JW1210

Scalable Adaptive 100/120Hz Current Ripple Remover
350mA maximum input current

Parameters Subject to Change Without Notice

FEATURES

- Scalable Adaptive 100/120Hz Current Ripple Remover
- 5V~60V Input Voltage
- Built-in LED Driving MOSFET
- LED Voltage Low to 0.65V @ 0.25A
- Programmable LED Current Ripple
- Programmable maximum LED Voltage
- Over thermal protection
- eSOP8 and TO220-5L package

APPLICATIONS

- LED Lighting

DESCRIPTION

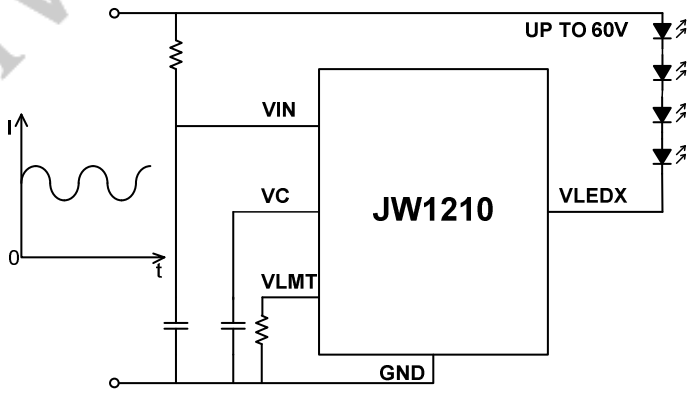
JW1210 is used to drive a LED string (＜60V), and remove the 100/120Hz current ripple on AC/DC power by a capacitor between VC and GND.

JW1210 allows user to setup the maximum voltage on LED pin by connect a resistor between VLMT and GND. If the voltage on LED pin exceeds limit threshold, the current ripple remover is disabled and remain the LED voltage, which could help limiting the power dissipation on chip.

Multiple JW1210s can operate in parallel by shorting all VC PINs together. The average current matching rate between each JW1210s is less than ±1%.

The maximum LED current is internally limited as 440mA. JW1210 provides thermal protection.

TYPICAL APPLICATION



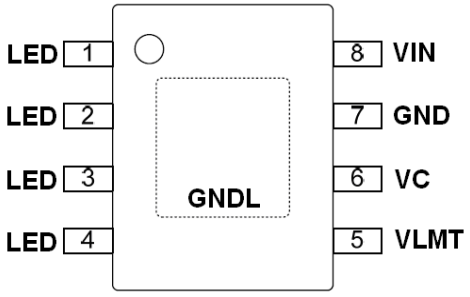
ORDERING INFORMATION

LEAD FREE FINISH	TAPE AND REEL	PACKAGE	TOP MARKING	JUNCTION TEMPERATURE RANGE
JW1210ESOP#PBF	JW1210ESOP#TRPBF	eSOP8	JW1210	- 40 ℃ to 150 ℃

JWXXXXPPPP#TRPBF
- Pb Free
- Tape and Reel（If "TR" is not shown, it means Tube）
- Package Code
- Part Number

PIN CONFIGURATION

TOP View



eSOP8

ABSOLUTE MAXIMUM RATING 1)

VIN PIN 60V
LED PIN ..... -0.3V to 60V
VC, VLMT ..... -0.3V to 6V
Junction Temperature[2) 3)] 150ºC
Lead Temperature ..... 260 ºC
Storage Temperature..... −65 ºC to +150 ºC

RECOMMEND OPERATING RANGE

VIN..... 4.7V to 55V
LED pin ..... <60V
Maximum Junction Temperature (T_J)..... 150ºC

THERMAL RESISTANCE θ_{JA} θ_{Jc}

eSOP8 ..... 50 . . . 10℃/W

Note:

1) Exceeding these ratings may damage the device.
2) The JW1210 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 JW1210 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, 2-layer PCB.

ELECTRICAL CHARATERISTICS

VIN = 12V, TA = 25ºC, unless otherwise stated.

