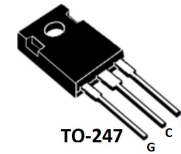


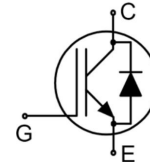
## Features

- 650V 60A,  $V_{CE(sat)}(typ.)=1.8V$
- Field Stop IGBT Technology
- 10 $\mu s$  Short Circuit Capability
- Square RBSOA
- Positive  $V_{CE(on)}$  Temperature Coefficient



## Applications

- General purpose inverters
- Induction heating(IH)
- Welding Converters
- UPS
- Motor drive



## Absolute Ratings (T<sub>c</sub>=25°C)

| Parameter                                           | Symbol           |                      | Value   | Unit |
|-----------------------------------------------------|------------------|----------------------|---------|------|
| Collector-Emitter Voltage                           | Vces             |                      | 650     | V    |
| Continuous Gate-Emitter Voltage                     | V <sub>GE</sub>  |                      | ±20     | V    |
| Transient Gate-emitter voltage                      | V <sub>GE</sub>  |                      | ±30     | V    |
| Collector Current-continuous                        | I <sub>c</sub>   | T <sub>C</sub> =25℃  | 100     | A    |
|                                                     |                  | T <sub>C</sub> =100℃ | 50      | A    |
| Collector Current-pulse(note 1)                     | I <sub>CM</sub>  |                      | 200     | A    |
| Diode Forward current, limited by T <sub>jmax</sub> | I <sub>F</sub>   | T <sub>C</sub> =25℃  | 100     | A    |
|                                                     |                  | T <sub>C</sub> =100℃ | 50      | A    |
| Diode Maximum Forward Current (note 1)              | I <sub>FM</sub>  |                      | 200     | A    |
| Short Circuit withstand time                        | t <sub>sc</sub>  |                      | 10      | μs   |
| Short Circuit Current                               | I <sub>SC</sub>  |                      | 240     | A    |
| Power Dissipation                                   | P <sub>D</sub>   | T <sub>C</sub> =25℃  | 394     | W    |
|                                                     |                  | T <sub>C</sub> =100℃ | 197     | W    |
| Operating Temperature Range                         | T <sub>J</sub>   |                      | -40~175 | ℃    |
| Storage Temperature Range                           | T <sub>STG</sub> |                      | -55~150 | ℃    |
| Maximum Lead Temperature for Soldering Purposes     | T <sub>L</sub>   |                      | 300     | ℃    |

