

*Parameters Subject to Change Without Notice*

## DESCRIPTION

The JW<sup>®</sup>1757A/B/C is a constant current LED driver with high current accuracy which applies to single stage step-down power factor corrected LED drivers. High voltage power MOS is integrated, which can significantly simplify the design of LED lighting system.

JW1757A/B/C 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.

JW1757A/B/C has multi-protection functions which largely enhance the safety and reliability of the system, including VCC over-voltage protection, VCC UVLO, LED open protection, inductor short protection, pulse-by-pulse current limit, over-temperature protection.

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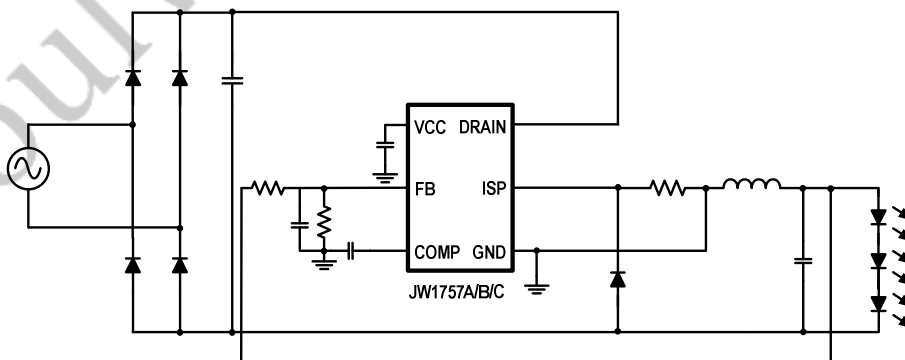
## FEATURES

- No auxiliary winding
- Supplied from line voltage directly
- high voltage power MOSFET integrated
- High current accuracy of line and load regulation
- High power factor
- Critical conduction mode
- High efficiency over wide operating range
- Cycle-by-cycle current limit
- LED open protection
- Inductor short protection
- ISP short protection
- Internal over-temperature protection
- SOP7 and DIP7 package

## APPLICATIONS

- Non-isolation Offline LED driver

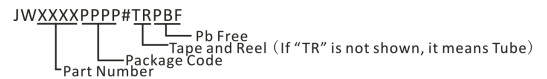
## TYPICAL APPLICATION



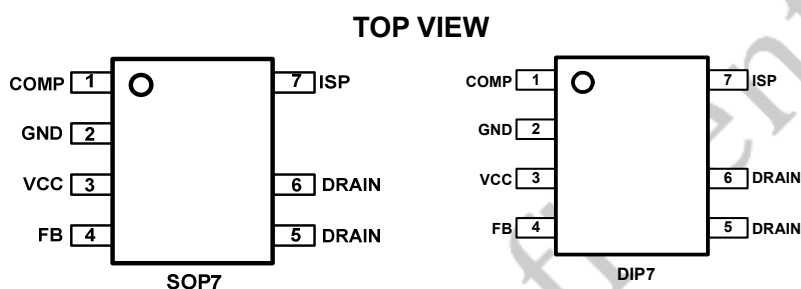
ORDER INFORMATION

LEAD FREE FINISH	TAPE AND REEL	PACKAGE	TOP MARKING
JW1757ASOPA#PBF	JW1757ASOPA#TRPBF	SOP7	JW1757A
JW1757BSOPA#PBF	JW1757BSOPA#TRPBF	SOP7	JW1757B
JW1757CSOPA#PBF	JW1757CSOPA#TRPBF	SOP7	JW1757C
JW1757CDIPA#PBF		DIP7	JW1757C

Note:



PIN CONFIGURATION



ABSOLUTE MAXIMUM RATING<sup>1)</sup>

VCC Voltage.....	40V
All other pins.....	-0.3V to 4.5V
Junction Temperature <sup>2) 3)</sup> .....	150°C
Lead Temperature.....	260°C
Storage Temperature.....	-65°C to +150°C
ESD Susceptibility (Human Body Model).....	2kV

RECOMMENDED OPERATING CONDITIONS

VCC Voltage.....	13V
FB PIN.....	0.8V to 1.2V
Operating Junction Temp (T <sub>J</sub> ).....	-40°C to 125°C

THERMAL PERFORMANCE<sup>4)</sup>

	$\theta_{JA}$	$\theta_{JC}$
SOP7.....	96	45°C/W
DIP7.....	80	45°C/W

Note:

- 1) Exceeding these ratings may damage the device.
- 2) The JW1757A/B/C 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 JW1757A/B/C 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 JE51-7, 4-layer PCB.

