DESIGNS from our LABS

STEVAL-ILL053V2 48 V - 130 W high efficiency converter with PFC for LED street lighting applications

Designs from our labs *describe tested circuit designs from ST labs which provide optimized solutions for specific applications. For more information or support, visit www.st.com*

By Santina Leo

Main ST components	
L6562AT	Transition-mode PFC controller
L6599AT	Improved high voltage resonant controller
STF25N60M2-EP	N-channel 600 V, 0.175 Ω typ., 18 A MDmesh™ M2 EP Power MOSFET
STD11N60M2-EP	N-channel 600 V, 0.550 Ω typ., 7.5 A MDmesh™ M2 EP Power MOSFET

Specification

- Extended input mains range: 85 to 305 VAC - frequency 45 to 55 Hz
- Output voltage: 48 V at 2.7 A
- Long-life, electrolytic capacitors are not used
- Efficiency at full load: better than 90% at 115 VAC
- EMI: according to EN55022-Class-B, EN55015
- Safety: double insulation, according to EN60950, SELV
- Dimensions: 75 x 135 mm, 30 mm components maximum height
- PCB: single side, 35 µm, FR-4, mixed PTH/SMT

Circuit description

The STEVAL-ILL053V2 demonstration board implements a 130 W LED power supply for street lighting.

The circuit consists of the following stages:

1. a front-end PFC using the L6562AT and STF25N60M2-EP as power switch
2. an LLC resonant converter based on the L6599AT with STD11N60M2-EP used as power switches.

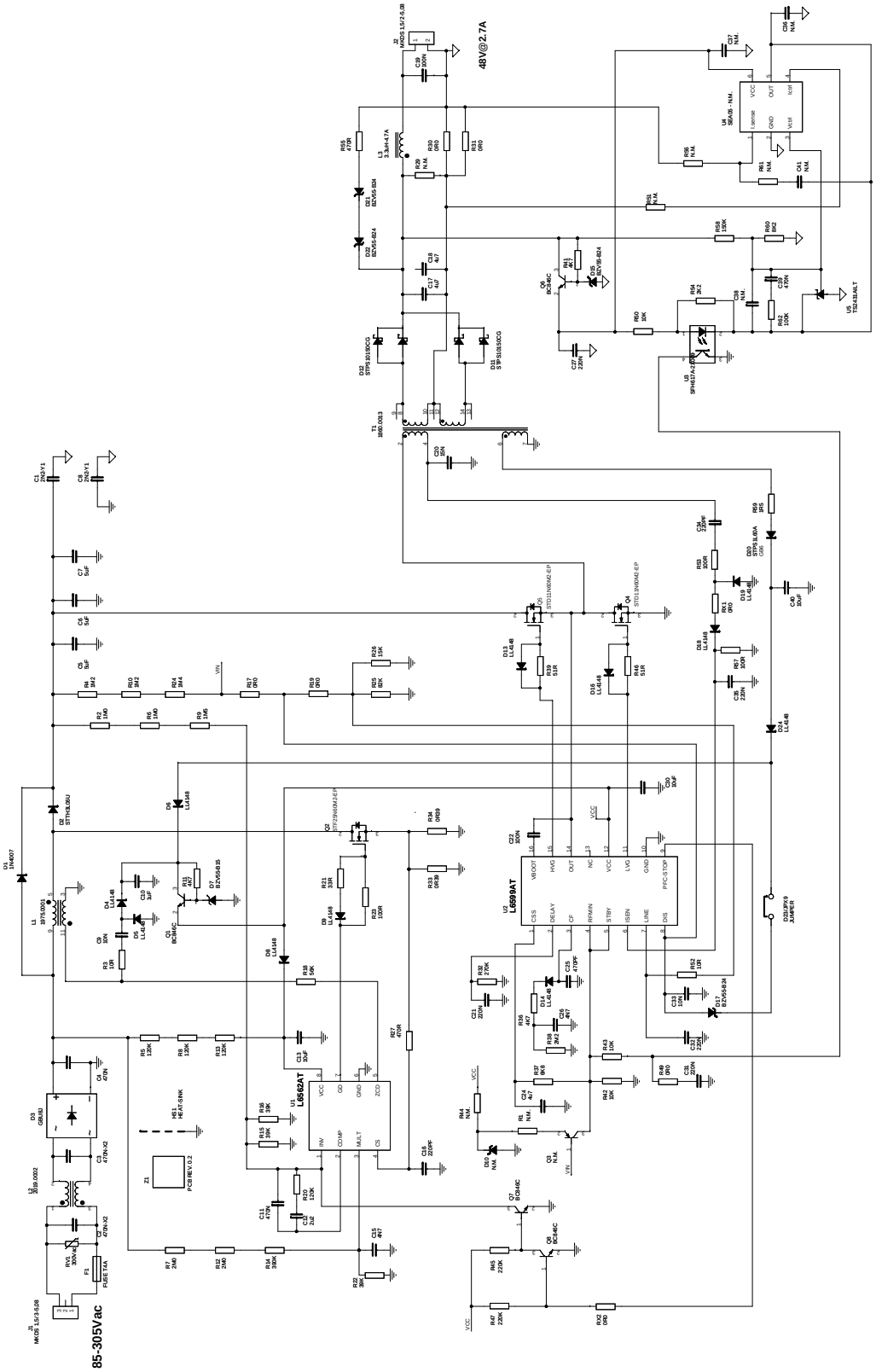
The strengths of this design are very high efficiency, wide input mains range (85-305 VAC) operation, and long-term reliability.

