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Design note

STEVAL-ILL066V1
Modification for 2 channel output

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By Ambrogio D'Adda

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

Specification

- Two output channels

- Output power, 48W for channel (total 96W)

- Output 2x60V maximum

- Output 2x800mA maximum

- Analog dimming algorithm from 10mA to 800mA, same as the ILL066V1 demo board

- Same Iout on the two channels

Circuit description

This document describes in detail the modification of the STEVAL-ILL066V1 demo board to implement two output LEDs channels (or more if the number of output channels is increased).

This Design Note describes how to drive two output channels but the same procedure is usable for a different numbers of output channels. A limitation is given by both the half voltage of half bridge power supply applied to the output transformer and the maximum output power of the PFC stage used on the board. The board is depicted in *Figure 1*.

The output voltage automatically adapts to the required load; the verified output range is from 20V to 60V. The output current is the same for the two output circuits and, for this application, there is no way to regulate a different output current on the two output channels. NOTE: if an output circuit is short circuited, the other output circuit is not affected by this.

The circuit modification applies only to the output schematics sheet available with the AN4382 as showed in *Figure 2*. The two channel output circuits are showed in *Figure 3*. To clarify the page schematics, each main function is highlighted by a red area.

The half bridge driver and MOSFET highlighted in area 1 is exactly the same for the two output channels showed in *Figure 3*. Only the shunt resistor is modified to adapt the maximum output current to 800mA. In this case the R36 and R37 resistors are changed to 1.69 Ω. The resonant inductor (T1) is the same as the original circuit.

The area 2 is the shunt resistor for S_CH0 signal. The S_CH0 signal is acquired by the ADC channel of STLux and the level is function of the output voltage of the output transformer (via pins 6 and 7). The S_CH0 signal is used to protect the output capacitor when the load (LEDs in series) is not connected or is opened. The same function is implemented when two channels are used. In this case and for this circuit, when one of the two loads is open the other channel is powered off. If the user wants to preserve the function for the available single channel, a short circuit (MOSFET with drivers) is applied to the pin 3 and 5 of the output transformers (T2 or T8) with the "no load" condition. In order to detect the open channel, STLux must monitor two S_CH0 circuit (not present in *Figure 3*). Another option to detect it is to implement two or more opto coupler reporting the output voltage measure to STLUX. If the user wants to preserve the single output channel when the others are opened, the circuit defined in *Figure 3* is not applicable. The area 3 output is the S_CH0 signal and R102 and R103 resistors in *Figure 3* are simple voltage adders. To change the maximum output voltage, a PSR parameters library is available using the "in" or "ip" serial command (parameter #48 - "no load S_CH0").

