AN2934
Application note

STEVAL-ISA062V1: 6 W, wide-range dual and single output SMPS demonstration board based on the VIPer17

By John Lo Giudice

Introduction

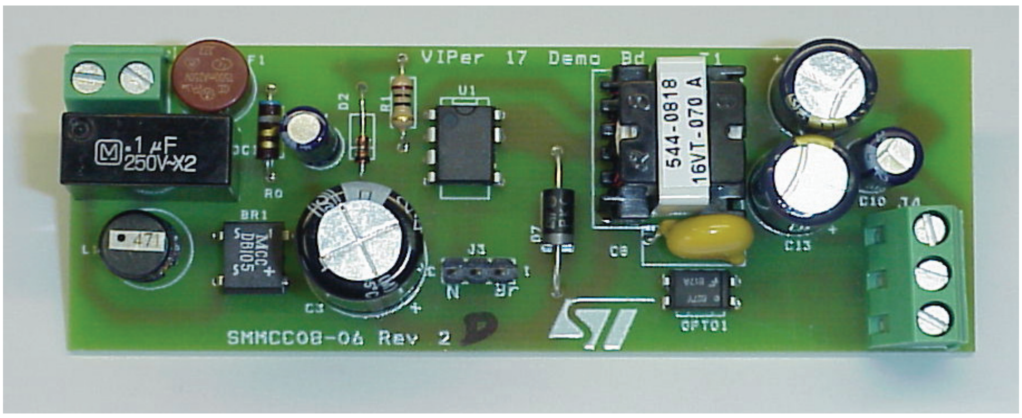
The new VIPer17 device is a converter that offers a PWM controller built in BCD6 technology and an 800 V, avalanche-rugged vertical power section all in one package. The converter is housed in a DIP7 or surface-mount SO-16 narrow package. The device has two fixed switching frequencies: the VIPer17LN switches at 60 kHz and the VIPer17HN at 115 kHz. The device can deliver 6 W from wide-range operation from 85 to 305 Vac. It can also deliver 10 W when operating from the European range of 175 to 264 Vac.

The VIPer17 incorporates the following additional features in high demand from customers.

- Burst mode operation has been improved from earlier VIPers, providing a switching power supply standby wattage as low as 50 mW at no load
- Frequency jittering is implemented to ensure EMI measurements meet today's standards.
- Adjustable overload
- Output short-circuit protection for hard shorts such as transformer saturation or shorted diode
- Adjustable brownout and power surge features
- Output overvoltage protection.

Not all of these additional features are necessary to operate the converter and some may be omitted to reduce part count.

Figure 1. VIPer17 dual output demonstration board



AM03418v1

Contents

List of tables

List of figures

1 Circuit description

The VIPer17 has two switching frequencies: the VIPer17HN switches at 115 kHz and the VIPer17LN at 60 kHz. The choice of frequency is left up to the designer. The "HN" version makes the transformer smaller, whereas the "LN" version makes it easier to optimize EMI. This document focuses on the VIPer17HN, switching at 115 Hz. The following description refers to the circuit shown in *Figure 1*. The board has been designed so that it can be used with either single or double outputs, the only difference being the extra output parts, the transformer and the voltage divider for the feedback loop. For the board's operation, we have taken as example the dual output. The input is connected to the line input, which operates from 85 to 264 Vac. It is fused for safety and has 6.8 ohms ¼ W. A carbon resistor is better for inrush than carbon or metal film. If a surge is required, a 2 to 3 W wire-wound resistor should be used to pass the 6 kV ring wave test. C1 is a 0.1 µf X capacitor and L1 forms an EMI filter to reduce line-conducted emissions. BR1 is a bridge rectifier and the C3 filter is the input line to a DC level.

The topology used is of a discontinuous flyback type with an isolated output. The regulation comes from the output (as opposed to a stable TL431, which uses an optocoupler for isolation) to feed the information back to the VIPer17HN.

Table 1. Dual output board specifications

Parameter	Limits
Input voltage range	85 Vac to 264 Vac
Input frequency	47 Hz to 63 Hz
Temperature range	0° to 85° Celsius, 105°C possible
Output voltage and current # 1	5 V at 0.5 A
Output voltage and current # 2	12 V at 0.25 A
Load and cross regulation #1	+/-1%
Load and cross regulation #2	+/-10%
Output power	5.5 W
Line regulation	+/- 0.2%
Efficiency	80% typical at 12 V output
Safety	Overvoltage, overcurrent, brownout
EMI	EN55022 Class "B"

Table 2. Single output board specifications

Parameter	Limits
Output voltage and current	12 V at 0.5 A, 6 W
Load regulation	+/- 1%

