

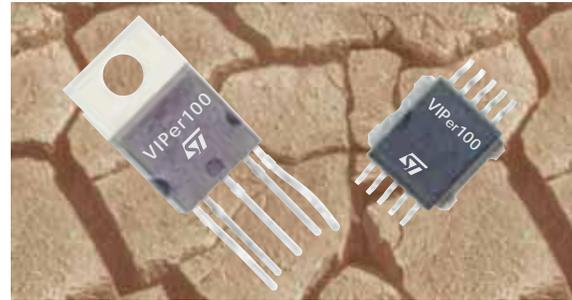
VIPer100™

by A. Russo
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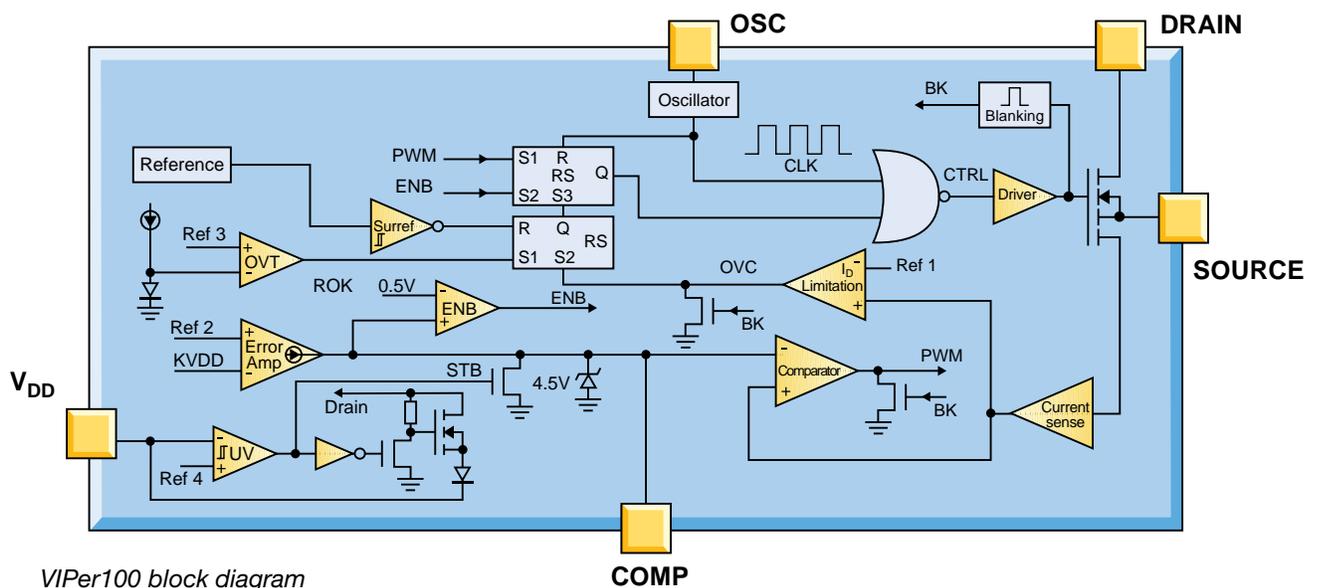
AN ADVANCED MONOLITHIC SOLUTION FOR OFF-LINE SMPS PRIMARY CONVERTERS

Following the ever increasing consumer market needs for advanced, albeit cost effective solutions for Off Line Switch Mode Power Supplies, ST has developed the VIPer100. It is the first of a family of monolithic devices for SMPS applications using the well consolidated VIPower M0 technology. VIPer100 combines on the same silicon chip a state-of-the-art PWM circuit with current mode control and a dedicated compensation path, together with an optimized high voltage avalanche rugged Vertical Power MOSFET (600V/3.5A).

Housed in the 5 pin TO-220, as well as in the PowerSO-10 surface mounting package, it offers maximum flexibility to designers allowing both primary or secondary regulation loop, despite using around 50% less components than a discrete solution.



