COOLED ACDrv3.0
AC LED Driver

Low Cost, High Efficiency, High PF, Low THD, TRIAC Dimming
Built in 3 MOS, AC Drive Directly,4 segments

Datasheet

Features:

- LEDs driven directly from AC line
- Adjustable power setting
- Flexible with different kinds of Vf LEDs
- Built in 3pcs FETs, up to 25W per driver
- Constant current precision at 2%
- High efficiency, more than 90% at optimized configuration
- High power factor, up to 0.98
- Low THD, 13% THD typical (4 segments)
- Compatible with AC100V/220V operation
- 50/60 Hz operation
- Compatible with TRIAC dimming (Leading/Trialing edge)
- Over voltage protection
- Over temperature protection
- Minimum number of external components
- Small package QFN6*6

Application:

- Down light
- LED Tube
- Ceiling lamp
- Spot Light

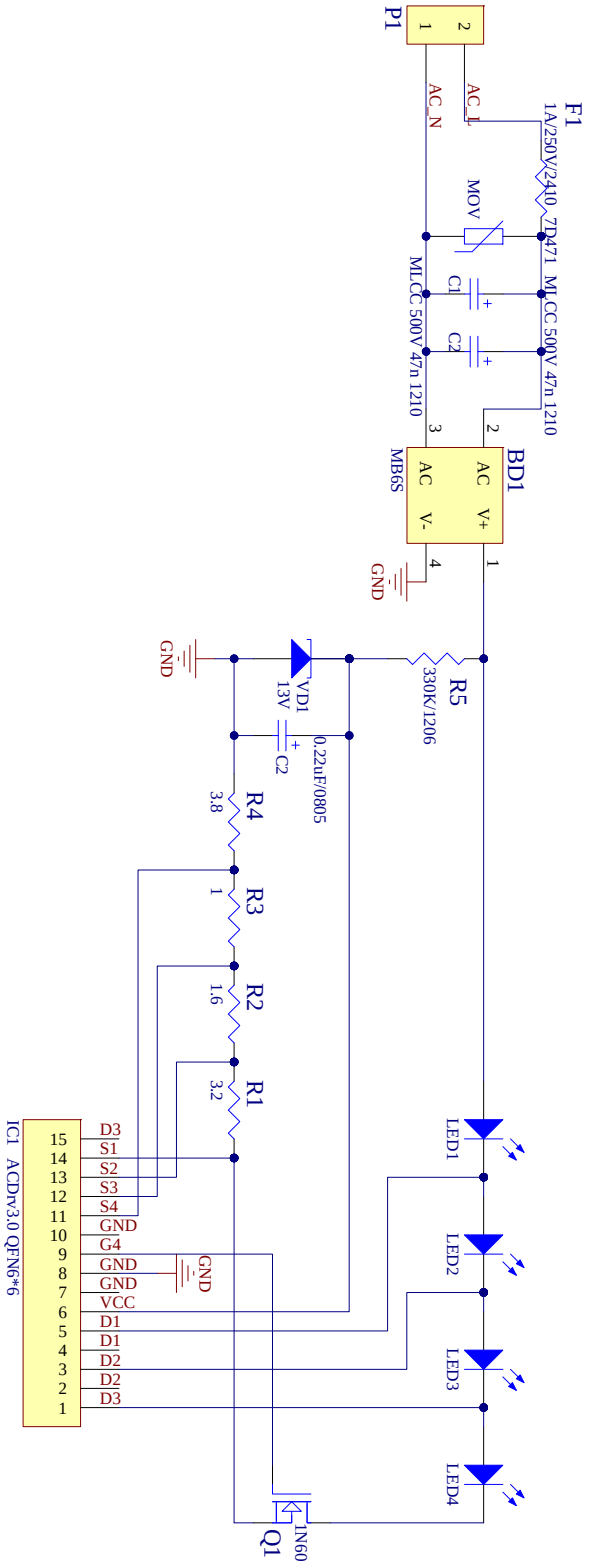
Description:

ACDrv3.0 is designed For AC directly driving LED, with creativE architecture, ACDrv3.0 eliminates the Bulk capacitor and transformer, which are the bottleneck of LED lamp life time.
ACDrv3.0 provides a ideal driver for LED lighting with low cost, compact size, stable and long lifetime.
ACDrv3.0 integrates all the necessary components including 3 pcs MOS in single chip. With external resistors, the four segments LED current could be set separately, which increases the LED utilization ratio and improves the THD.
With one external MOSFET configuration, the driver power configuration is up to 25W per driver.
Driver based on ACDrv3.0 has a ideal power parameters such as PF, Efficiency, THD,EMI.
ACDrv3.0 is compatible with various brands TRIAC. Providing blink free dimming.

