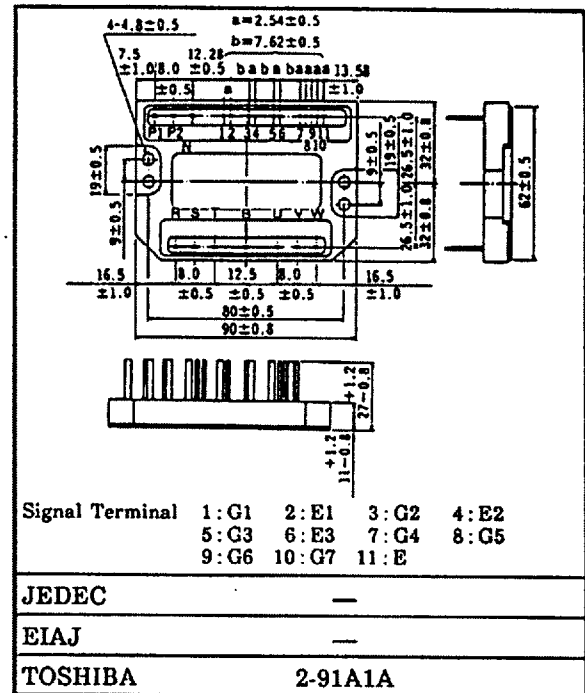


### High Power Switching Applications

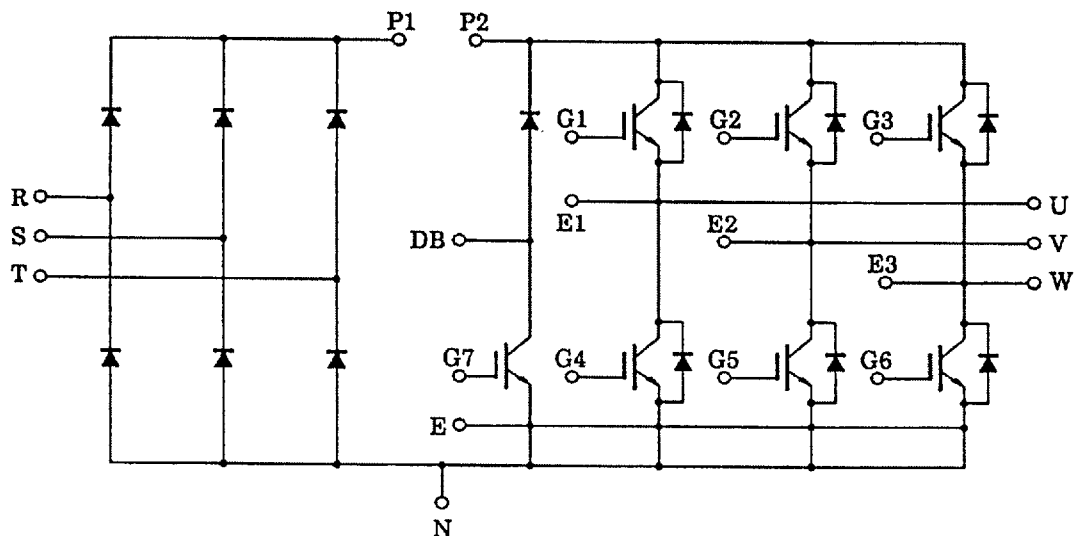
#### Motor Control Applications

- Integrates Inverter, Converter and Brake Power Circuits in One Package.
- Output (Inverter Stage)
  - 3 $\phi$ 20A/600V High Speed Type IGBT
  - $V_{CE(sat)}$  = 4.00V (Max.)
  - $t_f$  = 0.30 $\mu$ s (Max.)
  - $t_{rr}$  = 0.15 $\mu$ s (Max.)
- Input (Converter Stage)
  - 1 $\phi$ 30A/800V Silicon Rectifier
  - $V_F$  = 1.20V (Max.)
- Brake Stage
  - 20A/600V IGBT & 20A/600V FRD
- The Electrodes are Isolated from Case.



