ULTRA-SMALL PACKAGE PWM/PFM SWITCHING CONTROL
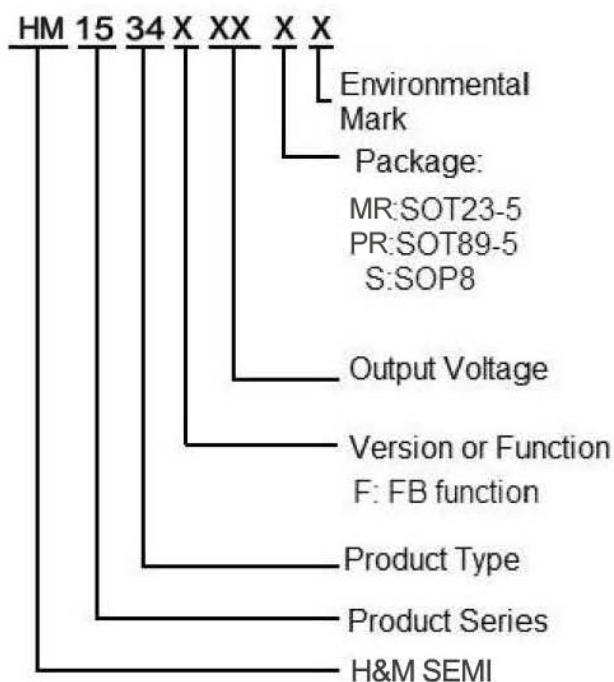
STEP-UP SWITCHING REGULATOR

Description

The HM1534 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 HM1534 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.

Feature

- Low voltage operation: Start-up is guaranteed from 0.9 V(I_{OUT} =1 mA)

- Duty ratio: Built-in PWM/PFM switching control circuit 15 to 78 % .

- oscillator frequency：1.0MHz

- Output voltage range: 1.5V ~12 V

- Output voltage accuracy：±2%

- Soft start function: 2 mS.

- PACKAGE：SOT23-5,SOT89-5,SOP8

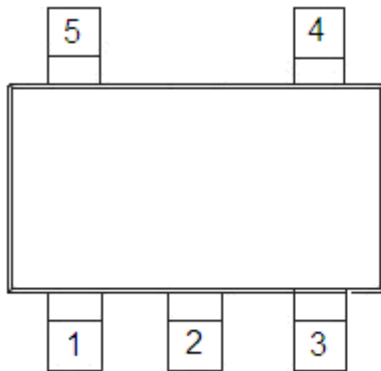### Selection Guide

HM 15 34 X XX X X

- Environmental Mark
- Package:
  MR:SOT23-5
  PR:SOT89-5
  S:SOP8
- Output Voltage
- Version or Function
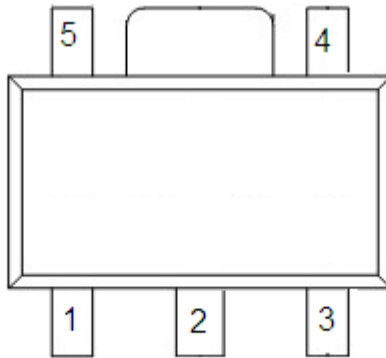 F: FB function
- Product Type
- Product Series
- H&M SEMI

