

# MOSFET - Power, N-Channel, Automotive SUPERFET® III, Easy-Drive 650 V, 72 mΩ, 44 A NVB072N65S3

## 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 Easy-drive series helps manage EMI issues and allows for easier design implementation.

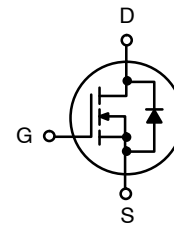
## Features

- AEC-Q101 Qualified
- Max Junction Temperature 150°C
- Typ.  $R_{DS(on)} = 61 \text{ m}\Omega$
- Ultra Low Gate Charge (Typ.  $Q_G = 82 \text{ nC}$ )
- Low Effective Output Capacitance (Typ.  $C_{OSS(eff.)} = 724 \text{ pF}$ )
- 100% Avalanche Tested
- These Devices are Pb-Free and are RoHS Compliant

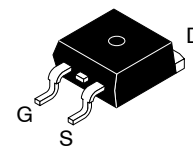
## Typical Applications

- Automotive PHEV-BEV DC-DC Converter
- Automotive Onboard Charger for PHEV-BEV

| $BV_{DSS}$ | $R_{DS(on)} \text{ MAX}$ | $I_D \text{ MAX}$ |
|------------|--------------------------|-------------------|
| 650 V      | 72 mΩ @ 10 V             | 44 A              |

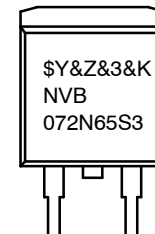


N-Channel MOSFET



D2PAK  
3 LEAD  
CASE 418AJ

## MARKING DIAGRAM



|             |                        |
|-------------|------------------------|
| \$Y         | = onsemi Logo          |
| &Z          | = Assembly Plant Code  |
| &3          | = Numeric Date Code    |
| &K          | = Lot Code             |
| NVB072N65S3 | = Specific Device Code |

## ORDERING INFORMATION

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

# NVB072N65S3

## ABSOLUTE MAXIMUM RATINGS (T<sub>C</sub> = 25°C, Unless otherwise specified)

| Symbol                            | Parameter                                                            |                                     | Value       | Unit |
|-----------------------------------|----------------------------------------------------------------------|-------------------------------------|-------------|------|
| V <sub>DSS</sub>                  | Drain to Source Voltage                                              |                                     | 650         | V    |
| V <sub>GSS</sub>                  | Gate to Source Voltage                                               | DC                                  | ±30         | V    |
|                                   |                                                                      | AC (f > 1 Hz)                       | ±30         | V    |
| I <sub>D</sub>                    | Drain Current                                                        | Continuous (T <sub>C</sub> = 25°C)  | 44          | A    |
|                                   |                                                                      | Continuous (T <sub>C</sub> = 100°C) | 28          | A    |
| I <sub>DM</sub>                   | Pulsed Drain Current                                                 | Pulsed (Note 1)                     | 110         | A    |
| E <sub>AS</sub>                   | Single Pulsed Avalanche Energy (Note 2)                              |                                     | 214         | mJ   |
| E <sub>AR</sub>                   | Repetitive Avalanche (Note 1)                                        |                                     | 3.12        | mJ   |
| dv/dt                             | MOSFET dv/dt                                                         |                                     | 100         | V/ns |
|                                   | Peak Diode Recovery dv/dt (Note 3)                                   |                                     | 20          | V/ns |
| P <sub>D</sub>                    | Power Dissipation                                                    | (T <sub>C</sub> = 25°C)             | 312         | W    |
|                                   |                                                                      | Derate Above 25°C                   | 2.5         | W/°C |
| T <sub>J</sub> , T <sub>STG</sub> | Operating and Storage Temperature Range                              |                                     | -55 to +150 | °C   |
| T <sub>L</sub>                    | 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<sub>AS</sub> = 4.8 A, R<sub>G</sub> = 25 Ω, starting T<sub>J</sub> = 25°C.
3. I<sub>SD</sub> < 44 A, di/dt ≤ 200 A/ms, V<sub>DD</sub> ≤ BVDSS, starting T<sub>J</sub> = 25°C.
4. Essentially independent of operating temperature typical characteristics.

