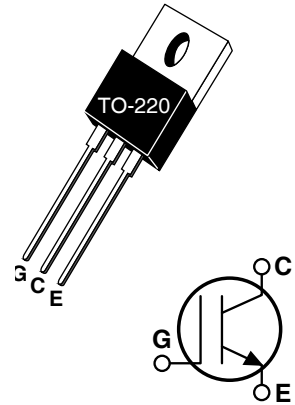


### POWER MOS 7® IGBT

A new generation of high voltage power IGBTs. Using punch-through technology and a proprietary metal gate, this IGBT has been optimized for very fast switching, making it ideal for high frequency, high voltage switch-mode power supplies and tail current sensitive applications. In many cases, the POWER MOS 7® IGBT provides a lower cost alternative to a Power MOSFET.

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



#### MAXIMUM RATINGS

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

Symbol	Parameter	APT13GP120K	UNIT
$V_{CES}$	Collector-Emitter Voltage	1200	Volts
$V_{GE}$	Gate-Emitter Voltage	$\pm 20$	
$V_{GEM}$	Gate-Emitter Voltage Transient	$\pm 30$	
$I_{C1}$	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> @ $T_C = 150^\circ\text{C}$	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	UNIT
$BV_{CES}$	Collector-Emitter Breakdown Voltage ( $V_{GE} = 0V, I_C = 250\mu\text{A}$ )	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>			250	$\mu\text{A}$
	Collector Cut-off Current ( $V_{CE} = 1200V, V_{GE} = 0V, T_J = 125^\circ\text{C}$ ) <sup>②</sup>			2500	
$I_{GES}$	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**
**APT13GP120K**

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	<b>Gate Charge</b> $V_{GE} = 15V$ $V_{CE} = 600V$ $I_C = 13A$		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>				114		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>				223		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			1.90	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 Figure 24.)

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

APT13GP120K

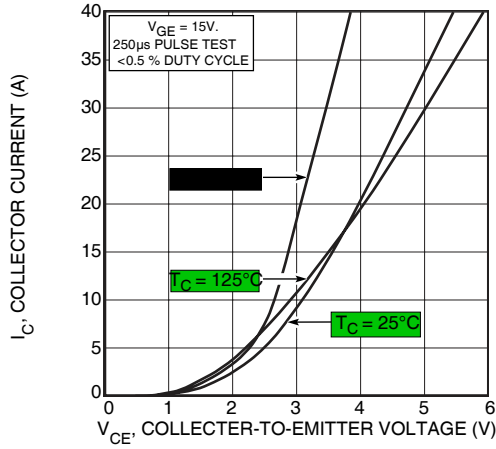


FIGURE 1, Output Characteristics ( $V_{GE} = 15V$ )

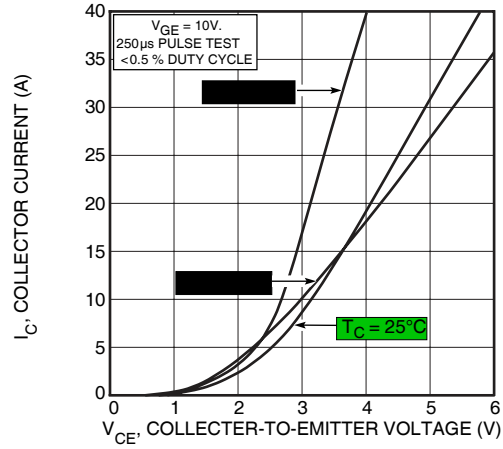


FIGURE 2, Output Characteristics ( $V_{GE} = 10V$ )

