JW1123

2A, 28V Synchronous Buck LED Driver

Parameters Subject to Change Without Notice

DESCRIPTION

The JW®1123 is a current mode monolithic buck LED driver. Operating with an input range of 4.5V-28V, JW1123 delivers 2A of continuous output current with two integrated N-Channel MOSFETs. The internal synchronous power switches provide high efficiency without the use of an external Schottky diode. It integrates PWM signal to analogy dimming mode to achieve dimmable LED lighting application.

The JW1123 guarantees robustness with LED short protection, thermal protection, start-up current run-away protection, input under voltage lockout.

The JW1123 is available in 6-pin SOT23 packages, which provide a compact solution with minimal external components.

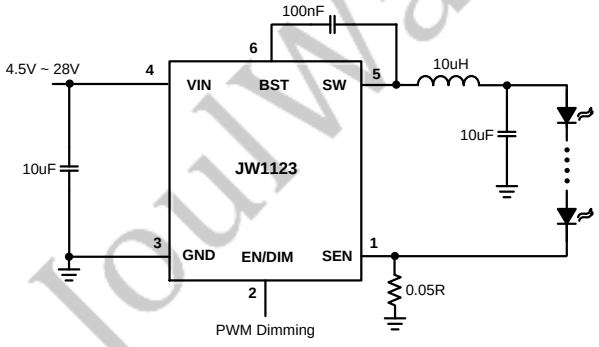
FEATURES

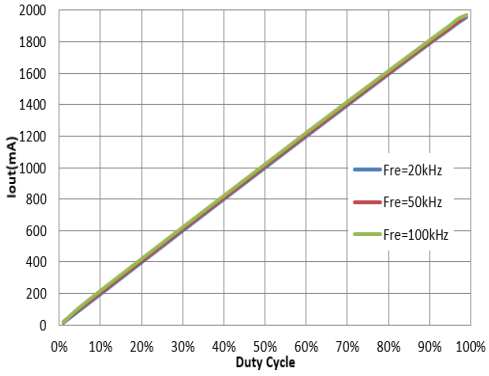
- 4.5V to 28V operating input range
  2A output current
- Up to 94% efficiency
  @ Vin=12V, Vout=6V, ILED=2A
- 600kHz Switching frequency
- Input under voltage lockout
- Start-up current run-away protection
- LED short protection
- Thermal protection
- Available in SOT23-6 packages

APPLICATIONS

- IP camera and CCD camera
- Flash light
- Display cabinet lamp
- LED Sign

TYPICAL APPLICATION





ORDER INFORMATION

DEVICE[1)]	PACKAGE	TOP MARKING[2)]
JW1123SOTB#TRPBF	SOT23-6	JWDR□ YW□□□

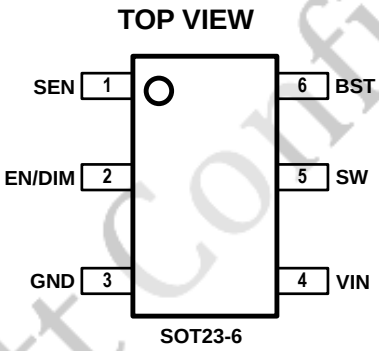
Note：

1) JW□□ # TRPBF
- PB Free
- Tape and Reel(If" TR" is not shown, it means tube)
- Package Code
- Part No.

2) Line1: JW□□□
- Internal control code
- Product code
- Joulwatt LOGO

Line2: YW□□□
- Lot number
- Week code
- Year code

PIN CONFIGURATION



ABSOLUTE MAXIMUM RATING[1)]

VIN Pin .....-0.3V to 30V
SW Pin .....-0.3V (-4.5V for 10ns) to 30V (32V for 10ns)
BST Pin..... SW-0.3V to SW+5V
All other Pins ..... -0.3V to 6V
Junction Temperature[(2) (3)] 150ºC
Lead Temperature 260ºC
Storage Temperature ..... -65 ºC to +150ºC

RECOMMENDED OPERATING CONDITIONS

Input Voltage VIN .....4.5V to 28V
Operating Junction Temperature.....-40ºC to 125ºC

THERMAL PERFORMANCE[4)]

	θ_{JA}	θ_{Jc}
SOT23-6	220	130ºC/W

Note：

1) Exceeding these ratings may damage the device.

2) The JW1123 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) The JW1123 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.

