Low Noise, Regulated Charge Pump DC/DC Converter

Features

- Fixed 4.9V ± 2% Output
- VIN Range: 2.7V to 4.5V
- Output Current: Up to 110mA （VIN≥3V）
  Up to 230mA （VIN≥3.6V）
- Low Noise Constant Frequency (360kHz) Operation
- Shutdown Current <1μA
- No Inductors
- Available in Low Profile 6-Lead SOT23 Package

Applications

- White LED Backlighting
- Li-Ion Battery Backup Supplies
- Smart Card Readers
- PCMCIA Local 5V Supplies

Description

The FS2115A is a low noise switched capacitor voltage doubler. It produce a regulated output voltage from a 2.7V to 4.5V input. Low external parts count (one flying capacitor and two small bypass capacitors at VIN and VOUT) make the FS2115A ideally suited for small, battery-powered applications.

The FS2115A have thermal shutdown capability and can survive a continuous short circuit from VOUT to GND. A low current shutdown feature disconnects the load from VIN and reduces quiescent current to <1uA.

The FS2115A is available in the industry standard SOT-23-6L power packages.

Typical Application

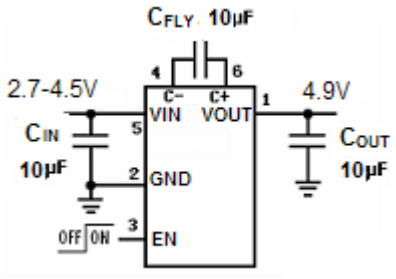
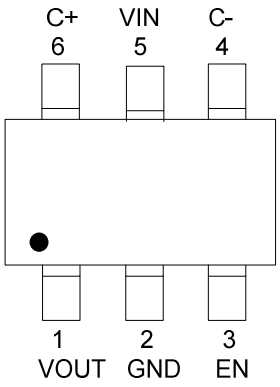


Figure 1: Regulated 4.9V Output

Pin Description

Top View



SOT-23-6L

PIN NUMBER SOT-23-6L	PIN NAME
1	VOUT
2	GND
3	EN
4	C-
5	VIN
6	C+

Absolute Maximum Ratings (Note 1)

- V_{IN} ……- 0.3V to 6V
- V_{OUT}……- 0.3V to 5.5V
- VOUT Short-circuit Duration……indefinite
- V_{EN}……- 0.3V to 6V
- IOUT (Note 2) …… 300mA
- Operating Temperature Range (Note 3)……- 30℃ to 85℃
- Lead Temperature (Soldering 10 sec.) ……300℃
- Storage Temperature Range ……- 65℃ to 125℃

Note 1: Absolute Maximum Ratings are those values beyond which the life of a device may be impaired.
Note 2: Based on long term current density limitations.
Note 3: The FS4004A are guaranteed to meet performance spec ifications from 0°C to 70°C. Specifications over the –40°C to 85°C operating temperature range are assured by design, characterization and correlation with statistical process controls.

Electrical Characteristics

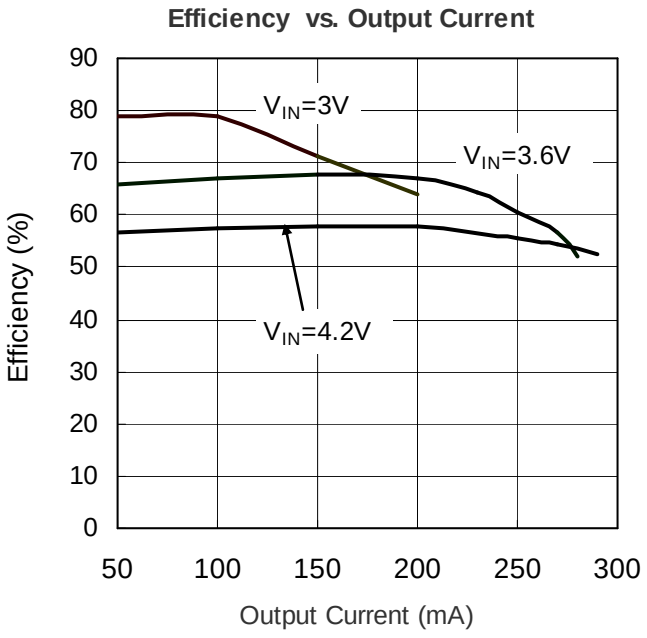
The specifications are at TA = 25 ℃. EN= V_{IN}, C_{IN}=C_{OUT}=C_{FLY} =10uF,unless otherwise noted.

