

# MOSFET – Power, P-Channel, SOT-23

**-20 V, -1 A**

## NTR1P02, NVR1P02

### Features

- Ultra Low On-Resistance Provides Higher Efficiency and Extends Battery Life
  - $R_{DS(on)} = 0.180 \Omega$ ,  $V_{GS} = -10 \text{ V}$
  - $R_{DS(on)} = 0.280 \Omega$ ,  $V_{GS} = -4.5 \text{ V}$
- Power Management in Portable and Battery-Powered Products
- Miniature SOT-23 Surface Mount Package Saves Board Space
- Mounting Information for SOT-23 Package Provided
- NVR 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

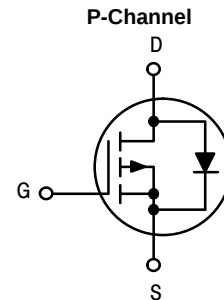
- DC-DC Converters
- Computers
- Printers
- PCMCIA Cards
- Cellular and Cordless Telephones

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

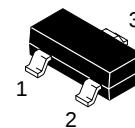
| Rating                                                                                                                                                                                   | Symbol            | Value         | Unit               |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------|---------------|--------------------|
| Drain-to-Source Voltage                                                                                                                                                                  | $V_{DS}$          | -20           | V                  |
| Gate-to-Source Voltage – Continuous                                                                                                                                                      | $V_{GS}$          | $\pm 20$      | V                  |
| Drain Current <ul style="list-style-type: none"> <li>– Continuous @ <math>T_A = 25^\circ\text{C}</math></li> <li>– Pulsed Drain Current (<math>t_p \leq 1 \mu\text{s}</math>)</li> </ul> | $I_D$<br>$I_{DM}$ | -1.0<br>-2.67 | A                  |
| Total Power Dissipation @ $T_A = 25^\circ\text{C}$                                                                                                                                       | $P_D$             | 400           | mW                 |
| Operating and Storage Temperature Range                                                                                                                                                  | $T_J, T_{stg}$    | -55 to 150    | $^\circ\text{C}$   |
| Thermal Resistance; Junction-to-Ambient                                                                                                                                                  | $R_{\theta JA}$   | 300           | $^\circ\text{C/W}$ |
| 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.

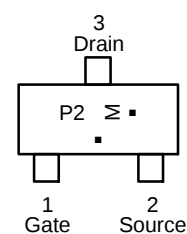
| $V_{(BR)DSS}$ | $R_{DS(on)}$ TYP       | $I_D$ MAX |
|---------------|------------------------|-----------|
| -20 V         | 148 m $\Omega$ @ -10 V | -1.0 A    |



### MARKING DIAGRAM/ PIN ASSIGNMENT



SOT-23  
CASE 318  
STYLE 21



P2 = Specific Device Code  
M = Date Code  
▪ = Pb-Free Package  
(Note: Microdot may be in either location)

### ORDERING INFORMATION

| Device     | Package          | Shipping†          |
|------------|------------------|--------------------|
| NTR1P02T1G | SOT-23 (Pb-Free) | 3000 / Tape & Reel |
| NVR1P02T1G | SOT-23 (Pb-Free) | 3000 / Tape & Reel |

### DISCONTINUED (Note 1)

|            |                  |                     |
|------------|------------------|---------------------|
| NTR1P02T3G | SOT-23 (Pb-Free) | 10000 / 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](#).

- DISCONTINUED:** This device is not recommended for new design. Please contact your onsemi representative for information. The most current information on this device may be available on [www.onsemi.com](#).

# NTR1P02, NVR1P02

## ELECTRICAL CHARACTERISTICS ( $T_A = 25\text{ }^{\circ}\text{C}$ 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 | 32 |             | V<br>mV/ $^{\circ}\text{C}$ |
| Zero Gate Voltage Drain Current<br>( $V_{DS} = -20\text{ V}$ , $V_{GS} = 0\text{ V}$ , $T_J = 25\text{ }^{\circ}\text{C}$ )<br>( $V_{DS} = -20\text{ V}$ , $V_{GS} = 0\text{ V}$ , $T_J = 150\text{ }^{\circ}\text{C}$ ) | $I_{DSS}$     |     |    | -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>-4.0   | -2.3           | V<br>mV/ $^{\circ}\text{C}$ |
| Static Drain-to-Source On-State Resistance<br>( $V_{GS} = -10\text{ V}$ , $I_D = -1.5\text{ A}$ )<br>( $V_{GS} = -4.5\text{ V}$ , $I_D = -0.75\text{ A}$ ) | $R_{DS(on)}$ |      | 0.148<br>0.235 | 0.180<br>0.280 | $\Omega$                    |

