

36V Low Current Consumption 250mA CMOS Voltage Regulator

LR6375 Series

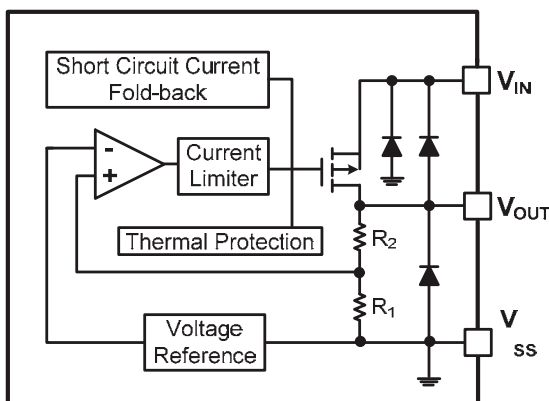
■ INTRODUCTION

The 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 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.

■ APPLICATIONS

- Cordless Phones
- Radio control systems
- Laptop, Palmtops and PDAs
- Single-lens reflex DSC
- PC peripherals with memory

■ BLOCK DIAGRAM



■ FEATURES

- Low Quiescent Current: 1.5μA
- 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: $\pm 2\%/\pm 1\%$ (Typ.)
- High Power Supply Rejection Ratio:
70dB@1kHz
- Low Output Noise:
 $27 \times V_{OUT} \mu V_{RMS}(10Hz \sim 100kHz)$
- Excellent Line and Load Transient Response
- Built-in Current Limiter, Short-Circuit Protection
- Over-Temperature Protection
- Stable with Ceramic or Tantalum Capacitor
- Wireless Communication Equipments
- Portable Audio Video Equipments
- Car Navigation Systems
- LAN Cards
- Ultra Low Power Microcontrolle

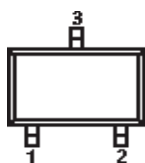
■ ORDERING INFORMATION

LR6375①②③④

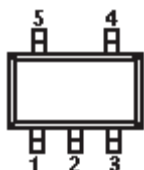
DESIGNATOR	SYMBOL	DESCRIPTION
①	A	Without EN
②	Integer	Output Voltage e.g. 5.0V=50
③	M/MC/MY	Package: SOT-23-3
	MF/MR	Package: SOT-23-5
	P/PT/PL	Package: SOT-89-3
	S	Package: SOT223
	U	Package: DFN3030-8
	D	Package: TO-252
④	-	2% Accuracy
	1	1% Accuracy

PIN CONFIGURATION

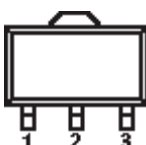
SOT-23-3



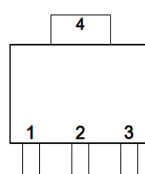
SOT-23-5



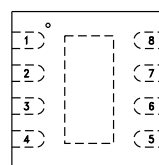
SOT-89-3



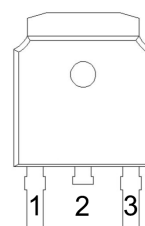
SOT223



DFN3030-8



TO-252



PIN NUMBER							PIN NAME	FUNCTION
SOT-23-3			SOT-89-3			TO-252		
M	MC	MY	P	PT	PL	D		
1	3	3	1	2	2	2	V_{SS}	Ground
2	2	1	3	1	3	3	V_{OUT}	Output
3	1	2	2	3	1	1	V_{IN}	Power input

SOT-23-5

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

SOT223

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

DFN3030-8

PIN NUMBER	NAME	FUNCTION
1	V_{IN}	Power Input
2, 3, 5, 6, 7, and exp. pad	NC	No Connection
4	V_{SS}	Ground
8	V_{OUT}	Output

■ ABSOLUTE MAXIMUM RATINGS⁽¹⁾

(Unless otherwise specified, $T_A=25^{\circ}\text{C}$)

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
	TO-252		1.56	W
Operating Junction Temperature Range ⁽³⁾		T_j	150	$^{\circ}\text{C}$
Storage Temperature		T_{stg}	-65~150	$^{\circ}\text{C}$
Lead Temperature(Soldering, 10 sec)		T_{solder}	260	$^{\circ}\text{C}$
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 may 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.

■ 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	$^{\circ}\text{C}$
Operating free air temperature range, T_A	-40		85	$^{\circ}\text{C}$

■ THERMAL CHARACTERISTICS

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

(5) $R_{\theta JL}$ 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) $R_{\theta JC}$ test point is at the center position of the metal pad under the plastic encapsulation.

■ ELECTRICAL CHARACTERISTICS

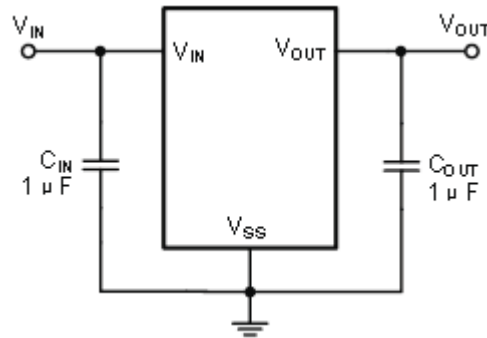
LR6375 Series ($V_{IN}=V_{OUT}+2V$, $C_{IN}=C_{OUT}=1\mu F$, $T_A=25^\circ C$, unless otherwise specified)

