

## 1MHz, 2.5A Step-Up Current Mode PWM Converter



### General Description

The FP6291 is a current mode boost DC-DC converter. Its PWM circuitry with built-in 0.2Ω power MOSFET make this regulator highly power efficient. The internal compensation network also minimizes as much as 6 external component counts. The non-inverting input of error amplifier connects to a 0.6V precision reference voltage and internal soft-start function can reduce the inrush current.

The FP6291 is available in the SOT23-6L package and provides space-saving PCB for the application fields.

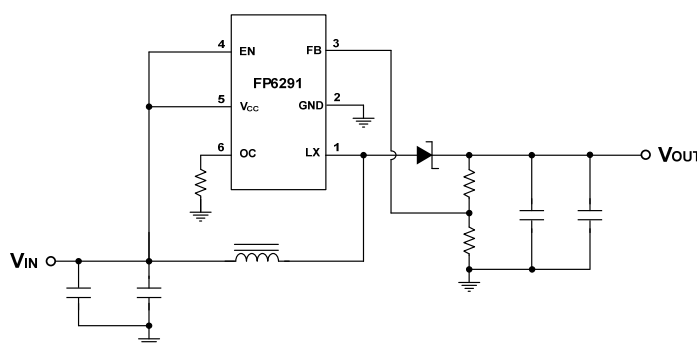
### Features

- Adjustable Output up to 12V
- Internal Fixed PWM frequency: 1.0MHz
- Precision Feedback Reference Voltage: 0.6V ( $\pm 2\%$ )
- Internal 0.2Ω, 2.5A, 16V Power MOSFET
- Shutdown Current: 0.1μA
- Over Temperature Protection
- Over Voltage Protection
- Adjustable Over Current Protection: 0.5A ~ 2.5A
- Package: SOT23-6L

### Applications

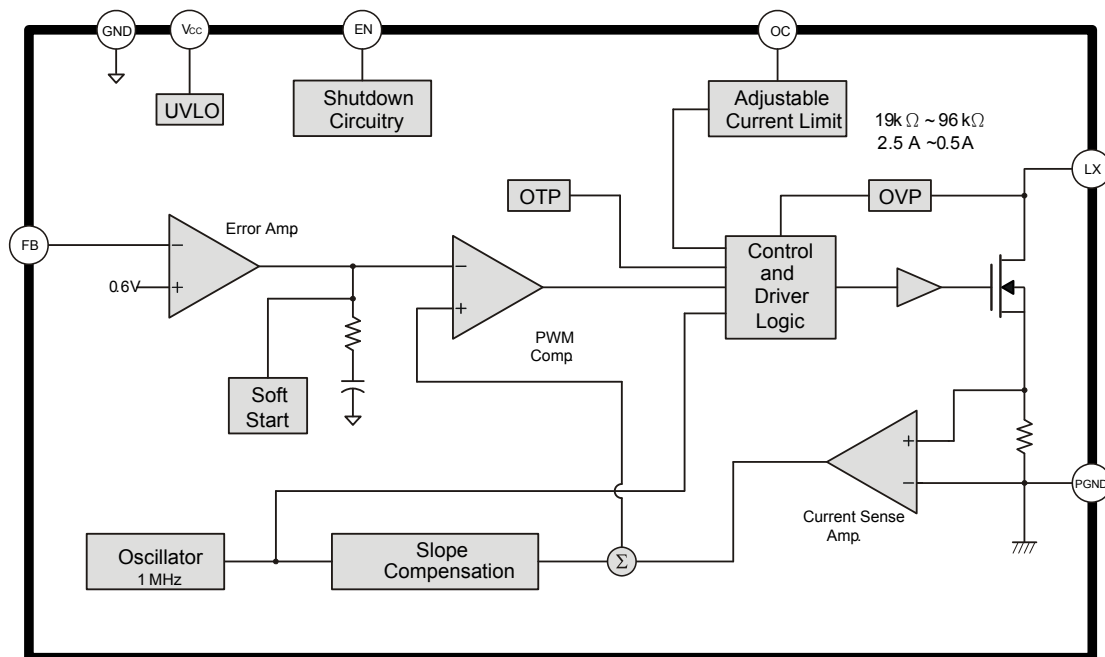
- Chargers
- LCD Displays
- Digital Cameras
- Handheld Devices
- Portable Products

