JW1789

Integrated 500V MOS Non-isolated Buck LED Driver

Parameters Subject to Change Without Notice

DESCRIPTION

JW®1789 is a non-isolated, constant output current step-down LED driver with 500V MOSFET integrated. Operating in the boundary mode makes it high efficiency and low radiation. Patented algorithms ensure good current accuracy and excellent line/load regulations with lowest BOM cost.

JW1789 is supplied from the MOSFET drain directly, so the auxiliary winding is eliminated, which can light up the LED within 100mS.

With unique sampling techniques, JW1789 has multi-protection functions which can largely enhance the safety and reliability of the system, including VDD UVLO, LED short protection and over-temperature protection.

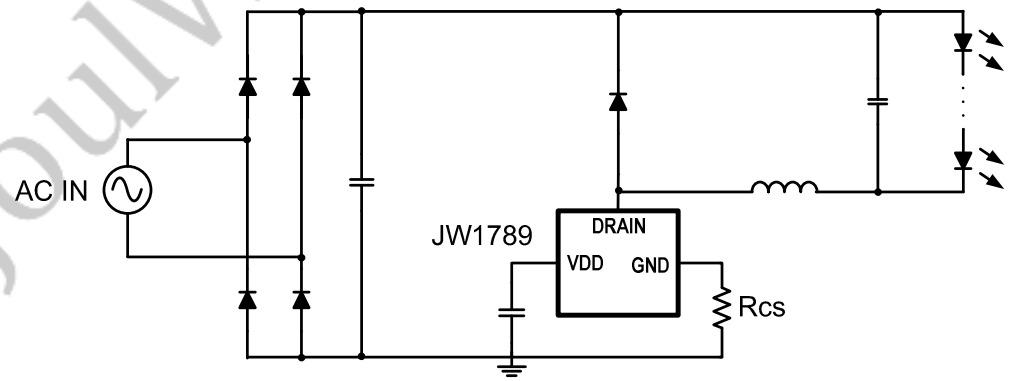
FEATURES

- Integrate 500V, Low R_{dson} MOSFET
- Excellent line/load regulation
- Boundary mode operation
- High efficiency
- LED SCP
- VDD UVLO
- Over-temperature protection
- TO-92, SOT23-3, CPC4 package

APPLICATIONS

- LED Lighting

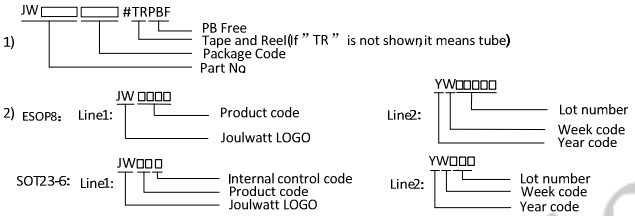
TYPICAL APPLICATION



ORDER INFORMATION

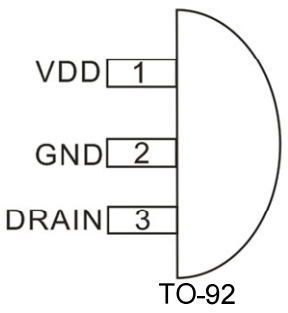
DEVICE[1)]	PACKAGE	TOP MARKING[2)]
JW1789TOC#TPBF	TO92	JW1789 YW□□□□□
JW1789TOC#APBF	TO92 (A)	JW1789 YW□□□□□
JW1789TOC#BPBF	TO92 (B)	JW1789 YW□□□□□
JW1789SOTF#TRPBF	SOT23-3	JWC2□ YW□□□
JW1789CPC#TRPBF	CPC4	JW1789 YW□□□□□

Notes:

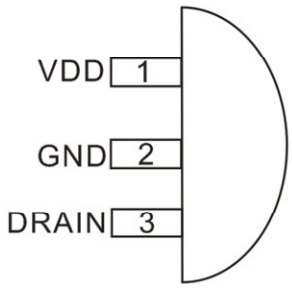


PIN CONFIGURATION

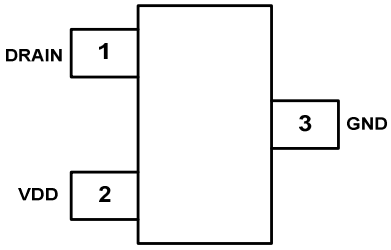
TOP VIEW



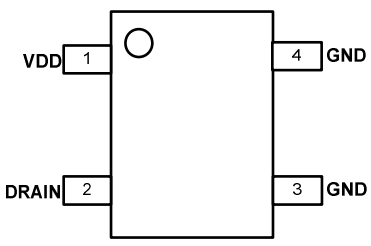
TO-92



TO-92(B)



