JW1660M/JW1660A
JW1660B/JW1660C

Isolated Flyback
LED Driver Regulator

DESCRIPTION

JW1660M/JW1660A/JW1660B/JW1660C(JW1660X series) is a primary side control constant current regulator with high current accuracy which applies to isolated flyback LED drivers. Operating in the discontinuous conduction mode makes it high efficiency and low radiation. Patented algorithms ensure good current accuracy and excellent line/load regulations.

JW1660X series is supplied from the line directly without auxiliary winding or external capacitor, which can lower the system BOM cost.

With unique sampling techniques, JW1660X series has multi-protection functions which can largely enhance the safety and reliability of the system, including LED open protection and over-temperature protection.

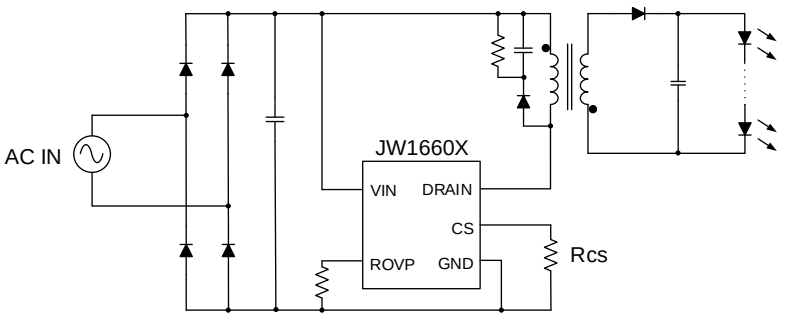
FEATURES

- No Auxiliary Winding
- Excellent Line/load Regulation
- Universal Input
- DCM Operation
- High Efficiency
- LED Open Protection
- Over-temperature Protection
- SOP7 Package

APPLICATIONS

- LED Driver

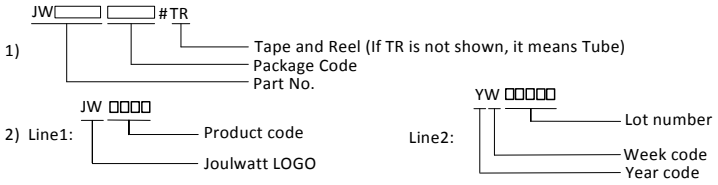
TYPICAL APPLICATION



ORDER INFORMATION

DEVICE[1)]	PACKAGE	TOP MARKING[2)]	ENVIRONMENTAL[3)]
JW1660MSOPA#TR	SOP7	JW1660M YW□□□□□	Green
JW1660ASOPA#TR	SOP7	JW1660A YW□□□□□	Green
JW1660BSOPA#TR	SOP7	JW1660B YW□□□□□	Green
JW1660CSOPA#TR	SOP7	JW1660C YW□□□□□	Green

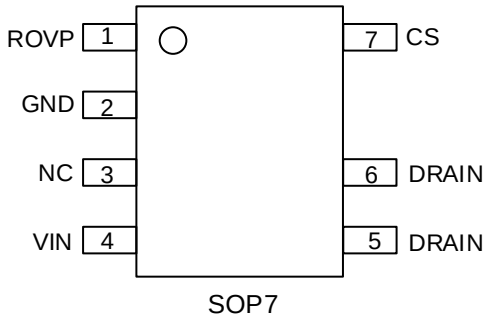
Note：



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

PIN CONFIGURATION

TOP VIEW



SOP7

ABSOLUTE MAXIMUM RATING[1)]

VIN Voltage 700V
CS Voltage.....-0.3V to 5V
ROVP Voltage..... -0.3V to 5V
DRAIN Voltage 650V
Junction Temperature[2)3)].....150ºC
Storage Temperature.....-65ºC to +150ºC