## THERMAL CHARACTERISTICS

| Symbol           | Parameter                                                                            | Value | Unit |
|------------------|--------------------------------------------------------------------------------------|-------|------|
| R <sub>θJC</sub> | Thermal Resistance, Junction to Case, Max.                                           | 0.37  | °C/W |
| R <sub>θJA</sub> | Thermal Resistance, Junction to Ambient (Minimum Pad of 2-oz Copper), Max.           | 62.5  | °C/W |
| R <sub>θJA</sub> | Thermal Resistance, Junction to Ambient (1 in <sup>2</sup> Pad of 2-oz Copper), Max. | 40    | °C/W |

## PACKAGE MARKING AND ORDERING INFORMATION

| Part Number | Top Marking | Package              | Packing Method | Reel Size | Tape Width | Quantity  |
|-------------|-------------|----------------------|----------------|-----------|------------|-----------|
| NVB072N65S3 | NVB072N65S3 | D <sup>2</sup> PAK-3 | Tape and Reel  | 330 mm    | 24 mm      | 800 units |

# NVB072N65S3

## ELECTRICAL CHARACTERISTICS (T<sub>C</sub> = 25°C unless otherwise noted)

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

### OFF CHARACTERISTICS

|                                      |                                           |                                                                        |     |      |      |      |
|--------------------------------------|-------------------------------------------|------------------------------------------------------------------------|-----|------|------|------|
| BV <sub>DSS</sub>                    | Drain-to-Source Breakdown Voltage         | V <sub>GS</sub> = 0 V, I <sub>D</sub> = 1 mA, T <sub>J</sub> = 25°C    | 650 | –    | –    | V    |
|                                      |                                           | V <sub>GS</sub> = 0 V, I <sub>D</sub> = 1 mA, T <sub>J</sub> = 150°C   | 700 | –    | –    | V    |
| ΔBV <sub>DSS</sub> / ΔT <sub>J</sub> | Breakdown Voltage Temperature Coefficient | I <sub>D</sub> = 1 mA, Referenced to 25°C                              | –   | 0.60 | –    | V/°C |
| I <sub>DSS</sub>                     | Zero Gate Voltage Drain Current           | V <sub>DS</sub> = 650 V, V <sub>GS</sub> = 0 V                         | –   | 0.30 | 1    | μA   |
|                                      |                                           | V <sub>DS</sub> = 520 V, V <sub>GS</sub> = 0 V, T <sub>C</sub> = 125°C | –   | 7.30 | –    |      |
| I <sub>GSS</sub>                     | Gate to Body Leakage Current              | V <sub>GS</sub> = ±30 V, V <sub>DS</sub> = 0 V                         | –   | –    | ±100 | nA   |

### ON CHARACTERISTICS

|                     |                                      |                                                                       |     |      |     |    |
|---------------------|--------------------------------------|-----------------------------------------------------------------------|-----|------|-----|----|
| V <sub>GS(th)</sub> | Gate to Source Threshold Voltage     | V <sub>GS</sub> = V <sub>DS</sub> , I <sub>D</sub> = 1.0 mA           | 2.5 | –    | 4.5 | V  |
| R <sub>DS(on)</sub> | Static Drain to Source On Resistance | V <sub>GS</sub> = 10 V, I <sub>D</sub> = 22 A, T <sub>J</sub> = 25°C  | –   | 61   | 72  | mΩ |
|                     |                                      | V <sub>GS</sub> = 10 V, I <sub>D</sub> = 22 A, T <sub>J</sub> = 100°C | –   | 107  | –   | mΩ |
| g <sub>FS</sub>     | Forward Transconductance             | V <sub>DS</sub> = 20 V, I <sub>D</sub> = 44 A                         | –   | 29.7 | –   | S  |

