

# 7MBP300VEA060-50

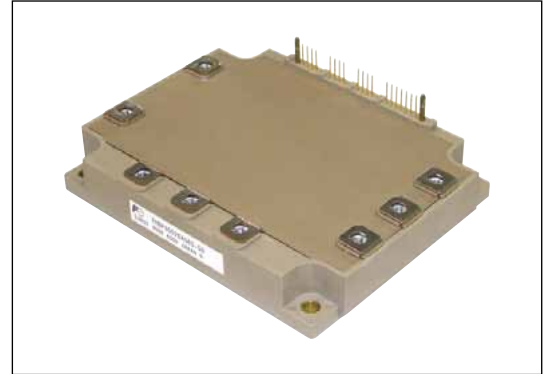
IGBT Modules

## 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>       | -     | 150 | A |
|                                   |                             | 1ms             | I <sub>CP</sub>      | -     | 300 | A |
|                                   | Forward Current of Diode    | I <sub>F</sub>  | -                    | 150   | A   |   |
|                                   | Collector Power Dissipation | 1 device (*3)   | P <sub>C</sub>       | -     | 625 | 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<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±1 sec. 1 time.

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

● Electrical Characteristics (T<sub>J</sub>=25°C, V<sub>cc</sub>=15V 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> =300A                                      | Terminal                                    | -    | -    | 1.90  | V  |
|  |  |  |   | Chip  | -    | 1.25 | -     | V  |
|  | Forward voltage of FWD (*10)               | V <sub>F</sub>   | I <sub>F</sub> =300A                                      | Terminal                                    | -    | -    | 2.45  | V  |
| Chip   |  |  |   | -   | 1.80 | -    | V     |    |
| Brake  | 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> =150A                                      | Terminal                                    | -    | -    | 1.85  | V  |
|  |  |  |   | Chip  | -    | 1.40 | -     | V  |
|  | Forward voltage of FWD (*10)               | V <sub>F</sub>   | I <sub>F</sub> =150A                                      | Terminal                                    | -    | -    | 2.55  | V  |
| Chip   |  |  |   | -   | 2.05 | -    | V     |    |
| Switching time                                       | t <sub>on</sub>                            | V <sub>DC</sub> =300V, T <sub>J</sub> =125°C, I <sub>C</sub> =300A |   | 1.1   | -    | -    | μs    |    |
|  | t <sub>off</sub>                           |  |   | -   | -    | 2.1  | μs    |    |
|  | t <sub>rr</sub>                            |  |   | V <sub>DC</sub> =300V, I <sub>F</sub> =300A | -    | -    | 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 | -   | -    | 36   | mA    |    |
| Supply current of N-side pre-driver                  |  | I <sub>ccn</sub>   |   | -   | -    | 127  | 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                                     | 450   | -    | -    | A     |    |
|  | Brake                                      |  |   | 225   | -    | -    | 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<sub>c</sub> = 25°C)

| Items  |          |      | Symbol                | Min. | Typ. | Max.  | Units |
|--|----------|------|-----------------------|------|------|-------|-------|
| Junction to Case Thermal Resistance (*11)    | Inverter | IGBT | R <sub>th(j-c)Q</sub> | -    | -    | 0.135 | °C/W  |
|  |          | FWD  | R <sub>th(j-c)D</sub> | -    | -    | 0.230 | °C/W  |
|  | Brake    | IGBT | R <sub>th(j-c)Q</sub> | -    | -    | 0.200 | °C/W  |
|  |          | FWD  | R <sub>th(j-c)D</sub> | -    | -    | 0.480 | °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<sub>DC</sub>=300V, V<sub>CC</sub>=15V)

| Items                         | Conditions   | Min. | Typ. | Max. | Units |
|-------------------------------|--|------|------|------|-------|
| Common mode rectangular noise | Pulse width 1μs, polarity ±, 10 min.<br>Judge : no over-current, no miss operating | ±2.0 | -    | -    | kV    |

