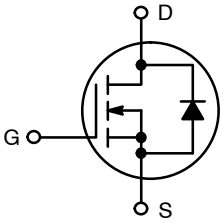
# MOSFET – Power, N-Channel, SUPERFET® III, Automotive, Easy-drive
## 650 V, 12 A, 260 mΩ

# NVB260N65S3

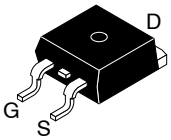
**ON Semiconductor®**

www.onsemi.com

| $V_{DSS}$ | $R_{DS(ON)}$ MAX | $I_D$ MAX |
|---|---|---|
| 650 V | 260 mΩ @ 10 V | 12 A |




**POWER MOSFET**




**D²–PAK**
**CASE 418AJ**

### 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 advance 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 various power system miniaturization and higher efficiency.

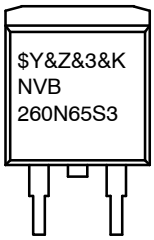
### Features

- AEC–Q101 Qualified
- 700 V @ $T_J$ = 150°C
- Typ. $R_{DS(on)}$ = 222 mΩ
- Ultra Low Gate Charge (Typ. $Q_g$ = 24 nC)
- Low Effective Output Capacitance (Typ. $C_{oss(eff.)}$ = 248 pF)
- 100% Avalanche Tested
- These Devices are Pb–Free and are RoHS Compliant

### Applications

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

### MARKING DIAGRAM




| | |
|---|---|
| $Y | = ON Semiconductor Logo |
| &Z | = Assembly Plant Code |
| &3 | = Data Code (Year & Week) |
| &K | = Lot |
| NVB260N65S3 | = Specific Device Code |

### ORDERING INFORMATION

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

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**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) | 12 | A |
| | | Continuous ($T_C$ = 100°C) | 7.6 | |
| $I_{DM}$ | Drain Current | Pulsed (Note 1) | 30 | A |
| $E_{AS}$ | Single Pulsed Avalanche Energy (Note 2) | | 57 | mJ |
| $I_{AS}$ | Avalanche Current (Note 1) | | 2.3 | A |
| $E_{AR}$ | Repetitive Avalanche Energy (Note 1) | | 0.9 | mJ |
| dv/dt | MOSFET dv/dt | | 100 | V/ns |
| | Peak Diode Recovery dv/dt (Note 3) | | 20 | |
| $P_D$ | Power Dissipation | ($T_C$ = 25°C) | 90 | W |
| | | Derate Above 25°C | 0.72 | 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. $I_{AS}$ = 2.3 A, $R_G$ = 25 Ω, starting $T_J$ = 25°C.
3. $I_{SD}$ ≤ 6 A, di/dt ≤ 200 A/μs, $V_{DD}$ ≤ 400 V, starting $T_J$ = 25°C.

**THERMAL CHARACTERISTICS**

| Symbol | Parameter | Value | Unit |
|---|---|---|---|
| $R_{\theta JC}$ | Thermal Resistance, Junction to Case, Max. | 1.39 | °C/W |
| $R_{\theta JA}$ | Thermal Resistance, Junction to Ambient, Max. (Note 4) | 40 | |

4. Device on 1 $in^2$ pad 2 oz copper pad on 1.5 x 1.5 in. board of FR−4 material.

**PACKAGE MARKING AND ORDERING INFORMATION**

| Part Number | Top Marking | Package | Reel Size | Tape Width | Shipping† |
|---|---|---|---|---|---|
| NVB260N65S3 | NVB260N65S3 | $D^2$−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.

