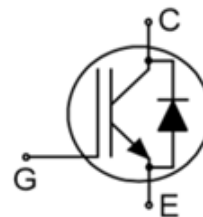


## Trench Field-Stop Technology IGBT

### Features

- 1200V, 15A
- $V_{CE(sat)(typ.)}=2.00V@V_{GE}=15V, I_C=15A$
- Low Switching Losses
- $V_{CE(sat)}$  with Positive Temperature Coefficient
- Pb-free Lead Plating; RoHS Compliant



### Applications

- Frequency Converters
- Uninterrupted Power Supply
- Air Conditioning
- Motor Drives

### Absolute Maximum Ratings

| Symbol    | Parameter  | Value      | Unit       |
|-----------|--|------------|------------|
| $V_{CES}$ | Collector-Emitter Voltage                              | 1200       | V          |
| $V_{GES}$ | Gate-Emitter Voltage                                   | $\pm 20$   | V          |
| $I_C$     | Continuous Collector Current ( $T_C=25^\circ C$ )      | 30         | A          |
|           | Continuous Collector Current ( $T_C=100^\circ C$ )     | 15         | A          |
| $I_{CM}$  | Pulsed Collector Current (Note 1)                      | 45         | A          |
| $I_F$     | Diode Continuous Forward Current ( $T_C=100^\circ C$ ) | 15         | A          |
| $I_{FM}$  | Diode Maximum Forward Current (Note 1)                 | 45         | A          |
| $t_{sc}$  | Short Circuit Withstand Time                           | 10         | us         |
| $P_D$     | Maximum Power Dissipation ( $T_C=25^\circ C$ )         | 245        | W          |
|           | Maximum Power Dissipation ( $T_C=100^\circ C$ )        | 122        | W          |
| $T_J$     | Operating Junction Temperature Range                   | -40 to 175 | $^\circ C$ |
| $T_{STG}$ | Storage Temperature Range                              | -55 to 150 | $^\circ C$ |

### Thermal Data

| Symbol          | Parameter                                      | Max. | Unit         |
|-----------------|--|------|--------------|
| $R_{\theta JC}$ | Thermal Resistance, Junction to Case for IGBT  | 0.61 | $^\circ C/W$ |
| $R_{\theta JC}$ | Thermal Resistance, Junction to Case for Diode | 0.77 | $^\circ C/W$ |
| $R_{\theta JA}$ | Thermal Resistance, Junction to Ambient        | 40   | $^\circ C/W$ |