Typical Application

- MP3 players, digital audio players

- Digital cameras, GPS, wireless transceiver

- Portable devices

Pin Configuration
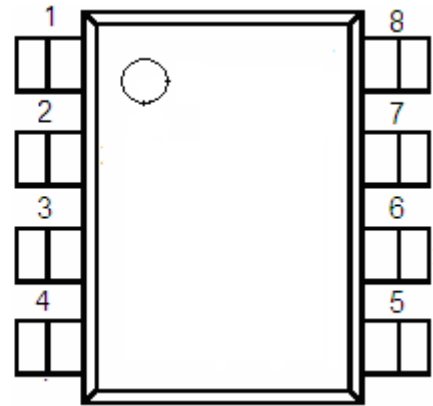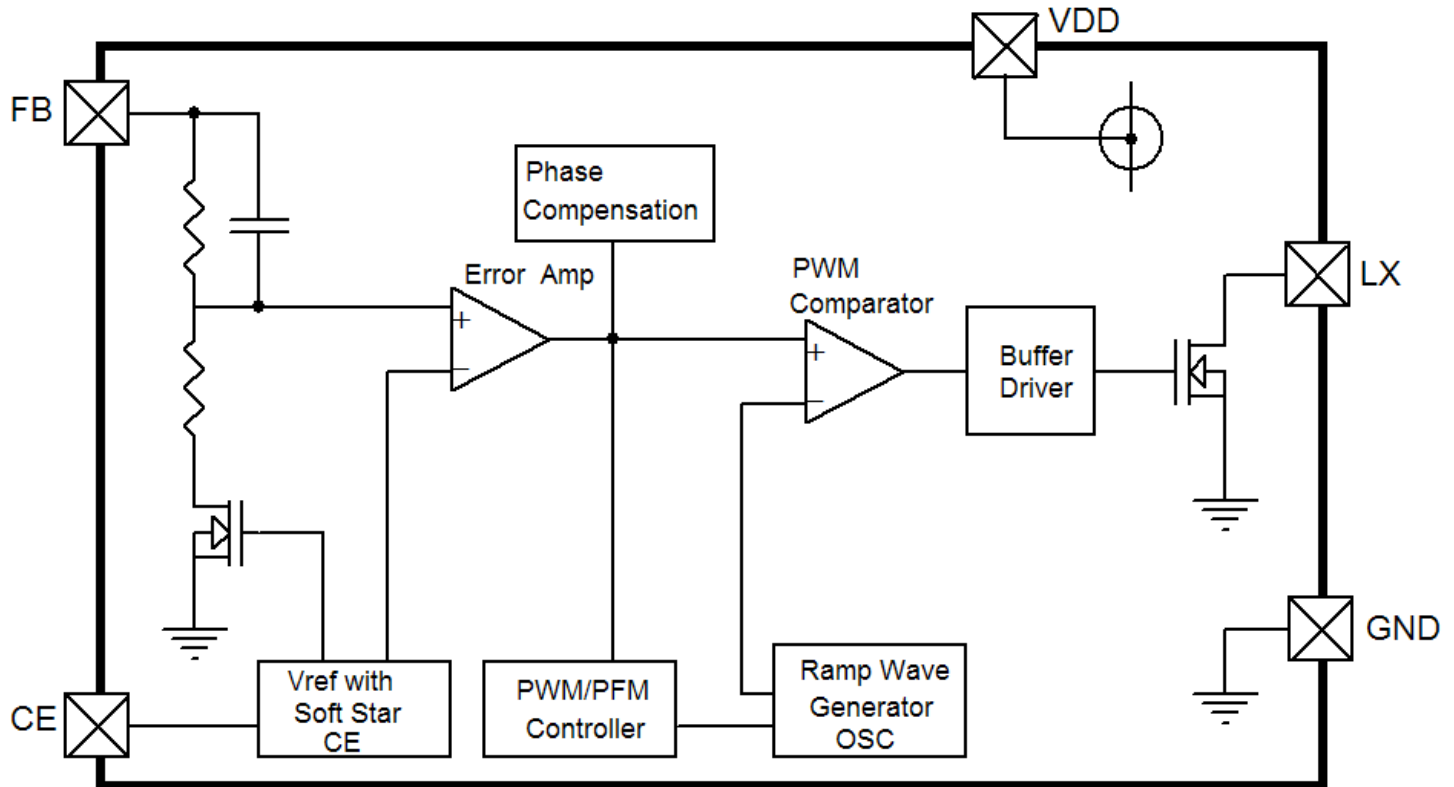

SOT23-5

SOT89-5

SOP8

Pin information

TYPE	POSFIX	PACKAGE	SWICHING TRANSISTOR	CE FUNCTION	VDD FUNCTION	FB FUNCTION	FEATURE
HM1534F	MR	SOT23-5	Build in Transistor	Yes	Yes	Yes	LX+FB
	PR	SOT89-5					
	SOP8	SOP8					

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Pin Number			Pin Name	Function
SOT23-5	SOT89-5	SOP8		
1	3	3	CE	Shutdown pin
2	2	7,8	LX	External transistor connection pin
3	1	2	GND	GND pin
4	5	5,6	VDD	IC power supply pin
5	4	4	FB	Feed Back voltage pin
		1	NC	NC

