2MHz 2A MAX Output Synchronous Step Down Converter

Features

- Soft Start
- Internal Current Limit
- High Efficiency – Up to 95%
- Very Low Quiescent Current of 40uA
- MAX 2A Output Current at V_{IN}=3V
- 2MHz 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

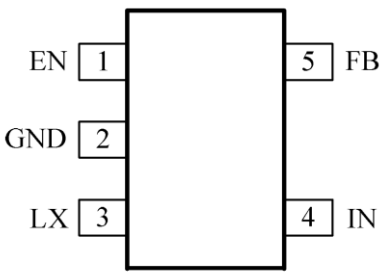
- Blue Tooth Headsets
- Portable Audio Players
- Mobile Phones
- Wireless and DSL Modems
- Digital Cameras
- Portable Instruments

General Description

The FS1405 is a fixed-frequency current-modes Synchronous PWM step down converter that is capable of delivering MAX 2A of output current while achieving peak efficiency of 95%.Under light load conditions, the FS1405 operates in a proprietary pulse skipping mode that consumes just 40uA of supply current, maximizing battery life in portable applications. The FS1405 operates with a fixed frequency of 2MHz, minimizing noise in noise-sensitive applications and allowing the use of small external components. The FS1405 is an ideal solution for applications powered by Li-Ion batteries or other portable applications that require small board space.

The FS1405 is available in an adjustable output voltage version capable of generating output voltage version from 0.6V to V_{IN}. The FS1405 is available in the tiny 6-pin SOT23-5L package.

Pin Configurations



FS1405 / SOT25L

Absolute Maximum Ratings

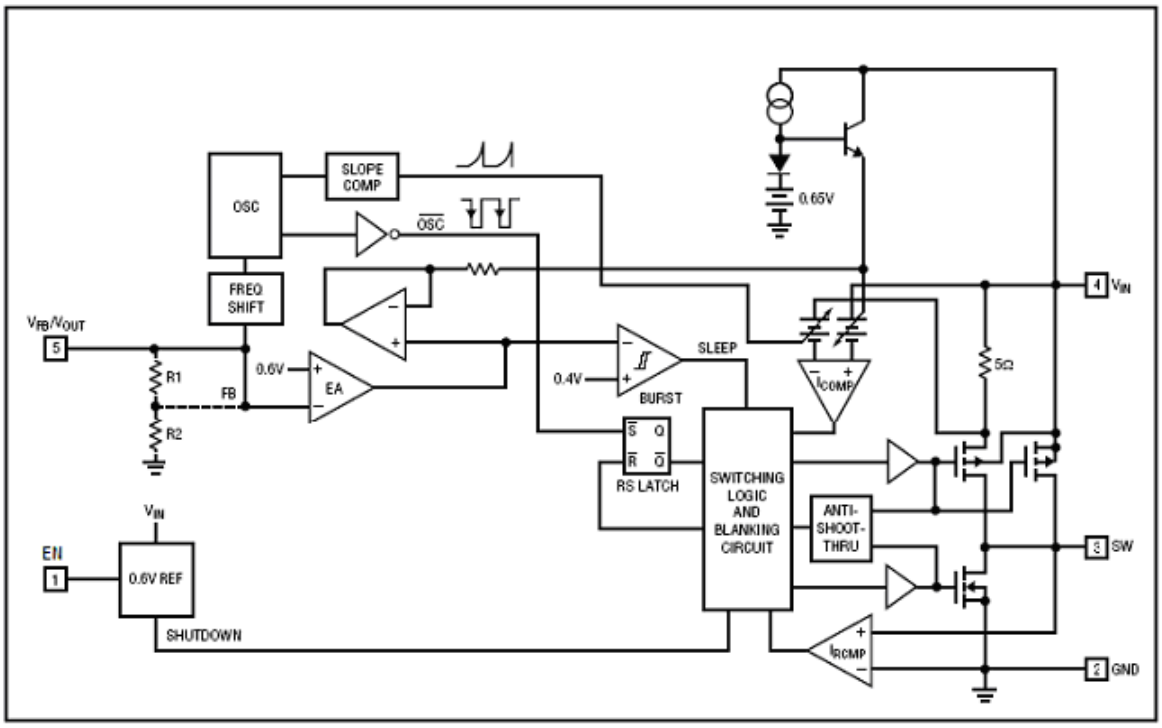
Parameter	Symbol	Ratings	Unit
IN Pin Voltage	V_{IN}	-0.3 to 7V	V
FB Pin Voltage	V_{FB}	-0.3 to 7V	V
EN Pin Voltage	V_{EN}	-0.3 to 7V	V
SW Pin Voltage	V_{sw}	-0.3 to V_{IN} + 0.3	V
Continuous SW Current	I_{sw}	Internally limited	A
Maximum Power Dissipation (derate 5.3mW/℃ above T_A=50℃)	P_D	530	mW
Operating Junction Temperature	T_{opr}	-40 to + 150	℃
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_{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	--	33	40	uA
Shutdown Supply Current		V_{EN}=0V,V_{IN}=4.2V	--	0.1	5	uA
Adjustable Version Regulation Voltage	V_{FB}	T_A=25℃	0.591	0.6	0.609	V
		0℃<T_A<85℃	0.588	0.6	0.612	V
		-40℃<T_A<85℃	0.582	0.6	0.618	V
Output Voltage Line Regulation		V_{IN}=3V to 5V	--	0.016	0.4	%/V
Output Voltage Load Regulation		I_{out}=10mA to 1500mA	--	1	--	%
Inductor Current Limit	I_{LIM}	V_{IN}=3.0V,V_{FB}=90% of $V_{out(NOM)}$	--	2.5	--	A
Oscillator Frequency	f_{SW}	V_{FB} or V_{OUT} in regulation		2		MHz
PMOS On Resistance	R_{ONP}	I_{SW}=-100mA	--	0.25	--	Ω
NMOS On Resistance	R_{ONN}	I_{SW}=100mA	--	0.23	--	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**



