

# NTR4101P

## Trench Power MOSFET –20 V, Single P–Channel, SOT–23

### Features

- Leading –20 V Trench for Low  $R_{DS(on)}$
- –1.8 V Rated for Low Voltage Gate Drive
- SOT–23 Surface Mount for Small Footprint
- Pb–Free Package is Available

### Applications

- Load/Power Management for Portables
- Load/Power Management for Computing
- Charging Circuits and Battery Protection

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

| Parameter   | Symbol                                | Value                    | Unit                     |   |
|---|---------------------------------------|--------------------------|--------------------------|---|
| Drain–to–Source Voltage   | $V_{DSS}$                             | –20                      | V                        |   |
| Gate–to–Source Voltage  | $V_{GS}$                              | $\pm 8.0$                | V                        |   |
| Continuous Drain Current (Note 1)                                 | Steady State                          | $T_A = 25^\circ\text{C}$ | $I_D$ –2.4               | A |
|   |                                       | $T_A = 85^\circ\text{C}$ | –1.7                     |   |
|   |                                       | $t \leq 10$ s            | $T_A = 25^\circ\text{C}$ |   |
| Power Dissipation (Note 1)  | Steady State                          | $T_A = 25^\circ\text{C}$ | $P_D$ 0.73               | W |
|   |                                       | $t \leq 10$ s            | 1.25                     |   |
| Continuous Drain Current (Note 2)                                 | Steady State                          | $T_A = 25^\circ\text{C}$ | $I_D$ –1.8               | A |
|   |                                       | $T_A = 85^\circ\text{C}$ | –1.3                     |   |
|   |                                       | $T_A = 25^\circ\text{C}$ | $P_D$ 0.42               |   |
| Power Dissipation (Note 2)  |                                       |                          |                          |   |
| Pulsed Drain Current  | $t_p = 10$ $\mu\text{s}$              | $I_{DM}$                 | –7.5                     | A |
| ESD Capability (Note 3)   | $C = 100$ pF,<br>$RS = 1500$ $\Omega$ | ESD                      | 225                      | V |
| Operating Junction and Storage Temperature                        | $T_J$ ,<br>$T_{STG}$                  | –55 to 150               | $^\circ\text{C}$         |   |
| Source Current (Body Diode)                                       | $I_S$                                 | –2.4                     | A                        |   |
| Lead Temperature for Soldering Purposes (1/8" from case for 10 s) | $T_L$                                 | 260                      | $^\circ\text{C}$         |   |

Maximum ratings are those values beyond which device damage can occur. Maximum ratings applied to the device are individual stress limit values (not normal operating conditions) and are not valid simultaneously. If these limits are exceeded, device functional operation is not implied, damage may occur and reliability may be affected.

### THERMAL RESISTANCE RATINGS

| Parameter                                   | Symbol          | Max | Unit                      |
|---|-----------------|-----|---------------------------|
| Junction–to–Ambient – Steady State (Note 1) | $R_{\theta JA}$ | 170 | $^\circ\text{C}/\text{W}$ |
| Junction–to–Ambient – $t < 10$ s (Note 1)   | $R_{\theta JA}$ | 100 |                           |
| Junction–to–Ambient – Steady State (Note 2) | $R_{\theta JA}$ | 300 |                           |

1. Surface–mounted on FR4 board using 1 in sq pad size (Cu area = 1.127 in sq [1 oz] including traces)
2. Surface–mounted on FR4 board using the minimum recommended pad size.
3. ESD Rating Information: HBM Class 0

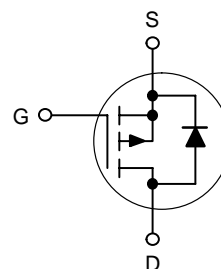


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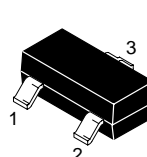
<http://onsemi.com>

| $V_{(BR)DSS}$ | $R_{DS(ON)}$ TYP        | $I_D$ MAX |
|---------------|-------------------------|-----------|
| –20 V         | 70 m $\Omega$ @ –4.5 V  | –3.2 A    |
|               | 90 m $\Omega$ @ –2.5 V  |           |
|               | 112 m $\Omega$ @ –1.8 V |           |