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

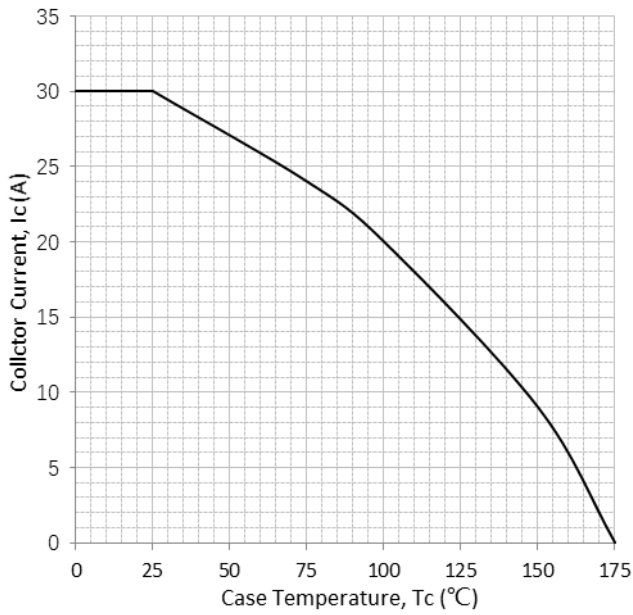
| Symbol        | Parameter                            | Conditions   | Min. | Typ. | Max. | Unit |
|---------------|--------------------------------------|--|------|------|------|------|
| $BV_{CES}$    | Collector-Emitter Breakdown Voltage  | $V_{GE}=0V, I_C=500\mu A$  | 1200 | ---  | ---  | V    |
| $I_{CES}$     | Collector-Emitter Leakage Current    | $V_{CE}=1200V, V_{GE}=0V$  | ---  | ---  | 1    | mA   |
| $I_{GES}$     | Gate Leakage Current, Forward        | $V_{GE}=20V, V_{CE}=0V$  | ---  | ---  | 400  | nA   |
|               | Gate Leakage Current, Reverse        | $V_{GE}=-20V, V_{CE}=0V$   | ---  | ---  | -400 | nA   |
| $V_{GE(th)}$  | Gate Threshold Voltage               | $V_{GE}=V_{CE}, I_C=480\mu A$  | 5.2  | 5.8  | 6.4  | V    |
| $V_{CE(sat)}$ | Collector-Emitter Saturation Voltage | $V_{GE}=15V, I_C=15A$  | ---  | 2.00 | 2.25 | V    |
| $Q_G$         | Total Gate Charge                    | $V_{CC}=960V$  | ---  | 68   | ---  | nC   |
| $Q_{GE}$      | Gate-Emitter Charge                  | $V_{GE}=15V$   | ---  | 12.8 | ---  | nC   |
| $Q_{GC}$      | Gate-Collector Charge                | $I_C=15A$  | ---  | 50.2 | ---  | nC   |
| $t_{d(on)}$   | Turn-on Delay Time                   | $V_{CC}=600V$<br>$V_{GE}=\pm 15V$<br>$I_C=15A$<br>$R_G=39\Omega$<br>Inductive Load<br>$T_c=25^\circ\text{C}$ | ---  | 36   | ---  | ns   |
| $t_r$         | Turn-on Rise Time                    |  | ---  | 28   | ---  | ns   |
| $t_{d(off)}$  | Turn-off Delay Time                  |  | ---  | 215  | ---  | ns   |
| $t_f$         | Turn-off Fall Time                   |  | ---  | 226  | ---  | ns   |
| $E_{on}$      | Turn-on Switching Loss               |  | ---  | 1.62 | ---  | mJ   |
| $E_{off}$     | Turn-off Switching Loss              |  | ---  | 1.11 | ---  | mJ   |
| $E_{ts}$      | Total Switching Loss                 |  | ---  | 2.73 | ---  | mJ   |
| $C_{ies}$     | Input Capacitance                    | $V_{CE}=25V$   | ---  | 903  | ---  | pF   |
| $C_{oes}$     | Output Capacitance                   | $V_{GE}=0V$  | ---  | 94   | ---  | pF   |
| $C_{res}$     | Reverse Transfer Capacitance         | $f=1\text{MHz}$  | ---  | 48   | ---  | pF   |

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

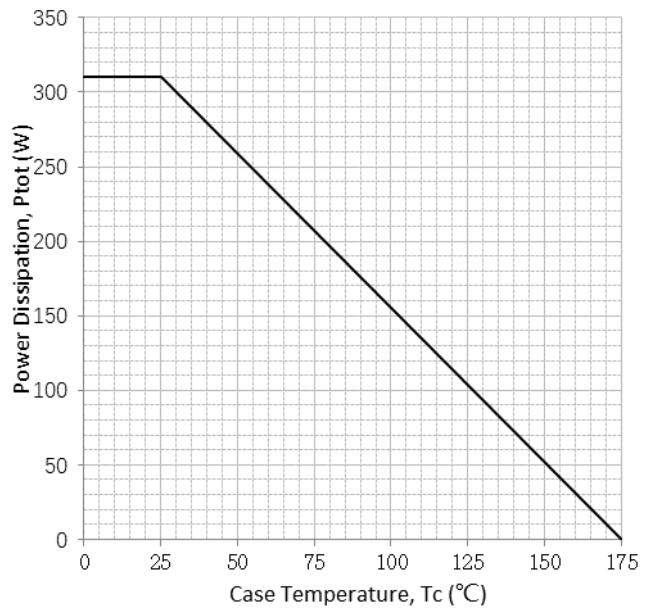
| Symbol   | Parameter                           | Conditions   | Min. | Typ.  | Max. | Unit |
|----------|-------------------------------------|--|------|-------|------|------|
| $V_F$    | Diode Forward Voltage               | $I_F=15A$  | ---  | 2.6   | 3.2  | V    |
| $t_{rr}$ | Diode Reverse Recovery Time         | $V_{CE}=600V$<br>$I_F=15A$<br>$di_F/dt=450A/\mu s$ | ---  | 131.5 | ---  | ns   |
| $I_{rr}$ | Diode Peak Reverse Recovery Current |  | ---  | 7.2   | ---  | A    |
| $Q_{rr}$ | Diode Reverse Recovery Charge       |  | ---  | 466   | ---  | nC   |

