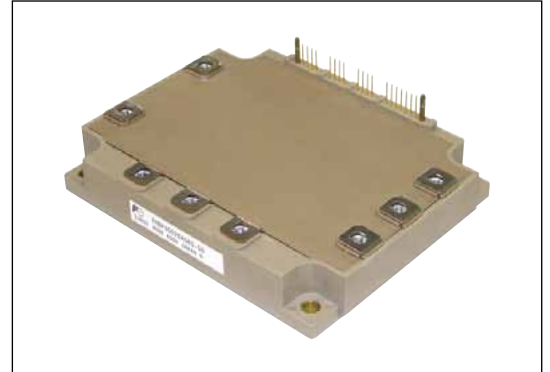
IGBT Modules

## IGBT MODULE (V series)

600V / 300A / 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<sub>c</sub>=25°C, V<sub>cc</sub>=15V 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>       | -     | 300 | A |
|                                   |                             | 1ms             | I <sub>CP</sub>      | -     | 600 | A |
|                                   |                             | Duty=73.9% (*2) | -I <sub>c</sub>      | -     | 300 | A |
| Collector Power Dissipation       | 1 device (*3)               | P <sub>c</sub>  | -                    | 925   | 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)               | -               | -                    | -     |     |   |
|                                   | Mounting (M5)               | -               | -                    | 3.5   | Nm  |   |

Note \*1: V<sub>CEs</sub> 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°C/R<sub>th(j-c)</sub>/(I<sub>F</sub>×V<sub>F</sub> Max.)×100

Note \*3: P<sub>c</sub>=125°C/R<sub>th(j-c)</sub> (Inverter & Brake)

Note \*4: V<sub>CC</sub> 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<sub>in</sub> 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<sub>ALM</sub> shall be applied to the voltage between terminal No.4 and 1, 8 and 5, 12 and 9, 19 and 13.

Note \*7: I<sub>ALM</sub> shall be applied to the input current to terminal No.4, 8, 12 and 19.

Note \*8: Immersion time 10±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      | $I_{CES}$  | $V_{CE}=600\text{V}$  | -                       | -    | 1.0  | mA               |    |
|  | Collector-Emitter saturation voltage (*10) | $V_{CE(sat)}$  | $I_C=300\text{A}$   | Terminal                | -    | -    | 1.90             | V  |
|  |  |  |   | Chip                    | -    | 1.25 | -                | V  |
|  | Forward voltage of FWD (*10)               | $V_F$  | $I_F=300\text{A}$   | Terminal                | -    | -    | 2.45             | V  |
| Chip   |  |  |   | -                       | 1.80 | -    | V                |    |
| Brake  | Collector Current at off signal input      | $I_{CES}$  | -   | -                       | -    | -    | mA               |    |
|  | Collector-Emitter saturation voltage (*10) | $V_{CE(sat)}$  | -   | -                       | -    | -    | V                |    |
|  |  |  | -   | -                       | -    | -    | V                |    |
| Forward voltage of FWD (*10)                         | $V_F$                                      | -  | -   | -                       | -    | V    |                  |    |
|  |  | -  | -   | -                       | -    | V    |                  |    |
| Switching time                                       | $t_{on}$                                   | $V_{DC}=300\text{V}$ , $T_J=125^\circ\text{C}$ , $I_C=300\text{A}$ |   | 1.1                     | -    | -    | $\mu\text{s}$    |    |
|  | $t_{off}$                                  |  |   | -                       | -    | 2.1  | $\mu\text{s}$    |    |
|  | $t_{rr}$                                   | $V_{DC}=300\text{V}$ , $I_F=300\text{A}$                           |   | -                       | -    | 0.3  | $\mu\text{s}$    |    |
| Supply current of P-side pre-driver (per one unit)   |  | $I_{cop}$  | Switching Frequency= 0-15kHz<br>$T_C=-20\sim 110^\circ\text{C}$ | -                       | -    | 36   | mA               |    |
| Supply current of N-side pre-driver                  |  | $I_{con}$  |   | -                       | -    | 108  | mA               |    |
| Input signal threshold voltage                       |  | $V_{in(th)(on)}$   | $V_{in}-\text{GND}$   | ON                      | 1.2  | 1.4  | 1.6              | V  |
|  |  | $V_{in(th)(off)}$  |   | OFF                     | 1.5  | 1.7  | 1.9              | V  |
| Over Current Protection Level                        | Inverter                                   | $I_{OC}$   | $T_J=125^\circ\text{C}$   | 450                     | -    | -    | A                |    |
|  | Brake                                      |  |   | -                       | -    | -    | A                |    |
| Over Current Protection Delay time                   |  | $t_{dOC}$  | $T_J=125^\circ\text{C}$   | -                       | 5    | -    | $\mu\text{s}$    |    |
| Short Circuit Protection Delay time                  |  | $t_{SC}$   | $T_J=125^\circ\text{C}$   | -                       | 2    | 3    | $\mu\text{s}$    |    |
| IGBT Chips Over Heating Protection Temperature Level |  | $T_{J(OH)}$  | Surface of IGBT Chips   | 150                     | -    | -    | $^\circ\text{C}$ |    |
| Over Heating Protection Hysteresis                   |  | $T_{JH}$   |   | -                       | 20   | -    | $^\circ\text{C}$ |    |
| Under Voltage Protection Level                       |  | $V_{UV}$   |   | 11.0                    | -    | 12.5 | V                |    |
| Under Voltage Protection Hysteresis                  |  | $V_H$  |   | 0.2                     | 0.5  | -    | V                |    |
| Alarm Signal Hold Time                               |  | $t_{ALM(OC)}$  | ALM-GND<br>$T_C=-20\sim 110^\circ\text{C}$                      | $V_{CC}\geq 10\text{V}$ | 1.0  | 2.0  | 2.4              | ms |
|  |  | $t_{ALM(UV)}$  |   |                         | 2.5  | 4.0  | 4.9              | ms |
|  |  | $t_{ALM(TJOH)}$  |   |                         | 5.0  | 8.0  | 11.0             | ms |
| Resistance for current limit                         |  | $R_{ALM}$  |   | 960                     | 1265 | 1570 | $\Omega$         |    |

