

SuperMOS – SOT-523 60V BV_{DSS} 1.5 Ω $R_{DS(on)}$ 0.3A I_D , N-channel MOSFET

1. Description

The 2N7002T-HAF-ES is N-Channel enhancement MOS Field Effect Transistor. Uses advanced trench technology and design to provide excellent $R_{DS(ON)}$ with low gate charge. Device is suitable for use in DC-DC conversion, power switch and charging circuit. Standard Product 2N7002T-HAF-ES is Pb-free.

2. Features

- 60V, $R_{DS(ON)}=1.5\Omega(Typ)$, $V_{GS}=10V$
- $R_{DS(ON)}=2.4\Omega(Typ)$, $V_{GS}=4.5V$
- Use trench MOSFET technology
- High density cell design for low $R_{DS(on)}$
- Material: Halogen free
- Reliable and rugged
- Avalanche Rated
- Low leakage current

3. Applications

- PWM applications
- Load switch
- Power management in portable/desktop PCs
- DC/DC conversion

4. Ordering Information

| Part Number | Package | Material | Packing | Quantity per reel | Flammability Rating | Reel Size |
|----------------|---------|--------------|-------------|-------------------|---------------------|-----------|
| 2N7002T-HAF-ES | SOT-523 | Halogen free | Tape & Reel | 3,000 PCS | UL 94V-0 | 7 inches |

Table-1 Ordering information

5. Pin Configuration and Functions

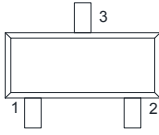
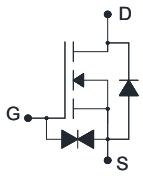
| Pin | Function | Outline | Circuit Diagram |
|-----|----------|---|---|
| 1 | Gate |  |  |
| 2 | Source | | |
| 3 | Drain | | |

Table-2 Pin configuration

6. Specification

Absolute Maximum Rating & Thermal Characteristics

Ratings at 25 °C ambient temperature unless otherwise specified.

| Parameter | | Symbol | Limit | Unit |
|-----------------------------------|------------------------|------------|------------|------|
| Drain-Source Voltage | | BV_{DSS} | 60 | V |
| Gate-Source Voltage | | V_{GS} | ± 20 | V |
| Continuous Drain Current | $T_A=25^\circ\text{C}$ | I_D | 0.3 | A |
| | $T_A=75^\circ\text{C}$ | | 0.14 | |
| Maximum Power Dissipation | | P_D | 150 | mW |
| Pulsed Drain Current ^a | | I_{DM} | 0.72 | A |
| Operating Junction Temperature | | T_J | 150 | °C |
| Lead Temperature | | T_L | 260 | °C |
| Storage Temperature Range | | T_{stg} | -55 to 150 | °C |

Thermal resistance ratings

| Single Operation | | | |
|--|-----------------|---------|------|
| Parameter | Symbol | Typical | Unit |
| Junction-to-Ambient Thermal Resistance | $R_{\theta JA}$ | 833 | °C/W |

Note:

a: Repetitive rating, pulse width limited by junction temperature, $t_p=10\mu\text{s}$, Duty Cycle=1%

