



# N-Channel 60-V (D-S) MOSFET

| PRODUCT SUMMARY |                           |            |
|-----------------|---------------------------|------------|
| $V_{DS}$ (V)    | $r_{DS(on)}$ ( $\Omega$ ) | $I_D$ (mA) |
| 60              | 3 @ $V_{GS} = 10$ V       | 240        |

### FEATURES

- Low On-Resistance: 3  $\Omega$
- Low Threshold: 2 V (typ)
- Low Input Capacitance: 25 pF
- Fast Switching Speed: 7.5 ns
- Low Input and Output Leakage

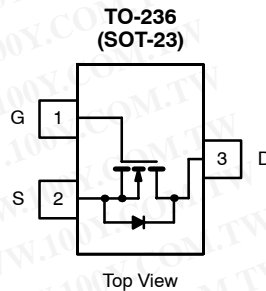
### BENEFITS

- Low Offset Voltage
- Low-Voltage Operation
- Easily Driven Without Buffer
- High-Speed Circuits
- Low Error Voltage

### APPLICATIONS

- Direct Logic-Level Interface: TTL/CMOS
- Drivers: Relays, Solenoids, Lamps, Hammers, Display, Memories, Transistors, etc.
- Battery Operated Systems
- Solid-State Relay

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Marking Code: 7Ew/

E = Part Number Code for 2N7002E

w = Week Code

/ = Lot Traceability

Ordering Information: 2N7002E-T1

| ABSOLUTE MAXIMUM RATINGS ( $T_A = 25^\circ\text{C}$ UNLESS OTHERWISE NOTED) |                |                          |                           |
|---|----------------|--------------------------|---------------------------|
| Parameter   | Symbol         | Limit                    | Unit                      |
| Drain-Source Voltage  | $V_{DS}$       | 60                       | V                         |
| Gate-Source Voltage   | $V_{GS}$       | $\pm 20$                 | V                         |
| Continuous Drain Current ( $T_J = 150^\circ\text{C}$ )                      | $I_D$          | $T_A = 25^\circ\text{C}$ | 240                       |
|   |                | $T_A = 70^\circ\text{C}$ | 190                       |
| Pulsed Drain Current <sup>a</sup>   | $I_{DM}$       | 1300                     | mA                        |
| Power Dissipation   | $P_D$          | $T_A = 25^\circ\text{C}$ | 0.35                      |
|   |                | $T_A = 70^\circ\text{C}$ | 0.22                      |
| Thermal Resistance, Junction-to-Ambient                                     | $R_{thJA}$     | 357                      | $^\circ\text{C}/\text{W}$ |
| Operating Junction and Storage Temperature Range                            | $T_J, T_{stg}$ | -55 to 150               | $^\circ\text{C}$          |

Notes

a. Pulse width limited by maximum junction temperature.

