

## Low-Noise Step-Up Current Mode PWM IC



### General Description

The FP6292 is a current mode boost DC-DC converter. Its PWM circuitry with built-in 0.75Ω power MOSFET make this regulator highly power efficient. The internal compensation network also minimizes as much as 5 external component counts. The non-inverting input of error amplifier connects to a 1.24V precision reference voltage and internal soft-start function can reduce the inrush current

The FP6292 is available in the TSOT23-6L / TSOT23-5L package and provides space-saving PCB for the application fields.

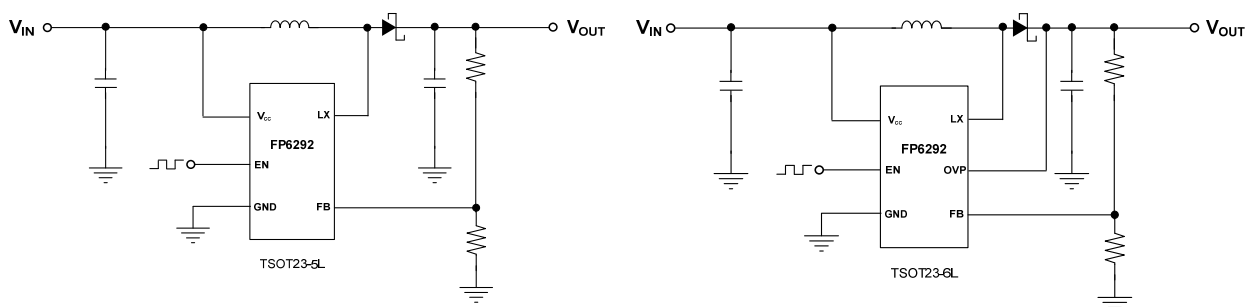
### Features

- Precision Feedback Reference Voltage: 1.24V (±4%)
- Under Voltage Lockout Protection
- Over Voltage Protection
- Over Temperature Protection
- Internal Soft-Start
- Zero Shutdown Current
- Adjustable Output up to 24V
- Package: TSOT23-6L / TSOT23-5L

### Applications

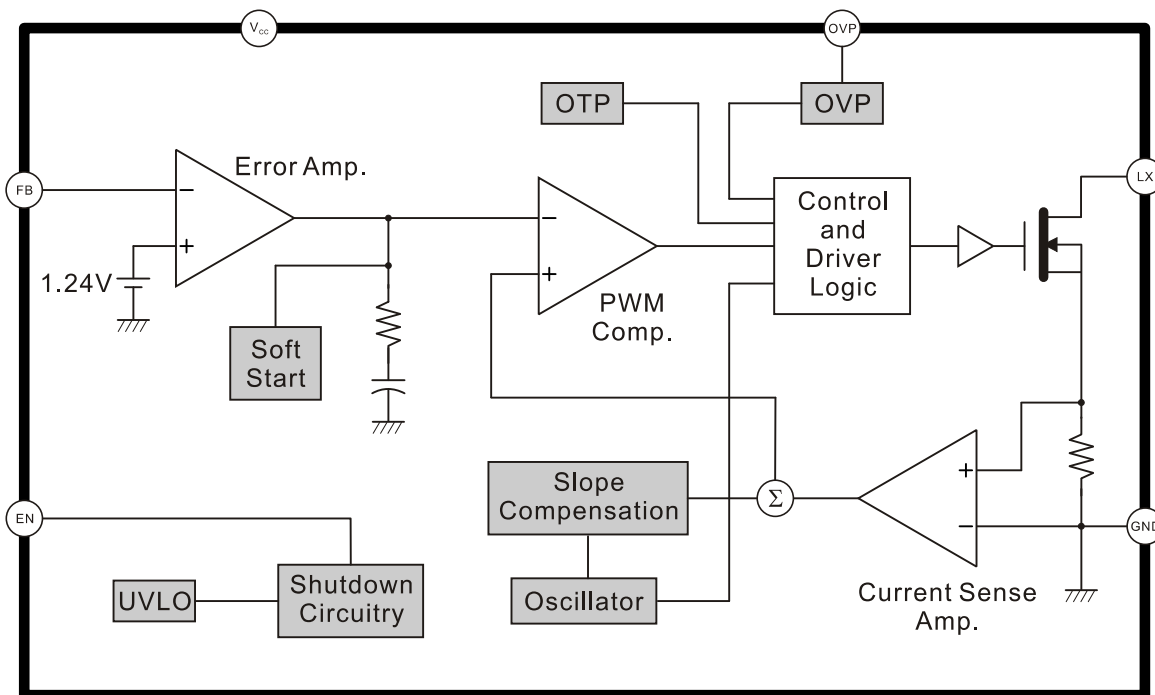
- LCD Displays
- Digital Cameras
- Camcorders

