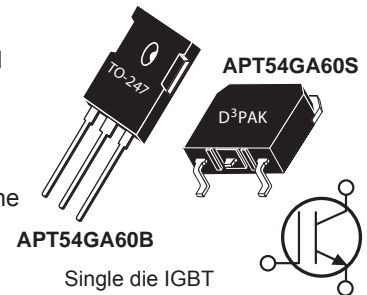



## High Speed PT IGBT

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 @ $T_c = 25^\circ\text{C}$         | 96          | A    |
| $I_{C2}$       | Continuous Collector Current @ $T_c = 100^\circ\text{C}$        | 54          |      |
| $I_{CM}$       | Pulsed Collector Current <sup>1</sup>                           | 161         |      |
| $V_{GE}$       | Gate-Emitter Voltage <sup>2</sup>                               | $\pm 30$    | V    |
| $P_D$          | Total Power Dissipation @ $T_c = 25^\circ\text{C}$              | 416         | W    |
| SSOA           | Switching Safe Operating Area @ $T_j = 150^\circ\text{C}$       | 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

$T_J = 25^\circ\text{C}$  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        | $V_{GE} = 15V, I_C = 32A$<br>$T_J = 25^\circ\text{C}$<br>$T_J = 125^\circ\text{C}$    |     | 2.0<br>1.9 | 2.5         |               |
| $V_{GE(th)}$  | Gate Emitter Threshold Voltage      | $V_{GE} = V_{CE}, I_C = 1mA$  | 3   | 4.5        | 6           |               |
| $I_{CES}$     | Zero Gate Voltage Collector Current | $V_{CE} = 600V, V_{GE} = 0V$<br>$T_J = 25^\circ\text{C}$<br>$T_J = 125^\circ\text{C}$ |     |            | 250<br>2500 | $\mu\text{A}$ |
| $I_{GES}$     | 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                | -   | -   | .3  | °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<sub>J</sub> = 25°C unless otherwise specified

APT54GA60B\_S

| Symbol                        | Parameter                     | Test Conditions   | Min | Typ  | Max | Unit |    |
|-------------------------------|-------------------------------|---|-----|------|-----|------|----|
| C <sub>ies</sub>              | Input Capacitance             | Capacitance<br>V <sub>GE</sub> = 0V, V <sub>CE</sub> = 25V<br>f = 1MHz  |     | 4130 |     | pF   |    |
| C <sub>oes</sub>              | Output Capacitance            |   |     | 350  |     |      |    |
| C <sub>res</sub>              | Reverse Transfer Capacitance  |   |     | 45   |     |      |    |
| Q <sub>g</sub> <sup>3</sup>   | Total Gate Charge             | Gate Charge<br>V <sub>GE</sub> = 15V<br>V <sub>CE</sub> = 300V<br>I <sub>C</sub> = 32A  |     | 158  |     | nC   |    |
| Q <sub>ge</sub>               | Gate-Emitter Charge           |   |     | 26   |     |      |    |
| Q <sub>gc</sub>               | Gate- Collector Charge        |   |     | 52   |     |      |    |
| SSOA                          | Switching Safe Operating Area | T <sub>J</sub> = 150°C, R <sub>G</sub> = 4.7Ω <sup>4</sup> , V <sub>GE</sub> = 15V,<br>L = 100uH, V <sub>CE</sub> = 600V  | 161 |      |     | A    |    |
| t <sub>d(on)</sub>            | Turn-On Delay Time            | Inductive Switching (25°C)<br>V <sub>CC</sub> = 400V<br>V <sub>GE</sub> = 15V<br>I <sub>C</sub> = 32A<br>R <sub>G</sub> = 4.7Ω <sup>4</sup><br>T <sub>J</sub> = +25°C   |     | 17   |     | ns   |    |
| t <sub>r</sub>                | Current Rise Time             |   |     | 20   |     |      |    |
| t <sub>d(off)</sub>           | Turn-Off Delay Time           |   |     | 112  |     |      |    |
| t <sub>f</sub>                | Current Fall Time             |   |     | 86   |     |      |    |
| E <sub>on2</sub>              | Turn-On Switching Energy      |   |     | 534  |     |      | μJ |
| E <sub>off</sub> <sup>6</sup> | Turn-Off Switching Energy     |   | 466 |      |     |      |    |
| t <sub>d(on)</sub>            | Turn-On Delay Time            | Inductive Switching (125°C)<br>V <sub>CC</sub> = 400V<br>V <sub>GE</sub> = 15V<br>I <sub>C</sub> = 32A<br>R <sub>G</sub> = 4.7Ω <sup>4</sup><br>T <sub>J</sub> = +125°C |     | 16   |     | ns   |    |
| t <sub>r</sub>                | Current Rise Time             |   |     | 21   |     |      |    |
| t <sub>d(off)</sub>           | Turn-Off Delay Time           |   |     | 146  |     |      |    |
| t <sub>f</sub>                | Current Fall Time             |   |     | 145  |     |      |    |
| E <sub>on2</sub>              | Turn-On Switching Energy      |   |     | 891  |     |      | μJ |
| E <sub>off</sub> <sup>6</sup> | Turn-Off Switching Energy     |   |     | 838  |     |      |    |

