

## Econo IPM series

600V / 75A 7 in one-package

### 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(at Tc=25°C unless otherwise specified)

| Item                                                          |                             |                   | Symbol                 | Rating |                      | Unit |
|---------------------------------------------------------------|-----------------------------|-------------------|------------------------|--------|----------------------|------|
|                                                               |                             |                   |                        | Min.   | Max.                 |      |
| Bus voltage                                                   | DC                          |                   | V <sub>DC</sub>        | 0      | 450                  | V    |
|                                                               | Surge                       |                   | V <sub>DC(surge)</sub> | 0      | 500                  | V    |
|                                                               | Short operating             |                   | V <sub>SC</sub>        | 200    | 400                  | V    |
| Collector-Emitter voltage *1                                  |                             |                   | V <sub>CES</sub>       | 0      | 600                  | V    |
| Inverter                                                      | Collector current           | DC                | I <sub>C</sub>         | -      | 75                   | A    |
|                                                               |                             | 1ms               | I <sub>CP</sub>        | -      | 150                  | A    |
|                                                               |                             | Duty=75.0% *2     | -I <sub>C</sub>        | -      | 75                   | A    |
|                                                               | Collector power dissipation | One transistor *3 | P <sub>C</sub>         | -      | 198                  | W    |
|                                                               | Collector current           | DC                | I <sub>C</sub>         | -      | 50                   | A    |
|                                                               |                             | 1ms               | I <sub>CP</sub>        | -      | 100                  | A    |
|                                                               | Forward current diode       |                   | I <sub>F</sub>         | -      | 50                   | A    |
|                                                               | Collector power dissipation | One transistor *3 | P <sub>C</sub>         | -      | 198                  | 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    |
| Input signal current                                          |                             |                   | I <sub>in</sub>        | -      | 3                    | mA   |
| 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    | 100                  | °C   |
| Storage temperature                                           |                             |                   | T <sub>stg</sub>       | -40    | 125                  | °C   |
| Solder temperature *8                                         |                             |                   | T <sub>sol</sub>       | -      | 260                  | °C   |
| Isolating voltage (Terminal to base, 50/60Hz sine wave 1min.) |                             |                   | V <sub>iso</sub>       | -      | AC2500               | V    |
| Screw torque                                                  | Mounting (M5)               |                   |                        | -      | 3.5                  | N·m  |

#### Note

\*1 : V<sub>CES</sub> shall be applied to the input voltage between terminal P and U or ,u or W, N and U or V or W

\*2 : 125°C/FWD R<sub>th(j-c)</sub>/(I<sub>C</sub> x V<sub>F</sub> MAX)=125/0.855/(75 x 2.6) x 100=75.0%

\*3 : P<sub>C</sub>=125°C/IGBT R<sub>th(j-c)</sub>=125/0.63=198W [Inverter]

P<sub>C</sub>=125°C/IGBT R<sub>th(j-c)</sub>=125/0.63=198W [Breake]

\*4 : V<sub>CC</sub> shall be applied to the input voltage between terminal No.4 and 1, 8 and 5, 12 and 9, 14 and 13

\*5 : V<sub>in</sub> shall be applied to the input voltage between terminal No.3 and 1, 7 and 5, 11 and 9, 16,17,18 and 13.

\*6 : V<sub>ALM</sub> shall be applied to the voltage between terminal No.2 and 1, No6 and 5, No10 and 9, No.19 and 13.

\*7 : I<sub>ALM</sub> shall be applied to the input current to terminal No.2,6,10 and 19.

\*8 : Immersion time 10±1sec.

Electrical characteristics (at Tc=Tj=25°C, Vcc=15V unless otherwise specified.)

## ● Main circuit

| Main circuit                                   |                                       | Symbol   | Condition                                                             | Min.     | Typ. | Max. | Unit |   |
|------------------------------------------------|---------------------------------------|----------|-----------------------------------------------------------------------|----------|------|------|------|---|
| Inverter                                       | Collector current at off signal input | ICES     | VCE=600V Vin terminal open.                                           | -        | -    | 1.0  | mA   |   |
|                                                | Collector-Emitter saturation voltage  | VCE(sat) | Ic=75A                                                                | Terminal | -    | -    | 2.4  | V |
|                                                |                                       |          |                                                                       | Chip     | -    | 2.0  | -    |   |
|                                                | Forward voltage of FWD                | VF       | -Ic=75A                                                               | Terminal | -    | -    | 2.6  | V |
|                                                |                                       |          |                                                                       | Chip     | -    | 1.6  | -    |   |
| Brake                                          | Collector current at off signal input | ICES     | VCE=600V Vin terminal open.                                           | -        | -    | 1.0  | mA   |   |
|                                                | Collector-Emitter saturation voltage  | VCE(sat) | Ic=50A                                                                | Terminal | -    | -    | 2.2  | V |
|                                                |                                       |          |                                                                       | Chip     | -    | 1.75 | -    |   |
|                                                | Forward voltage of Diode              | VF       | -Ic=50A                                                               | Terminal | -    | -    | 3.3  | V |
|                                                |                                       |          |                                                                       | Chip     | -    | 1.9  | -    |   |
| Turn-on time                                   |                                       | ton      | VDC=300V,Tj=125°C                                                     | 1.2      | -    | -    | μs   |   |
| Turn-off time                                  |                                       | toff     | IC=75A Fig.1, Fig.6                                                   | -        | -    | 3.6  |      |   |
| Reverse recovery time                          |                                       | trr      | VDC=300V, IC=75A Fig.1, Fig.6                                         | -        | -    | 0.3  |      |   |
| Maximum Avalanche Energy<br>(A non-repetition) |                                       | PAV      | Internal wiring inductance=50nH<br>Main circuit wiring inductace=54nH | 40       | -    | -    | mJ   |   |