2 Schematics

Figure 2. Schematic for dual output

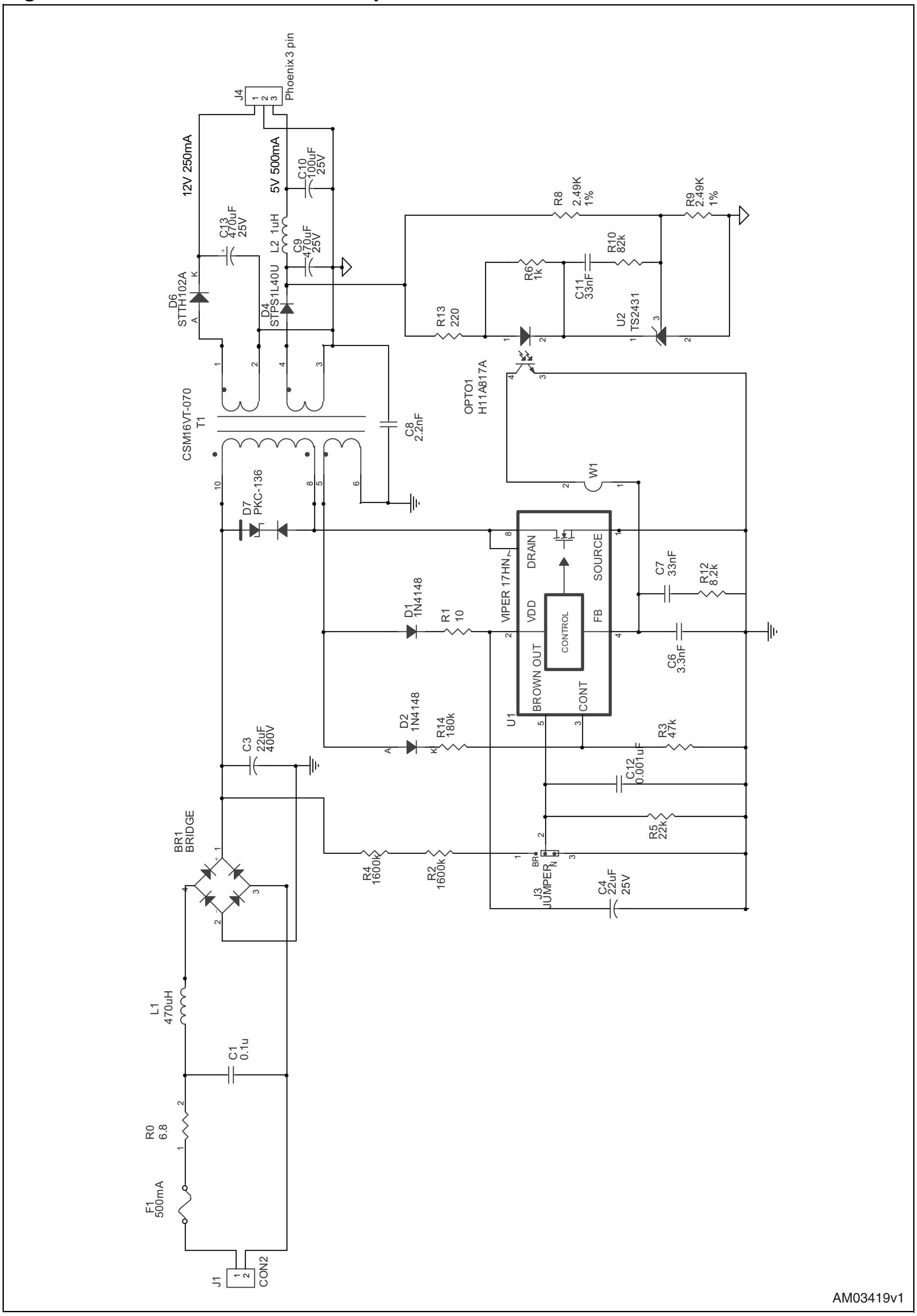
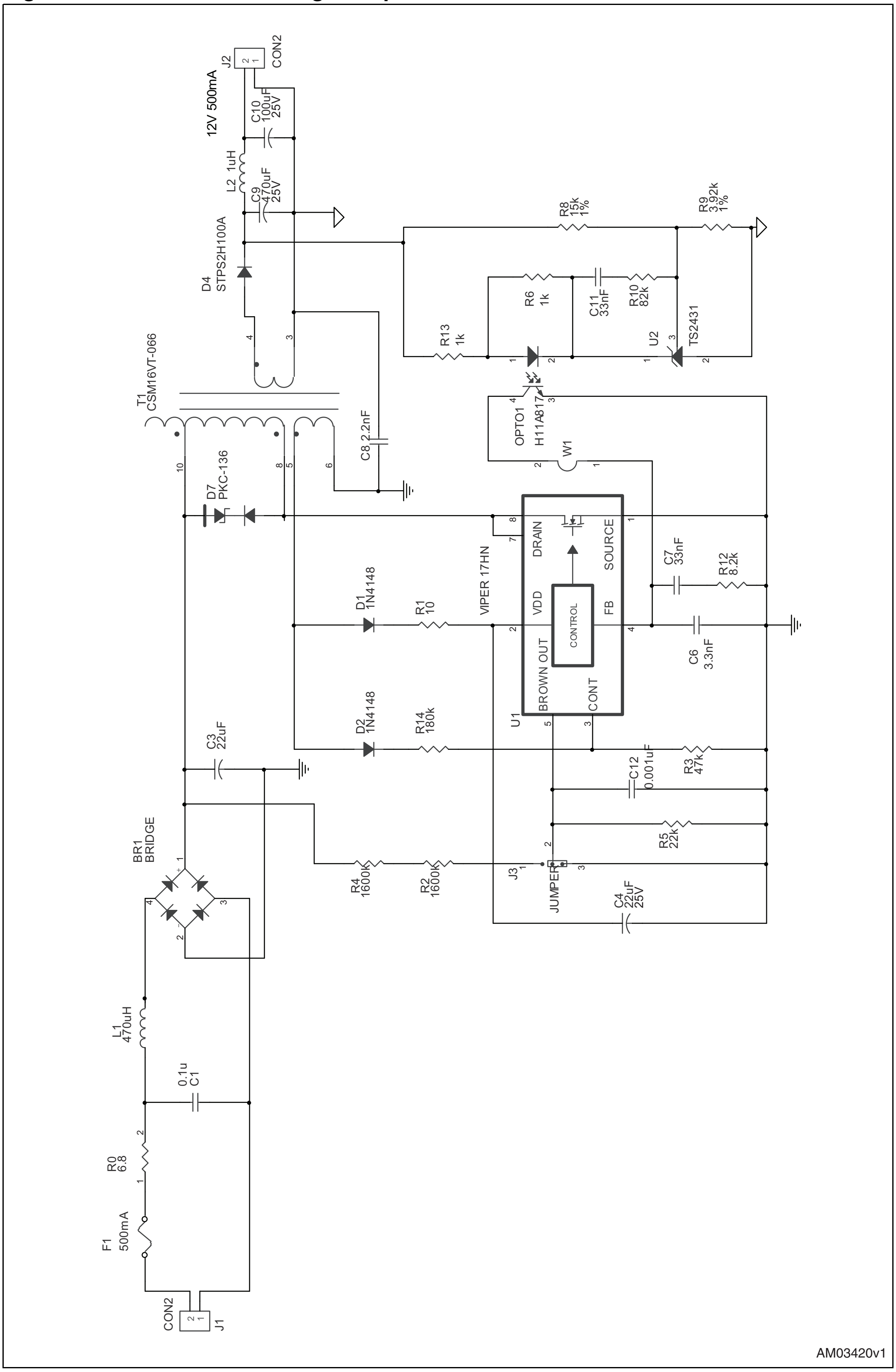