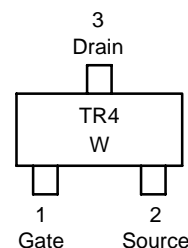
### P–Channel MOSFET



### MARKING DIAGRAM & PIN ASSIGNMENT



SOT–23  
CASE 318  
STYLE 21



TR4 = Device Code  
W = Work Week

### ORDERING INFORMATION

| Device      | Package           | Shipping†        |
|-------------|-------------------|------------------|
| NTR4101PT1  | SOT–23            | 3000/Tape & Reel |
| NTR4101PT1G | SOT–23<br>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 Specifications Brochure, BRD8011/D.

# NTR4101P

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

| Characteristic  | Symbol               | Min | Typ | Max  | Unit |
|---|----------------------|-----|-----|------|------|
| <b>OFF CHARACTERISTICS</b>  |                      |     |     |      |      |
| Drain-to-Source Breakdown Voltage (Note 4)<br>(V <sub>GS</sub> = 0 V, I <sub>D</sub> = -250 μA) | V <sub>(BR)DSS</sub> | -20 |     |      | V    |
| Zero Gate Voltage Drain Current (Note 4)<br>(V <sub>GS</sub> = 0 V, V <sub>DS</sub> = -16 V)    | I <sub>DSS</sub>     |     |     | -1.0 | μA   |
| Gate-to-Source Leakage Current<br>(V <sub>GS</sub> = ±8.0 V, V <sub>DS</sub> = 0 V)             | I <sub>GSS</sub>     |     |     | ±100 | nA   |

## ON CHARACTERISTICS

|  |                     |       |                 |                  |    |
|--|---------------------|-------|-----------------|------------------|----|
| Gate Threshold Voltage (Note 4)<br>(V <sub>GS</sub> = V <sub>DS</sub> , I <sub>D</sub> = -250 μA)  | V <sub>GS(th)</sub> | -0.40 | -0.720          | -1.5             | V  |
| Drain-to-Source On-Resistance<br>(V <sub>GS</sub> = -4.5 V, I <sub>D</sub> = -1.6 A)<br>(V <sub>GS</sub> = -2.5 V, I <sub>D</sub> = -1.3 A)<br>(V <sub>GS</sub> = -1.8 V, I <sub>D</sub> = -0.9 A) | R <sub>DS(on)</sub> |       | 70<br>90<br>112 | 85<br>120<br>210 | mΩ |
| Forward Transconductance (V <sub>DS</sub> = -5.0 V, I <sub>D</sub> = -2.3 A)   | g <sub>FS</sub>     |       | 75              |                  | S  |

## CHARGES, CAPACITANCES & GATE RESISTANCE

|                               |  |                     |     |     |    |
|-------------------------------|--|---------------------|-----|-----|----|
| Input Capacitance             | (V <sub>GS</sub> = 0 V, f = 1 MHz, V <sub>DS</sub> = -10 V)                  | C <sub>iSS</sub>    | 675 |     | pF |
| Output Capacitance            |  | C <sub>oss</sub>    | 100 |     |    |
| Reverse Transfer Capacitance  |  | C <sub>rSS</sub>    | 75  |     |    |
| Total Gate Charge             | (V <sub>GS</sub> = -4.5 V, V <sub>DS</sub> = -10 V, I <sub>D</sub> = -1.6 A) | Q <sub>G(tot)</sub> | 7.5 | 8.5 | nC |
| Gate-to-Source Gate Charge    | (V <sub>DS</sub> = -10 V, I <sub>D</sub> = -1.6 A)                           | Q <sub>GS</sub>     | 1.2 |     | nC |
| Gate-to-Drain "Miller" Charge | (V <sub>DS</sub> = -10 V, I <sub>D</sub> = -1.6 A)                           | Q <sub>GD</sub>     | 2.2 |     | nC |
| Gate Resistance               |  | R <sub>G</sub>      | 6.5 |     | Ω  |

