

## Econo IPM series

1200V / 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      | 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>         | -      | 75                   | A    |
|                                                               |                             | 1ms               | I <sub>CP</sub>        | -      | 150                  | A    |
|                                                               |                             | DC                | -I <sub>C</sub>        | -      | 75                   | A    |
|                                                               | Collector power dissipation | One transistor *3 | P <sub>C</sub>         | -      | 368                  | W    |
| Brake                                                         | Collector current           | DC                | I <sub>C</sub>         | -      | 25                   | A    |
|                                                               |                             | 1ms               | I <sub>CP</sub>        | -      | 50                   | A    |
|                                                               | Forward current diode       |                   | I <sub>F</sub>         | -      | 25                   | A    |
|                                                               | Collector power dissipation | One transistor *3 | P <sub>C</sub>         | -      | 212                  | 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 or DB, N and U or V or W or DB

\*2 : 125°C/FWD R<sub>th(j-c)</sub>/(I<sub>C</sub> x V<sub>F</sub> MAX)=125/0.61/(75 x 2.0) x 100>100%

\*3 : P<sub>C</sub>=125°C/IGBT R<sub>th(j-c)</sub>=125/0.34=368W [Inverter]

P<sub>C</sub>=125°C/IGBT R<sub>th(j-c)</sub>=125/0.59=212W [Brake]

\*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

| 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=75A                        | Terminal | -    | -    | 3.1  | V    |
|                       |                                       |          |                               | Chip     | -    | 2.2  | -    |      |
|                       | Forward voltage of FWD                | VF       | -Ic=75A                       | Terminal | -    | -    | 2.0  | V    |
|                       |                                       |          |                               | Chip     | -    | 1.6  | -    |      |
| Brake                 | Collector current at off signal input | ICES     | VCE=1200V Vin terminal open.  |          | -    | -    | 1.0  | mA   |
|                       | Collector-Emitter saturation voltage  | VCE(sat) | Ic=25A                        | Terminal | -    | -    | 2.6  | V    |
|                       |                                       |          |                               | Chip     | -    | 1.9  | -    |      |
|                       | Forward voltage of Diode              | VF       | -Ic=25A                       | Terminal | -    | -    | 3.7  | V    |
|                       |                                       |          |                               | Chip     | -    | 2.3  | -    |      |
| Turn-on time          |                                       | ton      | VDC=600V,Tj=125°C             |          | 1.2  | -    | -    | μs   |
| Turn-off time         |                                       | toff     | Ic=75A Fig.1, Fig.6           |          | -    | -    | 3.6  |      |
| Reverse recovery time |                                       | trr      | VDC=600V, If=75A 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) | Iccp    | Switching Frequency : 0 to 15kHz | -    | -    | 15   | mA   |
| Supply current of N-line side pre-driver           | ICCN    | Tc=-20 to 125°C Fig.7            | -    | -    | 45   | 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              | 38   | -    | -    | A    |
| Over Current Protection Delay time                | tBOC   | 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   |
| Protection Temperature Level                      |        |                       |      |      |      | °C   |
| Over Heating Protection Hysteresis                | TjH    |                       | -    | 20   | -    | V    |
| Under Voltage Protection Level                    | VUV    |                       | 11.0 | -    | 12.5 | V    |
| Under Voltage Protection Hysteresis               | VH     |                       | 0.2  | 0.5  | -    |      |

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

| Item                                         |          |      | Symbol   | Min. | Typ. | Max. | Unit |
|----------------------------------------------|----------|------|----------|------|------|------|------|
| Junction to Case thermal resistance *9       | Inverter | IGBT | Rth(j-c) | -    | -    | 0.34 | °C/W |
|                                              |          | FWD  | Rth(j-c) | -    | -    | 0.61 | °C/W |
|                                              | Brake    | IGBT | Rth(j-c) | -    | -    | 0.59 | °C/W |
| Case to fin thermal resistance with compound |          |      | Rth(c-f) | -    | 0.05 | -    | °C/W |

\*9 For 1device, 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    | -    | -    | 800  | 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    |