Weight : g

### Equivalent Circuit



The information contained here is subject to change without notice.

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# MIG20J902H

## Maximum Ratings (Ta = 25°C)

| STAGE     |      | CHARACTERISTIC                                              |     | SYMBOL     | RATINGS            | UNIT |
|-----------|------|-------------------------------------------------------------|-----|------------|--------------------|------|
| Inverter  |      | Collector-Emitter Voltage                                   |     | $V_{CES}$  | 600                | V    |
|           |      | Gate-Emitter Voltage                                        |     | $V_{GES}$  | ±20                | V    |
|           |      | Collector Current                                           | DC  | $I_C$      | 20                 | A    |
|           |      |                                                             | 1ms | $I_{CP}$   | 40                 |      |
|           |      | Forward Current                                             | DC  | $I_F$      | 20                 | A    |
|           |      |                                                             | 1ms | $I_{FM}$   | 40                 |      |
|           |      | Collector Power Dissipation (Tc = 25°C)                     |     | $P_C$      | 80                 | W    |
| Converter |      | Repetitive Peak Reverse Voltage                             |     | $V_{RRM}$  | 800                | V    |
|           |      | Average Output Rectified Current                            |     | $I_O$      | 20                 | A    |
|           |      | Peak One Cycle Surge Forward Current (50Hz, Non-Repetitive) |     | $I_{FSM}$  | 250                | A    |
| Brake     | IGBT | Collector-Emitter Voltage                                   |     | $V_{CES}$  | 600                | V    |
|           |      | Gate-Emitter Voltage                                        |     | $V_{GES}$  | ±20                | V    |
|           |      | Collector Current                                           | DC  | $I_C$      | 20                 | A    |
|           |      |                                                             | 1ms | $I_{CP}$   | 40                 |      |
|           |      | Collector Power Dissipation (Tc = 25°C)                     |     | $P_C$      | 80                 | W    |
|           | FRD  | Repetitive Peak Reverse Voltage                             |     | $V_{RRM}$  | 600                | V    |
|           |      | Forward Current                                             | DC  | $I_F$      | 20                 | A    |
|           |      |                                                             | 1ms | $I_{FM}$   | 40                 |      |
| Module    |      | Junction Temperature                                        |     | $T_J$      | 150                | °C   |
|           |      | Storage Temperature Range                                   |     | $T_{stg}$  | -40 ~ 125          | °C   |
|           |      | Isolation Voltage                                           |     | $V_{isol}$ | 2500 (AC 1 minute) | V    |
|           |      | Screw Torque                                                |     | —          | 3                  | N•m  |

