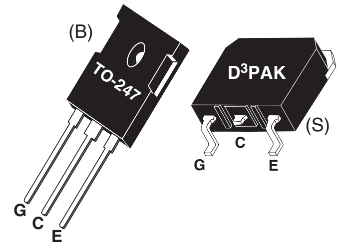
Microsemi
POWER PRODUCTS GROUP

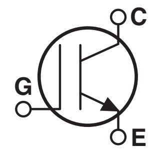
APT50GN60B APT50GN60S APT50GN60B(G) APT50GN60S(G) 600V

*G Denotes RoHS Compliant, Pb Free Terminal Finish.

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. Low gate charge simplifies gate drive design and minimizes losses.



- **600V Field Stop**
- **Trench Gate: Low $V_{CE(on)}$**
- **Easy Paralleling**
- **6µs Short Circuit Capability**
- **175°C Rated**



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

MAXIMUM RATINGS

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

Symbol	Parameter	APT50GN60B(G)	UNIT
V_{CES}	Collector-Emitter Voltage	600	Volts
V_{GE}	Gate-Emitter Voltage	±30	
I_{C1}	Continuous Collector Current ⑧ @ T_C = 25°C	107	Amps
I_{C2}	Continuous Collector Current @ T_C = 110°C	64	
I_{CM}	Pulsed Collector Current ① @ T_C = 175°C	150	
SSOA	Switching Safe Operating Area @ T_J = 175°C	150A @ 600V	
P_D	Total Power Dissipation	366	Watts
T_J,T_{STG}	Operating and Storage Junction Temperature Range	-55 to 175	°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 = 800µA, T_j = 25°C)	5.0	5.8	6.5	
$V_{CE(ON)}$	Collector-Emitter On Voltage (V_{GE} = 15V, I_C = 50A, T_j = 25°C)	1.05	1.45	1.85	
	Collector-Emitter On Voltage (V_{GE} = 15V, I_C = 50A, T_j = 125°C)		1.7		
I_{CES}	Collector Cut-off Current (V_{CE} = 600V, V_{GE} = 0V, T_j = 25°C) ②			25	µA
	Collector Cut-off Current (V_{CE} = 600V, V_{GE} = 0V, T_j = 125°C) ②			TBD	
I_{GES}	Gate-Emitter Leakage Current (V_{GE} = ±20V)			600	nA
$R_{G(int)}$	Intergrated Gate Resistor		N/A		Ω

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

DYNAMIC CHARACTERISTICS

Symbol	Characteristic	Test Conditions	MIN	TYP	MAX	UNIT
C_{ies}	Input Capacitance	**Capacitance** V_{GE} = 0V, V_{CE} = 25V f = 1 MHz		3200		pF
C_{oes}	Output Capacitance			125		
C_{res}	Reverse Transfer Capacitance			100		
V_{GEP}	Gate-to-Emitter Plateau Voltage	Gate Charge V_{GE} = 15V V_{CE} = 300V I_C = 50A		9.0		V
Q_g	Total Gate Charge ③			325		nC
Q_{ge}	Gate-Emitter Charge			25		
Q_{gc}	Gate-Collector ("Miller") Charge			175		
SSOA	Switching Safe Operating Area	T_J = 175°C, R_G = 4.3Ω⑦, V_{GE} = 15V, L = 100µH, V_{CE} = 600V	150			A
SCSOA	Short Circuit Safe Operating Area	V_{CC} = 360V, V_{GE} = 15V, T_J = 150°C, R_G = 4.3Ω⑦	6			µs
$t_{d(on)}$	Turn-on Delay Time	**Inductive Switching (25°C)** V_{CC} = 400V V_{GE} = 15V I_C = 50A R_G = 4.3Ω⑦ T_J = +25°C		20		ns
t_r	Current Rise Time			25		
$t_{d(off)}$	Turn-off Delay Time			230		
t_f	Current Fall Time			100		
E_{on1}	Turn-on Switching Energy ④			1185		µJ
E_{on2}	Turn-on Switching Energy (Diode) ⑤			1275		
E_{off}	Turn-off Switching Energy ⑥			1565		
$t_{d(on)}$	Turn-on Delay Time	**Inductive Switching (125°C)** V_{CC} = 400V V_{GE} = 15V I_C = 50A R_G = 4.3Ω⑦ T_J = +125°C		20		ns
t_r	Current Rise Time			25		
$t_{d(off)}$	Turn-off Delay Time			260		
t_f	Current Fall Time			140		
E_{on1}	Turn-on Switching Energy ④			1205		µJ
E_{on2}	Turn-on Switching Energy (Diode) ⑤			1850		
E_{off}	Turn-off Switching Energy ⑥			2125		

