VIPer® design software help

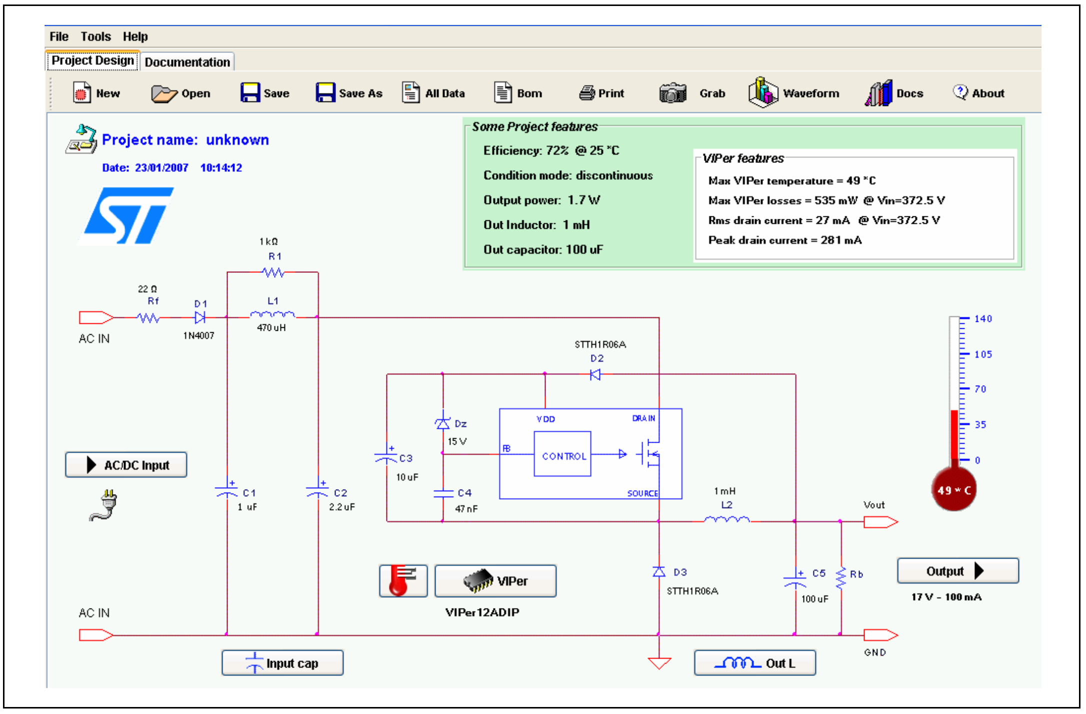
Introduction

This software offers a straightforward step-by-step procedure for designing a non-isolated single output power supply with the VIPer12A-E or VIPer22A-E.

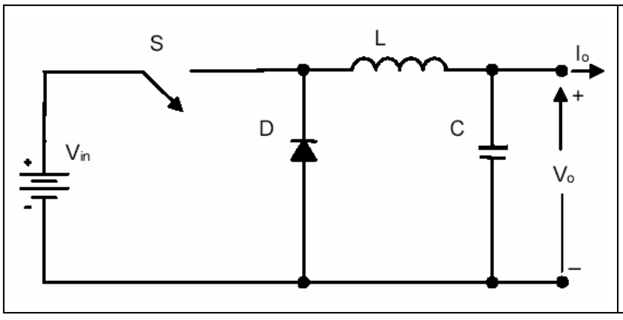
The topologies are:

- buck for positive output voltage;
- buck-boost for negative output voltage.

