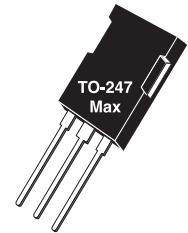


## Field Stop IGBT

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. A built-in gate resistor ensures extremely reliable operation, even in the event of a short circuit fault. Low gate charge simplifies gate drive design and minimizes losses.



- **1200V Field Stop**
- **Trench Gate: Low  $V_{CE(ON)}$**
- **Easy Paralleling**
- **Integrated Gate Resistor :Low EMI, High Reliability**
- **RoHS Compliant**

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

### Maximum Ratings

All Ratings:  $T_c = 25^\circ C$  unless otherwise specified.

| Symbol         | Parameter   | Ratings     | Unit       |
|----------------|---|-------------|------------|
| $V_{CES}$      | Collector-Emitter Voltage                                   | 600         | Volts      |
| $V_{GE}$       | Gate-Emitter Voltage  | $\pm 20$    |            |
| $I_{C1}$       | Continuous Collector Current @ $T_c = 25^\circ C$           | 283         | Amps       |
| $I_{C2}$       | Continuous Collector Current @ $T_c = 110^\circ C$          | 158         |            |
| $I_{CM}$       | Pulsed Collector Current <sup>①</sup>                       | 600         |            |
| SSOA           | Switching Safe Operating Area @ $T_j = 175^\circ C$         | 600A @ 600V |            |
| $P_D$          | Total Power Dissipation                                     | 682         | Watts      |
| $T_J, T_{STG}$ | Operating and Storage Junction Temperature Range            | -55 to 175  | $^\circ C$ |
| $T_L$          | Max. Lead Temp. for Soldering: 0.063" from Case for 10 Sec. | 300         |            |

### Static Electrical Characteristics

| Symbol        | Characteristic / Test Conditions   | Min  | Typ  | Max  | Unit     |
|---------------|--|------|------|------|----------|
| $V_{(BR)CES}$ | Collector-Emitter Breakdown Voltage ( $V_{GE} = 0V, I_C = 4mA$ )                           | 600  | -    | -    | Volts    |
| $V_{GE(TH)}$  | Gate Threshold Voltage ( $V_{CE} = V_{GE}, I_C = 3.2mA, T_j = 25^\circ C$ )                | 5.0  | 5.8  | 6.5  |          |
| $V_{CE(ON)}$  | Collector Emitter On Voltage ( $V_{GE} = 15V, I_C = 200A, T_j = 25^\circ C$ )              | 1.05 | 1.45 | 1.85 |          |
|               | Collector Emitter On Voltage ( $V_{GE} = 15V, I_C = 200A, T_j = 125^\circ C$ )             | -    | 1.65 | -    |          |
| $I_{CES}$     | Collector Cut-off Current ( $V_{CE} = 600V, V_{GE} = 0V, T_j = 25^\circ C$ ) <sup>②</sup>  | -    | -    | 25   | $\mu A$  |
|               | Collector Cut-off Current ( $V_{CE} = 600V, V_{GE} = 0V, T_j = 125^\circ C$ ) <sup>②</sup> | -    | -    | 1000 |          |
| $I_{GES}$     | Gate-Emitter Leakage Current ( $V_{GE} = \pm 20V$ )  | -    | -    | 600  | nA       |
| $R_{G(int)}$  | Integrated Gate Resistor   | -    | 2    | -    | $\Omega$ |

