300mA Low Power LDO

1 FEATURES

- **Low Quiescent Current I_Q:**
  3μA Typical at Light Loads
- **300mA Output Current**
- **Low Dropout Voltage**
- **Low Temperature Coefficient**
- **High Input Voltage (up to 45V)**
- **Output Voltage Accuracy: ±2%**
- **Fixed 1.8 V, 2.5 V, 3.0 V, 3.3 V, 3.6 V and 5 V Output Voltage**
- **Over temperature protection and over-current protection function**
- **Micro Size Packages: SOT23-3, SOT89-3 (L-Type)**

2 APPLICATIONS

- **Smart Power Network Equipment**
- **Portable Power Tools**
- **BMS Systems**
- **Motor Control System/Industrial Control System**
- **Power Meter/Instrument**
- **Vehicle-Mounted System**
- **Firefighting / Security Equipment**
- **Consumer Products**

3 DESCRIPTIONS

The RS73xx-1 series is a set of low dropout linear regulators implemented in CMOS technology. Which can provide 300mA output current. The device allows input voltage as high as 45V. It is very suitable for multicell battery systems, bus voltage power supply systems and other high DC voltage systems. Wide input voltage can make it well withstand the impact of surge voltage and ensure the stability of output voltage.

The RS73xx-1 series only 3μA (typical) current is consumed by itself, which is especially important in multi-battery power supply systems and can reduce the standby power consumption of the whole system.

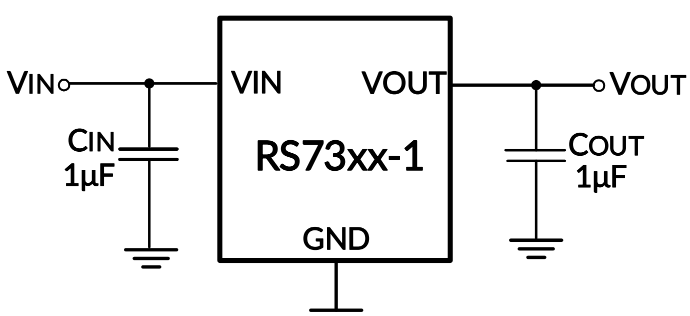
The RS73xx-1 is available in Green SOT23-3 and SOT89-3 (L-Type) packages. Meet the requirements of dissipative power for different applications.

Device Information (1)

PART NUMBER	PACKAGE	BODY SIZE(NOM)
RS73xx-1	SOT23-3	1.60mm×2.92mm
	SOT89-3	2.45mm×4.50mm

(1) For all available packages, see the orderable addendum at the end of the data sheet.

4 TYPICAL APPLICATION SCHEMATIC



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5 REVISION HISTORY

Note: Page numbers for previous revisions may different from page numbers in the current version.

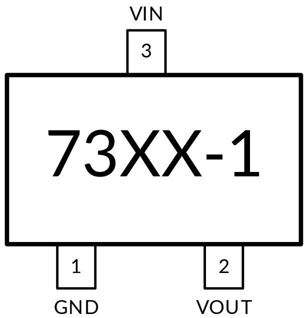
Version	Change Date	Change Item
A.4	2024/03/07	(1) Change SOT23-3 and SOT89-3 (L-Type) Thermal Information on Page 4 @A.3 Version. (2) Add the TAPE AND REEL INFORMATION (3) Modify packaging naming
A.5	2024/06/03	1. Add MSL on Page 5@RevA.4 2. Add Package thermal impedance on Page 4@RevA.4 3. Update PACKAGE note

6 PACKAGE/ORDERING INFORMATION [1]

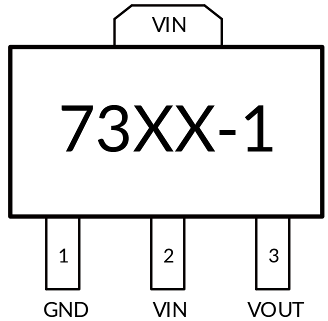
PRODUCT	ORDERING NUMBER	V_{OUT}(V)	PACKAGE LEAD	PACKAGE MARKING [2]	MSL [3]	PACKAGE OPTION
RS7318-1	RS7318-1YF3	1.8	SOT23-3	7318	MSL3	Tape and Reel, 3000
	RS7318-1YE3L	1.8	SOT89-3(L-Type)	7318	MSL3	Tape and Reel, 1000
RS7325-1	RS7325-1YF3	2.5	SOT23-3	7325	MSL3	Tape and Reel, 3000
	RS7325-1YE3L	2.5	SOT89-3(L-Type)	7325	MSL3	Tape and Reel, 1000
RS7330-1	RS7330-1YF3	3.0	SOT23-3	7330	MSL3	Tape and Reel, 3000
	RS7330-1YE3L	3.0	SOT89-3(L-Type)	7330	MSL3	Tape and Reel, 1000
RS7333-1	RS7333-1YF3	3.3	SOT23-3	7333	MSL3	Tape and Reel, 3000
	RS7333-1YE3L	3.3	SOT89-3(L-Type)	7333	MSL3	Tape and Reel, 1000
RS7336-1	RS7336-1YF3	3.6	SOT23-3	7336	MSL3	Tape and Reel, 3000
	RS7336-1YE3L	3.6	SOT89-3(L-Type)	7336	MSL3	Tape and Reel, 1000
RS7350-1	RS7350-1YF3	5.0	SOT23-3	7350	MSL3	Tape and Reel, 3000
	RS7350-1YE3L	5.0	SOT89-3(L-Type)	7350	MSL3	Tape and Reel, 1000

