36V Low Current Consumption
250mA CMOS Voltage Regulator

S-LR6375 Series

■ INTRODUCTION

The S-LR6375 series are a group of positive voltage regulators manufactured by CMOS technologies with low power consumption and low dropout voltage, which provide large output currents even when the difference of the input-output voltage is small. The S-LR6375 series can deliver 250mA output current and allow an input voltage as high as 36V. The series are very suitable for the battery-powered equipments, such as RF applications and other systems requiring a quiet voltage source.

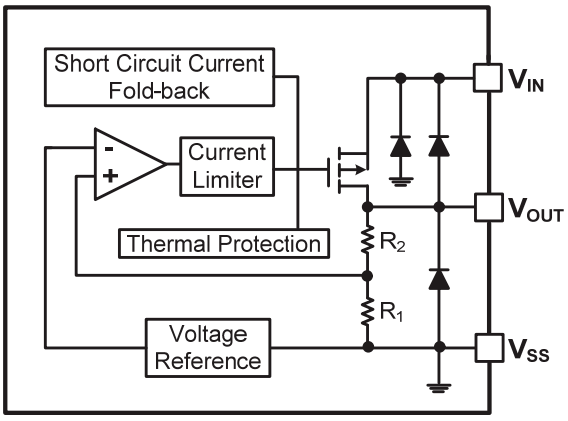
■ FEATURES

- Low Quiescent Current: 2μA
- Operating Voltage Range: 2.5V～36V
- Output Current: 250mA
- Low Dropout Voltage:
  400mV@100mA(V_{OUT}=3.3V)
- Output Voltage: 1.8~ 5.0V
- High Accuracy: ±2%/±1%(Typ.)
- High Power Supply Rejection Ratio: 70dB@1kHz
- Low Output Noise:
  27xVOUT μVRMS(10Hz~100kHz)
- Excellent Line and Load Transient Response
- Built-in Current Limiter, Short-Circuit Protection
- Over-Temperature Protection
- Stable with Ceramic or Tantalum Capacitor
- S-Prefix for Automotive And Other Applications Requiring Unique Site and Control Change Requirements; AEC-Q100 Qualified and PPAP Capable.
- MSL: 3

■ APPLICATIONS

- Cordless Phones
- Radio control systems
- Laptop, Palmtops and PDAs
- Single-lens reflex DSC
- PC peripherals with memory
- Wireless Communication Equipments
- Portable Audio Video Equipments
- Car Navigation Systems
- LAN Cards
- Ultra Low Power Microcontroller

■ BLOCK DIAGRAM



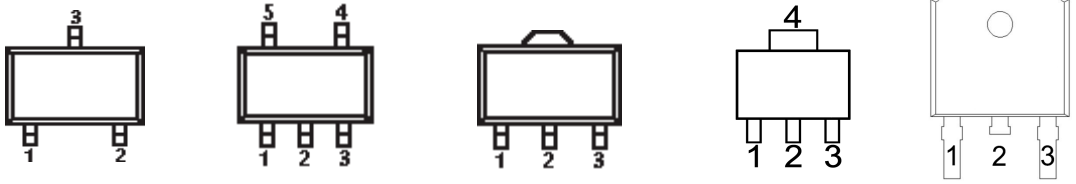
■ ORDER INFORMATION

S-LR6375①②③④⑤

DESIGNATOR	SYMBOL	DESCRIPTION
①	A	Without EN
②	Integer	Output Voltage e.g. 5.0V=50
③	M/MC/MY	Package:SOT-23-3
	MF/MR/MH	Package:SOT-23-5
	P/PT/PL	Package:SOT-89-3
④	S	Package:SOT223
	D	Package:TO252
⑤	-	2% Accuracy
	1	1% Accuracy

■ PIN CONFIGURATION

SOT-23-3 SOT-23-5 SOT-89-3 SOT-223 TO-252



PIN NUMBER						PIN NAME	FUNCTION
SOT-23-3			SOT-89-3				
M	MC	MY	P	PT	PL		
1	3	3	1	2	2	V_{SS}	Ground
2	2	1	3	1	3	V_{OUT}	Output
3	1	2	2	3	1	V_{IN}	Power input

SOT-23-5

PIN NUMBER			PIN NAME	FUNCTION
MF	MR	MH		
1	2	1	V_{IN}	Power Input
2	1	3/4	V_{SS}	Ground
3/4	4/5	2	NC	No Connection
5	3	5	V_{OUT}	Output

SOT-223

PIN NUMBER	PIN NAME	FUNCTION
S		
1	V_{IN}	Power Input
2	V_{SS}	Ground
3	Vout	Output
4	V_{SS}	Ground

TO-252

PIN NUMBER	PIN NAME	FUNCTION
D		
1	V_{IN}	Power Input Pin
2	V_{SS}	Ground
3	V_{OUT}	Output Pin

■ ABSOLUTE MAXIMUM RATINGS(1)

(Unless otherwise specified, T_A=25°C)

PARAMETER		SYMBOL	RATINGS	UNITS
Input Voltage(2)		V_{IN}	-0.3~40	V
Output Voltage(2)		V_{OUT}	-0.3~13	V
Power Dissipation	SOT-23	P_D	0.25	W
	SOT-89		0.5	W
Operating Junction Temperature Range (3)		T_j	150	°C
Storage Temperature		T_{stg}	-65~150	°C
Lead Temperature(Soldering, 10 sec)		T_{solder}	260	°C
ESD rating(4)		Human Body Model -(HBM)	4	KV
		Machine Model- (MM)	200	V

(1) Stresses beyond those listed under *absolute maximum ratings may* cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated under *recommended operating conditions* is not implied. Exposure to absolute-maximum-rated conditions for extended periods my affect device reliability.

(2) All voltages are with respect to network ground terminal.

(3) This IC includes over temperature protection that is intended to protect the device during momentary overload. Junction temperature will exceed 125°C when over temperature protection is active. Continuous operation above the specified maximum operating junction temperature may impair device reliability.

(4) ESD testing is performed according to the respective AEC-Q100 standard.

The human body model is a 100 pF capacitor discharged through a 1.5kΩ resistor into each pin. The machine model is a 200pFcapacitor discharged directly into each pin.

