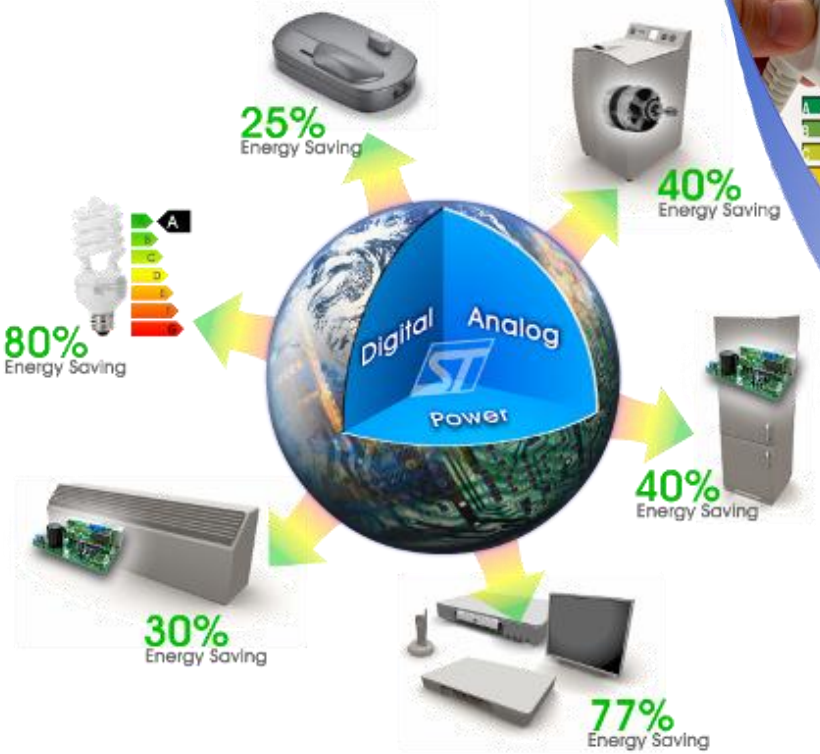
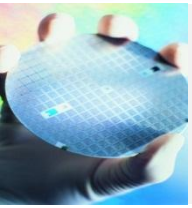


Microelectronics

WWW.EMCU.IT

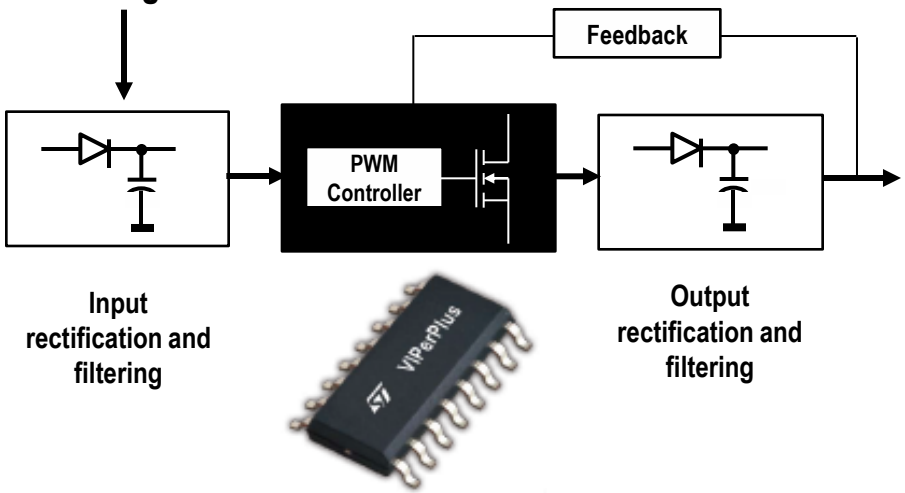
High Voltage Converters



VIPerPlus - high voltage converter

Advanced controller with embedded 800V Power MOSFET

..directly
from AC Mains ~
voltage...



Input rectification and filtering

Output rectification and filtering

.. to +/- DC bus
(3V3, 5V, 12V)
to supply:

- Microcontroller
- PWM driver
- Relay

Robustness and Reliability

800V Power MOSFET, thermal shutdown, soft start, OLP protection, auto-restart

Energy saving

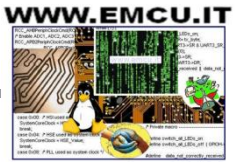
Power consumption less than 30mW at no load

High integration

Direct feedback, jittering, HV start-up

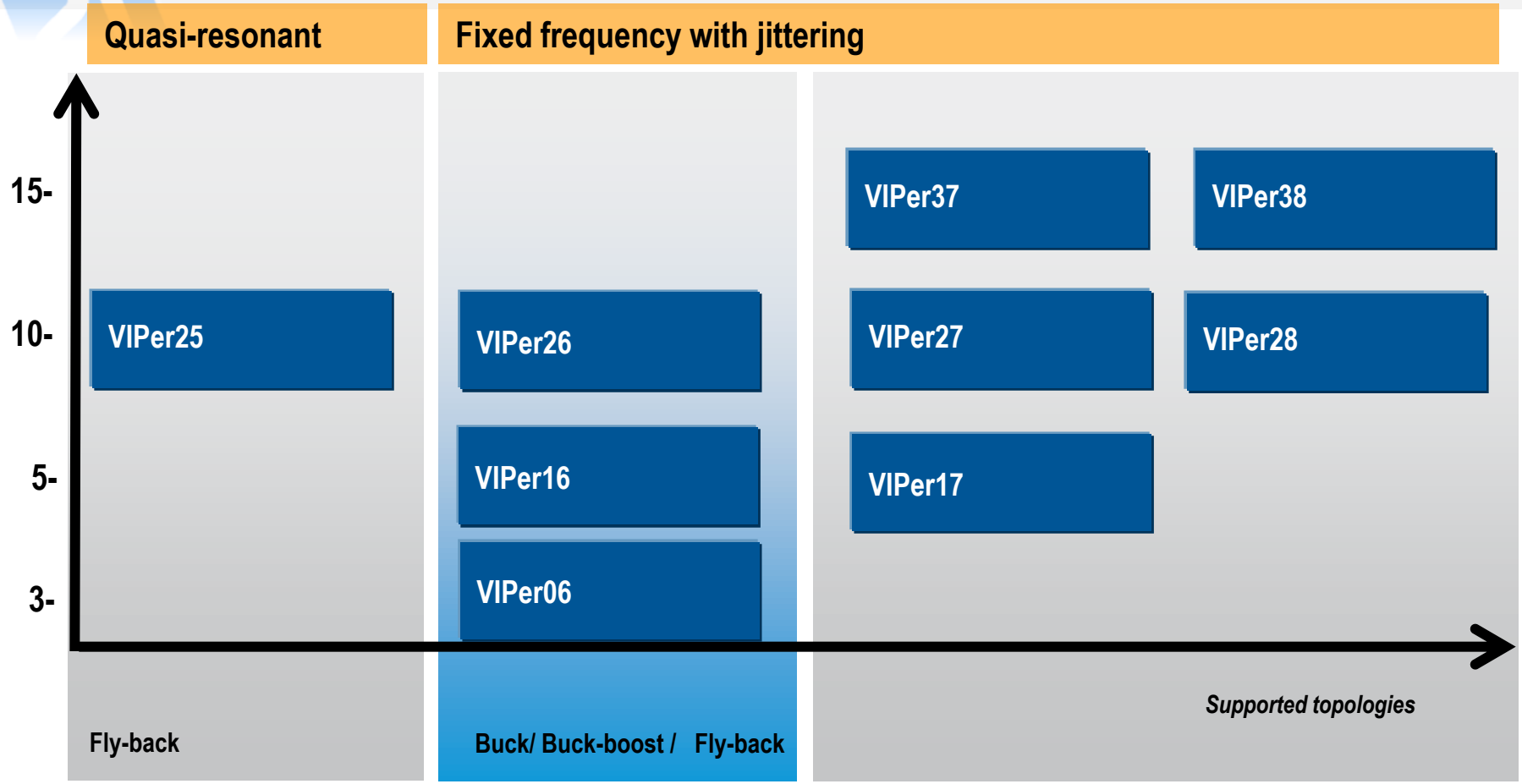
Flexibility

power scalability up to 12W, no aux winding, clamp-less design, no CM EMC filter



VIPER FAMILY

0W-25W European range



In full production

POWER (W) with universal mains

High Voltage Converters

portfolio

30 Ω	18 Ω	5.5 Ω	3 Ω	1 Ω
VIPer12	VIPer22 VIPer20	VIPer50	VIPer100	VIPer53

800V Avalanche Ruggedness

	30 Ω	24 Ω	7 Ω	4.5 Ω	3 Ω	1 Ω	0.5 Ω
Controller x7		VIPer17	VIPer27	VIPer37			
Controller x5			VIPer25	VIPer35			
Controller x8			VIPer28	VIPer38			
Controller x6	VIPer06	VIPer16	VIPer26				
	4W(1) / 8W(2)	6W(1) / 12W(2)	12W(1) / 24W(2)	15W(1) / 30W(2)			

(1) *Open frame, V_{IN} = 85 - 264V_{AC} ,*
(2) *Open frame, V_{IN} = 230V_{AC} ±15%,*
(3) *Achievable consumption at no load with Vin 264V_{AC}*

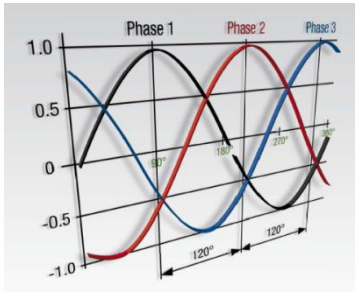
under development, SOP planned within Q1 2012

VIPer** for Metering

VIPer in smart energy meter**

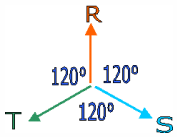
Viper** based
AC/DC auxiliary power supply for

- microcontrollers
- transceivers
- metrology ICs

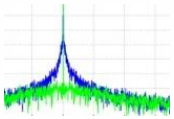


Aux SMPS market needs

Not isolated solution for
Single phase meter



Isolated solution for
3 phase meter



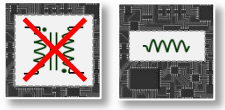
Reduced noise in the communication band

Robustness

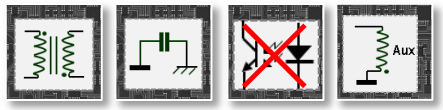
VIPer, key benefits & topologies supported**

Viper**,
key benefits for the application

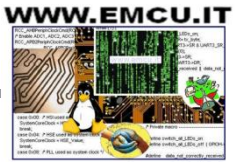
- 30kHz switching frequency to reduce noise in the communication band (only VIPer06)
- 800V breakdown
- Op-amp available for primary regulation



Inductor based topology
Buck



Flyback topology
Isolated
with primary regulation



VIPer** for Home Appliances

VIPer in home appliances**

Viper based AC/DC auxiliary power supply for**

- microcontrollers
- LEDs
- user interfaces
- motor driver ICs

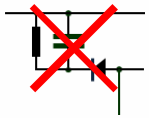
Small Home Appliances

Major Appliances

Aux SMPS market needs

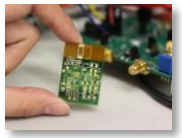
Small EMI input filter

Power scalability

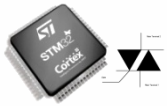


Clamp-less

High efficiency



Reduced size



Powering MCU to drive TRIAC

VIPer, key benefits & supported topologies**

VIPer, key benefits for the application**

- Frequency jittering
- Viper** pin to pin compatible
- 800V breakdown
- Self supply
- Op-amp available for primary regulation or direct feedback

Inductor based topologies

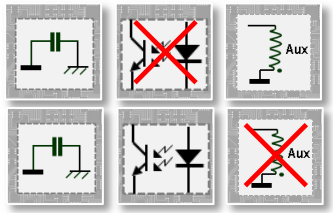
Buck common neutral

Buck-Boost negative output, common neutral

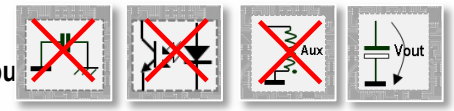
Smart Flyback topologies

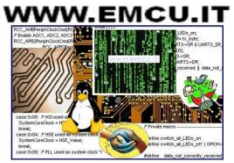
Isolated

- primary regulation
- secondary regulation



Not isolated direct feedback, positive/negative outpu common neutral





VIPer** for Home Automation

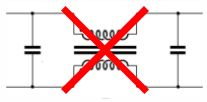
VIPer in home automation**

Viper based AC/DC auxiliary power supply for**

- microcontrollers
- transceivers
- sensors
- motor driver ICs

Aux SMPS market needs

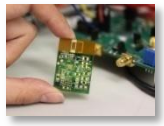
Low stand-by power



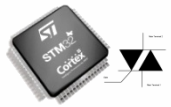
Small EMI input filter

Reliability

Cost saving



Cap SMPS replacement

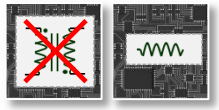


Powering MCU to drive TRIAC

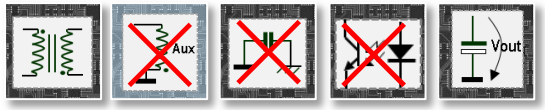
Viper, key benefits & topologies supported**