### DYNAMIC CHARACTERISTICS

|                                                                                                           |           |  |     |  |    |
|-----------------------------------------------------------------------------------------------------------|-----------|--|-----|--|----|
| Input Capacitance<br>( $V_{DS} = -5\text{ V}$ , $V_{GS} = 0\text{ V}$ , $f = 1.0\text{ MHz}$ )            | $C_{iss}$ |  | 165 |  | pF |
| Output Capacitance<br>( $V_{DS} = -5\text{ V}$ , $V_{GS} = 0\text{ V}$ , $f = 1.0\text{ MHz}$ )           | $C_{oss}$ |  | 110 |  |    |
| Reverse Transfer Capacitance<br>( $V_{DS} = -5\text{ V}$ , $V_{GS} = 0\text{ V}$ , $f = 1.0\text{ MHz}$ ) | $C_{rss}$ |  | 35  |  |    |

### SWITCHING CHARACTERISTICS (Note 3)

|                                                                                                                               |              |  |      |  |    |
|-------------------------------------------------------------------------------------------------------------------------------|--------------|--|------|--|----|
| Turn-On Delay Time<br>( $V_{DD} = -15\text{ V}$ , $I_D = -1\text{ A}$ , $V_{GS} = -5\text{ V}$ , $R_G = 2.5\text{ }\Omega$ )  | $t_{d(on)}$  |  | 7.0  |  | ns |
| Rise Time<br>( $V_{DD} = -15\text{ V}$ , $I_D = -1\text{ A}$ , $V_{GS} = -5\text{ V}$ , $R_G = 2.5\text{ }\Omega$ )           | $t_r$        |  | 9.0  |  |    |
| Turn-Off Delay Time<br>( $V_{DD} = -15\text{ V}$ , $I_D = -1\text{ A}$ , $V_{GS} = -5\text{ V}$ , $R_G = 2.5\text{ }\Omega$ ) | $t_{d(off)}$ |  | 9.0  |  |    |
| Fall Time<br>( $V_{DD} = -15\text{ V}$ , $I_D = -1\text{ A}$ , $V_{GS} = -5\text{ V}$ , $R_G = 2.5\text{ }\Omega$ )           | $t_f$        |  | 3.0  |  |    |
| Total Gate Charge<br>( $V_{DS} = -15\text{ V}$ , $V_{GS} = -5\text{ V}$ , $I_D = -0.8\text{ A}$ )                             | $Q_{tot}$    |  | 2.5  |  | nC |
| Gate-Source Charge<br>( $V_{DS} = -15\text{ V}$ , $V_{GS} = -5\text{ V}$ , $I_D = -0.8\text{ A}$ )                            | $Q_{gs}$     |  | 0.75 |  |    |
| Gate-Drain Charge<br>( $V_{DS} = -15\text{ V}$ , $V_{GS} = -5\text{ V}$ , $I_D = -0.8\text{ A}$ )                             | $Q_{gd}$     |  | 1.0  |  |    |

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

|                                                                                                                                                                                   |          |  |              |      |               |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------|--|--------------|------|---------------|
| Diode Forward On-Voltage (Note 3)<br>( $I_S = -0.6\text{ A}$ , $V_{GS} = 0\text{ V}$ )<br>( $I_S = -0.6\text{ A}$ , $V_{GS} = 0\text{ V}$ , $T_J = 150\text{ }^{\circ}\text{C}$ ) | $V_{SD}$ |  | -0.8<br>-0.6 | -1.0 | V             |
| Reverse Recovery Time<br>( $I_S = -1\text{ A}$ , $dI_S/dt = 100\text{ A}/\mu\text{s}$ , $V_{GS} = 0\text{ V}$ )                                                                   | $t_{rr}$ |  | 13.5         |      | ns            |
|                                                                                                                                                                                   | $t_a$    |  | 10.5         |      |               |
|                                                                                                                                                                                   | $t_b$    |  | 3.0          |      |               |
| Reverse Recovery Stored Charge<br>( $I_S = -1\text{ A}$ , $dI_S/dt = 100\text{ A}/\mu\text{s}$ , $V_{GS} = 0\text{ V}$ )                                                          | $Q_{RR}$ |  | 0.008        |      | $\mu\text{C}$ |

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.



