



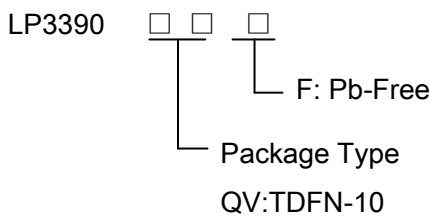
High Performance, Constant Current Switching for White LED and Boost Converter

General Description

The LP3390 is a high frequency, asynchronous boost converter for constant current white LED driver applications. The internal MOSFET can support up to 8 White LEDs for backlighting and OLED power application, and the internal soft start function can reduce the inrush current. The LED current is initially set with the external sense resistor. To improve efficiency, the feedback voltage is set to 200mV, which reduces the power dissipation in the current setting resistor.

The LP3390 implements a constant frequency 1.2MHz PWM control scheme. Optimized operation frequency can meet the requirement of small LC filters value. Highly integration and internal compensation network minimizes as component counts to provide the best solution for PCB space saving and total BOM cost. DFN-10 3*3mm packages.

Order Information



Marking information

| Device | Marking | Package | Shipping |
|-----------|-----------------------|---------|----------|
| LP3390QVF | LPS LP3390 xxxx | QV:SQVF | 3K/reel |

Y:Production year W:Production period X:Production batch

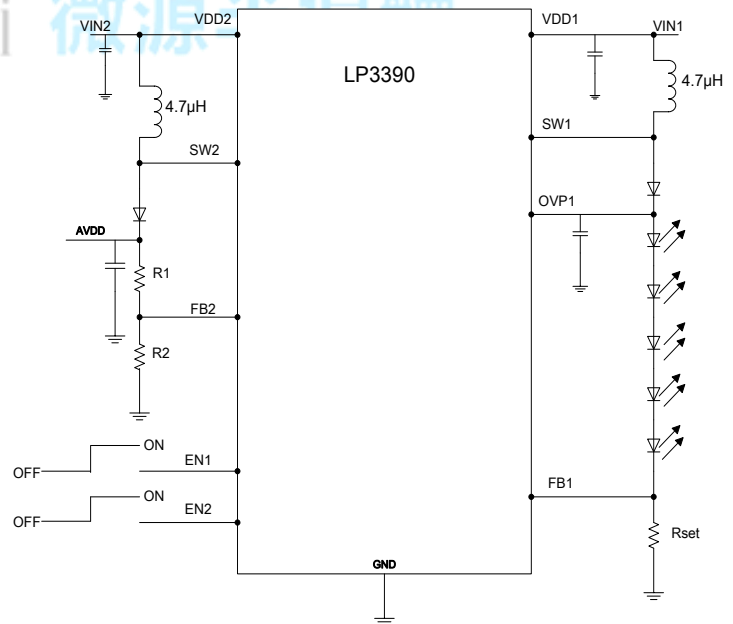
Features

- ◆ High Efficiency: 95%
- ◆ 1.2MHz Fixed-Frequency PWM Operation
- ◆ Maximum Output Voltage up to 30V
- ◆ Operating Range : 2.5V to 5.5V
- ◆ Shutdown Supply Current: <1uA
- ◆ Minimize the External Component.
- ◆ RoHS Compliant and 100% Lead (Pb)-Free

