Automotive 750 V, 800 A 
Dual Side Cooling 
Half-Bridge Power Module

VE-Trac™ Dual 
NVG800A75L4DSB

Product Description
The NVG800A75L4DSB is part of a family of power modules with dual side cooling and compact footprints for Hybrid (HEV) and Electric Vehicle (EV) traction inverter application.

The module consists of two narrow mesa Field Stop (FS4) IGBTs in a half–bridge configuration. The chipset utilizes the new narrow mesa IGBT technology in providing high current density and robust short circuit protection with higher blocking voltage to deliver outstanding performance in EV traction applications.

Features
• Dual–Side Cooling
• Integrated Chip Level Temperature and Current Sensor
• $T_{\text{Vj max}} = 175^\circ\text{C}$ for Continuous Operation
• Ultra–low Stray Inductance
• Low $V_{\text{CESAT}}$ and Switching Losses
• Automotive Grade FS4 IGBT & Soft Diode Chip Technologies
• 4.2 kV Isolated DBC Substrate
• This Device is RoHS Compliant

Typical Applications
• Hybrid and Electric Vehicle Traction Inverter
• High Power DC–DC Converter

ORDERING INFORMATION
See detailed ordering and shipping information on page 11 of this data sheet.
PIN DESCRIPTION

<table>
<thead>
<tr>
<th>Pin #</th>
<th>Pin</th>
<th>Pin Function Description</th>
<th>Pin Arrangement</th>
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<tbody>
<tr>
<td>1</td>
<td>N</td>
<td>Low Side Emitter</td>
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</tr>
<tr>
<td>2</td>
<td>P</td>
<td>High Side Collector</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>H/S COLLECTOR SENSE</td>
<td>High Side Collector Sense</td>
<td></td>
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<tr>
<td>4</td>
<td>H/S CURRENT SENSE</td>
<td>High Side Current Sense</td>
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</tr>
<tr>
<td>5</td>
<td>H/S EMITTER SENSE</td>
<td>High Side Emitter Sense</td>
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</tr>
<tr>
<td>6</td>
<td>H/S GATE</td>
<td>High Side Gate</td>
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</tr>
<tr>
<td>7</td>
<td>H/S TEMP SENSE (CATHODE)</td>
<td>High Side Temp sense Diode Cathode</td>
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</tr>
<tr>
<td>8</td>
<td>H/S TEMP SENSE (ANODE)</td>
<td>High Side Temp sense Diode Anode</td>
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</tr>
<tr>
<td>9</td>
<td>–</td>
<td>Phase Output</td>
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<td>10</td>
<td>L/S CURRENT SENSE</td>
<td>Low Side Current Sense</td>
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<td>11</td>
<td>L/S EMITTER SENSE</td>
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<td>12</td>
<td>L/S GATE</td>
<td>Low Side Gate</td>
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<td>13</td>
<td>L/S TEMP SENSE (CATHODE)</td>
<td>Low Side Temp sense Diode Cathode</td>
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<td>14</td>
<td>L/S TEMP SENSE (ANODE)</td>
<td>Low Side Temp sense Diode Anode</td>
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<td>15</td>
<td>L/S COLLECTOR SENSE</td>
<td>Low Side Collector Sense</td>
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Materials
DBC Substrate: Al₂O₃ isolated substrate, basic isolation, and copper on both sides
Lead Frame: Copper with Tin electro–plating

Flammability Information
All materials present in the power module meet UL flammability rating class 94V–0

