2N7002

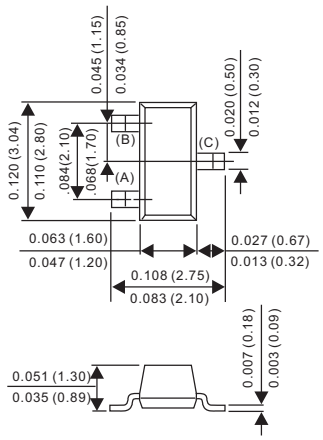
List

2N7002

60V N-Channel Enhancement Mode MOSFET

Package outline

SOT-23



Dimensions in inches and (millimeters)

Features

- Super high density cell design for extremely low $R_{DS(ON)}$
- Exceptional on-resistance and maximum DC current capability
- Rugged and reliable
- High saturation current capability
- In compliance with EU RoHS 2002/95/EC directives.
- Suffix "-H" indicates Halogen-free part, ex. 2N7002-H.

Mechanical data

- Epoxy:UL94-V0 rated flame retardant
- Case : Molded plastic, SOT-23
- Terminals : Solder plated, solderable per MIL-STD-750, Method 2026
- Mounting Position : Any
- Weight : Approximated 0.008 gram

Applications

- Power Management in Note book
- Portable Equipment
- Battery Powered System
- Load Switch

Maximum ratings (AT T_A=25°C unless otherwise noted)

PARAMETER	Symbol	MIN.	TYP.	MAX.	UNIT
Drain-source voltage	V_{DSS}			60	V
Drain-gate voltage(R_{GS} = 1.0MΩ)	V_{DGR}			60	V
Drain current-continuous T_A=25°C (Note 1) T_A=100°C (Note 1)	I_D			±115 ±75	mA
-pulsed (Note 2)	I_{DM}			±800	
Gate–source voltage-continuous	V_{GS}			±20	V
-non–repetitive (tp ≤ 50 μs)	V_{GSM}			±40	Vpk
Total power dissipation FR-5 board (Note 3)T_A=25°C	P_D			225	mW
Derate above 25°C				1.8	mW/°C
Thermal resistance, junction to ambient	$R_{\theta JA}$			556	°C/W
Total power dissipation alumina substrate,(Note 4) T_A=25°C	P_D			300	mW
Derate above 25°C				2.4	mW/°C
Thermal resistance, junction to ambient	$R_{\theta JA}$			417	°C/W
Operation junction and storage temperature range	T_J, T_{STG}	-55		+150	°C

Note 1: The Power Dissipation of the package may result in a lower continuous drain current.
2: Pulse Test: Pulse Width ≤ 300 μs, Duty Cycle ≤ 2.0%.
3: FR–5 = 1.0 x 0.75 x 0.062 in.
4: Alumina = 0.4 x 0.3 x 0.025 in 99.5% alumina

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Electrical characteristics (AT T_A=25°C unless otherwise noted)

Off characteristics

PARAMETER	CONDITIONS	Symbol	MIN.	TYP.	MAX.	UNIT
Drain–source breakdown voltage	V_{GS} = 0V, I_D = 10uA	$V_{(BR)DSS}$	60			V
Zero gate voltage drain current	V_{DS} = 60V, V_{GS} = 0V	I_{DSS}			1.0	uA
	V_{DS} = 60V, V_{GS} = 0V, T_J = 125°C				0.5	mA
Gate–body leakage current, forward	V_{GS} = 20V	I_{GSSF}			1	uA
Gate–body leakage current, reverse	V_{GS} = -20V	I_{GSSR}			-1	uA

On characteristics (Note 1)

PARAMETER	CONDITIONS	Symbol	MIN.	TYP.	MAX.	UNIT
Gate threshold voltage	V_{DS} = V_{GS}, I_D = 250uA	$V_{GS(th)}$	1.0	1.6	2.0	V
On-state drain current	V_{DS} ≥ 20$V_{DS(on)}$, V_{GS} = 10V	$I_{D(on)}$	500			mA
Static drain-source on-resistance	V_{GS} = 10V, I_D = 0.5A V_{GS} = 10V, I_D = 0.5A, T_J = 125°C V_{GS} = 5.0V, I_D = 50mA V_{GS} = 5.0V, I_D = 50mA, T_J = 125°C	$R_{DS(on)}$		1.4 - 1.8 -	7.5 13.5 7.5 13.5	Ω
Drain-source on-voltage	V_{GS} = 10V, I_D = 0.5A V_{GS} = 5.0V, I_D = 50mA	$V_{DS(on)}$			3.75 0.375	V
Forward transconductance	V_{DS}≥ 2.0$V_{DS(on)}$, I_D = 200mA	g_{FS}	80			mmhos