PARAMETER	SYMBOL	CONDITIONS	MIN.	TYP. ⁽⁵⁾	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}	$I_{OUT}=0A$, $2.1V \leq V_{OUT} \leq 5.0V$	1.5	2	5	μA
		$I_{OUT}=0A$, $5.0V < V_{OUT} \leq 12.0V$	1.5	5	10	μA
Line Regulation	$\frac{\Delta V_{OUT}}{V_{OUT} \times \Delta V_{IN}}$	$I_{OUT}=10mA$ $V_{OUT}+1V \leq V_{IN} \leq 36V$	-0.1	0.01	0.1	%/V
Load Regulation	ΔV_{OUT}	$V_{IN}=V_{OUT}+2V$, $1mA \leq I_{OUT} \leq 100mA$	-40	10	40	mV
Temperature Coefficient	$\frac{\Delta V_{OUT}}{V_{OUT} \times \Delta T_A}$	$I_{OUT}=40mA$, $-40^\circ C < T_A < 85^\circ C$	—	50	500	ppm/ $^\circ C$
Output Current Limit	I_{LIM}	$V_{OUT}=0.5 \times V_{OUT(Normal)}$	250	350	500	mA
Short Current	I_{SHORT}	$V_{OUT}=V_{SS}$	—	25	50	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	—	$27 \times V_{OUT}$	—	μV_{RMS}
Thermal Shutdown Temperature	T_{SD}	$I_{LOAD}=30mA$	—	160	—	$^\circ C$
Thermal Shutdown Hysteresis	ΔT_{SD}	—	—	20	—	$^\circ C$

(8) Typical numbers are at $25^\circ C$ 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

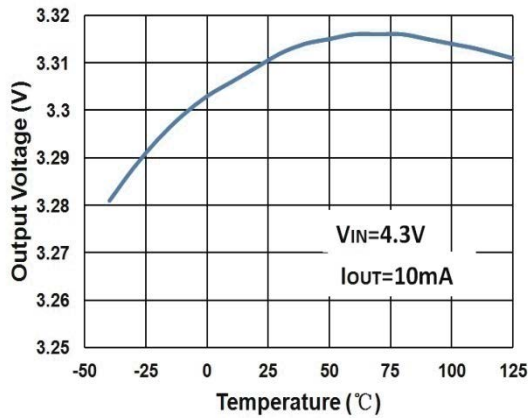
Selection of Input/ Output Capacitors

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

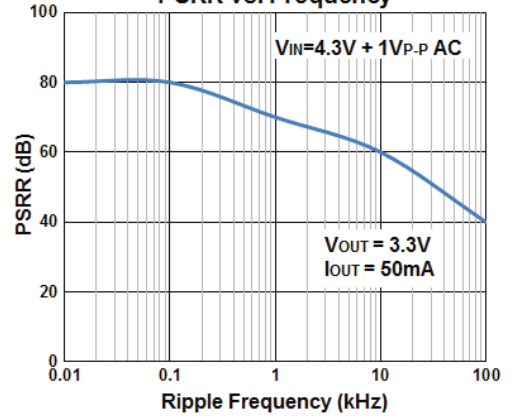
A recent trend in the design of portable devices has been to use ceramic capacitors to filter DC-DC converter inputs. Ceramic capacitors are often chosen because of their small size, low equivalent series resistance (ESR) and high RMS current capability. Also, recently, designers have been looking to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

