ST’s Solutions for LED General Illumination

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ST LED Lighting Solutions

Low Power
(<15w)

Medium
Power
(15w~75w)
Demo

High Power
(>75w)

Design
Software

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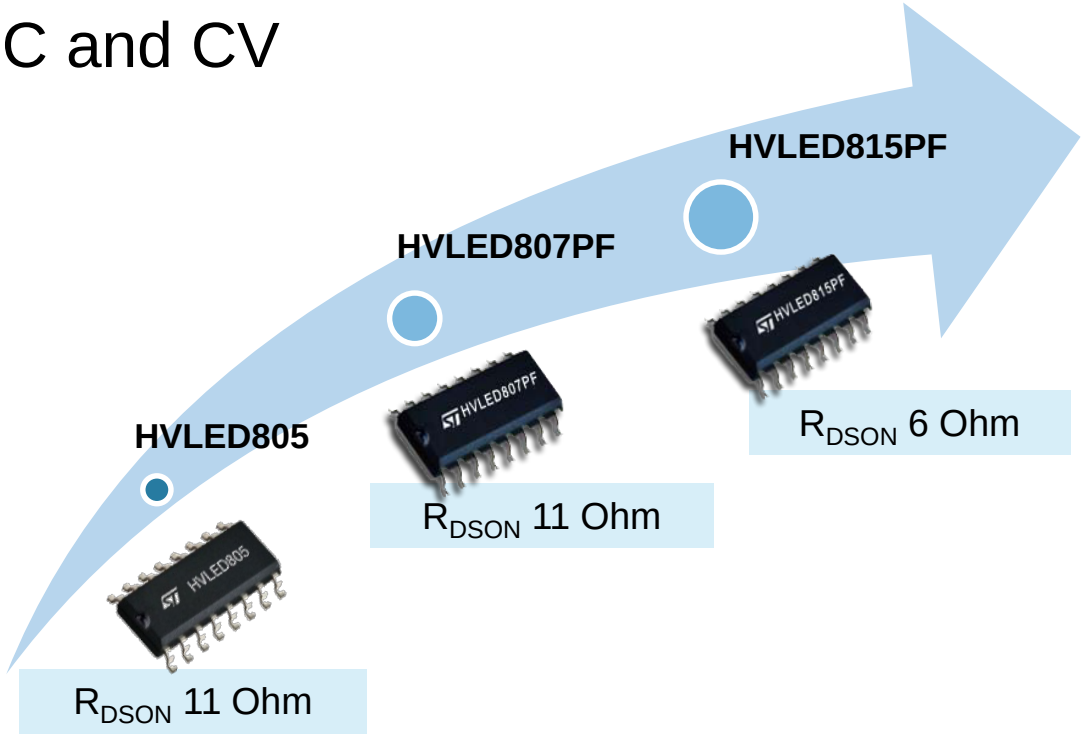
HVLED8XX Controller + MOSFET

- Embedded with 800V MOSFET
- Primary Regulation CC and CV
- HPF and Low THD



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Eval Boards

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

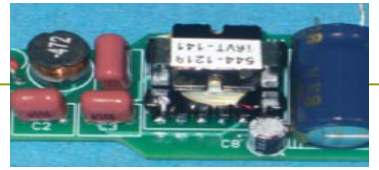
NEW

EVLHVLED815W8CV
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%

AN4350

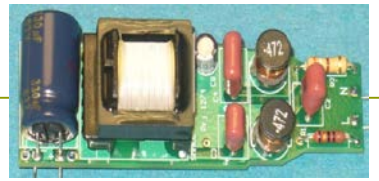
STEVAL-ILL045V1
9W HPF Buck-Boost
Triac dimmable solution
based on HVLED815PF



- Vin = 90-132 Vac
- Iled=175mA
- Efficiency >86%
- Power Factor >0.98
- THD <20%

AN4130

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%

AN4129

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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

Available

HVLED003

Dimmable HPF Flyback Controller

- Current Primary side controlled
- Dimmable: Triac/0-10/PWM
- Very High PF & Very Low THD

Es Q1 2016

HVLED005

Full PSR HPF Flyback Controller

- Current Primary side controlled
- Dimmable: 0-10/PWM
- Very High PF & Very Low THD
- HV start up embedded

Es Q2 2016

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HVLED001

Constant voltage primary side flyback controller

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

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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

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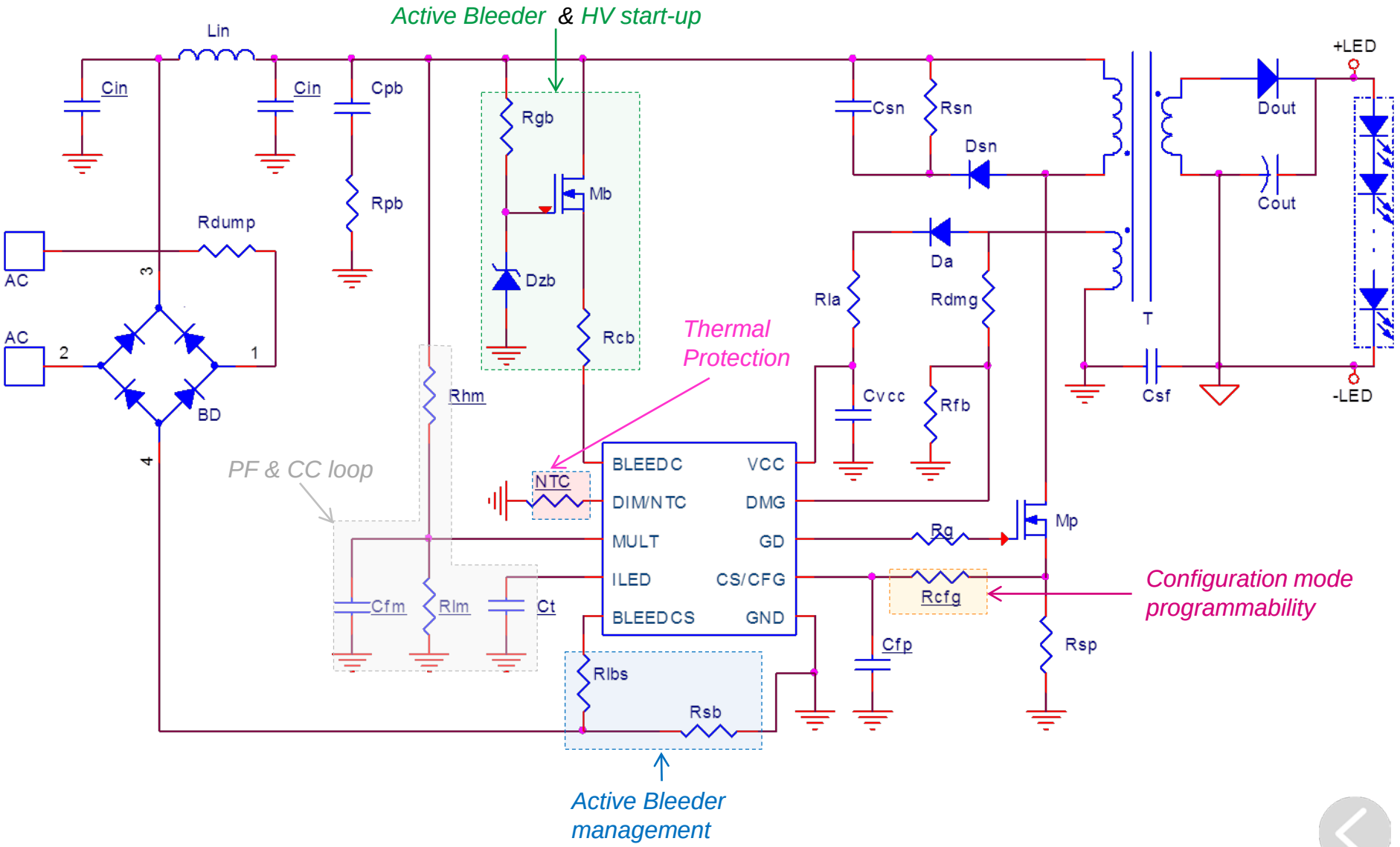
HVLED003 Demo Board:

