

2N7002K-H

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2N7002K-H

330mA 60V N-Channel Enhancement Mode MOSFET ESD Protection

Features

- $R_{DS(on)} \leq 2.0\Omega$ @ $V_{GS}=10V$, $I_D=300mA$
- $R_{DS(on)} \leq 2.4\Omega$ @ $V_{GS}=4.5V$, $I_D=200mA$
- High density cell design for low on-resistance
- High saturation current capability
- Voltage controlled small signal switch
- Rugged and reliable
- ESD protected up to 2.0kV (HBM)
- Lead-free parts meet RoHS requirements
- Halogen-free (IEC61249-2-21)

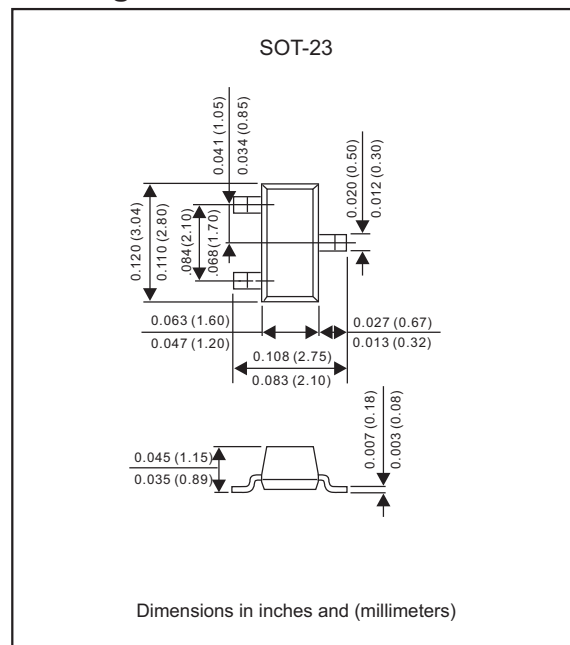
Application

- Load switch for portable devices
- DC/DC converter

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

Package outline



Maximum ratings (at $T_A=25^\circ C$ unless otherwise noted)

Parameter	Symbol	Ratings	Unit
Drain-source voltage	V_{DS}	60	V
Gate-source voltage	V_{GS}	± 20	V
Continuous drain current ($V_{GS}=10V$) (Note 1)	I_D	330	mA
($T_A=70^\circ C$)		260	
Pulsed drain current (Note 2)	I_{DM}	1.30	A
Power dissipation	P_D	0.48	W
		0.31	
Thermal resistance junction to ambient (Note 3)	$R_{\theta JA}$	260	$^\circ C/W$
Operating junction temperature range	T_J	-55 to +150	$^\circ C$
Storage temperature range	T_{STG}	-55 to +150	$^\circ C$

Notes 1: This current is chip limited, which is calculated based on R_{thja} .

2: This current is calculated on single pulse with 10 μs Pulse & Duty Cycle=1%.

3: Device mounted on FR-4 substrate PC board with 2oz copper in 1inch square cooling area.

