

TOSHIBA INTEGRATED IGBT MODULE SILICON N CHANNEL IGBT

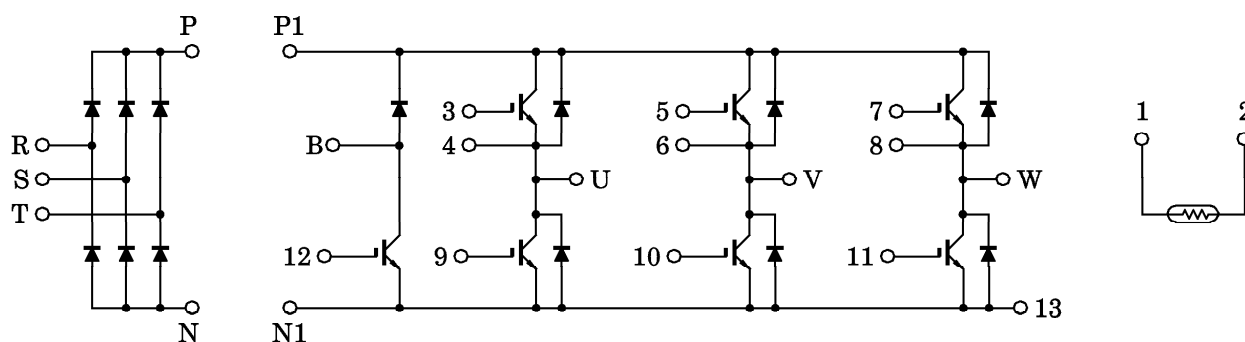
# MIG15Q906H, MIG15Q906HA

HIGH POWER SWITCHING APPLICATIONS

MOTOR CONTROL APPLICATIONS

- Integrates Inverter, Converter and Brake Power Circuits and Thermistor in One Package.
- Output (Inverter Stage) :  $3\phi$  15 A / 1200 V IGBT
- Input (Converter Stage) :  $3\phi$  15 A / 1600 V Silicon Rectifier
- The Electrodes are Isolated from Case.
- Outline
  - MIG15Q906H : 2-108E5A
  - MIG15Q906HA : 2-108E6A
- Weight : 190 g

