

MOSFET – Power, N-Channel, SUPERFET III, FRFET

650 V, 36 A, 95 mΩ



ON Semiconductor®

www.onsemi.com

NVB095N65S3F

Description

SUPERFET III MOSFET is ON Semiconductor'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 FRFET MOSFET's optimized reverse recovery performance of body diode can remove additional component and improve system reliability.

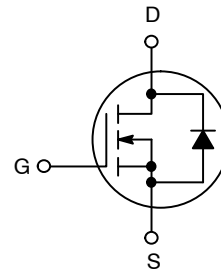
Features

- 700 V @ $T_J = 150^\circ\text{C}$
- Typ. $R_{DS(on)} = 78\text{ m}\Omega$
- Ultra Low Gate Charge (Typ. $Q_g = 65\text{ nC}$)
- Low Effective Output Capacitance (Typ. $C_{oss(eff.)} = 597\text{ pF}$)
- 100% Avalanche Tested
- AEC-Q101 Qualified and PPAP Capable
- These Devices are Pb-Free, Halogen-Free/BFR-Free and are RoHS Compliant

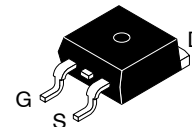
Applications

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

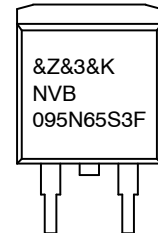
| V_{DSS} | $R_{DS(on)}\text{ MAX}$ | $I_D\text{ MAX}$ |
|-----------|-------------------------|------------------|
| 650 V | 95 mΩ @ 10 V | 36 A |



MARKING DIAGRAM



D²PAK-3
TO-263
CASE 418AJ



&Z = Assembly Plant Code
&3 = Data Code (Year & Week)
&K = Lot
NVB095N65S3F = Specific Device Code

ORDERING INFORMATION

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

NVB095N65S3F

ABSOLUTE MAXIMUM RATINGS (T_C = 25°C, Unless otherwise noted)

| Symbol | Parameter | Value | Unit |
|-----------------------------------|--|---------------------------------------|-------|
| V _{DSS} | Drain to Source Voltage | 650 | V |
| V _{GSS} | Gate to Source Voltage | - DC | ±30 |
| | | - AC (f > 1 Hz) | ±30 |
| I _D | Drain Current | - Continuous (T _C = 25°C) | 36 |
| | | - Continuous (T _C = 100°C) | 22.8 |
| I _{DM} | Drain Current | - Pulsed (Note 1) | 90 |
| E _{AS} | Single Pulsed Avalanche Energy (Note 2) | 440 | mJ |
| I _{AS} | Avalanche Current (Note 2) | 4.6 | A |
| E _{AR} | Repetitive Avalanche Energy (Note 1) | 2.72 | 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) | 272 |
| | | - Derate Above 25°C | 2.176 |
| 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 seconds | 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} = 4.6 A, R_G = 25 Ω, starting T_J = 25°C.

3. I_{SD} ≤ 18 A, di/dt ≤ 200 A/μs, V_{DD} ≤ 400 V, starting T_J = 25°C.

THERMAL CHARACTERISTICS

| Symbol | Parameter | Value | Unit |
|------------------|---|-------|------|
| R _{θJC} | Thermal Resistance, Junction to Case, Max. | 0.46 | °C/W |
| R _{θJA} | Thermal Resistance, Junction to Ambient, Max. | 40 | |

PACKAGE MARKING AND ORDERING INFORMATION

| Part Number | Top Marking | Package | Reel Size | Tape Width | Shipping [†] |
|--------------|--------------|--------------------|-----------|------------|-----------------------|
| NVB095N65S3F | NVB095N65S3F | D ² PAK | 330 mm | 24 mm | 800 / Tape & Reel |

[†]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](#).

NVB095N65S3F

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

| Parameter | Symbol | Test Conditions | Min. | Typ. | Max. | Unit |
|-----------|--------|-----------------|------|------|------|------|
|-----------|--------|-----------------|------|------|------|------|

OFF CHARACTERISTICS

| | | | | | | |
|---|-------------------------------------|---|-----|-----|------|-------|
| Drain to Source Breakdown Voltage | BV _{DSS} | 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 |
| Breakdown Voltage Temperature Coefficient | ΔBV _{DSS} /ΔT _J | I _D = 15 mA, Referenced to 25°C | | 640 | | mV/°C |
| Zero Gate Voltage Drain Current | I _{DSS} | V _{DS} = 650 V, V _{GS} = 0 V | | | 10 | μA |
| | | V _{DS} = 520 V, T _C = 125°C | | 12 | | |
| Gate to Body Leakage Current | I _{GSS} | V _{GS} = ±30 V, V _{DS} = 0 V | | | ±100 | nA |

