WD15-S30A

4 Steps AC Direct LED Driver IC with Analog Dimming

Rev1.1 – 11 May 2021

1. General Description

The WD15-S30A is an AC Direct LED Driving IC with internal 4 steps. It can drive several series LEDs from rectified AC voltage. It will give much convenience to the design because it requires a small number of external components. The WD15-S30A has higher LED current driving capability and its current can be adjustable with external resistors. The WD15-S30A will help engineers to produce excellent products in LED lightings for energy efficiency, design efficiency, cost efficiency, and so on.
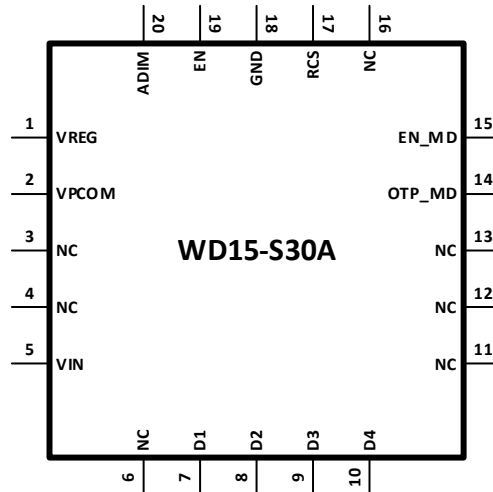
2. Features

- LEDs direct driver from AC line
- Wide input range : 90VAC~305VAC
- Constant current driving with internal 4 steps
- Adjustable driving current
- Compatible with analog dimming
- Including power compensation function
- Excellent power factor > 0.9
- Lower total harmonic distortion < 15%
- Over temperature protection
- OTP mode selectable : Auto recovery or latch
- EN pin mode selectable : EN pin activation or deactivation
- EMI safe operation
- Thermally enhanced QFN 20pin

3. Applications

- AC direct LED light Applications
- Down Light
- Flush Mount Light
- Ceiling Light

4. Package Information

Type number	Package		
	Name	Description	Marking
WD15-S30A	20 QFN	20 QFN 6mm x 6mm	WD15-S30A

5. Typical Application

* TVS2 is only used 230V non flicker free application.

6. Pin Information

Top View

Pin	Symbol	I/O	Description
1	VREG	O	Internal Reference Voltage
2	VPCOM	I	VIN Sensing Input for Power Compensation
3	NC	-	No Connection
4	NC	-	No Connection
5	VIN	P	AC Supply Input
6	NC	-	No Connection
7	D1	O	LED Driver Output 1
8	D2	O	LED Driver Output 2
9	D3	O	LED Driver Output 3
10	D4	O	LED Driver Output 4
11	NC	-	No Connection
12	NC	-	No Connection
13	NC	-	No Connection
14	OTP_MD	I	Mode for Over Temperature Protection OTP_MD=OPEN → OTP=Auto Recovery Mode (Same to WD35-S28A) OTP_MD=GND → OTP=Latch Mode (Same to DT3007 with VREG Cap) In Latch Mode, IC must be turned off to restart.
15	EN_MD	I	Mode for Enable Operation EN_MD=OPEN → EN Pin=Deactivated (ON/OFF is done by ADIM Pin) EN_MD=GND → EN Pin=Activated (ON/OFF is done by EN Pin)

6. Pin Information (Continued)

Pin	Symbol	I/O	Description
16	NC	-	No Connection
17	RCS	I/O	LED Current Setting
18	GND	P	Ground
19	EN	I	Chip Enable. The activation of EN is set by EN_MD Pin.
20	ADIM	I	Analog Dimming Input

