Expat Audio Uber Power Supply

A simple to stuff power supply with integrated high frequency filtering (CRC) and 48V generation from a 16, 24 or similar VAC (Transformer output) Source.

Introduction

The Expat Audio Uber Power Supply (… a project name that stuck…) is a power supply designed for DIY Pro Audio systems including Microphone Preamps, Audio Compressors/Limiters and others that require a Bipolar power supply, along with a 48V Phantom supply (Optional).

The Uber PSU is an extension to the popular CRC board, using some of it's functionality to create a more universal power supply, along with a full bridge Cockroft Walton voltage generator for generating a low noise Phantom supply.

Additionally, a variety of input transformers can be used with the board, without too much concern regarding power dissipation in the voltage regulators used. The reason for this is that high wattage resistors can be used to dissipate some of the excess voltage, as well as filter out some of the high frequency noise on the incoming power supply.

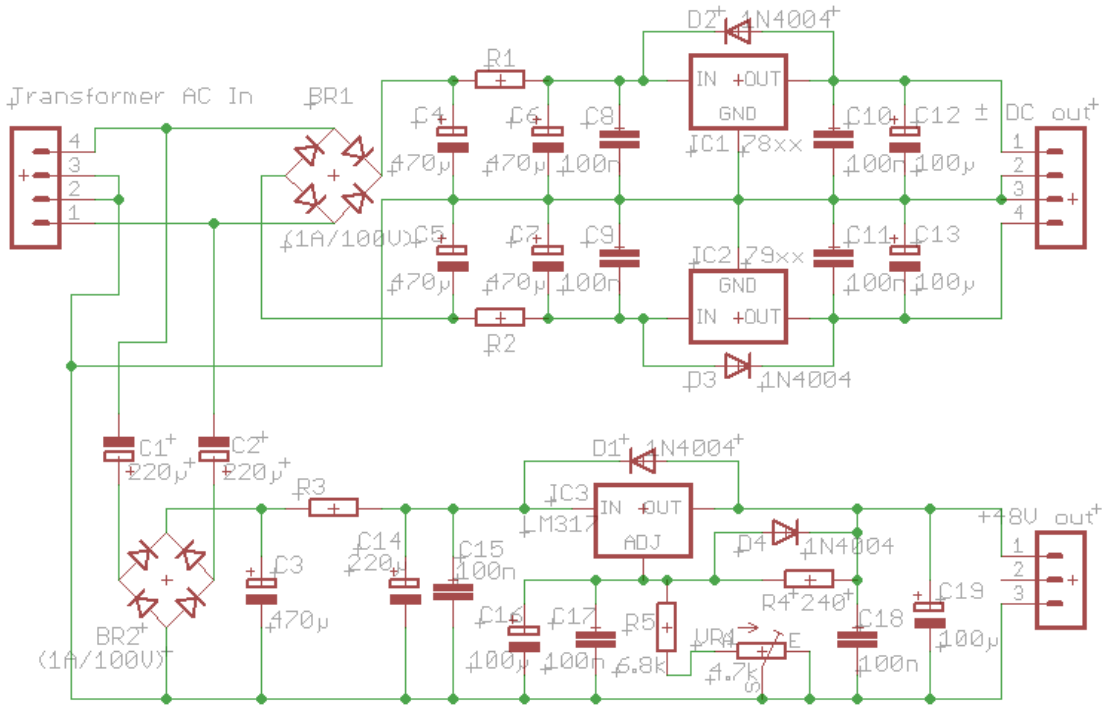
An Excel file is also in this zip file for use in calculating the optimal value and size of the resistor required.

Revision Control & Edits

Expat Audio PCB's are typically designed using a X.Y versioning system Please look on your PCB to see the version number. The silkscreen will either read "version X.Y" or PG X.Y

PG1.0 is the current value, and is known to be working just fine. ☺

The Schematic



Think of the schematic as two different circuits, both connected to the same low-ish voltage 16VAC/24VAC inputs. The top circuit is a well known circuit using off the shelf 78xx and 79xx regulators (e.g. the 7815 regulator is a +15V regulator, whilst its cousin, the 7915 is a -15V regulator.)

The banks of capacitors along with R1/R2/R3 serve three key purposes.