TYPICAL PERFORMANCE CHARACTERISTICS

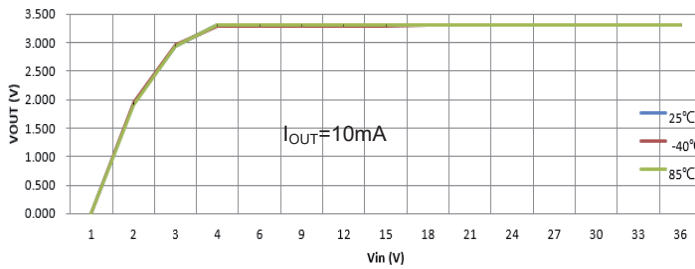
Output Voltage vs. Temperature



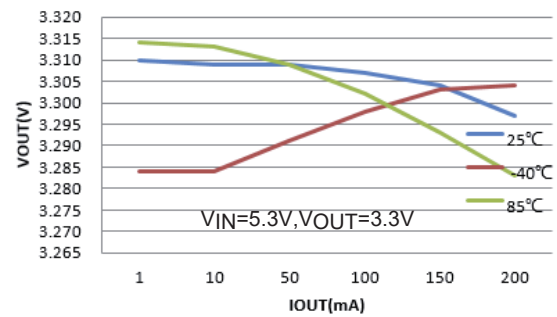
PSRR vs. Frequency



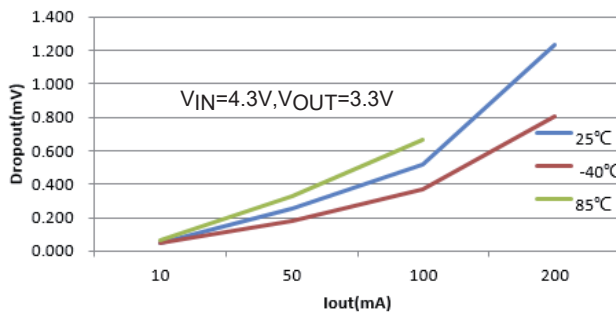
Line Regulation



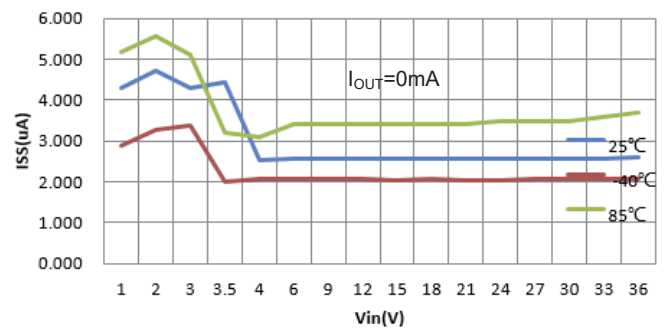
Load Regulation



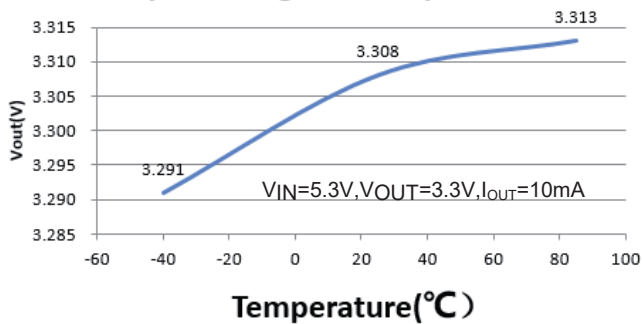
Dropout Voltage vs. Output Current



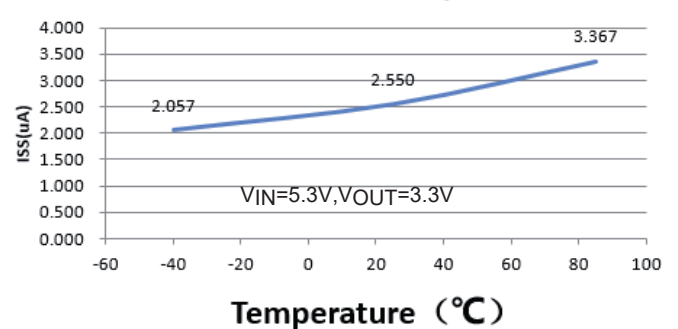
Ground Pin Current vs. Input Voltage



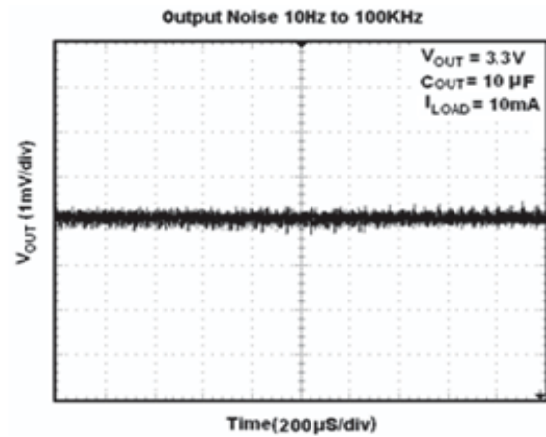
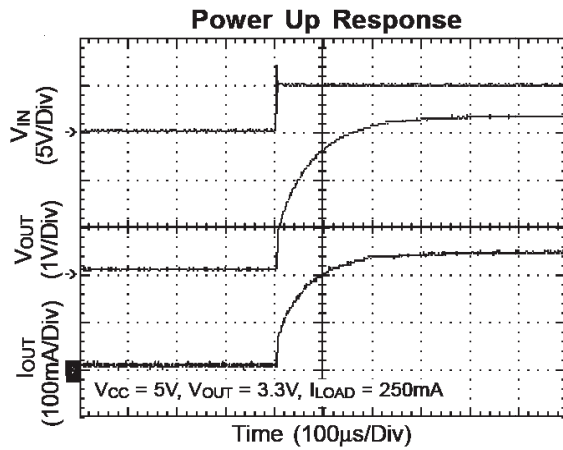
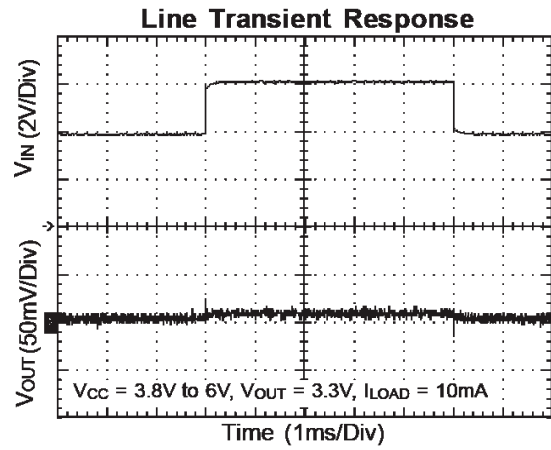
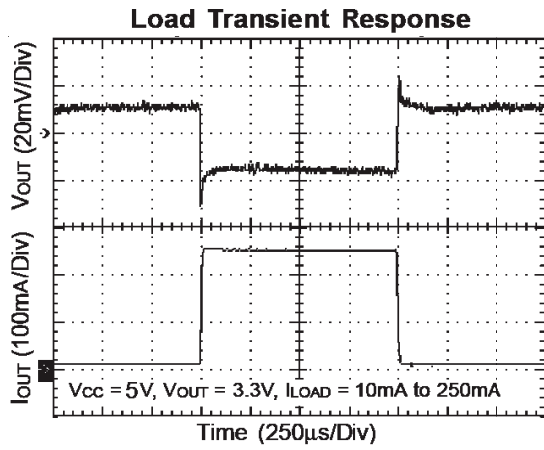
Output Voltage vs. Temperature