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

## Dynamic Characteristics

APT200GN60B2G

| Symbol       | Characteristic                           | Test Conditions   | Min | Typ   | Max | Unit |
|--------------|--|---|-----|-------|-----|------|
| $C_{ies}$    | Input Capacitance                        | $V_{GE} = 0V, V_{CE} = 25V$<br>$f = 1MHz$   | -   | 14100 | -   | pF   |
| $C_{oes}$    | Output Capacitance                       |   | -   | 461   | -   |      |
| $C_{res}$    | Reverse Transfer Capacitance             |   | -   | 393   | -   |      |
| $V_{GEP}$    | Gate-to-Emitter Plateau Voltage          | Gate Charge<br>$V_{GE} = 15V$<br>$V_{CE} = 300V$<br>$I_C = 100A$  | -   | 8.2   | -   | V    |
| $Q_g$        | Total Gate Charge                        |   | -   | 1180  | -   | nC   |
| $Q_{ge}$     | Gate-Emitter Charge                      |   | -   | 85    | -   |      |
| $Q_{gc}$     | Gate-Collector Charge                    |   | -   | 660   | -   |      |
| SSOA         | Switching Safe Operating Area            | $T_J = 150^\circ C, R_G = 1.0\Omega^{(2)}, V_{GE} = 15V,$<br>$L = 100\mu H, V_{CE} = 600V$  | 600 |       |     | A    |
| $t_{d(on)}$  | Turn-On Delay Time                       | Inductive Switching ( $25^\circ C$ )<br>$V_{CC} = 400V$<br>$V_{GE} = 15V$<br>$I_C = 200A$<br>$R_G = 1.0\Omega$<br>$T_J = +25^\circ C$   | -   | 50    | -   | ns   |
| $t_r$        | Current Rise Time                        |   | -   | 80    | -   |      |
| $t_{d(off)}$ | Turn-Off Delay Time                      |   | -   | 560   | -   |      |
| $t_f$        | Current Fall Time                        |   | -   | 100   | -   | mJ   |
| $E_{on1}$    | Turn-On Switching Energy <sup>(4)</sup>  |   | -   | 13    | -   |      |
| $E_{on2}$    | Turn-On Switching Energy <sup>(5)</sup>  |   | -   | 15    | -   |      |
| $E_{off}$    | Turn-Off Switching Energy <sup>(6)</sup> | -   | 11  | -     |     |      |
| $t_{d(on)}$  | Turn-On Delay Time                       | Inductive Switching ( $125^\circ C$ )<br>$V_{CC} = 400V$<br>$V_{GE} = 15V$<br>$I_C = 200A$<br>$R_G = 1.0\Omega$<br>$T_J = +125^\circ C$ | -   | 50    | -   | ns   |
| $t_r$        | Current Rise Time                        |   | -   | 80    | -   |      |
| $t_{d(off)}$ | Turn-Off Delay Time                      |   | -   | 620   | -   |      |
| $t_f$        | Current Fall Time                        |   | -   | 70    | -   | mJ   |
| $E_{on1}$    | Turn-On Switching Energy <sup>(4)</sup>  |   | -   | 14    | -   |      |
| $E_{on2}$    | Turn-On Switching Energy <sup>(5)</sup>  |   | -   | 16    | -   |      |
| $E_{off}$    | Turn-Off Switching Energy <sup>(6)</sup> | -   | 10  | -     |     |      |

## Thermal and Mechanical Characteristics

| Symbol          | Characteristic / Test Conditions | Min | Typ | Max  | Unit         |
|-----------------|----------------------------------|-----|-----|------|--------------|
| $R_{\theta JC}$ | Junction to Case (IGBT)          | -   | -   | 0.13 | $^\circ C/W$ |
| $R_{\theta JC}$ | Junction to Case (DIODE)         | -   | -   | N/A  |              |
| $W_T$           | Package Weight                   | -   | 6.1 | -    | 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 gate driver impedance.

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

# Typical Performance Curves

APT200GN60B2G

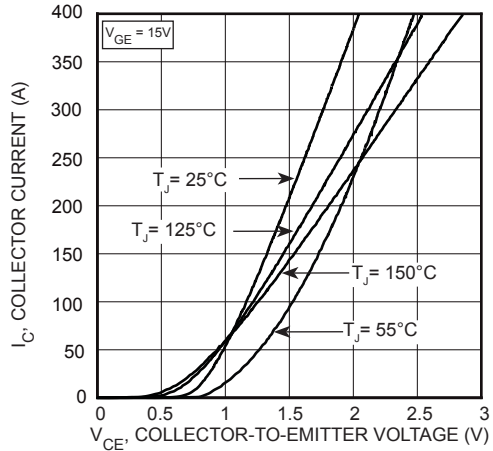


FIGURE 1, Output Characteristics ( $T_J = 25^\circ\text{C}$ )

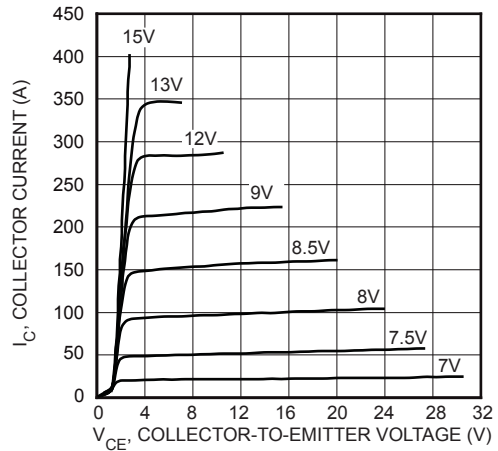


FIGURE 2, Output Characteristics ( $T_J = 25^\circ\text{C}$ )