**ELECTRICAL CHARACTERISTICS**

*VIN=20V, TA=25 °C, unless otherwise stated.*

Item	Symbol	Condition	Min.	Typ.	Max.	Units	
VCC Start-Up Voltage	V <sub>CC_ST</sub>		12	13.5	15	V	
VCC Under Voltage Lockout	V <sub>CC_UVLO</sub>		8	9.5	11	V	
VCC Operational Current	I <sub>CCO</sub>	VCC=15.5V,FB=2V	120	150	180	μA	
VCC Over Voltage Threshold <sup>5)</sup>	V <sub>CC_OVP</sub>			19		V	
VCC Shunt Current <sup>5)</sup>	I <sub>SHUNT</sub>	VCC=18V		5		mA	
ISP Sample Reference	V <sub>REF</sub>		198	205	212	mV	
Maximum On Time of MOSFET	T <sub>ON_MAX</sub>	COMP=2.4V	25	39	48	μs	
COMP Source Current	I <sub>COMP</sub>	1.2V<COMP<2.4V, ISP=0V	7.5	10.5	13.5	μA	
Maximum Switch Frequency	F <sub>MAX</sub>	COMP<1.2V		105	155	kHz	
FB High Voltage Threshold	V <sub>FB_H</sub>		1.52	1.6	1.68	V	
ISP Maximum Voltage	V <sub>ISP_MAX</sub>		1.1	1.2	1.3	V	
Over Thermal Protection Threshold <sup>5)</sup>	Temp <sub>OTP</sub>			145		°C	
MOS R <sub>dson</sub> <sup>5)</sup>	JW1757A	R <sub>dson</sub>	V <sub>gs</sub> =10V		9		Ω
	JW1757B				5		
	JW1757C				2.8		
Breakdown Voltage	JW1757A	BV		500			V
	JW1757B			550			
	JW1757C			500			

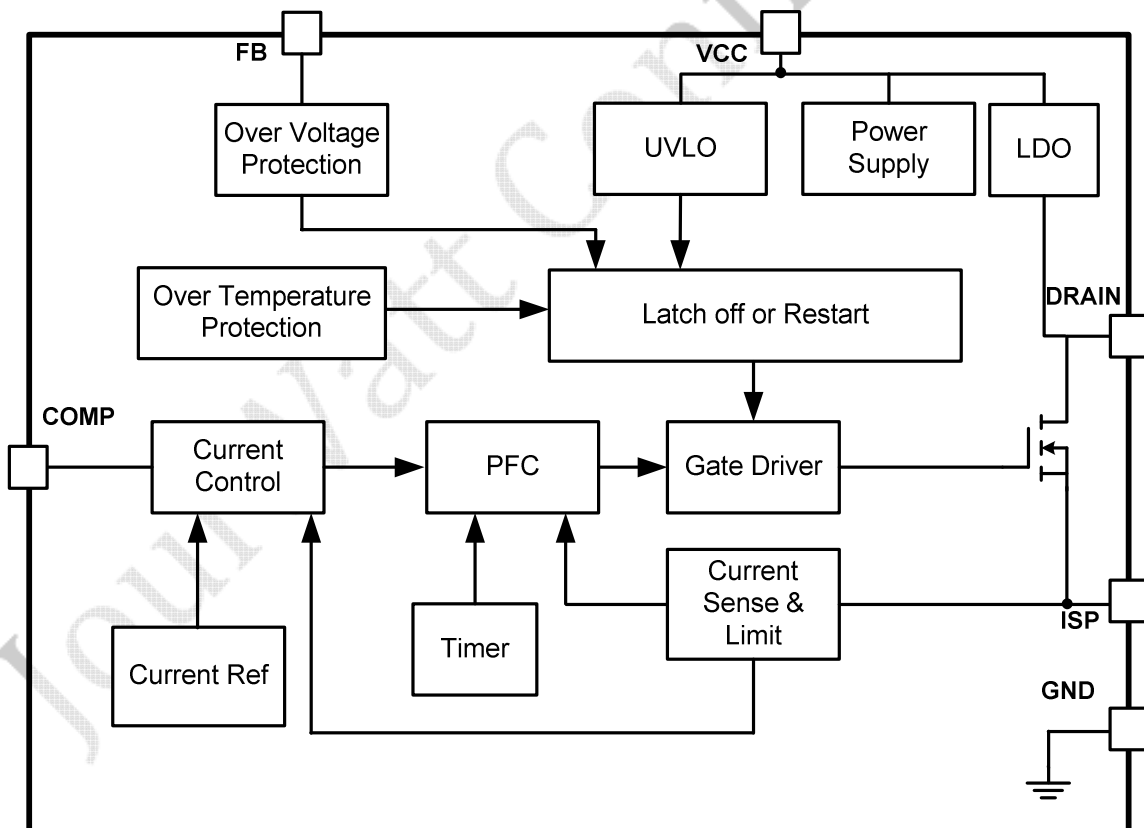
**Note:**

5) Guaranteed by design.

