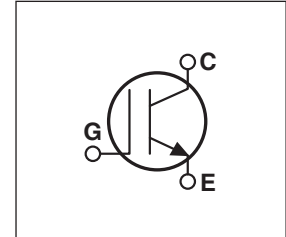
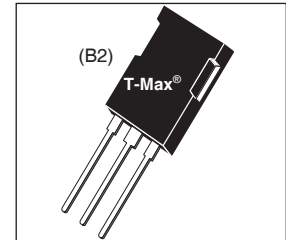


Utilizing the latest Non-Punch Through (NPT) Field Stop technology, these IGBT's have a very short, low amplitude tail current and low Eoff. The Trench Gate design results in superior  $V_{CE(on)}$  performance. Easy paralleling results from very tight parameter distribution and slightly positive  $V_{CE(on)}$  temperature coefficient. Built-in gate resistance ensures ultra-reliable operation. Low gate charge simplifies gate drive design and minimizes losses.

- **1200V NPT 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, SMPS, Motor drives, UPS**

### MAXIMUM RATINGS

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

Symbol	Parameter	APT50GN120B2(G)	UNIT
$V_{CES}$	Collector-Emitter Voltage	1200	Volts
$V_{GE}$	Gate-Emitter Voltage	$\pm 30$	
$I_{C1}$	Continuous Collector Current <sup>(3)</sup> @ $T_C = 25^\circ\text{C}$	134	Amps
$I_{C2}$	Continuous Collector Current @ $T_C = 110^\circ\text{C}$	66	
$I_{CM}$	Pulsed Collector Current <sup>(1)</sup> @ $T_C = 150^\circ\text{C}$	150	
SSOA	Switching Safe Operating Area @ $T_J = 150^\circ\text{C}$	150A @ 1200V	
$P_D$	Total Power Dissipation	543	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 ( $V_{GE} = 0V, I_C = 400\mu\text{A}$ )	1200			Volts
$V_{GE(TH)}$	Gate Threshold Voltage ( $V_{CE} = V_{GE}, I_C = 2\text{mA}, T_J = 25^\circ\text{C}$ )	5	5.8	6.5	
$V_{CE(ON)}$	Collector-Emitter On Voltage ( $V_{GE} = 15V, I_C = 50A, T_J = 25^\circ\text{C}$ )	1.4	1.7	2.1	
	Collector-Emitter On Voltage ( $V_{GE} = 15V, I_C = 50A, T_J = 125^\circ\text{C}$ )		1.9		
$I_{CES}$	Collector Cut-off Current ( $V_{CE} = 1200V, V_{GE} = 0V, T_J = 25^\circ\text{C}$ ) <sup>(2)</sup>			100	$\mu\text{A}$
	Collector Cut-off Current ( $V_{CE} = 1200V, V_{GE} = 0V, T_J = 125^\circ\text{C}$ ) <sup>(2)</sup>			TBD	
$I_{GES}$	Gate-Emitter Leakage Current ( $V_{GE} = \pm 20V$ )			600	nA
$R_{GINT}$	Intergrated Gate Resistor		4		$\Omega$

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

## DYNAMIC CHARACTERISTICS

APT50GN120B2(G)

