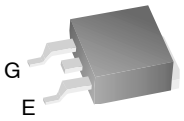
# ECOSPARK®2 320 mJ, 450 V, N-Channel Ignition IGBT

# FGD3245G2-F085, FGB3245G2-F085




**JEDEC TO−263AB**
**D²PAK−3 (TO−263, 3−LEAD)**
**CASE 418AJ**

**JEDEC TO−263AA**
**DPAK3 (TO−252 3 LD)**
**CASE 369AS**

### General Description

The FGB3245G2−F085 and FGD3245G2 are N−channel IGBTs designed in **onsemi**'s ECOSPARK−2 technology which helps in eliminating external protection circuitry. The technology is optimized for driving the coil in the harsh environment of automotive ignition systems and offers out−standing Vsat and SCIS Energy capability also at elevated operating temperatures. The logic level gate input is ESD protected and features an integrated gate resistor. An integrated zener−circuitry clamps the IGBT's collecter−to−emitter voltage at 450 V which enables systems requiring a higher spark voltage

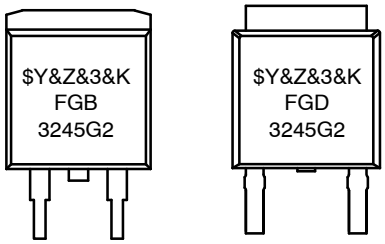
### Features

- SCIS Energy = 320 mJ at $T_J$ = 25°C
- Logic Level Gate Drive
- Low Saturation Voltage
- AEC−Q101 Qualified and PPAP Capable
- These Devices are Pb−Free and are RoHS Compliant

### Applications

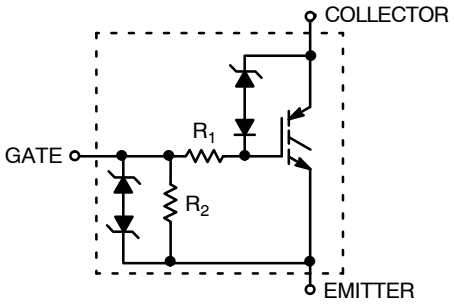
- Automotive Ignition Coil Driver Circuits
- Coil On Plug Applications

### MARKING DIAGRAM




FGB3245G2 = Device Code
FGD3245G2
$Y = **onsemi** Logo
&Z = Assembly Plant Code
&3 = 3−Digit Date Code
&K = 2−Digits Lot Run Traceability Code

### SYMBOL




### ORDERING INFORMATION

See detailed ordering and shipping information on page 7 of this data sheet.

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**DEVICE MAXIMUM RATINGS** ($T_A$ = 25°C unless otherwise noted)

| Symbol | Parameter | Rating | Unit |
|---|---|---|---|
| $BV_{CER}$ | Collector to Emitter Breakdown Voltage ($I_C$ = 1 mA) | 450 | V |
| $BV_{ECS}$ | Emitter to Collector Voltage − Reverse Battery Condition ($I_C$ = 10 mA) | 28 | V |
| $E_{SCIS25}$ | Self Clamping Inductive Switching Energy (Note 1) | 320 | mJ |
| $E_{SCIS150}$ | Self Clamping Inductive Switching Energy (Note 2) | 180 | mJ |
| $I_{C25}$ | Collector Current Continuous, at $V_{GE}$ = 5 V, $T_C$ = 25°C | 41 | A |
| $I_{C110}$ | Collector Current Continuous, at $V_{GE}$ = 5 V, $T_C$ = 110°C | 27 | A |
| $V_{GEM}$ | Gate to Emitter Voltage Continuous | ±10 | V |
| $P_D$ | Power Dissipation Total, at $T_C$ = 25°C | 150 | W |
| | Power Dissipation Derating, for $T_C$ > 25°C | 1.1 | W/°C |
| $T_J$ | Operating Junction Temperature Range | −40 to +175 | °C |
| $T_{STG}$ | Storage Junction Temperature Range | −40 to +175 | °C |
| $T_L$ | Max. Lead Temp. for Soldering (Leads at 1.6 mm from case for 10 s) | 300 | °C |
| $T_{PKG}$ | Max. Lead Temp. for Soldering (Package Body for 10 s) | 260 | °C |
| ESD | Electrostatic Discharge Voltage at 100 pF, 1500 Ω | 4 | kV |
| | CDM−Electrostatic Discharge Voltage at 1 Ω | 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 Clamping Inductive Switching Energy ($E_{SCIS25}$) of 320 mJ is based on the test conditions that starting Tj = 25°C; L = 3 mHy, $I_{SCIS}$ = 14.6 A, $V_{CC}$ = 100 V during inductor charging and $V_{CC}$ = 0 V during the time in clamp.
2. Self Clamping Inductive Switching Energy ($E_{SCIS150}$) of 180 mJ is based on the test conditions that starting Tj = 150°C; L = 3 mHy, $I_{SCIS}$ = 10.9 A, $V_{CC}$ = 100 V during inductor charging and $V_{CC}$ = 0 V during the time in clamp.

