

650V, 80A, Trench FS II Fast IGBT

General Description:

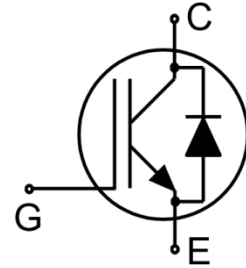
Using VCRR's proprietary trench design and advanced FS (Field Stop) second generation technology, the 650V Trench FSII IGBT offers superior conduction and switching performances, and easy parallel operation;

Features

- Trench FSII Technology offering
- Very low $V_{CE(sat)}$
- High speed switching
- Positive temperature coefficient in $V_{CE(sat)}$
- Very tight parameter distribution
- High ruggedness, temperature stable behavior

Application

- Air Condition
- Inverters
- Motor drives



Schematic diagram

Package Marking and Ordering Information

| Device | Device Package | Device Marking |
|--------------|----------------|----------------|
| VCRR80TD65BT | TO-247 | VCRR80TD65BT |



Absolute Maximum Ratings ($T_C=25^\circ\text{C}$ unless otherwise noted)

| Symbol | Parameter | Value | Units |
|----------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------|------------------|
| V_{CES} | Collector-Emitter Voltage | 650 | V |
| V_{GES} | Gate- Emitter Voltage | ± 30 | V |
| | Gate- Emitter Voltage (AC) | ± 40 | V |
| I_C | Collector Current | 160 | A |
| | Collector Current @ $T_C = 100^\circ\text{C}$ | 80 | A |
| I_{Cpuls} | Pulsed Collector Current, t_p limited by T_{jmax} | 320 | A |
| - | Turn off safe operating area, $V_{CE}=650\text{V}$, $T_j=175^\circ\text{C}$ | 320 | A |
| I_F | Diode Continuous Forward Current @ $T_C = 100^\circ\text{C}$ | 80 | A |
| I_{FM} | Diode Maximum Forward Current | 320 | A |
| P_D | Power Dissipation @ $T_C = 25^\circ\text{C}$ | 468 | W |
| | Power Dissipation @ $T_C = 100^\circ\text{C}$ | 234 | W |
| T_J, T_{stg} | Operating Junction and Storage Temperature Range | -55 to +175 | $^\circ\text{C}$ |
| T_L | Maximum Temperature for Soldering | 260 | $^\circ\text{C}$ |
| t_{sc} | Short circuit withstand time $V_{GE}=15\text{V}$, $V_{CC}\leq 400\text{V}$, Allowed number of short circuits<1000Time between short circuits: $\geq 1.0\text{s}$, $T_j\leq 150^\circ\text{C}$ | 5 | us |

Thermal Characteristic

| Symbol | Parameter | Value | Units |
|-----------------|------------------------------------------------|-------|-----------------------------|
| $R_{\theta JC}$ | Thermal Resistance, Junction to case for IGBT | 0.32 | $^{\circ}\text{C}/\text{W}$ |
| $R_{\theta JC}$ | Thermal Resistance, Junction to case for Diode | 0.44 | $^{\circ}\text{C}/\text{W}$ |
| $R_{\theta JA}$ | Thermal Resistance, Junction to Ambient | 40 | $^{\circ}\text{C}/\text{W}$ |

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

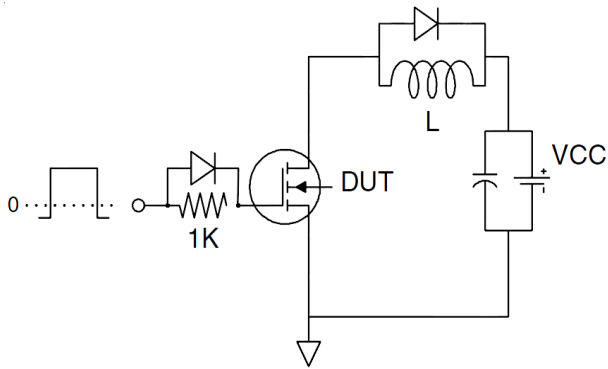
| Symbol | Parameter | Conditions | Value | | | Units | |
|----------------------------------|---------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------|------|------|---------------|----|
| | | | Min. | Typ. | Max. | | |
| Static Characteristics | | | | | | | |
| $V_{(BR)CES}$ | Collector-Emitter Breakdown Voltage | $V_{GE}=0\text{V}, I_{CE}=1\text{mA}$ | 650 | -- | -- | V | |
| I_{CES} | Collector-Emitter Leakage Current | $V_{GE}=0\text{V}, V_{CE}=650\text{V}$ | -- | -- | 75 | μA | |
| $I_{GES(F)}$ | Gate to Emitter Forward Leakage | $V_{GE}=+30\text{V}, V_{CE}=0\text{V}$ | -- | -- | 200 | nA | |
| $I_{GES(R)}$ | Gate to Emitter Reverse Leakage | $V_{GE}=-30\text{V}, V_{CE}=0\text{V}$ | -- | -- | 200 | nA | |
| $V_{CE(sat)}$ | Collector-Emitter Saturation Voltage | $I_C=80\text{A}$ $V_{GE}=15\text{V}$ | $T_j=25^{\circ}\text{C}$ | -- | 1.7 | 1.9 | V |
| | | | $T_j=175^{\circ}\text{C}$ | -- | 1.9 | -- | V |
| $V_{GE(th)}$ | Gate Threshold Voltage | $I_C=1\text{mA}, V_{CE}=V_{GE}$ | 4.0 | 5.0 | 6.0 | V | |
| Dynamic Characteristics | | | | | | | |
| C_{ies} | Input Capacitance | $V_{CE}=25\text{V}, V_{GE}=0\text{V},$ $f=1\text{MHz}$ | -- | 9188 | -- | pF | |
| C_{oes} | Output Capacitance | | -- | 258 | -- | | |
| C_{res} | Reverse Transfer Capacitance | | -- | 181 | -- | | |
| Q_g | Total Gate Charge | $V_{CC}=480\text{V}, I_C=80\text{A},$ $V_{GE}=15\text{V}$ | -- | 331 | -- | nC | |
| Q_{ge} | Gate to Emitter Charge | | -- | 74 | -- | | |
| Q_{gc} | Gate to Collector Charge | | -- | 136 | -- | | |
| $I_{C(SC)}$ | Short circuit collector current Max.1000 short circuits Time between short circuits: $\geq 1.0\text{s}$ | $V_{GE}=15\text{V}, V_{CC}\leq 400\text{V},$ $t_{sc}\leq 5\mu\text{s}, T_j\leq 150^{\circ}\text{C}$ | -- | 450 | -- | A | |
| Switching Characteristics | | | | | | | |
| $t_{d(ON)}$ | Turn-on Delay Time | $V_{CC}=400\text{V}, I_C=80\text{A},$ $V_{GE}=0/15\text{V}, R_g=5\Omega,$ Inductive Load | -- | 19 | -- | ns | |
| t_r | Rise Time | | -- | 17 | -- | | |
| $t_{d(OFF)}$ | Turn-Off Delay Time | | -- | 172 | -- | | |
| t_f | Fall Time | | -- | 20 | -- | | |
| E_{on} | Turn-On Switching Loss | | | -- | 1.6 | -- | mJ |
| E_{off} | Turn-Off Switching Loss | | | -- | 1.2 | -- | |
| E_{ts} | Total Switching Loss | | | -- | 2.8 | -- | |
| E_{on} | Turn-On Switching Loss | | $V_{CC}=400\text{V}, I_C=80\text{A},$ $V_{GE}=0/15\text{V}, R_g=5\Omega,$ $T_j=175^{\circ}\text{C}$ | -- | 2.0 | -- | mJ |
| E_{off} | Turn-Off Switching Loss | -- | | 1.6 | -- | | |
| E_{ts} | Total Switching Loss | -- | | 3.6 | -- | | |