### DYNAMIC CHARACTERISTICS

|                        |                                   |                                                                                    |   |       |   |    |
|------------------------|-----------------------------------|------------------------------------------------------------------------------------|---|-------|---|----|
| C <sub>iss</sub>       | Input Capacitance                 | V <sub>DS</sub> = 400 V, V <sub>GS</sub> = 0 V, f = 1 MHz                          | – | 3300  | – | pF |
| C <sub>oss</sub>       | Output Capacitance                |                                                                                    | – | 72.8  | – | pF |
| C <sub>rss</sub>       | Reverse Transfer Capacitance      |                                                                                    | – | 14.6  | – | pF |
| C <sub>oss(eff.)</sub> | Effective Output Capacitance      | V <sub>DS</sub> = 0 V to 400 V, V <sub>GS</sub> = 0 V                              | – | 724   | – | pF |
| C <sub>oss(er.)</sub>  | Energy Related Output Capacitance | V <sub>DS</sub> = 0 V to 400 V, V <sub>GS</sub> = 0 V                              | – | 104   | – | pF |
| Q <sub>g(tot)</sub>    | Total Gate Charge                 | V <sub>DS</sub> = 400 V, V <sub>GS</sub> = 10 V, I <sub>D</sub> = 44 A<br>(Note 4) | – | 82.0  | – | nC |
| Q <sub>gs</sub>        | Gate to Source Gate Charge        |                                                                                    | – | 23.3  | – | nC |
| Q <sub>gd</sub>        | Gate to Drain “Miller” Charge     |                                                                                    | – | 34.0  | – | nC |
| R <sub>G</sub>         | Gate Resistance                   | f = 1 MHz                                                                          | – | 0.685 | – | Ω  |

### SWITCHING CHARACTERISTICS

|                     |                     |                                                                                                            |   |      |   |    |
|---------------------|---------------------|------------------------------------------------------------------------------------------------------------|---|------|---|----|
| t <sub>d(on)</sub>  | Turn-On Delay Time  | V <sub>DD</sub> = 400 V, I <sub>D</sub> = 44 A, V <sub>GS</sub> = 10 V,<br>R <sub>G</sub> = 4.7 Ω (Note 4) | – | 26.3 | – | ns |
| t <sub>r</sub>      | Turn-On Rise Time   |                                                                                                            | – | 50   | – | ns |
| t <sub>d(off)</sub> | Turn-Off Delay Time |                                                                                                            | – | 65.9 | – | ns |
| t <sub>f</sub>      | Fall Time           |                                                                                                            | – | 32   | – | ns |

### DRAIN-SOURCE DIODE CHARACTERISTICS

|                 |                                                          |                                                                              |   |      |     |    |
|-----------------|----------------------------------------------------------|------------------------------------------------------------------------------|---|------|-----|----|
| I <sub>S</sub>  | Maximum Continuous Drain to Source Diode Forward Current |                                                                              | – | –    | 44  | A  |
| I <sub>SM</sub> | Maximum Pulsed Drain to Source Diode Forward Current     |                                                                              | – | –    | 110 | A  |
| V <sub>SD</sub> | Drain to Source Diode Forward Voltage                    | V <sub>GS</sub> = 0 V, I <sub>SD</sub> = 22 A                                | – | –    | 1.2 | V  |
| t <sub>rr</sub> | Reverse Recovery Time                                    | V <sub>GS</sub> = 0 V, I <sub>SD</sub> = 44 A dI <sub>F</sub> /dt = 100 A/μs | – | 576  | –   | nS |
| Q <sub>rr</sub> | Reverse Recovery Charge                                  |                                                                              | – | 14.3 | –   | 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.

