6-Channel LED Driver for Backlights

General Description

LP3352 is a cost effective LED driver optimized for media size LCD backlighting application. It provides a high performance LED backlight solution with minimized bill of material count.

LP3352 have a high performance boost converter with integrated 2.5A/40V power MOS. The boost structure which uses current mode control and fixed frequency operation to regulate the LED current. The 6-CH sink current can be adjusted through an external resistor. In addition, the LP3352 offers external frequency PWM dimming method for a wide range of dimming control.

Other features include over current protection (OCP), output over voltage protection (OVP), and under-voltage lockout (UVLO). The LP3352 is available in a space saving QFN-16 (0.5mm pitch) package.

Features

- Wide V_{IN} Range: 2.7V to 24V
- Current-Mode Boost Converter
- Integrated 2.5A/40V boost power MOS
- Built-in Internal Current soft-start
- Six programmable current sinks
  - Current up to 30mA per channel
  - PWM dimming from 100Hz to 30kHz
  - 2.5% current matching
  - 3% current accuracy
- LED string open/short detection
- Under-Voltage Lockout
- Over Voltage Protection
- Over Current Protection
- Over-Temperature Protection
- Available in QFN-16 (3mm×3mm)
- RoHS Compliant and Halogen Free
- Pb-Free Package

Order Information

LP3352□□□
- F: Green
- Package Type
  - QV: QFN-16

Applications

- Notebook LED Backlight
- TFT LCD Monitor LED Backlight
- Tablet Display Backlight

Marking Information

Device	Marking	Package	Shipping
LP3352	LPS LP3352 YWX	QFN-16	5K/REEL
Y: Y is year code. W: W is week code. X: X is series number.			