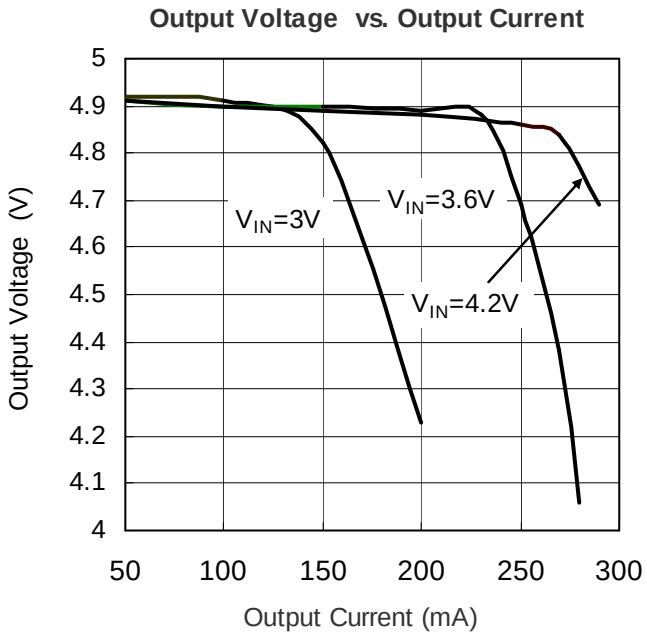
PARAMETER	CONDITIONS	MIN	TYP	MAX	UNITS
Input Voltage Range (V_{IN})		2.7		4.5	V
Output Voltage Range (V_{OUT})	2.7V <V_{IN} < 5.5V, I_{OUT} < 65mA	4.83	4.9	4.97	V
I_{SHDN} Shutdown Current	EN=0V,V_{OUT} = 0V		0.2		μA
No Load Input Current	I_{OUT} = 0mA, V_{IN} = 3V		0.17		mA
Output Ripple (VR)	V_{IN} = 3.6V , I_{OUT} = 100mA		20		mVP-P
Efficiency	V_{IN} = 3V, I_{OUT} =100mA		78		%
Switching Frequency (f_{osc})	V_{IN} = 3.6V , I_{OUT} = 100mA		360		kHz

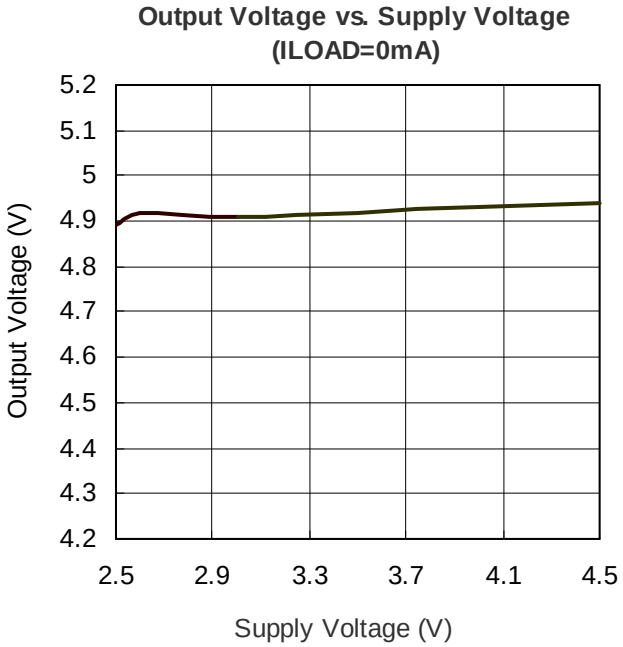
＊ EFFI = [(Output Voltage × Output Current) / (Input Voltage × Input Current)] × 100%

