JW1121A

1.5A, 20V Synchronous Buck LED Driver

Parameters Subject to Change Without Notice

DESCRIPTION

The JW®1121A is a current mode monolithic buck LED driver. Operating with an input range of 4.2V-20V, JW1121A delivers 1.5A 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 incorporates analog dimming mode and PWM signal to analogy dimming mode onto a single control pin.

The JW1121A guarantees robustness with LED short protection, thermal protection, start-up current run-away protection, input under voltage lockout.

The JW1121A is available in 6-pin SOT23 packages, which provide a compact solution with minimal external components.

FEATURES

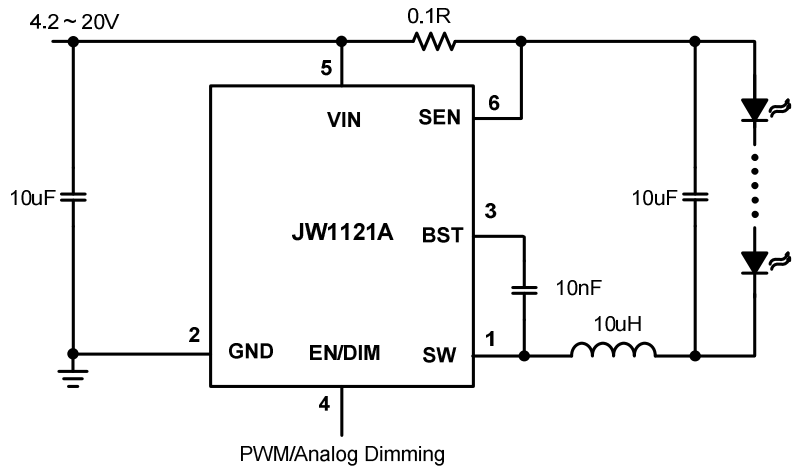
- 4.2V to 20V operating input range
  1.5A output current
- Up to 94% efficiency
  @ Vin=12V, Vout=6V
- 1MHz Switching frequency
- PWM to Analog dimming mode
- Input under voltage lockout
- Start-up current run-away protection
- LED short protection
- Thermal protection
- Available in SOT23-6 packages

APPLICATIONS

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

TYPICAL APPLICATION

1.5A Buck LED Driver



ORDER INFORMATION

DEVICE[1)]	PACKAGE	TOP MARKING[2)]
JW1121ASOTB#TRPBF	SOT23-6	JWLWX YWLLL

Notes:

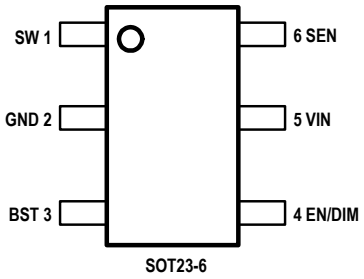
1) JW□□□□# TRPBF
- PB Free
- Tape and Reel(If "TR" is not shown, it means tube)
- Package Code
- Part No.

2) Line1: JWPNA
- Initial control code
- Product code of JWXXXX
- Joulwatt LOGO

Line2: YWLLL
- Lot number
- Week code
- Year code

PIN CONFIGURATION

TOP VIEW



SOT23-6

ABSOLUTE MAXIMUM RATING[1)]

VIN ,SEN Pin .....-0.3V to 28V
SW Pin .....-0.3V (-2V for 10ns)to 28V
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 .....4.2V to 20V
Operating Junction Temperature.....-40ºC to 125ºC

THERMAL PERFORMANCE[4)]

	θ_{JA}	θ_{Jc}
SOT23-6	220	110ºC/W

Note:

1) Exceeding these ratings may damage the device.

