

## Econo IPM series

1200V / 50A 6 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      | 900                  | V    |
|                                                               | Surge                       |                   | V <sub>DC(surge)</sub> | 0      | 1000                 | V    |
|                                                               | Short operating             |                   | V <sub>SC</sub>        | 400    | 800                  | V    |
| Collector-Emitter voltage *1                                  |                             |                   | V <sub>CES</sub>       | 0      | 1200                 | V    |
| Inverter                                                      | Collector current           | DC                | I <sub>C</sub>         | -      | 50                   | A    |
|                                                               |                             | 1ms               | I <sub>CP</sub>        | -      | 100                  | A    |
|                                                               |                             | DC                | -I <sub>C</sub>        | -      | 50                   | A    |
|                                                               | Collector power dissipation | One transistor *3 | P <sub>C</sub>         | -      | 287                  | 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 ,V 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)=125/0.86/(50 x 2.0) x 100>100%

\*3 : P<sub>C</sub>=125°C/IGBT R<sub>th(j-c)</sub>=125/0.44=287W [Inverter]

\*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  $T_c=T_j=25^{\circ}\text{C}$ ,  $V_{cc}=15\text{V}$  unless otherwise specified.)

**Main circuit**

| Item                  |                                       | Symbol   | Condition                     | Min.     | Typ. | Max. | Unit |   |
|-----------------------|---------------------------------------|----------|-------------------------------|----------|------|------|------|---|
| Inverter              | Collector current at off signal input | ICES     | VCE=1200V Vin terminal open.  | -        | -    | 1.0  | mA   |   |
|                       | Collector-Emitter saturation voltage  | VCE(sat) | Ic=50A                        | Terminal | -    | -    | 3.1  | V |
|                       |                                       |          |                               | Chip     | -    | 2.2  | -    |   |
|                       | Forward voltage of FWD                | VF       | -Ic=50A                       | Terminal | -    | -    | 2.0  | V |
|                       |                                       |          |                               | Chip     | -    | 1.6  | -    |   |
| Turn-on time          |                                       | ton      | VDC=600V,Tj=125°C             | 1.2      | -    | -    | µs   |   |
| Turn-off time         |                                       | toff     | Ic=50A Fig.1, Fig.6           | -        | -    | 3.6  |      |   |
| Reverse recovery time |                                       | trr      | VDC=600V, IF=50A Fig.1, Fig.6 | -        | -    | 0.3  |      |   |

● **Control circuit**

| Item                                               | Symbol       | Condition                                                                    | Min. | Typ. | Max. | Unit |
|----------------------------------------------------|--------------|------------------------------------------------------------------------------|------|------|------|------|
| Supply current of P-line side pre-driver(one unit) | $I_{ccp}$    | Switching Frequency : 0 to 15kHz<br>$T_c=-20$ to $125^{\circ}\text{C}$ Fig.7 | -    | -    | 15   | mA   |
| Supply current of N-line side pre-driver           | $I_{ccn}$    |                                                                              | -    | -    | 45   | mA   |
| Input signal threshold voltage (on/off)            | $V_{in(th)}$ | ON                                                                           | 1.00 | 1.35 | 1.70 | V    |
|                                                    |              | OFF                                                                          | 1.25 | 1.60 | 1.95 | V    |
| Input zener voltage                                | $V_Z$        | $R_{in}=20\text{k ohm}$                                                      | -    | 8.0  | -    | V    |
| Alarm signal hold time                             | $t_{ALM}$    | $T_c=-20^{\circ}\text{C}$ Fig.2                                              | 1.1  | -    | -    | ms   |
|                                                    |              | $T_c=25^{\circ}\text{C}$ Fig.2                                               | -    | 2.0  | -    | ms   |
|                                                    |              | $T_c=125^{\circ}\text{C}$ Fig.2                                              | -    | -    | 4.0  | ms   |
| Current limit resistor                             | $R_{ALM}$    | Alarm terminal                                                               | 1425 | 1500 | 1575 | ohm  |

● **Protection Section** ( $V_{cc}=15\text{V}$ )

| Item                                                | Symbol    | Condition                       | Min. | Typ. | Max. | Unit               |
|-----------------------------------------------------|-----------|---------------------------------|------|------|------|--------------------|
| Over Current Protection Level of Inverter circuit   | $I_{oc}$  | $T_j=125^{\circ}\text{C}$       | 75   | -    | -    | A                  |
| Over Current Protection Delay time                  | $t_{doc}$ | $T_j=125^{\circ}\text{C}$       | -    | 5    | -    | $\mu\text{s}$      |
| SC Protection Delay time                            | $t_{sc}$  | $T_j=125^{\circ}\text{C}$ Fig.4 | -    | -    | 8    | $\mu\text{s}$      |
| IGBT Chip Over Heating Protection Temperature Level | $T_{joh}$ | 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                  |