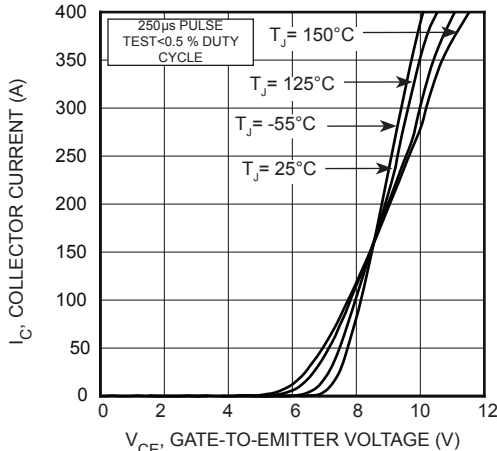


FIGURE 3, Transfer Characteristics

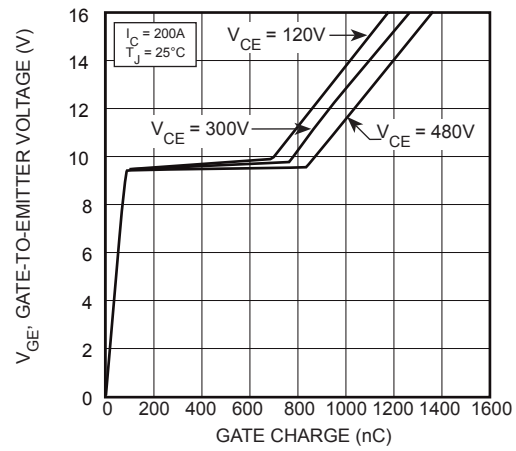


FIGURE 4, Gate charge

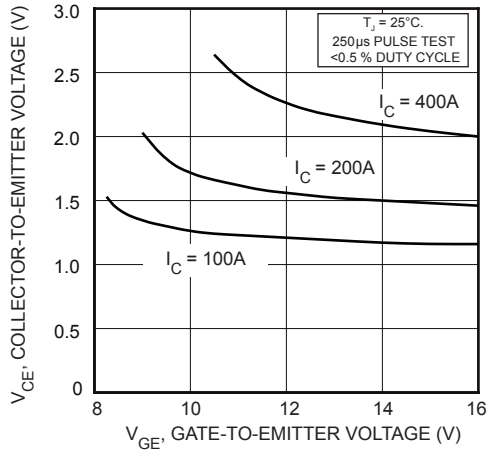


FIGURE 5, On State Voltage vs Gate-to-Emitter Voltage

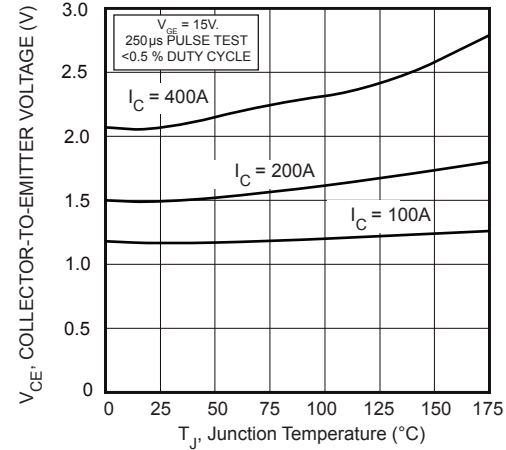


FIGURE 6, On State Voltage vs Junction Temperature

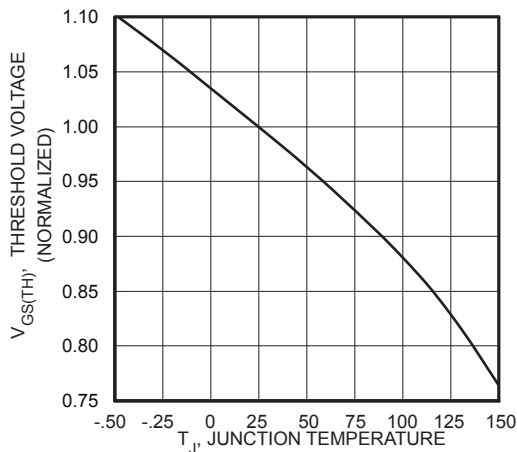


FIGURE 7, Threshold Voltage vs Junction Temperature