2) The JW1121A 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 JW1121A 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} falling		3.8		V
V_{IN} Under Voltage Lockout Hysteresis	$V_{IN\_MIN\_HYST}$	V_{IN} rising		300		mV
Shutdown Supply Current	I_{SD}	V_{EN}=0V		5		μA
Supply Current	I_Q	V_{EN}=5V, V_{FB}=1V		1		mA
Internal Reference Voltage	V_{REF}	4.2V<V_{VIN}<20V	96	100	104	mV
Top Switch Resistance[5)]	$R_{DS(ON)T}$			130		mΩ
Bottom Switch Resistance[5)]	$R_{DS(ON)B}$			130		mΩ
Top Switch Leakage Current	I_{LEAK_TOP}	V_{IN}=20V, V_{EN}=0V, V_{SW}=0V			1	uA
Bottom Switch Leakage Current	I_{LEAK_BOT}	V_{IN}=20V, V_{EN}=0V, V_{SW}=20V			1	uA
Bottom Switch Current Limit[5)]	I_{LIM_BOT}		2.6	3.1	3.7	A
Switch Frequency	F_{SW}		0.8	1	1.2	MHz
EN/DIM rising threshold	V_{ENH}	V_{EN} rising			0.65	V
EN/DIM falling threshold	V_{ENL}	V_{EN} falling	0.3			V
Analog Dimming Signal to EN/DIM pin						
EN/DIM Analog Dimming Mode Threshold	V_{A_ADIM}	Analog dimming	0.62	0.65	0.67	V
EN/DIM Analog Dimming Accuracy	$I_{LED,ACC}$	$V_{EN/DIM}$=0.65V		0%		
		$V_{EN/DIM}$=1.2V		100%		
PWM Dimming Signal to EN/DIM pin						
EN/DIM PWM/Analog Dimming Mode Threshold	V_{PWM_ADIM}	Rising	1.9	2	2.1	V
		Falling		1.8		V
Minimum on-time	T_{ON-MIN}			100		ns
Minimum off-time	$T_{OFF-MIN}$			60		ns
Maximum Duty Cycle	D_{MAX}			100		%
Thermal Shutdown[5)]	T_{TSD}			150		°C
Thermal Shutdown hysteresis[5)]	T_{TSD_HYST}			20		°C