2N7002E

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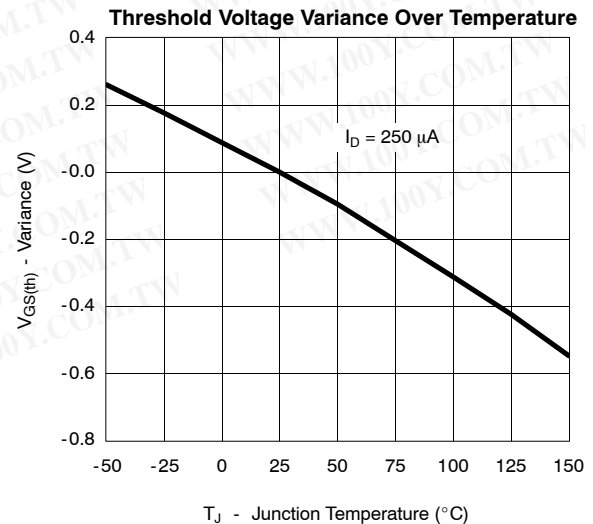
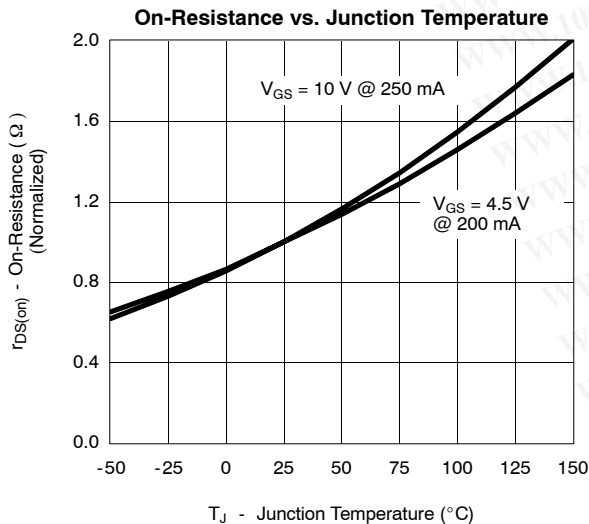
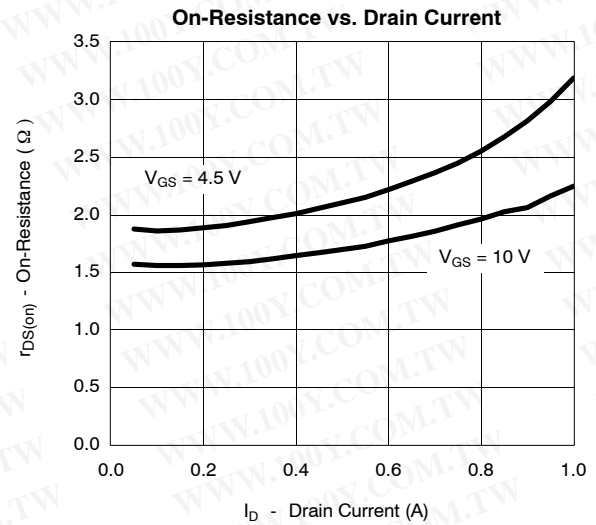
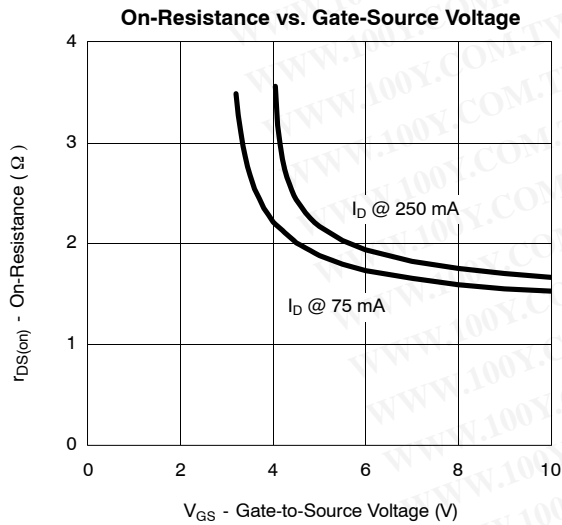
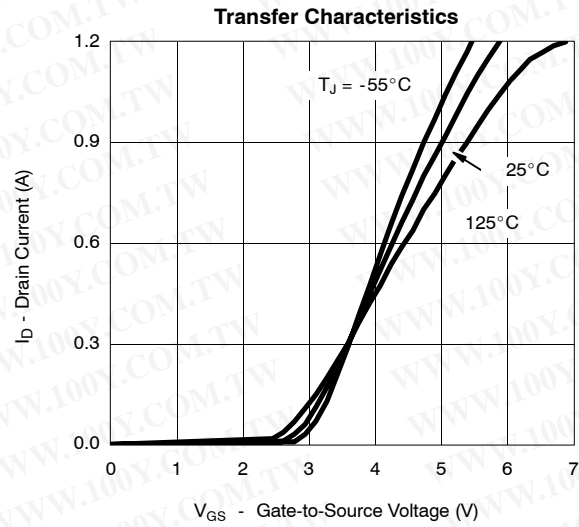
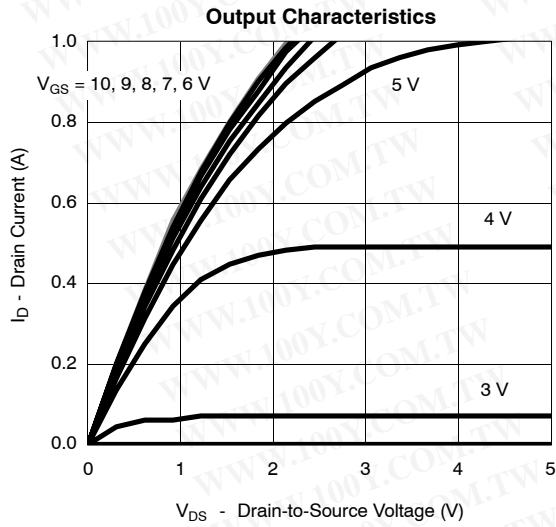
| SPECIFICATIONS (T <sub>J</sub> = 25 °C UNLESS OTHERWISE NOTED) |                      |   |        |                  |      |      |
|--|----------------------|---|--------|------------------|------|------|
| Parameter  | Symbol               | Test Conditions   | Limits |                  |      | Unit |
|  |                      |   | Min    | Typ <sup>a</sup> | Max  |      |
| <b>Static</b>  |                      |   |        |                  |      |      |
| Drain-Source Breakdown Voltage                                 | V <sub>(BR)DSS</sub> | V <sub>GS</sub> = 0 V, I <sub>D</sub> = 10 μA   | 60     | 68               |      | V    |
| Gate-Threshold Voltage   | V <sub>GS(th)</sub>  | V <sub>DS</sub> = V <sub>GS</sub> , I <sub>D</sub> = 250 μA   | 1      | 2                | 2.5  |      |
| Gate-Body Leakage  | I <sub>GSS</sub>     | V <sub>DS</sub> = 0 V, V <sub>GS</sub> = ± 15 V   |        |                  | ± 10 | nA   |
| Zero Gate Voltage Drain Current                                | I <sub>DSS</sub>     | V <sub>DS</sub> = 60 V, V <sub>GS</sub> = 0 V   |        |                  | 1    | μA   |
|  |                      | V <sub>DS</sub> = 60 V, V <sub>GS</sub> = 0 V, T <sub>C</sub> = 125 °C  |        |                  | 500  |      |
| On-State Drain Current <sup>b</sup>                            | I <sub>D(on)</sub>   | V <sub>GS</sub> = 10 V, V <sub>DS</sub> = 7.5 V   | 800    | 1300             |      | mA   |
|  |                      | V <sub>GS</sub> = 4.5 V, V <sub>DS</sub> = 10 V   | 500    | 700              |      |      |