### Typical Application Circuit



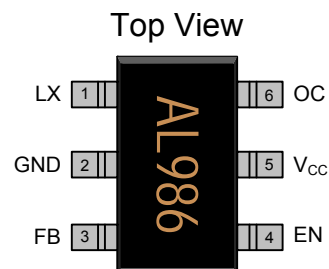
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## Function Block Diagram

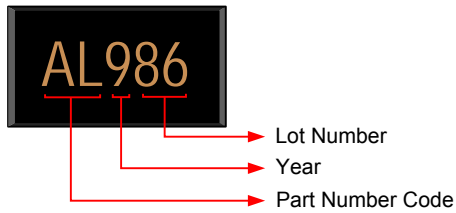


## Pin Descriptions

### SOT23-6L



| Name            | No. | I / O | Description                                   |
|-----------------|-----|-------|---|
| LX              | 1   | O     | Power Switch Output                           |
| GND             | 2   | P     | IC Ground                                     |
| FB              | 3   | I     | Error Amplifier Inverting Input               |
| EN              | 4   | I     | Enable Control (Active High)                  |
| V <sub>CC</sub> | 5   | P     | IC Power Supply                               |
| OC              | 6   | I     | Adjustable Current Limit (Floating Available) |

**Marking Information****SOT23-6L**

**Lot Number:** Wafer lot number's last two digits

For Example: 132386TB → 86

**Year:** Production year's last digit

**Part Number Code:** Part number identification code for this product. It should be always "AL".

## Ordering Information

| Part Number | Code | Operating Temperature | Package  | MOQ    | Description |
|-------------|------|-----------------------|----------|--------|-------------|
| FP6291LR-G1 | AL   | -40°C ~ 85°C          | SOT23-6L | 3000EA | Tape & Reel |

