

WD15-S30T

4 Steps AC Direct LED Driver IC with TRIAC Dimming

Rev1.1 – 11 May 2021

1. General Description

The WD15-S30T 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-S30T has higher LED current driving capability and its current can be adjustable with external resistors. The WD15-S30T 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 TRIAC dimming
- Including bleeder current to supply holding current of TRIAC dimmer
- Including the gate driver for external MOSFET supplying the latching current of TRIAC dimmer
- Excellent TRIAC dimmer compatibility due to the holding and latching currents
- Excellent power factor > 0.9
- Lower total harmonic distortion < 15%
- Over temperature protection
- OTP mode selectable : Auto recovery or latch
- Phase off mode selectable : Phase off activation or deactivation
- EMI safe operation
- Thermally enhanced QFN 20pin

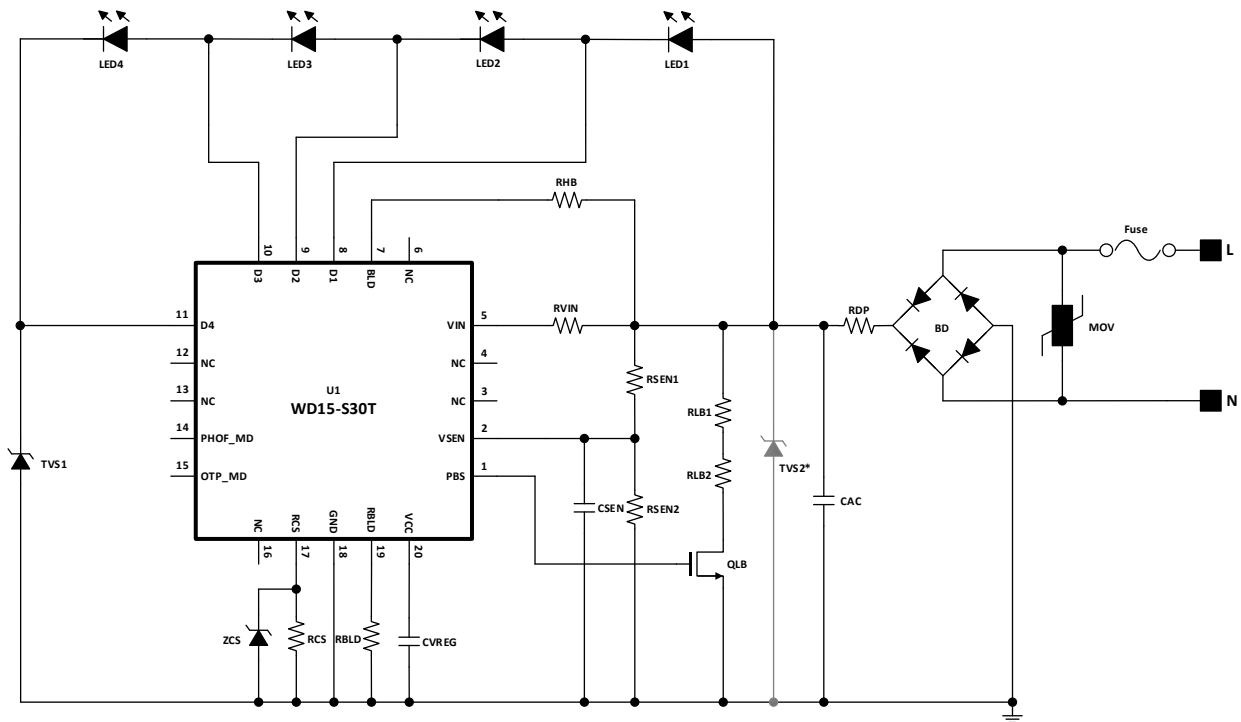
3. Applications

- AC Direct LED Light Applications
- Down Light
- Flush Mount Light
- Ceiling Light

4. Package Information

Type number	Package		
	Name	Description	Marking
WD15-S30T	20 QFN	20 QFN 6mm x 6mm	WD15-S30T