Symbol	Characteristic	Test Conditions	MIN	TYP	MAX	UNIT	
$C_{ies}$	Input Capacitance	<b>Capacitance</b> $V_{GE} = 0V, V_{CE} = 25V$ $f = 1 \text{ MHz}$		3600		pF	
$C_{oes}$	Output Capacitance			210			
$C_{res}$	Reverse Transfer Capacitance			170			
$V_{GEP}$	Gate-to-Emitter Plateau Voltage	Gate Charge $V_{GE} = 15V$ $V_{CE} = 600V$ $I_C = 50A$		9.5		V	
$Q_g$	Total Gate Charge <sup>③</sup>			315			
$Q_{ge}$	Gate-Emitter Charge			20			
$Q_{gc}$	Gate-Collector ("Miller") Charge			190			
SSOA	Switching Safe Operating Area	$T_J = 150^\circ\text{C}, R_G = 2.2\Omega^{\text{⑦}}, V_{GE} = 15V, L = 100\mu\text{H}, V_{CE} = 1200V$	150			A	
SCSOA	Short Circuit Safe Operating Area	$V_{CC} = 960V, V_{GE} = 15V, T_J = 125^\circ\text{C}, R_G = 2.2\Omega^{\text{⑦}}$	10			$\mu\text{s}$	
$t_{d(on)}$	Turn-on Delay Time	<b>Inductive Switching (25°C)</b> $V_{CC} = 800V$ $V_{GE} = 15V$ $I_C = 50A$ $R_G = 2.2\Omega^{\text{⑦}}$ $T_J = +25^\circ\text{C}$		28		ns	
$t_r$	Current Rise Time			27			
$t_{d(off)}$	Turn-off Delay Time			320			
$t_f$	Current Fall Time			115			
$E_{on1}$	Turn-on Switching Energy <sup>④</sup>				TBD		$\mu\text{J}$
$E_{on2}$	Turn-on Switching Energy (Diode) <sup>⑤</sup>				3900		
$E_{off}$	Turn-off Switching Energy <sup>⑥</sup>				4495		
$t_{d(on)}$	Turn-on Delay Time		<b>Inductive Switching (125°C)</b> $V_{CC} = 800V$ $V_{GE} = 15V$ $I_C = 50A$ $R_G = 2.2\Omega^{\text{⑦}}$ $T_J = +125^\circ\text{C}$		28		ns
$t_r$	Current Rise Time			27			
$t_{d(off)}$	Turn-off Delay Time			395			
$t_f$	Current Fall Time			205			
$E_{on1}$	Turn-on Switching Energy <sup>④</sup>				TBD		$\mu\text{J}$
$E_{on2}$	Turn-on Switching Energy (Diode) <sup>⑤</sup>				5660		
$E_{off}$	Turn-off Switching Energy <sup>⑥</sup>				6795		

## THERMAL AND MECHANICAL CHARACTERISTICS

Symbol	Characteristic	MIN	TYP	MAX	UNIT
$R_{\theta JC}$	Junction to Case (IGBT)			.23	$^\circ\text{C/W}$
$R_{\theta JC}$	Junction to Case (DIODE)			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. (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.)
- ⑦  $R_G$  is external gate resistance, not including  $R_{Gint}$  nor gate driver impedance.
- ⑧ Continuous current limited by package lead temperature.

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

# TYPICAL PERFORMANCE CURVES

APT50GN120B2(G)

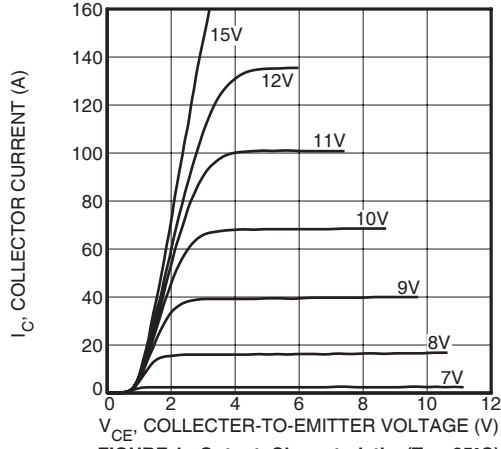


FIGURE 1, Output Characteristics ( $T_J = 25^\circ\text{C}$ )

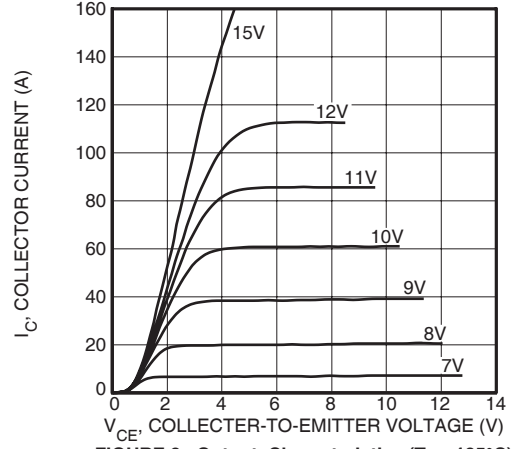


FIGURE 2, Output Characteristics ( $T_J = 125^\circ\text{C}$ )