TYPICAL CHARACTERISTICS

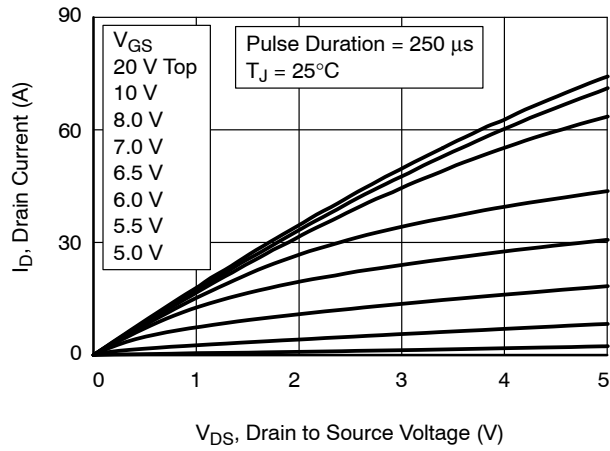


Figure 1. Saturation Characteristics

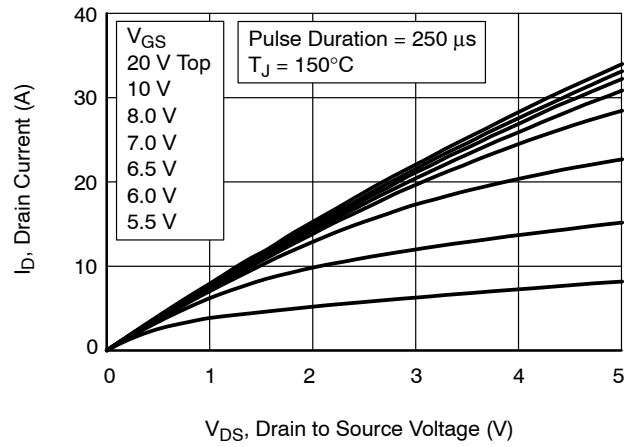


Figure 2. Saturation Characteristics

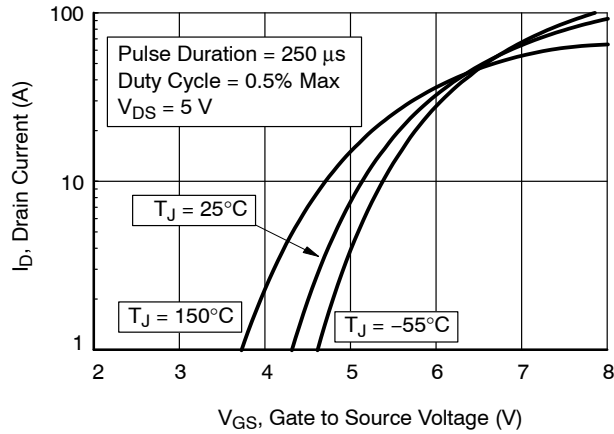


Figure 3. Transfer Characteristic

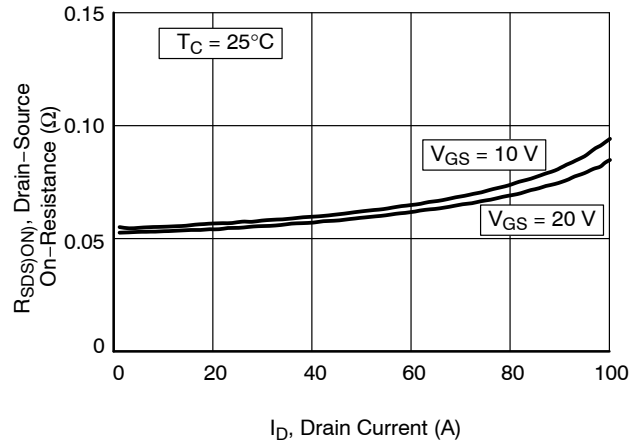


Figure 4. On-Resistance Variation vs. Drain Current and Gate Voltage

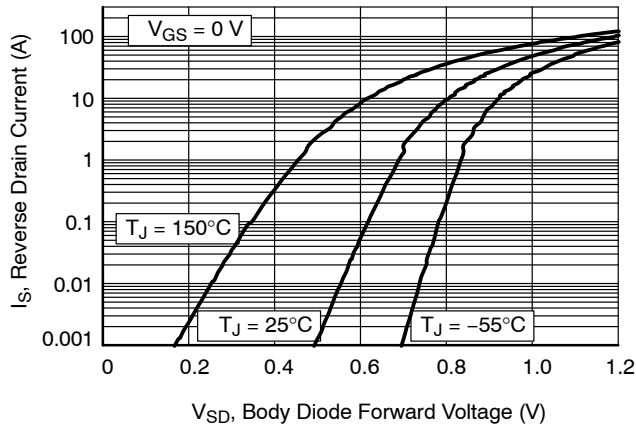


Figure 5. Forward Diode Characteristics

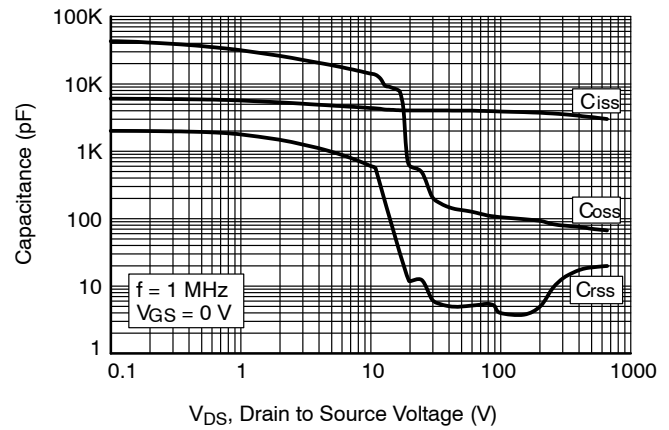


Figure 6. Capacitance vs. Drain to Source Voltage

TYPICAL CHARACTERISTICS (continued)