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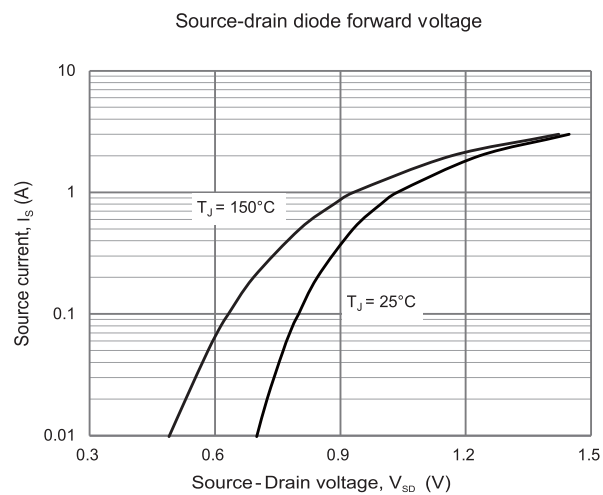
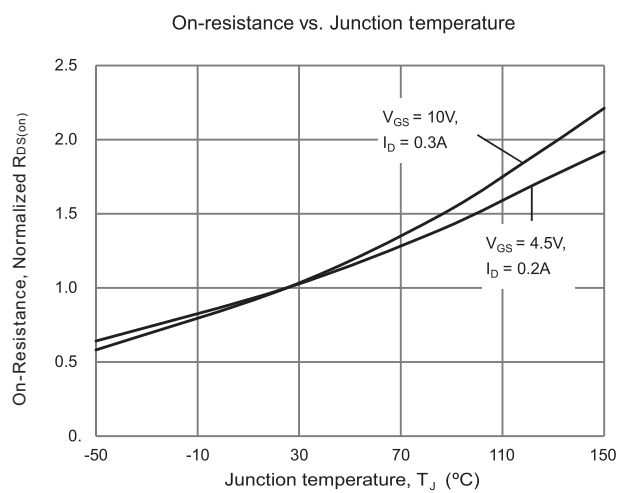
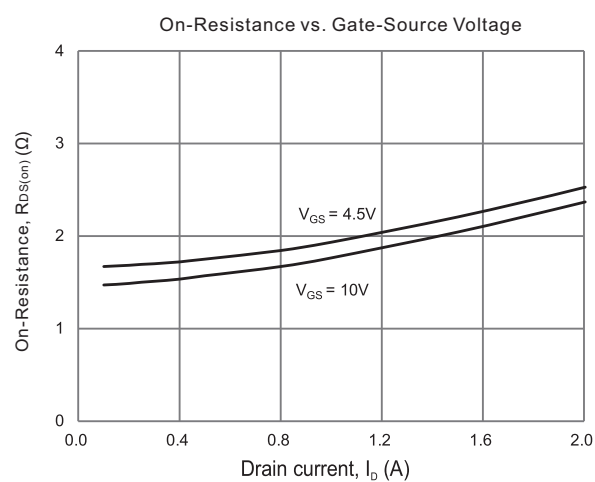
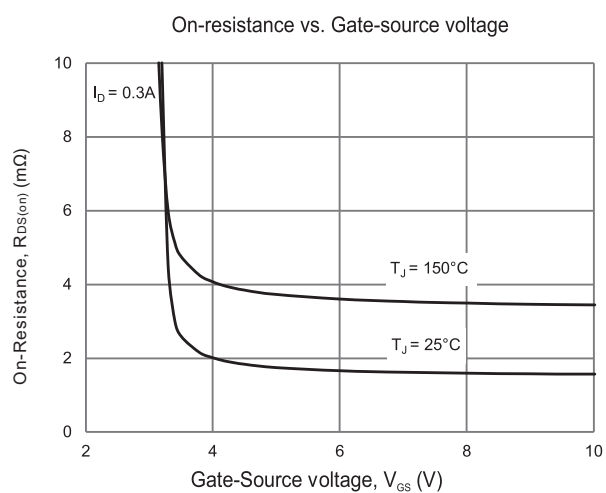
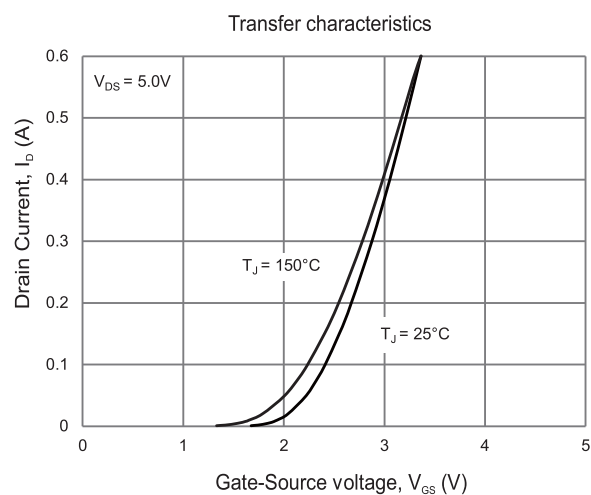
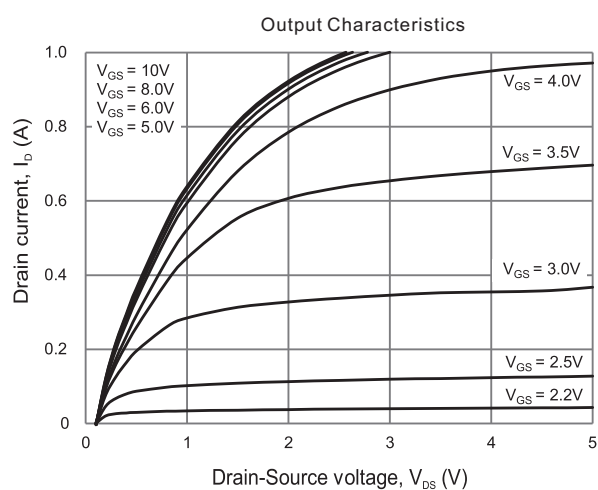
Electrical characteristics (at $T_A=25^\circ\text{C}$ unless otherwise noted)

