

**SuperMOS – SOT-23 60V  $BV_{DSS}$  1.5 $\Omega$   $R_{DS(on)}$  0.38A  $I_D$ , N-channel MOSFET**

**1. Description**

The 2N7002-7-F-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 2N7002-7-F-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
2N7002-7-F-ES	SOT-23	Halogen free	Tape & Reel	3,000 PCS	UL 94V-0	7 inches

Table-1 Ordering information

**5. Pin Configuration and Functions**

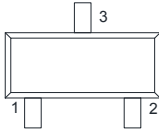
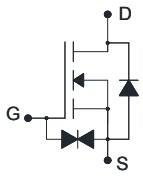
Pin	Function	Outline	Circuit Diagram
1	Gate		
2	Source		
3	Drain		

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	$I_{DSS}$	$V_{DS}=60V, V_{GS}=0V, T_J=25^\circ C$			1.0	uA
		$V_{DS}=48V, V_{GS}=0V, T_J=125^\circ C$			100	
Gate-to-source Leakage Current	$I_{GSS}$	$V_{DS}=0V, V_{GS}=\pm 20V$			$\pm 10$	uA
Forward Trans conductance	$g_{fs}$	$V_{DS}=10V, I_D=0.1A$		0.24		S
<b>ON CHARACTERISTICS</b>						
Gate Threshold Voltage	$V_{GS(TH)}$	$V_{GS}=V_{DS}, I_D=250uA$	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	$\Omega$
		$V_{GS}=4.5V, I_D=0.2A$		2.4	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



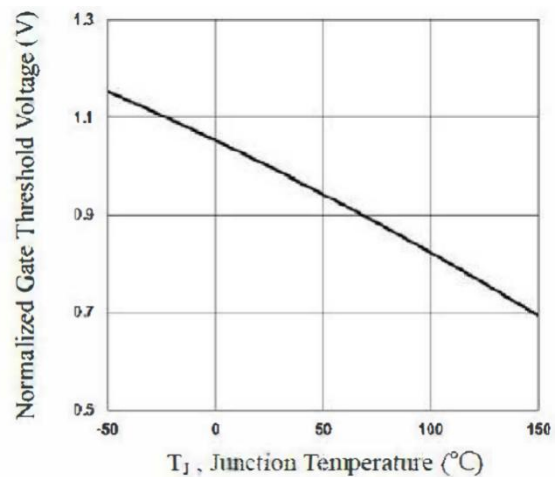
**Fig.1 Output Characteristics**



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



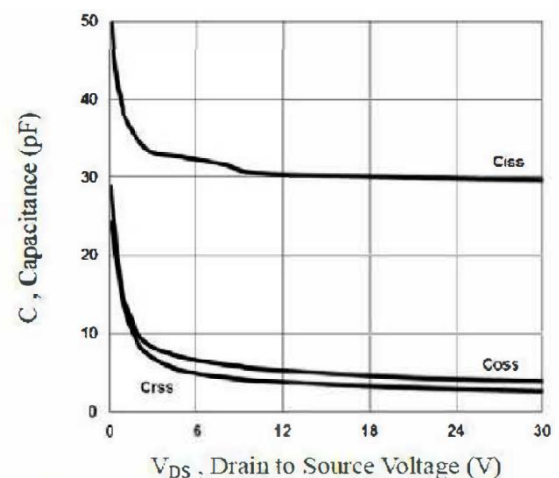
**Fig.3 Normalized  $R_{DSon}$  vs.  $T_J$**



