

# FGD3040G2-F085C FGB3040G2-F085C

## EcoSPARK<sup>®</sup> 2 Ignition IGBT

300 mJ, 400 V, N-Channel Ignition IGBT

### Features

- SCIS Energy = 300 mJ at  $T_J = 25^\circ\text{C}$
- Logic Level Gate Drive
- AEC-Q101 Qualified and PPAP Capable
- These Devices are Pb-Free and are RoHS Compliant

### Applications

- Automotive Ignition Coil Driver Circuits
- High Current Ignition System
- Coil on Plug Application

### MAXIMUM RATINGS ( $T_J = 25^\circ\text{C}$ unless otherwise noted)

| Symbol         | Parameter                                                                            | Value           | Unit                |
|----------------|--------------------------------------------------------------------------------------|-----------------|---------------------|
| $BV_{CER}$     | Collector to Emitter Breakdown Voltage ( $I_C = 1\text{ mA}$ )                       | 400             | V                   |
| $BV_{ECS}$     | Emitter to Collector Voltage – Reverse Battery Condition ( $I_C = 10\text{ mA}$ )    | 28              | V                   |
| $ESCIS_{25}$   | ISCIS = 14.2 A, L = 3.0 mHy, RGE = 1 K $\Omega$ , $T_C = 25^\circ\text{C}$ (Note 1)  | 300             | mJ                  |
| $ESCIS_{150}$  | ISCIS = 10.8 A, L = 3.0 mHy, RGE = 1 K $\Omega$ , $T_C = 150^\circ\text{C}$ (Note 2) | 170             | mJ                  |
| $IC_{25}$      | Collector Current Continuous at $V_{GE} = 5.0\text{ V}$ , $T_C = 25^\circ\text{C}$   | 41              | A                   |
| $IC_{110}$     | Collector Current Continuous at $V_{GE} = 5.0\text{ V}$ , $T_C = 110^\circ\text{C}$  | 25.6            | A                   |
| $V_{GEM}$      | Gate to Emitter Voltage Continuous                                                   | $\pm 10$        | V                   |
| PD             | Power Dissipation Total, $T_C = 25^\circ\text{C}$                                    | 150             | W                   |
|                | Power Dissipation Derating, $T_C > 25^\circ\text{C}$                                 | 1               | W/ $^\circ\text{C}$ |
| $T_J, T_{STG}$ | Operating Junction and Storage Temperature                                           | $-55$ to $+175$ | $^\circ\text{C}$    |
| $T_L$          | Lead Temperature for Soldering Purposes (1/8" from case for 10 s)                    | 300             | $^\circ\text{C}$    |
| $T_{PKG}$      | Reflow Soldering according to JESD020C                                               | 260             | $^\circ\text{C}$    |
| ESD            | HBM–Electrostatic Discharge Voltage at 100 pF, 1500 $\Omega$                         | 4               | kV                  |
|                | CDM–Electrostatic Discharge Voltage at 1 $\Omega$                                    | 2               | kV                  |

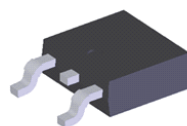
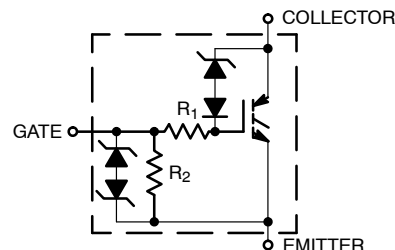
Stresses exceeding those listed in the Maximum Ratings table may damage the device. If any of these limits are exceeded, device functionality should not be assumed, damage may occur and reliability may be affected.

1. Self clamped inductive Switching Energy ( $ESCIS_{25}$ ) of 300 mJ is based on the test conditions that is starting  $T_J = 25^\circ\text{C}$ , L = 3 mHy, ISCIS = 14.2 A, VCC = 100 V during inductor charging and VCC = 0 V during time in clamp.
2. Self Clamped inductive Switching Energy ( $ESCIS_{150}$ ) of 170 mJ is based on the test conditions that is starting  $T_J = 150^\circ\text{C}$ , L = 3mHy, ISCIS = 10.8 A, VCC = 100 V during inductor charging and VCC = 0 V during time in clamp.

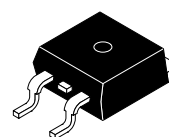


ON Semiconductor<sup>®</sup>

[www.onsemi.com](http://www.onsemi.com)

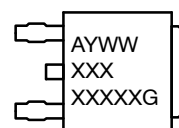


DPAK3  
CASE 369AS



D2PAK-3  
CASE 418AJ

### MARKING DIAGRAM



A = Assembly Location  
Y = Year  
WW = Work Week  
XXXX = Device Code  
G = Pb-Free Package

### ORDERING INFORMATION

See detailed ordering and shipping information on page 2 of this data sheet.

# FGD3040G2-F085C

## THERMAL RESISTANCE RATINGS

| Characteristic                          | Symbol          | Max | Units |
|-----------------------------------------|-----------------|-----|-------|
| Junction-to-Case – Steady State (Drain) | $R_{\theta JC}$ | 1   | °C/W  |

