User Guide for

FEBFSEZ1317WA_CH310v3 Evaluation Board

Primary-Side-Regulation PWM Controller FSEZ1317WAMY 5.0V/0.7A Mobile Phone Battery Charger

Featured Fairchild Product:

FSEZ1317WA

Direct questions or comments about this Evaluation Board to: "Worldwide Direct Support"

Fairchild Semiconductor.com

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This user guide supports the evaluation board for the FSEZ1317WA. It should be used in conjunction with the datasheet as well as Fairchild's application notes and technical support team. Please visit Fairchild's website at www.fairchildsemi.com. This kit supercedes the FEBFSEZ1317A_CH310v3. The revised kit incorporates the next generation FSEZ1317WA, which implements a new frequency hopping method.

1. Introduction

This document describes a 3.5W power supply using an FSEZ1317WAMY device. This power supply is targeted for mobile phone battery chargers for a 30mW solution with high efficiency.

The controller used on the board is Fairchild Semiconductor's FSEZ1317WAMY. This third-generation Primary-Side-Regulation (PSR) PWM controller with integrated MOSFET and improved EMI performance provides several features to enhance the performance of low-power flyback converters. The proprietary TRUECURRENT® technology enables precise Constant Current (CC) regulation and simplified circuit design for battery-charger applications. The result is a lower-cost, smaller, and lighter charger compared to conventional designs or a linear transformer. To minimize standby power consumption (30mW at 265V_{AC}), a proprietary Green Mode provides off-time modulation to linearly decrease PWM frequency under light-load conditions. Green Mode assists the power supply in meeting power conservation requirements. By using the FSEZ1317WA, a charger can be implemented with few external components and minimized cost. A typical output CV/CC (Constant Voltage / Constant Current) characteristic envelope is shown in Figure 23 and Figure 24.

2. General Specifications

Specification	Min.	Max.	Units
Input			
Voltage	90	264	V_{AC}
Frequency	47	63	Hz
Output			
Output Voltage	4.75	5.25	V
Output Current	0	0.7	A
Total Output Power			
Full-Load Output Power	0	3.5	W

Note:
1. All results tested with output DC cable, AWG 26, 1.8M.

3. Functional Test Report

Test Model	FEBFSEZ1317WA_CH310v3
Test Date	July 27, 2012
Test Temperature	Ambient
Test Equipment	AC Source: 6800 Series AC POWER SOURCE
	Electronic Load: Chroma 63030
	Power Meter: WT210
	Oscilloscope: TDS3014B
Test Items	1. Input current 2. Input power at no-load condition 3. Startup time 4. DC output rising time 5. Line regulation and load regulation 6. Efficiency 7. Output ripple and noise 8. Step response 9. Over-current protection 10. Hold-up time 11. Short-circuit protection 12. Brownout test 13. V_{DD} voltage level 14. Voltage stress on MOSFET and rectifier 15. Constant voltage and constant current curve 16. EMI test 17. Surge Test 18. ESD test

3.1. Input Current

3.1.1. Test Condition

Measure the AC input current at maximum load.

3.1.2. Test Result

Input Voltage	Input Current
90V / 60Hz	96.73mA
264V / 50Hz	49.14mA

3.2. Input Power at No-Load Condition

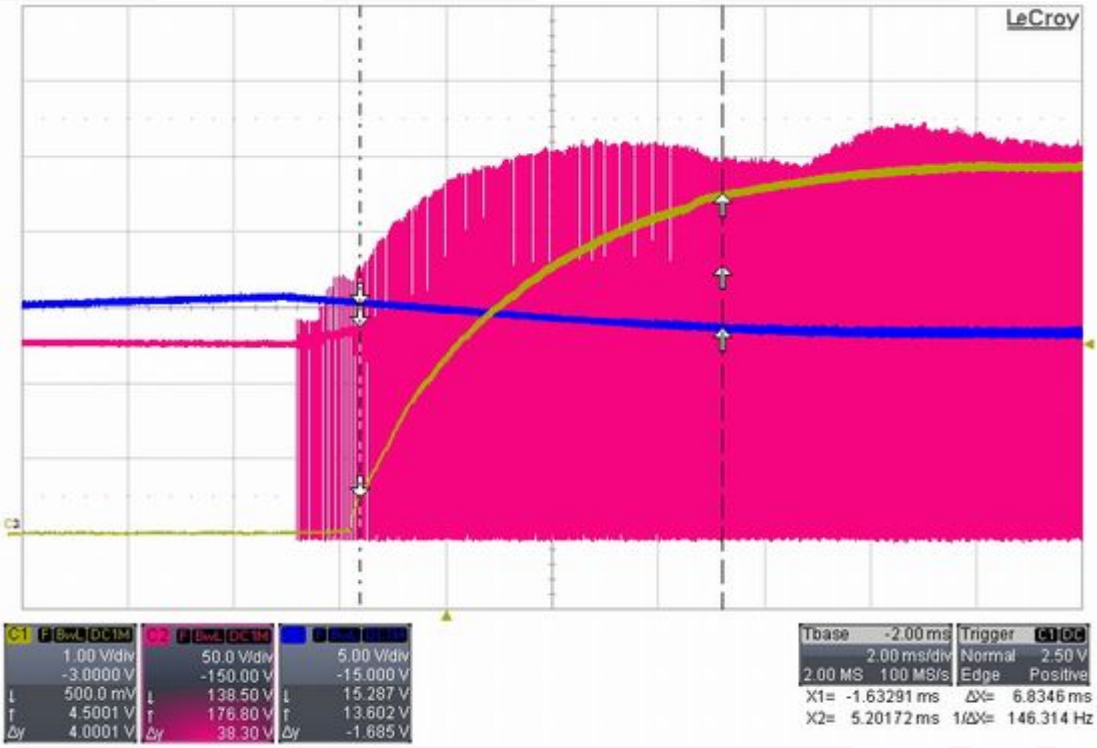
3.2.1. Test Condition

Measure the input power and output voltage at no-load condition.

3.2.2. Test Result

Input Voltage	Input Wattage (mW)	Output Voltage (V)
90V / 60Hz	21.84	5.055
115V / 60Hz	22.79	5.056
230V / 50Hz	25.8	5.075
264V / 50Hz	28.1	5.085

