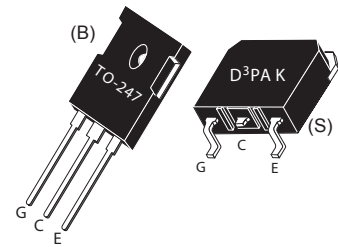


## Ultra Fast NPT - IGBT®

The Ultra Fast 650V NPT-IGBT® family of products is the newest generation of IGBTs optimized for outstanding ruggedness and best trade-off between conduction and switching losses.

### Features

- Low Saturation Voltage
- Low Tail Current
- RoHS Compliant 
- Short Circuit Withstand Rated
- High Frequency Switching
- Ultra Low Leakage Current



Unless stated otherwise, Microsemi discrete IGBTs contain a single IGBT die. This device is recommended for applications such as induction heating (IH), motor control, general purpose inverters and uninterruptible power supplies (UPS).

### MAXIMUM RATINGS

All Ratings:  $T_C = 25^\circ\text{C}$  unless otherwise specified.

| Symbol         | Parameter                                                                                  | Ratings    | Unit             |
|----------------|--------------------------------------------------------------------------------------------|------------|------------------|
| $V_{CES}$      | Collector Emitter Voltage                                                                  | 650        | V                |
| $V_{GE}$       | Gate-Emitter Voltage                                                                       | $\pm 30$   |                  |
| $I_{C1}$       | Continuous Collector Current @ $T_C = 25^\circ\text{C}$                                    | 134        | A                |
| $I_{C2}$       | Continuous Collector Current @ $T_C = 110^\circ\text{C}$                                   | 65         |                  |
| $I_{CM}$       | Pulsed Collector Current <sup>①</sup>                                                      | 260        |                  |
| SCWT           | Short Circuit Withstand Time: $V_{CE} = 600V$ , $V_{GE} = 15V$ , $T_C = 125^\circ\text{C}$ | 10         | $\mu\text{s}$    |
| $P_D$          | Total Power Dissipation @ $T_C = 25^\circ\text{C}$                                         | 595        | W                |
| $T_J, T_{STG}$ | Operating and Storage Junction Temperature Range                                           | -55 to 150 | $^\circ\text{C}$ |
| $T_L$          | Max. Lead Temp. for Soldering: 0.063" from Case for 10 Sec.                                | 300        |                  |

### STATIC ELECTRICAL CHARACTERISTICS

| Symbol        | Parameter                                                                                              | Min | Typ | Max       | Unit          |
|---------------|--------------------------------------------------------------------------------------------------------|-----|-----|-----------|---------------|
| $V_{(BR)CES}$ | Collector-Emitter Breakdown Voltage ( $V_{GE} = 0V$ , $I_C = 250\mu\text{A}$ )                         | 650 |     |           | Volts         |
| $V_{GE(TH)}$  | Gate Threshold Voltage ( $V_{CE} = V_{GE}$ , $I_C = 1.0\text{mA}$ , $T_J = 25^\circ\text{C}$ )         | 3.5 | 5.0 | 6.5       |               |
| $V_{CE(ON)}$  | Collector-Emitter On Voltage ( $V_{GE} = 15V$ , $I_C = 70A$ , $T_J = 25^\circ\text{C}$ )               |     | 1.9 | 2.4       |               |
|               | Collector-Emitter On Voltage ( $V_{GE} = 15V$ , $I_C = 70A$ , $T_J = 125^\circ\text{C}$ )              |     | 2.4 |           |               |
|               | Collector-Emitter On Voltage ( $V_{GE} = 15V$ , $I_C = 140A$ , $T_J = 25^\circ\text{C}$ )              |     | 2.6 |           |               |
| $I_{CES}$     | Collector Cut-off Current ( $V_{CE} = 650V$ , $V_{GE} = 0V$ , $T_J = 25^\circ\text{C}$ ) <sup>②</sup>  |     | 10  | 250       | $\mu\text{A}$ |
|               | Collector Cut-off Current ( $V_{CE} = 650V$ , $V_{GE} = 0V$ , $T_J = 125^\circ\text{C}$ ) <sup>②</sup> |     | 100 |           |               |
| $I_{GES}$     | Gate-Emitter Leakage Current ( $V_{GE} = \pm 20V$ )                                                    |     |     | $\pm 250$ | nA            |



