ADP1048 Bridgeless PFC Evaluation Kit

ADP1048-Brigeless

PRD 1378

FEATURES

Bridgeless Boost PFC topology providing high efficiency, high power factor and low THD
Protection features for AC line input and high voltage output
I2C serial interface to PC
Software GUI
Programmable digital filters
Programmable response to faults
Programmable inrush control
Accurate AC power metering
Digital Calibration and trimming

CAUTION

This evaluation board uses high voltages whenever it is powered up. The isolated AC power supply is required for the input voltage source. The output capacitor has high level of energy stored and it must be discharged before the load is disconnected. Extreme caution must be taken to ensure safety for the user. It is strongly advised to power down the evaluation board when not in use.

ADP1048 EVALUATION BOARD OVERVIEW

This evaluation board features the ADP1048 in a switching power supply application. With the evaluation board and software, the ADP1048 can be interfaced to any PC running Windows 2000/XP/Vista/NT via the computer's USB port. The software allows control and monitoring of the ADP1048 internal registers. The board is set up for the ADP1048 to act as boost power factor correction circuit with a rated load of 300W from an input voltage ranging from a 85 V_{RMS} to 265 V_{RMS}.

EVALUATION SYSTEM CONTENTS

The evaluation system package contains the following items:

- Application note ADP1048 bridgeless PFC
- ADP1048 bridgeless PFC evaluation board

The USB/I2C adapter for serial communication and software CD need to be ordered separately.

Rev. 1.3
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DEMO BOARD SPECIFICATIONS

Specification	*MIN*	*TYP*	*MAX*	*Units*	*Notes*
V_{IN}	90	115 or 230	265	V_{RMS}	
V_{OUT}		385		V	
P_{OUT}	0.0		300	W	
$T_{AMBIENT}$	0	30	65	ºC	
Efficiency		96		%	
Switching frequency		97.7		KHz	

Table 1 - Target Specifications

TOPOLOGY AND CIRCUIT DESCRIPTION

This evaluation board features the ADP1048 in a typical AC/DC switching power supply in a bridgeless boost power factor correction (PFC) topology. The circuit is designed to provide a rated load of 385V/300W from an AC input voltage source of 90 V_{RMS} to 265 V_{RMS} AC. The ADP1048 provides functions all the functions necessary for active PFC circuit plus accurate AC power metering. It achieves near-unity power factor, low distortion of the input current, the output voltage regulation, over current protection, AC line fault detection and protection, over temperature protection, and power supply shutdown. It also can optimize light load efficiency performance using output voltage adjustment and frequency reduction.

Please refer to the appendix for the detailed schematic. The AC input side consists of the input terminals, EMI filter, inrush relay and its control circuit. The D4 is used for input voltage sensing. The D21 is used to charge the output capacitor during the initial stage. It has two boost circuits, one consists of L3, Q2 and D15, while the other consists of L2,Q1 and D2. The D34 and D35 are slow recovery diodes. The boost circuit consists boost inductor (L2), boost switch (Q1) and diode (D2). The gate signal for the boost switch comes from the ADP1048 through the ADP3634 gate driver. The ADP1048 (U1, on daughter card) can be powered either via the USB 5V via an ADP3303 LDO (U2, on daughter card) present on the same daughter card, or via the auxiliary power supply on the board. Thermistor (RTD1) is placed close to the MOSFET on the board allowing over temperature protection functionality to be implemented.

CONNECTORS

The connections to the evaluation board are shown below.

Connector	Evaluation Board Function
J1	AC Input
J4	385V DC Voltage Output
J5	Ground Return for 385 V DC Voltage Output
J8	I2C Connector
J6	Daughter card

Table 2 - Evaluation board connectors

There is a 4 pin connector, J8 for I2C communication. This allows the software to communicate with the evaluation board through the USB port of the PC.

Pin	Evaluation Board Function
1	5V
2	SCL
3	SDA
4	Ground

Table 3 - J8, J11 connections

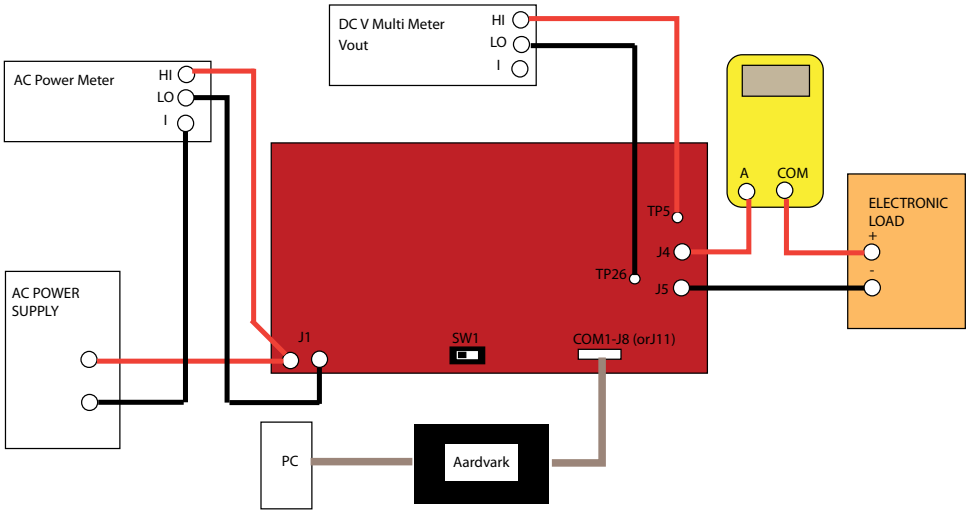


Figure 2 - Test configuration for the Evaluation Board

SETTING FILES AND EEPROM

The ADP1048 communicates with the GUI software using the I2C bus.

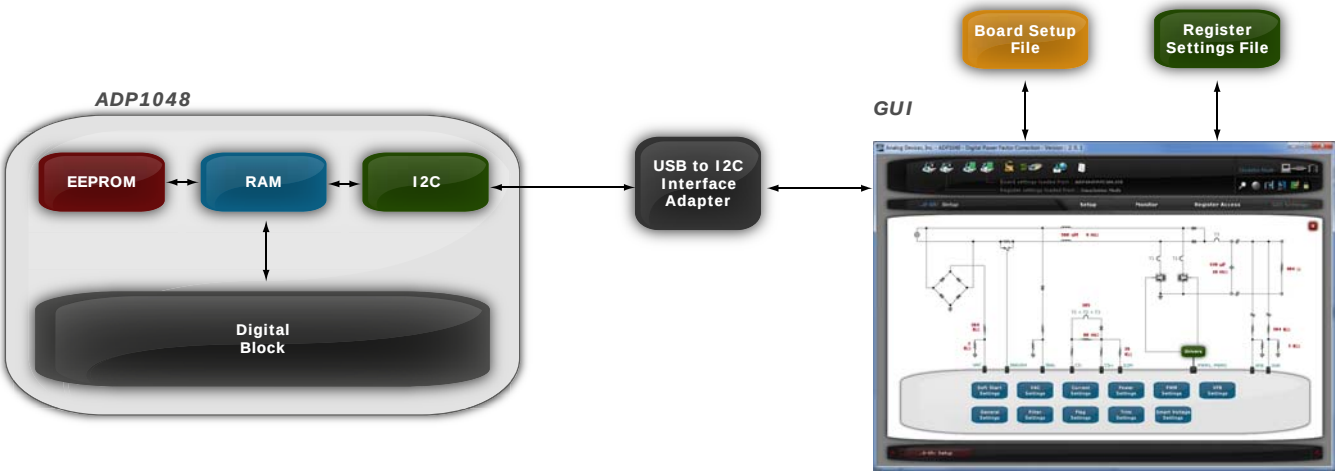


Figure 3 - ADP1048 and GUI interaction

The register settings (having extension .48r) and the board settings (having extension .48b) are two files that are associated with the ADP1048 software. The register settings file contains information that govern the functionality of the part such as the over voltage and over current limits, softstart timing, PWM settings etc. The ADP1048 stores all its settings in the EEPROM. When the ADP1048 is connected to the USB adapter the LDO powers the I.C. and the GUI downloads the settings from the registers of the ADP1048 so that the state of the part is known. It is possible to save these settings in a file for later use. Older register settings are overwritten when new files are loaded.

The EEPROM on the ADP1048 can contain the information about the board, such as current sense resistor, output inductor and capacitor values. This information is also stored in board setup file (extension .48b) and is necessary for the GUI to display the correct information in the 'Monitor' tab as well as 'Filter Settings' window. Always make sure that the correct board file has been loaded for the board currently in use.

Each ADP1048 chip has trim registers for the temperature, input current and the output voltage and input voltage. These can be configured during production and are not overwritten whenever a new register settings file is loaded. This is done in order to retain the trimming of all the ADCs for that corresponding environmental and circuit condition (component tolerances, thermal drift, etc.).

BOARD EVALUATION

EQUIPMENT

- AC Power Supply
- Electronic Load
- Oscilloscope with differential probes
- PC with ADP1048 GUI installed
- Precision Digital Multimeters (HP34401or equivalent - 6 digits) for measuring DC current and voltage

