ULTRA-SMALL Package PWM/PFM Switching Control

STEP-UP Switching Regulator

General Description

The ME2149 series is a CMOS step-up switching regulator which mainly consists of a reference voltage source, an oscillation circuit, an error amplifier, a phase compensation circuit, a PWM/PFM switching control circuit. With an internal low-ON-resistance Nch Power MOS, this product is applicable to applications requiring high efficiency and high output current. The ME2149 series switches its operation to the PFM control circuit whose duty ratio is 15 % with to the PWM/PFM switching control circuit under a light load and to prevent decline in the efficiency by IC operation current.

Features

- Low voltage operation: Start-up is guaranteed from 0.9V(I_{OUT} =1 mA)
- Duty ratio: Built-in PWM/PFM switching control circuit 15 to 78 % .
- oscillator frequency：1.0MHz
- Output voltage range：<20V
- Feedback voltage accuracy：±2%
- Soft start function: 2 mS

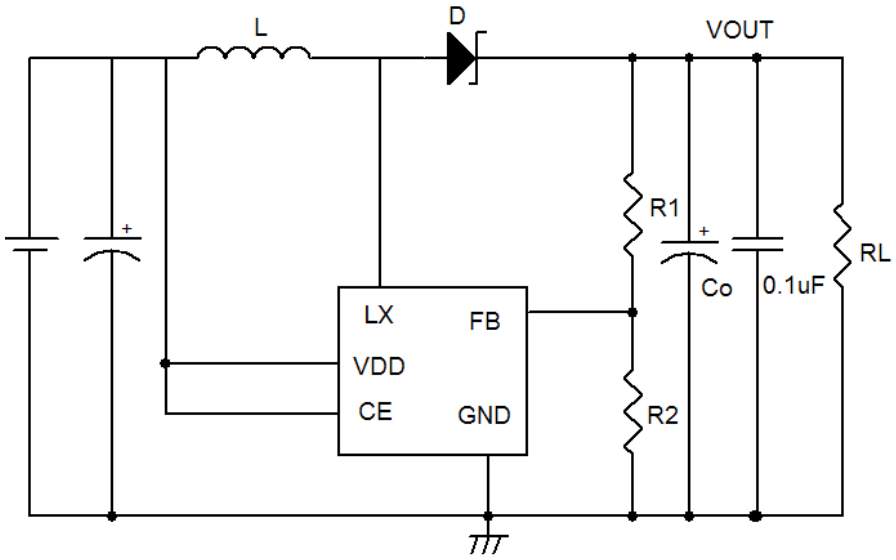
Applications

- MP3 players, digital audio players
- Digital cameras, GPS, wireless transceiver
- Portable devices

Package

- 5-pin SOT23-5、SOT89-5
- 8-pin SOP8

Typical Application Circuit

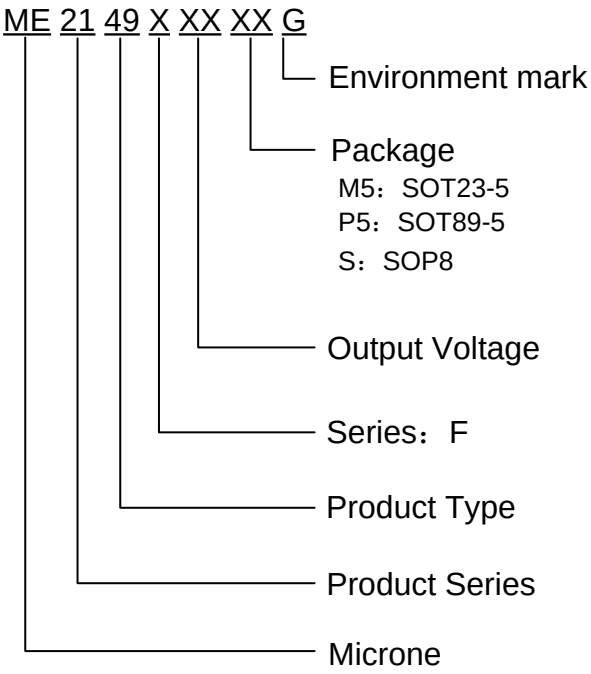


Note:

1. This product from the start when the VDD=0.9V booster work ,but in order to stabilize the output voltage and oscillation frequency ,to control the VDD,2.5V≦VDD<6V.

