

## USER GUIDE

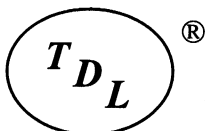
### Stereo RIAA Phono Preamp (for moving coil and moving magnet cartridges) Model 4041

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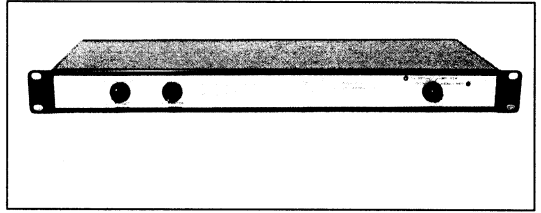
# STEREO RIAA PHONO PREAMP

(for moving coil and moving magnet cartridges)

## Model 4041

Revised August 2009

This preamplifier was especially designed to drive a computer sound card's line-input for restoring vinyl LP records which were recorded using RIAA equalization. However, it is also excellent for just listening to the music! The preamp has very low output noise and very low power line hum pickup, two features essential to creating a CD-quality wave file. The internal rechargeable batteries provide complete isolation from the power mains, however operation from the power mains is also switch selectable. We have developed a very low-noise power supply which is as quiet as battery operation.



**INPUT:** Matches all known magnetic pickup cartridges, both moving coil and moving magnet. (The cartridge load resistance can be set for each channel to 47 kohms, 470, 200, 100 or 20 ohms with two internal switches.)

**GAIN:** Zero to 52, 60, 70 or 80 dB at 30 to 35 Hz using the single-turn audio taper gain control. (The maximum gain for each channel is set with two internal switches.)

**RESPONSE:** Playback RIAA as shown in Figure 1. (Max gain can be set to 52, 60, 70 or 80 dB.) The rumble filters, which may be switched in and out, have corner frequencies of 20 Hz and change the response as shown. Because this preamp was designed to drive a sound card, it includes output lowpass filters with corner frequencies of 25 kHz. This causes no loss of quality because the CD sampling rate of 44.1 kHz limits the unaliased frequency response to 22 kHz.

**DYNAMIC RANGE:** Figure 2 is a spectrogram of a typical channel with the gain set to 52 dB and gain control at max. (47 K load resistance). Dynamic range is over 90 dB. Figure 3 is a spectrogram of a typical channel set to 80 dB and gain control at max. (200 ohm load resistance). Dynamic range is nearly 80 dB. Actual dynamic range will depend on the output noise and hum of your turntable.

**CONNECTORS:** Two female, panel mount RCA input connectors. Two female, panel mount RCA connectors plus a ¼ inch stereo phone jack for output. There is a 5-way binding post near the input connectors for connecting the preamp enclosure to the turntable frame as this may help reduce hum pickup (see the Operation section in the User Guide for more information on hum reduction). 2.5 mm male input power connector for the 24 VDC power supply. A green LED lights when the charging voltage is on and a red LED lights when the preamp is operated from the power mains.

**POWER:** Two internal 9 volt rechargeable NiCd or NiMH batteries provide about 3 hours of operation from a full charge. The 24 VDC power supply plugs into any (US) standard 115 VAC, 60 Hz outlet. (Power supplies for other mains voltages and outlets available on special order.) The charger can be left on to trickle charge the batteries all the time the preamp is not in use. Also, the batteries are on charge during power mains operation (both the green and red LEDs are lighted).

**FURNISHED ACCESSORIES:** 24 VDC wall power supply for 115 VAC, 60 Hz and Printed User Guide. The User Guide in .pdf format may also be downloaded from our web site.

**PHYSICAL:** Rack mount enclosure (1RU7) measuring 19 x 9 x 1-7/8 inches overall including connectors and knobs. Weight is 2 kgm (about 4.4 pounds) with batteries installed. Stick-on rubber bumpers for the four corners of the enclosure bottom are supplied for non-rack mount installation.

