EcoSPARK® 2 HV-HE IGBT
500 mJ, 560 V, N-Channel PTC Heater IGBT
FGB5056G2-F085

Features
• SCIS Energy = 500 mJ at \( T_J = 25°C \)
• Logic Level Gate Drive
• RoHS Compliant
• AEC–Q101 Qualification and PPAP Capable

Applications
• PTC Heater Circuits
• High Current Systems
• Ignition Systems

MAXIMUM RATINGS (\( T_J = 25°C \) unless otherwise noted)

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Parameter</th>
<th>Value</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>( BV_{CER} )</td>
<td>Collector–to–Emitter Breakdown Voltage (( I_C = 1 ) mA)</td>
<td>560</td>
<td>V</td>
</tr>
<tr>
<td>( BV_{ECS} )</td>
<td>Emitter–to–Collector Voltage – Reverse Battery Condition (( I_C = -10 ) mA)</td>
<td>28</td>
<td>V</td>
</tr>
<tr>
<td>( E_{SCIS25} )</td>
<td>Self Clamping Inductive Switching Energy (Note 1)</td>
<td>500</td>
<td>mJ</td>
</tr>
<tr>
<td>( E_{SCIS150} )</td>
<td>Self Clamping Inductive Switching Energy (Note 2)</td>
<td>300</td>
<td>mJ</td>
</tr>
<tr>
<td>( I_{C25} )</td>
<td>Collector Current Continuous at ( V_{GE} = 5.0 ) V, ( T_C = 25°C )</td>
<td>80</td>
<td>A</td>
</tr>
<tr>
<td>( I_{C100} )</td>
<td>Collector Current Continuous at ( V_{GE} = 5.0 ) V, ( T_C = 100°C )</td>
<td>56</td>
<td>A</td>
</tr>
<tr>
<td>( V_{GEM} )</td>
<td>Gate–to–Emitter Voltage Continuous</td>
<td>±10</td>
<td>V</td>
</tr>
<tr>
<td>( P_D )</td>
<td>Power Dissipation Total, ( T_C = 25°C )</td>
<td>300</td>
<td>W</td>
</tr>
<tr>
<td></td>
<td>Power Dissipation Derating, ( T_C &gt; 25°C )</td>
<td>2</td>
<td>W/°C</td>
</tr>
<tr>
<td>( T_J, T_{STG} )</td>
<td>Operating Junction and Storage Temperature Range</td>
<td>-55 to +175</td>
<td>°C</td>
</tr>
<tr>
<td>( T_L )</td>
<td>Lead Temperature for Soldering Purposes (1/8” from case for 10 s)</td>
<td>300</td>
<td>°C</td>
</tr>
<tr>
<td>( T_{PKG} )</td>
<td>Reflow Soldering according to JESD020C</td>
<td>260</td>
<td>°C</td>
</tr>
<tr>
<td>ESD</td>
<td>HBM–Electrostatic Discharge Voltage at 100 pF, 1500 ( \Omega )</td>
<td>8</td>
<td>kV</td>
</tr>
<tr>
<td></td>
<td>CDM–Electrostatic Discharge Voltage at 1 ( \Omega )</td>
<td>2</td>
<td>kV</td>
</tr>
</tbody>
</table>

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 500 mJ is based on the test conditions that is starting \( T_J = 25°C \), \( L = 3 \) mHy, \( I_{SCIS} = 18.3 \) A, \( V_{CC} = 100 \) V during inductor charging and \( V_{CC} = 0 \) V during time in clamp.

2. Self Clamped inductive Switching Energy (\( E_{SCIS150} \)) of 300 mJ is based on the test conditions that is starting \( T_J = 150°C \), \( L = 3 \) mHy, \( I_{SCIS} = 14.2 \) A, \( V_{CC} = 100 \) V during inductor charging and \( V_{CC} = 0 \) V during time in clamp.
### THERMAL RESISTANCE RATINGS

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Symbol</th>
<th>Max</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>Junction–to–Case – Steady State (Drain)</td>
<td>( R_{\text{JUC}} )</td>
<td>0.5</td>
<td>°C/W</td>
</tr>
</tbody>
</table>