Item	Symbol	Condition	Min.	Typ.	Max.	Units
V_{IN} Start Up Voltage Threshold	V_{IN_ON}		4.3	4.5	4.7	V
V_{IN} Start Up Voltage Hysteresis	V_{IN_HYS}		0.2	0.4	0.6	V
V_{IN} Operation Current	I_{IN}	I_{LED}=160mA	0.6	0.9	1.3	mA
VLMT Pull-up Current	I_{VLMTU}	R_{VLMT}=200K	3.6	4	4.4	uA
VC Start Up Current	I_{VCS}	VC short to GND when start-up	0.35	0.45	0.6	mA
LED Regulated Voltage	V_{LEDR}	I_{LED}=160mA	0.28	0.44	0.66	V
LED Current Limit	I_{CLMT}	V_{VC}>2V	0.41	0.44	0.47	A
Current Matching Between JW1210s When Operation In Parallel	--		--	±1%	--	--
Over thermal protection threshold	OTP			135		℃

PIN DESCRIPTION

eSOP8

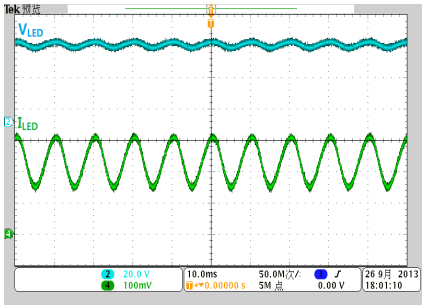
Pin No.	Name	Description
1~4	LED	Connect to Cathode of LED string
5	VLMT	LED Voltage Limit Programming
6	VC	LED Current Ripple Programming
7	GND	Ground
8	VIN	Power Supply
0(Exposed Pad)	GNDL	Power Ground

TYPICAL PERFORMANCE CHARACTERISTICS

Note：The pre-driver is JW1600 12W T8 program whose the output specification is 50V/240mA and the output capacitance chooses electrolytic capacitor 100uF/100V * 2. The Vo noted in the figure below refers to pre-driver output voltage, Io refers to the output current, VC refers to JW1210 VC PIN voltage and VLEDX is JW1210 LEDX PIN voltage.

Pre-driver output current

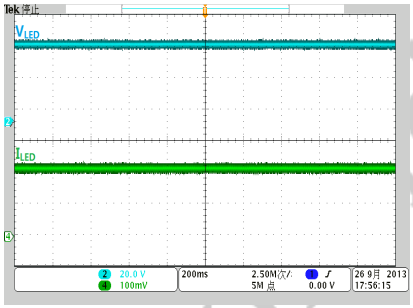
(VIN=220V,Io=250mA,Vo=50V, electrolytic capacitor 100uF/100V*2)current ripple:179mA,71.6%



System with JW1210 output current

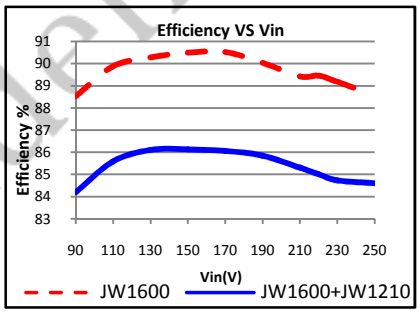
(VC=4.7uF//1M,VLMT=300K)

Current ripple 4mA,1.6%

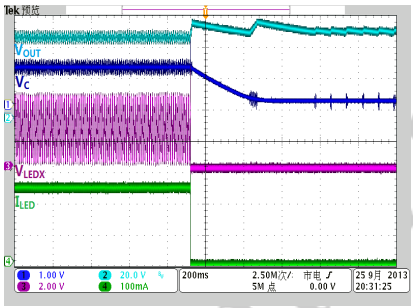


Efficiency comparison

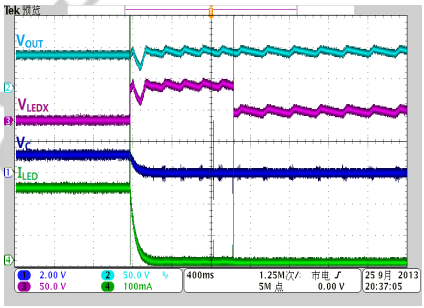
(JW1600&JW1600+JW1210)



