

# FGD3040G2-F085V

## 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
- RoHS Compliant

#### Applications

- Automotive Ignition Coil Driver Circuits
- Coil on Plug Application

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

| Symbol        | Parameter  | Value      | Units               |
|---------------|--|------------|---------------------|
| $BV_{CER}$    | 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                   |
| $E_{SCIS25}$  | Self Clamping Inductive Switching Energy (Note 1)                                    | 300        | mJ                  |
| $E_{SCIS150}$ | Self Clamping Inductive Switching Energy (Note 2)                                    | 170        | mJ                  |
| $I_{C25}$     | Collector Current Continuous at $V_{GE} = 5.0 \text{ V}$ , $T_C = 25^\circ\text{C}$  | 41         | A                   |
| $I_{C110}$    | 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                   |
| $P_D$         | Power Dissipation Total, $T_C = 25^\circ\text{C}$                                    | 150        | W                   |
|               | Power Dissipation Derating, $T_C > 25^\circ\text{C}$                                 | 1          | W/ $^\circ\text{C}$ |
| $T_J$         | Operating Junction and Storage Temperature   | -55 to 175 | $^\circ\text{C}$    |
| $T_{STG}$     | Storage Junction Temperature Range   | -55 to 175 | $^\circ\text{C}$    |
| $T_L$         | Max. Lead Temperature for Soldering (Package Body for 10 s)                          | 300        | $^\circ\text{C}$    |
| $T_{PKG}$     | Max. Lead Temperature for Soldering (Package Body for 10 s)                          | 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                  |

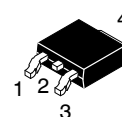
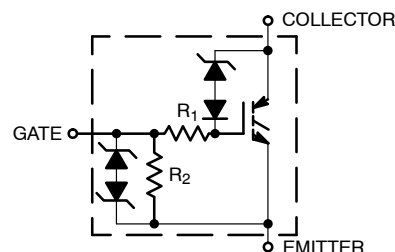
Stresses exceeding those listed in the Maximum Ratings table may damage the device. If any of these limits are exceeded, device functionality should not be assumed, damage may occur and reliability may be affected.

1. Self clamped inductive Switching Energy ( $E_{SCIS25}$ ) of 300 mJ is based on the test conditions that is starting  $T_J = 25^\circ\text{C}$ ,  $L = 3 \text{ mHy}$ ,  $ISCIS = 14.2 \text{ A}$ ,  $V_{CC} = 100 \text{ V}$  during inductor charging and  $V_{CC} = 0 \text{ V}$  during time in clamp.
2. Self Clamped inductive Switching Energy ( $E_{SCIS150}$ ) of 170 mJ is based on the test conditions that is starting  $T_J = 150^\circ\text{C}$ ,  $L = 3\text{mHy}$ ,  $ISCIS = 10.8 \text{ A}$ ,  $V_{CC} = 100 \text{ V}$  during inductor charging and  $V_{CC} = 0 \text{ V}$  during time in clamp.



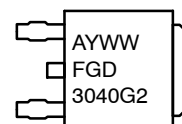
ON Semiconductor<sup>®</sup>

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DPAK (SINGLE GAUGE)  
CASE 369C

#### MARKING DIAGRAM



A = Assembly Location  
Y = Year  
WW = Work Week  
FGD3040G2 = Device Code

#### ORDERING INFORMATION

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

# FGD3040G2-F085V

## 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    |               |
|----------------------------|--|---|---------------------------|----------|------|----------|---------------|
| <b>OFF CHARACTERISTICS</b> |  |   |                           |          |      |          |               |
| $BV_{CER}$                 | Collector to Emitter Breakdown Voltage | $I_{CE} = 2\text{ mA}$ , $V_{GE} = 0\text{ V}$ ,<br>$R_{GE} = 1\text{ k}\Omega$ , $T_J = -40\text{ to }150^\circ\text{C}$ | 370                       | 400      | 430  | V        |               |
| $BV_{CES}$                 | Collector to Emitter Breakdown Voltage | $I_{CE} = 10\text{ mA}$ , $V_{GE} = 0\text{ V}$ ,<br>$R_{GE} = 0$ , $T_J = -40\text{ to }150^\circ\text{C}$               | 390                       | 420      | 450  | V        |               |
| $BV_{ECS}$                 | Emitter to Collector Breakdown Voltage | $I_{CE} = -20\text{ mA}$ , $V_{GE} = 0\text{ V}$ ,<br>$T_J = 25^\circ\text{C}$  | 28                        | –        | –    | V        |               |
| $BV_{GES}$                 | Gate to Emitter Breakdown Voltage      | $I_{GES} = \pm 2\text{ mA}$   | $\pm 12$                  | $\pm 14$ | –    | V        |               |
| $I_{CER}$                  | Collector to Emitter Leakage Current   | $V_{CE} = 250\text{ V}$<br>$R_{GE} = 1\text{ k}\Omega$  | $T_J = 25^\circ\text{C}$  | –        | –    | 25       | $\mu\text{A}$ |
|                            |  |   | $T_J = 150^\circ\text{C}$ | –        | –    | 1        | mA            |
| $I_{ECS}$                  | Emitter to Collector Leakage Current   | $V_{EC} = 24\text{ V}$  | $T_J = 25^\circ\text{C}$  | –        | –    | 1        | mA            |
|                            |  |   | $T_J = 150^\circ\text{C}$ | –        | –    | 40       |               |
| $R_1$                      | Series Gate Resistance                 |   | –                         | 120      | –    | $\Omega$ |               |
| $R_2$                      | Gate to Emitter Resistance             |   | 10K                       | –        | 30K  | $\Omega$ |               |

