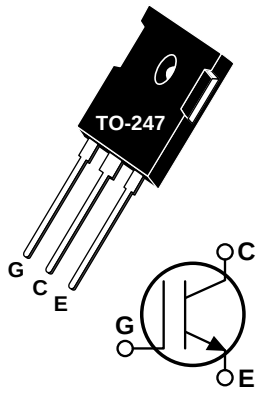
# APT20GT60BR

**600V 40A**

## Thunderbolt IGBT™




The Thunderbolt IGBT™ is a new generation of high voltage power IGBTs. Using Non-Punch Through Technology the Thunderbolt IGBT™ offers superior ruggedness and ultrafast switching speed.

- **Low Forward Voltage Drop**
- **High Freq. Switching to 150KHz**
- **Low Tail Current**
- **Ultra Low Leakage Current**
- **Avalanche Rated**
- **RBSOA and SCSOA Rated**

**MAXIMUM RATINGS** All Ratings: $T_C$ = 25°C unless otherwise specified.

| Symbol | Parameter | APT20GT60BR | UNIT |
|---|---|---|---|
| $V_{CES}$ | Collector-Emitter Voltage | 600 | Volts |
| $V_{CGR}$ | Collector-Gate Voltage ($R_{GE}$ = 20KΩ) | 600 | |
| $V_{EC}$ | Emitter-Collector Voltage | 15 | |
| $V_{GE}$ | Gate-Emitter Voltage | ±20 | |
| $I_{C1}$ | Continuous Collector Current @ $T_C$ = 25°C | 40 | Amps |
| $I_{C2}$ | Continuous Collector Current @ $T_C$ = 90°C | 20 | |
| $I_{CM}$ | Pulsed Collector Current ① @ $T_C$ = 25°C | 80 | |
| $I_{LM}$ | RBSOA Clamped Inductive Load Current @ $R_g$ = 11Ω $T_C$ = 125°C | 40 | |
| $E_{AS}$ | Single Pulse Avalanche Energy ② | 40 | mJ |
| $P_D$ | Total Power Dissipation | 175 | Watts |
| $T_J$,$T_{STG}$ | Operating and Storage Junction Temperature Range | -55 to 150 | °C |
| $T_L$ | Max. Lead Temp. for Soldering: 0.063" from Case for 10 Sec. | 300 | |

**STATIC ELECTRICAL CHARACTERISTICS**

| Symbol | Characteristic / Test Conditions | MIN | TYP | MAX | UNIT |
|---|---|---|---|---|---|
| $BV_{CES}$ | Collector-Emitter Breakdown Voltage ($V_{GE}$ = 0V, $I_C$ = 0.5mA) | 600 | | | Volts |
| $RBV_{CES}$ | Collector-Emitter Reverse Breakdown Voltage ($V_{GE}$ = 0V, $I_C$ = 50mA) | -15 | | | |
| $V_{GE}(TH)$ | Gate Threshold Voltage ($V_{CE}$ = $V_{GE}$, $I_C$ = 500µA, $T_j$ = 25°C) | 3 | 4 | 5 | |
| $V_{CE}(ON)$ | Collector-Emitter On Voltage ($V_{GE}$ = 15V, $I_C$ = $I_{C2}$, $T_j$ = 25°C) | 1.6 | 2.0 | 2.5 | |
| | Collector-Emitter On Voltage ($V_{GE}$ = 15V, $I_C$ = $I_{C2}$, $T_j$ = 125°C) | | | 2.8 | |
| $I_{CES}$ | Collector Cut-off Current ($V_{CE}$ = $V_{CES}$, $V_{GE}$ = 0V, $T_j$ = 25°C) | | | 40 | µA |
| | Collector Cut-off Current ($V_{CE}$ = $V_{CES}$, $V_{GE}$ = 0V, $T_j$ = 125°C) | | | 1000 | |
| $I_{GES}$ | Gate-Emitter Leakage Current ($V_{GE}$ = ±20V, $V_{CE}$ = 0V) | | | ±100 | nA |