7. Block Diagram
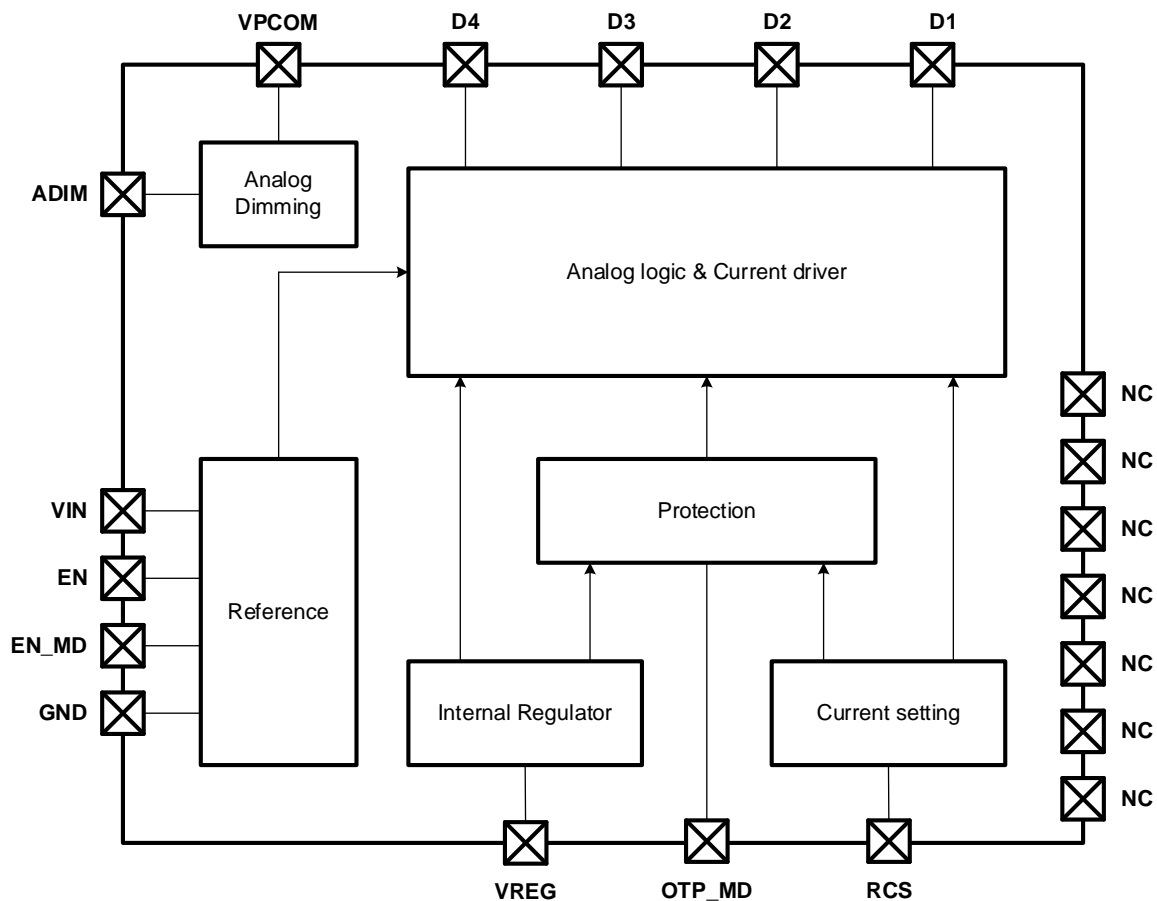
8. Absolute Maximum Ratings

Parameter	Symbol	Value	Unit
VIN, D1, D2, D3, D4	V_{HV1}	-0.3 ~ +700	V
VREG	V_{LV1}	-0.3 ~ +18	V
Other Pins	V_{LV3}	-0.3 ~ +7.5	V
Storage Temperature	T_{STG}	-65 ~ +150	°C

- Values beyond absolute ratings can cause the device to be prematurely damaged.
  Absolute maximum ratings are stress ratings only and functional device operation is not guaranteed.

