

Utilizing the latest Field Stop and Trench Gate technologies, these IGBTs have ultra low  $V_{CE(ON)}$  and are ideal for low frequency applications that require absolute minimum conduction loss. Easy paralleling is a result of very tight parameter distribution and a slightly positive  $V_{CE(ON)}$  temperature coefficient. A built-in gate resistor ensures extremely reliable operation, even in the event of a short circuit fault. Low gate charge simplifies gate drive design and minimizes losses.

- **600V Field Stop**
- **Trench Gate: Low  $V_{CE(on)}$**
- **Easy Paralleling**
- **10 $\mu$ s Short Circuit Capability**
- **Intergrated Gate Resistor: Low EMI, High Reliability**



**Applications:** welding, inductive heating, solar inverters, motor drives, UPS, pass transistor

### MAXIMUM RATINGS

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

Symbol	Parameter	APT200GN60J	UNIT
$V_{CES}$	Collector-Emitter Voltage	600	Volts
$V_{GE}$	Gate-Emitter Voltage	$\pm 20$	
$I_{C1}$	Continuous Collector Current @ $T_C = 25^\circ\text{C}$	250	Amps
$I_{C2}$	Continuous Collector Current @ $T_C = 110^\circ\text{C}$	110	
$I_{CM}$	Pulsed Collector Current <sup>①</sup> @ $T_C = 150^\circ\text{C}$	600	
SSOA	Switching Safe Operating Area @ $T_J = 150^\circ\text{C}$	600A @ 600V	
$P_D$	Total Power Dissipation	568	Watts
$T_J, T_{STG}$	Operating and Storage Junction Temperature Range	-55 to 150	$^\circ\text{C}$

### STATIC ELECTRICAL CHARACTERISTICS

Symbol	Characteristic / Test Conditions	MIN	TYP	MAX	UNIT
$V_{(BR)CES}$	Collector-Emitter Breakdown Voltage ( $V_{GE} = 0V, I_C = 4mA$ )	600			Volts
$V_{GE(TH)}$	Gate Threshold Voltage ( $V_{CE} = V_{GE}, I_C = 3.2mA, T_J = 25^\circ\text{C}$ )	5	5.8	6.5	
$V_{CE(ON)}$	Collector-Emitter On Voltage ( $V_{GE} = 15V, I_C = 200A, T_J = 25^\circ\text{C}$ )	1.05	1.45	1.85	
	Collector-Emitter On Voltage ( $V_{GE} = 15V, I_C = 200A, T_J = 125^\circ\text{C}$ )		1.65		
	Collector-Emitter On Voltage ( $V_{GE} = 15V, I_C = 100A, T_J = 25^\circ\text{C}$ )		1.15		
	Collector-Emitter On Voltage ( $V_{GE} = 15V, I_C = 100A, T_J = 125^\circ\text{C}$ )		1.19		
$I_{CES}$	Collector Cut-off Current ( $V_{CE} = 600V, V_{GE} = 0V, T_J = 25^\circ\text{C}$ ) <sup>②</sup>			4	mA
	Collector Cut-off Current ( $V_{CE} = 600V, V_{GE} = 0V, T_J = 125^\circ\text{C}$ ) <sup>②</sup>			TBD	
$I_{GES}$	Gate-Emitter Leakage Current ( $V_{GE} = \pm 20V$ )			600	nA
$R_{GINT}$	Intergrated Gate Resistor		2		$\Omega$