**CAUTION:** These Devices are Sensitive to Electrostatic Discharge. Proper Handling Procedures Should Be Followed.


*APT Website - http://www.advancedpower.com*

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052-6210 RevC 3-2001

## DYNAMIC CHARACTERISTICS

**APT20GT60BR**

| Symbol | Characteristic | Test Conditions | MIN | TYP | MAX | UNIT |
|---|---|---|---|---|---|---|
| $C_{ies}$ | Input Capacitance | **Capacitance** $V_{GE}$ = 0V, $V_{CE}$ = 25V, f = 1 MHz | | 1045 | 1200 | pF |
| $C_{oes}$ | Output Capacitance | | | 110 | 160 | |
| $C_{res}$ | Reverse Transfer Capacitance | | | 65 | 110 | |
| $Q_g$ | Total Gate Charge ③ | **Gate Charge** $V_{GE}$ = 15V, $V_{CC}$ = 0.5$V_{CES}$, $I_C$ = $I_{C2}$ | | 91 | 140 | nC |
| $Q_{ge}$ | Gate-Emitter Charge | | | 5.9 | 10 | |
| $Q_{gc}$ | Gate-Collector ("Miller") Charge | | | 40 | 60 | |
| $t_d(on)$ | Turn-on Delay Time | **Resistive Switching (25°C)** $V_{GE}$ = 15V, $V_{CC}$ = 0.5$V_{CES}$, $I_C$ = $I_{C2}$, $R_G$ = 10Ω | | 9.0 | 20 | ns |
| $t_r$ | Rise Time | | | 27 | 50 | |
| $t_d(off)$ | Turn-off Delay Time | | | 112 | 170 | |
| $t_f$ | Fall Time | | | 162 | 320 | |
| $t_d(on)$ | Turn-on Delay Time | **Inductive Switching (150°C)** $V_{CLAMP}$(Peak) = 0.66$V_{CES}$, $V_{GE}$ = 15V, $I_C$ = $I_{C2}$, $R_G$ = 10Ω, $T_J$ = +150°C | | 13 | 26 | ns |
| $t_r$ | Rise Time | | | 15 | 30 | |
| $t_d(off)$ | Turn-off Delay Time | | | 170 | 260 | |
| $t_f$ | Fall Time | | | 110 | 220 | |
| $E_{on}$ | Turn-on Switching Energy | | | 235 | 470 | uJ |
| $E_{off}$ | Turn-off Switching Energy | | | 595 | 1190 | |
| $E_{ts}$ | Total Switching Losses | | | 830 | 1660 | |
| $t_d(on)$ | Turn-on Delay Time | **Inductive Switching (25°C)** $V_{CLAMP}$(Peak) = 0.66$V_{CES}$, $V_{GE}$ = 15V, $I_C$ = $I_{C2}$, $R_G$ = 10Ω, $T_J$ = +25°C | | 12 | 20 | ns |
| $t_r$ | Rise Time | | | 16 | 30 | |
| $t_d(off)$ | Turn-off Delay Time | | | 129 | 190 | |
| $t_f$ | Fall Time | | | 45 | 90 | |
| $E_{ts}$ | Total Switching Losses | | | 575 | 1150 | uJ |
| gfe | Forward Transconductance | $V_{CE}$ = 20V, $I_C$ = $I_{C2}$ | 4 | | | S |

## THERMAL AND MECHANICAL CHARACTERISTICS

| Symbol | Characteristic | MIN | TYP | MAX | UNIT |
|---|---|---|---|---|---|
| $R_{\Theta JC}$ | Junction to Case | | | 0.72 | °C/W |
| $R_{\Theta JA}$ | Junction to Ambient | | | 40 | |
| $W_T$ | Package Weight | | 0.22 | | oz |
| | | | 6.1 | | gm |
| Torque | Mounting Torque (using a 6-32 or 3mm Binding Head Machine Screw) | | | 10 | lb•in |
| | | | | 1.1 | N•m |