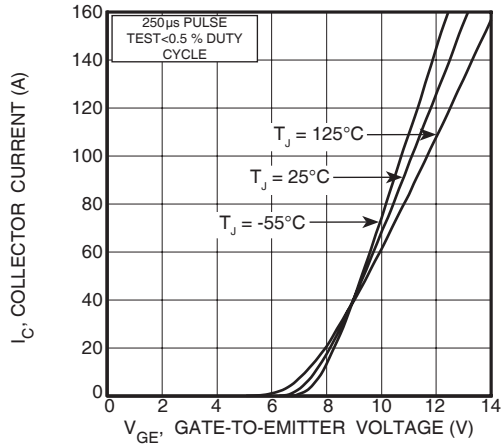


FIGURE 3, Transfer Characteristics

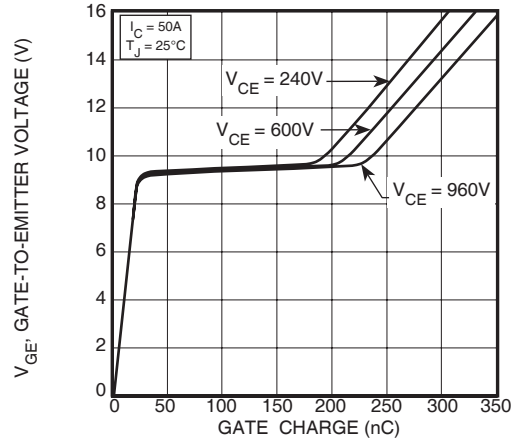


FIGURE 4, Gate Charge

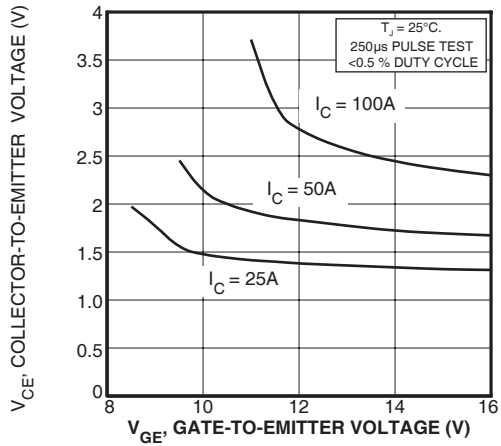


FIGURE 5, On State Voltage vs Gate-to-Emitter Voltage

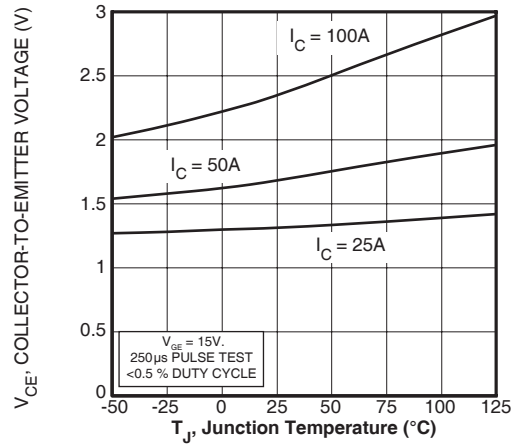


FIGURE 6, On State Voltage vs Junction Temperature

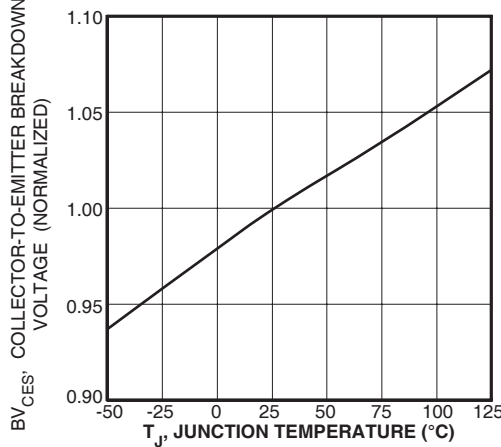


FIGURE 7, Breakdown Voltage vs. Junction Temperature

