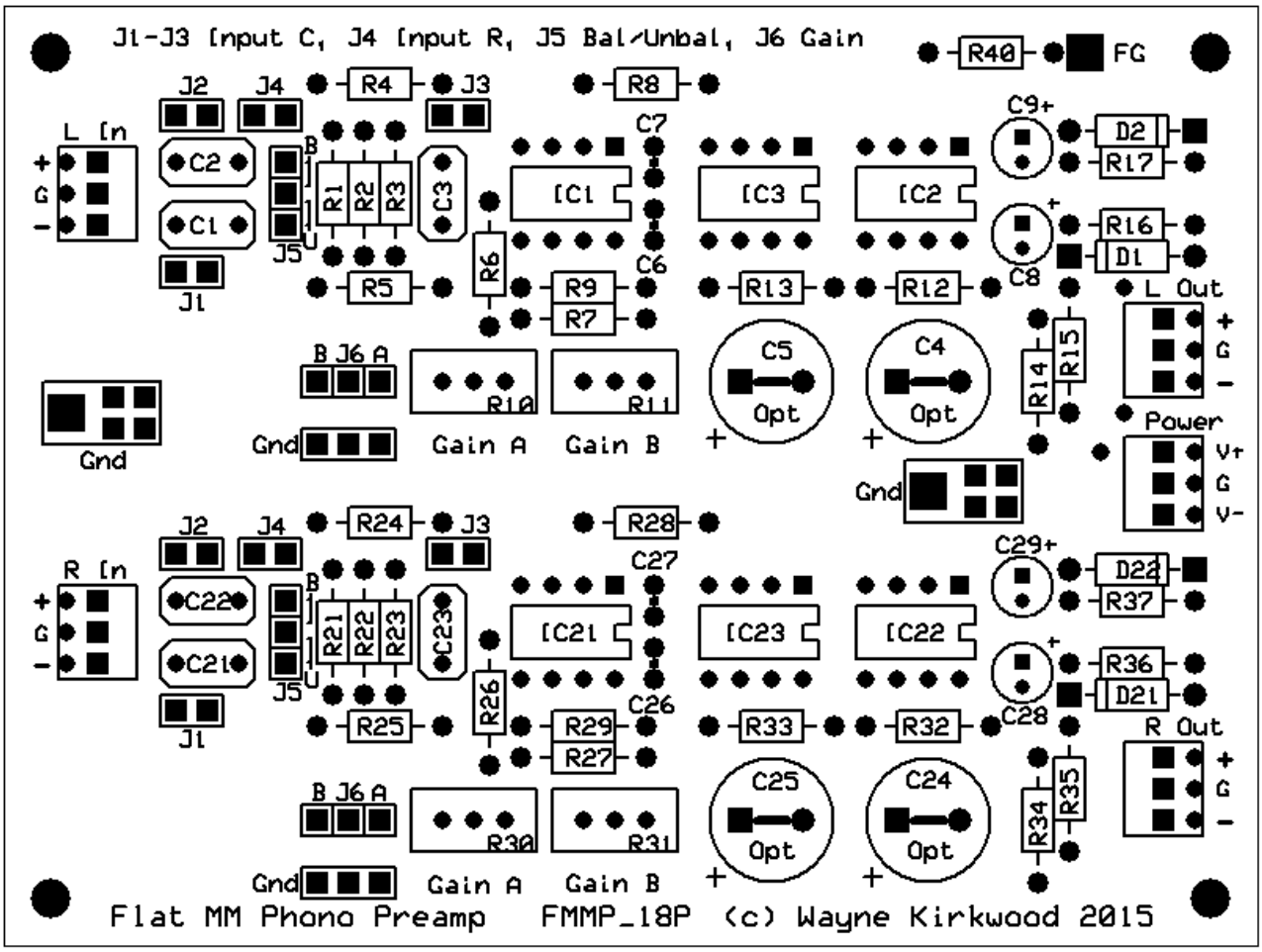
Assembly Instructions for the KA Electronics Flat MM Phono Preamplifier



Flat MM Phono Preamp PC Board Stuffing Guide

Install IC sockets

Place the PC Board on the bench silkscreen side face up.

Drop six 8 pin IC sockets into their respective locations. Observe orientation of the notch which should point to the right with the PC board oriented as shown above. Verify that socket IC1 and IC21 are not inserted into the capacitor holes.

Lift the board up and place a small piece of cardboard the same approximate size as the PC on top of the board to form a "sandwich" of PC board, sockets and cardboard.