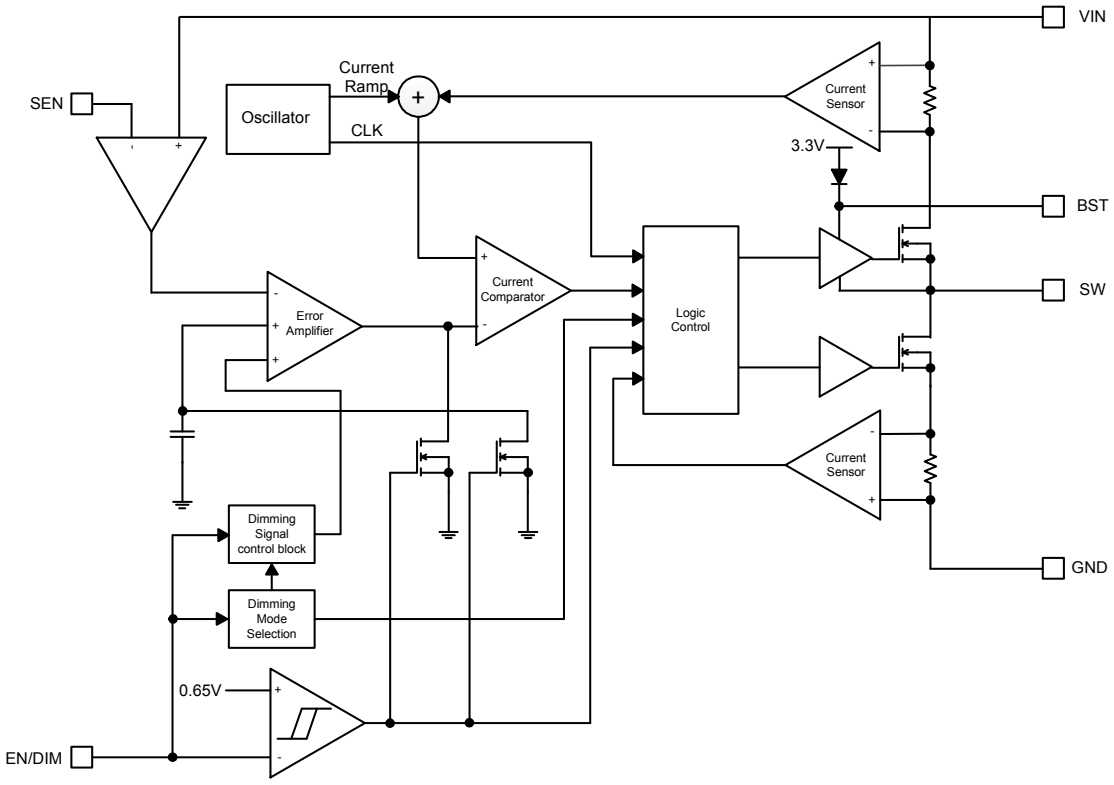
Note：

5) Guaranteed by design.

PIN DESCRIPTION

Pin	Name	Description
1	SW	SW is the switching node that supplies power to the output. Connect the output LC filter from SW to the output load.
2	GND	Ground.
3	BST	Bootstrap pin for top switch. A 0.01uF capacitor should be connected between this pin and the SW pin to supply current to the top switch and top switch driver.
4	EN/DIM	Drive EN pin above 0.65V to enable the LED driver. When EN/DIM pin voltage rises from 0.65V to 1.2V, the LED current will change from 1% to 100% of the maximum LED current. When EN/DIM pin is supplied by a PWM signal and its amplitude is higher than 2V, PWM to Analog dimming mode will be chosen.
5	VIN	Input voltage pin. VIN supplies power to the IC. Connect a 4.2V to 20V supply to VIN and bypass VIN to GND with a suitably large capacitor to eliminate noise on the input to the IC.
6	SEN	Negative current sense pin.