THERMAL AND MECHANICAL CHARACTERISTICS

Symbol	Characteristic	MIN	TYP	MAX	UNIT
$R_{\theta JC}$	Junction to Case **(IGBT)**			.41	°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. 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 lead temperature.

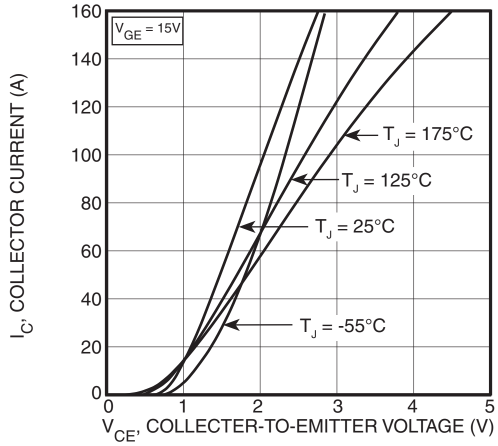


FIGURE 1, Output Characteristics(T_J = 25°C)

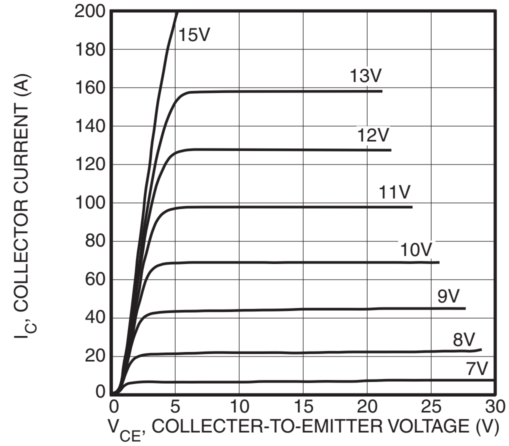


FIGURE 2, Output Characteristics (T_J = 125°C)

