



1.5MHz 1A Synchronous Step Down Converter

● Features

- Soft Start
- Internal Current Limit
- High Efficiency – Up to 93%
- Very Low Quiescent Current of 24uA
- Guaranteed 1A Output Current
- 1.5MHz Constant Frequency Operation
- Internal Synchronous Rectifier Eliminates Schottky Diode
- Adjustable Output Voltages From 0.6V to V_{IN}
- Fixed Output Voltage Options Available
- 100% Duty Cycle Low-Dropout Operation
- 0.1uA Shutdown Current
- Tiny SOT23-5L Package

● Applications

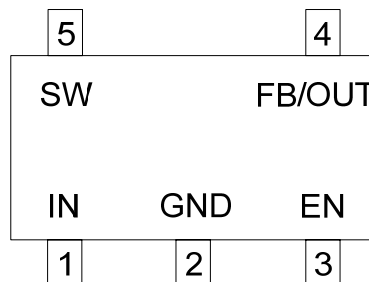
- Blue Tooth Headsets
- Portable Audio Players
- Mobile Phones
- Wireless and DSL Modems
- Digital Cameras
- Portable Instruments

● General Description

The FS1402 is a fixed-frequency current-modes Synchronous PWM step down converter that is capable of delivering 1A of output current while achieving peak efficiency of 93%. Under light load conditions, the FS1402 operates in a proprietary pulse skipping mode that consumes just 24uA of supply current, maximizing battery life in portable applications. The FS1402 operates with a fixed frequency of 1.5MHz, minimizing noise in noise-sensitive applications and allowing the use of small external components. The FS1402 is an ideal solution for applications powered by Li-Ion batteries or other portable applications that require small board space.

The FS1402 is available in a variety of fixed output voltage options, 1.2V, 1.5V, 1.8V, 2.5V and is also available in an adjustable output voltage version capable of generating output voltage version from 0.6V to V_{IN} . The FS1402 is available in the tiny 5-pin SOT23-5L package.

● Pin Configurations



SOT23-5L



● Absolute Maximum Ratings

Parameter	Symbol	Ratings	Unit
IN Pin Voltage	V _{IN}	-0.3 to 7V	V
FB Pin Voltage	V _{FB}	-0.3 to 7V	
EN Pin Voltage	V _{EN}	-0.3 to 7V	
SW Pin Voltage	V _{sw}	-0.3 to V _{IN} + 0.3	
Continuous SW Current	I _{sw}	Internally limited	A
Maximum Power Dissipation (derate 5.3mW/°C above T _A =50°C)	P _D	530	mW
Operating Junction Temperature	T _{opr}	-40 to + 150	°C
Storage Temperature Range	T _{stg}	-55 to + 150	
Lead Temperature (Soldering, 10 seconds)	T _{solder}	300	