This board is designed with film capacitors from EPCOS instead of electrolytic capacitors that often have a negative impact on reliability or mean time between failures (MTBF), especially the less expensive examples. Component de-rating is also an important design feature of this board as it decreases the stress of the components, as recommended in MIL-HDBK-217D.

Thanks to the high efficiency levels, only a small heatsink is needed for the PFC stage. The other power components, like most of the passive components, are surface mount technology (SMT) for lower production labor costs.

The STEVAL-ILL053V2 evaluation board includes protection mechanisms against overload, short-circuit, open loop in any stage or input overvoltage. For this particular application, any protections that are triggered are followed by an auto-restart function.

Figure 1. Circuit diagram



Measurement results

For a Vin of 230 Vac, **Figure 2** shows how the evaluation board efficiency rises from approximately 84% to a little over 93% as the load level increases from 20% to 100%.

Figure 2. Efficiency at different load level

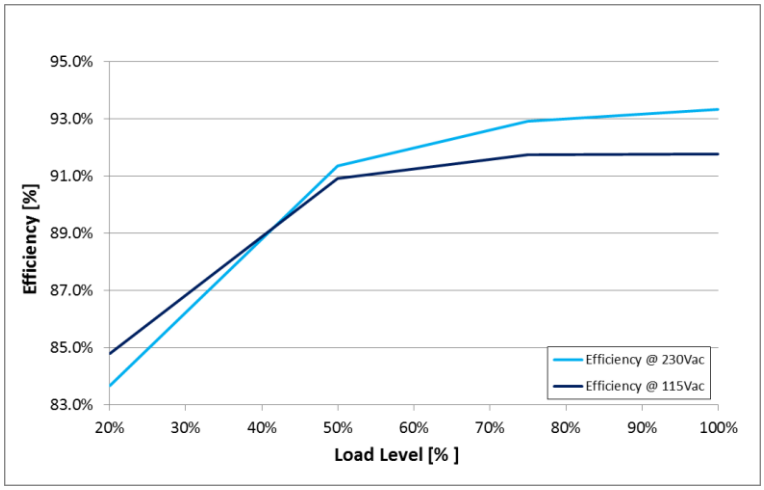
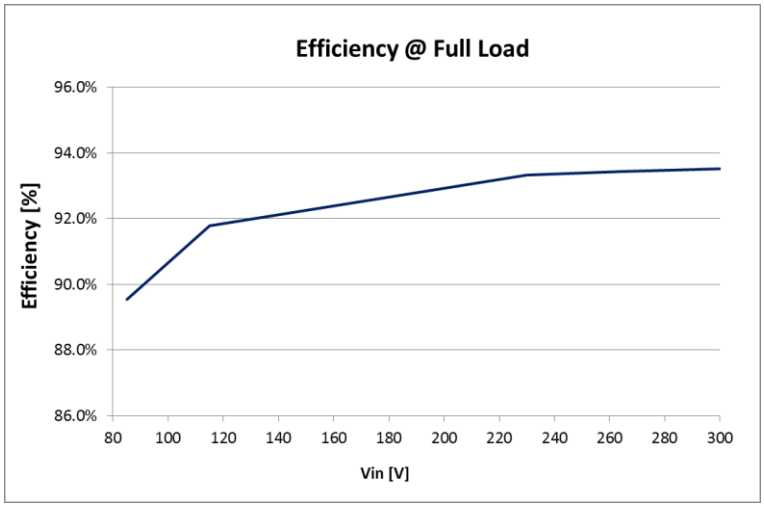


