

SuperMOS – SOT-523 60V BV_{DSS} , 1.85 Ω $R_{DS(on)}$, N-channel MOSFET

1. Description

The 2N7002T-HAF-ES is N-Channel enhancement MOS Field Effect Transistor. Uses advanced 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, $R_{DS(ON)}=1.85\Omega(TYP.) @V_{GS}=10V$
- $R_{DS(ON)}=2.05\Omega(TYP.) @V_{GS}=4.5V$
- High density cell design for low $R_{DS(on)}$
- ESD Protection - HBM : 2kV
- 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
2N7002T-HAF-ES	SOT-523	72KW	Halogen free	Tape & Reel	3,000 PCS	UL 94V-0	7 inches

Table-1 Ordering information

5. Pin Configuration and Functions

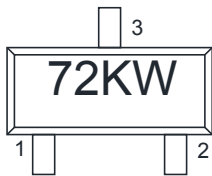
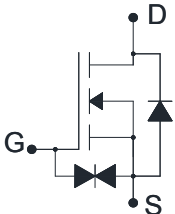
Pin	Function	Outline	Circuit Diagram
1	Gate		
2	Source		
3	Drain		

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
	$T_A=100^\circ\text{C}$		0.2	
Maximum Power Dissipation		P_D	350	mW
Pulsed Drain Current		I_{DM}	1.2	A
Operating Junction Temperature		T_J	150	$^\circ\text{C}$
Lead Temperature		T_L	260	$^\circ\text{C}$
Storage Temperature Range		T_{stg}	-55 to 150	$^\circ\text{C}$

Thermal resistance ratings

Single Operation			
Parameter	Symbol	Typical	Unit
Junction-to-Ambient Thermal Resistance	$R_{\theta JA}$	357	$^\circ\text{C}/\text{W}$

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}	$V_{GS}=0V, I_D=250\mu A$	60			V
Zero Gate Voltage Drain Current	I_{DSS}	$V_{DS}=60V, V_{GS}=0V$			1.0	μA
Gate-to-source Leakage Current	I_{GSS}	$V_{DS}=0V, V_{GS}=\pm 20V$			± 10	μA
ON CHARACTERISTICS						
Gate Threshold Voltage	$V_{GS(TH)}$	$V_{GS}=V_{DS}, I_D=250\mu A$	1.0	1.6	2.5	V
Drain-to-source On-resistance	$R_{DS(on)}$	$V_{GS}=10V, I_D=0.3A$		1.85	2.2	Ω
		$V_{GS}=4.5V, I_D=0.2A$		2.05	3.0	
CHARGES, CAPACITANCES AND GATE RESISTANCE						
Input Capacitance	C_{ISS}	$V_{GS}=0V, f=1MHz, V_{DS}=25V$		28		pF
Output Capacitance	C_{OSS}			11		
Reverse Transfer Capacitance	C_{RSS}			4		
Total Gate Charge	$Q_{G(TOT)}$	$V_{GS}=4.5V, V_{DS}=10V, I_D=0.3A$		1.8		nC
Gate-to-Source Charge	Q_{GS}			0.3		
Gate-to-Drain Charge	Q_{GD}			0.6		
SWITCHING CHARACTERISTICS						
Turn-On Delay Time	$t_{d(ON)}$	$V_{GS}=10V, V_{DS}=10V, I_D=0.2A, R_G=10\Omega$		2		ns
Rise Time	t_r			15		
Turn-Off Delay Time	$t_{d(OFF)}$			7		
Fall Time	t_f			20		
BODY DIODE CHARACTERISTICS						
Forward Voltage	V_{SD}	$V_{GS}=0V, I_S=0.3A$			1.5	V

