1.2MHz 1.7A Synchronous Boost DC/DC Regulator

Features

- Up to 96% Efficiency
- Low voltage start-up：0.9V
- Shut-down current: < 1μA
- Input voltage：0.6V~5V
- Output voltage：1.2V~5V (Up to 5V with Schottky)
- Low switch on resistance RDS(ON),
- Internal switch: 0.35Ω
- 1.2MHz fixed frequency switching
- High switch on current: 1.7A
- Short-Circuit protection
- Low profile SOT23-6L package

Applications

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

General Description

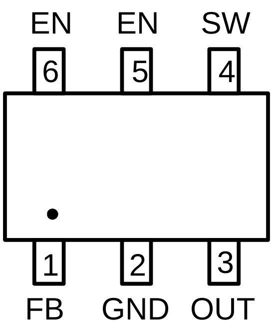
The FS1901 is high efficiency synchronous, PWM step-up DC/DC converters optimized to provide a high efficient solution to medium power systems. The devices work under the input voltage between 0.6V and 5V with a 1.2MHz fixed frequency switching. These features minimize overall solution footprint by allowing the use of tiny, low profile inductors and ceramic capacitors.

The FS1901 is capable of supplying an output voltage between 2.5V and 4.3V, the internal synchronous switch is desired to provide high efficiency without Schottky.

The devices also featured providing up to 260mA from a single AA cell input or up to 600mA from a 2-cell AA with a 3V/3.3V output.

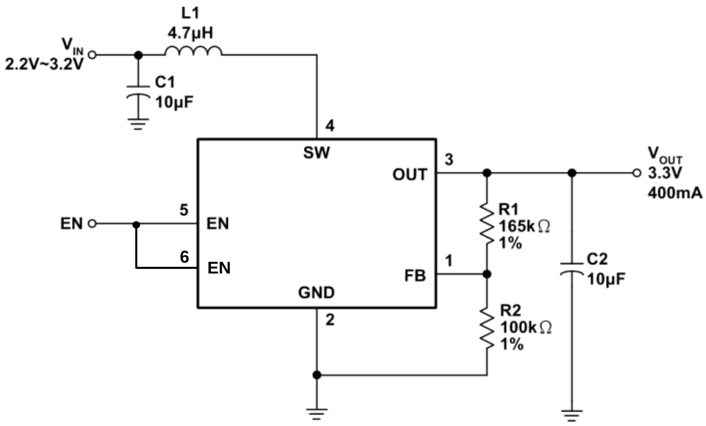
The FS1901 regulators are available in the industry standard SOT23-6L power packages (or upon request).

Pin Configurations



SOT23-6L

Typical Application Circuit



- **Absolute Maximum Ratings**

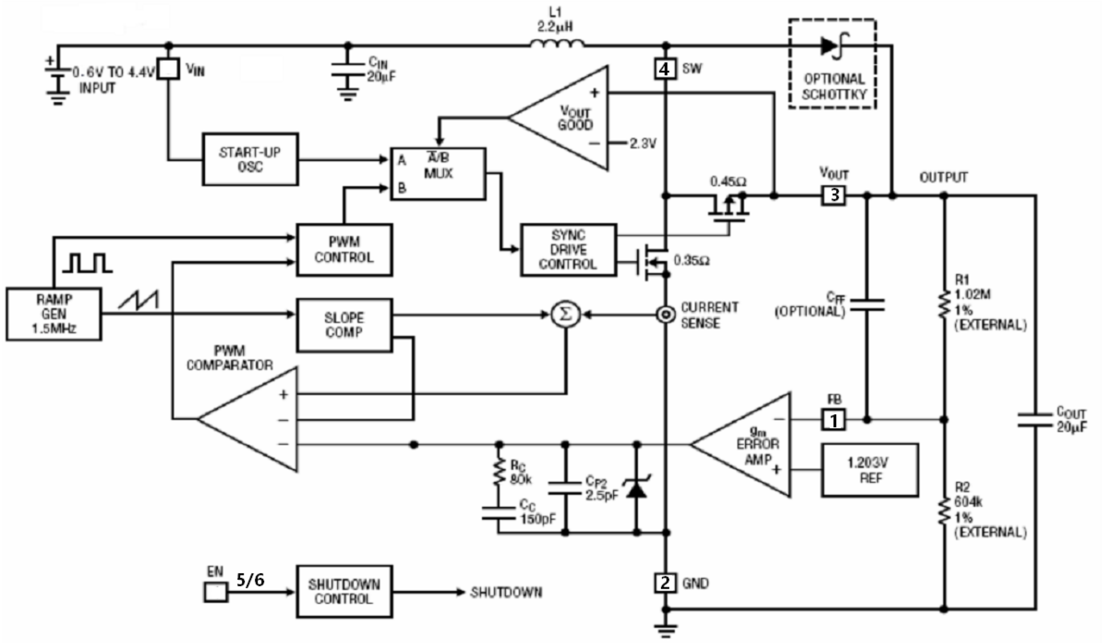
Parameter	Symbol	Ratings	Unit
IN Pin Voltage	VIN	-0.3 to 6V	V
FB Pin Voltage	V_{FB}	-0.3 to 6V	V
EN Pin Voltage	V_{EN}	-0.3 to 6V	V
SW Pin Voltage	Vsw	-0.3 to 6V	V
Continuous SW Current	Isw	Internally limited	A
Maximum Power Dissipation (derate 5.3mW/℃ above T_A=50℃)	P_D	530	mW
Operating Junction Temperature	Topr	-30 to + 85	℃
Storage Temperature Range	Tstg	-65 to + 125	
Lead Temperature (Soldering, 10 seconds)	Tsolder	300	

