JW19673C/JW19673D

BUCK LED Regulator With Power Factor Correction

DESCRIPTION

The JW19673C/ JW19673D (JW19673X series) is a constant current LED regulator which applies to single stage step-down power factor corrected LED drivers.

JW19673X series integrates high voltage power source, and can be supplied by line voltage directly, auxiliary winding and VCC capacitor are not needed.

Patented current sensing and digital compensation technics ensure a unit power factor and high accuracy output current. The critical conduction mode operation reduces the switching losses and increases the efficiency.

JW19673X series has multi-protection functions which largely enhance the safety and reliability of the system, including LED open protection, LED short protection, VIN over voltage protection and over temperature protection.

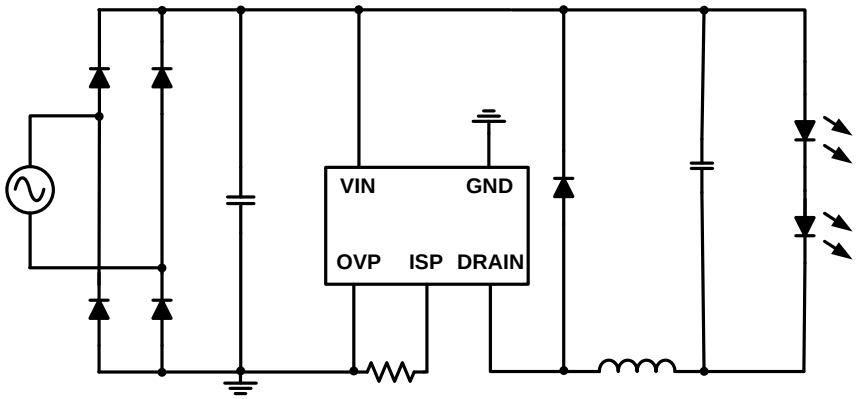
FEATURES

- No Auxiliary Winding and VCC Capacitor
- Supplied from Line Voltage Directly
- High Current Accuracy of Line and Load Regulation
- Internal Compensation PFC Technics
- Critical Conduction Mode
- High Efficiency Over Wide Operating Range
- High Voltage Power MOSFET Integrated
- LED Open Protection
- LED Short Protection
- VIN Over Voltage Protection
- Internal Over Temperature Protection
- SOP7 Package

APPLICATIONS

- Non-isolation Offline LED Driver

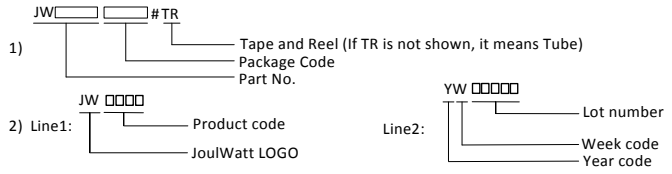
TYPICAL APPLICATION



ORDER INFORMATION

DEVICE[1)]	PACKAGE	TOP MARKING[2)]
JW19673CSOPA#TRPBF	SOP7	JW19673C YW□□□□□
JW19673DSOPA#TRPBF	SOP7	JW19673D YW□□□□□

Notes:

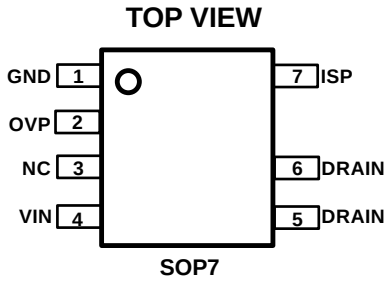


3) All JoulWatt products are packaged with Pb-free and Halogen-free materials and compliant to RoHS standards.

