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## P-Channel Enhancement Mode MOSFET

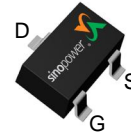
### Features

- -20V/-4.9A ,
  - $R_{DS(ON)}=43m\Omega$  (Max.) @  $V_{GS}=-4.5V$
  - $R_{DS(ON)}=58m\Omega$  (Max.) @  $V_{GS}=-2.5V$
  - $R_{DS(ON)}=88m\Omega$  (Max.) @  $V_{GS}=-1.8V$
- 100% UIS +  $R_g$  Tested
- Reliable and Rugged
- Lead Free and Green Devices Available (RoHS Compliant)

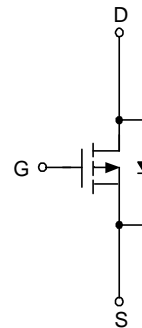
### Applications

- Power Management in Notebook Computer, Portable Equipment and Battery Powered Systems.

### Pin Description



Top View of SOT-23



P-Channel MOSFET

### Ordering and Marking Information

<p>SM2305PS    □□-□□ □</p> <div style="margin-left: 20px;"> <p>└─ Assembly Material</p> <p>└─ Handling Code</p> <p>└─ Temperature Range</p> <p>└─ Package Code</p> </div>	<p>Package Code A : SOT-23</p> <p>Operating Junction Temperature Range C : -55 to 150 °C</p> <p>Handling Code TR : Tape &amp; Reel</p> <p>Assembly Material G : Halogen and Lead Free Device</p>
<p>SM2305PS A :    <span style="border: 1px solid black; padding: 2px;">B05XX</span></p>	<p>XX - Lot Code</p>

Note : SINOPOWER lead-free products contain molding compounds/die attach materials and 100% matte tin plate termination finish; which are fully compliant with RoHS. SINOPOWER lead-free products meet or exceed the lead-free requirements of IPC/JEDEC J-STD-020D for MSL classification at lead-free peak reflow temperature. SINOPOWER defines “Green” to mean lead-free (RoHS compliant) and halogen free (Br or Cl does not exceed 900ppm by weight in homogeneous material and total of Br and Cl does not exceed 1500ppm by weight).

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**Absolute Maximum Ratings** ( $T_A = 25^\circ\text{C}$  unless otherwise noted)

Symbol	Parameter	Rating	Unit	
$V_{DSS}$	Drain-Source Voltage	-20	V	
$V_{GSS}$	Gate-Source Voltage	$\pm 12$		
$I_D^*$	Continuous Drain Current	$T_A=25^\circ\text{C}$	-4.9	A
		$T_A=70^\circ\text{C}$	-3.9	
$I_{DM}^*$	Pulsed Drain Current	$T_A=25^\circ\text{C}$	-19.7	
		$T_A=70^\circ\text{C}$	-15.7	
$I_S^*$	Diode Continuous Forward Current	-2	A	
$T_J$	Maximum Junction Temperature	150	$^\circ\text{C}$	
$T_{STG}$	Storage Temperature Range	-55 to 150		
$P_D^*$	Maximum Power Dissipation	$T_A=25^\circ\text{C}$	1.6	W
		$T_A=70^\circ\text{C}$	1.0	
$R_{\theta JA}^*$	Thermal Resistance-Junction to Ambient	$t \leq 10\text{s}$	80	$^\circ\text{C/W}$
		Steady state	100	
$R_{\theta JL}$	Thermal Resistance-Junction to Lead	Steady state	52	

Note : \*Surface Mounted on 1in<sup>2</sup> pad area,  $t \leq 10\text{sec}$ .

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

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
<b>STATIC CHARACTERISTICS</b>						
$BV_{DSS}$	Drain-Source Breakdown Voltage	$V_{GS}=0\text{V}, I_{DS}=-250\mu\text{A}$	-20	-	-	V
$I_{DSS}$	Zero Gate Voltage Drain Current	$V_{DS}=-16\text{V}, V_{GS}=0\text{V}$ $T_J=85^\circ\text{C}$	-	-	-1	$\mu\text{A}$
			-	-	-30	
$V_{GS(th)}$	Gate Threshold Voltage	$V_{DS}=V_{GS}, I_{DS}=-250\mu\text{A}$	-0.5	-0.7	-1	V
$I_{GSS}$	Gate Leakage Current	$V_{GS}=\pm 12\text{V}, V_{DS}=0\text{V}$	-	-	$\pm 100$	nA
$R_{DS(ON)}^a$	Drain-Source On-State Resistance	$V_{GS}=-4.5\text{V}, I_{DS}=-4.9\text{A}$	-	33	43	m $\Omega$
		$V_{GS}=-2.5\text{V}, I_{DS}=-3.1\text{A}$	-	42	58	
		$V_{GS}=-1.8\text{V}, I_{DS}=-2\text{A}$	-	60	88	
$V_{SD}^a$	Diode Forward Voltage	$I_{SD}=-1\text{A}, V_{GS}=0\text{V}$	-	-0.7	-1	V
<b>GATE CHARGE CHARACTERISTICS<sup>b</sup></b>						
$Q_g$	Total Gate Charge	$V_{DS}=-10\text{V}, V_{GS}=-4.5\text{V},$ $I_{DS}=-4.9\text{A}$	-	8	11	nC
$Q_{gs}$	Gate-Source Charge		-	1.6	-	
$Q_{gd}$	Gate-Drain Charge		-	1.9	-	