## EQUIVALENT CIRCUIT

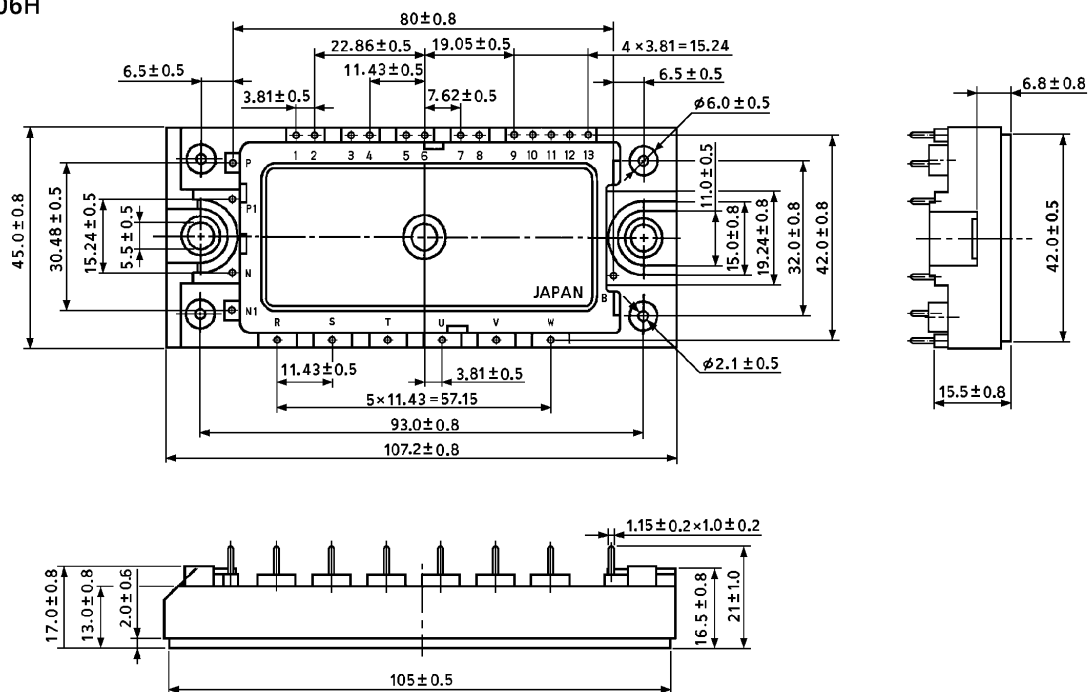


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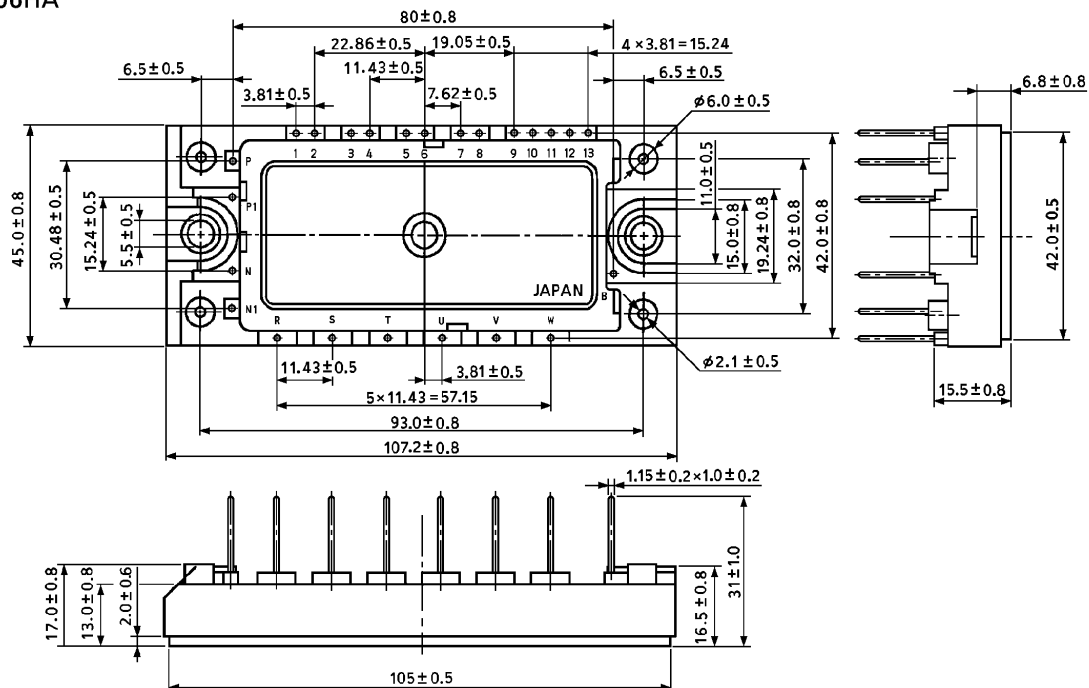
## Unit : mm

2-108E5A



Unit : mm

2-108E6A



## MAXIMUM RATINGS (Ta = 25°C)

| STAGE     |      | CHARACTERISTIC                                               |      | SYMBOL            | RATING                | UNIT |                                |
|-----------|------|--------------------------------------------------------------|------|-------------------|-----------------------|------|--------------------------------|
| Inverter  |      | Collector-Emitter Voltage                                    |      | V <sub>CES</sub>  | 1200                  | V    | (25°C / 80°C)<br>(25°C / 80°C) |
|           |      | Gate-Emitter Voltage                                         |      | V <sub>GES</sub>  | ±20                   | V    |                                |
|           |      | Collector Current                                            | DC   | I <sub>C</sub>    | 25 / 15               | A    |                                |
|           |      |                                                              | 1 ms | I <sub>CP</sub>   | 50 / 30               | A    |                                |
|           |      | Forward Current                                              | DC   | I <sub>F</sub>    | 15                    | A    |                                |
|           |      |                                                              | 1 ms | I <sub>FM</sub>   | 30                    | A    |                                |
|           |      | Collector Power Dissipation<br>(T <sub>c</sub> = 25°C)       |      | P <sub>C</sub>    | 145                   | W    |                                |
| Converter |      | Repetitive Peak Reverse Voltage                              |      | V <sub>RRM</sub>  | 1600                  | V    |                                |
|           |      | Average Output Rectified Current                             |      | I <sub>O</sub>    | 15                    | A    |                                |
