

# NTS4409N, NVS4409N

## Small Signal MOSFET

25 V, 0.75 A, Single, N-Channel,  
ESD Protection, SC-70/SOT-323

### Features

- Advance Planar Technology for Fast Switching, Low  $R_{DS(on)}$
- Higher Efficiency Extending Battery Life
- AEC-Q101 Qualified and PPAP Capable – NVS4409N
- These Devices are Pb-Free and are RoHS Compliant

### Applications

- Boost and Buck Converter
- Load Switch
- Battery Protection

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

| Rating                                                            |                        |                       | Symbol                               | Value          | Unit |
|-------------------------------------------------------------------|------------------------|-----------------------|--------------------------------------|----------------|------|
| Drain-to-Source Voltage                                           |                        |                       | V <sub>DSS</sub>                     | 25             | V    |
| Gate-to-Source Voltage                                            |                        |                       | V <sub>GS</sub>                      | ± 8.0          | V    |
| Drain Current                                                     | t < 5 s                | T <sub>A</sub> = 25°C | I <sub>D</sub>                       | 0.75           | A    |
| Continuous Drain Current (Note 1)                                 | Steady State           | T <sub>A</sub> = 25°C | I <sub>D</sub>                       | 0.7            | A    |
|                                                                   |                        | T <sub>A</sub> = 75°C |                                      | 0.6            |      |
| Power Dissipation (Note 1)                                        | Steady State           |                       | P <sub>D</sub>                       | 0.28           | W    |
| Power Dissipation (Note 1)                                        | t ≤ 5 s                |                       | P <sub>D</sub>                       | 0.33           | W    |
| Pulsed Drain Current                                              | t <sub>p</sub> = 10 μs |                       | I <sub>DM</sub>                      | 3.0            | A    |
| Operating Junction and Storage Temperature                        |                        |                       | T <sub>J</sub> ,<br>T <sub>STG</sub> | –55 to<br>+150 | °C   |
| Source Current (Body Diode) (Note 1)                              |                        |                       | I <sub>S</sub>                       | 0.3            | A    |
| Lead Temperature for Soldering Purposes (1/8" from case for 10 s) |                        |                       | T <sub>L</sub>                       | 260            | °C   |
| ESD Rating – Machine Model                                        |                        |                       |                                      | 25             | V    |

### THERMAL RESISTANCE RATINGS

| Rating                                              | Symbol          | Max | Unit               |
|-----------------------------------------------------|-----------------|-----|--------------------|
| Junction-to-Ambient – Steady State (Note 1)         | $R_{\theta JA}$ | 450 | $^\circ\text{C/W}$ |
| Junction-to-Ambient – $t \leq 5 \text{ s}$ (Note 1) | $R_{\theta JA}$ | 375 |                    |

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).

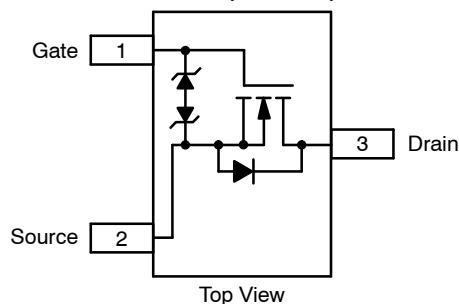


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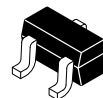
<http://onsemi.com>

| $V_{(BR)DS}$ | $R_{DS(on)}$ Typ       | $I_D$ Max |
|--------------|------------------------|-----------|
| 25 V         | 249 m $\Omega$ @ 4.5 V | 0.75 A    |
|              | 299 m $\Omega$ @ 2.7 V |           |

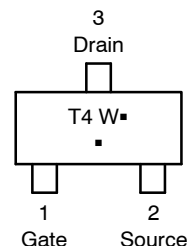
### SC-70 (3-Leads)



### MARKING DIAGRAM & PIN ASSIGNMENT



SC-70/SOT-323  
CASE 419  
STYLE 8



T4 = Device Code  
W = Work Week  
▪ = Pb-Free Package  
(Note: Microdot may be in either location)

### ORDERING INFORMATION

| Device      | Package           | Shipping†          |
|-------------|-------------------|--------------------|
| NTS4409NT1G | SOT-323 (Pb-Free) | 3000 / Tape & Reel |
| NVS4409NT1G | 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.

