JW1756

Boost LED Controller With PFC and No Auxiliary Winding

Parameters Subject to Change Without Notice

DESCRIPTION

JW®1756 is a constant current LED controller with high current accuracy which applies to single stage Boost power factor corrected LED drivers.

JW1756 integrates high voltage power source, and can be supplied by line voltage directly, and auxiliary winding is not needed.

High accuracy of output current is achieved by sampling the output current directly. Critical conduction mode operation reduces the switching losses and largely increases the efficiency.

JW1756 has multi-protection functions which largely enhance the safety and reliability of the system, including VCC over-voltage protection, VCC UVLO, LED open protection andover-temperature protection.

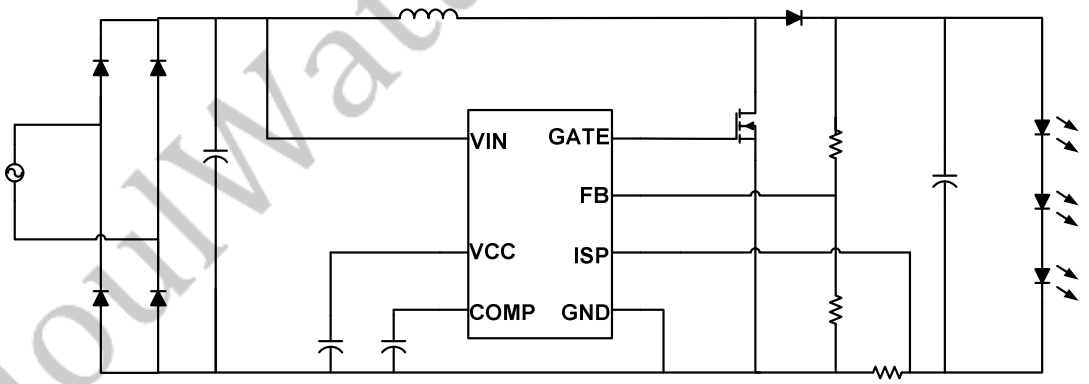
FEATURES

- No auxiliary winding
- High current accuracy of line and load regulation
- High power factor
- Critical conduction mode
- High efficiency over wide operating range
- LED open protection
- Freewheeling diode open protection
- Overtemperature protection
- SOP8 package

APPLICATIONS

- Non-isolation Offline LED driver

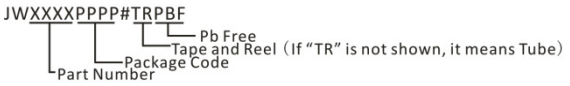
TYPICAL APPLICATION



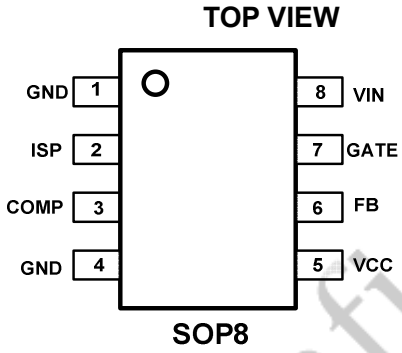
ORDER INFORMATION

LEAD FREE FINISH	TAPE AND REEL	PACKAGE	TOP MARKING
JW1756SOPB#PBF	JW1756SOPB#TRPBF	SOP8	JW1756

Note：



PIN CONFIGURATION



ABSOLUTE MAXIMUM RATING[1)]

VIN Voltage.....700V
VCC Voltage.....20V
GATE Voltage.....18V
Junction Temperature[2) 3)] 150ºC
Lead Temperature..... ..... 260ºC
Storage Temperature..... -65ºC to +150ºC

RECOMMENDED OPERATING CONDITIONS

VIN Voltage.....30V to550V
VCC Voltage.....10V to13V
Operating Junction Temp (T_J) .....-40ºC to 125ºC

THERMALPERFORMANCE[4)]

	θ_{JA}	θ_{Jc}
SOP8	96	45ºC/W

Note：

1) Exceeding these ratings may damage the device.

