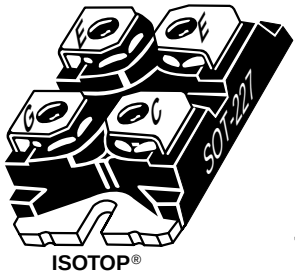
APT65GP60J

600V

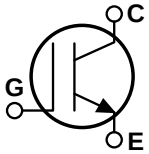
POWER MOS 7® IGBT



ISOTOP®

The POWER MOS 7® IGBT is a new generation of high voltage power IGBTs. Using Punch Through Technology this IGBT is ideal for many high frequency, high voltage switching applications and has been optimized for high frequency switchmode power supplies.

- **Low Conduction Loss**
- **Low Gate Charge**
- **Ultrafast Tail Current shutoff**
- **100 kHz operation @ 400V, 33A**
- **50 kHz operation @ 400V, 47A**
- **SSOA rated**



MAXIMUM RATINGS All Ratings: T_C = 25°C unless otherwise specified.

Symbol	Parameter	APT65GP60J	UNIT
V_{CES}	Collector-Emitter Voltage	600	Volts
V_{GE}	Gate-Emitter Voltage	±20	
V_{GEM}	Gate-Emitter Voltage Transient	±30	
I_{C1}	Continuous Collector Current @ T_C = 25°C	130	Amps
I_{C2}	Continuous Collector Current @ T_C = 110°C	60	
I_{CM}	Pulsed Collector Current ① @ T_C = 25°C	250	
SSOA	Safe Operating Area @ T_J = 150°C	250A@600V	
P_D	Total Power Dissipation	431	Watts
T_J,T_{STG}	Operating and Storage Junction Temperature Range	-55 to 150	°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 = 1000µA)	600			Volts
$V_{GE(TH)}$	Gate Threshold Voltage (V_{CE} = V_{GE}, I_C = 2.5mA, T_j = 25°C)	3	4.5	6	
$V_{CE(ON)}$	Collector-Emitter On Voltage (V_{GE} = 15V, I_C = 65A, T_j = 25°C)		2.2	2.7	
	Collector-Emitter On Voltage (V_{GE} = 15V, I_C = 65A, T_j = 125°C)		2.1		
I_{CES}	Collector Cut-off Current (V_{CE} = 600V, V_{GE} = 0V, T_j = 25°C) ②			1000	µA
	Collector Cut-off Current (V_{CE} = 600V, V_{GE} = 0V, T_j = 125°C) ②			5000	
I_{GES}	Gate-Emitter Leakage Current (V_{GE} = ±20V)			±100	nA

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

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

050-7439 Rev A 4-2003

DYNAMIC CHARACTERISTICS

Symbol	Characteristic	Test Conditions	MIN	TYP	MAX	UNIT
C_{ies}	Input Capacitance	**Capacitance**		7400		
C_{oes}	Output Capacitance	V_{GE} = 0V, V_{CE} = 25V		580		pF
C_{res}	Reverse Transfer Capacitance	f = 1 MHz		35		
V_{GEP}	Gate-to-Emitter Plateau Voltage	**Gate Charge**		7.5		V
Q_g	Total Gate Charge ③	V_{GE} = 15V		210		
Q_{ge}	Gate-Emitter Charge	V_{CE} = 300V		50		nC
Q_{gc}	Gate-Collector ("Miller") Charge	I_C = 65A		65		
SSOA	Safe Operating Area	T_J = 150°C, R_G = 5Ω, V_{GE} = 15V, L = 100µH, V_{CE} = 600V	250			A
$t_{d(on)}$	Turn-on Delay Time	**Inductive Switching (25°C)**		30		
t_r	Current Rise Time	V_{CC} = 400V		54		ns
$t_{d(off)}$	Turn-off Delay Time	V_{GE} = 15V		91		
t_f	Current Fall Time	I_C = 65A		65		
E_{on1}	Turn-on Switching Energy ④	R_G = 5Ω		605		
E_{on2}	Turn-on Switching Energy (Diode) ⑤	T_J = +25°C		1408		µJ
E_{off}	Turn-off Switching Energy ⑥			896		
$t_{d(on)}$	Turn-on Delay Time	**Inductive Switching (125°C)**		30		
t_r	Current Rise Time	V_{CC} = 400V		54		ns
$t_{d(off)}$	Turn-off Delay Time	V_{GE} = 15V		128		
t_f	Current Fall Time	I_C = 65A		91		
E_{on1}	Turn-on Switching Energy ④	R_G = 5Ω		605		
E_{on2}	Turn-on Switching Energy (Diode) ⑤	T_J = +125°C		1925		µJ
E_{off}	Turn-off Switching Energy ⑥			1470		

