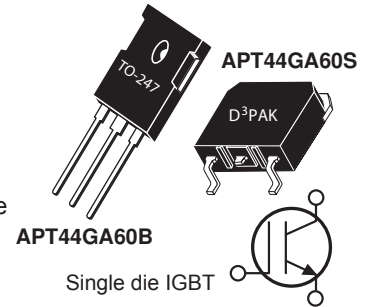



## High Speed PT IGBT

POWER MOS 8® is a high speed Punch-Through switch-mode IGBT. Low  $E_{off}$  is achieved through leading technology silicon design and lifetime control processes. A reduced  $E_{off} - V_{CE(ON)}$  tradeoff results in superior efficiency compared to other IGBT technologies. Low gate charge and a greatly reduced ratio of  $C_{res}/C_{ies}$  provide excellent noise immunity, short delay times and simple gate drive. The intrinsic chip gate resistance and capacitance of the poly-silicone gate structure help control di/dt during switching, resulting in low EMI, even when switching at high frequency.



### FEATURES

- Fast switching with low EMI
- Very Low  $E_{off}$  for maximum efficiency
- Ultra low  $C_{res}$  for improved noise immunity
- Low conduction loss
- Low gate charge
- Increased intrinsic gate resistance for low EMI
- RoHS compliant 

### TYPICAL APPLICATIONS

- ZVS phase shifted and other full bridge
- Half bridge
- High power PFC boost
- Welding
- UPS, solar, and other inverters
- High frequency, high efficiency industrial

### Absolute Maximum Ratings

Symbol	Parameter	Ratings	Unit
$V_{CES}$	Collector Emitter Voltage	600	V
$I_{C1}$	Continuous Collector Current @ $T_c = 25^\circ\text{C}$	78	A
$I_{C2}$	Continuous Collector Current @ $T_c = 100^\circ\text{C}$	44	
$I_{CM}$	Pulsed Collector Current <sup>1</sup>	130	
$V_{GE}$	Gate-Emitter Voltage <sup>2</sup>	$\pm 30$	V
$P_D$	Total Power Dissipation @ $T_c = 25^\circ\text{C}$	337	W
SSOA	Switching Safe Operating Area @ $T_j = 150^\circ\text{C}$	130A @ 600V	
$T_J, T_{STG}$	Operating and Storage Junction Temperature Range	-55 to 150	°C
$T_L$	Lead Temperature for Soldering: 0.063" from Case for 10 Seconds	300	

### Static Characteristics

$T_J = 25^\circ\text{C}$  unless otherwise specified

Symbol	Parameter	Test Conditions	Min	Typ	Max	Unit
$V_{BR(CES)}$	Collector-Emitter Breakdown Voltage	$V_{GE} = 0V, I_C = 1.0mA$	600			V
$V_{CE(on)}$	Collector-Emitter On Voltage	$V_{GE} = 15V, I_C = 26A$		2.0	2.5	
		$T_J = 25^\circ\text{C}$ $T_J = 125^\circ\text{C}$		1.9		
$V_{GE(th)}$	Gate Emitter Threshold Voltage	$V_{GE} = V_{CE}, I_C = 1mA$	3	4.5	6	
$I_{CES}$	Zero Gate Voltage Collector Current	$V_{CE} = 600V, V_{GE} = 0V$			250	$\mu\text{A}$
		$T_J = 25^\circ\text{C}$ $T_J = 125^\circ\text{C}$			2500	
$I_{GES}$	Gate-Emitter Leakage Current	$V_{GS} = \pm 30V$			$\pm 100$	nA

### Thermal and Mechanical Characteristics

Symbol	Characteristic	Min	Typ	Max	Unit
$R_{\theta JC}$	Junction to Case Thermal Resistance	-	-	.37	°C/W
$W_T$	Package Weight	-	5.9	-	g
Torque	Mounting Torque (TO-247 Package), 4-40 or M3 screw			10	in·lbf

