

1200V, 40A, Trench FS II Fast IGBT

General Description:

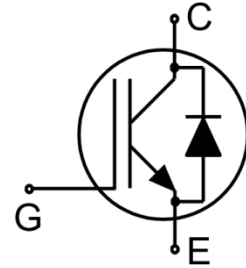
Using VCRR's proprietary trench design and advanced FS (Field Stop) second generation technology, the 1200V Trench FSII IGBT offers superior conduction and switching performances, and easy parallel operation;

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

- Welding



Schematic diagram

Package Marking and Ordering Information

| Device | Device Package | Device Marking |
|---------------|----------------|----------------|
| VCRR40TD120WT | TO-247 | VCRR40TD120WT |



TO-247

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

| Symbol | Parameter | Value | Units |
|----------------|---|-------------|------------------|
| V_{CES} | Collector-Emitter Voltage | 1200 | V |
| V_{GES} | Gate- Emitter Voltage | ± 30 | V |
| I_C | Collector Current | 80 | A |
| | Collector Current @ $T_C = 100^\circ\text{C}$ | 40 | A |
| I_{Cplus} | Pulsed Collector Current, t_p limited by T_{jmax} | 160 | A |
| - | turn off safe operating area, $V_{CE}=1200\text{V}$, $T_j=175^\circ\text{C}$ | 160 | A |
| I_F | Diode Continuous Forward Current @ $T_C = 100^\circ\text{C}$ | 40 | A |
| I_{FM} | Diode Maximum Forward Current | 160 | 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 | $^\circ\text{C}$ |

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 | 0.75 | $^{\circ}\text{C}/\text{W}$ |
| $R_{\theta JA}$ | Thermal Resistance, Junction to Ambient | 40 | $^{\circ}\text{C}/\text{W}$ |

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

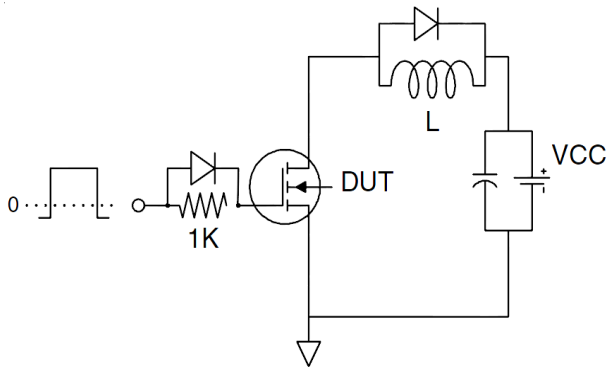
| Symbol | Parameter | Conditions | Value | | | Units |
|----------------------------------|--------------------------------------|--|-------|------|------|---------------|
| | | | Min. | Typ. | Max. | |
| Static Characteristics | | | | | | |
| $V_{(BR)CES}$ | Collector-Emitter Breakdown Voltage | $V_{GE}=0\text{V}, I_{CE}=1\text{mA}$ | 1200 | -- | -- | V |
| I_{CES} | Collector-Emitter Leakage Current | $V_{GE}=0\text{V}, V_{CE}=1200\text{V}$ | -- | -- | 200 | 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 | $I_C=40\text{A}$ | -- | 1.9 | 2.2 | V |
| | | $V_{GE}=15\text{V}$ | -- | 2.2 | -- | V |
| $V_{GE(th)}$ | Gate Threshold Voltage | $I_C=1\text{mA}, V_{CE}=V_{GE}$ | 4.5 | -- | 6.5 | V |
| Dynamic Characteristics | | | | | | |
| C_{ies} | Input Capacitance | $V_{CE}=30\text{V}, V_{GE}=0\text{V}, f=1\text{MHz}$ | -- | 6190 | -- | pF |
| C_{oes} | Output Capacitance | | -- | 185 | -- | |
| C_{res} | Reverse Transfer Capacitance | | -- | 133 | -- | |
| Q_g | Total Gate Charge | $V_{CC}=960\text{V}, I_C=40\text{A}, V_{GE}=15\text{V}$ | -- | 242 | -- | nC |
| Q_{ge} | Gate to Emitter Charge | | -- | 51 | -- | |
| Q_{gc} | Gate to Collector Charge | | -- | 115 | -- | |
| Switching Characteristics | | | | | | |
| $t_{d(ON)}$ | Turn-on Delay Time | $V_{CE}=600\text{V}, I_C=40\text{A}, V_{GE}=0/15\text{V}, R_g=8\Omega$ Inductive Load | -- | 19 | -- | ns |
| t_r | Rise Time | | -- | 17 | -- | |
| $t_{d(OFF)}$ | Turn-Off Delay Time | | -- | 170 | -- | |
| t_f | Fall Time | | -- | 18 | -- | |
| E_{on} | Turn-On Switching Loss | | -- | 2.1 | -- | mJ |
| E_{off} | Turn-Off Switching Loss | | -- | 1.2 | -- | |
| E_{ts} | Total Switching Loss | | -- | 3.3 | -- | |

