

# 2N7002W, 2V7002W

## Small Signal MOSFET

60 V, 340 mA, Single, N-Channel, SC-70

### Features

- ESD Protected
- Low  $R_{DS(on)}$
- Small Footprint Surface Mount Package
- These Devices are Pb-Free, Halogen Free/BFR Free and are RoHS Compliant
- 2V Prefix for Automotive and Other Applications Requiring Unique Site and Control Change Requirements; AEC-Q101 Qualified and PPAP Capable

### Applications

- Low Side Load Switch
- Level Shift Circuits
- DC-DC Converter
- Portable Applications i.e. DSC, PDA, Cell Phone, etc.

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

| Rating   | Symbol         | Value                    | Unit             |
|--|----------------|--------------------------|------------------|
| Drain-to-Source Voltage  | $V_{DSS}$      | 60                       | V                |
| Gate-to-Source Voltage   | $V_{GS}$       | $\pm 20$                 | V                |
| Drain Current (Note 1)<br>Steady State                               | $I_D$          | $T_A = 25^\circ\text{C}$ | 310              |
|  |                | $T_A = 85^\circ\text{C}$ | 220              |
| $t < 5$ s  |                | $T_A = 25^\circ\text{C}$ | 340              |
|  |                | $T_A = 85^\circ\text{C}$ | 240              |
| Power Dissipation (Note 1)<br>Steady State<br>$t < 5$ s              | $P_D$          |                          | 280              |
|  |                |                          | 330              |
| Pulsed Drain Current ( $t_p = 10 \mu\text{s}$ )                      | $I_{DM}$       | 1.4                      | A                |
| Operating Junction and Storage Temperature Range                     | $T_J, T_{STG}$ | -55 to +150              | $^\circ\text{C}$ |
| Source Current (Body Diode)  | $I_S$          | 250                      | mA               |
| Lead Temperature for Soldering Purposes<br>(1/8" from case for 10 s) | $T_L$          | 260                      | $^\circ\text{C}$ |
| Gate-Source ESD Rating<br>(HBM, Method 3015)                         | ESD            | 900                      | V                |

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.

### THERMAL CHARACTERISTICS

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

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

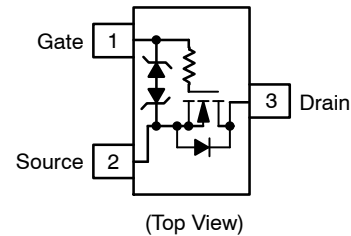


ON Semiconductor®

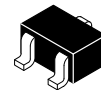
<http://onsemi.com>

| $V_{(BR)DSS}$ | $R_{DS(on)}$ MAX     | $I_D$ MAX<br>(Note 1) |
|---------------|----------------------|-----------------------|
| 60 V          | 1.6 $\Omega$ @ 10 V  | 340 mA                |
|               | 2.5 $\Omega$ @ 4.5 V |                       |

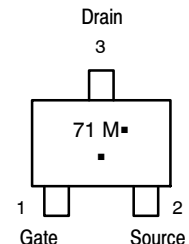
### SIMPLIFIED SCHEMATIC



### MARKING DIAGRAM & PIN ASSIGNMENT



SC-70/SOT-323  
CASE 419  
STYLE 8



71 = Device Code  
M = Date Code  
▪ = Pb-Free Package

(Note: Microdot may be in either location)

### ORDERING INFORMATION

| Device     | Package            | Shipping†        |
|------------|--------------------|------------------|
| 2N7002WT1G | SC-70<br>(Pb-Free) | 3000/Tape & Reel |
| 2V7002WT1G | SC-70<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.

