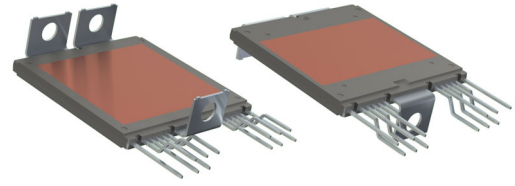


# Automotive 750 V, 800 A Dual Side Cooling Half-Bridge Power Module

## VE-Trac™ Dual Gen II NVG800A75L4DSC2



AHPM15-CEA  
 CASE MODHS

### Product Description

The NVG800A75L4DSC2 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.

Liquid cooling heatsink reference design, loss models and CAD models are available to support customers in inverter designs.

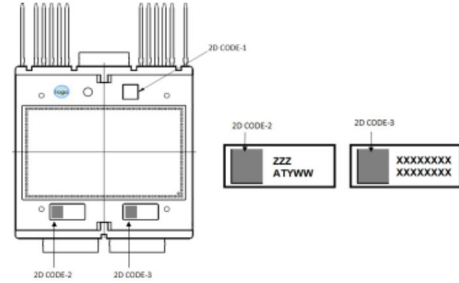
### Features

- Dual-Side Cooling
- Integrated Chip Level Temperature and Current Sensor
- $T_{vj\ max} = 175^{\circ}C$  for Continuous Operation
- Low-stray Inductance
- Low Conduction and Switching Losses
- Automotive Grade
- 4.2 kV Isolated DBC Substrate
- AEC Qualified and PPAP Capable
- This Device is Pb-Free and is RoHS Compliant

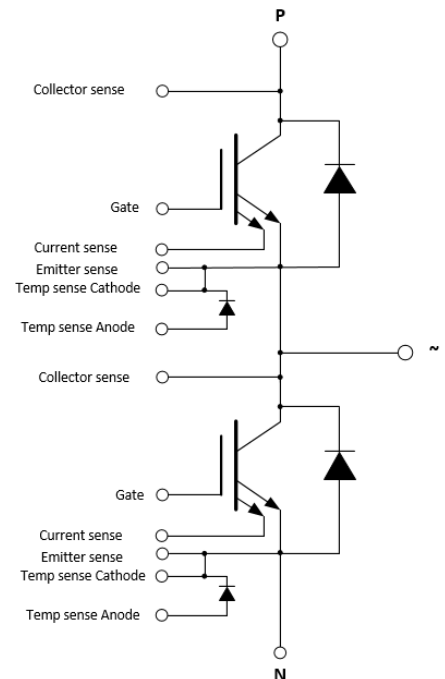
### Typical Applications

- Hybrid and Electric Vehicle Traction Inverter
- High Power DC-DC Converter

### MARKING DIAGRAM



ZZZ = Assembly Lot Code  
 AT = Assembly & Test Location  
 Y = Year  
 WW = Work Week  
 XXXX = Specific Device Code



### ORDERING INFORMATION

See detailed ordering and shipping information on page 5 of this data sheet.

# VE-Trac™ Dual Gen II NVG800A75L4DSC2

## PIN DESCRIPTION

| Pin # | Pin                      | Pin Function Description           | Pin Arrangement |
|-------|--------------------------|------------------------------------|-----------------|
| 1     | N                        | Low Side Emitter                   |                 |
| 2     | P                        | High Side Collector                |                 |
| 3     | H/S COLLECTOR SENSE      | High Side Collector Sense          |                 |
| 4     | H/S CURRENT SENSE        | High Side Current Sense            |                 |
| 5     | H/S EMITTER SENSE        | High Side Emitter Sense            |                 |
| 6     | H/S GATE                 | High Side Gate                     |                 |
| 7     | H/S TEMP SENSE (CATHODE) | High Side Temp sense Diode Cathode |                 |
| 8     | H/S TEMP SENSE (ANODE)   | High Side Temp sense Diode Anode   |                 |
| 9     | ~                        | Phase Output                       |                 |
| 10    | L/S CURRENT SENSE        | Low Side Current Sense             |                 |
| 11    | L/S EMITTER SENSE        | Low Side Emitter Sense             |                 |
| 12    | L/S GATE                 | Low Side Gate                      |                 |
| 13    | L/S TEMP SENSE (CATHODE) | Low Side Temp sense Diode Cathode  |                 |
| 14    | L/S TEMP SENSE (ANODE)   | Low Side Temp sense Diode Anode    |                 |
| 15    | L/S COLLECTOR SENSE      | Low Side Collector Sense           |                 |

