Super-Small Package VFM Control Step-up Switching Regulator

■ General Description

The LN2352 Series is a CMOS PFM-control step-up switching controller 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 LN2352 Series, a step-up switching regulator can be configured by using an external coil, capacitor, NMOSFET and diode. This feature, along with the mini package and low current consumption, makes the LN2352 Series ideal for applications such as the power supply unit of portable equipment. The LN2352 Series, which features an external transistor, is suitable for applications requiring a high output current.

■ Features

- Low voltage operation: Start up at 0.9V min (I_{OUT}=1 mA) guaranteed
- Low input current: During maximum operation: 23μA (V_{OUT}=3.3 V, typ.)
- Duty ratio: 75% or 88% Built-in fixed-type PFM controller
- External parts: Coil, capacitor, NMOSFET and diode
- Output voltage: settable to between 1.5V to 6.0V , 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

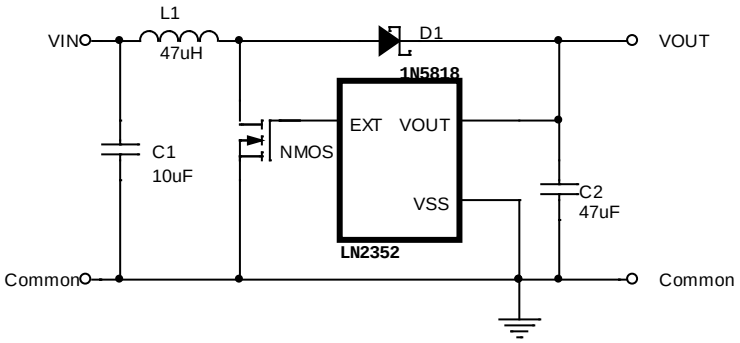
- SOT-23-3L
- SOT-23-5L
- SOT-89-3L

■ Ordering Information

LN2352P ②③④⑤⑥
①

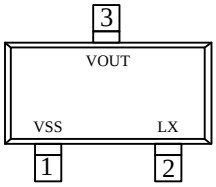
Designator	Symbol	Description	Designator	Symbol	Description
①	52	Indicates the product number	④	2	Output Voltage Accuracy e.g. 2: ±2%
②③	15～70	Output Voltage e.g. 30:3.0V 50:5.0V	⑤	M	SOT-23-3L
				N	SOT-23-5L
				P	SOT-89-3L
			⑥	R	Embossed Tape :Standard Feed
				L	Embossed Tape :Reverse Feed

■ Typical Application Circuit

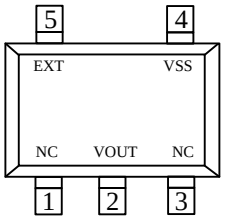


Caution The above connection diagram and constant will not guarantee successful operation. Perform thorough evaluation using the actual application to set the constant.

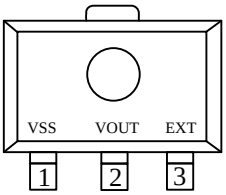
■ Pin Configuration



SOT-23-3L
(Top View)



SOT-23-5L
(Top View)



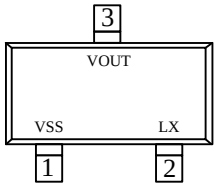
SOT-89-3L
(Top View)

■ Pin Assignment

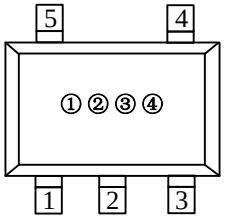
Pin Number			Pin Name	Function
SOT-23-3L	SOT-23-5L	SOT-89-3L		
3	2	2	Vout	Output
1	4	1	Vss	Ground
2	5	3	EXT	External Transistor Connection
-	1，3	-	NC	No Connected

■ Marking Rule

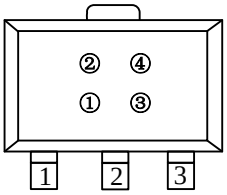
- **SOT-23-3L, SOT-23-5L,SOT-89-3L,**



SOT-23-3L
(Top View)



SOT-23-5L
(Top View)



SOT-89-3L
(Top View)