● **Thermal characteristics**( $T_c=25^{\circ}\text{C}$ )

| Item                                         |          | Symbol        | Min.          | Typ. | Max. | Unit                 |
|----------------------------------------------|----------|---------------|---------------|------|------|----------------------|
| Junction to Case thermal resistance *9       | Inverter | IGBT          | $R_{th(j-c)}$ | -    | 0.44 | $^{\circ}\text{C/W}$ |
|                                              |          | FWD           | $R_{th(j-c)}$ | -    | 0.86 | $^{\circ}\text{C/W}$ |
| Case to fin thermal resistance with compound |          | $R_{th(c-f)}$ | -             | 0.05 | -    | $^{\circ}\text{C/W}$ |

\*9 : (For 1 device, Case is under the device)

● **Noise Immunity** ( $V_{DC}=300\text{V}$ ,  $V_{cc}=15\text{V}$ , Test Circuit Fig.5)

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

● **Recommendable value**

| Item                                   | Symbol   | Min. | Typ. | Max. | Unit |
|----------------------------------------|----------|------|------|------|------|
| DC Bus Voltage                         | $V_{DC}$ | -    | -    | 800  | V    |
| Operating Supply Voltage of Pre-Driver | $V_{cc}$ | 13.5 | 15.0 | 16.5 | V    |
| Screw torque (M5)                      | -        | 2.5  | -    | 3.0  | Nm   |

● **Weight**

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

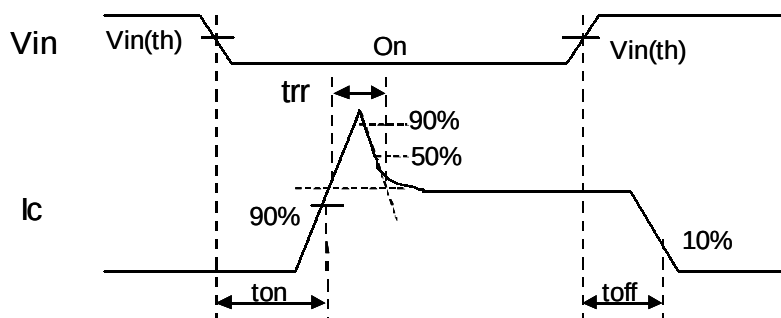
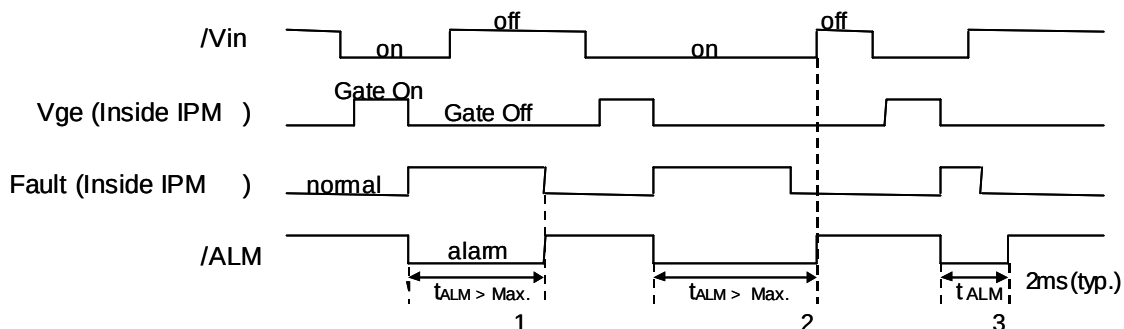


