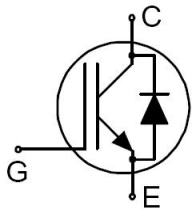
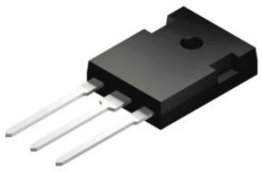
# 1200V , 40A , Trench-FS IGBT

## Features

- Advanced Trench +FS (Field Stop) IGBT technology
- Low Collector-Emitter Saturation voltage, typical data is 1.8V @ 40A.
- Short-Circuit withstand time-10uS
- Easy parallel switching capability due to positive Temperature coefficient in Vce.
- Fast switching
- High input impedance
- Pb- Free product




**Schematic Diagram**



**TO--247**

## Applications

- General purpose inverters
- Welding
- Motor controls
- Induction Heating
- UPS

| Absolute Max Ratings(TJ = 25°C unless otherwise noted) | | | |
|---|---|---|---|
| **Symbol** | **Parameter** | **Units** | **Maximum** |
| $V_{CES}$ | Collector-to-Emitter Voltage | V | 1200 |
| $V_{GES}$ | Gate to Emitter Voltage | V | ± 30 |
| $I_C$ @ TC = 25°C | Collector current @$T_c$ = 25 °C | A | 80 |
| $I_C$ @ TC = 100°C | Collector Current @$T_c$ = 100 °C | A | 40 |
| $I_{CM}$ | Pulsed Drain Current② | A | 160 |
| $I_F$ @ TC = 25°C | Diode continuous forward current | A | 80 |
| $I_F$ @ TC = 100°C | Diode continuous forward current | A | 40 |
| $I_{FM}$ | Diode maximum forward current | A | 160 |
| $P_D$ | Power Dissipation @$T_c$ = 25 °C | W | 480 |
| | Power Dissipation @$T_c$ = 100 °C | W | 240 |
| $T_J$ | Operating Junction Temperature Range | °C | -50 to + 175 |
| $T_{STG}$ | Storage Temperature Range | °C | -50 to + 175 |
| $T_L$ | Maximum Temperature of Solding | °C | 260 |
| $R_{\theta JC}$ | Maximum Junction-to-Case① | °C/W | 0.31 |
| $R_{\theta JA}$ | Maximum Junction-to-Ambient② | °C/W | 40 |

①These curves are based on the junction-to-case thermal impedance which is measured with the device mounted to a large heat sink, assuming maximum junction temperature of $T_{J(MAX)}$=175° C.

②The $R_{\theta JA}$ is the sum of the thermal impedance from junction to case $R_{\theta JC}$ and case to ambient.

| Electrical characteristics(TJ = 25°C unless otherwise noted) | | | | | | |
|---|---|---|---|---|---|---|
| **Symbol** | **Parameter** | **Test conditions** | **Units** | **Min.** | **Typ.** | **Max.** |
| $V_{(BR)CES}$ | Collector - Emitter breakdown voltage | $V_{GE}$ = 0V, $I_D$ = 0.5mA | V | 1200 | — | — |
| $V_{CE(sat)}$ | Collector-Emitter Saturation voltage | $V_{GE}$=15V, $I_C$=40A,$T_C$=25°C | V | — | 1.8 | 2.3 |
| | | $V_{GE}$=15V, $I_C$=40A,$T_C$=125°C | V | — | 1.95 | — |
| $V_{GE(th)}$ | Gate threshold voltage | $V_{GE}$= $V_{CE}$, $I_D$ = 0.4mA | V | 4.0 | - | 6.5 |
| $V_F$ | Diode Forward voltage | Ic=40A | V | — | 2.2 | 2.8 |
| $I_{GES}$ | Gate to Emitter Forward Leakage | Vge=+30V | nA | — | — | 200 |
| $I_{GESR}$ | Gate to Emitter reverse Leakage | Vge=-30V | | -200 | — | — |
| $I_{CES}$ | Zero gate voltage collector current | $V_{CE}$ =1200V | uA | — | — | 100 |