3.2.3. Measured Waveforms



CH1: V_O
CH2: V_{DS}
CH3: V_{DD}

Figure 1. 90V/60Hz at Maximum Load

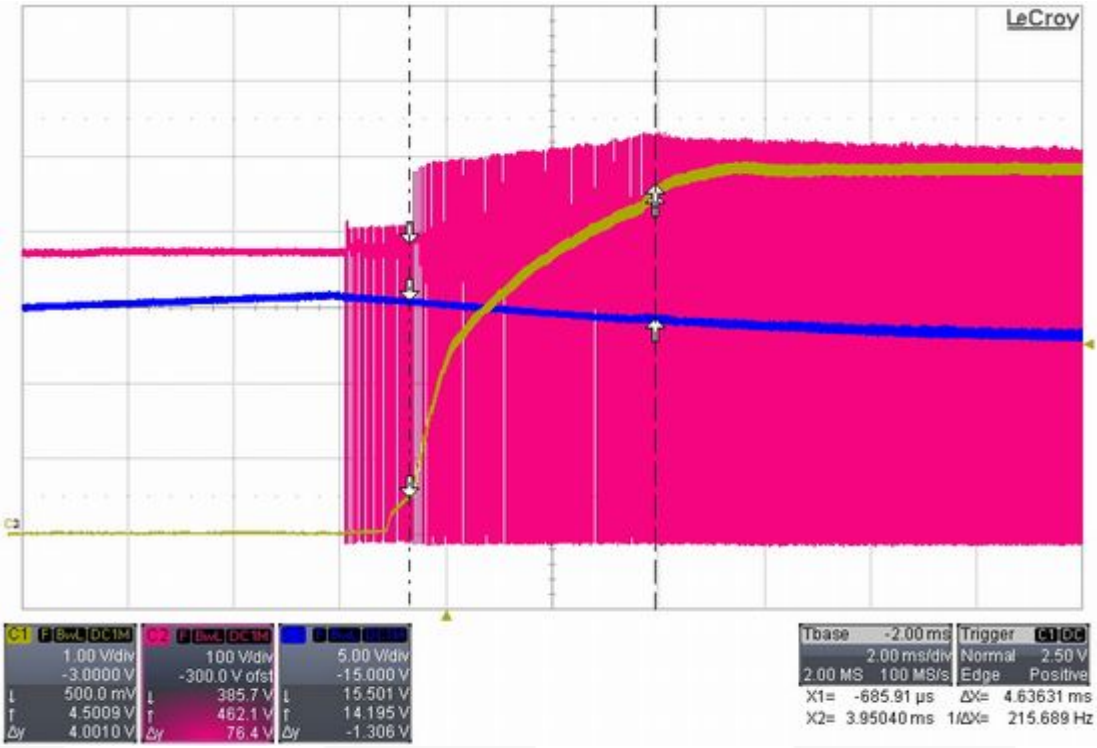


Figure 2. 264V/50Hz at Maximum Load

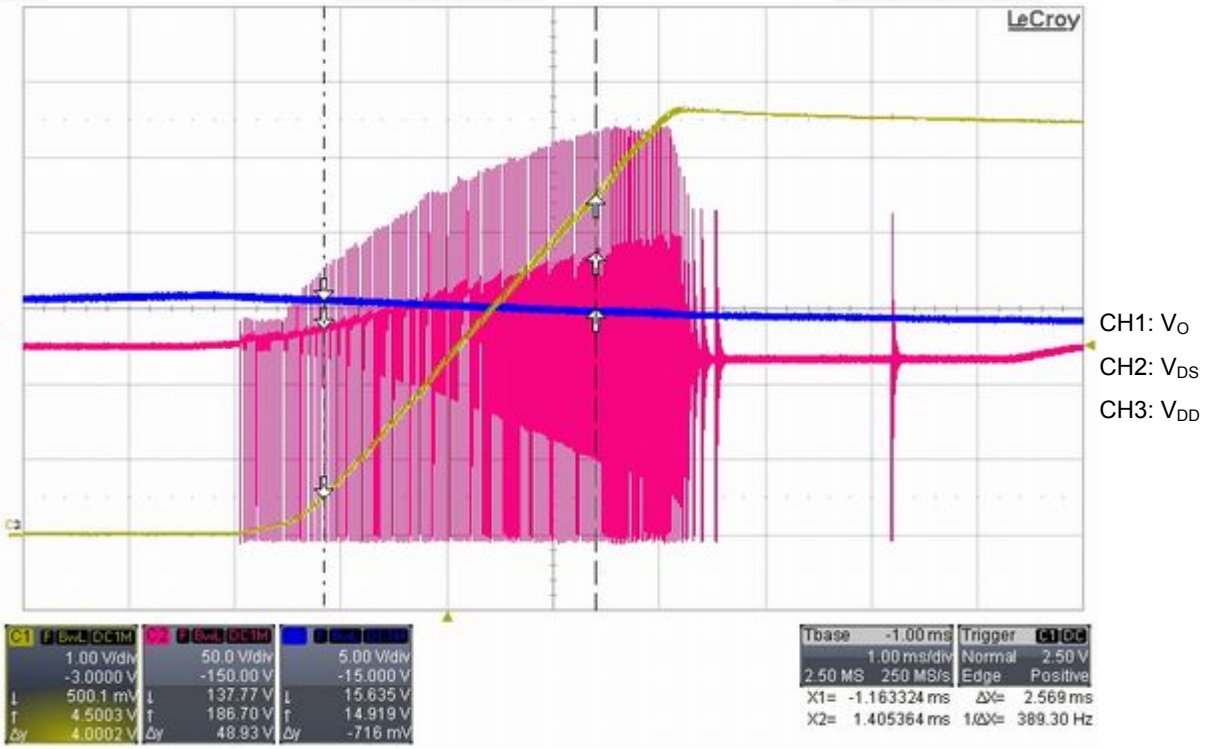


Figure 3. 90V/60Hz at No Load

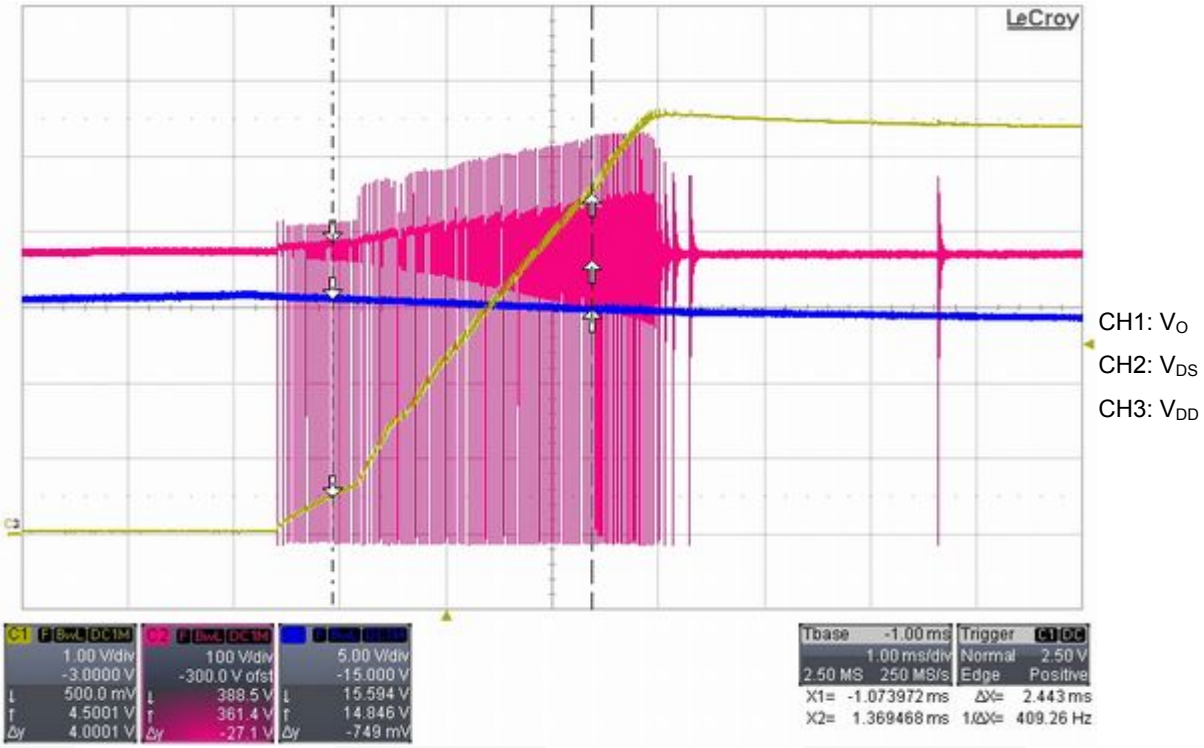


Figure 4. 264V/50Hz at No Load

3.3. Line Regulation and Load Regulation

3.3.1. Test Condition

Measure line regulation and load regulation according to below table of test results.

3.3.2. Test Result

Input Voltage	Output Voltage at Maximum Load (V)	Output Voltage at Minimum Load (V)	Load Regulation (%)	Specification
90V / 60Hz	5.032	5.055	0.23	±5%
115V / 60Hz	5.035	5.056	0.21	
230V / 50Hz	5.036	5.075	0.39	
264V / 50Hz	5.038	5.085	0.47	
Line Regulation(%)	0.06	0.3		

3.4. Efficiency

3.4.1. Test Condition

Measure input power and output power at maximum load.

3.4.2. Test Result

Input Voltage	Input Wattage (W)	Output Wattage (W)	Efficiency (%)
90V / 60Hz	5.061	3.518	69.50
115V / 60Hz	4.981	3.526	70.79
230V / 50Hz	4.979	3.537	71.03
264V / 50Hz	5.013	3.537	70.55

3.4.3. Test Result

	Efficiency(%)				
Input Voltage	**25% Load**	**50% Load**	**75% Load**	**100% Load**	**Avg.**
115V / 60Hz	71.24	72.58	72.02	70.79	71.66
230V / 50Hz	68.94	71.50	71.73	71.03	70.80

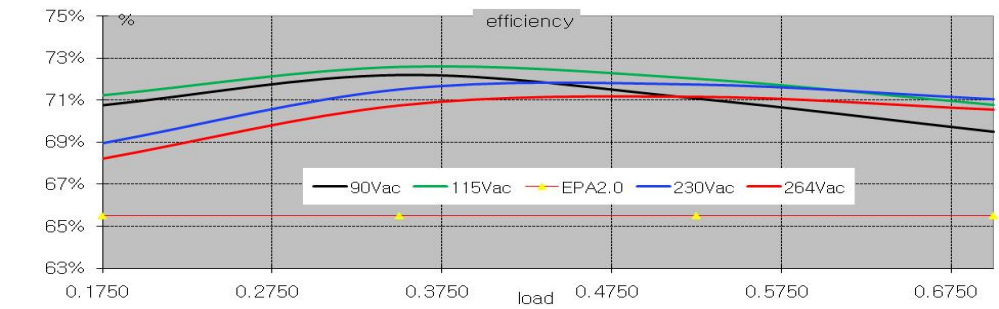


Figure 5. Efficiency

3.5. Output Ripple and Noise

3.5.1. Test Condition

Ripple and noise are measured by using a 20MHz bandwidth-limited oscilloscope with a 10µF capacitor paralleled with a high-frequency 0.1µF capacitor across each output.

3.5.2. Test Result

Input Voltage	Maximum Load (mV)	Minimum Load (mV)	Specification
90V / 60Hz	136	40	200mV
115V / 60Hz	134	32	
230V / 50Hz	146	35	
264V / 50Hz	154	40	

3.5.3. Measured Waveforms

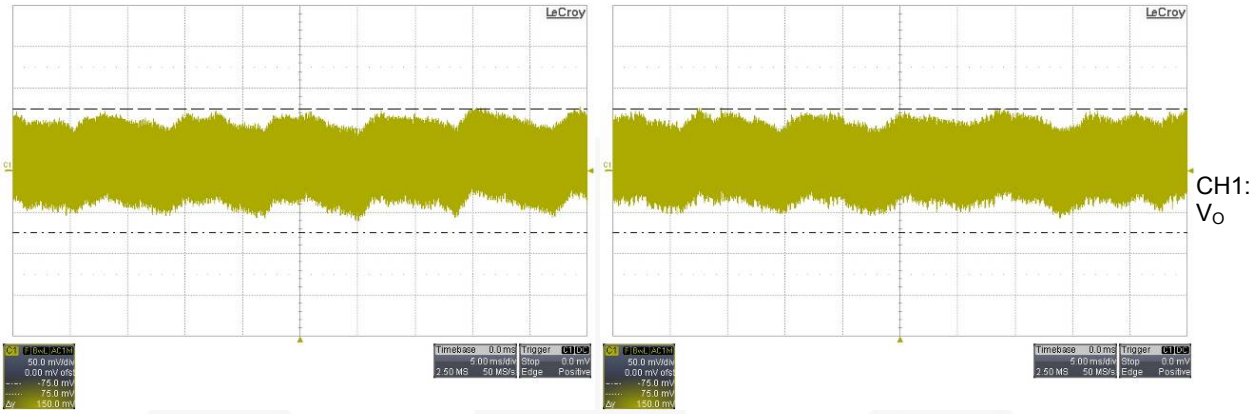


Figure 6. 90V/60Hz and 115V/60Hz at Maximum Load

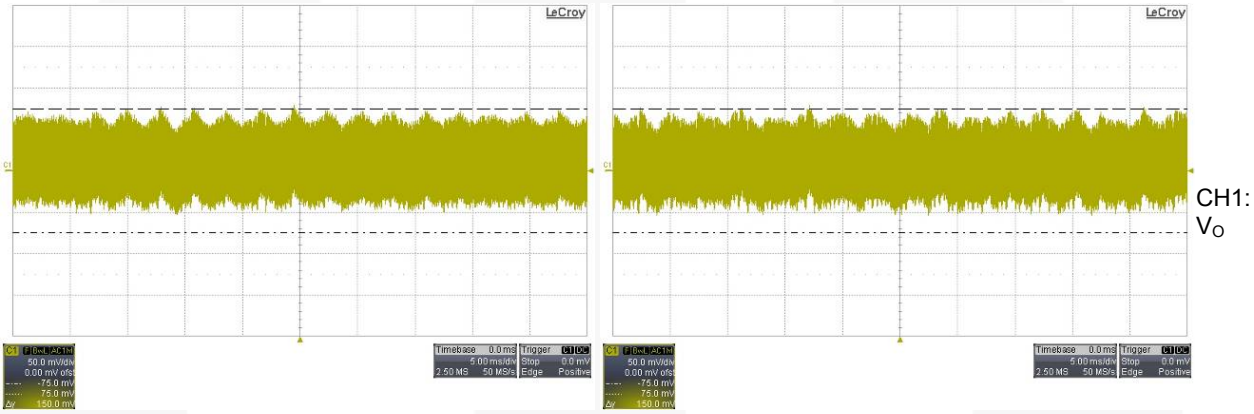


Figure 7. 230V/50Hz and 264V/50Hz at Maximum Load

3.6. Step Response

3.6.1. Test Condition

Dynamic loading (20%~80% of the full load, 5ms duty cycle, 2.5 A/μs rise/fall time).

3.6.2. Test Result

Input Voltage	Overshoot (mV)	Undershoot (mV)
115V / 60Hz	300	310
230V / 50Hz	320	320

3.6.3. Measured Waveforms

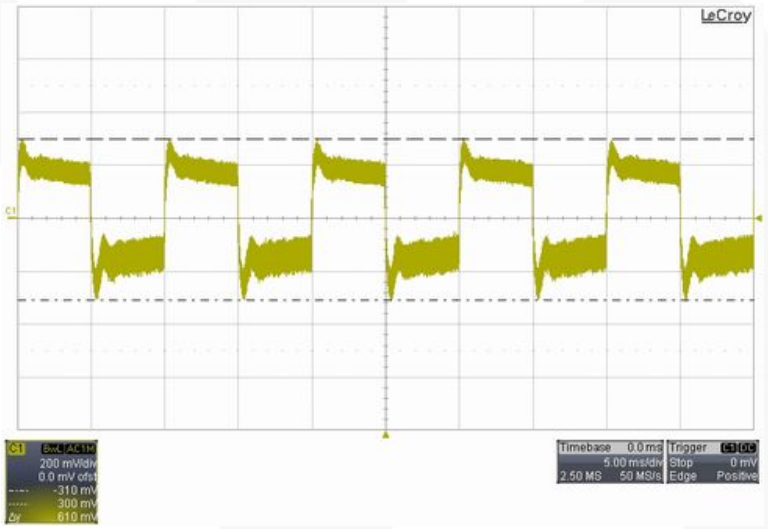


Figure 8. 115V/60Hz at Maximum Load

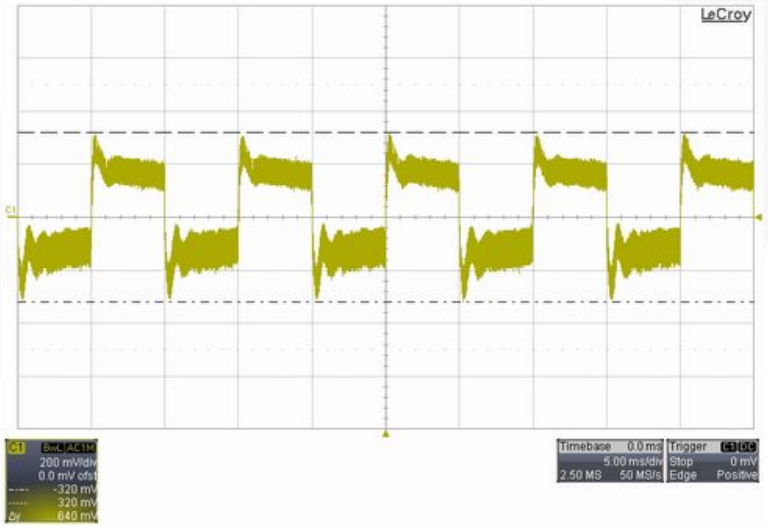


Figure 9. 230V/50Hz at Maximum Load

3.7. Over-Power Protection

3.7.1. Test Condition

Increase output loading gradually. Measure the output maximum power.