## ON CHARACTERISTICS (Note 5)

|               |   |   |   |      |      |    |
|---------------|---|---|---|------|------|----|
| $V_{CE(SAT)}$ | 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 | $I_{CE} = 15\text{ A}$ , $V_{GE} = 4.5\text{ V}$ , $T_J = 150^\circ\text{C}$          | – | 1.68 | 1.85 | V  |
| $E_{SCIS}$    | Self Clamped Inductive Switching        | $L = 3.0\text{ mHy}$ , $R_G = 1\text{ K}\Omega$ , $V_{GE} = 5\text{ V}$ ,<br>(Note 1) | – | –    | 300  | mJ |

## DYNAMIC CHARACTERISTICS

|              |                                   |   |                           |      |     |     |   |
|--------------|-----------------------------------|---|---------------------------|------|-----|-----|---|
| $Q_{G(ON)}$  | Gate Charge                       | $I_{CE} = 10\text{ A}$ , $V_{CE} = 12\text{ V}$ , $V_{GE} = 5\text{ V}$ | –                         | 21   | –   | nC  |   |
| $V_{GE(TH)}$ | Gate to Emitter Threshold Voltage | $I_{CE} = 1\text{ mA}$<br>$V_{CE} = V_{GE}$                             | $T_J = 25^\circ\text{C}$  | 1.3  | 1.7 | 2.2 | V |
|              |                                   |   | $T_J = 150^\circ\text{C}$ | 0.75 | 1.2 | 1.8 |   |
| $V_{GEP}$    | Gate to Emitter Plateau Voltage   | $V_{CE} = 12\text{ V}$ , $I_{CE} = 10\text{ A}$                         | –                         | 2.8  | –   | V   |   |

## SWITCHING CHARACTERISTICS

|               |                                       |  |   |     |    |               |
|---------------|---------------------------------------|--|---|-----|----|---------------|
| $t_{d(ON)R}$  | Current Turn-On Delay Time-Resistive  | $V_{CE} = 14\text{ V}$ , $R_L = 1\text{ }\Omega$ , $V_{GE} = 5\text{ V}$ ,<br>$R_G = 1\text{ K}\Omega$ , $T_J = 25^\circ\text{C}$                      | – | 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 | $V_{CE} = 300\text{ V}$ , $L = 1\text{ mH}$ , $V_{GE} = 5\text{ V}$ ,<br>$R_G = 1\text{ K}\Omega$ , $I_{CE} = 6.5\text{ A}$ , $T_J = 25^\circ\text{C}$ | – | 4.8 | 15 |               |
| $t_{fL}$      | 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 DEVICE ORDERING INFORMATION

| Device Marking | Device          | Package        | Reel Diameter | Tape Width | Qty <sup>†</sup> |
|----------------|-----------------|----------------|---------------|------------|------------------|
| FGD3040G2      | FGD3040G2-F085V | DPAK (Pb-Free) | 330 mm        | 16 mm      | 2500             |

