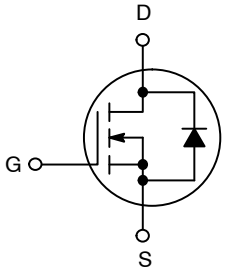
# MOSFET - Power, N-Channel, SUPERFET® III, FRFET®

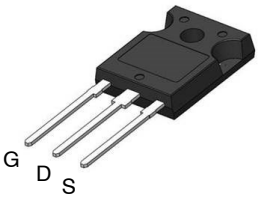
## 650 V, 110 mΩ, 30 A

## NVHL110N65S3HF

| $V_{DSS}$ | $R_{DS(on)}$ MAX | $I_D$ MAX |
|---|---|---|
| 650 V | 110 mΩ @ 10 V | 30 A |




**N−Channel MOSFET**




**TO−247 Long Leads**
**CASE 340CX**

### Description

SUPERFET III MOSFET is **onsemi**'s brand-new high voltage super-junction (SJ) MOSFET family that is utilizing charge balance technology for outstanding low on-resistance and lower gate charge performance. This advanced technology is tailored to minimize conduction loss, provide superior switching performance, and withstand extreme dv/dt rate.

Consequently, SUPERFET III MOSFET is very suitable for the various power system for miniaturization and higher efficiency.

SUPERFET III HF version provides fast recovery for improved efficiency in high speed switching applications.

### Features

- 700 V @ $T_J$ = 150°C
- Typ. $R_{DS(on)}$ = 89 mΩ
- Ultra Low Gate Charge (Typ. $Q_g$ = 58 nC)
- Low Effective Output Capacitance (Typ. $C_{oss(eff.)}$ = 510 pF)
- 100% Avalanche Tested
- NVHL Prefix for Automotive and Other Applications Requiring Unique Site and Control Change Requirements; AEC−Q101 Qualified and PPAP Capable
- These Devices are Pb−Free, Halogen Free/BFR Free and are RoHS Compliant

### Applications

- Automotive On Board Charger HEV−EV
- Automotive DC/DC Converter for HEV−EV

### MARKING DIAGRAM




| | |
|---|---|
| A | = Assembly Plant Code |
| YWW | = Data Code (Year & Week) |
| ZZ | = Assembly Lot Code |
| NVHL110N65S3HF | = Specific Device Code |

### ORDERING INFORMATION

See detailed ordering and shipping information on page 2 of this data sheet.

© Semiconductor Components Industries, LLC, 2020

**ABSOLUTE MAXIMUM RATINGS** ($T_C$ = 25°C, Unless otherwise specified)

| Symbol | Parameter | | Value | Unit |
|---|---|---|---|---|
| $V_{DSS}$ | Drain−to−Source Voltage | | 650 | V |
| $V_{GSS}$ | Gate−to−Source Voltage | DC | ±30 | V |
| | | AC (f > 1 Hz) | ±30 | V |
| $I_D$ | Drain Current | Continuous ($T_C$ = 25°C) | 30 | A |
| | | Continuous ($T_C$ = 100°C) | 19.5 | |
| $I_{DM}$ | Drain Current | Pulsed (Note 1) | 69 | A |
| $E_{AS}$ | Single Pulsed Avalanche Energy (Note 2) | | 380 | mJ |
| $E_{AR}$ | Repetitive Avalanche Energy (Note 1) | | 2.4 | mJ |
| dv/dt | MOSFET dv/dt | | 100 | V/ns |
| | Peak Diode Recovery dv/dt (Note 3) | | 50 | |
| $P_D$ | Power Dissipation | ($T_C$ = 25°C) | 240 | W |
| | | Derate Above 25°C | 1.92 | W/°C |
| $T_J$, $T_{STG}$ | Operating and Storage Temperature Range | | −55 to +150 | °C |
| $T_L$ | Maximum Lead Temperature for Soldering, 1/8″ from Case for 5 s | | 300 | °C |

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. Repetitive rating: pulse-width limited by maximum junction temperature.
2. $I_{AS}$ = 3.5 A, $R_G$ = 25 Ω, starting $T_J$ = 25°C.
3. $I_{SD} \le$ 15 A, di/dt ≤ 200 A/μs, $V_{DD} \le$ 400 V, starting $T_J$ = 25°C.

**THERMAL CHARACTERISTICS**

| Symbol | Parameter | Value | Unit |
|---|---|---|---|
| $R_{\theta JC}$ | Thermal Resistance, Junction−to−Case, Max. | 0.52 | °C/W |
| $R_{\theta JA}$ | Thermal Resistance, Junction−to−Ambient, Max. | 40 | |

**PACKAGE MARKING AND ORDERING INFORMATION**

| Part Number | Top Marking | Package | Packing Method | Reel Size | Tape Width | Quantity |
|---|---|---|---|---|---|---|
| NVHL110N65S3HF | NVHL110N65S3HF | TO−247 | Tube | N/A | N/A | 30 Units |

