1MHz Step-Up PWM Converter with 2A Switch Current

Description

The FP6291 is a current-mode boost DC/DC converter with a build-in 16V, 2.5A, 0.18Ω internal power MOSFET to provide this regulator highly power efficient. The FP6291 operates at 1MHz allowing for easy filtering and low noise. Internal compensation makes the user to set system easily, which allows the use of small, low-ESR ceramic output capacitors.

Fault protection includes over-current latch off, input UVLO and thermal shutdown. This device uses current mode control scheme that provides fast transient response. In shutdown mode, the supply current is less than 1uA. The FP6291 is available in a SOT23-6L package, provides a very compact system and low cost solution.

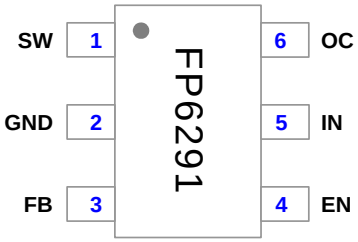
Features

- Adjustable Output Voltage up to 12V
- Internal 16V, 2.5A, 0.18Ω Power MOSFET
- Internal Soft-Start
- Fixed 1MHz Switching Frequency
- Current Mode Operation
- Cycle-by-Cycle current limit
- Adjustable Over Current Protection: 0.5A ~ 2.5A
- Input Under Voltage Lockout
- Over-Temperature Protection
- RoHS Compliant
- SOT23-6L Packaged

Applications

- LCD Displays
- Chargers
- Portable Products
- Digital Cameras
- Handheld Computers and PADs
- Mobile Power Bank

Pin Configuration



Pin Description

Pin No.	Symbol	Pin Description
1	SW	Power Switch Output. It is the output pin that internal MOSFET. Connect the inductor and output rectifier to SW.
2	GND	Ground Pin.
3	FB	Voltage Feedback Input Pin. Connecting FB and V_{OUT} with a resistive voltage driver. The IC senses feedback voltage via FB and regulate if at 0.6V.
4	EN	Enable Input Pin. This pin provides a digital control to turn the converter on or off. Connect to V_{IN} with a 100KΩ resistor for self-startup. EN cannot be left floating.
5	IN (Vcc)	Power Supply Input Pin. Connecting a ceramic bypass capacitor between IN and GND to eliminate noise.
6	OC	Current Limited Setting Pin. Connect a resister from OC to GND to set the peak switching current. It can be left floating.

Typical Application Circuit

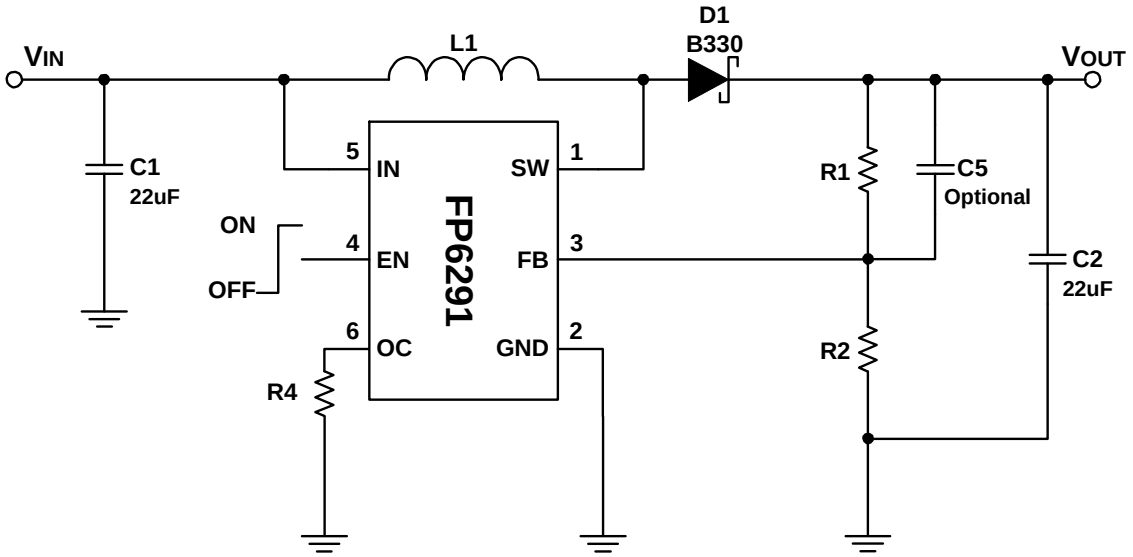


Figure 1 Typical application circuit

V_{OUT}	R1	R2	L1	C2
5V	73.4KΩ	10KΩ	3.3uH	22uF
12V	190KΩ	10KΩ	3.3uH	22uF

Functional Block Diagram:

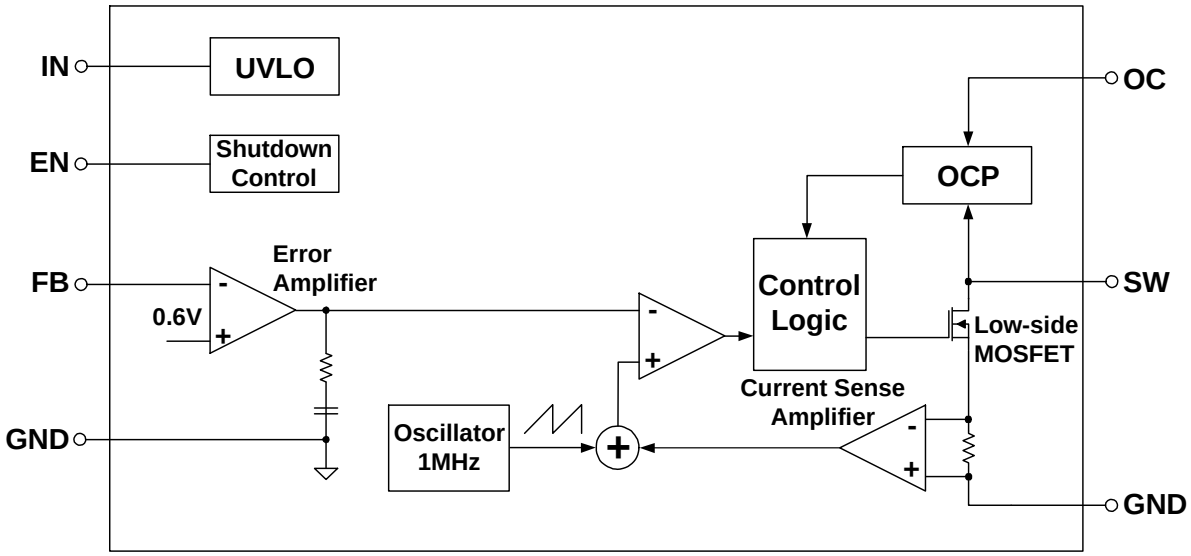


Figure 2 Functional block diagram

Absolute Maximum Ratings: (Note 1)

Parameter	Symbol	Conditions	Min.	Typ.	Max.	Unit
Input Supply Voltage	V_{IN}		0		6	V
SW Voltage	V_{SW}		0		16	V
EN, FB and OC Voltage			0		6	V
Power Dissipation	P_D	SOT23-6L @T_A=25°C			455	mW
Thermal Resistance (Note 2)	θ_{JA}	SOT23-6L			220	°C/W
Junction Temperature	T_J				150	°C
Operating Temperature	T_{OP}		-40		85	°C
Storage Temperature	T_{ST}		-65		150	°C
Lead Temperature		Soldering 10 sec			260	°C
ESD Classification		HBM		Class 2		

Recommended Operating Conditions: (Note 3)

Parameter	Symbol	Conditions	Min.	Typ.	Max.	Unit
Input Supply Voltage	V_{IN}		2.6		5.5	V
Ambient Temperature	T_A		-40		85	°C

Note 1: Stresses exceed those ratings may damage the device.

2. θ_{JA} is measured in the natural convection at T_A=25°C on a low effective thermal conductivity test board of JEDEC 51-3 thermal measurement standard

3: If out of its operation conditions, the device is not guaranteed to function.

Electrical Characteristics (V_{IN}=3.3V, T_A=25°C, unless otherwise specified)

Parameter	Symbol	Test Conditions	Min.	Typ.	Max.	Unit
Input Supply Voltage	V_{IN}		2.6		5.5	V
Input Average Supply Current	I_{IN}	V_{FB} = 0.66V, No Switching		190		uA
Shutdown Supply Current	I_{IN}	V_{EN} = 0V		0.1	3	uA
Feedback Voltage	V_{FB}		0.585	0.6	0.615	V
Output Voltage	V_{OUT}	V_{OUT} = 5V	-3		3	%
Low-Side MOSFET On Resistance (Note 4)	$R_{DS(ON)}$	I_{SW} = 1A		180		mΩ
Low-Side MOSFET Current Limit (Note 4)			2	2.5		A
Adjustable Over Current (Note 4)		With External Resistor: 10K~100K	0.5		2.5	A
Oscillation Frequency	F_{OSC}		0.7	1	1.3	MHz
Maximum Duty Cycle	D_{MAX}			90		%
Input UVLO Threshold	V_{UVLO}	V_{IN} Rising		2.2		V
Under Voltage Locked Threshold Hysteresis				100		mV
EN Shutdown Threshold Voltage	V_{EN}		0.6	0.85	0.96	V
Thermal Shutdown Threshold (Note 4)				150		°C

Note 4: Not production tested.

