



## DYNAMIC CHARACTERISTICS

APT13GP120B\_S(G)

Symbol	Characteristic	Test Conditions	MIN	TYP	MAX	UNIT	
$C_{ies}$	Input Capacitance	<b>Capacitance</b> $V_{GE} = 0V, V_{CE} = 25V$ $f = 1 \text{ MHz}$		1145		pF	
$C_{oes}$	Output Capacitance			90			
$C_{res}$	Reverse Transfer Capacitance			15			
$V_{GEP}$	Gate-to-Emitter Plateau Voltage	Gate Charge		7.5		V	
$Q_g$	Total Gate Charge <sup>(3)</sup>	$V_{GE} = 15V$		55		nC	
$Q_{ge}$	Gate-Emitter Charge	$V_{CE} = 600V$		8			
$Q_{gc}$	Gate-Collector ("Miller") Charge	$I_C = 13A$		26			
RBSOA	Reverse Bias Safe Operating Area	$T_J = 150^\circ\text{C}, R_G = 5\Omega, V_{GE} = 15V, L = 100\mu\text{H}, V_{CE} = 960V$	50			A	
$t_{d(on)}$	Turn-on Delay Time	<b>Inductive Switching (25°C)</b> $V_{CC} = 600V$ $V_{GE} = 15V$ $I_C = 13A$ $R_G = 5\Omega$ $T_J = +25^\circ\text{C}$		9		ns	
$t_r$	Current Rise Time			12			
$t_{d(off)}$	Turn-off Delay Time			28			
$t_f$	Current Fall Time			34			
$E_{on1}$	Turn-on Switching Energy <sup>(4)</sup>				115		μJ
$E_{on2}$	Turn-on Switching Energy (Diode) <sup>(5)</sup>			330			
$E_{off}$	Turn-off Switching Energy <sup>(6)</sup>			165			
$t_{d(on)}$	Turn-on Delay Time	<b>Inductive Switching (125°C)</b> $V_{CC} = 600V$ $V_{GE} = 15V$ $I_C = 13A$ $R_G = 5\Omega$ $T_J = +125^\circ\text{C}$		9		ns	
$t_r$	Current Rise Time			12			
$t_{d(off)}$	Turn-off Delay Time			70			
$t_f$	Current Fall Time			200			
$E_{on1}$	Turn-on Switching Energy <sup>(4)</sup>				225		μJ
$E_{on2}$	Turn-on Switching Energy (Diode) <sup>(5)</sup>				710		
$E_{off}$	Turn-off Switching Energy <sup>(6)</sup>			840			

## THERMAL AND MECHANICAL CHARACTERISTICS

Symbol	Characteristic	MIN	TYP	MAX	UNIT
$R_{\theta JC}$	Junction to Case (IGBT)			.50	°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,  $I_{oes}$  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.

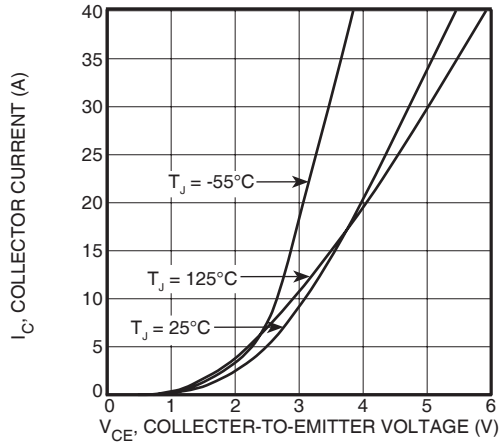
⑤  $E_{on2}$  is the clamped inductive turn-on energy that includes a commutating diode reverse recovery current in the IGBT turn-on switching loss. (See Figures 21, 22.)

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

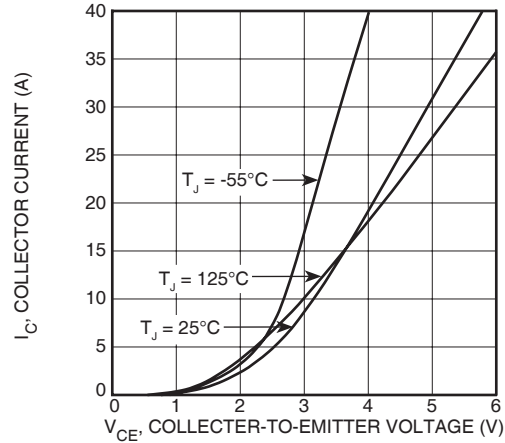
APT Reserves the right to change, without notice, the specifications and information contained herein.

