FSDH321

(Application for DVB Power Supply)

Test Report

Featured Fairchild Products:

FSDH321, KA431A, FOD817

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Table of Content

1. General Introduction

FSDH321 Fairchild Power Switch (FPS) which is utilized in DVB power supply. FSDH321 is also used in adapter, charger applications. In order to minimize the power consumption in standby mode, the burst operation was applied. This demo board operates over an AC input range of 85VAC to 265VAC.

1.1 Features of Fairchild Products

FSDH321 http://www.fairchildsemi.com/pf/FS/FSDH321.html

Fairchild Power Switch (FPS)

- Internal avalanche rugged sense FET
- Consumes only 0.65W at 240VAC & 0.3W load with Advanced Burst-Mode Operation
- Frequency Modulation for EMI Reduction
- Precision Fixed Operating Frequency
- Internal Start-up Circuit
- Pulse-by-Pulse current limiting
- Abnormal over current protection (AOCP)
- Over voltage protection (OVP)
- Over load protection (OLP)
- Internal thermal shutdown function (TSD)
- Auto-restart mode
- Under voltage lockout (UVLO)
- Low operating current (max 3mA)
- Adjustable peak current limit
- Built-in soft start

KA431A

- Programmable output voltage to 36V
- 2.5V reference voltage, 50ppm/℃ typical temperature coefficient
- Sink current capability of 1.0mA to 100mA

FOD817

- 4-DIP optotransistor output opto-coupler
- 5300 Vrms isolation

1.2 Electrical specification Requirement

Description	Min	Typ	Max	Units
Input Voltage (Vin)	85		265	Vac
Output Voltage (Vout1)	3.25	3.3	3.35	Vdc
Output Current (Iout1)			1.0	Adc
Output Voltage (Vout2)	20.50	21	21.50	Vdc
Output Current (Iout2)			0.15	Adc

Table 1. Power Supply Spec.

2. Circuit Description

2.1 Demo Board Photo

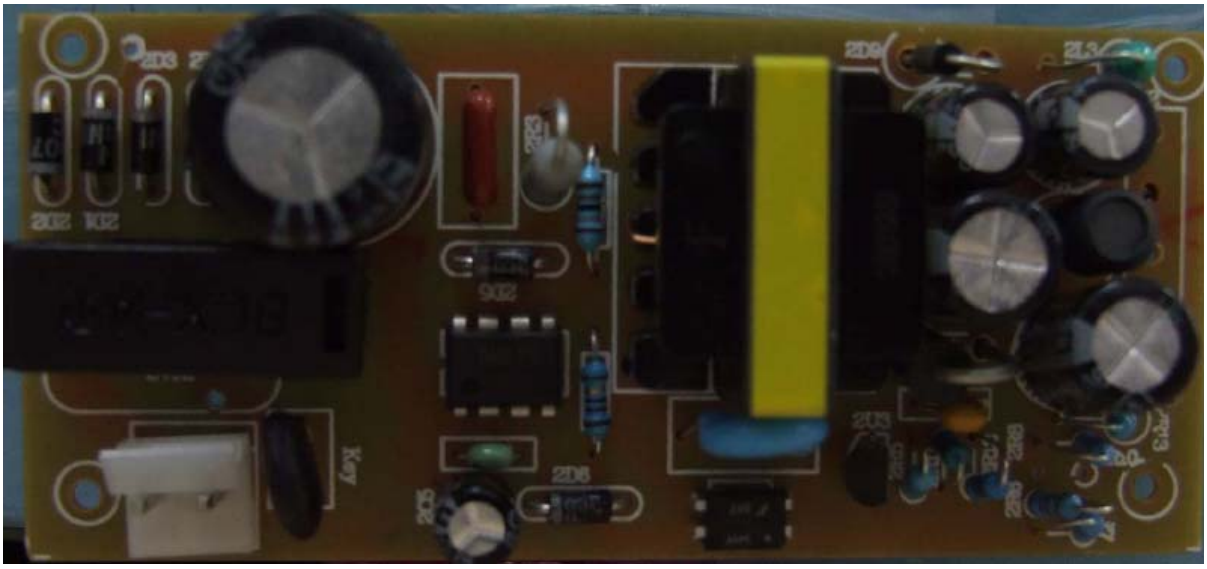

Figure 1. Photograph of Demo Board

2.2 Schematic

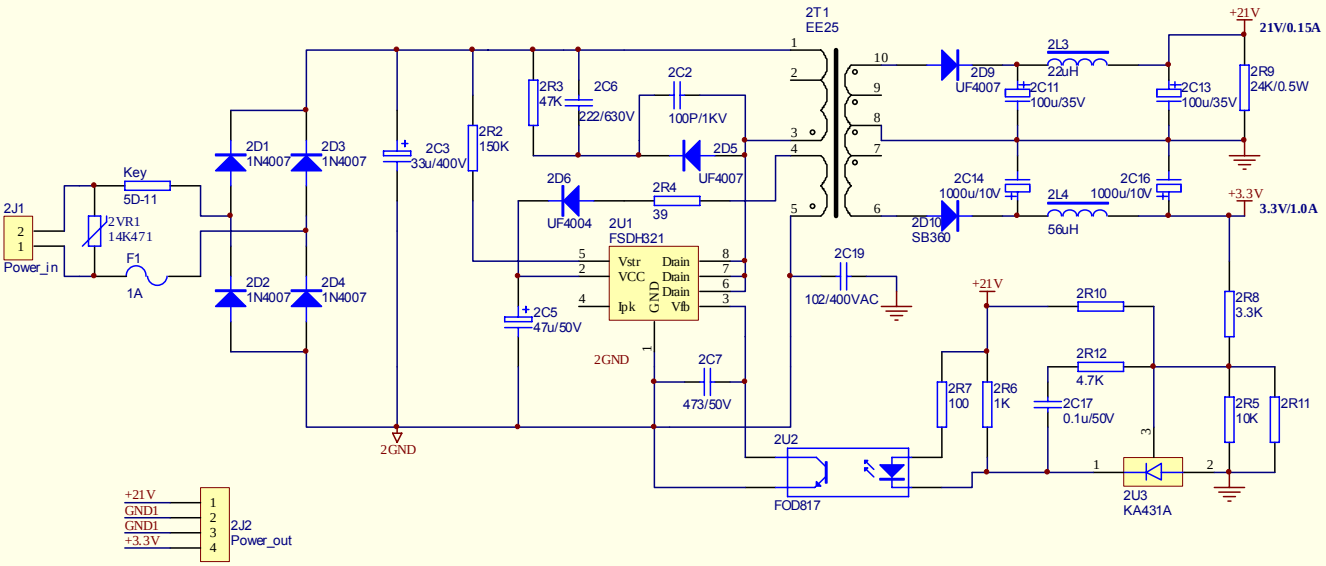

Figure 2. Flyback Converter Schematic

2.2.1 Circuit Description

The demo board was based on flyback topology design. Flyback topology is poplar in power conversion because of the small relative components, the output power can be up to 100W. The detail design guides can be found in FSC application notes AN-4137 and AN-4140.