Electrical Characteristics of the Diode (T_c= 25°C unless otherwise specified)

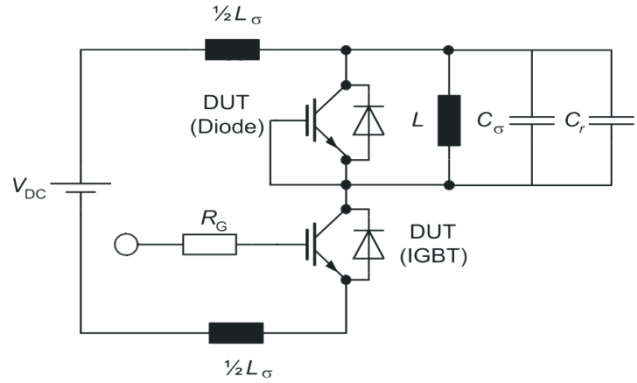
| Symbol | Parameter | Conditions | Rating | | | Units |
|------------------|-------------------------------------|---------------------------------------|--------|------|------|-------|
| | | | Min. | Typ. | Max. | |
| V _{FM} | Diode Forward Voltage | I _F =80A | -- | 1.75 | 2.4 | V |
| T _{rr} | Reverse Recovery Time | I _F =80A, di/dt=200A/us | -- | 194 | -- | ns |
| I _{RRM} | Diode Peak Reverse Recovery Current | | -- | 2.8 | -- | A |
| Q _{rr} | Reverse Recovery Charge | | -- | 0.2 | -- | uC |