**Dynamic Characteristics**
 **$T_J = 25^\circ\text{C}$  unless otherwise specified**
**APT44GA60B\_S**

Symbol	Parameter	Test Conditions	Min	Typ	Max	Unit
$C_{ies}$	Input Capacitance	Capacitance $V_{GE} = 0V, V_{CE} = 25V$ $f = 1\text{MHz}$		3404		pF
$C_{oes}$	Output Capacitance			358		
$C_{res}$	Reverse Transfer Capacitance			43		
$Q_g^3$	Total Gate Charge	Gate Charge $V_{GE} = 15V$ $V_{CE} = 300V$ $I_C = 26A$		128		nC
$Q_{ge}$	Gate-Emitter Charge			22		
$Q_{gc}$	Gate- Collector Charge			44		
SSOA	Switching Safe Operating Area	$T_J = 150^\circ\text{C}, R_G = 4.7\Omega^4, V_{GE} = 15V,$ $L = 100\mu\text{H}, V_{CE} = 600V$	130			A
$t_{d(on)}$	Turn-On Delay Time	Inductive Switching ( $25^\circ\text{C}$ ) $V_{CC} = 400V$ $V_{GE} = 15V$ $I_C = 26A$ $R_G = 4.7\Omega^4$ $T_J = +25^\circ\text{C}$		16		ns
$t_r$	Current Rise Time			14		
$t_{d(off)}$	Turn-Off Delay Time			84		
$t_f$	Current Fall Time			29		
$E_{on2}$	Turn-On Switching Energy			409		
$E_{off}^6$	Turn-Off Switching Energy			258		$\mu\text{J}$
$t_{d(on)}$	Turn-On Delay Time	Inductive Switching ( $125^\circ\text{C}$ ) $V_{CC} = 400V$ $V_{GE} = 15V$ $I_C = 26A$ $R_G = 4.7\Omega^4$ $T_J = +125^\circ\text{C}$		14		ns
$t_r$	Current Rise Time			15		
$t_{d(off)}$	Turn-Off Delay Time			109		
$t_f$	Current Fall Time			99		
$E_{on2}$	Turn-On Switching Energy			621		
$E_{off}^6$	Turn-Off Switching Energy			474		$\mu\text{J}$

1 Repetitive Rating: Pulse width and case temperature limited by maximum junction temperature.

2 Pulse test: Pulse Width <  $380\mu\text{s}$ , duty cycle < 2%.

3 See Mil-Std-750 Method 3471

4  $R_G$  is external gate resistance, not including internal gate resistance or gate driver impedance. (MIC4452)

5  $E_{on2}$  is the clamped inductive turn on energy that includes a commutating diode reverse recovery current in the IGBT turn on energy loss. A combi device is used for the clamping diode.

6  $E_{off}$  is the clamped inductive turn-off energy measured in accordance with JEDEC standard JESD24-1.

**Microsemi reserves the right to change, without notice, the specifications and information contained herein.**

Typical Performance Curves

APT44GA60B\_S

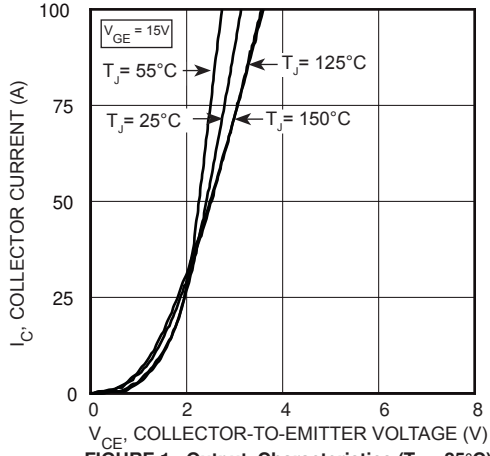


FIGURE 1, Output Characteristics ( $T_J = 25^\circ\text{C}$ )

