HVLED
New High Power Factor PSR LED Drivers

HVLED807PF
HVLED815PF

STMicroelectronics

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• We are assisting at the raising of global energy demand that is strictly correlated with the raising of CO2 emissions, main responsible of climate changes.

• Lighting consumes 19% of all electricity in the world.*

• WW Governments are addressing, with regulations and incentives, a more efficient usage of the electrical energy.

• Heightened awareness about energy saving and environmental impact due to degradation of hazardous materials (metal halide, mercury,…). Cost of ownership, rather than initial price, is gaining importance.

* Source: Energy Information Administration (EIA)
LEDs for General Illumination

• LEDs represent the best solution to meet targets for electricity and CO₂ emission reduction:
  • Low power consumption
  • High Lumen/Watt
  • Mercury-free
  • High CRI
  • Extremely robust
  • Flexible form factor

• LEDs for General Illumination is a nascent application with great growth expectation:
  • Technology improvements and mass manufacturing contribute to the commercial availability of brighter and cheaper HB-LEDs
  • Recent EuP regulations will definitely phase out incandescent lamps by 2012 in Europe. Canada, Australia and other countries have already adopted similar regulations
Retrofit LED lamps have very limited space for power conversion IC and its circuitry. Power conversion becomes very critical to avoid high temperatures and to ensure a very long lifetime of the LED lamps.

As a consequence, a LED driver circuit must be very compact and efficient.

A minimum Power Factor of 0.7 for a variety of residential lighting products (0.9 for commercial products) is now required (Energy STAR Rev 1.1).

ST has a dedicated portfolio of offline LED drivers with best-in-class performances and features for LED lamps and AC-DC LED power supply:
High Power Factor PSR LED drivers

• HVLED is an off-line all-primary sensing switching regulator based on quasi-resonant ZVS (zero voltage switching at switch turn-on) flyback topology.
  • No secondary sensing
  • No opto-coupler

• HVLED operates directly from the mains with minimum external parts providing an efficient, compact and cost-effective solution to drive LEDs

Typical offline LED application solution
HVLED series overview

• New platform of dedicated products tailored for efficient LED lighting, providing cost effective and compact applications in wide range mains applications

• Different topologies will be supported to offer the maximum flexibility in the design of modern LED lamps and AC-DC power supply, in compliance with new standards and regulations such as Energy Star

Effective 2012 April, 1st

High PF > 5W
>0.7 residential
>0.9 commercial
HVLED807/815PF Introduction

800V avalanche rugged Power MOSFET in SuperMESH Technology

HVLED807PF: 800V, 11 Ω (typ.)
HVLED815PF: 800V, 5 Ω (typ.)

85% efficiency

4 drain pins available to enhance power dissipation

HIGH POWER CAPABILITY: UP TO 20W IN 230V MAINS
HVLED807/815: introduction

- The IC can be powered directly from the rectified mains
- High performances 800V MOSfet embedded
- The IC needs very few cheap external parts due to the primary side sensing regulation that avoid secondary sensing and opto-coupler
High Power Factor

- Feeding HVLED807PF/815PF with Input Current information allows implementing HIGH POWER FACTOR solutions (PF>0.92) with ONLY two external resistors.

HVLED SOLUTIONS ARE COMPLIANT with ENERGY STAR Rev 1.1
Constant Current Mode

Principle of operations

\[ I_{LED} = \frac{n}{2} \left( \frac{R}{R_{SENSE}} \right) \times I_{REF} \]

\( R, I_{REF} \) are internal parameters

OUTPUT LED DOES NOT CHANGE WITH \( V_{IN} \), \( V_{OUT} \), \( F_{SW} \)

±5% LED CURRENT ACCURACY WITHOUT 2ND SIDE IC
High Voltage circuitry

• HVLED integrates an High Voltage start up circuit that is connected to the DRAIN pin. A current of 5mA is sunk to charge the $V_{CC}$ bulk capacitor up to $V_{CCSTART}$ in order to start the chip operations. This circuit is promptly re-activated to keep the energy stored at required minimum level.

• Based on the application and the flyback voltage, energy could also be drawn by the AUX winding.

• At converter power-down the system loses regulation as soon as the input voltage falls below $V_{START}$.