## Materials

DBC Substrate: Al<sub>2</sub>O<sub>3</sub> 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

| Symbol               | Parameter                                       | Rating     | Unit       |            |    |
|----------------------|---|------------|------------|------------|----|
| T <sub>vj</sub>      | Continuous Operating Junction Temperature Range | -40 to 175 | °C         |            |    |
| T <sub>STG</sub>     | Storage Temperature range                       | -40 to 125 | °C         |            |    |
| V <sub>ISO</sub>     | Isolation Voltage, AC, f = 50 Hz, t = 1 s       | 4200       | V          |            |    |
| Creepage             | Minimum: Terminal to Terminal                   | 5.0        | mm         |            |    |
| Clearance            | Minimum: (Note 1) Terminal to Terminal          | 3.2        | mm         |            |    |
| CTI                  | Comparative Tracking Index                      | >600       |            |            |    |
|                      |   | <b>Min</b> | <b>Typ</b> | <b>Max</b> |    |
| L <sub>sCE</sub>     | Stray Inductance                                |            | 8          |            | nH |
| R <sub>CC'+EE'</sub> | Module Lead Resistance, Terminals - Chip        |            | 0.15       |            | mΩ |
| G                    | Module Weight                                   |            | 75         |            | g  |
| M                    | M4 Screws for Module Terminals                  |            |            | 2.2        | Nm |

1. Verified by design / not by test.

# VE-Trac™ Dual Gen II NVG800A75L4DSC2

## ABSOLUTE MAXIMUM RATINGS (T<sub>VJ</sub> = 25°C, Unless Otherwise Specified)

| Symbol             | Parameter   | Rating             | Unit |
|--------------------|---|--------------------|------|
| <b>IGBT</b>        |   |                    |      |
| V <sub>CES</sub>   | Collector to Emitter Voltage  | 750                | V    |
| V <sub>GES</sub>   | Gate to Emitter Voltage   | ±20                | V    |
| I <sub>CN</sub>    | Implemented Collector Current   | 800                | A    |
| I <sub>C nom</sub> | Continuous DC Collector Current, T <sub>VJmax</sub> = 175°C, T <sub>F</sub> = 65°C, ref. heatsink | 550 <sup>(1)</sup> | A    |
| I <sub>CRM</sub>   | Pulsed Collector Current @ V <sub>GE</sub> = 15 V, t <sub>p</sub> = 1 ms                          | 1600               | A    |

## DIODE

|                        |  |                    |                  |
|------------------------|--|--------------------|------------------|
| V <sub>RRM</sub>       | Repetitive peak reverse voltage  | 750                | V                |
| I <sub>FN</sub>        | Implemented Forward Current  | 800                | A                |
| I <sub>F</sub>         | Continuous Forward Current, T <sub>VJmax</sub> = 175°C, T <sub>F</sub> = 65°C, ref. heatsink                               | 420 <sup>(1)</sup> | A                |
| I <sub>FRM</sub>       | Repetitive Peak Forward Current, t <sub>p</sub> = 1 ms   | 1600               | A                |
| I <sup>2</sup> t value | Surge current capability, V <sub>R</sub> = 0 V, t <sub>p</sub> = 10 ms, T <sub>VJ</sub> = 150°C<br>T <sub>VJ</sub> = 175°C | 20000<br>18000     | A <sup>2</sup> s |

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.

2. Verified by characterization, not by test.

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

| Symbol                    | Parameter   | Min | Typ   | Max  | Unit |
|---------------------------|---|-----|-------|------|------|
| IGBT.R <sub>th,J-C</sub>  | Effective Rth, Junction to Case <sup>(3)</sup>  |     | 0.05  | 0.07 | °C/W |
| IGBT.R <sub>th,J-F</sub>  | Effective Rth, Junction to Fluid, λ <sub>TIM</sub> = 6 W/m-K, F = 660 N<br>10 L/min, 65°C, 50/50 EGW, Ref. Heatsink |     | 0.128 |      | °C/W |
| Diode.R <sub>th,J-C</sub> | Effective Rth, Junction to Case <sup>(3)</sup>  |     | 0.07  | 0.09 | °C/W |
| Diode.R <sub>th,J-F</sub> | Effective Rth, Junction to Fluid, λ <sub>TIM</sub> = 6 W/m-K, F = 660 N<br>10 L/min, 65°C, 50/50 EGW, Ref. Heatsink |     | 0.186 |      | °C/W |

3. For the measurement point of case temperature (T<sub>c</sub>), DBC discoloration, picker circle print is allowed, please refer to the VE-Trac Dual assembly guide for additional details about acceptable DBC surface finish.