Viper, key benefits for the application**

- 30mW @ no load
- Frequency jittering
- 800V breakdown
- Self supply
- Op-amp available for direct feedback



Inductor based topology
Buck



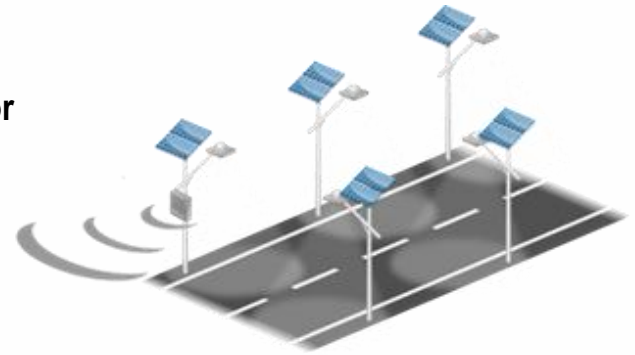
Smart Flyback topologies
Not isolated, direct feedback, positive/negative output, common neutral

VIPer** for Lighting

VIPer in street lighting**

VIPer based AC/DC auxiliary power supply for**

- microcontrollers
- transceivers
- lighting driver ICs



Aux SMPS market needs

- Low stand-by power
- Robustness
- Cost saving
- Reduced size
- High efficiency

Viper, key benefits & supported topologies**

Viper, key benefits for the application**

- 30mW @ no load
- Operating temperature: -25°C to +125°C
- 800V breakdown
- Self supply
- Op-amp available for primary regulation

Inductor based topology
Buck

Smart Flyback topologies

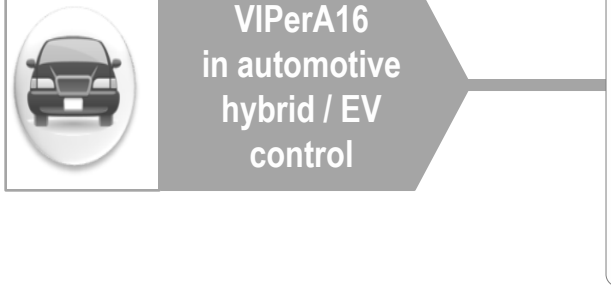
Isolated with secondary regulation

Isolated with primary regulation

VIPerA16 for Automotive

SILICA An Avnet Company

VIPerA16 in automotive hybrid / EV control



HV DC/DC aux SMPS based on VIPerA16 for

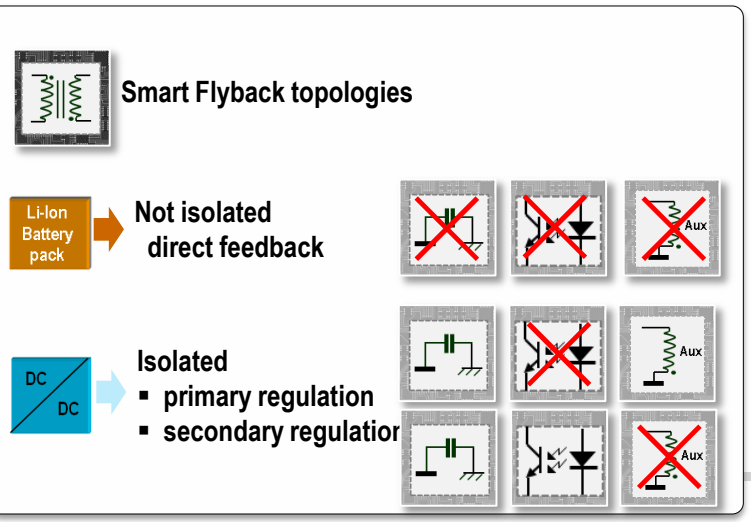
- *Li-Ion battery monitoring and cell balancing system*
- *DC-DC conversion to generate 12V/24V needs to subsystems*

Aux SMPS market needs

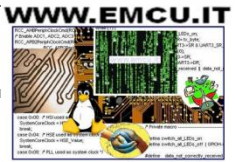
VIPerA16 Key benefits & topologies supported

VIPerA16 - Automotive grade 1, key benefits for the application

- AEQ100 compliant
- Operating temperature: -40°C to +125°C
- 800V breakdown
- Op-amp available for direct feedback



- Contact to ST office for further info on VIPerA16 -



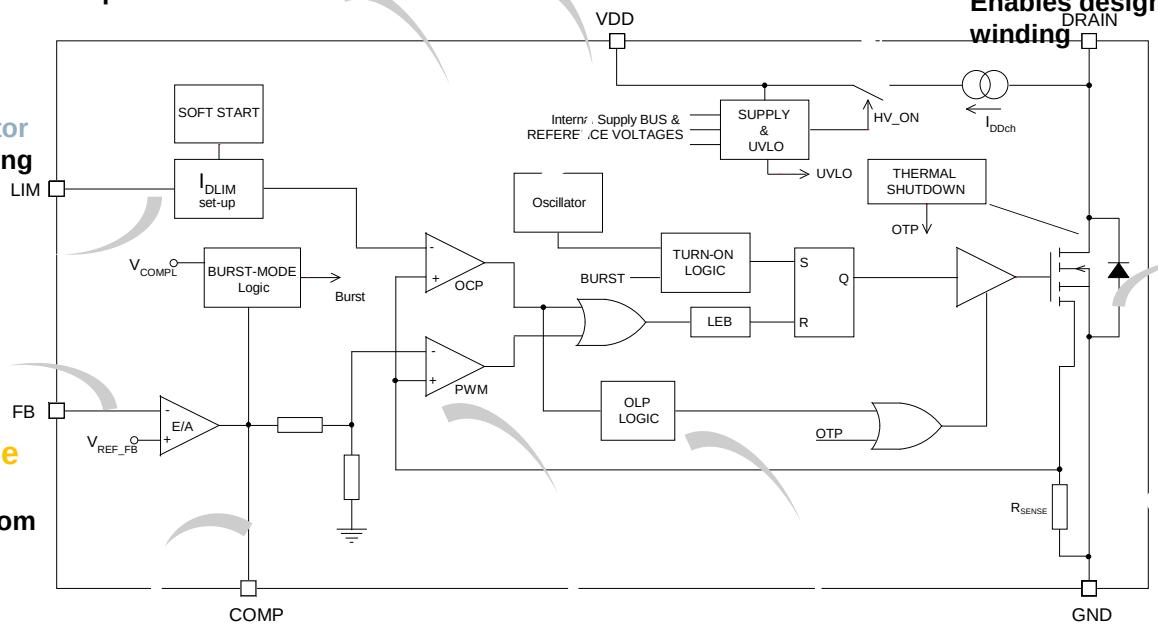
Viper** Family: Block Diagram

OCP comparator
Overload protection (I_{DLIM}) works in parallel with PWM comparator

Jittered oscillator
Three frequency option: 30,60 and 115 kHz with Jittering +/-6%

High Voltage START-UP
Enabled during the start-up and every time VDD voltage is lower than 9.5V (min).
Enables design without auxiliary winding

OCP comparator
threshold setting



800V AR Power MOSFET
senseFET +
thermal sensor +
current sense resistor

3V3 reference voltage
Embedded E/A for direct feedback with resistor from the output

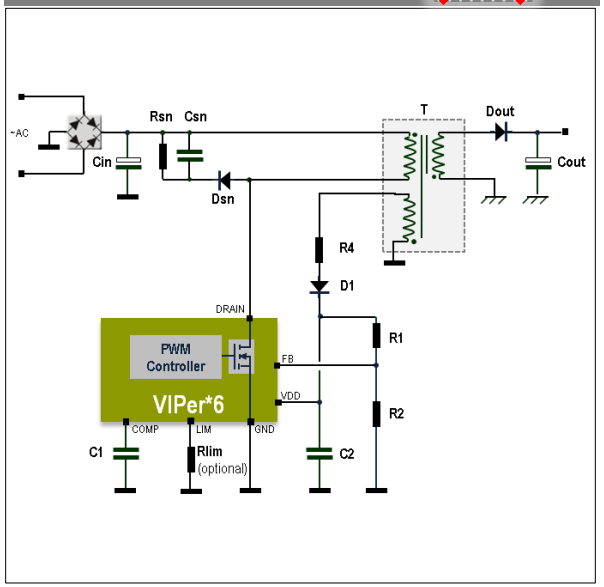
E/A compensation
and/or OPTO-COUPLER input only for isolated solution

PWM comparator
For cycle by cycle turn-off

Short circuit protection:
In case of overload, alternate 50ms ON / 1sec OFF

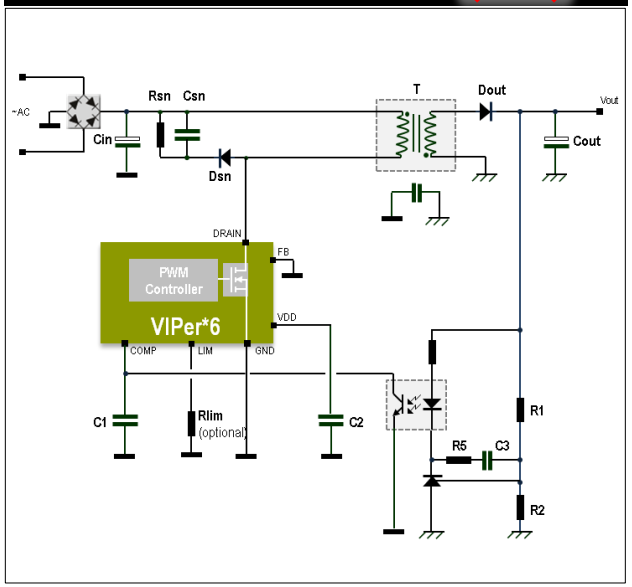
Viper**: isolated Flyback

Primary regulation



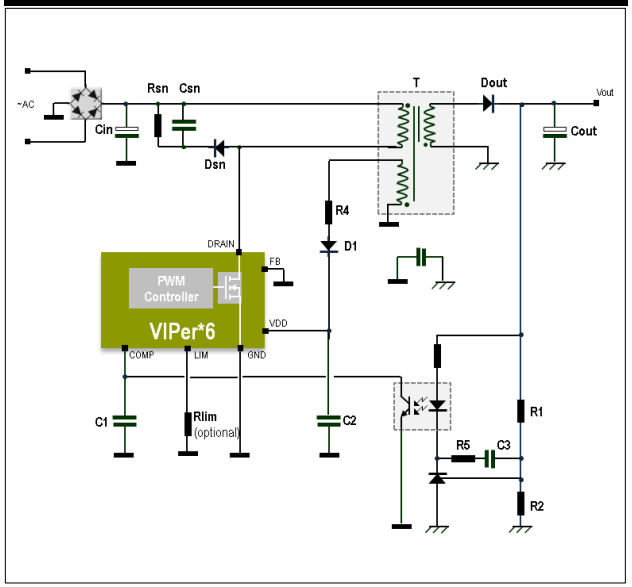
Perfect trade-off amongst isolation, cost and output regulation

Secondary regulation

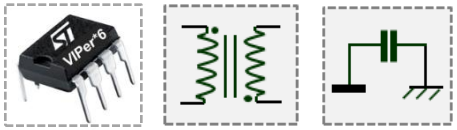


Standard topology without aux winding (VIPer self supply)

