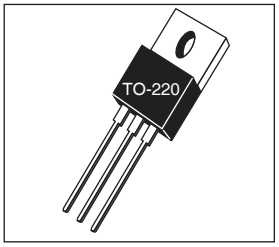
**ADVANCED POWER TECHNOLOGY®**

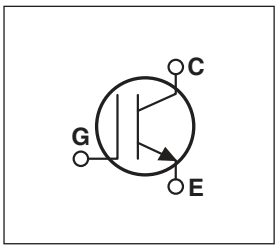
**1200V**
**APT11GF120KR**
**APT11GF120KRG***
***G Denotes RoHS Compliant, Pb Free Terminal Finish.**

# FAST IGBT & FRED




The Fast IGBT is a new generation of high voltage power IGBTs. Using Non-Punch through technology, the Fast IGBT combined with an APT free wheeling Ultra Fast Recovery Epitaxial Diode (FRED) offers superior ruggedness and fast switching speed.

- **Low Forward Voltage Drop**
- **High Freq. Switching to 20KHz**
- **RBSOA and SCSOA Rated**
- **Ultra Low Leakage Current**
- **Ultrafast Soft Recovery Anti-parallel Diode**




## MAXIMUM RATINGS

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

| Symbol | Parameter | APT11GF120KR(G) | UNIT |
|---|---|---|---|
| $V_{CES}$ | Collector-Emitter Voltage | 1200 | Volts |
| $V_{GE}$ | Gate-Emitter Voltage | ±30 | |
| $I_{C1}$ | Continuous Collector Current @ $T_C$ = 25°C | 25 | Amps |
| $I_{C2}$ | Continuous Collector Current @ $T_C$ = 100°C | 14 | |
| $I_{CM}$ | Pulsed Collector Current ① | 44 | |
| SSOA | Switching Safe Operating Area @ $T_J$ = 150°C | 44A @ 1200V | |
| $P_D$ | Total Power Dissipation | 156 | 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 | Units |
|---|---|---|---|---|---|
| $V_{(BR)CES}$ | Collector-Emitter Breakdown Voltage ($V_{GE}$ = 0V, $I_C$ = 400µA) | 1200 | | | Volts |
| $V_{GE(TH)}$ | Gate Threshold Voltage ($V_{CE}$ = $V_{GE}$, $I_C$ = 350µA, $T_j$ = 25°C) | 4.5 | 5.5 | 6.5 | |
| $V_{CE(ON)}$ | Collector-Emitter On Voltage ($V_{GE}$ = 15V, $I_C$ = 8A, $T_j$ = 25°C) | | 2.5 | 3.0 | |
| | Collector-Emitter On Voltage ($V_{GE}$ = 15V, $I_C$ = 8A, $T_j$ = 125°C) | | 3.1 | | |
| $I_{CES}$ | Collector Cut-off Current ($V_{CE}$ = 1200V, $V_{GE}$ = 0V, $T_j$ = 25°C) ② | | | 400 | µA |
| | Collector Cut-off Current ($V_{CE}$ = 1200V, $V_{GE}$ = 0V, $T_j$ = 125°C) ② | | | 2000 | |
| $I_{GES}$ | Gate-Emitter Leakage Current ($V_{GE}$ = ±20V) | | | ±100 | nA |