|           |      | Peak One Cycle Surge Forward Current (50 Hz, Non-Repetitive) |      | I <sub>FSM</sub>  | 250                   | A    |                                |
| Brake     | IGBT | Collector-Emitter Voltage                                    |      | V <sub>CES</sub>  | 1200                  | V    | (25°C / 80°C)<br>(25°C / 80°C) |
|           |      | Gate-Emitter Voltage                                         |      | V <sub>GES</sub>  | ±20                   | V    |                                |
|           |      | Collector Current                                            | DC   | I <sub>C</sub>    | 25 / 15               | A    |                                |
|           |      |                                                              | 1 ms | I <sub>CP</sub>   | 50 / 30               | A    |                                |
|           |      | Collector Power Dissipation<br>(T <sub>c</sub> = 25°C)       |      | P <sub>C</sub>    | 145                   | W    |                                |
|           | FWD  | Reverse Voltage                                              |      | V <sub>R</sub>    | 1200                  | V    |                                |
|           |      | Forward Current                                              | DC   | I <sub>F</sub>    | 15                    | A    |                                |
|           |      |                                                              | 1 ms | I <sub>FM</sub>   | 30                    | A    |                                |
| Module    |      | Junction Temperature                                         |      | T <sub>j</sub>    | 150                   | °C   |                                |
|           |      | Storage Temperature Range                                    |      | T <sub>stg</sub>  | −40~125               | °C   |                                |
|           |      | Isolation Voltage                                            |      | V <sub>Isol</sub> | 2500<br>(AC 1 minute) | V    |                                |
|           |      | Screw Torque                                                 |      | —                 | 6                     | N·m  |                                |