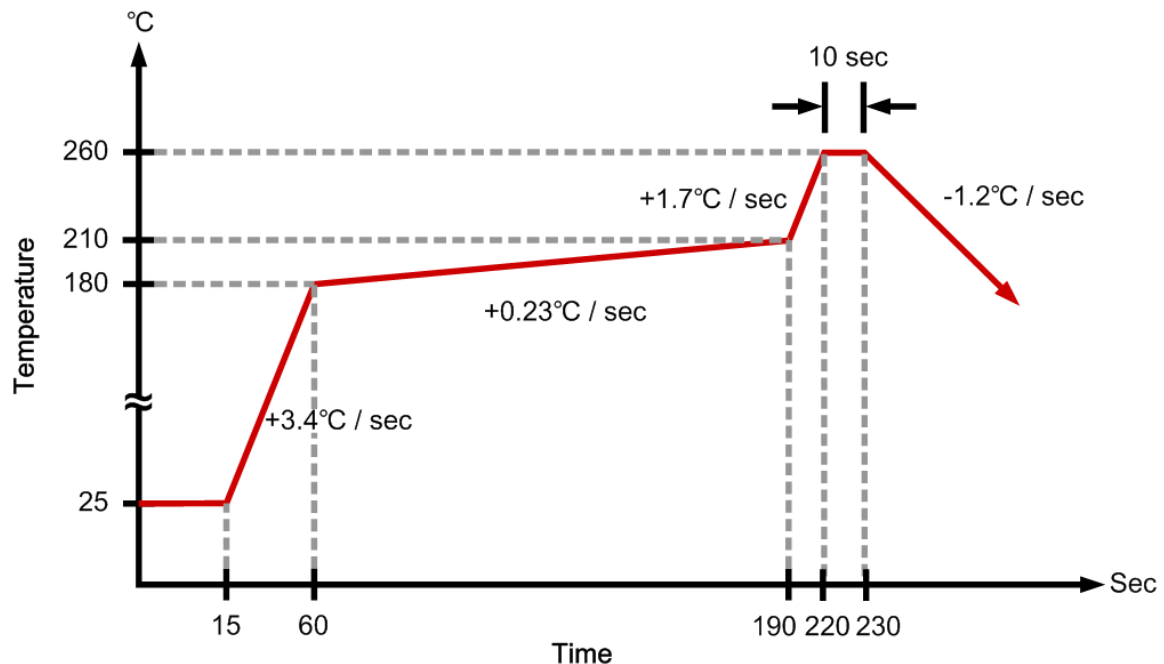
## Absolute Maximum Ratings

| Parameter                  | Symbol        | Conditions                          | Min. | Typ. | Max. | Unit                          |
|----------------------------|---------------|-------------------------------------|------|------|------|-------------------------------|
| Supply Voltage             | $V_{CC}$      |                                     | 0    |      | 6    | V                             |
| LX Voltage                 | $V_{LX}$      |                                     | 0    |      | 16   | V                             |
| EN,FB Voltage              |               |                                     | 0    |      | 6    | V                             |
| Power Dissipation          | $P_D$         | SOT23-6L @ $T_A=25^{\circ}\text{C}$ |      |      | 455  | mW                            |
| Thermal Resistance (Note1) | $\theta_{JA}$ | SOT23-6L                            |      |      | +220 | $^{\circ}\text{C} / \text{W}$ |
| Junction Temperature       | $T_J$         |                                     |      |      | +150 | $^{\circ}\text{C}$            |
| Operating Temperature      | $T_{OP}$      |                                     | -40  |      | +85  | $^{\circ}\text{C}$            |
| Storage Temperature        | $T_{ST}$      |                                     | -65  |      | +150 | $^{\circ}\text{C}$            |
| Lead Temperature           |               | (soldering, 10 sec)                 |      |      | +260 | $^{\circ}\text{C}$            |

### Note1:

$\theta_{JA}$  is measured in the natural convection at  $T_A=25^{\circ}\text{C}$  on a low effective thermal conductivity test board of JEDEC 51-3 thermal measurement standard.