## SWITCHING CHARACTERISTICS (Note 5)

|                     |   |                     |      |  |    |
|---------------------|---|---------------------|------|--|----|
| Turn-On Delay Time  | (V <sub>GS</sub> = -4.5 V, V <sub>DS</sub> = -10 V,<br>I <sub>D</sub> = -1.6 A, R <sub>G</sub> = 6.0 Ω) | t <sub>d(on)</sub>  | 7.5  |  | ns |
| Rise Time           |   | t <sub>r</sub>      | 12.6 |  |    |
| Turn-Off Delay Time |   | t <sub>d(off)</sub> | 30.2 |  |    |
| Fall Time           |   | t <sub>f</sub>      | 21.0 |  |    |

## DRAIN-SOURCE DIODE CHARACTERISTICS

|                         |  |                 |       |      |    |
|-------------------------|--|-----------------|-------|------|----|
| Forward Diode Voltage   | (V <sub>GS</sub> = 0 V, I <sub>S</sub> = -2.4 A)                                     | V <sub>SD</sub> | -0.82 | -1.2 | V  |
| Reverse Recovery Time   | (V <sub>GS</sub> = 0 V,<br>dI <sub>SD</sub> /dt = 100 A/μs, I <sub>S</sub> = -1.6 A) | t <sub>rr</sub> | 12.8  | 15   | ns |
| Charge Time             |  | t <sub>a</sub>  | 9.9   |      | ns |
| Discharge Time          |  | t <sub>b</sub>  | 3.0   |      | ns |
| Reverse Recovery Charge |  | Q <sub>rr</sub> | 1008  |      | nC |

4. Pulse Test: Pulse Width ≤ 300 μs, Duty Cycle ≤ 2%.  
 5. Switching characteristics are independent of operating junction temperature.