| Dynamic characteristics(TJ = 25°C unless otherwise noted) | | | | | | |
|---|---|---|---|---|---|---|
| **Symbol** | **Parameter** | **Test conditions** | **Units** | **Min.** | **Typ.** | **Max.** |
| $C_{iss}$ | Input capacitance | $V_{GE}$ = 0V<br>$V_{CE}$= 25V<br>$f$ = 1MHz | pF | — | 2480 | — |
| $C_{oss}$ | Output capacitance | | | — | 240 | — |
| $C_{rss}$ | Reverse transfer capacitance | | | — | 125 | — |
| $Q_g$ | Total gate charge | $I_C$ =40A,<br>$V_{CE}$=600V,<br>$V_{GE}$ =15V | nC | — | 192 | — |
| $Q_{ge}$ | Gate-to-Emitter charge | | | — | 16 | — |
| $Q_{gc}$ | Gate-to-Collector("Miller") charge | | | — | 78 | — |
| $T_{d(on)}$ | Turn-On DelayTime | $T_J$=25°,Vcc=600V,<br>Ic=40A,Rg=10ohm,<br>$V_{GE}$ =15V | ns | — | 35 | — |
| Tr | Rise Time | | | — | 30 | — |
| $T_{d(off)}$ | Turn-Off DelayTime | | | — | 310 | — |
| $T_f$ | Turn-Off Fall Time | | | — | 100 | — |
| $E_{on}$ | Turn-on switch loss | | mJ | — | 3.3 | — |
| $E_{off}$ | Turn-off switch loss | | mJ | — | 2.1 | — |
| $t_{rr}$ | Diode Reverse Recovery Time | $I_F$ = 40 A,<br>$V_{GE}$ = 0 V,<br>di/dt = -20 A/μs | ns | — | 260 | — |
| $Q_{rr}$ | Diode Reverse Recovery Charge | | nC | — | 3050 | — |
| SCSOA | Short Circuit Safe Operation Area | $V_{cc}$=600V, $R_G$=25 Ω ,$V_G$=15V to 0V | uS | 10 | | — |

## Typical electrical and thermal characteristics：

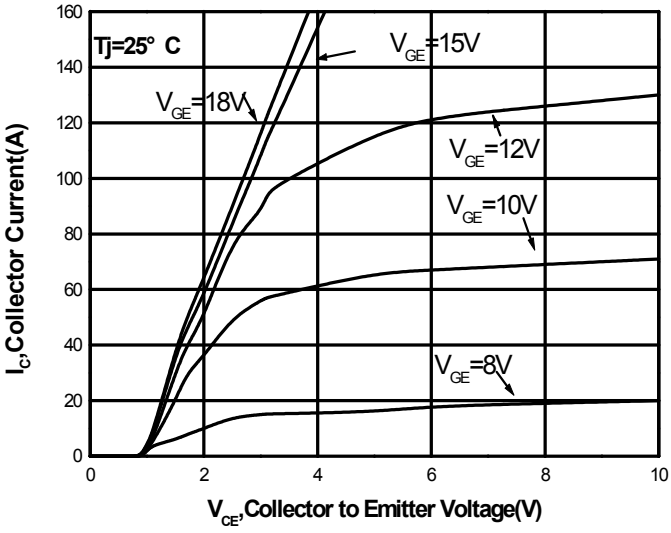



Figure 1: Typical Output Characteristics ($T_J$=25°C)

