JW1237

Adaptive 100/120Hz Current Ripple Remover With High Voltage MOSFET Integrated

Parameters Subject to Change Without Notice

DESCRIPTION

JW1237, integrated with 150V NMOSFET, is used to drive a LED string, and remove the 100/120Hz LED current ripple on AC/DC power by a capacitor between VC and GND.

The adaptive technology ensures minimum power dissipation on JW1237 while removing LED current ripple.

JW1237 clamps the input voltage on VIN pin to 31V. Only one resistor is needed when the output voltage of AC/DC power is higher than 31V.

JW1237 allows user to setup maximum LED current by the sensing resistor between VS pin and GND, which protects JW1237 from being damaged when LED short connected or hot-plug.

By sensing the voltage of LED- pin via a resistor between LED- pin and VLMT pin, JW1237 allows users to setup the maximum cathode voltage of LED string, which could help limit the power dissipation on chip.

It is considered that LED is shorted when the cathode voltage of LED- is higher than short connecting threshold and remains over 180us JW1237 shuts down when LED is shorted and recovers after 12ms.

JW1237 provides over thermal protection. When the temperature of JW1237 exceed 135℃, OTP is trigged. JW1237 shuts down until the temperature decrease to 110℃.

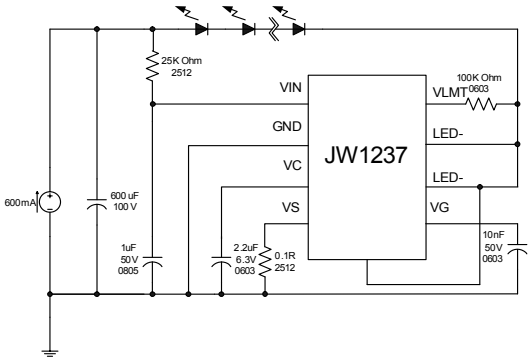
FEATURES

- Adaptive 100/120Hz current ripple remover
- 150V high voltage NMOSFET integrated
- Built-in zener diode for input voltage clamping
- VG output voltage high to 10V
- Programmable amplitude of LED current ripple
- Programmable maximum cathode voltage of LED
- Programmable maximum LED current
- Short protection
- Over temperature protection
- ESOP8 Package

APPLICATIONS

- LED lighting

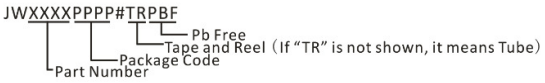
TYPICAL APPLICATION



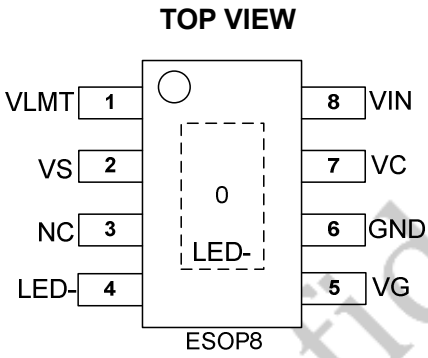
ORDER INFORMATION

LEAD FREE FINISH	TAPE AND REEL	PACKAGE	TOP MARKING
JW1237ESOP#PBF	JW1237ESOP#TRPBF	ESOP8	JW1237

Note：



PIN CONFIGURATION



ABSOLUTE MAXIMUM RATING[1)]

VIN clamp voltage..... 31V
VG 20V
VS, VC, VLMT ..... -0.3V to 6V
LED-..... 150V
Junction Temperature[2)3)]..... 150ºC
Lead Temperature 260ºC
Storage Temperature ..... -65ºC to +150ºC

RECOMMENDED OPERATING CONDITIONS

Junction Temperature (T_J)..... -40ºC to 125ºC

THERMAL PERFORMANCE[4)]

	θ_{JA}	θ_{JC}
ESOP8	50	10ºC/W

Note：

1) Exceeding these ratings may damage the device.