Applications

- ◇ WLED Backlight driver
- ◇ Panel Bias Voltage supply

Typical Application Circuit





Functional Pin Description

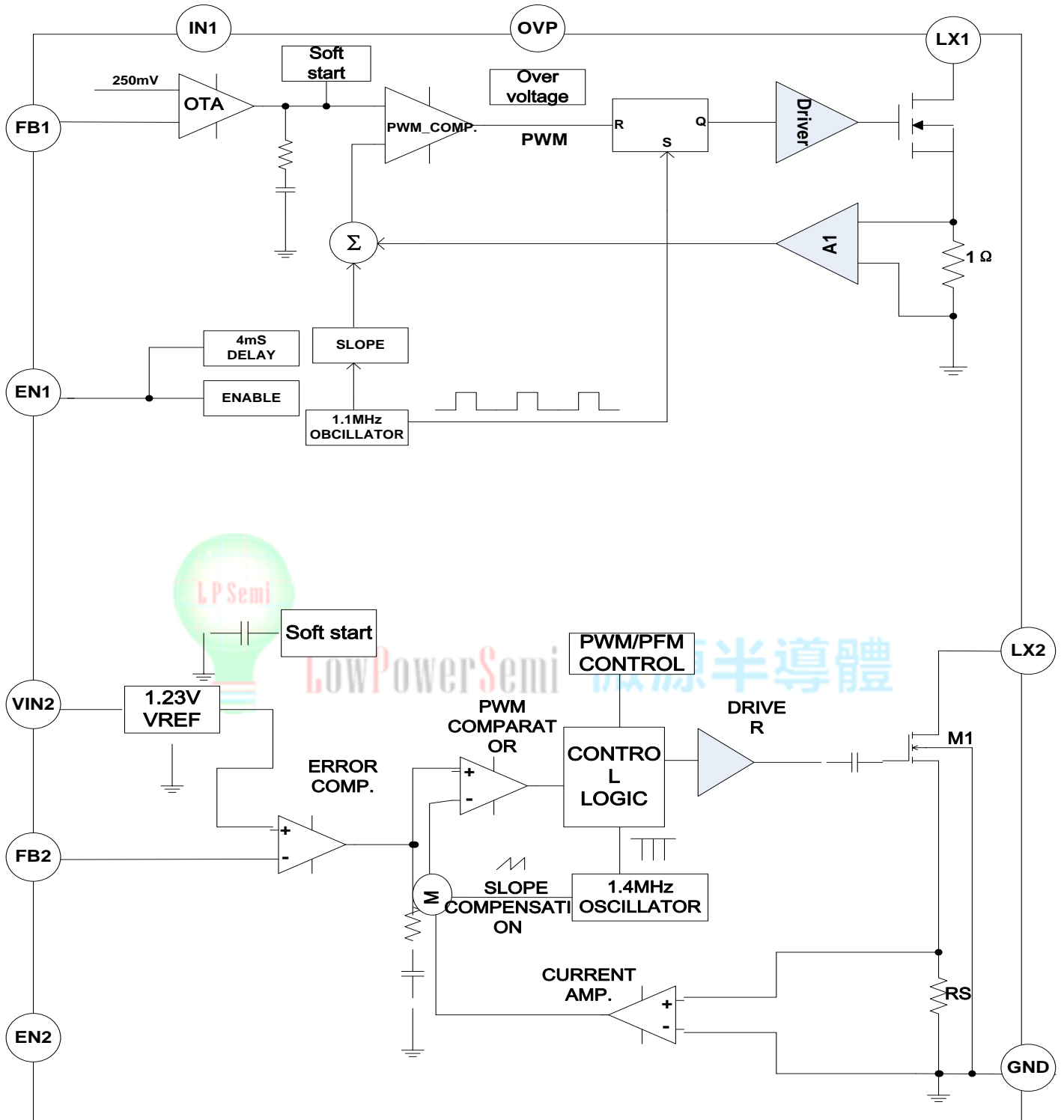
| Package Type | Pin Configurations |
|--------------|---|
| TDFN-10 | <p style="text-align: center;">Top View</p> |

Pin Description

| Pin | Name | Description |
|-----|------|--|
| 1 | GND | Ground Pin |
| 2 | VIN2 | Supply Input Voltage Pin. Bypass 10uF capacitor to GND to reduce the input noise. |
| 3 | EN2 | Chip Enable (Active High). Voltage sensing input to trigger the function of over voltage protection. Note that this pin is high impedance. There should be a pull low 100kΩ resistor connected to GND when the control signal is floating. |
| 4 | FB1 | Feedback Reference Voltage Pin. Series connect a resistor between WLED and ground as a current sense. Sense the current feedback voltage to set the current rating. FB voltage is 200mV. |
| 5 | SW1 | Switch Pin. Connect this Pin to inductor and catch diode. Minimize the track area to reduce EMI. |
| 6 | VIN1 | Supply Input Voltage Pin. Bypass 10uF capacitor to GND to reduce the input noise. |
| 7 | OVP | OVP Pin. Overvoltage Sense. |
| 8 | EN1 | Chip Enable (Active High). Voltage sensing input to trigger the function of over voltage protection. Note that this pin is high impedance. There should be a pull low 100kΩ resistor connected to GND when the control signal is floating. |
| 9 | FB2 | Feedback Reference Voltage Pin. Series connect a resistor between WLED and ground as a current sense. Sense the current feedback voltage to set the current rating. FB voltage is 1250mV. |
| 10 | SW2 | Switch Pin. Connect this Pin to inductor and catch diode. Minimize the track area to reduce EMI. |



