



# THE DATASHEET OF NTMS4503NR2

# NTMS4503N

## Power MOSFET

28 V, 14 A, N-Channel, SOIC-8

### Features

- Low  $R_{DS(on)}$
- High Power and Current Handling Capability
- Low Gate Charge
- Pb-Free Package is Available

### Applications

- DC/DC Converters
- Motor Drives
- Synchronous Rectifier – POL
- Buck Low-Side

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

| Rating                                                                                                                                                                                                            | Symbol         | Value          | Unit             |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------|----------------|------------------|
| Drain-to-Source Voltage                                                                                                                                                                                           | $V_{DS}$       | 28             | V                |
| Gate-to-Source Voltage – Continuous                                                                                                                                                                               | $V_{GS}$       | $\pm 20$       | V                |
| Drain Current                                                                                                                                                                                                     | $I_D$          |                | A                |
| Continuous @ $T_A = 25^\circ\text{C}$ (Note 1)                                                                                                                                                                    |                | 14             |                  |
| Continuous @ $T_A = 25^\circ\text{C}$ (Note 2)                                                                                                                                                                    |                | 12             |                  |
| Continuous @ $T_A = 25^\circ\text{C}$ (Note 3)                                                                                                                                                                    |                | 9.0            |                  |
| Single Pulse ( $t_p = 10 \mu\text{s}$ )                                                                                                                                                                           | $I_{DM}$       | 40             |                  |
| Total Power Dissipation                                                                                                                                                                                           | $P_D$          |                | W                |
| $T_A = 25^\circ\text{C}$ (Note 1)                                                                                                                                                                                 |                | 2.5            |                  |
| $T_A = 25^\circ\text{C}$ (Note 2)                                                                                                                                                                                 |                | 1.66           |                  |
| $T_A = 25^\circ\text{C}$ (Note 3)                                                                                                                                                                                 |                | 0.93           |                  |
| Operating and Storage Temperature                                                                                                                                                                                 | $T_J, T_{stg}$ | $-55$ to $150$ | $^\circ\text{C}$ |
| Single Pulse Drain-to-Source Avalanche Energy – Starting $T_J = 25^\circ\text{C}$<br>( $V_{DD} = 30 \text{ V}$ , $V_{GS} = 10 \text{ V}$ , $I_L = 12.2 \text{ A}$ ,<br>$L = 1.0 \text{ mH}$ , $R_G = 25 \Omega$ ) | $E_{AS}$       | 75             | mJ               |
| Maximum Lead Temperature for Soldering Purposes, $1/8''$ from case for 10 seconds                                                                                                                                 | $T_L$          | 260            | $^\circ\text{C}$ |

### THERMAL RESISTANCE RATINGS

| Rating                       | Symbol          | Value | Unit               |
|------------------------------|-----------------|-------|--------------------|
| Thermal Resistance           | $R_{\theta JA}$ |       | $^\circ\text{C/W}$ |
| Junction-to-Ambient (Note 1) |                 | 50    |                    |
| Junction-to-Ambient (Note 2) |                 | 75    |                    |
| Junction-to-Ambient (Note 3) |                 | 135   |                    |

Stresses exceeding Maximum Ratings may damage the device. Maximum Ratings are stress ratings only. Functional operation above the Recommended Operating Conditions is not implied. Extended exposure to stresses above the Recommended Operating Conditions may affect device reliability.

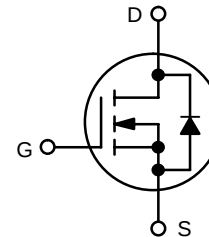
1. Surface-mounted on FR4 board using minimum recommended pad size (Cu area 0.412 in sq),  $t < 10 \text{ s}$ .
2. Surface-mounted on FR4 board using  $1''$  pad size (Cu area 1.127 in sq) steady state.
3. Surface-mounted on FR4 board using minimum recommended pad size (Cu area 0.412 in sq), steady state.