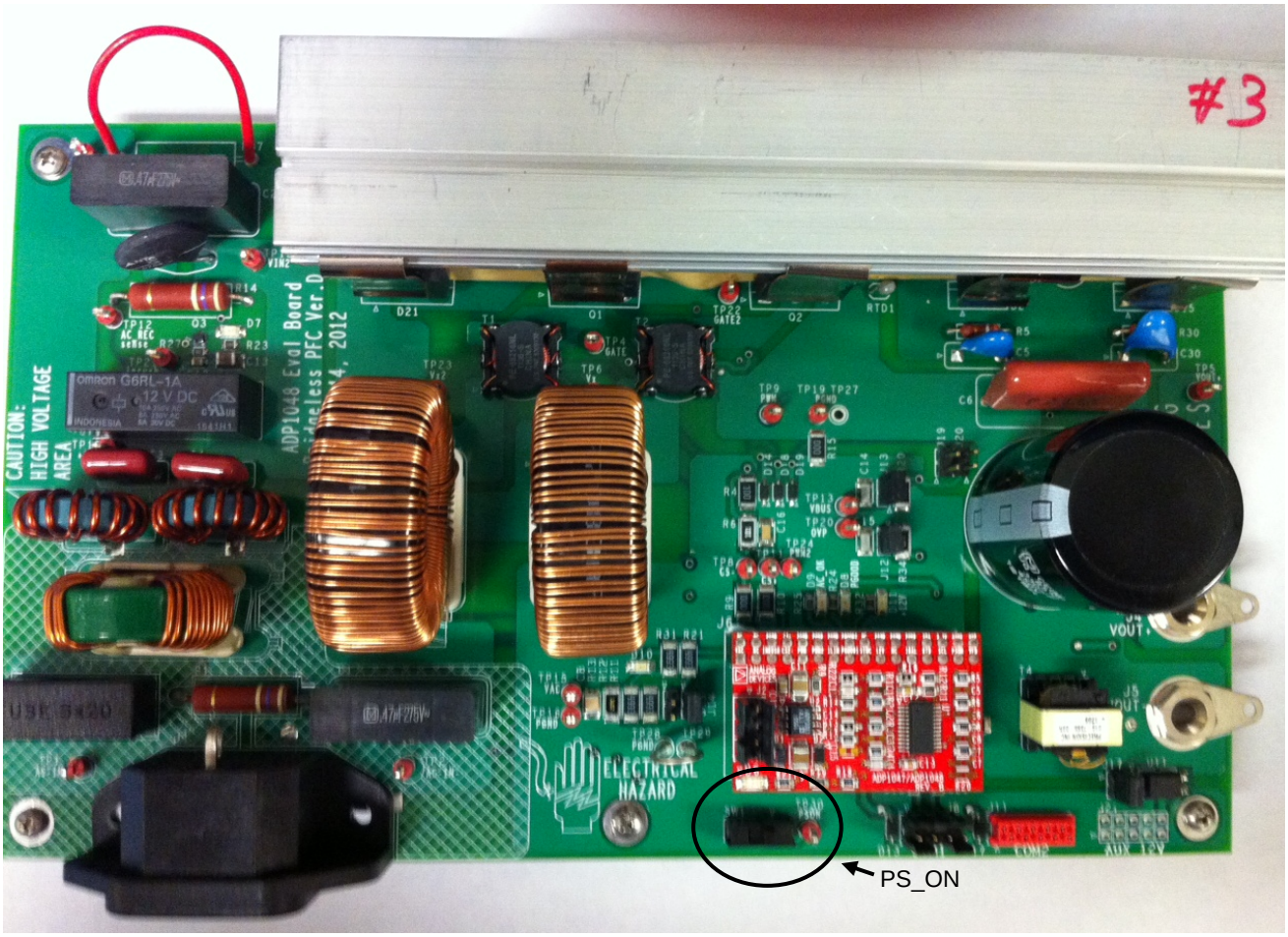


Figure 4 - 300W evaluation board showing PS_ON hardware switch

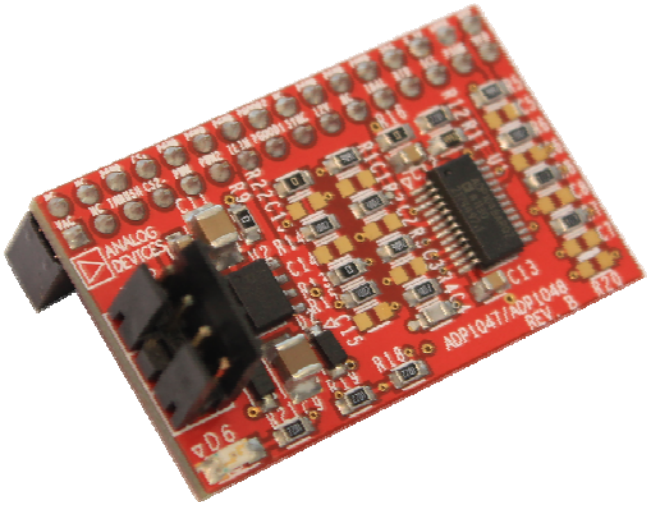


Figure 5 - ADP1048 daughter card

SETUP

NOTE: DO NOT CONNECT THE USB CABLE TO THE EVALUATION BOARD UNTIL THE SOFTWARE HAS FINISHED INSTALLING

1) Install the ADP1048 software by inserting the installation CD. The software setup will start automatically and a guided process will install the software as well as the USB drivers for communication of the GUI with the IC using the USB adapter.
2) Insert the daughter card in connector J6 as shown in Figure 4.
3) Ensure that the PS_ON switch (SW1 on schematic) is turned to the on position. It is located on the bottom left half of the board (Figure 4).
4) Connect the evaluation board to the USB port on the PC using the "USB to I2C interface" adapter as shown in **Error! Reference source not found.**1.
5) The software should report that the ADP1048 has been located on the board. Click "Finish" to proceed to the Main Software Interface Window. The serial number reported on the side of the checkbox indicates the USB adapter serial number. The windows also displays the device I2C address.

Figure 6 - ADP1048 address in the GUI

6) If the software does not detect the part it enters into simulation mode. Ensure that the connector is connected to J8/J11 (on main board) Click on 'Scan for ADP1048A now' icon (magnifying glass) located on the top right hand corner of the screen.

Figure 7 - "Scan for ADP1048 Now' icon

7) **The board setting is store in the IC and this step is optional.** Click on the "Load Board Settings" icon (fourth button from the left) and select the ADI1048bridgelessPFC**.48b** file. This file contains all the board information including values of shunt and voltage dividers. Note: All board setting files have an extension of .48b

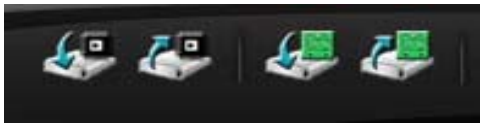


Figure 8 - Different icons on dashboard for loading and saving .48r and .48b files

8) **The IC on the evaluation board comes preprogrammed and this step is optional.** The original register configuration is stored in the ADP1048bridgelessPFC**.48r** register file. Note: All register files have an extension of .48r. The file can be loaded using the second icon from the left in Figure .

9) Connect a resistive or electronic load to the output connections of Vout+ and Vout-. Note that the load should be connected before the input power is supplied to the evaluation board for safety concerns.
10) Connect a 50 or 60 Hz isolated ac power source, which has to be turned off, to ac plug J1 or terminals J9 and J10.
11) Turn on AC power source and increase the input voltage within the range from 85Vrms to 265Vrms.
12) The evaluation board should now up and running, and ready for evaluation. The output should now read about 385 VDC.
13) Click on the 'MONITOR' tab and then on the Flags and readings icon. This window provides a snapshot of the entire state of the PSU in a single user friendly window.

Figure 9 - Monitor window in GUI

During power up, the ADP1048 is connected to the USB port (5V) and the LDO powers the IC. It takes 20µsec for VCORE (pin 26) to reach an internal voltage of 2.5V. After this, the I.C. downloads the contents of the registers into the EEPROM. After this the softstart ramp begins.

After successful startup and in steady state condition, 5 LEDs on the board to provide to the user the status of the board. All the LEDs will be turned ON indicating that there are no faults detected such as over voltage or over current. In case of a fault the PGOOD or AC_OK LEDs will be turned OFF indicating that some flag has tripped due to an out of bounds condition. The monitor window will display the appropriate state of the PSU.

LED	Location	Description
D7	Bottom left	Inrush signal
D8	Bottom right	PGOOD signal (active high)
D9	Bottom right	AC_OK signal (active high)
D10	Bottom right	Indicates input voltage is present
D11	Top right	Indicates 12V or USB5V is present

Table 4 – List of LEDs on the evaluation board

ADP1048 PROGRAMMING SOFTWARE

The goal of this evaluation kit is to allow the user to get an insight into the flexibility offered by the extensive programming options offered by the ADP1048. Several test points on the board allow easy monitoring of the various signals. The user can also use the software to program multiple responses (such as disable power supply or disable the PWM) for various fault conditions. There are several main windows where the user can use to program and evaluate the PSU. They can be accessed from the Setup window in the GUI. The ADP1048 can be easily programmed to modify the behavior of the PSU under different fault and load conditions without any hardware changes. All the changes are purely through software and do not require desoldering components and replacing them with new values to specify a different operating condition.