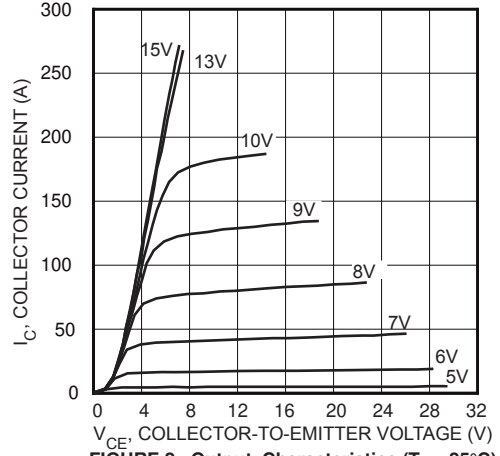


FIGURE 2, Output Characteristics ( $T_J = 25^\circ\text{C}$ )

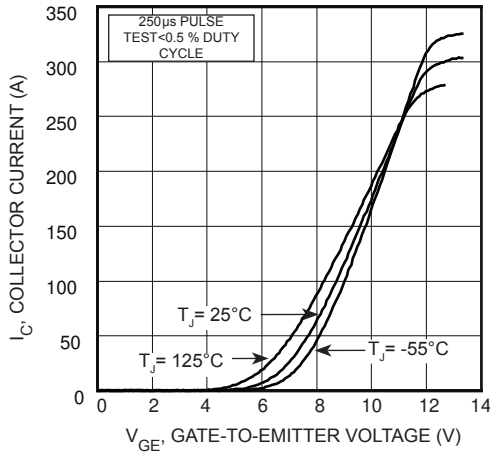


FIGURE 3, Transfer Characteristics

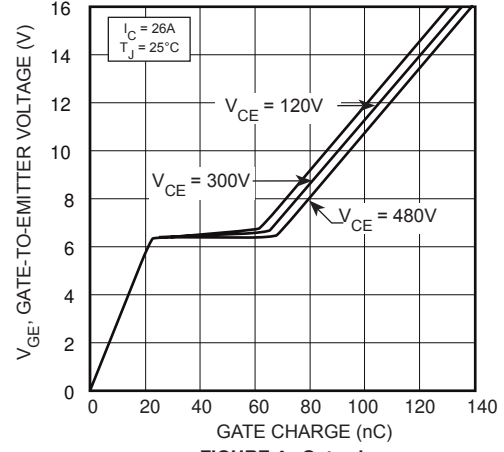


FIGURE 4, Gate charge

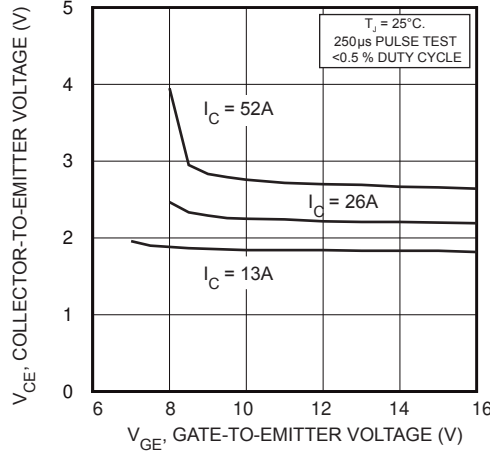


FIGURE 5, On State Voltage vs Gate-to-Emitter Voltage

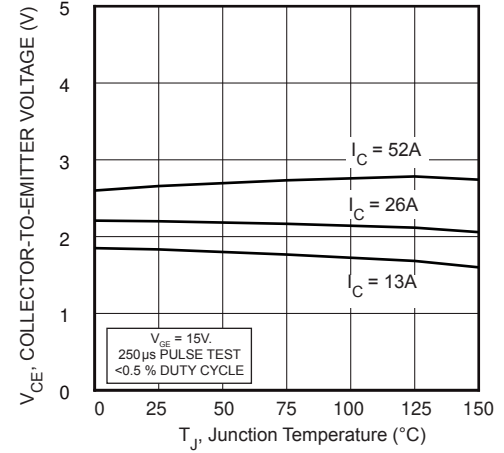


FIGURE 6, On State Voltage vs Junction Temperature