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

② $I_C$ = $I_{C2}$, $V_{CC}$ = 50V, $R_{GE}$ = 25Ω, L = 200µH, $T_j$ = 25°C

③ See MIL-STD-750 Method 3471

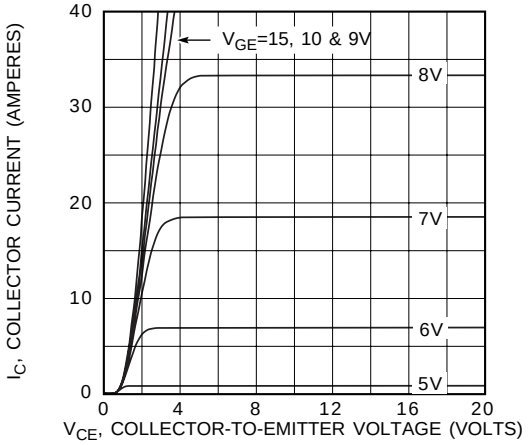



**Figure 1, Typical Output Characteristics ($T_J$ = 25°C)**

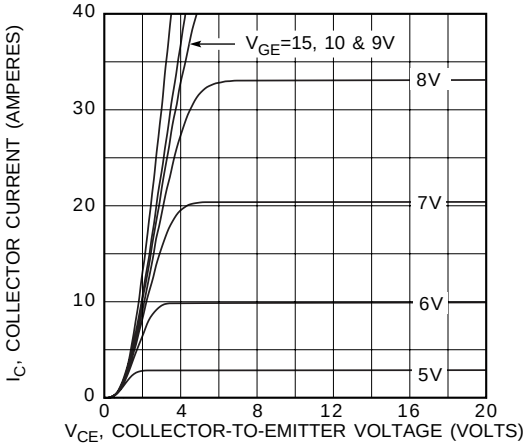



**Figure 2, Typical Output Characteristics ($T_J$ = 150°C)**

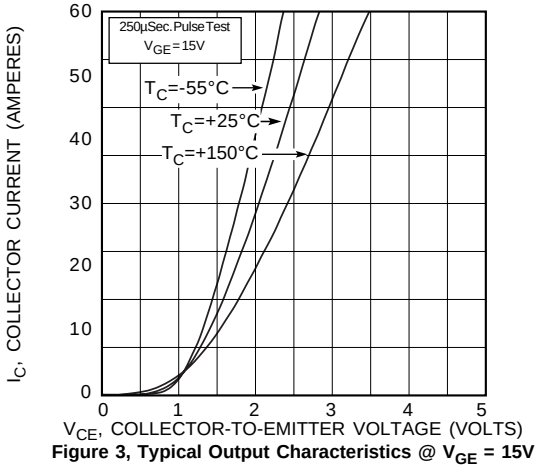



