

# NTR2101P

## Small Signal MOSFET

-8.0 V, -3.7 A, Single P-Channel, SOT-23

### Features

- Leading Trench Technology for Low  $R_{DS(on)}$
- -1.8 V Rated for Low Voltage Gate Drive
- SOT-23 Surface Mount for Small Footprint (3 x 3 mm)
- Pb-Free Package is Available

### Applications

- High Side Load Switch
- DC-DC Conversion
- Cell Phone, Notebook, PDAs, etc.

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

| Parameter   | Symbol                   | Value                    | Unit             |   |
|---|--------------------------|--------------------------|------------------|---|
| Drain-to-Source Voltage   | $V_{DSS}$                | -8.0                     | V                |   |
| Gate-to-Source Voltage  | $V_{GS}$                 | $\pm 8.0$                | V                |   |
| Continuous Drain Current (Note 1)                                 | $t \leq 10$ s            | $T_A = 25^\circ\text{C}$ | -3.7             | A |
|   |                          | $T_A = 70^\circ\text{C}$ | -3.0             | A |
| Power Dissipation (Note 1)  | $t \leq 10$ s            | $P_D$                    | 0.96             | W |
| Pulsed Drain Current  | $t_p = 10$ $\mu\text{s}$ | $I_{DM}$                 | -11              | A |
| Operating Junction and Storage Temperature                        | $T_J, T_{STG}$           | -55 to 150               | $^\circ\text{C}$ |   |
| Source Current (Body Diode)                                       | $I_S$                    | -1.2                     | A                |   |
| Lead Temperature for Soldering Purposes (1/8" from case for 10 s) | $T_L$                    | 260                      | $^\circ\text{C}$ |   |

### THERMAL RESISTANCE RATINGS

| Parameter                           | Symbol          | Max | Unit                      |
|-------------------------------------|-----------------|-----|---------------------------|
| Junction-to-Ambient - Steady State  | $R_{\theta JA}$ | 160 | $^\circ\text{C}/\text{W}$ |
| Junction-to-Ambient - $t \leq 10$ s | $R_{\theta JA}$ | 130 |                           |

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.

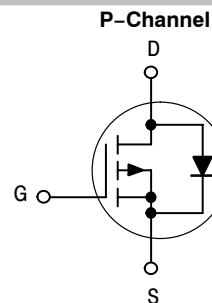
1. Surface mounted on FR4 board using 1 in sq pad size (Cu area = 1.127 in sq [1 oz] including traces).



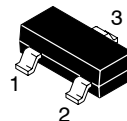
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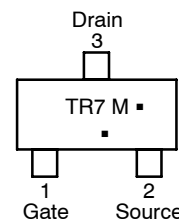
| $V_{(BR)DSS}$ | $R_{DS(on)}$ Typ       | $I_D$ Max |
|---------------|------------------------|-----------|
| -8.0 V        | 39 m $\Omega$ @ -4.5 V | -3.7 A    |
|               | 52 m $\Omega$ @ -2.5 V |           |
|               | 79 m $\Omega$ @ -1.8 V |           |



### MARKING DIAGRAM & PIN ASSIGNMENT



SOT-23  
CASE 318  
STYLE 21



TR7 = 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†        |
|-------------|------------------|------------------|
| NTR2101PT1  | SOT-23           | 3000/Tape & Reel |
| NTR2101PT1G | 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.

# NTR2101P

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

| Parameter   | Symbol            | Test Condition                                   | Min                       | Typ | Max       | Unit                 |
|---|-------------------|--|---------------------------|-----|-----------|----------------------|
| <b>OFF CHARACTERISTICS</b>                                |                   |  |                           |     |           |                      |
| Drain-to-Source Breakdown Voltage                         | $V_{(BR)DSS}$     | $V_{GS} = 0\text{ V}, I_D = -250\ \mu\text{A}$   | -8.0                      |     |           | V                    |
| Drain-to-Source Breakdown Voltage Temperature Coefficient | $V_{(BR)DSS}/T_J$ |  |                           | 10  |           | mV/ $^\circ\text{C}$ |
| Zero Gate Voltage Drain Current                           | $I_{DSS}$         | $V_{GS} = 0\text{ V}, V_{DS} = -6.4\text{ V}$    | $T_J = 25^\circ\text{C}$  |     | -1.0      | $\mu\text{A}$        |
|   |                   |  | $T_J = 125^\circ\text{C}$ |     | -100      |                      |
| Gate-to-Source Leakage Current                            | $I_{GSS}$         | $V_{DS} = 0\text{ V}, V_{GS} = \pm 8.0\text{ V}$ |                           |     | $\pm 100$ | nA                   |