■ RECOMMENDED OPERATING CONDITIONS

PARAMETER	MIN.	NOM.	MAX.	UNITS
Supply voltage at V_{IN}	2.5		36	V
Operating junction temperature range, T_J	-40		125	°C
Operating free air temperature range, T_A	-40		105	°C

■ THERMAL CHARACTERISTICS

PACKAGE	PARAMETER	MIN.	NOM.	MAX.	UNITS
SOT-89-3	Junction to Ambient, $R_{\theta JA}$		215		°C/W
SOT-89-3	Junction to Lead, $R_{\theta JL}$(5)		62		°C/W
TO-252	Junction to Ambient, $R_{\theta JA}$(6)		80		°C/W
TO-252	Junction to Case, $R_{\theta JC}$(7)		18		°C/W

(5) RθJL test point is at the center directly above the PIN 2.

(6) Thermal resistance test board size: 1.5in.×1.5in. (FR4); Copper foil 1in²×70um

(7) RθJC test point is at the center position of the metal pad under the plastic encapsulation.

■ ELECTRICAL CHARACTERISTICS

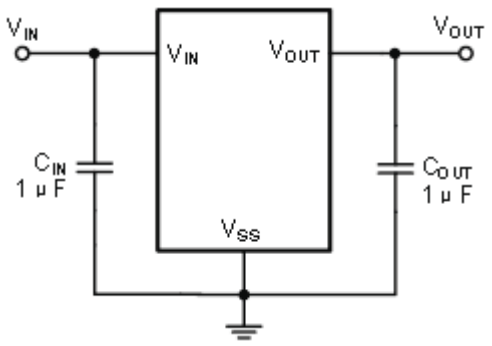
S-LR6375 Series **(V_{IN}=V_{OUT}+2V, C_{IN}=C_{OUT}=1μF, T_A=25℃,unless otherwise specified)**

PARAMETER	SYMBOL	CONDITIONS		MIN.	TYP.(7)	MAX.	UNITS
Input Voltage	V_{IN}			2.5	—	36	V
Output Voltage Range	V_{OUT}			1.8	—	5.0	V
DC Output Accuracy		I_{OUT}=10mA		-2	—	2	%
				-1	—	1	%
Dropout Voltage	V_{dif}(9)	I_{OUT} =100mA,V_{OUT}=3.3V		—	400	—	mV
Supply Current	I_{SS}	I_{OUT}=0A, 2.1V≤V_{OUT}≤5.0V		—	2	5	μA
		I_{OUT}=0A, 5.0V<V_{OUT}≤12.0V		-	5	10	μA
Line Regulation	$\frac{\Delta V_{OUT}}{V_{OUT} \times \Delta V_{IN}}$	I_{OUT} =10mA V_{OUT} +1V≤V_{IN}≤36V		—	0.01	0.1	%/V
Load Regulation	ΔV_{OUT}	V_{IN}= V_{OUT} +2V, 1mA≤I_{OUT}≤100mA		—	10	—	mV
Temperature Coefficient	$\frac{\Delta V_{OUT}}{V_{OUT} \times \Delta T_A}$	I_{OUT}=40mA, -40°C<T_A<85°C			50		ppm/°C
Output Current Limit	I_{LIM}	V_{OUT}= 0.5 x $V_{OUT(Normal)}$			350		mA
Short Current	I_{SHORT}	V_{OUT} =V_{SS}		—	25	—	mA
Power Supply Rejection Ratio	PSRR	I_{OUT}=50mA	100Hz		80		dB
			1kHz	—	70	—	
			10kHz	—	60	—	
			100kHz	—	50	—	
Output Noise Voltage	V_{ON}	BW=10Hz to 100kHz		—	27 x V_{OUT}	—	μV_{RMS}
Thermal Shutdown Temperature	T_{SD}	I_{LOAD} = 30mA		—	160	—	°C
Thermal Shutdown Hysteresis	ΔT_{SD}	——		—	20	—	°C

(8) Typical numbers are at 25°C and represent the most likely norm.

(9) V_{dif}: The Difference Of Output Voltage And Input Voltage When Input Voltage Is Decreased Gradually Till Output Voltage Equals To 98% Of V_{OUT} (E).

■ TYPICAL APPLICATION CIRCUIT



■ APPLICATION INFORMATION

Selection of Input/ Output Capacitors

In general, all the capacitors need to be low leakage. Any leakage the capacitors have will reduce efficiency, increase the quiescent current.

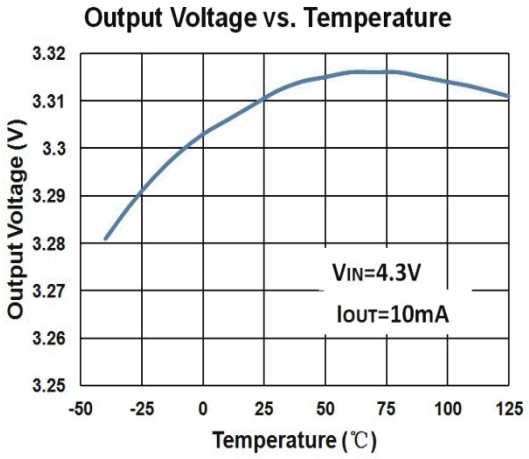
A recent trend in the design of portable devices has been to use ceramic capacitors to filter DC-DC converter inputs. Ceramic capacitors are often chosen because of their small size, low equivalent series resistance (ESR) and high RMS current capability. Also, recently, designers have been looking to ceramic capacitors due to shortages of tantalum capacitors.