NOTE:
(1) This information is the most current data available for the designated devices. This data is subject to change without notice and revision of this document. For browser-based versions of this data sheet, refer to the right-hand navigation.
(2) There may be additional marking, which relates to the lot trace code information (data code and vendor code), the logo or the environmental category on the device.
(3) MSL, The Moisture Sensitivity Level rating according to the JEDEC industry standard classifications.

7 PIN CONFIGURATION AND FUNCTIONS



SOT23-3



SOT89-3(L-Type)

NOTE: XX indicate Output Voltage, xx indicate Date Code
For example: 7333-1(V_{OUT}=3.3V)

PIN DESCRIPTION

NAME	PIN		FUNCTION
	SOT23-3	SOT89-3(L-Type)	
GND	1	1	Ground.
VOUT	2	3	Output Pin. Recommended output capacitor range: 1μF to 10μF.
VIN	3	2	Input Pin. At least 1μF supply bypass capacitor is recommended.
EN	/	/	Enable Pin. EN pin voltage is higher than V_{EN}(H) enable output and lower than V_{EN} (L) close output.
NC	/	/	No connection

8 SPECIFICATIONS

8.1 Absolute Maximum Ratings

over operating free-air temperature range (unless otherwise noted) (1) (2)

			MIN	MAX	UNIT
V_{IN}	Input voltage		-0.3	48	V
V_{EN}	V_{EN} voltage range		-0.3	V_{IN}	V
θ_{JA}	Package thermal impedance (3)	SOT23-3		315	°C/W
		SOT89-3(L-Type)		210	
T_J	PN Junction temperature (4)		-40	175	°C
P_D	Continuous power dissipation (5)		Internal thermal protection temperature limit		W
T_{stg}	Storage temperature range		-55	150	°C

(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 the GND pin.
(3) The package thermal impedance is calculated in accordance with JESD-51.
(4) The maximum power dissipation is a function of $T_{J(MAX)}$, $R_{\theta JA}$, and T_A. The maximum allowable power dissipation at any ambient temperature is $P_D = (T_{J(MAX)} - T_A) / R_{\theta JA}$. All numbers apply for packages soldered directly onto a PCB.
(5) Internal thermal shutdown circuitry protects the device from permanent damage. The actual chip output current is subject to the input-output voltage difference, ambient temperature and PCB heat dissipation design.

8.2 ESD Ratings

The following ESD information is provided for handling of ESD-sensitive devices in an ESD protected area only.

			VALUE	UNIT
$V_{(ESD)}$	Electrostatic discharge	Human-Body Model (HBM)	±4000	V
		Charge Device Model (CDM)	±1500	V

ESD SENSITIVITY CAUTION

ESD damage can range from subtle performance degradation to complete device failure. Precision integrated circuits may be more susceptible to damage because very small parametric changes could cause the device not to meet its published specifications.

8.3 Recommended Operating Conditions

over operating free-air temperature range (unless otherwise noted) (1)

		MIN	MAX	UNIT
V_{IN}	Input supply voltage	2.5	45	V
I_{OUT}	Output current	0	300	mA
C_{IN}	Input pin capacitance	1	10	µF
C_{OUT}	Output pin capacitance	1	10	µF
ESR	Capacitance equivalent resistance	5	100	mΩ
T_A	Operating temperature	-40	+85 (2)	°C

(1) All voltage is with respect to the GND pin.
(2) The operating temperature of the actual chip depends on the PN junction temperature. Please refer to the detailed calculation method in the application precautions section.

8.4 Electrical Characteristics

(V_{IN} = V_{OUT} + 2V, C_{IN} = C_{OUT} = 1μF, Full = -40°C to +85°C, typical values are at T_A = +25°C, unless otherwise noted.)