Electrical Characteristics of the Diode ($T_c=25^{\circ}\text{C}$ unless otherwise specified)

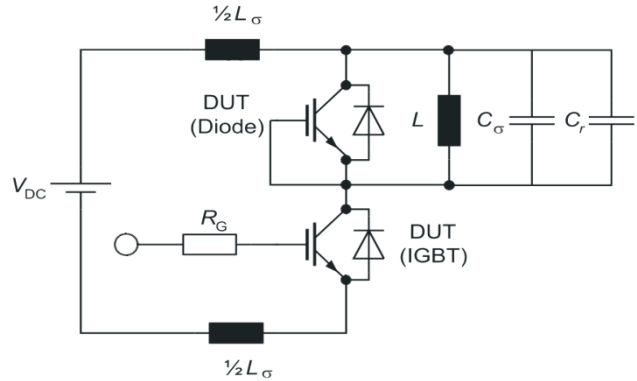
| Symbol | Parameter | Conditions | Rating | | | Units |
|--|-------------------------------------|---|--------|------|------|---------------|
| | | | Min. | Typ. | Max. | |
| V_{FM} | Diode Forward Voltage | $I_F=20\text{A}$ | -- | 2.1 | 2.8 | V |
| T_{rr} | Reverse Recovery Time | $I_F=20\text{A}, di/dt=500\text{A}/\mu\text{s}$ | -- | 203 | -- | ns |
| I_{RRM} | Diode Peak Reverse Recovery Current | | -- | 10 | -- | A |
| Q_{rr} | Reverse Recovery Charge | | -- | 1.6 | -- | μC |
| Pulse width $t_p \leq 380\mu\text{s}, \delta \leq 2\%$ | | | | | | |

