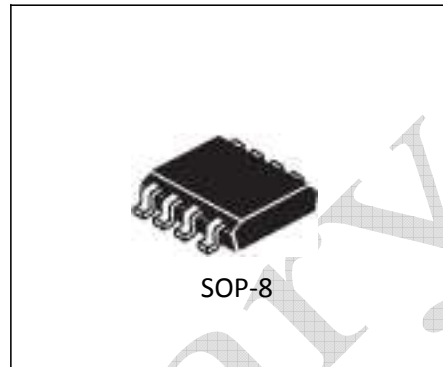# AMAS**IC**

AP9910

Power LED Driver

Features

- PWM power LED driver with output driving current up to 1.5A

- Wide range system supply operation (8 V - 20 V, chip supply voltage 4V to 6V)

- Cascode LED configuration

- Constant current output

- Thermal overload protection

- Under voltage lock out

SOP-8

Description

The AP9910 is a driver IC aiming at LED replacement of low voltage (12V) MR-16 Halogen lamps.

On-chip shunt regulator provides stabilized chip voltage even when line voltage fluctuates.

Regulated LED current.

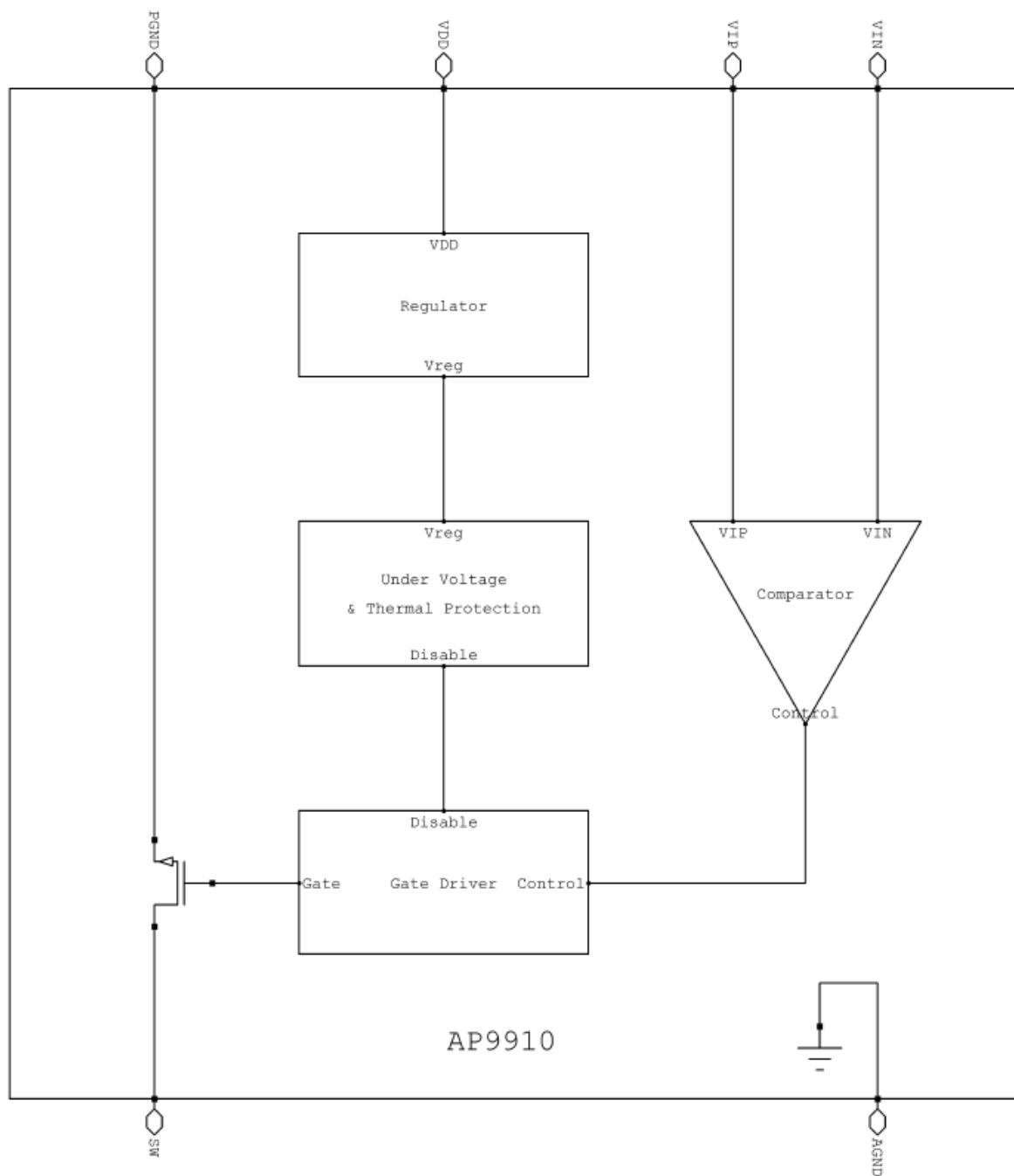Over temperature protection and under voltage lock out.

