Microsemi
POWER PRODUCTS GROUP

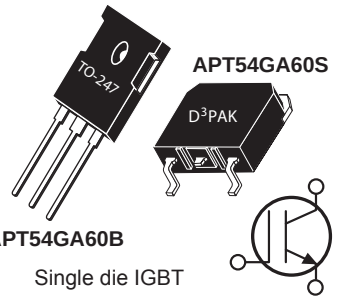
Power MOS 8 Cooler!

# APT54GA60B
# APT54GA60S

## 600V

## 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.




Single die IGBT

## 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°C | 96 | A |
| $I_{C2}$ | Continuous Collector Current @ $T_C$ = 100°C | 54 | |
| $I_{CM}$ | Pulsed Collector Current [1] | 161 | |
| $V_{GE}$ | Gate-Emitter Voltage [2] | ±30 | V |
| $P_D$ | Total Power Dissipation @ $T_C$ = 25°C | 416 | W |
| SSOA | Switching Safe Operating Area @ $T_J$ = 150°C | 161A @ 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°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, $I_C$ = 32A | $T_J$ = 25°C | | 2.0 | 2.5 | |
| | | | $T_J$ = 125°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 | $T_J$ = 25°C | | | 250 | µA |
| | | | $T_J$ = 125°C | | | 2500 | |
| $I_{GES}$ | Gate-Emitter Leakage Current | $V_{GS}$ = ±30V | | | | ±100 | nA |

### Thermal and Mechanical Characteristics

| Symbol | Characteristic | Min | Typ | Max | Unit |
|---|---|---|---|---|---|
| $R_{\theta JC}$ | Junction to Case Thermal Resistance | - | - | .3 | °C/W |
| $W_T$ | Package Weight | - | 5.9 | - | g |
| Torque | Mounting Torque (TO-247 Package), 4-40 or M3 screw | | | 10 | in·lbf |



052-6328 Rev E 6 - 2011

## Dynamic Characteristics $T_J$ = 25°C unless otherwise specified APT54GA60B_S

| Symbol | Parameter | Test Conditions | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|
| $C_{ies}$ | Input Capacitance | Capacitance | | 4130 | | pF |
| $C_{oes}$ | Output Capacitance | $V_{GE}$ = 0V, $V_{CE}$ = 25V | | 350 | | |
| $C_{res}$ | Reverse Transfer Capacitance | f = 1MHz | | 45 | | |
| $Q_g$ [3] | Total Gate Charge | Gate Charge | | 158 | | nC |
| $Q_{ge}$ | Gate-Emitter Charge | $V_{GE}$ = 15V | | 26 | | |
| $Q_{gc}$ | Gate- Collector Charge | $V_{CE}$= 300V<br>$I_C$ = 32A | | 52 | | |
| SSOA | Switching Safe Operating Area | $T_J$ = 150°C, $R_G$ = 4.7Ω[4], $V_{GE}$ = 15V,<br>L= 100uH, $V_{CE}$ = 600V | 161 | | | A |
| $t_{d(on)}$ | Turn-On Delay Time | Inductive Switching (25°C) | | 17 | | ns |
| $t_r$ | Current Rise Time | $V_{CC}$ = 400V | | 20 | | |
| $t_{d(off)}$ | Turn-Off Delay Time | $V_{GE}$ = 15V | | 112 | | |
| $t_f$ | Current Fall Time | $I_C$ = 32A | | 86 | | |
| $E_{on2}$ | Turn-On Switching Energy | $R_G$ = 4.7Ω[4] | | 534 | | µJ |
| $E_{off}$ [6] | Turn-Off Switching Energy | $T_J$ = +25°C | | 466 | | |
| $t_{d(on}$ | Turn-On Delay Time | Inductive Switching (125°C) | | 16 | | ns |
| $t_r$ | Current Rise Time | $V_{CC}$ = 400V | | 21 | | |
| $t_{d(off)}$ | Turn-Off Delay Time | $V_{GE}$ = 15V | | 146 | | |
| $t_f$ | Current Fall Time | $I_C$ = 32A | | 145 | | |
| $E_{on2}$ | Turn-On Switching Energy | $R_G$ = 4.7Ω[4] | | 891 | | µJ |
| $E_{off}$ [6] | Turn-Off Switching Energy | $T_J$ = +125°C | | 838 | | |