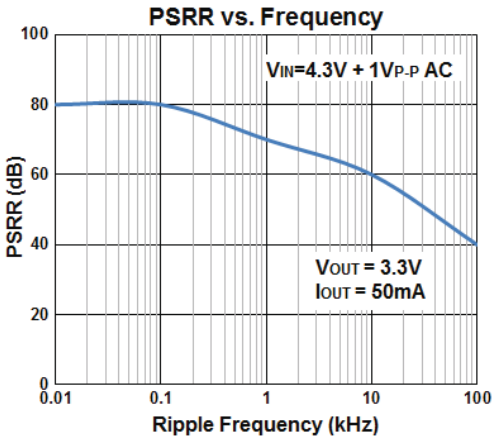
Unfortunately, using ceramic capacitors for input filtering can cause problems. Applying a voltage step to a ceramic capacitor causes a large current surge that stores energy in the inductances of the power leads. A large voltage spike is created when the stored energy is transferred from these inductances into the ceramic capacitor. These voltage spikes can easily be twice the amplitude of the input voltage step. (See “Ceramic Input Capacitors Can Cause Overvoltage Transients”——Linear Technology application note 88, March 2001)

Many types of capacitors can be used for input bypassing, however, caution must be exercised when using multilayer ceramic capacitors (MLCC). Because of the self-resonant and high Q characteristics of some types of ceramic capacitors, high voltage transients can be generated under some start-up conditions, such as connecting the LDO input to a live power source. Adding a 3Ω resistor in series with an X5R ceramic capacitor will minimize start-up voltage transients.

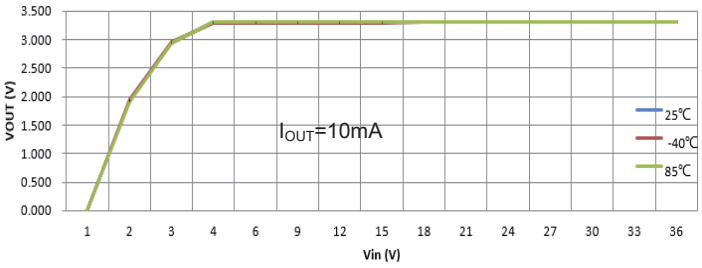
The LDO also requires an output capacitor for loop stability. Connect a 1μF tantalum capacitor from OUT to GND close to the pins. For improved transient response, this output capacitor may be ceramic.