**Electrical Characteristics (Cont.)** ( $T_A = 25^\circ\text{C}$  unless otherwise noted)

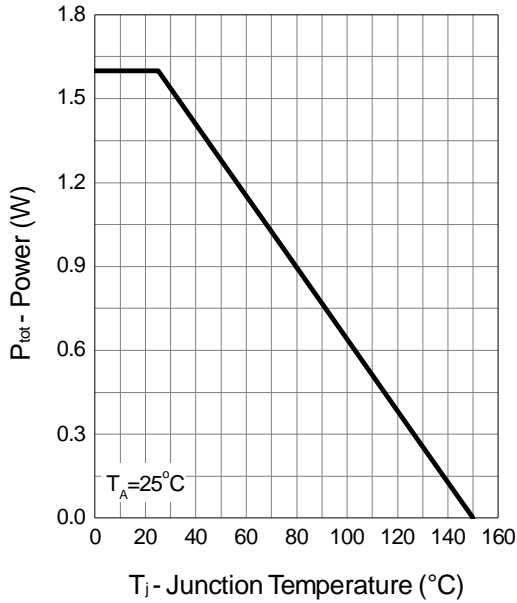
Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
<b>DYNAMIC CHARACTERISTICS<sup>b</sup></b>						
$R_G$	Gate Resistance	$V_{GS}=0V, V_{DS}=0V, F=1\text{MHz}$	-	2.4	5	$\Omega$
$C_{iss}$	Input Capacitance	$V_{GS}=0V,$ $V_{DS}=-10V,$ Frequency=1.0MHz	-	815	1060	pF
$C_{oss}$	Output Capacitance		-	145	-	
$C_{rss}$	Reverse Transfer Capacitance		-	110	-	
$t_{d(ON)}$	Turn-on Delay Time	$V_{DD}=-10V, R_L=10\Omega,$ $I_{DS}=-1A, V_{GEN}=-4.5V,$ $R_G=6\Omega$	-	8	14.4	ns
$t_r$	Turn-on Rise Time		-	12.8	23	
$t_{d(OFF)}$	Turn-off Delay Time		-	33	59.4	
$t_f$	Turn-off Fall Time		-	18	32.4	
$t_{rr}$	Reverse Recovery Time	$I_{SD}=-4.9A, di_{SD}/dt = 100A/\mu s$	-	16	-	ns
$Q_{rr}$	Reverse Recovery Charge		-	8	-	nC

Note a : Pulse test ; pulse width $\leq 300\mu s$ , duty cycle $\leq 2\%$ .

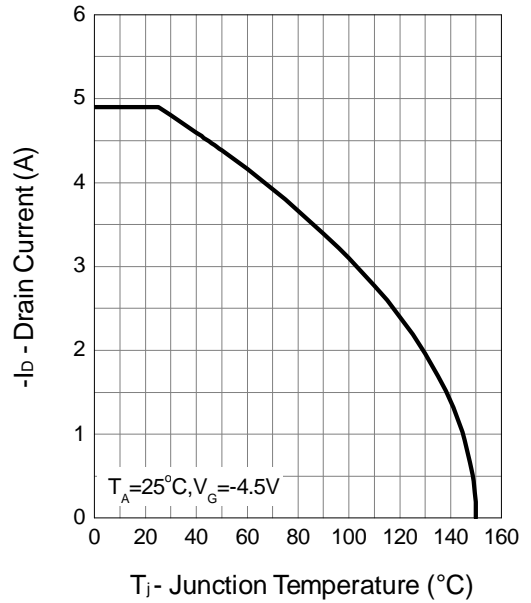
Note b : Guaranteed by design, not subject to production testing.