MODULE CHARACTERISTICS

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Parameter</th>
<th>Rating</th>
<th>Unit</th>
</tr>
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<tbody>
<tr>
<td>Tᵥj</td>
<td>Continuous Operating Junction Temperature Range</td>
<td>−40 to 175</td>
<td>°C</td>
</tr>
<tr>
<td>TᵥSTG</td>
<td>Storage Temperature Range</td>
<td>−40 to 125</td>
<td>°C</td>
</tr>
<tr>
<td>VᵥISO</td>
<td>Isolation Voltage, DC, t = 1 s</td>
<td>4200</td>
<td>V</td>
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<tr>
<td>Creepage</td>
<td>Terminal to Terminal</td>
<td>6.0</td>
<td>mm</td>
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<tr>
<td>Clearance</td>
<td>Terminal to Terminal</td>
<td>3.2</td>
<td>mm</td>
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<tr>
<td>CTI</td>
<td>Comparative Tracking Index</td>
<td>&gt;600</td>
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<table>
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<th>Min</th>
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<th>Max</th>
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<tr>
<td>LᵥSCE</td>
<td>8</td>
<td></td>
<td></td>
</tr>
<tr>
<td>RᵥCC+EE</td>
<td>0.15</td>
<td></td>
<td></td>
</tr>
<tr>
<td>G</td>
<td>75</td>
<td></td>
<td></td>
</tr>
<tr>
<td>M</td>
<td>2.2</td>
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www.onsemi.com
### ABSOLUTE MAXIMUM RATINGS (TVJ = 25°C, Unless Otherwise Specified)

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Parameter</th>
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<th>Unit</th>
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<tr>
<td>VCES</td>
<td>Collector to Emitter Voltage</td>
<td>750</td>
<td>V</td>
</tr>
<tr>
<td>VGES</td>
<td>Gate to Emitter Voltage</td>
<td>±20</td>
<td>V</td>
</tr>
<tr>
<td>ICN</td>
<td>Implemented Collector Current</td>
<td>800</td>
<td>A</td>
</tr>
<tr>
<td>ICRM</td>
<td>Continuous DC Collector Current, TVJmax = 175°C, TF = 65°C, Ref. Heatsink</td>
<td>550 (Note 1)</td>
<td>A</td>
</tr>
<tr>
<td></td>
<td>Pulsed Collector Current @ VGE = 15 V, tp = 1 ms</td>
<td>1600</td>
<td>A</td>
</tr>
</tbody>
</table>

