

Modification of STEVAL-ILL066V1 100w LED Streetlight board

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Main components	
STEAVL-ILL066V1	100w PSR-ZVS streetlight demo board
STLUX385A	State Machine Event Driven digital controller

Purpose and benefits

STEVAL-ILL066V1 is a complete and configurable solution for high efficient single string high brightness LED driver. For different application, customers need to modify the eval board. This design tip provides some guidance if modification is necessary.

For detailed schematic, please refer to AN4461.

Description

1. Input voltage range and PFC Vout

In the eval board, the input voltage range is 90VAC-265VAC. The PFC output voltage is 400Vdc. For 277VAC input, the max input voltage is 305VAC. Therefore, it is necessary to modify the PFC output voltage to 460Vdc.

From the schematic, the resistor network R46, R52, R55, and R58 provide voltage feedback to STLUX385A. The internal reference voltage Vref is 1.1151v.

We have: $V_{ref} = V_{out} \cdot R_{58} / (R_{58} + R_{55} + R_{52} + R_{46})$. So we can change R58 from 18K to 16K to get 460V.

The OVP level will be changed as well. The internal OVP setting point is 1.23v. Therefore, with the change of R58, the OVP level is moved to 507V.

Also it is necessary to change MOSFET to 600V rating and increase bulk capacitor voltage to 500V accordingly.

2. PFC input current limit

For different power, the input current limit needs to be adjusted. The current limit reference voltage in STLUX385A is set at different value for different input voltage thanks to intelligence of the digital controller. For 120VAC input, the setting point is at

$V_{ocp}=1.066V$. With current sensing resistors R49 and R50, the current limit is $I_{lim}=V_{ocp}/(R49//R50)=5.47A$. For 220VAC and above, the setting point is at $V_{ocp}=0.656V$. The current limit is 3.36A. Changing the value of R49 and R50 will change the current limit.

3. Output LED current

The output LED current can be calculated by the equation: $I_{LED}=I_{pk}*n/2$

Where I_{pk} is the primary side peak current, n is the turn's ratio of the transformer. The max output current 1A is corresponding to "II" command value "3450". The reference voltage V_{ref} for the max current is 1.053v. The turn's ratio of the transformer is 1.85. Therefore, max LED current can be obtained: $I_{LED}=(V_{ref}/R_{cs})*1.85/2$. Current sensing resistor R_{cs} is R36 and R37 in parallel. Because of propagation delay, the calculated value is lower than actual value. The resistor value needs to be fine-tuned in the circuit to get exact right LED current.

The maximum output current on the LEDs can be changed by modifying the value of the R36 // R37. For example, to change the output current to 1.28A at the same output voltage, R36//R37 can be changed to 0.90Ω value (or use two 1.8 Ω resistor). Similarly, if the max output LED current needs to be reduced, the value of R36//R37 can be increased.

4. Secondary output voltage

If the max output voltage needs to be different from 100v, try to select transformer turns ratio such that the reflected is same as the eval board. For example, if the maximum output voltage needs to be 42v, the new turn's ratio can be $N=n*(100+V_d)/(42+V_d)$,

Where N is the new turns ratio, n is the old turns ratio 1.85; V_d is output diode voltage drop, 1v. We can calculate $N=1.85*101/43=4.3$.

5. Secondary over voltage protection

The auxiliary winding is to detect the output voltage for protection purpose. The turn's ratio from secondary to auxiliary is N_{aux} 5:1. The internal OVP tripping value is $V_{ovp_ref}=0.9995v$. We have the equation:

$$(V_{ovp}/N_{aux} - 2*V_d)*R_{29}/(R_{29}+R_{28}+R_{92})=V_{ovp_ref}$$

Where V_d is the voltage drop of the bridge diode, 0.7v.

The V_{ovp} is around 100V. If the OVP value needs to be changed, R29 can be modified accordingly.

If different transformer is used, the OVP level can be calculated according to the formular.

6. Double the secondary output voltage

If the double output voltage is desired, a very simple change can be performed. Remove the SMD resistor R102 and put D42 and D43 on the PCB. D42 and D43 is a STTH3R06S (ultrafast rectifier - SMC case) diode. When the circuit is modify, the maximum output voltage is around 200V but the maximum output current is 500mA.

7. Design of circuit

A design spreadsheet is available upon request. Users can design the circuit according to their own requirements. It is a very helpful tool to design PFC choke, resonant inductor, and output transformer.

Support material

Related design support material
EVAL board STEAVL-ILL066V1
Documentation
Datasheet STLUX385A
Application note, AN4461

Revision history

Date	Version	Changes
29-Aug-2014	1	Initial release

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