Parameter	Symbol	Conditions	Min.	Typ.	Max.	Unit
Off characteristics (Note 4)						
Drain-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
		$V_{DS}=60V, V_{GS}=0V, T_J=125^{\circ}C$			100	
Gate-source leakage current	I_{GSS}	$V_{GS}=\pm 20V, V_{DS}=0V$			± 10	μA
On characteristics (Note 4)						
Gate threshold voltage	$V_{GS(th)}$	$V_{GS}=V_{DS}, I_D=250\mu A$	1.0	1.6	2.5	V
Static drain-source on-resistance	$R_{DS(on)}$	$V_{GS}=10V, I_D=300mA$		1.5	2.0	Ω
		$V_{GS}=4.5V, I_D=200mA$		1.7	2.4	
Forward transconductance	g_{fs}	$V_{DS}=5.0V, I_D=200mA$		335		mS
Dynamic parameters (Note 5)						
Input capacitance	C_{iss}	$V_{DS}=30V, V_{GS}=0V, f=1.0MHz$		19		pF
Output capacitance	C_{oss}			7.2		
Reverse transfer capacitance	C_{rss}			3.3		
Gate resistance	R_g	$V_{GS}=0V, V_{DS}=0V, f=1.0MHz$		412		Ω
Switching parameters (Note 5)						
Total gate charge	Q_g	$V_{DS}=30V, V_{GS}=10V, I_D=300mA$		0.80		nC
	Q_g	$V_{DS}=30V, V_{GS}=4.5V, I_D=300mA$		0.42		
Gate-source charge	Q_{gs}	$V_{DS}=30V, V_{GS}=10V, I_D=300mA$		0.12		
Gate-drain charge	Q_{gd}			0.19		
Gate plateau voltage	$V_{plateau}$			2.90		V
Turn-on delay time	$t_{d(on)}$	$V_{GS}=10V, V_{DS}=30V, I_D=300mA, R_{GEN}=3\Omega$		2.8		ns
Rise time	t_r			2.2		
Turn-off delay time	$t_{d(off)}$			13		
Fall time	t_f			5.4		
Source-drain diode ratings and characteristics (Note 5)						
Diode forward voltage	V_{SD}	$I_S=115mA, V_{GS}=0V$		0.85	1.20	V
Diode forward current	I_S	$T_A=25^{\circ}C$			0.33	A