- **Electrical Characteristics**

(VIN=1.2V,TA= 25℃ Vout=3.3V C1=C2=20uF all capacitors are ceramic, unless otherwise specified.)

PARAMETER	CONDITIONS	MIN	TYP	MAX	UNITS
Output Voltage Range (Adj.)		2.5		5	V
Minimum Start-Up Voltage	I_{LOAD} =1mA		0.9	1.1	V
Minimum Operating Voltage	EN = VIN		0.6	0.75	V
Switching Frequency		1.0	1.2	1.5	MHz
Max Duty Cycle	V_{FB} = 1.15V	80	87		%
Current Limit Delay to Output			40		ns
Feedback Voltage		1.165	1.22	1.241	V
Feedback Input Current	V_{FB} = 1.22V		1		nA
NMOS Switch Leakage	V_{SW} =5V		0.1	5	µA
PMOS Switch Leakage	V_{SW} =0V		0.1	5	µA
NMOS Switch On Resistance	V_{OUT} = 3.3V		0.35		Ω
PMOS Switch On Resistance	V_{OUT} = 3.3V		0.45		Ω
NMOS Current Limit		1.5	1.7		A
Quiescent Current (Active)	Measured On VOUT, Non-switching		300	500	µA
Shutdown Current	V_{EN}=0V, Including Switch Leakage		0.1	1	µA
En Input High		1			V
En Input Low				0.35	V
En Input Current	V_{EN} = 5.5V		0.01	1	µA

- **Typical Block Diagram**



- **Pin Description**

Pin Port	Pin Name	Pin Description
①	FB	Feedback Input to the gm Error Amplifier. Connect resistor divider tap to this pin. The output voltage can be adjusted from 2.5V to 5V by: VOUT = 1.24V • [1 + (R1/R2)]
②	GND	Signal and Power Ground. Provide a short direct PCB path between GND and the (–) side of the output capacitor(s).
③	VOUT	Output Voltage Sense Input and Drain of the Internal Synchronous Rectifier MOSFET. Bias is derived from VOUT. PCB trace length from VOUT to the output filter capacitor(s) should be as short and wide as possible.
④	SW	Switch Pin. Connect inductor between SW and VIN. Keep these PCB trace lengths as short and wide as possible to reduce EMI and voltage overshoot.
⑤、⑥	EN	Logic Controlled Shutdown Input. EN = High: Normal free running operation, 1.2MHz typical operating frequency. EN = Low: Shutdown, quiescent current <1μA. Output capacitor can be completely discharged through the load or feedback resistors.

- **Application note:**

PCB LAYOUT GUIDELINES

The high speed operation of the FS1901 demands careful attention to board layout. You will not get advertised performance with careless layout. The followed figure shows the recommended component placement. A large ground pin copper area will help to lower the chip temperature. A multilayer board with a separate ground plane is ideal, but not absolutely necessary.

