

DYNAMIC CHARACTERISTICS

APT40GP60B_S

Symbol	Characteristic	Test Conditions	MIN	TYP	MAX	UNIT
C_{ies}	Input Capacitance	Capacitance $V_{GE} = 0V, V_{CE} = 25V$ $f = 1 \text{ MHz}$		4610		pF
C_{oes}	Output Capacitance			395		
C_{res}	Reverse Transfer Capacitance			25		
V_{GEP}	Gate-to-Emitter Plateau Voltage	Gate Charge $V_{GE} = 15V$ $V_{CE} = 300V$ $I_C = 40A$		7.5		V
Q_g	Total Gate Charge ^③			135		nC
Q_{ge}	Gate-Emitter Charge			30		
Q_{gc}	Gate-Collector ("Miller") Charge			40		
SSOA	Switching SOA	$T_J = 150^\circ C, R_G = 5\Omega, V_{GE} = 15V, L = 100\mu H, V_{CE} = 600V$	160			A
$t_{d(on)}$	Turn-on Delay Time	Inductive Switching (25°C) $V_{CC(peak)} = 400V$ $V_{GE} = 15V$ $I_C = 40A$ $R_G = 5\Omega$ $T_J = +25^\circ C$		20		ns
t_r	Current Rise Time			29		
$t_{d(off)}$	Turn-off Delay Time			64		
t_f	Current Fall Time			45		
E_{on1}	Turn-on Switching Energy ^④			385		μJ
E_{on2}	Turn-on Switching Energy (Diode) ^⑤			644		
E_{off}	Turn-off Switching Energy ^⑥			352	450	
$t_{d(on)}$	Turn-on Delay Time	Inductive Switching (125°C) $V_{CC(peak)} = 400V$ $V_{GE} = 15V$ $I_C = 40A$ $R_G = 5\Omega$ $T_J = +125^\circ C$		20		ns
t_r	Current Rise Time			29		
$t_{d(off)}$	Turn-off Delay Time			89		
t_f	Current Fall Time			69		
E_{on1}	Turn-on Switching Energy ^④			385		μJ
E_{on2}	Turn-on Switching Energy (Diode) ^⑤			972		
E_{off}	Turn-off Switching Energy ^⑥			615	950	

THERMAL AND MECHANICAL CHARACTERISTICS

Symbol	Characteristic	MIN	TYP	MAX	UNIT
$R_{\theta JC}$	Junction to Case (IGBT)			.23	$^\circ C/W$
$R_{\theta JC}$	Junction to Case (DIODE)			N/A	
W_T	Package Weight			5.90	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. (See Figure24.)
 - 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. A Combi device is used for the clamping diode as shown in the E_{on2} test circuit. (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.)
 - ⑦ Continuous current limited by package lead temperature.
- APT Reserves the right to change, without notice, the specifications and information contained herein.**

TYPICAL PERFORMANCE CURVES

APT40GP60B_S

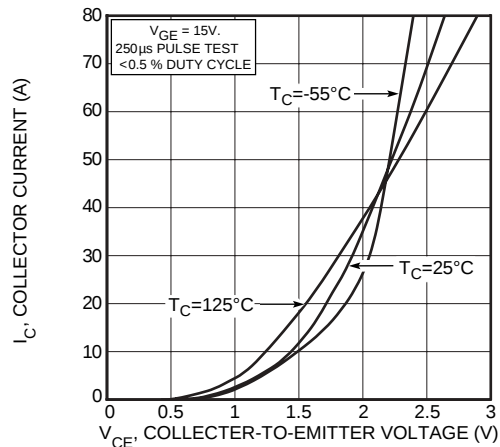


FIGURE 1, Output Characteristics ($V_{GE} = 15V$)

