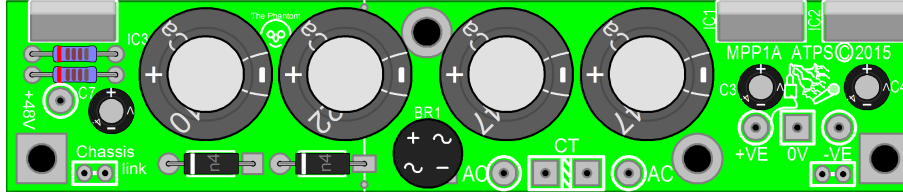




Australian Technical Production Services



Mic-Pre Power supply MPP1A



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Credits

This Article contains contributions by:
Richard Freeman

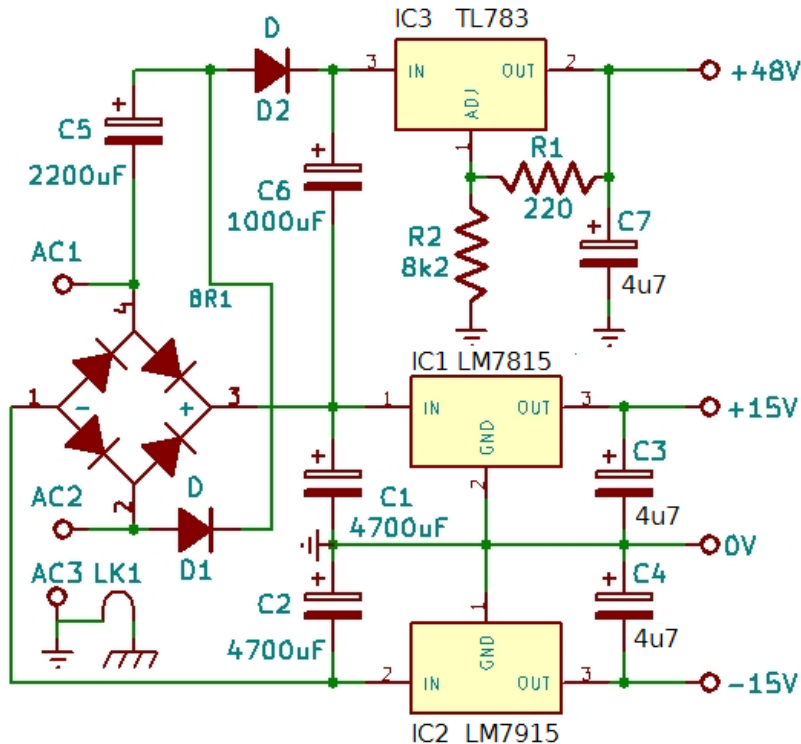
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Microphone Pre-amplifier power supply

Project description

This is a compact regulator board designed to fit in a 1 Rack unit case. While the original intention was to power a microphone pre-amplifier it could also comfortably supply a smaller mixing desk or any other device that requires +/- 15 Volts at up to 1 Amp and 48 Volts at up to 250mA

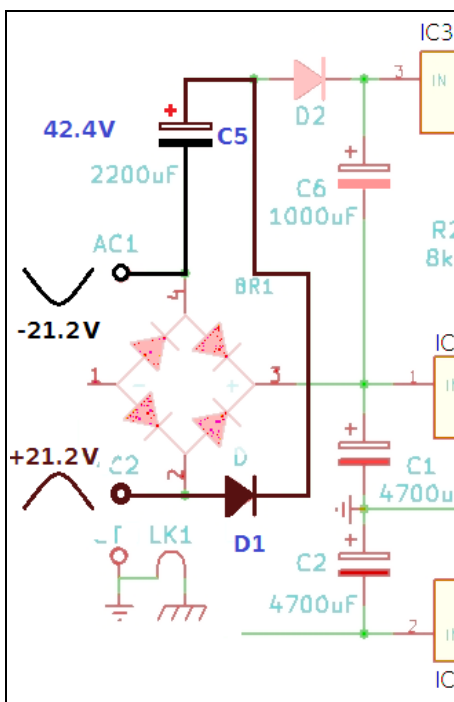


The circuitry in this project is pretty standard, a 7815 positive regulator for the +15 volt rail, 7915 negative regulator for the -15 volt rail and a TL783 set up to regulate at 48 Volts.

