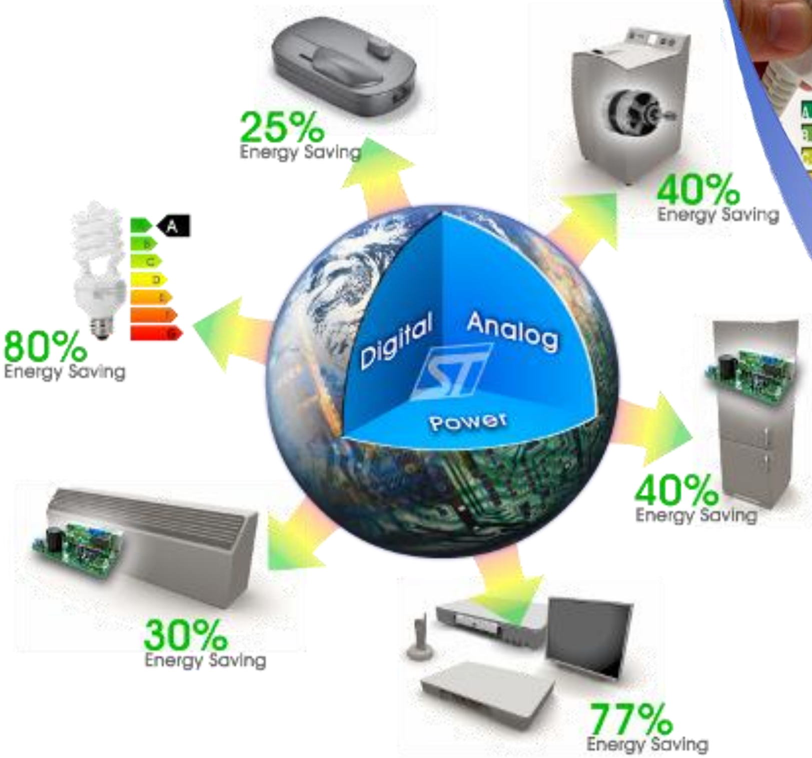
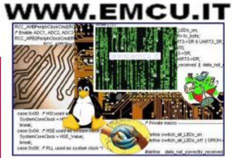