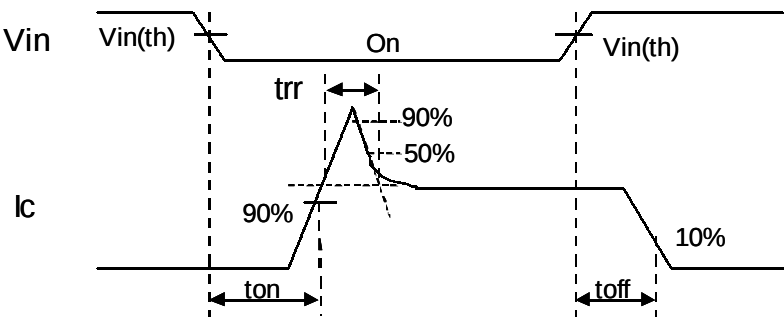
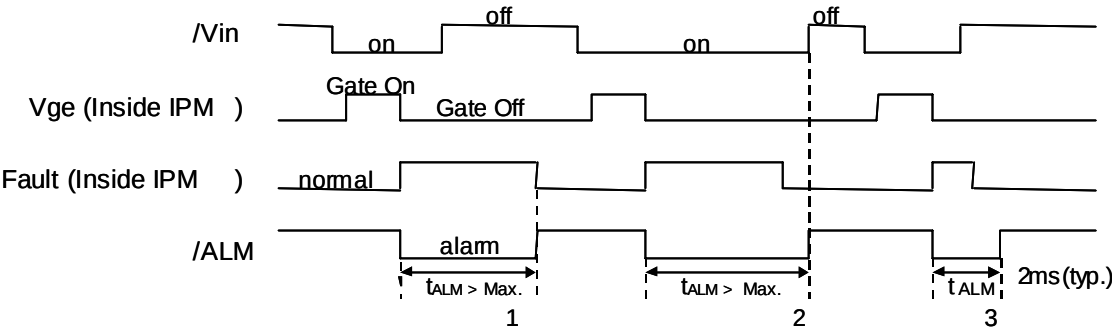