Note 1: Repetitive rating, pulse width limited by maximum junction temperature

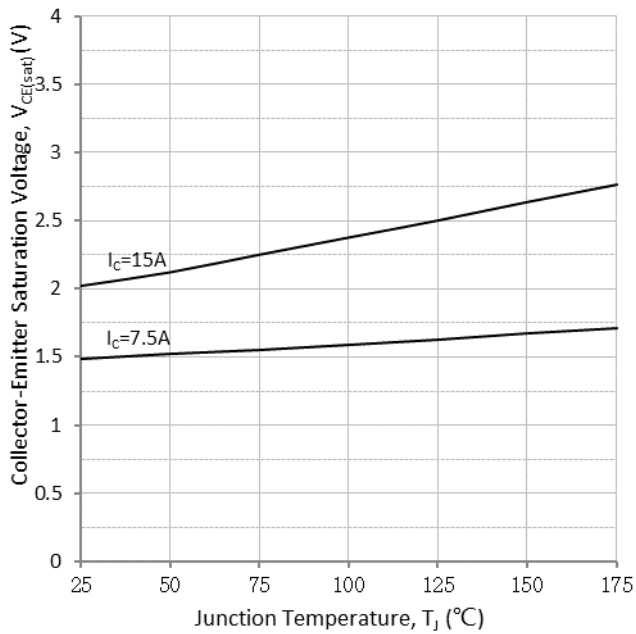
## Typical Characteristics



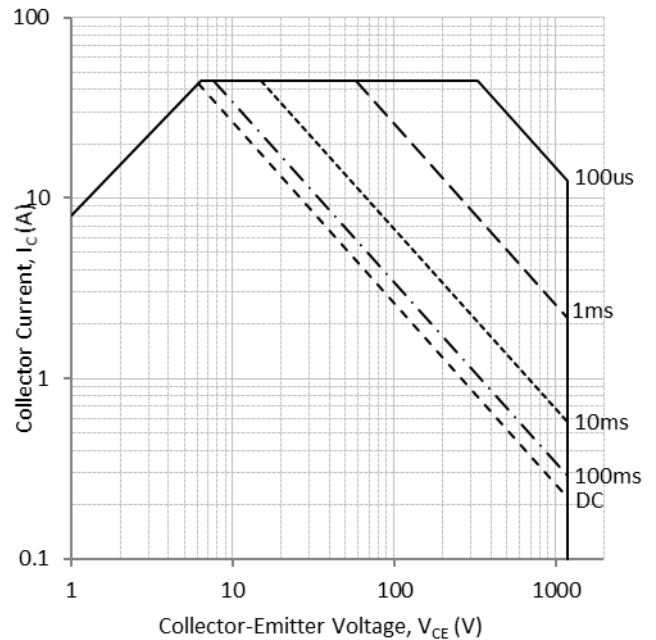
**Fig. 1 Maximum DC Collector Current vs. Case Temperature**



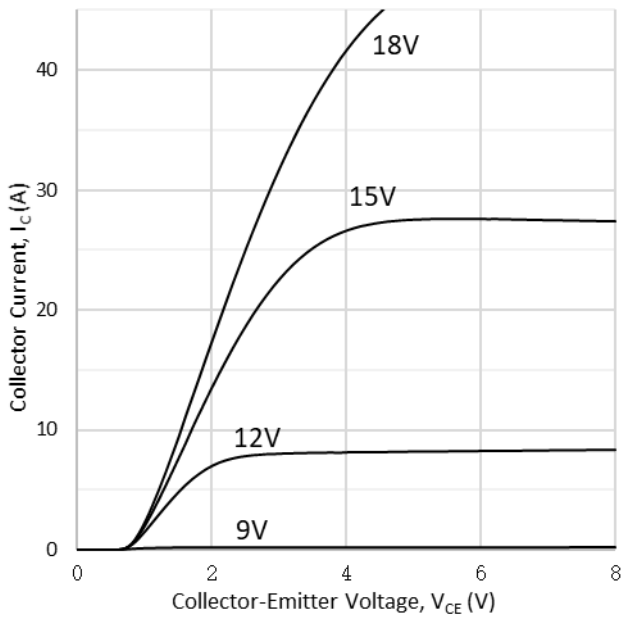
**Fig. 2 Power Dissipation vs. Case Temperature**