# NTS4409N, NVS4409N

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

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

### OFF CHARACTERISTICS

|                                                           |                   |                                                     |                           |    |     |                      |
|-----------------------------------------------------------|-------------------|-----------------------------------------------------|---------------------------|----|-----|----------------------|
| Drain-to-Source Breakdown Voltage                         | $V_{(BR)DSS}$     | $V_{GS} = 0\text{ V}, I_D = 250\text{ }\mu\text{A}$ | 25                        |    |     | V                    |
| Drain-to-Source Breakdown Voltage Temperature Coefficient | $V_{(BR)DSS}/T_J$ |                                                     |                           | 30 |     | mV/ $^\circ\text{C}$ |
| Zero Gate Voltage Drain Current                           | $I_{DSS}$         | $V_{GS} = 0\text{ V}, V_{DS} = 20\text{ V}$         | $T_J = 25^\circ\text{C}$  |    | 0.5 | $\mu\text{A}$        |
|                                                           |                   |                                                     | $T_J = 70^\circ\text{C}$  |    | 2.0 |                      |
|                                                           |                   |                                                     | $T_J = 125^\circ\text{C}$ |    | 5.0 |                      |
| Gate-to-Source Leakage Current                            | $I_{GSS}$         | $V_{DS} = 0\text{ V}, V_{GS} = 8.0\text{ V}$        |                           |    | 100 | nA                   |

### ON CHARACTERISTICS (Note 2)

|                                            |                  |                                                 |      |      |     |                      |
|--------------------------------------------|------------------|-------------------------------------------------|------|------|-----|----------------------|
| Gate Threshold Voltage                     | $V_{GS(TH)}$     | $V_{GS} = V_{DS}, I_D = 250\text{ }\mu\text{A}$ | 0.65 |      | 1.5 | V                    |
| Negative Threshold Temperature Coefficient | $V_{GS(TH)}/T_J$ |                                                 |      | -2.0 |     | mV/ $^\circ\text{C}$ |
| Drain-to-Source On Resistance              | $R_{DS(on)}$     | $V_{GS} = 4.5\text{ V}, I_D = 0.6\text{ A}$     |      | 249  | 350 | m $\Omega$           |
|                                            |                  | $V_{GS} = 2.7\text{ V}, I_D = 0.2\text{ A}$     |      | 299  | 400 |                      |
|                                            |                  | $V_{GS} = 4.5\text{ V}, I_D = 1.2\text{ A}$     |      | 260  |     |                      |
| Forward Transconductance                   | $g_{FS}$         | $V_{DS} = 5.0\text{ V}, I_D = 0.5\text{ A}$     |      | 0.5  |     | S                    |

### CHARGES AND CAPACITANCES

|                              |              |                                                                   |  |      |      |    |
|------------------------------|--------------|-------------------------------------------------------------------|--|------|------|----|
| Input Capacitance            | $C_{ISS}$    | $V_{GS} = 0\text{ V}, f = 1.0\text{ MHz}, V_{DS} = 10\text{ V}$   |  | 49   | 60   | pF |
| Output Capacitance           | $C_{OSS}$    |                                                                   |  | 22.4 | 30   |    |
| Reverse Transfer Capacitance | $C_{RSS}$    |                                                                   |  | 8.0  | 12   |    |
| Total Gate Charge            | $Q_{G(TOT)}$ | $V_{GS} = 4.5\text{ V}, V_{DS} = 15\text{ V}, I_D = 0.8\text{ A}$ |  | 1.2  | 1.5  | nC |
| Threshold Gate Charge        | $Q_{G(TH)}$  |                                                                   |  | 0.2  |      |    |
| Gate-to-Source Charge        | $Q_{GS}$     |                                                                   |  | 0.28 | 0.50 |    |
| Gate-to-Drain Charge         | $Q_{GD}$     |                                                                   |  | 0.3  | 0.40 |    |

