

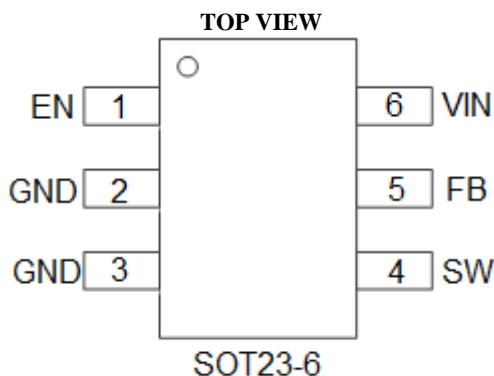
■ General Description

The XR9213 is a high efficiency current-mode boost converter with a fixed operation frequency. The XR9213 has been integrated a very low Rds-on NMOSFET to reduce power loss and achieve high efficiency. The maximum efficiency is up to 93%. XR9213 can output 2A current when VIN is higher than 3.6V and output is 5V. 1.2MHz operation frequency minimizes L and C value, and internal compensation network reduces external component counts. SOT23-6 package provides the best solution for PCB layout area.

■ Features

- Up To 5V-2A Output Current
- 1.2MHz Switching Frequency
- Low RDS(ON): 68mΩ
- Up to 93% Efficiency
- Over Voltage Protection
- Under-Voltage Lockout Protection
- Over-Temperature Protection
- Internal Soft Start
- 1uA Shutdown Current
- Accurate Reference: 0.6V VREF
- Compact package: SOT23-6

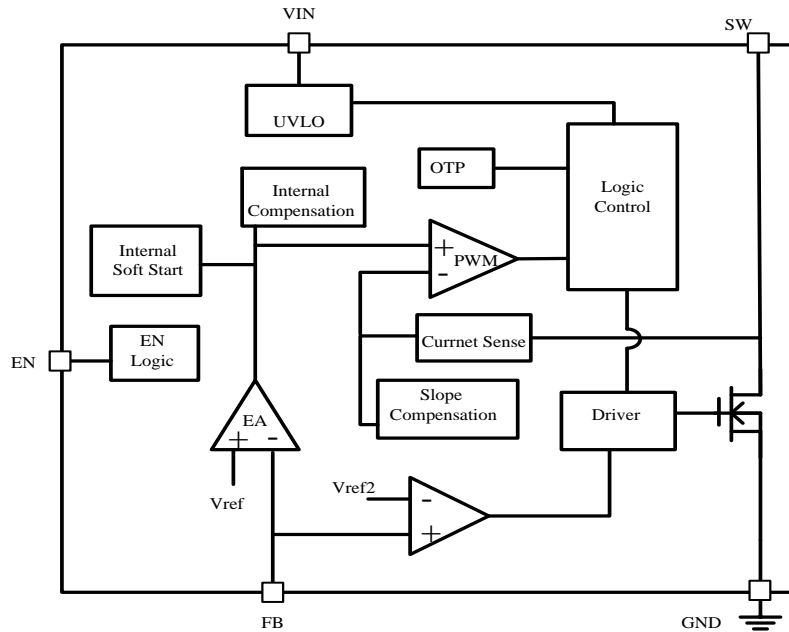
■ Pin Configuration



■ Pin Descriptions

Pin Name	Symbol	Pin Function
1	EN	Enable pin. A high input at EN enables the device and a low input disables the devices. When not used, connect EN to the input source for automatic startup.
2、3	GND	GND
4	SW	Power switch output. Connect the inductor and the blocking Schottky diode to SW.
5	FB	Feedback
6	VIN	Input supply pin. Must be locally bypassed.