Figure 3 shows the demo board efficiency rising to above 93% as the input voltage (Vin) increases from 85 Vac to 300 Vac.

Figure 3. Efficiency at different input voltage



The power factor (PF) and the total harmonic distortion (THD) versus load are shown in **Figure 4** and **Figure 5**. The figures show that for 115 Vac, the PF remains close to one and the THD remains low.

Figure 4. Power Factor at different loads

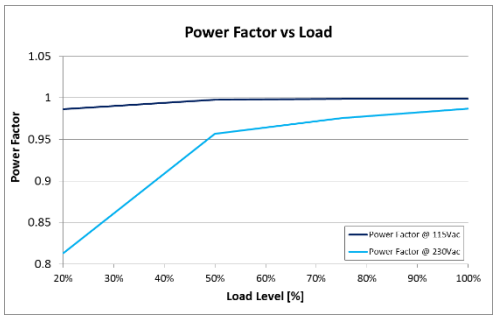
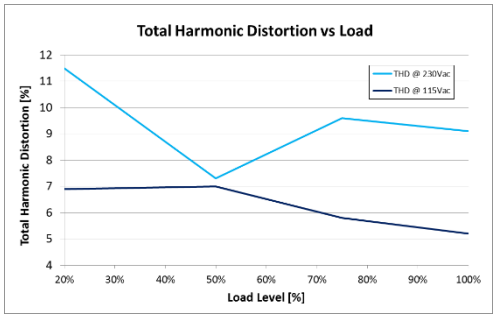


Figure 5.THD at different loads



Figures 6 and **Figure7** show the power factor and THD versus input voltage mains variation. The PF is greater than 0.96 and the THD is less than 10% across that entire input voltage mains variation.

Figure 6. Power Factor at different input voltage

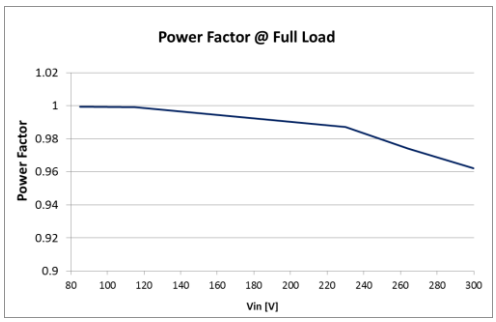


Figure 7. THD at different input voltage

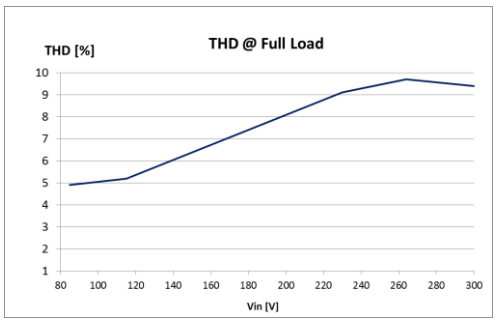


Figure 8 and Figure 9 show the average measurements of conducted noise at full load and nominal mains voltages. The limits in the diagrams are those stipulated by EN55022 Class-B. The diagrams show that the measurements are within the limits in all test conditions.