**PRICE:** See price list.



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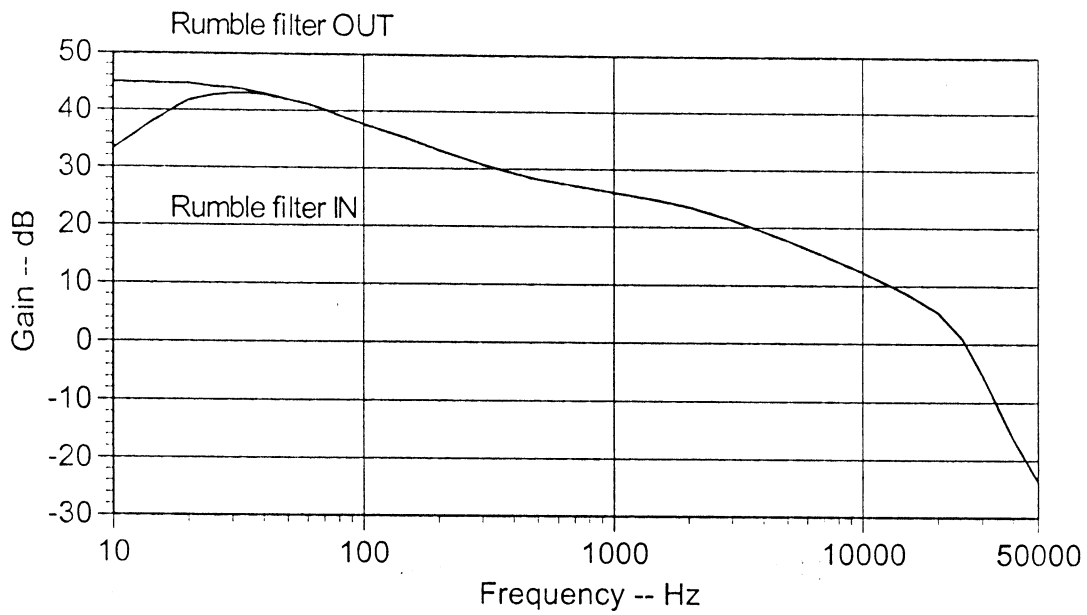


Figure 1 -- Playback RIAA response. Max gain can be set to 52, 60, 70 or 80 dB.

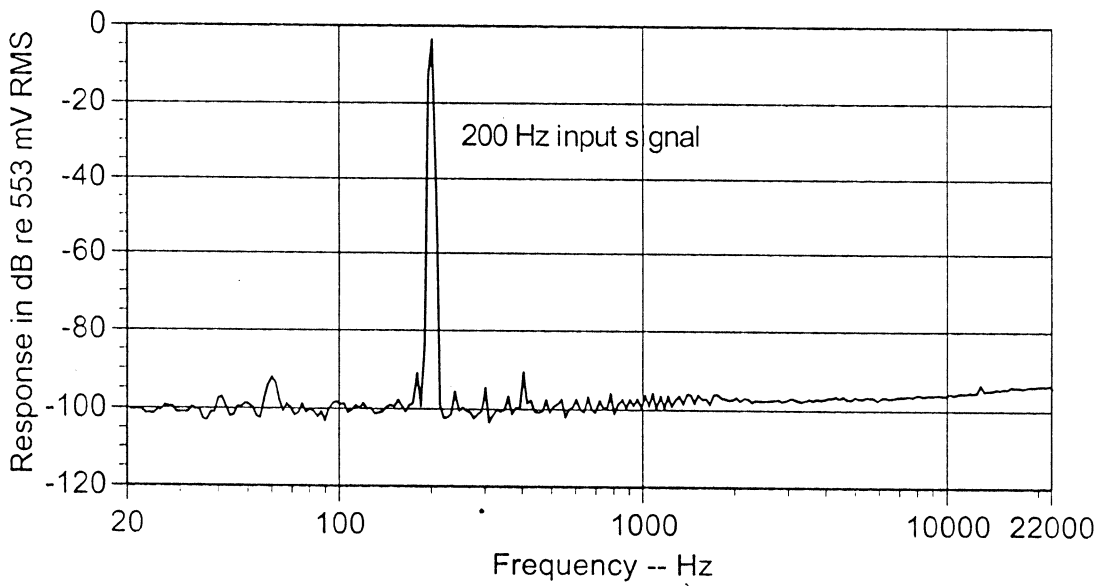


Figure 2 -- Typical output spectrum at 52 dB max gain with volume control set to max.

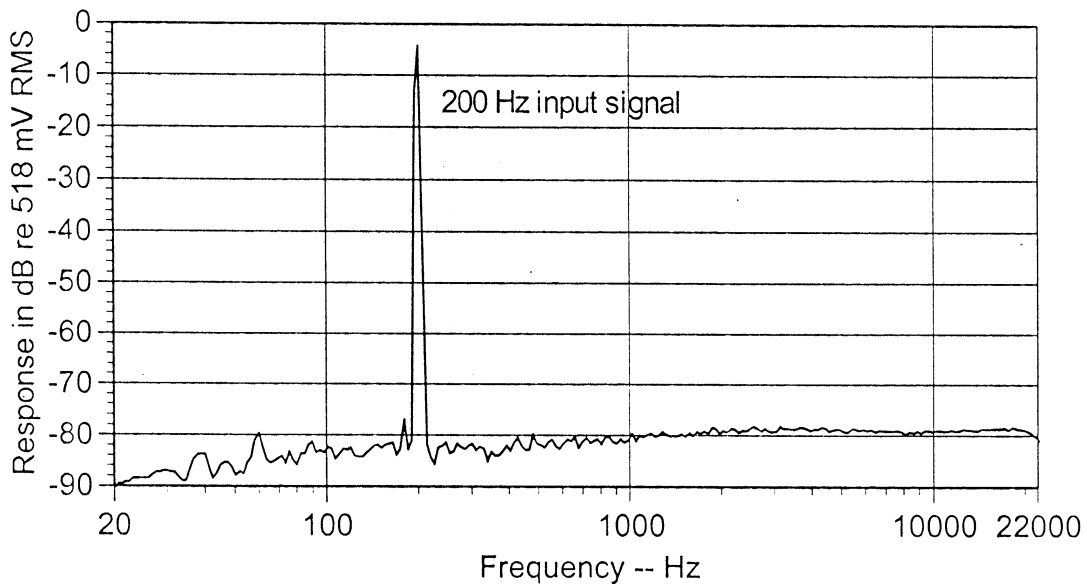


Figure 3 -- Typical output spectrum at 80 dB max gain with volume control set to max.