SOT23-3



CPC4

ABSOLUTE MAXIMUM RATING[1)]

DRAIN Voltage.....550V
VDD Voltage..... 12V
GND Voltage.....-0.3V to 12V
Junction Temperature[2)3)].....150ºC
Storage Temperature.....-65ºC to +150ºC
ESD Susceptibility (Human Body Model) 2kV

RECOMMENDED OPERATING CONDITIONS

DRAIN Voltage 400V
Operating Junction Temp. .....-40ºC to 125ºC

RECOMMENDED OUTPUT CURRENT[1)]

JW1789.....<80mA

THERMAL PERFORMANCE[4)]

	θ_{JA}	θ_{JC}
TO-92	120	60ºC/W
SOT23-3	313.1	144ºC/W
CPC4	150	75ºC/W

Note:

1) Exceeding these ratings may damage the device.

2) 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) 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

T_A=25 ℃, unless otherwise stated

Item	Symbol	Condition	Min.	Typ.	Max.	Units
V_{DD} Regulation Voltage	V_{DD}		7.02	7.35	7.68	V
V_{DD} Start Up threshold	V_{DD_ST}	V_{DD} rising	7.02	7.35	7.68	V
V_{DD} Under Voltage Lockout [5)]	V_{DD_UVLO}	V_{DD} falling		6		V
V_{DD} IQ	I_Q		200	290	380	μA
Reference Voltage	V_{REF}		580	600	620	mV
MOS Max ON Time[5)]	T_{ONMAX}			56		μs
MOS Min ON Time[5)]	T_{ONMIN}			1		μs
MOS Max OFF Time[5)]	T_{OFFMAX}			440		μs
MOS Min OFF Time[5)]	T_{OFFMIN}			1.2		μs
MOS Max Current[5)]	I_{MAX}		0.35	0.4		A
MOS BV Voltage	V_{BRDSS}		500	550		V
MOS R_{dson}[5)]	R_{dson}	I(DRAIN)=50mA		27	30	Ω
Min Output Voltage[5)]	V_{OMIN}				15	V
Thermal Protection Threshold[5)]	OTP_{CHIP}			145		℃

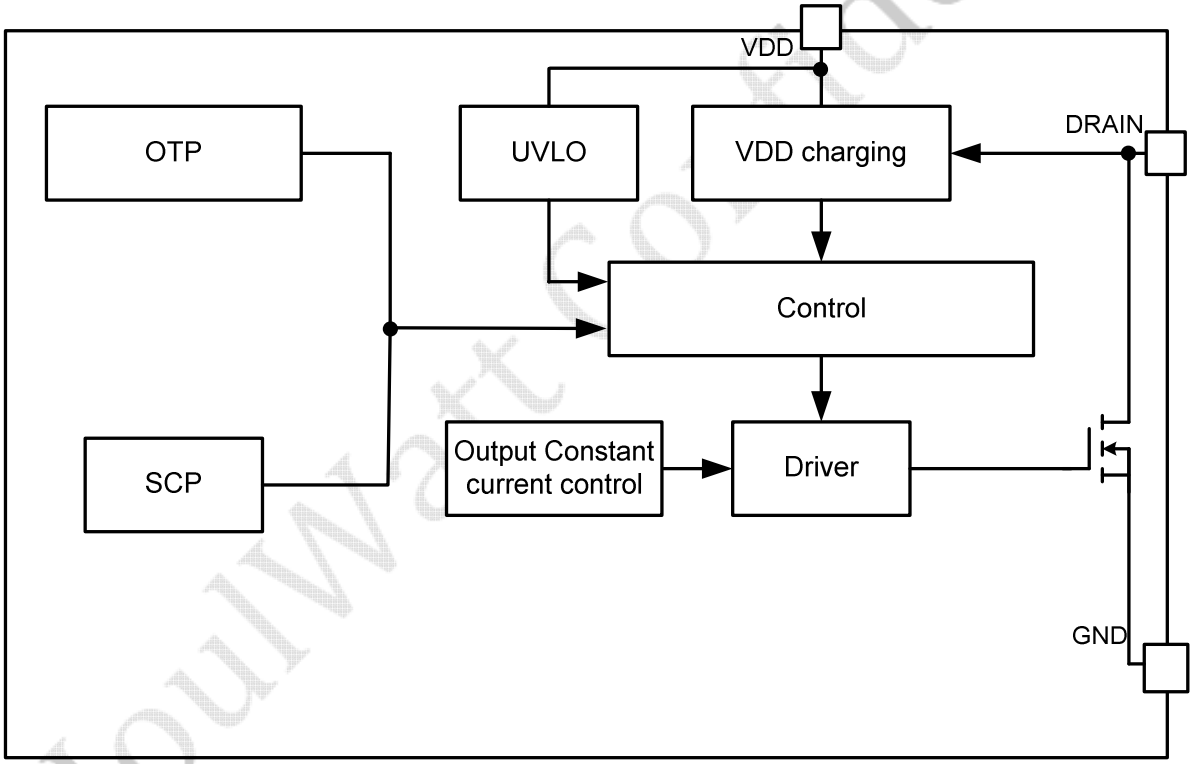
Notes:

5) Guaranteed by design

PIN DESCRIPTION

Pin TO-92	Name	Description
1	VDD	This pin supplies current to the internal start-up circuitry. This pin must be locally bypassed with a capacitor
2	GND	Chip ground
3	DRAIN	The drain of MOSFET

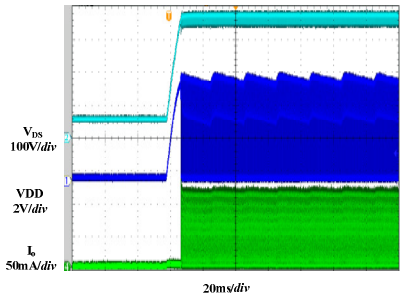
BLOCK DIAGRAM



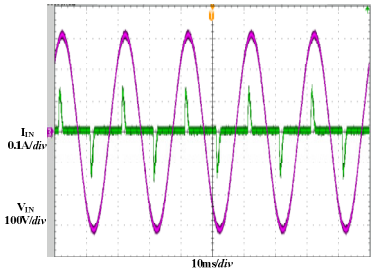
TYPICAL PERFORMANCE CHARACTERISTICS

Waveforms ,V_{IN}=90~264Vac,Io=50mA,Vo=60V or 20LEDs (VF=3V) in series

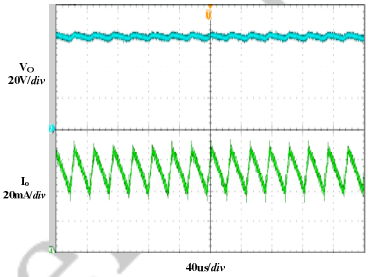
Start Up
V_{IN}=220Vac,I_O=50mA,P_O=3W



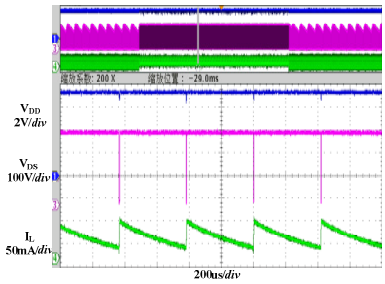
Steady State (Input)
V_{IN}=220Vac,I_O=50mA,P_O=3W



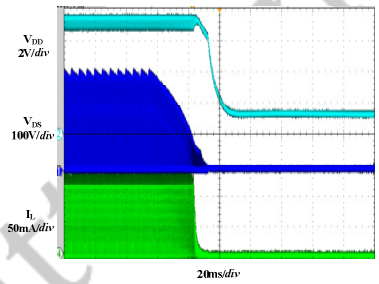
Steady State (Output)
V_{IN}=220Vac,I_O=50mA,P_O=3W



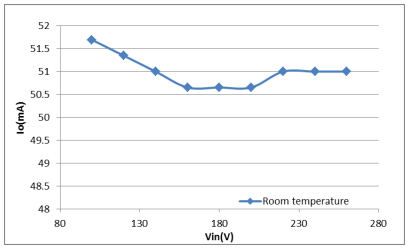
Short Circuit Protection
V_{IN}=220Vac



Power Off
V_{IN}=220Vac,I_O=50mA,P_O=3W



Line Regulation



FUNCTIONAL DESCRIPTION

The JW1789 is a constant current LED driver which applies to non-isolation step-down LED system. JW1789 can achieve excellent line and load regulation, high efficiency and low system cost with few peripheral components.