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

2 Pulse test: Pulse Width < 380μs, duty cycle < 2%.

3 See Mil-Std-750 Method 3471

4 R<sub>G</sub> is external gate resistance, not including internal gate resistance or gate driver impedance. (MIC4452)

5 E<sub>on2</sub> 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<sub>off</sub> 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

APT54GA60B\_S

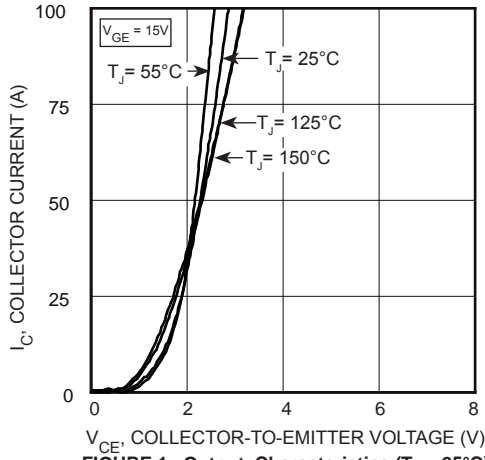


FIGURE 1, Output Characteristics ( $T_J = 25^\circ\text{C}$ )

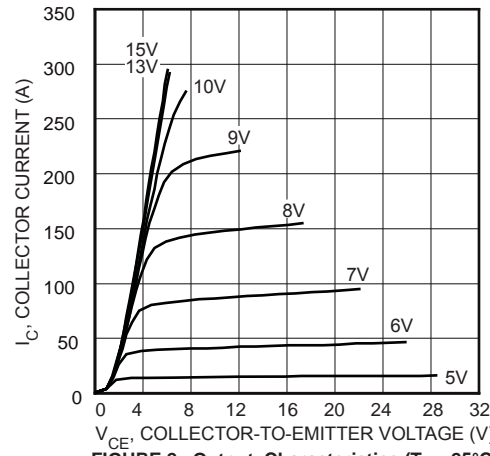


FIGURE 2, Output Characteristics ( $T_J = 25^\circ\text{C}$ )

