

# NTR0202PL, NVTR0202PL

## MOSFET – Power, P-Channel, SOT-23

**-20 V, -400 mA**

### Features

- Low  $R_{DS(on)}$  Provides Higher Efficiency and Extends Battery Life  
 $R_{DS(on)} = 0.80 \Omega$ ,  $V_{GS} = -10 \text{ V}$   
 $R_{DS(on)} = 1.10 \Omega$ ,  $V_{GS} = -4.5 \text{ V}$
- Miniature SOT-23 Surface Mount Package Saves Board Space
- NVT Prefix for Automotive and Other Applications Requiring Unique Site and Control Change Requirements; AEC-Q101 Qualified and PPAP Capable
- These Devices are Pb-Free and are RoHS Compliant

### Applications

- DC-DC Converters
- Computers
- Printers
- PCMCIA Cards
- Cellular and Cordless Telephones

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

| Rating                                                                                                    | Symbol            | Value        | Unit               |
|-----------------------------------------------------------------------------------------------------------|-------------------|--------------|--------------------|
| Drain-to-Source Voltage                                                                                   | $V_{DS}$          | -20          | V                  |
| Gate-to-Source Voltage – Continuous                                                                       | $V_{GS}$          | $\pm 20$     | V                  |
| Continuous Drain Current @ $T_A = 25^\circ\text{C}$<br>Pulsed Drain Current ( $t_p \leq 10 \mu\text{s}$ ) | $I_D$<br>$I_{DM}$ | -0.4<br>-1.0 | A                  |
| Total Power Dissipation @ $T_A = 25^\circ\text{C}$ (Note 1)                                               | $P_D$             | 225          | mW                 |
| Operating and Storage Temperature Range                                                                   | $T_J$ , $T_{stg}$ | -55 to 150   | $^\circ\text{C}$   |
| Thermal Resistance – Junction-to-Ambient                                                                  | $R_{\theta JA}$   | 556          | $^\circ\text{C/W}$ |
| Source Current (Body Diode)                                                                               | $I_S$             | 0.4          | A                  |
| Maximum Lead Temperature for Soldering Purposes, 1/8" from case for 10 s                                  | $T_L$             | 260          | $^\circ\text{C}$   |

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.

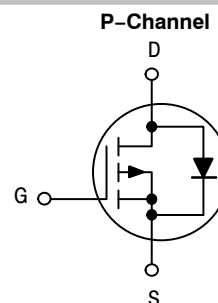
1. Pulse Test: Pulse Width  $\leq 300 \mu\text{s}$ , Duty Cycle  $\leq 2\%$ .



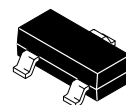
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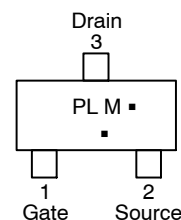
| $V_{(BR)DSS}$ | $R_{DS(on)}$ Typ       | $I_D$ MAX |
|---------------|------------------------|-----------|
| -20 V         | 550 m $\Omega$ @ -10 V | -400 mA   |



### MARKING DIAGRAM & PIN ASSIGNMENT



**SOT-23  
CASE 318  
STYLE 21**



PL = Specific Device Code  
M = Date Code\*  
■ = Pb-Free Package

(Note: Microdot may be in either location)

\*Date Code orientation may vary depending upon manufacturing location.

### ORDERING INFORMATION

| Device        | Package          | Shipping†           |
|---------------|------------------|---------------------|
| NTR0202PLT1G  | SOT-23 (Pb-Free) | 3000 / Tape & Reel  |
| NTR0202PLT3G  | SOT-23 (Pb-Free) | 10000 / Tape & Reel |
| NVTR0202PLT1G | SOT-23 (Pb-Free) | 3000 / Tape & Reel  |

†For information on tape and reel specifications, including part orientation and tape sizes, please refer to our Tape and Reel Packaging Specification Brochure, BRD8011/D.