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

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

052-6213 Rev C 1-2006

## DYNAMIC CHARACTERISTICS

**APT11GF120KR(G)**

| Symbol | Characteristic | Test Conditions | MIN | TYP | MAX | UNIT |
|---|---|---|---|---|---|---|
| $C_{ies}$ | Input Capacitance | **Capacitance** | | 620 | | pF |
| $C_{oes}$ | Output Capacitance | $V_{GE}$ = 0V, $V_{CE}$ = 25V | | 90 | | |
| $C_{res}$ | Reverse Transfer Capacitance | f = 1 MHz | | 40 | | |
| $V_{GEP}$ | Gate-to-Emitter Plateau Voltage | Gate Charge | | 10.0 | | V |
| $Q_g$ | Total Gate Charge ③ | $V_{GE}$ = 15V | | 65 | | nC |
| $Q_{ge}$ | Gate-Emitter Charge | $V_{CE}$ = 600V | | 10 | | |
| $Q_{gc}$ | Gate-Collector ("Miller") Charge | $I_C$ = 8A | | 35 | | |
| SSOA | Switching Safe Operating Area | $T_J$ = 150°C, $R_G$ = 10Ω, $V_{GE}$ = 15V, L = 100µH, $V_{CE}$ = 1200V | 44 | | | A |
| $t_{d(on)}$ | Turn-on Delay Time | **Inductive Switching (25°C)** | | 7 | | ns |
| $t_r$ | Current Rise Time | $V_{CC}$ = 800V | | 5 | | |
| $t_{d(off)}$ | Turn-off Delay Time | $V_{GE}$ = 15V | | 100 | | |
| $t_f$ | Current Fall Time | $I_C$ = 8A | | 55 | | |
| $E_{on1}$ | Turn-on Switching Energy ④ | $R_G$ = 10Ω | | 300 | | µJ |
| $E_{on2}$ | Turn-on Switching Energy (Diode) ⑤ | $T_J$ = +25°C | | 485 | | |
| $E_{off}$ | Turn-off Switching Energy ⑥ | | | 285 | | |
| $t_{d(on)}$ | Turn-on Delay Time | **Inductive Switching (125°C)** | | 7 | | ns |
| $t_r$ | Current Rise Time | $V_{CC}$ = 800V | | 5 | | |
| $t_{d(off)}$ | Turn-off Delay Time | $V_{GE}$ = 15V | | 115 | | |
| $t_f$ | Current Fall Time | $I_C$ = 8A | | 46 | | |
| $E_{on1}$ | Turn-on Switching Energy ④ | $R_G$ = 10Ω | | 295 | | µJ |
| $E_{on2}$ | Turn-on Switching Energy (Diode) ⑤ | $T_J$ = +125°C | | 915 | | |
| $E_{off}$ | Turn-off Switching Energy ⑥ | | | 325 | | |

## THERMAL AND MECHANICAL CHARACTERISTICS

| Symbol | Characteristic | MIN | TYP | MAX | UNIT |
|---|---|---|---|---|---|
| $R_{\theta JC}$ | Junction to Case **(IGBT)** | | | .80 | °C/W |
| $R_{\theta JC}$ | Junction to Case **(DIODE)** | | | N/A | |
| $W_T$ | Package Weight | 5.9 | | | gm |

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

② For Combi devices, $I_{ces}$ includes both IGBT and FRED leakages

③ See MIL-STD-750 Method 3471.

④ $E_{on1}$ is the clamped inductive turn-on energy of the IGBT only, without the effect of a commutating diode reverse recovery current adding to the IGBT turn-on loss. Tested in inductive switching test circuit shown in figure 21, but with a Silicon Carbide diode.

⑤ $E_{on2}$ is the clamped inductive turn-on energy that includes a commutating diode reverse recovery current in the IGBT turn-on switching loss. (See Figures 21, 22.)

⑥ $E_{off}$ is the clamped inductive turn-off energy measured in accordance with JEDEC standard JESD24-1. (See Figures 21, 23.)