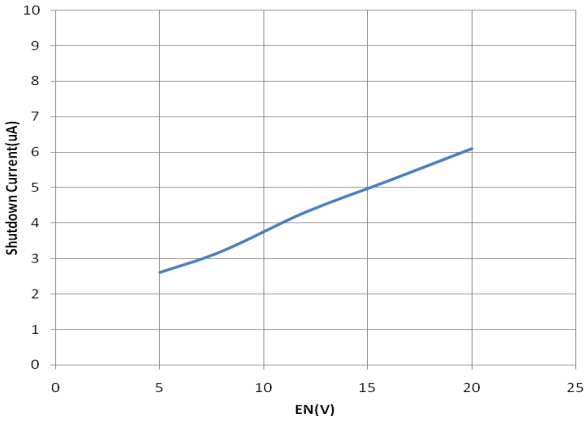
BLOCK DIAGRAM



TYPICAL PERFORMANCE CHARACTERISTICS

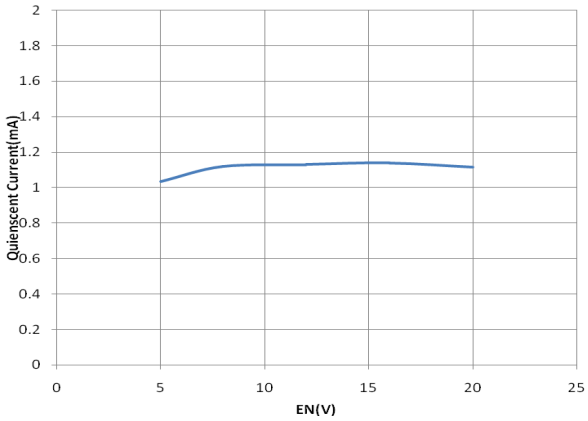
Shutdown Current Vs. Input Voltage

VEN=3V



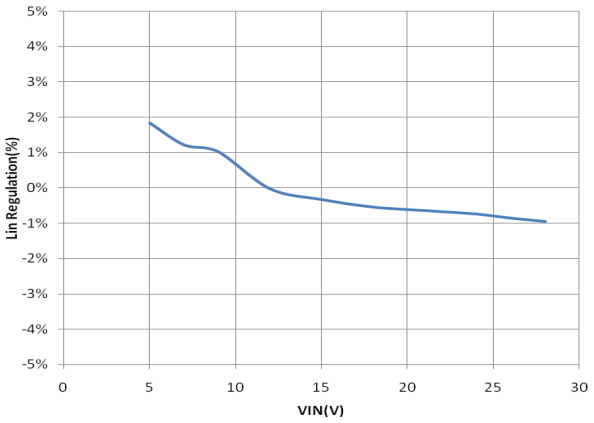
Quiescent Current Vs. Input Voltage

VEN=3V



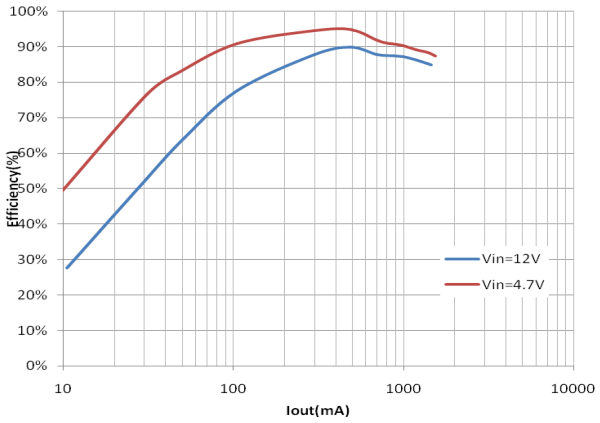
Line Regulation

VIN=12V, VEN=3V, Vout=4V,L=4.7uH



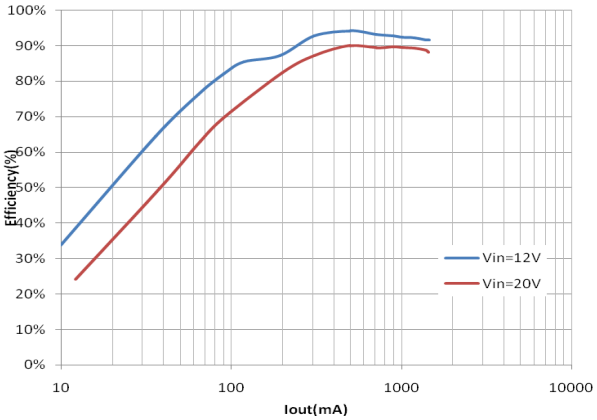
Efficiency vs. Vin

2LED in series, L=4.7uH



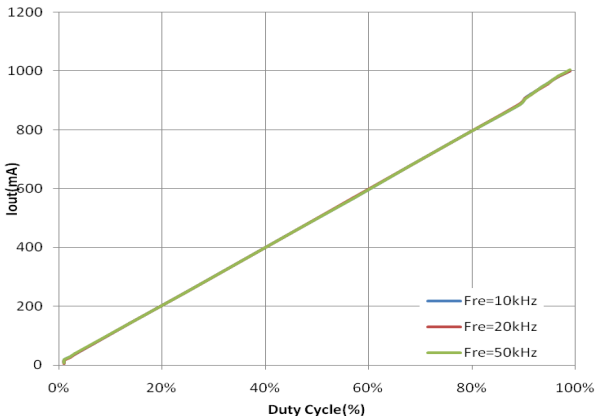
Efficiency vs. Iout

1LED in series, L=4.7uH



PWM to Analog DIMMING
Duty cycle VS Output Current

VIN=12V, Vout=2#LED PWM=1kHz

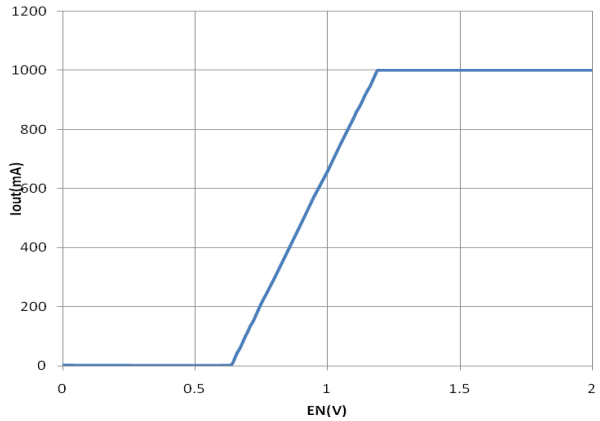


TYPICAL PERFORMANCE CHARACTERISTICS*(continued)*

Analog Dimming

ILED VS EN/DIM Voltage

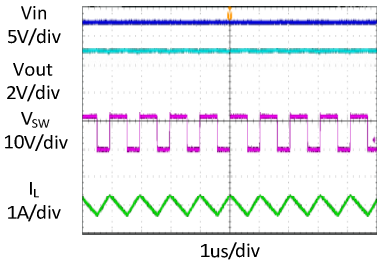