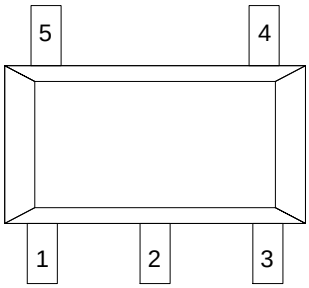
2. ME2149F has three packages, suggestion: SOT23-5 loading is not more than 1A; SOT89-5 is not more than 1.5A; SOP8 is not more than 2A.

Selection Guide

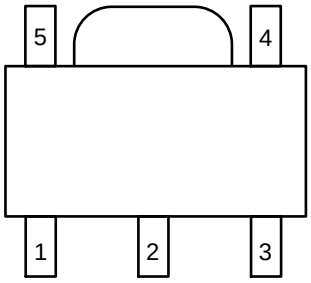


product series	switching transistor	CE function	VDD function	FB function	features	Package
ME2149FM5G	Build in	Yes	Yes	Yes	LX+FB	SOT23-5
ME2149FP5G	Build in	Yes	Yes	Yes	LX+FB	SOT89-5
ME2149FSG	Build in	Yes	Yes	Yes	LX+FB	SOP8

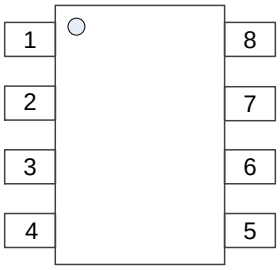
Pin Configuration



SOT23-5



SOT89-5

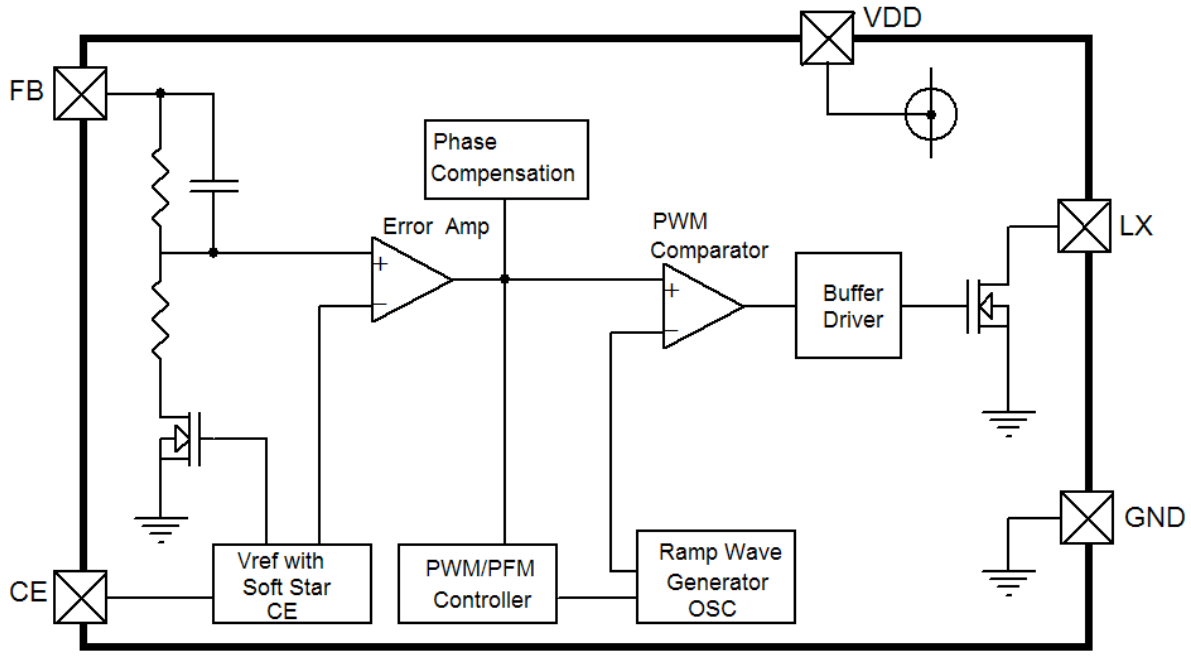


SOP8

Pin Assignment

Pin Number			Pin	Number
SOT23-5	SOT89-5	SOP8		
1	3	3	CE	Shutdown pin
2	2	7,8	LX	Power conversion pin
3	1	2	GND	GND pin
4	5	5,6	VDD	IC power supply pin
5	4	4	FB	Feed Back voltage pin

