

Super-Small Package VFM Control Step-up Switching Regulator

General Description

The LN2351 Series is a CMOS VFM-control step-up switching regulator that mainly consists of a reference voltage source, an oscillator, and a comparator. enabling products with a low ripple over a wide range, high efficiency, and high output current. Products with a fixed duty ratio of 75 % (Lower Output Voltage) or 88%(Higher Output Voltage) are also available. With the LN2351 Series, a step-up switching regulator can be configured by using an external coil, capacitor, and diode. A protection circuit turns off the built-in MOS FET when the voltage at the CONT pin exceeds the limit to prevent it from being damaged. This feature, along with the mini package and low current consumption, makes the LN2351 Series ideal for applications such as the power supply unit of portable equipment.

Features

- Low voltage operation: Start up at 0.9 V min(IOUT=1 mA) guaranteed
- Low input current: During maximum operation: 6.5 μ A (VOUT=3.3 V, typ.)

Ordering Information

LN2351P ②③④⑤⑥
↑
①

- Duty ratio: 77 % Built-in fixed-type PFM controller
- External parts: Coil, capacitor, and diode
- Output voltage: Settable to between 2.5V to 5.5V ,accuracy of 2%

Applications

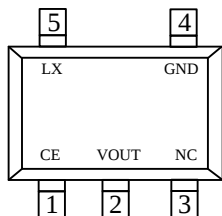
- Power supply for portable equipment such as digital cameras, electronic notebooks, and PDA
- Power supply for audio equipment such as portable CD/MD players
- Constant voltage power supply for cameras, video equipment and communications equipment
- Power supply for microcomputers

Package

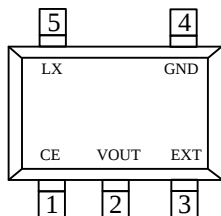
- SOT-23-5L
- SOT-23-3L
- SOT-23-3B
- SOT-89-3L

Designator	Symbol	Description	Designator	Symbol	Description
①	51	Indicates the product number	④	2	Output Voltage Accuracy e.g. 2: $\pm 2\%$
②③	15~70	Output Voltage e.g: 33: 3.3V 50: 5.0V	⑤	M	SOT-23-3L
				N	SOT-23-3B
				P	SOT-89-3L
				S	SOT-23-5L(A)
				K	SOT-23-5L(B)
			⑥	R	Embossed Tape : Standard Feed
				L	Embossed Tape : Reverse Feed

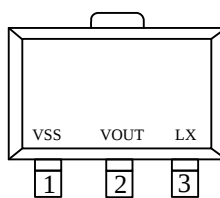
Pin Configuration



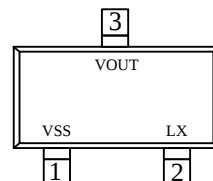
SOT-23-5L(A)
(Top View)



SOT-23-5L(B)
(Top View)



SOT-89-3L
(Top View)



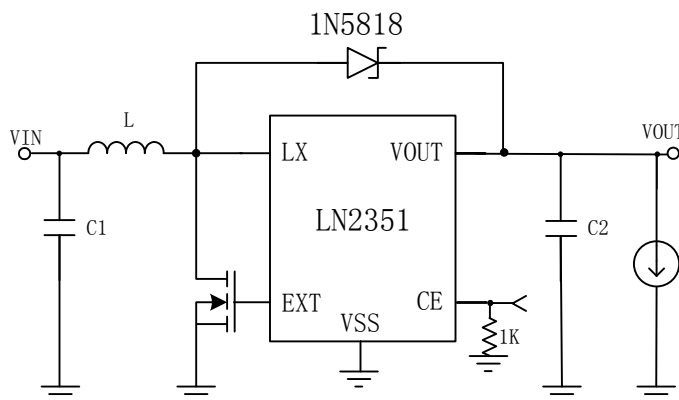
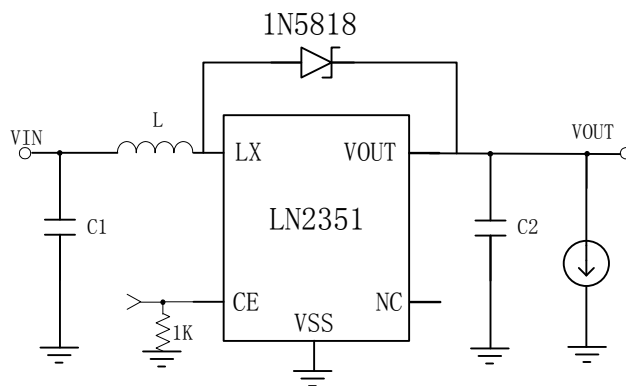
SOT-23-3L/SOT-23-3B
(Top View)

Pin Assignment

Pin Number				Pin Name	Function
SOT-23-5L(A)	SOT-23-5L(B)	SOT-23-3B	SOT-89-3L		
1	1	—	—	CE	Chip Enable
2	2	3	2	VOUT	Output
3	—	—	—	NC	No Connect
4	4	1	1	GND	Ground
5	5	2	3	LX	External Coil Connection
—	3	—	—	EXT	Connect External MOS