## ELECTRICAL CHARACTERISTICS (Ta = 25°C)

## a. Inverter stage

| CHARACTERISTIC                       |               | SYMBOL        | TEST CONDITION                                                                                                                             | MIN. | TYP. | MAX.      | UNIT                      |
|--------------------------------------|---------------|---------------|--------------------------------------------------------------------------------------------------------------------------------------------|------|------|-----------|---------------------------|
| Gate Leakage Current                 |               | $I_{GES}$     | $V_{GE} = \pm 20 \text{ V}$ , $V_{CE} = 0$                                                                                                 | —    | —    | $\pm 500$ | nA                        |
| Collector Cut-Off Current            |               | $I_{CES}$     | $V_{CE} = 1200 \text{ V}$ , $V_{GE} = 0$                                                                                                   | —    | —    | 0.5       | mA                        |
| Gate-Emitter Cut-Off Voltage         |               | $V_{GE(off)}$ | $I_C = 15 \text{ mA}$ , $V_{CE} = 5 \text{ V}$                                                                                             | —    | 6.0  | —         | V                         |
| Collector-Emitter Saturation Voltage |               | $V_{CE(sat)}$ | $I_C = 15 \text{ A}$ $T_j = 25^\circ\text{C}$                                                                                              | —    | 2.8  | 3.2       | V                         |
|                                      |               |               | $V_{GE} = 15 \text{ V}$ $T_j = 125^\circ\text{C}$                                                                                          | —    | 3.1  | 3.7       |                           |
| Input Capacitance                    |               | $C_{ies}$     | $V_{CE} = 10 \text{ V}$ , $V_{GE} = 0$ ,<br>$f = 1 \text{ MHz}$                                                                            | —    | 1850 | —         | pF                        |
| Switching Time                       | Rise Time     | $t_r$         | $V_{CC} = 600 \text{ V}$<br>$I_C = 15 \text{ A}$<br>$V_{GE} = \pm 15 \text{ V}$<br>$R_G = 82 \Omega$<br>$T_j = 125^\circ\text{C}$ (Note 1) | —    | 0.07 | 0.15      | $\mu\text{s}$             |
|                                      | Turn-On Time  | $t_{on}$      |                                                                                                                                            | —    | 0.15 | 0.30      |                           |
|                                      | Fall Time     | $t_f$         |                                                                                                                                            | —    | 0.07 | 0.10      |                           |
|                                      | Turn-Off Time | $t_{off}$     |                                                                                                                                            | —    | 0.60 | 0.90      |                           |
| Forward Voltage                      |               | $V_F$         | $I_F = 15 \text{ A}$ , $V_{GE} = 0$                                                                                                        | —    | 2.0  | 2.8       | V                         |
| Reverse Recovery Time                |               | $t_{rr}$      | $I_F = 15 \text{ A}$ , $V_{GE} = -10 \text{ V}$ ,<br>$di/dt = 200 \text{ A}/\mu\text{s}$                                                   | —    | 0.10 | 0.25      | $\mu\text{s}$             |
| Thermal Resistance                   |               | $R_{th(j-c)}$ | Transistor                                                                                                                                 | —    | —    | 0.86      | $^\circ\text{C}/\text{W}$ |
|                                      |               |               | Diode                                                                                                                                      | —    | —    | 1.5       |                           |