Secondary regulation

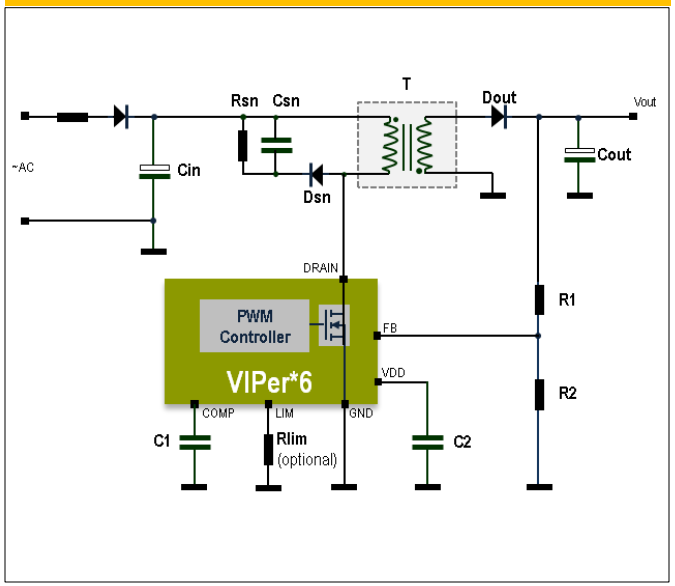


Standard topology with the lowest stand-by consumption



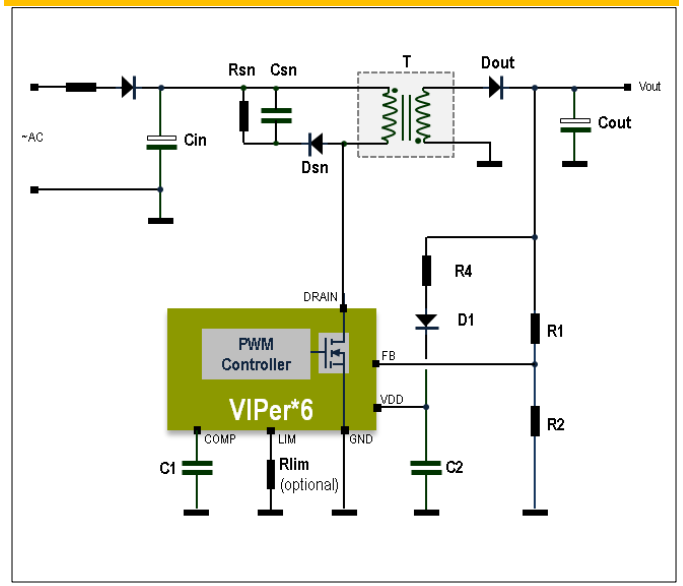
Viper**: not isolated Flyback(1/2)

Direct feedback

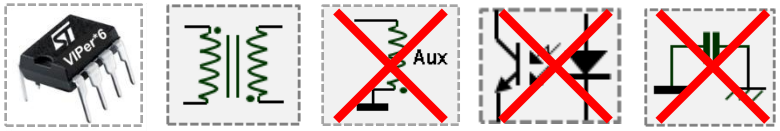


Minimal components count

Direct feedback



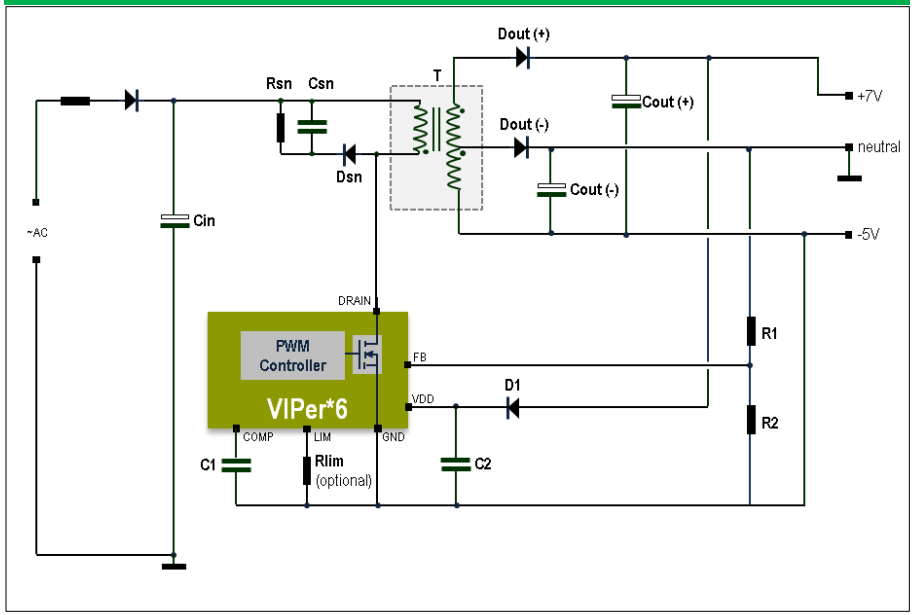
Minimal components count with the lowest stand-by consumption (Vout ≥ 12V)



Viper**: not isolated Flyback(2/2)

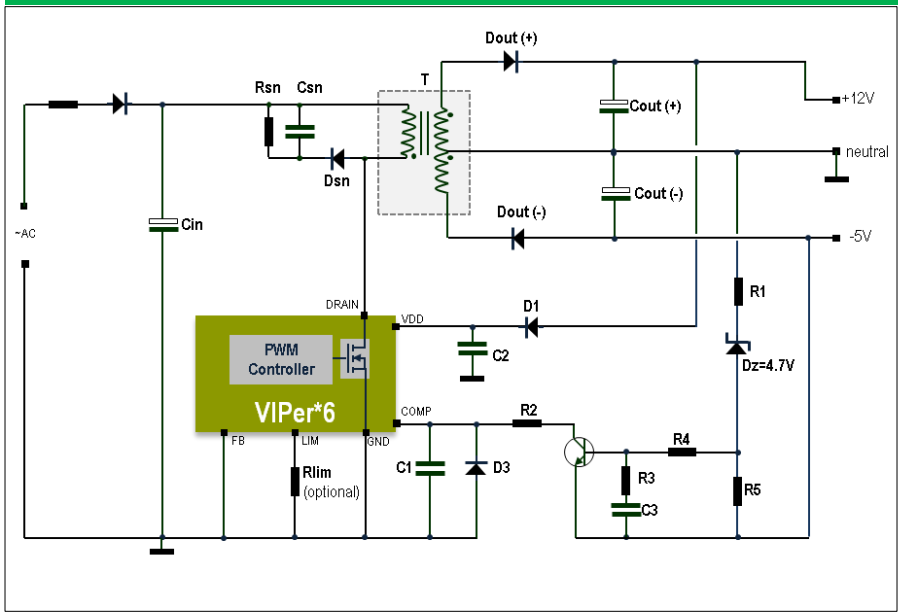
Configurations with positive and negative outputs

Direct feedback



+7V and -5V: outputs referred to neutral with lowest stand-by consumption

Secondary regulation

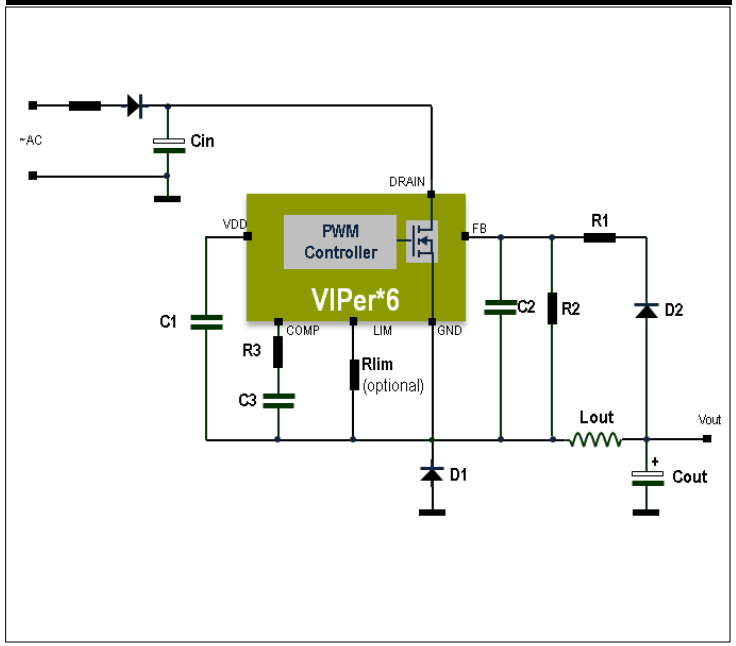


+12V and -5V: outputs referred to neutral with lowest stand-by consumption

Viper**: inductor based topologies

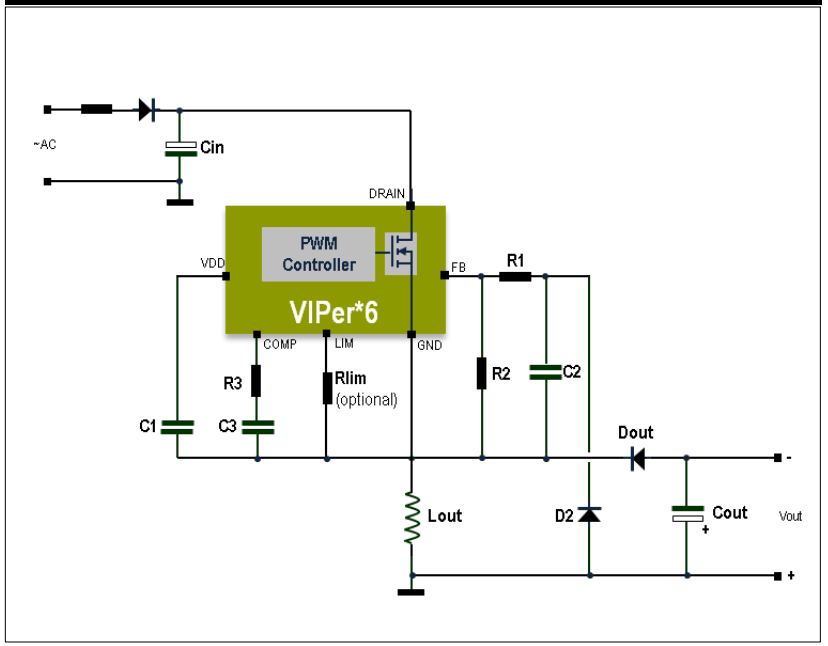
NOT isolated auxiliary SMPS

Buck



Simplicity and minimum size guaranteed

Buck-Boost with negative output



Powering a MCU able to drive a TRIAC

Viper** based solutions(1/3)

Solutions up to 2W

STEVAL-ISA130V1 (*)
1.7 W Buck converter
based on VIPer06X
(output referred to neutral)

- Vin = 90-265 Vac
- Vout = 12V
- Iout = 140mA
- Efficiency = 82.6% @85Vac (full load)

DN0009

STEVAL-ISA115V1 (*)
1.8W Buck converter
based on VIPer06XN
(output referred to neutral)

- Vin = 90-265 Vac
- Vout = 12V
- Iout = 150mA

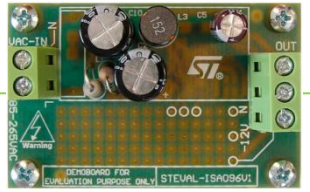
AN4260 (*)

STEVAL-ISA010V1
1.8W Super wide range
Buck converter
based on VIPer16LN
(dual outputs referred to neutral)

- Vin = 85-500 Vac
- Vout1 = 12V
- Vout2 = 5V
- IoutTOT= 150mA
- Standby= 96mW @230Vac

AN2872

STEVAL-ISA096V1
2W Buck-Boost converter
based on VIPer06XS
(negative output referred to neutral)



- Vin = 85-264 Vac
- Vout = -12V
- Iout= 150mA
- Efficiency = 80%@230Vac (full load)
- Standby< 30mW @264Vac

UM1470

(*) Available on request

Viper** based solutions(2/3)

Solutions up to 4.5 W

STEVAL-ISA071V2
4W Not isolated Flyback converter based on VIPer16L
(direct feedback, dual outputs referred to neutral)

- Vin = 85-264 Vac
- Vout1 = +7V
- Iout1 = 160mA
- Vout2 = -5V
- Iout2= 400mA
- Standby= 35mW @230Vac

UM0920

STEVAL-ISA117V1 (*)
4.2W Isolated Flyback converter based on VIPer16LN
(secondary regulation)

- Vin = 90-265 Vac
- Vout = 12V
- Iout = 350mA

AN4259 (*)

STEVAL-ISA112V1
STEVAL-ISA113V1
4.2W Not isolated Flyback converter
based on VIPer06HN / VIPer06HS
(direct feedback)

- Vin = 90-265 Vac
- Vout = 12V
- Iout= 350mA
- Efficiency 83%@115V (full load)
- Standby<28.5mW@264Vac

AN4116, AN4164

STEVAL-ISA118V1
4.5W Not isolated Flyback converter
based on VIPer16LN
(direct feedback)