ON CHARACTERISTICS

| | | | | | | |
|--------------------------------------|---------------------------------------|--|-----|----|-----|-------|
| Gate Threshold Voltage | V _{GS(th)} | V _{GS} = V _{DS} , I _D = 0.86 mA | 3.0 | | 5.0 | V |
| Threshold Temperature Coefficient | ΔV _{GS(th)} /ΔT _J | V _{GS} = V _{DS} , I _D = 0.86 mA | | -7 | | mV/°C |
| Static Drain to Source On Resistance | R _{DS(on)} | V _{GS} = 10 V, I _D = 18 A | | 78 | 95 | mΩ |
| Forward Transconductance | g _{FS} | V _{DS} = 20 V, I _D = 18 A | | 19 | | S |

DYNAMIC CHARACTERISTICS

| | | | | | | |
|-----------------------------------|------------------------|--|--|------|--|----|
| Input Capacitance | C _{iss} | V _{DS} = 400 V, V _{GS} = 0 V, f = 1 MHz | | 3020 | | pF |
| Output Capacitance | C _{oss} | | | 61 | | |
| Reverse Transfer Capacitance | C _{rss} | | | 7.0 | | |
| Effective Output Capacitance | C _{oss(eff.)} | V _{DS} = 0 V to 400 V, V _{GS} = 0 V | | 597 | | pF |
| Energy Related Output Capacitance | C _{oss(er.)} | V _{DS} = 0 V to 400 V, V _{GS} = 0 V | | 107 | | pF |
| Total Gate Charge at 10V | Q _{g(tot)} | V _{GS} = 10 V, V _{DS} = 400 V, I _D = 18 A (Note 4) | | 66 | | nC |
| Threshold Gate Charge | Q _{g(th)} | | | 13 | | |
| Gate to Source Gate Charge | Q _{gs} | | | 22 | | |
| Gate to Drain "Miller" Charge | Q _{gd} | | | 26 | | |
| Equivalent Series Resistance | ESR | f = 1 MHz | | 2.4 | | Ω |

SWITCHING CHARACTERISTICS

| | | | | | | |
|---------------------|---------------------|---|--|-----|--|----|
| Turn-On Delay Time | t _{d(on)} | V _{GS} = 10 V, V _{DD} = 400 V, I _D = 18 A, R _g = 2.2 Ω (Note 4) | | 26 | | ns |
| Turn-On Rise Time | t _r | | | 26 | | ns |
| Turn-Off Delay Time | t _{d(off)} | | | 62 | | ns |
| Turn-Off Fall Time | t _f | | | 4.0 | | ns |

SOURCE-DRAIN DIODE CHARACTERISTICS

| | | | | | | |
|--|-----------------|--|--|-----|-----|----|
| Maximum Continuous Source to Drain Diode Forward Current | I _S | V _{GS} = 0 V | | | 36 | A |
| Maximum Pulsed Source to Drain Diode Forward Current | I _{SM} | V _{GS} = 0 V | | | 90 | A |
| Source to Drain Diode Forward Voltage | V _{SD} | V _{GS} = 0 V, I _{SD} = 18 A | | | 1.3 | V |
| Reverse Recovery Time | t _{rr} | V _{GS} = 0 V, dI _F /dt = 100 A/μs, I _{SD} = 18 A | | 97 | | ns |
| Charge Time | t _a | | | 78 | | |
| Discharge Time | t _b | | | 19 | | |
| Reverse Recovery Charge | Q _{rr} | | | 349 | | |

