1A, Step-down High Brightness LED Driver

General Description

The HM4115 is a continuous conduction mode inductive step-down converter, designed for driving single or multiple series connected LED efficiently from a voltage source higher than the total LED chain voltage. The device operates from an input supply between 9V and 36V and provides an externally adjustable output current of up to 1A. Depending upon the supply voltage and external components, the HM4115 can provide more than 30 watts of output power.

The HM4115 includes the power switch and a high-side output current sensing circuit, which uses an external resistor to set the nominal average output current, and a dedicated DIM input accepts a wide range of pulsed dimming. The HM4115 is available in SOT89-5,TO-252, SOT-25 and MSOP-8L packages.

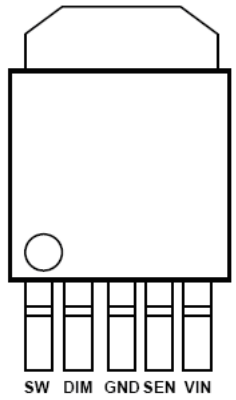
Features

- Wide input voltage range: 9V to 36V
- Up to 1A output current
- Single pin on/off and brightness control using PWM
- Up to 1MHz switching frequency
- Typical 3% output current accuracy
- Inherent open-circuit LED protection
- High efficiency (up to 96%)
- High-Side Current Sense
- Hysteretic Control: No Compensation
- Adjustable Constant LED Current

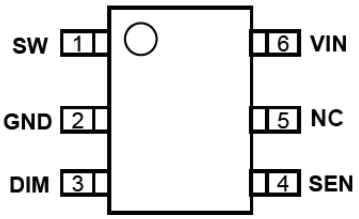
Applications

- Low voltage halogen replacement LEDs
- Automotive lighting
- Low voltage industrial lighting
- Illuminated signs