Block Diagram

Absolute Maximum Rang

PARAMETER	SYMBOL	RATING		UNIT
VDD Pin Voltage	VDD	$-0.3\sim6.5$		V
LX Pin Voltage	LX	$-0.3\sim20$		V
CE Pin Voltage	V_{CE}	$-0.3\sim Vin+0.3$		V
LX Pin Current	I_{LX}	±4000		mA
Power Dissipation	Pd	SOT23-5	300	mW
		SOT89-5	500	
		SOP8	800	
Operating Temperature Range	T_{Opr}	$-25\sim+85$		℃
Storage Temperature Range	T_{stg}	$-40\sim+125$		℃

Electrical Characteristics

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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	VDD	-		-	-	6	V	2
Operation start voltage	V$_{ST1}$	I$_{OUT}$=1mA		-	-	0.9	V	2
Oscillation start voltage	V$_{ST2}$	No external parts, voltage applied to V$_{OUT}$		-	-	0.7	V	1
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. VDD/V$_{OUT}$ separate type:

   1.8V≦VDD<6V is recommended to stabilize the output voltage and oscillation frequency.

Test Circuit

1.
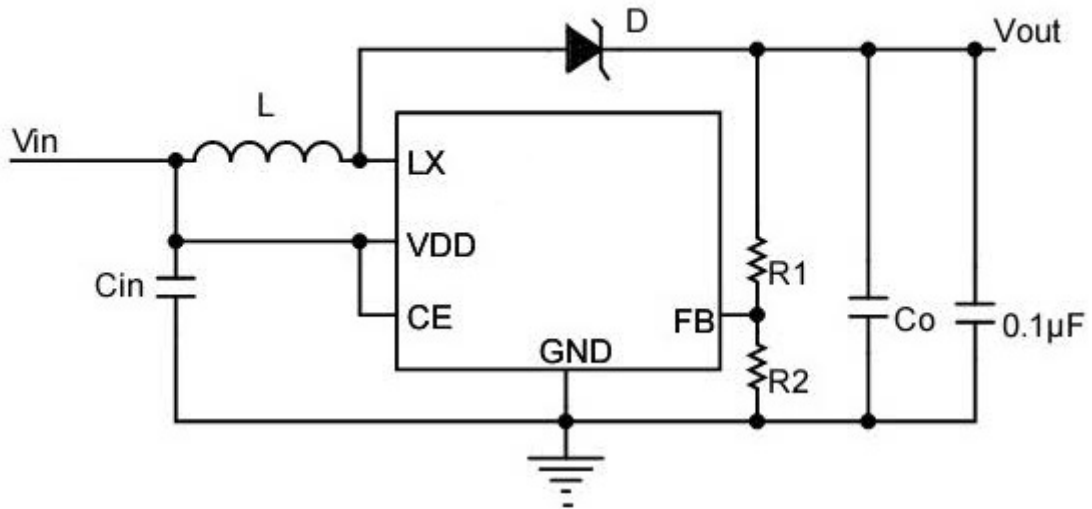
2.
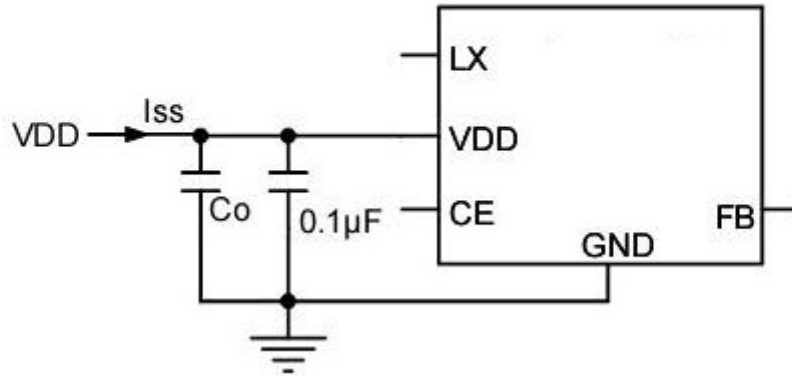
External parts（suggest）

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）

4、Feed back resistors:R1+R2<50KΩ

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.