RECOMMENDED OPERATING CONDITIONS

VIN Voltage 630V
DRAIN Voltage 600V
Operating Junction Temperature.....-25ºC 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 JW1660X 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**
Threshold of VIN Power On		V_{IN_ON}	V_{IN} rising	13	14	15	V
VIN Quiescent Current		I_Q	VIN=40V, f=2.3k	90	130	170	μA
Reference Voltage		V_{REF}		384	400	416	mV
Maximum On Time		T_{ONMAX}		20	27	34	μs
Minimum On Time		T_{ONMIN}		0.75	1	1.25	μs
Maximum Off Time		T_{OFFMAX}		270	360	450	μs
Minimum Off Time		T_{OFFMIN}		2	2.4	2.8	μs
ROVP Short OVP Threshold[5)]		V_{OVP_SHORT}	ROVP short	123	136	149	V
ROVP Open OVP Threshold[5)]		V_{OVP_OPEN}	ROVP open	81	90	99	V
OVP Hic-cup Time[5)]		T_{OVP_HC}			560		ms
MOSFET Break-down Voltage	JW1660X series	BV_{DSS}	Vg=0V Ids=250μA	650			V
MOSFET R_{DSON}[5)]	JW1660M	R_{DS_ON}	Vg=15V Ids=0.5A		22	26	ohm
	JW1660A				17.5	21	
	JW1660B				13.5	16	
	JW1660C				6	7.2	
DS Leakage Current		I_{DSS}	Vg=0V Vds=500V			10	μA
Thermal Protection Threshold[5)]		OTP_{CHIP}			150		℃

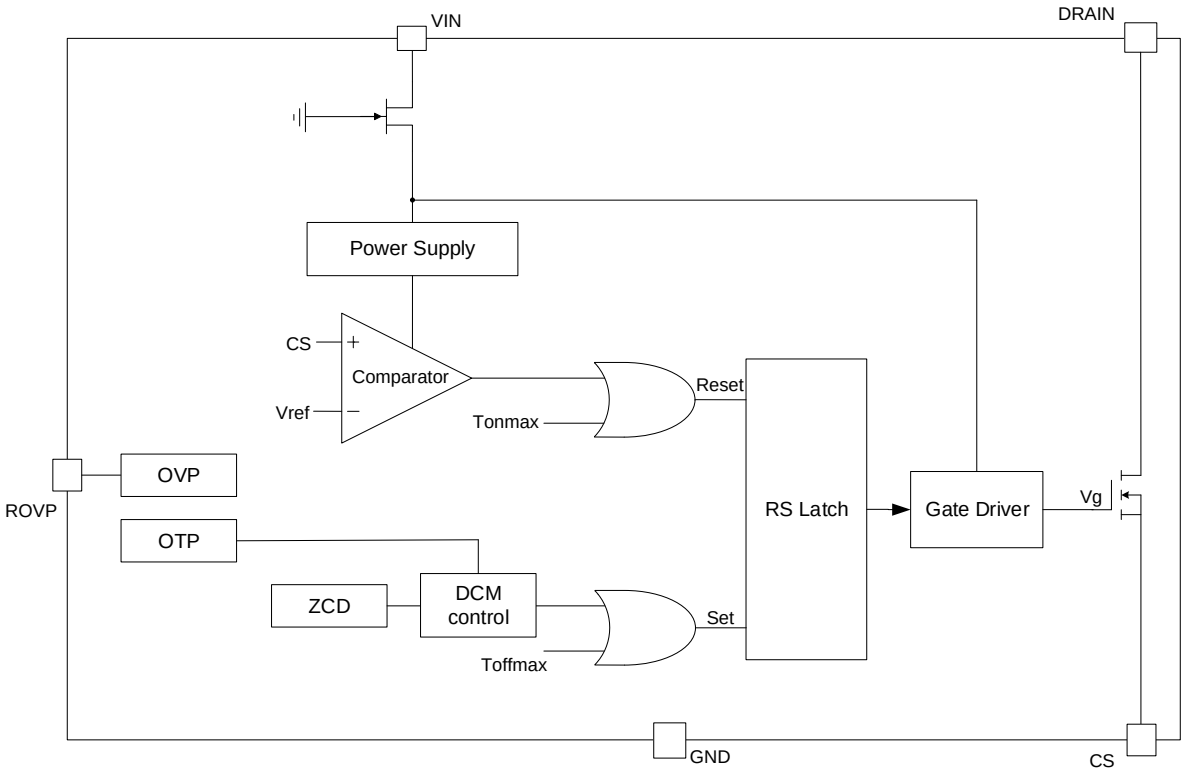
Notes:

5) Guaranteed by design.

PIN DESCRIPTION

Pin	Name	Description
1	ROVP	LED OVP set pin
2	GND	Chip ground
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 JW1660X series is a constant current LED regulator, which applies to isolated Flyback LED lighting system. JW1660X series can achieve excellent line and load regulations, high efficiency and low system cost with few peripheral components.