PARAMETER	SYMBOL	CONDITIONS	TEMP	MIN (2)	TYP (3)	MAX (2)	UNITS
Input Voltage (1)	V_{IN}		+25°C	2.5 (1)		45	V
Output Voltage Accuracy		I_{OUT} = 10mA	+25°C	-2.0		2.0	%
Static Power Consumption	I_Q	I_{OUT} = 0mA	+25°C		3.0	4.0	μA
Shutdown Current	$I_{Q\text{-}OFF}$	V_{EN} =0V	+25°C		0.1	1.0	μA
Output Current (4)			+25°C	300	350	-	mA
Dropout Voltage (5)	V_{DROP} I_{OUT} = 100mA	V_{OUT} =1.8V	+25°C	-	450	550	mV
		V_{OUT} =2.5V		-	385	485	
		V_{OUT} =3.0V		-	350	450	
		V_{OUT} =3.3V		-	335	435	
		V_{OUT} =5.0V		-	300	400	
Line Regulation	$\frac{\Delta V_{OUT}}{\Delta V_{IN} \times V_{OUT}}$	V_{IN} = V_{OUT} + 2V to 36V, I_{OUT} = 1mA	+25°C	-	0.05	0.2	%/V
Load Regulation	ΔV_{OUT}	V_{IN} =V_{OUT}+1V, I_{OUT} = 1mA to 50mA	+25°C	-	5	20	mV
Output Limiting Current	I_LMT	V_{IN} =V_{OUT}+1V	+25°C	300	450	-	mA
Short-Circuit Current	I_{short}	V_{OUT} = 0	+25°C	-	100	-	mA
Power Supply Rejection Ratio	PSRR	V_{OUT} = 3.3V, I_{OUT} = 10mA, f = 217Hz	+25°C	-	72	-	dB
		f = 1KHz		-	77	-	
		f = 10KHz		-	60	-	
Enable Pin Threshold	V_{ENH}		+25°C	1.2	-	-	V
	V_{ENL}			-	-	0.4	V
Output Voltage Temperature Coefficient (6)	$\frac{\Delta V_{OUT}}{\Delta T_A \times V_{OUT}}$	I_{OUT} = 1mA	FULL	-	100	-	ppm/°C
Output Noise Voltage	e_n	V_{IN} =V_{OUT}+1V, I_{OUT} =1mA, V_{OUT}=3.0V, f = 10Hz to 100KHz		-	100	-	μVrms
Thermal Shutdown Temperature	T_{SHDN}			-	170	-	°C
Thermal Shutdown Hysteresis Temperature	T_{SDH}			-	20	-	°C

NOTES:

(1) V_{IN} = $V_{OUT\ (NOMINAL)}$ or 2.5V, or higher voltage.

(2) Limits are 100% production tested at 25°C. Limits over the operating temperature range are ensured through correlations using statistical quality control (SQC) method.

(3) Typical values represent the most likely parametric norm as determined at the time of characterization. Actual typical values may vary over time and will also depend on the application and configuration.

(4) The maximum output current of the actual chip is subject to PCB heat dissipation design, input voltage, output voltage difference and ambient temperature.

(5) Under the condition of V_{IN} = V_{OUT} + 2V and a fixed load, the output voltage decreases by 2%. At this time, the input voltage minus the output voltage is the dropout voltage.

(6) Output voltage temperature coefficient is defined as the worst-case voltage change divided by the total temperature range.

8.5 Typical Characteristics

NOTE: The graphs and tables provided following this note are a statistical summary based on a limited number of samples and are provided for informational purposes only.

(V_{IN} = V_{OUT} + 2V, C_{IN} = C_{OUT} = 1μF, V_{OUT} = 3.3V, typical values are at T_A = +25°C, unless otherwise noted.)