2.2.2 Start Up

The input of demo board is 85Vac to 265Vac.

When power on, the internal high voltage current source charge the Vcc capacitor C5 through 2R2. The internal switch will shut off when Vcc is above 12V and the operation voltage of Vcc will come from the source turn of transformer. The 2R2 is no use during FPS is normal operation until next start up process, so it can reduce the power consumption.

3. PCB Layout

3.1 Components Placement

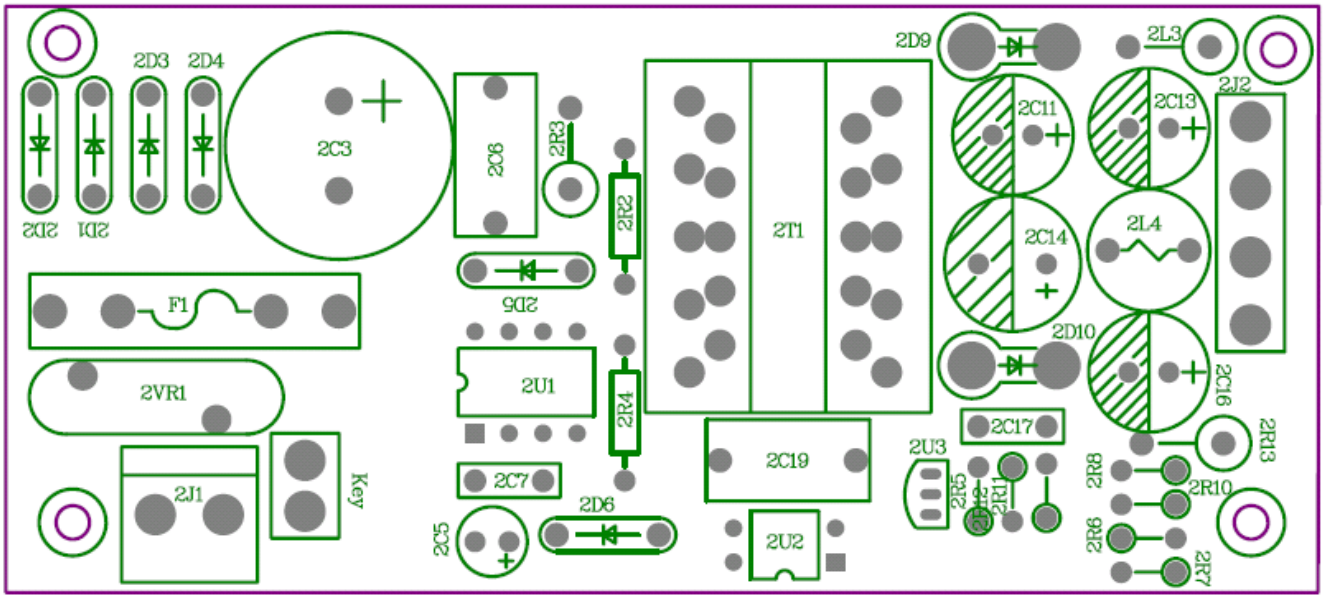

Figure 3. Top PCB Image

3.2 Bottom PCB layout

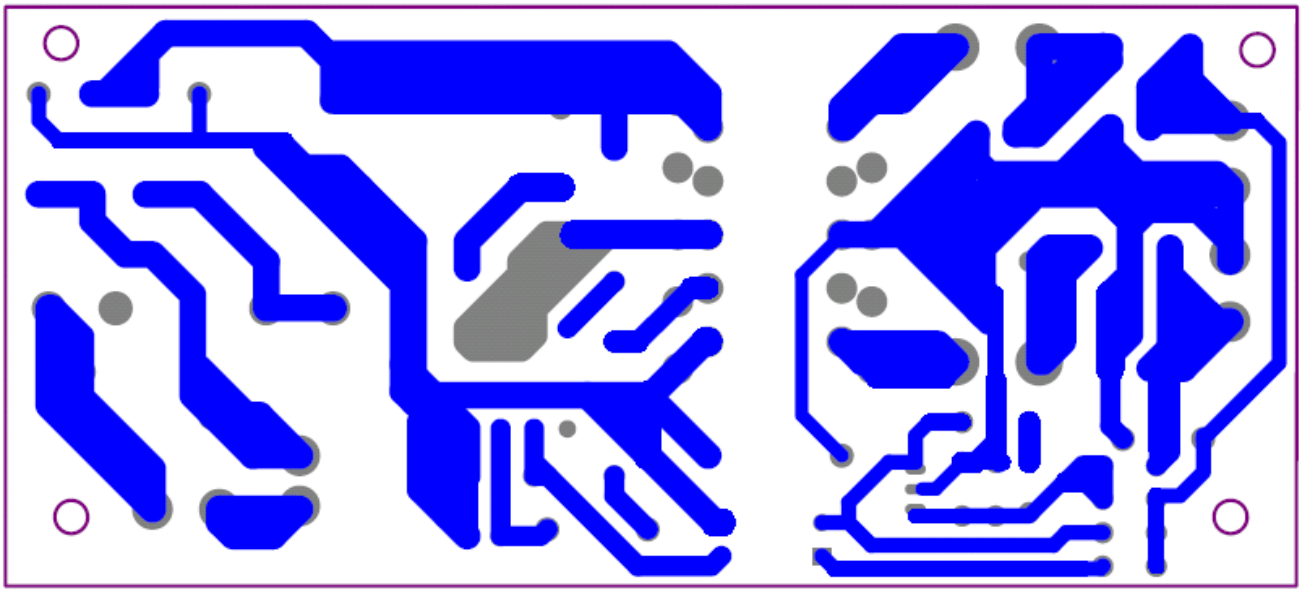

Figure 4. Bottom PCB Image

4. Bill of Material

4.1 Transformer Design

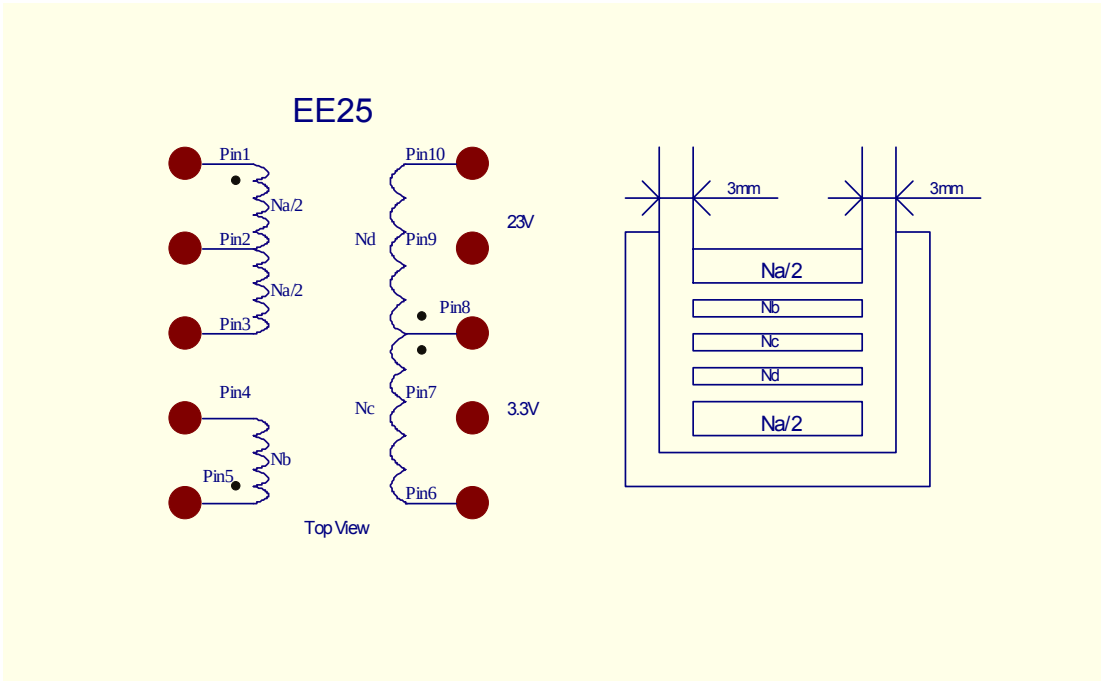

Figure 5. Transformer Specification

	Pin	Wire	Turn	Winding Method
Na/2	1-2	φ0.35*1	30	Center Solenoid Winding
Insulation: Polyester Tape t=0.050mil, 2Layers				
Nb	5-4	φ0.23*1	12	Center Solenoid Winding
Insulation: Polyester Tape t=0.050mil, 2Layers				
Nc	8-6	φ0.35*3	3	Center Solenoid Winding
Insulation: Polyester Tape t=0.050mil, 2Layers				
Nd	8-10	φ0.35*1	18	Center Solenoid Winding