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

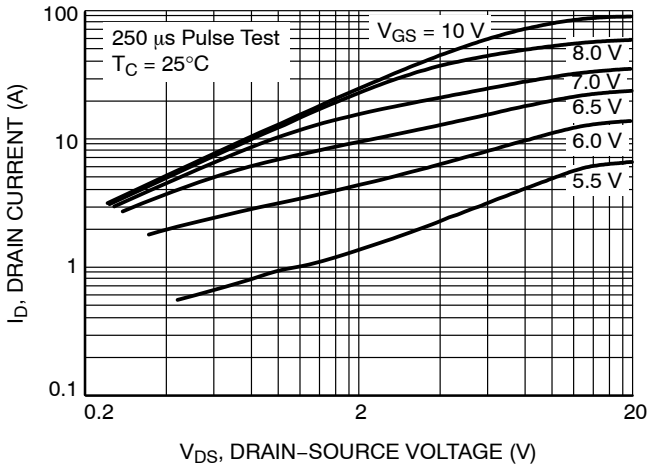


Figure 1. On-Region Characteristics
25°C

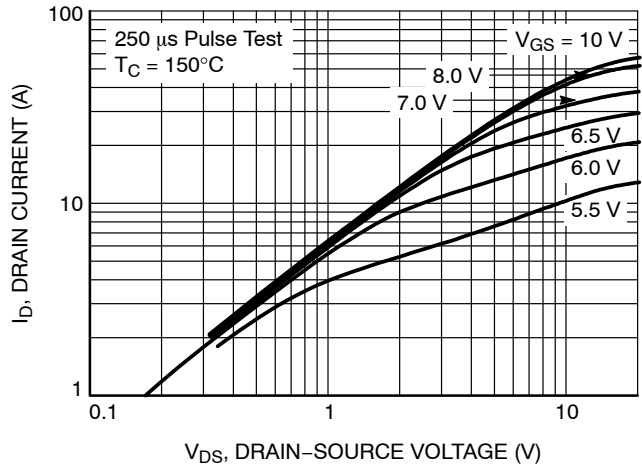


Figure 2. On-Region Characteristics
150°C

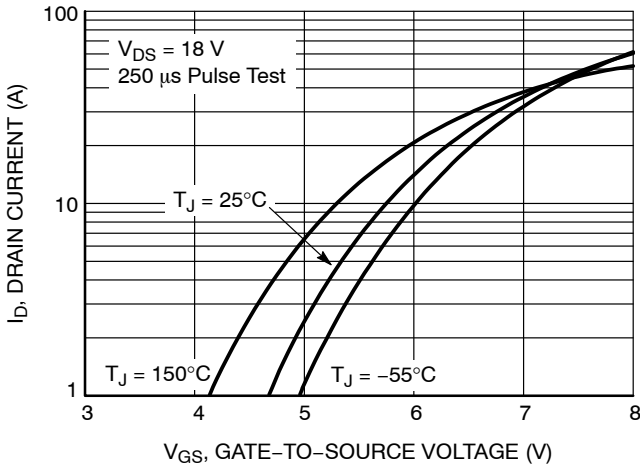


Figure 3. Transfer Characteristics

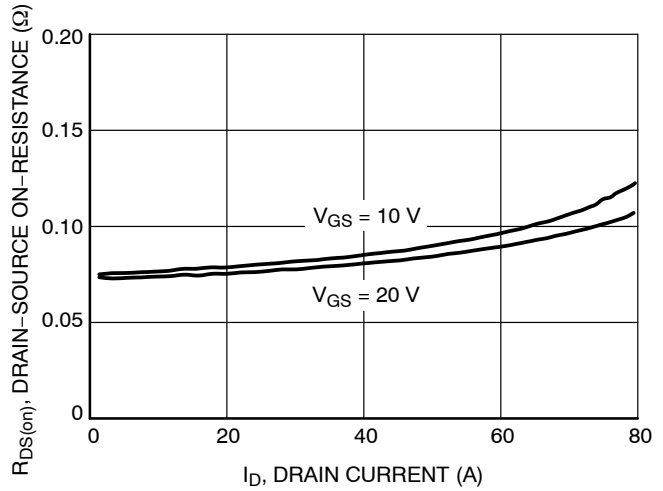


Figure 4. On-Resistance Variation vs. Drain Current and Gate Voltage

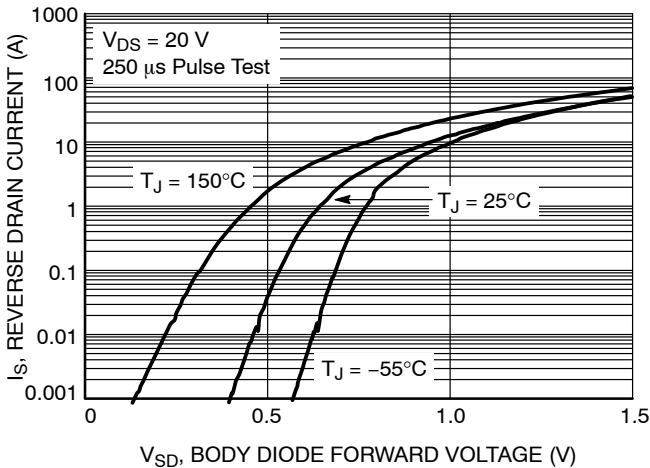


Figure 5. Body Diode Forward Voltage Variation vs. Source Current and Temperature