**Figure 3, Typical Output Characteristics @ $V_{GE}$ = 15V**

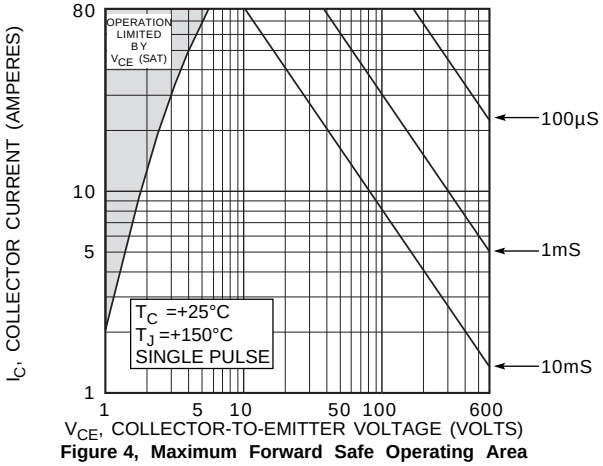



**Figure 4, Maximum Forward Safe Operating Area**

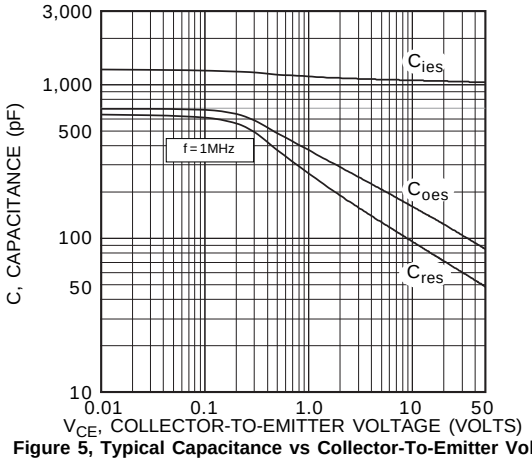



**Figure 5, Typical Capacitance vs Collector-To-Emitter Voltage**

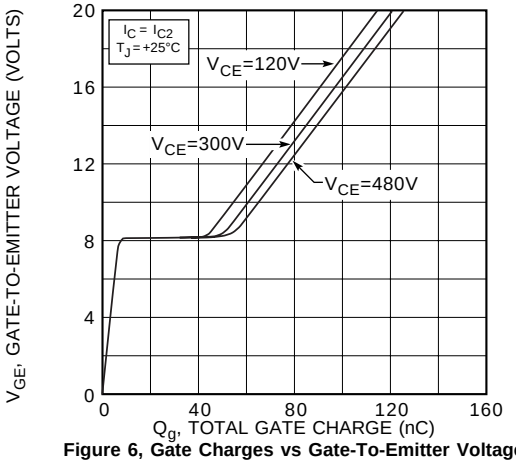



**Figure 6, Gate Charges vs Gate-To-Emitter Voltage**

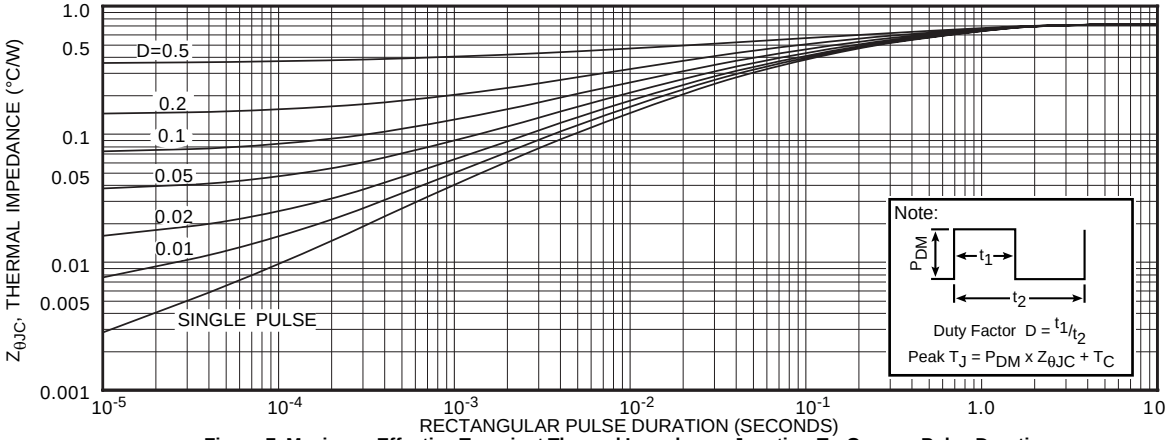