**PIN DESCRIPTION**

Pin No.	Name	Description
1	COMP	Compensation pin for internal error amplifier. Connect a capacitor between the pin and GND to compensate the internal feedback loop.
2	GND	Ground.
3	VCC	Power supply pin.
4	FB	Output voltage feedback pin.
5,6	DRAIN	DARIN of the MOSFET.
7	ISP	Output Current Sense Pin.

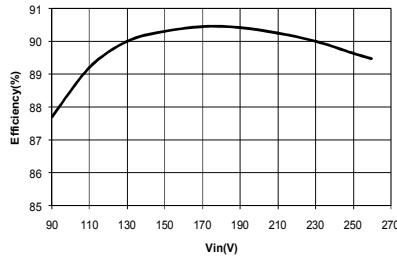
**BLOCK DIAGRAM**



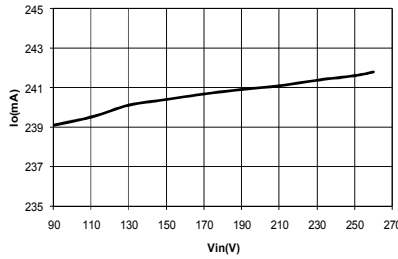
TYPICAL PERFORMANCE CHARACTERISTICS

JW1757B,  $V_{IN}=220VAC$ ,  $V_{OUT}=75V$ ,  $I_o=240mA$ , unless otherwise noted

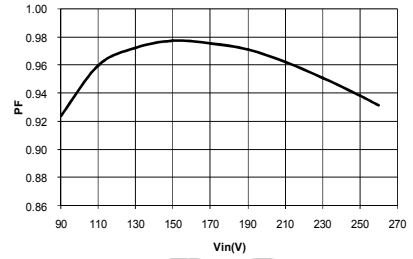
Efficiency Vs Vin



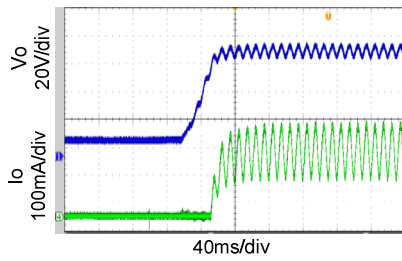
Io Vs Vin



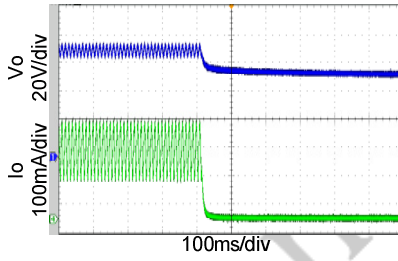
PF VS Vin



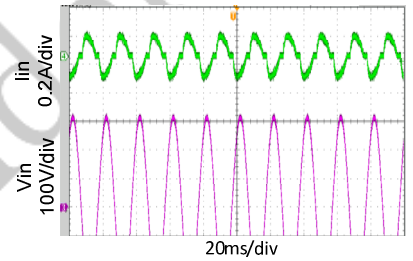
Start Up(Output)



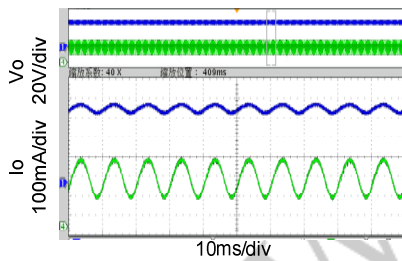
Power Off(Output)



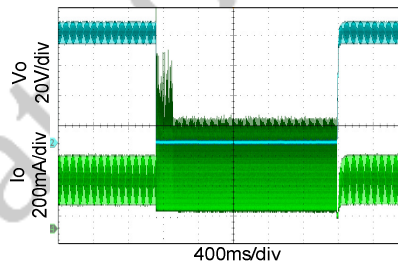
Steady State(Input)