■ TYPICAL PERFORMANCE CHARACTERISTICS

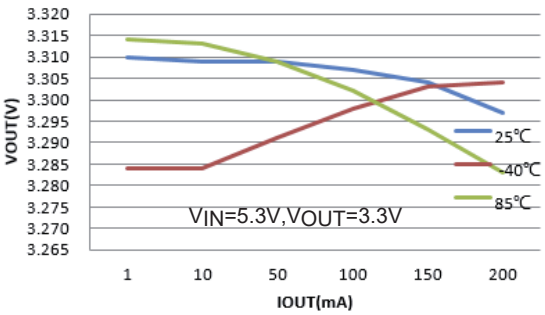




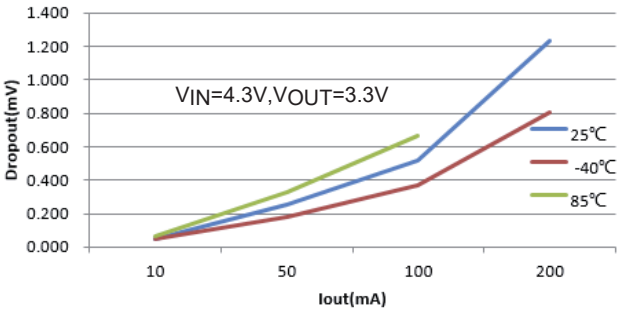
Line Regulation



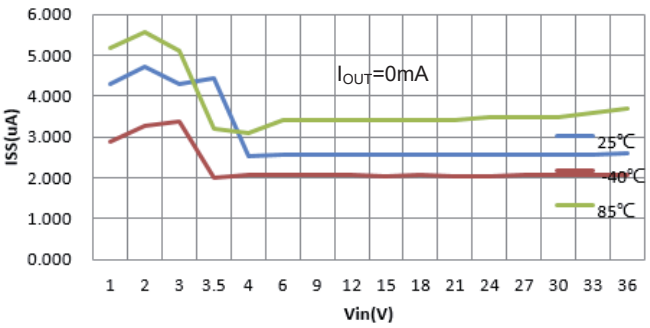
Load Regulation



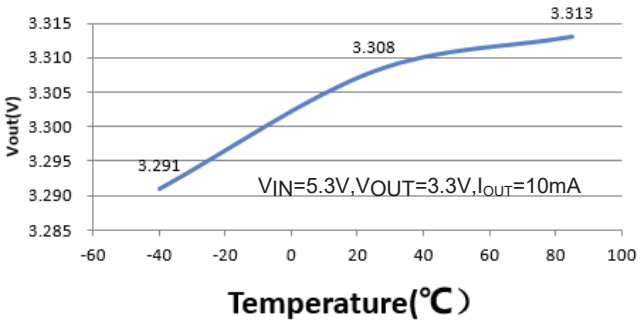
Dropout Voltage vs. Output Current



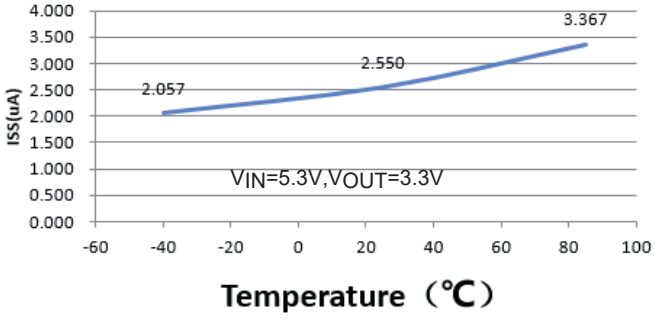
Ground Pin Current vs. Input Voltage



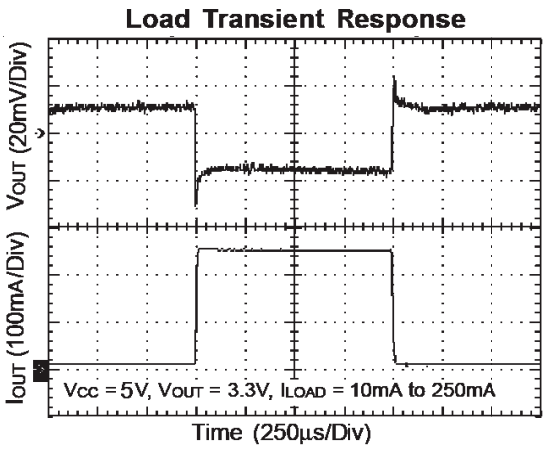
Output Voltage vs. Temperature

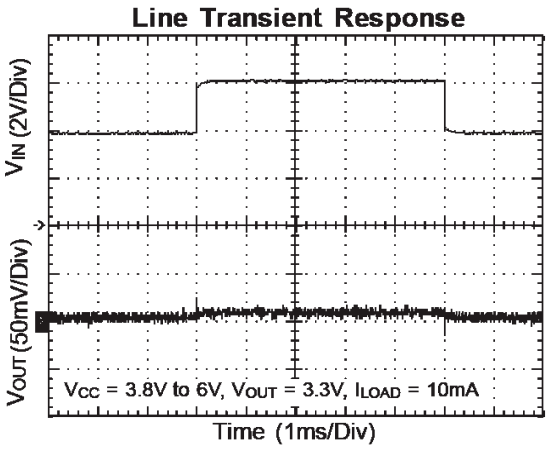


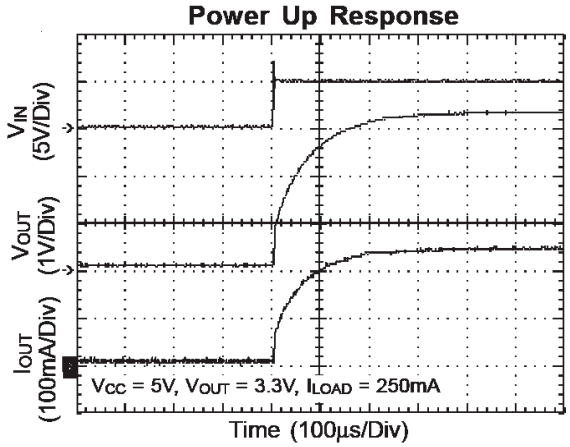
Ground Current vs. Temperature

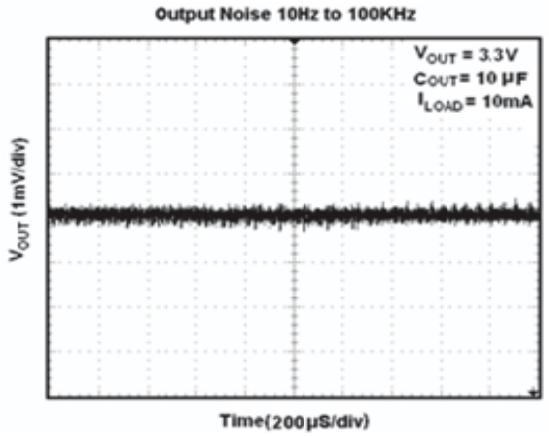


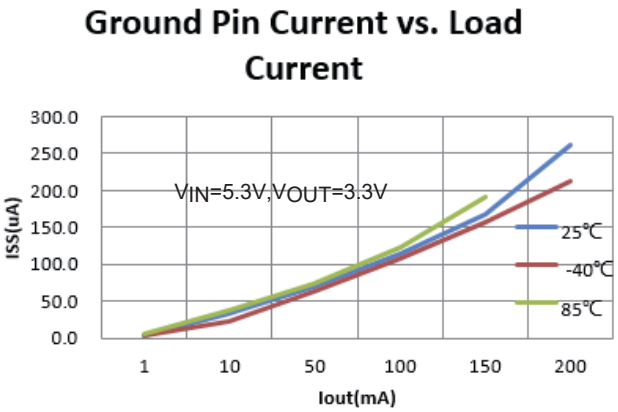
■ TYPICAL PERFORMANCE CHARACTERISTICS





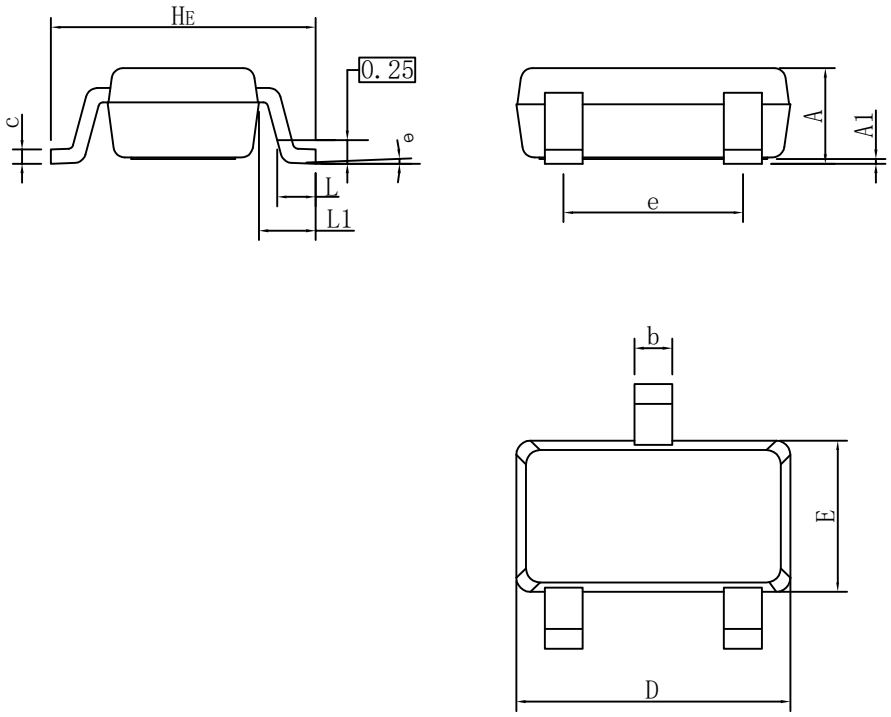






■ PACKING INFORMATION

- **SOT-23-3 PACKAGE OUTLINE DIMENSIONS**

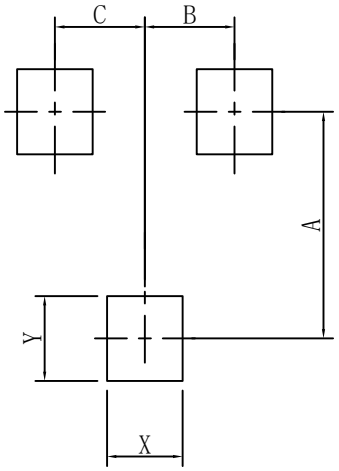


SOT23LC			
DIM	MIN	NOR	MAX
A	0.90	1.00	1.10
A1	0.01	0.06	0.10
b	0.30	0.40	0.50
c	0.10	0.17	0.20
D	2.80	2.90	3.00
E	1.50	1.60	1.70
e	1.80	1.90	2.00
L	0.20	0.40	0.60
L1	0.60REF		
HE	2.60	2.80	3.00
θ	0°	-	10°
All Dimensions in mm			