Block Diagram



Absolute Maximum Ratings

Parameter	Symbol	Rating		Unit
VDD Pin Voltage	VDD	-0.3 ~ 6.5		V
LX Pin Voltage	LX	-0.3 ~ 20		V
CE Pin Voltage	V_{CE}	-0.3 ~ VDD+0.3		V
LX Pin Current	I_{LX}	±4000		mA
Power Dissipation	Pd	SOT23-5	0.6	W
		SOT89-5	1.25	
		SOP8	0.92	
Thermal resistance	θ_{JA}	SOT23-5	210	ºC /W
		SOT89-5	100	
		SOP8	136	
Operating Temperature Range	T_{Opr}	-25 ~ +85		ºC
Storage Temperature Range	T_{stg}	-55 ~ +150		ºC

Electrical Characteristics

Measuring conditions：VDD=V_{CE}=3.3V，Topt=25℃。Unless otherwise specified。

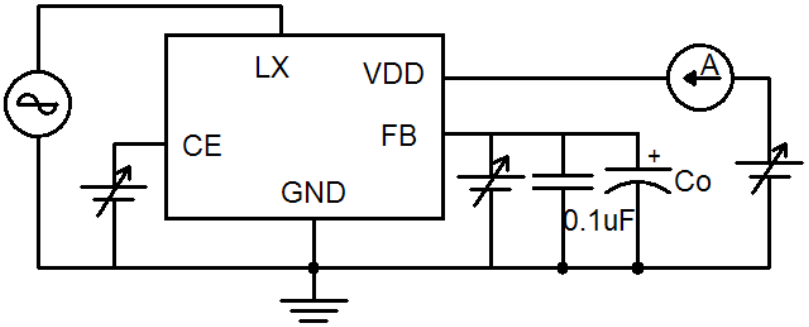
Parameter	Symbol	Condition		Min	Typ	Max	Unit	Circuit
Feedback voltage	V_{FB}	-		1.225	1.25	1.275	V	2
Input voltage	V_{IN}	-		-	-	6	V	2
Operation start voltage	V_{ST}	I_{OUT}=1mA		-	-	0.9	V	2
Operation holding voltage	V_{HLD}	I_{OUT}=1mA，Measured by decreasing VIN voltage gradually		0.7	-	-	V	2
Current consumption 1	I_{SS1}	V_{FB}=V_{FB}(S)× 0.95		-	4.0	-	mA	1
Current consumption 2	I_{SS2}	V_{FB}=1.5V		-	25	-	μA	1
Current consumption during shutdown	I_{SSS}	V_{CE}=0V		-	0.02	0.5	μA	1
Feedback voltage temperature coefficient		Ta=-25 ~ 85℃		-	±50	-	ppm/℃	2
Oscillation frequency	Fosc	-		0.8	1.0	1.2	MHz	1
Max. duty ratio	MAXDUTY	V_{FB}=V_{FB}(S)× 0.95		-	78	-	%	1
PWM/PFM switchingduty ratio	PFMDUTY	V_{FB}=V_{FB}(S)× 1.5, no load		-	15	-	%	1
Shutdown pin input voltage	V_{SH}	Measured the oscillation at LX pin		0.75	-	-	V	1
	V_{SL1}	Judged the stop of oscillation at LX pin	V_{OUT}≥1.5V	-	-	0.3	V	1
	V_{SL2}		V_{OUT}<1.5V	-	-	0.2	V	1
Shutdown pin input voltage	I_{SH}	V_{CE}=V_{FB}(S)×0.95		-0.1	-	0.1	μA	1
	I_{SL}	V_{CE}=0V		-0.1	-	0.1	μA	1
Soft start time	tss	-		-	2	-	mS	2
Efficiency	EFFI	-		-	90	-	%	2

Note:

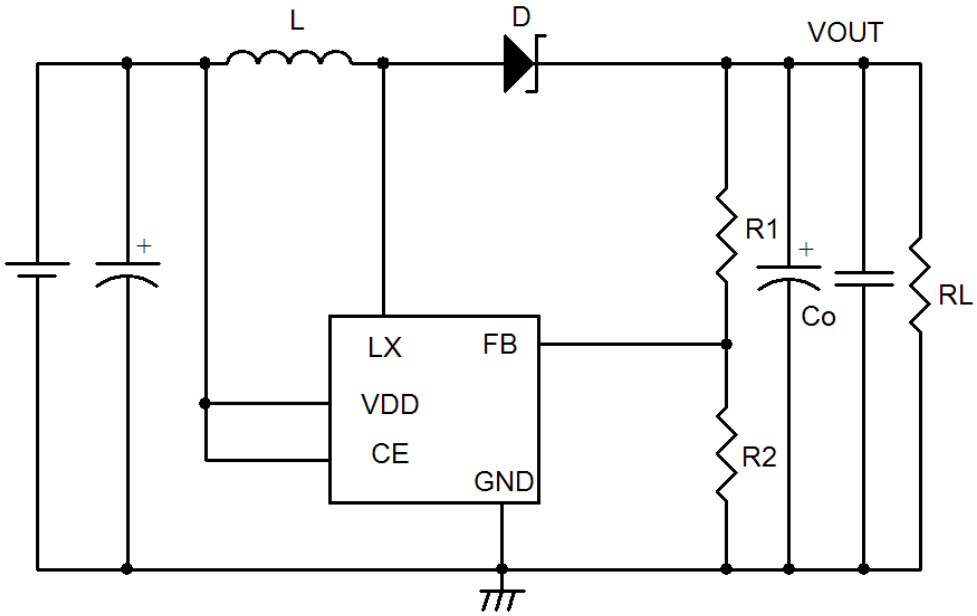
1. V_{OUT}(S) is the set output voltage value, and V_{OUT} is the typical value of the output voltage.
2. V_{OUT}(S) can be set by using the rate of V_{FB} and output voltage setting resistors (R1, R2).
3. V_{FB}(S) is the set output voltage value.
4. This product from the start when the VDD=0.9V booster work , but in order to stabilize the output voltage and oscillation frequency ,to control the VDD, 2.5V≦VDD<6V.

Test Circuit

1.



2.



External parts（suggest）

1、Diode use Schottky diode such as SS14 or　SS34 (forward voltage drop：0.2V)

2、Inductor：3.3μH（r<30mΩ）

3、Capacitor：ceramic　capacitor 22μF（It is best to use two parallel connection ceramic capacitors）

External parts selection for DC/DC converter

The relationship between major characteristics of the step-up circuit and characteristics parameters of the external parts are shown in Figure 1.

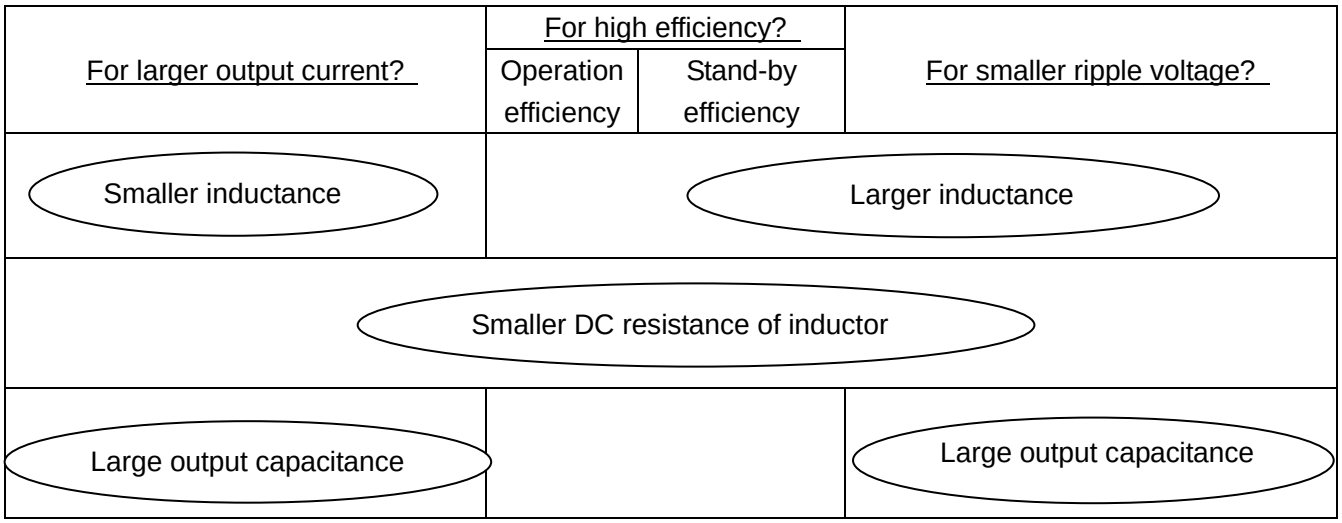


Figure 1 Relationship between major characteristics of the step-up circuit and external parts

1. Inductor

An inductance has strong influence on maximum output current I_{OUT} and efficiency η.1.

Figure 2 shows the relation between I_{OUT}, and η characteristics to L of ME2149.