# NTR0202PL, NVTR0202PL

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

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

### OFF CHARACTERISTICS

|                                                                                                                                                                                                      |               |     |    |             |                                             |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------|-----|----|-------------|---------------------------------------------|
| Drain-to-Source Breakdown Voltage<br>( $V_{GS} = 0\text{ V}$ , $I_D = -10\text{ }\mu\text{A}$ )<br>(Positive Temperature Coefficient)                                                                | $V_{(BR)DSS}$ | -20 | 33 |             | $\frac{\text{V}}{\text{mV}/^\circ\text{C}}$ |
| Zero Gate Voltage Drain Current<br>( $V_{DS} = -20\text{ V}$ , $V_{GS} = 0\text{ V}$ , $T_J = 25^\circ\text{C}$ )<br>( $V_{DS} = -20\text{ V}$ , $V_{GS} = 0\text{ V}$ , $T_J = 150^\circ\text{C}$ ) | $I_{DSS}$     |     |    | -1.0<br>-10 | $\mu\text{A}$                               |
| Gate-Body Leakage Current ( $V_{GS} = \pm 20\text{ V}$ , $V_{DS} = 0\text{ V}$ )                                                                                                                     | $I_{GSS}$     |     |    | $\pm 100$   | nA                                          |

### ON CHARACTERISTICS (Note 2)

|                                                                                                                                                      |              |      |              |              |                                             |
|------------------------------------------------------------------------------------------------------------------------------------------------------|--------------|------|--------------|--------------|---------------------------------------------|
| Gate Threshold Voltage<br>( $V_{DS} = V_{GS}$ , $I_D = -250\text{ }\mu\text{A}$ )<br>(Negative Temperature Coefficient)                              | $V_{GS(th)}$ | -1.1 | -1.9<br>3.0  | -2.3         | $\frac{\text{V}}{\text{mV}/^\circ\text{C}}$ |
| Static Drain-to-Source On-Resistance<br>( $V_{GS} = -10\text{ V}$ , $I_D = -200\text{ mA}$ )<br>( $V_{GS} = -4.5\text{ V}$ , $I_D = -50\text{ mA}$ ) | $R_{DS(on)}$ |      | 0.55<br>0.80 | 0.80<br>1.10 | $\Omega$                                    |
| Forward Transconductance<br>( $V_{DS} = -10\text{ V}$ , $I_D = -200\text{ mA}$ )                                                                     | $g_{fs}$     |      | 0.5          |              | Mhos                                        |

### DYNAMIC CHARACTERISTICS

|                              |                                                                              |           |    |  |    |
|------------------------------|------------------------------------------------------------------------------|-----------|----|--|----|
| Input Capacitance            | $(V_{DS} = -5.0\text{ V}$ , $V_{GS} = 0\text{ V}$ ,<br>$F = 1.0\text{ MHz})$ | $C_{iss}$ | 70 |  | pF |
| Output Capacitance           |                                                                              | $C_{oss}$ | 74 |  |    |
| Reverse Transfer Capacitance |                                                                              | $C_{rss}$ | 26 |  |    |

### SWITCHING CHARACTERISTICS (Note 3)

|                     |                                                                                                              |              |      |  |    |
|---------------------|--------------------------------------------------------------------------------------------------------------|--------------|------|--|----|
| Turn-On Delay Time  | $(V_{DD} = -15\text{ V}$ , $I_D = -200\text{ mA}$ ,<br>$V_{GS} = -10\text{ V}$ , $R_G = 6.0\text{ }\Omega$ ) | $t_{d(on)}$  | 3.0  |  | ns |
| Rise Time           |                                                                                                              | $t_r$        | 6.0  |  |    |
| Turn-Off Delay Time |                                                                                                              | $t_{d(off)}$ | 18   |  |    |
| Fall Time           |                                                                                                              | $t_f$        | 4    |  |    |
| Total Gate Charge   | $(V_{DS} = -15\text{ V}$ , $I_D = -200\text{ mA}$ ,<br>$V_{GS} = -10\text{ V})$                              | $Q_{TOT}$    | 2.18 |  | nC |
| Gate-Source Charge  |                                                                                                              | $Q_{GS}$     | 0.41 |  |    |
| Gate-Drain Charge   |                                                                                                              | $Q_{GD}$     | 0.40 |  |    |