## MODEL 4041 -- OPERATION

This preamp was designed for both moving coil (MC) and moving magnet (MM) cartridges. Four internal DIP switches let you set the cartridge load resistance and maximum gain for both stereo channels. The settings are shown on the next page and also on the underside of the top cover plate. You have to remove the Phillips head screw at each end of the rear aluminum top rail to remove the top cover plate to be able to change the switch settings. The preamp is supplied with the load resistance set to 47 Kohms and the maximum gain set to 52 dB which is the most common setting for a moving magnet cartridge. If you have a low-output MM cartridge, you may need to increase the maximum gain setting to 60 dB.

If you have a moving coil cartridge, just set the switches to the manufacturer's recommended setting for load resistance. (You have the choices of 20, 100, 200 or 470 ohms.) Set the maximum gain to either 70 or 80 dB. You can try 70 dB first and if the gain is too low increase it to 80 dB.

To operate the preamp connect your turntable pickup cables to the RCA input connectors on the preamp's rear panel. Connect the output RCA connectors or the stereo phone jack to your amplifier, recorder or sound card line-input. The POWER switch is the four-position rotary switch on the right-hand side of the front panel. The first position is OFF. The second position turns on the charger for the internal batteries and the green LED will light. The third position turns ON operation from the internal batteries. (Note that there is no power-on indicator as this conserves battery power.) A full charge will operate the preamp for 3 to 4 hours. The fourth switch position turns ON operation from the power line and both the green and red LEDs will light.

There is a blue 5-way binding post near the input connectors that connects only to the aluminum case. You will generally get lower hum in the input if this post is connected to the turntable frame with a separate wire. Also the power plug polarity can make as much as 6 to 10 dB difference in the amount of hum pickup so experiment! It is most helpful to look at the preamp output with a sound card (use the line-input) and an appropriate spectrum analyzer program.\* This way you can easily see and minimize the amplitudes of the power line frequency and its harmonics.

Adjust the GAIN control as needed. To turn on the 20 Hz rumble filter, set its switch to the ON position.

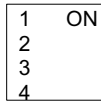
For battery operation, this preamp is powered by a pair of 9 volt rechargeable NiCd or NiMH batteries. The battery charging current is basically a trickle charge so the preamp can be left on charge all the time. (In August 2009, 9V NiCd are becoming difficult to find so they may be replaced with the more common NiMH.)

The batteries are in snap-in holders so they can be easily replaced if this should become necessary.

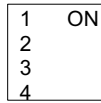
I believe in good quality audio cables. All the wiring inside the model 4041 has teflon insulation and teflon insulated cables are ideal but they are a bit pricy. Next best are cables such as *Radio Shack Goldline*. In my opinion, the gold plating on the connectors is just cosmetic but the center conductors are larger and the shielding is better than on “garden variety” cables. *Dayton Audio Cables* (available from Parts Express, [www.partsexpress.com](http://www.partsexpress.com) or call 800-338-0531) are also quite good and not too expensive.

\* A couple of examples: *AtSpecPro* is a shareware program that can be downloaded from [www.taquis.com](http://www.taquis.com). *TrueRTA* (tm) (Real Time Audio Spectrum Analyzer) can be downloaded from [www.trueaudio.com](http://www.trueaudio.com).

## CIRCUIT BOARD TOP VIEW



INPUT SIDE



SET BOTH SWITCHES



LOAD RESISTANCE

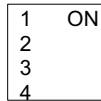
20 ohms - 1 ON (2, 3, 4 OFF)

100 ohms - 2 ON (1, 3, 4 OFF)

200 ohms - 3 ON (1, 2, 4 OFF)

470 ohms - 4 ON (1, 2, 3 OFF)

47K ohms - 1, 2, 3 and 4 OFF



MAXIMUM GAIN

52 dB - 1 ON (OTHERS OFF)

60 dB - 2 ON (OTHERS OFF)

70 dB - 3 ON (OTHERS OFF)

80 dB - 4 ON (OTHERS OFF)

## MODEL 4041 -- CIRCUIT DESCRIPTION

The model 4041 was especially designed for both moving coil and moving magnet cartridges.