### Typical Application Circuit



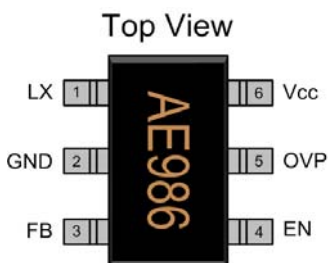
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## Function Block Diagram



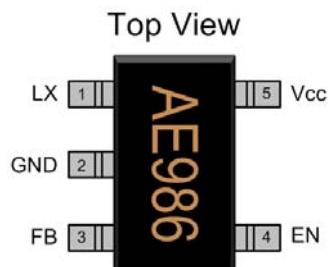
## Pin Descriptions

### TSOT23-6L



| 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)    |
| OVP             | 5   | O     | Over Voltage Protection         |
| V <sub>CC</sub> | 6   | P     | IC Power Supply                 |

### TSOT23-5L

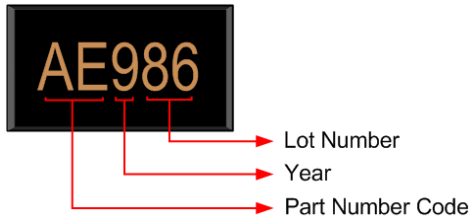


| Name            | No. | I / O | Description                     |
|-----------------|-----|-------|---------------------------------|
| LX              | 1   | O     | Power Switch Output             |
| GND             | 2   | P     | Ground                          |
| FB              | 3   | I 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

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## Marking Information

TSOT23-6L / TSOT23-5L



**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 "AE".

## Ordering Information

| Part Number | Code | Operating Temperature | Package   | MOQ    | Description |
|-------------|------|-----------------------|-----------|--------|-------------|
| FP6292iR-G1 | AE   | -40°C ~ 85°C          | TSOT23-5L | 3000EA | Tape & Reel |
| FP6292hR-G1 | AE   | -40°C ~ 85°C          | TSOT23-6L | 3000EA | Tape & Reel |