The cardboard is used to hold the sockets in place so the board can be turned over without the sockets dropping out. With the sandwich held in place flip the board over to the solder side.

Tack solder only two of the corner IC pins.

Once all the IC sockets are tack soldered in place on two pins, flip the

board over to the component side. Make certain that each socket is correctly oriented, fully seated on the board and square.

If you're satisfied with the positioning of the sockets, solder all of the remaining pins.

Visually check each pin's connection particularly those to the ground plane. Reheat any pins if needed.

Install resistors and diodes

Install two 88K7 1% resistors at R1 and R21.

Install four 49K9 1% resistors at R2, R3, R22 and R23.

Install four 100R* 1% resistors at R4, R5, R24 and R25.

Install four 10R 1% resistors at R6, R7, R26 and R27. These are metal film precision resistors, not the 10R metal oxide fusible resistors that will be installed in a later step.

Install four 1K 1% resistors at R8, R9, R28 and R29.

Install four 49R9 1% resistors at R12, R13, R32 and R33.

Install four 100K 1% at R14, R15, R34 and R35.

Install four 10R 1W fusible resistors at R16, R17, R36 and R37. (These fusible resistors are metal oxide 1W resistors in a 1/4W size.)

Install four 1N4004 diodes at D1, D2, D21 and D22. Observe polarity.

Install ceramic capacitors

Install four 100 nF (0.1uF) at C6, C7, C26 and C27.

Install film capacitors

Install six 100 pF film capacitors at C1, C2, C3, C21, C22 and C23.

Install jumper headers

Before soldering the headers, install jumper shunts onto the pins. The shunts serve as insulators which allows you to position them while soldering without burning your fingers.

When installing the jumpers, tack solder only one pin and reheat it to adjust the position of the header so that its square and flush with the board. Once you're satisfied with the orientation of the headers solder the remaining pins.

Note that the left and right channels use the same jumper designations.

Install eight 2 pin headers at J1, J2, J3 and J4. There are eight jumpers in this step because there are two channels.

Install four 3 pin headers at J5 and J6. There are four 3 pin jumpers total.

Install electrolytic capacitors

Note: The + (positive) terminals for the electrolytic capacitors have a square pad.

Install four 47uF 35V at C8, C9, C28 and C29. The polarity of these capacitors are critical.

The preferred configuration for the flat phono preamp is to install wire jumpers in place of the output coupling capacitors C4, C5, C24 and C25. The low offset inherent with a balanced input connection and the DC common mode rejection provided by the preamp permit a DC-coupled output in most cases.

Install C4, C5, C24 and C25 only if the flat phono preamp is not going to be used with the EQ monitor switcher or when AC-coupling is needed. (Typically when an unbalanced cartridge connection is used and there is no monitor switcher.)

If the Flat Preamp is going to be used with the EQ Monitor Switcher or connected to the phono cartridge fully-balanced, then proceed with the following step.

Install bare wire jumpers, made from trimmed resistor leads, at C4, C5, C24 and C25. Form the jumpers as a U-shaped loop spaced off the board so that they can be used as output test points.

Install Phoenix three pin connectors

When installing the Phoenix connectors make sure that the wire openings point to the outside edge of the PC board.

Install five Phoenix connectors on the PC board.

Install Trim Pots

Preamp final test is simplified if the gain pots are preset to a known value. Orient the pot before soldering it so that the screw adjustment is on the right and the leads are facing you. Two different settings will be used for the Gain A and Gain B trim pots. (Gain B is optional.) With an Ohmmeter measure the resistance between the middle and left pin.

Adjust two trim pots to approximately 140 Ohms.

Install two 500 Ohm trim pots adjusted to 140 Ohms at Gain A which are labeled R10 and R30. The screw adjustment should be on the right-hand side.

If the gain jumpers at J6 are going to be used, install two additional 500 Ohm trim pots.

Adjust the optional Gain B trim pots to approximately 330 Ohms and install at Gain B labeled R11 and R31.

Note: These may not be the best gain settings for the final preamp setup but provide a good starting point for initial electrical test.

Note: Do not install the ICs at this time.

Check all solder connections and reheat or reflow them if necessary.

Is is recommended that the PC board be stripped and cleaned of flux. When removing flux make sure that areas near the input IC and it's components are very clean and

that no flux bridges exist that could, under some conditions, make the input noisy. Acetone used sparingly on a Q-tip works well but make sure that it does not contact any plastic on the top side of the PC board or contaminate the IC sockets, jumpers and trim pots.