**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, $I_D$ = 1 mA, $T_J$ = 150°C | 700 | | | V |
| $\Delta BV_{DSS}/\Delta T_J$ | Breakdown Voltage Temperature Coefficient | $I_D$ = 1 mA, Referenced to 25°C | | 0.66 | | V/°C |
| $I_{DSS}$ | Zero Gate Voltage Drain Current | $V_{DS}$ = 650 V, $V_{GS}$ = 0 V | | | 1 | μA |
| | | $V_{DS}$ = 520 V, $T_C$ = 125°C | | 0.77 | | |
| $I_{GSS}$ | Gate to Body Leakage Current | $V_{GS}$ = ±30 V, $V_{DS}$ = 0 V | | | ±100 | nA |
| **ON CHARACTERISTICS** | | | | | | |
| $V_{GS(th)}$ | Gate Threshold Voltage | $V_{GS}$ = $V_{DS}$, $I_D$ = 0.29 mA | 2.5 | | 4.5 | V |
| $R_{DS(on)}$ | Static Drain to Source On Resistance | $V_{GS}$ = 10 V, $I_D$ = 6 A | | 222 | 260 | mΩ |
| $g_{FS}$ | Forward Transconductance | $V_{DS}$ = 20 V, $I_D$ = 6 A | | 7.4 | | S |
| **DYNAMIC CHARACTERISTICS** | | | | | | |
| $C_{iss}$ | Input Capacitance | $V_{DS}$ = 400 V, $V_{GS}$ = 0 V, f = 1 MHz | | 1010 | | pF |
| $C_{oss}$ | Output Capacitance | | | 25 | | pF |
| $C_{oss(eff.)}$ | Effective Output Capacitance | $V_{DS}$ = 0 V to 400 V, $V_{GS}$ = 0 V | | 248 | | pF |
| $C_{oss(er.)}$ | Energy Related Output Capacitance | $V_{DS}$ = 0 V to 400 V, $V_{GS}$ = 0 V | | 33 | | pF |
| $Q_{g(tot)}$ | Total Gate Charge at 10 V | $V_{DS}$ = 400 V, $I_D$ = 6 A, $V_{GS}$ = 10 V (Note 5) | | 24 | | nC |
| $Q_{gs}$ | Gate to Source Gate Charge | | | 6.1 | | nC |
| $Q_{gd}$ | Gate to Drain “Miller” Charge | | | 9.7 | | nC |
| ESR | Equivalent Series Resistance | f = 1 MHz | | 8.7 | | Ω |
| **SWITCHING CHARACTERISTICS** | | | | | | |
| $t_{d(on)}$ | Turn-On Delay Time | $V_{DD}$ = 400 V, $I_D$ = 6 A, $V_{GS}$ = 10 V, $R_g$ = 4.7 Ω (Note 5) | | 18 | | ns |
| $t_r$ | Turn-On Rise Time | | | 18 | | ns |
| $t_{d(off)}$ | Turn-Off Delay Time | | | 49 | | ns |
| $t_f$ | Turn-Off Fall Time | | | 12 | | ns |
| **SOURCE-DRAIN DIODE CHARACTERISTICS** | | | | | | |
| $I_S$ | Maximum Continuous Source to Drain Diode Forward Current | | | | 12 | A |
| $I_{SM}$ | Maximum Pulsed Source to Drain Diode Forward Current | | | | 30 | A |
| $V_{SD}$ | Source to Drain Diode Forward Voltage | $V_{GS}$ = 0 V, $I_{SD}$ = 6 A | | | 1.2 | V |
| $t_{rr}$ | Reverse Recovery Time | $V_{DD}$ = 400 V, $I_{SD}$ = 6 A, $dI_F/dt$ = 100 A/μs | | 251 | | ns |
| $Q_{rr}$ | Reverse Recovery Charge | | | 3.4 | | μC |

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.