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          | $R_{th(j-c)Q}$ | -    | -    | 0.135                     | $^\circ\text{C}/\text{W}$ |
|  |          | FWD           | $R_{th(j-c)D}$ | -    | -    | 0.230                     | $^\circ\text{C}/\text{W}$ |
|  | Brake    | IGBT          | $R_{th(j-c)Q}$ | -    | -    | -                         | $^\circ\text{C}/\text{W}$ |
|  |          | FWD           | $R_{th(j-c)D}$ | -    | -    | -                         | $^\circ\text{C}/\text{W}$ |
| Case to Fin Thermal Resistance with Compound |          | $R_{th(c-f)}$ | -              | 0.05 | -    | $^\circ\text{C}/\text{W}$ |                           |

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    |

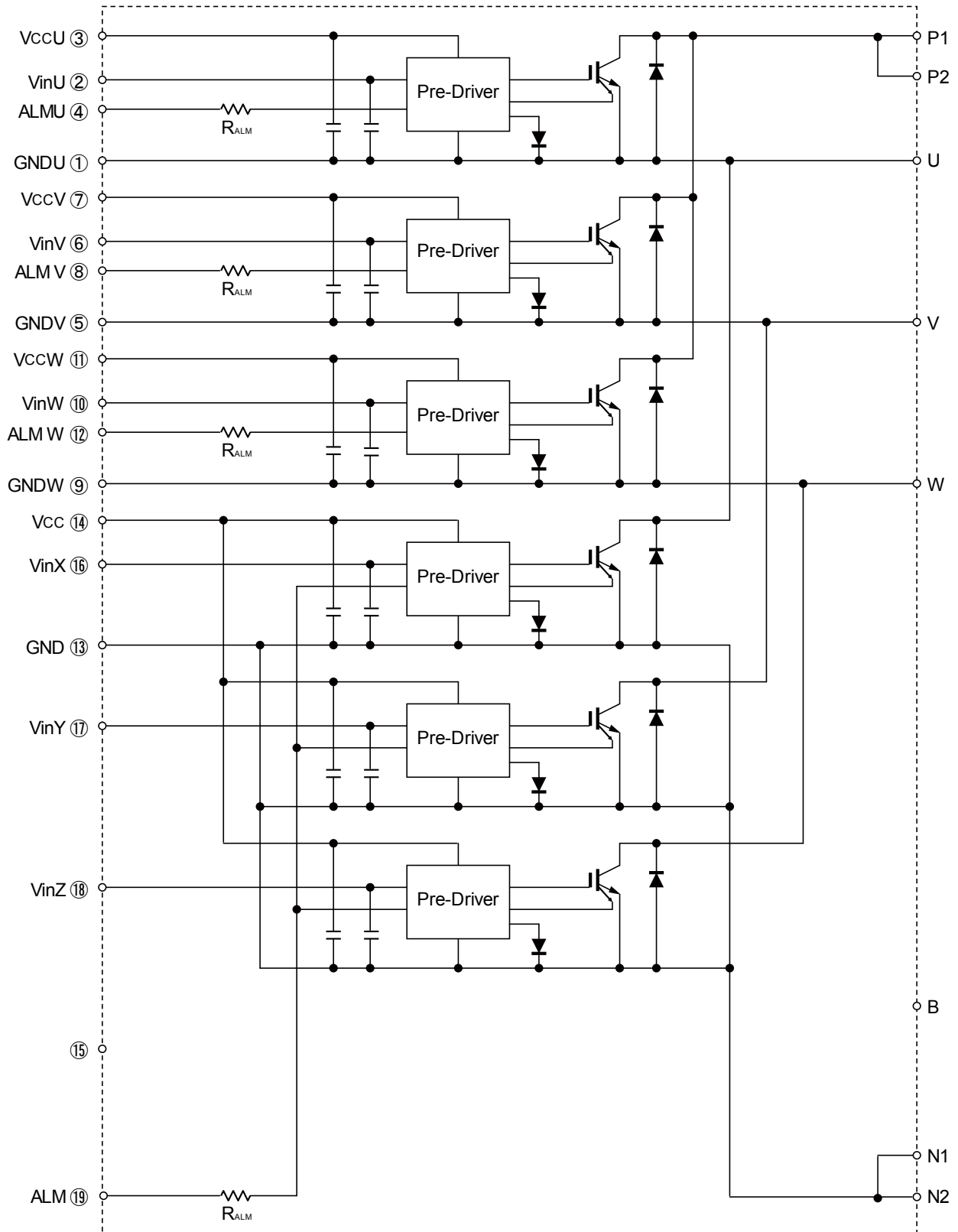
● Recommended Operating Conditions

| 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 | $W_t$  | -    | 980  | -    | g     |

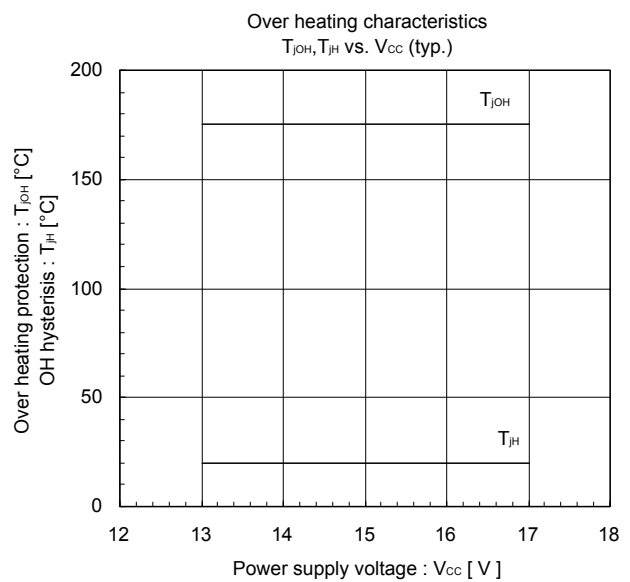
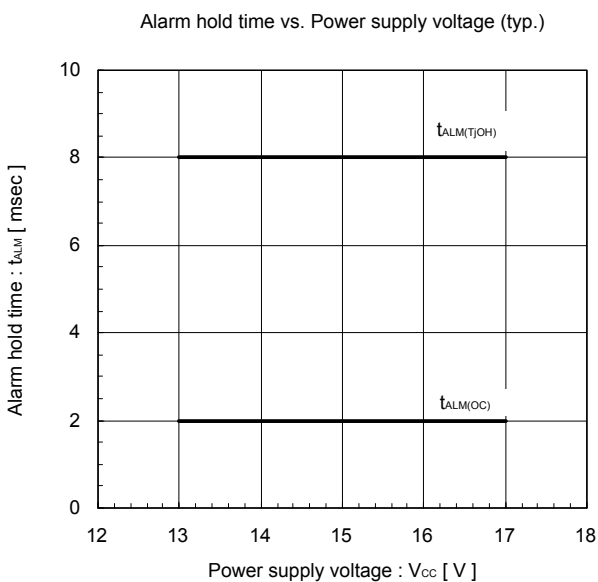
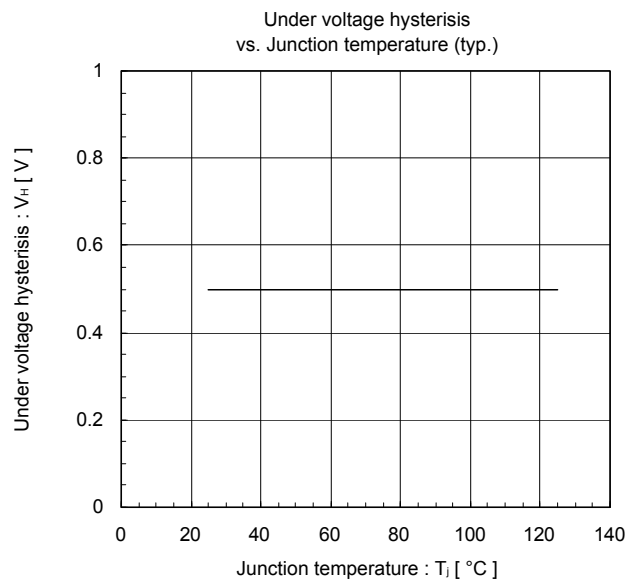
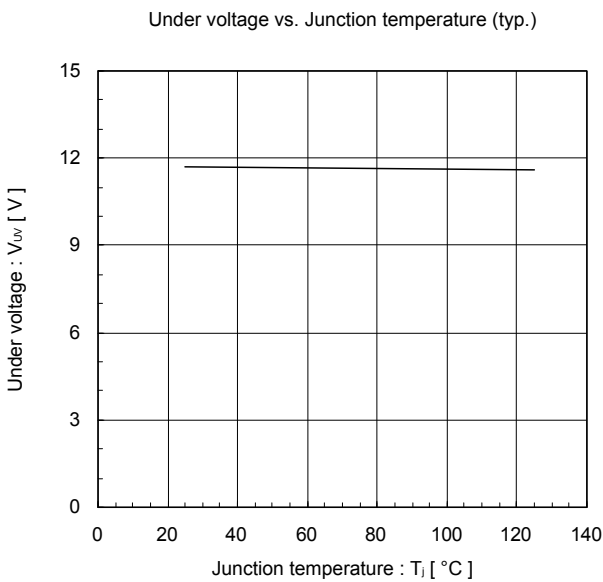
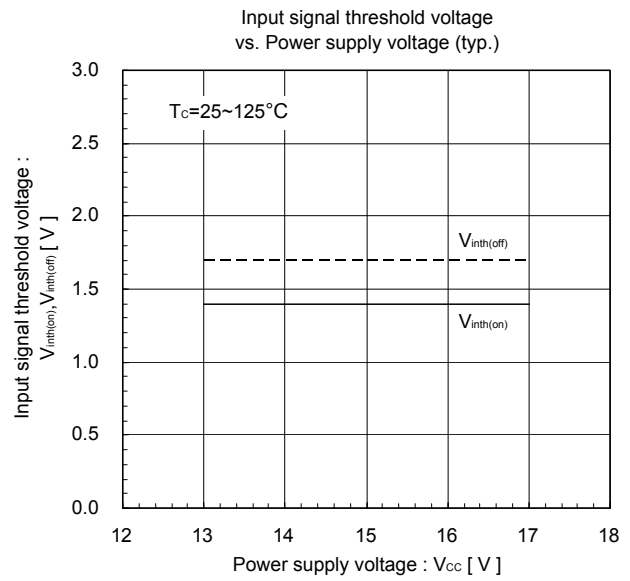
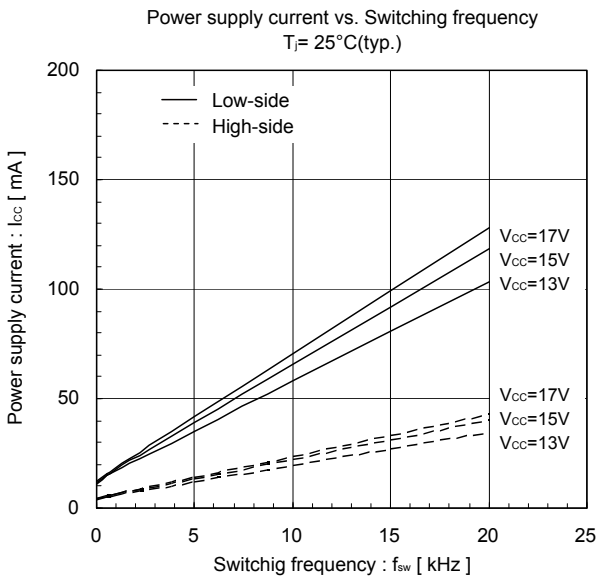
■ Block Diagram