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

APT Website - <http://www.advancedpower.com>

**DYNAMIC CHARACTERISTICS**

**APT200GN60J**

Symbol	Characteristic	Test Conditions	MIN	TYP	MAX	UNIT	
C <sub>ies</sub>	Input Capacitance	<b>Capacitance</b> V <sub>GE</sub> = 0V, V <sub>CE</sub> = 25V f = 1 MHz		14100		pF	
C <sub>oes</sub>	Output Capacitance			4610			
C <sub>res</sub>	Reverse Transfer Capacitance			4000			
V <sub>GEP</sub>	Gate-to-Emitter Plateau Voltage	Gate Charge		8.2		V	
Q <sub>g</sub>	Total Gate Charge <sup>③</sup>	V <sub>GE</sub> = 15V		1180		nC	
Q <sub>ge</sub>	Gate-Emitter Charge	V <sub>CE</sub> = 300V		85			
Q <sub>gc</sub>	Gate-Collector ("Miller") Charge	I <sub>C</sub> = 100A		660			
SSOA	Switching Safe Operating Area	T <sub>J</sub> = 150°C, R <sub>G</sub> = 5Ω <sup>⑦</sup> , V <sub>GE</sub> = 15V, L = 100μH, V <sub>CE</sub> = 600V	600			A	
SCSOA	Short Circuit Safe Operating Area	V <sub>CC</sub> = 480V, V <sub>GE</sub> = 15V, T <sub>J</sub> = 125°C, R <sub>G</sub> = 5Ω <sup>⑦</sup>	10			μs	
t <sub>d(on)</sub>	Turn-on Delay Time	<b>Inductive Switching (25°C)</b>  V <sub>CC</sub> = 400V V <sub>GE</sub> = 15V I <sub>C</sub> = 100A R <sub>G</sub> = 5Ω <sup>⑦</sup> T <sub>J</sub> = +25°C		55		ns	
t <sub>r</sub>	Current Rise Time			20			
t <sub>d(off)</sub>	Turn-off Delay Time			1050			
t <sub>f</sub>	Current Fall Time			50			
E <sub>on1</sub>	Turn-on Switching Energy <sup>④</sup>				TBD		μJ
E <sub>on2</sub>	Turn-on Switching Energy (Diode) <sup>⑤</sup>				1720		
E <sub>off</sub>	Turn-off Switching Energy <sup>⑥</sup>				2810		
t <sub>d(on)</sub>	Turn-on Delay Time	<b>Inductive Switching (125°C)</b>  V <sub>CC</sub> = 400V V <sub>GE</sub> = 15V I <sub>C</sub> = 100A R <sub>G</sub> = 5Ω <sup>⑦</sup> T <sub>J</sub> = +125°C		55		ns	
t <sub>r</sub>	Current Rise Time			20			
t <sub>d(off)</sub>	Turn-off Delay Time			1150			
t <sub>f</sub>	Current Fall Time			60			
E <sub>on1</sub>	Turn-on Switching Energy <sup>④</sup>				TBD		μJ
E <sub>on2</sub>	Turn-on Switching Energy (Diode) <sup>⑤</sup>				1955		
E <sub>off</sub>	Turn-off Switching Energy <sup>⑥</sup>				2865		

**THERMAL AND MECHANICAL CHARACTERISTICS**

Symbol	Characteristic	MIN	TYP	MAX	UNIT
R <sub>θJC</sub>	Junction to Case ( <b>IGBT</b> )			.22	°C/W
R <sub>θJC</sub>	Junction to Case ( <b>DIODE</b> )			N/A	
V <sub>Isolation</sub>	RMS Voltage (50-60Hz Sinusoidal Waveform from Terminals to Mounting Base for 1 Min.)	2500			Volts
W <sub>T</sub>	Package Weight		1.03		oz
			29.2		gm
Torque	Maximum Terminal & Mounting Torque			10	lb•in
				1.1	N•m

- ① Repetitive Rating: Pulse width limited by maximum junction temperature.
- ② For Combi devices, I<sub>CES</sub> includes both IGBT and FRED leakage.
- ③ See MIL-STD-750 Method 3471.
- ④ E<sub>on1</sub> 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<sub>on2</sub> 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<sub>off</sub> is the clamped inductive turn-off energy measured in accordance with JEDEC standard JESD24-1. (See Figures 21, 23)
- ⑦ R<sub>G</sub> is external gate resistance, not including R<sub>Gint</sub> nor gate driver impedance. (MIC4452)