① Represents the product name

Symbol	Product Name
A	LN2352P*****

② Represents the range of output voltage

Voltage(V)	0.1～3.0	3.1～6.0
Symbol	7	8

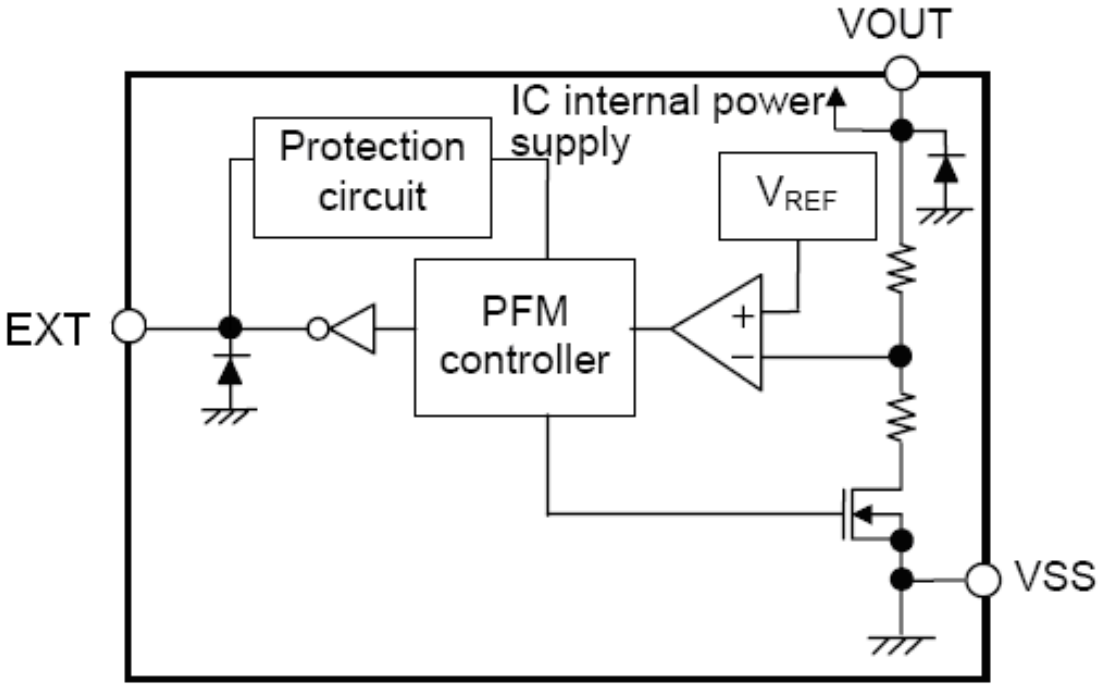
③ Represents the output voltage

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 mirror writing，repeated（G，I，J，O，Q，W exception）

■ Function Block Diagram



■ Absolute Maximum Ratings

Parameter	Symbol		Maximum Rating	Unit
Input voltage	V_{DD}		Vss-0.3～Vss+10	V
Output voltage	V_{OUT}		Vss-0.3～Vss+10	
	V_{CONT}		Vss-0.3～Vss+10	
Power dissipation	PD	SOT-23-3L,SOT23-5L	250	mW
		SOT-89-3L	500	
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

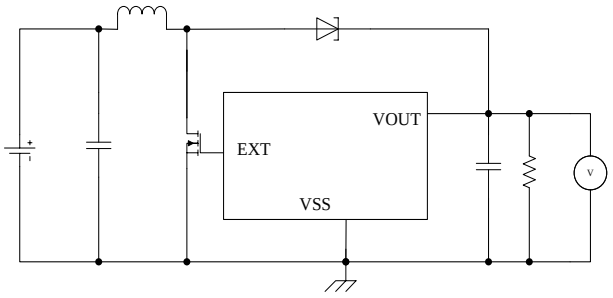
(Ta=25℃, unless otherwise noted)