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

2 Pulse test: Pulse Width < 380$\mu s$, 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.

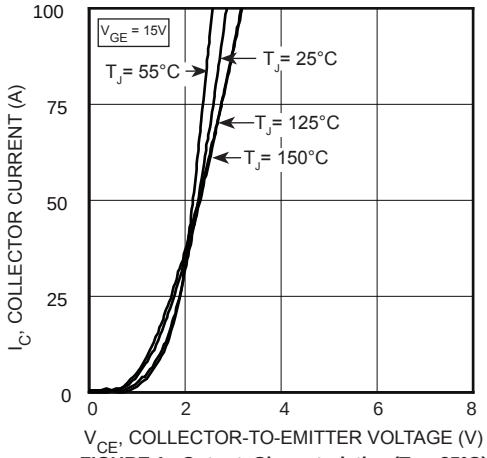



**FIGURE 1, Output Characteristics ($T_J$ = 25°C)**

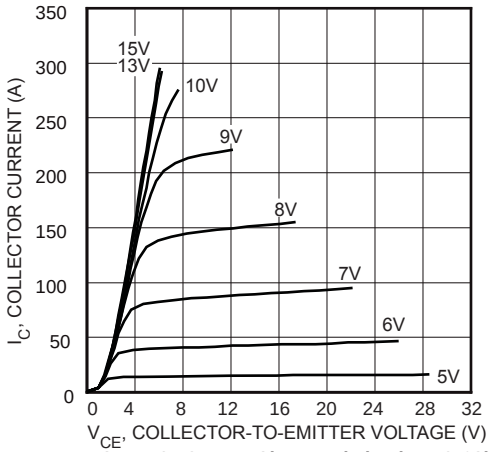



**FIGURE 2, Output Characteristics ($T_J$ = 25°C)**

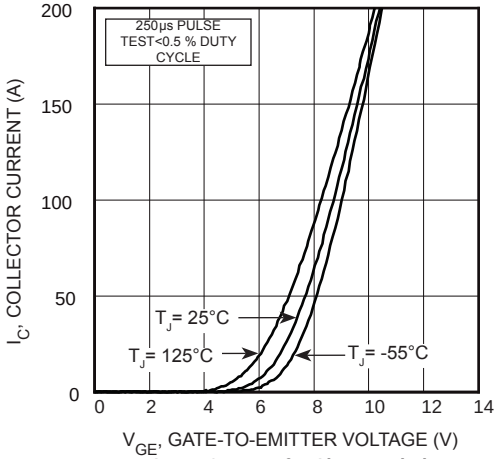



**FIGURE 3, Transfer Characteristics**

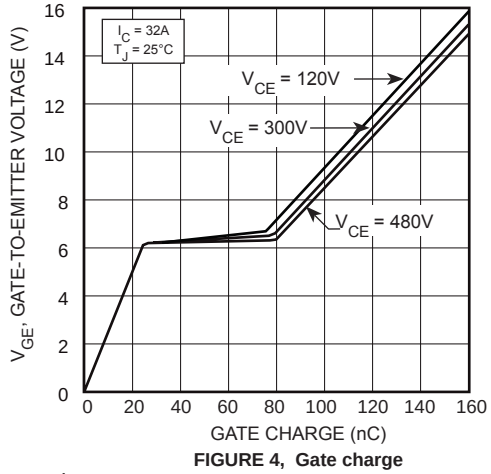



**FIGURE 4, Gate charge**

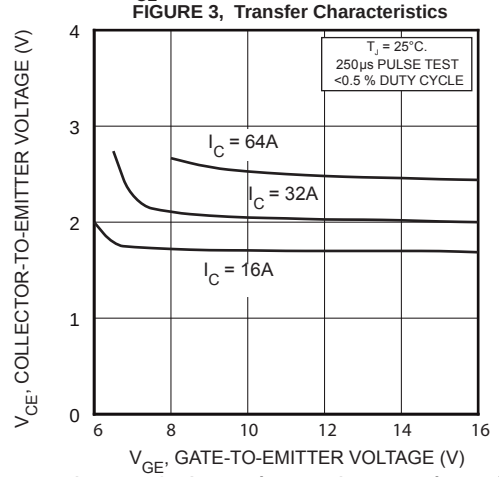