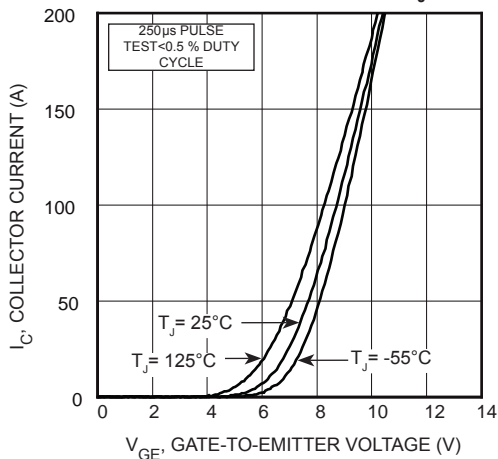


FIGURE 3, Transfer Characteristics

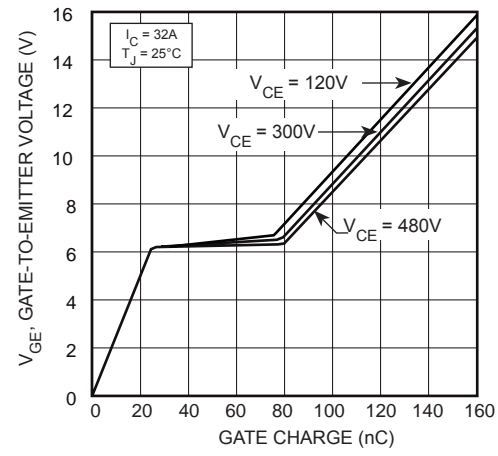


FIGURE 4, Gate charge

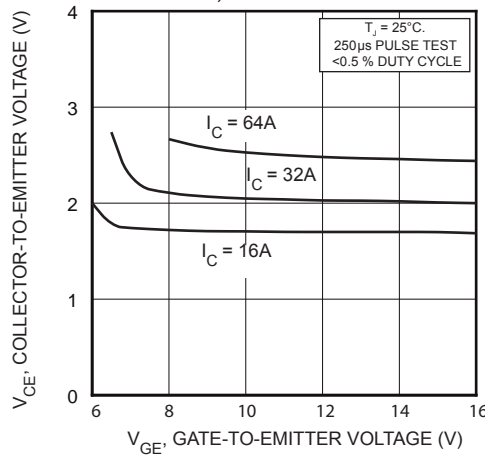


FIGURE 5, On State Voltage vs Gate-to-Emitter Voltage

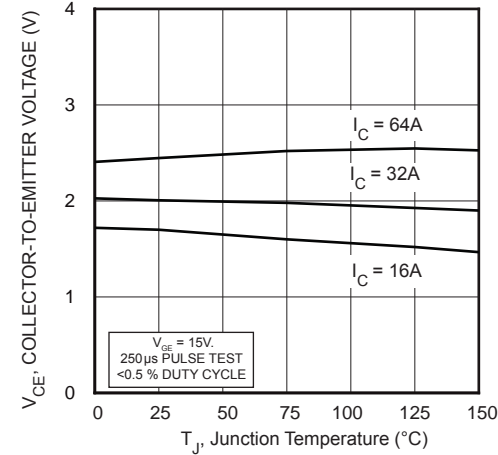


FIGURE 6, On State Voltage vs Junction Temperature

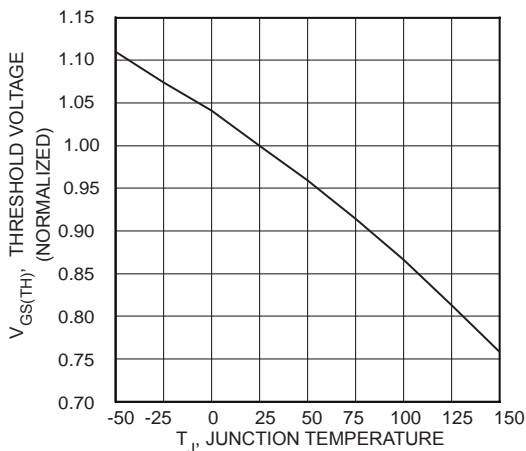


FIGURE 7, Threshold Voltage vs Junction Temperature