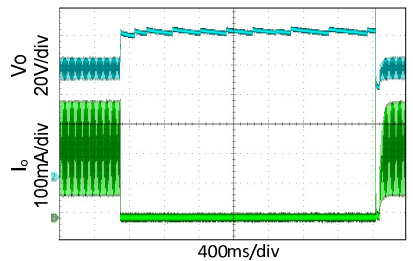
Steady State(Output)



Short Circuit Protection



Open Circuit Protection

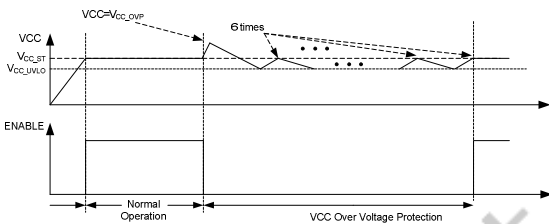


**FUNCTIONAL DESCRIPTION**

The JW1757A/B/C is a constant current LED driver which applies to non-isolation step-down LED system with power factor correction. JW1757A/B/C can achieve excellent line and load regulation, high efficiency and low system cost with few peripheral components.

**Start Up**

JW1757A/B/C can be supplied by line voltage directly. When DRIAN charges VCC up to VCC Start-Up Voltage(V<sub>CC\_ST</sub>), the GATE driver begins to switch. An internal 16V clamp is attached to the VCC pin to prevent VCC from being too high. Once VCC exceeds V<sub>CC\_OVP</sub>, system shuts down and VCC is charged again after it's pulled down to V<sub>CC\_UVLO</sub>. When VCC is charged to V<sub>CC\_ST</sub> for 6 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 JW1757A/B/C 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<sub>REF</sub> – The reference voltage;

R<sub>S</sub> – The sensing resistor connected between ISP and GND.

**Critical Conduction Mode Operation**

JW1757A/B/C works in the critical conduction mode of the inductor current. When the internal power MOSFET is turned on, the inductor current begins to increase from zero. The turn on time of the MOSFET can be calculated as:

$$T_{ON} = I_{PK} \times L / (V_{IN} - V_{OUT})$$

Where,

L –inductance.

I<sub>PK</sub> – peak current in one switch period.

V<sub>IN</sub> – input voltage after rectification and filtering.

V<sub>OUT</sub> – output LED voltage.

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. The turn off time of the MOSFET can be calculated as:

$$T_{OFF} = I_{PK} \times L / V_{OUT}$$

And the inductance of the system can be calculated as:

$$L = V_{OUT} \times (V_{IN} - V_{OUT}) / (f \times I_{PK} \times V_{IN})$$

Where, f is the frequency of the step-down system. You may choose the minimum input voltage when you want to set up the minimum system working frequency.

**Over Temperature Protection**

When internal temperature of the chip exceeds 145°C, JW1757A/B/C decrease the source 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(V<sub>FB\_H</sub>), the power MOSFET gate driver 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 6 times, system restarts. The recommended value of FB pull up resistor is between 200 to 300K $\Omega$ , and a capacitor, such as 68pF, could be paralleled to FB and GND Pin if LED open protection is false triggered by unreasonable PCB layout.

### **ISP Short Protection and Continuous Power On/Off**

There are three conditions when JW1757A/B/C cannot sense the inductor current. The first condition is the difference of  $V_{IN}$  and  $V_{OUT}$  is too small, and the second condition is ISP short to GND. The last condition is power off.

JW1757A/B/C folds the operation frequency to 10kHz if ISP voltage is lower than 25mV during the period of MOSFET turned on. It's considered that ISP is shorted connected to GND or power off if low frequency operation last 15ms. Then JW1757A/B/C pulls down the COMP to minimum value and the HV power source is disconnected until VCC decreases to  $V_{CC\_UVLO}$ . When VCC is charged to  $V_{CC\_ST}$  for 6 times, system restarts.

### **Inductor Short Protection**

When inductor is short connected, ISP voltage increase sharply after MOSFET turned on. JW1757A/B/C stops switching if ISP voltage is over  $V_{ISP\_MAX}$  within 250ns~500ns after MOSFET turned on. Then the HV power source is disconnected until VCC decreases to  $V_{CC\_UVLO}$ . When VCC is charged to  $V_{CC\_ST}$  for 6 times, system restarts.

### **PCB Design**

When designing the PCB of the JW1757A/B/C system, please follow the directions:

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 inductor and the freewheel diode.
4. Note the chip ground is not connected to the cathode of the input capacitor as usual.