Figure 1. Switching Time Waveform Definitions



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

Figure 2. Input/Output Timing Diagram

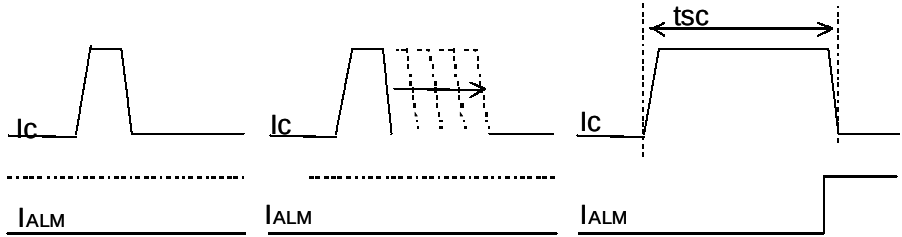


Figure.4 Definition of tsc

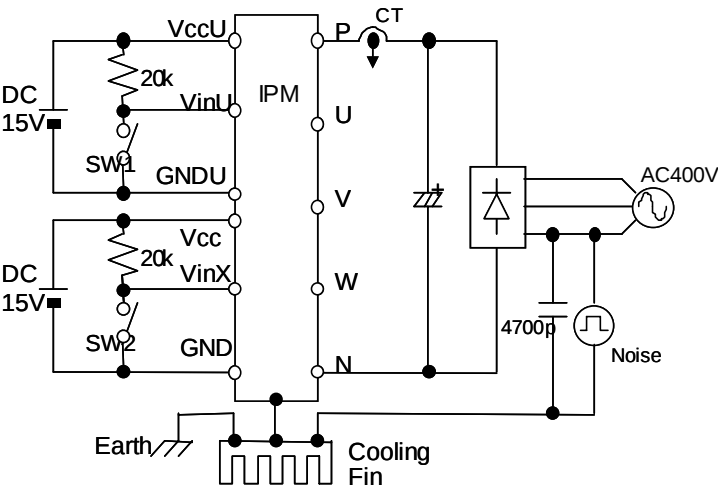


Figure 5. Noise Test Circuit

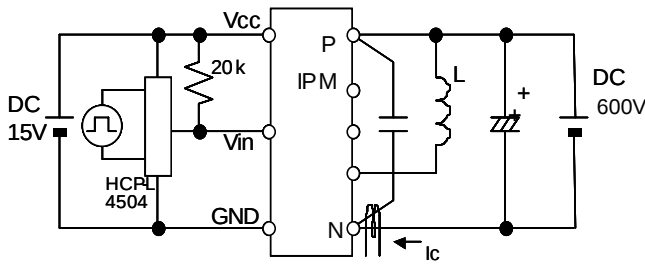


Figure 6. Switching Characteristics Test Circuit

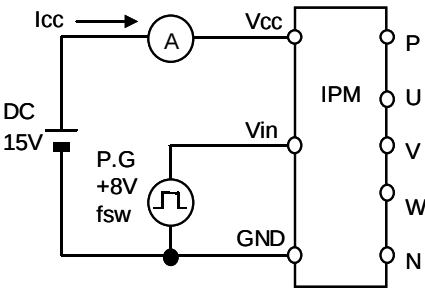
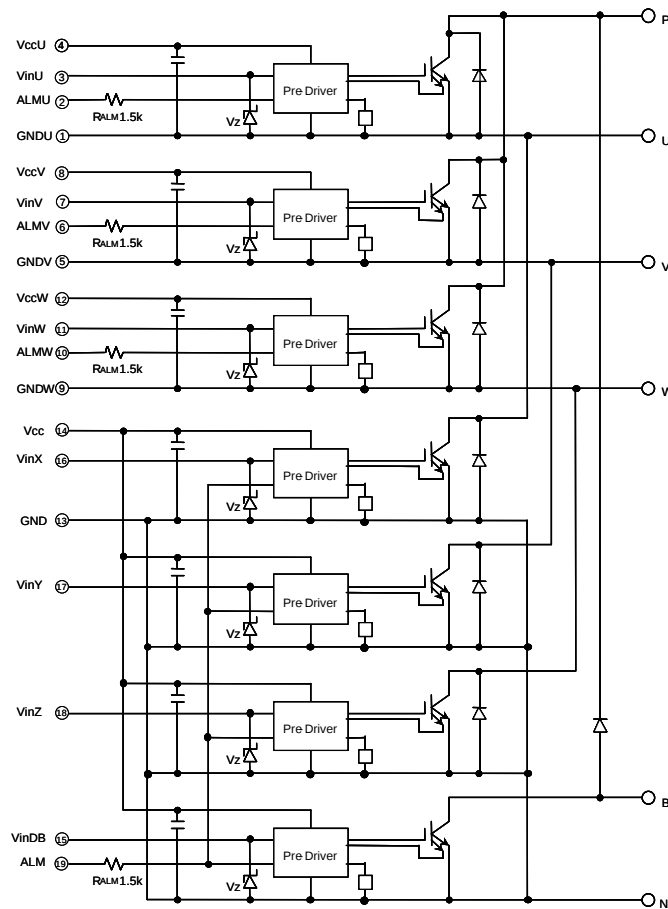