Microelectronics

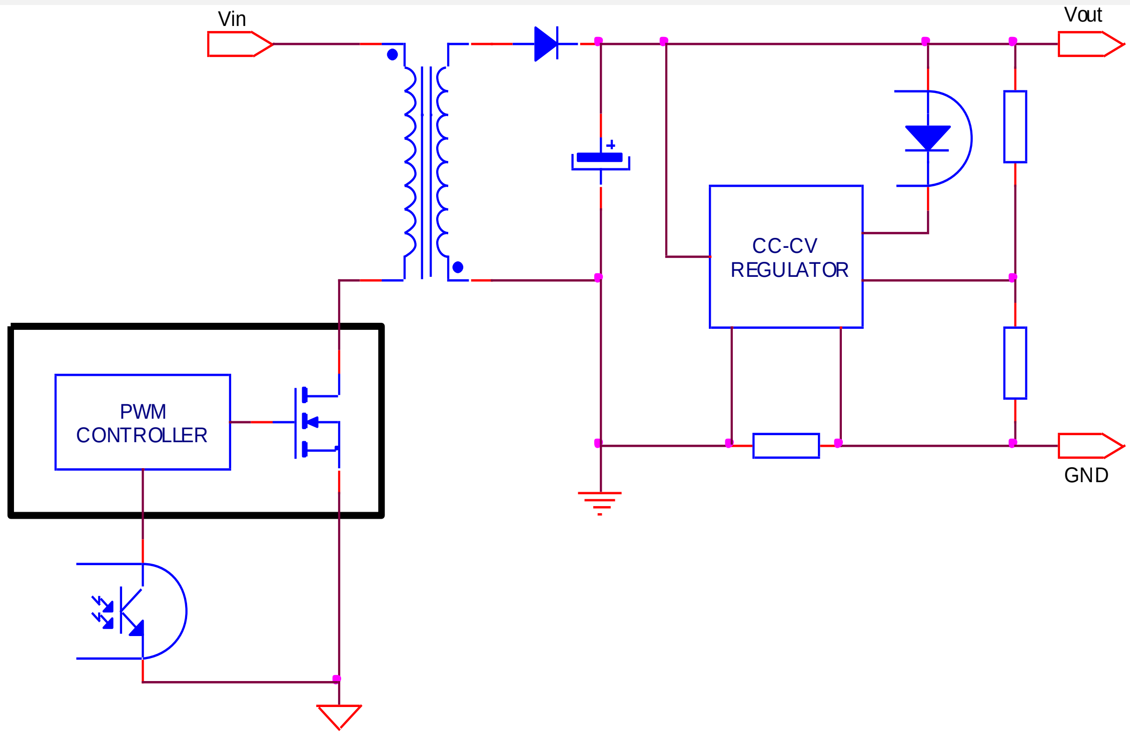


Off-line All-Primary AC/DC converter

ALTAIR05T-800

ALTAIR04 - 900

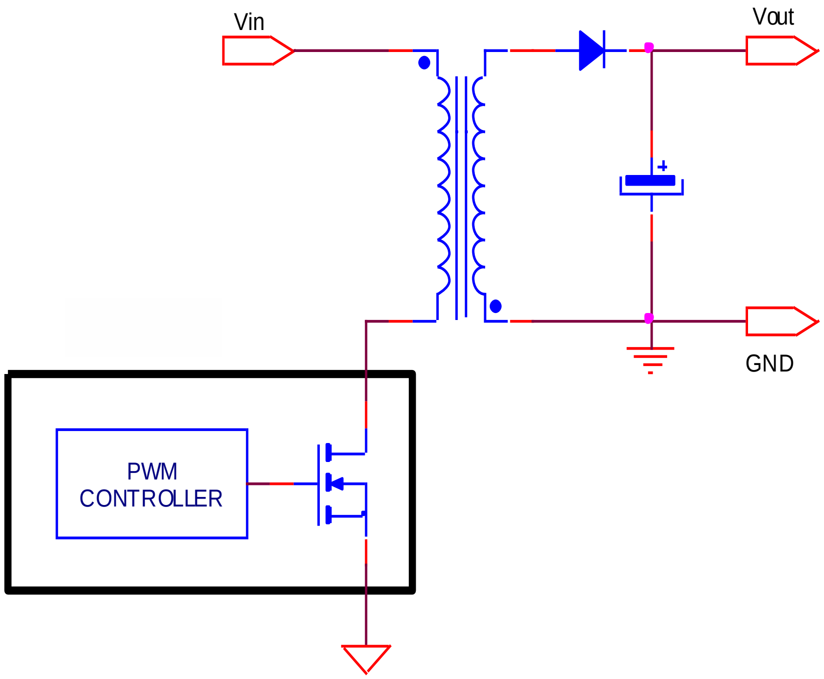
Typical (CV-CC) application solutions



- Accurate CC-CV regulation

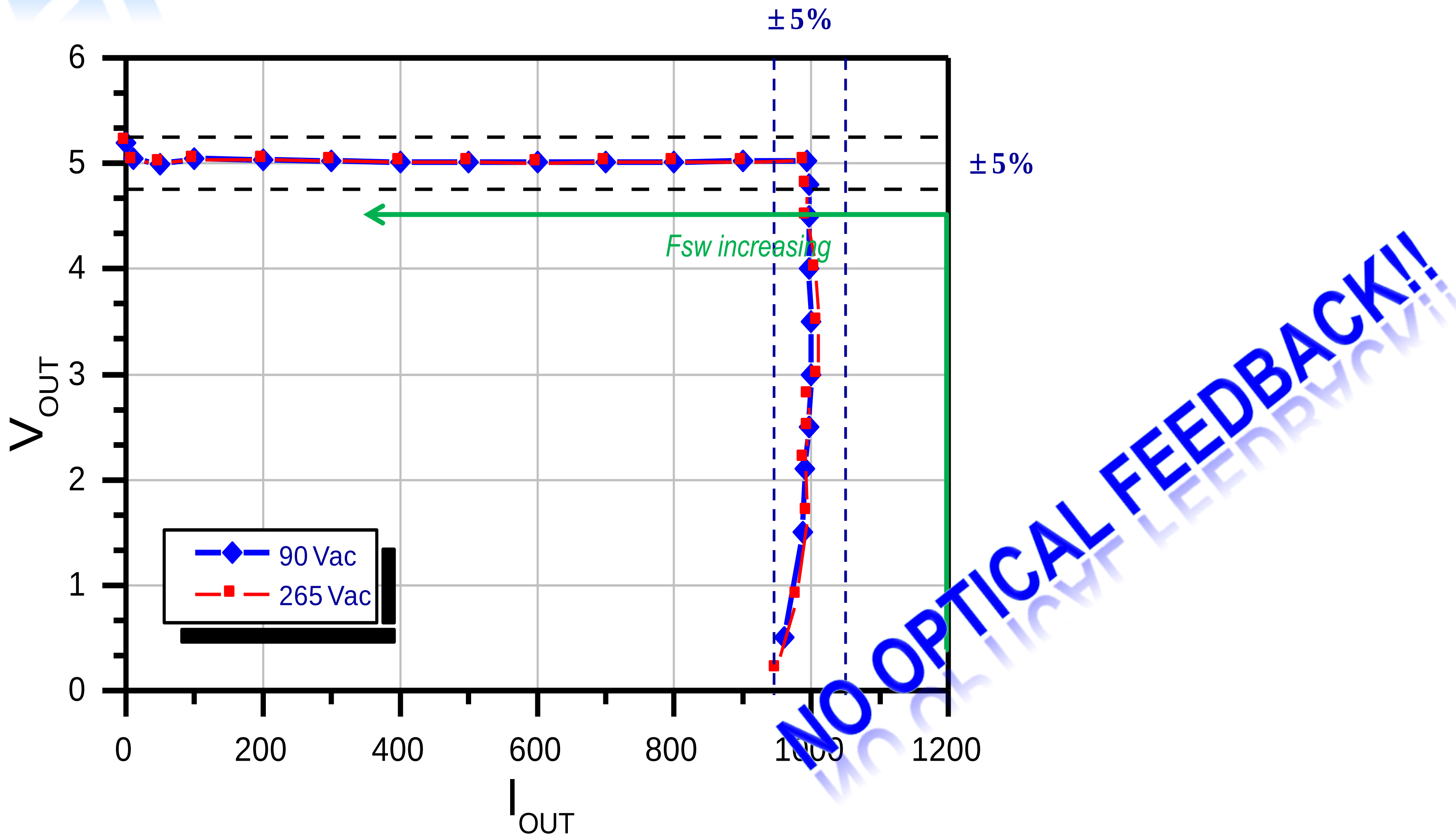
- Need dedicated CV-CC regulator
- Need secondary components and opto
- Power dissipation on sense resistor
- Expensive solution

Proposed (CV-CC) application solution



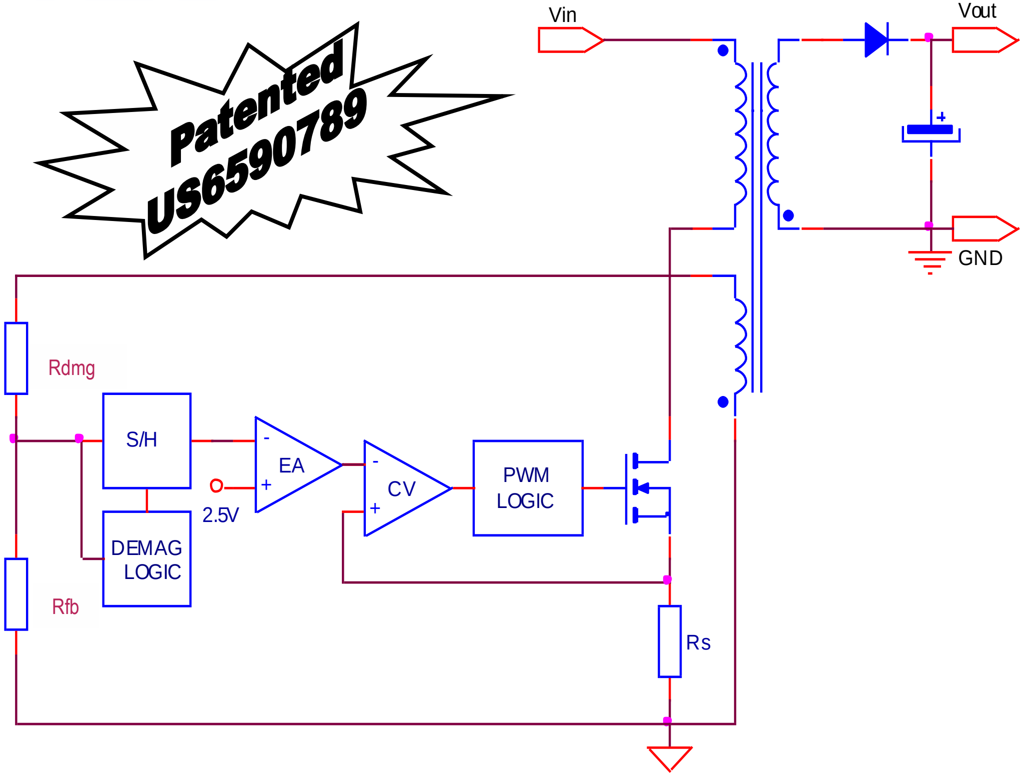
- Control of output voltage and current entirely from primary side
- Benefit: Save all secondary regulation components (voltage reference, error amplifier(s), optocoupler, sense resistor)