Compatible with Triac Dimmer



HVLED005

0-10v 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
- 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

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Eval Boards

Single stage Constant Current LED driver

STEVAL-ILL070V1

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

STEVAL-ILL069V1

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

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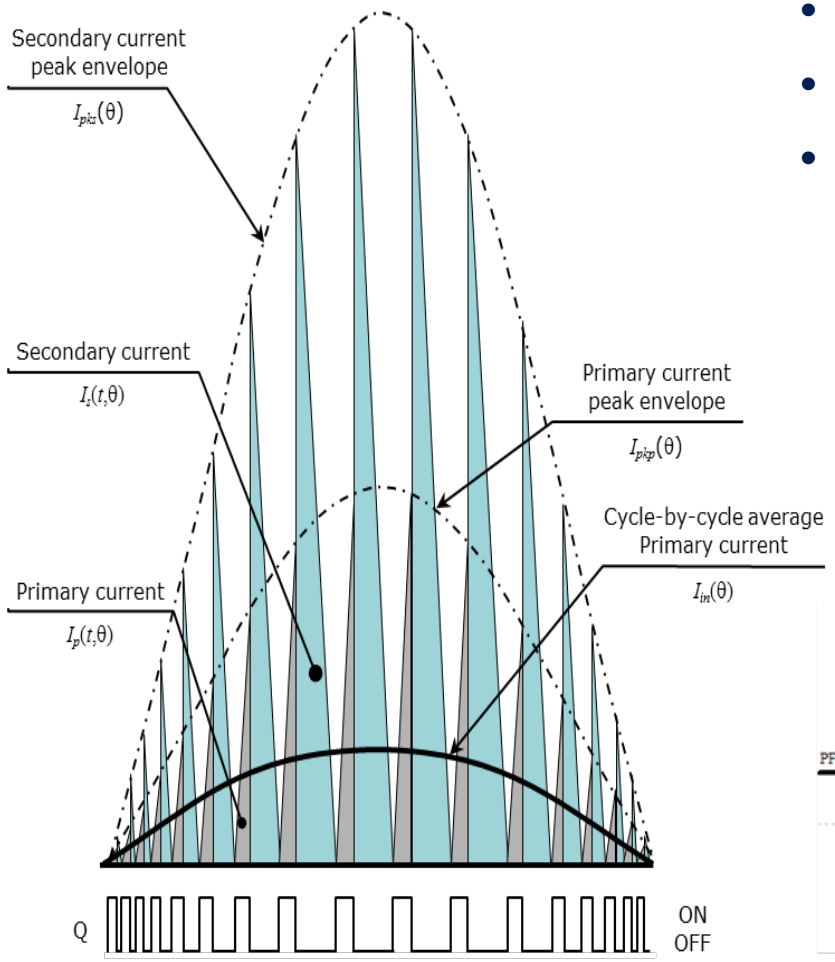
Improved THD for Single Stage Flyback: Issue



- 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)

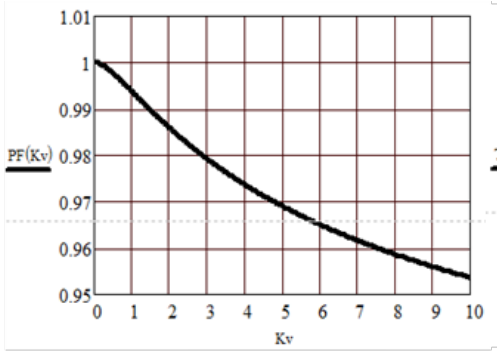
$$I_{pkp}(\theta) = I_{PKp} \sin\theta$$

$$\downarrow$$

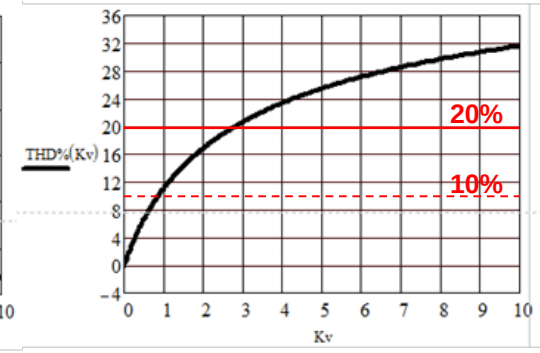
$$I_{in}(\theta) = \frac{1}{2} I_{PKp} \sin\theta \frac{T_{ON}}{T_{SW}(\theta)}$$

