DN0002
Design note

DESIGNS from our LABS

10W offline LED driver based on VIPER27

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 Luigi Galioto

Main components	
VIPER27	Offline high voltage converter
SEA05	Advanced constant voltage and constant current controller

Specification

- 10W LED driver
- Wide input voltage range: 88Vac to 265Vac
- 300mA LED current
- Isolated SMPS
- Short circuit protection

Circuit description

The use of LEDs in lighting applications is becoming increasingly popular due to: rapid improvements in lighting efficiency, longer life, higher reliability and overall cost effectiveness.

This converter is a simple example of an offline isolated LED application (10W).

The LEDs are driven by the VIPER27 high voltage converter. The secondary side is managed by the SEA05 advanced CC/CV controller.

Excellent results in terms of current control precision (±3%) and efficiency performance (η>80%), combined with the compact form factor which can fit in existing bulb housing, are key benefits.

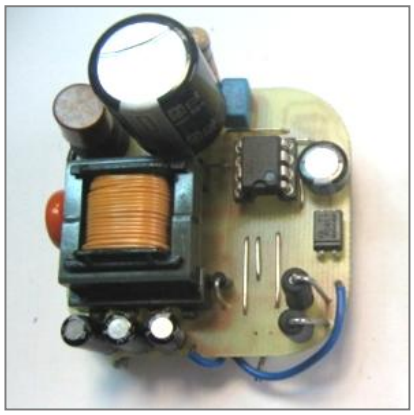
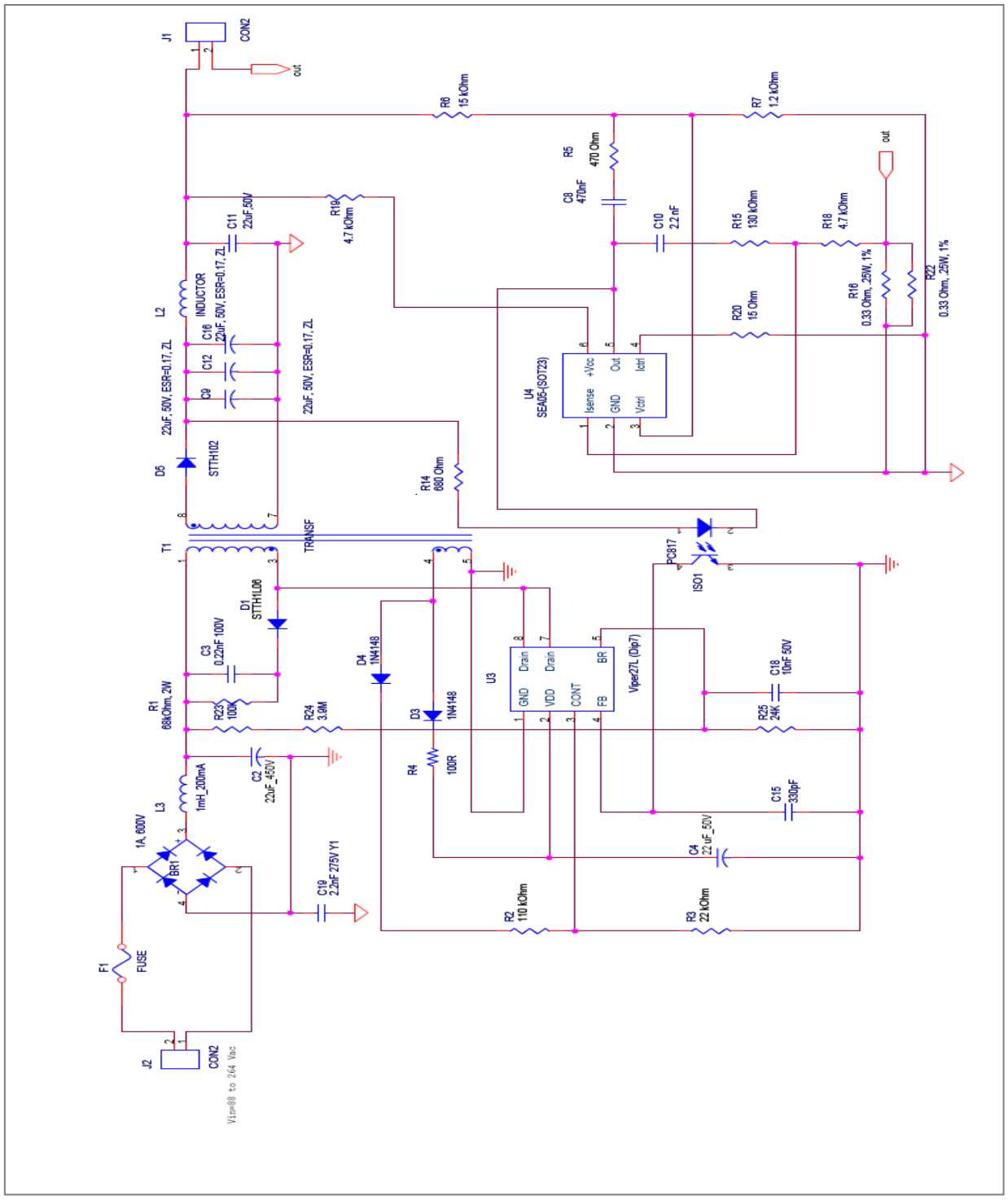