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

| Symbol | Parameter | Test Conditions | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|
| **OFF CHARACTERISTICS** | | | | | | |
| $BV_{DSS}$ | Drain−to−Source Breakdown Voltage | $V_{GS}$ = 0 V, $I_D$ = 1 mA, $T_J$ = 25°C | 650 | – | – | V |
| | | $V_{GS}$ = 0 V, $I_D$ = 10 mA, $T_J$ = 150°C | 700 | – | – | V |
| $\Delta BV_{DSS}/\Delta T_J$ | Breakdown Voltage Temperature Coefficient | $I_D$ = 20 mA, Referenced to 25°C | – | 0.61 | – | V/°C |
| $I_{DSS}$ | Zero Gate Voltage Drain Current | $V_{DS}$ = 650 V, $V_{GS}$ = 0 V | – | – | 10 | μA |
| | | $V_{DS}$ = 520 V, $T_C$ = 125°C | – | 9 | – | |
| $I_{GSS}$ | Gate−to−Body Leakage Current | $V_{GS}$ = ±30 V, $V_{DS}$ = 0 V | – | – | ±100 | nA |
| **ON CHARACTERISTICS** | | | | | | |
| $V_{GS(th)}$ | Gate Threshold Voltage | $V_{GS}$ = $V_{DS}$, $I_D$ = 0.74 mA | 3.0 | – | 5.0 | V |
| $R_{DS(on)}$ | Static Drain−to−Source On Resistance | $V_{GS}$ = 10 V, $I_D$ = 15 A | – | 89 | 110 | mΩ |
| $g_{FS}$ | Forward Transconductance | $V_{DS}$ = 20 V, $I_D$ = 15 A | – | 16 | – | S |
| **DYNAMIC CHARACTERISTICS** | | | | | | |
| $C_{iss}$ | Input Capacitance | $V_{DS}$ = 400 V, $V_{GS}$ = 0 V, f = 1 MHz | – | 2753 | – | pF |
| $C_{oss}$ | Output Capacitance | | – | 52 | – | pF |
| $C_{oss(eff.)}$ | Effective Output Capacitance | $V_{DS}$ = 0 V to 400 V, $V_{GS}$ = 0 V | – | 510 | – | pF |
| $C_{oss(er.)}$ | Energy Related Output Capacitance | $V_{DS}$ = 0 V to 400 V, $V_{GS}$ = 0 V | – | 94 | – | pF |
| $Q_{g(tot)}$ | Total Gate Charge at 10 V | $V_{DS}$ = 400 V, $I_D$ = 15 A, $V_{GS}$ = 10 V (Note 4) | – | 58 | – | nC |
| $Q_{gs}$ | Gate−to−Source Gate Charge | | – | 18 | – | nC |
| $Q_{gd}$ | Gate−to−Drain “Miller” Charge | | – | 23 | – | nC |
| ESR | Equivalent Series Resistance | f = 1 MHz | – | 1.6 | – | Ω |
| **SWITCHING CHARACTERISTICS** | | | | | | |
| $t_{d(on)}$ | Turn-On Delay Time | $V_{DD}$ = 400 V, $I_D$ = 15 A, $V_{GS}$ = 10 V, $R_g$ = 4.7 Ω (Note 4) | – | 27.1 | – | ns |
| $t_r$ | Turn-On Rise Time | | – | 16.9 | – | ns |
| $t_{d(off)}$ | Turn-Off Delay Time | | – | 66 | – | ns |
| $t_f$ | Turn-Off Fall Time | | – | 2.9 | – | ns |
| **SOURCE-DRAIN DIODE CHARACTERISTICS** | | | | | | |
| $I_S$ | Maximum Continuous Source−to−Drain Diode Forward Current | | – | – | 30 | A |
| $I_{SM}$ | Maximum Pulsed Source−to−Drain Diode Forward Current | | – | – | 69 | A |
| $V_{SD}$ | Source−to−Drain Diode Forward Voltage | $V_{GS}$ = 0 V, $I_{SD}$ = 15 A | – | – | 1.3 | V |
| $t_{rr}$ | Reverse Recovery Time | $V_{GS}$ = 0 V, $I_{SD}$ = 15 A, $dI_F/dt$ = 100 A/μs | – | 90 | – | ns |
| $Q_{rr}$ | Reverse Recovery Charge | | – | 128 | – | nC |

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.