## ● Control circuit

| Item                                               | Symbol  | Condition                                                 | Min. | Typ. | Max. | Unit |
|----------------------------------------------------|---------|-----------------------------------------------------------|------|------|------|------|
| Supply current of P-line side pre-driver(one unit) | Iccp    | Switching Frequency : 0 to 15kHz<br>Tc=-20 to 125°C Fig.7 | -    | -    | 18   | mA   |
| Supply current of N-line side pre-driver           | IccN    |                                                           | -    | -    | 65   | mA   |
| Input signal threshold voltage (on/off)            | Vin(th) | ON                                                        | 1.00 | 1.35 | 1.70 | V    |
|                                                    |         | OFF                                                       | 1.25 | 1.60 | 1.95 | V    |
| Input zener voltage                                | Vz      | Rin=20k ohm                                               | -    | 8.0  | -    | V    |
| Alarm signal hold time                             | tALM    | Tc=-20°C Fig.2                                            | 1.1  | -    | -    | ms   |
|                                                    |         | Tc=25°C Fig.2                                             | -    | 2.0  | -    | ms   |
|                                                    |         | Tc=125°C Fig.2                                            | -    | -    | 4.0  | ms   |
| Current limit resistor                             | RALM    | Alarm terminal                                            | 1425 | 1500 | 1575 | ohm  |

## ● Protection Section ( Vcc=15V)

| Item                                              | Symbol | Condition             | Min. | Typ. | Max. | Unit |
|---------------------------------------------------|--------|-----------------------|------|------|------|------|
| Over Current Protection Level of Inverter circuit | Ioc    | Tj=125°C              | 113  | -    | -    | A    |
| Over Current Protection Level of Brake circuit    | Ioc    | Tj=125°C              | 75   | -    | -    | A    |
| Over Current Protection Delay time                | tDOC   | Tj=125°C              | -    | 5    | -    | μs   |
| SC Protection Delay time                          | tSC    | Tj=125°C Fig.4        | -    | -    | 8    | μs   |
| IGBT Chip Over Heating                            | TjOH   | Surface of IGBT chips | 150  | -    | -    | °C   |
| Over Heating Protection Hysteresis                | TjH    |                       | -    | 20   | -    | °C   |
| Under Voltage Protection Level                    | VUV    |                       | 11.0 | -    | 12.5 | V    |
| Under Voltage Protection Hysteresis               | VH     |                       | 0.2  | 0.5  | -    | V    |

## ● Thermal characteristics( Tc=25°C)

| Item                                         |          |      | Symbol   | Min. | Typ. | Max.  | Unit |
|----------------------------------------------|----------|------|----------|------|------|-------|------|
| Junction to Case thermal resistance *9       | Inverter | IGBT | Rth(j-c) | -    | -    | 0.63  | °C/W |
|                                              |          | FWD  | Rth(j-c) | -    | -    | 0.855 | °C/W |
|                                              | Brake    | IGBT | Rth(j-c) | -    | -    | 0.63  | °C/W |
| Case to fin thermal resistance with compound |          |      | Rth(c-f) | -    | 0.05 | -     | °C/W |

\*9 For 1 device, Case is under the device

## ● Noise Immunity ( VDC=300V, Vcc=15V, Test Circuit Fig.5)

| Item                          | Condition                                                                                               | Min. | Typ. | Max. | Unit |
|-------------------------------|---------------------------------------------------------------------------------------------------------|------|------|------|------|
| Common mode rectangular noise | Pulse width 1μs, polarity ±, 10minuets<br>Judge : no over-current, no miss operating                    | ±2.0 | -    | -    | kV   |
| Common mode lightning surge   | Rise time 1.2μs, Fall time 50μs<br>Interval 20s, 10 times<br>Judge : no over-current, no miss operating | ±5.0 | -    | -    | kV   |

## ● Recommendable value

| Item                                   | Symbol | Min. | Typ. | Max. | Unit |
|----------------------------------------|--------|------|------|------|------|
| DC Bus Voltage                         | VDC    | -    | -    | 400  | V    |
| Operating Supply Voltage of Pre-Driver | VCC    | 13.5 | 15.0 | 16.5 | V    |
| Screw torque (M5)                      | -      | 2.5  | -    | 3.0  | Nm   |

## ● Weight

| Item   | Symbol | Min. | Typ. | Max. | Unit |
|--------|--------|------|------|------|------|
| Weight | Wt     | -    | 270  | -    | g    |

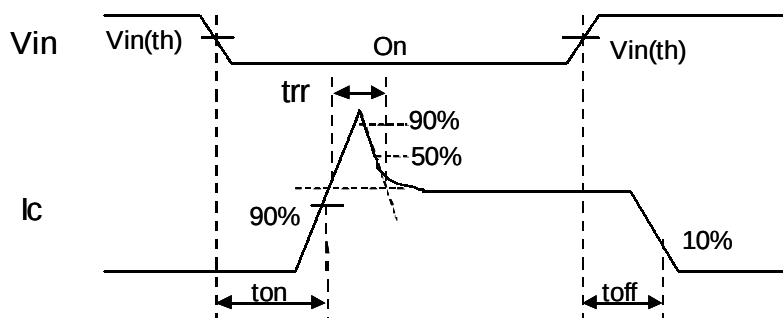
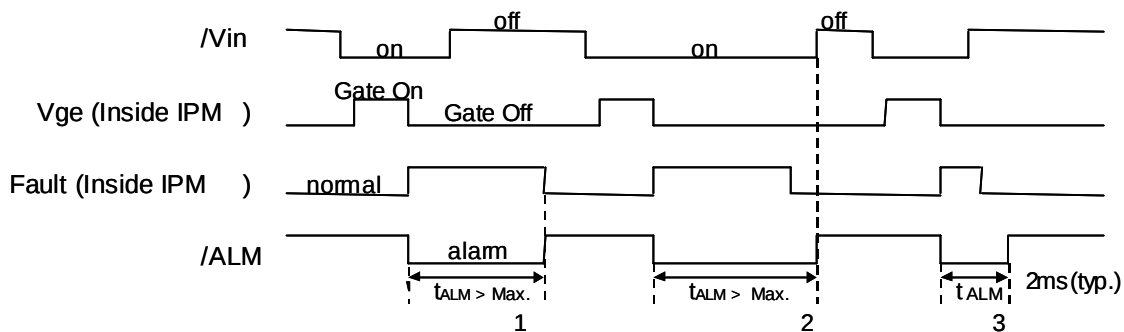


