DESCRIPTION

The A9913 is a high voltage buck control IC for constant LED current regulation. The A9913 operates constant off-time mode. It allow efficient operation of High Brightness (HB) LEDs from voltage sources ranging from 8VDC up to 450VDC or 12VAC~265VAC.

The A9913 is available in SOT-26 package.

ORDERING INFORMATION

Package Type	Part Number	
SOT-26	E6	A9913E6R
		A9913E6VR
Note	V: Halogen free Package R: Tape & Reel	
AiT provides all RoHS products Suffix " V " means Halogen free Package		

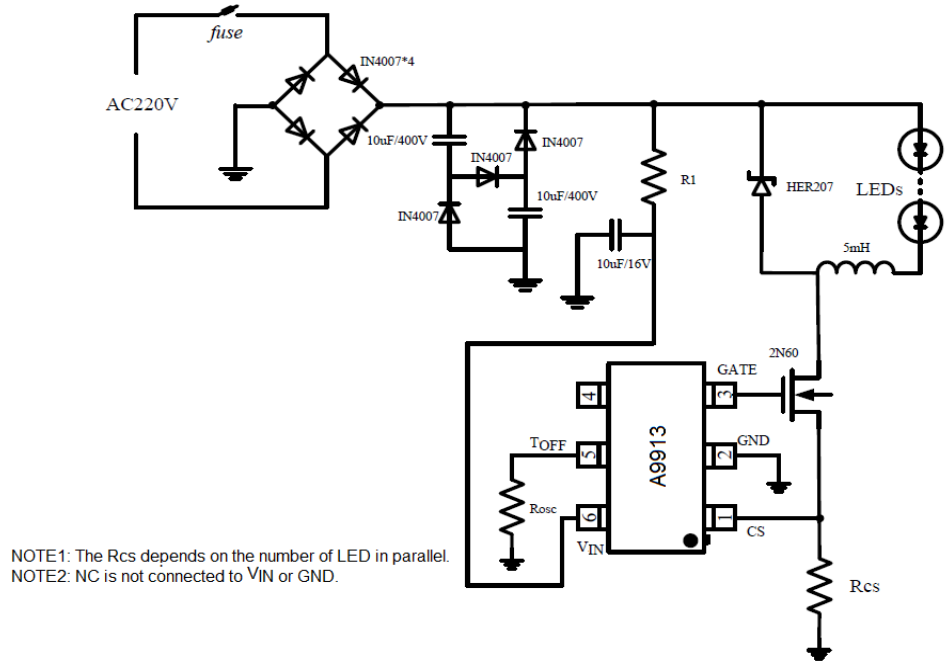
FEATURES

- Switch mode controller for single switch LED Drivers
- Open loop peak current controller
- Wide Input range from 8VDC~450VDC or 12VAC~265VAC
- Application from a few mA to more than 1A output
- Up to hundreds of LEDs
- Constant off-time operation
- Requires few external components for operation
- Available in SOT-26 Package

APPLICATION

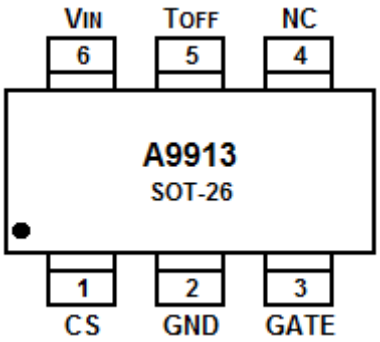
- DC/DC or AC/DC LED driver applications
- RGB backlighting LED driver
- General purpose constant current source
- Signal and decorative LED lighting

TYPICAL APPLICATION



NOTE1: The Rcs depends on the number of LED in parallel.
NOTE2: NC is not connected to V_{IN} or GND.