5. Essentially independent of operating temperature typical characteristics.

## TYPICAL PERFORMANCE CHARACTERISTICS

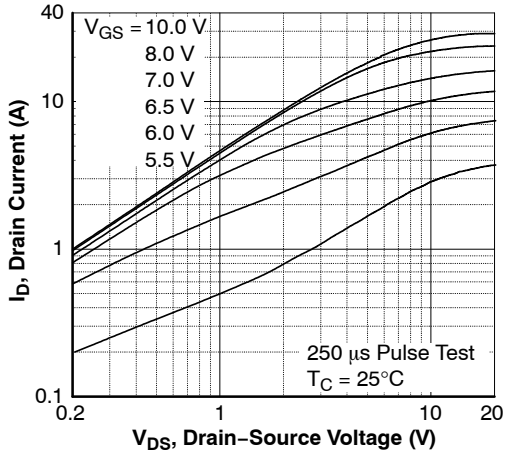


**Figure 1. On−Region Characteristics 25°C**

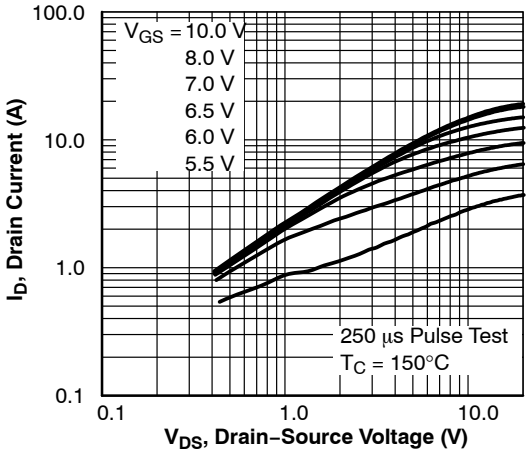


**Figure 2. On−Region Characteristics 150°C**

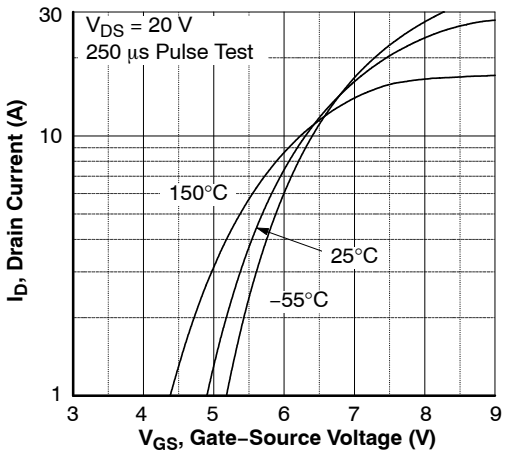


**Figure 3. Transfer Characteristics**

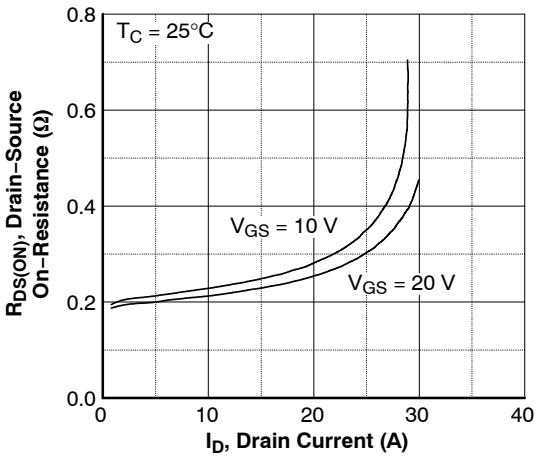


**Figure 4. On−Resistance Variation vs. Drain Current and Gate Voltage**

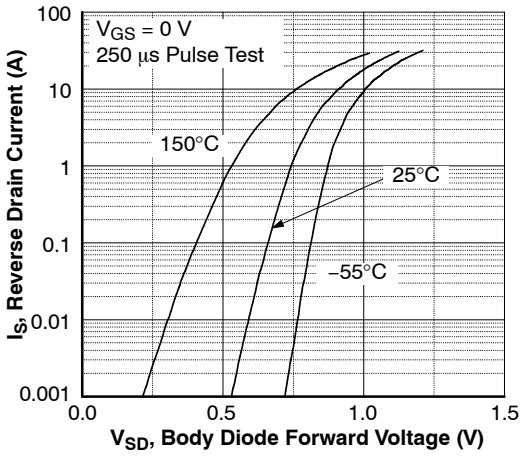


