

# N-Channel Enhancement Mode Field Effect Transistor

## 2N7002KW

### Features

- Low On-Resistance
- Low Gate Threshold Voltage
- Low Input Capacitance
- Fast Switching Speed
- Low Input/Output Leakage
- Ultra-Small Surface Mount Package
- These Devices are Pb-Free and are RoHS Compliant
- ESD HBM = 1000 V as per JESD22 A114 and ESD CDM = 1500 V as per JESD22 C101

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

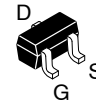
| Rating                               | Symbol    | Value             | Unit             |
|--------------------------------------|-----------|-------------------|------------------|
| Drain-Source Voltage                 | $V_{DS}$  | 60                | V                |
| Gate-Source Voltage                  | $V_{GS}$  | $\pm 20$          | V                |
| Maximum Drain Current                | $I_D$     | 310<br>195<br>1.2 | mA<br>mA<br>A    |
| Operating Junction Temperature Range | $T_J$     | $-55$ to $+150$   | $^\circ\text{C}$ |
| Storage Temperature Range            | $T_{STG}$ | $-55$ to $+150$   | $^\circ\text{C}$ |

Stresses exceeding those listed in the Maximum Ratings table may damage the device. If any of these limits are exceeded, device functionality should not be assumed, damage may occur and reliability may be affected.

### THERMAL CHARACTERISTICS

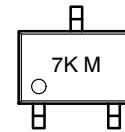
| Parameter                                                           | Symbol          | Value      | Unit                       |
|---------------------------------------------------------------------|-----------------|------------|----------------------------|
| Total Device Dissipation<br>Derating above $T_A = 25^\circ\text{C}$ | $P_D$           | 300<br>2.4 | mW<br>mW/ $^\circ\text{C}$ |
| Thermal Resistance,<br>Junction to Ambient*                         | $R_{\theta JA}$ | 410        | $^\circ\text{C/W}$         |

\*Device mounted on FR-4 PCB, 1" x 0.85" x 0.062". Minimum land pad size

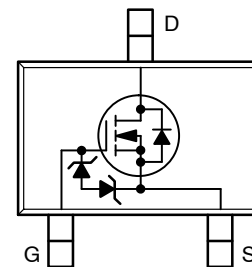


SC-70  
3 LEAD  
CASE 419AB

### MARKING DIAGRAM



7K = Device Code  
M = Date Code



### ORDERING INFORMATION†

| Device   | Package | Shipping†          |
|----------|---------|--------------------|
| 2N7002KW | SC-70   | 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.

## 2N7002KW

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

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

#### OFF CHARACTERISTICS

|            |                                 |                                                                                                                     |    |   |            |                     |
|------------|---------------------------------|---------------------------------------------------------------------------------------------------------------------|----|---|------------|---------------------|
| $BV_{DSS}$ | Drain-Source Breakdown Voltage  | $V_{GS} = 0\text{ V}, I_D = 10\text{ }\mu\text{A}$                                                                  | 60 | – | –          | V                   |
| $I_{DSS}$  | Zero Gate Voltage Drain Current | $V_{DS} = 60\text{ V}, V_{GS} = 0\text{ V}$<br>$V_{DS} = 60\text{ V}, V_{GS} = 0\text{ V}, T_J = 125^\circ\text{C}$ | –  | – | 1.0<br>0.5 | $\mu\text{A}$<br>mA |
| $I_{GSS}$  | Gate-Body Leakage               | $V_{DS} = 0\text{ V}, V_{GS} = \pm 20\text{ V}$                                                                     | –  | – | $\pm 10$   | $\mu\text{A}$       |