Test Circuit

1) Gate Charge Test Circuit

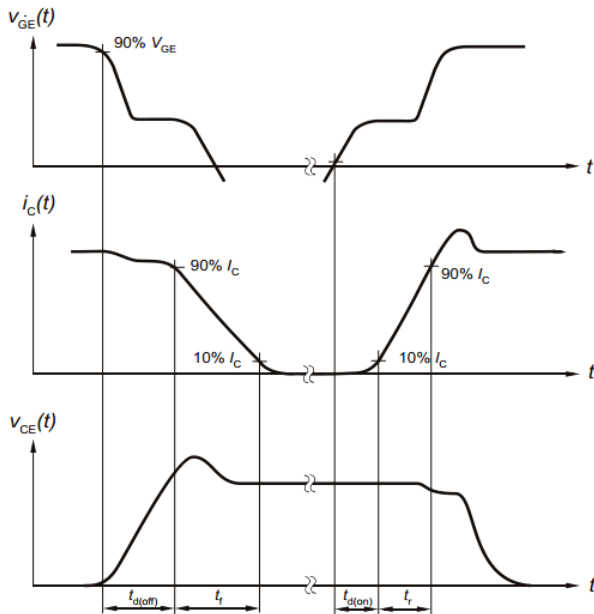


2) Switch Time Test Circuit

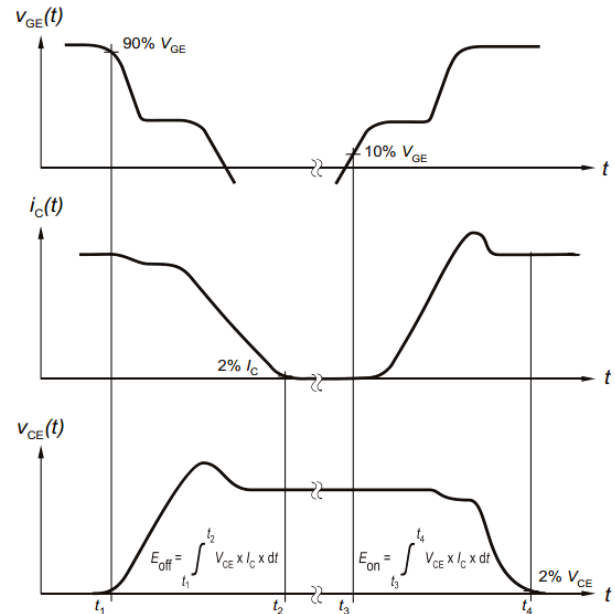


Switching characteristics

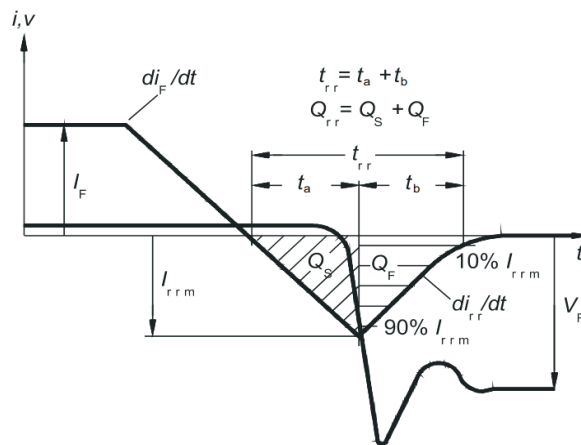
1) Definition of switching times



2) Definition of switching losses



3) Definition of diode switching characteristics



Typical Electrical and Thermal Characteristics

Figure 1 Output Characteristics