Dynamic characteristics

PARAMETER	CONDITIONS	Symbol	MIN.	TYP.	MAX.	UNIT
Input capacitance	V_{DS} = 25V, V_{GS} = 0V, f = 1.0MHz	C_{iss}		17	50	pF
Output capacitance		C_{oss}		10	25	
Reverse transfer capacitance		C_{rss}		2.5	5.0	

Switching characteristics (Note 1)

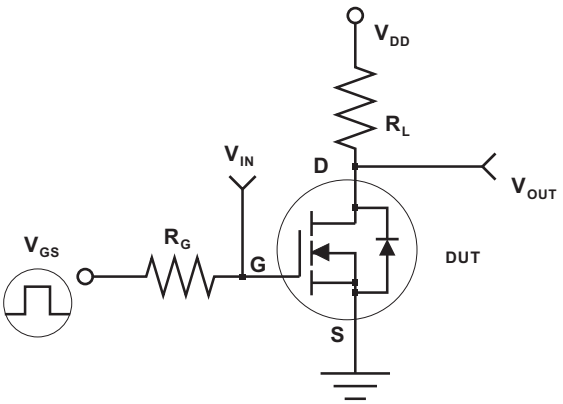
PARAMETER	CONDITIONS	Symbol	MIN.	TYP.	MAX.	UNIT
Turn-on delay time	V_{DD} = 25V, I_D = 500mA, V_{gen} = 10V, R_G = 25Ω, R_L = 50Ω	$t_{d(on)}$		7	20	ns
Turn-off delay time		$t_{d(off)}$		11	40	

Body–drain diode ratings

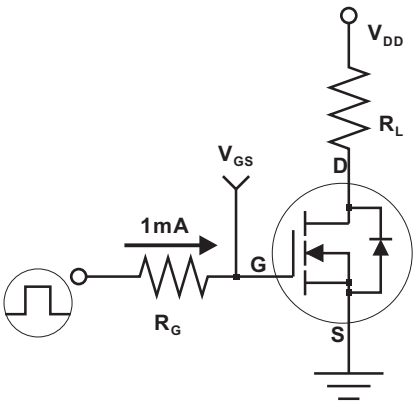
PARAMETER	CONDITIONS	Symbol	MIN.	TYP.	MAX.	UNIT
Diode forward on-voltage	I_S = 115mA, V_{GS} = 0V	V_{SD}			-1.5	V
Source current continuous	Body diode	I_S			-115	mA
Source current pulsed		I_{SM}			-800	mA

Note 1: Pules test : Pules width ≤ 300us, duty cycle ≤ 2%

Switching Test Circuit



Gate Charge Test Circuit



Rating and characteristic curves (2N7002)