GENERAL NOTES

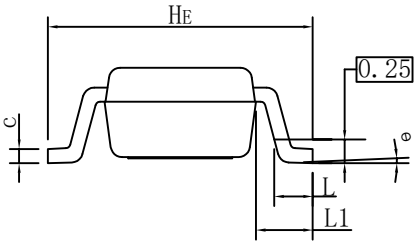
1. Top package surface finish Ra0.4±0.2um
2. Bottom package surface finish Ra0.7±0.2um
3. Side package surface finish Ra0.4±0.2um

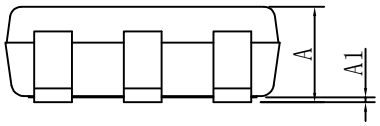
■ RECOMMENDED PAD LAYOUT

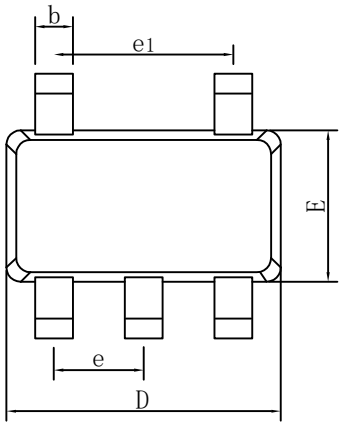


DIM	(mm)
X	0.80
Y	0.90
A	2.40
B	0.95
C	0.95

- **SOT-23-5 PACKAGE OUTLINE DIMENSIONS**





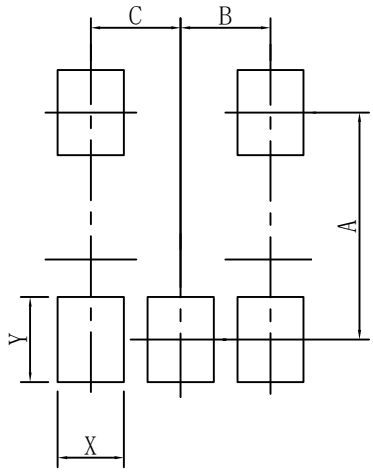


SOT25			
DIM	MIN	NOR	MAX
A	0.90	1.00	1.10
A1	0.01	0.06	0.10
b	0.30	0.40	0.50
c	0.10	0.17	0.20
D	2.80	2.90	3.00
E	1.50	1.60	1.70
e	0.85	0.95	1.05
e1	1.80	1.90	2.00
L	0.20	0.40	0.60
L1	0.60REF		
HE	2.60	2.80	3.00
θ	0°	-	10°

GENERAL NOTES

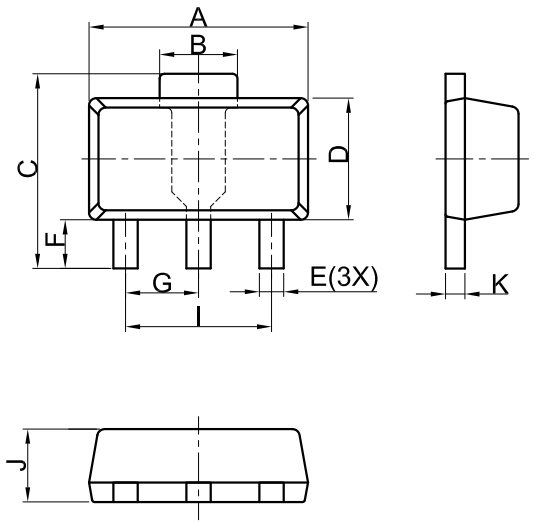
1. Top package surface finish Ra0.4±0.2um
2. Bottom package surface finish Ra0.7±0.2um
3. Side package surface finish Ra0.4±0.2um

■ RECOMMENDED PAD LAYOUT



SOT25	
DIM	(mm)
X	0.70
Y	0.90
A	2.40
B	0.95
C	0.95

- **SOT-89-3 PACKAGE OUTLINE DIMENSIONS**

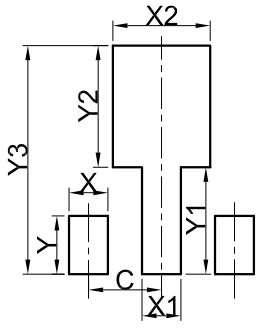


SOT89			
DIM	MIN	NOR	MAX
A	4.30	4.50	4.70
B	1.40	1.60	1.80
C	3.90	4.00	4.25
D	2.30	2.50	2.70
E	0.40	0.50	0.58
F	0.90	1.00	1.20
G	1.50 BSC		
I	3.00 BSC		
J	1.40	1.50	1.60
K	0.34	0.40	0.50
All Dimensions in mm			

GENERAL NOTES

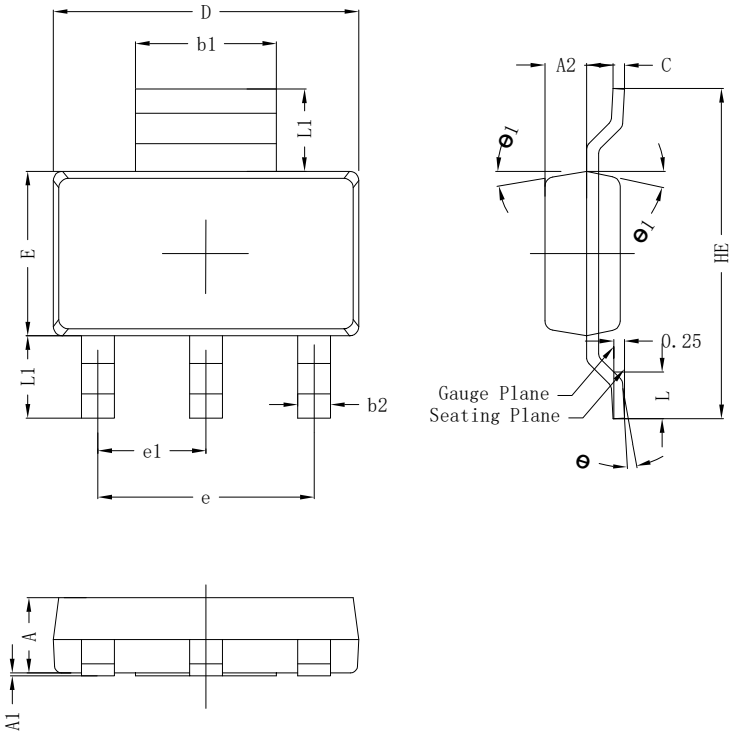
1. Top package surface finish Ra0.4±0.2um
2. Bottom package surface finish Ra0.7±0.2um
3. Side package surface finish Ra0.4±0.2um
4. Protrusion or Gate Burrs shall not exceed 0.10mm per side.