3.7.2. Test Result

Input Voltage	Output Power(W)
90V / 60Hz	3.80
115V / 60Hz	3.83
230V / 50Hz	3.90
264V / 50Hz	3.93

3.8. Hold-up Time

3.8.1. Test Condition

Set output at maximum load. Measure the time interval between AC off and output voltage falling to lower limit of rated value. The AC waveform should be off at zero degrees.

3.8.2. Test Result

Input Voltage	Hold-up Time (ms)
90V / 60Hz	11.32
115V / 60Hz	20.71
230V / 50Hz	102.00
264V / 50Hz	136.50

3.9. Measured Waveforms

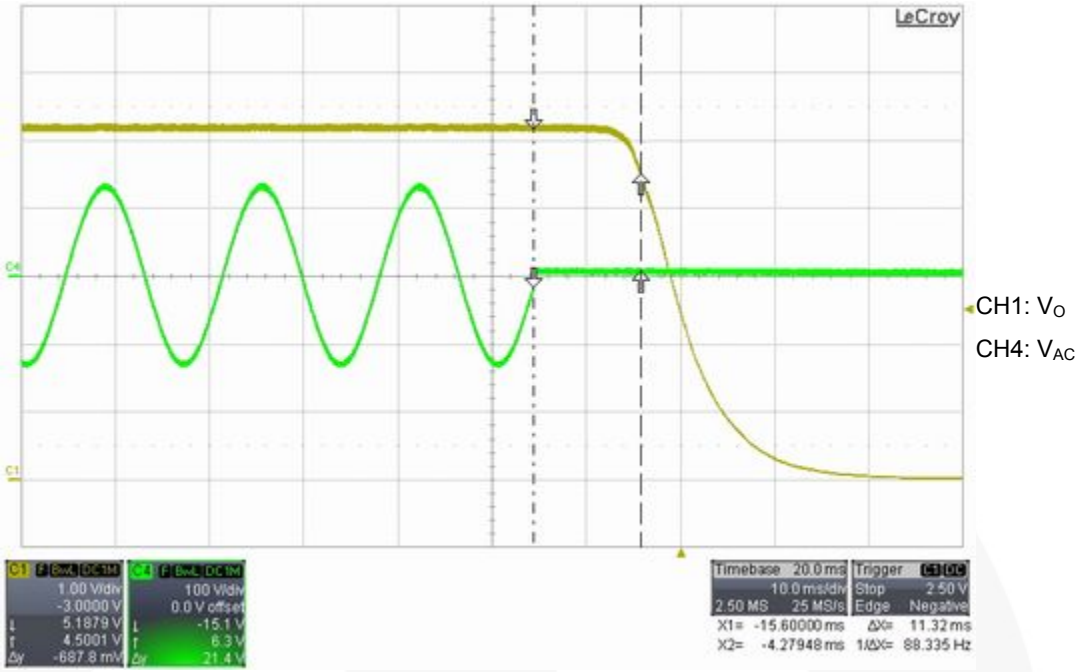


Figure 10. 90V/60Hz at Maximum Load

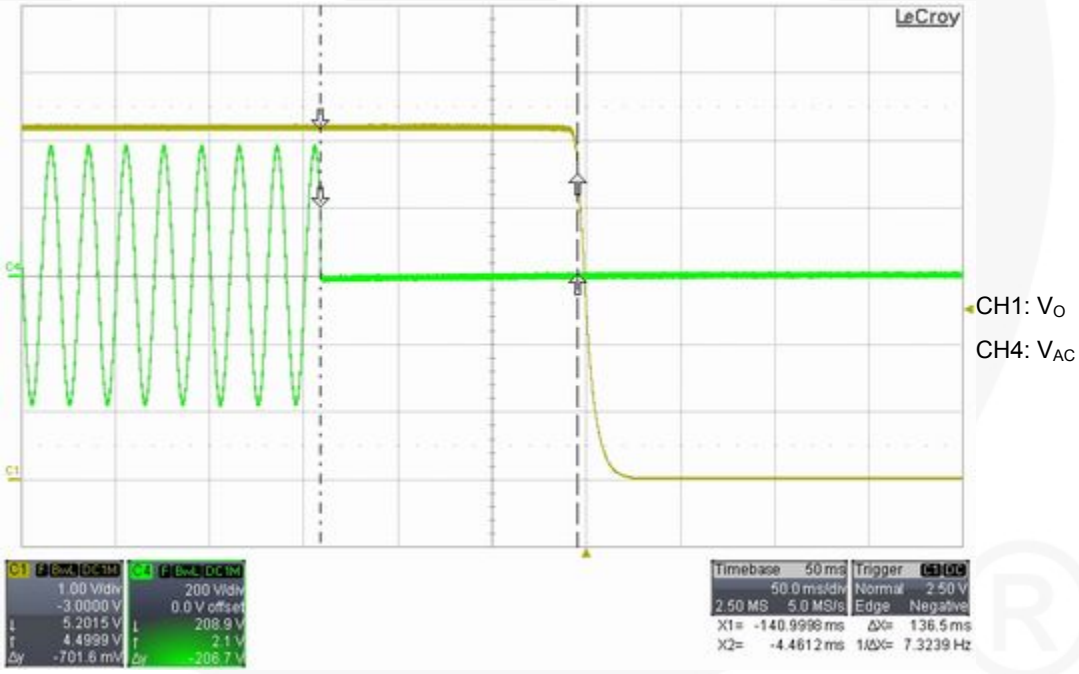


Figure 11. 264V/50Hz at Maximum Load

3.10. Short-Circuit Protection

3.10.1. Test Condition

Short the output of the power supply. The power supply should enter “Hiccup” Mode protection with less than 2W input voltage.

3.10.2. Test Result

Input Voltage	Input Wattage at Maximum Load (W)	Input Wattage at Minimum Load (W)
90V / 60Hz	0.2770	0.2825
264V / 50Hz	0.8230	0.8460

3.10.3. Measured Waveforms

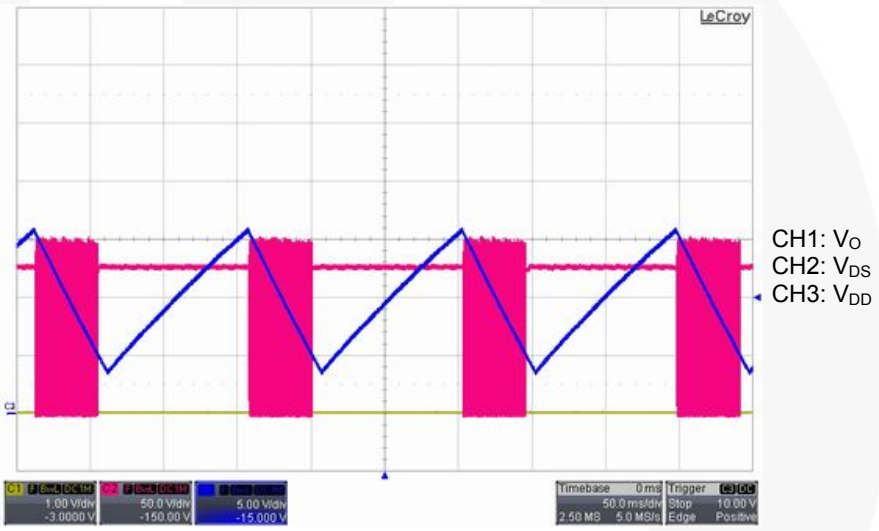


Figure 12. 90V/60Hz at Maximum Load

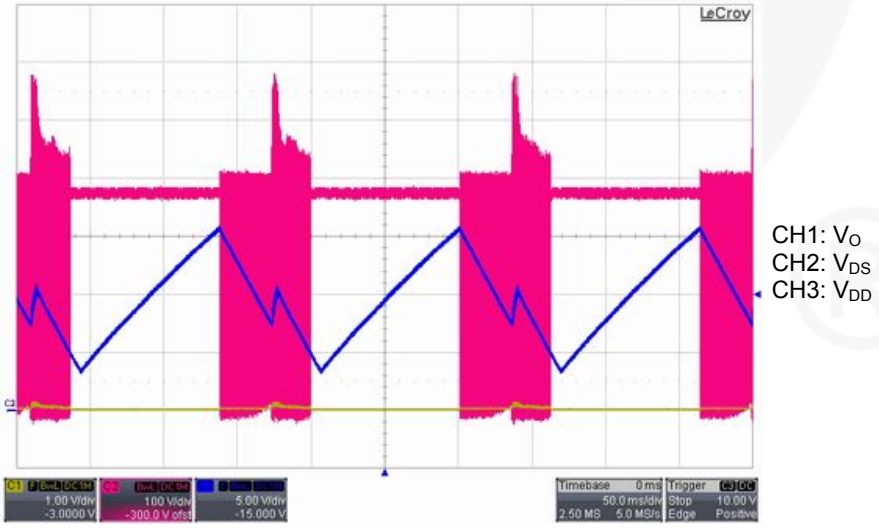


Figure 13. 264V/50Hz at Maximum Load

3.11. Brownout Test

3.11.1. Test Condition

Set output at maximum loading. Decrease input voltage with $5V_{AC}$ step. Record input wattage and output voltage. After the output is off, increase the AC voltage gradually and record the recovery voltage.