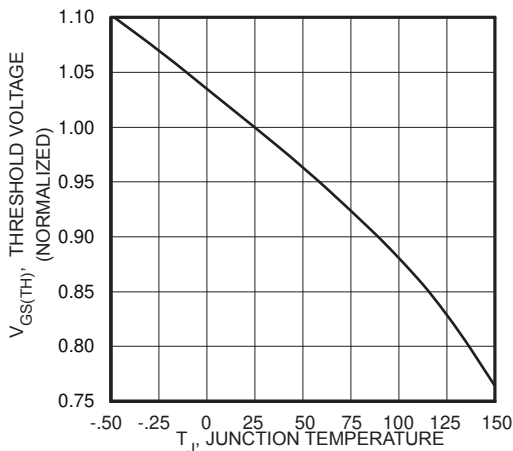


FIGURE 7, Threshold Voltage vs Junction Temperature

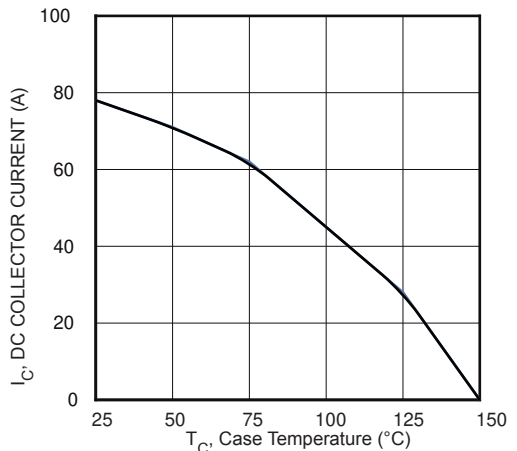


FIGURE 8, DC Collector Current vs Case Temperature

Typical Performance Curves

APT44GA60B\_S

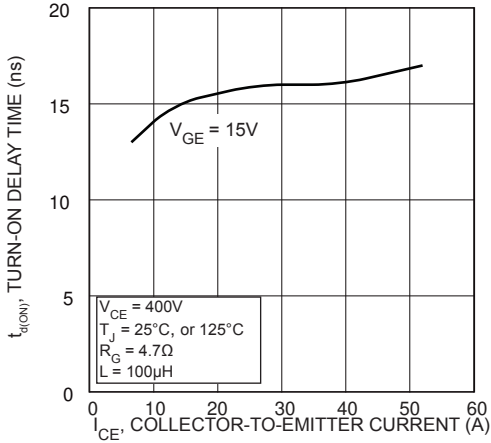


FIGURE 9, Turn-On Delay Time vs Collector Current

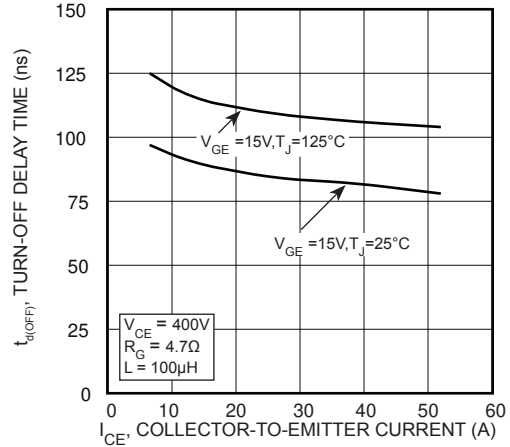


FIGURE 10, Turn-Off Delay Time vs Collector Current

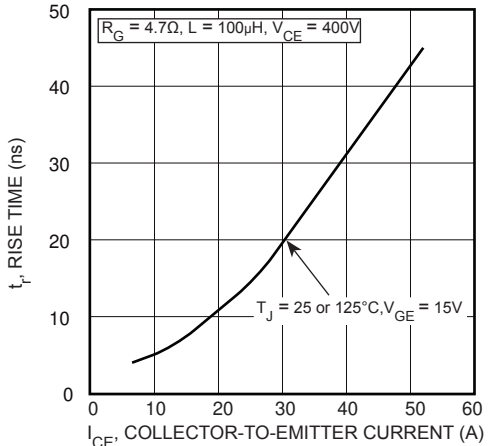