Figure 8. Average measurements under full load conditions at 115 Vac

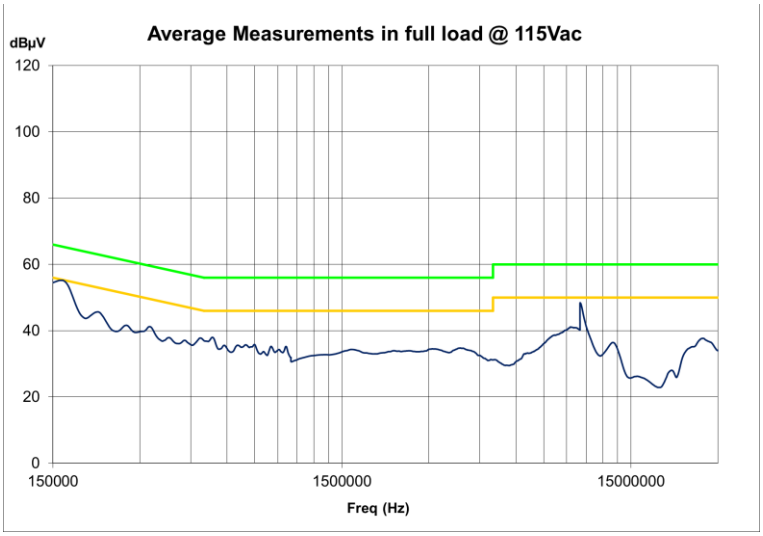
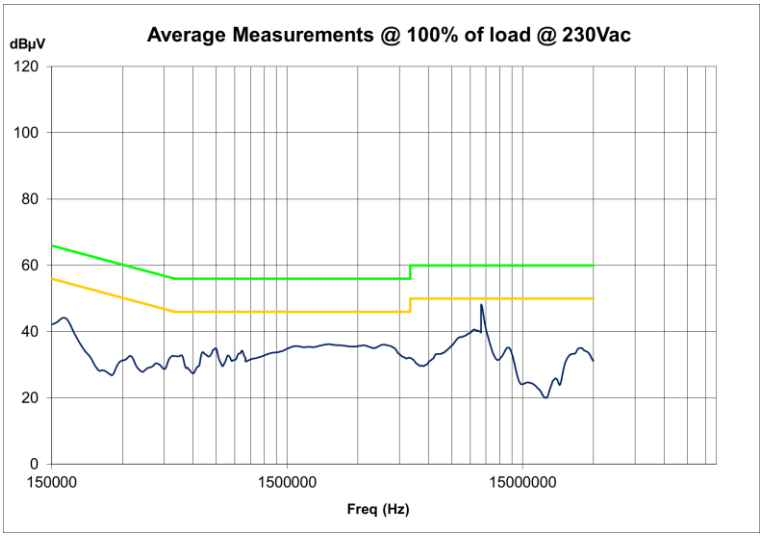


Figure 9. Average measurements under full load conditions at 230 Vac



Support material

Related design support material
Documentation
Data brief DB3803: 48 V - 130 W high efficiency converter with PFC for LED street lighting applications based on L6562 and L6599
Application Note AN3106: 48 V - 130 W high-efficiency converter with PFC for LED street lighting applications

Revision history

Date	Version	Changes
11-Dec-2018	1	Initial release