9. Package Thermal Characteristics

Parameter	Symbol	Value	Unit
Junction to ambient thermal resistance	θ_{JA}	33.8	°C/W
Junction to case thermal resistance	θ_{JC}	7.5	°C/W

- Test conditions
  - θ_{JA} : The package thermal impedance is calculated in accordance with JESD 51-7
  - θ_{JC} : The package thermal impedance is calculated in accordance with JESD 51-14

10. Recommended Operating Conditions

Parameter	Symbol	Min	Typ.	Max	Unit
Supply Voltage	V_{IN}	90		305	VAC
Ambient Temperature	T_A	-25		85	°C
Junction Temperature	T_J			125	°C

11. Electrical Characteristics

T_A = 80°C, V_{AC} = 100/120/220V, unless otherwise specified

Parameter	Symbol	Conditions	Min	Typ.	Max	Unit
General						
Bias Current	I_{BIAS}			600		uA
Power Factor	PF		0.9			-
Total Harmonic Distortion	I_{THD}				15	%
VREG Voltage	V_{REG}	No load		14.8		V
Logic Input High	V_{IH}		2.0		5.0	V
Logic Input Low	V_{IL}		0		0.8	V
Thermal Shutdown	T_{SHDN}			160		°C
Driver Stage Current						
Max. Driver Current(Note 1)	I_{D1}				100	mA
	I_{D2}				160	mA
	I_{D3}				200	mA
	I_{D4}				220	mA

Note 1)
- The maximum drive current means the guaranteed operating current.
- The maximum drive current is not the DC current. It is the maximum peak current of the four stage for guaranteeing normal operation in AC direct drive method.
- The operating drive current must be determined within the maximum drive current with margin.

12. Functional Description

Driver Current and Power Setting

The WD15-S30A is 4-step LED lighting driver IC that controls constant LED current regulation in order to control brightness at the LED lighting system by internal 4 steps which consist of high voltage FETs. The constant LED current regulation value can be controlled by external resistor. The LED current can be set by using RCS pin and the equations are as below.

$$\text{Step 1 Current} = 0.4 \times \frac{2.0V}{R_{CS}}$$

$$\text{Step 2 Current} = 0.7 \times \frac{2.0V}{R_{CS}}$$

$$\text{Step 3 Current} = 0.9 \times \frac{2.0V}{R_{CS}}$$

$$\text{Step 4 Current} = 1.0 \times \frac{2.0V}{R_{CS}}$$

RCS Open

When RCS Pin is open, the LED current becomes almost zero.

Over Temperature Protection

The WD15-S30A has two modes for over temperature protection and can be selected by OTP_MD pin.

When OTP_MD pin is open, the over temperature protection operates in Auto Recovery mode. The WD15-S30A makes all LEDs off when its junction temperature is higher than 160°C. The WD15-S30A will restart the normal operation by itself when the junction temperature is lower than the temperature hysteresis of over temperature protection.

When OTP_MD pin is GND, the over temperature protection operates in Latch mode. The WD15-S30A makes all LEDs off when its junction temperature is higher than 160°C. The WD15-S30A will restart the normal operation, if the WD15-S30A is turned off and turned on after the junction temperature is lower than the temperature hysteresis of over temperature protection.

Enable Mode Select

WD15-S30A can decide whether EN pin works or not according to Enable mode.

When EN_MD pin is open, EN pin is deactivated. LED on/off can be controlled by analog dimming operation.

When EN_MD pin is GND, EN pin is activated. LED on/off can be controlled by EN pin state. If EN pin is open or high, then all LEDs are turned on. If EN pin is GND, then all LEDs are turned off. LED on/off control in the analog dimming operation is disabled.