Start Up

When the internal high voltage start-up circuit charges VDD up to the turn-on threshold, the gate driver starts to switch. In the normal working state, the current source charges VDD to V_{DD} when the power MOSFET is off. Once the voltage of VDD is lower than V_{DD_UVLO}, JW1789 stops switching.

Constant Current Control

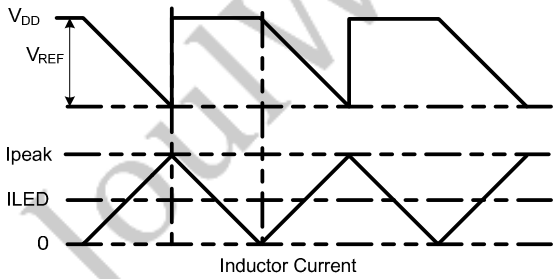
JW1789 controls the output current from the information of the current sensing resistor. The output LED average current can be calculated as:

$$I_{LED} = V_{REF} / (2R_{CS})$$

Where,

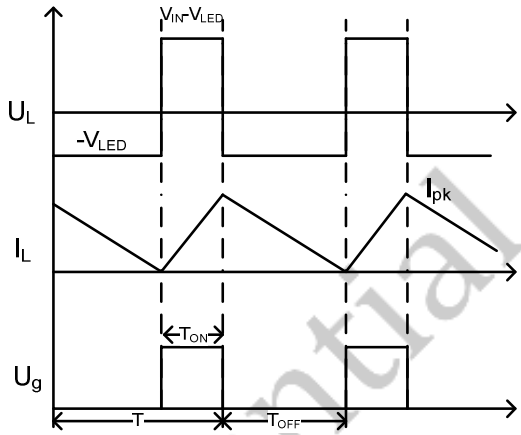
R_{CS} – the sensing resistor connected between chip GND and the VDD capacitor ground.

The inductor current and VDD waveforms are as follows:



Critical Conduction Mode Operation

JW1789 works in the critical conduction mode of the inductor current. When the internal power MOSFET turns on, the inductor current increases from zero linearly. The turn on time of the MOSFET can be calculated as:



$$T_{ON} = 2\ I_{LED} \times L / (V_{IN} - V_{LED})$$

Where,

L –inductance.

I_{LED} – output led current.

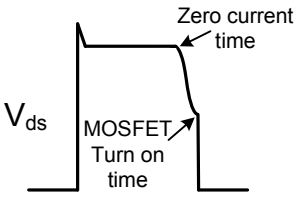
V_{IN} – input voltage after rectification and filtering.

V_{LED} – output voltage.

When the power MOSFET turns off, the inductor current decreases. The power MOSFET turns on again when the inductor current is zero. The turn-off time of the MOSFET is:

$$T_{OFF} = 2\ I_{LED} \times L / V_{LED}$$

JW1789 works in quasi-resonant mode. When the inductor current decreases to zero, resonance takes place between the power inductor, MOSFET output capacitor and stray capacitor. JW1789 can detect the zero-current signals of the inductor, and turn on the MOSFET in the valley, which can reduce the power loss and the EMI radiation. If JW1789 cannot get the zero current signals, the turn off time will be changed to T_{OFFMAX}.



Over Temperature Protection

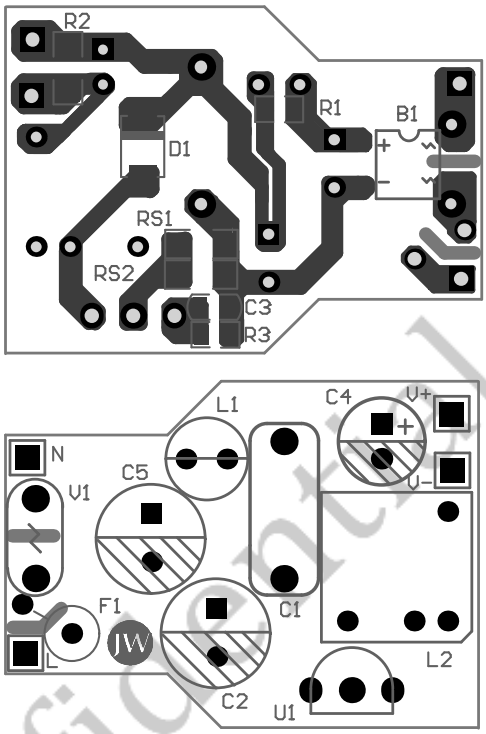
When the junction temperature is higher than 145°C, JW1789 works in DCM by increasing the MOS OFF time to decrease the LED current and help the chip cooling.