**Figure 5. Body Diode Forward Voltage Variation vs. Source Current and Temperature**

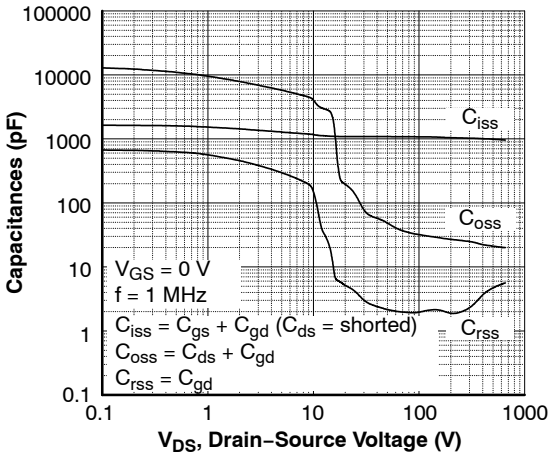


**Figure 6. Capacitance Characteristics**

## TYPICAL PERFORMANCE CHARACTERISTICS

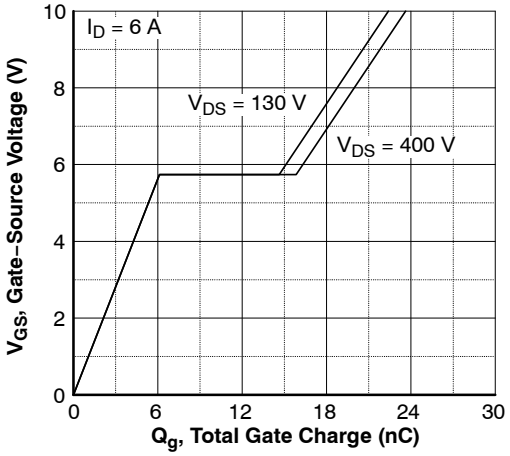


**Figure 7. Gate Charge Characteristics**

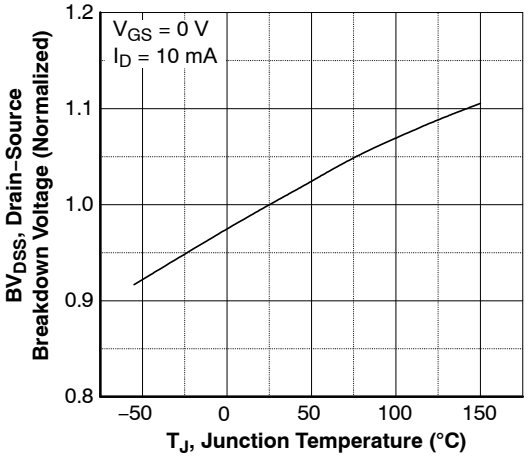


**Figure 8. Breakdown Voltage Variation vs. Temperature**

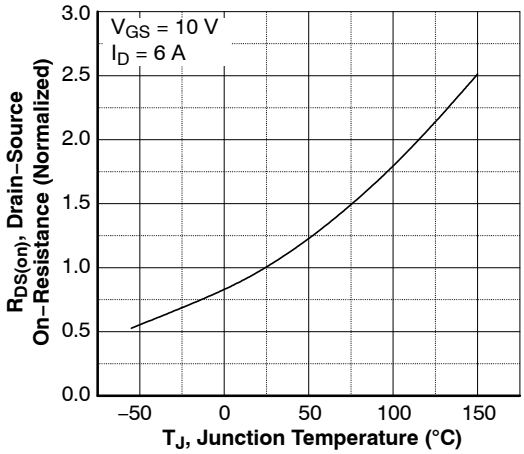