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

uneven chopping effect



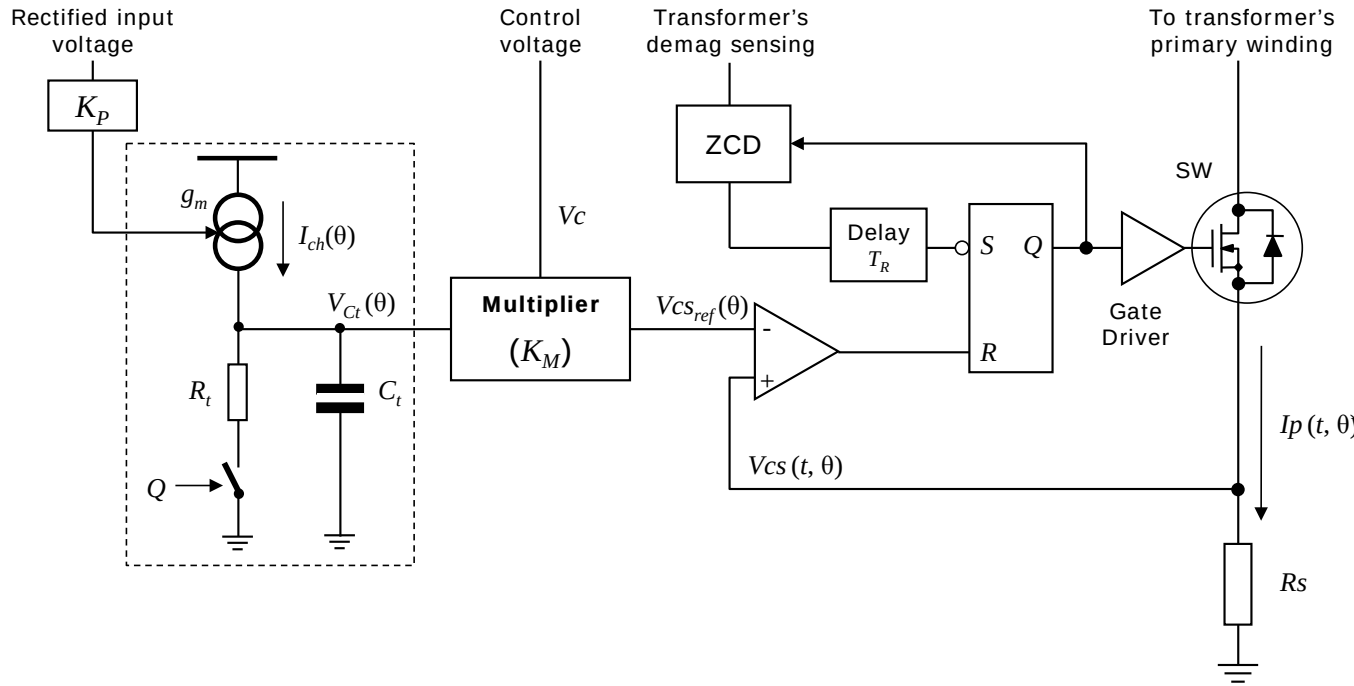
PF> 0.95

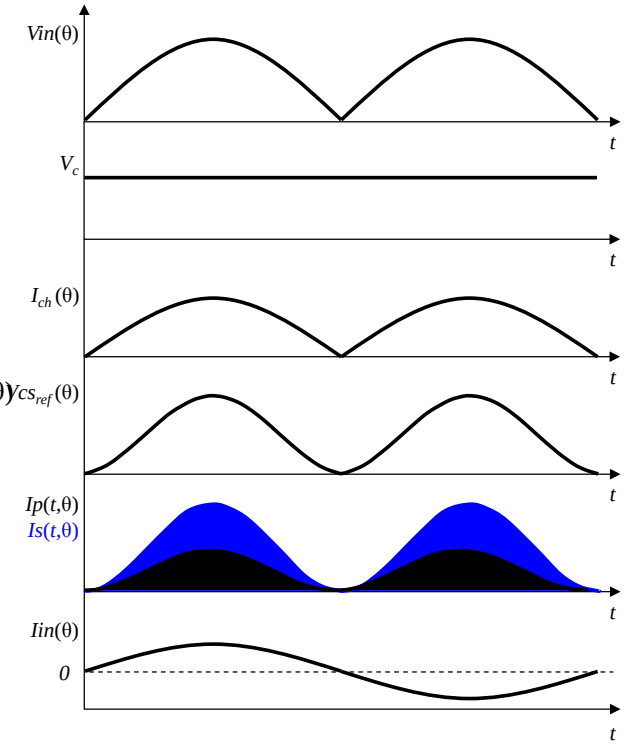


THD in excess of 20%

Kv=Vkp/Vr

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.
- Vc (control voltage of outer CV/CC loop) and multiplier adjust amplitude of $V_{Ct}(\theta)$, generating $Vcs_{ref}(\theta)$.
- Turn-on & turn-off conditions for SW are unchanged
- C_t is an external component