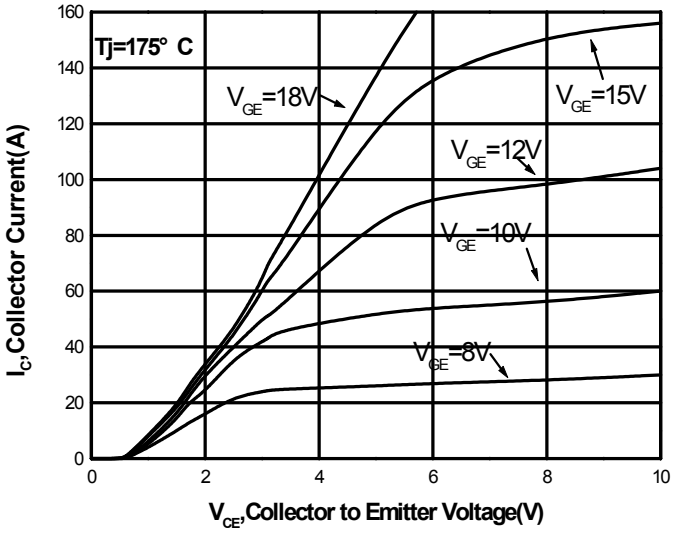



Figure 2: Typical Output Characteristics ($T_J$=175°C)