Figure 1. Circuit diagram



Measurement results

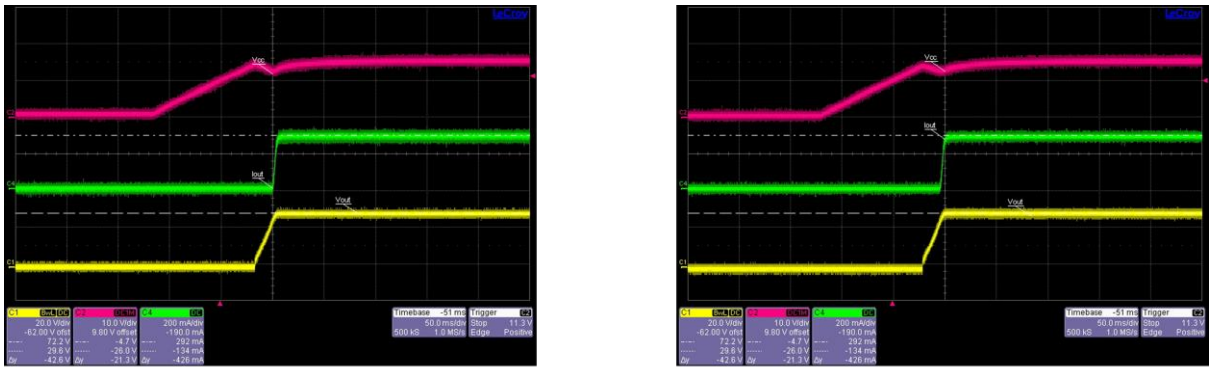
The board was tested in terms of efficiency, output voltage limitation and LED current regulation for a wide input voltage range. Table 1 shows the results obtained for a 30 minute test. High efficiency and excellent LED current regulation were obtained.

Table 1. Experimental results

Vin	Pin(W)	In(mA)	Pout(W)	Efficiency	Iout (mA)	Vout(V)
85	10.4	190	8.36	80.34%	294	28.42
110	10.1	155	8.36	82.73%	294	28.42
140	9.9	130	8.41	84.92%	295	28.5
185	10	110	8.35	83.51%	292	28.6
230	10.2	97	8.30	81.37%	290.2	28.6
265	10.35	90	8.32	80.42%	290	28.7

Start up tests with Vin=110V and Vin=230V were also reported in full load and no load conditions. The behavior of Vout, Vcc and Iout were monitored.

