JW1251O

Controller for Adaptive 100/120Hz Current Ripple Removing Circuit

Parameters Subject to Change Without Notice

DESCRIPTION

JW®1251O is a controller for driving external NMOSFET to remove the 100/120Hz LED current ripple on AC/DC power by a capacitor between VC and GND.

The adaptive technology of JW1251O ensures minimum power dissipation on NMOSFET while removing LED current ripple.

Patented control strategies are optimized for dimmable solutions.

JW1251O enables good ripple removing performance in the whole output current range and excellent system dynamic responding speed in the fast dimming.

JW1251O provides short circuit protection and over temperature protection (OTP). OTP is trigged at 145ºC, ripple current will be released with the temperature.

FEATURES

- Controller for adaptive 100/120Hz current ripple remover
- Built-in zener diode for input voltage clamping
- Compatible with dimmable applications
- Programmable amplitude of LED current ripple
- Programmable maximum cathode voltage of LED
- Programmable maximum LED current
- Short protection
- Over temperature protection
- SOT23-6 Package

APPLICATIONS

- LED lighting

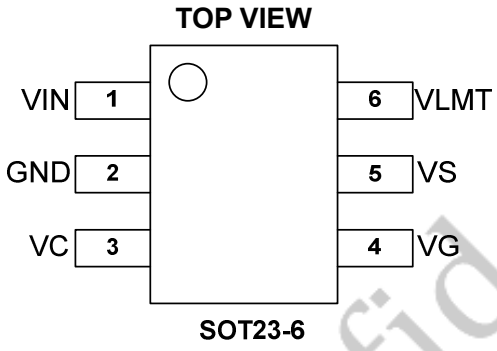
TYPICAL APPLICATION

ORDER INFORMATION

LEAD FREE FINISH	TAPE AND REEL	PACKAGE	TOP MARKING
JW1251OSOTB#PBF	JW1251OSOTB#TRPBF	SOT23-6	JWE9

Note：

PIN CONFIGURATION



ABSOLUTE MAXIMUM RATING[1)]

VIN clamp voltage..... 35V
VG 20V
VS, VC, VLMT ..... -0.3V to 6V
Junction Temperature[2)3)]..... 150ºC
Lead Temperature 260ºC
Storage Temperature ..... -65ºC to +150ºC
ESD Susceptibility (Human Body Model) 2kV

RECOMMENDED OPERATING CONDITIONS

Junction Temperature (T_J).....150ºC

THERMAL PERFORMANCE[4)]

	θ_{JA}	θ_{JC}
SOT23-6	220	130ºC/W

Note：

1) Exceeding these ratings may damage the device.

2) The JW1251O 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 JW1251O 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