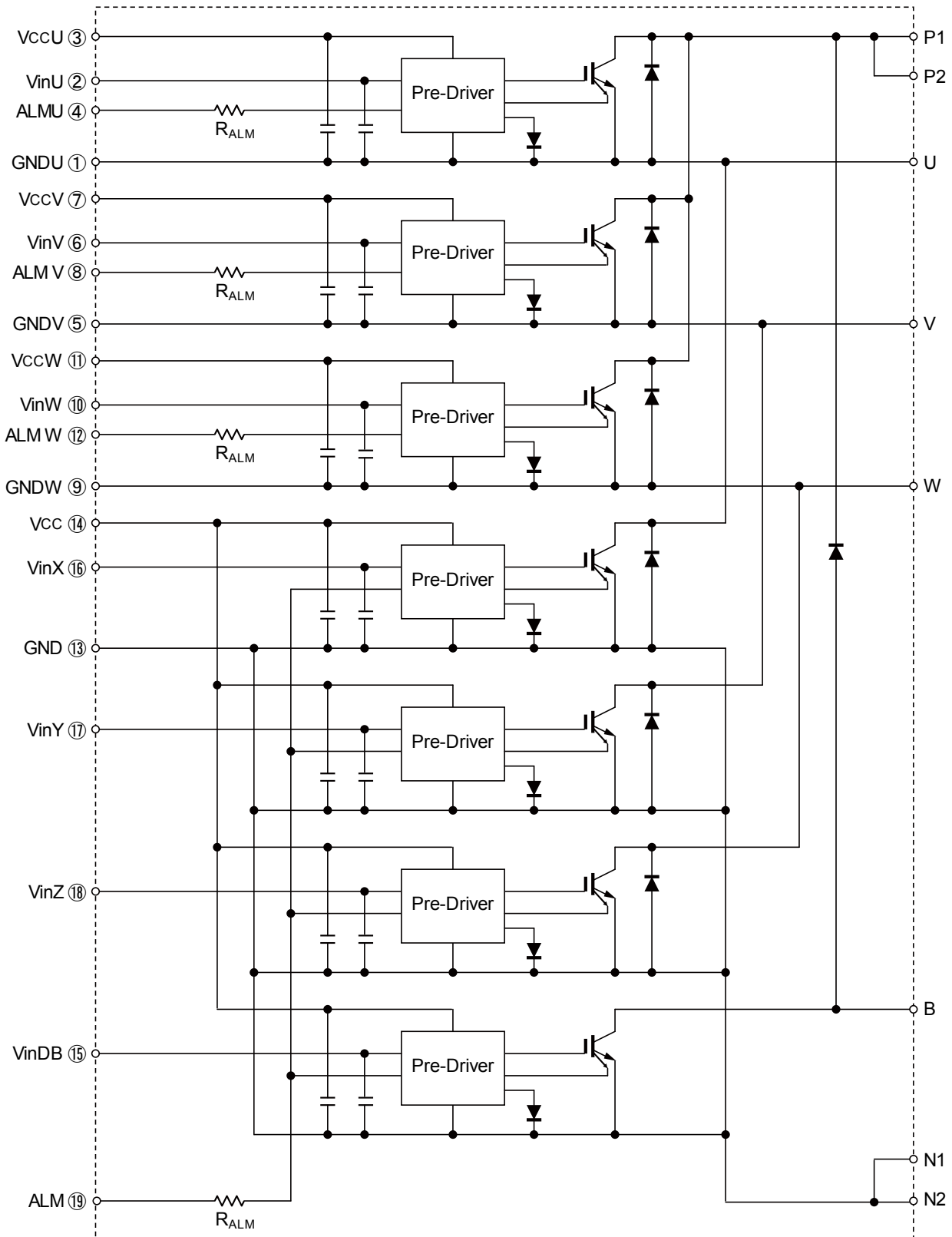
● Recommended Operating Conditions

| Items  | Symbol            | Min. | Typ. | Max. | Units |
|--|-------------------|------|------|------|-------|
| DC Bus Voltage   | V <sub>DC</sub>   | -    | -    | 400  | V     |
| Power Supply Voltage of Pre-Driver                     | V <sub>CC</sub>   | 13.5 | 15.0 | 16.5 | V     |
| Switching frequency of IPM                             | f <sub>sw</sub>   | -    | -    | 20   | kHz   |
| Arm shoot through blocking time for IPM's input signal | t <sub>dead</sub> | 1.0  | -    | -    | μs    |
| Screw Torque (M5)                                      | -                 | 2.5  | -    | 3.5  | Nm    |

● Weight

| Items  | Symbol | Min. | Typ. | Max. | Units |
|--------|--------|------|------|------|-------|
| Weight | Wt     | -    | 980  | -    | g     |

■ Block Diagram

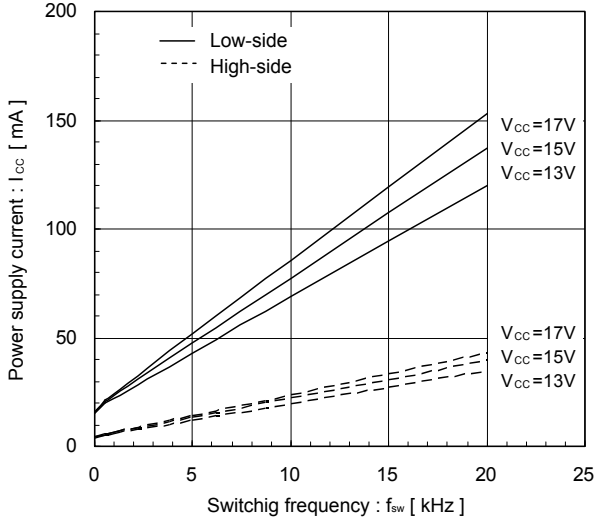


Pre-drivers include following functions

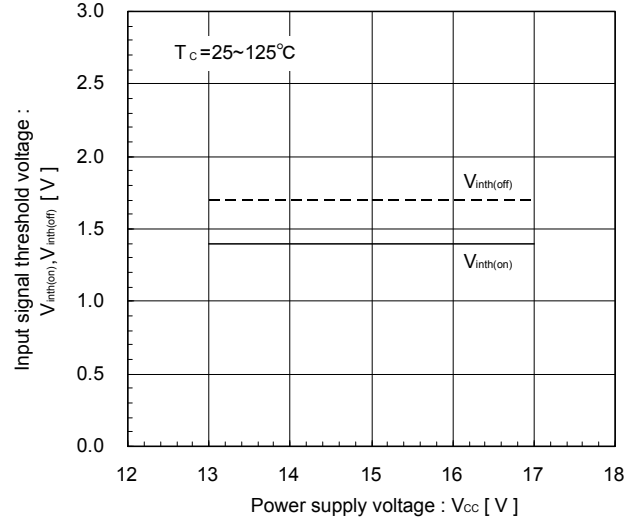
1. Amplifier for driver
2. Short circuit protection
3. Under voltage lockout circuit
4. Over current protection
5. IGBT chip over heating protection

■ Characteristics (Representative)

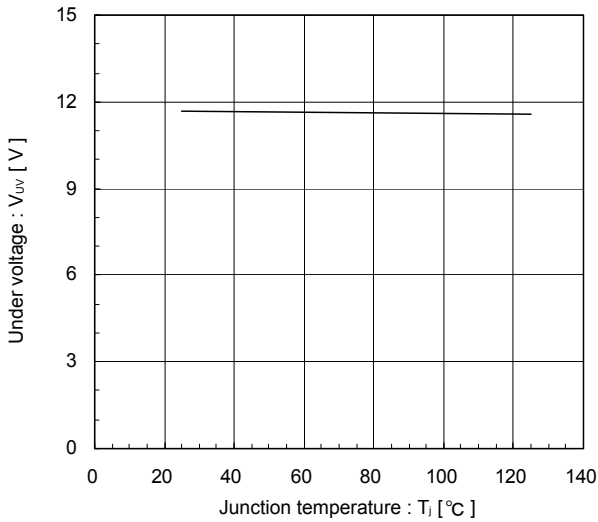
Power supply current vs. Switching frequency  
 $T_j = 25^\circ\text{C}$  (typ.)