Pre-drivers include following functions

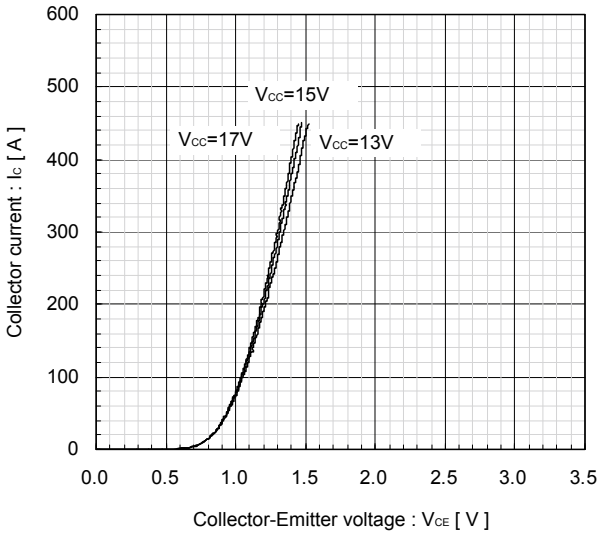
1. Amplifier for driver
2. Short circuit protection
3. Under voltage lockout circuit
4. Over current protection
5. IGBT chip over heating protection

■ Characteristics (Representative)