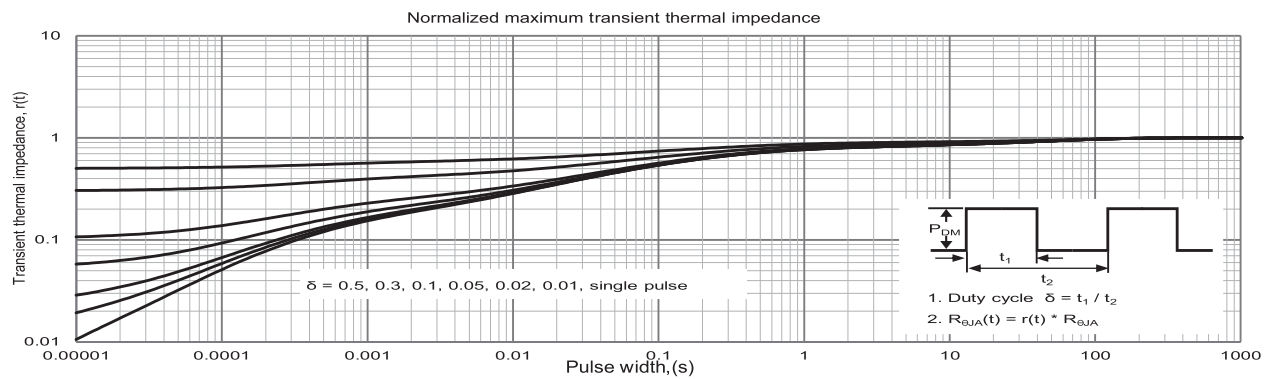
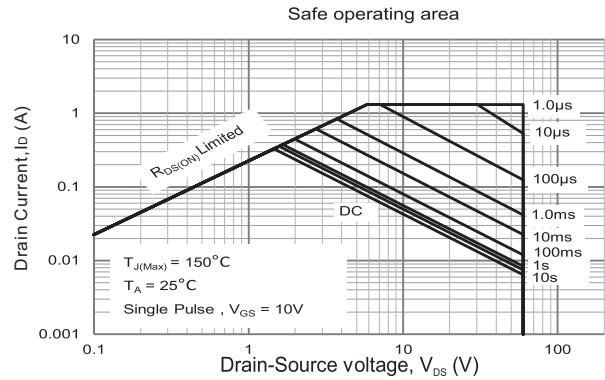
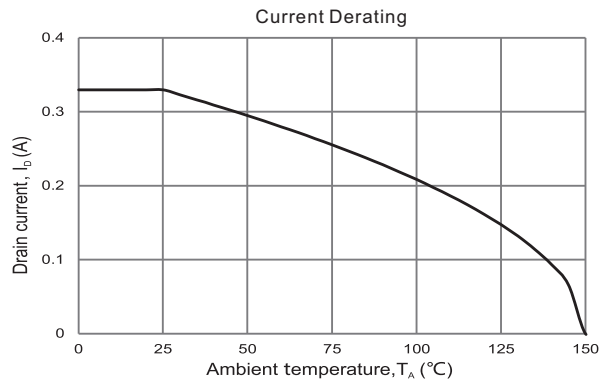
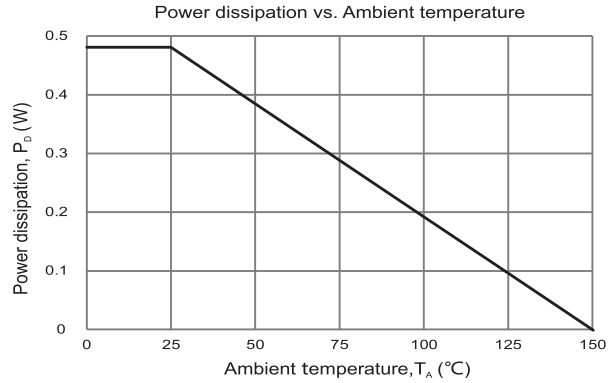
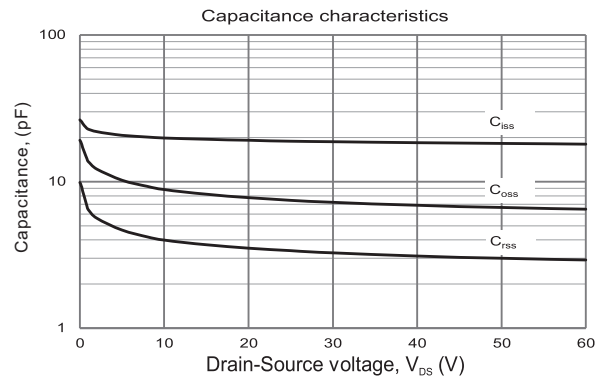
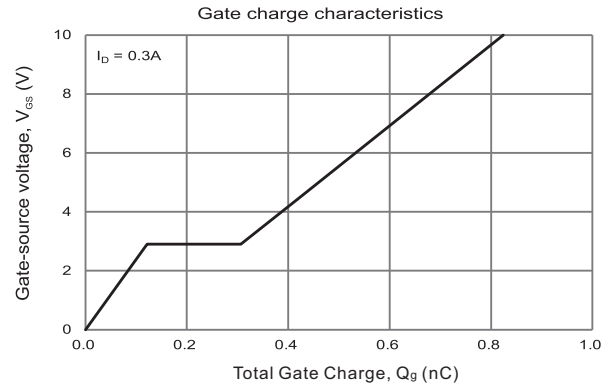
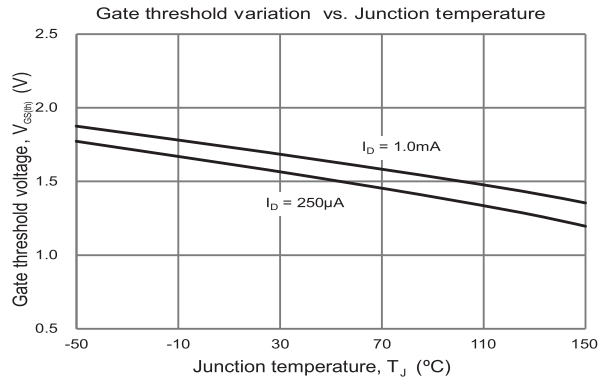
Notes 4: Short duration pulse test used to minimize self-heating effect.

5: Defined by design, not subject to production.