DEVICE INFORMATION

DEVICE	MOS RDSON
JW19673CSOPA#TRPBF	4.7Ω
JW19673DSOPA#TRPBF	2.5Ω

PIN CONFIGURATION



ABSOLUTE MAXIMUM RATING[1)]

VIN Voltage.....700V
OVP,ISP Voltage.....6V
Junction Temperature[2) 3)] 150ºC
Lead Temperature..... 260ºC
Storage Temperature..... -65ºC to +150ºC

RECOMMENDED OPERATING CONDITIONS

VIN Voltage.....30V to 500V

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

THERMAL PERFORMANCE[4)]

	θ_{JA}	θ_{JC}
SOP7	96	45ºC/W

Note：

1) Exceeding these ratings may damage the device. These stress ratings do not imply function operation of the device at any other conditions beyond those indicated under RECOMMENDED OPERATING CONDITIONS.

2) The JW19673X series includes thermal protection that is intended to protect the device in overload conditions. Continuous operation over the specified absolute maximum operating junction temperature may damage the device.

3) The device is not guaranteed to function outside of its operating conditions.

4) Measured on JESD51-7, 4-layer PCB.

ELECTRICAL CHARACTERISTICS

T_A=25℃, unless otherwise stated.

Item		Symbol	Condition	Min.	Typ.	Max.	Units
POWER SUPPLY							
VIN Start-up Voltage		V_{IN_ST}				10	V
VIN Quiescent Current		I_{INQ}			180	225	μA
CURRENT REGULATION							
ISP Sample Reference		V_{REF}		192	200	208	mV
Minimum On Time of MOSFET[5)]		T_{ON_MIN}			1.2		μS
Maximum On Time of MOSFET		T_{ON_MAX}		3.75	5	7.25	μS
Minimum Off Time of MOSFET[5)]		T_{OFF_MIN}			2		μS
Maximum Off Time of MOSFET		T_{OFF_MAX}		255	340	425	μS
Maximum Switch Frequency[5)]		f_{MAX}			100		KHz
Switching Period of VINL[5)]		T_{VINL}			65		μS
PROTECTION							
ISP Over Voltage Protection Threshold		V_{ISP_MAX}		1.08	1.2	1.32	V
Vo Over Voltage Protection Threshold		V_{O_OVP1}	R_{OVP}=510KΩ	84	93	102	V
		V_{O_OVP2}	OVP Short	93	103	113	
		V_{O_OVP3}	OVP NC	113	125	137	
		V_{O_OVP4}	R_{OVP}=120KΩ	216	239	262	
OVP Pin Current		I_{OVP}		3.45	4	5.75	μA
VIN Over Voltage Protection Threshold[5)]		V_{IN_OVP}			440		V
Thermal Protection Threshold[5)]		T_{OTP}		140	150		℃
MOS							
MOS Rdson[5)]	JW19673C	Rdson	Vgs=10V		4.7		Ω
	JW19673D				2.5		
Breakdown Voltage		BV		650			V