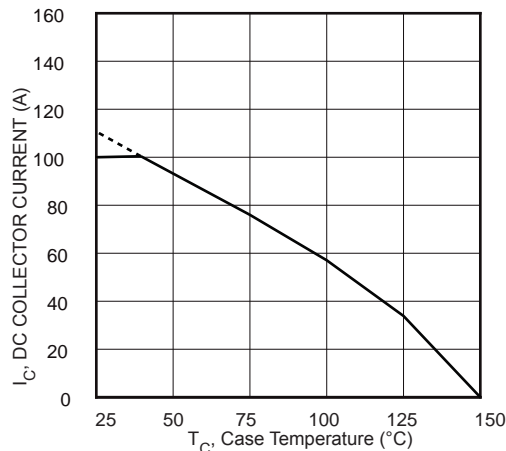


FIGURE 8, DC Collector Current vs Case Temperature

# Typical Performance Curves

APT54GA60B\_S

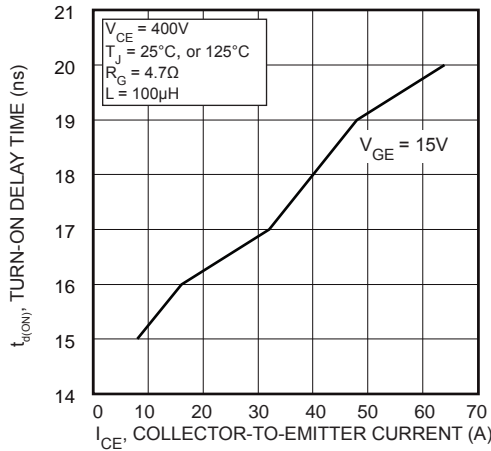


FIGURE 9, Turn-On Delay Time vs Collector Current

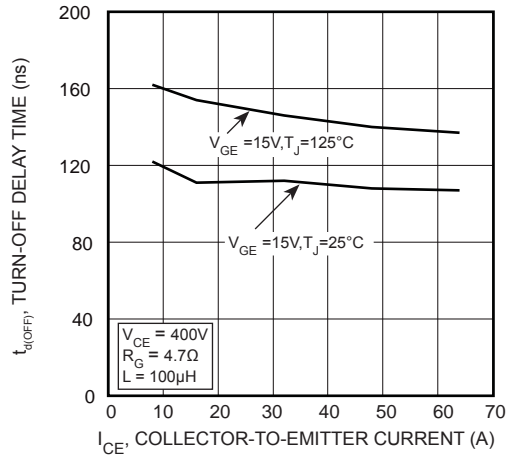


FIGURE 10, Turn-Off Delay Time vs Collector Current

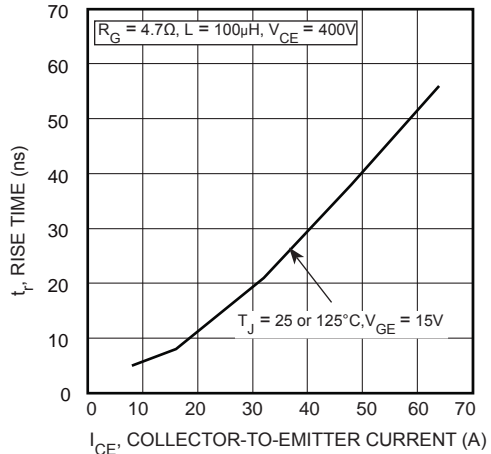


FIGURE 11, Current Rise Time vs Collector Current

