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# NTS4101P

## Power MOSFET

-20 V, -1.37 A, Single P-Channel, SC-70

### Features

- Leading -20 V Trench for Low  $R_{DS(on)}$
- -2.5 V Rated for Low Voltage Gate Drive
- SC-70 Surface Mount for Small Footprint (2x2 mm)
- Pb-Free Package is Available

### Applications

- High Side Load Switch
- Charging Circuit
- Single Cell Battery Applications such as: Cell Phones, Digital Cameras, PDAs

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

| Parameter   |                        | Symbol         | Value                    | Units            |   |
|---|------------------------|----------------|--------------------------|------------------|---|
| Drain-to-Source Voltage   |                        | $V_{DSS}$      | -20                      | V                |   |
| Gate-to-Source Voltage  |                        | $V_{GS}$       | $\pm 8$                  | V                |   |
| Continuous Drain Current (Note 1)                                 | Steady State           | $I_D$          | $T_A = 25^\circ\text{C}$ | -1.37            | A |
|   |                        |                | $T_A = 70^\circ\text{C}$ | -0.62            |   |
| Power Dissipation (Note 1)  | Steady State           | $P_D$          | 0.329                    | W                |   |
| Pulsed Drain Current  | $t_p = 10 \mu\text{s}$ | $I_{DM}$       | -4.0                     | A                |   |
| Operating Junction and Storage Temperature                        |                        | $T_J, T_{STG}$ | -55 to 150               | $^\circ\text{C}$ |   |
| Source Current (Body Diode), Continuous                           |                        | $I_S$          | -0.5                     | 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 | Units              |
|---|-----------------|-----|--------------------|
| Junction-to-Ambient - Steady State (Note 1) | $R_{\theta JA}$ | 380 | $^\circ\text{C/W}$ |

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).

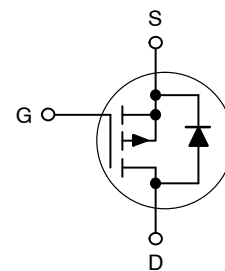


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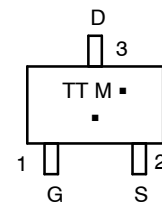
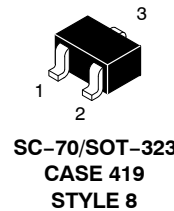
<http://onsemi.com>

| $V_{(BR)DSS}$ | $R_{DS(on)}$ Typ        | $I_D$ Max |
|---------------|-------------------------|-----------|
| -20 V         | 83 m $\Omega$ @ -4.5 V  | -1.37 A   |
|               | 88 m $\Omega$ @ -3.6 V  |           |
|               | 104 m $\Omega$ @ -2.5 V |           |

### P-Channel MOSFET



### MARKING DIAGRAM & PIN ASSIGNMENT



TT = 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†        |
|-------------|-------------------|------------------|
| NTS4101PT1  | SOT-323           | 3000/Tape & Reel |
| NTS4101PT1G | SOT-323 (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.

# NTS4101P

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

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

### OFF CHARACTERISTICS

|   |                                      |   |                       |       |      |       |
|---|--------------------------------------|---|-----------------------|-------|------|-------|
| Drain-to-Source Breakdown Voltage                         | V <sub>(BR)DSS</sub>                 | V <sub>GS</sub> = 0 V, I <sub>D</sub> = -250 μA | -20                   | -24.5 |      | V     |
| Drain-to-Source Breakdown Voltage Temperature Coefficient | V <sub>(BR)DSS</sub> /T <sub>J</sub> |   |                       | -13.7 |      | mV/°C |
| Zero Gate Voltage Drain Current                           | I <sub>DSS</sub>                     | V <sub>GS</sub> = 0 V, V <sub>DS</sub> = -16 V  | T <sub>J</sub> = 25°C |       | -1.0 | μA    |
|   |                                      |   | T <sub>J</sub> = 70°C |       | -5.0 |       |
| Gate-to-Source Leakage Current                            | I <sub>GSS</sub>                     | V <sub>DS</sub> = 0 V, V <sub>GS</sub> = ±8 V   |                       |       | ±100 | nA    |