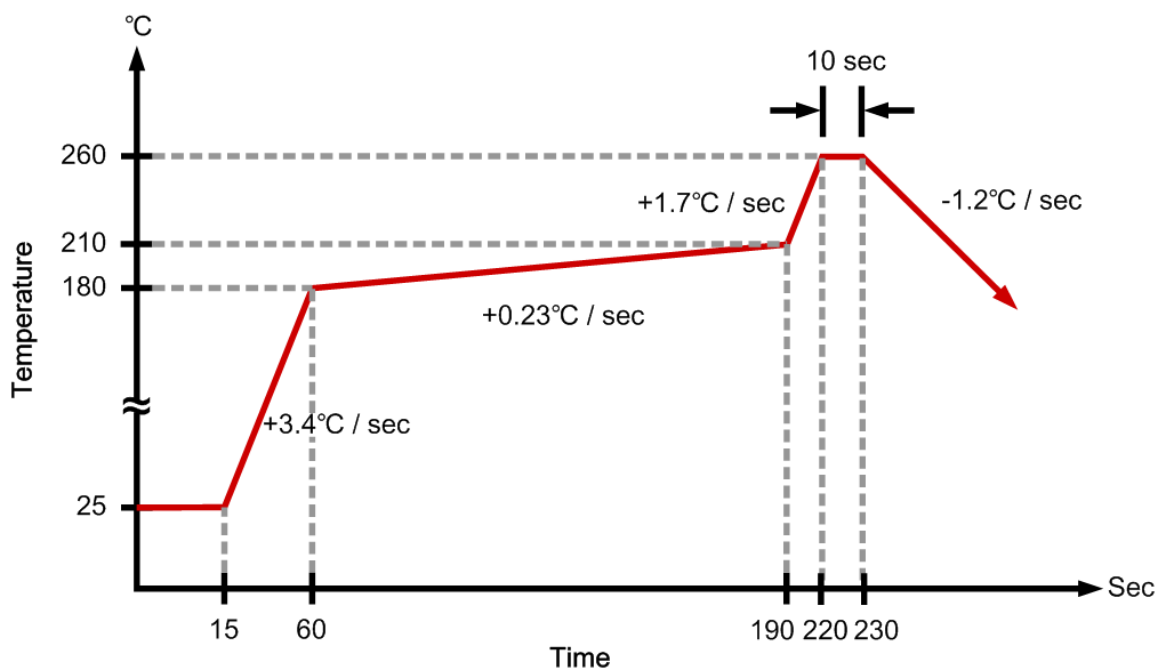
## Absolute Maximum Ratings

| Parameter                  | Symbol        | Conditions                         | Min. | Typ. | Max. | Unit   |
|----------------------------|---------------|------------------------------------|------|------|------|--------|
| Supply Voltage             | $V_{CC}$      |                                    | 0    |      | 6    | V      |
| OVP Voltage                | $V_{OVP}$     |                                    | 0    |      | 25   | V      |
| LX Input Voltage           | $V_{LX}$      |                                    | 0    |      | 25   | V      |
| EN,FB Voltage              |               |                                    | 0    |      | 6    | V      |
| Power Dissipation          | $P_D$         | TSOT23-5L @ $T_A=25^\circ\text{C}$ |      |      | 455  | mW     |
|                            |               | TSOT23-6L @ $T_A=25^\circ\text{C}$ |      |      | 455  |        |
| Thermal Resistance (Note1) | $\theta_{JA}$ | TSOT23-5L                          |      |      | +220 | °C / W |