Figure 7. Icc Test Circuit

## Block diagram

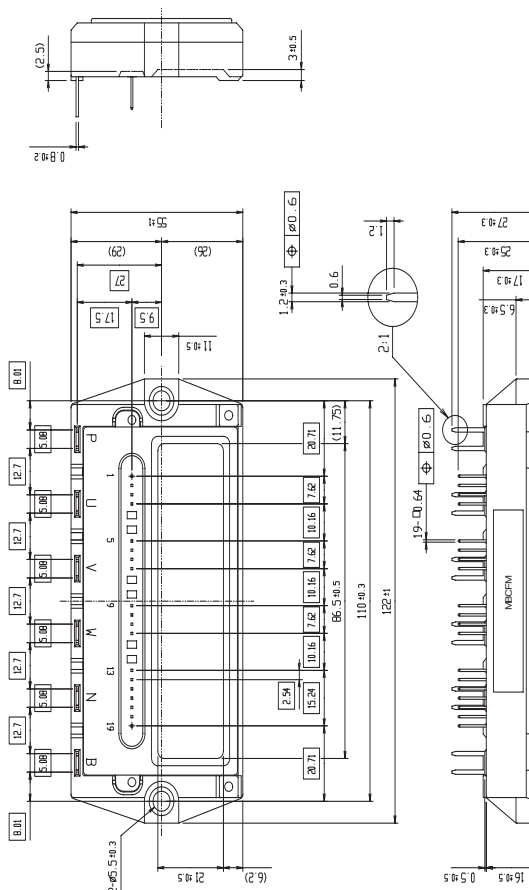


Pre-drivers include following functions

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

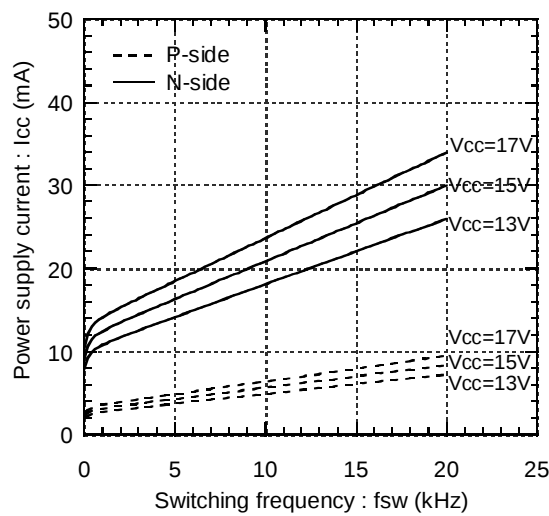


Mass : 270g

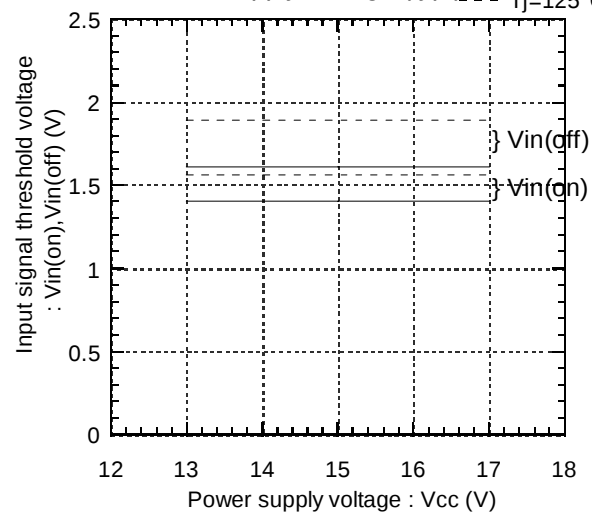
Characteristics

Control circuit characteristics (Representative)

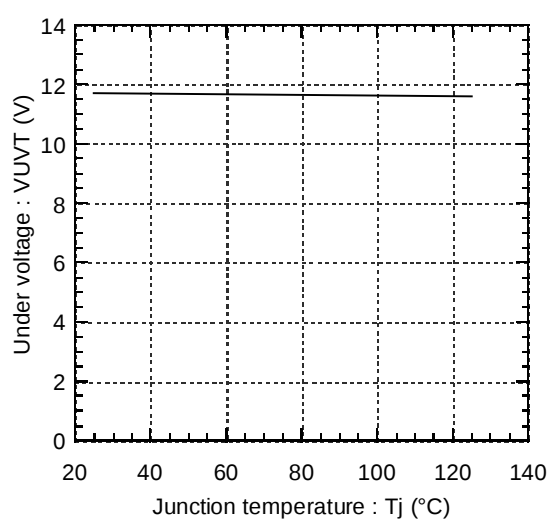
Power supply current vs. Switching frequency  
Tc=125°C (typ.)



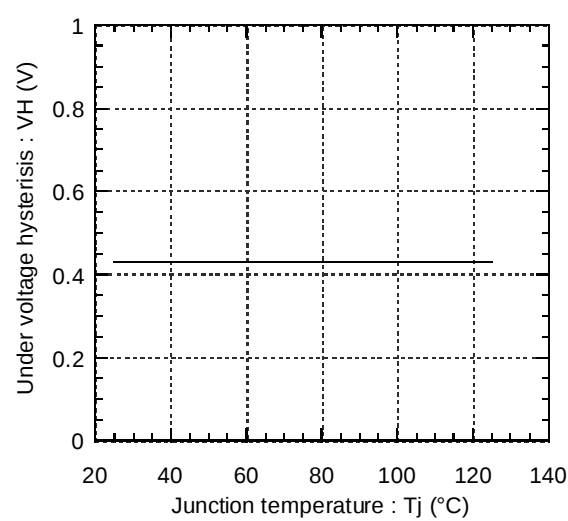
Input signal threshold voltage vs. Power supply voltage (typ.)  
Tj=25°C (solid line), Tj=125°C (dashed line)



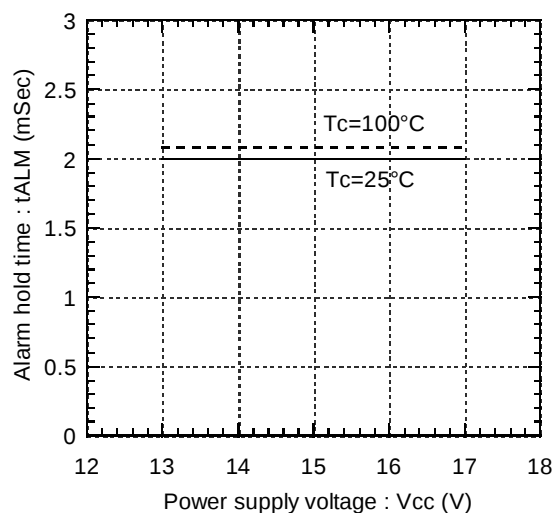
Under voltage vs. Junction temperature (typ.)