### SWITCHING CHARACTERISTICS (Note 3)

|                     |              |                                                                                           |  |     |     |    |
|---------------------|--------------|-------------------------------------------------------------------------------------------|--|-----|-----|----|
| Turn-On Delay Time  | $t_{d(ON)}$  | $V_{GS} = 4.5\text{ V}, V_{DS} = 15\text{ V}, I_D = 0.7\text{ A}, R_G = 51\text{ }\Omega$ |  | 5.0 | 12  | ns |
| Rise Time           | $t_r$        |                                                                                           |  | 8.2 | 8.0 |    |
| Turn-Off Delay Time | $t_{d(OFF)}$ |                                                                                           |  | 23  | 35  |    |
| Fall Time           | $t_f$        |                                                                                           |  | 41  | 60  |    |

### DRAIN-SOURCE DIODE CHARACTERISTICS

|                       |          |                                           |                          |  |      |      |   |
|-----------------------|----------|-------------------------------------------|--------------------------|--|------|------|---|
| Forward Diode Voltage | $V_{SD}$ | $V_{GS} = 0\text{ V}, I_S = 0.6\text{ A}$ | $T_J = 25^\circ\text{C}$ |  | 0.82 | 1.20 | V |
|-----------------------|----------|-------------------------------------------|--------------------------|--|------|------|---|

- Pulse Test: pulse width  $\leq 300\text{ }\mu\text{s}$ , duty cycle  $\leq 2\%$ .
- Switching characteristics are independent of operating junction temperatures.

