JW1969X Series

BUCK LED Regulator With Power Factor Correction

Parameters Subject to Change Without Notice

DESCRIPTION

The JW®1969A/JW1969B/JW1969C/JW1969D/JW1969E/JW1969BC/JW1969DC/JW1969EC (JW1969X series) is a constant current LED regulator which apply to single stage step-down power factor corrected LED drivers.

JW1969X 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.

JW1969X series has multi-protection functions which largely enhance the safety and reliability of the system, including LED open protection, LED short protection and over-temperature protection.

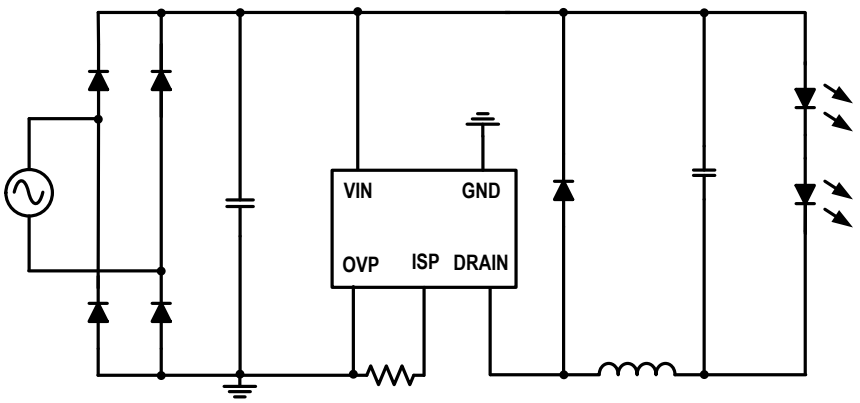
FEATURES

- No auxiliary winding and VCC capacitor
- Supplied from line voltage directly
- High current accuracy of line and load regulation
- Internal compensation PFC technics
- Harmonic current meets IEC61000-3-2
- Critical conduction mode
- High efficiency over wide operating range
- High voltage power MOSFET integrated
- LED open protection
- LED short protection
- Internal over-temperature protection
- SOP7 and DIP7 packages

APPLICATIONS

- Non-isolation Offline LED driver

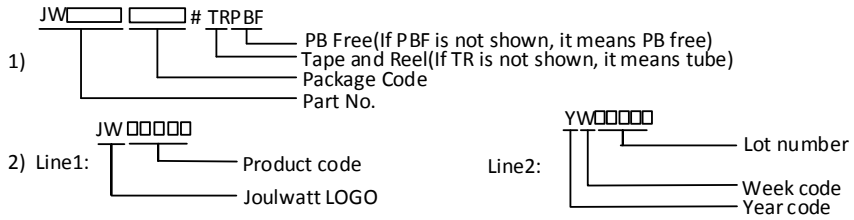
TYPICAL APPLICATION



ORDER INFORMATION

DEVICE[1)]	PACKAGE	TOP MARKING[2)]	ENVIRONMENTAL[3)]
JW1969ASOPA#TRPBF	SOP7	JW1969A YW□□□□□	Green
JW1969BSOPA#TRPBF	SOP7	JW1969B YW□□□□□	Green
JW1969CSOPA#TRPBF	SOP7	JW1969C YW□□□□□	Green
JW1969DSOPA#TRPBF	SOP7	JW1969D YW□□□□□	Green
JW1969ESOPA#TRPBF	SOP7	JW1969E YW□□□□□	Green
JW1969EDIPA#PBF	DIP7	JW1969E YW□□□□□	Green
JW1969BCSOPA#TR	SOP7	JW1969BC YW□□□□□	Green
JW1969DCSOPA#TR	SOP7	JW1969DC YW□□□□□	Green
JW1969ECSOPA#TR	SOP7	JW1969EC YW□□□□□	Green

Notes:

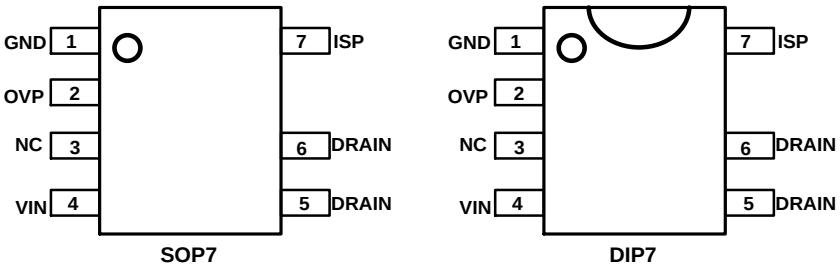


DEVICE INFORMATION

DEVICE	BV	MOS RDSON
JW1969ASOPA#TRPBF	500V	8.5Ω
JW1969BSOPA#TRPBF	550V	5.5Ω
JW1969CSOPA#TRPBF	500V	3Ω
JW1969DSOPA#TRPBF	550V	2.3Ω
JW1969EDIPA#PBF	500V	1.5Ω
JW1969BCSOPA#TR	500V	5.5Ω
JW1969DCSOPA#TR	500V	2.3Ω
JW1969ECSOPA#TR	500V	1.8Ω

PIN CONFIGURATION

TOP VIEW



ABSOLUTE MAXIMUM RATING[1)]

VIN Voltage.....700V
OVP,ISP Voltage.....8V
Junction Temperature[2) 3)] 150ºC
Lead Temperature..... 260ºC
Storage Temperature..... -65ºC to +150ºC
ESD Susceptibility (Human Body Model) 2kV

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
DIP7	80	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 JW1969X 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.