Start Up

When the VIN exceeds the turn-on threshold V_{IN_ON}, the gate driver will start to switch after a 10ms' delay.

Constant Current Control

JW1660X series controls the output current from the information of the current sensing resistor.

The transformer primary and secondary peak current can be calculated as:

$$I_{PRI\_PEAK} = V_{REF} / R_{CS}$$

$$I_{SEC\_PEAK} = N * I_{PRI\_PEAK}$$

The MOSFET turn-on-delay time can be calculated as:

$$T_{DELAY} = T_{OFF} - T_{ON}$$

The output LED average current can be calculated as:

$$I_{LED} \approx N*V_{REF} /(4R_{CS})$$

Where,

V_{REF} is the reference voltage;

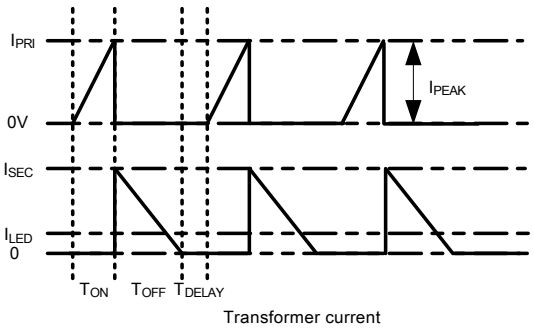
R_{CS} – the sensing resistor connected between the pin CS and pin GND.

I_{PRI_PEAK} is the peak current of primary side;

I_{SEC_PEAK} is the peak current of secondary side;

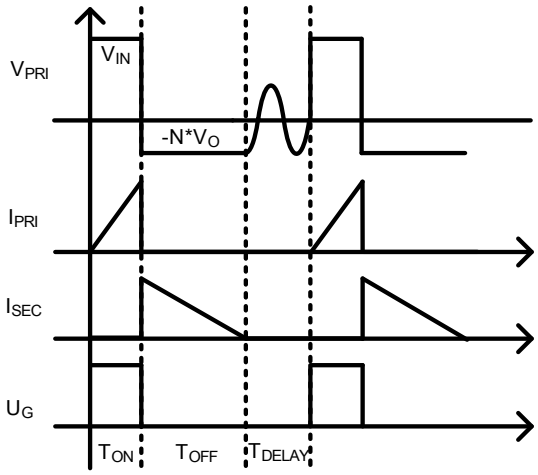
N is the primary to the secondary turns ratio of transformer;

The transformer current waveforms are as follows:



Discontinuous Conduction Mode (DCM) Operation

JW1660X series works in the DCM 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:



$$T_{ON} = I_{PRI\_PEAK} \times L_{PRI} / V_{IN}$$

Where,

L_{PRI} – primary side inductance of transformer.

L_{SEC} – secondary side inductance of transformer.

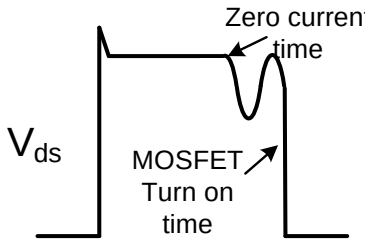
V_{IN} – input voltage after rectification and filtering.

V_{LED} – output voltage.

When the power MOSFET turns off, the inductor current decreases. The power MOSFET turns on again when the T_{DELAY} is over. The turn-off time can be calculated as:

$$T_{OFF} = I_{SEC\_PEAK} \times L_{SEC} / V_{LED}$$

When the inductor current decreases to zero, resonance takes place between the primary side of transformer, MOSFET output capacitors and stray capacitors. JW1660X series can detect the zero-current signals, and then calculate the delay time, then turns on the MOSFET. If JW1660X cannot get the zero current signals, the turn off time will be T_{OFFMAX}.



Over Temperature Protection

When the junction temperature is higher than OTP_{CHIP}, JW1660X series works in DCM by increasing the MOS OFF time to decrease the LED current and help the chip cooling.

LED Open Protection

In the LED open condition, the system frequency increases and duty of each cycle increases accordingly. When the calculation of V_{IN}*D/(1-D) is larger than V_{OVP} (set by ROVP pin), the power MOSFET is shut down and restarts after T_{OVP_HC}.

LED Short Protection

When the output is shorted, JW1660X series stops switching for T_{OFFMAX} 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. JW1660X series should be kept away from noisy and heating components, such as power inductor and diode.