Figure 2. Test results: start up sequence at full load condition



Vin=110V

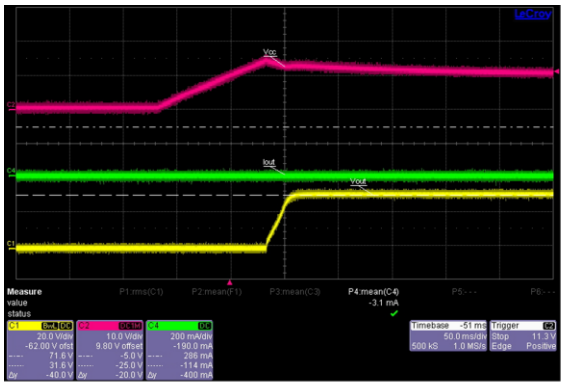
Vin=230V

Yellow => Vout

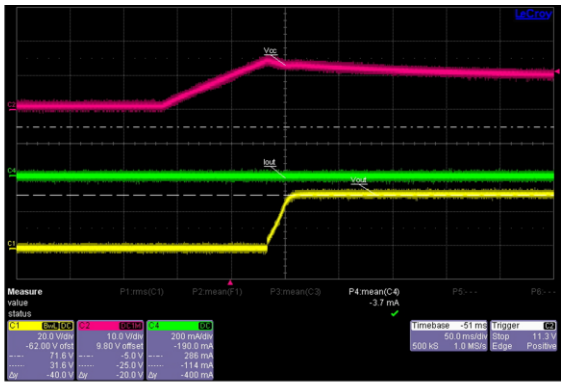
Green => Iout

Purple => Vcc

Figure 3. Test results: start up sequence at no load condition



Vin=110V



Vin=230V

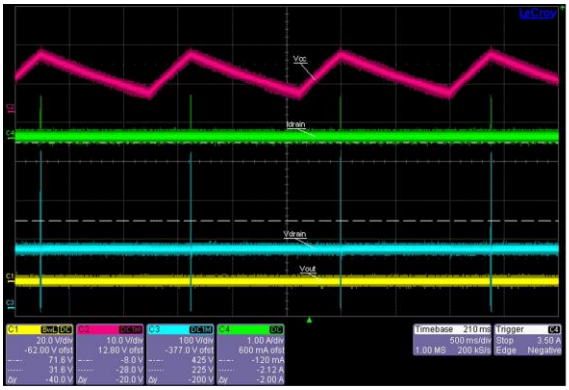
Yellow => Vout

Green => Iout

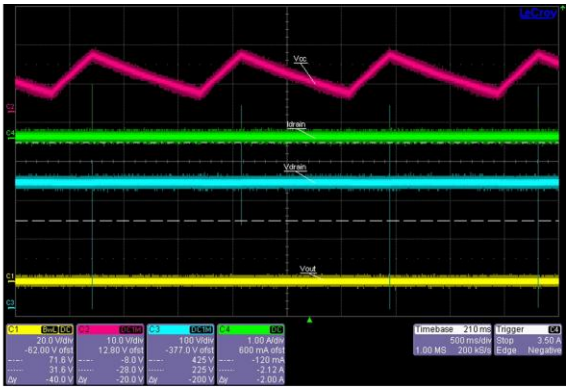
Purple => Vcc

The VIPER27 is protected against short circuits on the secondary rectifier and secondary winding, and a hard-saturation of the flyback transformer. Tests were conducted where the board was subject to short circuits and it protected itself well. The behavior shown in figure 3 illustrates the typical low frequency intermittent operation (hiccup- mode operation).

Figure 4. Test results: short circuit condition



Vin=110V



Vin=230V

Yellow => Vout

Green => Idrain

Blue => Vdrain

Purple => Vcc

Support material

Related design support material
EVLVIP27-7WLED: 3.5W to 7W high power factor offline LED driver based on VIPer devices
Gerber files for 10W LED driver - http://www.st.com/internet/com/TECHNICAL_RESOURCES/TECHNICAL_DIAGRAM/PCB_LAYOUT/10wled_pcb_layout.zip
Documentation
Magnetica, Switch Mode Transformer 10W 55kHz 980uH – see attachment at end of document. www.magnetica.eu Code 1715.0032
AN3212: 3.5W to 7W high power factor offline LED driver based on VIPer devices

Revision history

Date	Version	Changes
15-May-2012	1	Initial release

STP 21	Product Technical Specification	*Code*: **1715.0032**

Product: Switch Mode Transformer 10W 55kHz 980uH

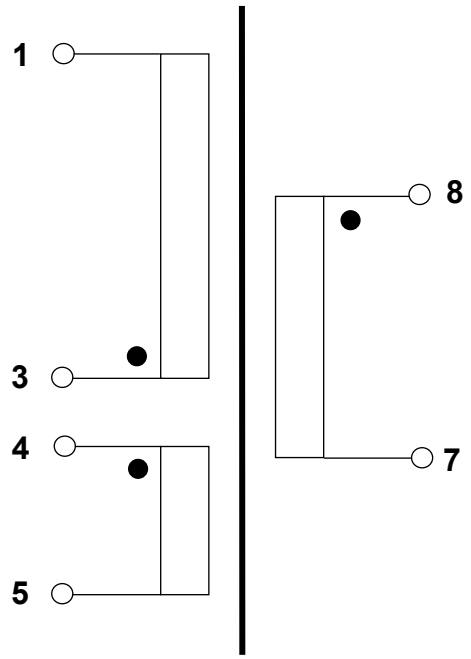
Customer: **STMICROELECTRONICS** *Customer code:*

Date : 27.04.12 *Revision:* 01

TYPICAL APPLICATION

TRANSFORMER FOR FLYBACK POWER SUPPLIES IN APPLICATIONS WITH CONTROLLER VIPER28

CIRCUIT DIAGRAM



TECHNICAL DATA

INDUCTANCE
(*MEASURE 1KHZ, TA 20°C)*

PIN 3-1	980 uH ±15%
PIN 4-5	39 uH ±15%
PIN 8-7	179 uH ±15%

RESISTANCE
(*MEASURE D.C, TA 20°C)*

PIN 3-1	1.22 Ω MAX
PIN 4-5	280 mΩ MAX
PIN 8-7	250 mΩ MAX

TRANSFORMER RATIO
(*MEASURE 10KHZ, TA 20°C)*

PIN 3-1 ⇔ 4-5	5 ± 5%
PIN 3-1 ⇔ 8-7	2.36 ± 5%

LEAKAGE INDUCTANCE 2.5 % NOM
(MEASURE 3-1 AND 4-5-7-8 IN S.C, F 10KHZ, TA 20°C)

