ST’s Solutions for LED General Illumination
ST LED Lighting Solutions

- Low Power (<15w)
- Medium Power (15w~75w) Demo
- High Power (>75w)
- Design Software
HVLED8XX Controller + MOSFET

• Embedded with 800V MOSFET
• Primary Regulation CC and CV
• HPF and Low THD
## Eval Boards

### Evaluation boards (1/2) for analog solutions up to 15W

<table>
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<tr>
<th>Evaluation Board</th>
<th>Description</th>
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| **EVLHVLED815W8CV**<sup><small>NEW</small></sup> | 8W HPF Flyback primary side CV based on HVLED815PF | - Vin = 200-265 Vac  
- Vout=25V, Iout=310mA  
- Efficiency >86%  
- Power Factor >0.98  
- THD <20% |
| **STEVAL-ILL045V1** | 9W HPF Buck-Boost Triac dimmable solution based on HVLED815PF | - Vin = 90-132 Vac  
- Iled=175mA  
- Efficiency >86%  
- Power Factor >0.98  
- THD <20% |
| **STEVAL-ILL044V1** | 9W HPF Flyback Triac dimmable solution based on HVLED815PF | - Vin = 90-132 Vac  
- Iled=175mA  
- Efficiency >86%  
- Power Factor >0.98  
- THD <20% |

AN4350  
AN4130  
AN4129
**HVLED Controllers: HVLED001/003/005**

**HVLED001**
- High Power Factor Flyback Controller
- Voltage Primary side controlled
- High Voltage components Integrated
- Dimmable: 0-10 and PWM
- High PF & Low THD

**HVLED003**
- Dimmable HPF Flyback Controller
- Current Primary side controlled
- Dimmable: Triac/0-10/PWM
- Very High PF & Very Low THD

**HVLED005**
- Full PSR HPF Flyback Controller
- Current Primary side controlled
- Dimmable: 0-10/PWM
- Very High PF & Very Low THD
- HV start up embedded

**Availability:**
- Available
- Es Q1 2016
- Es Q2 2016
Key Features

- Quasi Resonant Flyback (Peak Current Mode)
- 800V HV startup & Multi fast start-up, high efficiency
- Frequency fold-back for low-load dimming (0-10, PWM)
- High Efficiency and output stability in wide voltage and current range
- Primary side control of the output voltage
- Full set of auto-restart protections
  - Overload
  - Short and Open Circuit
  - Opto-coupler failure
  - Input Overvoltage (Surge) & Undervoltage
  - Transformer/Inductor Saturation
HVLED003
Triac dimmable constant current primary side flyback controller

Key Features

• Quasi Resonant Flyback (Peak Current Mode)
• Primary sense current regulation (PSR)
• ± 3% accuracy on constant LED output current
• TRIAC dimming compatible
• PWM/0-10 dimming compatible
• **Very Low THD and High PF**
• Open or short Fault LED string management
• Start-up and Self supply
• Thermal protection
HVLED003 Demo Board:
Compatible with Triac Dimmer

Active Bleeder & HV start-up

Configuration mode programmability

Active Bleeder management

PF & CC loop

Thermal Protection
Key Features

• Quasi Resonant Flyback (Peak Current Mode)
• Primary sense current regulation (PSR)
• ± 3% accuracy on constant LED output current
• PWM/0-10 dimming compatible
• 800V HV startup & Mult: fast start-up, high efficiency

**Very Low THD and High PF**
• Open or short Fault LED string management
• Start-up and Self supply
• Thermal protection
**Eval Boards**

**Single stage Constant Current LED driver**
- VIN = 90 to 305 Vrms
- OUT = 700 mA (VLED = 0 to 48 V)
- 0-10/PWM Dimming: 100% to 10% (any condition)
- Efficiency: > 90% @ full load
- No-load: better than 300 mW @ 230 VIN

**First stage Constant Voltage PSU 35W**
- VIN = 90-305 Vrms
- Output voltage = 48 V / 730 mA
- Full load efficiency: better than 90%
- No-load: better than 400 mW @ 230 Vin
- Short circuit protection with auto restart
Improved THD for Single Stage Flyback: Issue