4. Essentially independent of operating temperature typical characteristics.

## TYPICAL CHARACTERISTICS

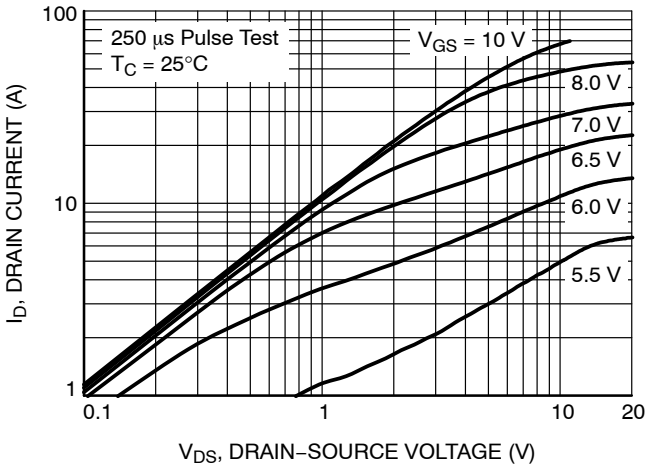



**Figure 1. On−Region Characteristics 25°C**

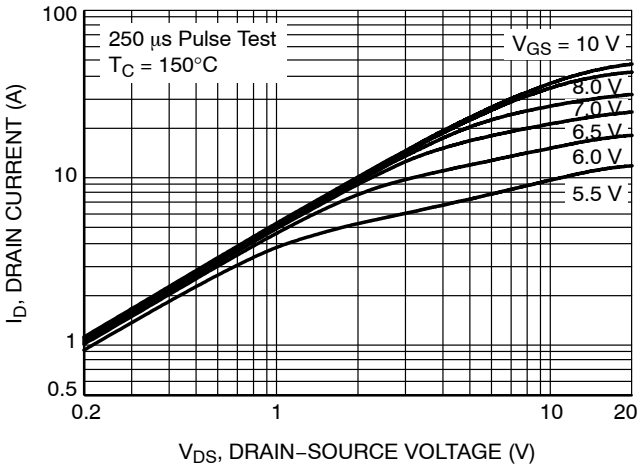



**Figure 2. On−Region Characteristics 150°C**

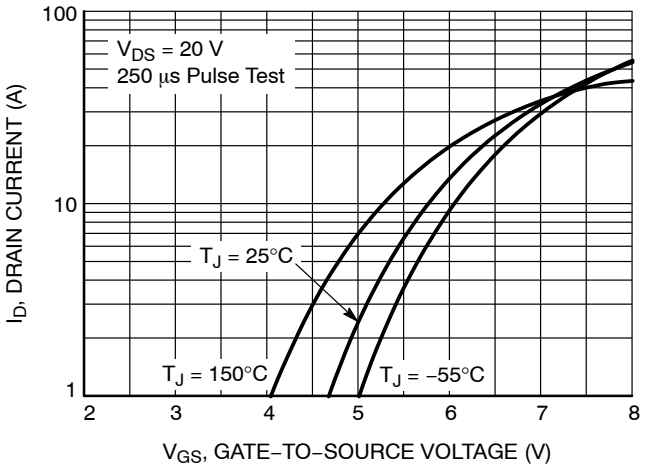



**Figure 3. Transfer Characteristics**

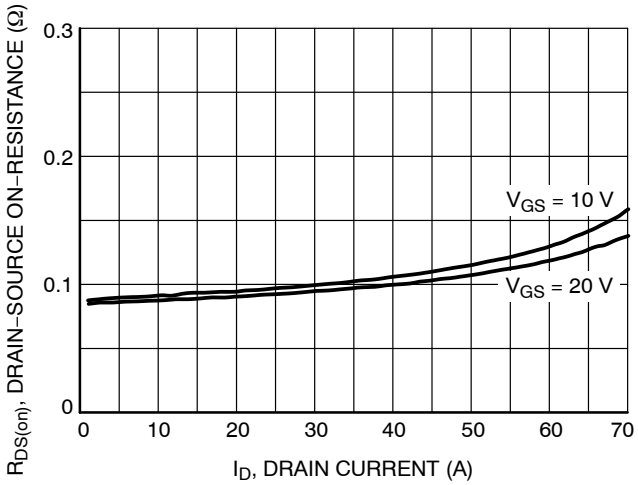



**Figure 4. On−Resistance Variation vs. Drain Current and Gate Voltage**

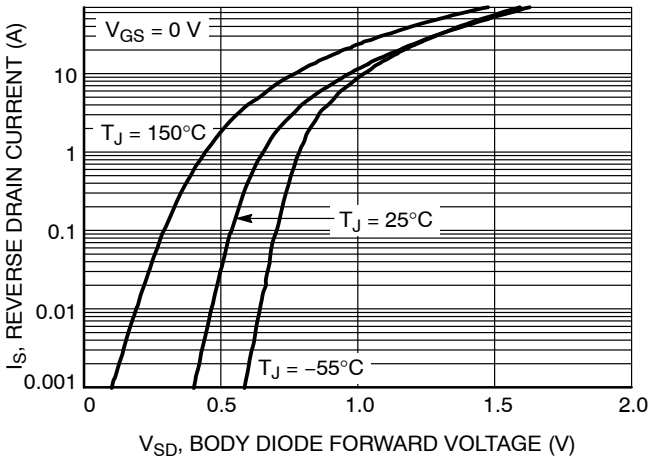