Figure 1. Ohmic Region

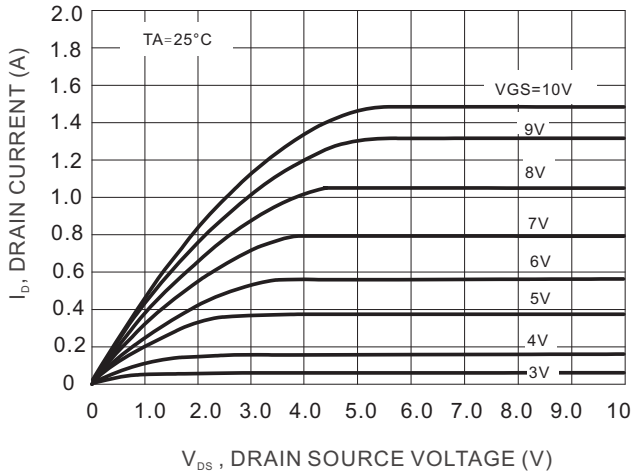


Figure 2. Transfer Characteristics

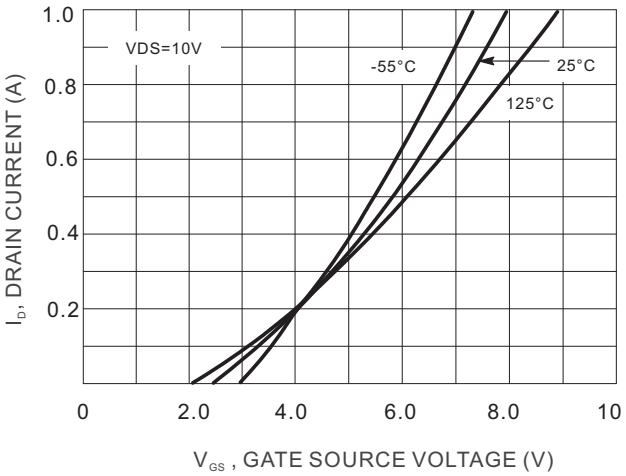


Figure 3. Temperature versus Static Drain-Source On-Resistance

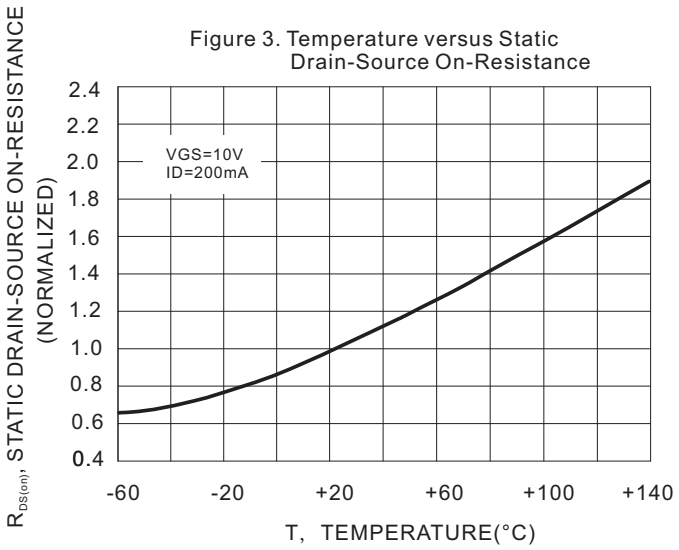
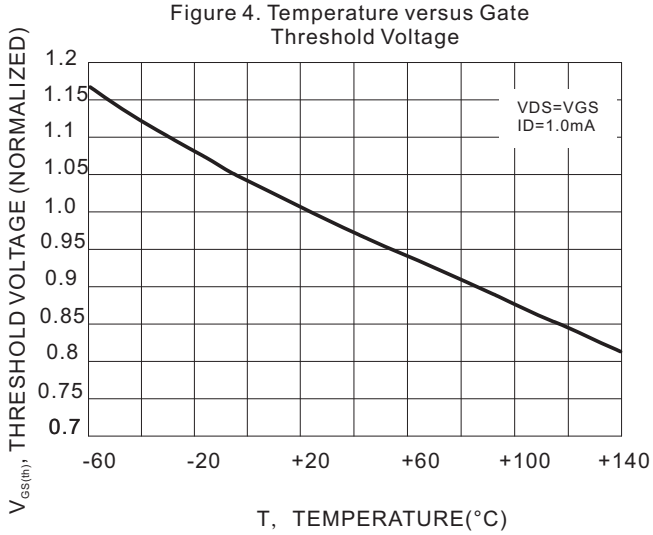


Figure 4. Temperature versus Gate Threshold Voltage



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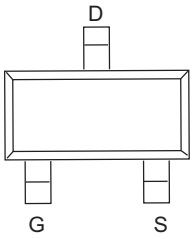
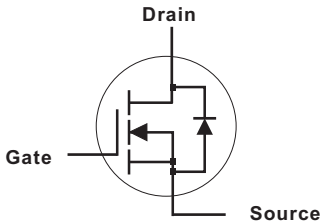
Pinning information

Pin	Simplified outline	Symbol
PinD Drain PinG Gate PinS Source		

Marking

Type number	Marking code
2N7002	702 ≧ (Note 1)

Note 1: M = Month code

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Odd Year	1	2	3	4	5	6	7	8	9	T	V	C
Even Year	E	F	H	J	K	L	N	P	U	X	Y	Z

Suggested solder pad layout

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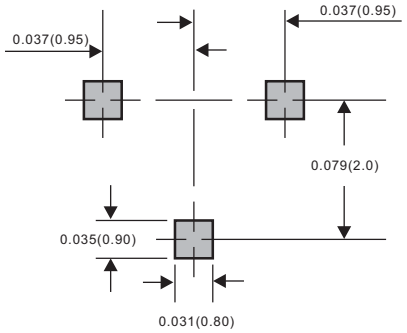

Dimensions in inches and (millimeters)