PIN DESCRIPTION



Top View

Pin #	Symbol	Function
1	CS	This pin is the current sense pin used to sense the FET current by means of an external sense resistor.
2	GND	Ground.
3	GATE	This pin is the output gate driver for an external N-channel power MOSFET.
4	NC	No connect
5	T_{OFF}	This pin sets the off time of the power MOSFET and this chip operates in constant off time mode. It can be floating with the internal set off time 510ns. When a resistor is connected between T_{OFF} and GND, the off time is increased.
6	V_{IN}	This pin is the input of an 8V~450V voltage supply through a resistor, it must be bypassed with a capacitor to GND.

ABSOLUTE MAXIMUM RATINGS

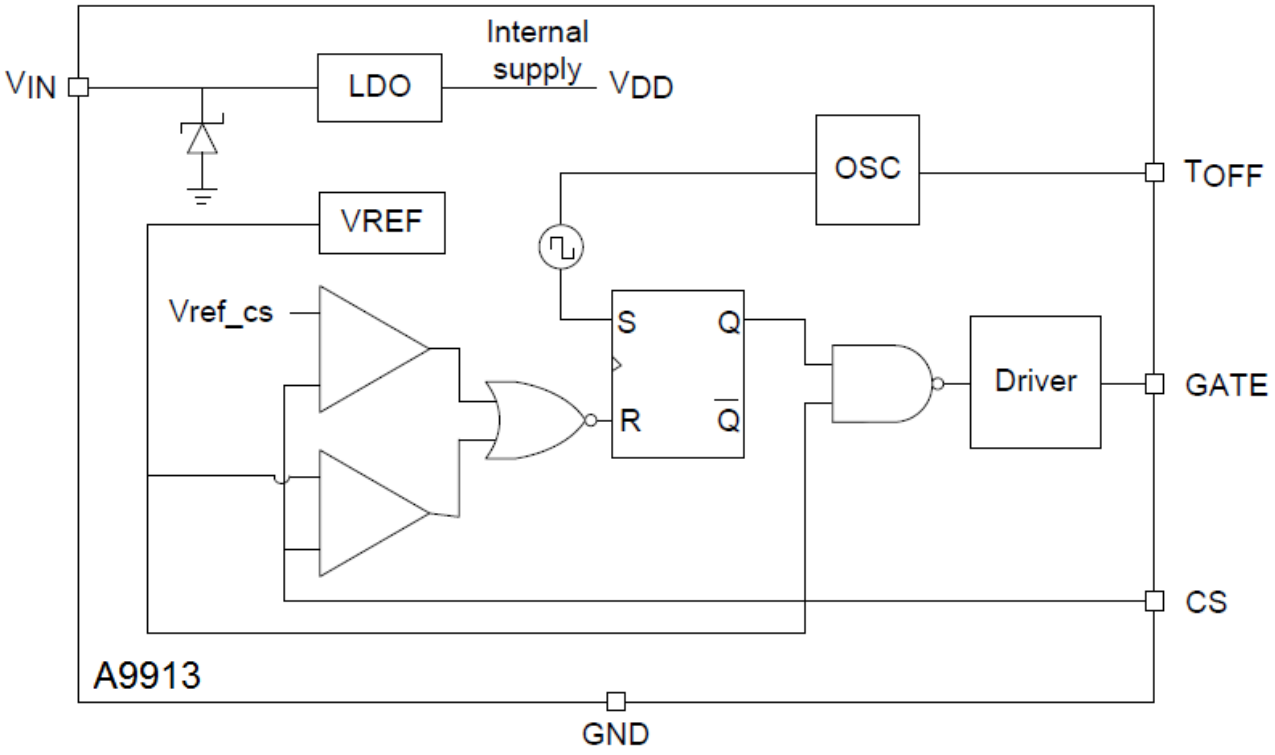
V_{IN}, V_{IN} pin Voltage to GND	-0.3V~14V
CS, T_{OFF} pin Voltage to GND	-0.3V~6V
V_{GATE},GATE pin to GND	-0.3V~12V
I_{VIN}, V_{IN} pin Input Current Range	1mA ~20mA
T_{STG}, Storage Temperature Range	-40℃~150℃
T_J, Operating Junction Temperature	-40℃~150℃
ESD Human Model	4000V