For larger output current?	For high efficiency?		For smaller ripple voltage?
	Operation efficiency	Stand-by efficiency	
Smaller inductance		Larger inductance	
Smaller DC resistance of inductor			
Large output capacitance			Large output capacitance

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 HM1534.

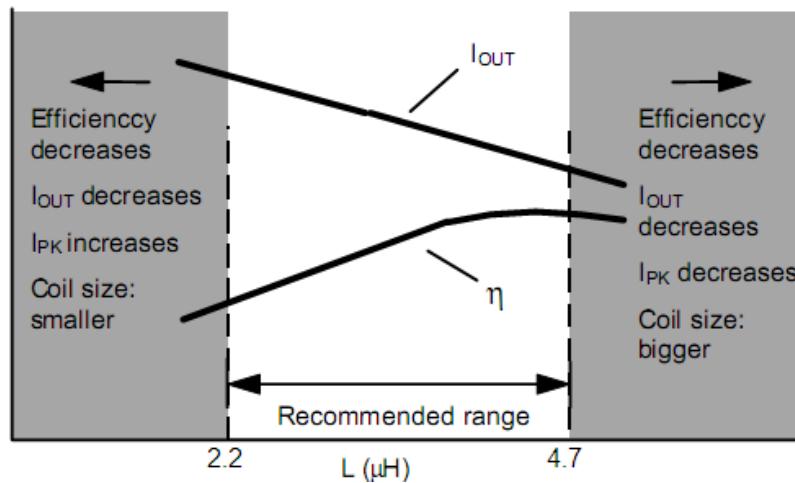Figure 2   L－I_{OUT} and η characteristics