**Figure 7, Maximum Effective Transient Thermal Impedance, Junction-To-Case vs Pulse Duration**

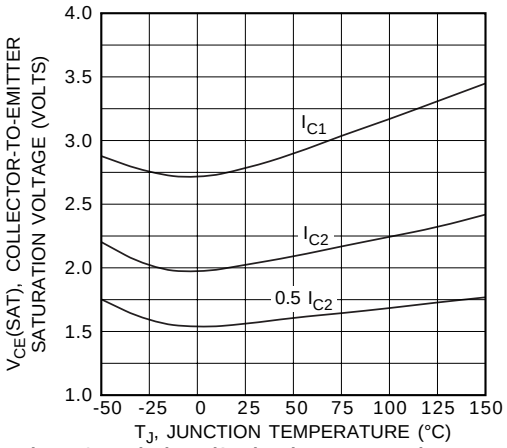



**Figure 8, Typical $V_{CE}$(SAT) Voltage vs Junction Temperature**

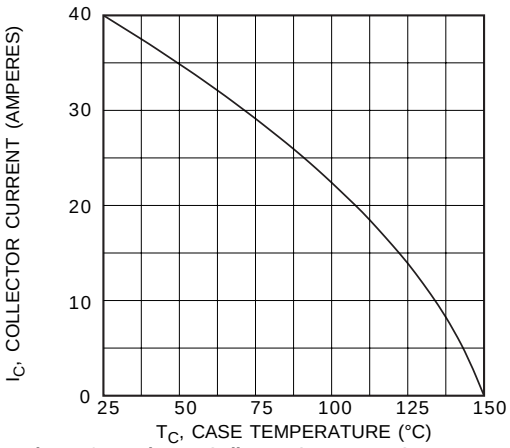



**Figure 9, Maximum Collector Current vs Case Temperature**

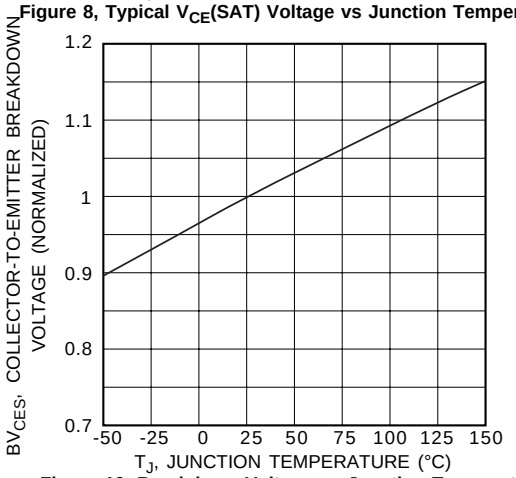



