

# MOSFET - Single N-Channel

100 V, 9.0 mΩ, 60 A

## NTBS9D0N10MC

### Features

- Low  $R_{DS(on)}$  to Minimize Conduction Losses
- Low  $Q_G$  and Capacitance to Minimize Driver Losses
- Lowers Switching Noise/EMI
- These Devices are Pb-Free, Halogen Free/BFR Free and are RoHS Compliant

### Typical Applications

- Power Tools, Battery Operated Vacuums
- UAV/Drones, Material Handling
- BMS/Storage, Home Automation

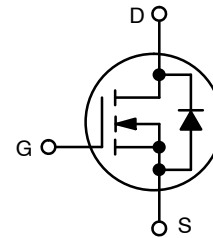
### MAXIMUM RATINGS ( $T_J = 25^\circ\text{C}$ unless otherwise noted)

| Parameter                                                                                      |                                                |                       | Symbol                            | Value       | Unit |
|------------------------------------------------------------------------------------------------|------------------------------------------------|-----------------------|-----------------------------------|-------------|------|
| Drain-to-Source Voltage                                                                        |                                                |                       | V <sub>DSS</sub>                  | 100         | V    |
| Gate-to-Source Voltage                                                                         |                                                |                       | V <sub>GS</sub>                   | ±20         | V    |
| Continuous Drain Current R <sub>θJC</sub> (Note 2)                                             | Steady State                                   | T <sub>C</sub> = 25°C | I <sub>D</sub>                    | 60          | A    |
| Power Dissipation R <sub>θJC</sub> (Note 2)                                                    |                                                |                       | P <sub>D</sub>                    | 68          | W    |
| Continuous Drain Current R <sub>θJA</sub> (Notes 1, 2)                                         | Steady State                                   | T <sub>A</sub> = 25°C | I <sub>D</sub>                    | 14          | A    |
| Power Dissipation R <sub>θJA</sub> (Notes 1, 2)                                                |                                                |                       | P <sub>D</sub>                    | 3.8         | W    |
| Pulsed Drain Current                                                                           | T <sub>C</sub> = 25°C, t <sub>p</sub> = 100 μs |                       | I <sub>DM</sub>                   | 239         | A    |
| Operating Junction and Storage Temperature Range                                               |                                                |                       | T <sub>J</sub> , T <sub>stg</sub> | -55 to +175 | °C   |
| Source Current (Body Diode)                                                                    |                                                |                       | I <sub>S</sub>                    | 57          | A    |
| Single Pulse Drain-to-Source Avalanche Energy (I <sub>L</sub> = 11 A <sub>pk</sub> , L = 3 mH) |                                                |                       | E <sub>AS</sub>                   | 181.5       | mJ   |
| Lead Temperature for Soldering Purposes (1/8" from case for 10 s)                              |                                                |                       | T <sub>L</sub>                    | 260         | °C   |

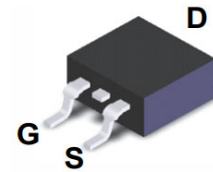
Stresses exceeding those listed in the Maximum Ratings table may damage the device. If any of these limits are exceeded, device functionality should not be assumed, damage may occur and reliability may be affected.

1. Surface-mounted on FR4 board using a 1 in<sup>2</sup>, 2 oz. Cu pad.
2. The entire application environment impacts the thermal resistance values shown, they are not constants and are only valid for the particular conditions noted.

| $V_{(BR)DS}$ | $R_{DS(ON)} \text{ MAX}$ | $I_D \text{ MAX}$ |
|--------------|--------------------------|-------------------|
| 100 V        | 9.0 mΩ @ 10 V            | 60 A              |



N-CHANNEL MOSFET



D<sup>2</sup>PAK3  
TO-263  
CASE 418AJ

### MARKING DIAGRAM

AYWWZZ  
NTBS9D0  
N10MC

A = Assembly Location  
Y = Year  
WW = Work Week  
ZZ = Lot Traceability  
NTBS9D0N10MC = Specific Device Code

### ORDERING INFORMATION

| Device       | Package                      | Shipping†         |
|--------------|------------------------------|-------------------|
| NTBS9D0N10MC | D <sup>2</sup> PAK (Pb-Free) | 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.