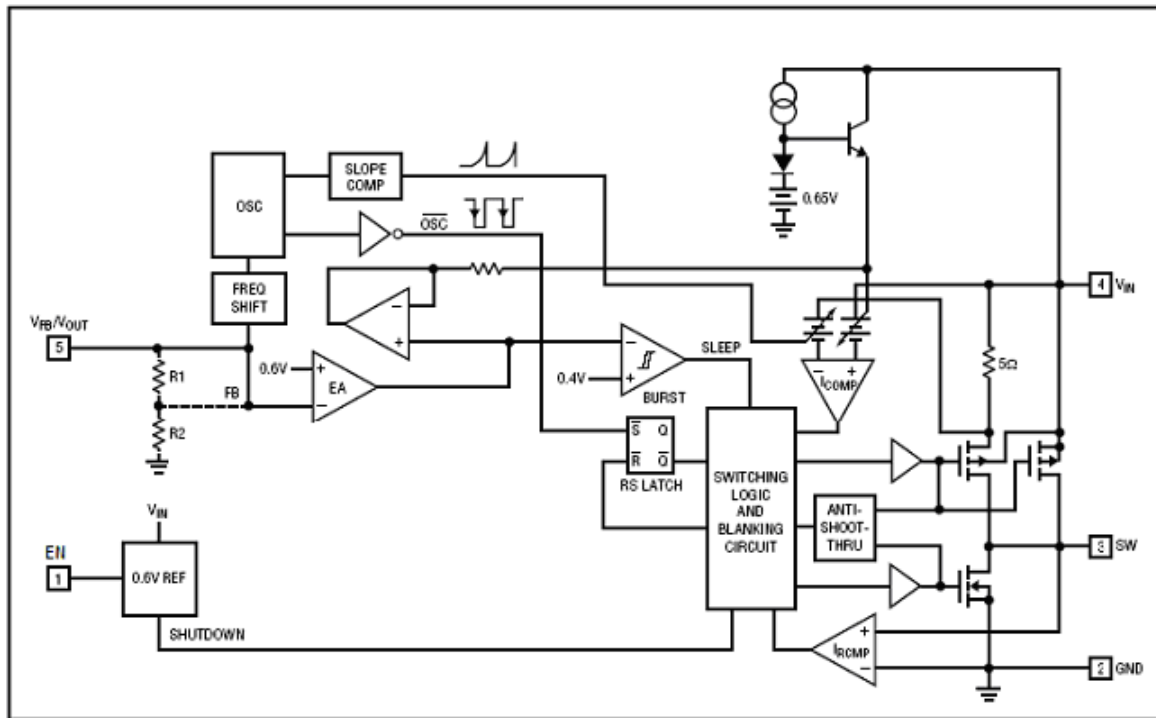
● Electrical Characteristics

(V_{IN}=V_{EN}=3.6V, T_A= 25°C C_{IN}=4.7uF C_{OUT}=10uF all capacitors are ceramic, unless otherwise specified.)

Parameter	Symbol	Conditions	Min	Typ	Max	Units
Input Voltage Range	V _{IN}		2.5		6.5	V
Under Voltage Lockout Threshold	V _{UVLO}	V _{IN} rising, hysteresis =0.1V	2.25	2.4	2.5	V
Operating Supply Current		V _{FB} =60%, I _{OUT} =0	--	586	--	uA
Standby Supply Current		V _{FB} =105%, I _{OUT} =0	--	22	33	uA
Shutdown Supply Current		V _{EN} =0V, V _{IN} =4.2V	--	0.1	5	uA
Adjustable Version Regulation Voltage	V _{FB}	T _A =25°C	0.591	0.6	0.609	V
		0°C<T _A <85°C	0.588	0.6	0.612	V
		-40°C<T _A <85°C	0.582	0.6	0.618	V
Fixed Output Regulation voltage	V _{OUT}	FS1402-12SK	1.178	1.2	1.222	V
		FS1402-15SK	1.473	1.5	1.527	
		FS1402-18SK	1.768	1.8	1.832	
		FS1402-25SK	2.455	2.5	2.545	
Output Voltage Line Regulation		V _{IN} =3V to 5V	--	0.016	0.4	%/V
Output Voltage Load Regulation		I _{OUT} =10mA to 500mA	--	0.5	--	%
Inductor Current Limit	I _{LIM}	V _{IN} =3.6V, V _{FB} =90% of V _{OUT(NOM)}	--	1.4	--	A
Oscillator Frequency	f _{sw}	V _{FB} or V _{OUT} in regulation	1.2	1.5	1.8	MHz
		V _{FB} or V _{OUT} =80% , of V _{OUT(NOM)}	--	360	--	KHz
PMOS On Resistance	R _{ONP}	I _{SW} =-100mA	--	0.37	0.6	Ω
NMOS On Resistance	R _{ONN}	I _{SW} =100mA	--	0.36	0.6	Ω
SW Leakage Current		EN=GND, V _{IN} =5.5V V _{SW} =5.5V	--	--	1	uA
EN Logic High Threshold	V _{IH}	V _{IN} =2.7V to 5.5V	1.4	--	--	V
EN Logic Low Threshold	V _{IL}	V _{IN} =2.7V to 5.5V			0.4	V
EN Input Bias Current	I _{EN}	V _{IN} =5.5V, EN=GND or IN		0.01	0.1	uA