Figure 3. Schematic for single output



3 Bill of materials

Table 3. Bill of materials for dual output, 5 V at 0.5 A and 12 V at 0.25 A

Ref.	Part	Volt/Watt	Description	CAT #
BR1	BRIDGE			
C1	0.1 µ			P4610
C3	22 µF	400 V	105C	CompoStar LTech TYD2DM220J20O
C4	22 µF	25 V	GP	Panasonic EET-HC2G561DA
C6	3.3 nF		SM 0805	
C7	33 nF		SM 0805	
C8	2.2 nF		Y1	Panasonic ECK-ANA222ME
C9	470 µF	25 V	Low ESR	Panasonic EEU-FC1E471
C10	100 µF	25 V	GP	Panasonic EEU-FC1E101S
C11	33 nF	50 V	SM 0805	
C12	0.001 µF	50 V	SM 0805	
C13	470 µF	25 V		Panasonic EEU-FC1E471
D1	1N4148	100 V	SOD 123	Diodes Inc 1N4148W-7
D2	1N4148	100 V	TH	1N4148
D4	STPS1L40U			STMicroelectronics
D6	STTH102A			STMicroelectronics
D7	PKC-136			STMicroelectronics
F1	500 mA			Wickmann USA Inc 37204000411
J1	CON2		2 position	Phoenix contact 1729018
J3	JUMPER		3 pins	
J4	Phoenix 3 pin		3 position	Phoenix contact 1729021
L1	470 µH			
L2	1 µH			Coil Craft ME3220-102ML or Ice Components LO32-1R0-RM
OPTO1	H11A817A			H11A817A
R0	6.8 Ω		1/4 W carbon comp	OD68GJ
R1	10 Ω	5%	1/4 W	
R2	1600 kΩ		SM 0805	
R3	47 kΩ		SM 0805	
R4	1600 kΩ		SM 0805	
R5	22 kΩ		SM 0805	
R6	1 kΩ		SM 0805	

Table 3. Bill of materials for dual output, 5 V at 0.5 A and 12 V at 0.25 A (continued)

Ref.	Part	Volt/Watt	Description	CAT #
R8	2.49 kΩ	1%	SM 0805	
R9	2.49 kΩ	1%	SM 0805	
R10	82 kΩ		SM 0805	
R12	8.2 kΩ		SM 0805	
R13	220 Ω		SM 0805	
R14	180 kΩ		SM 0805	
T1	CSM16VT-070			Cramer Coil VSM16VT-070
U1	VIPer17HN			STMicroelectronics
U2	TS2431			STMicroelectronics
W1	Val		0805 jumper	
P3	Shorting strap			Sullins STC02SYAN

Table 4. Bill of materials for single output, 12 V at 0.5 A

Ref	Part	Volt/Watt	Description	CAT #
BR1	Bridge			
C1	0.1 µ			P4610
C3	22 µF	400 V	105C	CompoStar LTech TYD2DM220J20o
C4	22 µF	25 V	GP	Panasonic EET-HC2G561Da
C6	3.3 nF		SM 0805	
C7	33 nF		SM0805	
C8	2.2 nF		Y1	Panasonic ECK-ANA222ME
C9	470 µF	25 V	Low ESR	Panasonic EEU-FC1E471
C10	100 µF	25 V	GP	Panasonic EEU-FC1E101S
C11	33 nF	50 V	SM 0805	
C12	0.001 µF	50 V	SM 0805	
D1	1N4148	100 V	SOD123	Diodes Inc 1N4148W-7
D2	1N4148	100 V	TH	Fairchild 1N4148
D4	STPS2H100APKC-136			STMicroelectronics
D7	500 mA			STMicroelectronics
F1	CON2			Wickmann USA Inc 372040004411
J1	CON2		2 position	Phoenix contact 1729018
J2	Jumper		2 position	Phoenix contact 1729018
J3	470 µH			
L1	470 µH			

Table 4. Bill of materials for single output, 12 V at 0.5 A (continued)

Ref	Part	Volt/Watt	Description	CAT #
L2	1 µH			Coil Craft ME3220-102ML or Ice components LO32-1R0-RM
OPTO1	H11A817			H11817A
R0	6.8 Ω		1/4 W carbon comp	OD68GJ
R1	10 Ω	5%	1/4 W	
R2	1600 kΩ		SM 0805	
R3	47 kΩ		SM 0805	
R4	1600 kΩ		SM 0805	
R5	22 kΩ		SM 0805	
R6	1 kΩ		SM 0805	
R8	15 kΩ	1%	SM 0805	
R9	3.92 kΩ	1%	SM 0805	
R10	82 kΩ		SM 0805	
R12	8.2 kΩ		SM 0805	
R13	1 kΩ		SM 0805	
R14	180 kΩ		SM 0805	
T1	CSM16VT-081			Cramer coil CSM16VT-081
U1	VIPer17HN			STMicroelectronics
U2	TS2431			STMicroelectronics
W1	Val		0805 jumper	
P3	Shorting strap			Sullins STC02SYAN

The same PC board is used for both dual and single output by deleting the second output components and changing the transformer as described in *Table 5*.

Table 5. Bill of material changes for single output of 12 V at 0.5 A from dual output(1)

Item	Ref.	Part	Volt/Watt	Description	CAT #
Omit	C13	470 µF	25 V		Panasonic EEU-FC1E471
Omit	D6	STTH102A			STMicroelectronics
Omit	T1	CSM16VT-081			Cramer coil CSM16VT-081
Change	D4	STPS2H100A			STMicroelectronics
Change	J4	Phoenix 2 pin		2 position	Phoenix contact 1729018
Change	R13	1 kΩ		SM 0805	
Change	R8	15 kΩ	1%	SM 0805	
Change	R9	3.92 kΩ	1%	SM 0805	

1. Parts changed to make a single output power supply of 12 V at 0.5 A.

Table 6. Bill of material changes for single output of 5 V at 1 A from dual output(1)

Item	Ref.	Part	Volt/Watt	Description	CAT #
Omit	C13	470 µF	25 V		Panasonic EEU-FC1E471
Omit	D6	STTH102A			STMicroelectronics
Change	T1	CSM16VT-084			Cramer coil CSM16VT-084
Change	D4	STPS3L60U			STMicroelectronics
Change	C9	820 µF	25 V		Panasonic EEU-FC1E821
Change	J4	Phoenix 2 pin		2 position	Phoenix contact 1729018
Change	R13	390 Ω		SM 0805	
Change	R8	3.92 kΩ	1%	SM 0805	
Change	R9	3.92 kΩ	1%	SM 0805	

1. Parts changed to make a single output power supply of 5 V at 1 A.

The VIPer17HN has several extra features that can be implemented if needed.