## IR Re-flow Soldering Curve



## Recommended Operating Conditions

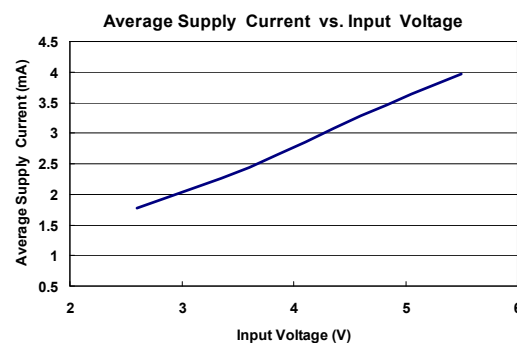
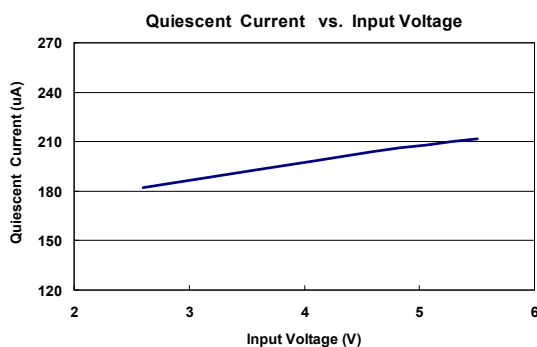
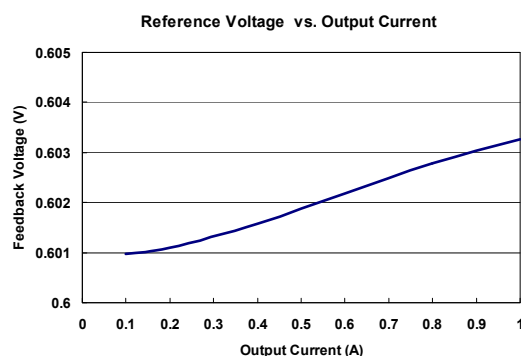
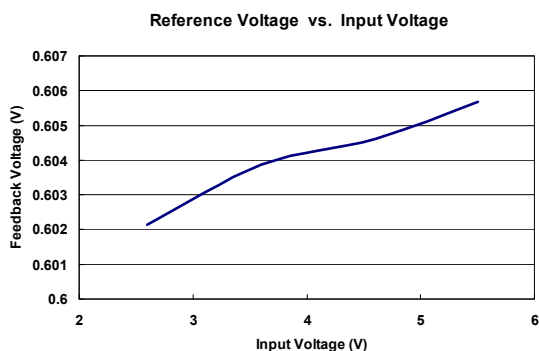
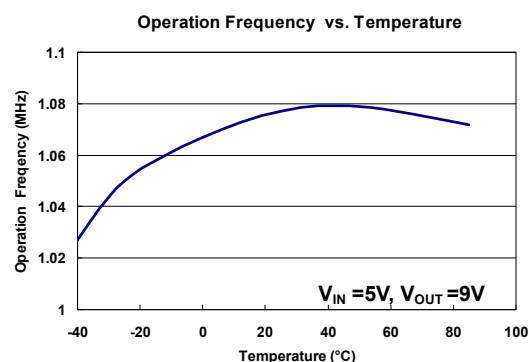
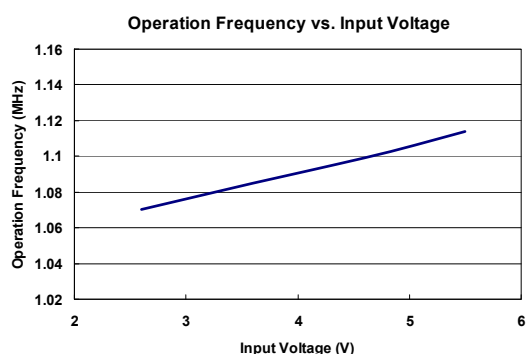
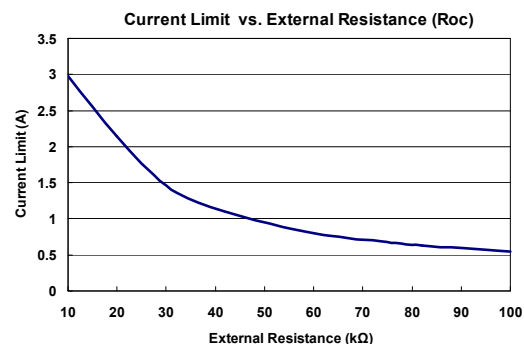
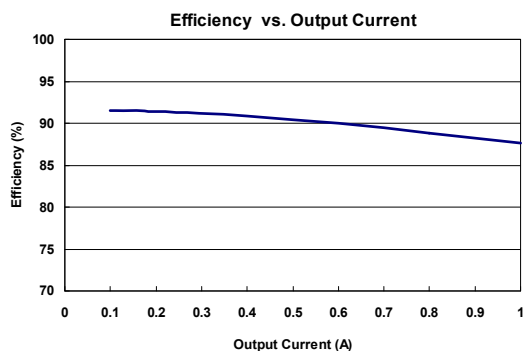
| Parameter                   | Symbol          | Conditions          | Min. | Typ. | Max. | Unit |
|-----------------------------|-----------------|---------------------|------|------|------|------|
| Supply Voltage              | V <sub>IN</sub> |                     | 2.6  |      | 5.5  | V    |
| Operating Temperature Range | T <sub>A</sub>  | Ambient Temperature | -40  |      | +85  | °C   |

