DN0028
Design note

STEVAL-ILL066V1
90Vac-305Vac input

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Main components	
STLUX385A	Digital controller for lighting and power supply applications
STEVAL-ILL066V1 (prev. STEVAL385LEDPSR)	100W LED street lighting demonstration board using STLUX385A

Specification

The following Design Note specifies how to:

- Increase the STEVAL-ILL066V1 input Vac voltage range to 90Vac - 305Vac
- Reduce the THD below 20% when output power is between 50% and 100%

Circuit description

The STLUX385A based STEVAL-ILL066V1 demo board natively supports a 90 V to 265 V AC input range. This Design Note describes in detail the hardware changes required to modify the STEVAL-ILL066V1 demo board to increase the input ac voltage to 90Vac-305Vac.

Support for the extended voltage range is provided by firmware release V3R29. The firmware is structured to support any hardware configured Vac level. The user is required to modify the software tables mapping the DALI and 0-10V interface to the output current. This Design Note protects the user to misuse DALI and 0-10V by disabling the interfaces.

The following commands shall be entered via the serial line before implementing the hardware modifications described in this Design Note:

1- "*in 7 0*": disable the DEBUG mode.

2- "*in 3 0*": disable DALI

3- "in 9 0": disable the 0-10V interface

4- "in 27 251": start the PFC when Vac >= 90V.

The hardware modifications required are listed below.

- Change the PFC output voltage: set R46, R52 and R55 so that the R46 + R52 + R55 equals to 7420KΩ.
- Decrease the THD current distortions: set R101 to 220Ω.
- Set the PFC primary inductance T6 to be equal to 550uH (6A saturation)
- the PFC MOSFET type Q12 must be STF18N60M2
- Change the default C43 so that the minimum granted working Voltage of C43 is 600Vdc.
- The HB MOSFET type Q10-Q11 must be STD13N60M2

Given the maximum input voltage of 305Vac, most of these hardware modifications are required in order to support the increased PFC output voltage. In particular the new target PFC output voltage is 462Vdc and the PFC OVP voltage is increased to 510Vdc. In order to properly achieve this result, the R46, R52 and R55 resistors must be changed so that R46+R52+R55 is increased from 6600KΩ to 7420KΩ.

Since STLUX385A monitors the voltage sensed at pin 38 (ADCIN[0]), the software PFC loop compensation is automatically adapted to the new inductor-output voltage. The reference to this pin, imposed internally, is:

$$\left(\frac{ADCtopvoltage}{ADCbitnumbers}\right) * PFC\_ADCreference = \left(\frac{1.25}{1023}\right) * 912 = 1.1143V$$

Should a different PFC output voltage be required, the partition resistors can be modified to a different value. Please note that the minimum input impedance of any ADC pin is more the 10MΩ.

The increased PFC voltage affects the association between the “Il” command parameters and the real output current. When the hardware modifications are in place, the “Il” values are mapped according to the *Table 1*. The user shall modify the software conversion tables to enable the correct DALI and 0-10V conversion.

Table 1. "*Il*" value vs Iout

Target Iout mA	“*Il*” Value
10	539
100	640
200	740
300	850
400	960
500	1070
600	1610
700	2075
800	2500
900	2900
1000	3330

To reduce the THD current distortion, the value of R101 is modified. In this Design Note R101 is set to 220Ω consequently resulting in a less than 20% THD current distortion for output power ranging from 50% to 100%. The THD profile is reported in *Figure 3*.

Measurement results

Figure 1 shows the demo board efficiency when input voltage varies from 90Vac to 305Vac. When output power ranges between 50% and 100%, the efficiency of the demo board is more than 88%. The maximum efficiency, around 93%, is obtained with Iout of 1A and high Vac input voltage. The x axis reports the output current.