ELECTRICALCHARACTERISTICS

VIN=12V, T_A=25℃, Unless otherwise stated

Item	Symbol	Conditions	Min.	Typ.	Max.	Unit
V_{IN} Under Voltage Lock-out Threshold	V_{IN_MIN}	V_{IN} rising	3.6	3.8	4.0	V
V_{IN} Under Voltage Lockout Hysteresis	$V_{IN\_MIN\_HYST}$			200		mV
Shutdown Supply Current	I_{SD}	V_{EN}=0V			10	μA
Feedback Reference Voltage	V_{FB}	D_{DIM}=100%	96	100	104	mV
Feedback Min Reference Voltage	V_{FB_MIN}	D_{DIM}=1%		3		mV
Top Switch Resistance[5)]	$R_{DS(ON)T}$			80		mΩ
Bottom Switch Resistance[5)]	$R_{DS(ON)B}$			80		mΩ
Top Switch Leakage Current	I_{LEAK_TOP}	V_{IN}=28V, V_{EN}=0V, V_{SW}=0V			1	μA
Bottom Switch Leakage Current	I_{LEAK_BOT}	V_{IN}=28V, V_{EN}=0V, V_{SW}=28V			1	μA
Top Switch Current Limit[5)]	I_{LIM_TOP}		2.8	3.5	4.2	A
Bottom Switch Current Limit[5)]	I_{LIM_BOT}		1.8	2.2	2.6	A
Switch Frequency	F_{SW}		450	600	750	kHz
EN/DIM High input threshold	V_{ENH}	V_{EN} rising	1.5			V
EN/DIM Low input threshold	V_{ENL}	V_{EN} falling			0.5	V
PWM Dimming Duty Range[5)]	D_{DIM}		1%		100%	
Minimum on-time	T_{ON-MIN}			90		ns
Minimum off-time	$T_{OFF-MIN}$			120		ns
Maximum Duty Cycle	D_{MAX}		90	93		%
Thermal Shutdown[5)]	T_{TSD}			160		°C
Thermal Shutdown hysteresis[5)]	T_{TSD_HYST}			30		°C

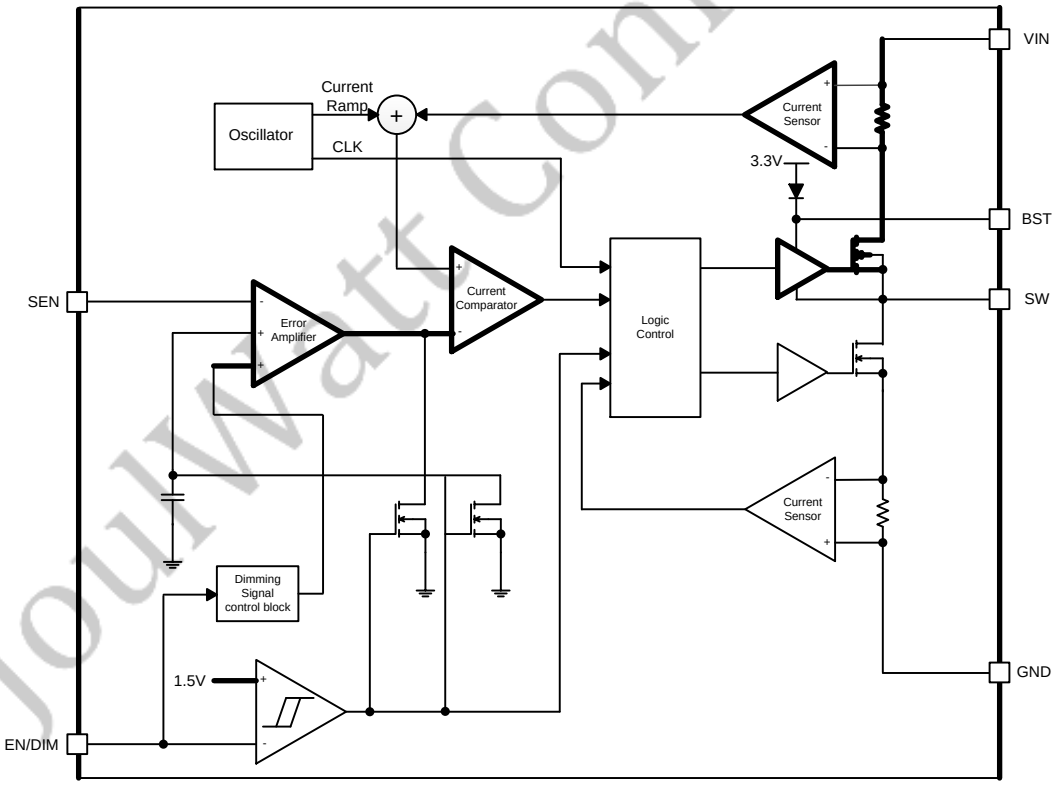
Note:

5) Guaranteed by design.