## ELECTRICAL CHARACTERISTICS ( $T_J = 25^\circ\text{C}$ unless otherwise specified)

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

### OFF CHARACTERISTICS

|                   |                                        |                                                                                                            |                        |     |     |     |    |
|-------------------|----------------------------------------|------------------------------------------------------------------------------------------------------------|------------------------|-----|-----|-----|----|
| BV <sub>CER</sub> | Collector to Emitter Breakdown Voltage | I <sub>CE</sub> = 2 mA, V <sub>GE</sub> = 0 V,<br>R <sub>GE</sub> = 1 kΩ,<br>T <sub>J</sub> = −40 to 150°C |                        | 370 | 400 | 430 | V  |
| BV <sub>CES</sub> | Collector to Emitter Breakdown Voltage | I <sub>CE</sub> = 10 mA, V <sub>GE</sub> = 0 V,<br>R <sub>GE</sub> = 0,<br>T <sub>J</sub> = −40 to 150°C   |                        | 390 | 420 | 450 | V  |
| BV <sub>ECS</sub> | Emitter to Collector Breakdown Voltage | I <sub>CE</sub> = −75 mA, V <sub>GE</sub> = 0 V,<br>T <sub>J</sub> = 25°C                                  |                        | 28  | –   | –   | V  |
| BV <sub>GES</sub> | Gate to Emitter Breakdown Voltage      | I <sub>GES</sub> = ±2 mA                                                                                   |                        | ±12 | ±14 | –   | V  |
| I <sub>CER</sub>  | Collector to Emitter Leakage Current   | V <sub>CE</sub> = 175 V<br>R <sub>GE</sub> = 1 kΩ                                                          | T <sub>J</sub> = 25°C  | –   | –   | 25  | μA |
|                   |                                        |                                                                                                            | T <sub>J</sub> = 150°C | –   | –   | 1   | mA |
| I <sub>ECS</sub>  | Emitter to Collector Leakage Current   | V <sub>EC</sub> = 24 V                                                                                     | T <sub>J</sub> = 25°C  | –   | –   | 1   | mA |
|                   |                                        |                                                                                                            | T <sub>J</sub> = 150°C | –   | –   | 40  |    |
| R <sub>1</sub>    | Series Gate Resistance                 |                                                                                                            |                        | –   | 120 | –   | Ω  |
| R <sub>2</sub>    | Gate to Emitter Resistance             |                                                                                                            |                        | 10K | –   | 30K | Ω  |

### ON CHARACTERISTICS

|               |                                         |                                                                              |   |      |      |   |
|---------------|-----------------------------------------|------------------------------------------------------------------------------|---|------|------|---|
| $V_{CE(SAT)}$ | Collector to Emitter Saturation Voltage | $I_{CE} = 6\text{ A}$ , $V_{GE} = 4\text{ V}$ , $T_J = 25^\circ\text{C}$     | – | 1.15 | 1.25 | V |
| $V_{CE(SAT)}$ | Collector to Emitter Saturation Voltage | $I_{CE} = 10\text{ A}$ , $V_{GE} = 4.5\text{ V}$ , $T_J = 150^\circ\text{C}$ | – | 1.35 | 1.50 | V |
| $V_{CE(SAT)}$ | Collector to Emitter Saturation Voltage | $I_{CE} = 15\text{ A}$ , $V_{GE} = 5\text{ V}$ , $T_J = 150^\circ\text{C}$   | – | 1.68 | 1.85 | V |

### DYNAMIC CHARACTERISTICS

|                     |                                   |                                                                       |                        |      |     |     |    |
|---------------------|-----------------------------------|-----------------------------------------------------------------------|------------------------|------|-----|-----|----|
| Q <sub>G(ON)</sub>  | Gate Charge                       | I <sub>CE</sub> = 10 A, V <sub>CE</sub> = 12 V, V <sub>GE</sub> = 5 V |                        | –    | 21  | –   | nC |
| V <sub>GE(TH)</sub> | Gate to Emitter Threshold Voltage | I <sub>CE</sub> = 1 mA<br>V <sub>CE</sub> = V <sub>GE</sub>           | T <sub>J</sub> = 25°C  | 1.3  | 1.5 | 2.2 | V  |
|                     |                                   |                                                                       | T <sub>J</sub> = 150°C | 0.75 | 1.2 | 1.8 |    |
| V <sub>GEP</sub>    | Gate to Emitter Plateau Voltage   | V <sub>CE</sub> = 12 V, I <sub>CE</sub> = 10 A                        |                        | –    | 2.8 | –   | V  |

### SWITCHING CHARACTERISTICS

|               |                                       |                                                                                                                                                            |   |     |    |               |
|---------------|---------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------|---|-----|----|---------------|
| $t_{d(ON)R}$  | Current Turn-On Delay Time–Resistive  | $V_{CE} = 14\text{ V}$ , $R_L = 1\text{ }\Omega$ ,<br>$V_{GE} = 5\text{ V}$ , $R_G = 470\text{ }\Omega$ ,<br>$T_J = 25^\circ\text{C}$                      | – | 0.9 | 4  | $\mu\text{s}$ |
| $t_{rR}$      | Current Rise Time–Resistive           |                                                                                                                                                            | – | 1.9 | 7  |               |
| $t_{d(OFF)L}$ | Current Turn-Off Delay Time–Inductive | $V_{CE} = 300\text{ V}$ , $L = 1\text{ mH}$ ,<br>$V_{GE} = 5\text{ V}$ , $R_G = 470\text{ }\Omega$ ,<br>$I_{CE} = 6.5\text{ A}$ , $T_J = 25^\circ\text{C}$ | – | 4.8 | 10 |               |
| $t_{fL}$      | Current Fall Time–Inductive           |                                                                                                                                                            | – | 2.0 | 15 |               |

Product parametric performance is indicated in the Electrical Characteristics for the listed test conditions, unless otherwise noted. Product performance may not be indicated by the Electrical Characteristics if operated under different conditions.

## PACKAGE MARKING AND ORDERING INFORMATION

| Device          | Package                         | Shipping <sup>†</sup>    |
|-----------------|---------------------------------|--------------------------|
| FGD3040G2-F085C | DPAK<br>(Pb-Free)               | 2500 Units / Tape & Reel |
| FGB3040G2-F085C | D <sup>2</sup> PAK<br>(Pb-Free) | 800 Units / Tape & Reel  |

<sup>†</sup>For information on tape and reel specifications, including part orientation and tape sizes, please refer to our Tape and Reel Packaging Specifications Brochure, BRD8011/D.