Typical Application Circuit

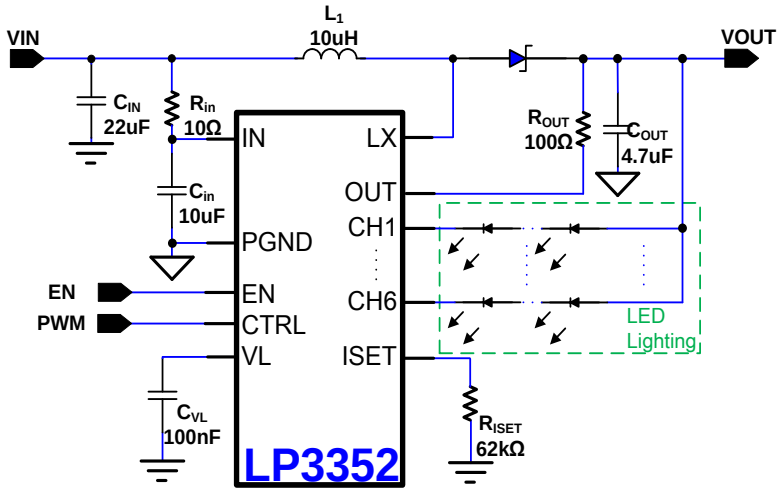


Figure 1. Typical Application Circuit of LP3352

Pin Configuration

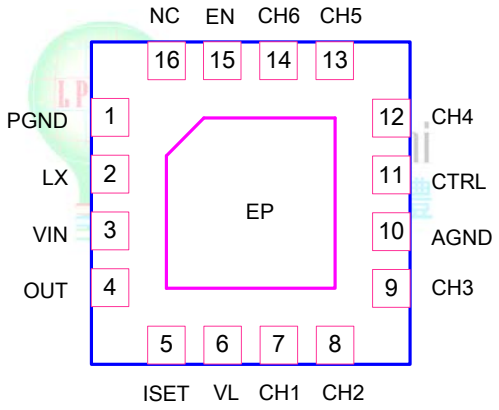


Figure 2. QFN-16 Package Top View

Function Block Diagram

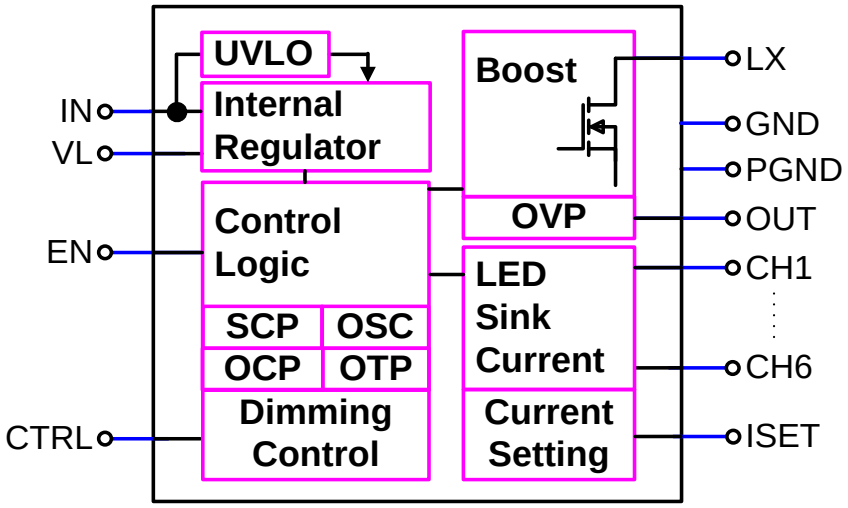


Figure 3. Function Block Diagram

Functional Pin Description

Pin NO.	Pin Name	Description
1	PGND	Power Ground.
2	LX	Boost Regulator Switching Node. Connect the inductor and the schottky diode to LX.
3	IN	Input Supply Pin. Decouple with 10μF ceramic capacitor close to the pin.
4	OUT	Output Voltage Sense Pin.
5	ISET	LED Current Set Pin. Connect external resistor between this pin to gnd.
6	VL	Regulator Output Pin. Connect a ceramic capacitor between VL and GND.
7	CH1	LED string current sink channel 1.
8	CH2	LED string current sink channel 2.
9	CH3	LED string current sink channel 3.
10	AGND	Analog Ground.
11	CTRL	External PWM Dimming Control Pin.
12	CH4	LED string current sink channel 4.
13	CH5	LED string current sink channel 5.
14	CH6	LED string current sink channel 6.
15	EN	Enable Pin.
16	NC	No Connection.
17	EP	Exposed thermal pad. Connect to AGND or PGND.

Absolute Maximum Ratings Note 1

- ✧ VIN to GND ---------- −0.3V to +27V
- ✧ CH1~CH6, LX, OUT to GND ---------- −0.3V to +40V
- ✧ EN, CTRL to GND ---------- −0.3V to +27V
- ✧ VL, ISET to GND ---------- −0.3V to +7V
- ✧ Operating Junction Temperature Range (T_J) ---------- −40℃ to +150℃
- ✧ Operation Ambient Temperature Range ---------- −40°C to +85°C
- ✧ Storage Temperature Range ---------- −65°C to +150°C
- ✧ Maximum Soldering Temperature (at leads, 10sec) ---------- +260°C
- ✧ Maximum Junction Temperature ---------- +150°C

Note 1. Stresses beyond those listed under "Absolute Maximum Ratings" may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated in the operational sections of the specifications is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

Thermal Information

- ✧ Thermal Resistance

  QFN-16, θ_{JA} ---------- 88°C/W

  QFN-16, θ_{JC} ---------- 39°C/W

Recommended Operating Conditions

- ✧ Input Voltage, V_{IN} ---------- 2.7V to 24V
- ✧ LED Current per Channel, I_{LED} ---------- 3mA to 30mA
- ✧ Junction Temperature, T_J ---------- -40°C to 125°C
- ✧ Ambient temperature, T_A ---------- -40°C to 85°C

Electrical Characteristics

(V_{IN}=12V, V_{EN}=V_{CTRL}=3V, T_A=25°C, unless otherwise specified)

Parameter	Symbol	Test Conditions	Min	Typ	Max	Units
General						
Input Supply Voltage	V_{IN}		2.7		24	V
Internal Voltage Output	VL	V_{IN}=12V		5		V
V_{IN} Supply Current	I_Q	Shutdown Current		2	18	uA
		Operation Current		2.5	3	mA
VOUT Input Current	I_{Q_OUT}				30	uA
Input UVLO Threshold	V_{UVLO}	V_{IN} Rising		2.6		V
UVLO Threshold Hysteresis	$V_{UVLO(H)}$	Falling Hysteresis		100		mV
Current Soft Start Time	T_{SS}			1		ms
Thermal Shutdown Threshold	T_{SD}	Temperature Rising	140	160	180	°C
Thermal Shutdown Hysteresis	ΔT_{SD}			15		°C
Logic Control (EN, CTRL)						
EN/CTRL Threshold Voltage	V_{IH}		1.5			V
	V_{IL}				0.4	V
EN/CTRL Logic Sink Current	I_{LS}	V_{EN}=V_{CTRL}=3V		15		uA
Dimming Frequency	F_{DIM}		100		30k	Hz
Boost Regulator						
Internal Oscillator Frequency	F_{OSC}		0.8	1	1.2	MHz
Switch On Resistance	$R_{DS(ON)}$			250	450	mΩ
LX Leakage current	I_{Leak_LX}	EN=L, V_{LX}=35V			1	uA
Maximum Duty Cycle	D_{MAX}		85	93		%
Minimum Duty Cycle	D_{MIN}			70		ns