In Figure 1, the two very-low noise, low distortion opamps (U1 and U2) provide 20, 28, 38 or 48 dB of gain depending on the settings of switches S3 and S4. The cartridge load resistance can be set to 47 Kohms, 470, 200, 100 or 20 ohms depending on the settings of switches S1 and S2.

The dual, low-noise opamp (U3) provides an additional 32 dB of gain and also shapes the frequency response to the inverse RIAA curve with the RC feedback networks. The DC and low frequency left-channel gain is set by the ratio:

$$(R26+ R27) / R28 = 1100000 / 27500 = 40 = 32 \text{ dB}$$

The left and right channel circuits are identical. To eliminate ground loops, the circuit board common is connected to the enclosure at only one point; at the input connectors.

The dual, low-noise opamps in U4 (Figure 2) are the rumble filters with corner frequencies of 20 Hz. These filters may be switched in and out with toggle switch S5. Capacitors C9 and C10 block the small DC offset voltages from U3 (without changing the frequency response) when the rumble filters are switched out. All capacitors in the signal path are high-quality plastic film or COG ceramic (or silver mica).

Figure 2 also shows the dual gain control and output lowpass filter. The filters have a four-pole Butterworth response and a corner frequency of 25 kHz. The filters have unity low frequency gain and use low-noise opamps in a quad package (U5). This filter reduces high frequency noise from the preceding opamps and provide an anti-aliasing function. The overall frequency response of each channel is shown in Data Sheet Figure 1.

The power supply is shown in Figure 3. The four-position rotary switch, S101, controls the mode of operation. The switch position 1, the preamp is OFF. In position 2 the value of R107 and R108 sets the battery charging currents and the green front panel LED is lighted. In position 3 the unit is ON using power from the batteries but there is no "on" indicator to save battery power. In position 4 the preamp is ON using power from the mains and both the green and red LEDs are lighted.

When battery power is being used, the battery voltages are regulated to  $\pm 5$  volts by the low dropout voltage regulators U103 and U105 and their associated capacitors. For power mains operation, the incoming DC voltage is "split" by U101 and its associated resistors to approximately  $\pm 12$  volts and then preregulated to  $\pm 9$  volts by U102 and U104 before being sent to the low dropout voltage regulators. This double regulation and large-value filter capacitors results in a very high suppression of the power mains frequencies (hum). Thus power mains operation is nearly as quiet as battery operation. In fact, it's difficult to tell the difference most of the time.