3.11.2. Test Result

Input Voltage	Input Wattage (W)	Output Voltage(V)
90V / 60Hz	5.136	5.186
85V / 60Hz	5.169	5.186
80V / 60Hz	5.198	5.182
75V / 60Hz	5.236	5.176
70V / 60Hz	5.281	5.162
Recovery Input Voltage		
70V / 60Hz	5.280	5.162

3.12. V_{DD} Voltage Level

3.12.1. Test Result

	Min. Load (V)	Max. Load (V)	Near OPP (V)	Output Short Circuit (V)
90V / 60Hz	7.7	13.6	13.7	16.0
264V / 50Hz	7.4	13.5	13.5	15.8

3.12.2. Measured Waveforms

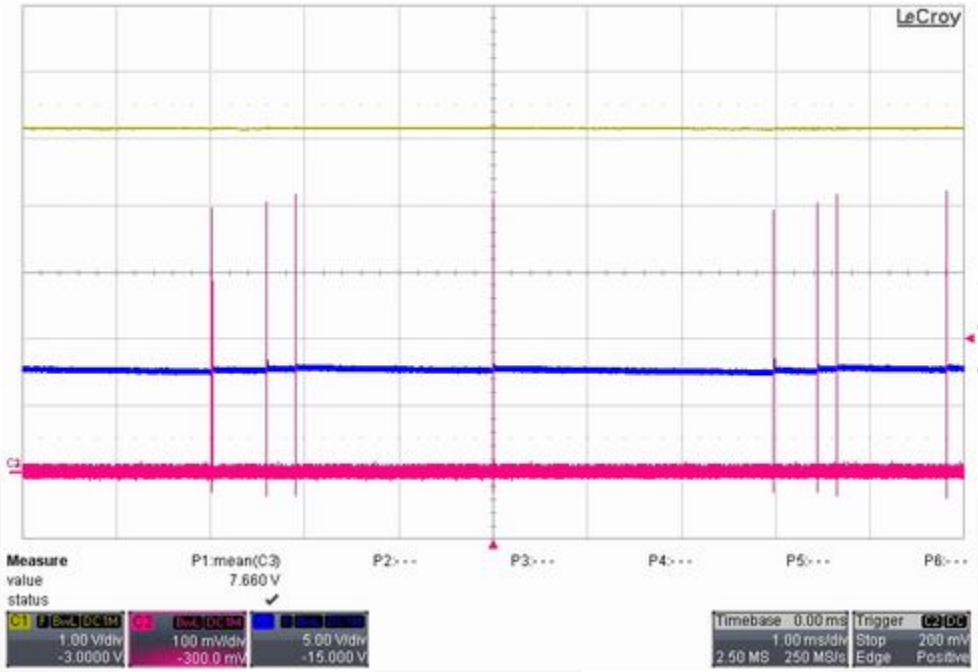


Figure 14. 90V/60Hz at No Load

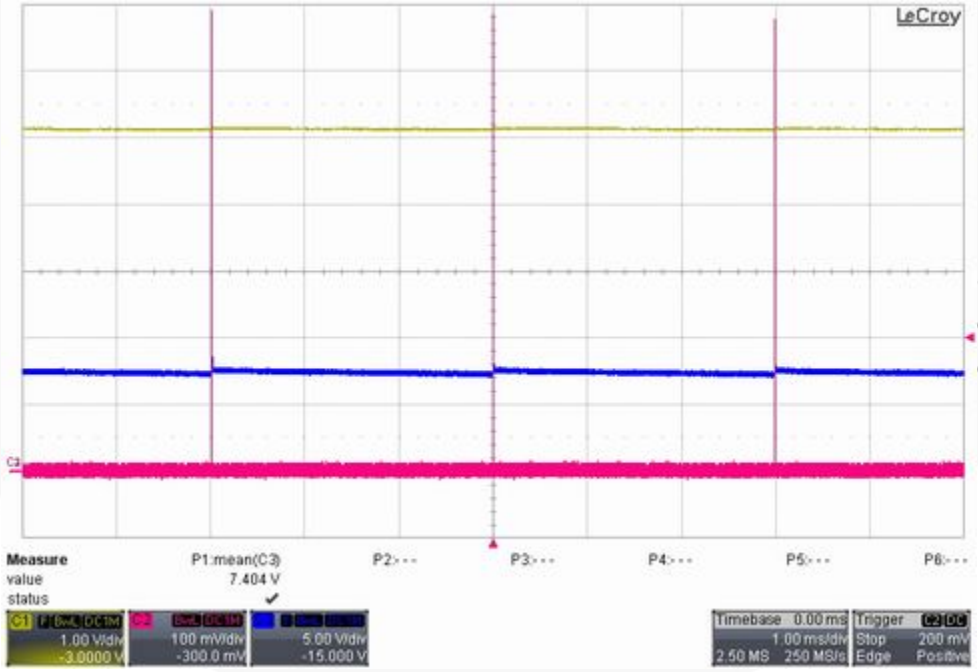


Figure 15. 264V/50Hz at No Load

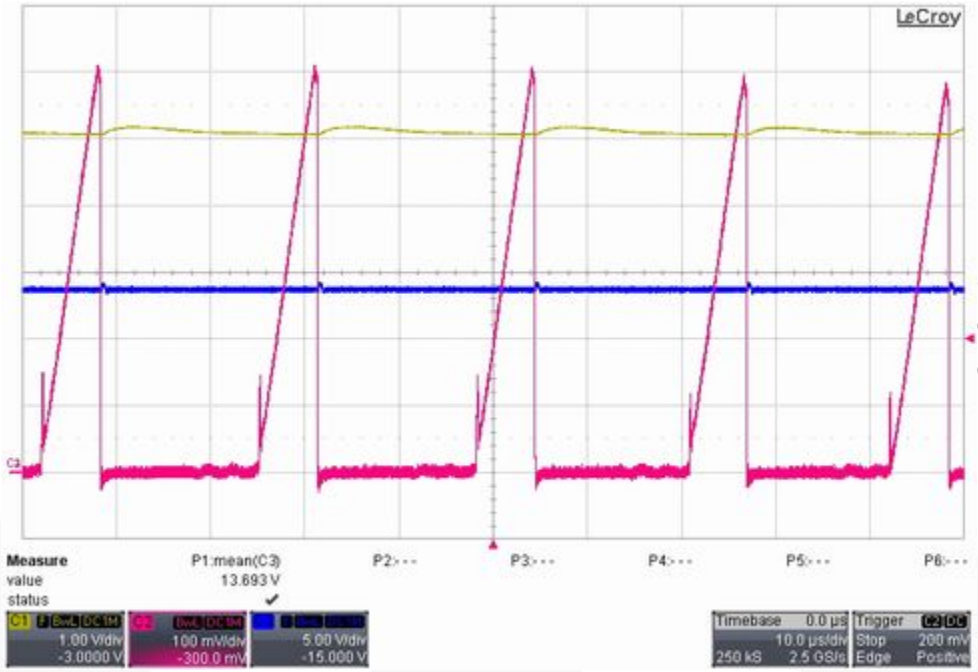


Figure 16. 90V/60Hz at Over-Power Protection

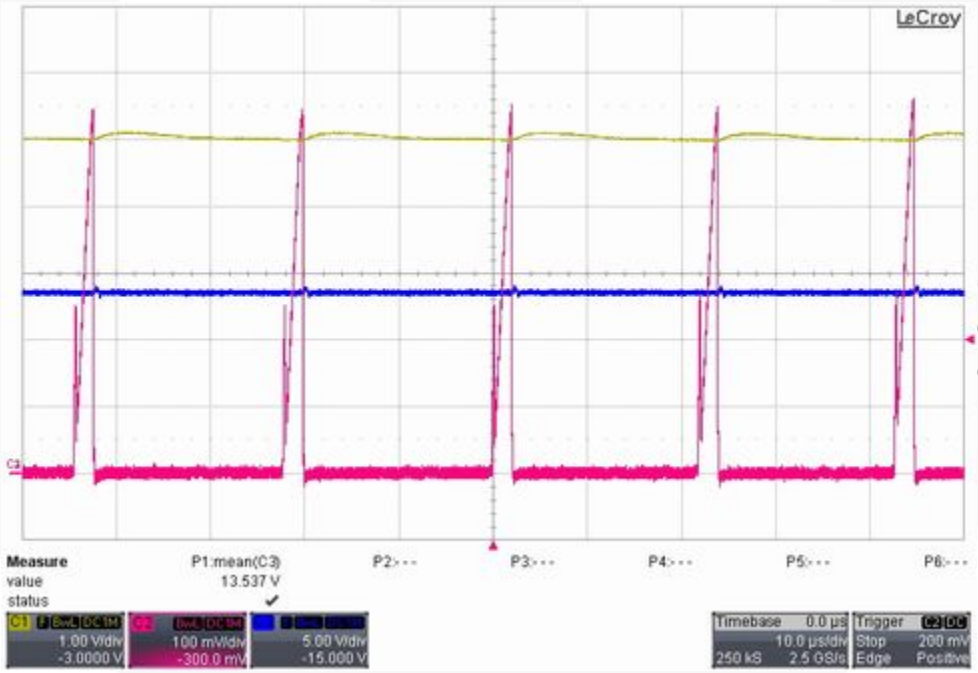


Figure 17. 264V/50Hz at Over-Power Protection

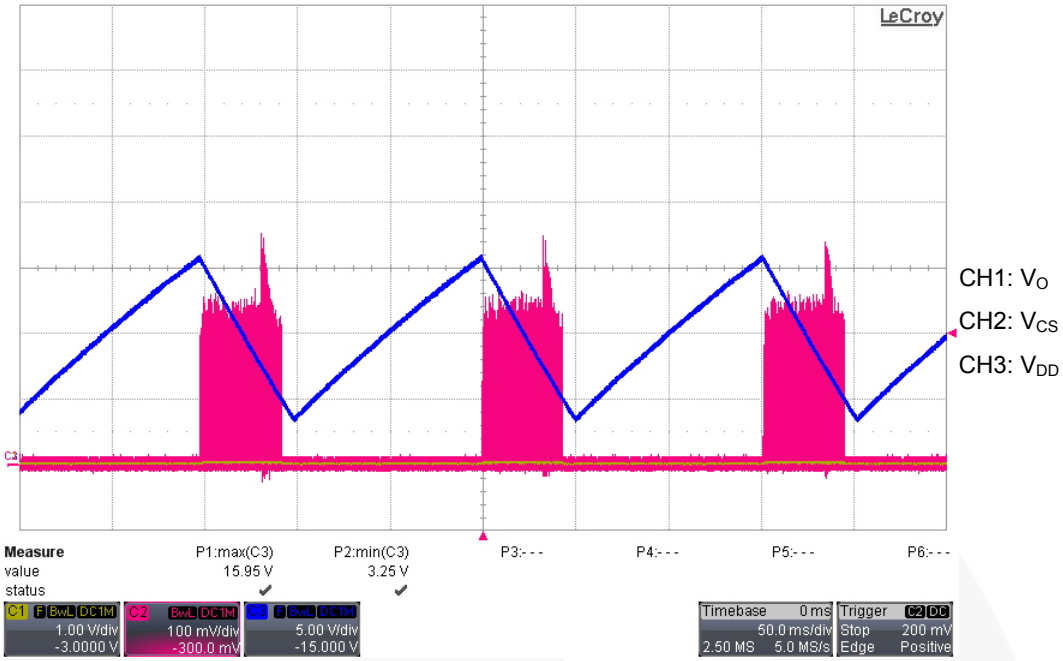


Figure 18. 90V/60Hz at Output Short

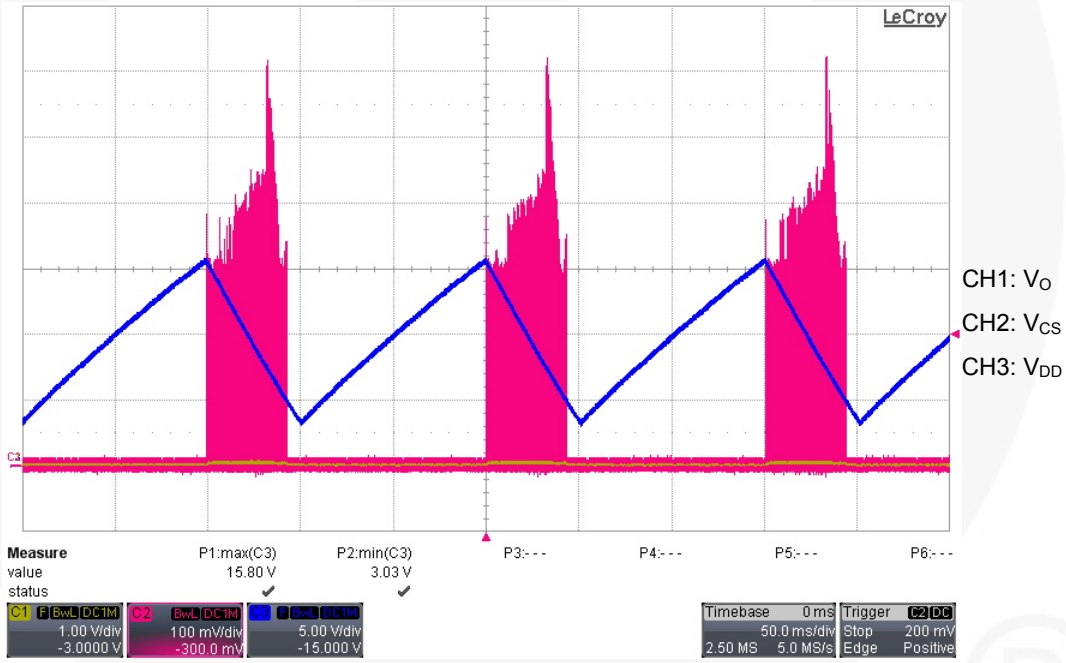


Figure 19. 264V/50Hz at Output Short

3.13. Voltage Stress on MOSFET & Rectifiers

3.13.1. Test Condition

Measure the voltage stress on MOSFET and secondary rectifiers under conditions specified below.