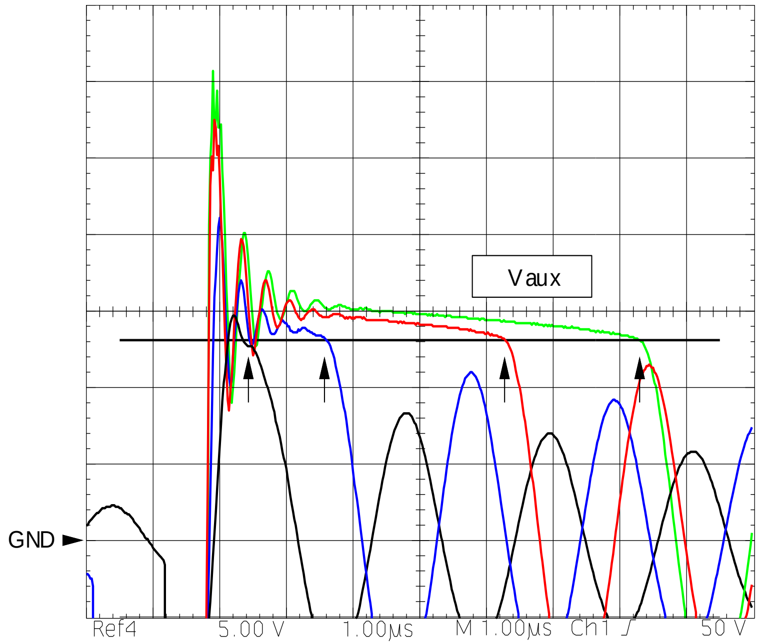
CV/CC operation



Constant Voltage Mode

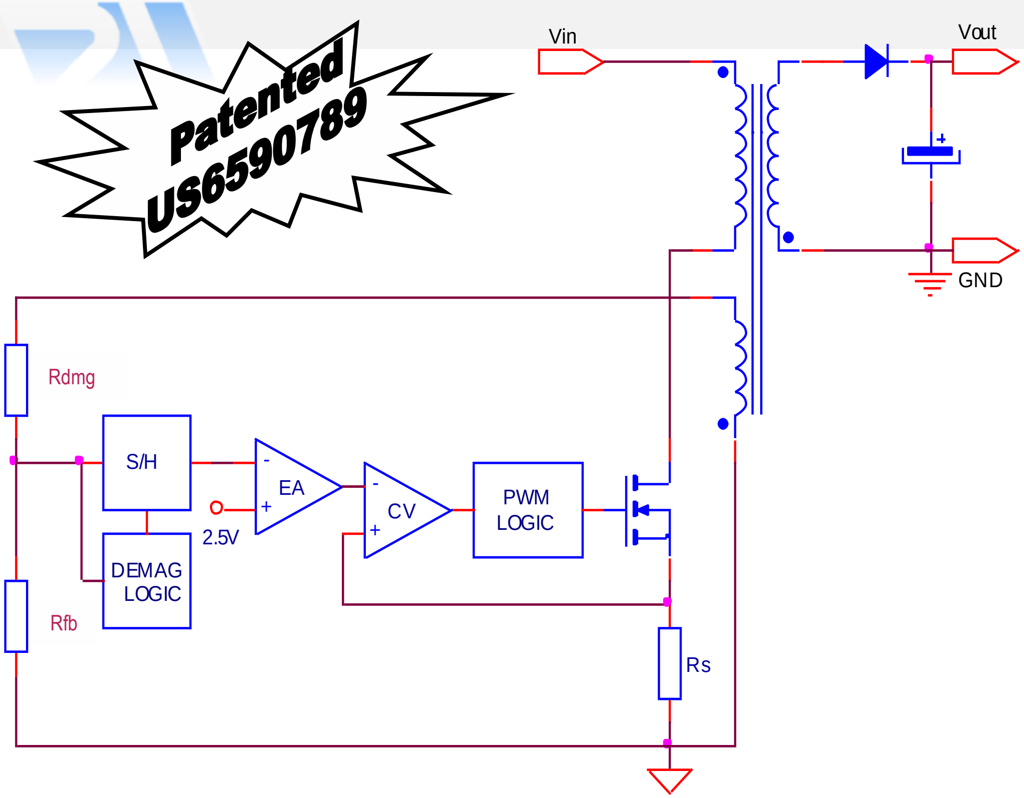
Principle of operations



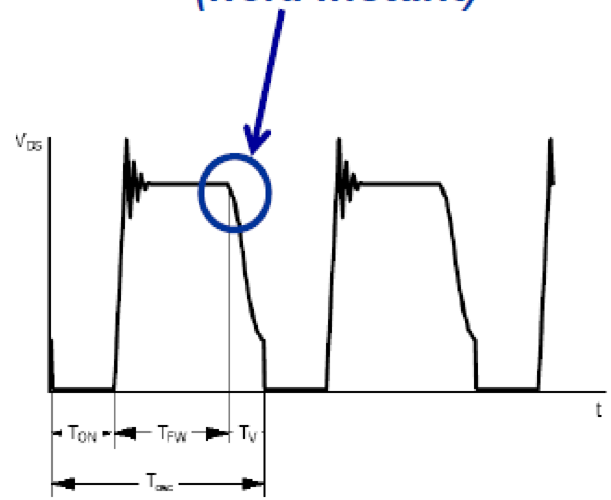


An accurate image of the output voltage can be obtained by sampling the voltage of the auxiliary winding right at the end of transformer’s demagnetization. An ST proprietary technique to do the job.

CV Mode – Principle of operations



DMG proportional to Vout (hold instant)



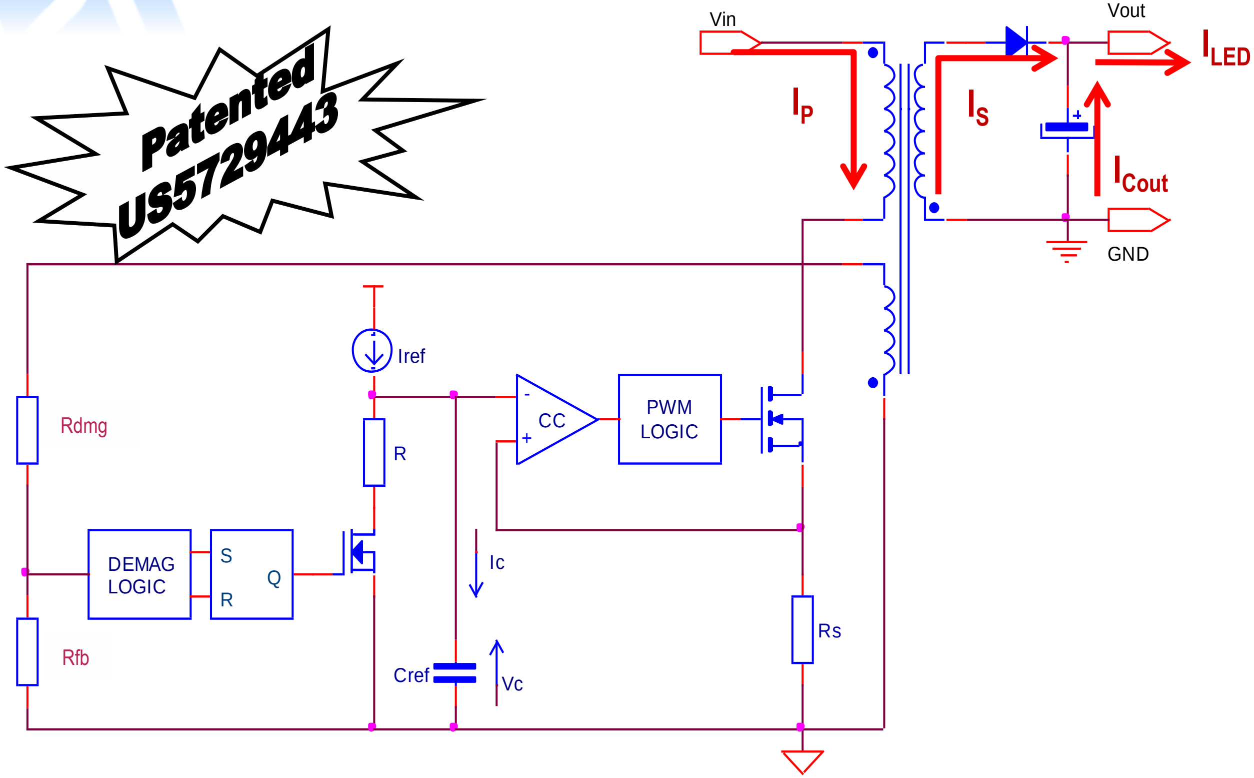
$$VDMG = \frac{RFB}{RFB + RDMG} * \frac{Naux}{Ns} * Vout$$

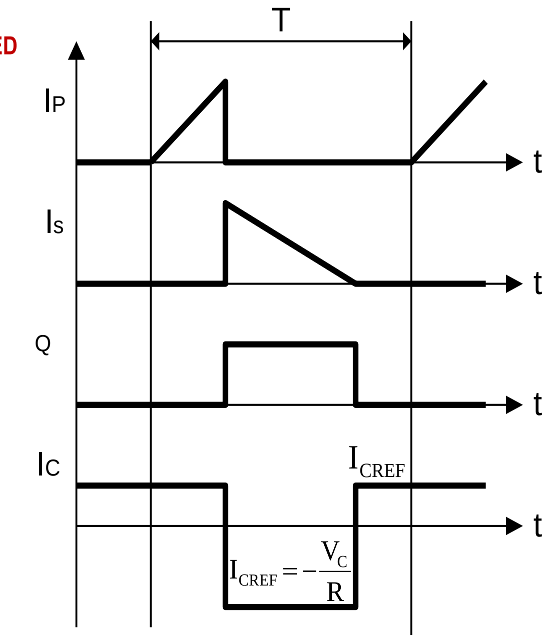
An accurate image of the output voltage can be obtained by sampling the voltage of the auxiliary winding right at the end of transformer's demagnetization. An ST proprietary technique to do the job.

Constant Current Mode

Principle of operations

Patented US5729443





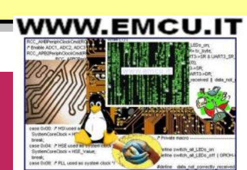
$$I_{OUT} = \frac{n \cdot I_P}{2} \cdot \left(\frac{T_{ONSEC}}{T} \right)$$

$$I_{REF} \cdot (T - T_{ONSEC}) + \left(I_{REF} - \frac{V_C}{R} \right) \cdot T_{ONSEC} = 0$$