**Electrical Characteristics (Ta = 25°C)****a. Inverter Stage**

| CHARACTERISTIC                       |                     | SYMBOL         | TEST CONDITION                                                                                          | MIN. | TYP. | MX.      | UNIT          |
|--------------------------------------|---------------------|----------------|---------------------------------------------------------------------------------------------------------|------|------|----------|---------------|
| Gate Leakage Current                 |                     | $I_{GES}$      | $V_{GE} = \pm 20V, V_{CE} = 0$                                                                          | –    | –    | $\pm 20$ | $\mu A$       |
| Collector Cut-off Current            |                     | $I_{CES}$      | $V_{CE} = 600V, V_{GE} = 0$                                                                             | –    | –    | 1.0      | mA            |
| Gate-Emitter Cut-off Voltage         |                     | $V_{GE (off)}$ | $V_{CE} = 5V, I_C = 20mA$                                                                               | 3.0  | –    | 6.0      | V             |
| Collector-Emitter Saturation Voltage |                     | $V_{CE (sat)}$ | $I_C = 20A, V_{GE} = 15V$                                                                               | –    | 3.0  | 4.0      | V             |
| Input Capacitance                    |                     | $C_{ies}$      | $V_{CE} = 10V, V_{GE} = 0$<br>$f = 1MHz$                                                                | –    | 1300 | –        | pF            |
| Switching Time                       | Turn-on Delay Time  | $t_{d(on)}$    | Inductive Load<br>$V_{CC} = 300V$<br>$I_C = 20A$<br>$V_{GE} = \pm 15V$<br>$R_G = 120\Omega$<br>(Note 1) | –    | 0.08 | 0.16     | $\mu s$       |
|                                      | Rise Time           | $t_r$          |                                                                                                         | –    | 0.12 | 0.24     |               |
|                                      | Turn-on Time        | $t_{on}$       |                                                                                                         | –    | 0.40 | 0.80     |               |
|                                      | Turn-off Delay Time | $t_{d(off)}$   |                                                                                                         | –    | 0.30 | 0.60     |               |
|                                      | Fall Time           | $t_f$          |                                                                                                         | –    | 0.15 | 0.30     |               |
|                                      | Turn-off Time       | $t_{off}$      |                                                                                                         | –    | 0.60 | 1.00     |               |
| Forward Voltage                      |                     | $V_F$          | $I_F = 20A, V_{GE} = 0$                                                                                 | –    | 1.7  | 2.5      | V             |
| Reverse Recovery Time                |                     | $t_{rr}$       | $I_F = 20A, V_{GE} = -10V$<br>$di/dt = 50A/\mu s$                                                       | –    | 0.08 | 0.15     | $\mu s$       |
| Thermal Resistance                   |                     | $R_{th(j-c)}$  | Transistor                                                                                              | –    | –    | 1.56     | $^{\circ}C/W$ |
|                                      |                     |                | Diode                                                                                                   | –    | –    | 2.80     |               |

**b. Converter Stage**

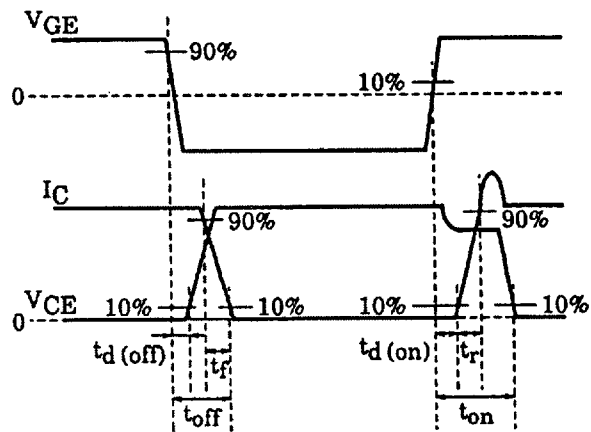
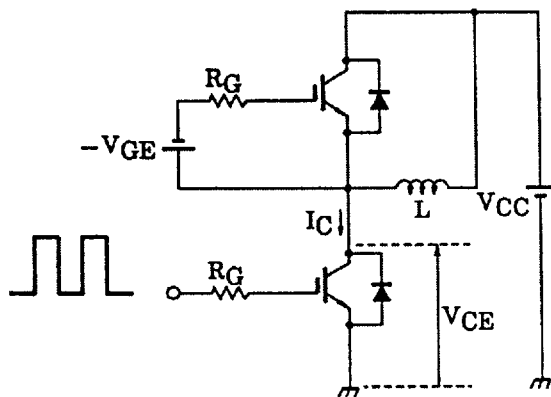
| CHARACTERISTIC                       | SYMBOL        | TEST CONDITION      | MIN. | TYP. | MX.  | UNIT          |
|--------------------------------------|---------------|---------------------|------|------|------|---------------|
| Repetitive Peak Reverse Current      | $I_{RRM}$     | $V_{RRM} = 800V$    | –    | –    | 50   | $\mu A$       |
| Peak Forward Voltage                 | $V_{FM}$      | $I_{FM} = 20A$      | –    | 1.05 | 1.20 | V             |
| Peak One Cycle Surge Forward Current | $I_{FSM}$     | 50Hz Sine-half-wave | 250  | –    | –    | A             |
| Thermal Resistance                   | $R_{th(j-c)}$ | –                   | –    | –    | 2.50 | $^{\circ}C/W$ |