VIN=12V, Vout=2#LED



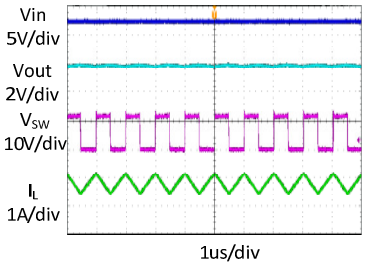
TYPICAL PERFORMANCE CHARACTERISTICS*(continued)*

Vin =12V, Vout = 2#LED, L = 4.7μH, Cout = 10μF, TA = +25°C, unless otherwise noted

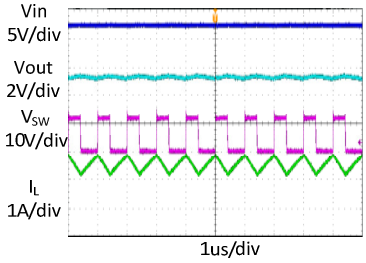
Steady State Test
VIN=12V, Vout=2#LED
Iout=0.1A



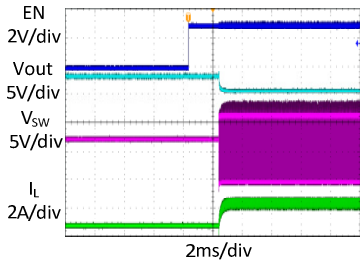
Steady State Test
VIN=12V, Vout=2#LED
Iout=0.75A



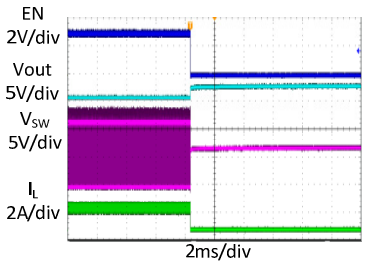
Steady State Test
VIN=12V, Vout=2#LED
Iout=1.5A



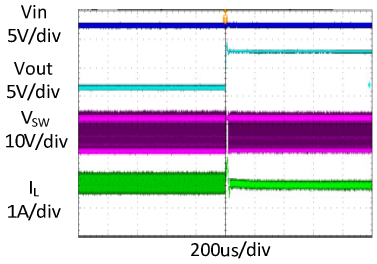
Startup through Enable
VIN=12V, Vout=2#LED
Iout=1.5A



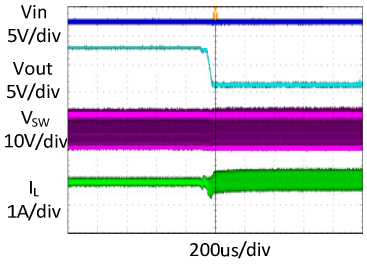
Shutdown through Enable
VIN=12V, Vout=2#LED
Iout=1.5A



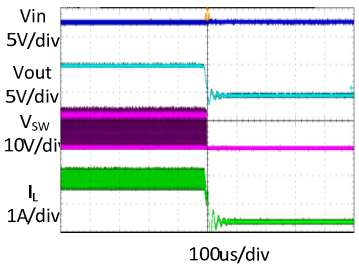
Short LED+ to LED- Protection
VIN=12V, Vout=2#LED
Iout=1.5A- Short