<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

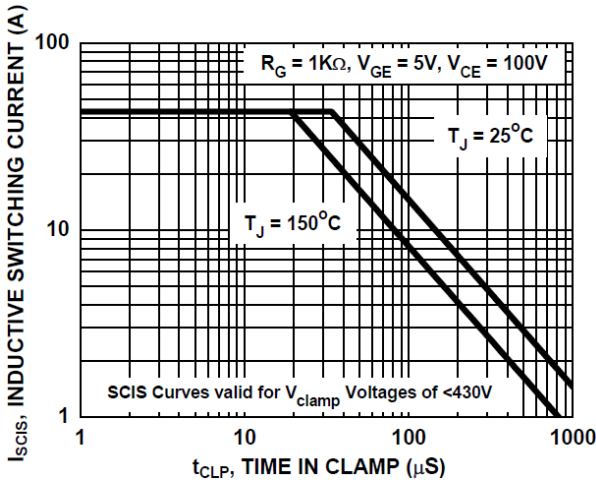


Figure 1. Self Clamped Inductive Switching Current vs. Time in Clamp

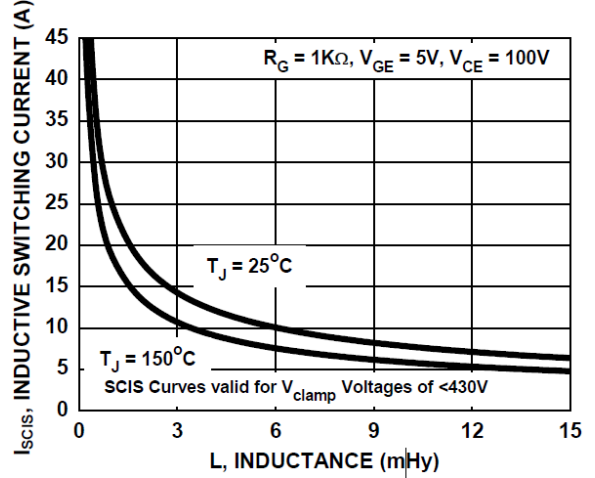


Figure 2. Self Clamped Inductive Switching Current vs. Inductance

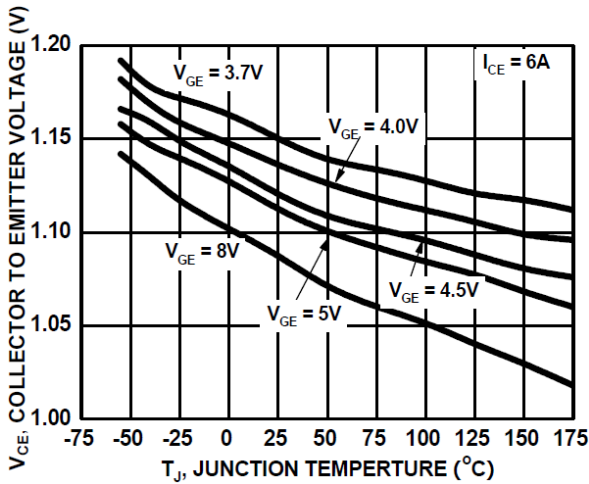


Figure 3. Collector to Emitter On-State Voltage vs. Junction Temperature

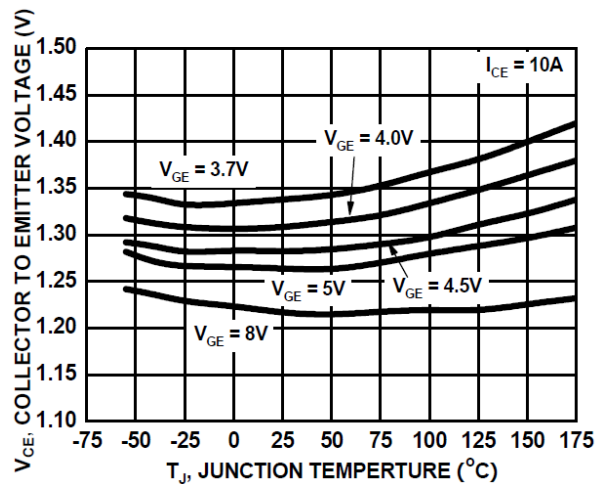


Figure 4. Collector to Emitter On-State Voltage vs. Junction Temperature

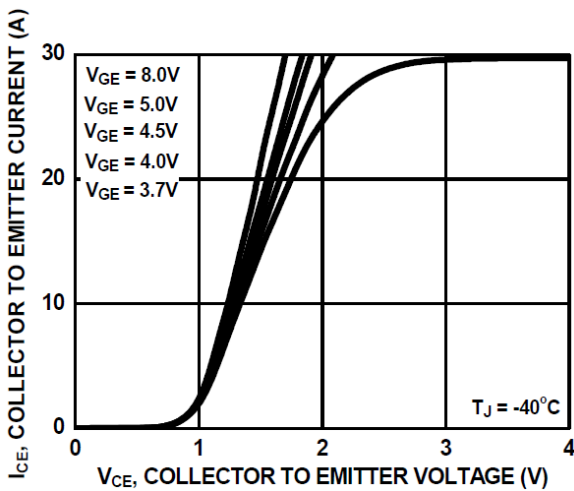


Figure 5. Collector to Emitter On-State Voltage vs. Collector Current

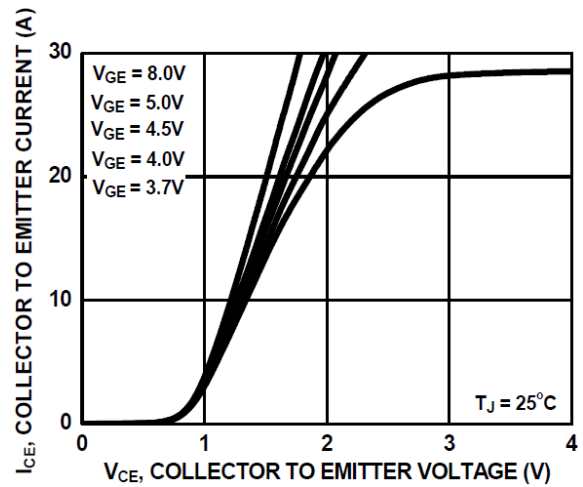


Figure 6. Collector to Emitter On-State Voltage vs. Collector Current

TYPICAL CHARACTERISTICS (continued)