|                            |               | TSOT23-6L                          |      |      | +220 |        |
| 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     |

### 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



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**Recommended Operating Conditions (Note 1)**

| Parameter                   | Symbol         | Conditions | Min. | Typ. | Max. | Unit |
|-----------------------------|----------------|------------|------|------|------|------|
| Junction Temperature Range  | T <sub>J</sub> |            | -40  |      | +125 | °C   |
| Operating Temperature Range | T <sub>A</sub> |            | -40  |      | +85  | °C   |

**Note 1:**

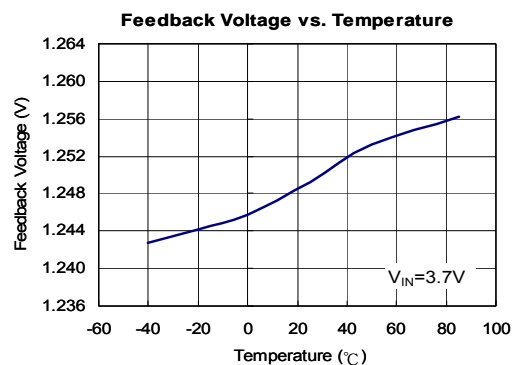
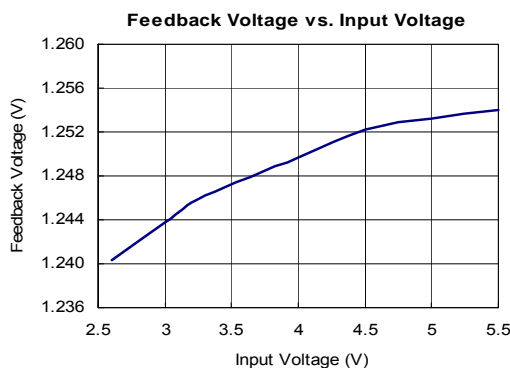
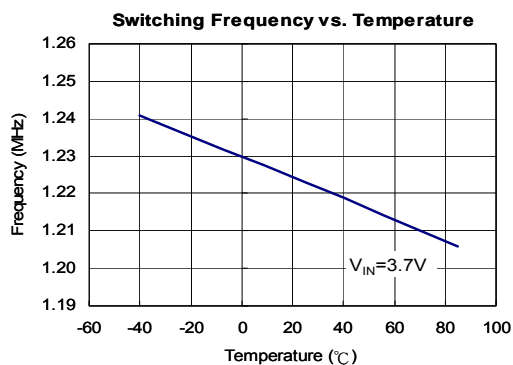
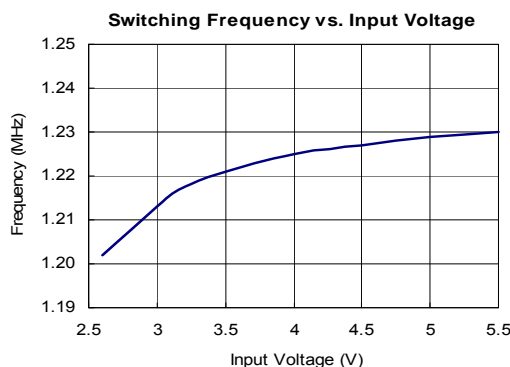
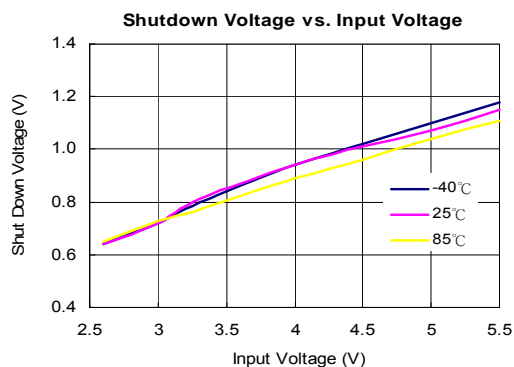
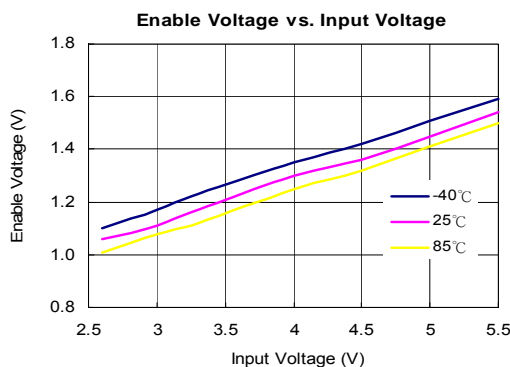
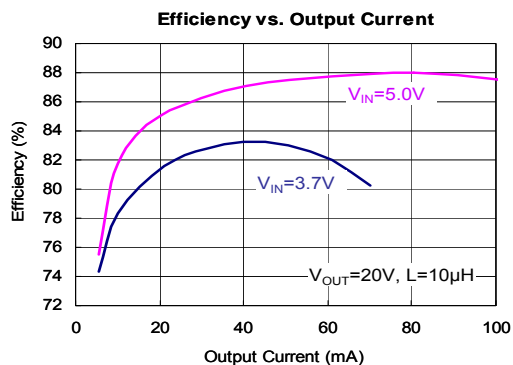
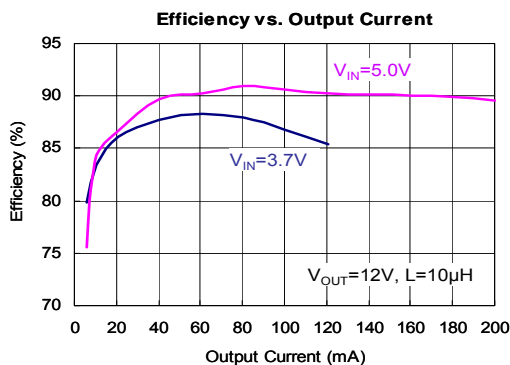
The device is not guaranteed to function outside its operating conditions.