2) The JW1756 guarantees robust performance from -40°C to 150°C junction temperature. The junction temperature range specification is assured by design, characterization and correlation with statistical process controls.

3) The JW1756 includes thermal protection that is intended to protect the device in overload conditions. Thermal protection is active when junction temperature exceeds the maximum operating junction temperature. Continuous operation over the specified absolute maximum operating junction temperature may damage the device.

4) Measured on JESD51-7, 4-layer PCB.

ELECTRICAL CHARACTERISTICS

VIN=20V, T_A=25℃, unless otherwise stated.

Item	Symbol	Condition	Min.	Typ.	Max.	Units
VCC Start-Up Voltage	V_{CC_ST}		12	13.6	15.5	V
VCC UVLO[5)]	V_{CC_UVLO}			9.5		V
VCC Quiescent Current	I_{CCQ}	VCC=6V		130	150	μA
VCC Operational Current	I_{CCO}	VCC=15.5V,FB=2V		350	400	μA
VCC Over Voltage Threshold	V_{CC_OVP}		16.5	18	21	V
VCC Shunt Current	I_{SHUNT}	VCC= V_{CC_OVP}-0.5V	3.2	5	8.2	mA
Reference Voltage	V_{REF}		146	153	160	mV
Maximum On Time of MOSFET[5)]	t_{ON_MAX}			35		μs
COMP Pull Up Current	I_{COMP}	1.2V<COMP<2.4V, ISP=0V	3	8	13	μA
Maximum Switch Frequency[5)]	f_{MAX}	COMP<1.2V		130		kHz
FB High Voltage Threshold	V_{FB_H}		1.52	1.6	1.68	V
FB Low Voltage Threshold	V_{FB_L}		255	300	345	mV
ISP Maximum Voltage	V_{ISP_LIMIT}		3.3	3.8	4.2	V
Over Thermal Protection Threshold[5)]	$Temp_{OTP}$			145		℃

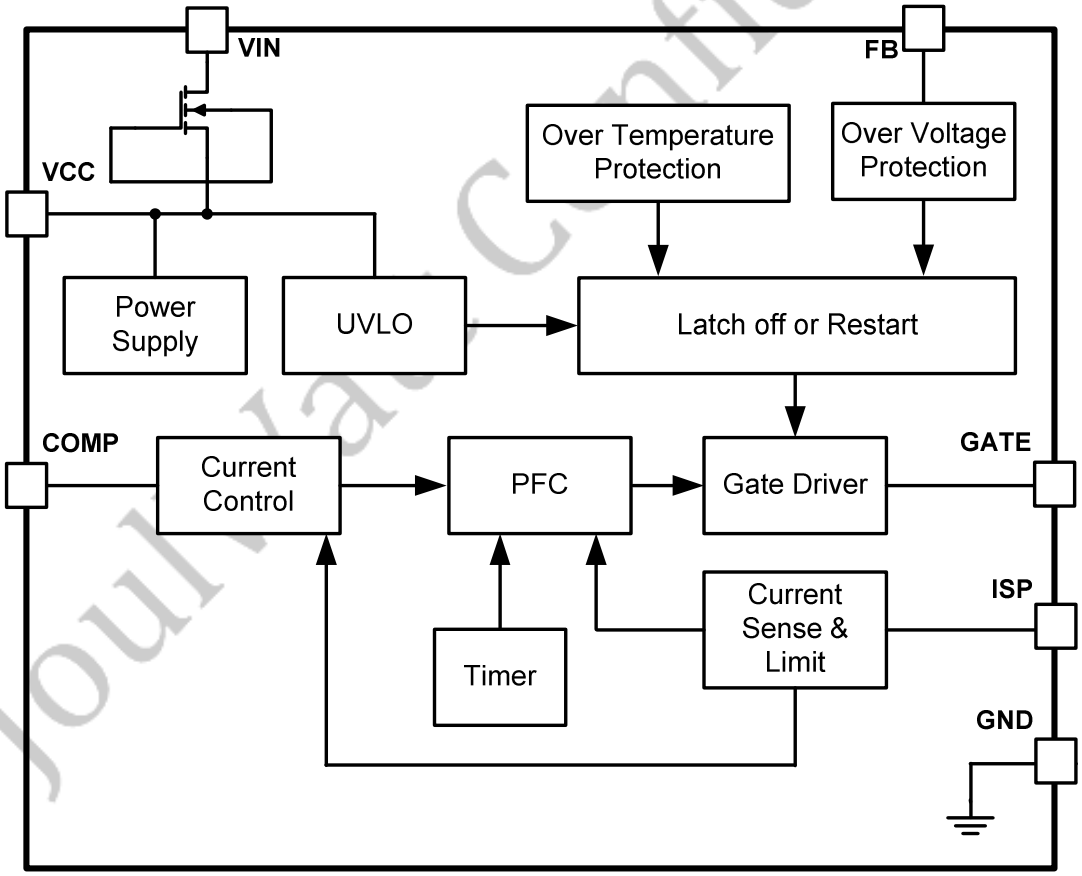
Note:

5) Guaranteed by design

PIN DESCRIPTION

Pin No.	Name	Description
1, 4	GND	Chip ground.
2	ISP	Output current sense. This pin is used for output current control.
3	COMP	Compensation for internal error amplifier. Connect a capacitor between the pin and GND to compensate the internal feedback loop.
5	VCC	Power supply. This pin supplies current to the internal circuit and must be locally bypassed with a capacitor.
6	FB	Output voltage feedback pin.
7	GATE	Gate driver for the external main MOSFET switch.
8	VIN	Line voltage input.

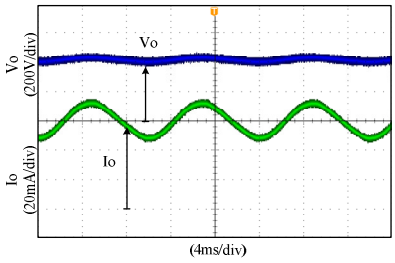
BLOCK DIAGRAM



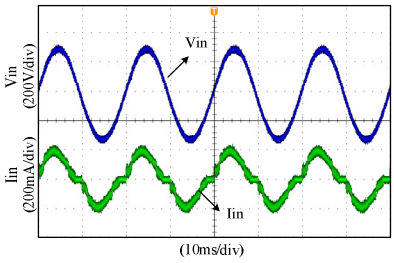
TYPICAL PERFORMANCE CHARACTERISTICS

V_{IN}=220VAC, V_{OUT}=420V, Io=60mA, unless otherwise noted

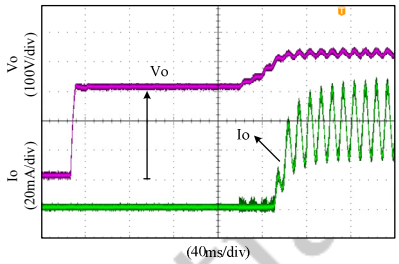
Steady state(Output)



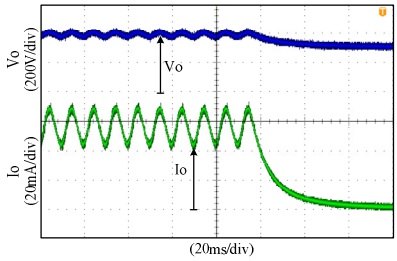
Steady state(Input)



