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**FAIRCHILD**  
SEMICONDUCTOR®

**FGB3236\_F085 / FGI3236\_F085**

**EcoSPARK**

October 2013



**FGB3236\_F085 / FGI3236\_F085 320mJ, 360V, N-Channel Ignition IGBT**

**Device Maximum Ratings**  $T_A = 25^\circ\text{C}$  unless otherwise noted

| Symbol        | Parameter   | Ratings     | Units               |
|---------------|---|-------------|---------------------|
| $BV_{CER}$    | Collector to Emitter Breakdown Voltage ( $I_C = 1\text{mA}$ )   | 360         | V                   |
| $BV_{ECS}$    | Emitter to Collector Voltage - Reverse Battery Condition ( $I_C = 10\text{mA}$ )  | 24          | V                   |
| $E_{SCIS25}$  | Self Clamping Inductive Switching Energy ( $I_{SCIS} = 14.7\text{A}$ , $L = 3.0\text{mH}$ , $T_J = 25^\circ\text{C}$ )  | 320         | mJ                  |
| $E_{SCIS150}$ | Self Clamping Inductive Switching Energy ( $I_{SCIS} = 10.4\text{A}$ , $L = 3.0\text{mH}$ , $T_J = 150^\circ\text{C}$ ) | 160         | mJ                  |
| $I_{C25}$     | Collector Current Continuous, at $V_{GE} = 4.0\text{V}$ , $T_C = 25^\circ\text{C}$                                      | 44          | A                   |
| $I_{C110}$    | Collector Current Continuous, at $V_{GE} = 4.0\text{V}$ , $T_C = 110^\circ\text{C}$                                     | 27          | A                   |
| $V_{GEM}$     | Gate to Emitter Voltage Continuous  | $\pm 10$    | V                   |
| $P_D$         | Power Dissipation Total, at $T_C = 25^\circ\text{C}$  | 187         | W                   |
|               | Power Dissipation Derating, for $T_C > 25^\circ\text{C}$  | 1.25        | W/ $^\circ\text{C}$ |
| $T_J$         | Operating Junction Temperature Range  | -40 to +175 | $^\circ\text{C}$    |
| $T_{STG}$     | Storage Junction Temperature Range  | -40 to +175 | $^\circ\text{C}$    |
| $T_L$         | Max. Lead Temp. for Soldering (Leads at 1.6mm from case for 10s)  | 300         | $^\circ\text{C}$    |
| $T_{PKG}$     | Max. Lead Temp. for Soldering (Package Body for 10s)  | 260         | $^\circ\text{C}$    |
| ESD           | Electrostatic Discharge Voltage at 100pF, 1500 $\Omega$   | 4           | kV                  |

**Package Marking and Ordering Information**

| Device Marking | Device       | Package | Reel Size | Tape Width | Quantity  |
|----------------|--------------|---------|-----------|------------|-----------|
| FGB3236        | FGB3236_F085 | TO263   | 330mm     | 24mm       | 800 units |
| FGI3236        | FGI3236_F085 | TO262   | Tube      | NA         | 50 units  |

**Electrical Characteristics**  $T_A = 25^\circ\text{C}$  unless otherwise noted

| Symbol | Parameter | Test Conditions | Min | Typ | Max | Units |
|--------|-----------|-----------------|-----|-----|-----|-------|
|--------|-----------|-----------------|-----|-----|-----|-------|

**Off State Characteristics**

|            |  |  |                           |          |     |          |               |
|------------|--|--|---------------------------|----------|-----|----------|---------------|
| $BV_{CER}$ | Collector to Emitter Breakdown Voltage | $I_{CE} = 2\text{mA}$ , $V_{GE} = 0$ ,<br>$R_{GE} = 1\text{K}\Omega$ , See Fig. 15<br>$T_J = -40$ to $150^\circ\text{C}$ | 330                       | 363      | 390 | V        |               |
| $BV_{CES}$ | Collector to Emitter Breakdown Voltage | $I_{CE} = 10\text{mA}$ , $V_{GE} = 0\text{V}$ ,<br>$R_{GE} = 0$ ,<br>$T_J = -40$ to $150^\circ\text{C}$                  | 350                       | 378      | 410 | V        |               |
| $BV_{ECS}$ | Emitter to Collector Breakdown Voltage | $I_{CE} = -75\text{mA}$ , $V_{GE} = 0\text{V}$ ,<br>$T_C = 25^\circ\text{C}$   | 30                        | -        | -   | V        |               |
| $BV_{GES}$ | Gate to Emitter Breakdown Voltage      | $I_{GES} = \pm 2\text{mA}$   | $\pm 12$                  | $\pm 14$ | -   | V        |               |
| $I_{CES}$  | Collector to Emitter Leakage Current   | $V_{CES} = 250\text{V}$ ,<br>See Fig. 11   | $T_C = 25^\circ\text{C}$  | -        | -   | 25       | $\mu\text{A}$ |
|            |  |  | $T_C = 150^\circ\text{C}$ | -        | -   | 1        | mA            |
| $I_{ECS}$  | Emitter to Collector Leakage Current   | $V_{EC} = 24\text{V}$ ,<br>See Fig. 11   | $T_C = 25^\circ\text{C}$  | -        | -   | 1        | mA            |
|            |  |  | $T_C = 150^\circ\text{C}$ | -        | -   | 40       |               |
| $R_1$      | Series Gate Resistance                 |  | -                         | 100      | -   | $\Omega$ |               |
| $R_2$      | Gate to Emitter Resistance             |  | 10K                       | -        | 30K | $\Omega$ |               |

