

Parameters Subject to Change Without Notice

DESCRIPTION

JW[®]19987A/JW19987B/JW19987C(JW19987X series) is a non-isolated constant current LED regulator with high current accuracy which applies to single stage step-down LED drivers. Operating in the boundary mode makes it high efficiency and low radiation. Patented algorithms ensure good current accuracy and excellent line/load regulations.

JW19987X is supplied from the line directly without auxiliary winding or external capacitor, which can lower the system BOM cost.

With unique sampling techniques, JW19987X has multi-protection functions which can largely enhance the safety and reliability of the system, including LED short protection, LED open protection and over-temperature protection.

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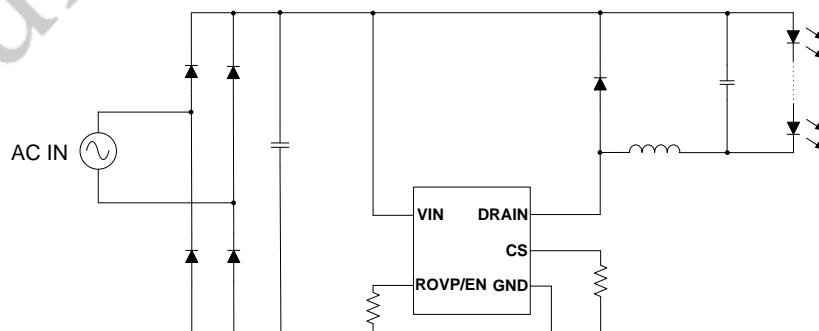
FEATURES

- 500V MOSFET Integrated
- Excellent Line/load Regulation
- Boundary Mode Operation
- EN Function
- High Efficiency
- LED Short Protection
- LED Open Protection
- SOP7 package

APPLICATIONS

- LED Driver

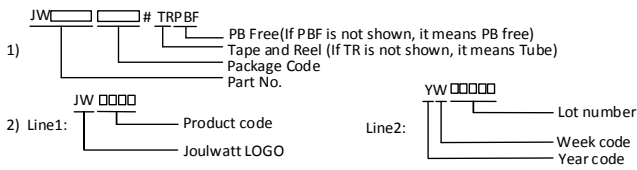
TYPICAL APPLICATION



ORDER INFORMATION

DEVICE ¹⁾	PACKAGE	TOP MARKING ²⁾	ENVIRONMENTAL ³⁾
JW19987ASOPA#TRPBF	SOP7	JW19987A YW□□□□□	Green
JW19987BSOPA#TRPBF	SOP7	JW19987B YW□□□□□	Green
JW19987CSOPA#TR	SOP7	JW19987C YW□□□□□	Green

Note:

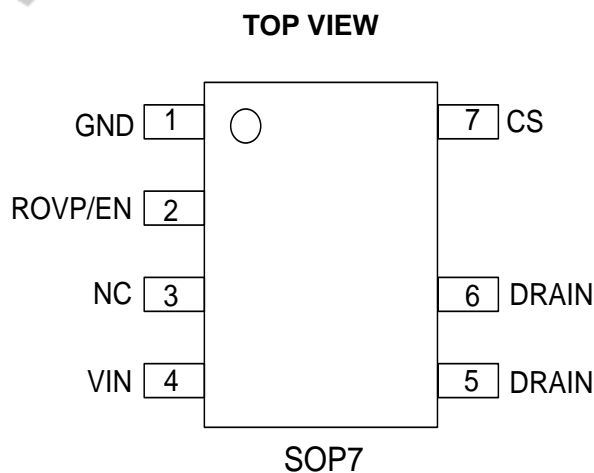


3) All Joulwatt products are packaged with Pb-free and Halogen-free materials and compliant to RoHS standards.