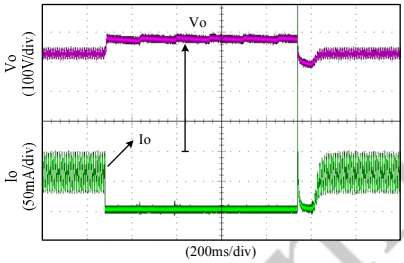
Start up



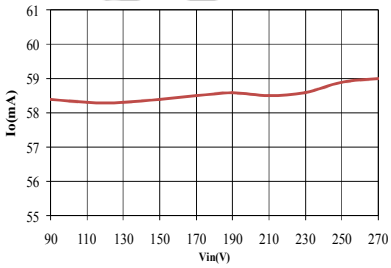
Power off



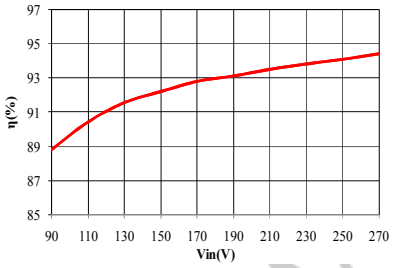
Over voltage protection



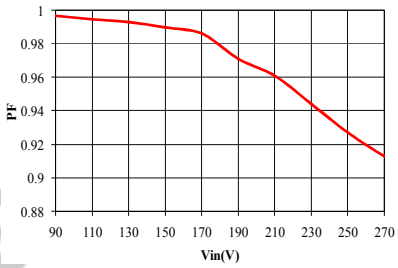
Line Regulation



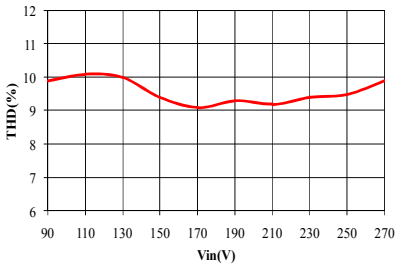
Efficiency VS Vin



PF VS Vin



THD VS Vin

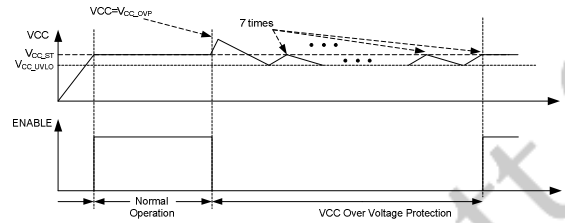


FUNCTIONAL DESCRIPTION

The JW1756 is a constant current LED controller which applies to Boost LED system with power factor correction. JW1756 can achieve excellent line and load regulation, high efficiency and low system cost with few peripheral components.

Start Up

JW1756 can be supplied by drainofthe power MOSFET directly. When VIN charges VCC up toVCC start up voltage(V_{CC_ST}), the GATE driver begins to switch. Also, JW1756 can be supplied by input voltage. An internal 16V clamp is attached to the VCC pin to prevent VCC from being too high. Once VCC exceeds V_{CC_OVP}, system shut down and VCC is charged again after it's pulled down to V_{CC_UVLO}. When VCC is charged to $V_{CC_ST}$for 7 times, system restarts.



Loop Compensation

An integrator configuration is applied to the output current feedback loop with a capacitor connected to the COMP pin. For offline applications, the crossover frequency should be set much less than the line frequency of 120Hz or 100Hz. A capacitor of 1μF connected to COMP pin is recommended to ensure the excellent PFC performance.

Constant Current Control

The JW1756 controls the output current from the information of the sensed resistor voltage. The output LED mean current can be calculated as:

$$I_{LED} = V_{REF} / R_S$$

Where

V_{REF}– The reference voltage;

R_S – The sensing resistor connected between ISP and GND.

Critical Conduction Mode Operation

JW1756 works in the Critical conduction mode of the inductor current. When the external power MOSFET is turned on, the inductor current begins to increase from zero. When the power MOSFET is turned off, the inductor current begins to decrease. The power MOSFET turns on again when the inductor current is zero.

Over Temperature Protection

When internal temperature of the chip exceeds 145°C, JW1756 decreases the pull up current of COMP to degrade LED current.

LED Open Protection

The output voltage can be detected by the FB pin. When the FB voltage is higher than FB High Voltage Threshold voltage(V_{FB_H}),the power MOSFET stops switching, and the HV power source is disconnected until VCC decreases to V_{CC_UVLO}. When VCC is charged to V_{CC_ST} for 7 times, system restarts.