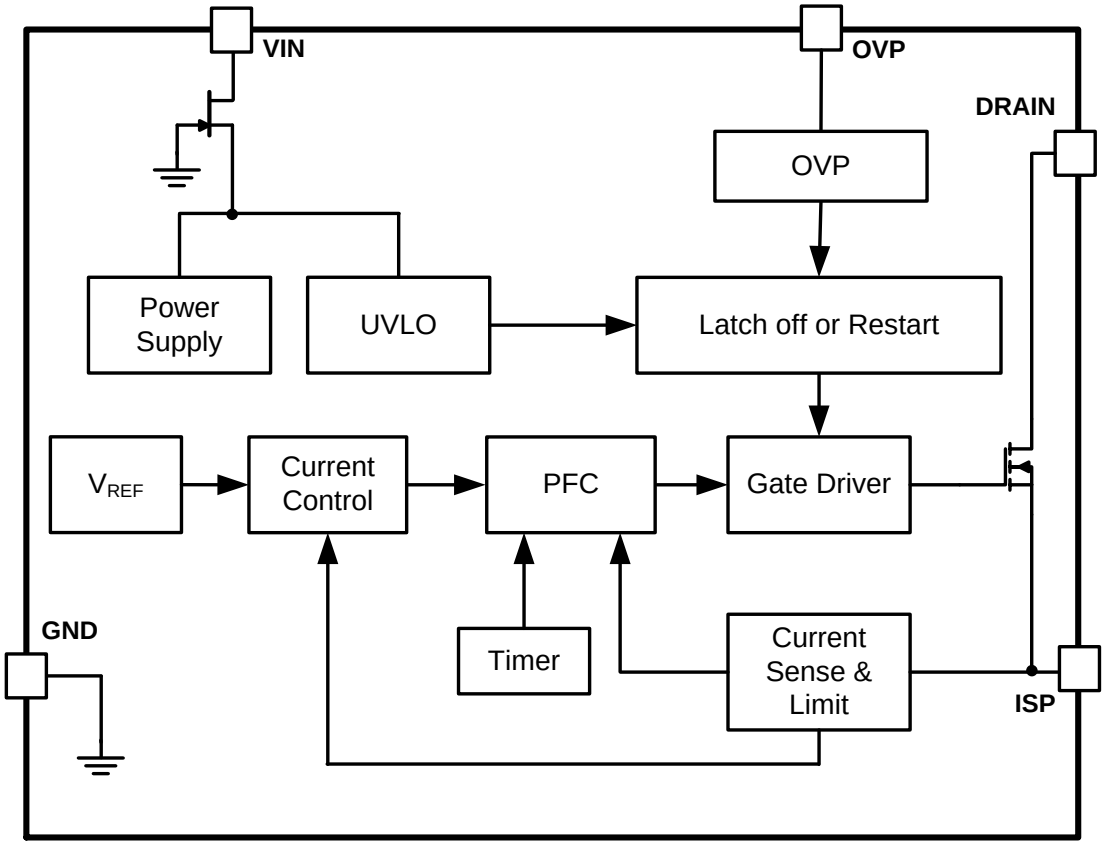
Item		Symbol	Condition	Min.	Typ.	Max.	Units
POWER SUPPLY							
VIN Start-Up Voltage		V_{IN_ST}				12	V
VIN Quiescent Current		I_{INQ}			200	250	μA
CURRENT REGULATION							
ISP Sample Reference		V_{REF}		192	200	208	mV
Minimum On Time of MOSFET[5)]		T_{ON_MIN}			0.8		μS
Maximum On Time of MOSFET		T_{ON_MAX}		13	18	27	μS
Minimum Off Time of MOSFET[5)]		T_{OFF_MIN}			0.9		μS
Maximum Off Time of MOSFET[5)]		T_{OFF_MAX}			470		μS
Maximum Switch Frequency[5)]		f_{MAX}			120		KHz
Switching Period of VINL[5)]		T_{VINL}			60		μS
PROTECTION							
ISP Over Voltage Protection Threshold		V_{ISP_MAX}		1.08	1.2	1.32	V
Vo Over Voltage Protection Threshold[5)]		V_{O_OVP1}	V_{OVP}=0V	80	90	100	V
		V_{O_OVP2}	V_{OVP}=4.8V	105	117	129	
		V_{O_OVP3}	V_{OVP}=2V	162	180	198	
		V_{O_OVP4}	V_{OVP}=0.5V	214	237	260	
Thermal Protection Threshold[5)]		T_{OTP}		140	150		℃
MOS							
MOS Rdson[5)]	JW1969A	Rdson	Vgs=10V		8.5		Ω
	JW1969B/BC				5.5		
	JW1969C				3		
	JW1969D/DC				2.3		
	JW1969EC				1.8		
	JW1969E				1.5		
MOS Saturation Current[5)]	JW1969A	Id		1.6			A
	JW1969B/BC			2			
	JW1969C/D/DC/EC			6			
	JW1969E			10			
Breakdown Voltage	JW1969B/D	BV		550			V
	JW1969A/C/E/BC/DC/EC			500			

5) Guaranteed by design

PIN DESCRIPTION

Pin No.		Name	Description
SOP7	DIP7		
1	1	GND	Chip ground.
2	2	OVP	Set OVP threshold.
3	3	NC	No connection.
4	4	VIN	Line voltage input.
5,6	5,6	DRAIN	DRAIN of the MOSFET.
7	7	ISP	Output current sense.

BLOCK DIAGRAM



FUNCTIONAL DESCRIPTION

The JW1969X series is a constant current LED driver which applies to non-isolation step-down LED system with power factor correction. JW1969X series can achieve excellent line and load regulation, high efficiency and low system cost with few peripheral components.

Start Up

JW1969X 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, JW1969X series stops switching.

Constant Current Control

The JW1969X 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

JW1969X 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}), JW1969X series decreases LED current to help the chip cooling.