## VE-Trac™ Dual Gen II NVG800A75L4DSC2

### CHARACTERISTICS OF IGBT (T<sub>vj</sub> = 25°C, Unless Otherwise Specified)

| Parameters         |  | Conditions   | Min    | Typ  | Max    | Unit     |
|--------------------|--|--|--------|--|--------|----------|
| V <sub>CESAT</sub> | Collector to Emitter Saturation Voltage (Terminal)             | V <sub>GE</sub> = 15 V, I <sub>C</sub> = 600 A, T <sub>vj</sub> = 25°C<br>T <sub>vj</sub> = 150°C<br>T <sub>vj</sub> = 175°C<br><br>V <sub>GE</sub> = 15 V, I <sub>C</sub> = 800 A, T <sub>vj</sub> = 25°C<br>T <sub>vj</sub> = 150°C<br>T <sub>vj</sub> = 175°C   | –      | 1.30<br>1.42<br>1.44<br><br>1.43<br>1.63<br>1.66 | 1.69   | V        |
| I <sub>CES</sub>   | Collector to Emitter Leakage Current                           | V <sub>GE</sub> = 0, V <sub>CE</sub> = 750 V T <sub>vj</sub> = 25°C<br>T <sub>vj</sub> = 175°C   | –<br>– | –<br>8   | 1<br>– | mA<br>mA |
| I <sub>GES</sub>   | Gate – Emitter Leakage Current                                 | V <sub>CE</sub> = 0, V <sub>GE</sub> = ± 20 V  | –      | –  | ±400   | nA       |
| V <sub>th</sub>    | Threshold Voltage  | V <sub>CE</sub> = V <sub>GE</sub> , I <sub>C</sub> = 500 mA  | 4.5    | 5.5  | 6.5    | V        |
| Q <sub>G</sub>     | Total Gate Charge  | V <sub>GE</sub> = –8 to 15 V, V <sub>CE</sub> = 400 V  | –      | 1.7  | –      | μC       |
| R <sub>Gint</sub>  | Internal gate resistance                                       |  | –      | 2  | –      | Ω        |
| C <sub>ies</sub>   | Input Capacitance  | V <sub>CE</sub> = 30 V, V <sub>GE</sub> = 0 V, f = 100 KHz   | –      | 43   | –      | nF       |
| C <sub>oes</sub>   | Output Capacitance   | V <sub>CE</sub> = 30 V, V <sub>GE</sub> = 0 V, f = 100 KHz   | –      | 1.48   | –      | nF       |
| C <sub>res</sub>   | Reverse Transfer Capacitance                                   | V <sub>CE</sub> = 30 V, V <sub>GE</sub> = 0 V, f = 100 KHz   | –      | 0.19   | –      | nF       |
| T <sub>d,on</sub>  | Turn on delay, inductive load                                  | I <sub>C</sub> = 600 A, V <sub>CE</sub> = 400 V T <sub>vj</sub> = 25°C<br>V <sub>GE</sub> = +15/–8 V T <sub>vj</sub> = 150°C<br>R <sub>g,on</sub> = 4.7 Ω T <sub>vj</sub> = 175°C  | –      | 377<br>382<br>382                                | –      | ns       |
| T <sub>r</sub>     | Rise time, inductive load                                      | I <sub>C</sub> = 600 A, V <sub>CE</sub> = 400 V T <sub>vj</sub> = 25°C<br>V <sub>GE</sub> = +15/–8 V T <sub>vj</sub> = 150°C<br>R <sub>g,on</sub> = 4.7 Ω T <sub>vj</sub> = 175°C  | –      | 104<br>127<br>132                                | –      | ns       |
| T <sub>d,off</sub> | Turn off delay, inductive load                                 | I <sub>C</sub> = 600 A, V <sub>CE</sub> = 400 V T <sub>vj</sub> = 25°C<br>V <sub>GE</sub> = +15/–8 V T <sub>vj</sub> = 150°C<br>R <sub>g,off</sub> = 15 Ω T <sub>vj</sub> = 175°C  | –      | 917<br>1042<br>1075                              | –      | ns       |
| T <sub>f</sub>     | Fall time, inductive load                                      | I <sub>C</sub> = 600 A, V <sub>CE</sub> = 400 V T <sub>vj</sub> = 25°C<br>V <sub>GE</sub> = +15/–8 V T <sub>vj</sub> = 150°C<br>R <sub>g,off</sub> = 15 Ω T <sub>vj</sub> = 175°C  | –      | 129<br>199<br>212                                | –      | ns       |
| E <sub>ON</sub>    | Turn-On Switching Loss (including diode reverse recovery loss) | I <sub>C</sub> = 600 A, V <sub>CE</sub> = 400 V, V <sub>GE</sub> = +15/–8 V,<br>L <sub>s</sub> = 20 nH, R <sub>g,on</sub> = 4,7 Ω<br>di/dt (T <sub>vj</sub> = 25°C) = 4.77 A/ns<br>di/dt (T <sub>vj</sub> = 175°C) = 3.78 A/ns<br><br>T <sub>vj</sub> = 25°C<br>T <sub>vj</sub> = 150°C<br>T <sub>vj</sub> = 175°C | –      | <br><br><br>22.93<br>35.87<br>37.70              | –      | mJ       |
| E <sub>OFF</sub>   | Turn-Off Switching Loss  | I <sub>C</sub> = 600 A, V <sub>CE</sub> = 400 V, V <sub>GE</sub> = +15/–8 V,<br>L <sub>s</sub> = 20 nH, R <sub>g,off</sub> = 15 Ω<br>dv/dt (T <sub>vj</sub> = 25°C) = 2.79 V/ns<br>dv/dt (T <sub>vj</sub> = 175°C) = 2.05 V/ns<br><br>T <sub>vj</sub> = 25°C<br>T <sub>vj</sub> = 150°C<br>T <sub>vj</sub> = 175°C | –      | <br><br><br>33.57<br>47.30<br>49.09              | –      | mJ       |
| E <sub>SC</sub>    | Minimum Short Circuit Energy Withstand                         | V <sub>GE</sub> = 15 V, V <sub>CC</sub> = 400 V<br><br>T <sub>vj</sub> = 25°C<br>T <sub>vj</sub> = 175°C   | 5      | 5  |        | J        |