| Drain-Source On-Resistance <sup>b</sup>                        | r <sub>DS(on)</sub>  | V <sub>GS</sub> = 10 V, I <sub>D</sub> = 250 mA   |        | 1.2              | 3    | Ω    |
|  |                      | V <sub>GS</sub> = 4.5 V, I <sub>D</sub> = 200 mA  |        | 1.8              | 4    |      |
| Forward Transconductance <sup>b</sup>                          | g <sub>fs</sub>      | V <sub>DS</sub> = 15 V, I <sub>D</sub> = 200 mA   |        | 600              |      | mS   |
| Diode Forward Voltage  | V <sub>SD</sub>      | I <sub>S</sub> = 200 mA, V <sub>GS</sub> = 0 V  |        | 0.85             | 1.2  | V    |
| <b>Dynamic<sup>a</sup></b>                                     |                      |   |        |                  |      |      |
| Total Gate Charge  | Q <sub>g</sub>       | V <sub>DS</sub> = 10 V, V <sub>GS</sub> = 4.5 V<br>I <sub>D</sub> ≅ 250 mA  |        | 0.4              | 0.6  | nC   |
| Gate-Source Charge   | Q <sub>gs</sub>      |   |        | 0.06             |      |      |
| Gate-Drain Charge  | Q <sub>gd</sub>      |   |        | 0.06             |      |      |
| Input Capacitance  | C <sub>iss</sub>     | V <sub>DS</sub> = 5 V, V <sub>GS</sub> = 0 V, f = 1 MHz   |        | 21               |      | pF   |
| Output Capacitance   | C <sub>oss</sub>     |   |        | 7                |      |      |
| Reverse Transfer Capacitance                                   | C <sub>rss</sub>     |   |        | 2.5              |      |      |
| <b>Switching<sup>a, c</sup></b>                                |                      |   |        |                  |      |      |
| Turn-On Time   | t <sub>on</sub>      | V <sub>DD</sub> = 10 V, R <sub>L</sub> = 40 Ω<br>I <sub>D</sub> ≅ 250 mA, V <sub>GEN</sub> = 10V<br>R <sub>G</sub> = 10 Ω |        | 13               | 20   | ns   |
| Turn-Off Time  | t <sub>off</sub>     |   |        | 18               | 25   |      |