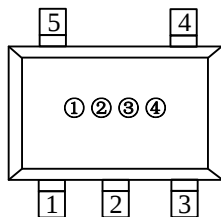
Typical Application Circuit

Components Normal Value: C1=10uF, C2=47uF, L=22uH, D1 1N5818

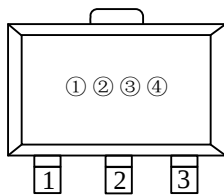


■ Marking Rule

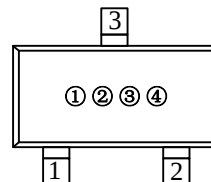
- SOT-23-5L, SOT-89-3L, SOT-23-3L/B,



SOT-23-5L
(Top View)



SOT-89-3L
(Top View)



SOT-23-3L/SOT-23-3B
(Top View)

- ① Represents the product name

Symbol	Product Name
A	LN2351P****

- ② Represents the type of regulator

Voltage(V)	0.1~3.0	3.1~6.0
300KHz	5	6
180KHz	3	4
100KHz	1	2

- ③ Represents the output voltage

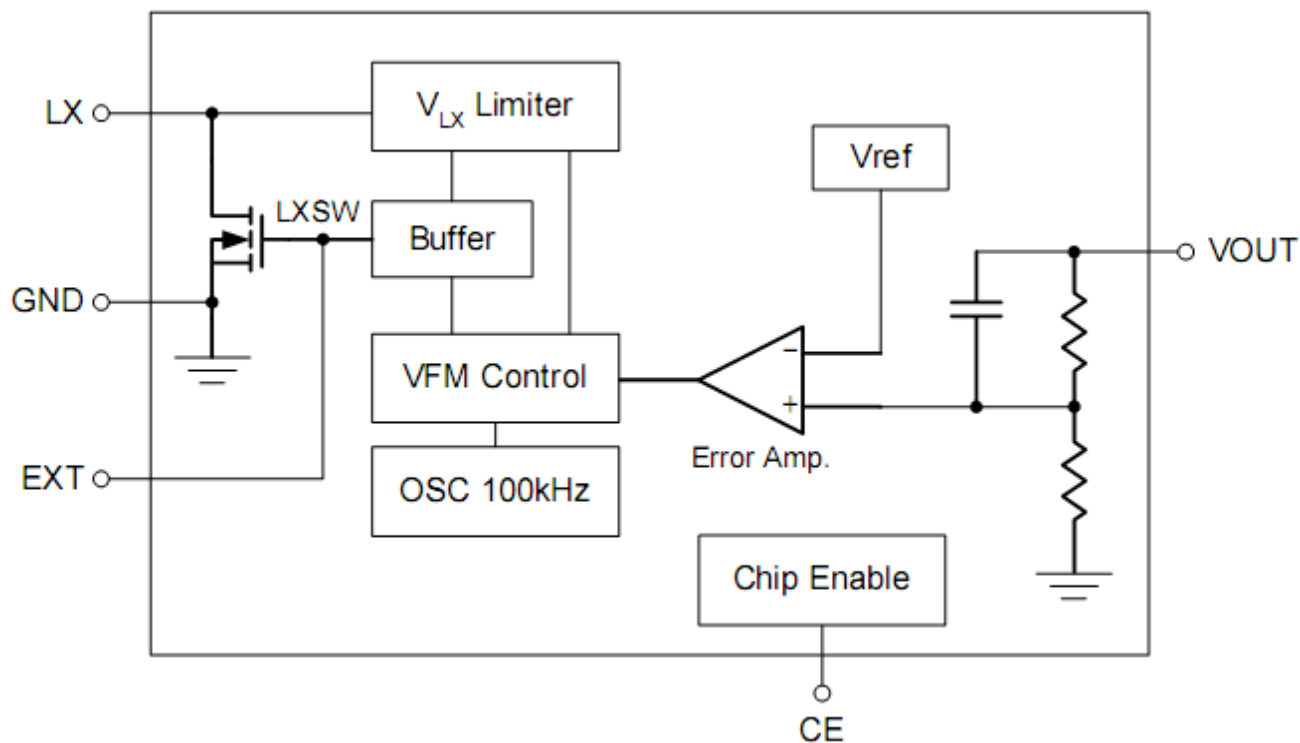
Symbol	Output Voltage (V)			Symbol	Output Voltage (V)		
0	-	3.1	-	F	1.6	4.6	-
1	-	3.2	-	H	1.7	4.7	-
2	-	3.3	-	K	1.8	4.8	-
3	-	3.4	-	L	1.9	4.9	-
4	-	3.5	-	M	2	5.0	-
5	-	3.6	-	N	2.1	5.1	-
6	-	3.7	-	P	2.2	5.2	-
7	-	3.8	-	R	2.3	5.3	-
8	-	3.9	-	S	2.4	5.4	-
9	-	4	-	T	2.5	5.5	-
A	-	4.1	-	U	2.6	5.6	-
B	-	4.2	-	V	2.7	5.7	-
C	-	4.3	-	X	2.8	5.8	-
D	-	4.4	-	Y	2.9	5.9	-
E	1.5	4.5	-	Z	3	6.0	-

- ④ Represents the assembly lot No.

0-9, A-Z; 0-9, A-Z mirror writing, repeated (G, I, J, O, Q, W exception)

Eg: A6TX represents LN2351P,output voltage is 5.5V.