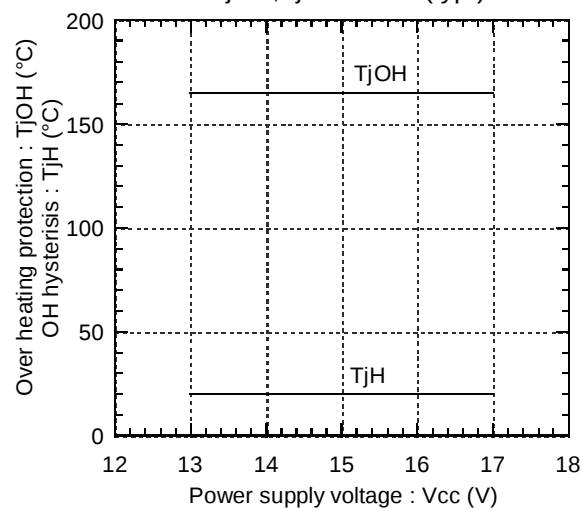
Under voltage hysteresis vs. Jnction temperature (typ.)



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

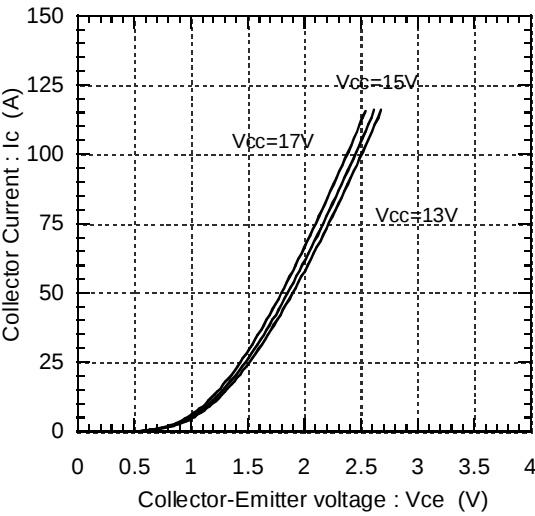


Over heating characteristics  
TjOH, TjH vs. Vcc (typ.)

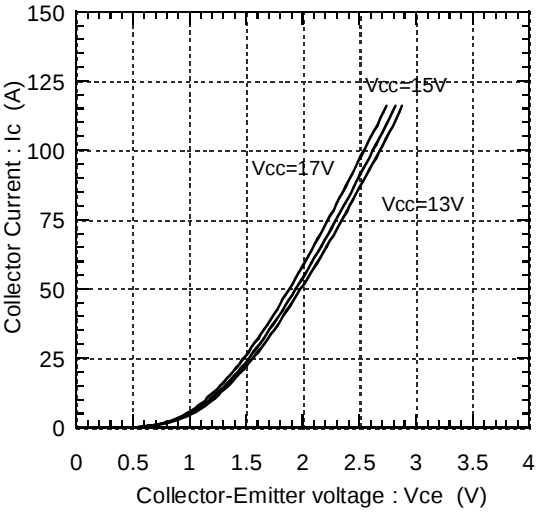


● Main circuit characteristics (Representative)

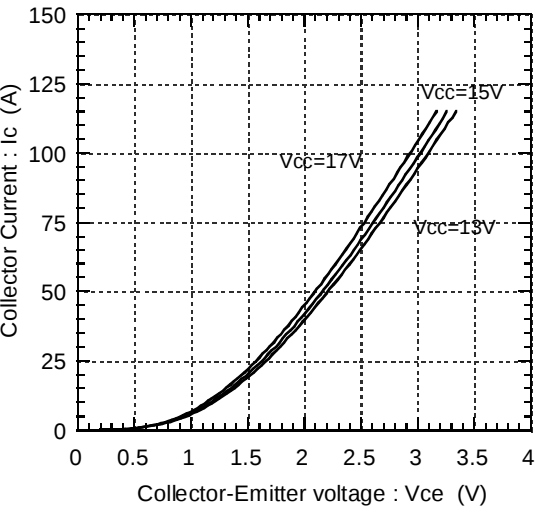
Collector current vs. Collector-Emitter voltage (typ.)  
 $T_j=25^{\circ}\text{C}(\text{Chip})$