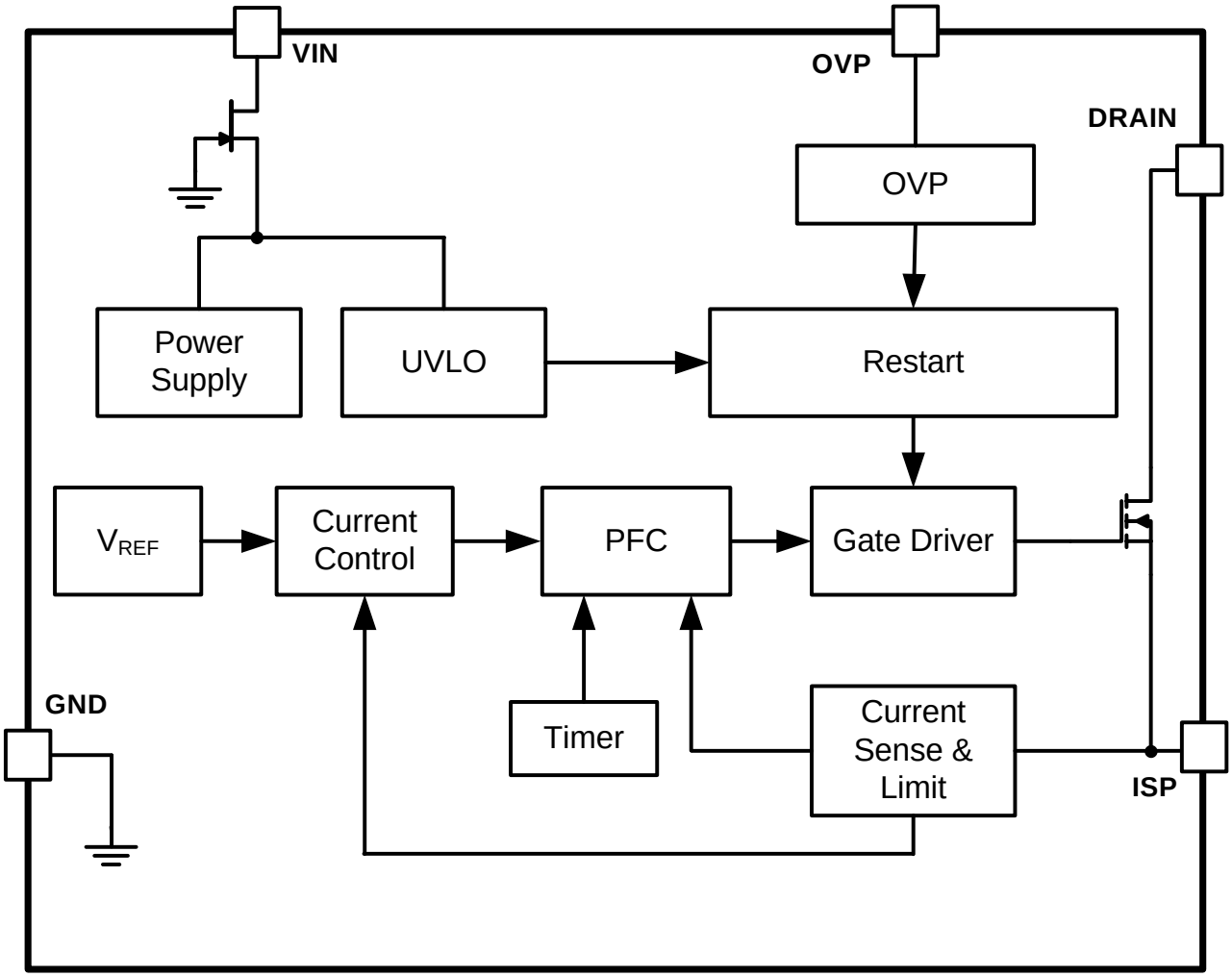
Note:

5) Guaranteed by design.

PIN DESCRIPTION

Pin No.	Name	Description
1	GND	Chip ground.
2	OVP	Set OVP threshold.
3	NC	No connection.
4	VIN	Bus voltage input.
5,6	DRAIN	DRAIN of the power MOSFET.
7	ISP	Output current sense.

BLOCK DIAGRAM



FUNCTIONAL DESCRIPTION

The JW19673X series is a constant current LED driver which applies to non-isolation step-down LED system with power factor correction. JW19673X series can achieve excellent line and load regulations, high efficiency and low system cost with few peripheral components.

Start Up

JW19673X series is supplied by line voltage directly. When VIN reaches VIN Start-up Voltage (V_{IN_ST}), the chip begins to switch. Once VIN is lower than VIN under voltage lockout, JW19673X series stops switching.

Constant Current Control

The JW19673X series controls the output current from the information of the sensing resistor voltage. The output LED mean current can be calculated as:

$$I_{LED} = V_{REF} / R_{SNS}$$

Where

V_{REF} – ISP sample reference;

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

Critical Conduction Mode Operation

JW19673X series works in the Critical conduction mode of the inductor current. When the 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_{PK} – Peak current in one switch cycle;

V_{IN} – Input voltage after rectification and filtering;

V_{OUT} – 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 switching frequency of the step-down system.

LED Over Temperature Protection

When internal temperature of the chip exceeds the Thermal Protection Threshold(T_{OTP}), JW19673X series decreases LED current to help the chip cooling.