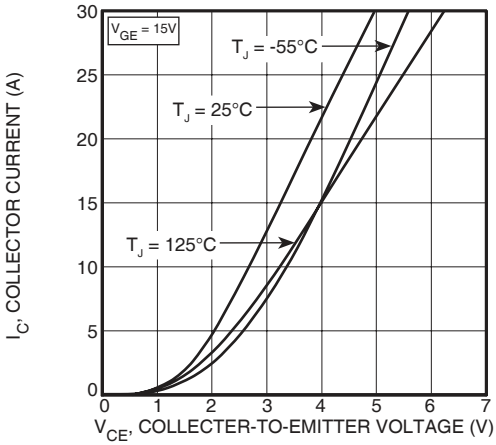



**FIGURE 1, Output Characteristics($T_J$ = 25°C)**

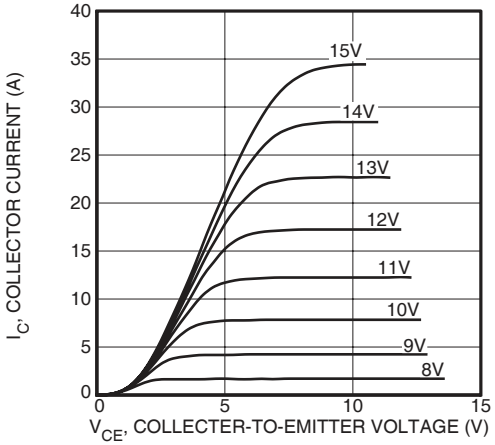



**FIGURE 2, Output Characteristics ($T_J$ = 125°C)**

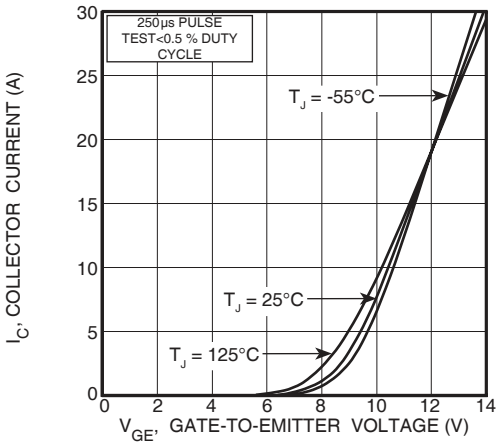



**FIGURE 3, Transfer Characteristics**

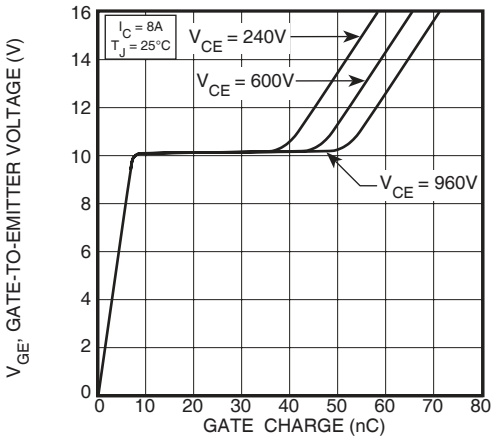



**FIGURE 4, Gate Charge**

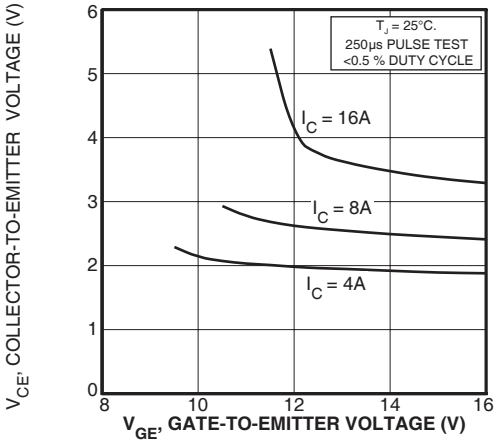



**FIGURE 5, On State Voltage vs Gate-to- Emitter Voltage**

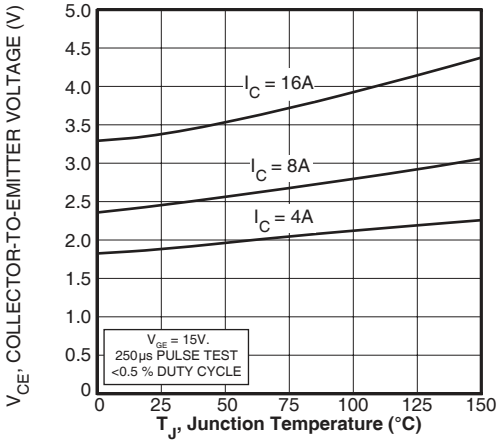