**Electrical Characteristics** ( $T_C=25^\circ\text{C}$  unless otherwise noted)

| Parameter                            | Symbol        | Tests conditions                                                                                                  | Min | Type | Max       | Units         |
|--------------------------------------|---------------|-------------------------------------------------------------------------------------------------------------------|-----|------|-----------|---------------|
| <b>Off-Characteristics</b>           |               |                                                                                                                   |     |      |           |               |
| Collector-Emitter Voltage            | $BV_{CES}$    | $I_C=250\mu\text{A}, V_{GE}=0\text{V}$                                                                            | 650 | -    | -         | V             |
| Zero Gate Voltage Collector Current  | $I_{CES}$     | $V_{CE}=650\text{V}, V_{GE}=0\text{V}, T_C=25^\circ\text{C}$                                                      | -   | -    | 50        | $\mu\text{A}$ |
| Gate-body leakage current            | $I_{GES}$     | $V_{CE}=0\text{V}, V_{GE}=\pm 20\text{V}$                                                                         | -   | -    | $\pm 100$ | nA            |
| <b>On-Characteristics</b>            |               |                                                                                                                   |     |      |           |               |
| Gate-Emitter Threshold Voltage       | $V_{GE(th)}$  | $V_{CE}=V_{GE}, I_C=250\mu\text{A}$                                                                               | 4.0 | -    | 6.0       | V             |
| Collector-Emitter saturation Voltage | $V_{CE(sat)}$ | $V_{GE}=15\text{V}, I_C=60\text{A}$                                                                               | -   | 1.8  | 2.0       | V             |
| <b>Dynamic Characteristics</b>       |               |                                                                                                                   |     |      |           |               |
| Input capacitance                    | $C_{ies}$     | $V_{CE}=25\text{V}, V_{GE}=0\text{V}, f=1.0\text{MHz}$                                                            | -   | 1.6  | -         | nF            |
| Output capacitance                   | $C_{oes}$     |                                                                                                                   | -   | 275  | -         | pF            |
| Reverse transfer capacitance         | $C_{res}$     |                                                                                                                   | -   | 108  | -         | pF            |
| Integrated gate resistor             | $R_{Gint}$    | $f=1\text{MHz}; V_{pp}=1\text{V}$                                                                                 |     | 1.9  |           | $\Omega$      |
| <b>Switching Characteristics</b>     |               |                                                                                                                   |     |      |           |               |
| Turn-On delay time                   | $t_d(on)$     | $V_{CC}=400\text{V}, I_C=50\text{A}, R_G=10\Omega, V_{GE}=15\text{V}$<br>$T_C=25^\circ\text{C}$<br>Inductive Load | -   | 32   | -         | ns            |
| Turn-On rise time                    | $t_r$         |                                                                                                                   | -   | 78   | -         | ns            |
| Turn-off delay time                  | $t_d(off)$    |                                                                                                                   | -   | 231  | -         | ns            |
| Turn-off Fall time                   | $t_f$         |                                                                                                                   | -   | 52   | -         | ns            |
| Turn-on energy                       | $E_{on}$      |                                                                                                                   | -   | 2.15 | -         | mJ            |
| Turn-off energy                      | $E_{off}$     |                                                                                                                   | -   | 1.41 | -         | mJ            |
| Total switching Energy               | $E_{total}$   |                                                                                                                   | -   | 3.56 | -         | mJ            |
| Total Gate Charge                    | $Q_g$         | $V_{CE}=400\text{V}, I_C=50\text{A}, V_{GE}=15\text{V}$                                                           | -   | 116  | -         | nC            |
| Gate to emitter Charge               | $Q_{ge}$      |                                                                                                                   | -   | 16   | -         | nC            |
| Gate to Collector charge             | $Q_{gc}$      |                                                                                                                   | -   | 64   | -         | nC            |

| Anti-Parallel Diode Characteristics and Maximum Ratings |          |                                                             |   |      |   |    |
|---------------------------------------------------------|----------|-------------------------------------------------------------|---|------|---|----|
| Diode Forward Voltage                                   | $V_F$    | $V_{GE}=0V, I_F=50A$                                        | - | 1.7  | - | V  |
| Diode Reverse recovery time                             | $t_{rr}$ | $V_{GE}=0V,$<br>$V_R=400V$<br>$I_F=50A$<br>$di_F/dt=500/us$ | - | 198  | - | ns |
| Reverse recovery charge                                 | $Q_{rr}$ |                                                             | - | 1940 | - | nC |
| Reverse Recovery Current                                | $I_{rr}$ |                                                             | - | 18.6 | - | A  |

## Thermal Characteristic

| Parameter                                 | Symbol        | Max  | Unit          |
|-------------------------------------------|---------------|------|---------------|
| IGBT Thermal Resistance,Junction to Case  | $R_{th(j-c)}$ | 0.38 | $^{\circ}C/W$ |
| Diode Thermal Resistance,Junction to Case | $R_{th(j-c)}$ | 0.45 | $^{\circ}C/W$ |
| Thermal Resistance,Junction to Ambient    | $R_{th(j-A)}$ | 80   | $^{\circ}C/W$ |

Notes:

1. Repetitive Rating: Pulse width limited by maximum junction temperature.

## Order Information

| Order codes  | package | packaging |
|--------------|---------|-----------|
| MSG50T65QHC0 | TO-247  | Tube      |

## Electrical Characteristics(curves)

Fig 1. DC Collector current as a function of case temperature ( $V_{GE} \geq 15V$ ,  $T_j \leq 150^{\circ}C$ )