■ Function Block Diagram



■ Absolute Maximum Ratings

Parameter	Symbol		Maximum Rating	Unit
Input voltage	VDD		Vss-0.3~Vss+6.5	V
Output voltage	VOUT		Vss-0.3~Vss+6.5	
	VCONT		Vss-0.3~Vss+6.5	
Output Current	ILX		1000	mA
Power dissipation	PD	SOT-23-3	150	mW
		SOT-89-3L	500	
		SOT-23-5L	250	
Operating ambient temperature	Topr		-40~+80	℃
Storage ambient temperature	Tstg		-40~+125	

Caution The absolute maximum ratings are rated values exceeding which the product could suffer physical damage. These values must therefore not be exceeded under any conditions.

Electrical Characteristics

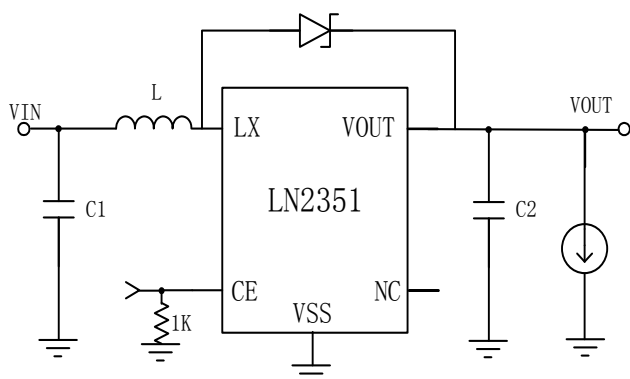
(Ta=25°C, VIN=1.5V, VOUT=3.3V unless otherwise noted)

Item	Symbol	Condition	Min.	Typ.	Max.	Unit	Test circuit
Output voltage	VOUT	-	VOUT(s) ×0.98	VOUT(s)	VOUT(S) ×1.02	V	1
Input Voltage	VIN	-	-	-	6.5		
Operation start voltage	VST1	IOUT=1mA	-	-	1.1		
Active current	Iact	VOUT=Output voltage×0.9		40	55	uA	2
Input current without load	Iss	VOUT=Output voltage×1.1	—	6.5	7.5		
Line regulation	Δ VOUT1	IOUT=30mA	—	0.22	0.4	%	1
Load regulation	Δ VOUT2	IOUT=10uA—100mA	—	0.35	0.5		
Output voltage temperature coefficient	$\frac{\Delta VOUT}{\Delta Ta \cdot VOUT}$	Ta=-40°C~+85°C	—	±40	—	ppm/°C	
Maximum oscillation frequency	fosc	VOUT=Output voltage×0.95	225	300	375	kHz	2
Duty ratio	Duty	VOUT=Output voltage×0.95	70	77	84		
Efficiency	EFFI	—	—	88	—	%	1

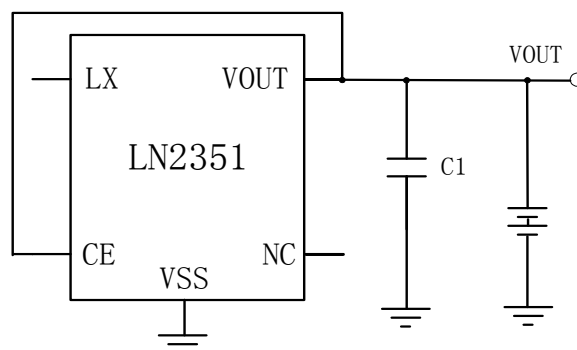
Remarks: VOUT(S) specified above is the set output voltage value, and VOUT is the typical value of the actual output voltage. fo is the working frequency.