INDUCTOR SELECTION

The FS1901 can utilize small surface mount and chip inductors due to its fast 1.2MHz switching frequency. Typically, a 2.2µH inductor is recommended for most applications. Larger values of inductance will allow greater output current capability by reducing the inductor ripple current. Increasing the inductance above 10µH will increase size while providing little improvement in output current capability.

$$I_{OUT(MAX)} = \eta \bullet \left(I_P - \frac{V_{IN} \bullet D}{f \bullet L \bullet 2}\right) \bullet (1 - D)$$

where:

η= estimated efficiency

I_P = peak current limit value (0.6A)

V_{IN} = input (battery) voltage

D = steady-state duty ratio = (VOUT – VIN)/VOUT

f = switching frequency (1.2MHz typical)

L = inductance value

The inductor current ripple is typically set for 20% to 40% of the maximum inductor current (IP). High frequency ferrite core inductor materials reduce frequency dependent power losses compared to cheaper powdered iron types, improving efficiency. The inductor should have low ESR (series resistance of the windings) to reduce the I^2R power losses, and must be able to handle the peak inductor current without saturating. Molded chokes and some chip inductors usually do not have enough core to support the peak inductor currents of 850mA seen on the FS1901. To minimize radiated noise, use a toroid, pot core or shielded bobbin inductor. See Table 1 for some suggested components and suppliers.

Table 1. Recommended Inductors

PART	L (µH)	MAX DCR m	MAX DC CURRENT (A)	SIZE W × L × H (mm3)	VENDOR
CDRH3D16	2.2	75	1.20	3.8 × 3.8 × 1.8	Sumida
CDH3B16	2.2	70	1.20	4.0 × 4.0 × 1.8	Sumida

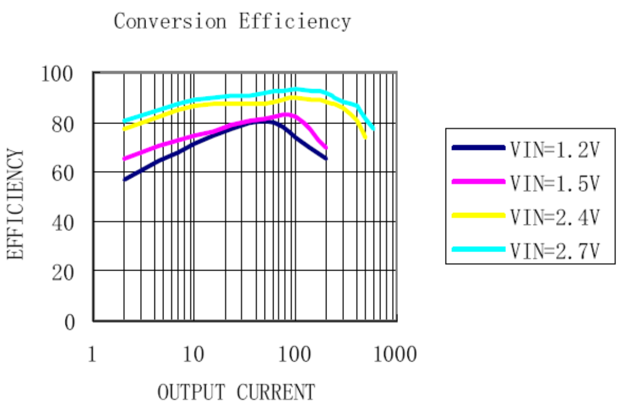
OUTPUT AND INPUT CAPACITOR SELECTION

Low ESR (equivalent series resistance) capacitors should be used to minimize the output voltage ripple. Multilayer ceramic capacitors are an excellent choice as they have extremely low ESR and are available in small footprints. A 4.7µF to 20µF output capacitor is sufficient for most applications. Larger values up to 22µF may be used to obtain extremely low output voltage ripple and improve transient response. An additional phase lead capacitor may be required with output capacitors larger than 10µF to maintain acceptable phase margin. X5R and X7R dielectric materials are preferred for their ability to maintain capacitance over wide voltage and temperature ranges.

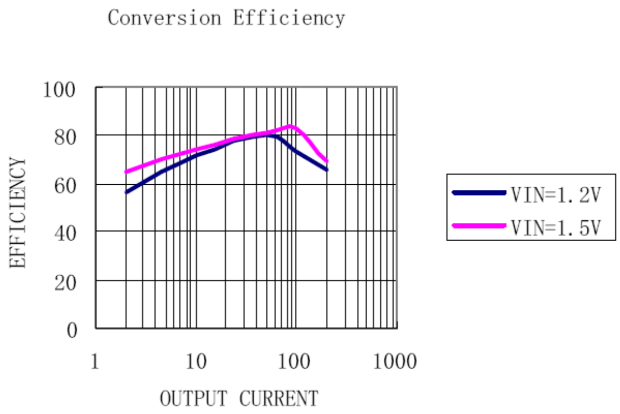
Low ESR input capacitors reduce input switching noise and reduce the peak current drawn from the battery. It follows that ceramic capacitors are also a good choice for input decoupling and should be located as close as possible to the device. A 10µF input capacitor is sufficient for virtually any application. Larger values may be used without limitations. Table 2 shows a list of several ceramic capacitor manufacturers. Consult the manufacturers directly for detailed information on their entire selection of ceramic capacitors.