Figure 1. Switching Time Waveform Definitions



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

Figure 2. Input/Output Timing Diagram

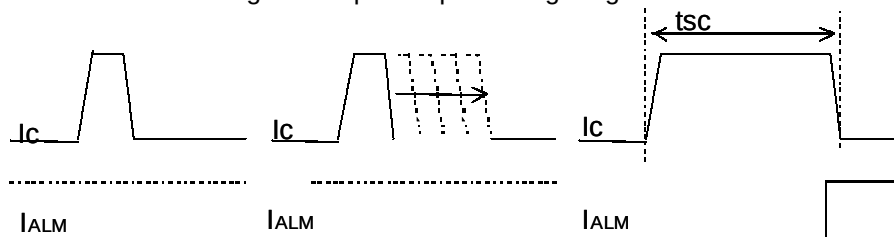


Figure.4 Definition of tsc

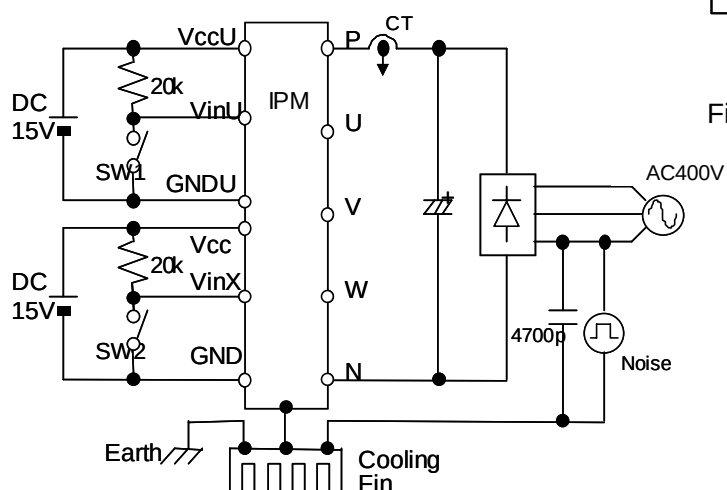


Figure 5. Noise Test Circuit

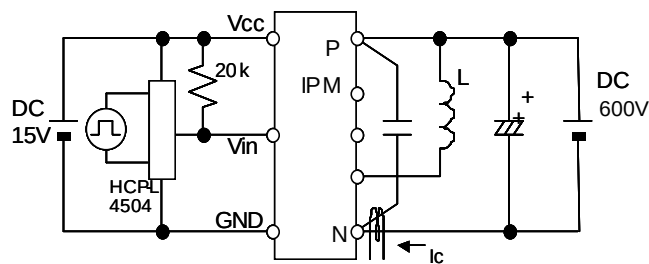


Figure 6. Switching Characteristics Test Circuit

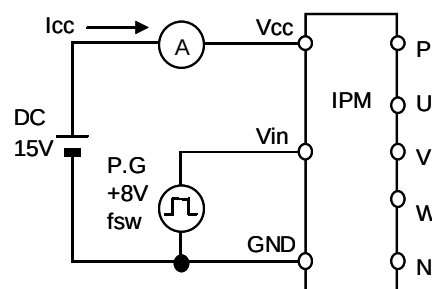
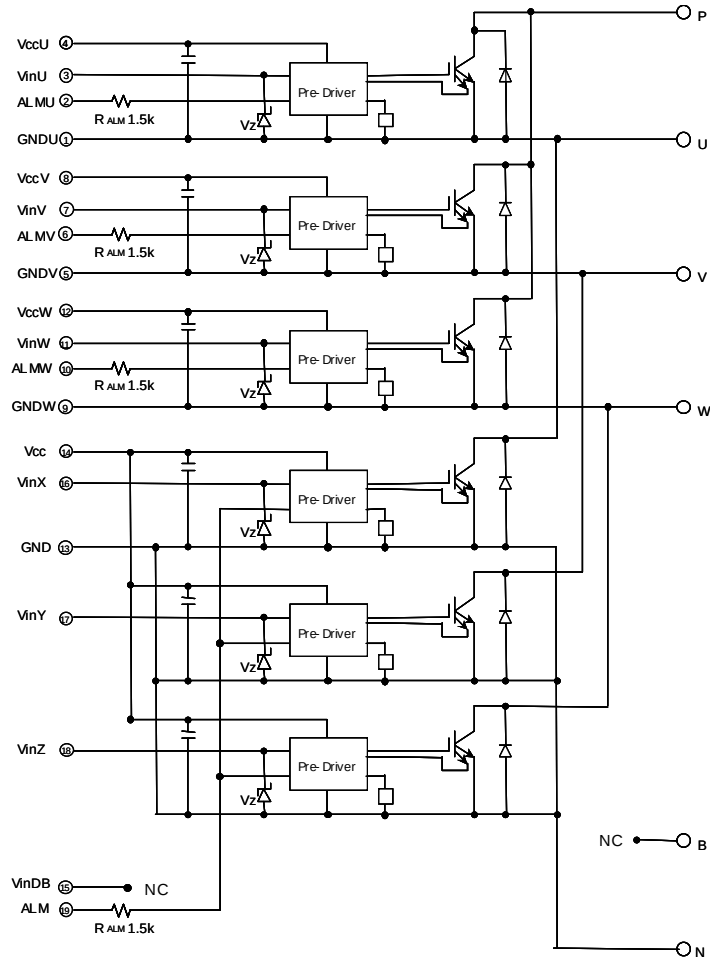