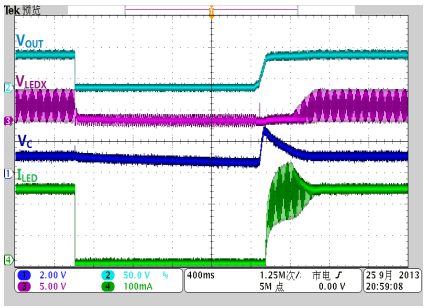
Open circuit test



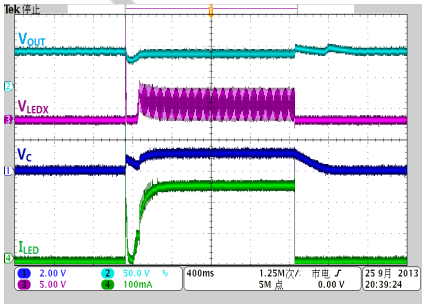
Output short test



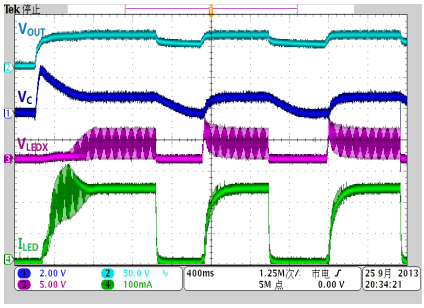
Electrolytic capacitor short test



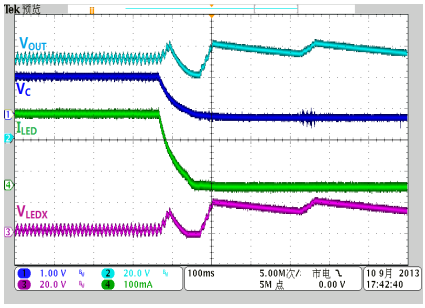
LED hot plug test



Continuous power on/off test



Thermal test



FUNCTIONAL DESCRIPTION

JW1210 is designed for driving one LED string (＜60V) and removing the 100/120Hz LED current ripple.

Theory of Operation

The LED string and JW1210 are both supplied by an AC/DC current source. The LED pin is connected to the cathode of LED string. JW1210 transfers the LED current ripple to voltage ripple on chip, and ensures the constant voltage across LED string and the current flow through LED string.
The SCALABLE ADAPTIVE function of JW1210 can regulate the voltage of LED string Cathode to minimum for improving efficiency,

Current Ripple Remove

The Capacitor between VC and GND should be large enough for removing the current ripple of LED string. However, too large capacitor may slow down the dynamic response.
Multiple JW1210s can operate in parallel by shorting all VC pin together. C_{COMP} should be multiple when 2 or more JW1210s operation in parallel.

$$C_{COMP\_M}=C_{COMP}*N$$

Where C_{COMP_M} is the total capacitor and N is the quantity of JW1210s.

LED Current Limit

The current of LED is limited to 0.44A internally. If the output of the AC current source is higher than 0.44A, the LED pin voltage increases to V_{LIMIT}, and the LED current remains 0.44A.

LED Voltage Limit

The voltage ripple on LED pin is very large when JW1210 removes current ripple, which would bring large power dissipation on chip. The resistor connected between VLMT and GND can setup the limit value of LED voltage. The limit threshold is calculated as below:

$$V_{limit}= R_{LMT} *16*10^{-6} \ V$$

Over Thermal Protection

JW1210 provides two thermal detectors. Either the temperature of LED driver or control blocks reaches 150℃, JW1210 shuts down until system restart.

PCB Guidelines

1. The bypass capacitor of VIN should be nearby the VIN and GND of IC as close as possible.
2. JW1210 should be placed far away from the POWER devices such as MOSFET and SBD.
3. When multiplier operation, the VC pin of all JW1210s should be connected together.
4. The area of LED current loop should be as small as possible.