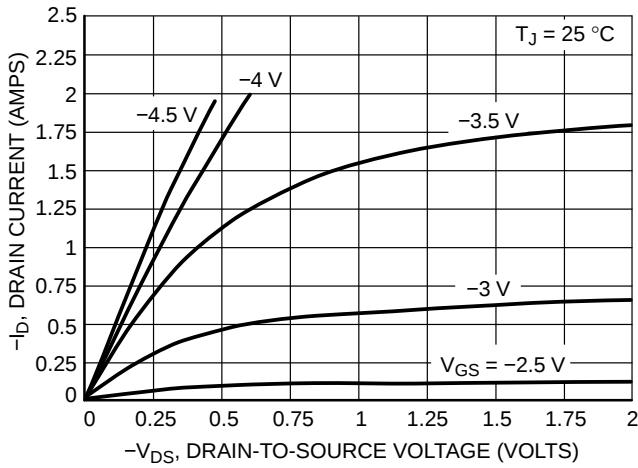


Figure 1. On-Region Characteristics

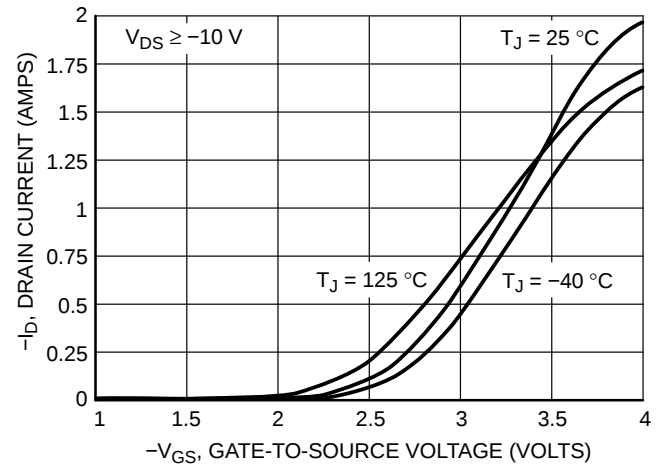


Figure 2. Transfer Characteristics

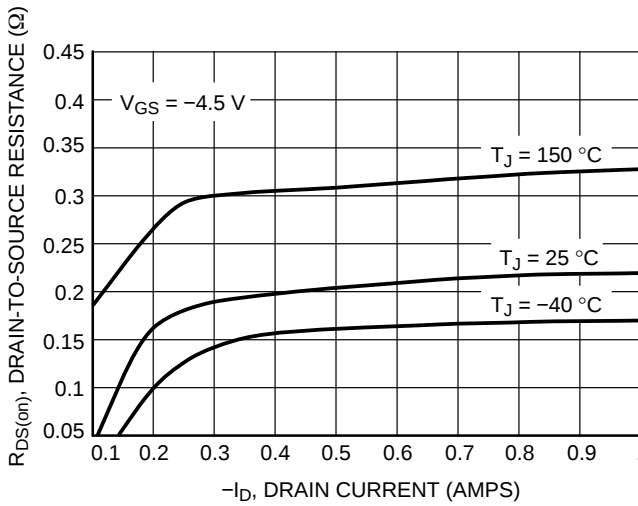


Figure 3. On-Resistance versus Drain Current and Temperature

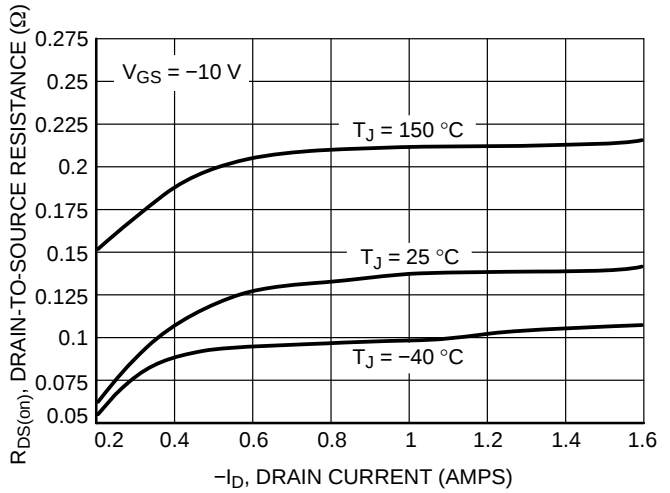


Figure 4. On-Resistance versus Drain Current and Temperature

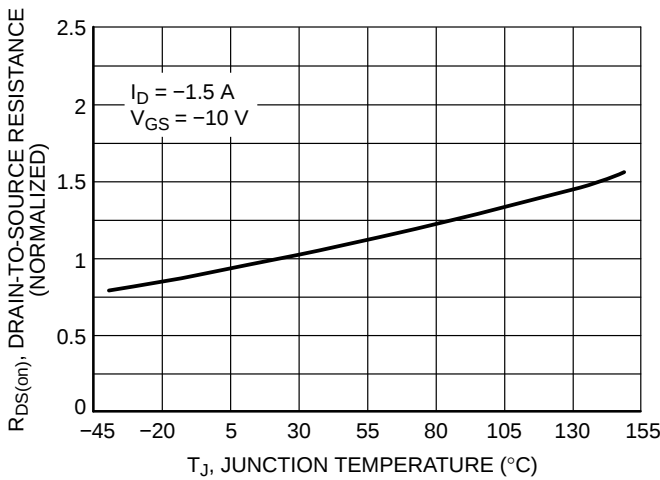


Figure 5. On-Resistance Variation with Temperature