**TYPICAL PERFORMANCE CURVES**

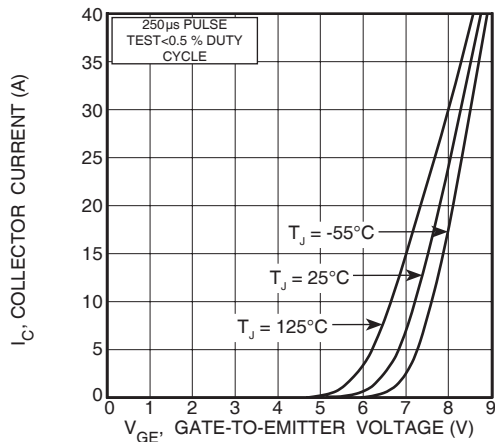
**APT13GP120B\_S(G)**



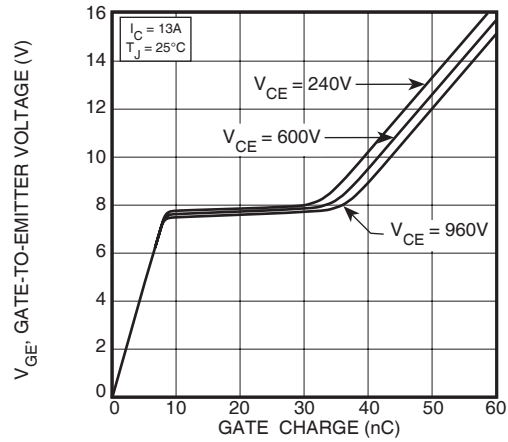
**FIGURE 1, Output Characteristics( $T_J = 25^\circ\text{C}$ )**



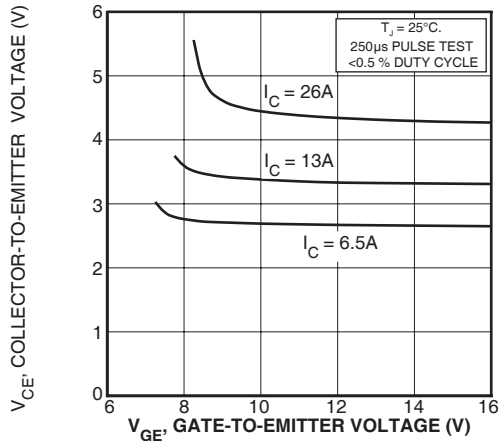
**FIGURE 2, Output Characteristics ( $T_J = 125^\circ\text{C}$ )**