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

# DYNAMIC CHARACTERISTICS

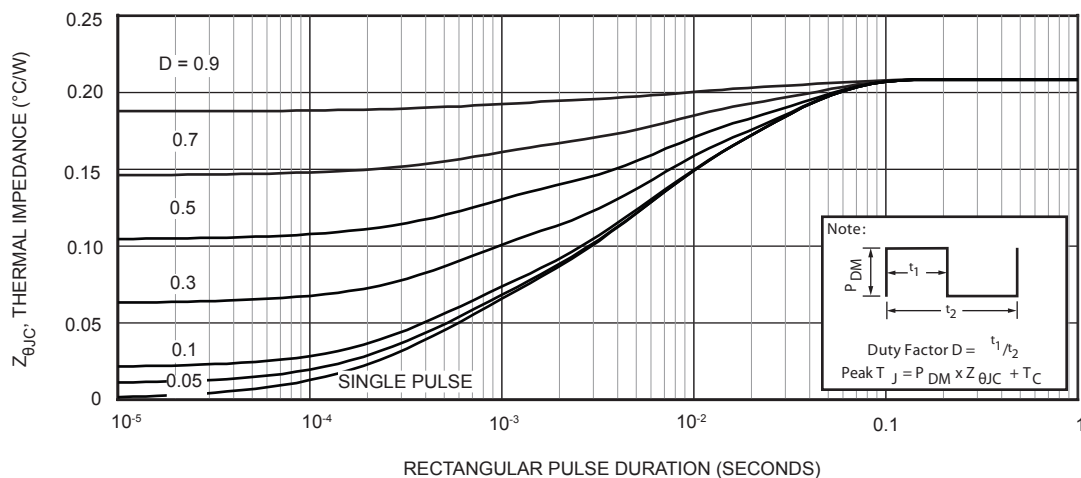
APT70GR65B

| Symbol          | Parameter                       | Test Conditions                                                                                                                    | Min | Typ  | Max  | Unit    |
|-----------------|---------------------------------|------------------------------------------------------------------------------------------------------------------------------------|-----|------|------|---------|
| $C_{ies}$       | Input Capacitance               | Capacitance<br>$V_{GE} = 0V, V_{CE} = 25V$<br>$f = 1MHz$                                                                           |     | 4250 |      | $\mu F$ |
| $C_{oes}$       | Output Capacitance              |                                                                                                                                    |     | 847  |      |         |
| $C_{res}$       | Reverse Transfer Capacitance    |                                                                                                                                    |     | 415  |      |         |
| $V_{GEP}$       | Gate to Emitter Plateau Voltage | Gate Charge<br>$V_{GE} = 15V$<br>$V_{CE} = 325V$<br>$I_C = 70A$                                                                    |     | 7.0  |      | V       |
| $Q_g^{(3)}$     | Total Gate Charge               |                                                                                                                                    |     | 226  | 305  | nC      |
| $Q_{ge}$        | Gate-Emitter Charge             |                                                                                                                                    |     | 26   | 35   |         |
| $Q_{gc}$        | Gate- Collector Charge          |                                                                                                                                    |     | 104  | 140  |         |
| $t_{d(on)}$     | Turn-On Delay Time              | Inductive Switching (25°C)<br>$V_{CC} = 433V$<br>$V_{GE} = 15V$<br>$I_C = 70A$<br>$R_G = 4.3\Omega^{(4)}$<br>$T_J = +25^\circ C$   |     | 19   |      | ns      |
| $t_r$           | Current Rise Time               |                                                                                                                                    |     | 45   |      |         |
| $t_{d(off)}$    | Turn-Off Delay Time             |                                                                                                                                    |     | 170  |      |         |
| $t_f$           | Current Fall Time               |                                                                                                                                    |     | 67   |      |         |
| $E_{on2}^{(5)}$ | Turn-On Switching Energy        |                                                                                                                                    |     | 1505 | 2260 | $\mu J$ |
| $E_{off}^{(6)}$ | Turn-Off Switching Energy       |                                                                                                                                    |     | 1460 | 1970 |         |
| $t_{d(on)}$     | Turn-On Delay Time              | Inductive Switching (125°C)<br>$V_{CC} = 433V$<br>$V_{GE} = 15V$<br>$I_C = 70A$<br>$R_G = 4.3\Omega^{(4)}$<br>$T_J = +125^\circ C$ |     | 19   |      | ns      |
| $t_r$           | Current Rise Time               |                                                                                                                                    |     | 45   |      |         |
| $t_{d(off)}$    | Turn-Off Delay Time             |                                                                                                                                    |     | 190  |      |         |
| $t_f$           | Current Fall Time               |                                                                                                                                    |     | 74   |      |         |
| $E_{on2}^{(5)}$ | Turn-On Switching Energy        |                                                                                                                                    |     | 1560 | 2340 | $\mu J$ |
| $E_{off}^{(6)}$ | Turn-Off Switching Energy       |                                                                                                                                    |     | 1720 | 2580 |         |