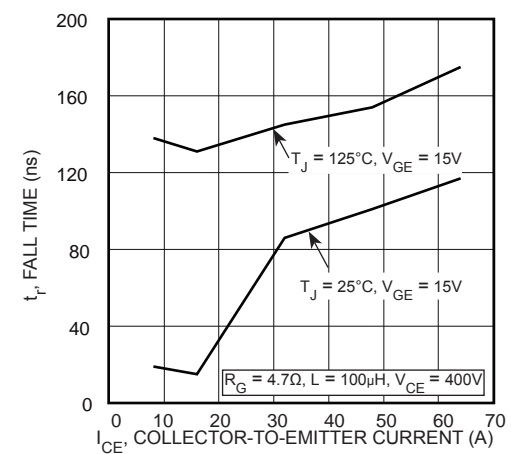


FIGURE 12, Current Fall Time vs Collector Current

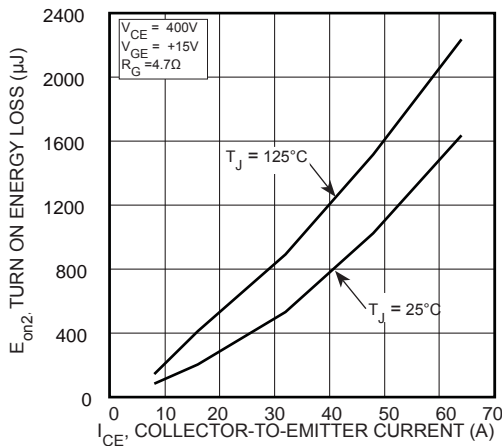


FIGURE 13, Turn-On Energy Loss vs Collector Current

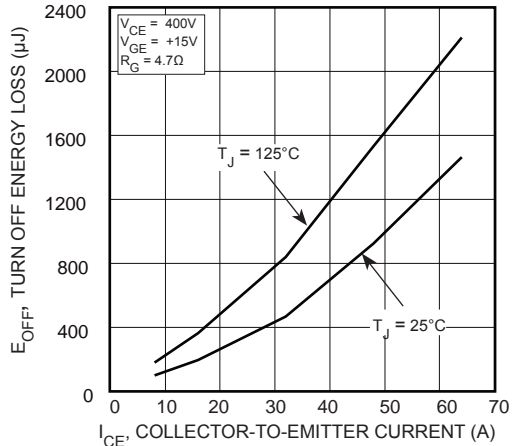


FIGURE 14, Turn-Off Energy Loss vs Collector Current

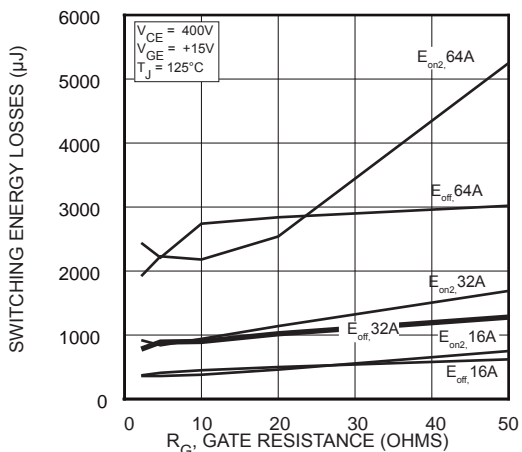


FIGURE 15, Switching Energy Losses vs Gate Resistance

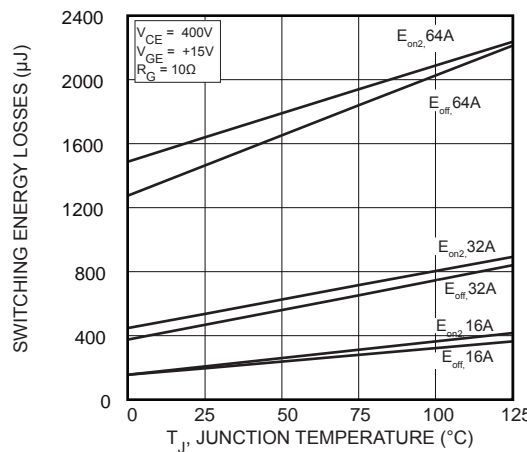