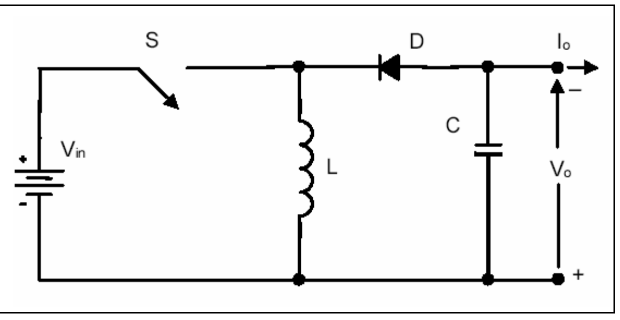
Schematic window



Buck topology



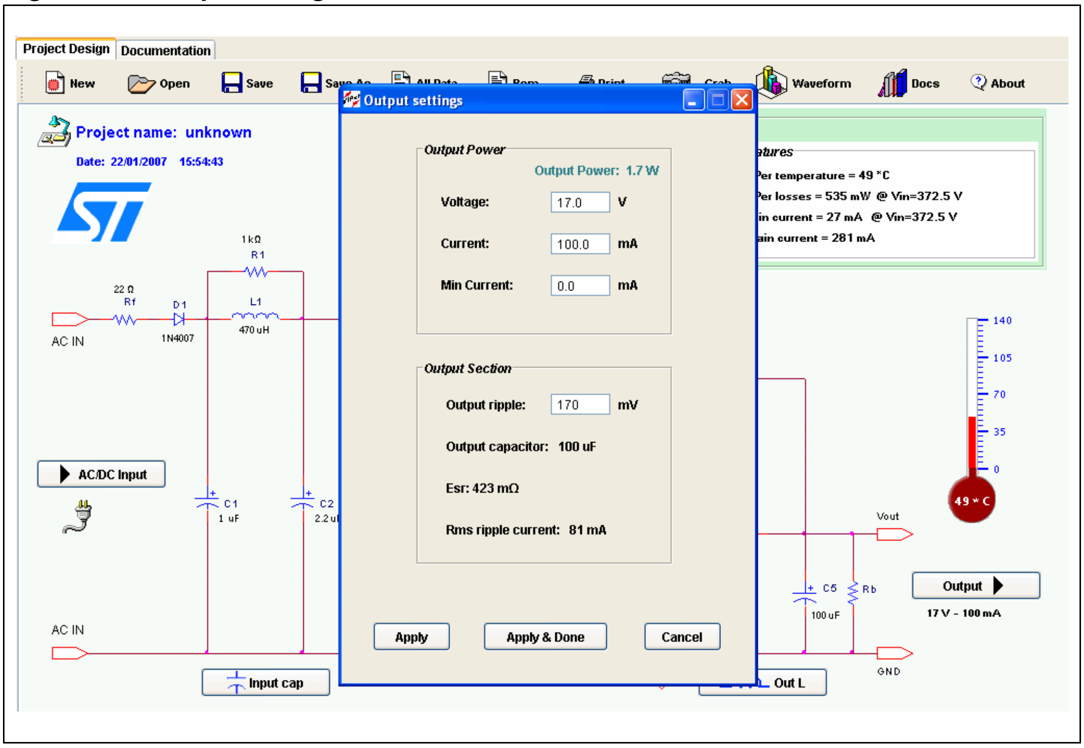
Buck-boost topology



Contents

1 Output voltage selection - step 1

Figure 1. Output voltage window



1.1 Operations

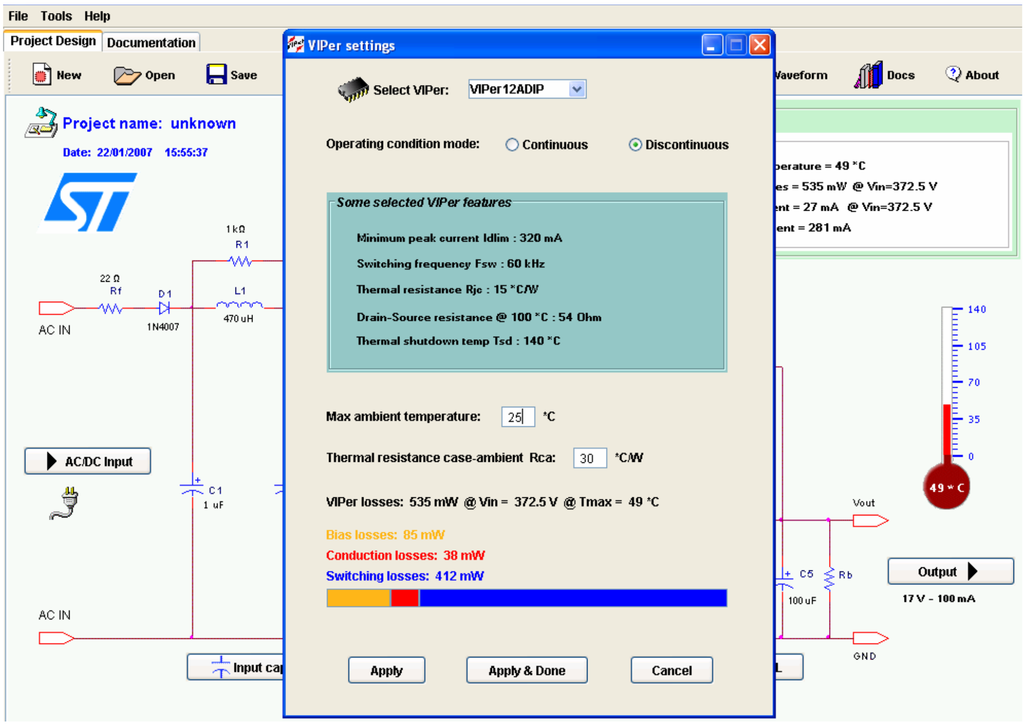
In the output voltage window the user must set:

- output voltage
- output current
- output voltage ripple.

The results are the needed capacitance value and equivalent series resistance (ESR) of the output capacitor.

2 VIPer selection - step 2