**FIGURE 6, On State Voltage vs Junction Temperature**

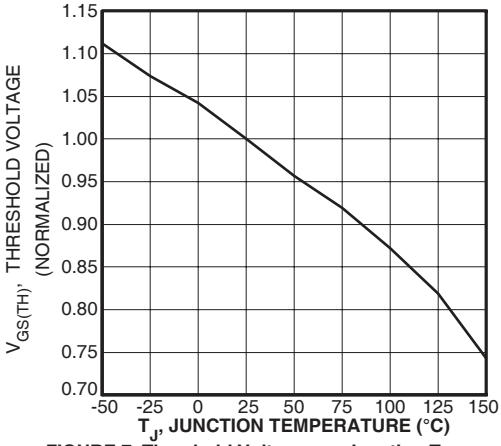



**FIGURE 7, Threshold Voltage vs. Junction Temperature**

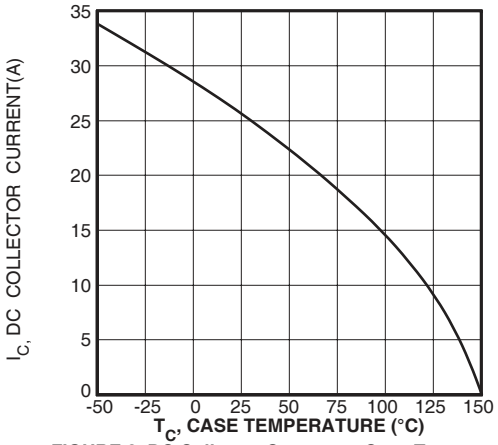



**FIGURE 8, DC Collector Current vs Case Temperature**

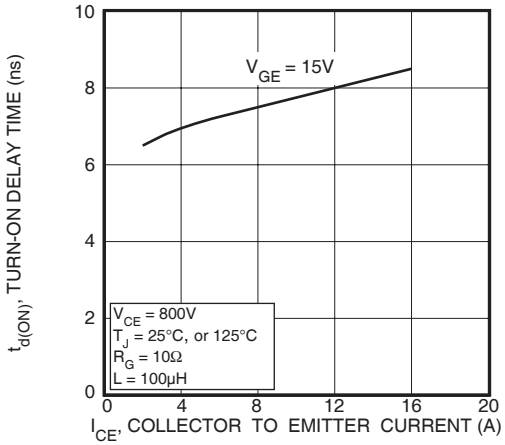



**FIGURE 9, Turn-On Delay Time vs Collector Current**

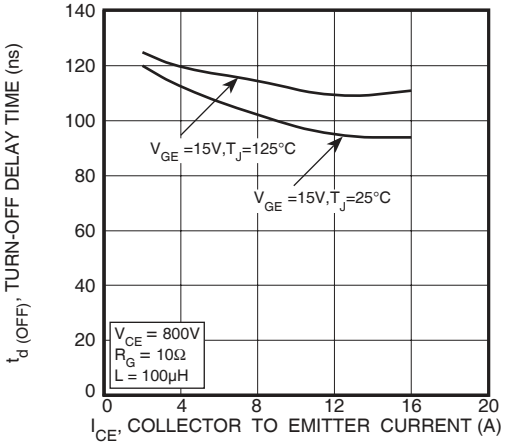



**FIGURE 10, Turn-Off Delay Time vs Collector Current**

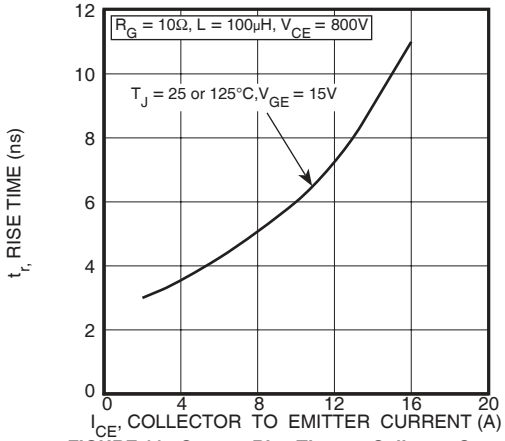