3.13.2. Test Result

	Stress on MOSFET	Rating	Stress on Rectifier	Rating
90V / 60Hz, Max. Load	287	700V	16.0	40V
90V / 60Hz, Max. Load, Startup	284		16.0	
90V / 60Hz, Max. Load, Output Short	182		11.0	
264V / 50Hz, Max. Load	549		36.8	
264V / 50Hz, Max. Load, Startup	542		36.2	
264V / 50Hz, Max. Load, Output Short	606		32.3	
264V / 50Hz, Max. Load Turns Off	549		36.8	

3.13.3. Measured Waveforms

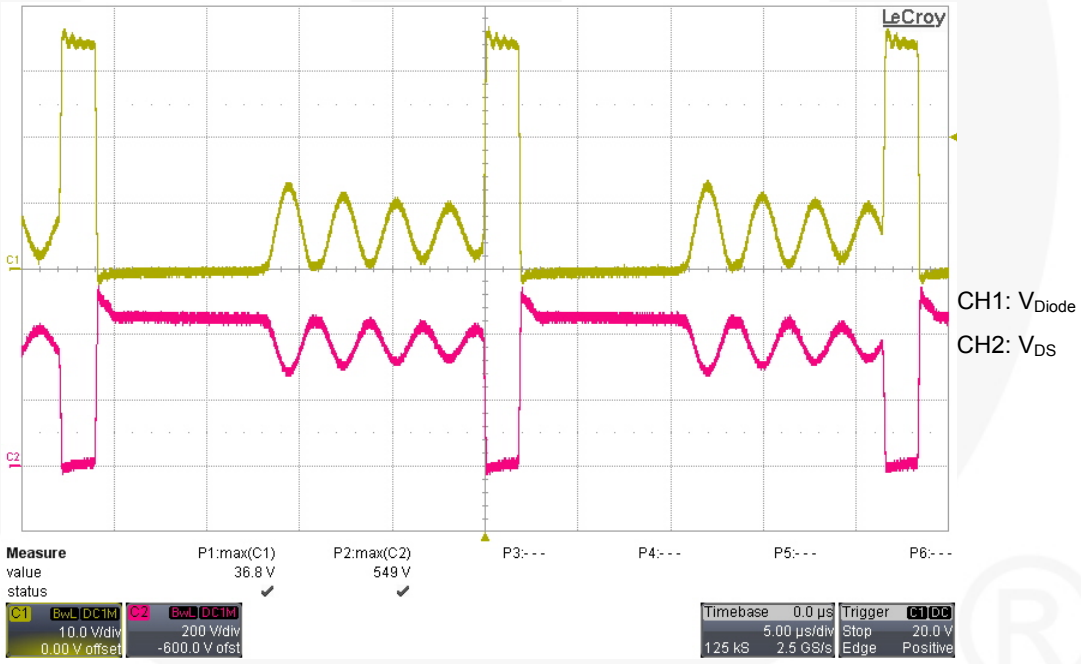


Figure 20. 264V/50Hz at Maximum Load

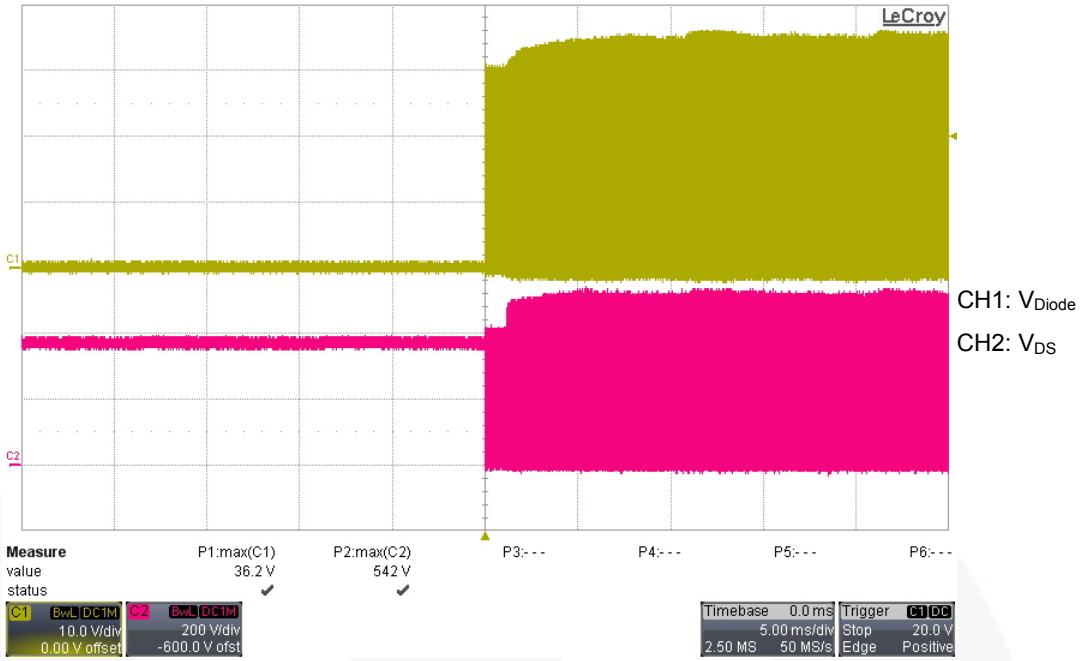


Figure 21. 264V/50Hz at Maximum Load Startup

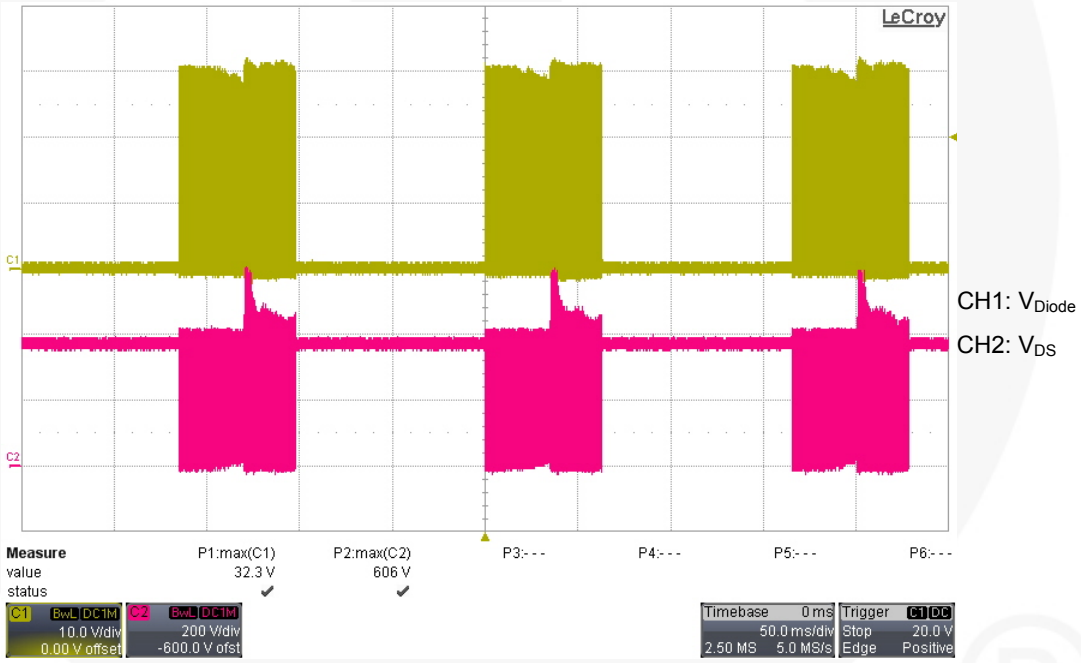


Figure 22. 264V/50Hz at Maximum Load Short

3.14. Constant Voltage (CV) and Constant Current (CC) Curves

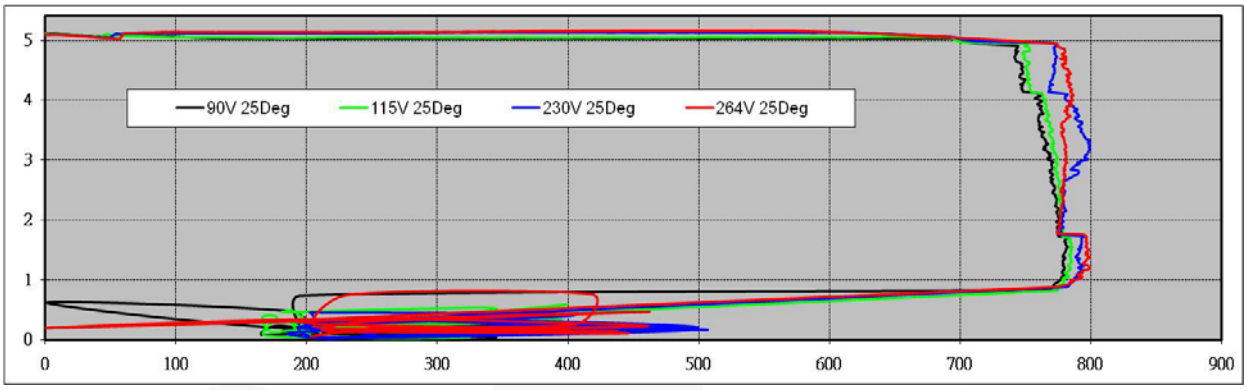


Figure 23. Constant Current Curve

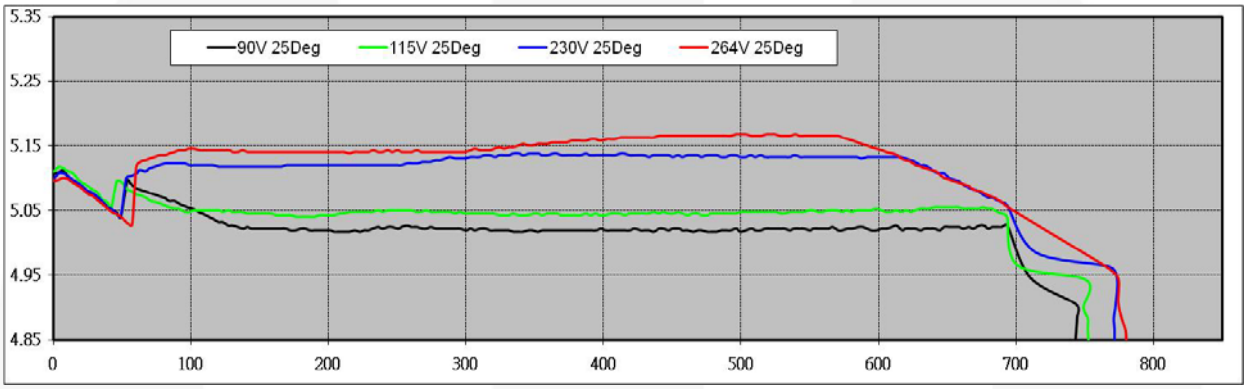
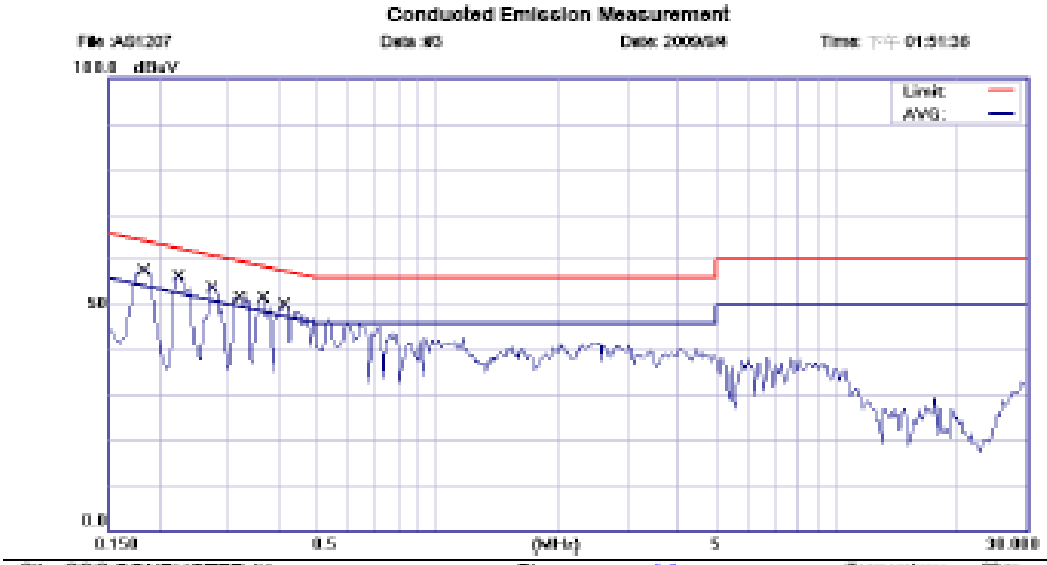


Figure 24. Constant Voltage Curve

3.15. EMI Test (Output with 1.8M Cable Wire)

SGS
臺灣檢驗科技股份有限公司-電子產品試驗部
台北縣五股工業區五工路134號
電話：（02）22993279 傳真：（02）22982698



Site: SGS CONDUCTED #1
Limit: CISPR22/11/EN55022 Class B
EUT: CHARGE
M/N: AS1207
Note: 3.5W NO.4

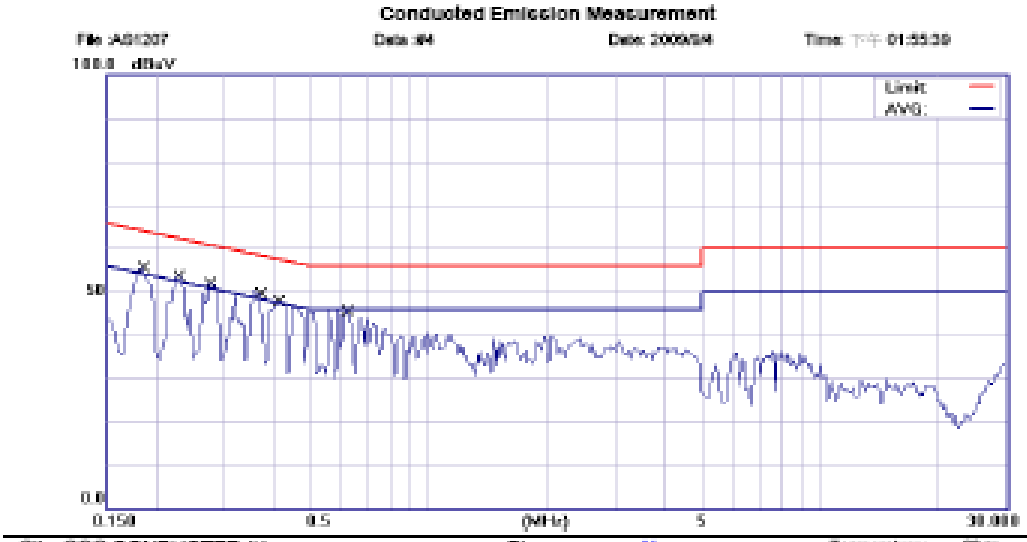
Phase: L1
Power: AC 230V/50Hz
Distance:

Temperature: 25 °C
Humidity: 60 %
Air Pressure: hpa

No.	Mk.	Freq.	Reading Level	Factor	Measure-ment	Limit	Over		
		MHz	dBuV	dB	dBuV	dBuV	dB	Detector	Comment
1	*	0.1810	54.19	0.14	54.33	64.44	-10.11	QP	
2		0.1810	38.57	0.14	38.71	54.44	-15.73	AVG	
3		0.2268	51.69	0.11	51.80	62.57	-10.77	QP	
4		0.2268	35.93	0.11	36.04	52.57	-16.53	AVG	
5		0.2755	48.99	0.10	49.09	60.95	-11.86	QP	
6		0.2755	34.79	0.10	34.89	50.95	-16.06	AVG	
7		0.3222	45.46	0.10	45.56	59.65	-14.09	QP	
8		0.3222	30.58	0.10	30.68	49.65	-18.97	AVG	
9		0.3616	46.03	0.09	46.12	58.69	-12.57	QP	