## 2N7002W, 2V7002W

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

| Parameter   | Symbol            | Test Condition                                   | Min                       | Typ | Max      | Units                |
|---|-------------------|--|---------------------------|-----|----------|----------------------|
| <b>OFF CHARACTERISTICS</b>                                |                   |  |                           |     |          |                      |
| Drain-to-Source Breakdown Voltage                         | $V_{(BR)DSS}$     | $V_{GS} = 0\text{ V}, I_D = 250\ \mu\text{A}$    | 60                        |     |          | V                    |
| Drain-to-Source Breakdown Voltage Temperature Coefficient | $V_{(BR)DSS}/T_J$ |  |                           | 71  |          | mV/ $^\circ\text{C}$ |
| Zero Gate Voltage Drain Current                           | $I_{DSS}$         | $V_{GS} = 0\text{ V}, V_{DS} = 60\text{ V}$      | $T_J = 25^\circ\text{C}$  |     | 1.0      | $\mu\text{A}$        |
|   |                   |  | $T_J = 150^\circ\text{C}$ |     | 15       | $\mu\text{A}$        |
|   |                   | $V_{GS} = 0\text{ V}, V_{DS} = 50\text{ V}$      | $T_J = 25^\circ\text{C}$  |     | 100      | nA                   |
|   |                   |  | $T_J = 150^\circ\text{C}$ |     | 10       | $\mu\text{A}$        |
| Gate-to-Source Leakage Current                            | $I_{GSS}$         | $V_{DS} = 0\text{ V}, V_{GS} = \pm 20\text{ V}$  |                           |     | $\pm 10$ | $\mu\text{A}$        |
|   |                   | $V_{DS} = 0\text{ V}, V_{GS} = \pm 10\text{ V}$  |                           |     | 450      | nA                   |
|   |                   | $V_{DS} = 0\text{ V}, V_{GS} = \pm 5.0\text{ V}$ |                           |     | 150      | nA                   |

### ON CHARACTERISTICS (Note 2)

|  |                  |  |     |      |     |                      |
|--|------------------|--|-----|------|-----|----------------------|
| Gate Threshold Voltage                     | $V_{GS(TH)}$     | $V_{GS} = V_{DS}, I_D = 250\ \mu\text{A}$    | 1.0 |      | 2.5 | V                    |
| Negative Threshold Temperature Coefficient | $V_{GS(TH)}/T_J$ |  |     | 4.0  |     | mV/ $^\circ\text{C}$ |
| Drain-to-Source On Resistance              | $R_{DS(on)}$     | $V_{GS} = 10\text{ V}, I_D = 500\text{ mA}$  |     | 1.19 | 1.6 | $\Omega$             |
|  |                  | $V_{GS} = 4.5\text{ V}, I_D = 200\text{ mA}$ |     | 1.33 | 2.5 |                      |
| Forward Transconductance                   | $g_{FS}$         | $V_{DS} = 5\text{ V}, I_D = 200\text{ mA}$   |     | 530  |     | mS                   |

### CHARGES AND CAPACITANCES

|                              |              |  |  |      |  |    |
|------------------------------|--------------|--|--|------|--|----|
| Input Capacitance            | $C_{ISS}$    | $V_{GS} = 0\text{ V}, f = 1\text{ MHz}, V_{DS} = 20\text{ V}$      |  | 24.5 |  | pF |
| Output Capacitance           | $C_{OSS}$    |  |  | 4.2  |  |    |
| Reverse Transfer Capacitance | $C_{RSS}$    |  |  | 2.2  |  |    |
| Total Gate Charge            | $Q_{G(TOT)}$ | $V_{GS} = 4.5\text{ V}, V_{DS} = 10\text{ V}; I_D = 200\text{ mA}$ |  | 0.7  |  | nC |
| Threshold Gate Charge        | $Q_{G(TH)}$  |  |  | 0.1  |  |    |
| Gate-to-Source Charge        | $Q_{GS}$     |  |  | 0.3  |  |    |
| Gate-to-Drain Charge         | $Q_{GD}$     |  |  | 0.1  |  |    |

### SWITCHING CHARACTERISTICS, $V_{GS} = V$ (Note 3)

|                     |              |   |  |      |  |    |
|---------------------|--------------|---|--|------|--|----|
| Turn-On Delay Time  | $t_{d(ON)}$  | $V_{GS} = 10\text{ V}, V_{DD} = 25\text{ V}, I_D = 500\text{ mA}, R_G = 25\ \Omega$ |  | 12.2 |  | ns |
| Rise Time           | $t_r$        |   |  | 9.0  |  |    |
| Turn-Off Delay Time | $t_{d(OFF)}$ |   |  | 55.8 |  |    |
| Fall Time           | $t_f$        |   |  | 29   |  |    |

### DRAIN-SOURCE DIODE CHARACTERISTICS

|                       |          |  |                          |  |     |     |   |
|-----------------------|----------|--|--------------------------|--|-----|-----|---|
| Forward Diode Voltage | $V_{SD}$ | $V_{GS} = 0\text{ V}, I_S = 200\text{ mA}$ | $T_J = 25^\circ\text{C}$ |  | 0.8 | 1.2 | V |
|                       |          |  | $T_J = 85^\circ\text{C}$ |  | 0.7 |     |   |