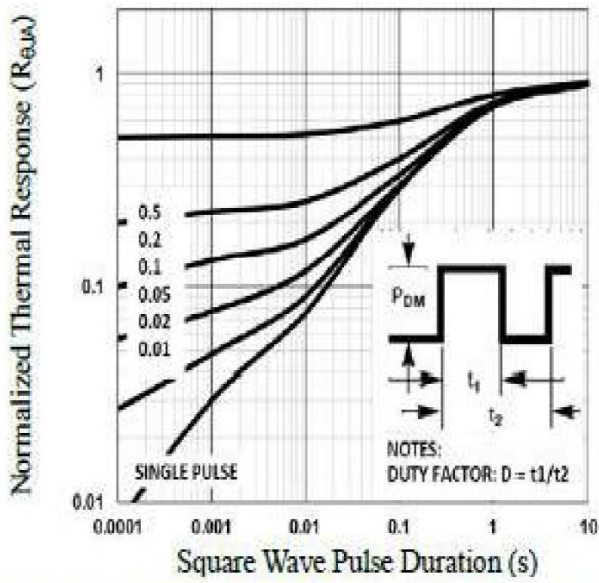
**Fig.4 Normalized  $V_{th}$  vs.  $T_J$**



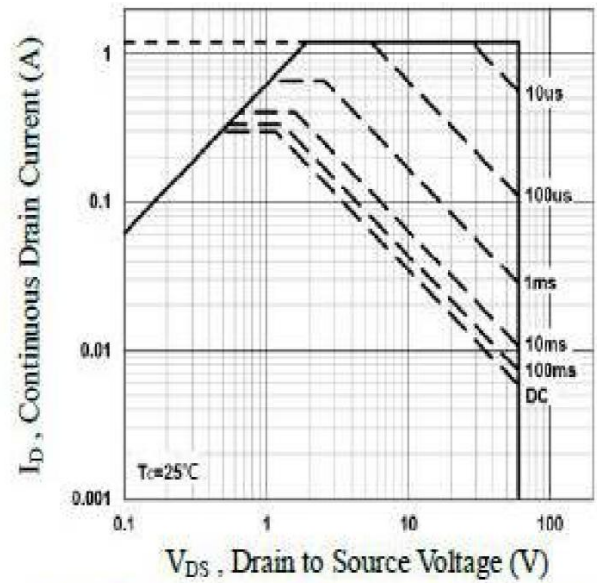
**Fig.5 Gate Charge Waveform**



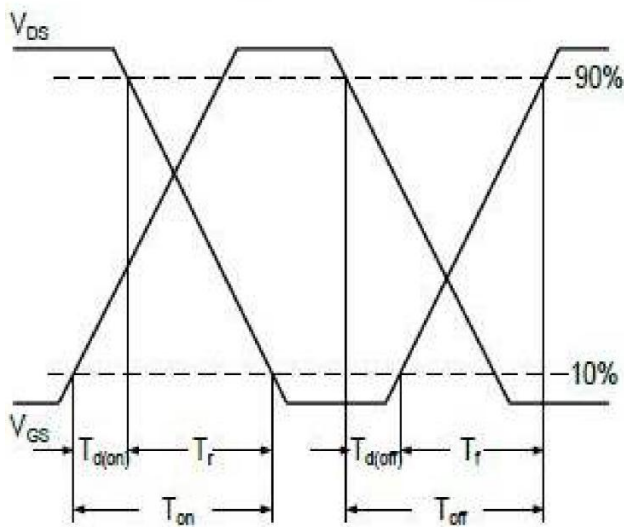
**Fig.6 Capacitance Characteristics**



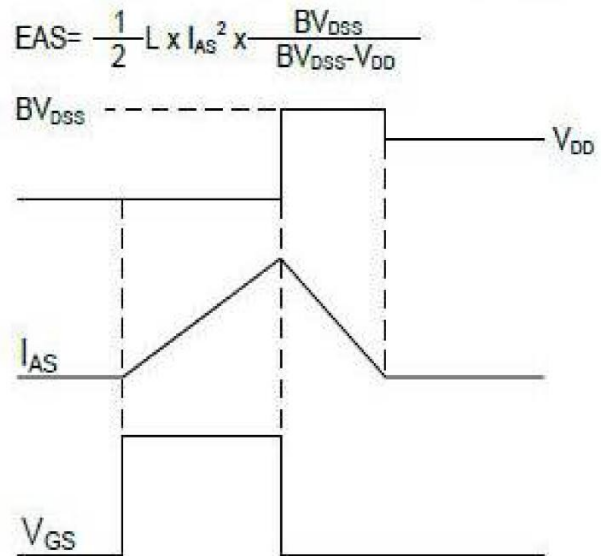
**Fig.7 Normalized Transient Impedance**