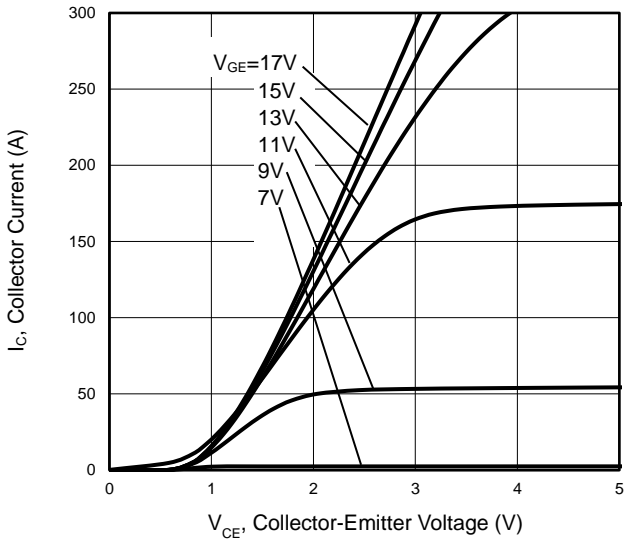


Figure 2 Transfer Characteristics

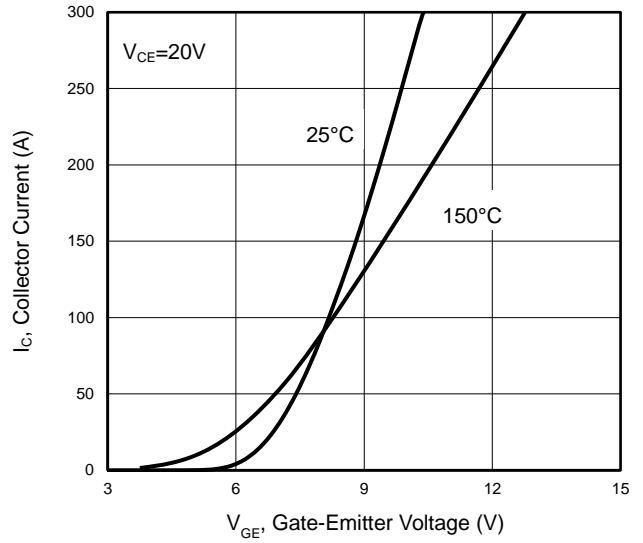


Figure 3 $V_{CE(sat)}$ vs. Temperature

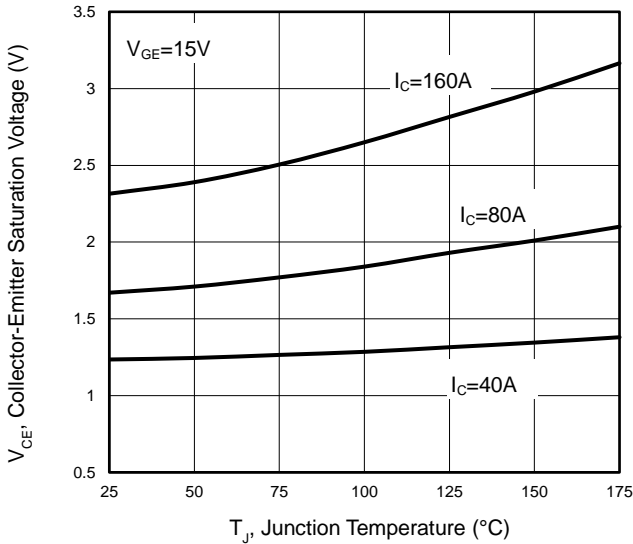


Figure 4 Saturation Voltage vs. V_{GE}

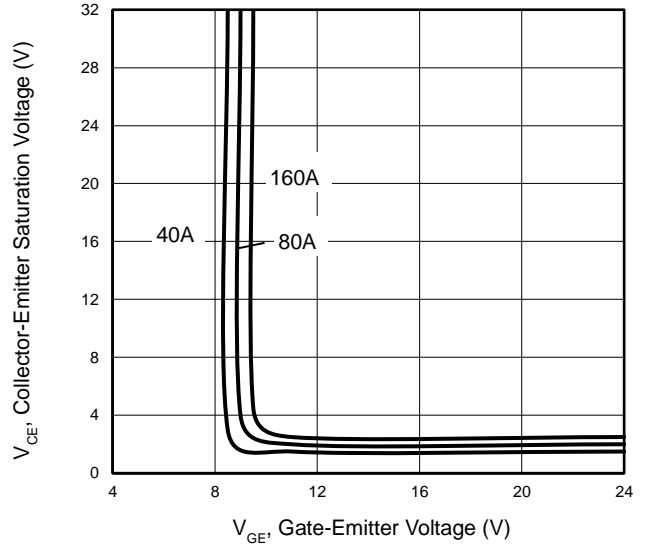


Figure 5 Capacitance Characteristics

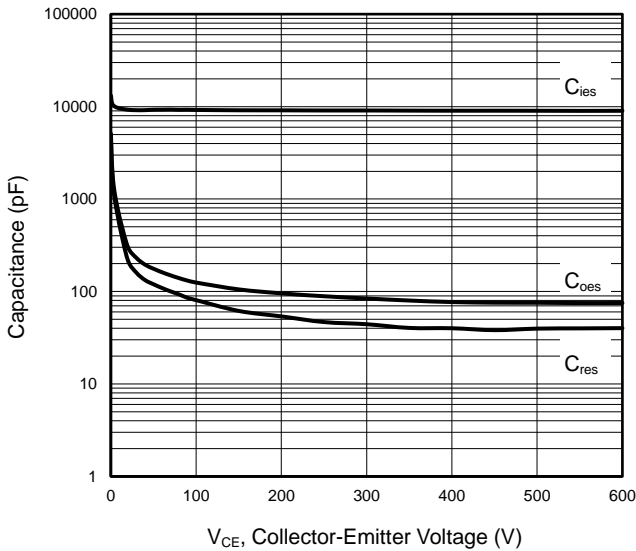
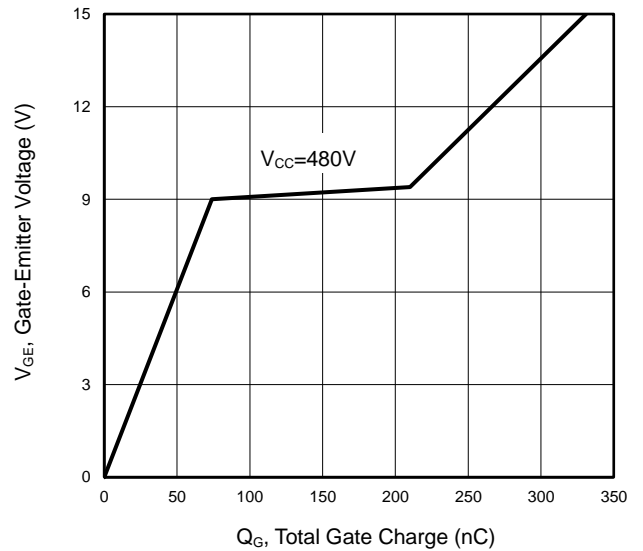