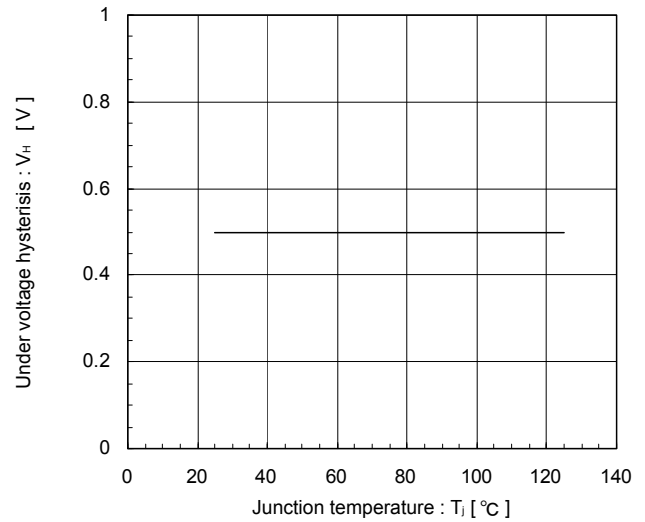
Input signal threshold voltage vs. Power supply voltage (typ.)



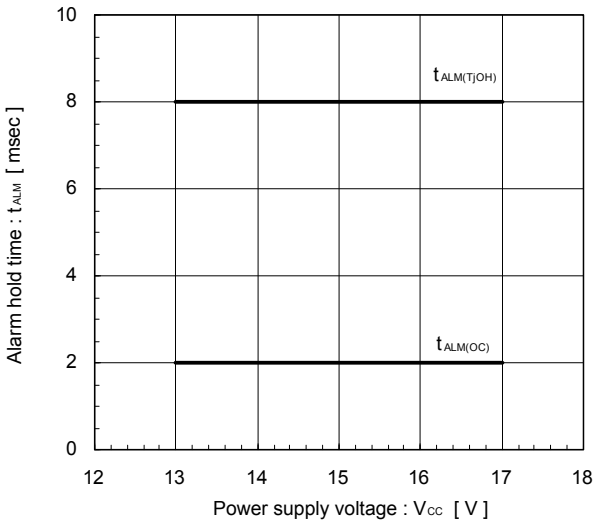
Under voltage vs. Junction temperature (typ.)



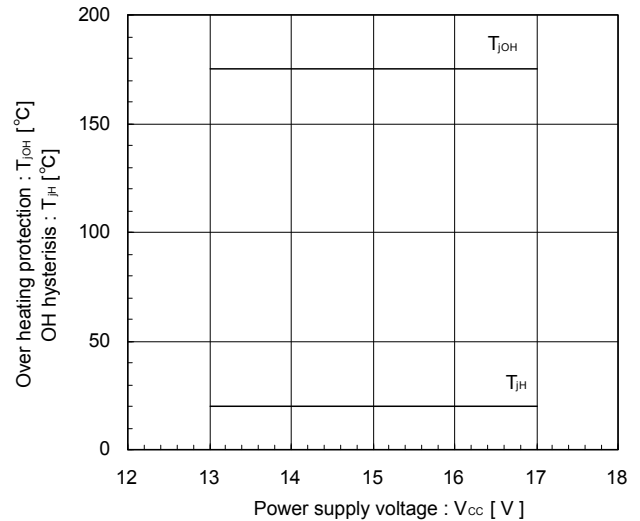
Under voltage hysteresis vs. Junction temperature (typ.)



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

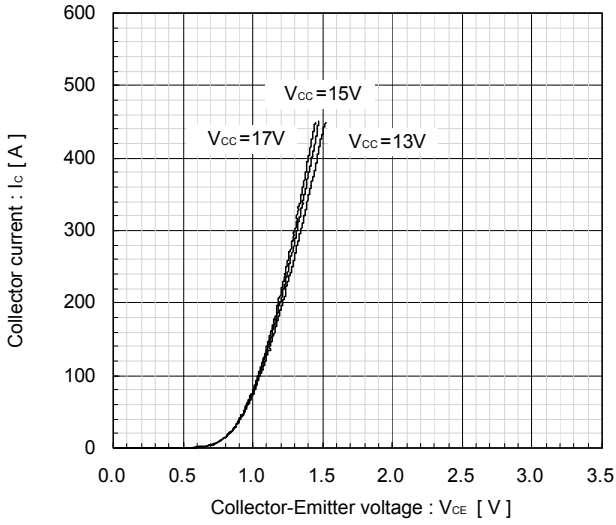


Over heating characteristics  
 $T_{jOH}, T_{jH}$  vs.  $V_{cc}$  (typ.)

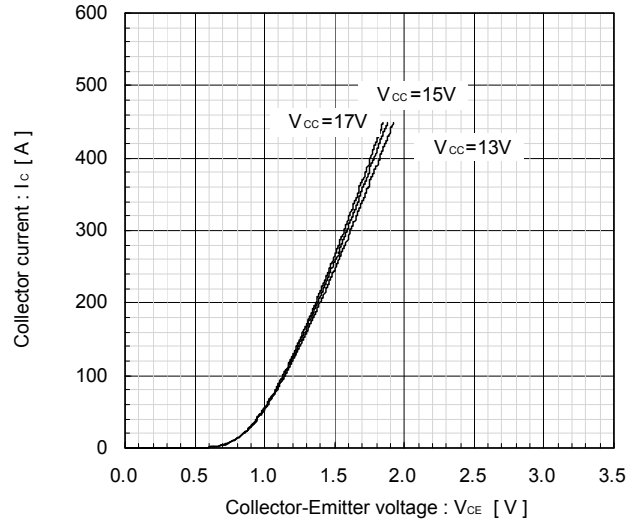


Inverter

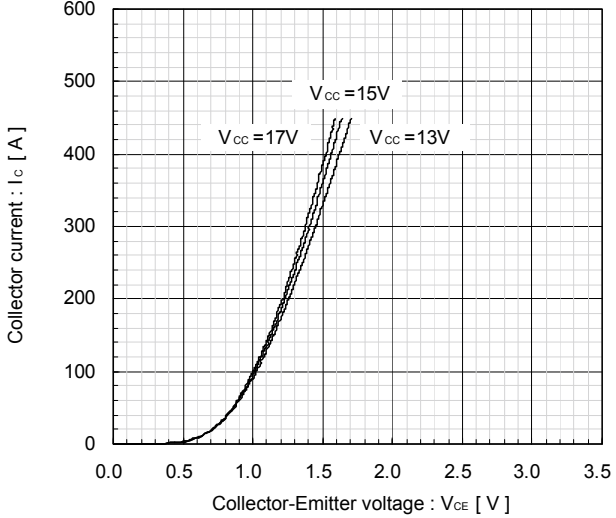
Collector current vs. Collector-Emitter voltage  
 $T_j = 25^\circ\text{C}$  [Chip] (typ.)