2) The JW1237 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 JW1237 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

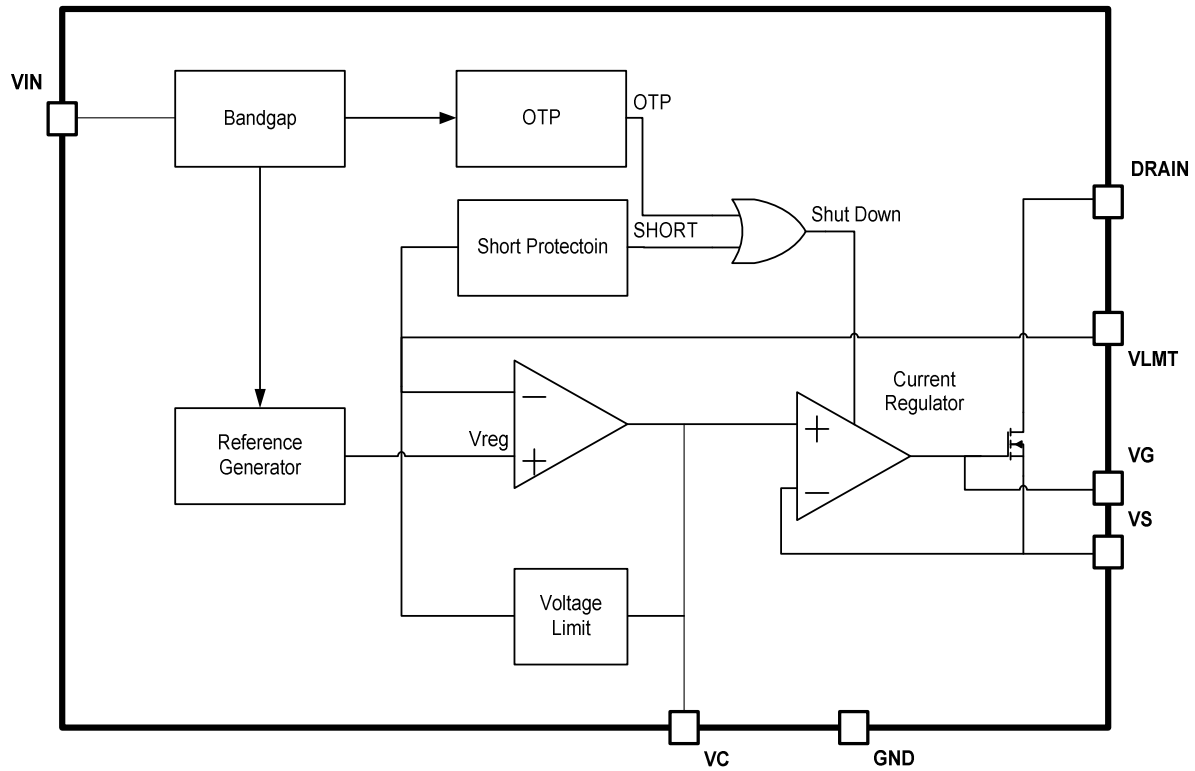
VIN = 12V, TA = 25ºC, unless otherwise stated.

Item	Symbol	Condition	Min.	Typ.	Max.	Units
VIN clamp voltage	V_{IN_CLP}		28	31	34	V
VIN operation current	I_{IN}	5V<VIN<33V	0.24	0.3	0.58	mA
VIN startup voltage threshold	V_{THULVO}		15	16	17	V
VIN startup voltage hysteresis	$V_{HYSUVLO}$			5		V
Maximum VG output voltage	V_{VG}		9.5	10	10.5	V
VC startup current	I_{VCST}	VC short to GND when startup	0.7	0.8	0.9	mA
VLMT reference voltage	V_{VLMTR}		1.95	2	2.05	V
LED- voltage limit	V_{D_CLP}	The voltage of LED- when voltage limit is trigged. R_{LIMIT}=100K.	3.4	4	4.6	V
SHORT protection threshold	V_{TH_SHORT}	The voltage of LED- when SHORT is trigged. R_{LIMIT}=100K.	5	6	7.5	V
SHORT protection delay time	TSPD			160		us
SHORT protection hold time	TSPH			13		ms
VS voltage limit	V_{VS}		0.18	0.2	0.22	V
MOS R_{dson}	R_{dson}	V_{gs}=10V		260		mΩ
Breakdown Voltage	BV		150			V

PIN DESCRIPTION

ESOP8 Pin No.	Name	Description
1	VLMT	LED- Voltage Limit and SHORT protection Programming
2	VS	LED current sensing input
3	NC	Not connected
4	LED-	Connect to the Cathode of LED string
5	VG	NMOSFET GATE Cap
6	GND	Ground
7	VC	LED Current Ripple Programming
8	VIN	Power Supply
0 (exposed PAD)	LED-	Connect to the Cathode of LED string