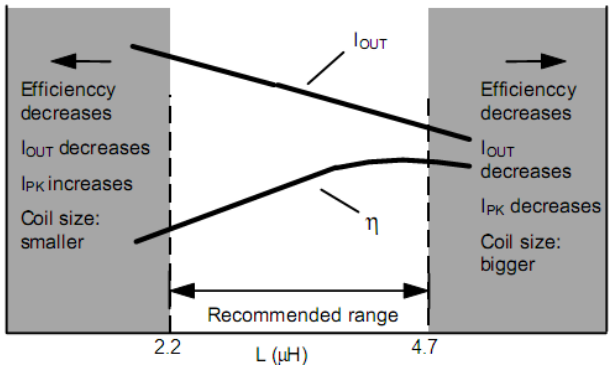


Figure 2 L－I_{OUT} and η characteristics

The peak current (I_{PK}) increases by decreasing L and the stability of a circuit improves and I_{OUT} increases. If L is furthermore made small, efficiency falls and in running short, I_{OUT} decreases. (Based on the current drive capability of external switching transistor.)

The loss of I_{PK} by the switching transistor decreases by increasing L and the efficiency becomes maximum at a certain L value. Further increasing L decreases efficiency due to the loss of DC resistance of the coil. Also, I_{OUT} decreases, too.

Oscillation frequency is higher, smaller one can be chose and also makes coil smaller. The recommended inductances are 2.2 to 4.7 μH inductor for ME2149.

Choose a value for L by referring to the reference data because the maximum output current is due to the input

voltage in an actual case. Choose an inductor so that I_{PK} does not exceed the allowable current. Exceeding the allowable current of the inductor causes magnetic saturation, remarkable low efficiency and destruction of the IC chip due to a large current.

I_{PK} in uncontinuous mode is calculated from the following equation:

$$I_{PK} = \sqrt{\frac{2I_{OUT}(V_{OUT} + V_D - V_{IN})}{f_{OSC}.L}}(A)$$

Fosc = oscillation frequency, V_{DD} =0.4 V.

2. Diode

Use an external diode that meets the following requirements:

- Low forward voltage: (V_F<0.3 V)
- High switching speed: (50 ns max.)
- Reverse voltage: V_{OUT} + V_F or more
- Rated current: I_{PK} or more

3. Capacitor (C_{IN}, C_O)

To improve efficiency, an input capacitor (C_{IN}) lowers the power supply impedance and averages the input current. Select C_{IN} according to the impedance of the power supply used. The recommended capacitance is 10μF for the ME2149.

An output capacitor (C_{OUT}), which is used to smooth the output voltage, requires a capacitance larger than that of the step-down type because the current is intermittently supplied from the input to the output side in the step-up type. A 22μF ceramic capacitor is recommended for the ME2149 . However, a higher capacitance is recommended if the output voltage is high or the load current is large. If the output voltage or load current is low, about 10μF can be used without problems.

Select C_{OUT} after sufficient evaluation with actual application.

A ceramic capacitor can be used for both the input and output.

4. Precautions

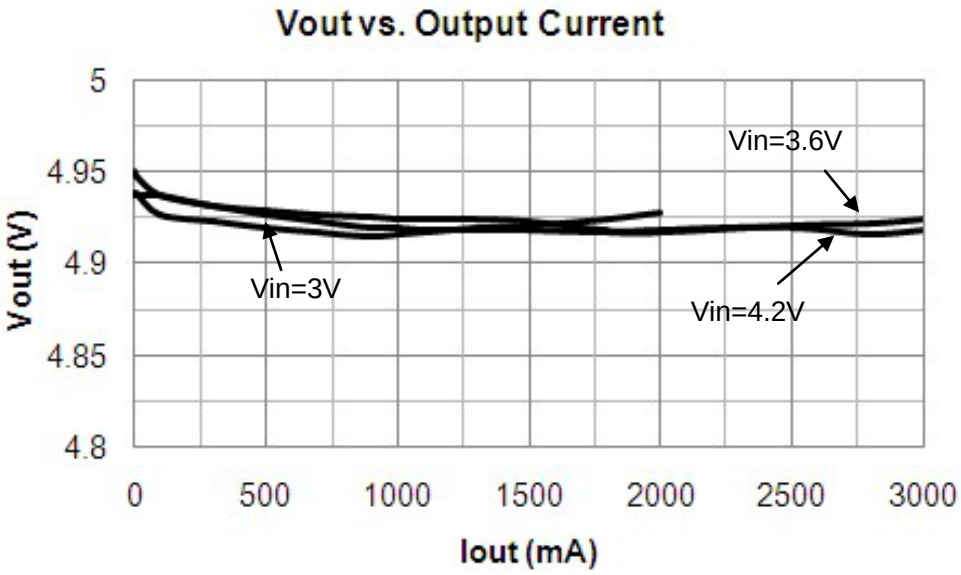
● Mount external capacitors, a diode, and a coil as close as possible to the IC.