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

# TYPICAL PERFORMANCE CURVES

APT200GN60J

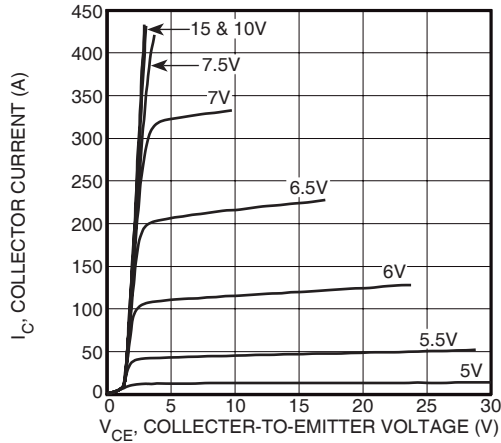


FIGURE 1, Output Characteristics ( $T_J = 25^\circ\text{C}$ )

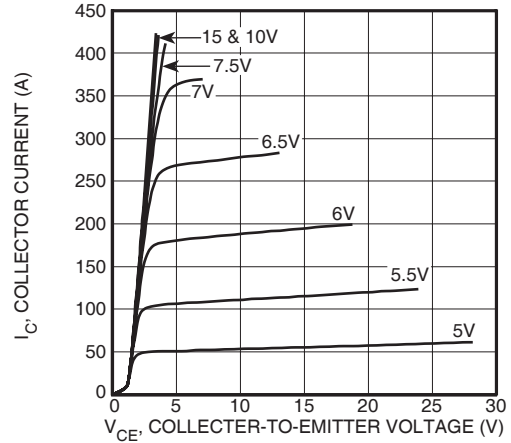


FIGURE 2, Output Characteristics ( $T_J = 125^\circ\text{C}$ )