DEVICE INFORMATION

DEVICE	MOS BV	MOS RDSON
JW19987ASOPA#TRPBF	500V	8Ω
JW19987BSOPA#TRPBF	500V	6.5Ω
JW19987CSOPA#TR	500V	2.9Ω

PIN CONFIGURATION



ABSOLUTE MAXIMUM RATING¹⁾

VIN Voltage 700V
 CS Voltage.....-0.3V to 8V
 ROVP Voltage..... -0.3V to 8V
 DRAIN Pin500V
 Junction Temperature²⁾³⁾.....-40°C to + 150°C
 Storage Temperature -40°C to +150°C

RECOMMENDED OPERATING CONDITIONS

VIN Voltage400V
 Junction Temperature-25°C to 125°C

PN/Package	Limit Output Current (T _J =125°C) ⁵⁾	Recommended MAX Output Current (T _J =125°C) ⁵⁾
JW19987A/SOP7	<350mA	280mA ⁶⁾
JW19987B/SOP7	<500mA	350mA ⁶⁾
JW19987C/SOP7	<800mA	500mA ⁶⁾

RECOMMENDED OUTPUT VOLTAGE

JW19987X.....>10V

THERMAL PERFORMANCE⁴⁾

θ_{JA} θ_{JC}

SOP7.....96...45°C/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 RECOMMENDE OPERATING CONDITIONS.
- 2) The JW19987X 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.
- 5) The maximum output current is recommended in the application according to chip junction temperature T_J=125°C. The maximum output current could be increased properly if the heat dissipation is better.
- 6) Limited by chip temperature.

ELECTRICAL CHARACTERISTICS

T_A=25 °C, unless otherwise stated

Item	Symbol	Condition	Min.	Typ.	Max.	Units
Threshold of Vin Power On ⁷⁾	V _{IN_ON}	V _{IN} rising		5	20	V
V _{IN} Quiescent Current	I _Q	V _{IN} ~40V		200	220	μA
Reference Voltage	V _{REF}		390	402	420	mV
CS Minimum Voltage	CS _{min}			50		mV
Neon Switch VIN Sink Current	I _{NNSK}			540		μA
Mos Max On Time	T _{ONMAX}		30	42	55	μs
Mos Min On Time ⁷⁾	T _{ONMIN}			0.6	0.8	μs
Mos Max Off Time_1	T _{OFFMAX_1}		280	400	528	μs
Mos Max Off Time_2	T _{OFFMAX_2}		28	40	53	μs
EN Low Voltage Threshold	V _{EN_L}		0.16	0.2	0.24	V
Vo Over Voltage Protection Threshold ⁷⁾	V _{O_OVP1}	R _{OVP} =7.5K	66	75	84	V
	V _{O_OVP2}	R _{OVP} =18K	108	120	132	V
	V _{O_OVP3}	R _{OVP} ~float	216	240	264	V
OVP Hic-cup Time ⁷⁾	T _{OVP_HC}			400	440	ms
Drain-Source Voltage	JW19987X BV _{DSS}	V _g =0V I _{ds} =250μA	500			V
Mos R _{DSON}	JW19987A	R _{DSON} V _g =15V I _{ds} =0.5A		8	9	ohm
	JW19987B			6.5	8	
	JW19987C			2.9	3.5	
DS Leakage Current	JW19987X I _{DSS}	V _g =0V V _{ds} =500V		1	5	μA
Thermal Protection Threshold ⁷⁾	OTP _{CHIP}		140	150	160	°C