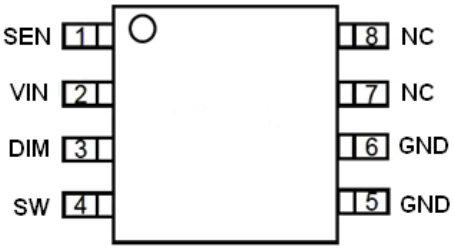
Pin Configuration



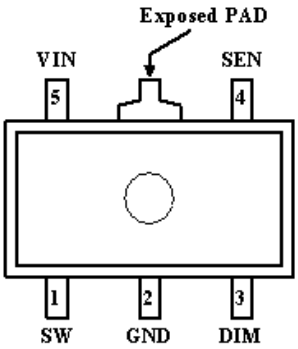
TO-252（HM4115T）



SOT-25（HM4115MR）



MSOP-8L（HM4115M）

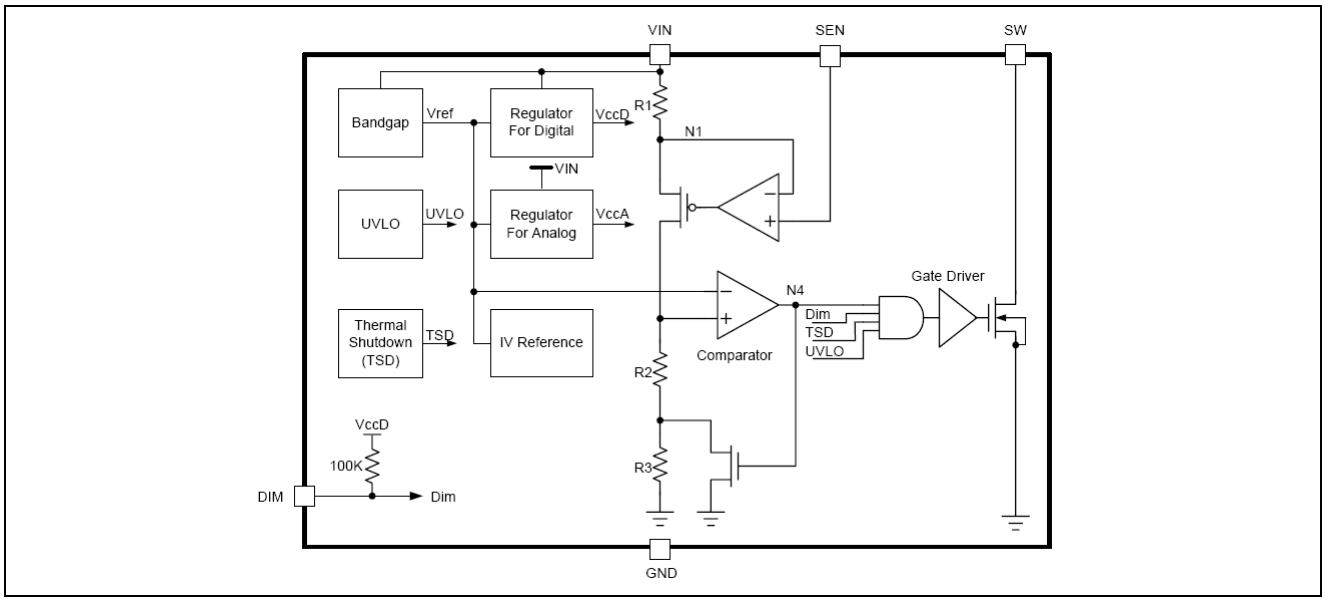


SOT89-5（HM4115）

Pin Function

PIN NAMES	DESCRIPTION
GND	Signal and power ground. Connect directly to ground plane.
SW	Switch Output. SW is the drain of the internal N-Ch MOSFET switch.
DIM	Logic level dimming input. Drive DIM low to turn off the current regulator. Drive DIM high to enable the current regulator.
SEN	Current sense input
VIN	Input Supply Pin. Must be locally bypassed.
NC	No connection
Thermal Pad	Internally connected to GND. Mount on board for lower thermal resistance.

Block Diagram



Functional Description

The device, in conjunction with the coil (L1) and current sense resistor (R_S), forms a self oscillating continuous-mode buck converter.

When input voltage VIN is first applied, the initial current in L1 and R_S is zero and there is no output from the current sense circuit. Under this condition, the output of CS comparator is high. This turns on an internal switch and switches the SW pin low, causing current to flow from VIN to ground, via R_S, L1 and the LED(s). The current rises at a rate determined by VIN and L1 to produce a voltage ramp (V_{CSN}) across R_S. When (V_{IN}-V_{CSN}) > 115mV, the output of CS comparator switches low and the switch turns off. The current flowing on the RS decreases at another rate. When (V_{IN}-V_{CSN}) < 85mV, the switch turns on again and the mean current on the LED is determined by

$$\left(\frac{85+115}{2}\ mV\right) / R_S = 100\ mV / R_S\ .$$

The high-side current-sensing scheme and on-board current-setting circuitry minimize the number of external components while delivering LED current with ±3% accuracy, using a 1% sense resistor.

The HM4115 allow dimming with a PWM signal at the DIM input. A logic level below 0.5V at DIM forces HM4115 to turn off the LED and the logic level at DIM must be at least 3.5V to turn on the full LED current. The frequency of PWM dimming ranges from 100Hz to more than 20 kHz.

The DIM pin is pulled up to the internal regulator (5V) by a 100KΩ resistor. It can be floated at normal working. When a voltage applied to DIM falls below the threshold (0.5V), the output switch is turned off.

If the connection to the LED(s) is open-circuited, the coil is isolated from the SW pin of the chip, so the device and LED will not be damaged.

To ensure the reliability, the HM4115 is built with a thermal shutdown (T_{SD}) protection function. The T_{SD} protests the IC from over temperature (165℃). When the chip temperature decreases (135℃), the IC recovers again.

Absolute Maximum Ratings

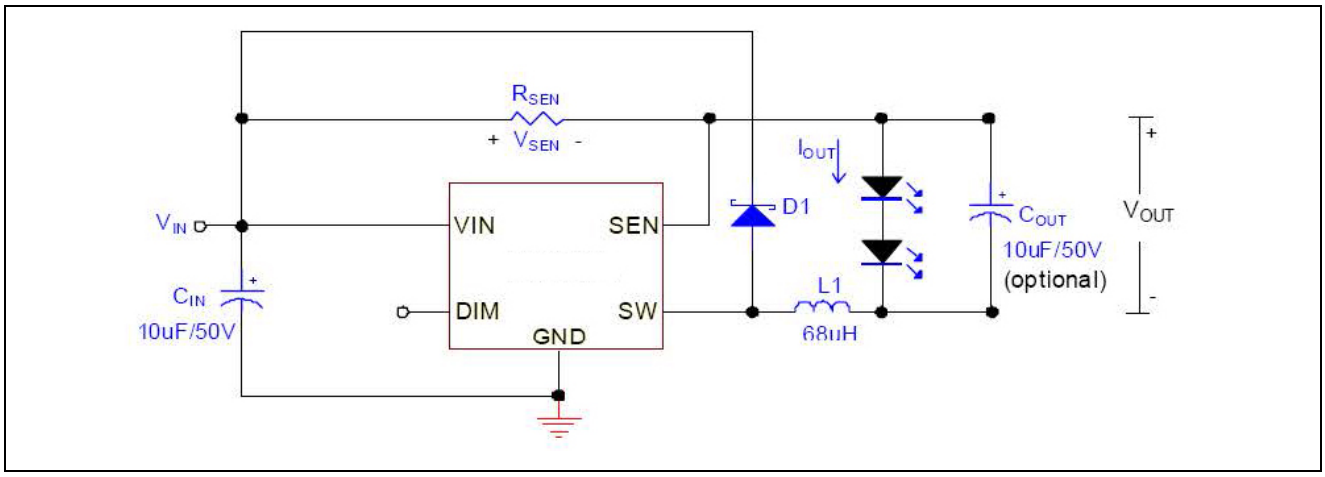
SYMBOL	ITEMS	VALUE	UNIT
V_{IN}	Supply Voltage	0~40	V
SW	Drain of the internal power switch	-0.5~45	V
DIM	Logic level dimming input	-0.3~6	V
I_{SW}	Switch output current	1.2	A
P_{DMAX}	Power Dissipation (SOT89-5)	1.5	W
P_{TR}	Thermal Resistance, SOT89-5 θ_{JA}	45	℃/W
T_J	Operation Junction Temperature Range	-40 to 150	℃
T_{STG}	Storage Temperature	-55 to 150	℃
	ESD Susceptibility (Note 3)	2	kV
T_{OPT}	Operating Temperature	-40 to +125	℃