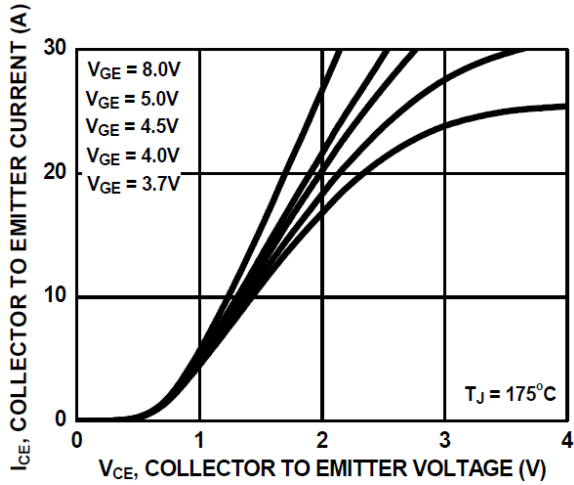


Figure 7. Collector to Emitter On-State Voltage vs. Collector Current

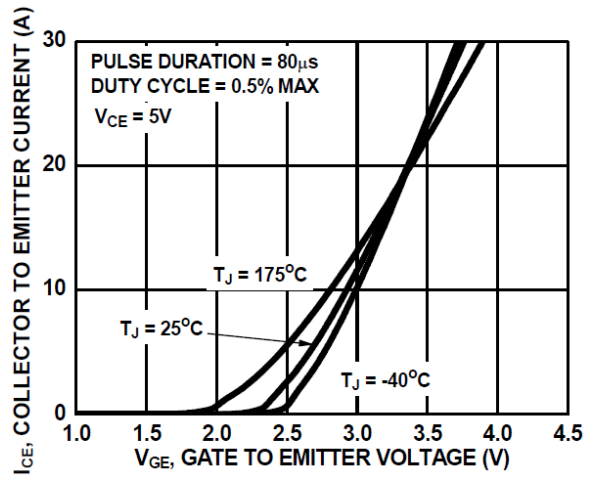


Figure 8. Transfer Characteristics

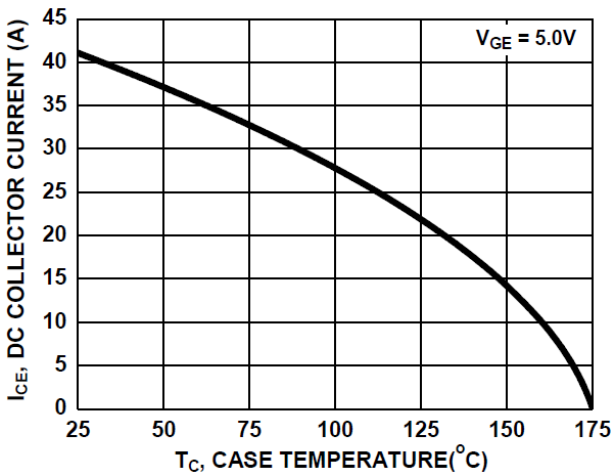


Figure 9. DC Collector Current vs. Case Temperature

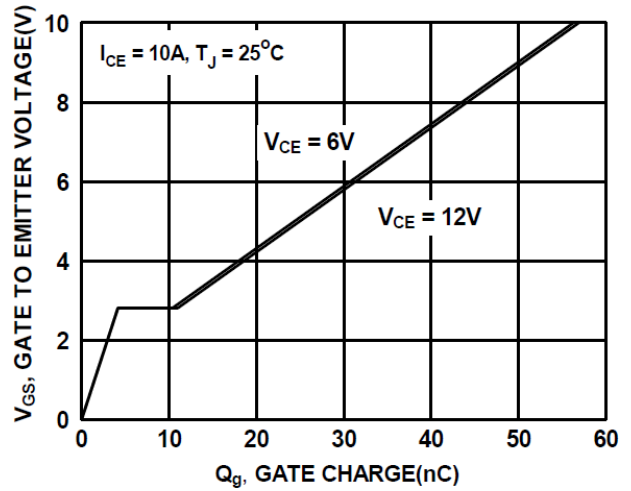


Figure 10. Gate Charge

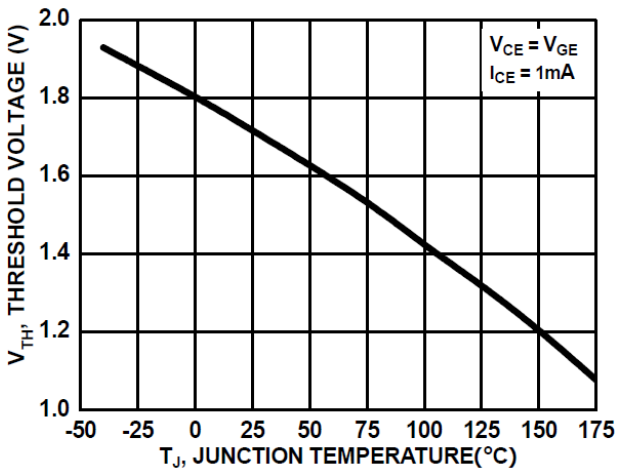


Figure 11. Threshold Voltage vs. Junction Temperature