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 HM1534.

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 HM1534.

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 HM1534 . 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 Application Circuit
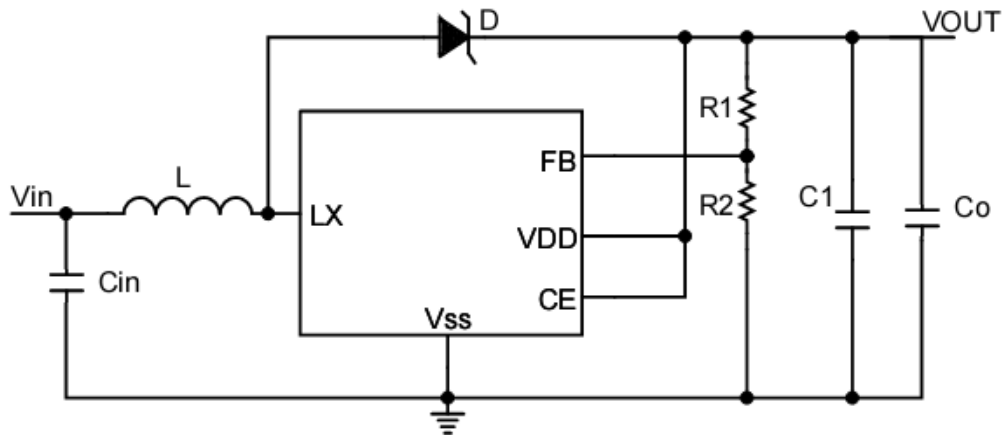
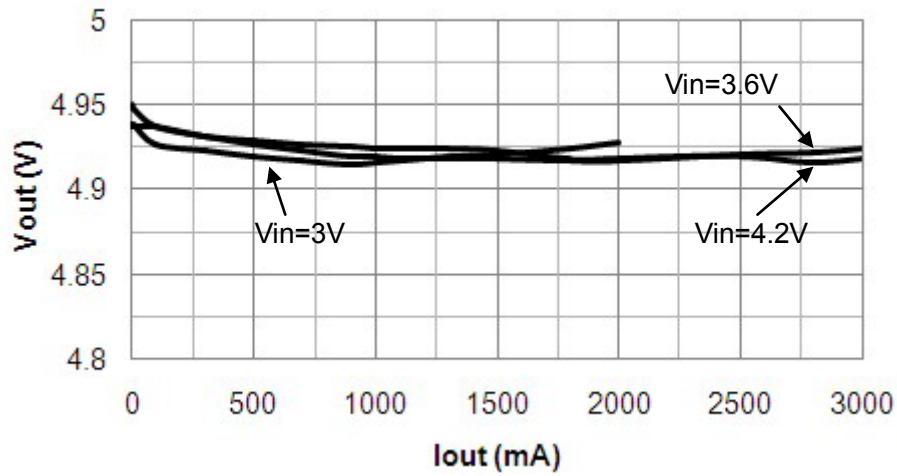For FB and external 1
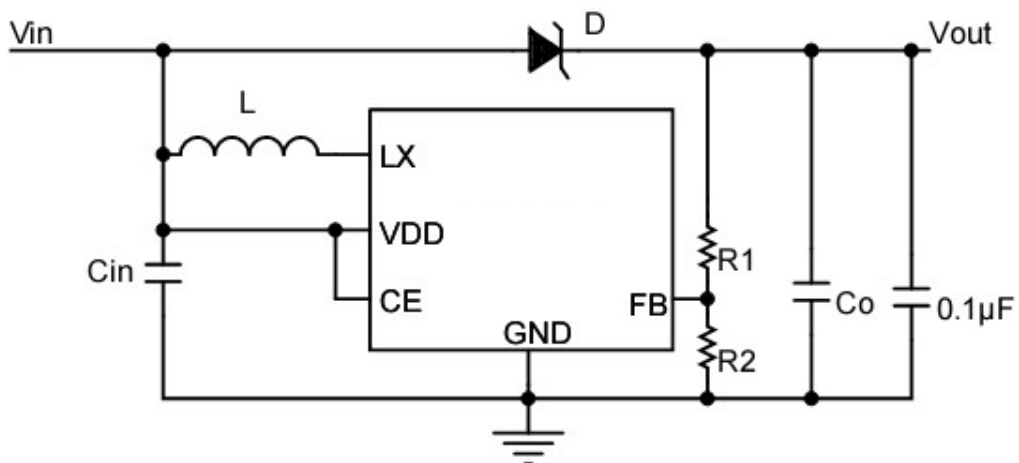
For FB and external 2