**ELECTRICAL CHARACTERISTICS** ($T_J$ = 25°C unless otherwise noted)

| Symbol | Parameter | Test Conditions | | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|---|
| **OFF STATE CHARACTERISTICS** | | | | | | | |
| $BV_{CER}$ | Collector to Emitter Breakdown Voltage | $I_{CE}$ = 2 mA, $V_{GE}$ = 0, $R_{GE}$ = 1 kΩ, $T_J$ = −40 to 150°C | | 420 | – | 480 | V |
| $BV_{CES}$ | Collector to Emitter Breakdown Voltage | $I_{CE}$ = 10 mA, $V_{GE}$ = 0 V, $R_{GE}$ = 0, $T_J$ = −40 to 150°C | | 440 | – | 500 | V |
| $BV_{ECS}$ | Emitter to Collector Breakdown Voltage | $I_{CE}$ = −75 mA, $V_{GE}$ = 0 V, $T_J$ = 25°C | | 28 | – | – | V |
| $BV_{GES}$ | Gate to Emitter Breakdown Voltage | $I_{GES}$ = ±2 mA | | ±12 | ±14 | – | V |
| $I_{CER}$ | Collector to Emitter Leakage Current | $V_{CE}$ = 250 V, $R_{GE}$ = 1 kΩ | $T_J$ = 25°C | – | – | 25 | μA |
| | | | $T_J$ = 150°C | – | – | 1 | mA |
| $I_{ECS}$ | Emitter to Collector Leakage Current | $V_{EC}$ = 24 V | $T_J$ = 25°C | – | – | 1 | mA |
| | | | $T_J$ = 150°C | – | – | 40 | |
| $R_1$ | Series Gate Resistance | | | – | 120 | – | Ω |
| $R_2$ | Gate to Emitter Resistance | | | 10 k | – | 30 k | Ω |
| **ON STATE CHARACTERISTICS** | | | | | | | |
| $V_{CE(SAT)}$ | Collector to Emitter Saturation Voltage | $I_{CE}$ = 6 A, $V_{GE}$ = 4 V | $T_J$ = 25°C | – | 1.13 | 1.25 | V |
| $V_{CE(SAT)}$ | Collector to Emitter Saturation Voltage | $I_{CE}$ = 10 A, $V_{GE}$ = 4.5 V | $T_J$ = 150°C | – | 1.32 | 1.50 | V |
| $V_{CE(SAT)}$ | Collector to Emitter Saturation Voltage | $I_{CE}$ = 15 A, $V_{GE}$ = 4.5 V | $T_J$ = 150°C | – | 1.64 | 1.85 | V |
| **DYNAMIC CHARACTERISTICS** | | | | | | | |
| $Q_{G(ON)}$ | Gate Charge | $I_{CE}$ = 10 A, $V_{CE}$ = 12 V, $V_{GE}$ = 5 V | | – | 23 | – | nC |
| $V_{GE(TH)}$ | Gate to Emitter Threshold Voltage | $I_{CE}$ = 1 mA, $V_{CE}$ = $V_{GE}$ | $T_J$ = 25°C | 1.3 | 1.6 | 2.2 | V |
| | | | $T_J$ = 150°C | 0.75 | 1.1 | 1.8 | |
| $V_{GEP}$ | Gate to Emitter Plateau Voltage | $V_{CE}$ = 12 V, $I_{CE}$ = 10 A | | – | 2.7 | – | V |
| **SWITCHING CHARACTERISTICS** | | | | | | | |
| $t_{d(ON)R}$ | Current Turn−On Delay Time−Resistive | $V_{CE}$ = 14 V, $R_L$ = 1 kΩ $V_{GE}$ = 5 V, $R_G$ = 1 kΩ, $T_J$ = 25°C | | – | 0.9 | 4 | μs |
| $t_{rR}$ | Current Rise Time−Resistive | | | – | 2.6 | 7 | μs |
| $t_{d(OFF)L}$ | Current Turn−Off Delay Time−Inductive | $V_{CE}$ = 300 V, L = 1 mH, $V_{GE}$ = 5 V, $R_G$ = 1 kΩ, $I_{CE}$ = 6.5 A, $T_J$ = 25°C | | – | 5.4 | 15 | μs |
| $t_{fL}$ | Current Fall Time−Inductive | | | – | 2.7 | 15 | μs |
| $E_{SCIS}$ | Self Clamped Inductive Switching | L = 3.0 mHy, $R_G$ = 1 kΩ, $V_{GE}$ = 5 V, (Note 3) | $T_J$ = 25°C | – | – | 320 | mJ |
| **THERMAL CHARACTERISTICS** | | | | | | | |
| $R_{\theta JC}$ | Thermal Resistance Junction to Case | All packages | | – | – | 0.9 | °C/W |

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.

3. Self Clamping Inductive Switching Energy ($E_{SCIS25}$) of 320 mJ is based on the test conditions that starting Tj = 25°C; L = 3 mHy, $I_{SCIS}$ = 14.6 A, $V_{CC}$ = 100 V during inductor charging and $V_{CC}$ = 0 V during the time in clamp.