Initial Tests

In this section DC and signal tests check basic functionality. Final gain calibration will likely be required when the preamp is installed and connected to a cartridge.

You will need a DC voltmeter capable of reading mV levels and a source of DC power to perform the following tests.

DC Tests

Connect a source of bipolar DC power.

Ground is in the middle of the three pin power connector. Observe polarity.

If a variable power supply is used, slowly raise the voltage to about +/-15V.

There should be no measurable current draw. If high current is drawn stop immediately and check the board for solder bridges and for correct polarity of D1, D2, C8, C9, C28 and C29. If all is well, then proceed.

Check the voltages at pin 8 of IC1 and IC21. They should be +15V. The voltages at pin 4 should be -15V.

Check the voltages at pin 7 of IC2, IC3 IC22 and IC23. They should be +15V. The voltages at pin 4 should be -15V.

If the voltages are correct on some pins but absent on others check to make sure the IC socket pins were actually soldered.

Temporarily remove power.

Install the ICS

Install two NJM2068 ICs at IC1, IC21. Note that the left and right channels use the same jumper designations. (Many other dual op amps may also be used such as the NE5532, NJM2114 and OPA2134.)

Install four THAT1240 (INA134) ICs at IC2, IC3, IC22 and IC23.

DC Offset and Current Draw Tests

Reconnect power.

Install shunts on the two upper pins of J5 in the balanced “B” position.

If a variable power supply is used, slowly raise the voltage to about +/-15V.

Measure the DC voltage drop across R16, R17, R36 and R37. Each should measure approximately 80-200 mV indicating a current draw of 8-20 mA per channel.

Measure the DC voltages relative to ground at pins 1 and 7 of IC1 and IC21. They should each measure less than 100 mV. (This measurement depends greatly on the op amp used and its offset voltage and bias current. The objective of

this test is to make sure the outputs are not pinned to the supply rail.)

Measure the DC voltages relative to ground at pins 3 and 5 of IC1 and IC21. They should each measure less than 100 mV. (This measurement also depends greatly on the op amp used. The primary objective of this test is to make sure the inputs are not pinned to the supply rail.)

Measure the DC voltages at both pins 6 of IC2, IC3, IC22 and IC23. They should each measure less than 10 mV.

If the voltages above are out of range check to make sure that a shunt is installed in the balanced position of J5. Also check for solder bridges and proper IC installation.

This completes assembly and DC tests.

Signal Tests

You will need an Ohmmeter, an AC-Voltmeter with a balanced and/or floating input (or DVM) capable of reading dBu (preferred) or AC mV, a signal generator and a source of DC power.

Before beginning this section, please make sure that the Gain trim pots have been adjusted to 140 Ohms for Gain A and 330 Ohms for Gain B. If they have not been preset and need to be trimmed in-circuit, make sure that the Ohmmeter is set for a "low-current" measurement and not a range that permits diode testing.

Test Connections

Install a short length of bus wire to the "G" Input pins. A previously-trimmed component lead is ideal. Do this for both channels.

Install a 2K resistor between Inputs "+" and "-". Do this for both channels.

Connect a source of bipolar DC power.

Check jumper installation. J1-J4 should be installed. J5 should be in the "B" balanced position. J6 should be in the "A" Gain position.

The following instructions apply to both the left and right channels. Perform the steps for the left channel from beginning to end, then repeat them for the right channel. This reduces test lead movement and speeds testing.

DC Tests with Input Termination

This test checks the DC voltage across the input termination and the output DC offset of the preamp. The results of this test vary significantly with the op amp used. The typical figures are for an NJM2068. The primary objective is to make certain that no large bias current develop across the cartridge coil and that no large output DC offsets exist.

Measure the DC offset with the voltmeter connected to the C4 and C5 test points. (If C4 and C5 are installed use the output connector or 49R9 resistor leads.)

The output DC offset should measured from C4 to C5 should be 50 mV or less.

Measure the DC potential across the input termination resistor connected the "+" and "-" inputs. It should be significantly less than 100 uV if measurable

at all.

Move jumper J5 to the "U" unbalanced position.

The DC offset at the input termination resistor should be less than 5 mV.

The output DC offset measured from C4 to C5 should be less than 50 mV.

Make certain that J5 is in the "U" position to complete the following tests.

Adjust Generator Level

Connect a signal generator to the "+" and "-" inputs using the resistor leads to clamp on to. Set the generator to 1 kHz.