THERMAL AND MECHANICAL CHARACTERISTICS

Symbol	Characteristic	MIN	TYP	MAX	UNIT
$R_{\Theta JC}$	Junction to Case (IGBT)			.29	°C/W
$R_{\Theta JC}$	Junction to Case (DIODE)			N/A	
W_T	Package Weight			29.2	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. A Combi device is used for the clamping diode as shown in the E_{on2} test circuit. (See Figures 21, 22.)

⑥ E_{off} is the clamped inductive turn-off energy measured in accordance with JEDEC standard JEDS24-1. (See Figures 21, 23.)

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

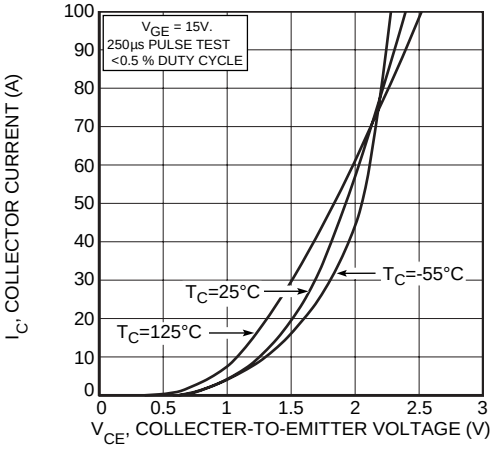


FIGURE 1, Output Characteristics(V_{GE} = 15V)

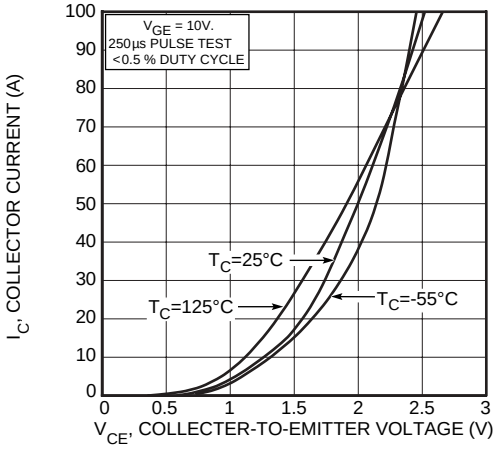


FIGURE 2, Output Characteristics (V_{GE} = 10V)