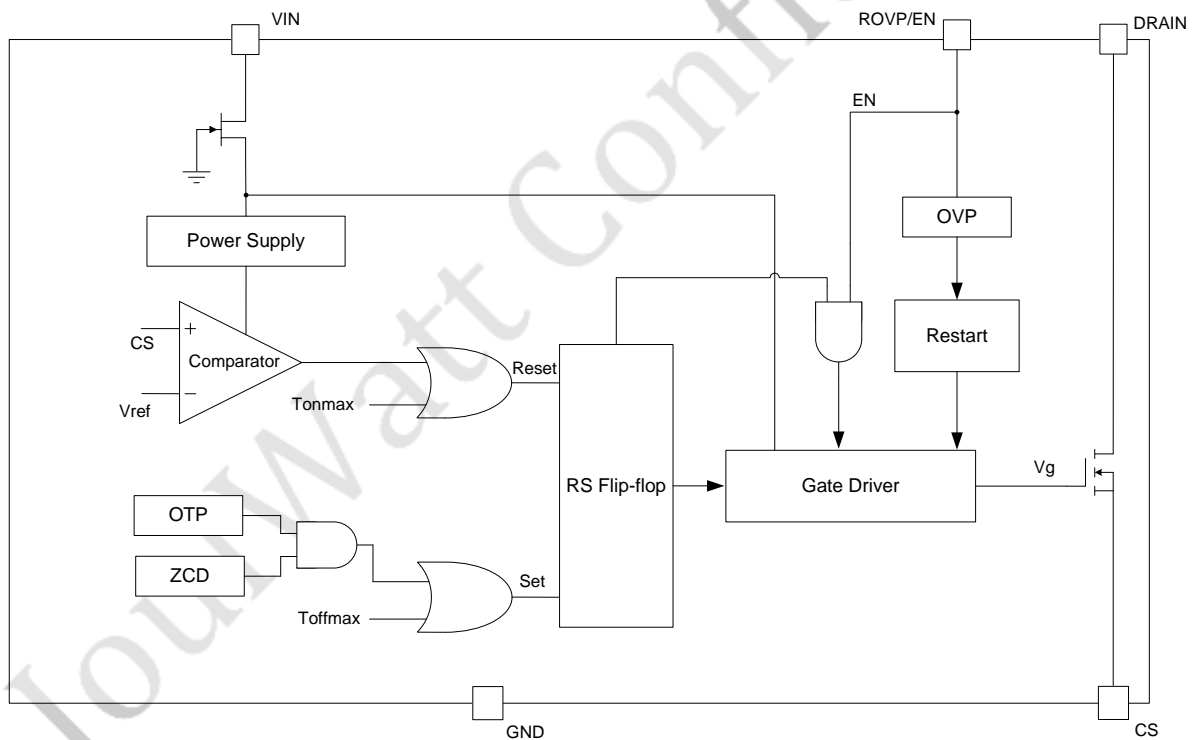
Notes:

7) Guaranteed by design.

PIN DESCRIPTION

Pin	Name	Description
1	GND	Chip ground
2	ROVP/EN	Led ovp set pin/Enable pin
3	NC	No connection
4	VIN	Power supply
5,6	DRAIN	The drain of internal power MOSFET
7	CS	Current sensing pin

BLOCK DIAGRAM



FUNCTIONAL DESCRIPTION

The JW19987X is a constant current LED regulator, which applies to non-isolation step-down LED system. JW19987X can achieve excellent line and load regulation, high efficiency and low system cost with few peripheral components.

Start Up

When the VIN exceeds VIN_ON, the gate driver will start to switch after 10mS delay.

Constant Current Control

JW19987X controls the output current from the information of the current sensing resistor. The output LED average current can be calculated as:

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

Where,

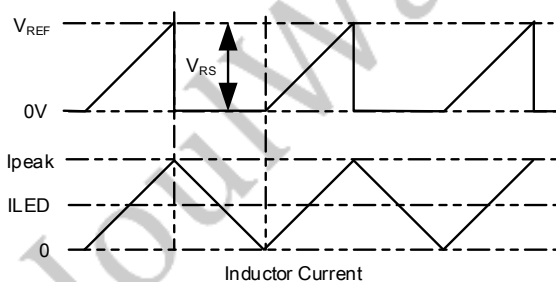
VREF is the reference voltage;

RCS – the sensing resistor connected between the pin CS and chip GND.

The inductor current and VRS waveforms are as follows:

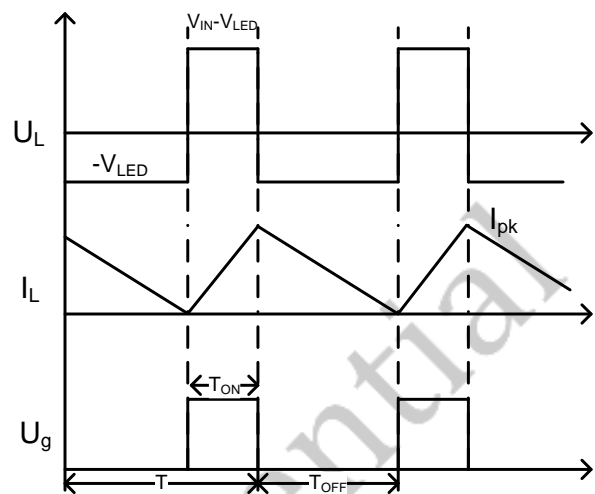
Where,

VRS – the voltage between pin CS and chip GND.