Rating and characteristic curves (2N7002K-H)

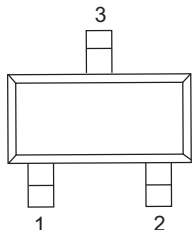
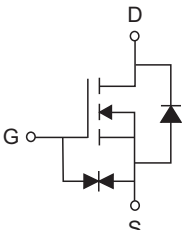


Rating and characteristic curves (2N7002K-H)



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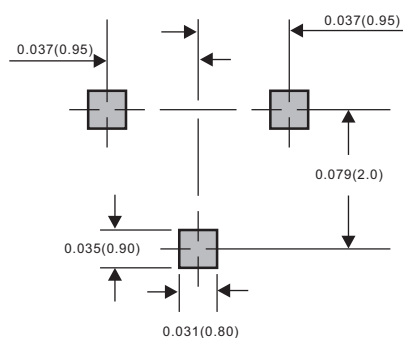
Pinning information

Pin	Simplified outline	Symbol
Pin 1 Gate Pin 2 Source Pin 3 Drain		

Marking

Type Number	Marking code
2N7002K-H	7002

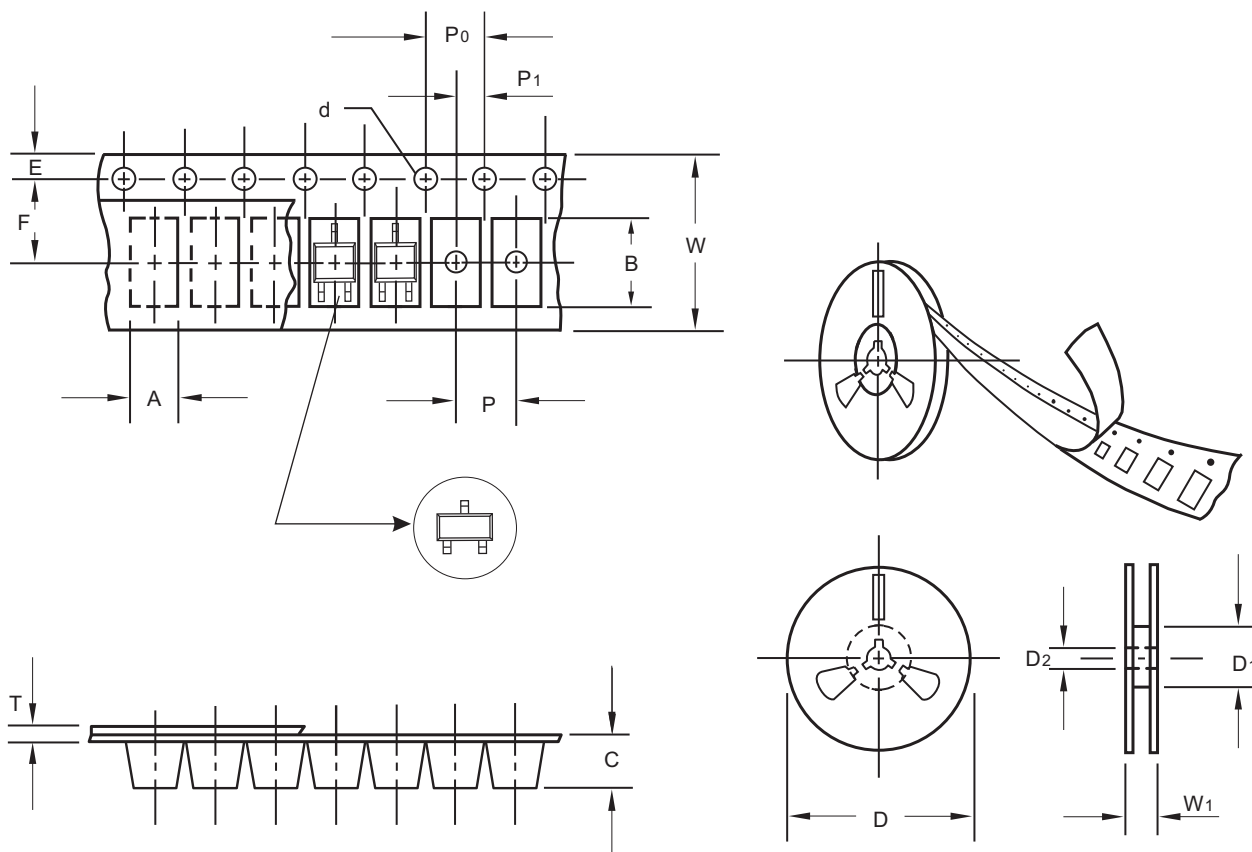
Suggested solder pad layout



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
7" Reel outside diameter	D	2.0	178.00
7" Reel inner diameter	D1	min	54.40
Feed hole diameter	D2	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	P0	0.1	4.00
Embossment center	P1	0.05	2.00
Overall tape thickness	T	0.02	0.20
Tape width	W	0.3	8.00
Reel width	W1	1.0	12.0

Note: Devices are packed in accordance with EIA standard RS-481-A and specifications listed above.