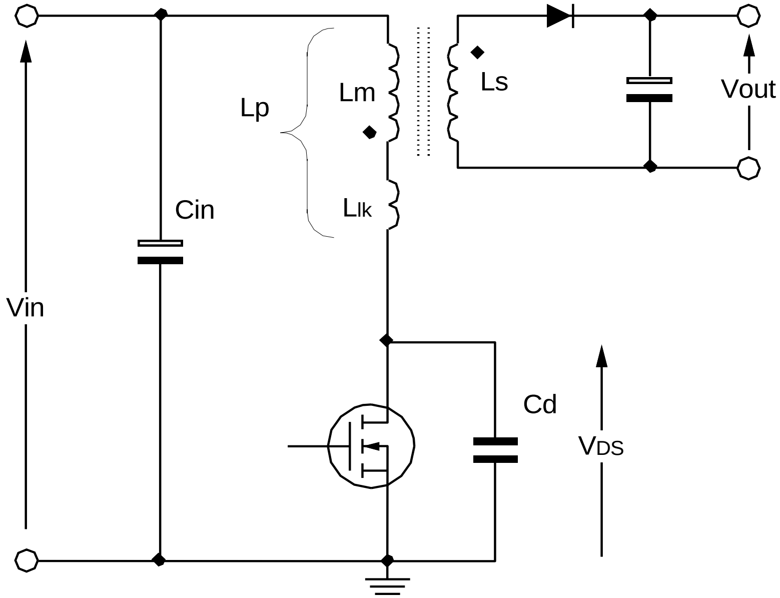
$$I_P = \frac{V_C}{R_{SENSE}}$$

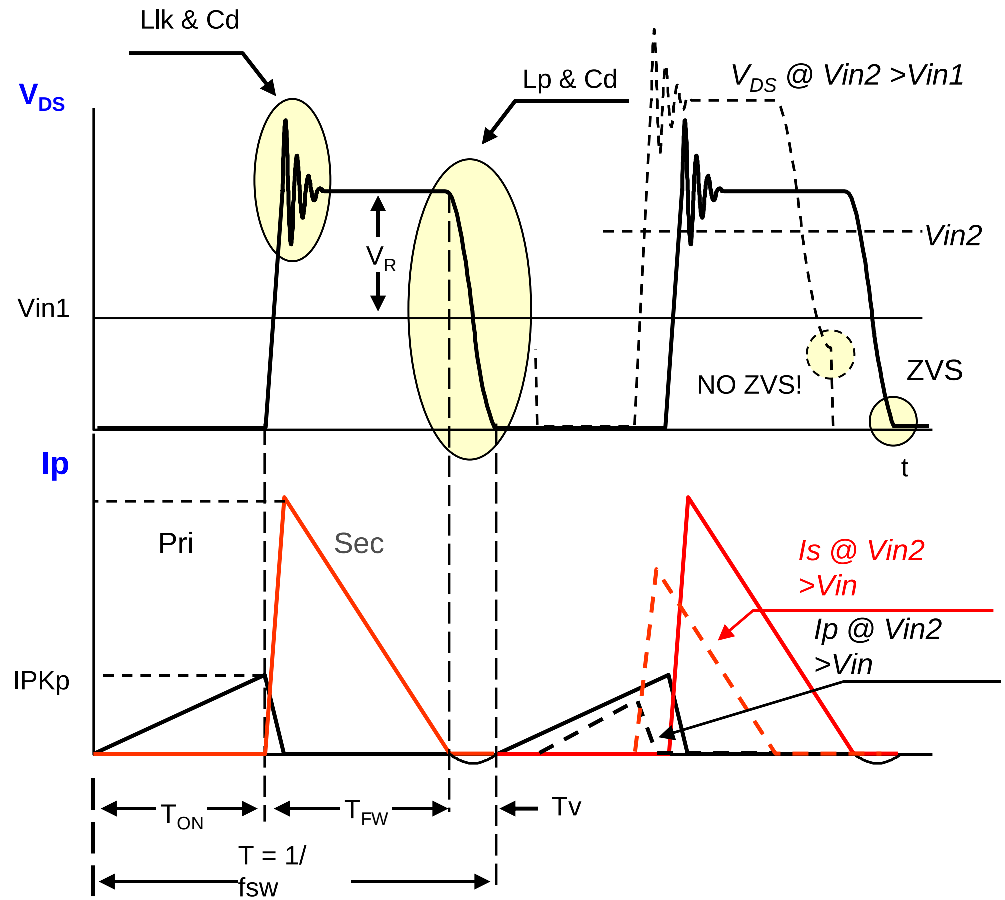
$$I_{OUT} = \frac{n}{2} \cdot \frac{R \cdot I_{REF}}{R_{SENSE}}$$

- ✓ Valid in DCM only
- ✓ Iout does not depend on either Vin, Vout or Fsw
- ✓ Cout net charge exchange is null



QR Conversion principle of operation



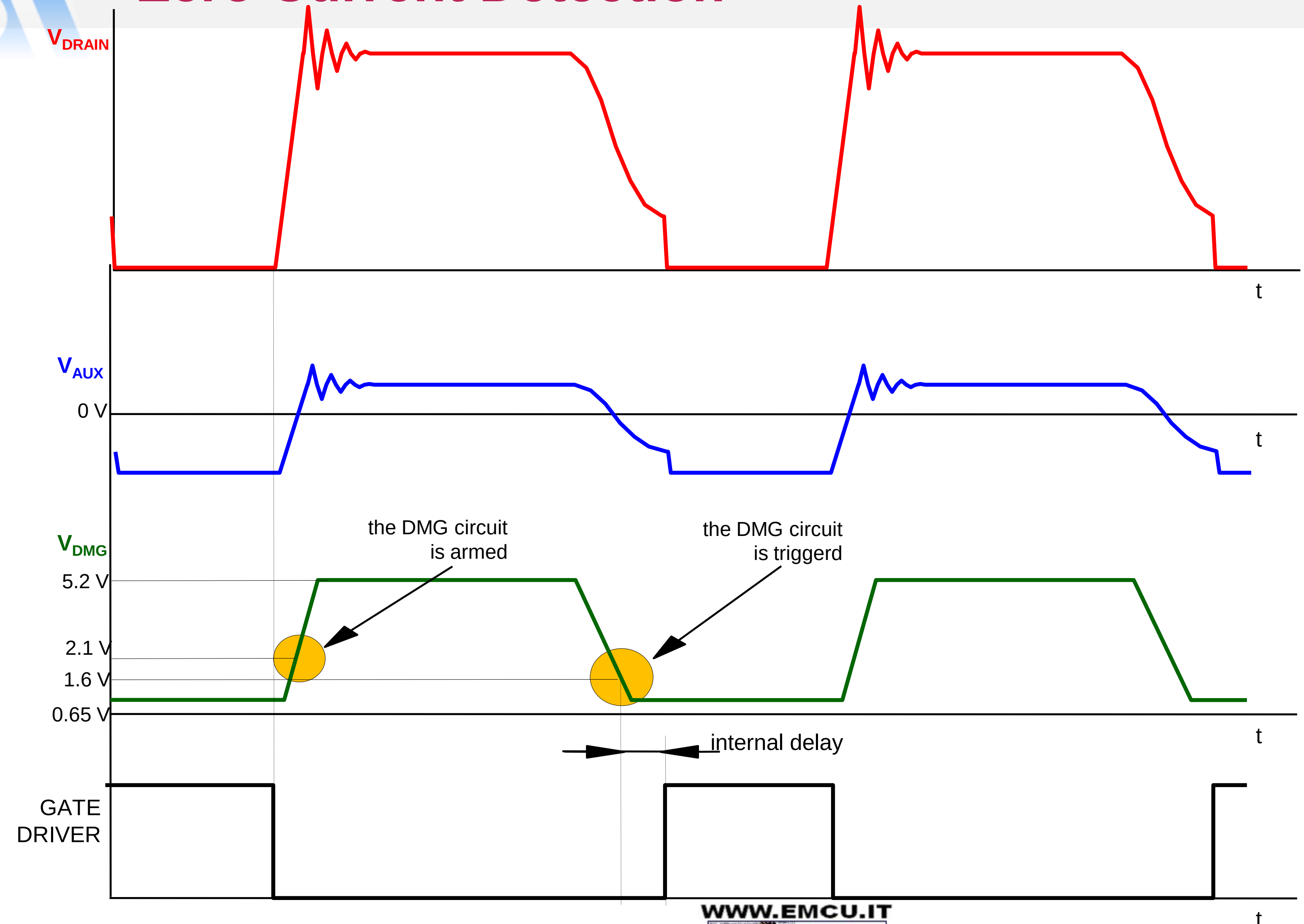


- ✓ Operation close to the boundary between CCM and DCM
- ✓ Zero Voltage / Zero Current Switching at turn-on achievable
- ✓ Less EMI
- ✓ Variable Frequency spreads spectrum

ZVS condition: Vin < VR

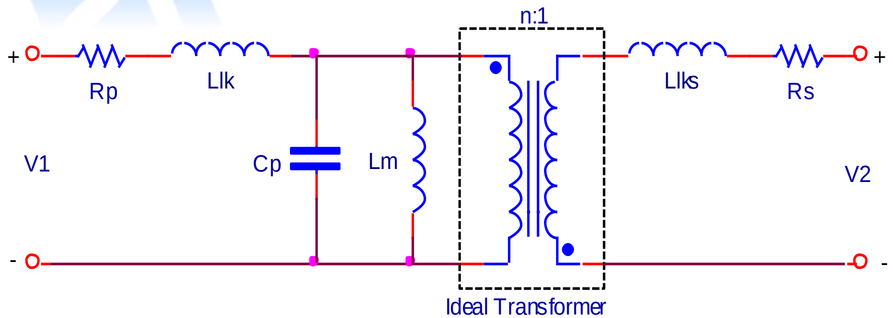
QR Conversion

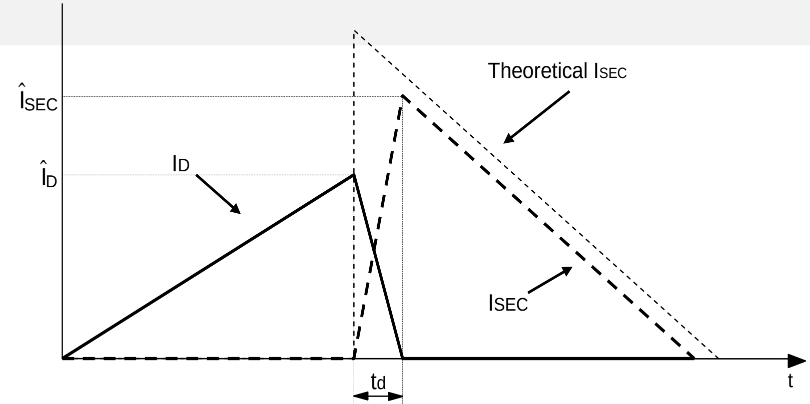
Zero Current Detection



Constant Current Mode

Transformer coupling





- ✓ The energy on the primary is transferred to the secondary side only once the parasitic capacitor Cp is charged to Vcp = - n Vout.
- ✓ The resulting transfer time delay causes the peak secondary current to be less than the theoretical one, resulting in an effective turn’s ratio less than the theoretical one.

$$n_{REAL} = n \cdot \left[1 - \frac{L_{LK}}{L_P - L_{LK}} \cdot \frac{n \cdot V_{OUT}}{V_S - n \cdot V_{OUT}} \right]$$

- ✓ A leakage inductance of 3% can easily deliver an output current 10% lower than the one computed.
- ✓ All these parameters are generally repetitive in production and easily compensated.