#### ON CHARACTERISTICS (Note 1)

|              |                                   |                                                                                                                                                                                                                                        |     |   |                      |          |
|--------------|-----------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|---|----------------------|----------|
| $V_{GS(th)}$ | Gate Threshold Voltage            | $V_{DS} = V_{GS}, I_D = 250\text{ }\mu\text{A}$                                                                                                                                                                                        | 1.1 | – | 2.1                  | V        |
| $R_{DS(on)}$ | Static Drain-Source On-Resistance | $V_{GS} = 10\text{ V}, I_D = 500\text{ mA}$<br>$V_{GS} = 10\text{ V}, I_D = 500\text{ mA}, T_J = 100^\circ\text{C}$<br>$V_{GS} = 5\text{ V}, I_D = 50\text{ mA}$<br>$V_{GS} = 5\text{ V}, I_D = 50\text{ mA}, T_J = 100^\circ\text{C}$ | –   | – | 1.6<br>2.4<br>2<br>3 | $\Omega$ |
| $V_{DS(on)}$ | Drain-Source On-Voltage           | $V_{GS} = 10\text{ V}, I_D = 500\text{ mA}$<br>$V_{GS} = 5\text{ V}, I_D = 50\text{ mA}$                                                                                                                                               | –   | – | 3.75<br>1.5          | V        |
| $I_{D(on)}$  | On-State Drain Current            | $V_{GS} = 10\text{ V}, V_{DS} = 2\text{ V}$                                                                                                                                                                                            | 500 | – | –                    | mA       |
| $g_{FS}$     | Forward Transconductance          | $V_{DS} = 2\text{ V}, I_D = 0.2\text{ A}$                                                                                                                                                                                              | 80  | – | –                    | mS       |

#### DYNAMIC CHARACTERISTICS

|           |                              |                                                                 |   |   |    |    |
|-----------|------------------------------|-----------------------------------------------------------------|---|---|----|----|
| $C_{iss}$ | Input Capacitance            | $V_{DS} = 25\text{ V}, V_{GS} = 0\text{ V}, f = 1.0\text{ MHz}$ | – | – | 50 | pF |
| $C_{oss}$ | Output Capacitance           |                                                                 | – | – | 25 | pF |
| $C_{rss}$ | Reverse Transfer Capacitance |                                                                 | – | – | 5  | pF |

#### SWITCHING CHARACTERISTICS

|              |                     |                                                                                                                             |   |   |    |    |
|--------------|---------------------|-----------------------------------------------------------------------------------------------------------------------------|---|---|----|----|
| $t_{d(on)}$  | Turn-On Delay Time  | $V_{DD} = 30\text{ V}, R_L = 150\text{ }\Omega, V_{GS} = 10\text{ V},$<br>$I_D = 200\text{ mA}, R_{GEN} = 25\text{ }\Omega$ | – | – | 20 | ns |
| $t_{d(off)}$ | Turn-Off Delay Time |                                                                                                                             | – | – | 60 | ns |

#### DRAIN-SOURCE DIODE CHARACTERISTICS

|                 |                                                       |                                                |   |   |     |    |
|-----------------|-------------------------------------------------------|------------------------------------------------|---|---|-----|----|
| I <sub>S</sub>  | Maximum Continuous Drain–Source Diode Forward Current |                                                | – | – | 115 | mA |
| I <sub>SM</sub> | Maximum Pulsed Drain–Source Diode Forward Current     |                                                | – | – | 0.8 | A  |
| V <sub>SD</sub> | Drain–Source Diode Forward Voltage                    | V <sub>GS</sub> = 0 V, I <sub>S</sub> = 115 mA | – | – | 1.1 | V  |

Product parametric performance is indicated in the Electrical Characteristics for the listed test conditions, unless otherwise noted. Product performance may not be indicated by the Electrical Characteristics if operated under different conditions.