# NTBS9D0N10MC

## THERMAL RESISTANCE MAXIMUM RATINGS

| Parameter                                       | Symbol          | Value | Unit |
|-------------------------------------------------|-----------------|-------|------|
| Junction-to-Case – Steady State (Note 2)        | $R_{\theta JC}$ | 2.2   | °C/W |
| Junction-to-Ambient – Steady State (Notes 1, 2) | $R_{\theta JA}$ | 40    |      |

## ELECTRICAL CHARACTERISTICS ( $T_J = 25^\circ\text{C}$ unless otherwise specified)

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

### OFF CHARACTERISTICS

|                                                           |                   |                                                                   |                           |    |           |               |
|-----------------------------------------------------------|-------------------|-------------------------------------------------------------------|---------------------------|----|-----------|---------------|
| Drain-to-Source Breakdown Voltage                         | $V_{(BR)DSS}$     | $V_{GS} = 0\text{ V}, I_D = 250\text{ }\mu\text{A}$               | 100                       |    |           | V             |
| Drain-to-Source Breakdown Voltage Temperature Coefficient | $V_{(BR)DSS}/T_J$ | $I_D = 250\text{ }\mu\text{A}$ , referenced to $25^\circ\text{C}$ |                           | 56 |           | mV/°C         |
| Zero Gate Voltage Drain Current                           | $I_{DSS}$         | $V_{GS} = 0\text{ V}, V_{DS} = 80\text{ V}$                       | $T_J = 25^\circ\text{C}$  |    | 1         | $\mu\text{A}$ |
|                                                           |                   |                                                                   | $T_J = 150^\circ\text{C}$ |    | 100       | $\mu\text{A}$ |
| Gate-to-Source Leakage Current                            | $I_{GSS}$         | $V_{GS} = \pm 20\text{ V}, V_{DS} = 0\text{ V}$                   |                           |    | $\pm 100$ | nA            |

### ON CHARACTERISTICS (Note 3)

|                                            |                  |                                                                   |     |      |      |            |
|--------------------------------------------|------------------|-------------------------------------------------------------------|-----|------|------|------------|
| Gate Threshold Voltage                     | $V_{GS(TH)}$     | $V_{GS} = V_{DS}, I_D = 131\text{ }\mu\text{A}$                   | 2.0 | 3.0  | 4.0  | V          |
| Negative Threshold Temperature Coefficient | $V_{GS(TH)}/T_J$ | $I_D = 131\text{ }\mu\text{A}$ , referenced to $25^\circ\text{C}$ |     | -9.6 |      | mV/°C      |
| Drain-to-Source On Resistance              | $R_{DS(on)}$     | $V_{GS} = 10\text{ V}, I_D = 23\text{ A}$                         |     | 7.8  | 9.0  | m $\Omega$ |
|                                            |                  | $V_{GS} = 6\text{ V}, I_D = 12\text{ A}$                          |     | 12   | 22.2 |            |
| Forward Transconductance                   | $g_{FS}$         | $V_{DS} = 10\text{ V}, I_D = 23\text{ A}$                         |     | 59   |      | S          |
| Gate-Resistance                            | $R_G$            | $T_A = 25^\circ\text{C}$                                          |     | 0.6  |      | $\Omega$   |

### CHARGES & CAPACITANCES

|                              |              |                                                                 |  |      |  |    |
|------------------------------|--------------|-----------------------------------------------------------------|--|------|--|----|
| Input Capacitance            | $C_{ISS}$    | $V_{GS} = 0\text{ V}, f = 1\text{ MHz}, V_{DS} = 50\text{ V}$   |  | 1695 |  | pF |
| Output Capacitance           | $C_{OSS}$    |                                                                 |  | 935  |  |    |
| Reverse Transfer Capacitance | $C_{RSS}$    |                                                                 |  | 13   |  |    |
| Total Gate Charge            | $Q_{G(TOT)}$ | $V_{GS} = 10\text{ V}, V_{DS} = 50\text{ V}, I_D = 23\text{ A}$ |  | 23   |  | nC |
| Threshold Gate Charge        | $Q_{G(TH)}$  |                                                                 |  | 5    |  |    |
| Gate-to-Source Charge        | $Q_{GS}$     |                                                                 |  | 8    |  |    |
| Gate-to-Drain Charge         | $Q_{GD}$     |                                                                 |  | 5    |  |    |
| Output Charge                | $Q_{OSS}$    | $V_{DS} = 50\text{ V}, V_{GS} = 0\text{ V}$                     |  | 59   |  |    |

