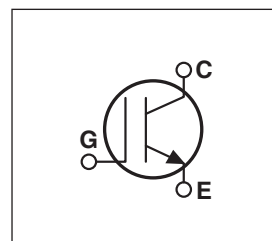
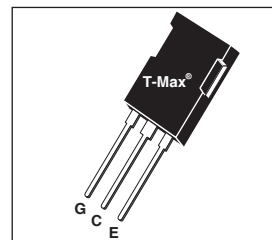


Utilizing the latest Field Stop and Trench Gate technologies, these IGBT's have ultra low  $V_{CE(ON)}$  and are ideal for low frequency applications that require absolute minimum conduction loss. Easy paralleling is a result of very tight parameter distribution and a slightly positive  $V_{CE(ON)}$  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
- 6 $\mu$ s Short Circuit Capability
- Intergrated Gate Resistor: Low EMI, High Reliability

**Applications:** Welding, Inductive Heating, Solar Inverters, SMPS, Motor drives, UPS



## MAXIMUM RATINGS

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

Symbol	Parameter	APT100GN60B2(G)	UNIT
$V_{CES}$	Collector-Emitter Voltage	600	Volts
$V_{GE}$	Gate-Emitter Voltage	$\pm 30$	
$I_{C1}$	Continuous Collector Current <sup>⑧</sup> @ $T_C = 25^\circ\text{C}$	229	Amps
$I_{C2}$	Continuous Collector Current <sup>⑧</sup> @ $T_C = 110^\circ\text{C}$	135	
$I_{CM}$	Pulsed Collector Current <sup>①</sup>	300	
SSOA	Switching Safe Operating Area @ $T_J = 175^\circ\text{C}$	300A @ 600V	
$P_D$	Total Power Dissipation	625	Watts
$T_J, T_{STG}$	Operating and Storage Junction Temperature Range	-55 to 175	$^\circ\text{C}$
$T_L$	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 ( $V_{GE} = 0V, I_C = 4mA$ )	600			Volts
$V_{GE(TH)}$	Gate Threshold Voltage ( $V_{CE} = V_{GE}, I_C = 1mA, T_J = 25^\circ\text{C}$ )	5.0	5.8	6.5	
$V_{CE(ON)}$	Collector-Emitter On Voltage ( $V_{GE} = 15V, I_C = 100A, T_J = 25^\circ\text{C}$ )	1.05	1.45	1.85	
	Collector-Emitter On Voltage ( $V_{GE} = 15V, I_C = 100A, T_J = 125^\circ\text{C}$ )		1.87		
$I_{CES}$	Collector Cut-off Current ( $V_{CE} = 600V, V_{GE} = 0V, T_J = 25^\circ\text{C}$ ) <sup>②</sup>			25	$\mu\text{A}$
	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
$R_{G(int)}$	Intergrated Gate Resistor		2		$\Omega$



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

# DYNAMIC CHARACTERISTICS

APT100GN60B2(G)

