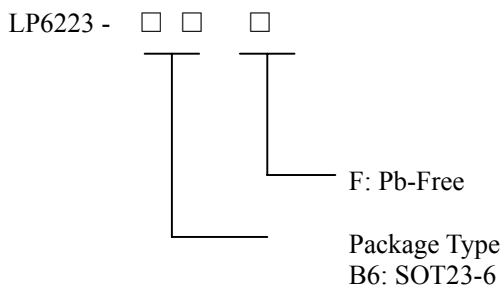


High Efficiency Boost DC/DC Converter

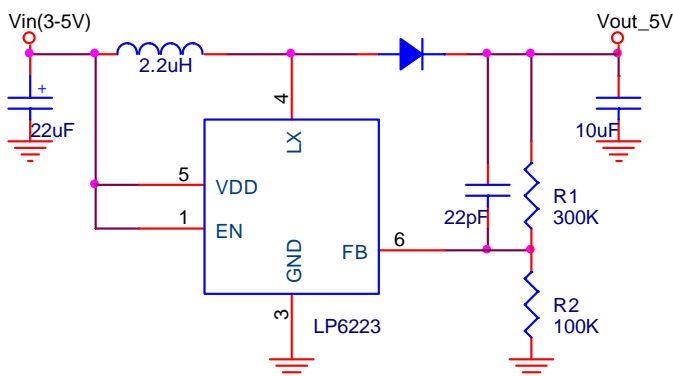
General Description

The LP6223 is a current mode boost DC-DC converter. Its PWM circuitry with built-in $0.3\Omega, 24V, 1.5A$ Current power MOSFET makes this converter highly power efficiently. Selectable high switching frequency allows faster loop response and easy filtering with a low noise output. The non-inverting input its error amplifier is connected to an internal $0.6V$ precision reference voltage. Soft-Start time can be programmed with an external capacitor, which sets the input current ramp rate. Current mode control and external compensation network make it easy and flexible to stabilize the system.

Ordering Information



Typical Application Circuit



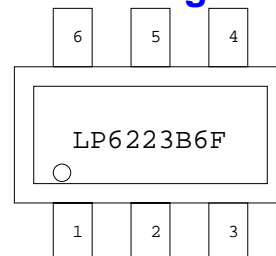
Features

- ◆ Up to 94% efficiency
- ◆ Output to Input Disconnect at Shutdown Mode
- ◆ Shut-down current: $<1\mu A$
- ◆ Output voltage Up to 28V
- ◆ Internal Compensation, Soft-start
- ◆ 1.1MHz fixed frequency switching
- ◆ High switch on current: $1.5A/30V$
- ◆ Available in sot23-6 Package