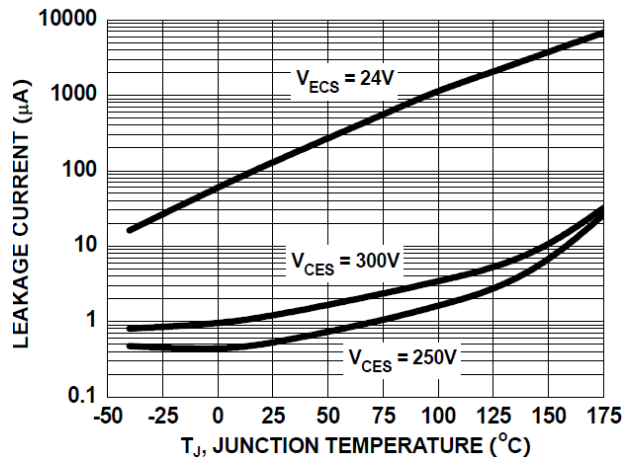


Figure 12. Leakage Current vs. Junction Temperature

# FGD3040G2-F085V

## TYPICAL CHARACTERISTICS (continued)

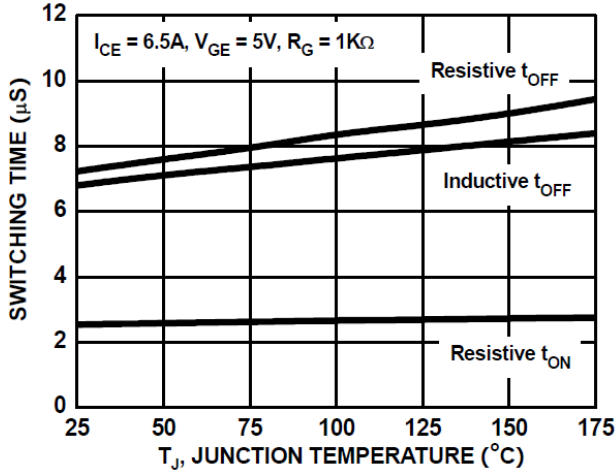


Figure 13. Switching Time vs. Junction Temperature

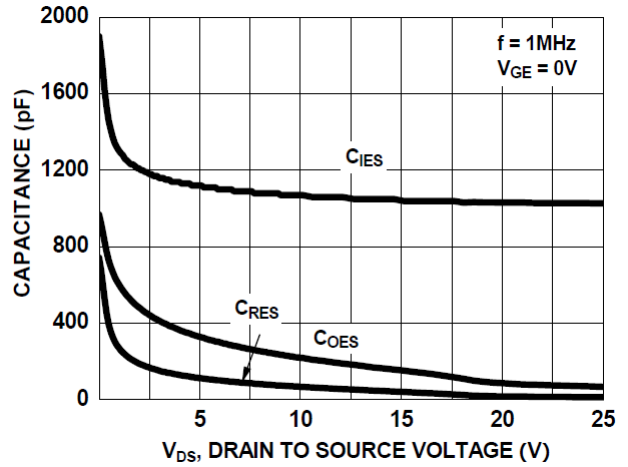


Figure 14. Capacitance vs. Collector to Emitter Voltage

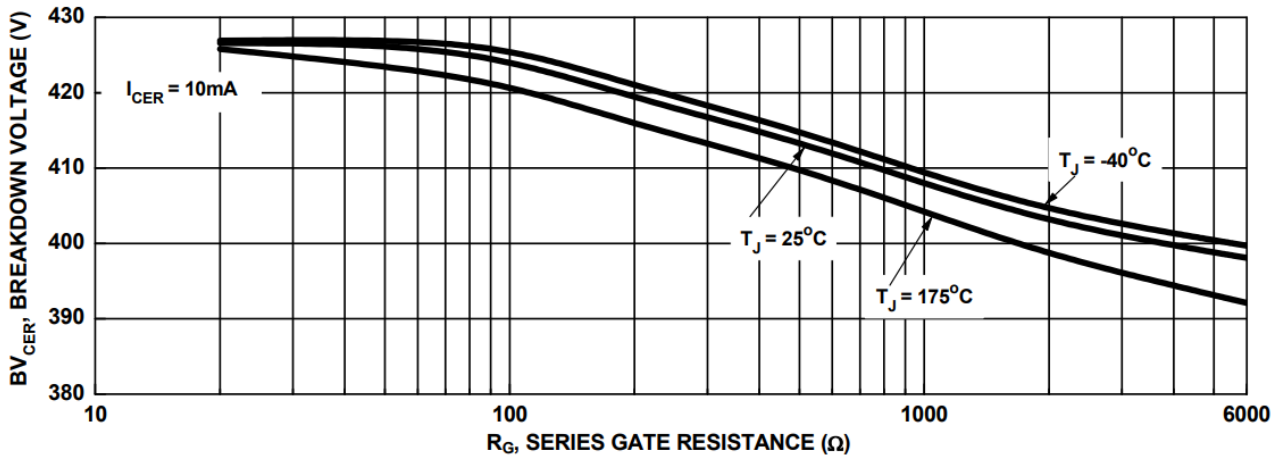


Figure 15. Break down Voltage vs. Series Resistance