Voltage multiplier

The only slightly unusual, or maybe just less common circuitry, is the voltage multiplier used to generate the 62 Volt rail (which then gets regulated to 48V). The voltage multiplier consists of C5, C6, D1 and D2.

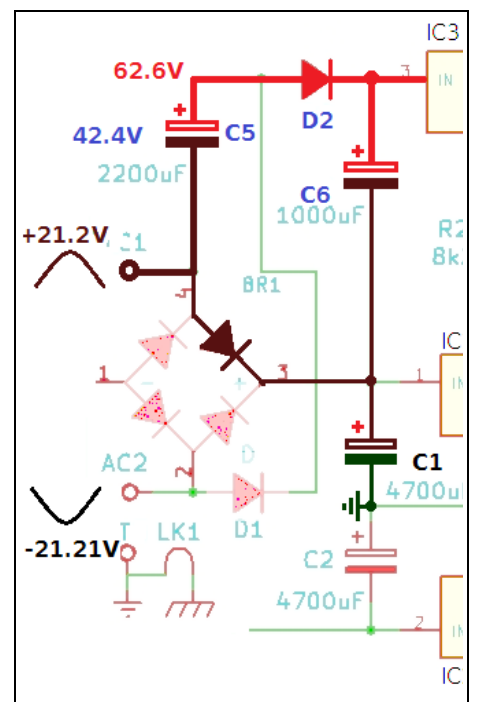
So how this works is.



In the first half cycle (highlighted on the left) with positive on AC2, and negative on AC1 diode D1 conducts, charging C5 to the peak voltage, which for a 15-0-15 volt Transformer would be 30×1.414 or 42.42 Volts.

In the second half cycle (+VE on AC1, -VE on AC2) on the right, the negative terminal of C5 is raised to 21.21 Volts, so the positive terminal is now at 62.63 Volts, D2 turns on and charges C6 from C5.

By connecting C6 to the (unregulated) positive rail rather than ground, we can use lower voltage, so physically smaller capacitors for C6, at the cost of slightly more ripple (although still well within the range the 7815 regulator can handle).



A few words about notation

You may have noticed on the schematic I use component values like 4u7, 2K2, 8R2 and 51R, so what's this about?

In the 'old days' of paper schematics, (yes OK I still prefer to work off print outs, I must be a follower of Ned Lud) diagrams could knock about a workshop for some time getting dirtier and more tattered as time went by, or alternatively would be photo-copied time and time again (and indeed some of the schematics in my library are copies of copies of copies). This meant that after a while, it could become difficult to distinguish small, but vitally important characters such as the decimal point (.) due to everyday wear and tear, dirt or just noise in one of the copies. To get around this it was decided to replace the decimal point with the multiplier.

So 2,200 Ohms becomes 2.2K Ohms, then we replace the decimal point with the multiplier (in this case K) to give us 2K2 Ohms. Since resistors are usually measured in Ohms, the word ohms (or the symbol Ω) is redundant and only takes up valuable real-estate, so we drop it to end up with 2K2.

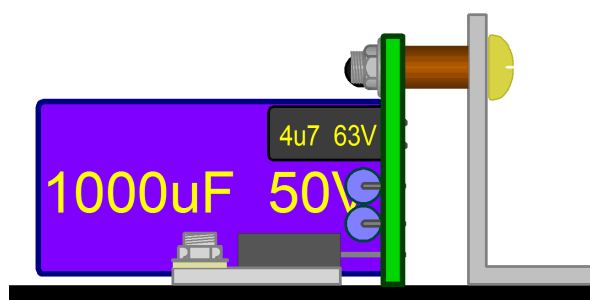
Likewise with Capacitor values, 4.7uF changes to 4u7F, and then we drop the redundant F to end up with 4u7.

So what about 51 Ω ? Well since the standard ASCII character set does not include the Ω symbol, so instead R is often used to denote Ohms (much like u is used, instead of μ or mu), next Resistors frequently have values greater than 100 Ω so we need to clarify that that this is 51 Ohms, rather than say, 51 K Ω , so as an exception to the dropping the unit of measurement rule above, we express this as 51R.