● Typical Block Diagram



● Pin Description

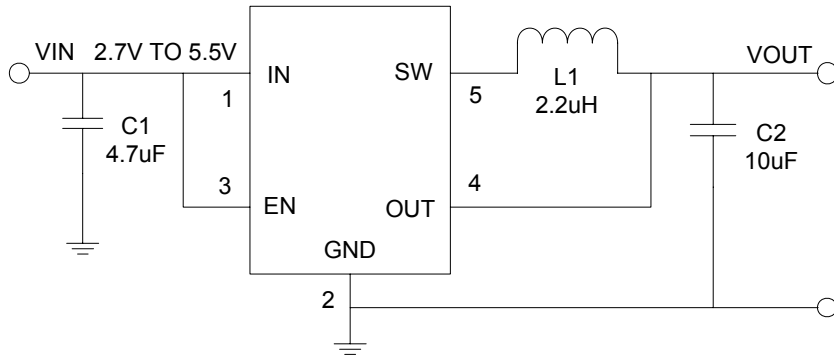
FS1402-①②③④

Designator	Symbol	Description
①②	Output Detection Voltage	18=1.8V,33=3.3V, AD=ADJ
③④	Package Type:	SK: SOT23-5L

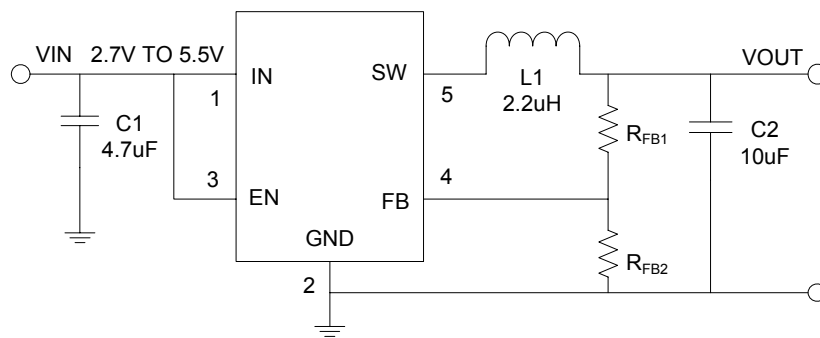
Pin Name	Pin Description
①	IN Power Input. Bypass to GND as close as possible to the IC with a high quality ceramic capacitor.
②	GND Ground.
③	EN Enable Control Input. Drive EN to IN or to a logic high for normal operation, drive to GND or a logic low to disable the regulator.
④	OUT / FB Feedback Node. For fixed output voltage options, connects this pin directly to the output. For the Adjustable output version the voltage at this pin is regulated to 0.6V; connect to this pin to the center of the output voltage feedback network.
⑤	SW Switching Node Output. Connect this pin to the switching end of the inductor.



● Application Information



For fixed voltage



For adjustable

● Application note:

- 1、 Inductor Value (Table 1)

Table 1. Typical Inductor Values

V _{OUT}	0.6V to 0.9V	0.9V to 1.8V	>1.8V
L	1.5uH	2.2uH	2.7uH

- 2、 C_{IN}=4.7uF(ceramic capacitor).
- 3、 C_{OUT}=10uF(ceramic capacitor).
- 4、 Output Voltage Programming

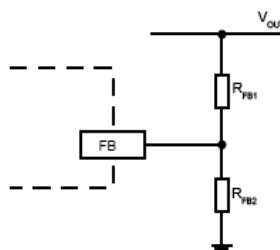


Figure 1. Output Voltage Programming

Figure 1 shows the Feedback network necessary to set the output voltage when the adjustable version is used. Select the proper ratio of the two feedback resistors R_{FB1} and R_{FB2} based on the desired output voltage. Typically choose



$R_{FB2} \approx 100K\Omega$ and determine R_{FB1} from the output voltage:

$$R_{FB1} = R_{FB2} \left(\frac{V_{OUT}}{0.6V} - 1 \right)$$

Connect a small capacitor across R_{FB1} for feed forward capacitance at the FB pin:

$$C_{ff} = 2 \times 10^{-5} / R_{FB1}$$

where $R_{FB1} = 900K\Omega$ use 22pF. When using very low ESR output capacitors, such as ceramic, check for stability while examining load-transient response, and increase the compensation capacitor C_1 if needed.