Figure 1. Switching Time Waveform Definitions



Fault : Over-current, Over-heat or Under-voltage

Figure 2. Input/Output Timing Diagram

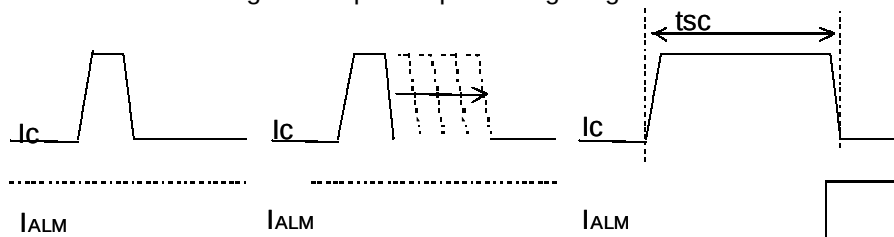


Figure.4 Definition of tsc

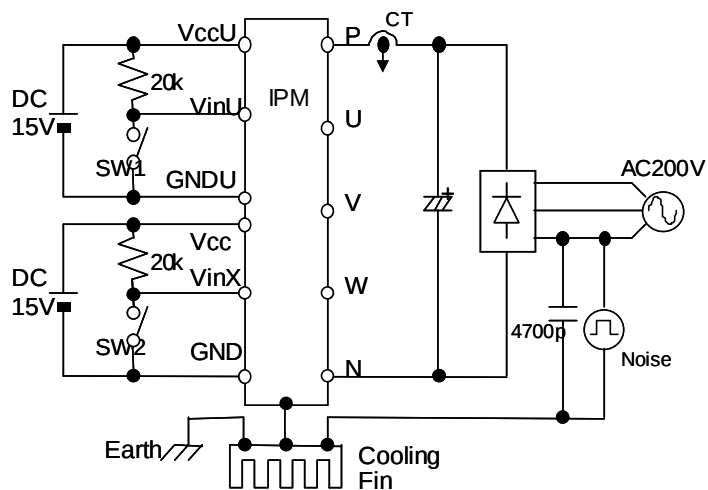


Figure 5. Noise Test Circuit

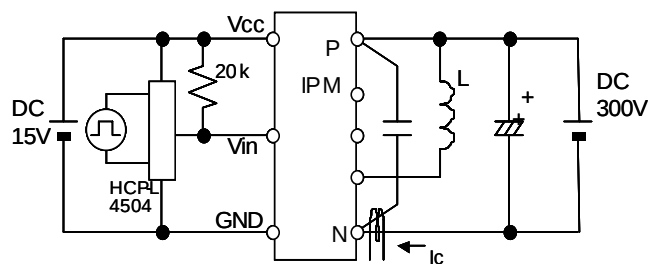


Figure 6. Switching Characteristics Test Circuit

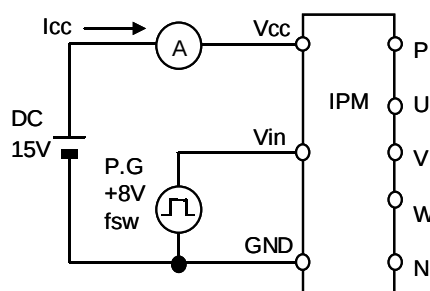
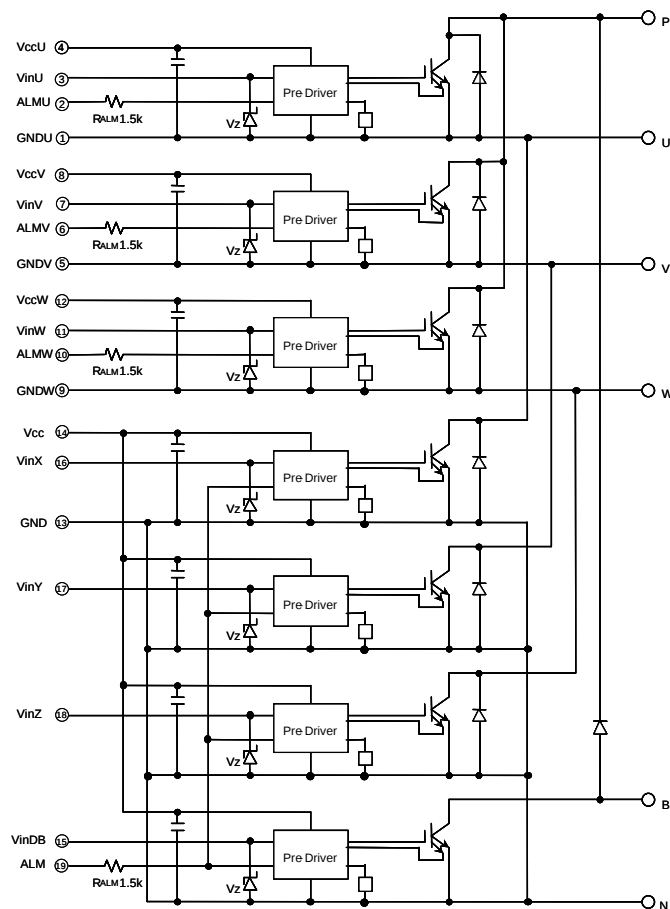


