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COOLED ACDrv2.2 AC LED Driver

Low Cost, High Efficiency, High PF, Low THD, TRIAC Dimming
Easy to Use, AC Drive Directly, 4 segments

Datasheet

Features:

- ❑ LEDs driven directly from AC line
- ❑ Adjustable power setting
- ❑ Flexible with different kinds of Vf LEDs
- ❑ Scalable to higher power using external FETs, up to 75W per driver
- ❑ Constant current precision at 2%
- ❑ Constant power compensation
- ❑ High efficiency, more than 90% at optimized configuration
- ❑ High power factor, up to 0.98
- ❑ Low THD, 16% THD typical (4 segments)
- ❑ Daisy chain configuration, support multiple chip configuration for more segments control
- ❑ Support AC100V/220V, up to 300V operation
- ❑ 50/60 Hz operation
- ❑ Compatible with TRIAC dimming (Leading/Trialing edge)
- ❑ PWM and analog dimming
- ❑ Over voltage protection
- ❑ Over temperature protection
- ❑ Minimum number of external components
- ❑ Small package TSSOP14

Application:

- ❑ Downlight retrofit lighting
- ❑ LED Tube
- ❑ LED Street lamp
- ❑ High Bay

Description:

ACDrv2.2 is designed For AC directly driving LED, with creative architecture, ACDrv2.2 eliminates the Bulk capacitor and transformer, which are the bottleneck of LED lamp life time.

ACDrv2.2 provides a ideal driver for LED lighting with low cost, compact size, stable and long lifetime.

ACDrv2.2 integrates all the necessary components in single chip, driven by AC line directly. With external resistors, the four segments LED current could be set separately, which increases the LED utilization ratio and improves the THD.

With external MOSFET configuration, the driver power configuration is flexible up to 75W per driver.

Driver based on ACDrv2.2 has a ideal power parameters such as PF, Efficiency, THD,EMI.

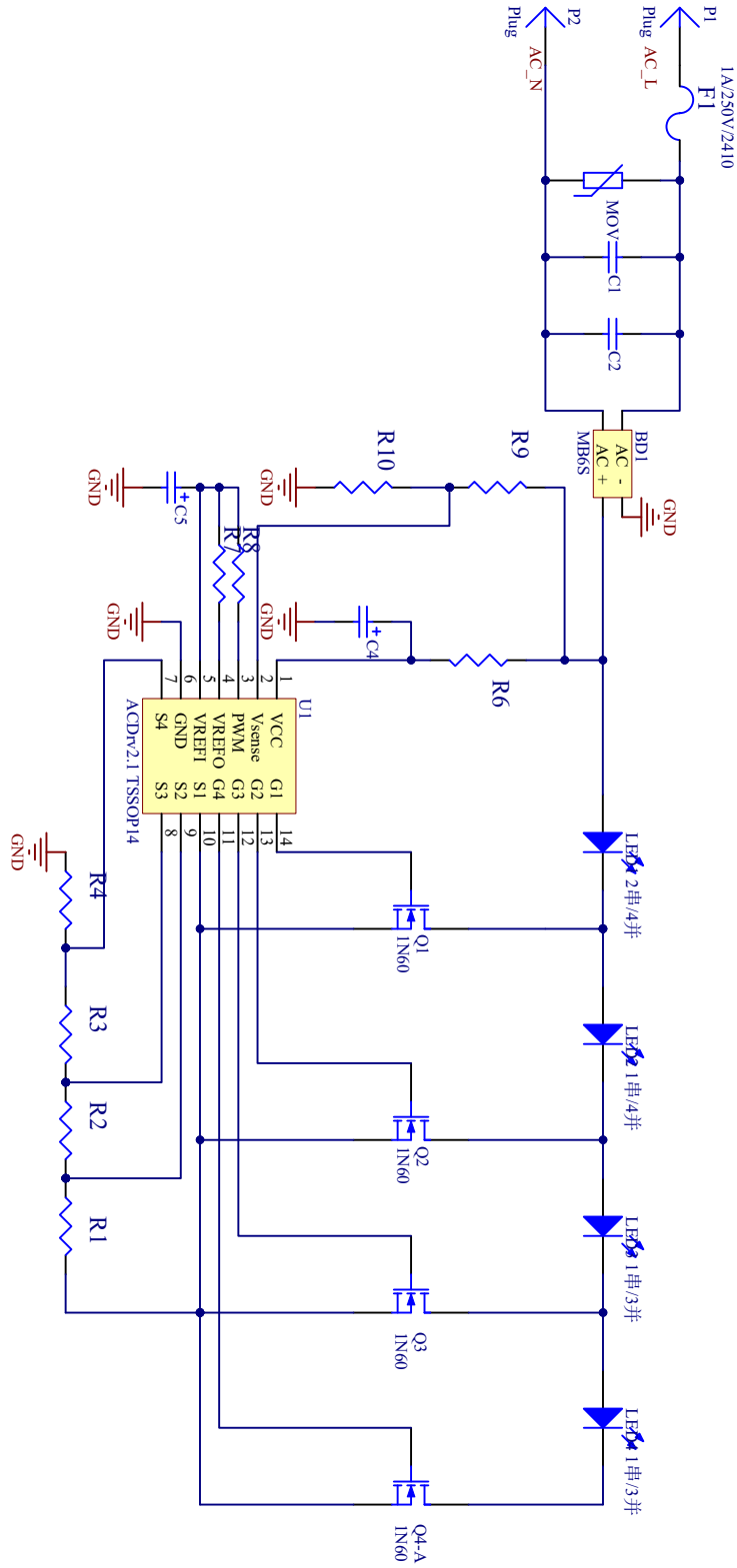
With integrated power compensation, the driver system input power keep constant when the input voltage changing.