FIGURE 11, Current Rise Time vs Collector Current

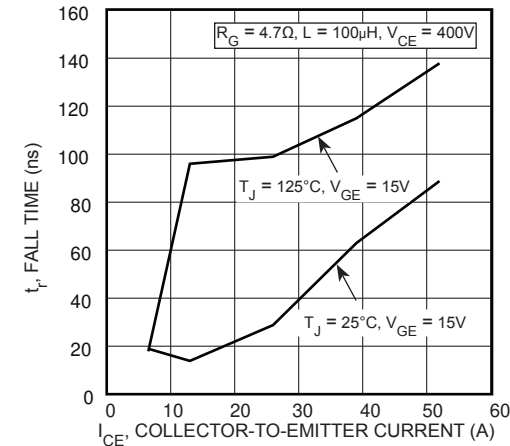


FIGURE 12, Current Fall Time vs Collector Current

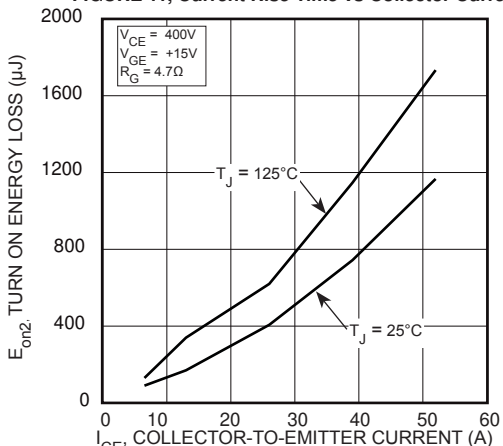


FIGURE 13, Turn-On Energy Loss vs Collector Current

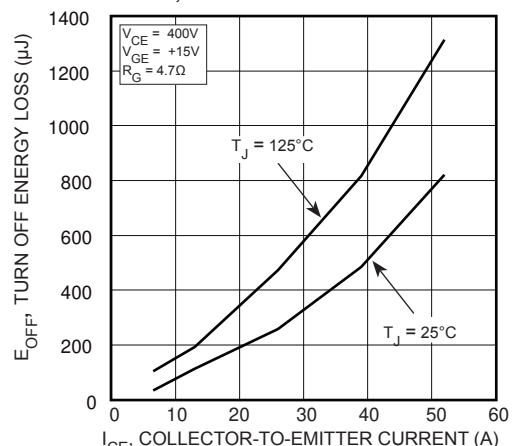


FIGURE 14, Turn-Off Energy Loss vs Collector Current

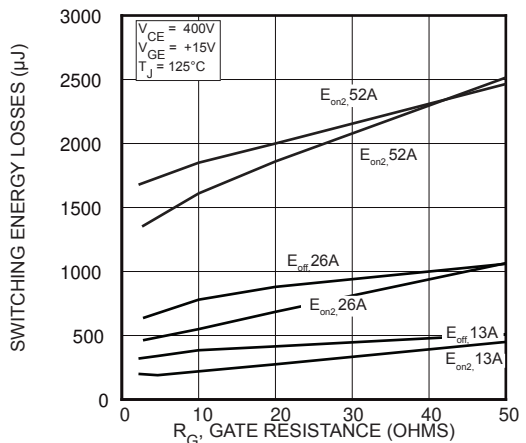


FIGURE 15, Switching Energy Losses vs Gate Resistance