**Figure 9. On−Resistance Variation vs. Temperature**

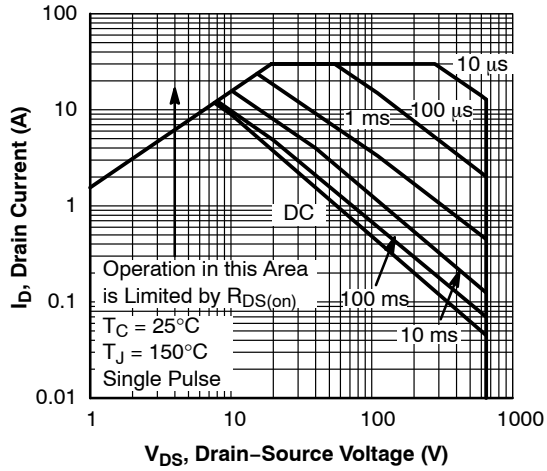


**Figure 10. Maximum Safe Operating Area**

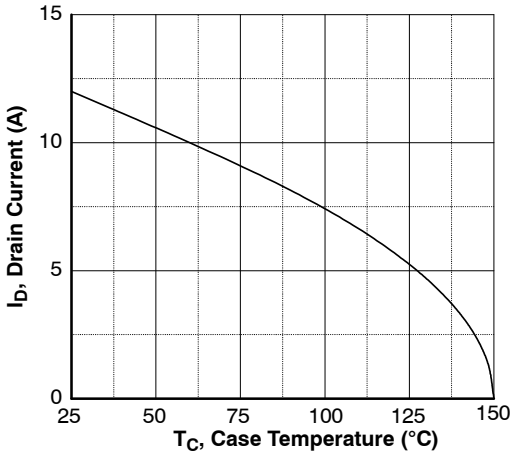


**Figure 11. Maximum Drain Current vs. Case Temperature**

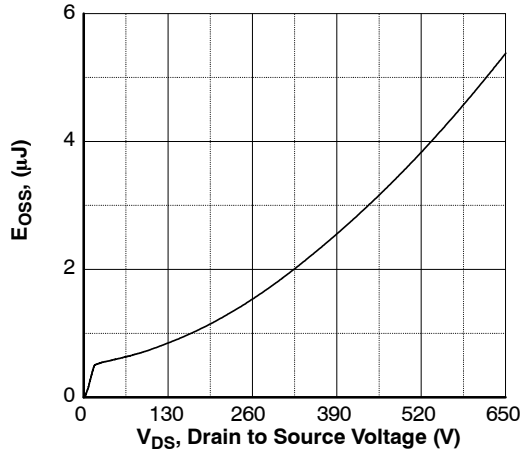


**Figure 12. $E_{OSS}$ vs. Drain to Source Voltage**

## TYPICAL PERFORMANCE CHARACTERISTICS

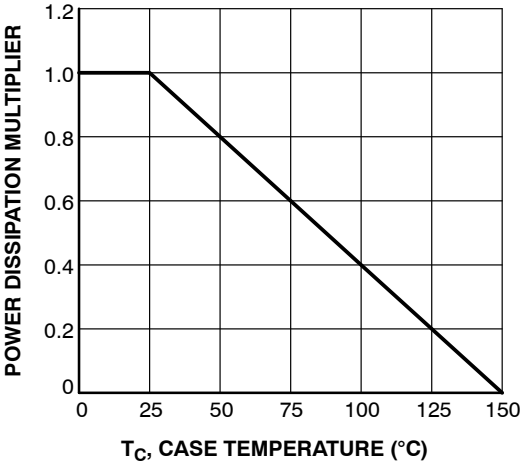