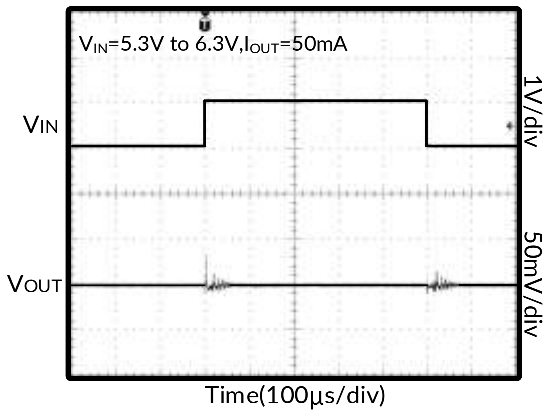


Figure 1. Line Transient Response

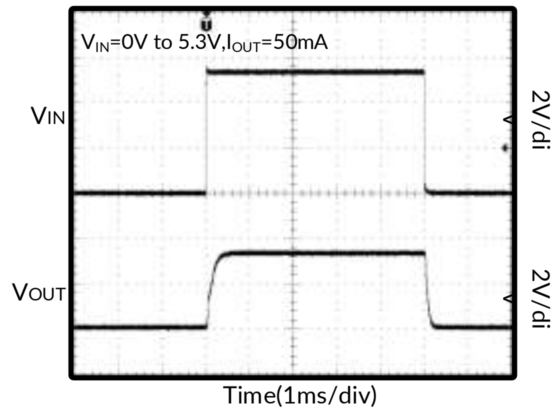


Figure 2. Power-Up/Power-Down Output Waveform

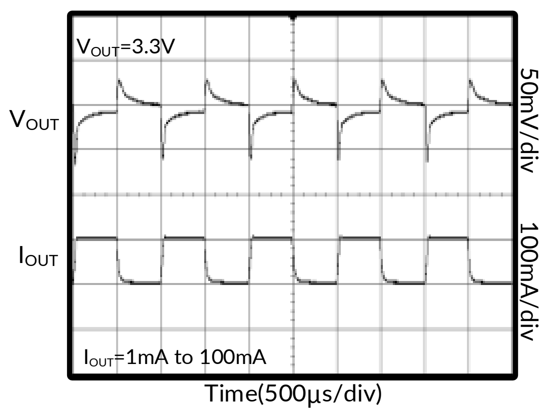


Figure 3. Load Transient Response

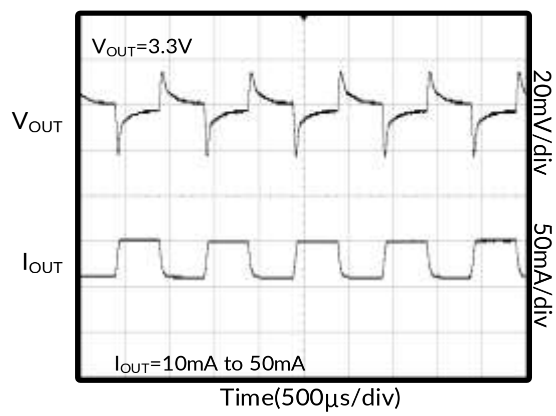


Figure 4. Load Transient Response

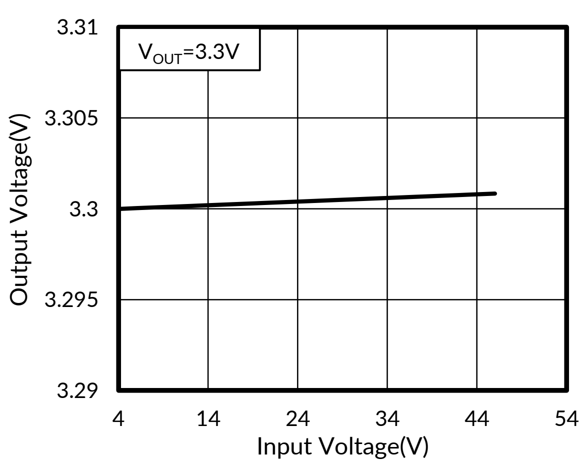


Figure 5. Line Regulation

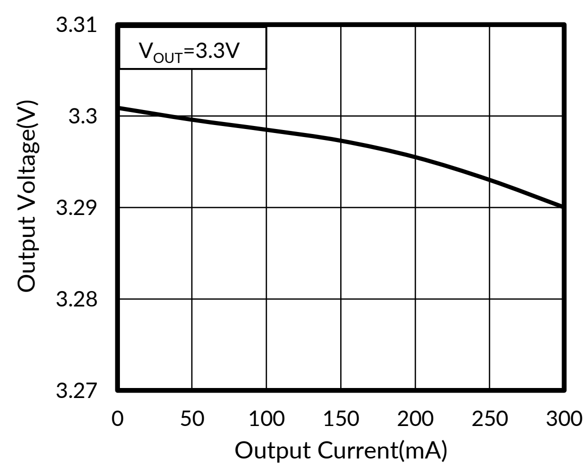


Figure 6. Load Regulation

Typical Characteristics (Continued)

NOTE: The graphs and tables provided following this note are a statistical summary based on a limited number of samples and are provided for informational purposes only.

(V_{IN} = V_{OUT} + 2V, C_{IN} = C_{OUT} = 1µF, V_{OUT} = 3.3V, typical values are at T_A = +25°C, unless otherwise noted.)