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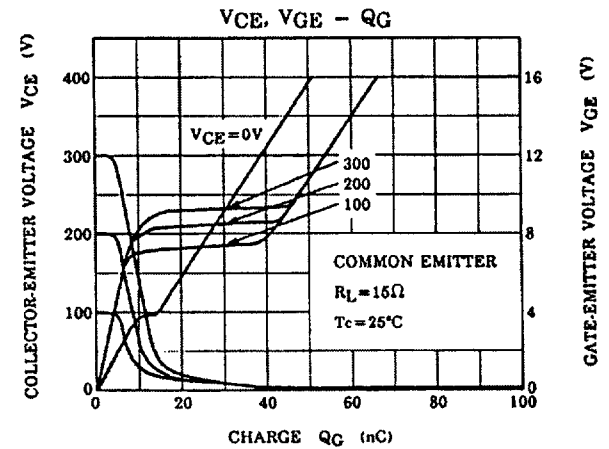
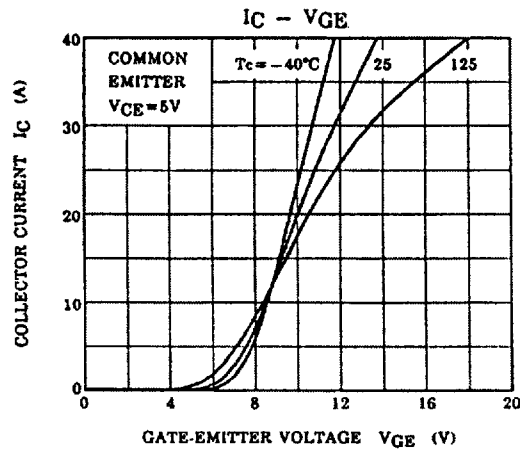
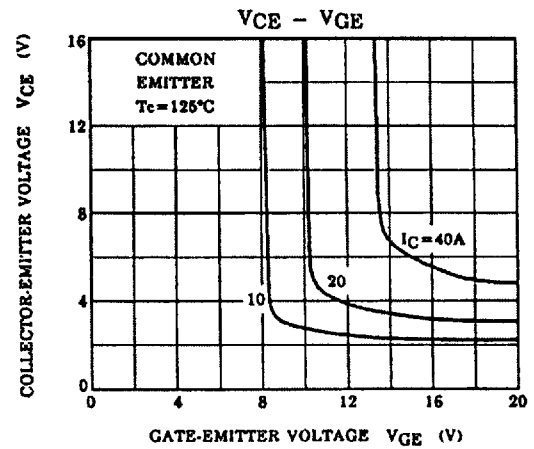
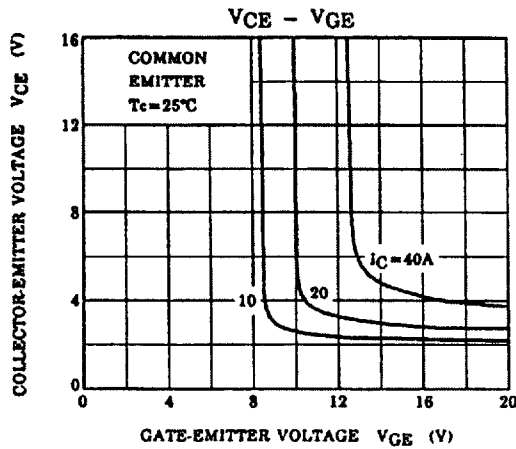
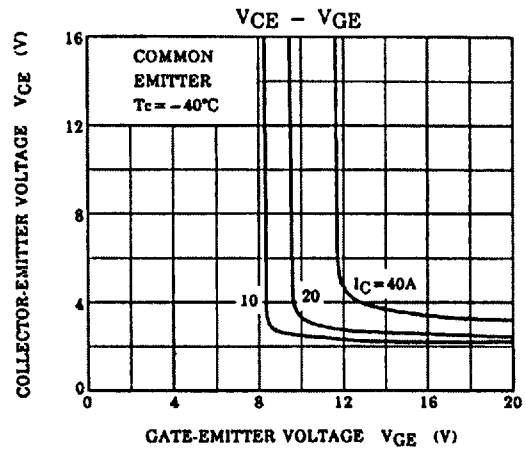
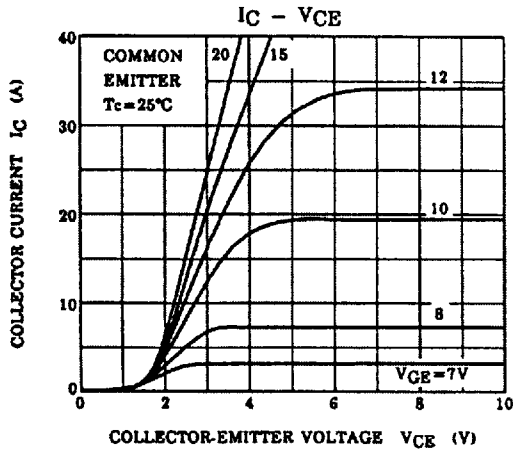
c. Brake Stage