**REFERENCE DESIGN**

This reference design is suitable for 3 ~ 12W non-isolated Step-down LED driver, using JW1757A/B/C, with high efficiency, excellent line regulation.

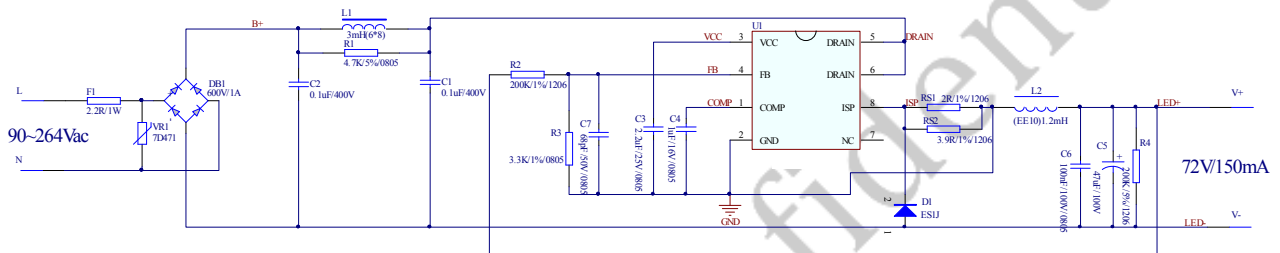
**Reference :**

$V_{IN}$ : 90VAC~264VAC