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. The following table shows the V_{O_OVP} design guide:

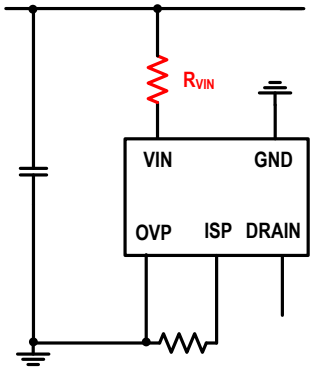
OVP Pin	V_{O_OVP}(V)
Short connected	V_{O_OVP1}
Not connected	V_{O_OVP2}
Connected with 510KΩ resistor	V_{O_OVP3}
Connected with 120KΩ resistor	V_{O_OVP4}

APPLICATION NOTES

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

To enhance the surge capability, VIN pin of JW1969X 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 please note that too large R_{VIN} may decrease the drive current, and the maximum R_{VIN} is limited by

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



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}
46~72	10K	
73~97	10K~15K	V_{O_OVP2}
98~145	10K~20K	V_{O_OVP3}
146~190	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 JW1969X 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

This reference design is suitable for 7 ~ 12W non-isolated Step-down LED driver, using JW1969B, with high efficiency, excellent line regulation.

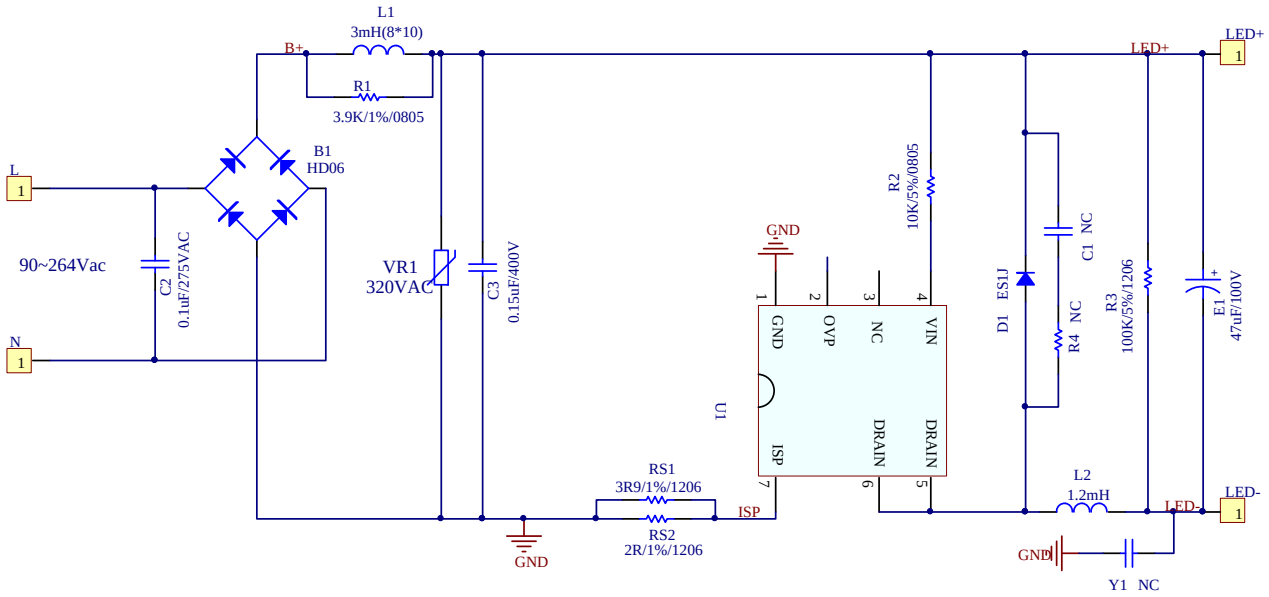
Reference ：

V_{IN}: 90VAC~264VAC

V_{OUT}: 40~75V

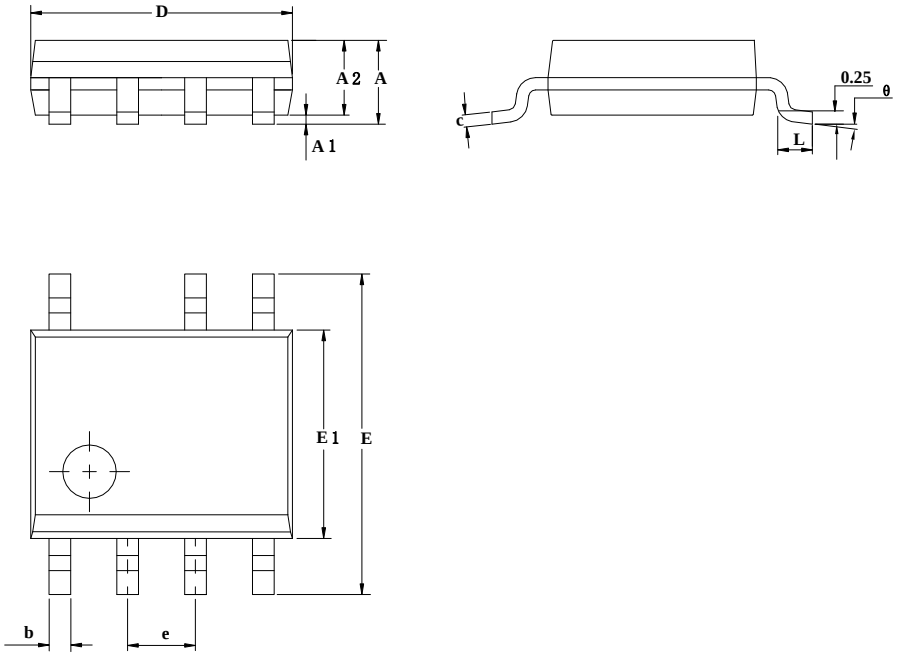
I_{OUT}: 150mA

PF: >0.9



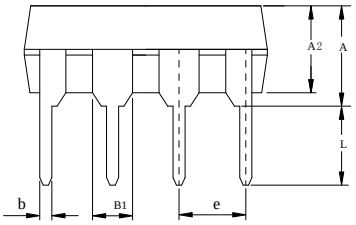
PACKAGE OUTLINE

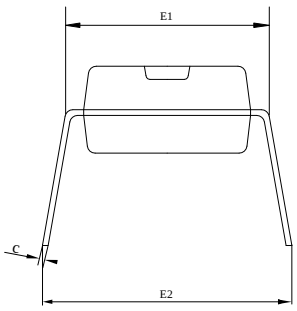
SOP7 UNIT: mm

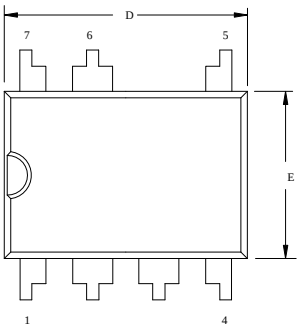


Symbol	MILLIMETER		
	MIN	NOM	MAX
A	—	—	1.75
A1	0.05	0.15	0.25
A2	1.25	1.40	1.65
b	0.32	0.42	0.52
c	0.10	0.20	0.30
D	4.50	5.00	5.50
E	5.50	6.00	6.50
E1	3.50	3.90	4.30
e	1.27TYP		
L	0.40	—	1.27
θ	0°	—	8°

DIP7 UNIT: mm







SYMBOL	MILLIMETER		
	MIN	NOM	MAX
A	3.71	—	4.31
A2	3.15	—	3.60
b	0.38	0.46	0.57
B1	1.47	1.52	1.57
c	0.20	0.25	0.36
D	9.00	9.20	9.40
E	6.10	—	6.60
E1	7.32	7.62	7.92
e	2.54BSC		
E2	8.00	—	9.02
L	3.00	3.30	3.60

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