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

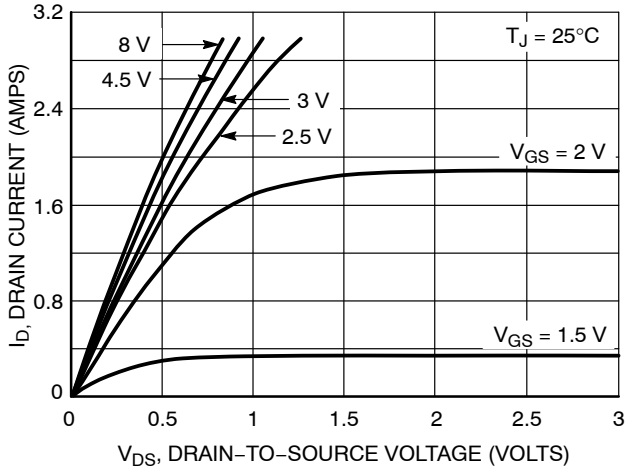


Figure 1. On-Region Characteristics

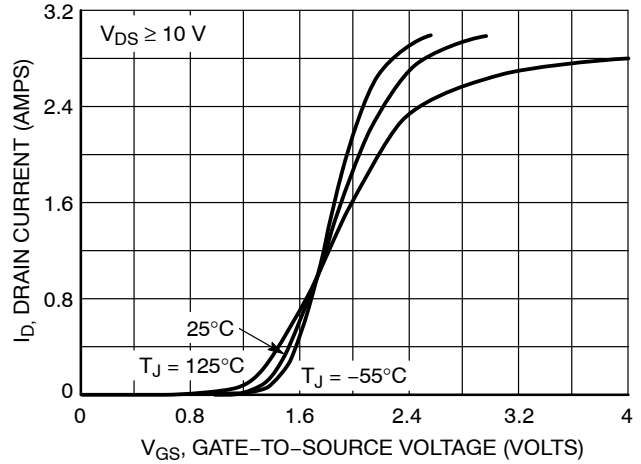


Figure 2. Transfer Characteristics

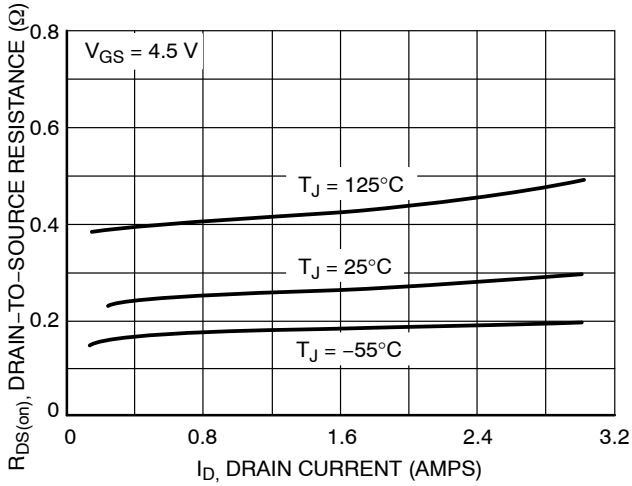


Figure 3. On-Resistance vs. Drain Current and Temperature

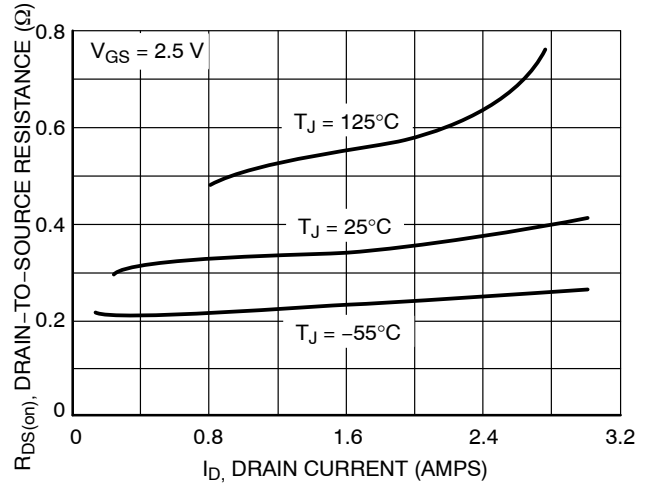


Figure 4. On-Resistance vs. Drain Current and Gate Voltage

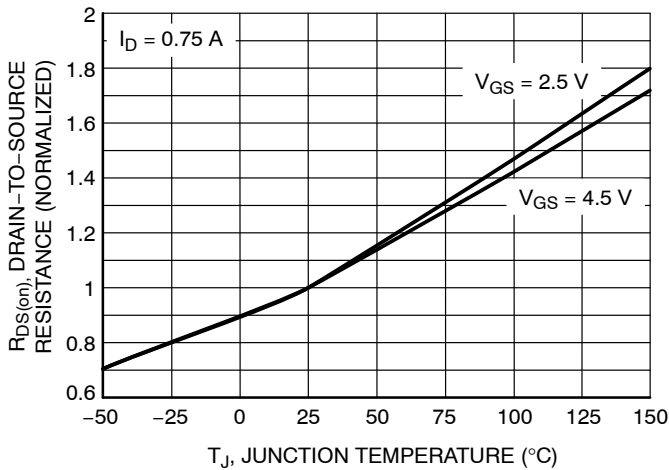


Figure 5. On-Resistance Variation with Temperature

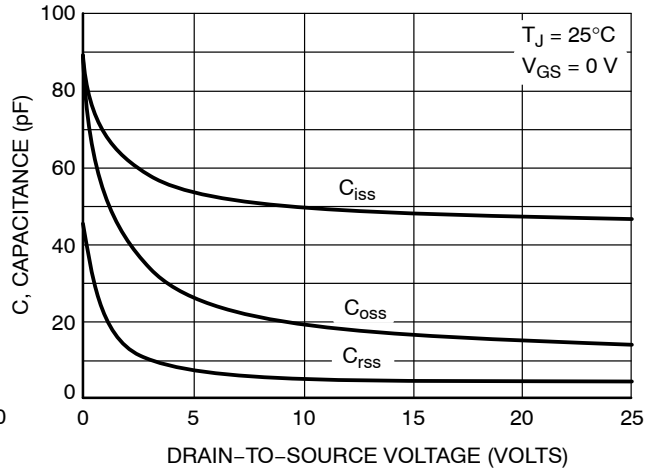


Figure 6. Capacitance Variation