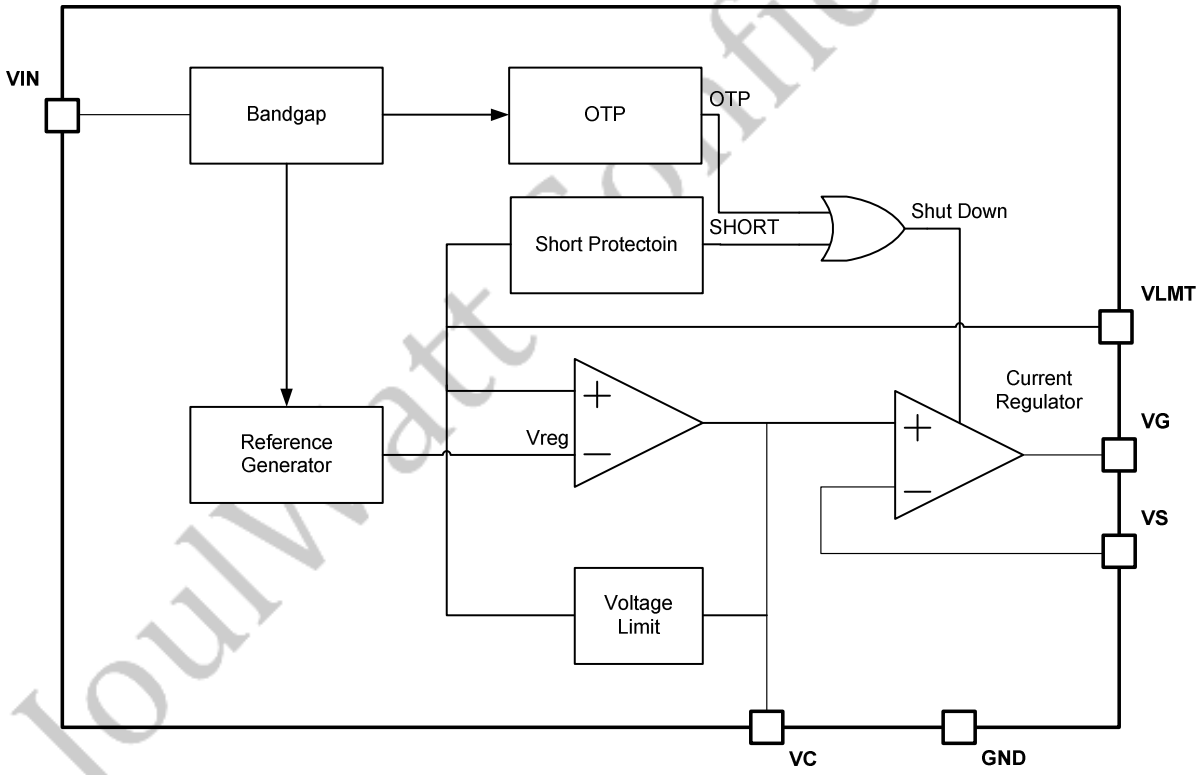
VIN = 18V, TA = 25ºC, unless otherwise stated.

Item	Symbol	Condition	Min.	Typ.	Max.	Units
VIN clamp voltage	V_{IN_CLP}		29	32	35	V
VIN operation current	I_{IN}	VIN=29V	0.15	0.225	0.3	mA
VIN startup voltage threshold	V_{IN_ST}		7.5	9	10.5	V
VIN UVLO threshold	V_{IN_UVLO}		5	6	7	V
Maximum VG output voltage	V_{VG}		5	6	7	V
VLMT reference voltage	V_{VLMTR}		1.85	2.05	2.25	V
SHORT protection threshold	V_{TH_SHORT}	Drain voltage of NMOSFET when SHORT is trigged. R_{LIMIT}=100K.	5	6	7.5	V
SHORT protection delay time[5)]	TSPD			160		us
SHORT protection hold time[6)]	TSPH			800		ms
VS voltage limit	V_{VS}		0.2		0.25	V

PIN DESCRIPTION

Pin No.	Name	Description
1	VIN	Power Supply
2	GND	Ground
3	VC	LED Current Ripple Programming
4	VG	NMOSFET GATE driving voltage output
5	VS	LED current sensing input
6	VLMT	LED Voltage Limit and SHORT protection Programming

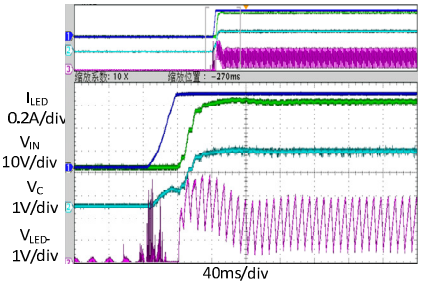
BLOCK DIAGRAM



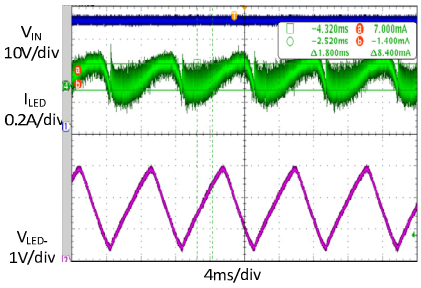
TYPICAL PERFORMANCE CHARACTERISTICS

V_{IN}= 120V_{AC}, V_{OUT}=42V, I_{OUT}=600mA, COUT= 330μF/63V*2, Ta = +25°C, unless otherwise noted