**On State Characteristics**

|               |   |  |   |    |      |      |   |
|---------------|---|--|---|----|------|------|---|
| $V_{CE(SAT)}$ | Collector to Emitter Saturation Voltage | $I_{CE} = 6\text{A}$ , $V_{GE} = 4\text{V}$ ,    | $T_C = 25^\circ\text{C}$ ,<br>See Fig. 3  | -  | 1.14 | 1.4  | V |
| $V_{CE(SAT)}$ | Collector to Emitter Saturation Voltage | $I_{CE} = 10\text{A}$ , $V_{GE} = 4.5\text{V}$ , | $T_C = 150^\circ\text{C}$ ,<br>See Fig. 4 | -  | 1.32 | 1.7  | V |
| $V_{CE(SAT)}$ | Collector to Emitter Saturation Voltage | $I_{CE} = 15\text{A}$ , $V_{GE} = 4.5\text{V}$ , | $T_C = 150^\circ\text{C}$                 | -  | 1.61 | 2.05 | V |
| $I_{CE(ON)}$  | Collector to Emitter On State Current   | $V_{GE} = 5\text{V}$ , $V_{CE} = 5\text{V}$      |   | 50 | -    | -    | A |

**Electrical Characteristics**  $T_A = 25^\circ\text{C}$  unless otherwise noted

| Symbol | Parameter | Test Conditions | Min | Typ | Max | Units |
|--------|-----------|-----------------|-----|-----|-----|-------|
|--------|-----------|-----------------|-----|-----|-----|-------|

**Dynamic Characteristics**

|              |                                   |  |  |     |   |    |
|--------------|-----------------------------------|--|--|-----|---|----|
| $Q_{G(ON)}$  | Gate Charge                       | $I_{CE} = 10\text{A}$ , $V_{CE} = 12\text{V}$ ,<br>$V_{GE} = 5\text{V}$ , See Fig.14 | -  | 20  | - | nC |
| $V_{GE(TH)}$ | Gate to Emitter Threshold Voltage | $I_{CE} = 1\text{mA}$ , $V_{CE} = V_{GE}$ ,<br>See Fig. 10                           | $T_C = 25^\circ\text{C}$ 1.3    1.6    2.2<br>$T_C = 150^\circ\text{C}$ 0.75    1.1    1.8 |     | V |    |
| $V_{GEP}$    | Gate to Emitter Plateau Voltage   | $V_{CE} = 12\text{V}$ , $I_{CE} = 10\text{A}$  | -  | 2.6 | - | V  |

**Switching Characteristics**

|               |                                       |  |   |      |     |               |
|---------------|---------------------------------------|--|---|------|-----|---------------|
| $t_{d(ON)R}$  | Current Turn-On Delay Time-Resistive  | $V_{CE} = 14\text{V}$ , $R_L = 1\Omega$  | - | 0.65 | 4   | $\mu\text{s}$ |
| $t_{rR}$      | Current Rise Time-Resistive           | $V_{GE} = 5\text{V}$ , $R_G = 1\text{K}\Omega$<br>$T_J = 25^\circ\text{C}$ , See Fig.12  | - | 1.7  | 7   | $\mu\text{s}$ |
| $t_{d(OFF)L}$ | Current Turn-Off Delay Time-Inductive | $V_{CE} = 300\text{V}$ , $L = 500\mu\text{Hy}$ ,   | - | 5.4  | 15  | $\mu\text{s}$ |
| $t_{fL}$      | Current Fall Time-Inductive           | $V_{GE} = 5\text{V}$ , $R_G = 1\text{K}\Omega$<br>$T_J = 25^\circ\text{C}$ , See Fig.12  | - | 1.64 | 15  | $\mu\text{s}$ |
| SCIS          | Self Clamped inductive Switching      | $T_J = 25^\circ\text{C}$ , $L = 3.0\text{mHy}$ , $I_{CE} = 14.7\text{A}$ ,<br>$R_G = 1\text{K}\Omega$ , $V_{GE} = 5\text{V}$ , See Fig.1&2 | - | -    | 320 | mJ            |

**Thermal Characteristics**

|                 |                                     |              |   |   |     |                    |
|-----------------|-------------------------------------|--------------|---|---|-----|--------------------|
| $R_{\theta JC}$ | Thermal Resistance Junction to Case | All Packages | - | - | 0.8 | $^\circ\text{C/W}$ |
|-----------------|-------------------------------------|--------------|---|---|-----|--------------------|