Electrical Characteristics (Continued)

(V_{IN}=12V, V_{EN}=V_{CTRL}=3V, T_A=25°C, unless otherwise specified)

Parameter	Symbol	Test Conditions	Min	Typ	Max	Units
LED Current Regulation						
Minimum Regulation Voltage of CHx			600	700		mV
CHx Leakage Current	I_{Leak_CHx}	EN=L, V_{CHx}=20V			3	uA
CHx Maximum Current	I_{LED_MAX}	V_{IN}>2.7, CHx>0.7V	30			mA
ISET Voltage	V_{ISET}		1.204	1.229	1.253	V
ISET to ICHx Current Ratio	K_{ISET}	ISET=20uA	970	1000	1030	A/A
ICHx Current Accuracy	I_{LED}	ISET=20uA	19.4	20	20.6	mA
ICHx Current Matching		$(I_{MAX}-I_{MIN})/I_{AVG}$, I_{LED}=20mA		1	2.5	%
Protection Threshold						
V_{OUT} Over Voltage Protection	V_{O_OVP}	Threshold of OVP	38	39	40	V
V_{OUT} Over Voltage Protection Hysteresis	$V_{O\_OVP(H)}$			1		V
CHx Over Voltage Protection	V_{CH_OVP}	Threshold of OVP	15	17	20	V

Power On/ Off Sequence

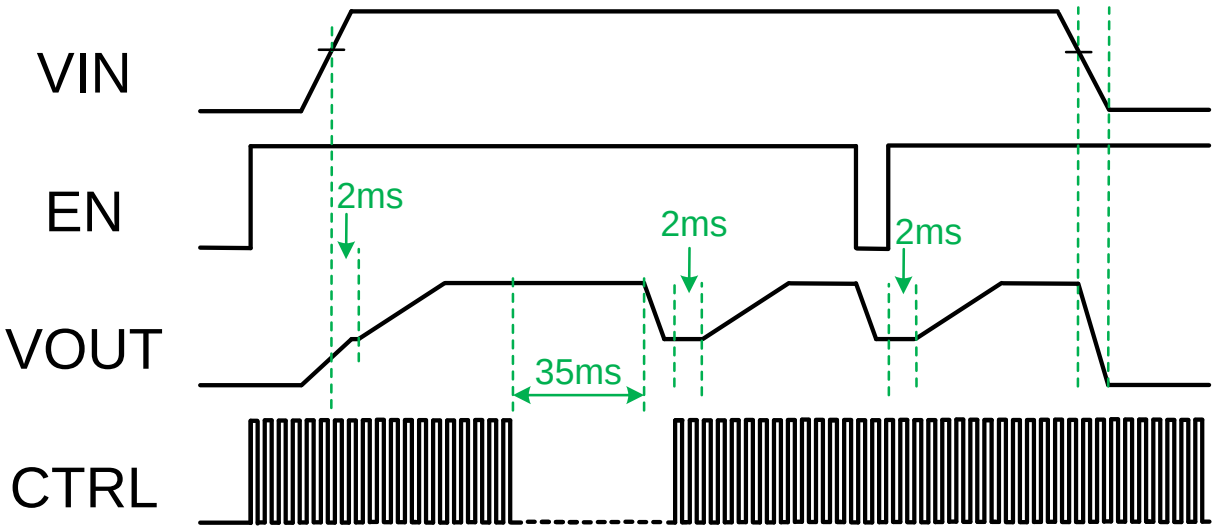


Figure 4. Power Sequence

Application Information

The LP3352 is designed in a current mode, constant frequency PWM boost converter. It can use dimming input that can by external control signal with a duty ratio of 1%-100% in 100Hz to 30kHz. The LP3352 include a boost converter with a built-in 2.5A/40V power MOS, six LED string current sink regulators of up to 30mA per channel, LED string open and short detection, output over-current protection, over-voltage protection, and over-temperature protection.

Under Voltage Lockout (UVLO)

The LP3352 had an UVLO internal circuit that enable the device once the voltage on the VIN voltage exceeds the UVLO threshold voltage.

Soft Start

To ensure a LED flash and low input inrush current can be control, the chip features a built-in soft-start current controller.