Figure 7. Icc Test Circuit

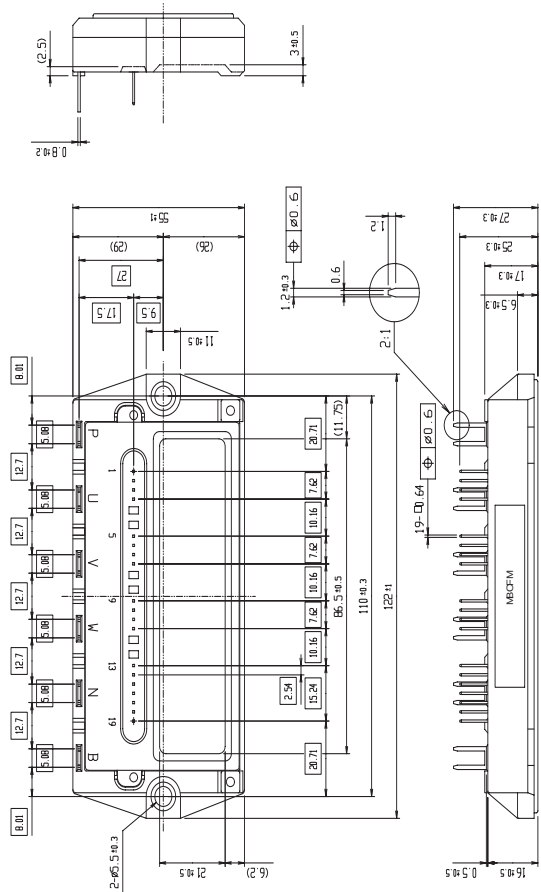
Block diagram



- 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

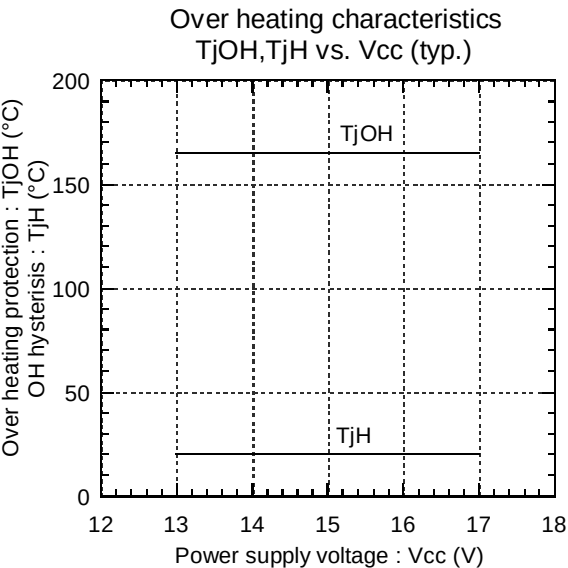
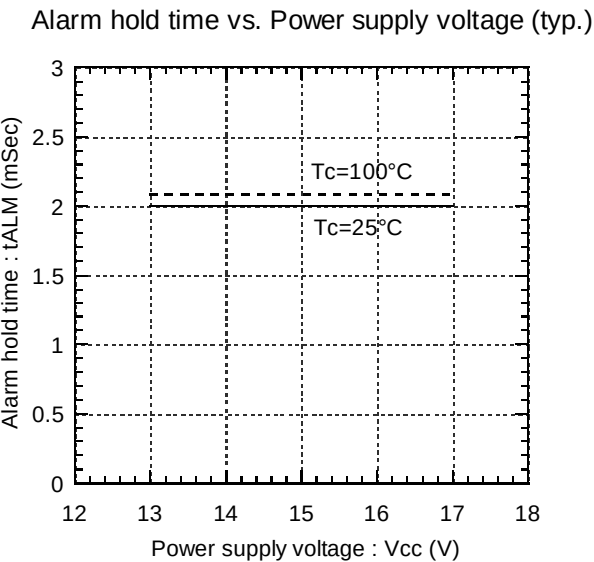
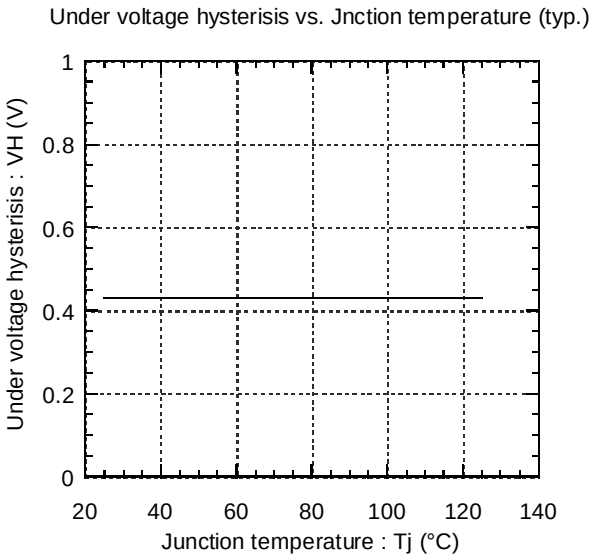