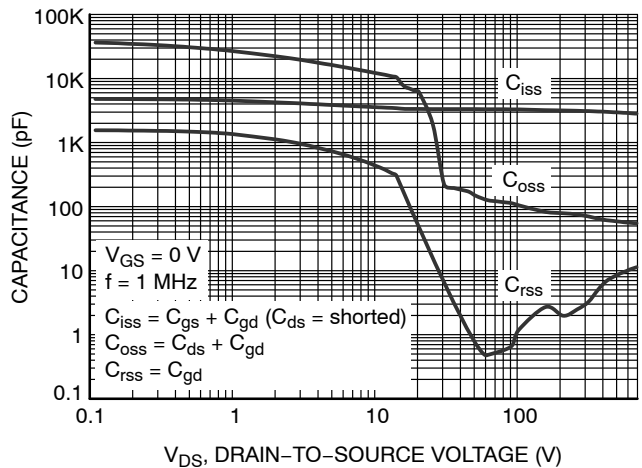


Figure 6. Capacitance Characteristics

TYPICAL CHARACTERISTICS

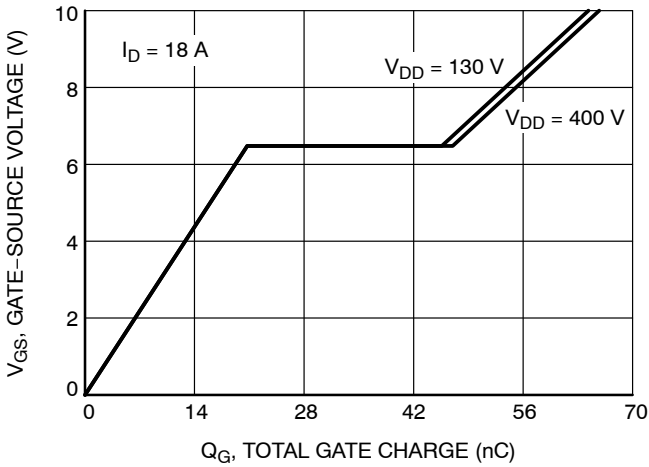


Figure 7. Gate Charge Characteristics

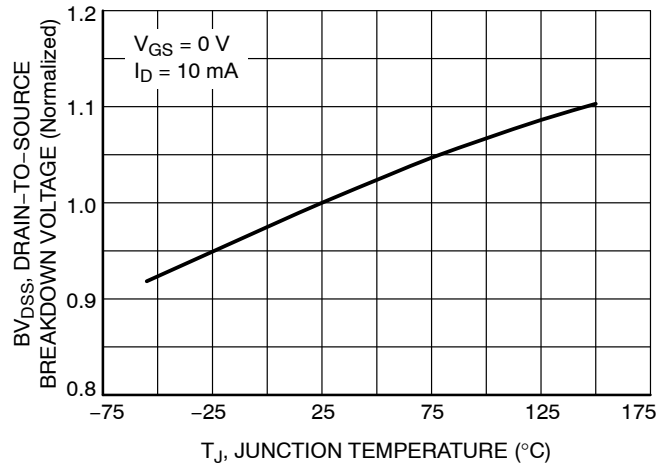


Figure 8. Breakdown Voltage Variation vs. Temperature

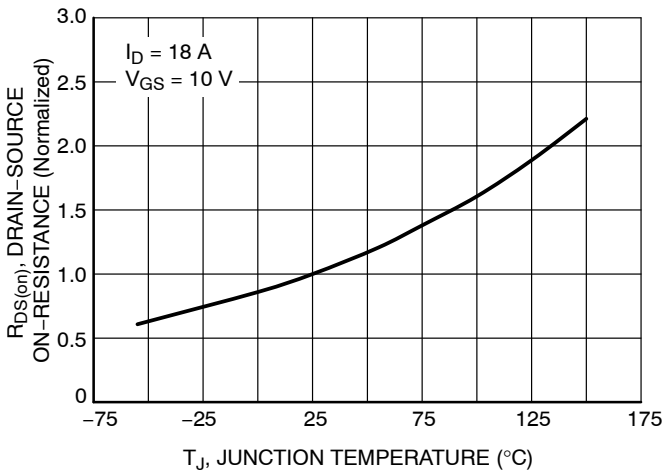


Figure 9. On-Resistance Variation vs. Temperature

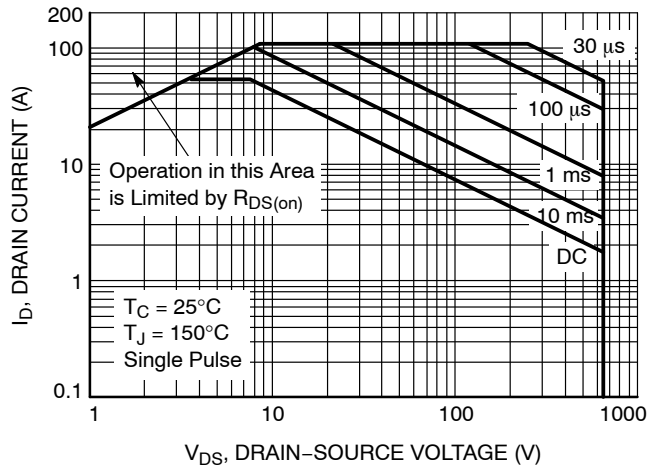