4 Pins and their functions

4.1 Brownout and power surge features

The VIPer17HN has a dedicated pin–called the BR pin– for the brownout and power surge features. This pin (pin 5) has its comparator set for a 0.45 V input. The unit’s shutdown and start-up can be set to the desired line voltages by attaching a resistor divider from the bulk to this pin. If this feature is not required, the pin can be grounded. The J3 jumper is used for this purpose. When the jumper is installed on the left-two pins marked "N", the brownout is grounded or defeated. With the unit set to half the output power, it shuts down at 32 Vac and restarts at 53 Vac. When the jumper is installed on the right-two pins marked "BR", the brownout feature is active and the unit shuts down at 60 Vac and restarts at 70 Vac.

In today's appliances, such as washing machines, dryers, dishwashers and the like, mechanical timers have been replaced with electronics. When the AC line drops for a short duration, the appliance must ride through its cycle without going back to the beginning. If the AC line drops for a longer period, information about where the appliance is in the cycle must be saved. When the AC line comes back, the appliance has to continue from where it left off and not start over again. This is known as the "hold-up time".

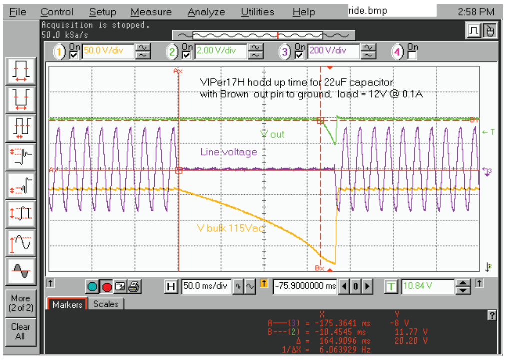
Ride-through is defined as the input line voltage dropping for a number of cycles and the unit under test continuing to operate correctly without the microprocessor being reset. Typically, tests are done at a nominal 115 Vac. The line is sensed and when missing pulses are detected, the unit starts shedding loads, saves the settings and tries to "ride through" the line dropout. If the input line does not come back in time, the power supply has to maintain an output voltage until all the information has been saved. When the line does come back, the cycle starts again from where it left off instead of from the beginning. Since $E=½\ C(V^2_{start}-V^2_{end})$, most of the energy comes from the V^2 of the input capacitor (C3). The delta from the starting input voltage to the point where the PWM stops is the time the unit runs for. The brownout pin turns off the unit at a certain voltage, reducing stress on the components but affecting the hold-up time. C12 may be increased to delay the turn-off, forming an RC time constant and therefore achieving a good hold-up, but turning off the unit if the voltage dwells at a low line. The customer must evaluate the stresses on the components with regard to the hold-up required.

The plots in *Figure 4* and *Figure 5* show the difference between the two settings of J3 on the single reference board. The strap can be set to ground (N) or to (BR) with brownout active. With the strap in the (N) position, the input capacitor can discharge to ~45 Vdc before a glitch becomes noticeable on the main output. With the strap in the (BR) position, the brownout is active and stops the PWM from switching when the voltage on the input capacitor reaches a predetermined voltage set by the brownout divider. Vout is equal to 0.45 Vdc.

Equation 1

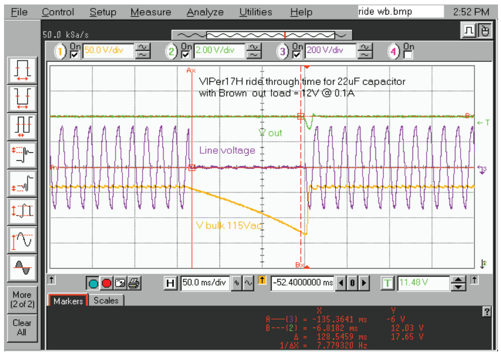
$$Vin = \frac{Vout(R1 + R2)}{R2}$$

Figure 4. 165 ms ride-through



AM03421v1

Figure 5. 128 ms ride-through



AM03422v1

Both figures show a ride-through from 115 Vac at a12 V/100 mA constant current load. *Figure 4* shows that the bulk voltage (yellow trace) can reach 45 Vdc before a glitch becomes visible on the output (green trace). With the brownout pin active, we can see a definite pulse shutdown at ~70 Vdc. The purple trace is the AC line. Note that one contradicts the other: the higher the difference of input voltage, the longer the hold-up or ride-through.

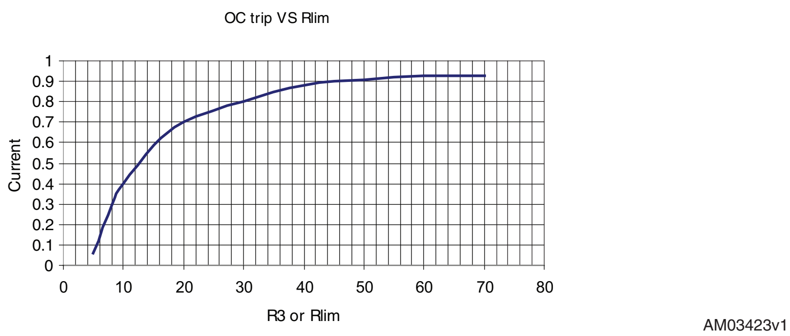
4.2 CONT pin

The CONT pin has multiple purposes. One of them is to reduce the output current or power. A resistor can be set from this pin to ground to reduce the pulse-by-pulse current limit according to *Figure 16 "Current limit vs. Rlim"* in the VIPER17 datasheet[a]. This is useful when lower power is needed and a smaller transformer is used as it prevents saturation of the transformer. The results of this function can be seen in *Figure 6*. The function itself can be activated by changing R3 on the VIPer17HN reference board. A second-level protection, which latches the device if exceeded, ensures safety in the case of transformer or diode shorts. If the VIPer17 detects a current pulse of 600 mA, it considers it to be a disturbance; if it detects this disturbance two consecutive times, it interprets it as a hard short and shuts down.

Another purpose of the CONT pin is overvoltage monitoring. A voltage over 3 V shuts down the IC, reducing power consumption, which is useful for overvoltage sensing or if there is an open component in the feedback loop caused by faulty soldering. This monitoring function has been tested by paralleling a resistor with R9 to raise the output voltage. The unit went into a "hiccup" mode at an output voltage of 18 V. The voltage limit can be adjusted as needed by changing R14.

a. Refer to the datasheet *VIPER17: Off-line high voltage converters* available on www.st.com.