FIGURE 16, Switching Energy Losses vs Junction Temperature

# Typical Performance Curves

APT54GA60B\_S

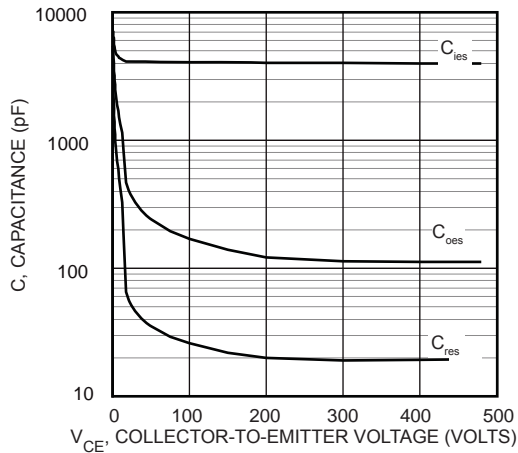


FIGURE 17, Capacitance vs Collector-To-Emitter Voltage

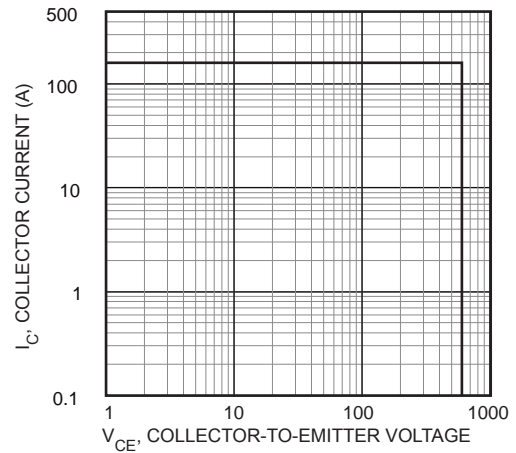


FIGURE 18, Minimum Switching Safe Operating Area

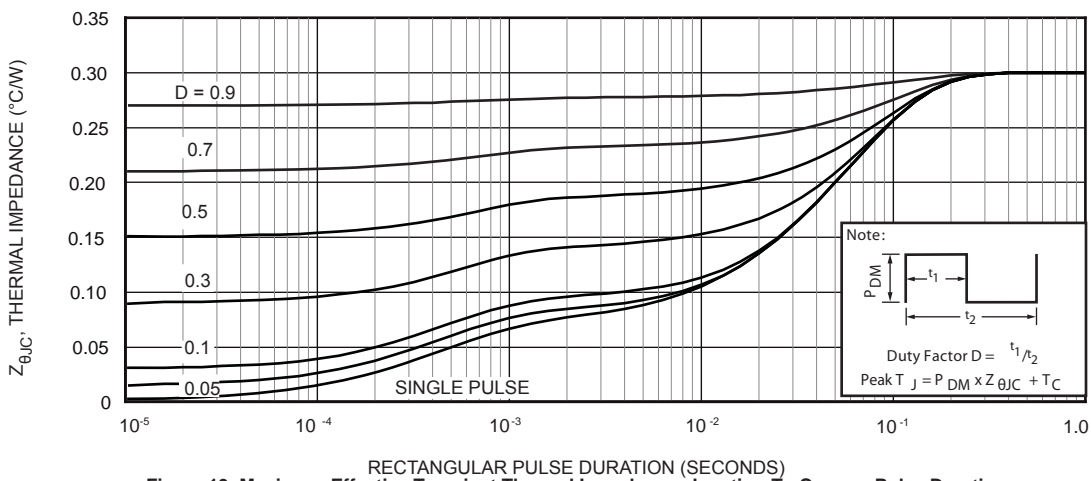


Figure 19, Maximum Effective Transient Thermal Impedance, Junction-To-Case vs Pulse Duration