Typical Operating Characteristics

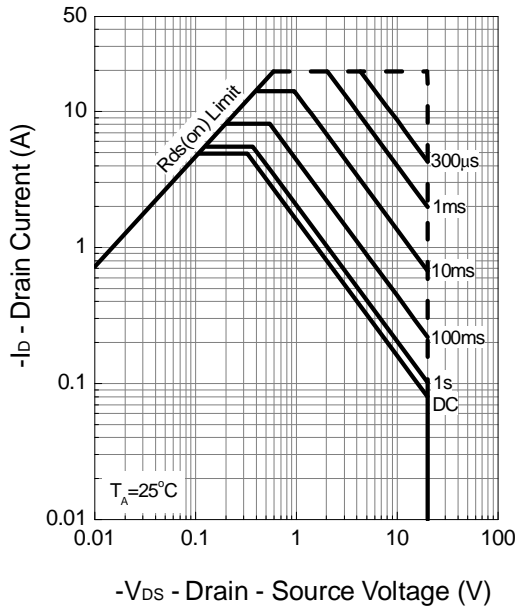
Power Dissipation



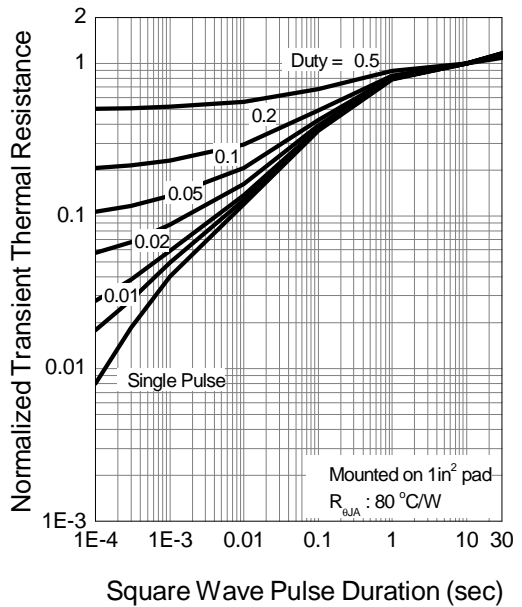
Drain Current



Safe Operation Area

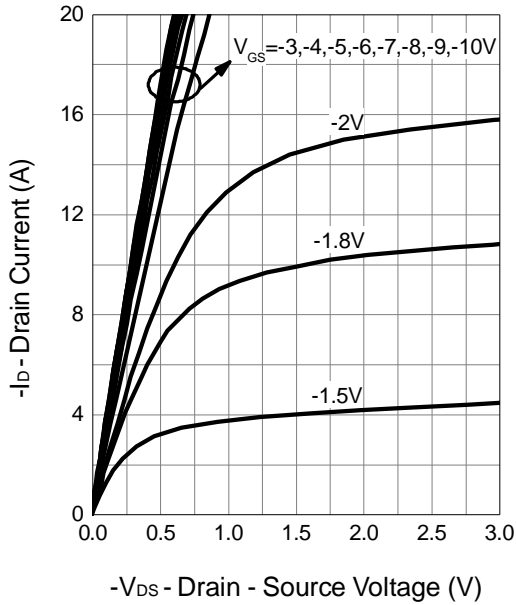


Thermal Transient Impedance

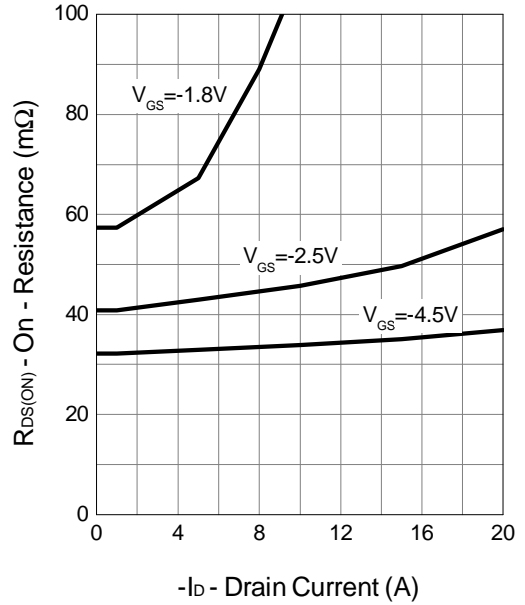


Typical Operating Characteristics (Cont.)