TYPICAL CHARACTERISTICS

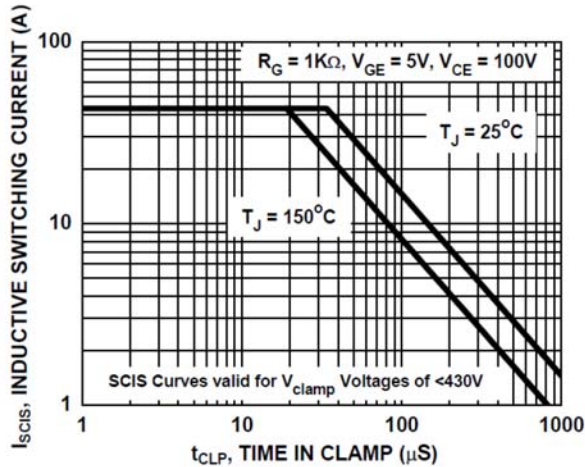


Figure 1. Self Clamped Inductive Switching Current vs. Time in Clamp

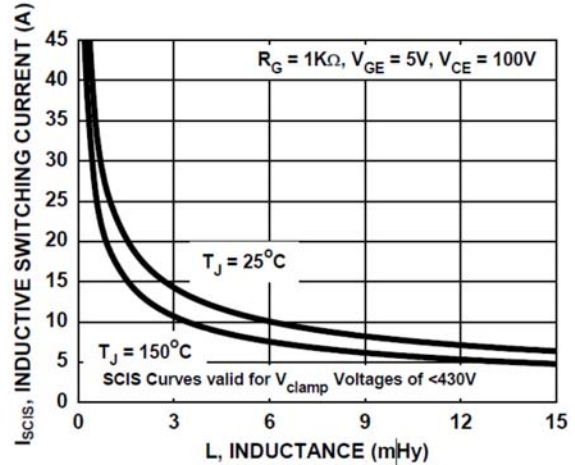


Figure 2. Self Clamped Inductive Switching Current vs. Inductance

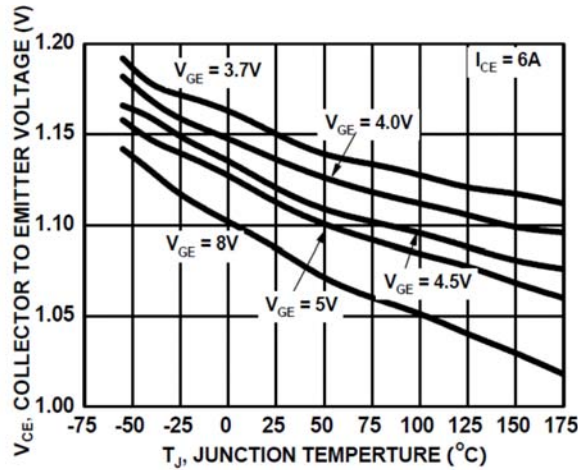


Figure 3. Collector to Emitter On-State Voltage vs. Junction Temperature

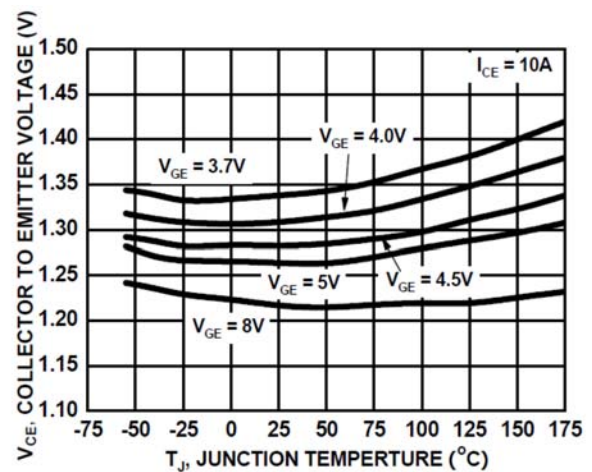


Figure 4. Collector to Emitter On-State Voltage vs. Junction Temperature

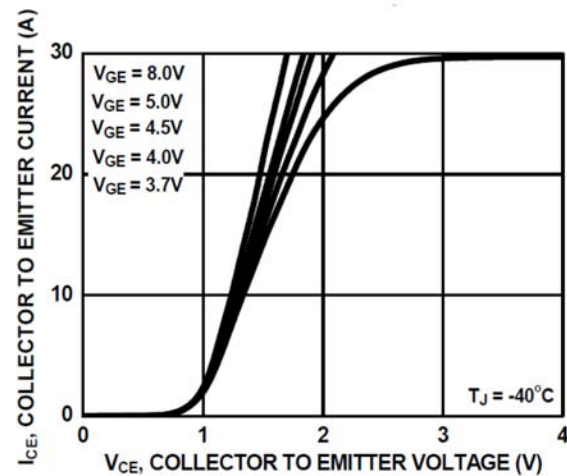


Figure 5. Collector to Emitter On-State Voltage vs. Collector Current

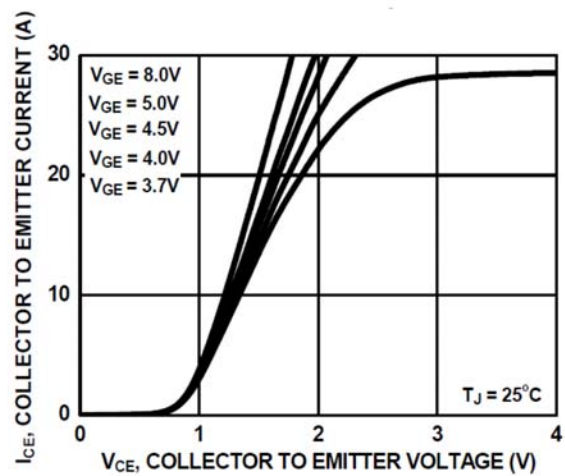


Figure 6. Collector to Emitter On-State Voltage vs. Collector Current

TYPICAL CHARACTERISTICS (continued)