Figure 10. Maximum Safe Operating Area

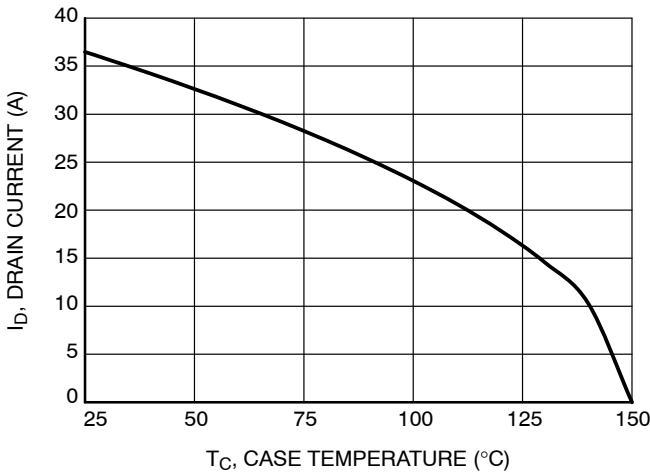


Figure 11. Maximum Drain Current vs. Case Temperature

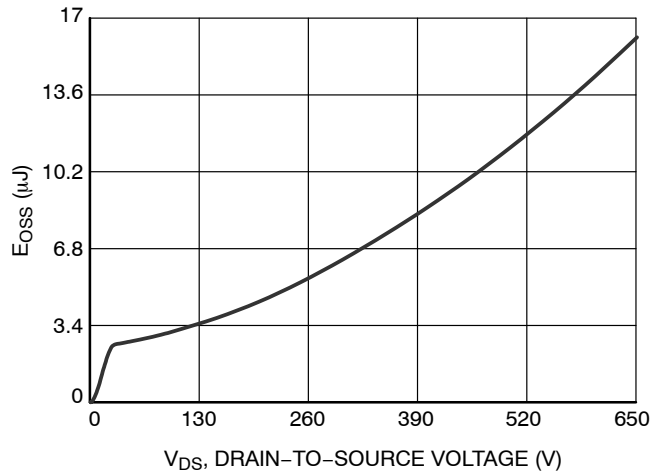


Figure 12. E_{OSS} vs. Drain-to-Source Voltage

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TYPICAL CHARACTERISTICS

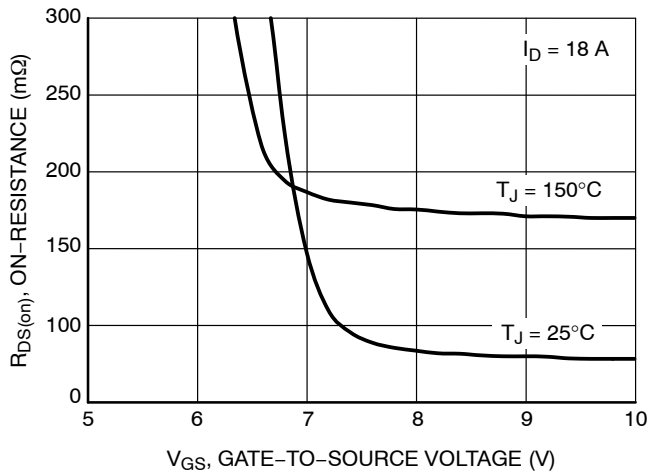


Figure 13. $R_{DS(on)}$ vs. Gate Voltage