1. Pulse Test: Pulse Width < 300  $\mu\text{s}$ , Duty Cycle < 2.0%.

TYPICAL PERFORMANCE CHARACTERISTICS

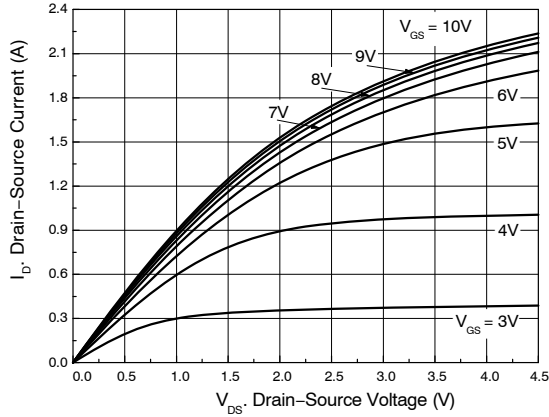


Figure 1. On-Region Characteristics

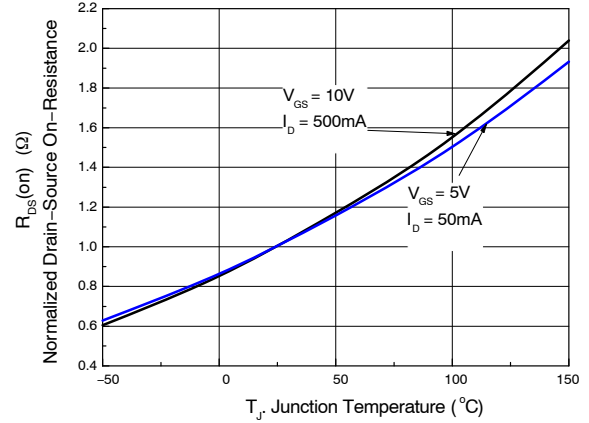


Figure 2. On-Resistance Variation with Temperature

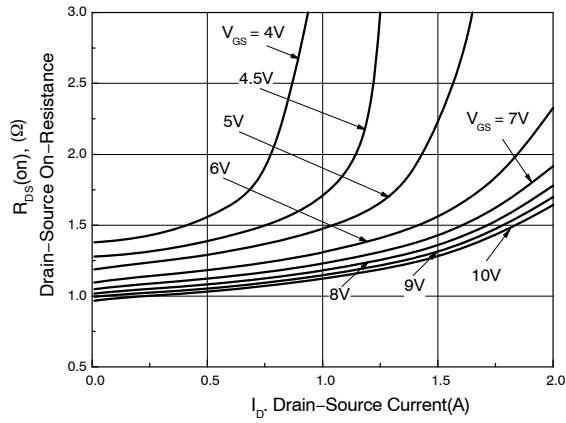


Figure 3. On-Resistance Variation with Gate Voltage and Drain Current

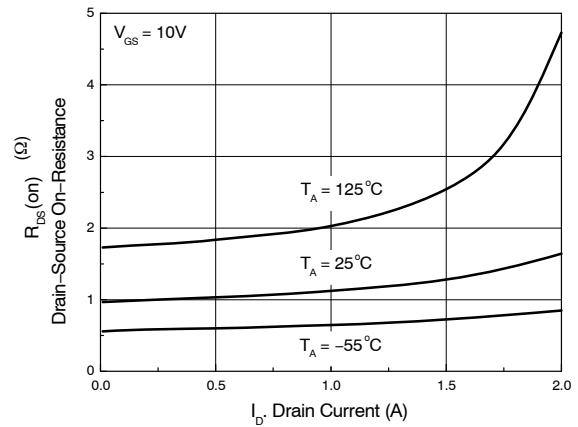