Electrical Characteristics (Note 4,5)

The following specifications apply for V_{IN}=12V, T_A=25℃, unless specified otherwise.

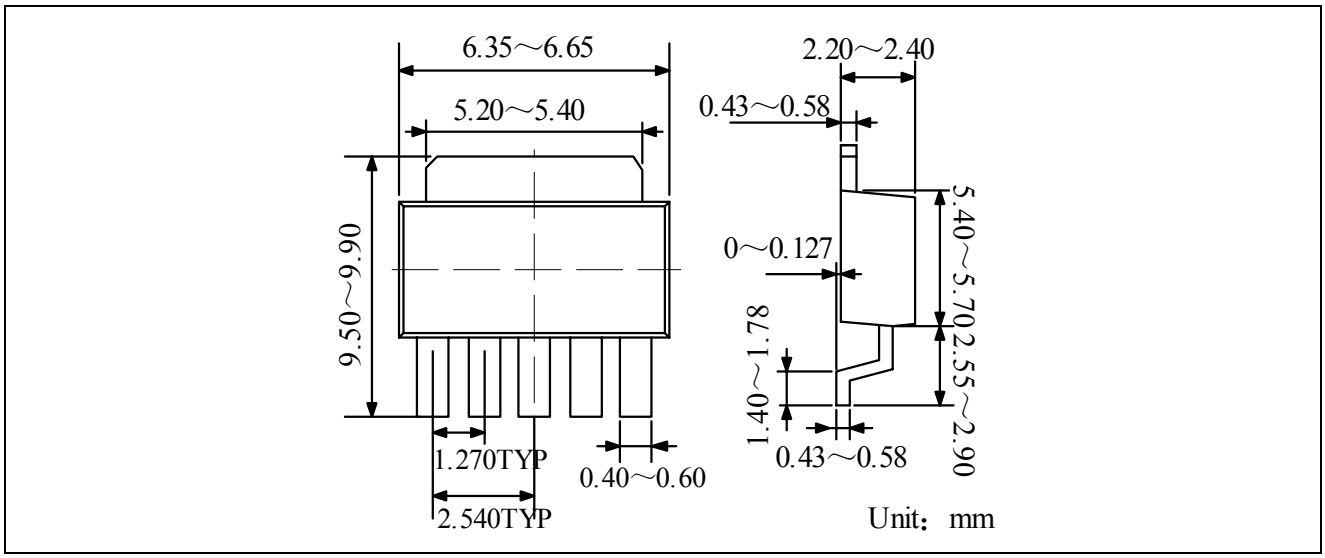
SYMBOL	ITEMS	CONDITIONS	Min.	Typ.	Max.	UNIT
V_{IN}	Input Voltage		9		36	V
V_{UVLO}	Under voltage lock out	V_{IN} falling	5.4	5.8	6.1	V
$V_{UVLO, HYS}$	UVLO hysterisis	V_{IN} rising		200		mV
F_{SW}	Max. Switching Frequency				1	MHz
Current Sense						
V_{SEN}	Mean current sense threshold voltage	V_{IN}-V_{SEN}	95	100	105	mV
Operating Current						
I_{IN}	supply current	VIN=9~36V		1	2	mA
DIM Input						
V_{DIM}	Internal supply voltage	DIM floating		5		V
V_{DIM_H}	DIM input voltage High		3.5			V
V_{DIM_L}	DIM input voltage Low				0.5	V
$Duty_{DIM}$	Duty cycle range of low frequency dimming	f_{DIM} =100Hz~1KHz	1		100	%
R_{DIM}	DIM pull up resistor to Internal supply voltage			100		KΩ
Output Switch						
R_{SW}	SW On Resistance	V_{IN}=12V		0.45		Ω
I_{SWmean}	Continuous SW Current				1	A
I_{LEAK}	SW Leakage Current			0.5	5	μA
Thermal Shutdown						
T_{SD}	Thermal Shutdown Threshold			165		℃
T_{SD-hys}	Thermal Shutdown hysteresis			30		℃