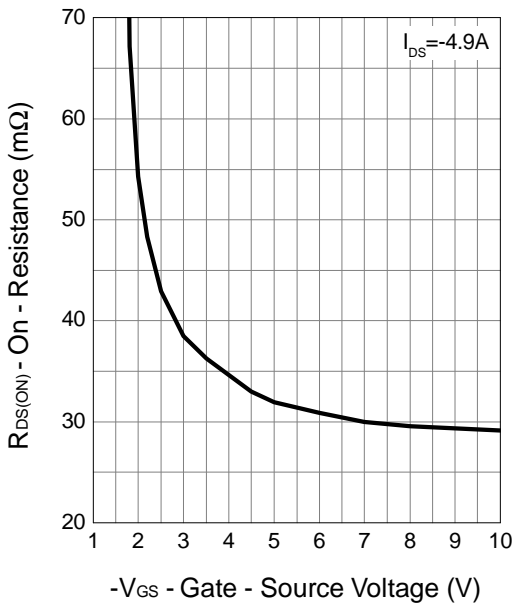
Output Characteristics



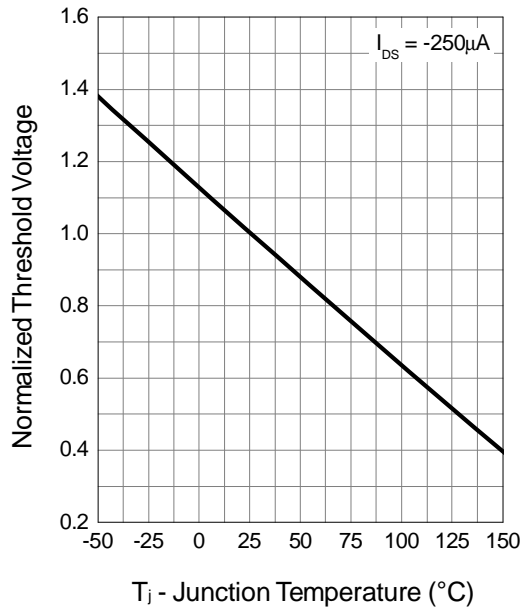
Drain-Source On Resistance



Gate-Source On Resistance

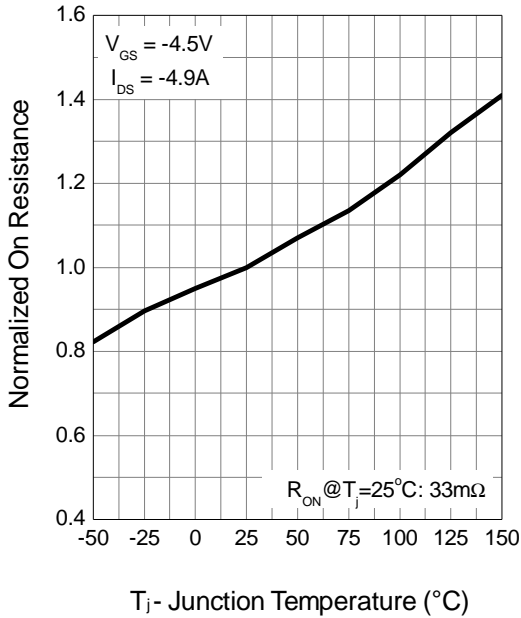


Gate Threshold Voltage

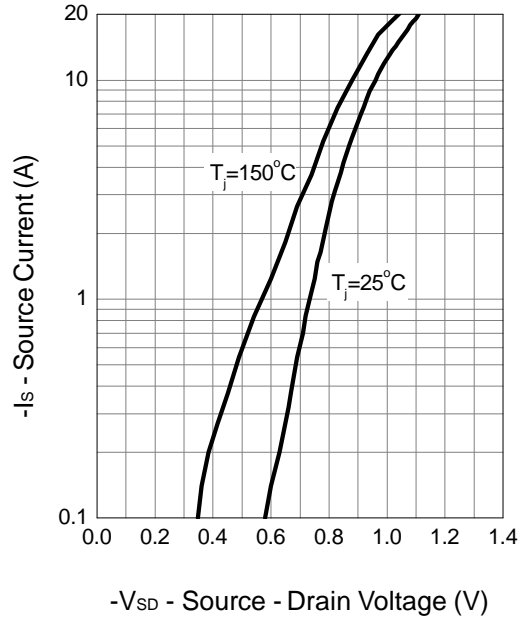


Typical Operating Characteristics (Cont.)