Figure 6 Gate Charge Wave Form



Typical Electrical and Thermal Characteristics

Figure 7 Forward Characteristics

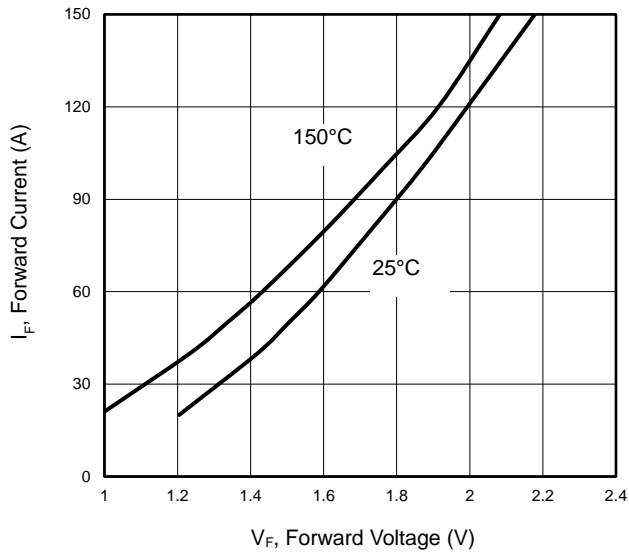


Figure 8 V_F vs. Temperature

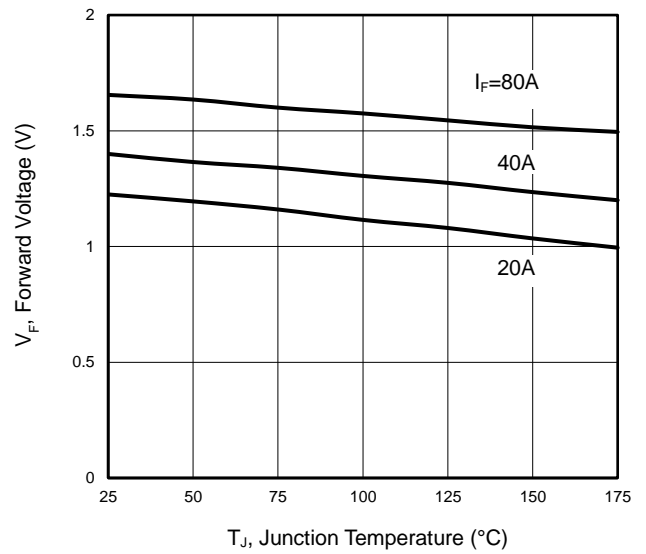


Figure 9 $V_{GE(th)}$ vs. Temperature

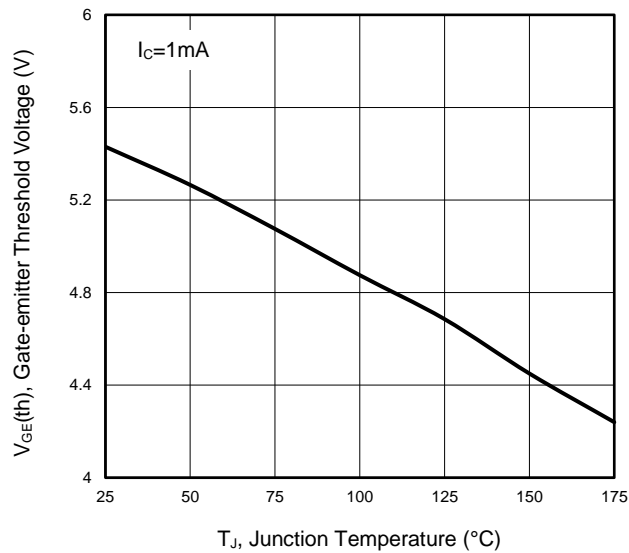


Figure 10 $V_{CE(sat)}$ vs. Collector Current

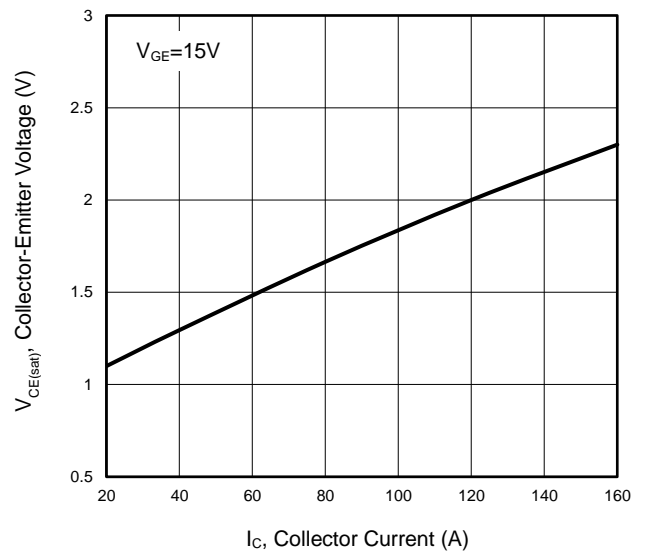


Figure 11 P_{tot} vs. Case Temperature

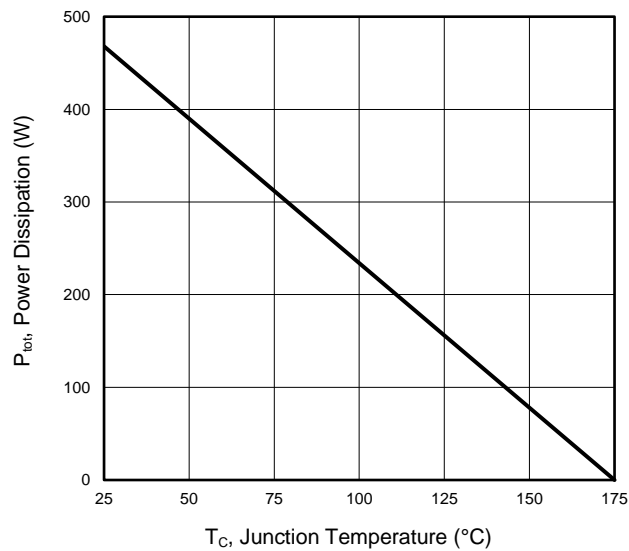
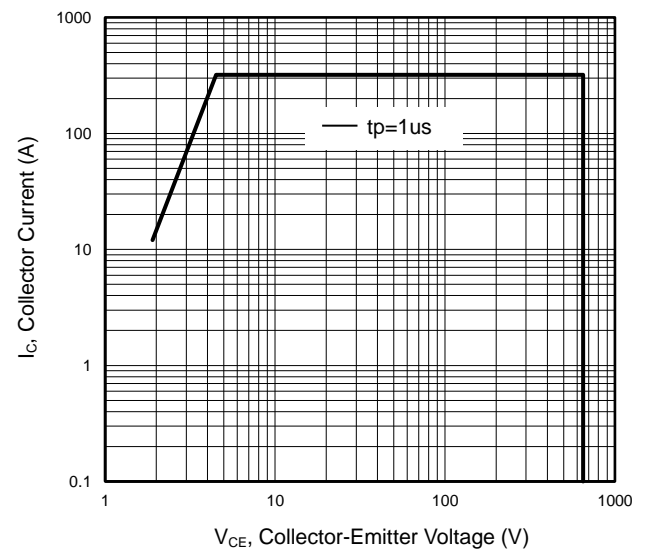