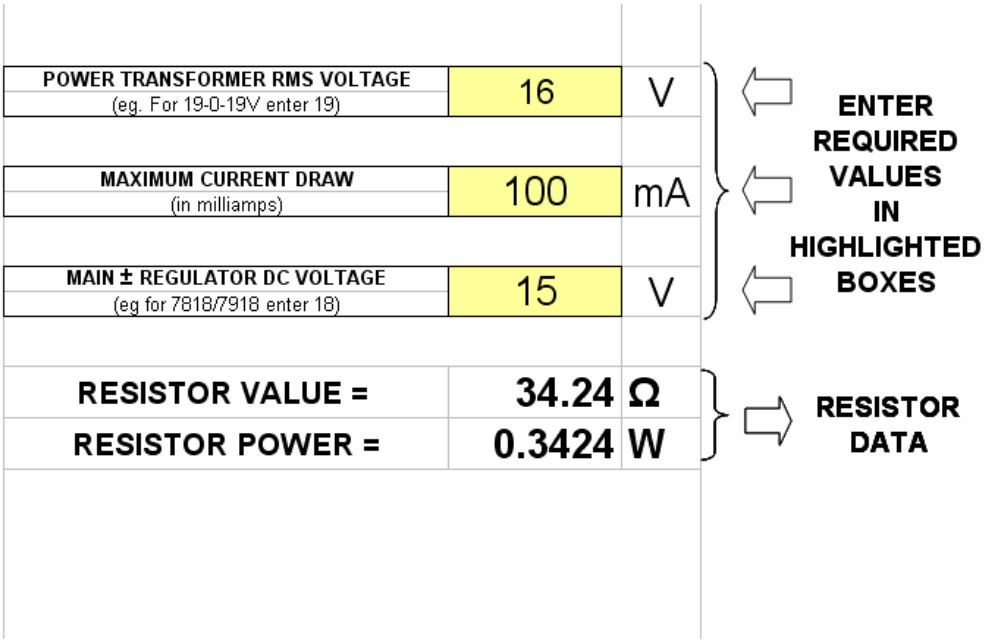
- Filter out the high frequency content from the incoming AC (because household mains is NOT just 60Hz… there's lots of other crud on it too!)
- Power supply decoupling/lowering the amount of ripple.
- Dissipate some of the peak voltage from the bridge rectifier, so that the regulators don't need to drop so many volts.

The lower circuit for the 48V phantom supply generator is a Cockroft Walton Full Bridge design (have fun with Wikipedia!). A circuit typically kept for particle accelerators, it's now found its way into an Expat Audio circuit! The LM317 in the circuit is designed to be tuned to provide the 48V required.

Calculating the value of R1 and R2

An excel file is available from the expat audio product folder (the same place you downloaded this from!) with a calculator to suggest the optimized value of R1 and R2.

Power will be dissipated in these resistors to help ease the voltage drop required by the linear regulators. The calculator is very easy to use, and should be self explanatory.



Calculating the value of R3.

Initially, R3 can be a short wire. However, depending on the current consumption on the 48V rail, a small resistor can be used to help filter the incoming power. One as low as 3.6Ohms should be appropriate.

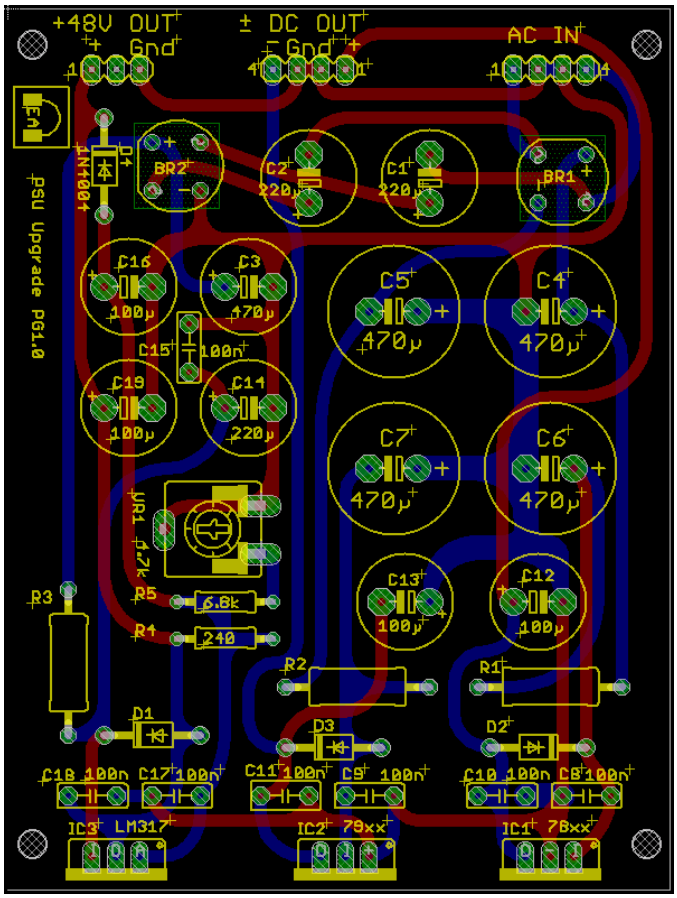
Assembling the board

WARNING! Primaries to the transformer feeding this power supply board will be passing mains voltages (110V -> 240VAC!) These are not nice voltages and can prove to be fatal!