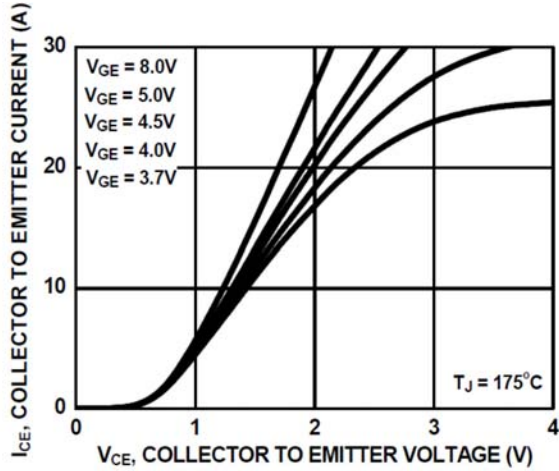


Figure 7. Collector to Emitter On-State Voltage vs. Collector Current

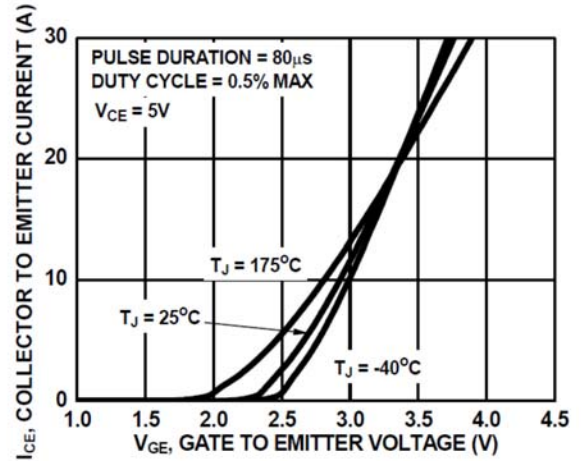


Figure 8. Transfer Characteristics

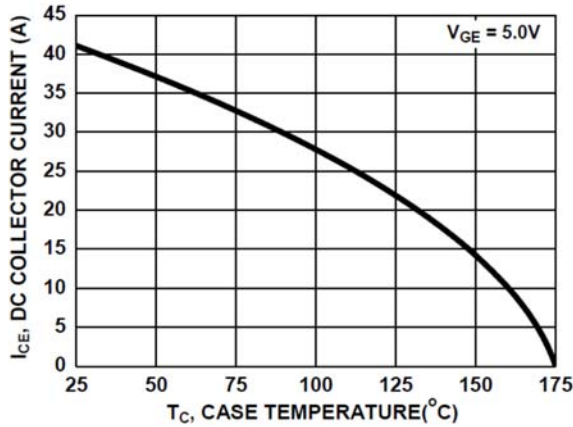


Figure 9. DC Collector Current vs. Case Temperature

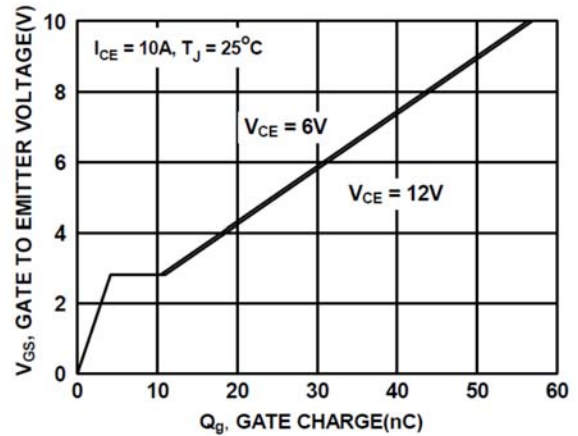


Figure 10. Gate Charge

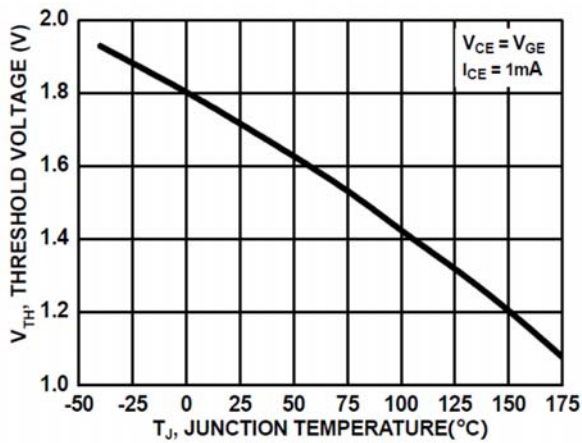


Figure 11. Threshold Voltage vs. Junction Temperature

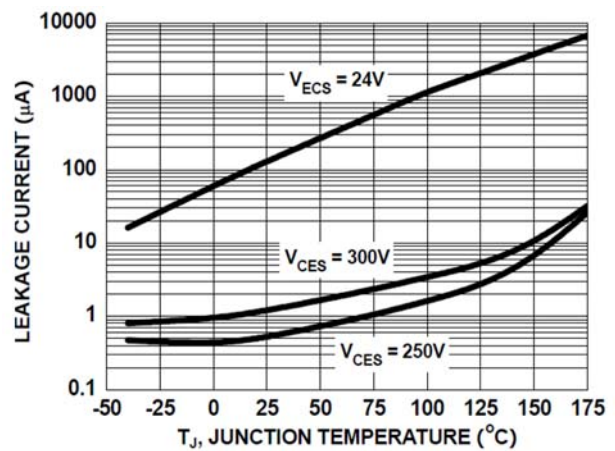


Figure 12. Leakage Current vs. Junction Temperature

TYPICAL CHARACTERISTICS (continued)