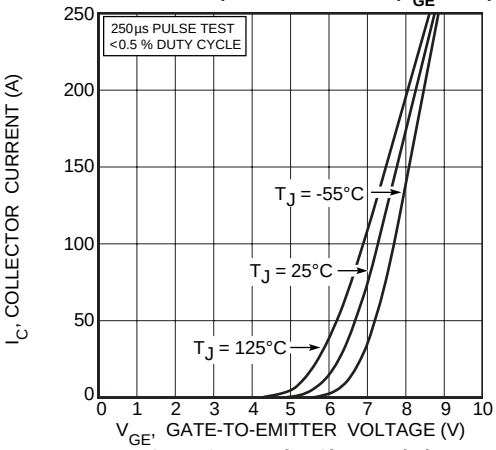


FIGURE 3, Transfer Characteristics

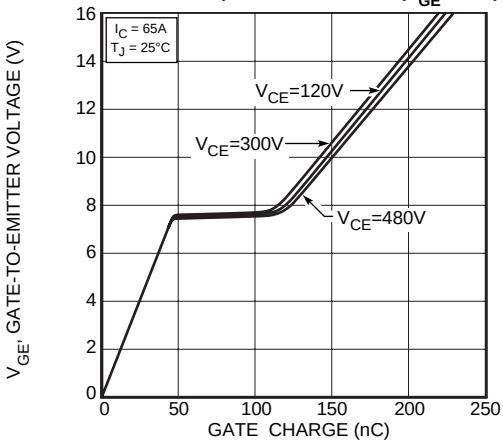


FIGURE 4, Gate Charge

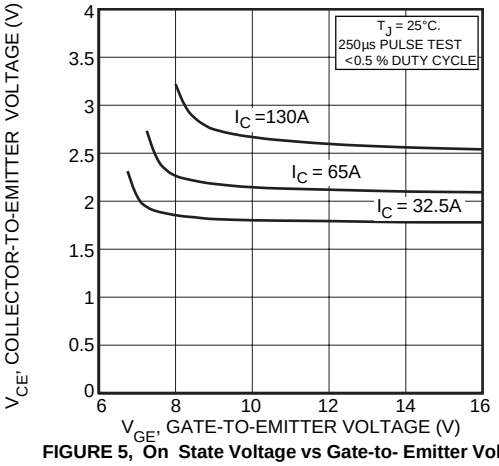


FIGURE 5, On State Voltage vs Gate-to- Emitter Voltage

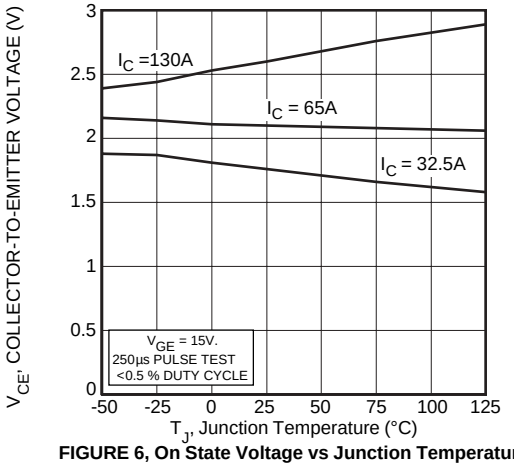


FIGURE 6, On State Voltage vs Junction Temperature

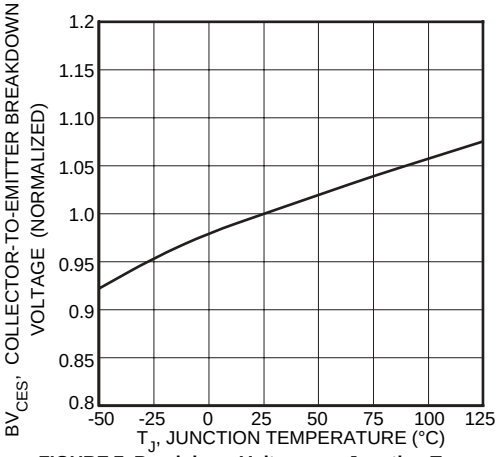


FIGURE 7, Breakdown Voltage vs. Junction Temperature

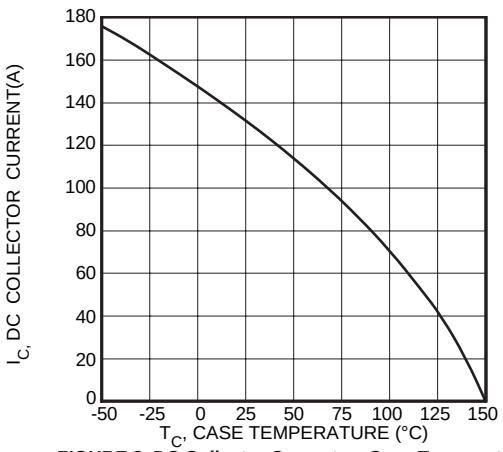


FIGURE 8, DC Collector Current vs Case Temperature

TYPICAL PERFORMANCE CURVES