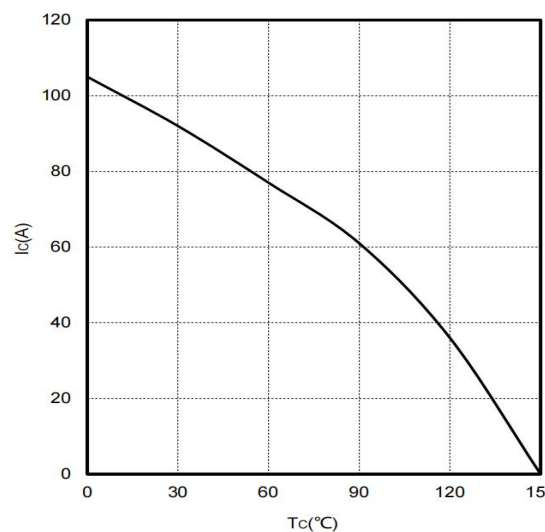


Fig 2. Power dissipation as a function of case temperature ( $T_j \leq 150^{\circ}C$ )

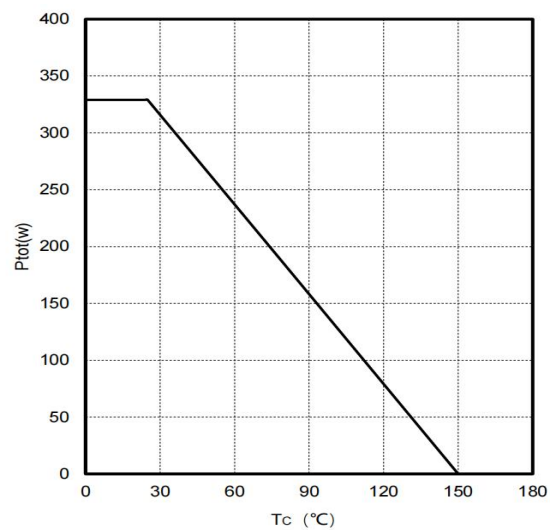


Fig 3. IGBT Forward safe operation area

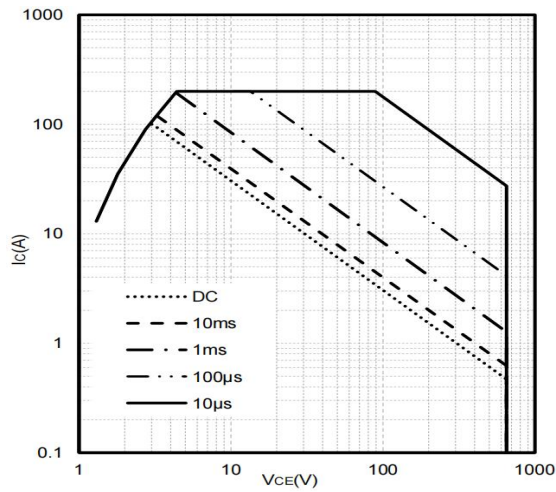


Fig 4. IGBT Reverse safe operation area

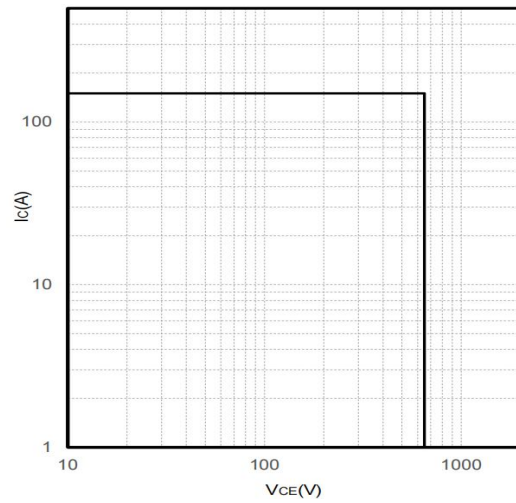


Fig 5. Typical output characteristic ( $T_J=25^\circ\text{C}$ )