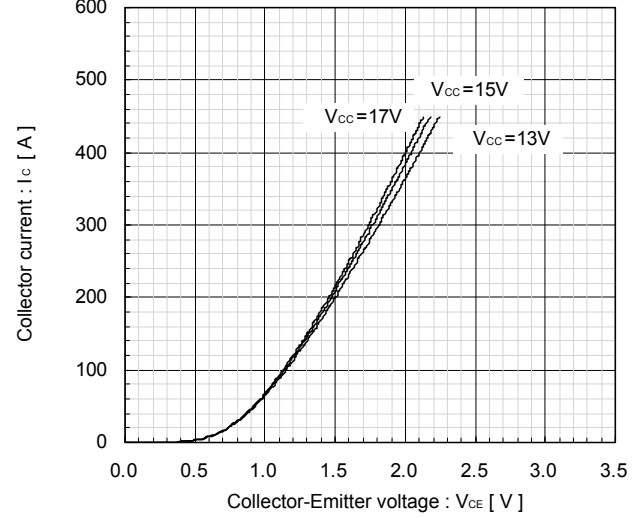
Collector current vs. Collector-Emitter voltage  
 $T_j = 25^\circ\text{C}$  [Terminal] (typ.)



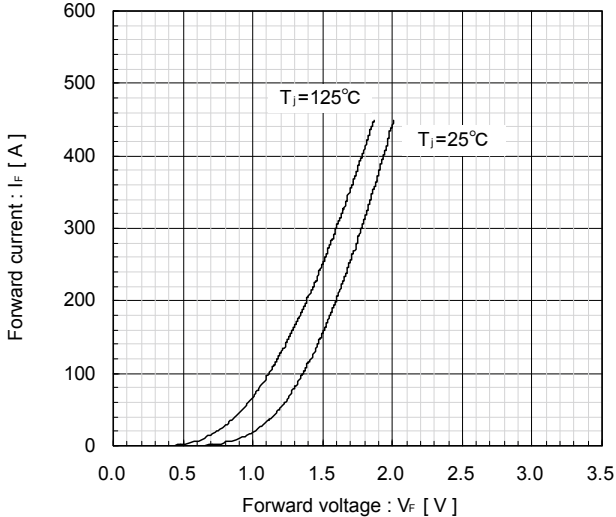
Collector current vs. Collector-Emitter voltage  
 $T_j = 125^\circ\text{C}$  [Chip] (typ.)



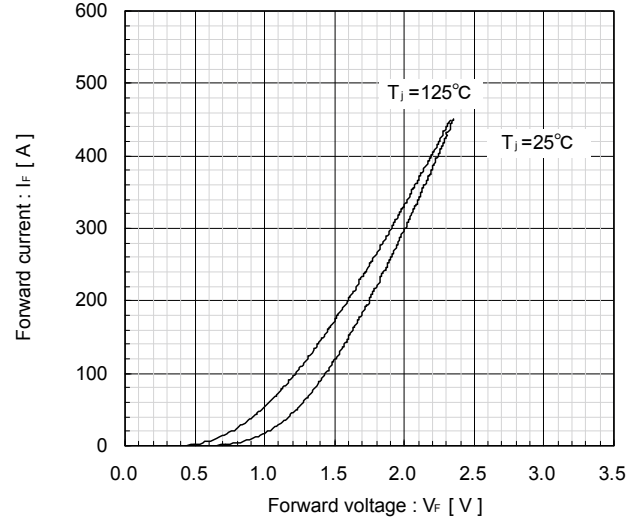
Collector current vs. Collector-Emitter voltage  
 $T_j = 125^\circ\text{C}$  [Terminal] (typ.)



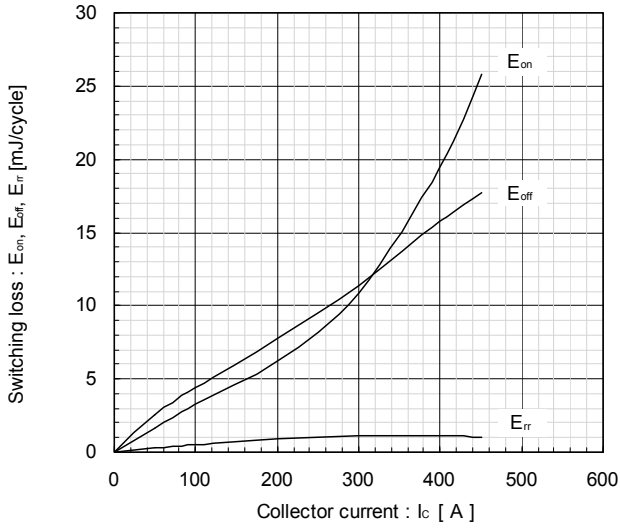
Forward current vs. Forward voltage  
 [Chip] (typ.)



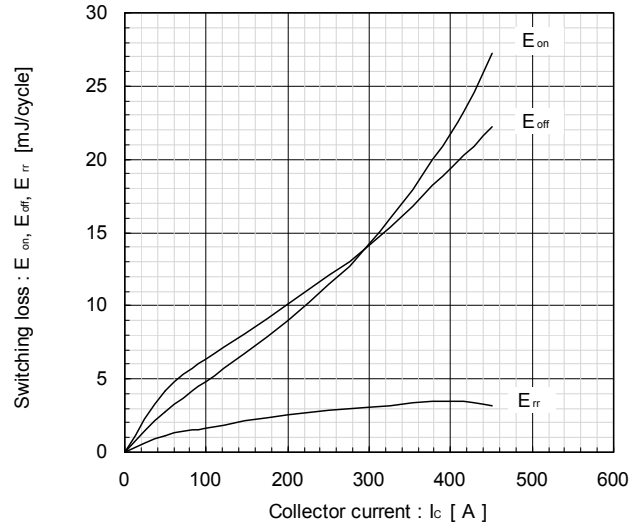
Forward current vs. Forward voltage  
 [Terminal] (typ.)