Function Block Diagram





Absolute Maximum Ratings

- ◇ Supply Input Voltage ----- -0.3V to 6.5V
- ◇ LX/OVP Pin to GND ----- -0.3V to 36V
- ◇ The Other Pins ----- -0.3V to 6.5V
- ◇ Power Dissipation, PD @ TA = 25°C ----- 1.5W
- ◇ Thermal Resistance (JA) ----- 65°C/W
- ◇ Lead Temperature (Soldering, 10 sec.) ----- 260°C
- ◇ Operation Temperature Range ----- -20°C to 85°C
- ◇ Storage Temperature Range ----- -65°C to 165°C

Electrical Characteristics

| Parameter | Symbol | Test Condition | Min | Typ. | Max | Units |
|----------------------------|---------|------------------|------|------|------|-------|
| System Supply Input | | | | | | |
| Operation voltage Range | VDD | | 2.5 | | 5.5 | V |
| Under Voltage Lock Out | UVLO | | | 2.3 | | V |
| Supply Current | IDD | FB=0V, Switching | | 0.8 | 1.3 | mA |
| Shut Down Current | IDD | VEN < 0.4V | | 0.1 | 1 | uA |
| Line Regulation | | VIN : 3.0~4.3V | | 3 | | % |
| Oscillator | | | | | | |
| Operation Frequency | FOSC | | | 1.2 | | MHz |
| Maximum Duty Cycle | | | 89 | 92 | 96 | % |
| Dimming Frequency | | | 100 | | 1M | Hz |
| Feedback1 Voltage | VFB1 | | 185 | 200 | 215 | mV |
| Feedback2Voltage | VFB2 | | 1220 | 1250 | 1280 | mV |
| MOSFET | | | | | | |
| On Resistance of MOSFET | RDS(ON) | | | 0.5 | | Ω |
| Protection | | | | | | |
| OVP Threshold | VOVP | | | 29 | | V |
| OVP Sink Current | | | | 5 | | μ A |
| OCP | | | | 1250 | | mA |
| Shut Down Voltage | VEN | | | | 0.4 | V |
| Enable Voltage | VEN | | 1.5 | | | V |



Applications Information

LED Current Control

The loop of Boost structure will keep the FB pin voltage equal to the reference voltage VREF.

FB voltage is 200mV, Therefore, when Rset connects FB pin and GND, the current flows from VOUT through LED and RSET to GND will be decided by the current on RSET, which is equal to following equation:

$$I_{LED} = V_{FB1} / R_{set}$$

Dimming Control

a. Using a PWM Signal to EN Pin

To control the brightness of LED, the LP3302 can perform the dimming control by applying a PWM signal to EN pin. The internal soft-start and wide range dimming frequency from 100Hz to 1MHz can insignificantly reduce audio noise when dimming.

The average LED current is proportional to the PWM signal duty cycle. The magnitude of the PWM signal should be higher than the maximum enable voltage of EN pin, in order to let the dimming control perform correctly.

b. Using a DC Voltage

Using a variable DC voltage to adjust the brightness is a popular method in some applications. The dimming control using a DC voltage circuit. The output voltage can be calculated by the following Equations.

c. Using a Filtered PWM signal

Another common application is using a filtered PWM signal as an adjustable DC voltage for LED dimming control. A filtered PWM signal acts as the DC voltage

to regulate the output current. In this circuit, the output ripple depends on the frequency of PWM signal. For smaller output voltage ripple (<100mV), the recommended frequency of 2.8V PWM signal should be above 2kHz. To fix the frequency of PWM signal and change the duty cycle of PWM signal can get different output current.

Constant Output Voltage Control

The output voltage of the LP3390 can be adjusted by the divider circuit on the FB pin. The output voltage can be calculated by the following Equations.

$$V_{out} = V_{FB2} \times (R1/R2 + 1)$$

Power Sequence

In order to assure the normal soft start function for suppressing the inrush current the input voltage should be ready before EN pulls high.

Soft-Start

The function of soft-start is made for suppressing the inrush current to an acceptable value at the beginning of power on. The LP3390 provides a built-in soft-start function by clamping the output voltage of error amplifier so that the duty cycle of the PWM will be increased gradually in the soft-start period.

Current Limiting

The current flow through inductor as charging period is detected by a current sensing circuit. As the value comes across the current limiting threshold, the N-MOSFET will be turned off so that the inductor will be forced to leave charging stage and enter discharging stage. Therefore, the inductor current will not increase over the current limiting threshold.



OVP/UVLO/OTP

The Over Voltage Protection is detected by a junction breakdown detecting circuit. Once VOUT goes over the detecting voltage, LX pin stops switching and the power N-MOSFET will be turned off. Then, the VOUT will be clamped to be near VOVP. As the output voltage is higher than a specified value or input voltage is lower than a specified value, the chip will enter protection mode to prevent abnormal function. As the die temperature is higher than 150°C, the chip also will enter protection mode. The power MOSFET will be turned off during protection mode to prevent abnormal operation.