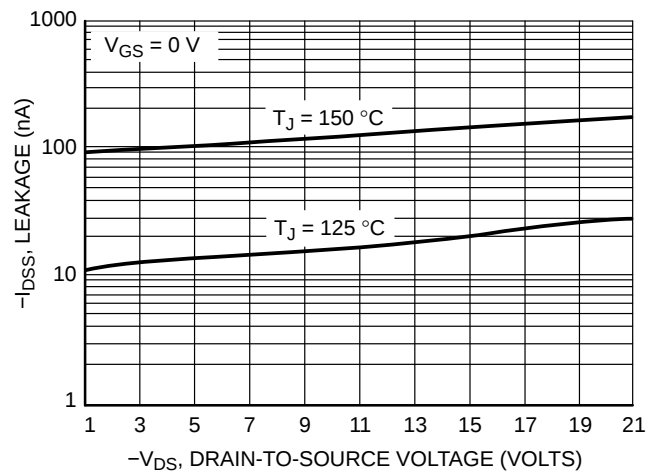
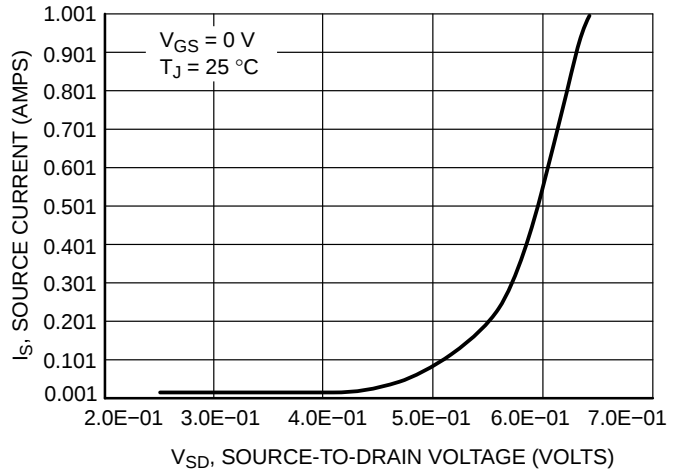
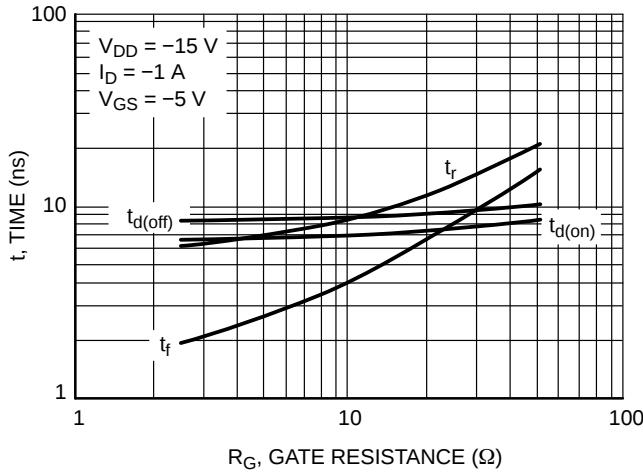
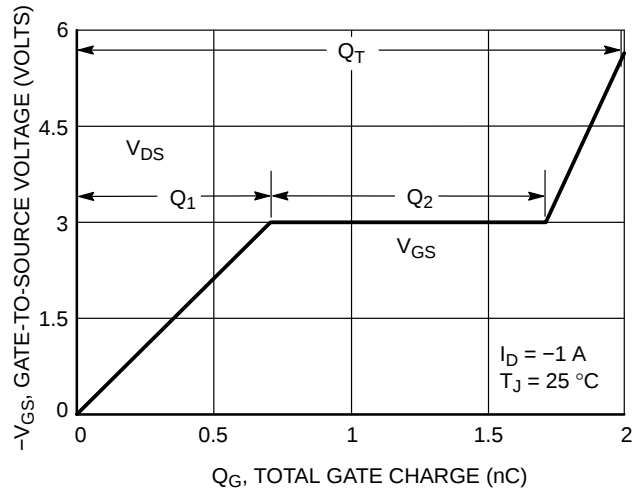
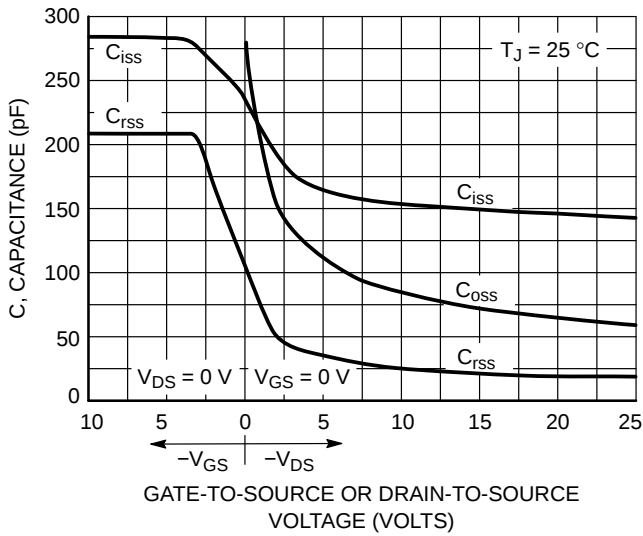


Figure 6. Drain-to-Source Leakage Current versus Voltage



## NTR1P02, NVR1P02

### REVISION HISTORY

| Revision | Description of Changes                                                                 | Date     |
|----------|----------------------------------------------------------------------------------------|----------|
| 9        | Rebranded the document to <b>onsemi</b> format. NTR1P02T3G OPN marked as Discontinued. | 2/5/2026 |

This document has undergone updates prior to the inclusion of this revision history table. The changes tracked here only reflect updates made on the noted approval dates.

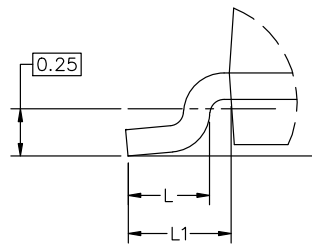
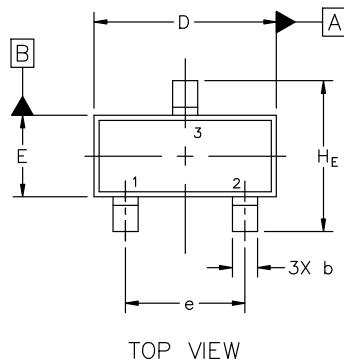