TEST WAVEFORMS

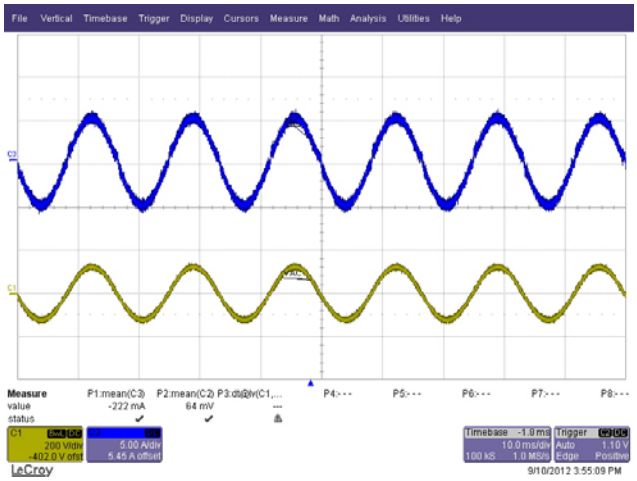


Figure 10 – Input voltage and current under 300W, 90VAC

Ch3: Iin, 5A/div, Ch1:VAC,200V/div

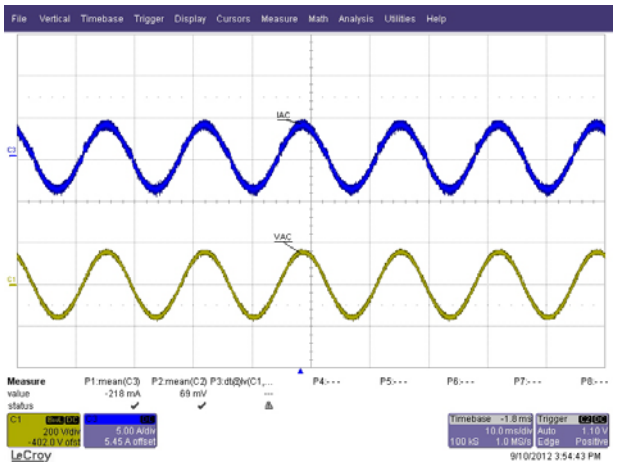


Figure 11 - Input voltage and current under 300W, 120VAC

Ch3: Iin, 5A/div, Ch1:VAC,200V/div

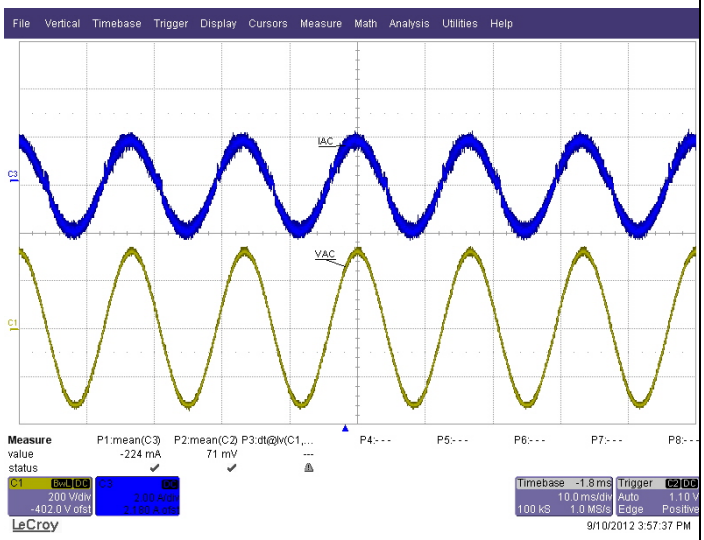


Figure 12 - Input voltage and current under 300W, 220VAC

Ch3: Iin, 2A/div, Ch1:VAC,200V/div

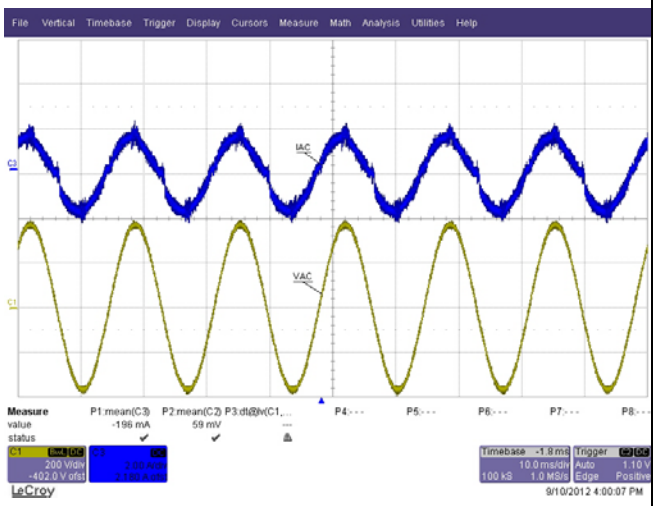


Figure 13 - Input voltage and current under 300W, 260VAC

Ch3: Iin, 2A/div, Ch1:VAC,200V/div

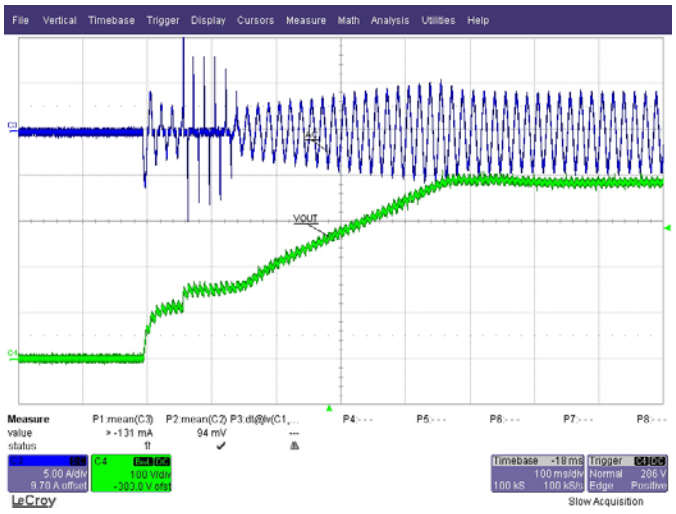


Figure 14 - Output voltage start up at 120VAC, 300W load

Ch3: Iin, 5A/div, Ch1:Vac,200V/div,Ch4:Vout,100V/div

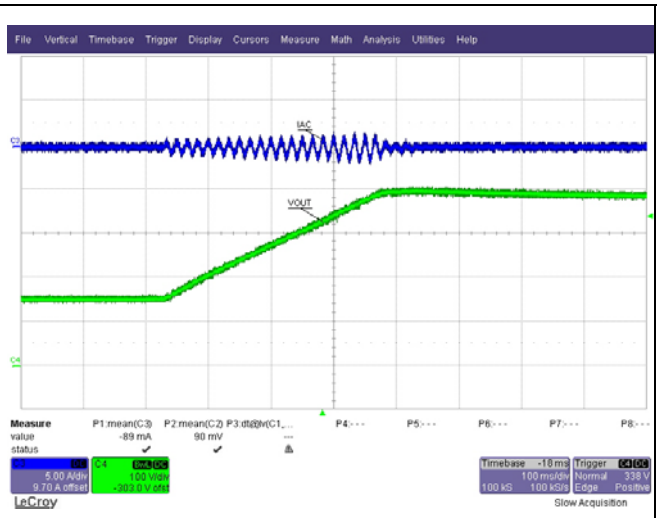