Figure 6. Overload setpoint at 115 Vac



4.3 V_{DD} pin

The V_{DD} pin is connected to an electrolytic capacitor that is charged during start-up by an internal constant-current source inside the VIPer17HN. This pin is only enabled if the input voltage is higher than 80 Vdc at the drain of the device. It is fixed and not dependent on the brownout section. Once V_{DD} reaches the start threshold of 15 V maximum, the VIPer17HN shuts off the current source and starts switching. The charge current at start-up is 3 mA. If a fault is detected, the charge current is reduced to 0.6 mA to obtain a slow duty cycle during the restart phase and prevent overheating. The MOSFET is an 800 V minimum, avalanche-rugged N channel with a typical $R_{DS(on)}$ of 20 Ω at 25°C. The VIPer17HN also has a soft-start feature that progressively raises the drain current limitation to the maximum value as shown in *Figure 19*. In this way, stresses on other components are considerably reduced.

4.4 Feedback pin

The feedback pin is the control input for duty cycle control. A voltage below 0.5 V activates the burst mode operation. The upper level of 3.3 V borders on the cycle-by-cycle overcurrent setpoint. For isolation this pin can be controlled by an optocoupler. The feedback point is tied to 12 V in the single output reference design and to 5 V in the dual reference design. It is normally tied before L2 to avoid a phase shift.

5 Experimental results

This section focuses on a power supply tested at 25° Celsius. The results are given as typical of the unit and may vary from unit to unit.

5.1 Regulation

Regulation has been tested from 10% to 100%. Efficiency and ripple have been tested at full load.

Two transformers were experimented: one with a single primary and a wired shield and the other with a split primary and no shield. The shield minimizes line-conducted noise more than the solution without the shield by some additional 5 dB, but the drawback of the shielded transformer is dissipation and less efficiency.

Table 7. Regulation for dual output: with shield

Vin	5 V load	12 V load	5 V	12 V	W in	Efficiency	Vdd
85 Vac	0.05	0.025	5.02	12.33	0.81		12.22
85 Vac	0.05	0.25	5.01	11.58	4.09		11.96
85 Vac	0.5	0.025	4.97	13.83	3.76		13.56
85 Vac	0.5	0.25	4.99	12.4	7.07	79.1%	12.75
264 Vac	0.5	0.25	4.99	12.4	7.42	75.4%	12.74
Minimum			4.97	11.58			11.96
Maximum			5.02	13.83			13.56
Delta			0.05	2.25			1.6
Line regulation			0.0%	0.0%			0.1%
+/-% load/cross regulation			0.5%	9.1%			6.3%
Ripple	mv pp		10	61			
Input wattage at no load at 115 Vac in mW					61		
Short-circuit			Ok	Ok			

Table 8. Regulation for dual output: without shield(1)

Vin	5 V load	12 V load	5 V	12 V	W in	Efficiency	Vdd
85 Vac	0.05	0.025	5.02	12.47	0.72		13.08
85 Vac	0.05	0.25	5.02	11.93	3.81		16.12
85 Vac	0.5	0.025	5	14.26	3.53		16.72
85 Vac	0.5	0.25	4.99	12.56	6.95	81.1%	17.29
264 Vac	0.5	0.25	4.99	12.55	6.94	81.2%	16.75
Minimum			4.99	11.93			13.08
Maximum			5.02	14.26			17.29

Table 8. **Regulation for dual output: without shield(1) (continued)**

Vin	5 V load	12 V load	5 V	12 V	W in	Efficiency	Vdd
Delta			0.03	2.33			4.21
Line regulation			0.0%	0.1%			3.3%
+/-% load/cross regulation			0.3%	9.3%			12.2%
Ripple	mv pp		25	75			
Input wattage at no load at 115 Vac in mW						42	
Short-circuit			Ok	Ok			

1. Unit #1, CSM16VT-082 split primary, no shield.

For the dual output board, the second output relies on the main output for regulation. 10% regulation is typical for load and cross regulation for a swing of 10% to 100% of the output's maximum load. The ripple on the first output is very low because of the pie filter (L2, C10) that eliminates the switching ripple and the spikes.

Table 9. **Regulation for single output: with shield and single primary(1)**

Vin	A at 12 V	12 Vout	W in	I in	Efficiency	Vdd
85 Vac	0.05	12.01	0.87			11.93
85 Vac	0.5	11.98	7.38		81.2%	12.27
264 Vac	0.05	12.01	1.24			11.99
264 Vac	0.5	11.98	7.91		75.7%	12.26
Minimum		11.98				11.99
Maximum		12.01				12.27
Delta		0.03				0.28
Line regulation		0.00%				0.08%
+/-% load/cross regulation		0.12%				1.17%
Ripple in mV pp at 115					22	
Input at no load at 115 Vac in mW					82	
Short-circuit		Ok				

1. VIPer17HN unit #1 green with CSM16VT-066E with shield.

Table 10. **Regulation for single output: without shield and single primary(1)**

Vin	A at 12 V	12 Vout	W in	I in	Efficiency	Vdd
85 Vac	0.05	12.00	0.787			11.91
85 Vac	0.5	11.97	7.37		81.2%	12.27
264 Vac	0.05	12.00	0.907			11.93
264 Vac	0.5	11.97	7.31		81.9%	12.28
Minimum		11.97				11.93
Maximum		12.00				12.28
Delta		0.03				0.35

Table 10. Regulation for single output: without shield and single primary[1] (continued)

Vin	A at 12 V	12 Vout	W in	I in	Efficiency	Vdd
Line regulation		0.00%				0.08%
+/-% load/cross regulation		0.12%				1.47%
Ripple in mV pp at 115					25	
Input at no load at 115 Vac in mW					86	
Short-circuit		Ok				

1. VIPer17HN unit #1 with single primary, no shield CSM16VT-081.

As shown in the above tables for the double and single outputs, line and load regulation are excellent. The shield helps to protect the device from EMI, as shown in *Figure 15*, but at the expense of efficiency due to the extra wattage in the transformer's energy dissipated as a result of the coupling between the primary and the shield at high lines.