### SWITCHING CHARACTERISTICS, $V_{GS} = 10\text{ V}$ (Note 3)

|                     |              |                                                                                        |  |    |  |    |
|---------------------|--------------|----------------------------------------------------------------------------------------|--|----|--|----|
| Turn-On Delay Time  | $t_{d(ON)}$  | $V_{GS} = 10\text{ V}, V_{DS} = 50\text{ V}, I_D = 23\text{ A}, R_G = 6\text{ }\Omega$ |  | 15 |  | ns |
| Rise Time           | $t_r$        |                                                                                        |  | 6  |  |    |
| Turn-Off Delay Time | $t_{d(OFF)}$ |                                                                                        |  | 21 |  |    |
| Fall Time           | $t_f$        |                                                                                        |  | 7  |  |    |

### DRAIN-SOURCE DIODE CHARACTERISTICS

|                         |          |                                                                               |  |      |     |    |
|-------------------------|----------|-------------------------------------------------------------------------------|--|------|-----|----|
| Forward Diode Voltage   | $V_{SD}$ | $V_{GS} = 0\text{ V}, I_S = 23\text{ A}, T_J = 25^\circ\text{C}$              |  | 0.87 | 1.2 | V  |
|                         |          | $V_{GS} = 0\text{ V}, I_S = 23\text{ A}, T_J = 150^\circ\text{C}$             |  | 0.72 |     |    |
| Reverse Recovery Time   | $t_{RR}$ | $V_{GS} = 0\text{ V}, dI_S/dt = 300\text{ A}/\mu\text{s}, I_S = 12\text{ A}$  |  | 29   |     | ns |
| Reverse Recovery Charge | $Q_{RR}$ |                                                                               |  | 61   |     | nC |
| Reverse Recovery Time   | $t_{RR}$ | $V_{GS} = 0\text{ V}, dI_S/dt = 1000\text{ A}/\mu\text{s}, I_S = 12\text{ A}$ |  | 23   |     | ns |
| Reverse Recovery Charge | $Q_{RR}$ |                                                                               |  | 147  |     | 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.