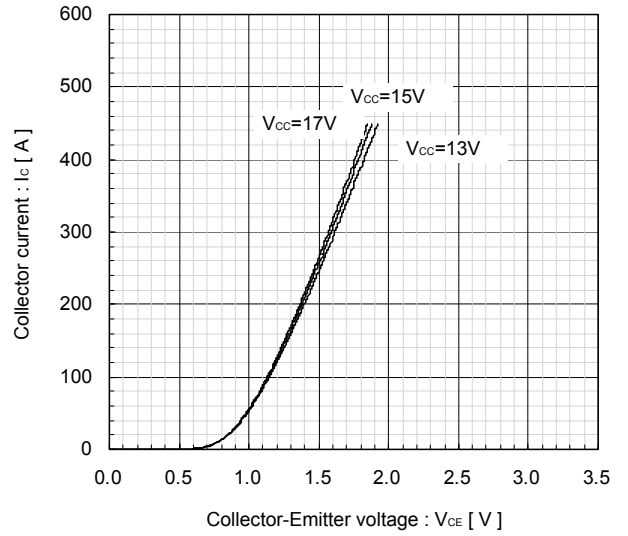


Inverter

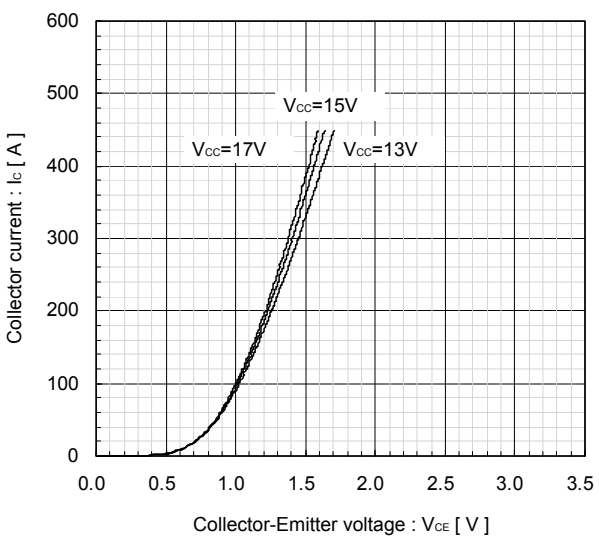
Collector current vs. Collector-Emitter voltage  
 $T_j=25^\circ\text{C}$ [Chip] (typ.)



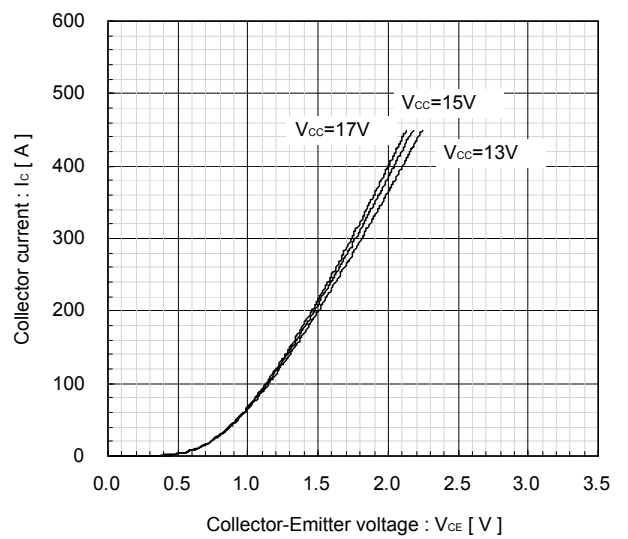
Collector current vs. Collector-Emitter voltage  
 $T_j=25^\circ\text{C}$ [Terminal] (typ.)



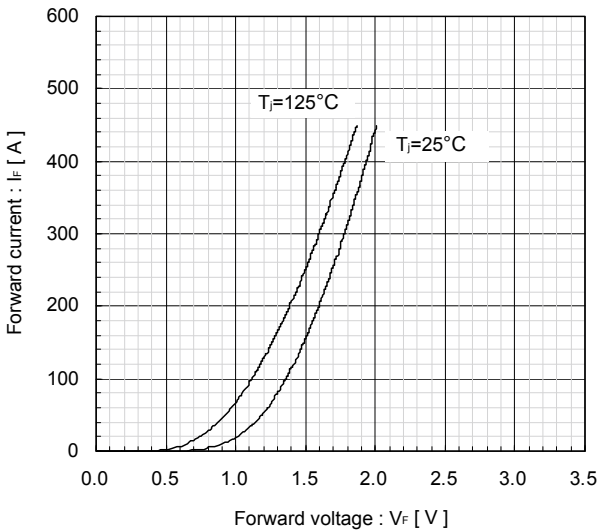
Collector current vs. Collector-Emitter voltage  
 $T_j=125^\circ\text{C}$ [Chip] (typ.)