5.2 Transformers

Figure 7. Transformers for dual output

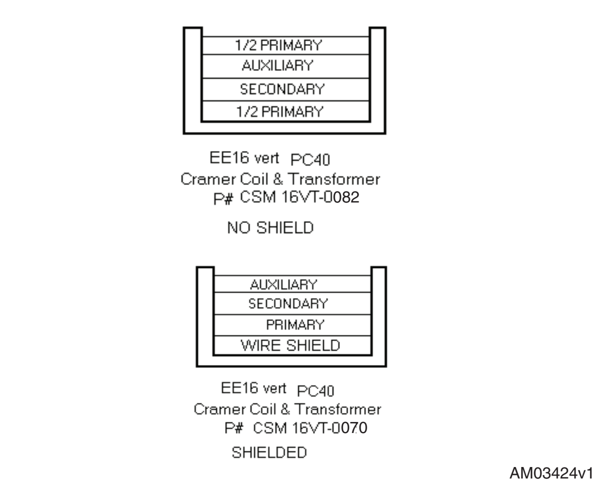


Figure 8. Transformers for single output

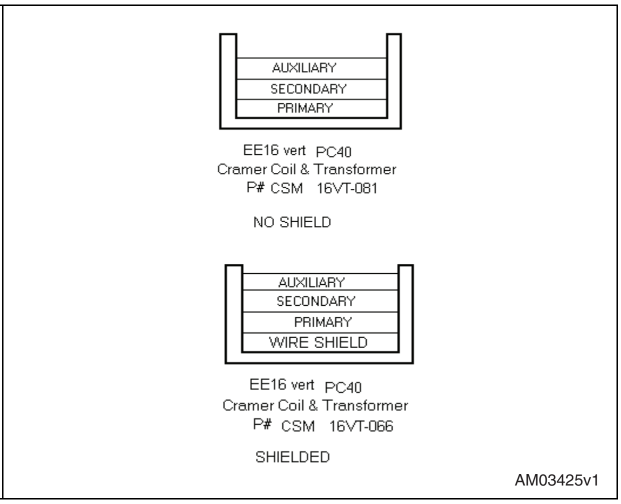


Figure 9. Transformer specifications

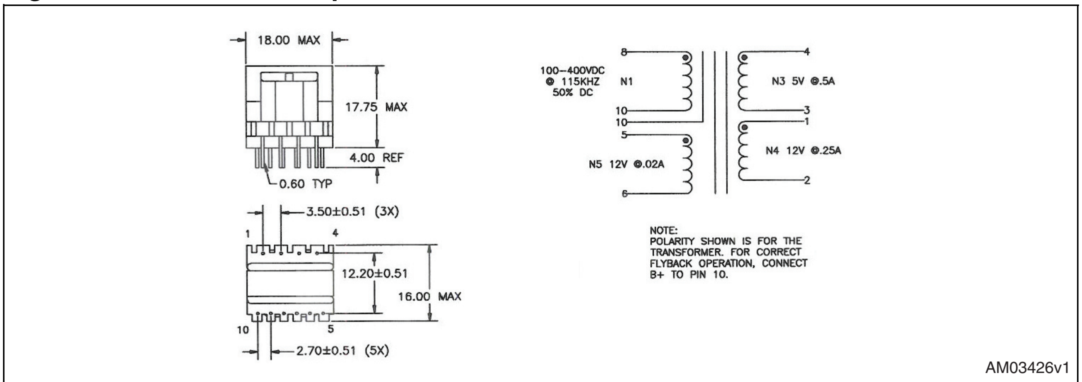


Table 11. Transformer parameters

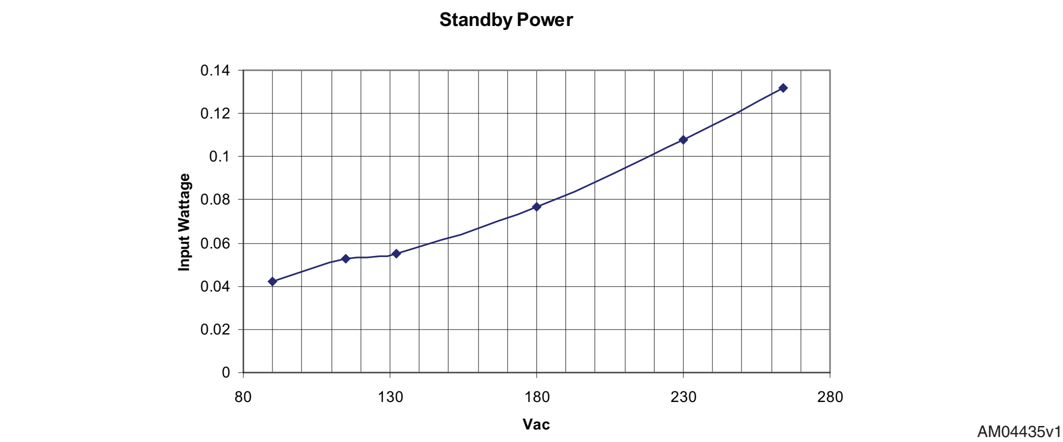
Part #	Winding	Pins	Primary inductance	Number of turns	Wire type
Dual output (5 V and 12 V), shield, single primary					
CSM 16VT-070	Shield	NC-10		40	34 awg
	Primary	8-10	1.36 mH +/-10%	95	34 awg
	5 V	4-3		5	0.45 mm triple-insulated
	12 V	1-2		12	0.25 mm triple-insulated
	Vdd	5-6		12	34 awg
Dual output (5 V and 12 V), no shield, split primary					
CSM 16VT-082	Primary	8-10	1.36 mH +/-10%	95	34 awg
	5 V	4-3		5	0.45 mm triple-insulated
	12 V	1-2		12	0.25 mm triple-insulated
	Vdd	5-6		12	34 awg
12 V single output, shield, single primary					
CSM 16VT-066	Shield	NC-10		40	34 awg
	Primary	8-10	1.36 mH +/-10%	95	34 awg
	12 V	4-3		12	0.32 mm triple-insulated
	Vdd	5-6		12	34 awg
12 V single output, no shield, single primary					
CSM 16VT-081	Primary	8-10	1.36 mH +/-10%	95	34 awg
	12 V	4-3		12	2 x 0.32 mm triple-insulated
	Vdd	5-6		12	34 awg
5 V single output, no shield, single primary					
CSM 16VT-084	Primary	8-10	1.36 mH +/-10%	95	34 awg
	5 V	4-3		5	2 x 0.32 mm triple-insulated
	Vdd	5-6		12	34 awg

Note: Core material is TDK PC40 or equivalent. High potential is 4000 Vac for 1 second. Operating frequency is 115 kHz.

5.3 Standby and efficiency

Figure 10 shows the board's standby power. If designing the board with low consumption in mind, a higher impedance should be used for R8, R9 and R13.

Figure 10. Standby power



The board's efficiency with respect to the line voltage and load has also been measured and is shown in *Figure 11* and *Figure 12*.