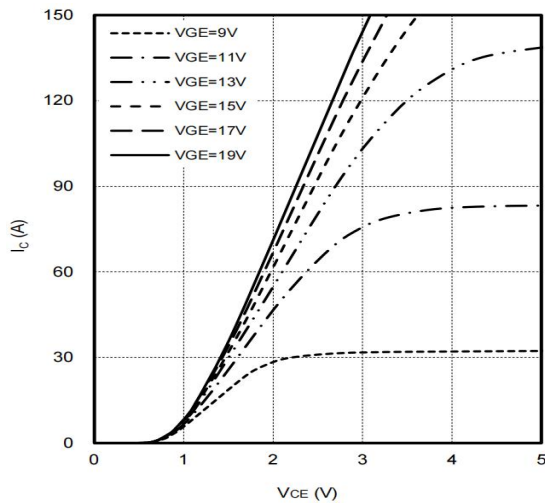


Fig 6. Typical output characteristic ( $T_J=125^\circ\text{C}$ )

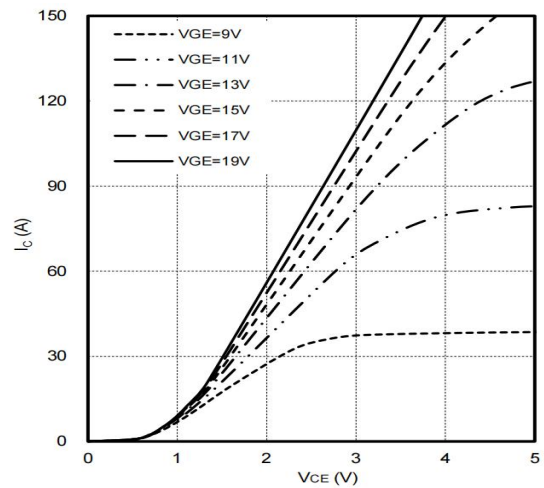


Fig 7. Typical transfer characteristic ( $V_{CE}=20\text{V}$ )

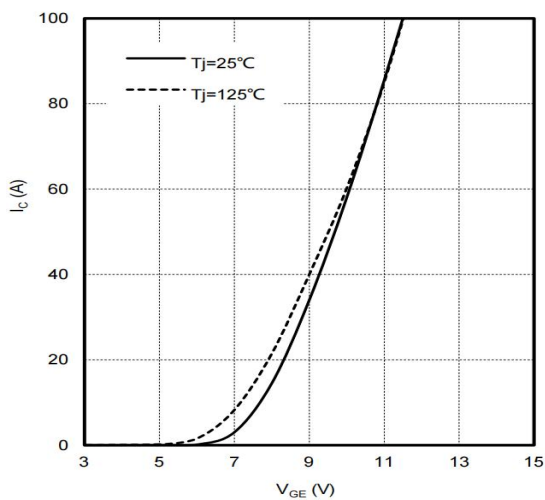


Fig 8. Typical collector-emitter saturation voltage as a function of junction temperature ( $V_{GE}=15\text{V}$ )

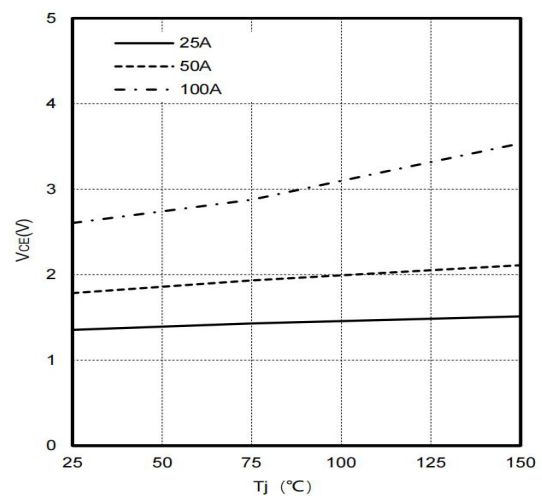


Fig 9. Typical collector-emitter saturation voltage as a function of  $V_{GE}$  ( $T_j=25^\circ\text{C}$ )