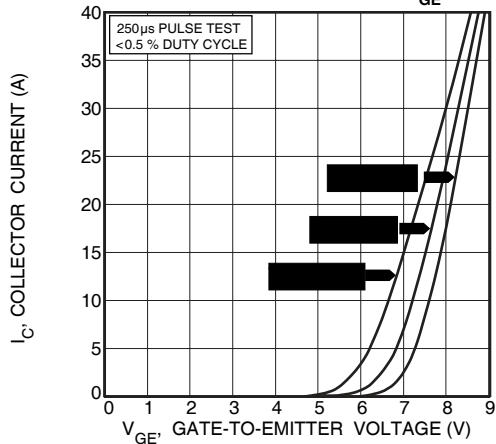


FIGURE 3, Transfer Characteristics

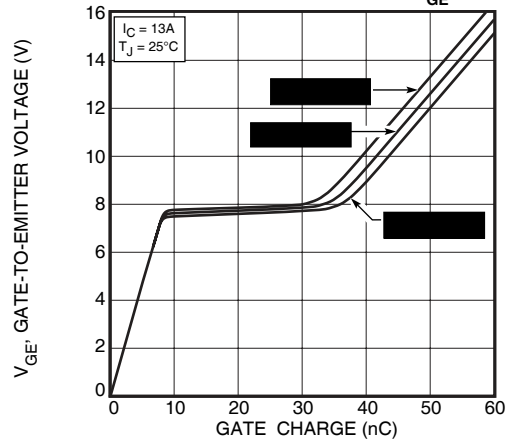


FIGURE 4, Gate Charge

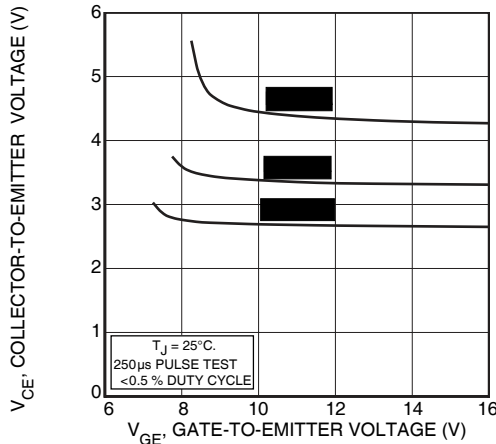


FIGURE 5, On State Voltage vs Gate-to-Emitter Voltage

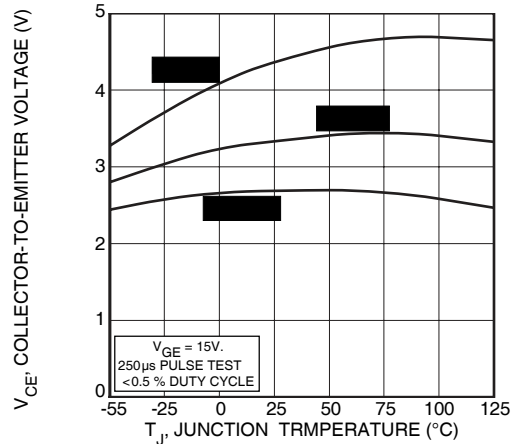


FIGURE 6, On State Voltage vs Junction Temperature

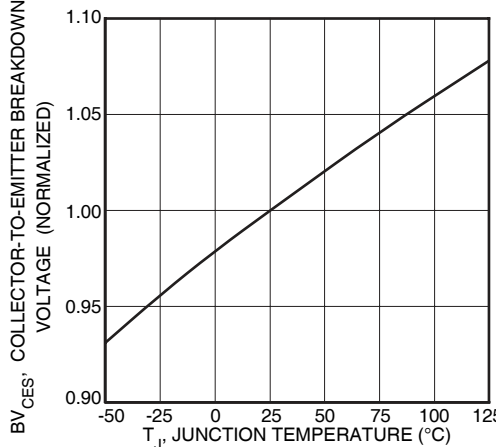


FIGURE 7, Breakdown Voltage vs. Junction Temperature

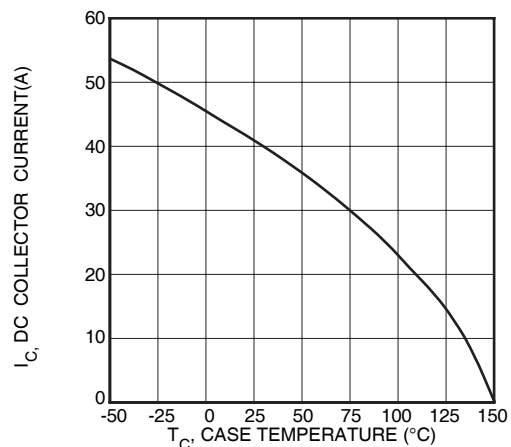


FIGURE 8, DC Collector Current vs Case Temperature

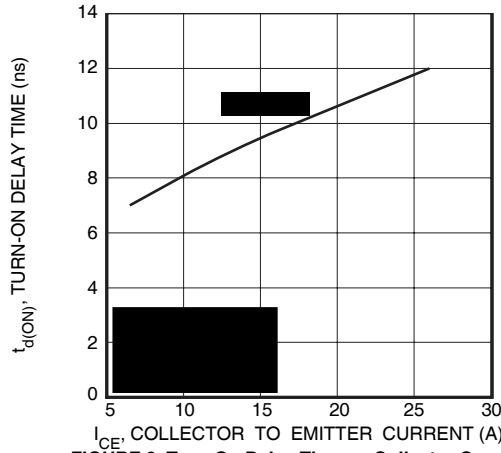