Figure 12 Forward Bias Safe Operating Area



Typical Electrical and Thermal Characteristics

Figure 13 Switching Loss vs. R_G

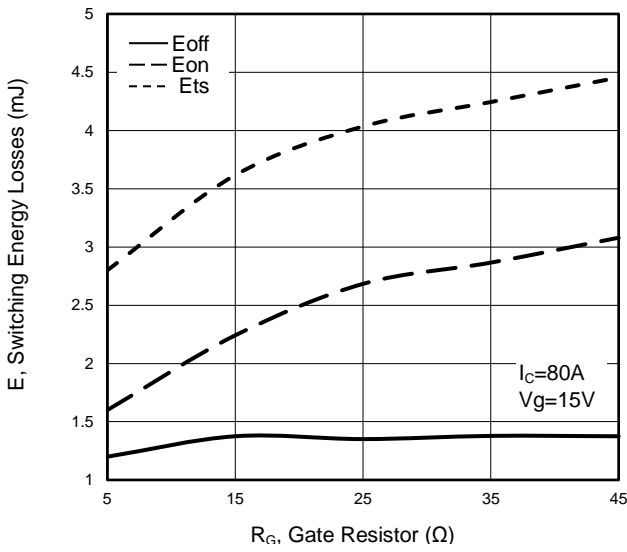


Figure 14 Switching Loss vs. Collector Current

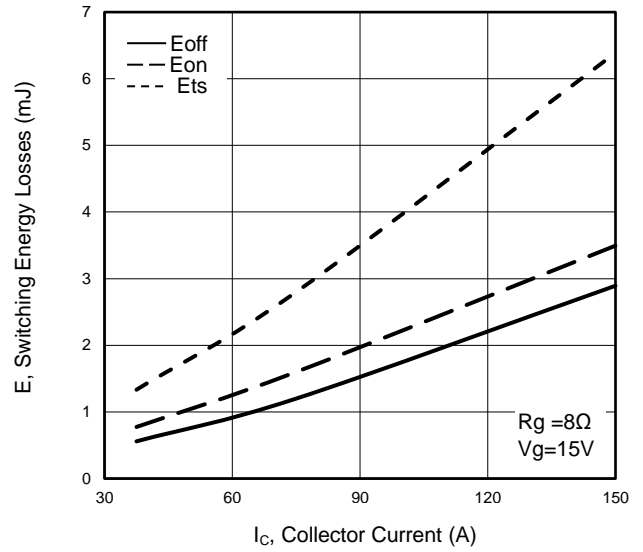


Figure 15 Switching Energy vs. Temperature

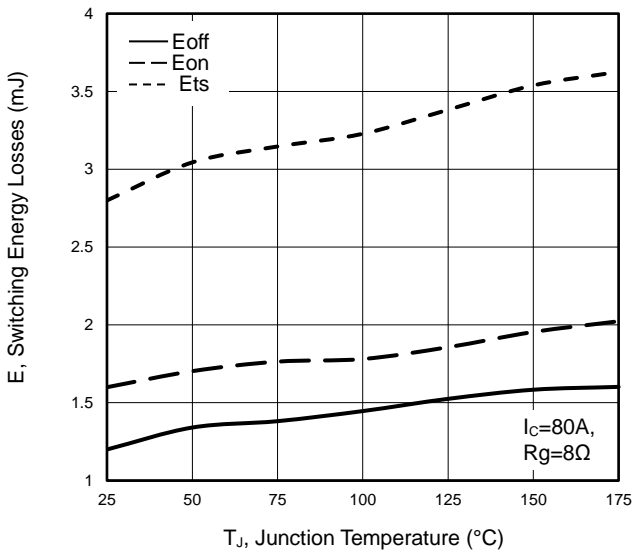


Figure 16 Switching Loss vs. Collector Current

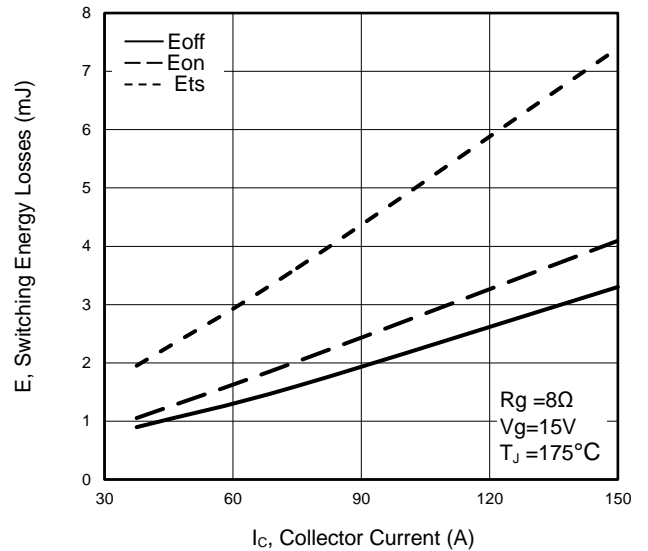


Figure 17 V_{CES} vs. Case Temperature

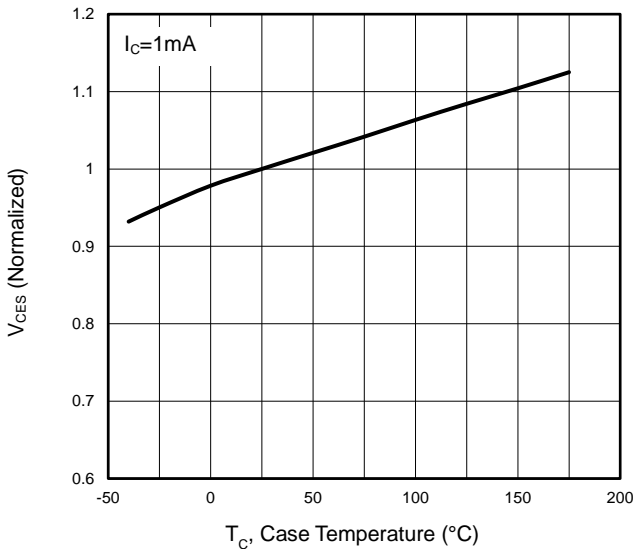
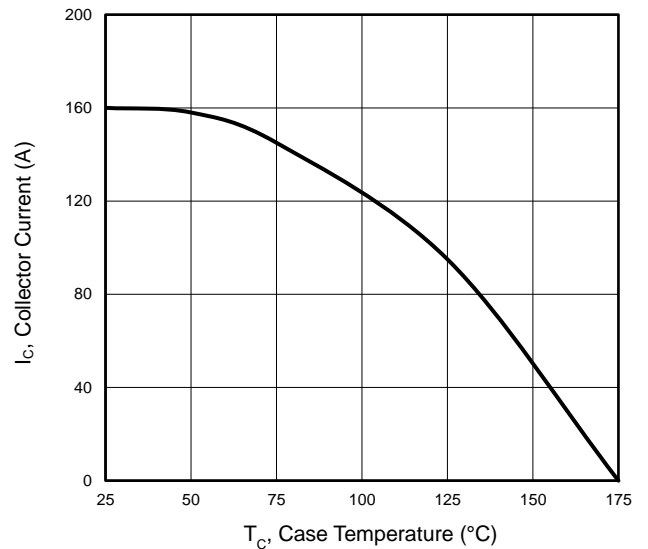