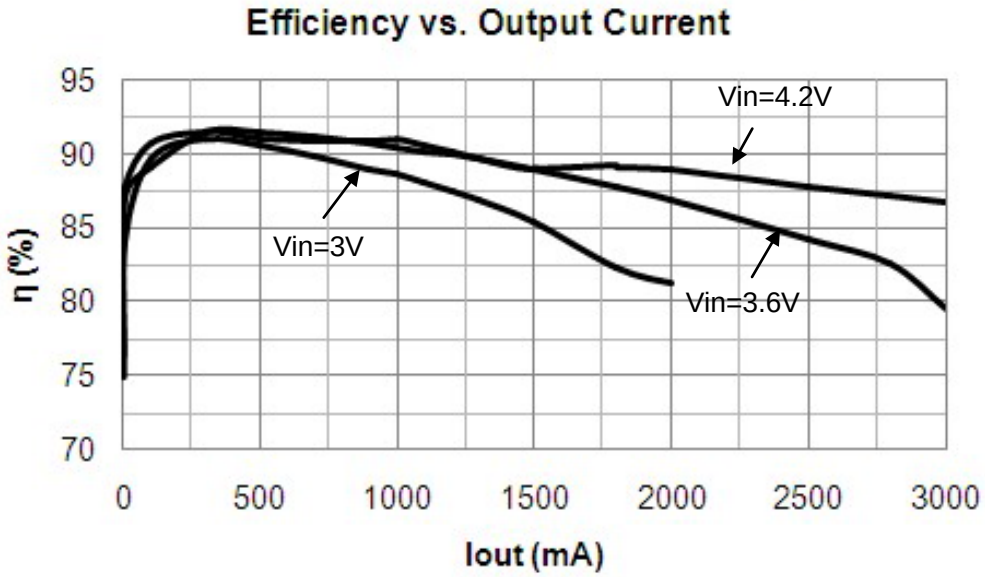
● Unique ripple voltage and spike noise occur in switching regulators. Because they largely depend on the coil and the capacitor used, check them using an actually mounted model.

●Make sure dissipation of the switching transistor (especially at a high temperature) does not exceed the allowable power dissipation of the package.

●The performance of this IC varies depending on the design of the PCB patterns, peripheral circuits and external parts. Thoroughly test all settings with your device. Also, try to use recommended external parts.