**Figure 10, Breakdown Voltage vs Junction Temperature**

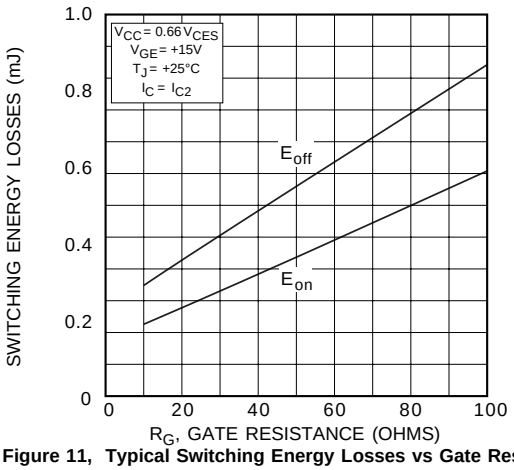



**Figure 11, Typical Switching Energy Losses vs Gate Resistance**

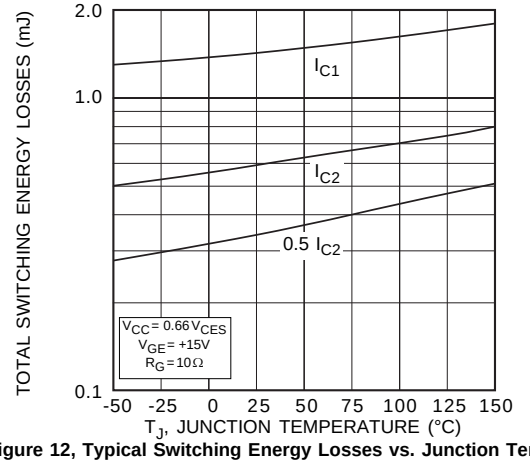



**Figure 12, Typical Switching Energy Losses vs. Junction Temperature**

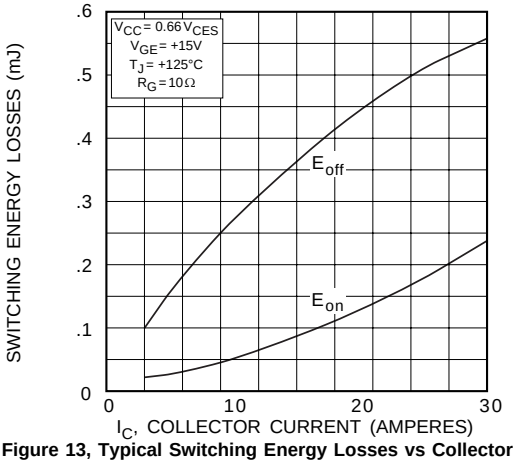



**Figure 13, Typical Switching Energy Losses vs Collector Current**

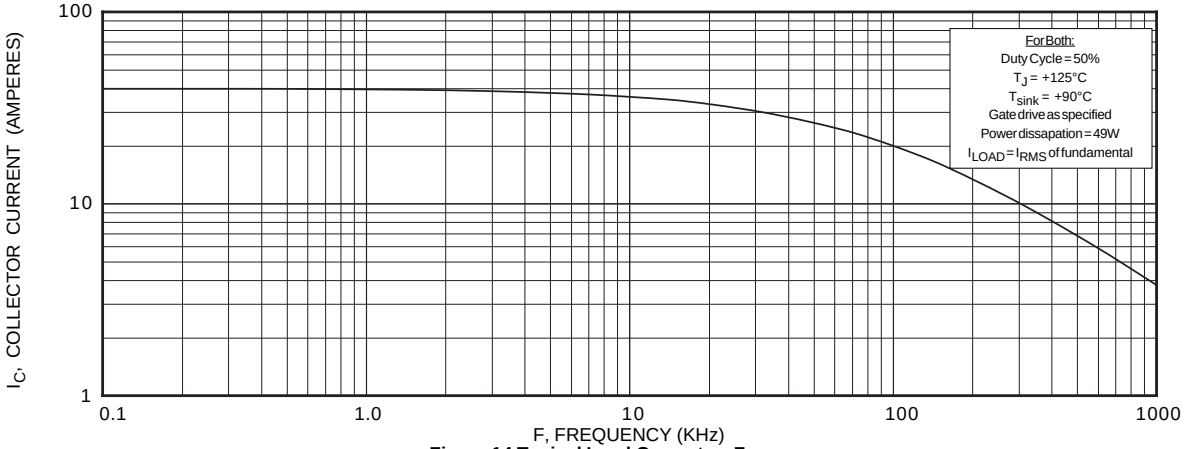