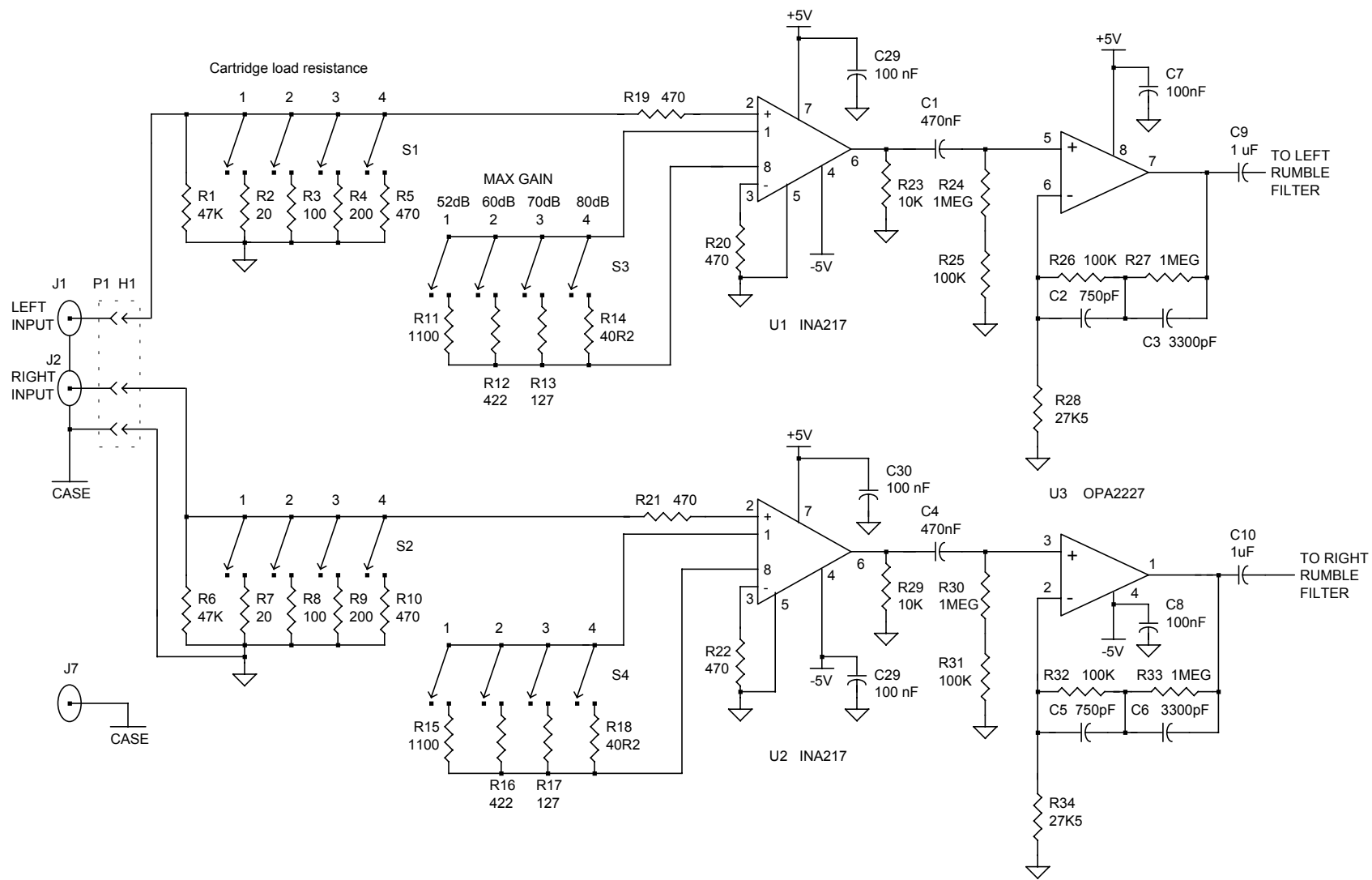


Fig. 1 -- Input amplifiers  
 Alternate circuit: MAIN4041B.PCB

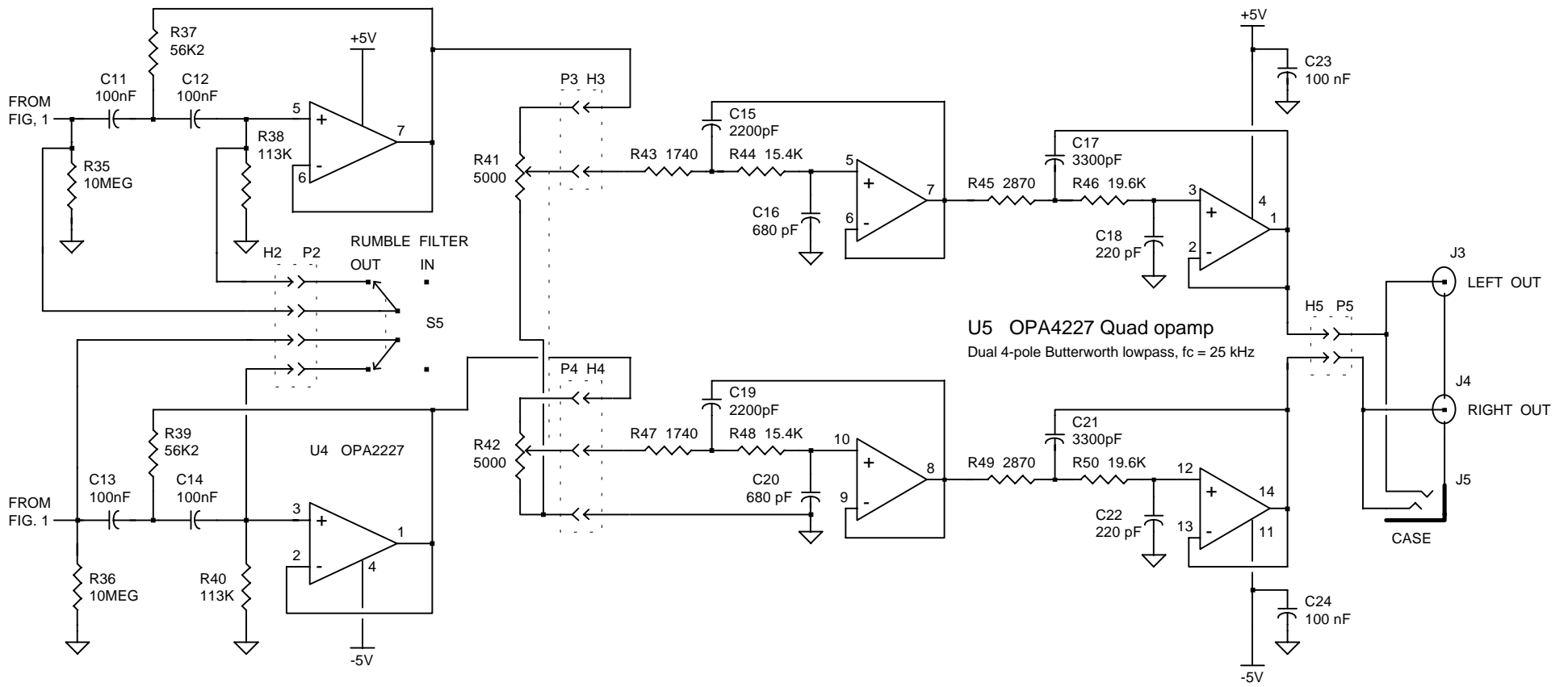