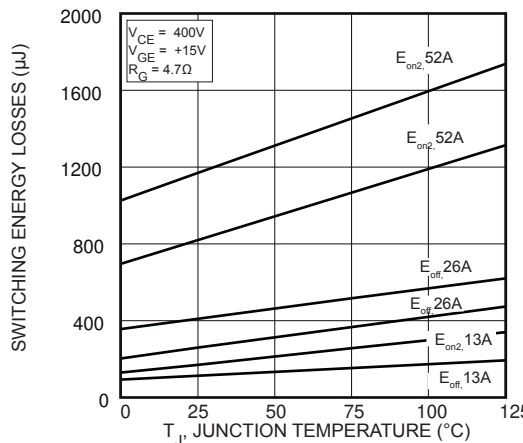


FIGURE 16, Switching Energy Losses vs Junction Temperature

# Typical Performance Curves

APT44GA60B\_S

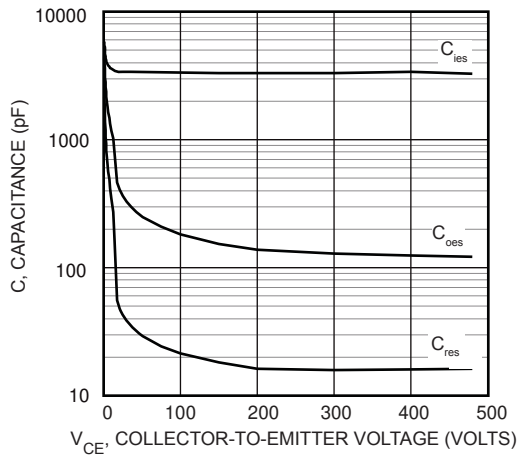


FIGURE 17, Capacitance vs Collector-To-Emitter Voltage

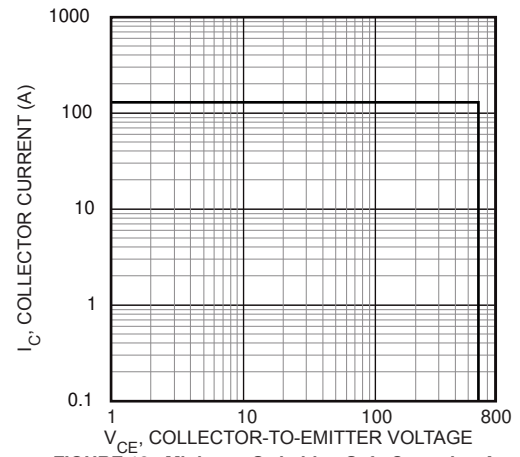


FIGURE 18, Minimum Switching Safe Operating Area

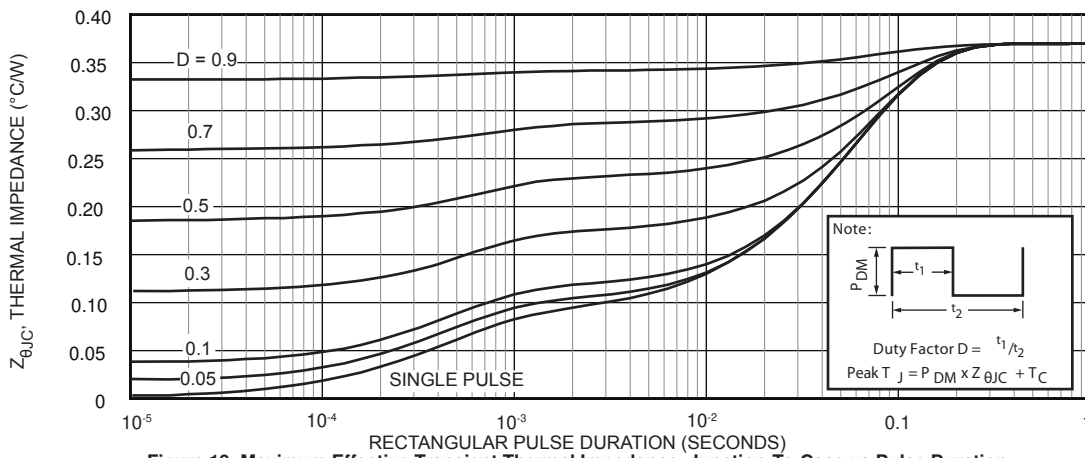


Figure 19, Maximum Effective Transient Thermal Impedance, Junction-To-Case vs Pulse Duration