Test Circuit

1) Gate Charge Test Circuit

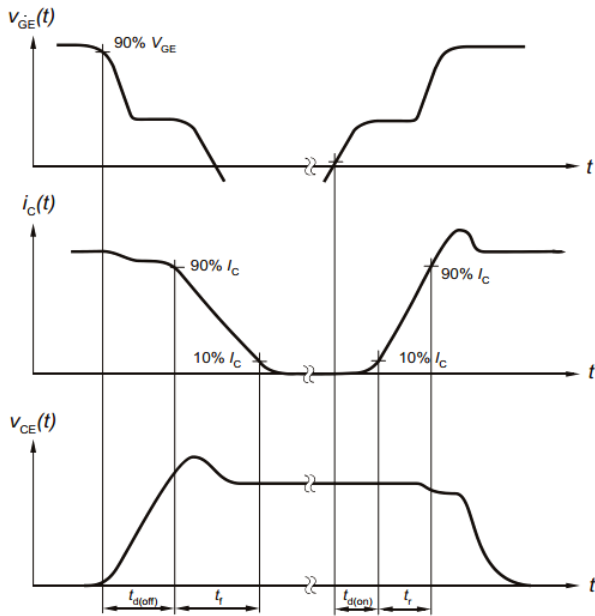


2) Switch Time Test Circuit

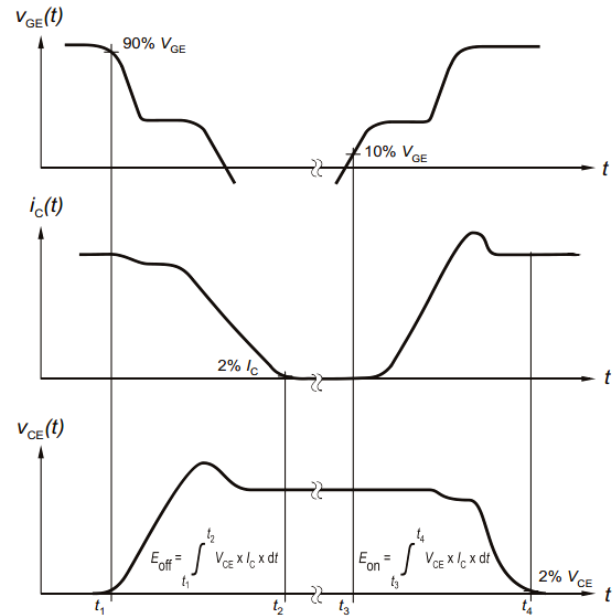


Switching characteristics

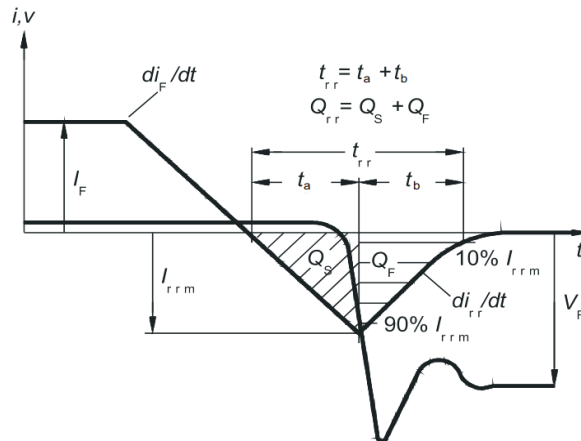
1) Definition of switching times



2) Definition of switching losses



3) Definition of diode switching characteristics



Typical Electrical and Thermal Characteristics

Figure 1 Output Characteristics