Boost Controller

The LP3352 uses 1MHz fixed-frequency, current mode architecture to fixed the output current. The output voltage automatically adjusts its voltage to the LED forward voltage to improve performance.

Boost Over Current Protection

The internal power MOS switch current is monitored cycle-by-cycle and current limited value not exceed 2.5A(Typ.). When the inductor current exceeds the current limit, the switching will turns off immediately. It prevents large current damaging the external component.

Output Over Voltage Protection

The LP3352 converter has an over voltage protection by VOUT pin. When the LEDs fail open circuit or LEDs are disconnected from the circuit, the over voltage function will monitor the output voltage through VOUT pin to protect the converter. When LP3352 Output occur OVP, it will close LX function.

LED Current Setting

The LED current is specified by current sense resistor between the ISET pin to ground. In order to have accurate LED current, precision resistors are preferred. The LED current can be programmed by:

$$I_{LED}=(V_{ISET} /R_{ISET})x K_{ISET}$$

Dimming Control

The LED brightness is controlled by the PWM signal at CTRL pin which has different duty cycle. LP3352 can accept an external PWM signal to CTRL pin in the range of 100Hz to 30kHz.

Input Capacitor Selection

For better input bypassing, low-ESR ceramic capacitors are recommended for performance. A 20μF input capacitor is sufficient for most applications. For a lower output power requirement application, this value can be decreased.

Boost 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.

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.

$$V_{RIPPLE} = V_{RIPPLE(ESR)}+V_{RIPPLE(C)}$$

$$\cong I_{PEAK}\times R_{ESR}+\frac{I_{PEAK}}{C_{OUT}}\frac{V_{OUT}-V_{IN}}{V_{OUT}\times F_{OSC}}$$

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. Depending on the application, the recommended inductor value is between 4.7μH to 10μH.

Over Temperature Protection

The LP3352 device enters over temperature protection(OTP) if its junction temperature exceeds 160°C (Typ.). During over temperature protection none of the device's functions are available. To resume normal operation the junction temperature need cool down, and the outputs will restart.

Application Information (Continued)

LED Open Protection

If one of the LED strings is open at any time, the boost converter output voltage rises to the OVP threshold during the start-up period before the LP3352 auto-detect the open LED string. The controller removes the open CHx pin and continues to regulate current for the other strings.

LED Short Protection

If there are several shorted LEDs in one string, that total voltage will smaller than other LED strings and the voltage on the affected CHx pin will be higher than on the other CHx pins. If any CHx pin voltage exceeds CHx OVP threshold, the IC turns off the corresponding current sink and removes this CHx pin from regulation loop, the other CHx pins' current regulation is not affected. This state will keep until the chip is power restart or EN cycled.

Layout Guideline

The proper PCB layout and component placement are critical for all circuit. The careful attention should be prevent electromagnetic interference (EMI) problems. Here are some suggestions to the layout of LP3352 design.

1. Connected all ground together with one uninterrupted ground plane with at least two vias .

2. The input capacitor should be located as closed as possible to the VIN and ground plane.

3. Minimize the distance of all traces connected to the LX node, that the traces short and wide route to obtain optimum efficiency.

4. All output capacitor must be closed to ground plane. The ground terminal of COUT must be located as closed as possible to ground plane.