Insulation: Polyester Tape t=0.050mil, 2Layers				
Na/2	2-3	φ0.35*1	38	Center Solenoid Winding
Insulation: Polyester Tape t=0.050mil, 2Layers				

Table 3. Winding Specification

Core: EE25 (Ae=44.3 mm^2)

	Pin	Spec.	Remark
Inductance	1-3	1.0mH +/-10%	@100KHz
Leakage	1-3	10uH	Short all other pins

Table 4. Electrical Characteristics

4.2 Part List

Part	Value	Comment	Part	Value	Comment
Resistor			**Capacitor**		
2R2	150K	1/4W	2C2	100p/1KV	Open
2R3	47K	1W	2C3	33u/400V	Electrolytic
2R4	39	1/4W	2C5	47u/50V	Electrolytic
2R5	10K	1/4W	2C6	222/630V	Polyester
2R6	1K	1/4W	2C7	473/50V	Ceramic
2R7	100	1/4W	2C11	100u/35V	Electrolytic
2R8	3.3K	1/4W	2C13	100u/35V	Electrolytic
2R9	24K	1/2W	2C14	1000u/10V	Electrolytic
2R10		Open	2C16	1000u/10V	Electrolytic
2R11		Open	2C17	0.1u/50V	Ceramic
2R12	4.7K	1/4W	2C19	102/2KV	Ceramic
2VR1	14K471	Open	**Diode**		
Inductor			2D1	1N4007	
2L3	22uH	0.5A	2D2	1N4007	
2L4	56uH	1.5A	2D3	1N4007	
IC			2D4	1N4007	
2U1	FSDH321	FPS	2D5	UF4007	
2U2	FOD817	Opto-Coupler	2D6	UF4004	
2U3	KA431A	Ref Voltage	2D9	UF4007	
Fuse			2D10	SB360	
F1	1.5A	250VAC	**NTC**		
Transformer			Key	5D-11	
2T1	EE25				