APPLICATION NOTE

JW1210 design guide:

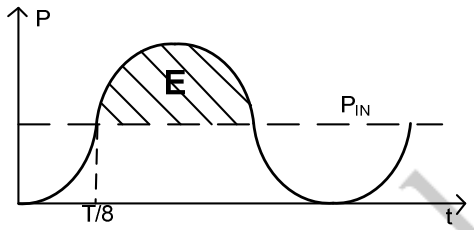
1. Design considerations:
   a) The withstand voltage of LEDX PIN is 60V, so the overvoltage of the pre-driver must be less than 60V in order to protect the chip in short circuit condition.
   b) The output should be connected to the LEDs when testing the characteristics of JW1210 including open and short circuit test.
2. The recommended operating current of JW1210 is 240mA (max 440mA). The loss and temperature rise of the chip depend on the amplitude of the output current ripple and the final amplitude required. The power loss of JW1210 can be calculated approximately as follows:

$$P_{JW1210} \approx V_{LED-} * I_{LED}$$

3. Based on the power factor correction of the pre-driver, the law of conservation of energy and the reasonable temperature rise of the JW1210, the output capacitance of the pre-driver can be calculated as follows:

P_{IN}: Input power
P_{OUT}: Output power
P_D: Power loss of JW1210
I_{LED}: LED current
U: Output voltage
△U: Peak to peak output voltage ripple
V_{LED}-: LED- pin voltage
V_{MIN}: the minimum LED- voltage
T: line cycle
η: Efficiency of the system

a) The power factor correction of the pre-driver and the law of conservation of energy:



$$P_{IN} = (P_{OUT} + P_D)/\eta \quad \text{.....①}$$

$$E = 2[P_{IN} * \frac{T}{8} - \int_0^{T/8} P_{IN}(1 - \cos 2\omega t)dt] \quad \text{.....②}$$

a) The energy formula of capacitance:

$$E = \frac{1}{2} * C[\left(U + \frac{\Delta U}{2}\right)^2 - \left(U - \frac{\Delta U}{2}\right)^2] \quad \text{.....③}$$

b) The reasonable temperature rising of the JW1210

$$V_{MIN} = I_{LED} * R_{DSON} \quad \text{.....④}$$

$$P_D = I_{LED} * V_{LED-} \approx I_{LED} * (\frac{\Delta U}{2} + V_{MIN}) \quad \text{.....⑤}$$

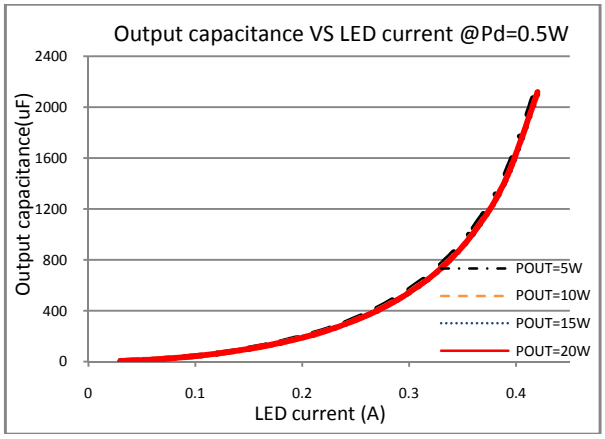
$$C = \frac{P_{OUT} + P_D}{2 * \pi * f * \eta * P_{OUT} * \Delta U} * I_{LED} \quad \text{.....⑥}$$

c) The smaller output power, the larger capacitance is needed as it can see in the equation above.

d) For example :

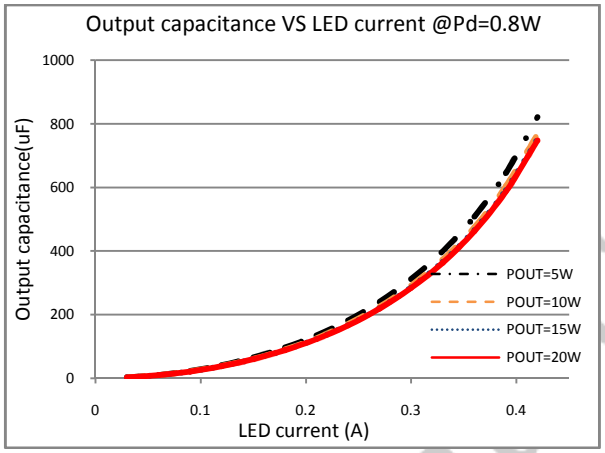
i. Given : P_D=0.5W (Equivalent to 40℃ temperature rise in E-sop8 package); η=0.85; f=1/T=50Hz