### Typical Performance Curves

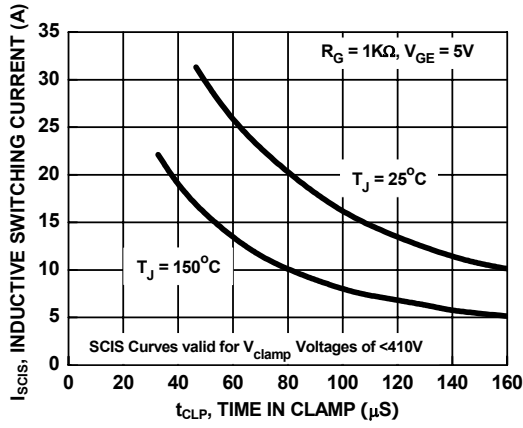


Figure 1. Self Clamped Inductive Switching Current vs. Time in Clamp

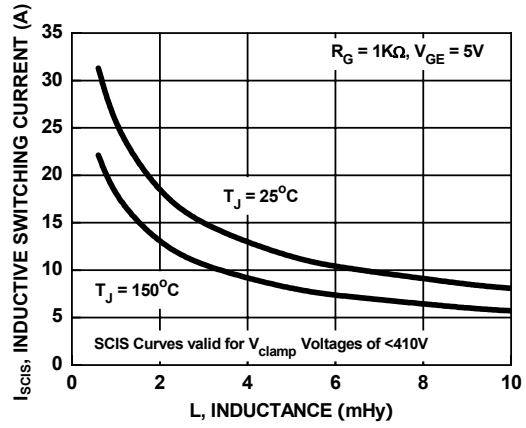


Figure 2. Self Clamped Inductive Switching Current vs. Inductance

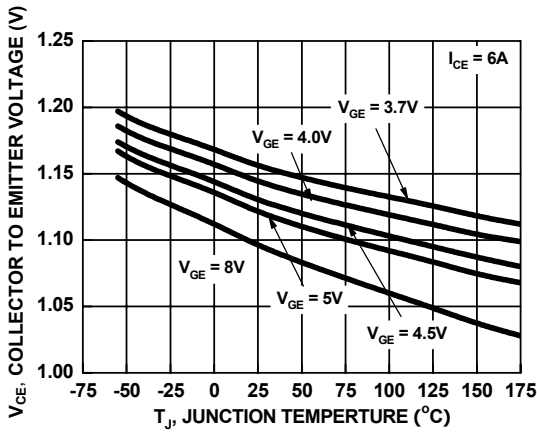


Figure 3. Collector to Emitter On-State Voltage vs. Junction Temperature

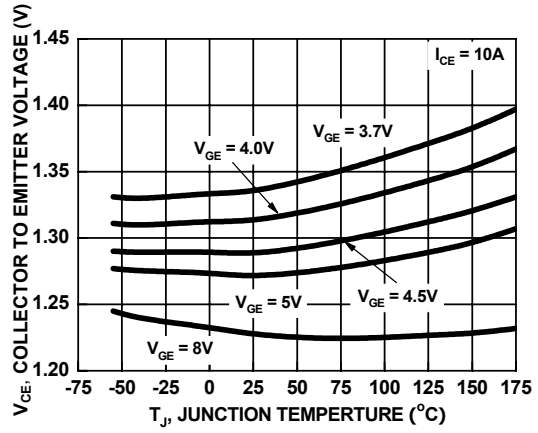


Figure 4. Collector to Emitter On-State Voltage vs. Junction Temperature

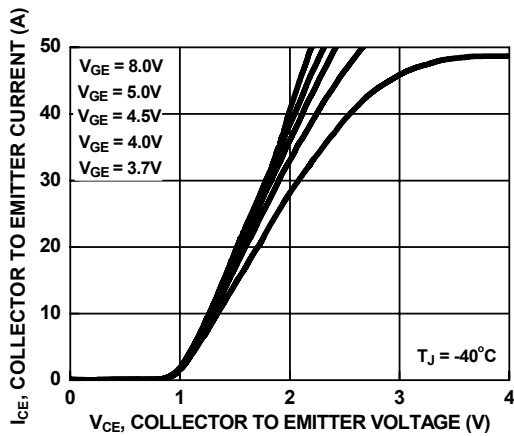


Figure 5. Collector to Emitter On-State Voltage vs. Collector Current

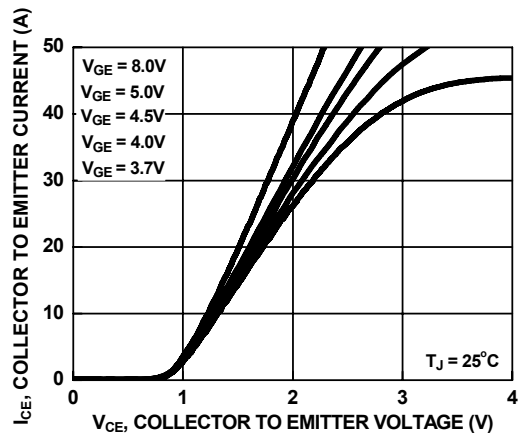


Figure 6. Collector to Emitter On-State Voltage vs. Collector Current

Typical Performance Curves (Continued)