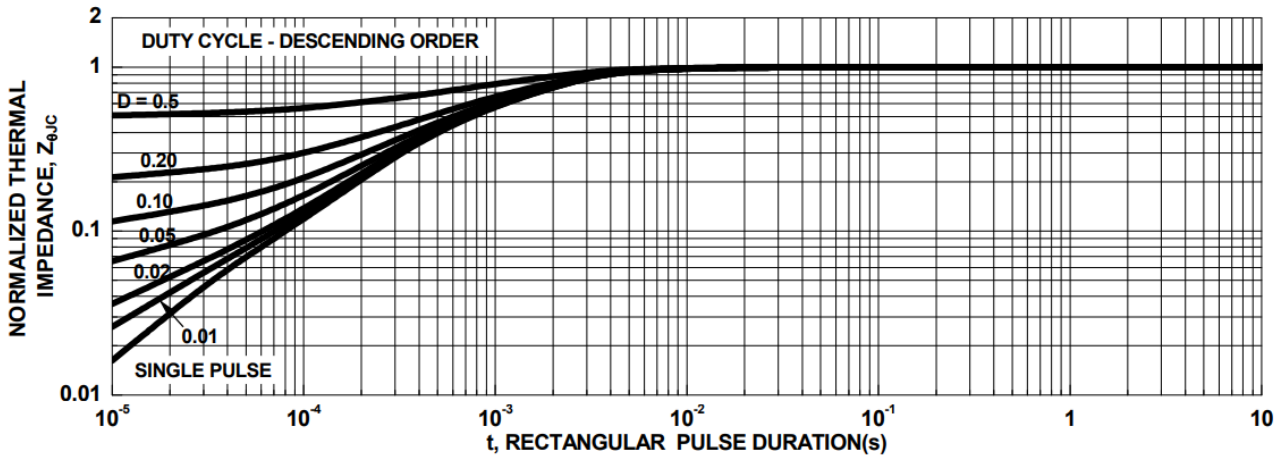


Figure 16. IGBT Normalized Transient Thermal Impedance, Junction to Case

# FGD3040G2-F085V

## TYPICAL CHARACTERISTICS (continued)

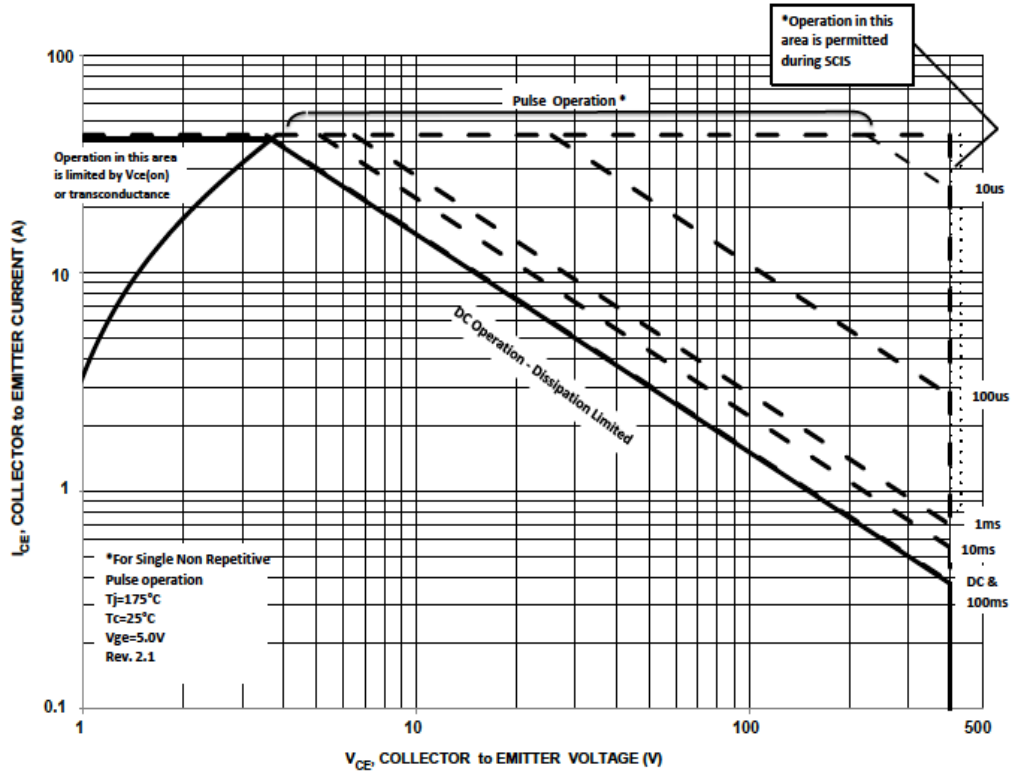


Figure 17. Forward Safe Operating Area

# FGD3040G2-F085V

## TEST CIRCUIT AND WAVEFORMS

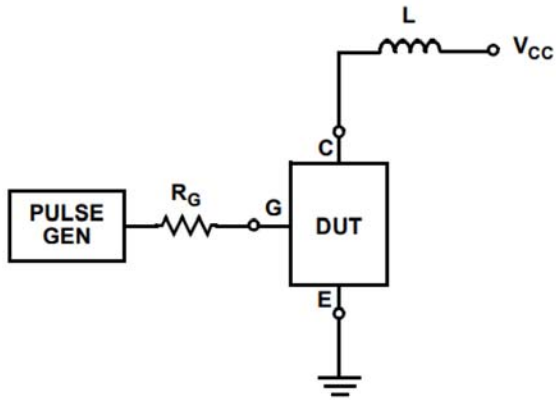


Figure 18. Inductive Switching Test Circuit

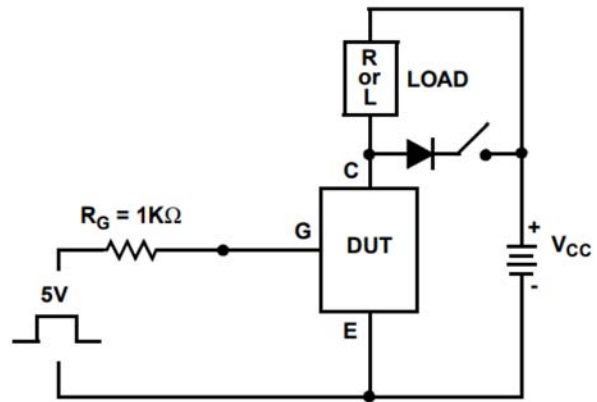