Symbol	Characteristic	Test Conditions	MIN	TYP	MAX	UNIT
$C_{ies}$	Input Capacitance	<b>Capacitance</b> $V_{GE} = 0V, V_{CE} = 25V$ $f = 1 \text{ MHz}$		6000		pF
$C_{oes}$	Output Capacitance			560		
$C_{res}$	Reverse Transfer Capacitance			200		
$V_{GEP}$	Gate-to-Emitter Plateau Voltage	<b>Gate Charge</b> $V_{GE} = 15V$ $V_{CE} = 300V$ $I_C = 100A$		9.5		V
$Q_g$	Total Gate Charge <sup>③</sup>			600		nC
$Q_{ge}$	Gate-Emitter Charge			45		
$Q_{gc}$	Gate-Collector ("Miller") Charge			340		
SSOA	Switching Safe Operating Area	$T_J = 175^\circ\text{C}, R_G = 4.3\Omega^{⑦}, V_{GE} = 15V, L = 100\mu\text{H}, V_{CE} = 600V$	300			A
SCSOA	Short Circuit Safe Operating Area	$V_{CC} = 600V, V_{GE} = 15V, T_J = 125^\circ\text{C}, R_G = 4.3\Omega^{⑦}$	6			$\mu\text{s}$
$t_{d(on)}$	Turn-on Delay Time	<b>Inductive Switching (25°C)</b>  $V_{CC} = 400V$ $V_{GE} = 15V$ $I_C = 100A$ $R_G = 1.0\Omega^{⑦}$ $T_J = +25^\circ\text{C}$		31		ns
$t_r$	Current Rise Time			65		
$t_{d(off)}$	Turn-off Delay Time			310		
$t_f$	Current Fall Time			55		
$E_{on1}$	Turn-on Switching Energy <sup>④</sup>			4750		$\mu\text{J}$
$E_{on2}$	Turn-on Switching Energy (Diode) <sup>⑤</sup>			5095		
$E_{off}$	Turn-off Switching Energy <sup>⑥</sup>			2675		
$t_{d(on)}$	Turn-on Delay Time	<b>Inductive Switching (125°C)</b>  $V_{CC} = 400V$ $V_{GE} = 15V$ $I_C = 100A$ $R_G = 1.0\Omega^{⑦}$ $T_J = +125^\circ\text{C}$		31		ns
$t_r$	Current Rise Time			65		
$t_{d(off)}$	Turn-off Delay Time			350		
$t_f$	Current Fall Time			85		
$E_{on1}$	Turn-on Switching Energy <sup>④</sup>			5000		$\mu\text{J}$
$E_{on2}$	Turn-on Switching Energy (Diode) <sup>⑤</sup>			6255		
$E_{off}$	Turn-off Switching Energy <sup>⑥</sup>			3300		

# THERMAL AND MECHANICAL CHARACTERISTICS

Symbol	Characteristic	MIN	TYP	MAX	UNIT
$R_{\theta JC}$	Junction to Case ( <b>IGBT</b> )			.21	$^\circ\text{C/W}$
$R_{\theta JC}$	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.)

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

⑧ Continuous current limited by package pin temperature to 100A.

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

# TYPICAL PERFORMANCE CURVES

APT100GN60B2(G)

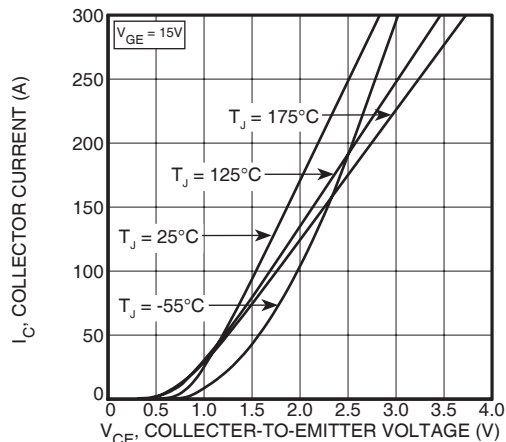


FIGURE 1, Output Characteristics( $T_J = 25^\circ\text{C}$ )

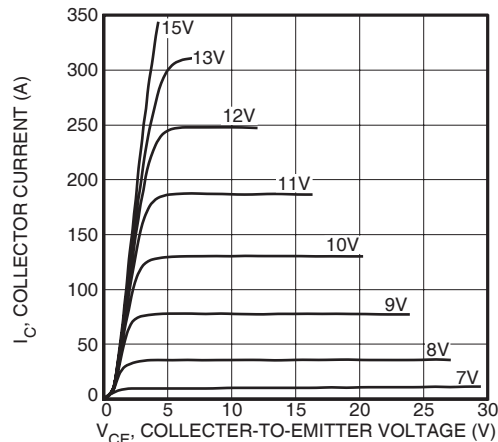


FIGURE 2, Output Characteristics ( $T_J = 125^\circ\text{C}$ )