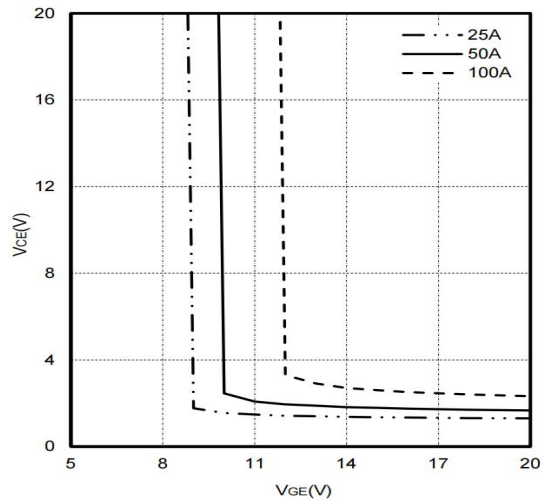


Fig 10. Typical collector-emitter saturation voltage as a function of  $V_{GE}$  ( $T_j=125^\circ\text{C}$ )

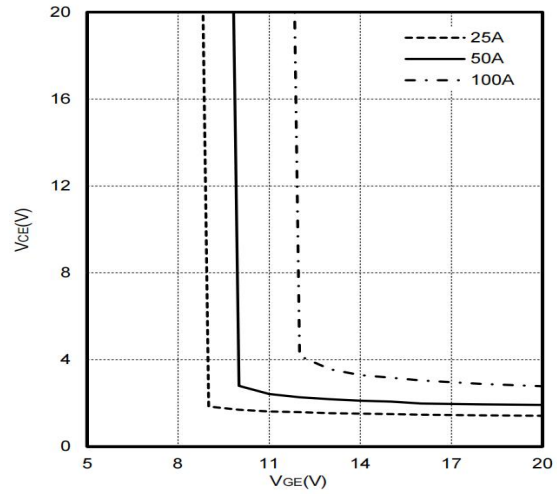


Fig 11. Typical switch energy as a function of  $I_c$  (Inductive load,  $T_j=25^\circ\text{C}$ ,  $V_{ce}=400\text{V}$ ,  $V_{ge}=15\text{V}$ ,  $R_g=15\Omega$ )

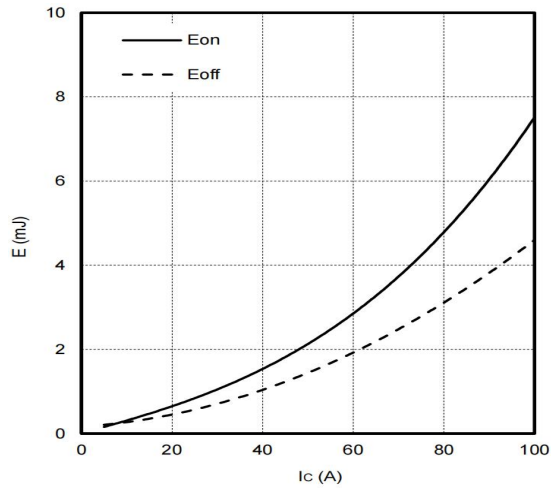


Fig 12. Typical switch time as a function of  $I_c$  (Inductive load,  $T_j=25^\circ\text{C}$ ,  $V_{ce}=400\text{V}$ ,  $V_{ge}=15\text{V}$ ,  $R_g=15\Omega$ )