Test Circuits

Test circuit 1

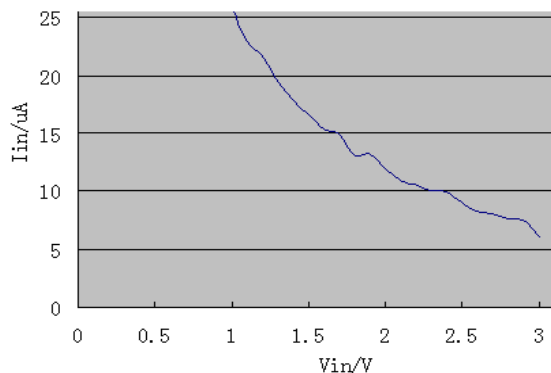


Test circuit 2

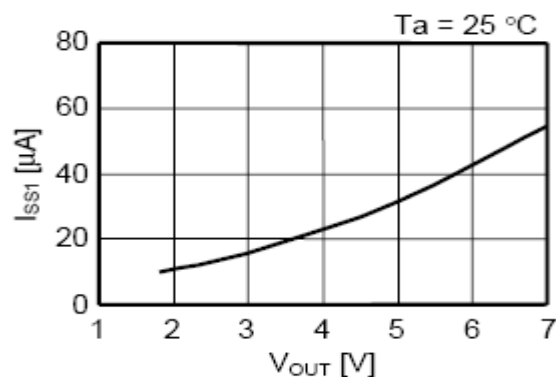


Typical Performance Characteristics

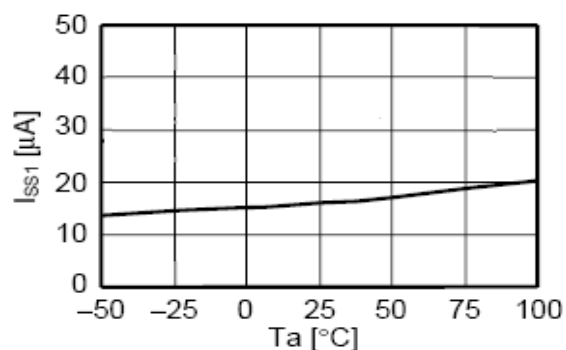
1. Input voltage vs. Power Supply



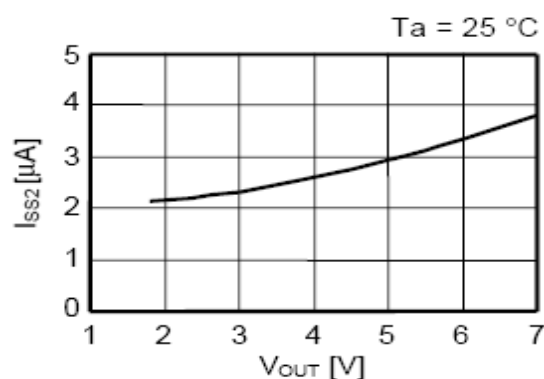
2. Output Voltage vs. Current Consumption



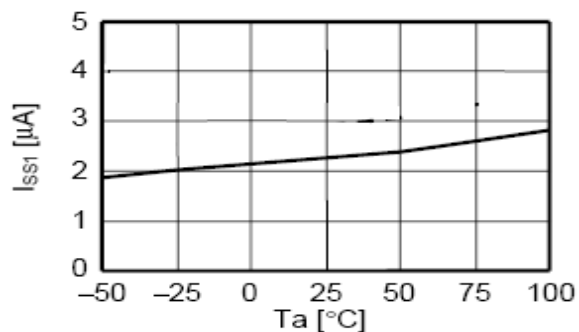
3. Temperature vs. Active Current



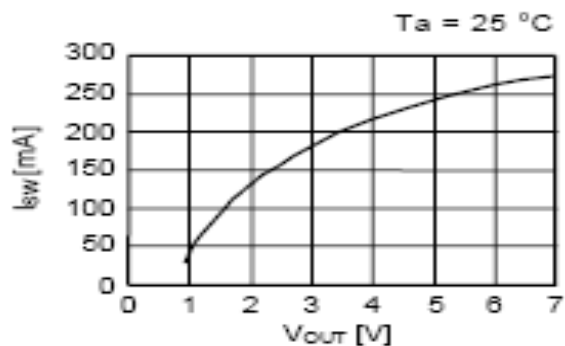
4. Output Voltage vs. Input Current



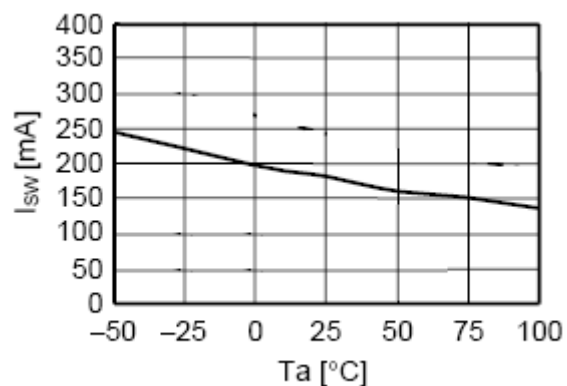
5. Temperature vs. Input Current



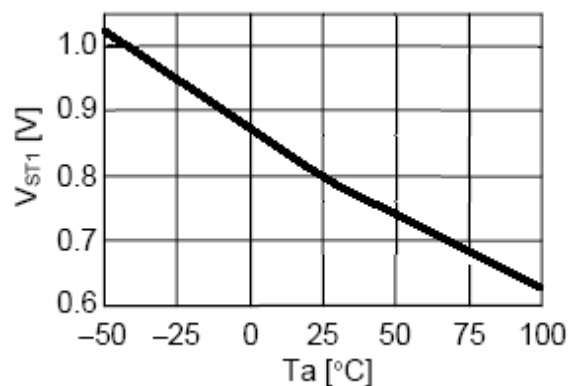
6. Output Voltage vs. Switching Current



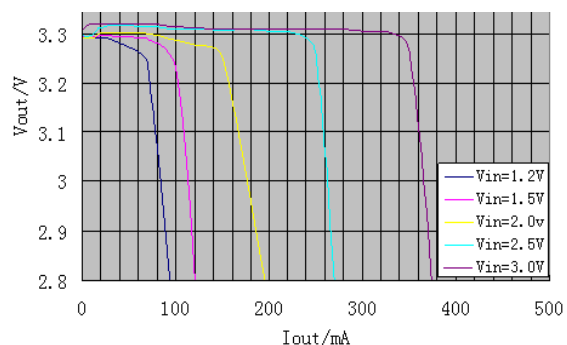
7. Temperature vs. Switching Current



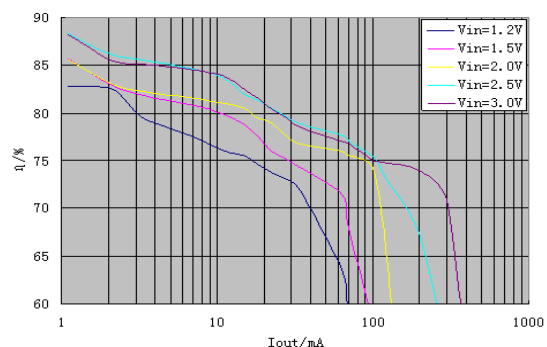
8. Temperature vs. Operation Start Voltage