PIN DESCRIPTION

Pin	Name	Description
1	SEN	LED current sense pin.
2	EN/DIM	Drive EN pin above 1.5V to enable the LED driver. When a 20kHz ~ 80kHz is applied to EN/DIM pin, the internal feedback reference is proportional to the PWM input duty cycle.
3	GND	Ground.
4	VIN	Input voltage pin. VIN supplies power to the IC. Connect a 4.5V to 28V supply to VIN and bypass VIN to GND with a suitably large capacitor to eliminate noise on the input to the IC.
5	SW	SW is the switching node that supplies power to the output. Connect the output LC filter from SW to the output load.
6	BST	Bootstrap pin for top switch. A 0.1μF or larger capacitor should be connected between this pin and the SW pin to supply current to the top switch and top switch driver.

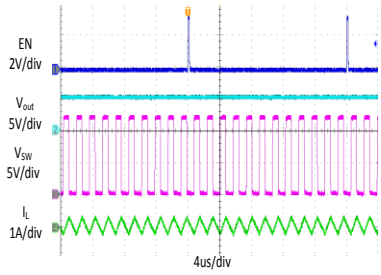
BLOCK DIAGRAM



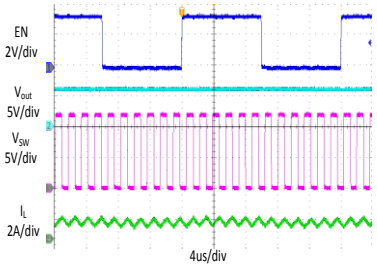
TYPICAL PERFORMANCE CHARACTERISTICS

Vin = 12V, Vout = 2#LED, L = 10μH, Cout = 10μF, TA = +25°C, unless otherwise noted

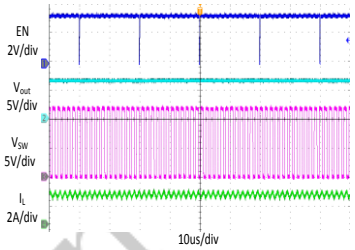
Steady State Test
VIN=12V, Vout=2#LED
PWM=50kHz, 1%



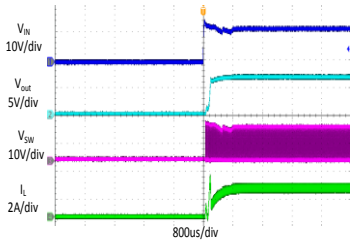
Steady State Test
VIN=12V, Vout=2#LED
PWM=50kHz, 50%



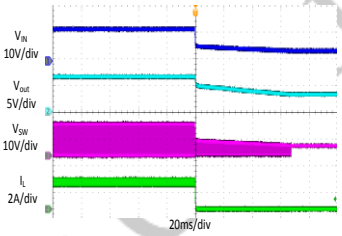
Steady State Test
VIN=12V, Vout=2#LED
PWM=50kHz, 99%



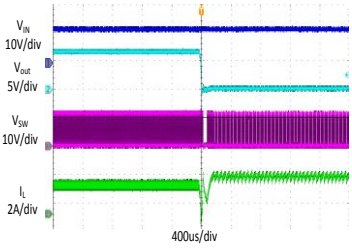
Startup through Vin
VIN=12V, Vout=2#LED
PWM=50kHz, 99%



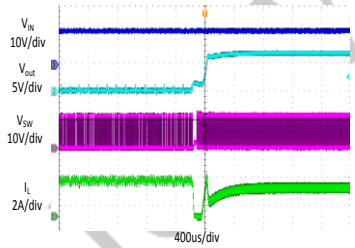
Shutdown through Vin
VIN=12V, Vout=2#LED
PWM=50kHz, 99%