10		0.3616	32.67	0.09	32.76	48.69	-15.93	AVG	
11		0.4175	43.30	0.08	43.38	57.50	-14.12	QP	
12		0.4175	32.99	0.08	33.07	47.50	-14.43	AVG	

Figure 25. Conduction-Line at 230V$_{AC}$

SGS
台灣檢驗科技股份有限公司-電子電通訊服務部
台北縣五股工業區五工路134號
電話：（02）22993279 傳真：（02）22982698



Site: SGS CONDUCTED #1
Limit: CISPR22/11/EN55022 Class B
EUT: CHARGE
M/N: AS1207
Note: 3.5W NO.4

Phase: N
Power: AC 230V/50Hz
Distance:

Temperature: 25 °C
Humidity: 60 %
Air Pressure: hpa

No.	Mk.	Freq.	Reading Level	Factor	Measure-ment	Limit	Over		
		MHz	dBuV	dB	dBuV	dBuV	dB	Detector	Comment
1	*	0.1855	51.68	0.16	51.84	64.23	-12.39	QP	
2		0.1856	34.45	0.16	34.61	54.23	-19.62	AVG	
3		0.2288	49.88	0.14	50.02	62.49	-12.47	QP	
4		0.2288	32.66	0.14	32.80	52.49	-19.69	AVG	
5		0.2777	46.55	0.13	46.68	60.88	-14.20	QP	
6		0.2777	28.74	0.13	28.87	50.88	-22.01	AVG	
7		0.3668	44.19	0.11	44.30	58.57	-14.27	QP	
8		0.3668	27.88	0.11	27.99	48.57	-20.58	AVG	
9		0.4138	41.17	0.11	41.28	57.57	-16.29	QP	
10		0.4138	27.50	0.11	27.61	47.57	-19.96	AVG	
11		0.6199	38.27	0.10	38.37	56.00	-17.63	QP	
12		0.6199	18.72	0.10	18.82	46.00	-27.18	AVG	

Figure 26. Conduction- Neutral at 230V_{AC}

3.16. Surge test

3.16.1. Test Condition

- Maximum Load, V_{IN} (AC) = 230V 50Hz
- L-PE: (Positive & Negative) 1KV~4.4KV
- N-PE: (Positive & Negative) 1KV~4.4KV
- L-N: (Positive & Negative) 500V~1KV

3.16.2. Test Result

Mode	Polarity	Phase	Voltage	Condition
L-PE	+/-	0◦	4.4KV	Pass
	+/-	90◦		Pass
	+/-	180◦		Pass
	+/-	270◦		Pass
N-PE	+/-	0◦	4.4KV	Pass
	+/-	90◦		Pass
	+/-	180◦		Pass
	+/-	270◦		Pass
L-N	+/-	0◦	2.0KV	Pass
	+/-	90◦		Pass
	+/-	180◦		Pass
	+/-	270◦		Pass

3.17. ESD Test

3.17.1. Test Condition

- Maximum Load, V_{IN} (AC) = 230V 50Hz
- Air: (Positive & Negative) 8KV~16KV
- Contact: (Positive & Negative) 4KV~8KV