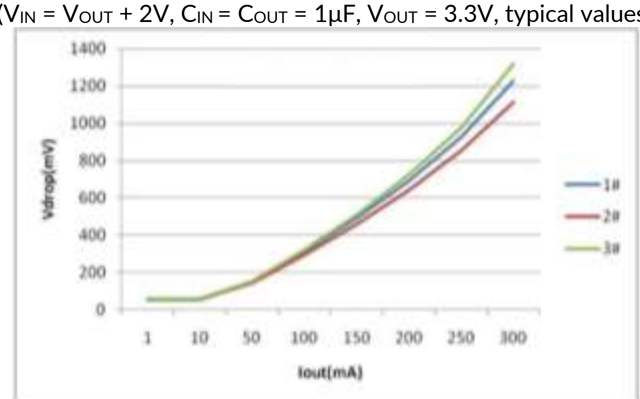


Figure 7. Vdrop vs Iout

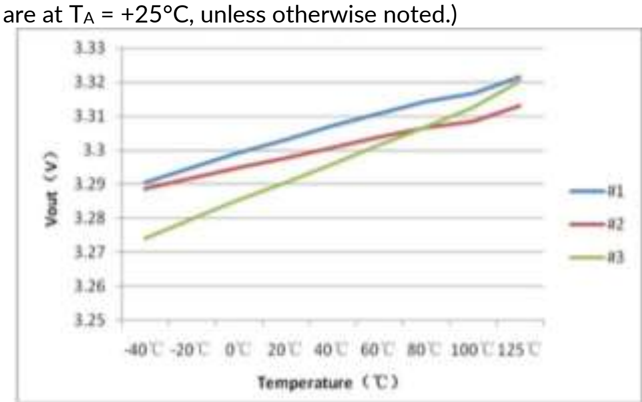


Figure 8. Vout vs Temperature

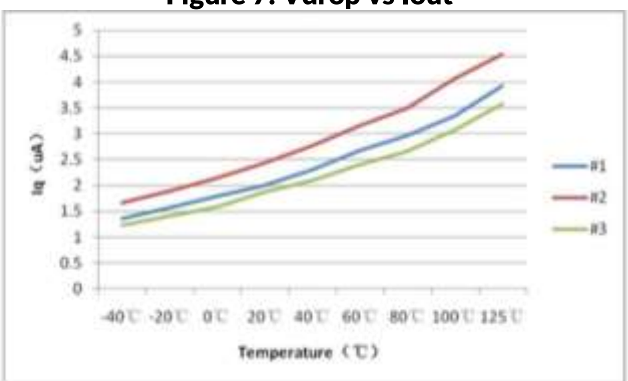


Figure 9. Iq vs Temperature

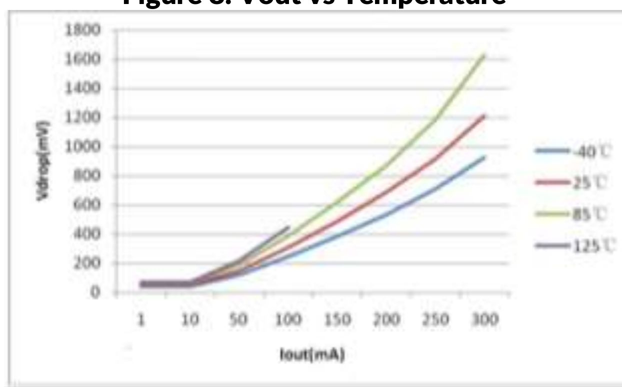


Figure 10. Vdrop – Iout vs Temperature

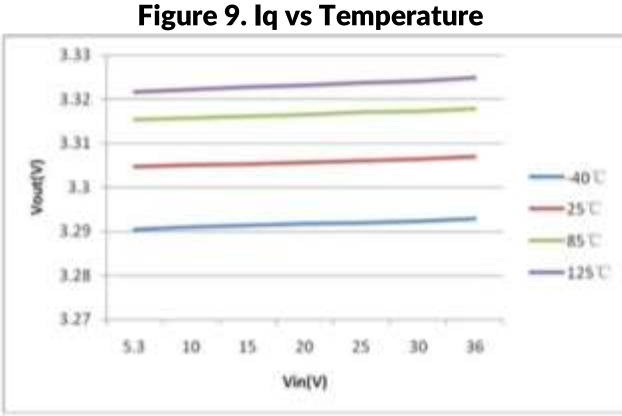


Figure 11. Vout – Vin vs Temperature (Iout=1mA)