The area 4 is the isolated output circuit and is the same for the two outputs. Please note that the secondary GND connected together for the two outputs in this area can also be divided. In this case the two output channels can be serially connected allowing so to reduce the output pins.
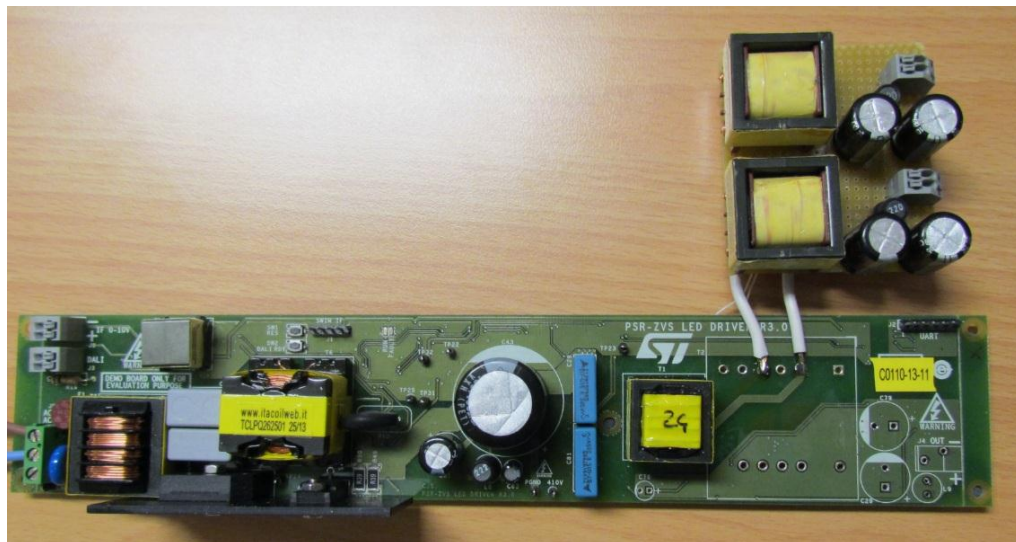
Figure 1. Modified board
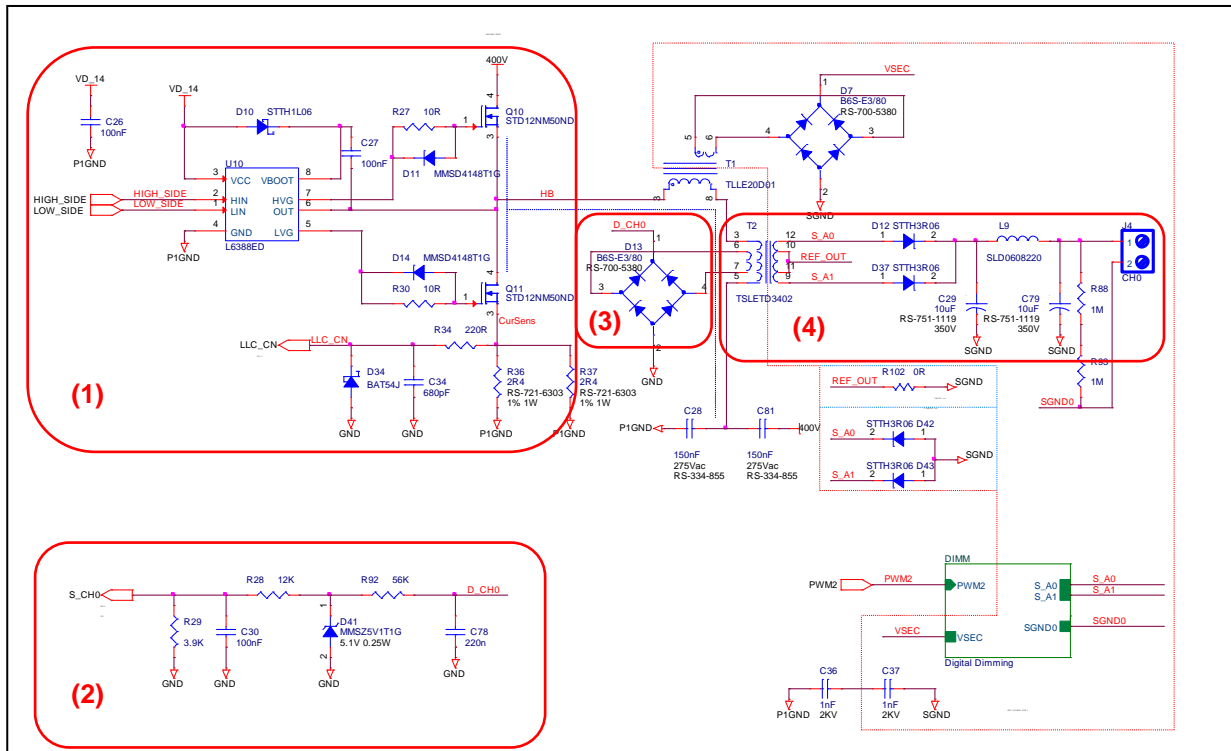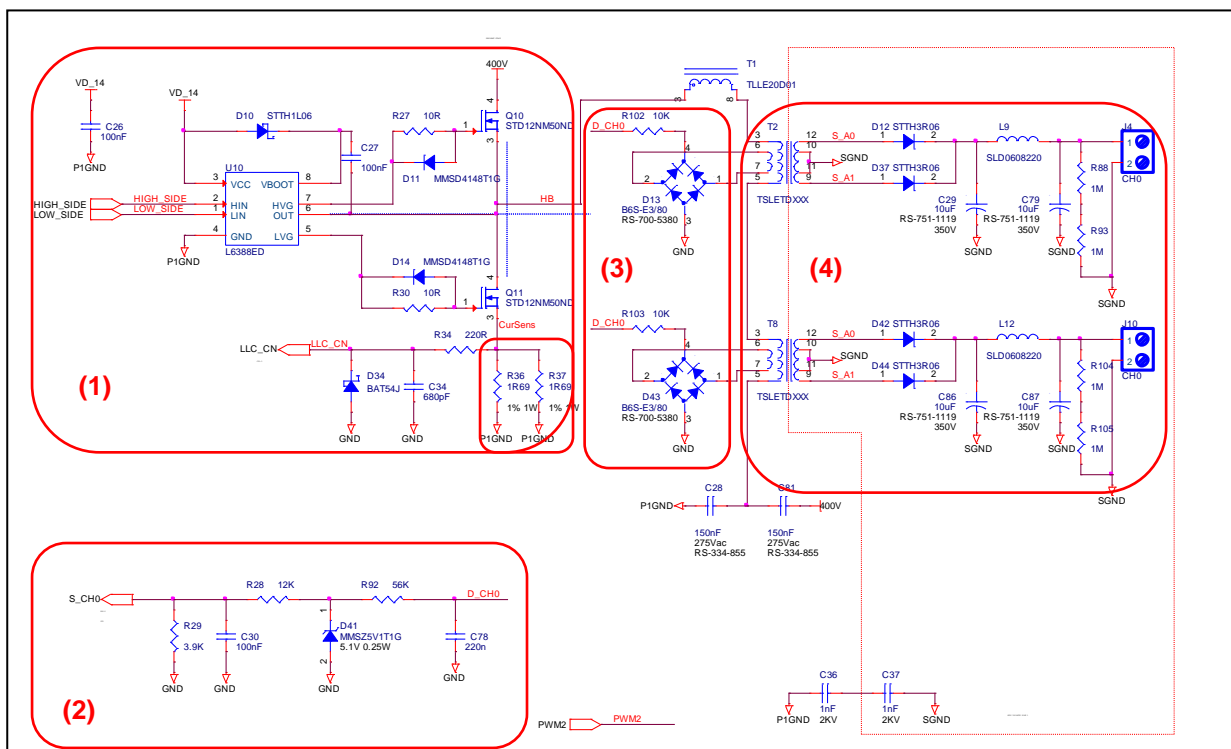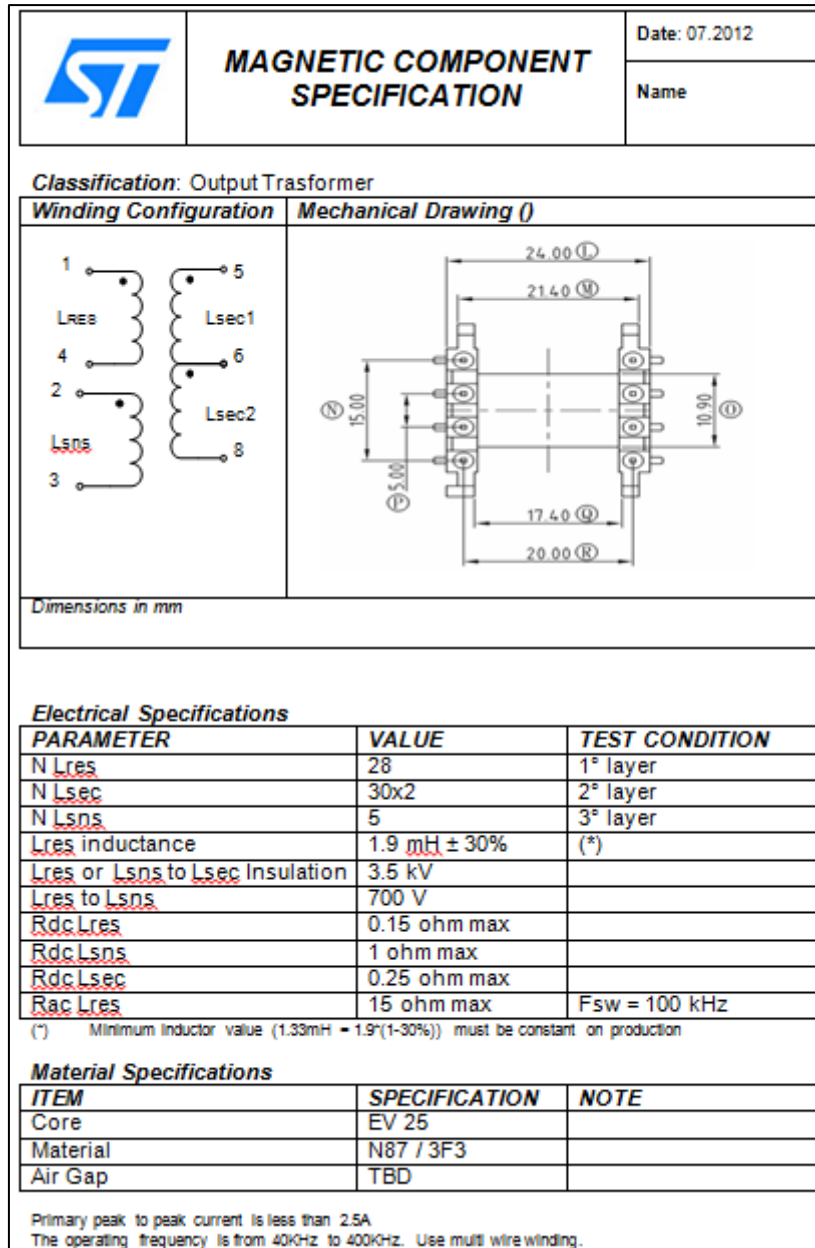
Figure 2. AN4382 - original circuit diagram