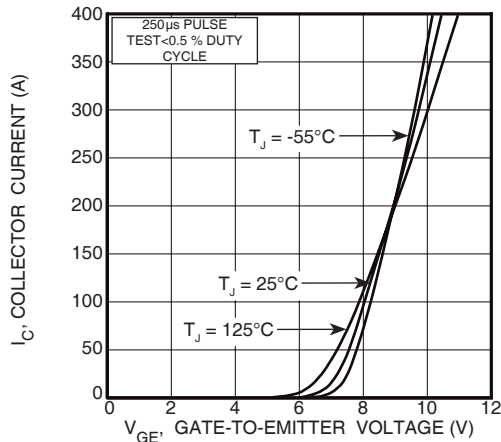


FIGURE 3, Transfer Characteristics

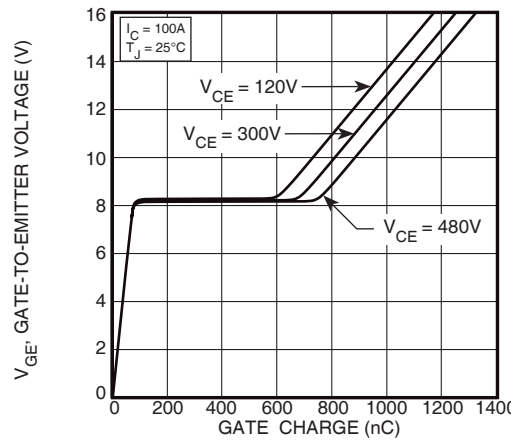


FIGURE 4, Gate Charge

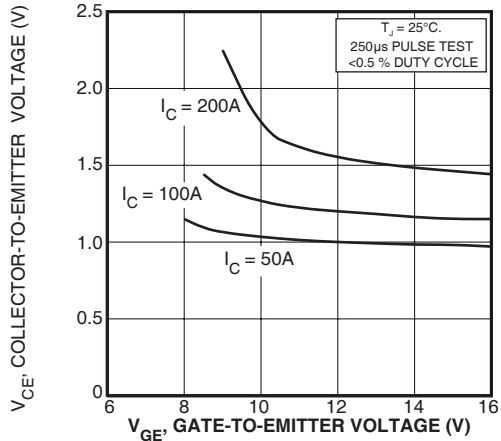


FIGURE 5, On State Voltage vs Gate-to-Emitter Voltage

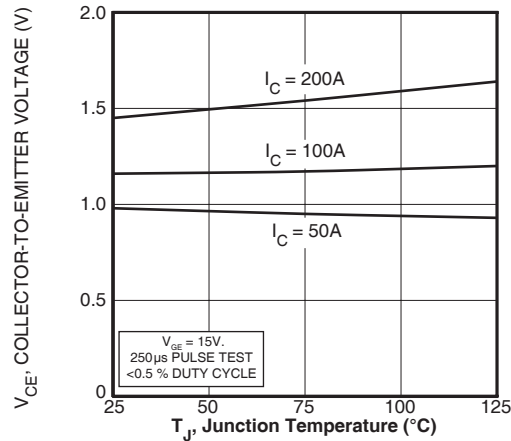


FIGURE 6, On State Voltage vs Junction Temperature

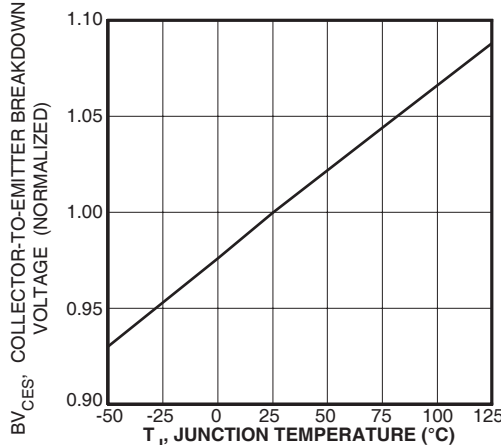


FIGURE 7, Breakdown Voltage vs. Junction Temperature

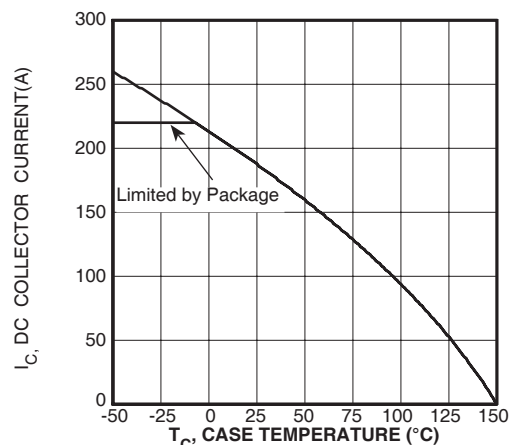


FIGURE 8, DC Collector Current vs Case Temperature

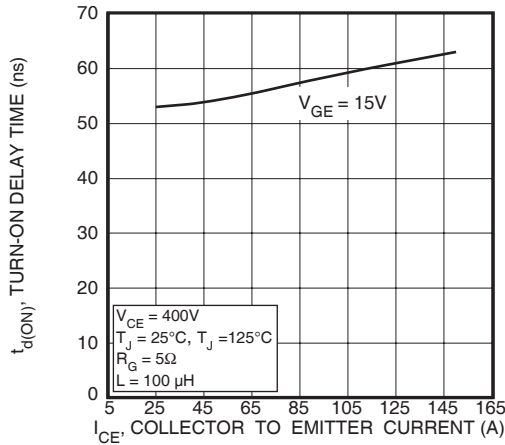