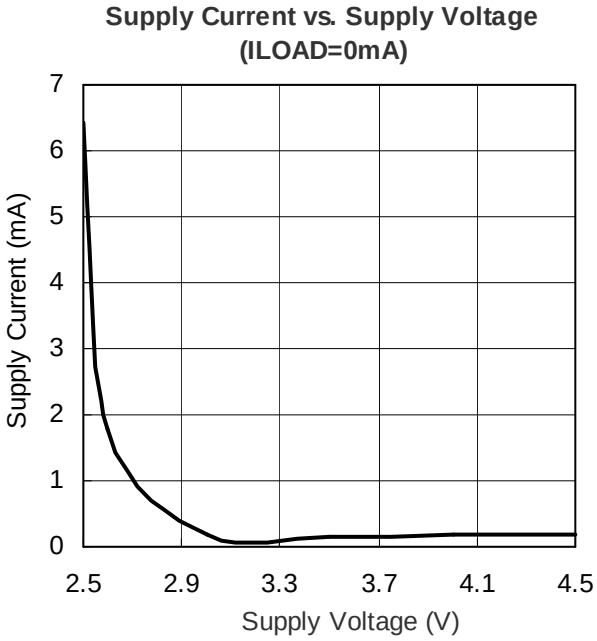
Typical Performance Characteristics

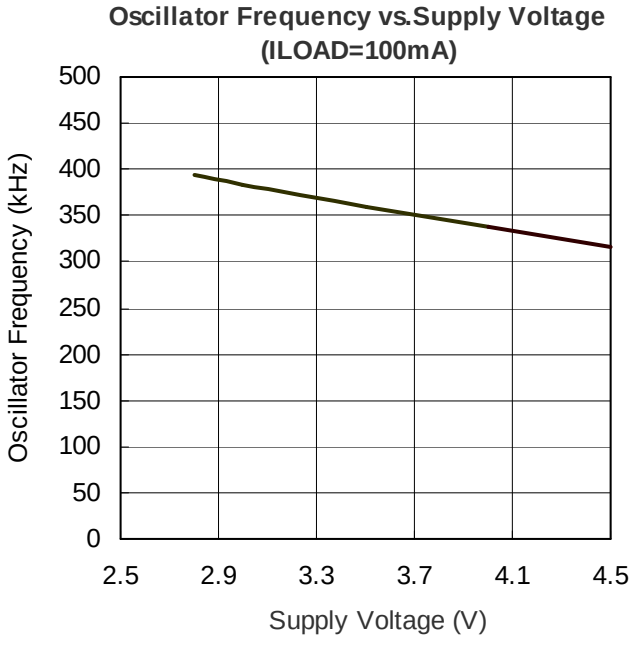
TA=25℃, EN= V_{IN}, C_{IN} =10uF, C_{OUT} =10uF, C_{FLY}=10uF, unless otherwise noted.



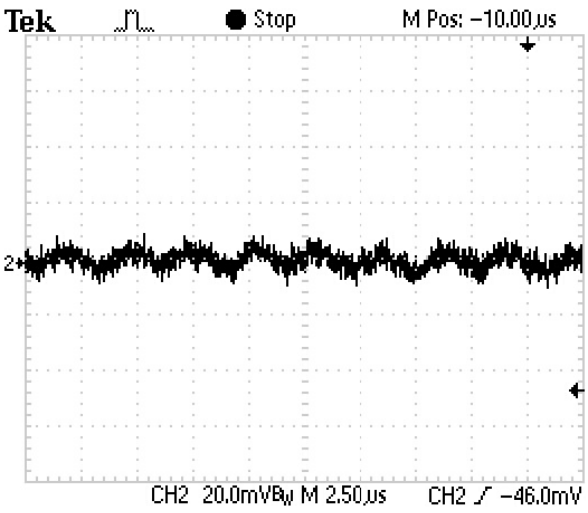



Output Voltage vs. Supply Voltage
(ILOAD=0mA)
Output Voltage (V)
5.2
5.1
5
4.9
4.8
4.7
4.6
4.5
4.4
4.3
4.2
2.5
2.9
3.3
3.7
4.1
4.5
Supply Voltage (V)