APPLICATION REFERENCE

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 6W non-isolated step-down LED driver, using JW1660B, with high efficiency and excellent line regulation.

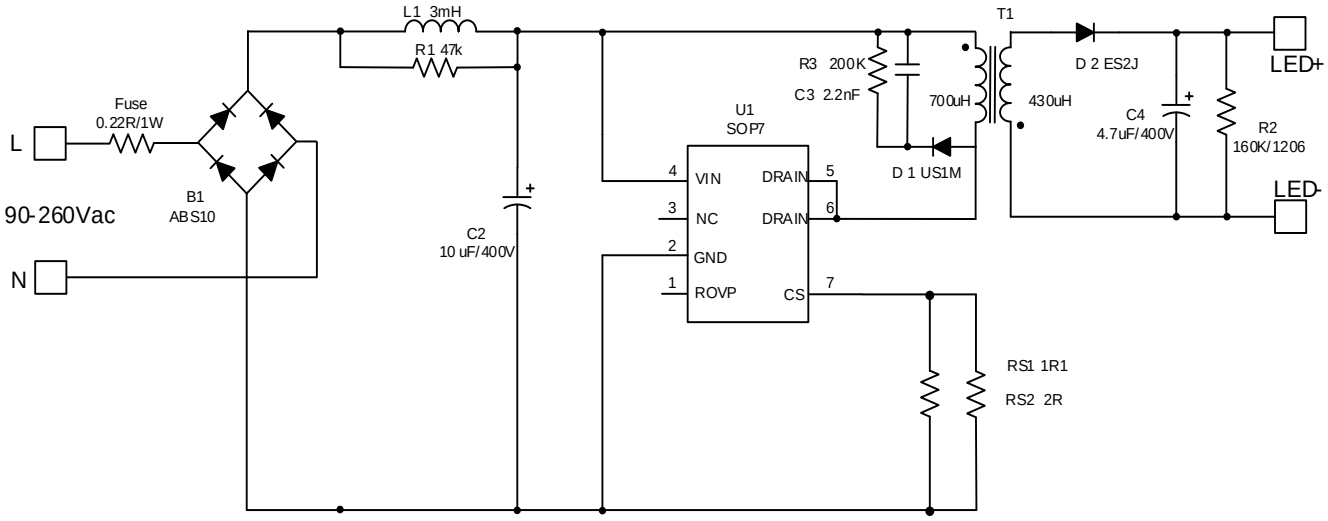
Reference ：

V_{IN}: 90VAC~260VAC

V_{OUT}: 36V

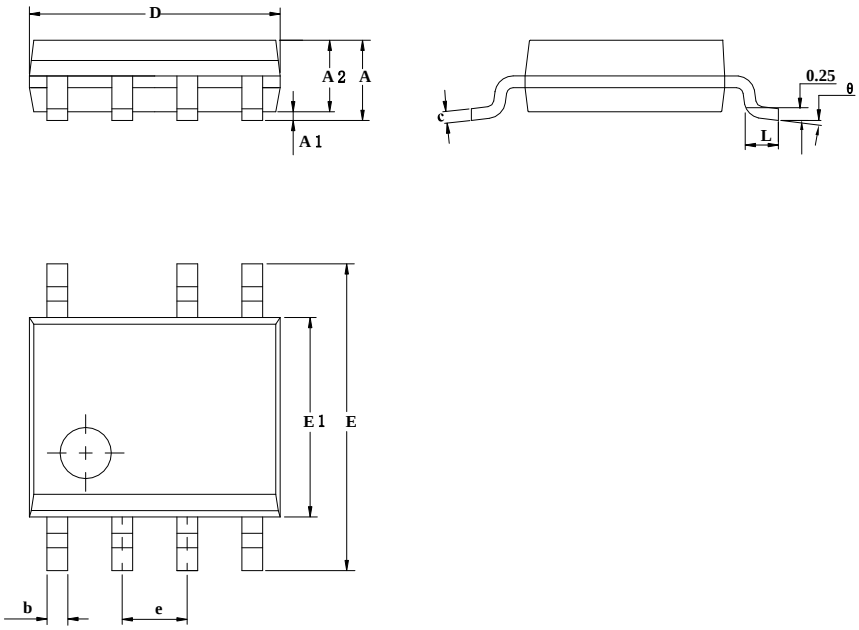
I_{OUT}: 165mA

PF: >0.5



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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