Measure with an AC voltmeter the input signal level and adjust it to -44 dBu (Approximately 4.9 mV AC).

Measure Unbalanced Output Levels

Move the AC voltmeter ground connection to the "G" terminal and measure the level at the test point located at C4. (If C4 is installed use the 49R9 resistor or output connector.) The level should be approximately -22 dBu. (Approximately 62 mV.)

Measure the level at the test point located at C5. The level should be approximately -22 dBu.

Measure and Adjust Balanced Output Levels

Move the AC voltmeter ground connection to the C5 test point. (It is important that the meter's input is floating from ground.) Connect the meter's positive lead to C4. The level should read approximately -16 dBu. (Approximately 125 mV.)

Adjust Gain A trim pot to read -16 dBu.

Remove J6. The output level should now read -38 dBu. (Approximately 10 mV.)

Install J6 at the Gain B position. The output level should now read approximately -22 dBu. (62 mV.)

Adjust the Gain B trim pot to -22 dBu output level reading from C5 to C4.

Maintain the AC voltmeter connections to the C4 and C5 test points to perform the next set of tests.

Move jumper J6 back to the "A" Gain position.

Check Common Mode Rejection

Move the generator ground connection to the input "G" terminal.

Move jumper J5 to the "B" Balanced position.

Connect the generator output to the "+" input. Short the "+" and "-" inputs together with a clip lead or piece of wire so the generator output is feeding both the "+" and "-" inputs simultaneously.

Check the output level between test points C4 and C5. There should be no measurable signal other than preamp noise indicating common mode rejection of the generator.

Perform a reality check. Remove the short between the "+" and "-" inputs so that the "-" input floats and the "+" input is still connected to the generator. The output level should increase out of the noise floor to approximately -44 dBu. The level measurement is not critical (it will vary with generator output impedance and other variables) but it should increase above the noise floor.

Move jumper J5 back to the "U" unbalanced position. The output level should again read -22 dBu.

Noise Tests

Noise tests will be performed after the preamp is installed in a metal or foil-lined enclosure and connected to either a sound card or the companion RIAA EQ/Monitor switcher.

Noise problems in the preamp itself are usually either the dual op amp input, THAT1240 or solder flux contamination on the PC board near the dual op amps and input network.

Repeat Tests for the Right Channel

Repeat all of the Signal Tests for the Right Channel.

Reset Jumpers

Verify jumper J6 is in the "A" Gain position.

Set J5 to "B" or "U."

A balanced cartridge connection is preferred. If the final installation will use a balanced cartridge connection with shielded twisted pair wiring, move J5 to the "B" position.

If the final installation will be using coaxial (RCA) wiring and connections then place Jumper J5 in the "U" unbalanced position.