Likewise 8.2 Ω , since we have no multiplier and cannot print an Ohms symbol (in ASCII), so R is used instead giving us 8R2.

Construction

The entire circuit fits on a single circuit board measuring 23 by 109mm. I would advise mounting all the smaller parts (Diodes, Resistors and smaller capacitors) and Voltage regulators before the larger capacitors.

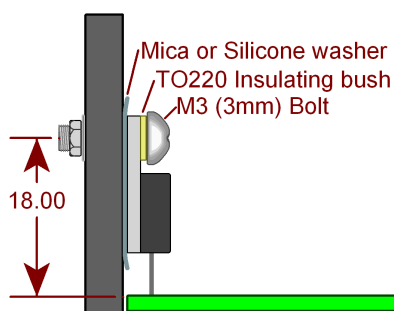


Note that all components except the resistor are polarity sensitive and need to be mounted as per the markings on the PCB.

The board was designed to fit into a 1 rack unit case, Although capacitors could take the height to 38mm, so it would probably be safer to mount the PCB vertically- Note you will need a support bracket of some sort if you do this, although you could always use the side of the case for this purpose.

Note there are no Fuses mounted on this PCB, this was to save space and it is strongly recommended that you mount at least an AC mains fuse on the primary side of the Transformer for safety.

Heatsink



I would expect that for most applications, bolting the regulators to a metal case would suffice for heat sinking. Note that the regulators will need to be insulated from the case so you will need to use insulating bushes for the bolt, and mica or silicone insulating washers for the regulators.

To calculate ballpark heatsink requirements we first need to know what the power dissipation in the regulators is. This can be calculated by $P_{diss}=(V_{in}-V_{out})\times I$ (where I is current).

For the 15 volt regulators, using a 15 Volt Transformer and assuming 1 Amp current we have: $V_{in} = 21.21$ Volts, $V_{out} = 15$ Volts

so $P_{diss}=(21.2-15)\times 1$ or 6.2 watts.

The TL783 will be dissipating $(62.6-48)\times 0.25 = 3.65$ Watts

Since the 7815/7915 almost twice the power of the TL783 they will get hotter, so I will use them to calculate heatsink requirements. I usually assume an ambient temperature of 45°C (think inside an equipment rack with poor ventilation) and will use specifications from the National semiconductor data sheet;

Maximum junction temperature is specified as 125°C

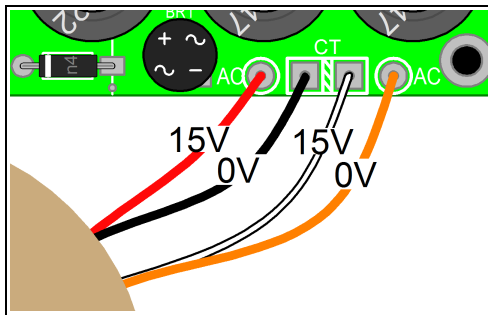
$R_{\theta JC}$ or Junction to case thermal resistance is $5^{\circ}\text{C}/\text{W}$ and then add another $1^{\circ}\text{C}/\text{W}$ to allow for the thermal resistance between the regulator and the heatsink so total of $6^{\circ}\text{C}/\text{W}$.

The junction at full power (6.2 Watts as calculated previously) will be $J_{temp} = P_{diss} \times R_{\theta JC}$ or $6.2 \times 6 = 37.2^{\circ}\text{C}$ hotter than the heatsink. So we want the heatsink to be cooler than $(125 - 37.2) = 87.8^{\circ}\text{C}$, which is (pretty hot) 42.8°C above ambient air temperature.

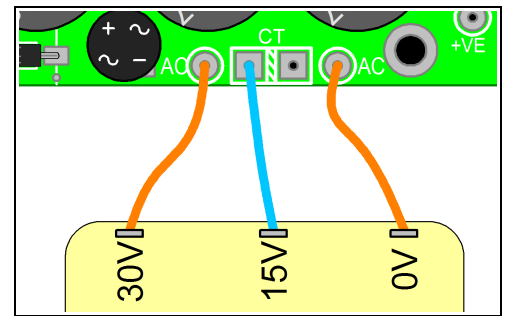
This heatsink is trying to dissipate the heat from all three regulators, so the total power dissipation is $6.2 + 6.2 + 3.65 = 16.05$ Watts so the heatsink needs to be at least $87.8 / 16.05 = 5.5^{\circ}\text{C}/\text{W}$.