Applications

- ◇ Battery products
- ◇ Host Products
- ◇ Panel

Pin Configurations



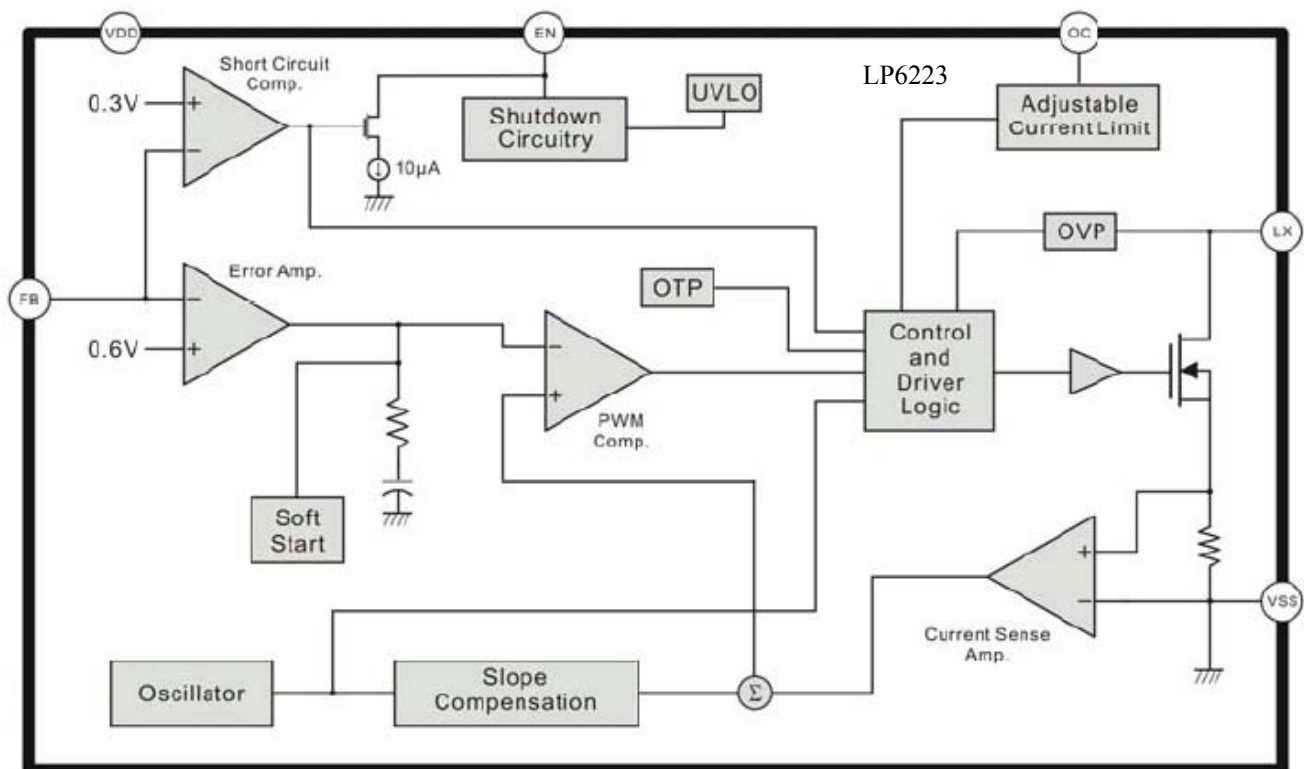
Marking Information

Please see website: www.lowpowersemi.com.

Functional Pin Description

| Pin Number | Pin Name | Pin Name |
|------------|----------|--|
| SOT23-6 | | |
| 1 | EN | Chip ON/OFF(High Enable) |
| 2 | EXT | External switch transistor driver output. |
| 3 | GND | Ground. |
| 4 | LX | Pin for switching MOS output. |
| 5 | VDD | Chip power supply. |
| 6 | FB | Feedback input pin, Internal reference voltage for the error amplifier is 1.25V. |

Function Block Diagram



Absolute Maximum Ratings

| | |
|---------------------------------------|--------------|
| Supply Input Voltage | -----6V |
| Power Dissipation, PD @ TA = 25° C | |
| SOT23-6 | -----450mW |
| Package Thermal Resistance | |
| SOT23-6, θ_{JA} | -----165°C/W |
| Lead Temperature (Soldering, 10 sec.) | -----260°C |

Recommended Operating Conditions

| | |
|--------------------------------------|--------------------|
| Supply Input Voltage | -----2.2V to 6V |
| EN Input Voltage | -----0V to 5.5V |
| Operation Junction Temperature Range | -----40°C to 125°C |
| Operation Ambient Temperature Range | -----40°C to 85°C |

Electrical Characteristics

(Vin=2.4V, Vout=3.5V, Cin=10uF, Cout=22uF, L1=2.2uH, R1=178K, R2=100K)

| Parameter | Conditions | LP6223 | | | Units |
|--------------------------|---------------------|--------|------|-----|-------|
| | | Min | Typ | Max | |
| Supply Voltage | | 1.6 | | 6 | V |
| Output Voltage Range | | 2.5 | | 28 | V |
| Supply Current(Shutdown) | VEN=VOUT=0V, VSW=5V | | 0.05 | 1 | uA |
| Supply Current | VFB=0.7V | | 0.19 | | mA |
| Feedback Voltage | | | 0.6 | | V |
| Feedback Input Current | VFB=0.7V | | 50 | | nA |
| Switching Frequency | | | 1.10 | | MHz |
| Maximum Duty Cycle | | 80 | 90 | 95 | % |
| EN Input Low Voltage | | | | 0.4 | V |
| EN Input High Voltage | | 1.4 | | | V |
| High-side On Resistance | Vout=3.3V | | 300 | | mΩ |
| Mosfet Voltage | | | 28 | | V |
| Mosfet Current | | | 1.5 | | A |

Operation Information

The LP6223 uses a 1.1MHz fixed-frequency, current-mode regulation architecture to regulate the output voltage. The LP6223 measures the output voltage through an external resistive voltage divider and compares that to the internal 0.6V reference to generate the error voltage to the inductor current to regulate the output voltage. The use of current-mode regulation improves transient response and control loop stability.

When the LP6223 is disabled (EN=Low), both power switches are off. There is no current path from SW to OUT. Therefore, the output voltage discharges to ground. When the LP6223 is enabled (EN=High), a limited start-current charges the output voltage rising to SW, then the part operates in force PWM mode for regulating the output voltage to the target value. At the beginning of each cycle, the N-channel MOSFET switch is turned on, forcing the inductor current to rise. The current at the source of the switch is internally measured and converted to a voltage by the current sense amplifier. That voltage is compared to the error voltage. When the inductor current rises sufficiently, the PWM comparator turns off the switch, forcing the inductor current to the output capacitor through the internal P-Channel MOSFET rectifier, which forces the inductor current to decrease. The peak inductor current is controlled by the error voltage. Thus the output voltage controls the inductor current to satisfy the load.

Setting the Output Voltage

Set the output voltage by selecting the resistive voltage divider ratio. The voltage divider drops the output voltage to the 0.6V feedback voltage. Use a 100K resistor for R2 of the voltage divider. Determine the high-side resistor R1 by the equation:

$$V_{out} = (R1/R2 + 1) \times V_{FB}$$

Current Limitation

The internal power-MOS switch current is monitored cycle-by-cycle and is limited to the value not exceed

1.5A (Typ.). When the switch current reaches the limited value, the internal power-MOS is turned off immediately until the next cycle.