**Figure 13. Normalized Power Dissipation vs. Case Temperature**

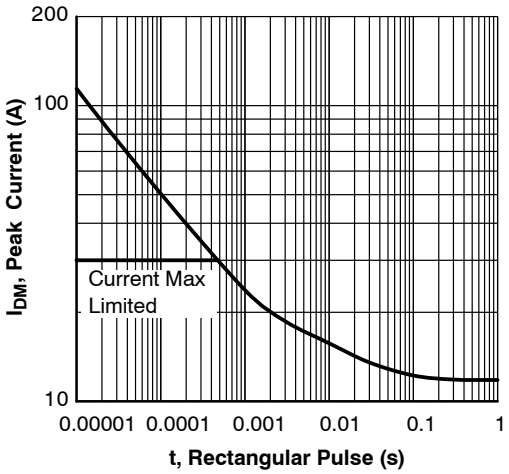


**Figure 14. Peak Current Capability**

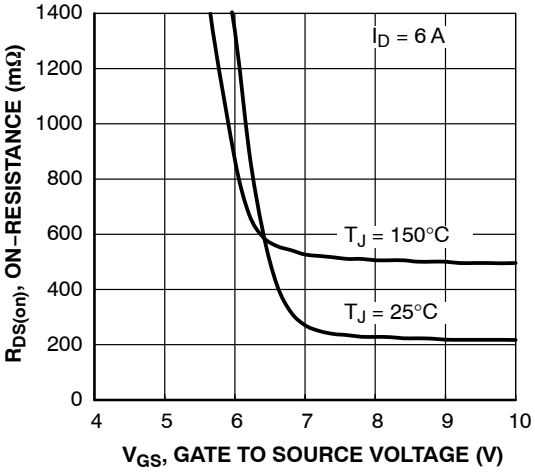


**Figure 15. $R_{DS(on)}$ vs. Gate Voltage**

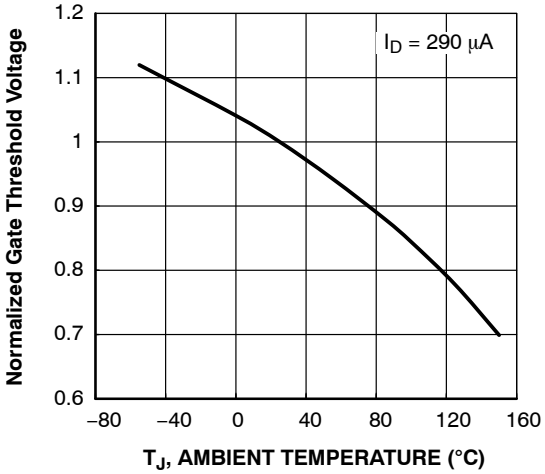


**Figure 16. Normalized Gate Threshold Voltage vs. Temperature**

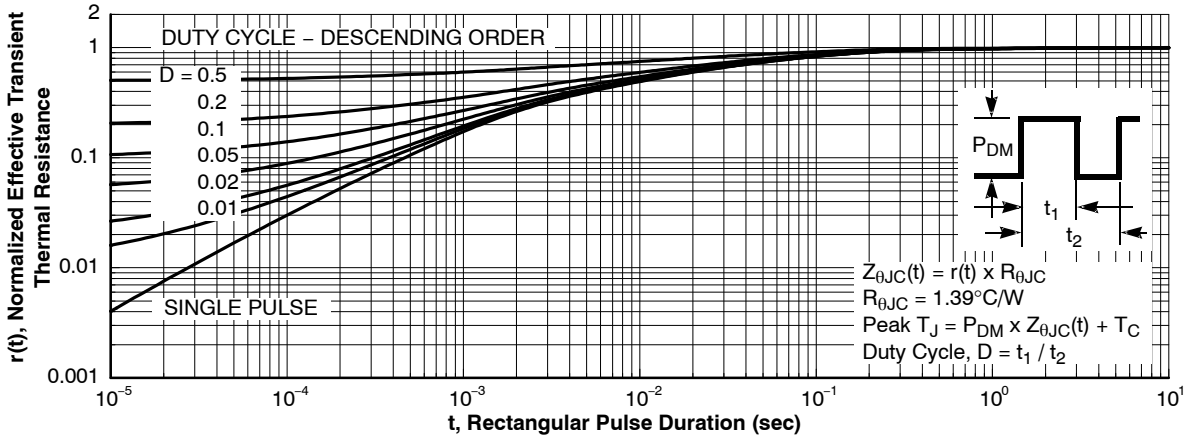


**Figure 17. Transient Thermal Response Curve**

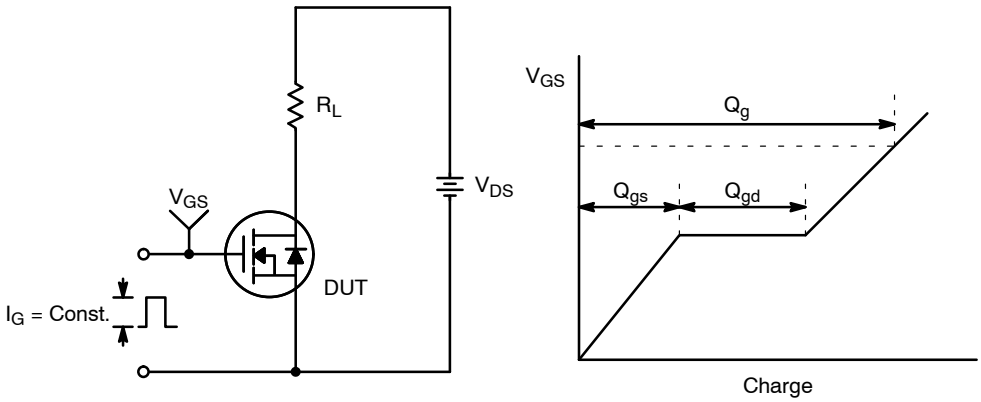