Electrical Characteristics

At TA = 25°C unless otherwise specified

| Parameter | Symbol | Test Conditions | Min. | Typ. | Max. | Unit |
|--|--------------|---|------|------|----------|----------|
| OFF CHARACTERISTICS | | | | | | |
| Drain-to-Source Breakdown Voltage | BV_{DSS} | $V_{GS}=0V, I_D=10mA$ | 60 | | | V |
| Zero Gate Voltage Drain Current | I_{DSS} | $V_{DS}=60V, V_{GS}=0V, T_J=25^\circ C$ | | | 1.0 | uA |
| | | $V_{DS}=48V, V_{GS}=0V, T_J=125^\circ C$ | | | 100 | |
| Gate-to-source Leakage Current | I_{GSS} | $V_{DS}=0V, V_{GS}=\pm 20V$ | | | ± 10 | uA |
| Forward Trans conductance | g_{fs} | $V_{DS}=10V, I_D=0.1A$ | | 0.24 | | S |
| ON CHARACTERISTICS | | | | | | |
| Gate Threshold Voltage | $V_{GS(TH)}$ | $V_{GS}=V_{DS}, I_D=250uA$ | 0.8 | 1.5 | 2.5 | V |
| Drain-to-source On-resistance | $R_{DS(on)}$ | $V_{GS}=10V, I_D=0.3A$ | | 1.5 | 3 | Ω |
| | | $V_{GS}=4.5V, I_D=0.2A$ | | 2.4 | 4 | |
| CHARGES, CAPACITANCES AND GATE RESISTANCE | | | | | | |
| Input Capacitance | C_{ISS} | $V_{GS}=0V, f=1MHz, V_{DS}=10V$ | | 30.5 | 45 | pF |
| Output Capacitance | C_{OSS} | | | 5.5 | 10 | |
| Reverse Transfer Capacitance | C_{RSS} | | | 4.1 | 8 | |
| Total Gate Charge | $Q_{G(TOT)}$ | $V_{GS}=10V, V_{DS}=30V, I_D=0.2A$ | | 1.12 | 2 | nC |
| Gate-to-Source Charge | Q_{GS} | | | 0.1 | 0.2 | |
| Gate-to-Drain Charge | Q_{GD} | | | 0.23 | 0.5 | |
| SWITCHING CHARACTERISTICS | | | | | | |
| Turn-On Delay Time | $t_{d(ON)}$ | $V_{GS}=10V, V_{DS}=30V, I_D=0.2A, R_G=6\Omega$ | | 3 | 6 | ns |
| Rise Time | t_r | | | 5 | 10 | |
| Turn-Off Delay Time | $t_{d(OFF)}$ | | | 14 | 27 | |
| Fall Time | t_f | | | 9 | 17 | |
| BODY DIODE CHARACTERISTICS | | | | | | |
| Forward Voltage | V_{SD} | $V_{GS}=0V, I_S=1A$ | | | 1 | V |