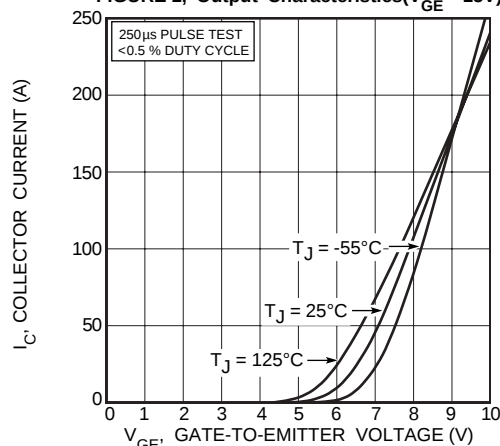


FIGURE 3, Transfer Characteristics

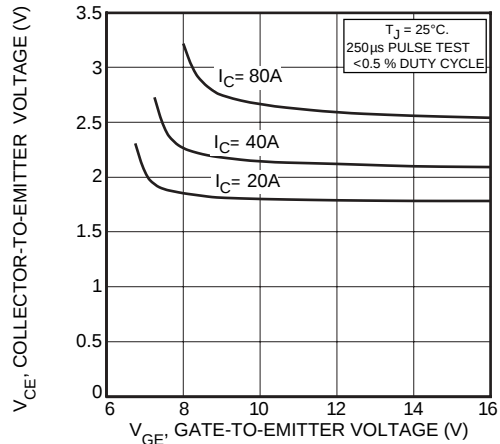


FIGURE 5, On State Voltage vs Gate-to-Emitter Voltage

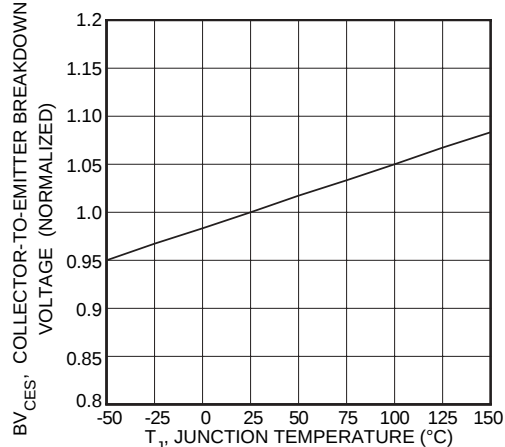


FIGURE 7, Breakdown Voltage vs. Junction Temperature

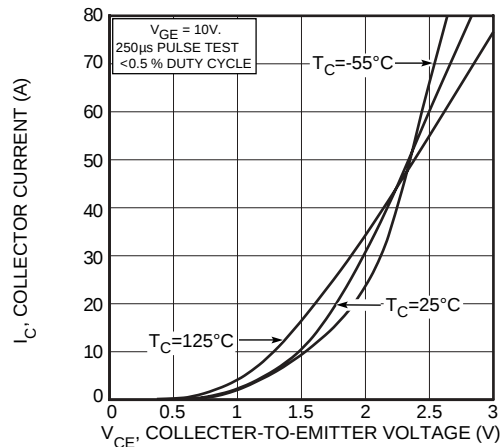


FIGURE 2, Output Characteristics ($V_{GE} = 10V$)

