

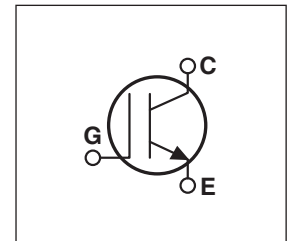


**THE DATASHEET OF  
APT200GN60J**



Utilizing the latest Field Stop and Trench Gate technologies, these IGBT's 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
- 5 $\mu$ s Short Circuit Capability
- Intergrated Gate Resistor: Low EMI, High Reliability
- 175°C Rated



**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 @ $T_C = 25^\circ\text{C}$	283	Amps
$I_{C2}$	Continuous Collector Current @ $T_C = 110^\circ\text{C}$	158	
$I_{CM}$	Pulsed Collector Current <sup>①</sup>	600	
SSOA	Switching Safe Operating Area @ $T_J = 175^\circ\text{C}$	600A @ 600V	
$P_D$	Total Power Dissipation	682	Watts
$T_J, T_{STG}$	Operating and Storage Junction Temperature Range	-55 to 175	$^\circ\text{C}$

### STATIC ELECTRICAL CHARACTERISTICS

Symbol	Characteristic / Test Conditions	MIN	TYP	MAX	UNIT
$V_{(BR)CES}$	Collector-Emitter Breakdown Voltage ( $V_{GE} = 0\text{V}, I_C = 4\text{mA}$ )	600			Volts
$V_{GE(TH)}$	Gate Threshold Voltage ( $V_{CE} = V_{GE}, I_C = 3.2\text{mA}, T_J = 25^\circ\text{C}$ )	5	5.8	6.5	
$V_{CE(ON)}$	Collector-Emitter On Voltage ( $V_{GE} = 15\text{V}, I_C = 200\text{A}, T_J = 25^\circ\text{C}$ )	1.05	1.45	1.85	
	Collector-Emitter On Voltage ( $V_{GE} = 15\text{V}, I_C = 200\text{A}, T_J = 125^\circ\text{C}$ )		1.65		
	Collector-Emitter On Voltage ( $V_{GE} = 15\text{V}, I_C = 100\text{A}, T_J = 25^\circ\text{C}$ )		1.15		
	Collector-Emitter On Voltage ( $V_{GE} = 15\text{V}, I_C = 100\text{A}, T_J = 125^\circ\text{C}$ )		1.19		
$I_{CES}$	Collector Cut-off Current ( $V_{CE} = 600\text{V}, V_{GE} = 0\text{V}, T_J = 25^\circ\text{C}$ ) <sup>②</sup>			25	$\mu\text{A}$
	Collector Cut-off Current ( $V_{CE} = 600\text{V}, V_{GE} = 0\text{V}, T_J = 125^\circ\text{C}$ ) <sup>②</sup>			TBD	
$I_{GES}$	Gate-Emitter Leakage Current ( $V_{GE} = \pm 20\text{V}$ )			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
$C_{ies}$	Input Capacitance	<b>Capacitance</b> $V_{GE} = 0V, V_{CE} = 25V$ $f = 1 \text{ MHz}$		14100		pF
$C_{oes}$	Output Capacitance			4610		
$C_{res}$	Reverse Transfer Capacitance			4000		
$V_{GEP}$	Gate-to-Emitter Plateau Voltage	Gate Charge		8.2		V
$Q_g$	Total Gate Charge <sup>③</sup>	$V_{GE} = 15V$		1180		nC
$Q_{ge}$	Gate-Emitter Charge	$V_{CE} = 300V$		85		
$Q_{gc}$	Gate-Collector ("Miller") Charge	$I_C = 100A$		660		
SSOA	Switching Safe Operating Area	$T_J = 175^\circ\text{C}, R_G = 1.0\Omega^{\text{⑦}}, V_{GE} = 15V, L = 100\mu\text{H}, V_{CE} = 600V$	600			A
SCSOA	Short Circuit Safe Operating Area	$V_{CC} = 360V, V_{GE} = 15V, T_J = 150^\circ\text{C}, R_G = 1.0\Omega^{\text{⑦}}$	5			$\mu\text{s}$
$t_{d(on)}$	Turn-on Delay Time	<b>Inductive Switching (25°C)</b> $V_{CC} = 400V$ $V_{GE} = 15V$ $I_C = 200A$ $R_G = 1.0\Omega^{\text{⑦}}$ $T_J = +25^\circ\text{C}$		50		ns
$t_r$	Current Rise Time			80		
$t_{d(off)}$	Turn-off Delay Time			560		
$t_f$	Current Fall Time			100		mJ
$E_{on1}$	Turn-on Switching Energy <sup>④</sup>			13		
$E_{on2}$	Turn-on Switching Energy (Diode) <sup>⑤</sup>			15		
$E_{off}$	Turn-off Switching Energy <sup>⑥</sup>		11			
$t_{d(on)}$	Turn-on Delay Time	<b>Inductive Switching (125°C)</b> $V_{CC} = 400V$ $V_{GE} = 15V$ $I_C = 200A$ $R_G = 1.0\Omega^{\text{⑦}}$ $T_J = +125^\circ\text{C}$		50		ns
$t_r$	Current Rise Time			80		
$t_{d(off)}$	Turn-off Delay Time			620		
$t_f$	Current Fall Time			70		mJ
$E_{on1}$	Turn-on Switching Energy <sup>④</sup>			14		
$E_{on2}$	Turn-on Switching Energy (Diode) <sup>⑤</sup>			16		
$E_{off}$	Turn-off Switching Energy <sup>⑥</sup>		10			