### ON CHARACTERISTICS (Note 2)

|  |                                     |  |       |       |      |       |
|--|-------------------------------------|--|-------|-------|------|-------|
| Gate Threshold Voltage                     | V <sub>GS(TH)</sub>                 | V <sub>GS</sub> = V <sub>DS</sub> , I <sub>D</sub> = -250 μA | -0.45 | -0.64 | -1.5 | V     |
| Negative Threshold Temperature Coefficient | V <sub>GS(TH)</sub> /T <sub>J</sub> |  |       | 2.7   |      | mV/°C |
| Drain-to-Source On Resistance              | R <sub>DS(on)</sub>                 | V <sub>GS</sub> = -4.5 V, I <sub>D</sub> = -1.0 A            |       | 83    | 120  | mΩ    |
|  |                                     | V <sub>GS</sub> = -3.6 V, I <sub>D</sub> = -0.7 A            |       | 88    | 130  |       |
|  |                                     | V <sub>GS</sub> = -2.5 V, I <sub>D</sub> = -0.3 A            |       | 104   | 160  |       |
| Forward Transconductance                   | G <sub>FS</sub>                     | V <sub>DS</sub> = -5.0 V, I <sub>D</sub> = -1.3 A            |       | 5.2   |      | S     |

### CHARGES AND CAPACITANCES

|                              |                     |   |  |     |     |    |
|------------------------------|---------------------|---|--|-----|-----|----|
| Input Capacitance            | C <sub>ISS</sub>    | V <sub>GS</sub> = 0 V, f = 1.0 MHz, V <sub>DS</sub> = -20 V                 |  | 603 | 840 | pF |
| Output Capacitance           | C <sub>OSS</sub>    |   |  | 90  | 125 |    |
| Reverse Transfer Capacitance | C <sub>RSS</sub>    |   |  | 62  | 85  |    |
| Total Gate Charge            | Q <sub>G(TOT)</sub> | V <sub>GS</sub> = -4.5 V, V <sub>DS</sub> = -4.5 V, I <sub>D</sub> = -1.0 A |  | 6.4 | 9.0 | nC |
| Threshold Gate Charge        | Q <sub>G(TH)</sub>  |   |  | 0.7 |     |    |
| Gate-to-Source Charge        | Q <sub>GS</sub>     |   |  | 1.0 |     |    |
| Gate-to-Drain Charge         | Q <sub>GD</sub>     |   |  | 1.5 |     |    |

### SWITCHING CHARACTERISTICS (Note 3)

|                     |                     |   |  |      |    |    |
|---------------------|---------------------|---|--|------|----|----|
| Turn-On Delay Time  | t <sub>d(ON)</sub>  | V <sub>GS</sub> = -4.5 V, V <sub>DD</sub> = -4.0 V, I <sub>D</sub> = -1.0 A, R <sub>G</sub> = 6.2 Ω |  | 6.2  | 12 | ns |
| Rise Time           | t <sub>r</sub>      |   |  | 14.9 | 25 |    |
| Turn-Off Delay Time | t <sub>d(OFF)</sub> |   |  | 26   | 40 |    |
| Fall Time           | t <sub>f</sub>      |   |  | 18   | 30 |    |

### DRAIN-SOURCE DIODE CHARACTERISTICS

|                         |                 |   |                        |      |       |      |    |
|-------------------------|-----------------|---|------------------------|------|-------|------|----|
| Forward Diode Voltage   | V <sub>SD</sub> | V <sub>GS</sub> = 0 V, I <sub>S</sub> = -0.3 A                                  | T <sub>J</sub> = 25°C  |      | -0.61 | -1.2 | V  |
|                         |                 |   | T <sub>J</sub> = 125°C |      | -0.5  |      |    |
| Reverse Recovery Time   | t <sub>RR</sub> | V <sub>GS</sub> = 0 V, dI <sub>SD</sub> /dt = 100 A/μs, I <sub>S</sub> = -1.0 A |                        | 10.9 | 20    | ns   |    |
| Charge Time             | T <sub>a</sub>  |   |                        | 7.1  |       |      |    |
| Discharge Time          | T <sub>b</sub>  |   |                        | 3.8  |       |      |    |
| Reverse Recovery Charge | Q <sub>RR</sub> |   |                        | 4.25 |       |      | nC |

2. Pulse Test: pulse width ≤ 300 μs, duty cycle ≤ 2%.
3. Switching characteristics are independent of operating junction temperatures.