Figure 19.  $t_{ON}$  and  $t_{OFF}$  Switching Test Circuit

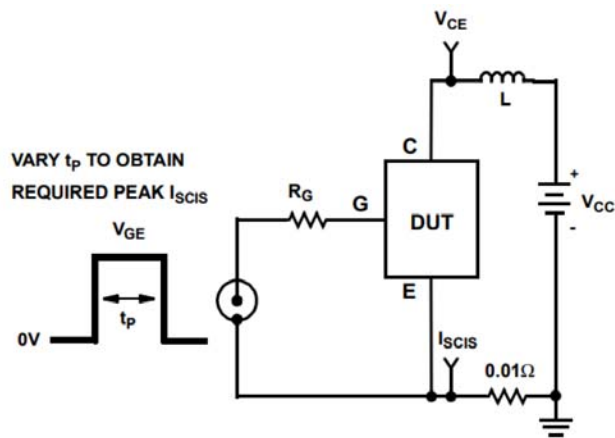


Figure 20. Energy Test Circuit

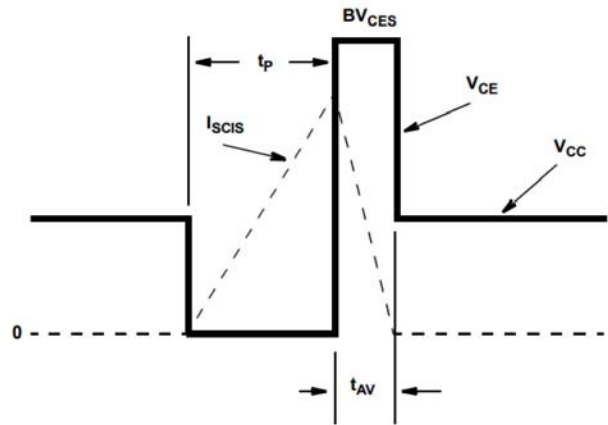


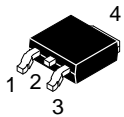
Figure 21. Energy Waveforms

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# MECHANICAL CASE OUTLINE

## PACKAGE DIMENSIONS

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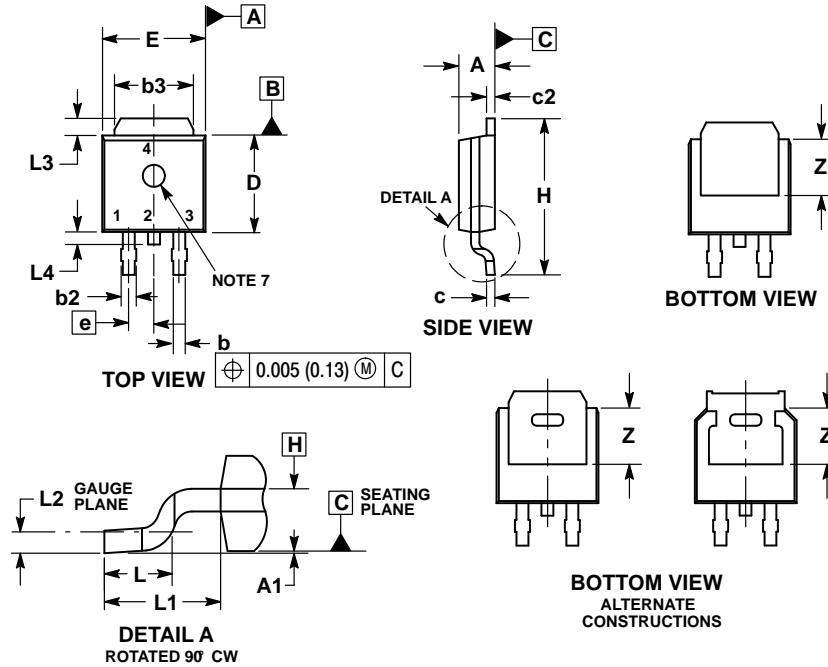
SCALE 1:1