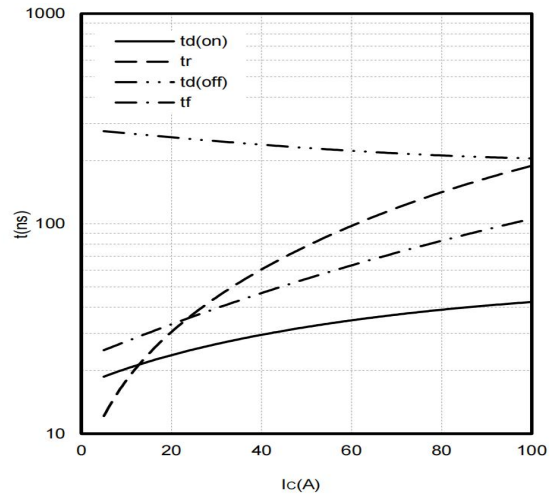


Fig 13. Typical switch energy as a function of  $R_g$  (inductive load,  $T_j=25^\circ\text{C}$ ,  $V_{ce}=400\text{V}$ ,  $V_{ge}=15\text{V}$ ,  $I_c=50\text{A}$ )

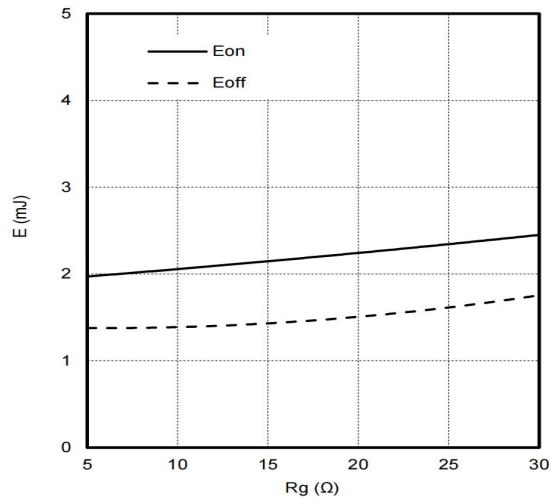


Fig 14. Typical switch time as a function of  $R_g$  (inductive load,  $T_j=25^\circ\text{C}$ ,  $V_{ce}=400\text{V}$ ,  $V_{ge}=15\text{V}$ ,  $I_c=50\text{A}$ )

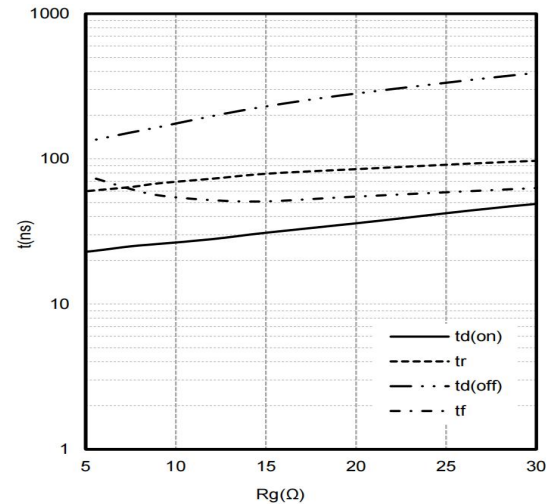




Fig 15. Typical capacitance as a function of collector-emitter voltage ( $V_{ge}=0V, f=1MHz$ )