- Key waveforms @ line cycle time-scale

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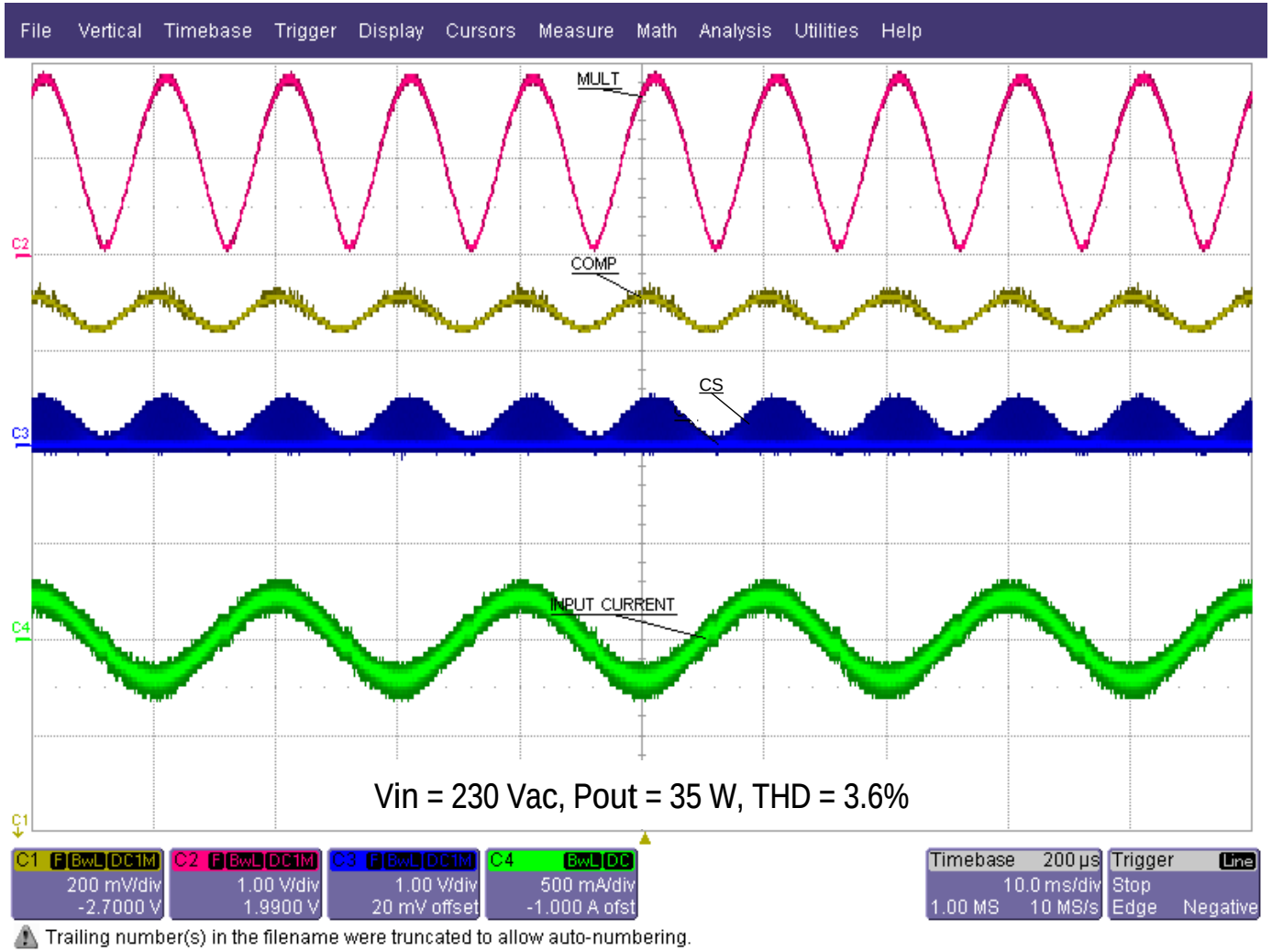
Improved THD for Single Stage Flyback:

THD<10% for high line



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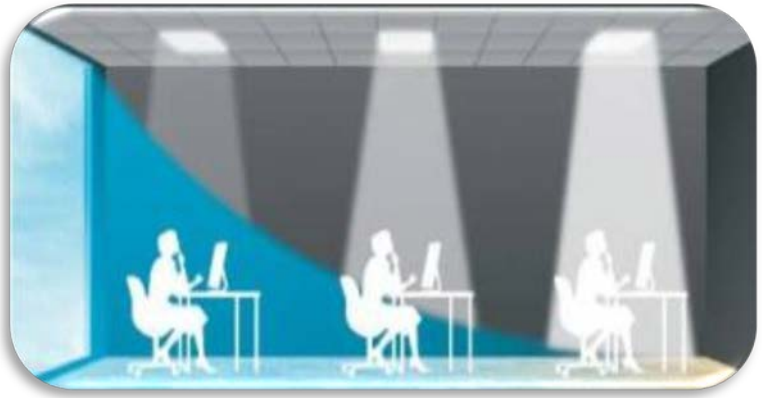
Digital Controller STLUX

- 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



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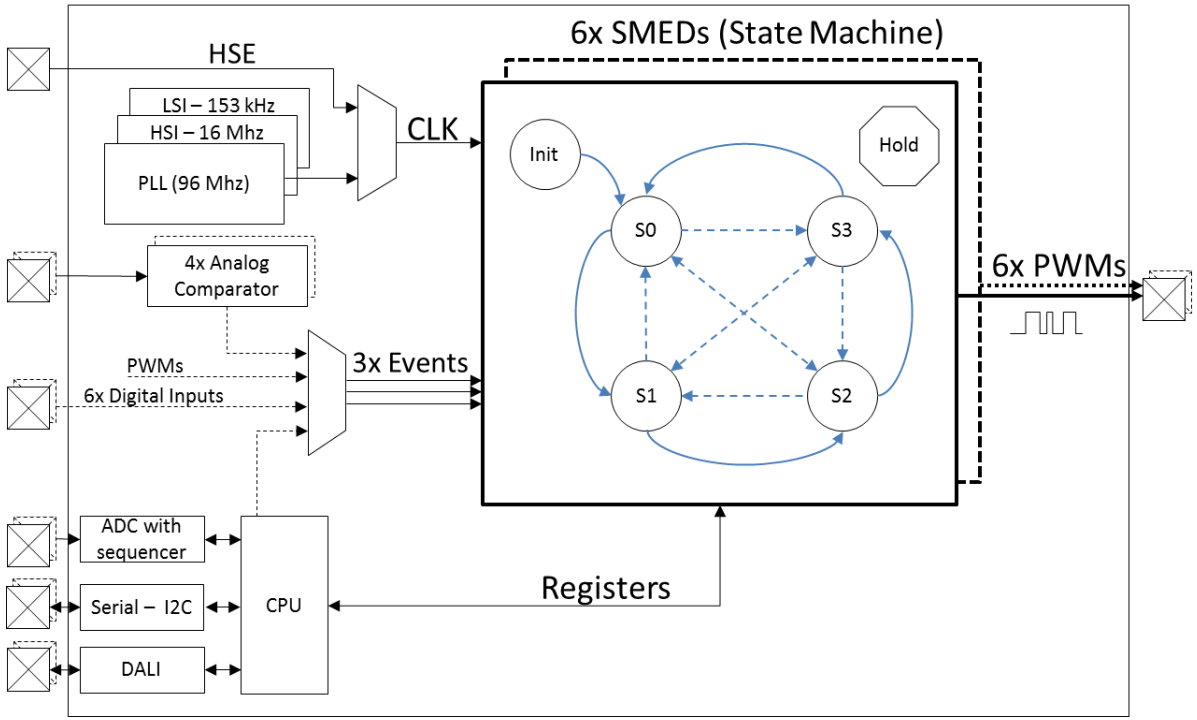
State Machine Event Driven Block