# THERMAL AND MECHANICAL CHARACTERISTICS

| Symbol          | Characteristic                                     | Min | Typ | Max | Unit         |
|-----------------|----------------------------------------------------|-----|-----|-----|--------------|
| $R_{\theta JC}$ | Junction to Case Thermal Resistance                |     |     | .21 | $^\circ C/W$ |
| $R_{\theta JA}$ | Junction to Ambient Thermal Resistance             |     |     | 40  |              |
| $W_T$           | Package Weight                                     |     | .22 |     | oz           |
|                 |                                                    |     | 6.2 |     | g            |
| Torque          | Mounting Torque (TO-247 Package), 4-40 or M3 screw |     |     | 10  | in-lbf       |
|                 |                                                    |     |     | 6.2 | N·m          |

- 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 energy loss at turn-on and includes the charge stored in the freewheeling 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.



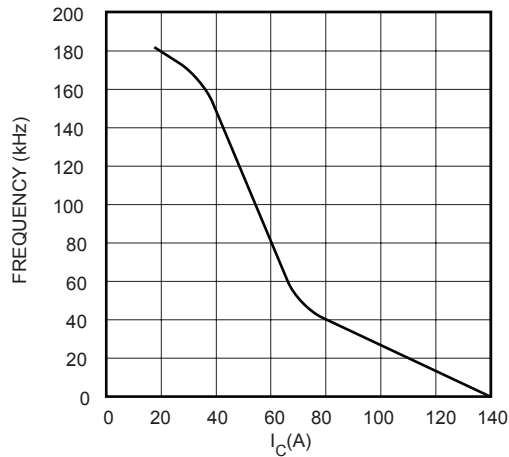
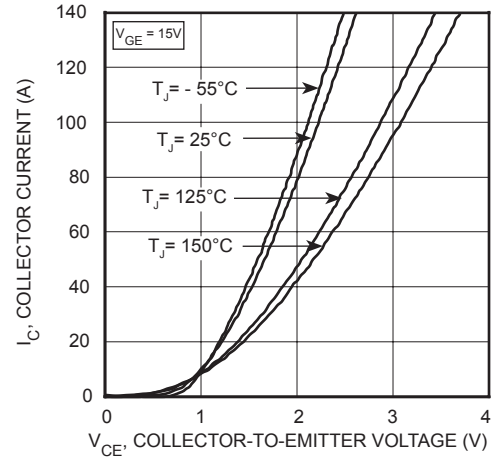
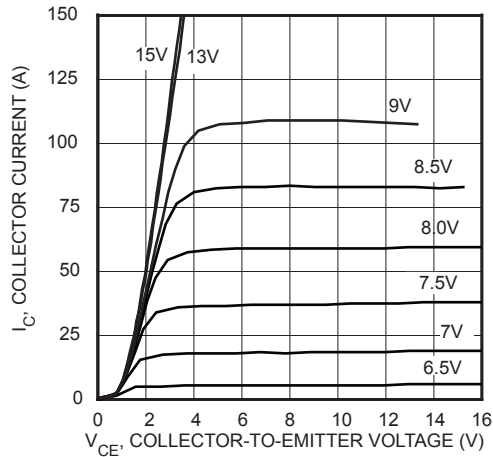
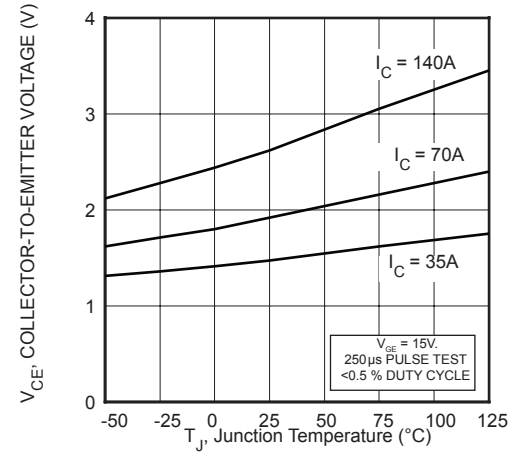
FIGURE 2, Max Frequency vs Current ( $T_{case} = 75^{\circ}\text{C}$ )FIGURE 3, Saturation Voltage Characteristics ( $T_J = 25^{\circ}\text{C}$ )FIGURE 4, Output Characteristics ( $T_J = 25^{\circ}\text{C}$ )

