High Brightness Step-Down LED Driver

Description

The TNL4115SR is a high-efficiency step-down LED driver controller with a wide input voltage range of 6V to 30V. It is designed to operate in continuous current mode.

The TNL4115SR employs a hysteretic control architecture that accurately regulates LED current with a feedback coming from an external high-side current-sense resistor. This control scheme optimizes circuit stabilization and fast response time without loop compensation. Its low 200mV average feedback voltage reduces power loss and improves the converter's efficiency.

The TNL4115SR implements PWM and analog dimming together through the DIM pin. It also Includes thermal overload protection in case of output overload.

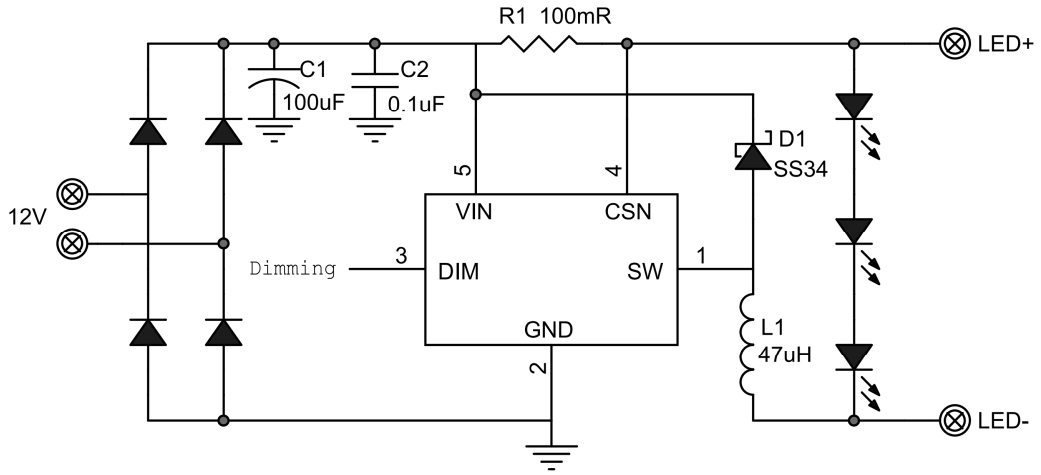
Features

- Wide 6V to 30V Input Range
- Able to Drive ＜1.5A LED Load
- High Efficiency
- Open LED Protection
- No need compensation
- Thermal Shutdown
- Hysteresis Control
- RoHS and Halogen free compliance
- Available in SOT-89-5 Package

Applications

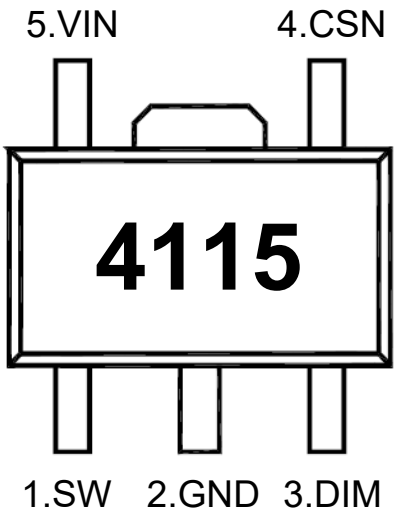
- Automotive/Decorative LED Lighting
- Emergency Lighting
- LED Backlighting
- Low Voltage Halogen Replacement