#### IGBT

**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. Verified by characterization, not by test.

#### THERMAL CHARACTERISTICS (Verified by characterization, not by test.)

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Parameter</th>
<th>Min</th>
<th>Typ</th>
<th>Max</th>
<th>Unit</th>
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</thead>
<tbody>
<tr>
<td>IGBT.Rth,J-C</td>
<td>Effective Rth, Junction to Case (Note 2)</td>
<td>0.05</td>
<td>0.07</td>
<td>°C/W</td>
<td></td>
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<tr>
<td>IGBT.Rth,J-F</td>
<td>Effective Rth, Junction to Fluid, λTIM = 6 W/m–K, F = 660 N 10 L/min, 65°C, 50/50 EGW, Ref. Heatsink</td>
<td>0.14</td>
<td>°C/W</td>
<td></td>
<td></td>
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<tr>
<td>Diode.Rth,J-C</td>
<td>Effective Rth, Junction to Case (Note 2)</td>
<td>0.08</td>
<td>0.10</td>
<td>°C/W</td>
<td></td>
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<tr>
<td>Diode.Rth,J-F</td>
<td>Effective Rth, Junction to Fluid, λTIM = 6 W/m–K, F = 660 N 10 L/min, 65°C, 50/50 EGW, Ref. Heatsink</td>
<td>0.21</td>
<td>°C/W</td>
<td></td>
<td></td>
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2. For the measurement point of case temperature (Tc), DBC discoloration, picker circle print is allowed, please refer to the VE–Trac Dual assembly guide for additional details about acceptable DBC surface finish.
<table>
<thead>
<tr>
<th>Parameters</th>
<th>Conditions</th>
<th>Min</th>
<th>Typ</th>
<th>Max</th>
<th>Unit</th>
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<tbody>
<tr>
<td><strong>V_{CESAT}</strong></td>
<td>Collector to Emitter Saturation Voltage (Terminal)</td>
<td>V_{GE} = 15 V, I_{C} = 600 A, T_{VJ} = 25°C T_{VJ} = 150°C T_{VJ} = 175°C</td>
<td>–</td>
<td>1.30</td>
<td>1.55</td>
</tr>
<tr>
<td></td>
<td>V_{GE} = 15 V, I_{C} = 800 A, T_{VJ} = 25°C T_{VJ} = 150°C T_{VJ} = 175°C</td>
<td>–</td>
<td>1.42</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td></td>
<td></td>
<td>–</td>
<td>1.45</td>
<td>–</td>
<td>–</td>
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<tr>
<td><strong>I_{CES}</strong></td>
<td>Collector to Emitter Leakage Current</td>
<td>V_{GE} = 0, V_{CE} = 750 V T_{VJ} = 25°C T_{VJ} = 175°C</td>
<td>–</td>
<td>–</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td></td>
<td>–</td>
<td>8</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td><strong>I_{GES}</strong></td>
<td>Gate – Emitter Leakage Current</td>
<td>V_{CE} = 0, V_{GE} = ±20 V</td>
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<td>–</td>
<td>±400</td>
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<tr>
<td><strong>V_{th}</strong></td>
<td>Threshold Voltage</td>
<td>V_{CE} = V_{GE}, I_{C} = 500 mA</td>
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<td>5.5</td>
<td>6.2</td>
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<tr>
<td><strong>Q_{G}</strong></td>
<td>Total Gate Charge</td>
<td>V_{GE} = –8 to 15 V, V_{CE} = 400 V</td>
<td>–</td>
<td>2.2</td>
<td>–</td>
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<tr>
<td><strong>R_{Gint}</strong></td>
<td>Internal Gate Resistance</td>
<td>–</td>
<td>2</td>
<td>–</td>
<td>Ω</td>
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<tr>
<td><strong>C_{ies}</strong></td>
<td>Input Capacitance</td>
<td>V_{CE} = 30 V, V_{GE} = 0 V, f = 1 MHz</td>
<td>–</td>
<td>48</td>
<td>–</td>
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<tr>
<td><strong>C_{oes}</strong></td>
<td>Output Capacitance</td>
<td>V_{CE} = 30 V, V_{GE} = 0 V, f = 1 MHz</td>
<td>–</td>
<td>1.37</td>
<td>–</td>
</tr>
<tr>
<td><strong>C_{res}</strong></td>
<td>Reverse Transfer Capacitance</td>
<td>V_{CE} = 30 V, V_{GE} = 0 V, f = 1 MHz</td>
<td>–</td>
<td>0.15</td>
<td>–</td>
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<tr>
<td><strong>T_{d.on}</strong></td>
<td>Turn On Delay, Inductive Load</td>
<td>I_{C} = 600 A, V_{CE} = 400 V, T_{VJ} = 25°C T_{VJ} = 150°C T_{VJ} = 175°C</td>
<td>–</td>
<td>253</td>
<td>–</td>
</tr>
<tr>
<td></td>
<td></td>
<td>–</td>
<td>282</td>
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<td></td>
<td></td>
<td>–</td>
<td>287</td>
<td>–</td>
<td>–</td>
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<tr>
<td><strong>T_{r}</strong></td>
<td>Rise Time, Inductive Load</td>
<td>I_{C} = 600 A, V_{CE} = 400 V, T_{VJ} = 25°C T_{VJ} = 150°C T_{VJ} = 175°C</td>
<td>–</td>
<td>94</td>
<td>–</td>
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<td></td>
<td></td>
<td>–</td>
<td>112</td>
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<td></td>
<td></td>
<td>–</td>
<td>117</td>
<td>–</td>
<td>–</td>
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<tr>
<td><strong>T_{d.off}</strong></td>
<td>Turn Off Delay, Inductive Load</td>
<td>I_{C} = 600 A, V_{CE} = 400 V, T_{VJ} = 25°C T_{VJ} = 150°C T_{VJ} = 175°C</td>
<td>–</td>
<td>760</td>
<td>–</td>
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<td></td>
<td></td>
<td>–</td>
<td>790</td>
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<td></td>
<td>–</td>
<td>800</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td><strong>T_{f}</strong></td>
<td>Fall Time, Inductive Load</td>
<td>I_{C} = 600 A, V_{CE} = 400 V, T_{VJ} = 25°C T_{VJ} = 150°C T_{VJ} = 175°C</td>
<td>–</td>
<td>95</td>
<td>–</td>
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<td></td>
<td></td>
<td>–</td>
<td>140</td>
<td>–</td>
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</tr>
<tr>
<td></td>
<td></td>
<td>–</td>
<td>153</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td><strong>E_{ON}</strong></td>
<td>Turn–On Switching Loss (including diode reverse recovery loss)</td>
<td>I_{C} = 600 A, V_{CE} = 400 V, V_{GE} = +15/–8 V, L_{s} = 20 nH, R_{g.on} = 4.7 Ω, di/dt (T_{VJ} = 25°C) = 5.13 A/ns, di/dt (T_{VJ} = 175°C) = 4.11 A/ns</td>
<td>–</td>
<td>21.30</td>
<td>–</td>
</tr>
<tr>
<td></td>
<td></td>
<td>–</td>
<td>32.55</td>
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<td>–</td>
<td>33.66</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td><strong>E_{OFF}</strong></td>
<td>Turn–Off Switching Loss</td>
<td>I_{C} = 600 A, V_{CE} = 400 V, V_{GE} = +15/–8 V, L_{s} = 20 nH, R_{g.off} = 15 Ω, dv/dt (T_{VJ} = 25°C) = 2.81 V/ns, dv/dt (T_{VJ} = 175°C) = 2.11 V/ns</td>
<td>–</td>
<td>22.62</td>
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<td>31.77</td>
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<td></td>
<td>–</td>
<td>33.60</td>
<td>–</td>
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<tr>
<td><strong>E_{SC}</strong></td>
<td>Minimum Short Circuit Energy Withstand</td>
<td>V_{GE} = 15 V, V_{CC} = 400 V T_{VJ} = 25°C T_{VJ} = 175°C</td>
<td>–</td>
<td>5</td>
<td>–</td>
</tr>
<tr>
<td></td>
<td></td>
<td>–</td>
<td>7.5</td>
<td>–</td>
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### CHARACTERISTICS OF INVERSE DIODE (TVJ = 25°C, Unless Otherwise Specified)