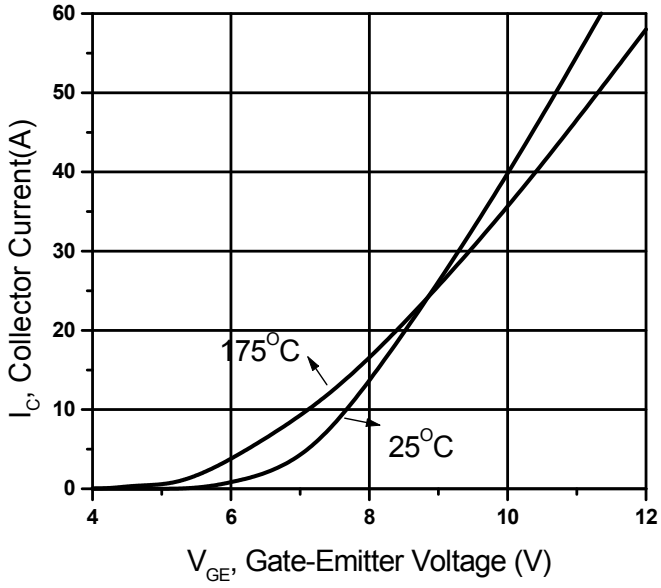



Figure 3: Typical Transfer Characteristics

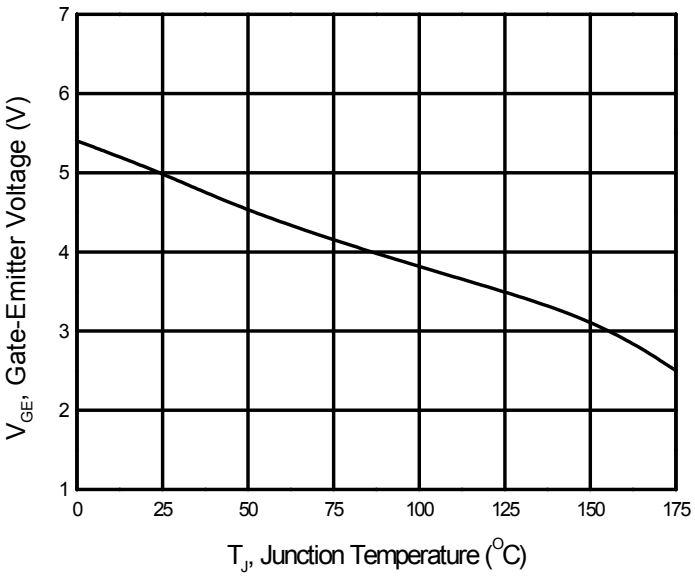



Figure 4: Gate to Emitter threshold Voltage as a function of Tj

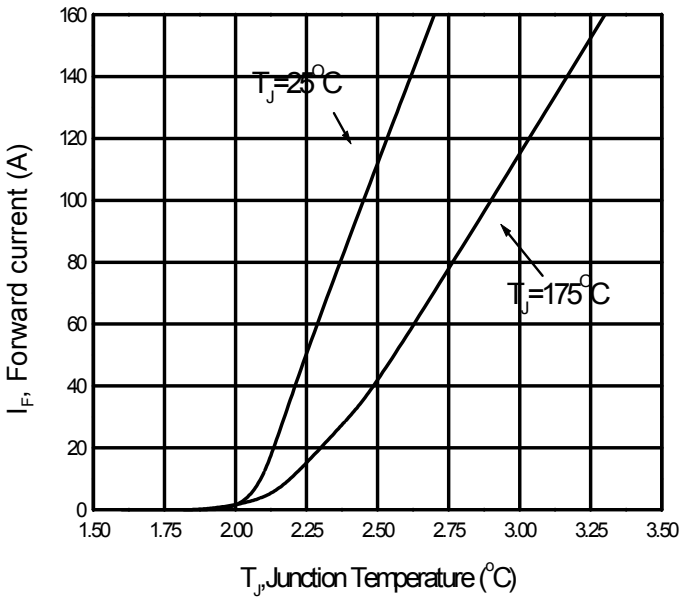



**Figure 5: Typical Diode Forward Characteristics**