FIGURE 5, On State Voltage vs Junction Temperature

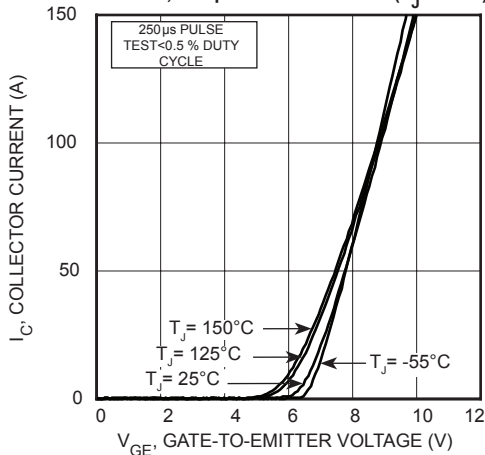


FIGURE 6, Transfer Characteristics

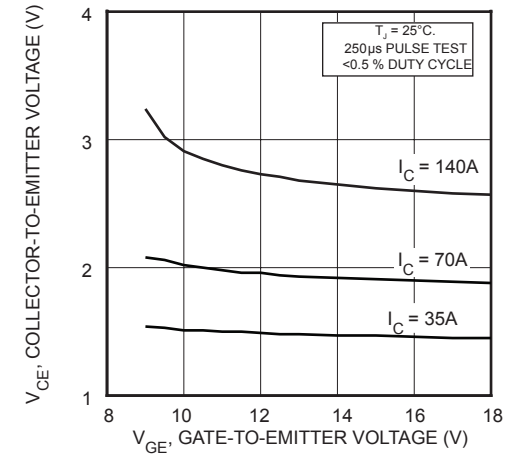


FIGURE 7, On State Voltage vs Gate-to-Emitter Voltage

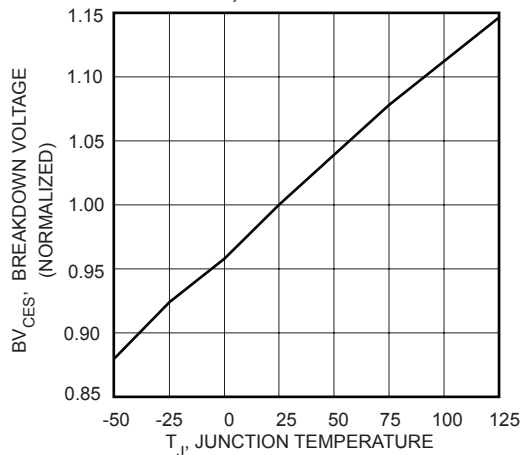


FIGURE 8, Breakdown Voltage vs Junction Temperature

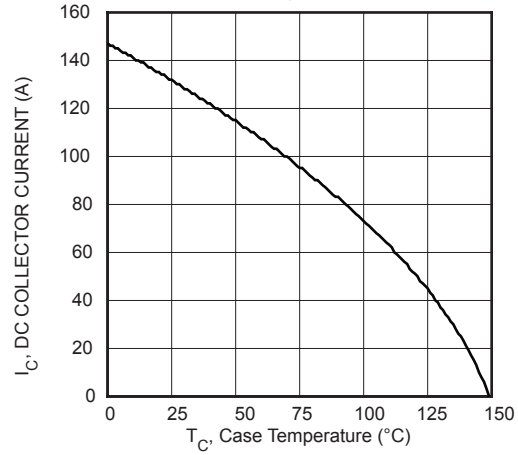


FIGURE 9, DC Collector Current vs Case Temperature

# TYPICAL PERFORMANCE CURVES

APT70GR65B