Table 2. Part List

5. Test Result

5.1 Start Up

Vin (AC)	Time (S)
85V	1.04
265V	0.604

Table 5. Start-up Time

85Vac input and full load condition

Blue---Vcc, Azury---Vfb, Purple---Vds, Green---Ids

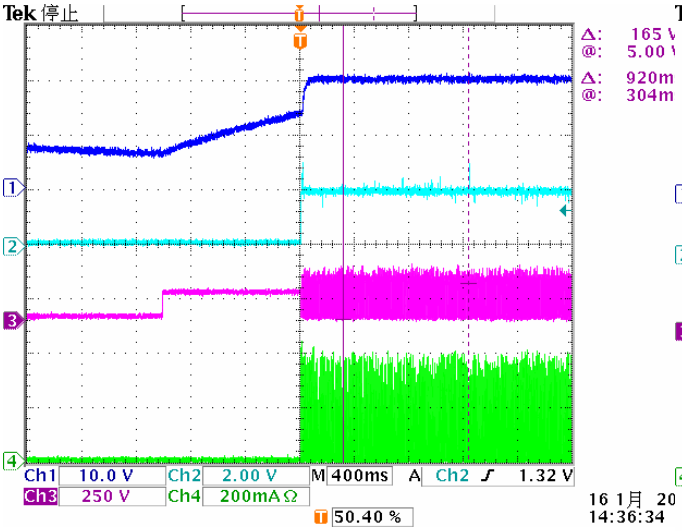

Figure 6. Start-up waveform at 85Vac input and full load

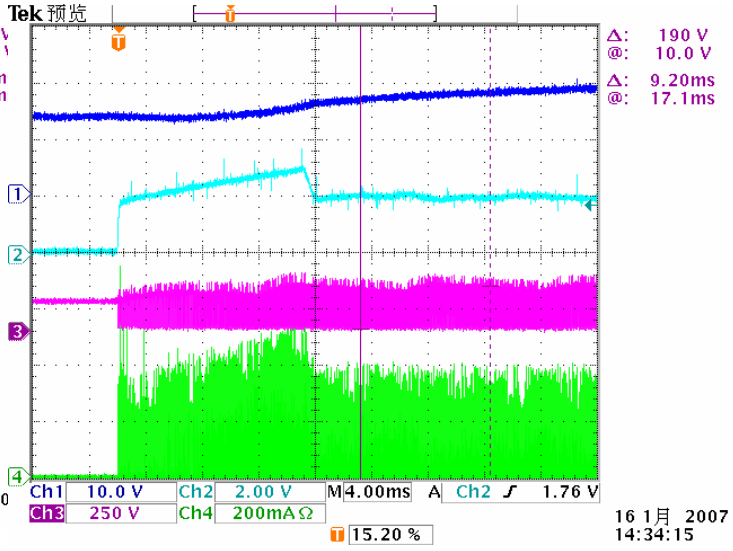

Figure 7. Start-up waveform at 85Vac input and full load (Zoom in)

265Vac input and full load condition

Blue---Vcc, Azury---Vfb, Purple---Vds, Green---Ids

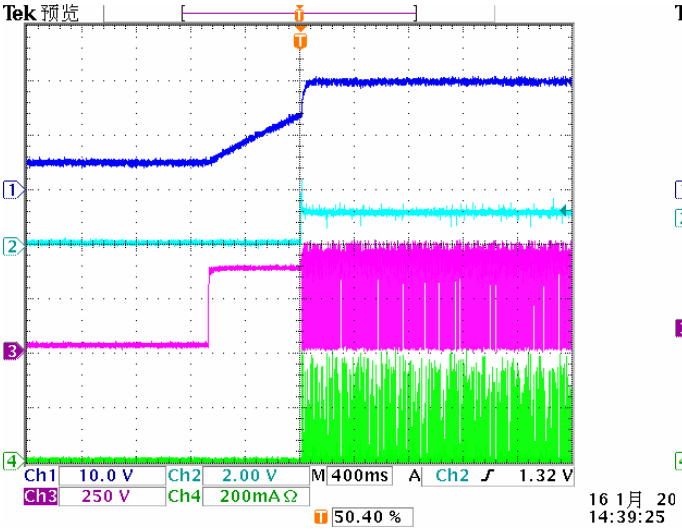

Figure 8. Start-up waveform at 265Vac input and full load

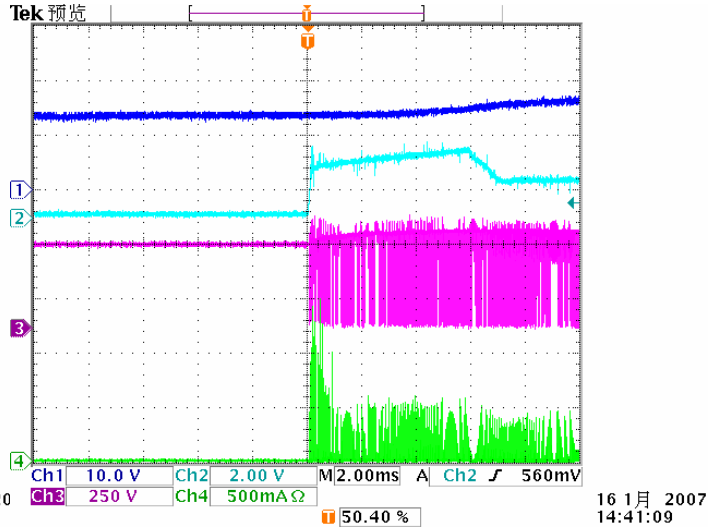

Figure 9. Start-up waveform at 265Vac input and full load (Zoom in)

