

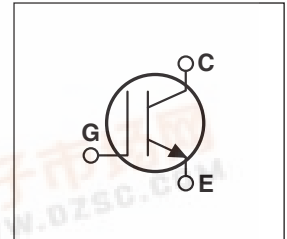
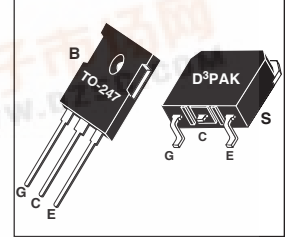


**1200V**  
**APT13GP120B**      **APT13GP120S**  
**APT13GP120BG\***   **APT13GP120SG\***  
 \*G Denotes RoHS Compliant, Pb Free Terminal Finish.

## POWER MOS 7<sup>®</sup> IGBT

The POWER MOS 7<sup>®</sup> IGBT is a new generation of high voltage power IGBTs. Using Punch Through Technology this IGBT is ideal for many high frequency, high voltage switching applications and has been optimized for high frequency switchmode power supplies.

- **Low Conduction Loss**                      • **100 kHz operation @ 600V, 10A**
- **Low Gate Charge**                         • **50 kHz operation @ 600V, 16A**
- **Ultrafast Tail Current shutoff**         • **RBSOA Rated**



### MAXIMUM RATINGS

All Ratings:  $T_C = 25^\circ\text{C}$  unless otherwise specified.

Symbol	Parameter	APT13GP120B_S(G)	UNIT
$V_{CES}$	Collector-Emitter Voltage	1200	Volts
$V_{GE}$	Gate-Emitter Voltage	$\pm 30$	
$I_{C1}$	Continuous Collector Current @ $T_C = 25^\circ\text{C}$	41	Amps
$I_{C2}$	Continuous Collector Current @ $T_C = 110^\circ\text{C}$	20	
$I_{CM}$	Pulsed Collector Current <sup>①</sup>	50	
RBSOA	Reverse Bias Safe Operating Area @ $T_j = 150^\circ\text{C}$	50A @ 960V	
$P_D$	Total Power Dissipation	250	Watts
$T_J, T_{STG}$	Operating and Storage Junction Temperature Range	-55 to 150	$^\circ\text{C}$
$T_L$	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 ( $V_{GE} = 0V, I_C = 500\mu\text{A}$ )	1200			Volts
$V_{GE(TH)}$	Gate Threshold Voltage ( $V_{CE} = V_{GE}, I_C = 1\text{mA}, T_j = 25^\circ\text{C}$ )	3	4.5	6	
$V_{CE(ON)}$	Collector-Emitter On Voltage ( $V_{GE} = 15V, I_C = 13A, T_j = 25^\circ\text{C}$ )		3.3	3.9	
	Collector-Emitter On Voltage ( $V_{GE} = 15V, I_C = 13A, T_j = 125^\circ\text{C}$ )		3.0		
$I_{CES}$	Collector Cut-off Current ( $V_{CE} = 1200V, V_{GE} = 0V, T_j = 25^\circ\text{C}$ ) <sup>②</sup>			500	$\mu\text{A}$
	Collector Cut-off Current ( $V_{CE} = 1200V, V_{GE} = 0V, T_j = 125^\circ\text{C}$ ) <sup>②</sup>			3000	
$I_{GES}$	Gate-Emitter Leakage Current ( $V_{GE} = \pm 20V$ )			$\pm 100$	nA

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

## 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 $V_{GE} = 15V$ $V_{CE} = 600V$ $I_C = 13A$		7.5		V	
$Q_g$	Total Gate Charge <sup>(3)</sup>			55		nC	
$Q_{ge}$	Gate-Emitter Charge			8			
$Q_{gc}$	Gate-Collector ("Miller") Charge			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 ( <b>IGBT</b> )			.50	°C/W
$R_{\theta JC}$	Junction to Case ( <b>DIODE</b> )			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.