5. Radiated noise can be decreased by choosing a shielded inductor.

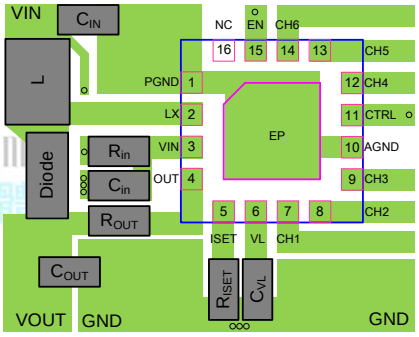
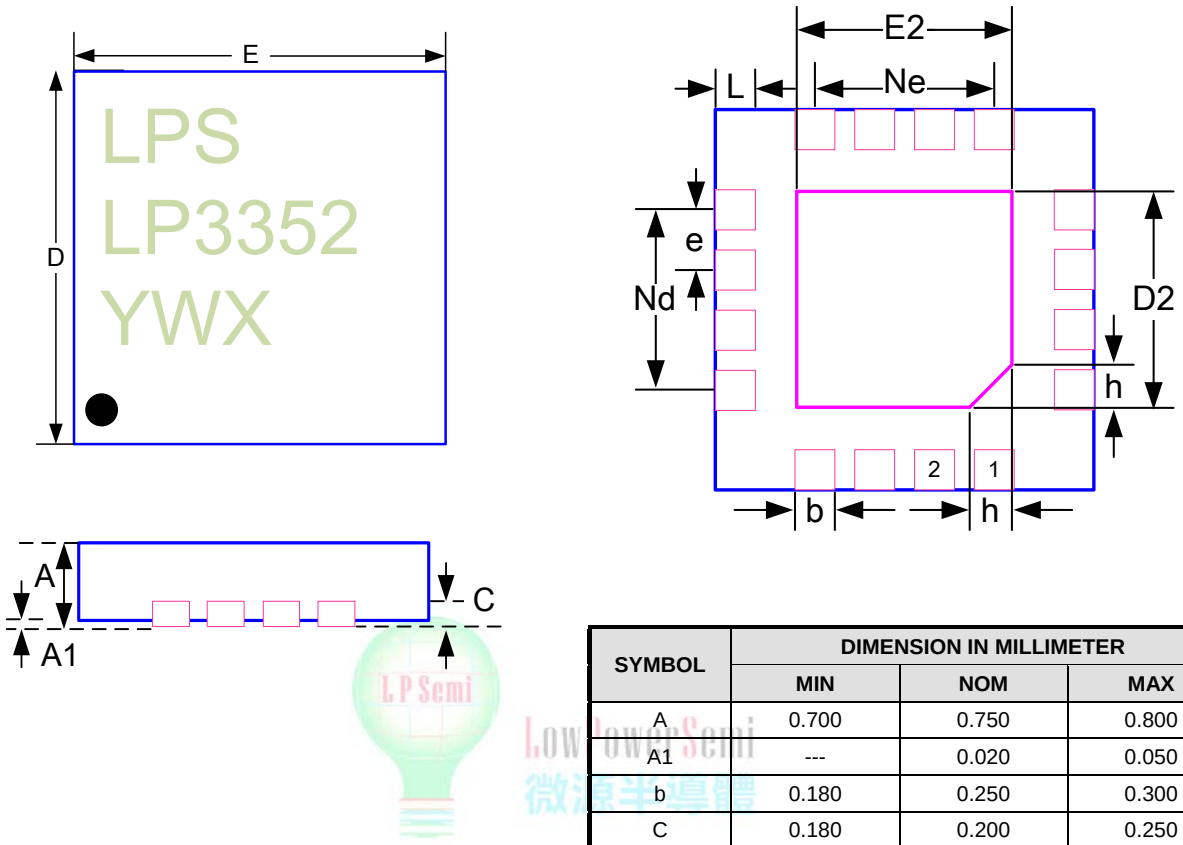


Figure 5. Recommended PCB Layout Diagram

.

Outline Information

QFN-16 Package (3x3) pitch 0.5 (Unit: mm)



SYMBOL	DIMENSION IN MILLIMETER		
	MIN	NOM	MAX
A	0.700	0.750	0.800
A1	---	0.020	0.050
b	0.180	0.250	0.300
C	0.180	0.200	0.250
D	2.900	3.000	3.100
D2	1.550	1.650	1.750
E	2.900	3.000	3.100
E2	1.550	1.650	1.750
e	0.500 BSC		
Nd	1.500 BSC		
Ne	1.500 BSC		
L	0.350	0.400	0.450
h	0.200	0.250	0.300

X-ON Electronics

Largest Supplier of Electrical and Electronic Components

Click to view similar products for LED Display Drivers ***category:***

Click to view products by LOWPOWER ***manufacturer:***

Other Similar products are found below :

MAP9000QNRH AP5726WUG-7 AL8806QMP-13 AP5726FDCG-7 AS3693B-ZTQT AP5725WUG-7 MAX139EQH+D STP16DP05PTR STP16CPP05PTR STP16CPP05XTTR LV5236VZ-TLM-H BP9911CC ZXLD1366QEN8TC MT7725D TX6143 SY6813PEC SD1002L4 AW3643CSR MP3370GN-Z LA2284L-G09-T SEDA SCT2027CSSG LYT3315D LYT3324D LYT4211E2 LYT4214E2 LYT4215E2 LYT4217E2 LYT4218E2 LYT4222E LYT4317E2 LYT4321E LYT4323E LYT4324E3 LYT4326E3 TPS92020DR TPS92691PWPR BCR420U HV9801ALG-G IS31FL3199-QFLS2-TR IS31FL3731-QFLS2-TR CAT4238TD SCT2001ASIG SCT2024CSTG SCT2167CSOG SCT2167CSSG STP16CPPS05XTTR TLE4241GMFUMA1 ICM7212MIQH+D ICM7212AIQH+D