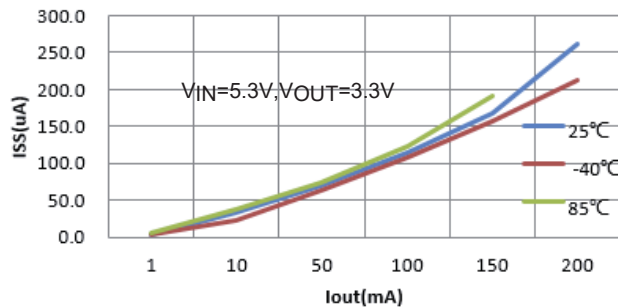
Ground Current vs. Temperature



■ TYPICAL PERFORMANCE CHARACTERISTICS

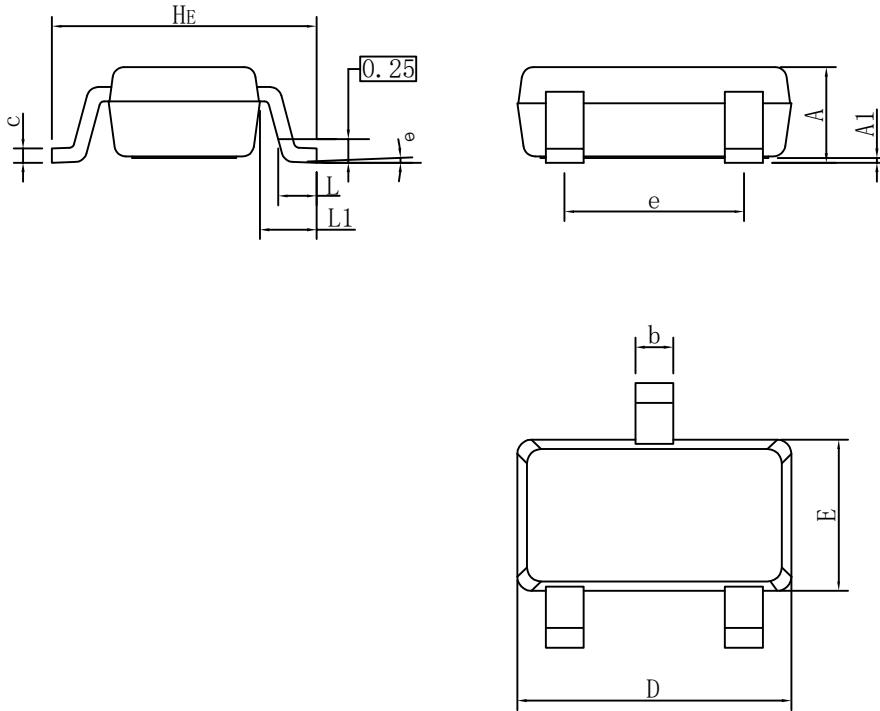


Ground Pin Current vs. Load Current



■ PACKAGING INFORMATION

• SOT-23-3 PACKAGE OUTLINE DIMENSIONS

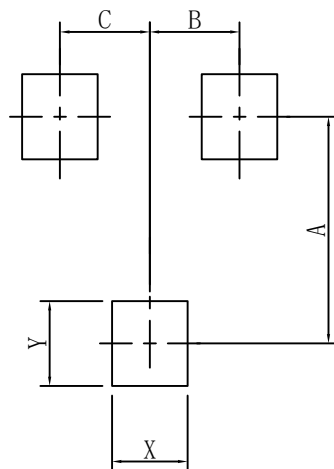


SOT23LC			
DIM	MIN	NOR	MAX
A	0.90	1.00	1.10
A1	0.01	0.06	0.10
b	0.30	0.40	0.50
c	0.10	0.17	0.20
D	2.80	2.90	3.00
E	1.50	1.60	1.70
e	1.80	1.90	2.00
L	0.20	0.40	0.60
L1	0.60REF		
HE	2.60	2.80	3.00
θ	0°	-	10°
All Dimensions in mm			

GENERAL NOTES

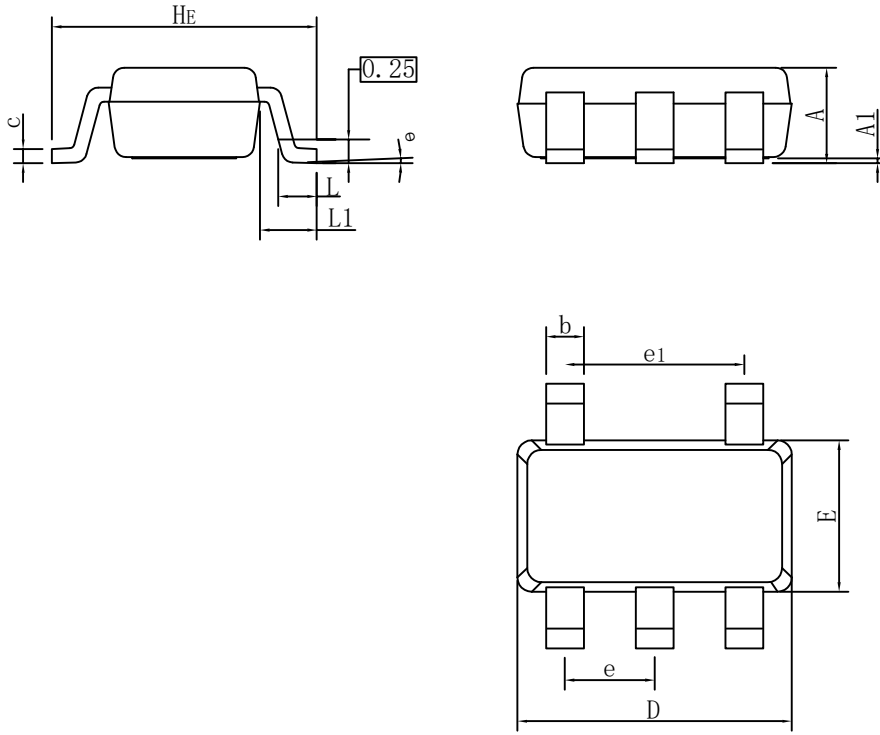
- 1.Top package surface finish $Ra0.4\pm0.2\mu m$
- 2.Bottom package surface finish $Ra0.7\pm0.2\mu m$
- 3.Side package surface finish $Ra0.4\pm0.2\mu m$