Figure 11. Efficiency vs Vin

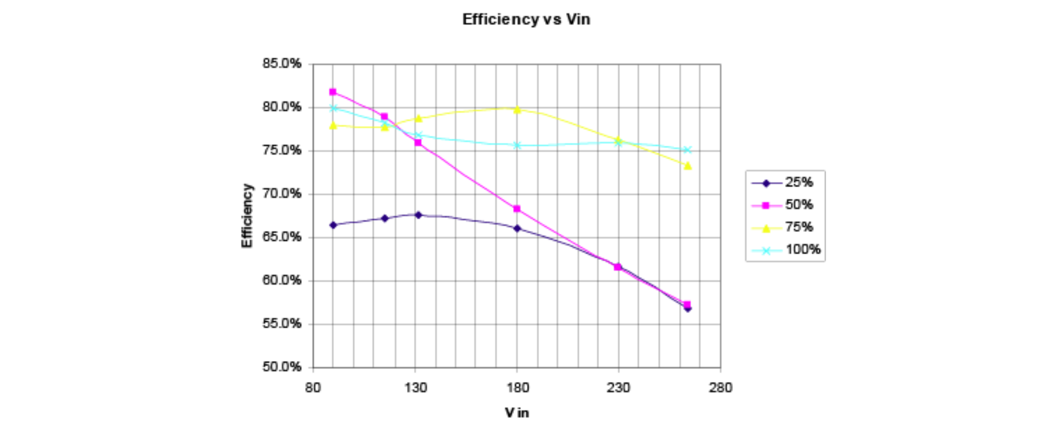
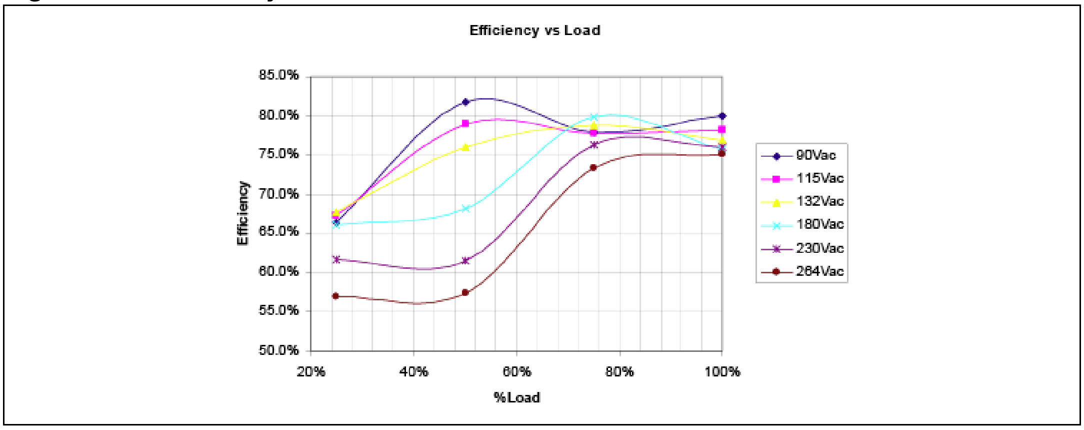
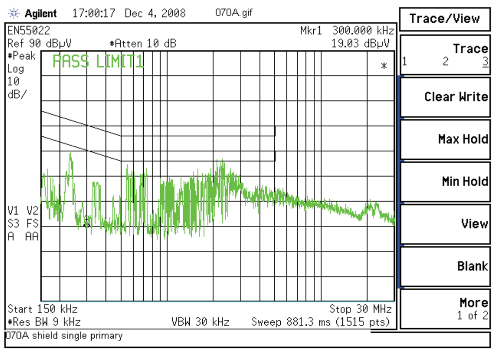


Figure 12. Efficiency vs load



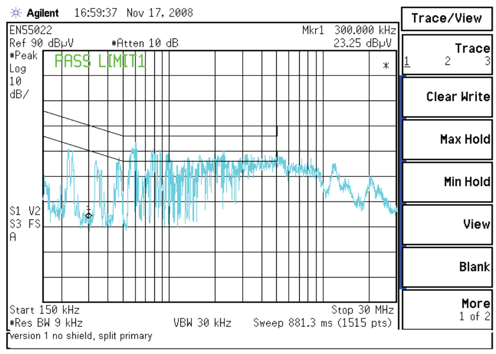
6 Comparison of EMI for single and dual output device with and without shield

Figure 13. Dual output with shielded transformer



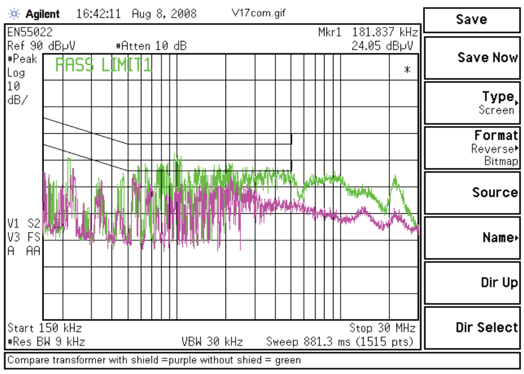
AM03427v1

Figure 14. Dual output without shielded transformer



AM03428v1

Figure 15. Comparison of EMI for single output with and without shield



AM03429v1

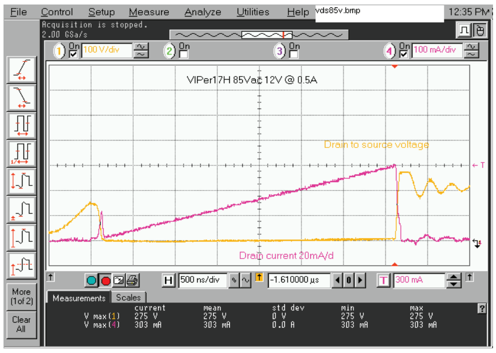
The readings in the above plot are of 3 max and hold (scanned three times, with the graph displaying the highest reading).

The green trace is the dual output transformer with a wire shield and efficiency of 75.7%. The blue trace is the dual output without shield but with an efficiency of 81.2%. The choice has been made to go with the regular, non-shielded transformer since it is still 5 db under the peak limit with better efficiency.

6.1 Main switch waveforms

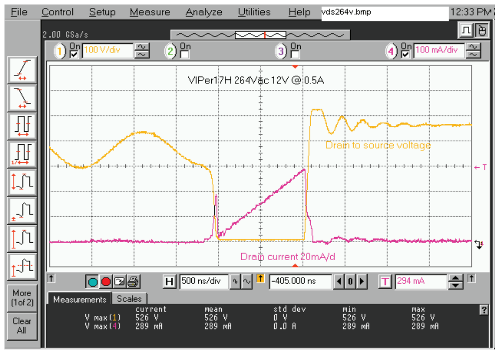
Figure 16 shows the MOSFET's drain voltage and current waveforms for a minimum line of 85 V, and *Figure 17* shows the waveforms at a high line of 264 V. Both measurements have been taken at a full load of 12 V at 0.5 A.