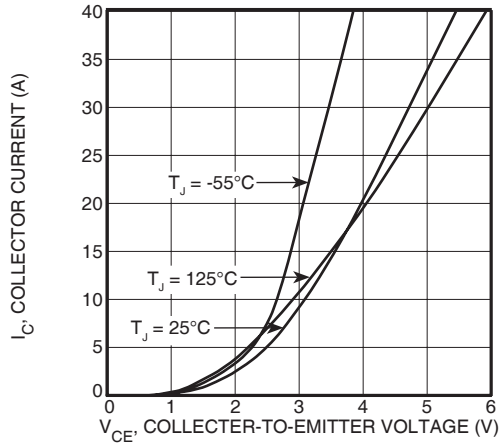
⑤  $E_{on2}$  is the clamped inductive turn-on energy that includes a commutating diode reverse recovery current in the IGBT turn-on switching loss. (See Figures 21, 22.)

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

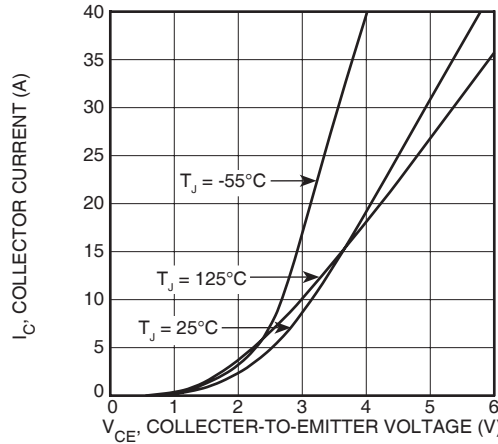
APT Reserves the right to change, without notice, the specifications and information contained herein.

**TYPICAL PERFORMANCE CURVES**

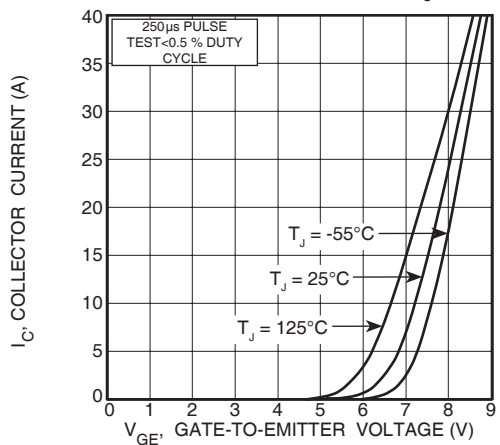
**APT13GP120B\_S(G)**



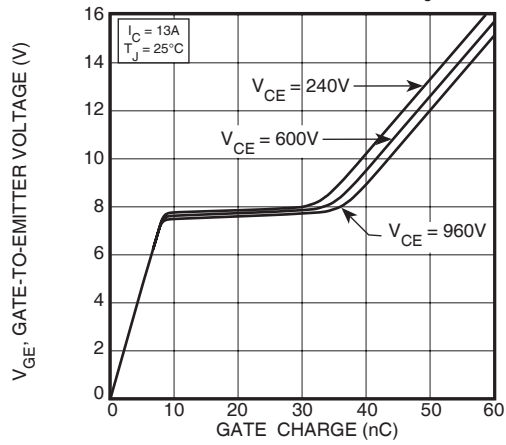
**FIGURE 1, Output Characteristics (T<sub>J</sub> = 25°C)**



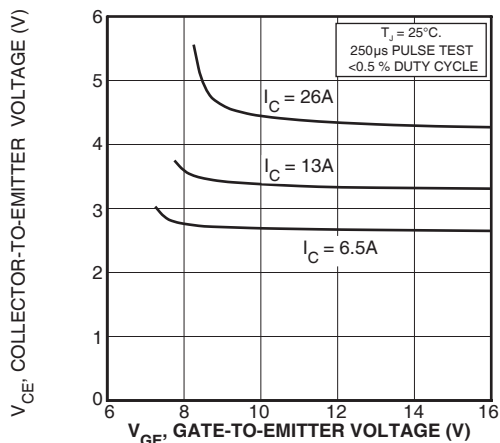
**FIGURE 2, Output Characteristics (T<sub>J</sub> = 125°C)**