Figure 18 I_C vs. Temperature



Typical Electrical and Thermal Characteristics

Figure 19 Switching Time vs. I_C

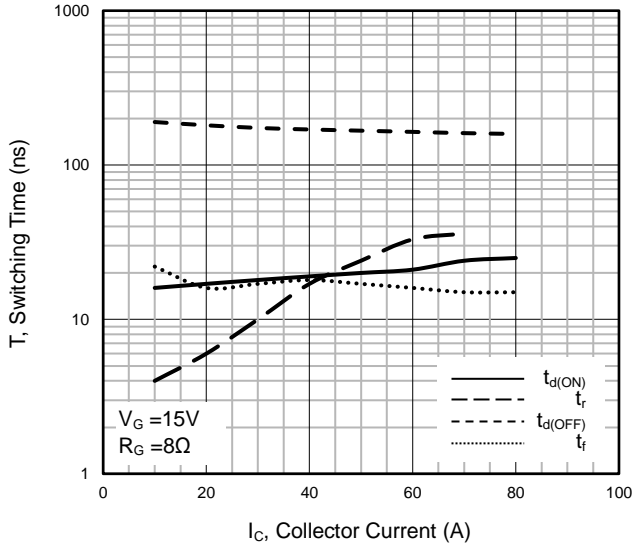


Figure 20 Switching Time vs. R_G

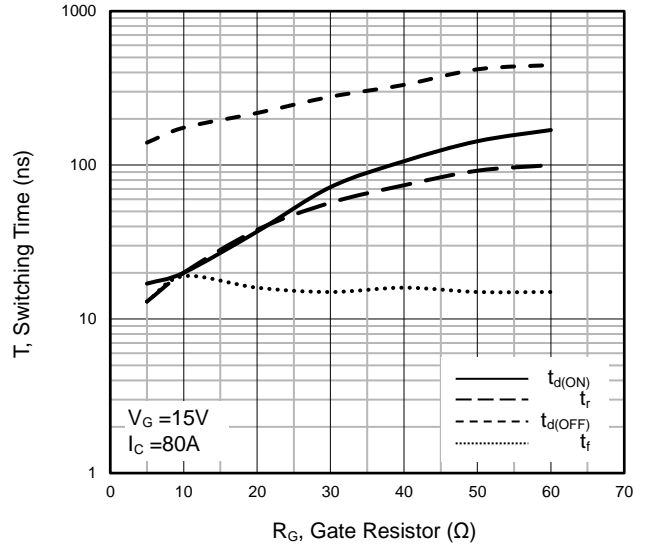


Figure 21 Switching Time vs. I_C

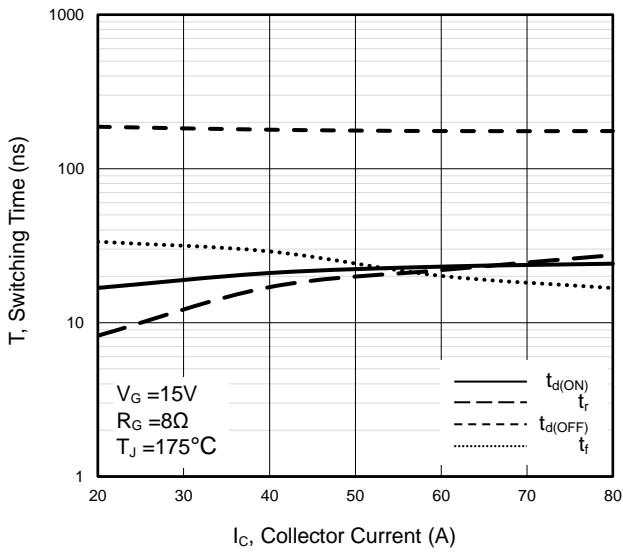
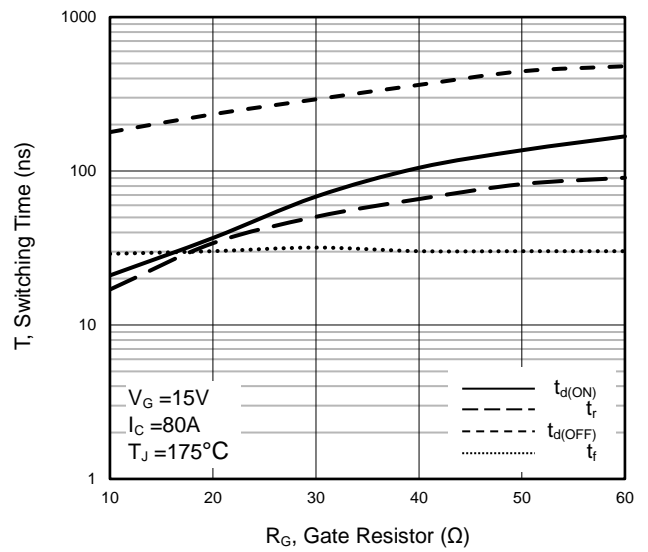
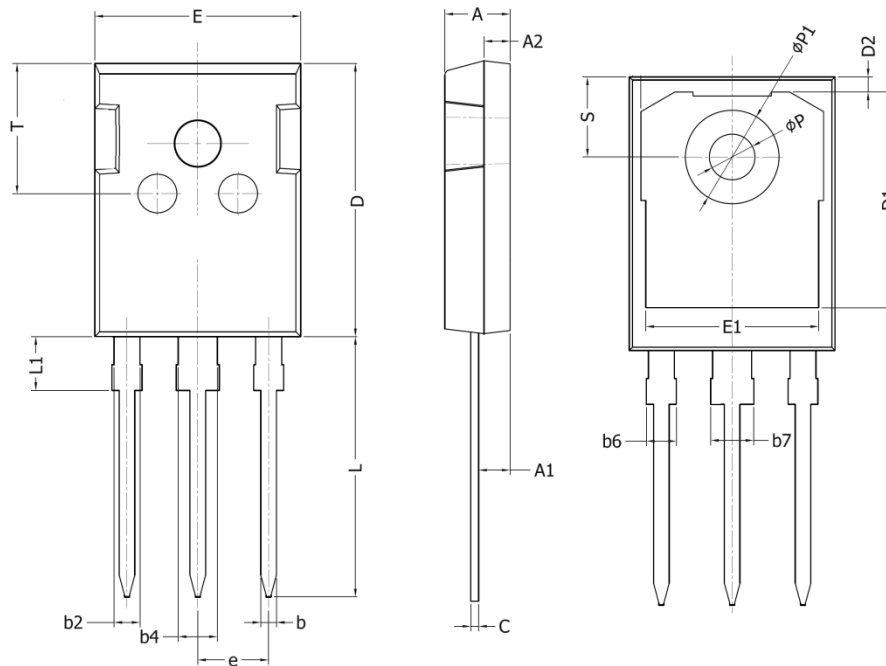