3.17.2. Test Result

Mode	Polarity	Voltage	Condition
Air	+/-	16.5KV	Pass
Contact	+/-	8.8KV	Pass

4. Photographs

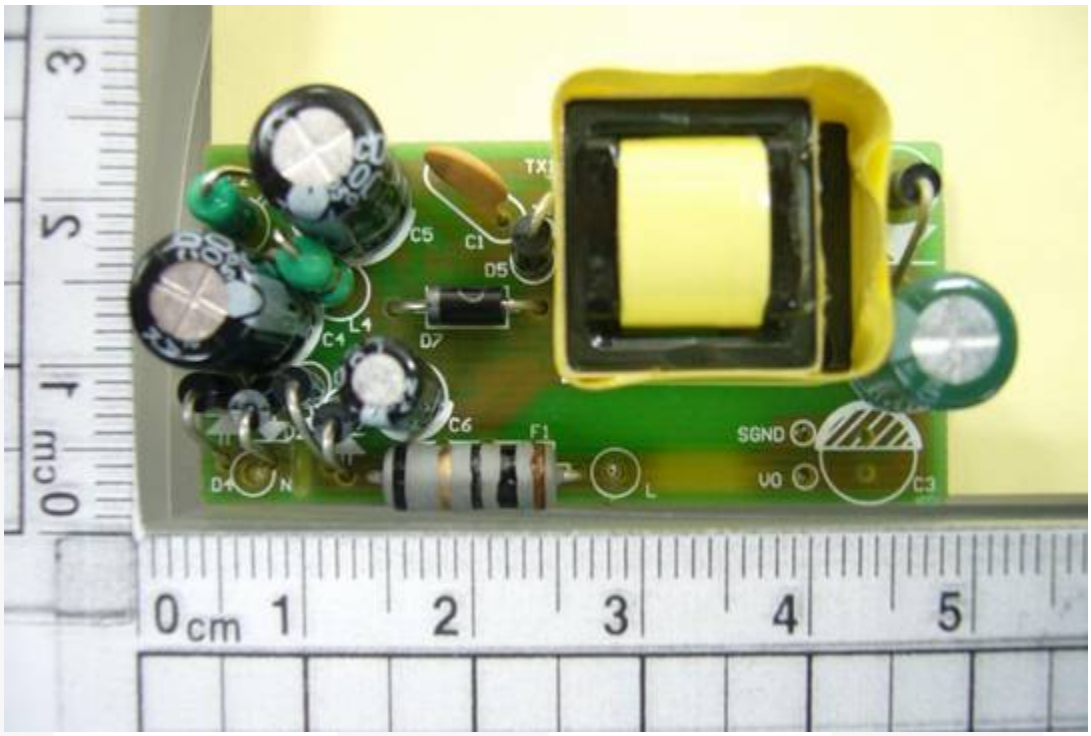


Figure 27. Vertical View

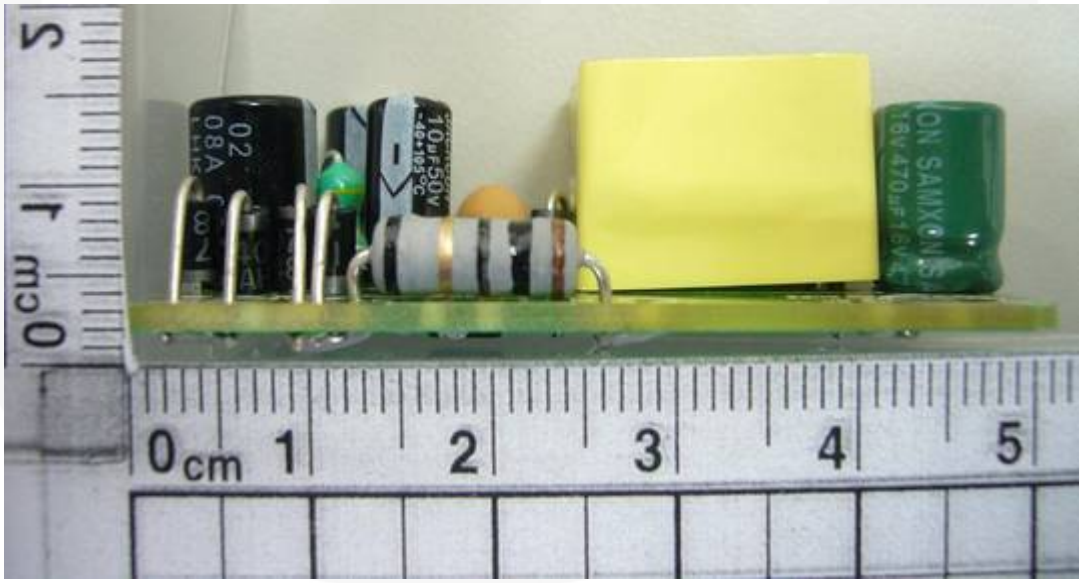


Figure 28. Lateral View

5. Circuit Schematic

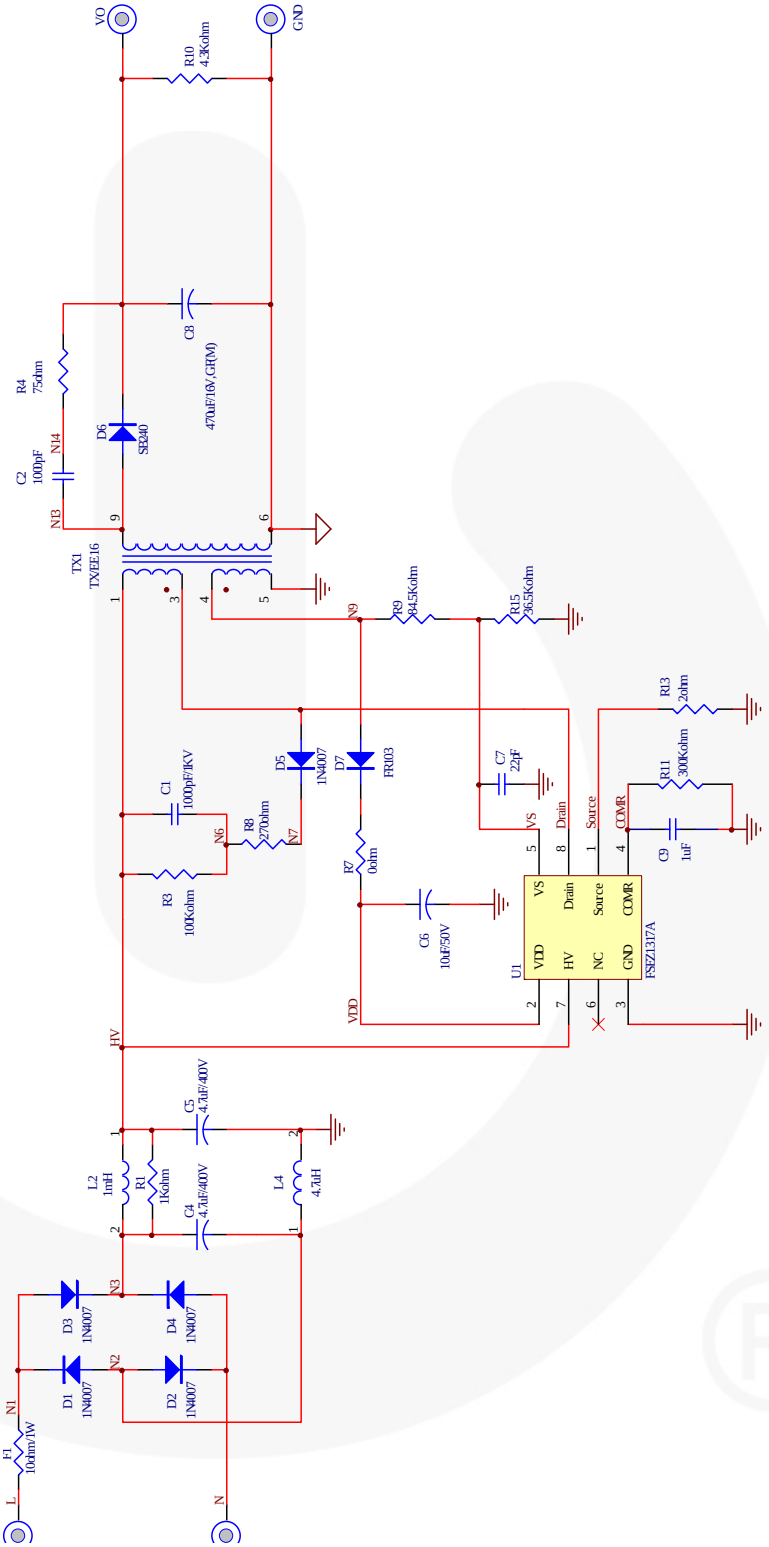


Figure 29. Circuit Schematic

6. PCB Layout

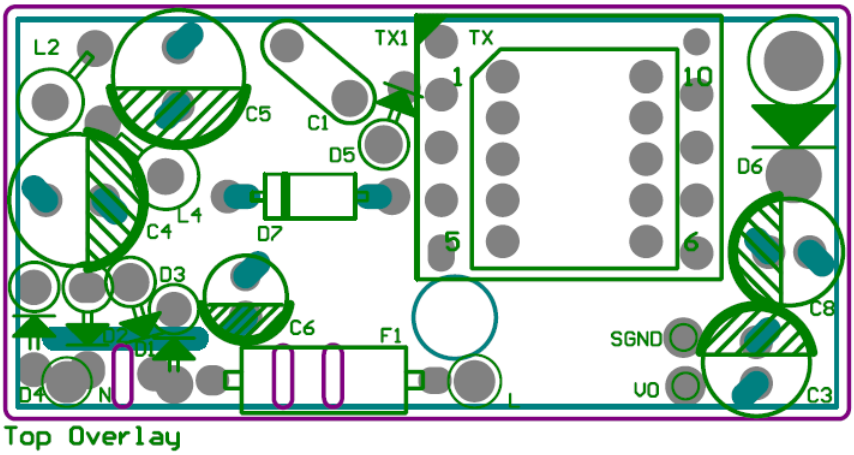


Figure 30. Top Overlay

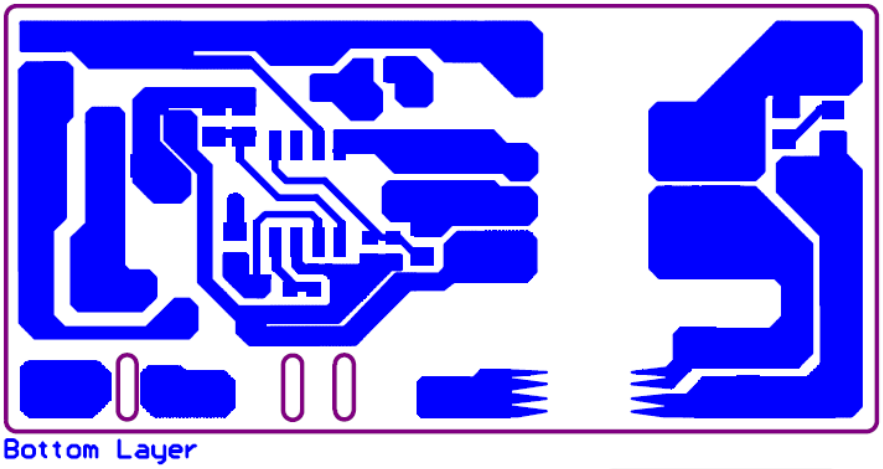


Figure 31. Bottom Layer

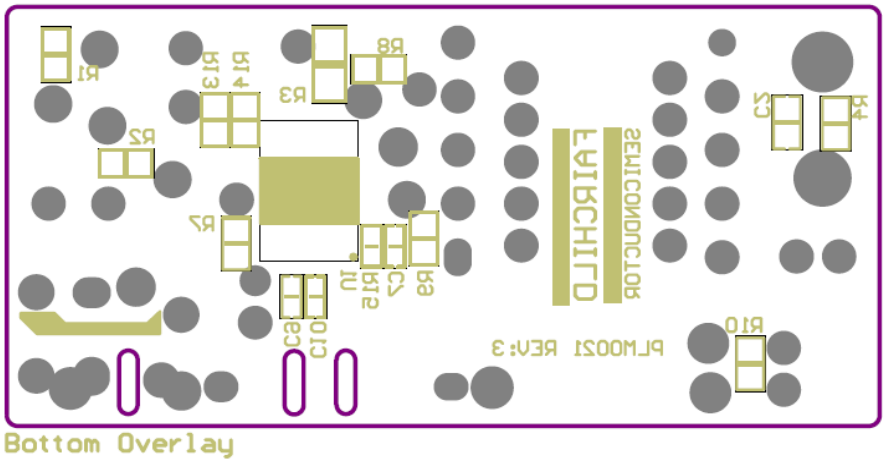


Figure 32. Bottom Overlay

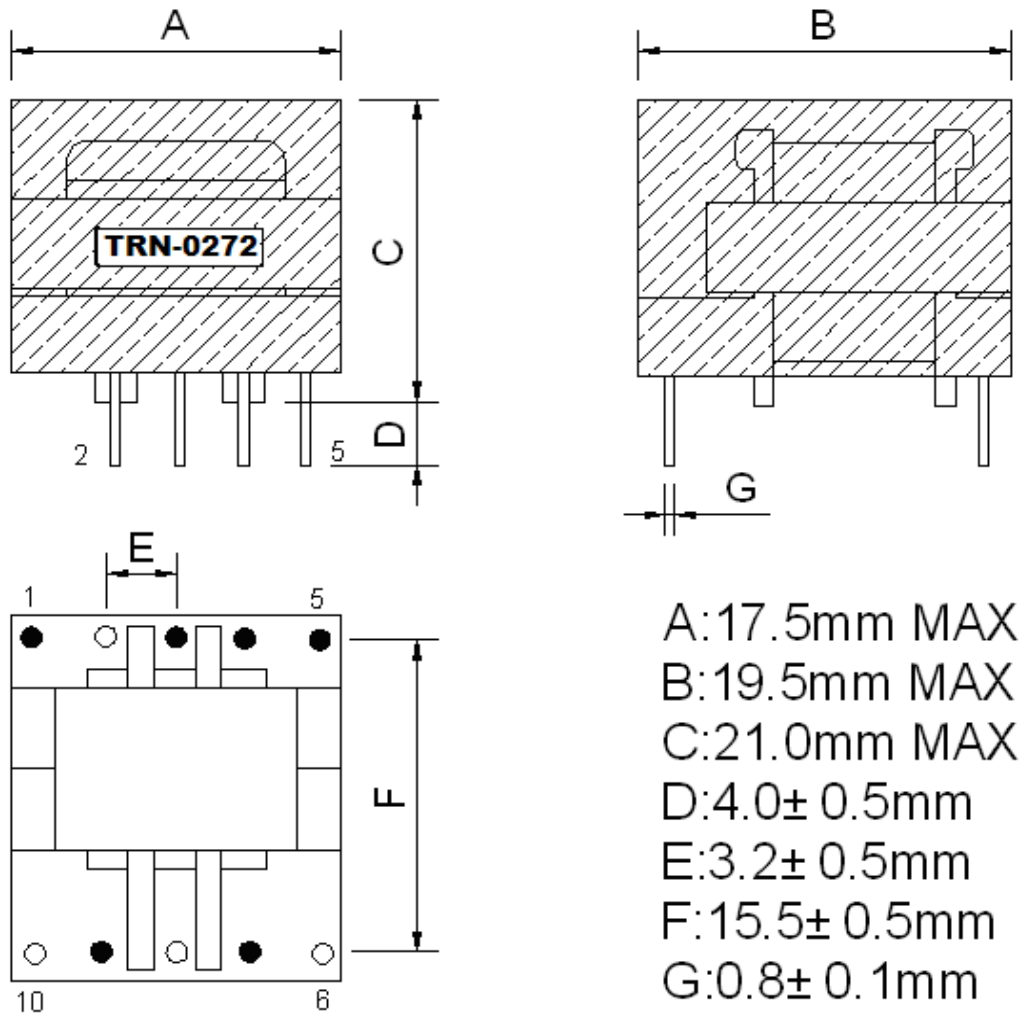
7. 76-B070063-00 FSEZ1317WA Evaluation Board BOM

Component	Qty	Part No.	Manufacturer	Reference
Wire Wound Resistor 1W 10Ω±5%	1	KNP1W10ΩJP	TZAI YUAN	F1
Chip Resistor 0603 36.5KΩ±1%	1			R15
Chip Resistor 0603 300KΩ±1%	1			R11
Chip Resistor 0805 0Ω±5%	1			R7
Chip Resistor 0805 2Ω ±1%	1			R13
Chip Resistor 0805 75Ω±5%	1			R4
Chip Resistor 0805 270Ω±5%	1			R8
Chip Resistor 0805 1KΩ±5%	1			R1
Chip Resistor 0805 4.3KΩ±5%	1			R10
Chip Resistor 0805 84.5KΩ±1%	1			R9
Chip Resistor 1206 100KΩ±5%	1			R3
MLCC 0603 NPO 22P 50V±5%	1			C7
MLCC 0603 X7R 1μF 25±10%	1			C9
MLCC 0805 X7R 1000P 50V±10%	1			C2
Ceramic Capacitor 1000P 1KV+80/-20%	1			C1
Electrolytic Capacitor 4μ7 400V 105℃	2		JACKCON	C4 C5
Electrolytic Capacitor 10μ 50V 105℃	1		JACKCON	C6
Electrolytic Capacitor 470μ 16V105℃	1	EGF477M1CF12TV	SAMXON	C8
Fixed Inductor 1mH±10%	1	EC36-102K	SYNTON	L2
Fixed Inductor 4.7μH±10%	1	EC36-4R7K	SYNTON	L4
Transformer EE-16-H 2.25mH	1	TRN0272	SEN HUEI	TX1
Fast Diode DO-41 1A/200V	1	FR103	CP	D7
Diode DO-41 1A/200V	5	1N4007		D1 D2 D3 D4 D5
Schottky Diode DO-15 2A/40V	1	SB240	CP	D6
1.0A/700V PSR IC	1	FSEZ1317WAMY	Fairchild Semiconductor	U1
PCB PLM0021 REV 3	1			

8. Specification Approval

Customer	SYSTEM GENERAL CORP.			P/N:	TRN-0272
DATE	08/24/2009	Version	A	Page	1/4

尺寸图：

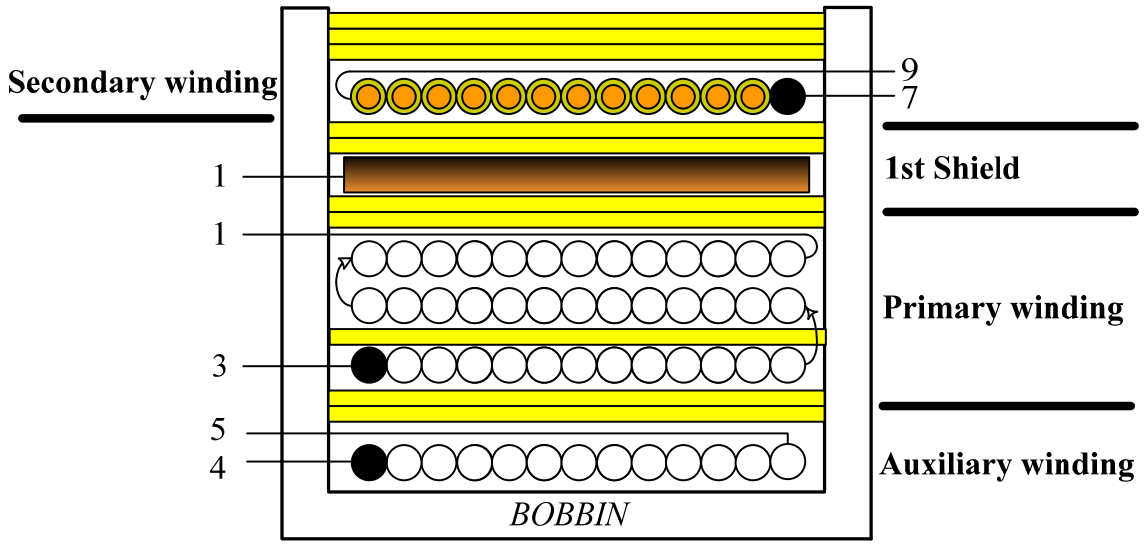


1.Pin2.6,.8.10.removed
2.copper shield:0.025x7mm,lead to pin 1
3.Transformer outside need use 14mm insulation tape 4turns

UNIT	m/m	DRAWN	CHECK	TITLE	TRANS
TEL	(02)29450588	Ci wun Chen	Guo long Huang	IDENT NO.	TRN-0272
FAX	(02)2215-8293	SEN HUEI INDUSTRIAL CO.,LTD.		DWG NO.	
No.26-1, Lane 128, Sec. 2, Singnan Rd., Jhonghe City, Taipei County 235, Taiwan (R.O.C.)					

Customer	SYSTEM GENERAL CORP.			P/N:	TRN-0272
DATE	08/24/2009	Version	A	Page	2/4

2.SCHEMATIC :



** W4R's winding is reversed winding.
** When W4R winding, need to add tube at beginning and terminal.
** When W4 is winding, it must wind one layer.
** When W2 is winding, put one layer tape after winding first layer.

NO	TERMINAL		WIRE	Ts	INSULATION	BARRIER	
	S	F			Ts	pri	sec
W1	4	5	2UEW 0.23*2	15	2	-	-
W2	3	1	2UEW 0.17*1	40	1	-	-
				40	0		
				37	2		
W3	1	-	COPPER SHIELD	1.2	2	-	-
W4R	7	9	TEX-E 0.55*1	9	2	-	-
			CORE ROUNDING TAPE		3	`	

UNIT	m/m	DRAWN	CHECK	TITLE	TRANS