<table>
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<th>Parameters</th>
<th>Conditions</th>
<th>Min</th>
<th>Typ</th>
<th>Max</th>
<th>Unit</th>
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<tbody>
<tr>
<td><strong>V_F</strong> Diode Forward Voltage (Terminal)</td>
<td>V_GE = 0 V, I_C = 600 A, TVJ = 25°C</td>
<td>–</td>
<td>1.50</td>
<td>1.70</td>
<td>V</td>
</tr>
<tr>
<td></td>
<td>TVJ = 150°C</td>
<td>–</td>
<td>1.46</td>
<td>–</td>
<td></td>
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<tr>
<td></td>
<td>TVJ = 175°C</td>
<td>–</td>
<td>1.44</td>
<td>–</td>
<td></td>
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<tr>
<td></td>
<td>V_GE = 0 V, I_C = 800 A, TVJ = 25°C</td>
<td>–</td>
<td>1.73</td>
<td>–</td>
<td></td>
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<tr>
<td></td>
<td>TVJ = 150°C</td>
<td>–</td>
<td>1.69</td>
<td>–</td>
<td></td>
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<tr>
<td></td>
<td>TVJ = 175°C</td>
<td>–</td>
<td>1.68</td>
<td>–</td>
<td></td>
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<tr>
<td><strong>E_rr</strong> Reverse Recovery Energy</td>
<td>I_F = 600 A, V_R = 400 V, V_GE = –8 V, R_g.on = 4.7 Ω, –di/dt = 3.12 A/ns (175°C)</td>
<td>–</td>
<td>3.58</td>
<td>–</td>
<td>mJ</td>
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<td>TVJ = 25°C</td>
<td>–</td>
<td>11.71</td>
<td>–</td>
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<tr>
<td></td>
<td>TVJ = 150°C</td>
<td>–</td>
<td>12.33</td>
<td>–</td>
<td></td>
</tr>
<tr>
<td><strong>Q RR</strong> Recovered Charge</td>
<td>I_F = 600 A, V_R = 400 V, V_GE = –8 V, R_g.on = 4.7 Ω, –di/dt = 3.12 A/ns (175°C)</td>
<td>–</td>
<td>16.36</td>
<td>–</td>
<td>μC</td>
</tr>
<tr>
<td></td>
<td>TVJ = 25°C</td>
<td>–</td>
<td>47.65</td>
<td>–</td>
<td></td>
</tr>
<tr>
<td></td>
<td>TVJ = 150°C</td>
<td>–</td>
<td>49.78</td>
<td>–</td>
<td></td>
</tr>
<tr>
<td><strong>Irr</strong> Peak Reverse Recovery Current</td>
<td>I_F = 600 A, V_R = 400 V, V_GE = –8 V, R_g.on = 4.7 Ω, –di/dt = 3.12 A/ns (175°C)</td>
<td>–</td>
<td>220</td>
<td>–</td>
<td>A</td>
</tr>
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<td></td>
<td>TVJ = 25°C</td>
<td>–</td>
<td>350</td>
<td>–</td>
<td></td>
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<tr>
<td></td>
<td>TVJ = 175°C</td>
<td>–</td>
<td>360</td>
<td>–</td>
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### SENSOR CHARACTERISTICS (TVJ = 25°C, Unless Otherwise Specified)