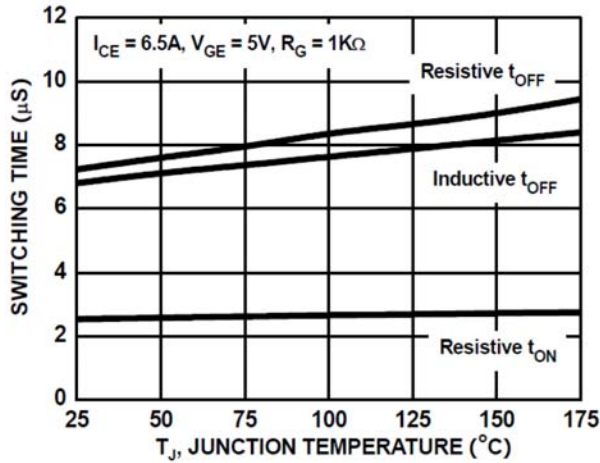


Figure 13. Switching Time vs. Junction Temperature

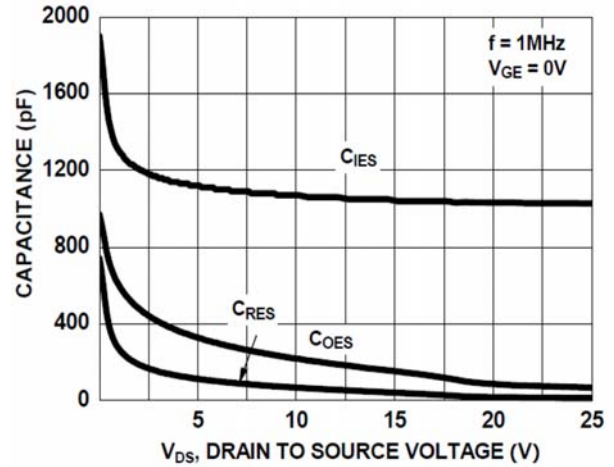


Figure 14. Capacitance vs. Collector to Emitter

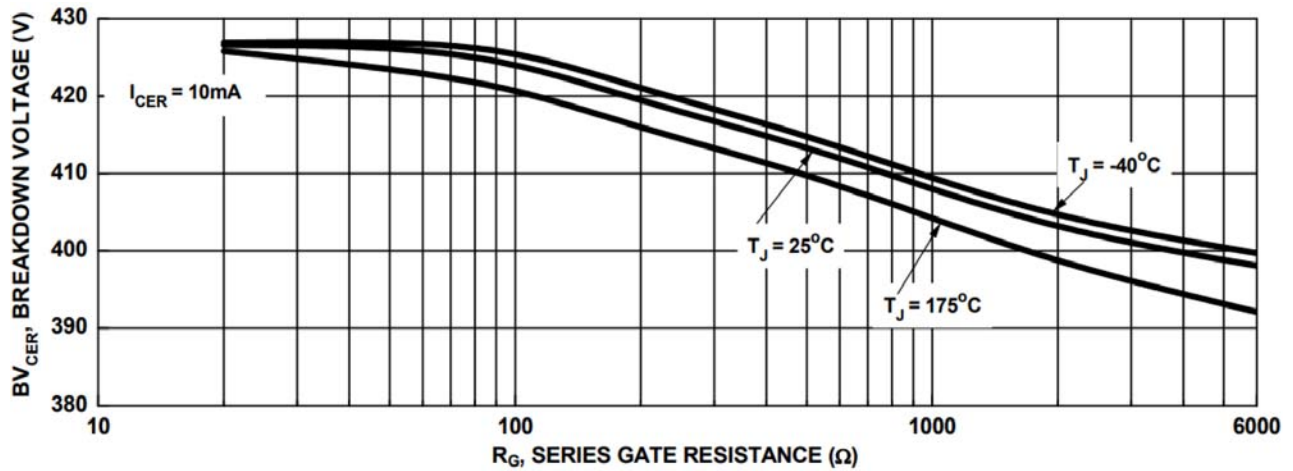


Figure 15. Break Down Voltage vs. Series Resistance

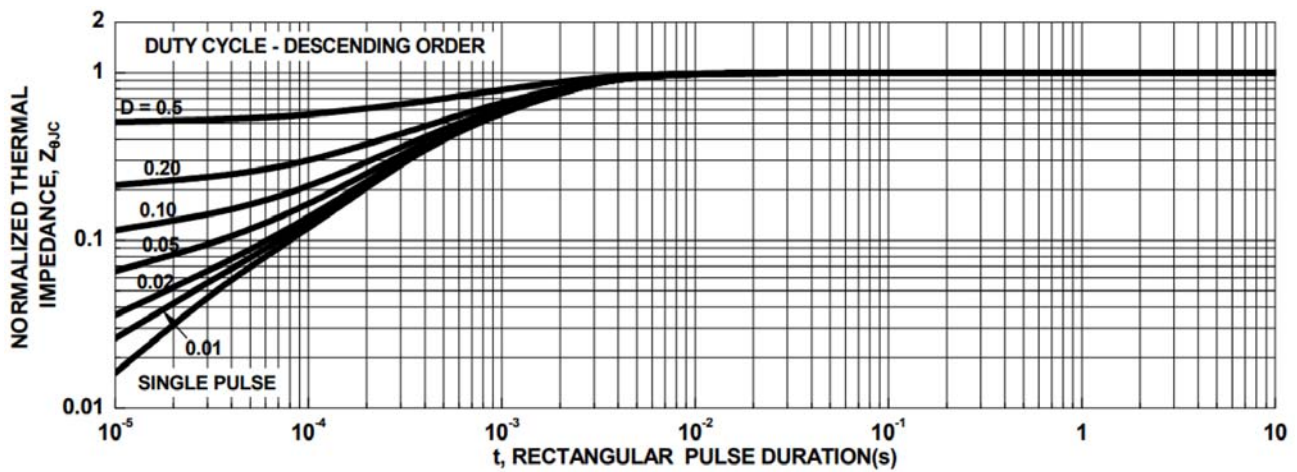


Figure 16. IGBT Normalized Transient Thermal Impedance, Junction to Case

TEST CIRCUIT AND WAVEFORMS

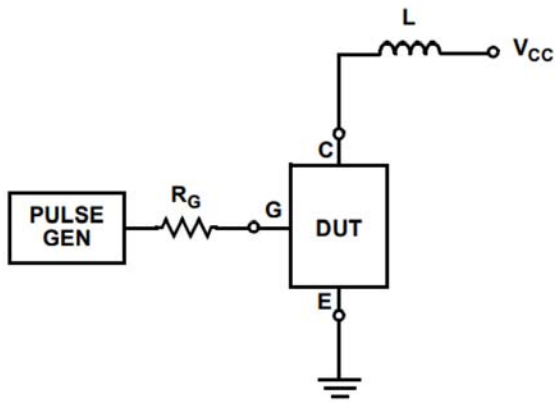