Typical Application



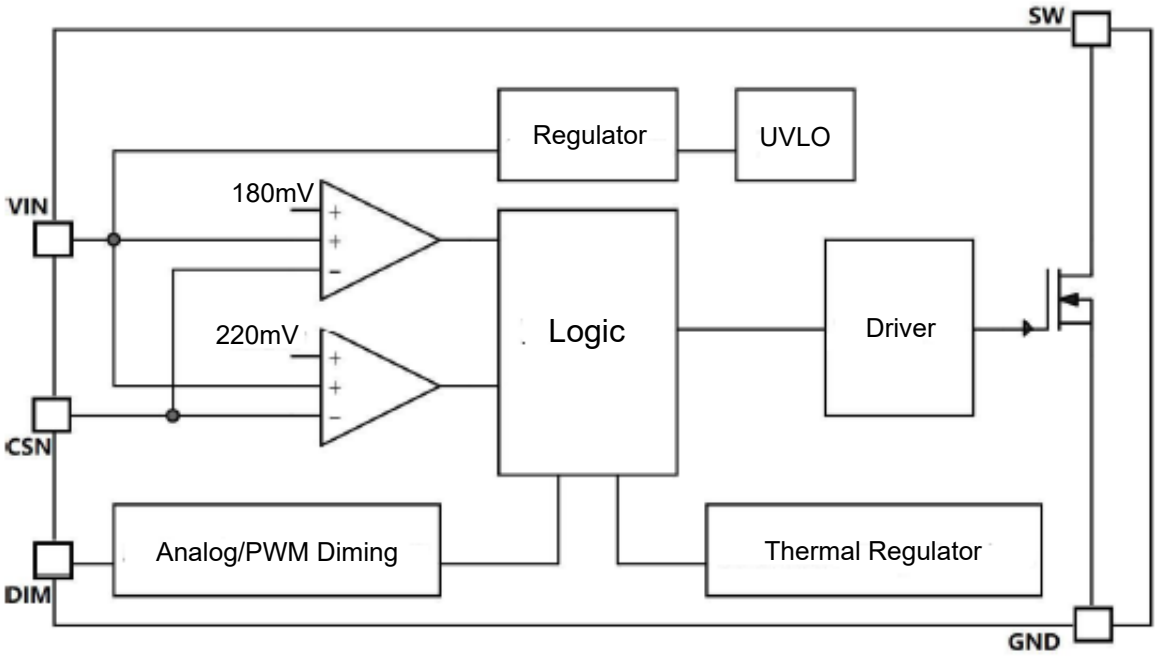
Pin Function And Descriptions

SOT-89-5



Pin No.	Symbol	Description
1	SW	Drain of the internal NMOS
2	GND	Ground
3	DIM	PWM/Analog Diming Input. Internal weak pull up. Drive DIM low to turn off the output
4	CSN	Connect sensor input reference to VIN for measure output current.
5	VIN	Power input

Block Diagram



Absolute Maximum Ratings (at T_A = 25°C)

Parameter		Value	Unit
VIN,CSN to GND		-0.3 ~ +36	V
SW to GND		-0.3 ~ +36	V
DIM to GND		-0.3 ~ +6.5	V
Junction to Ambient Thermal Resistance	$R_{\theta JA}$	45	°C/W
Operation Junction temperature range	T_J	-40 ~ +150	°C
Storage temperature range	T_{STG}	-55 ~ +150	°C