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.



# VE-Trac™ Dual Gen II NVG800A75L4DSC2

## TYPICAL CHARACTERISTICS

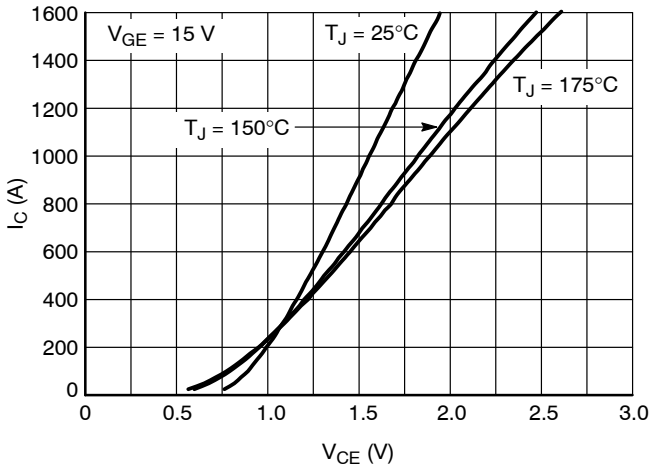


Figure 1. IGBT Output Characteristic

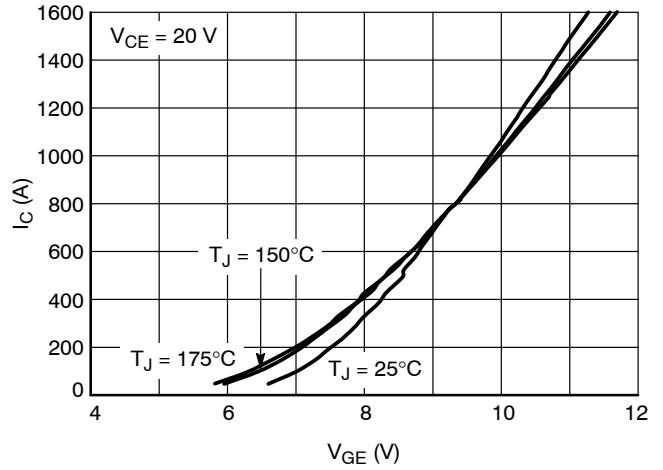


Figure 2. IGBT Transfer Characteristic

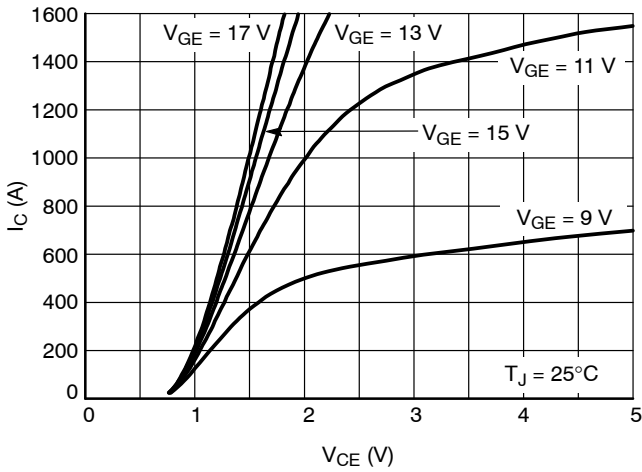


Figure 3. IGBT Output Characteristic, 25°C

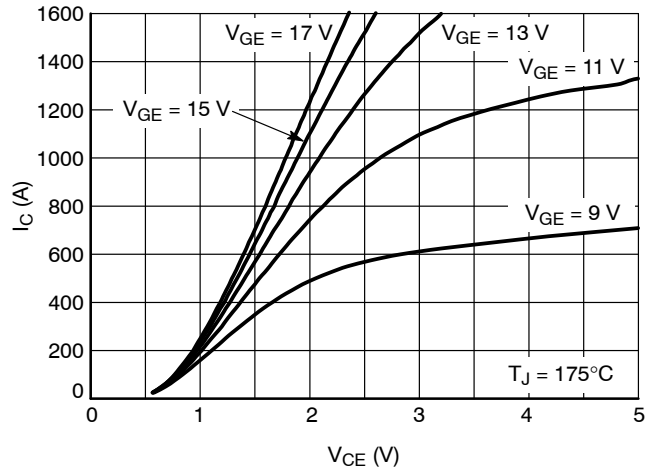


Figure 4. IGBT Output Characteristic, 175°C