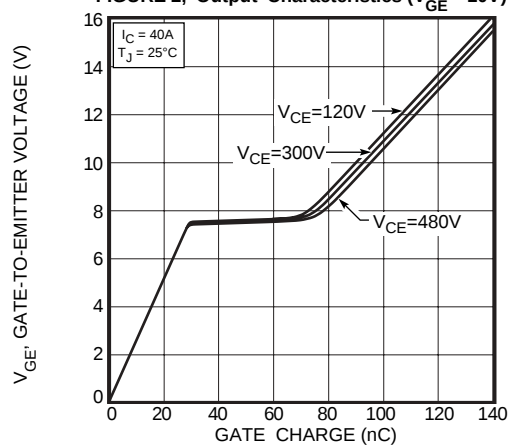


FIGURE 4, Gate Charge

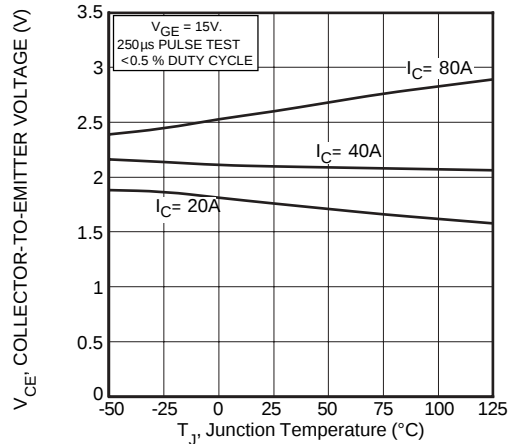


FIGURE 6, On State Voltage vs Junction Temperature

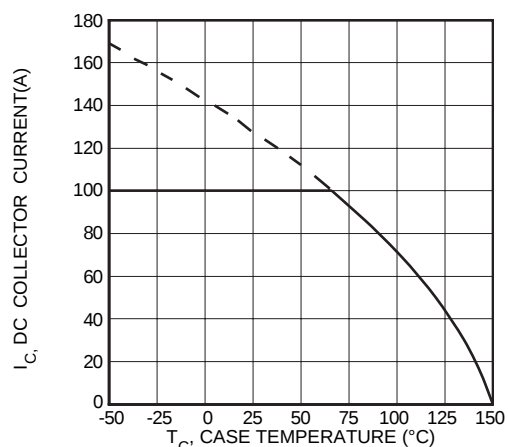


FIGURE 8, DC Collector Current vs Case Temperature

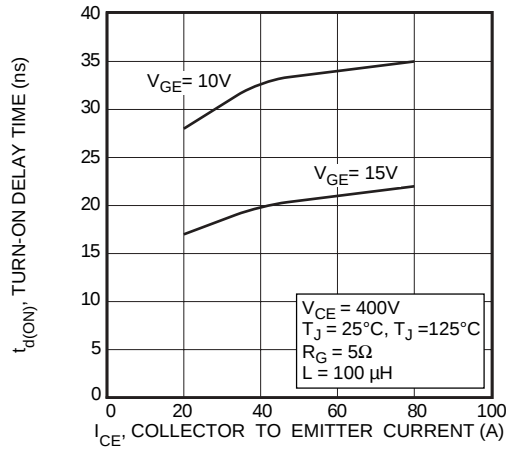


FIGURE 9, Turn-On Delay Time vs Collector Current

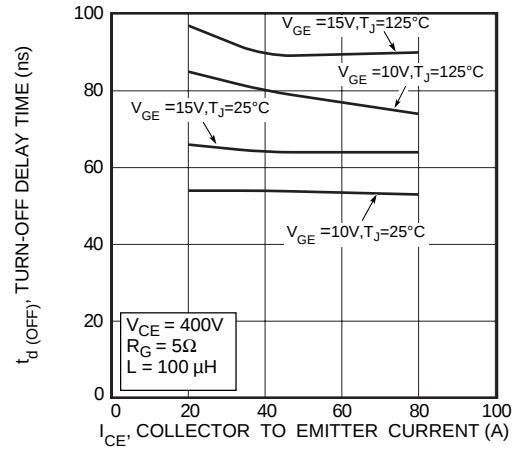


FIGURE 10, Turn-Off Delay Time vs Collector Current

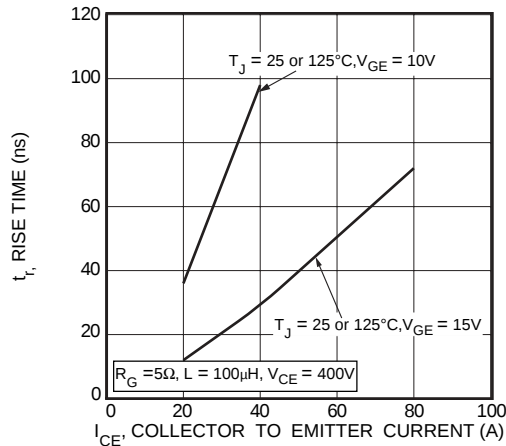


FIGURE 11, Current Rise Time vs Collector Current