# NTR4101P

## TYPICAL PERFORMANCE CURVES ( $T_J = 25^\circ\text{C}$ unless otherwise noted)

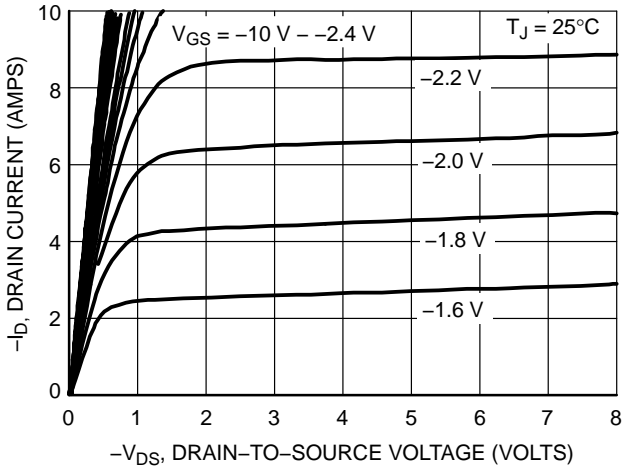


Figure 1. On-Region Characteristics

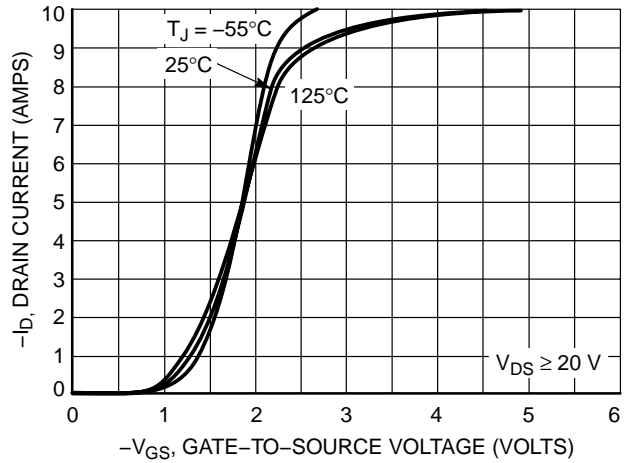


Figure 2. Transfer Characteristics

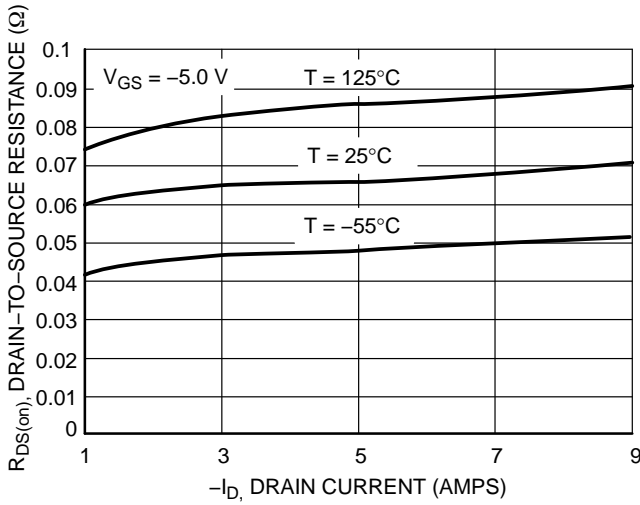


Figure 3. On-Resistance vs. Drain Current and Temperature

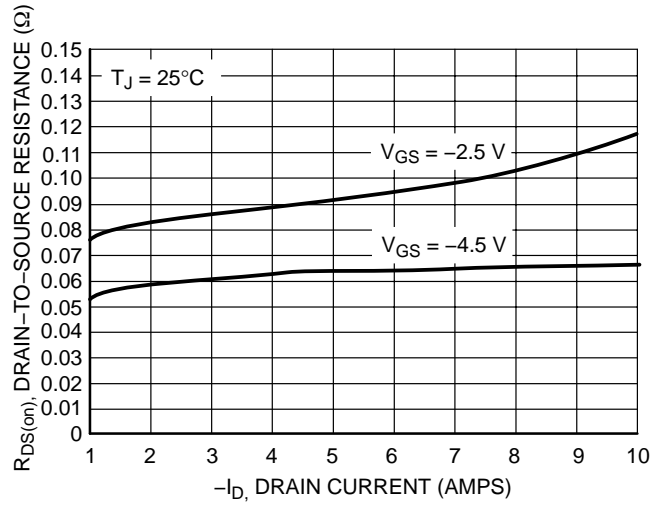


Figure 4. On-Resistance vs. Drain Current and Temperature

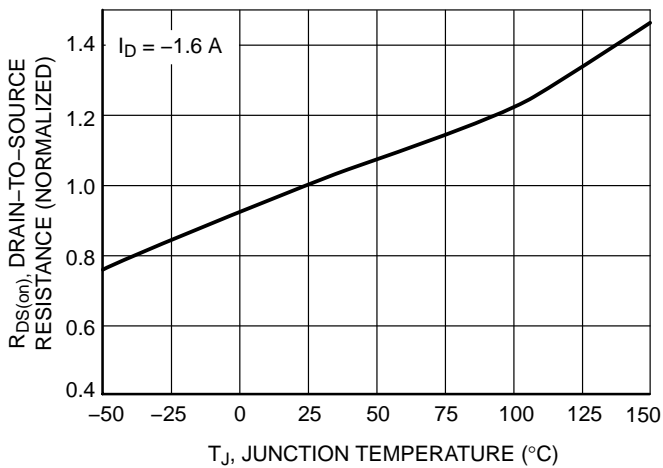


Figure 5. On-Resistance Variation with Temperature

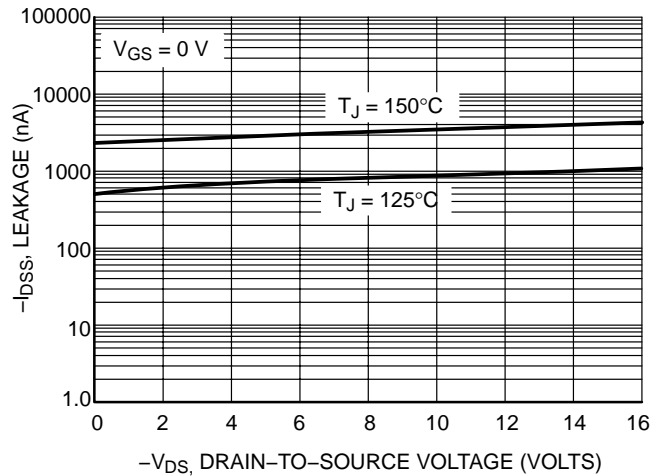


Figure 6. Drain-to-Source Leakage Current vs. Voltage

# NTR4101P

## TYPICAL PERFORMANCE CURVES ( $T_J = 25^\circ\text{C}$ unless otherwise noted)

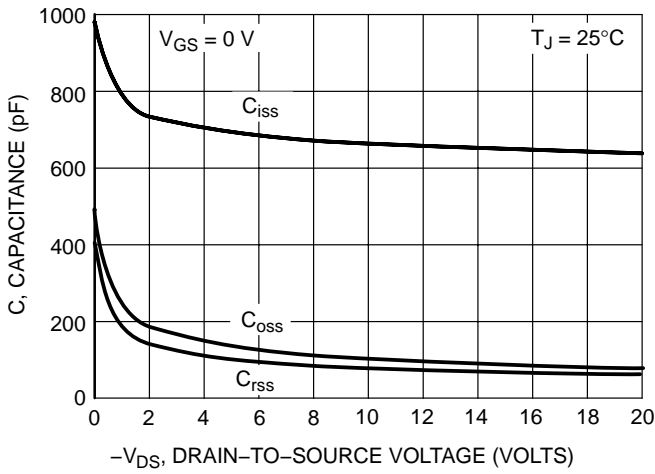


Figure 7. Capacitance Variation