- **SIX** configurable PWM **S**tate **M**achine **E**vent **D**riven (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

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

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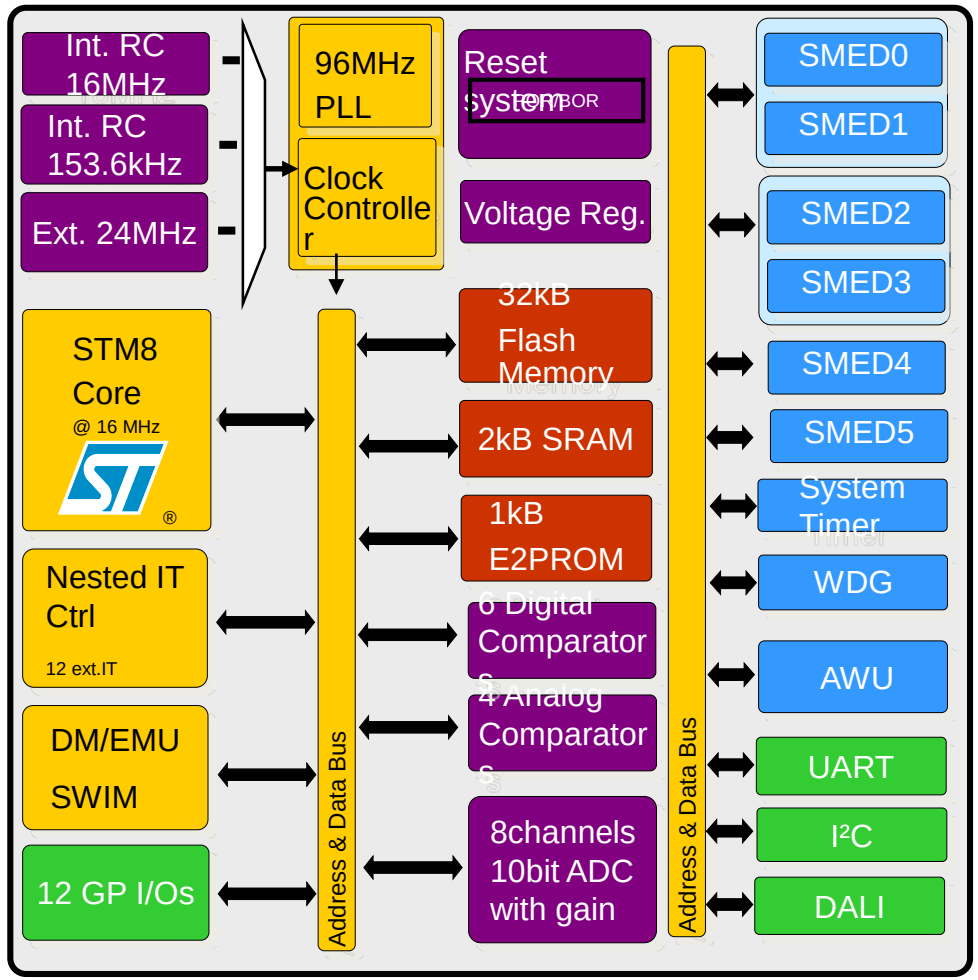
Block Diagram of STLUX385



- 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

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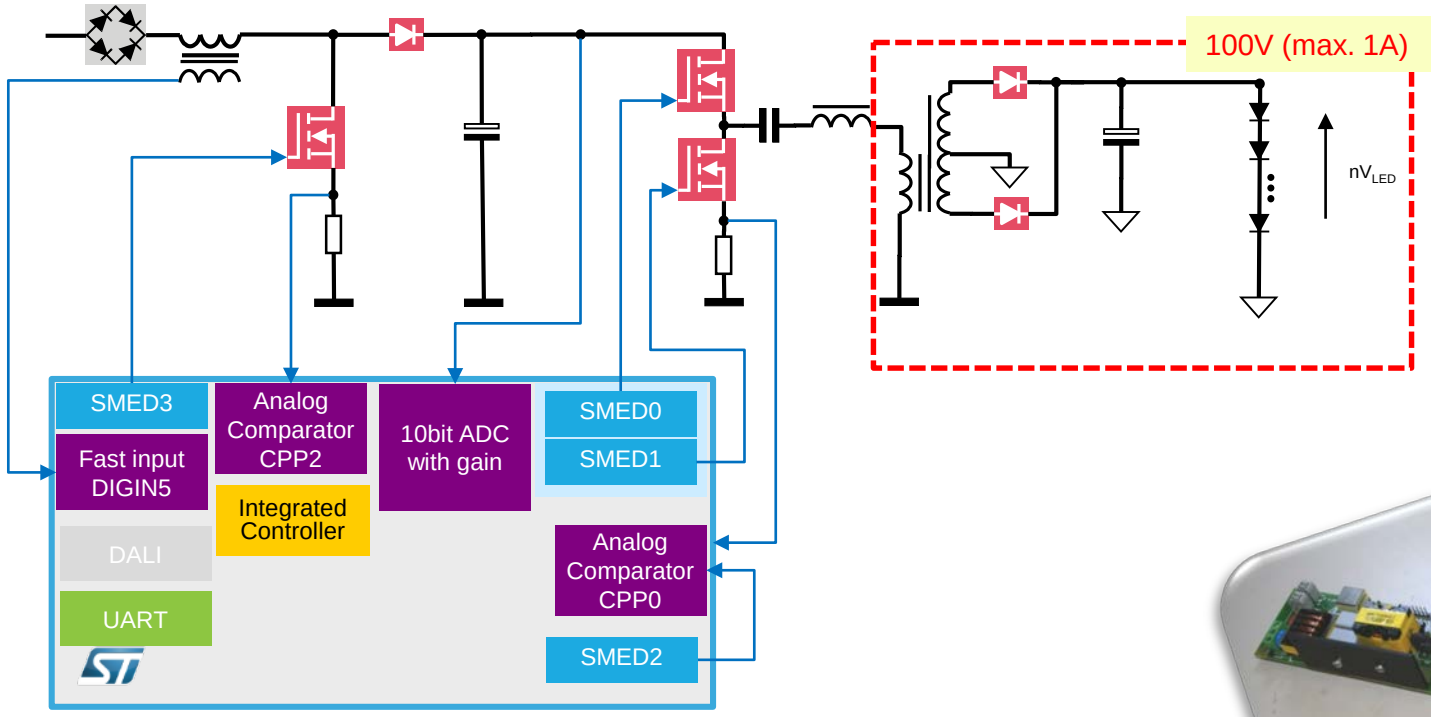
Eval Board:100W LED Streetlight