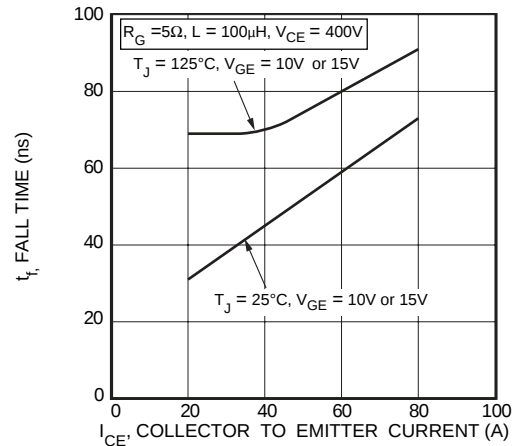


FIGURE 12, Current Fall Time vs Collector Current

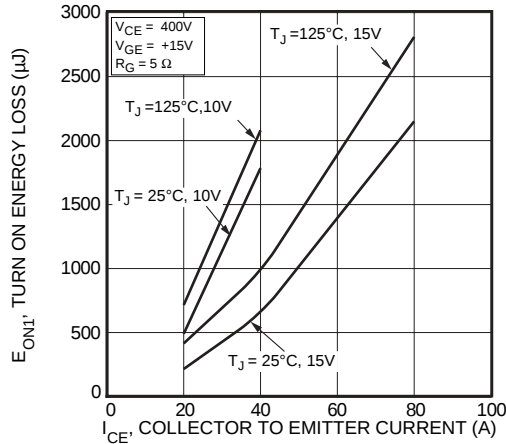


FIGURE 13, Turn-On Energy Loss vs Collector Current

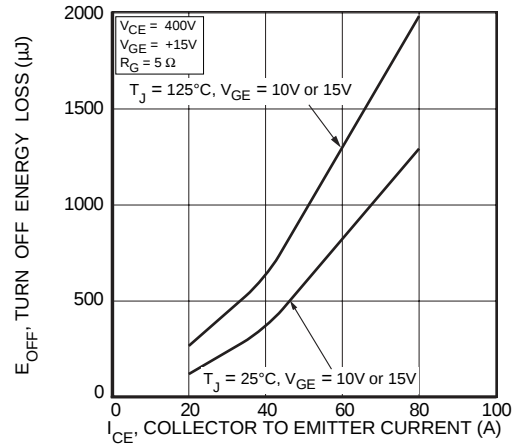


FIGURE 14, Turn Off Energy Loss vs Collector Current

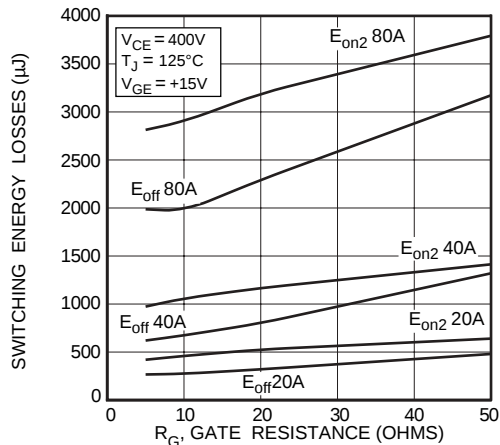


FIGURE 15, Switching Energy Losses vs. Gate Resistance

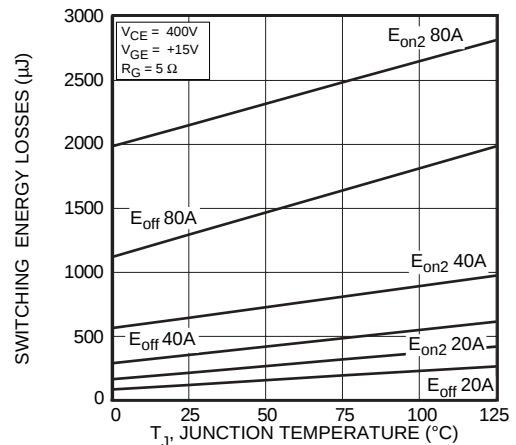


FIGURE 16, Switching Energy Losses vs Junction Temperature

TYPICAL PERFORMANCE CURVES