**Figure 5. Body Diode Forward Voltage Variation vs. Source Current and Temperature**

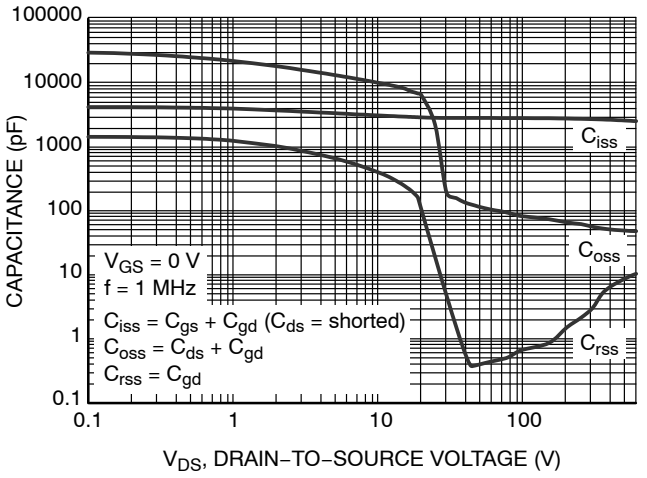



**Figure 6. Capacitance Characteristics**

## TYPICAL CHARACTERISTICS

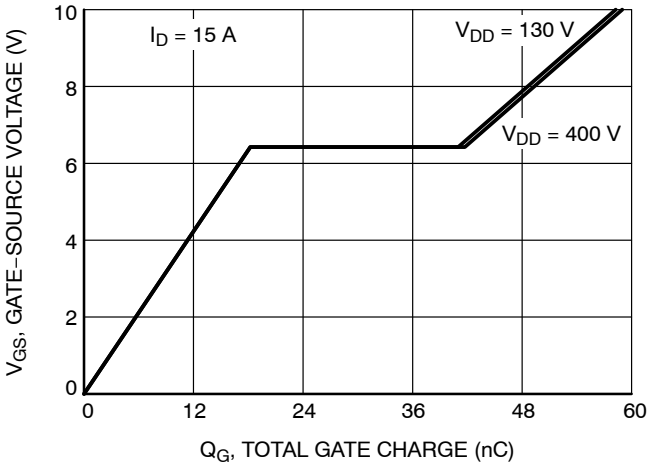



**Figure 7. Gate Charge Characteristics**

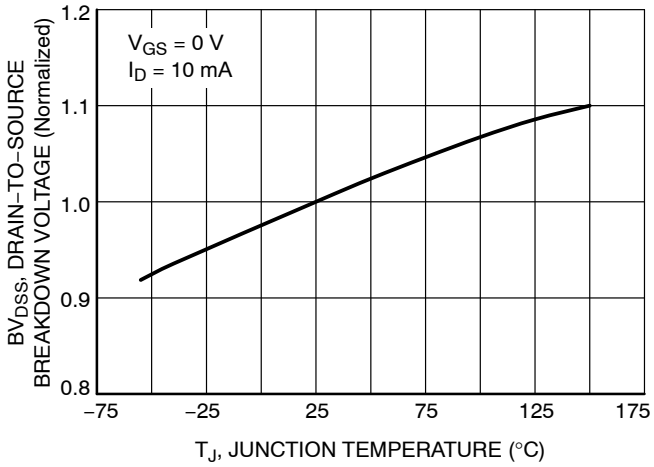



**Figure 8. Breakdown Voltage Variation vs. Temperature**

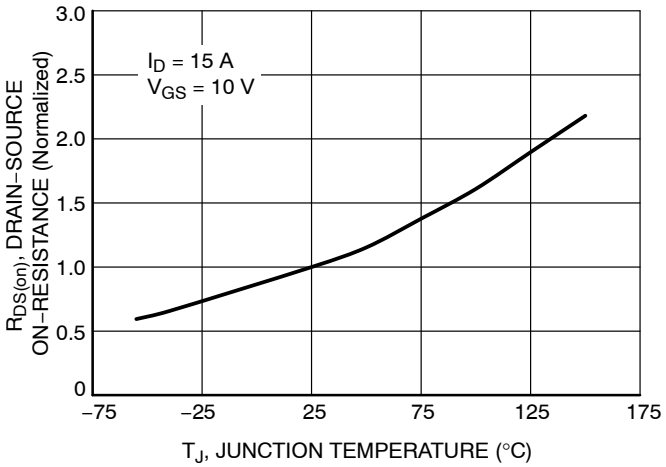