5.2 Normal Operation

85Vac input and full load condition **265Vac input and full load condition**

Purple---Vds, Green---Ids

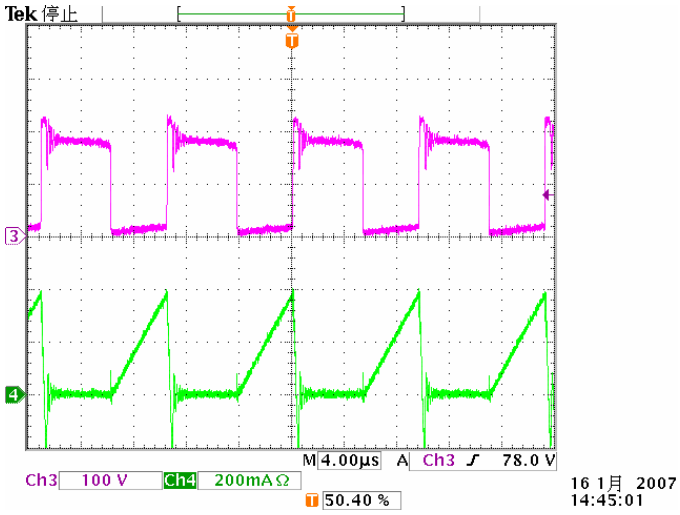

Figure 10. Normal operation waveform at 85Vac input and full load

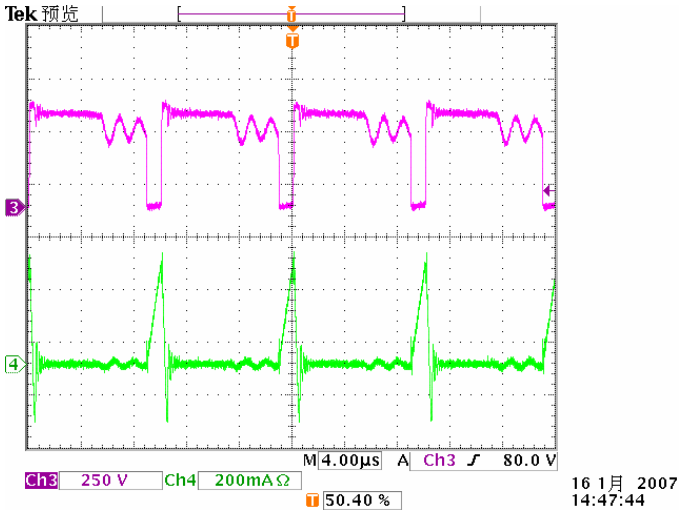

Figure 11. Normal operation waveform at 265Vac input and full load

5.3 Power Off Waveform

85Vac input and full load condition **265Vac input and full load condition**

Purple---Vds, Green---Ids

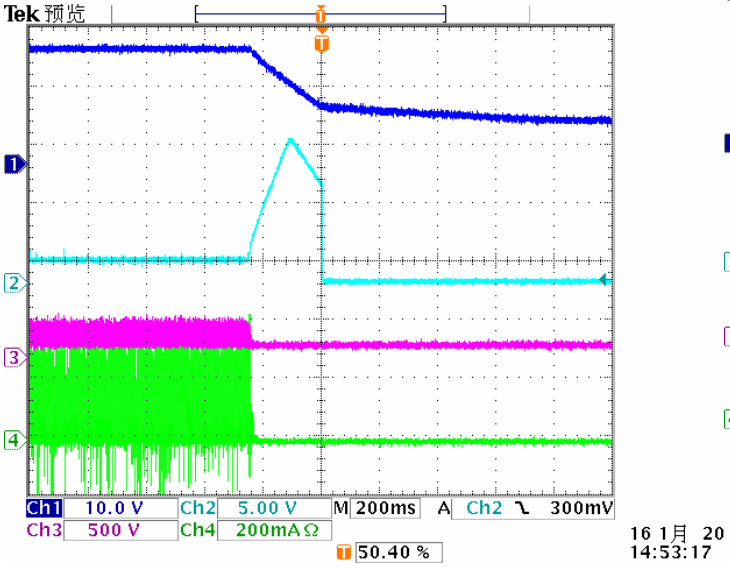

Figure 12. Power off waveform at 85Vac input and full load

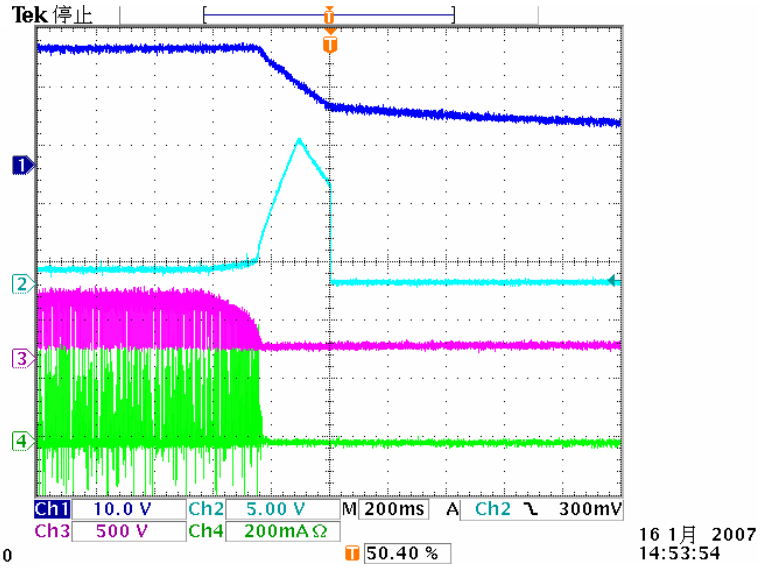

Figure 13. Power off waveform at 265Vac input and full load

5.4 Output Short Protection

Vin (AC)	3.3V/2A	21V/1A
85V	**Pass**	**Pass**
265V	**Pass**	**Pass**

Table 6. Output Short Test

3.3V output short at 85Vac input voltage condition

Blue---Vcc, Azury---Vfb, Purple---Vds, Green---Ids

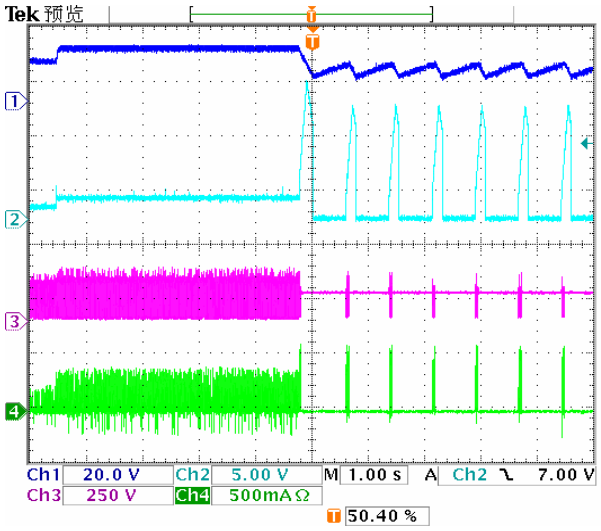

Figure 14. 3.3V output short at 85Vac input voltage condition

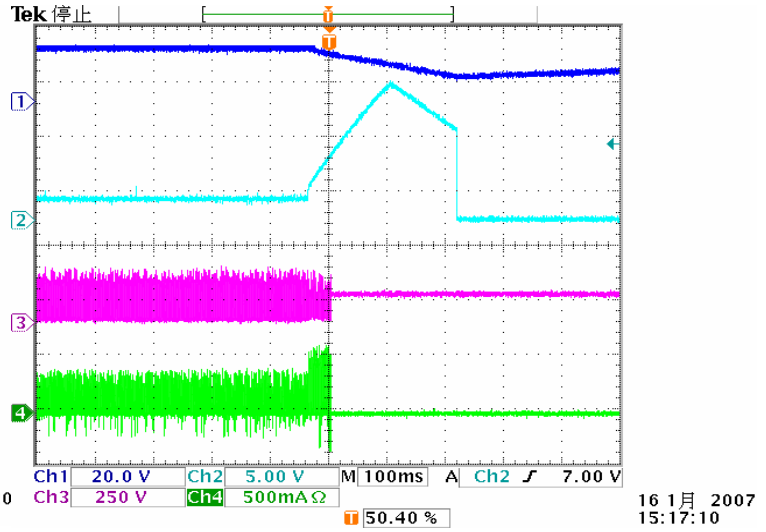

Figure 15. 3.3V output short at 85Vac input voltage condition (Zoom in)