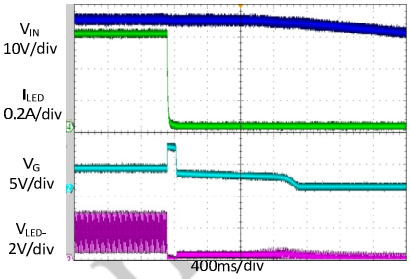
Start up



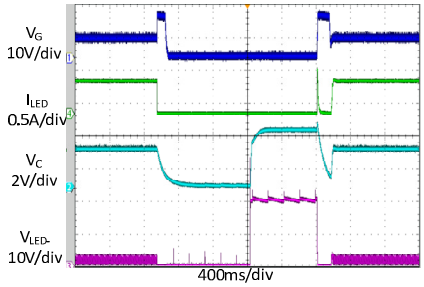
Steady State



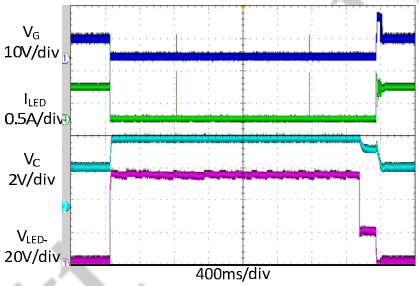
Power Off



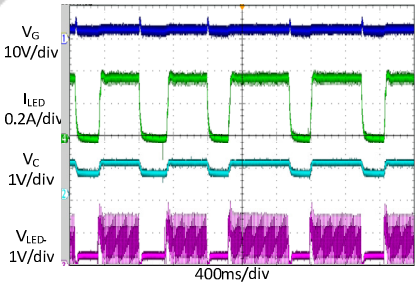
OVP/Hot-plug Test



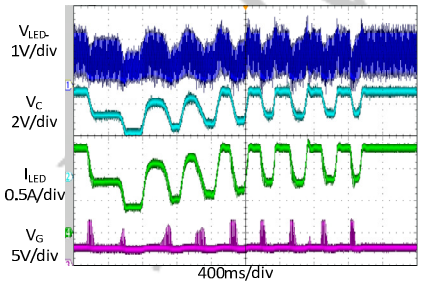
SCP Test



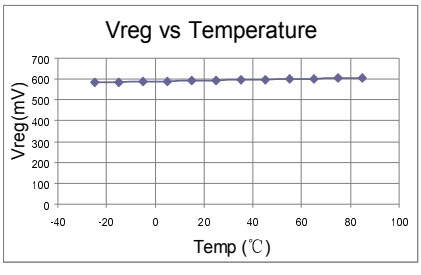
Fast on/off test



Fast Dimming



Regulated LED pin Voltage VS Temperature *(I_{LED}=700mA, R_S=0.20 Ohm)*



FUNCTIONAL DESCRIPTION

JW1251O is a controller for driving external NMOSFET to remove the 100/120Hz LED current ripple on AC/DC power.

Theory of Operation

The LED string and JW1251O are both supplied by an AC/DC current source. The drain of external NMOSFET is connected to the cathode of LED string. A sensing resistor R_{SENSE} is connected between the source of NMOSFET and GND. The gate is connected to the VG of JW1251O.

JW1251O drives NMOSFET to transfer the LED current ripple to voltage ripple on NMOSFET, and ensures the constant voltage across LED string and the current flow through LED string.

The scalable adaptive function of JW1251O can regulate the cathode voltage of LED string to minimum to improve the efficiency of the system.

Current Ripple Removing

The capacitor C_C between VC and GND is an integration capacitor. JW1251O transform the voltage on C_C to a reference voltage. The current regulator regulates the voltage on R_{SENSE} equal to the reference voltage.

The relationship between the voltage on C_C and R_S is shown as following:

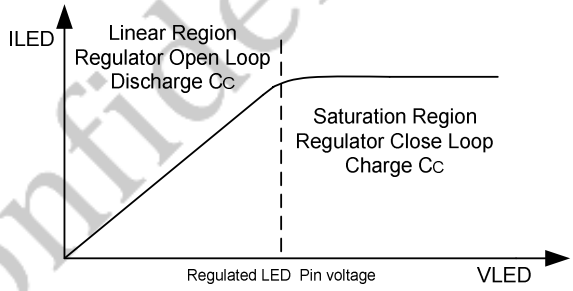
$$V_{RS} = I_{LED} * R_{SENSE} = V_{VC}/10\text{-}0.059$$

C_C should be large enough in order to remove the current ripple of the LED string. However, too large capacitor may slow down the dynamic response.