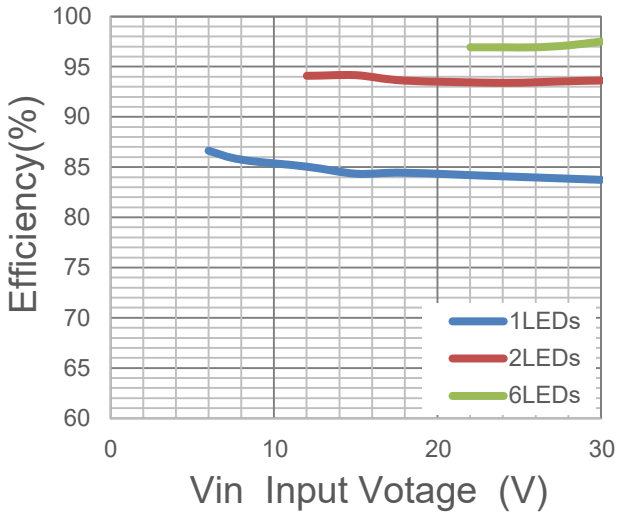
Electrical Characteristics

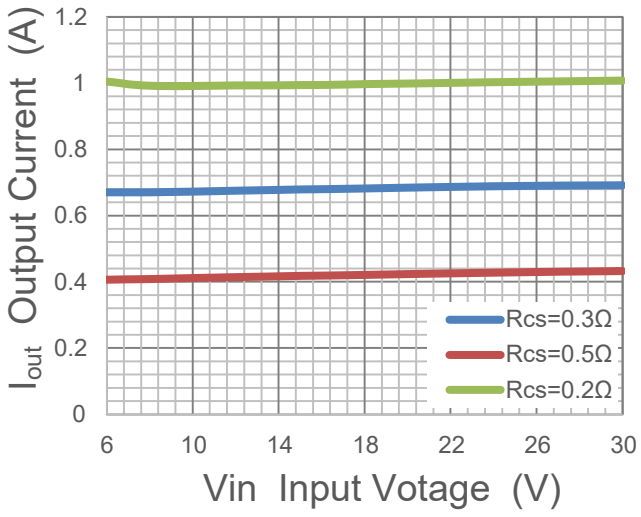
T_J = 25°C, V_{IN} = 12V, unless otherwise noted

Parameter	Symbol	Test Conditions	Min.	Typ.	Max.	Unit
Input Voltage	V_{IN}		6	--	30	V
VCC UVLO Threshold	V_{UVLOTH}	V_{CC} Rising	--	5.5	--	V
VCC UVLO Hysteresis	$V_{UVLOHYS}$	V_{CC} Falling	--	0.5	--	V
Quiescent Supply Current	I_Q	No Switching	--	270	--	μA
Current Sense Voltage	V_{CS}	V_{IN}-C_{SN}	194	200	206	mV
Current Sense Threshold	V_{CS_HY}		--	15	--	%
CSN Input Current	I_{CSN}		--	3	--	μA
DIM Floating Voltage	V_{DIM_F}		--	3.8	--	V
DIM Input Leakage Current	I_{DIM}	V_{DIM}=5V	--	27	--	μA
DIM Pull Up Current	I_{DIM_PU}	V_{DIM}=0V	--	-25	--	μA
DIM Input High	V_{DIM_H}		2.5	--	--	V
DIM Input Low	V_{DIM_L}		--	--	0.3	V
DIM Voltage Range	V_{DIM}	V_{DIM} Rising	0.5	--	2.5	V
Min. Recommended PWM Dimming Frequency	F_{PWMmin}		--	0.1	--	KHz
Max. Recommended PWM Dimming Frequency	F_{PWMmax}		--	20	--	KHz
Max. Switch Frequency	F_{MAX}		--	1	--	MHz
MOSFET ON Resistance	$R_{DS(ON)}$		--	240	--	mΩ
Thermal Regulate	T_{REG}	Temp Rising	--	105	--	°C
Thermal Shutdown	T_{SH}		--	160	--	°C

Typical Characteristic Curves

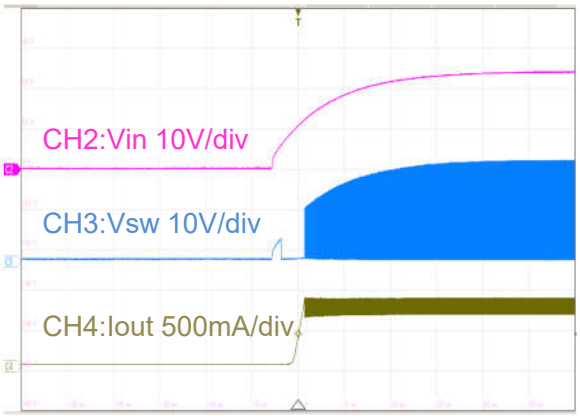
T_A = 25°C, V_{IN} =24V, R_{CS}=0.3Ω, unless otherwise noted





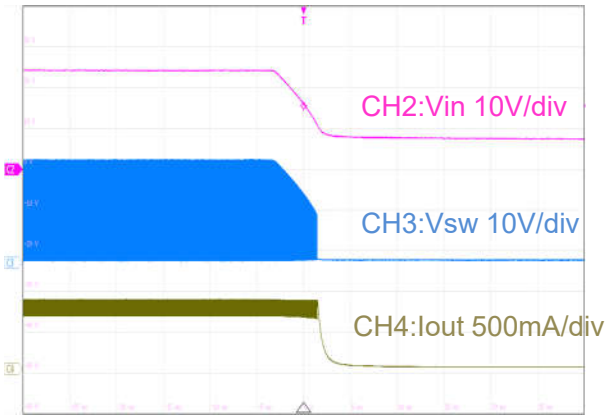
Power ON

(Vin=24V,L=33uH, 4LEDs)