**Figure 18. Gate Charge Test Circuit & Waveform**

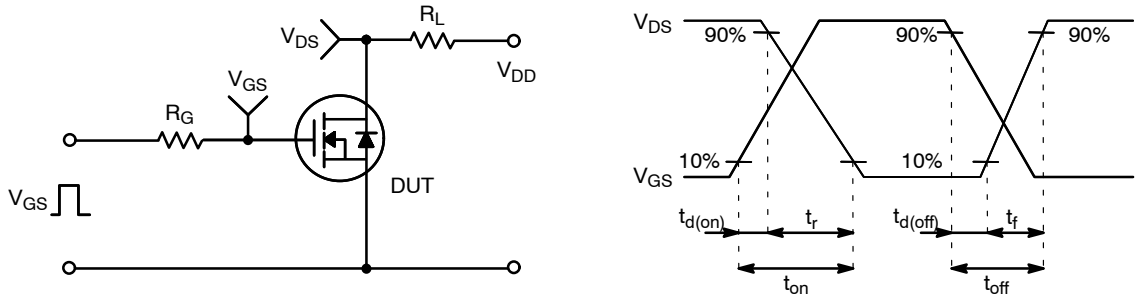


**Figure 19. Resistive Switching Test Circuit & Waveforms**

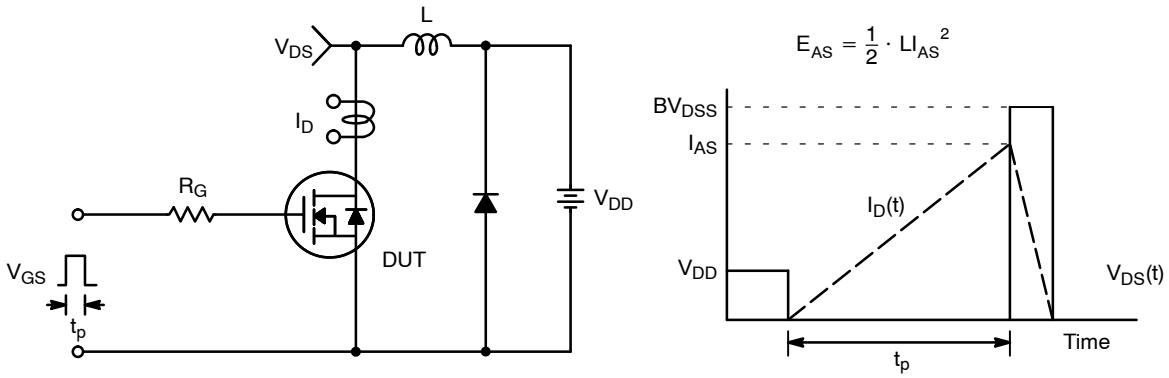


**Figure 20. Unclamped Inductive Switching Test Circuit & Waveforms**

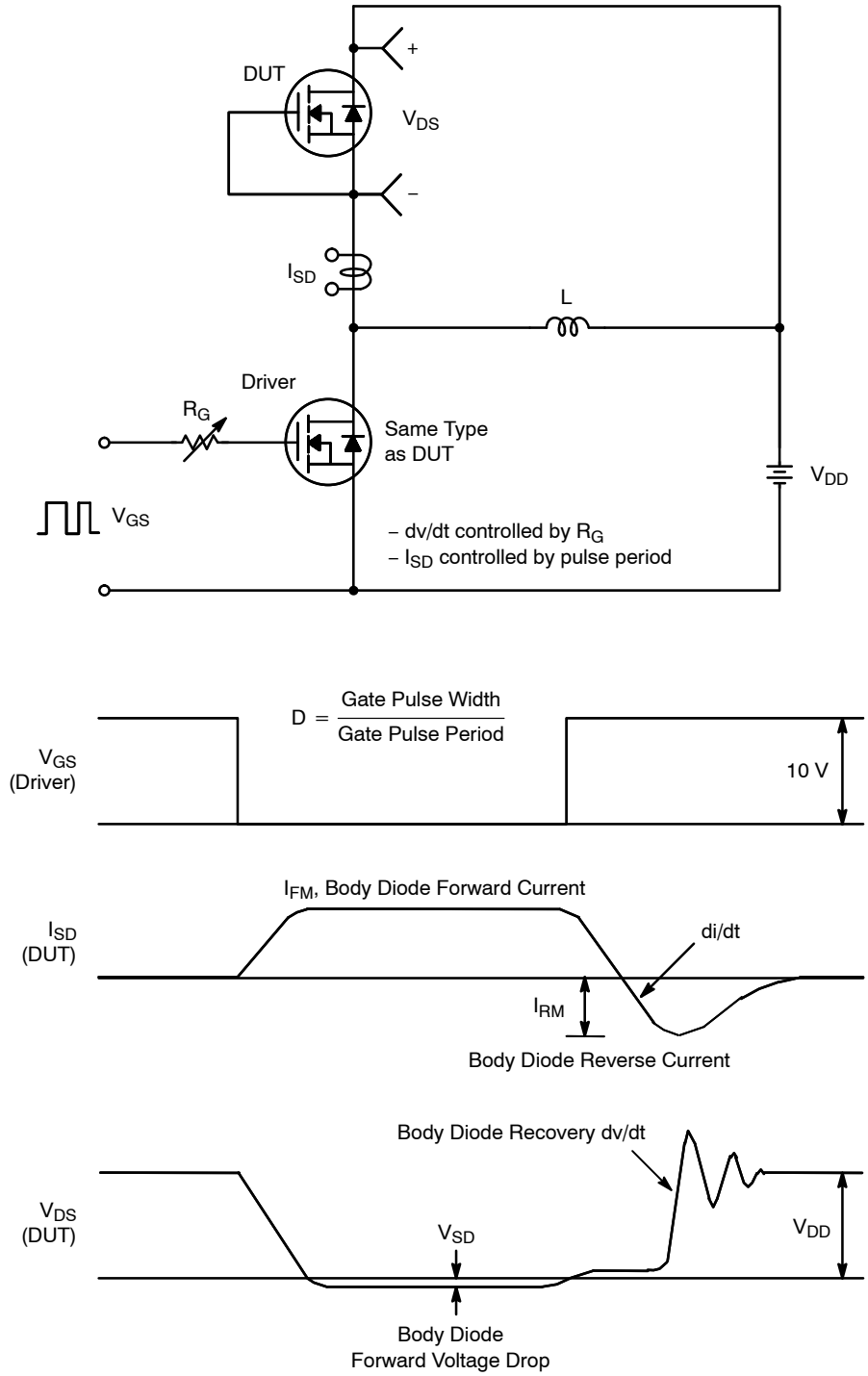


**Figure 21. Peak Diode Recovery dv/dt Test Circuit & Waveforms**

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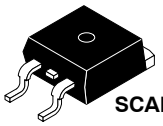
# MECHANICAL CASE OUTLINE
## PACKAGE DIMENSIONS