**FIGURE 5, On State Voltage vs Gate-to-Emitter Voltage**

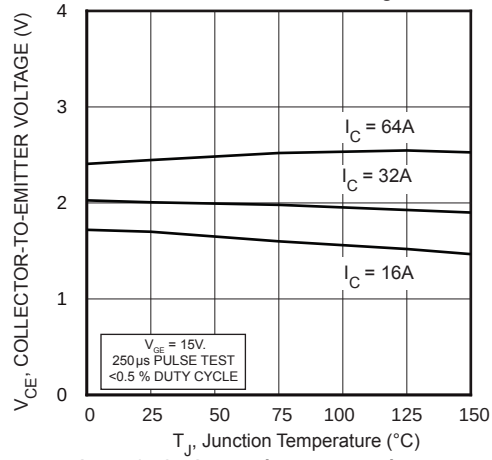



**FIGURE 6, On State Voltage vs Junction Temperature**

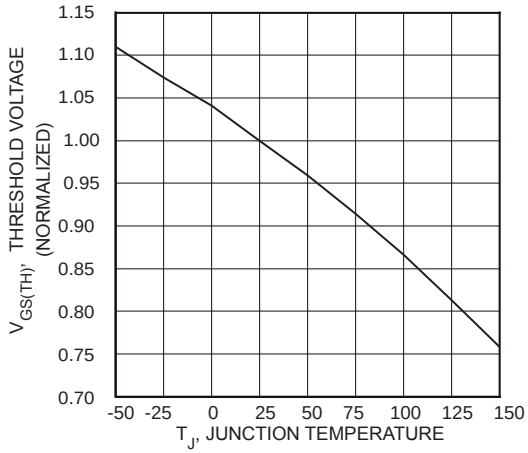



**FIGURE 7, Threshold Voltage vs Junction Temperature**

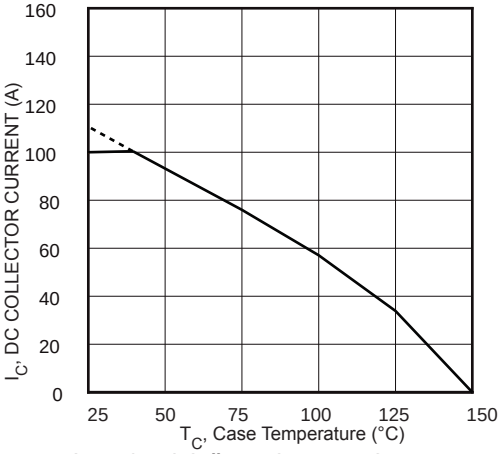



**FIGURE 8, DC Collector Current vs Case Temperature**

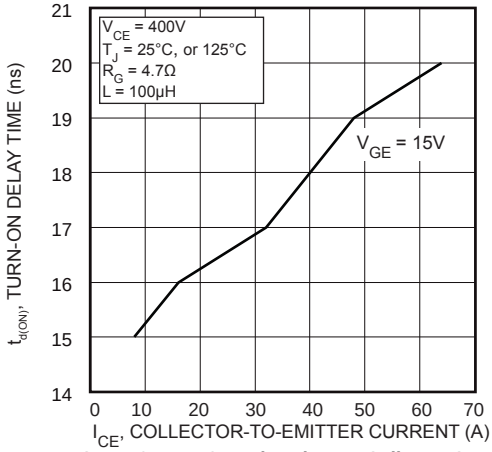



**FIGURE 9, Turn-On Delay Time vs Collector Current**

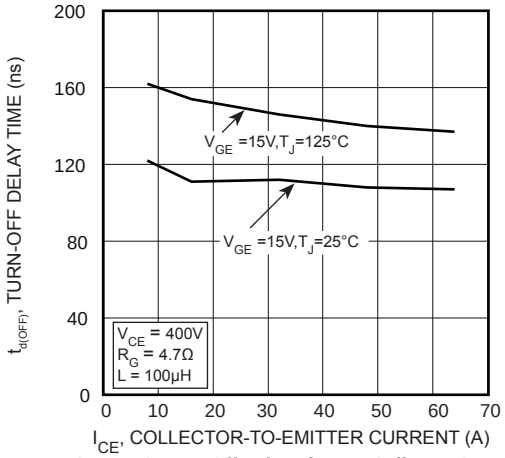



