**Phase leg**

*Fast Trench + Field Stop IGBT3 Power Module*

**Absolute maximum ratings**

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Parameter</th>
<th>Max ratings</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>$V_{CES}$</td>
<td>Collector - Emitter Breakdown Voltage</td>
<td>1200</td>
<td>V</td>
</tr>
<tr>
<td>$I_C$</td>
<td>Continuous Collector Current</td>
<td>$T_C = 25^\circ C$&lt;br&gt;$T_C = 80^\circ C$</td>
<td>110&lt;br&gt;75</td>
</tr>
<tr>
<td>$I_{CM}$</td>
<td>Pulsed Collector Current</td>
<td>$T_C = 25^\circ C$</td>
<td>175</td>
</tr>
<tr>
<td>$V_{GE}$</td>
<td>Gate – Emitter Voltage</td>
<td>±20</td>
<td>V</td>
</tr>
<tr>
<td>$P_D$</td>
<td>Maximum Power Dissipation</td>
<td>$T_C = 25^\circ C$</td>
<td>357</td>
</tr>
<tr>
<td>RBSOA</td>
<td>Reverse Bias Safe Operating Area</td>
<td>$T_J = 125^\circ C$</td>
<td>150A @ 1150V</td>
</tr>
</tbody>
</table>

CAUTION: These Devices are sensitive to Electrostatic Discharge. Proper Handling Procedures Should Be Followed. See application note APT0502 on www.microsemi.com
### Electrical Characteristics

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Characteristic</th>
<th>Test Conditions</th>
<th>Min</th>
<th>Typ</th>
<th>Max</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>ICES</td>
<td>Zero Gate Voltage Collector Current</td>
<td>VGE = 0V, VCE = 1200V</td>
<td>250</td>
<td>µA</td>
<td></td>
<td></td>
</tr>
<tr>
<td>VCE(sat)</td>
<td>Collector Emitter saturation Voltage</td>
<td>VGE = 15V, IC = 75A</td>
<td>1.4</td>
<td>1.7</td>
<td>2.1</td>
<td>V</td>
</tr>
<tr>
<td>VGE(th)</td>
<td>Gate Threshold Voltage</td>
<td>VGE = VCE, IC = 3 mA</td>
<td>5.0</td>
<td>6.5</td>
<td>V</td>
<td></td>
</tr>
<tr>
<td>IGE</td>
<td>Gate – Emitter Leakage Current</td>
<td>VGE = 20V, VCE = 0V</td>
<td>400</td>
<td>nA</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Dynamic Characteristics

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Characteristic</th>
<th>Test Conditions</th>
<th>Min</th>
<th>Typ</th>
<th>Max</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cies</td>
<td>Input Capacitance</td>
<td>VGE = 0V</td>
<td>5340</td>
<td>pF</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Coes</td>
<td>Output Capacitance</td>
<td>VGE = 25V</td>
<td>280</td>
<td>pF</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cres</td>
<td>Reverse Transfer Capacitance</td>
<td>f = 1MHz</td>
<td>240</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Td(on)</td>
<td>Turn-on Delay Time</td>
<td>Inductive Switching (25°C)</td>
<td>260</td>
<td>ns</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tr</td>
<td>Rise Time</td>
<td>VGE = ±15V</td>
<td>30</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Td(off)</td>
<td>Turn-off Delay Time</td>
<td>IBus = 600V, IC = 75A</td>
<td>420</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tf</td>
<td>Fall Time</td>
<td>Rg = 4.7Ω</td>
<td>70</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Td(on)</td>
<td>Turn-on Delay Time</td>
<td>Inductive Switching (125°C)</td>
<td>285</td>
<td>ns</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tr</td>
<td>Rise Time</td>
<td>VGE = ±15V</td>
<td>50</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Td(off)</td>
<td>Turn-off Delay Time</td>
<td>IBus = 600V, IC = 75A</td>
<td>520</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tf</td>
<td>Fall Time</td>
<td>Rg = 4.7Ω</td>
<td>90</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Eon</td>
<td>Turn-on Switching Energy</td>
<td>VGE = ±15V, IBus = 600V, IC = 75A</td>
<td>7</td>
<td></td>
<td></td>
<td>mJ</td>
</tr>
<tr>
<td>Eoff</td>
<td>Turn-off Switching Energy</td>
<td>Rg = 4.7Ω, Tj = 125°C</td>
<td>8.1</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Reverse diode ratings and characteristics

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Characteristic</th>
<th>Test Conditions</th>
<th>Min</th>
<th>Typ</th>
<th>Max</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>VRRM</td>
<td>Maximum Peak Repetitive Reverse Voltage</td>
<td>VR = 1200V, Tj = 25°C</td>
<td>350</td>
<td>µA</td>
<td></td>
<td></td>
</tr>
<tr>
<td>IRM</td>
<td>Maximum Reverse Leakage Current</td>
<td>VR = 1200V, Tj = 125°C</td>
<td>600</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>IF</td>
<td>DC Forward Current</td>
<td>Tc = 80°C</td>
<td>75</td>
<td></td>
<td></td>
<td>A</td>
</tr>
<tr>
<td>VF</td>
<td>Diode Forward Voltage</td>
<td>IF = 75A, Tj = 25°C</td>
<td>1.6</td>
<td></td>
<td></td>
<td>V</td>
</tr>
<tr>
<td>Qr</td>
<td>Reverse Recovery Charge</td>
<td>Tj = 125°C</td>
<td>280</td>
<td></td>
<td></td>
<td>µC</td>
</tr>
<tr>
<td>Ef</td>
<td>Reverse Recovery Energy</td>
<td>Tj = 25°C</td>
<td>2.8</td>
<td></td>
<td></td>
<td>mJ</td>
</tr>
</tbody>
</table>
Thermal and package characteristics