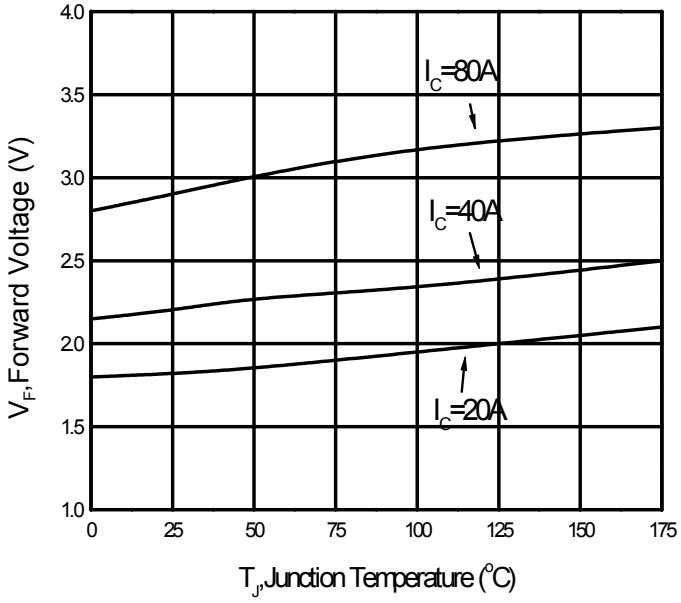



**Figure 6: Forward Voltage as a function of Tj**

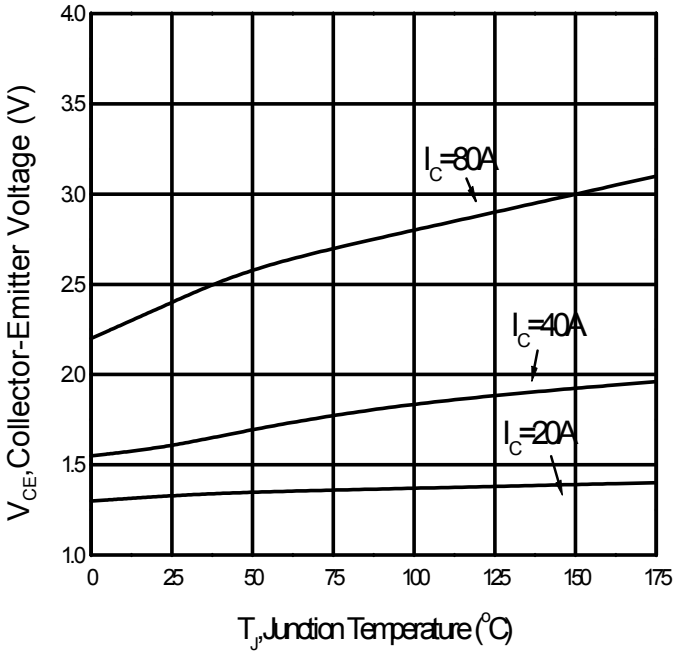



**Figure 7: Typical $V_{CE(sat)}$ as a Function of $T_J$**

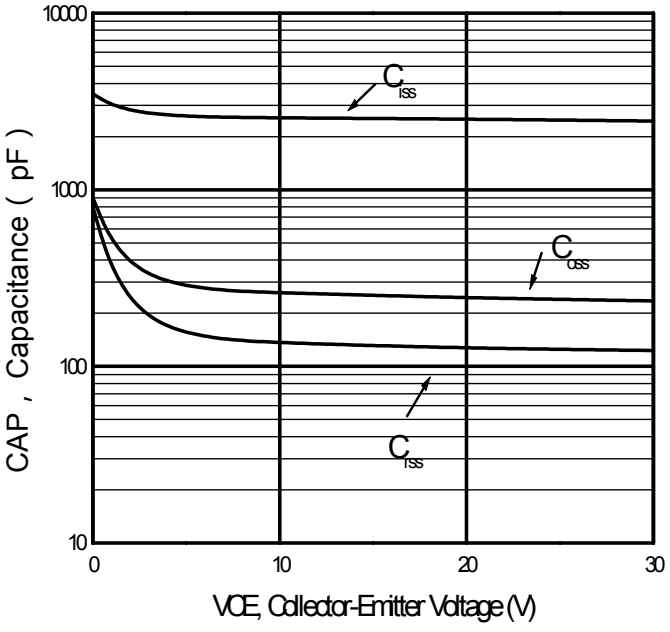



**Figure 8: Capacitance Characteristics**

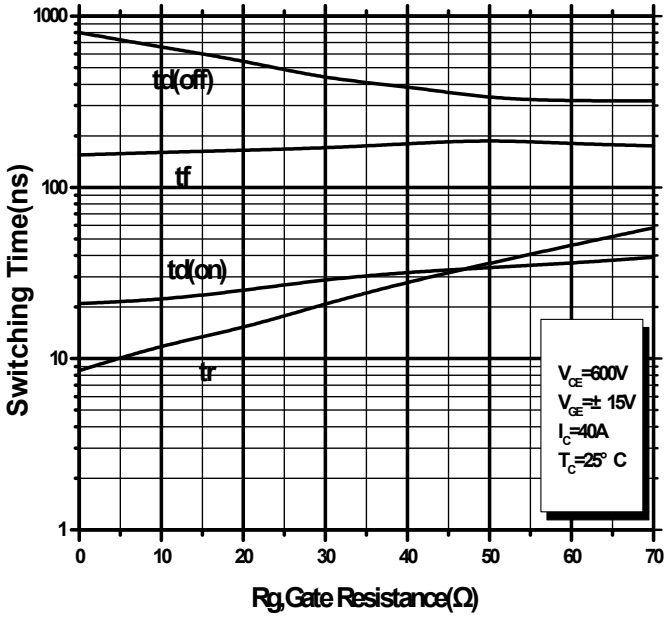