**Figure 9. On−Resistance Variation vs. Temperature**

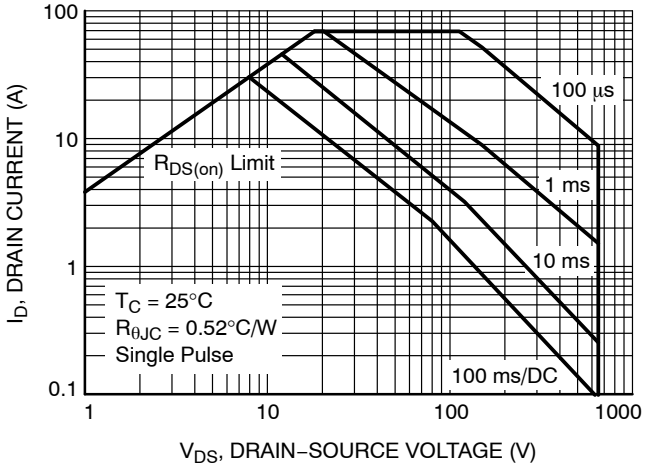



**Figure 10. Maximum Safe Operating Area**

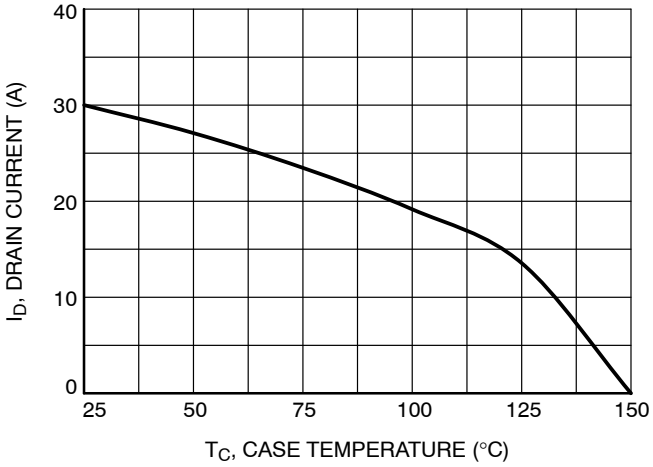



**Figure 11. Maximum Drain Current vs. Case Temperature**

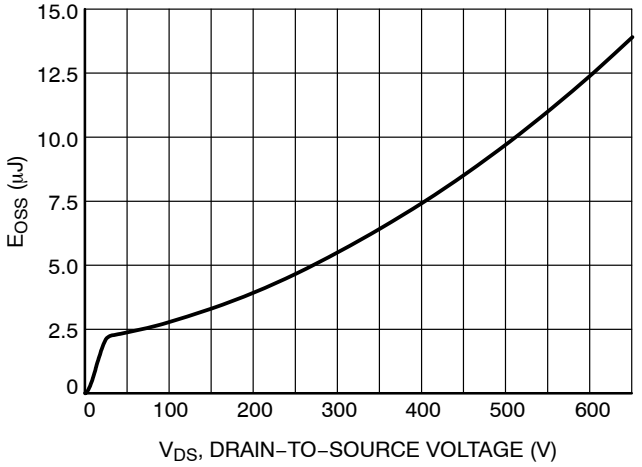



**Figure 12. $E_{OSS}$ vs. Drain−to−Source Voltage**

## TYPICAL CHARACTERISTICS

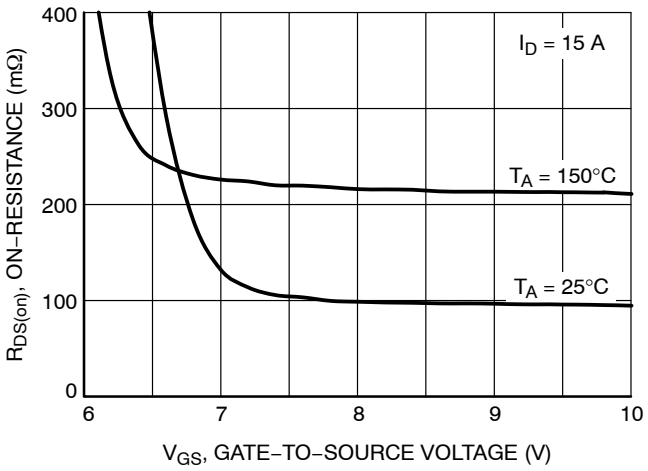



**Figure 13. $R_{DS(on)}$ vs. Gate Voltage**

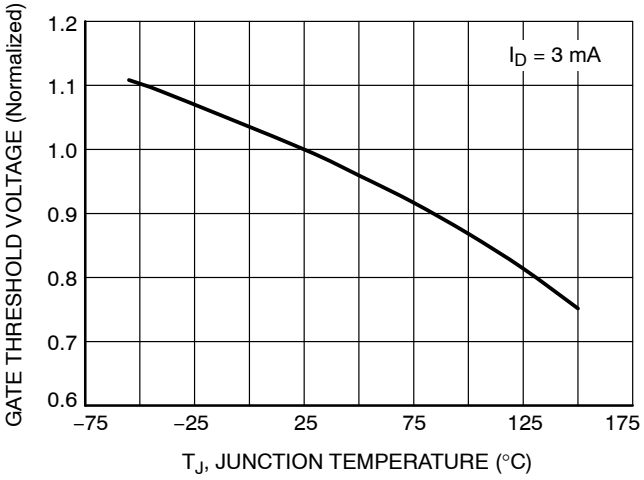
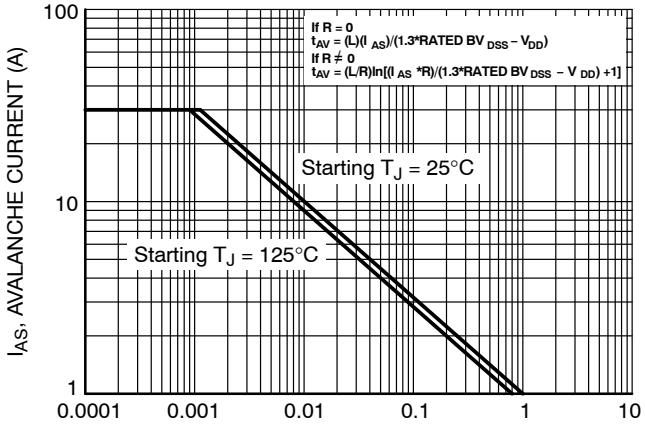