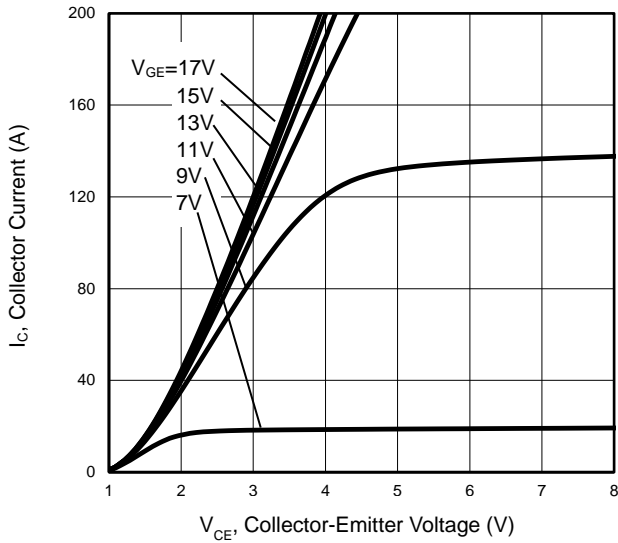


Figure 2 Transfer Characteristics

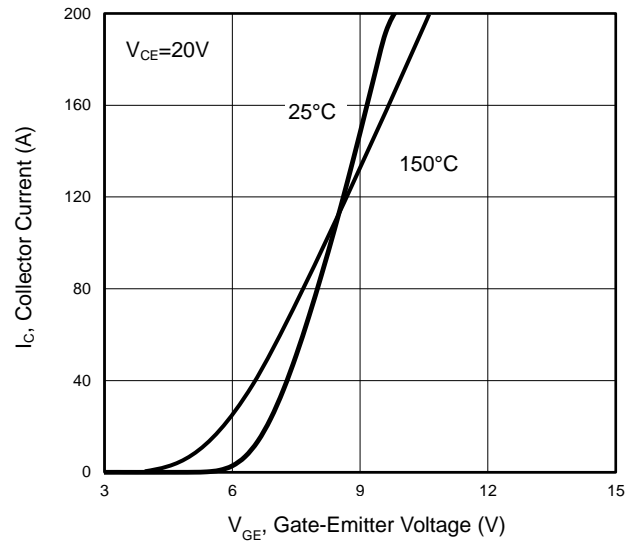


Figure 3 $V_{CE(sat)}$ vs. Case Temperature

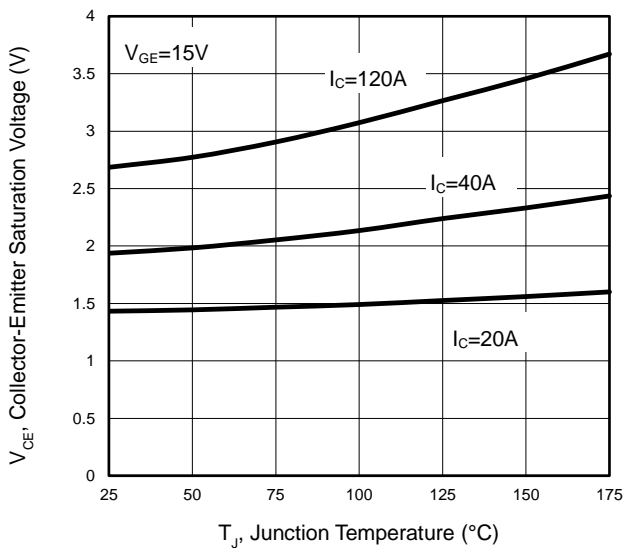


Figure 4 Saturation Voltage vs. V_{GE}

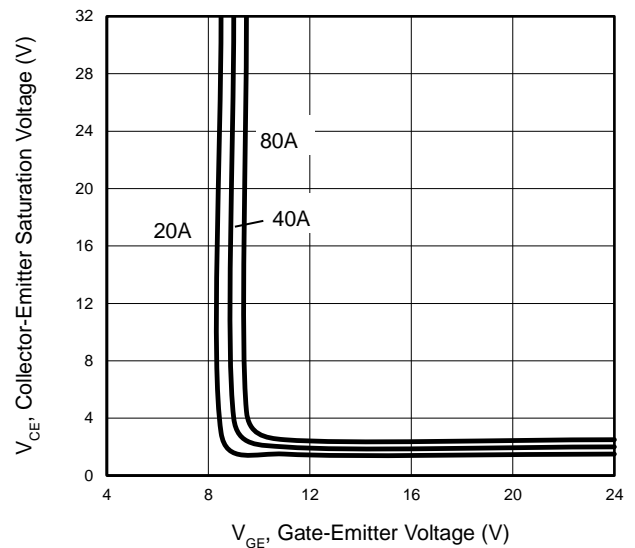


Figure 5 Capacitance Characteristics

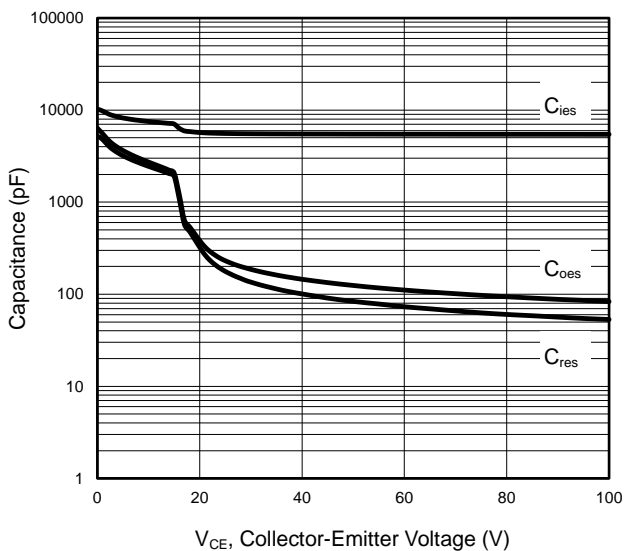
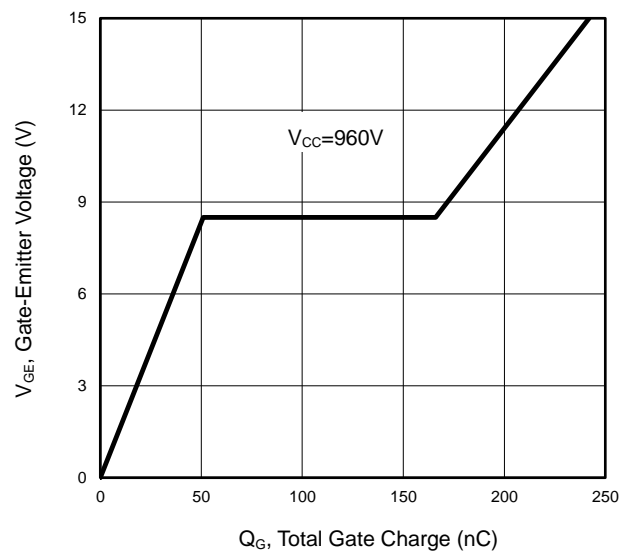