Figure 15 - Output voltage start up at 120VAC, 0W load

Ch3: Iin, 5A/div, Ch1:Vac,200V/div, Ch4:Vout,100V/div

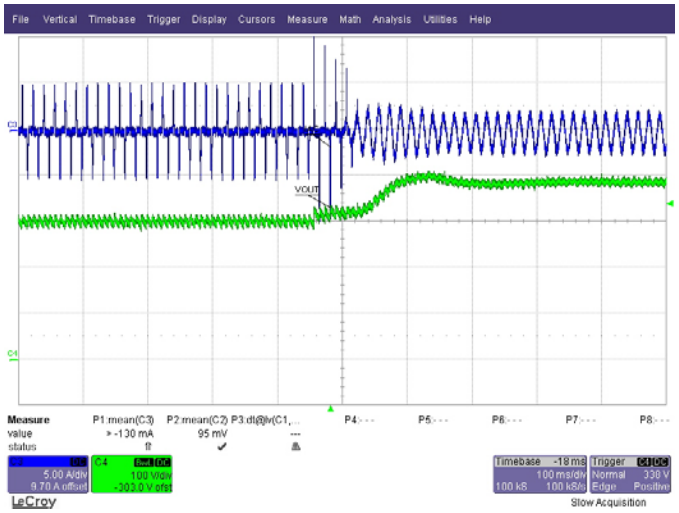


Figure 2 - Output voltage start up at 220VAC, 300W load

Ch3: Iin, 5A/div, Ch4:Vout,100V/div

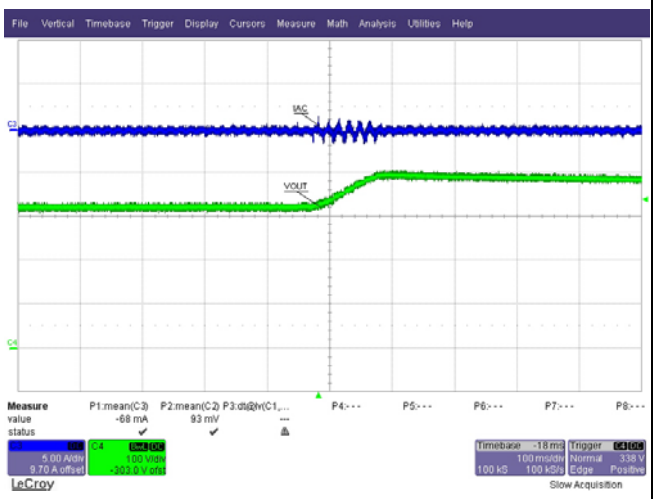


Figure 17 - Output voltage start up at 220VAC, 0W load

Ch3: Iin, 5A/div, Ch4:Vout,100V/div

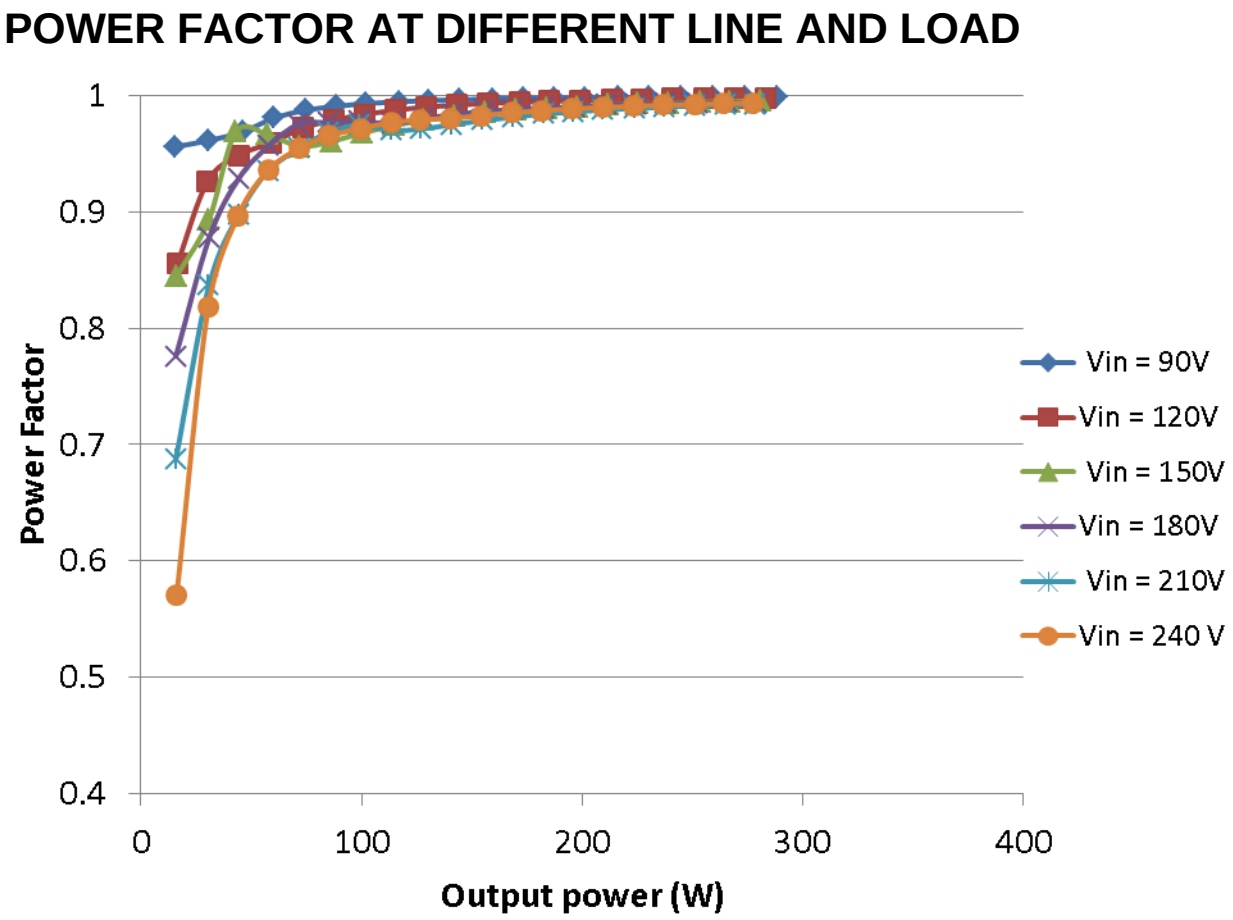


Figure 38 – Power factor vs load and line input

POWER METERING AT DIFFERENT LINE AND LOAD

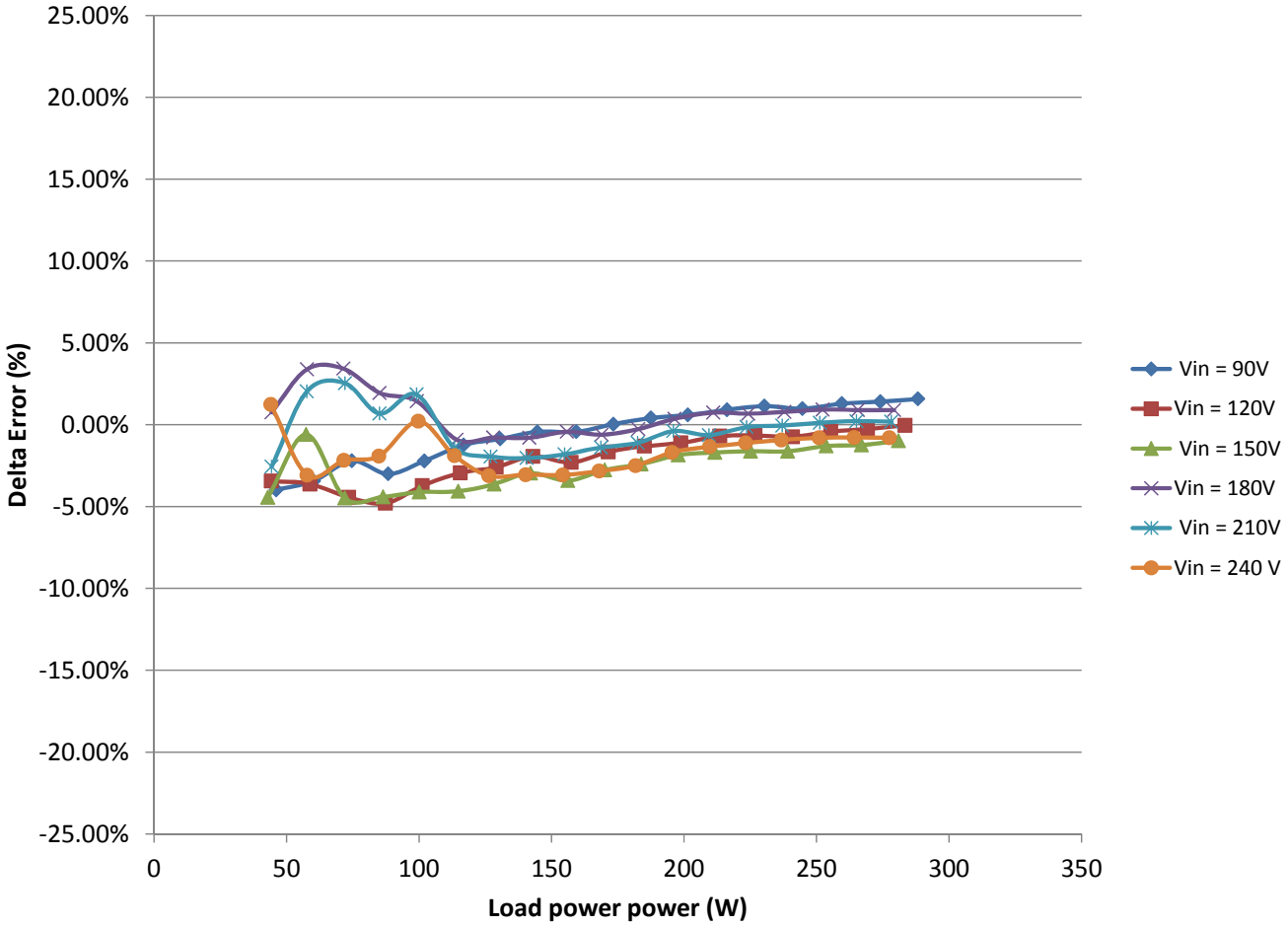
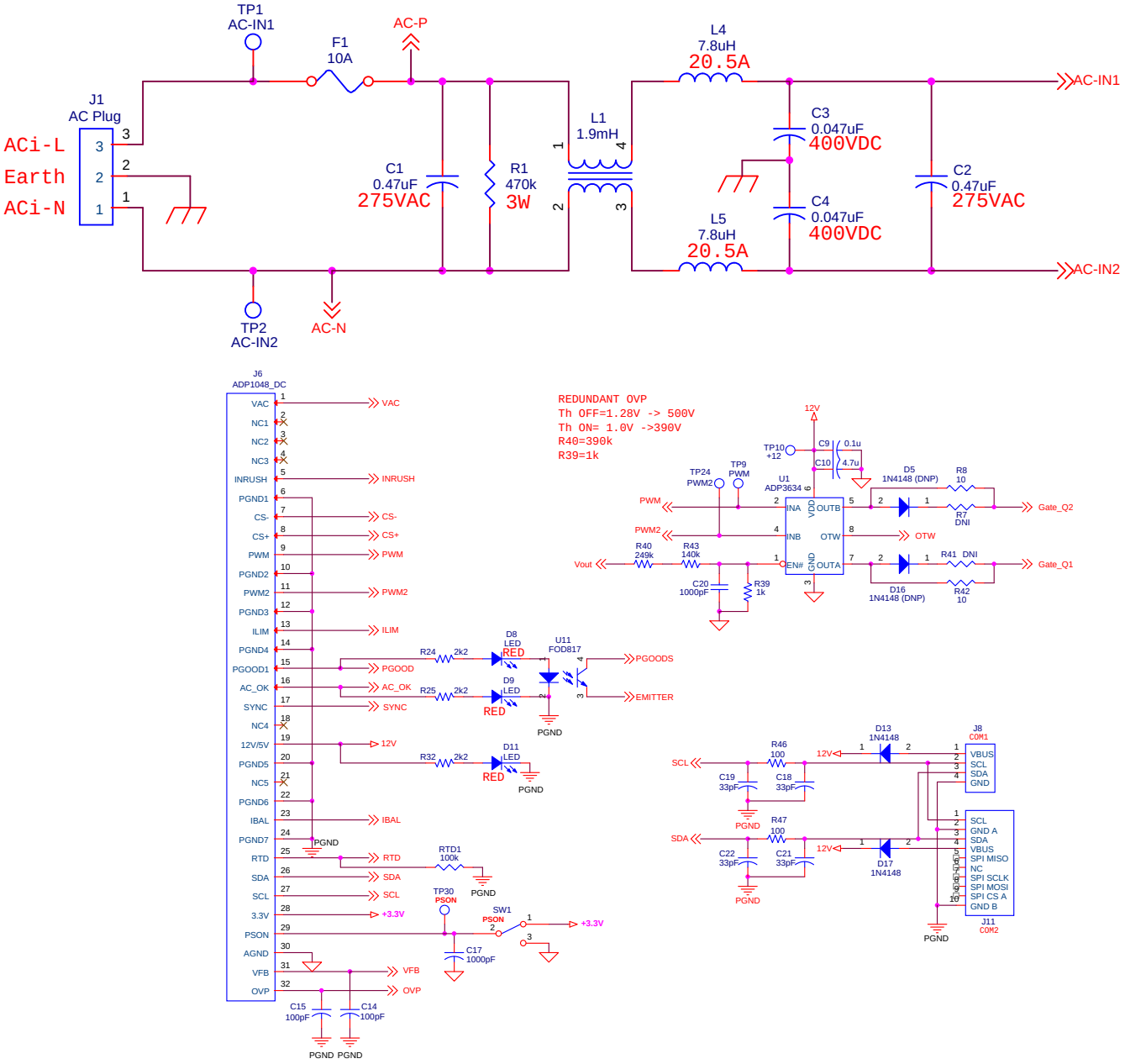
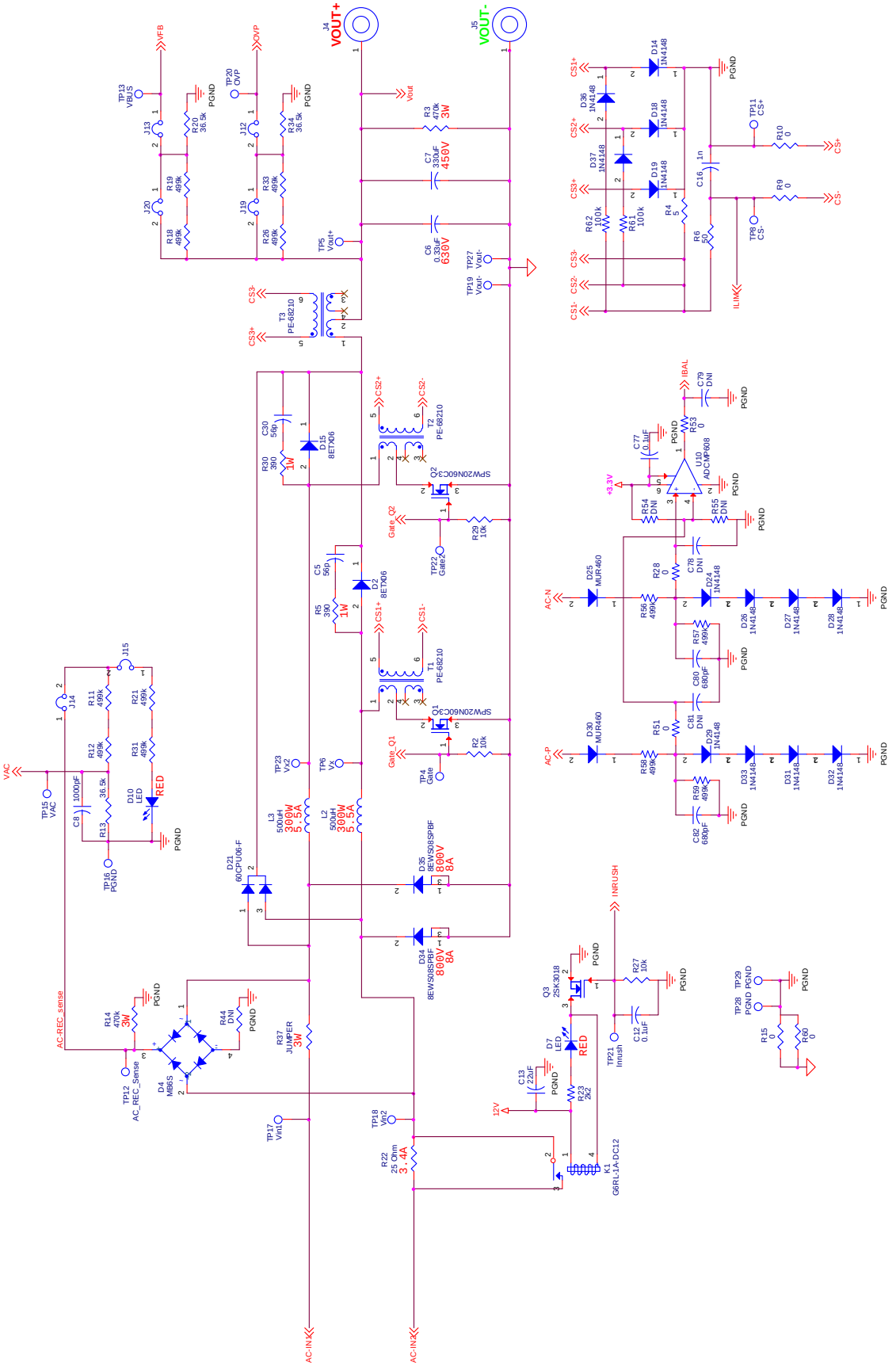


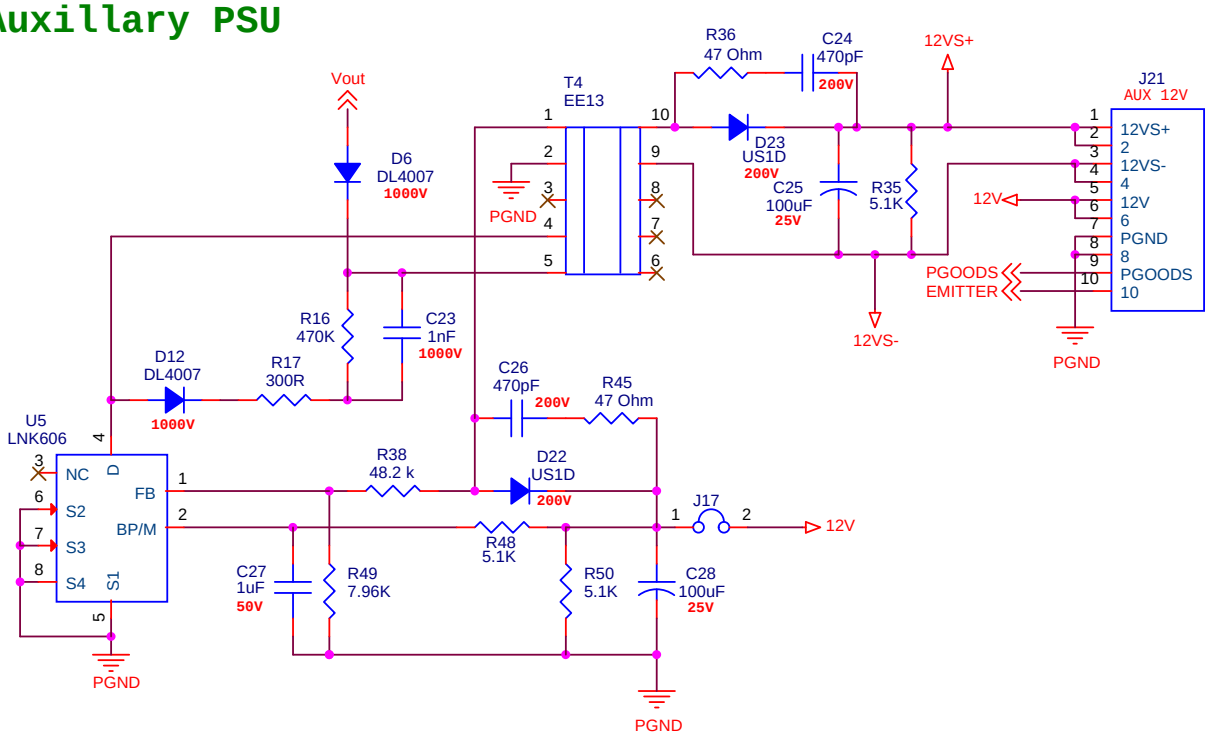
Figure 19 - Power metering accuracy vs load and line input

APPENDIX I – SCHEMATIC (MAIN BOARD)