FIGURE 9, Turn-On Delay Time vs Collector Current

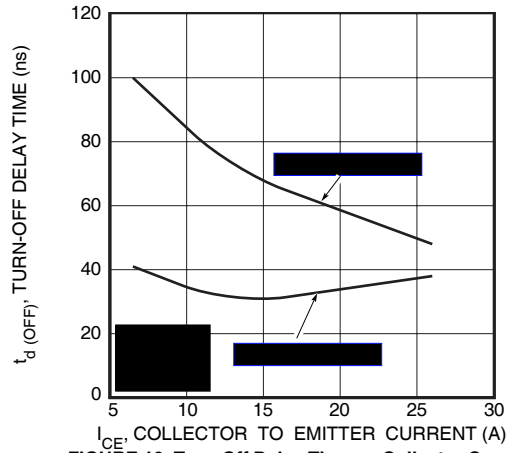


FIGURE 10, Turn-Off Delay Time vs Collector Current

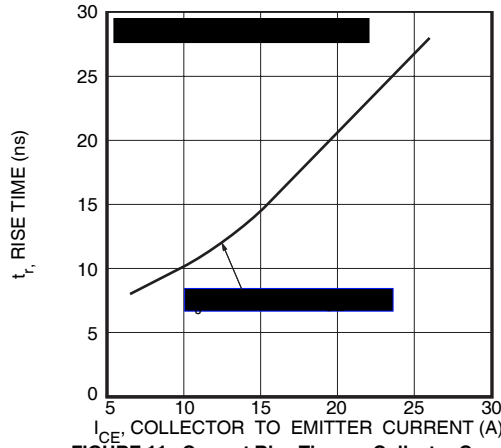


FIGURE 11, Current Rise Time vs Collector Current

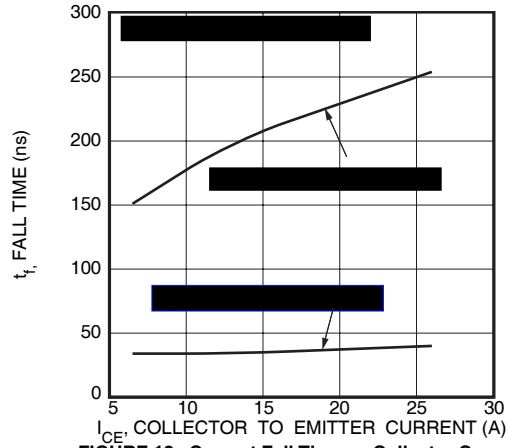


FIGURE 12, Current Fall Time vs Collector Current

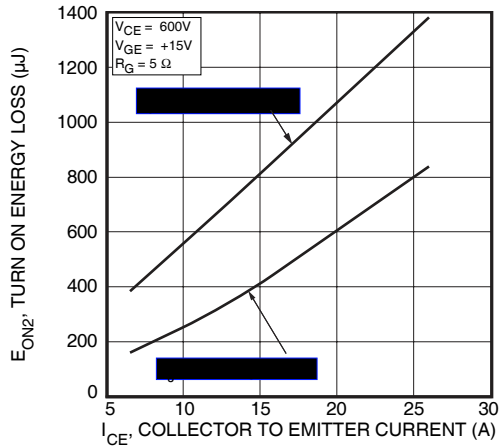


FIGURE 13, Turn-On Energy Loss vs Collector Current

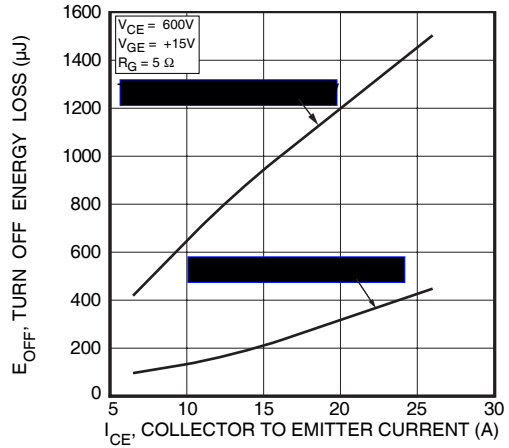


FIGURE 14, Turn Off Energy Loss vs Collector Current