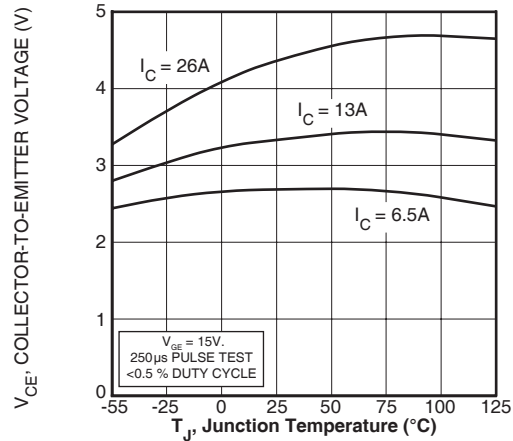
**FIGURE 3, Transfer Characteristics**



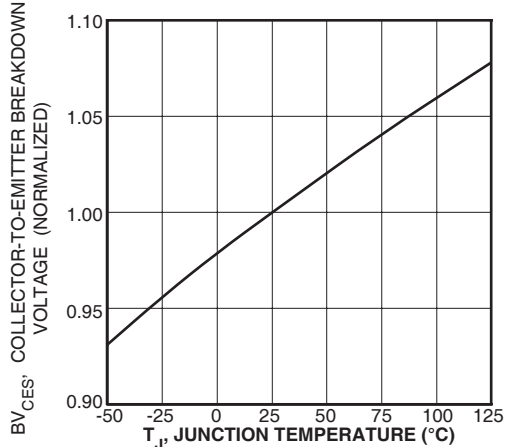
**FIGURE 4, Gate Charge**



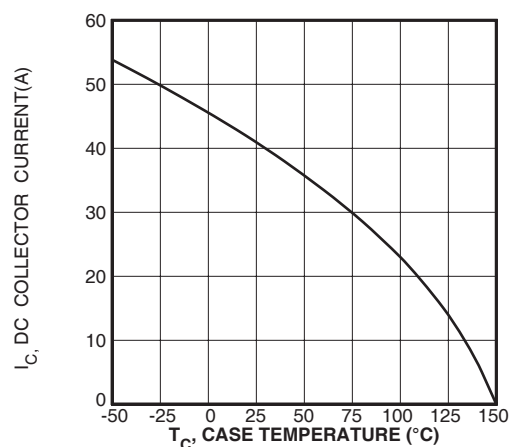
**FIGURE 5, On State Voltage vs Gate-to-Emitter Voltage**