- Current reference is proportional to $V_{in}(\theta)$
- Switch ON-time is constant along a line cycle
- Peak primary current is sinusoidal, input current is not (uneven chopping effect: $T_{ON}$ is constant, $T_{SW}(\theta)$ is variable)

$$I_{pkp}(\theta) = I_{pkp} \sin \theta$$

$$I_{in}(\theta) \text{ is NOT sinusoidal}$$

$$I_{in}(\theta) = \frac{1}{2} I_{pkp} \sin \theta \frac{T_{ON}}{T_{SW}(\theta)}$$

$K_v = \frac{V_{kp}}{V_r}$
Improved THD for Single Stage Flyback: Solution

- Boxed block generates $V_{Ct}(\theta)$ with an appropriate pre-distortion so that cycle-by-cycle averaged primary current is sinusoidal.
- $V_C$ (control voltage of outer CV/CC loop) and multiplier adjust amplitude of $V_{Ct}(\theta)$, generating $V_{CS_{ref}}(\theta)$.
- Turn-on & turn-off conditions for SW are unchanged
- $C_t$ is an external component

- Key waveforms @ line cycle time-scale
Improved THD for Single Stage Flyback:

THD < 10% for high line

Vin = 230 Vac, Pout = 35 W, THD = 3.6%
Digital Controller STLUX

• The STLUX is a flexible digital platform with a full set of specific features and peripherals for AC/DC and DC/DC Power Conversion

• Suitable for:
  • Digital Power Supply (DPS): PFC control, LLC, Asymmetrical Half Bridge, Fly-back, Full Bridge topologies and Buck/Boost single/multi channel synchronous rectification
  • SMART LIGHTING: LED, HID, Fluorescent applications - Dimming capability (PWM and/or LINEAR) and integration with sensors
  • Wireless Battery Chargers: STLUX handles energy transfer and communication – Qi, PMA & proprietary

• Wired or wireless communications, simple installation in large indoor and outdoor area, reducing maintenance costs
STLUX digital power converters are the right solution for digital power conversion applications.

ST programmable SMED peripherals + Switch matrix and 8 bits ST core provide flexible and complete power management functionalities in a single IC.

By providing high-speed PWMs (96MHz), dedicated 8ch ADCs with selectable gain, STLUX exploits system performance and reliability

- **SIX** configurable PWM *State Machine Event Driven* (SMED) 1.3ns resolution (with automatic dithering) – 10.4 native.

- 4 Analog Comparators and 6 fast digital inputs synchronized with 96MHz clock

- 8 channels 10 bit ADC with programmable op amp GAIN resolution, 2.4 µs conversion time,

- -40 ºC to 105 ºC temperature range

- TSSOP38
Block Diagram of STLUX385

- STM8 core based (up to 20 MIPS)
- 16-bit/8-bit and 16-bit/16-bit divisions
- Faster 8-bit*8-bit multiplication, signed arithmetic operation
- 6 software configurable State Machine Event Driven (SMED) and Connection Box for maximum flexibility
- 4 Analog Comparators and 6 independent Digital comparators synchronized with 96 MHz clock
- Built-in DALI communication hardware
Eval Board: 100W LED Streetlight

- 100 W (100V Vout @ 1A) Single string LED driver
- Primary side regulation (no opto-coupler needed)
- LC resonant Half Bridge, extremely high efficiency (> 90%)
- Accurate light regulation
- PWM digital dimming: >1kHz, 11bit (OPTIONAL)
- Communication: DALI, UART ctrl and 0-10V dimming
Eval Board: Multi-String LED Driver

4 channel independently dimming (PWM and Analog)
Input Voltage 12~48V, max output current 1A
eDesign Suite – Power Conversion Simulation Tool

The new, easy power management design tool

- AC-DC Conversion
- DC-DC Conversion
- AC-DC LED Driving
- DC-DC LED Driving

www.st.com/edesignsuite

Login on my.st.com (register yourself if not yet done)
Complete, Interactive Schematic and BOM

Screwdriver and Wrench icon: the user can refine sections of the schematic

The user can customize some aspects of the design by interacting with the schematic

The BOM window provides an effective user interface (table) for all the circuit components and their characteristics
Evaluate the Performance of the Design

Simulates key voltage and current waveforms, displays bode plots, power losses and efficiency analysis.
The user can customize the Flyback transformer.
Designs Are Portable

Export the current design project for *PSpice Simulation in OrCAD*.

Save your project to *ST server/edesign suite My Projects* folder.

You can then open it from *ANY* machine.