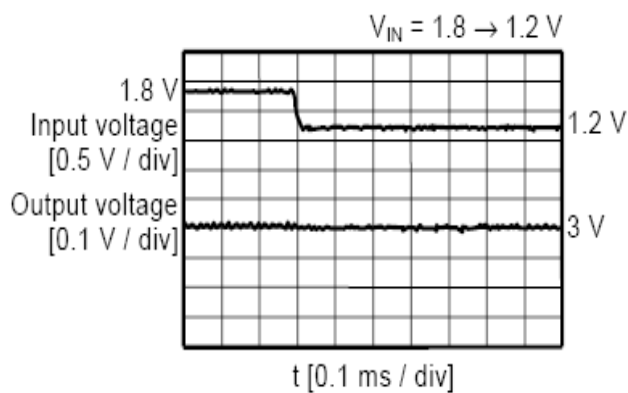
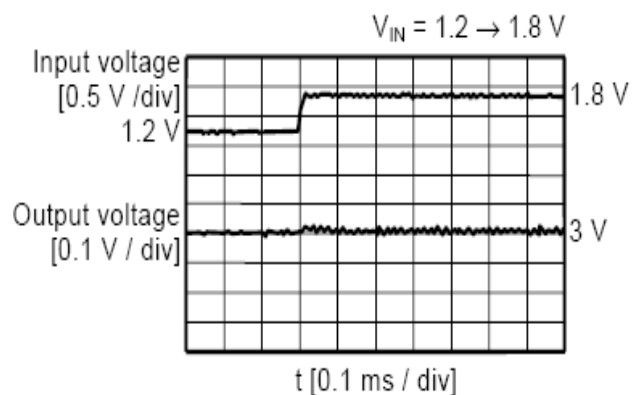
9. Output Current vs. Output Voltage



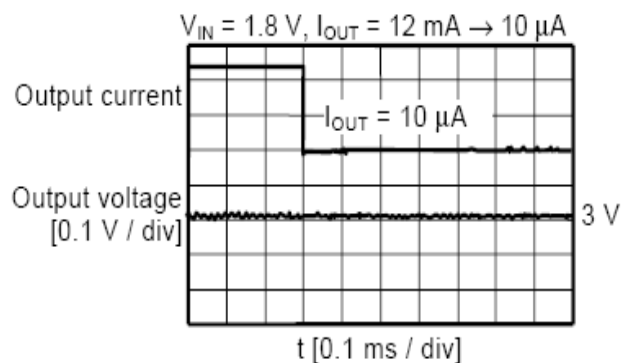
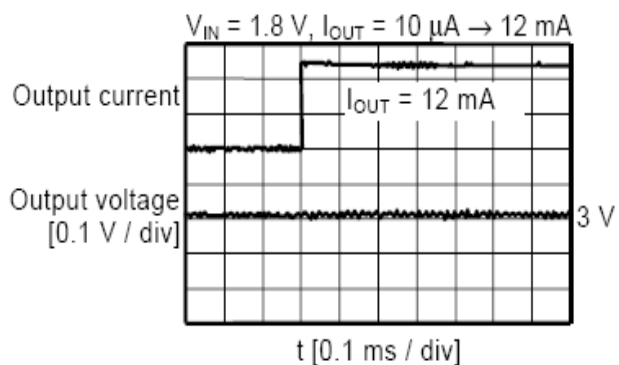
10. Output Current vs. Efficiency



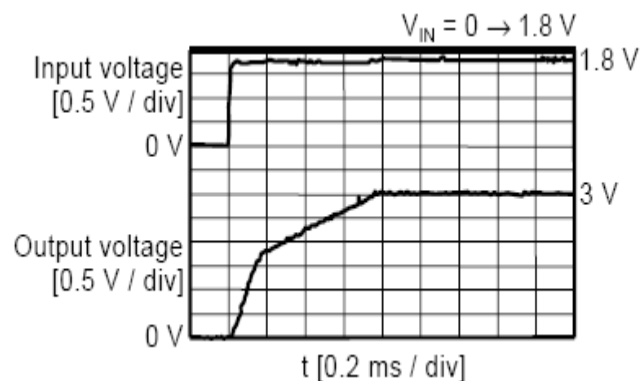
11. Power Supply Voltage Fluctuation ($T_a=25^\circ C, R_L=250\Omega$)