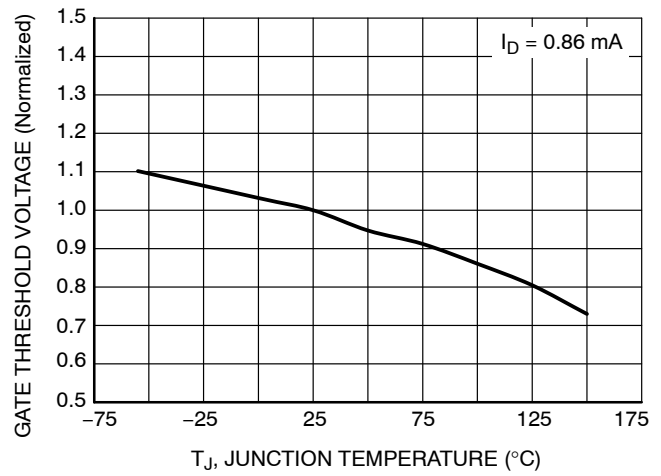


Figure 14. Normalized Gate Threshold Voltage vs. Temperature

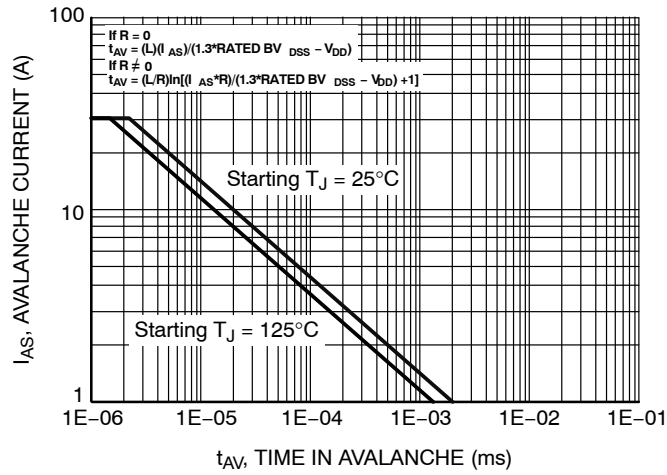


Figure 15. Unclamped Inductive Switching Capability

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TYPICAL CHARACTERISTICS

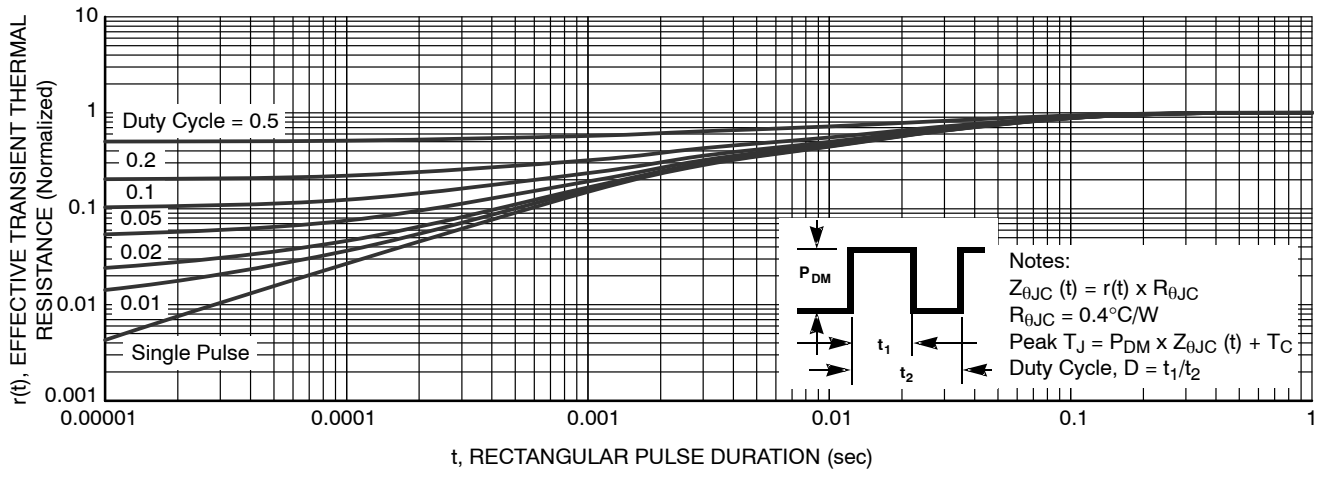


Figure 16. Transient Thermal Response

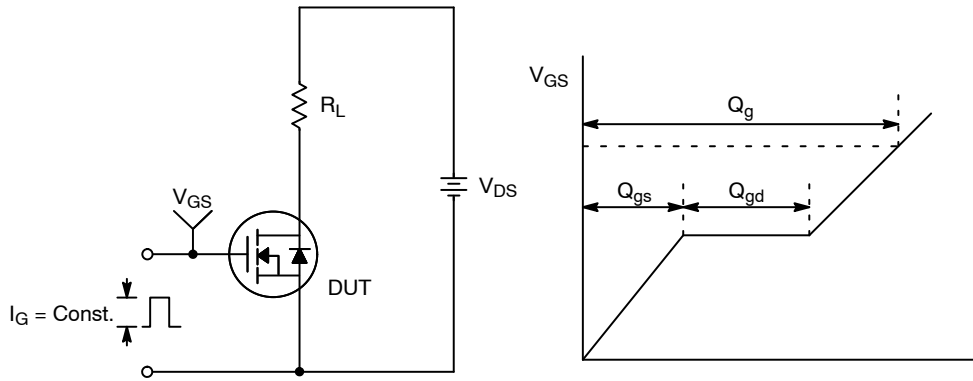