**Figure 14. Normalized Gate Threshold Voltage vs. Temperature**




NOTE: Refer to Application Notes AN7514 and AN7515

**Figure 15. Unclamped Inductive Switching Capability**

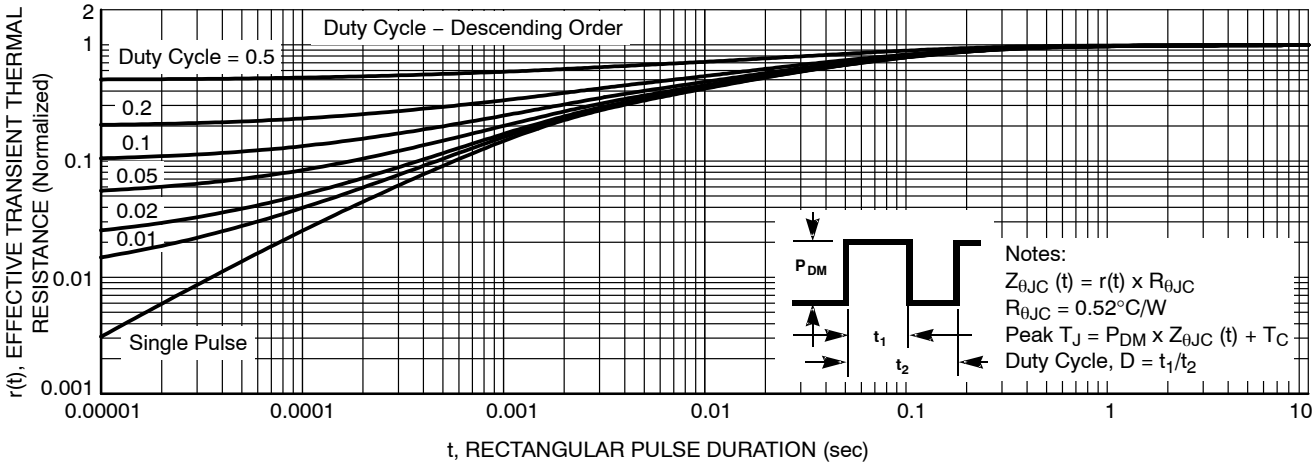



**Figure 16. Transient Thermal Response**

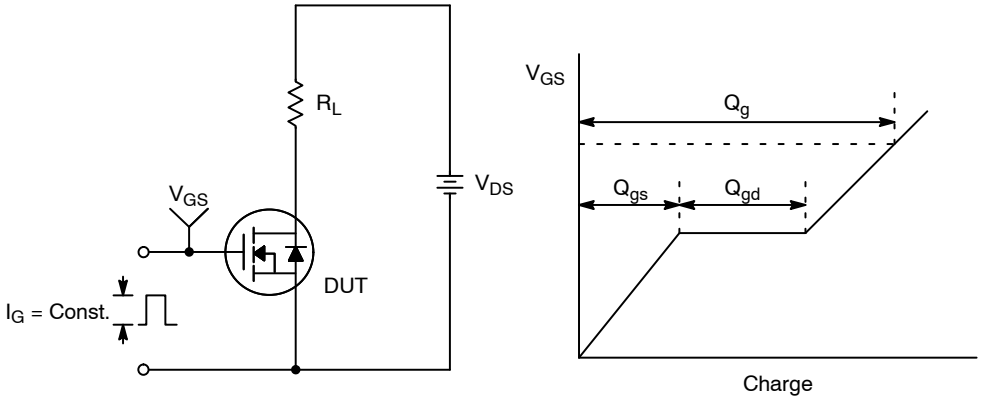