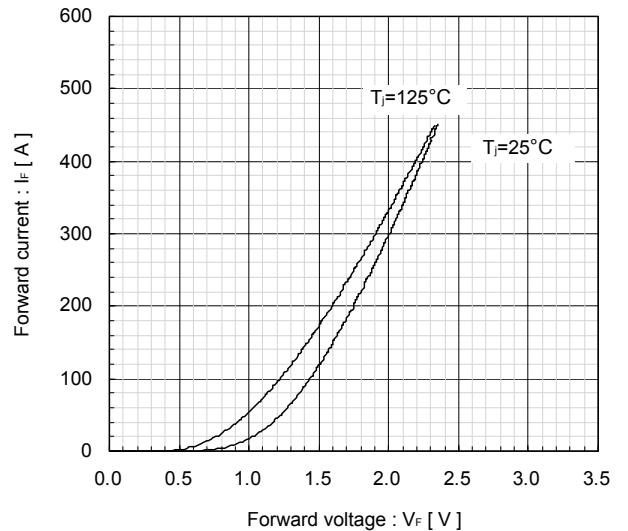
Collector current vs. Collector-Emitter voltage  
 $T_j=125^\circ\text{C}$ [Terminal] (typ.)



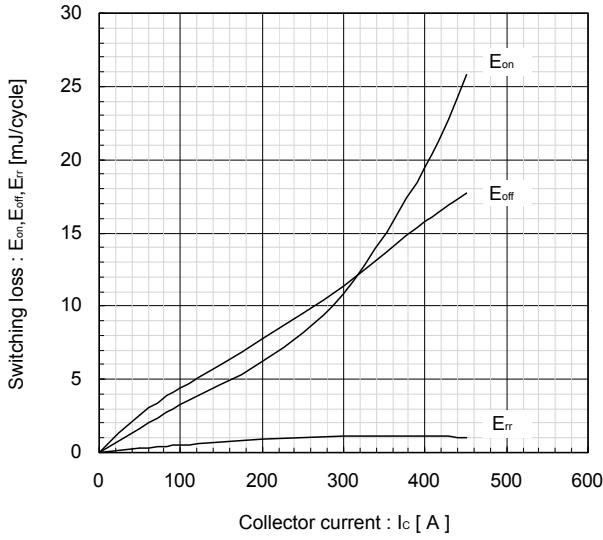
Forward current vs. Forward voltage  
 [Chip] (typ.)



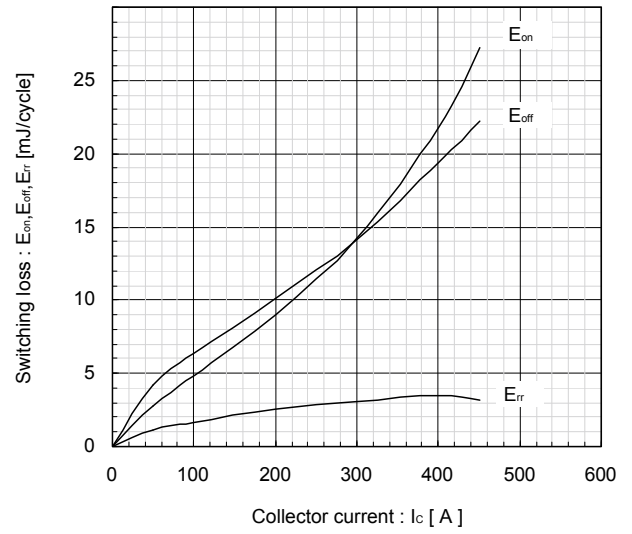
Forward current vs. Forward voltage  
 [Terminal] (typ.)



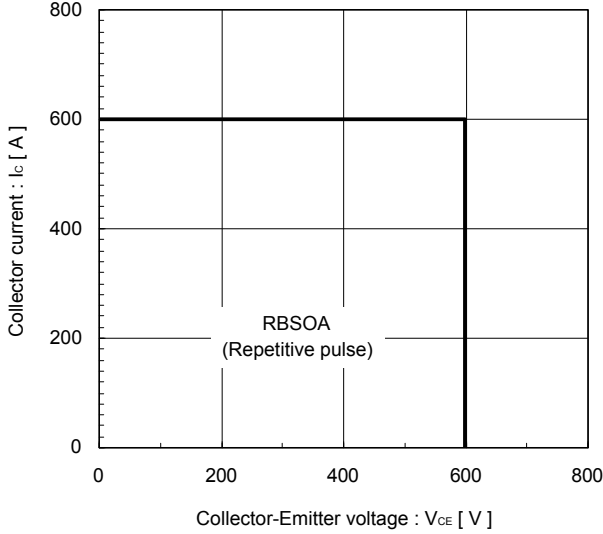
Switching Loss vs. Collector Current (typ.)  
 $V_{DC}=300V, V_{CC}=15V, T_J=25^\circ C$