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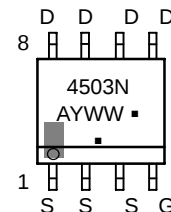
| $V_{(BR)DSS}$ | $R_{DS(on)}$ Typ       | $I_D$ Max (Note 1) |
|---------------|------------------------|--------------------|
| 28 V          | 7.0 m $\Omega$ @ 10 V  | 14 A               |
|               | 8.8 m $\Omega$ @ 4.5 V |                    |



### MARKING DIAGRAM & PIN ASSIGNMENT



SOIC-8  
CASE 751  
STYLE 12



4503N = Specific Device Code  
A = Assembly Location  
Y = Year  
WW = Work Week  
■ = Pb-Free Package

(Note: Microdot may be in either location)

### ORDERING INFORMATION

| Device       | Package          | Shipping†        |
|--------------|------------------|------------------|
| NTMS4503NR2  | SOIC-8           | 2500/Tape & Reel |
| NTMS4503NR2G | SOIC-8 (Pb-Free) | 2500/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.

# NTMS4503N

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

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

### OFF CHARACTERISTICS

|                                                           |                   |                                                     |                           |    |    |           |               |
|-----------------------------------------------------------|-------------------|-----------------------------------------------------|---------------------------|----|----|-----------|---------------|
| Drain-to-Source Breakdown Voltage                         | $V_{(BR)DSS}$     | $V_{GS} = 0\text{ V}, I_D = 250\text{ }\mu\text{A}$ |                           | 28 | 31 | –         | V             |
| Drain-to-Source Breakdown Voltage Temperature Coefficient | $V_{(BR)DSS}/T_J$ | –                                                   |                           | –  | 22 | –         | mV/°C         |
| Zero Gate Voltage Drain Current                           | $I_{DSS}$         | $V_{GS} = 0\text{ V}, V_{DS} = 24\text{ V}$         | $T_J = 25^\circ\text{C}$  | –  | –  | 1.0       | $\mu\text{A}$ |
|                                                           |                   |                                                     | $T_J = 100^\circ\text{C}$ | –  | –  | 25        |               |
| Gate-to-Source Leakage Current                            | $I_{GSS}$         | $V_{DS} = 0\text{ V}, V_{GS} = \pm 20\text{ V}$     |                           | –  | –  | $\pm 100$ | nA            |

### ON CHARACTERISTICS (Note 4)

|                                            |                  |                                                 |     |      |     |            |
|--------------------------------------------|------------------|-------------------------------------------------|-----|------|-----|------------|
| Gate Threshold Voltage                     | $V_{GS(TH)}$     | $V_{GS} = V_{DS}, I_D = 250\text{ }\mu\text{A}$ | 1.0 | –    | 2.0 | V          |
| Negative Threshold Temperature Coefficient | $V_{GS(TH)}/T_J$ | –                                               | –   | –5.0 | –   | mV/°C      |
| Drain-to-Source On Resistance              | $R_{DS(on)}$     | $V_{GS} = 10\text{ V}, I_D = 14\text{ A}$       | –   | 7.0  | 8.0 | m $\Omega$ |
|                                            |                  | $V_{GS} = 4.5\text{ V}, I_D = 10\text{ A}$      | –   | 8.8  | 9.8 |            |
| Forward Transconductance                   | $g_{FS}$         | $V_{DS} = 10\text{ V}, I_D = 14\text{ A}$       | –   | 30   | –   | S          |

### CHARGES, CAPACITANCES AND GATE RESISTANCE

|                              |              |                                                                  |   |      |   |    |
|------------------------------|--------------|------------------------------------------------------------------|---|------|---|----|
| Input Capacitance            | $C_{ISS}$    | $V_{GS} = 0\text{ V}, f = 1.0\text{ MHz}, V_{DS} = 16\text{ V}$  | – | 2400 | – | pF |
| Output Capacitance           | $C_{OSS}$    |                                                                  | – | 1000 | – |    |
| Reverse Transfer Capacitance | $C_{RSS}$    |                                                                  | – | 375  | – |    |
| Total Gate Charge            | $Q_{G(TOT)}$ | $V_{GS} = 4.5\text{ V}, V_{DS} = 16\text{ V}, I_D = 10\text{ A}$ | – | 23   | – | nC |
| Threshold Gate Charge        | $Q_{G(TH)}$  |                                                                  | – | 2.0  | – |    |
| Gate-to-Source Charge        | $Q_{GS}$     |                                                                  | – | 5.0  | – |    |
| Gate-to-Drain Charge         | $Q_{GD}$     |                                                                  | – | 12   | – |    |