STEVAL-ILL066V1

- 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

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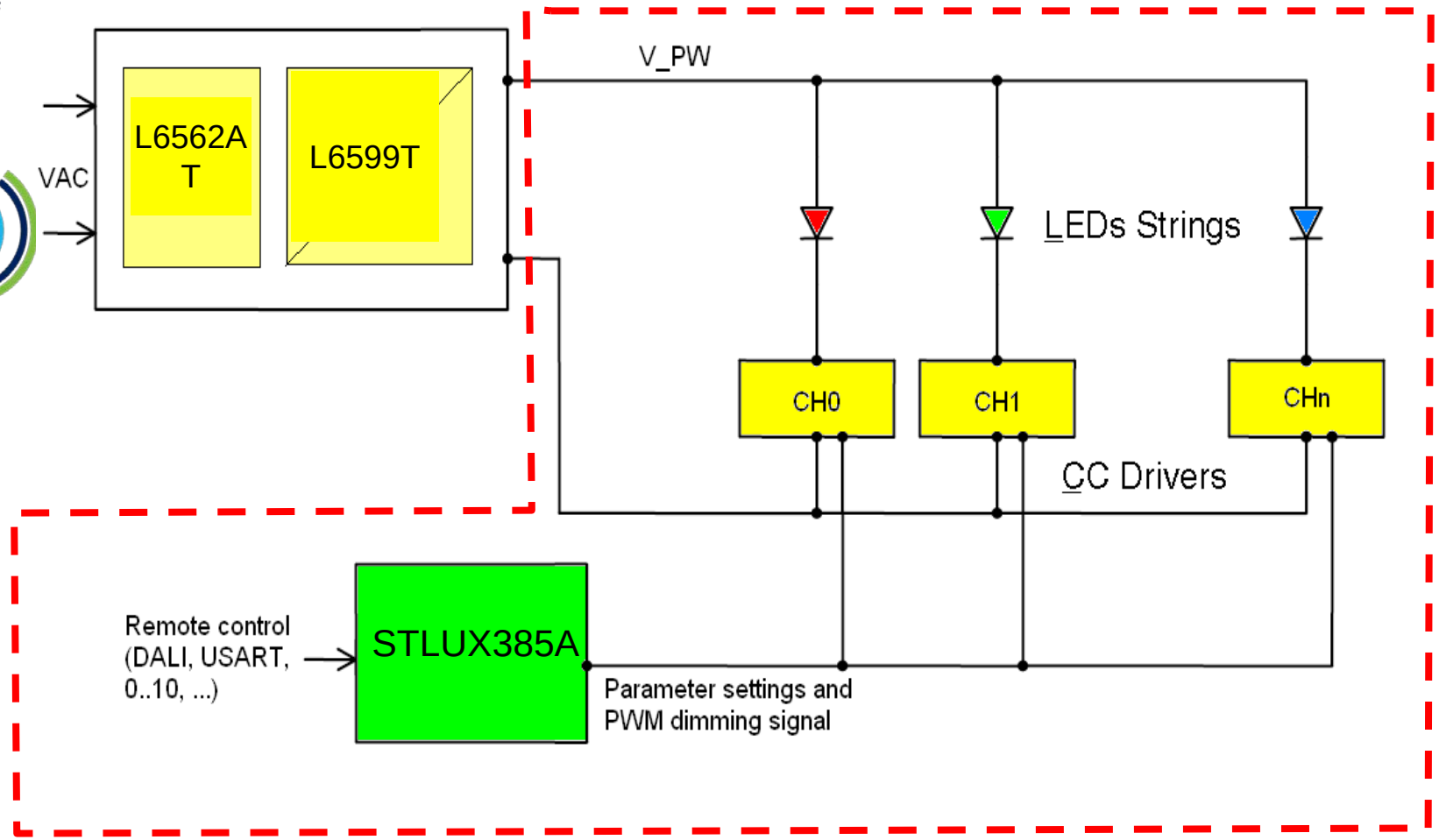
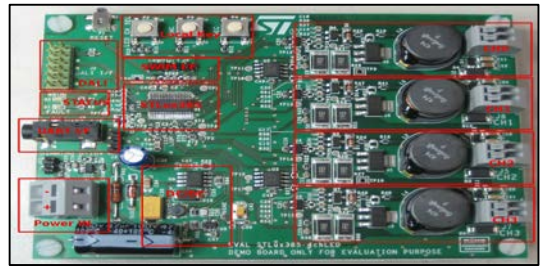
Eval Board: Multi-String LED Driver





STEVAL-ILL057V1

4 channel independently dimming (PWM and Analog)
Input Voltage 12~48V, max output current 1A

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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)