21V output short at 85Vac input voltage condition

Blue---Vcc, Azury---Vfb, Purple---Vds, Green---Ids

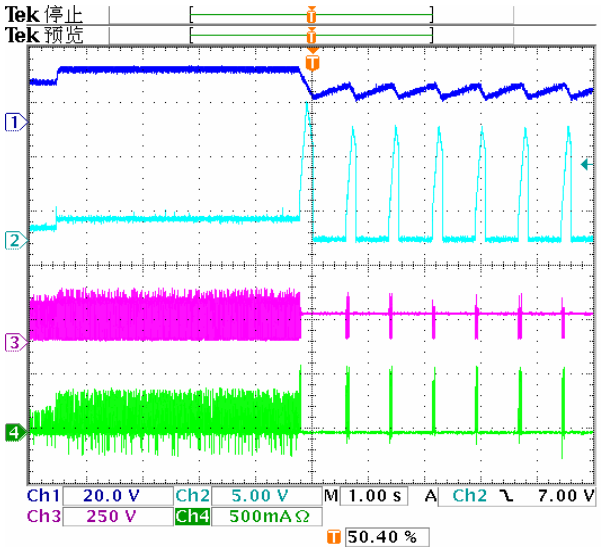

Figure 16. 21V output short at 85Vac input voltage condition

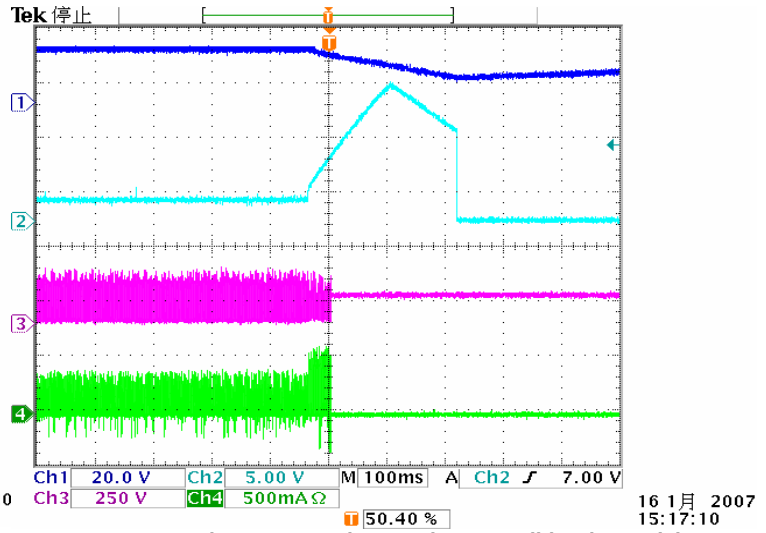

Figure 17. 21V output short at 85Vac input voltage condition (Zoom in)

3.3V output short at 265Vac input voltage condition

Blue---Vcc, Azury---Vfb, Purple---Vds, Green---Ids

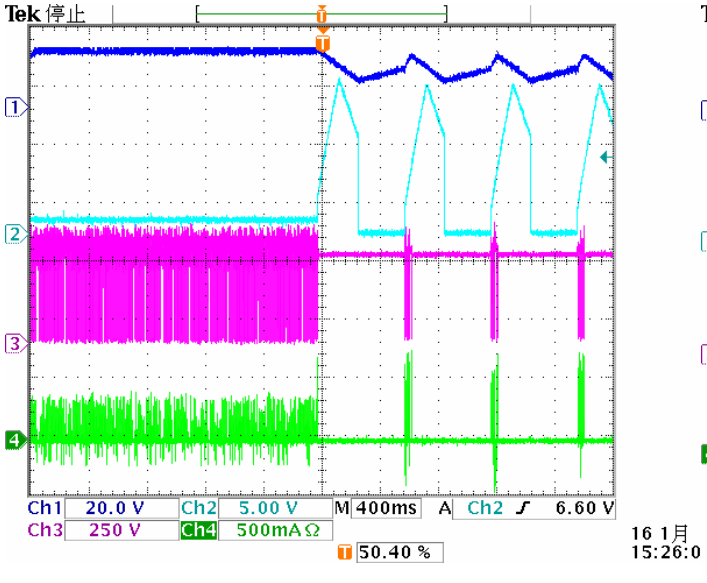

Figure 18. 3.3V output short at 265Vac input voltage condition

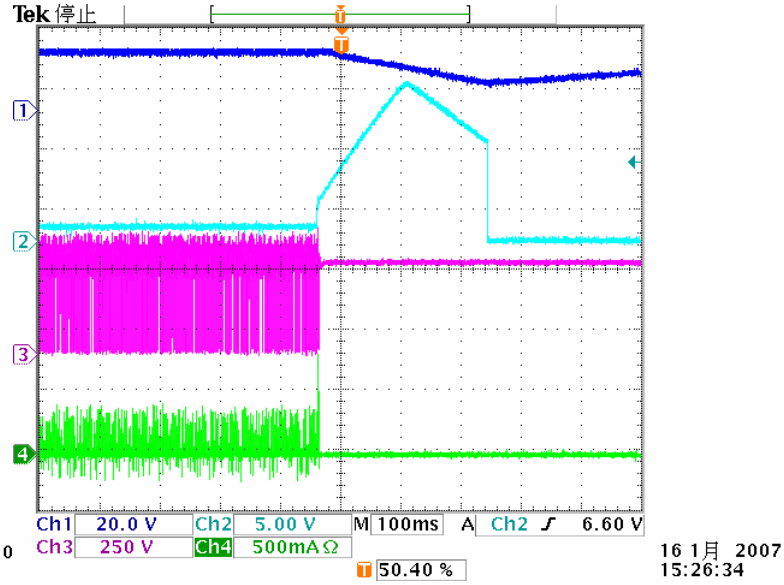

Figure 19. 3.3V output short at 265Vac input voltage condition (Zoom in)