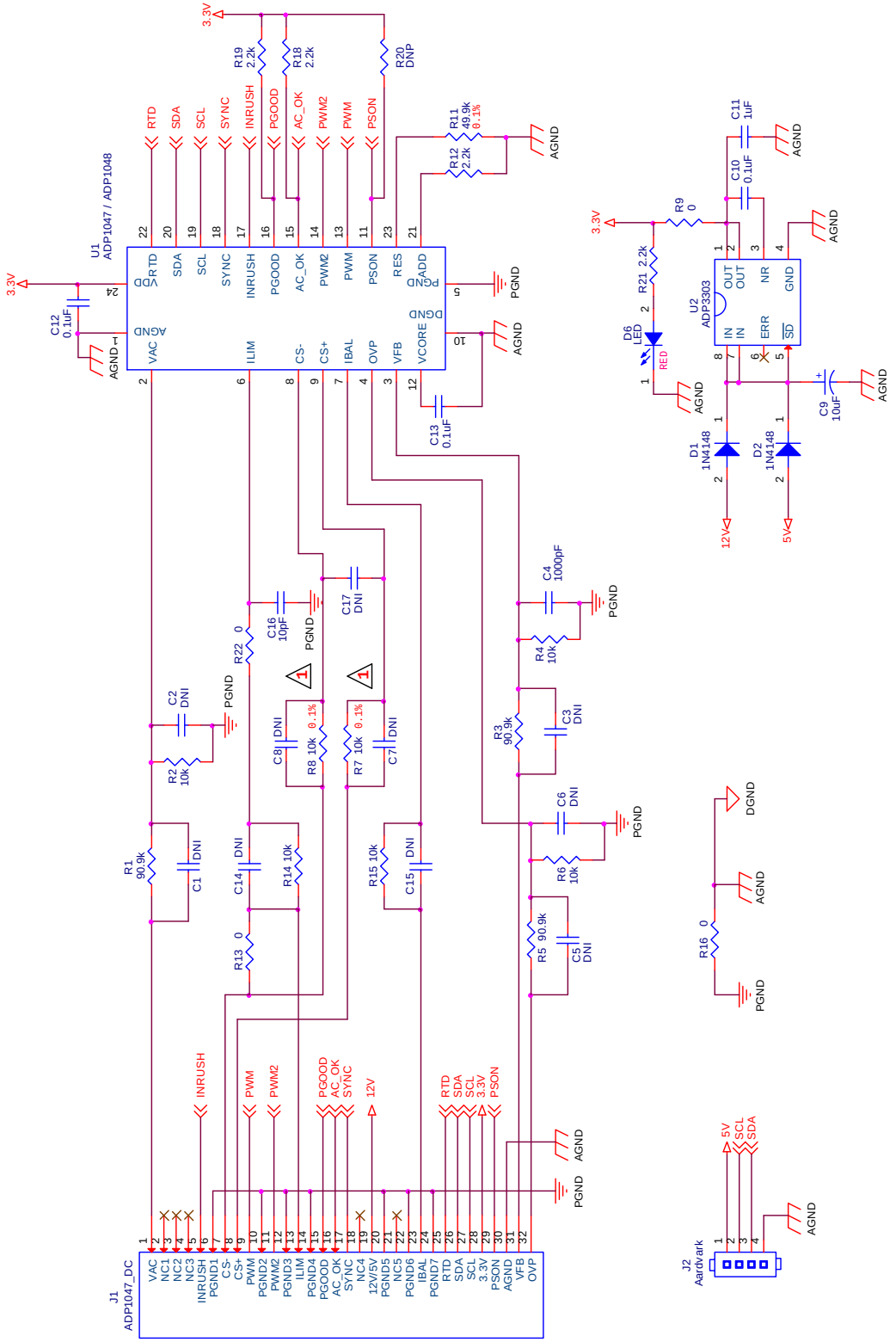



VOUT+
VOUT-
AC-IN
AC-IN
INRUSH
ILIM
IBAL
AC-REC_sense
VAC
PGND
+3.3V
12V
Gate_Q1
Gate_Q2
SPW20N60C3
T1 PE-68210
T2 PE-68210
T3 PE-68210
D21 60CPU06-F
D34 8EWS08SPBF 800V 8A
D35 8EWS08SPBF 800V 8A
L2 500uH 300W 5.5A
L3 500uH 300W 5.5A
K1 G6RL-1A-DC12
U10 ADCMP608
D25 MUR460
D30 MUR460
D4 MB6S
D10 LED RED
D7 LED RED
Q3 2SK3018
R22 25 Ohm 3.4A
R37 JUMPER 3W
R14 470k 3W
R3 470k 3W
C7 330uF 450V
C6 0.33uF 630V
R23 2k2
C13 2.2uF
C12 0.1uF
C77 0.1uF
C16 1n
C79 DNI
C78 DNI
C80 680pF
C81 DNI
C82 680pF
R62 100k
R61 100k
R4 5
R6 50
R9 0
R10 0
R53 0
R54 DNI
R55 DNI
R28 0
R56 499k
R57 499k
R58 499k
R59 499k
R51 0
R27 10k
R29 10k
R2 10k
R5 390 1W
R30 390 1W
C5 560
C30 560
C8 1000pF
R13 36.5k
R15 0
R60 0
TP1 CS1+
TP11 CS2+
TP8 CS-
TP5 Vout+
TP27 Vout-
TP19 Vout-
TP22 Gate2
TP4 Gate
TP6 Vx
TP23 Vx2
TP15 VAC
TP16 PGND
TP12 AC_REC_Sense
TP17 Vin1
TP18 Vin2
TP21 Inrush
TP28 PGND
TP29 PGND

Auxillary PSU



APPENDIX II – SCHEMATIC (DAUGHTER CARD)



APPENDIX III – LAYOUT (MAIN BOARD)