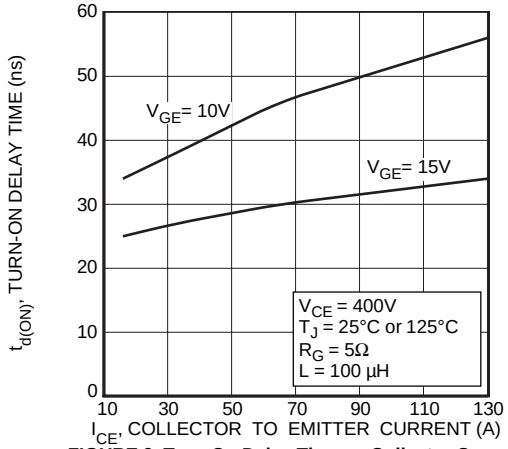


FIGURE 9, Turn-On Delay Time vs Collector Current

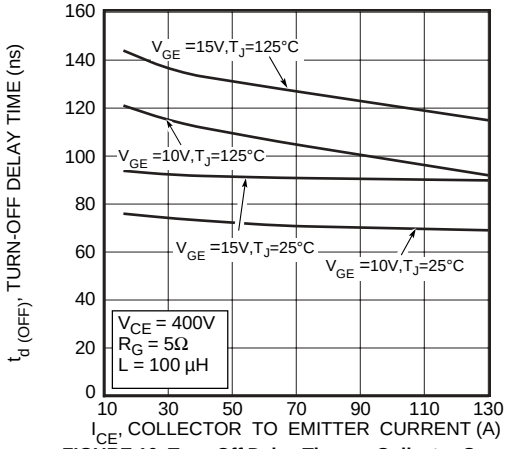


FIGURE 10, Turn-Off Delay Time vs Collector Current

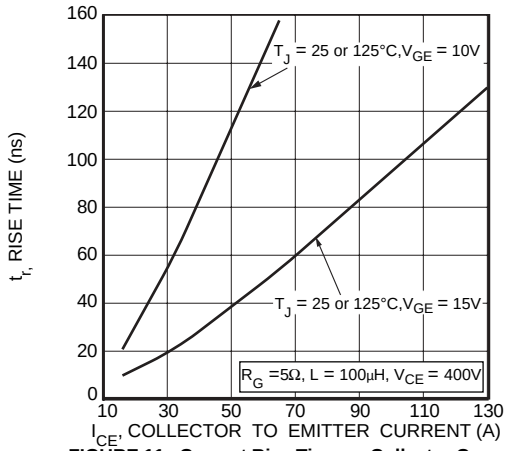


FIGURE 11, Current Rise Time vs Collector Current

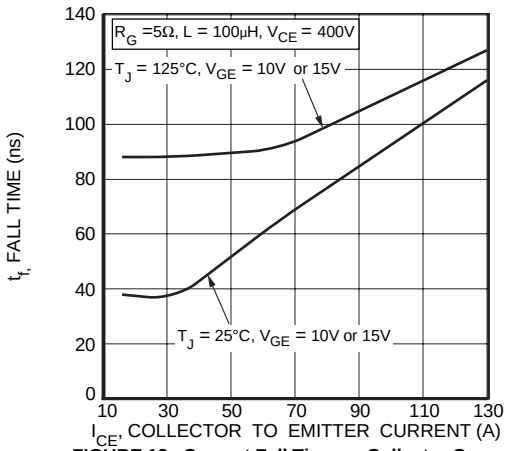


FIGURE 12, Current Fall Time vs Collector Current

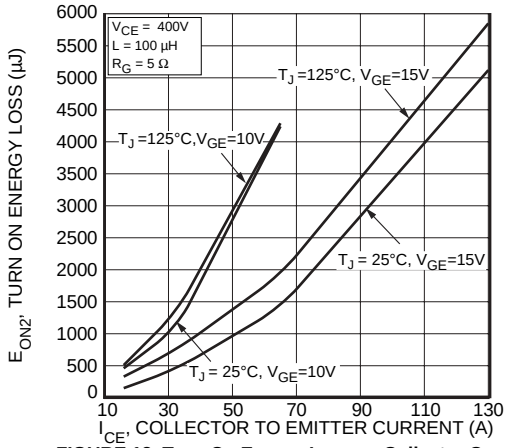


FIGURE 13, Turn-On Energy Loss vs Collector Current

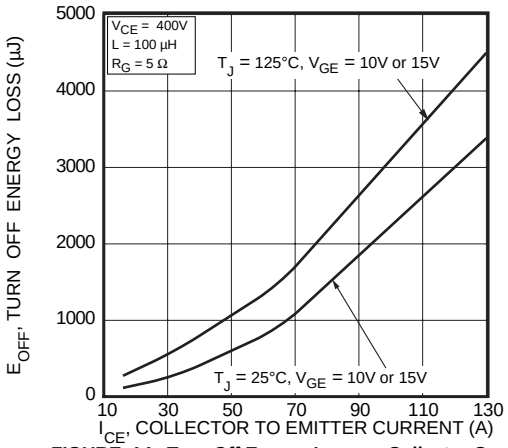


FIGURE 14, Turn Off Energy Loss vs Collector Current