Critical Conduction Mode Operation

JW19987X works in the critical conduction mode of the inductor current. When the 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.

ILED – output led current.

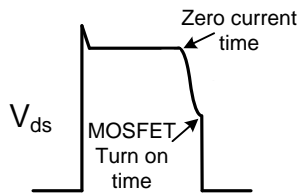
VIN – input voltage after rectification and filtering.

VLED – 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 can be calculated as:

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

JW19987X works in quasi-resonant mode. When the inductor current decreases to zero, resonance takes place between the power inductor, MOSFET output capacitors and stray capacitors. JW19987X 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 JW19987X cannot get the zero current signals, the turn-off time will be changed to TOFFMAX_1. The output voltage should be higher than recommended voltage in order to avoid the loss of zero current signals.



Over Temperature Protection

When the junction temperature is higher than OTP_{CHIP} , JW19987X works in DCM by increasing the turn-off time of the MOSFET to decrease the LED current and help the chip cooling.

LED Open Protection

In the LED open condition, the output voltage increases and the duty of each cycles increases accordingly. When the $VIN \cdot D$ is larger than V_{O_OVP} (Setup by R_{OVP}), the power MOSFET is shut down and restarts after T_{OVP_HC} (400ms

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

OVP Pin	$V_{O_OVP}(V)$
$R_{OVP}=7.5K$	75V
$R_{OVP}=18K$	120V
$R_{OVP} \sim \text{Float}$	240V
$R_{OVP} \sim \text{Short}$	Shut down

LED Short Protection

When the output is shorted, JW19987X stops switching for T_{OFFMAX_1} until the next pulse.

PCB Layout Guidelines

1. Make the area of the power loop as small as possible in order to reduce the EMI radiation.
2. JW19987X should be kept away from noisy and heating components, such as power inductor and diode.

APPLICATION REFERENCE

This reference design is suitable for 10~20W non-isolated step-down LED driver, using JW19987B, with high efficiency, excellent line regulation.

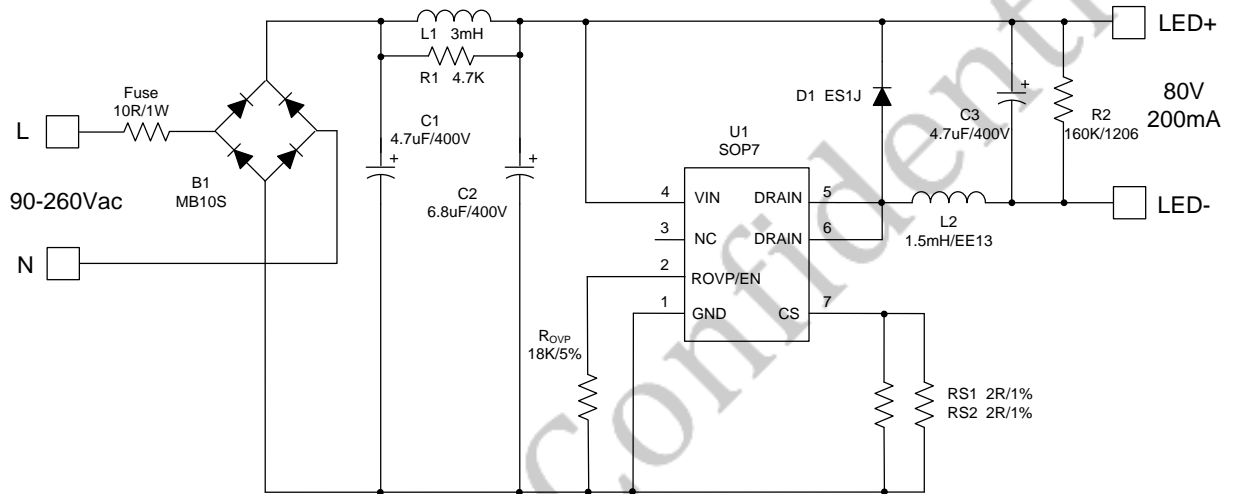
Reference :