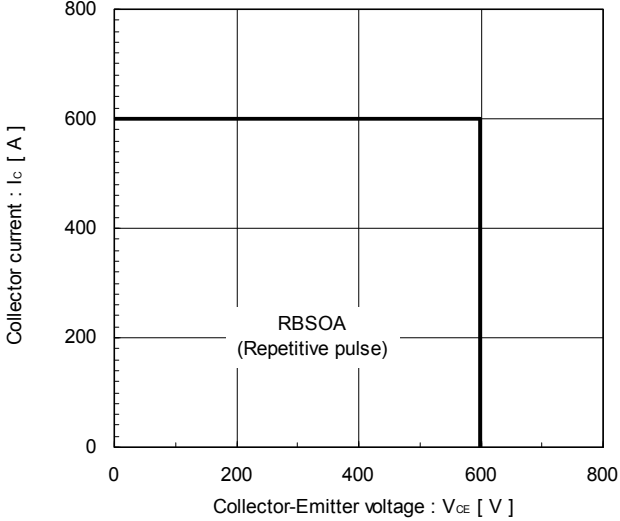
Switching Loss vs. Collector Current (typ.)  
 $V_{DC}=300V, V_{CC}=15V, T_j=25^\circ C$



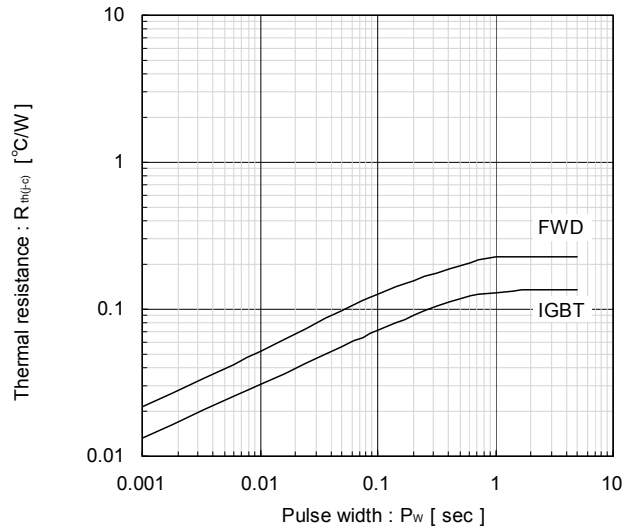
Switching Loss vs. Collector Current (typ.)  
 $V_{DC}=300V, V_{CC}=15V, T_j=125^\circ C$



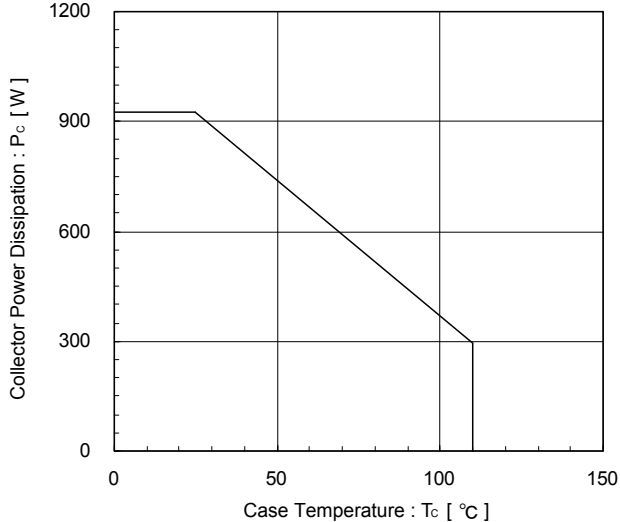
Reversed biased safe operating area  
 $V_{CC}=15V, T_j \le 125^\circ C$  [Main Terminal] (min.)



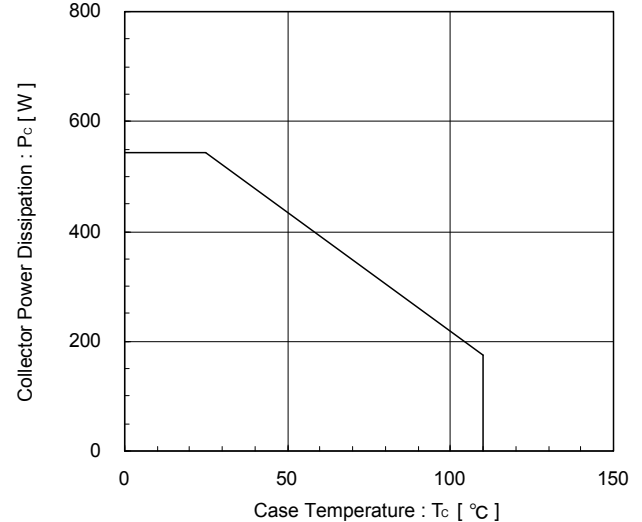
Transient thermal resistance (max.)



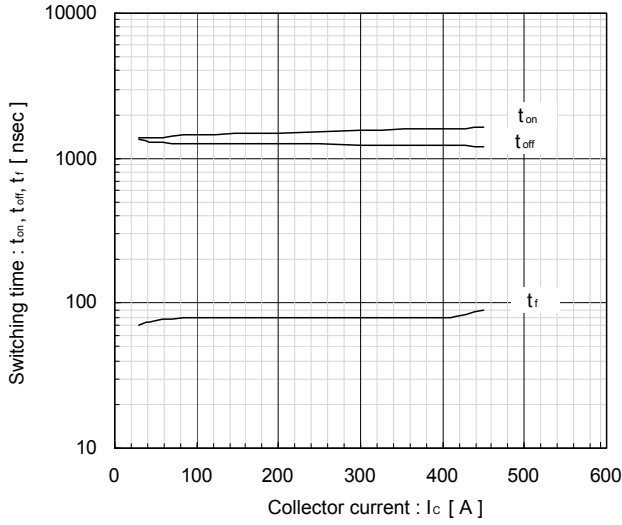
Power derating for IGBT (max.)  
 [per device]