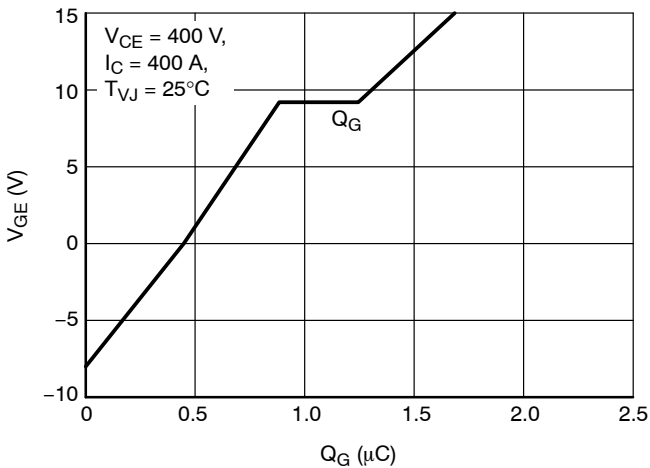


Figure 5. Gate Charge Characteristics

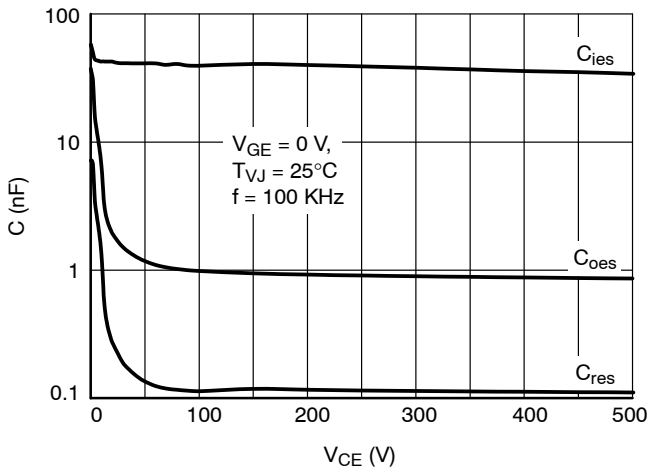


Figure 6. Capacitance Characteristics

# VE-Trac™ Dual Gen II NVG800A75L4DSC2

## TYPICAL CHARACTERISTICS

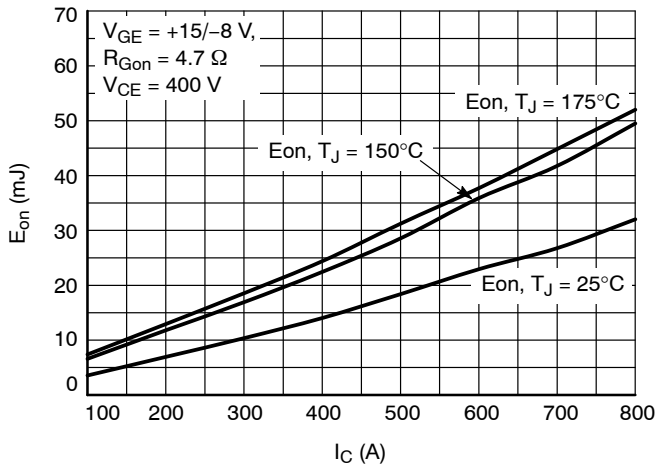


Figure 7.  $E_{on}$  vs.  $I_C$

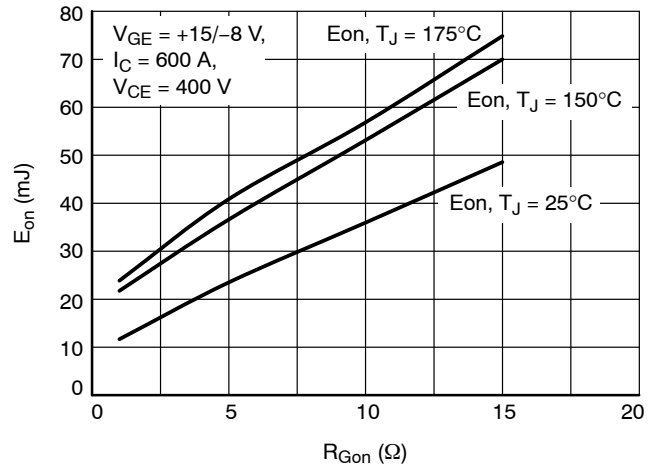


Figure 8.  $E_{on}$  vs.  $R_{Gon}$

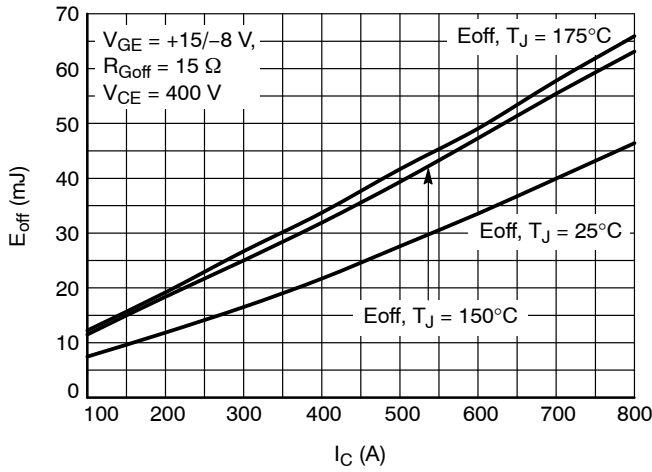


Figure 9.  $E_{off}$  vs.  $I_C$

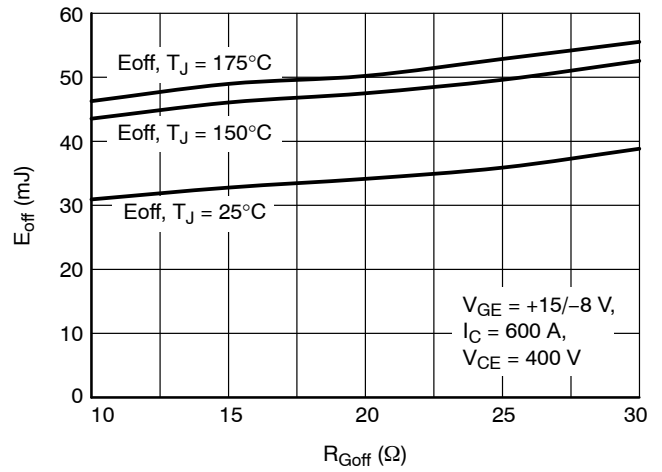