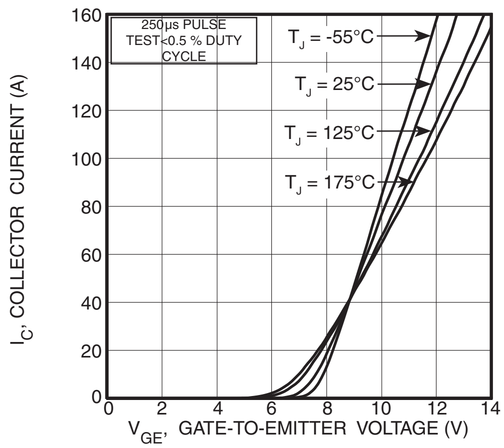


FIGURE 3, Transfer Characteristics

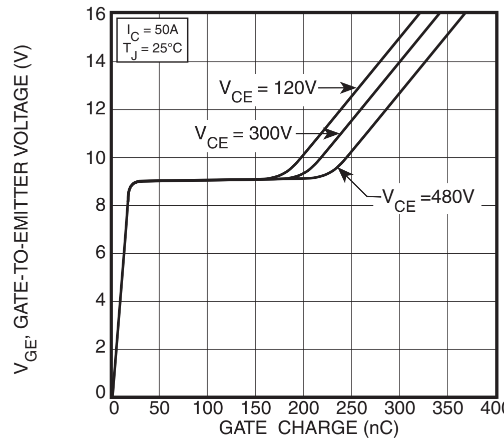


FIGURE 4, Gate Charge

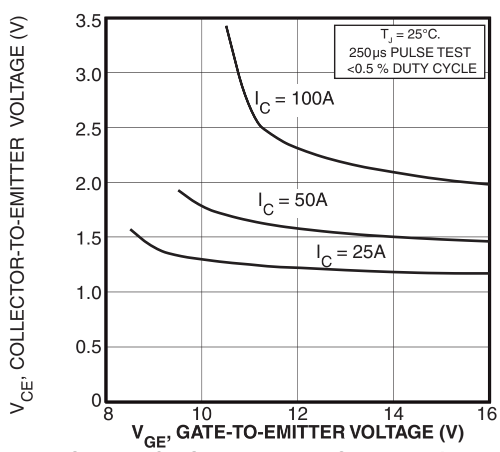


FIGURE 5, On State Voltage vs Gate-to- Emitter Voltage

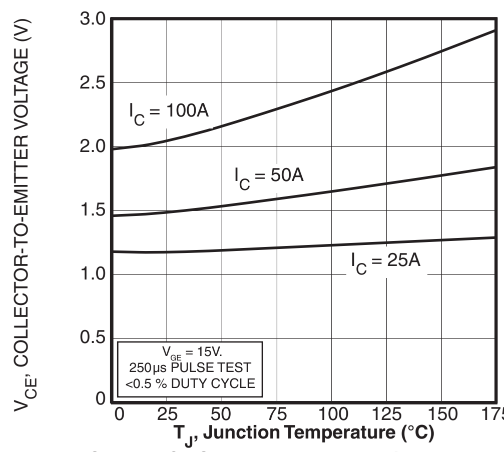


FIGURE 6, On State Voltage vs Junction Temperature

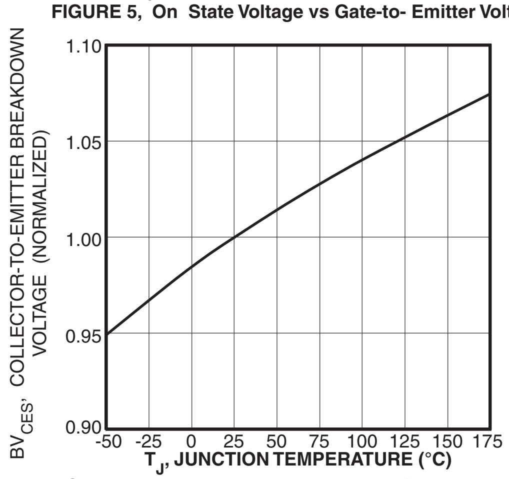


FIGURE 7, Breakdown Voltage vs. Junction Temperature