VIN Over Voltage Protection

When Vin voltage is higher than VIN Over Voltage Protection Threshold(V_{IN_OVP}), JW19673X series decreases LED current to improve the reliability of the system.

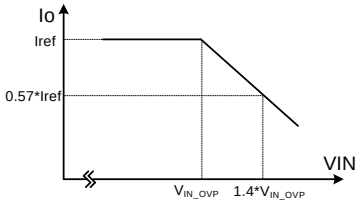


Figure. 1 VIN over voltage protection

LED Open Protection

The OVP threshold (V_{O_OVP}) is set by the OVP pin. When Vo is higher than V_{O_OVP}, LED open protection is triggered and the chip stops switching for 800ms in typical. The following table shows the V_{O_OVP} design guide:

OVP Pin	V_{O_OVP}(V)
Connected with 510KΩ resistor	V_{O_OVP1}
Short connected	V_{O_OVP2}
Not connected	V_{O_OVP3}
Connected with 120KΩ resistor	V_{O_OVP4}

APPLICATION NOTES

1: R_{VIN} and V_{O_OVP} design guide

To enhance the surge capability, VIN pin of JW19673X series should be connected to input capacitor by a resistor R_{VIN}(0805/1206 package, no less than 4.7KΩ is recommended). Larger R_{VIN} means better surge capability but should note that too large R_{VIN} may decrease the drive current, and the maximum R_{VIN} is limited by

$(Vo-15V)/R_{VIN}>3mA$

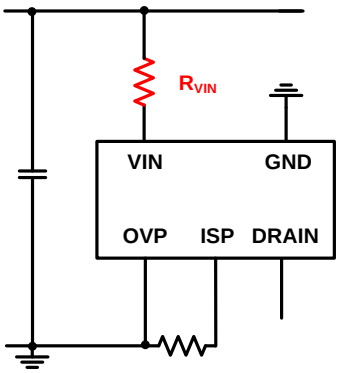


Figure. 2 R_{VIN} design guide

R_{VIN} and V_{O_OVP} design guide is shown in following Tab:

V_{O_PEAK} (V)	Recommended R_{VIN} (Ω)	OVP(V)
30~45	5.1K	V_{O_OVP1}
46~70	10K	
71~80	10K~15K	V_{O_OVP2}
81~95	10K~20K	V_{O_OVP3}
96~180	20K~51K	V_{O_OVP4}

Where V_{O_PEAK} is the peak value of the Vo, the ripple of the Vo and suitable margin should be taken into consideration when designing the OVP.

2：PCB Design

When designing the PCB of the JW19673X series system, please follow the directions:

1. Make the area of the power loop as small as possible in order to reduce the EMI radiation.
2. The chip should be far away from the heating element, such as the power inductor and the freewheel diode.

REFERENCE DESIGN

Note: Information in the following reference design sections is not part of JoulWatt component specification. Customers are responsible for determining suitability of components chosen for their purposes and should validate their design implementation to make sure the proper system functionality.

This reference design is suitable for 8 ~ 15W non-isolated Step-down LED driver, using JW19673C, with high efficiency, excellent line regulation.