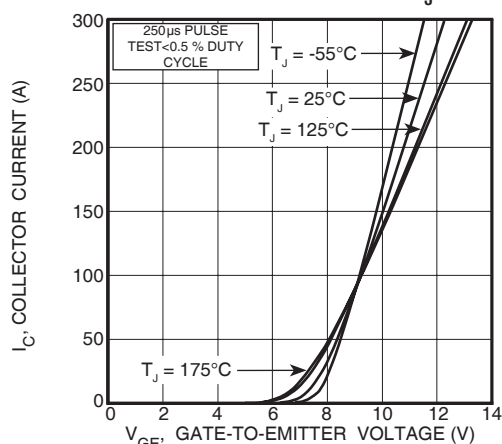


FIGURE 3, Transfer Characteristics

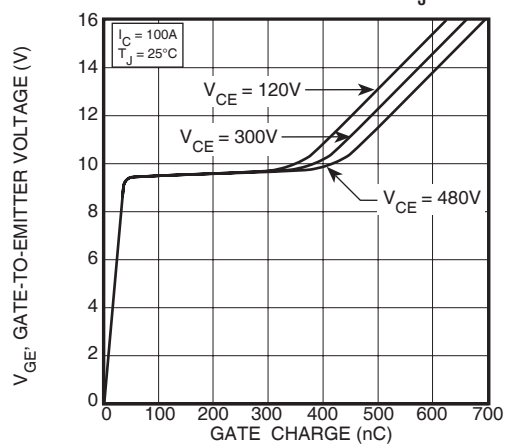


FIGURE 4, Gate Charge

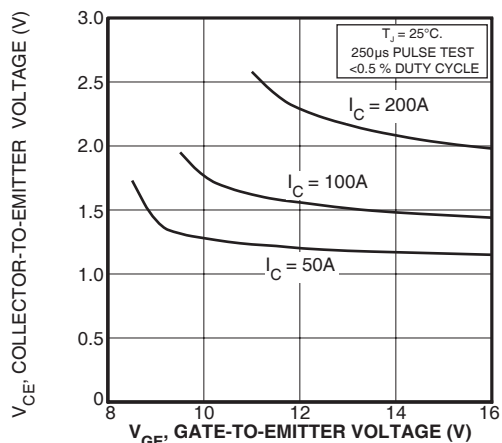


FIGURE 5, On State Voltage vs Gate-to-Emitter Voltage

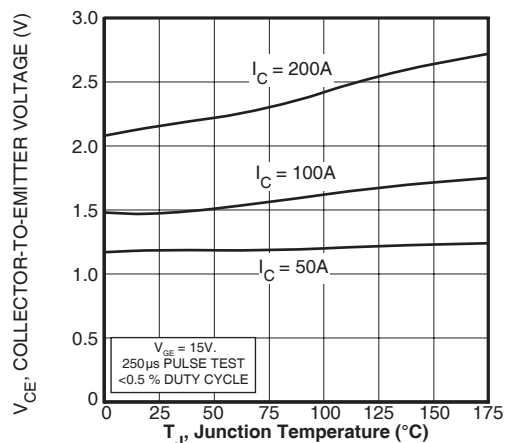


FIGURE 6, On State Voltage vs Junction Temperature

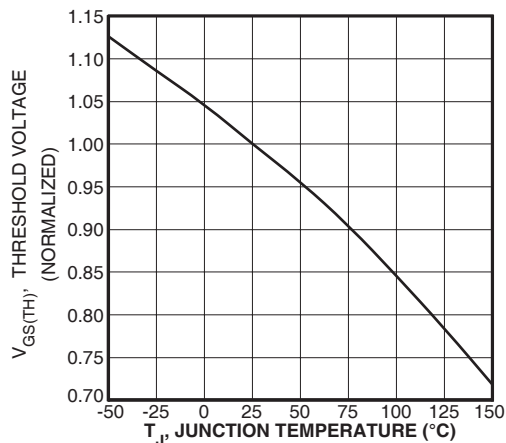


FIGURE 7, Threshold Voltage vs. Junction Temperature