## DC Electrical Characteristics (V<sub>CC</sub>=3.3V, T<sub>A</sub>=25°C, unless otherwise specified)

| Parameter                     | Symbol               | Conditions                           | Min.  | Typ. | Max.  | Unit  |
|-------------------------------|----------------------|--------------------------------------|-------|------|-------|-------|
| <b>System Supply Input</b>    |                      |                                      |       |      |       |       |
| Input Supply Range            | V <sub>CC</sub>      |                                      | 2.6   |      | 5.5   | V     |
| Under Voltage Lockout         | V <sub>UVLO</sub>    |                                      |       | 2.2  |       | V     |
| UVLO Hysteresis               |                      |                                      |       | 0.1  |       | V     |
| Quiescent Current             | I <sub>CC</sub>      | V <sub>FB</sub> =0.66V, No switching |       | 0.19 |       | mA    |
| Average Supply Current        | I <sub>CC</sub>      | V <sub>FB</sub> =0.55V, Switching    |       | 2.84 |       | mA    |
| Shutdown Supply Current       | I <sub>CC</sub>      | V <sub>EN</sub> =GND                 |       | 0.1  |       | μA    |
| <b>Oscillator</b>             |                      |                                      |       |      |       |       |
| Operation Frequency           | F <sub>OSC</sub>     | V <sub>FB</sub> =1.0V                | 0.8   | 1.0  | 1.2   | MHz   |
| Frequency Change with Voltage | Δf / ΔV              | V <sub>CC</sub> =2.6V to 5.5V        |       | 5    |       | %     |
| Maximum Duty Cycle            | T <sub>DUTY</sub>    |                                      |       | 90   |       | %     |
| <b>Reference Voltage</b>      |                      |                                      |       |      |       |       |
| Reference Voltage             | V <sub>REF</sub>     |                                      | 0.588 | 0.6  | 0.612 | V     |
| Line Regulation               |                      | V <sub>CC</sub> =2.6V ~ 5.5V         |       | 0.2  |       | % / V |
| <b>Enable Control</b>         |                      |                                      |       |      |       |       |
| Enable Voltage                | V <sub>EN</sub>      |                                      | 0.96  |      |       | V     |
| Shutdown Voltage              | V <sub>EN</sub>      |                                      |       |      | 0.6   | V     |
| <b>MOSFET</b>                 |                      |                                      |       |      |       |       |
| On Resistance of Driver       | R <sub>DS (ON)</sub> | I <sub>LX</sub> =2A                  |       | 0.2  |       | Ω     |
| <b>Protection</b>             |                      |                                      |       |      |       |       |
| OCP Current                   | I <sub>OCP</sub>     |                                      |       | 2.5  |       | A     |
| Adjustable OCP Current        | I <sub>OCP</sub>     | With External Resistor :<br>19k~96k  | 0.5   |      | 2.5   | A     |
| OTP Temperature               | T <sub>OTP</sub>     |                                      |       | +150 |       | °C    |

## Typical Operating Characteristics

( $V_{CC}=3.3V$ ,  $V_{OUT}=5V$ ,  $T_A=25^{\circ}C$ , unless otherwise noted)



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## Function Description

### Operation

The FP6291 is a current mode boost converter. The constant switching frequency is 1MHz and operates with pulse width modulation (PWM). Build-in 16V / 2.5A MOSFET provides a high output voltage. The control loop architecture is peak current mode control; therefore slope compensation circuit is added to the current signal to allow stable operation for duty cycles larger than 50%.

### Soft Start Function

Soft start circuitry is integrated into FP6291 to avoid inrush current during power on. After the IC is enabled, the output of error amplifier is clamped by the internal soft-start function, which causes PWM pulse width increasing slowly and thus reducing input surge current.

### Current Limit Program

A resistor between OC and GND pin programs peak switch current. The resistor value should be between 19k and 96k. The current limit will be set from 2.5A to 0.5A. Keep traces at this pin as short as possible. Do not put capacitance at this pin. To set the over current trip point according to the following equation:

$$I_{OCP} = \frac{48000}{R3}$$

### Over Temperature Protection (OTP)

FP6291 will turn off the power MOSFET automatically when the internal junction temperature is over 150°C. The power MOSFET wake up when the junction temperature drops 30°C under the OTP threshold temperature.

### Over Voltage Protection (OVP)

In some condition, the resistive divider may be unconnected, which will cause PWM signal to operate with maximum duty cycle and output voltage is boosted higher and higher. The power MOSFET will be turned off immediately, when the output voltage exceeds the OVP threshold level. The FP6291's OVP threshold is 16V.

## Application Information

### Inductor Selection

Inductance value is decided based on different condition. 3.3uH to 4.7uH inductor value is recommended for general application circuit. There are three important inductor specifications, DC resistance, saturation current and core loss. Low DC resistance has better power efficiency. Also, it avoid inductor saturation which will cause circuit system unstable and lower core loss at 1 MHz.

### Capacitor Selection

The output capacitor is required to maintain the DC voltage. Low ESR capacitors are preferred to reduce the output voltage ripple. Ceramic capacitor of X5R and X7R are recommended, which have low equivalent series resistance (ESR) and wider operation temperature range.