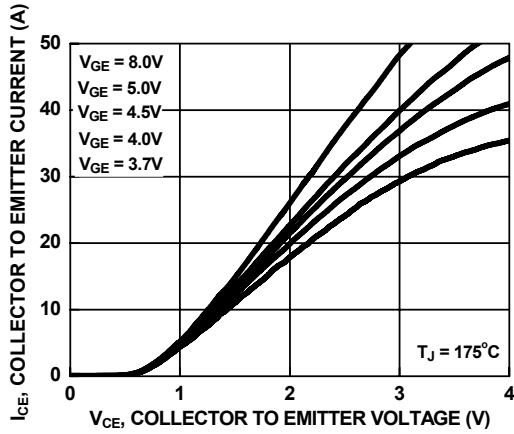


Figure 7. Collector to Emitter On-State Voltage vs. Collector Current

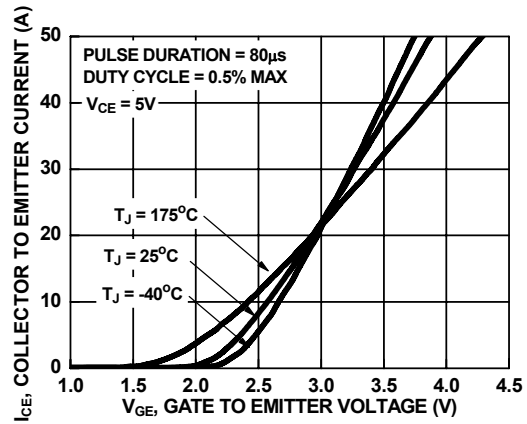


Figure 8. Transfer Characteristics

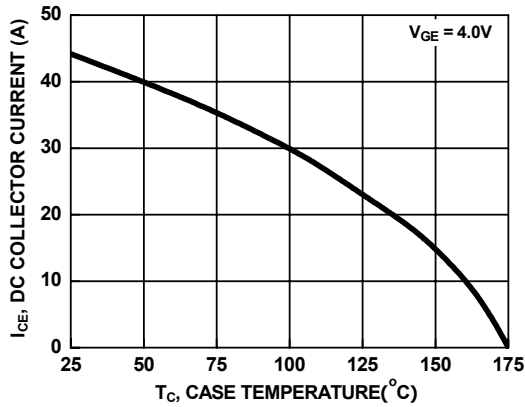


Figure 9. DC Collector Current vs. Case Temperature

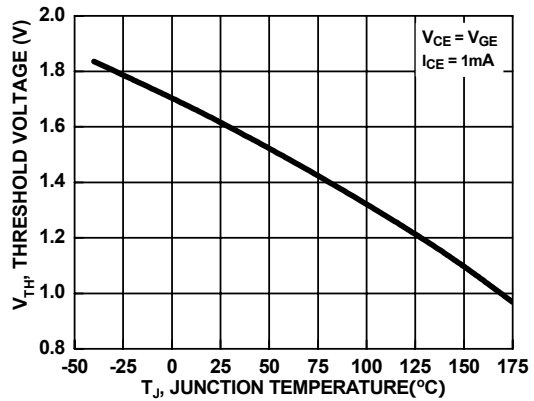


Figure 10. Threshold Voltage vs. Junction Temperature

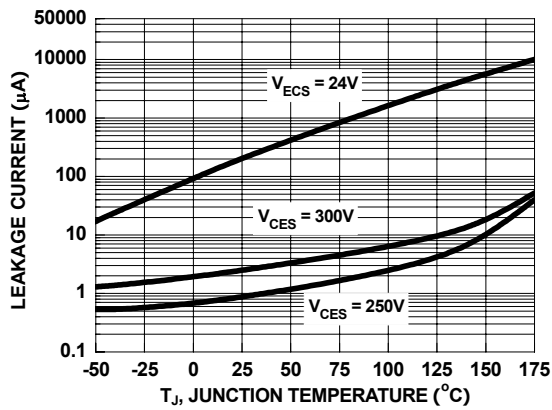


Figure 11. Leakage Current vs. Junction Temperature

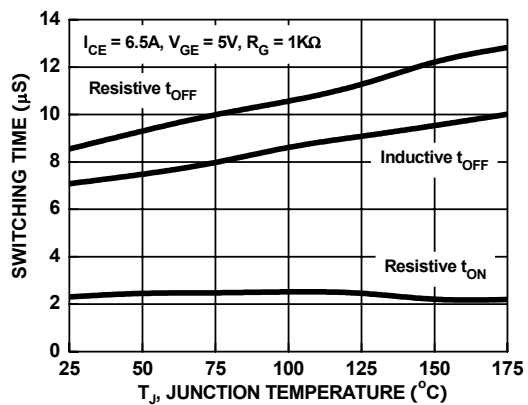
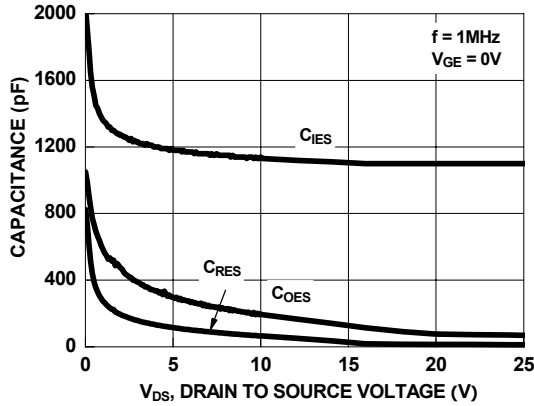
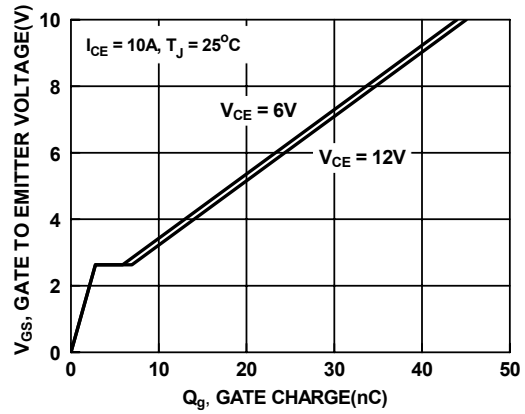


