10W offline LED driver based on VIPER27

By Luigi Galioto

Main components

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>VIPER27</td>
<td>Offline high voltage converter</td>
</tr>
<tr>
<td>SEA05</td>
<td>Advanced constant voltage and constant current controller</td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th>Vin</th>
<th>Pin(W)</th>
<th>In(mA)</th>
<th>Pout(W)</th>
<th>Efficiency</th>
<th>Iout (mA)</th>
<th>Vout(V)</th>
</tr>
</thead>
<tbody>
<tr>
<td>85</td>
<td>10.4</td>
<td>190</td>
<td>8.35</td>
<td>80.34%</td>
<td>294</td>
<td>28.42</td>
</tr>
<tr>
<td>110</td>
<td>10.1</td>
<td>155</td>
<td>8.36</td>
<td>82.73%</td>
<td>294</td>
<td>28.42</td>
</tr>
<tr>
<td>140</td>
<td>9.9</td>
<td>130</td>
<td>8.41</td>
<td>84.92%</td>
<td>295</td>
<td>28.5</td>
</tr>
<tr>
<td>185</td>
<td>10</td>
<td>110</td>
<td>8.35</td>
<td>83.51%</td>
<td>292</td>
<td>28.6</td>
</tr>
<tr>
<td>230</td>
<td>10.2</td>
<td>97</td>
<td>8.30</td>
<td>81.37%</td>
<td>290.2</td>
<td>28.6</td>
</tr>
<tr>
<td>285</td>
<td>10.35</td>
<td>90</td>
<td>8.32</td>
<td>80.42%</td>
<td>290</td>
<td>28.7</td>
</tr>
</tbody>
</table>

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
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

**Yellow** => Vout
**Green** => I_drain
**Blue** => V_drain
**Purple** => V_cc

Vin = 230V

Support material

<table>
<thead>
<tr>
<th>Related design support material</th>
</tr>
</thead>
<tbody>
<tr>
<td>EVLVIP27-7WLED: 3.5W to 7W high power factor offline LED driver based on VIPer devices</td>
</tr>
</tbody>
</table>

Documentation

Magnetica, Switch Mode Transformer 10W 55kHz 980uH – see attachment at end of document.
[www.magnetica.eu](http://www.magnetica.eu)  Code 1715.0032

AN3212: 3.5W to 7W high power factor offline LED driver based on VIPer devices

Revision history

<table>
<thead>
<tr>
<th>Date</th>
<th>Version</th>
<th>Changes</th>
</tr>
</thead>
<tbody>
<tr>
<td>15-May-2012</td>
<td>1</td>
<td>Initial release</td>
</tr>
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</table>
TYPICAL APPLICATION
TRANSFORMER FOR FLYBACK POWER SUPPLIES IN APPLICATIONS WITH CONTROLLER VIPER28

CIRCUIT DIAGRAM

TECHNICAL DATA

INDUCTANCE
(MEASURE 1kHz, TA 20°C)

<table>
<thead>
<tr>
<th>PIN</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>3-1</td>
<td>980 uH ±15%</td>
</tr>
<tr>
<td>4-5</td>
<td>39 uH ±15%</td>
</tr>
<tr>
<td>8-7</td>
<td>179 uH ±15%</td>
</tr>
</tbody>
</table>

RESISTANCE
(MEASURE D.C, TA 20°C)

<table>
<thead>
<tr>
<th>PIN</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>3-1</td>
<td>1.22 Ω MAX</td>
</tr>
<tr>
<td>4-5</td>
<td>280 mΩ MAX</td>
</tr>
<tr>
<td>8-7</td>
<td>250 mΩ MAX</td>
</tr>
</tbody>
</table>

TRANSFORMER RATIO
(MEASURE 10kHz, TA 20°C)

<table>
<thead>
<tr>
<th>PIN</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>3-1</td>
<td>5 ± 5%</td>
</tr>
<tr>
<td>8-7</td>
<td>2.36 ± 5%</td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.5 % NOM</td>
</tr>
</tbody>
</table>

PARASITIC CAPACITANCE
(MEASURE 3-1, F 1MHz, TA 20°C)

<table>
<thead>
<tr>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>14 PF NOM</td>
</tr>
</tbody>
</table>

SATURATION CURRENT
(MEASURE 3-1, Bsat 0.32T, TA 20°C)

<table>
<thead>
<tr>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.94Aps MAX</td>
</tr>
</tbody>
</table>

OPERATING CURRENT
(MEASURE 3-1, Pmax 10W, F 55kHz, TA 20°C)

<table>
<thead>
<tr>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.85Aps MAX</td>
</tr>
</tbody>
</table>

OPERATING FREQUENCY
(Pmax 10W, TA 20°C)

<table>
<thead>
<tr>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>55 kHz NOM</td>
</tr>
</tbody>
</table>

OPERATING TEMPERATURE RANGE
(F 50Hz, DURATION TEST 2', TA 20°C)

| -10°C:+45°C |

PRIMARY TO SECONDARY INSULATION
(F 50Hz, DURATION TEST 2', TA 20°C)

| 4 kV |

MAXIMUM DIMENSIONS

<table>
<thead>
<tr>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>27x22xH18 mm</td>
</tr>
</tbody>
</table>

WEIGHT

<table>
<thead>
<tr>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>12 g APPROX</td>
</tr>
</tbody>
</table>

PIN DESCRIPTION

<table>
<thead>
<tr>
<th>PIN(*)</th>
<th>FUNCTION</th>
<th>PIN(*)</th>
<th>FUNCTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>PRIMARY +VB 120-400VDC</td>
<td>6</td>
<td>NOT USED</td>
</tr>
<tr>
<td>2</td>
<td>NOT USED</td>
<td>7</td>
<td>SECONDARY GROUND</td>
</tr>
<tr>
<td>3</td>
<td>PRIMARY DRAIN</td>
<td>8</td>
<td>SECONDARY</td>
</tr>
<tr>
<td>4</td>
<td>AUXILIARY</td>
<td>9</td>
<td>NOT USED</td>
</tr>
<tr>
<td>5</td>
<td>AUXILIARY GROUND</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

(*)PIN WITH THE SAME SUBSCRIPT MUST BE CONNECTED TOGETHER ON PCB
STP 21 Product Technical Specification

Product: Switch Mode Transformer 10W 55kHz 980uH

Customer: STMICROELECTRONICS

Date: 27.04.12  Revision: 01

DIMENSIONAL DRAWING

DIMENSIONS IN MILLIMETERS, DRAWING NOT IN SCALE