■ RECOMMENDED PAD LAYOUT



SOT89-3	
DIM	(mm)
X	0.80
Y	1.20
X1	0.80
Y1	2.20
X2	2.00
Y2	2.50
C	1.50
Y3	4.70

- **SOT-223 PACKAGE OUTLINE DIMENSIONS**

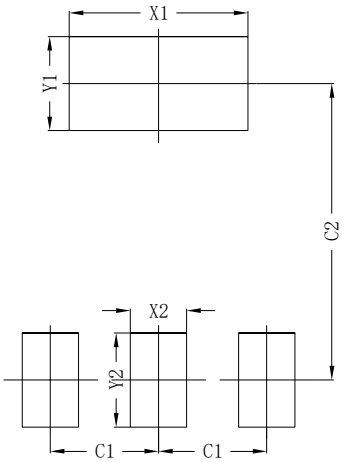


SOT223			
DIM	MIN	NOR	MAX
A	1.50	1.60	1.70
A1	0.00	0.05	0.10
A2	0.80	0.90	1.00
b1	2.90	3.02	3.10
b2	0.60	0.72	0.80
c	0.20	0.27	0.35
D	6.30	6.50	6.70
E	3.30	3.50	3.70
e	4.60BSC		
e1	2.30BSC		
HE	6.80	7.00	7.20
L	0.80	1.00	1.20
L1	1.75(REF)		
θ	0°~8°		
θ 1	8°	10°	12°
All Dimensions in mm			

GENERAL NOTES

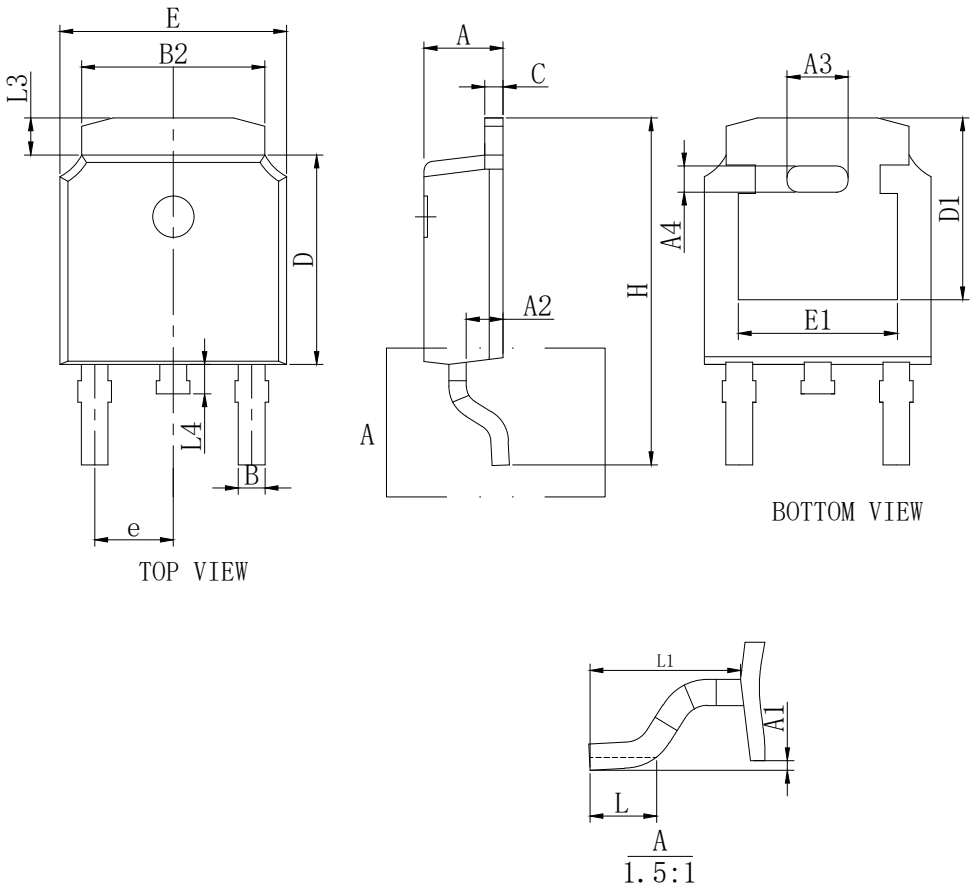
1. Top package surface finish Ra0.4±0.2um
2. Bottom package surface finish Ra0.7±0.2um
3. Side package surface finish Ra0.4±0.2um
4. Protrusion or Gate Burrs shall not exc d 0.10mm per side.