Figure 2. VIPer setting window

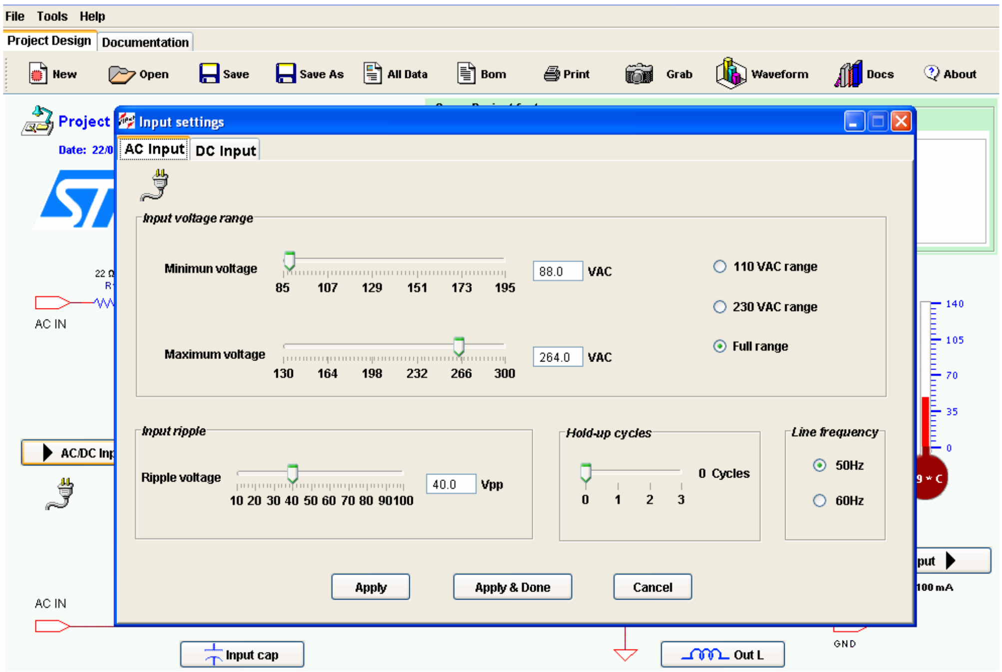


2.1 Operations

1. Device selection: the software automatically selects the device based on the output power.
2. Operating mode: discontinuous mode is set by default but the user can change it to continuous.
3. Maximum ambient temperature: has an impact on power dissipation, thus on the converter's power capability.
4. Case-ambient thermal resistance: the default value can be decreased and power dissipation improved by providing a heat sink.