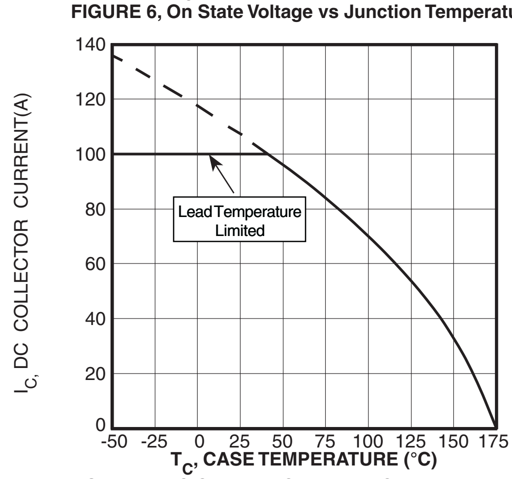


FIGURE 8, DC Collector Current vs Case Temperature

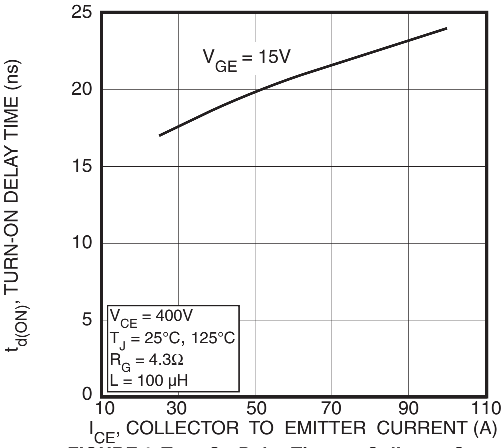


FIGURE 9, Turn-On Delay Time vs Collector Current

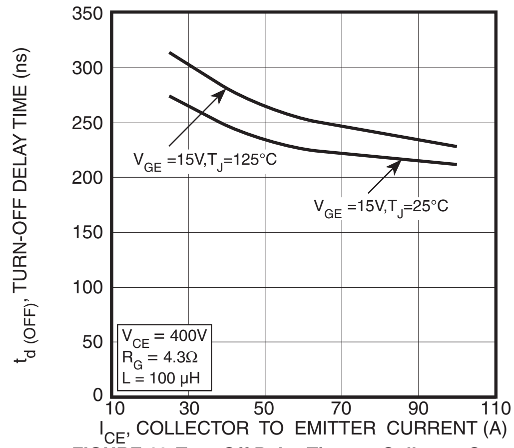


FIGURE 10, Turn-Off Delay Time vs Collector Current

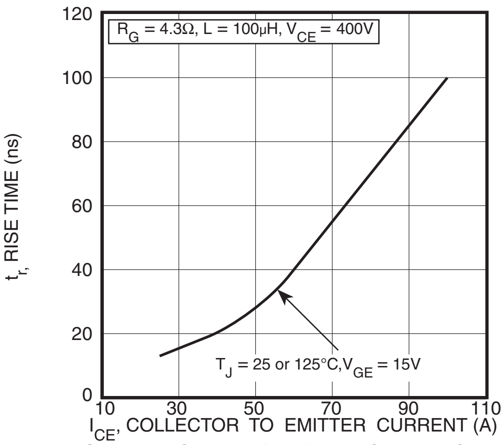


FIGURE 11, Current Rise Time vs Collector Current

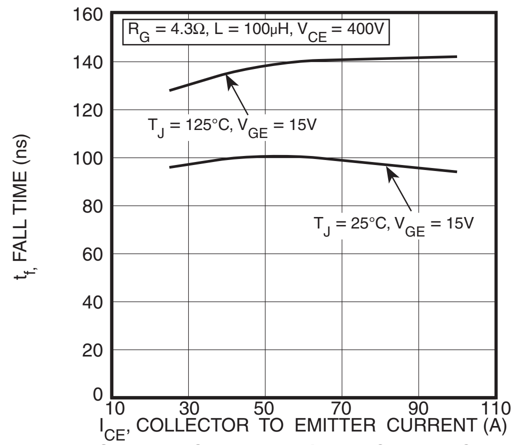