Application Circuits

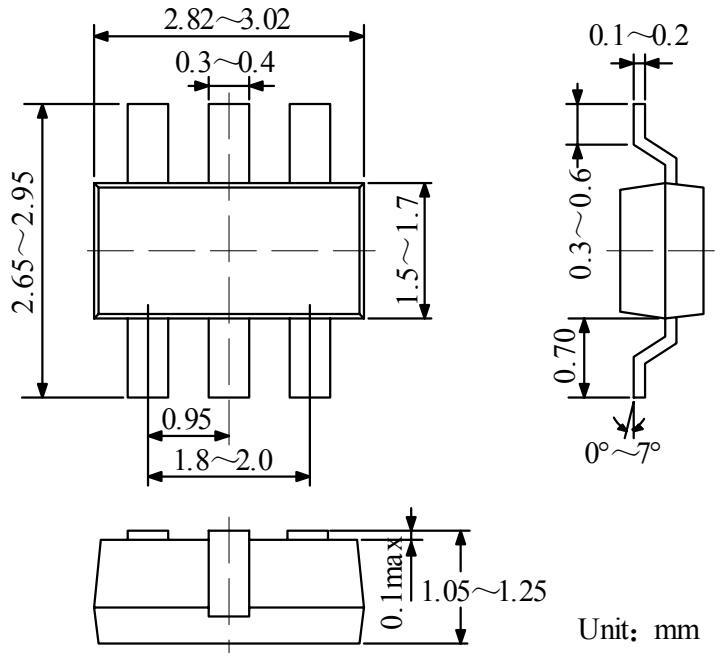


Package Dimension

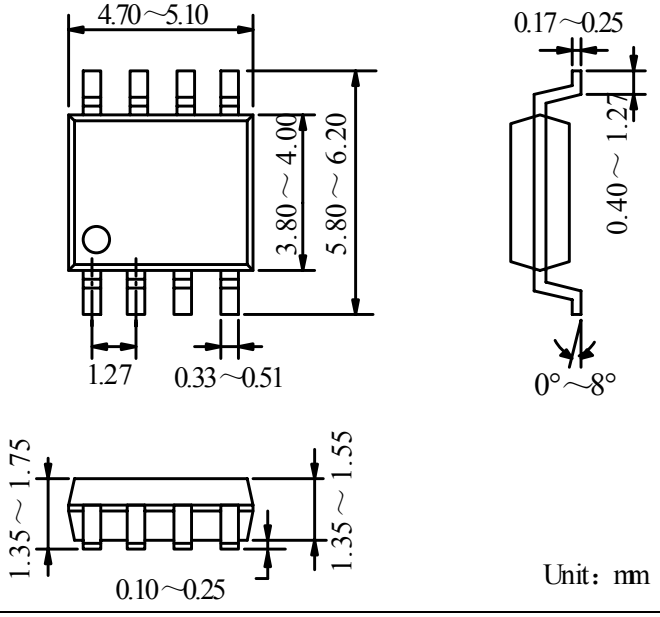
TO-252



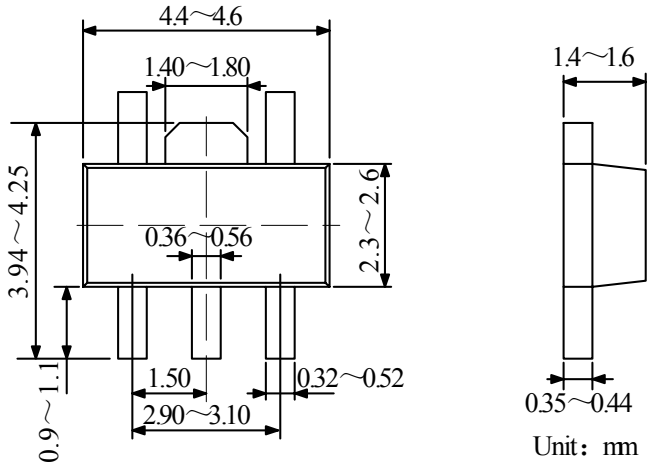
SOT-25



MSOP-8L



SOT89-5


4.4～4.6
1.40～1.80
3.94～4.25
0.36～0.56
2.3～2.6
1.50
0.32～0.52
2.90～3.10
0.9～1.1
1.4～1.6
0.35～0.44
Unit：mm