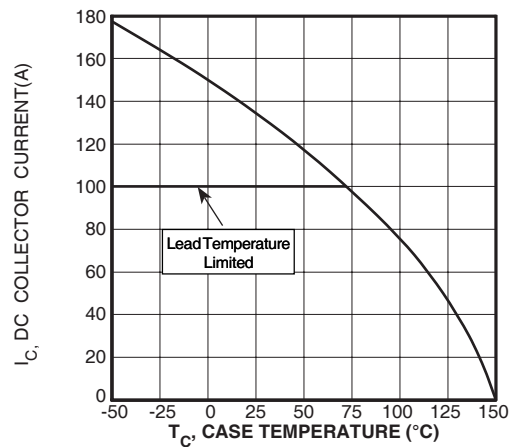


FIGURE 8, DC Collector Current vs Case Temperature

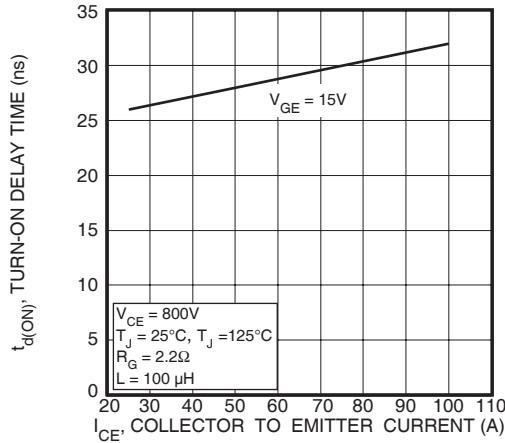


FIGURE 9, Turn-On Delay Time vs Collector Current

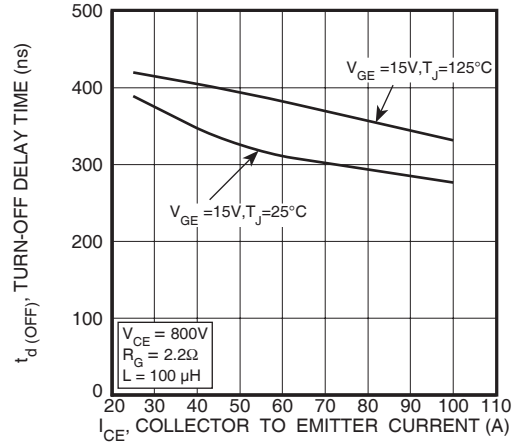


FIGURE 10, Turn-Off Delay Time vs Collector Current

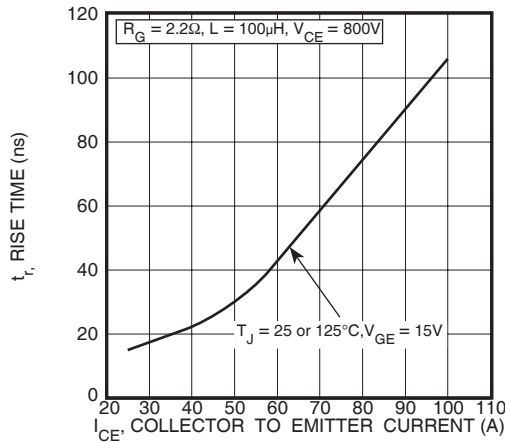


FIGURE 11, Current Rise Time vs Collector Current

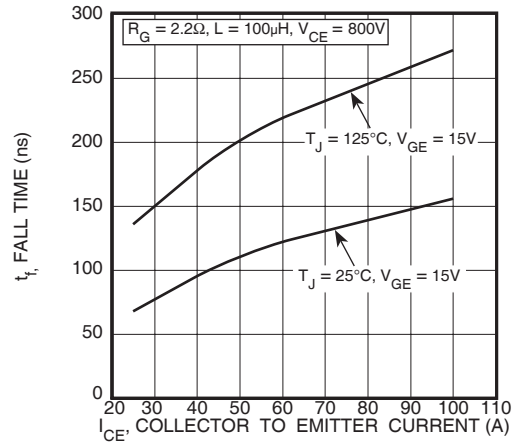


FIGURE 12, Current Fall Time vs Collector Current