■ Block Diagram



■ Absolute Maximum Ratings

SYMBOL	NAME	VALUE	UNIT
V_{IN}	Input Voltage	-0.3~6.5	V
V_{SW}	Voltage at SW Pin	-0.5~15	V
V_{IO}	All Other I/O Pins	-0.3~6.5	V
P_{TR1}	Thermal Resistance(SOT23-6) Θ_{JA}	220	°C/W
T_{stg}	Storage Temperature	-55 to 150	°C
T_{solder}	Package Lead Soldering Temperature	260°C, 10s	
ESD Susceptibility	HBM(Human Body Mode)	2	kV

Note1: Exceeding these ratings may damage the device.

■ Recommended Operating Conditions(Note 2)

SYMBOL	NAME	VALUE	UNIT
V_{IN}	VIN Supply Voltage	2.1 to 5.3	V
V_{OUT}	Output Voltage	V_{IN} to 12.6	V
T_{OTP}	Operating Temperature	-40 to +85	°C

Note2: The device is not guaranteed to function outside of its operating rating.

■ Electrical Characteristics

($V_{IN} = 3.3V$, $V_{OUT} = 5V$, $I_{OUT} = 100mA$, $T_A = 25^\circ C$ unless otherwise specified)

SYMBOL	ITEMS	CONDITIONS	Min.	Typ.	Max.	UNIT
V_{IN}	Input Voltage		2.1		5.3	V
Feedback						
V_{FB}	Feedback Voltage		588	600	612	mV
I_{bias}	FB Pin Input Bias Current			0.05	1	μA

UVLO						
UVLO	Under Voltage Lock Out			2.1		V
Operating Current						
I _{sby}	No Switching	V _{in} =3V V _{FB} =0.7V		100		μA
F _{sw}	Switching Frequency			1.2		MHz
D _{max}	Maximum Duty Cycle	V _{FB} =0V		90		%
Chip Enable						
V _{EN_H}	EN Minimum High Level		1.5			V
V _{EN_L}	EN Maximum Low Level				0.4	V
V _{HYS}	EN Hysteresis			90		mV
I _{EN}	EN Input Bias Current				1	μA
OTP						
OTP				120		°C
OTP Hystersis				20		°C
Output Switch						
R _{ON}	SW On Resistance (Note 3)			68		mΩ
I _{LIMIT}	SW Current Limit			5		A
I _{LEAK}	SW Leakage Current	V _{sw} =5V		0.01	1	μA
Open Voltage Protection						
OVP		V _{ov} Rising		V _{OUT} ×112%		V
Soft Start						
t _{ss}	Soft Start Time (Note 3)	V _{IN} Power On		400		μS

Note3: Guaranteed by design.