ACDrv2.2 is compatible with various brands TRIAC, also supports PWM and 0-10V analog dimming.

Order information:

PART NO	PACKAGE	DELIVERY
ACDrv2.2-C	TSSOP14	Reel
ACDrv2.2-D	Die	Wafer

Typical Application



30W Street Lamp Application Circuit

Operation Principle

LED1,LED2,LED3,LED4 indicates a series string of LEDs or HVLEDs, for example at 220V input voltage, the LED1 LED2 LED3 LED4 could be Vf 65V HVLEDs.

The 220 VAC line is connected to a bridge rectifier to generate a rectified half sine waveform.

The LEDs and Driver are powered by the rectified AC voltage.

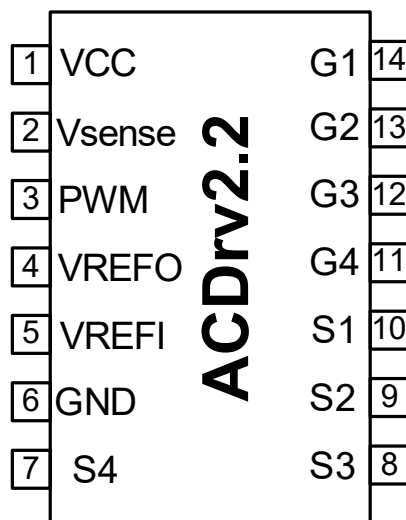
Current of LED1 LED2 LED3 LED4 are set by the four external sense resistors R1~R4.

As the rectified voltage rises from 0V and overcomes the Vf of LED1, the internal control logic will control the LED1 to be lighted and set current in constant level 1, When the rectified line voltage continues to rise and overcomes the combined Vf of LED1 and LED2, the internal control logic will control the LED1 and LED2 To be lighted and set current in constant level 2, so on for LED1 LED2 LED3 series.

As the rectified voltage continues to rise on its positive slope and overcomes the combined Vf of LED1 LED2 LED3 LED4, control logic will control the LED1 to LED4 To be lighted and set current in constant level 4.

The control Logic will detect the LED VF and current of every segment LED to decide the internal state machine operation. The selection of forward voltage of LED has no limitation to make the system work, But note the total voltage in series could be close to the peak voltage of peak rectified voltage in order to have a high conversion efficiency. For example in 220V application, the suggested total Vf of LED is from 260-270V

Pin Description



No.	Name	Type	Description
1	VCC	Power	Supply of IC
2	VSENSE	Input	Sense pin of line voltage, resistors divide from rectified voltage to GND
3	PWM	Input	The pin is used to module the VrefO to generate Vrefi According to input AC voltage, When AC input voltage is higher, the PWM on duty(Low level) is longer.
4	VREFO	Output	Reference voltage output Pin, the output voltage of VREFO is 1V
5	VREFI	Input	Reference voltage input pin, the regulation voltage of S1-S4 is define by this pin. Analog Dimming Pin
6	GND	GND	Ground of IC
7	S4	Input	The 4 th segment LED current feedback input
8	S3	Input	The 3rd segment LED current feedback input
9	S2	Input	The 2nd segment LED current feedback input
10	S1	Input	The 1st segment LED current feedback input
11	G4	Output	The 4 th segment LED current control output
12	G3	Output	The 3rd segment LED current control output
13	G2	Output	The 2nd segment LED current control output
14	G1	Output	The 1st segment LED current control output