Adaptive Regulation

JW1251O control the voltage on C_C by monitoring the operation state of external NMOSFET. The efficiency of system is relatively low when NMOSFET is working in the saturation region. JW1251O detects it and charges C_C to raise the V_{VC} and I_{LED}, then the output voltage of power supply is reduced, and the voltage drop on NMOSFET decreases.

Conversely, when NMOSFET is working in the linear region, LED current regulation loop is open. JW1251O detects it and discharges C_C to reduce the V_{VC} and I_{LED}, then the output voltage of power supply is raised, and the LED current regulation loop is close.



LED Current Limit

The voltage of VS pin is limited to 0.23V typ. internally. So the current limitation is $0.23V/R_S$.

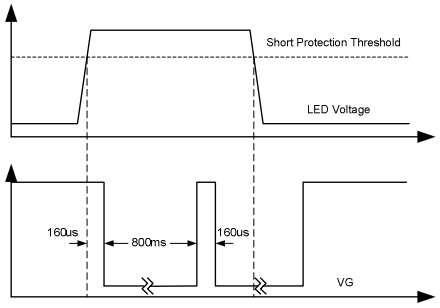
Current limit can protect the chip when LED is short connected or HOT-PLUG.

LED Short Protection

JW1251O detect SHORT by the resistor divider. When the drain voltage of NMOSFET exceeds the SHORT PROTECTION THRESHOLD and the state holds for more than 160us, JW1251O considers the LED string is SHORT connected, and shut down the external MOSFET. The SHORT state is reset after 800ms.

The SHORT PROTECTION THRESHOLD is calculated as:

$$V_{THSCP} = 2V^* \ （R_{LMT1}+R_{LMT2}）/R2+ R1 * 35uA$$



Over Thermal Protection

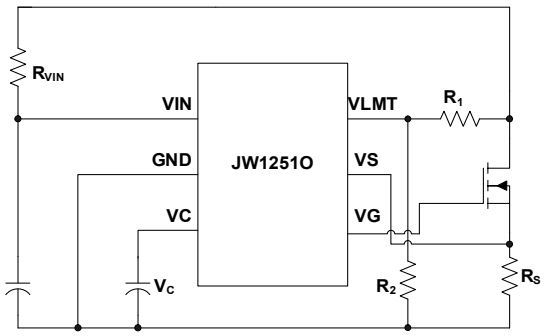
JW1251O monitors operation temperature. When the temperature is higher than 145℃, JW1251O releases the current ripple unless restarts.

PCB Design Guideline

1. The bypass capacitor of VIN should be placed as close as possible to the VIN pin and GND pin of IC.
2. JW1251O should be placed far away from the power devices such as MOSFET and SBD.
3. The area of LED current loop should be as small as possible.

APPLICATION INFORMATION

JW1251O design guide:



1. Because of the 32V zener integrated and the 9V V_{IN} start threshold, the value of R_{VIN} may satisfy the following conditions:

$$R_{VIN} < \frac{V_F - 9V}{1mA}$$

V_F: the voltage of LED

2. The maximum voltage of VS pin is 0.23V in order to limit the maximum output current especially in the short circuit condition. The value of R_S can be calculated as below:

$$R_S < \frac{0.18V}{I_{LED}}$$

I_{LED}: the output current of the pre-driver

3. When the voltage of LED- reaches V_{SCP} which is set by the $R_1$and R_2, JW1251O pulls down the VIN then turns off the MOSFET. In order to ensure nothing will be damaged in the short circuit condition, the value of R_1 and R_2 must satisfy the following conditions:

$$V_{OVP} - V_F < V_{SCP} < V_F$$

$$V_{SCP} = 2V(R_2 + R_1)/R_2 + 35uA * R_1$$

V_{OVP}: the output voltage when the pre-driver is open.