### ELECTRICAL CHARACTERISTICS (\( T_J = 25°C \) unless otherwise specified)

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Parameter</th>
<th>Test Conditions</th>
<th>Min</th>
<th>Typ</th>
<th>Max</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>OFF CHARACTERISTICS</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>( B\text{VCER} )</td>
<td>Collector–to–Emitter Breakdown Voltage</td>
<td>( I_{\text{CE}} = 2 \text{ mA}, V_{\text{GE}} = 0 \text{ V} ) ( R_{\text{GE}} = 1 \text{ kΩ} ), ( T_J = -40 \text{ to } 150°C )</td>
<td>520</td>
<td>560</td>
<td>600</td>
<td>V</td>
</tr>
<tr>
<td>( B\text{VCES} )</td>
<td>Collector–to–Emitter Breakdown Voltage</td>
<td>( I_{\text{CE}} = 10 \text{ mA}, V_{\text{GE}} = 0 \text{ V} ) ( R_{\text{GE}} = 0 ), ( T_J = -40 \text{ to } 150°C )</td>
<td>–</td>
<td>583</td>
<td>–</td>
<td>V</td>
</tr>
<tr>
<td>( B\text{VECS} )</td>
<td>Emitter–to–Collector Breakdown Voltage</td>
<td>( I_{\text{CE}} = -75 \text{ mA}, V_{\text{GE}} = 0 \text{ V} ) ( T_J = 25°C )</td>
<td>28</td>
<td>–</td>
<td>–</td>
<td>V</td>
</tr>
<tr>
<td>( B\text{VGES} )</td>
<td>Gate–to–Emitter Breakdown Voltage</td>
<td>( I_{\text{GES}} = \pm 2 \text{ mA} )</td>
<td>±12</td>
<td>±14</td>
<td>–</td>
<td>V</td>
</tr>
<tr>
<td>( I_{\text{CER}} )</td>
<td>Collector–to–Emitter Leakage Current</td>
<td>( V_{\text{CE}} = 250 \text{ V} ) ( R_{\text{GE}} = 1 \text{ kΩ} ) ( T_J = 25°C )</td>
<td>–</td>
<td>–</td>
<td>25</td>
<td>μA</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>( T_J = 150°C )</td>
<td>–</td>
<td>–</td>
<td>1</td>
</tr>
<tr>
<td>( I_{\text{ECS}} )</td>
<td>Emitter–to–Collector Leakage Current</td>
<td>( V_{\text{EC}} = 24 \text{ V} ) ( T_J = 25°C )</td>
<td>–</td>
<td>–</td>
<td>1</td>
<td>mA</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>( T_J = 150°C )</td>
<td>–</td>
<td>–</td>
<td>40</td>
</tr>
<tr>
<td>( R_1 )</td>
<td>Series Gate Resistance</td>
<td></td>
<td>–</td>
<td>116</td>
<td>–</td>
<td>Ω</td>
</tr>
<tr>
<td>( R_2 )</td>
<td>Gate–to–Emitter Resistance</td>
<td></td>
<td>10K</td>
<td>–</td>
<td>30K</td>
<td>Ω</td>
</tr>
<tr>
<td><strong>ON CHARACTERISTICS</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>( V_{\text{CE(SAT)}} )</td>
<td>Collector–to–Emitter Saturation Voltage</td>
<td>( I_{\text{CE}} = 10 \text{ A}, V_{\text{GE}} = 4.5 \text{ V} ), ( T_J = 25°C )</td>
<td>–</td>