Item	Symbol	Condition	Min.	Typ.	Max.	Unit	Test Circuit
Output Voltage	V_{OUT}	-	$V_{OUT(S)}$ ×0.98	$V_{OUT(S)}$	$V_{OUT(S)}$ ×1.02	V	1
Input Voltage	V_{IN}	-	-	-	10		
Operation Start Voltage	V_{ST1}	I_{OUT}=1mA	-	-	0.9		
OSC Start Voltage	V_{ST2}	-	-	-	0.8		2
Input Current Without Load	I_{IN}	I_{OUT}=0	—	5.0	—	μA	1
Current Consumption 1	I_{SS1}	V_{OUT}=Output Voltage×0.95		23.2	38.6	μA	2
Current Consumption 2	I_{SS2}	V_{OUT}=Output Voltage+0.5	—	2.9	4.4		
Line Regulation	$\triangle V_{OUT1}$	V_{IN}=V_{OUT}（S）×0.4～0.6	—	30	60	mV	1
Load Regulation	$\triangle V_{OUT2}$	I_{OUT}=10μA～ $V_{OUT(S)}$/250×1.25	—	30	60		
Output Voltage Temperature Coefficient	$\frac{\triangle V_{OUT}}{\triangle Ta*V_{OUT}}$	Ta=-40℃～+85℃	—	±50	—	ppm /℃	
Maximum Oscillation Frequency	Fosc	V_{OUT}=Output Voltage×0.95, Measured Waveform at CONT Pin	280	330	370	KHz	2
Duty Ratio	Duty	V_{OUT}=Output Voltage×0.95, Measured Waveform at CONT Pin	70	75	80	%	
			84	88	92		
Efficiency	EFFI	—	—	88	—	%	1
EXT “High” ON Resistance	Rexth	V_{OUT}=3.3V,EXT=Vdd-0.4V		24	36	Ω	3
EXT “LOW” ON Resistance	Rextl	V_{OUT}=3.3V,EXT= 0.4V		16	24	Ω	3

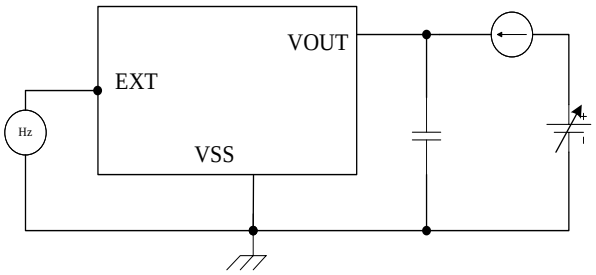
Remarks : $V_{OUT(S)}$ specified above is the set output voltage value, and V_{OUT} is the typical value of the actual output voltage.