21V output short at 265Vac input voltage condition

Blue---Vcc, Azury---Vfb, Purple---Vds, Green---Ids

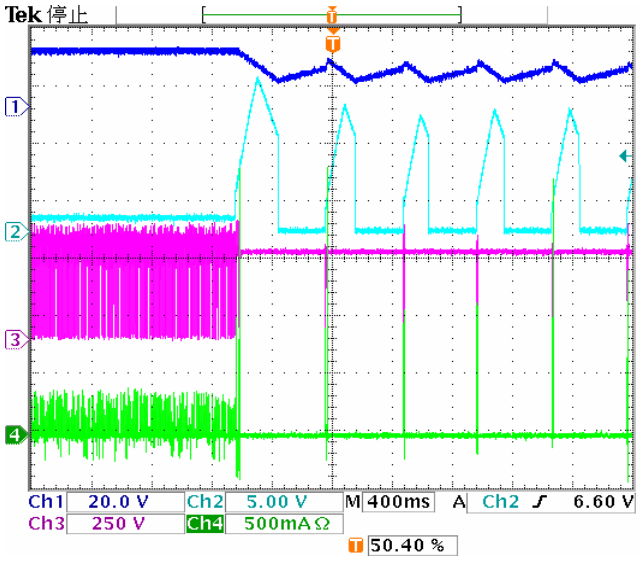

Figure 20. 21V output short at 265Vac input voltage condition

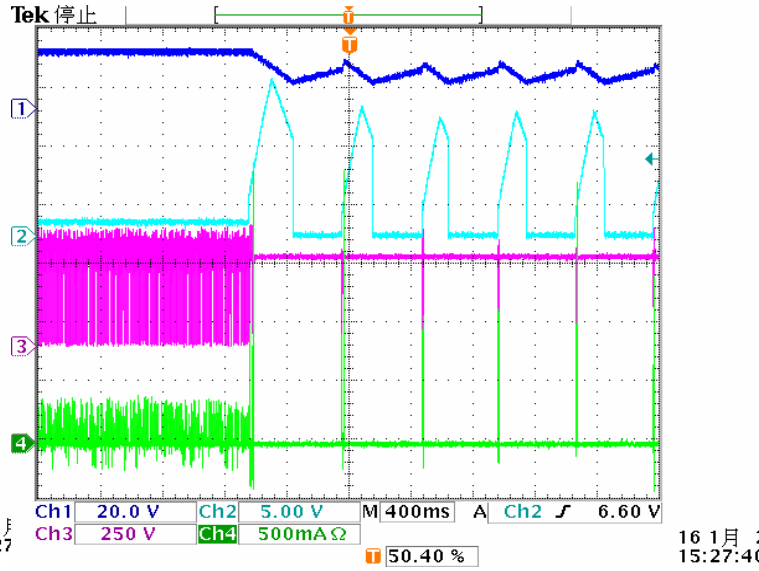

Figure 21. 21V output short at 265Vac input voltage condition (Zoom in)

5.5 Feed Back Circuit Open

Feed back open at 85Vac input voltage condition

Blue---Vcc, Azury---Vfb, Purple---Vds, Green---Ids

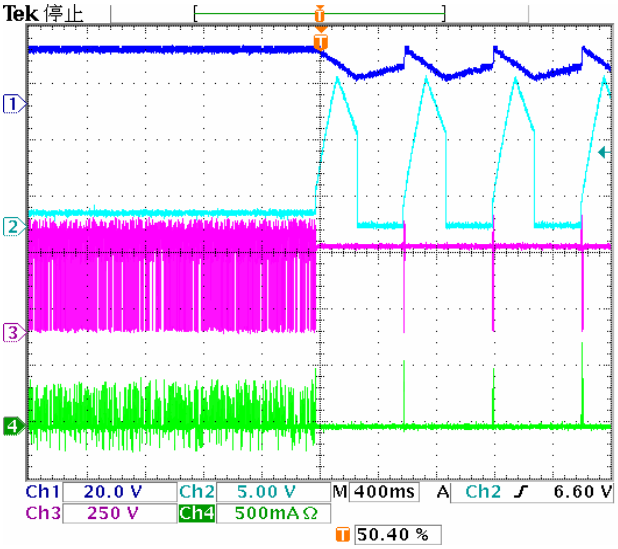

Figure 22. Feed back open at 85Vac input voltage condition

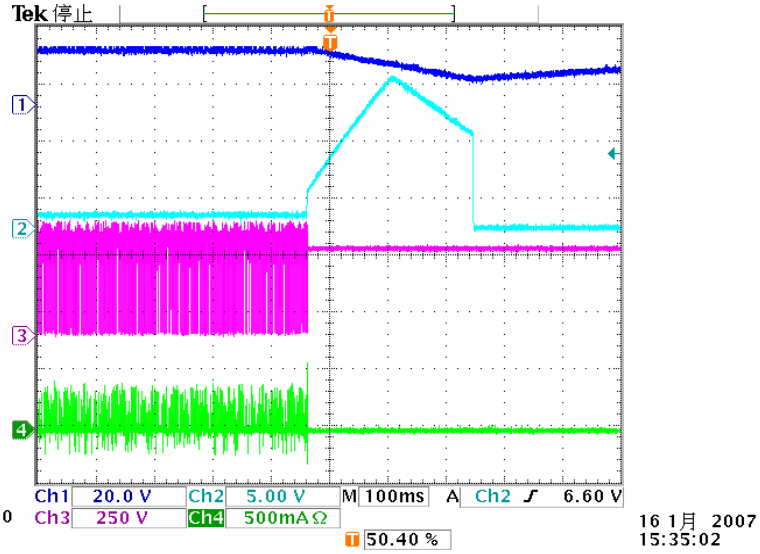

Figure 23. Feed back open at 85Vac input voltage condition (Zoom in)

Feed back open at 265Vac input voltage condition

Blue---Vcc, Azury---Vfb, Purple---Vds, Green---Ids

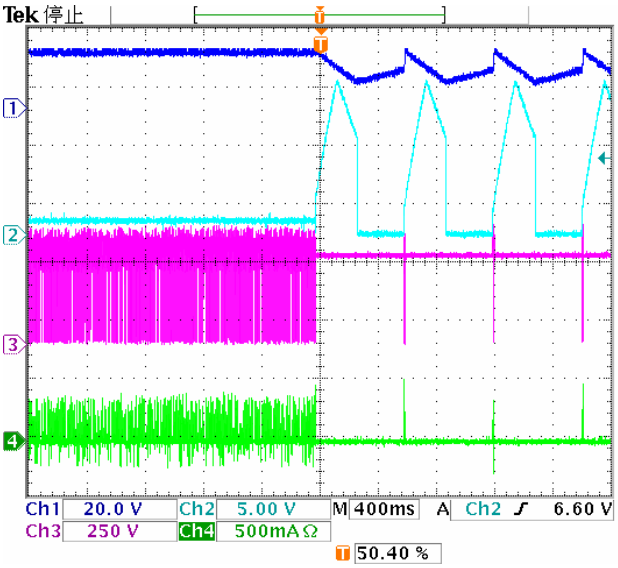

Figure 24. Feed back open at 265Vac input voltage condition

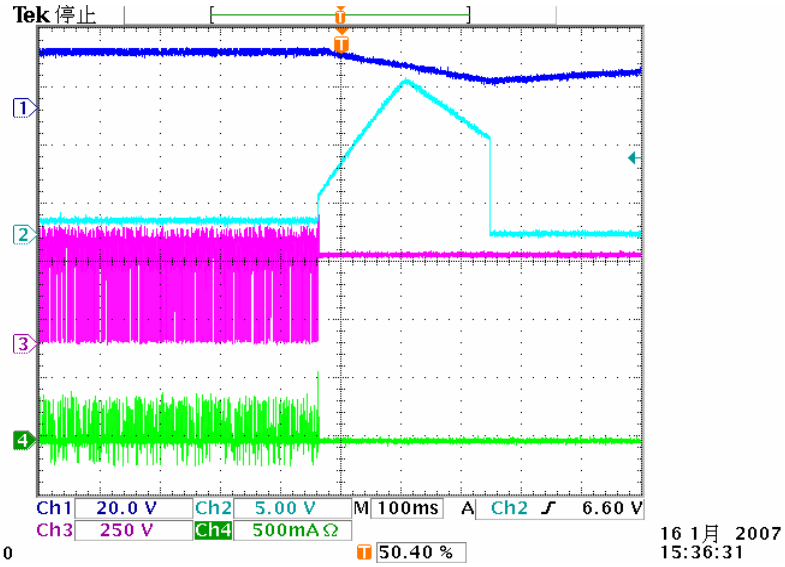

Figure 25. Feed back open at 265Vac input voltage condition (Zoom in)