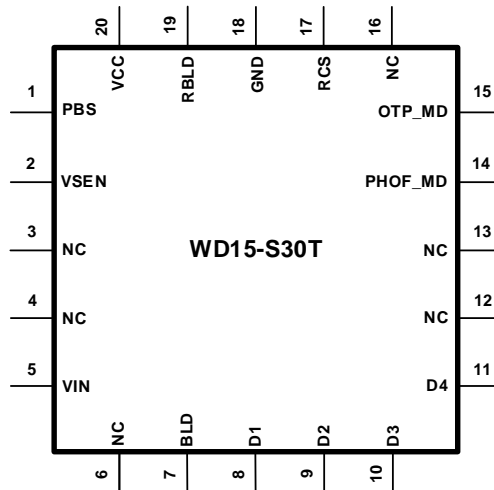
5. Typical Application



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

6. Pin Information

Top View

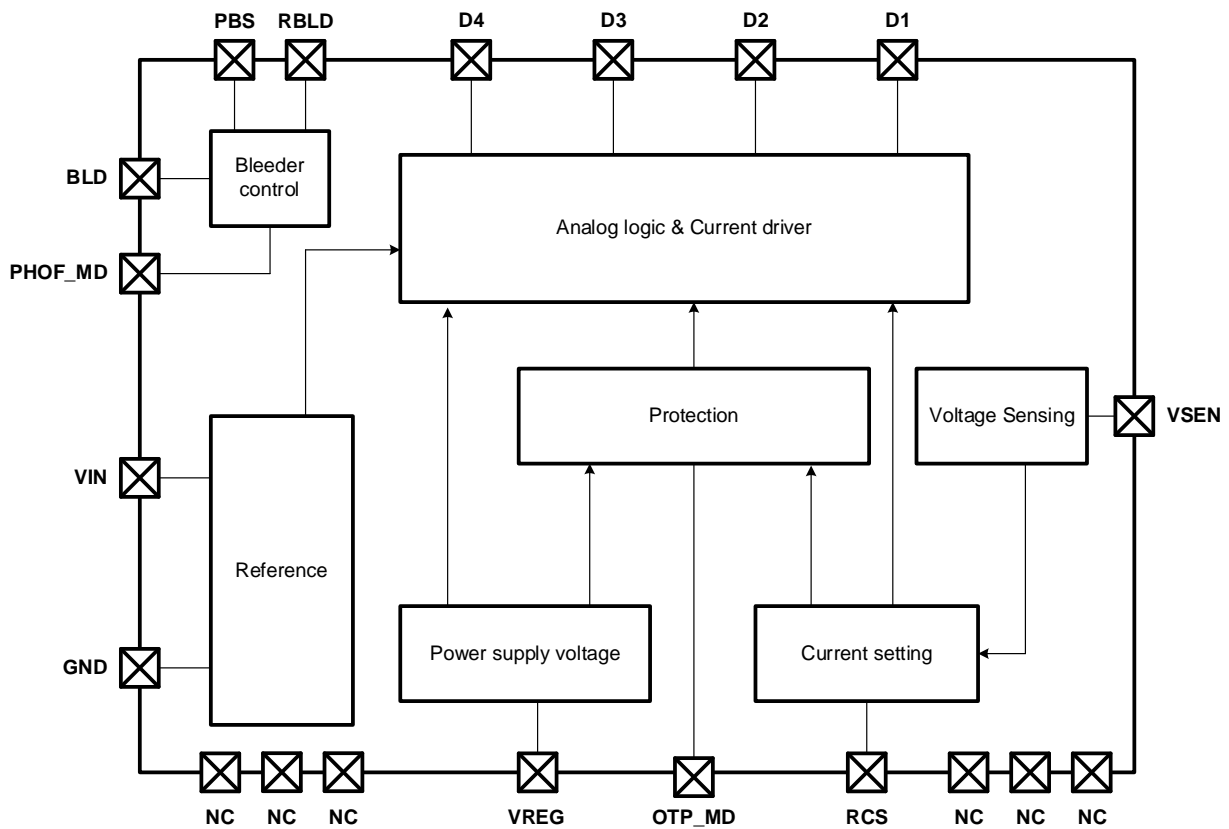


Pin	Symbol	I/O	Description
1	PBS	O	Gate Driver Output of Ext Bleeder MOSFET
2	VSEN	I	AC Supply Voltage Sense Input
3	NC	-	No Connection
4	NC	-	No Connection
5	VIN	P	AC Supply Input
6	NC	-	No Connection
7	BLD	O	Internal Bleeder Output
8	D1	O	LED Driver Output 1
9	D2	O	LED Driver Output 2
10	D3	O	LED Driver Output 3
11	D4	O	LED Driver Output 4
12	NC	-	No Connection
13	NC	-	No Connection
14	PHOF_MD	I	Mode Selection Pin for Phase Off function in TRIAC dimming PHOF_MD=OPEN → Phase Off function Disable (Same to WD35-S28T) PHOF_MD=GND → Phase Off function Enable (Same to DT3007)
15	OTP_MD	I	Mode Selection Pin for Over Temperature Protection OTP_MD=OPEN → OTP=Auto Recovery Mode (Same to WD35-S28T) OTP_MD=GND → OTP=Latch Mode (Same to DT3007 with VREG Cap) In Latch Mode, IC must be turned off to restart.