APT40GP60B_S

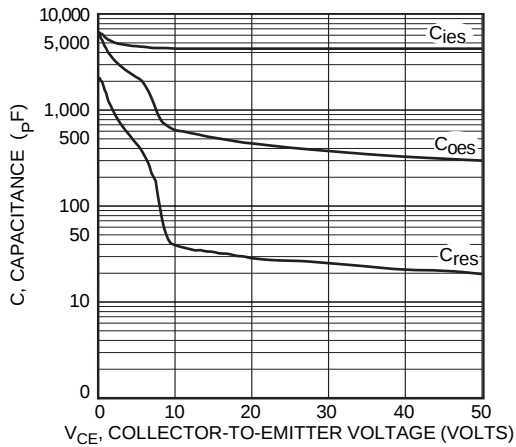


Figure 17, Capacitance vs Collector-To-Emitter Voltage

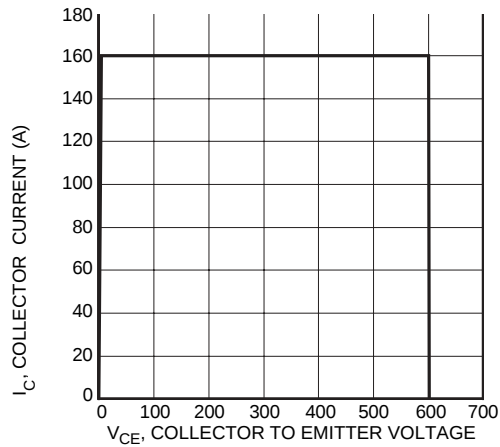


Figure 18, Minimum Switching Safe Operating Area

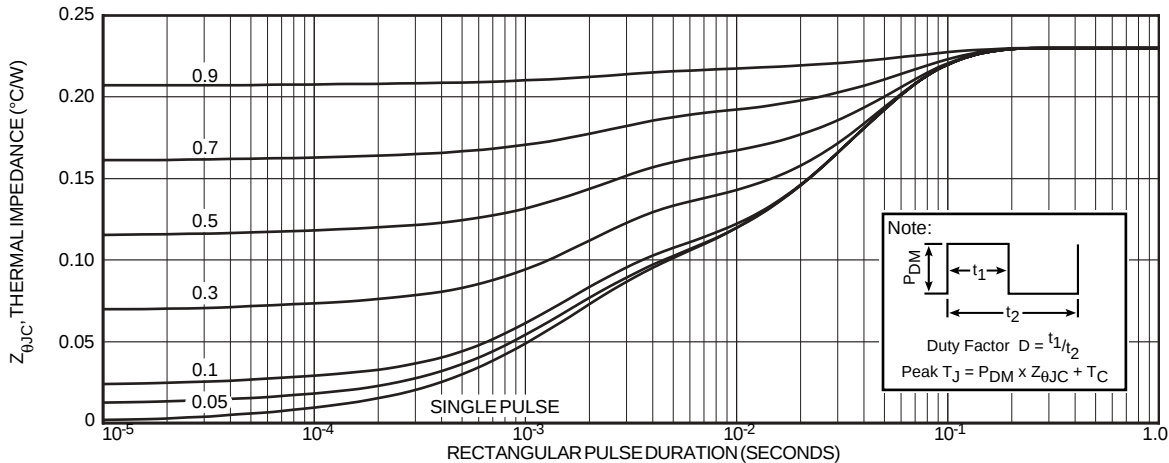


FIGURE 1, MAXIMUM EFFECTIVE TRANSIENT THERMAL IMPEDANCE, JUNCTION-TO-CASE vs PULSE DURATION

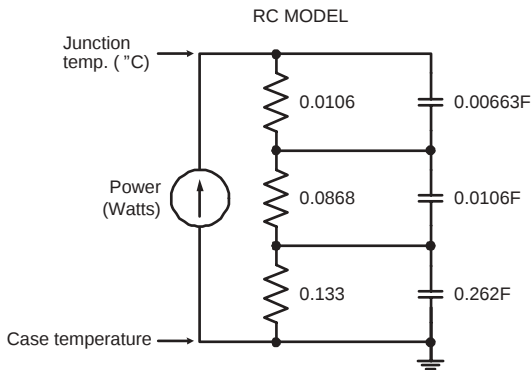


FIGURE 19B, TRANSIENT THERMAL IMPEDANCE MODEL

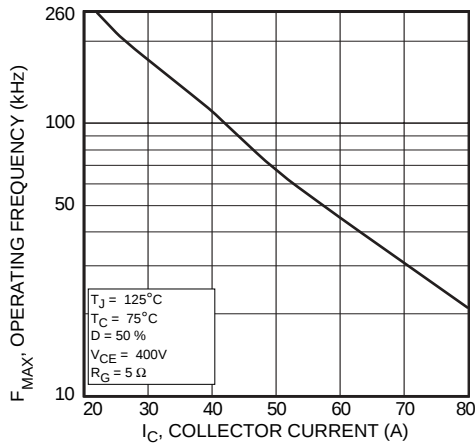


Figure 20, Operating Frequency vs Collector Current