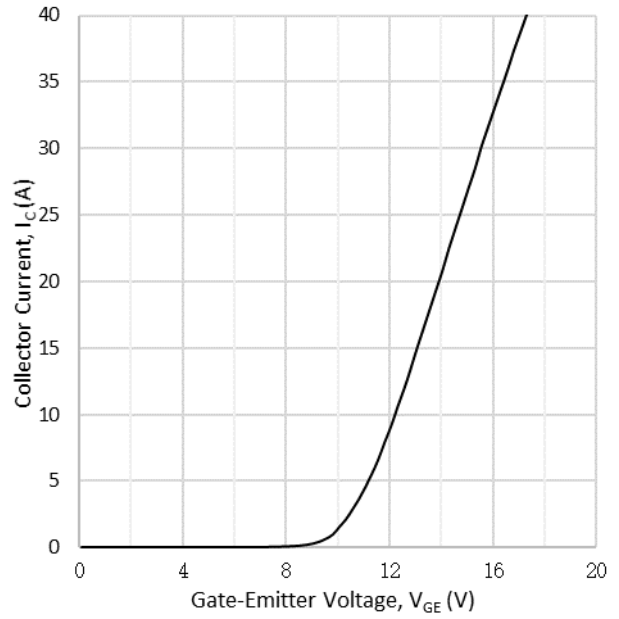
**Fig. 3 Typical Collector-Emitter Saturation Voltage vs. Junction Temperature at  $V_{GE}=15V$**



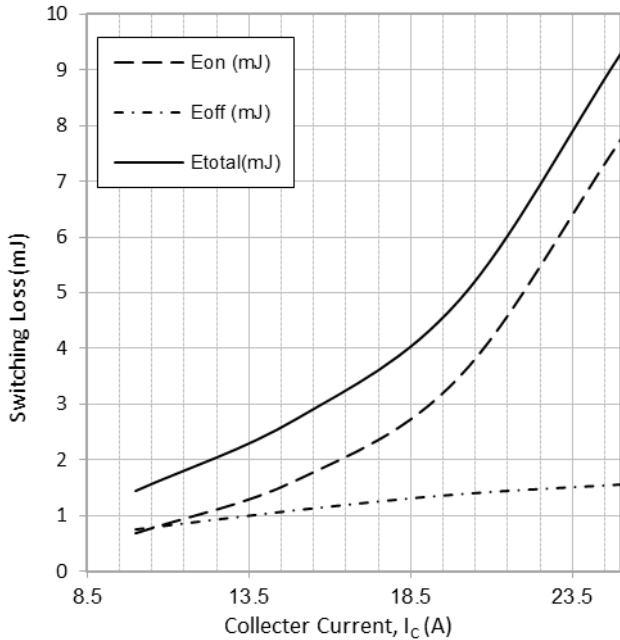
**Fig. 4 Safe Operating Area at  $T_c=25^\circ C$  and  $T_j \leq 175^\circ C$**



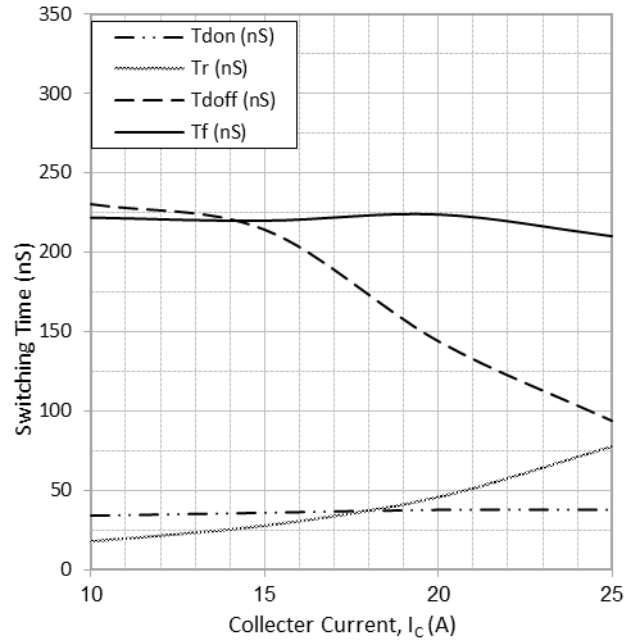
**Fig. 5 Typical IGBT Output Characteristics at  $T_J=25^\circ\text{C}$**