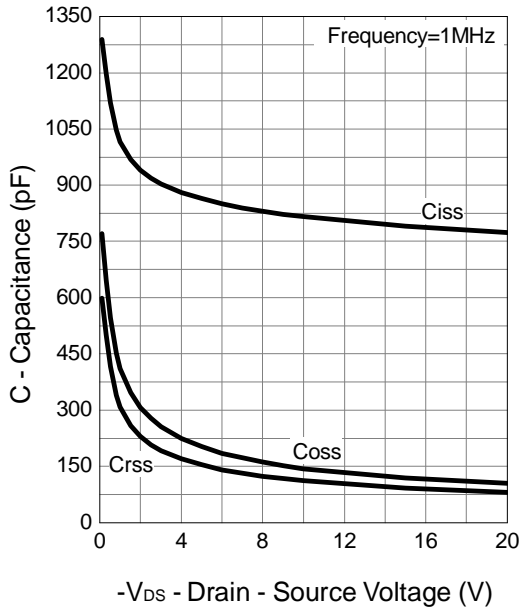
Drain-Source On Resistance



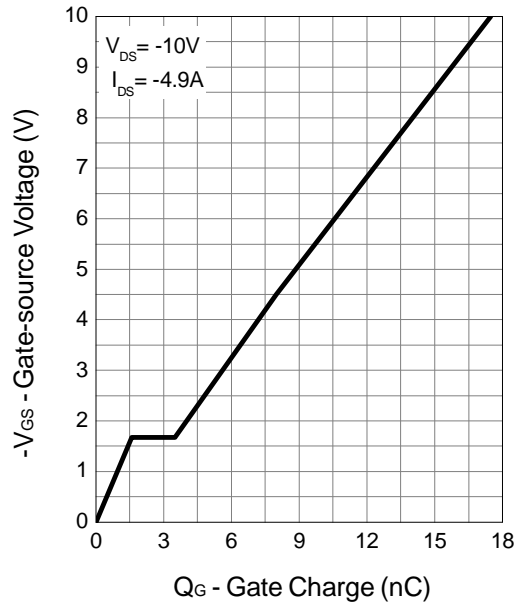
Source-Drain Diode Forward



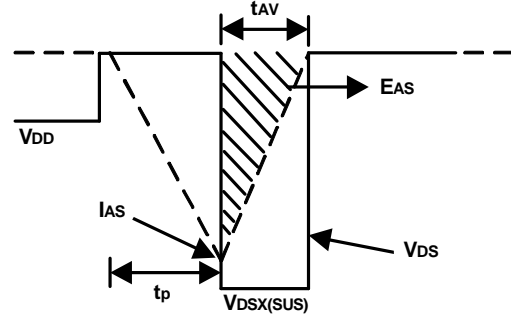
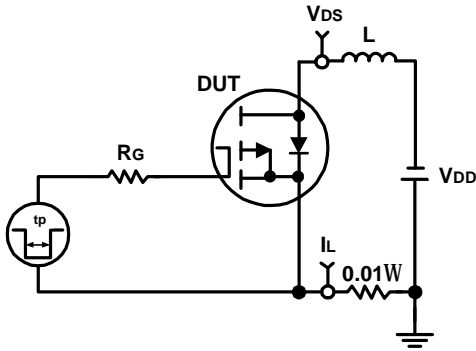
Capacitance



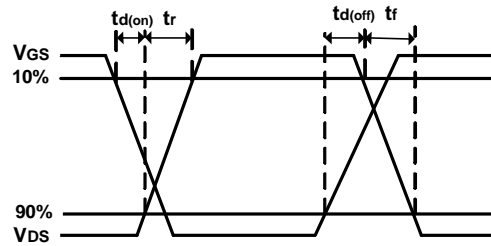
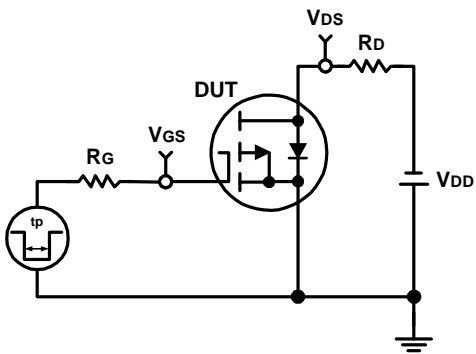
Gate Charge