Typical Performance Characteristics

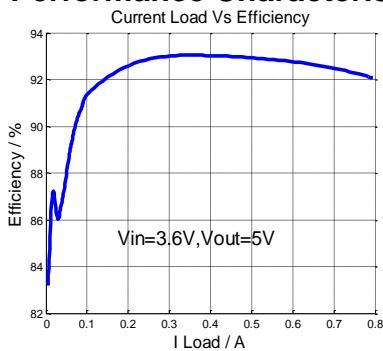


Fig 1 Efficiency Vs Light Load

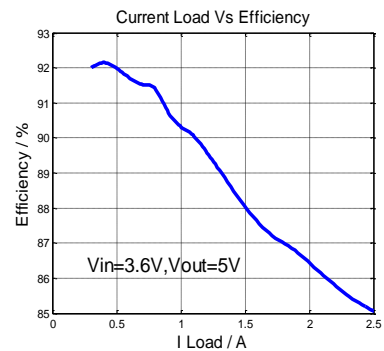


Fig 2 Efficiency Vs Heavy Load

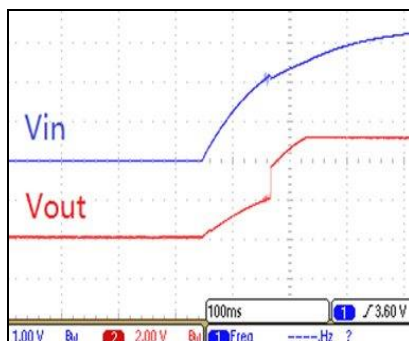


Fig 3 Startup with V_{in}

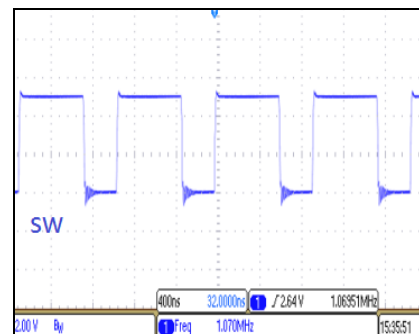


Fig 4 SW Waveform

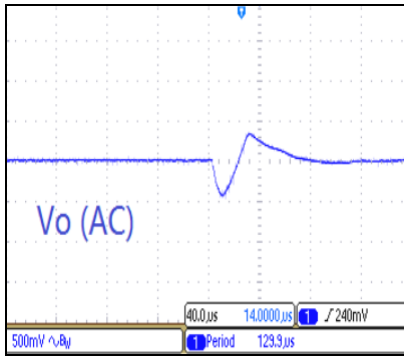


Fig 5 Transient Response
($V_{IN}=3.6V$, $V_{out}=5V$, $I_{load}=0.15A$ to $0.9A$)

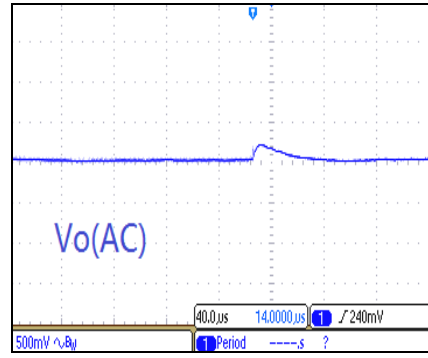
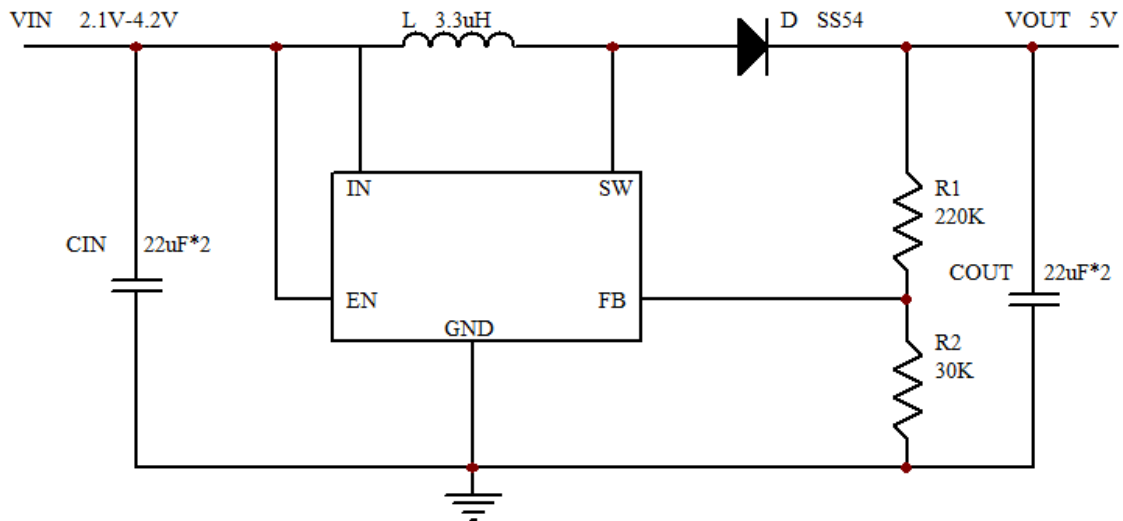
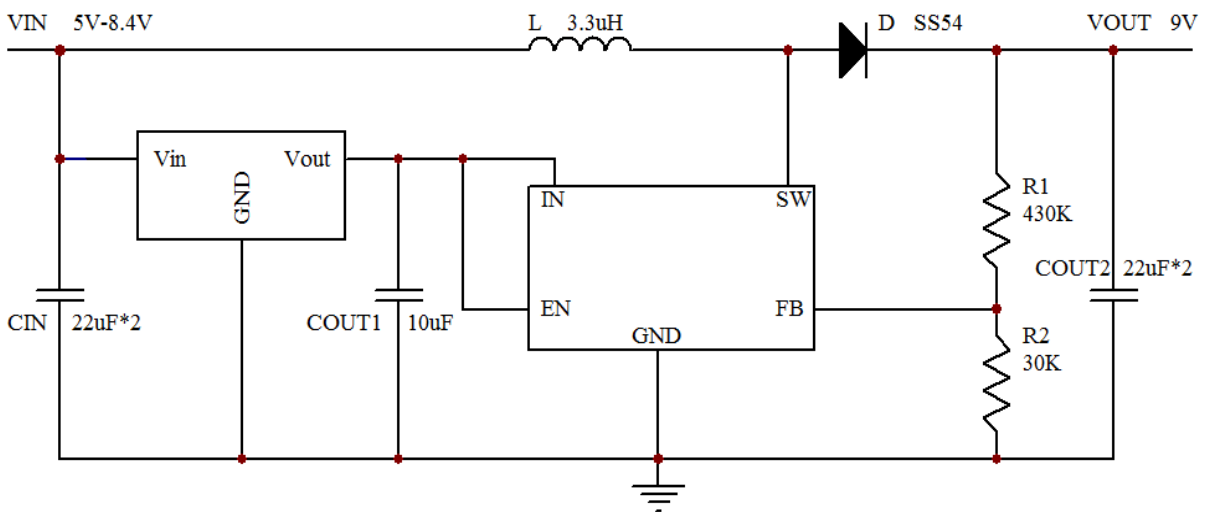