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

TYPICAL CHARACTERISTICS

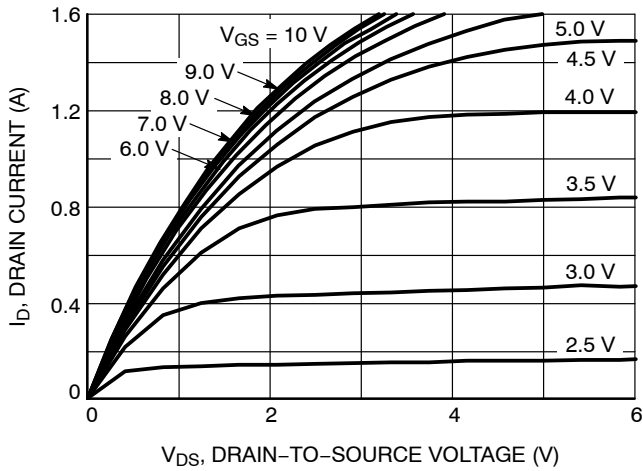


Figure 1. On-Region Characteristics

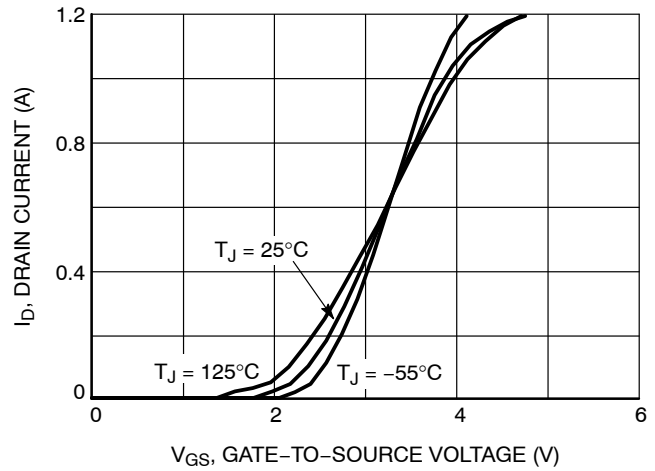


Figure 2. Transfer Characteristics

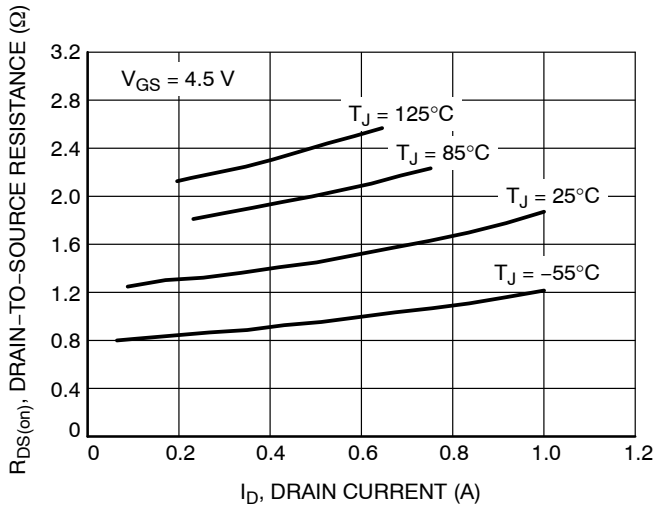


Figure 3. On-Resistance vs. Drain Current and Temperature