**DC Electrical Characteristics (V<sub>CC</sub>=3.7V, T<sub>A</sub>=25°C, unless otherwise specified)**

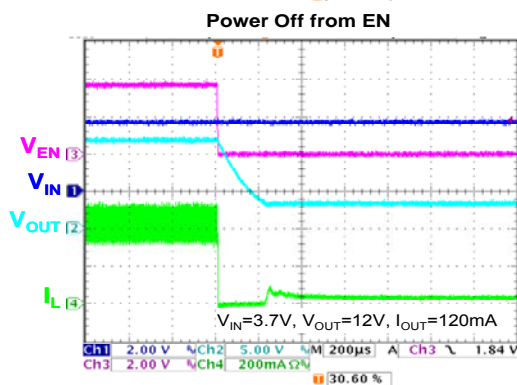
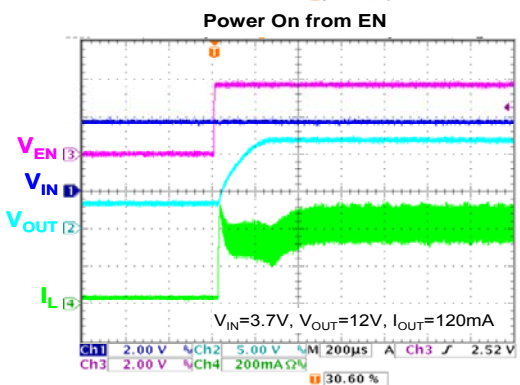
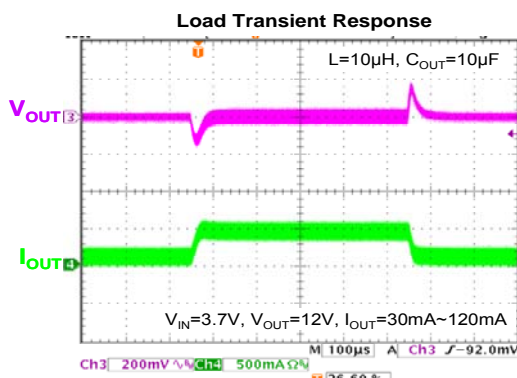
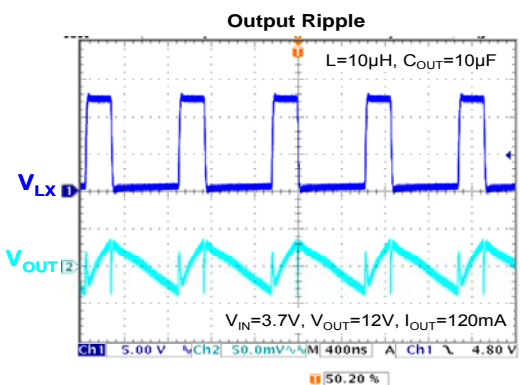
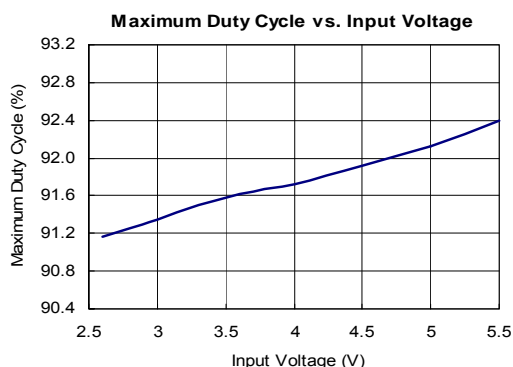
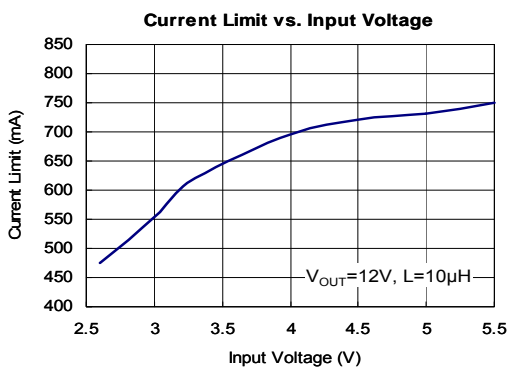
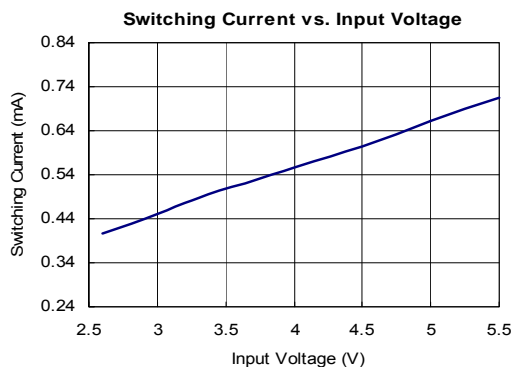
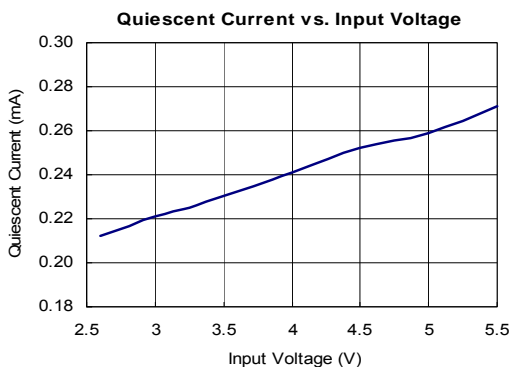
| Parameter                                | Symbol                 | Conditions                          | Min. | Typ. | Max. | Unit  |
|--|------------------------|-------------------------------------|------|------|------|-------|
| <b>System Supply Input</b>               |                        |                                     |      |      |      |       |
| Input Supply Range                       | V <sub>CC</sub>        |                                     | 2.7  |      | 5.5  | V     |
| Under Voltage Lockout                    | V <sub>UVLO</sub>      |                                     |      | 2.2  |      | V     |
| Quiescent Current                        | I <sub>CC</sub>        | V <sub>FB</sub> =1.3V, No switching |      | 0.3  |      | mA    |
| Average Supply Current                   | I <sub>CC</sub>        | V <sub>FB</sub> =1.0V, Switching    |      | 0.5  |      | 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               | 0.9  | 1.2  | 1.5  | MHz   |
| Frequency Change with Voltage            | Δf / ΔV                | V <sub>CC</sub> =2.7V to 5.5V       |      | 2    |      | %     |
| Frequency Change with Temperature        | Δf / ΔT                | T <sub>A</sub> =-40°C to 85°C       |      | 10   |      | %     |
| Maximum Duty Cycle                       | T <sub>DUTY</sub>      |                                     | 85   |      |      | %     |
| <b>Reference Voltage</b>                 |                        |                                     |      |      |      |       |
| Feedback Voltage                         | V <sub>REF</sub>       |                                     | 1.19 | 1.24 | 1.29 | V     |
| Feedback Voltage Change with Temperature | ΔV <sub>REF</sub> / ΔT | T <sub>A</sub> =-40°C to 25°C       |      | 1.5  |      | %     |
|  |                        | T <sub>A</sub> =25°C to 85°C        |      | 1.5  |      |       |
| Line Regulation                          |                        | V <sub>CC</sub> =2.7V ~ 5.5V        |      | 0.01 |      | % / V |
| <b>MOSFET</b>                            |                        |                                     |      |      |      |       |
| On Resistance of Driver                  | R <sub>DS (ON)</sub>   | I <sub>LX</sub> =0.1A               |      | 0.75 |      | Ω     |
| <b>Protection</b>                        |                        |                                     |      |      |      |       |
| OVP Threshold Voltage                    | V <sub>OVP</sub>       |                                     |      | 24   |      | V     |
| OVP Sink Current                         | I <sub>SINK</sub>      |                                     |      | 5    |      | μA    |
| OCP Current                              | I <sub>OCP</sub>       |                                     |      | 750  |      | mA    |
| OTP Temperature                          | T <sub>OTP</sub>       |                                     |      | +150 |      | °C    |
| Enable Voltage                           | V <sub>EN</sub>        |                                     | 1.5  |      |      | V     |
| Shutdown Voltage                         | V <sub>EN</sub>        |                                     |      |      | 0.4  | V     |