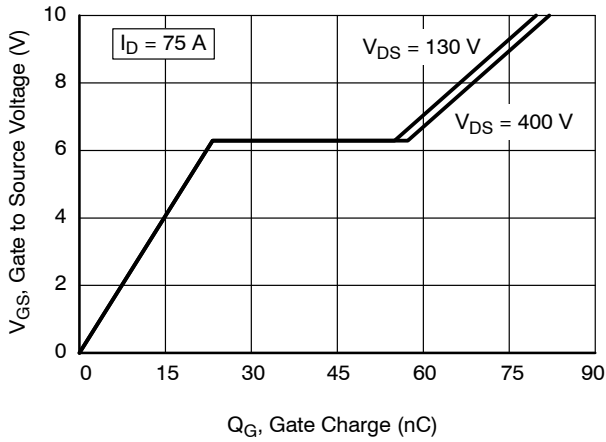


Figure 7. Gate Charge vs. Gate to Source Voltage

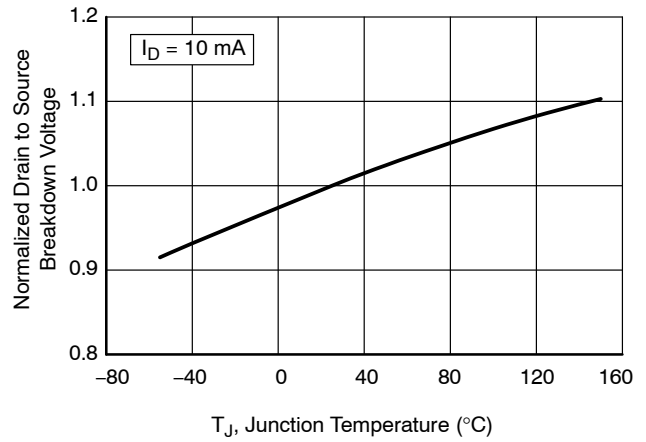


Figure 8. Normalized Drain to Source Breakdown Voltage vs. Junction Temperature

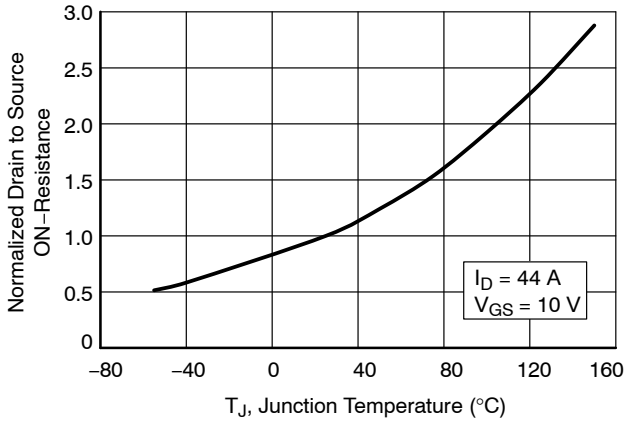


Figure 9. Normalized  $R_{DS(on)}$  vs. Junction Temperature