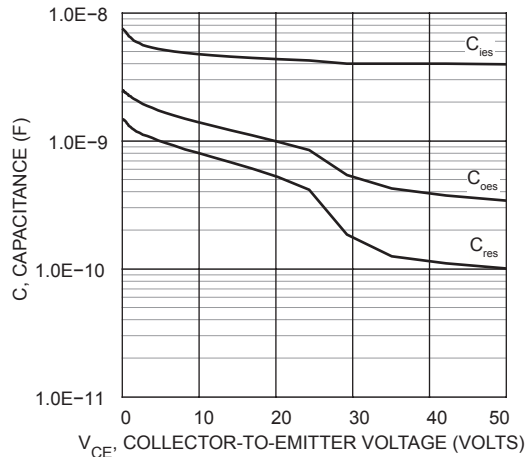


FIGURE 10, Capacitance vs Collector-To-Emitter Voltage

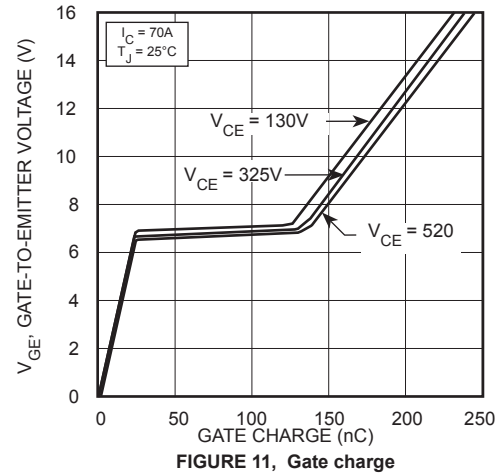


FIGURE 11, Gate charge

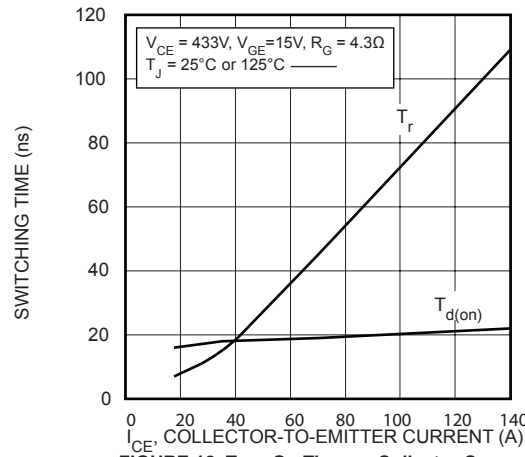


FIGURE 12, Turn-On Time vs Collector Current

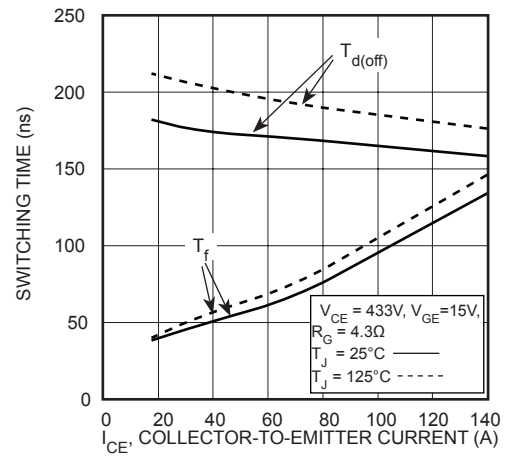


FIGURE 13, Turn-Off Time vs Collector Current

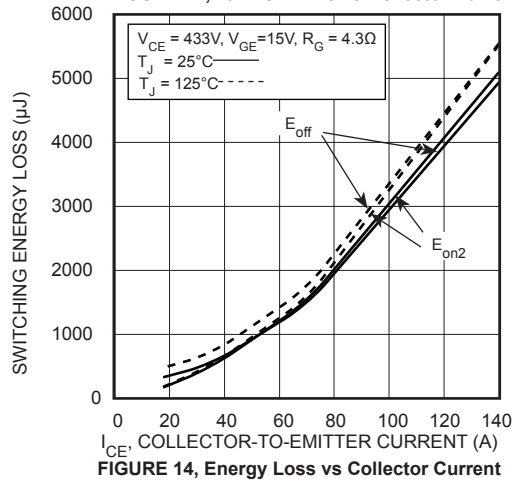


FIGURE 14, Energy Loss vs Collector Current

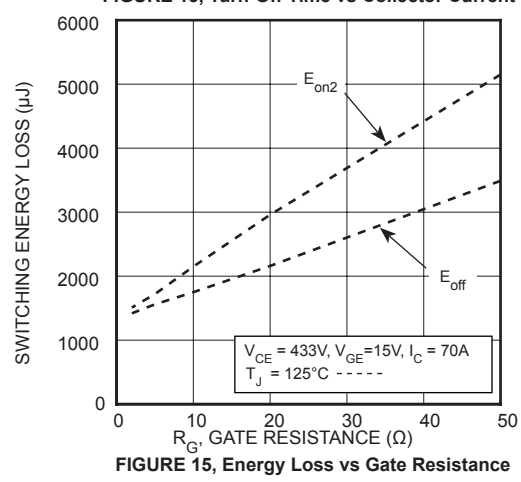