Table 1. Device summary

Order code	Operating Temp. range	Package	Packing
AP9910	0°to 70°C	SOP8	Tube

1 Device block diagram

Figure 1 shows the block diagram of the AP9910 LED driver.

Figure 1.   Internal block diagram

2 Pin description

2.1 Pin out

Figure 2. Pin connection (top view, PCB view)

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    PGND  VDD   VIP   VIN
                        ○
          AP9910

     SW   SW   AGND  AGND
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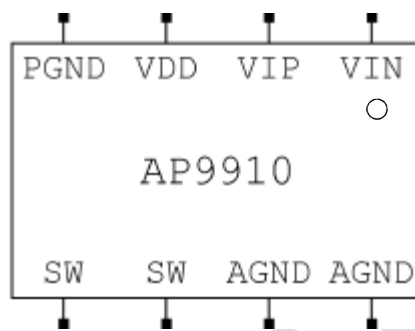
2.2 Pin list

Table 1. Pin description

Number	Name	Type	Description
1	VIN	INPUT	Negative input of differential amplifier. Sensing the current going through the external Power MOSFET as well as the LED chain.
2	VIP	INPUT	Positive input of differential amplifier. Sensing the current going through the external Power MOSFET as well as the LED chain.
3	VDD	POWER	Power supply for the controller chip. With the help of on-chip shunt regulator and an external voltage adjusting resistor, chip supply voltage can be stabilized over a wide range of system supply voltage
4	PGND	POWER	Ground pin for internal MOSFET driver.
5,6	SW	OUTPUT	The driving signal for the external LED. Sufficient driving for 1.5A loading current
7,8	AGND	POWER	Ground pins for analog circuit

3 Electrical specifications

3.1 Absolute maximum ratings

Table 2.   Absolute maximum ratings

Symbol	Parameter	Value	Unit
VIP,VIN	DC Input Voltage	20	V
VSW	Maximum Loading Voltage	20	V
Idd	DC supply current for Vdd	10m	A
T_{op}	Operating temperature	0 to 70	℃
T_j	Junction temperature	−40 to 150	℃
T_{stg}	Storage temperature	−40 to 150	℃
HBM	ESD Susceptibility	2000	V
MM	ESD Susceptibility	200	V

3.2 Thermal data

Table 3.   Thermal data

Symbol	Parameter	Min	Typ	Max	Unit
$R_{th\ j\text{-}case}$	Thermal resistance, junction to case		TBD		
$R_{th\ j\text{-}amb}$	Thermal resistance, junction to ambient (mounted on recommended PCB)[1]		TBD		℃/W

3.3 Electrical specifications

Unless otherwise stated, the results in *Table 4* below are given for the conditions: Vdd = 5 V   and T_A = 25 ℃.

Table 4.   Electrical specifications

Symbol	Parameter	Condition	Min	Typ	Max	Unit
V_{DD}	Internally regulated supply voltage	$I_{DD} = 3.5\text{mA}$	4.5	5	5.5	V
V_{UV}	Under voltage triggering voltage			4		V
I_q	Total quiescent current	$R_{VDD}{}^* = 2\text{K}\,\Omega,\ V_{in} = 12V$		3.5		mA
T_j	Junction temperature at thermal shut-down			TBD		℃
Vid+	Average Current sensing voltage threshold			0.13		V
Vid_hys	Hysteresis of Current sensing voltage			+/- 15		%

* Refer to Figure 3 of Application Circuit section

Table 4.   **Electrical specifications (continued)**

Symbol	Parameter	Condition	Min	Typ	Max	Unit
R_{SW}	SW on resistance			0.1		Ohm
I_{SW}	Maximum output current			1.5		A