FIGURE 12, Current Fall Time vs Collector Current

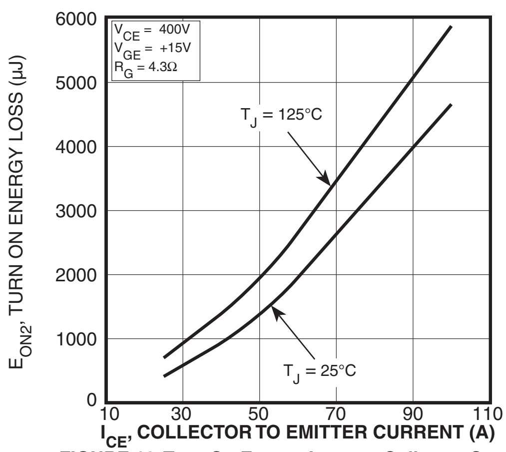


FIGURE 13, Turn-On Energy Loss vs Collector Current

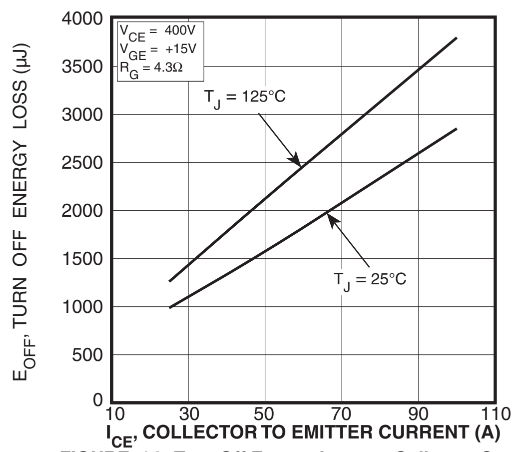


FIGURE 14, Turn Off Energy Loss vs Collector Current

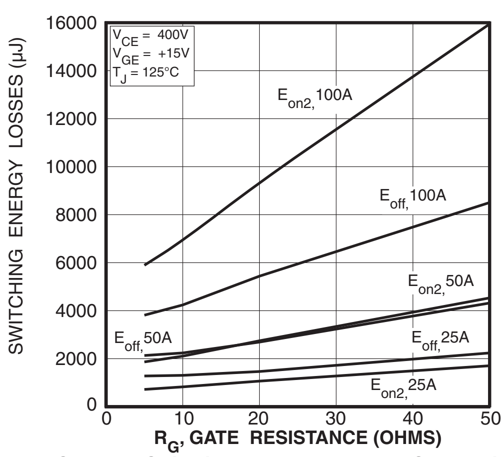


FIGURE 15, Switching Energy Losses vs. Gate Resistance

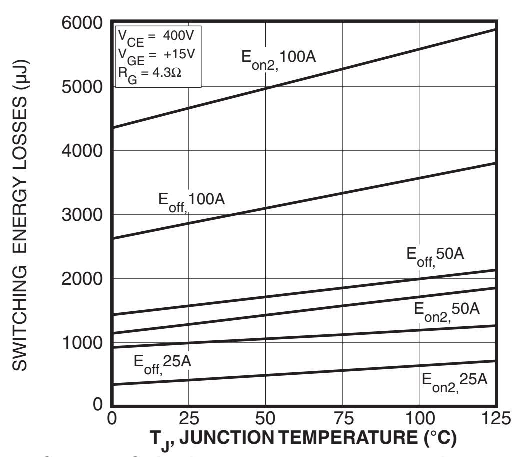