Function Description:

The FP6291 is a constant frequency current mode boost asynchronous DC/DC converter. It regulates input voltage from 2.6V to 5.5V, boost to an output voltage as high as 12V, and can provide up to 1A of continuous load current.

Control Loop

During normal operation, the output voltage is sensed at FB pin through a resistive voltage divider and amplified through the error amplifier. The voltage of error amplifier output is compared to the switch current to controls the RS latch. At each cycle, the low side NMOS would be turned on when the oscillator sets the RS latch and would be turned off when current comparator resets the RS latch.

Enable

The FP6291 EN pin provides digital control to turn on / turn off the regulator. When the voltage of EN exceeds the threshold voltage, the regulator starts the soft start function. If the EN pin voltage is below than the threshold voltage, the regulator will be disable and into the shutdown mode.

Adjustable Peak Switch Current

To select the peak switch current connect a resistor R4 from OC to GND. According to following equation, the peak current I_{OCP} is calculated:

Input Under Voltage Lockout

When the FP6291 power on, the internal circuits are held inactive until V_{IN} exceeds the input UVLO threshold voltage. And the regulator will be disabled when V_{IN} below the input UVLO threshold voltage. The hysteretic of the UVLO comparator is 100 mV.

Over Current Protection

The FP6291 provides over current protection function to prevent the device damage from over current condition. When the output current is too high, the switching current is limited. Once an over-current lasting more than 50us is sensed, the converter will latch off. Another power sequence is needed to restart the converter.

Over Temperature Protection

The FP6291 incorporates an over temperature protection circuit to protect itself from overheating. When the junction temperature exceeds the thermal shutdown threshold temperature, the regulator will be shutdown.

Application Information

Output Voltage Setting

The output voltage V_{OUT} is set by a resistive divider from the output to FB. The FB pin regulated voltage is 0.6V. Thus the output voltage is:

R2 recommended value is 10kΩ, so R1 is determined by:

Table1 lists recommended value of R1 and R2 for most used output voltage.

V_{OUT}	R1	R2
12V	190KΩ	10KΩ
5V	73.4KΩ	10KΩ

Table 1 Recommended Resistance Values

Place resistors R1 and R2 close to FB pin to prevent stray pickup.

Capacitor Selection

The output capacitor is used to keep the DC output voltage and supply the load transient current. Low ESR capacitors are preferred. Ceramic, tantalum or low ESR electrolytic capacitors can be used, depends on the output ripple requirement. Ceramic capacitor of X5R and X7R are recommended, which have low ESR and wider operation temperature range.

Inductor Selection

The inductor is used for store energy and filter output ripple current. 2.2uH to 4.7uH inductor is recommended for general application circuit.

Diode Selection

Schottky diodes with low forward voltages and fast recovery times are recommended for better efficiency. The diode average

and peak current rating must be larger than the average output current and peak switching current. And the reverse breakdown voltage must exceed the output voltage.

PCB Layout Recommendation

The device's performance and stability is dramatically affected by PCB layout. It is recommended to follow these general guidelines show below:

1. Place the input capacitors, output capacitors as close to the device as possible. Trace to these capacitors should be as short and wide as possible to minimize parasitic inductance and resistance.
2. The SW trace (include SW, Inductor and Diode switching node) should be kept short and wide to reduce parasitic resistance and EMI.
3. Place V_{IN} bypass capacitors close to the IN pin.
4. Place feedback resistors close to the FB pin.
5. Keep the sensitive FB trace away from the switching signal (SW).
6. The exposed pad of the package should be soldered to an equivalent area of metal on the PCB. This area should connect to the GND plane and have multiple via connections to the back of the PCB as well as connections to intermediate PCB layers. The GND plane area connects to the exposed pad should be maximized to improve thermal performance.
7. Multi-layer PCB design is recommended.