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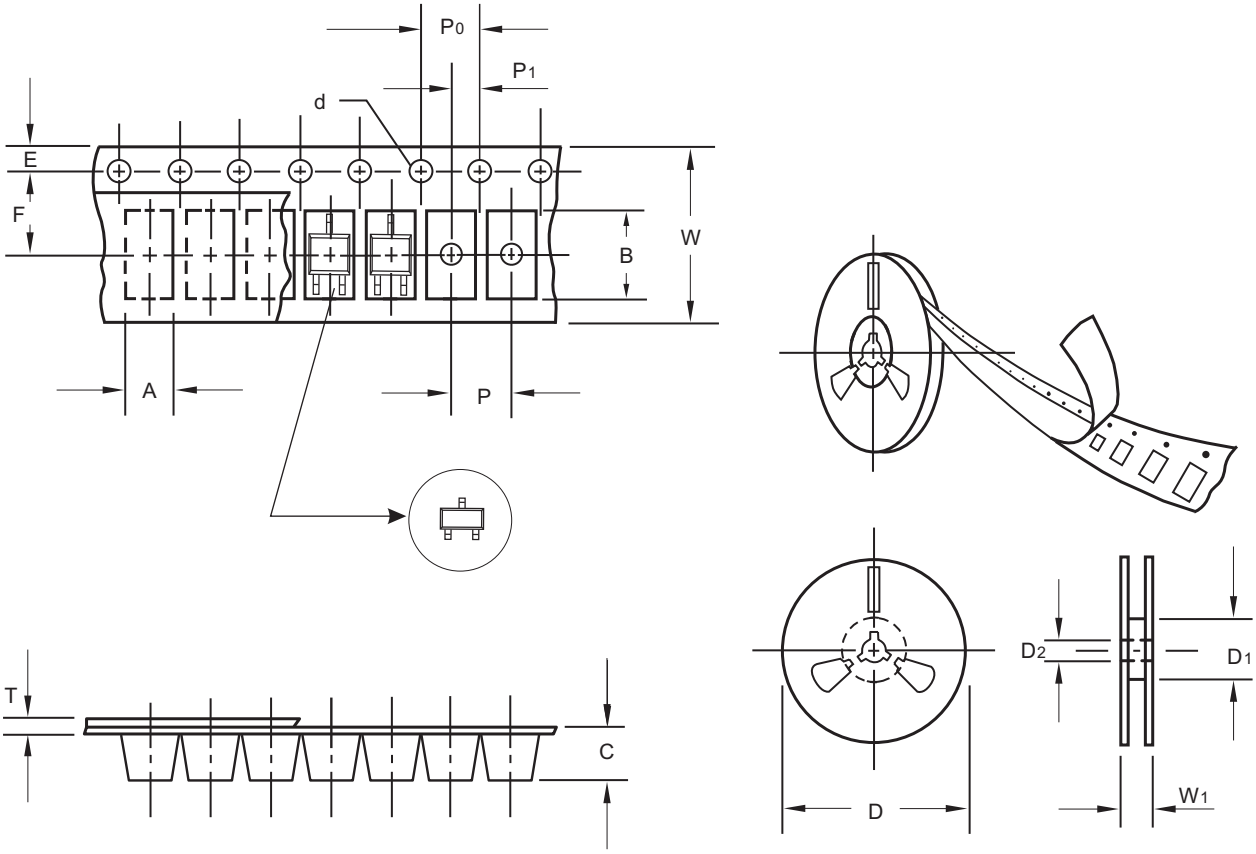
Packing information



unit:mm

Item	Symbol	Tolerance	SOT-23
Carrier width	A	0.1	3.15
Carrier length	B	0.1	2.77
Carrier depth	C	0.1	1.22
Sprocket hole	d	0.1	1.50
13" Reel outside diameter	D	2.0	-
13" Reel inner diameter	D_1	min	-
7" Reel outside diameter	D	2.0	178.00
7" Reel inner diameter	D_1	min	55.00
Feed hole diameter	D_2	0.5	13.00
Sprocket hole position	E	0.1	1.75
Punch hole position	F	0.1	3.50
Punch hole pitch	P	0.1	4.00
Sprocket hole pitch	P_0	0.1	4.00
Embossment center	P_1	0.1	2.00
Overall tape thickness	T	0.1	0.23
Tape width	W	0.3	8.00
Reel width	W_1	1.0	12.0

Note:Devices are packed in accor dance with EIA standar RS-481-A and specifications listed above.