HVLED CAN WORK WITH RECTIFIED MAINS. NO NEED FOR ANY $V_{CC}$ RAILS. NO EXTERNAL COMPONENTS.
Application high reliability

- LED applications implemented with HVLED807PF/815PF are safely protected against an open/short circuit of the secondary winding / rectifier or a hard-saturated flyback transformer.

- HVLED monitors the voltage on the RSENSE and when an HARD OVERCURRENT (>1V) is detected for two consecutive switching cycles the device is stopped.

- After the VCC Bulck capacitor is discharged, the HVLED restart and check whether the FAULT conditions have been removed and the LED can be properly driven (Low Frequency HICCUP).
Efficiency and Low EMI emissions

- HVLED807PF/815PF demagnetizing circuit monitors the current running at secondary side

- The Flyback MOSfet is turned ON only when VDS is close to 0V (ZVS, VR>VIN) to dramatically reduce turn-on losses (more efficient) and avoid Hardswitching (more reliable).

Quasi Resonancy reduces Power Spectrum density and EMI emissions
Compact, cost effective applications

- Isolated Flyback with HVLED807PF/815PF
  - NO Need dedicated CV-CC regulator
  - NO Need secondary components and optocoupler
  - NO Additional power dissipation on sense resistor
  - NO External Switch: 800V MOSfet embedded
  - NO dedicated VCC rail: start-up from rectified main

EFFICIENT, COMPACT AND COST EFFECTIVE SOLUTION FOR LED
High Power Factor and Low THD

Just few Additional passive Components for >0.9 PF and Low THD

High PF > 5W
>0.7 residential
>0.9 commercial
HVLED815PF compatibility with TRIAC dimming

Performance is excellent for an isolated LED driver of this size and simplicity. The added bonuses of dimmability and power factor correction compel consideration of this design.
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**Key Features**

- Internal 6 Ω (HVLED815PF) 11 Ω (HVLED805/07PF) 800 V avalanche rugged Power MOSFET and HV start-up
- ±3% accuracy on constant LED output current with Primary Sensing Regulation (NO secondary SENSE and NO optocoupler)
- Quasi resonant (ZVS) operation mode
- High Power Factor (HVLED807PF/815PF)
- TRIAC dimmable applications
- Open and short LED string management
- Input voltage feed-forward for mains independent CC regulation

**Main Applications**

- LED Retrofit lamps up to 15W
- Low power AC-DC LED drivers up to 15 W
HVLED807PF / HVLED815PF: Key benefits

- **Accuracy**
  - Primary side regulation allows ±3 % LED current accuracy

- **Power Factor and Dimmability**
  - PF > 0.92 with few external passive components
  - Compatible with TRIAC dimmers

- **Efficiency**
  - Quasi–resonant operation allows the reduction of conduction and switching losses and, working at variable frequency, reduces the EMI level
  - 800 V MOSFET allows optimization of valley switching consequently reducing the power dissipation
  - HV start-up allows efficient and reliable turn-on phase and reduces external components

- **Robustness**
  - 800 V avalanche rugged internal power MOSFET allows:
    - High reliability
    - Reduced snubber network
  - All primary sensing control allows:
    - Elimination of secondary voltage reference
    - Elimination of the opto-coupler
  - Safe operation against open or short LED string

- **Compactness**
Samples, DS

Evaluation Boards

EVALHVLED815: 10W (30V, 340 mA) High PF, Isolated LED driver (Wide range Input voltage)

EVALHVLED815: 15W (30V, 340 mA) High PF, Isolated LED driver (220V Input voltage)

STEVAL-ILL044V1: 9W Triac dimmable, high power factor, Isolated LED driver based on HVLED815PF (for US Market)

STEVAL-ILL04xxx: 9W A19 Format Triac dimmable, high power factor, Non-Isolated LED driver based on HVLED815PF (for US Market)

Support

All the information including DS, Flyer, e-Presentation and e-design Studio at:

www.st.com
HVLED Series ROADMAP

HVLED: ready for the future!

- New platform of dedicated products tailored for efficient LED lighting, providing cost effective and compact applications in wide range mains applications.

- Different topologies (isolated or non isolated) are supported to offer the maximum flexibility in the design of modern LED lamps and AC-DC power supply, in compliance with new standards and regulations such as Energy Star.
THANK YOU VERY MUCH!