■ 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**

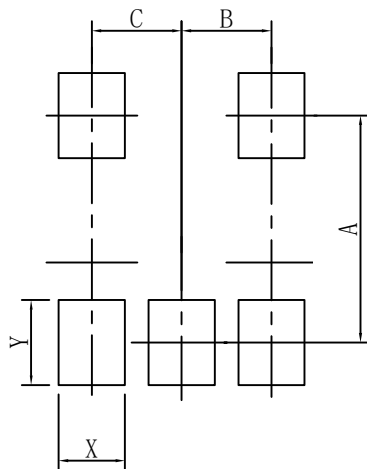


SOT25			
DIM	MIN	NOR	MAX
A	0.90	1.00	1.10
A1	0.01	0.06	0.10
b	0.30	0.40	0.50
c	0.10	0.17	0.20
D	2.80	2.90	3.00
E	1.50	1.60	1.70
e	0.85	0.95	1.05
e1	1.80	1.90	2.00
L	0.20	0.40	0.60
L1	0.60REF		
HE	2.60	2.80	3.00
θ	0°	-	10°

GENERAL NOTES

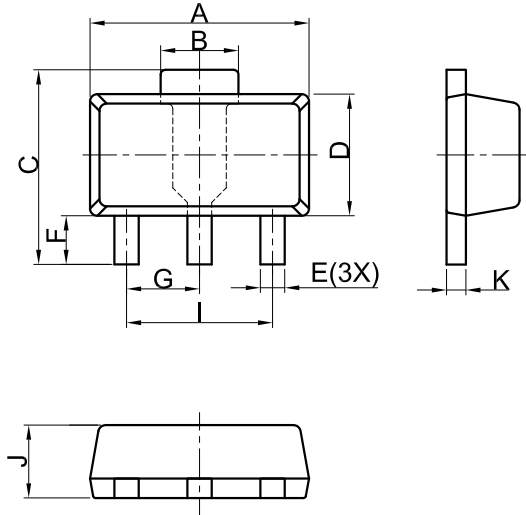
- 1.Top package surface finish $Ra0.4\pm0.2\mu m$
- 2.Bottom package surface finish $Ra0.7\pm0.2\mu m$
- 3.Side package surface finish $Ra0.4\pm0.2\mu m$

■ **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

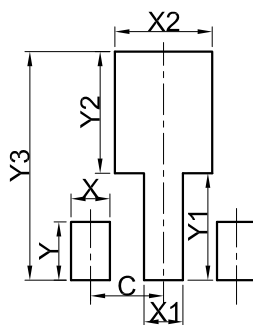


SOT89			
DIM	MIN	NOR	MAX
A	4.30	4.50	4.70
B	1.40	1.60	1.80
C	3.90	4.00	4.25
D	2.30	2.50	2.70
E	0.40	0.50	0.58
F	0.90	1.00	1.20
G	1.50 BSC		
I	3.00 BSC		
J	1.40	1.50	1.60
K	0.34	0.40	0.50
All Dimensions in mm			

GENERAL NOTES

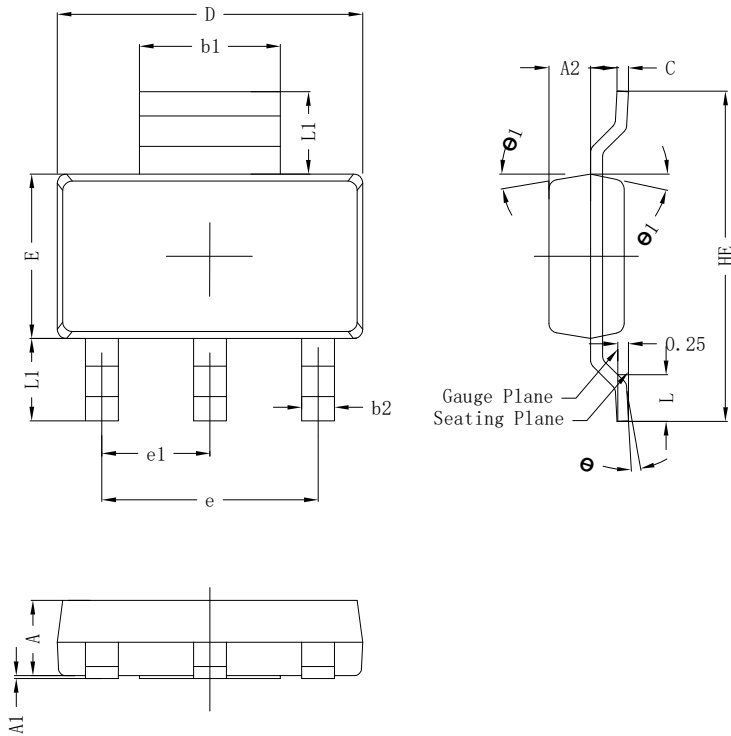
1. Top package surface finish $Ra0.4\pm0.2\mu m$
2. Bottom package surface finish $Ra0.7\pm0.2\mu m$
3. Side package surface finish $Ra0.4\pm0.2\mu m$
4. Protrusion or Gate Burrs shall not exceed 0.10mm per side.