Fig. 2 -- Rumble filters, gain control and output lowpass filters

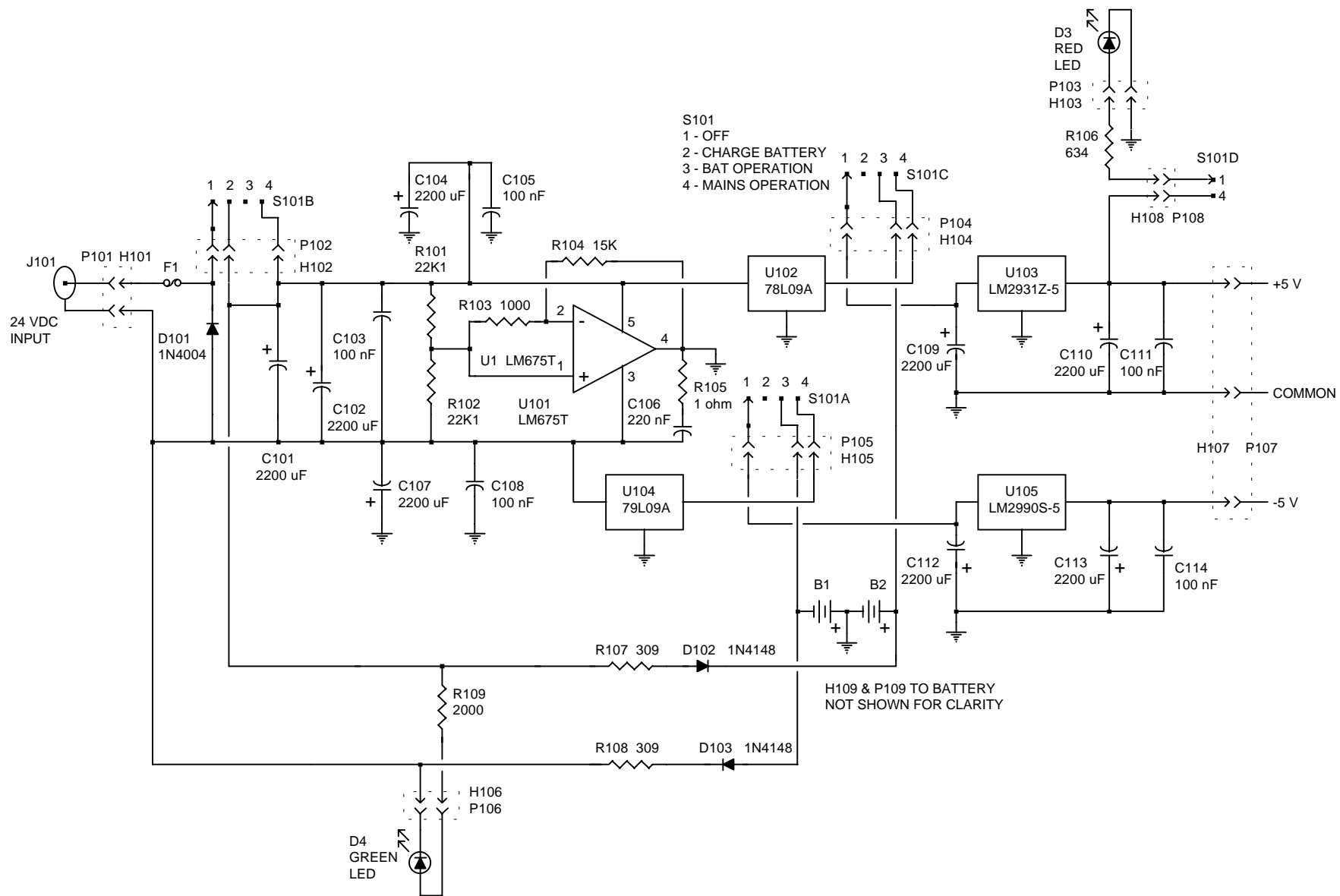
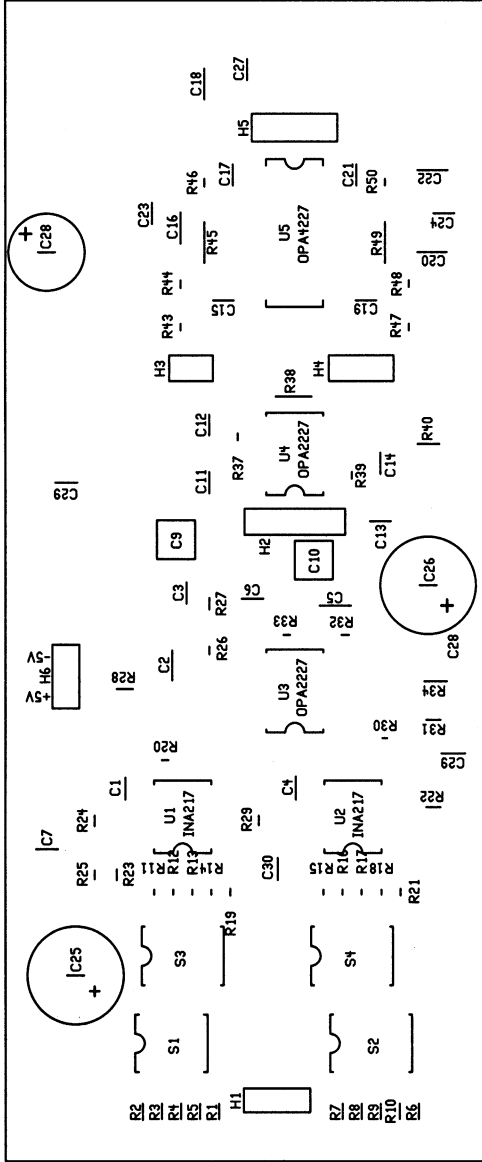
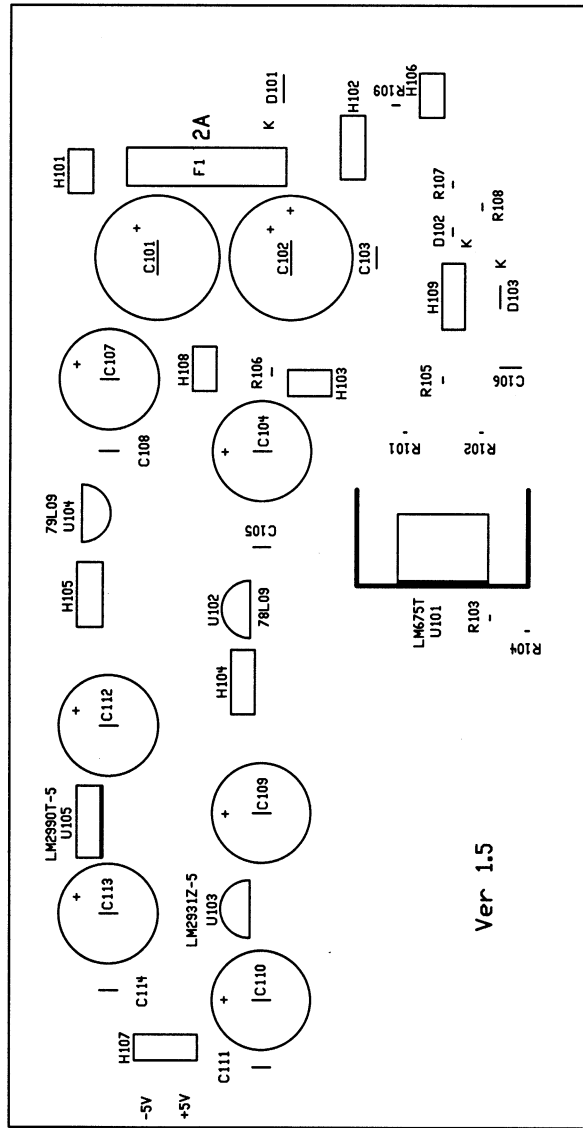