Figure 12. Switching Time vs. Junction Temperature

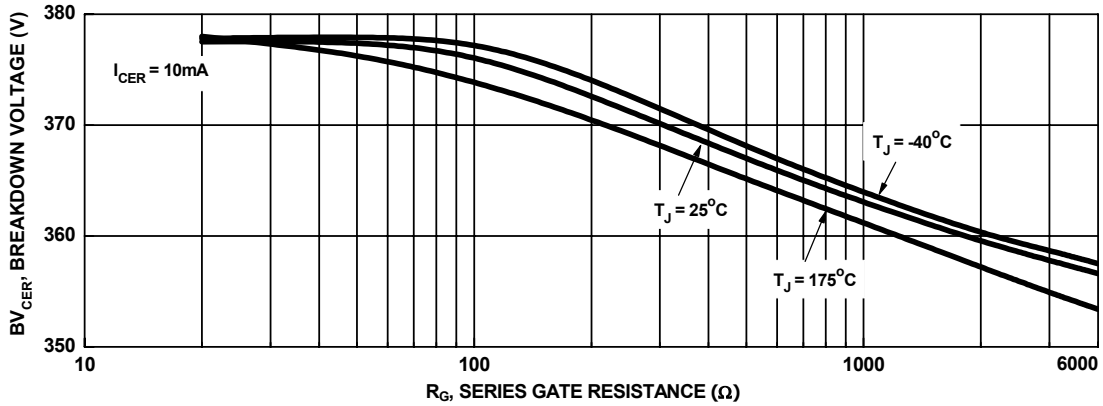
**Typical Performance Curves** (Continued)



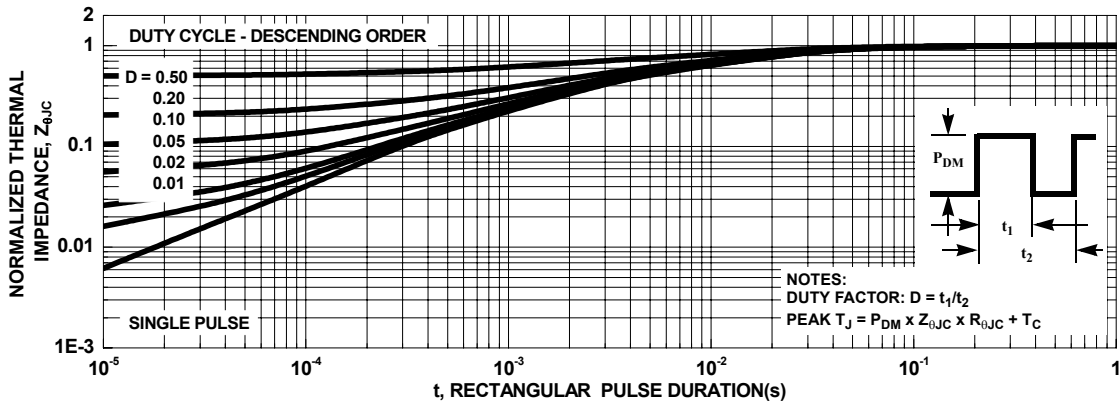
**Figure 13. Capacitance vs. Collector to Emitter Voltage**