Figure 7. Icc Test Circuit

### ■ Block diagram

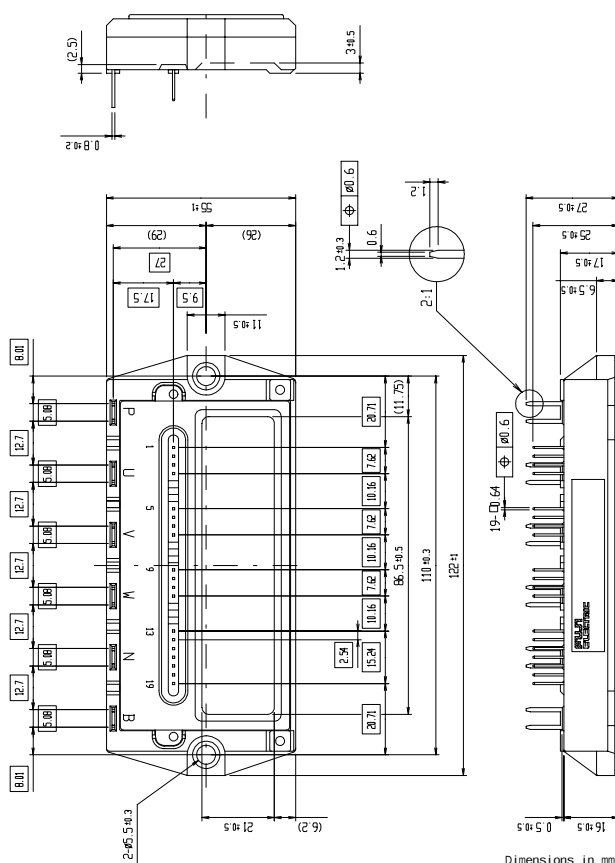


Pre-drivers include following functions

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

### ■ Outline drawings, mm

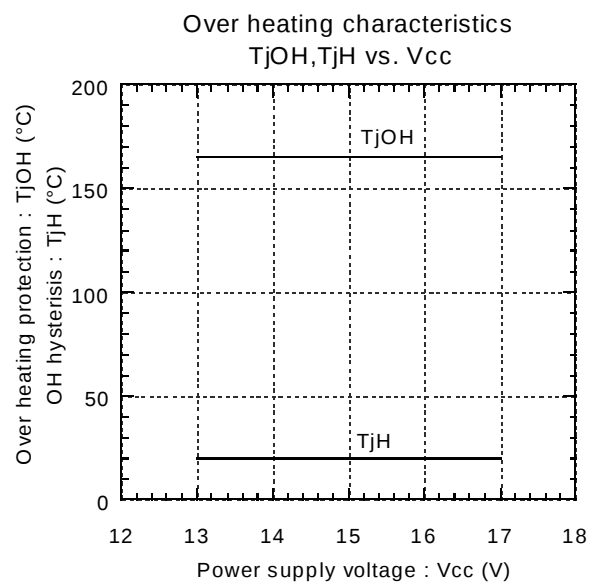
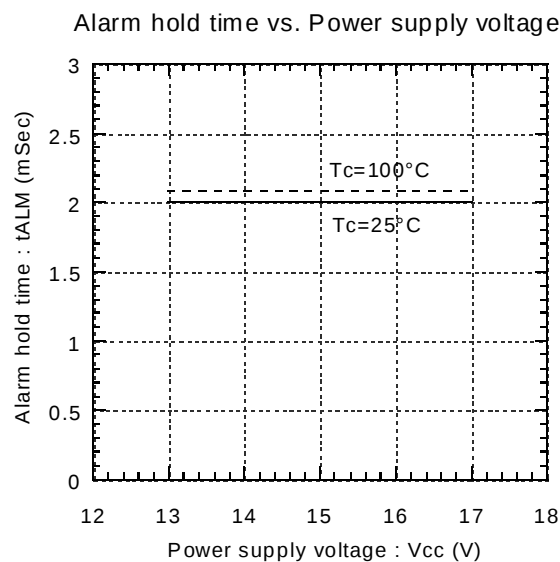
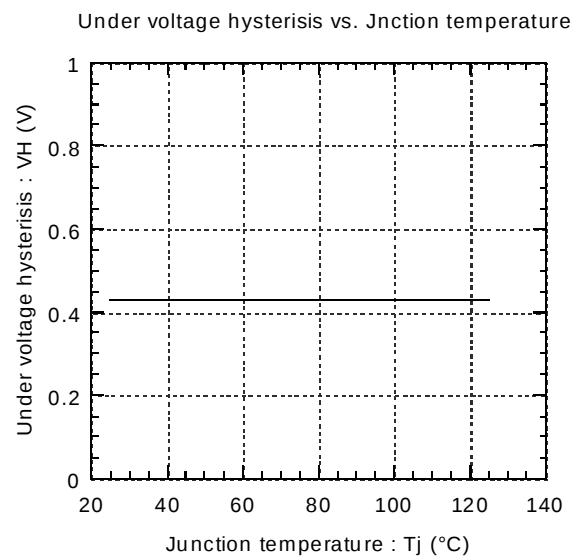
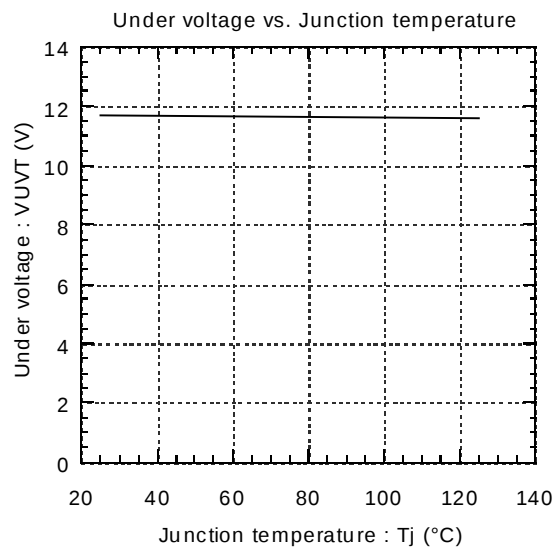
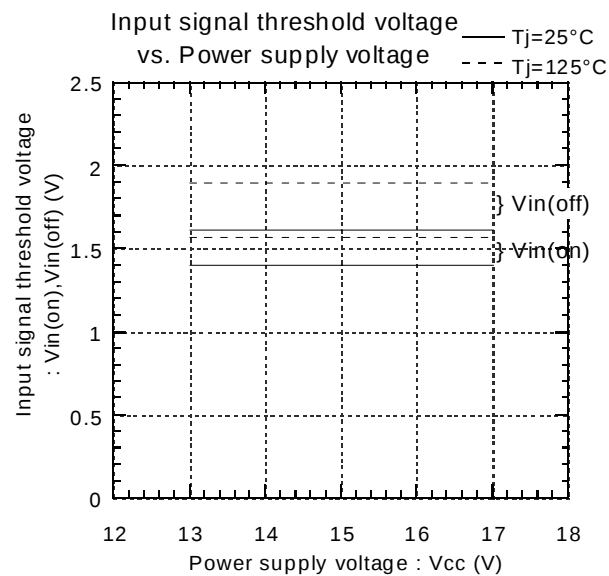
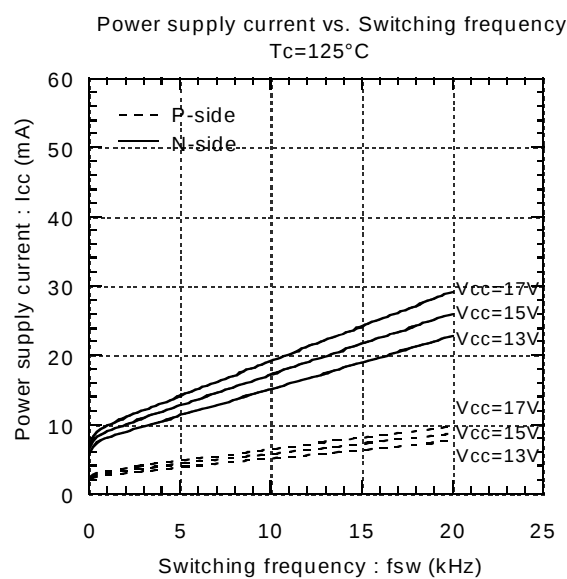
Package type : P622