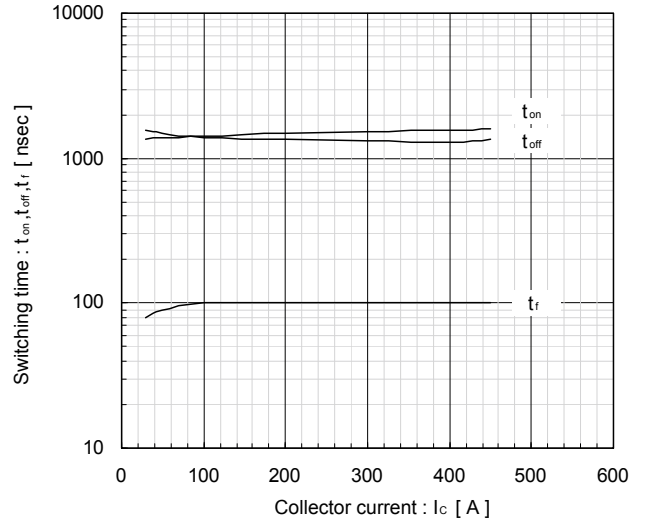
Power derating for FWD (max.)  
 [per device]



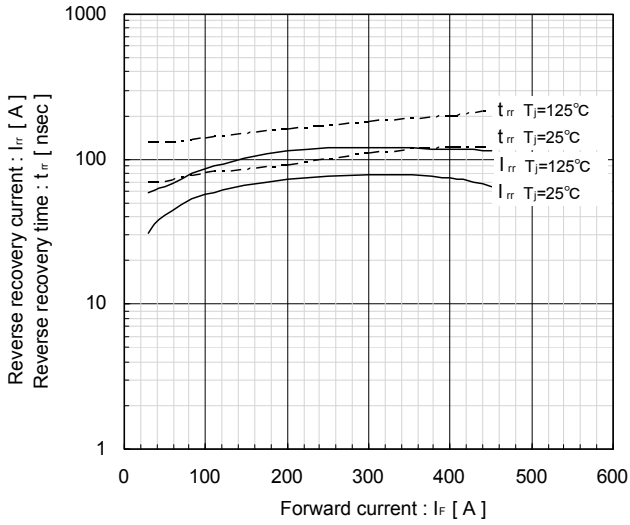
Switching time vs. Collector current (typ.)  
 $V_{DC}=300V, V_{CC}=15V, T_J=25^\circ C$



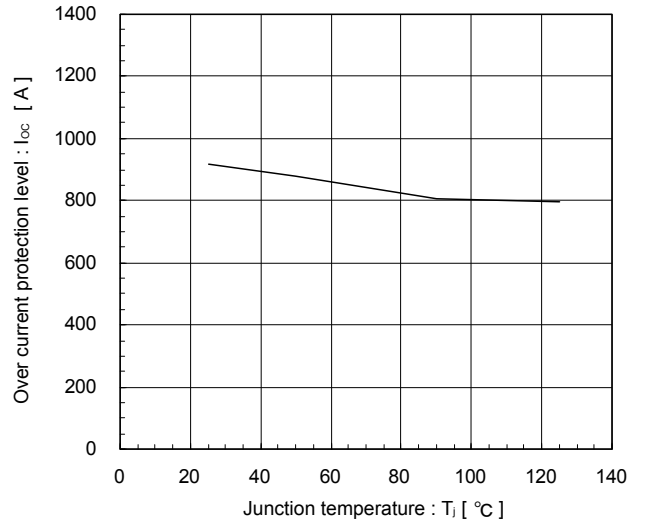
Switching time vs. Collector current (typ.)  
 $V_{DC}=300V, V_{CC}=15V, T_J=125^\circ C$



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

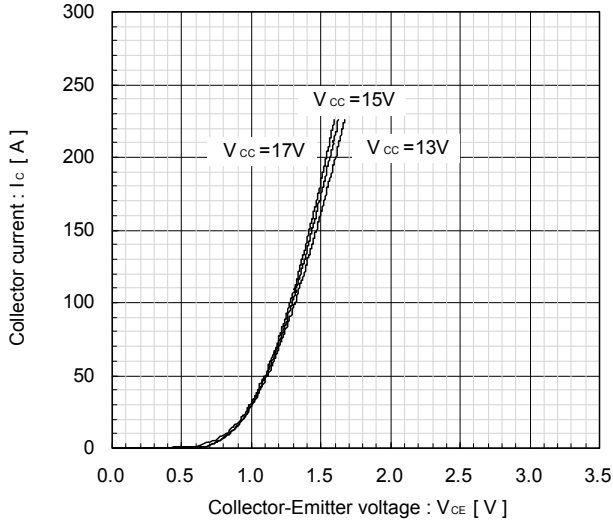


Over current protection vs. Junction temperature (typ.)  
 $V_{CC}=15V$

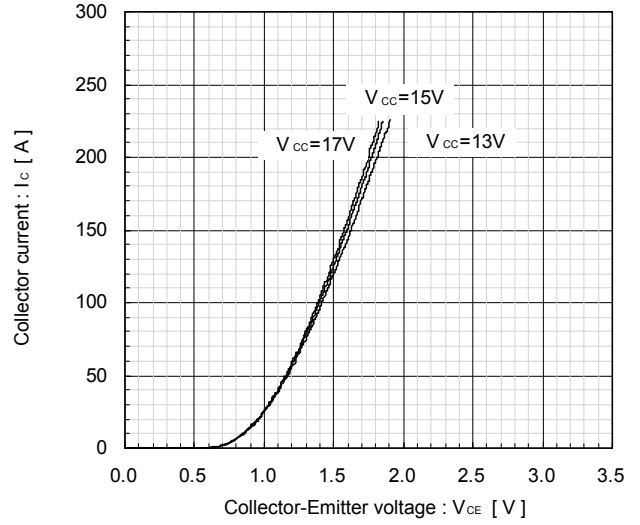


Brake

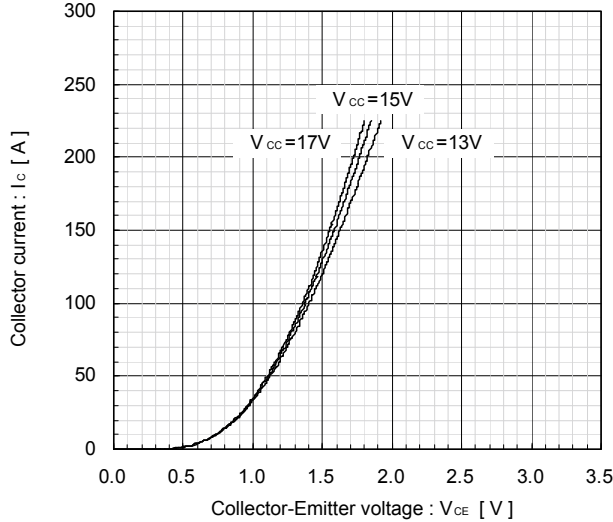
Collector current vs. Collector-Emitter voltage  
 $T_J = 25^\circ\text{C}$  [Chip] (typ.)