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<th>Conditions</th>
<th>Min</th>
<th>Typ</th>
<th>Max</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>T_sense</strong> Temperature Sense</td>
<td>I_F = 1 mA, TVJ = –40°C, TVJ = 25°C (Note 3)</td>
<td>–</td>
<td>2.96</td>
<td>–</td>
<td>V</td>
</tr>
<tr>
<td></td>
<td>TVJ = 150°C</td>
<td>–</td>
<td>2.54</td>
<td>–</td>
<td></td>
</tr>
<tr>
<td></td>
<td>TVJ = 175°C</td>
<td>–</td>
<td>2.60</td>
<td>–</td>
<td></td>
</tr>
<tr>
<td><strong>I_sense</strong> Current Sense</td>
<td>R_shunt = 5 Ω</td>
<td>I_C = 1600 A</td>
<td>–</td>
<td>379</td>
<td>mV</td>
</tr>
<tr>
<td></td>
<td>I_C = 800 A</td>
<td>–</td>
<td>200</td>
<td>–</td>
<td></td>
</tr>
<tr>
<td></td>
<td>I_C = 100 A</td>
<td>–</td>
<td>43.0</td>
<td>–</td>
<td></td>
</tr>
<tr>
<td></td>
<td>R_shunt = 20 Ω</td>
<td>I_C = 1600 A</td>
<td>–</td>
<td>644</td>
<td>–</td>
</tr>
<tr>
<td></td>
<td>I_C = 800 A</td>
<td>–</td>
<td>351</td>
<td>–</td>
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</tr>
<tr>
<td></td>
<td>I_C = 100 A</td>
<td>–</td>
<td>94.0</td>
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</tr>
</tbody>
</table>

3. Measured at chip level
VE–Trac™ Dual NVG800A75L4DSB

**Figure 1. IGBT Output Characteristic**

$V_{GE} = +15V$

![IGBT Output Characteristic Graph](image1)

**Figure 2. IGBT Transfer Characteristic**

$V_{CE} = 20V$

![IGBT Transfer Characteristic Graph](image2)

**Figure 3. IGBT Output Characteristic**

$T_J = +25^\circ C$

![IGBT Output Characteristic Graph](image3)

**Figure 4. IGBT Output Characteristic**

$T_J = +175^\circ C$

![IGBT Output Characteristic Graph](image4)
Gate Charge Characteristic

$V_{ce} = 400V$, $I_c=600A$, $T_{j}=25^\circ C$

\[ V_{GE} \text{ [V]} \]
\[ Q_G \text{ [nC]} \]

Figure 5. Gate Charge Characteristic

Capacitance Characteristic

$V_{GE} = 0V$, $T_{j}=25^\circ C$, $f=1MHz$

\[ C \text{ [nF]} \]
\[ V_{CE} \text{ [V]} \]

Figure 6. Capacitance Characteristic

$E_{ON}$ vs $I_c$

$V_{GE}=+15/-8V$, $R_{on}=4.7\Omega$, $R_{off}=15\Omega$, $V_{ce}=400V$

\[ E \text{ [mJ]} \]
\[ I_c \text{ [A]} \]