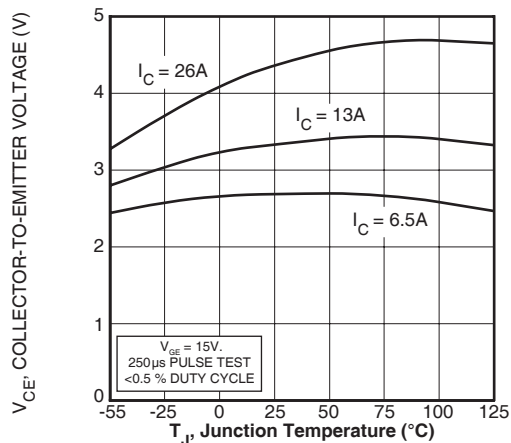
**FIGURE 3, Transfer Characteristics**



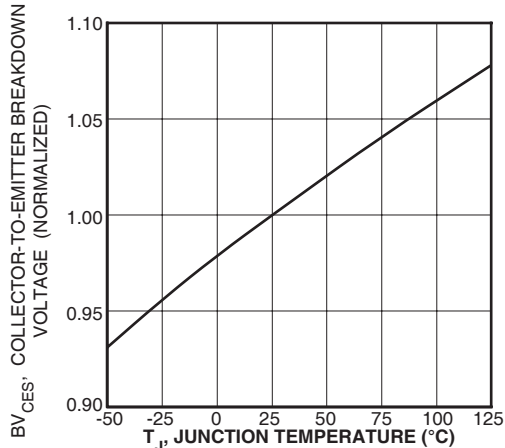
**FIGURE 4, Gate Charge**



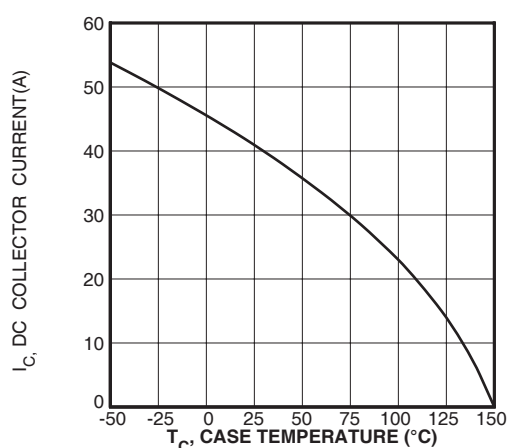
**FIGURE 5, On State Voltage vs Gate-to-Emitter Voltage**