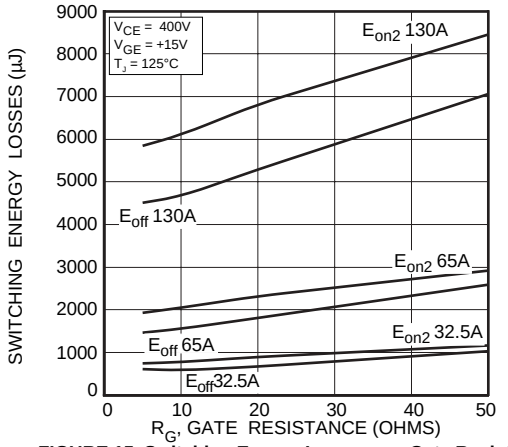


FIGURE 15, Switching Energy Losses vs. Gate Resistance

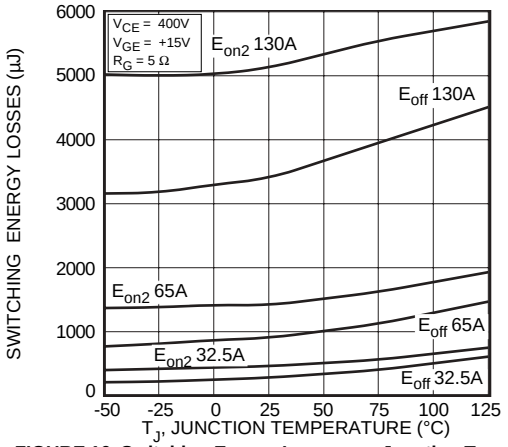


FIGURE 16, Switching Energy Losses vs Junction Temperature

TYPICAL PERFORMANCE CURVES

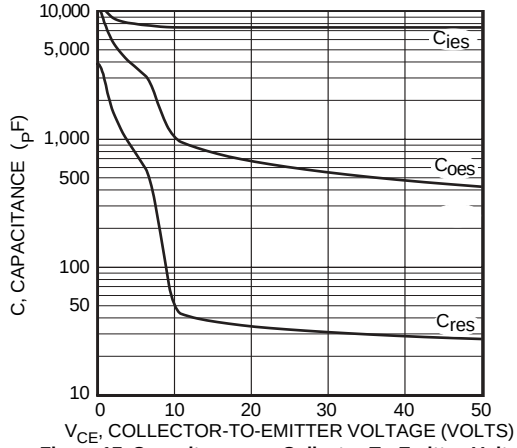


Figure 17, Capacitance vs Collector-To-Emitter Voltage

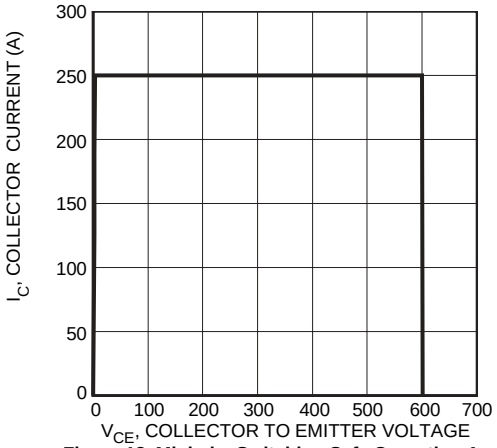


Figure 18, Minimim Switching Safe Operating Area

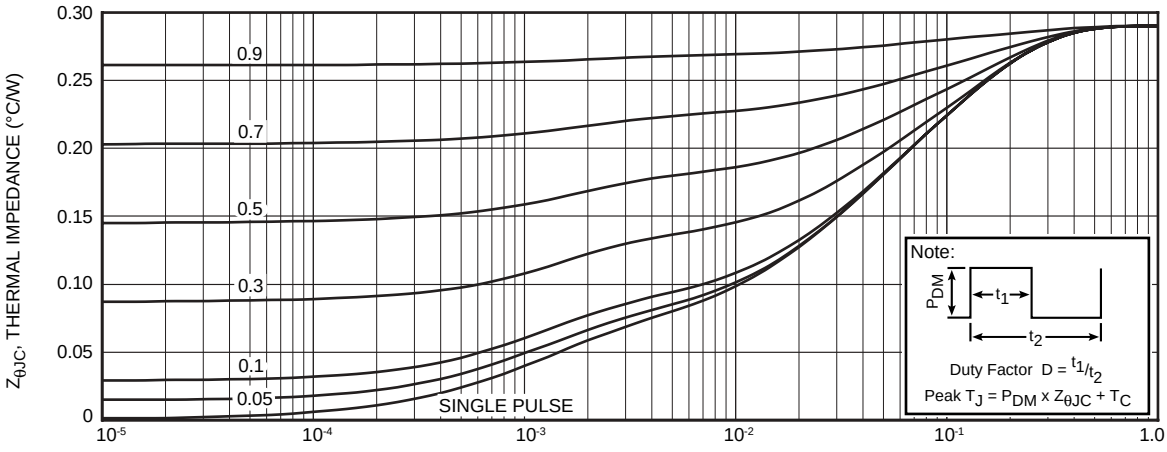


Figure 19A, Maximum Effective Transient Thermal Impedance, Junction-To-Case vs Pulse Duration