## THERMAL AND MECHANICAL CHARACTERISTICS

Symbol	Characteristic	MIN	TYP	MAX	UNIT
$R_{\theta JC}$	Junction to Case (IGBT)			.22	$^\circ\text{C/W}$
$R_{\theta JC}$	Junction to Case (DIODE)			N/A	
$V_{Isolation}$	RMS Voltage (50-60Hz Sinusoidal Waveform from Terminals to Mounting Base for 1 Min.)	2500			Volts
$W_T$	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,  $I_{ces}$  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.)

⑦  $R_G$  is external gate resistance, not including  $R_{G(int)}$  nor gate driver impedance. (MIC4452)

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

# TYPICAL PERFORMANCE CURVES

APT200GN60J

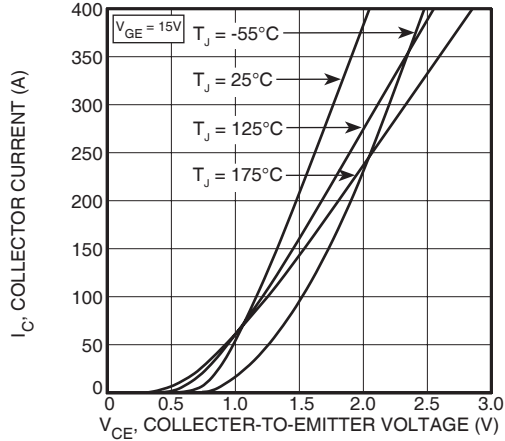


FIGURE 1, Output Characteristics ( $T_J = 25^\circ\text{C}$ )

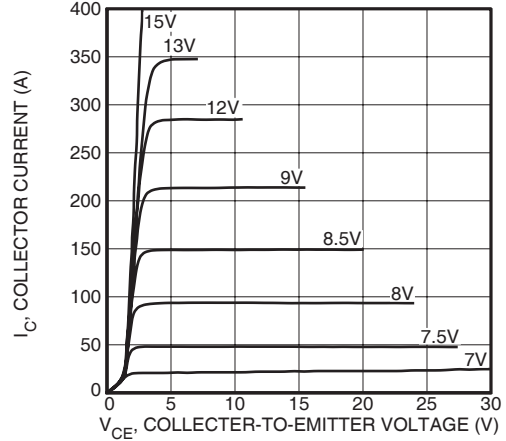


FIGURE 2, Output Characteristics ( $T_J = 125^\circ\text{C}$ )

