JW JOULWATT

JW1765

Offline Step-down LED Controller With PFC and No Auxiliary Winding

Parameters Subject to Change Without Notice

DESCRIPTION

The JW®1765 is a constant current LED controller with high current accuracy which applies to single stage step-down power factor corrected LED drivers.

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. JW1765 is supplied from the output directly, and auxiliary winding is not needed.

JW1765 has multi-protection functions which largely enhance the safety and reliability of the system, including VCC over-voltage protection, VCC UVLO, short-circuit protection, LED open protection, cycle-by-cycle current limit and over-temperature protection.

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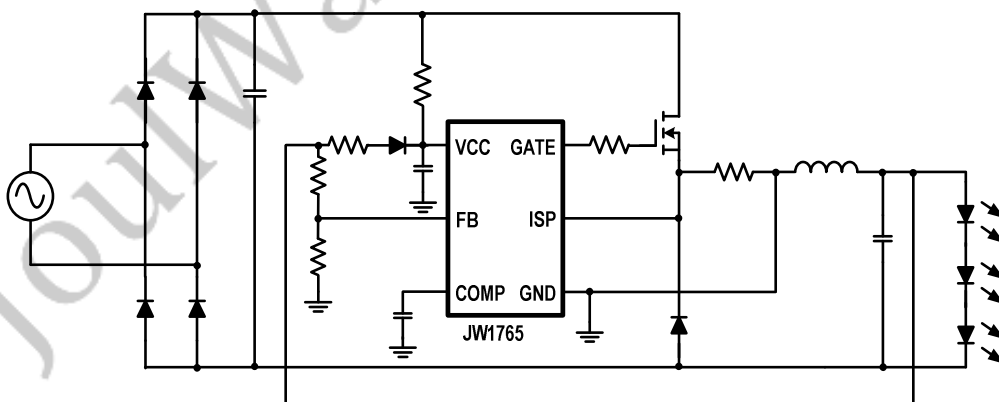
FEATURES

- No auxiliary winding
- High current accuracy of line and load regulation
- High power factor with low output current-ripple
- Critical conduction mode
- High efficiency over wide operating range
- Cycle-by-cycle current limit
- LED short protection
- LED open protection
- Over-temperature protection
- Compact SOT23-6 package
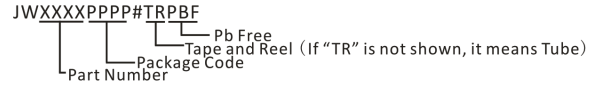
APPLICATIONS
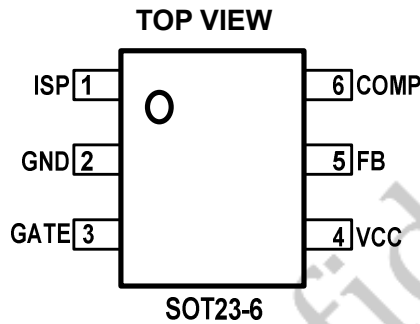
- Non-isolation Offline LED driver

TYPICAL APPLICATION

JW1765 Rev.1.01

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ORDER INFORMATION

LEAD FREE FINISH	TAPE AND REEL	PACKAGE	TOP MARKING
JW1765SOTB#PBF	JW1765SOTB#TRPBF	SOT23-6	1765

Note：

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

PIN CONFIGURATION

TOP VIEW

```
        ISP  1          6  COMP
        GND  2    O     5  FB
        GATE 3          4  VCC
```

SOT23-6

ABSOLUTE MAXIMUM RATING[1]

VCC PIN..43V
GATE PIN...18V
All Other Pins...-0.3V to 4.5V
Junction Temperature[2] [3] 150ºC
Lead Temperature.. 260ºC
Storage Temperature.. -65ºC to +150ºC
ESD Susceptibility (Human Body Model) 2kV

RECOMMENDED OPERATING CONDITIONS

VCC PIN ....8V to 43V
FB PIN ....1.6V to 2.6V
Operating Junction Temp (T_J) .... -40ºC to 125ºC

THERMAL PERFORMANCE[4]　　　　　　　　　　　　　θ_{JA}　　θ_{JC}

SOT23-6 ....220......130ºC/W

Note：

1) Exceeding these ratings may damage the device.
2) The JW1765 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 JW1765 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.