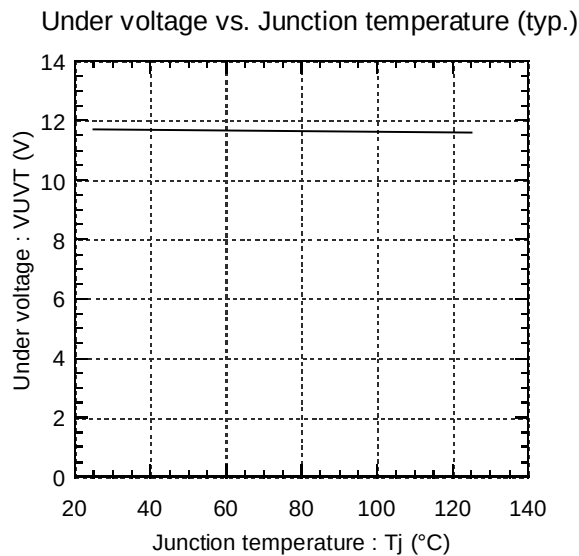
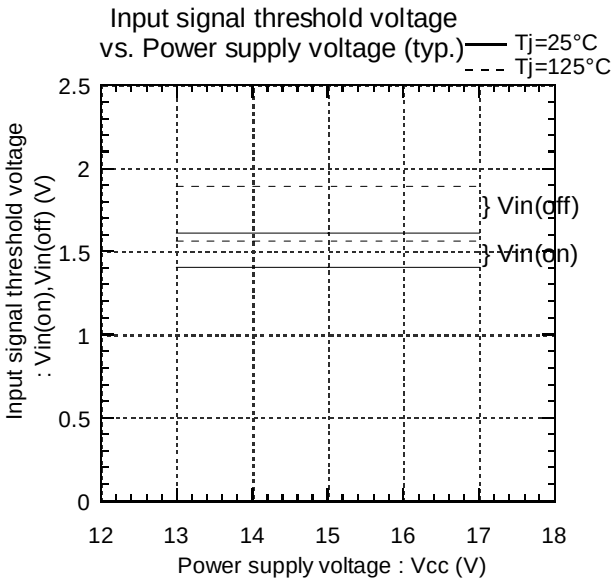
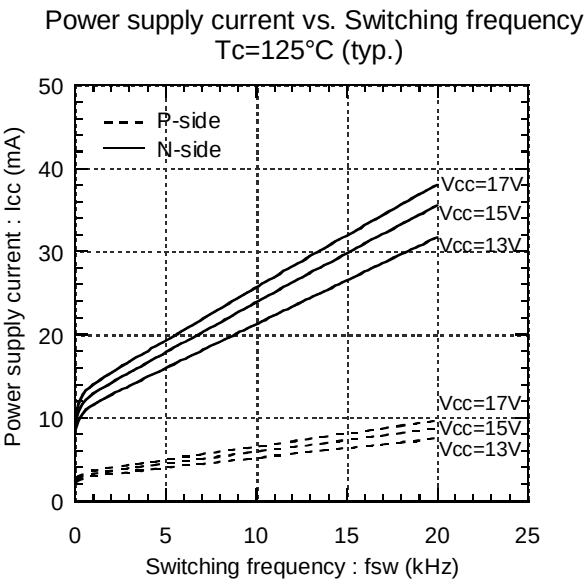
Package type : P622  
Dimensions in mm



Mass : 270g

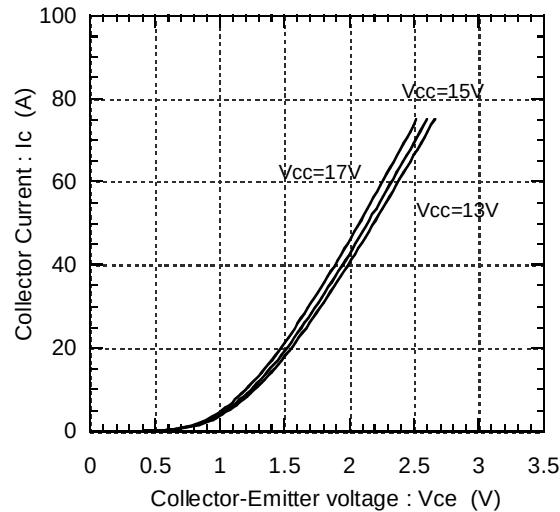
Characteristics

Control circuit characteristics (Representative)