### Avalanche Test Circuit and Waveforms



### Switching Time Test Circuit and Waveforms





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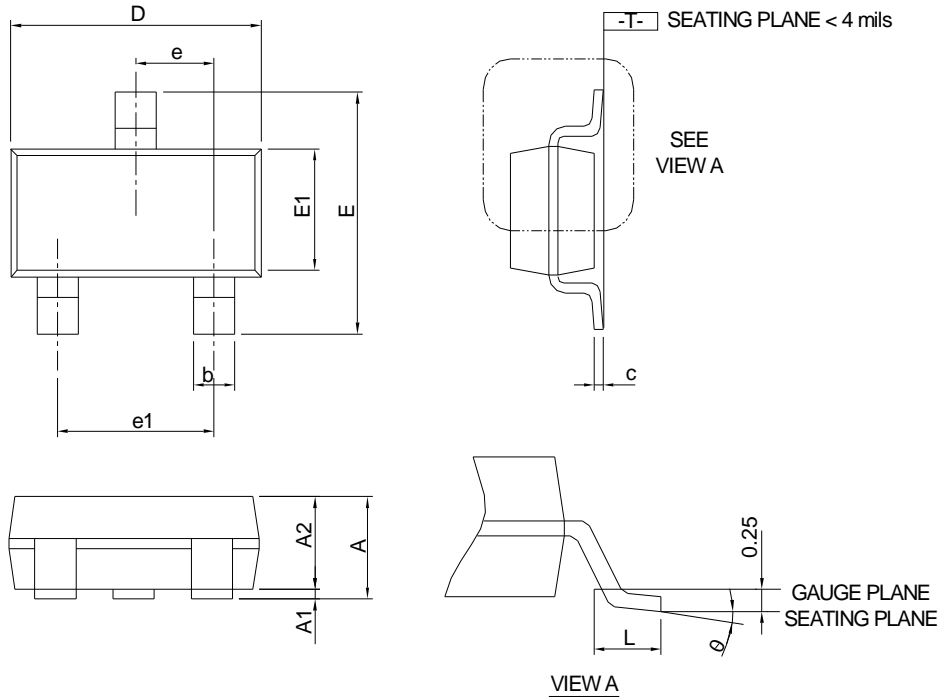
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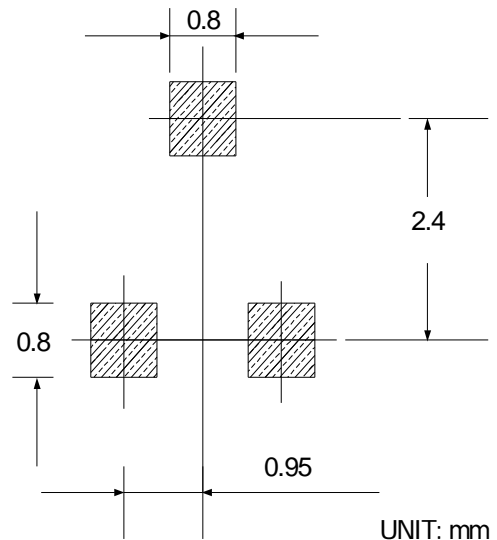
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Package Information



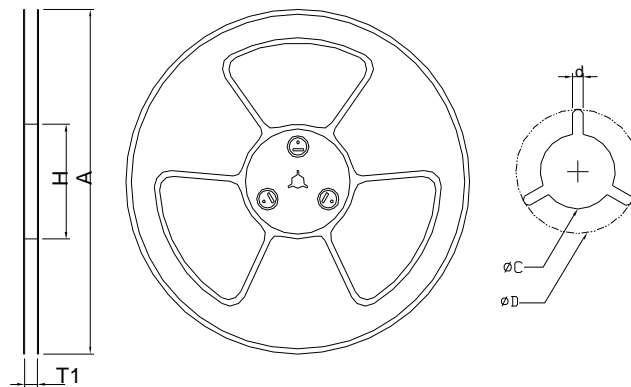
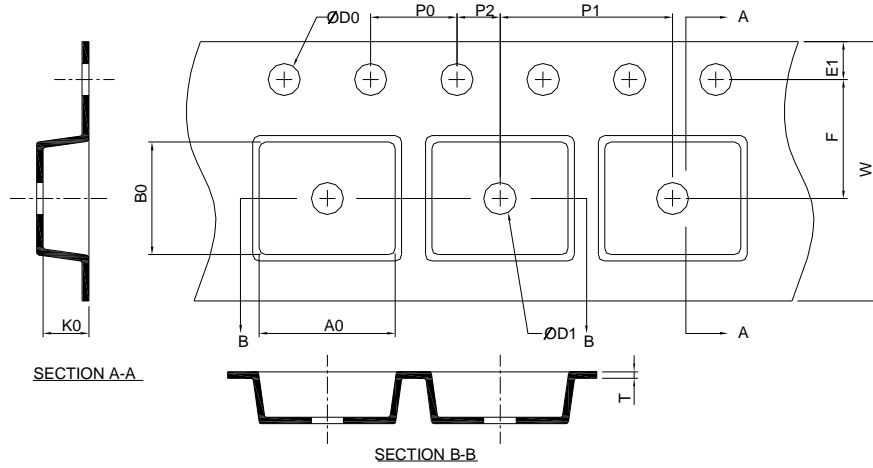
SYMBOL	SOT-23			
	MILLIMETERS		INCHES	
	MIN.	MAX.	MIN.	MAX.
A	-	1.20	-	0.047
A1	0.00	0.08	0.000	0.003
A2	0.90	1.12	0.035	0.044
b	0.30	0.50	0.012	0.020
c	0.08	0.22	0.003	0.009
D	2.70	3.10	0.106	0.122
E	2.60	3.00	0.102	0.118
E1	1.40	1.80	0.055	0.071
e	0.95 BSC		0.037 BSC	
e1	1.90 BSC		0.075 BSC	
L	0.30	0.60	0.012	0.024
$\theta$	0°	8°	0°	8°