### BODY-DRAIN DIODE CHARACTERISTICS (Note 2)

|                                                                                                                                                                        |          |  |               |      |               |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------|--|---------------|------|---------------|
| Diode Forward Voltage (Note 2)<br>( $I_S = -400\text{ mA}$ , $V_{GS} = 0\text{ V}$ )<br>( $I_S = -400\text{ mA}$ , $V_{GS} = 0\text{ V}$ , $T_J = 150^\circ\text{C}$ ) | $V_{SD}$ |  | -0.8<br>-0.65 | -1.0 | V             |
| Reverse Recovery Time<br><br>( $I_S = -1.0\text{ A}$ , $V_{GS} = 0\text{ V}$ ,<br>$dI_S/dt = 100\text{ A}/\mu\text{s}$ )                                               | $t_{rr}$ |  | 11.8          |      | ns            |
|                                                                                                                                                                        | $t_a$    |  | 9             |      |               |
|                                                                                                                                                                        | $t_b$    |  | 3             |      |               |
| Reverse Recovery Stored Charge<br><br>( $I_S = -1.0\text{ A}$ , $V_{GS} = 0\text{ V}$ ,<br>$dI_S/dt = 100\text{ A}/\mu\text{s}$ )                                      | $Q_{RR}$ |  | 0.007         |      | $\mu\text{C}$ |

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.