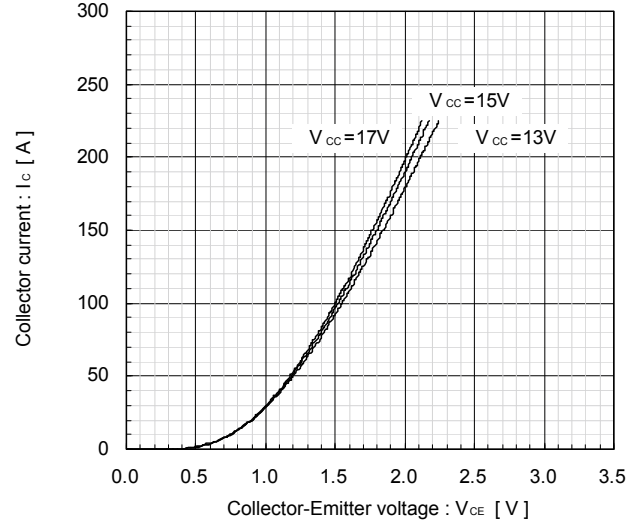
Collector current vs. Collector-Emitter voltage  
 $T_J = 25^\circ\text{C}$  [Terminal] (typ.)



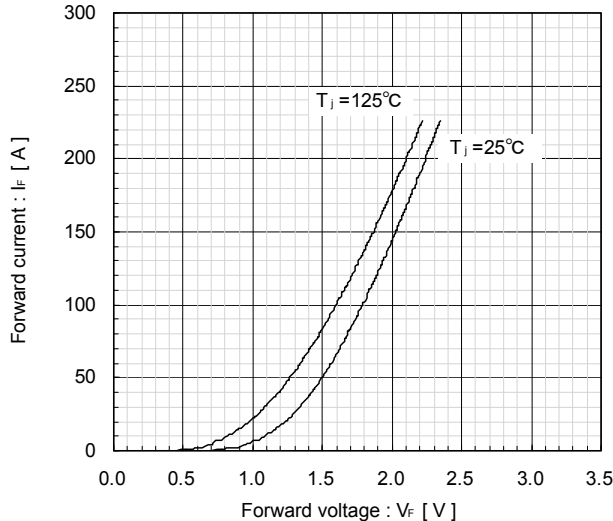
Collector current vs. Collector-Emitter voltage  
 $T_J = 125^\circ\text{C}$  [Chip] (typ.)



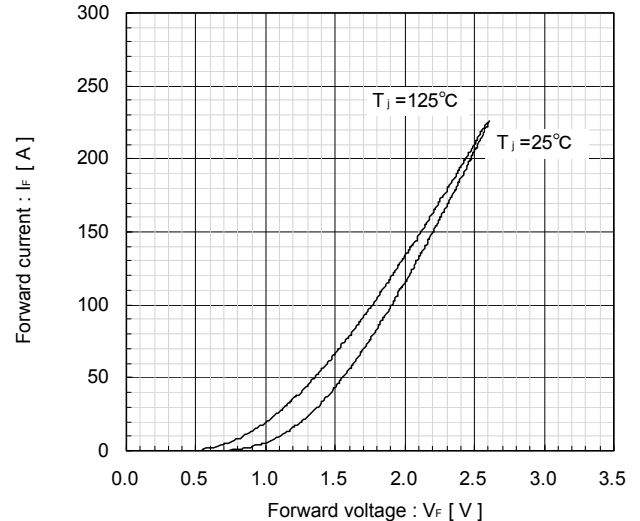
Collector current vs. Collector-Emitter voltage  
 $T_J = 125^\circ\text{C}$  [Terminal] (typ.)