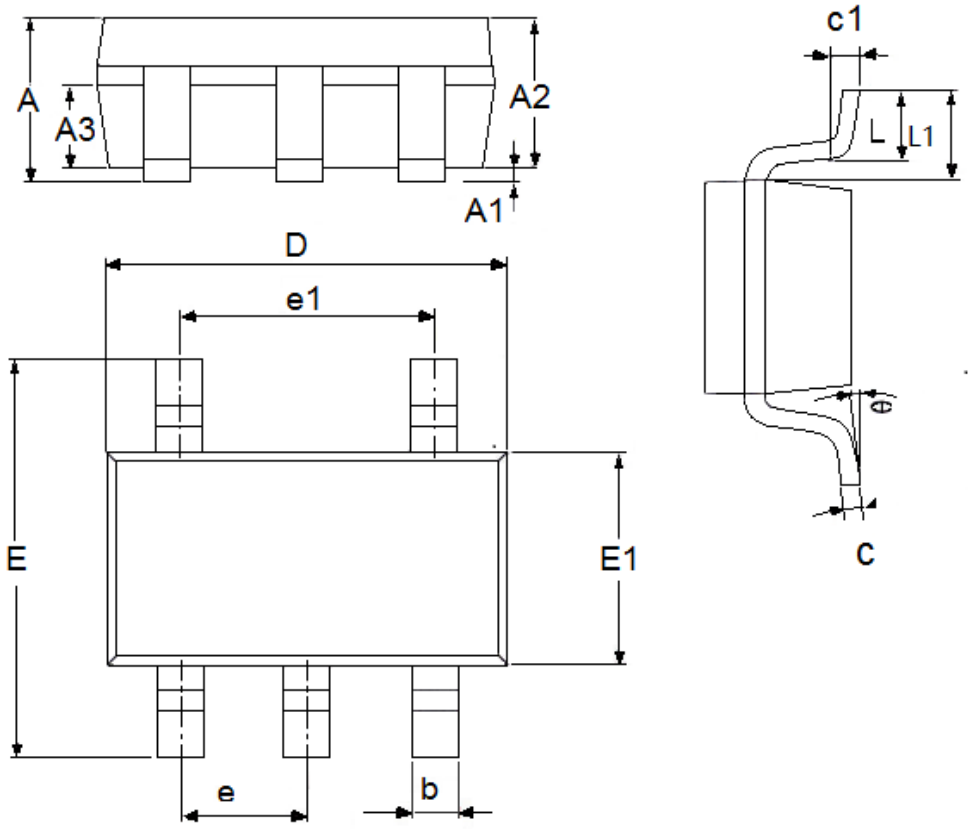
Typical Performance Characteristics





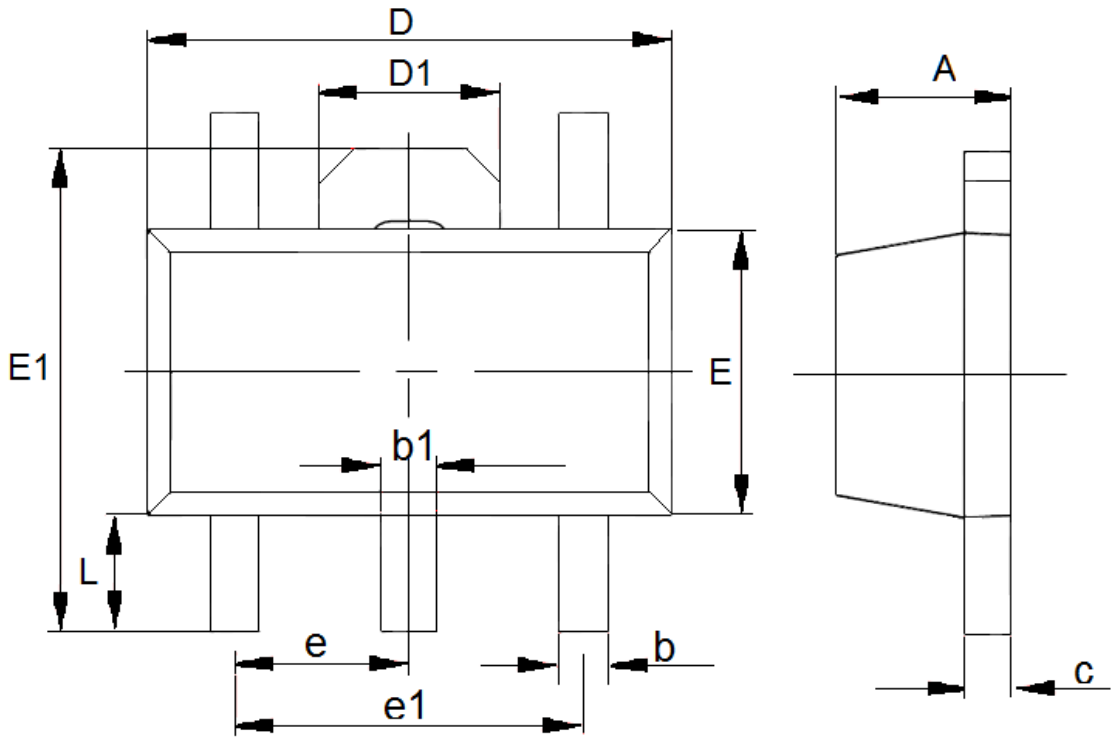
Packaging Information

- **Package Type：SOT23-5**



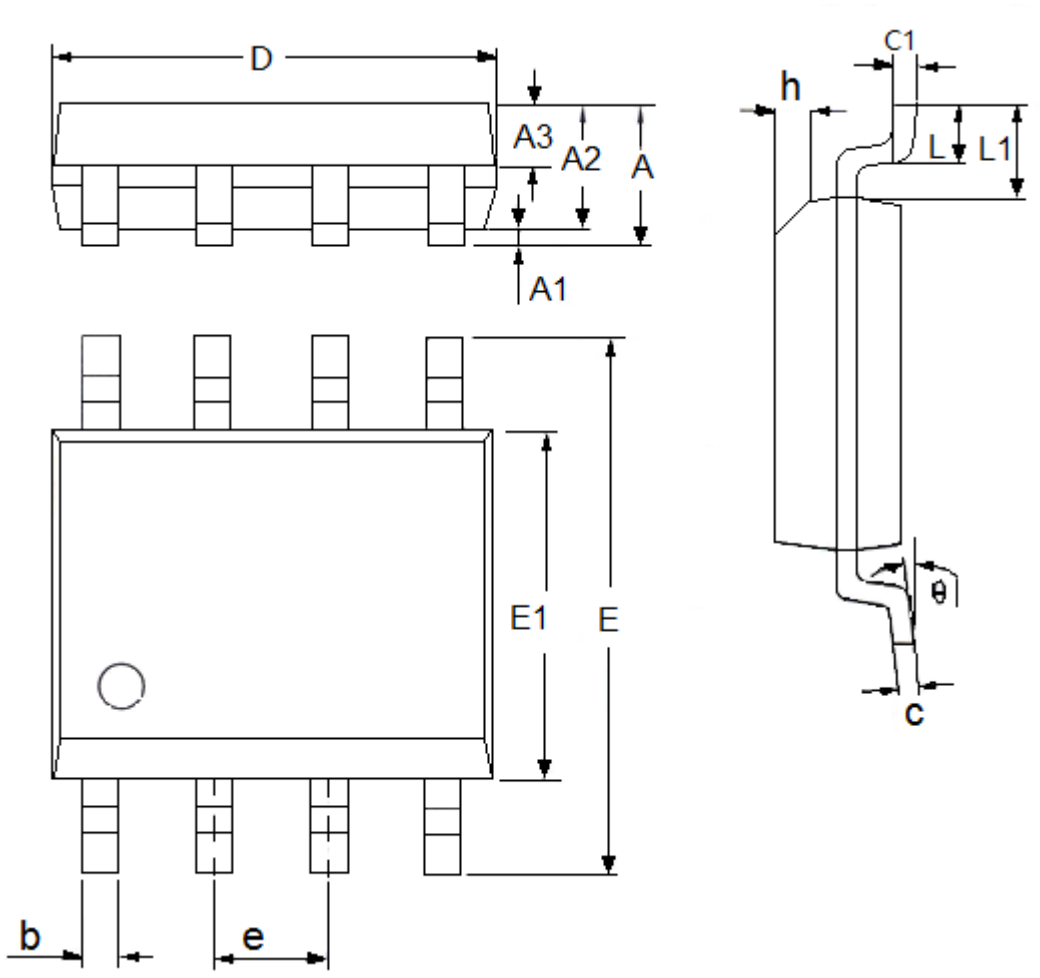
DIM	Millimeters		Inches	
	Min	Max	Min	Max
A	1.05	1.45	0.0413	0.0571
A1	0	0.15	0.0000	0.0059
A2	0.9	1.3	0.0354	0.0512
A3	0.6	0.7	0.0236	0.0276
b	0.25	0.5	0.0098	0.0197
c	0.1	0.23	0.0039	0.0091
D	2.82	3.05	0.1110	0.1201
e1	1.9(TYP)		0.0748(TYP)	
E	2.6	3.05	0.1024	0.1201
E1	1.5	1.75	0.0512	0.0689
e	0.95(TYP)		0.0374(TYP)	
L	0.25	0.6	0.0098	0.0236
L1	0.59(TYP)		0.0232(TYP)	
θ	0	8°	0.0000	8°
c1	0.2(TYP)		0.0079(TYP)	

- **Package Type：SOT89-5**



DIM	Millimeters		Inches	
	Min	Max	Min	Max
A	1.4	1.6	0.0551	0.0630