### Diode Selection

Schottky diodes with fast recovery times and low forward voltages are recommended. Ensure the diode average and peak current rating exceed the average output current and peak inductor current. In addition, the diode's reverse breakdown voltage must exceed the output voltage.

### Output Voltage Programming

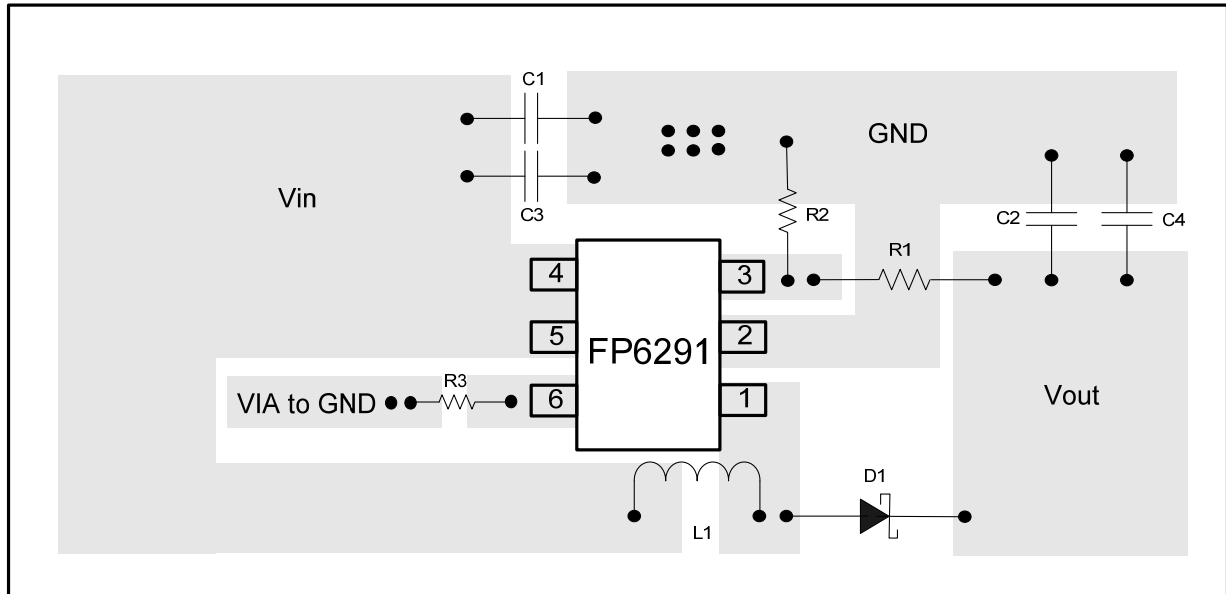
The output voltage is set by a resistive voltage divider from the output voltage to FB. The output voltage is:

$$V_{OUT} = 0.6V \left( 1 + \frac{R1}{R2} \right)$$

### Layout Considerations

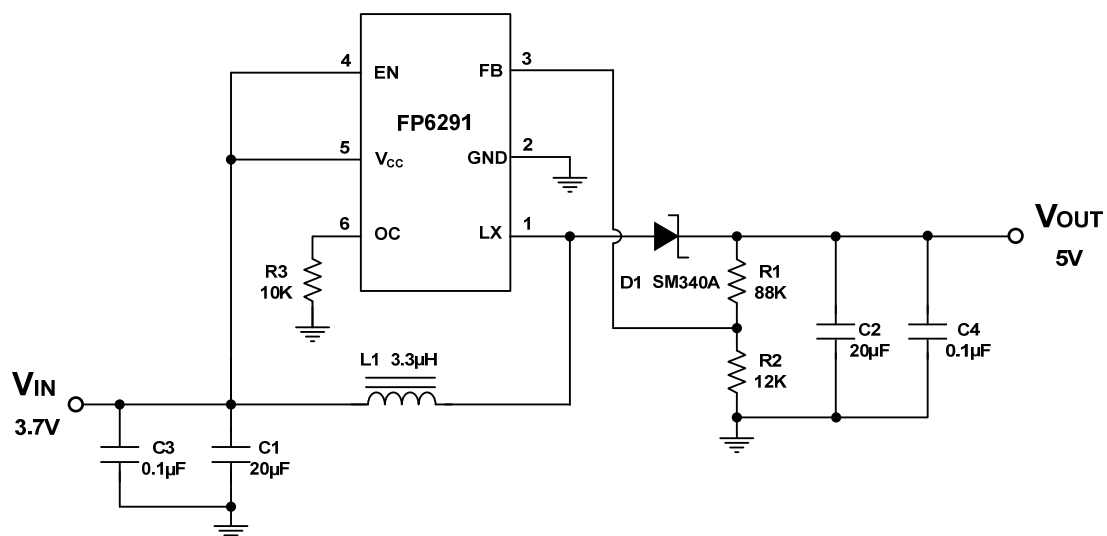
1. The power traces, consisting of the GND trace, the LX trace and the V<sub>CC</sub> trace should be kept short, direct and wide.
2. LX、L and D switching node, wide and short trace to reduce EMI.
3. Place C<sub>IN</sub> near V<sub>CC</sub> pin as closely as possible to maintain input voltage steady and filter out the pulsing input current.
4. The resistive divider R1 and R2 must be connected to FB pin directly as closely as possible.
5. FB is a sensitive node. Please keep it away from switching node, LX.
6. The GND of the IC, C<sub>IN</sub> and C<sub>OUT</sub> should be connected close together directly to a ground plane.





Suggested Layout

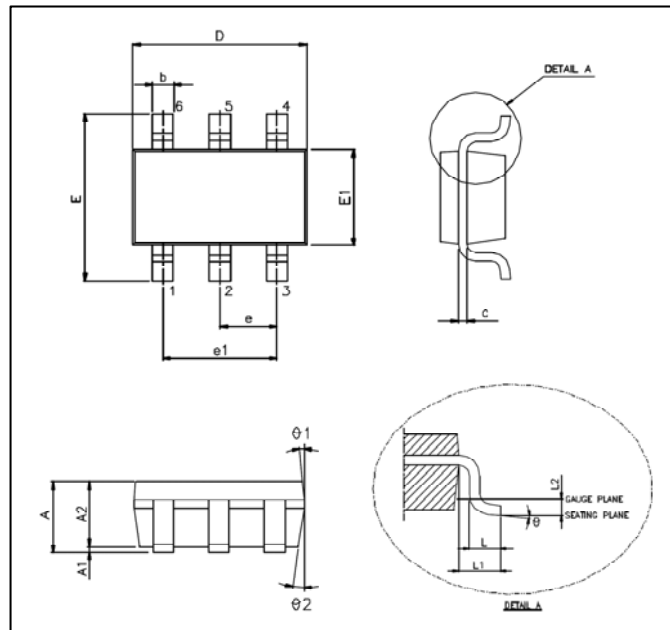
## Typical Application



**Note:** Don't pull the Vout back to the FP6291's Vcc pin. When the system receives the noise, it will lead to Vout ripple too high and over the absolute maximum rating of the Vcc pin.

## Package Outline

### SOT23-6L



Unit: mm

| Symbols | Min. (mm) | Max. (mm) |
|---------|-----------|-----------|
| A       | 1.050     | 1.450     |
| A1      | 0.050     | 0.150     |
| A2      | 0.900     | 1.300     |
| b       | 0.300     | 0.500     |
| c       | 0.080     | 0.220     |
| D       | 2.900 BSC |           |
| E       | 2.800 BSC |           |
| E1      | 1.600 BSC |           |
| e       | 0.950 BSC |           |
| e1      | 1.900 BSC |           |
| L       | 0.300     | 0.600     |
| L1      | 0.600 REF |           |
| L2      | 0.250 BSC |           |
| θ°      | 0°        | 8°        |
| θ1°     | 3°        | 7°        |
| θ2°     | 6°        | 15°       |

#### Note:

- Package dimensions are in compliance with JEDEC outline: MO-178 AB.
- Dimension "D" does not include molding flash, protrusions or gate burrs.
- Dimension "E1" does not include inter-lead flash or protrusions.

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