Figure 6 Gate Charge Wave Form



Typical Electrical and Thermal Characteristics

Figure 7 Forward Characteristics

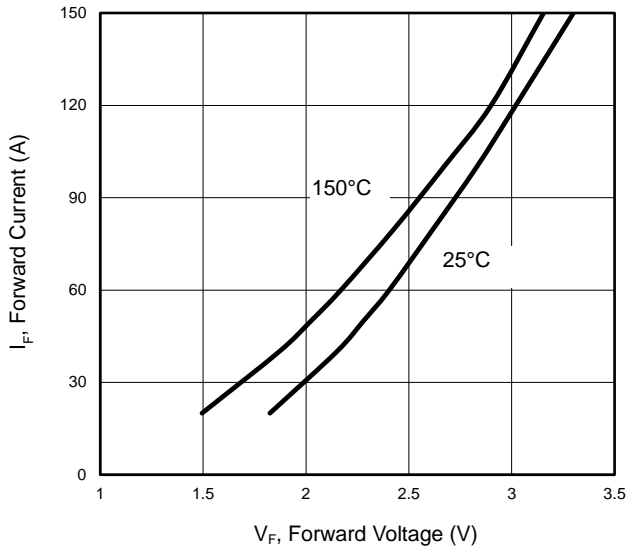


Figure 8 V_F vs. Temperature

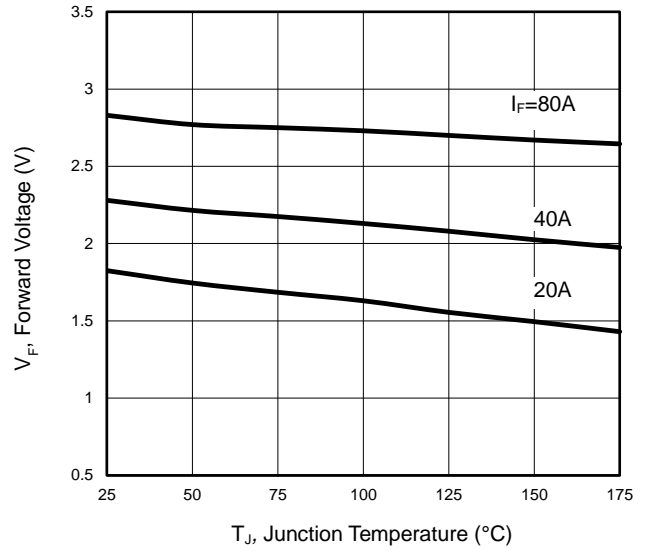


Figure 9 Switching Energy vs. Temperature

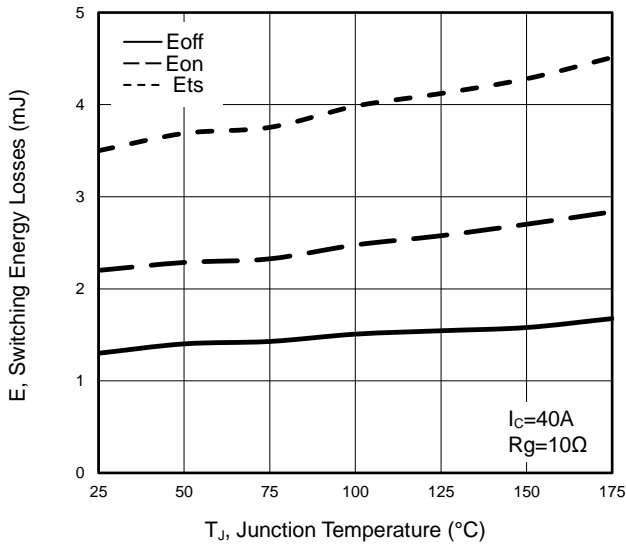


Figure 10 Forward Bias Safe Operating Area