**Fig. 6 Typical Transfer Characteristics at  $V_{CE}=20\text{V}$**



**Fig. 7 Typical Energy Loss vs.  $I_C$  at  $T_C=25^\circ\text{C}$ ,  $V_{CE}=600\text{V}$ ,  $V_{GE}=\pm 15\text{V}$  and  $R_G=39\Omega$**



**Fig. 8 Typical Switching Time vs.  $I_C$  at  $T_C=25^\circ\text{C}$ ,  $V_{CE}=600\text{V}$ ,  $V_{GE}=\pm 15\text{V}$  and  $R_G=39\Omega$**

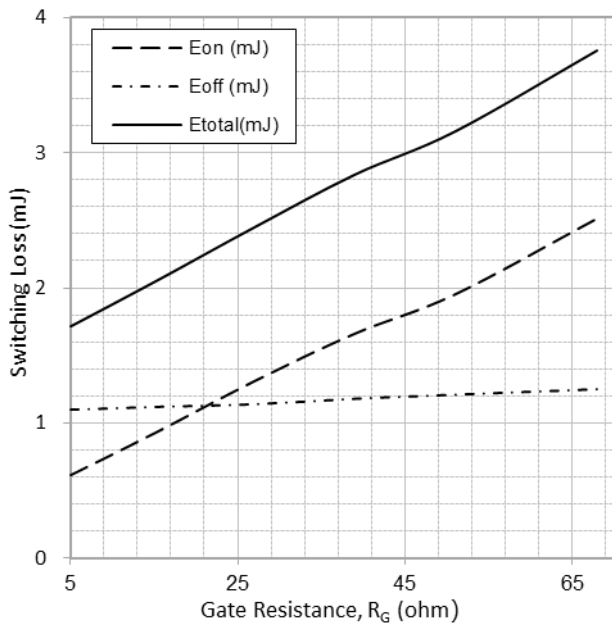


Fig. 9 Typical Energy Loss vs.  $R_G$  at  $T_C=25^\circ\text{C}$ ,  $V_{CE}=600\text{V}$ ,  $V_{GE}=15\text{V}$  and  $I_C=15\text{A}$

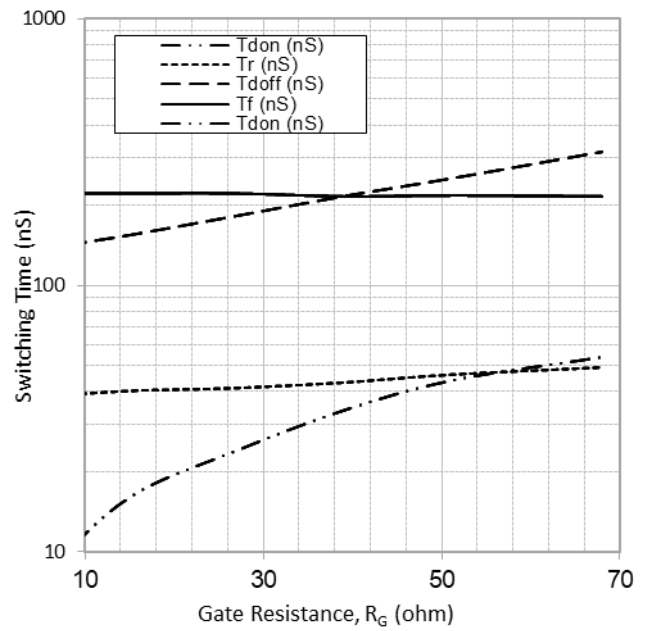


Fig. 10 Typical Switching Time vs.  $R_G$  at  $T_C=25^\circ\text{C}$ ,  $V_{CE}=600\text{V}$ ,  $V_{GE}=15\text{V}$  and  $I_C=15\text{A}$