RECOMMENDED LAND PATTERN



Note : Dimension D and E1 do not include mold flash, protrusions or gate burrs. Mold flash, protrusion or gate burrs shall not exceed 10 mil per side.

### Carrier Tape & Reel Dimensions

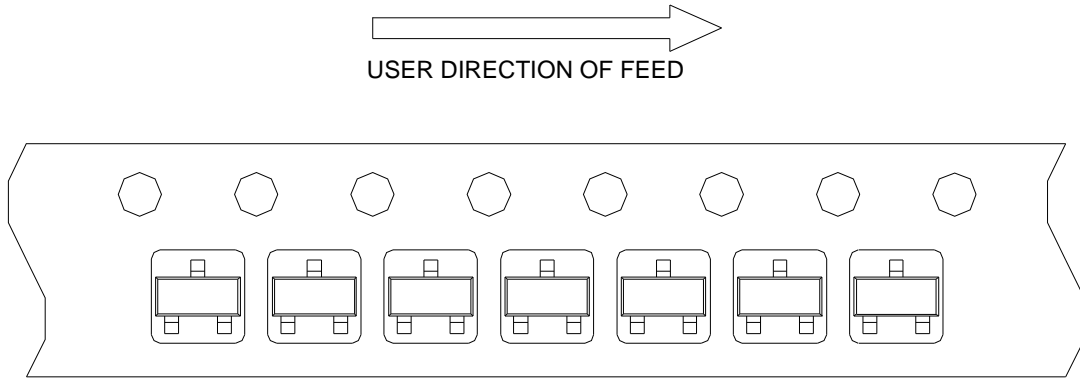


Application	A	H	T1	C	d	D	W	E1	F
SOT-23	178.0±2.00	50 MIN.	8.4+2.00 -0.00	13.0+0.50 -0.20	1.5 MIN.	20.2 MIN.	8.0±0.30	1.75±0.10	3.5±0.05
	P0	P1	P2	D0	D1	T	A0	B0	K0
	4.0±0.10	4.0±0.10	2.0±0.05	1.5+0.10 -0.00	1.0 MIN.	0.6+0.00 -0.40	3.20±0.20	3.10±0.20	1.50±0.20