7. Typical Characteristic

Figure 1: Output Characteristics

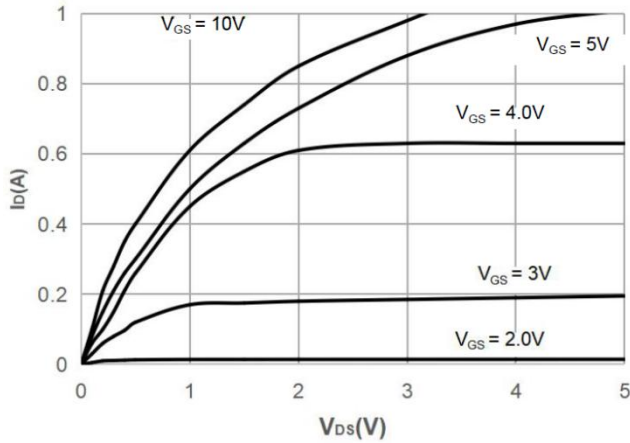


Figure 2: Typical Transfer Characteristics

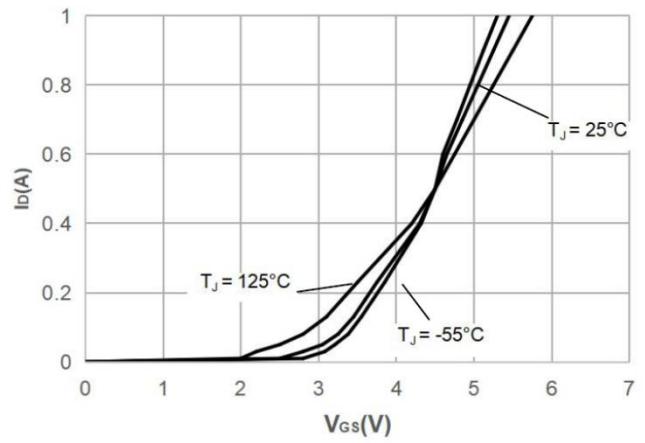


Figure 3: On-resistance vs. Drain Current

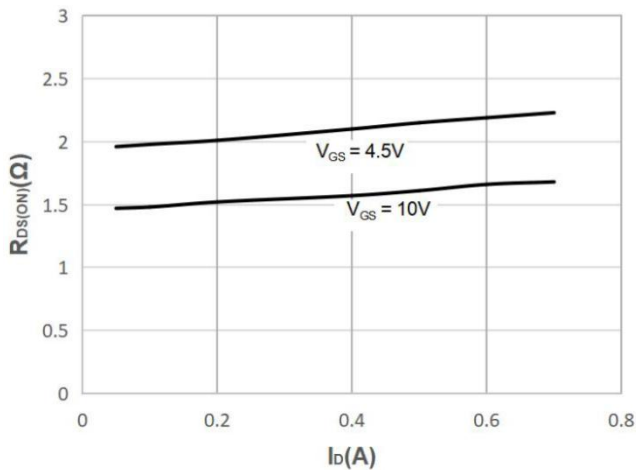


Figure 4: Body Diode Characteristics

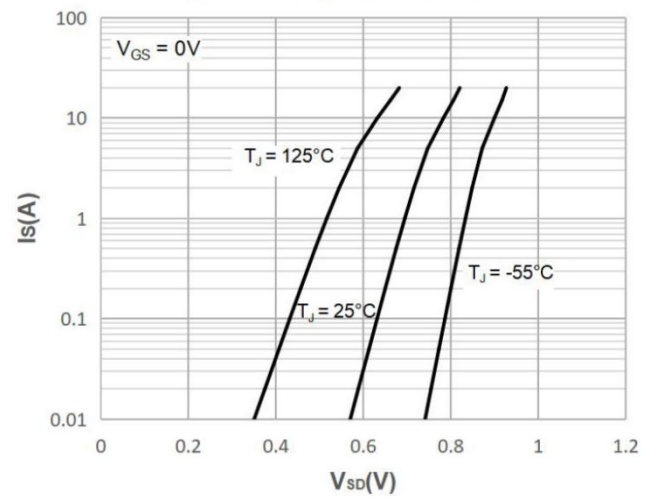


Figure 5: Gate Charge Characteristics

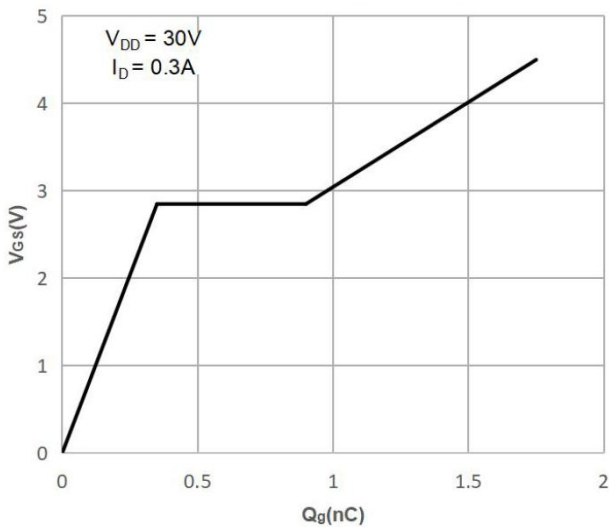


Figure 6: Capacitance Characteristics