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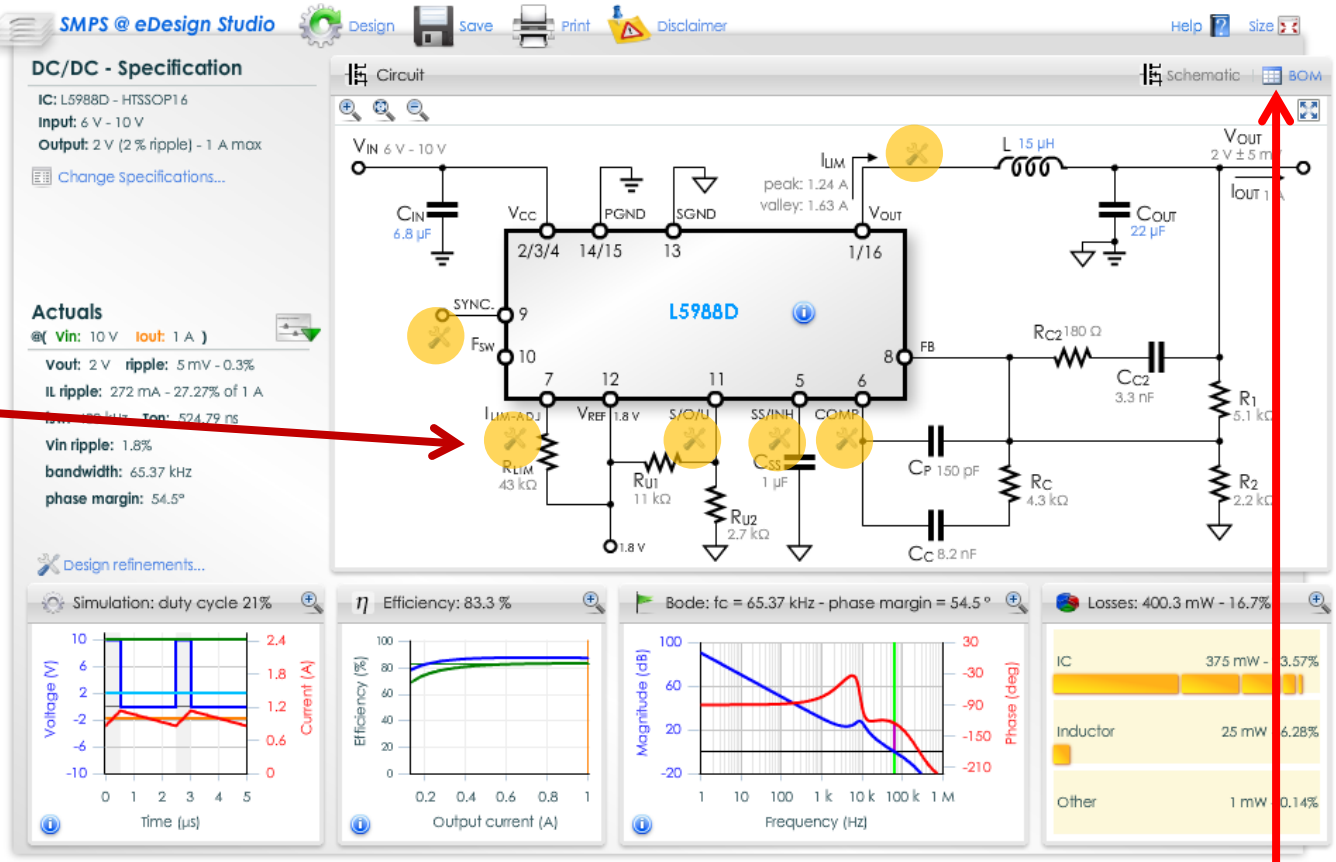
Complete, Interactive Schematic and BOM

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

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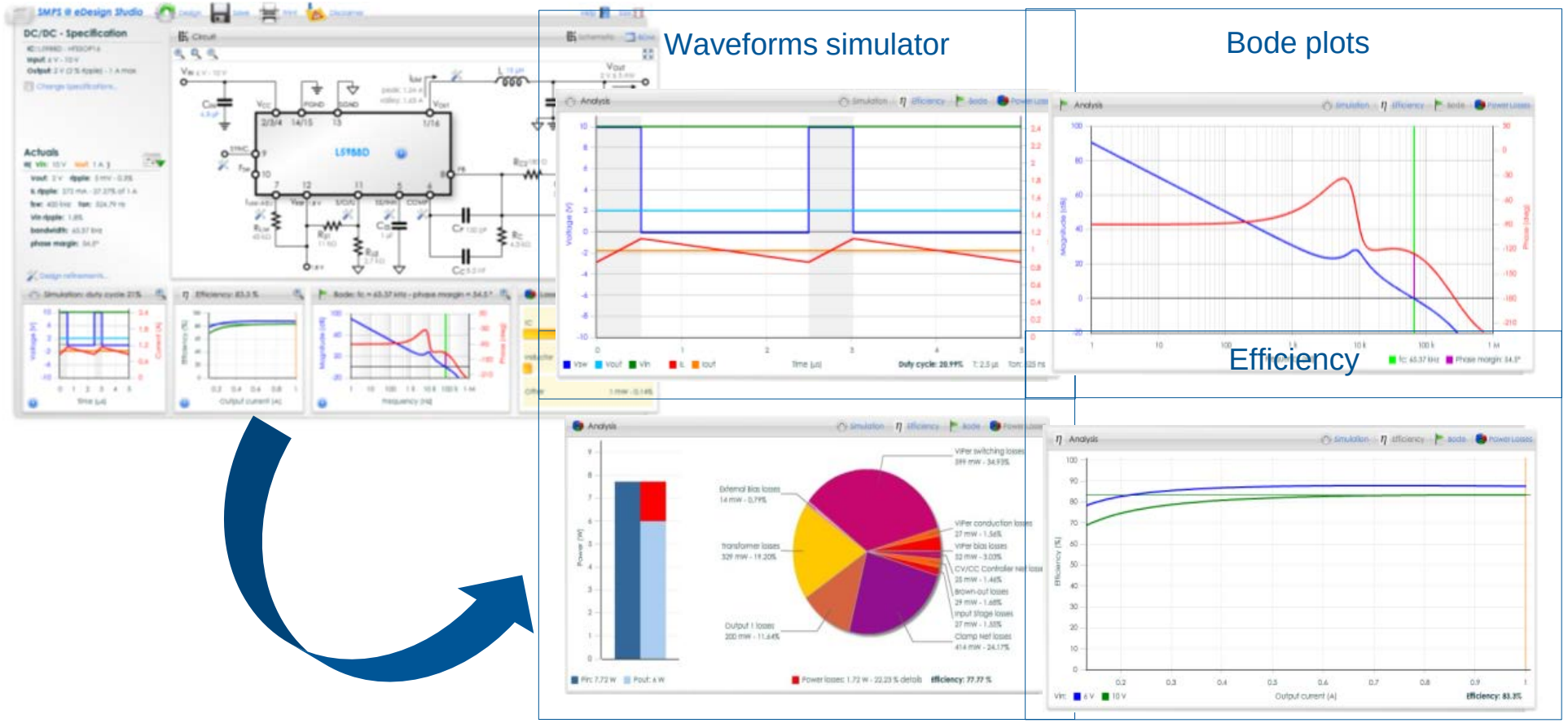
Evaluate the Performance of the Design



Simulates key voltage and current waveforms, displays bode plots, power losses and efficiency analysis