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	RBLD	I/O	Internal Bleeder Current Setting
20	VREG	O	Internal Reference Voltage

7. Block Diagram



8. Absolute Maximum Ratings

Parameter	Symbol	Value	Unit
VIN, BLD, D1, D2, D3, D4	V _{HV1}	-0.3 ~ +700	V
VREG	V _{LV1}	-0.3 ~ +16	V
PBS	V _{LV2}	-0.3 ~ +8	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

$T_A = 85^\circ\text{C}$, $V_{AC} = 100/120/230\text{V}$, unless otherwise specified

Parameter	Symbol	Conditions	Min	Typ.	Max	Unit
General						
Bias Current	I_{BIAS}			1.0		mA
Power Factor	PF		0.9			-
Total Harmonic Distortion	I_{THD}				15	%
VREG Voltage	V_{REG}	No load		13.5		V
PBS Output	V_{PBS}			7.0		V
Thermal Shutdown	T_{SHDN}			160		$^\circ\text{C}$
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-S30T 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-S30T 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-S30T makes all LEDs off when its junction temperature is higher than 160°C. The WD15-S30T 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-S30T makes all LEDs off when its junction temperature is higher than 160°C. The WD15-S30T will restart the normal operation, if the WD15-S30T is turned off and turned on after the junction temperature is lower than the temperature hysteresis of over temperature protection.

12. Functional Description (Continued)

TRIAC Dimming Function

The WD15-S30T can be used with TRIAC dimmer. To use TRIAC dimmer properly, a resistor network must be added on VSEN, VIN and GND pins. Please refer to the typical application circuit.

As the voltage of VSEN pin decreases, all the output current of each steps decreases, but the bleeder current increases. This operation improves the compatibility of the TRIAC dimmer from various manufacturers and the dimming characteristic.

Phase Off Function

WD15-S30T has two modes for Phase Off Function and can be selected by PHOF_MD pin.

When PHOF_MD pin is open, the phase off function is deactivated. In this mode, when TRIAC dimmer goes to minimum angle, LEDs are turned off from step 4 LED to step 2 LED sequentially.

When PHOF_MD pin is GND, the phase off function is activated. In this mode, when TRIAC dimmer goes to minimum angle, all LEDs are turned off at about 65° of TRIAC angle. That is, all LEDs are turned off at VSEN=0.71V and are turned on at VSEN=0.84V.

LED Current in TRIAC Dimming

As the TRIAC dimming angle varies from its full angle of 180° to low angle for dimming control, the existing time of AC input voltage is decreased and hence the average LED current is accordingly decreased. The brightness of LED is, therefore, controlled by this turn-on angle variation of TRIAC dimmer. As the TRIAC dimming angle varies from its full angle to low angle, the brightness of LED must satisfy the NEMA regulation. Usually, the LED brightness decreasing amount only according to the decrease of TRIAC dimming angle is not sufficient to satisfy the NEMA limit.

The WD15-S30T has a function to scale down the LED current starting from TRIAC dimming angle of about 130° by using the voltage of VSEN which is decreasing according to TRIAC dimming angle with some proper gain.

In these ways, the WD15-S30T can satisfy the NEMA regulation in TRIAC dimming control.

12. Functional Description (Continued)

Bleeder Current

The current flowing through the TRIAC dimmer must be larger than its minimum holding current limit to maintain its turn-on state at every turn-on time duration after it is turned-on. As the TRIAC dimming angle is decreasing, the WD15-S30T scales down the magnitude of each step currents to satisfy the NEMA regulation and this operation can make the current of TRIAC dimmer smaller than its holding current limit. So, the WD15-S30T provides a function of the bleeder current varying according to the TRIAC dimming angle.

The bleeder current is maintained its minimum level from full angle of 180° to about 140°. From that angle to about 90°, the bleeder current is increased linearly up and reached its maximum level. From about 90° to the minimum TRIAC dimming angle, the bleeder current is maintained its maximum level. The maximum current of the bleeder current is given by the following equation and can be determined by the external resistor RBLD. For higher compatibility of TRIAC dimmer, it is recommended to set the bleeder current larger than 30mA.