**FIGURE 11, Current Rise Time vs Collector Current**

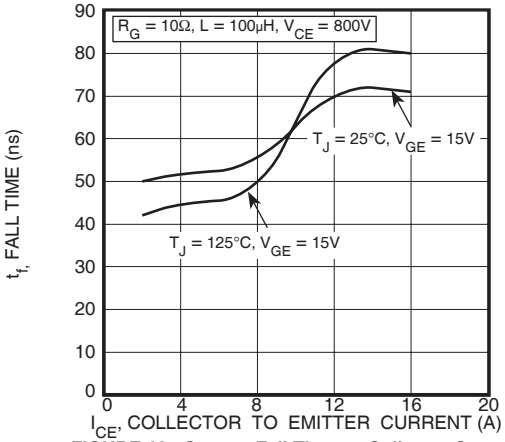



**FIGURE 12, Current Fall Time vs Collector Current**

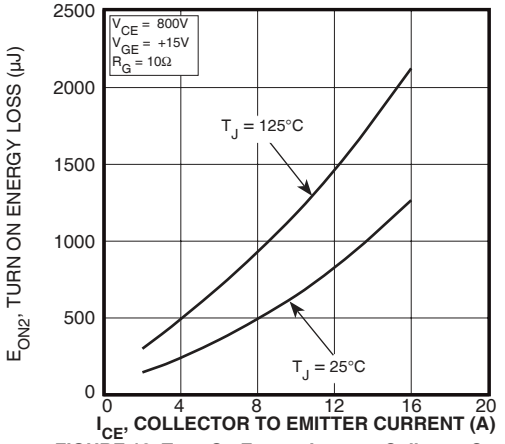



**FIGURE 13, Turn-On Energy Loss vs Collector Current**

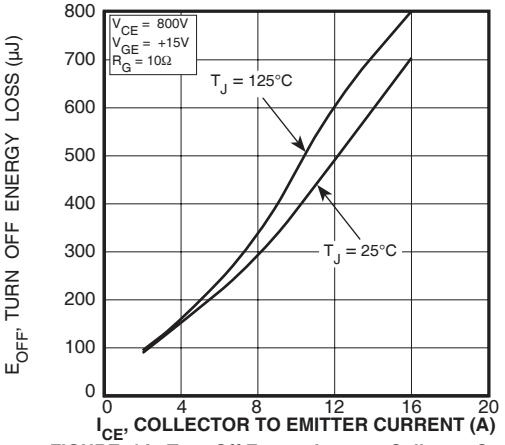



**FIGURE 14, Turn Off Energy Loss vs Collector Current**

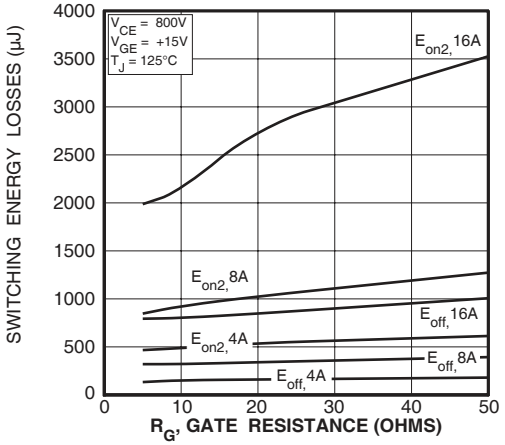



**FIGURE 15, Switching Energy Losses vs. Gate Resistance**

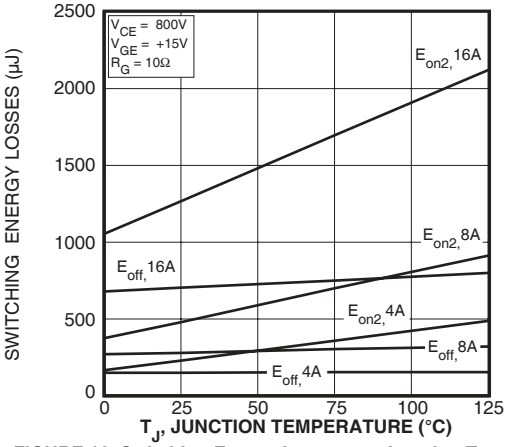