LED Short Protection

When the output is shorted, JW1789 can't get the zero current signals. JW1789 stops switching for T_{OFFMAX} until the next pulse.

PCB Layout Guidelines

1. The VDD pin must be locally bypassed by a ceramic capacitor.
2. Make the area of the power loop as small as possible in order to reduce the EMI radiation.



APPLICATION REFERENCE

This reference design is suitable for 3~ 5W non-isolated Step-down LED driver, using JW1789, with high efficiency, excellent line regulation.

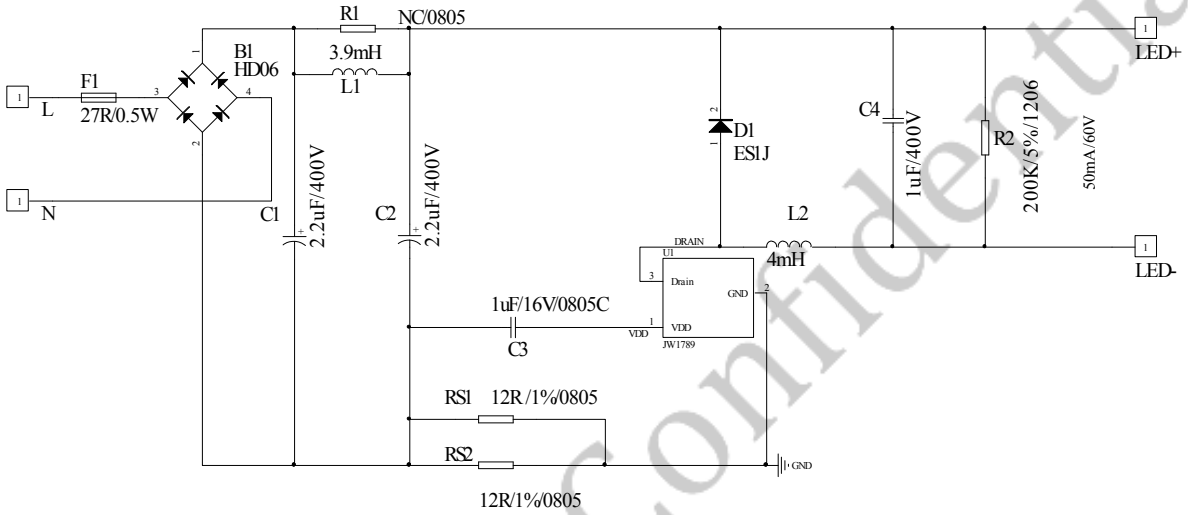
Reference ：

V_{IN}: 90VAC~264VAC

V_{OUT}: 40~60V

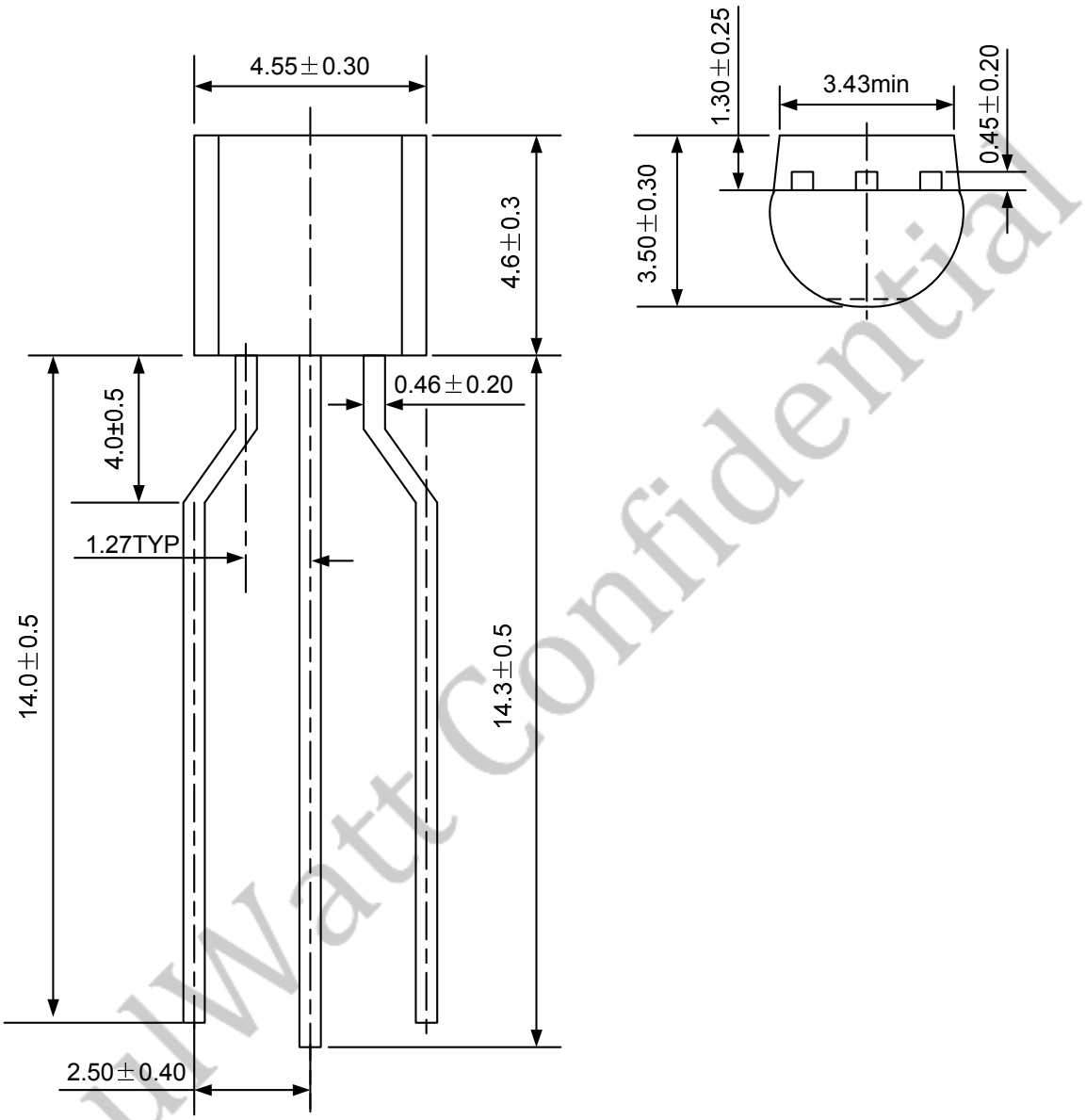
I_{OUT}: 50mA

PF: >0.5

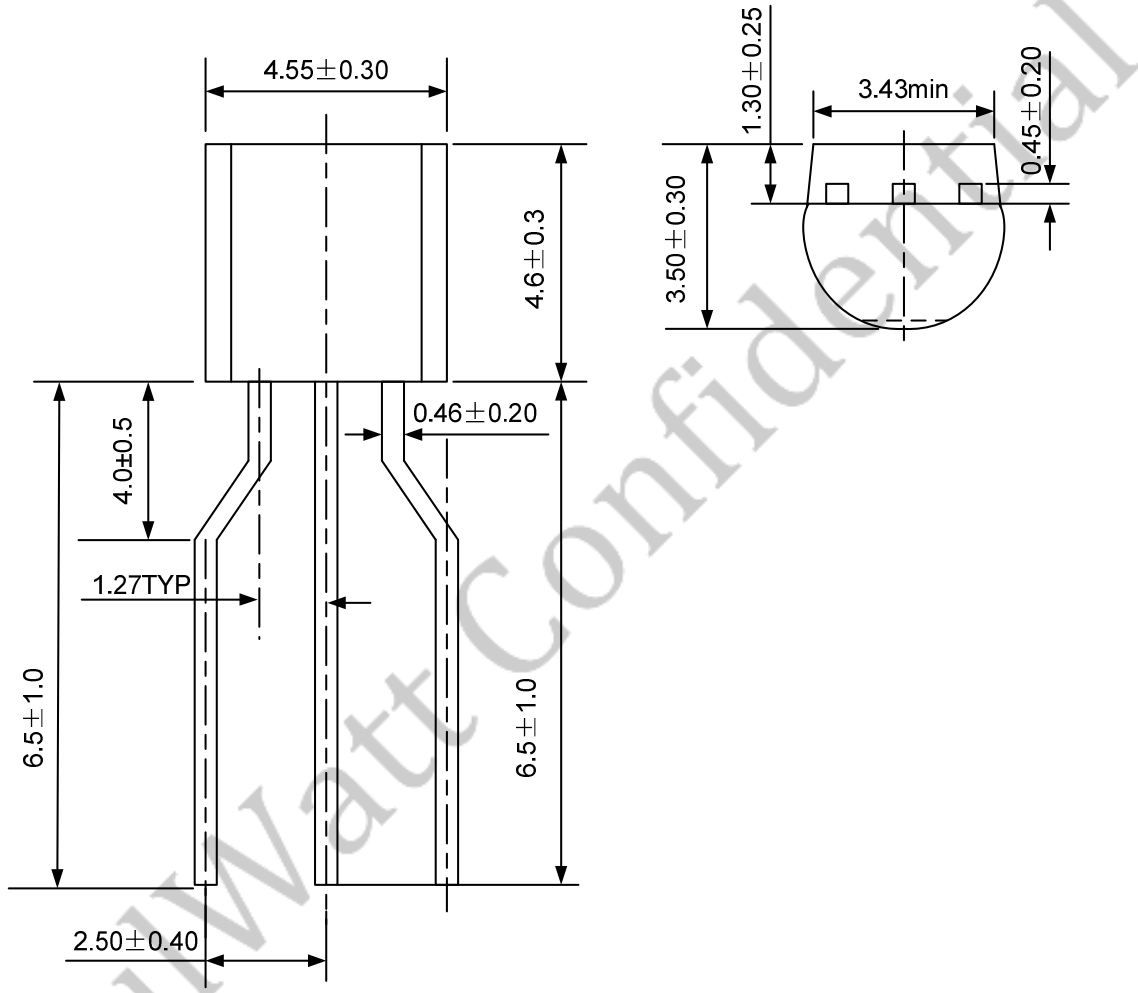


PACKAGE OUTLINE

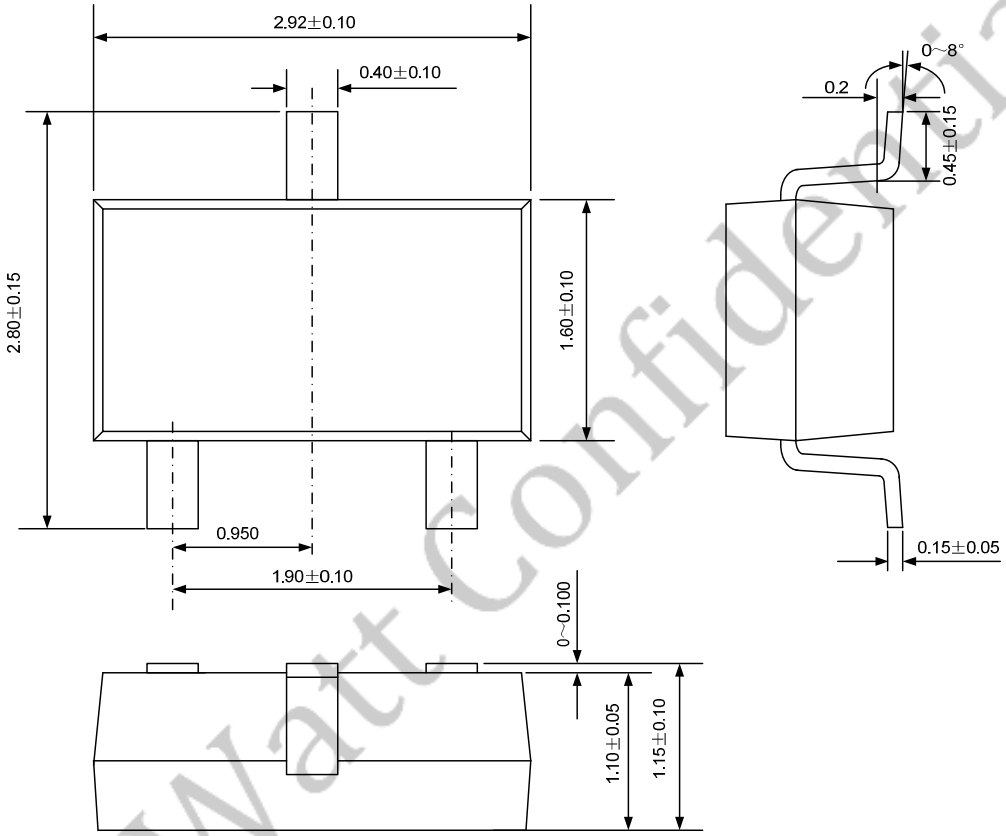
TO-92 UNIT : mm