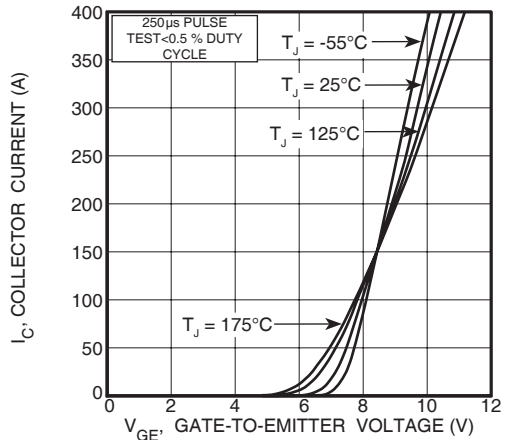


FIGURE 3, Transfer Characteristics

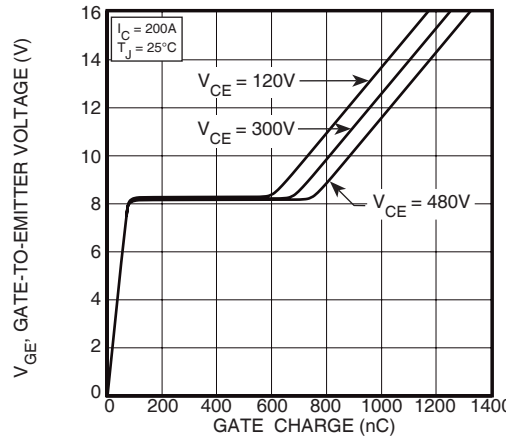


FIGURE 4, Gate Charge

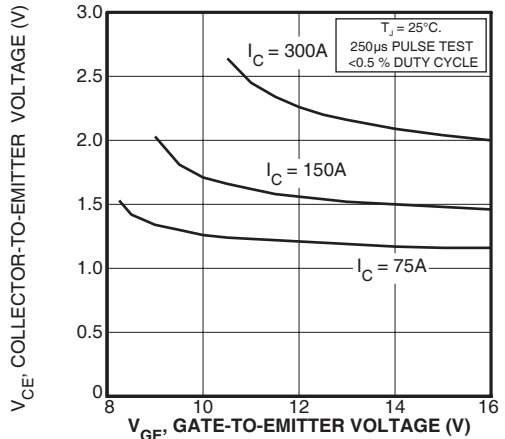


FIGURE 5, On State Voltage vs Gate-to-Emitter Voltage

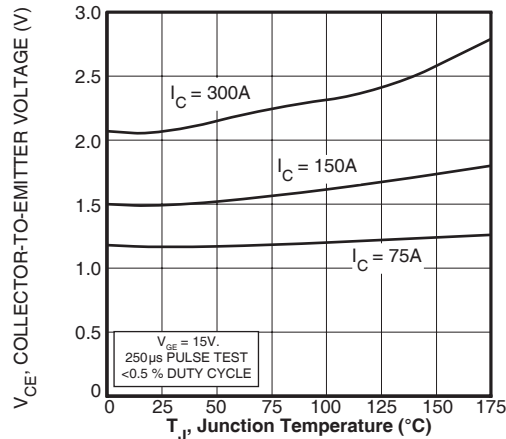


FIGURE 6, On State Voltage vs Junction Temperature

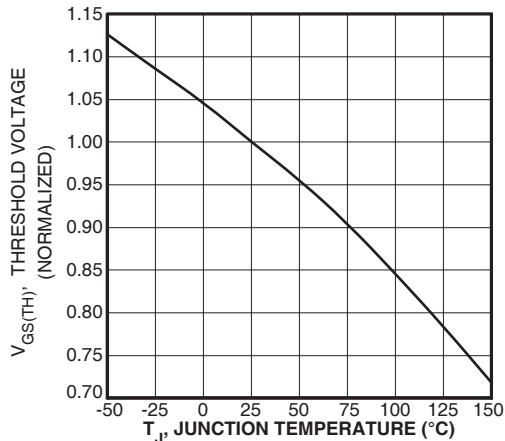


FIGURE 7, Threshold Voltage vs. Junction Temperature