■ RECOMMENDED PAD LAYOUT



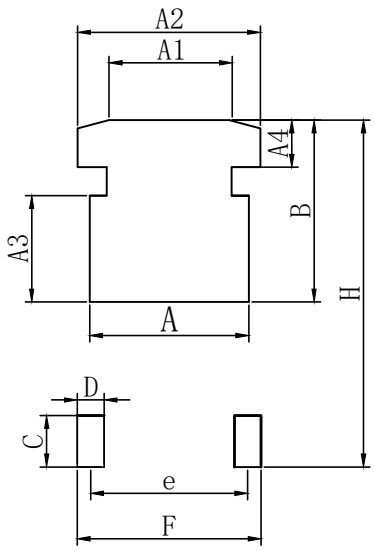
SOT223	
DIM	(mm)
X1	3.80
Y1	2.00
X2	1.20
Y2	2.00
C1	2.30
C2	6.30

- **TO-252 PACKAGE OUTLINE DIMENSIONS**



DIM	MILLIMETERS		
	MIN	NOM	MAX
A	2.15	2.30	2.45
A1	0	-	0.20
A2	0.90	1.07	1.17
A3	1.58	1.78	1.98
A4	0.56	0.76	0.96
B	0.68	0.78	0.88
B2	5.20	5.33	5.46
C	0.49	-	0.58
D	5.90	6.10	6.30
D1	5.30REF		
E	6.40	6.60	6.80
E1	4.63	4.83	5.03
e	2.286BSC		
H	9.8	10.10	10.4
L	1.09	1.29	1.49
L1	2.90REF		
L3	0.88	1.08	1.28
L4	0.55	0.80	1.05

■ RECOMMENDED PAD LAYOUT



DIM	MIN(mm)
A	6.03
A1	4.50
A2	6.46
A3	4.10
A4	2.37
B	6.50
C	2.50
D	1.68
e	4.57(TYP)
H	12.35
F	6.25

■ ORDER INFORMATION APPENDIX

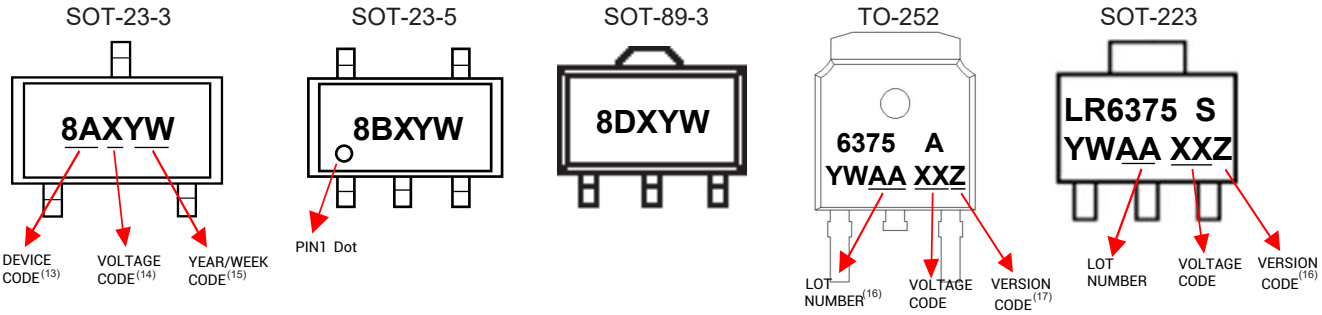
Device(10)	Output Voltage(11)	Package	Marking(12)	Shipping
S-LR6375AxxM	1.8V~5.0V	SOT-23-3	8AX	3K/Reel
S-LR6375AxxMC	1.8V~5.0V	SOT-23-3	8CX	3K/Reel
S-LR6375AxxMY	1.8V~5.0V	SOT-23-3	8YX	3K/Reel
S-LR6375AxxMF	1.8V~5.0V	SOT-23-5	8BX	3K/Reel
S-LR6375AxxMR	1.8V~5.0V	SOT-23-5	8RX	3K/Reel
S-LR6375AxxMH	1.8V~5.0V	SOT-23-5	8HX	3K/Reel
S-LR6375AxxP	1.8V~5.0V	SOT-89-3	8DX	1K/Reel
S-LR6375AxxPL	1.8V~5.0V	SOT-89-3	8LX	1K/Reel
S-LR6375AxxPT	1.8V~5.0V	SOT-89-3	8TX	1K/Reel
S-LR6375AxxP1	1.8V~5.0V	SOT-89-3	8ZX	1K/Reel
S-LR6375AxxS	1.8V~5.0V	SOT-223	LR6375 S	1K/Reel
S-LR6375AxxD	1.8V~5.0V	TO-252(DPAK)	6375 A	2.5K/Reel

(10) The "xx" in part number represents output voltage, eg "18" = 1.8V, "50" = 5.0V.

(11) Output voltage varies from 1.8V to 5.0V, 0.1V an interval.

(12) There are additional marking, which relates to the date code. For detailed information, please refer to MARKING INFORMATION APPENDIX below.

■ MARKING INFORMATION APPENDIX



(13) The first two letters in the Marking represent DEVICE CODE. For TO-252 package, the DEVICE CODE contains five letters. For SOT-223 package, the DEVICE CODE contains seven letters.

(14) The following letter "X" in the Marking changes along with the output voltage, as the chart shows below.

Voltage(V)	···	1.0	1.2	1.5	1.8	2.5	2.7	2.8	3.0	3.3	3.6	4.0	5.0	···
Symbol	···	D	E	F	G	H	I	J	K	L	M	N	P	···

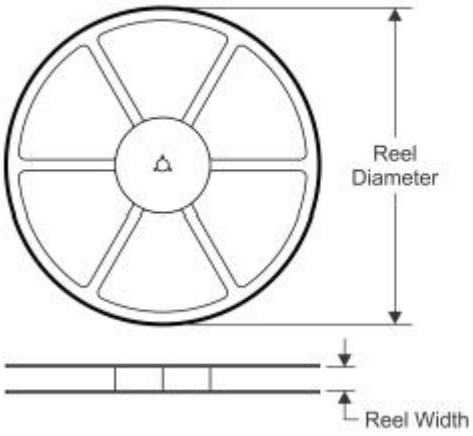
For TO-252 and SOT-223 package, the VOLTAGE CODE is a two-digit number changing along with the output voltage. For example, 18 = 1.8V, 33 = 3.3V, 50 = 5.0V, etc.

(15) The last two letters in the Marking represent YEAR/WEEK CODE.