$$F_{\max} = \min(f_{\max 1}, f_{\max 2})$$

$$f_{\max 1} = \frac{0.05}{t_{d(on)} + t_r + t_{d(off)} + t_f}$$

$$f_{\max 2} = \frac{P_{diss} - P_{cond}}{E_{on2} + E_{off}}$$

$$P_{diss} = \frac{T_J - T_C}{R_{\theta JC}}$$

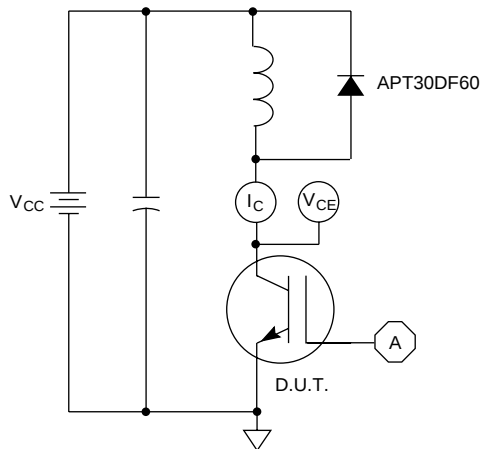


Figure 21, Inductive Switching Test Circuit

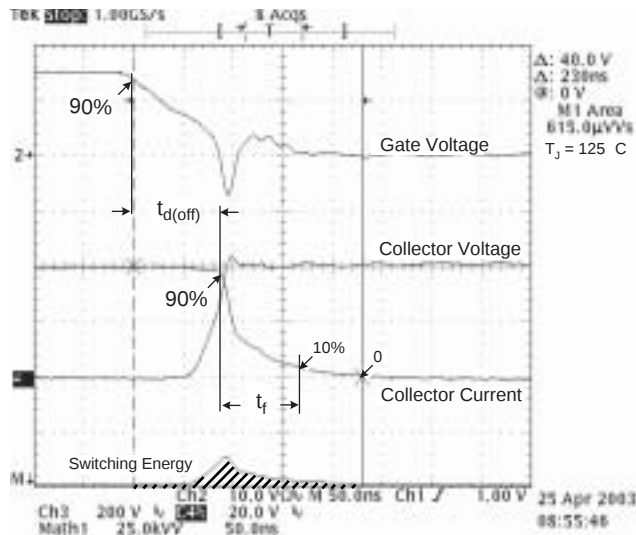


Figure 23, Turn-off Switching Waveforms and Definitions

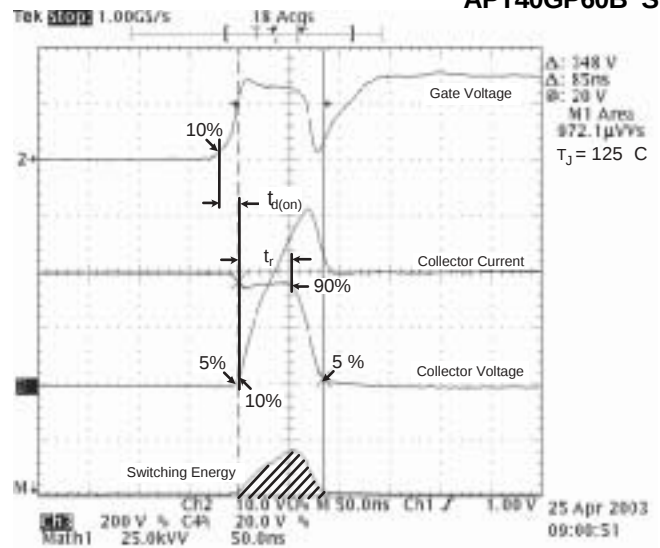
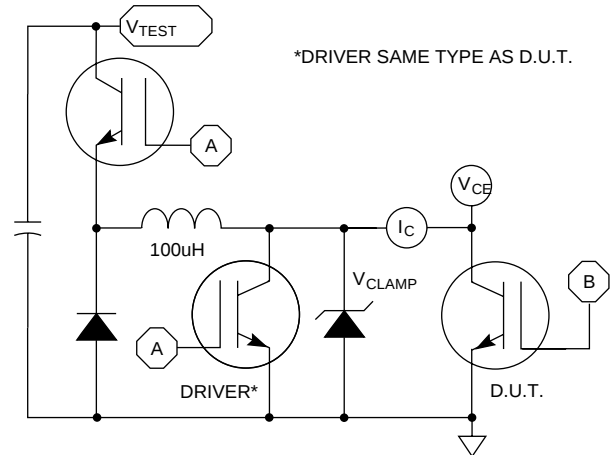
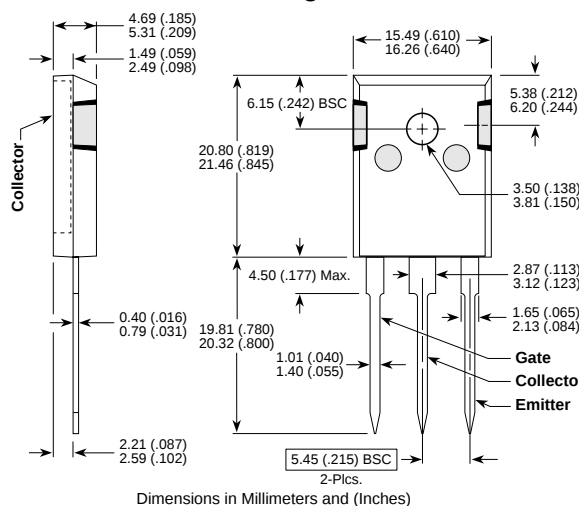