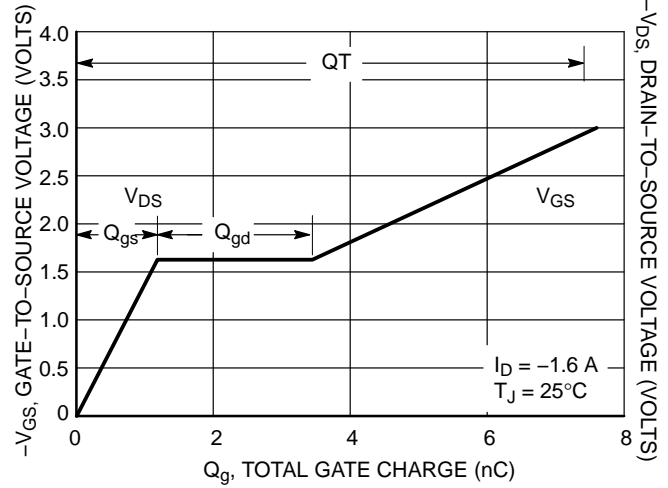


Figure 8. Gate-to-Source and Drain-to-Source Voltage vs. Total Gate Charge

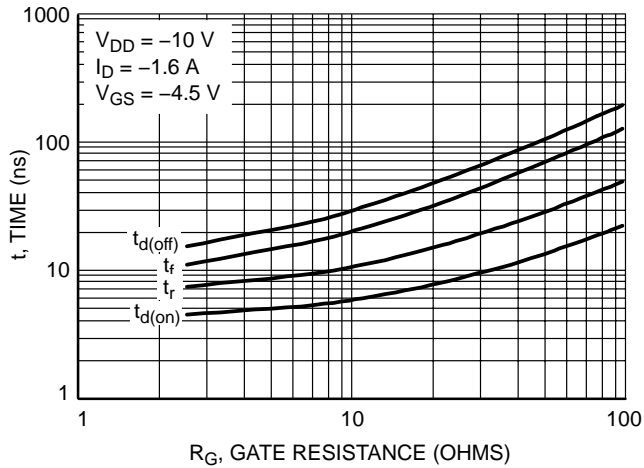


Figure 9. Resistive Switching Time Variation vs. Gate Resistance

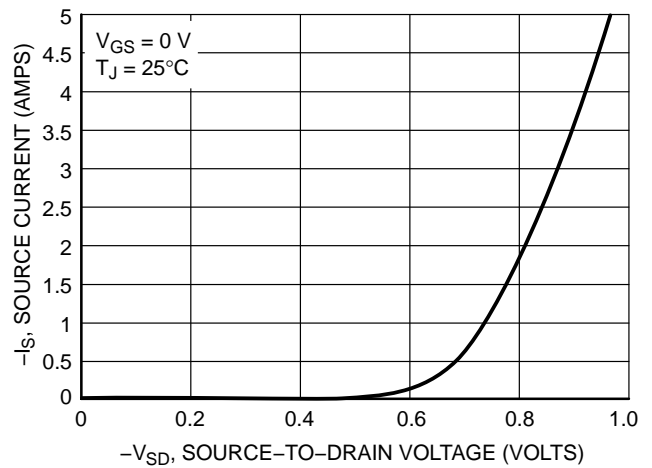
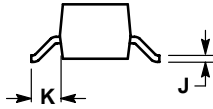
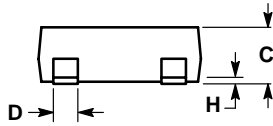
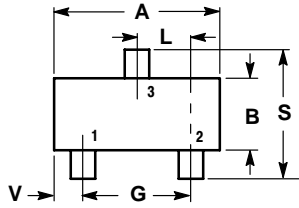


Figure 10. Diode Forward Voltage vs. Current

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## PACKAGE DIMENSIONS

SOT-23 (TO-236)  
CASE 318-08  
ISSUE AK



NOTES:

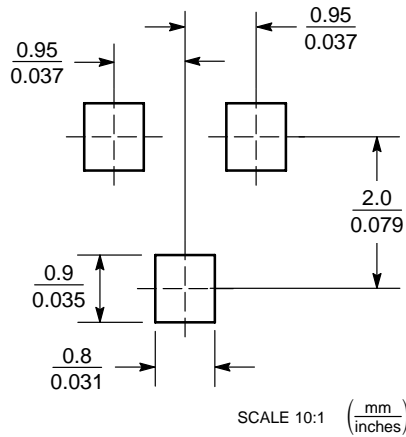
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: INCH.
3. MAXIMUM LEAD THICKNESS INCLUDES LEAD FINISH THICKNESS. MINIMUM LEAD THICKNESS IS THE MINIMUM THICKNESS OF BASE MATERIAL.
4. 318-03 AND -07 OBSOLETE, NEW STANDARD 318-08.

| DIM | INCHES |        | MILLIMETERS |       |
|-----|--------|--------|-------------|-------|
|     | MIN    | MAX    | MIN         | MAX   |
| A   | 0.1102 | 0.1197 | 2.80        | 3.04  |
| B   | 0.0472 | 0.0551 | 1.20        | 1.40  |
| C   | 0.0350 | 0.0440 | 0.89        | 1.11  |
| D   | 0.0150 | 0.0200 | 0.37        | 0.50  |
| G   | 0.0701 | 0.0807 | 1.78        | 2.04  |
| H   | 0.0005 | 0.0040 | 0.013       | 0.100 |
| J   | 0.0034 | 0.0070 | 0.085       | 0.177 |
| K   | 0.0140 | 0.0285 | 0.35        | 0.69  |
| L   | 0.0350 | 0.0401 | 0.89        | 1.02  |
| S   | 0.0830 | 0.1039 | 2.10        | 2.64  |
| V   | 0.0177 | 0.0236 | 0.45        | 0.60  |

STYLE 21:


- PIN 1. GATE
- SOURCE
- DRAIN

### SOLDERING 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.

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