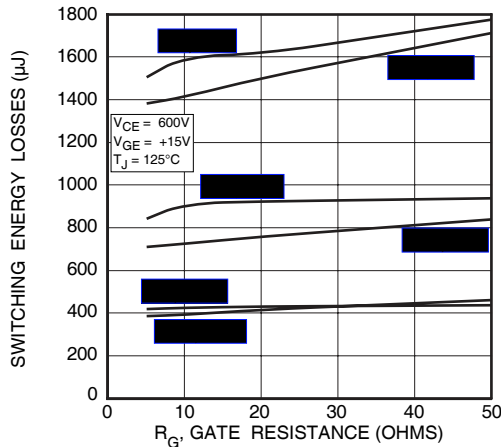


FIGURE 15, Switching Energy Losses vs. Gate Resistance

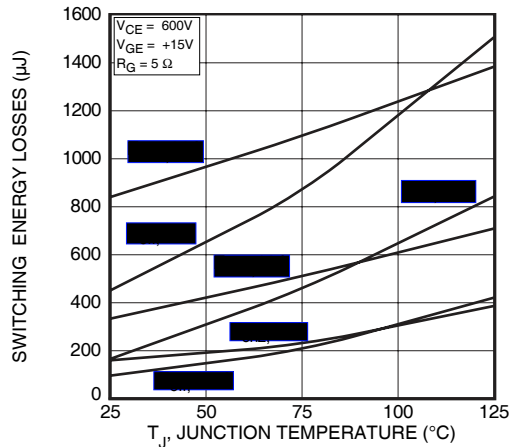


FIGURE 16, Switching Energy Losses vs Junction Temperature

TYPICAL PERFORMANCE CURVES

APT13GP120K

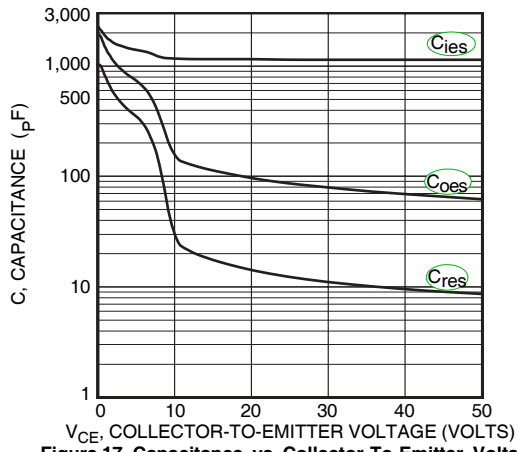


Figure 17, Capacitance vs Collector-To-Emitter Voltage

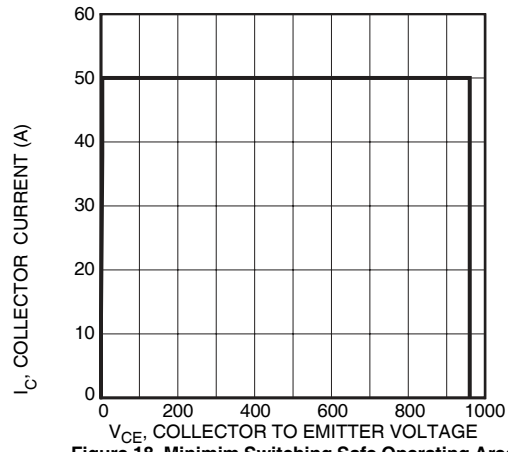


Figure 18, Minimum Switching Safe Operating Area

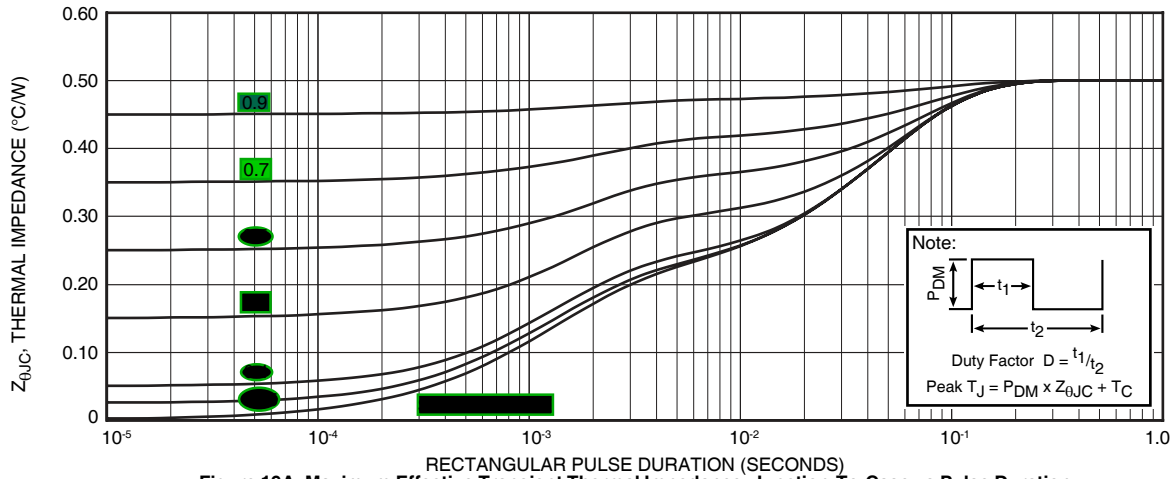


Figure 19A, Maximum Effective Transient Thermal Impedance, Junction-To-Case vs Pulse Duration

