

**SuperMOS – SOT23-3L 60V BV<sub>DSS</sub> 1.5Ω R<sub>DS(on)</sub> 0.38A I<sub>D</sub>, N-channel MOSFET**

**1. Description**

The 2N7002K-T1-GE3-ES is N-Channel enhancement MOS Field Effect Transistor. Uses advanced trench technology and design to provide excellent R<sub>DS(ON)</sub> with low gate charge. Device is suitable for use in DC-DC conversion, power switch and charging circuit. Standard Product 2N7002K-T1-GE3-ES is Pb-free.

**2. Features**

- 60V, R<sub>DS(ON)</sub>=1.5Ω(Typ), V<sub>GS</sub>=10V  
R<sub>DS(ON)</sub>=2.06Ω(Typ), V<sub>GS</sub>=4.5V
- Use trench MOSFET technology
- High density cell design for low R<sub>DS(on)</sub>
- 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  | Marking | Material     | Packing     | Quantity per reel | Flammability Rating | Reel Size |
|-------------------|----------|---------|--------------|-------------|-------------------|---------------------|-----------|
| 2N7002K-T1-GE3-ES | SOT23-3L | 72KA    | Halogen free | Tape & Reel | 3,000 PCS         | UL 94V-0            | 7 inches  |

Table-1 Ordering information

**5. Pin Configuration and Functions**

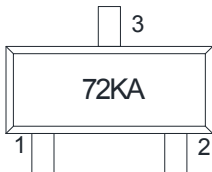
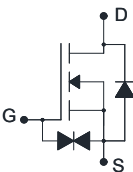
| Pin | Function | Outline   | Circuit Diagram   |
|-----|----------|---|---|
| 1   | Gate     |  |  |
| 2   | Source   |   |   |
| 3   | Drain    |   |   |

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          | $T_A=25^{\circ}C$  | $I_D$      | 0.38       | A    |
|                                   | $T_A=100^{\circ}C$ |            | 0.25       |      |
| Maximum Power Dissipation         |                    | $P_D$      | 350        | mW   |
| Pulsed Drain Current <sup>a</sup> |                    | $I_{DM}$   | 1.5        | 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 | $R_{\theta JA}$ | 300     | °C/W |

Note:

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

## Electrical Characteristics

At TA = 25°C unless otherwise specified

| Parameter  | Symbol       | Test Conditions                                 | Min. | Typ. | Max.     | Unit     |
|--|--------------|---|------|------|----------|----------|
| <b>OFF CHARACTERISTICS</b>                       |              |   |      |      |          |          |
| Drain-to-Source Breakdown Voltage                | $BV_{DSS}$   | $V_{GS}=0V, I_D=10mA$                           | 60   |      |          | V        |
| Zero Gate Voltage Drain Current                  | $I_{DSS}$    | $V_{DS}=60V, V_{GS}=0V$                         |      |      | 1.0      | $\mu A$  |
| Gate-to-source Leakage Current                   | $I_{GSS}$    | $V_{DS}=0V, V_{GS}=\pm 20V$                     |      |      | $\pm 10$ | $\mu A$  |
| Forward Trans conductance                        | $g_{fs}$     | $V_{DS}=10V, I_D=0.1A$                          |      | 0.24 |          | S        |
| <b>ON CHARACTERISTICS</b>                        |              |   |      |      |          |          |
| Gate Threshold Voltage                           | $V_{GS(TH)}$ | $V_{GS}=V_{DS}, I_D=250\mu A$                   | 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        | $\Omega$ |
|  |              | $V_{GS}=4.5V, I_D=0.2A$                         |      | 2.06 | 4        |          |
| <b>CHARGES, CAPACITANCES AND GATE RESISTANCE</b> |              |   |      |      |          |          |
| 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      |          |
| <b>SWITCHING CHARACTERISTICS</b>                 |              |   |      |      |          |          |
| 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       |          |
| <b>BODY DIODE CHARACTERISTICS</b>                |              |   |      |      |          |          |
| Forward Voltage                                  | $V_{SD}$     | $V_{GS}=0V, I_S=1A$                             |      |      | 1        | V        |