Order Information

PART No	PACKAGE	DELIVERY
ACDrv3.0	QFN6*6	3k/Reel

Application Schematics

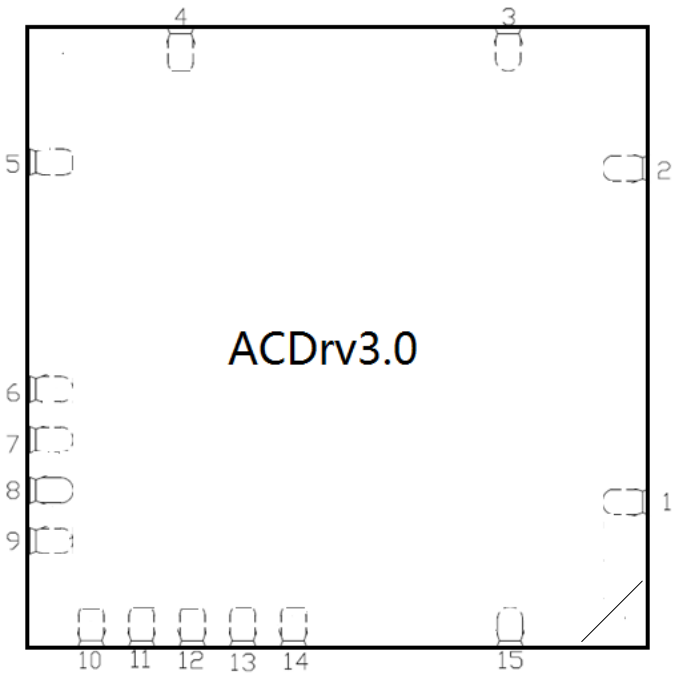


20W DownLight Application

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 Exceeds the Vf of LED1, the internal control logic will control the LED1 to be Lighted on and set current in constant level 1,When the rectified line voltage continues to rise and exceeds the added Vf of LED1 and LED2, the internal control logic will control the LED1 and LED2 To be lighted On and set current in constant level 2.
As the rectified voltage continues to rise on its positive slope and exceeds 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	D3	Output	Drain of MOS3，Connected with Segment3 LED
2	D2	Output	Drain of MOS2，Connected with Segment2 LED
3	D2	Output	Drain of MOS2，Connected with Segment2 LED
4	D1	Output	Drain of MOS1，Connected with Segment1 LED
5	D1	Output	Drain of MOS1，Connected with Segment1 LED
6	VCC	Power Supply	Power supply of Driver, connected with 0.22uF Cap.
7	GND	Ground	Ground
8	GND	Ground	Ground
9	G4	Output	Control pin of segment4 LED, connected with external MOS
10	GND	Ground	Ground
11	S4	Input	Segment 4 feedback signal
12	S3	Input	Segment 3 feedback signal
13	S2	Input	Segment 2 feedback signal
14	S1	Input	Segment 1 feedback signal
15	D3	Input	Drain of MOS3，Connected with Segment3 LED