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## Typical Operating Characteristics



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## Function Description

### Operation

The FP6292 is a current mode boost converter. The constant switching frequency is 1.2MHz and operates with pulse width modulation (PWM). Build-in 24V / 0.75A 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 FP6292 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.

### 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 FP6292's OVP threshold is 24V.

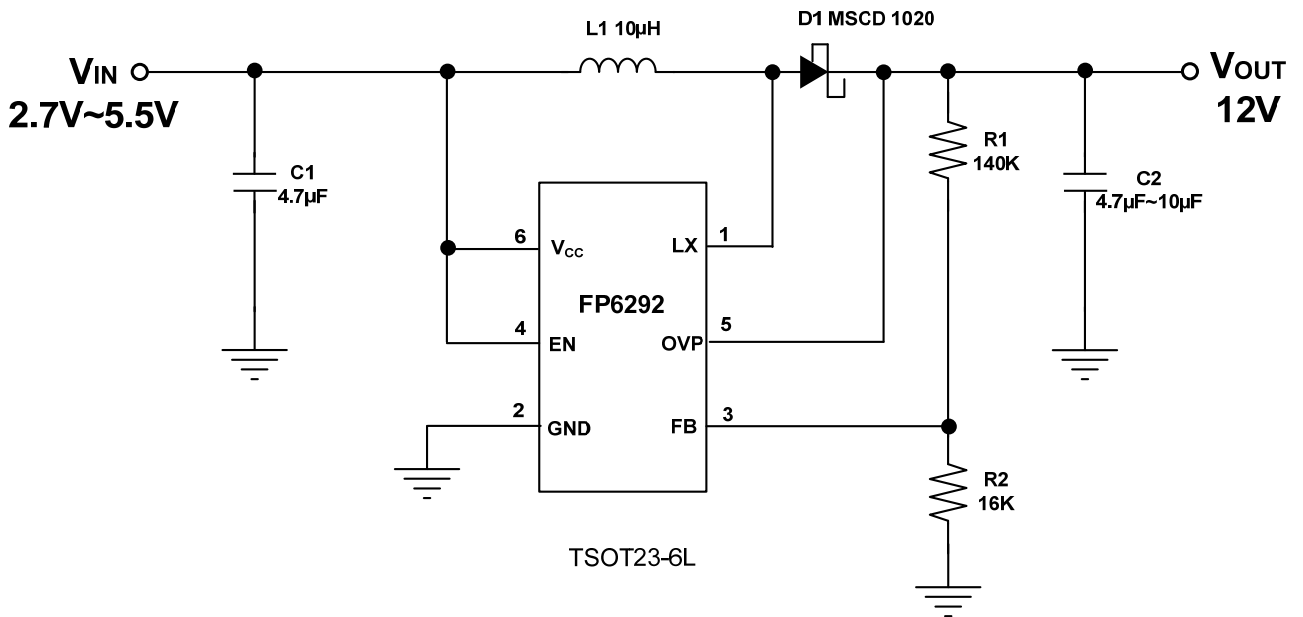
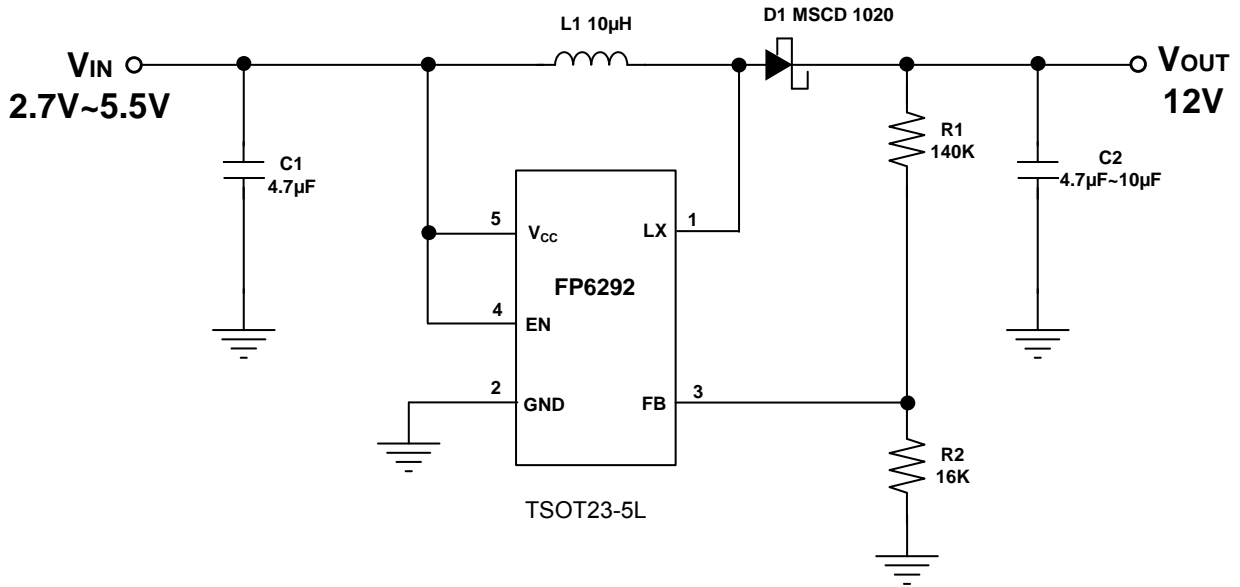
### Over Temperature Protection (OTP)