Fig 6 Transient Response
($V_{IN}=3.6V$, $V_{out}=5V$, $I_{load}=0.9A$ to $0.15A$)

■ Typical Application Circuit



Typical application 1 (V_{IN} at 2.1V-4.2V)



Typical application 2 (V_{IN} at 5V-8.4V)

■ Operation Description

The XR9213 adopts fixed frequency, peak current mode boost regulator architecture to regulate output voltage. The operating principle of the XR9213 can be easily understood by referring to the functional block diagram. At the beginning of each oscillator cycle the MOSFET is turned on by the control circuit. To prevent sub-harmonic oscillations at duty cycle larger than 50 percent, a stabilizing ramp is added to the output of the current sense amplifier and the result is fed into the negative input of the PWM comparator. When this voltage equals the output voltage of the error amplifier, the power MOSFET is turned off. The voltage at the output of the error amplifier is an amplified result of the difference between the 0.6V reference voltage and the feedback voltage. In this way the peak current level keeps the output voltage in regulation. If the feedback voltage starts to drop, the output of the error amplifier increases, resulting in more current to flow through the power MOSFET, thus increasing the power delivered to the output. The XR9213 has internal soft start to avoid rush input current during the startup and also to avoid overshoot on the output.

■ Application Information

Because of the high integration in the XR9213, the application circuit based on this regulator IC is rather simple. Only input capacitor C_{IN} , output capacitor C_{OUT} , inductor L, schottky diode and feedback resistors (R1 and R2) need to be selected for the targeted applications.