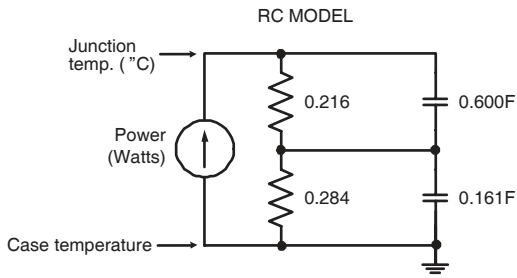


FIGURE 19B, TRANSIENT THERMAL IMPEDANCE MODEL

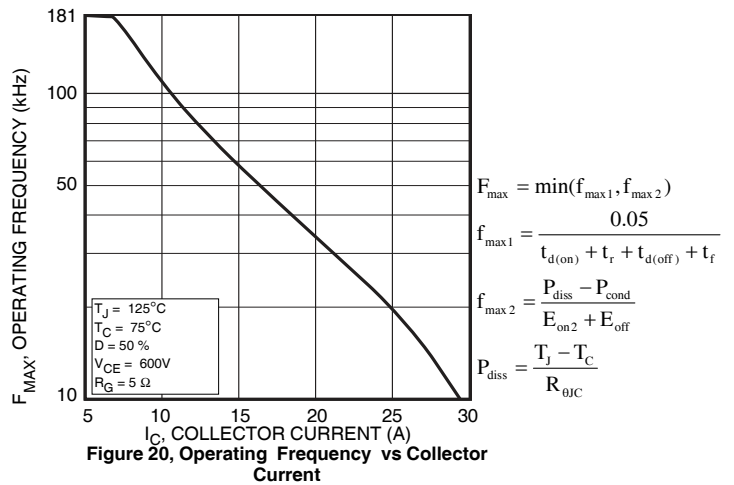


Figure 20, Operating Frequency vs Collector Current

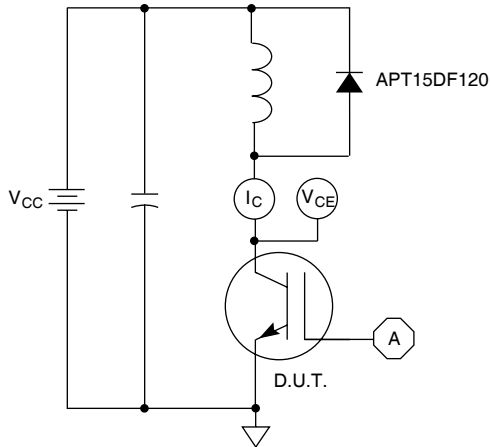


Figure 21, Inductive Switching Test Circuit

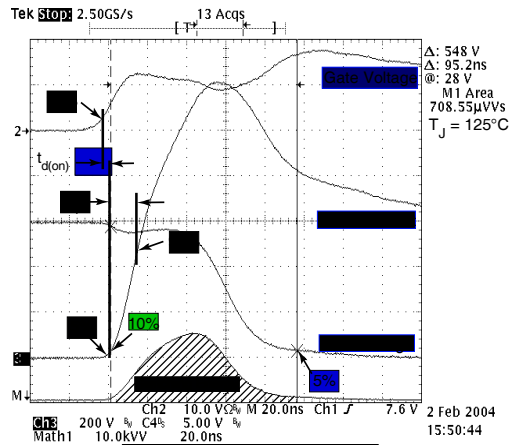