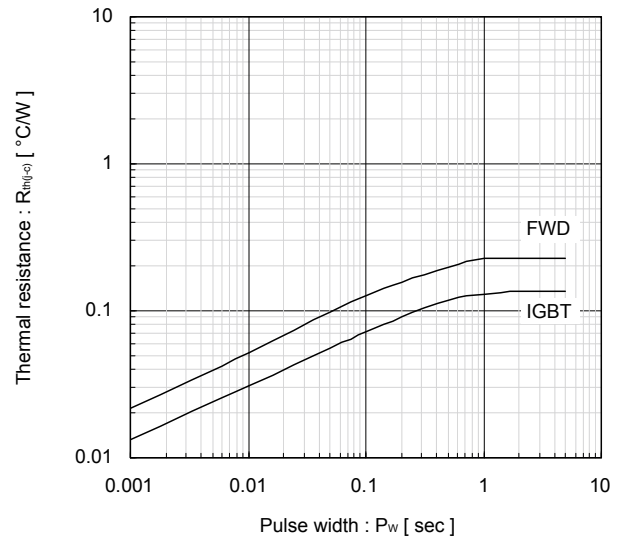
Switching Loss vs. Collector Current (typ.)  
 $V_{DC}=300V, V_{CC}=15V, T_J=125^\circ C$



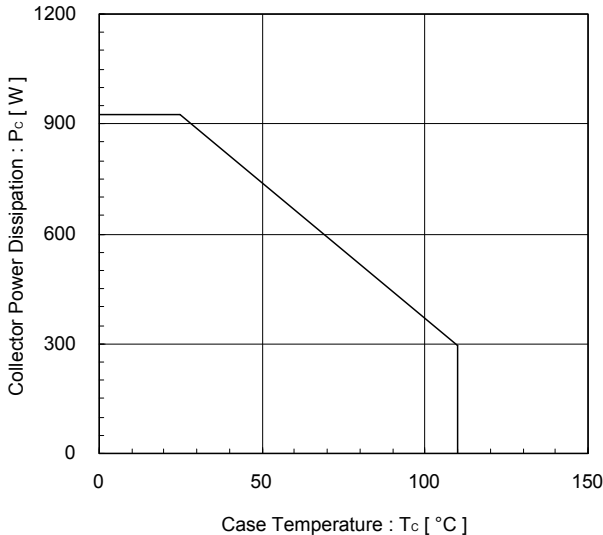
Reversed biased safe operating area  
 $V_{CC}=15V, T_J \le 125^\circ C$  [Main Terminal] (min.)



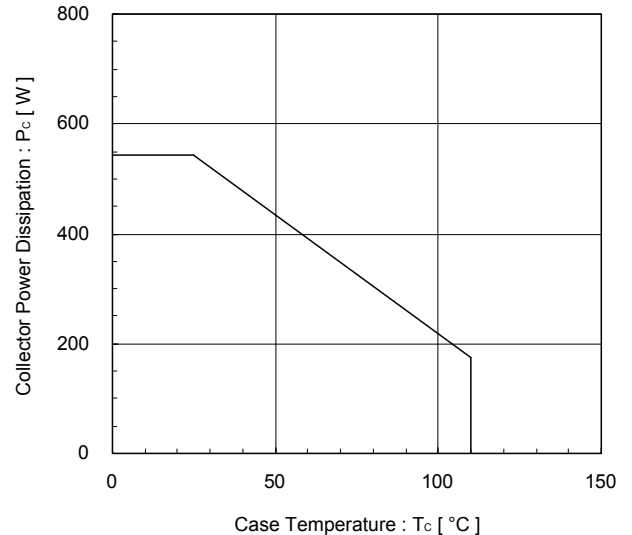
Transient thermal resistance (max.)



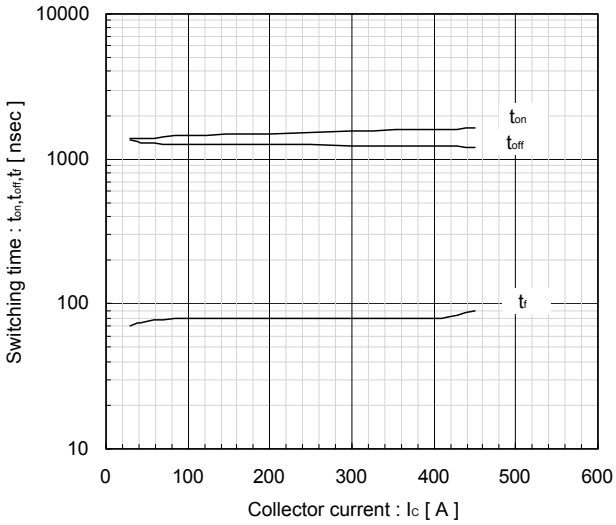
Power derating for IGBT (max.)  
 [per device]