Feedback Resistor Divider R1 and R2:

Choose R1 and R2 to program the proper output voltage. To minimize the power consumption under light loads, it is desirable to choose large resistance values for both R1 and R2. A value of between 30K Ω and 500K Ω is recommended for both resistors. If R1=220K Ω is chosen and VOUT is 5V, then R2 can be calculated to be 30K Ω based on the following equation:

$$R2 = (R1 \times 0.6V) / (VOUT - 0.6V)$$

Input Capacitor C_{IN} :

To minimize the potential noise problem, place a typical X5R or better grade ceramic capacitor really close to the IN and GND pins. Care should be taken to minimize the loop area formed by CIN, and IN/GND pins. In this case a 10uF low ESR ceramic is recommended.

Output Capacitor C_{OUT} :

The output capacitor is selected to meet the output ripple noise requirements. Both steady state ripple and transient requirements must be taken into consideration when selecting this capacitor. For the best performance, it is recommended C_{OUT} should be X5R or better grade ceramic capacitor with 10V rating and more than two pieces of 22uF Capacitor. Only when C_{OUT} is big enough, it can absorb the energy of inductor and prevent the voltage of output up to too high when current load suddenly be shut.

Boost Inductor L:

The recommended values of inductor is 3.3uH. Small size and better efficiency are the major concerns for portable devices. The inductor should have low core loss at 1.2MHz and low DCR for better efficiency. To avoid inductor saturation current rating should be considered.

Diode Selection:

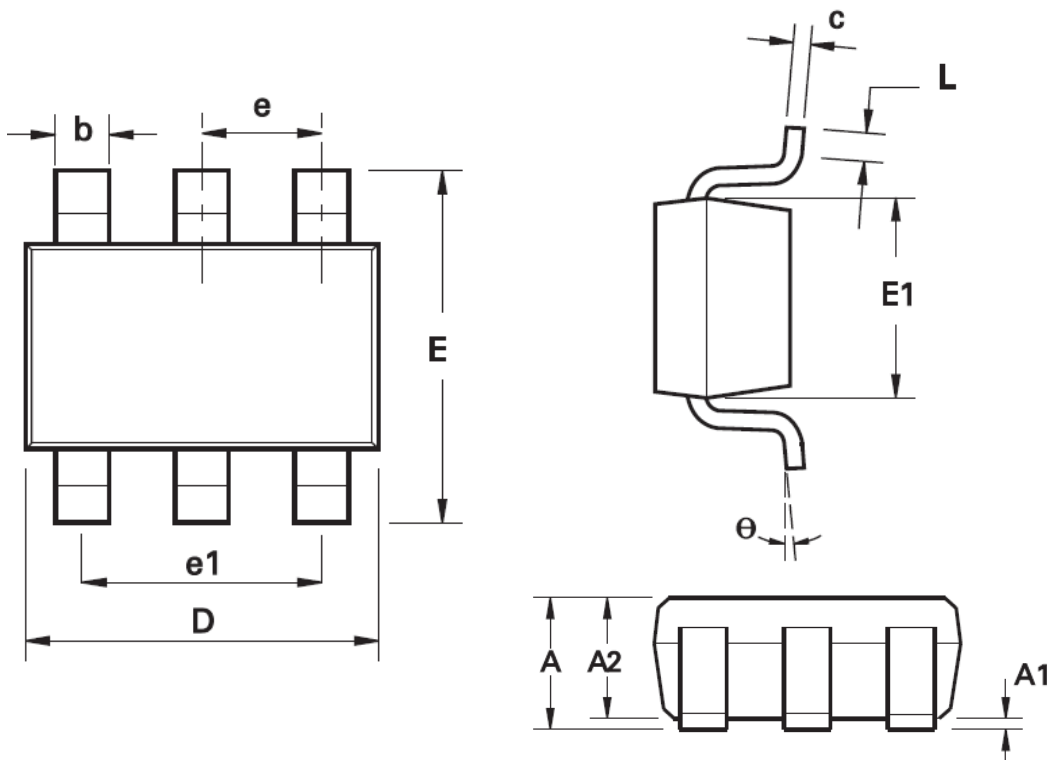
Schottky diode is a good choice for XR9213 because of its low forward voltage drop and fast reverse recovery in order to get better efficiency. The high speed rectification is also a good characteristic of Schottky diode for high switching frequency. The diode reverse breakdown voltage should be larger than the output voltage, and its forward voltage should be less than 0.6V.