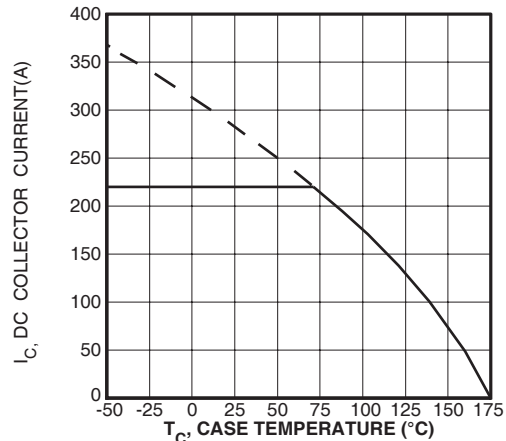


FIGURE 8, DC Collector Current vs Case Temperature

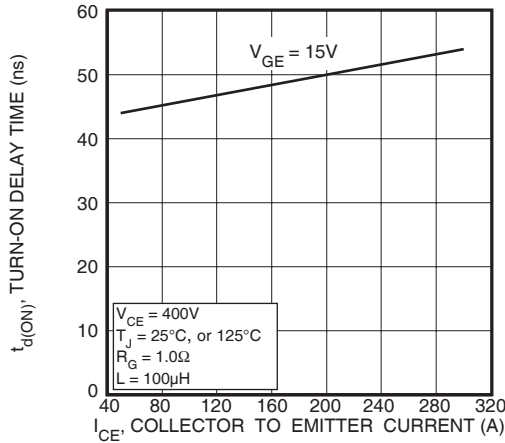


FIGURE 9, Turn-On Delay Time vs Collector Current

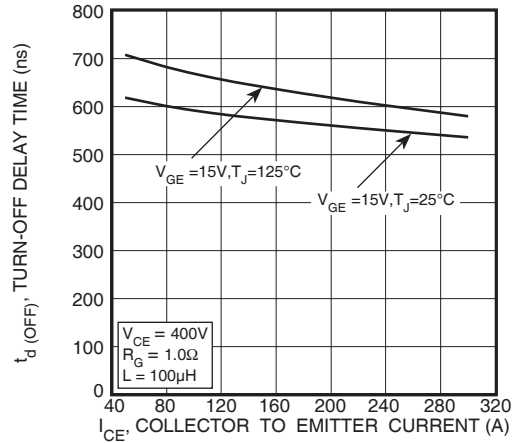


FIGURE 10, Turn-Off Delay Time vs Collector Current

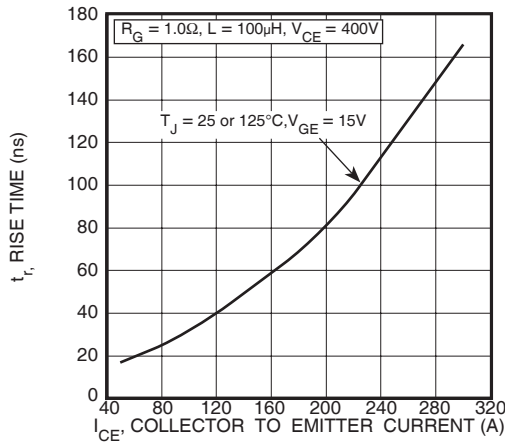


FIGURE 11, Current Rise Time vs Collector Current

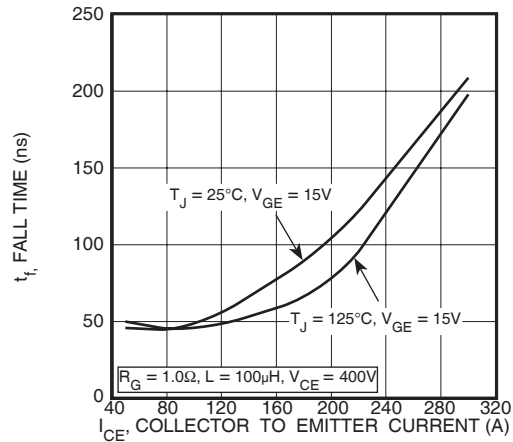