Thermal Considerations

For continuous operation, do not exceed absolute maximum operation junction temperature. The maximum power dissipation depends on the thermal resistance of IC package, PCB layout, the rate of surroundings airflow and temperature difference between junction to ambient. The maximum power dissipation can be calculated by following formula :

$$P_{D(MAX)} = (T_{J(MAX)} - T_A) / \theta_{JA}$$

Where TJ(MAX) is the maximum operation junction temperature, TA is the ambient temperature and the θ_{JA} is the junction to ambient thermal resistance.

For the recommended operating conditions specification of LP3390, the maximum junction temperature of the die is 125°C. The junction to ambient thermal resistance θ_{JA} is layout dependent.

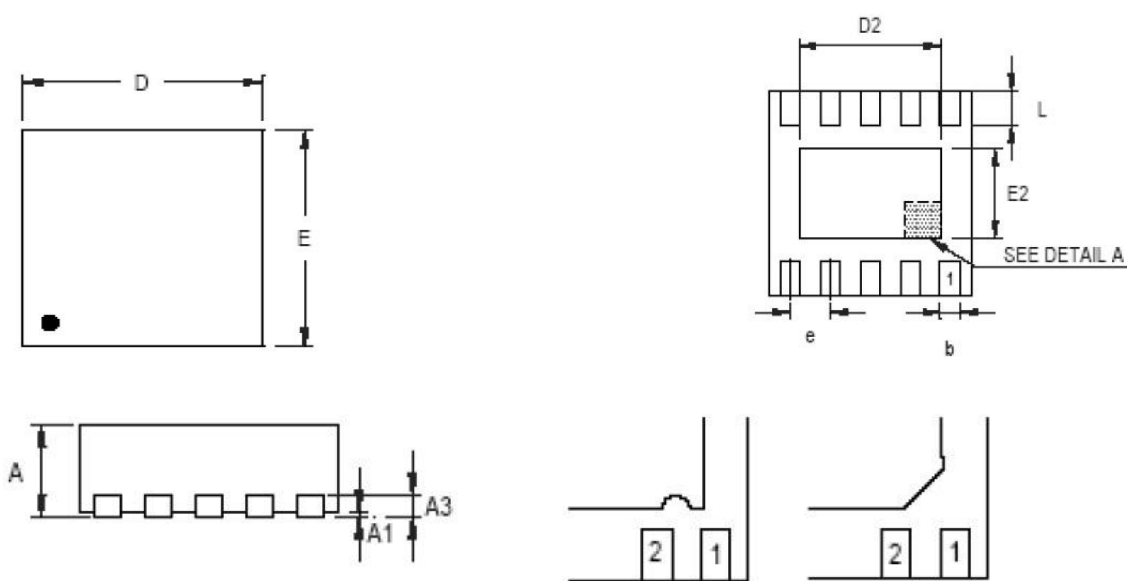
Layout Consideration

For best performance of the LP3390, the following guidelines must be strictly followed.

- Input and Output capacitors should be placed close to the IC and connected to ground plane to reduce noise coupling.
- The GND and Exposed Pad should be connected to a strong ground plane for heat sinking and noise protection.
- Keep the main current traces as possible as short and wide.
- LX node of DC-DC converter is with high frequency voltage swing. It should be kept at a small area.
- Place the feedback components as close as possible to the IC and keep away from the noisy devices.



Packaging Information



DETAIL A

Pin#1 ID and TIE Bar Mark Options

Note: The configuration of Pin #1 identifier is optional, but must be located within the zone indicated.

| Symbol | Dimensions in Millimeters | | Dimensions in Inches | |
|--------|---------------------------|-------|----------------------|-------|
| | Min | Max | Min | Max |
| A | 0.700 | 0.800 | 0.028 | 0.031 |
| A1 | 0.000 | 0.050 | 0.000 | 0.002 |
| A3 | 0.175 | 0.250 | 0.007 | 0.010 |
| b | 0.180 | 0.300 | 0.007 | 0.012 |
| D | 2.950 | 3.050 | 0.116 | 0.120 |
| D2 | 2.300 | 2.650 | 0.091 | 0.104 |
| E | 2.950 | 3.050 | 0.116 | 0.120 |
| E2 | 1.500 | 1.750 | 0.059 | 0.069 |
| e | 0.500 | | 0.020 | |
| L | 0.350 | 0.450 | 0.014 | 0.018 |