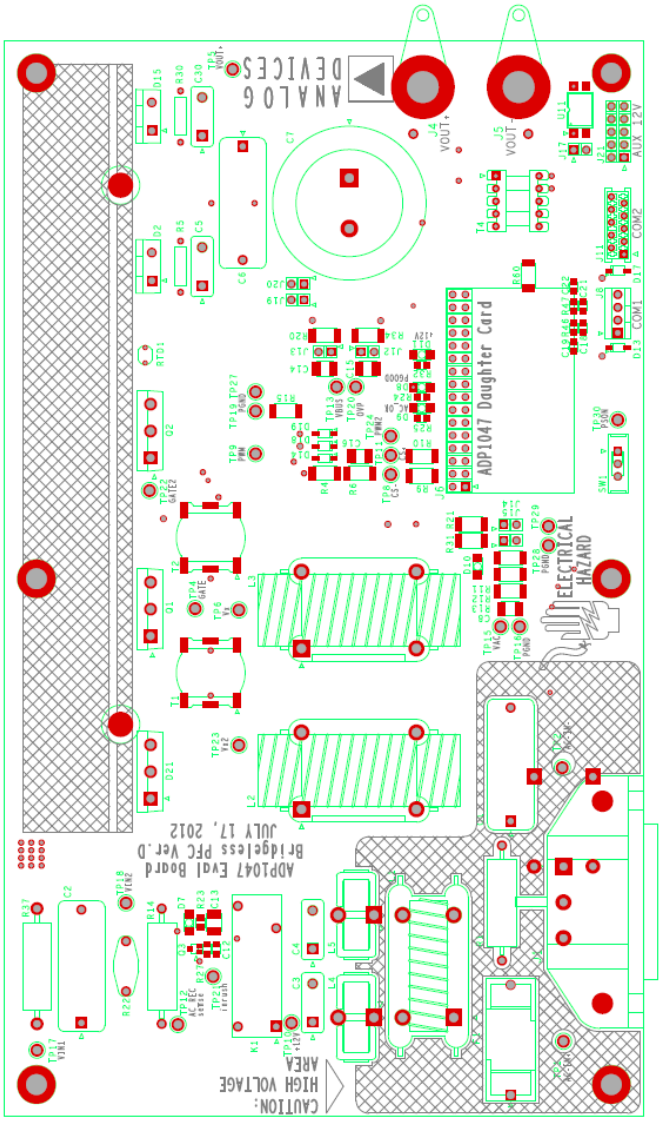


Figure 20 – Layout, Top Silkscreen

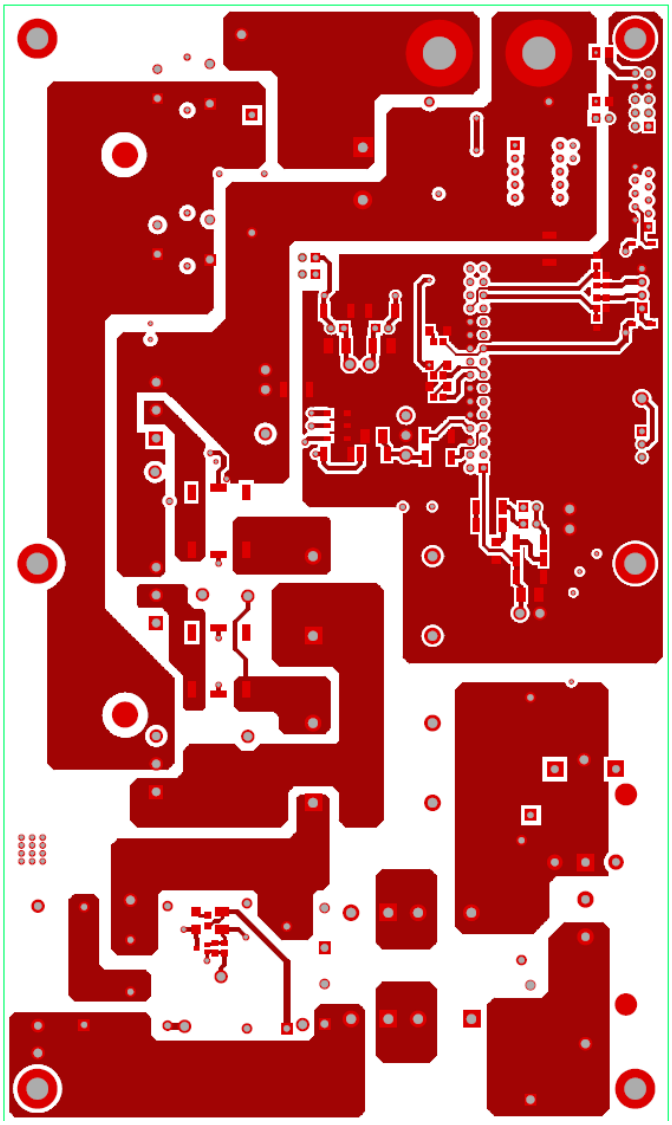


Figure 21 - Layout, Top layer

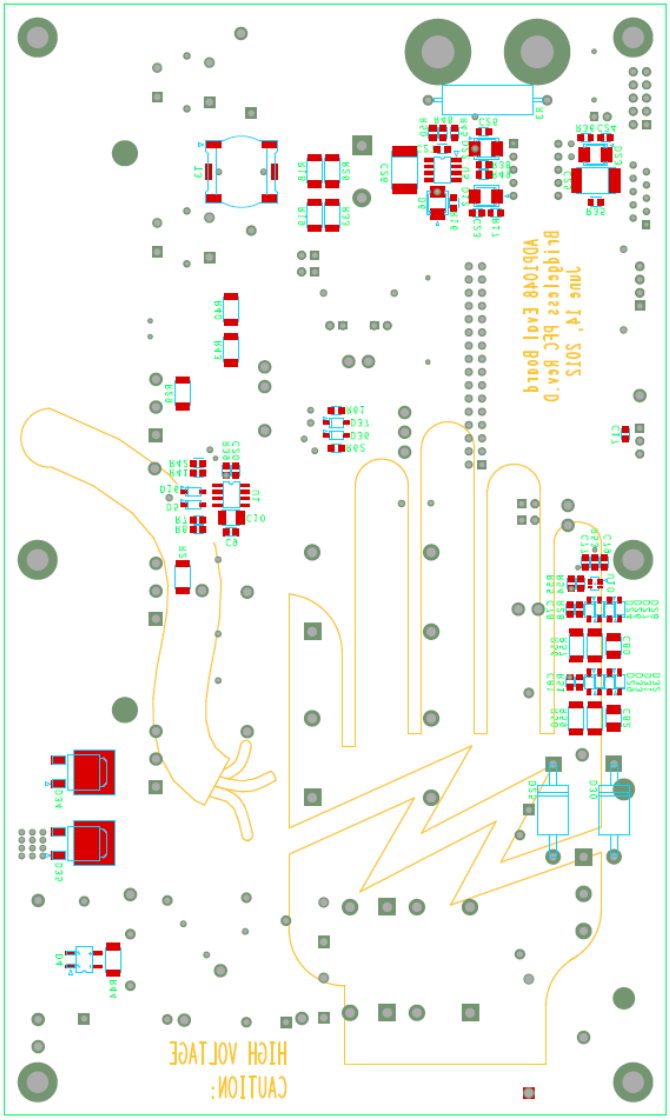


Figure 22 - Layout, Bottom silkscreen

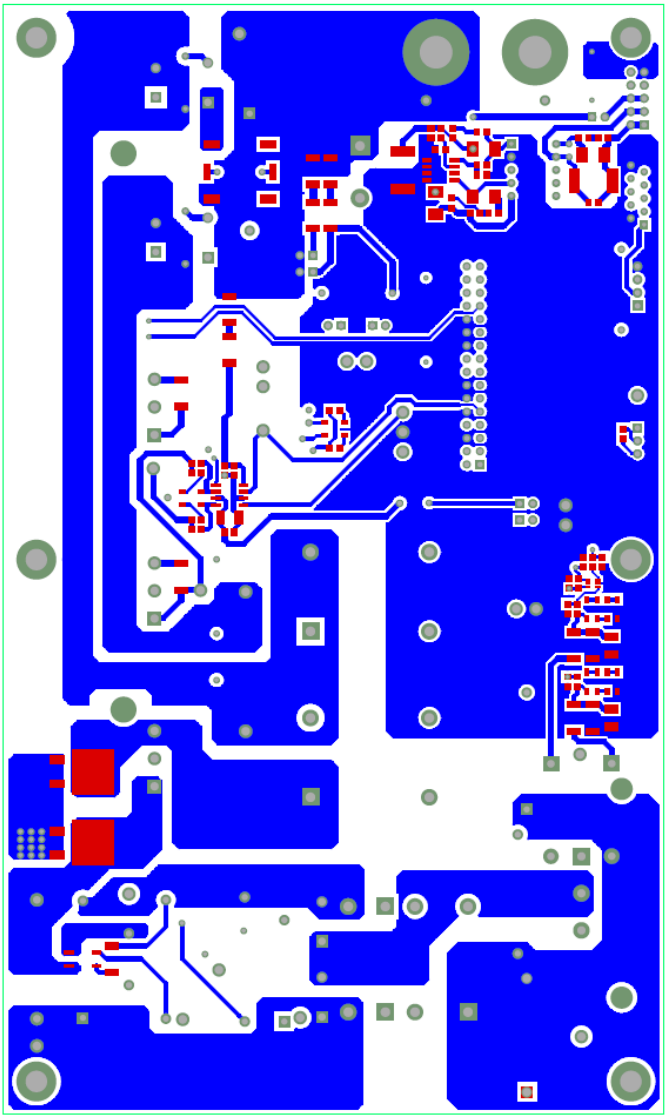


Figure 23 - Layout, Bottom layer

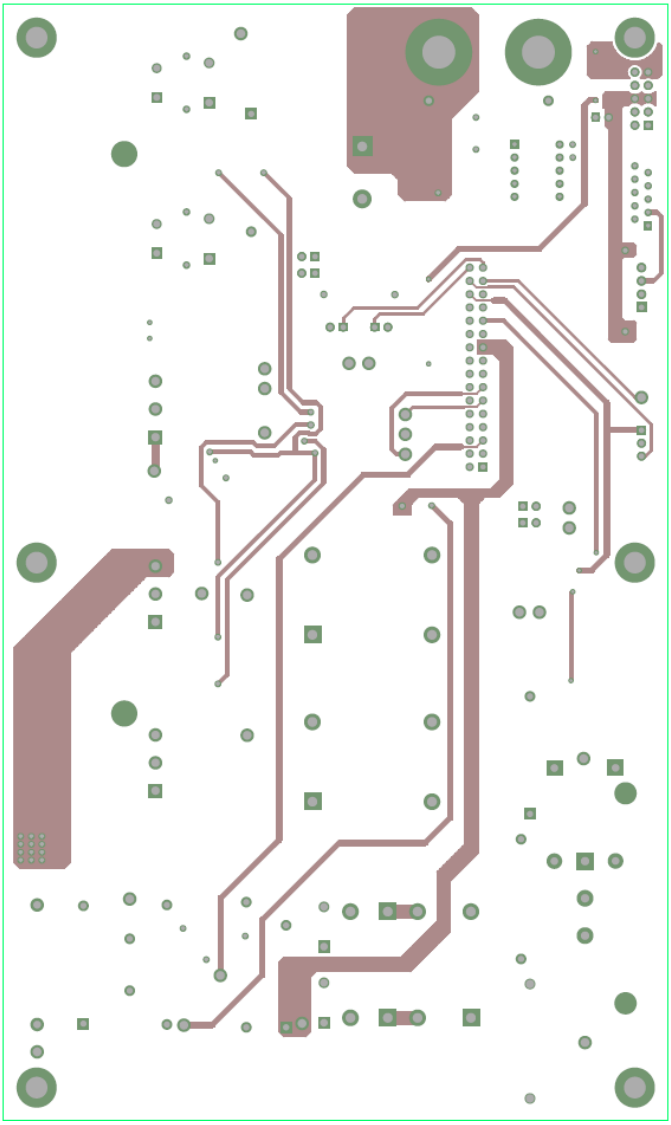


Figure 24 - Layout, Bottom silkscreen

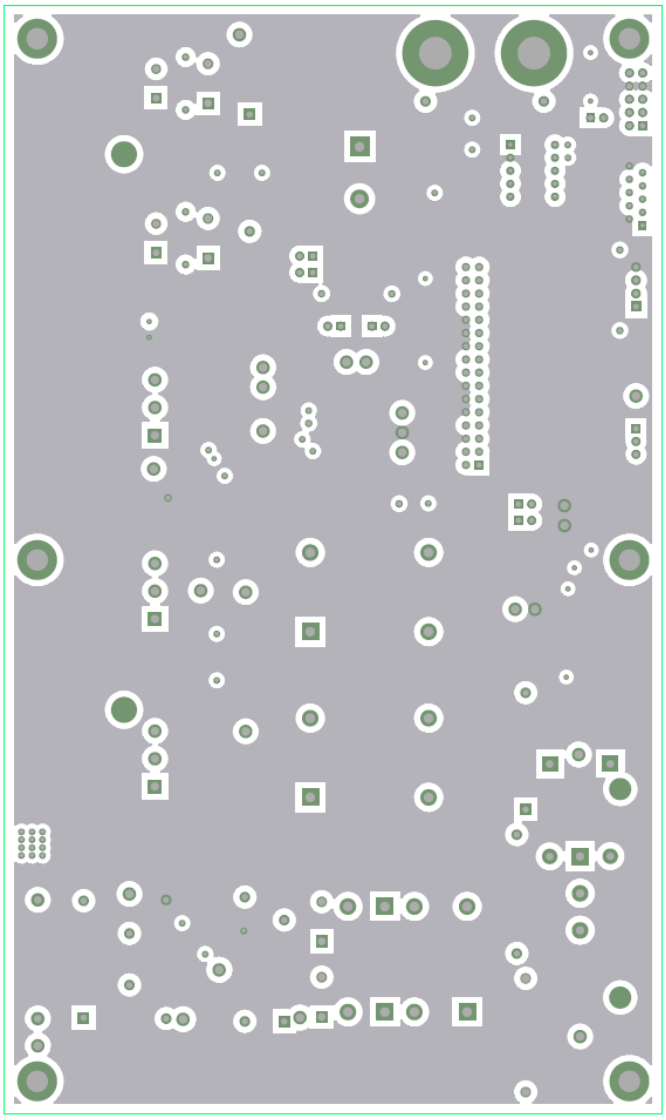


Figure 25 - Layout, Bottom layer

APPENDIX IV – LAYOUT (DAUGHTER CARD)