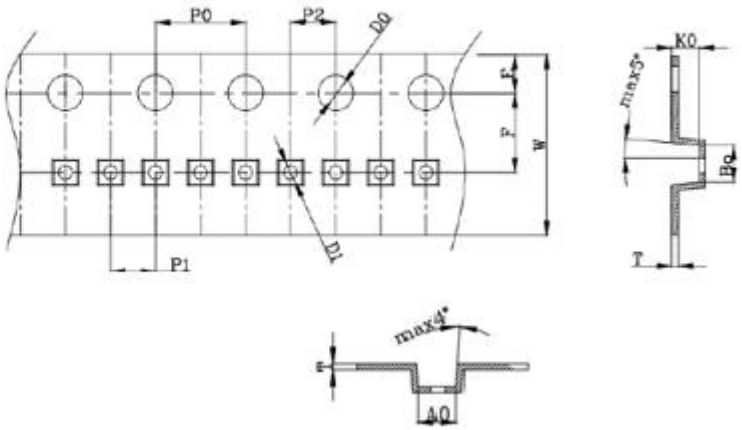
(16)(17) The LOT NUMBER and VERSION CODE are only used for internal production control of the factory.

■ TAPE ANDA REEL INFORMATION

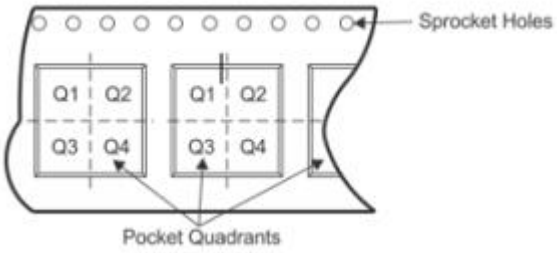
REEL DEMENSIONS



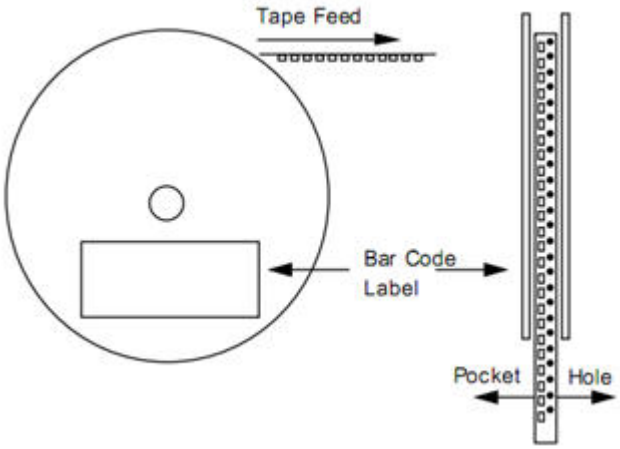
TAPE DEMENSIONS



PIN ORIENTATION



ROLLING ORIENTATION



Device	Package	Reel Diameter (mm)	Reel width (mm)	P0 (mm)	P1 (mm)	A0 (mm)	B0 (mm)	K0 (mm)	W (mm)	PIN1
S-LR6375AxxM	SOT-23-3	178±1	9.6±1.2	4.00±0.1	4.00±0.1	3.1±0.1	3.28±0.1	1.32±0.1	8.0±0.1	NA
S-LR6375AxxMC	SOT-23-3	178±1	9.6±1.2	4.00±0.1	4.00±0.1	3.1±0.1	3.28±0.1	1.32±0.1	8.0±0.1	NA
S-LR6375AxxMY	SOT-23-3	178±1	9.6±1.2	4.00±0.1	4.00±0.1	3.1±0.1	3.28±0.1	1.32±0.1	8.0±0.1	NA
S-LR6375AxxMF	SOT-23-5	178±1	9.6±1.2	4.00±0.1	4.00±0.1	3.25±0.05	3.15±0.05	1.5±0.05	8.0±0.1	Q3
S-LR6375AxxMR	SOT-23-5	178±1	9.6±1.2	4.00±0.1	4.00±0.1	3.25±0.05	3.15±0.05	1.5±0.05	8.0±0.1	Q3
S-LR6375AxxMH	SOT-23-5	178±1	9.6±1.2	4.00±0.1	4.00±0.1	3.25±0.05	3.15±0.05	1.5±0.05	8.0±0.1	Q3
S-LR6375AxxP	SOT-89-3	178±1	$13.0^{+1}_{-0.5}$	4.00±0.1	8.00±0.1	4.75±0.1	4.2±0.1	1.75±0.1	$12.0^{+0.3}_{-0.1}$	NA
S-LR6375AxxPT	SOT-89-3	178±1	$13.0^{+1}_{-0.5}$	4.00±0.1	8.00±0.1	4.75±0.1	4.2±0.1	1.75±0.1	$12.0^{+0.3}_{-0.1}$	NA
S-LR6375AxxPL	SOT-89-3	178±1	$13.0^{+1}_{-0.5}$	4.00±0.1	8.00±0.1	4.75±0.1	4.2±0.1	1.75±0.1	$12.0^{+0.3}_{-0.1}$	NA
S-LR6375AxxP1	SOT-89-3	178±1	$13.0^{+1}_{0.5}$	4.00±0.1	8.00±0.1	4.75±0.1	4.2±0.1	1.75±0.1	$12.0^{+0.3}_{-0.1}$	NA
S-LR6375AxxS	SOT-223	178±1	$13.0^{+1}_{0.5}$	4.00±0.1	8.00±0.1	4.75±0.1	4.2±0.1	1.75±0.1	$12.0^{+0.3}_{-0.1}$	NA

■ REVISION HISOTRY

Version	Description	Update by	Update Date
1.0	LRC ORIGINAL RELEASE.	Wu Jie	2021-10-22
1.1	增加S-LR6375AxxS产品型号和对应的marking 8SX.	Chen S	2022-10-08
1.2	增加产品marking详细说明.	Chen S	2023-02-17
1.3	线性调整上限值由0.3%/V收紧为0.1%/V; S-LR6375AxxS的marking由8SX改为LR6375 S.	Chen S	2023-02-23
1.4	增加S-LR6375AxxMH型号规格以及对应marking 8HX	Chen S	2023-03-08
1.5	增加S-LR6375AxxD产品型号和对应的marking.	Chen S	2023-11-29
1.6	增加TO-252热阻及测试条件.	Chen S	2024-03-28
1.7	增加SOT-89 JL热阻及测试条件.	Chen S	2024-04-12

DISCLAIMER

- Curve guarantee in the specification. The curve of test items with electric parameter is used as quality guarantee. The curve of test items without electric parameter is used as reference only.

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