Figure 9: Switching Time Vs Rg

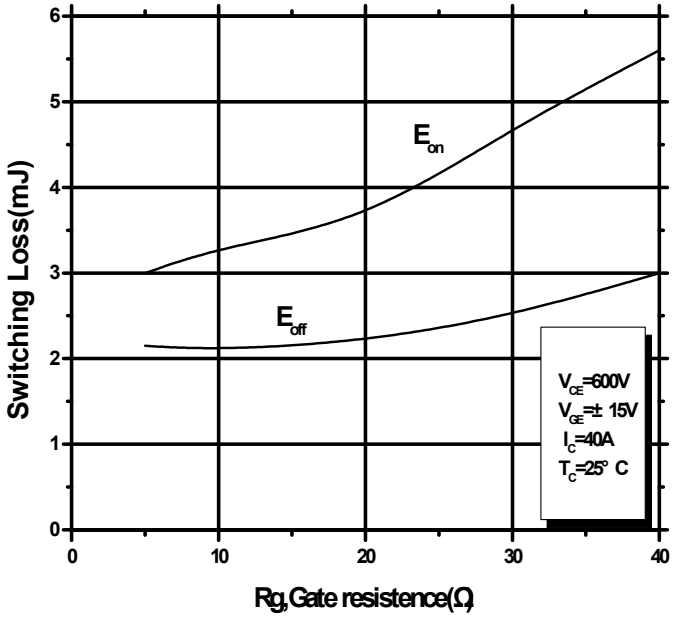



Figure 10: Switching Loss Vs Rg

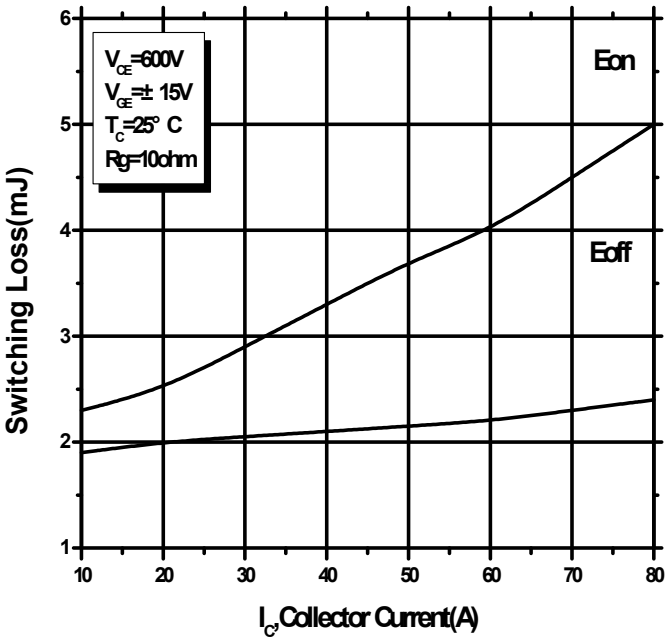



Figure 11: Switching Loss Vs $I_C$

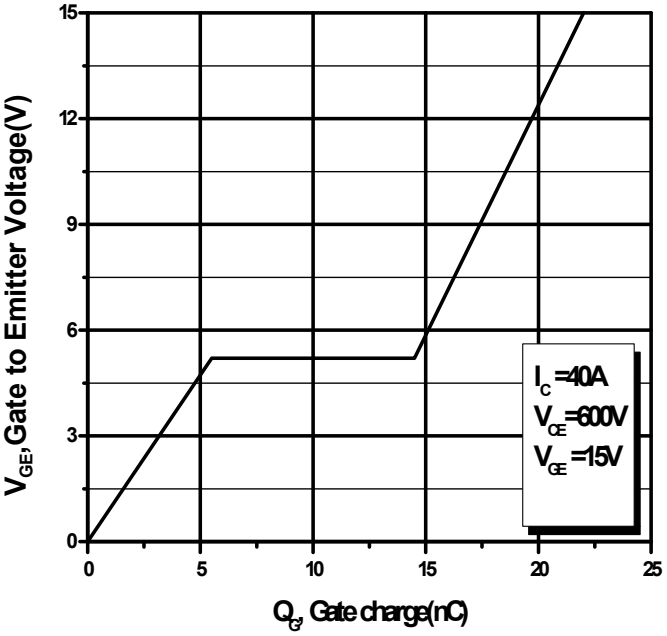