■ Test Circuits

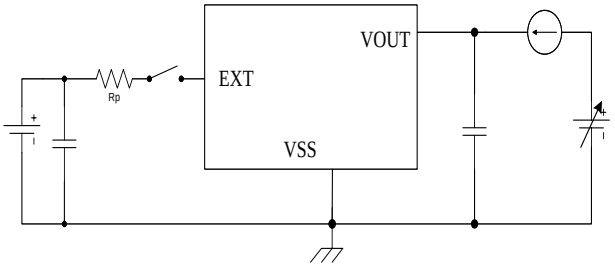
Test circuit 1



Test circuit 2

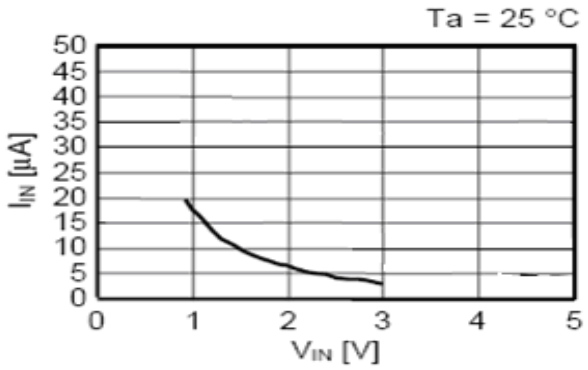


Test circuit 3

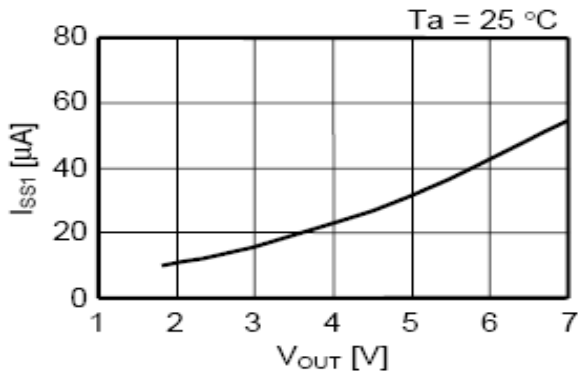


■ Typical Performance Characteristics

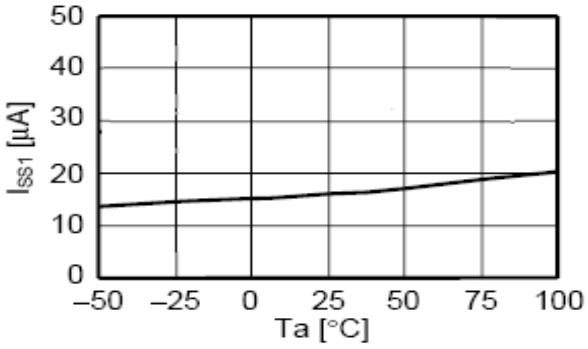
1. **Input voltage vs. Power Supply**



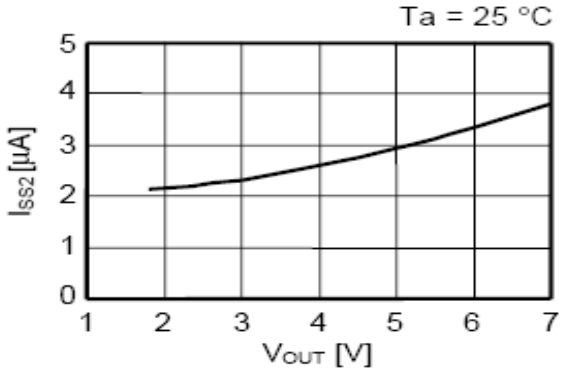
2. **Output Voltage vs. Current Consumption 1**



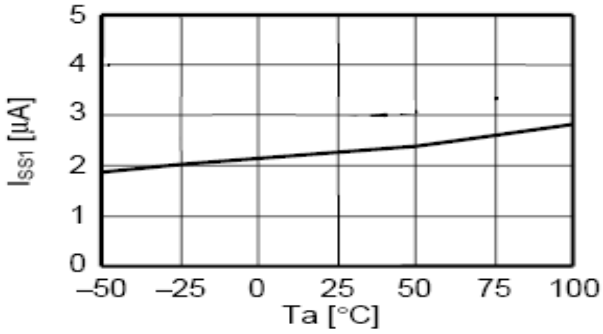
3. **Temperature vs. Current consumption 1**



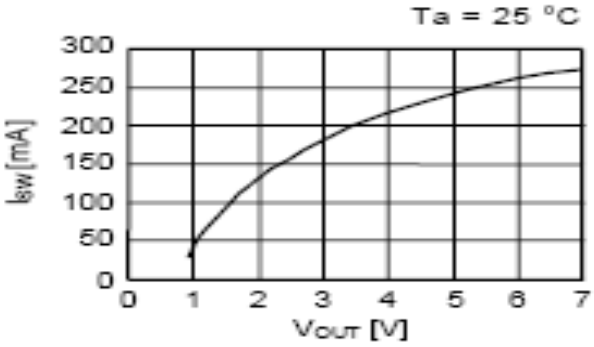
4. **Output Voltage vs. Current consumption 2**



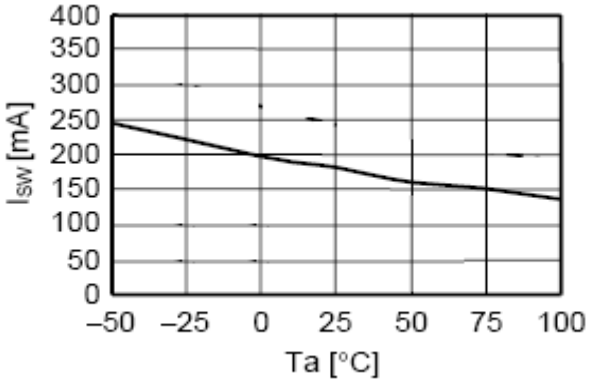
5. **Temperature vs. Current consumption 2**