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



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



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

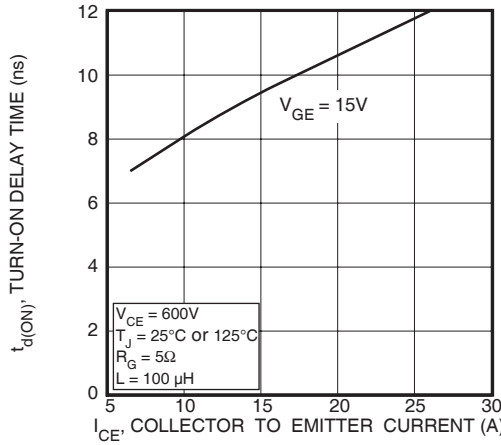


FIGURE 9, Turn-On Delay Time vs Collector Current

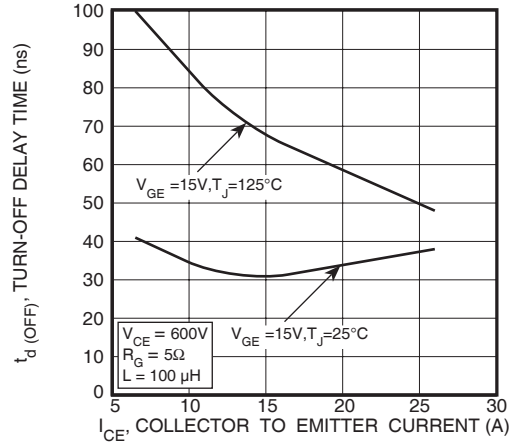


FIGURE 10, Turn-Off Delay Time vs Collector Current

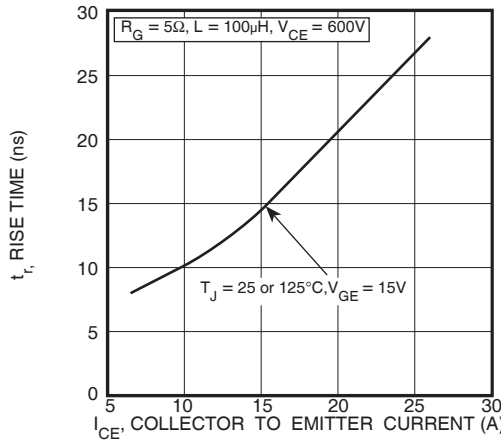


FIGURE 11, Current Rise Time vs Collector Current

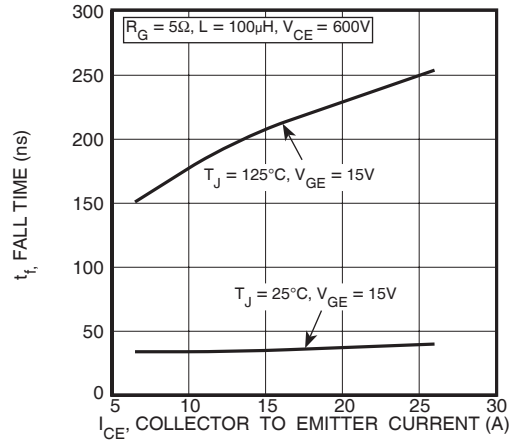


FIGURE 12, Current Fall Time vs Collector Current

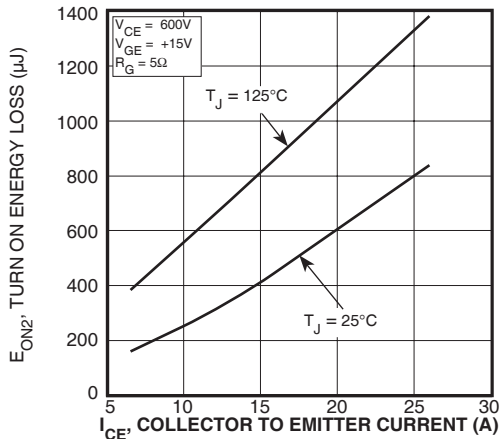


FIGURE 13, Turn-On Energy Loss vs Collector Current