Start up of the circuit is insured by an internal high voltage current source which is switched off during normal operation. Adjustable switching frequency up to 200KHz is achieved by an external R-C network. Synchronisation to an external clock generator is also possible. A dedicated circuit for limiting the primary current during the start up phase or overload condition, gives a real power limitation and correct soft start without any extra components.



VIPer100 block diagram

Built in overtemperature protection offers additional safety and silicon self protection in the case of abnormal operating conditions. Burst mode operation is an additional feature of this device, offering the possibility to operate in stand by mode without extra components.

APPLICATIONS

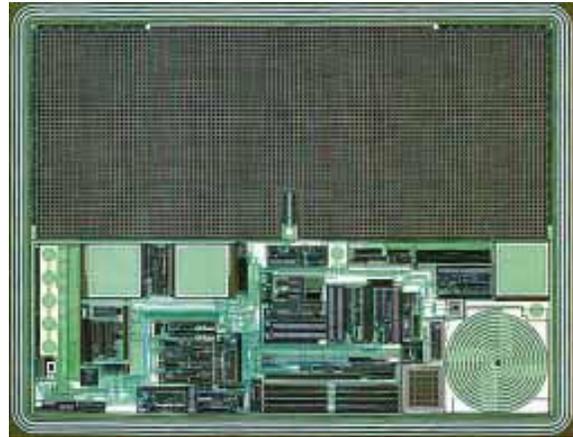
The VIPer100 can be efficiently used for implementing a current mode flyback configuration in the discontinuous inductor current mode. It has a maximum power capability of 100W on a European voltage range (180 to 270V AC) and 50W for a universal input voltage range (85 to 270V AC).

Set top box, satellite receivers, decoders, video recorders, laptop computers, monitors, camcorders, television sets represent only a small selection of the consumer products that can easily benefit from all the advantages of the best integrated solution available on the market.

GREATER RELIABILITY

The increased overall reliability of the system is great due to the approximate 50% reduction in the components used with respect of a similar discrete implementation and complete protection built into the silicon.

TYPE	V _{DSS}	I _D	R _{DS(on)}	PACKAGE
VIPer100	600V	3.5A	2.8Ω	PowerSO-10 PENTAWATT HV

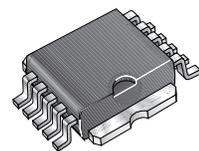
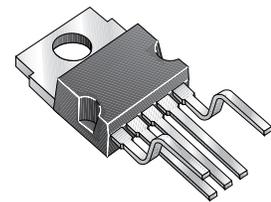


VIPer100 Layout

VIPer100 FEATURES

- ▶ Adjustable switching frequency up to 200KHz;
- ▶ Optimized for current mode control topology;
- ▶ Inherent feedforward compensation;
- ▶ Soft-start and enable function;
- ▶ Overcurrent protection;
- ▶ Overtemperature protection;
- ▶ Overvoltage protection;
- ▶ Undervoltage lock-out with hysteresis;
- ▶ Low stand-by current;
- ▶ Integrated start-up supply;
- ▶ Automatic burst mode operation in stand-by condition;
- ▶ Internally trimmed Zener reference.

V Vertical
I Intelligent
P Power
e Enhanced
r Regulator
100 Maximum output power to the load



ADVANTAGES vs MONOLITHIC SOLUTIONS

The additional advantages of VIPer100 when compared with existing monolithic solution are numerous.

- ▶ The useful duty cycle range extends from 0% to about 90% for VIPer100, versus the 3% to 70% available on the market. The main benefit for users is the possibility to operate in stand-by mode with nearly zero power output.
- ▶ Larger regulation loop bandwidth. VIPer100 provides a specific path for compensation components (COMP pin), offering a maximum of freedom for the users to adjust the regulation bandwidth with good repetitivity.
- ▶ Excellent line regulation due to the current mode control topology.
- ▶ Better regulation point voltage because of the higher value of this voltage when compared with monolithic solutions available on the market. This allows greater precision of the output voltage especially in the case of primary regulation. A better saturation of the output Power MOSFET at high current values is also assured.