PARASITIC CAPACITANCE 14 PF NOM
(MEASURE 3-1, F 1MHZ, TA 20°C)

SATURATION CURRENT 0.94A_P MAX
(MEASURE 3-1, B_{SAT} 0.32T, TA 20°C)

OPERATING CURRENT 0.85 A_P MAX
(MEASURE 3-1, P_{MAX} 10W ,F 55KHZ, TA 20°C)

OPERATING FREQUENCY 55 KHZ NOM
(P_{MAX} 10W , TA 20°C)

OPERATING TEMPERATURE RANGE -10°C÷+45°C
(P_{MAX} 10W)

PRIMARY TO SECONDARY INSULATION 4 K V
(F 50HZ,DURATION TEST 2", TA 20°C)

MAXIMUM DIMENSIONS 27X22XH18 mm

WEIGHT 12 g APPROX

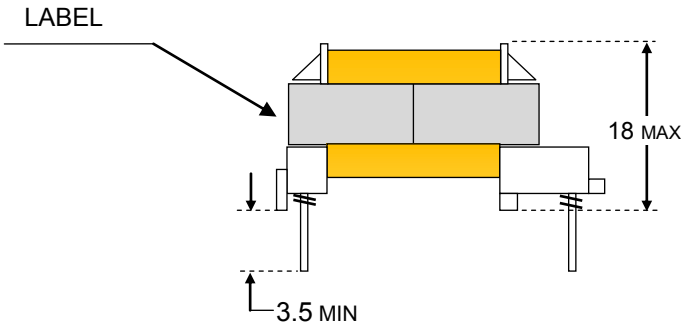
PIN DESCRIPTION

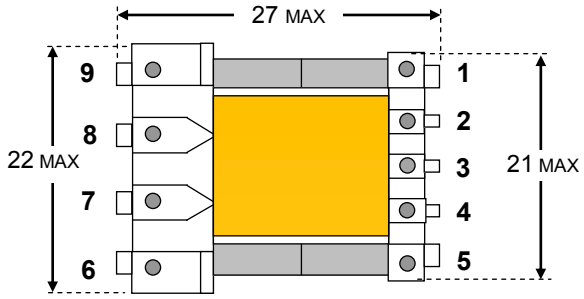
PIN(*)	FUNCTION		PIN(*)	FUNCTION	
1	PRIMARY +VB 120-400VDC		6	NOT USED	
2	NOT USED		7	SECONDARY GROUND	+33V 300mA
3	PRIMARY DRAIN		8	SECONDARY	
4	AUXILIARY	+15V 15mA	9	NOT USED	
5	AUXILIARY GROUND				

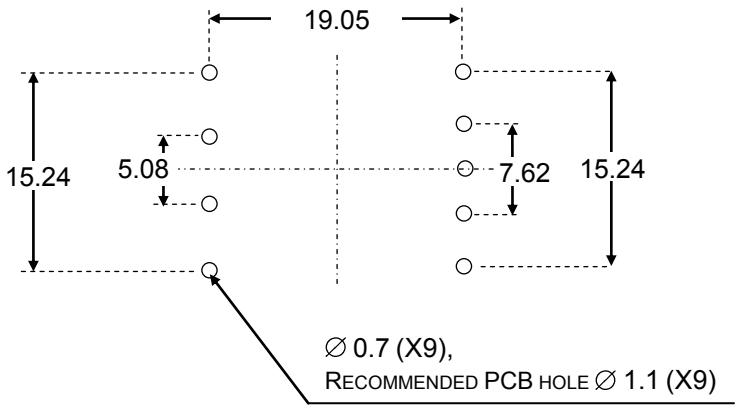
(*)PIN WITH THE SAME SUBSCRIPT MUST BE CONNECTED TOGETHER ON PCB

MAGNETICA
Via Marcora, 20 60022 Castelfidardo (AN)
Tel +39 071 7823855

DIMENSIONAL DRAWING







BOTTOM VIEW (PIN SIDE)

DIMENSIONS IN MILLIMETERS, DRAWING NOT IN SCALE

MAGNETICA
Via Marcora, 20 60022 Castelfidardo (AN)
Tel +39 071 7823855