3 AC/DC input - step 3

Figure 3. Input voltage window

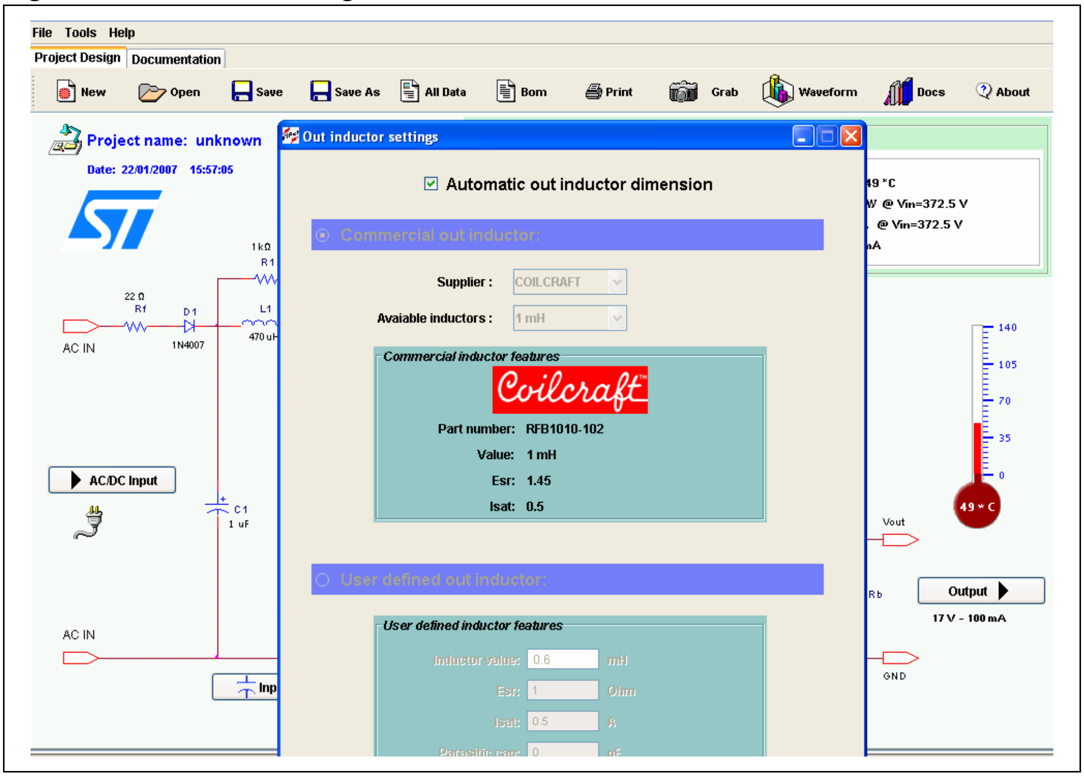


3.1 Operations

1. Input voltage range selection:
   – 110 V range
   – 230 V range
   – Full range
2. Input ripple selection
3. Hold-up cycles selection
4. Line frequency selection: 50 or 60 Hz

4 Output inductance selection - step 4

Figure 4. Inductor setting window



4.1 Operations

In the inductor setting window, the user can change the default inductor by either choosing another inductor in a given database, or directly entering the inductance value, ESR, I_{SAT} and parasitic capacitance of the custom inductor.