Then the result showing in the below:



ii. Given ： P_D=0.8W (Equivalent to 64℃ temperature rise in E-sop8 package); η=0.85; f=1/T=50Hz

Then the result showing in the below:



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, 2.2uF or 4.7uF is reasonable.

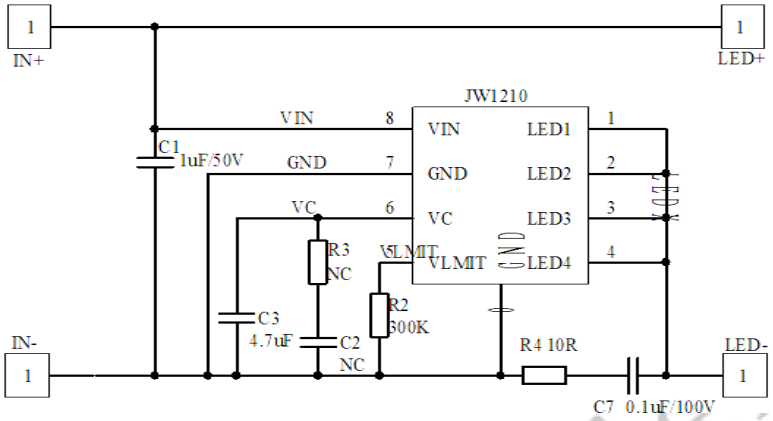
5. In normal condition, the voltage of the LED pin limit at 5V is reasonable. The limit threshold is calculated as below:

   V_{limit}= R_{LMT} *16*10^{-6} V
   Then, R_{LMT}=310K

APPLICATION REFERENCE

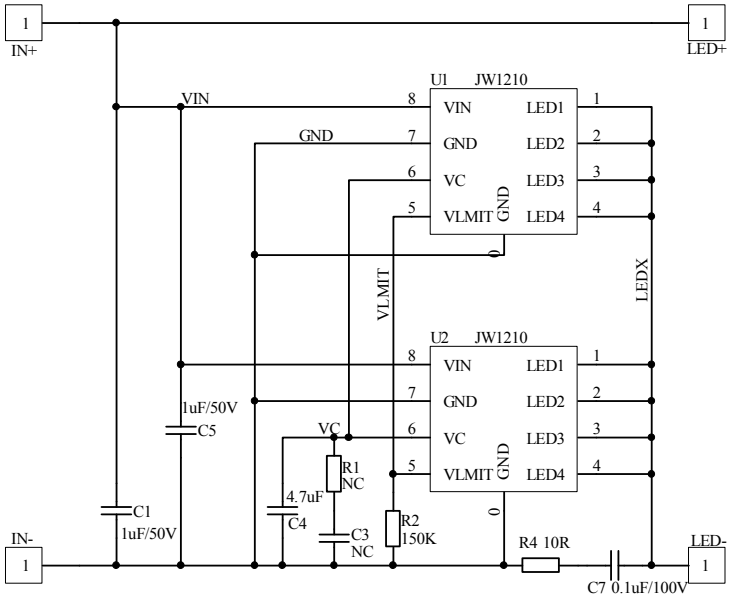
Reference 1：

Single IC Operation:



Reference 2：

2 ICs Operation In Parallel:

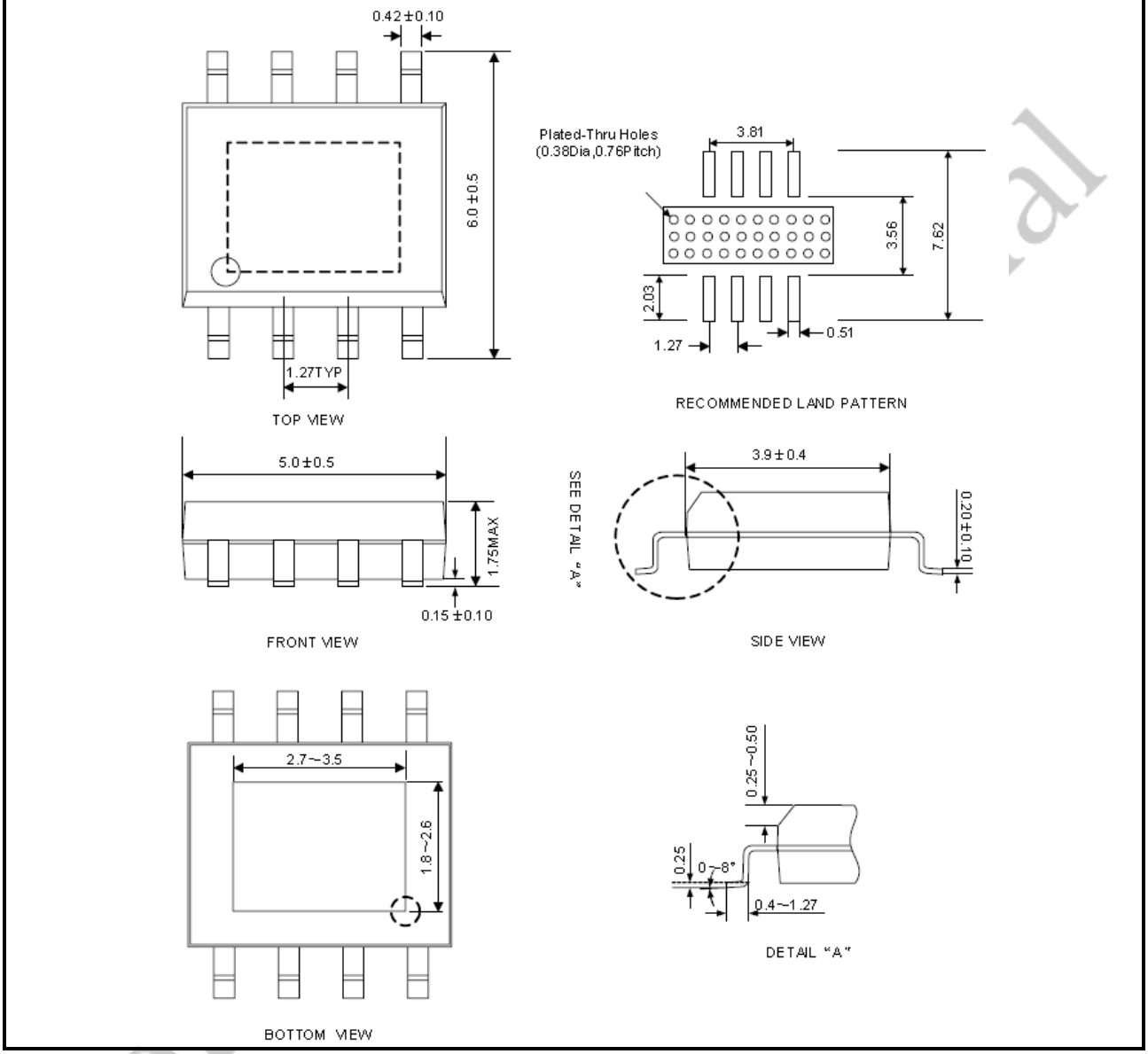


Note ：

1. The role of C7 and R4 in the two schematics above is to filter out high frequency switch current ripple, further to reduce the amplitude of the output current ripple. It can be omitted if the high frequency current ripple is not concerned.
2. R2 in the above schematics is the LEDX voltage-limiting resistance. Make the value of R2 300K and 150K respectively so that the LEDX voltage-limiting of the both applications above is 4.8V.
3. In the application with C7 and R4, the line between load and output of JW1210 should be short. If it is too long, the chip may be destroyed by the overshoot of the LEDX voltage in short circuit condition causing by the LC oscillation between the inductance of the output line and C7.

PACKAGE OUTLINE

eSOP8 **unit: mm**



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