■ 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

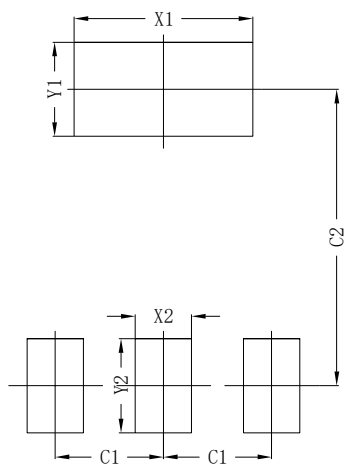


SOT223			
DIM	MIN	NOR	MAX
A	1.50	1.60	1.70
A1	0.00	0.05	0.10
A2	0.80	0.90	1.00
b1	2.90	3.02	3.10
b2	0.60	0.72	0.80
c	0.20	0.27	0.35
D	6.30	6.50	6.70
E	3.30	3.50	3.70
e	4.60BSC		
e1	2.30BSC		
HE	6.80	7.00	7.20
L	0.80	1.00	1.20
L1	1.75(REF)		
θ	0°~8°		
θ 1	8°	10°	12°
All Dimensions in mm			

GENERAL NOTES

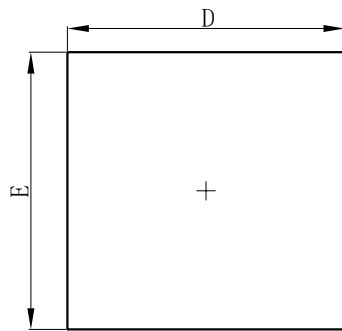
1. Top package surface finish $Ra0.4 \pm 0.2\mu m$
2. Bottom package surface finish $Ra0.7 \pm 0.2\mu m$
3. Side package surface finish $Ra0.4 \pm 0.2\mu m$
4. Protrusion or Gate Burrs shall not exceed 0.10mm per side.