| CHARACTERISTIC                       |                     | SYMBOL        | TEST CONDITION                           | MIN. | TYP. | MX.      | UNIT          |
|--------------------------------------|---------------------|---------------|------------------------------------------|------|------|----------|---------------|
| Gate Leakage Current                 |                     | $I_{GES}$     | $V_{GE} = \pm 20V, V_{CE} = 0$           | —    | —    | $\pm 20$ | $\mu A$       |
| Collector Cut-off Current            |                     | $I_{CES}$     | $V_{CE} = 600V, V_{GE} = 0$              | —    | —    | 1.0      | mA            |
| Repetitive Peak Reverse Current      |                     | $I_{RRM}$     | $V_{RRM} = 600V$                         | —    | —    | 1.0      | mA            |
| Gate-Emitter Cut-off Voltage         |                     | $V_{GE(off)}$ | $V_{CE} = 5V, I_C = 20mA$                | 3.0  | —    | 6.0      | V             |
| Collector-Emitter Saturation Voltage |                     | $V_{CE(sat)}$ | $I_C = 20A, V_{GE} = 15V$                | —    | 3.0  | 4.0      | V             |
| Input Capacitance                    |                     | $C_{ies}$     | $V_{CE} = 10V, V_{GE} = 0$<br>$f = 1MHz$ | —    | 1300 | —        | pF            |
| Switching Time                       | Turn-on Delay Time  | $t_{d(on)}$   | Inductive Load                           | —    | 0.08 | 0.16     | $\mu s$       |
|                                      | Rise Time           | $t_r$         | $V_{CC} = 300V$                          | —    | 0.12 | 0.24     |               |
|                                      | Turn-on Time        | $t_{on}$      | $I_C = 20A$                              | —    | 0.40 | 0.80     |               |
|                                      | Turn-off Delay Time | $t_{d(off)}$  | $V_{GE} = \pm 15V$                       | —    | 0.30 | 0.60     |               |
|                                      | Fall Time           | $t_f$         | $R_G = 120\Omega$                        | —    | 0.30 | 0.55     |               |
|                                      | Turn-off Time       | $t_{off}$     | (Note 1)                                 | —    | 0.70 | 1.00     |               |
| Forward Voltage                      |                     | $V_F$         | $I_F = 20A, V_{GE} = 0$                  | —    | 1.7  | 2.5      | V             |
| Thermal Resistance                   |                     | $R_{th(j-c)}$ | Transistor                               | —    | —    | 1.92     | $^{\circ}C/W$ |
|                                      |                     |               | Diode                                    | —    | —    | 2.80     |               |