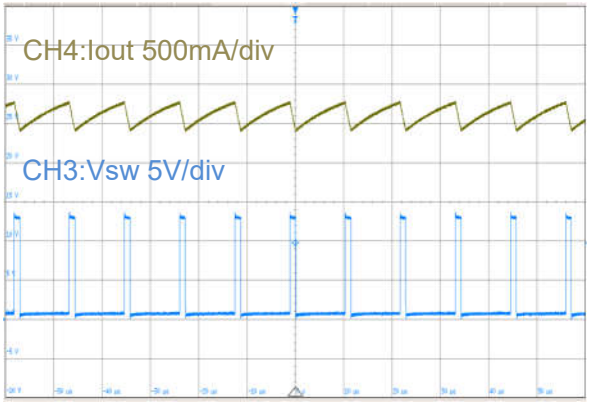
Power OFF

(Vin=24V,L=33uH, 4LEDs)



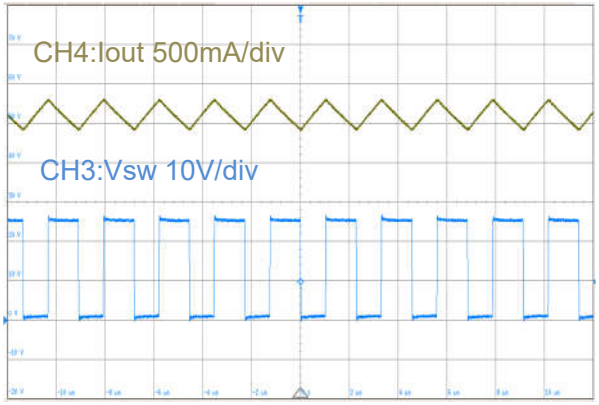
Operation waveform

(Vin=12V, L=33uH, 4LEDs)



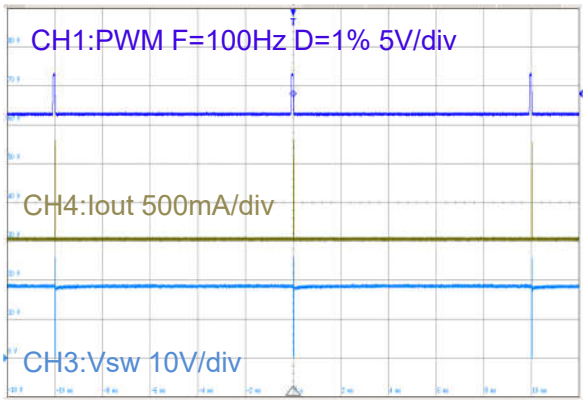
Operation waveform

(Vin=24V, L=33uH, 4LEDs)



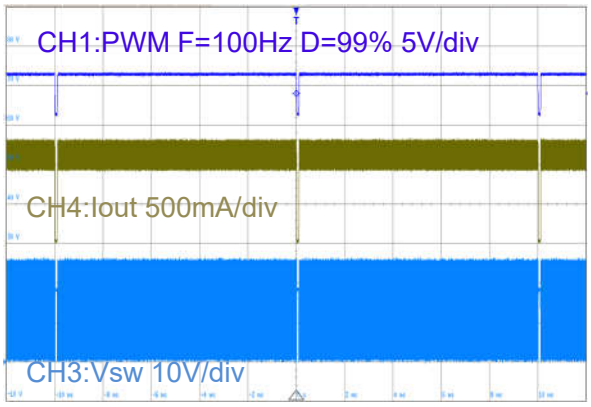
PWM Dimming

(Vin=24V, L=33uH, Iout=1A, 4LEDs)