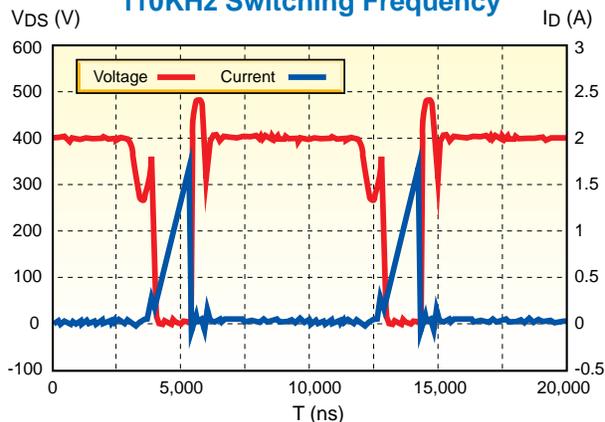
- ▶ Unlike monolithic devices available on the market the package tab is not sensitive to external influences.

ADVANTAGES OF FLYBACK CONVERTERS

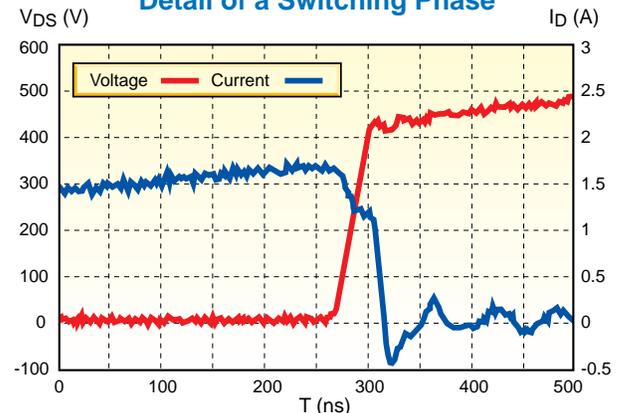
The main advantages of the Flyback Converters operating in the discontinuous inductor current mode are:

- ▶ All outputs will track each other within +/- 5 to 10% without post-regulation. Dynamic cross-regulation is also very good.
- ▶ The flyback transformer used in the discontinuous mode can be much smaller because the inductive energy stored is only 1/5 to 1/10 of the energy required in comparable continuous mode circuits.
- ▶ Load current in the Power MOSFET output stage is zero during turn-on avoiding turn on losses or turn-on snubber circuits, conducted EMI is also reduced.
- ▶ Regulation loop is easy to compensate because of the single pole (resulting in a single capacitor filter).
- ▶ Transient response is excellent.

VIPer100 - 50W Power Output
110KHz Switching Frequency



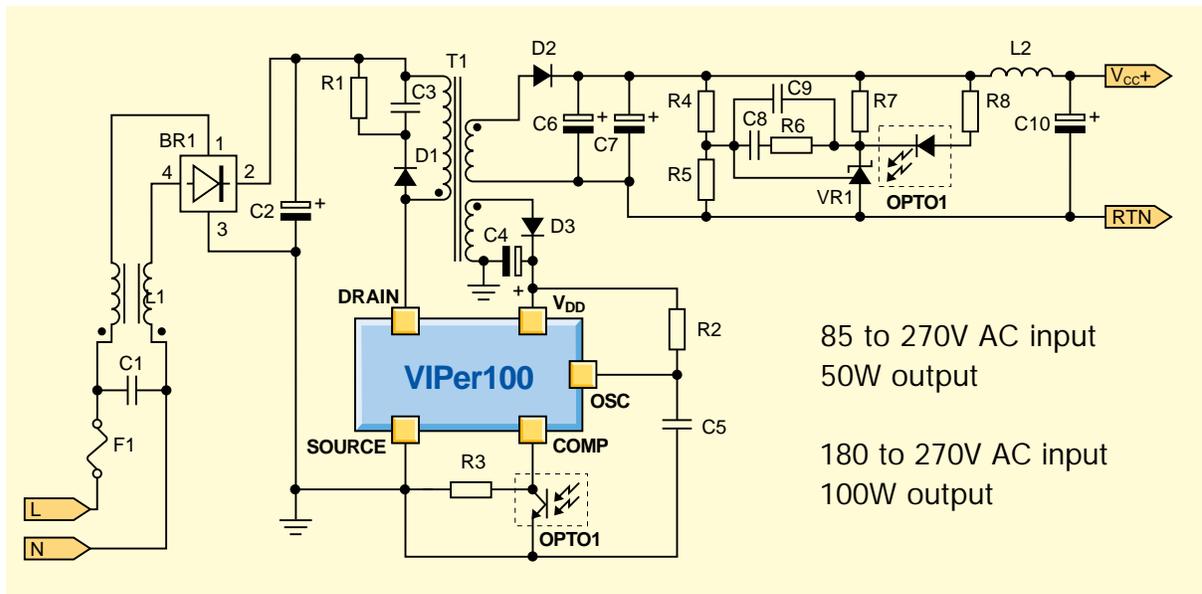
VIPer100 - 50W Power Output
Detail of a Switching Phase