Figure 10.  $E_{off}$  vs.  $R_{Goff}$

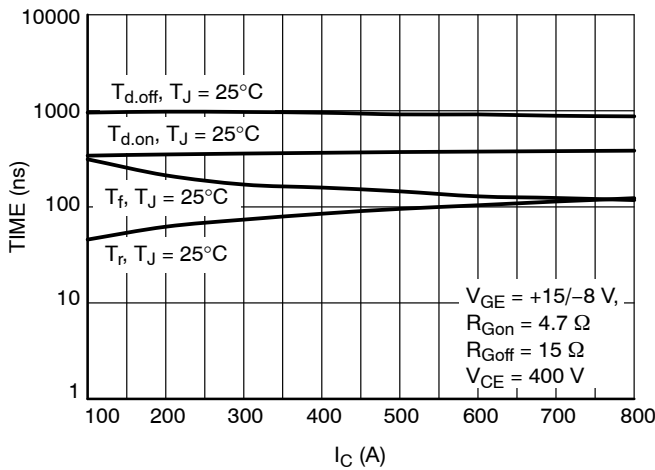


Figure 11. IGBT Switching Times vs.  $I_C$ ,  $T_{VJ} = 25^\circ\text{C}$

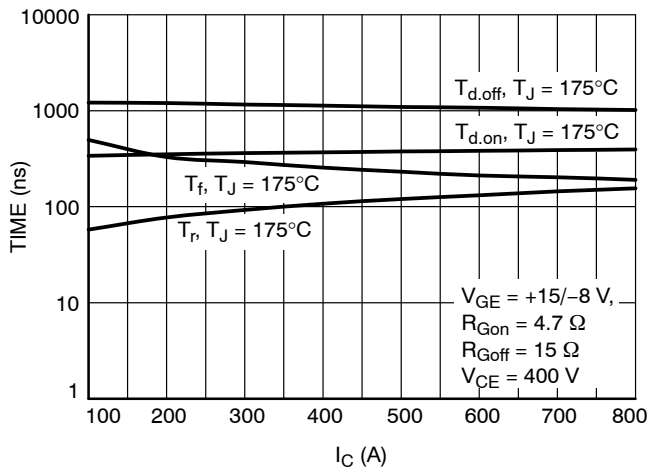


Figure 12. IGBT Switching Times vs.  $I_C$ ,  $T_{VJ} = 175^\circ\text{C}$

# VE-Trac™ Dual Gen II NVG800A75L4DSC2

## TYPICAL CHARACTERISTICS

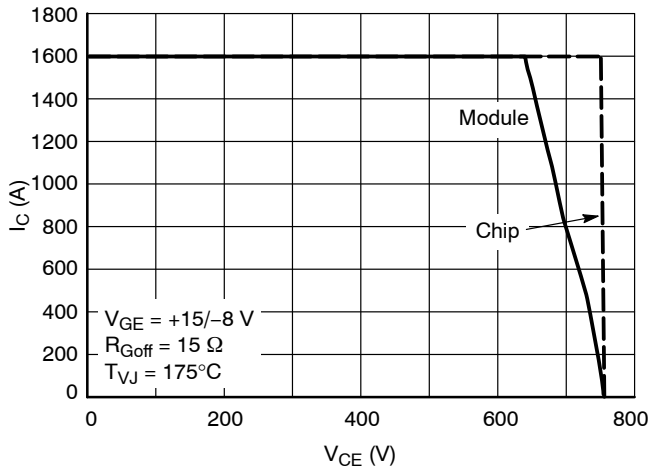


Figure 13. Reverse Bias Safe Operating Area

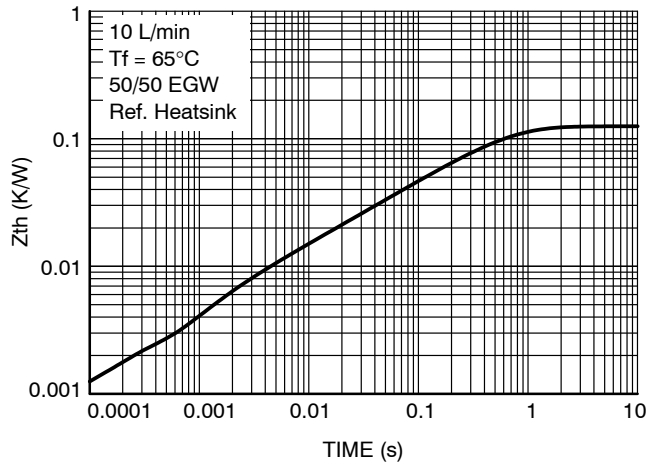