■ RECOMMENDED PAD LAYOUT

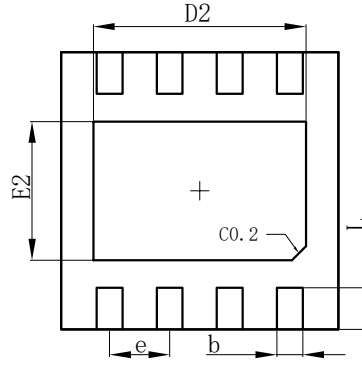


SOT223	
DIM	(mm)
X1	3.80
Y1	2.00
X2	1.20
Y2	2.00
C1	2.30
C2	6.30

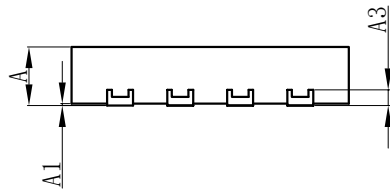
• DFN3030-8 PACKAGE OUTLINE DIMENSIONS



TOP VIEW



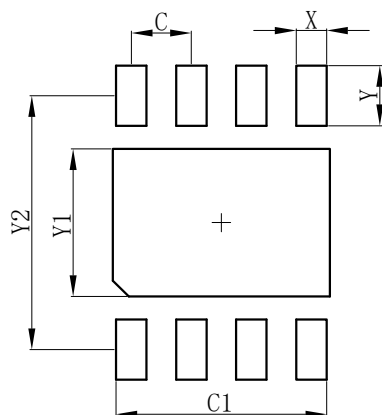
BOTTOM VIEW



SIDE VIEW

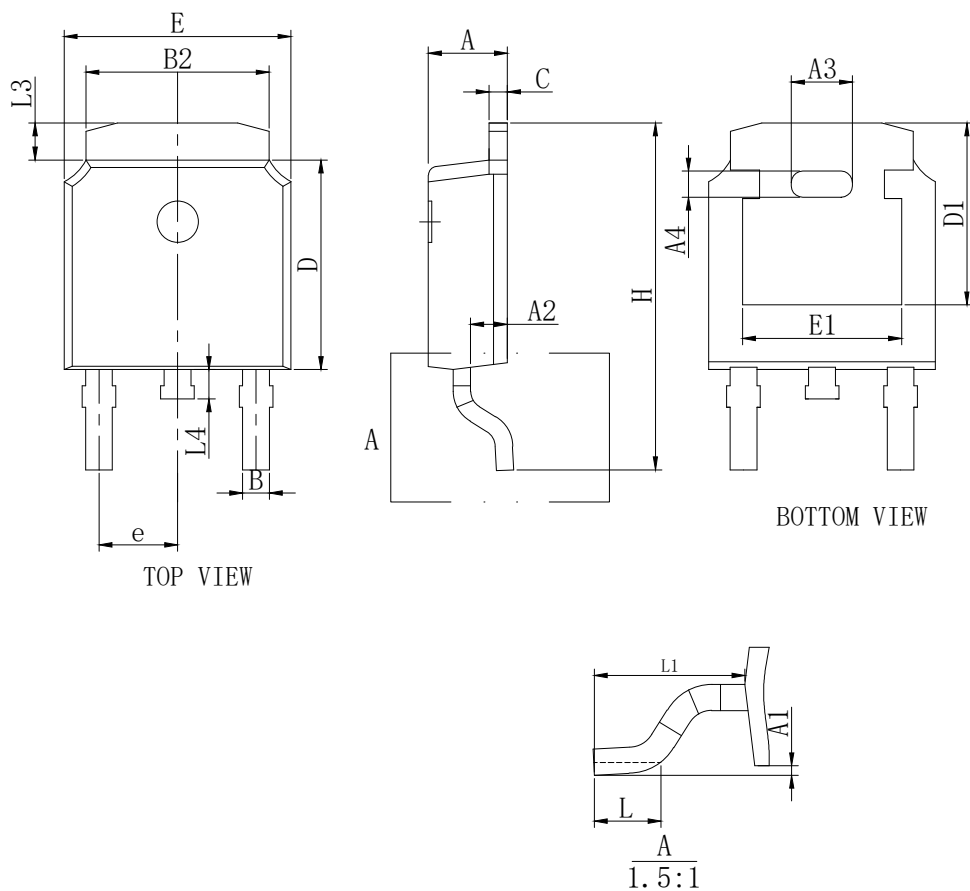
DFN3030-8A			
Dim	Min	Typ	Max
D	2.95	3.00	3.05
E	2.95	3.00	3.05
e	—	0.65	—
L	0.40	0.45	0.50
b	0.23	0.28	0.33
A	0.60	0.65	0.70
A1	0	0.02	0.05
A3	—	0.152	—
E2	1.45	1.50	1.55
D2	2.25	2.30	2.35
All Dimensions in mm			

■ RECOMMENDED PAD LAYOUT



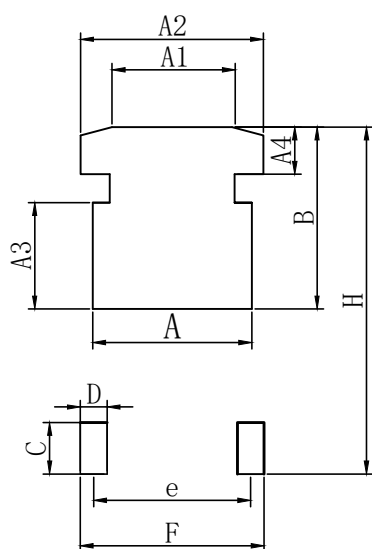
Dimensions	(mm)
C	0.65
C1	2.28
X	0.33
Y	0.65
Y1	1.60
Y2	2.75

• 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)
F	6.25

■ ORDER INFORMATION APPENDIX

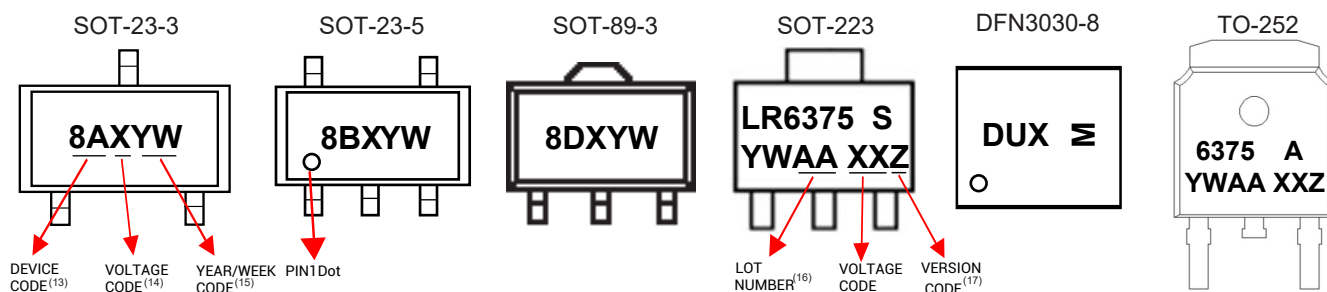
Device ⁽¹⁰⁾	Output Voltage ⁽¹¹⁾	Package	Marking ⁽¹²⁾	Shipping
LR6375AxxM	1.8V~5.0V	SOT-23-3	8AX	3K/Reel
LR6375AxxMC	1.8V~5.0V	SOT-23-3	8CX	3K/Reel
LR6375AxxMY	1.8V~5.0V	SOT-23-3	8YX	3K/Reel
LR6375AxxMF	1.8V~5.0V	SOT-23-5	8BX	3K/Reel
LR6375AxxMR	1.8V~5.0V	SOT-23-5	8RX	3K/Reel
LR6375AxxP	1.8V~5.0V	SOT-89-3	8DX	5K/Reel
LR6375AxxPL	1.8V~5.0V	SOT-89-3	8LX	5K/Reel
LR6375AxxPT	1.8V~5.0V	SOT-89-3	8TX	5K/Reel
LR6375AxxP1	1.8V~5.0V	SOT-89-3	8ZX	5K/Reel
LR6375AxxPT1	1.8V~5.0V	SOT-89-3	8UX	5K/Reel
LR6375AxxS	1.8V~5.0V	SOT-223	LR6375 S	4K/Reel
LR6375AxxU	1.8V~5.0V	DFN3030-8	DUX	3K/Reel
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 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	3.0(1%)	3.3	3.3(1%)	3.6	4.0	5.0	5.0(1%)	12	...
Symbol	...	D	E	F	G	H	I	J	K	B	L	Q	M	N	P	m	S	...