**Figure 14. Gate Charge**



**Figure 15. Break Down Voltage vs. Series Gate Resistance**



**Figure 16. IGBT Normalized Transient Thermal Impedance, Junction to Case**

## Test Circuit and Waveforms

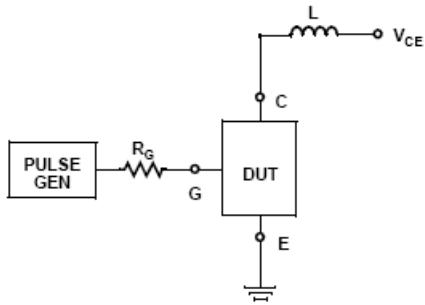


Figure 17. Inductive Switching Test Circuit

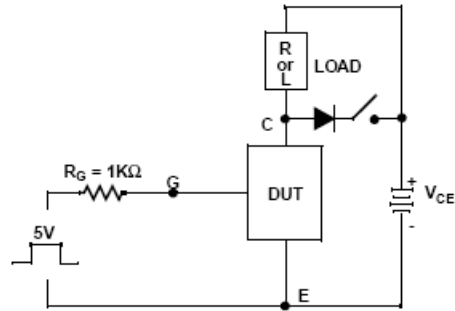


Figure 18.  $t_{ON}$  and  $t_{OFF}$  Switching Test Circuit

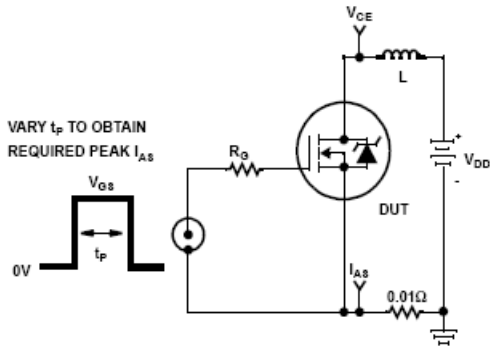


Figure 19. Energy Test Circuit

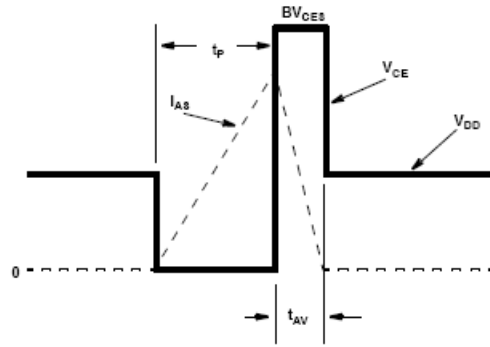
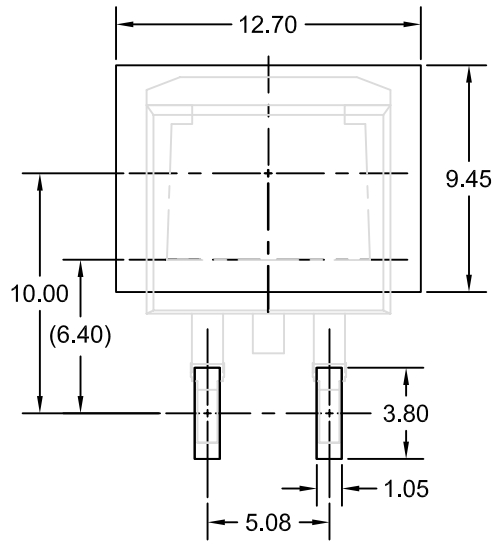
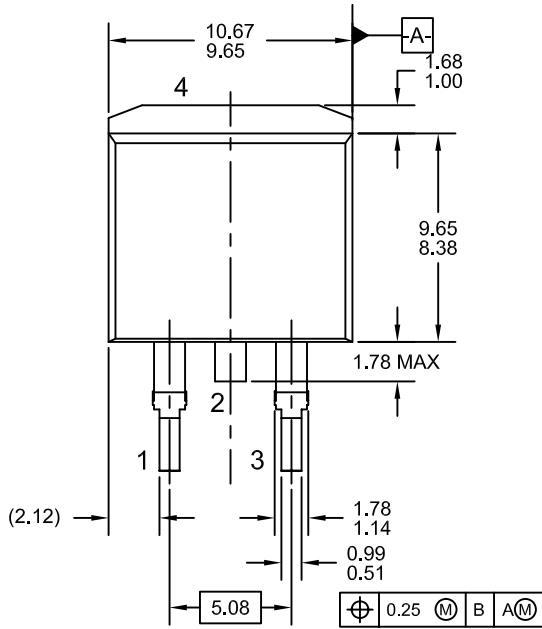


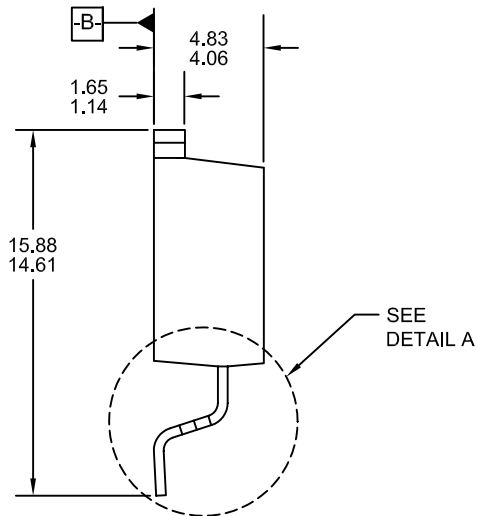
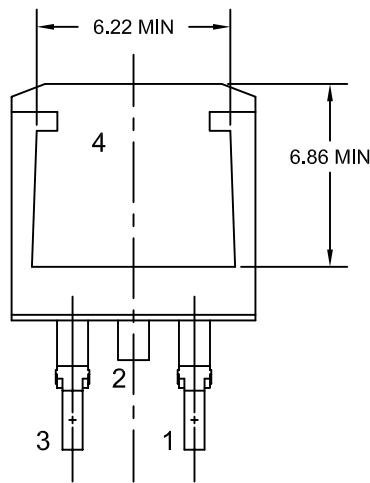
Figure 20. Energy Waveforms