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



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



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

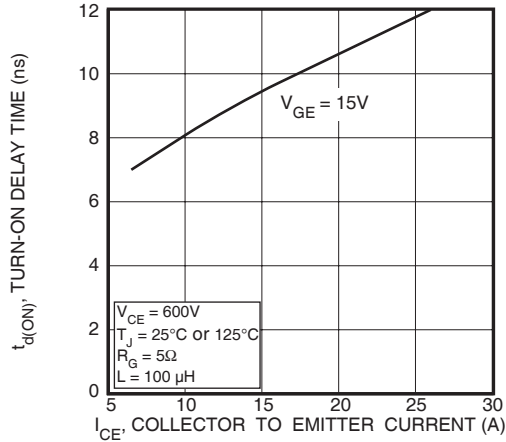


FIGURE 9, Turn-On Delay Time vs Collector Current

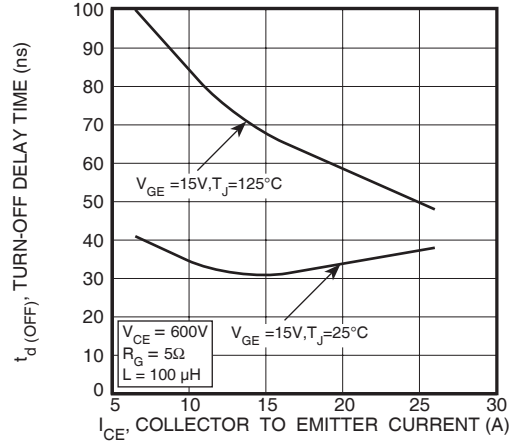


FIGURE 10, Turn-Off Delay Time vs Collector Current

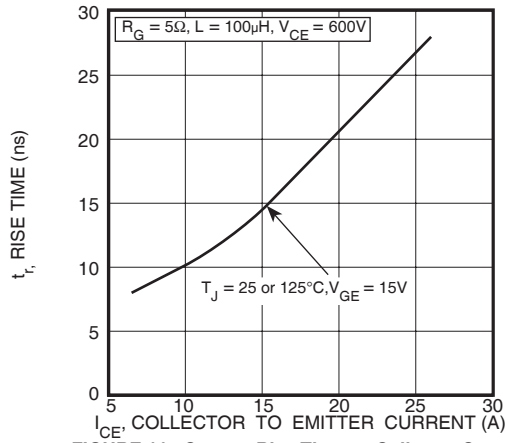


FIGURE 11, Current Rise Time vs Collector Current

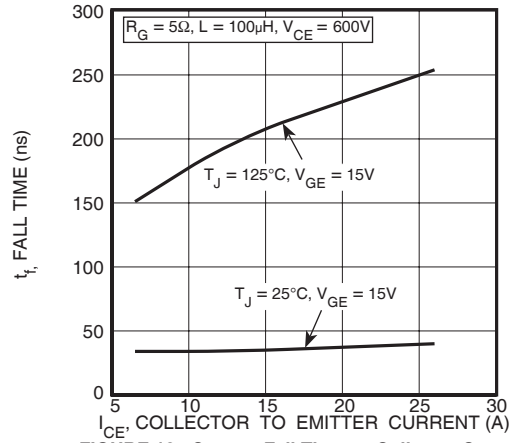


FIGURE 12, Current Fall Time vs Collector Current

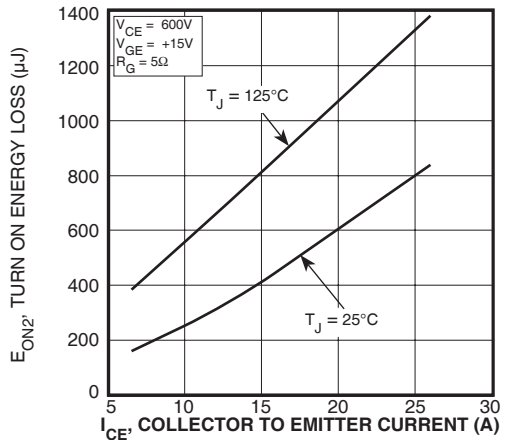