Figure 17. Gate Charge Test Circuit & Waveform

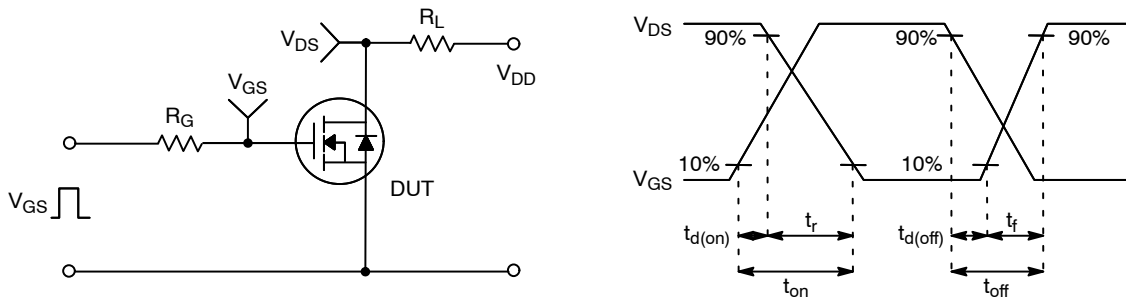


Figure 18. Resistive Switching Test Circuit & Waveforms

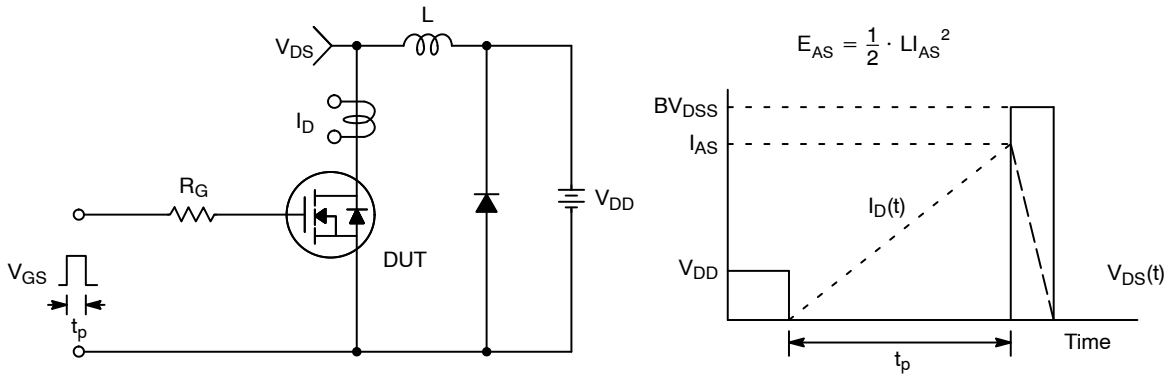


Figure 19. Unclamped Inductive Switching Test Circuit & Waveforms

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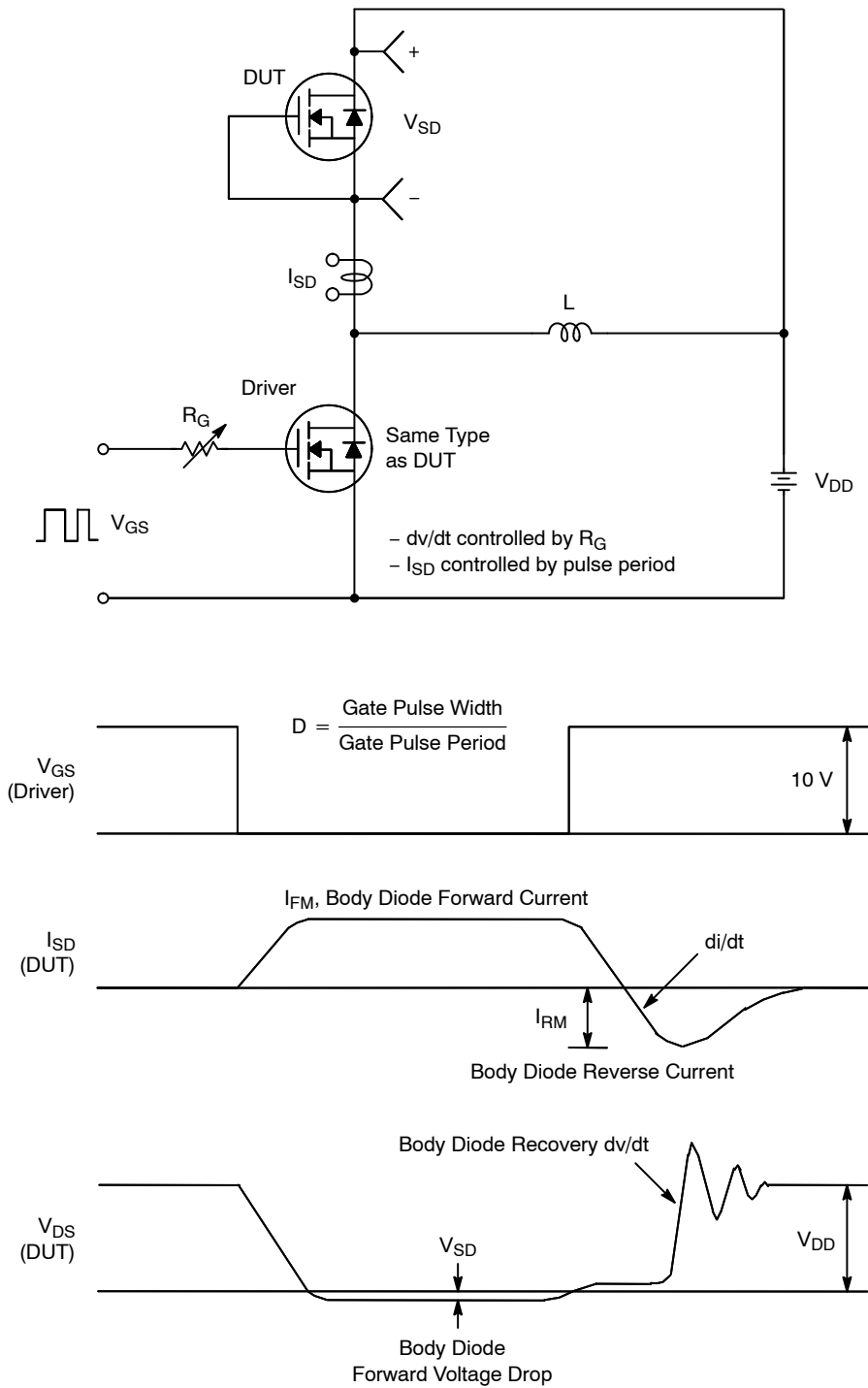
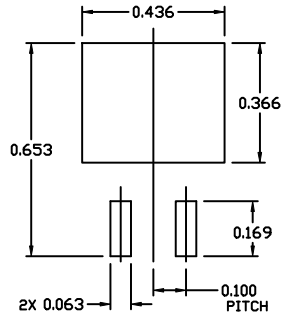