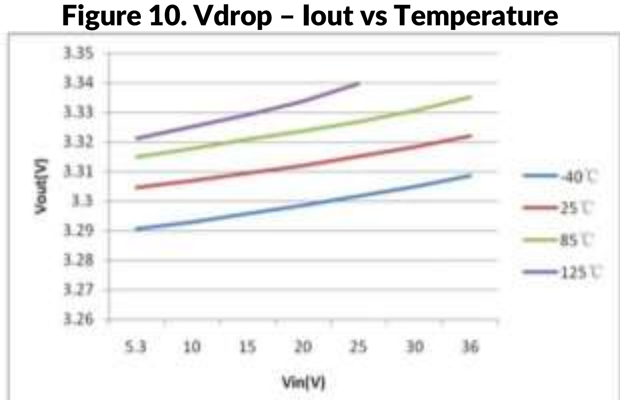


Figure 12. Vout – Vin vs Temperature (Iout=10mA)

Typical Characteristics (Continued)

NOTE: The graphs and tables provided following this note are a statistical summary based on a limited number of samples and are provided for informational purposes only.
(V_{IN} = V_{OUT} + 2V, C_{IN} = C_{OUT} = 1µF, V_{OUT} = 3.3V, typical values are at T_A = +25°C, unless otherwise noted.)

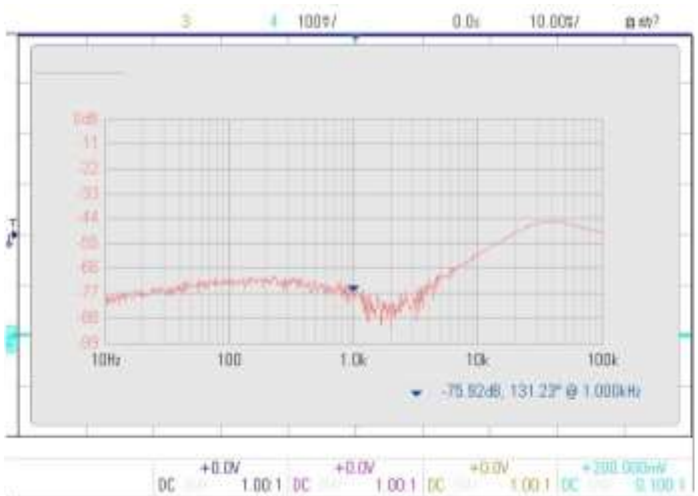
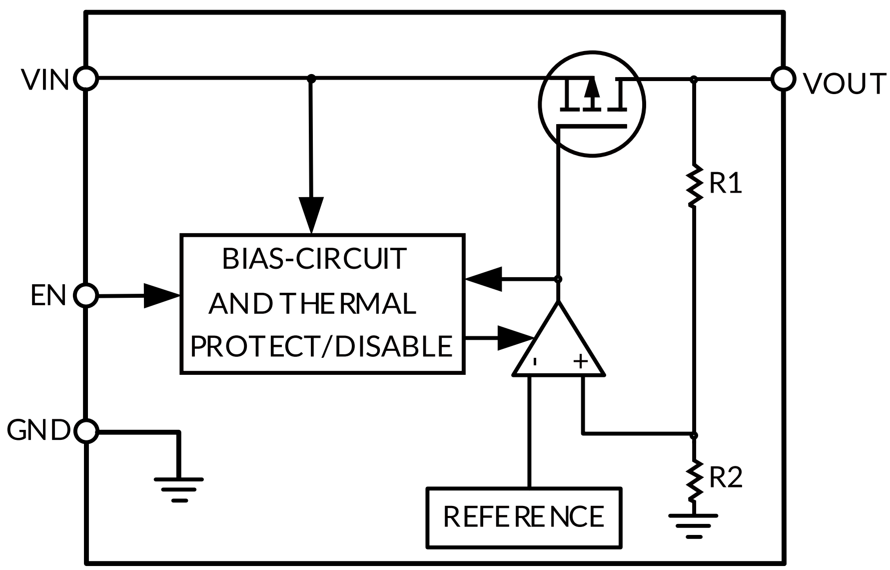


Figure 13. PSRR@30mA

9 FUNCTION INTRODUCTION

RS73xx-1 series low dropout linear regulator (LDO) consumes only 3μA of current and has excellent linear adjustment and load characteristics to meet the requirements of lower output noise and higher PSRR, making it more suitable for applications requiring ultra-low standby power consumption of the whole machine.

9.1 Functional Block Diagram



9.2 Precautions for Heat Dissipation Design

When the junction temperature of PN junction is too high and reaches the set temperature value, it will trigger the thermal protection circuit to send a signal to the control logic to turn off the chip output. When the PN junction temperature is lower than the set protection temperature, the chip will restart automatically. The maximum output power actually provided by the chip depends on the heat dissipation design of the system, including ambient temperature, wiring thickness and layout, and cooling design, such as adding heat sink and air cooling. Increasing the PCB area of GND pin can also obtain better heat dissipation performance.