Figure 4. On-Resistance Variation with Drain Current and Temperature

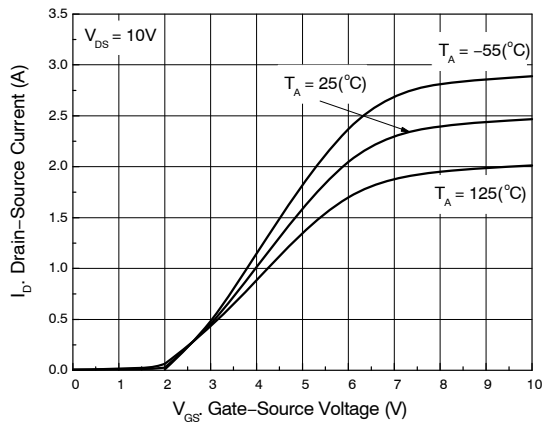


Figure 5. Transfer Characteristics

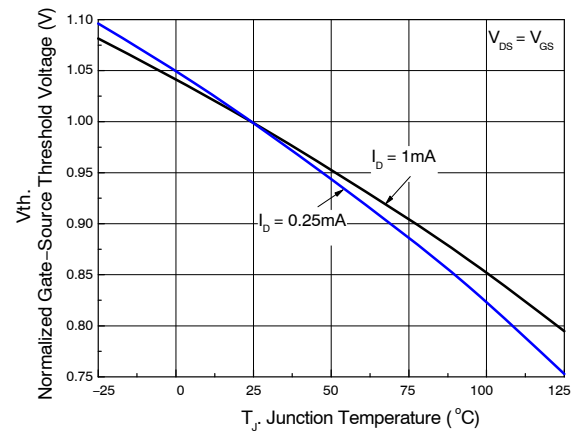


Figure 6. Gate Threshold Variation with Temperature

TYPICAL PERFORMANCE CHARACTERISTICS

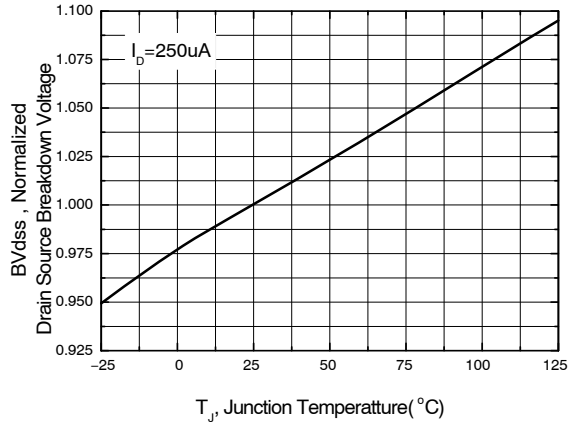


Figure 7. Breakdown Voltage Variation with Temperature

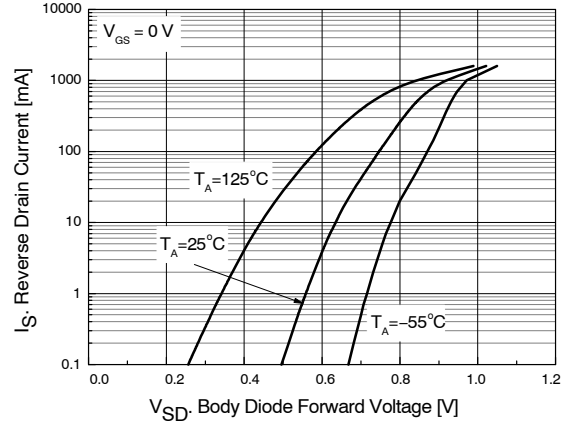


Figure 8. Body Diode Forward Voltage Variation with Source Current and Temperature