FP6292 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.



## Application Information

### General Application Circuit



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### Inductor Selection

Inductance value is decided based on different condition. 4.7 to 22 $\mu$ H 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 1.2MHz.

### 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:

$$V_{OUT} = 1.24V \left( 1 + \frac{R1}{R2} \right)$$

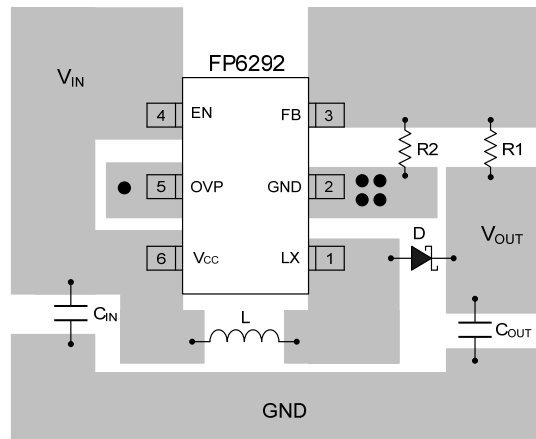
The recommended resistor value is summarized below:

| $V_{OUT}$ (V) | $R_1$ (k $\Omega$ ) | $R_2$ (k $\Omega$ ) |
|---------------|---------------------|---------------------|
| 5             | 140                 | 46                  |
| 12            | 140                 | 16                  |
| 15            | 145                 | 13                  |
| 18            | 150                 | 11                  |