Expat Audio is in no way responsible for what you do at the mains voltage end of things. Our AC IN is for the secondary of the transformer (typically 16VAC or 24VAC).

If you have any doubts, or don't fully understand what we're talking about with transformers, primaries and secondary's… STEP AWAY FROM THE VEHICLE SIR! ☺

…right, for those of you that stayed with us! Let's continue.



Assemble the board by soldering the components according to the board layout shown here.

R1 and R2 are power capable resistors, with values and power dissipation values calculated in the attached ZIP file.

Capacitor Voltage Tolerance Values should be at least 2x the rated voltage of the incoming AC. (e.g. if you use a 24VAC transformer, then a minimum 48V Capacitor should be used on C4 and C5.)

The board should be built in stages and go through a visual check at each point, along with a voltage check at each point.

We suggest that you build the board with everything BUT the voltage regulators to begin with, taking care to ensure that the electrolytic capacitors (the big 'round ones) are installed correctly. i.e positive marking to the positive pin, negative marking to the negative pin. Installing incorrectly may send the capacitor careering into your ceiling and releasing its special factory installed blue smoke. (get the picture?)

A DC peak voltmeter from ground to the input of the unpopulated 78xx voltage regulator should read around 1.4 times the specification of your transformer. This is expected. As current increases in the finished design, this voltage will drop gently as power is dissipated in R1. R2 and R3.

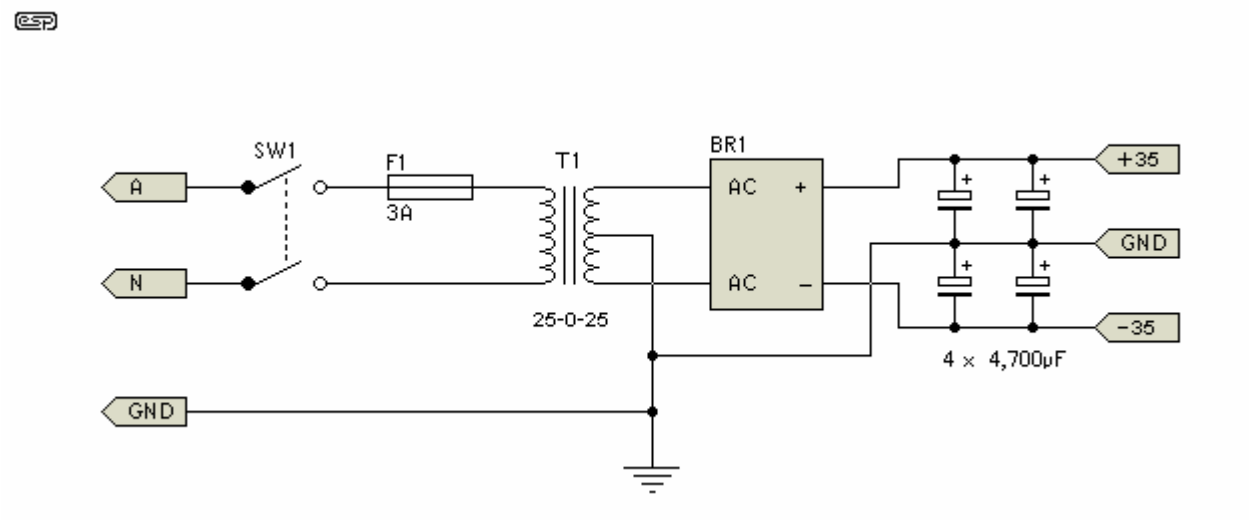
Now install the regulators (78xx and 79xx). Your output voltage should read the specified amount. (15V, 18V or whatever amount specified by the 78xx and 79xx regulators).

The regulators can all be connected to a common heatsink or backplate (say, on your product) – however, it should be noted that they need to be electrically isolated. The metal tab on these regulators are not always at the same voltage/potential as each other. If you do not electrically isolate the tabs, then you will potentially short the outputs and release the factory installed smoke on your regulator, and potentially take some other components with them.

Connecting in your system

The inputs to the board should be lower voltage than mains, which means you'll need an IEC connector, fuse and switch and transformer for your product.