## TYPICAL PERFORMANCE CURVES

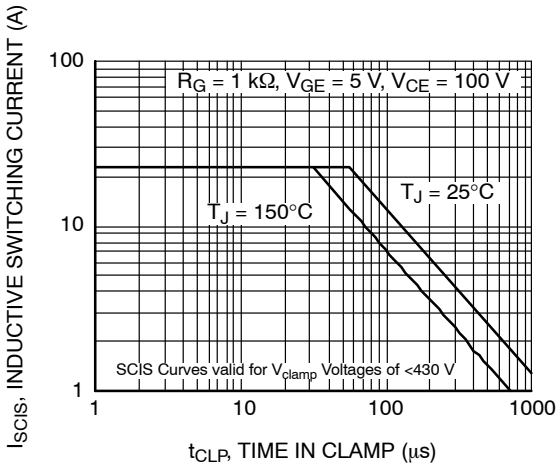


**Figure 1. Self Clamped Inductive Switching Current vs. Time in Clamp**

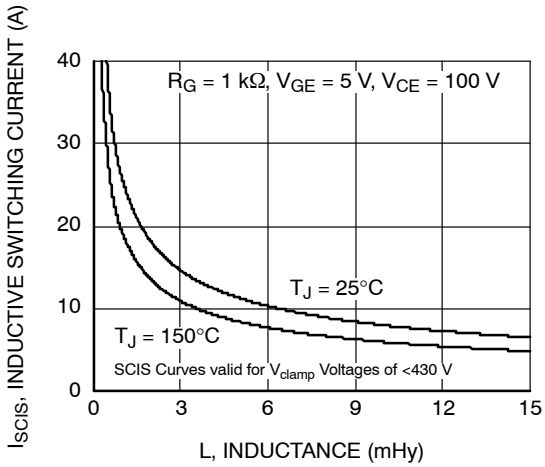


**Figure 2. Self Clamped Inductive Switching Current vs. Inductance**

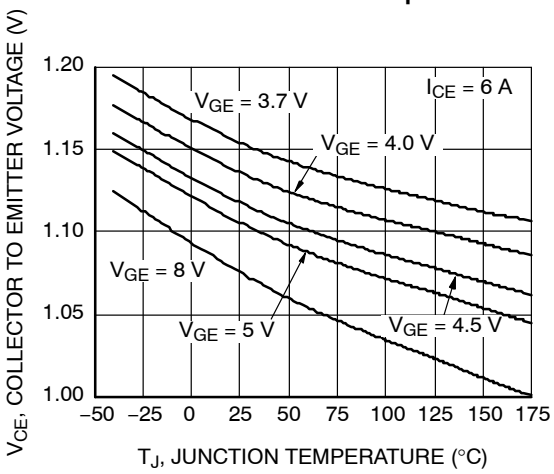


**Figure 3. Collector to Emitter On−State Voltage vs. Junction Temperature**

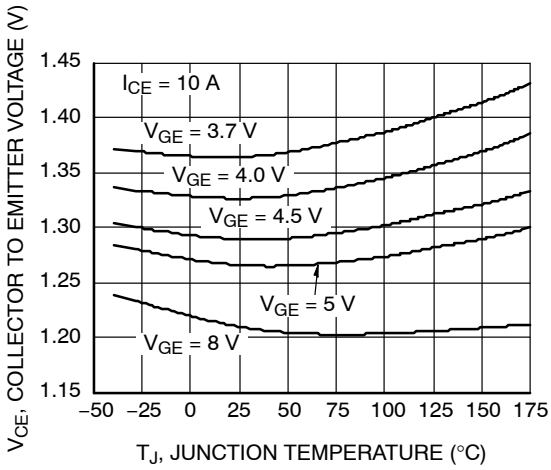


**Figure 4. Collector to Emitter On−State Voltage vs. Junction Temperature**

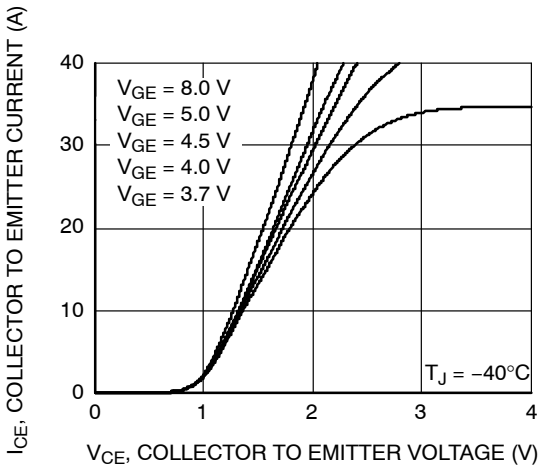


**Figure 5. Collector to Emitter On−State Voltage vs. Collector Current**

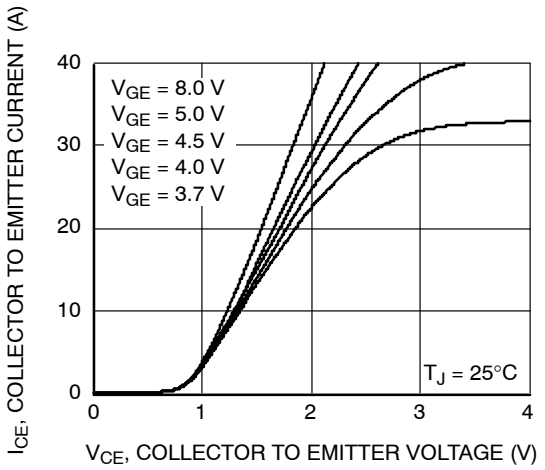