# NTS4101P

## TYPICAL CHARACTERISTICS

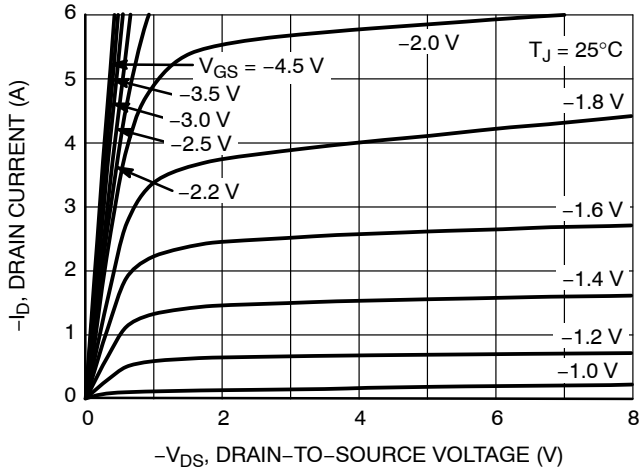


Figure 1. On-Region Characteristics

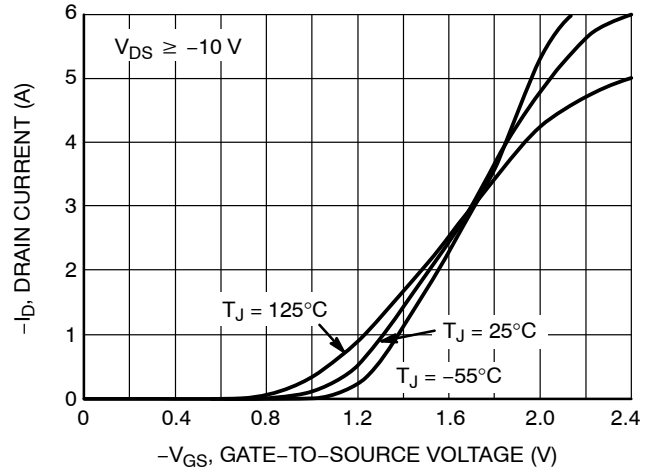


Figure 2. Transfer Characteristics

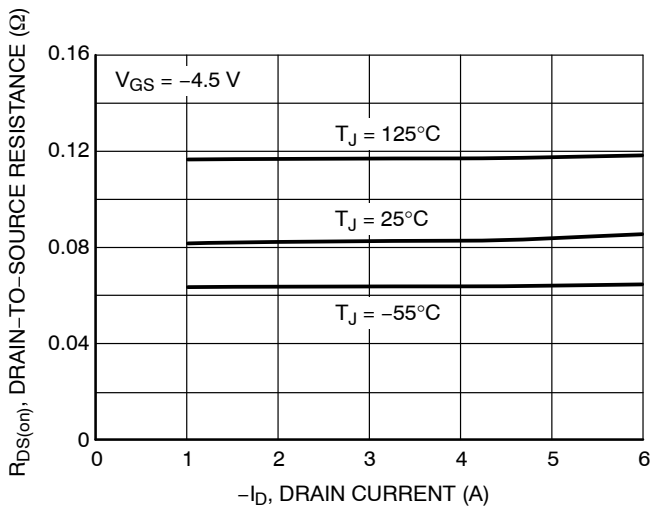


Figure 3. On-Resistance versus Drain Current and Temperature

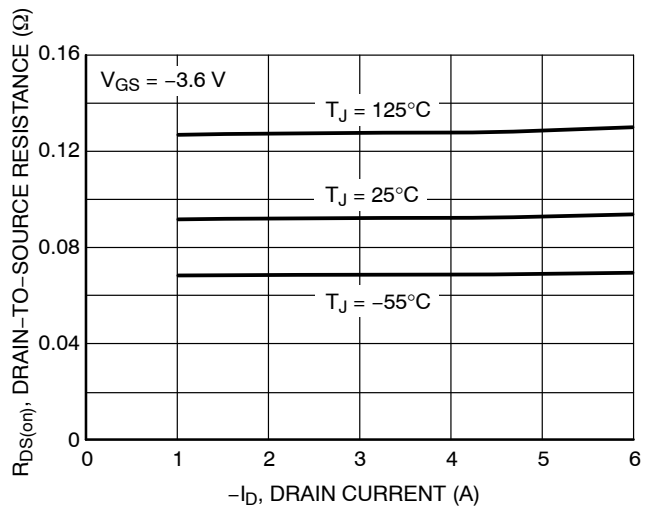


Figure 4. On-Resistance versus Drain Current and Temperature

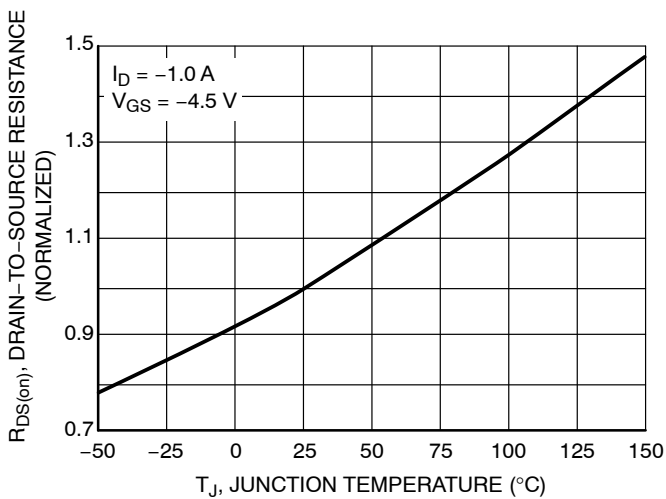


Figure 5. On-Resistance Variation with Temperature

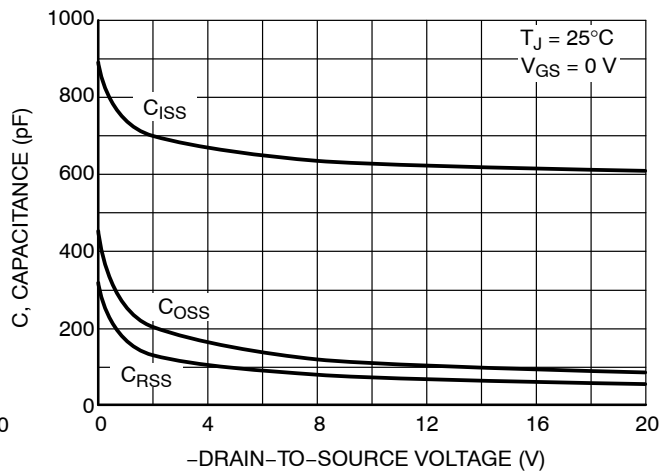


Figure 6. Capacitance Variation

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## TYPICAL CHARACTERISTICS

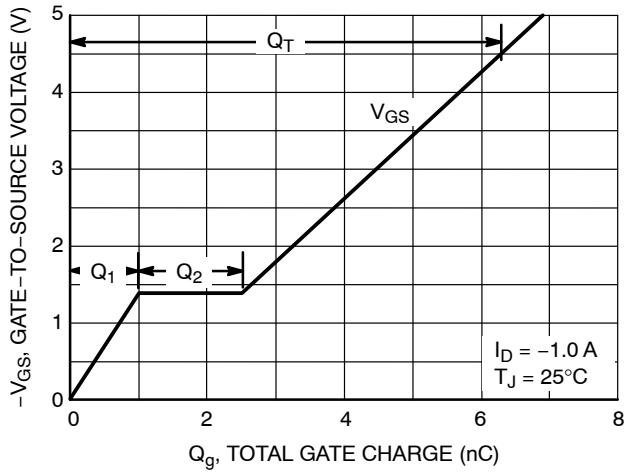