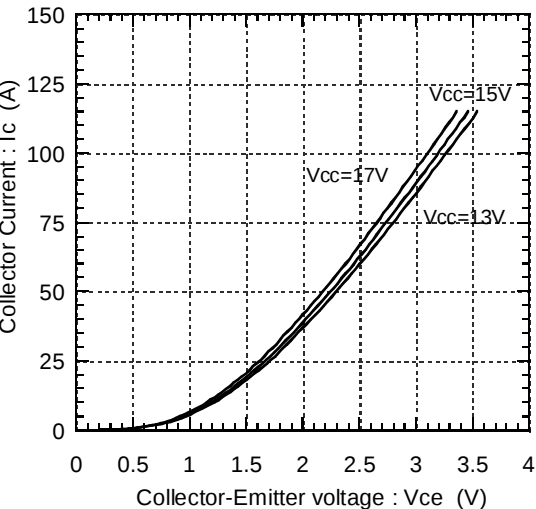
Collector current vs. Collector-Emitter voltage (typ.)  
 $T_j=25^{\circ}\text{C}(\text{Terminal})$



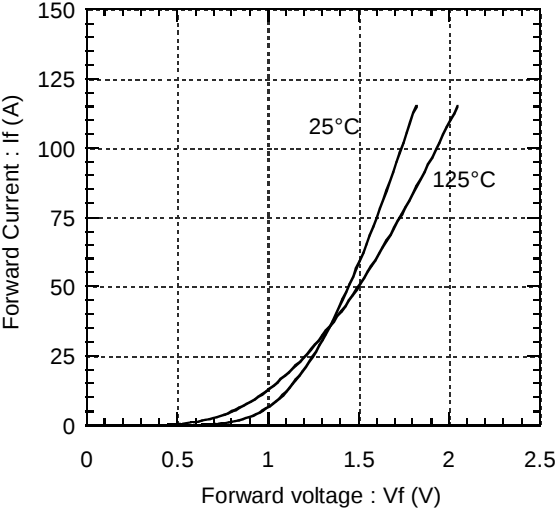
Collector current vs. Collector-Emitter voltage (typ.)  
 $T_j=125^{\circ}\text{C}(\text{Chip})$



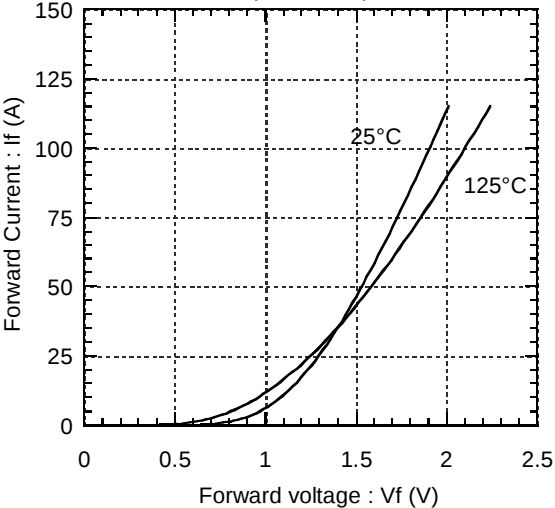
Collector current vs. Collector-Emitter voltage (typ.)  
 $T_j=125^{\circ}\text{C}(\text{Terminal})$