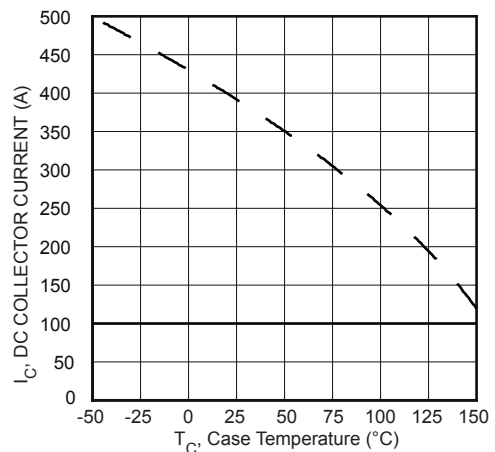


FIGURE 8, DC Collector Current vs Case Temperature

# Typical Performance Curves

APT200GN60B2G

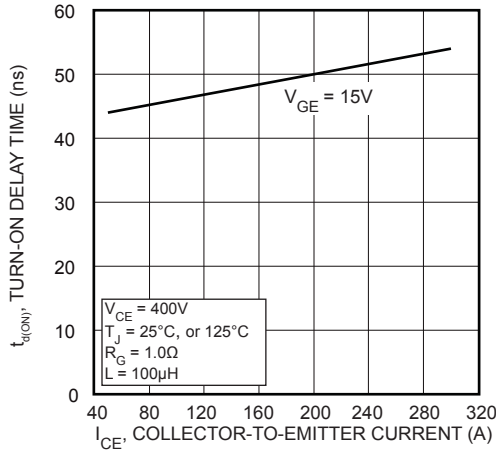


FIGURE 9, Turn-On Delay Time vs Collector Current

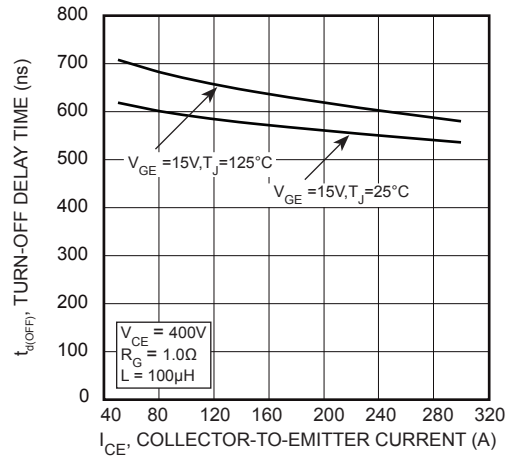


FIGURE 10, Turn-Off Delay Time vs Collector Current

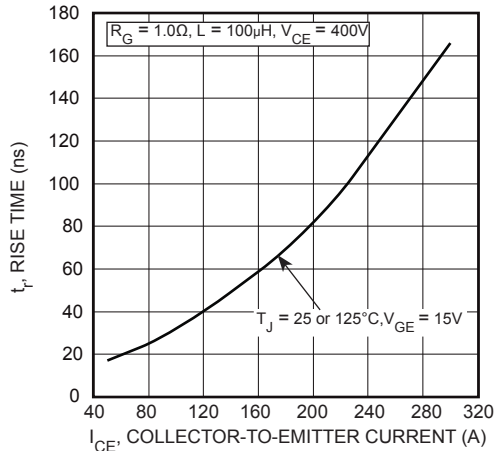


FIGURE 11, Current Rise Time vs Collector Current