Figure 17. Inductive Switching Test Circuit

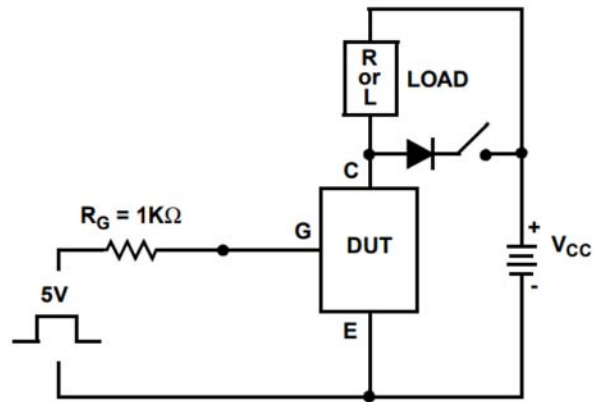


Figure 18.  $t_{ON}$  and  $t_{OFF}$  Switching Test Circuit

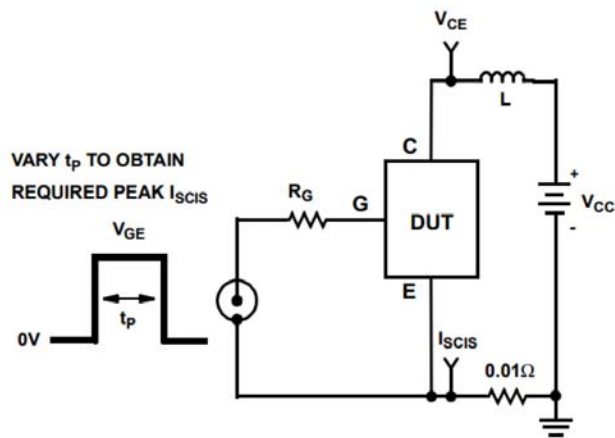


Figure 19. Energy Test Circuit

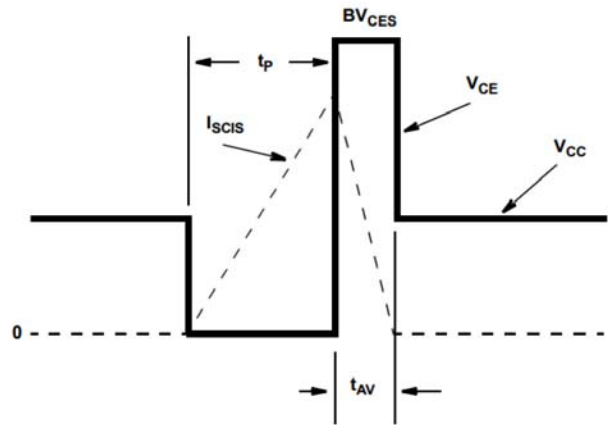
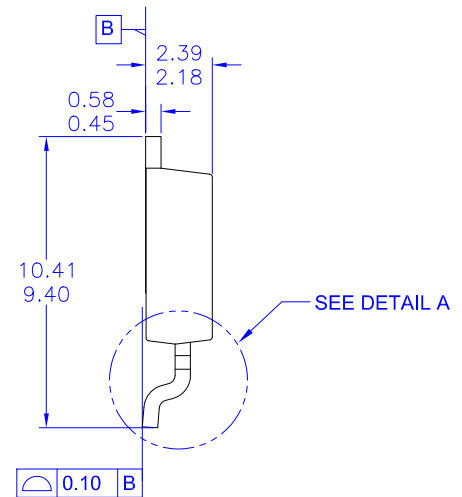
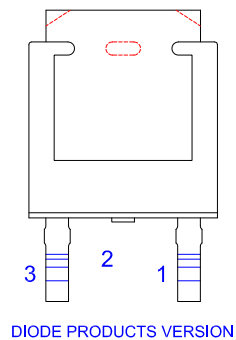
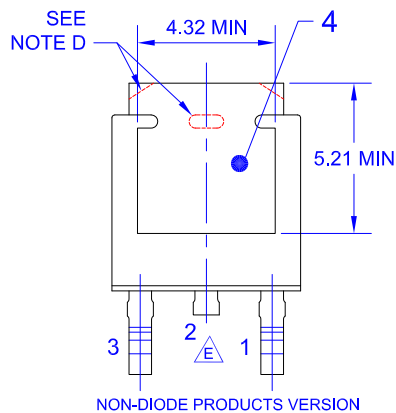
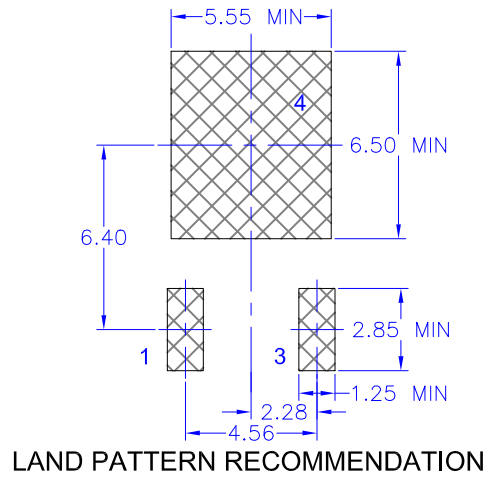
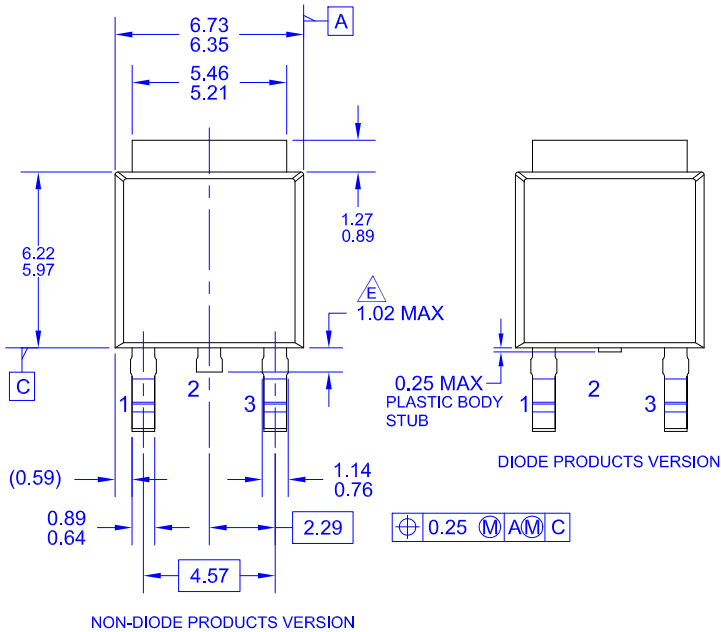