Figure 12: Gate Charge Characteristics

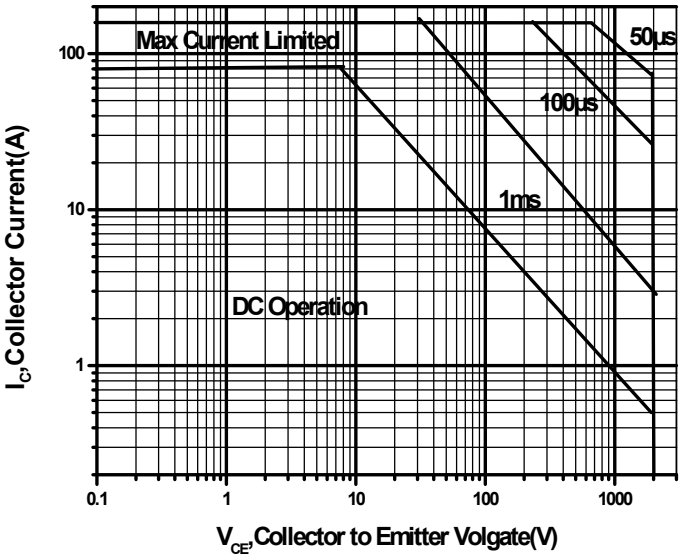



Figure 13: Maximum Forward Biased Safe Operating Area

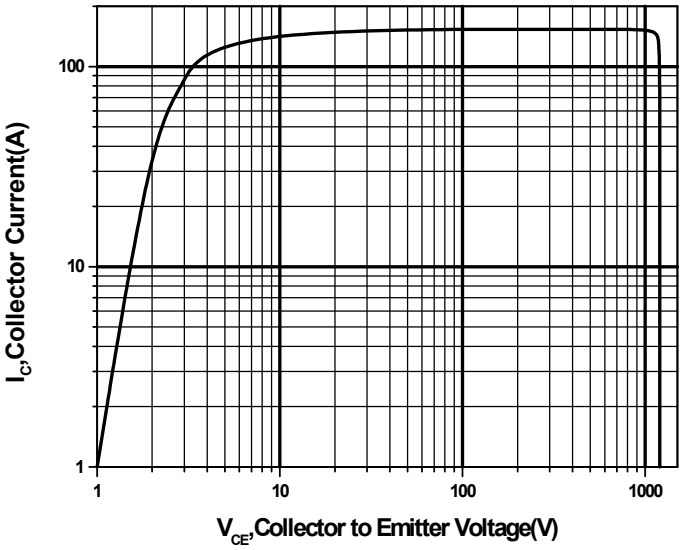



Figure 14: Turn Off Safe Operating Area

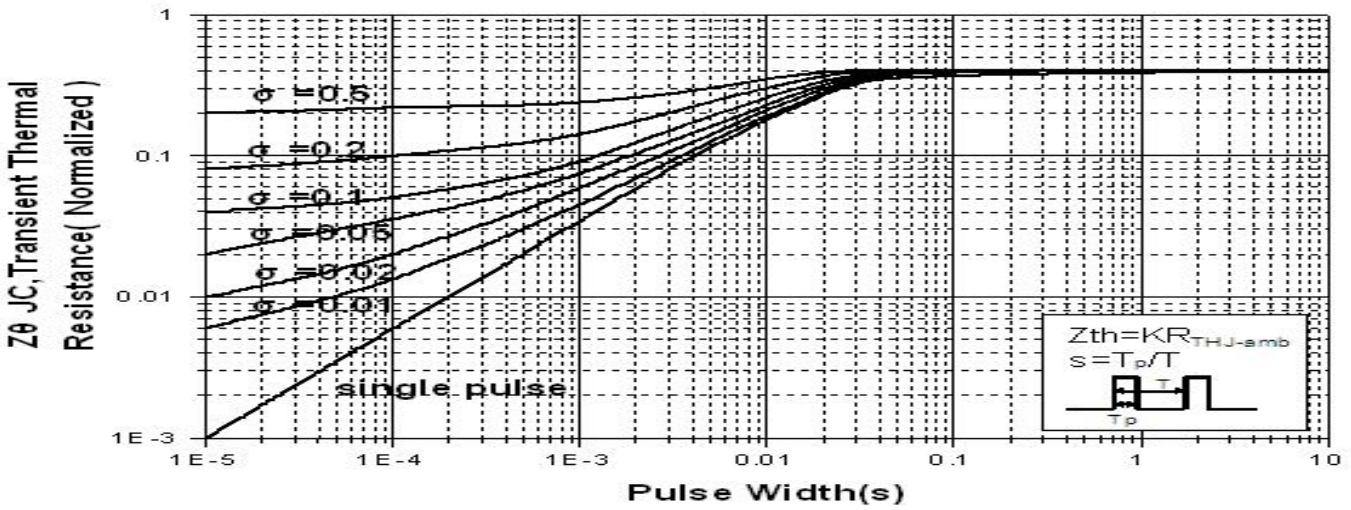
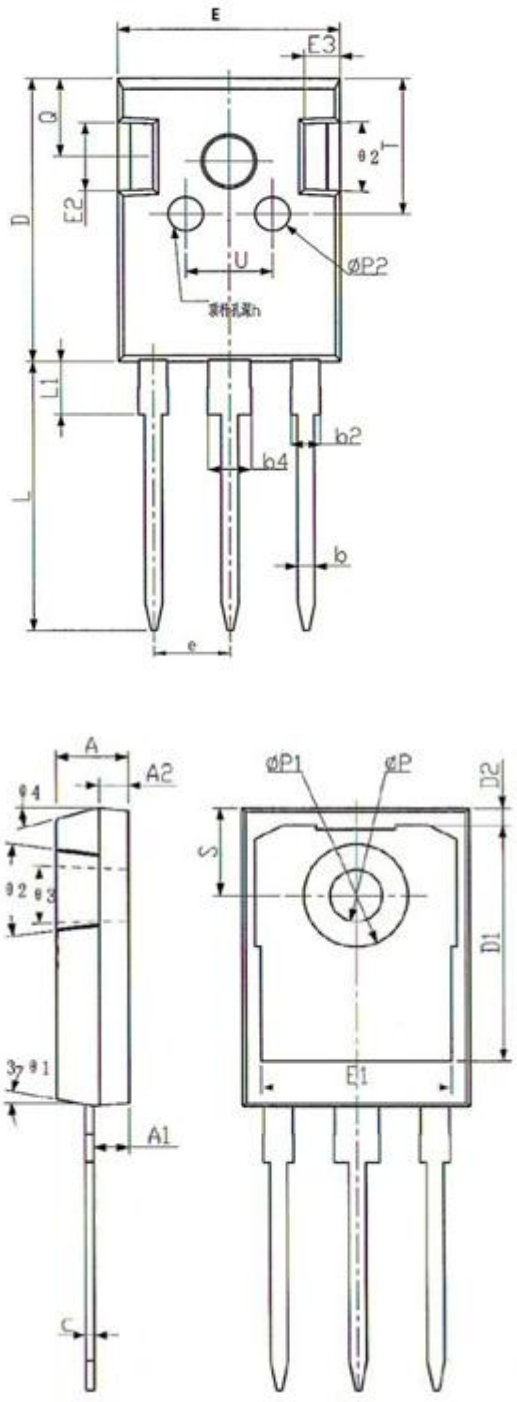