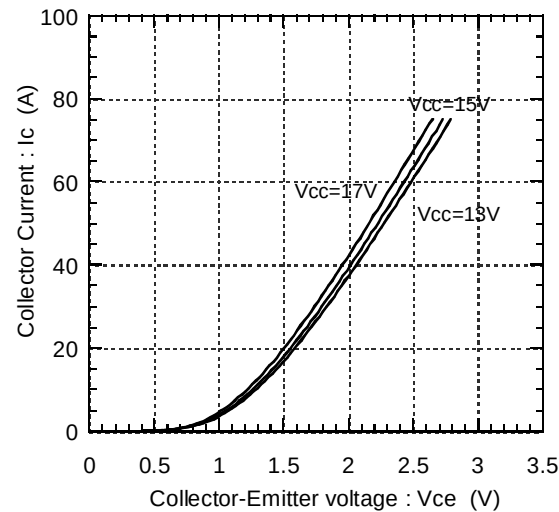


● Main circuit characteristics (Representative)

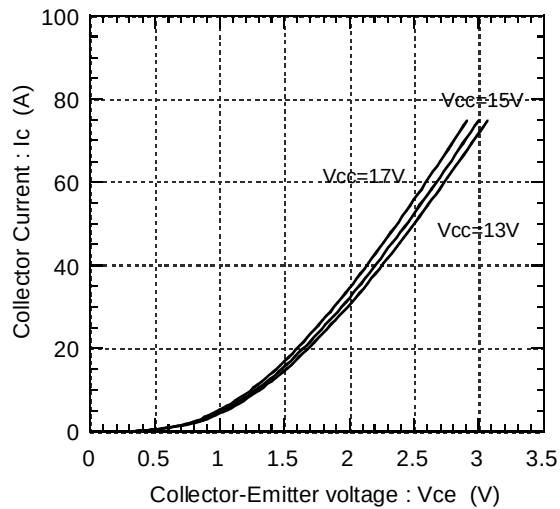
Collector current vs. Collector-Emitter voltage (typ.)  
Tj=25°C / Chip



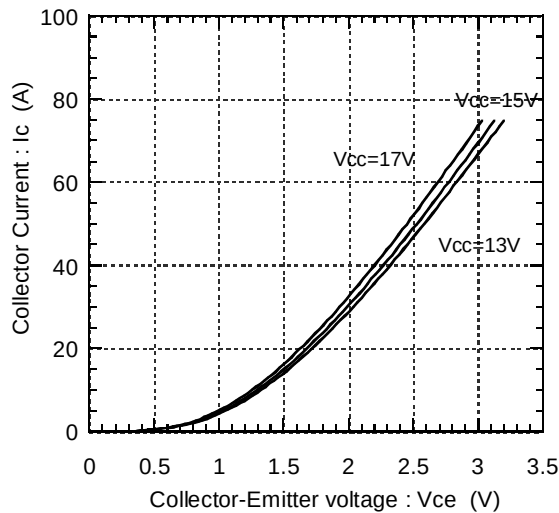
Collector current vs. Collector-Emitter voltage (typ.)  
Tj=25°C / Terminal



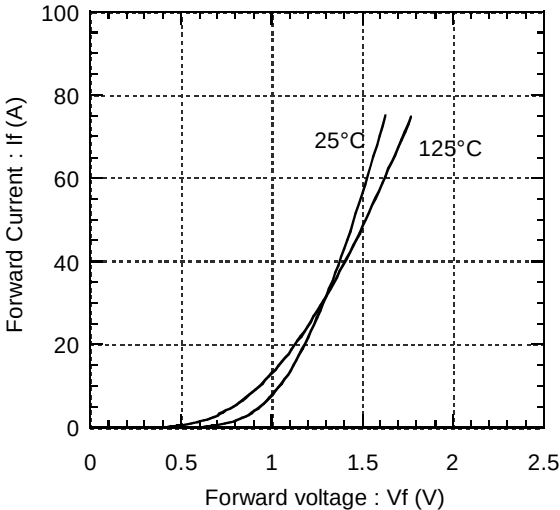
Collector current vs. Collector-Emitter voltage (typ.)  
Tj=125°C / Chip