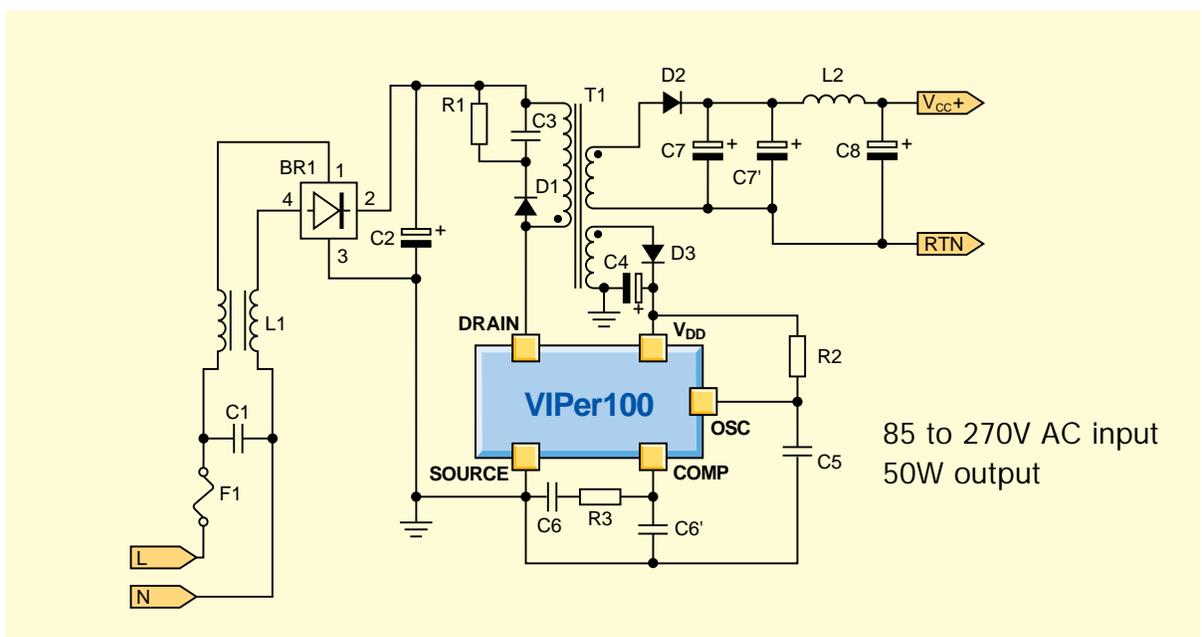
TYPICAL APPLICATION CIRCUITS

Two typical application examples for secondary and primary regulation are shown. Both circuits are current mode

Flyback Converters operating in the discontinuous inductor current mode. For both circuits the switching frequency is equal to 100KHz.