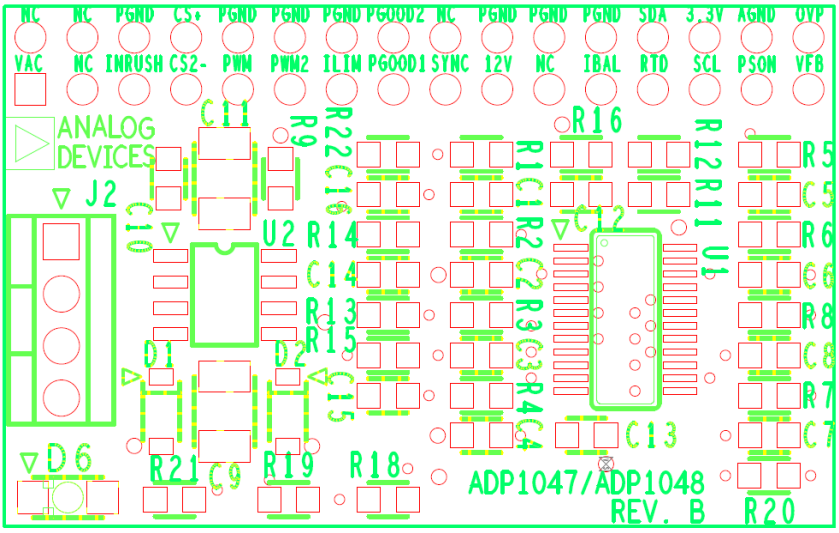


Figure 26 – Top silkscreen

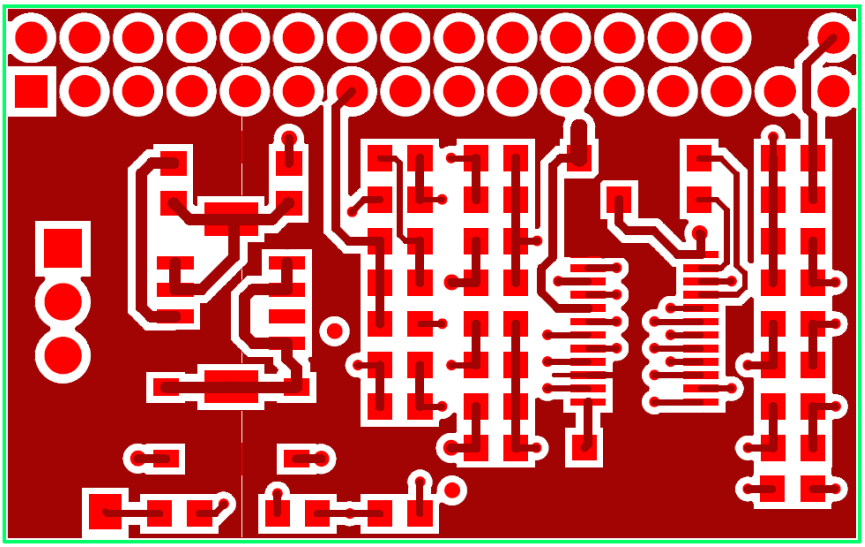


Figure 27 - Top Layer,

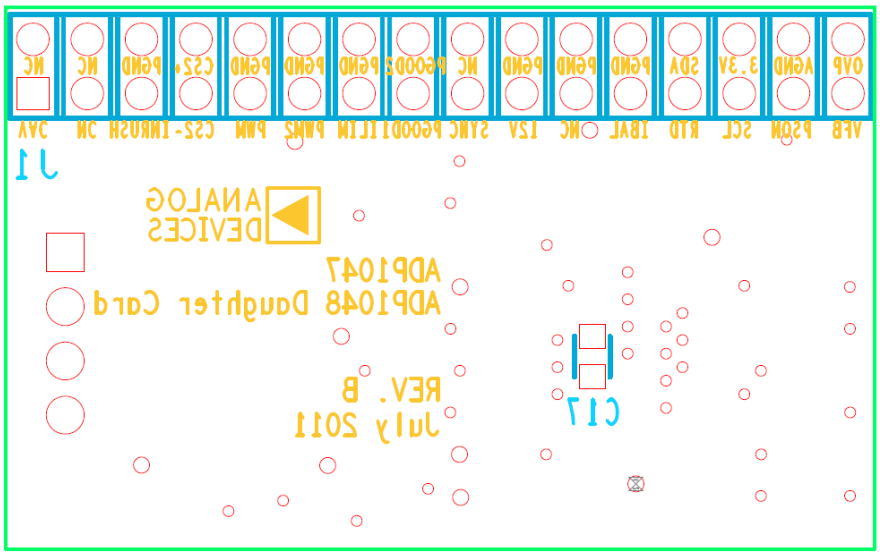


Figure 28 –Bottom Silkscreen

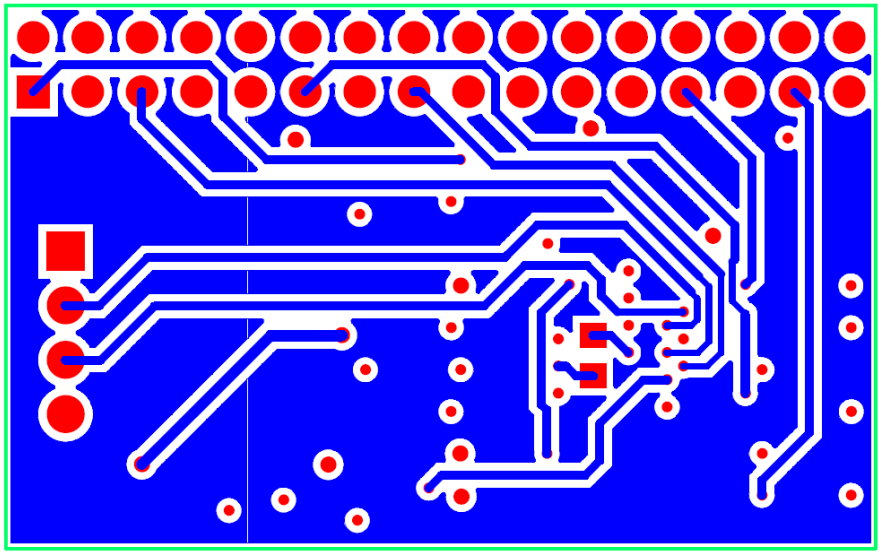


Figure 29– Bottom layer

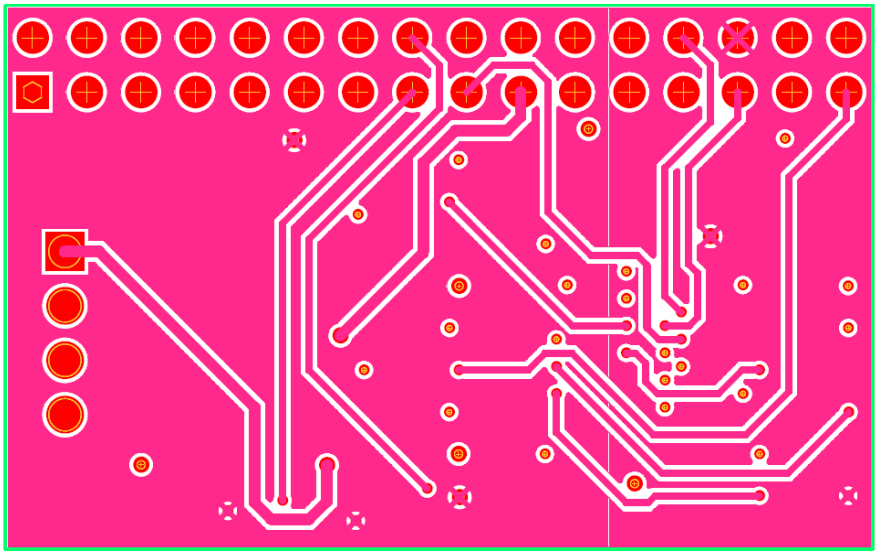


Figure 30 – Inner layer1 layout

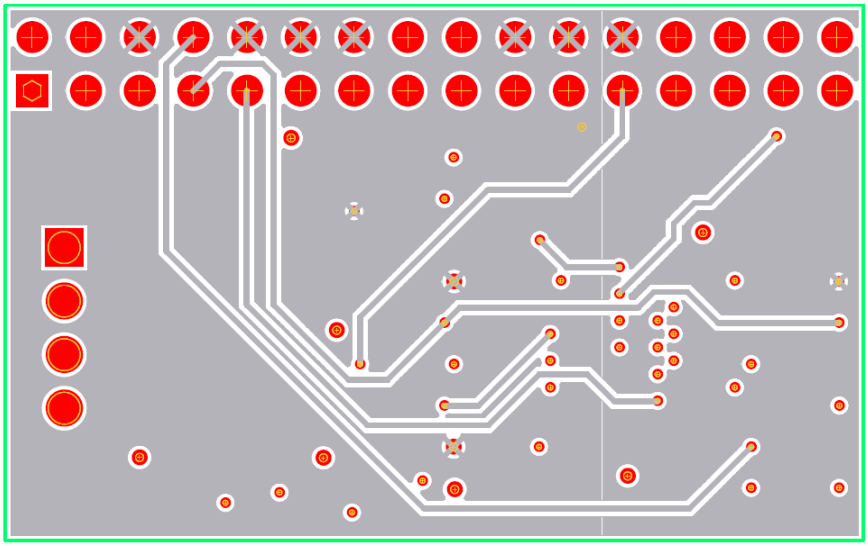


Figure 31 – inner layer2 layout

APPENDIX V – BILL OF MATERIALS (MAIN BOARD)

C1	0.47uF	CAP FILM 0.47uF 275 VAC RADIAL	Panasonic - ECG	ECQ-U2A474ML
C2	0.47uF	CAP FILM 0.47uF 275 VAC RADIAL	Panasonic - ECG	ECQ-U2A474ML
C3	0.047uF	CAP FILM 0.047UF 400VDC RADIAL	Panasonic ECG	ECW-F4473HL
C4	0.047uF	CAP FILM 0.047UF 400VDC RADIAL	Panasonic ECG	ECW-F4473HL
C5	56p	CAP CER 56pF 1KV 5% SL RADIAL	TDK Corp	CC45SL3AD560JYNN
C6	0.33uF	CAP FILM 0.033uF 630 VDC RADIAL	Panasonic - ECG	ECQ-E6333KF
C7	330uF	CAP ALUM 330uF 450V 20% SNAP	Panasonic - ECG	EET-UQ2W331CA
C8	1000pF	DNI		
C9	0.1u	CAP CER 0.1uF 50V 10% X7R SMD	Murata	GRM21BR71H104KA01L
C10	4.7u	CAP CER 4.7uF 25V 10% X5R SMD	Panasonic-ECG	ECJ-4YB1E475K
C12	0.1uF	CAP CER 0.1uF 50V 10% X7R SMD	Murata	GRM21BR71H104KA01L
C13	22uF	CAP CER 22uF 16V Y5V SMD	Taiyo Yuden	EMK325F226ZN-T
C14	100pF	CAP CER 100pF 50V 5% NPO	Johanson	500R15N101JV4T
C15	100pF	CAP CER 100pF 50V 5% NPO	Johanson	500R15N101JV4T
C16	1n	CAP CER 1000pF 10% 100V X7R SMD	AVX Corp	12101C102KAT2A
C17	1000pF	CAP 1000pF 50V 10% NPO SMD	Johanson	500R15W102KV4T
C18	33pF	CAP CER 33pF 50V 5% NPO SMD	AVX Corp	08055A330JAT2A
C19	33pF	CAP CER 33pF 50V 5% NPO SMD	AVX Corp	08055A330JAT2A
C20	1000pF	CAP CER 1000pF 50V 10% NPO SMD		500R15W102KV4T
C21	33pF	CAP CER 33pF 50V 5% NPO SMD	AVX Corp	08055A330JAT2A
C22	33pF	CAP CER 33pF 50V 5% NPO SMD	AVX Corp	08055A330JAT2A
C23	1nF	CAP CER 1000PF 1000V X7R SMD	Kemet	C0805C102KDRACTU
C24	470pF	CAP CER 470pF 200V X7R SMD	Panasonic - ECG	ECJ-2VB2D471K
C25	100uF	CAP TANT 100uF 25V 10% SMD	Kemet	T491X107K025ZT
C26	470pF	CAP CER 470pF 200V X7R SMD	Panasonic - ECG	ECJ-2VB2D471K
C27	1uF	CAP CER 1.0uF 50V X5R 10% SMD	AVX Corp	08055D105KAT2A
C28	100uF	CAP TANT 100uF 25V 10% SMD	Kemet	T491X107K025ZT
C30	56p	CAP CER 56pF 1KV 5% SL RADIAL	TDK Corp	CC45SL3AD560JYNN
C77	0.1uF	CAP CER 0.1uF 50V 10% X7R SMD	Murata	GRM21BR71H104KA01L
C78	DNI			
C79	DNI			
C80	680pF	CAP CER 680pF 50V 10% X7R SMD	AVX Corp	08055C681KAT2A
C81	DNI			
C82	680pF	CAP CER 680pF 50V 10% X7R SMD	AVX Corp	08055C681KAT2A
D2	8ETX06	DIODE HYPERFAST 600V 8A	Vishay	8ETX06PBF
D4	MB6S	IC RECT BRIDGE 0.5A 600V MBS-1	Micro Commercial	MB6S-TP
D5	1N4148 (DNP)	DNI	Micro Commercial	1N4148W-TP
D6	DL4007	MELF RECT PASSIVATD 1A 1000V SMD	Micro Commercial	
D7	LED	LED SUPPER RED CLEAR 75mA 1.7V SMD	Chicago	CMD15-21SRC/TR8
D8	LED	LED SUPPER RED CLEAR 75mA 1.7V SMD	Cicago	CMD15-21SRC/TR8
D9	LED	LED SUPPER RED CLEAR 75mA 1.7V SMD	Chicago	CMD15-21SRC/TR8
D10	LED	LED SUPPER RED CLEAR 75mA 1.7V SMD	Chicago	CMD15-21SRC/TR8
D11	LED	LED SUPPER RED CLEAR 75mA 1.7V SMD	Chicago	CMD15-21SRC/TR8

D12	DL4007	MELF RECT PASSIVATD 1A 1000V SMD	Micro Commercial	
D13	1N4148	DIODE SWITCH 100V 150MA SMD	Micro	1N4148W-TP
D14	1N4148	DIODE SWITCH 100V 150MA SMD	Micro	1N4148W-TP
D15	8ETX06	DIODE HYPERFAST 600V 8A	Vishay	8ETX06PBF
D16	1N4148 (DNP)	DNI	Micro Commercial	1N4148W-TP
D17	1N4148	DIODE SWITCH 100V 150MA SMD	Micro	1N4148W-TP
D18	1N4148	DIODE SWITCH 100V 150MA SMD	Micro	1N4148W-TP
D19	1N4148	DIODE SWITCH 100V 150MA SMD	Micro	1N4148W-TP
D21	60CPU06-F	RECTIFIERS 2x30 AMP 200V 300A IFSM	Mouser Elec	844-60CPU06-F
D22	US1D	DIODE ULTRA FAST SW 200V 1A SMD	Diodes Inc	US1D-13-F
D23	US1D	DIODE ULTRA FAST SW 200V 1A SMD	Diodes Inc	US1D-13-F
D24	1N4148	DIODE SWITCH 100V 150MA SMD	Micro	1N4148W-TP
D25	MUR460	DIODE ULTR FAST 4A 600V	ON Semi	MUR460RLG
D26	1N4148	DIODE SWITCH 100V 150MA SMD	Micro	1N4148W-TP
D27	1N4148	DIODE SWITCH 100V 150MA SMD	Micro	1N4148W-TP
D28	1N4148	DIODE SWITCH 100V 150MA SMD	Micro	1N4148W-TP
D29	1N4148	DIODE SWITCH 100V 150MA SMD	Micro	1N4148W-TP
D30	MUR460	DIODE ULTR FAST 4A 600V	ON Semi	MUR460RLG
D31	1N4148	DIODE SWITCH 100V 150MA SMD	Micro	1N4148W-TP
D32	1N4148	DIODE SWITCH 100V 150MA SMD	Micro	1N4148W-TP
D33	1N4148	DIODE SWITCH 100V 150MA SMD	Micro	1N4148W-TP
D34	8EWS08SPBF	RECTIFIERS 800V 200 AMP	Vishay	8EWS08S
D35	8EWS08SPBF	RECTIFIERS 800V 200 AMP	Vishay	8EWS08S
D36	1N4148	DIODE SWITCH 100V 150MA SMD	Micro	1N4148W-TP
D37	1N4148	DIODE SWITCH 100V 150MA SMD	Micro	1N4148W-TP
F1	10A	HOLDER PC FUSE 5mm LOW PROFILE	Keystone	4527
K1	G6RL-1A-DC12	RELAY PWR SPST-NO 8A 12VDC PCB	Omron Elec	G6RL-1A DC12
L1	1.9mH	COMMON MODE LINE CHOKES 1.9mH	Coilcraft	CMT1-1.9-9L
L2	500uH	INDUCTOR PFC 300W 820 UHY	Precision	PFC-01102-00
L3	500uH	INDUCTOR PFC 300W 820 UHY	Precision	PFC-01102-00
L4	7.8uH	INDUCTOR PWR 7.8uH 20.5A	Pulse Electronics	PA0431LNL
L5	7.8uH	INDUCTOR PWR 7.8uH 20.5A	Pulse Electronics	PA0431LNL
Q1	SPW20N60C3	MOSFET N-CH 650V 20.7A	Infineon	SPW20N60C3
Q2	SPW20N60C3	MOSFET N-CH 650V 20.7A	Infineon	SPW20N60C3
Q3	2SK3018	MOSFET N-CH 30V 0.1A SMD	Rohm Semi	2SK3018T106
RTD1	100k	THERMISTER NTC 100K OHM 5% RAD	EPCOS Inc	B57891M0104J000
R1	470k	RES 470K OHM METAL FILM 3W 5%	Vishay/BC Comp	PR03000204703JAC00
R2	10k	RES 10K OHM 3/4W 1% SMD	Vishay/Dale	CRCW201010K0FKEF
R3	470k	RES 470K OHM METAL FILM 3W 5%	Vishay/BC Comp	PR03000204703JAC00
R4	4.99	RES 4.99 OHM 1/2W 1% SMD	Vishay/Dale	CRCW20104R99FKEFHP
R5	390	RES 390 OHM METAL FILM 1W 5%	Vishay/BC Comp	PR01000103900JR500
R6	49.9	RES 49.9 OHM 1/2W 5% SMD	Vishay/Dale	CRCW201049R9FKEFHP
R7	DNI	DNI		