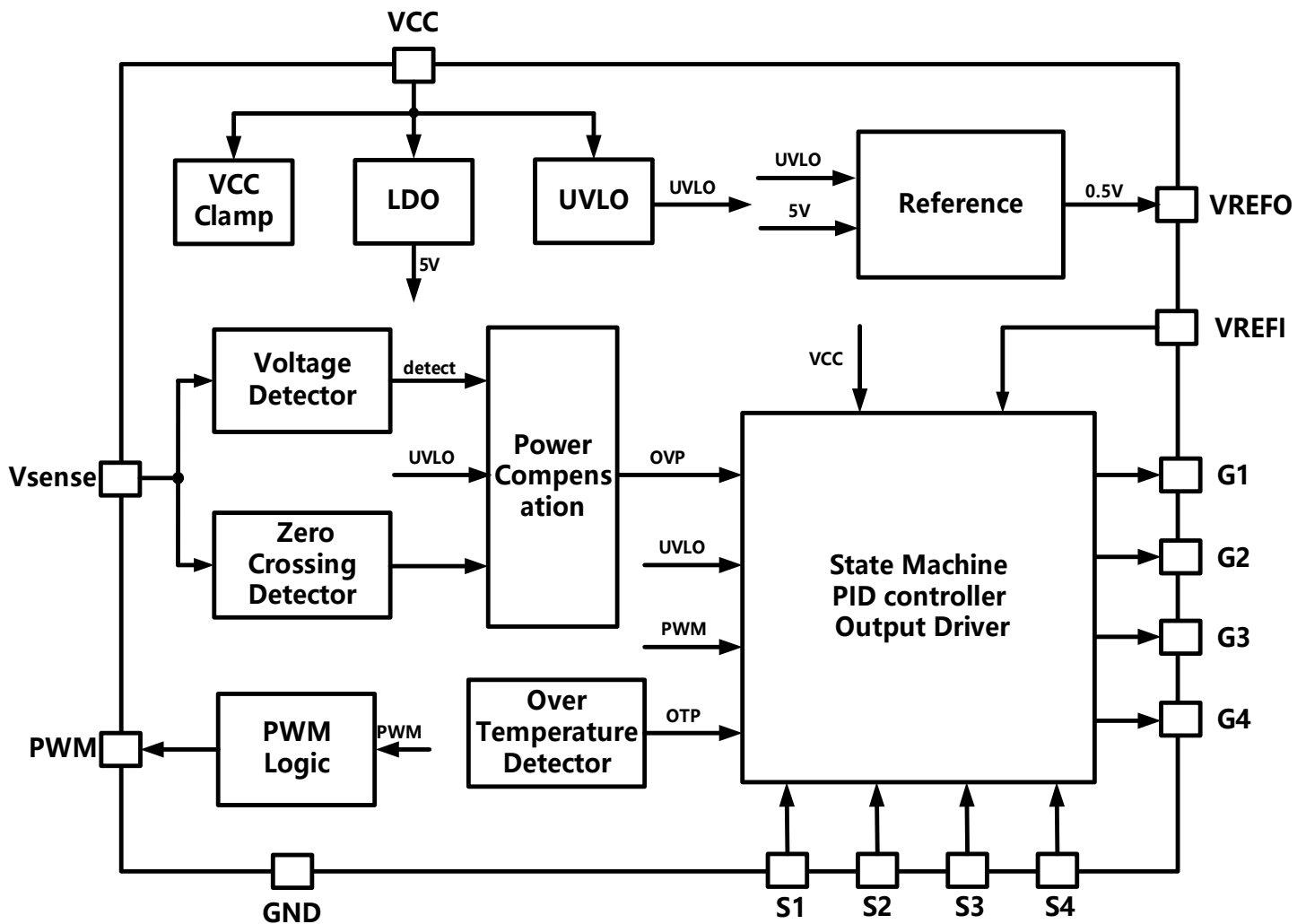
Block Diagram

UVLO:

This UVLO will monitor the voltage of VCC, when the voltage is higher than 6.5V, the UVLO block then enable the functional blocks and IC starts to work, and when the voltage of VCC is lower than 6V, the functional block will be disabled. A hysteresis of 2V is implemented so that the UVLO will not oscillate.