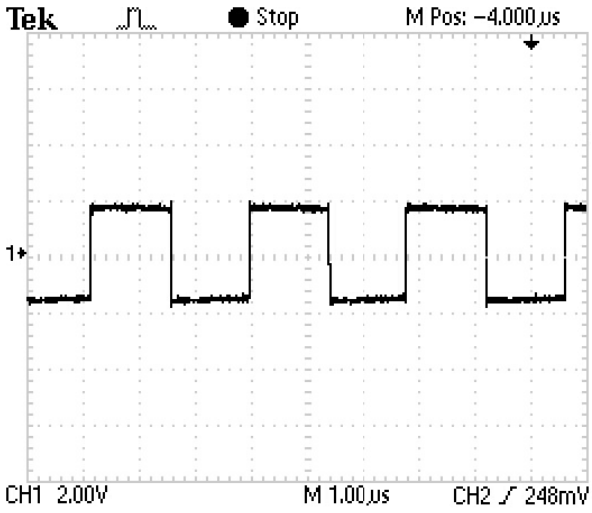

Supply Current vs. Supply Voltage
(ILOAD=0mA)
Supply Current (mA)
7
6
5
4
3
2
1
0
2.5
2.9
3.3
3.7
4.1
4.5
Supply Voltage (V)


Oscillator Frequency vs.Supply Voltage
(ILOAD=100mA)
Oscillator Frequency (kHz)
500
450
400
350
300
250
200
150
100
50
0
2.5
2.9
3.3
3.7
4.1
4.5
Supply Voltage (V)

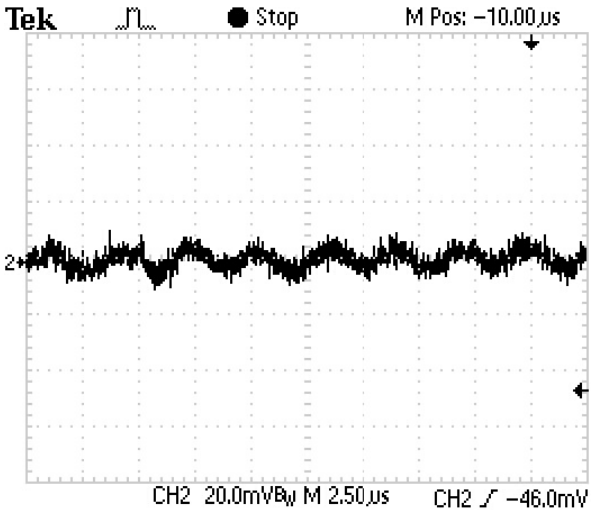
Output Noise（V_{IN}=3.6V, I_{LOAD}=100mA）



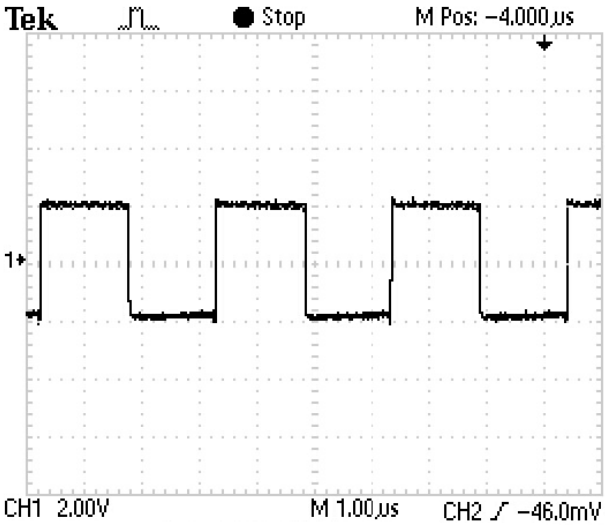
SW Noise（V_{IN}=3.6V, I_{LOAD}=100mA）



Output Noise（V_{IN}=4.2V, I_{LOAD}=100mA）



SW Noise（V_{IN}=4.2V, I_{LOAD}=100mA）



Pin Functions

VOUT (Pin 1): Regulated Output Voltage. VOUT should be bypassed with a low ESR ceramic capacitor providing at least 10μF of capacitance as close to the pin as possible for best performance.