TEL	(02)2215-8302	Ci wun Chen	Guo long Huang	IDENT NO.	TRN-0272
FAX	(02)2215-8293	SEN HUEI INDUSTRIAL CO.,LTD.		DWG NO.	
No.26-1, Lane 128, Sec. 2, Singnan Rd., Jhonghe City, Taipei County 235, Taiwan (R.O.C.)					

Customer	SYSTEM GENERAL CORP.			P/N:	TRN-0272
DATE	08/24/2009	Version	A	Page	¾

3.ELECTRICAL SPECIFICATION：

3.1 Inductance test： **at 1KHz ,1V**

P(3-1)：**2.25mH ±7% (2.1mH Min. ~ 2.4mH Max.)**

3.2 Hi-pot test：

AC 3.0K V /60Hz/5mA hi-pot for one minute between pri to sec.
AC 1.5K V /60Hz/5mA hi-pot for one minute between pri to core.
AC 1.5K V /60Hz/5mA hi-pot for one minute between sec to core.

3.3 Insulation test：

The insulation resistance is between pri to sec and windings to core measured by DC 500V, must be over 100MΩ.

3.4 Terminal strength：

1.0 Kg on terminals for 30 seconds, test the breakdown.

UNIT	m/m	DRAWN	CHECK	TITLE	TRANS
TEL	(02)2215-8302	Ci wun Chen	Guo long Huang	IDENT NO.	TRN-0272
FAX	(02)2215-8293	SEN HUEI INDUSTRIAL CO.,LTD.		DWG NO.	
No.26-1, Lane 128, Sec. 2, Singnan Rd., Jhonghe City, Taipei County 235, Taiwan (R.O.C.)					

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COMPONENT	MAT'L	MANUFACTURE	FILE NO.
1.Bobbin	Phenolic 94V-0,T373J,150℃	EE-16.(TF-1613) Chang Chun plastics co. ltd.	E59481(S)
2.Core	PC-40,BH2,2E6 3C85,NC-2H,	Ferrite core EE-16 TDK,Tokin.Tomita.Philip.Nicera.	
3.Wire	UEWE 130℃	Tai-I electric wire &cable co ltd.	E85640 S）
	UEW-2 130℃	Jung Shing wire co.,ltd	E174837
	UEW-B 130℃	Chuen Yih wire co.,ltd	E154709 S）
	TEX-E 105℃/120℃	Furukawa electric co.,ltd.	E206440
4.Varnish	BC-346A 180℃	John C Dolph co.,itd.	E51047 M）
	468-2FC 130℃	Ripley resin engineering co inc.	E81777 N）
5.Tape t=0.064mm	31CT 130℃	Nitto denk corp	E34833 M）
	Polyester 3M #1350(b) 130℃	Minnesota mining &MFG co.,ltd. CTI material group	E17385 N）
6.Tube	Teflon tube TFL 150V,200℃	Great holding industrial co.,ltd.	E156256 S）
7.Terminals	Tin coated- Copper wire	Will fore special wire corp	
		Hitachi cable lid	

MATERALS LIST：

UNIT	m/m	DRAWN	CHECK	TITLE	TRANS
TEL	(02)29450588	Ci wun Chen	Guo long Huang	IDENT NO.	TRN-0272
FAX	(02)29447647	SEN HUEI INDUSTRIAL CO.,LTD..		DWG NO.	
No.26-1, Lane 128, Sec. 2, Singnan Rd., Jhonghe City, Taipei County 235, Taiwan (R.O.C.)					

9. Revision History

Rev.	Date	Description
1.0.0	July 2012	Initial release

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Replace components on the Evaluation Board only with those parts shown on the parts list (or Bill of Materials) in the Users' Guide. Contact an authorized Fairchild representative with any questions.

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2. A critical component is any component of a life support device or system whose failure to perform can be reasonably expected to cause the failure of the life support device or system, or to affect its safety or effectiveness.

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