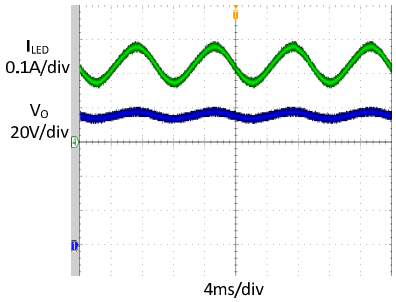
BLOCK DIAGRAM



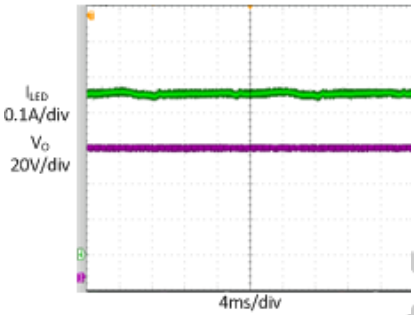
TYPICAL PERFORMANCE CHARACTERISTICS

V_{IN}= 90~264V_{AC}, V_{OUT}=75V, I_{OUT}=240mA, COUT= 100μF/100V*2, TA = +25°C, unless otherwise noted

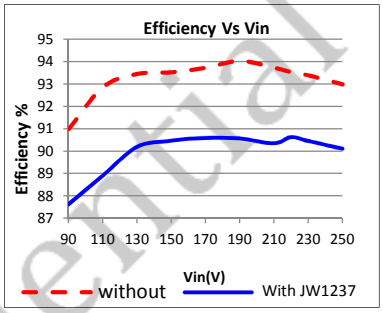
Pre-driver Output Steady State



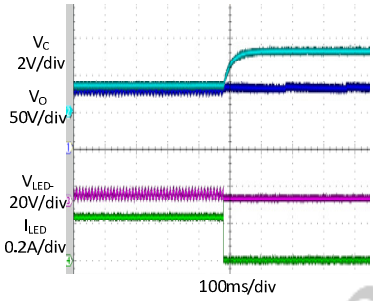
+JW1237 Output Steady State



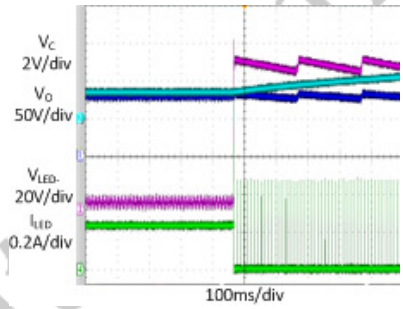
Efficiency comparison(with and without JW1237)



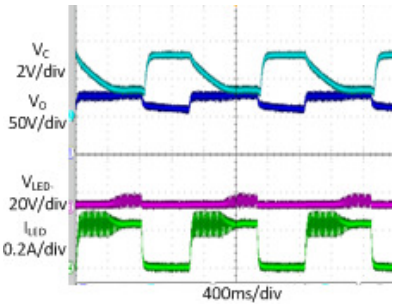
Open Circuit protection Test



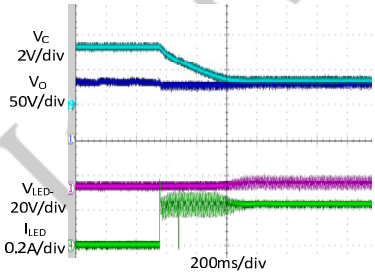
Short Circuit Protection Test



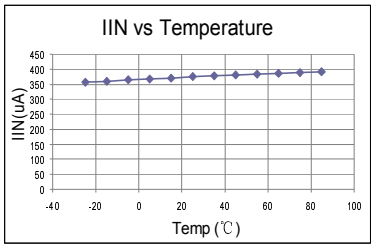
Continuous power on/off test



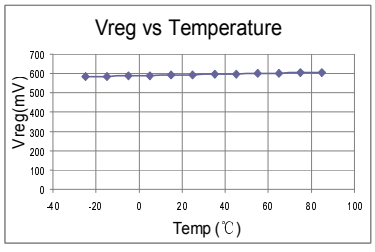
LED Hot plug



VIN Current VS Temperature



Regulated LED pin Voltage VS Temperature



FUNCTIONAL DESCRIPTION

JW1237 is used to drive a LED string, and remove the 100/120Hz LED current ripple on AC/DC power.

Theory of Operation

The LED string and JW1237 are both supplied by an AC/DC current source. The LED- pin is connected to the cathode of LED string. A sensing resistor R_{SENSE} is connected between the VS and GND.