## b. Converter stage

| CHARACTERISTIC                       |  | SYMBOL        | TEST CONDITION             | MIN. | TYP. | MAX. | UNIT                      |
|--------------------------------------|--|---------------|----------------------------|------|------|------|---------------------------|
| Repetitive Peak Reverse Current      |  | $I_{RRM}$     | $V_{RRM} = 1600 \text{ V}$ | —    | —    | 50   | $\mu\text{A}$             |
| Peak Forward Voltage                 |  | $V_{FM}$      | $I_{FM} = 15 \text{ A}$    | —    | 1.05 | 1.20 | V                         |
| Peak One Cycle Surge Forward Current |  | $I_{FSM}$     | 50 Hz sine-half-wave       | 250  | —    | —    | A                         |
| Thermal Resistance                   |  | $R_{th(j-c)}$ | —                          | —    | —    | 1.90 | $^\circ\text{C}/\text{W}$ |

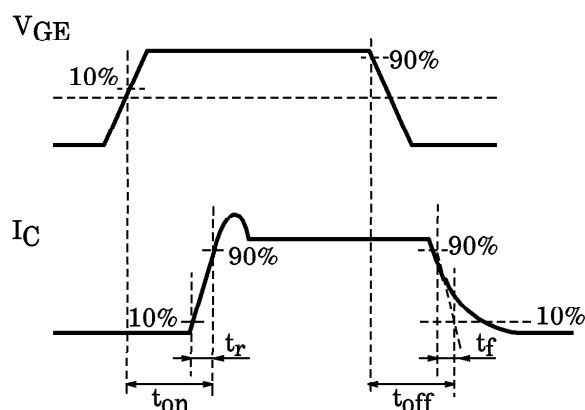
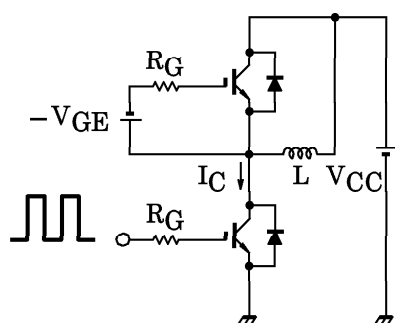
## c. Brake stage

| CHARACTERISTIC                       |               | SYMBOL               | TEST CONDITION                                                                                                                             | MIN. | TYP. | MAX.      | UNIT               |
|--------------------------------------|---------------|----------------------|--------------------------------------------------------------------------------------------------------------------------------------------|------|------|-----------|--------------------|
| Gate Leakage Current                 |               | $I_{GES}$            | $V_{GE} = \pm 20 \text{ V}, V_{CE} = 0$                                                                                                    | —    | —    | $\pm 500$ | nA                 |
| Collector Cut-Off Current            |               | $I_{CES}$            | $V_{CE} = 1200 \text{ V}, V_{GE} = 0$                                                                                                      | —    | —    | 0.5       | mA                 |
| Reverse Current                      |               | $I_R$                | $V_R = 1200 \text{ V}, V_{GE} = 0$                                                                                                         | —    | —    | 0.5       | mA                 |
| Gate-Emitter Cut-Off Voltage         |               | $V_{GE}(\text{off})$ | $I_C = 15 \text{ mA}, V_{CE} = 5 \text{ V}$                                                                                                | —    | 6.0  | —         | V                  |
| Collector-Emitter Saturation Voltage |               | $V_{CE}(\text{sat})$ | $I_C = 15 \text{ A}$<br>$V_{GE} = 15 \text{ V}$<br>$T_j = 25^\circ\text{C}$                                                                | —    | 2.8  | 3.2       | V                  |
|                                      |               |                      | $T_j = 125^\circ\text{C}$                                                                                                                  | —    | 3.1  | 3.7       |                    |
| Input Capacitance                    |               | $C_{ies}$            | $V_{CE} = 10 \text{ V}, V_{GE} = 0,$<br>$f = 1 \text{ MHz}$                                                                                | —    | 1850 | —         | pF                 |
| Switching Time                       | Rise Time     | $t_r$                | $V_{CC} = 600 \text{ V}$<br>$I_C = 15 \text{ A}$<br>$V_{GE} = \pm 15 \text{ V}$<br>$R_G = 82 \Omega$<br>$T_j = 125^\circ\text{C}$ (Note 1) | —    | 0.07 | 0.15      | $\mu\text{s}$      |
|                                      | Turn-On Time  | $t_{on}$             |                                                                                                                                            | —    | 0.15 | 0.30      |                    |
|                                      | Fall Time     | $t_f$                |                                                                                                                                            | —    | 0.07 | 0.10      |                    |
|                                      | Turn-Off Time | $t_{off}$            |                                                                                                                                            | —    | 0.60 | 0.90      |                    |
| Forward Voltage                      |               | $V_F$                | $I_F = 15 \text{ A}, V_{GE} = 0$                                                                                                           | —    | 2.0  | 2.8       | V                  |
| Thermal Resistance                   |               | $R_{th(j-c)}$        | Transistor                                                                                                                                 | —    | —    | 0.86      | $^\circ\text{C/W}$ |
|                                      |               |                      | Diode                                                                                                                                      | —    | —    | 1.5       |                    |