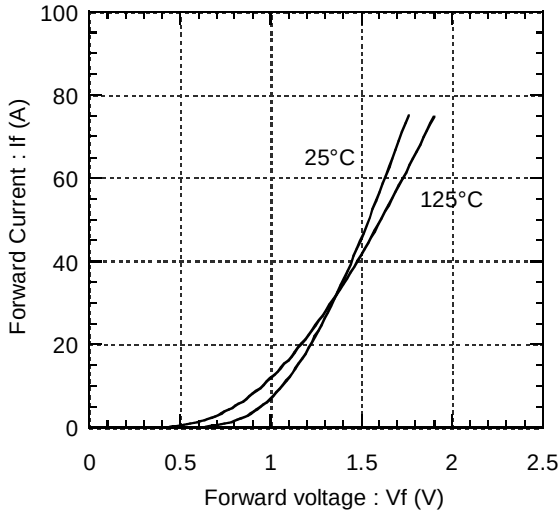
Collector current vs. Collector-Emitter voltage (typ.)  
Tj=125°C / Terminal



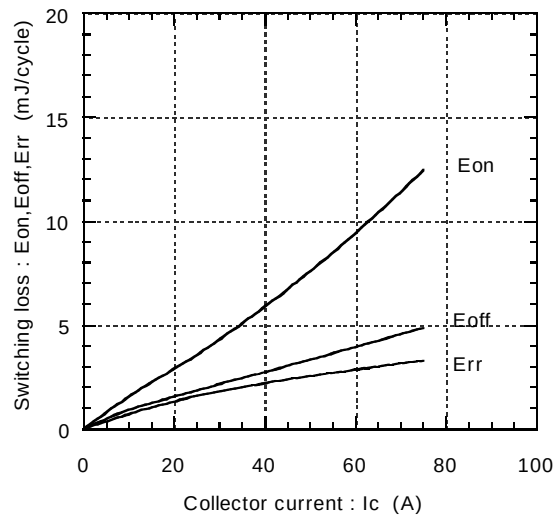
Forward current vs. Forward voltage (typ.)  
Chip



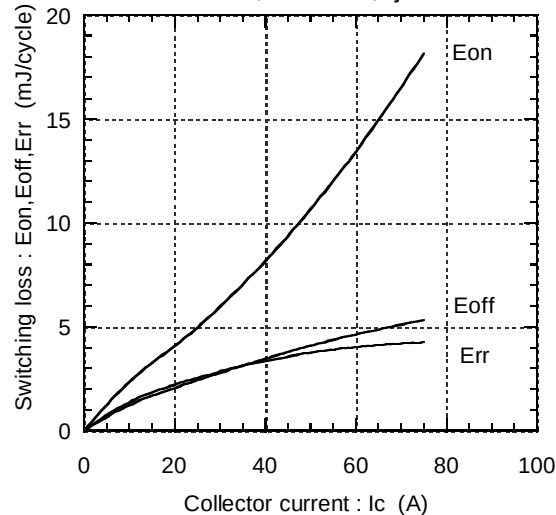
Forward current vs. Forward voltage (typ.)  
Terminal



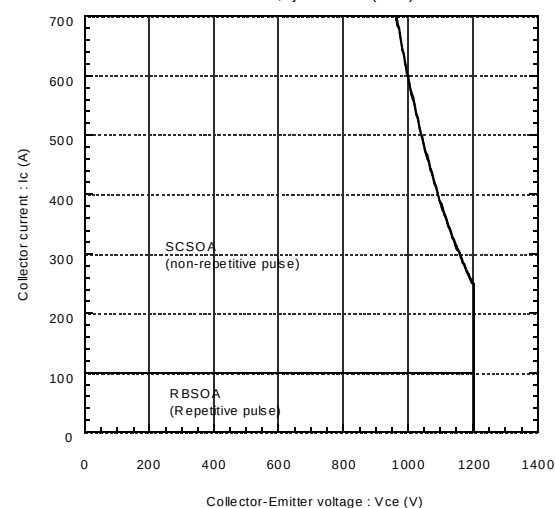
Switching Loss vs. Collector Current (typ.)  
Edc=600V,Vcc=15V,Tj=25°C



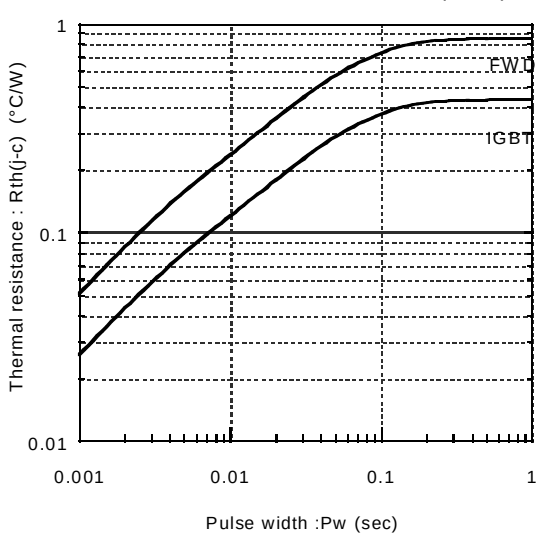
Switching Loss vs. Collector Current (typ.)  
Edc=600V,Vcc=15V,Tj=125°C