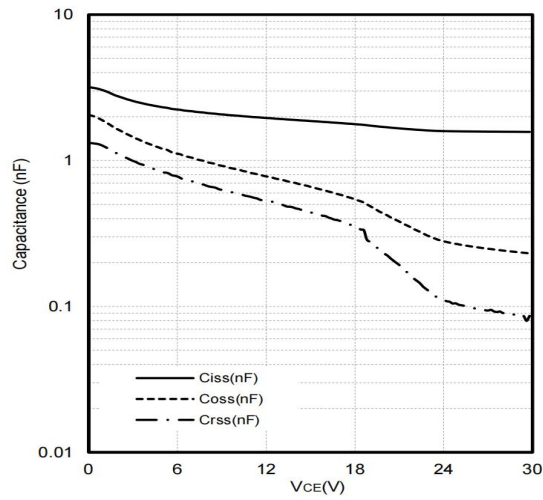


Fig 17. Typical diode forward current as a function of forward voltage

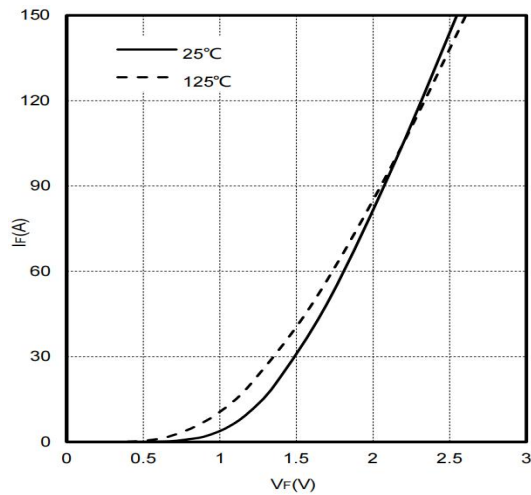


Fig 19. Typical  $I_{rrm}$  as a function of  $di/dt$ ,  $V_r=400V$ ,  $I_f=50A$ ,  $T_j=25^\circ C$

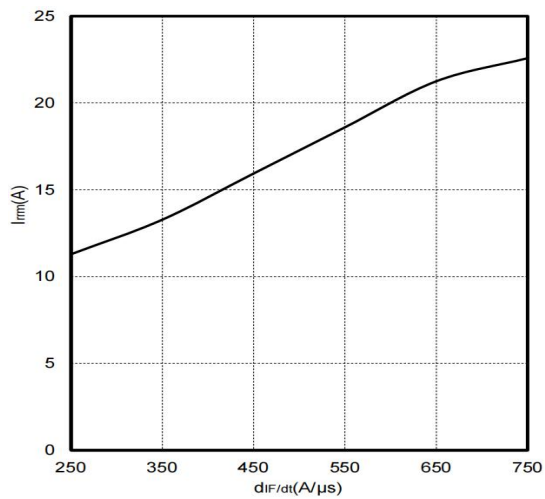


Fig 16. Typical gate charge ( $I_c=50A$ )

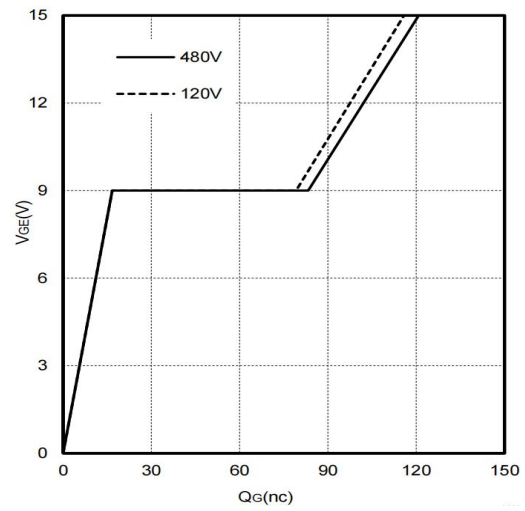


Fig 18. Typical  $trr$  as a function of  $di/dt$ ,  $V_r=400V$ ,  $I_f=50A$ ,  $T_j=25^\circ C$

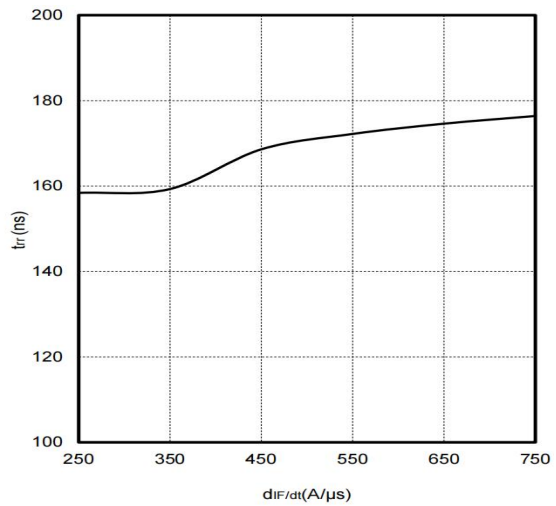


Fig 20. Typical  $Q_{rr}$  as a function of  $di/dt$ ,  $V_r=400V$ ,  $I_f=50A$ ,  $T_j=25^\circ C$