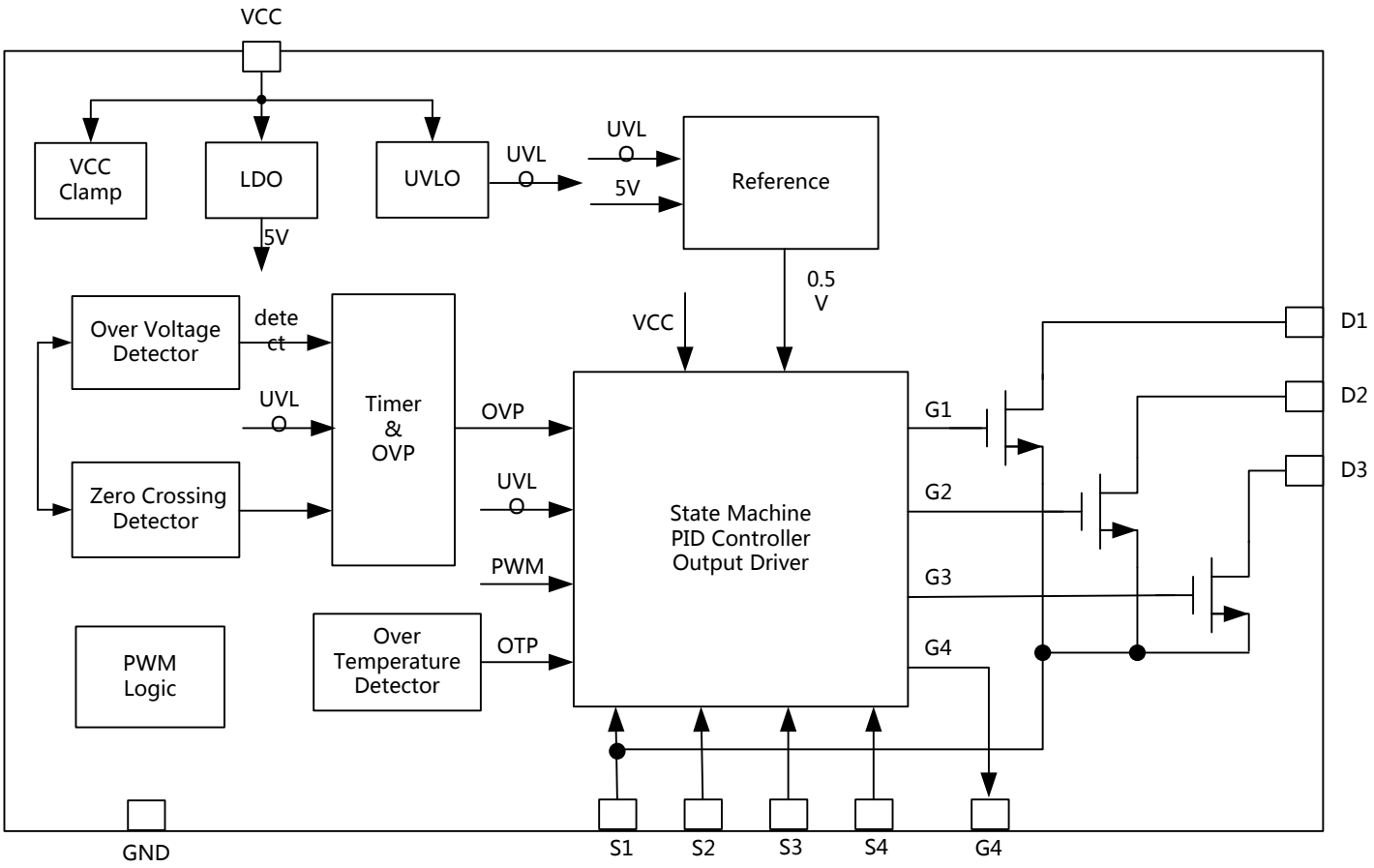
Block Diagram

UVLO:

This UVLO will monitor the voltage of VCC, when the voltage is higher than 8V, 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 0.22uF to 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 15V For internal power supply. If the VCC voltage is lower than 15 V, the block doesn' t limit the VCC voltage, if the voltage is higher than 15V, the block start to conduct more current to clamp the voltage to 15V with the current limit resistor connected from VCC pin to line voltage, the highest current going through VCC pin should be less than 1mA.

Integrated MOS

Inside the driver, packaged 3 pcs of high voltage MOSFET, whose break down voltage is 650V. Normally limited by heat distribution, working current of MOS recommended not to exceed 100mA. MOSFET is especially put on separated heat island, in order to rapidly distribute the heat. PCB layout need to have enough area of copper, to connect with MOS drain pad.

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 130 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 500mV 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 $I1=Vref/(R1+R2+R3+R4)$
Segment 2 $I2=Vref/(R2+R3+R4)$
Segment 3 $I3=Vref/(R3+R4)$
Segment 4 $I4=Vref/R4$