LDO :

The LDO generates the internal power supply, +5V. for all internal control logic and analog blocks, For the MOS control block, output driver uses power supply directly from the VCC in order to be compatible with various types of external MOSFET. A ceramic capacitor 1uF is needed to filter the ripple from AC line, this capacitor should be placed close to the IC.



VCC Clamp:

The block clamps VCC voltage of IC to 9V For internal power supply. If the VCC voltage is lower than 9V, the block doesn't limit the VCC voltage, if the voltage is higher than 9V, the block start to conduct more current to clamp the voltage to 9V with the current limit resistor connected from VCC pin to line voltage, the highest current going through VCC pin should be less than 1mA.

Voltage Detector & Power compensation:

This block monitors the external AC line divided voltage of Vsense pin, compares with internal fixed reference voltage, to generate the power compensation signal, which will modulate the Vrefo to generate a Vrefi which is related with input AC voltage, when the input AC voltage is higher, the Vrefi will turn out to be lower.

The zero crossing detector are working together with the over voltage detect to complete the detect function.

Over Temperature Detector:

This block will monitor the driver internal temperature, when the temperature is higher than 120 degree, the output driver will be disabled to turn off the LED current. When the temperature is lower than 100 degree, the output driver is enabled again. A internal hysteresis window 20 degree is implemented so that the output driver will not be turn on/off frequently.

Reference:

This block generates all the internal reference voltage, and a 1V precise reference voltage is applied at the VREFO with the accuracy of +-3%. The reference voltage is generated by band gap circuit which keeps stable when the temperature is changing. And the VREFI pin is used to define the regulation voltage of the current control loops. The system power is related with Vrefi voltage.

Control logic:

This is the core logic of AC driver, control logic analyze the input signals, managed a state machine as the following figure to switch the working mode. Control logic analyzes the different LED segment currents and AC voltage, to decide the switching time of MOS FET, and set the external MOS FET at ON/OFF/Linear mode. The current going through the LED segment is set by external resistor like Application circuit shows, herein the Vref is equal to 500mV. In order to keep the current at every LED constant, Series or Parallel LED combination is suggested.

segment 1 $I_1 = V_{ref} / (R_1 + R_2 + R_3 + R_4)$

Segment 2 $I_2 = V_{ref} / (R_2 + R_3 + R_4)$

Segment 3 $I_3 = V_{ref} / (R_3 + R_4)$

Segment 4 $I_4 = V_{ref} / R_4$

Output Driver:

This block outputs the control signal to external MOSFET, MO FET is N channel and High voltage type such as 1N60 etc. The external MOSFET should be placed close to the driver in order to lower the parasitic capacitor. Output driver could output voltage more than 10V in order to turn on the MOS FET completely.

Absolute Maximum Ratings

Item	Value	Unit
Voltage on S1 S2 S3 S4	5	V
Voltage on G1 G2 G3 G4	18	V
Voltage on VCC	18	V
Voltage on VSENSE	5	V
Voltage on PWM	5	V
Voltage on VREFI VREFO	5	V
Package power dissipation	0.5	W
Storage Temperature	-20-125	°C

DC Electrical Characteristics

Parameters	Condition	Min	Typ	Max	Unit
VCC Section					
VCC Clamp Voltage		-10%	9	+10%	V
Max Clamp Current	VCC=9		1		mA
VCC UVLO OFF		-10%	6	+10%	V
UVLO Hysteresis			0.5		V
Operation current			300		uA
PWM Section					
PWM high threshold		2			V
PWM low threshold				0.8	V
PWM push in current			100		uA
VREF Section					
VREFO output voltage	@25C	-2%	1	+2%	V
VREFO TC			100		ppm
Vsense Section					
Vsense High Level Detection			2.5		V
Vsense Recovery level			0.5		V
Current Sense Section(S1-S4)					
Sense Controlled voltage	VREFI=0.5V	-3%	0.5	+3%	V

Output Section (G1 – G4)					
Output voltage Range		0		VCC	V
Output impedance			200		ohm
Protection Section					
Over temperature			120		°C
Temperature Hysteresis			20		°C

Package (TSSOP14)