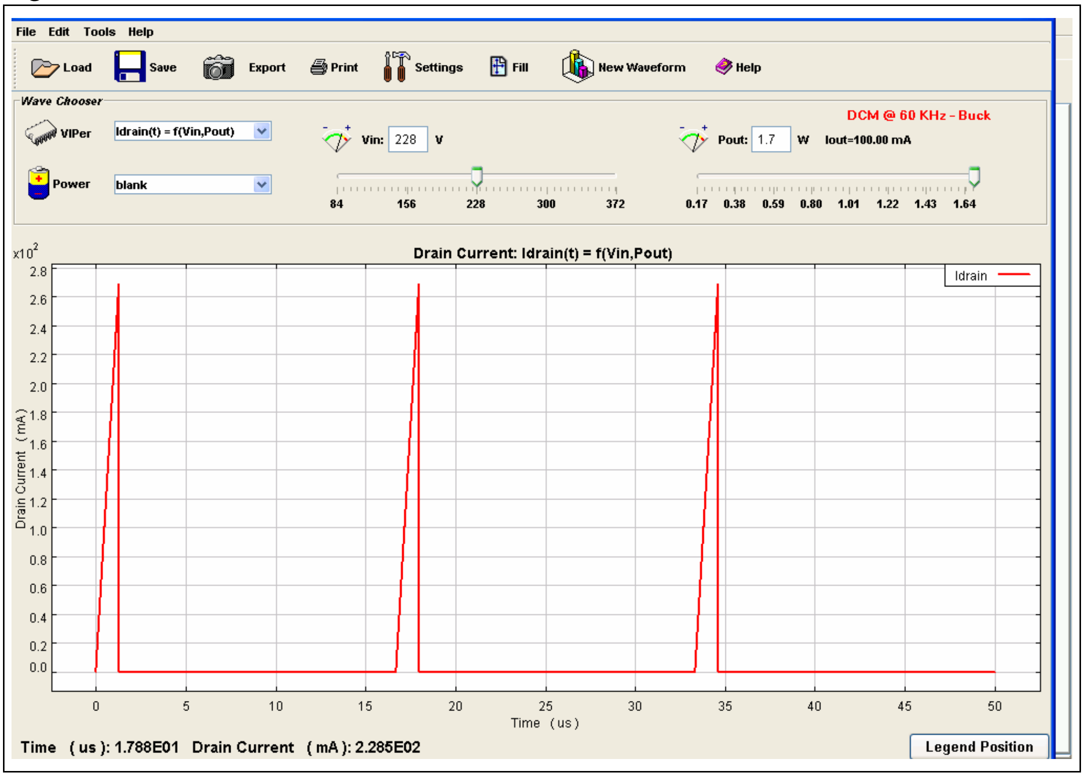
The inductor is used for energy storage, and its selection depends on the output power and on the power switch.

A custom ferrite inductor must be used in case of high output power converters. For low output power converters an axial insulated inductor can be used. The drawback of this low cost solution is the higher series resistance that could affect the efficiency of the converter.

The inductance value determines whether the circuit operates in discontinuous mode or in continuous mode for a given output current.

5 Project result - step 5

Figure 5. Waveform window



5.1 Operations

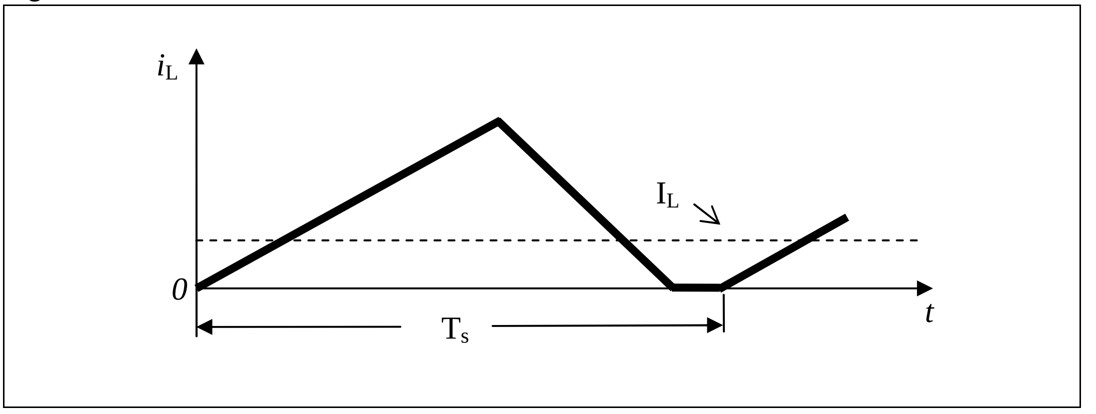
The voltage and current waveforms of the designed converter can be monitored as a function of the input voltage and/or of the output power.