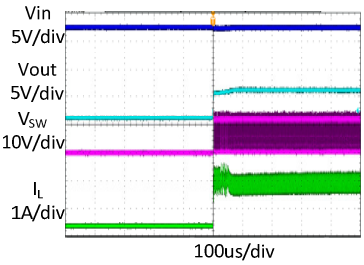
Short LED+ to LED- Recovery
VIN=12V, LED+ short to LED-,
Recovery



Open LED Load Protection
VIN=12V, Vout=2#LED
Iout=1.5A- open



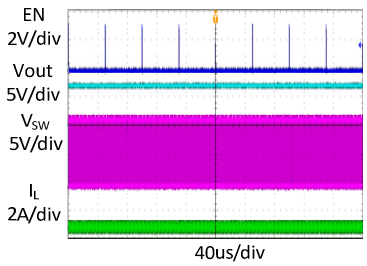
Open LED Load Recovery
VIN=12V, Vout=2#LED
Iout=1.5A



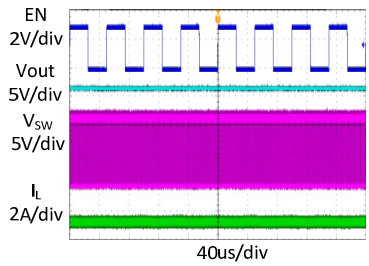
TYPICAL PERFORMANCE CHARACTERISTICS *(continued)*

Vin =12V, Vout = 2#LED, L = 4.7μH, Cout = 22μF, TA = +25°C, unless otherwise noted

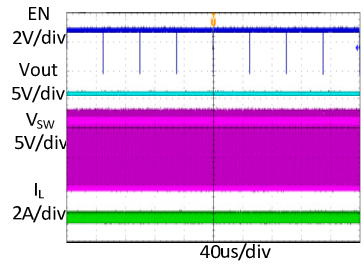
PWM Dimming
VIN=12V, Vout=2#LED
PWM=1kHz, 1%



PWM Dimming
VIN=12V, Vout=2#LED
PWM=1kHz,50%



PWM Dimming
VIN=12V, Vout=2#LED
PWM=1kHz,99%



FUNCTIONAL DESCRIPTION

The JW1121A is a synchronous, current-mode buck LED driver capable of supplying up to 1.5A of load current.

Voltage-Mode Control

The JW1121A utilizes voltage-mode control to regulate the SENSE voltage. Voltage between VIN pin and SENSE pin is regulated at 0.1V so that by connecting a resistor between VIN pin and SENSE pin, maximum current through the LED string can be accurately controlled.

FCC Mode

The frequency of JW1121A keeps constant at all load range for low output current ripple.

Shut-Down Mode

The JW1121A operates in shut-down mode when voltage at EN pin is driven below 0.3V. In shut-down mode, the entire regulator is off and the supply current consumed by the JW1121A drops below 5uA.

Dimming Mode Selection

Once a analog diming signal or a PWM dimming signal is applied to EN/DIM pin, the internal peak detector at EN/DIM pin will hold the magnitude of the dimming signal. Once the device is enabled, after 300us delay, the output of the peak detector will be compared with three voltage thresholds V_{A_ADIM} and V_{PWM_ADIM} , which is 0.65V, 1.2V and 2V respectively. If the output of peak detector is higher than 2V, PWM signal to Analog dimming mode will be chosen and locked. If it is lower than 1.2V and higher than 0.65V, Analog dimming mode will be chosen and locked. If it is less than 0.65V, the device will wait another 300us and compare again, and this process will repeat until one mode is chosen and locked. (Shown as figure1 and table 1)

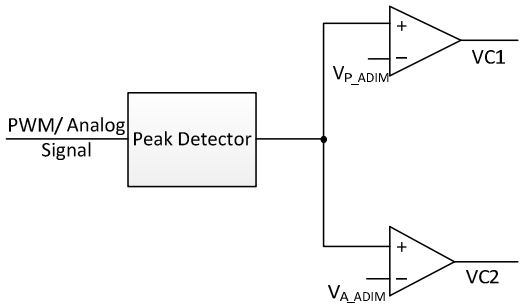


Figure 1. Dimming Mode Selection Circuit

Table 1. Dimming Mode Selection

VC1	VC2	MODE
H	H	PWM to Analog Dimming Mode
L	H	Analog Dimming Mode
L	L	Keep detecting until one mode is selected and locked

Analog Dimming

Once analog dimming is chosen, the internal voltage reference for FB pin will be proportional to the analog dimming signal and the current through LED string can be controlled by the analog voltage at the EN/DIM pin. Voltage below 0.65V leads to very small LED current, while voltage above 1.2V corresponds to full LED current. In between 0.65V and 1.2V, the LED current changes proportionally to the EN/DIM voltage.