GND (Pin 2): Ground. These pins should be tied to a ground plane for best performance.

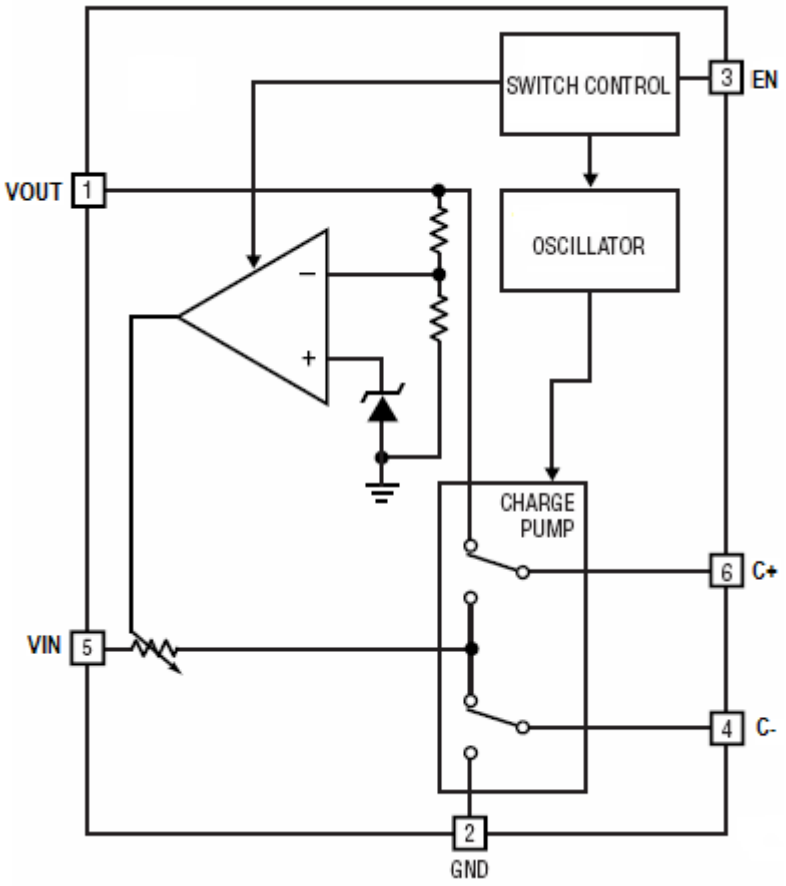
EN (Pin 3): Active Low Shutdown Input. This pin must not be allowed to float.

C- (Pin 4): Flying Capacitor Negative Terminal.

VIN (Pin 5): Input Supply Voltage. VIN should be bypassed with a low ESR ceramic capacitor providing at least 10μF of capacitance as close to the pin as possible for best performance.

C+ (Pin 6): Flying Capacitor Positive Terminal.

Block Diagram



Application Information

Operation

The FS2115A use a switched capacitor charge pump to boost VIN to a regulated output voltage. Regulation is achieved by sensing the output voltage through an internal resistor divider and modulating the charge pump output current based on the error signal. A 2-phase nonoverlapping clock activates the charge pump switches. The flying capacitor is charged from VIN on the first phase of the clock. On the second phase of the clock it is stacked in series with VIN and connected to VOUT. This sequence of charging and discharging the flying capacitor continues at a free running frequency of 360kHz (typ).

In shutdown mode all circuitry is turned off and the FS2115A draw only leakage current from the VIN supply. Furthermore, VOUT is disconnected from VIN. The EN pin is a CMOS input with a threshold voltage of approximately 0.8V. The FS2115A is in shut down when a logic low is applied to the EN pin. Since the EN pin is a high impedance CMOS input it should never be allowed to float. To ensure that its state is defined it must always be driven with a valid logic level.

VIN, VOUT Capacitor Selection

The style and value of capacitors used with the FS2115A determine several important parameters such as regulator control loop stability, output ripple, charge pump strength and minimum start-up time.