Figure 7. Gate-to-Source and Drain-to-Source Voltage versus Total Charge

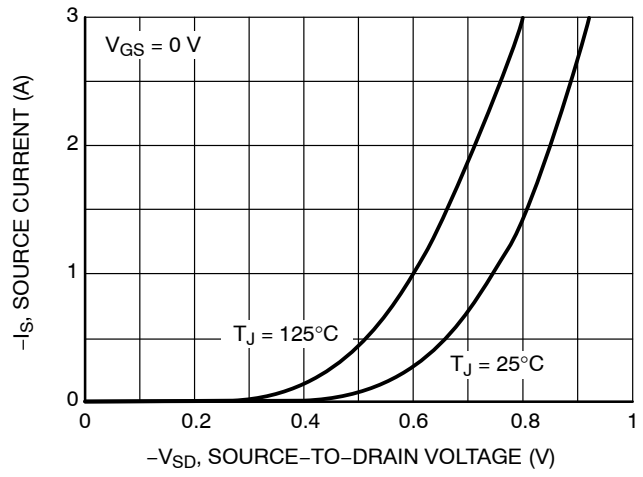
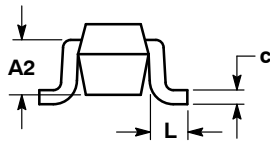
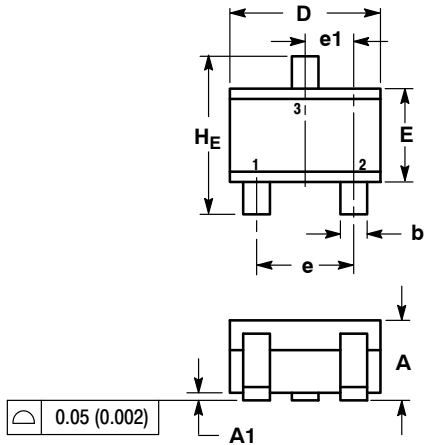


Figure 8. Diode Forward Voltage versus Current

# NTS4101P

## PACKAGE DIMENSIONS

SC-70 (SOT-323)  
CASE 419-04  
ISSUE N



**NOTES:**

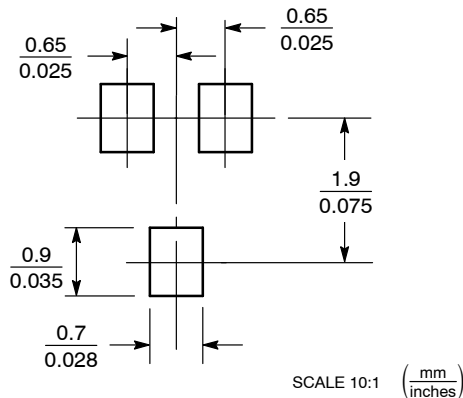
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: INCH.

| DIM | MILLIMETERS |      |      | INCHES    |       |       |
|-----|-------------|------|------|-----------|-------|-------|
|     | MIN         | NOM  | MAX  | MIN       | NOM   | MAX   |
| A   | 0.80        | 0.90 | 1.00 | 0.032     | 0.035 | 0.040 |
| A1  | 0.00        | 0.05 | 0.10 | 0.000     | 0.002 | 0.004 |
| A2  | 0.70 REF    |      |      | 0.028 REF |       |       |
| b   | 0.30        | 0.35 | 0.40 | 0.012     | 0.014 | 0.016 |
| c   | 0.10        | 0.18 | 0.25 | 0.004     | 0.007 | 0.010 |
| D   | 1.80        | 2.10 | 2.20 | 0.071     | 0.083 | 0.087 |
| E   | 1.15        | 1.24 | 1.35 | 0.045     | 0.049 | 0.053 |
| e   | 1.20        | 1.30 | 1.40 | 0.047     | 0.051 | 0.055 |
| e1  | 0.65 BSC    |      |      | 0.026 BSC |       |       |
| L   | 0.20        | 0.38 | 0.56 | 0.008     | 0.015 | 0.022 |
| HE  | 2.00        | 2.10 | 2.40 | 0.079     | 0.083 | 0.095 |

**STYLE 8:**

- 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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