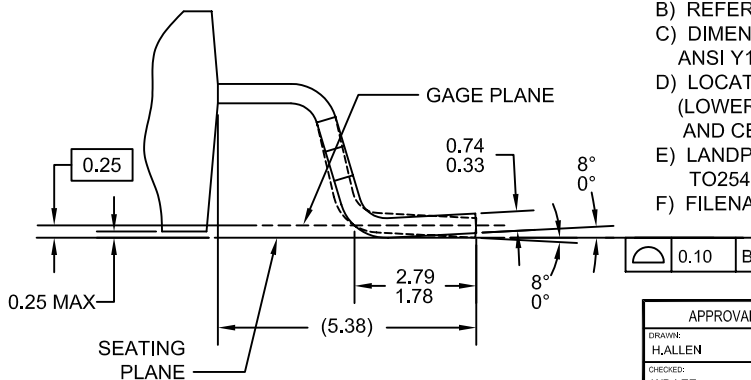
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|-----------|--|-----------|-----------|---------|
| LTR       | DESCRIPTION  | E.C.N.    | DATE      | BY/APPD |
| A         | RELEASE TO DOCUMENT CONTROL  | CB/085/99 | 08NOV1999 | MRG     |
| B         | CHG HEATSNK DIM FR 1.25 TO 1.50; INK DIM FR 1.25 TO 1.50; LD OUT FR 1.25 TO 1.50; ADD DIM 1.25; CHG THK FR 1.25 TO 1.50; NOT LSH FR 1.25 TO 1.50; ADD DETAIL A; CHG LD THCK FR 1.25 TO 1.50; CHG FOOT LSH FR 1.25 TO 1.50; ADD DIM 1.50; CHG LAND PATTERN DIM FR 2.00 TO 3.00 MIN; FR FOOT TO 3.00 MIN; FR 4.00 TO 4.00 MIN; FR 1.00 TO 1.50 MIN; DEL NOTE C; AND ARRANGE, ADD NOTE D. | CB/044/00 | 28FEB2000 | MRG     |
| C         | CHG ORDERED FR 1.25 TO 1.50; MAX LD WID FR 1.25 TO 1.50; INK THCK FR 1.25 TO 1.50; HEAT SNK THCK FR 1.25 TO 1.50; LD THCK FR 1.25 TO 1.50; FOOT LANDING FR 1.25 TO 1.50; FOOT ANGLE FR 3 TO 5 DEG; PROFILE DIM FR 1.5 TO MAX TO 1.50; MAX SINK HEAT SNK WID FR 1.50 TO 1.52 MIN; LEN FR 1.00 TO 1.80 MIN; REMOVE EJECTOR PIN MARK; ADD NOTE E.   | CB/254/04 | 7OCT2004  | RCM     |
| D         | REMOVE NOTE B; ADD NOTE E  | CB/043/05 | 30MAR2005 | MRG     |
| E         | REMOVED SITE INFO AND ECN COLUMN. ADDED NOTE F. TITLE CHANGED  | 06AUG2007 |           | H.ALLEN |
| F         | UPDATED HEATSNK PER IPC STANDARD. NOTE E IPC REFERENCE. FONT TO ARIAL. UPDATED DRAWING TITLE TO REFLECT JEDEC STANDARD.  |           | 02 MAY 09 | H.ALLEN |