- Vin = 90-265 Vac
- Vout = 16V
- Iout = 280mA
- Efficiency > 81% @230Vac (full load)

AN3028

(*) Available on request

Viper** based solutions(3/3)

Solutions up to 12 W

STEVAL-ISA116V1 (*)
5W Buck converter
based on VIPer26LD

- Vin = 85-305 Vac
- Vout 1= 16V
- Vout 2 = 5V
- Iout 1= 300mA
- Iout2= 15mA

AN draft (*)

STEVAL-ISA110V1 (*)
STEVAL-ISA111V1
12W Not isolated Flyback converter
based on VIPer26LN
(direct feedback;
60kHz, 115kHz version)

- Vin = 90-265 Vac
- Vout = 12V
- Iout = 1A
- Average efficiency @115Vac: 83.4% (115kHz), 87% (60kHz)

AN4106,
AN4165 (*)

STEVAL-ISA081V1
12W Isolated Flyback converter
based on VIPer16LND
(primary regulation)

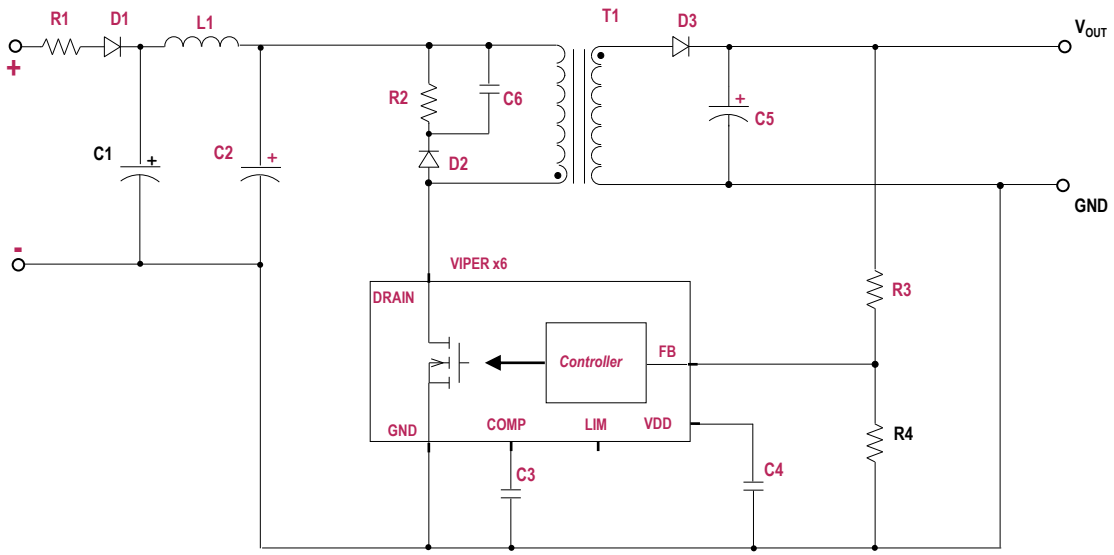
- Vin = 85-305 Vac
- Vout 1= 12V
- Vout 2 = 3.3V
- Iout 1= 900mA
- Iout2= 100mA
- Efficiency = 84% @230Vac (full load)

UM0984

Schematics with VIPerx6

VIPer06 / 16 / 26

FLY-BACK / Fixed Freq.
NON ISOLATED

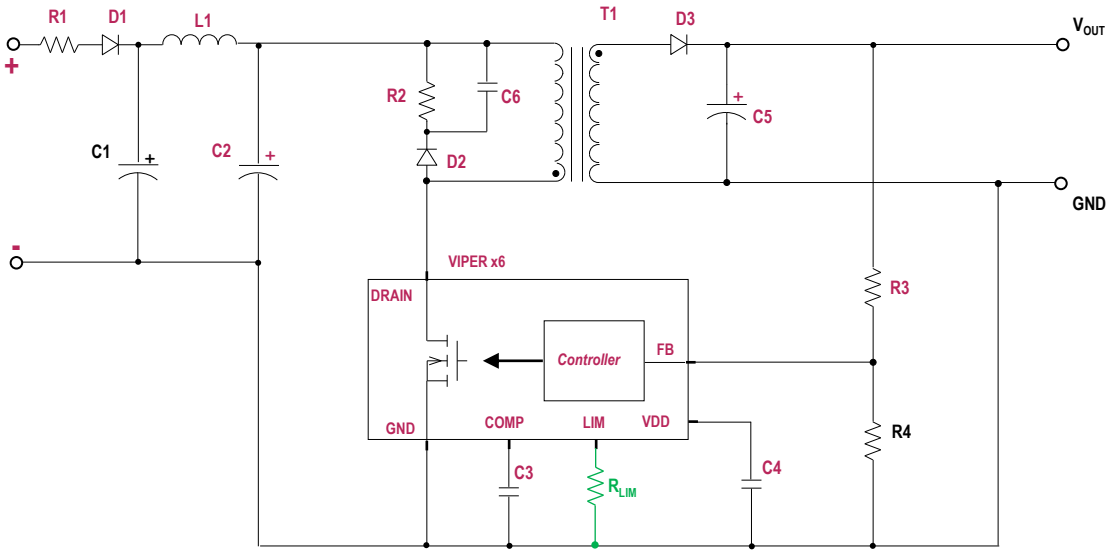


- **Simplified feedback loop**
  R3, R4
- **No Need auxiliary winding**
  C4
- **Low cost EMI filter**
  C1, C2, L1
- **Low cost clamp components**
  R2,D2,C6
- **Short circuit protection**
  (automatic restart)
- **Default current limit**
  400mA / 700mA
- **Stand-by, 300 mW**

Schematics with VIPerx6

VIPer06 / 16 / 26

FLY-BACK / FF
NON ISOLATED

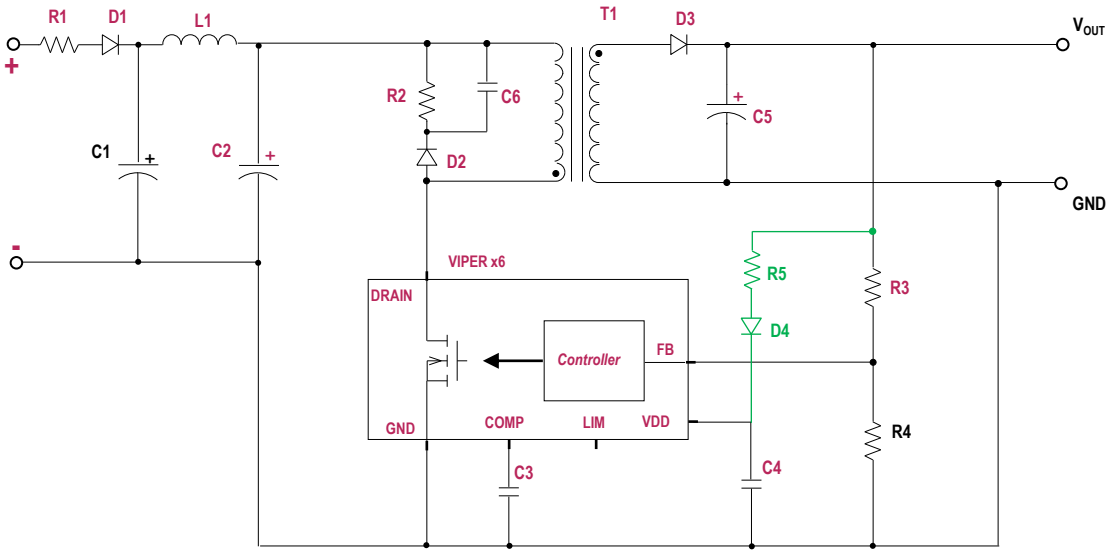


- **Simplified feedback loop**
  R3, R4
- **No Need auxiliary winding**
  C4
- **Low cost EMI filter**
  C1, C2, L1
- **Low cost clamp components**
  R2,D2,C6
- **Short circuit protection**
  (automatic restart)
- **Current limit set-up - R_{LIM}**
  <400mA or <700mA

Schematics with VIPerx6

VIPer06 / 16 / 26

FLY-BACK / FF
NON ISOLATED

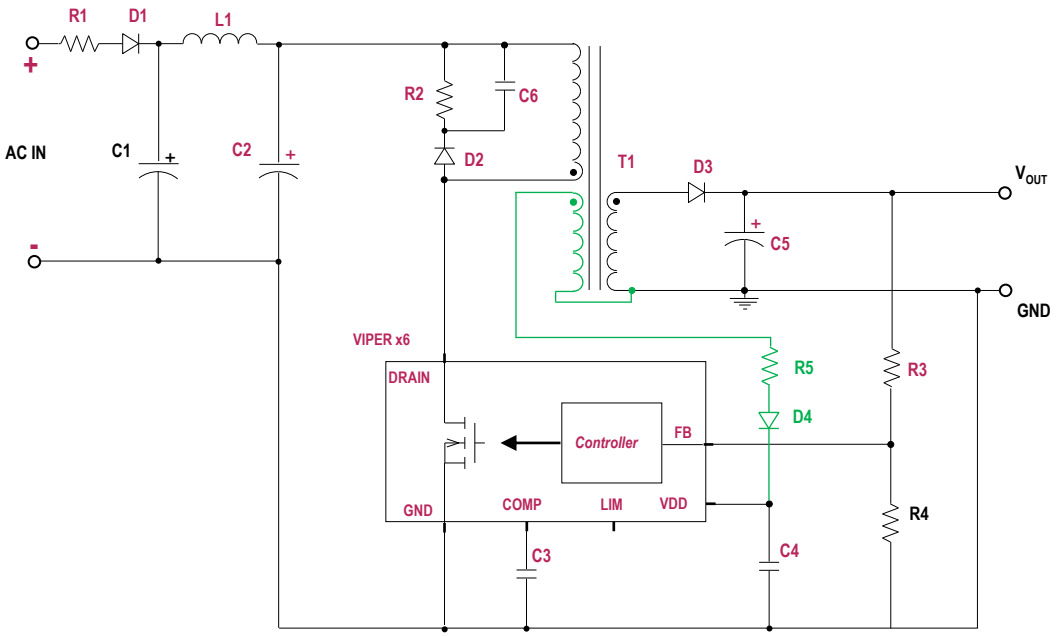


- Simplified feedback loop
  R3, R4
- No Need auxiliary winding
  C4
- Low cost EMI filter
  C1, C2, L1
- Low cost clamp components
  R2,D2,C6
- Short circuit protection
  (automatic restart)
- Feedback disconnection
  (automatic restart)
- Default current limit
  400mA / 700mA
- VOUT ≥ 12 V
- Stand-by optimization , 30 mW
  D4, R5

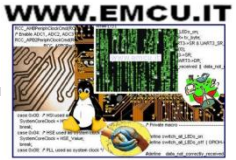
Schematics with VIPerx6

VIPer06 / 16 / 26

FLY-BACK / FF
NON ISOLATED



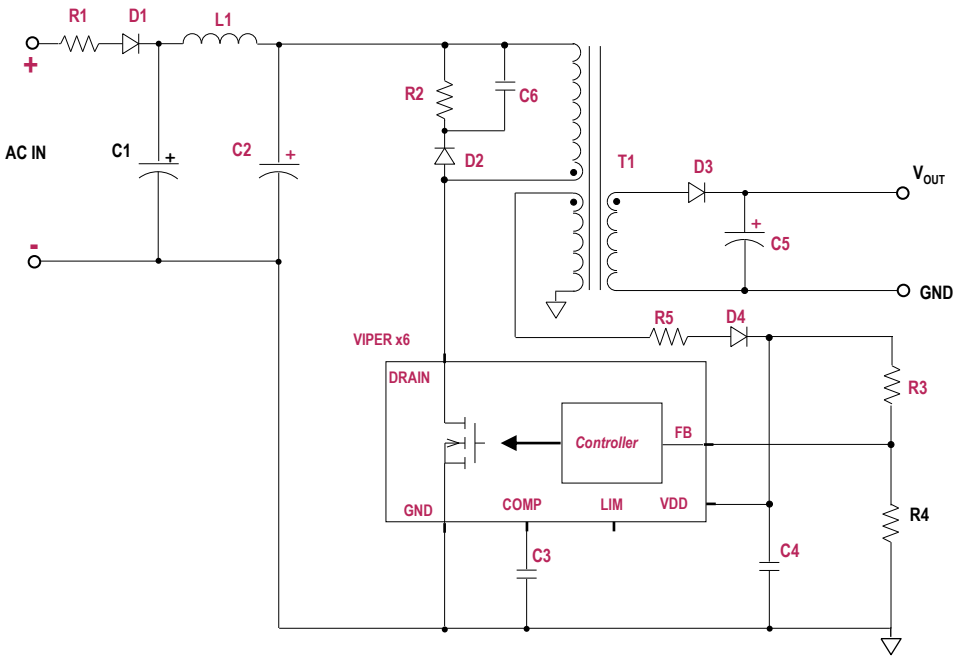
- Simplified feedback loop
  R3, R4
- Need auxiliary winding
  C4 + AUX
- Low cost EMI filter
  C1, C2, L1
- Low cost clamp components
  R2,D2,C6
- Short circuit protection
  (automatic restart)
- Feedback disconnection
  (automatic restart)
- Default current limit
  400mA / 700mA
- VOUT < 12 V
- Stand-by optimization , 30 mW
  D4, R5