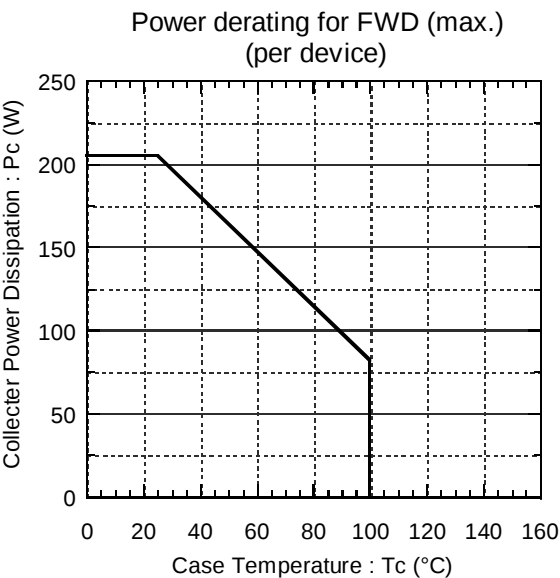
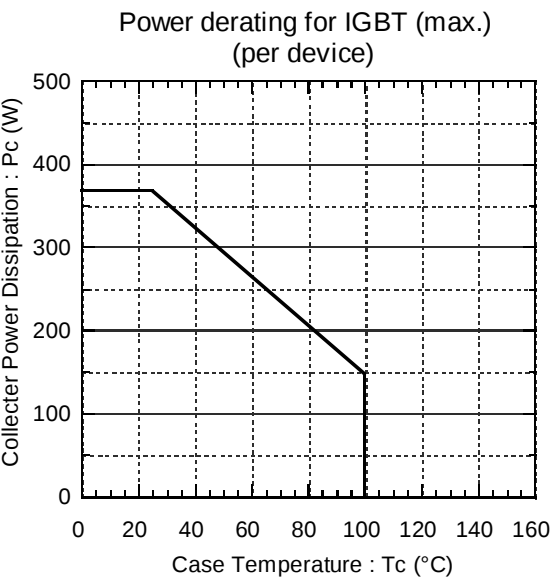
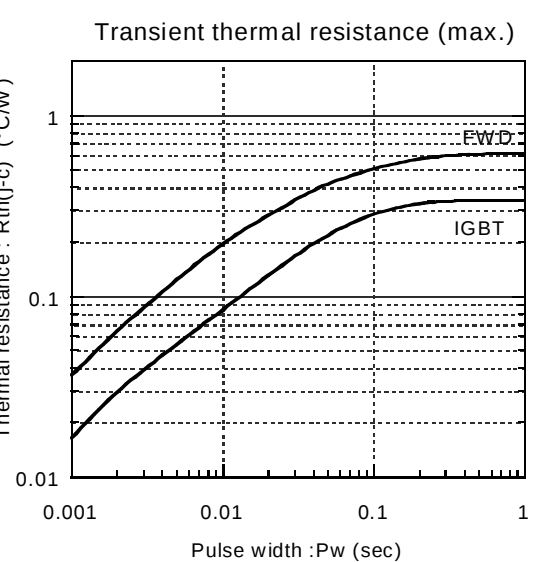
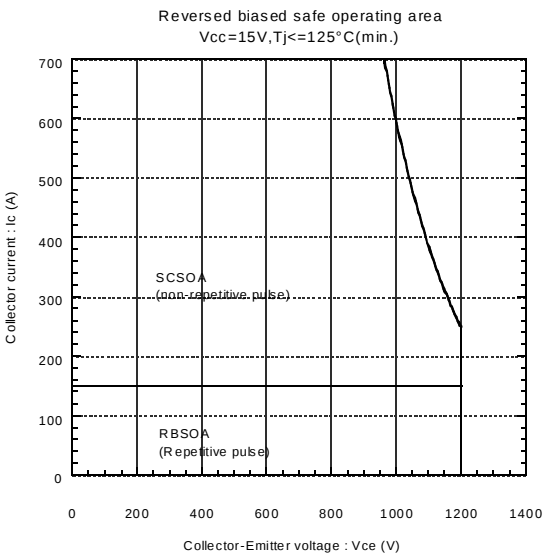
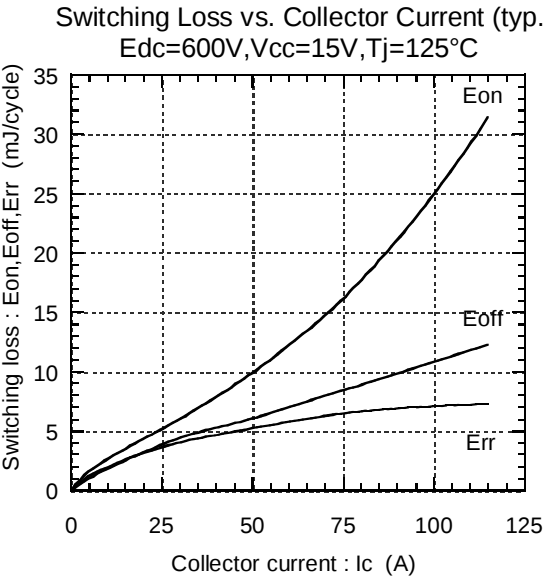
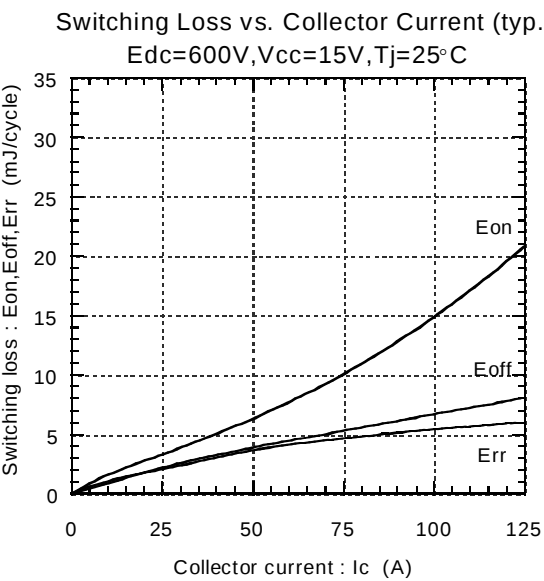