12. Load Current Fluctuation ($T_a=25^\circ C$)

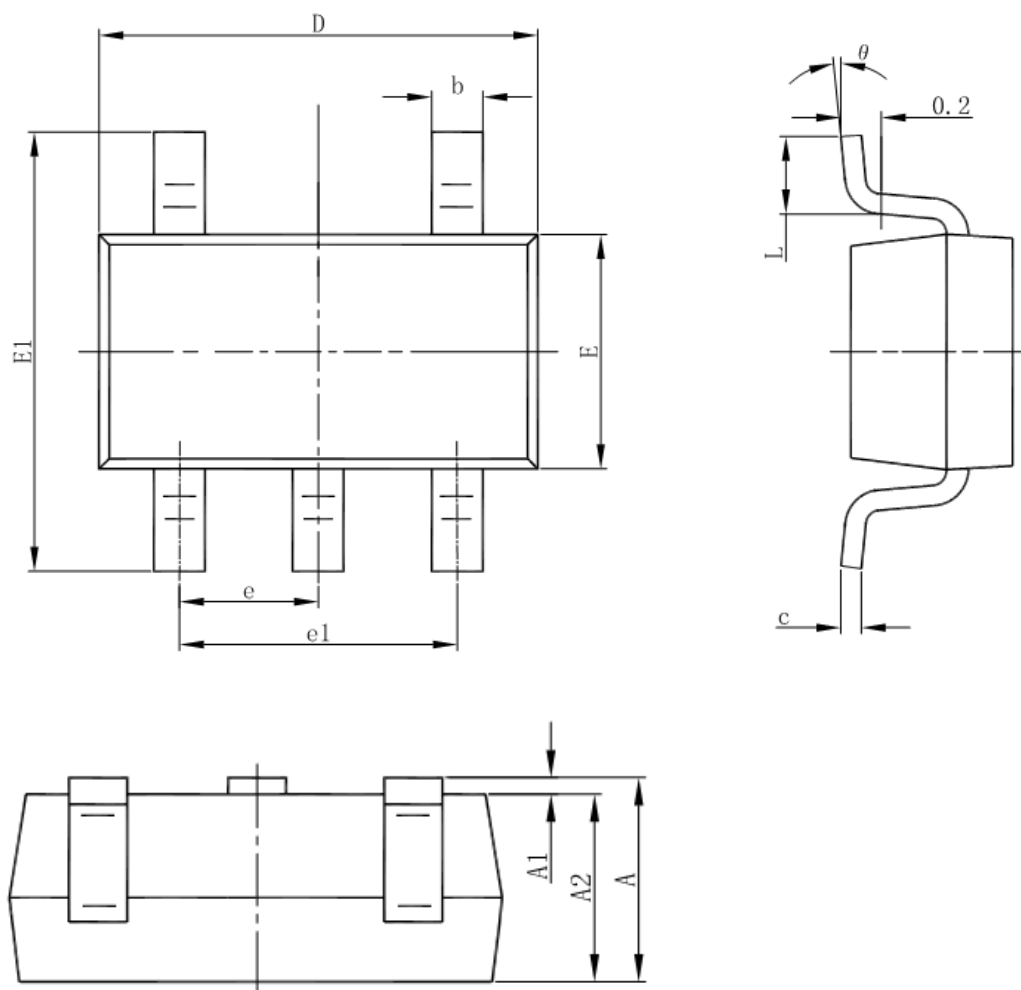


13. Power On

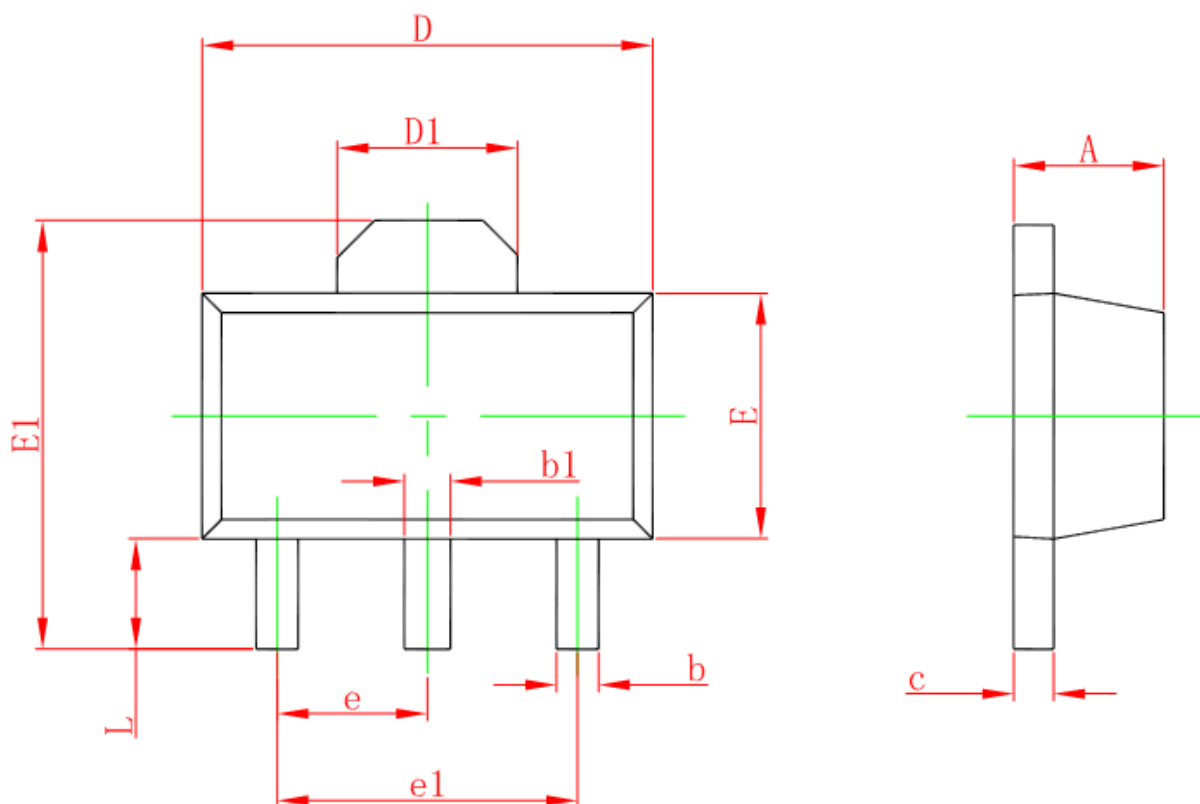


Package Information

SOT-23-5L

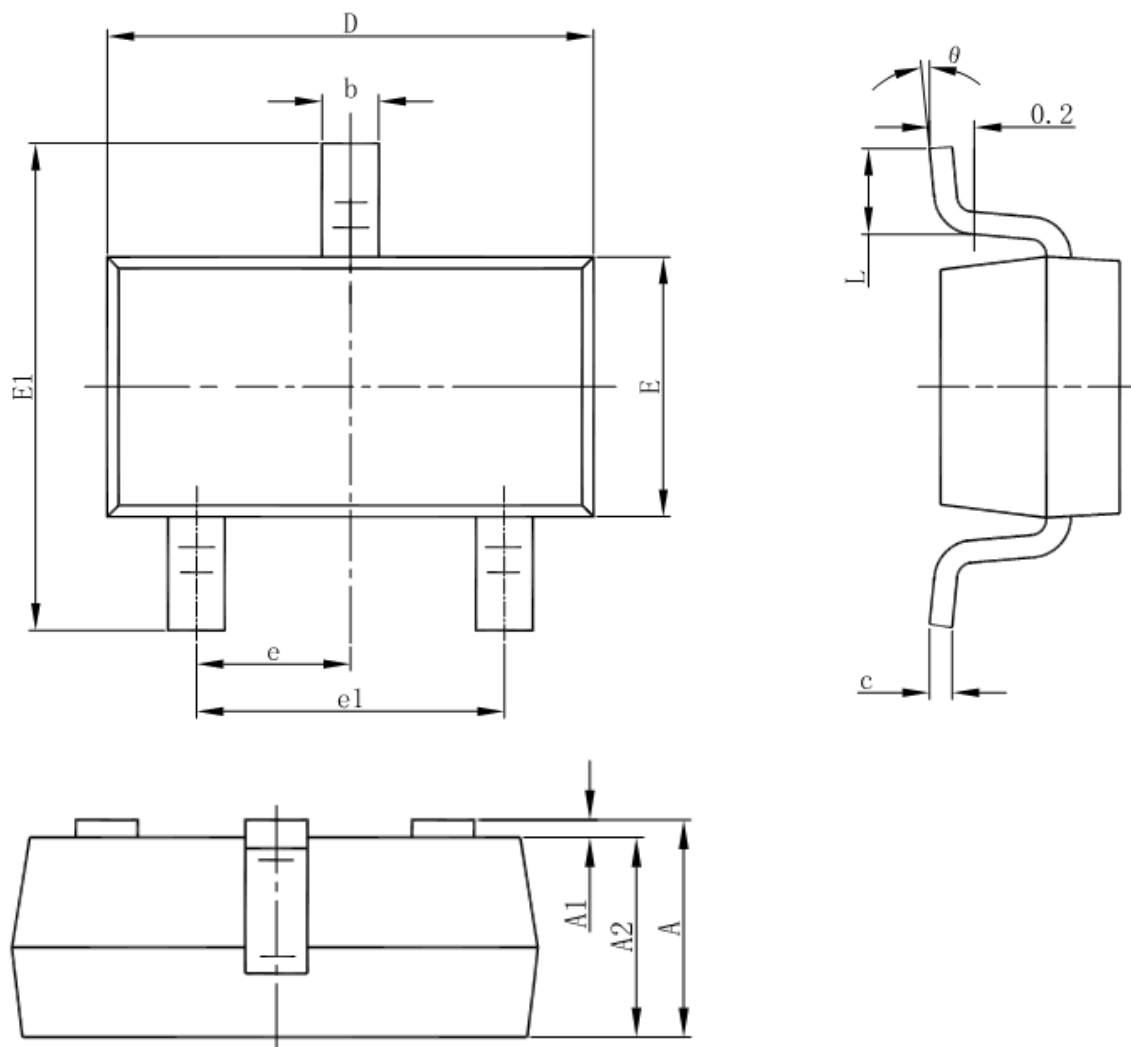


Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min	Max	Min	Max
A	1.050	1.250	0.041	0.049
A1	0.000	0.100	0.000	0.004
A2	1.050	1.150	0.041	0.045
b	0.300	0.500	0.012	0.020
c	0.100	0.200	0.004	0.008
D	2.820	3.020	0.111	0.119
E	1.500	1.700	0.059	0.067
E1	2.650	2.950	0.104	0.116
e	0.950(BSC)		0.037(BSC)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