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

3. Switching characteristics are independent of operating junction temperature.

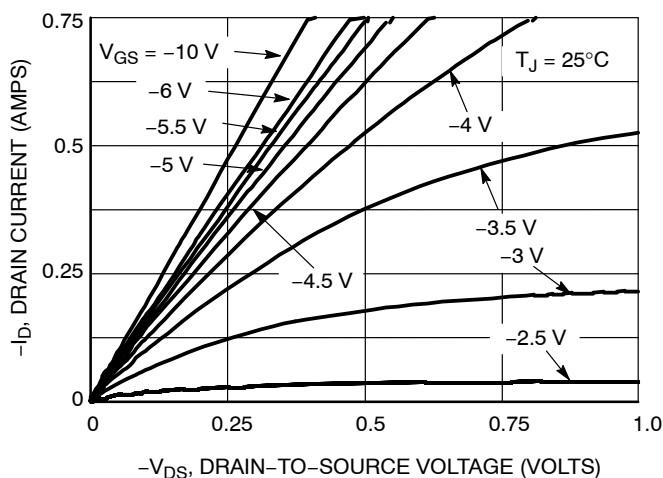


Figure 1. On-Region Characteristics

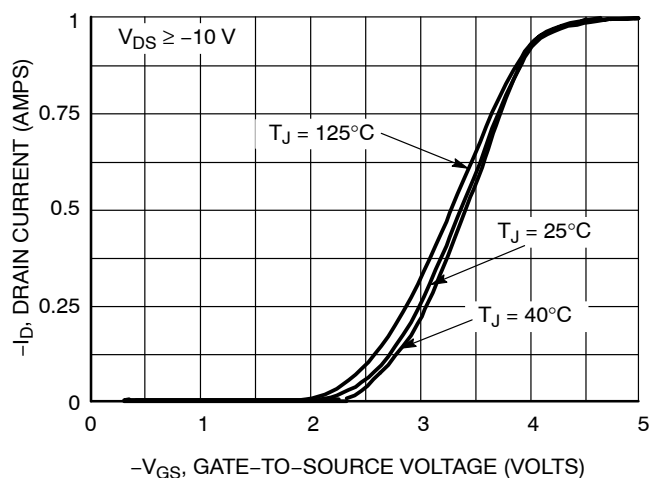


Figure 2. Transfer Characteristics

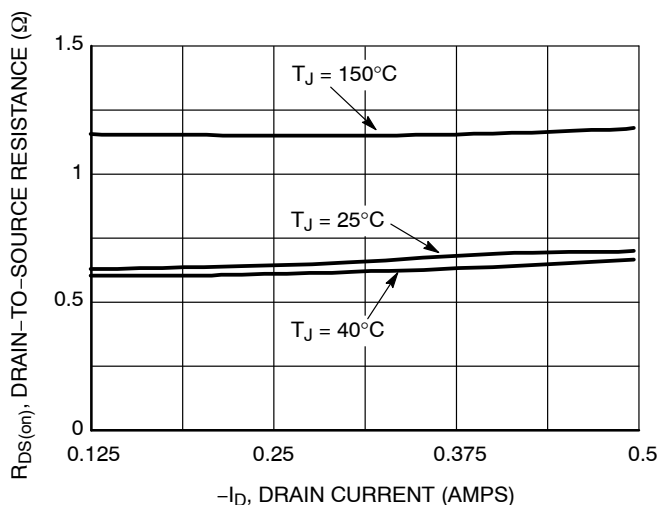


Figure 3. On-Resistance versus Drain Current

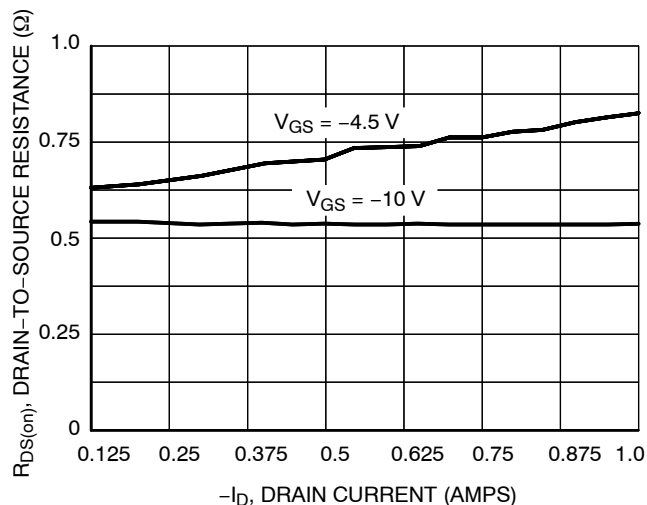


Figure 4. On-Resistance versus Drain Current and Gate Voltage

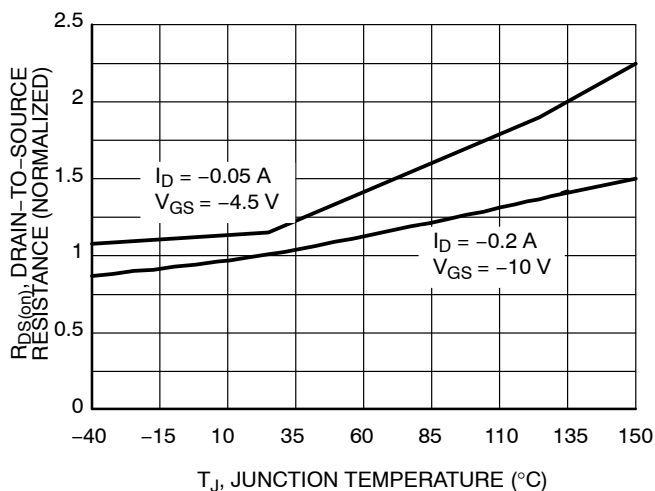


Figure 5. On-Resistance Variation with Temperature

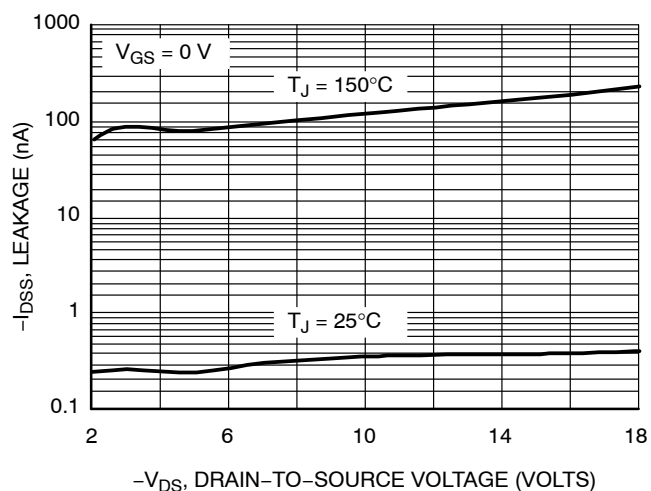


Figure 6. Drain-to-Source Leakage Current versus Voltage

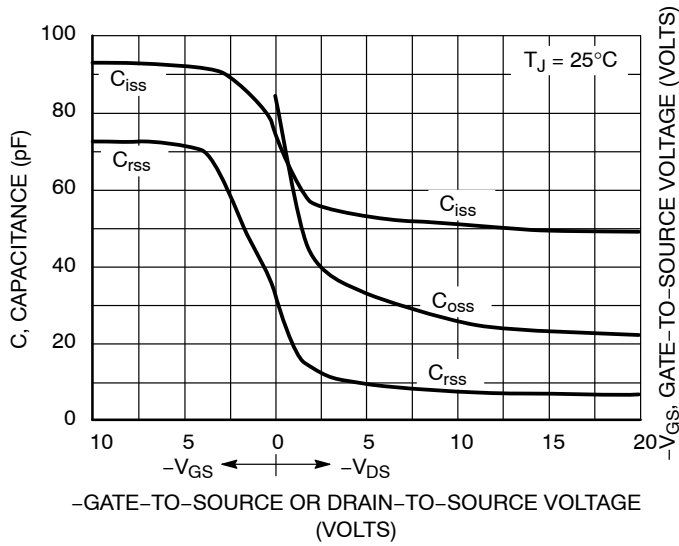


Figure 7. Capacitance Variation

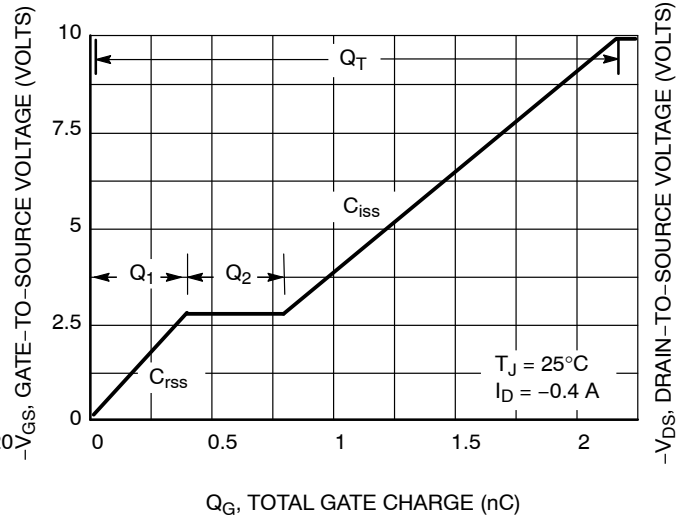


Figure 8. Gate-to-Source and Drain-to-Source Voltage versus Total Charge