5. Dropout Operation

As the input supply voltage decreases to a value approaching the output voltage, the duty cycle increases toward the maximum on-time. Further reduction of the supply voltage forces the main switch to remain on for more than one cycle until it reaches 100% duty cycle. Possible occurred larger ripple on the low-dropout operation. Recommended operating voltage $V_{IN} \geq V_{OUT} + 0.7V$

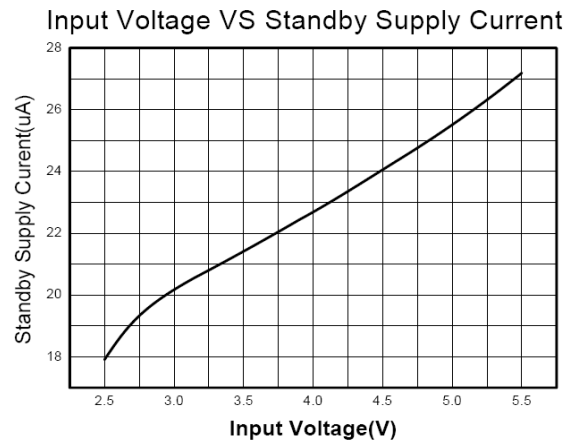
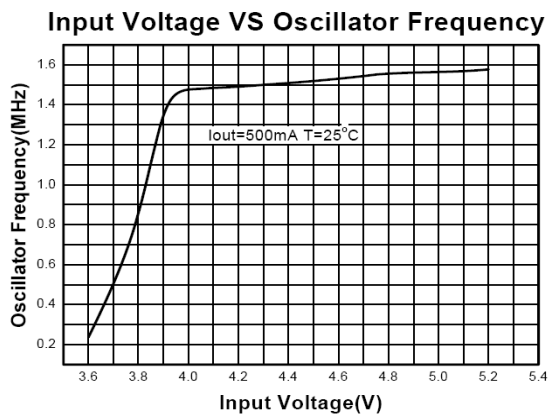
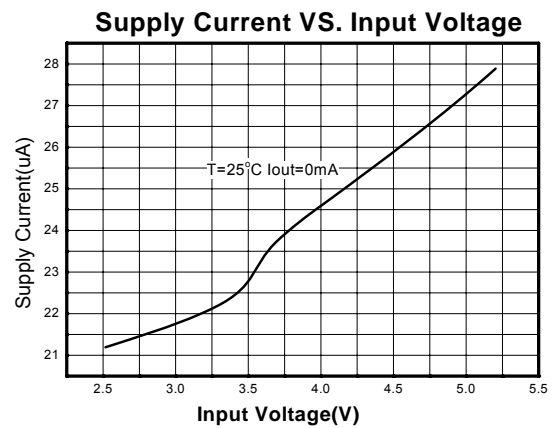
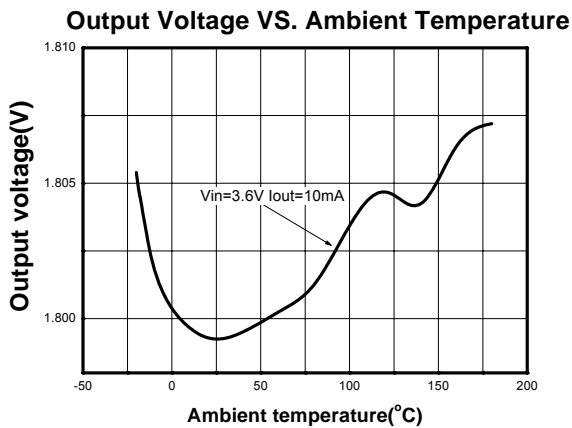
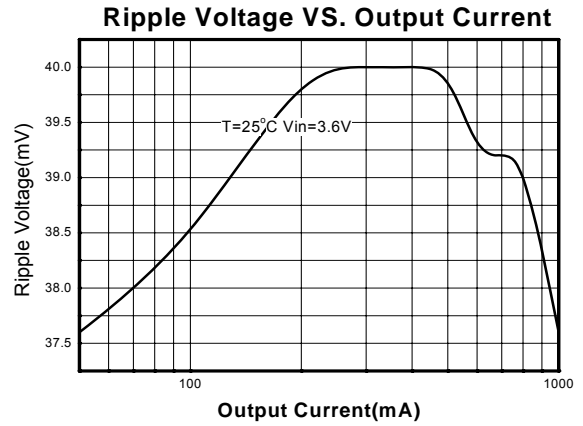
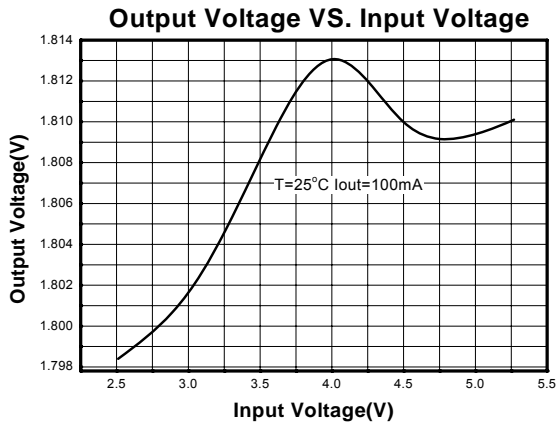
● PCB layout caution