Fig 3 -- Model 4041 Battery Charger and Power Supply



Model 4041B Parts Placement



Ver 1.5

PWR1041 Parts Placement

**Parts List**  
**Model 4041 Stereo RIAA Preamplifier**  
 Revised August 6, 2009

**MAIN4041B.PCB**

QUANTITY	REFERENCE	VALUE	DESCRIPTION	MANUFACTURER
2	R1, R6	47K	1%, 1/4 w, metal film	
2	R2, R7	20	1%, 1/4 w, metal film	
2	R3, R8	100	1%, 1/4 w, metal film	
2	R4, R9	200	1%, 1/4 w, metal film	
6	R5, R10, R19, R20, R21, R22	470	1%, 1/4 w, metal film	
2	R11, R15	1100	1%, 1/4 w, metal film	
2	R12, R16	422	1%, 1/4 w, metal film	
2	R13, R17	127	1%, 1/4 w, metal film	
2	R14, R18	40R2	1%, 1/4 w, metal film	
2	R23, R29	10K	1%, 1/4 w, metal film	
4	R24, R27, R30, R33	1 Meg	1%, 1/4 w, metal film	
4	R25, R26, R31, R32	100K	1%, 1/4 w, metal film	
2	R28, R34	27K5	1%, 1/4 w, metal film	
2	R35, R36	not used		
2	R37, R39	56K2	1%, 1/4 w, metal film	
2	R38, R40	113K	1%, 1/4 w, metal film	
2	R41, R42	5000	dual audio taper pot	
2	R43, R47	1740	1%, 1/4 w, metal film	
2	R44, R48	15K4	1%, 1/4 w, metal film	
2	R45, R49	2870	1%, 1/4 w, metal film	
2	R46, R50	19K6	1%, 1/4 w, metal film	
2	C1, C4	470 nF	5%, 50 V, polyester film	
2	C2, C5	750 pF	5%, 50 V, silver mica	
4	C3, C6, C17, C21	3300 pF	5%, 50 V, polyester film	
9	C7, C8, C11 C12, C13, C14, C23, C24, C29	100 nF	5%, 50 V, polyester film	
2	C9, C10	1 uF	5%, 50 V, polyester film	
2	C15, C19	2200 pF	5%, 50 V, polyester film	
2	C16, C20	680 pF	5%, 50 V, polyester film	
2	C18, C22	220 pF	5%, 50 V, COG ceramic	
2	C25, C26	470 uF	25 V, radial electrolytic	
1	C28	100 uF	25 V, radial electrolytic	
2	U1, U2	INA217	Low-noise opamp, 8-pin DIP	
2	U3, U4	OPA2227PA	Dual low-noise opamp, 8-pin DIP	
1	U5	OPA4227PA	Quad low-noise opamp, 14-pin DIP	