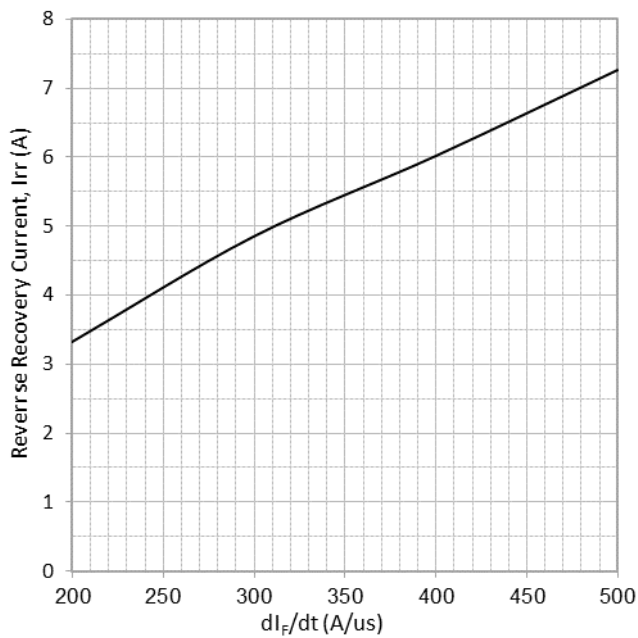


Fig. 11 Typical Diode  $I_{rr}$  vs.  $di_F/dt$  at  $V_{CC}=600\text{V}$  and  $V_F=15\text{A}$

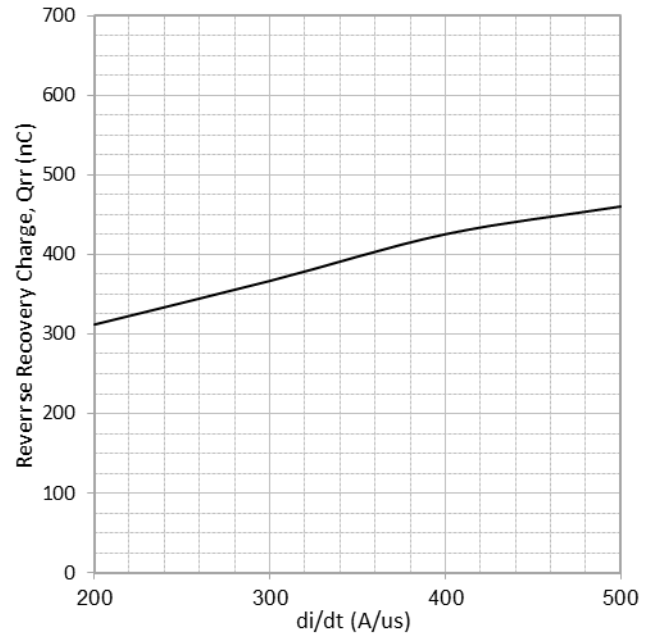


Fig. 12 Typical Diode  $Q_{rr}$  vs.  $di_F/dt$  at  $V_{CC}=600\text{V}$  and  $V_F=15\text{A}$