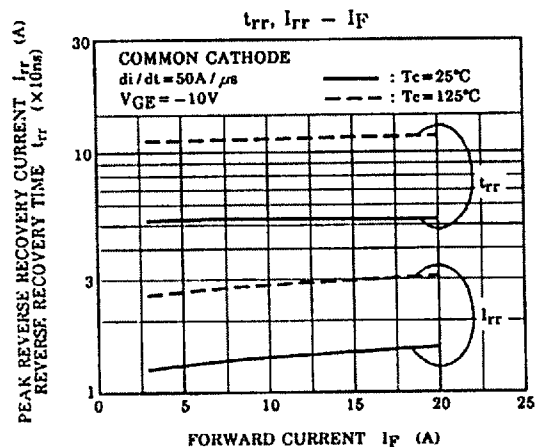
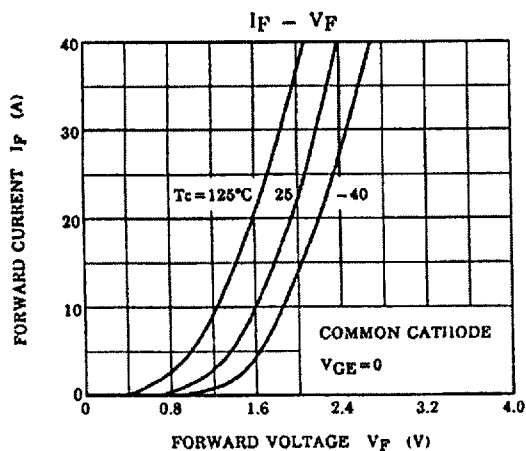
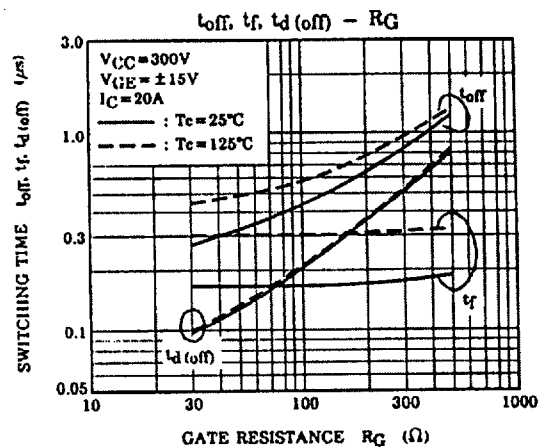
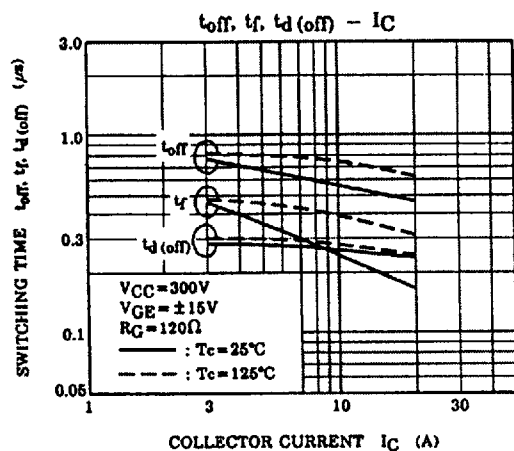
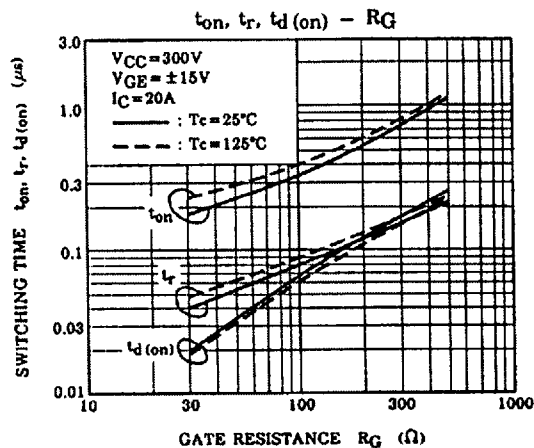
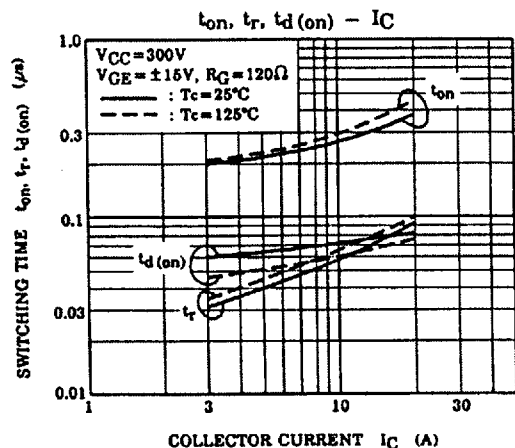
Note. 1 Switching Time Test Circuit & Timing Chart