$V_{OUT}$ : 40~72V

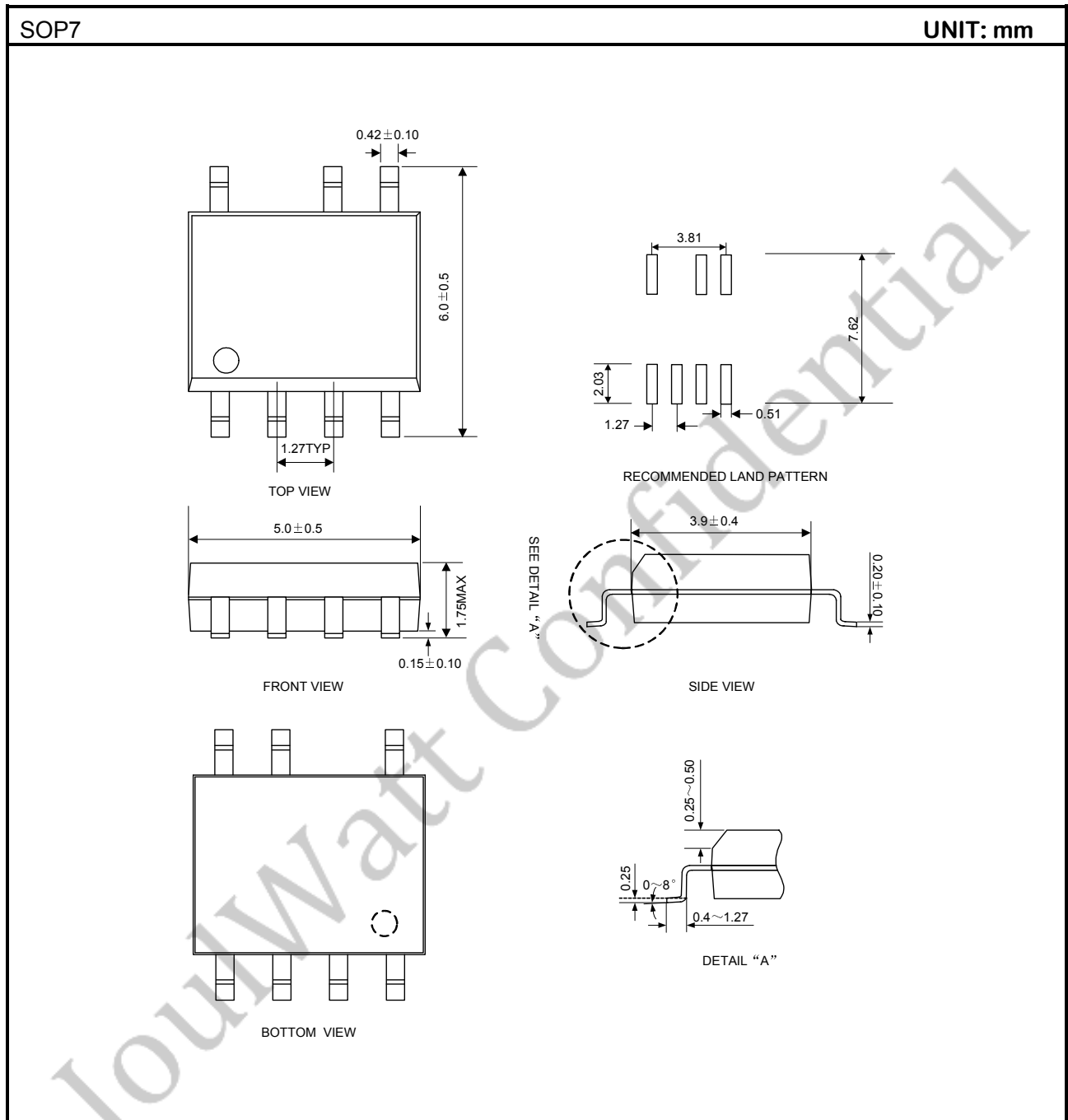
$I_{OUT}$ : 150mA

PF: >0.9



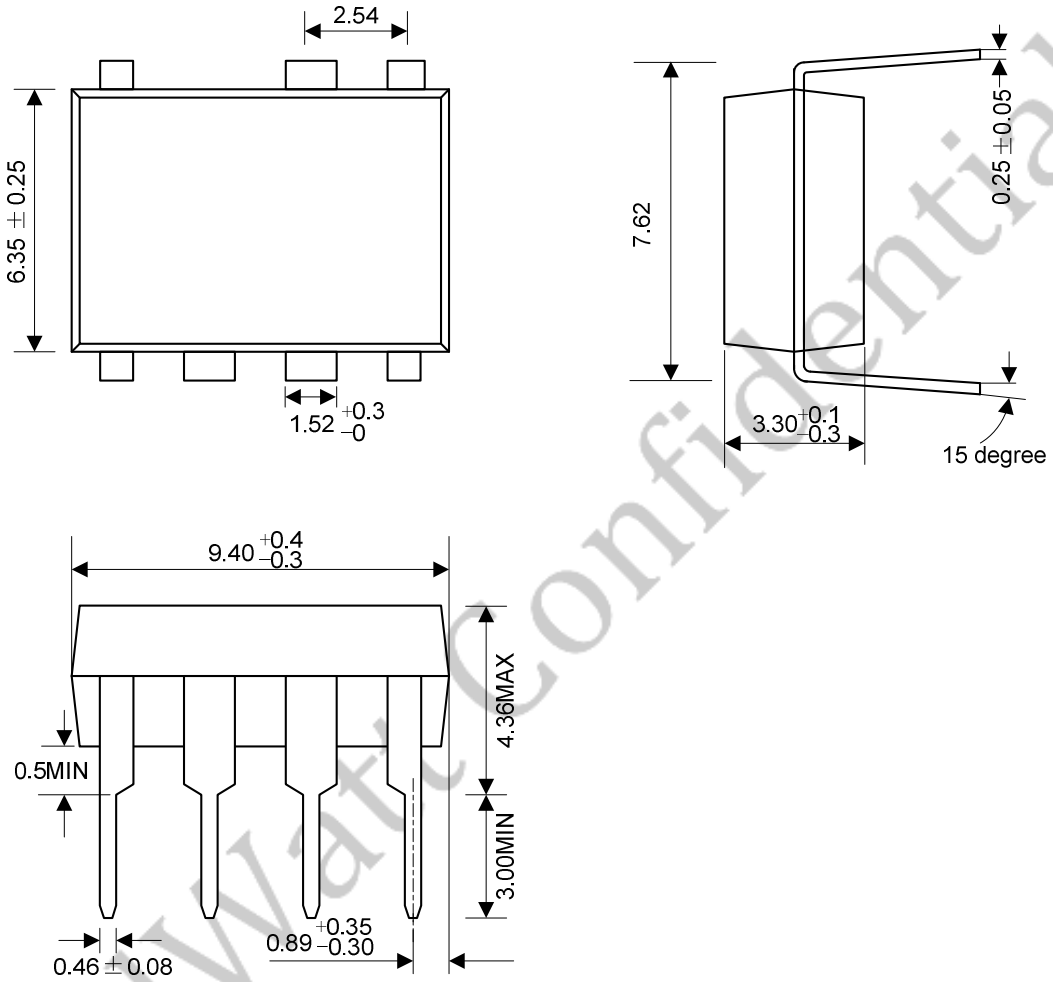


PACKAGE OUTLINE



DIP7

UNIT: mm



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