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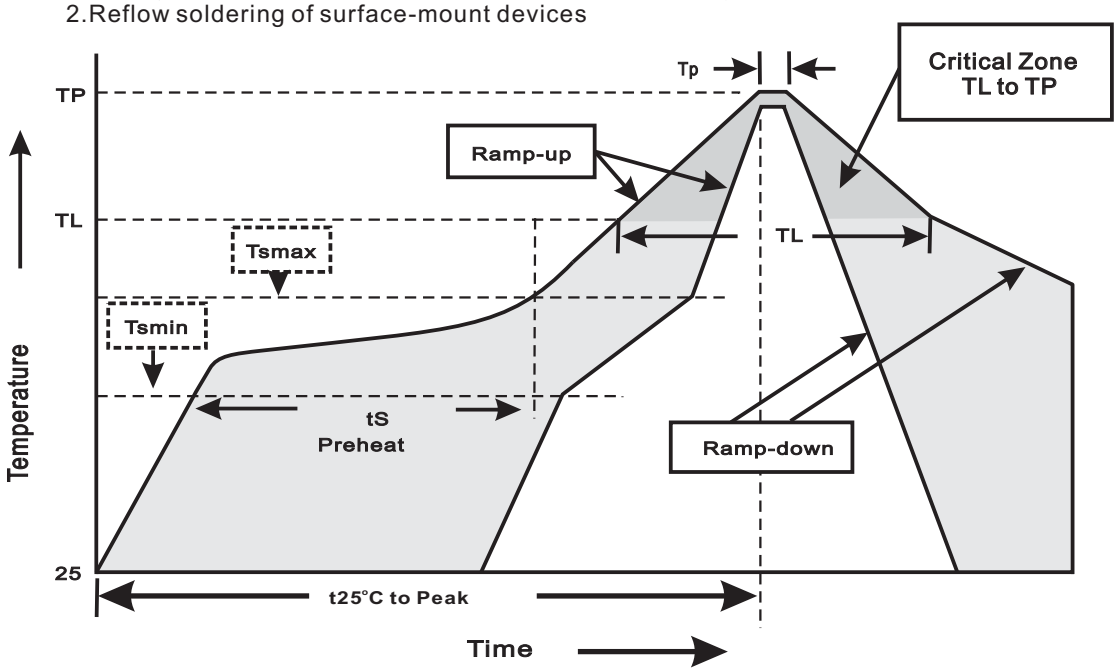
Reel packing

PACKAGE	REEL SIZE	REEL (pcs)	COMPONENT SPACING (m/m)	BOX (pcs)	INNER BOX (m/m)	REEL DIA, (m/m)	CARTON SIZE (m/m)	CARTON (pcs)	APPROX. GROSS WEIGHT (kg)
SOT-23	7"	3,000	4.0	30,000	183*123*183	178	382*257*387	240,000	11.6

Suggested thermal profiles for soldering processes

1.Storage environment: Temperature=5°C~40°C Humidity=55%±25%
2.Reflow soldering of surface-mount devices



3.Reflow soldering

Profile Feature	Soldering Condition
Average ramp-up rate(T_L to T_P)	<3°C/sec
Preheat -Temperature Min(Tsmin) -Temperature Max(Tsmax) -Time(min to max)(t_s)	 150°C 200°C 60~120sec
Tsmax to T_L -Ramp-upRate	 <3°C/sec
Time maintained above: -Temperature(T_L) -Time(t_L)	 217°C 60~260sec
Peak Temperature(T_P)	255°C-0/+5°C
Time within 5°C of actual Peak Temperature(t_P)	10~30sec
Ramp-down Rate	<6°C/sec
Time 25°C to Peak Temperature	<6minutes

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High reliability test capabilities

Item Test	Conditions	Reference
1. High Temperature Gate Bias	Ta=150℃ Vgs=0.8 x BVGSS for 1000hours	JESD22-A108-C
2. High Temperature Reverse Bias	Ta=150℃ Vds=0.8 x BVDSS for 1000hours	JESD22-A108-C
3. Solder ability Test	Temp=245℃ for 5sec	JESD22-B102-D
4. Pressure Cooker Test	Ta=121℃/100%RH Pressure=2Atm for 168hours	JESD22-A102-C
5. Temperature Cycle Test	-65℃/10min~150℃/10min Transfer<5min. total 1000 cycles.	JESD22-A104-B
6. Temperature Humidity Test	Ta=85℃ Humidity=85%RH for 1000hours	JESD22-A101-B
7. High Temperature Storage Test	Ta=150℃ for 1000hours	JESD22-B103-B