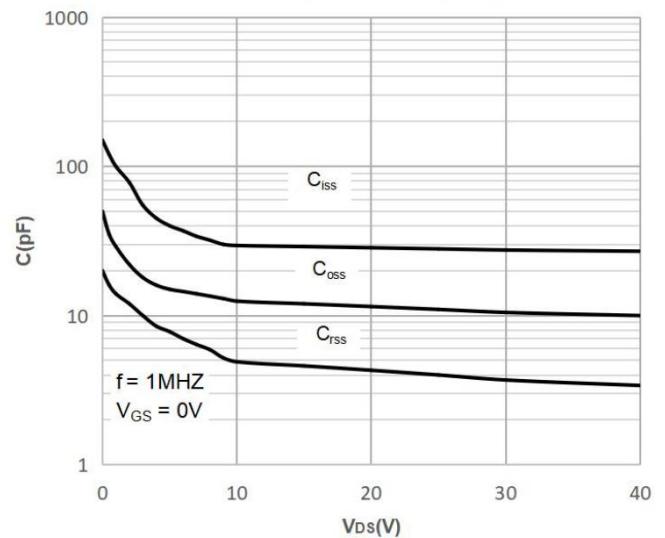


Figure 7: Normalized Breakdown voltage vs. Junction Temperature

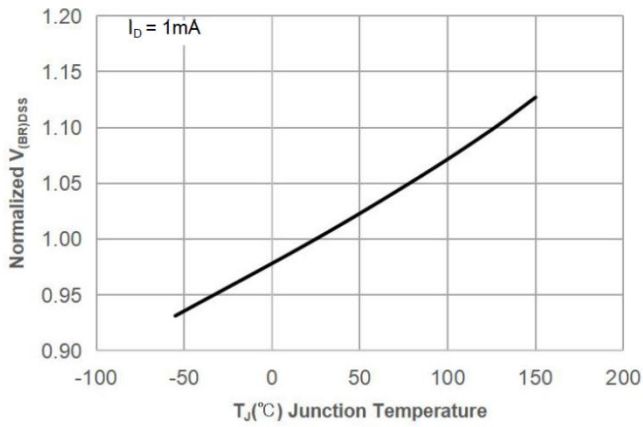


Figure 8: Normalized on Resistance vs. Junction Temperature

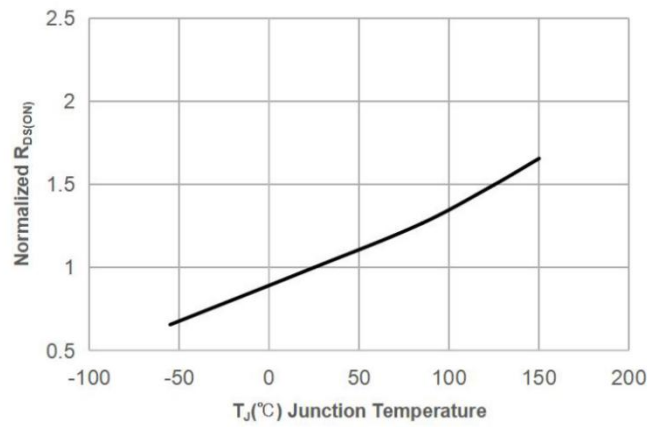


Figure 9: Maximum Safe Operating Area

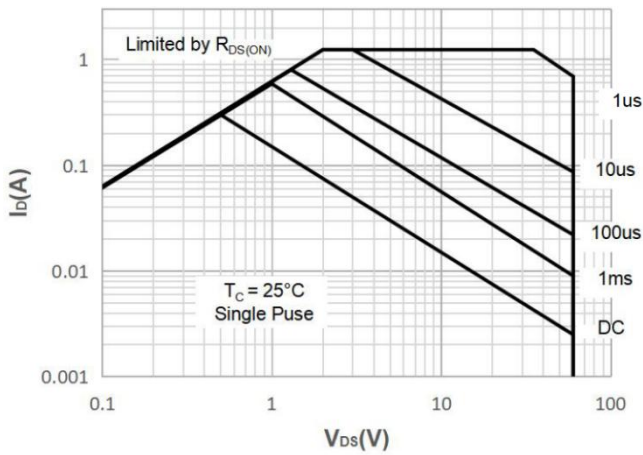


Figure 10: Maximum Continuous Drianc Current vs. Case Temperature

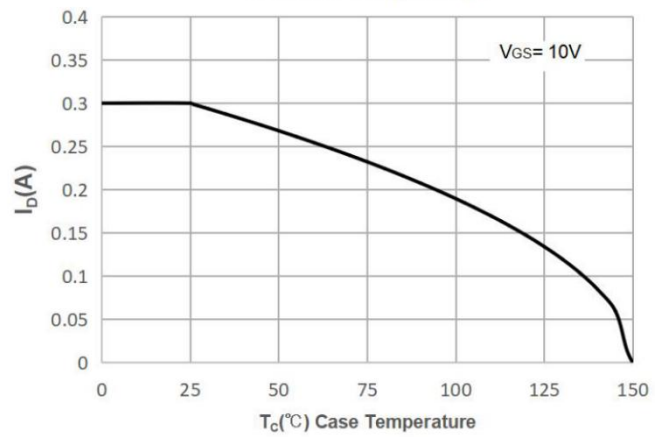


Figure 11: Normalized Maximum Transient Thermal Impedance