7. Typical Characteristic



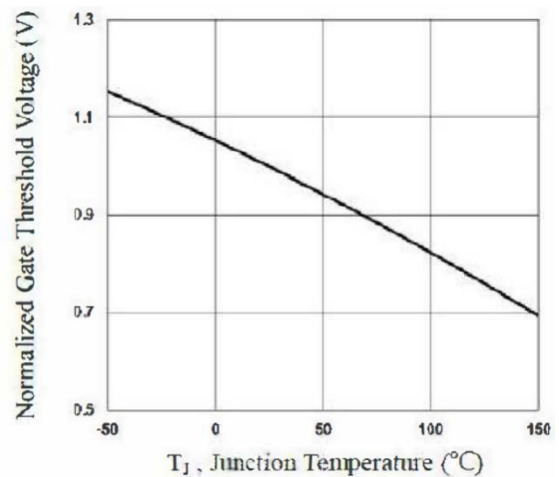
**Fig.1 Output Characteristics**



**Fig.2 Continuous Drain Current vs.  $T_c$**



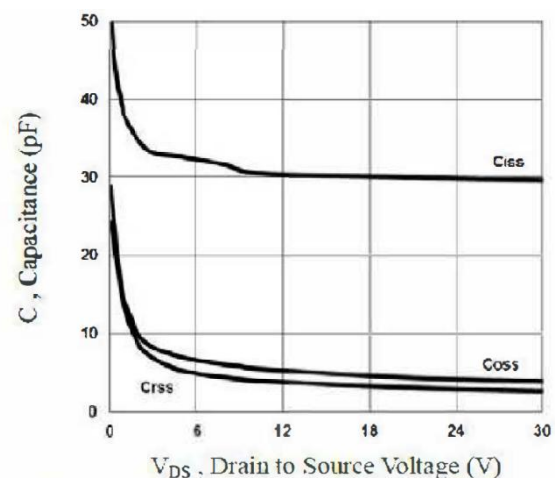
**Fig.3 Normalized  $R_{DSon}$  vs.  $T_J$**



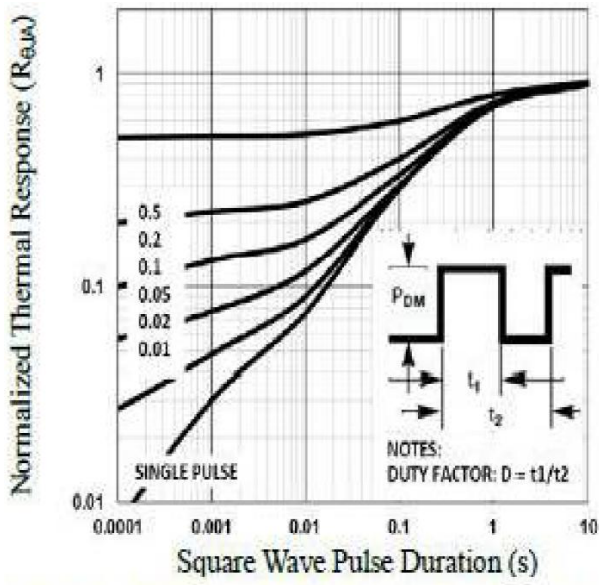
**Fig.4 Normalized  $V_{th}$  vs.  $T_J$**