Figure 15: Normalized Maximum Transient Thermal Impedance

## Mechanical Data：TO-247




| Dimensions | | | |
|---|---|---|---|
| | unit:mm | | |
| Symbol | Min | Typ | Max |
| A | 4.90 | 5.00 | 5.10 |
| A1 | 2.31 | 2.41 | 2.51 |
| A2 | 1.90 | 2.00 | 2.10 |
| b | 1.16 | 1.21 | 1.26 |
| b2 | 1.96 | 2.01 | 2.06 |
| b4 | 2.96 | 3.01 | 3.06 |
| c | 0.59 | 0.61 | 0.66 |
| D | 20.90 | 21.00 | 21.10 |
| D1 | 16.25 | 16.55 | 16.85 |
| D2 | 1.05 | 1.20 | 1.35 |
| E | 15.70 | 15.80 | 15.90 |
| E1 | 13.10 | 13.30 | 13.50 |
| E2 | 4.90 | 5.00 | 5.10 |
| E3 | 2.40 | 2.50 | 2.60 |
| e | 5.44BSC | | |
| h | 0.05 | - | 0.20 |
| L | 19.80 | 19.92 | 20.01 |
| L1 | - | - | 4.30 |
| ΦP | 3.50 | 3.60 | 3.70 |
| ΦP1 | - | - | 7.30 |
| ΦP2 | 2.40 | 2.50 | 2.60 |
| Q | 5.60 | 5.80 | 6.00 |
| S | 6.15BSC | | |
| T | 9.80 | - | 10.20 |
| U | 6.00 | - | 6.40 |
| θ1 | 6° | 7° | 8° |
| θ2 | 4° | 5° | 6° |
| θ3 | 1° | | 1.5° |
| θ4 | 14° | 15° | 16° |

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