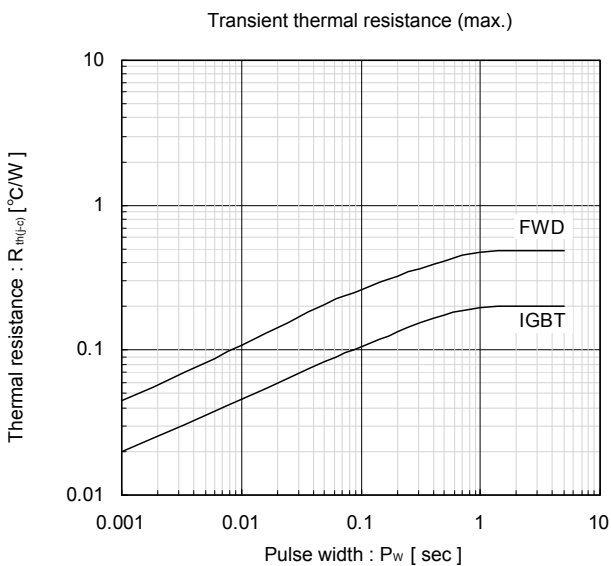
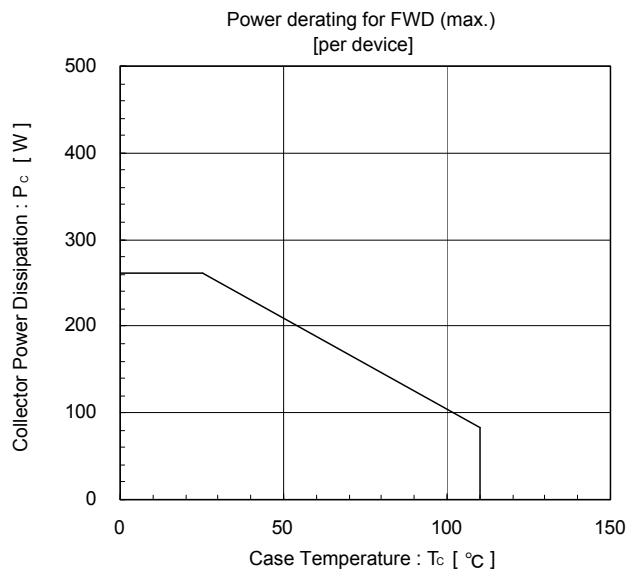
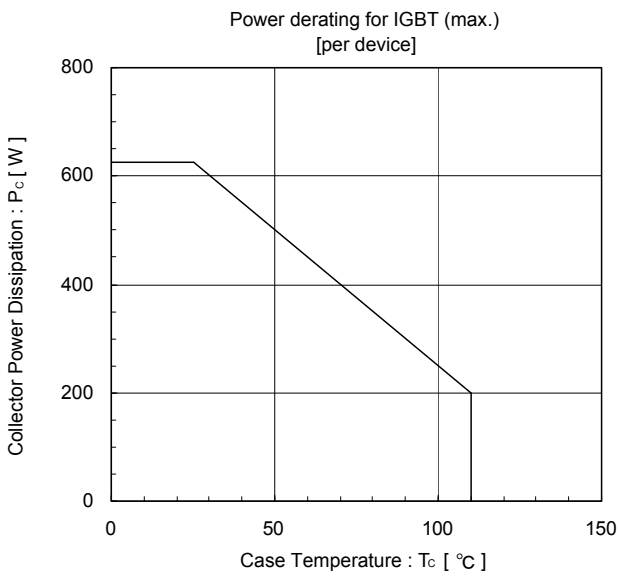
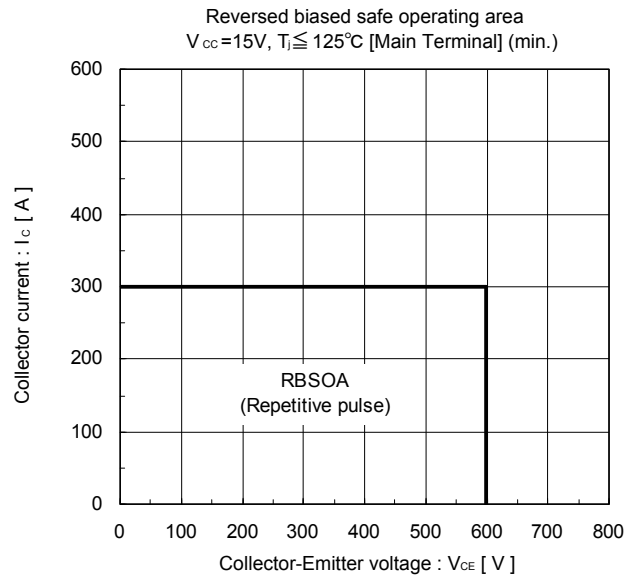
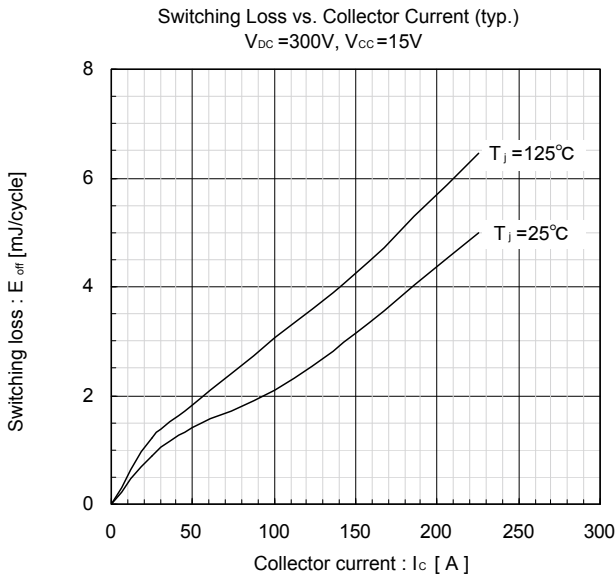
Forward current vs. Forward voltage  
 [Chip] (typ.)



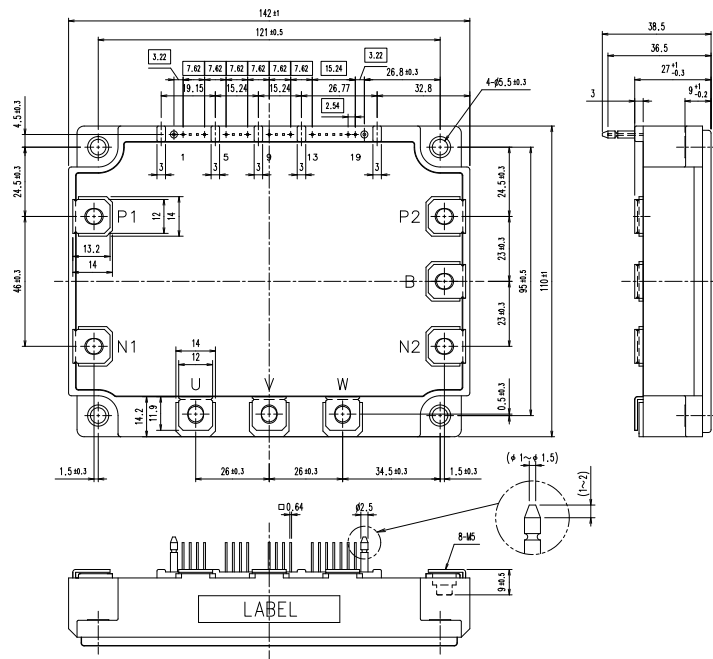
Forward current vs. Forward voltage  
 [Terminal] (typ.)







■ Outline Drawings, mm



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  - Measurement equipment
  - Machine tools
  - Audiovisual equipment
  - Electrical home appliances
  - Personal equipment
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  - Gas leakage detectors with an auto-shut-off feature
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  - Safety devices
  - Medical equipment
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