Figure 3. Modify circuit diagram for two channels

The output transformer used in this design is specified in *Figure 4* and the output voltage is, at maximum, equal to 60V. Instead of having a 1A output current as the regular application, when typing "*ll 3450*" at command line for this transformer you get an output current equal to 690mA. Please refer to *Table 1* to identify the new output current.

Figure 4. Output transformer - example

	MAGNETIC COMPONENT SPECIFICATION	Date: 07.2012
		Name

Classification: Output Trasformer

Winding Configuration	Mechanical Drawing ()

Dimensions in mm

Electrical Specifications

PARAMETER	VALUE	TEST CONDITION
N Lres	28	1° layer
N Lsec	30x2	2° layer
N Lsns	5	3° layer
Lres inductance	1.9 mH ± 30%	(*)
Lres or Lsns to Lsec Insulation	3.5 kV	
Lres to Lsns	700 V	
Rdc Lres	0.15 ohm max	
Rdc Lsns	1 ohm max	
Rdc Lsec	0.25 ohm max	
Rac Lres	15 ohm max	Fsw = 100 kHz

(*)   Minimum inductor value (1.33mH = 1.9*(1-30%)) must be constant on production

Material Specifications

ITEM	SPECIFICATION	NOTE
Core	EV 25	
Material	N87 / 3F3	
Air Gap	TBD	

Primary peak to peak current is less than 2.5A
The operating frequency is from 40KHz to 400KHz. Use multi wire winding.

Measurement results

The load of the two output cannels is a "CROMA 63101-63105-6312 " Used in "CV" mode to fix the output voltage.

The modification proposed in this document allows the board to have an output current and output voltage as defined in *Table 1*

Table 1.   Output current at different level and total board efficiency

"II" command	Pwin (W)	CH1		CH2		Efficiency
		Iout (mA)	Vout (V)	Iout (mA)	Vout (V)	
660	8.87	60	60	59	60	0.805
795	17.28	122	60	122	60	0.847
935	26.05	187	60	186	60	0.859
1070	33.44	238	60	238	60	0.854
1380	45.6	337	60	337	60	0.887
1770	53.88	405	60	405	60	0.902
2175	62.64	473	60	472	60	0.905
2600	71.8	543	60	543	60	0.908
3020	81.26	615	60	615	60	0.908
3450	90.96	690	60	690	60	0.910
3750	97.87	743	60	743	60	0.911
4070	105.18	800	60	800	60	0.913

When changing the Vout for a single channel, an Iout mismatch can be seen as shown in *Table 2*.

Table 2.   Iout mismatch vs Vout variation

"II" cmd	Pwin	CH1		CH2		Efficiency
		Iout (mA)	Vout (V)	Iout (mA)	Vout (V)	
4070	72.90	810	20	801	60	0.881
4070	80.91	806	30	799	60	0.891
4070	89.99	803	40	799	60	0.890
4070	97.50	800	50	798	60	0.901
4070	105.18	800	60	800	60	0.913

Variations

In order to see the results described above for the ILL066V1 demo board, a firmware update is needed to V3R29. No change is needed to the source code and to the file configuration. For this demo board the DALI and the 0-10V interfaces must be disabled because the output current is related to the original ILL066V1 (1CH only).

The relation of the output current respect to the "ll" command is depicted in *Table 1*. This is the only difference respect to what's defined in the AN4382.

Support material

Related design support material
STWS-PSRDEMO-V3R29, source code for STEVAL-ILL066V1 or STEVAL385LEDPSR
Documentation
Datasheet: STLUX385A - Digital controller for lighting and power supply applications
Application note: AN4382 - 100 W LED street lighting application using STLUX385A
STEVAL385LEDPSR Library - Application Note

Revision history

Date	Version	Changes
03-Mar-2014	1	Initial release

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