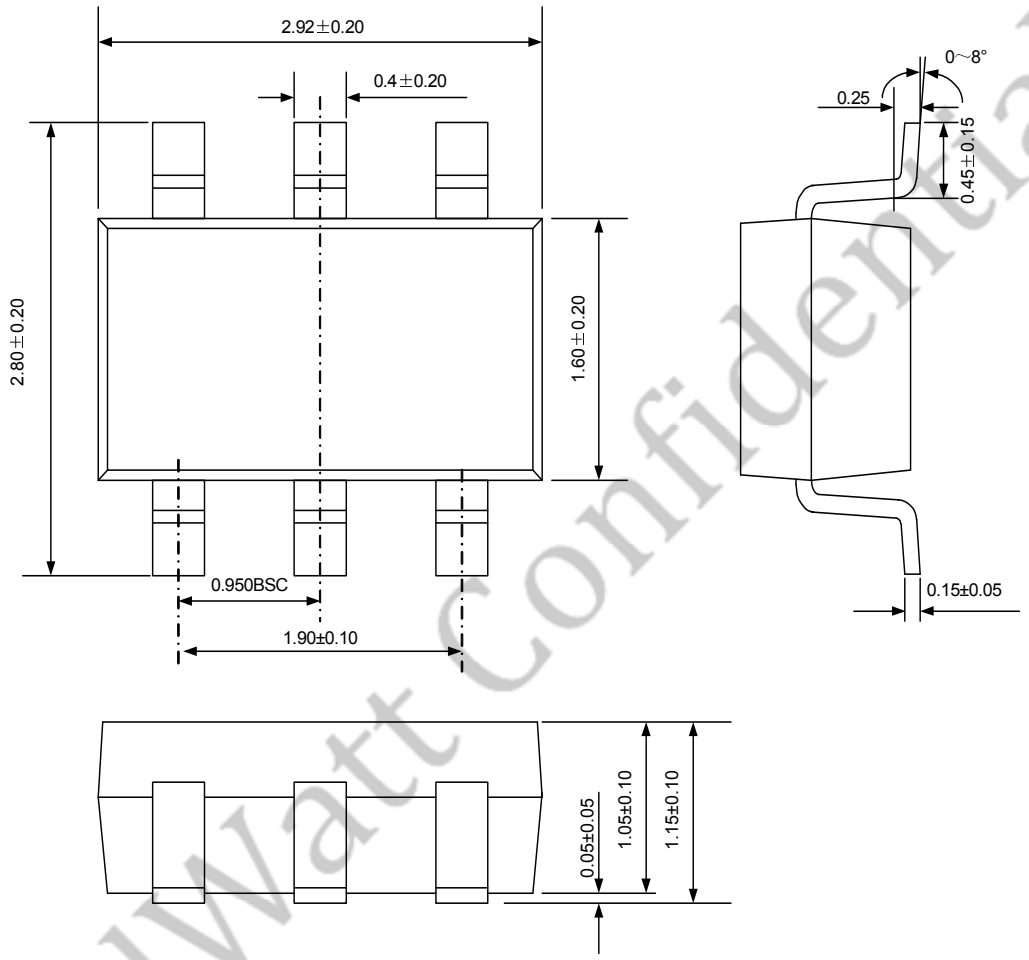
V_{SCP}: the threshold of JW1251O short circuit protection.

$V_{INSTART}$: the output voltage of the pre-driver when the VIN of JW1251O is 9V.

4. The value of the capacitor between VC and GND can determine the final amplitude of the current ripple. It should be large enough in order to remove the current ripple of the LED string. However, too large capacitor may slow down the dynamic response. In normal condition, 1uF or 2.2uF is relatively reasonable.
5. To ensure JW1251O work properly, the R_{DSON} of MOSFET must be less than $2R_S$. The MOSFET will endure a large power shorting the output on the moment, so the appropriate package and R_{DSON} of the MOSFET is necessary.
6. When short the LED, there is an overshoot on the drain of the MOSFET. The breakdown voltage of the MOSFET must be higher than V_{OVP}. A diode connected to LED+&LED- can reduce the overshoot when short.

PACKAGE OUTLINE

SOT23-6 **UNIT: mm**



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