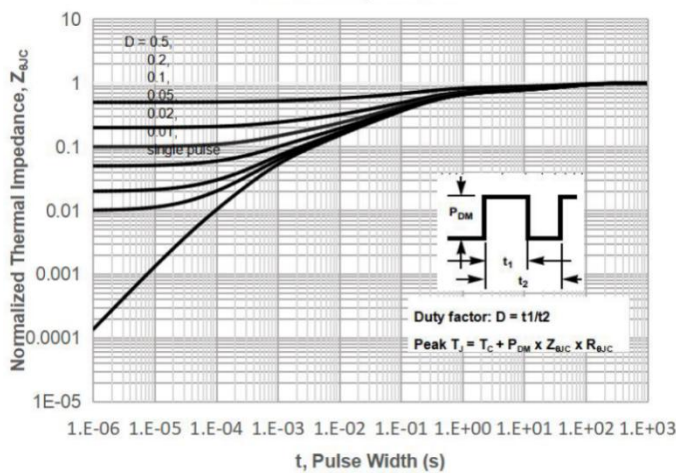
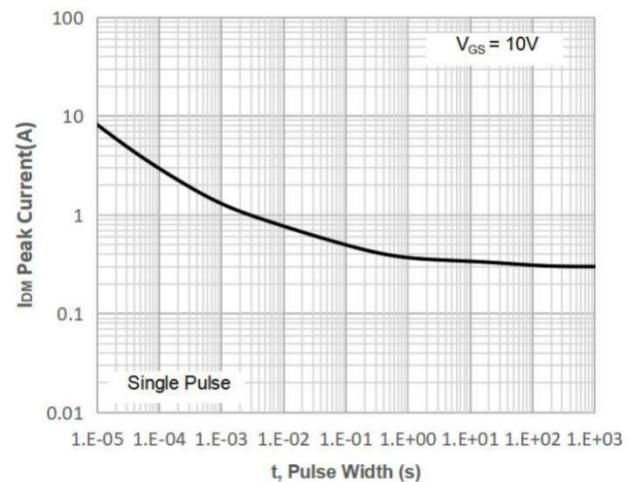
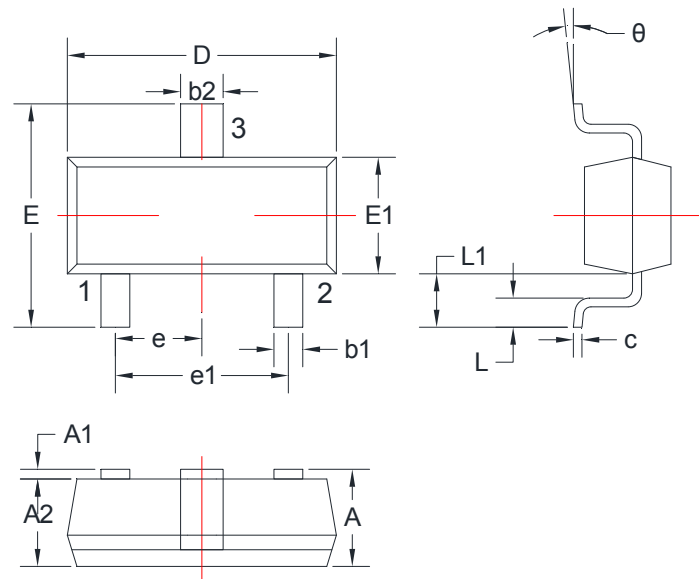


Figure 12: Peak Current Capacity



8. Dimension (SOT-523)



REF	Millimeters		REF	Millimeters	
	Min	Max		Min	Max
A	0.70	0.90	E	1.45	1.75
A1	0.00	0.10	E1	0.70	0.90
A2	0.70	0.80	e	0.50 TYP	
b1	0.15	0.25	e1	0.90	1.10
b2	0.25	0.35	L	0.26	0.46
c	0.10	0.20	L1	0.40 REF	
D	1.50	1.70	θ	0°	8°

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