**FIGURE 10, Turn-Off Delay Time vs Collector Current**

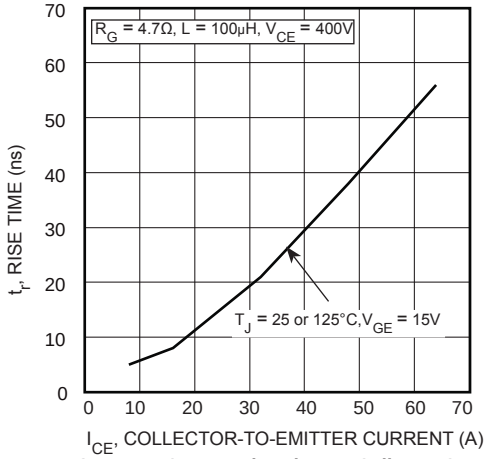



**FIGURE 11, Current Rise Time vs Collector Current**

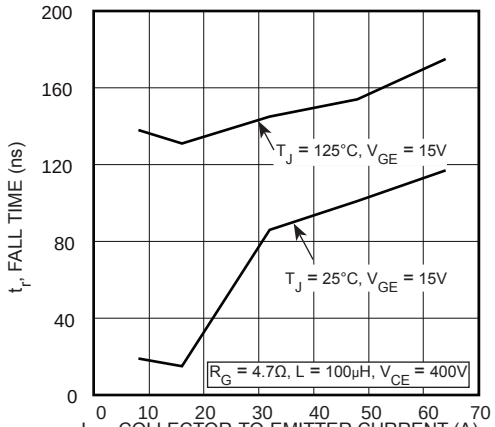



**FIGURE 12, Current Fall Time vs Collector Current**

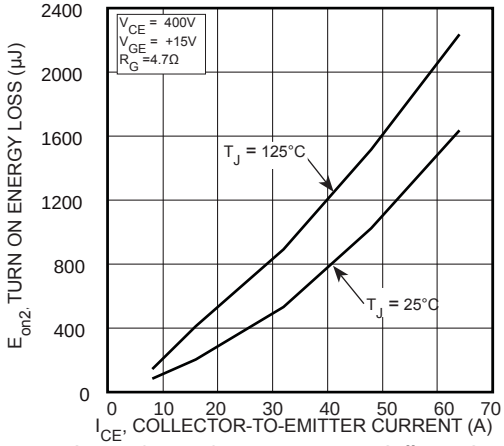



**FIGURE 13, Turn-On Energy Loss vs Collector Current**

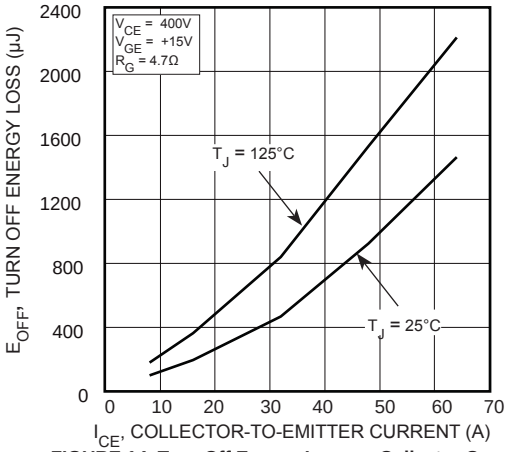



**FIGURE 14, Turn-Off Energy Loss vs Collector Current**

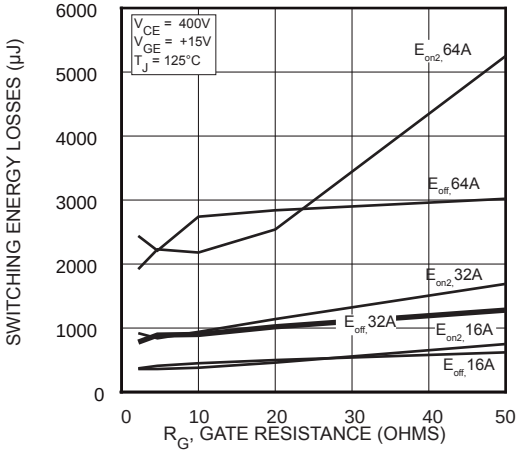



**FIGURE 15, Switching Energy Losses vs Gate Resistance**

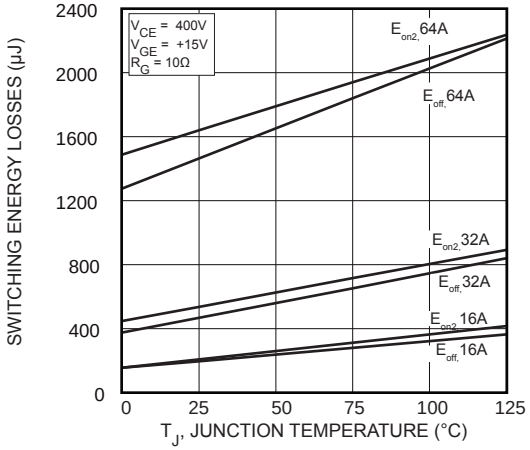