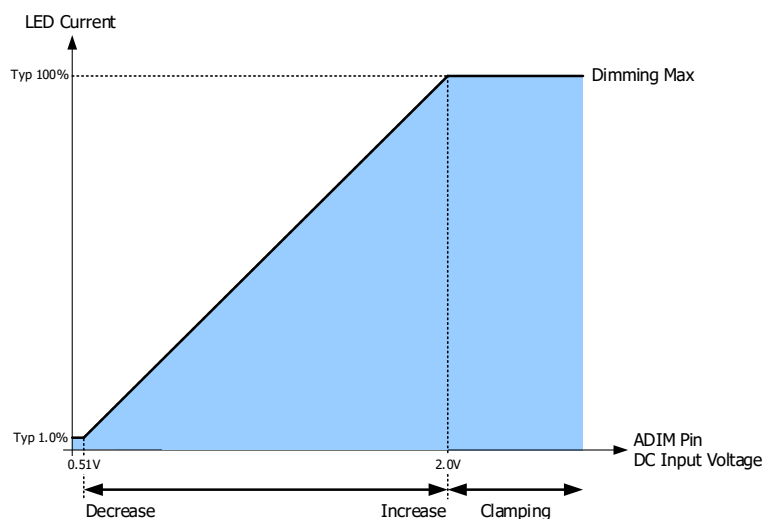## *12. Functional Description (Continued)*

Analog Dimming Function

The WD15-S30A can be used with analog dimming. To use analog dimming properly, a resister network must be a connection between external analog dimming signal, ADIM and GND. Please refer the typical application circuit. The brightness of the LED is controlled by ADIM voltage. If ADIM voltage is less than 2 volts, the brightness is proportional to the ADIM voltage. And if ADIM voltage is more than 2 volts, the brightness is clamped.

When EN_MD pin is open, LED on/off control is possible by analog dimming operation. If ADIM voltage is less than 0.54V(Typ), all LEDs are turned off. And ADIM voltage is more than 0.59V(Typ), all LEDs are turned on. The hysteresis of ADIM voltage is 50mV(typ). The figure below shows ADIM operation when EN_MD pin is open.
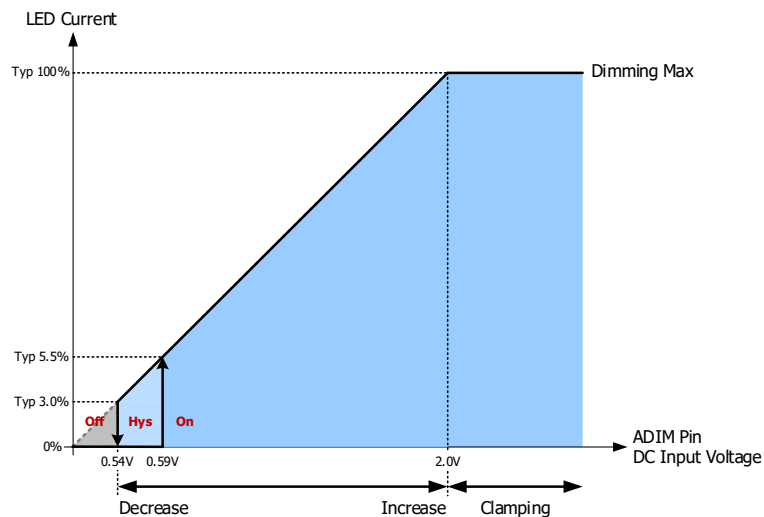
EN_MD pin is GND, LED on/off control is possible by EN pin state. In this mode, Analog dimming operation does not turn off LED, the brightness can be controlled from about 1% to 100% by analog dimming operation. The figure below shows ADIM operation when EN_MD pin is GND.

12. Functional Description (Continued)

Power Compensation Function

The WD15-S30A can adjust LED currents according to AC input voltage to maintain a total power consumption constant. VPCOM pin is an input to sense AC input voltage.

If VPCOM < 2V, LED Current of each step is 100%. In this section, a power compensation is deactivated.