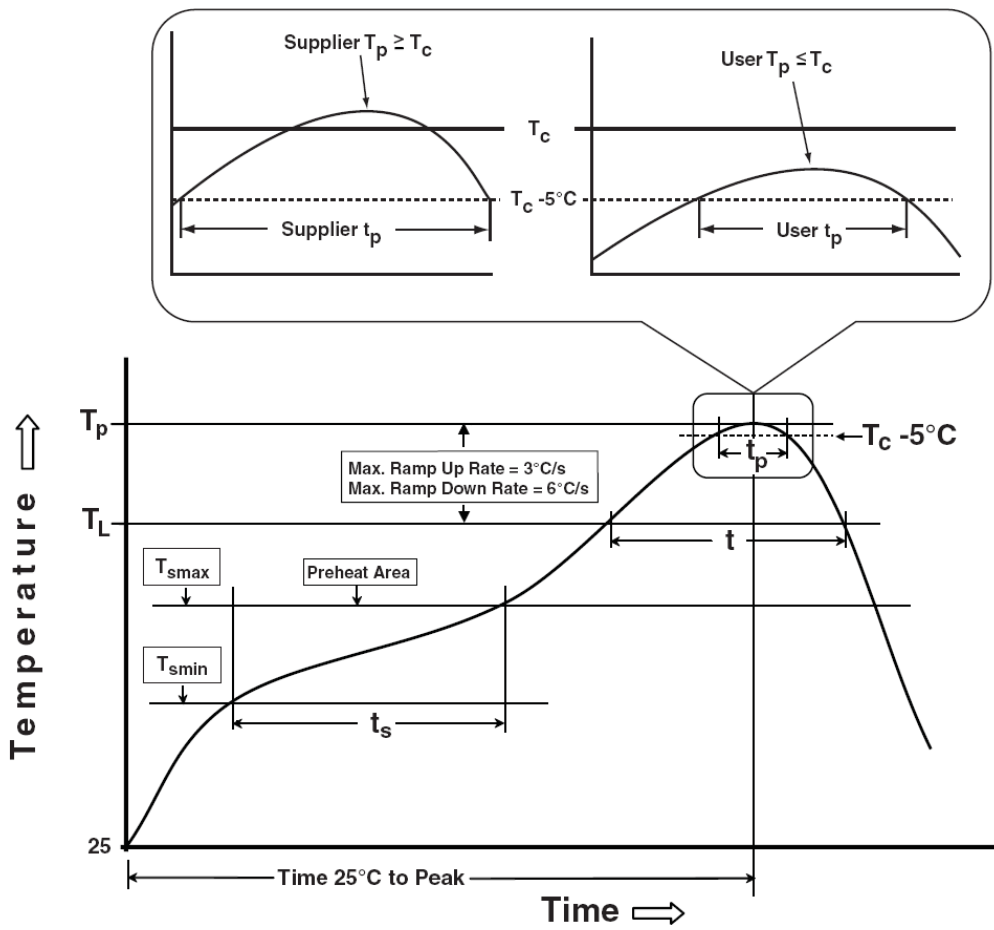
(mm)

## Taping Direction Information

SOT-23



## Classification Profile



## Classification Reflow Profiles

Profile Feature	Sn-Pb Eutectic Assembly	Pb-Free Assembly
<b>Preheat &amp; Soak</b>		
Temperature min ( $T_{smin}$ )	100 °C	150 °C
Temperature max ( $T_{smax}$ )	150 °C	200 °C
Time ( $T_{smin}$ to $T_{smax}$ ) ( $t_s$ )	60-120 seconds	60-120 seconds
Average ramp-up rate ( $T_{smax}$ to $T_p$ )	3 °C/second max.	3°C/second max.
Liquidous temperature ( $T_L$ )	183 °C	217 °C
Time at liquidous ( $t_L$ )	60-150 seconds	60-150 seconds
Peak package body Temperature ( $T_p$ )*	See Classification Temp in table 1	See Classification Temp in table 2
Time ( $t_p$ )** within 5°C of the specified classification temperature ( $T_c$ )	20** seconds	30** seconds
Average ramp-down rate ( $T_p$ to $T_{smax}$ )	6 °C/second max.	6 °C/second max.
Time 25°C to peak temperature	6 minutes max.	8 minutes max.
* Tolerance for peak profile Temperature ( $T_p$ ) is defined as a supplier minimum and a user maximum.		
** Tolerance for time at peak profile temperature ( $t_p$ ) is defined as a supplier minimum and a user maximum.		

Table 1. SnPb Eutectic Process – Classification Temperatures ( $T_c$ )

Package Thickness	Volume mm <sup>3</sup> <350	Volume mm <sup>3</sup> ≥350
<2.5 mm	235 °C	220 °C
≥2.5 mm	220 °C	220 °C

Table 2. Pb-free Process – Classification Temperatures ( $T_c$ )

Package Thickness	Volume mm <sup>3</sup> <350	Volume mm <sup>3</sup> 350-2000	Volume mm <sup>3</sup> >2000
<1.6 mm	260 °C	260 °C	260 °C
1.6 mm – 2.5 mm	260 °C	250 °C	245 °C
≥2.5 mm	250 °C	245 °C	245 °C

## Reliability Test Program

Test item	Method	Description
SOLDERABILITY	JESD-22, B102	5 Sec, 245°C
HTRB	JESD-22, A108	1000 Hrs, 80% of VDS max @ $T_{jmax}$
HTGB	JESD-22, A108	1000 Hrs, 100% of VGS max @ $T_{jmax}$
PCT	JESD-22, A102	168 Hrs, 100%RH, 2atm, 121°C
TCT	JESD-22, A104	500 Cycles, -65°C~150°C

## Customer Service

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