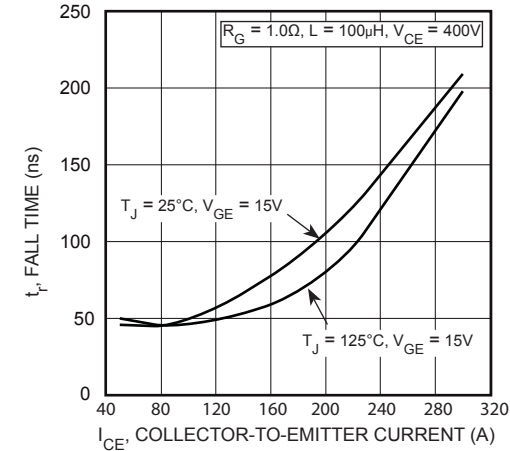


FIGURE 12, Current Fall Time vs Collector Current

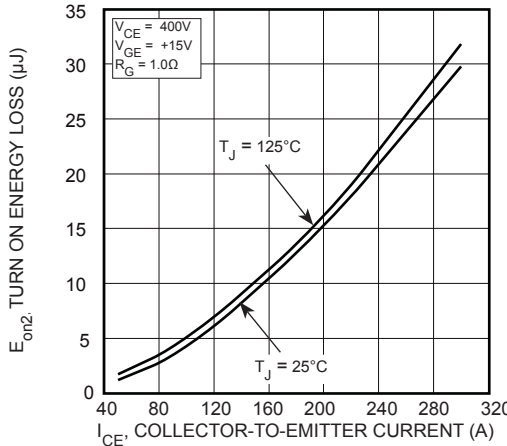


FIGURE 13, Turn-On Energy Loss vs Collector Current

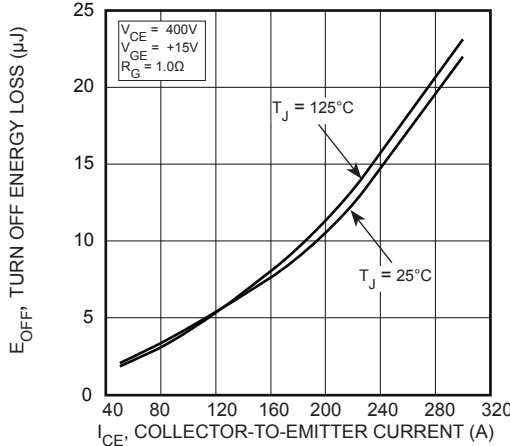


FIGURE 14, Turn-Off Energy Loss vs Collector Current

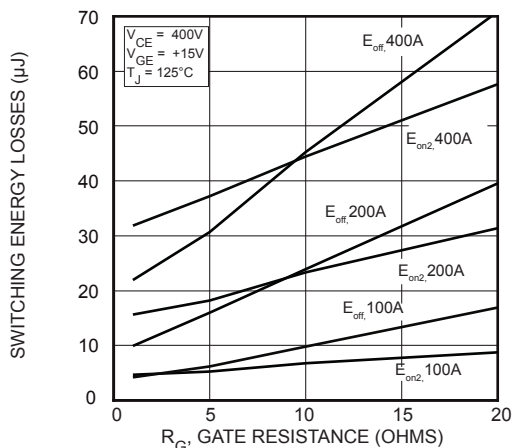


FIGURE 15, Switching Energy Losses vs Gate Resistance

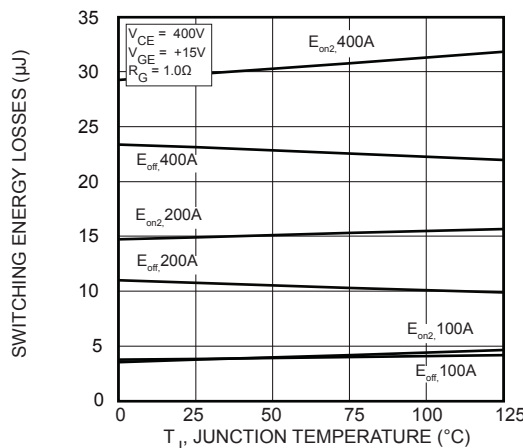