### SWITCHING CHARACTERISTICS, $V_{GS} = V$ (Note 5)

|                     |              |                                                                                           |   |      |   |    |
|---------------------|--------------|-------------------------------------------------------------------------------------------|---|------|---|----|
| Turn-On Delay Time  | $t_{d(ON)}$  | $V_{GS} = 4.5\text{ V}, V_{DD} = 16\text{ V}, I_D = 10\text{ A}, R_G = 2.0\text{ }\Omega$ | – | 18.5 | – | ns |
| Rise Time           | $t_r$        |                                                                                           | – | 70   | – |    |
| Turn-Off Delay Time | $t_{d(OFF)}$ |                                                                                           | – | 21   | – |    |
| Fall Time           | $t_f$        |                                                                                           | – | 23   | – |    |

### DRAIN-SOURCE DIODE CHARACTERISTICS

|                         |          |                                                                                            |                             |   |      |     |    |
|-------------------------|----------|--------------------------------------------------------------------------------------------|-----------------------------|---|------|-----|----|
| Forward Diode Voltage   | $V_{SD}$ | $V_{GS} = 0\text{ V}, I_S = 10\text{ A}$                                                   | $T_J = 25^{\circ}\text{C}$  | – | 0.82 | 1.2 | V  |
|                         |          |                                                                                            | $T_J = 125^{\circ}\text{C}$ | – | 0.65 | –   |    |
| Reverse Recovery Time   | $t_{RR}$ | $V_{GS} = 0\text{ V},$<br>$dI_{SD}/d_t = 100\text{ A}/\mu\text{s},$<br>$I_S = 14\text{ A}$ |                             | – | 48   | –   | ns |
| Charge Time             | $T_a$    |                                                                                            |                             | – | 23   | –   |    |
| Discharge Time          | $T_b$    |                                                                                            |                             | – | 25   | –   |    |
| Reverse Recovery Charge | $Q_{RR}$ |                                                                                            |                             | – | 25   | –   | nC |