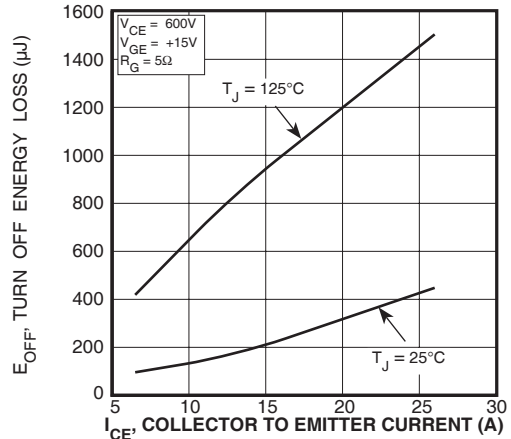


FIGURE 14, Turn Off Energy Loss vs Collector Current

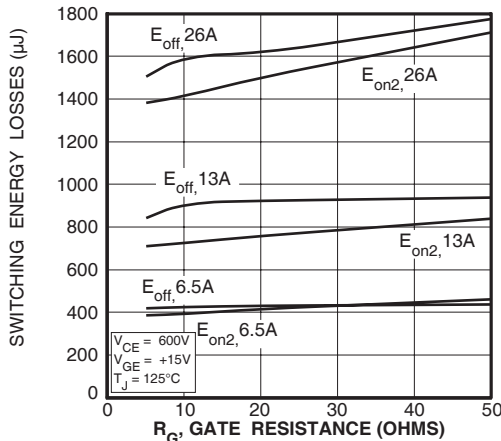


FIGURE 15, Switching Energy Losses vs. Gate Resistance

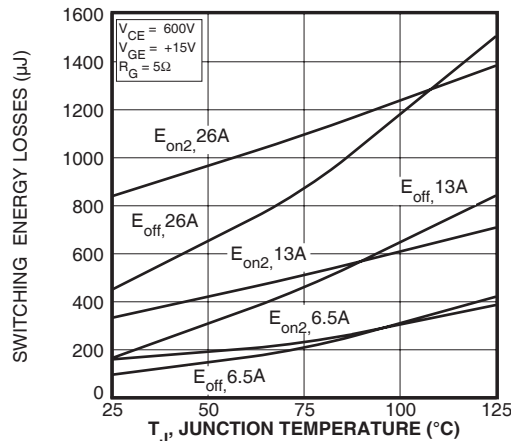


FIGURE 16, Switching Energy Losses vs Junction Temperature

**TYPICAL PERFORMANCE CURVES**

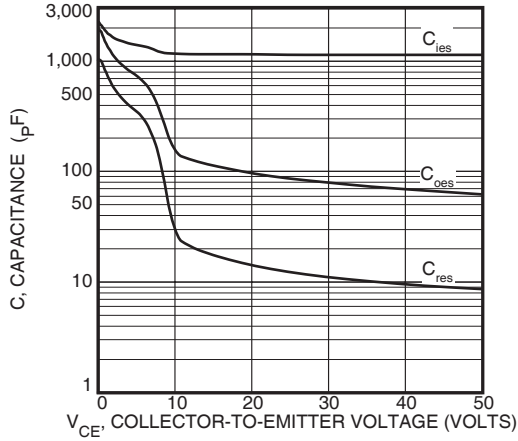


Figure 17, Capacitance vs Collector-To-Emitter Voltage

**APT13GP120B\_S(G)**

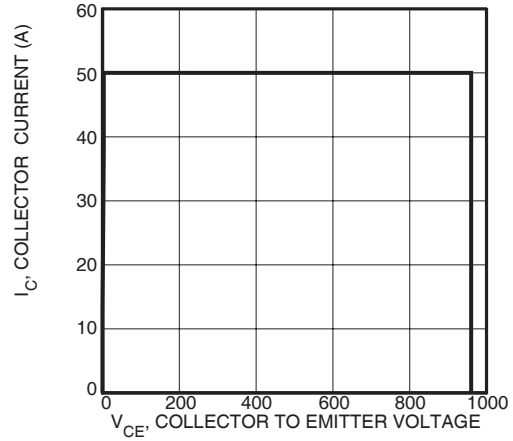


Figure 18, Minimum Switching Safe Operating Area

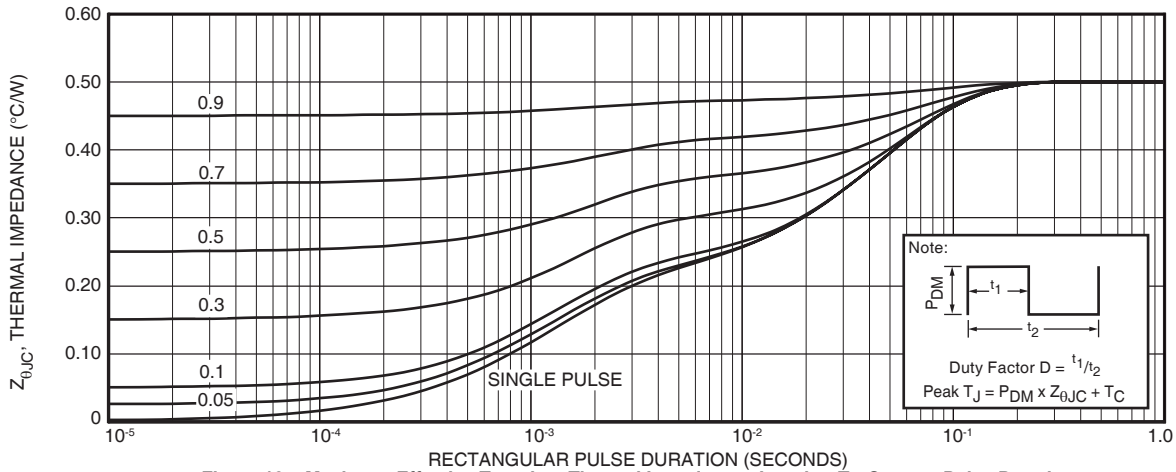


Figure 19a, Maximum Effective Transient Thermal Impedance, Junction-To-Case vs Pulse Duration