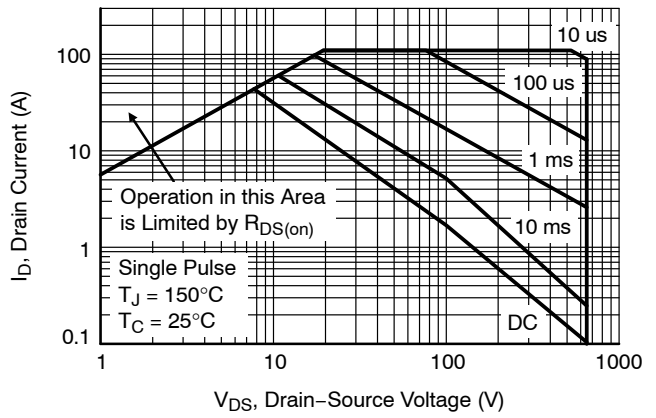


Figure 10. Forward Bias Safe Operating Area

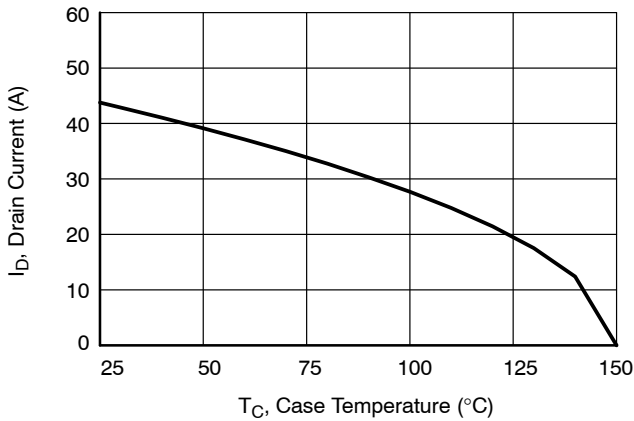


Figure 11. Maximum Continuous Drain Current vs. Case Temperature

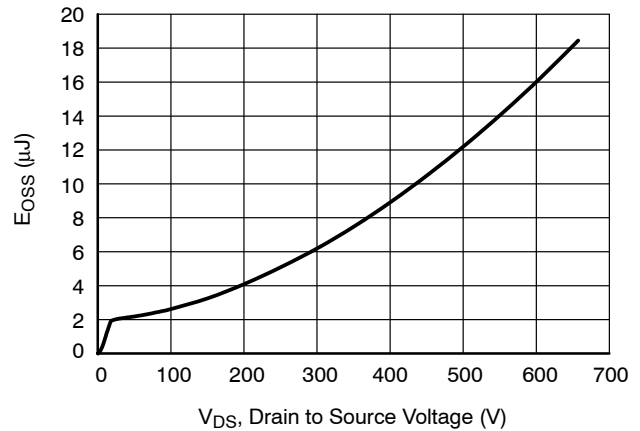


Figure 12.  $E_{OSS}$  vs. Drain to Source Voltage

TYPICAL CHARACTERISTICS (continued)