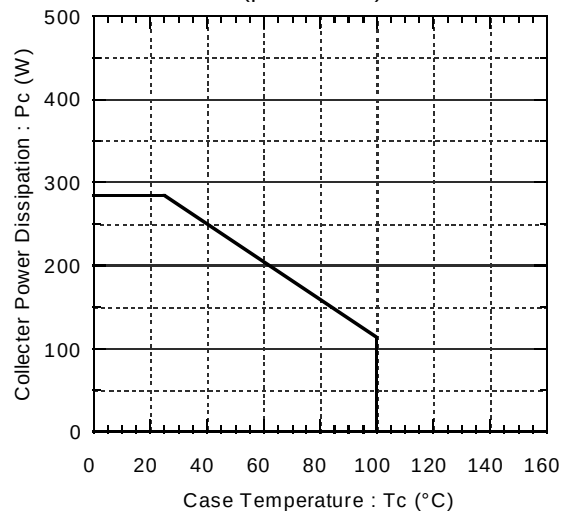
Reversed biased safe operating area  
Vcc=15V,Tj<=125°C (min.)



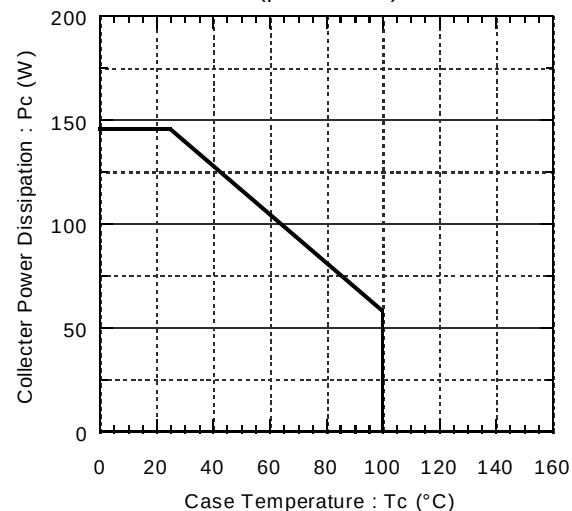
Transient thermal resistance (max.)



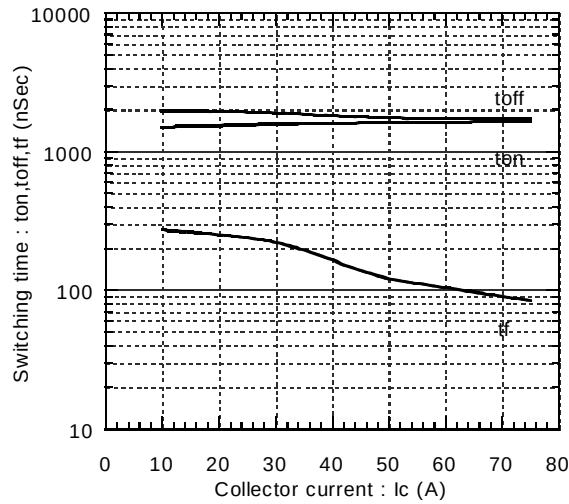
Power derating for IGBT (max.)  
(per device)



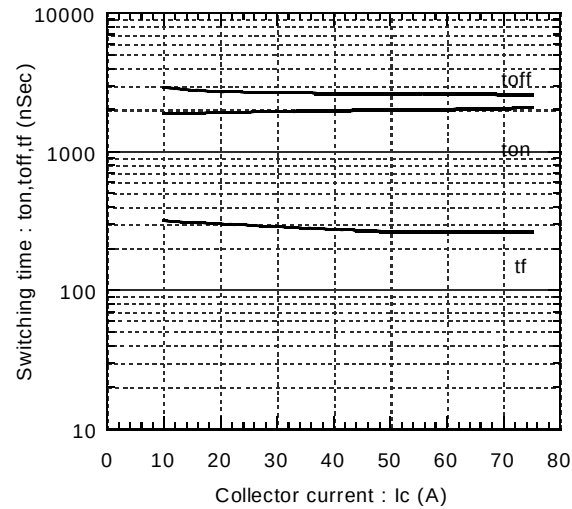
Power derating for FWD (max.)  
(per device)



Switching time vs. Collector current (typ.)  
Edc=600V,Vcc=15V,Tj=25°C



Switching time vs. Collector current (typ.)  
Edc=600V,Vcc=15V,Tj=125°C



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