**Figure 6. Collector to Emitter On−State Voltage vs. Collector Current**

## TYPICAL PERFORMANCE CURVES (Continued)

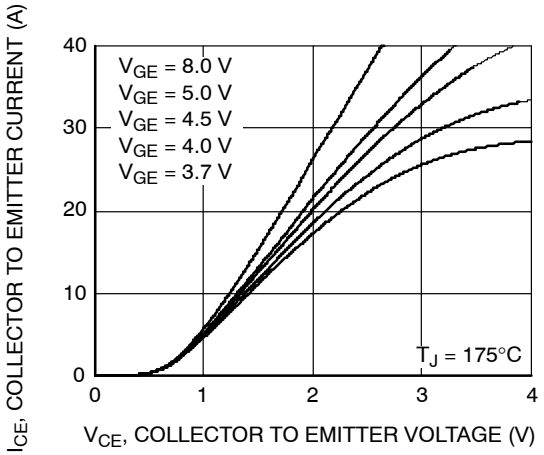


**Figure 7. Collector to Emitter On−Stage Voltage vs. Collector Current**

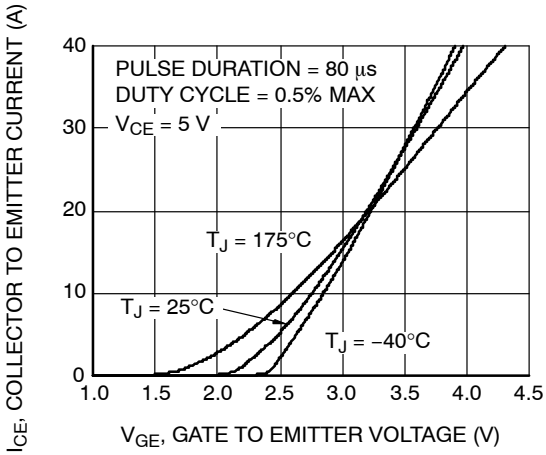


**Figure 8. Transfer Characteristics**

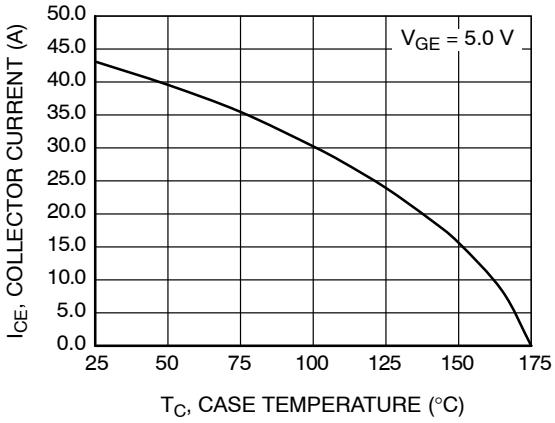


**Figure 9. DC Collector Current vs. Case Temperature**

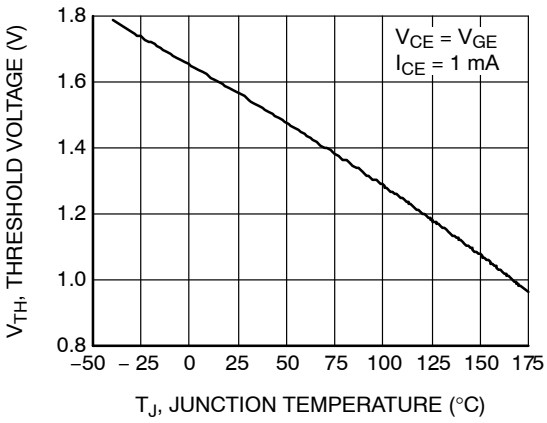


**Figure 10. Threshold Voltage vs. Junction Temperature**

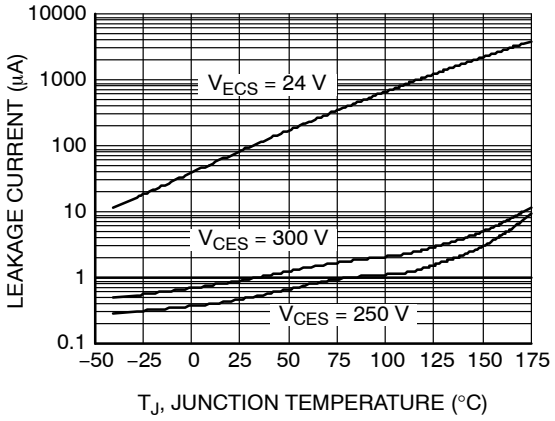


**Figure 11. Leakage Current vs. Junction Temperature**

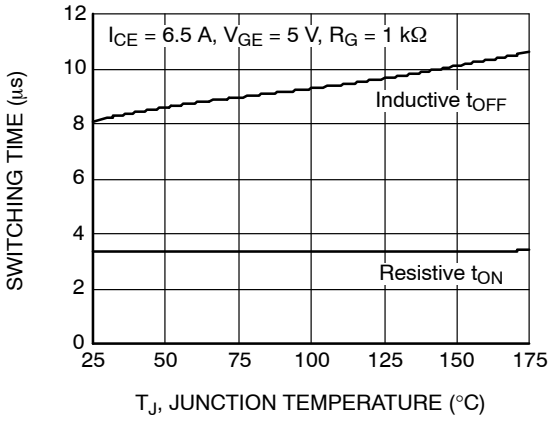