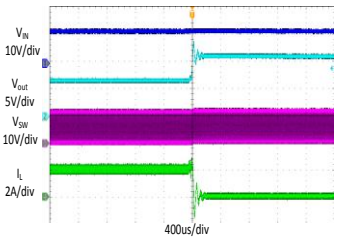
Short LED+ to LED- Protection
VIN=12V, Vout=2#LED
PWM=50kHz, 99%- Short



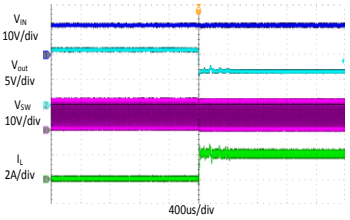
Short LED+ to LED- Recovery
VIN=12V, Vout=2#LED
Recovery



Open LED Load Protection
VIN=12V, Vout=2#LED
PWM=50kHz, 99%- open



Open LED Load Recovery
VIN=12V, Vout=2#LED
Recovery



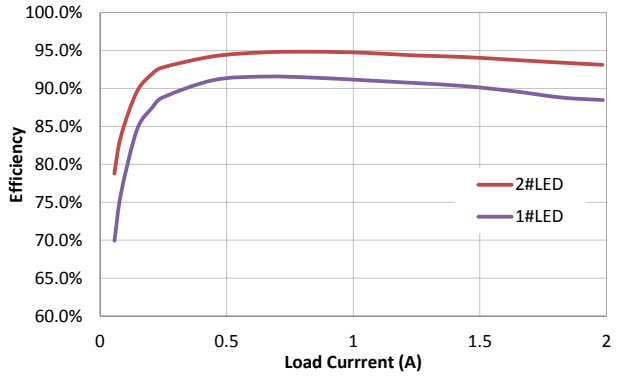


Figure 1. Efficiency vs Load Current (L=10μH)

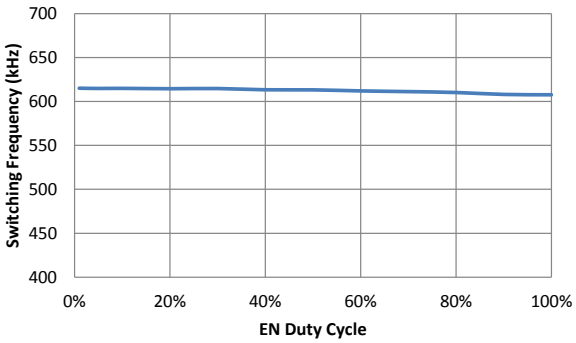


Figure 2. Frequency vs EN Duty Cycle

FUNCTIONAL DESCRIPTION

The JW1123 is a synchronous, current-mode buck LED driver capable of supplying up to 2A of load current.

Power Switch

N-Channel MOSFET switches are integrated on the JW1123 to down convert the input voltage to the regulated output voltage. Since the top MOSFET needs a gate voltage great than the input voltage, a boost capacitor connected between BST and SW pins is required to drive the gate of the top switch. The boost capacitor is charged by the internal 3.3V rail when SW is low.

Current-Mode Control

The JW1123 utilizes current-mode control to regulate the SEN pin voltage. Voltage between SEN pin and GND pin is regulated at 0.1V so that by connecting a resistor between SEN pin and GND pin, maximum current through the LED string can be accurately controlled.

FCCM Operation

JW1123 operates in FCCM mode, so its frequency keeps constant at all load range for low output current ripple.

Shut-Down Mode

The JW1123 operates in shut-down mode when voltage at EN pin is driven below 0.5V for 10ms or longer. In shut-down mode, the entire regulator is off and the supply current consumed by the JW1123 drops below 10μA.

PWM / Analog Dimming Mode

Once a PWM signal is applied to EN/DIM pin, the internal voltage reference will be proportional to PWM duty cycle as shown as figure 1. LED current is continuous, and the current magnitude can be adjusted by changing PWM duty cycle. Since the internal voltage reference is filtered from PWM signal, too low PWM frequency may cause a little big ripple at voltage reference. To minimize this ripple, PWM signal frequency is recommended to be higher than 20kHz, such as 50kHz.