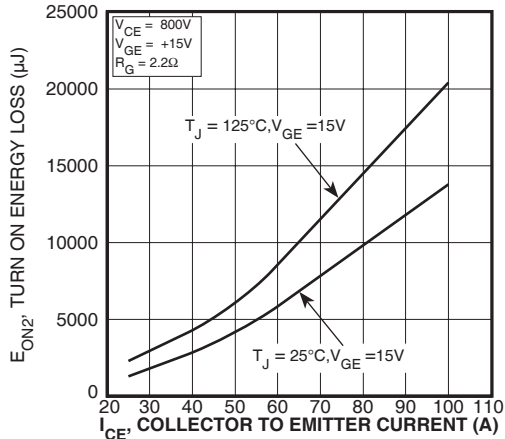


FIGURE 13, Turn-On Energy Loss vs Collector Current

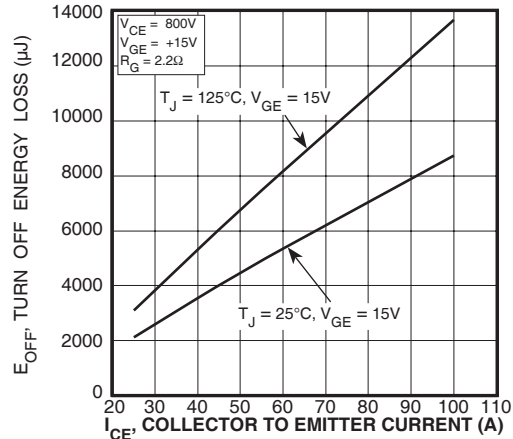


FIGURE 14, Turn Off Energy Loss vs Collector Current

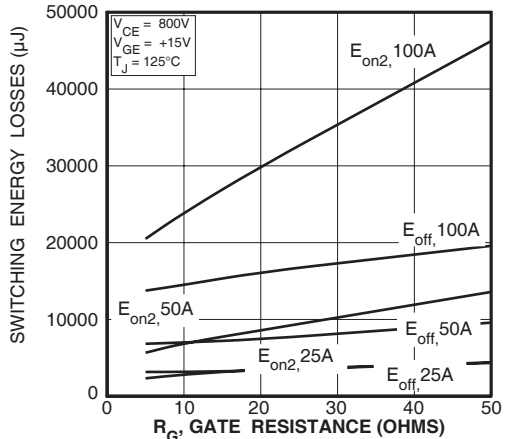


FIGURE 15, Switching Energy Losses vs. Gate Resistance

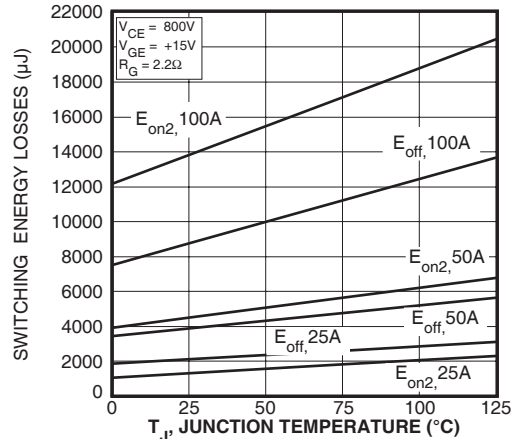


FIGURE 16, Switching Energy Losses vs Junction Temperature

# TYPICAL PERFORMANCE CURVES

APT50GN120B2(G)