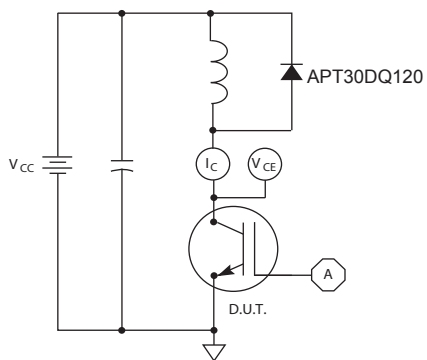


Figure 20, Inductive Switching Test Circuit

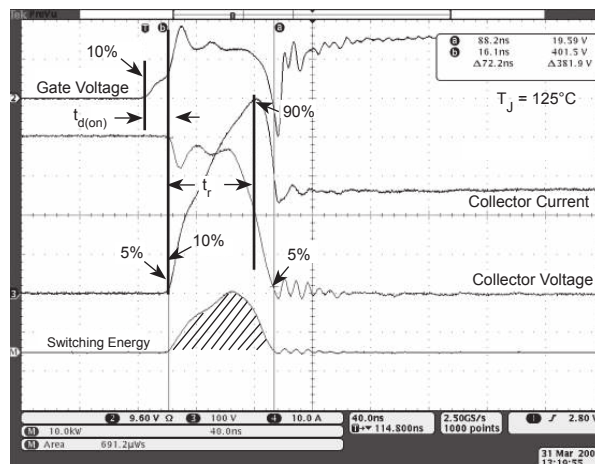


Figure 21, Turn-on Switching Waveforms and Definitions

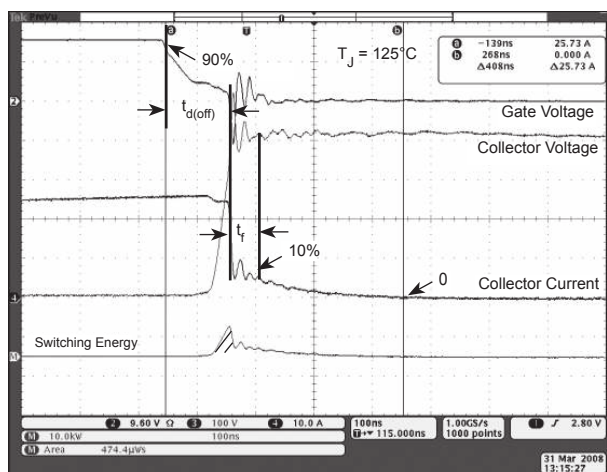
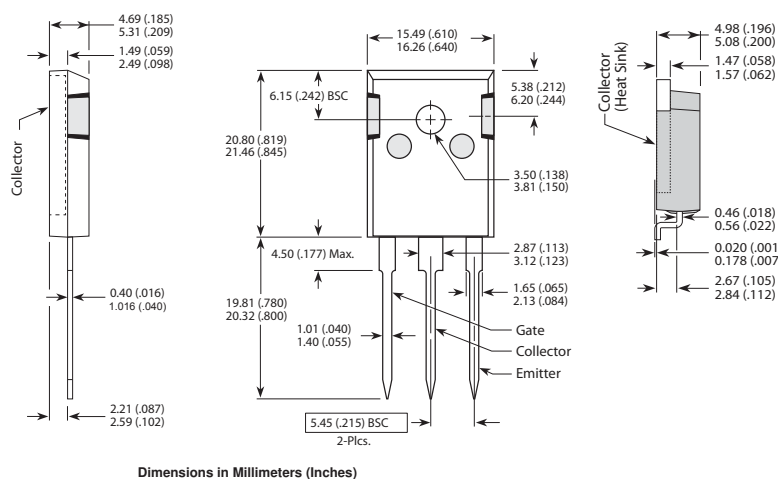


Figure 22, Turn-off Switching Waveforms and Definitions

### TO-247 Package Outline

Ⓔ1 SAC: Tin, Silver, Copper



### D<sup>3</sup>PAK Package Outline

Ⓔ3 100% Sn Plated