Notes

- a. For DESIGN AID ONLY, not subject to production testing.
- b. Pulse test: PW ≤ 300 μs duty cycle ≤ 2%.
- c. Switching time is essentially independent of operating temperature.



**TYPICAL CHARACTERISTICS (T<sub>A</sub> = 25°C UNLESS OTHERWISE NOTED)**



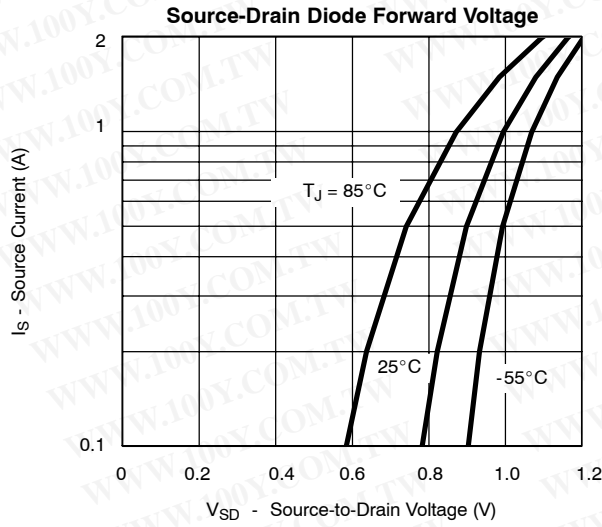
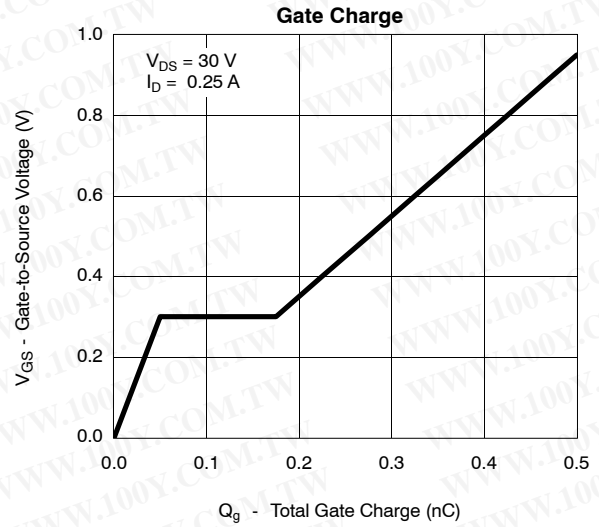
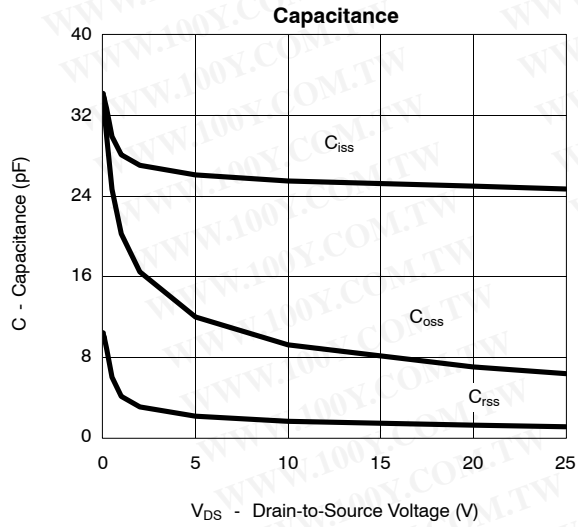
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