SCALE 4:1

**SOT-23 (TO-236) 2.90x1.30x1.00 1.90P**  
**CASE 318**  
**ISSUE AU**

DATE 14 AUG 2024



| MILLIMETERS |      |      |      |
|-------------|------|------|------|
| DIM         | MIN  | NOM  | MAX  |
| A           | 0.89 | 1.00 | 1.11 |
| A1          | 0.01 | 0.06 | 0.10 |
| b           | 0.37 | 0.44 | 0.50 |
| c           | 0.08 | 0.14 | 0.20 |
| D           | 2.80 | 2.90 | 3.04 |
| E           | 1.20 | 1.30 | 1.40 |
| e           | 1.78 | 1.90 | 2.04 |
| L           | 0.30 | 0.43 | 0.55 |
| L1          | 0.35 | 0.54 | 0.69 |
| HE          | 2.10 | 2.40 | 2.64 |
| T           | 0°   | ---  | 10°  |

**NOTES:**

1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 2018.
2. CONTROLLING DIMENSIONS: 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.

**GENERIC MARKING DIAGRAM\***



XXX = Specific Device Code  
M = Date Code  
▪ = Pb-Free Package

\*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.



**RECOMMENDED MOUNTING FOOTPRINT**

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

**STYLES ON PAGE 2**

|                         |                                             |                                                                                                                                                                                     |
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|                                                         |                                                       |                                                             |                                                             |                                                             |                                                             |
|---------------------------------------------------------|-------------------------------------------------------|-------------------------------------------------------------|-------------------------------------------------------------|-------------------------------------------------------------|-------------------------------------------------------------|
| STYLE 1 THRU 5:<br>CANCELLED                            | STYLE 6:<br>PIN 1. BASE<br>2. EMITTER<br>3. COLLECTOR | STYLE 7:<br>PIN 1. EMITTER<br>2. BASE<br>3. COLLECTOR       | STYLE 8:<br>PIN 1. ANODE<br>2. NO CONNECTION<br>3. CATHODE  |                                                             |                                                             |
| STYLE 9:<br>PIN 1. ANODE<br>2. ANODE<br>3. CATHODE      | STYLE 10:<br>PIN 1. DRAIN<br>2. SOURCE<br>3. GATE     | STYLE 11:<br>PIN 1. ANODE<br>2. CATHODE<br>3. CATHODE-ANODE | STYLE 12:<br>PIN 1. CATHODE<br>2. CATHODE<br>3. ANODE       | STYLE 13:<br>PIN 1. SOURCE<br>2. DRAIN<br>3. GATE           | STYLE 14:<br>PIN 1. CATHODE<br>2. GATE<br>3. ANODE          |
| STYLE 15:<br>PIN 1. GATE<br>2. CATHODE<br>3. ANODE      | STYLE 16:<br>PIN 1. ANODE<br>2. CATHODE<br>3. CATHODE | STYLE 17:<br>PIN 1. NO CONNECTION<br>2. ANODE<br>3. CATHODE | STYLE 18:<br>PIN 1. NO CONNECTION<br>2. CATHODE<br>3. ANODE | STYLE 19:<br>PIN 1. CATHODE<br>2. ANODE<br>3. CATHODE-ANODE | STYLE 20:<br>PIN 1. CATHODE<br>2. ANODE<br>3. GATE          |
| STYLE 21:<br>PIN 1. GATE<br>2. SOURCE<br>3. DRAIN       | STYLE 22:<br>PIN 1. RETURN<br>2. OUTPUT<br>3. INPUT   | STYLE 23:<br>PIN 1. ANODE<br>2. ANODE<br>3. CATHODE         | STYLE 24:<br>PIN 1. GATE<br>2. DRAIN<br>3. SOURCE           | STYLE 25:<br>PIN 1. ANODE<br>2. CATHODE<br>3. GATE          | STYLE 26:<br>PIN 1. CATHODE<br>2. ANODE<br>3. NO CONNECTION |
| STYLE 27:<br>PIN 1. CATHODE<br>2. CATHODE<br>3. CATHODE | STYLE 28:<br>PIN 1. ANODE<br>2. ANODE<br>3. ANODE     |                                                             |                                                             |                                                             |                                                             |

|                  |                                      |                                                                                                                                                                                     |
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| DESCRIPTION:     | SOT-23 (TO-236) 2.90x1.30x1.00 1.90P | PAGE 2 OF 2                                                                                                                                                                         |

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