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ELECTRICAL CHARACTERISTICS

V_{IN} = 25V, T_A = 25°C, unless otherwise stated.						
Item	**Symbol**	**Condition**	**Min.**	**Typ.**	**Max.**	**Units**
V_{CC} Turn-On Voltage	V_{CC_ON}		18	21.0	24	V
V_{CC} Turn-off Low Voltage	$V_{CC\_OFF\_L}$		6.4	7	8	V
V_{CC} Hysteresis	V_{CC_HYS}	V_{CC_ON}-$V_{CC\_OFF\_L}$		14		V
V_{CC} Over Voltage Threshold	V_{CC_OVTH}			35		V
V_{CC} Shunt Regulator Current Limit	I_{CC_SHUNT}	V_{CC} = 42V	4	6	8	mA
V_{CC} Quiescent Current	I_Q	V_{CC}<V_{CC_ON}	19	25	31	uA
FB OVP Threshold	V_{FB_H}		2.75	2.9	3.05	V
V_{ISP} Reference Voltage	V_{ISP}		96	100	104	mV
V_{ISP} Limit	V_{ISP_LIMIT}		500	550	610	mV
Gate Output High	V_{GATE_H}		11	13	15	V
Leading Edge Blanking Time	T_{LEB}		500	750	1000	ns
Maximum Frequency	F_{MAX}			120	145	kHz
Maximum MOS On Time	T_{ONMAX}			30		us
t_r Gate Driver Output Rise Time	T_{GATE_R}	C_L=1nF 10% to 90%		20		ns
t_f Gate Driver Output Fall Time	T_{GATE_F}	C_L=1nF 90% to 10%		20		ns

PIN DESCRIPTION

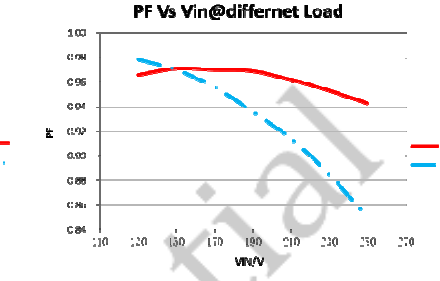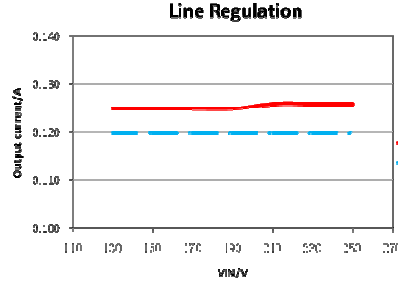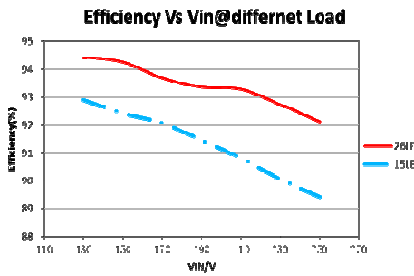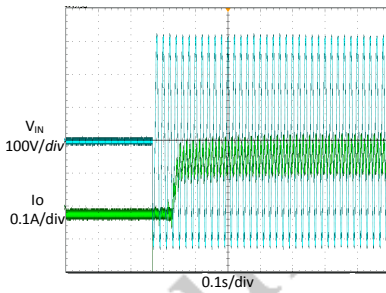| Pin	Name	Description
1	ISP	Output current sense Pin. The pin is used for output current control.
2	GND	Ground.
3	GATE	Gate Driver for the External Main MOSFET Switch.
4	VCC	Power Supply Pin. This pin supplies current to the internal start-up circuit. This pin must be bypassed with a capacitor nearby.
5	FB	Voltage Loop Feedback Pin. FB is used to detect LED open by sampling the output voltage.
6	COMP	Compensation Pin for Internal Error Amplifier. Connect a capacitor between the pin and GND to compensate the internal feedback loop.