<td>1.11</td>
<td>1.25</td>
<td>V</td>
</tr>
<tr>
<td></td>
<td></td>
<td>( I_{\text{CE}} = 30 \text{ A}, V_{\text{GE}} = 5 \text{ V} ), ( T_J = 25°C )</td>
<td>–</td>
<td>1.54</td>
<td>1.75</td>
<td>V</td>
</tr>
<tr>
<td></td>
<td></td>
<td>( I_{\text{CE}} = 50 \text{ A}, V_{\text{GE}} = 10 \text{ V} ), ( T_J = 25°C )</td>
<td>–</td>
<td>1.76</td>
<td>2.1</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>( I_{\text{CE}} = 15 \text{ A}, V_{\text{GE}} = 5 \text{ V} ), ( T_J = 150°C )</td>
<td>–</td>
<td>1.4</td>
<td>1.6</td>
<td></td>
</tr>
<tr>
<td><strong>DYNAMIC CHARACTERISTICS</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>( Q_{\text{G(ON)}} )</td>
<td>Gate Charge</td>
<td>( I_{\text{CE}} = 10 \text{ A}, V_{\text{CE}} = 12 \text{ V} ), ( V_{\text{GE}} = 5 \text{ V} )</td>
<td>–</td>
<td>39</td>
<td>–</td>
<td>nC</td>
</tr>
<tr>
<td>( V_{\text{GE(TH)}} )</td>
<td>Gate–to–Emitter Threshold Voltage</td>
<td>( I_{\text{CE}} = 1 \text{ mA} ) ( V_{\text{CE}} = V_{\text{GE}} ) ( T_J = 25°C )</td>
<td>1.18</td>
<td>1.5</td>
<td>2.2</td>
<td>V</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>( T_J = 150°C )</td>
<td>0.75</td>
<td>–</td>
<td>1.8</td>
</tr>
<tr>
<td>( V_{\text{GEP}} )</td>
<td>Gate–to–Emitter Plateau Voltage</td>
<td>( V_{\text{CE}} = 12 \text{ V} ), ( I_{\text{CE}} = 10 \text{ A} )</td>
<td>–</td>
<td>2.6</td>
<td>–</td>
<td>V</td>
</tr>
<tr>
<td><strong>SWITCHING CHARACTERISTICS</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>( t_{\text{d(ON)R}} )</td>
<td>Current Turn–On Delay Time–Resistive</td>
<td>( V_{\text{CE}} = 14 \text{ V} ), ( R_L = 1 \text{ Ω} ) ( V_{\text{GE}} = 5 \text{ V} ), ( R_{\text{G}} = 470 \text{ Ω} ), ( T_J = 25°C )</td>
<td>–</td>
<td>0.74</td>
<td>3</td>
<td>μs</td>
</tr>
<tr>
<td>( t_{\text{R}} )</td>
<td>Current Rise Time–Resistive</td>
<td>( V_{\text{CE}} = 300 \text{ V} ), ( L = 1 \text{ mH} ) ( V_{\text{GE}} = 5 \text{ V} ), ( R_{\text{G}} = 470 \text{ Ω} ), ( I_{\text{CE}} = 6.5 \text{ A} ), ( T_J = 25°C )</td>
<td>–</td>
<td>1.7</td>
<td>7</td>
<td></td>
</tr>
<tr>
<td>( t_{\text{d(OFF)L}} )</td>
<td>Current Turn–Off Delay Time–Inductive</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>( t_{\text{L}} )</td>
<td>Current Fall Time–Inductive</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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 ORDERING INFORMATION