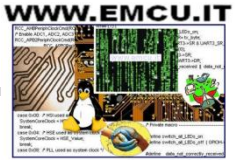
Schematics with VIPerx6

VIPer06 / 16 / 26

FLY-BACK / FF isolated
PRIMARY REGULATION



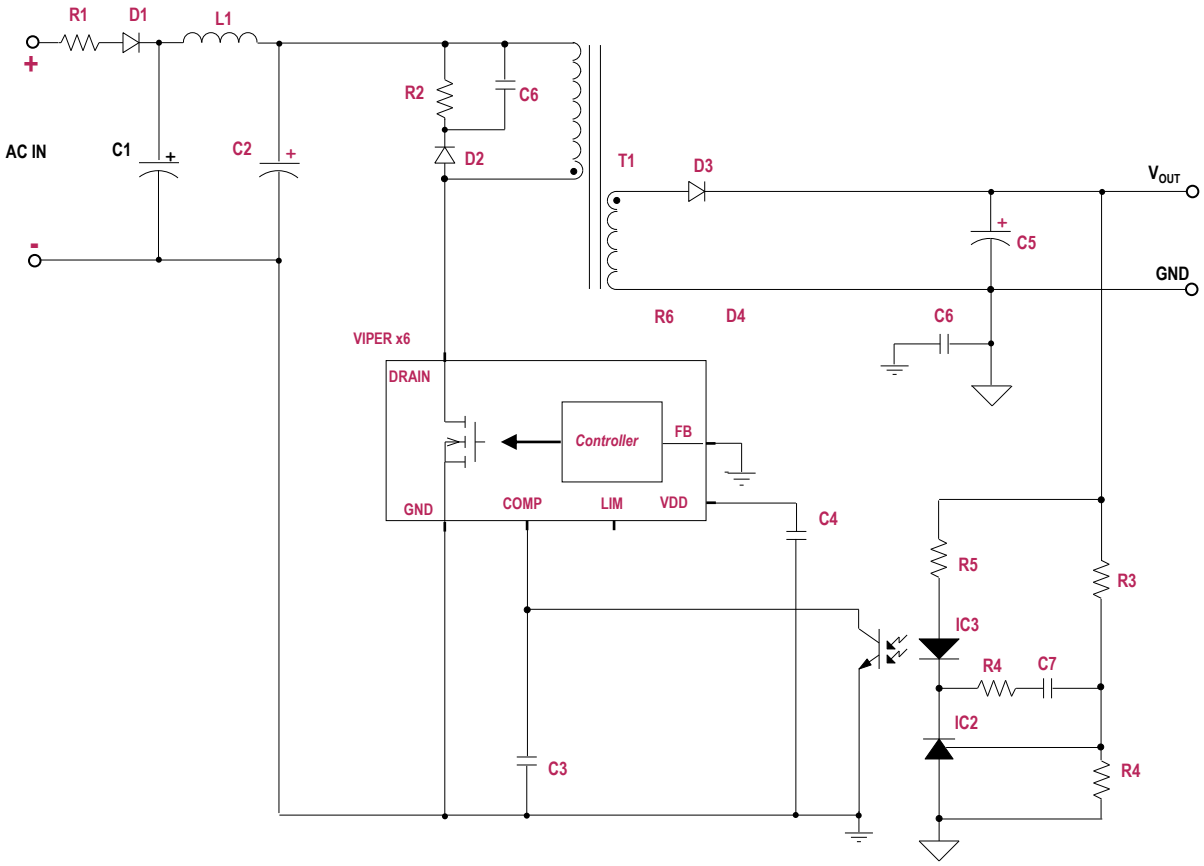
- Simplified feedback loop
  R3, R4
- Need auxiliary winding
  C4 + AUX
- Low cost EMI filter
  C1, C2, L1
- Low cost clamp components
  R2,D2,C6
- Short circuit protection
  (automatic restart)
- Feedback disconnection
  (automatic restart)
- Default current limit
  400mA / 700mA
- No need the optocoupler
- Stand-by optimization , 30 mW
  D4, R5



Schematics with VIPerx6

VIPer06 / 16 / 26

FLY-BACK / FF
ISOLATED

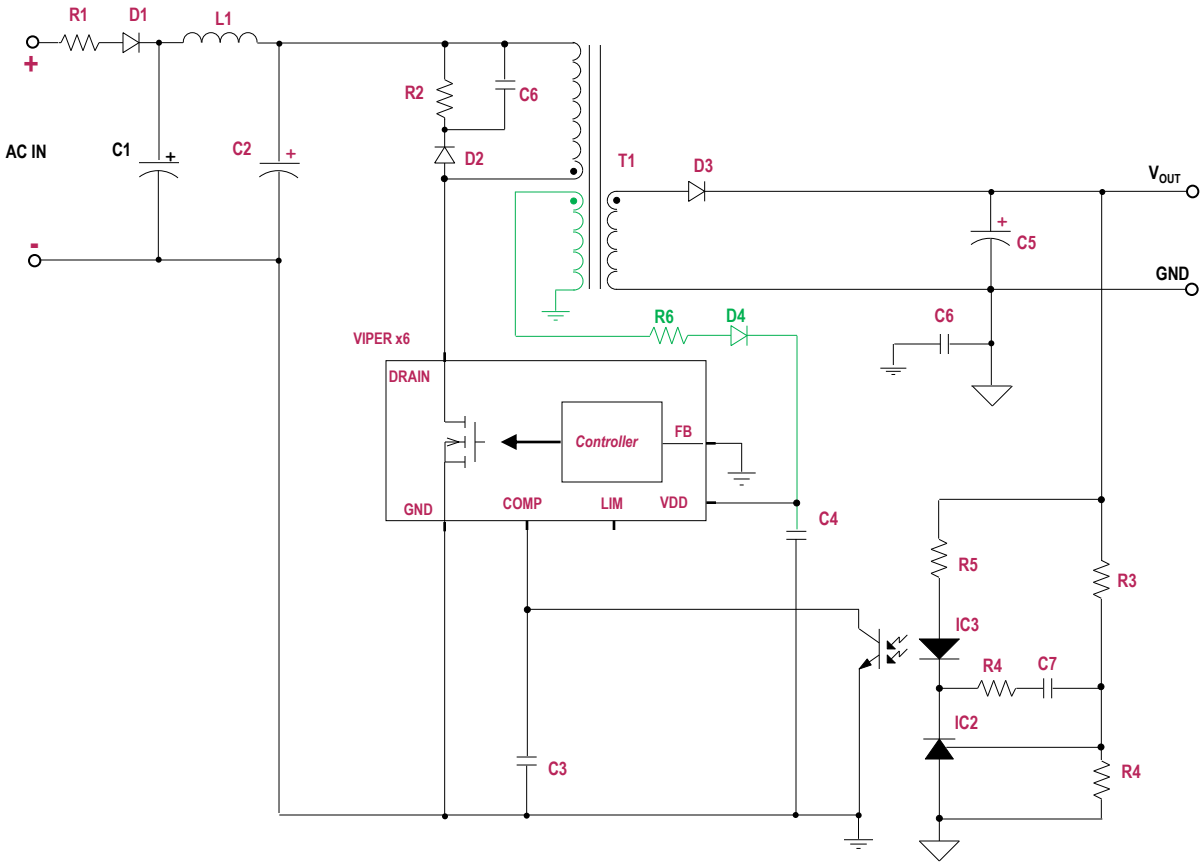


- **Minimum components count**
- **No Need auxiliary winding**
  C4
- **Low cost EMI filter**
  C1, C2, L1
- **Low cost clamp components**
  R2,D2,C6
- **Short circuit protection**
  (automatic restart)
- **Default current limit**
  400mA / 700mA

Schematics with VIPerx6

VIPer06 / 16 / 26

FLY-BACK / FF
ISOLATED



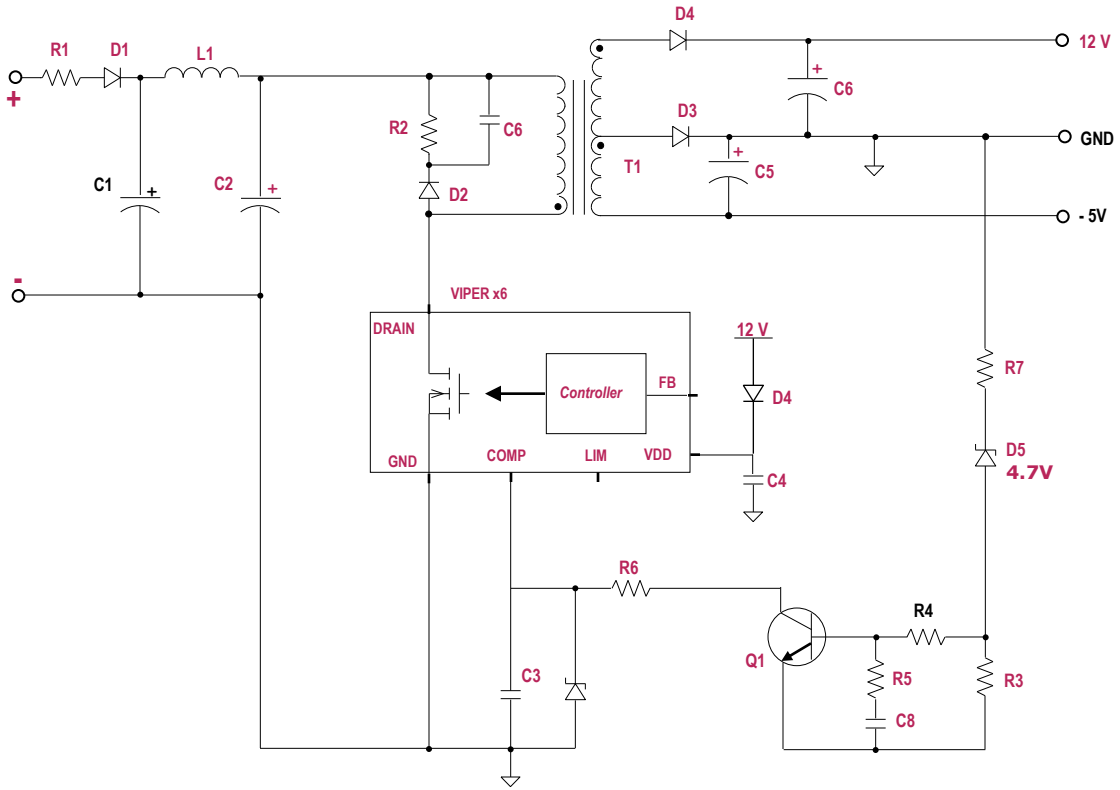
- **Minimum components count**
- **Need auxiliary winding**
  C4 + AUX
- **Low cost EMI filter**
  C1, C2, L1
- **Low cost clamp components**
  R2,D2,C6
- **Short circuit protection**
  (automatic restart)
- **Feedback disconnection**
  (automatic restart)
- **Default current limit**
  400mA / 700mA
- **Stand-by optimization , 30 mW**
  AUX + D4, R5

Schematics with VIPerx6

VIPer06 / 16 / 26

FLY-BACK / FF
NON ISOLATED

Negative voltage



Simplified feedback loop
R3, R4

No Need auxiliary winding
C4

Low cost EMI filter
C1, C2, L1

Low cost clamp components
R2,D2,C6

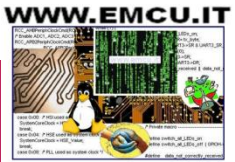
Short circuit protection
(automatic restart)

Feedback disconnection
(automatic restart)