Note:

1. If VDD connected to Vin , Vin should above 2.5V.

2. ＜A‰'（F 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.
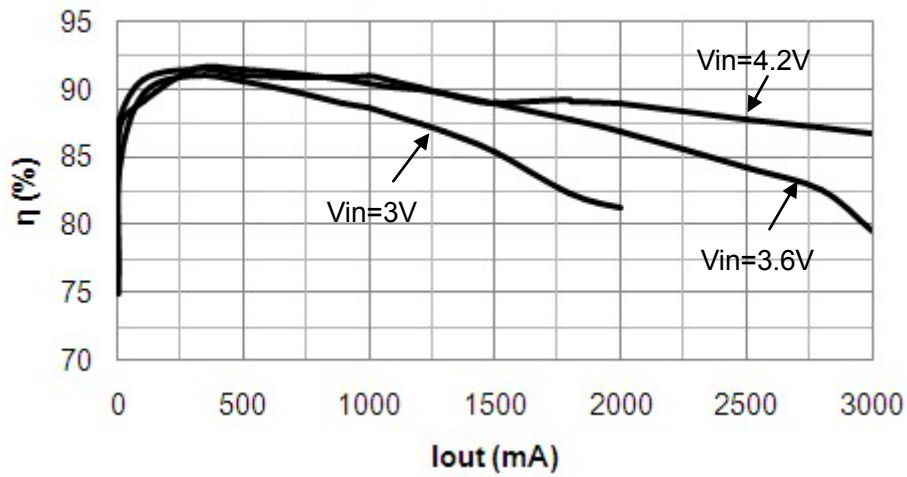
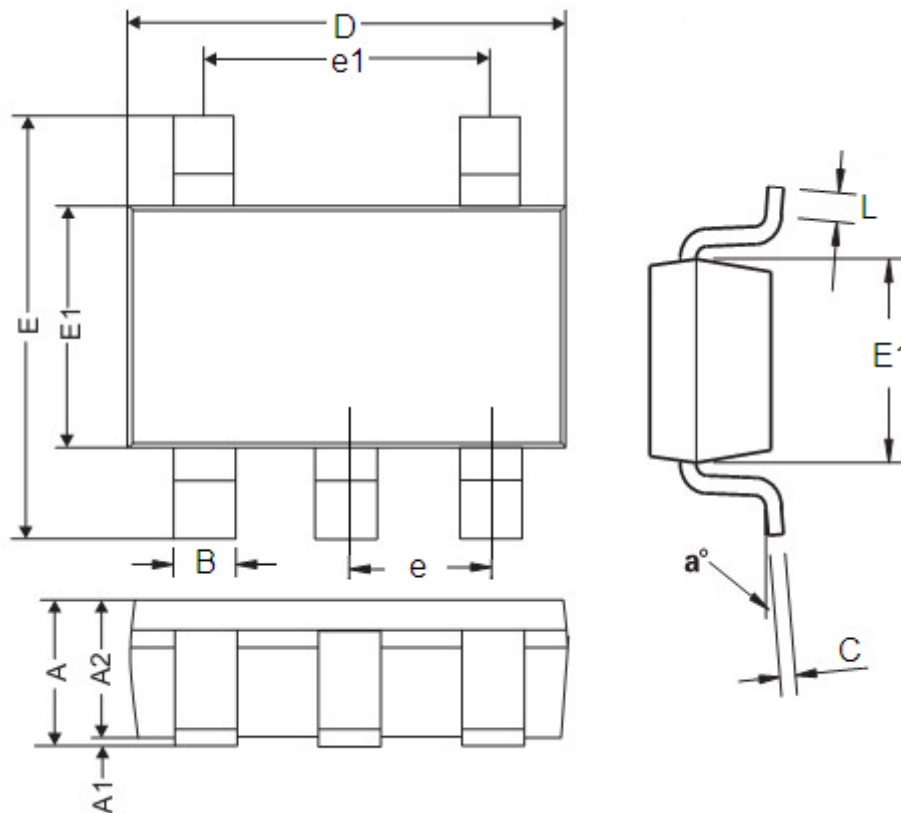**Typical Performance Characteristics**

Vout vs. Output Current

Vin=3.6V

Vin=3V

Vin=4.2V

Vout (V)

Iout (mA)

Efficiency vs. Output Current

Vin=4.2V

Vin=3V

Vin=3.6V

η (%)

Iout (mA)

Package Dimension

Package type:SOT23-5   Unit:mm(inch)

DIM	Millimeters		Inches	
	Min	Max	Min	Max
A	0.9	1.45	0.0354	0.0570
A1	0	0.15	0	0.0059
A2	0.9	1.3	0.0354	0.0511
B	0.2	0.5	0.0078	0.0196
C	0.09	0.26	0.0035	0.0102
D	2.7	3.10	0.1062	0.1220
E	2.2	3.2	0.0866	0.1181
E1	1.30	1.80	0.0511	0.0708
e	0.95REF		0.0374REF	
e1	1.90REF		0.0748REF	
L	0.10	0.60	0.0039	0.0236
a^0	0^0	30^0	0^0	30^0