9.3 Other Application Considerations

(1) The phase compensation circuit and ESR of the output capacitor are used inside the circuit to compensate, so a capacitor larger than 1.0μF must be connected to the ground.
(2) It is recommended to use 1μF polar capacitors for input and output, and to keep the capacitors as close to the V_{IN} and V_{OUT} pins of LDO as possible.
(3) Pay attention to the service conditions of input and output voltage and load current to make the junction temperature of PN junction lower than the overheat protection temperature.

Approximate estimation method of PN junction temperature:

$T_{PN}=(V_{IN}-V_{OUT}) \times I_{OUT}\times R_{\theta JA}+T$

I_{OUT} is Load current;

T is ambient temperature.

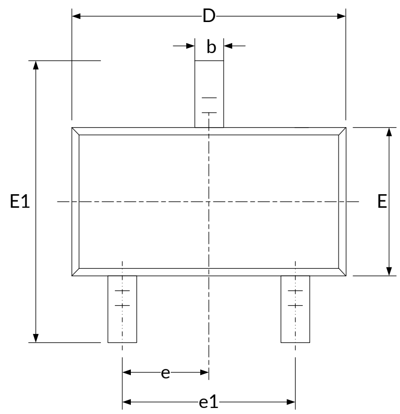
(4) When the input voltage V_{IN} is greater than 2.5V, if V_{IN} is also higher than the output set value plus the device dropout voltage, V_{OUT} is equal to the set value. Otherwise, V_{OUT} is equal to V_{IN} minus the dropout voltage. If V_{IN} lower than 2.5V, the V_{OUT} is:

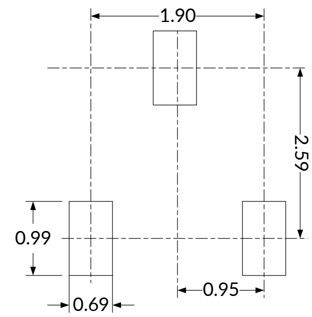
$V_{OUT} = V_{IN} - V_{Dropout}$

$V_{Dropout}$ is converted according to the actual load current and basically maintains a linear relationship.

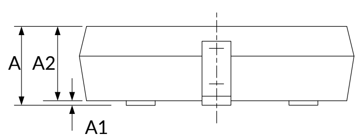
10 PACKAGE OUTLINE DIMENSIONS

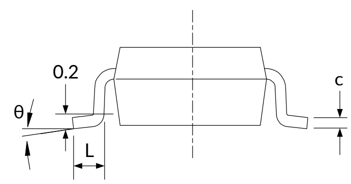
SOT23-3 (3)





RECOMMENDED LAND PATTERN (Unit: mm)



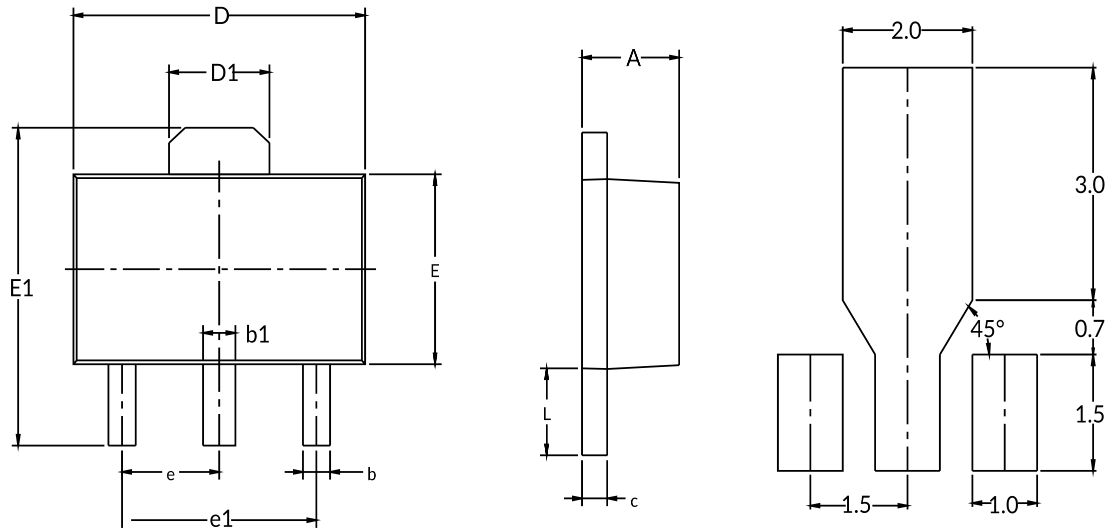


Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min	Max	Min	Max
A (1)	1.050	1.250	0.041	0.049
A1	0.000	0.100	0.000	0.004
A2	1.050	1.150	0.041	0.045
b	0.300	0.500	0.012	0.020
c	0.100	0.200	0.004	0.008
D (1)	2.820	3.020	0.111	0.119
E (1)	1.500	1.700	0.059	0.067
E1	2.650	2.950	0.104	0.116
e	0.950(BSC) (2)		0.037(BSC) (2)	
e1	1.800	2.000	0.071	0.079
L	0.300	0.600	0.012	0.024
θ	0°	8°	0°	8°