Figure 20. Peak Diode Recovery dv/dt Test Circuit & Waveforms

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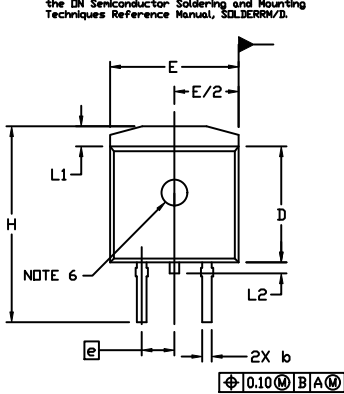
PACKAGE DIMENSIONS

D²PAK-3 (TO-263, 3-LEAD) CASE 418AJ ISSUE E



RECOMMENDED MOUNTING FOOTPRINT

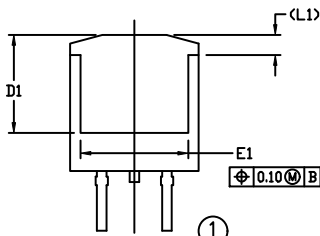
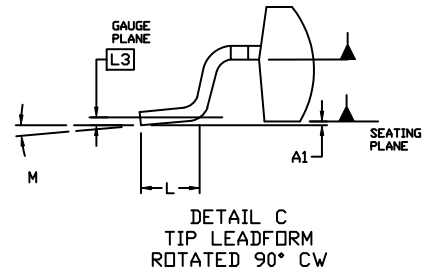
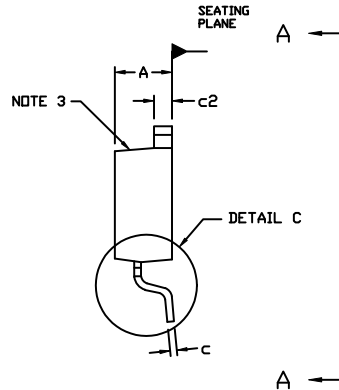
For additional information on our Pb-Free strategy and soldering details, please download the ON Semiconductor Soldering and Mounting Techniques Reference Manual, SOLDERM/D.



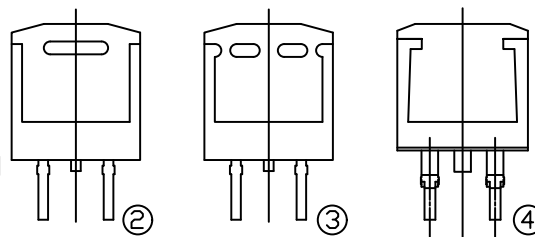
NOTES:

- DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 2009.
- CONTROLLING DIMENSION: INCHES
- CHAMFER OPTIONAL.
- 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.
- THERMAL PAD CONTOUR IS OPTIONAL WITHIN DIMENSIONS E, L1, D1, AND E1.
- OPTIONAL MOLD FEATURE.
- ①, ② ... OPTIONAL CONSTRUCTION FEATURE CALL OUTS.

| DIM | INCHES | | MILLIMETERS | |
|-----|--------|-------|-------------|-------|
| | MIN. | MAX. | MIN. | MAX. |
| A | 0.160 | 0.190 | 4.06 | 4.83 |
| A1 | 0.000 | 0.010 | 0.00 | 0.25 |
| b | 0.020 | 0.039 | 0.51 | 0.99 |
| c | 0.012 | 0.029 | 0.30 | 0.74 |
| c2 | 0.045 | 0.065 | 1.14 | 1.65 |
| D | 0.330 | 0.380 | 8.38 | 9.65 |
| D1 | 0.260 | --- | 6.60 | --- |
| E | 0.380 | 0.420 | 9.65 | 10.67 |
| E1 | 0.245 | --- | 6.22 | --- |
| e | 0.100 | BSC | 2.54 | BSC |
| H | 0.575 | 0.625 | 14.60 | 15.88 |
| L | 0.070 | 0.110 | 1.78 | 2.79 |
| L1 | --- | 0.066 | --- | 1.68 |
| L2 | --- | 0.070 | --- | 1.78 |
| L3 | 0.010 | BSC | 0.25 | BSC |
| M | -8° | 8° | -8° | 8° |



VIEW A-A



VIEW A-A
OPTIONAL CONSTRUCTIONS

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