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Characteristic</th>
<th>Min</th>
<th>Typ</th>
<th>Max</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>$R_{thJC}$</td>
<td>Junction to Case Thermal Resistance</td>
<td>0.35</td>
<td></td>
<td></td>
<td>°C/W</td>
</tr>
<tr>
<td>$V_{DSOL}$</td>
<td>RMS Isolation Voltage, any terminal to case t =1 min, 50/60Hz</td>
<td>4000</td>
<td></td>
<td></td>
<td>V</td>
</tr>
<tr>
<td>$T_J$</td>
<td>Operating junction temperature range</td>
<td>-40</td>
<td></td>
<td>150</td>
<td>°C</td>
</tr>
<tr>
<td>$T_{STG}$</td>
<td>Storage Temperature Range</td>
<td>-40</td>
<td></td>
<td>125</td>
<td>°C</td>
</tr>
<tr>
<td>$T_{C}$</td>
<td>Operating Case Temperature</td>
<td>-40</td>
<td></td>
<td>100</td>
<td></td>
</tr>
<tr>
<td>Torque</td>
<td>Mounting torque To heatsink</td>
<td>2</td>
<td></td>
<td>3</td>
<td>N.m</td>
</tr>
<tr>
<td>Wt</td>
<td>Package Weight</td>
<td>80</td>
<td></td>
<td></td>
<td>g</td>
</tr>
</tbody>
</table>

Temperature sensor NTC (see application note APT0406 on www.microsemi.com for more information).

Symbol | Characteristic | Min | Typ | Max | Unit |
--------|----------------|-----|-----|-----|------|
$R_{25}$ | Resistance @ 25°C                                     | 50  |     |     | kΩ   |
$B_{25/85}$ | $T_{25} = 298.15 \text{ K}$ | 3952 |     |     | K    |

\[
R_T = \frac{R_{25}}{\exp \left( \frac{B_{25/85}}{T_{25}} \right)}
\]

T: Thermistor temperature
$R_T$: Thermistor value at T

SP1 Package outline (dimensions in mm)

See application note 1904 - Mounting Instructions for SP1 Power Modules on www.microsemi.com
Typical Performance Curve

Output Characteristics (V_Ce=15V)

T_J=25°C
T_J=125°C
V_Ce (V)
0 25 50 75 100 125 150
I_C (A)
0 25 50 75 100

Output Characteristics

T_J = 125°C
V_Ce=17V
V_Ce=13V
V_Ce=16V
V_Ce=9V
V_Ce (V)
0 125 150
I_C (A)
0 50 75 100

Transfert Characteristics

T_J=25°C
T_J=125°C
V_Ce (V)
0 5 6 7 8 9 10 11 12
I_C (A)
0 25 50 75 100

Energy losses vs Collector Current

T_J=25°C
V_Ce=600V
V_Ce=15V
R_G=4.7Ω
E_{on}, E_{off}, E_{r}
E (mJ)
0 2 4 6 8 10
V_Ce (V)
0 400 800 1200 1600
I_C (A)
0 10

Switching Energy Losses vs Gate Resistance

V_Ce = 600V
V_Ce = 15V
G = 75A
T_J = 125°C
E_{on}, E_{off}, E_{r}
E (mJ)
0 2 4 6 8 10
Gate Resistance (ohms)
0 4 8 12 16 20 24 28 32

Reverse Bias Safe Operating Area

V_Ce=15V
T_J=125°C
R_G=4.7Ω
V_Ce (V)
0 150 175
I_C (A)
0 50 75 100

maximum Effective Transient Thermal Impedance, Junction to Case vs Pulse Duration

Thermal Impedance (°C/W)
0 0.05 0.1 0.15 0.2 0.25 0.3 0.35 0.4
rectangular Pulse Duration (Seconds)
0 0.00001 0.0001 0.001 0.01 0.1 1 10

www.microsemi.com
Forward Characteristic of diode

Operating Frequency vs Collector Current

- TJ = 25°C
- TJ = 125°C

VF (V)

IF (A)

Hard switching

ZCS

ZVS

Operating Frequency vs Collector Current

VCE = 600V
D = 50%
Rg = 4.7Ω

TJ = 125°C
Tc = 75°C

IC (A)

Fmax, Operating Frequency (kHz)

VCE = 600V
D = 50%

RG = 4.7Ω

TJ = 125°C
Tc = 75°C

maximum Effective Transient Thermal Impedance, Junction to case vs Pulse Duration

Thermal Impedance (°C/W)

rectangular Pulse Duration (Seconds)

0.9
0.7
0.5
0.3
0.1
0

Duty Factor: D = Tc / Tj

Peak TJ = D * Vpp * 2 * Rg / (1 - D)

Note:

Diode
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