Typical Application Circuit

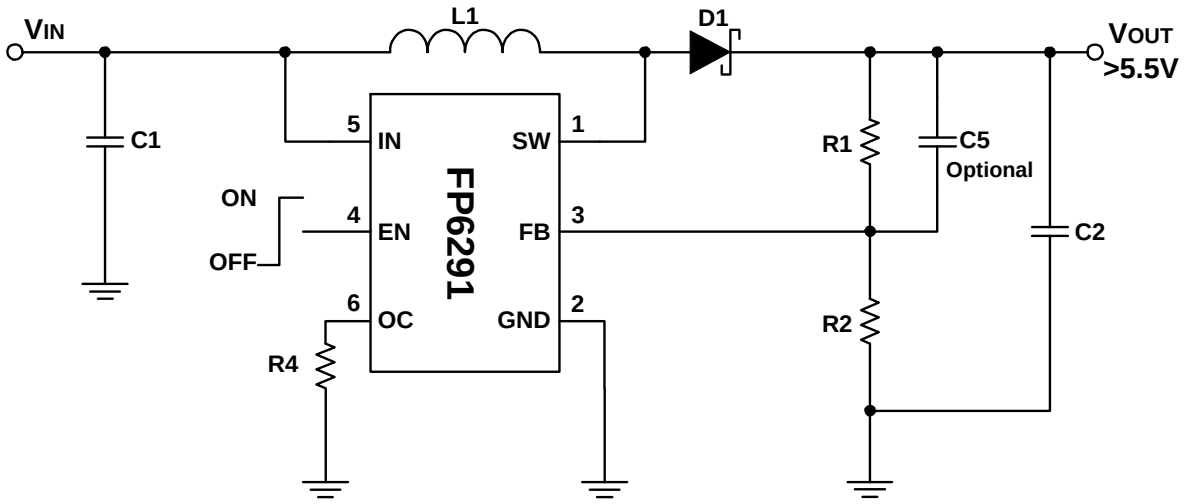


Figure 3 For output voltage exceed 5.5V applications

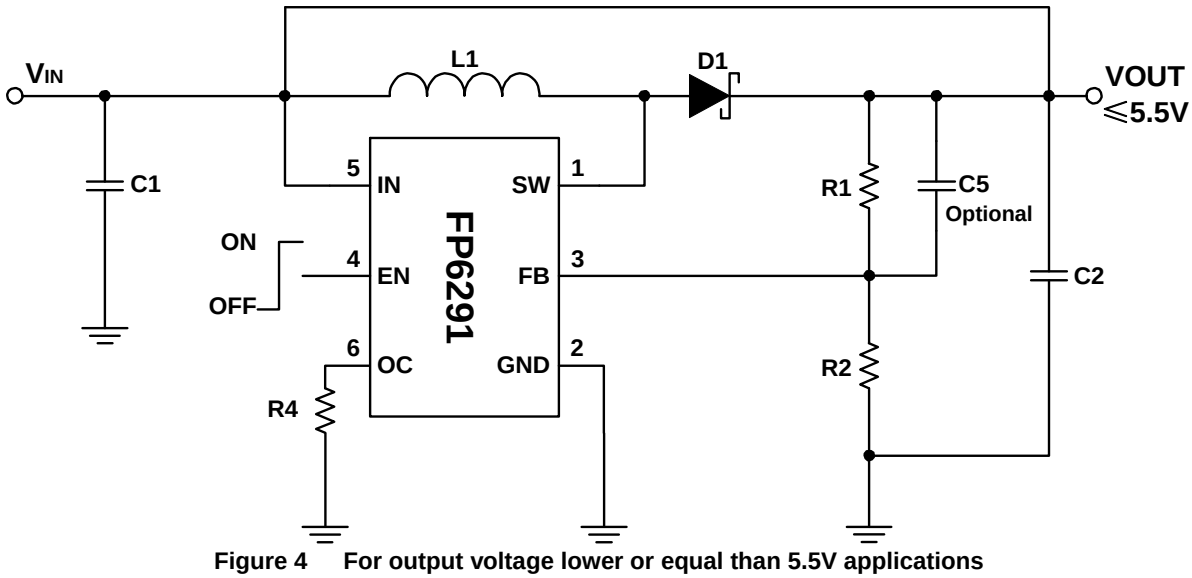
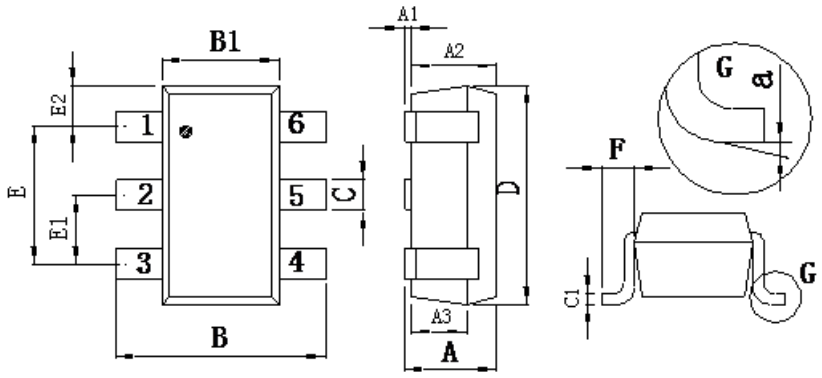