Figure 22 Switching Time vs. R_G

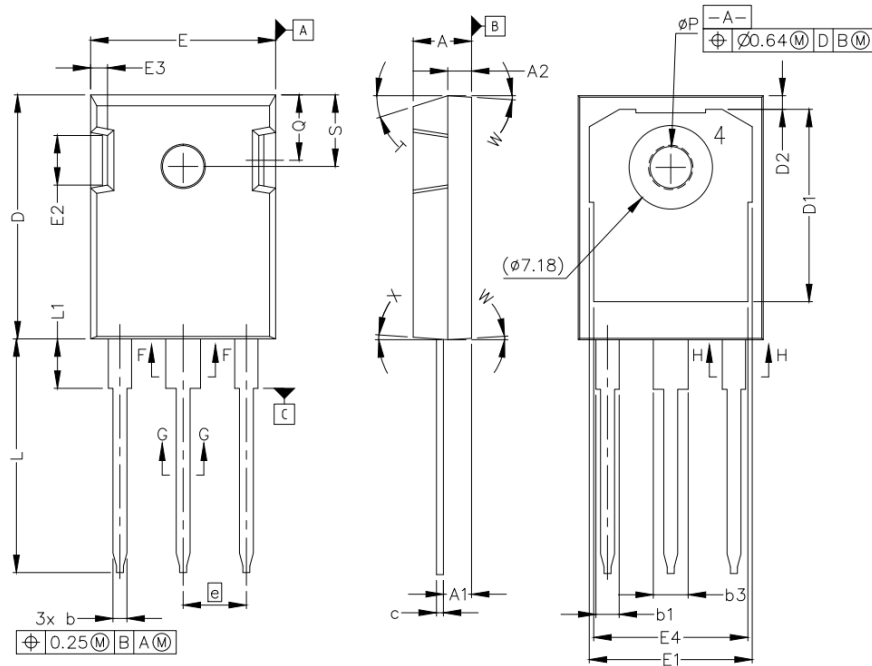


TO-247-P Package Information



| Symbol | Dimensions In Millimeters | | Dimensions In Inches | |
|--------|---------------------------|-------|----------------------|-------|
| | Min. | Max. | Min. | Max. |
| A | 4.90 | 5.10 | 0.193 | 0.201 |
| A1 | 2.31 | 2.51 | 0.091 | 0.099 |
| A2 | 1.9 | 2.1 | 0.075 | 0.083 |
| b | 1.16 | 1.26 | 0.046 | 0.050 |
| b2 | 1.96 | 2.06 | 0.077 | 0.081 |
| b4 | 2.96 | 3.06 | 0.117 | 0.120 |
| b6 | - | 2.25 | - | 0.089 |
| b7 | - | 3.25 | - | 0.128 |
| C | 0.59 | 0.66 | 0.023 | 0.026 |
| D | 20.90 | 21.10 | 0.823 | 0.831 |
| D1 | 16.25 | 16.85 | 0.640 | 0.663 |
| D2 | 1.05 | 1.35 | 0.041 | 0.053 |
| E | 15.70 | 15.90 | 0.618 | 0.626 |
| E1 | 13.10 | 13.50 | 0.516 | 0.531 |
| e | 5.436 BSC | | 0.214 BSC | |
| L | 19.80 | 20.10 | 0.780 | 0.791 |
| L1 | - | 4.30 | - | 0.169 |
| P | 3.40 | 3.60 | 0.134 | 0.142 |
| P1 | 7.00 | 7.40 | 0.276 | 0.291 |
| S | 6.05 | 6.25 | 0.238 | 0.246 |
| T | 9.80 | 10.20 | 0.386 | 0.402 |

TO-247-B Package Information



| Symbol | Dimensions In Millimeters | | Dimensions In Inches | |
|--------|---------------------------|-------|----------------------|-------|
| | Min. | Max. | Min. | Max. |
| A | 4.83 | 5.21 | 0.190 | 0.205 |
| A1 | 2.29 | 2.54 | 0.090 | 0.100 |
| A2 | 1.91 | 2.16 | 0.075 | 0.085 |
| b | 1.07 | 1.33 | 0.042 | 0.052 |
| b1 | 1.91 | 2.41 | 0.075 | 0.095 |
| b3 | 2.87 | 3.38 | 0.113 | 0.133 |
| c | 0.55 | 0.68 | 0.022 | 0.027 |
| D | 20.80 | 21.10 | 0.819 | 0.831 |
| D1 | 16.25 | 17.65 | 0.640 | 0.695 |
| D2 | 0.95 | 1.25 | 0.037 | 0.049 |
| E | 15.75 | 16.13 | 0.620 | 0.635 |
| E1 | 13.10 | 14.15 | 0.516 | 0.557 |
| E2 | 3.68 | 5.10 | 0.145 | 0.201 |
| E3 | 1.00 | 1.90 | 0.039 | 0.075 |
| E4 | 12.38 | 13.43 | 0.487 | 0.529 |
| e | 5.44 BSC | | 0.214 BSC | |
| N | 3.00 | | 0.118 | |
| L | 19.81 | 20.32 | 0.780 | 0.800 |
| L1 | 4.10 | 4.40 | 0.161 | 0.173 |
| P | 3.51 | 3.65 | 0.138 | 0.144 |
| Q | 5.49 | 6.00 | 0.216 | 0.236 |
| S | 6.04 | 6.30 | 0.238 | 0.248 |

Attention

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