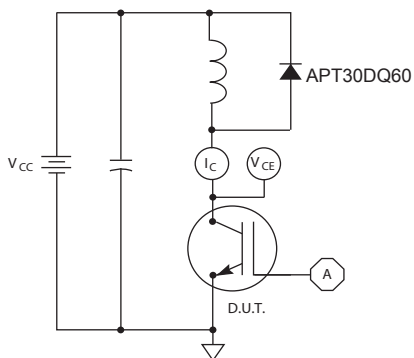


Figure 12, Inductive Switching Test Circuit

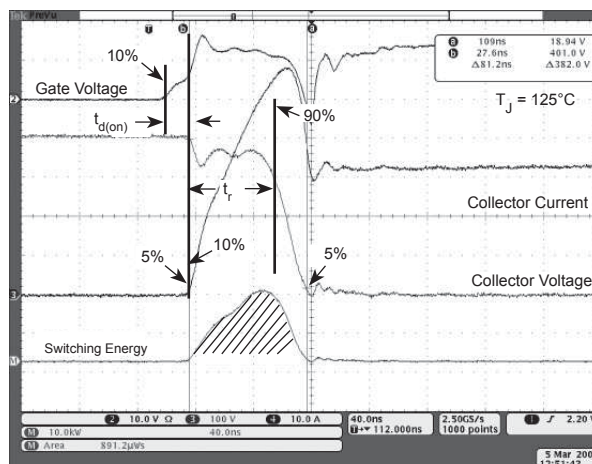


Figure 13, Turn-on Switching Waveforms and Definitions

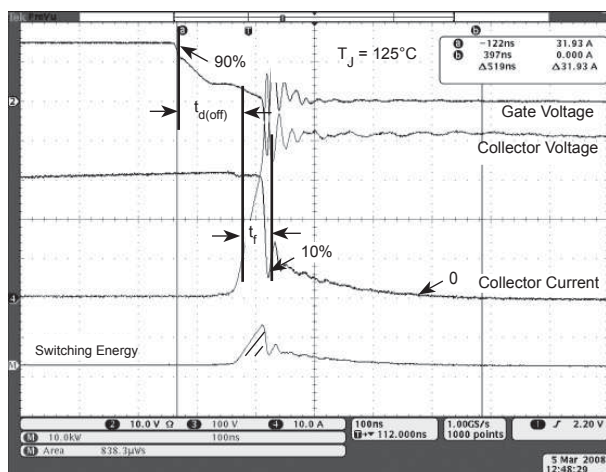
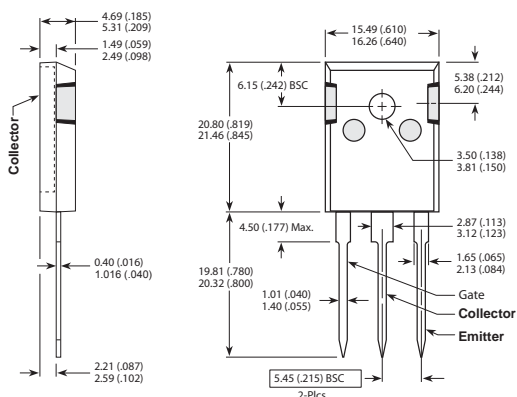


Figure 14, Turn-off Switching Waveforms and Definitions

### TO-247 Package Outline

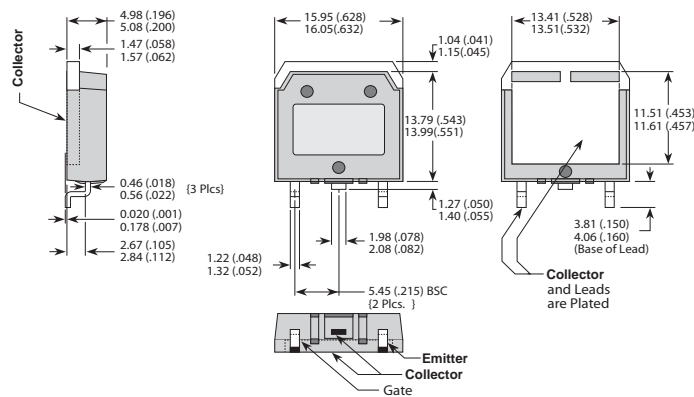
Ⓔ SAC: Tin, Silver, Copper



Dimensions in Millimeters (Inches)

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

Ⓔ 100% Sn Plated



Dimensions in Millimeters (Inches)