FIGURE 15, Energy Loss vs Gate Resistance

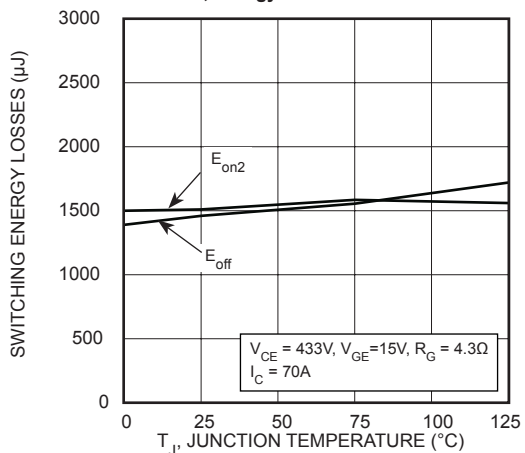


FIGURE 16, Switching Energy vs Junction Temperature

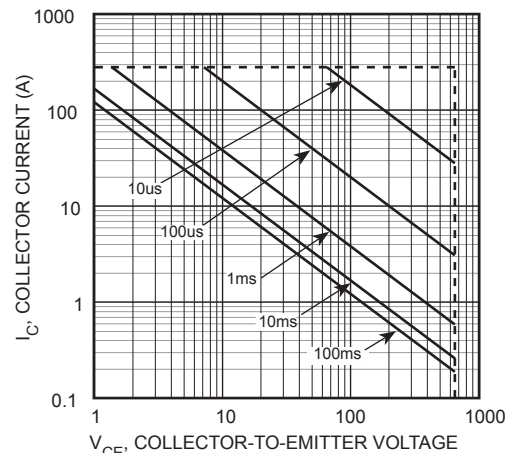
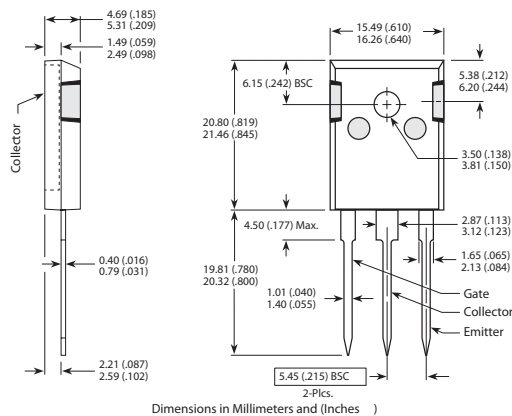


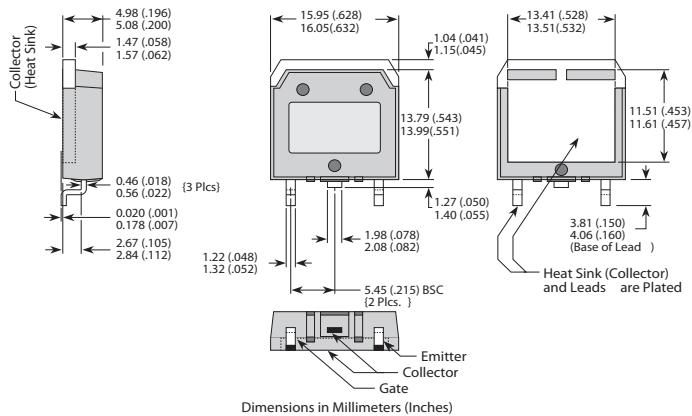
FIGURE 17, Minimum Switching Safe Operating Area

TO-247 Package Outline



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

e3 : 100% Sn Plating



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