7. Typical Characteristic



Fig.1 Output Characteristics



Fig.2 Continuous Drain Current vs. T_c



Fig.3 Normalized R_{DSon} vs. T_j



Fig.4 Normalized V_{th} vs. T_j



Fig.5 Gate Charge Waveform

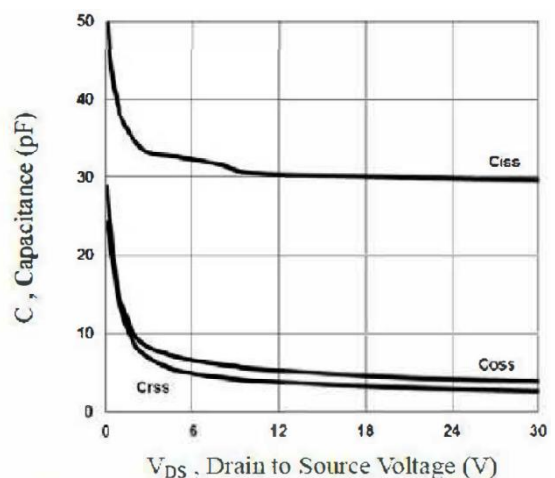


Fig.6 Capacitance Characteristics

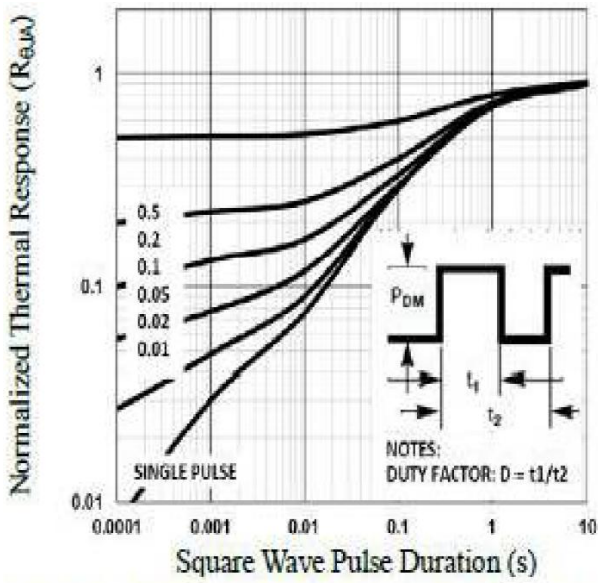


Fig.7 Normalized Transient Impedance



Fig.8 Maximum Safe Operation Area

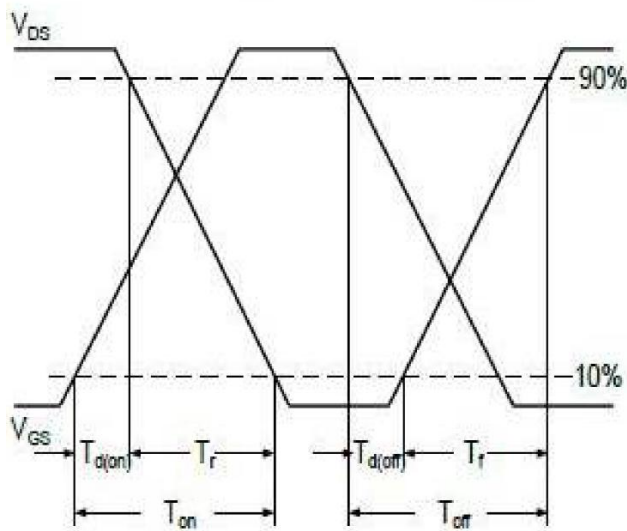


Fig.9 Switching Time Waveform

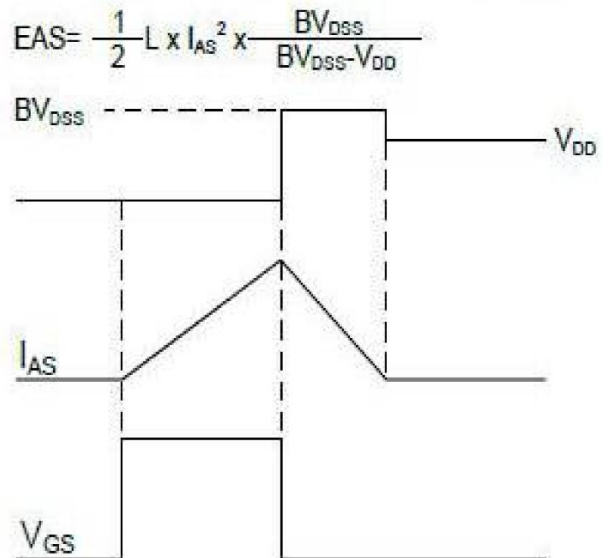
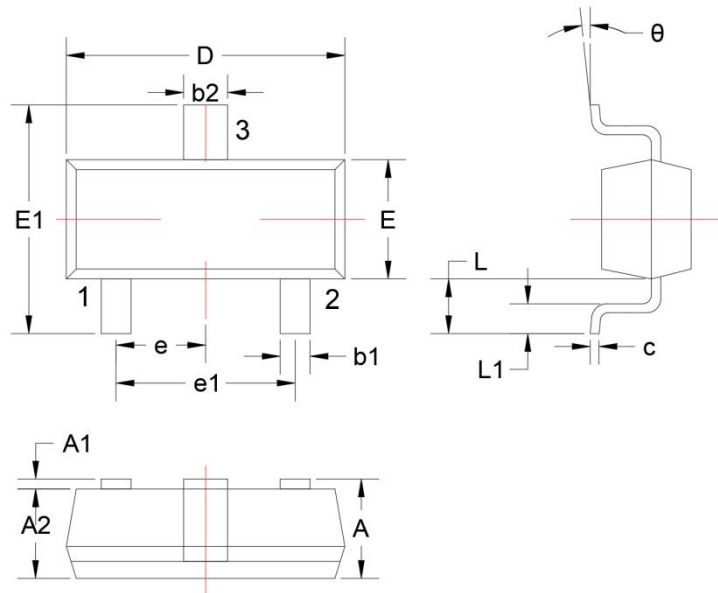


Fig.10 EAS Waveform

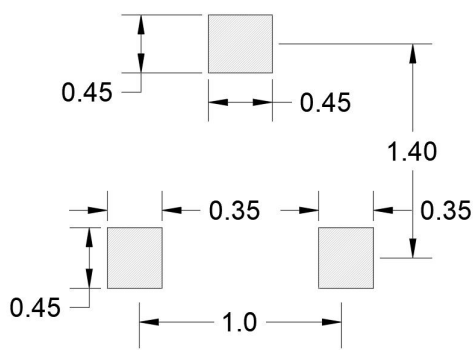
1. Dimension (SOT-523)



| Dimensions in Millimeters | | | | | |
|---------------------------|-------|-------|----------|----------|-------|
| Symbol | Min. | Max. | Symbol | Min. | Max. |
| A | 0.700 | 0.900 | e1 | 0.900 | 1.100 |
| A1 | 0.00 | 0.100 | e | 0.500TYP | |
| A2 | 0.700 | 0.800 | L | 0.400REF | |
| b1 | 0.150 | 0.250 | L1 | 0.260 | 0.460 |
| b2 | 0.250 | 0.350 | θ | 0° | 8° |
| c | 0.100 | 0.200 | | | |
| D | 1.500 | 1.700 | | | |
| E | 0.700 | 0.900 | | | |
| E1 | 1.450 | 1.750 | | | |

Table-5 Product dimensions

Recommended Land Pattern



Note:

1. Controlling dimension: in millimeters
2. General tolerance: ± 0.05 mm
3. The pad layout is for reference only

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