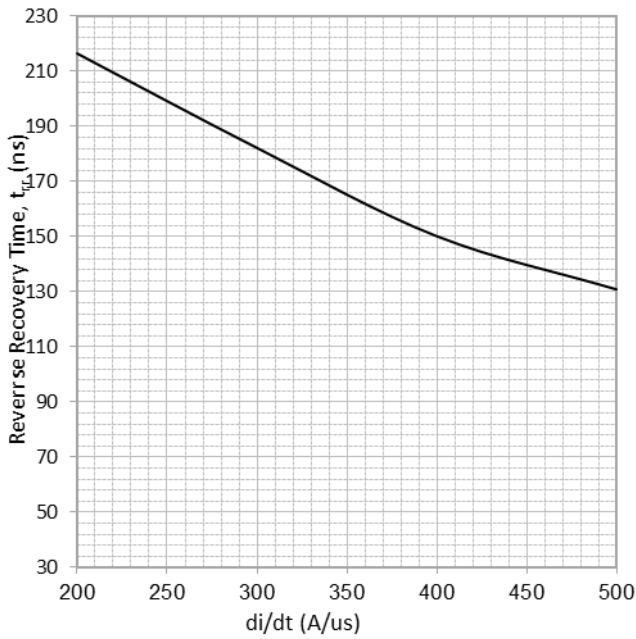


Fig. 13 Typical Diode  $t_{rr}$  vs.  $di/dt$  at  $V_{CC}=600V$  and  $V_F=15A$

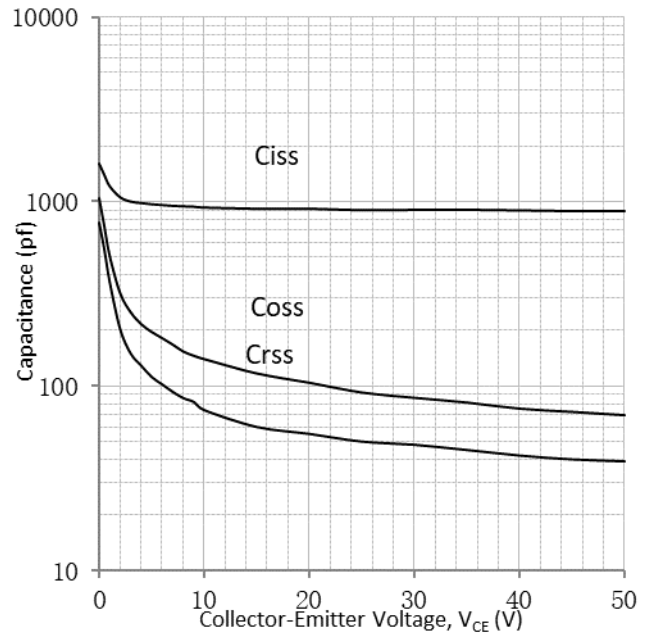


Fig. 14 Typical Capacitance vs.  $V_{CE}$  at  $V_{GE}=0V$  and  $f=1MHz$

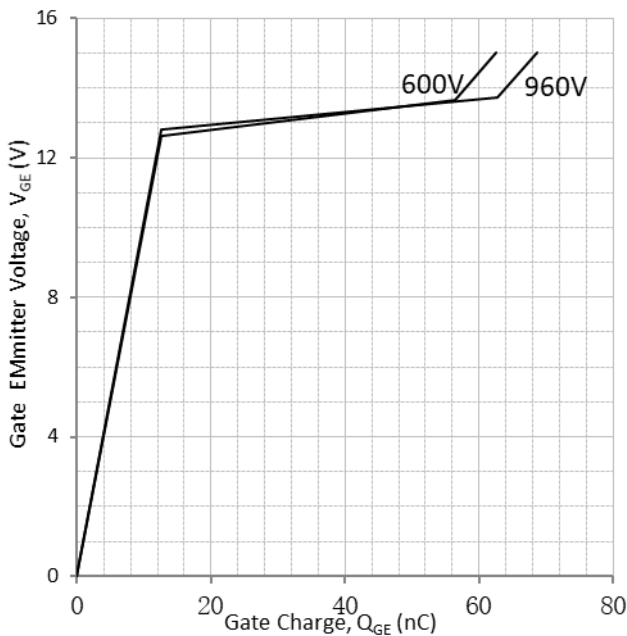


Fig. 15 Typical Gate Charge vs.  $V_{GE}$  at  $I_C=15A$

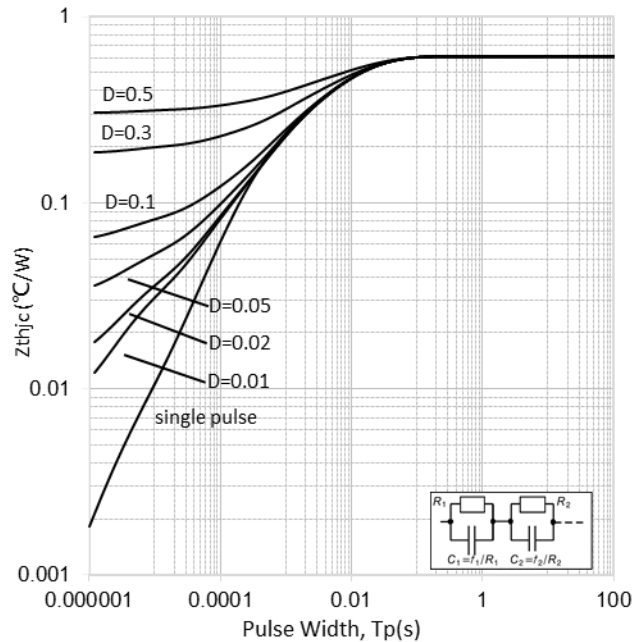
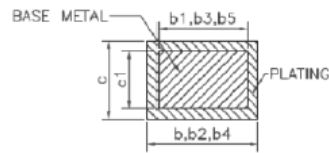
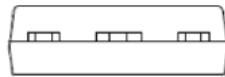
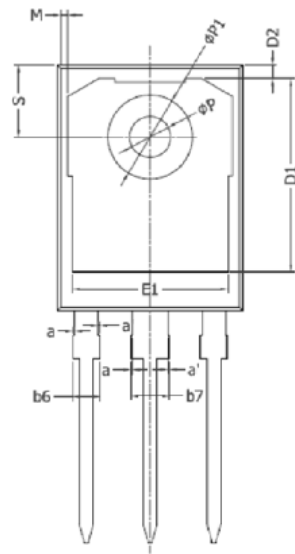
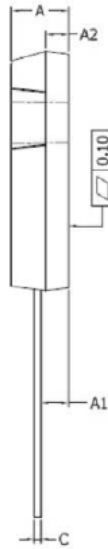
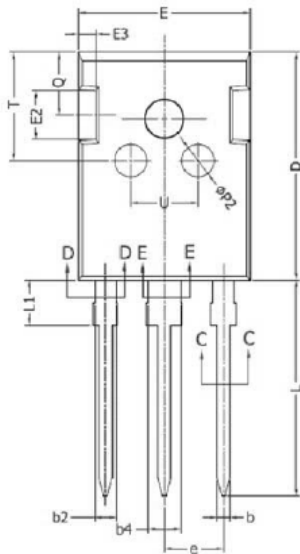


Fig. 16 IGBT Transient Thermal Resistance ( $D=t_p/T$ )

# Package Information

TO-247



SECTION C-C, D-D & E-E

COMMON DIMENSIONS  
(UNITS OF MEASURE =MILLIMETER)

| SYMBOL | MIN       | NOM   | MAX   |
|--------|-----------|-------|-------|
| A      | 4.90      | 5.00  | 5.10  |
| A1     | 2.31      | 2.41  | 2.51  |
| A2     | 1.90      | 2.00  | 2.10  |
| a      | 0         | ---   | 0.15  |
| a'     | 0         | ---   | 0.15  |
| b      | 1.16      | ---   | 1.26  |
| b1     | 1.15      | 1.2   | 1.22  |
| b2     | 1.96      | ---   | 2.06  |
| b3     | 1.95      | 2.00  | 2.02  |