# NTS4409N, NVS4409N

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

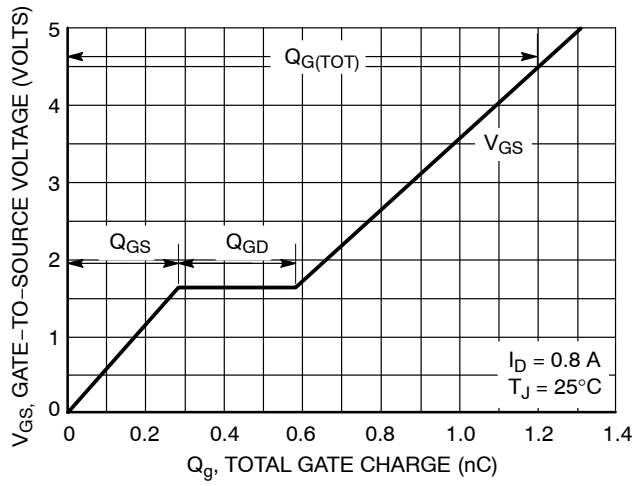


**Figure 7. Gate-to-Source and Drain-to-Source Voltage vs. Total Charge**

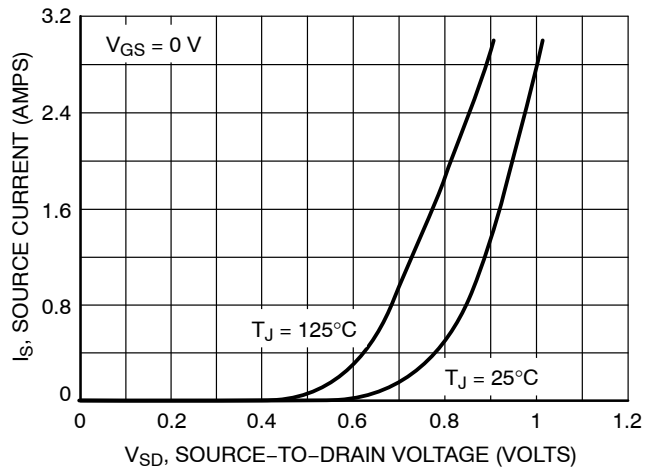
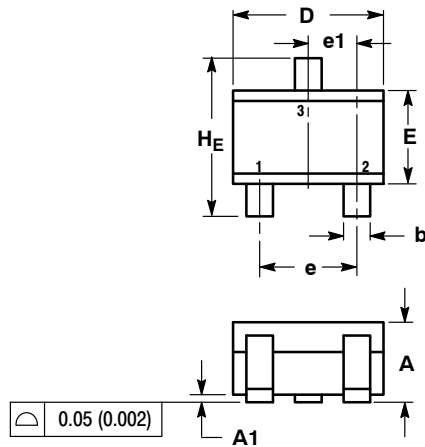


**Figure 8. Diode Forward Voltage vs. Current**

# NTS4409N, NVS4409N

## PACKAGE DIMENSIONS

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



#### NOTES:

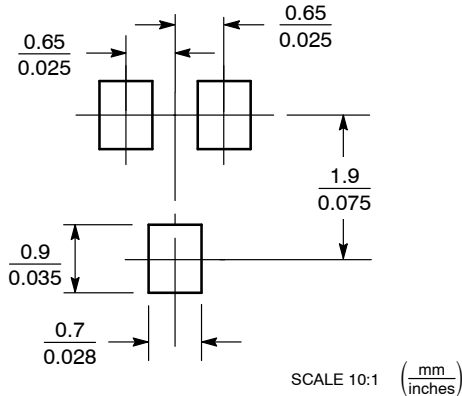
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: INCH.

| 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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