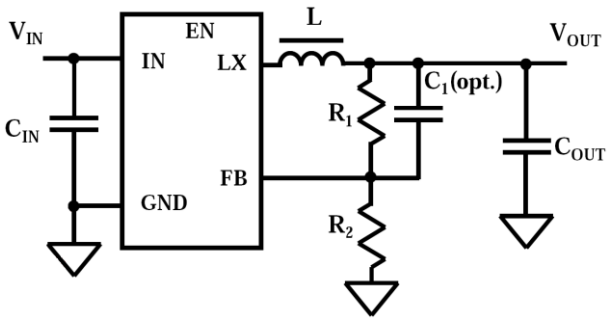
- **Pin Description**

FS1405 -①②③④

DESIGNATOR	SYMBOL	DESCRIPTION
①②	Output Detection Voltage	AD=ADJ
③④	Package Type:	SK：SOT23-5L

NO:	Pin Name	Pin Description
①	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.
②	GND	Ground.
③	LX	Switching Node Output. Connect this pin to the switching end of the inductor.
④	IN	Power Input. Bypass to GND as close as possible to the IC with a high quality ceramic capacitor.
⑤	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.

- **Application Information**



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

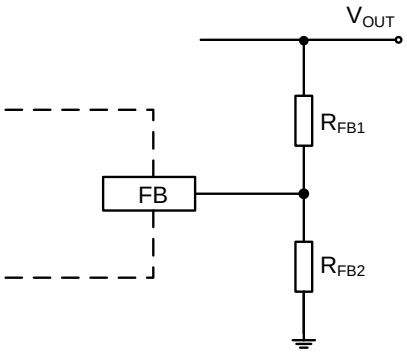


Figure 1. Output Voltage Programming

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:

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

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

$$C_{ff}=2\times10^{-5}/R_{FB1}$$

where R_{FB1}=900K Ω 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 move than one cycle until it reaches 100% duty cycle. Possible occurred larger ripple on the low-dropout operation. Recommended operating voltage $V_{IN} \geqslant V_{OUT}$ + 0.7V

PCB layout caution

1、The power traces, consisting of the GND trace, the SW trace and the Vin trace should be keep short,direct and wide.

2、V_{fb} should be connected directly to the feedback resistors, The resistive divider R1/R2 must connected between the (+) plate of C_{out} and ground.

3、The (+) plate of Cin should be connected to Vin as closely as possible, because this capacitor provides the AC current to the internal power MOSFETS.