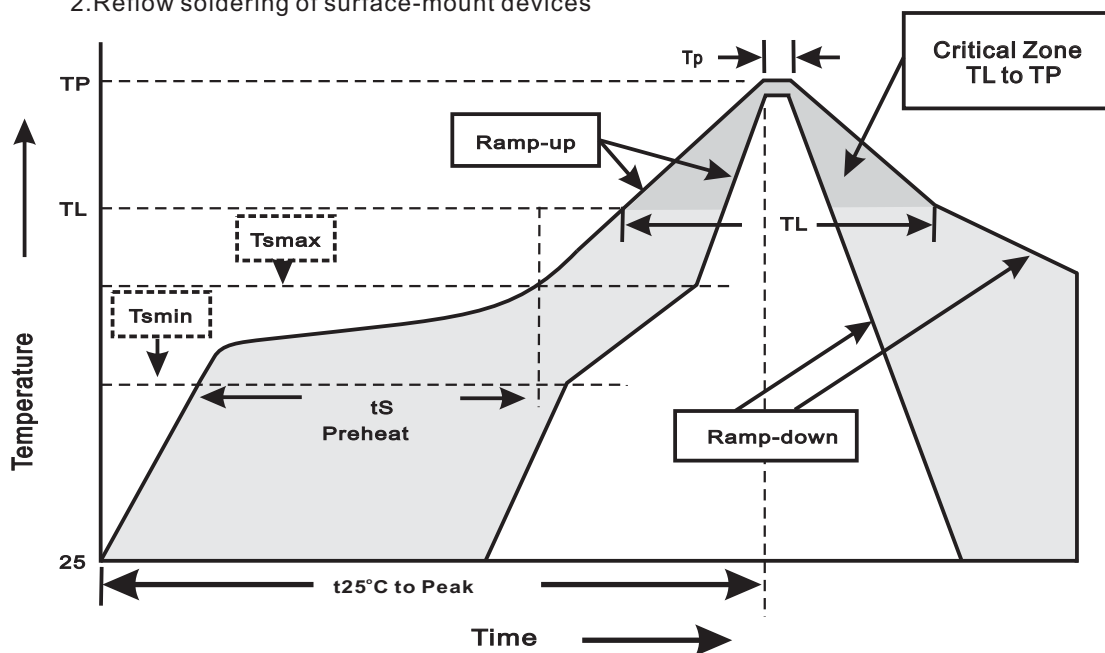
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Reel packing

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)	$<3^{\circ}\text{C/sec}$
Preheat -Temperature Min(T_{smin}) -Temperature Max(T_{smax}) -Time(min to max)(t_s)	150°C 200°C 60~120sec
T_{smax} to T_L -Ramp-upRate	$<3^{\circ}\text{C/sec}$
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	$<6^{\circ}\text{C/sec}$
Time 25°C to Peak Temperature	$<6\text{minutes}$

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High reliability test capabilities

Item Test	Conditions	Reference
1. Solder Resistance	at 260+0/-5°C for 10 sec.	MIL-STD-750D METHOD-2031
2. Solderability	at 245+0/-5°C for 5 sec.	MIL-STD-202F METHOD-208
3. High Temperature Reverse Bias	$V_{DS}=80\%$ rate at $T_J=T_{JMAX}$ for 168 hrs.	MIL-STD-750D METHOD-1038
4. Pressure Cooker	15P _{SIG} at $T_A=121^{\circ}\text{C}$ 100%RH for 4 hrs.	JESD22-A102
5. Temperature Cycling	-55°C to +125°C dwelled for 30 min total 10 cycles.	MIL-STD-750D METHOD-1051
6. Humidity	at $T_A=85^{\circ}\text{C}$, 85%RH for 1000 hrs.	MIL-STD-750D METHOD-1021
7. High Temperature Storage Life	at $T_A=150^{\circ}\text{C}$ for 1000 hrs.	MIL-STD-750D METHOD-1031