Default current limit
400mA / 700mA

VOUT ≥ 12 V

Stand-by optimization , 30 mW
D4, R5

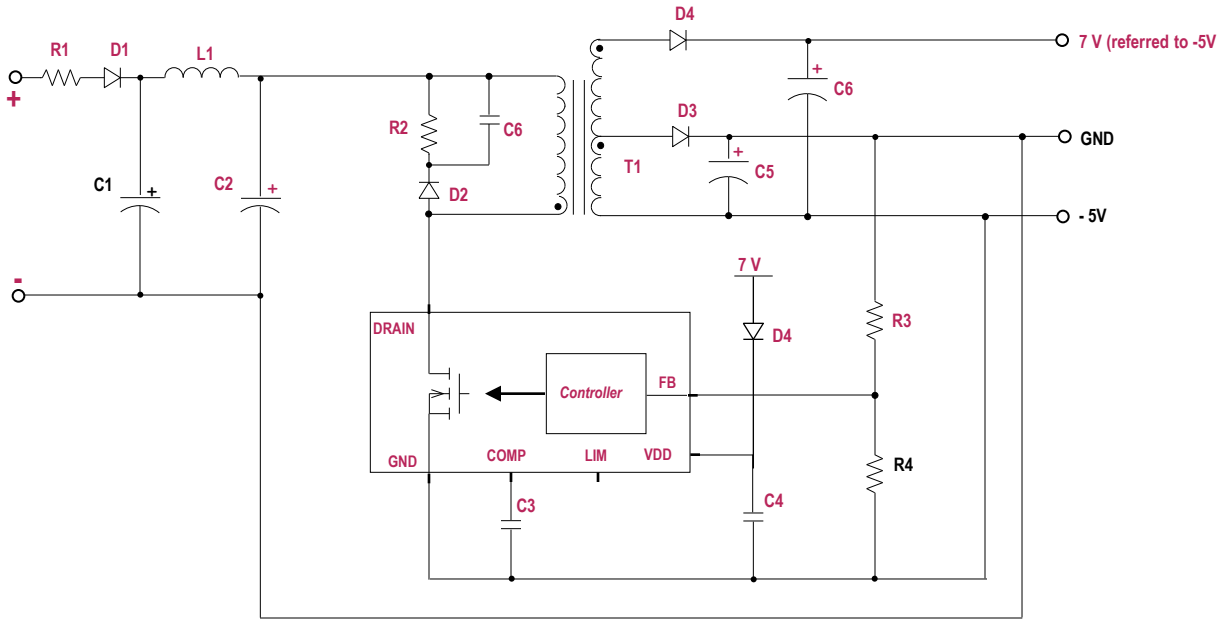


Schematics with VIPerx6

VIPer06 / 16 / 26

FLY-BACK / FF
NON ISOLATED

Negative voltage

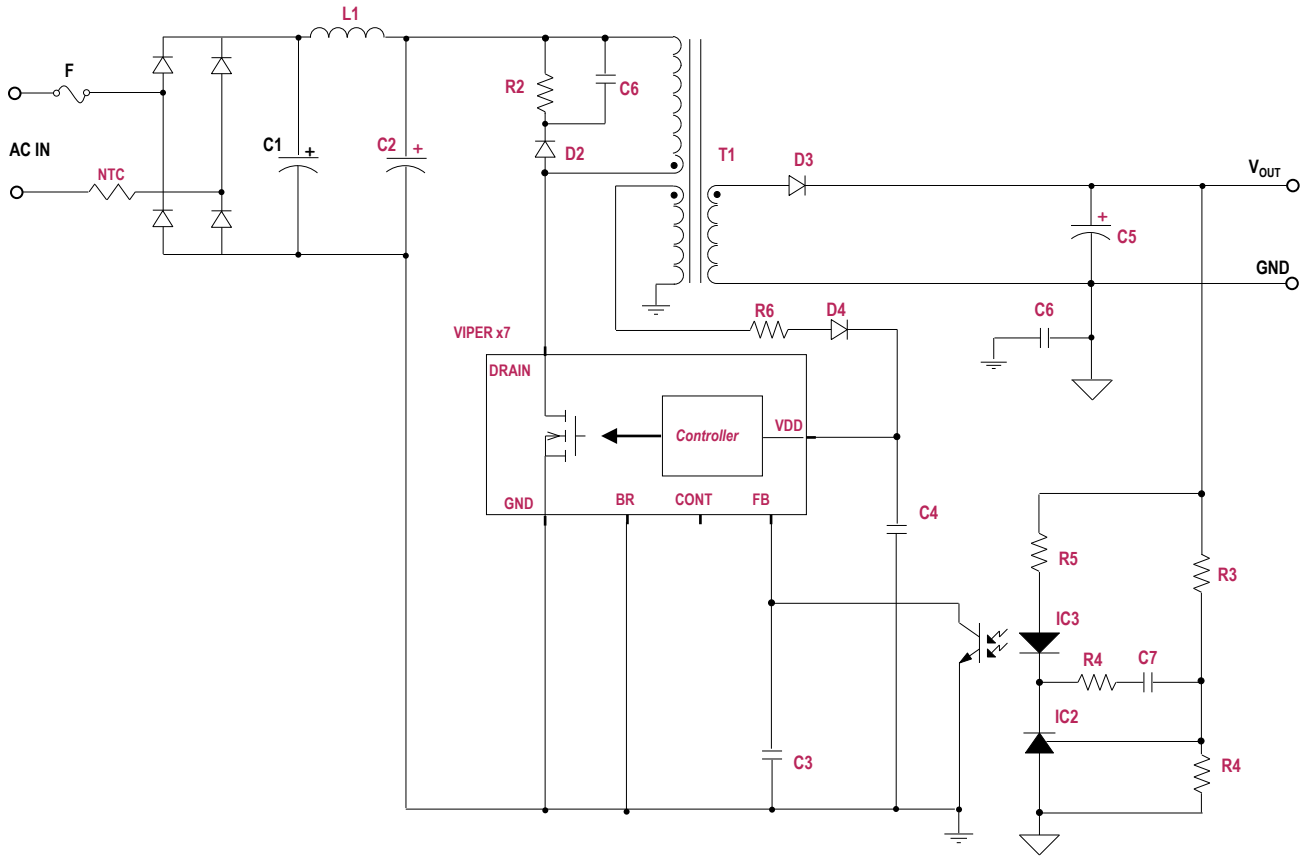


- Simplified feedback loop
  R3, R4
- No Need auxiliary winding
  C4
- Low cost EMI filter
  C1, C2, L1
- Low cost clamp components
  R2,D2,C6
- Short circuit protection
  (automatic restart)
- Feedback disconnection
  (automatic restart)
- Default current limit
  400mA / 700mA
- VOUT ≥ 12 V
- Stand-by optimization , 30 mW
  D4, R5

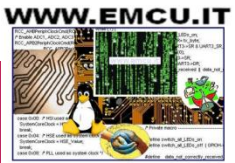
Schematics with VIPerx7

VIPer17 / 27 / 37

FLY-BACK / FF
ISOLATED



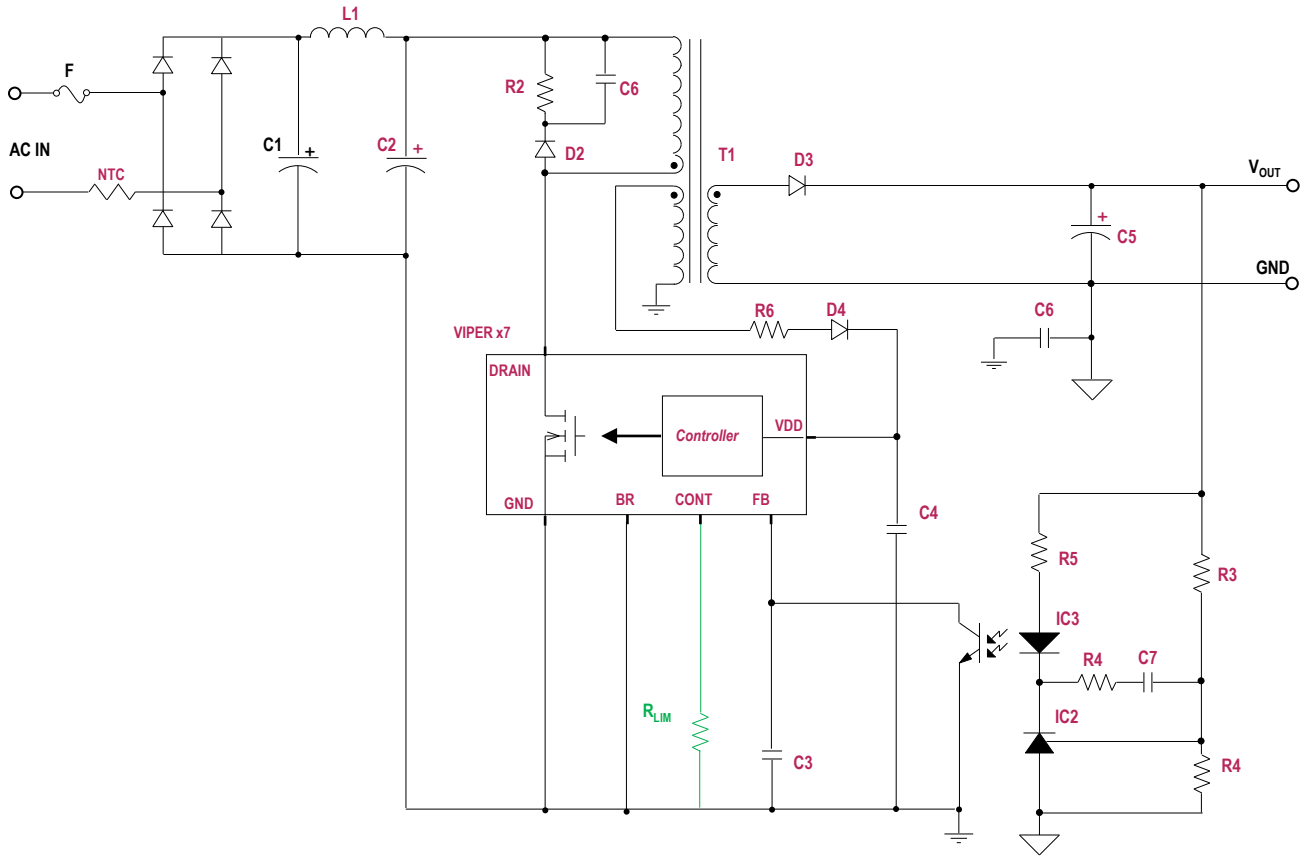
- 30mW Stand-by
- Minimum components count
- Low cost EMI filter
  C1,C2, L1
- Low cost clamp components
  R2,C6,D2
- Default current limit
  400mA / 700mA / 1000mA
- Short circuit protection
  No need ext components
- 2nd Over Current protection
  No need ext components