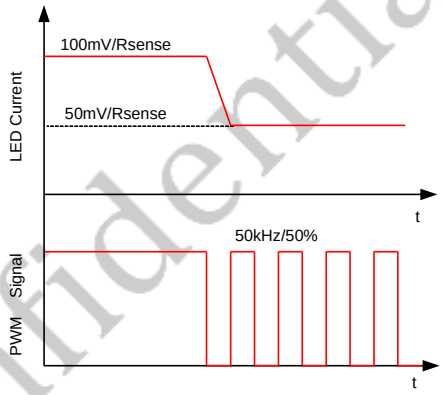


Figure 1. PWM Dimming Mode Operation

Output Current Run-Away Protection

At start-up, due to the high voltage at input and low voltage at output, current inertia of the output inductor can be easily built up, resulting in a large start-up output current. A valley current limit is designed in the JW1123 so that only when output current drops below the valley current limit can the bottom power switch be turned off. By such control mechanism, the output current at start-up is well controlled.

Sense Pin Short Protection

When the sense resistor is shorted, the SENSE voltage is low, and the internal COMP voltage is clamped to a max value. When the COMP voltage is clamped for 768 cycles and the maximum duty cycle is not triggered, the devices stop switching. The devices then automatically start a new start-up after 3840

cycles. The devices repeat this mode until the short condition is removed.

LED+ and LED- Short Protection

When the LED load is shorted, the SENSE voltage is higher than internal reference voltage, and the internal COMP voltage is driven low and clamped, and the high-side MOSFET is commanded on for a minimum on-time each cycle. In this condition, if the output voltage is too low, the inductor current may not be able to balance in a cycle, causing current runaway. Finally, the inductor current is clamped at the low-side MOSFET sourcing-current limit, which is much higher than target LED current.

LED+ and GND Short Protection

When LED+ is shorted to GND, the SENSE voltage is low, and the internal COMP voltage is clamped to a max value. When the COMP voltage is clamped for 768 cycles and the maximum duty cycle is not triggered, the devices stop switching. The devices then automatically start a new start-up after 3840 cycles. The devices repeat this mode until the short condition is removed.

Open Circuit Protection

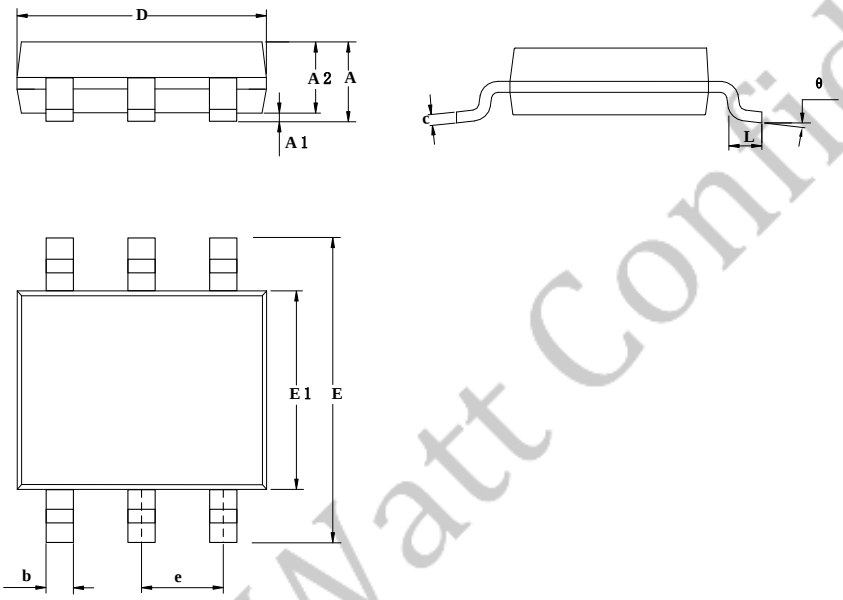
Once the LED load is open, the SENSE voltage is low, and the internal COMP voltage is driven high and clamped. This action charges the output capacitor to a voltage as high as VIN and the devices operate in maximum duty cycle status. Only when the open circuit condition is removed, the output voltage becomes normal.

Thermal Protection

When the temperature of the JW1123 rises above 160°C, it is forced into thermal shut-down. Only when core temperature drops below 130°C can the regulator becomes active again.

PACKAGE OUTLINE

SOT23-6 UNIT: mm



SYMBOL	MILLIMETER		
	MIN	NOM	MAX
A	1.05	1.15	1.25
A1	0	0.05	0.15
A2	0.95	1.10	1.20
b	0.20	0.40	0.60
c	0.05	—	0.21
D	2.72	2.92	3.12
E	2.60	2.80	3.00
E1	1.40	1.60	1.80
e	0.95（BSC)		
L	0.30	0.45	0.60
θ	0°	—	8°

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