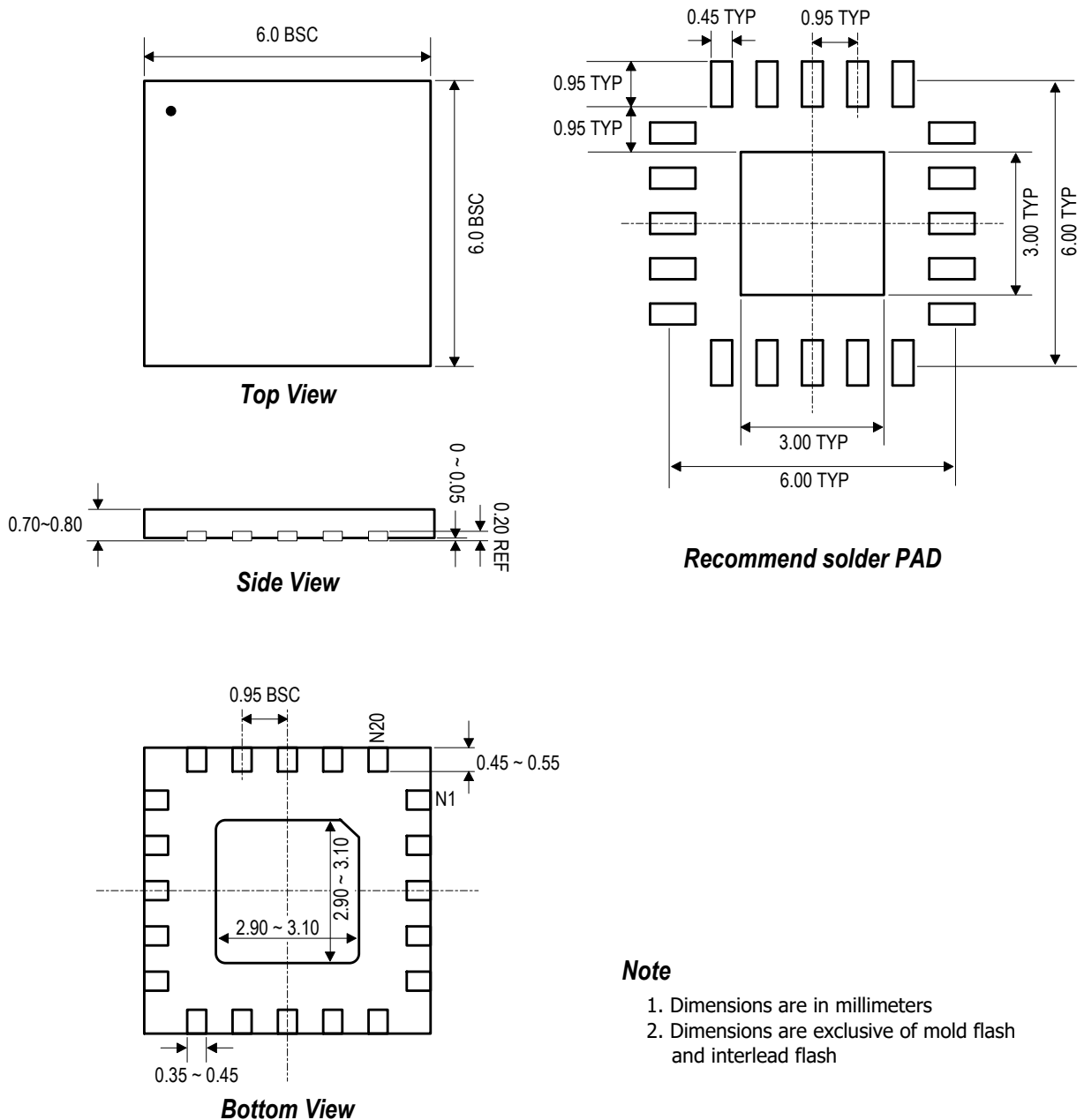
$$\text{Bleeder Current} = \frac{1.75V}{R_{BLD}}$$

PBS Output

The TRIAC dimmer can be turned on when the current of the TRIAC dimmer is larger than its latching current limit at the moment of turn-on. The WD15-S30T provides the PBS gate driver output for an external MOSFET to supply the latching current. The PBS signal is initiated at the rising moment of VIN input voltage and maintain its high state during about 130usec after that time. The PBS signal with external MOSFET can substitute to the well-known passive bleeder circuitry simply. Please refer to the typical application circuit.

13. Package Outline Dimensions

QFN 20Pin



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

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