FIGURE 13, Turn-On Energy Loss vs Collector Current

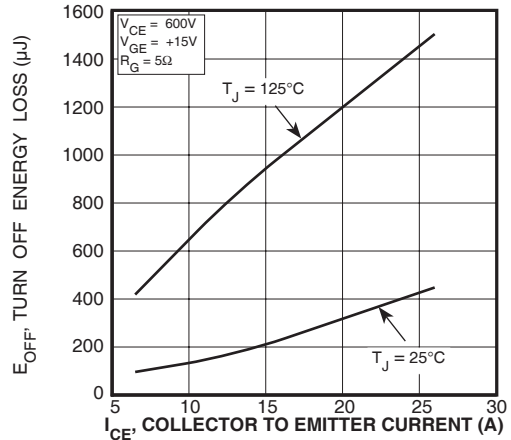


FIGURE 14, Turn Off Energy Loss vs Collector Current

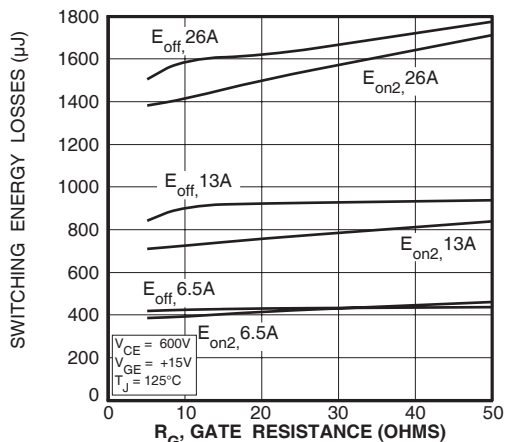


FIGURE 15, Switching Energy Losses vs. Gate Resistance

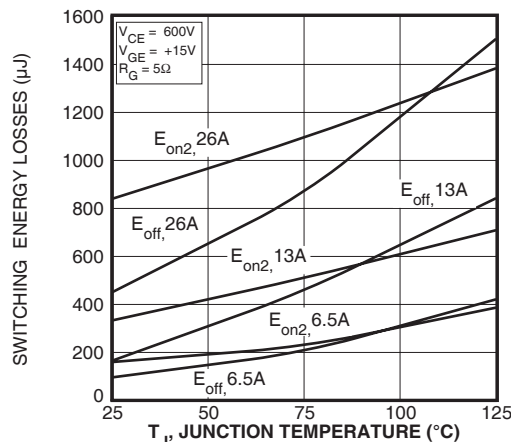


FIGURE 16, Switching Energy Losses vs Junction Temperature

**TYPICAL PERFORMANCE CURVES**

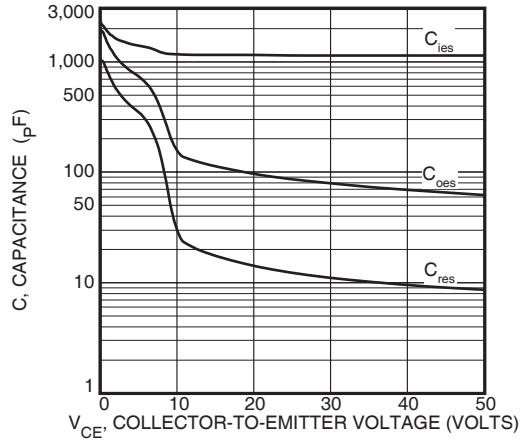


Figure 17, Capacitance vs Collector-To-Emitter Voltage

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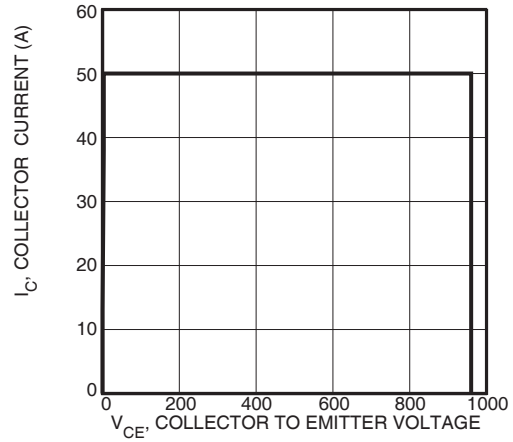