1. The power traces, consisting of the GND trace, the SW trace and the V_{IN} trace should be keep short, direct and wide.
2. V_{FB} should be connected directly to the feedback resistors, The resistive divider R_1/R_2 must connected between the (+) plate of C_{out} and ground.
3. The (+) plate of C_{IN} should be connected to V_{IN} as closely as possible, because this capacitor provides the AC current to the internal power MOSFETS.
4. Keep the switching node SW away from the sensitive V_{FB} node
5. Keep the (-) plates of C_{IN} and C_{OUT} as close as possible
6. The high current paths



● **Typical Performance Characteristics**

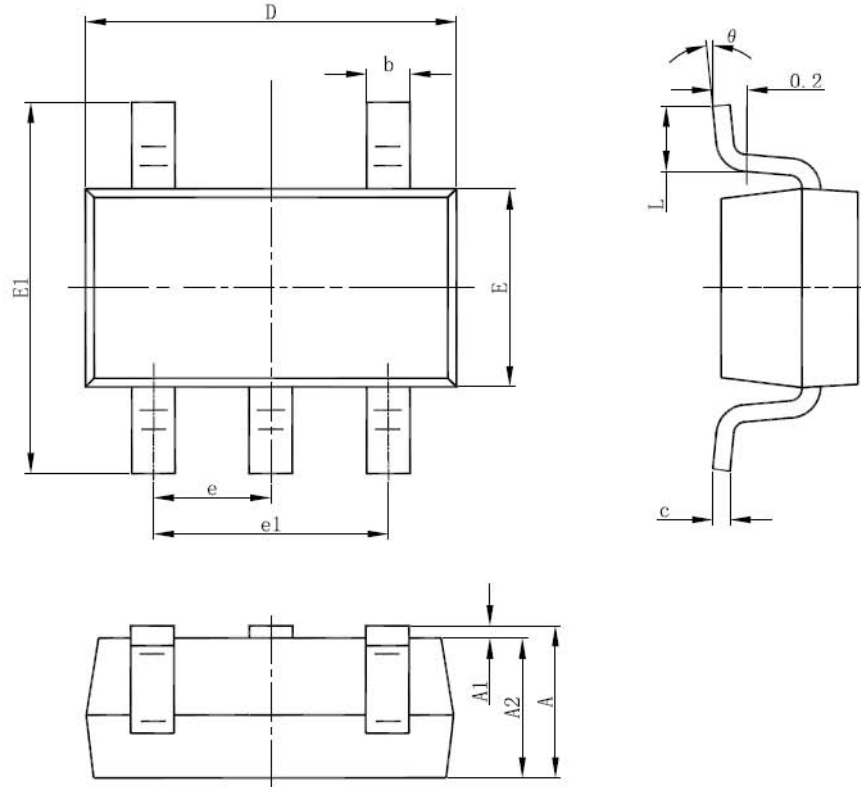
For FS1402A/B-1.8V





● Package Information

SOT-23-5L PACKAGE OUTLINE DIMENSIONS



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
theta	0°	8°	0°	8°