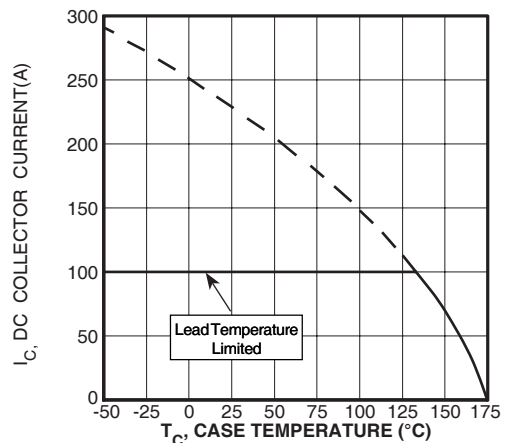


FIGURE 8, DC Collector Current vs Case Temperature

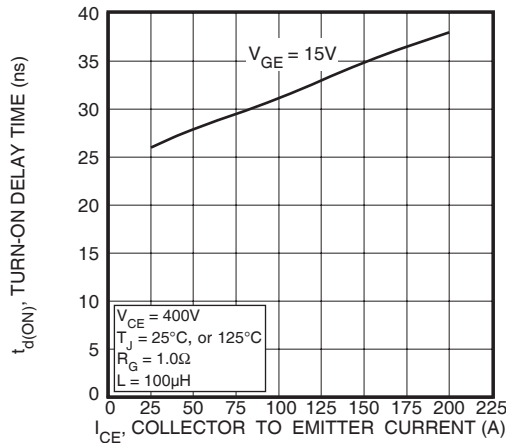


FIGURE 9, Turn-On Delay Time vs Collector Current

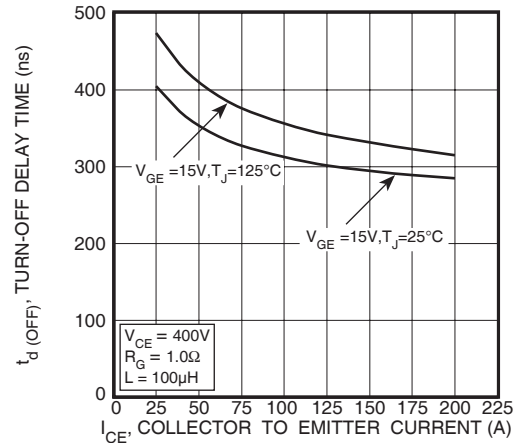


FIGURE 10, Turn-Off Delay Time vs Collector Current

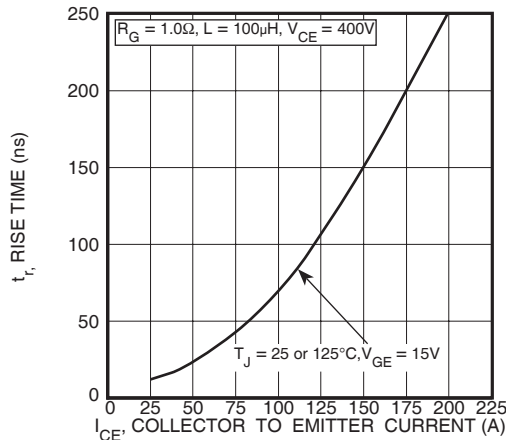


FIGURE 11, Current Rise Time vs Collector Current