Figure 18, Minimum Switching Safe Operating Area

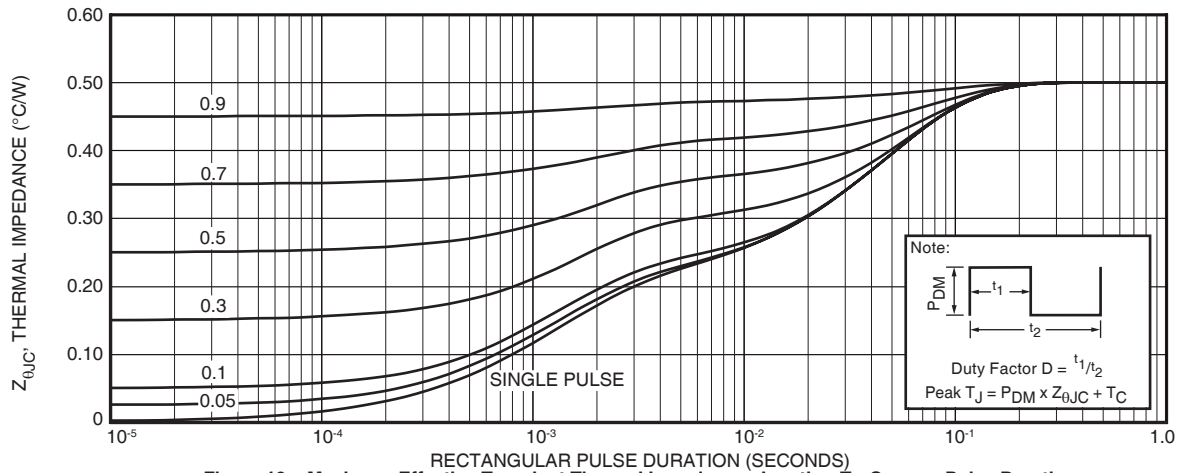


Figure 19a, Maximum Effective Transient Thermal Impedance, Junction-To-Case vs Pulse Duration