BLOCK DIAGRAM
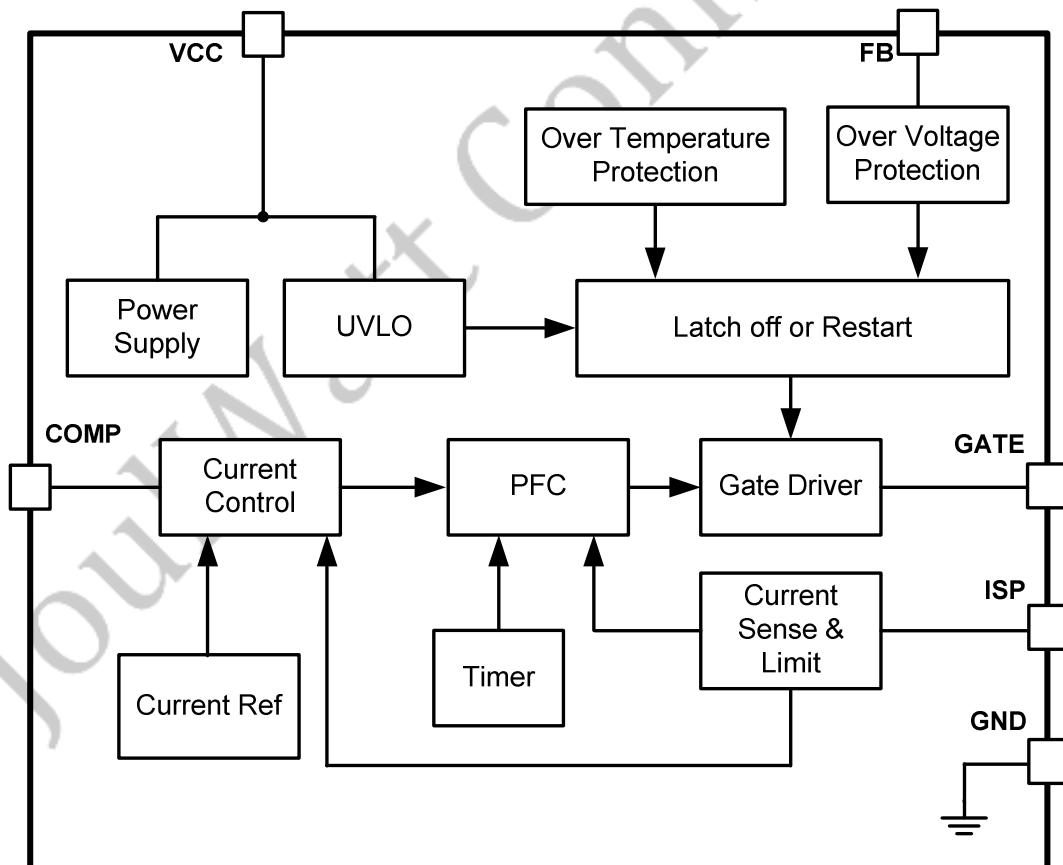
TYPICAL PERFORMANCE CHARACTERISTICS

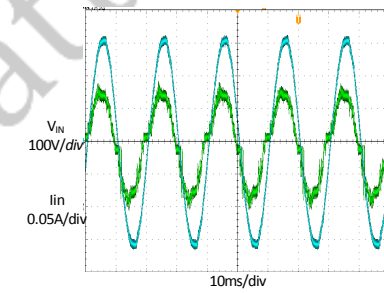*V$_{IN}$=85VAC~264VAC, V$_{OUT}$=75V, Io=120mA, unless otherwise noted*