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.

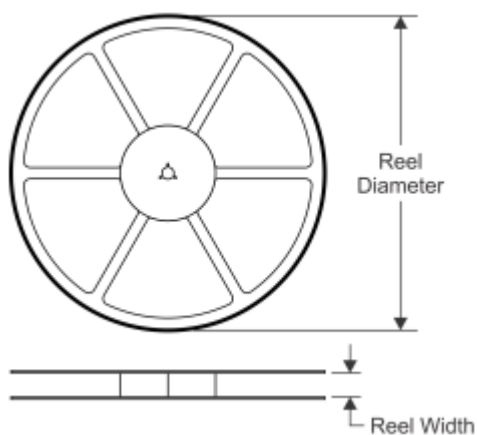
(15) The last two letters in the Marking represent YEAR/WEEK CODE.

For DFN3030-8 packages, the YEAR/WEEK CODE has only one letter (Rotated 90° CCW).

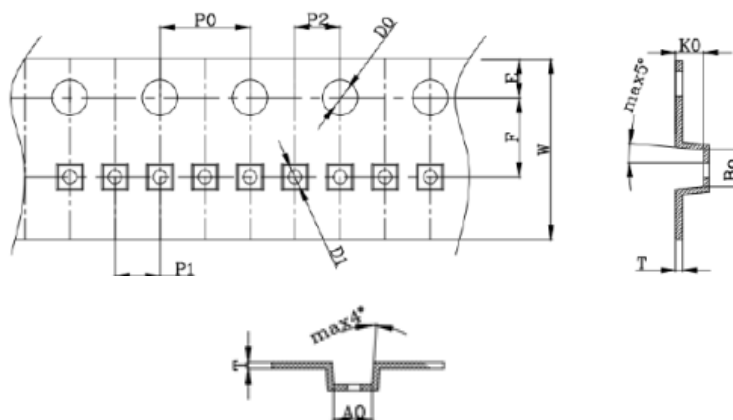
(16)(17) The LOT NUMBER and VERSION CODE are only used for internal production control of the factory.

■ TAPE AND REEL INFORMATION

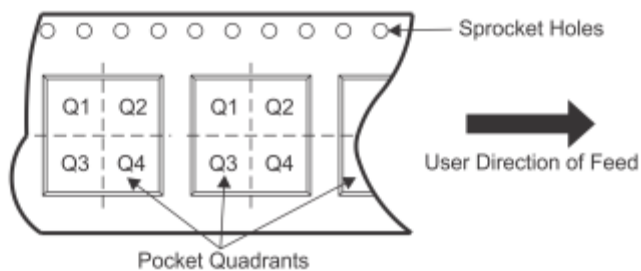
REEL DIMENSIONS



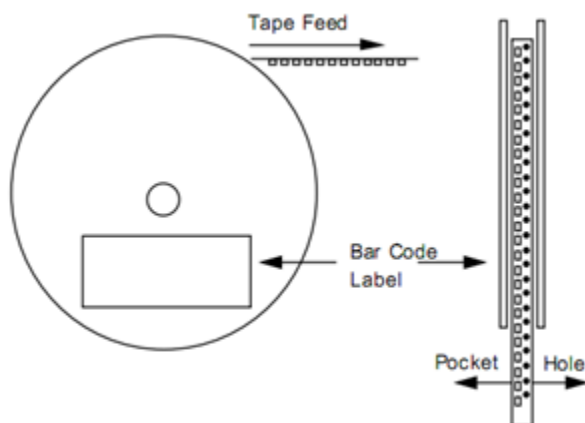
TAPE DIMENSIONS



QUADRANT ASSIGNMENTS FOR PIN 1 ORIENTATION IN TAPE



ROLLING ORIENTATION



Device	Package	Reel Diameter (mm)	Reel width (mm)	P0 (mm)	P1 (mm)	A0 (mm)	B0 (mm)	K0 (mm)	W (mm)	PIN1
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
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
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
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
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

■ REVISION HISTORY

Version	Description	Update by	Update Date
1.3	增加产品marking详细说明, LR6375AxxS的marking由8SX改为LR6375 S, 线性调整上限值由0.3%/V收紧为0.1%/V。	Chen S	2023-01-10
1.4	增加LR6375AxxPT1产品型号和对应的marking 8UX, 增加LR6375AxxU产品型号,POD和对应marking DUX。	Chen S	2023-06-22
1.5	更新关于应用描述中的电容选型描述。	Xia SS	2023-11-03
1.6	更新料号信息中的电压点描述。	Chen S	2023-11-20
1.7	增加LR6375AxxD产品型号, POD和对应marking。	Chen S	2024-03-21
1.8	增加SOT-89 TO-252 JL热阻及测试条件。	Chen S	2024-04-12
1.9	增加TO-252 Power Dissipation 1.56W.	Chen S	2024-05-21
2.0	SOT89包装数量由1K/卷更新为5K/卷. SOT223包装数量由1K/卷更新为4K/卷	Chen S	2024-08-26

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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