FIGURE 16, Switching Energy Losses vs Junction Temperature

Typical Performance Curves

APT200GN60B2G

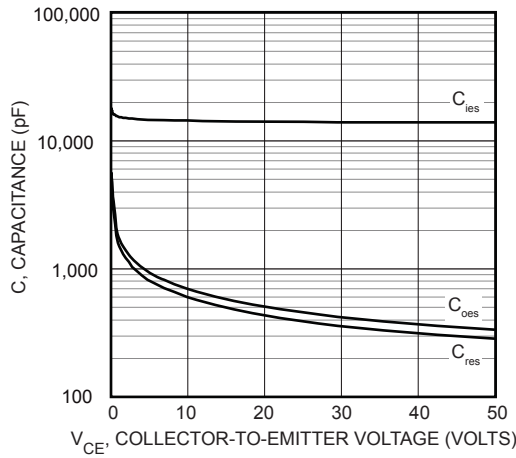


FIGURE 17, Capacitance vs Collector-To-Emitter Voltage

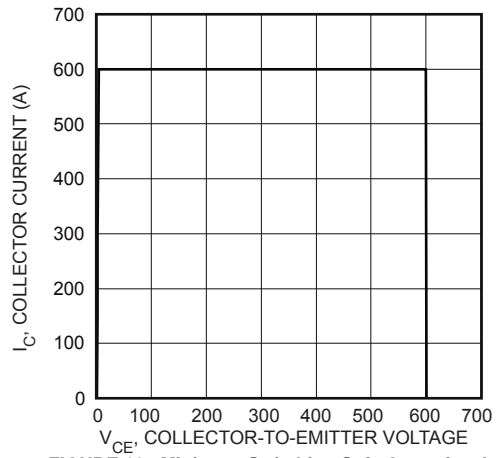


FIGURE 18, Minimum Switching Safe Operating Area

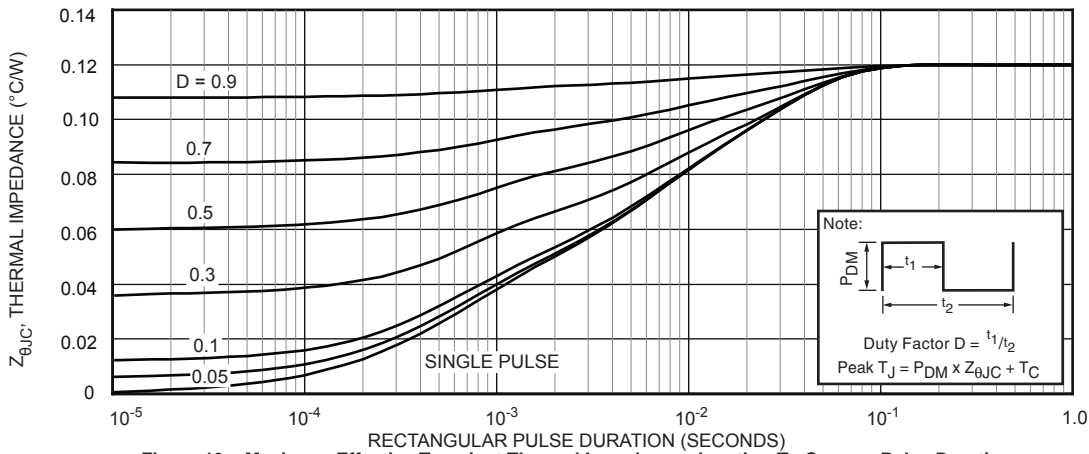


Figure 19a, Maximum Effective Transient Thermal Impedance, Junction-To-Case vs Pulse Duration