Figure 4 For output voltage lower or equal than 5.5V applications

Package Information

6-pin SOT23-6L(SOT-26) Outline Dimensions



SOT-26							
Symbols	Millimeters			Symbols	Millimeters		
	MIN.	NOM.	MAX.		MIN.	NOM.	MAX.
A	1.00	1.15	1.30	C1	0.10	0.15	0.20
A1	0.03	0.09	0.15	D	2.70	2.90	3.10
A2	0.90	1.05	1.20	E	1.90BSC		
A3	---	---	---	E1	0.90	0.95	1.00
B	2.50	2.75	3.00	E2	0.45	0.50	0.55
B1	1.30	1.50	1.70	F	0.55REF		
C	0.35	0.43	0.50	a	8° MAX		

Soldering Methods for Products

1. Storage environment : Temperature = 10ºC ~ 35ºC, Humidity = 65% ± 15%
2. Reflow soldering of surface mount devices

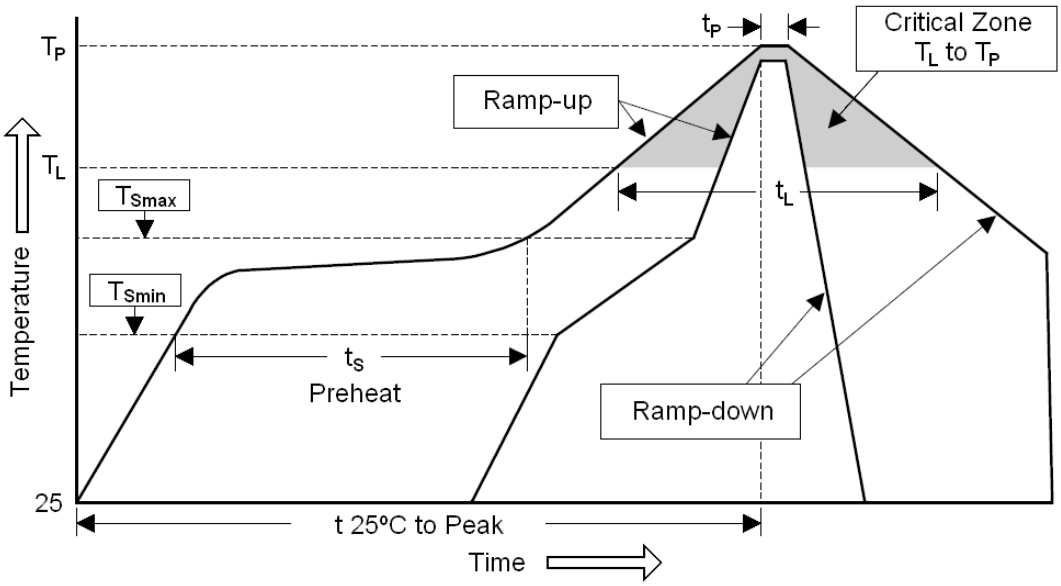


Figure : Temperature profile

Profile Feature	Sn-Pb Eutectic Assembly	Pb-Free Assembly
Average ramp-up rate (T_L to T_P)	< 3ºC/sec	< 3ºC/sec
Preheat		
- Temperature Min (TSmin)	100ºC	100ºC
- Temperature Max (TSmax)	150ºC	200ºC
- Time (Min to Max) (ts)	60 ~ 120 sec	60 ~ 180 sec
TSmax to T_L		
- Ramp-up rate	< 3ºC/sec	< 3ºC/sec
Time maintained above:		
- Temperature (T_L)	183ºC	217ºC
- Time (t_L)	60 ~ 150 sec	60 ~ 150 sec
Peak Temperature (T_P)	240ºC +0/-5ºC	260ºC +0/-5ºC
Time within 5ºC of actual Peak Temperature (t_P)	10 ~ 30 sec	20 ~ 40 sec
Ramp-down rate	< 6ºC/sec	< 6ºC/sec
Time 25ºC to Peak Temperature	< 6 minutes	< 8 minutes

3. Flow (wave) soldering (solder dipping)

Product	Peak Temperature	Dipping Time
Pb devices	245ºC ±5ºC	5sec ±1sec
Pb-Free devices	260ºC +0/-5ºC	5sec ±1sec

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