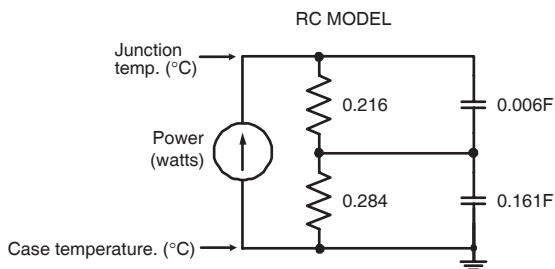


FIGURE 19b, TRANSIENT THERMAL IMPEDANCE MODEL

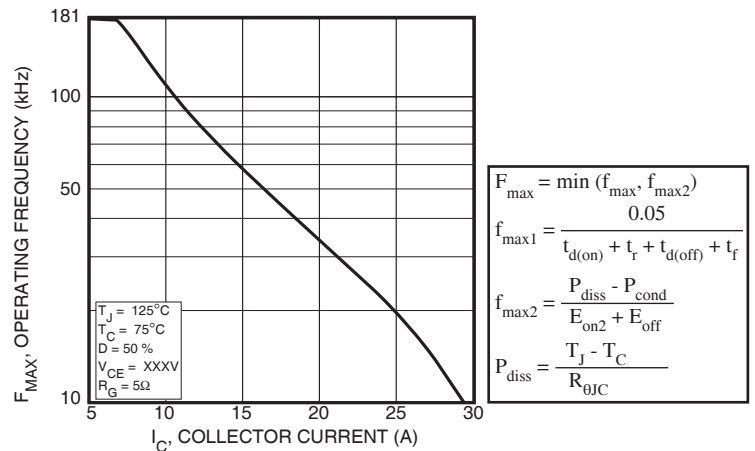


Figure 20, Operating Frequency vs Collector Current

$$F_{max} = \min(f_{max1}, f_{max2})$$

$$f_{max1} = \frac{0.05}{t_{d(on)} + t_r + t_{d(off)} + t_f}$$

$$f_{max2} = \frac{P_{diss} - P_{cond}}{E_{on2} + E_{off}}$$

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

# APT13GP120B\_S(G)

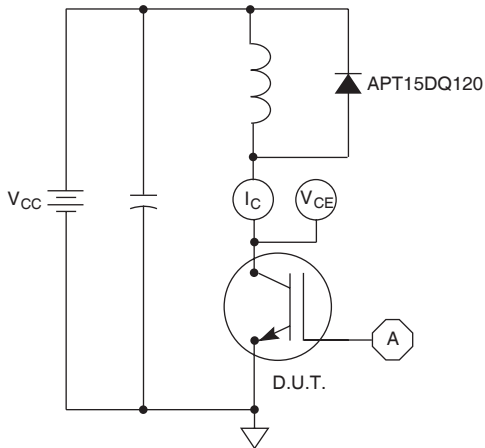


Figure 21, Inductive Switching Test Circuit

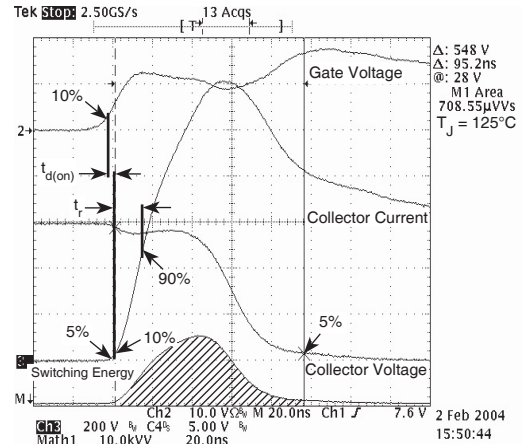


Figure 22, Turn-on Switching Waveforms and Definitions

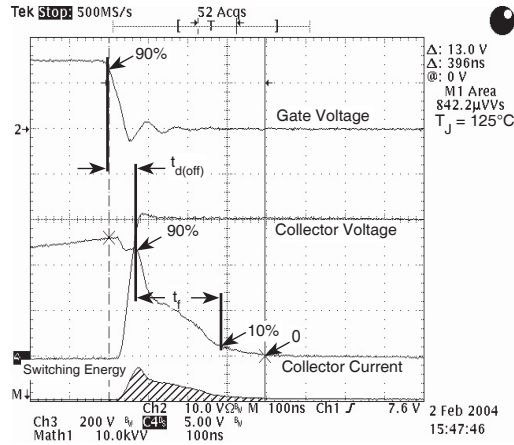
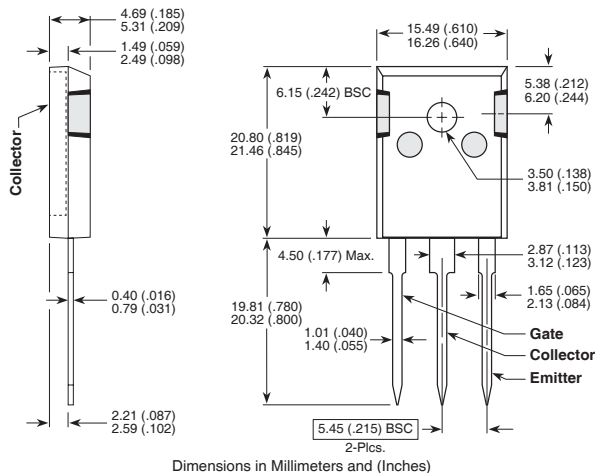


Figure 23, Turn-off Switching Waveforms and Definitions

## TO-247 Package Outline

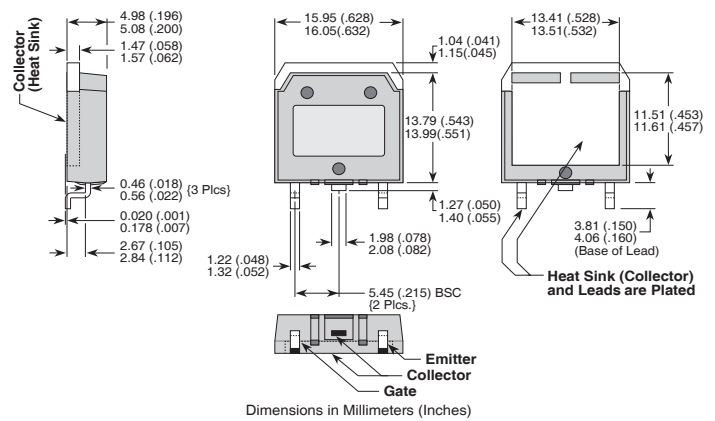
(e1) SAC: Tin, Silver, Copper



Dimensions in Millimeters and (Inches)

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

(e3) SAC: Tin, Silver, Copper



Dimensions in Millimeters (Inches)