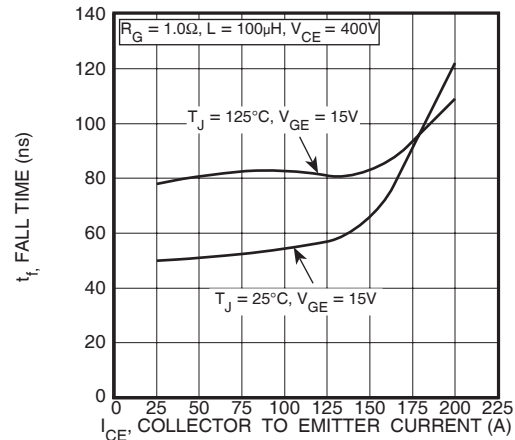


FIGURE 12, Current Fall Time vs Collector Current

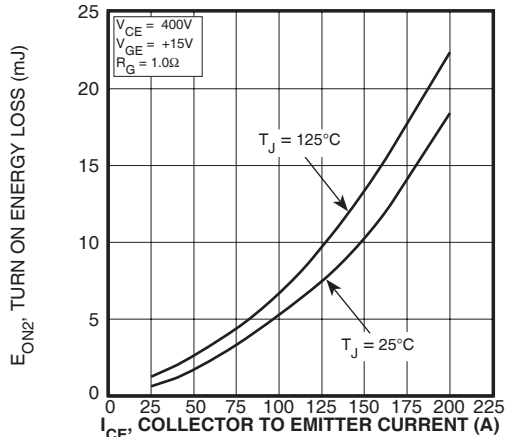


FIGURE 13, Turn-On Energy Loss vs Collector Current

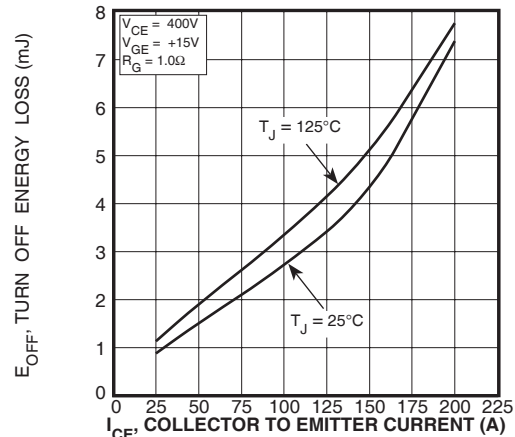


FIGURE 14, Turn Off Energy Loss vs Collector Current

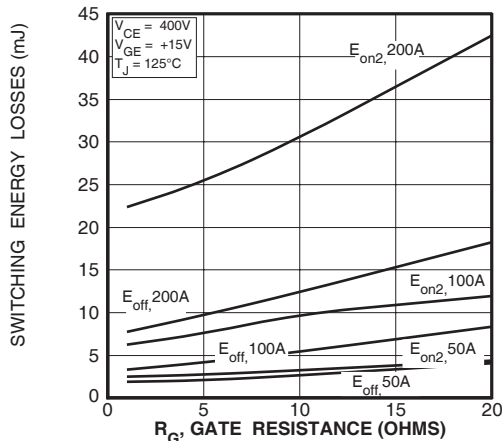


FIGURE 15, Switching Energy Losses vs. Gate Resistance

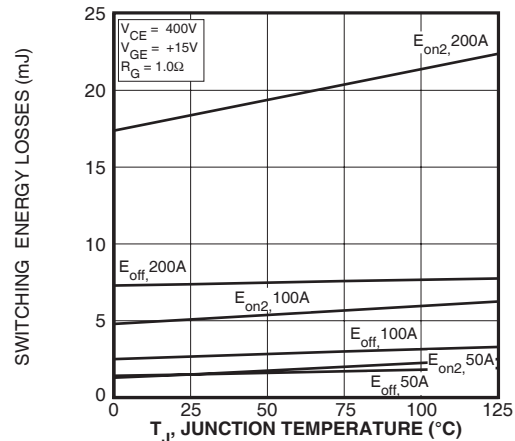