3. Switching characteristics are independent of operating junction temperature



TYPICAL CHARACTERISTICS

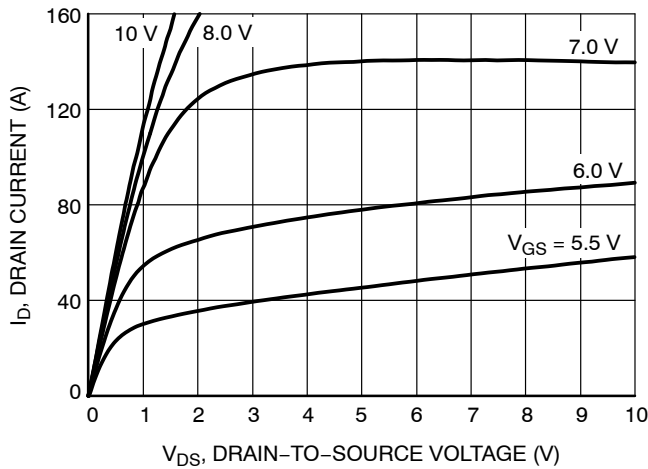


Figure 1. On-Region Characteristics

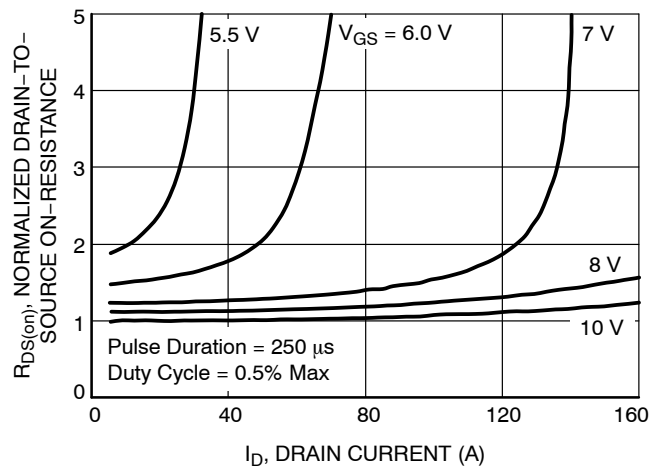


Figure 2. Normalized On-Resistance vs. Drain Current and Gate Voltage

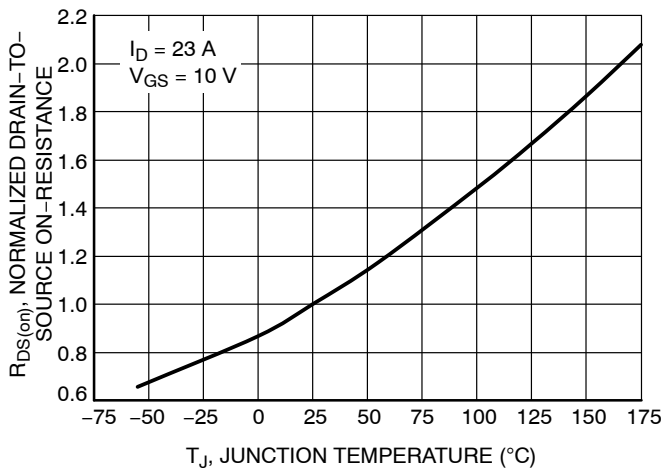


Figure 3. Normalized On-Resistance vs. Junction Temperature

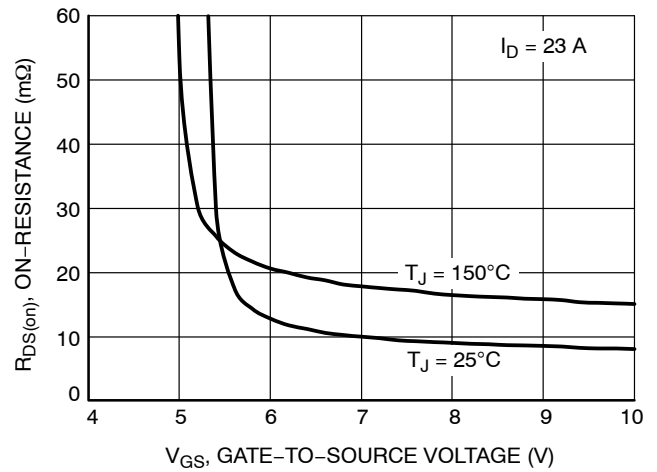