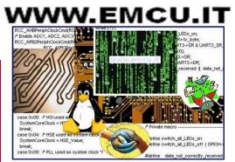
Schematics with VIPerx7

VIPer17 / 27 / 37

FLY-BACK / FF
ISOLATED



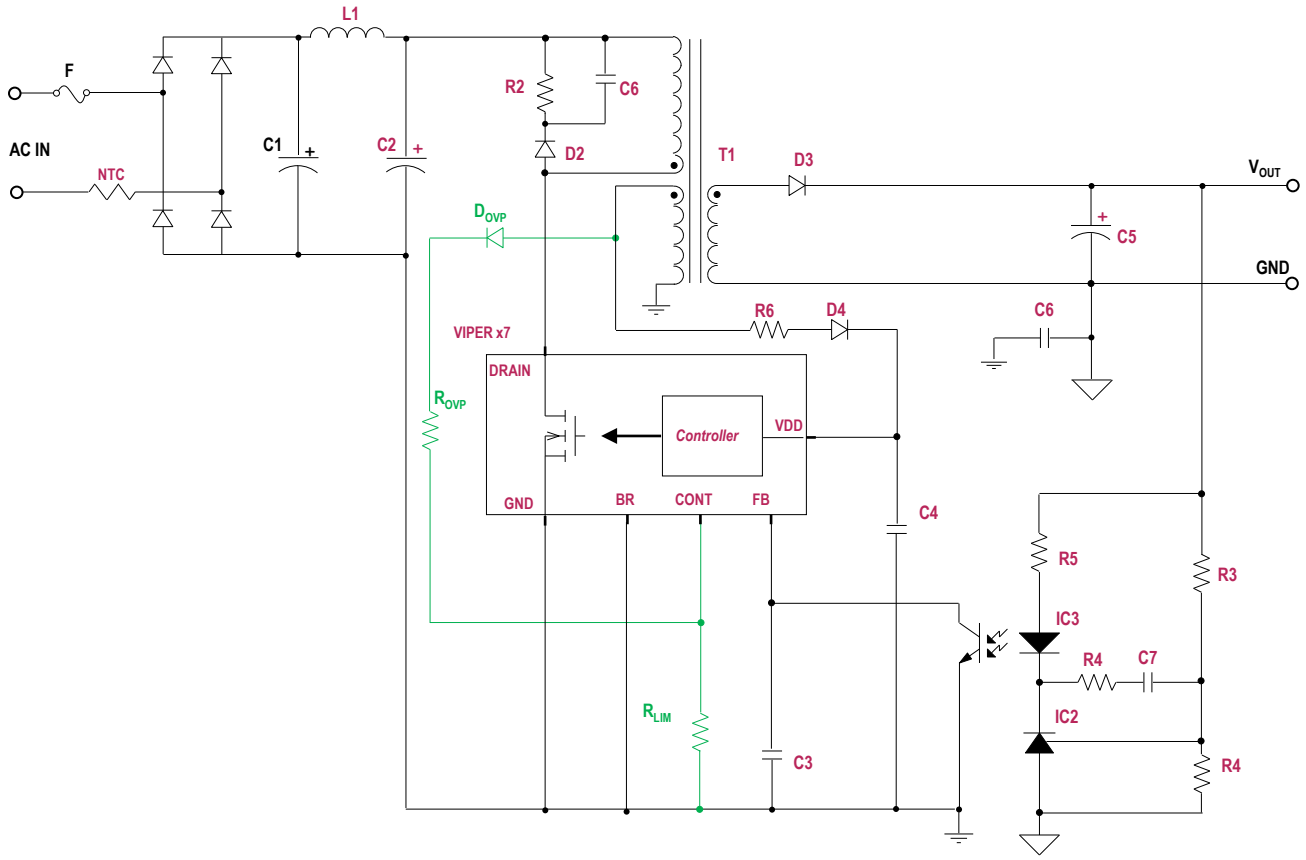
- 30mW Stand-by
- Minimum components count
- Low cost EMI filter
  C1,C2, L1
- Low cost clamp components
  R2,C6,D2
- Current limit set-up - R_{LIM}
  <400mA or <700mA or <1000mA
- Short circuit protection
  No need ext components
- 2nd Over Current protection
  No need ext components



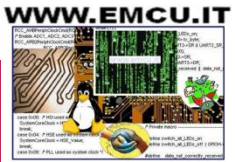
Schematics with VIPerx7

VIPer17 / 27 / 37

FLY-BACK / FF
ISOLATED



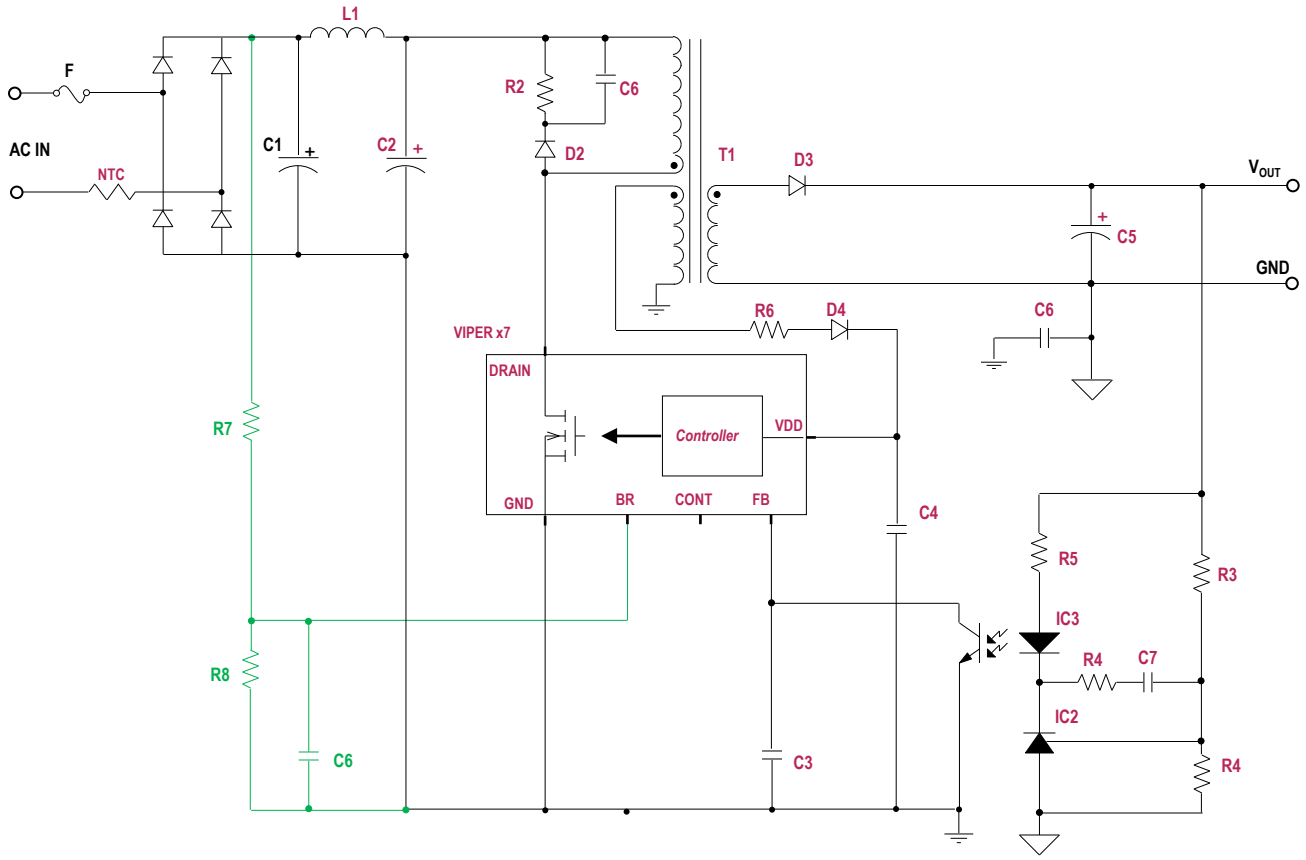
- **30mW Stand-by**
- **Minimum components count**
- **Low cost EMI filter**
  C1,C2, L1
- **Low cost clamp components**
  R2,C6,D2
- **Current limit set-up - R_{LIM}**
  <400mA or <700mA or <1000mA
- **Short circuit protection**
  No need ext components
- **2nd Over Current protection**
  No need ext components
- **Over Voltage Protection (V_{OUT})**
  R_{LIM} , R_{OVP} , D_{OVP}



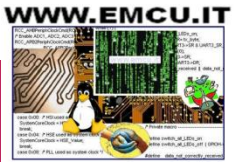
Schematics with VIPerx7

VIPer17 / 27 / 37

FLY-BACK / FF
ISOLATED



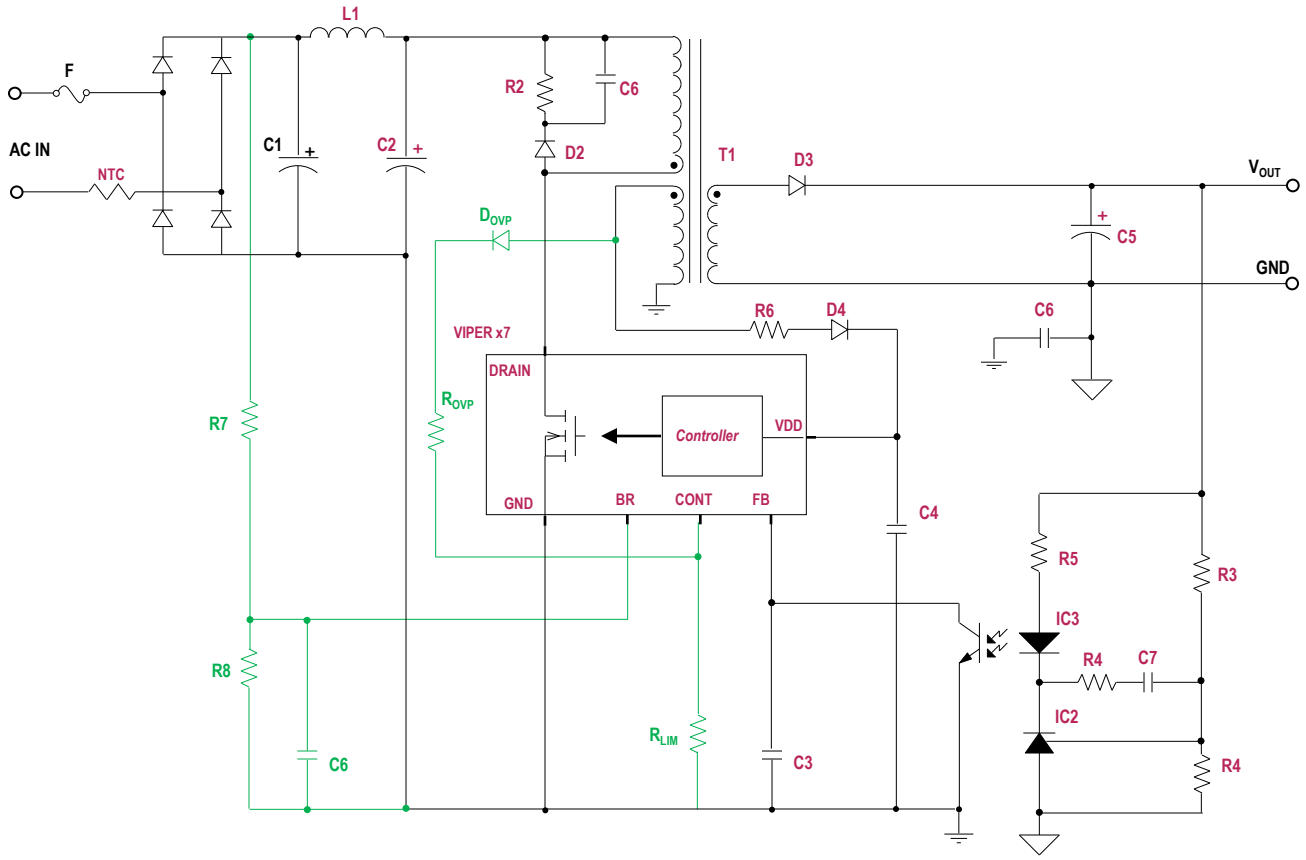
- 30mW Stand-by
- Minimum components count
- Low cost EMI filter
  C1,C2, L1
- Low cost clamp components
  R2,C6,D2
- Default current limit
  400mA / 700mA / 1000mA
- Short circuit protection
  No need ext components
- 2nd Over Current protection
  No need ext components
- Brown out set-up (V_{INDC})
  R7,R8, C6