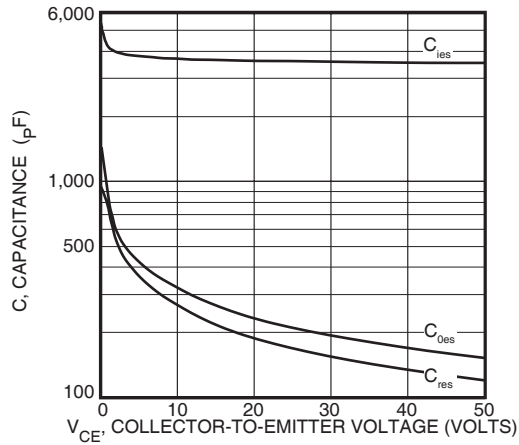


Figure 17, Capacitance vs Collector-To-Emitter Voltage

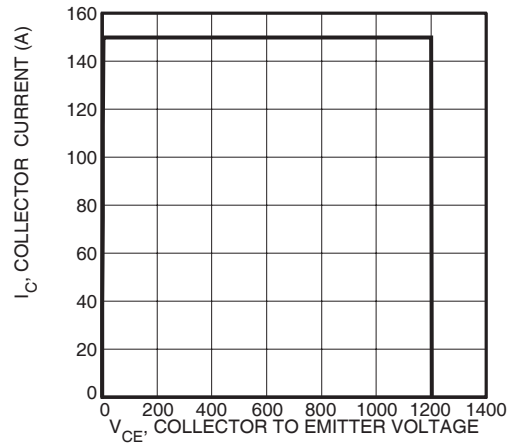


Figure 18, Minimum Switching Safe Operating Area

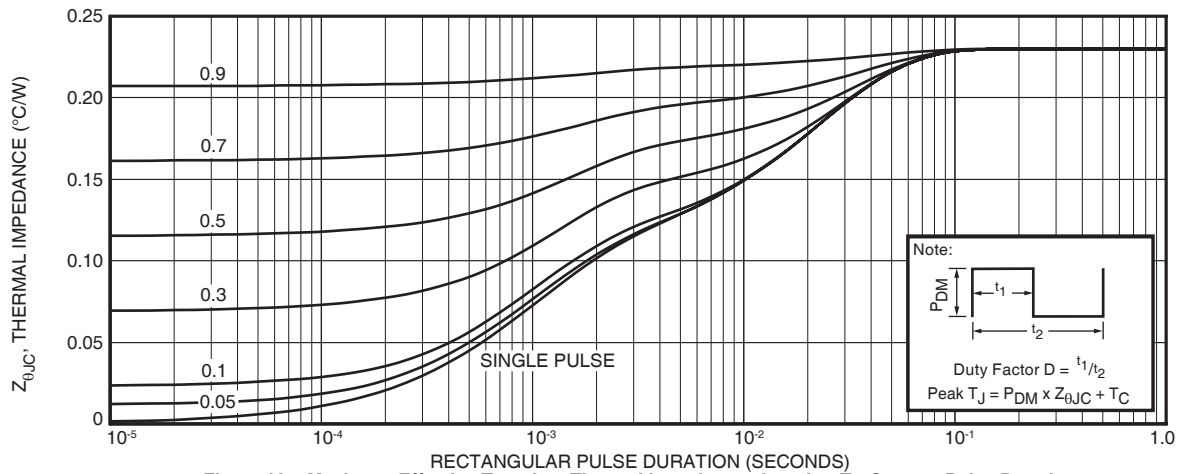


Figure 19a, Maximum Effective Transient Thermal Impedance, Junction-To-Case vs Pulse Duration