6 Glossary

- Discontinuous Mode (DCM):

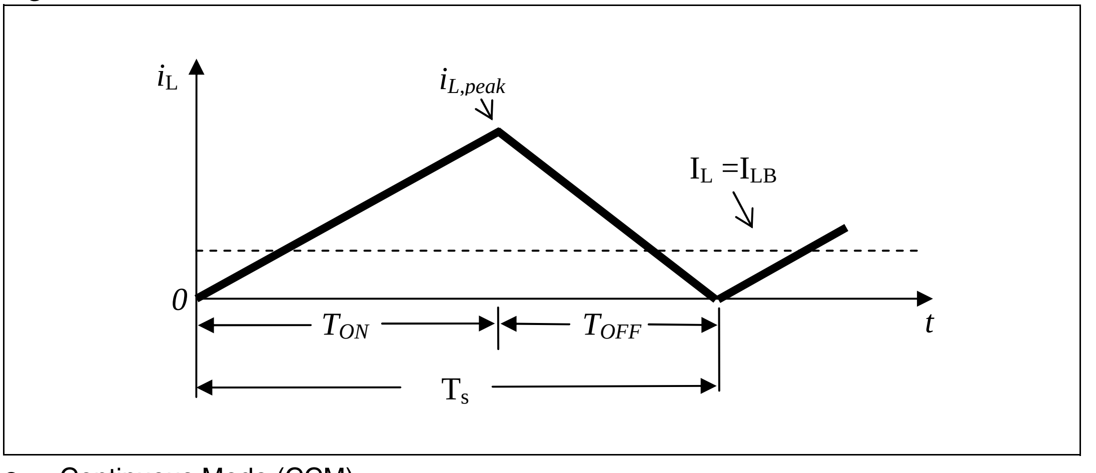
An operating mode in which the current flowing through the inductor goes to zero between two subsequent switching cycles.

Figure 6. Discontinuous mode inductor current



A condition of single zero point in the inductor current is referred to as "boundary" or "transition mode", because a further increase of the output current results in a switch to continuous mode.

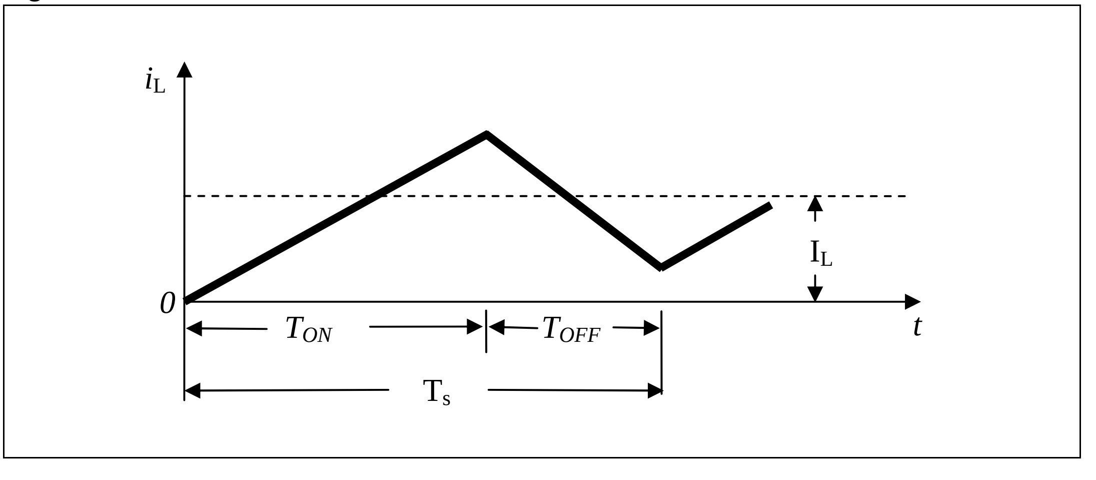
Figure 7. Transition mode



- Continuous Mode (CCM):

An operating mode in which the current flowing through the inductor never goes to zero.