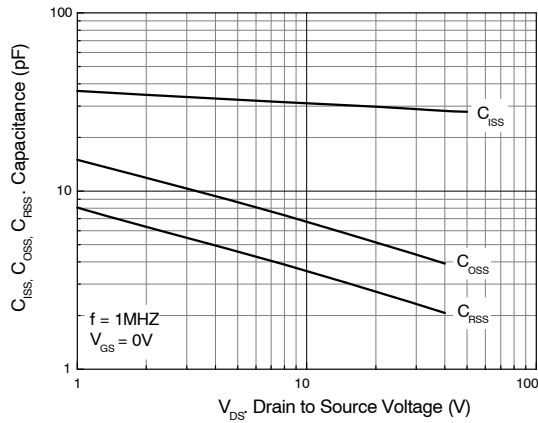


Figure 9. Capacitance Variation

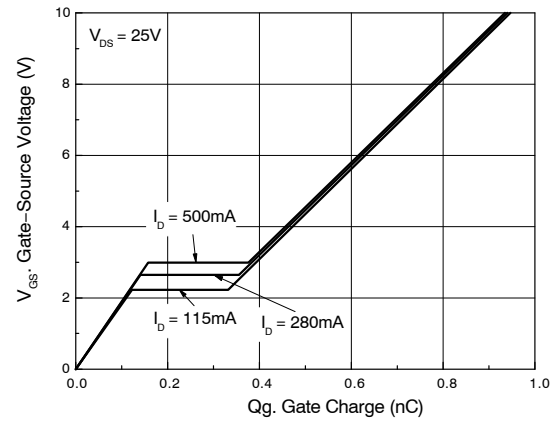


Figure 10. Gate Charge Characteristics

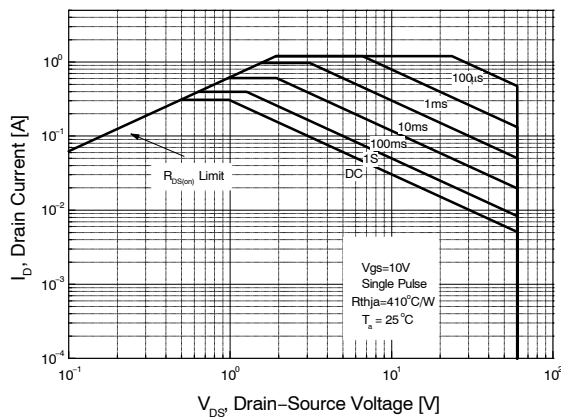


Figure 11. Maximum Safe Operating Area

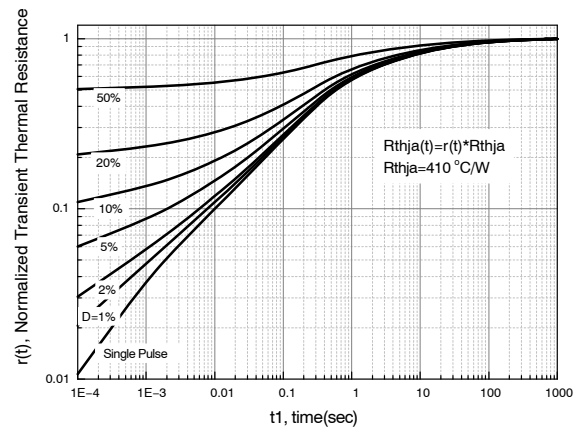
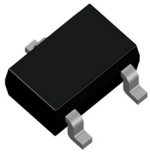
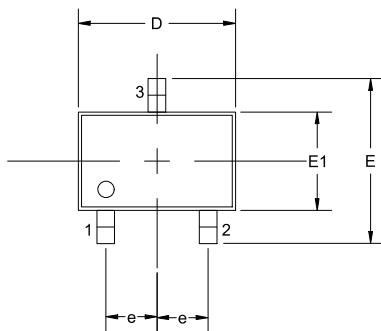


Figure 12. Transient Thermal Response Curve

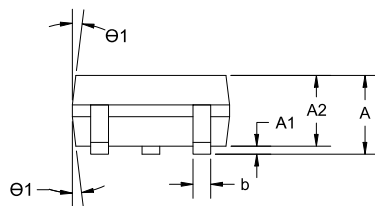


SC-70, 3 Lead, 1.25x2  
CASE 419AB  
ISSUE A

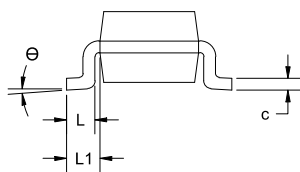
DATE 13 FEB 2023



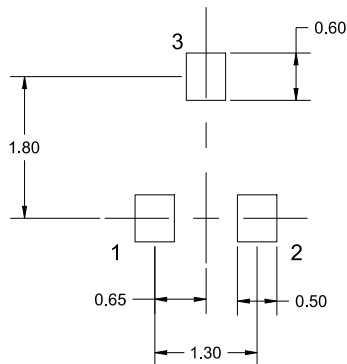
TOP VIEW



SIDE VIEW



END VIEW



SOLDERING FOOTPRINT

NOTES:

1. ALL DIMENSIONS ARE IN MILLIMETERS. ANGLES IN DEGREES.
2. COMPLIES WITH JEDEC MO-203

| DIM | MILLIMETERS |      |      |
|-----|-------------|------|------|
|     | MIN.        | NOM. | MAX. |
| A   | 0.80        |      | 1.10 |
| A1  | 0.00        |      | 0.10 |
| A2  | 0.80        | 0.90 | 1.00 |
| b   | 0.15        |      | 0.30 |
| c   | 0.08        |      | 0.22 |
| D   | 1.80        | 2.00 | 2.20 |
| E   | 1.80        | 2.10 | 2.40 |
| E1  | 1.15        | 1.25 | 1.35 |
| e   | 0.65 BSC    |      |      |
| L   | 0.26        | 0.36 | 0.46 |
| L1  | 0.42 REF    |      |      |
| Θ   | 0°          |      | 8°   |
| Θ1  | 4°          |      | 10°  |

\* 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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