Figure 22, Turn-on Switching Waveforms and Definitions

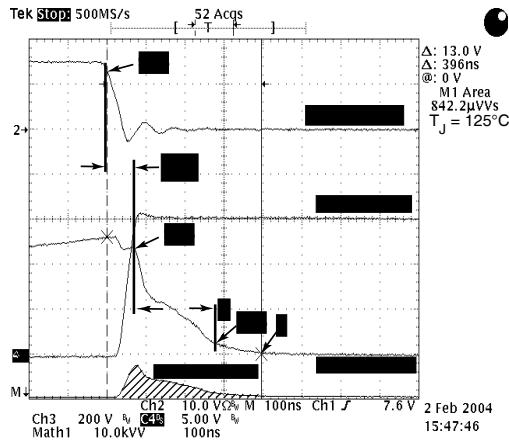


Figure 23, Turn-off Switching Waveforms and Definitions

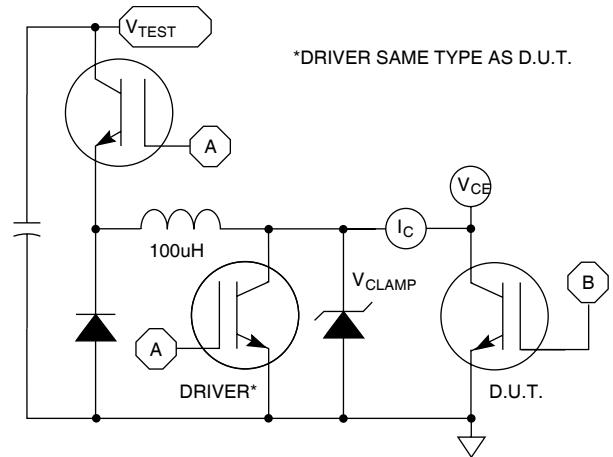
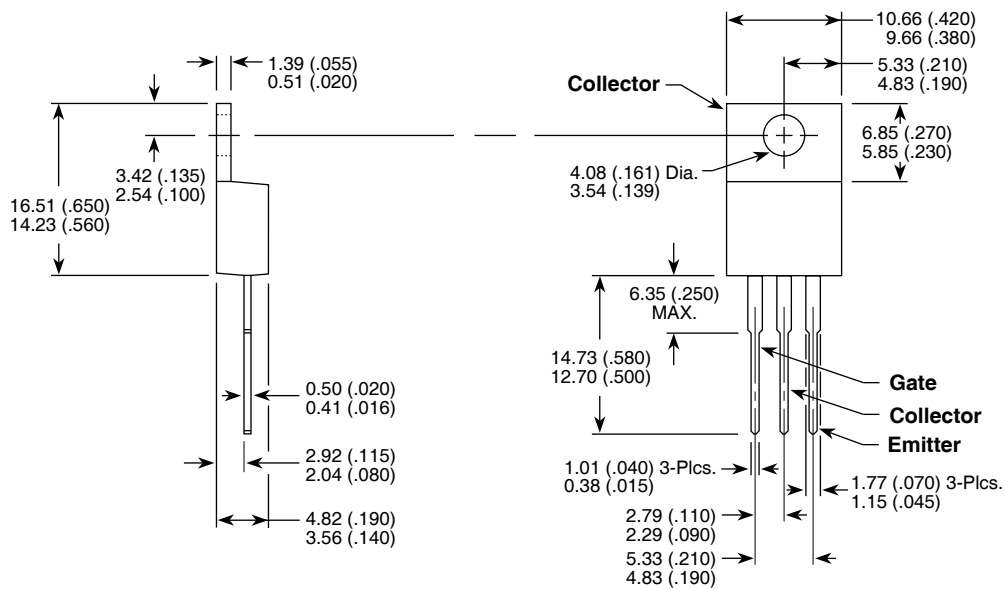


Figure 24, E<sub>ON1</sub> Test Circuit

TO-220AC Package Outline



Dimensions in Millimeters and (Inches)