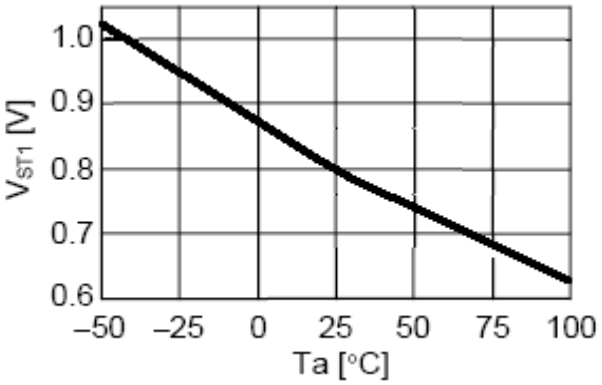
6. **Output Voltage vs. Switching Current**



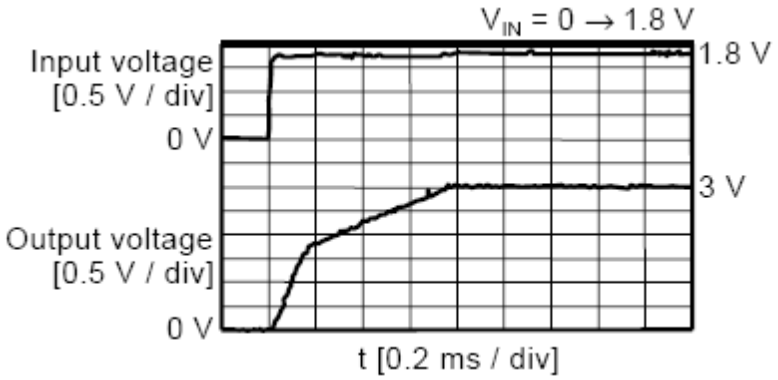
7. **Temperature vs. Switching Current**



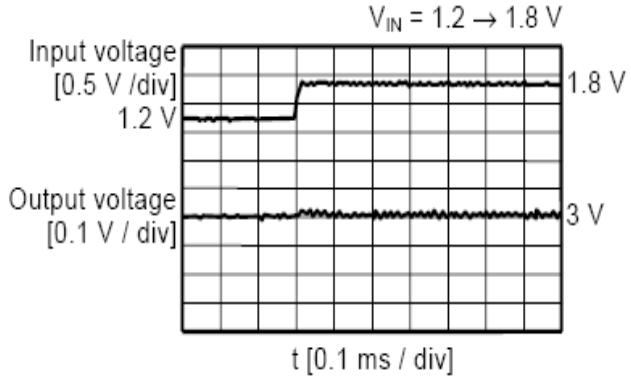
8. **Temperature vs. Operation Start Voltage**