Off-Line Flyback SMPS with secondary regulation



Off-Line Flyback SMPS with primary regulation

VIPer100

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ADVANCED MONOLITHIC SOLUTION FOR OFF-LINE SMPS PRIMARY CONVERTERS

After the announcement of the first silicon of the VIPer100 (see express 54) and the enthusiastic reaction of the market, we can now forecast that the final silicon will be ready for preproduction by Q3'97. The VIPer100A, a new option with a higher V_{DSS} will also be available soon. The new devices provide an unparalleled combination of performance, flexibility and cost-effectiveness, delivering an output power capability of 100W over the European mains voltage range (180 to 270V AC) or 50W for a universal input voltage range (85 to 270V AC), while using more than 50% fewer components than a discrete solution. Key features of the VIPer100/100A include automatic Burst Mode operation in stand-by condition, an integrated start-up supply, excellent line regulation due

to current mode operation, programmable switching frequency (up to 200kHz) and adjustable current limitation (up to 3A). The automatic Burst Mode operation allows the VIPer100/100A to meet the new German "Blue Angel" Eco Norm with less than 1W total power consumption for the system when working in stand-by. The datasheet for VIPer100 family describes the operation and suggests basic ideas and schematics to implement specific functions. In order to evaluate the performance of the VIPer100 ST has developed two demoboard.

Type	V_{DSS}	I_D	$R_{DS(on)}$	Package
VIPer100/SP	600V	3A	2.5 Ω	PowerSO-10
VIPer100A/ASP	670V	3A	3.3 Ω	PENTAWATT

ELECTRONIC DESIGN

Switch-Mode ICs Minimize Off-Line Power-Supply Size p. 53

The Ten Commandments Of Excellent Design p. 33
Networking Equipment And Downtime: Caught In The Middle p. 42
Portable PC CPUs Need Unique Power Supplies p. 64
Ethernet: Technology, Systems, And Network Applications p. 85
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Design Considerations For High-Performance Backplanes p. 133

COVER
ARTICLE

SGS-THOMSON MICROELECTRONICS

VIPer100/SP
VIPer100A/ASP

SMPS PRIMARY I.C.

ADVANCE DATA

TYPE	V_{DSS}	I_D	$R_{DS(on)}$
VIPer100/SP	600V	3 A	2.5 Ω
VIPer100A/ASP	670V	3 A	3.3 Ω

- ADJUSTABLE SWITCHING FREQUENCY UP TO 200KHZ
- CURRENT MODE CONTROL
- SOFT START AND SHUT DOWN CONTROL
- AUTOMATIC BURST MODE OPERATION IN STAND-BY CONDITION ABLE TO MEET "BLUE ANGEL" NORM (<1W TOTAL POWER CONSUMPTION)
- INTERNALLY TRIMMED ZENER REFERENCE
- UNDERVOLTAGE LOCK-OUT WITH HYSTERESIS
- INTEGRATED START-UP SUPPLY
- AVALANCHE RUGGED
- OVERTEMPERATURE PROTECTION
- LOW STAND-BY CURRENT
- ADJUSTABLE CURRENT LIMITATION

DESCRIPTION
VIPer100™/100A combines on the same silicon

chip a state-of-the-art PWM circuit together with an optimized high voltage avalanche rugged Vertical Power MOSFET (600V or 670V / 3A). Typical applications cover off line power supplies with a secondary power capability of 50W in wide range condition and 100W in single range or with doubler configuration. It is compatible from both primary or secondary regulation loop despite using around 50% less components when compared with a discrete solution. Burst mode operation is an additional feature of this device, offering the possibility to operate in stand-by mode without extra components.