Figure 16. 85 V



AM03430v1

Figure 17. 264 V

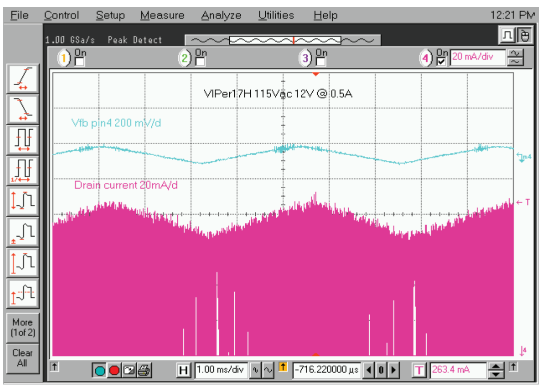


AM03431v1

6.2 Frequency jittering

Figure 18 shows the drain current and Vfb at maximum load. Jittering causes the drain current and the feedback voltage to modulate with a triangular wave. If the power supply had been operating at a fixed frequency, the drain current would be proportional to the output power. If you compare three or more current waveforms, you can see that the middle one stays still while the ones to the left and right tend to fluctuate from the middle. This indicates that the switching frequency is being modulated.

Figure 18. Frequency jittering

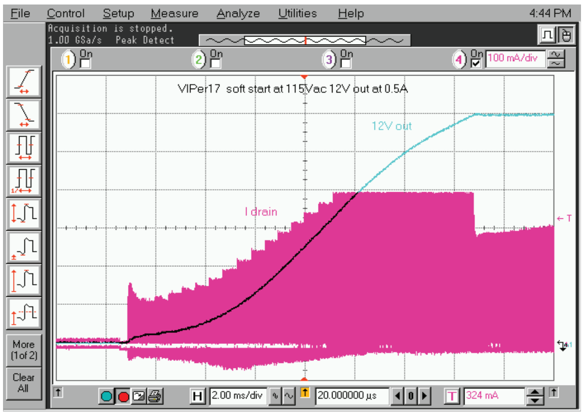


AM03432v1

6.3 Soft-start

When the power supply starts, the output capacitors need to be charged up to the operating voltage. During this initial time, the converter has to charge the output capacitors plus deliver any output current required. This results in the maximum current being delivered to the output. The maximum output current is proportional to the primary current limited by the pulse-by-pulse current limit of the device. With the soft-start feature, the current's trip level is raised in 16 equal steps for a total duration of 8.5 ms. This prevents the current from reaching a higher value during the start-up time. *Figure 19* shows the soft-start feature of the converter.

Figure 19. Soft-start feature



7 PCB layout

The board measures 95 x 35 mm and has both through holes and surface-mount components on the bottom. This makes the design compact and good for line-conducted noise by eliminating the common-mode choke with a single inductor. *Figure 20* shows the placement of the components. The bottom view shows the foil traces and surface-mount components.

Figure 20. Board: top view

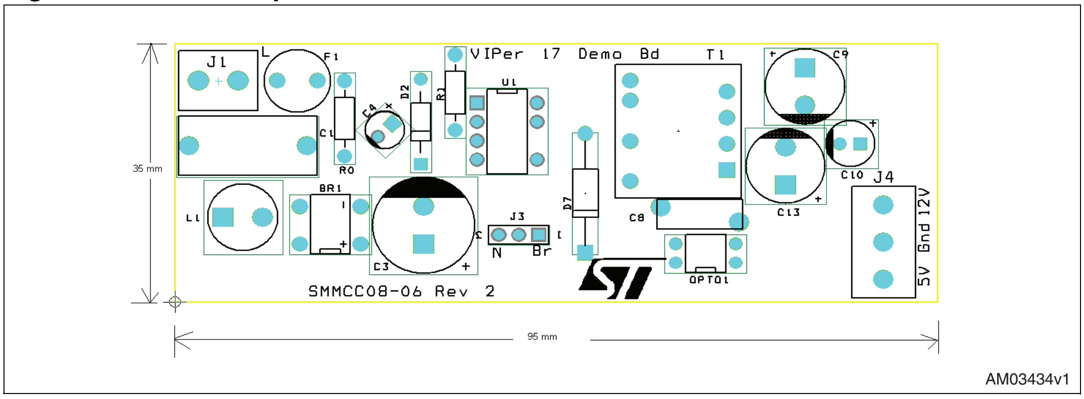
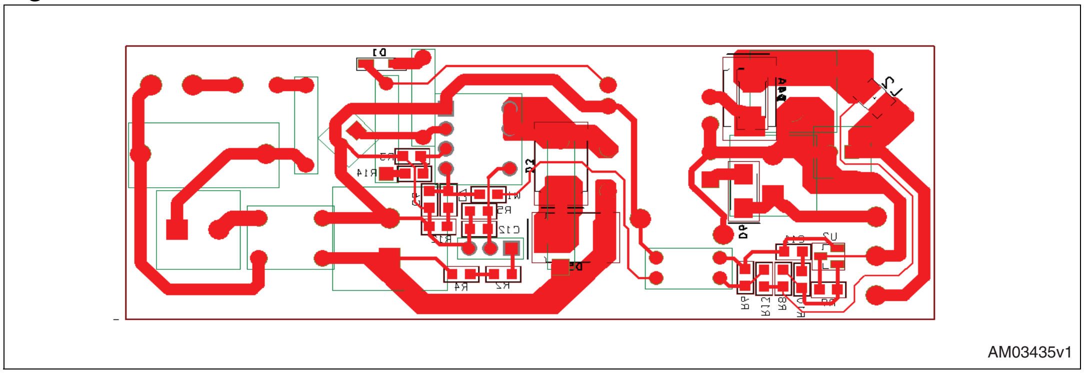


Figure 21. Board: bottom view



This is a reference design only and can be modified according to specific needs.

8 Conclusion

This application note describes a dual and single output flyback converter demonstration board using the VIPer17HN device. Both output types can be achieved with the same printed circuit board. The device integrates input from customers by offering several protections and a built-in 800 V, avalanche-rugged power section. It also provides efficient short-circuit, overload and overvoltage protections, and consumes little power at no load.

9 Revision history

Table 12. Document revision history

Date	Revision	Changes
27-Sep-2012	1	Initial release.