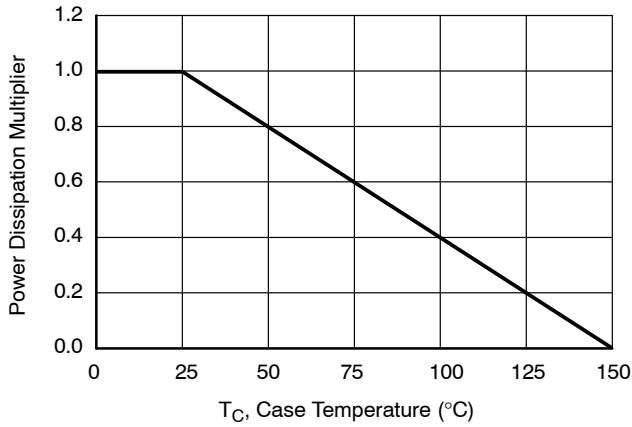


Figure 13. Normalized Power Dissipation vs. Case Temperature

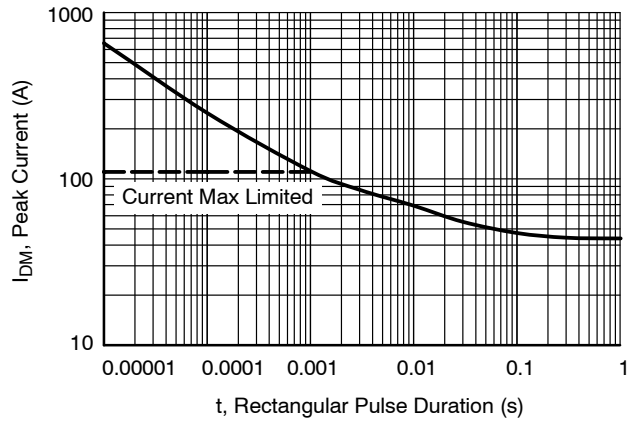


Figure 14. Peak Current Capability

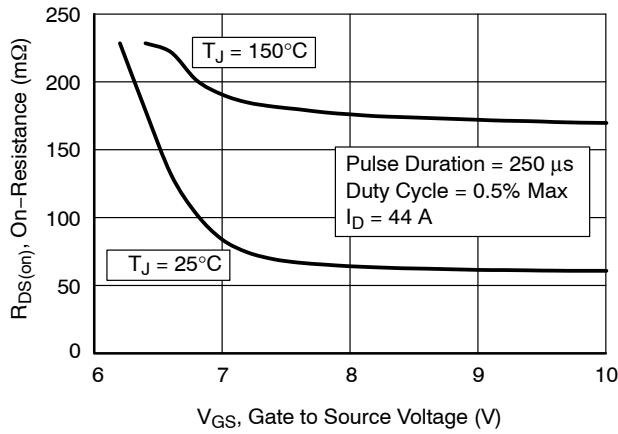


Figure 15. On-Resistance vs. Gate to Source Voltage

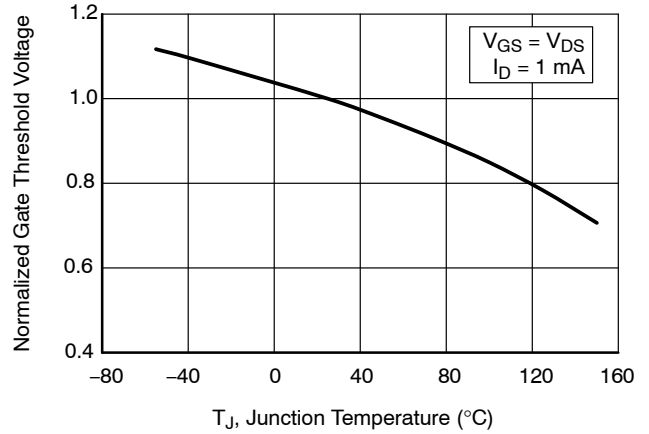


Figure 16. Normalized Gate Threshold Voltage vs. Temperature

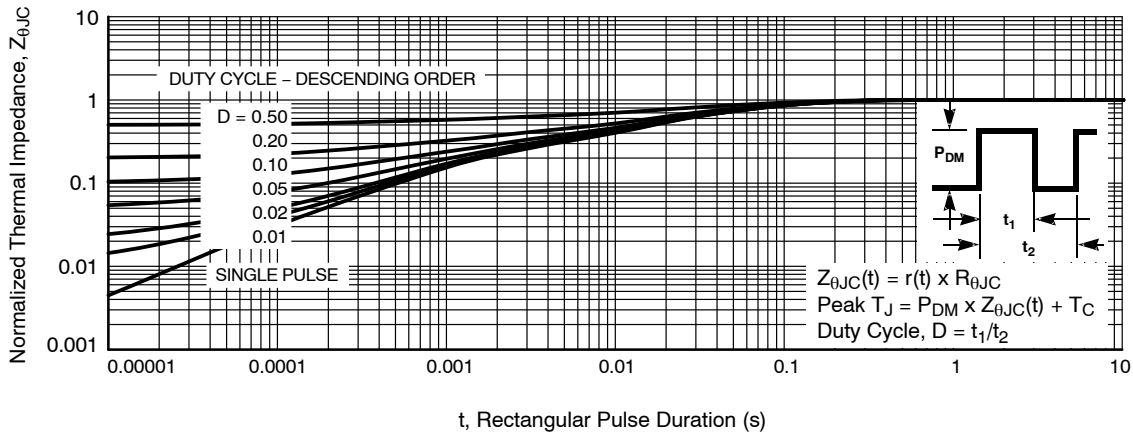
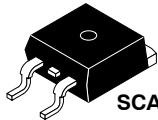