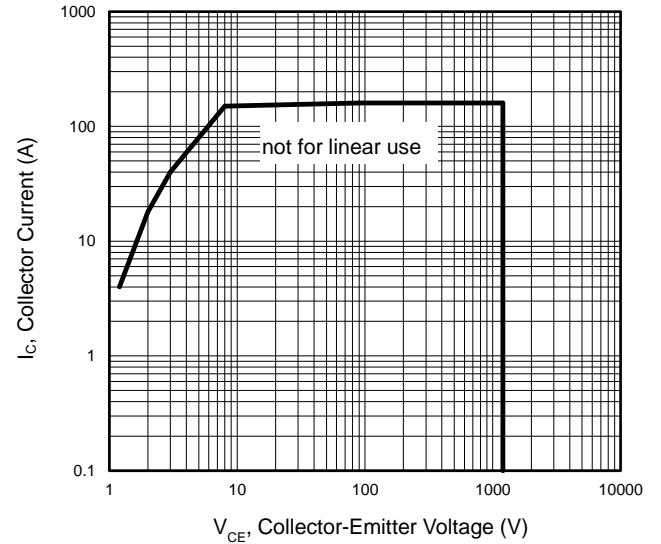


Figure 11 Gate-Emitter Threshold Voltage as a Function of Junction Temperature

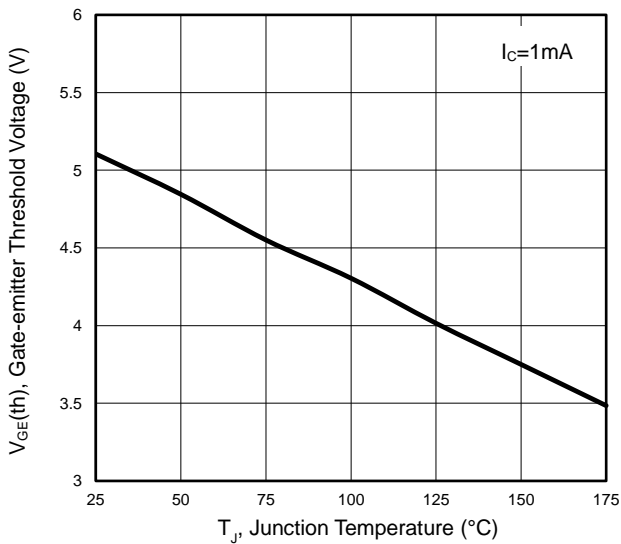
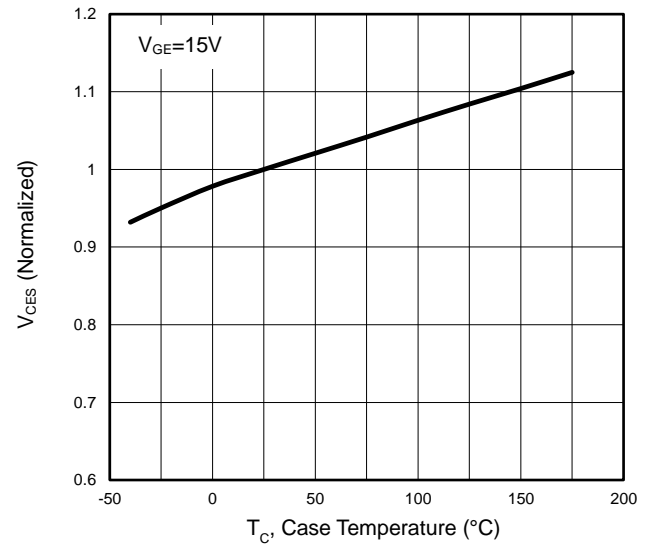
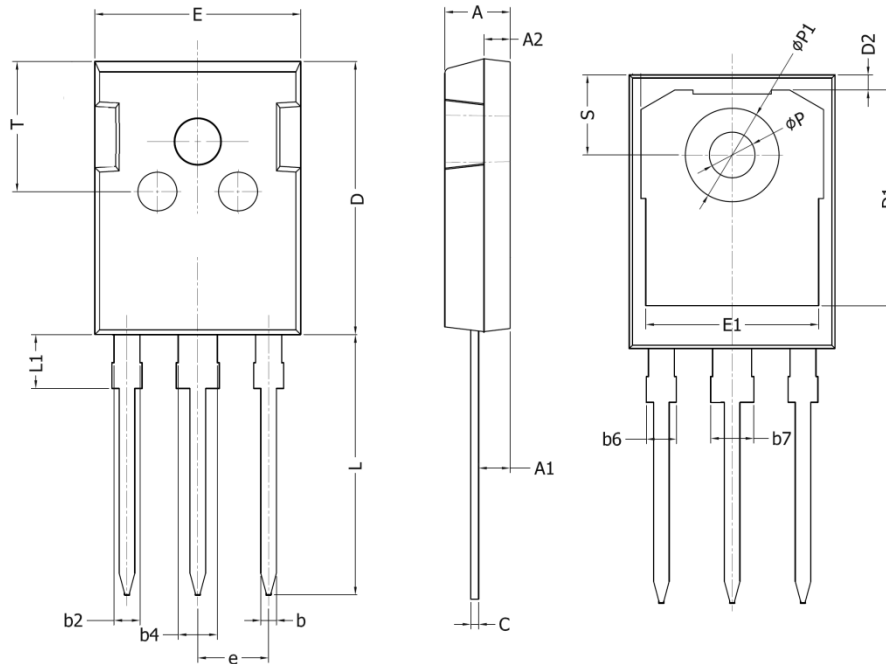


Figure 12 V_{CES} vs. Temperature



TO-247 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 |

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