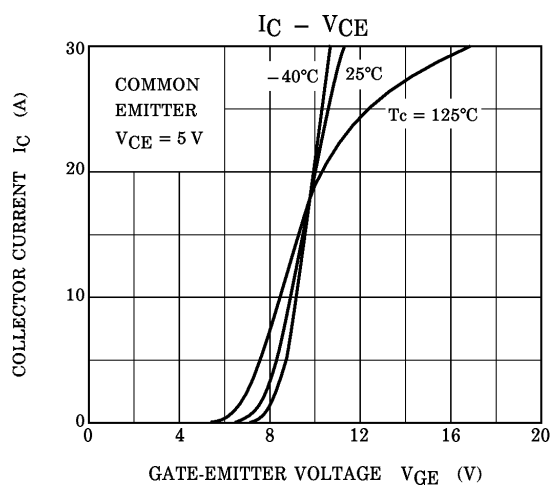
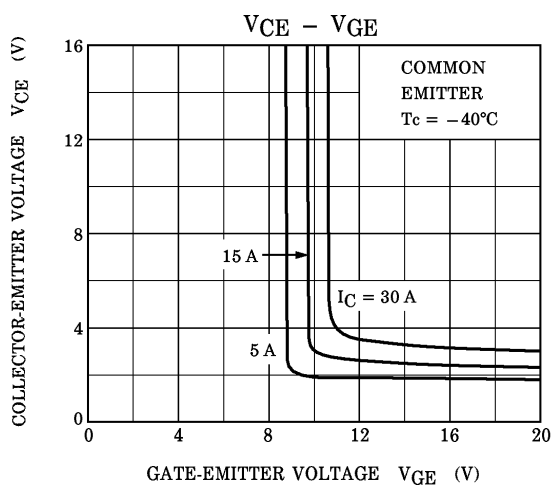
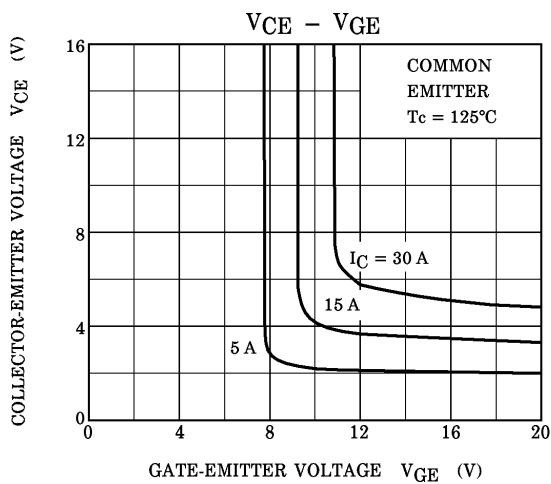
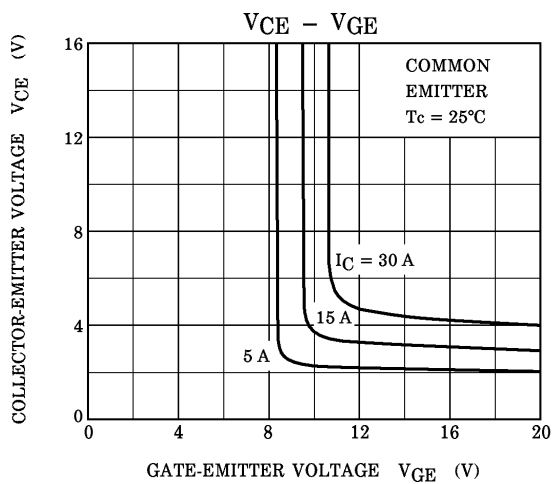
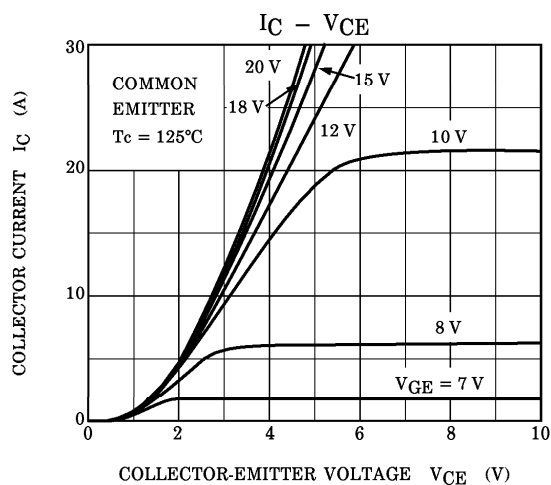
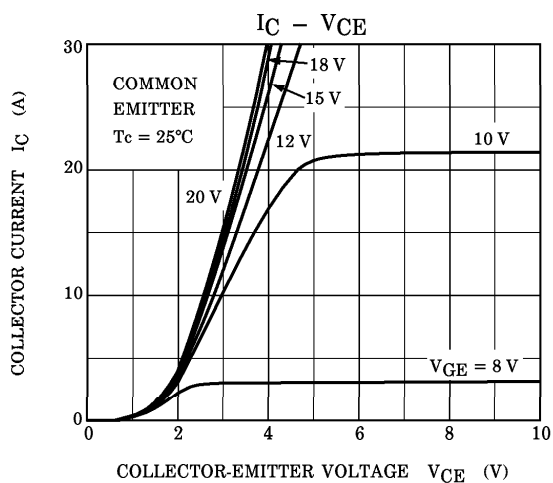
## d. Thermistor