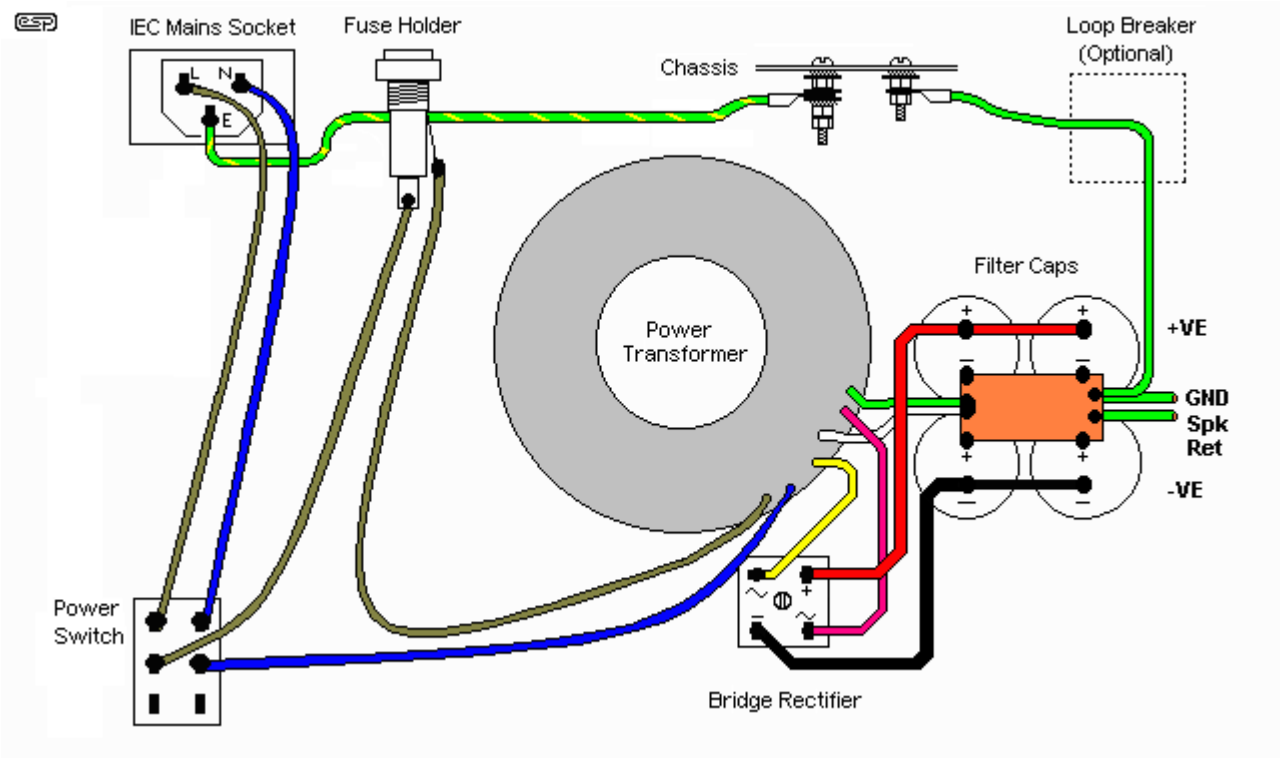
The ESP website has a fantastic, easy to understand diagram (and details worth reading and studying before you start soldering) at http://sound.westhost.com/psu-wiring.htm



In this case, the key circuitry outside the uber-PSU should be SW1, F1 (1 Amp) and T1

Fuses are a MUST have… don't think "oh, I'll put it in after I get it working!". You are endangering your life and others by not putting a fuse in the circuit.

Your Metal Chassis must also be connected to the EARTH (NOT NEUTRAL) connector on your IEC Socket. (see diagram below)



This diagram is from the same ESP website, showing how to safely wire the switch, fuse and earth connection from your IEC Mains socket. The Bridge Rectifier outputs should come into the Uber-PSU board, rather than into some filter caps shown in the diagram. (actually, there's no harm in adding the filter caps, but there's plenty on the board).

Bill of Materials

Qty	Value	Device	Parts
2	(1A/100V)	RB1A	BR1, BR2
3	220µ	CPOL-EUE5-10.5	C1, C2, C14
1	100n	C5/3	C11
4	100µ	CPOL-EUE5-10.5	C12, C13, C16, C19
1	470µ	CPOL-EUE5-10.5	C3
4	470µ	CPOL-EUE5-13	C4, C5, C6, C7
6	100n	C5/2.5	C8, C9, C10, C15, C17, C18
4	1N4004	1N4004	D1, D2, D3, D4
1	78xx	78XXS	IC1
1	79xx	79XXS	IC2
1	LM317	LM317TS	IC3
3	Calculate Via Excel	R-EU_0411/15	R1, R2, R3
1	240	R-EU_0207/10	R4
1	6.8k	R-EU_0207/10	R5
1	Transformer AC In	4 pin connector 0.1" pitch	Connector
1	± DC out	4 pin connector 0.1" pitch	Connector
1	+48V out	3 pin connector 0.1" pitch	Connector
1	4.7k	TRIM_EU-CA9V	Variable Resistor

R1,2,3, should be calculated using the attached Excel file.
All other resistors ¼-Watt, carbon film, metal film or similar.

C15,17 and 18 should all be 50V minimum rating (as they are in the phantom power path). All other capacitors can be lower rating (25V+)

All Non-Polarized capacitors can be ceramic or any film composition.