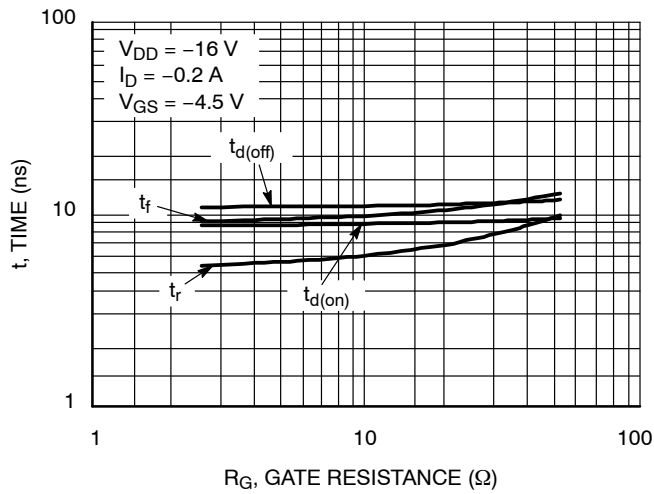


Figure 9. Resistive Switching Time Variation versus Gate Resistance

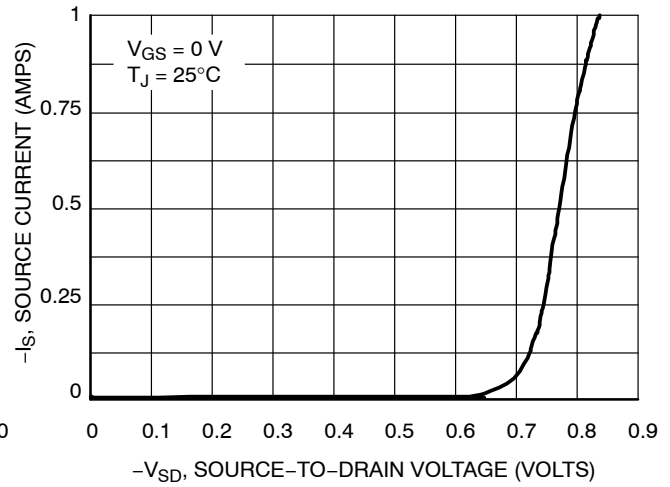


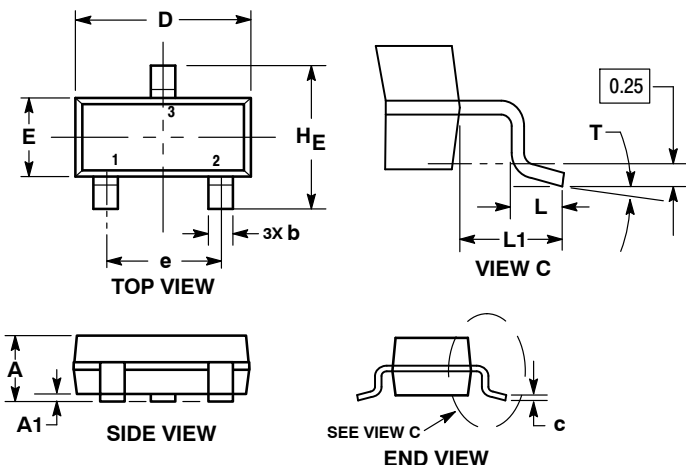
Figure 10. Diode Forward Voltage versus Current

## PACKAGE DIMENSIONS

## SOT-23 (TO-236)

CASE 318-08

ISSUE AR



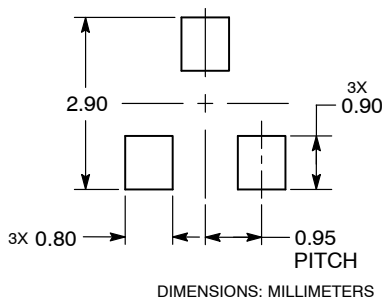
## NOTES:

1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 1994.
2. CONTROLLING DIMENSION: MILLIMETERS.
3. MAXIMUM LEAD THICKNESS INCLUDES LEAD FINISH. MINIMUM LEAD THICKNESS IS THE MINIMUM THICKNESS OF THE BASE MATERIAL.
4. DIMENSIONS D AND E DO NOT INCLUDE MOLD FLASH, PROTRUSIONS, OR GATE BURRS.

| DIM | MILLIMETERS |      |      | INCHES |       |       |
|-----|-------------|------|------|--------|-------|-------|
|     | MIN         | NOM  | MAX  | MIN    | NOM   | MAX   |