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

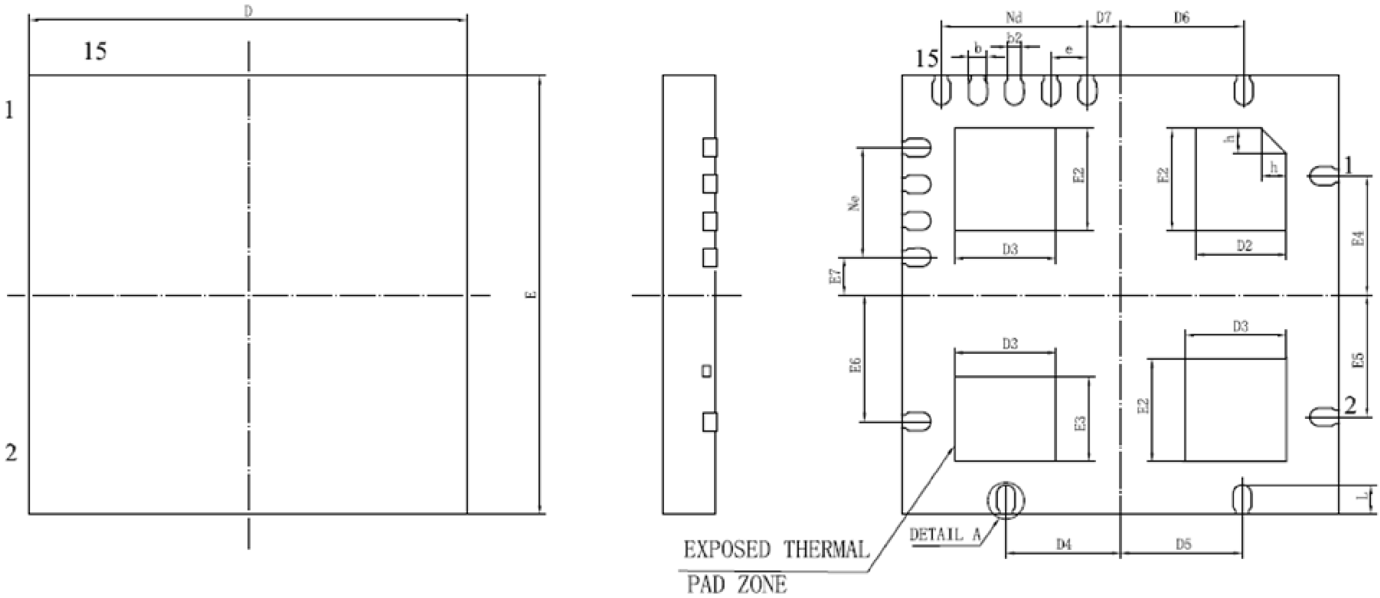
Item	Description	Unit
Voltage on S1 S2 S3 S4	5	V
Voltage on G4	18	V
Voltage on VCC	18	V
Voltage on D1 D2 D3	650	V

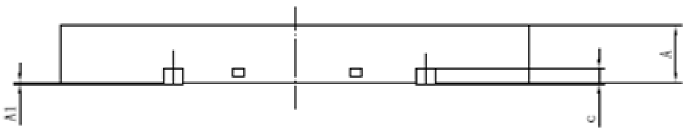
Package Power	2	W
Working temperature	-40-110	°C

DC Electrical Characteristics

Parameters	Condition	Min	Typ	Max	Uint
VCC Section					
VCC Clamp Voltage		-10%	15	+10%	V
Clamp Current	VCC=15		1		mA
VCC UVLO Enable Voltage		-10%	12	+10%	V
UVLO Hysteresis Window			4		V
Operating Current			250		uA
VREF Section					
VREFO Output Voltage	@25C	-2%	0.5	+2%	V
VREFO TC			100		ppm
Current sense section(S1-S4)					
Controlled feedback voltage	VREFI=0.5V	0.485	0.5	0.515	V
Output Section G4					
Output control voltage		0		VCC	V
Output impedance			200		ohm
Output Section D1 D2 D3					
MOS FET working current		0		100	mA
Protection Section					
Over Temperature threshold			130		°C
Temperature Window			20		°C

Package (QFN 6mm*6mm) Bottom View





SYMBOL	MILLIMETER		
	MIN	NOM	MAX
A	0.70	0.75	0.80
A1	—	0.02	0.05
b	0.20	0.25	0.30
b2	0.18REF		
c	0.18	0.20	0.25
D	5.90	6.00	6.10
D2	1.15	1.25	1.35
D3	1.30	1.40	1.50
D4	1.47	1.57	1.67
D5	1.57	1.67	1.77
D6	1.58	1.68	1.78
D7	0.35	0.45	0.55
E	5.90	6.00	6.10
E2	1.30	1.40	1.50
E3	1.06	1.16	1.26
E4	1.53	1.63	1.73
E5	1.57	1.67	1.77
E6	1.63	1.73	1.83
E7	0.41	0.51	0.61
e	0.50BSC		
Ne	1.50BSC		
Nd	2.00BSC		
L	0.35	0.40	0.45
h	0.25	0.35	0.25
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