4、Keep the switching node SW away form the sensitive V_{fb} node

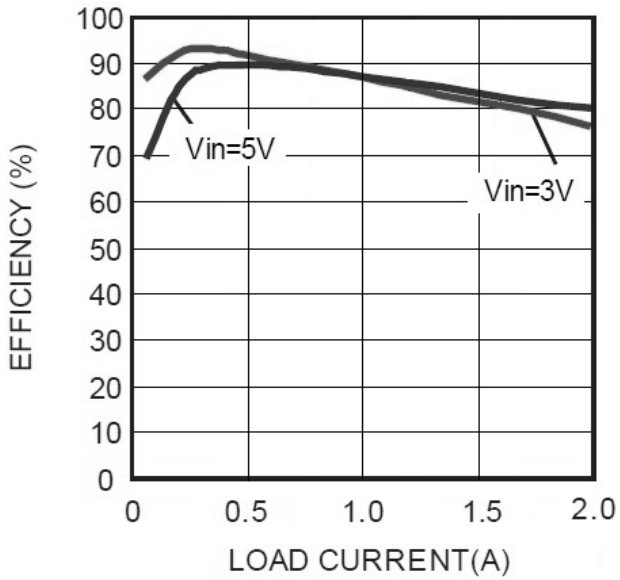
5、Keep the (-) plates of C_{in} and C_{out} as close as possible

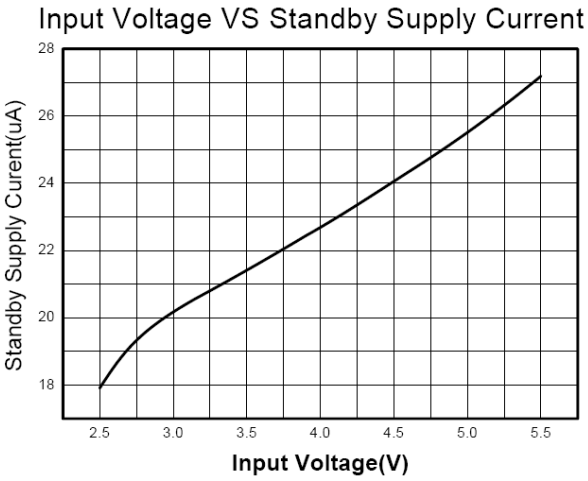
6、The high current paths

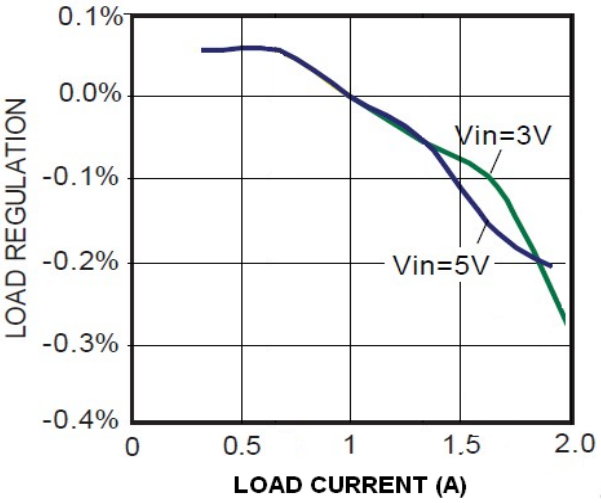
7、The recommended PCB layout

- **Typical Performance Characteristics**

For FS1405

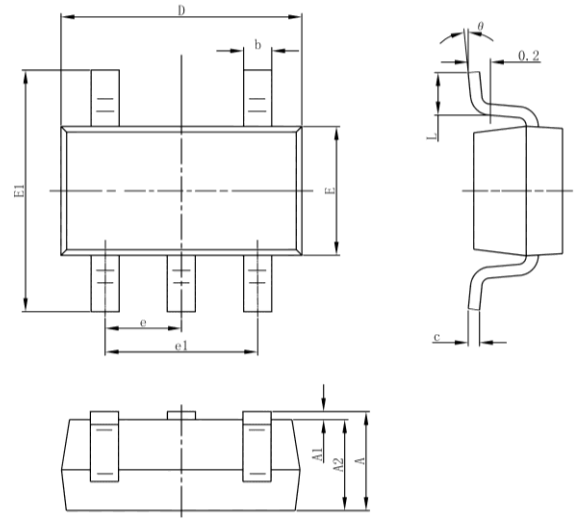



Input Voltage VS Standby Supply Current
Standby Supply Curent(uA)
28
26
24
22
20
18
2.5
3.0
3.5
4.0
4.5
5.0
5.5
Input Voltage(V)


0.1%
0.0%
-0.1%
-0.2%
-0.3%
-0.4%
LOAD REGULATION
Vin=3V
Vin=5V
0
0.5
1
1.5
2.0
LOAD CURRENT (A)

- **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
θ	0°	8°	0°	8°