APPLICATION NOTES

1. Output Capacitor

Normally the output voltage is about 400V. Considering OVP, the rated voltage of the capacitor should be no smaller than 500V and the recommended capacitance is

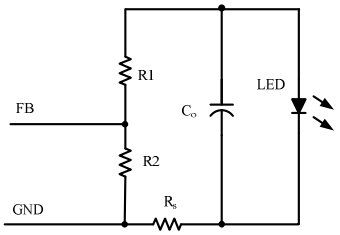
$$C_o = k \times P_o$$

Where

k=0.35~0.5μF/W;

P_o is the output power.

2. FB Divider Resistor Design



The FB divider resistorsare related to OVP voltage(OVP will be triggered when FB voltage is higher than 1.6V). When designingthe over voltage protection threshold (Vovp) ifLEDopens, the Maximum LED voltage(V_{LEDmax}, measured at rated current) and the output voltage ripple(ΔV_o) should be taken into consideration. So the max output voltage is

$$V_{omax} = V_{LEDmax} + \Delta V_o$$

And

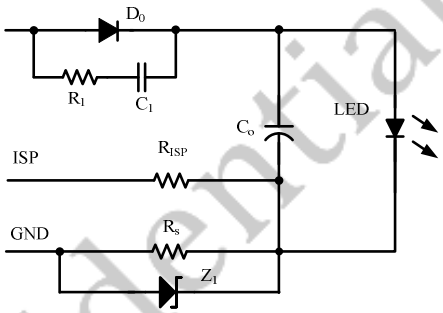
$$V_{ovp} = (1.15 \sim 1.2) V_{omax}$$

Besides, V_{ovp} should be lower than the rated voltage of the $C_o$and R1>500KΩ is recommended to ensure higher efficiency.

For example, if V_{LEDmax}=415V, ΔV_o=15V，then R1=1MΩ, R2=3.3KΩ, Vovp=486V.

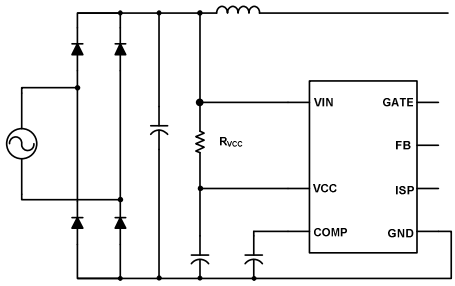
3. ISP Over Voltage Protection

Current overshoot may happen during thepower onor surge test, which results in the ISP voltage overshoot, and the chip may be damaged when ISP voltage is higher than 5V.A 3V/1W zener can be paralleled with Rs to bypass the surge current.In higher power application, the zener can be replaced by some cascaded diodes.R_{ISP}, between 47 to 100Ω, is essential to limit ISP negative current when the power MOS is on if the Diode D_0 has RC snubber(R_1, C_1) as the following figure shows.



4. VCC Power Supply

Normally 1μF/25V VCC capacitor is large enough to hold the VCC voltage.To decrease the temperature rise of the chip, a 300KΩ resistor connected between VIN and VCC pin is recommend as the following figure shows.



5. PCB Design

1. The VCC pin must be locally bypassed with a capacitor.
2. Make the area of the power loop as small as possible in order to reduce the EMI radiation.
3. The chip should be far away from the heating element, such as the MOSFET and the freewheel diode