Stress beyond above listed “Absolute Maximum Ratings” may lead permanent damage to the device. These are stress ratings only and operations of the device at these or any other conditions beyond those indicated in the operational sections of the specifications are not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

ELECTRICAL CHARACTERISTICS

Parameter	Symbol	Conditions	Min.	Typ.	Max.	Unit
Input DC Supply Voltage Range	V_{INDC}		8		450	V
V_{IN} Clamp Voltage	V_{IN_clamp}		6.0	6.5	7.0	
Operation Current Range	I_{IN}	V_{IN}=10.5V, GATE floating		0.4	1	mA
Under Voltage Lockout Threshold	UVLO	V_{IN} rising		5.5		V
Under Voltage Lockout Hysteresis	ΔUVLO	V_{IN} falling		700		mV
Current Sense pull-in Threshold Voltage	V_{CSTH}			500		mV
Off time	T_{OFF}	T_{OFF} pin Floating		510		ns

BLOCK DIAGRAM



DETAILED INFORMATION

Application Information

The A9913 is optimized to drive buck LED drivers using open-loop peak current mode control. This method of control enables fairly accurate LED current control without the need for high side current sensing or the design of any closed loop controllers. The IC uses very few external components and enables both Linear and PWM dimming of the LED current.

A capacitor connected to the T_{OFF} pin programs the off-time. The oscillator produces pulses at regular intervals. These pulses set the SR flip-flop in the A9913 which causes the GATE driver to turn on. When the FET turns on, the current through the inductor starts ramping up. This current flows through the external sense resistor R_{CS} and produces a ramp voltage at the CS pin. The comparators are constantly comparing the CS pin voltage to both the voltage at the LD pin and the internal 500mV. Once the blanking timer is complete, the output of these comparators is allowed to reset the flip flop. When the output of either one of the two comparators goes high, the flip flop is reset and the GATE output goes low. The GATE goes low until the SR flip flop is set by the oscillator. Assuming a 30% ripple in the inductor, the current sense resistor R_{CS} can be set using:

$$R_{CS} = \frac{0.5V}{(1+0.3/2)*I_{LIMT}} \approx \frac{0.43}{I_{LIMT}}$$

A constant off-time peak current control scheme can easily operate at duty cycles greater than 0.5 and also gives inherent input voltage rejection making the LED current almost insensitive to input voltage variations.

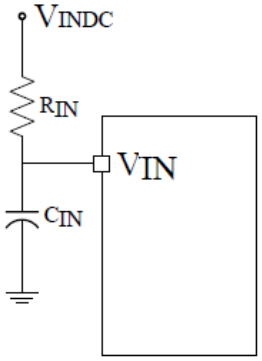
Input Voltage Regulator

When a voltage is applied at the decent resistor, the A9913 maintains a constant 6.5V at the V_{IN} pin. This voltage is used to power the IC and any external resistor dividers needed to control the IC. The V_{IN} pin must be bypassed by a low ESR capacitor to provide a low impedance path for the high frequency current of the output GATE driver.

The input current draw from the V_{IN} pin is a sum of the 1.0mA current draw by the internal circuit and the current drawn by the GATE driver (which in turn depends on the switching frequency and the GATE charge of the external FET).

The IC is allowed of input maximum current draw from the V_{IN} pin is about 20mA, so the resistor between V_{IN} pin and V_{IN} input can be set using:

$$R_{max} = \frac{V_{DCmin} - 6.5V}{1mA} \; ; \quad R_{min} = \frac{V_{DCmax} - 6.5V}{20mA}$$



The R_{IN}'s value must be between R_{MAX} and R_{MIN}.

Current Sense

The current sense input of the A9913 goes to the non inverting inputs of two comparators. The inverting terminal of one comparator is tied to a reference from DIM pin whereas the inverting terminal of the other comparator is connected to the RNTC pin. The outputs of both these comparators are fed into an OR GATE and the output of the OR GATE is fed into the reset pin of the flip-flop. Thus, the comparator which has the lowest voltage at the inverting terminal determines when the GATE output is turned off.