Package Dimension

Package type:SOT89-5   Unit:mm(inch)
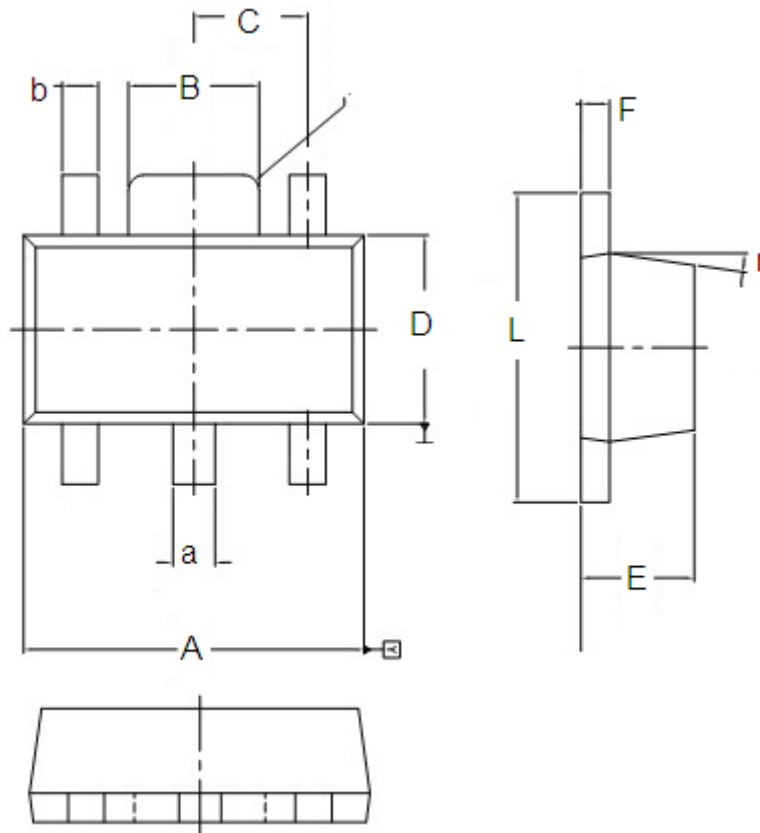
DIM	Millimeters		Inches	
	Min	Max	Min	Max
A	4.4	4.6	0.173	0.181
a	0.5	0.62	0.02	0.024
B	1.63	1.83	0.064	0.072
b	0.44	0.54	0.017	0.021
C	Type:1.5		Type:0.059	
D	2.4	2.6	0.094	0.102
E	1.4	1.6	0.054	0.063
F	0.35	0.43	0.013	0.017
L	3.95	4.25	0.155	0.167
r	Type:8^{0}		Type:8^{0}	

Package Dimension

Package type:SOP8   Unit:mm(inch)
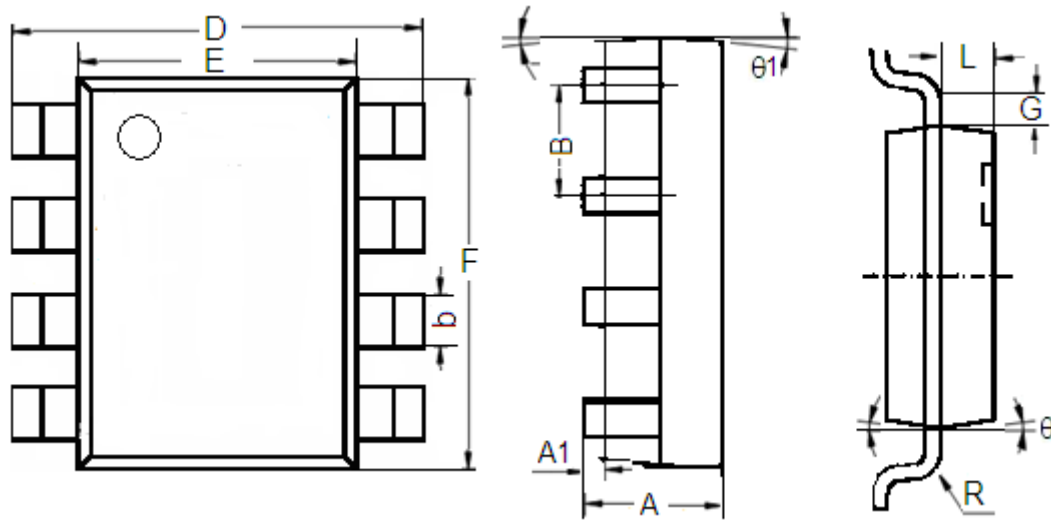
Character	Dimension (mm)		Dimension (Inches)	
	Min	**Max**	**Min**	**Max**
A	1.350	1.750	0.053	0.069
A1	0.1	0.3	0.004	0.012
B	1.27(Typ.)		0.05(Typ.)	
b	0.330	0.510	0.013	0.020
D	5.8	6.2	0.228	0.244
E	3.800	4.000	0.150	0.157
F	4.7	5.1	0.185	0.201
L	0.675	0.725	0.027	0.029
G	0.32(Typ.)		0.013(Typ.)	
R	0.15(Typ.)		0.006(Typ.)	
θ1	7°		7°	
θ	8°		8°	