Efficiency Vs Vin@differnet Load

Line Regulation

PF Vs Vin@differnet Load

THD(%) Vs Vin@differnet Load
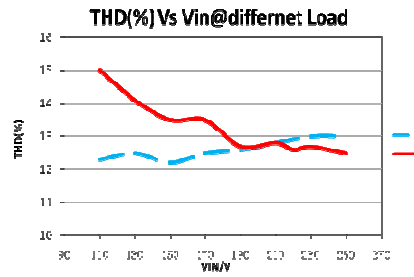
Start State

V$_{IN}$=220Vac,I$_O$=120mA,P$_O$=9W

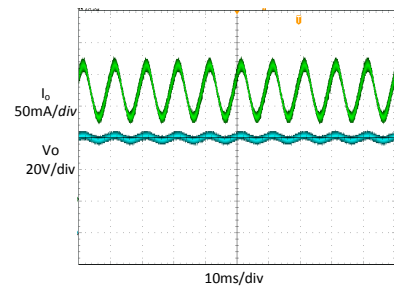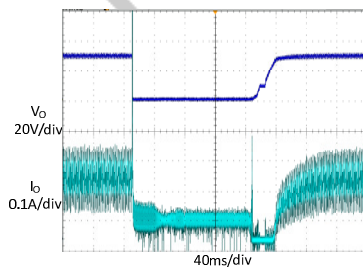**Steady State (Input)**

VIN=220Vac,IO=120mA,PO=9W

Steady State (Output)
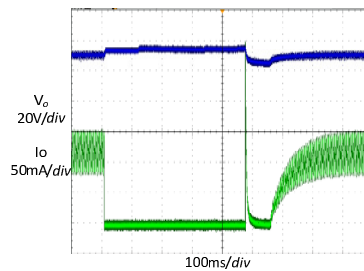
VIN=220Vac,IO=120mA,PO=9W

Short Circuit Protection

V$_{IN}$=220Vac,I$_O$=102mA,P$_{IN}$=0.39W

Open Circuit Protection

V$_{IN}$=220Vac,V$_O$=80V,P$_{IN}$=0.25W

FUNCTIONAL DESCRIPTION

The JW1765 is a constant current LED controller which applies to non-isolation step-down LED system with power factor correction. JW1765 can achieve excellent line and load regulation, high efficiency and low BOMcost.

Start Up

When the pull-up resistor charges VCC up to 21V, the gate drive signal begins to switch, and the output begins to provide power to the VCC pin when the output is enough. An internal voltage clamp is attached to the VIN pin to prevent VCC from being too high. An internal 5mA current pulls the VCC down when it is above 35V. When VCC is lower than 7V, it stops switching.

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. To have a good PFC performance, a capacitor of 1μF connected to COMP pin is recommended.

Constant Current Control

The JW1765 controls the output current from the information of the current sensing resistor. The output LED mean current can be calculated as:

$$I_{LED} = 100 / R_{CS} \quad (mA)$$

Where

R_{CS} – The sensing resistor connected between ISP and GND.

Critical Conduction Mode Operation

JW1765 works in the critical conduction mode of the inductor current. When the external power MOSFET turns on, the inductor current begins to increase from zero. The turn on time of the MOSFET can be calculated as:

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

Where,

L –inductance.

I_{PK} – peak current in one switch period.

V_{IN} – input voltage after rectification and filtering.

V_{LED} – output LED voltage.

When the power MOSFET turns 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:

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

And the inductance of the system can be calculated as:

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

Where, f is the switching frequency. You may choose the minimum input voltage when you want to set up the minimum switching frequency.

Inductor selection guide:

Output current(mA)	Inductor(mH)
120	1.30
180	1.00
240	0.83
320	0.73

Over Temperature Protection

When JW1765 is hotter than 135°C, the COMP voltage is pulled down by an internal current thus reduces the output current.

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LED Open Protection

The output voltage can be detected by the FB pin. When the FB voltage is higher than 3.0V, the LED open protection is triggered and the power MOSFET gate driver stops switching. After several seconds, the gate driver starts switching again.