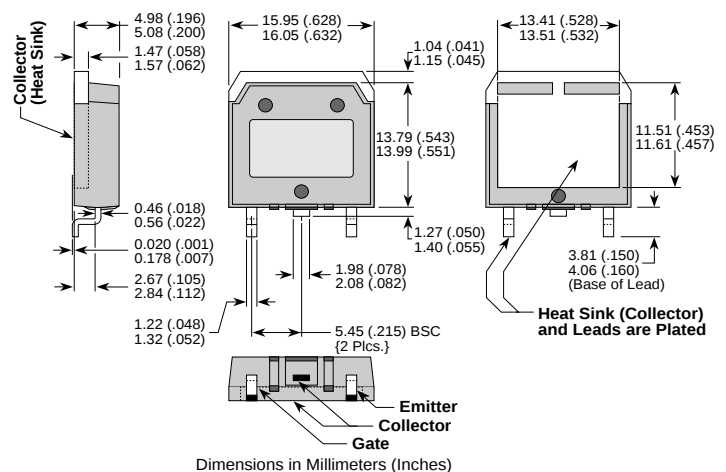
Figure 22, Turn-on Switching Waveforms and Definitions

Figure 24, E_{ON1} Test Circuit

TO-247 Package Outline



Dimensions in Millimeters and (Inches)

D³PAK Package Outline

Dimensions in Millimeters (Inches)

APT's products are covered by one or more of U.S. patents 4,895,810 5,045,903 5,089,434 5,182,234 5,019,522

5,262,336 6,503,786 5,256,583 4,748,103 5,283,202 5,231,474 5,434,095 5,528,058 and foreign patents. US and Foreign patents pending. All Rights Reserved.