V_{IN}: 90VAC~260VAC

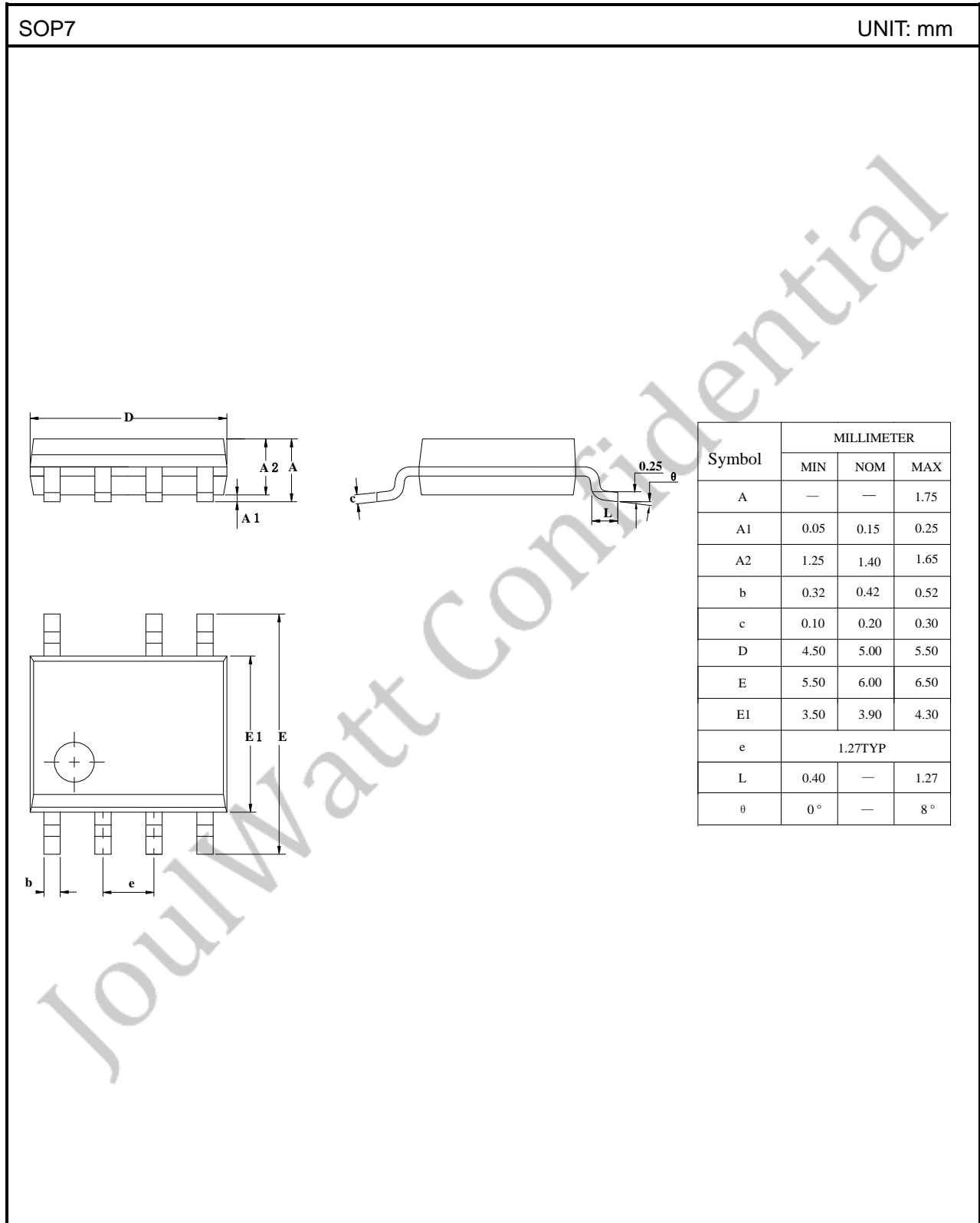
V_{OUT}: 40~80V

I_{OUT}: 200mA

PF: >0.5



PACKAGE OUTLINE



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