Figure 14. IGBT Transient Thermal Impedance

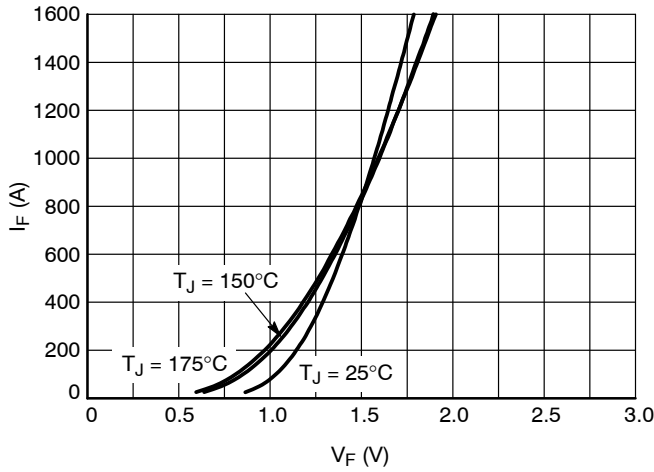


Figure 15. Diode Forward Characteristic

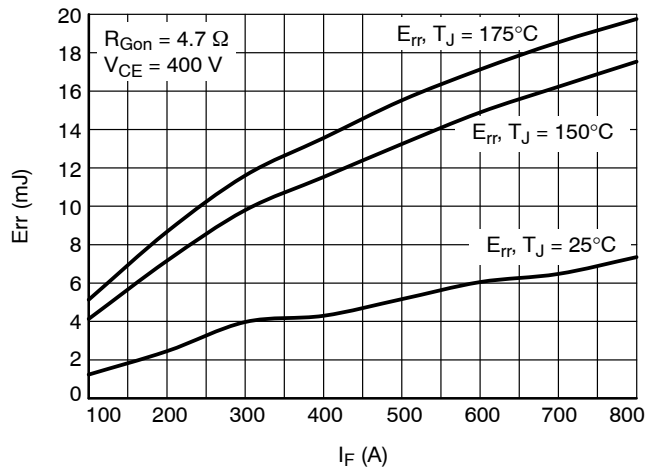


Figure 16. Diode Switching Losses vs.  $I_F$

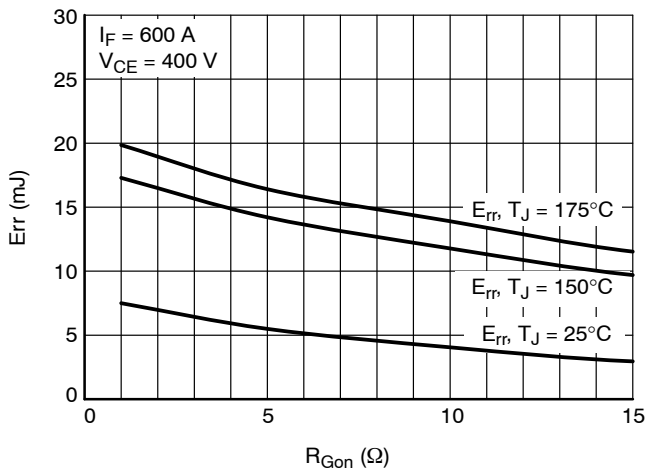


Figure 17. Diode Switching Losses vs.  $R_{Gon}$

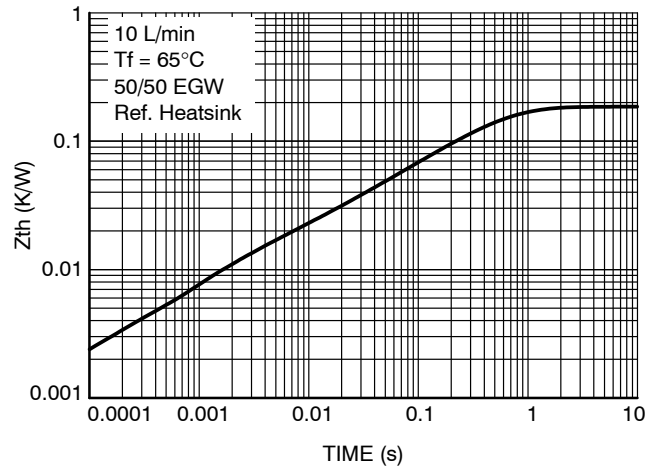


Figure 18. Diode Transient Thermal Impedance