## ON CHARACTERISTICS (Note 2)

|  |                  |   |       |        |      |                      |
|--|------------------|---|-------|--------|------|----------------------|
| Gate Threshold Voltage                     | $V_{GS(TH)}$     | $V_{GS} = V_{DS}, I_D = -250\ \mu\text{A}$    | -0.40 |        | -1.0 | V                    |
| Negative Threshold Temperature Coefficient | $V_{GS(TH)}/T_J$ |   |       | 0.0027 |      | mV/ $^\circ\text{C}$ |
| Drain-to-Source On Resistance              | $R_{DS(on)}$     | $V_{GS} = -4.5\text{ V}, I_D = -3.5\text{ A}$ |       | 39     | 52   | m $\Omega$           |
|  |                  | $V_{GS} = -2.5\text{ V}, I_D = -3.0\text{ A}$ |       | 52     | 72   |                      |
|  |                  | $V_{GS} = -1.8\text{ V}, I_D = -2.0\text{ A}$ |       | 79     | 120  |                      |
| Forward Transconductance                   | $g_{FS}$         | $V_{GS} = -5.0\text{ V}, I_D = -3.5\text{ A}$ |       | 9.0    |      | S                    |

## CHARGES AND CAPACITANCES

|                              |              |   |  |      |    |    |
|------------------------------|--------------|---|--|------|----|----|
| Input Capacitance            | $C_{ISS}$    | $V_{GS} = 0\text{ V}, f = 1.0\text{ MHz}, V_{DS} = -4.0\text{ V}$     |  | 1173 |    | pF |
| Output Capacitance           | $C_{OSS}$    |   |  | 289  |    |    |
| Reverse Transfer Capacitance | $C_{RSS}$    |   |  | 218  |    |    |
| Total Gate Charge            | $Q_{G(TOT)}$ | $V_{GS} = -4.5\text{ V}, V_{DS} = -4.0\text{ V}, I_D = -3.5\text{ A}$ |  | 12   | 15 | nC |
| Gate-to-Source Charge        | $Q_{GS}$     |   |  | 3.8  |    |    |
| Gate-to-Drain Charge         | $Q_{GD}$     |   |  | 2.5  |    |    |

## SWITCHING CHARACTERISTICS (Note 3)

|                     |              |  |  |       |    |    |
|---------------------|--------------|--|--|-------|----|----|
| Turn-On Delay Time  | $t_{d(on)}$  | $V_{GS} = -4.5\text{ V}, V_{DD} = -4.0\text{ V}, I_D = -1.2\text{ A}, R_G = 6.0\ \Omega$ |  | 7.4   | 15 | ns |
| Rise Time           | $t_r$        |  |  | 15.75 | 25 |    |
| Turn-Off Delay Time | $t_{d(off)}$ |  |  | 38    | 58 |    |
| Fall Time           | $t_f$        |  |  | 31    | 51 |    |

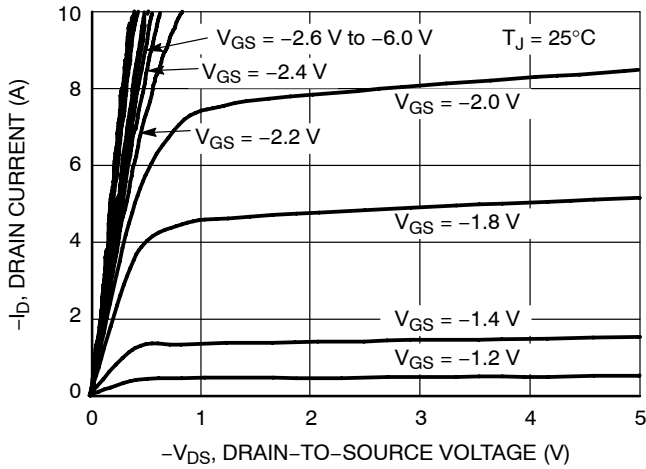
## DRAIN-SOURCE DIODE CHARACTERISTICS

|                       |          |  |                          |  |       |      |   |
|-----------------------|----------|--|--------------------------|--|-------|------|---|
| Forward Diode Voltage | $V_{SD}$ | $V_{GS} = 0\text{ V}, I_S = -1.2\text{ A}$ | $T_J = 25^\circ\text{C}$ |  | -0.73 | -1.2 | V |
|-----------------------|----------|--|--------------------------|--|-------|------|---|