### Layout Considerations

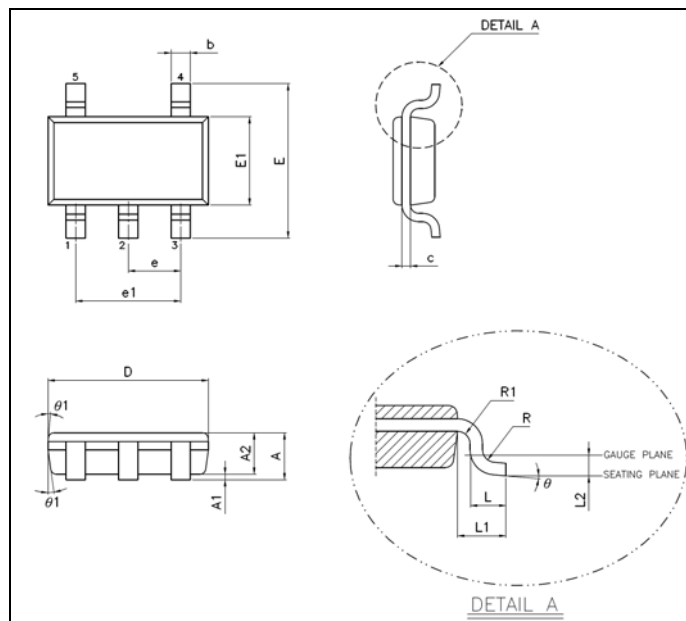
1. The power traces, consisting of the GND trace, the LX trace and the  $V_{CC}$  trace should be kept short, direct and wide.
2. LX、L and D switching node, wide and short trace to reduce EMI.
3. Place  $C_{IN}$  near  $V_{CC}$  pin as closely as possible to maintain input voltage steady and filter out the pulsing input current.
4. The resistive divider R1and 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,  $C_{IN}$  and  $C_{OUT}$  should be connected close together directly to a ground plane.

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## Package Outline

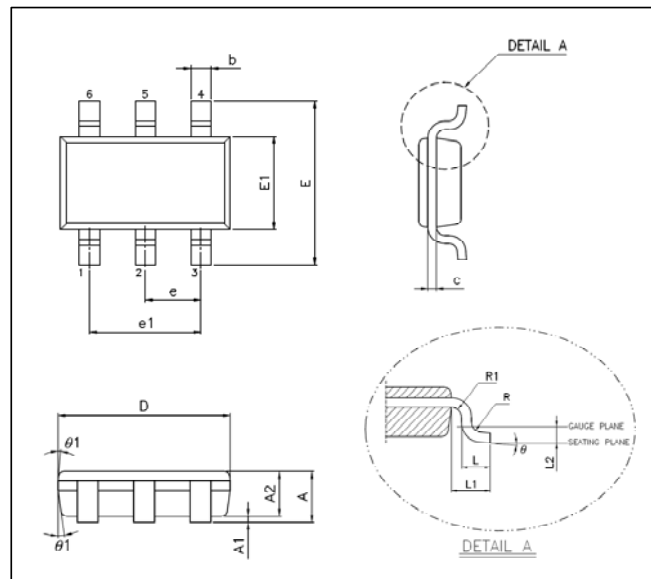
**TSOT23-5L**

**Unit: mm**

| Symbols | Min. (mm) | Max. (mm) |
|---------|-----------|-----------|
| A       | 0.750     | 0.800     |
| A1      | 0.000     | 0.050     |
| A2      | 0.700     | 0.775     |
| b       | 0.350     | 0.500     |
| c       | 0.100     | 0.200     |
| D       | 2.800     | 3.000     |
| E       | 2.600     | 3.000     |
| E1      | 1.500     | 1.700     |
| e       | 0.950 BSC |           |
| e1      | 1.900 BSC |           |
| L       | 0.370     | 0.600     |
| L1      | 0.600 REF |           |
| L2      | 0.250 BSC |           |
| R       | 0.100     |           |
| R1      | 0.100     | 0.250     |
| θ°      | 0°        | 8°        |
| θ1      | 4°        | 12°       |

**Note:**

1. Dimension "D" does not include molding flash, protrusions or gate burrs.
2. Dimension "E1" does not include inter-lead flash or protrusions.

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**TSOT23-6L**

**Unit: mm**

| Symbols        | Min. (mm) | Max. (mm) |
|----------------|-----------|-----------|
| A              | 0.750     | 0.800     |
| A1             | 0.000     | 0.050     |
| A2             | 0.700     | 0.775     |
| b              | 0.350     | 0.500     |
| c              | 0.100     | 0.200     |
| D              | 2.800     | 3.000     |
| E              | 2.600     | 3.000     |
| E1             | 1.500     | 1.700     |
| e              | 0.950 BSC |           |
| e1             | 1.900 BSC |           |
| L              | 0.370     | 0.600     |
| L1             | 0.600 REF |           |
| L2             | 0.250 BSC |           |
| R              | 0.100     |           |
| R1             | 0.100     | 0.250     |
| $\theta^\circ$ | 0°        | 8°        |
| $\theta_1$     | 4°        | 12°       |

**Note:**

1. Dimension "D" does not include molding flash, protrusions or gate burrs.
2. Dimension "E1" does not include inter-lead flash or protrusions.