Figure 7. $E_{ON}$ vs. $I_c$

$E_{ON}$ vs $R_g$

$V_{GE}=+15/-8V$, $I_c=600A$, $V_{ce}=400V$

\[ E \text{ [mJ]} \]
\[ R_g \text{ [\Omega]} \]

Figure 8. $E_{ON}$ vs. $R_g$
Figure 9. E_{OFF} vs. I_{c}

\[ V_{GE} = +15/-8V, R_{Gon} = 4.7\Omega, R_{Goff} = 15\Omega, V_{CE} = 400V \]

Figure 10. E_{OFF} vs. R_{g}

\[ V_{GE} = +15/-8V, I_{c} = 600A, V_{CE} = 400V \]

Figure 11. IGBT Switching Times vs I_{c}, T_{vj} = 25\degree C

\[ V_{GE} = +15/-8V, R_{Gon} = 4.7\Omega, R_{Goff} = 15\Omega, V_{CE} = 400V \]

Figure 12. IGBT Switching Times vs I_{c}, T_{vj} = 175\degree C

\[ V_{GE} = +15/-8V, R_{Gon} = 4.7\Omega, R_{Goff} = 15\Omega, V_{CE} = 400V \]
VE-Trac™ Dual NVG800A75L4DSB

Reverse Bias Safe Operating Area
\[ V_{CE} = \pm 15/-30V, R_{DSS} = 15\Omega, \; T_{j} = 175^\circ C \]

![Figure 13. Reverse Bias Safe Operating Area](image)

IGBT Transient Thermal Impedance (typ)
10L/min, Tf=65°C, 50/50 EGW, Ref. Heatsink

![Figure 14. IGBT Transient Thermal Impedance](image)

Diode Forward Characteristic

![Figure 15. Diode Forward Characteristic](image)

Diode Switching losses vs \( I_F \)
\[ R_{DSS} = 4.7\Omega, V_{CE} = 400V \]

![Figure 16. Diode Switching Losses vs. \( I_F \)](image)
Diode Switching losses vs Rg

\[ I_c = 600A, V_{ce} = 400V \]

**Figure 17. Diode Switching Losses vs. Rg**

Diode Transient Thermal Impedance (typ)

10L/min, TF=65°C, 50/50 EGW, Ref. Heatsink

**Figure 18. Diode Transient Thermal Impedance**

Temperature Sensor Characteristic

\[ I_{bias} = 1mA \]

**Figure 19. Temperature Sensor Characteristic**

Current Sensor Characteristic

\[ R_{shure} = 5 \Omega \]

**Figure 20. Current Sensor Characteristic**
VE–Trac™ Dual NVG800A75L4DSB

**Current Sensor Characteristic**

\[ y = 0.367x + 57.267 \]

**Maximum allowed Vce**

\[ V_{CCE} = 1\text{mA}, T_{j} \leq 25^\circ\text{C}; V_{CE} = 30\text{mA}, T_{j} > 25^\circ\text{C} \]

**Figure 21. Current Sensor Characteristic**

**Figure 22. Maximum Allowed V_{CE}**

<table>
<thead>
<tr>
<th>ORDERING INFORMATION</th>
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<tbody>
<tr>
<td>Part Number</td>
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<tr>
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</tr>
</tbody>
</table>

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MECHANICAL CASE OUTLINE
PACKAGE DIMENSIONS

AHPM15–CEC
CASE 100DV
ISSUE A

DATE 03 OCT 2022

NOTES:
2. CONTROLLING DIMENSION MILLIMETERS
3. DIMENSIONS D & E DO NOT INCLUDE MOLD PROTRUSIONS
4. DIMENSIONS A, B, C DO NOT INCLUDE MOLD GAP

NOTES:

GENERAL MARKING DIAGRAM*

ZZZ = Assembly Lot Code
AT = Assembly & Test Site Code
YWW = Year and Work Week Code
XXXXX = Specific Device Code
NNNNN = Serial Number

*This information is generic. Please refer to device data sheet for actual part marking. Pb−Free indicator, "G" or microdot "C0071", may or may not be present. Some products may not follow the Generic Marking.

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