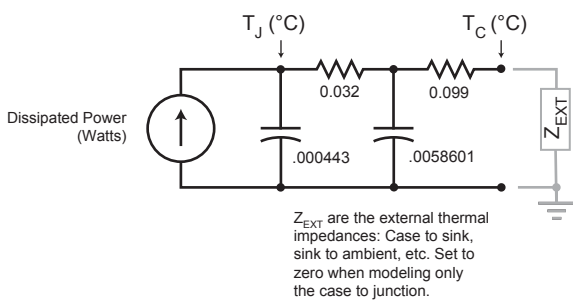


FIGURE 19b, TRANSIENT THERMAL IMPEDANCE MODEL

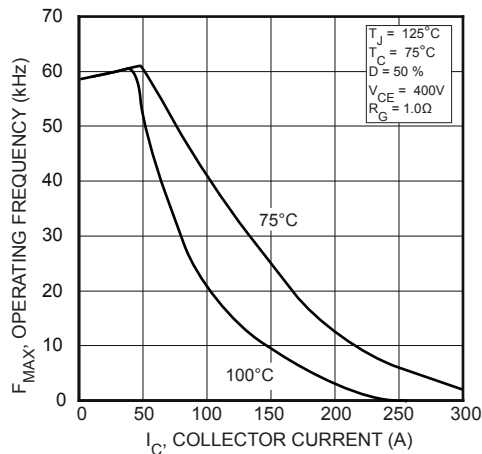


Figure 20, Operating Frequency vs Collector Current

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

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

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

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

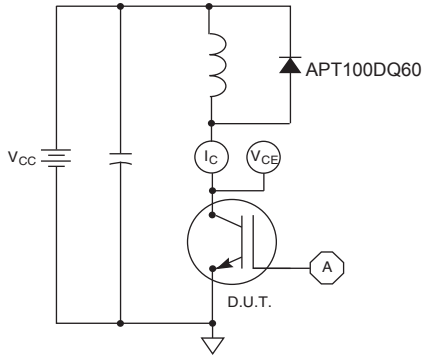


Figure 21, Inductive Switching Test Circuit

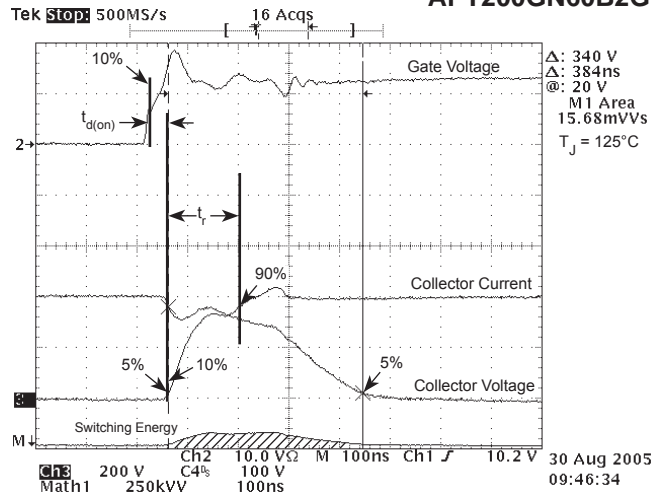


Figure 22, Turn-on Switching Waveforms and Definitions

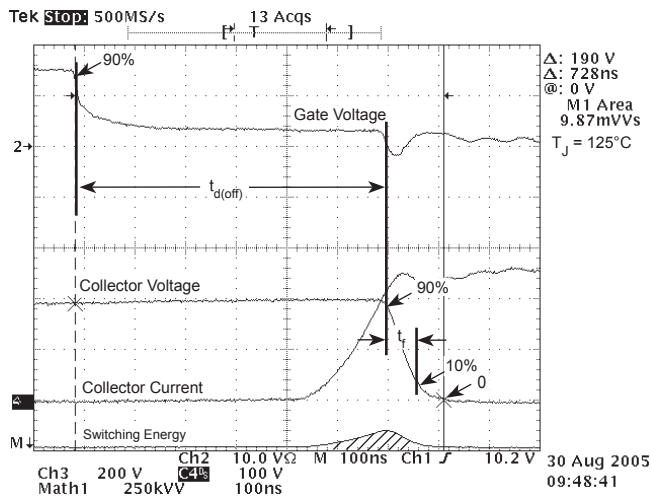
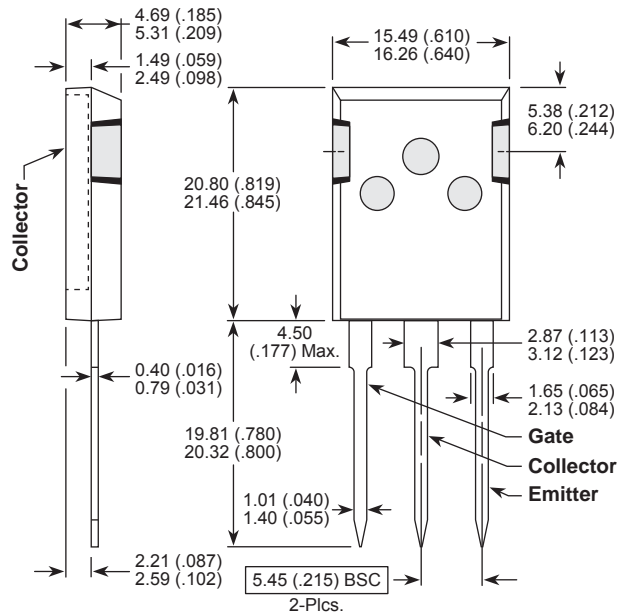


Figure 23, Turn-off Switching Waveforms and Definitions

T-MAX® Package Outline



Dimensions in Millimeters and (Inches)

Microsemi'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 6,939,743, 7,352,045 5,283,201 5,801,417 5,648,283 7,196,634 6,664,594 7,157,886 6,939,743 7,342,262 and foreign patents. US and Foreign patents pending. All Rights Reserved.