To reduce noise and ripple, it is recommended that low ESR (< 0.1Ω) ceramic capacitors be used for both CIN and COUT. These capacitors should be 10uF or greater. Tantalum and aluminum capacitors are not recommended because of their high ESR.

Flying Capacitor Selection

Warning: A polarized capacitor such as tantalum or aluminum should never be used for the flying capacitor since its voltage can reverse upon start-up of the FS2115A. Low ESR ceramic capacitors should always be used for the flying capacitor.

The flying capacitor controls the strength of the charge pump. In order to achieve the rated output current it is necessary to have at least 10uF of capacitance for the flying capacitor.

Layout Considerations

Due to its high switching frequency and the high transient currents produced by the FS2115A, careful board layout is necessary. A true ground plane and short connections to all capacitors will improve performance and ensure proper regulation under all conditions. Figure 2 shows an example layout for the FS2115A

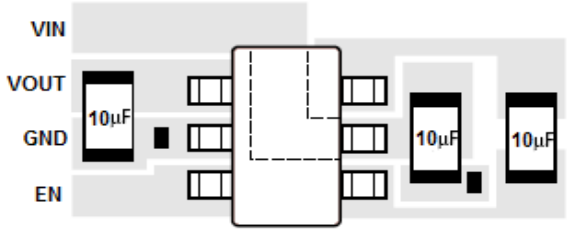
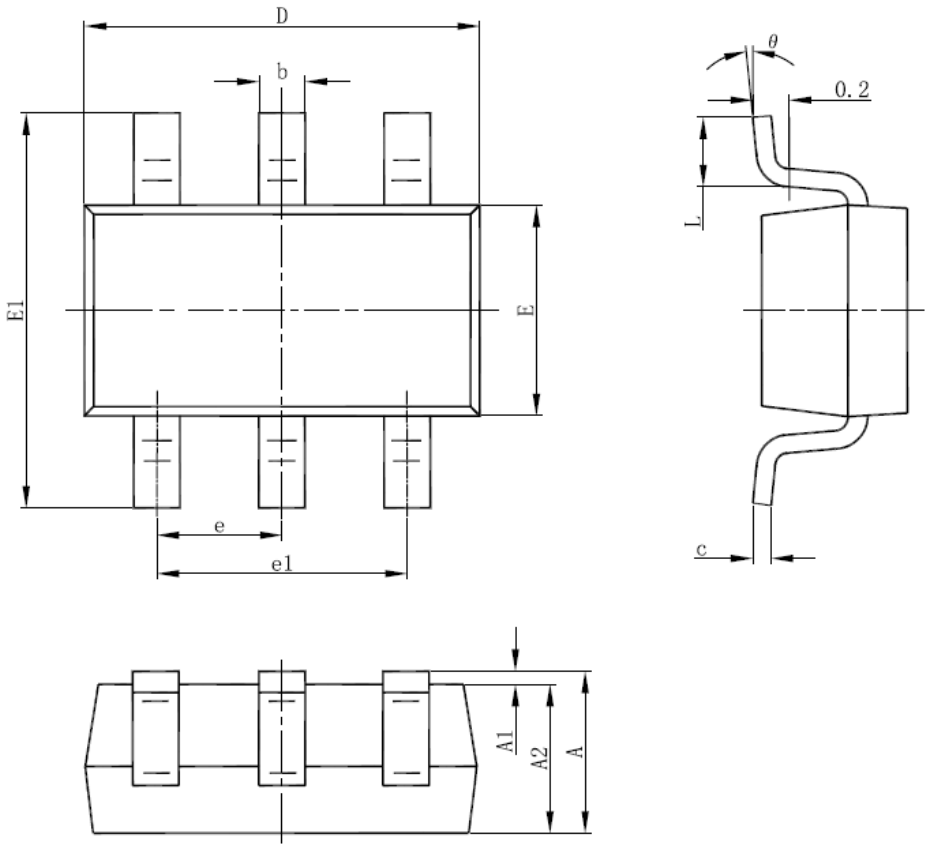


Figure 2: Recommended Layout

Packaging Information

SOT-23-6L Package Outline Dimension



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°	