Constant Current Mode – VFF

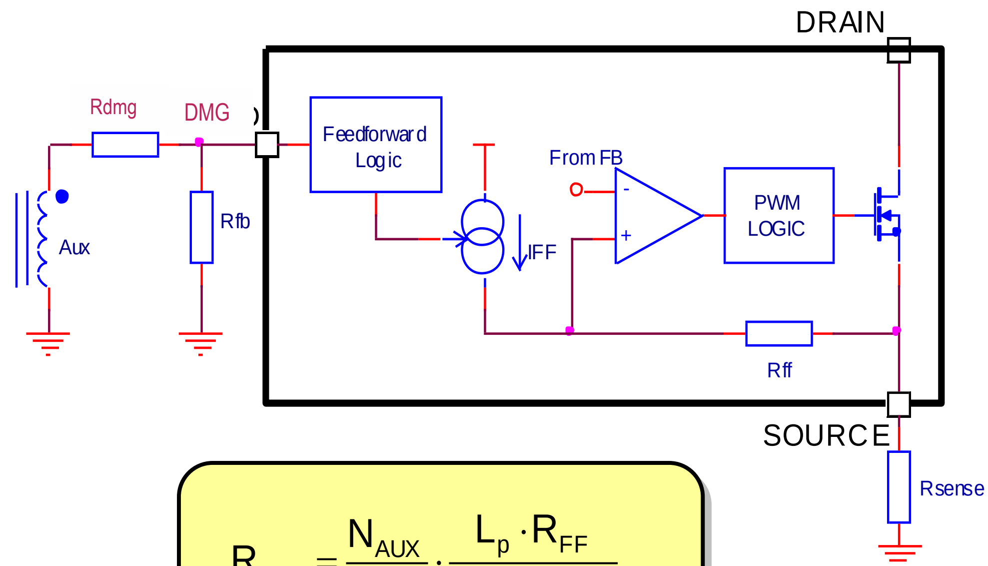
- The internal current comparator propagation delay (T_d) switches off the MOSFET with a higher peak current than the foreseen.
- Current variation depends on input voltage

$$\Delta I_P = \frac{V_{IN} \cdot T_d}{L_p}$$

Feedforward compensation introduces a negative offset that is proportional to input voltage to compensate Td

$$V_{OFFSET} = I_{FF} \cdot R_{FF} = \frac{V_{IN}}{R_{dmg}} \cdot \frac{N_{AUX}}{N_{PRI}} \cdot R_{FF}$$

$$\frac{V_{IN} \cdot T_d}{L_p} \cdot R_{SENSE} = \frac{V_{IN} \cdot R_{FF}}{R_{dmg}} \cdot \frac{N_{AUX}}{N_{PRI}}$$



$$R_{dmg} = \frac{N_{AUX}}{N_{PRI}} \cdot \frac{L_p \cdot R_{FF}}{T_d \cdot R_{SENSE}}$$

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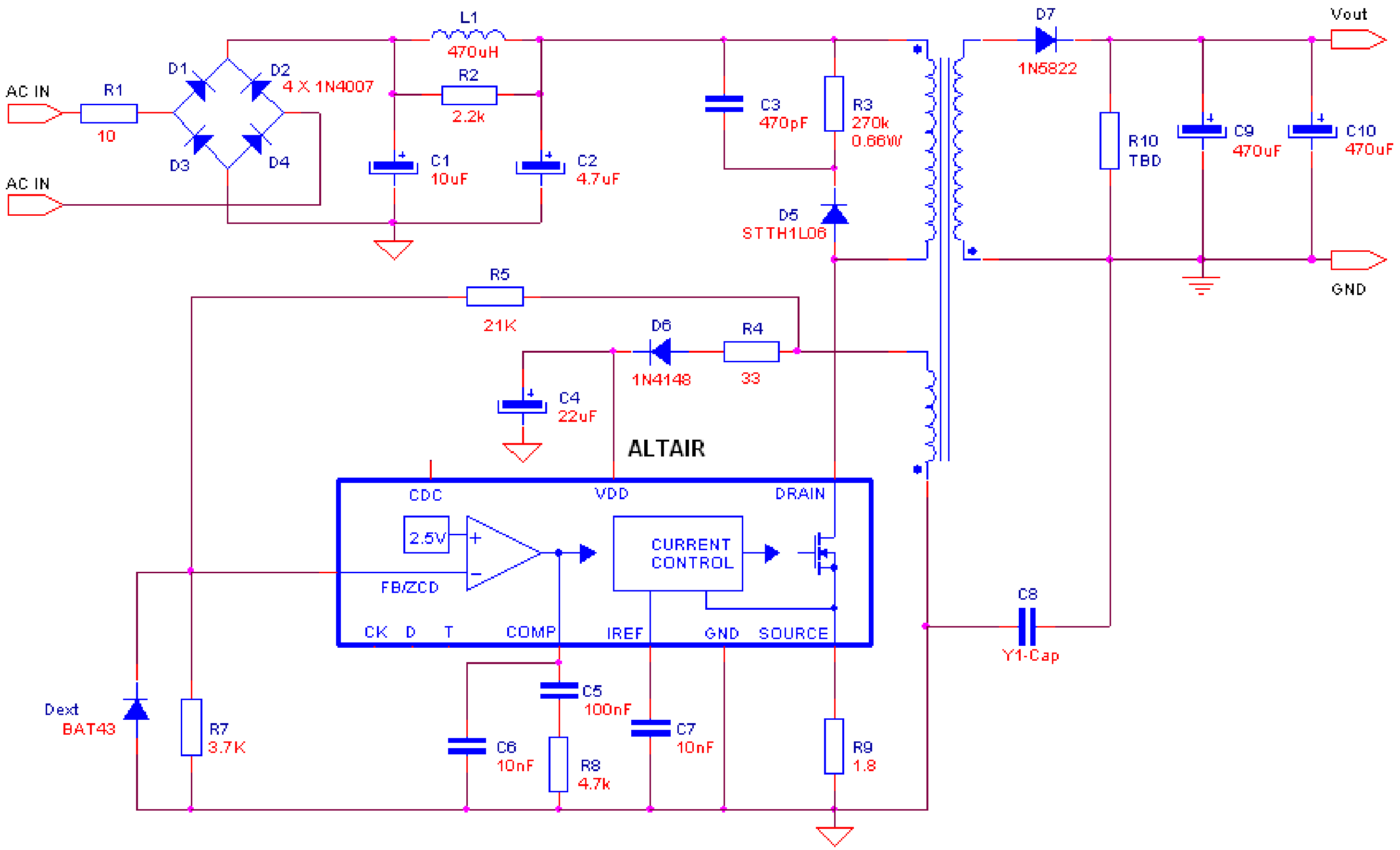
Application Design – INSULATED!!!