If VPCOM > 2V, LED Current of each step is getting down according to VPCOM. In this section, a power compensation is activated.
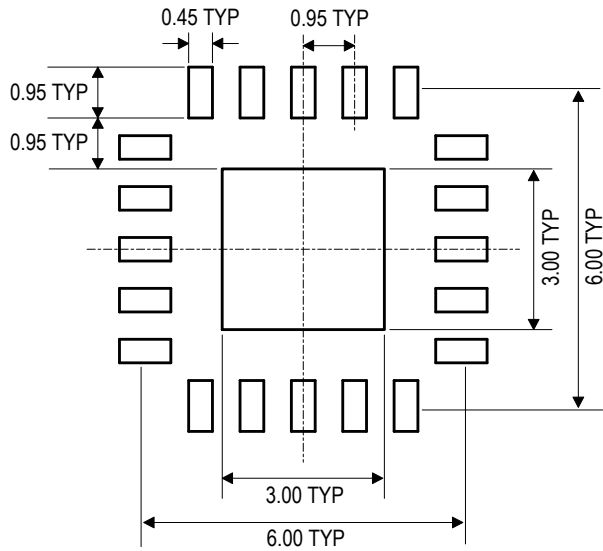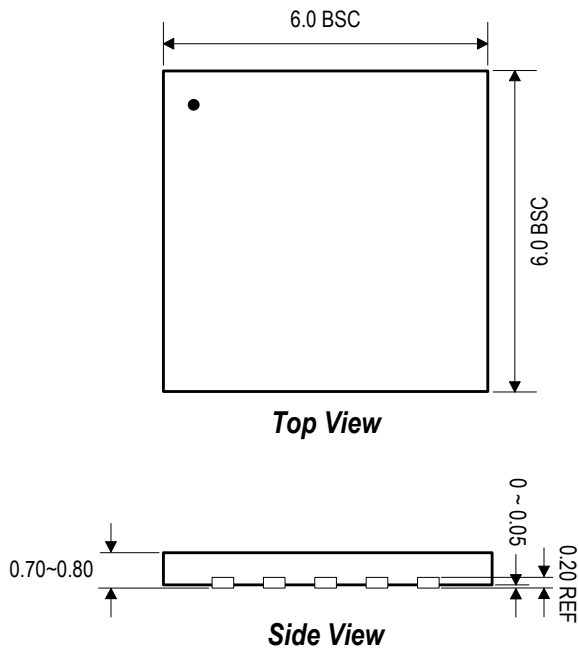
For example,

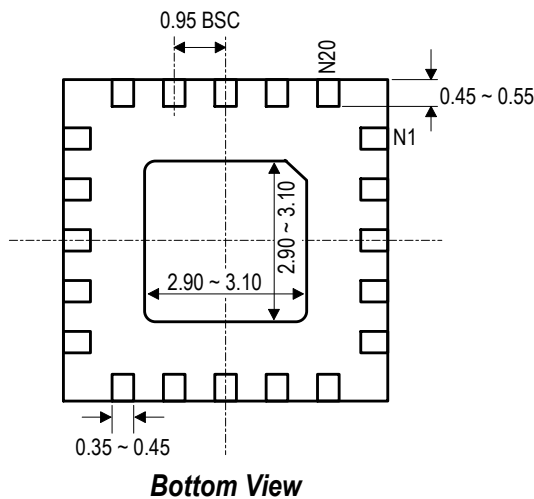To set a power compensation mode between from 200V to 260V, set RSEN2 value to become VPCOM=2V at 200V AC input.

To disable a power compensation mode, let VPCOM pin connect to GND.

13. Package Outline Dimensions

QFN 20Pin

Top View

Side View

Recommend solder PAD

Bottom View

Note
1. Dimensions are in millimeters
2. Dimensions are exclusive of mold flash and interlead flash

14. Important notices

- This product and its characteristic are subject to change without notice. Before considering use or application, you'd better consult Wellang.
- No part of this publication may be reproduced or transmitted or copied in any form or by any means without permission of Wellang.
- Although our product has internal protective circuit, you'd better adopt safety circuits or measures externally to prevent undesired probabilistic device failure.
- Wellang always strives to make a high quality and high reliability products.

15. Contact information

For sales & Technical information	snm@wellang.com
For additional information	http://www.wellang.com