FIGURE 16, Switching Energy Losses vs Junction Temperature

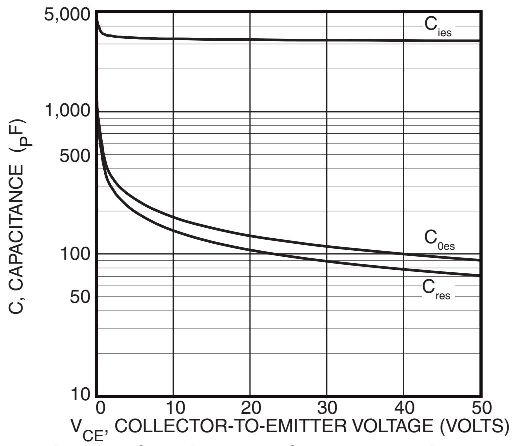


Figure 17, Capacitance vs Collector-To-Emitter Voltage

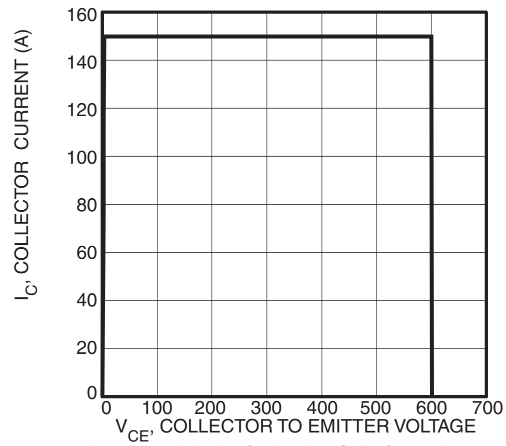


Figure 18,Minimim Switching Safe Operating Area

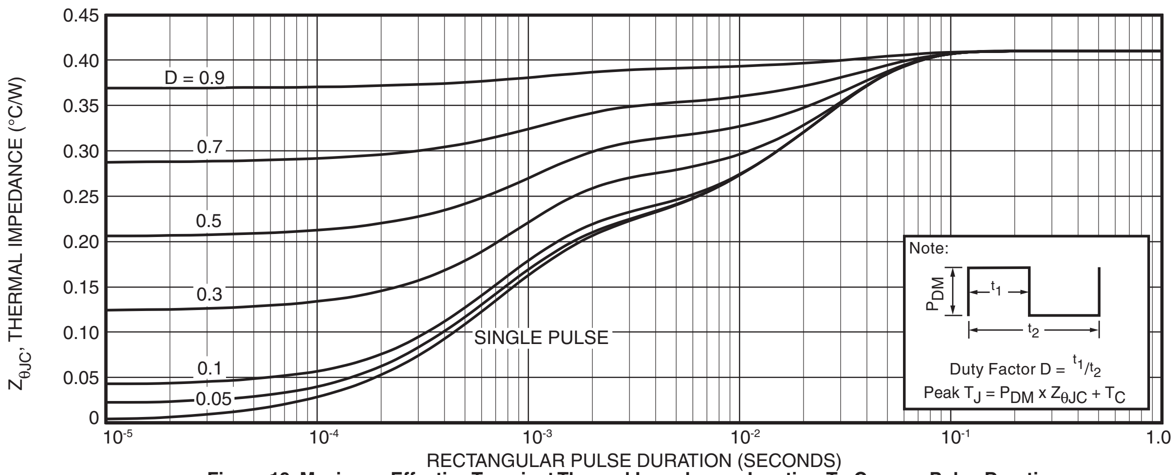
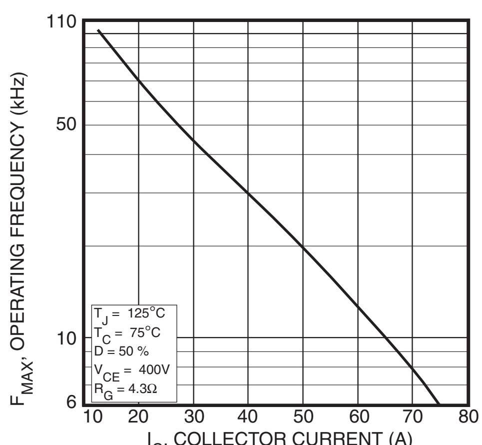


Figure 19, Maximum Effective Transient Thermal Impedance, Junction-To-Case vs Pulse Duration