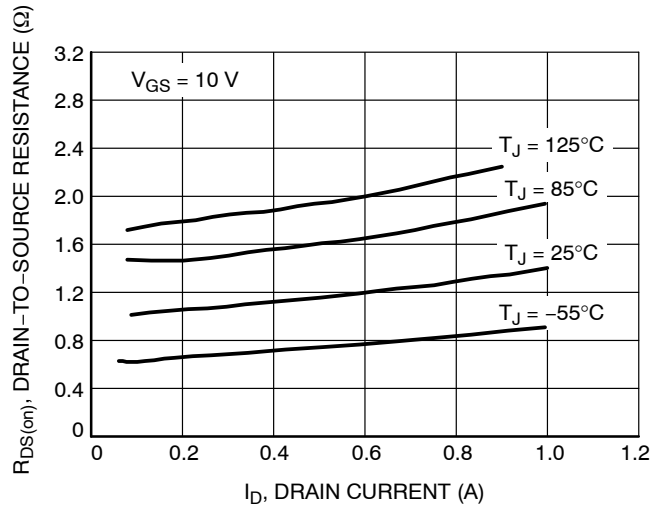


Figure 4. On-Resistance vs. Drain Current and Temperature

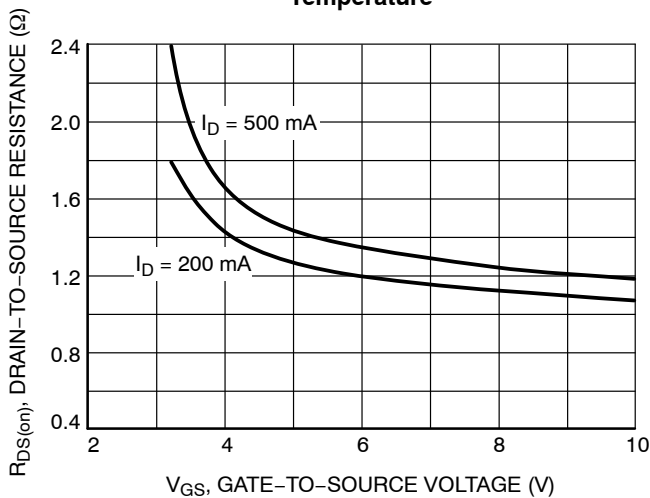


Figure 5. On-Resistance vs. Gate-to-Source Voltage

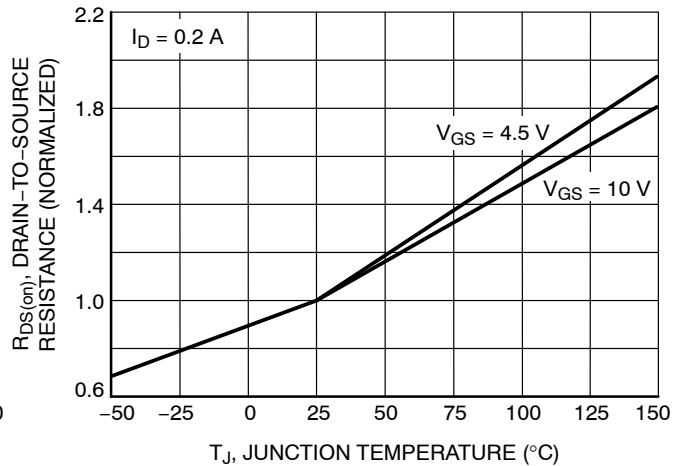
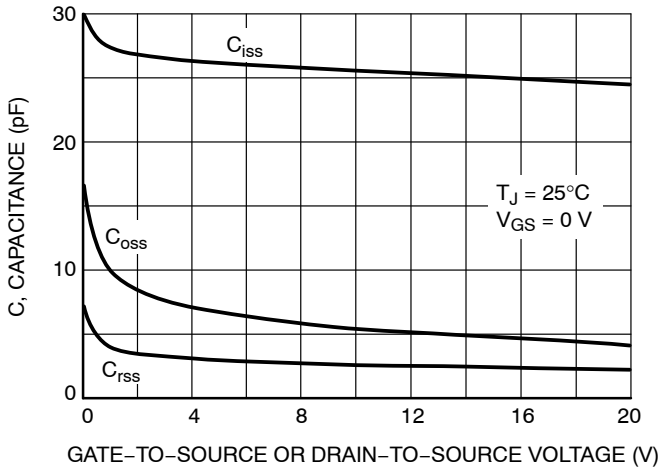


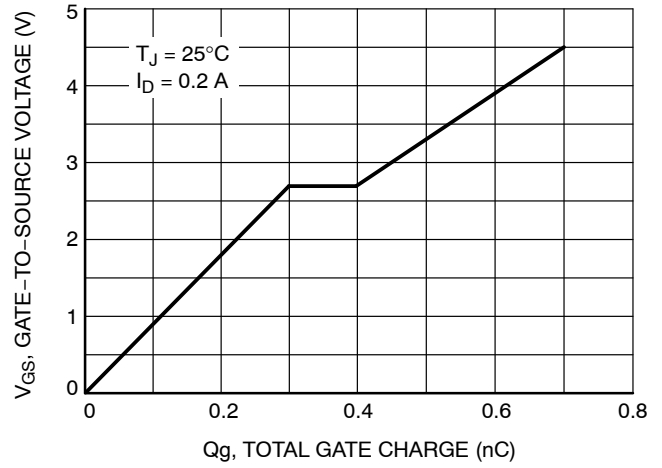
Figure 6. On-Resistance Variation with Temperature