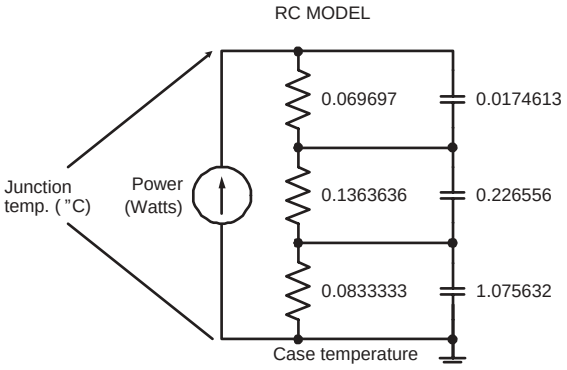


FIGURE 19B, TRANSIENT THERMAL IMPEDANCE MODEL

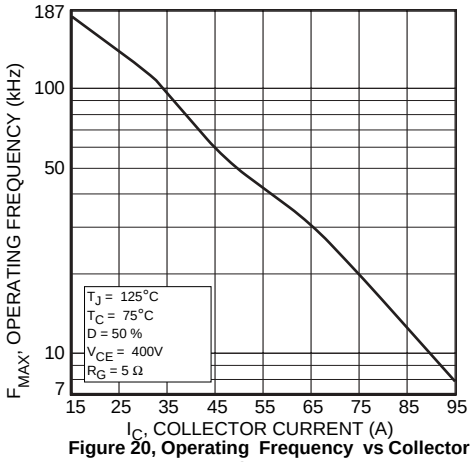


Figure 20, Operating Frequency vs Collector Current

$$F_{max} = \min(f_{max1}, f_{max2})$$

$$f_{max1} = \frac{0.05}{t_{d(on)} + t_r + t_{d(off)} + t_f}$$

$$f_{max2} = \frac{P_{diss} - P_{cond}}{E_{on2} + E_{off}}$$

$$P_{diss} = \frac{T_J - T_C}{R_{\theta JC}}$$

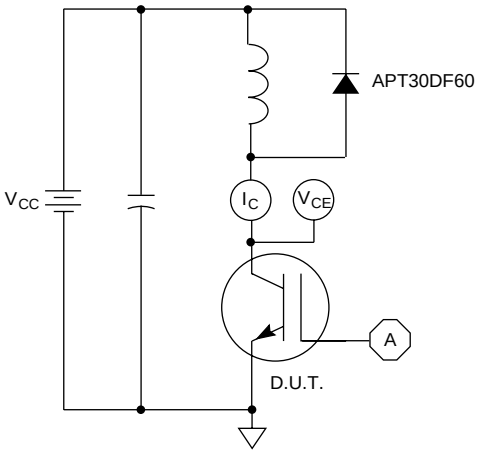