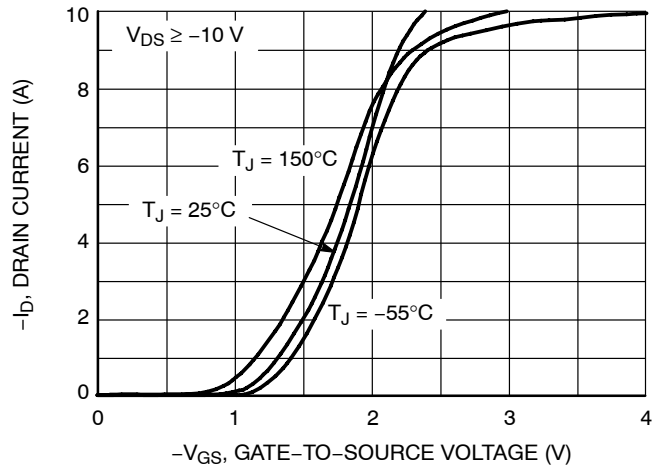
2. Pulse Test: pulse width  $\leq 300\ \mu\text{s}$ , duty cycle  $\leq 2\%$ .

3. Switching characteristics are independent of operating junction temperatures.

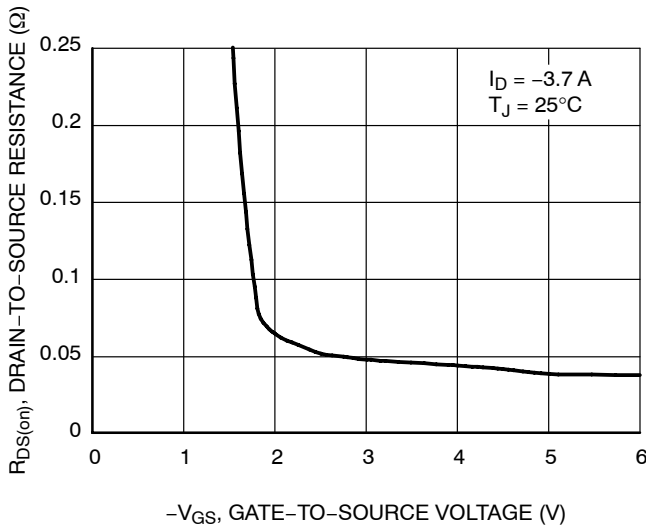
# NTR2101P



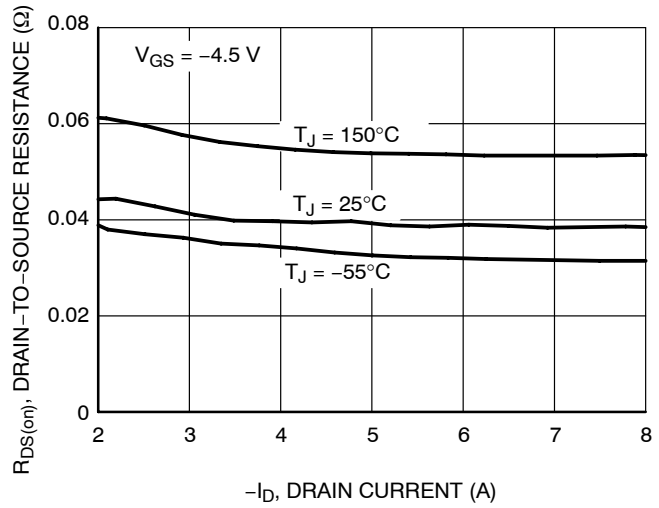
**Figure 1. On-Region Characteristics**



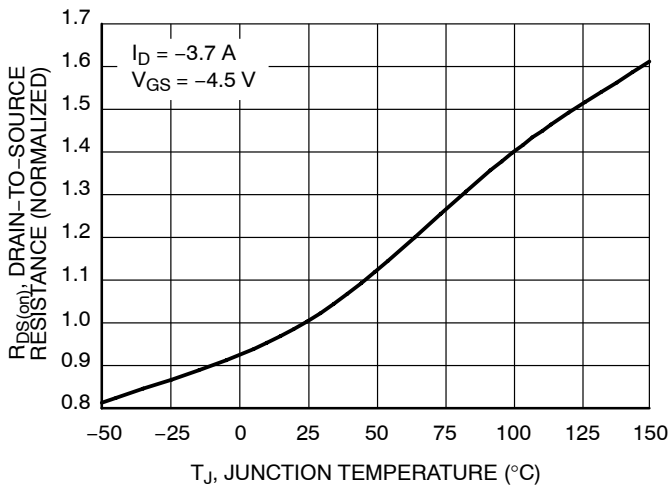
**Figure 2. Transfer Characteristics**



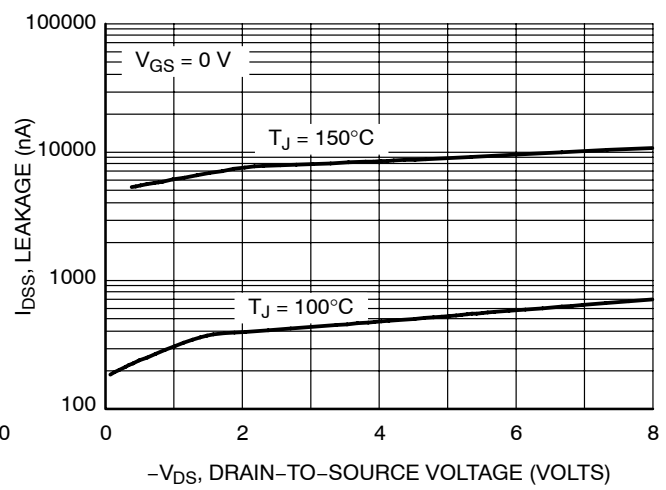
**Figure 3. On-Resistance versus Gate-to-Source Voltage**