4	S1, S2, S3, S4	Quad DIP switch, 8-pin DIP package	
3	H1, H4, H6	3-pin male header	Molex 22-03-2031
1	H2	5-pin male header	Molex 22-03-2051
1	H3	2-pin male header	Molex 22-03-2021
1	H5	4-pin male header	Molex 22-03-2041
3	P1, P4, P6	3-pin shell	Molex 22-01-2037
1	P2	5-pin shell	Molex 22-01-2057
1	P3	2-pin shell	Molex 22-01-2027
1	P5	4-pin shell	Molex 22-01-2047
20		terminal pins	Molex 08-50-0114
1		Circuit board, MAIN4041B.PCB	

### Power Supply: PWR4041.PCB

2	R101, R102	22K1	1%, 1/4 w, metal film
1	R103	1000	1%, 1/4 w, metal film
1	R104	15K	1%, 1/4 w, metal film
1	R105	1 ohm	5%, 1/2 w, carbon film
1	R106	634	1%, 1/4 w, metal film
2	R107, R108	309	1%, 1/4 w, metal film
1	R109	2000	1%, 1/2 w, metal film
2	C101, C102	2200 uF	35 V, radial electrolytic
5	C103, C105, C108, C111, C114	100 nF	5%, 50 V, polyester film
6	C104, C107, C109, C110, C112, C113	2200 uF	16 V, radial electrolytic
1	C106	220 nF	5%, 50 V, polyester film
1	F101	2A	fuse, GMA, 5 x 20 mm
2			PCB mount fuse clips
1	D101	1N4004	1 A, 200 V, silicon diode
2	D102, D103	1N4148	silicon diode
1	U101	LM675T	power opamp, TO220-5
1	U102	78L09	positive 9 volt regulator, TO-92
1	U103	LM2931Z-5	positive 5 volt low-dropout regulator, TO-92
1	U104	79L09	negative 9 volt regulator, TO-92
1	U105	LM2990T-5	negative 5 volt low-dropout regulator, TO-220
3	H101, H106, H108	2-pin male header	Molex 22-03-2021
6	H102, H103, H104, H105, H107, H109	3-pin male header	Molex 22-03-2031
24		terminal pins	Molex 08-50-0114

1	heat dissipater for U101	AVID (Mouser 532-563002B00)
1	Circuit board, PWR4041.PCB	

### Enclosure Mounted Parts

1		Rack mount enclosure	Wolgram 2RU7
1		Front panel, Metalphoto of Cincinnati	
1		Rear panel, Metalphoto of Cincinnati	
30 inches		1.5 x .25 inch aluminum bar for shielding	
2		NiCd or NiMH rechargeable battery, 8.4 V	
2		Battery holder	Keystone type 1295
2		Battery hold-down clips	
1	Red LED	Mains operation indicator	Lumax SSI-LXH3121ID-150
1	Green LED	Battery charge indicator	Lumax SSI-LXH3121GD-150
2	J1, J3	RCA, panel mount RCA connector, black	Mouser 161-1052
2	J2, J4	RCA, panel mount RCA connector, red	Mouser 161-1053
1	J101	2.5 mm male, insulated, panel mount, power input connector	Mouser 163-4303-EX
1	J5	Stereo phone jack, 1/4 inch	Mouser 502-12B
1	J7	5-way binding post, blue	
1	S5	2-pole, 2-position rotary switch	Mouser 105-13572
1	S101	4-pole, 4-position rotary switch	
3		Knobs	Jameco KN032
4		Stick-on rubber bumpers	DigiKey SJ5523-0
4		Rack mount screws	
3		Shaft couplings	
3		1/4 inch diameter extension rods	
3		1/4 inch nylon bushings	
1		Misc hardware and wire	

### Other Parts

1	Wall DC power supply, 24 VDC at 100 mA or higher	Various manufacturers
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