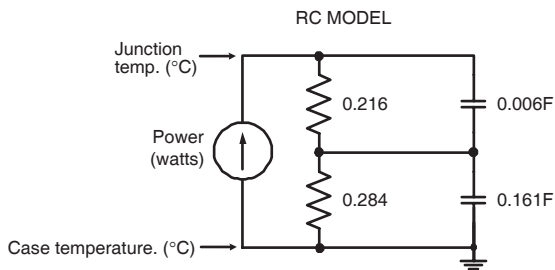


FIGURE 19b, TRANSIENT THERMAL IMPEDANCE MODEL

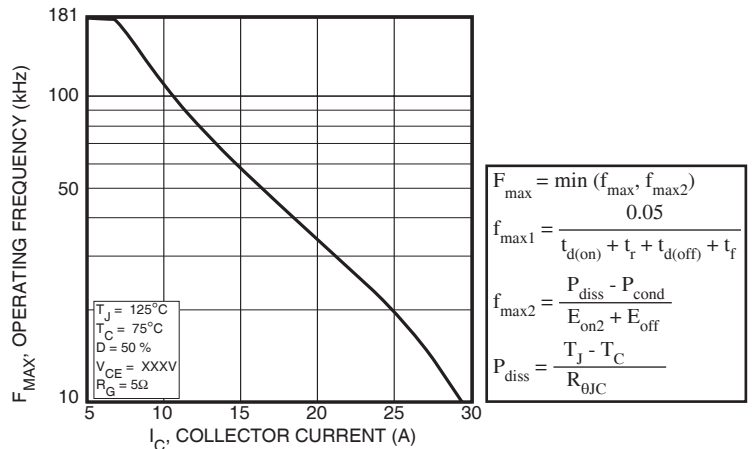


Figure 20, Operating Frequency vs Collector Current

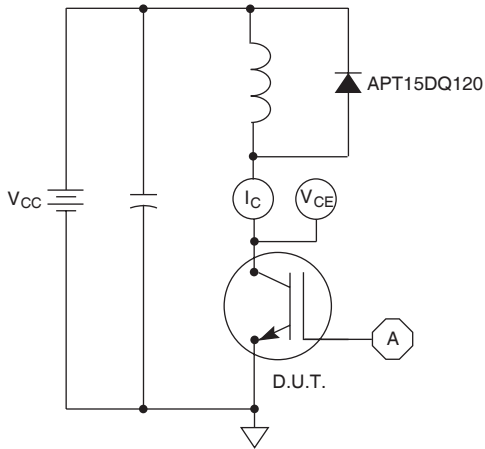


Figure 21, Inductive Switching Test Circuit

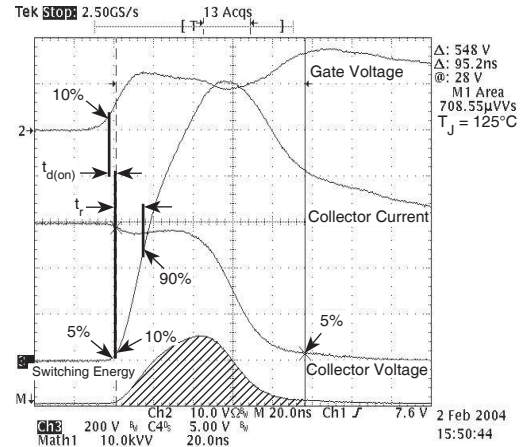


Figure 22, Turn-on Switching Waveforms and Definitions

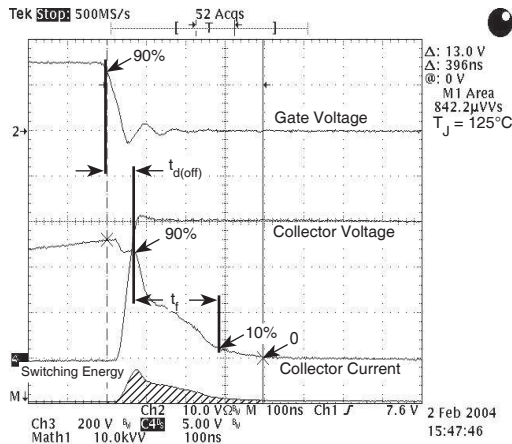
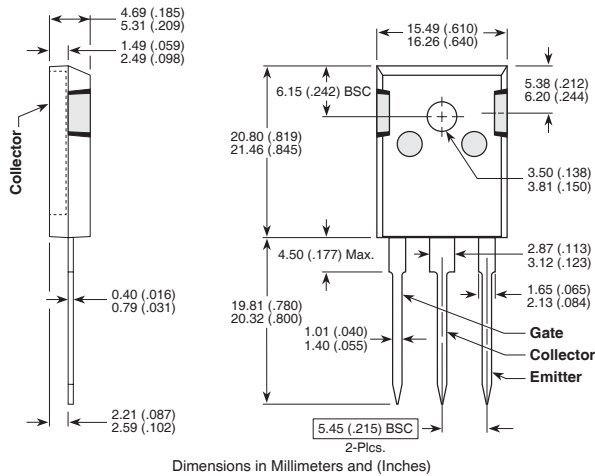


Figure 23, Turn-off Switching Waveforms and Definitions

**TO-247 Package Outline**

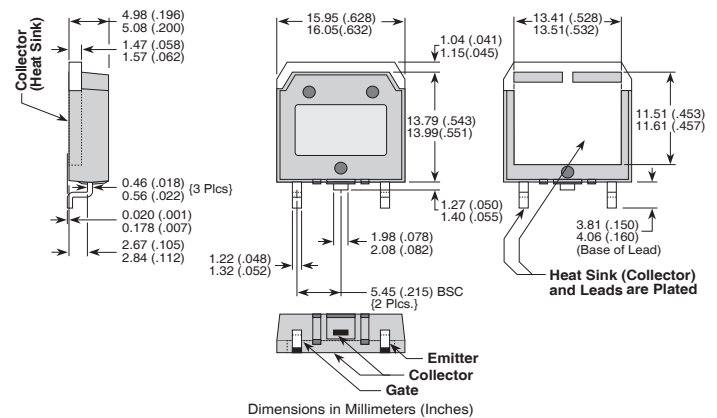
(e1) SAC: Tin, Silver, Copper



Dimensions in Millimeters and (Inches)

**TO-268 (D<sup>3</sup>) Package Outline**

(e3) SAC: Tin, Silver, Copper



Dimensions in Millimeters (Inches)

050-7412 Rev E 1-2006

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.