Start-up and Inrush Current:

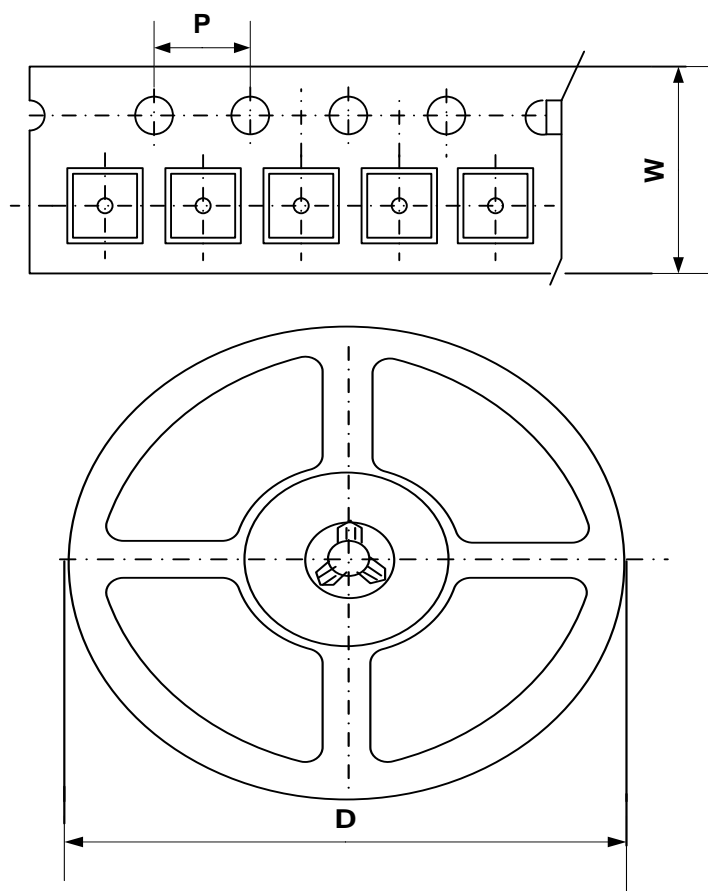
The XR9213 has internal soft start to limit the value of current through VIN during the startup and also to avoid overshoot on the output. The soft start is realized by gradually increasing the output of error amplify during start-up.

Over Voltage Protection:

The XR9213 has been integrated over voltage protection function. If the output voltage exceeds the targeted value of 12%, the internal circuit will shut power MOS, until V_{OUT} voltage falls down.

■ Package Outlines
SOT23-6


SYMBOL	MILLMETER			INCHES		
	MIN	NOM	MAX	MIN	NOM	MAX
A	--	--	1.35	--	--	0.053
A1	0.04	--	0.15	0.002	--	0.006
A2	1.00	1.10	1.20	0.039	0.043	0.047
b	0.34	--	0.43	0.013	--	0.017
c	0.15	--	0.21	0.006	--	0.008
D	2.72	2.92	3.12	0.107	0.115	0.123
E	2.60	2.80	3.00	0.102	0.110	0.118
E1	1.40	1.60	1.80	0.055	0.063	0.071
e	0.95 BSC			0.037 BSC		
e1	1.90 BSC			0.075 BSC		
L	0.30	--	0.60	0.012	--	0.024
θ	0	--	8°	0	--	8°

■ Packing Information


Package Type	Carrier Width (W)	Pitch (P)	Reel Size(D)	Packing Minimum
SOT23-6	8.0±0.1 mm	4.0±0.1 mm	180±1 mm	3000pcs

Note: Carrier Tape Dimension, Reel Size and Packing Minimum

NOTE: Subject changes without notice