**FIGURE 16, Switching Energy Losses vs Junction Temperature**

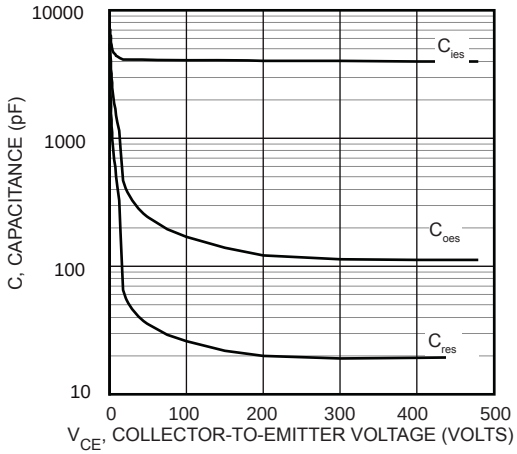



**FIGURE 17, Capacitance vs Collector-To-Emitter Voltage**

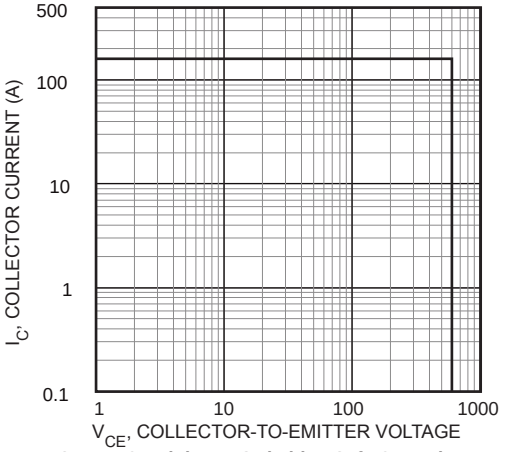



**FIGURE 18, Minimum Switching Safe Operating Area**

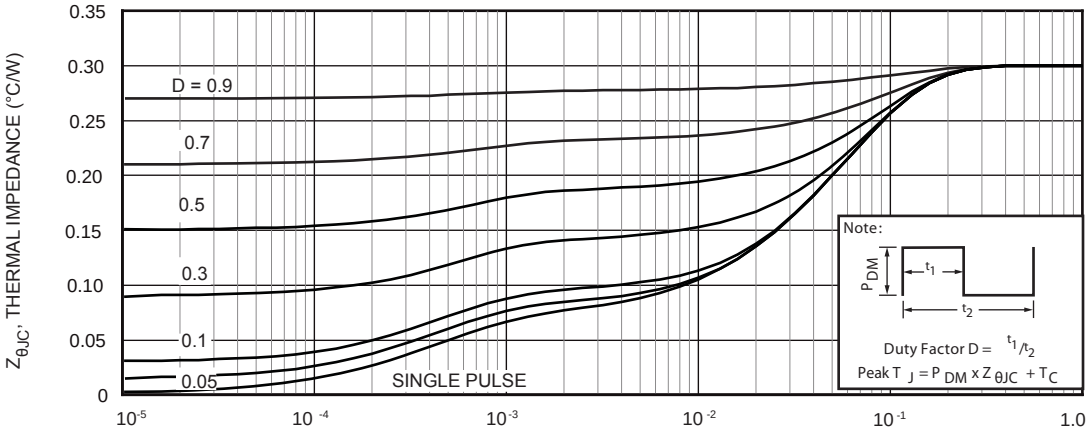



**Figure 19, Maximum Effective Transient Thermal Impedance, Junction-To-Case vs Pulse Duration**

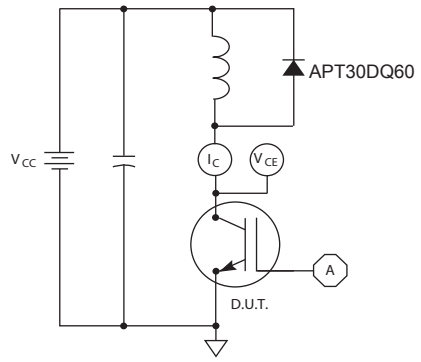



**Figure 12, Inductive Switching Test Circuit**

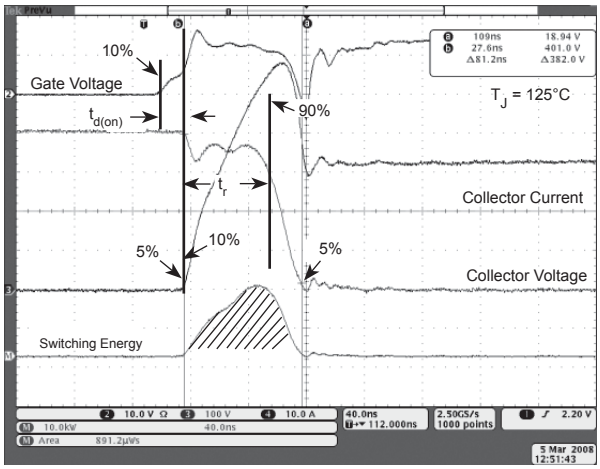