**Figure 17. Gate Charge Test Circuit & Waveform**

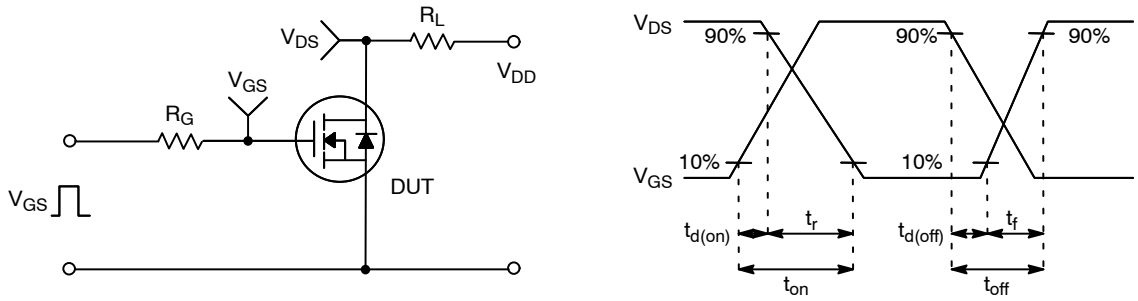



**Figure 18. Resistive Switching Test Circuit & Waveforms**

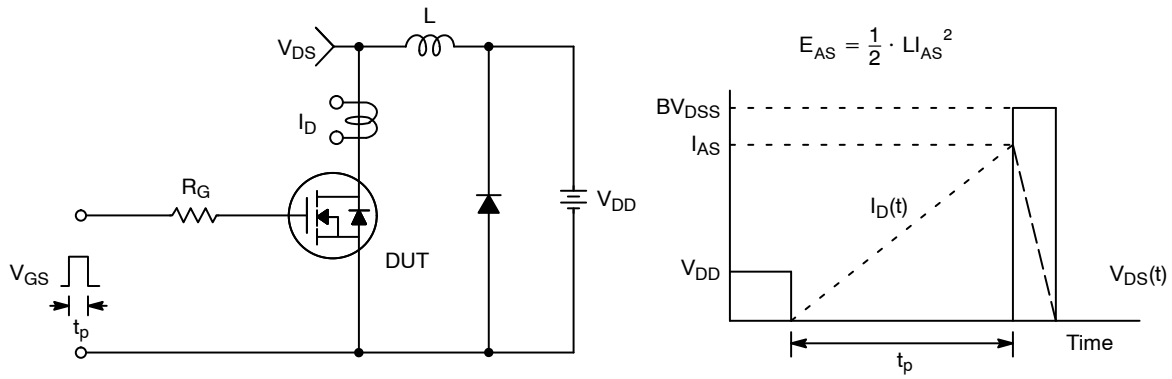



**Figure 19. Unclamped Inductive Switching Test Circuit & Waveforms**

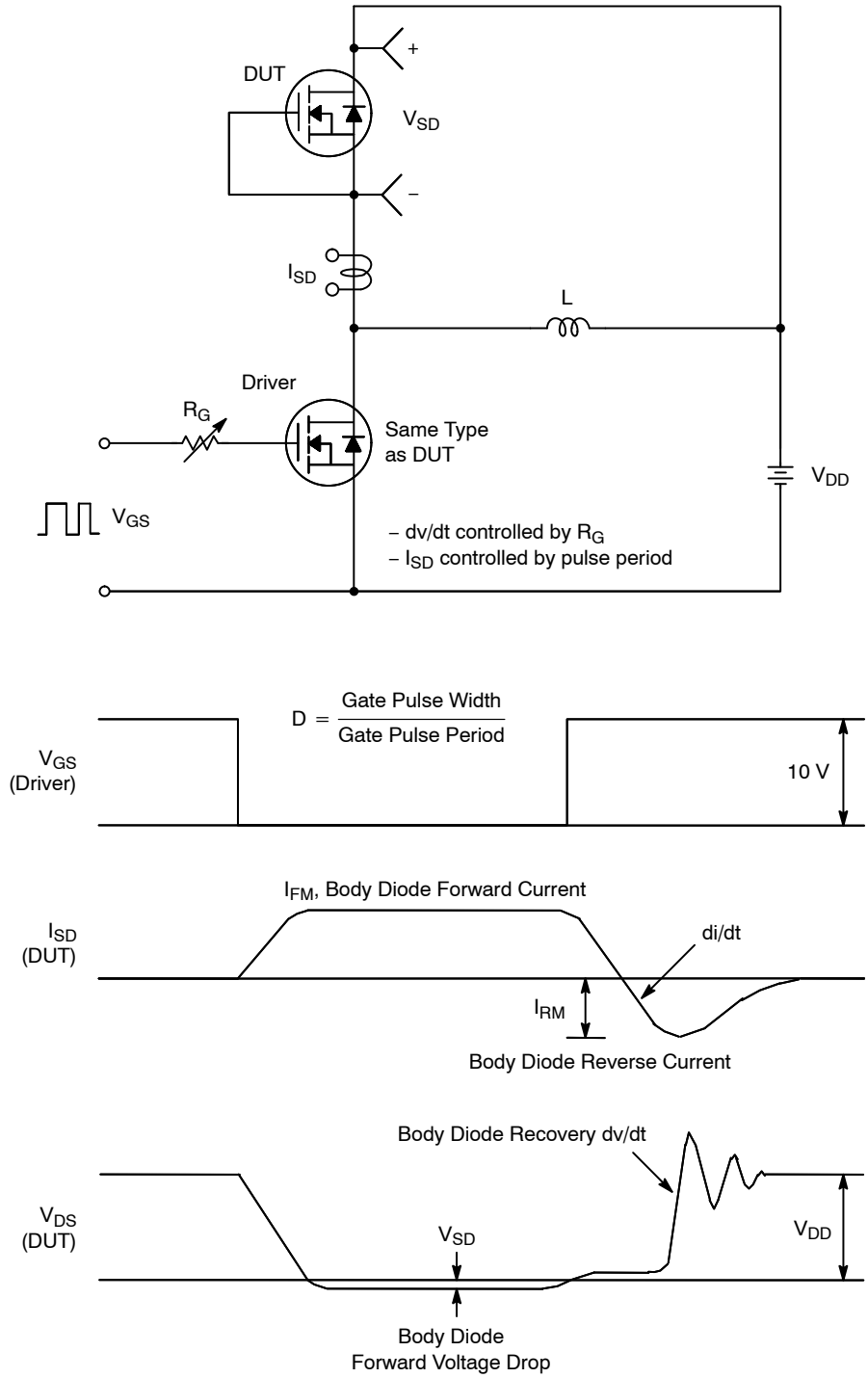
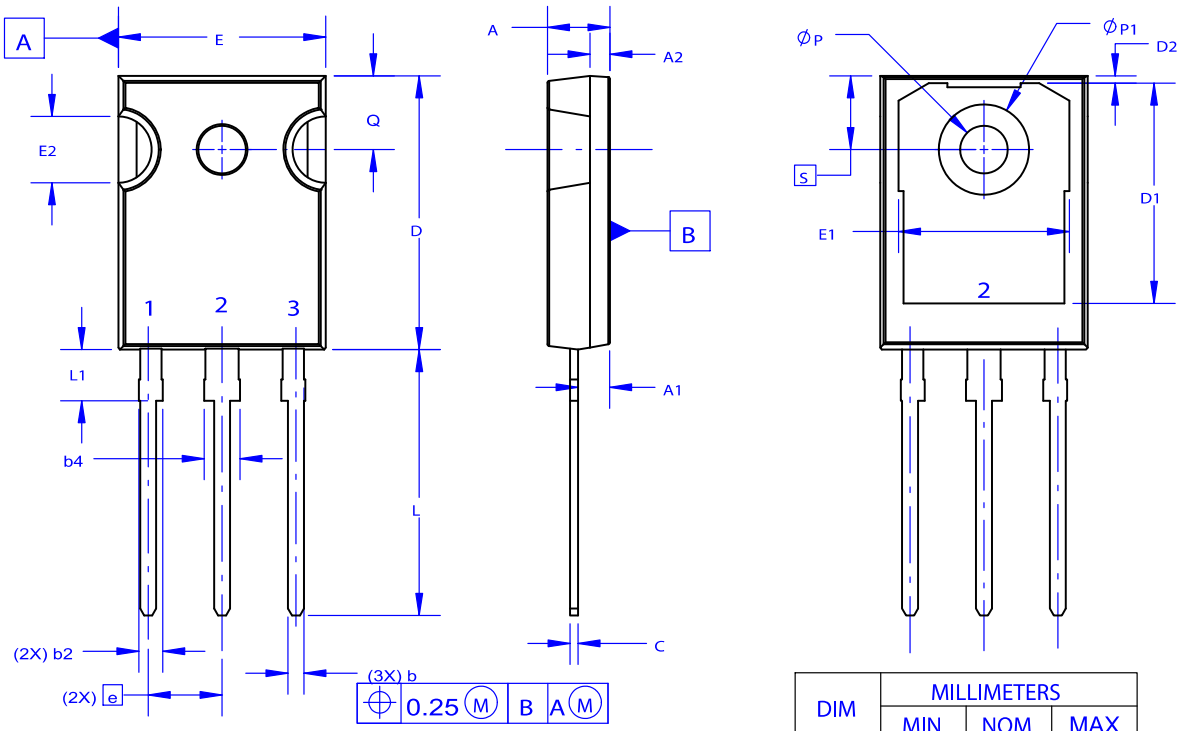