**FIGURE 16, Switching Energy Losses vs Junction Temperature**

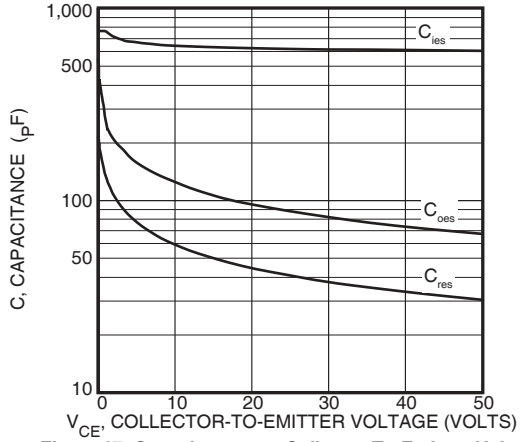



**Figure 17, Capacitance vs Collector-To-Emitter Voltage**

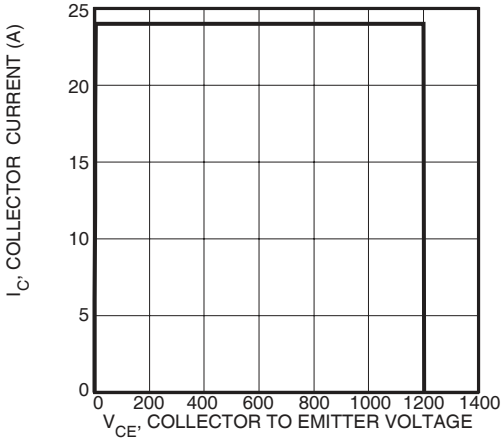



**Figure 18,Minimim Switching Safe Operating Area**

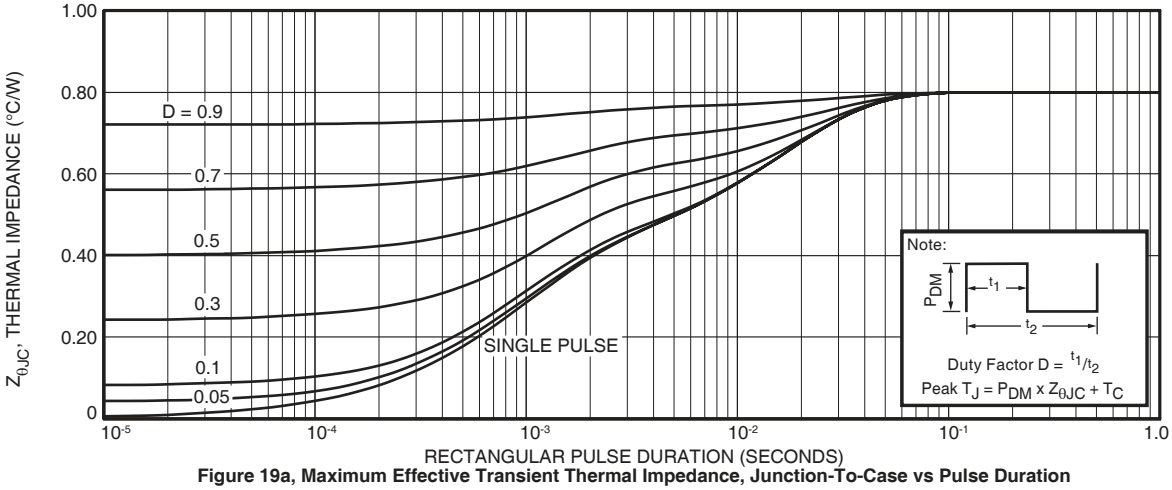



**Figure 19a, Maximum Effective Transient Thermal Impedance, Junction-To-Case vs Pulse Duration**

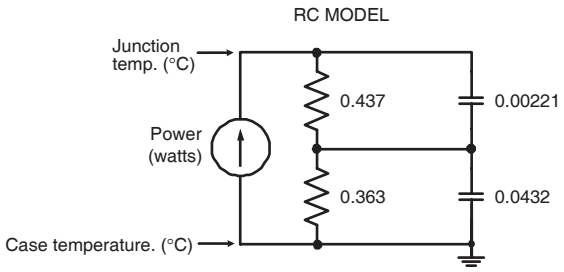



**FIGURE 19b, TRANSIENT THERMAL IMPEDANCE MODEL**

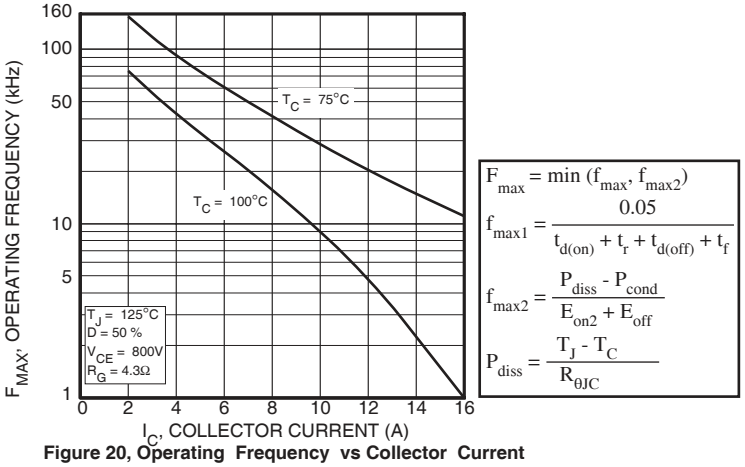