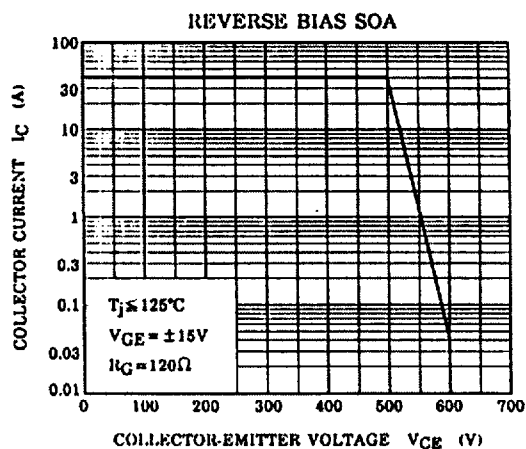
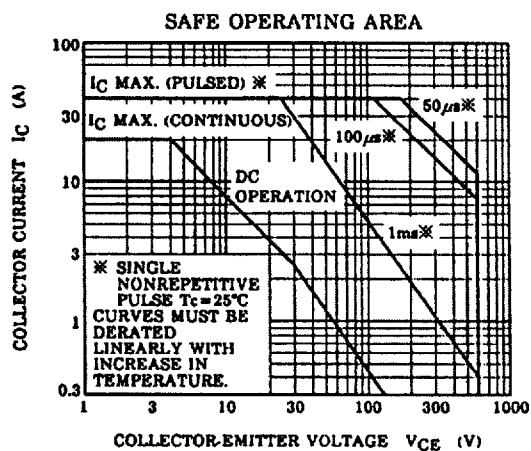
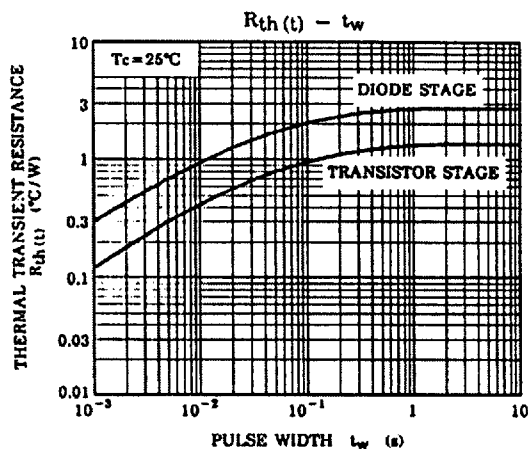
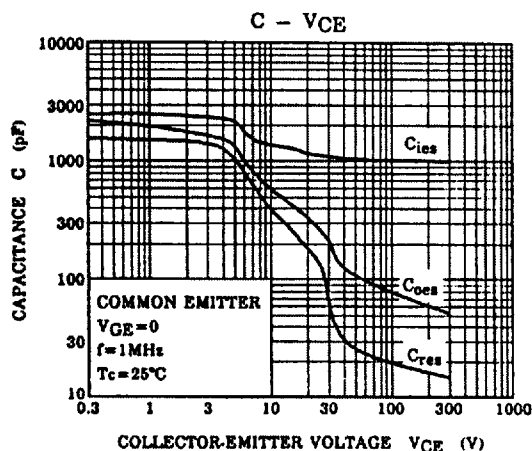
## a. Inverter Stage/c. Brake Stage



## a. Inverter Stage/c. Brake Stage



## a. Inverter Stage/c. Brake Stage



## b. Converter Stage