Transformer

This power supply can use either a centre tap or dual secondary Transformer. They do both connect slightly differently as shown in the pictures below



Dual Secondary windings – note phase

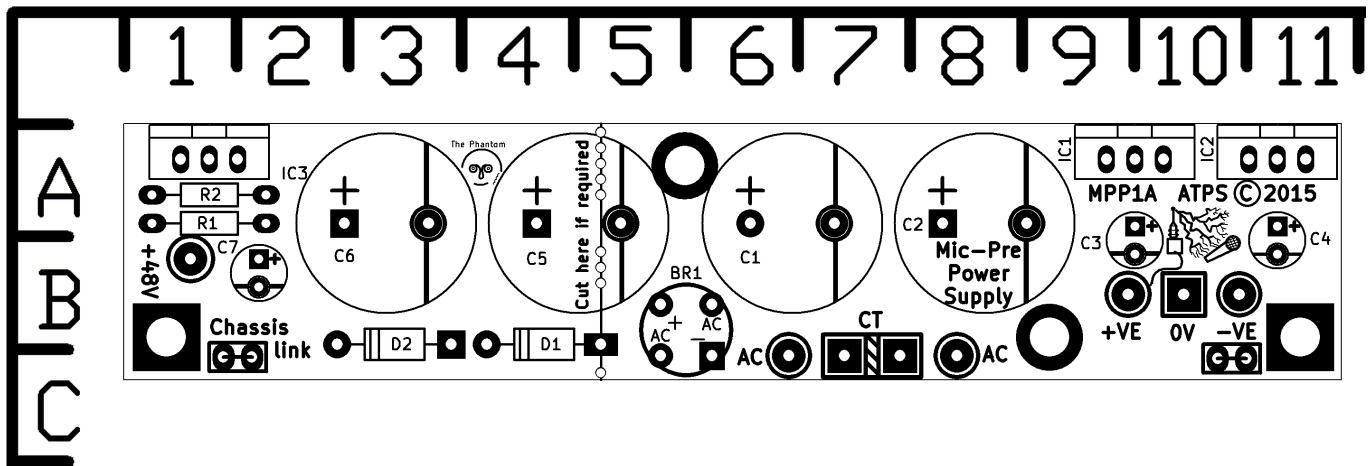


Centre tap connection

Either a dual 15V or 30V CT at 1.5 Amp (aka 45VA) or greater Transformer will usually be more than adequate for this application. Of course if you are not drawing full current from the power supply, then a much smaller Transformer could be used.

Note though, as this PCB has no option for fuses at the very minimum, a mains fuse is required.

Layout.



Parts locator

Part	Location	Description	Part	Location	Description
BR1	B5	W04	D1	B4	1N4001
C1	A6	4700uF 25V	D2	B3	1N4001
C2	A8	4700uF 25V	IC1	A9	LM7815
C3	B9	4u7 25V	IC2	A11	LM7915
C4	B11	4u7 25V	IC3	A1	TL783
C5	A5	2200uF 50V	R1	A1	220R
C6	A3	1000uF 50V	R2	A1	8K2
C7	B2	4u7 63V			

Parts list

This circuit contains no critical parts and substitutes of similar components can be readily made. 1% metal film resistors are specified and would be preferable for reasons of stability and accuracy for the 48V supply.

Bill of materials

Qty	Ref	Description	Notes
1	BR1	WO4 rectifier	
2	C1,C2	4700uF 25V	
2	C3, C4	4u7 25V	
1	C5	2200uF 50V	
1	C6	1000uF 50V	
2	C7	4u7 63V	
2	D1, D2	1N4001	
1	IC1	LM7815	
1	IC2	LM7915	
1	IC3	TL783	
1	R1	220R	
1	R2	8K2	

Template

Note print PDF as “Actual size” DO NOT “Fit” “ Shrink oversized pages” or “Custom scale”.
 Use the “Check scale” to confirm that the template has been printed to correct scaling, measure the distance of the scale with a ruler and confirm that it is indeed 100mm in length before using the Template.