**Figure 20, Operating Frequency vs Collector Current**

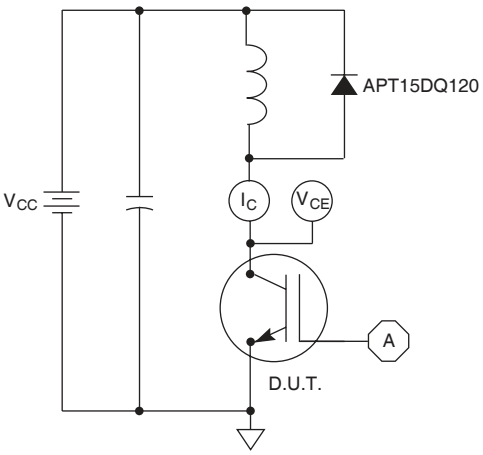



**Figure 21, Inductive Switching Test Circuit**

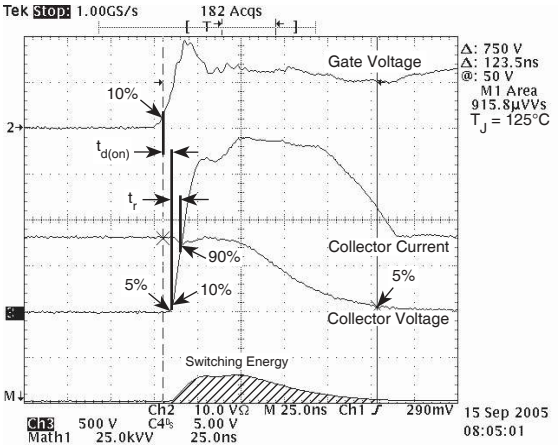



**Figure 22, Turn-on Switching Waveforms and Definitions**

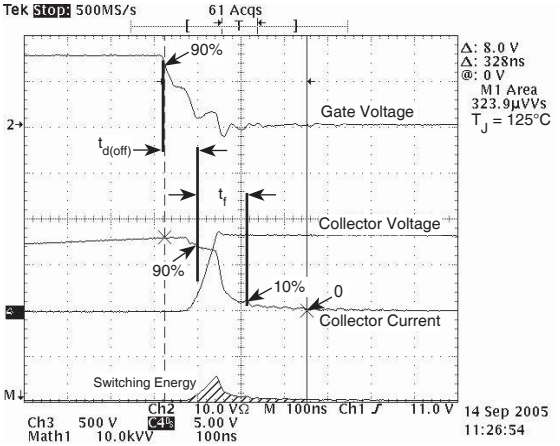
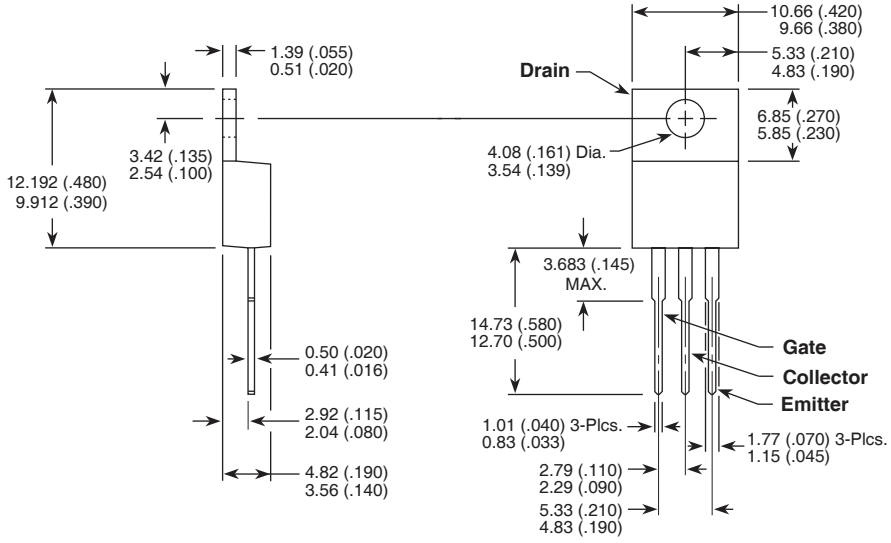



**Figure 23, Turn-off Switching Waveforms and Definitions**

## TO-220 (K) Package Outline

e3 100% Sn




Dimensions in Millimeters and (Inches)