FIGURE 9, Turn-On Delay Time vs Collector Current

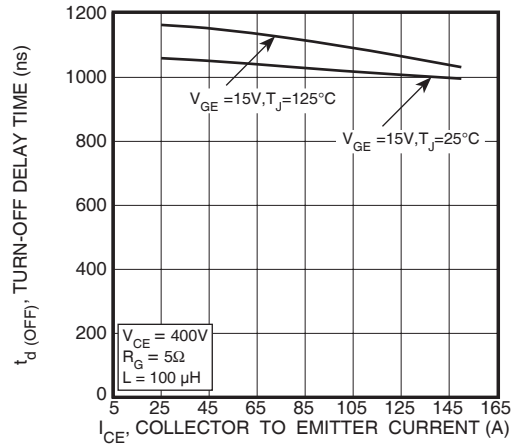


FIGURE 10, Turn-Off Delay Time vs Collector Current

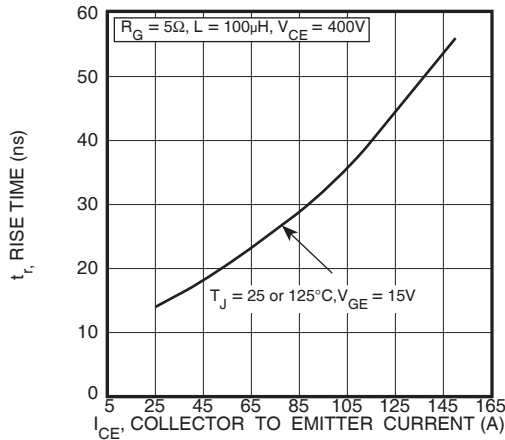


FIGURE 11, Current Rise Time vs Collector Current

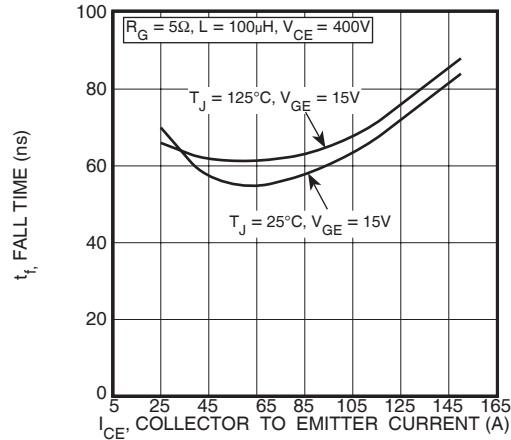


FIGURE 12, Current Fall Time vs Collector Current

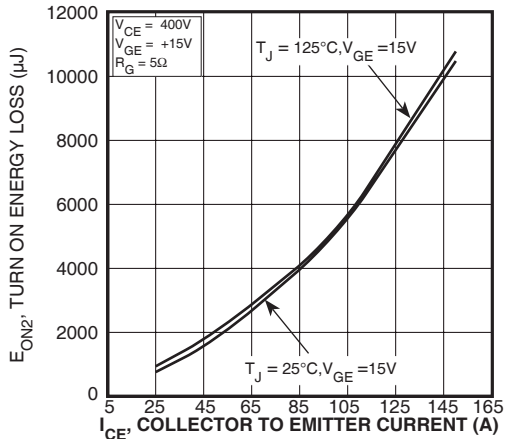


FIGURE 13, Turn-On Energy Loss vs Collector Current

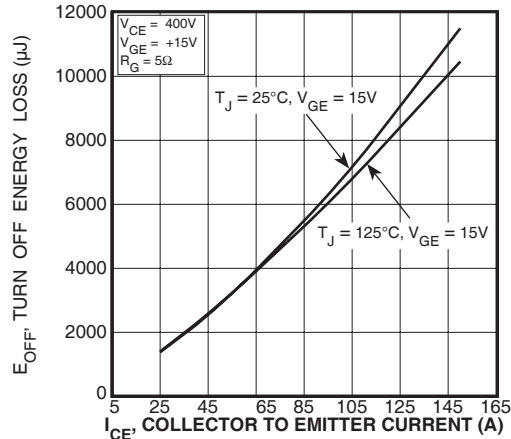


FIGURE 14, Turn Off Energy Loss vs Collector Current