**Fig.8 Maximum Safe Operation Area**

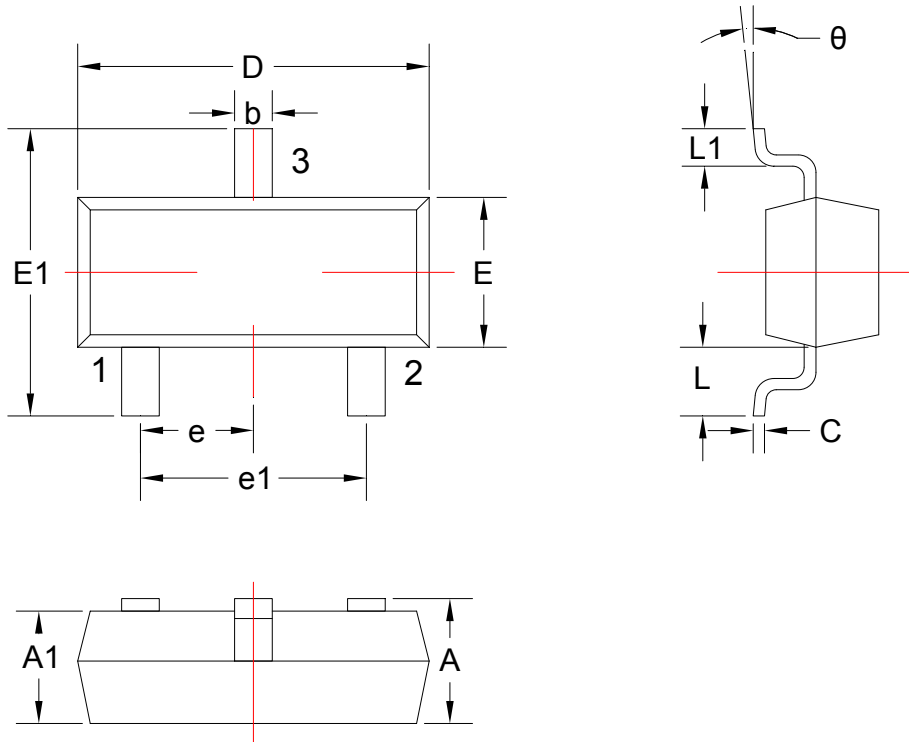


**Fig.9 Switching Time Waveform**



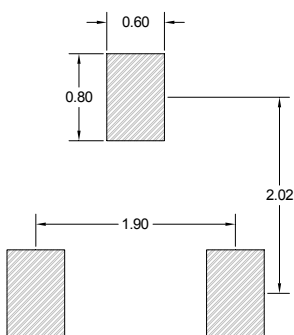
**Fig.10 EAS Waveform**

8. Dimension and Patterns (SOT-23)



Units: mm

Symbol	Dimensions		Symbol	Dimensions	
	Min.	Max.		Min.	Max.
A	0.900	1.150	E1	2.250	2.550
A1	0.900	1.050	e	0.950TYP	
b	0.300	0.500	e1	1.800	2.000
c	0.080	0.150	L	0.550REF	
D	2.800	3.000	L1	0.300	0.500
E	1.200	1.400	θ	0°	8°



Note:

1. Controlling dimension: in millimeters
2. General tolerance:  $\pm 0.05\text{mm}$
3. The pad layout is for reference only
4. Unit: mm

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