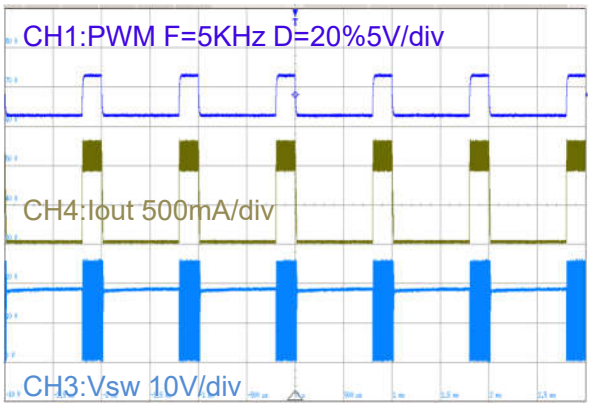
PWM Dimming

(Vin=24V, L=33uH, Iout=1A, 4LEDs)



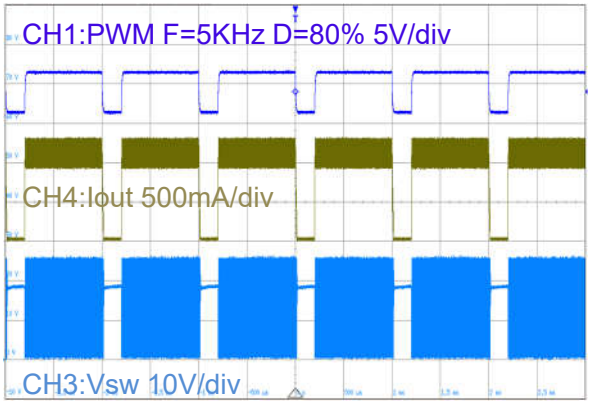
PWM Dimming

(Vin=24V, L=33uH, Iout=1A, 4LEDs)



PWM Dimming

(Vin=24V, L=33uH, Iout=1A, 4LEDs)



Operation

Steady State

The TNL4115SR is a step-down LED-current convertor that is easily configured for a wide input that ranges from 6V to 30V input. The TNL4115SR uses a High-side current-sense resistor to detect and regulate LED current. The average voltage across the current- sense resistor is measured and regulated in the 200mV range.

The internal 1.2V reference voltage provides a 0.5V reference to enable the part. When VDIM>0.5V, the output of the comparator goes high and enables the other blocks. While the internal DIM pin weak pull up to 3V

Dimming Control

The TNL4115SR allows the DIM pin to control both Analog and PWM dimming. Whenever the voltage on DIM is less than 0.3V, the chip turns off. For analog dimming, when the voltage on DIM is from 0.5V to 2.5V, the LED current will change from 0% to 100% of the maximum LED current. If the voltage on DIM pin is higher than 2.5V, output LED current will equal the maximum LED current. For PWM dimming, the signal amplitude must exceed 2.5V. Choose a PWM frequency in range of 100Hz to 20kHz for good dimming linearity.

Applications Information

Setting the LED Current

The LED current is identical and set by the current sense resistor between the CS pin and GND pin.

$$R_{SENSE}=200mV / ILED$$

For R_{SENSE}=0.2Ω, the LED current is set to 1A Selecting the Inductor Lower value of inductance can result in a higher switching frequency, which causes a larger switching loss. Choose a switch frequency between 100kHz to 500kHz for most application. According to switching frequency, inductor value can be estimated as

$$L=\frac{(1-V_{OUT}/V_{IN})\times V_{OUT}}{0.3\times I_{LED}\times f_{SW}}$$

For higher efficiency, choose an inductor with a DC resistance as small as possible.

Selecting the Input Capacitor

The input capacitor reduces the surge current drawn from the input supply and the switching noise from the device. Choose a capacitor of 100uF for most applications. The voltage rating should be greater than the input voltage. **U**se a low ESR capacitor for input decoupling.