### DPAK (SINGLE GAUGE)

#### CASE 369C

#### ISSUE F

DATE 21 JUL 2015

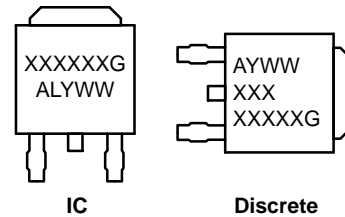


NOTES:

1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 1994.
2. CONTROLLING DIMENSION: INCHES.
3. THERMAL PAD CONTOUR OPTIONAL WITHIN DIMENSIONS b3, L3 and Z.
4. DIMENSIONS D AND E DO NOT INCLUDE MOLD FLASH, PROTRUSIONS, OR BURRS. MOLD FLASH, PROTRUSIONS, OR GATE BURRS SHALL NOT EXCEED 0.006 INCHES PER SIDE.
5. DIMENSIONS D AND E ARE DETERMINED AT THE OUTERMOST EXTREMES OF THE PLASTIC BODY.
6. DATUMS A AND B ARE DETERMINED AT DATUM PLANE H.
7. OPTIONAL MOLD FEATURE.

| DIM | INCHES    |       | MILLIMETERS |       |
|-----|-----------|-------|-------------|-------|
|     | MIN       | MAX   | MIN         | MAX   |
| A   | 0.086     | 0.094 | 2.18        | 2.38  |
| A1  | 0.000     | 0.005 | 0.00        | 0.13  |
| b   | 0.025     | 0.035 | 0.63        | 0.89  |
| b2  | 0.028     | 0.045 | 0.72        | 1.14  |
| b3  | 0.180     | 0.215 | 4.57        | 5.46  |
| c   | 0.018     | 0.024 | 0.46        | 0.61  |
| c2  | 0.018     | 0.024 | 0.46        | 0.61  |
| D   | 0.235     | 0.245 | 5.97        | 6.22  |
| E   | 0.250     | 0.265 | 6.35        | 6.73  |
| e   | 0.090 BSC |       | 2.29 BSC    |       |
| H   | 0.370     | 0.410 | 9.40        | 10.41 |
| L   | 0.055     | 0.070 | 1.40        | 1.78  |
| L1  | 0.114 REF |       | 2.90 REF    |       |
| L2  | 0.020 BSC |       | 0.51 BSC    |       |
| L3  | 0.035     | 0.050 | 0.89        | 1.27  |
| L4  | ---       | 0.040 | ---         | 1.01  |
| Z   | 0.155     | ---   | 3.93        | ---   |

### GENERIC MARKING DIAGRAM\*

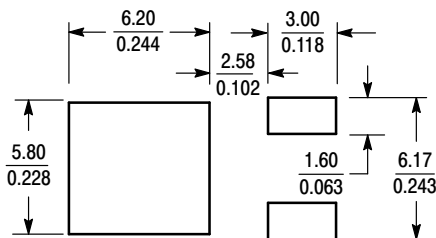


- XXXXXX = Device Code
- A = Assembly Location
- L = Wafer Lot
- Y = Year
- WW = Work Week
- G = Pb-Free Package

\*This information is generic. Please refer to device data sheet for actual part marking.

- |  |  |   |   |  |
|--|--|---|---|--|
| <p>STYLE 1:<br/>PIN 1. BASE<br/>2. COLLECTOR<br/>3. EMITTER<br/>4. COLLECTOR</p> | <p>STYLE 2:<br/>PIN 1. GATE<br/>2. DRAIN<br/>3. SOURCE<br/>4. DRAIN</p>          | <p>STYLE 3:<br/>PIN 1. ANODE<br/>2. CATHODE<br/>3. ANODE<br/>4. CATHODE</p> | <p>STYLE 4:<br/>PIN 1. CATHODE<br/>2. ANODE<br/>3. GATE<br/>4. ANODE</p>              | <p>STYLE 5:<br/>PIN 1. GATE<br/>2. ANODE<br/>3. CATHODE<br/>4. ANODE</p>     |
| <p>STYLE 6:<br/>PIN 1. MT1<br/>2. MT2<br/>3. GATE<br/>4. MT2</p>                 | <p>STYLE 7:<br/>PIN 1. GATE<br/>2. COLLECTOR<br/>3. EMITTER<br/>4. COLLECTOR</p> | <p>STYLE 8:<br/>PIN 1. N/C<br/>2. CATHODE<br/>3. ANODE<br/>4. CATHODE</p>   | <p>STYLE 9:<br/>PIN 1. ANODE<br/>2. CATHODE<br/>3. RESISTOR ADJUST<br/>4. CATHODE</p> | <p>STYLE 10:<br/>PIN 1. CATHODE<br/>2. ANODE<br/>3. CATHODE<br/>4. ANODE</p> |

### SOLDERING FOOTPRINT\*



SCALE 3:1 (mm/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.

|                         |  |  |
|-------------------------|--|--|
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| <b>STATUS:</b>          | <b>ON SEMICONDUCTOR STANDARD</b>       |  |
| <b>NEW STANDARD:</b>    | <b>REF TO JEDEC TO-252</b>             |  |
| <b>DESCRIPTION:</b>     | <b>DPAK SINGLE GAUGE SURFACE MOUNT</b> | <b>PAGE 1 OF 2</b>   |





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