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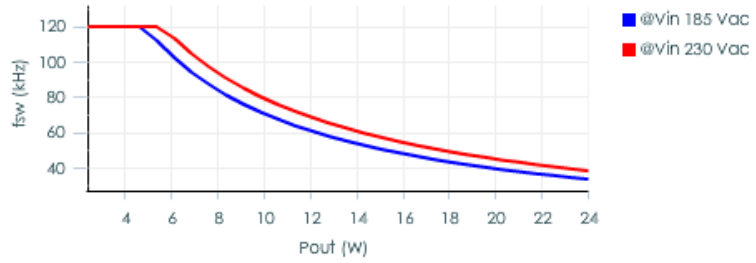
Transformer Design

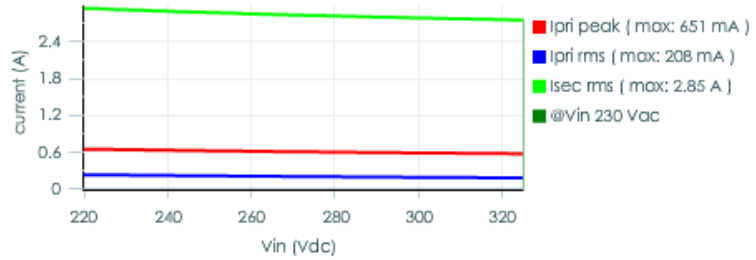
Flyback Parameters Specifications Help

Primary Reflected Voltage	150	V	from 60 V to 200 V
MOSFET drain node stray capacitance	64	pF	from 40 pF to 400 pF
Primary Inductance	4339	µH	max. 4339 µH
Transformer leakage inductance	43.39	µH	typ. 1% Lp
IC self supply voltage	12	V	≥ 12 V
Switching Frequency range			from 30 kHz to 120 kHz

Switching Frequency



Transformer Currents



Transformer Design Help

Core Type: EER28 Horizontal	Actuals	Required
Area Product	5878 mm^4	≥ 1690 mm^4
Losses	≤ 526 mW	

Winding	Turns Layers	Aw fill factor	Losses	Wire Type eq. Cu section [mm^2]
Primary	108 ≥ 108 4 Layers	27 %	≤ 142 mW	Solid_G2 0.25 mm 0.049 (≥ 0.046)
Secondary	9 2 Layers	63 %	≤ 204 mW	Litz 10 x 0.3 mm 0.707 (≥ 0.634)
Auxiliary	9 1 Layer	3 %	≤ 2 mW	Solid_G2 0.09 mm 0.006 (≥ 0.006)

Results

Primary Inductance:	4.34 mF
leakage inductance:	43.39 µF
Np/Ns:	12 *(Best Ratio: 11.719)*
Vaux:	12 V
total Aw fill factor:	91.83 %
maximum magnetic flux density:	319 mT
required gap length:	0.3 mm
Transformer total losses:	873 mW

The user can customize the Flyback transformer

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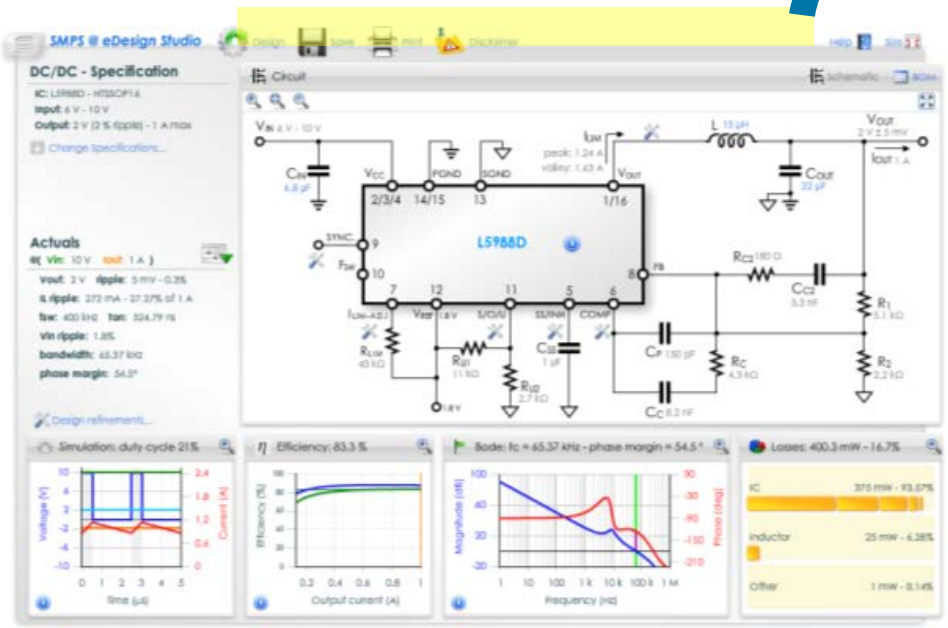
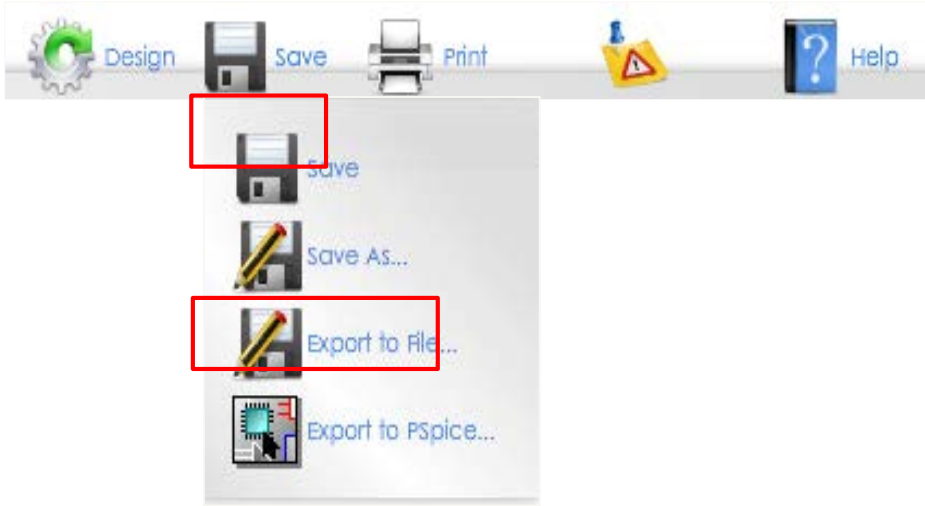
Designs Are Portable





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.

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