**Figure 12. Switching Time vs. Junction Temperature**

## TYPICAL PERFORMANCE CURVES (Continued)

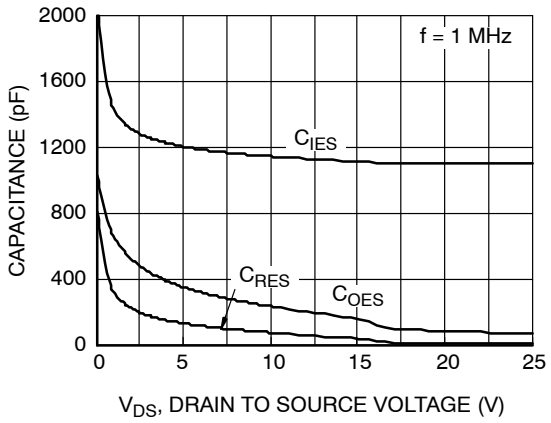


**Figure 13. Capacitance Collector to Emitter Voltage**

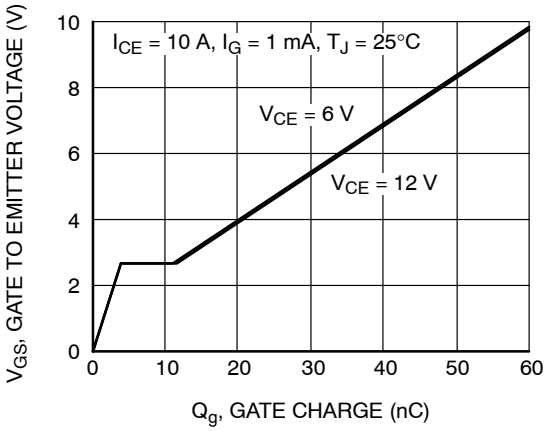


**Figure 14. Gate Charge**

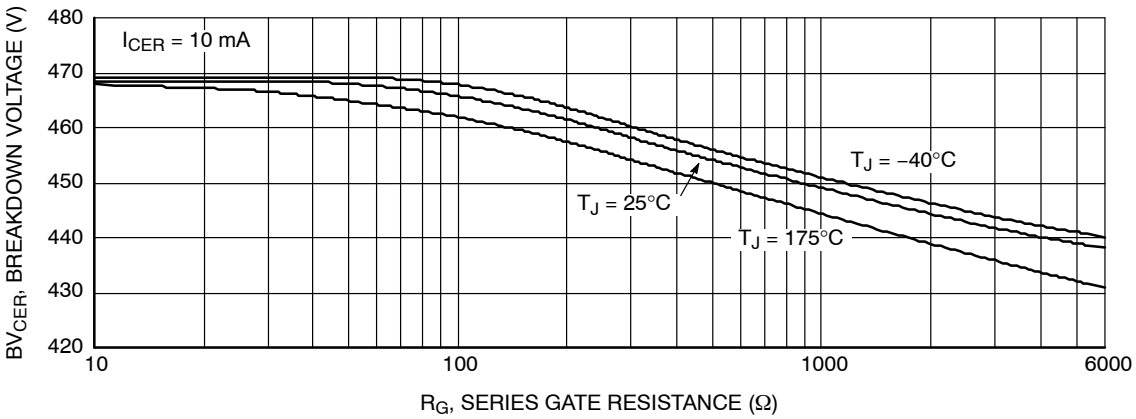


**Figure 15. Breakdown Voltage vs. Series Gate Resistance**

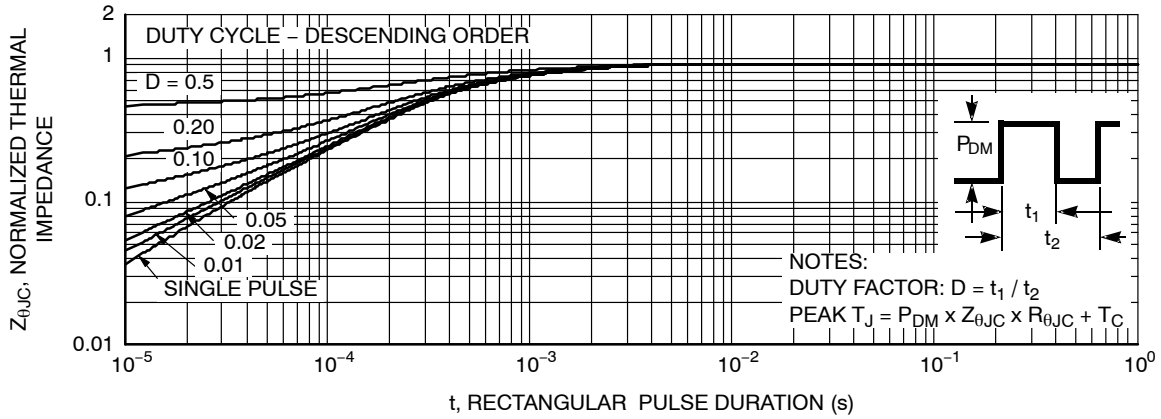


**Figure 16. IGBT Normalized Transient Thermal Impedance, Junction to Case**

## TESTE CIRCUITS AND WAVEFORMS

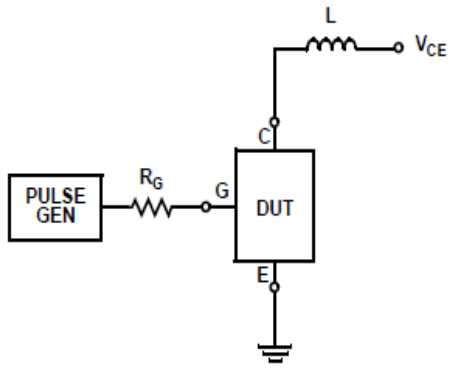


Figure 17. Inductive Switching Test Circuit

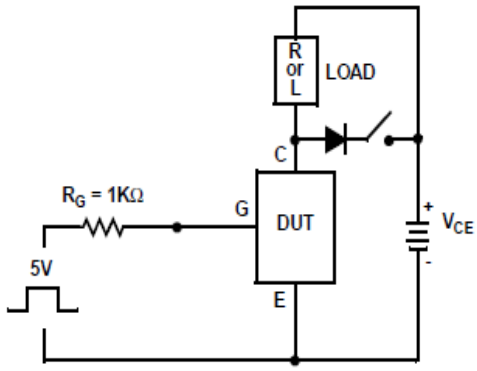