FIGURE 12, Current Fall Time vs Collector Current

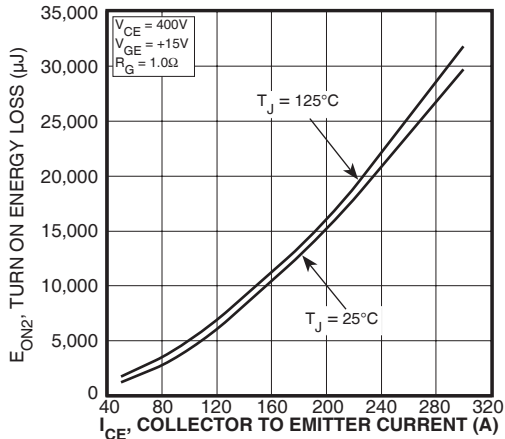


FIGURE 13, Turn-On Energy Loss vs Collector Current

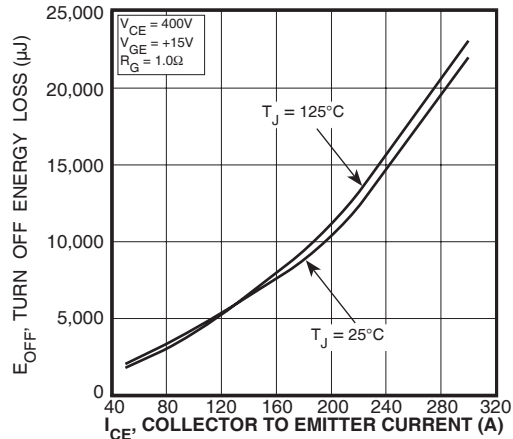


FIGURE 14, Turn Off Energy Loss vs Collector Current

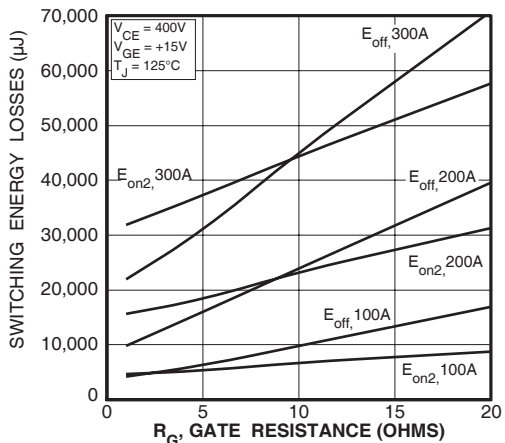


FIGURE 15, Switching Energy Losses vs. Gate Resistance

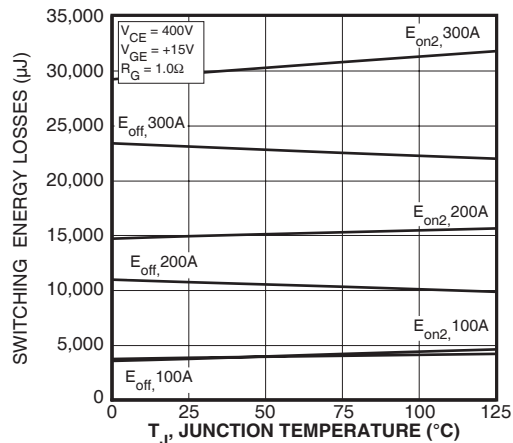