Figure 4. On-Resistance vs. Gate-to-Source Voltage

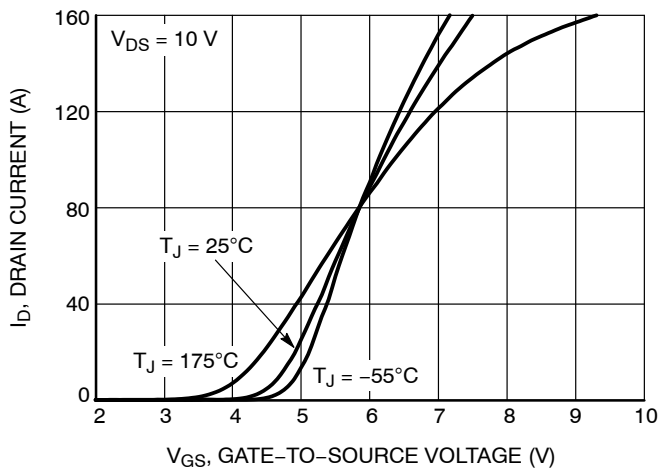


Figure 5. Transfer Characteristics

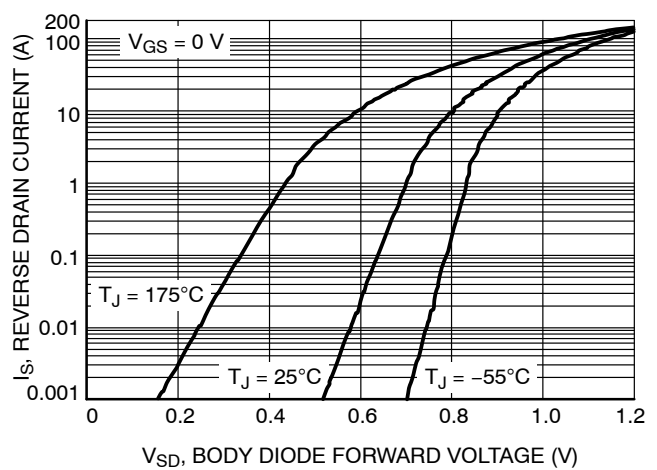


Figure 6. Source-to-Drain Diode Forward Voltage vs. Source Current

TYPICAL CHARACTERISTICS

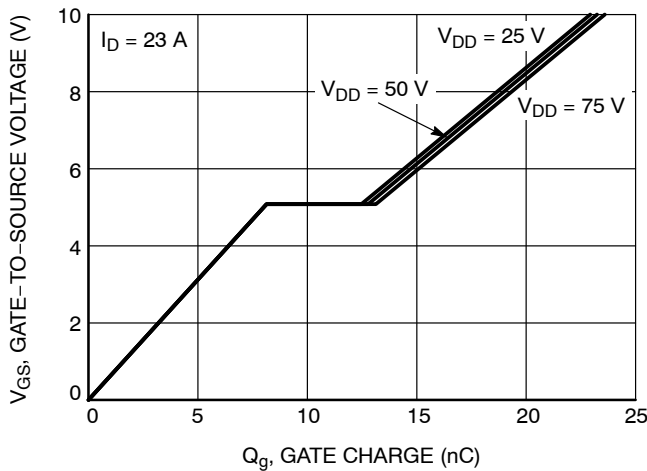


Figure 7. Gate Charge Characteristics

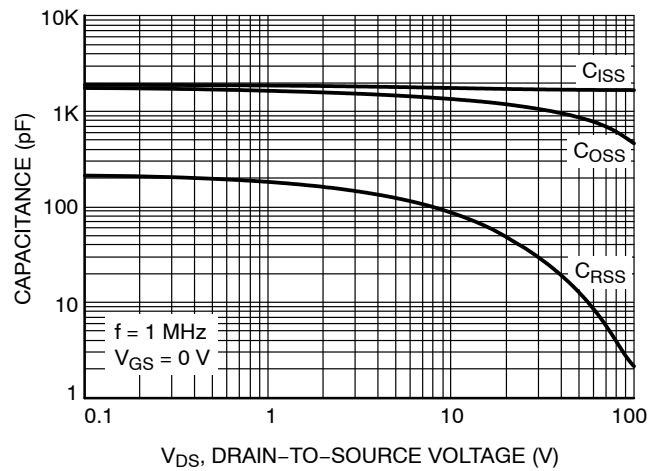


Figure 8. Capacitance vs. Drain-to-Source Voltage