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ALTAIR05T-800 & ALTAIR04-900 Boards

EVLALTAIR900-M1
(7.5W double output wide range for PLM)

EVLALTAIR05T-5W
(5W - 5V Single output wide range)

- ***Control of output voltage and current entirely from primary side***
- ***Accuracy 5% the best in primary control***
- ***Benefit: NO! secondary regulation components (voltage reference, error amplifier(s), optocoupler, sense resistor)***

HVLED family:
the new off-line LED driver family

Lighting the future

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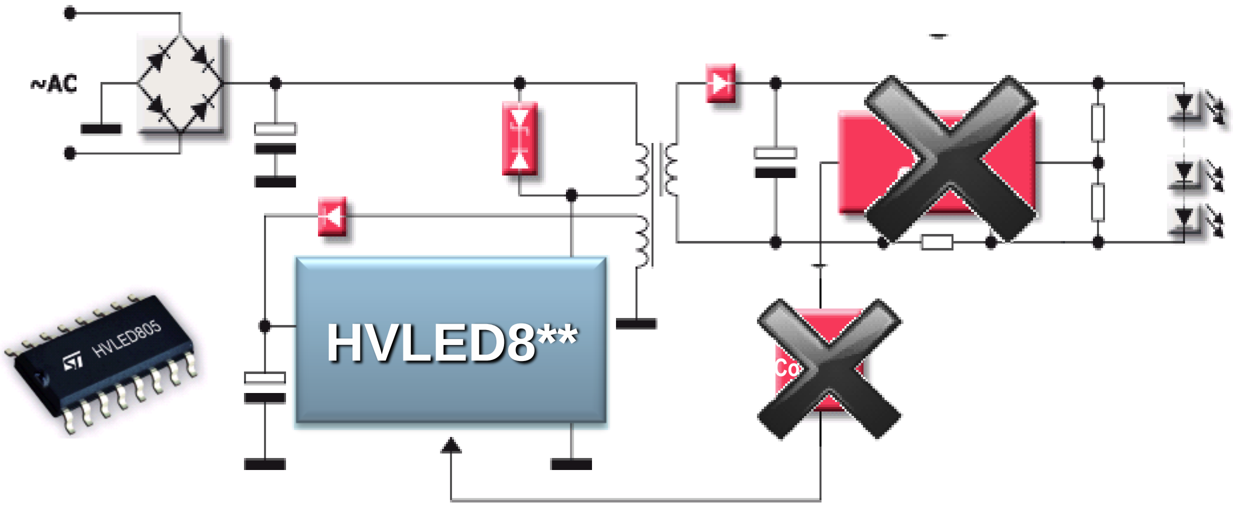
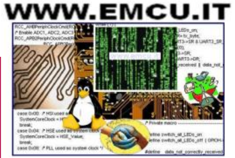
HVLED family

- ► **HVLED8** operates directly form the Mains voltage for ISOLATED AC-DC LED drivers**
  - **requiring only minimum external parts**
    - **Controller and MOSFET in the same chip**
  - **performing primary LED current control**
    - **no need of secondary sensing (sense resistor and CC controller)**

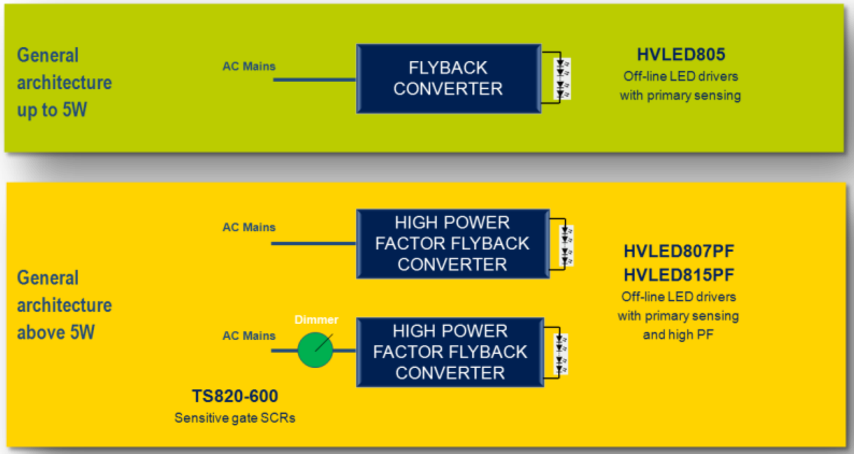




General illumination
HVLED family - products

▶ APPLICATIONS

- Retrofit of incandescent lamps
- AC Mains supplied spot lamps



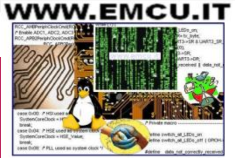
Maximum output power for V_{IN} = 185 - 265V_{AC}

High PF > 5W
>0.7 residential
>0.9 commercial

platforms with variable number of LEDs in series

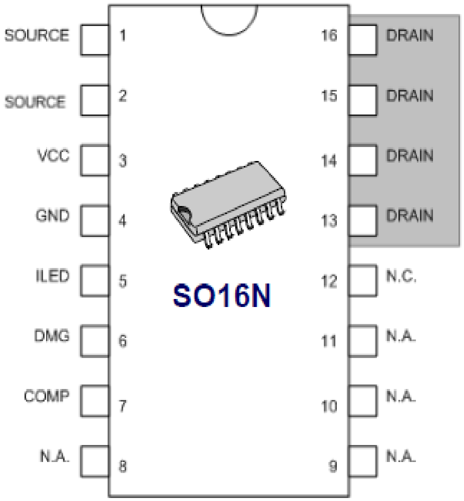
compliant with PF requirements

800V integrated mosfet (*state-of-the-art*) reduces application cost



HVLEDxx pinout

HVLED805

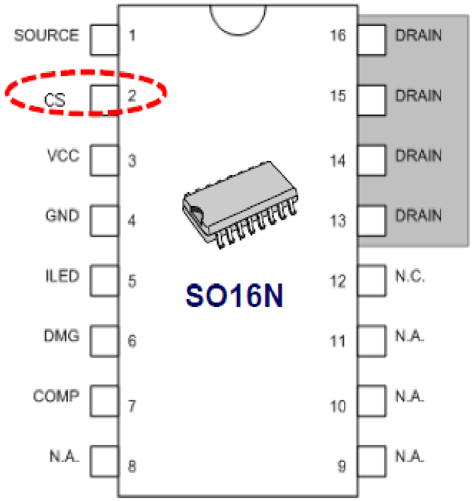


Rds_ON: 11Ω (typ)

Tdelay (MOS OFF): 330ns (typ)

3-5 W

HVLED807PF



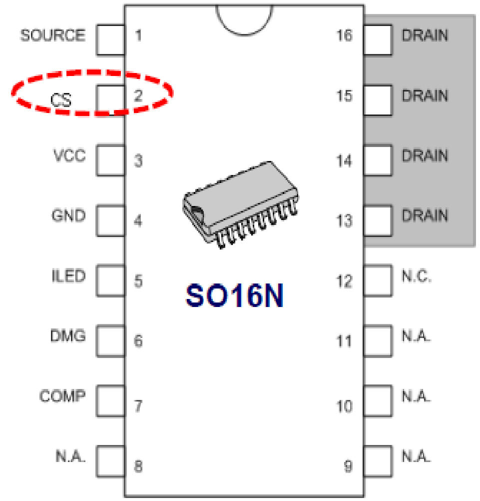
Rds_ON: 11Ω (typ)

Tdelay (MOS OFF): 100ns (typ)

CS pin available - for high PF

5 ~7 W

HVLED815PF

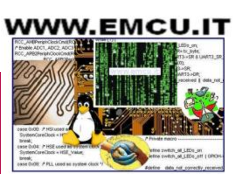


Rds_ON: 6Ω (typ)

Tdelay (MOS OFF): 100ns (typ)

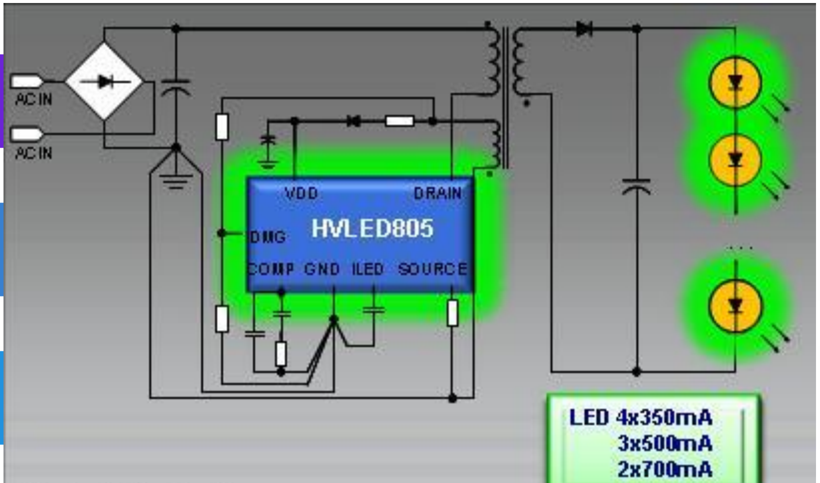
CS pin available - for high PF

Up to 15 W



HVLED family - products

- Internal 800 V avalanche rugged Power MOSFET and HV start-up
- 3% (HVLED807PF and HVLED815PF) or 5% (HVLED805) accuracy
- Primary Sensing Regulation
- Quasi resonant operation mode
- Automatic self supply
- Open and short LED string protection