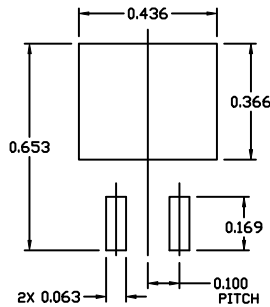
Figure 17. Normalized Maximum Transient Thermal Impedance



SCALE 1:1

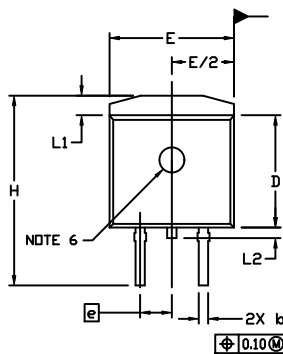
**D<sup>2</sup>PAK-3 (TO-263, 3-LEAD)**  
CASE 418AJ  
ISSUE F

DATE 11 MAR 2021



**RECOMMENDED  
MOUNTING FOOTPRINT**

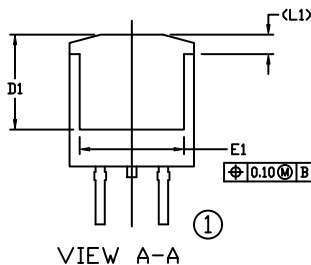
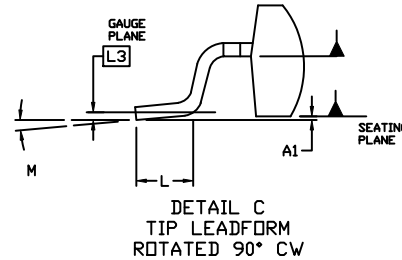
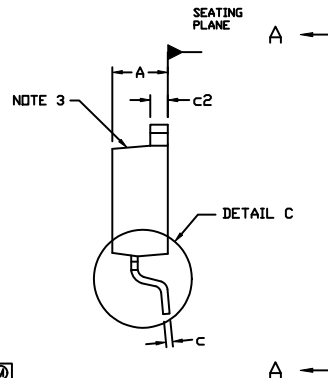
For additional information on our Pb-free strategy and soldering details, please download the ON Semiconductor Soldering and Mounting Techniques Reference Manual, SOLDERM1.



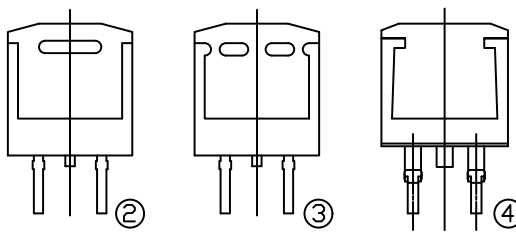
**NOTES:**

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.

| 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   | 0°        | 8°    | 0°          | 8°    |

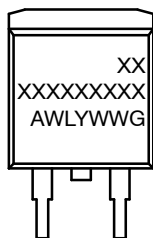


VIEW A-A

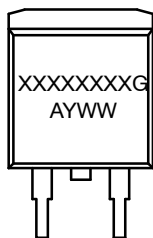


VIEW A-A  
OPTIONAL CONSTRUCTIONS

**GENERIC MARKING DIAGRAMS\***



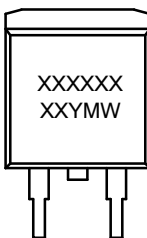
IC



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.

|                         |                                            |                                                                                                                                                                                  |
|-------------------------|--------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
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| <b>DESCRIPTION:</b>     | <b>D<sup>2</sup>PAK-3 (TO-263, 3-LEAD)</b> | <b>PAGE 1 OF 1</b>                                                                                                                                                               |

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onsemi Website: [www.onsemi.com](http://www.onsemi.com)

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