b	0.32	0.52	0.0126	0.0205
b1	0.38	0.58	0.0150	0.0228
c	0.35	0.47	0.0138	0.0185
D	4.4	4.6	0.1732	0.1811
D1	1.55(TYP)		0.061(TYP)	
e1	3(TYP)		0.1181(TYP)	
E	2.3	2.6	0.0906	0.1023
E1	3.94	4.4	0.1551	0.1732
e	1.5(TYP)		0.0591(TYP)	
L	0.8	1.2	0.0315	0.0472

- **Package Type：SOP8**



DIM	Millimeters		Inches	
	Min	Max	Min	Max
A	1.3	1.8	0.0512	0.0709
A1	0.05	0.25	0.002	0.0098
A2	1.25	1.65	0.0492	0.065
A3	0.5	0.7	0.0197	0.0276
b	0.3	0.51	0.0118	0.0201
c	0.17	0.25	0.0067	0.0098
D	4.7	5.1	0.185	0.2008
E	5.8	6.2	0.2283	0.2441
E1	3.8	4	0.1496	0.1575
e	1.27(TYP)		0.05(TYP)	
h	0.25	0.5	0.0098	0.0197
L	0.4	1.27	0.0157	0.05
L1	1.04(TYP)		0.0409(TYP)	
θ	0	8°	0	8°
c1	0.25(TYP)		0.0098(TYP)	

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