Inductor Selection

For a better efficiency in high switching frequency converter, the inductor selection has to use a proper core material such as ferrite core to reduce the core loss and choose low ESR wire to reduce copper loss. The most important point is to prevent the core saturated when handling the maximum peak current. Using a shielded inductor can minimize radiated noise in sensitive applications. The maximum peak inductor current is the maximum input current plus the half of inductor ripple current. The calculated peak current has to be smaller than the current limitation in the electrical characteristics. A typical setting of the inductor ripple current is 20% to 40% of the maximum input current. If the selection is 40%, the maximum peak inductor current is

$$I_{PEAK} = I_{IN(MAX)} + \frac{1}{2} I_{RIPPLE} = 1.2 \times I_{IN(MAX)} \\ = 1.2 \times \left[\frac{I_{OUT(MAX)} \times V_{OUT}}{\eta \times V_{IN(MIN)}} \right]$$

The minimum inductance value is derived from the following equation :

$$L = \frac{\eta \times V_{IN(MIN)}^2 \times [V_{OUT} - V_{IN(MIN)}]}{0.4 \times I_{OUT(MAX)} \times V_{OUT}^2 \times f_{OSC}}$$

Depending on the application, the recommended inductor value is between 2.2μH to 4.7μH.

Diode Selection

To achieve high efficiency, Schottky diode is good choice for low forward drop voltage and fast switching time. The output diode rating should be able to handle the maximum output voltage, average power dissipation and the pulsating diode peak current.

Input Capacitor Selection

For better input bypassing, low-ESR ceramic capacitors are recommended for performance. A 10 μ F input capacitor is sufficient for most applications. For a lower output power requirement application, this value can be decreased.

Output Capacitor Selection

For lower output voltage ripple, low-ESR ceramic capacitors are recommended. The tantalum capacitors can be used as well, but the ESR is

bigger than ceramic capacitor. The output voltage ripple consists of two components: one is the pulsating output ripple current flows through the ESR, and the other is the capacitive ripple caused by charging and discharging.

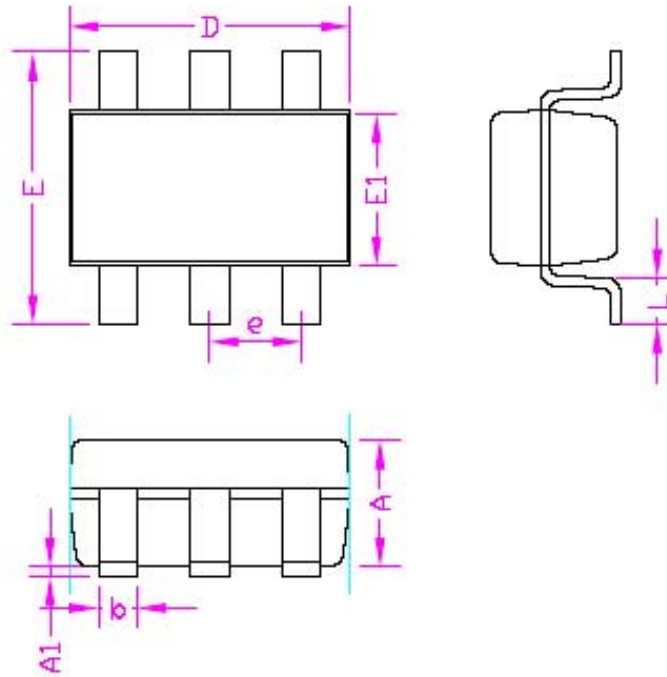
$$\begin{aligned}V_{\text{RIPPLE}} &= V_{\text{RIPPLE_ESR}} + V_{\text{RIPPLE_C}} \\ &\cong I_{\text{PEAK}} \times R_{\text{ESR}} + \frac{I_{\text{PEAK}}}{C_{\text{OUT}}} \left(\frac{V_{\text{OUT}} - V_{\text{IN}}}{V_{\text{OUT}} \times f_{\text{OSC}}} \right)\end{aligned}$$

Layout Guideline

For high frequency switching power supplies, the PCB layout is important step in system application design. In order to let IC achieve good regulation, high efficiency and stability, it is strongly recommended the power components should be placed as close as possible. The set traces should be wide and short. The feedback pin and then works of feedback and compensation should keep away from the power loops, and be shielded with a ground trace or plane to prevent noise coupling.

Packaging Information

SOT23-6



| SYMBOLS | MILLIMETERS | | INCHES | |
|---------|-------------|------|--------|-------|
| | MIN. | MAX. | MIN. | MAX. |
| A | - | 1.45 | - | 0.057 |
| A1 | 0.00 | 0.15 | 0.000 | 0.006 |
| b | 0.30 | 0.50 | 0.012 | 0.020 |
| D | 2.90 | | 0.114 | |
| E1 | 1.60 | | 0.063 | |
| e | 0.95 | | 0.037 | |
| E | 2.60 | 3.00 | 0.102 | 0.118 |
| L | 0.3 | 0.60 | 0.012 | 0.024 |