The outputs of the comparators also include a 50-280ns blanking time which prevents spurious turn-offs of the external FET due to the turn-on spike normally present in peak current mode control. In rare cases, this internal blanking might not be enough to filter out the turn-on spike. In these cases, an external RC filter needs to be added between the external sense resistor (R_{CS}) and the CS pin.

Please note that the comparators are fast (with a typical 80ns response time). A proper layout minimizing external inductances will prevent false triggering of these comparators.

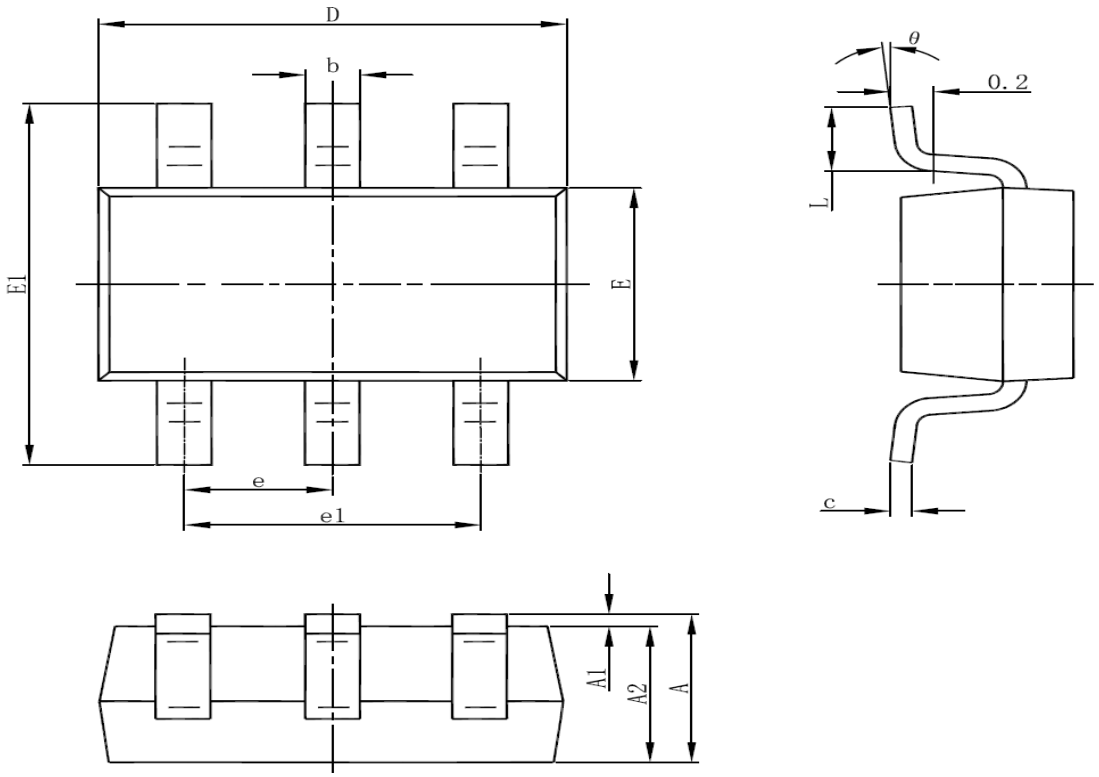
Oscillator

The oscillator in the A9913 is controlled by a single resistor connected at the T_{OFF} pin. The equation governing the $T_{OFF-TIME}$ of oscillation period is given by:

$$T_{OFF-TIME} = 45 \times 10^{-12} \times R_{OSC}$$

PACKAGE INFORMATION

Dimension in SOT-26 Package (Unit: mm)



SYMBOL	MIN	MAX
A	1.050	1.250
A1	0.000	0.100
A2	1.050	1.150
b	0.300	0.500
c	0.100	0.200
D	2.820	3.020
E	1.500	1.700
E1	2.650	2.950
e	0.950(BSC)	
e1	1.800	2.000
L	0.300	0.600
θ	0°	8°

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