FIGURE 16, Switching Energy Losses vs Junction Temperature

## TYPICAL PERFORMANCE CURVES

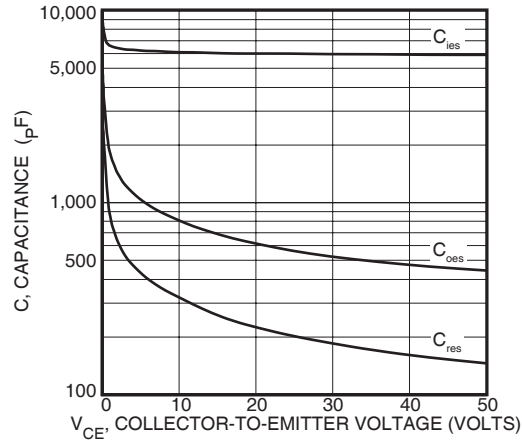


Figure 17, Capacitance vs Collector-To-Emitter Voltage

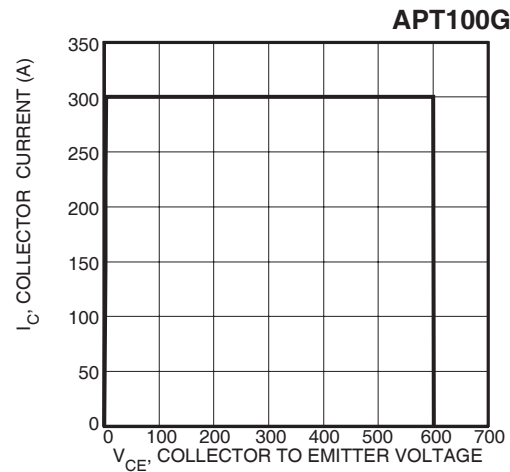


Figure 18, Minimum Switching Safe Operating Area

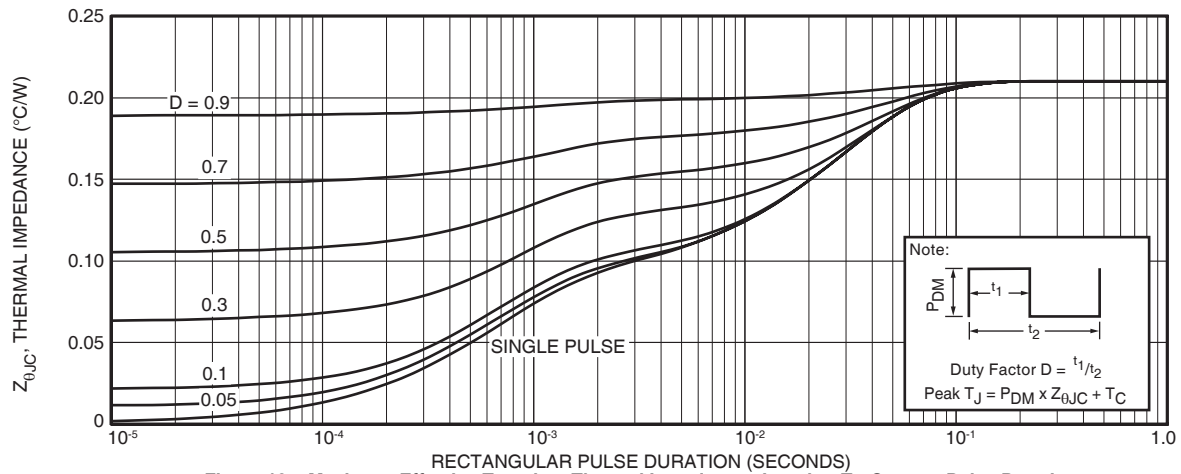


Figure 19a, Maximum Effective Transient Thermal Impedance, Junction-To-Case vs Pulse Duration