<table>
<thead>
<tr>
<th>Device</th>
<th>Package</th>
<th>Shipping†</th>
</tr>
</thead>
<tbody>
<tr>
<td>FGB5056G2–F085</td>
<td>D²PAK (Pb–Free)</td>
<td>800 Units / Tape &amp; Reel</td>
</tr>
</tbody>
</table>

†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

SCIS Curves valid for $V_{\text{clamp}}$ Voltages of < 560 V, $R_G = 1 \, \Omega$, $V_{GE} = 5 \, V$

TJ = 25°C
TJ = 150°C

$TJ = 25°C$
$TJ = 150°C$

ISCIS, INDUCTIVE SWITCHING CURRENT (A)

VCE, COLLECTOR-TO-EMITTER VOLTAGE (V)

ICE, COLLECTOR-TO-EMITTER CURRENT (A)

$V_{GE} = 3.7 \, V$
$V_{GE} = 5.0 \, V$
$V_{GE} = 8.0 \, V$

$TJ = -55°C$
$TJ = 25°C$

$4.0 \, V$
$4.5 \, V$
$5.0 \, V$

$TJ = 150°C$

$0.90$
$0.95$
$1.00$

$4.5 \, V$
$5.0 \, V$
$8.0 \, V$

$4.0 \, V$
$3.7 \, V$

$1.10$
$1.15$

$3.7 \, V$

$4.5 \, V$

$1.20$

$V_{CE} = 6 \, A$

$V_{CE} = 10 \, A$

$4.5 \, V$

$1.25$

$V_{CE} = 6 \, A$

$V_{CE} = 10 \, A$

$4.5 \, V$

$1.25$
TYPICAL CHARACTERISTICS

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

www.onsemi.com
TYPICAL CHARACTERISTICS

**Figure 13. Switching Time vs. Junction Temperature**

**Figure 14. Capacitance vs. Collector-to-Emitter Voltage**

**Figure 15. Forward Bias Safe Operating Area**

*Operation in this area is permitted during SCIS

*For Single Non Repetitive Pulse Operation

**DC Operation - Dissipation Limited**

**Resistive \( t_{OFF} \)**

**Inductive \( t_{OFF} \)**

**Resistive \( t_{ON} \)**

**Pulse Operation**

**Operation in this area is limited by \( V_{CE(on)} \) or transconductance**

**DC/100 ms**

**10 ms**

**100 \( \mu \)s**

**1 \( \mu \)s**

**1 ms**

**0.1**

**100000000**

**100**

**1000**

**10000**

**100000000**

**1000000000**

**1000000000000**

**0.01**

**100**

**1000**

**10000**

**100000000**

**1000000000**

**1000000000000**

**0.1**

**1**

**10**

**100**

**1000**

**10000**

**100000000**

**1000000000**

**1000000000000**

**1000000000000**

www.onsemi.com
**TYPICAL CHARACTERISTICS**

**Figure 16. Breakdown Voltage vs. Series Resistance**

![Breakdown Voltage vs. Series Resistance](image)

- $I_{CER} = 10$ mA
- $T_J = -55^\circ C$
- $T_J = 25^\circ C$
- $T_J = 175^\circ C$

**Figure 17. Normalized Transient Thermal Impedance, Junction–to–Case ($Z_{JC}$)**

![Normalized Transient Thermal Impedance](image)

- $Z_{JC}$, Normalized Thermal Impedance
- $t$, Rectangular Pulse Duration (s)

---

www.onsemi.com

6
TEST CIRCUIT AND WAVEFORMS

Figure 18. Inductive Switching Test Circuit

Figure 19. t\textsubscript{ON} and t\textsubscript{OFF} Switching Test Circuit

Figure 20. Energy Test Circuit

Figure 21. Energy Waveforms

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

D^2PAK-3 (TO-263, 3-LEAD)
CASE 418AJ
ISSUE F

NOTES:
2. CONTROL 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 CONTOR IS OPTIONAL WITHIN DIMENSIONS E, L1, B1, AND E1.
6. OPTIONAL MOLD FEATURE.
7. • • • OPTIMAL CONSTRUCTION FEATURE CALL OUTS.

RECOMMENDED MOUNTING FOOTPRINT
For additional information on our RoHS compliant and non-compliant models, please consult the RoHS Section Reference Manual, SLRA544.

DIMENSIONS

<table>
<thead>
<tr>
<th>INCHES</th>
<th>MILLIMETERS</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>0.160</td>
</tr>
<tr>
<td>a</td>
<td>0.020</td>
</tr>
<tr>
<td>b</td>
<td>0.059</td>
</tr>
<tr>
<td>c</td>
<td>0.029</td>
</tr>
<tr>
<td>c/2</td>
<td>0.045</td>
</tr>
<tr>
<td>D</td>
<td>0.330</td>
</tr>
<tr>
<td>E</td>
<td>0.260</td>
</tr>
<tr>
<td>H</td>
<td>0.380</td>
</tr>
<tr>
<td>L1</td>
<td>0.263</td>
</tr>
<tr>
<td>L2</td>
<td>0.263</td>
</tr>
<tr>
<td>L3</td>
<td>0.305</td>
</tr>
<tr>
<td>W</td>
<td>0.050</td>
</tr>
</tbody>
</table>

ADDITIONAL INFORMATION

TECHNICAL PUBLICATIONS:
Technical Library: www.onsemi.com/design/resources/technical-documentation
onsemi Website: www.onsemi.com

ONLINE SUPPORT: www.onsemi.com/support
For additional information, please contact your local Sales Representative at www.onsemi.com/supportsales