Figure 20. Energy Waveforms

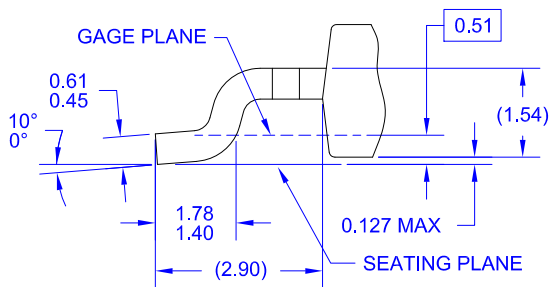
PACKAGE DIMENSIONS

DPAK3 (TO-252 3 LD)  
CASE 369AS  
ISSUE O



NOTES: UNLESS OTHERWISE SPECIFIED

- A) THIS PACKAGE CONFORMS TO JEDEC, TO-252, ISSUE C, VARIATION AA.
- B) ALL DIMENSIONS ARE IN MILLIMETERS.
- C) DIMENSIONING AND TOLERANCING PER ASME Y14.5M-2009.
- D) SUPPLIER DEPENDENT MOLD LOCKING HOLES OR CHAMFERED CORNERS OR EDGE PROTRUSION.
- E) TRIMMED CENTER LEAD IS PRESENT ONLY FOR DIODE PRODUCTS
- F) DIMENSIONS ARE EXCLUSIVE OF BURRS, MOLD FLASH AND TIE BAR EXTRUSIONS.
- G) LAND PATTERN RECOMMENDATION IS BASED ON IPC7351A STD TO228P991X239-3N.

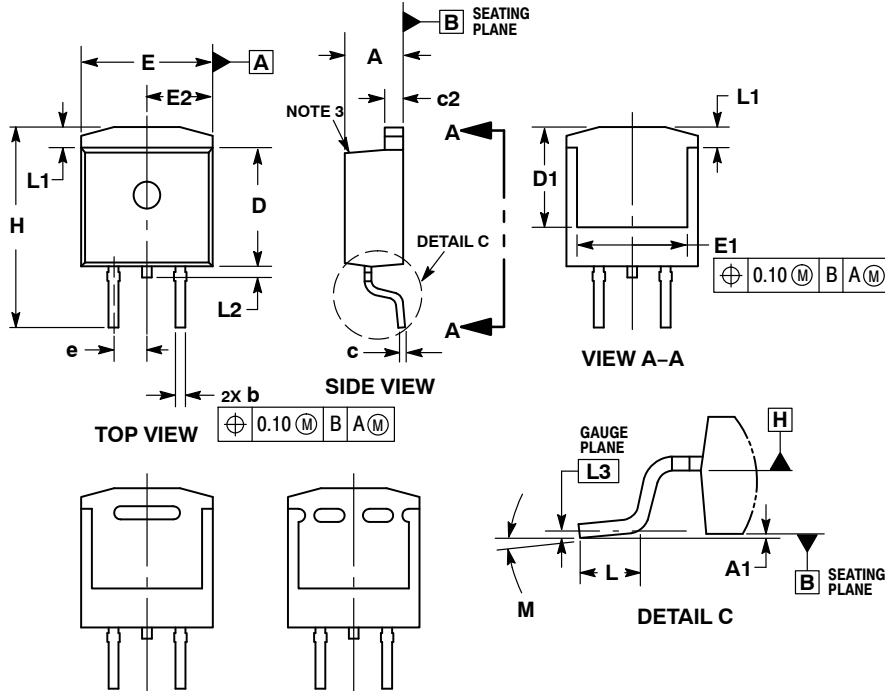


DETAIL A  
(ROTATED -90°)  
SCALE: 12X

# FGD3040G2-F085C

## PACKAGE DIMENSIONS

### D<sup>2</sup>PAK-3 (TO-263, 3-LEAD) CASE 418AJ ISSUE C



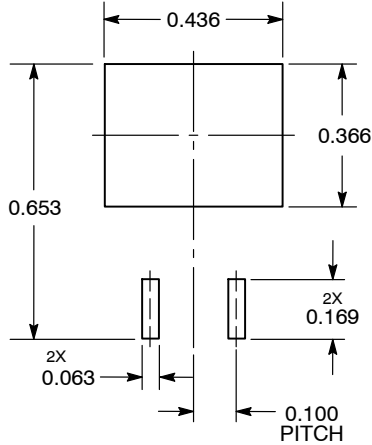
#### NOTES:

1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 1994.
2. CONTROLLING DIMENSION: INCHES.
3. CHAMFER OPTIONAL.
4. DIMENSIONS D AND E DO NOT INCLUDE MOLD FLASH. MOLD FLASH SHALL NOT EXCEED 0.005 PER SIDE. THESE DIMENSIONS ARE MEASURED AT THE OUTERMOST EXTREMES OF THE PLASTIC BODY AT DATUM H.
5. THERMAL PAD CONTOUR IS OPTIONAL WITHIN DIMENSIONS E, L1, D1 AND E1.

| DIM | INCHES    |       | MILLIMETERS |       |
|-----|-----------|-------|-------------|-------|
|     | MIN       | MAX   | MIN         | MAX   |
| A   | 0.160     | 0.190 | 4.06        | 4.83  |
| A1  | 0.000     | 0.010 | 0.00        | 0.25  |
| b   | 0.020     | 0.039 | 0.51        | 0.99  |
| c   | 0.012     | 0.029 | 0.30        | 0.74  |
| c2  | 0.045     | 0.065 | 1.14        | 1.65  |
| D   | 0.330     | 0.380 | 8.38        | 9.65  |
| D1  | 0.260     | ---   | 6.60        | ---   |
| E   | 0.380     | 0.420 | 9.65        | 10.67 |
| E1  | 0.245     | ---   | 6.22        | ---   |
| e   | 0.100 BSC |       | 2.54 BSC    |       |
| H   | 0.575     | 0.625 | 14.60       | 15.88 |
| L   | 0.070     | 0.110 | 1.78        | 2.79  |
| L1  | ---       | 0.066 | ---         | 1.68  |
| L2  | ---       | 0.070 | ---         | 1.78  |
| L3  | 0.010 BSC |       | 0.25 BSC    |       |
| M   | -8°       | 8°    | -8°         | 8°    |

VIEW A-A  
OPTIONAL CONSTRUCTIONS

#### RECOMMENDED SOLDERING FOOTPRINT\*



DIMENSIONS: INCHES

\*For additional information on our Pb-Free strategy and soldering details, please download the ON Semiconductor Soldering and Mounting Techniques Reference Manual, SOLDERRM/D.

ECOSPARK is registered trademark of Semiconductor Components Industries, LLC (SCILLC) or its subsidiaries in the United States and/or other countries.

ON Semiconductor and  are trademarks of Semiconductor Components Industries, LLC dba ON Semiconductor or its subsidiaries in the United States and/or other countries. ON Semiconductor owns the rights to a number of patents, trademarks, copyrights, trade secrets, and other intellectual property. A listing of ON Semiconductor's product/patent coverage may be accessed at [www.onsemi.com/site/pdf/Patent-Marking.pdf](http://www.onsemi.com/site/pdf/Patent-Marking.pdf). ON Semiconductor reserves the right to make changes without further notice to any products herein. ON Semiconductor makes no warranty, representation or guarantee regarding the suitability of its products for any particular purpose, nor does ON Semiconductor assume any liability arising out of the application or use of any product or circuit, and specifically disclaims any and all liability, including without limitation special, consequential or incidental damages. Buyer is responsible for its products and applications using ON Semiconductor products, including compliance with all laws, regulations and safety requirements or standards, regardless of any support or applications information provided by ON Semiconductor. "Typical" parameters which may be provided in ON Semiconductor data sheets and/or specifications can and do vary in different applications and actual performance may vary over time. All operating parameters, including "Typicals" must be validated for each customer application by customer's technical experts. ON Semiconductor does not convey any license under its patent rights nor the rights of others. ON Semiconductor products are not designed, intended, or authorized for use as a critical component in life support systems or any FDA Class 3 medical devices or medical devices with a same or similar classification in a foreign jurisdiction or any devices intended for implantation in the human body. Should Buyer purchase or use ON Semiconductor products for any such unintended or unauthorized application, Buyer shall indemnify and hold ON Semiconductor and its officers, employees, subsidiaries, affiliates, and distributors harmless against all claims, costs, damages, and expenses, and reasonable attorney fees arising out of, directly or indirectly, any claim of personal injury or death associated with such unintended or unauthorized use, even if such claim alleges that ON Semiconductor was negligent regarding the design or manufacture of the part. ON Semiconductor is an Equal Opportunity/Affirmative Action Employer. This literature is subject to all applicable copyright laws and is not for resale in any manner.

## PUBLICATION ORDERING INFORMATION

### LITERATURE FULFILLMENT:

Literature Distribution Center for ON Semiconductor  
19521 E. 32nd Pkwy, Aurora, Colorado 80011 USA  
**Phone:** 303-675-2175 or 800-344-3860 Toll Free USA/Canada  
**Fax:** 303-675-2176 or 800-344-3867 Toll Free USA/Canada  
**Email:** [orderlit@onsemi.com](mailto:orderlit@onsemi.com)

**N. American Technical Support:** 800-282-9855 Toll Free  
USA/Canada  
**Europe, Middle East and Africa Technical Support:**  
Phone: 421 33 790 2910

**ON Semiconductor Website:** [www.onsemi.com](http://www.onsemi.com)

**Order Literature:** <http://www.onsemi.com/orderlit>

For additional information, please contact your local Sales Representative