4. Pulse Test: Pulse Width  $\leq 300\text{ }\mu\text{s}$ , Duty Cycle  $\leq 2\%$ .

5. Switching characteristics are independent of operating junction temperatures.

TYPICAL PERFORMANCE CURVES

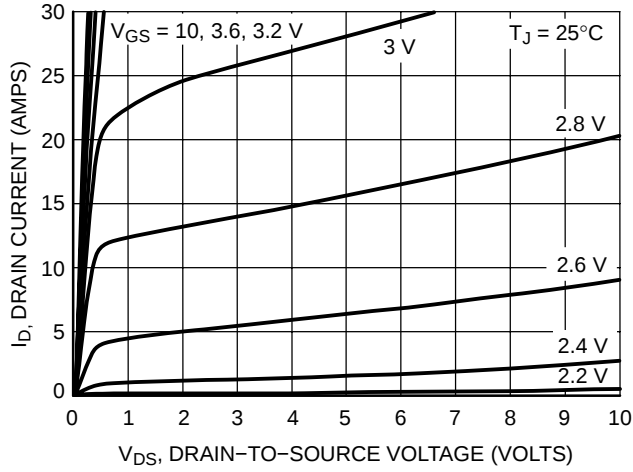


Figure 1. On-Region Characteristics

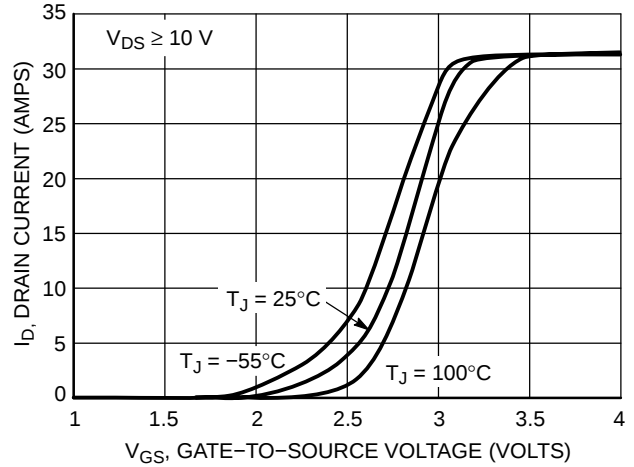


Figure 2. Transfer Characteristics

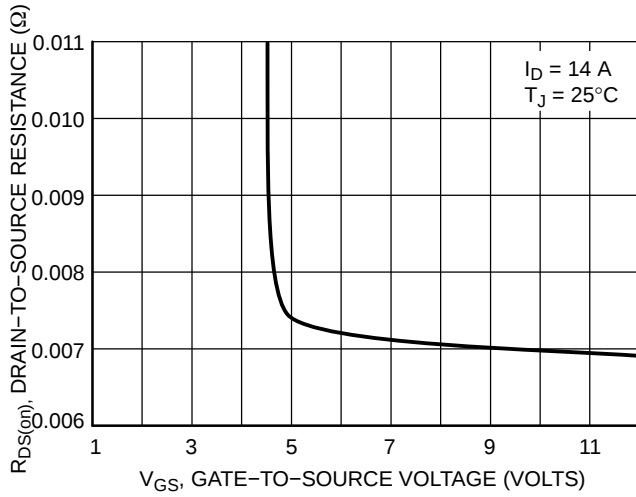


Figure 3. On-Resistance vs. Gate-to-Source Voltage

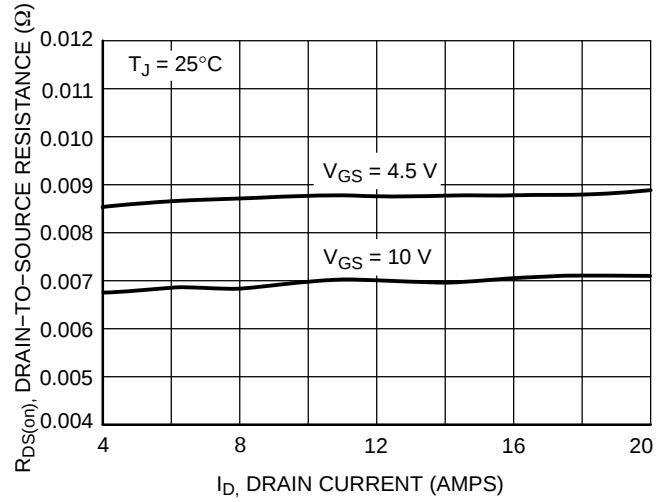


Figure 4. On-Resistance vs. Drain Current and Gate Voltage

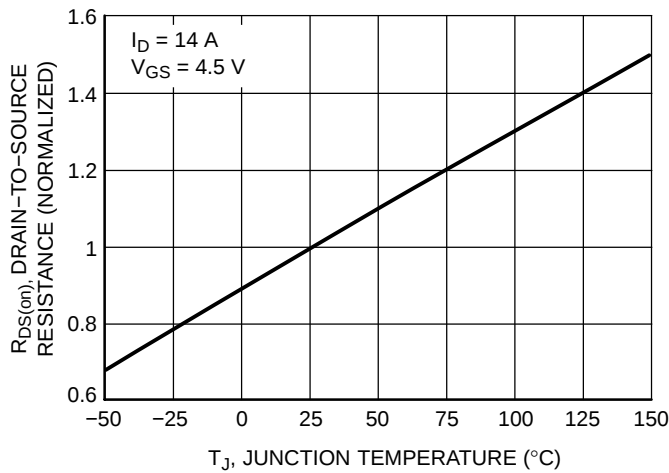


Figure 5. On-Resistance Variation with Temperature

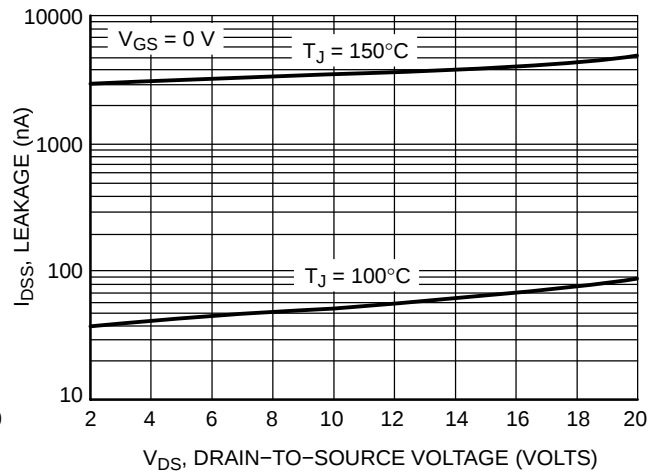


Figure 6. Drain-to-Source Leakage Current vs. Voltage

TYPICAL PERFORMANCE CURVES

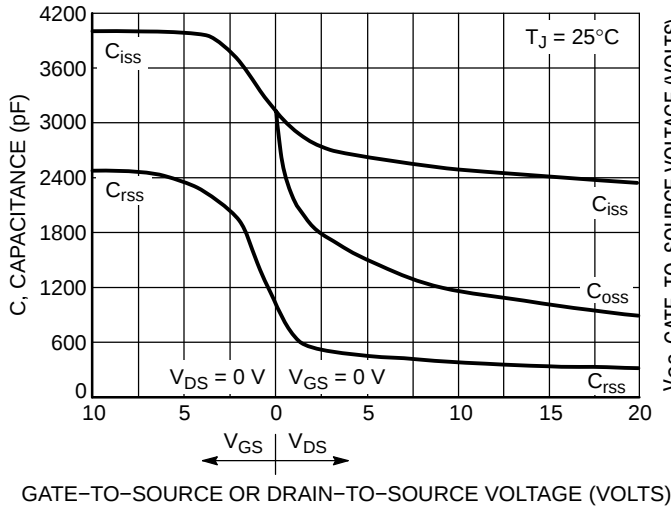


Figure 7. Capacitance Variation

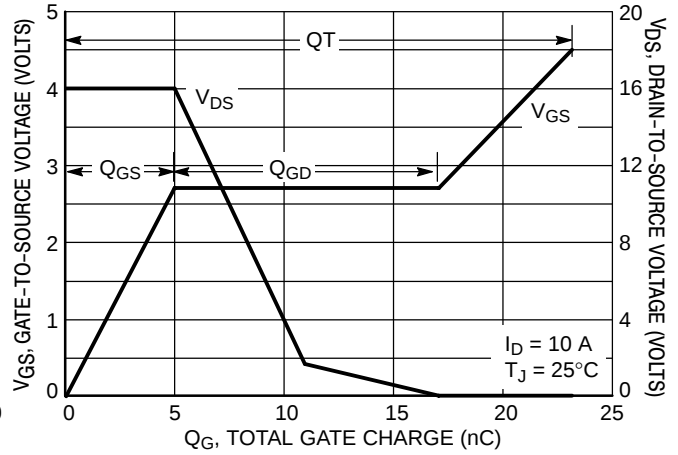