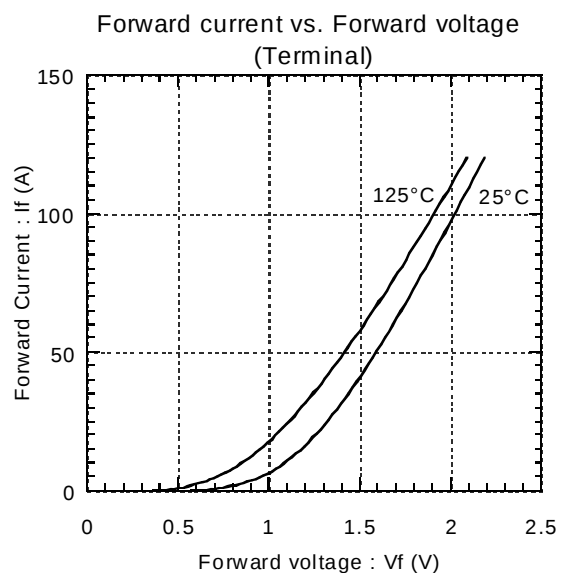
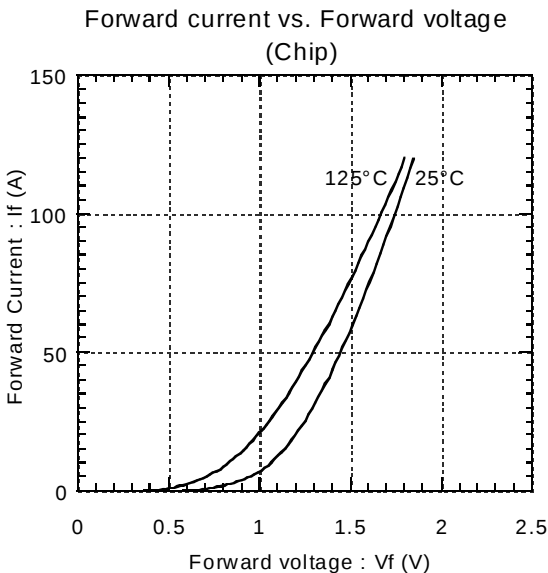
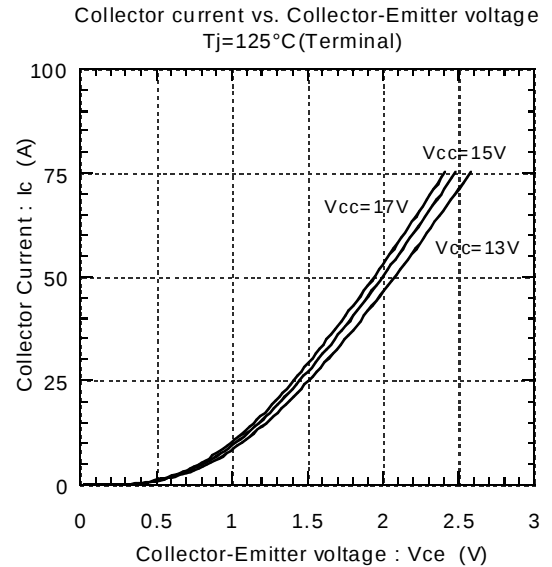
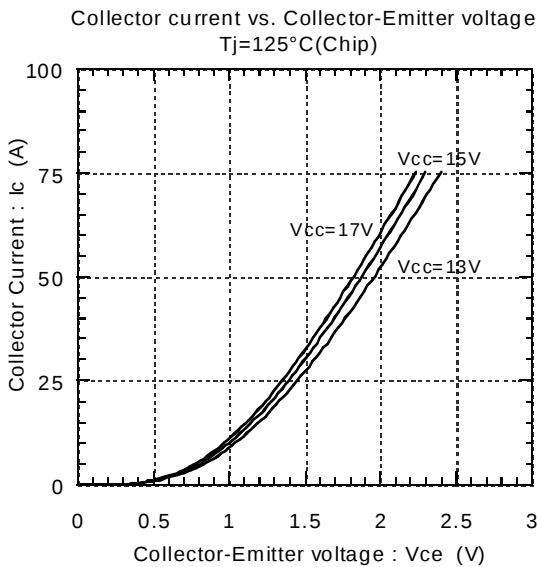
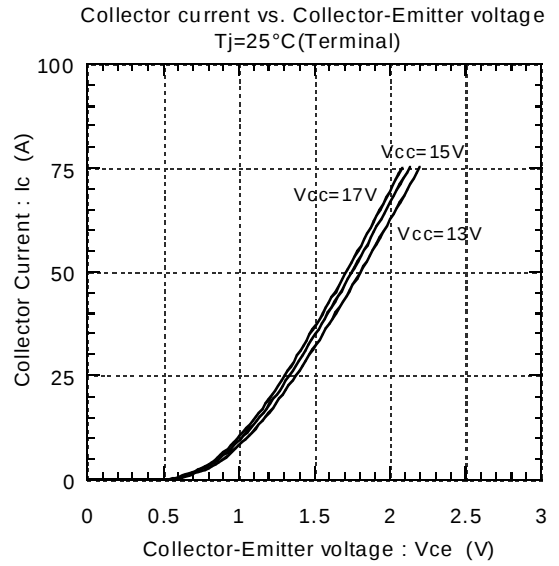
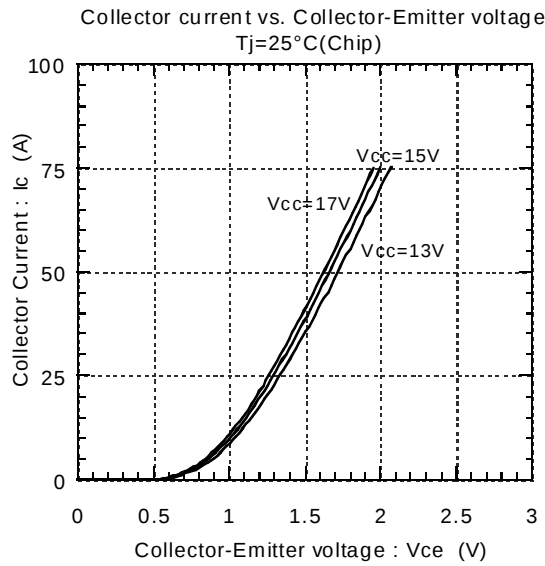