Typical Application

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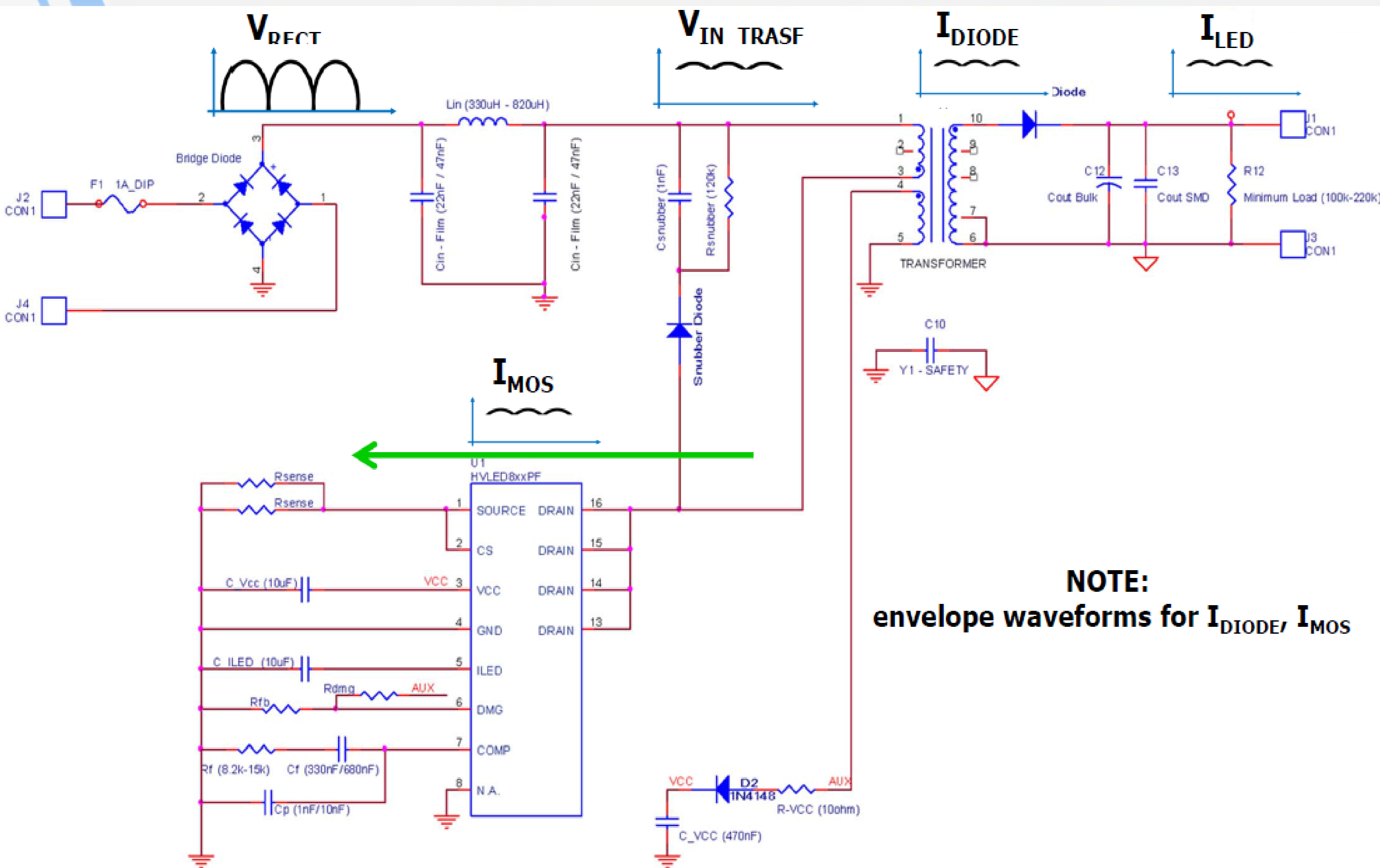
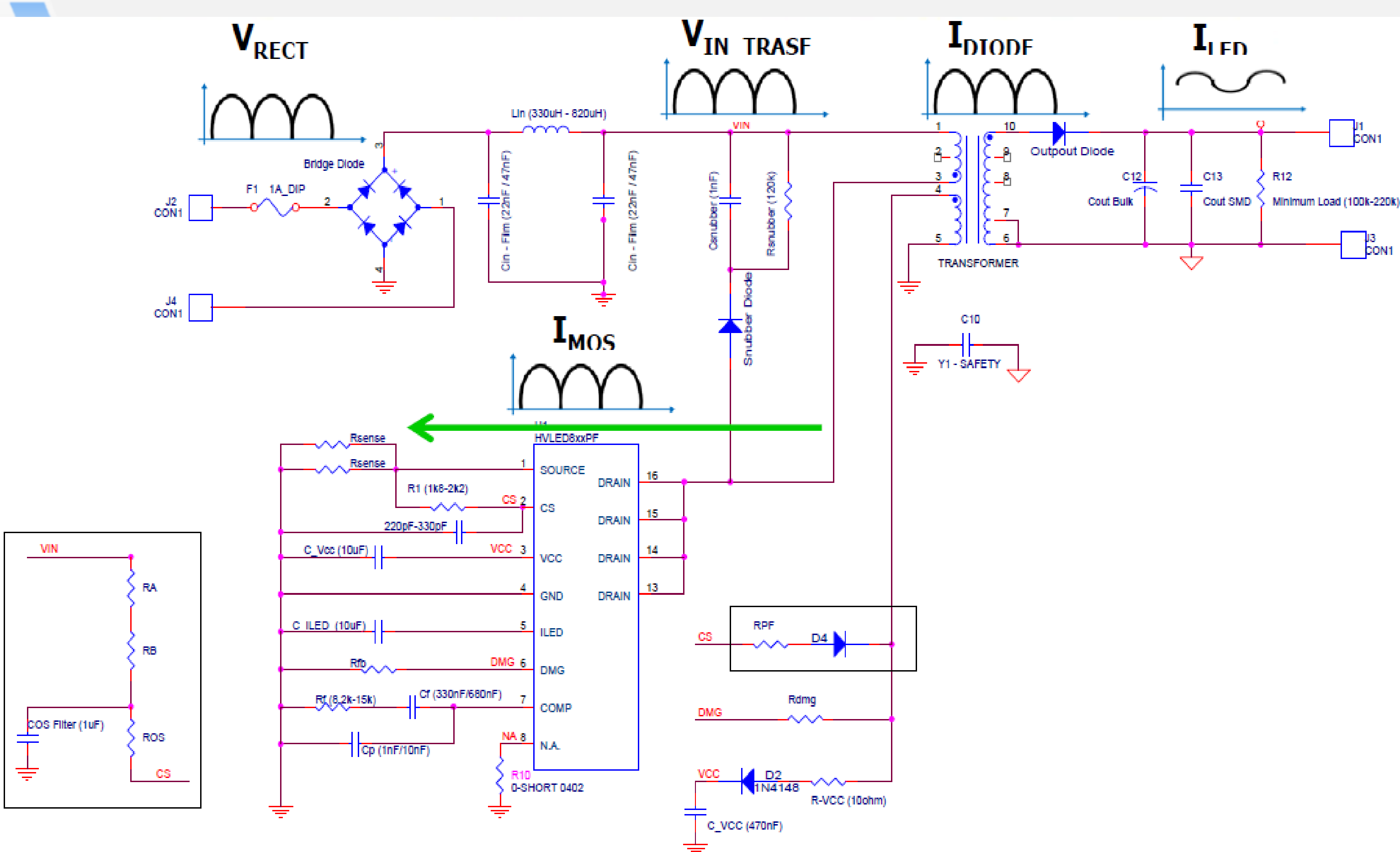
Standard PF implementation



NOTE:
envelope waveforms for I_{DIODE}, I_{MOS}

Standard schematic using HVLED805 (PF 0.5/0.6)

High PF implementation



High PF (>0.9) implementation using HVLED807PF/815PF

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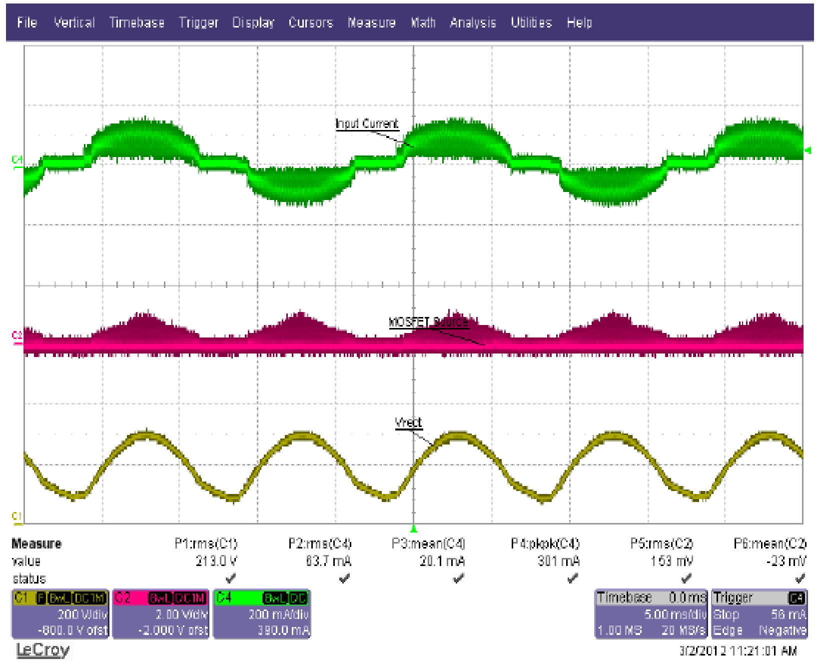
Waveforms - Test Results