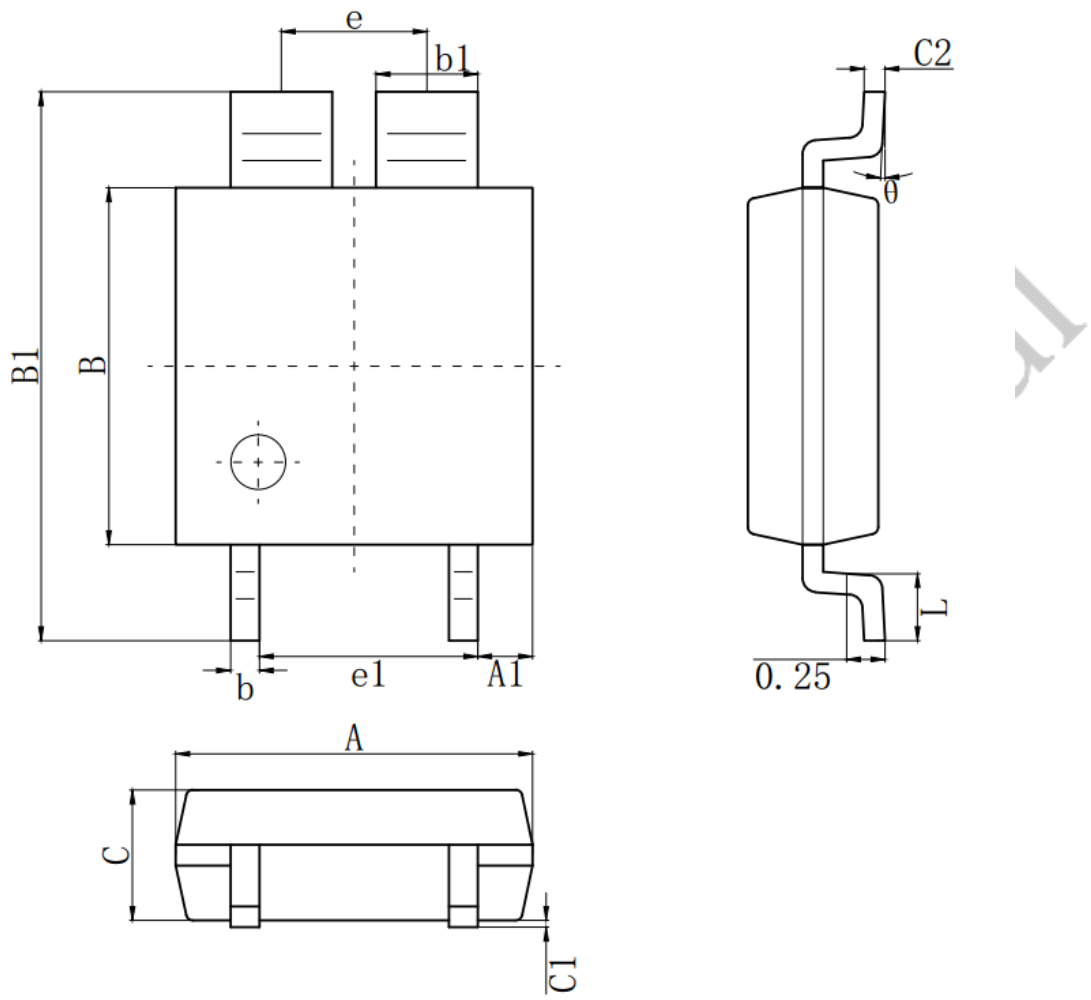
TO-92(B) UNIT: mm



SOT23-3 UNIT: mm



CPC4 UNIT: mm



Symbol	Dimensions In Millimeters	
	Min	Max
A	2.50	2.70
A1	0.35	0.45
e	1.06(BSC)	
e1	1.59(BSC)	
B	2.50	2.70
B1	3.85	4.15
b	0.16	0.26
b1	0.69	0.79
C	0.85	1.05
C1	0.00	0.15
C2	0.15	0.18
L	0.40	0.60
θ	0°	8°

IMPORTANT NOTICE

- **Joulwatt Technology Inc. reserves the right to make modifications, enhancements, improvements, corrections or other changes without further notice to this document and any product described herein.**
- **Any unauthorized redistribution or copy of this document for any purpose is strictly forbidden.**
- **Joulwatt Technology Inc. does not warrant or accept any liability whatsoever in respect of any products purchased through unauthorized sales channel.**