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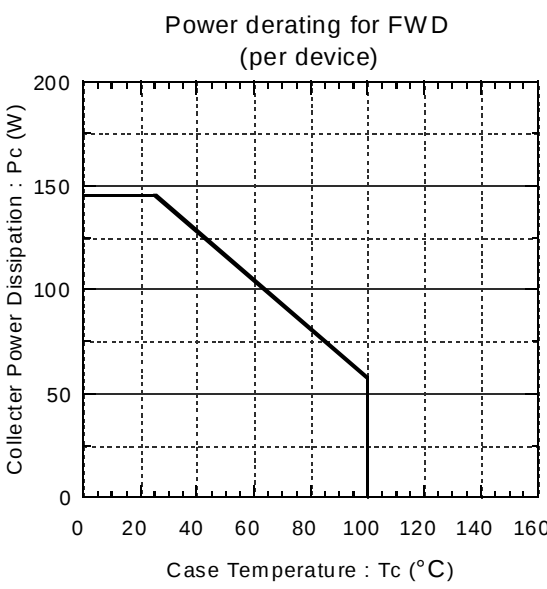
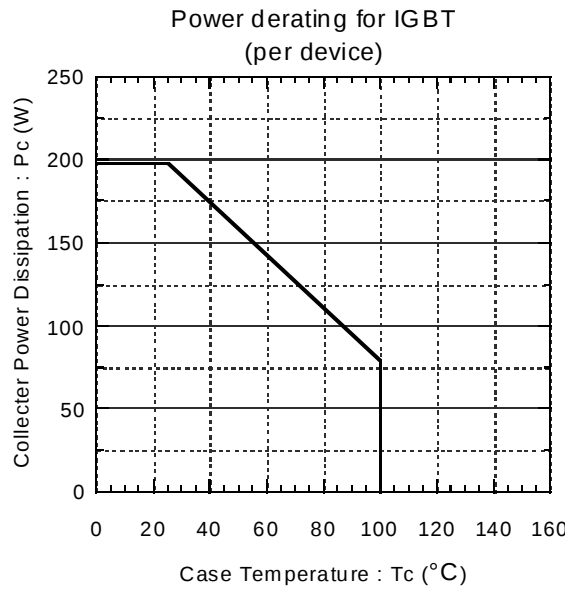
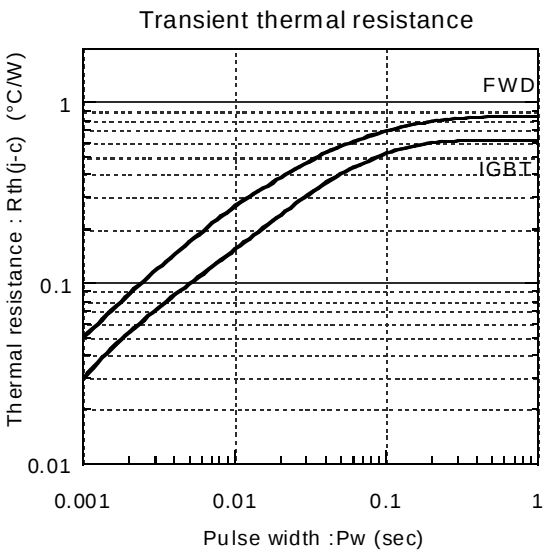
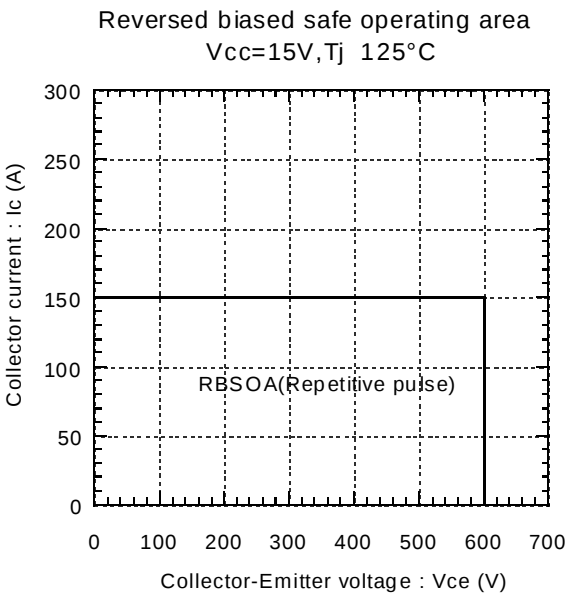
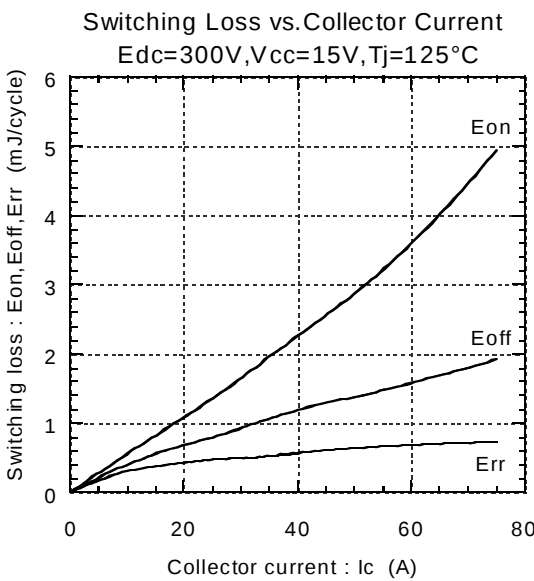
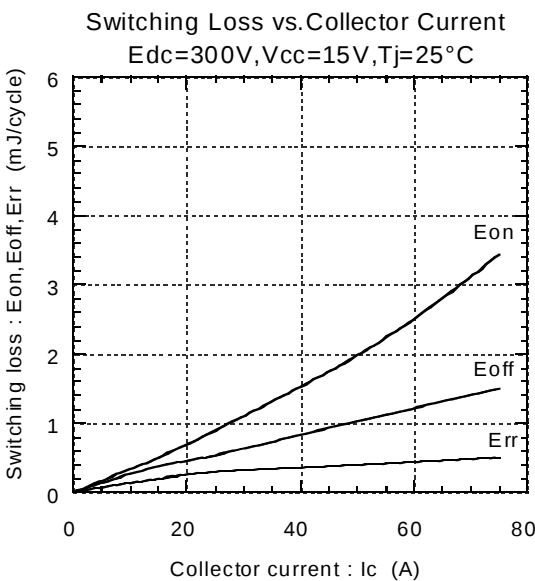
Characteristics