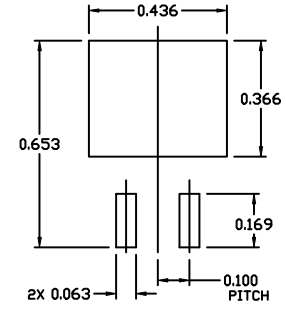
ON Semiconductor®



SCALE 1:1

**D²PAK–3 (TO–263, 3–LEAD)**
CASE 418AJ
ISSUE F

DATE 11 MAR 2021



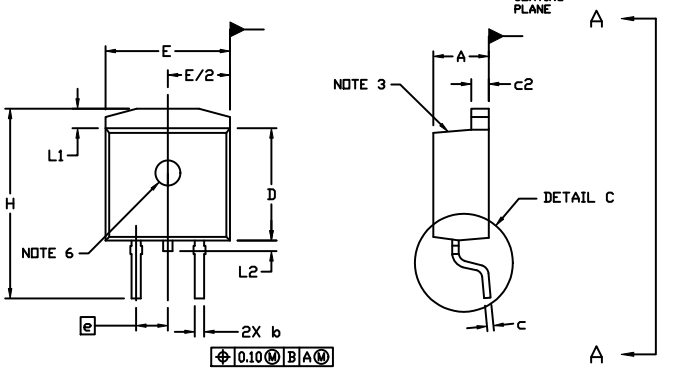

RECOMMENDED
MOUNTING FOOTPRINT

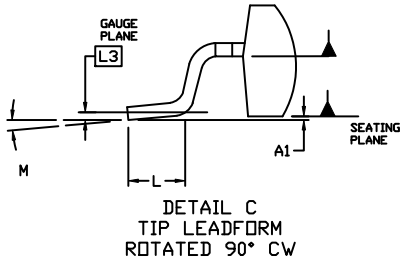
* For additional information on our Pb-Free strategy and soldering details, please download the ON Semiconductor Soldering and Mounting Techniques Reference Manual, SOLDERRM/D.

NOTES:

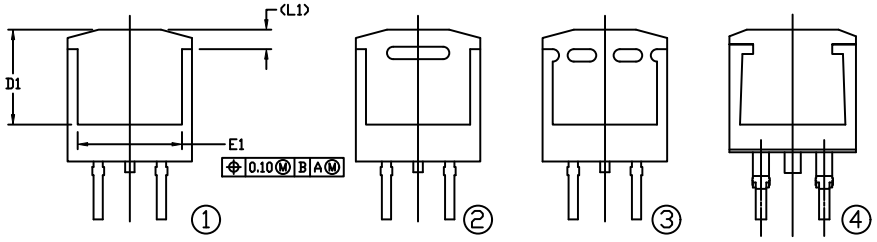
1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 2009.
2. CONTROLLING DIMENSION: INCHES
3. CHAMFER OPTIONAL.
4. DIMENSIONS D AND E DO NOT INCLUDE MOLD FLASH. MOLD FLASH SHALL NOT EXCEED 0.005 PER SIDE. THESE DIMENSIONS ARE MEASURED AT THE OUTERMOST EXTREMES OF THE PLASTIC BODY AT DATUM H.
5. THERMAL PAD CONTOUR IS OPTIONAL WITHIN DIMENSIONS E, L1, D1, AND E1.
6. OPTIONAL MOLD FEATURE.
7. ①, ② ... OPTIONAL CONSTRUCTION FEATURE CALL OUTS.

| | INCHES | | MILLIMETERS | |
|---|---|---|---|---|
| DIM | 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 | 0° | 8° | 0° | 8° |



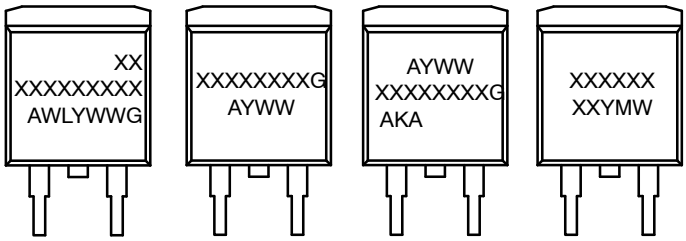

DETAIL C
TIP LEADFORM
ROTATED 90° CW




VIEW A–A

VIEW A–A
OPTIONAL CONSTRUCTIONS

### GENERIC MARKING DIAGRAMS*




IC | Standard | Rectifier | SSG

XXXXXX = Specific Device Code
A = Assembly Location
WL = Wafer Lot
Y = Year
WW = Work Week
W = Week Code (SSG)
M = Month Code (SSG)
G = Pb–Free Package
AKA = Polarity Indicator

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

| | | |
|---|---|---|
| **DOCUMENT NUMBER:** | **98AON56370E** | Electronic versions are uncontrolled except when accessed directly from the Document Repository. Printed versions are uncontrolled except when stamped “CONTROLLED COPY” in red. |
| **DESCRIPTION:** | **D²PAK–3 (TO–263, 3–LEAD)** | **PAGE 1 OF 1** |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