JW1237 transfers the LED current ripple to voltage ripple, and ensures the constant voltage across LED string and the current flow through LED string.

The scalable adaptive function of JW1237 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. JW1237 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:

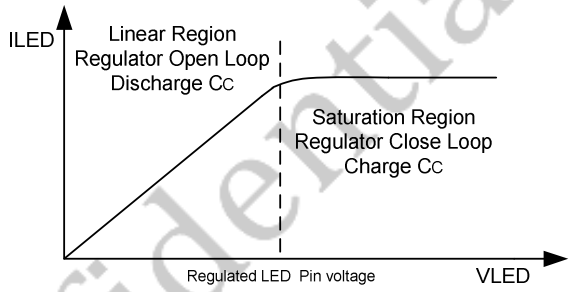
$$V_{RS} = I_{LED} * R_{SENSE} = V_{VC} / 10$$

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

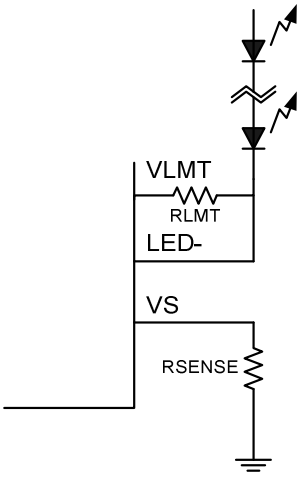
The voltage on C_C is controlled by monitoring the operation state of integrated NMOSFET. The efficiency of system is relatively low when NMOSFET is working in the saturation region. C_C is charged to raise the V_{VC} and I_{LED}, then the output voltage of power supply is reduced, and the voltage drop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

Conversely, when NMOSFET is working in the linear region, LED current regulation loop is open. C_C is discharged 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.



The Voltage of LED- Limit

The voltage ripple on LED- pin maybe very large when the current ripple is removed, which would bring large power dissipation on chip. The resistor between LED- pin and VLMT pin can setup the limit value of the voltage of LED- pin.



The limit threshold is calculated as below:

$$V_{limit} = 2V + R_{LMT} * 20uA$$

LED Current Limit

The voltage of VS pin is limited to 0.2V internally. So the current limitation is $0.2V/R_S$.

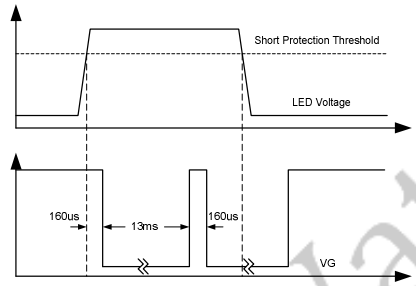
Current limit can protect the chip when LED is short connected or HOT-PLUG.

The function of current limit is higher priority than LED- voltage limit. It means that the voltage of LED- pin is not limited when LED current exceed current limit threshold.

LED Short Protection

JW1237 detect SHORT by R_{LMT}. When the voltage of LED- pin exceeds the SHORT PROTECTION THRESHOLD and the state holds for more than 160us, JW1237 considers the LED string is SHORT connected and shuts down. The SHORT state is reset after 13ms. The SHORT PROTECTION THRESHOLD is calculated as:

$$V_{THSCP} = 2V + R_{LMT} * 40uA$$



Over Thermal Protection

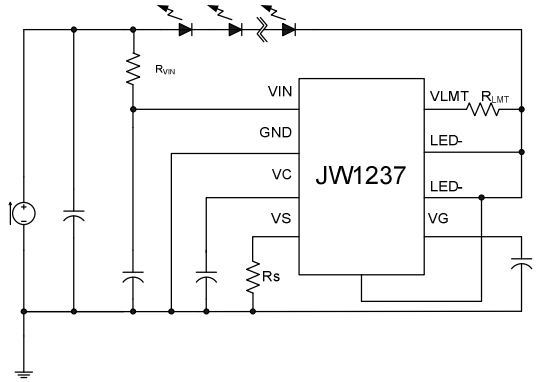
JW1237 monitors operation temperature. When the temperature is higher than 135℃, the chip shuts down until the temperature decrease to 115℃.

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. The area of LED current loop should be as small as possible.