NOTE:

1. Plastic or metal protrusions of 0.15mm maximum per side are not included.
2. BSC (Basic Spacing between Centers), "Basic" spacing is nominal.
3. This drawing is subject to change without notice.

SOT89-3 [(4)]



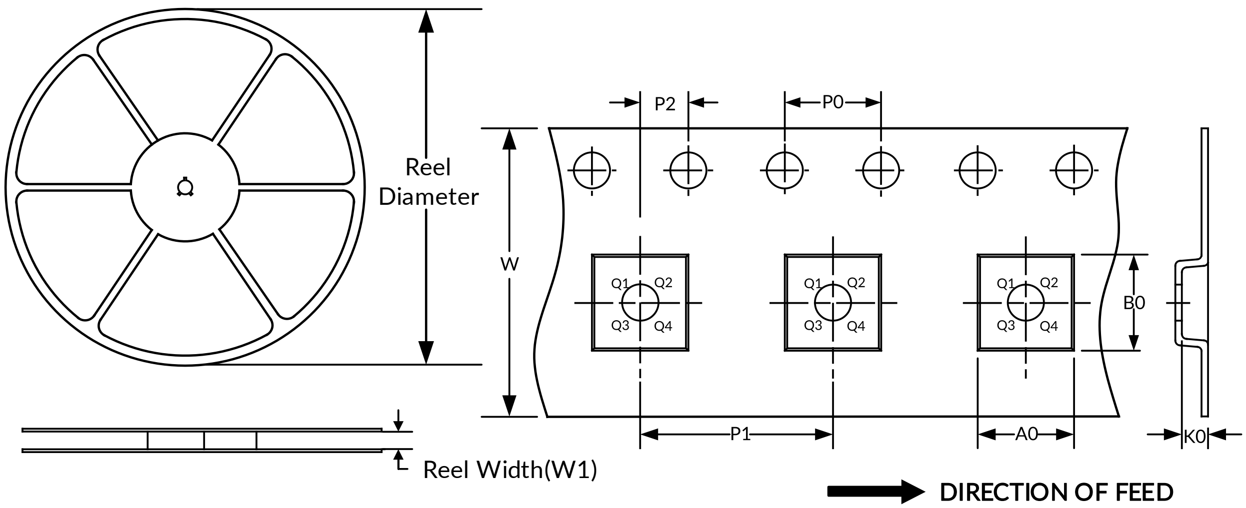
Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min	Max	Min	Max
A (1)	1.400	1.600	0.055	0.063
b	0.320	0.520	0.013	0.020
b1	0.400	0.580	0.016	0.023
c	0.350	0.440	0.014	0.017
D (1)	4.400	4.600	0.173	0.181
D1	1.550 REF (2)		0.061 REF (2)	
E (1)	2.300	2.600	0.091	0.102
E1	3.940	4.250	0.155	0.167
e	1.500 BSC (3)		0.060 BSC (3)	
e1	3.000 BSC (3)		0.118 BSC (3)	
L	0.900	1.200	0.035	0.047

NOTE:
1. Plastic or metal protrusions of 0.15mm maximum per side are not included.
2. REF is the abbreviation for Reference.
3. BSC (Basic Spacing between Centers), "Basic" spacing is nominal.
4. This drawing is subject to change without notice.

11 TAPE AND REEL INFORMATION

REEL DIMENSIONS

TAPE DIMENSION



NOTE: The picture is only for reference. Please make the object as the standard.

KEY PARAMETER LIST OF TAPE AND REEL

Package Type	Reel Diameter	Reel Width(mm)	A0 (mm)	B0 (mm)	K0 (mm)	P0 (mm)	P1 (mm)	P2 (mm)	W (mm)	Pin1 Quadrant
SOT23-3	7’’	9.0	3.20	3.30	1.30	4.0	4.0	2.0	8.0	Q3
SOT89-3	7’’	13.2	4.85	4.45	1.85	4.0	8.0	2.0	12.0	Q3

NOTE:
1. All dimensions are nominal.
2. Plastic or metal protrusions of 0.15mm maximum per side are not included.

IMPORTANT NOTICE AND DISCLAIMER