**Figure 13, Turn-on Switching Waveforms and Definitions**

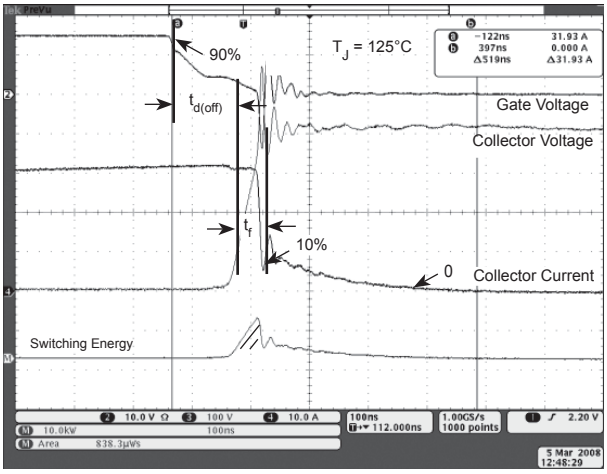
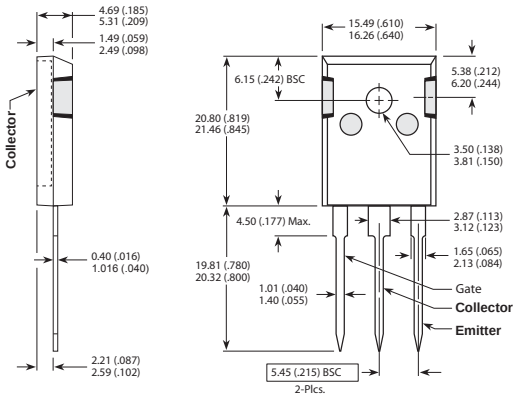



**Figure 14, Turn-off Switching Waveforms and Definitions**

## TO-247 Package Outline

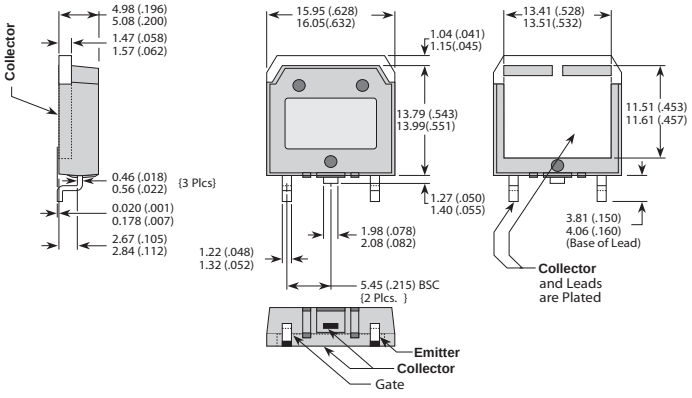
e1 SAC: Tin, Silver, Copper




**Dimensions in Millimeters (Inches)**

## D³PAK Package Outline

e3 100% Sn Plated




**Dimensions in Millimeters (Inches)**

Стандарт Электрон Связь

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