Figure 21, Inductive Switching Test Circuit

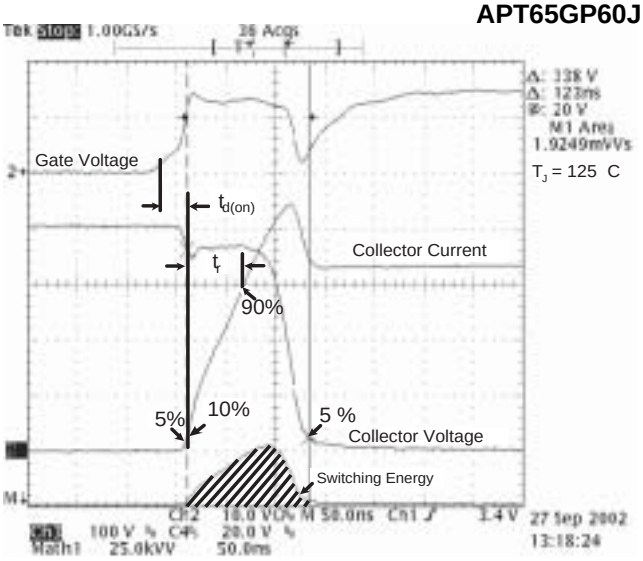


Figure 22, Turn-on Switching Waveforms and Definitions

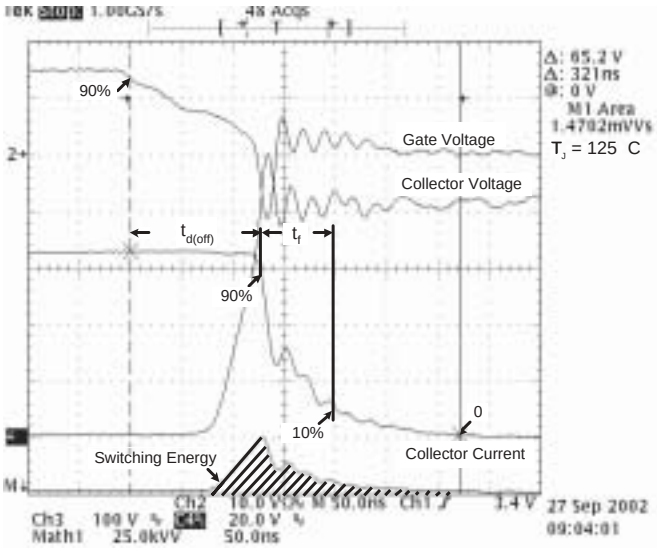


Figure 23, Turn-off Switching Waveforms and Definitions

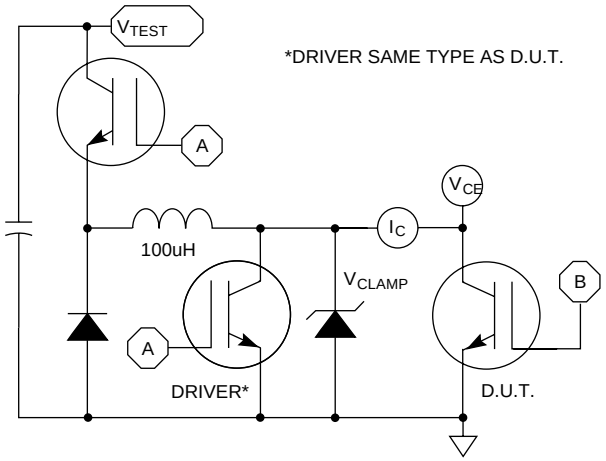
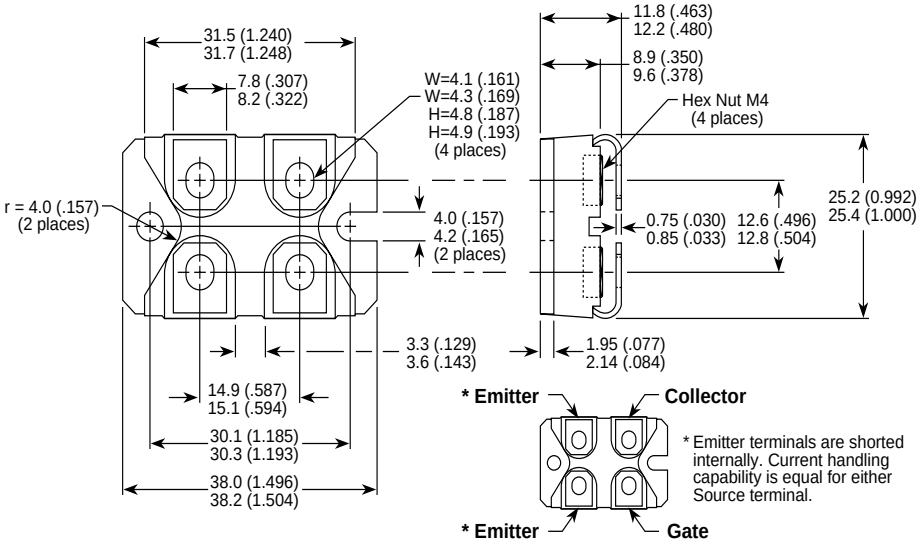


Figure 24, E_{ON1} Test Circuit

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.