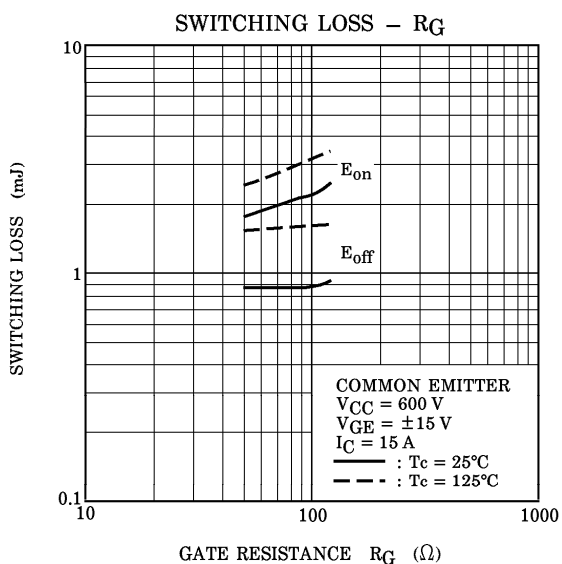
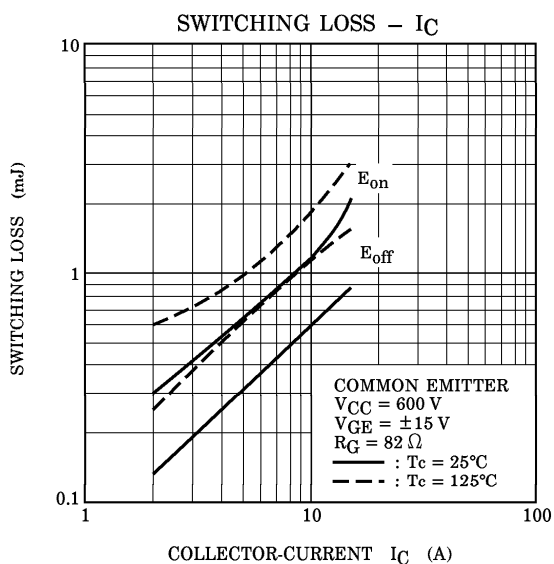
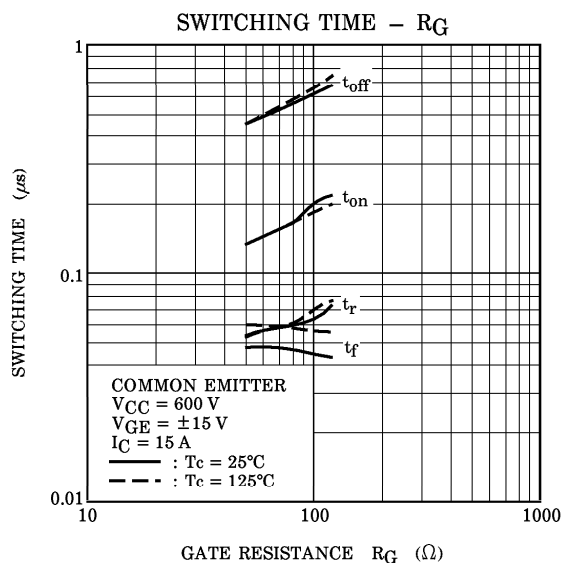
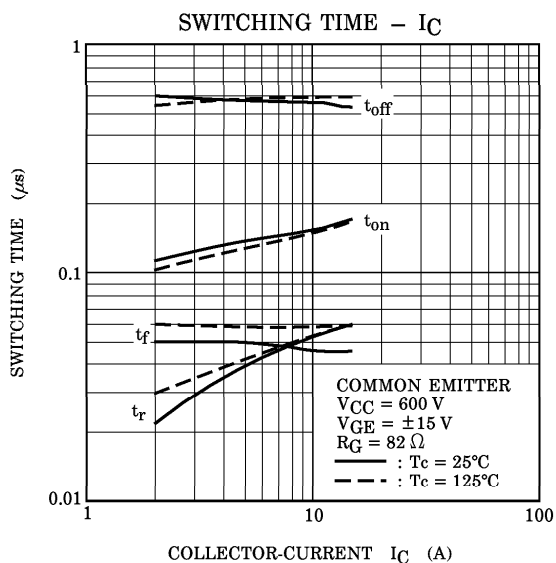
| CHARACTERISTIC        | SYMBOL      | TEST CONDITION                                    | MIN.  | TYP. | MAX.  | UNIT      |
|-----------------------|-------------|---------------------------------------------------|-------|------|-------|-----------|
| Zero-Power Resistance | $R_{25}$    | $I_{TM} = 0.2 \text{ mA}, T_c = 25^\circ\text{C}$ | 17.31 | 20   | 23.14 | $k\Omega$ |
| B Value               | $B_{25/85}$ | $T_c = 25^\circ\text{C} / T_c = 85^\circ\text{C}$ | —     | 3760 | —     | K         |