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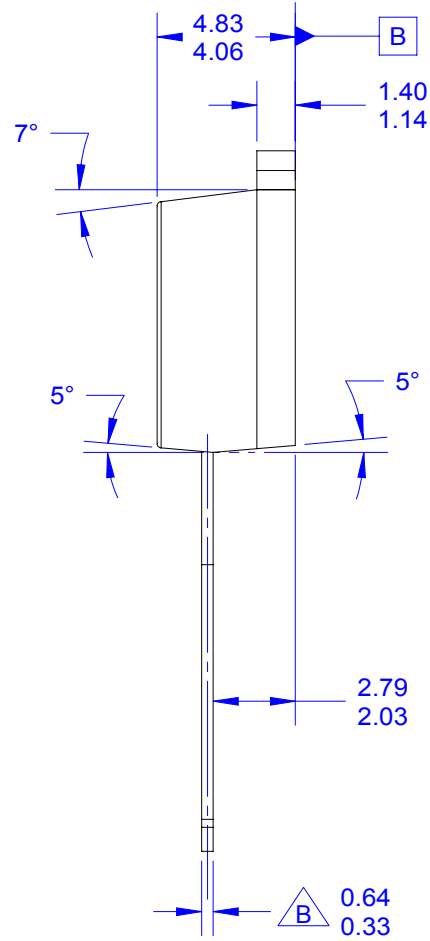
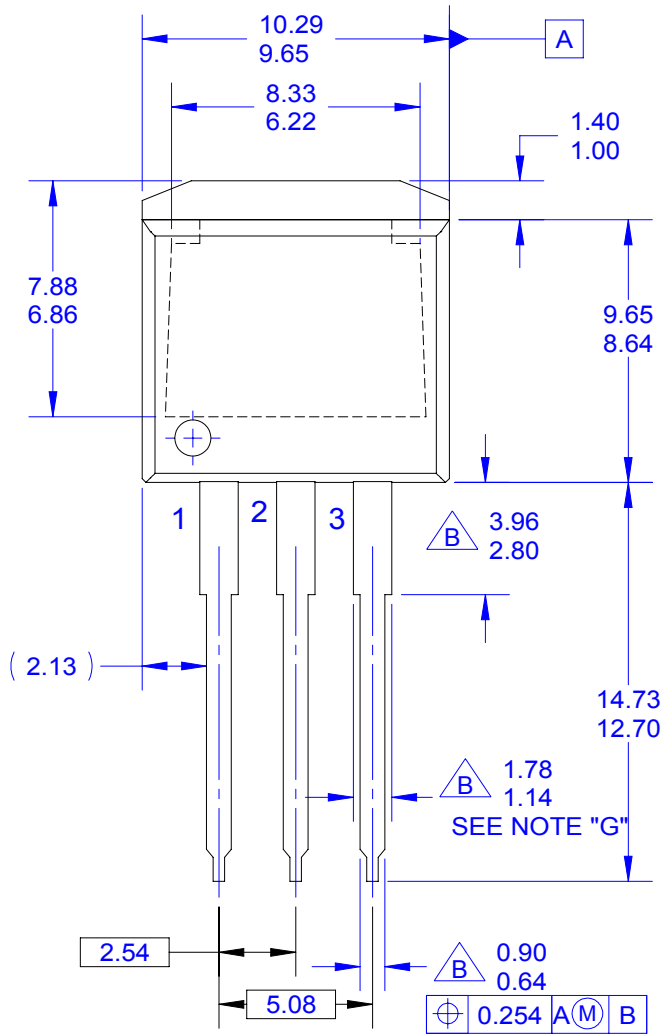
- NOTES: UNLESS OTHERWISE SPECIFIED
- A) ALL DIMENSIONS ARE IN MILLIMETERS.
  - B) REFERENCE JEDEC, TO-263, VARIATION AB.
  - C) DIMENSIONING AND TOLERANCING PER ANSI Y14.5M - 1994.
  - D) LOCATION OF THE PIN HOLE MAY VARY (LOWER LEFT CORNER, LOWER CENTER AND CENTER OF THE PACKAGE).
  - E) LANDPATTERN RECOMMENDATION PER IPC TO254P1524X482-3N
  - F) FILENAME: TO263A02REV6



DETAIL A, ROTATED 90°  
SCALE: 2X

| APPROVALS |         | DATE     |                              | <b>2LD, JEDEC TO-263, VARIATION AB, SURFACE MOUNT</b> |
|-----------|---------|----------|------------------------------|---|
| DRAWN:    | H.ALLEN | 2 MAY 09 |                              |   |
| CHECKED:  | WB LEE  | 2 MAY 09 |                              |   |
| APPROVED: |         |          |                              |   |
|           |         |          | SCALE: 1:1                   | SIZE: NA  |
|           |         |          | DRAWING NUMBER: MKT-TO263A02 | REV: 6  |
|           |         |          | FORMERLY: N/A                | SHEET: 1 OF 1   |

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NOTES:






- A. EXCEPT WHERE NOTED CONFORMS TO TO262 JEDEC VARIATION AA.
- B. DOES NOT COMPLY JEDEC STD. VALUE.
- C. ALL DIMENSIONS ARE IN MILLIMETERS.
- D. DIMENSIONS ARE EXCLUSIVE OF BURRS, MOLD FLASH AND TIE BAR PROTRUSIONS.
- E. DIMENSION AND TOLERANCE AS PER ANSI Y14.5-1994.
- F. LOCATION OF PIN HOLE MAY VARY (LOWER LEFT CORNER, LOWER CENTER AND CENTER OF PACKAGE)
- G. MAXIMUM WIDTH FOR F102 DEVICE = 1.35 MAX.
- H. DRAWING FILE NAME: TO262A03REV5

|                        |  |               |      |                                     |     |
|------------------------|--|---------------|------|-------------------------------------|-----|
| APPROVALS              |  | DATE          |      |                                     |     |
| DRAWN: BOBOY MALDO     |  | 11FEB2010     |      |                                     |     |
| CHECKED: KH LEE        |  |               |      | <b>TO262 3LD JEDEC VARIATION AA</b> |     |
| APPROVED: BY HUANG     |  |               |      |                                     |     |
| APPROVED: HOWARD ALLEN |  |               |      |                                     |     |
| PROJECTION             |  | SCALE         | SIZE | DRAWING NUMBER                      | REV |
|                        |  | 1:1           | N/A  | MKT-TO262A03                        | 5   |
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| AX-CAP®*  | FRFET®   | PowerTrench®  |  |
| BitSiC™   | Global Power Resource™                         | PowerXS™  | TinyBoost®  |
| Build it Now™   | GreenBridge™                                   | Programmable Active Droop™  | TinyBuck®   |
| CorePLUS™   | Green FPS™                                     | QFET®   | TinyCalc™   |
| CorePOWER™  | Green FPS™ e-Series™                           | QS™   | TinyLogic®  |
| CROSSVOL™   | Gmax™  | Quiet Series™   | TINYOPTO™   |
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