# VE-Trac™ Dual Gen II NVG800A75L4DSC2

## TYPICAL CHARACTERISTICS

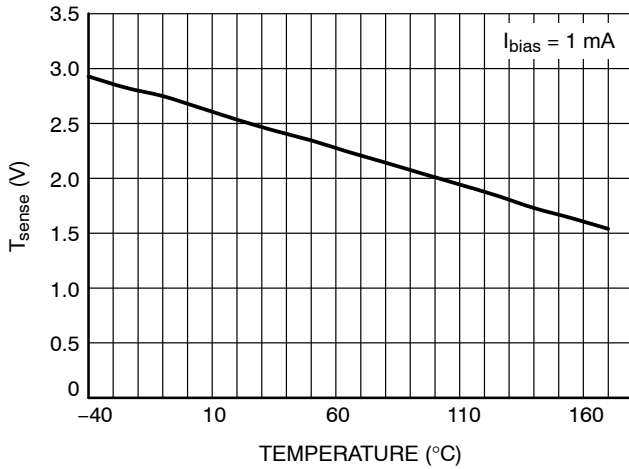


Figure 19. Temperature Sensor Characteristics

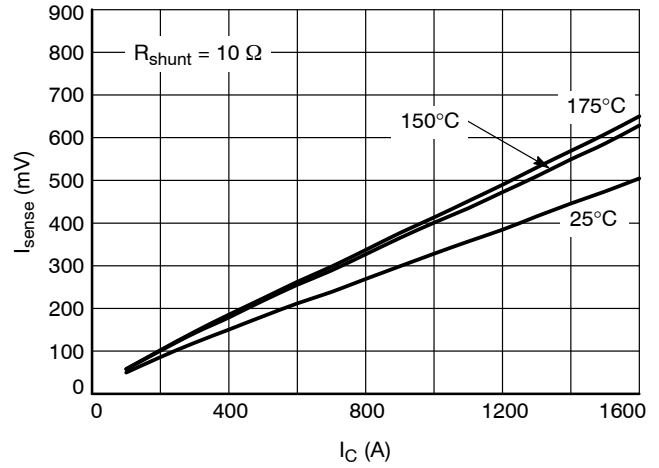


Figure 20. Current Sensor Characteristic

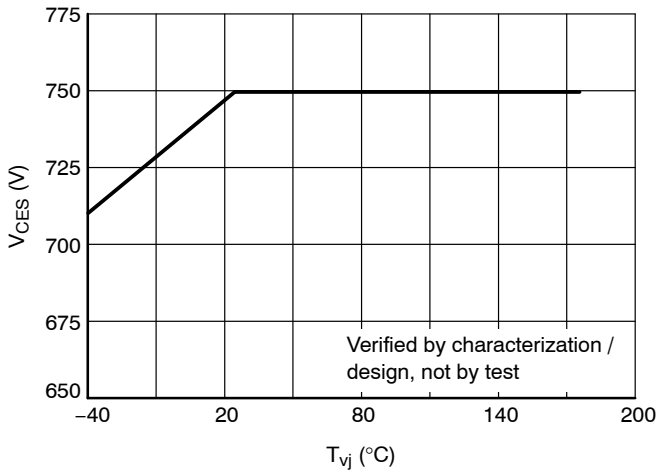


Figure 21. Maximum Allowed  $V_{CE}$

General Note: These are preliminary values measured from a small number of DV units. Values will be updated based on higher quantity of PV measurements.

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