Figure 18. $t_{ON}$ and $t_{OFF}$ Switching Test Circuit

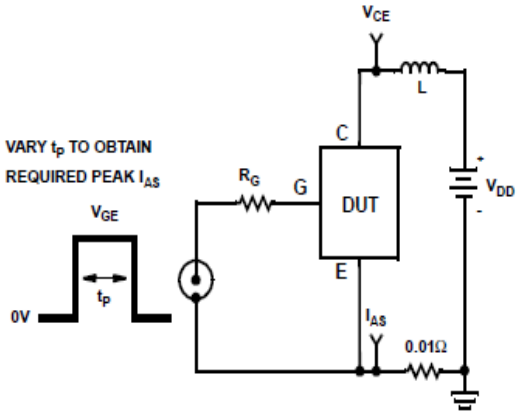


Figure 19. Energy Test Circuit

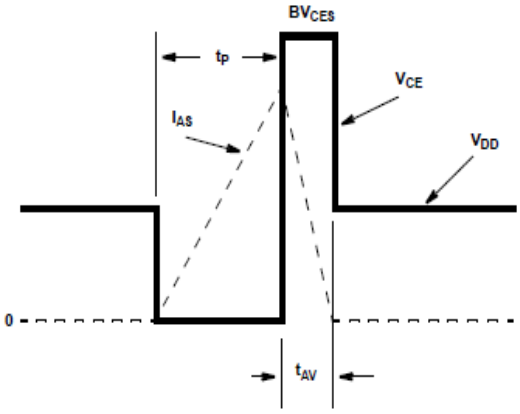


Figure 20. Energy Waveforms

## PACKAGE MARKING AND ORDERING INFORMATION

| Device Marking | Device | Package | Reel Size | Tape Width | Shipping† |
|---|---|---|---|---|---|
| FGD3245G2 | FGD3245G2−F085 | DPAK3 (TO−252 3 LD)<br>TO252AA<br>(Pb−Free) | 330 mm | 16 mm | 2500 / Tape & Reel |
| FGB3245G2 | FGB3245G2−F085 | $D^2PAK$−3 (TO−263, 3−LEAD)<br>TO263AB<br>(Pb−Free) | 330 mm | 24 mm | 800 / Tape & Reel |

†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.