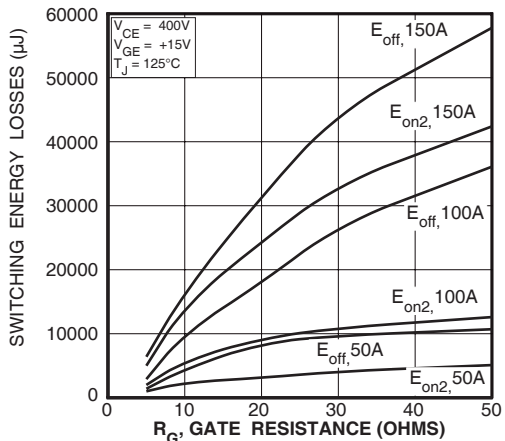


FIGURE 15, Switching Energy Losses vs. Gate Resistance

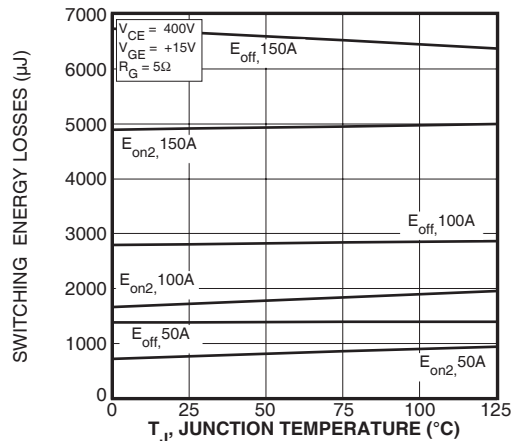


FIGURE 16, Switching Energy Losses vs Junction Temperature

# TYPICAL PERFORMANCE CURVES

APT200GN60J

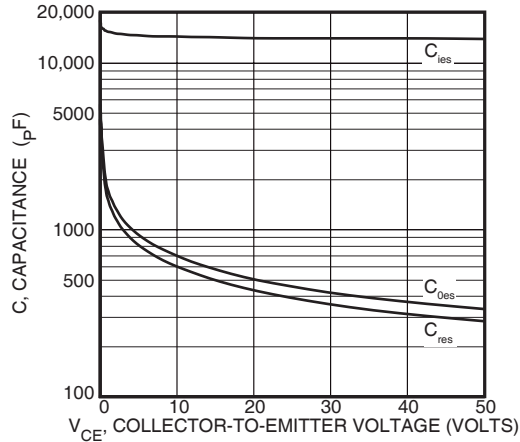


Figure 17, Capacitance vs Collector-To-Emitter Voltage

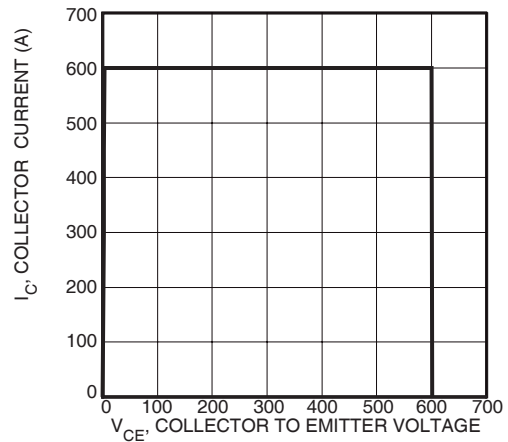


Figure 18, Minimum Switching Safe Operating Area

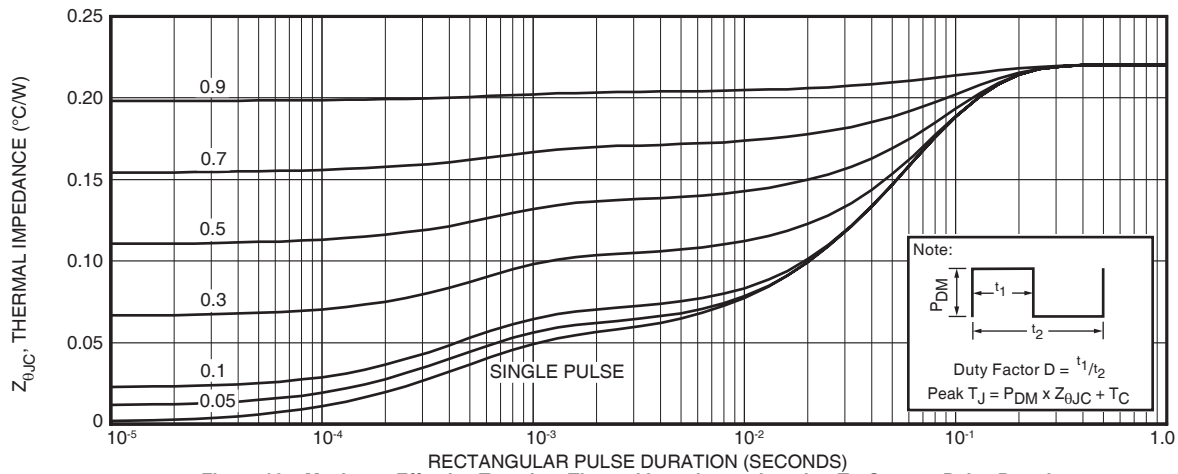


Figure 19a, Maximum Effective Transient Thermal Impedance, Junction-To-Case vs Pulse Duration