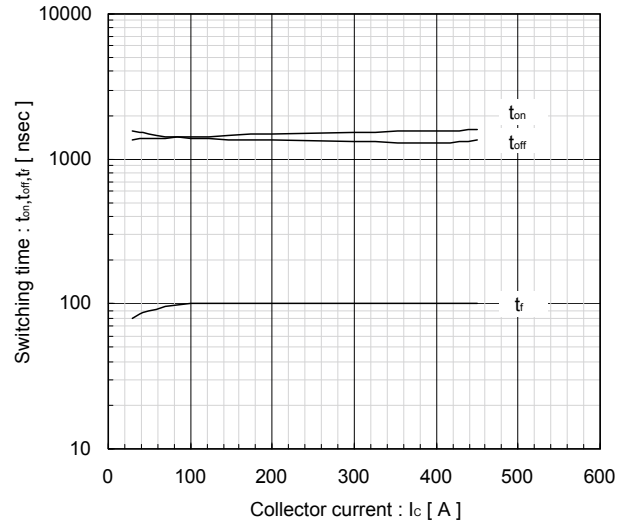
Power derating for FWD (max.)  
 [per device]



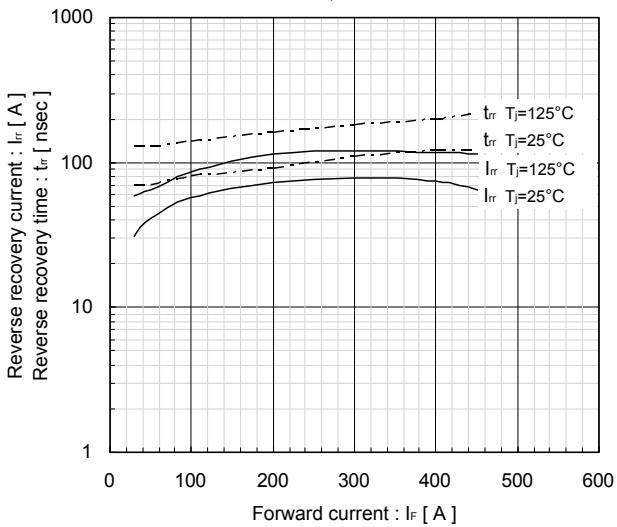
Switching time vs. Collector current (typ.)  
 $V_{DC}=300V, V_{CC}=15V, T_J=25^\circ C$



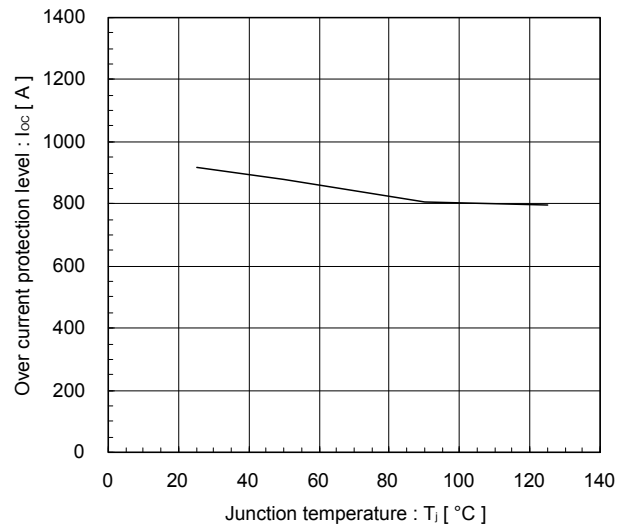
Switching time vs. Collector current (typ.)  
 $V_{DC}=300V, V_{CC}=15V, T_J=125^\circ C$



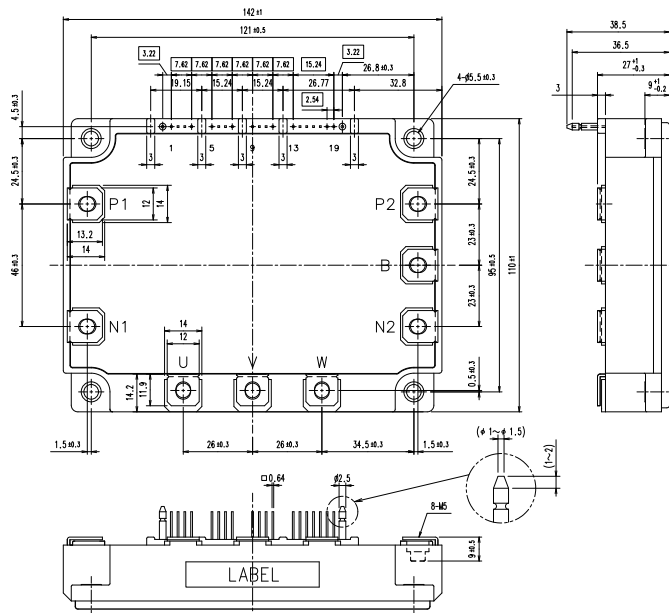
Reverse recovery characteristics (typ.)  
 $t_{rr}, I_{rr}$  vs.  $I_f$



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



■ Outline Drawings, mm



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  - Measurement equipment
  - Machine tools
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