PF=0.95; THD= 21%



CH1(green)=Iin; CH2(purple)=MOS Source; CH1(yellow)=Vin_rect

"Input current" in phase with the input voltage

Note: test results on 12W solution – 3-V/340 mA LED output

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General illumination

HVLED family – tools 1/2

Up to 15W

EVALHVLED815 (*) NEW

10.2 W LED power supply

based on HVLED815PF

HPF Flyback

- Vin = 185-265 Vac
- Iled = 340mA
- Vout = 30V
- Power factor = 0.92
- Average efficiency 86%

AN draft (*)

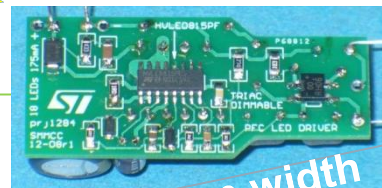
STEVAL-ILL044V1 (*), (**) NEW

9 W Triac dimmable

LED power supply

based on HVLED815PF

HPF Flyback



- Vin = 90-132 Vac
- Iled = 175mA
- Voutmax =56V
- Power factor >0.98
- Efficiency >86%
- Dimmable over 90V to 132V range
- Isolated version (**)

AN4129

AN4130

STEVAL-ILD003V1 / V2

6W / 8W Home analog Light dimmer

based on TS820-600

- Suitable for LED & CFL retrofit & incandescent lamps
- 230 V – 50 Hz Line (V1 version), 120 V – 60 Hz Line (V2 version)
- Leading edge-control
- Control with potentiometer
- Dimmable LED lamps: 6W (V1 version), 8W (V2 version)
- Dimmable 14W CFL lamps

UM1512

UM1513

(*) Available in Q4 2012

(**) Not isolated version available STEVAL-ILL045V1

HVLED family – tools 2/2

Up to 15W

EVALHVLED805
4.2 W LED power supply
based on HVLED805
Flyback

- Vin = 185-230 Vac
- Iled = 350mA
- Voutmax =12V
- Output current ripple < 10%
- Average efficiency >70%

Data brief

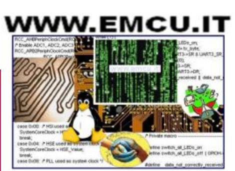
STEVAL – ILL037V1
3.2 W LED power supply
based on HVLED805
Flyback

- Vin = 90-265 Vac
- Iled = 200mA
- Voutmax =16V
- Efficiency = 85%

AN3360

HVLED available on eDesignSuite

www.st.com/edesignsuite



WEB Support

eDesignSuite

www.st.com/edesign

eDesignSuite
The smart tool to design your application

Login to
www.st.com/edesignsuite
(online registering is required)

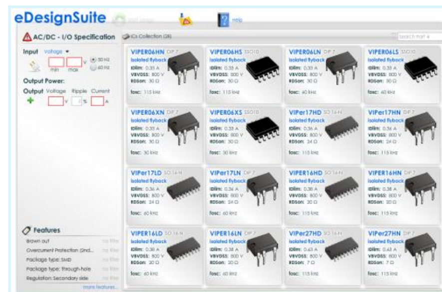
OR

Fill in
eDesignSuite Widget
(visit Viper** product pages
on www.st.com)

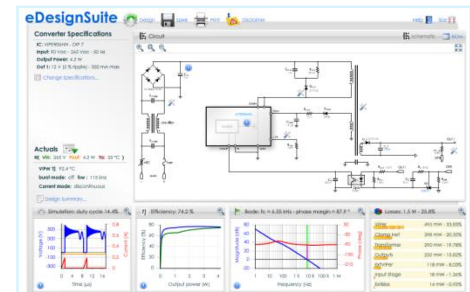
OR

Open
eDesignSuite off-line version
(ask to ST Sales office to get it)

1 Choose *Power Supply* application type and create your design



2 Insert your I/O specifications and select one of the proposed Viper**



3 The design is ready!

4

A complete design in a few steps

eDesignSuite

www.st.com/edesign

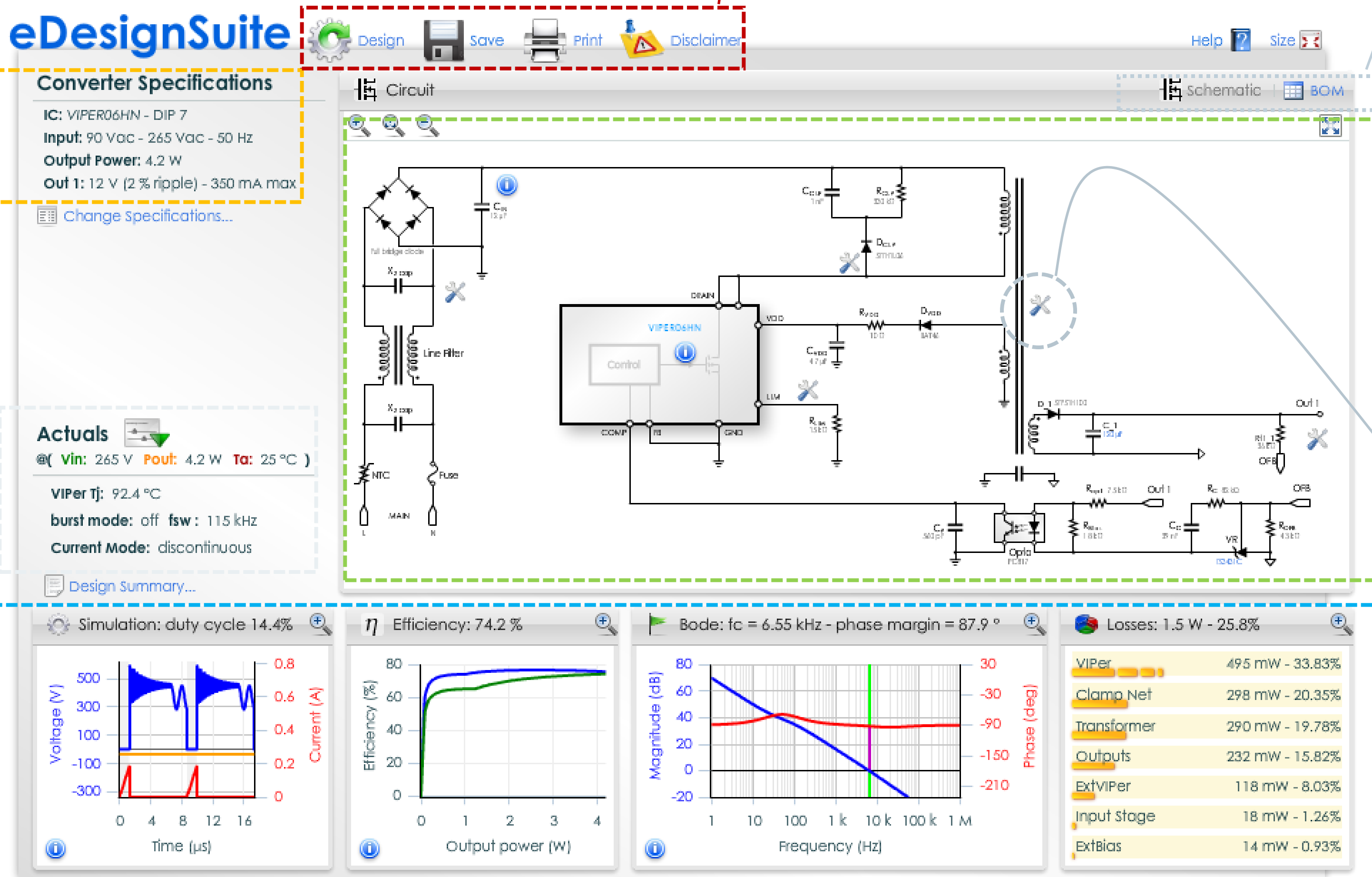
A full set of commands

The specifications view

A fully and interactive BOM

A fully annotated and interactive schematic

The actuals view



The user can customize the Flyback transformer

A full set of analysis diagrams

Thanks for your attention

Simone Franceschin – Silica FAEs

simone.franceschin@silica.com

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