| A   | 0.89        | 1.00 | 1.11 | 0.035  | 0.039 | 0.044 |
| A1  | 0.01        | 0.06 | 0.10 | 0.000  | 0.002 | 0.004 |
| b   | 0.37        | 0.44 | 0.50 | 0.015  | 0.017 | 0.020 |
| c   | 0.08        | 0.14 | 0.20 | 0.003  | 0.006 | 0.008 |
| D   | 2.80        | 2.90 | 3.04 | 0.110  | 0.114 | 0.120 |
| E   | 1.20        | 1.30 | 1.40 | 0.047  | 0.051 | 0.055 |
| e   | 1.78        | 1.90 | 2.04 | 0.070  | 0.075 | 0.080 |
| L   | 0.30        | 0.43 | 0.55 | 0.012  | 0.017 | 0.022 |
| L1  | 0.35        | 0.54 | 0.69 | 0.014  | 0.021 | 0.027 |
| HE  | 2.10        | 2.40 | 2.64 | 0.083  | 0.094 | 0.104 |
| T   | 0°          |      | 10°  | 0°     |       | 10°   |

## STYLE 21:

1. GATE
2. SOURCE
3. DRAIN

RECOMMENDED  
SOLDERING FOOTPRINT\*

DIMENSIONS: MILLIMETERS

\*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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