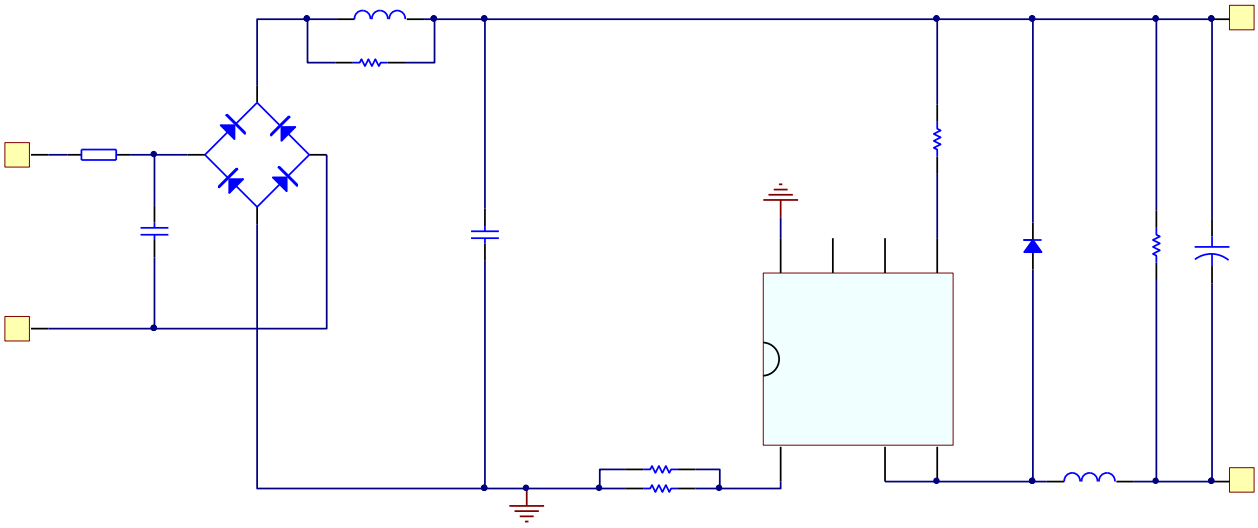
Reference ：

V_{IN}: 176VAC~264VAC

V_{OUT}: 46~90V

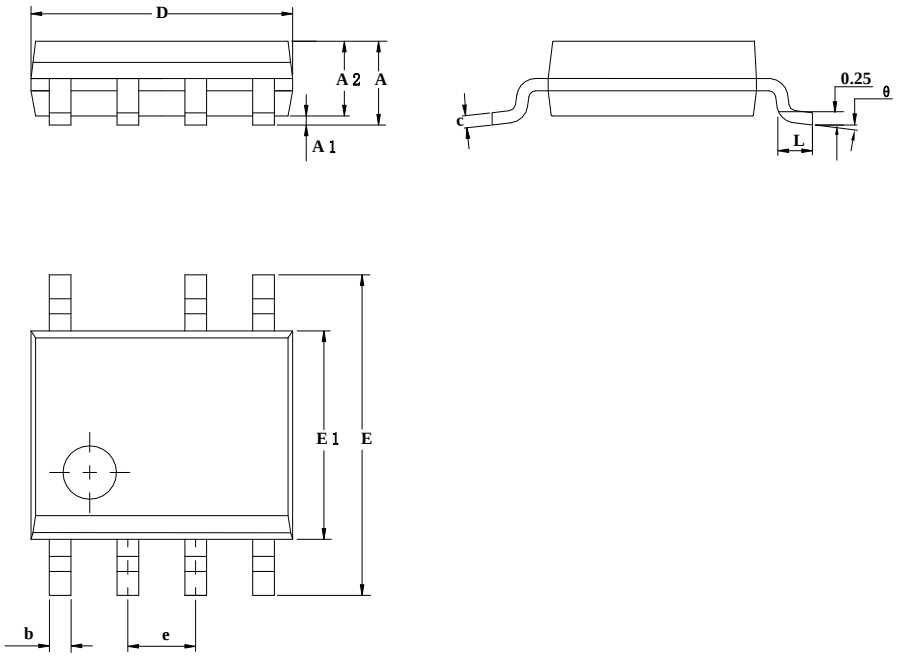
I_{OUT}: 160mA

PF: >0.9



PACKAGE OUTLINE

SOP7 UNIT: mm



Symbol	MILLIMETER		
	MIN	NOM	MAX
A	—	—	1.75
A1	0.05	0.15	0.25
A2	1.25	1.40	1.65
b	0.32	0.42	0.52
c	0.10	0.20	0.30
D	4.50	5.00	5.50
E	5.50	6.00	6.50
E1	3.50	3.90	4.30
e	1.27TYP		
L	0.40	—	1.27
θ	0°	—	8°

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