**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**

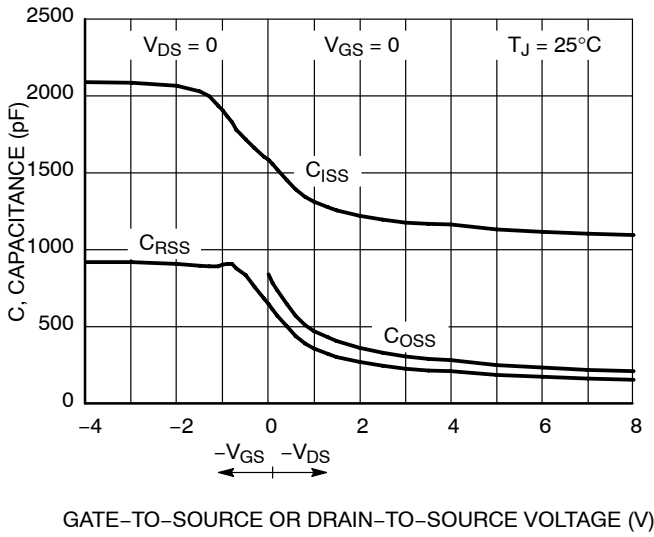


Figure 7. Capacitance Variation

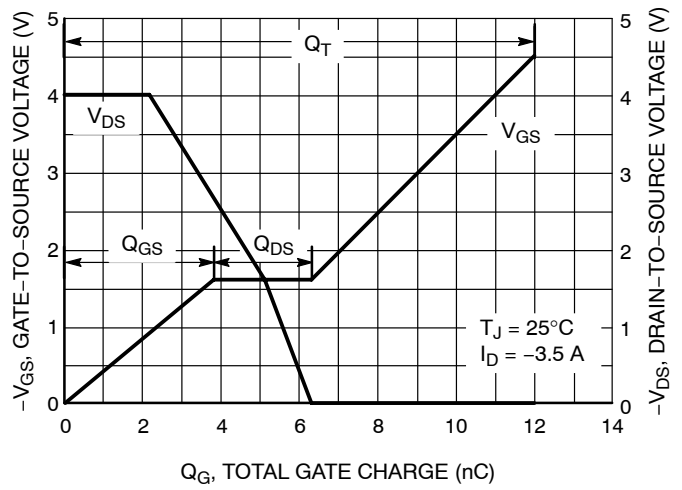


Figure 8. Gate-to-Source and Drain-to-Source Voltage versus Total Charge

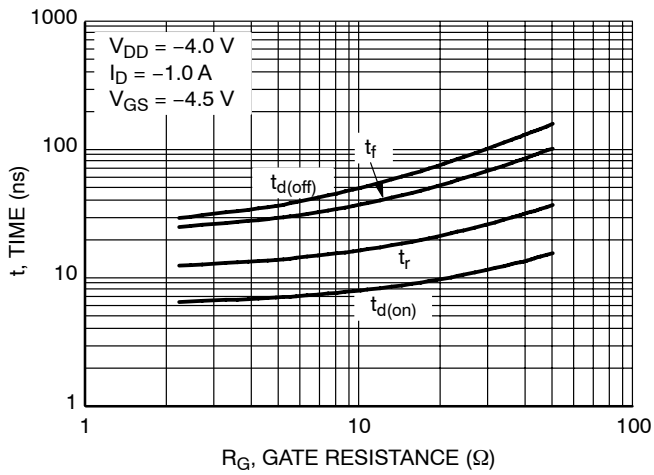


Figure 9. Resistive Switching Time Variation versus Gate Resistance

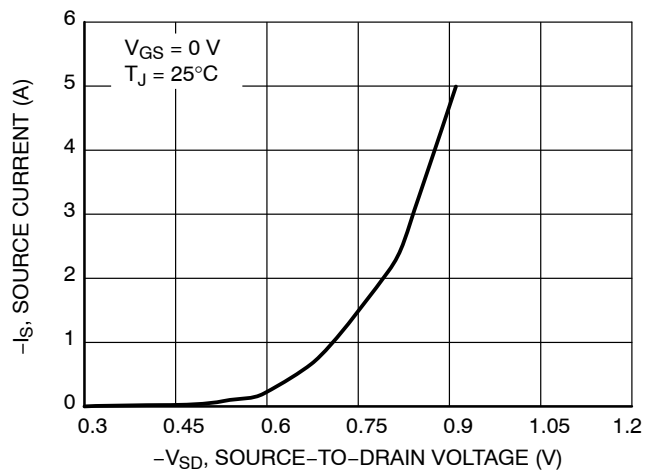
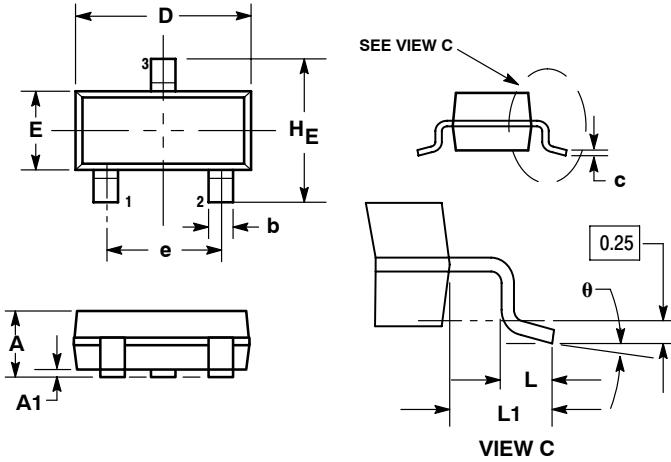


Figure 10. Diode Forward Voltage versus Current

# NTR2101P

## PACKAGE DIMENSIONS

### SOT-23 (TO-236) CASE 318-08 ISSUE AN



NOTES:

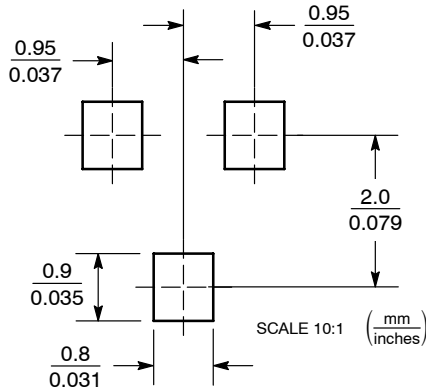
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: INCH.
3. MAXIMUM LEAD THICKNESS INCLUDES LEAD FINISH THICKNESS. MINIMUM LEAD THICKNESS IS THE MINIMUM THICKNESS OF BASE MATERIAL.
4. 318-01 THRU -07 AND -09 OBSOLETE, NEW STANDARD 318-08.

| DIM | MILLIMETERS |      |      | INCHES |       |       |
|-----|-------------|------|------|--------|-------|-------|
|     | MIN         | NOM  | MAX  | MIN    | NOM   | MAX   |
| A   | 0.89        | 1.00 | 1.11 | 0.035  | 0.040 | 0.044 |
| A1  | 0.01        | 0.06 | 0.10 | 0.001  | 0.002 | 0.004 |
| b   | 0.37        | 0.44 | 0.50 | 0.015  | 0.018 | 0.020 |
| c   | 0.09        | 0.13 | 0.18 | 0.003  | 0.005 | 0.007 |
| 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 | 0.081 |
| L   | 0.10        | 0.20 | 0.30 | 0.004  | 0.008 | 0.012 |
| L1  | 0.35        | 0.54 | 0.69 | 0.014  | 0.021 | 0.029 |
| HE  | 2.10        | 2.40 | 2.64 | 0.083  | 0.094 | 0.104 |

STYLE 21:

1. GATE
2. SOURCE
3. 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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