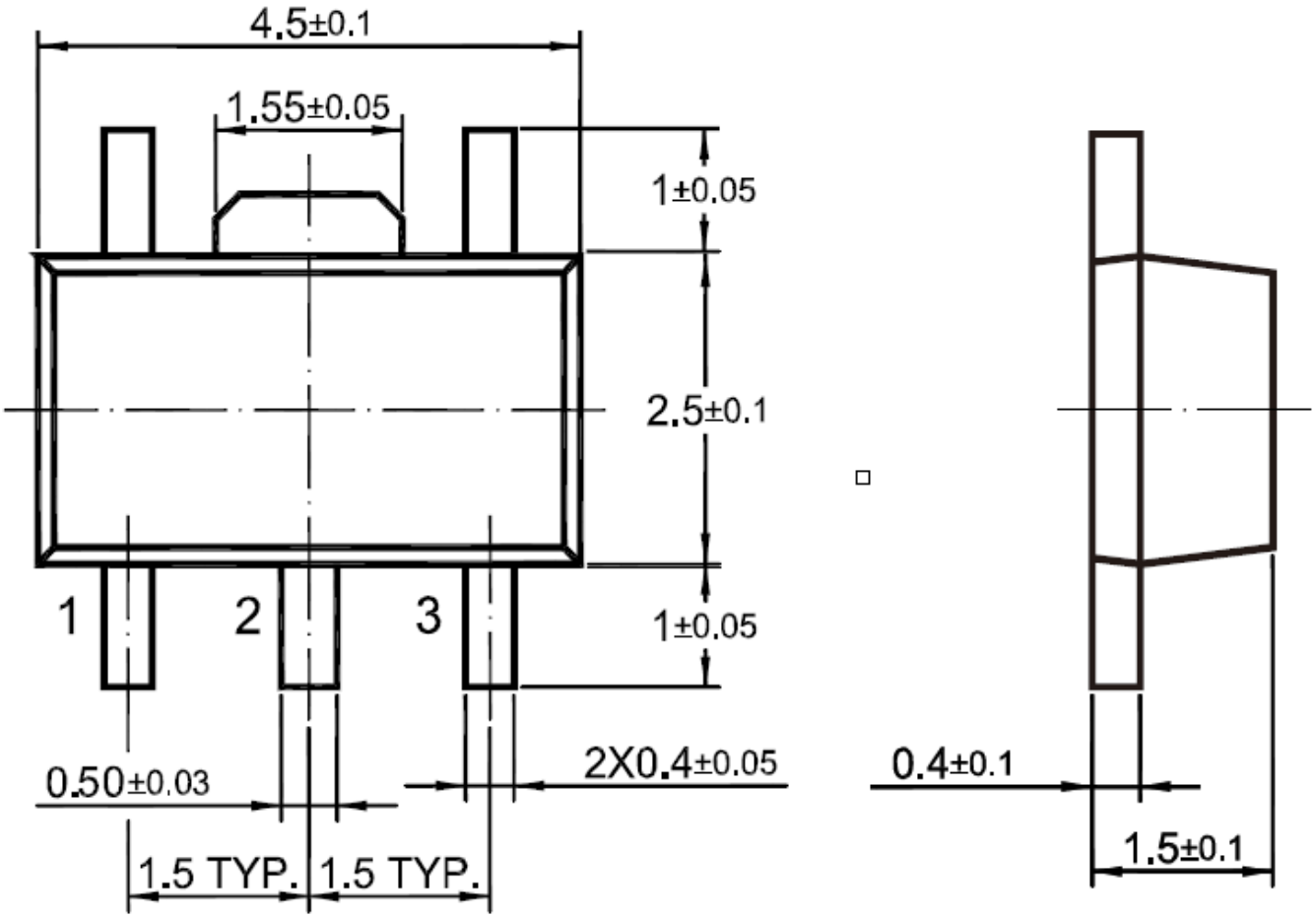
Layout Consideration

Pay careful attention to the PCB layout and component placement. RSENSE should be placed close to the CS pin and GND pin in order to minimize current sense error. The input loop—including input capacitor, Schottky diode, and MOSFET—should be as short as possible.

Package Outline

SOT-89-5

Dimensions in mm



Ordering Information

Device	Package	Shipping
TNL4115SR	SOT-89	1,000PCS/Reel&7inches
		3,000PCS/Reel&13inches

Contact Information

TANI website: **http://www.tanisemi.com** Email:tani@tanisemi.com

For additional information, please contact your local Sales Representative.

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