Figure 1. Efficiency at various Vin

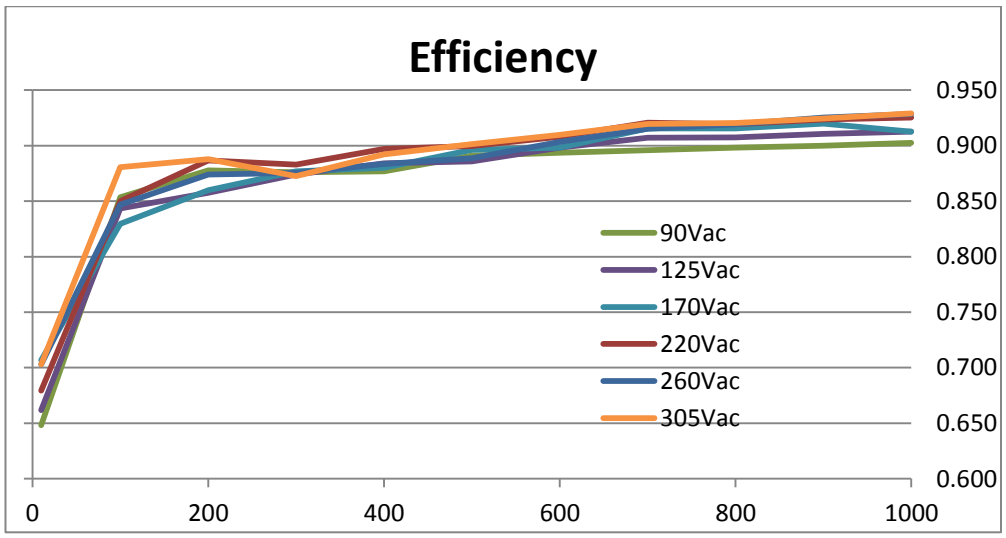


Figure 2 shows the Power Factor (PF) for different output power and different input voltage.

Figure 2. Power Factor at various Vin

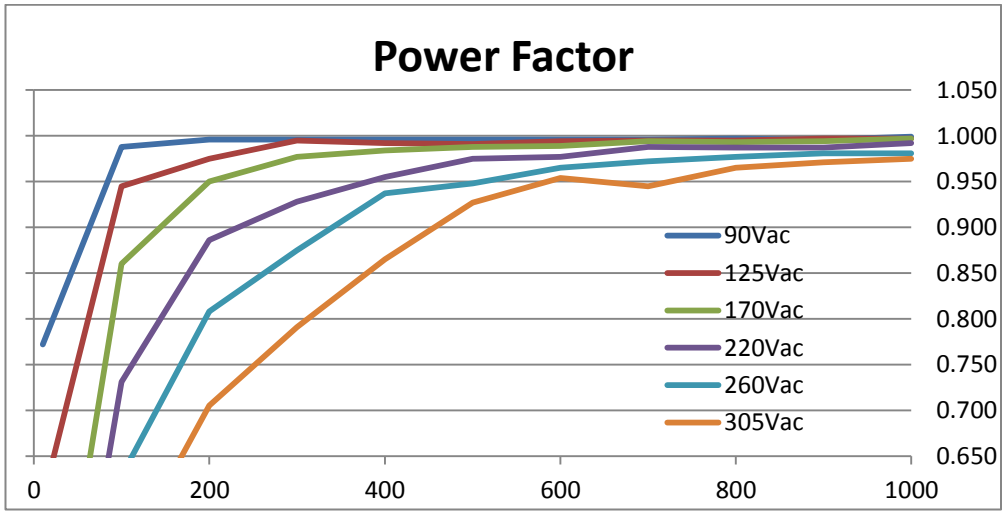
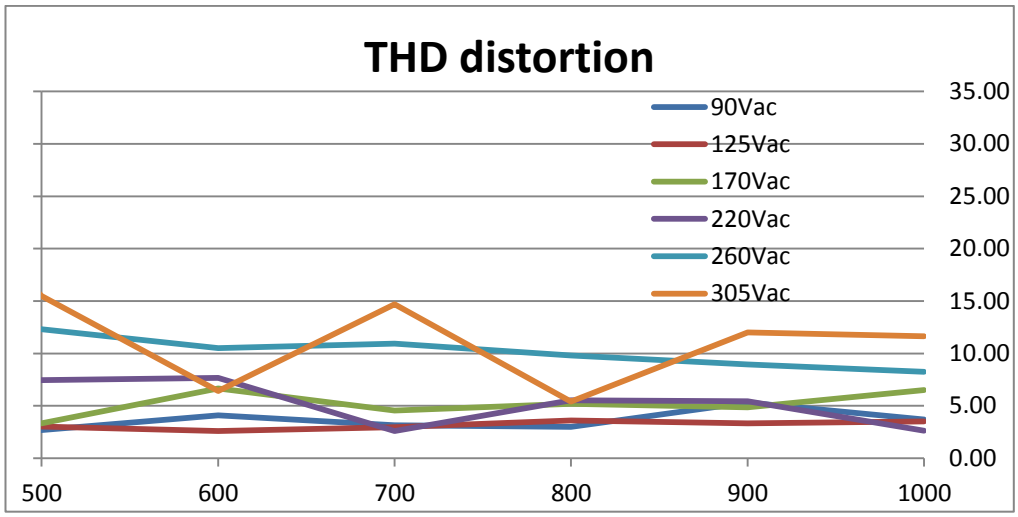


Figure 3 shows the THD distortion for different output power levels and different input voltage.

Figure 3. THD distortion at various Vin



Support material

Related design support material
STWS-PSRDEMO-V3R29: binary firmware for STEVAL-ILL066V1 or STEVAL385LEDPSR
Documentation
Datasheet: STLUX385A - Digital controller for lighting and power supply applications
Application note: AN4461 - 100 W LED street lighting application using STLUX385A

Revision history

Date	Version	Changes
28-Aug-2014	1	Initial release

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