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

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

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

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

Figure 20, Operating Frequency vs Collector Current

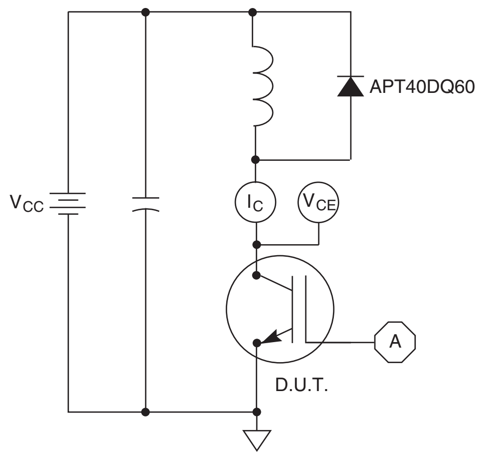


Figure 21, Inductive Switching Test Circuit

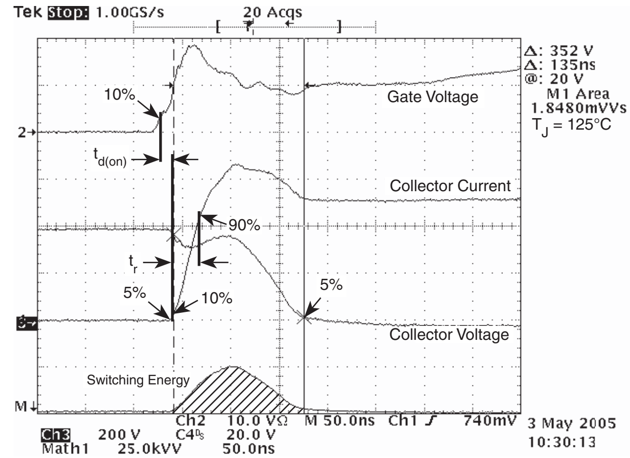


Figure 22, Turn-on Switching Waveforms and Definitions

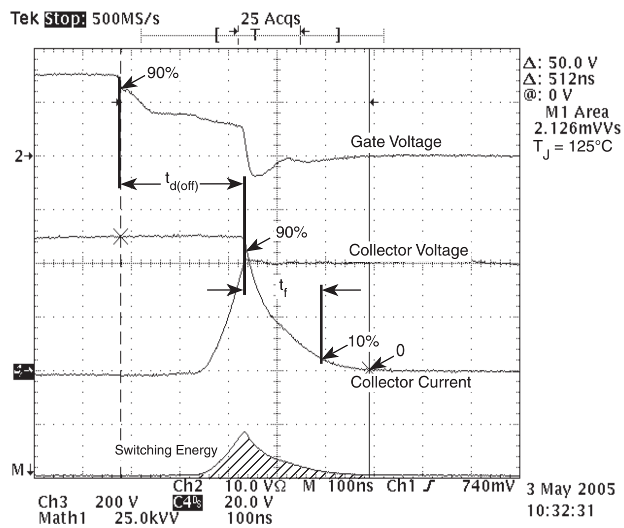
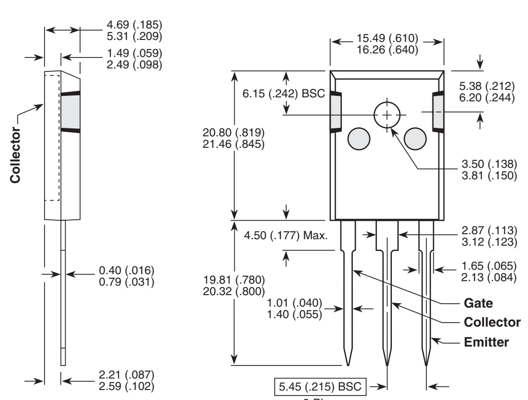


Figure 23, Turn-off Switching Waveforms and Definitions

TO-247 Package Outline

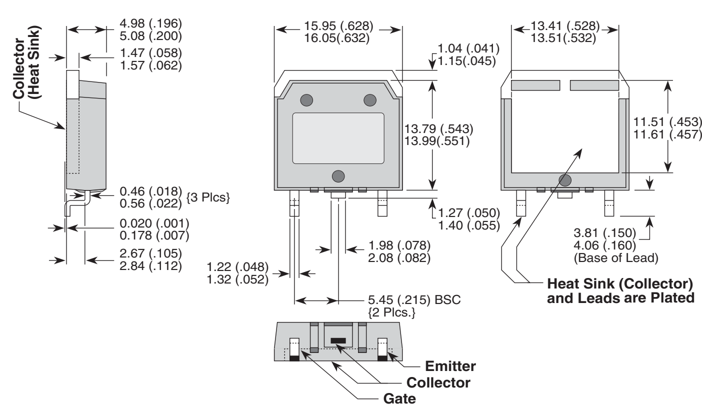
e1 SAC: Tin, Silver, Copper



Dimensions in Millimeters and (Inches)

D³PAK Package Outline

e3 SAC: Tin, Silver, Copper



Dimensions in Millimeters (Inches)