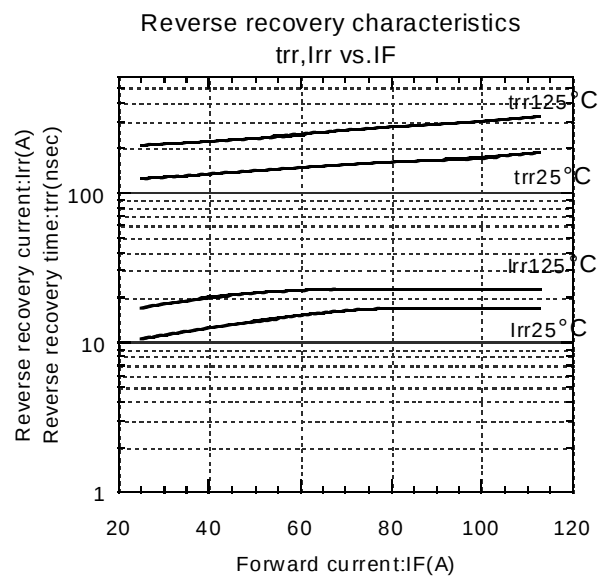
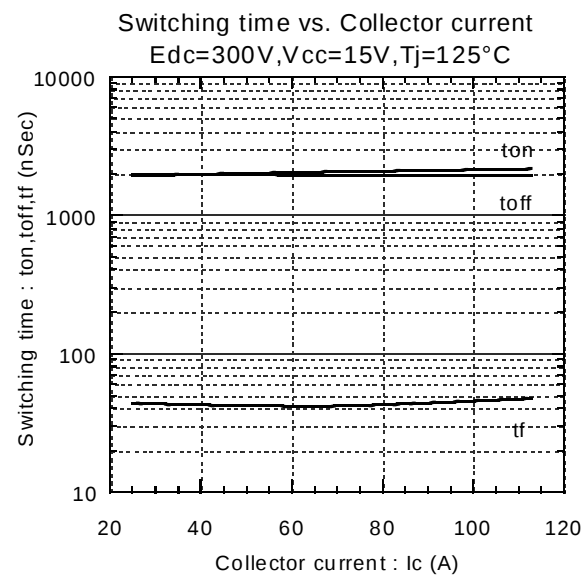
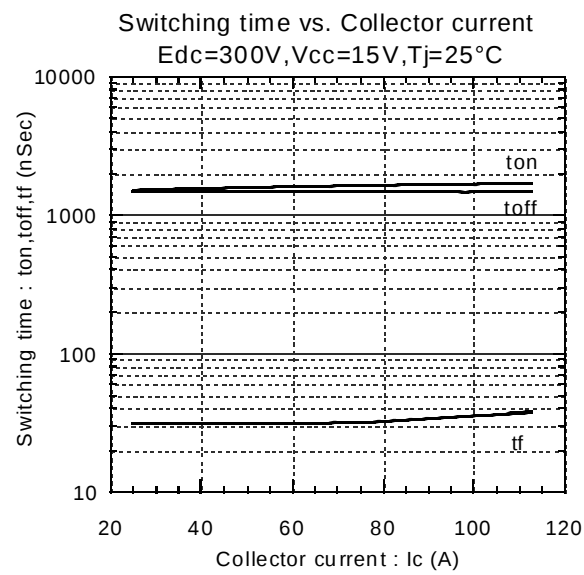
Control circuit characteristics (Representative)