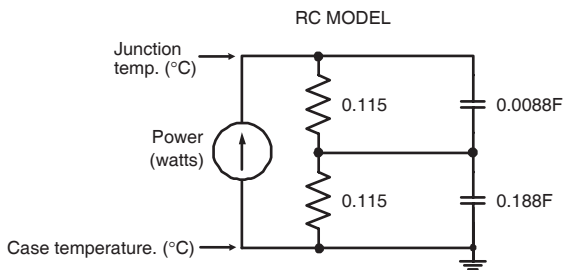


FIGURE 19b, TRANSIENT THERMAL IMPEDANCE MODEL

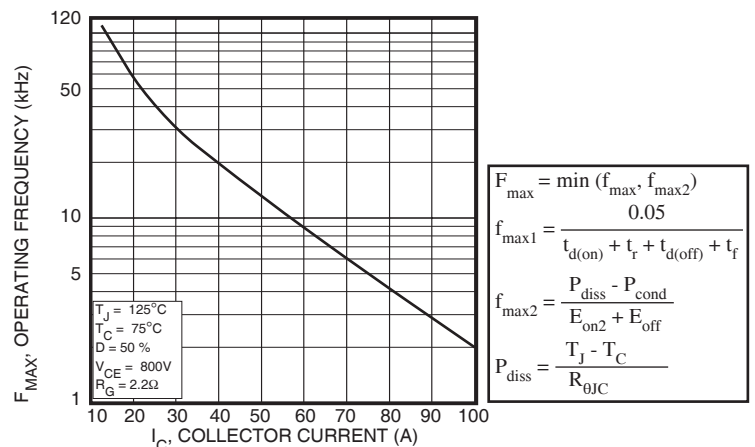


Figure 20, Operating Frequency vs Collector Current

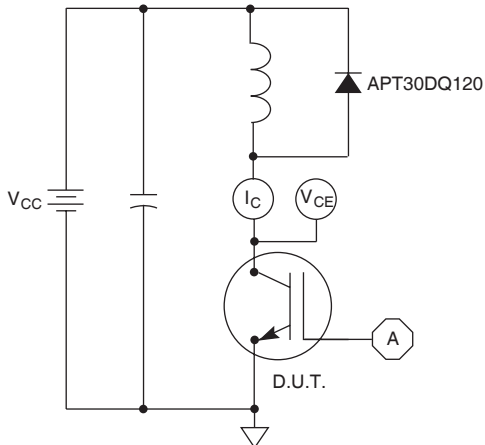


Figure 21, Inductive Switching Test Circuit

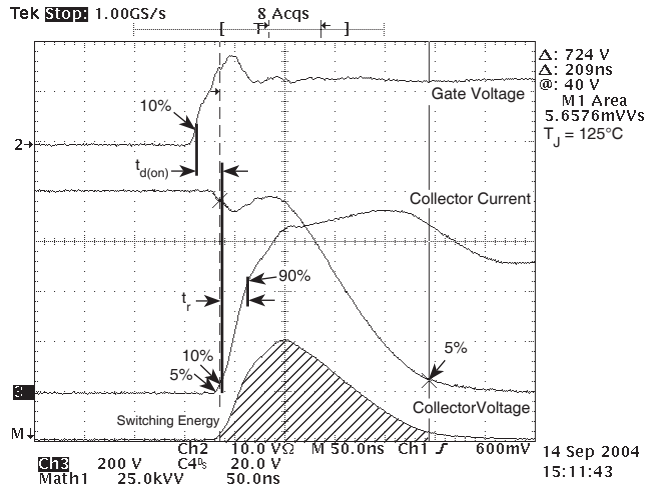


Figure 22, Turn-on Switching Waveforms and Definitions

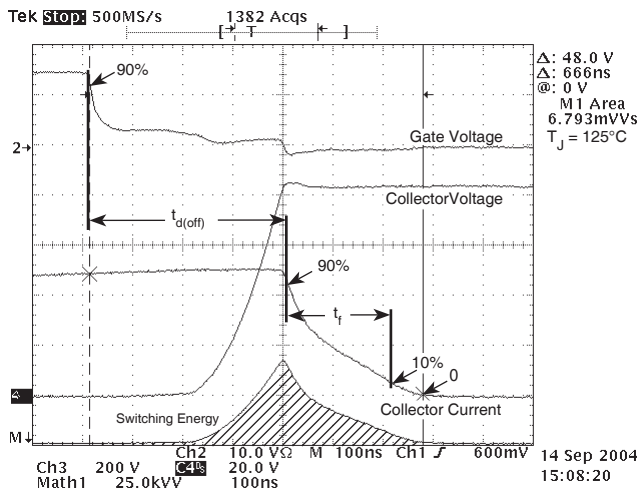


Figure 23, Turn-off Switching Waveforms and Definitions

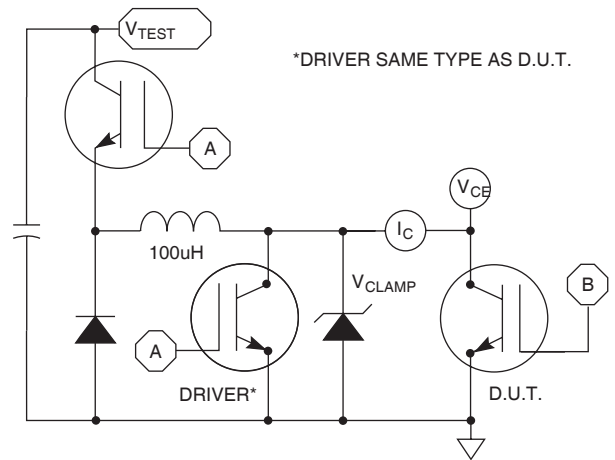
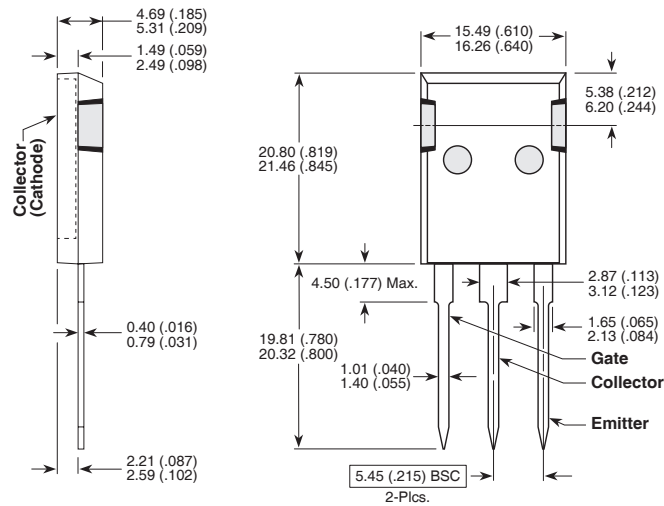


Figure 24, E<sub>ON1</sub> Test Circuit

### T-MAX™ (B2) Package Outline

Ⓧ1 SAC: Tin, Silver, Copper



Dimensions in Millimeters and (Inches)