R8	10	RES 10.0 OHM 1/8W 1% SMD	Yageo	RC0805FR-0710RL
R9	0	RES 0.0 OHM 1/2W 5% SMD	Vishay/Dale	CRCW20100000Z0EF
R10	0	RES 0.0 OHM 1/2W 5% SMD	Vishay/Dale	CRCW20100000Z0EF
R11	499k	RES 499K OHM 3/4W 1% SMD	Vishay/Dale	CRCW2010499KFKEF
R12	499k	RES 499K OHM 3/4W 1% SMD	Vishay/Dale	CRCW2010499KFKEF
R13	36.5k	RES 36.5K OHM 1/2W 5% SMD	Rohm	MCR50JZHF3652
R14	470k	RES 470K OHM METAL FILM 3W 5%	Vishay/BC Comp	PR03000204703JAC00
R15	0	RES 0.0 OHM 1/2W 5% SMD	Vishay/Dale	CRCW20100000Z0EF
R16	470K	RES 470K OHM 1/8W 1% SMD	Panasonic - ECG	ERJ-6ENF4703V
R17	300R	RES 300 OHM 1/8W 1% SMD	Panasonic - ECG	ERJ-6ENF3000V
R18	499k	RES 499K OHM 3/4W 1% SMD	Vishay/Dale	CRCW2010499KFKEF
R19	499k	RES 499K OHM 3/4W 1% SMD	Vishay/Dale	CRCW2010499KFKEF
R20	36.5k	RES 36.5K OHM 1/2W 5% SMD	Rohm	MCR50JZHF3652
R21	499k	RES 499K OHM 3/4W 1% SMD	Vishay/Dale	CRCW2010499KFKEF
R22	25 Ohm	CURRENT LIMITER INRSH 25 OHM 20%	EPCOS Inc	B57238S0250M000
R23	2k2	RES 2.20K OHM 1/8W 1% SMD	Yageo	RC0805FR-072K2L
R24	2k2	RES 2.20K OHM 1/8W 1% SMD	Yageo	RC0805FR-072K2L
R25	2k2	RES 2.20K OHM 1/8W 1% SMD	Yageo	RC0805FR-072K2L
R26	499k	RES 499K OHM 3/4W 1% SMD	Vishay/Dale	CRCW2010499KFKEF
R27	10k	RES 10.0K OHM 1/8W 1% SMD	Yageo	RC0805FR-0710KL
R28	0	RES 0.0 OHM 1/8W 1% SMD	Yageo	RC0805FR-070RL
R29	10k	RES 10K OHM 3/4W 1% SMD	Vishay/Dale	CRCW201010K0FKEF
R30	390	RES 390 OHM METAL FILM 1W 5%	Vishay/BC Comp	PR01000103900JR500
R31	499k	RES 499K OHM 3/4W 1% SMD	Vishay/Dale	CRCW2010499KFKEF
R32	2k2	RES 2.20K OHM 1/8W 1% SMD	Yageo	RC0805FR-072K2L
R33	499k	RES 499K OHM 3/4W 1% SMD	Vishay/Dale	CRCW2010499KFKEF
R34	36.5k	RES 36.5K OHM 1/2W 5% SMD	Rohm	MCR50JZHF3652
R35	5.1K	RES 5.10K 1/8W 1% SMD	Digi-Key	P5.10KCCT-ND
R36	47 Ohm	RES 47.0 OHM 1/8W 1% SMD	Panasonic - ECG	ERJ-6ENF47R0V
R37	JUMPER	DNI		
R38	48.2 k	RES 48.7K OHM 1/8W 1% SMD	Panasonic - ECG	ERJ-6ENF4872V
R39	1k	RES 1.00K OHM 1/8W 1% SMD	Yageo	RC0805FR-071KL
R40	249k	RES 249K OHM 1/2W 1% SMD	Vishay/Dale	CRCW2010249KFKEF
R41	DNI	DNI		
R42	10	RES 10.0 OHM 1/8W 1% SMD	Yageo	RC0805FR-0710RL
R43	140k	RES 140K OHM 1/2W 1% SMD	Vishay/Dale	CRCW2010140KFKEF
R44	DNI	DNI		
R45	47 Ohm	RES 47.0 OHM 1/8W 1% SMD	Panasonic - ECG	ERJ-6ENF47R0V
R46	100	RES 100 OHM 1/8W 1% SMD	Yageo	RC0805FR-07100RL
R47	100	RES 100 OHM 1/8W 1% SMD	Yageo	RC0805FR-07100RL
R48	5.1K	RES 5.10K 1/8W 1% SMD	Panasonic - ECG	ERJ-6ENF5101V
R49	7.96K	RES 8.06K OHM 1/8W 1% SMD	Panasonic - ECG	ERJ-6ENF8061V
R50	5.1K	RES 5.10K 1/8W 1% SMD	Panasonic - ECG	ERJ-6ENF5101V

R51	0	RES 0.0 OHM 1/8W 1% SMD	Yageo	RC0805FR-070RL
R53	0	RES 0.0 OHM 1/8W 1% SMD	Yageo	RC0805FR-070RL
R54	DNI			
R55	DNI			
R56	499k	RES 499K OHM 3/4W 1% SMD	Vishay/Dale	CRCW2010499KFKEF
R57	499k	RES 499K OHM 3/4W 1% SMD	Vishay/Dale	CRCW2010499KFKEF
R58	499k	RES 499K OHM 3/4W 1% SMD	Vishay/Dale	CRCW2010499KFKEF
R59	499k	RES 499K OHM 3/4W 1% SMD	Vishay/Dale	CRCW2010499KFKEF
R60	0	RES 0.0 OHM 1/2W 5% SMD	Vishay/Dale	CRCW20100000Z0EF
R61	0	RES 100K OHM 1/8W 1% SMD	Yageo	RC0805FR-07100KL
R62	0	RES 100K OHM 1/8W 1% SMD	Yageo	RC0805FR-07100KL
SW1	SW-SPDT	SW SLIDE SPDT 30V 0.2A PC MNT	E-Switch	EG1218
T1	PE-68210	XFRMR CURR SENSE 1:1:50 SMD	Pulse	
T2	PE-68210	XFRMR CURR SENSE 1:1:50 SMD	Pulse	
T3	PE-68210	XFRMR CURR SENSE 1:1:50 SMD	Pulse	
T4	EE13	TRANSFORMER	Precision Inc	019-7086-00R
U1	ADP3634	IC DRIVER DUAL 4A NONINV	Analog Devices	ADP3634ARDZ-R7
U5	LNK606	POWER INTEEGRATIONS 5.5W 85-265VAC	Power Integrations	LNK606DG
U10	ADCMP608	IC COMPARATOR TTL/CMOS	Analog Devices	ADCMP608BKSZ-REEL7
U11	FOD817	OPTOCOUPLER PHOTOTRANSISTOR	Fairchild	FOD817A3SD

APPENDIX VI – BILL OF MATERIALS (DAUGHTER CARD)

Part Reference	Part Description	Manufacture	Mfg Part No
C1	DNI		
C2	DNI		
C3	DNI		
C4	CAP CER 1000pF 50V 5% COG	Murata Electronics	GRM2165C1H102JA01D
C5	DNI		
C6	DNI		
C7	DNI		
C8	DNI		
C9	CAP CER 10uF 25V +/-20% X5R	Panasonic - ECG	ECJ-4YB1E106M
C10	CAP CER 0.1uF 50V 10% X7R	Murata Electronics	GRM21BR71H104KA01L
C11	CAP CER 1.0uF 50V 10% X7R	Murata Electronics	GRM32RR71H105KA01L
C12	CAP CER 0.1uF 50V 10% X7R	Murata Electronics	GRM21BR71H104KA01L
C13	CAP CER 0.1uF 50V 10% X7R	Murata Electronics	GRM21BR71H104KA01L
C14	DNI		
C15	DNI		
C16	DNI		
D1	DIODE SWITCH 100V 150MA	Micro Commercial	1N4148WTPMSCT-ND
D2	DIODE SWITCH 100V 150MA	Micro Commercial	1N4148WTPMSCT-ND
D6	LED SUPER RED CLEAR 75MA 1.7V SMD	CHICAGO MINIATURE LIGHTING	CMD15-21SRC/TR8
R1	RES 90.9K OHM 1/8W 1% SMD	Any	
R2	RES 10K OHM 1/8W 1% SMD	Any	
R3	RES 90.9K OHM 1/8W 1% SMD	Any	
R4	RES 10K OHM 1/8W 1% SMD	Any	
R5	RES 90.9K OHM 1/8W 1% SMD	Any	
R6	RES 10K OHM 1/8W 1% SMD	Any	
R7	RES 10K OHM 1/8W 0.1% SMD	Any	
R8	RES 10K OHM 1/8W 0.1% SMD	Any	
R9	RES 0.0 OHM 1/8W 5% SMD	Any	
R11	RES 49.9K OHM 1/8W 0.1% SMD	Any	
R12	RES 2.20K OHM 1/8W 1% SMD	Any	
R13	RES 0.0 OHM 1/8W 5% SMD	Any	
R14	RES 10K OHM 1/8W 1% SMD	Any	
R15	RES 10K OHM 1/8W 1% SMD	Any	
R16	RES 0.0 OHM 1/8W 5% SMD	Any	
R18	RES 2.20K OHM 1/8W 1% SMD	Any	
R19	RES 2.20K OHM 1/8W 1% SMD	Any	
R20	RES 2.20K OHM 1/8W 1% SMD	Any	
R21	RES 2.20K OHM 1/8W 1% SMD	Any	
R22	RES 0.0 OHM 1/8W 5% SMD	Any	
U1	Digital PFC Controller	Analog Devices	ADP1047
U2	Low Dropout Regulators	Analog Devices	ADP3303

NOTES

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