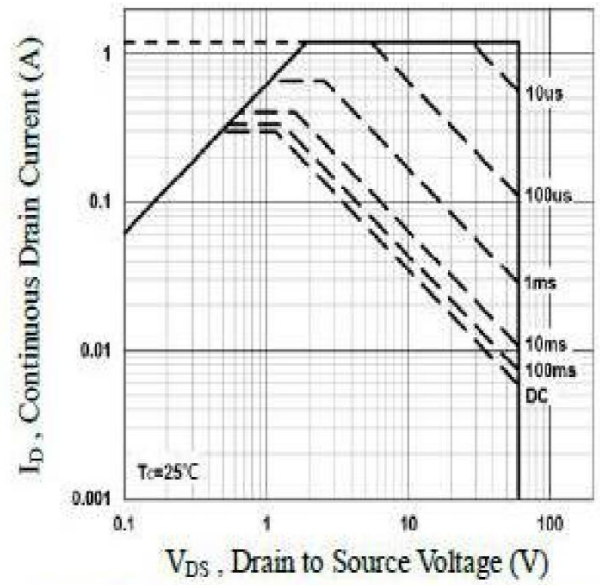
**Fig.5 Gate Charge Waveform**



**Fig.6 Capacitance Characteristics**

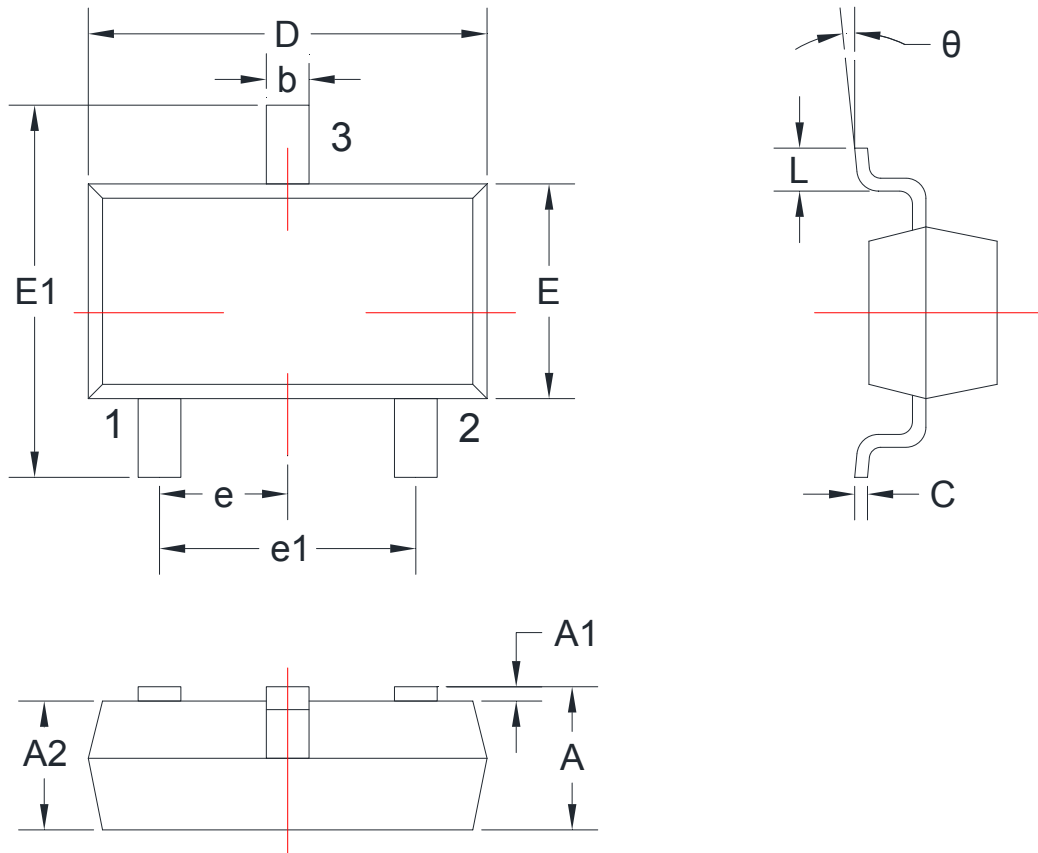


**Fig.7 Normalized Transient Impedance**



**Fig.8 Maximum Safe Operation Area**

**8. Dimension and Patterns (SOT23-3L)**



COMMON DIMENSIONS: UNITS OF MEASURE=MILLIMETER

| Symbol | Dimensions |      | Symbol   | Dimensions |      |
|--------|------------|------|----------|------------|------|
|        | Min.       | Max. |          | Min.       | Max. |
| A      | 1.05       | 1.25 | E        | 1.50       | 1.70 |
| A1     | 0          | 0.10 | E1       | 2.65       | 2.95 |
| A2     | 1.05       | 1.15 | e        | 0.95TYP    |      |
| b      | 0.30       | 0.50 | e1       | 1.80       | 2.00 |
| c      | 0.10       | 0.20 | L        | 0.30       | 0.60 |
| D      | 2.82       | 3.02 | $\theta$ | 0°         | 8°   |

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