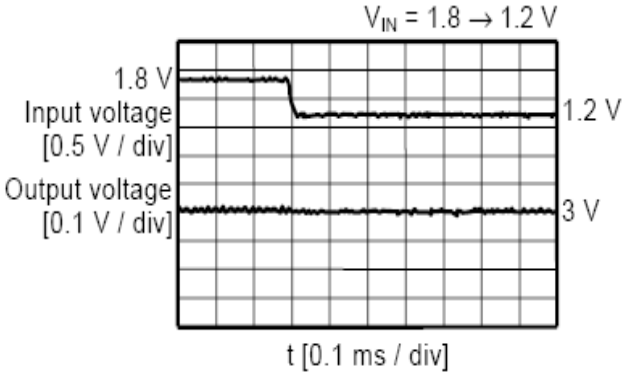


9. Power On

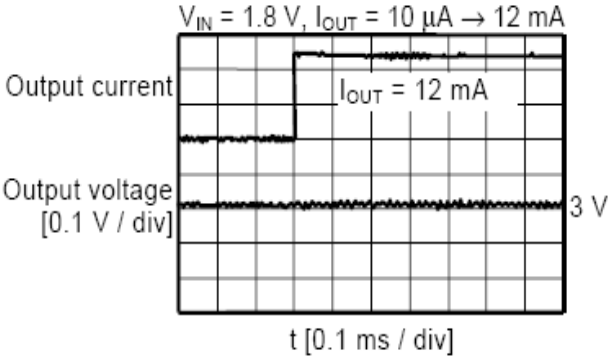


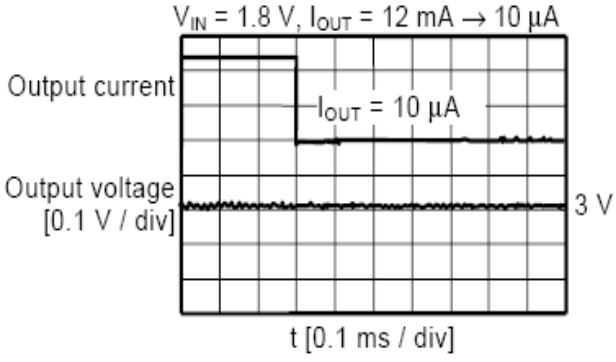
10. Power Supply Voltage Fluctuation(Ta=25℃,R_L=250Ω)





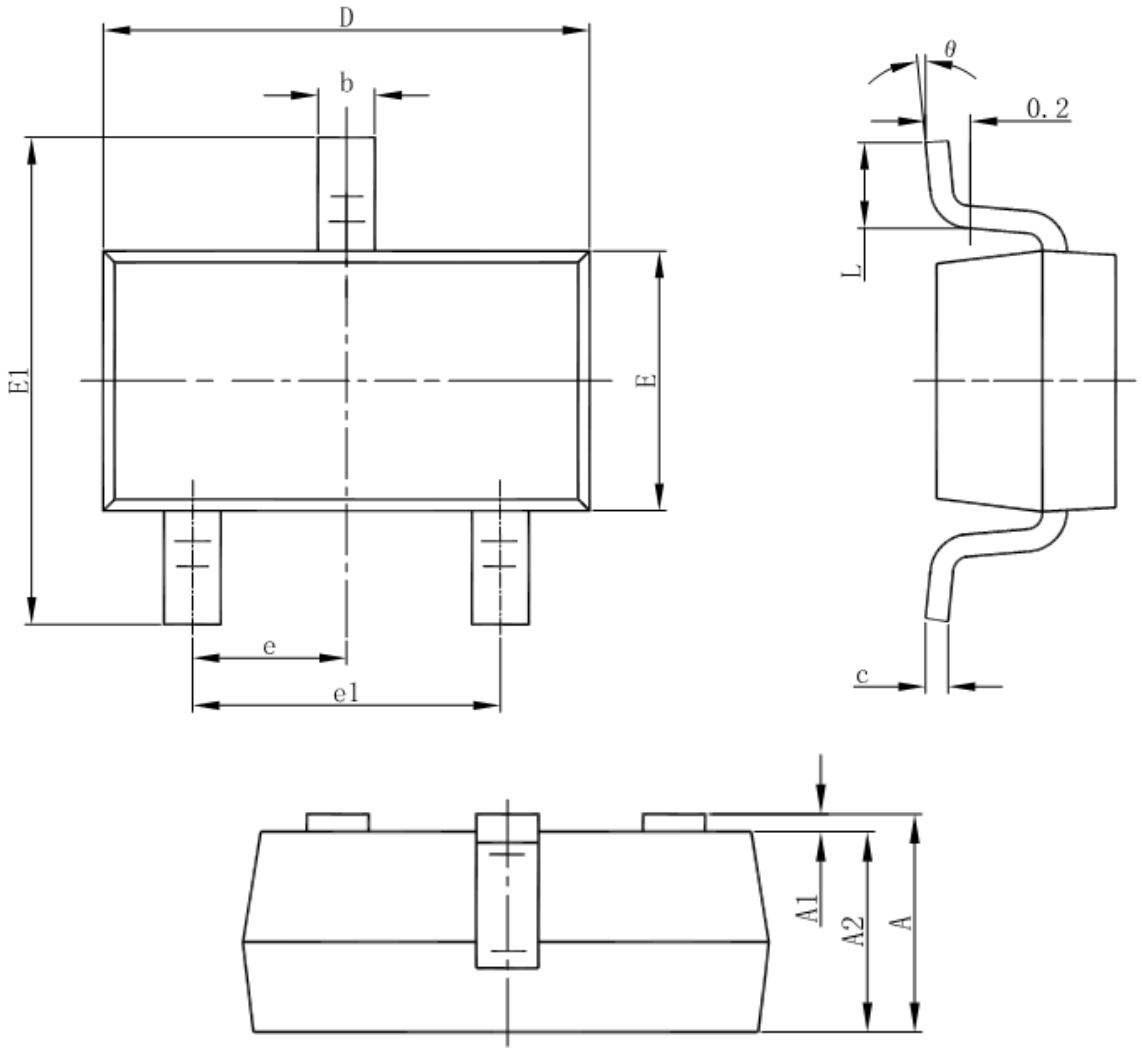
11. Load Current Fluctuation(Ta=25℃)