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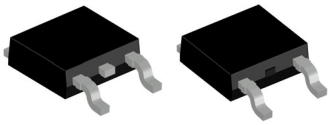
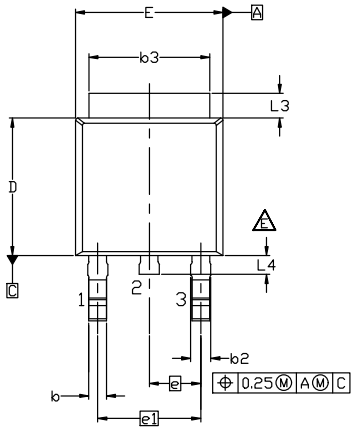
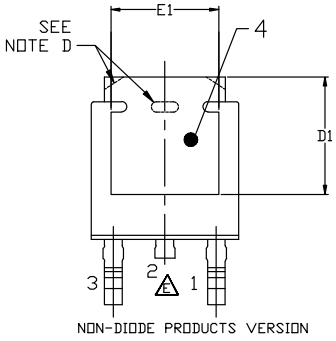


**DPAK3 6.10x6.54x2.29, 4.57P**
CASE 369AS
ISSUE B

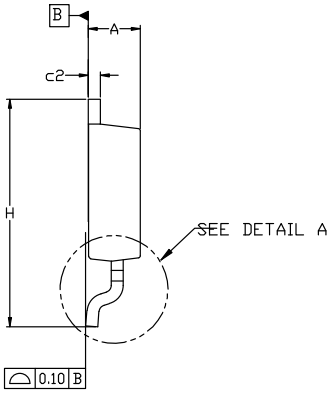
DATE 20 DEC 2023



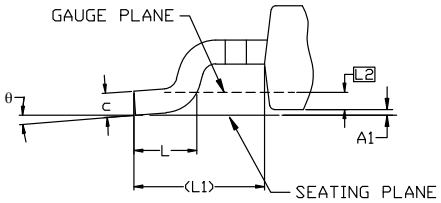

NON-DIODE PRODUCTS VERSION




NON-DIODE PRODUCTS VERSION

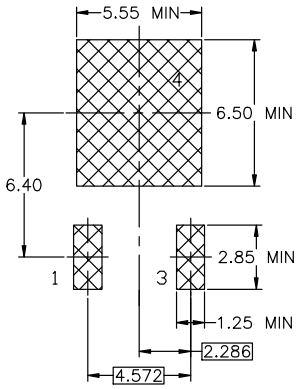



NOTES: UNLESS OTHERWISE SPECIFIED
A) THIS PACKAGE CONFORMS TO JEDEC, TO-252, ISSUE F, VARIATION AA.
B) ALL DIMENSIONS ARE IN MILLIMETERS.
C) DIMENSIONING AND TOLERANCING PER ASME Y14.5M-2018.
D) SUPPLIER DEPENDENT MOLD LOCKING HOLES OR CHAMFERED CORNERS OR EDGE PROTRUSION.
E) FOR DIODE PRODUCTS, L4 IS 0.25 MM MAX PLASTIC BODY STUB WITHOUT CENTER LEAD.
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

| DIM | MILLIMETERS | | |
|---|---|---|---|
| | MIN. | NOM. | MAX. |
| A | 2.18 | 2.29 | 2.39 |
| A1 | 0.00 | – | 0.127 |
| b | 0.64 | 0.77 | 0.89 |
| b2 | 0.76 | 0.95 | 1.14 |
| b3 | 5.21 | 5.34 | 5.46 |
| c | 0.45 | 0.53 | 0.61 |
| c2 | 0.45 | 0.52 | 0.58 |
| D | 5.97 | 6.10 | 6.22 |
| D1 | 5.21 | --- | --- |
| E | 6.35 | 6.54 | 6.73 |
| E1 | 4.32 | --- | --- |
| e | 2.286 BSC | | |
| e1 | 4.572 BSC | | |
| H | 9.40 | 9.91 | 10.41 |
| L | 1.40 | 1.59 | 1.78 |
| L1 | 2.90 REF | | |
| L2 | 0.51 BSC | | |
| L3 | 0.89 | 1.08 | 1.27 |
| L4 | --- | --- | 1.02 |
| θ | 0° | --- | 10° |




LAND PATTERN RECOMMENDATION

*FOR ADDITIONAL INFORMATION ON OUR PB-FREE STRATEGY AND SOLDERING DETAILS, PLEASE DOWNLOAD THE ON SEMICONDUCTOR SOLDERING AND MOUNTING TECHNIQUES REFERENCE MANUAL, SOLDERRM/D.

**GENERIC MARKING DIAGRAM***

*This information is generic. Please refer to device data sheet for actual part marking. Pb−Free indicator, “G” or microdot “▪”, may or may not be present. Some products may not follow the Generic Marking.