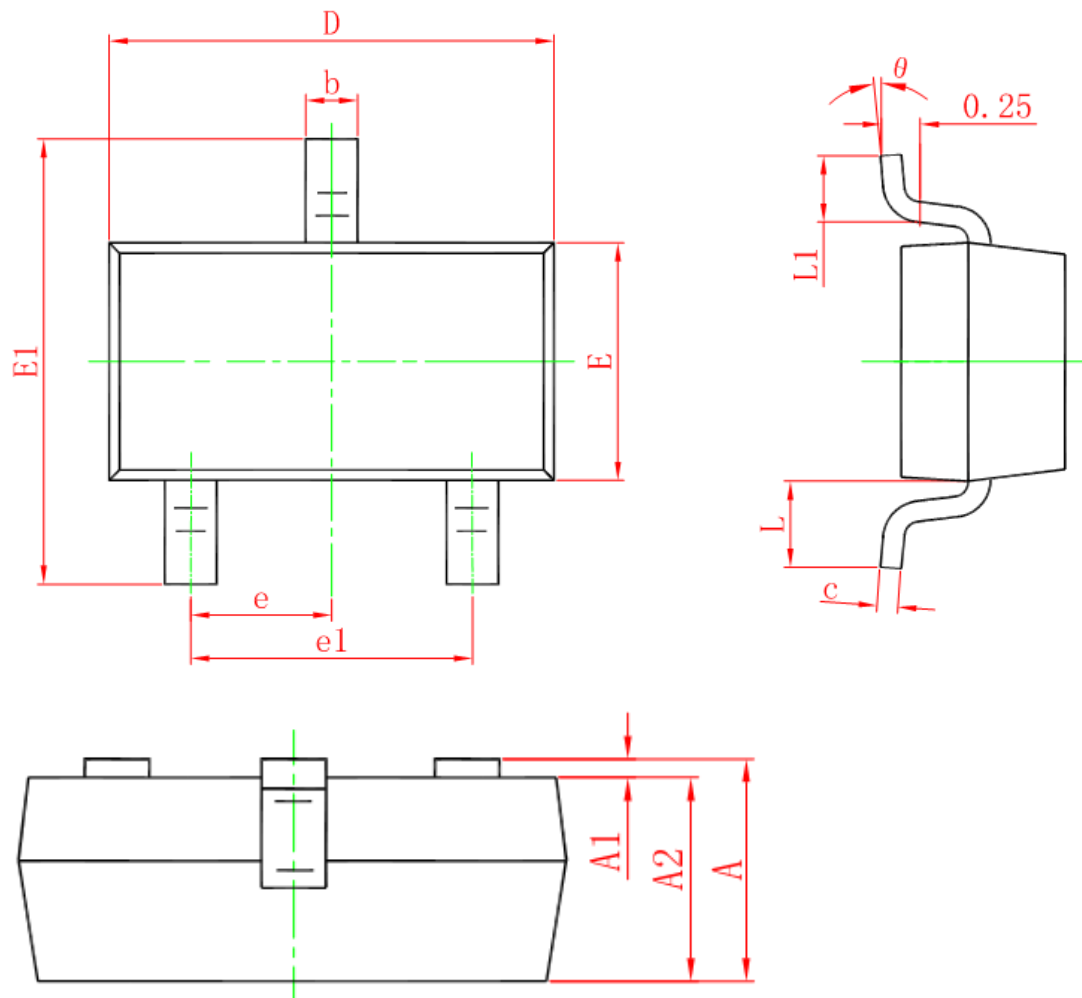
Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min	Max	Min	Max
A	1.400	1.600	0.055	0.063
b	0.320	0.520	0.013	0.020
b1	0.400	0.580	0.016	0.023
c	0.350	0.440	0.014	0.017
D	4.400	4.600	0.173	0.181
D1	1.550 REF.		0.061 REF.	
E	2.300	2.600	0.091	0.102
E1	3.940	4.250	0.155	0.167
e	1.500 TYP.		0.060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

● SOT-23-3L



Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min	Max	Min	Max
A	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	2.820	3.020	0.111	0.119
E	1.500	1.700	0.059	0.067
E1	2.650	2.950	0.104	0.116
e	0.950(BSC)		0.037(BSC)	
e1	1.800	2.000	0.071	0.079
L	0.300	0.600	0.012	0.024
θ	0°	8°	0°	8°

● SOT-23-3B



Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min.	Max.	Min.	Max.
A	0.900	1.150	0.035	0.045
A1	0.000	0.100	0.000	0.004
A2	0.900	1.050	0.035	0.041
b	0.300	0.500	0.012	0.020
c	0.080	0.150	0.003	0.006
D	2.800	3.000	0.110	0.118
E	1.200	1.400	0.047	0.055
E1	2.250	2.550	0.089	0.100
e	0.950 TYP.		0.037 TYP.	
e1	1.800	2.000	0.071	0.079
L	0.550 REF.		0.022 REF.	
L1	0.300	0.500	0.012	0.020
θ	0°	8°	0°	8°