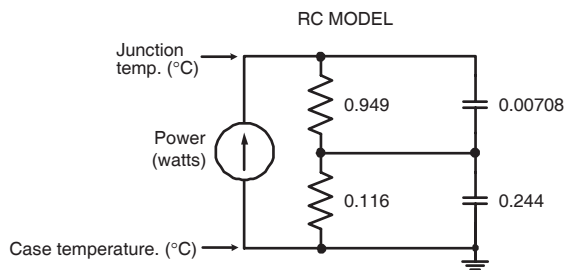


FIGURE 19b, TRANSIENT THERMAL IMPEDANCE MODEL

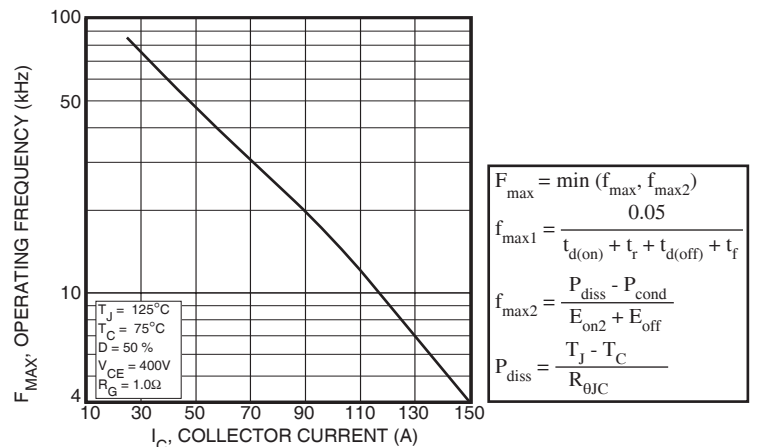


Figure 20, Operating Frequency vs Collector Current

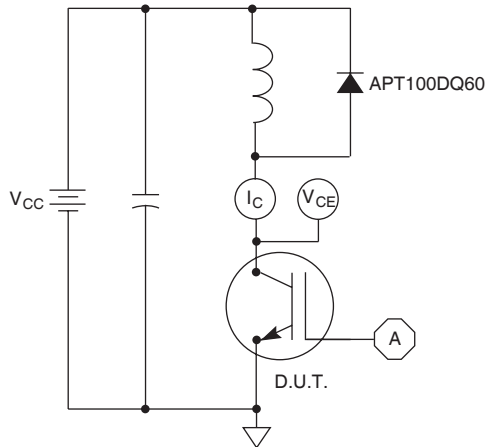


Figure 21, Inductive Switching Test Circuit

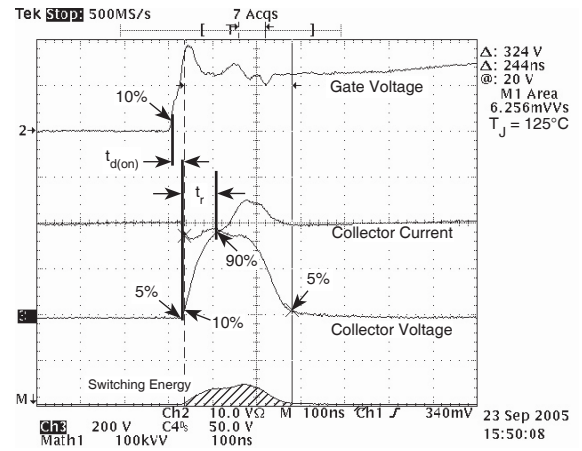


Figure 22, Turn-on Switching Waveforms and Definitions

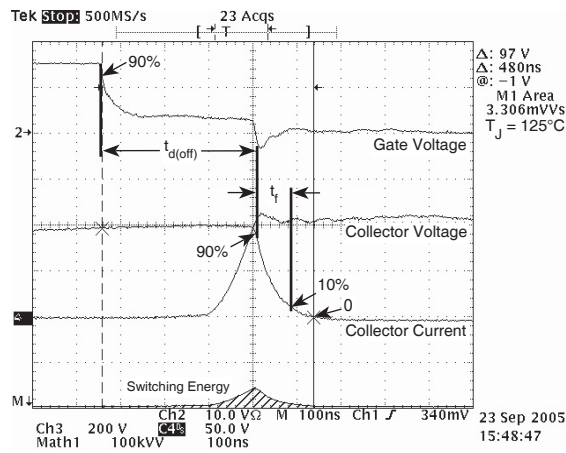
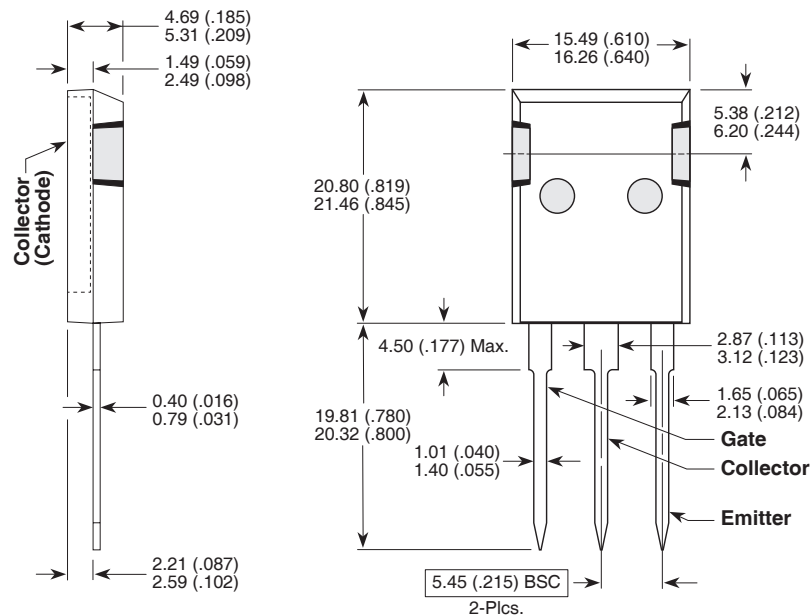


Figure 23, Turn-off Switching Waveforms and Definitions

## T-MAX® (B2) Package Outline

(e1) SAC: Tin, Silver, Copper



Dimensions in Millimeters and (Inches)