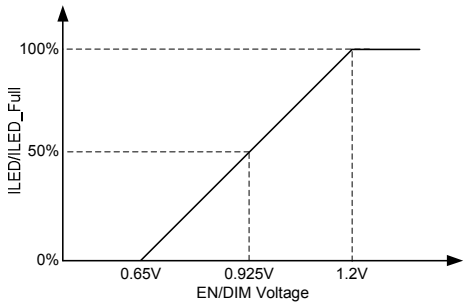


Figure 2. Analog Dimming Mode Operation

PWM / Analog Dimming Mode

Once PWM signal to analog dimming mode is chosen, the internal voltage reference will be proportional to PWM duty cycle as shown as figure 3. LED current is continuous in this mode, 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 10kHz, such as 50kHz.

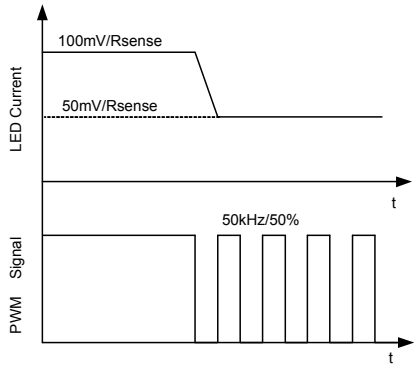


Figure 3. PWM/Analog Dimming Mode Operation

Power Switch

N-Channel MOSFET switches are integrated on the JW1121A 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.

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 JW1121A 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.

Thermal Protection

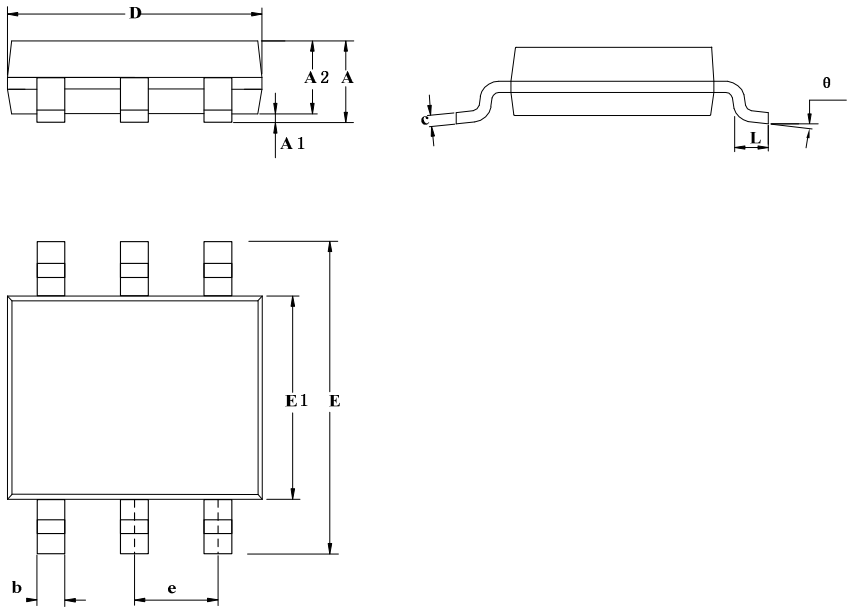
When the temperature of the JW1121A rises above 150°C, it is forced into thermal shut-down. Only when core temperature drops below 130°C can the regulator becomes active again.

E-Fuse Trim

JW1121A utilizes E-Fuse as trim bit to achieve high reliability and high accuracy of LED current.

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	1.05	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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