FIGURE 16, Switching Energy Losses vs Junction Temperature

### TYPICAL PERFORMANCE CURVES

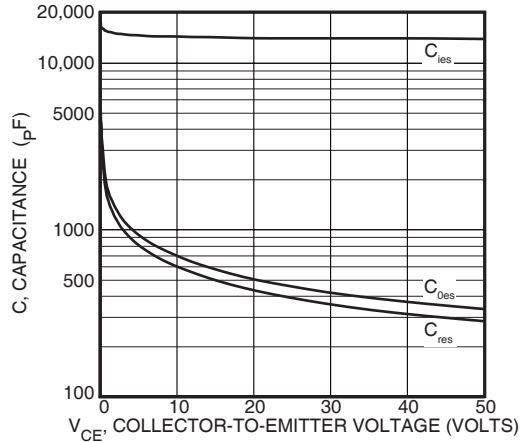


Figure 17, Capacitance vs Collector-To-Emitter Voltage

### APT200GN60J

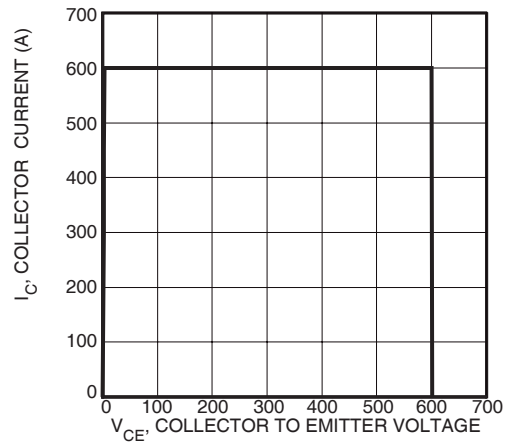


Figure 18, Minimum Switching Safe Operating Area

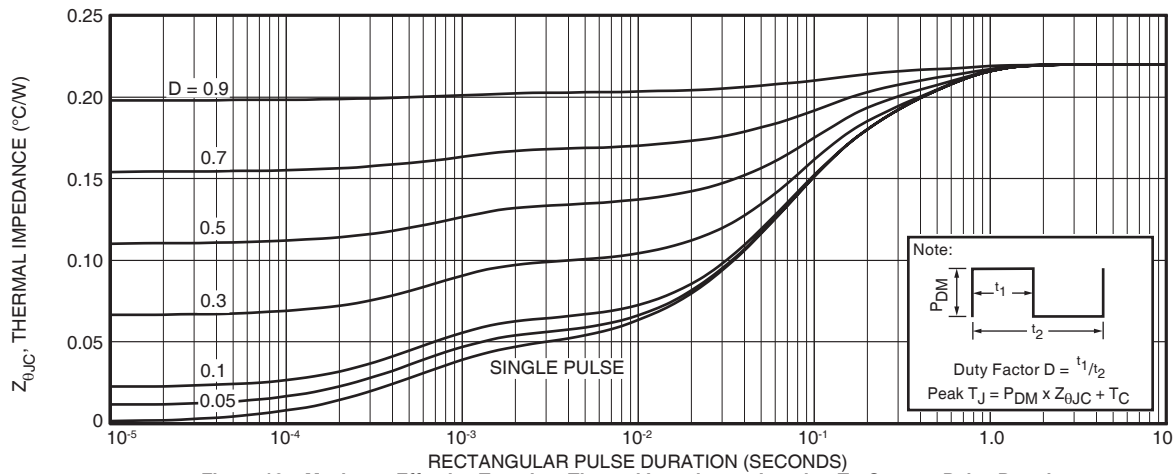


Figure 19a, Maximum Effective Transient Thermal Impedance, Junction-To-Case vs Pulse Duration