| b4     | 2.96      | ---   | 3.06  |
| b5     | 2.96      | 3.00  | 3.02  |
| b6     | ---       | ---   | 2.25  |
| b7     | ---       | ---   | 3.25  |
| c      | 0.59      | ---   | 0.66  |
| c1     | 0.58      | 0.60  | 0.62  |
| D      | 20.90     | 21.00 | 21.10 |
| D1     | 16.25     | 16.55 | 16.85 |
| D2     | 1.05      | 1.17  | 1.35  |
| E      | 15.70     | 15.80 | 15.90 |
| E1     | 13.10     | 13.30 | 13.50 |
| E2     | 4.40      | 4.50  | 4.60  |
| E3     | 1.50      | 1.60  | 1.70  |
| e      | 5.436 BSC |       |       |
| L      | 19.80     | 19.92 | 20.10 |
| L1     | ---       | ---   | 4.30  |
| M      | 0.35      | ---   | 0.95  |
| P      | 3.40      | 3.50  | 3.60  |
| P1     | 7.00      | ---   | 7.40  |
| P2     | 2.40      | 2.50  | 2.60  |
| Q      | 5.60      | ---   | 6.00  |
| S      | 6.05      | 6.15  | 6.25  |
| T      | 9.80      | ---   | 10.20 |
| U      | 6.00      | ---   | 6.40  |

**NOTES:**

ALL DIMENSIONS REFER TO JEDEC STANDARD TO-247 AND DO NOT INCLUDE MOLD FLASH OR PROTRUSIONS.

EJECTION MARK DEPTH  $0.10^{+0.15}_{-0.10}$

## Revision History

| Ver. | Date       | Change Notice |
|------|------------|---------------|
| 1.0  | 2020/11/11 | Released      |