Forward current vs. Forward voltage (typ.)  
(Chip)

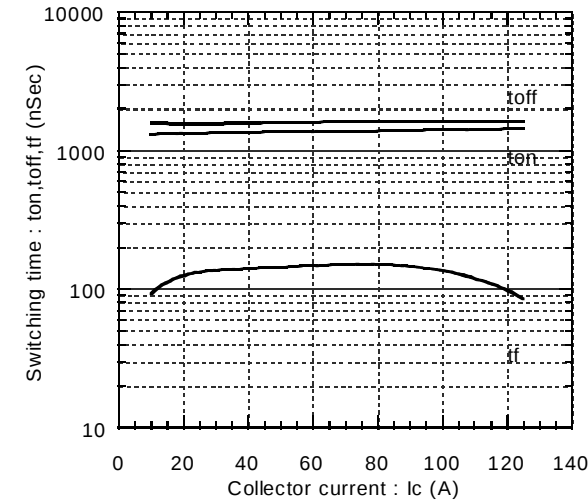


Forward current vs. Forward voltage (typ.)  
(Terminal)

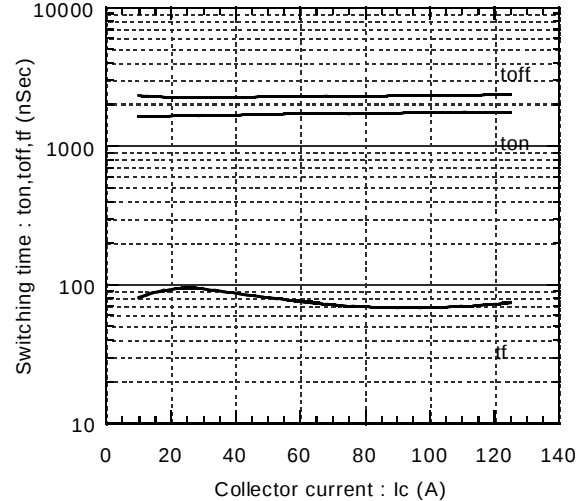




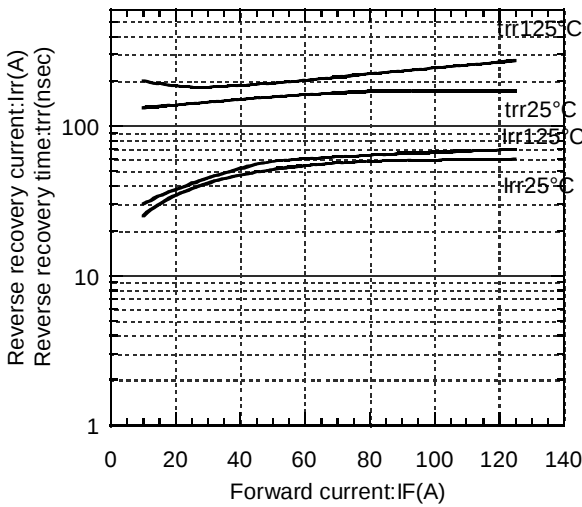
Switching time vs. Collector current (typ.)  
Edc=600V,Vcc=15V,Tj=25°C



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



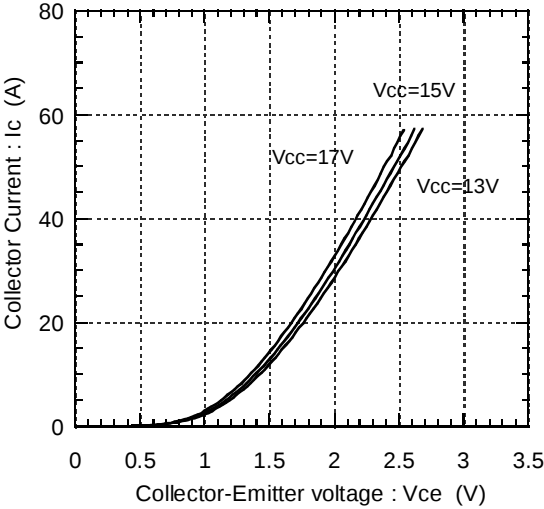
Reverse recovery characteristics (typ.)  
trr,Irr vs. IF



Characteristics

Dynamic Brake Characteristics (Representative)

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



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