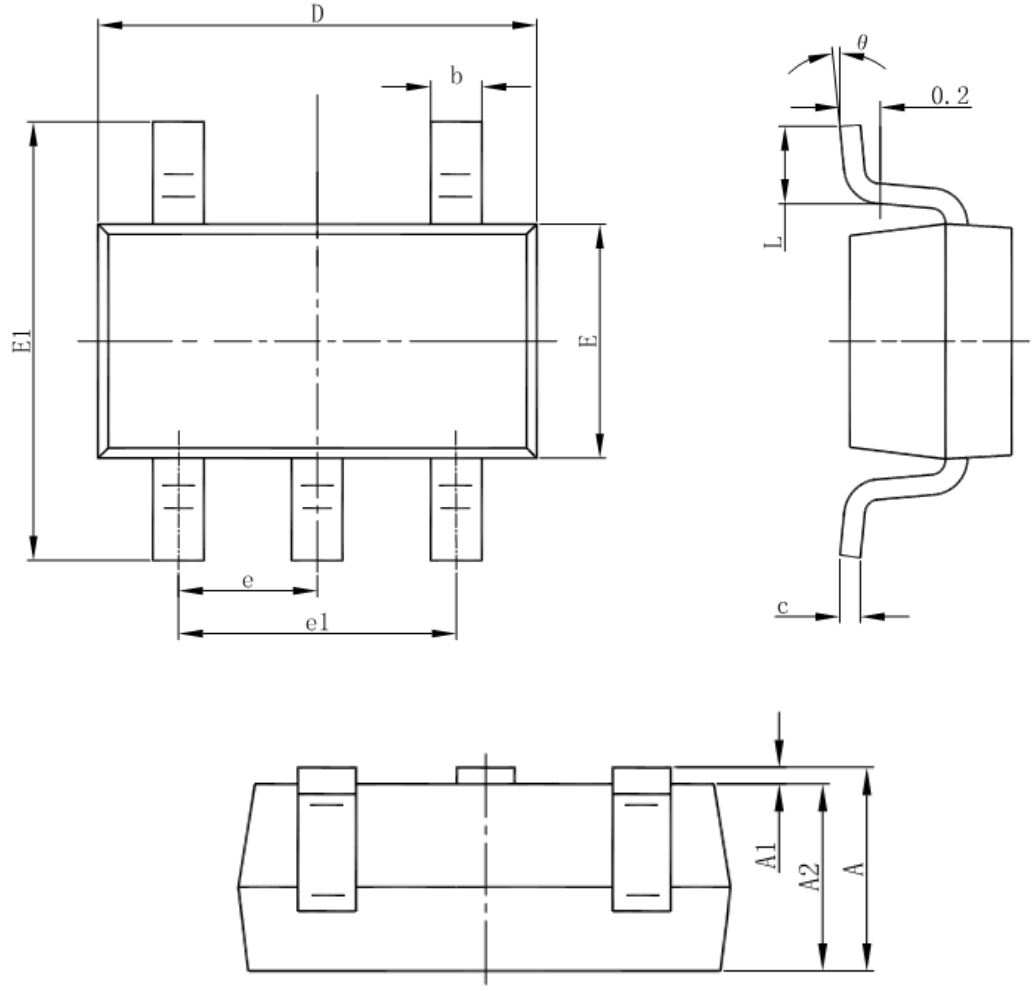
■ Package Information

- **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-23-5L**



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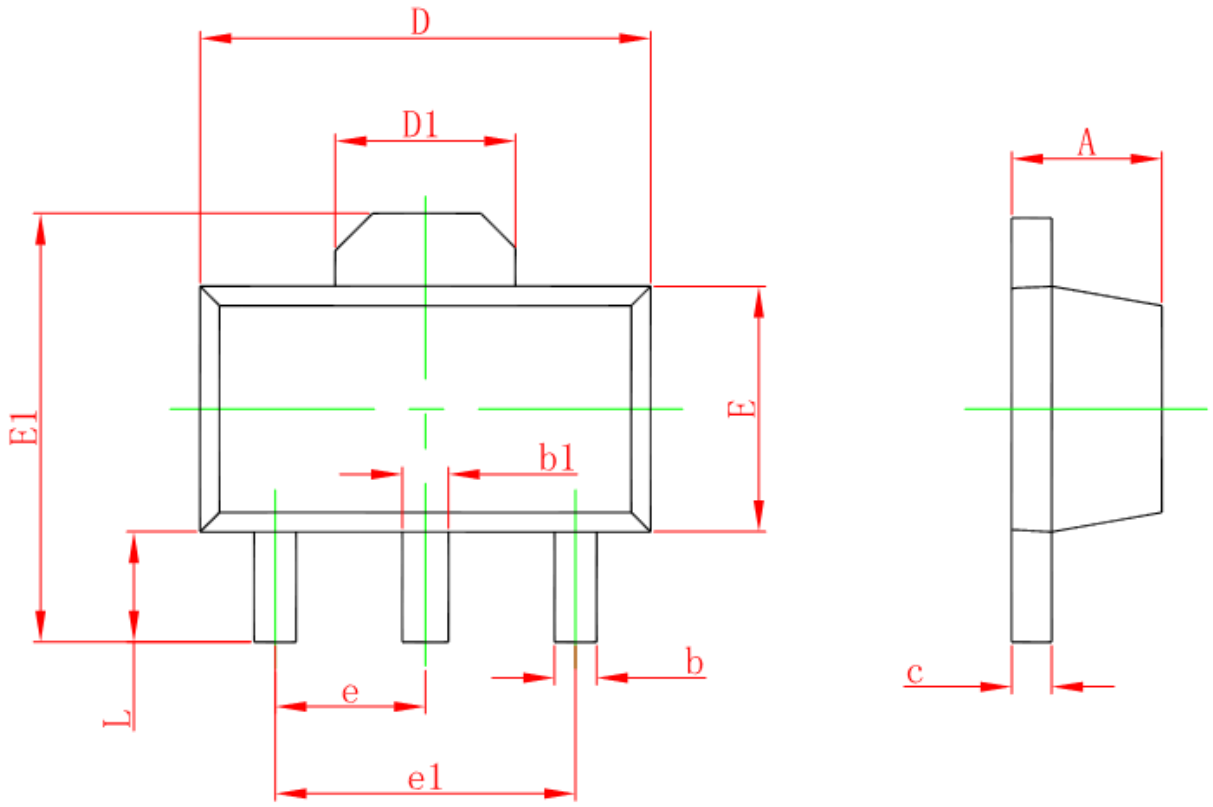

Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min	Max	Min	Max
A	1.400	1.600	0.055	0.063
b	0.320	0.520	0.013	0.020
b1	0.400	0.580	0.016	0.023
c	0.350	0.440	0.014	0.017
D	4.400	4.600	0.173	0.181
D1	1.550 REF.		0.061 REF.	
E	2.300	2.600	0.091	0.102
E1	3.940	4.250	0.155	0.167
e	1.500 TYP.		0.060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