APPLICATION INFORMATION

JW1237 design guide:



1. Because of the 30V zener integrated and the 16V V_{IN} start threshold, the value of R_{VIN} may satisfy the following conditions:

$$R_{VIN} < \frac{V_F - 16V}{0.5mA}$$

V_F: the voltage of LED

2. The maximum voltage of VS pin is 0.2V in order to limit the maximum output current especially in the short circuit condition. The value of R_S can be calculated as below:

$$R_S < \frac{0.2V}{I_{LED}}$$

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

3. When the voltage of LED- reaches V_{SCP} which is set by the R_{LMT}, JW1237 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_{LMT} must satisfy the following conditions:

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

$$V_{SCP} < V_{INSTART} = R_{VIN} * 0.5mA + 16V$$

$$V_{SCP} = 2V + 40uA * R_{LMT}$$

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

V_{SCP}: the threshold of JW1237 short circuit protection.

$V_{INSTART}$: the output voltage of the pre-driver when the VIN of JW1237 is 16V.

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 JW1237 work properly, the R_{DSON} of MOSFET must be less than $3R_S$. 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.

REFERENCE DESIGN

Reference：

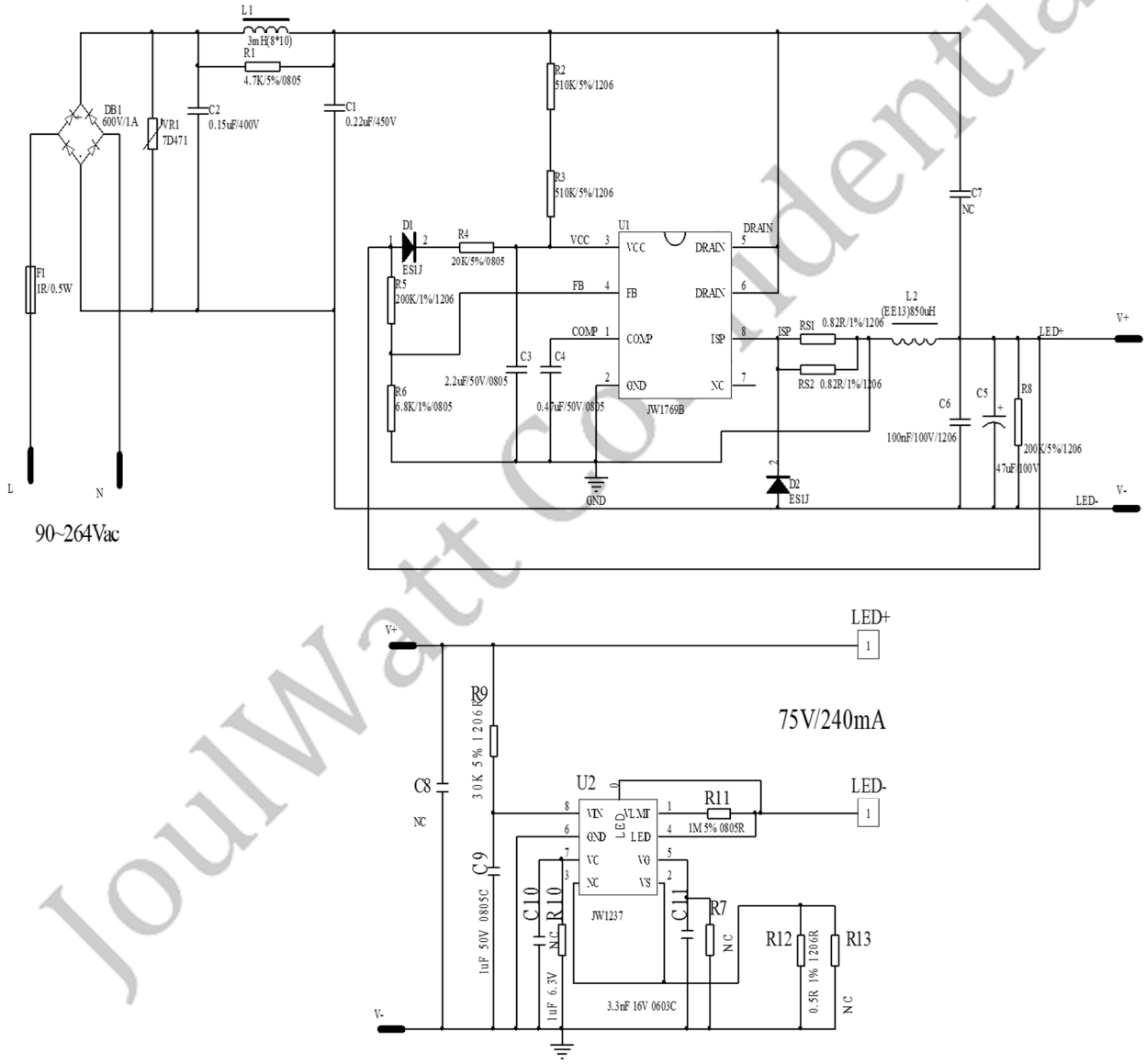
V_{IN}: 90~260VAC

V_{OUT}: 75V

I_{OUT}: 240mA

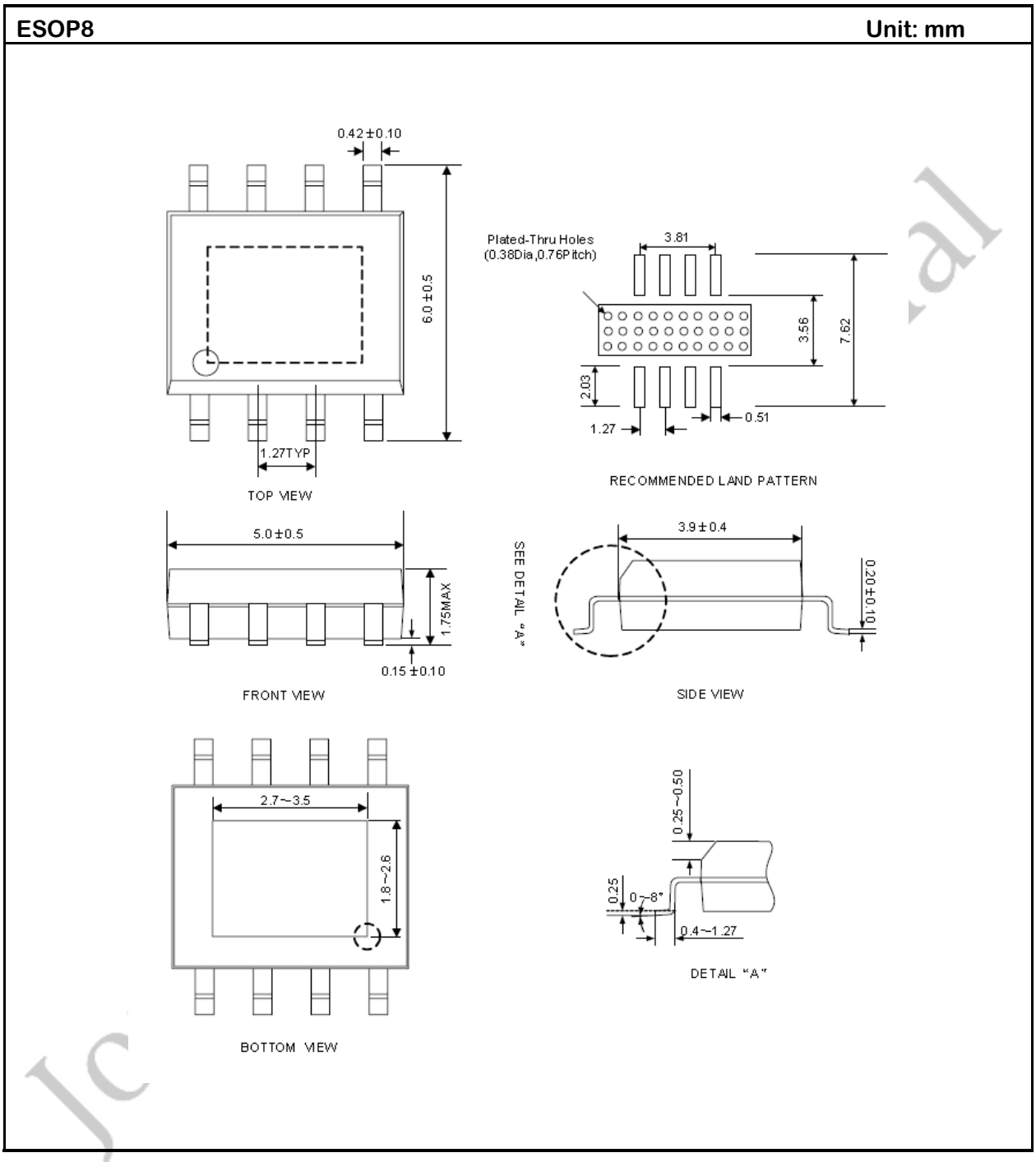
PF: >0.9

Current ripple:<5%



PACKAGE OUTLINE

ESOP8 **Unit: mm**



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