4   Application circuit

Figure 3.   Application Circuit
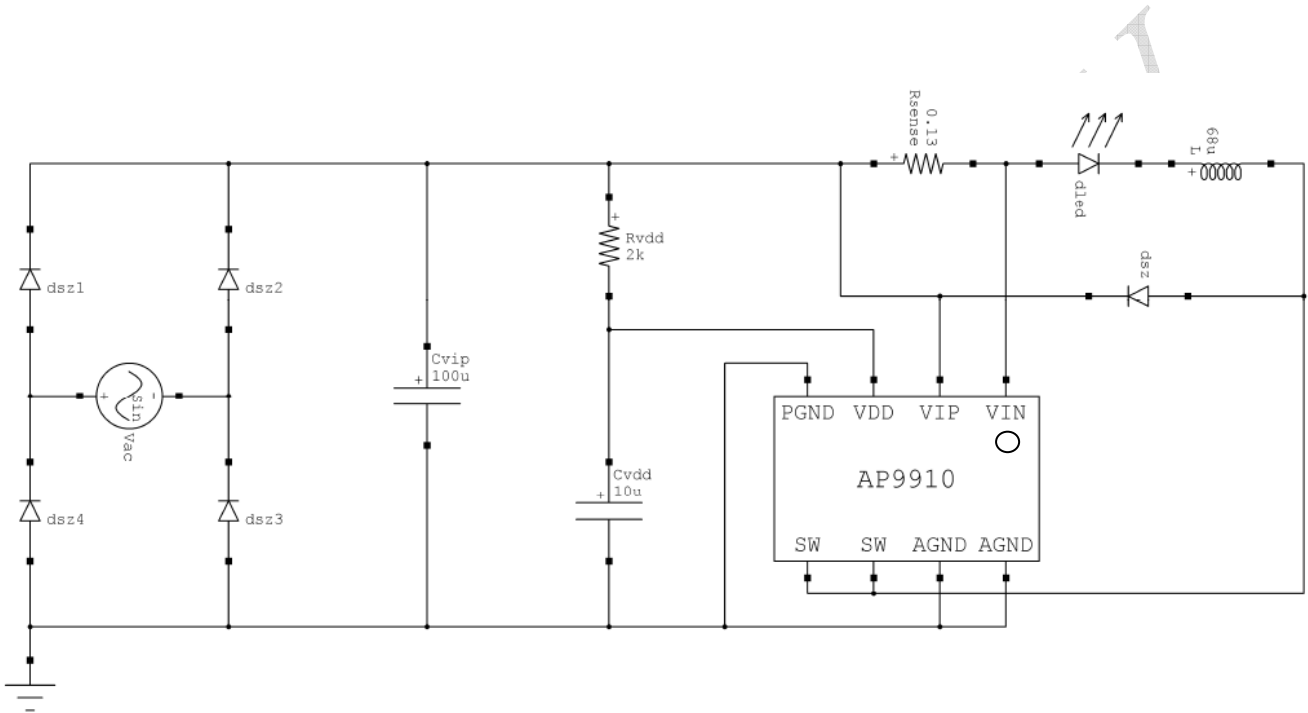
Component Table

Device ID	Description	Part Number	Vendor
AP9910	Controller IC	AP9910	AMASIC
Cvip	Supply decoupling E-cap	100µF	
Cvdd	Regulator decoupling Ceramic capacitor	2.2µF	
dsz1 – dsz4, dsz	Schottky Diodes	MBR130T1 or SS14	OnSemi
Rsense	Metal film resistor	0.27Ω , 0.1W (350mA)	
Rvdd	5% resistor	2K Ω	
L	Inductor	68µH, 1A	

5 Functional Description

The AP9910 drives an LED chain in a buck converter fashion.

5.1 The Shunt Regulator

An on-chip shunt voltage reference regulates the chip supply voltage so that the system can work up to a relatively high voltage, e.g. 20V, even the chip itself is designed on a low voltage CMOS technology.   Maximum operating voltage is around 20V and depends on the maximum dissipation on the voltage adjusting resistor R_{VDD}.   Apart from the line voltage fluctuation, transient on the line in can also be smoothed out by the shunt regulator and safe operation of the chip is hence guaranteed.

When system supply voltage goes below a certain level, the chip will enter under voltage protection mode.   The device will be turned off until the abnormal condition is removed.

5.2 Gate Driver

The gate driver senses the voltage difference between VIP and VIN to control the Power MOS.   During startup, the Power MOS is turned on and the voltage difference increases. When it is greater than 0.15V, the Power MOS is turned off until the voltage difference drops to 0.11V.   So the LED current will be well controlled within $0.11V/R_{sense}$ and $0.15V/R_{sense}$.

6   Package information

The AP9910 comes in a 8-pin PSOP package.

Figure 4 below shows the package outline and gives the dimensions.

Figure 4   SOP-8 outline drawing