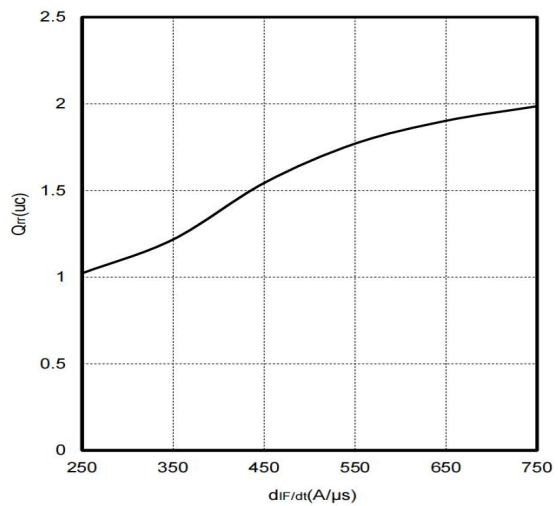
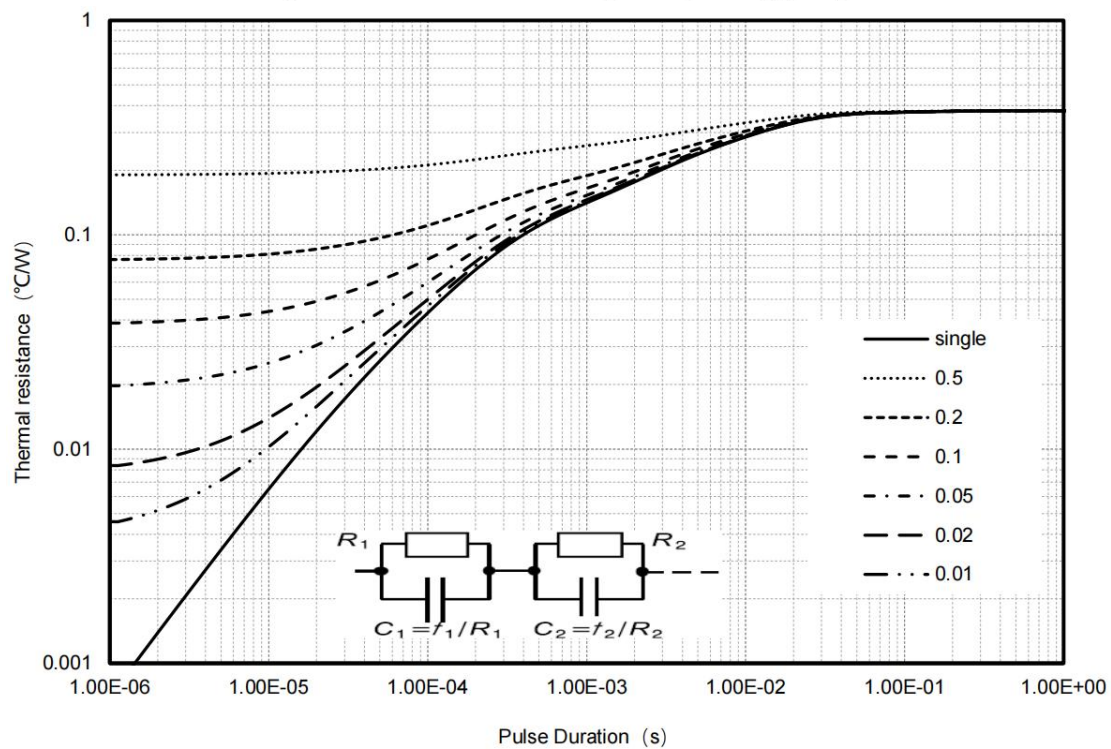


Fig 21. IGBT transient thermal impedance,  $Z_{th}=f(t_p), D=t_p/T$



## Package Mechanical DATA