**Figure 20. Peak Diode Recovery dv/dt Test Circuit & Waveforms**

SUPERFET and FRFET are a registered trademarks of Semiconductor Components Industries, LLC (SCILLC) or its subsidiaries in the United States and/or other countries.

## PACKAGE DIMENSIONS

**TO−247−3LD**
CASE 340CX
ISSUE A




NOTES: UNLESS OTHERWISE SPECIFIED.

A. DIMENSIONS ARE EXCLUSIVE OF BURRS, MOLD FLASH, AND TIE BAR EXTRUSIONS.
B. ALL DIMENSIONS ARE IN MILLIMETERS.
C. DRAWING CONFORMS TO ASME Y14.5 - 2009.
D. DIMENSION A1 TO BE MEASURED IN THE REGION DEFINED BY L1.
E. LEAD FINISH IS UNCONTROLLED IN THE REGION DEFINED BY L1.

| DIM | MILLIMETERS | | |
|---|---|---|---|
| | MIN | NOM | MAX |
| A | 4.58 | 4.70 | 4.82 |
| A1 | 2.20 | 2.40 | 2.60 |
| A2 | 1.40 | 1.50 | 1.60 |
| D | 20.32 | 20.57 | 20.82 |
| E | 15.37 | 15.62 | 15.87 |
| E2 | 4.96 | 5.08 | 5.20 |
| e | ~ | 5.56 | ~ |
| L | 19.75 | 20.00 | 20.25 |
| L1 | 3.69 | 3.81 | 3.93 |
| ØP | 3.51 | 3.58 | 3.65 |
| Q | 5.34 | 5.46 | 5.58 |
| S | 5.34 | 5.46 | 5.58 |
| b | 1.17 | 1.26 | 1.35 |
| b2 | 1.53 | 1.65 | 1.77 |
| b4 | 2.42 | 2.54 | 2.66 |
| c | 0.51 | 0.61 | 0.71 |
| D1 | 13.08 | ~ | ~ |
| D2 | 0.51 | 0.93 | 1.35 |
| E1 | 12.81 | ~ | ~ |
| ØP1 | 6.60 | 6.80 | 7.00 |

**onsemi**, ONSEMI , and other names, marks, and brands are registered and/or common law trademarks of Semiconductor Components Industries, LLC dba "**onsemi**" or its affiliates and/or subsidiaries in the United States and/or other countries. **onsemi** owns the rights to a number of patents, trademarks, copyrights, trade secrets, and other intellectual property. A listing of **onsemi's** product/patent coverage may be accessed at www.onsemi.com/site/pdf/Patent−Marking.pdf. **onsemi** reserves the right to make changes at any time to any products or information herein, without notice. The information herein is provided "as−is" and **onsemi** makes no warranty, representation or guarantee regarding the accuracy of the information, product features, availability, functionality, or suitability of its products for any particular purpose, nor does **onsemi** assume any liability arising out of the application or use of any product or circuit, and specifically disclaims any and all liability, including without limitation special, consequential or incidental damages. Buyer is responsible for its products and applications using **onsemi** products, including compliance with all laws, regulations and safety requirements or standards, regardless of any support or applications information provided by **onsemi**. "Typical" parameters which may be provided in **onsemi** data sheets and/or specifications can and do vary in different applications and actual performance may vary over time. All operating parameters, including "Typicals" must be validated for each customer application by customer's technical experts. **onsemi** does not convey any license under any of its intellectual property rights nor the rights of others. **onsemi** products are not designed, intended, or authorized for use as a critical component in life support systems or any FDA Class 3 medical devices or medical devices with a same or similar classification in a foreign jurisdiction or any devices intended for implantation in the human body. Should Buyer purchase or use **onsemi** products for any such unintended or unauthorized application, Buyer shall indemnify and hold **onsemi** and its officers, employees, subsidiaries, affiliates, and distributors harmless against all claims, costs, damages, and expenses, and reasonable attorney fees arising out of, directly or indirectly, any claim of personal injury or death associated with such unintended or unauthorized use, even if such claim alleges that **onsemi** was negligent regarding the design or manufacture of the part. **onsemi** is an Equal Opportunity/Affirmative Action Employer. This literature is subject to all applicable copyright laws and is not for resale in any manner.

## PUBLICATION ORDERING INFORMATION

**LITERATURE FULFILLMENT**:
**Email Requests to:** orderlit@onsemi.com

**onsemi Website:** www.onsemi.com

**TECHNICAL SUPPORT**
**North American Technical Support:**
Voice Mail: 1 800−282−9855 Toll Free USA/Canada
Phone: 011 421 33 790 2910

**Europe, Middle East and Africa Technical Support:**
Phone: 00421 33 790 2910
For additional information, please contact your local Sales Representative

◊