● Main circuit characteristics (Representative)



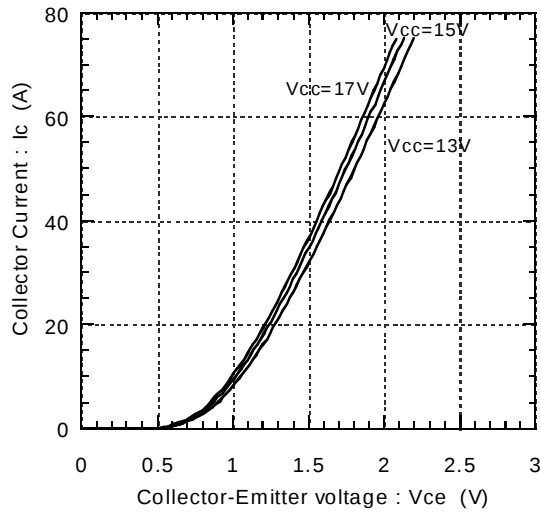




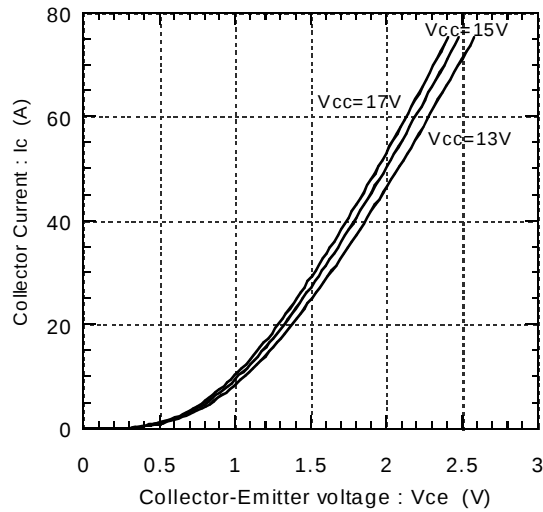
■ Characteristics

● Dynamic Brake Characteristics (Representative)

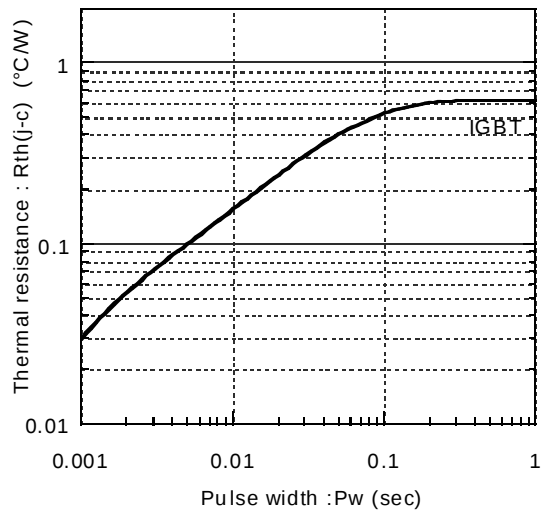
Collector current vs. Collector-Emitter voltage  
 $T_j=25^{\circ}\text{C}$



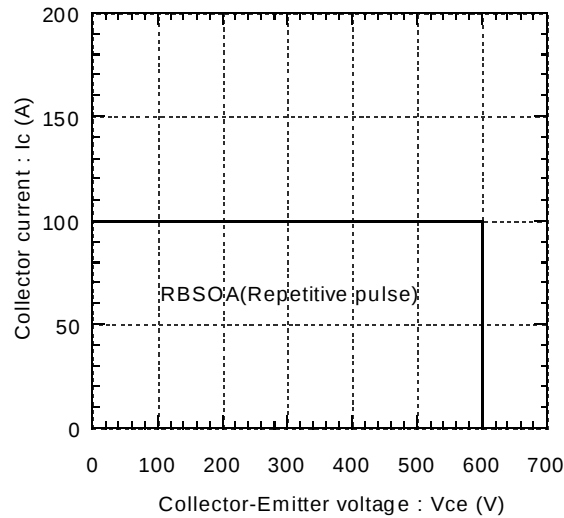
Collector current vs. Collector-Emitter voltage  
 $T_j=125^{\circ}\text{C}$



Transient thermal resistance



Reversed biased safe operating area  
 $V_{cc}=15\text{V}, T_j\ 125^{\circ}\text{C}$



Power derating for IGBT  
 (per device)