**Figure 14,Typical Load Current vs Frequency**

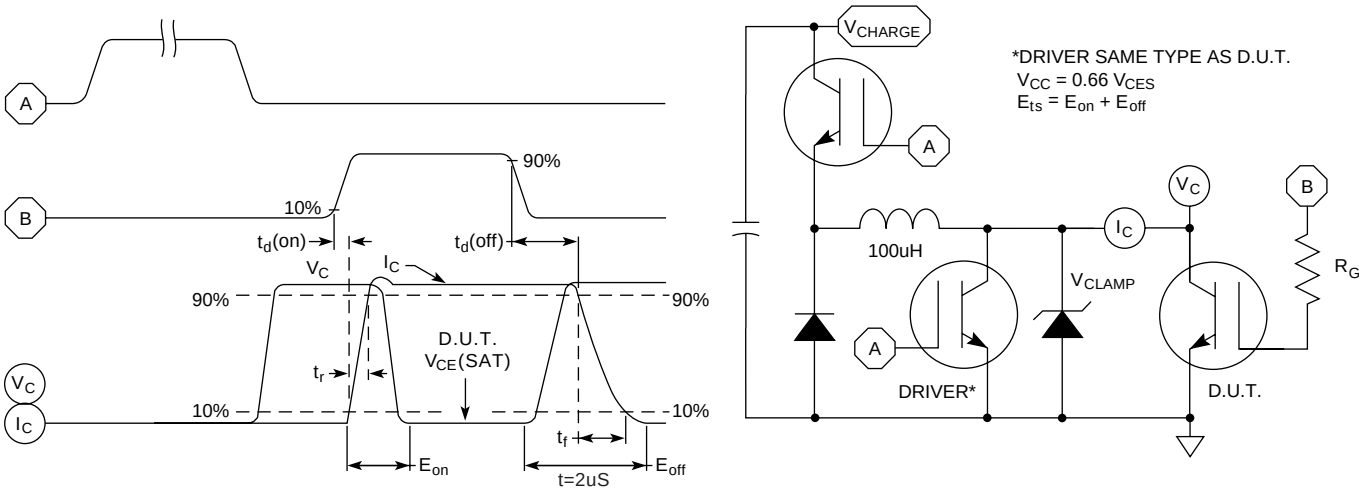



**Figure 15, Switching Loss Test Circuit and Waveforms**

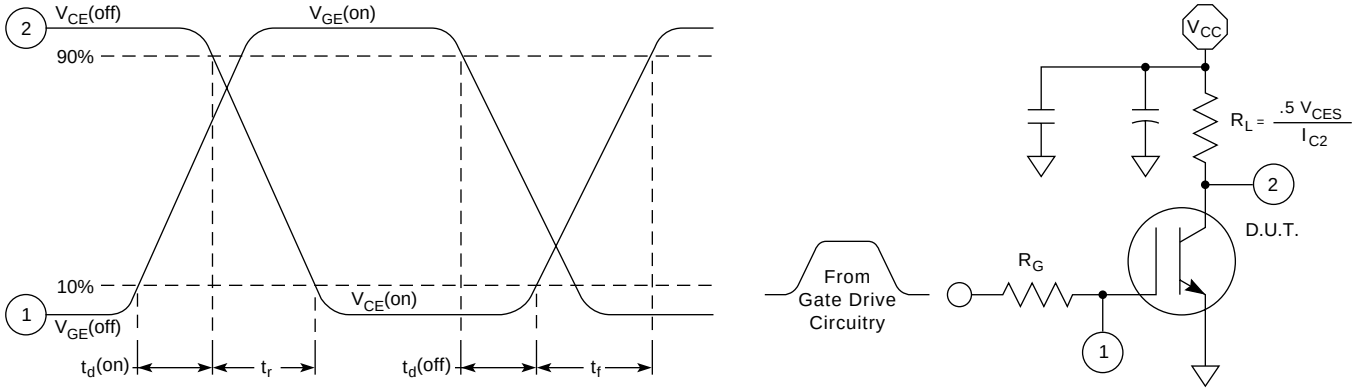
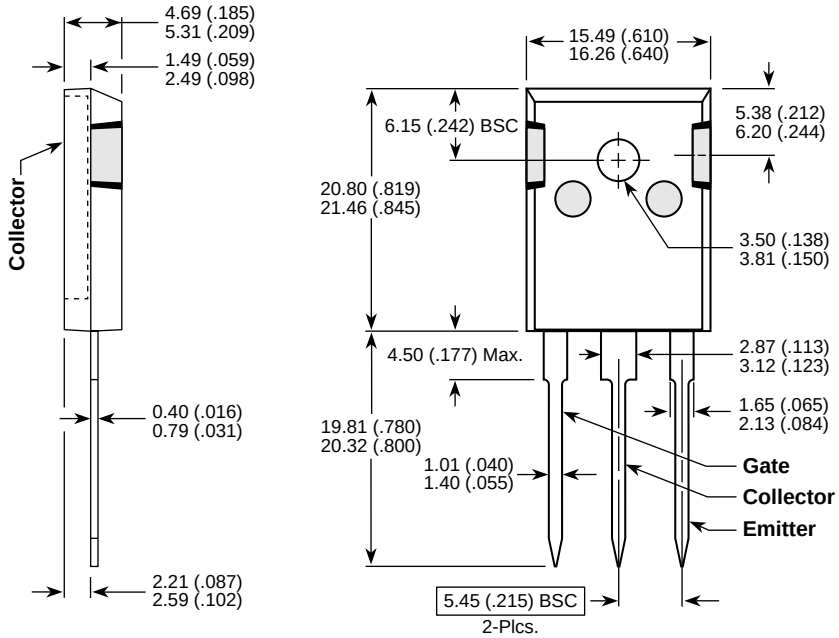



**Figure 16, Resistive Switching Time Test Circuit and Waveforms**

## T0-247 Package Outline




Dimensions in Millimeters and (Inches)