Figure 8. Continuous mode inductor current



Usually DCM is preferred to CCM due to the following characteristics:

- better system stability and closed loop response
- lower switching losses in the switch and free-wheeling diode
- smaller size and lower price of the output inductor

The disadvantages of DCM over CCM are:

- higher peak currents, which increase the stress on the power devices and decrease system reliability;
- lower output current capability (in DCM the max output current is half of the VIPer12A-E or VIPer22A-E peak current.)

For a given output current, the operating mode of the converter moves from CCM to DCM if:

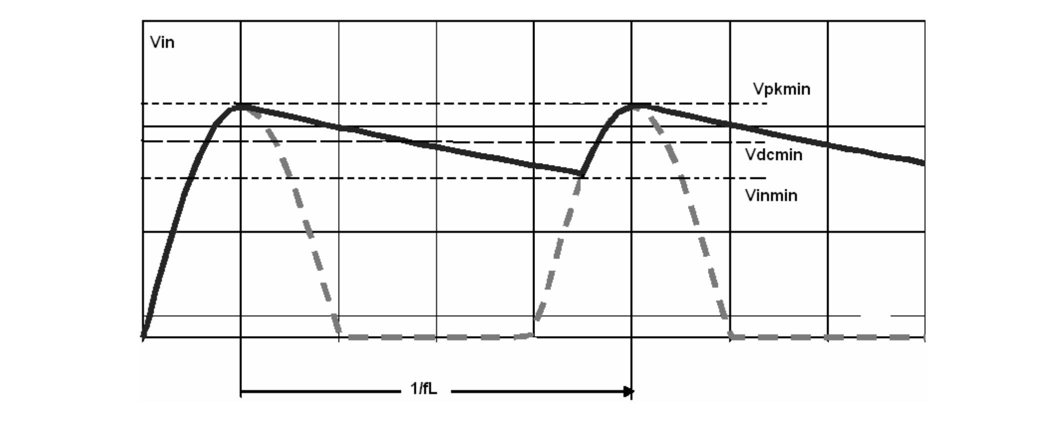
- output inductance value is decreased
- output power is decreased
- input voltage is increased

In order to avoid system instability, the duty cycle must be kept lower than 50% when operating in CCM.

Input ripple:

The input bulk capacitor Cin, along with the input diode rectifier, converts the AC mains voltage at line frequency f_L to an unregulated DC bus, Vin, which is the input voltage for the downstream converter. This voltage features a line frequency ripple superimposed over its DC level, as shown in *Figure 9*:

Figure 9. Input voltage ripple



In order for the converter to operate correctly, the Cin must be large enough to make the ripple very low. An excessively low value of the minimum input voltage could greatly increase the power dissipation because of the high RMS current flowing through the Power MOSFET.

A typical value of the input voltage peak to peak amplitude is 25-30%.

- Hold - up cycles:

The hold up requirement in power supply converters is the capability to regulate the output voltage even when main voltage cycles are missing. This is usually specified in terms of missing cycles (N_H). For example, if N_H = 1, the power converter must be able to sustain the output regulation even if one main voltage cycle is missing. The value of N_H will also have an impact on the size of the input capacitor, which will be much bigger than the case where $N_H = 0$.

If the expected ripple across the Cin is 25-30% after one missing cycle, during normal operation (no cycles missing) the input voltage ripple will be much less.

- Output ripple:

The output ripple is the peak to peak amplitude of the output voltage of the converter. It includes two frequency components: the main line frequency (f_L) and the VIPer switching frequency (f_{SW}).

The output ripple depends on the equivalent series resistor (ESR) of the output capacitor and on the power stage output current

Table 1. VIPer power capability (1)

	VIPer12AS-E	VIPer12ADIP-E	VIPer22AS-E	VIPer22ADIP-E
195-265 Vac	8 W	13 W	12 W	20 W
85-265 Vac	5 W	8 W	7 W	12 W

1. See datasheet for further details

7 Revision history

Table 2. Revision history

Date	Revision	Changes
24-Jan-2007	1	First issue
28-Mar-2007	2	Minor text change