- **Typical Performance Characteristics**

For V_{OUT}=3.3V



For V_{OUT}=3.3V



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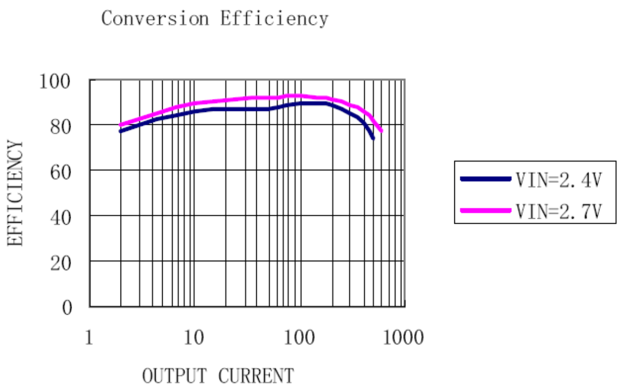
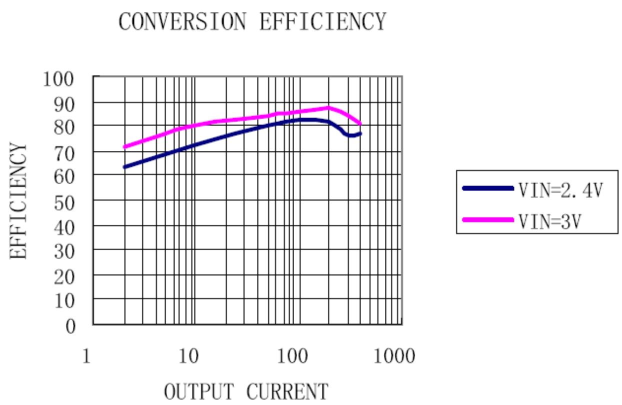
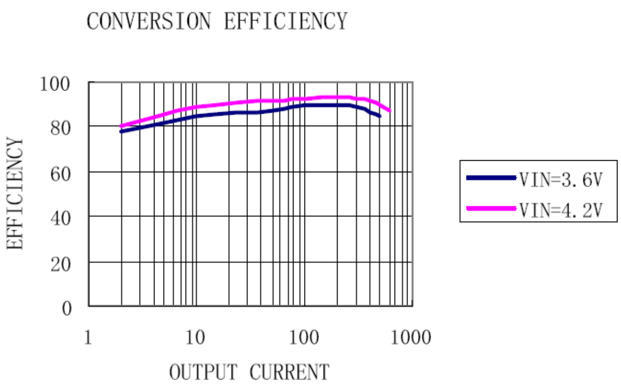


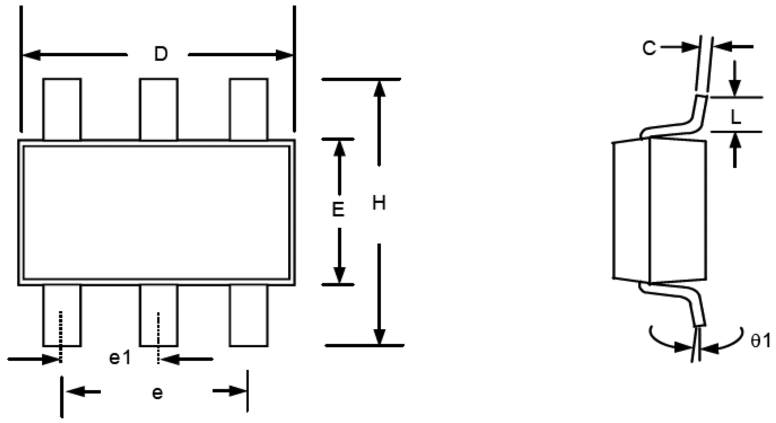
For V_{OUT}=5V

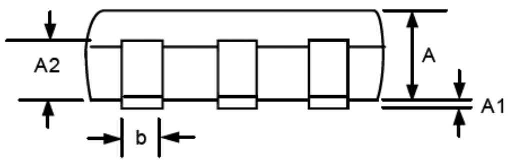


For V_{OUT}=5V



- **Package Information**





Symbol	Dimension mm			Dimension in inch		
	Min	Nom	Max	Min	Nom	Max
A	1.00	1.10	1.30	0.039	0.043	0.051
A1	0.00		0.10	0.000		0.004
A2	0.70	0.80	0.90	0.028	0.031	0.035
b	0.35	0.40	0.50	0.014	0.016	0.020
C	0.10	0.15	0.25	0.004	0.006	0.010
D	2.70	2.90	3.10	0.106	0.114	0.122
E	1.40	1.60	1.80	0.055	0.063	0.071
e		1.90(TYP)			0.075(TYP)	
H	2.60	2.80	3.00	0.102	0.110	0.118
L	0.37			0.015		
θ1	1º	5º	9º	1º	5º	9º