Schematics with VIPerx7

VIPer17 / 27 / 37

FLY-BACK / FF
ISOLATED

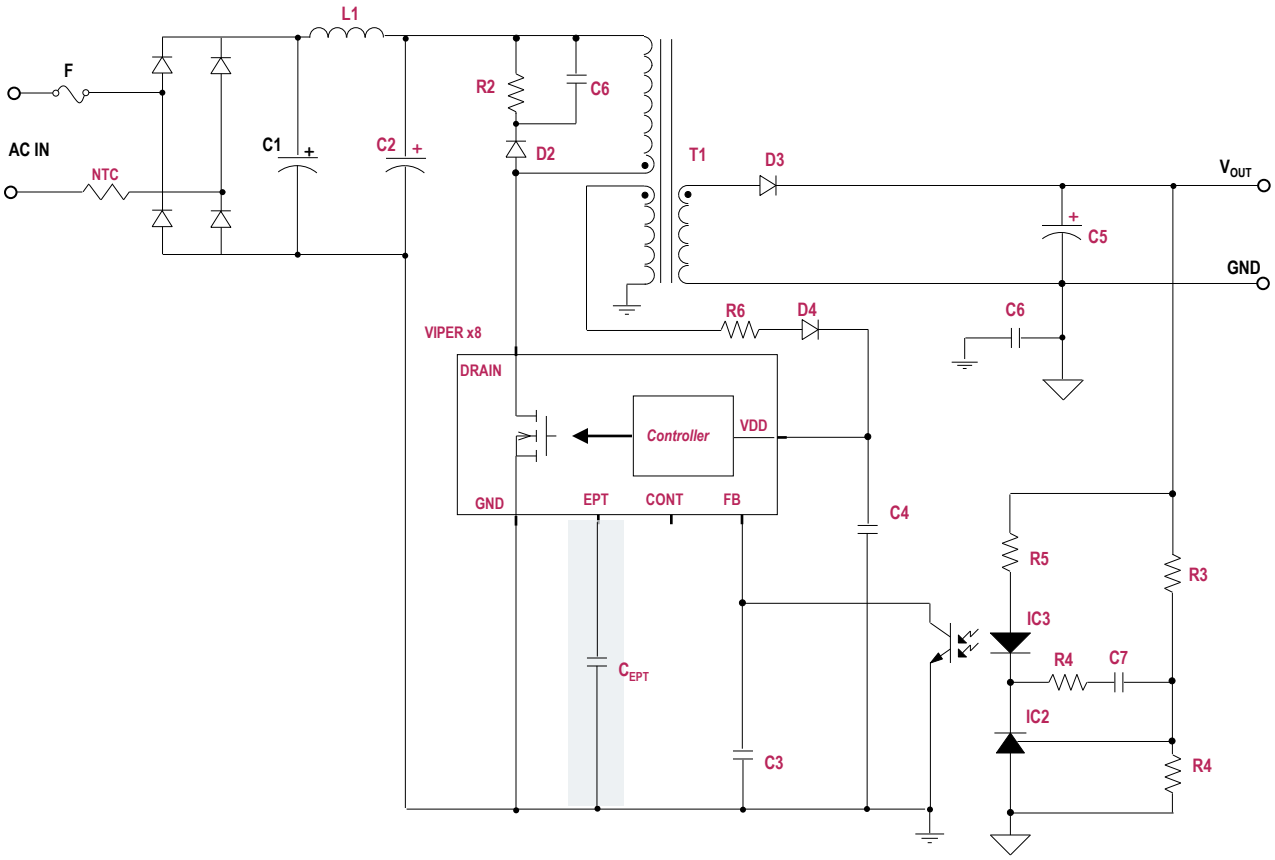


- **30mW Stand-by**
- **Minimum components count**
- **Low cost EMI filter**
  C1,C2, L1
- **Low cost clamp components**
  R2,C6,D2
- **Current limit set-up - R_{LIM}**
  <400mA or <700mA or <1000mA
- **Short circuit protection**
  No need ext components
- **2nd Over Current protection**
  No need ext components
- **Over Voltage Protection (V_{OUT})**
  R_{LIM} , R_{OVP} , D_{OVP}
- **Brown out set-up (V_{INDC})**
  R7,R8, C6

Schematics with VIPer28

VIPer28

FLY-BACK / FF
ISOLATED

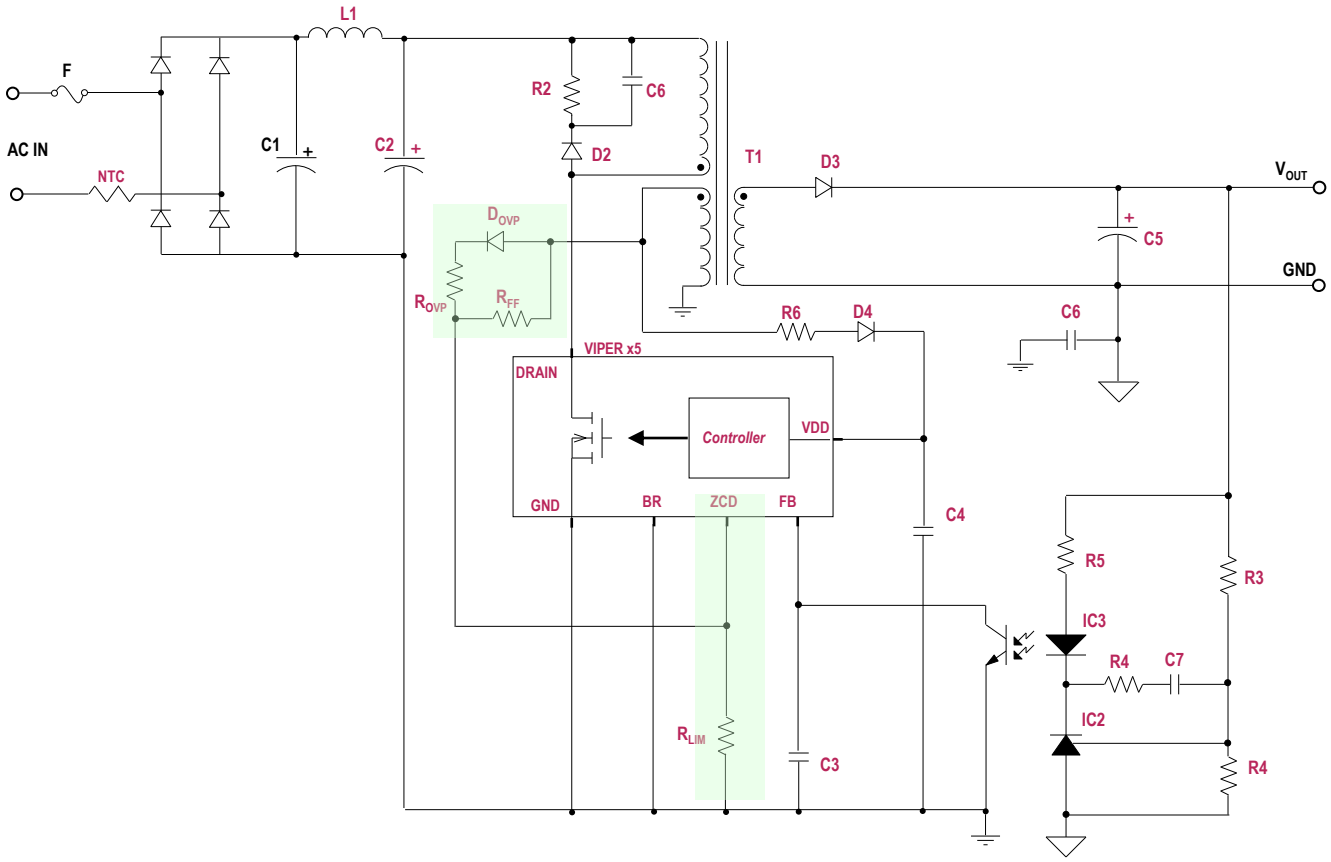


- **30mW Stand-by**
- **Minimum components count**
- **Low cost EMI filter**
  C1,C2, L1
- **Low cost clamp components**
  R2,C6,D2
- **Default current limit**
  400mA / 700mA / 1000mA
- **Short circuit protection**
  No need ext components
- **2nd Over Current protection**
  No need ext components
- **Extra Power Timer**
  C_{EPT}

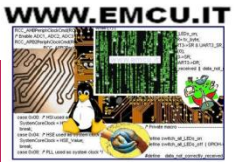
Schematics with VIPerx5

VIPerx5

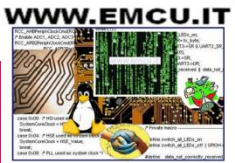
FLY-BACK / Quasi Res. ISOLATED



- 30mW Stand-by
- Minimum components count
- Low cost EMI filter
  C1,C2, L1
- Low cost clamp components
  R2,C6,D2
- Short circuit protection
  No need ext components
- 2nd Over Current protection
  No need ext components
- Zero current Detection (QR)
  R_{LIM} , R_{OVP} , D_{OVP}, R_{FF}
- Current limit set-up - R_{LIM}
  ≤400mA or ≤700mA or ≤1000mA
- Over Voltage Protection (V_{OUT})
  R_{LIM} , R_{OVP} , D_{OVP}
- Feed-Forward
  R_{FF}



WEB Support



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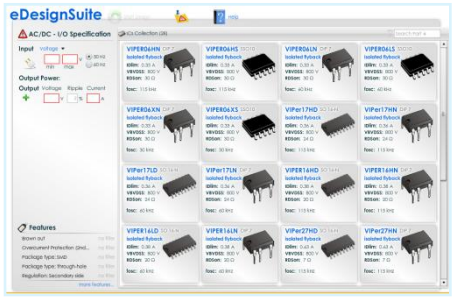
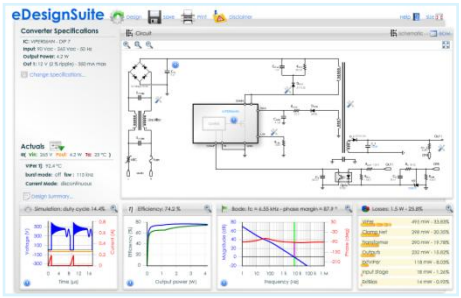


Insert your I/O specifications and
select one of the proposed Viper**



The design is ready!

1 → 2 → 3 → 4

A complete design in a few steps

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A full set of commands

The specifications view

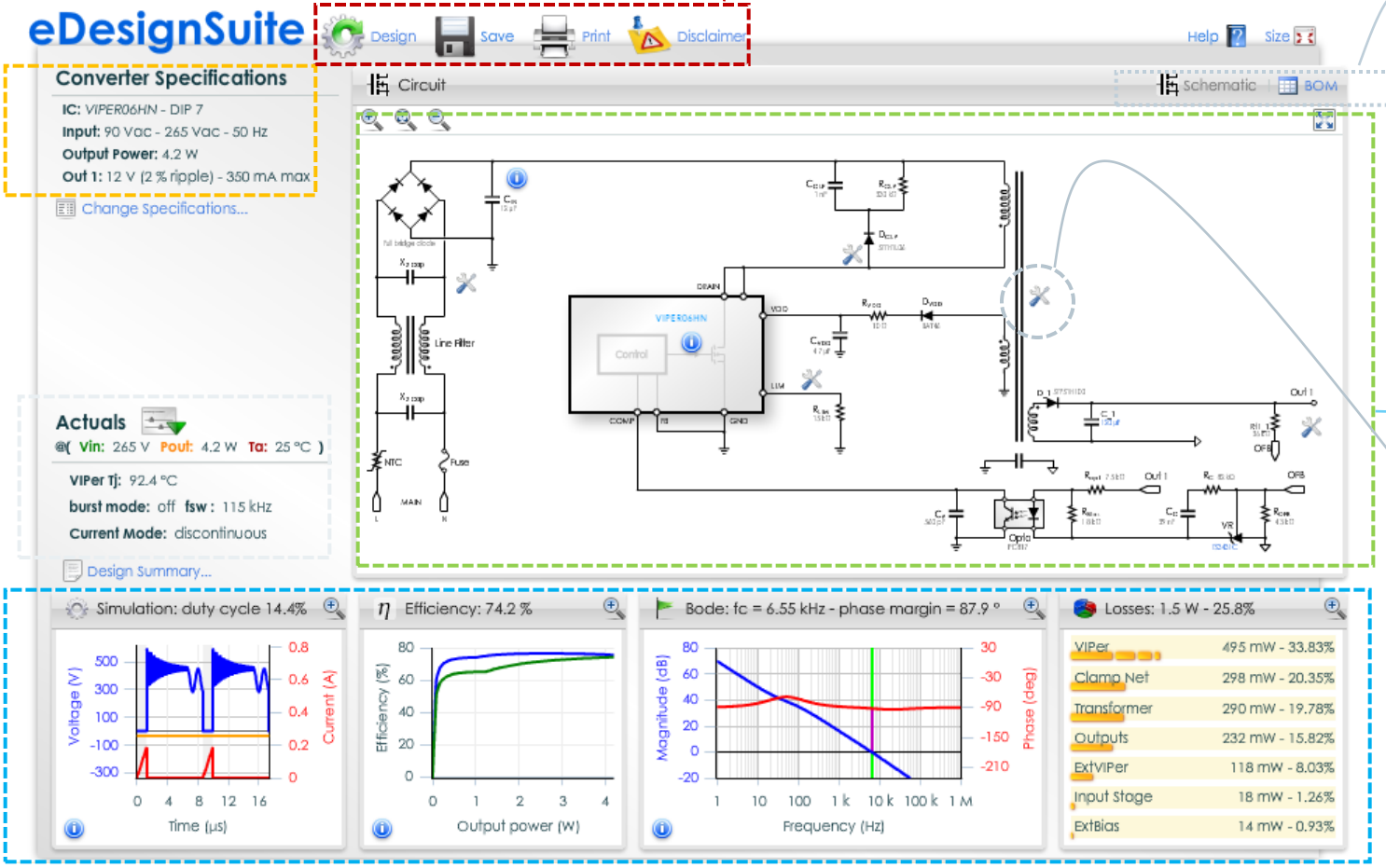
A fully and interactive BOM

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