XXXX = Specific Device Code
A = Assembly Location
Y = Year
WW = Work Week
ZZ = Assembly Lot Code

| | | |
|---|---|---|
| **DOCUMENT NUMBER:** | **98AON13810G** | Electronic versions are uncontrolled except when accessed directly from the Document Repository. Printed versions are uncontrolled except when stamped “CONTROLLED COPY” in red. |
| **DESCRIPTION:** | **DPAK3 6.10x6.54x2.29, 4.57P** | **PAGE 1 OF 1** |

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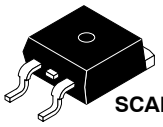
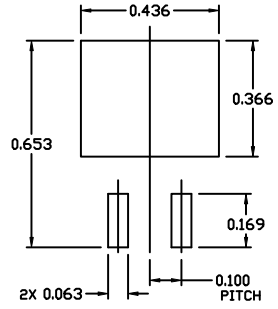
# D²PAK–3 (TO–263, 3–LEAD)
CASE 418AJ
ISSUE F

DATE 11 MAR 2021



**SCALE 1:1**



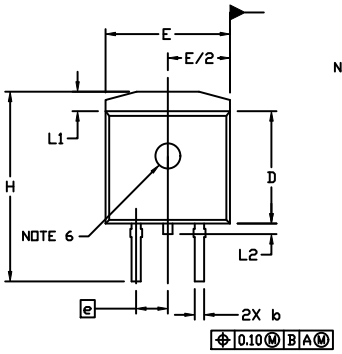

RECOMMENDED
MOUNTING FOOTPRINT

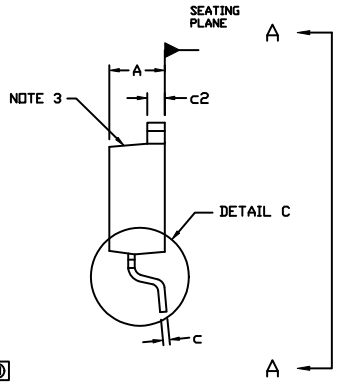
* For additional information on our Pb–Free strategy and soldering details, please download the ON Semiconductor Soldering and Mounting Techniques Reference Manual, SOLDERRM/D.

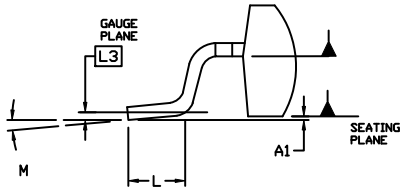
NOTES:

1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 2009.
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.
6. OPTIONAL MOLD FEATURE.
7. ①, ② ... OPTIONAL CONSTRUCTION FEATURE CALL OUTS.

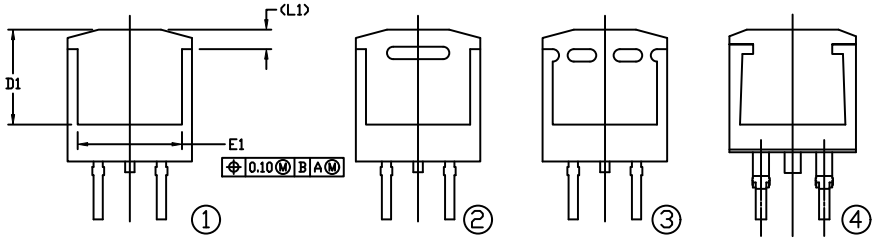
| | INCHES | | MILLIMETERS | |
|---|---|---|---|---|
| DIM | MIN. | MAX. | MIN. | MAX. |
| A | 0.160 | 0.190 | 4.06 | 4.83 |
| A1 | 0.000 | 0.010 | 0.00 | 0.25 |
| b | 0.020 | 0.039 | 0.51 | 0.99 |
| c | 0.012 | 0.029 | 0.30 | 0.74 |
| c2 | 0.045 | 0.065 | 1.14 | 1.65 |
| D | 0.330 | 0.380 | 8.38 | 9.65 |
| 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 | 0° | 8° | 0° | 8° |



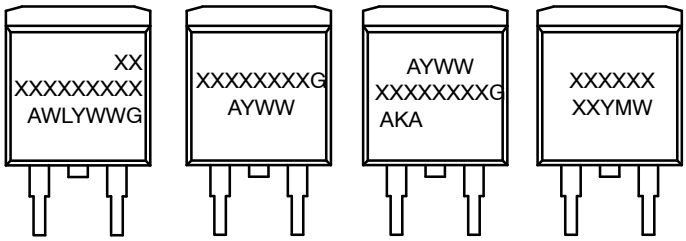

DETAIL C
TIP LEADFORM
ROTATED 90° CW




VIEW A–A

VIEW A–A
OPTIONAL CONSTRUCTIONS

## GENERIC MARKING DIAGRAMS*




**IC** **Standard** **Rectifier** **SSG**

XXXXXX = Specific Device Code
A = Assembly Location
WL = Wafer Lot
Y = Year
WW = Work Week
W = Week Code (SSG)
M = Month Code (SSG)
G = Pb–Free Package
AKA = Polarity Indicator

*This information is generic. Please refer to device data sheet for actual part marking. Pb–Free indicator, “G” or microdot “ ▪”, may or may not be present. Some products may not follow the Generic Marking.

| | | |
|---|---|---|
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