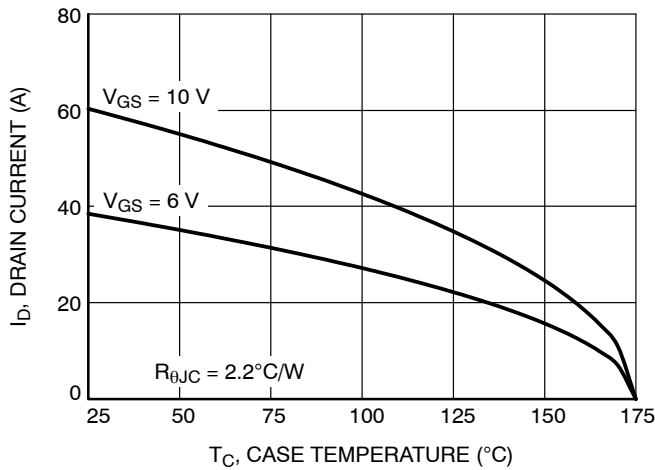


Figure 9. Drain Current vs. Case Temperature

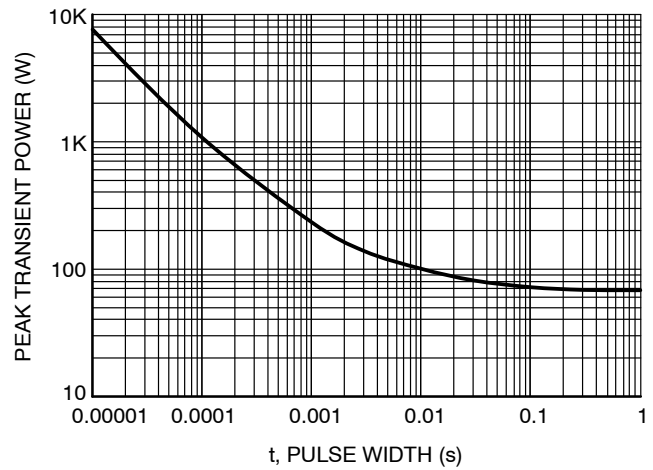


Figure 10. Peak Power

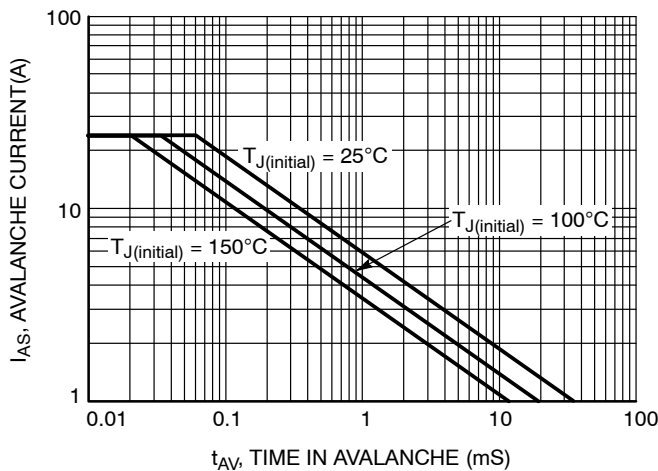


Figure 11. Unclamped Inductive Switching Capability

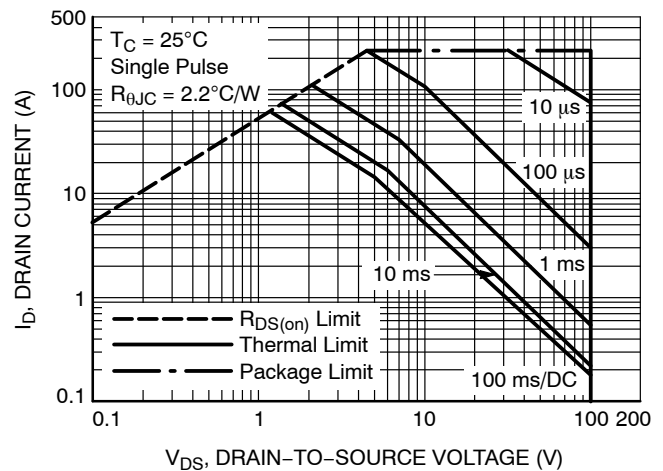


Figure 12. Forward Bias Safe Operating Area

TYPICAL CHARACTERISTICS

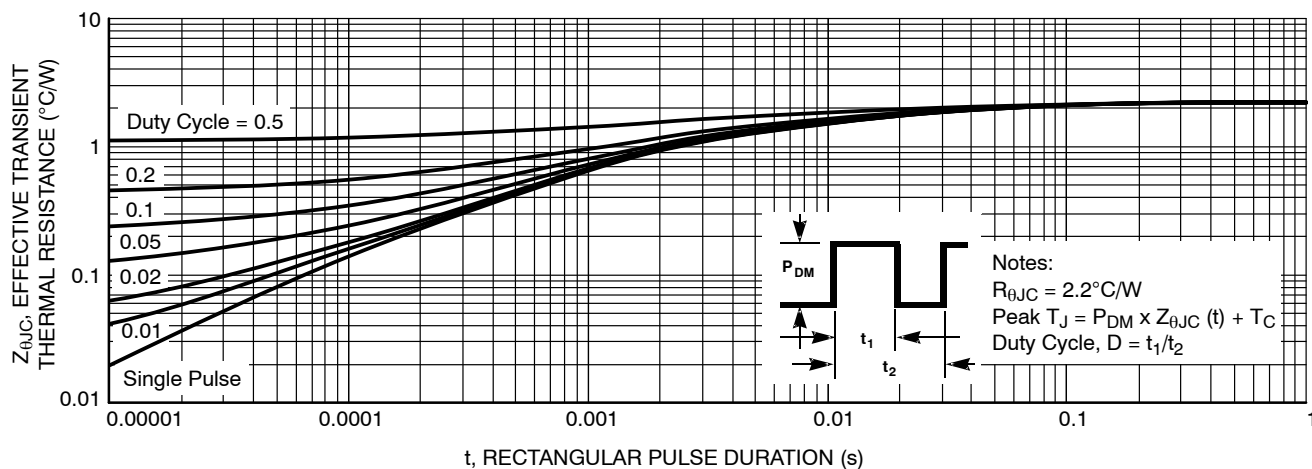
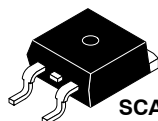