REFERENCE DESIGN

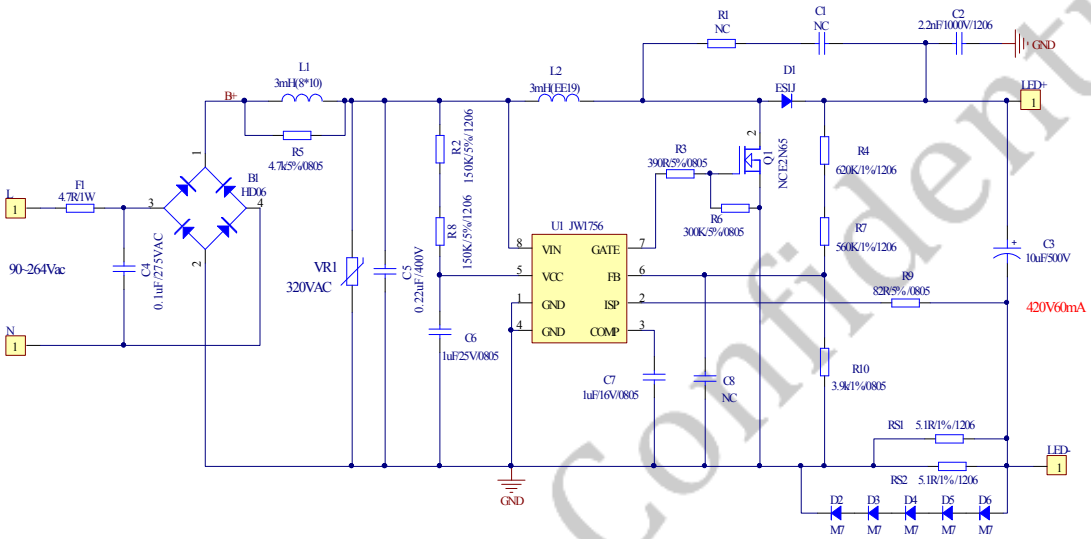
This reference design is suitable for 27W non-isolated LED driver, using JW1756, with good line regulation and high efficiency.

V_{IN}: 90~264VAC

V_{OUT}: 400-420V

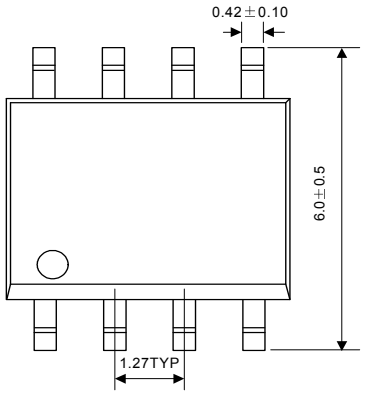
I_{OUT}: 60mA

PF: >0.9

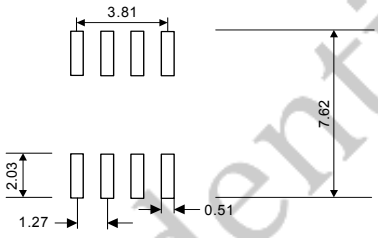


PACKAGE OUTLINE

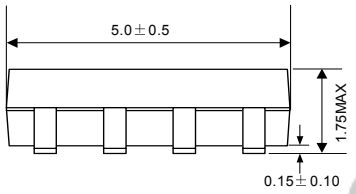
SOP8 UNIT: mm



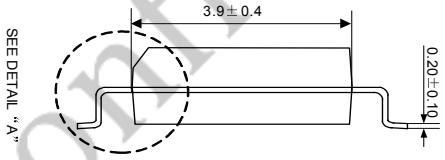
TOP VIEW



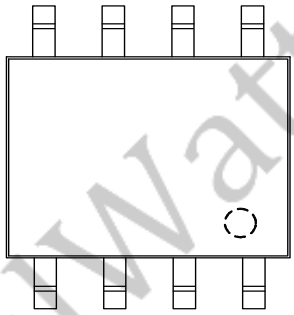
RECOMMENDED LAND PATTERN



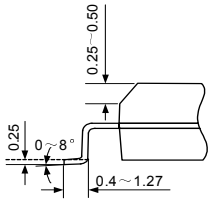
FRONT VIEW



SIDE VIEW



BOTTOM VIEW



DETAIL "A"

IMPORTANT NOTICE

- **Joulwatt Technology Inc. reserves the right to make modifications, enhancements, improvements, corrections or other changes without further notice to this document and any product described herein.**
- **Any unauthorized redistribution or copy of this document for any purpose is strictly forbidden.**
- **Joulwatt Technology Inc. does not warrant or accept any liability whatsoever in respect of any products purchased through unauthorized sales channel.**