5.6 Burst Operation

Burst Operation at 85Vac Input Voltage condition

Blue---Vcc, Azury---Vfb, Purple---Vds, Green---Ids

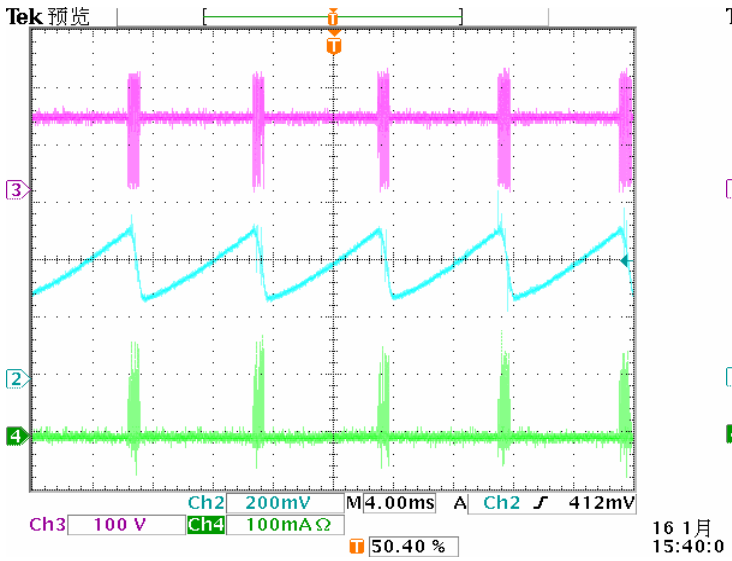

Figure 26. Burst Operation at 85Vac Input Voltage condition

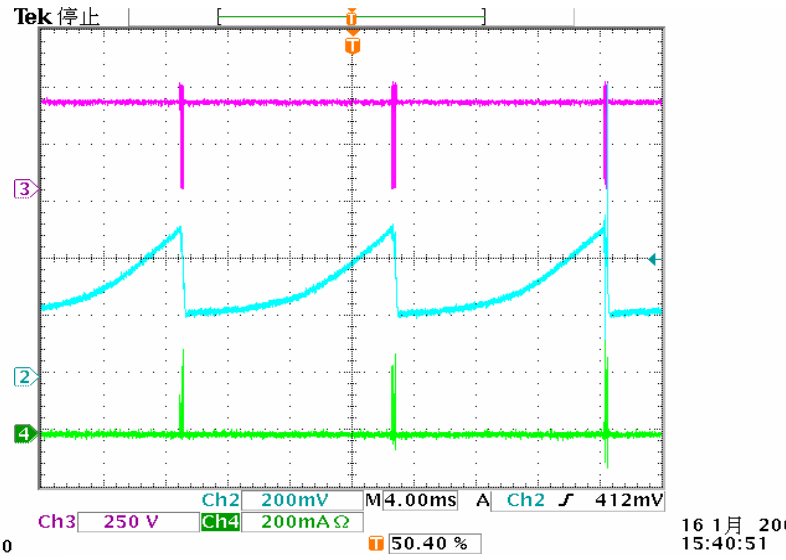

Figure 27. Burst Operation at 265Vac Input Voltage condition

6. Efficiency and Output Voltage Test Result

Vin	3.3V Output			21V Output			Pout (W)	Pin (W)	Efficicency
	Vout (V)	Iout (A)	Tolerance	Vout (V)	Iout (A)	Tolerance			
85Vac	3.33	0.20	0.91%	20.65	0.10	-1.67%	2.73	3.70	73.81%
	3.30	0.60	0.00%	21.26	0.10	1.24%	4.11	5.50	74.65%
	3.27	1.00	-0.91%	21.46	0.15	2.19%	6.49	8.70	74.59%
110Vac	3.33	0.20	0.91%	20.62	0.10	-1.81%	2.73	3.80	71.79%
	3.30	0.60	0.00%	21.26	0.10	1.24%	4.11	5.60	73.32%
	3.27	1.00	-0.91%	21.43	0.15	2.05%	6.48	8.70	74.53%
150Vac	3.33	0.20	0.91%	20.61	0.10	-1.86%	2.73	3.90	69.92%
	3.30	0.60	0.00%	21.27	0.10	1.29%	4.11	5.70	72.05%
	3.27	1.00	-0.91%	21.41	0.15	1.95%	6.48	8.70	74.50%
180Vac	3.33	0.20	0.91%	20.59	0.10	-1.95%	2.73	4.00	68.13%
	3.30	0.60	0.00%	21.27	0.10	1.29%	4.11	5.80	70.81%
	3.27	1.00	-0.91%	21.41	0.15	1.95%	6.48	8.80	73.65%
220Vac	3.33	0.20	0.91%	20.59	0.10	-1.95%	2.73	4.10	66.46%
	3.30	0.60	0.00%	21.28	0.10	1.33%	4.11	6.00	68.47%
	3.27	1.00	-0.91%	21.40	0.15	1.90%	6.48	8.90	72.81%
240Vac	3.33	0.20	0.91%	20.59	0.10	-1.95%	2.73	4.20	64.88%
	3.30	0.60	0.00%	21.29	0.10	1.38%	4.11	6.10	67.36%
	3.27	1.00	-0.91%	21.39	0.15	1.86%	6.48	9.00	71.98%
265Vac	3.33	0.20	0.91%	20.67	0.10	-1.57%	2.73	4.30	63.56%
	3.30	0.60	0.00%	21.31	0.10	1.48%	4.11	6.30	65.25%
	3.27	1.00	-0.91%	21.39	0.15	1.86%	6.48	9.20	70.42%

Table 7. Output Voltage and Efficiency Test

7. Reference and Resource

7.1 Application Notes

Application note:
Flyback: AN-4137, AN-4141, AN-4147

8 Warning and Disclaimer

This Evaluation Board may employ high voltages so appropriate safety precautions should be used when operating this board. Replace components on the Evaluation Board only with those parts shown on the parts list in the User's Guide. Contact an authorized Fairchild representative with any questions.

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