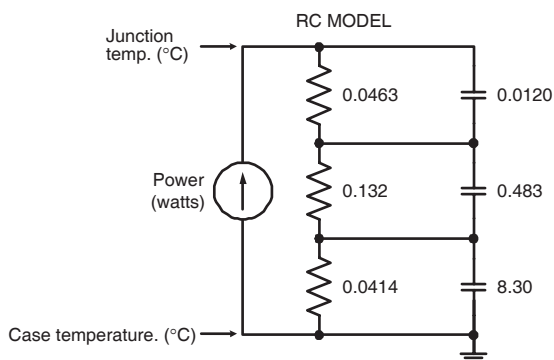


FIGURE 19b, TRANSIENT THERMAL IMPEDANCE MODEL

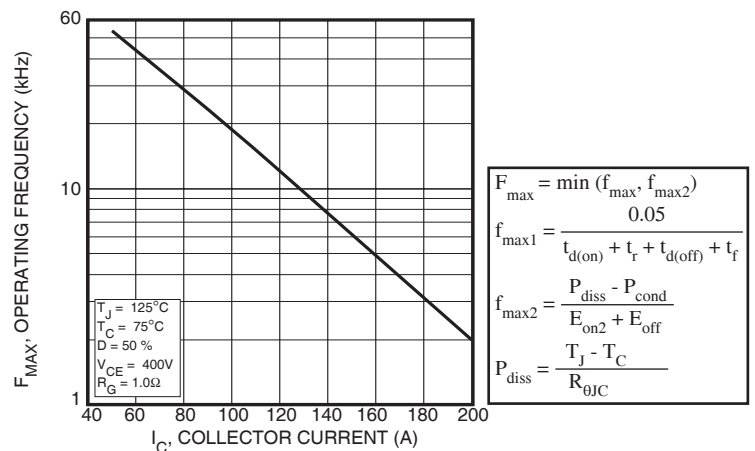


Figure 20, Operating Frequency vs Collector Current

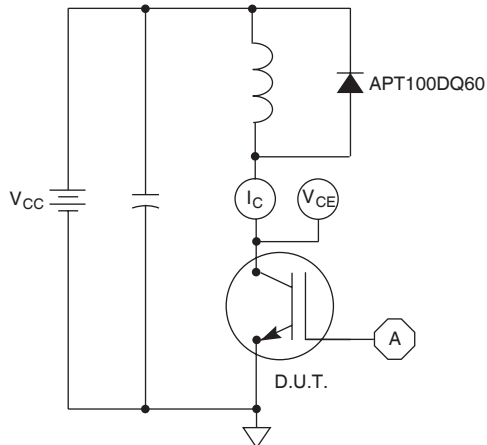


Figure 21, Inductive Switching Test Circuit

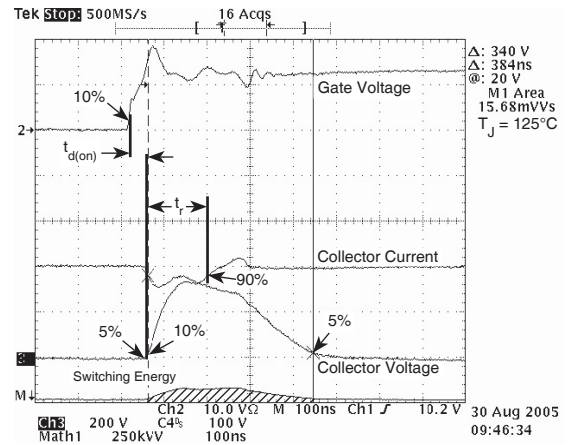


Figure 22, Turn-on Switching Waveforms and Definitions

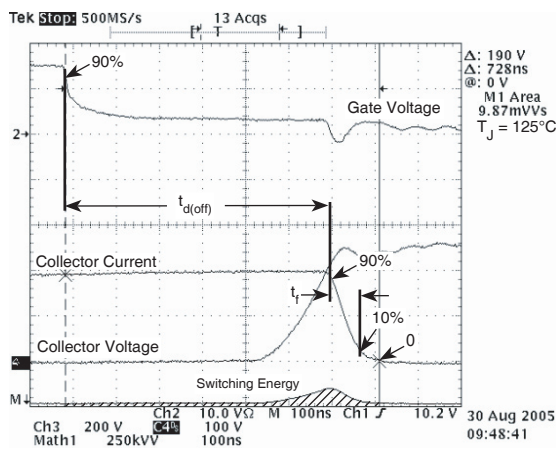
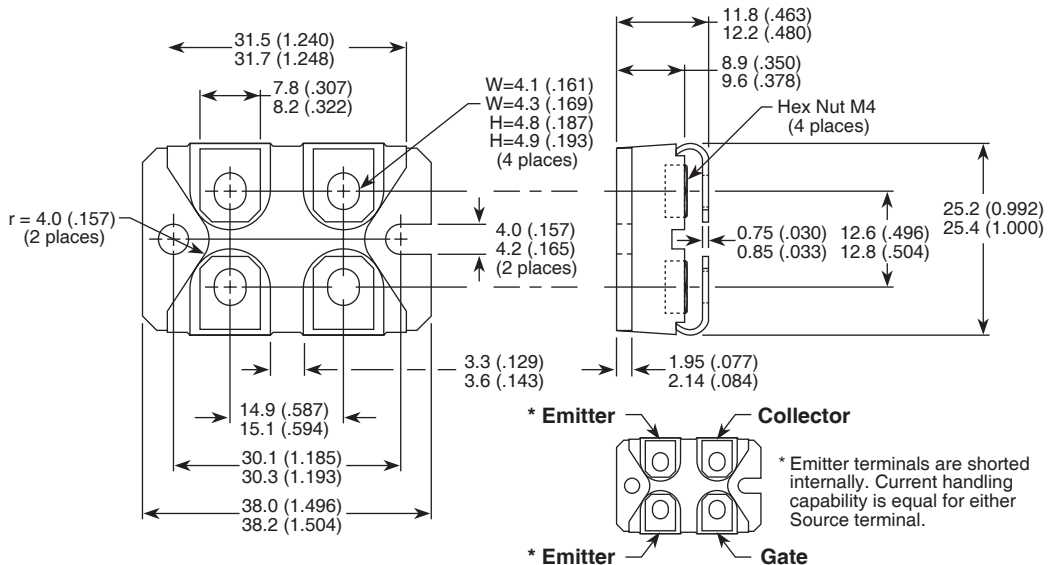


Figure 23, Turn-off Switching Waveforms and Definitions

SOT-227 (ISOTOP®) Package Outline



Dimensions in Millimeters and (Inches)

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