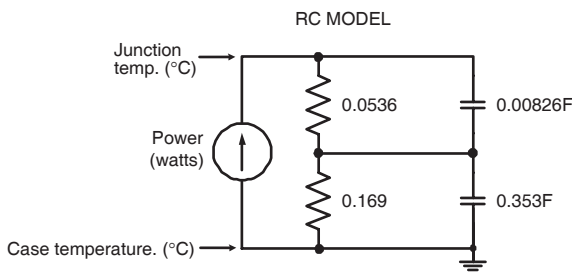


FIGURE 19b, TRANSIENT THERMAL IMPEDANCE MODEL

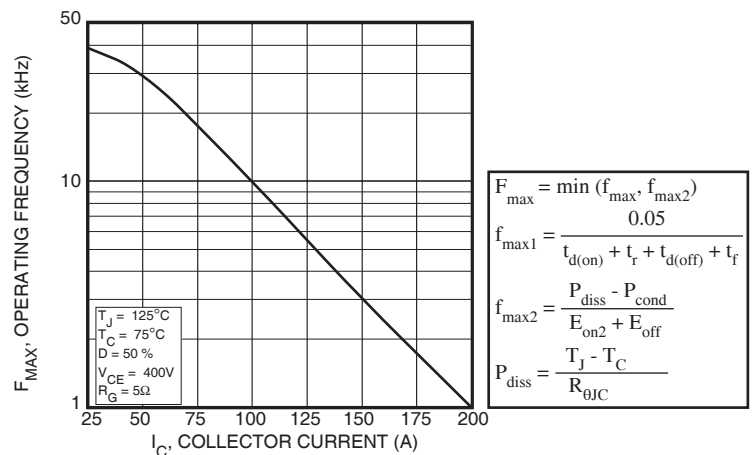


Figure 20, Operating Frequency vs Collector Current

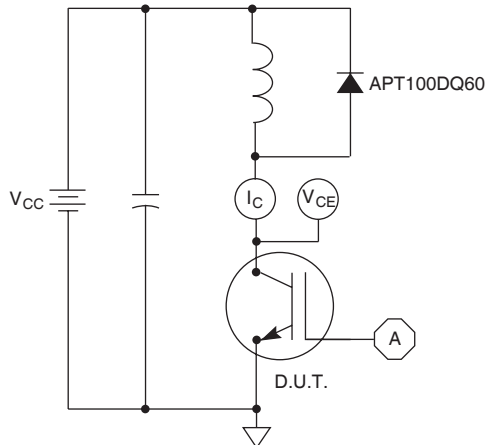


Figure 21, Inductive Switching Test Circuit

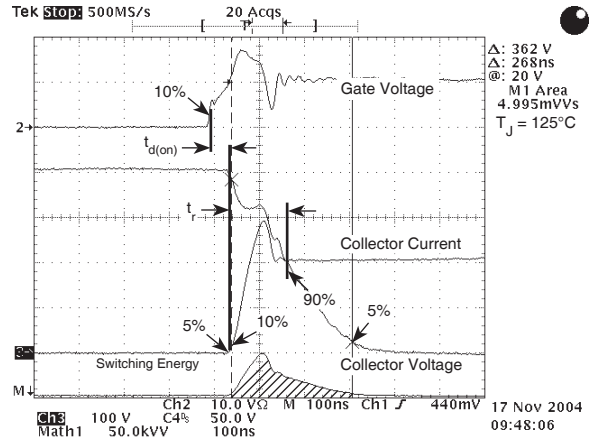


Figure 22, Turn-on Switching Waveforms and Definitions