Figure 8. Gate-To-Source and Drain-To-Source Voltage vs. Total Charge

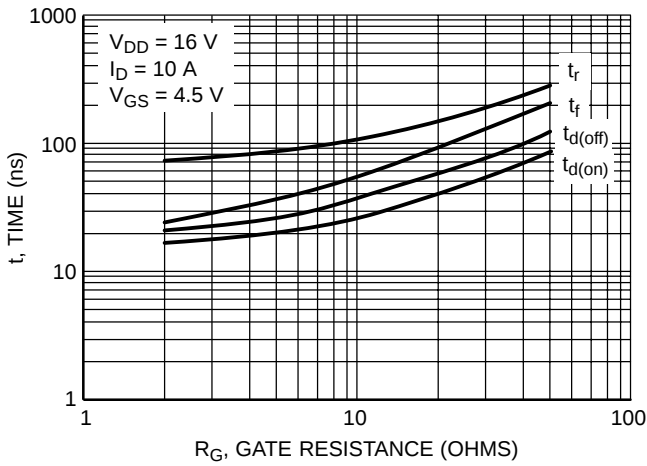


Figure 9. Resistive Switching Time Variation vs. Gate Resistance

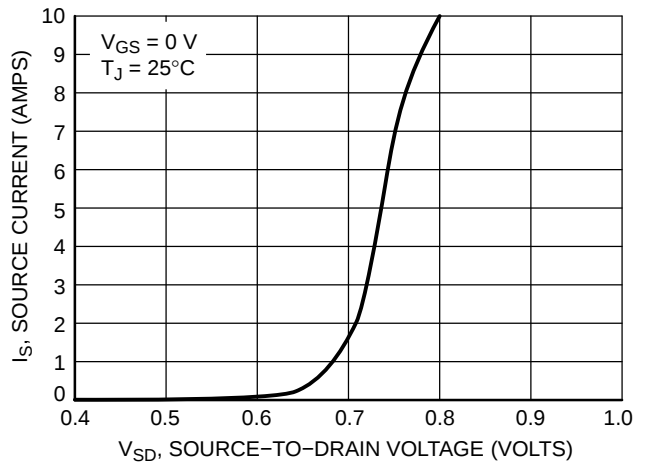
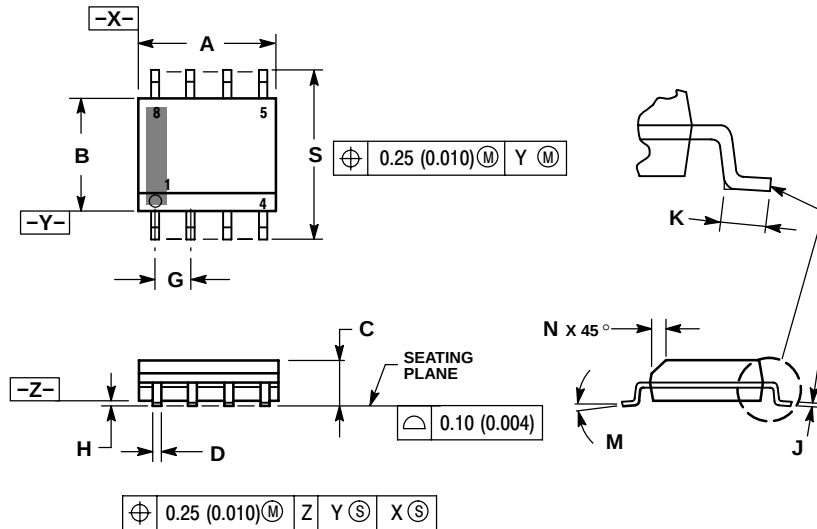


Figure 10. Diode Forward Voltage vs. Current

# NTMS4503N

## PACKAGE DIMENSIONS

### SOIC-8 NB CASE 751-07 ISSUE AH



#### NOTES:

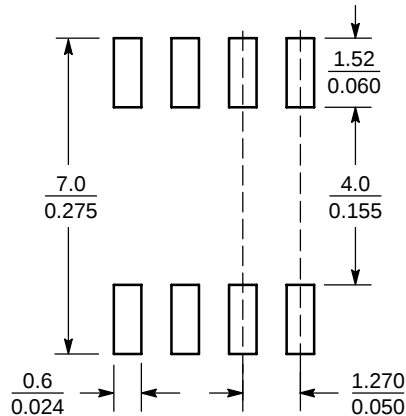
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: MILLIMETER.
3. DIMENSION A AND B DO NOT INCLUDE MOLD PROTRUSION.
4. MAXIMUM MOLD PROTRUSION 0.15 (0.006) PER SIDE.
5. DIMENSION D DOES NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE DAMBAR PROTRUSION SHALL BE 0.127 (0.005) TOTAL IN EXCESS OF THE D DIMENSION AT MAXIMUM MATERIAL CONDITION.
6. 751-01 THRU 751-06 ARE OBSOLETE. NEW STANDARD IS 751-07.

| DIM | MILLIMETERS |      | INCHES    |       |
|-----|-------------|------|-----------|-------|
|     | MIN         | MAX  | MIN       | MAX   |
| A   | 4.80        | 5.00 | 0.189     | 0.197 |
| B   | 3.80        | 4.00 | 0.150     | 0.157 |
| C   | 1.35        | 1.75 | 0.053     | 0.069 |
| D   | 0.33        | 0.51 | 0.013     | 0.020 |
| G   | 1.27 BSC    |      | 0.050 BSC |       |
| H   | 0.10        | 0.25 | 0.004     | 0.010 |
| J   | 0.19        | 0.25 | 0.007     | 0.010 |
| K   | 0.40        | 1.27 | 0.016     | 0.050 |
| M   | 0°          | 8°   | 0°        | 8°    |
| N   | 0.25        | 0.50 | 0.010     | 0.020 |
| S   | 5.80        | 6.20 | 0.228     | 0.244 |

#### STYLE 12:

- PIN 1. SOURCE
- SOURCE
- SOURCE
- GATE
- DRAIN
- DRAIN
- DRAIN
- DRAIN

### SOLDERING FOOTPRINT\*



SCALE 6:1 (mm inches)

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

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