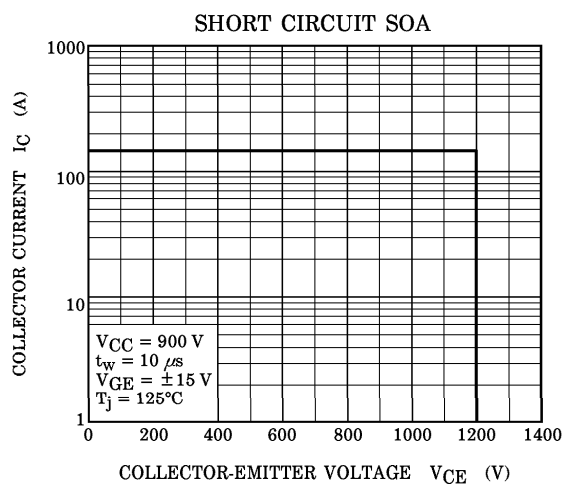
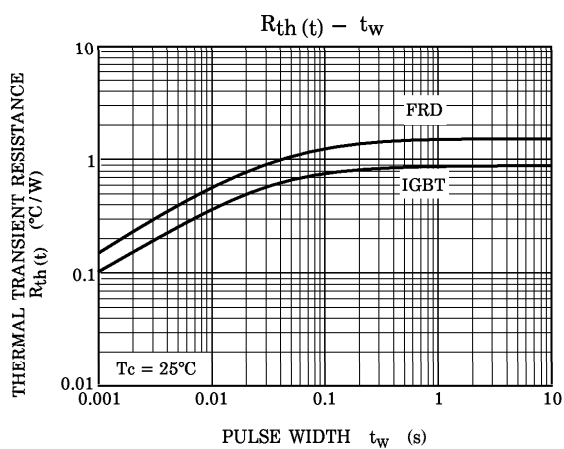
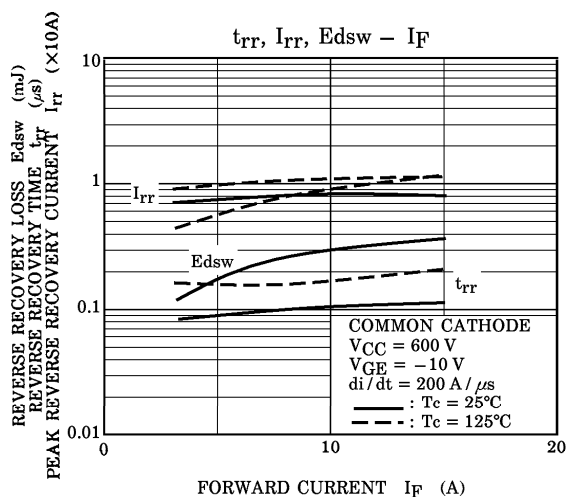
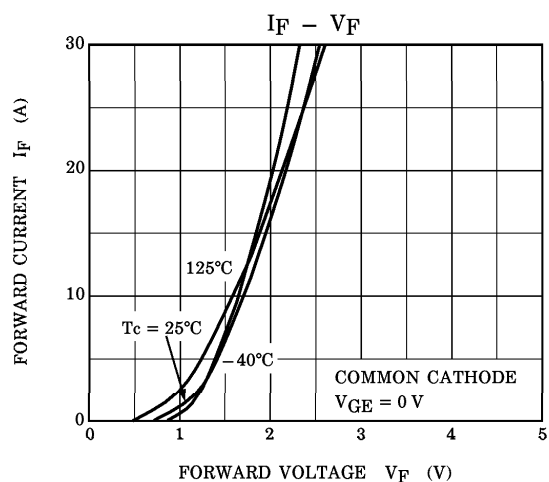
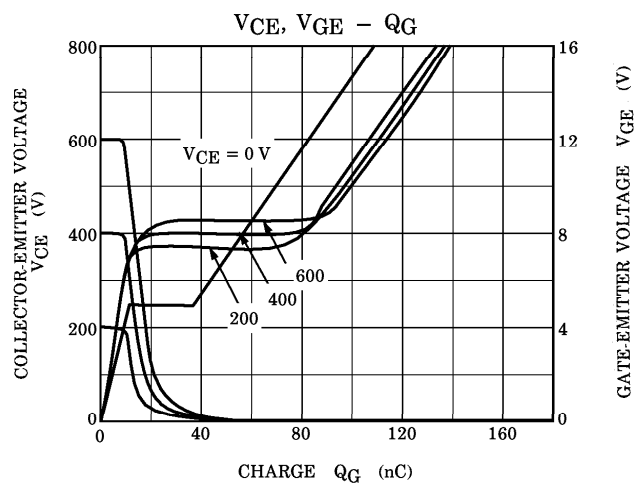
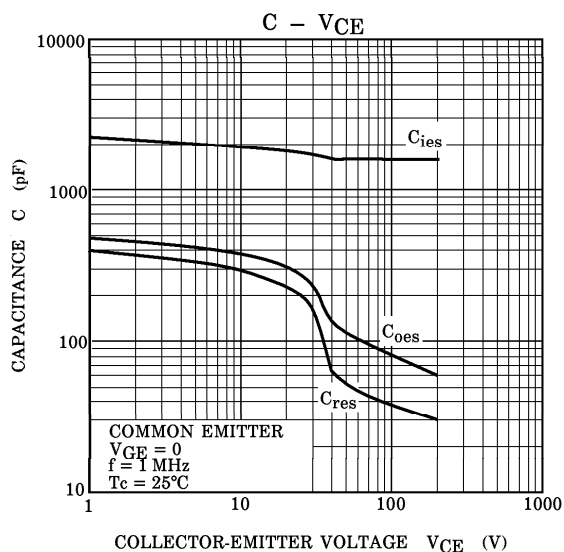
(Note 1) : Switching Time Test Circuit &amp; Timing Chart

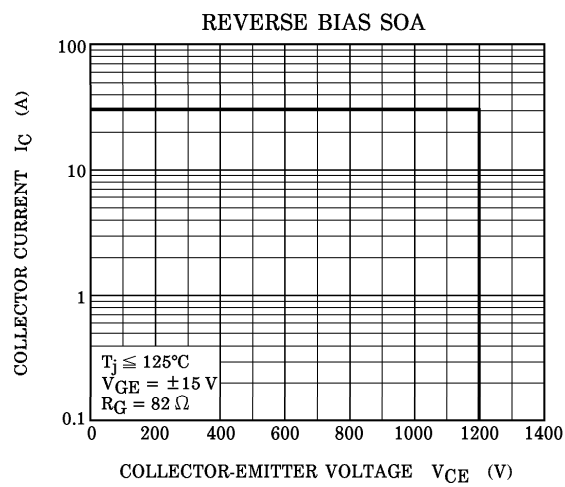


## a. Inverter stage / c. Brake stage









c. Converter stage