The recommended FB pin voltage is about 2.5Vat rated output，and it's pull-up resistor is typically in hundreds KΩ level.

LED short protection

JW1765 judges LED short from the FB voltage. During a shorted LED condition, JW1765 reduces the internal command current to a very low level and slows down the switching frequency to 1.25 kHz to decrease the output current.

If a LED short or LED open protection are false triggered by unreasonable PCB layout, a 20pF capacitor could be paralleled to FB pin and GND.

PCB Layout Guidelines

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 components, such as MOSFET, transformer and 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 ~ 20W non-isolated Step-down LED driver, using JW1765, with high efficiency, excellent line regulation.
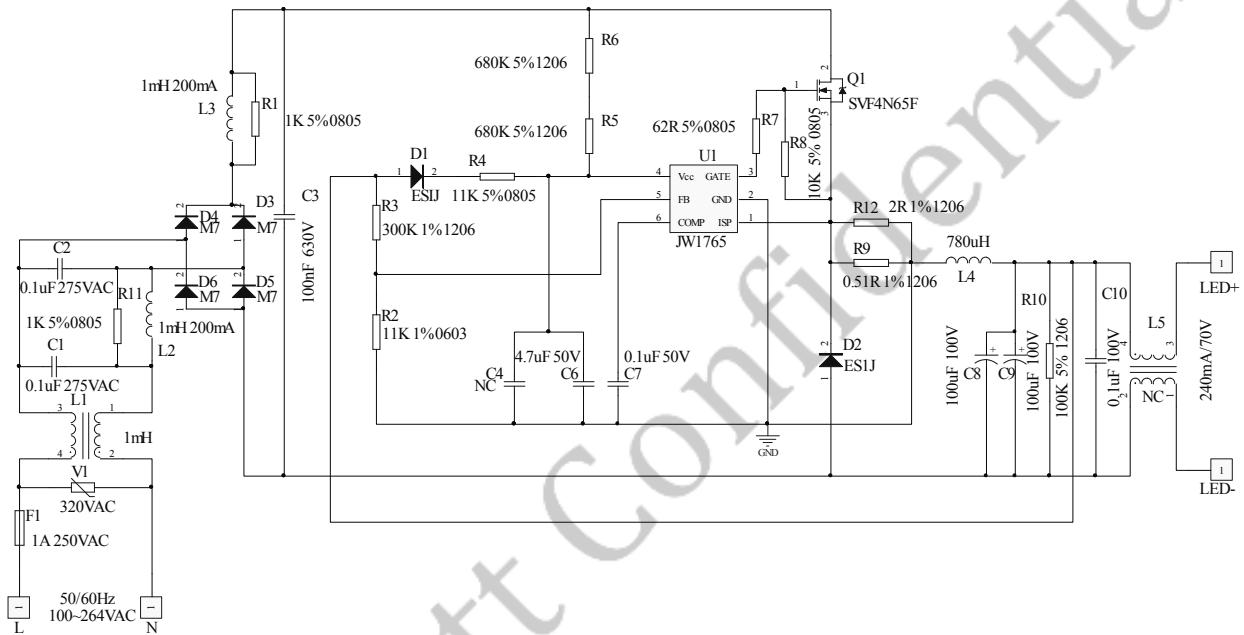
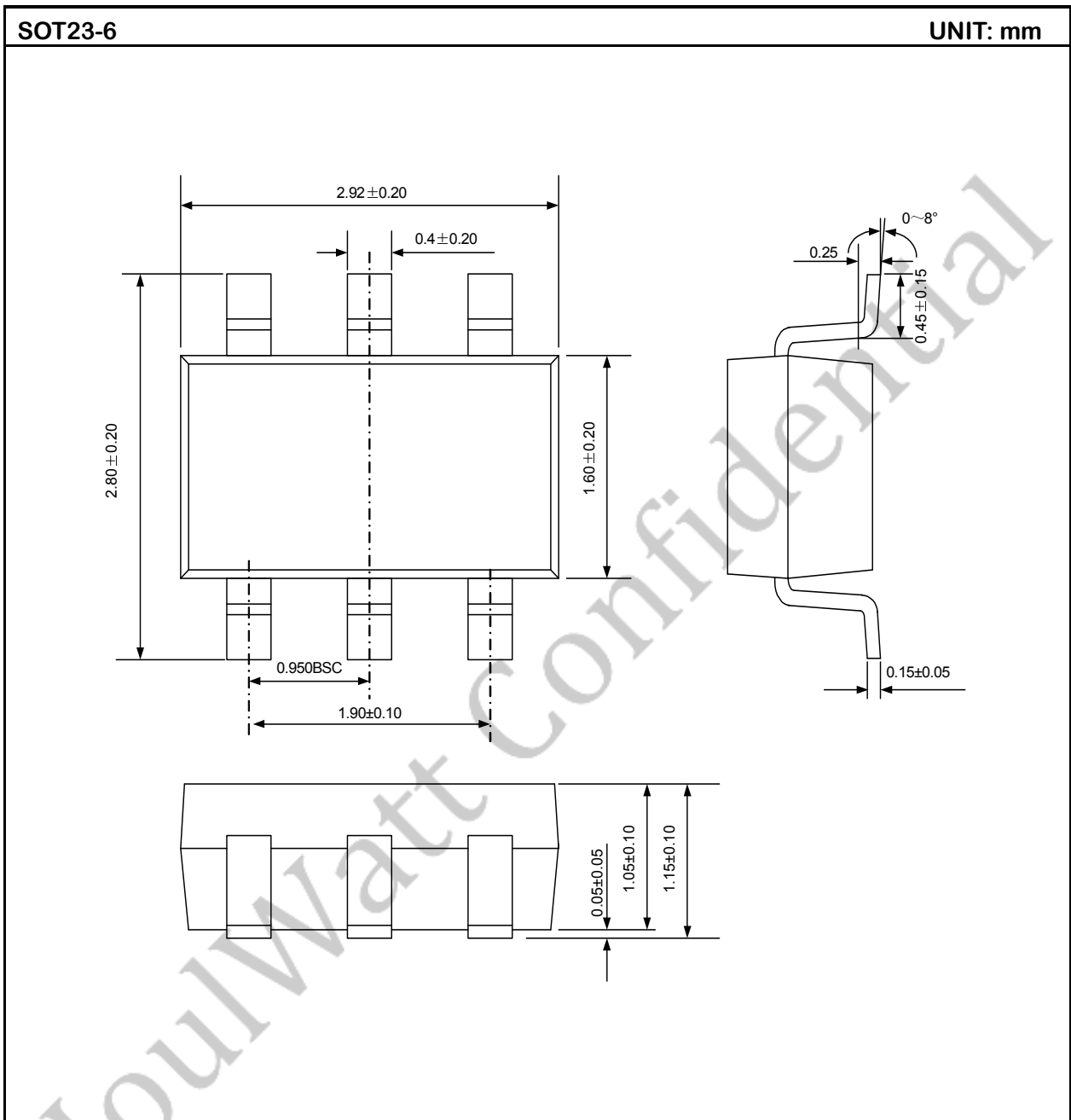### Reference 1：

V_{IN}:   90VAC~264VAC

V_{OUT}:   40~75V

I_{OUT}:   240mA

PF: >0.9

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PACKAGE OUTLINE

SOT23-6	UNIT: mm

SOT23-6 package outline drawing with dimensions:
- 2.92±0.20
- 0.4±0.20
- 2.80±0.20
- 1.60±0.20
- 0.950BSC
- 1.90±0.10
- 0~8°
- 0.25
- 0.45±0.15
- 0.15±0.05
- 0.05±0.05
- 1.05±0.10
- 1.15±0.10

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