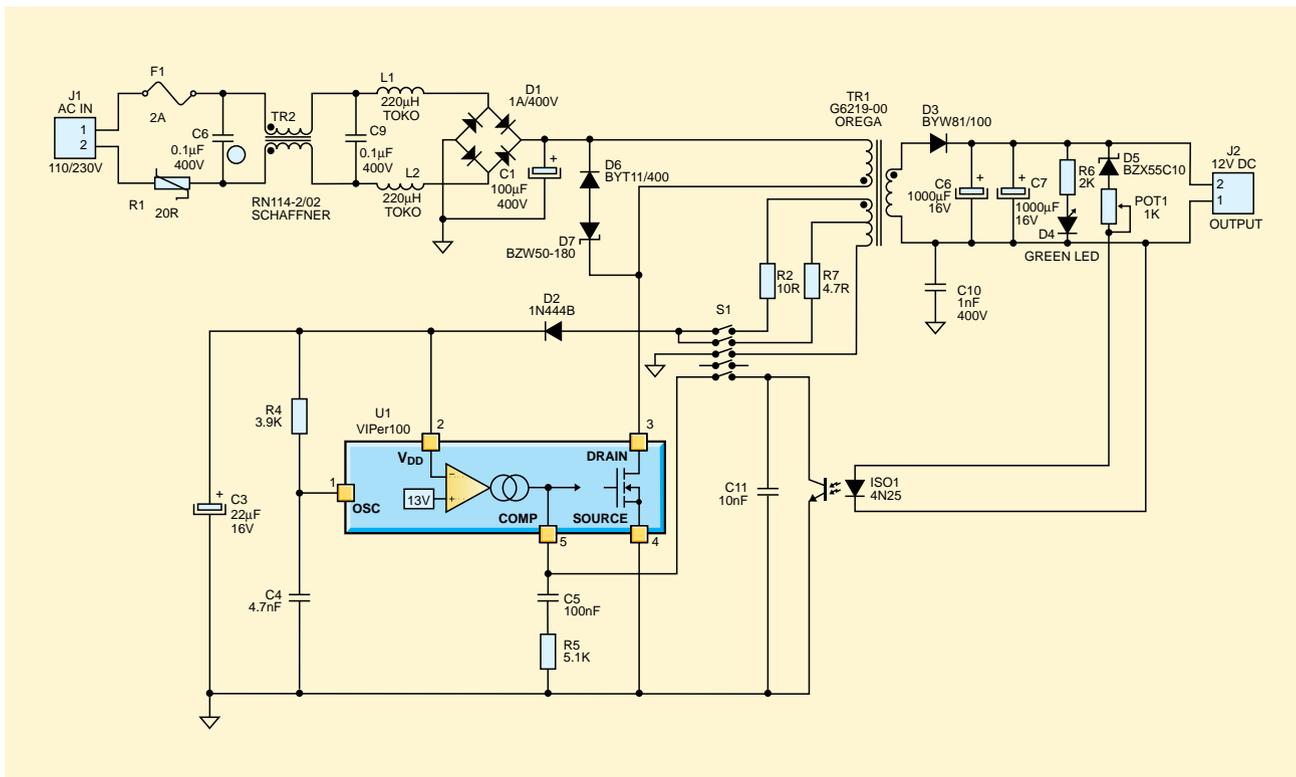
BLOCK DIAGRAM

VIPer100 STANDARD DEMOBOARD

The VIPer100 standard demoboard is a wide voltage range input off-line single switch Flyback, working at 100kHz and allows the user to choose between primary and secondary regulation. Primary regulation is carried out by the auxiliary winding which delivers the low level supply voltage on the V_{DD} pin of the device. Secondary regulation is achieved by an optocoupler directly from secondary output voltage. It acts on the COMP pin, and the auxiliary winding delivers the low level supply voltage at a lower value than when in primary regulation configuration, thanks to R7. The internal error amplifier is consequently saturated in high state, sourcing a constant current of about 0.5mA on the COMP pin. No power limitation has been set on the VIPer device, so the demoboard is able to deliver up to 130W in continuous running (for 5 seconds max). The demoboard withstands the no load condition and is fully protected against



AC input voltage	90-265V AC
Maximum output power	50W
DC output voltage/load	V _{out} = +12V, 4A
Operating frequency	100kHz



VIPer100 DEMOBOARD FOR SET TOP BOX SMPS

The power supply is intended to provide all the voltage used by the set top box board. To guarantee safety conditions, primary and secondary components were implemented in the opposite side of the board. The components TR2, ISO1, and C12 assure the isolation between the primary and secondary circuits, and are subject to safety standards such as VDE and UL. In order to reduce radiated EMI all high current loops have been minimized closing off the associated components one from the other.



Output line	Voltage	Max current
Main and Tuner	+5.0V	2.3A
Tuner	+3.3V	0.2A
Tuner	+28.0V	0.05A
Main	+12.0V	0.5A