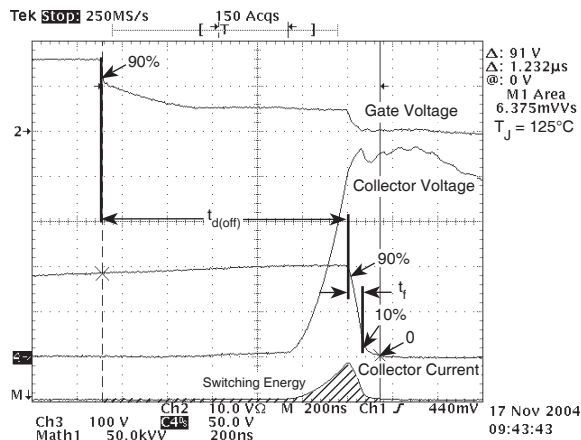


Figure 23, Turn-off Switching Waveforms and Definitions

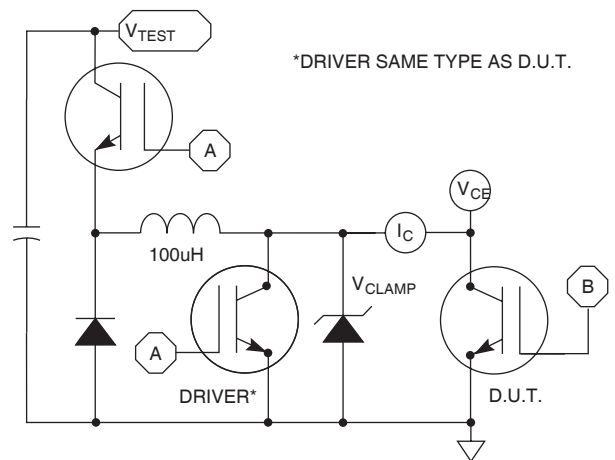
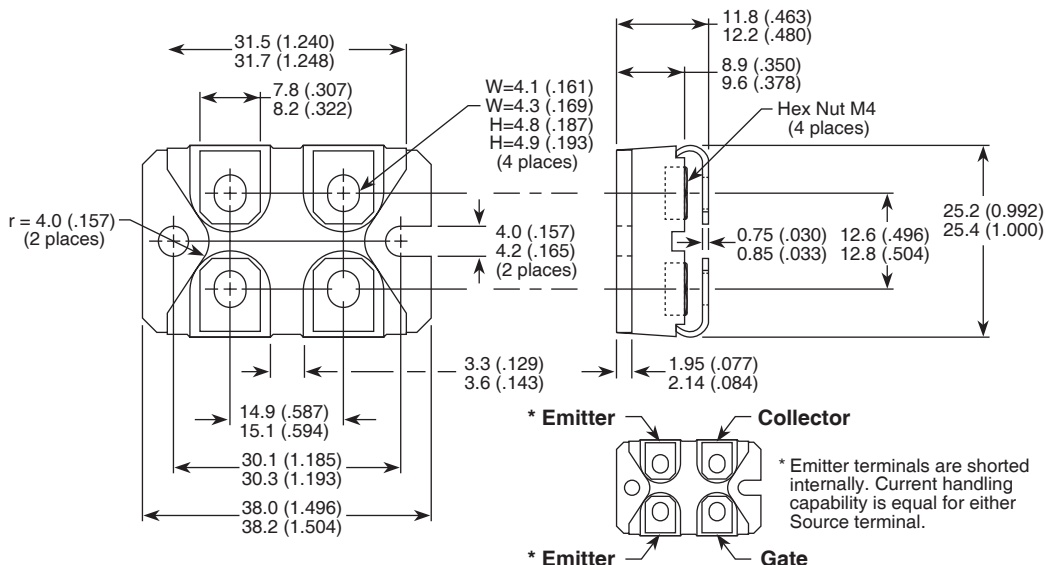


Figure 24, EON1 Test Circuit

SOT-227 (ISOTOP®) Package Outline



Dimensions in Millimeters and (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.