# 2N7002W, 2V7002W

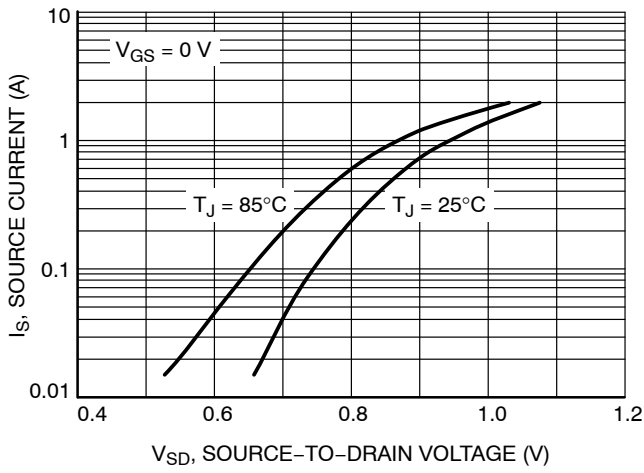
## TYPICAL CHARACTERISTICS



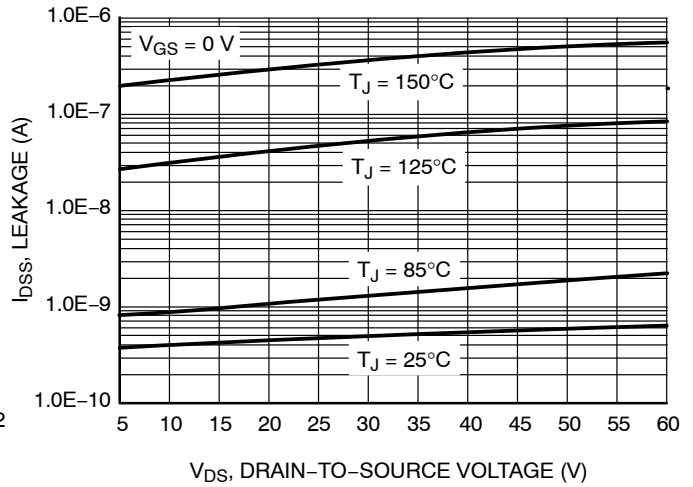
**Figure 7. Capacitance Variation**



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



**Figure 9. Diode Forward Voltage vs. Current**

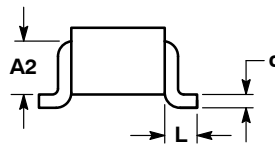
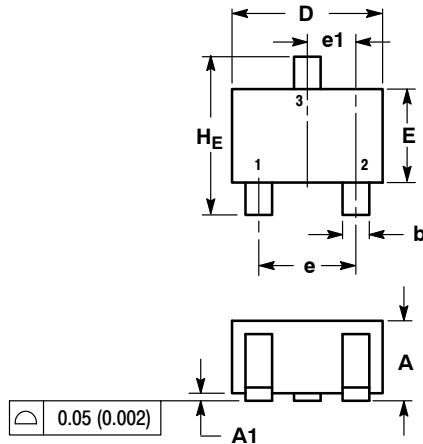


**Figure 10. Drain-to-Source Leakage Current vs. Voltage**

# 2N7002W, 2V7002W

## PACKAGE DIMENSIONS

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

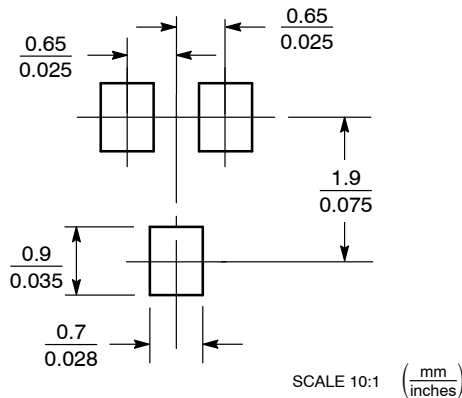


- NOTES:  
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.  
2. CONTROLLING DIMENSION: INCH.

| 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  | 0.7 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   | 0.425 REF   |      |      | 0.017 REF |       |       |
| HE  | 2.00        | 2.10 | 2.40 | 0.079     | 0.083 | 0.095 |

- STYLE 8:  
PIN 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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