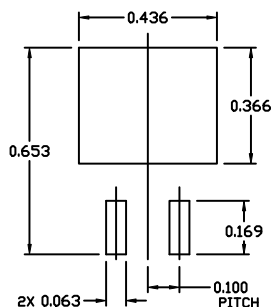
Figure 13. Transient Thermal Impedance



SCALE 1:1

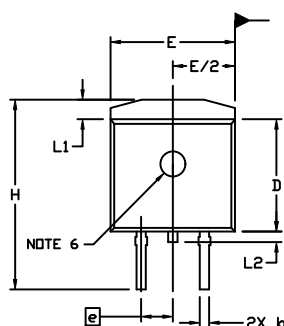
**D<sup>2</sup>PAK-3 (TO-263, 3-LEAD)**  
CASE 418AJ  
ISSUE F

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, SOLDERRM/D.

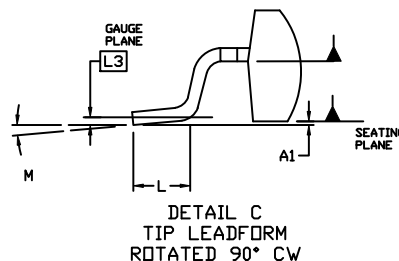
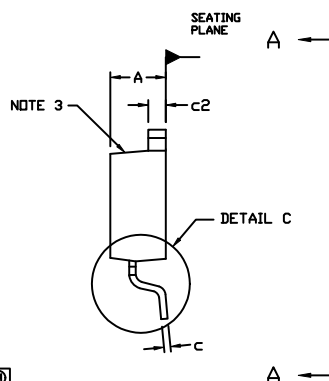


0.100 BSC 0.100 BSC 0.100 BSC

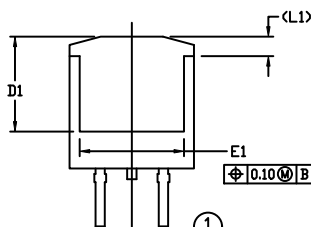
**NOTES:**

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.

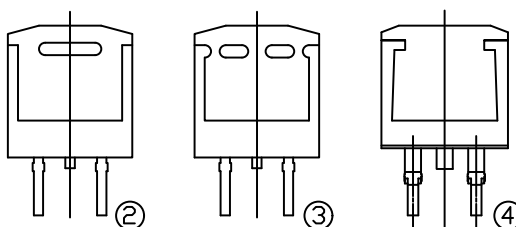
| DIM | INCHES    |       | MILLIMETERS |       |
|-----|-----------|-------|-------------|-------|
|     | MIN.      | MAX.  | MIN.        | MAX.  |
| A   | 0.160     | 0.190 | 4.06        | 4.83  |
| A1  | 0.000     | 0.010 | 0.00        | 0.25  |
| b   | 0.020     | 0.039 | 0.51        | 0.99  |
| 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°    |



DETAIL C  
TIP LEADFORM  
ROTATED 90° CW

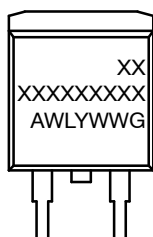


VIEW A-A

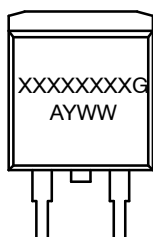


VIEW A-A  
OPTIONAL CONSTRUCTIONS

**GENERIC MARKING DIAGRAMS\***



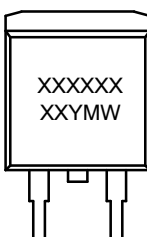
IC



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.

|                         |                                            |                                                                                                                                                                                  |
|-------------------------|--------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
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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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