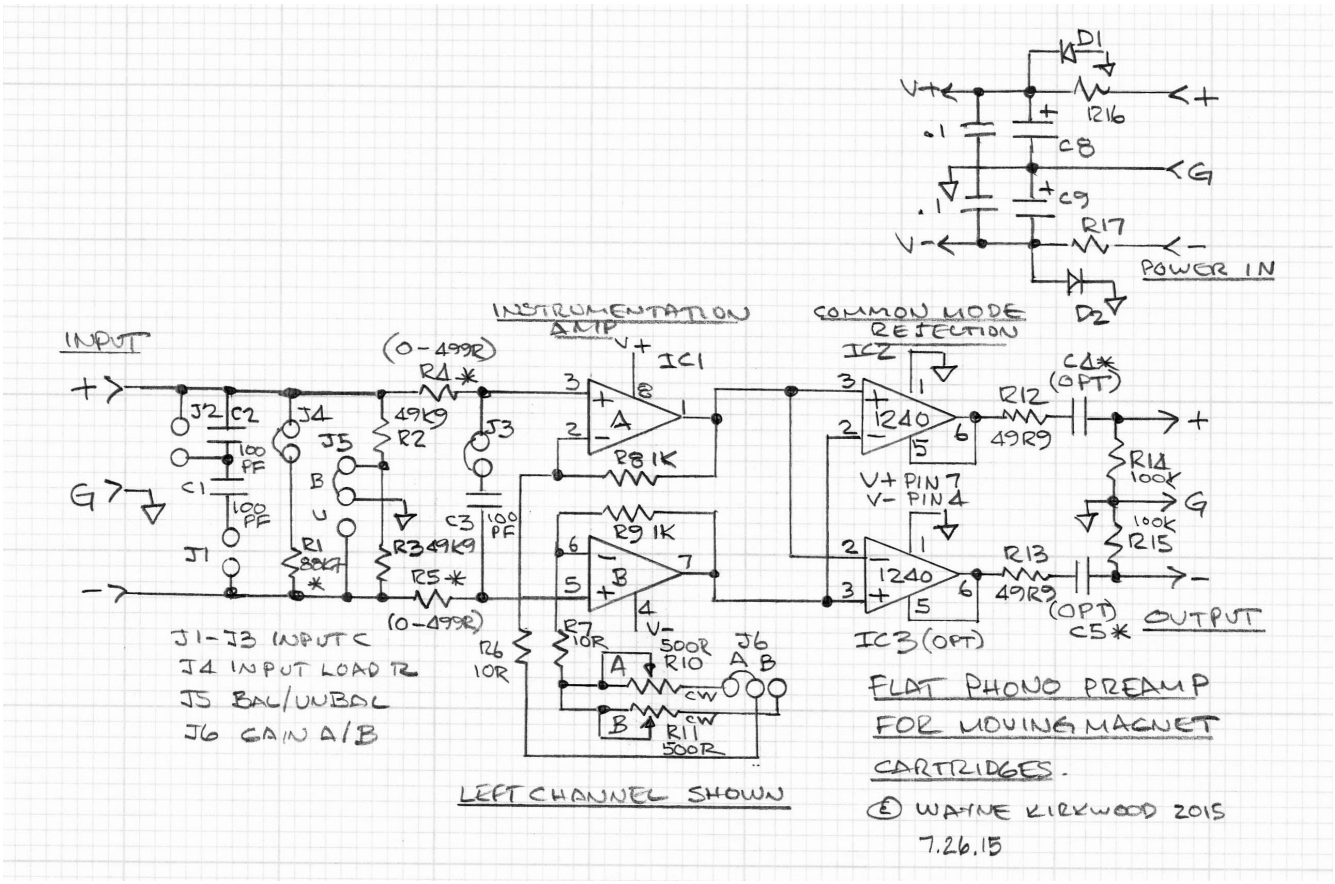
Do not use the preamp with a cart connected unless J5 is installed. J5 should never be left open.

Jumpers J1-J4 set input resistance and capacitive loading. As a starting point leave J1-J2 open with J3 linked for 100 pF added Cload. For 47K cart loading J4 should be linked. (Unused jumpers can be installed on one pin to prevent loss.)

Input capacitance loading.

0 pF added all links open.
+50 pf link J1.
+100 pF link J3. (This 100 pF setting provides added RFI protection.)
+150 pF link J1 and J3.
+200 pf link J1, J2 and J3.

Flat Phono Preamp Schematic



Detailed Parts List

A complete bill of materials is available from Mouser Electronics:

With THAT ICs: http://www.mouser.com/ProjectManager/ProjectDetail.aspx?AccessID=995b00e9e8

Parts List Spreadsheet:

http://www.ka-electronics.com/kaelectronics/Phono_Transfer_System/Flat_Preamp_Project_092115.xls

Component Designations

Semiconductors

D1, D2, D3, D4 1N4004
IC1, IC21 Dual Op Amp NJM2068, NJM2114, NE5532, OPA2134
IC2, IC3, IC22, IC23 THAT1240 or INA134.

Electromechanical and Connectors

J1-J4 2 Pin Header (8 total)
J5-J6 3 Pin Header (4 total)
Shunt (12 total)
3 Pin Terminal Block (5 total)

Capacitors

C1, C2, C3, C21, C22, C23 100 pF 10%
C4, C5, C24, C25 not used*
C6, C7, C26, C27 100 nF ceramic
C8, C9, C28, C29 47 uF 35V

Resistors

R1, R21 88K7 1%
R2, R3, R22, R23 49K9 1%
R4, R5, R24, R25 100R 1%
R6, R7, R26, R27 10R 1%
R8, R9, R28, R29 1K 1%
R12, R13, R32, R33 49R9 1%
R14, R15, R34, R35 100K 1%
R16, R17, R36, R37 10R 1W fusible metal oxide

R10, R11, R30, R31 500R Vertical Trim Pot

Other Resources

Pro Audio Design Forum Build Thread:

http://www.proaudiodesignforum.com/forum/php/viewtopic.php?f=7&t=753

For more information or technical support contact: sales@ka-electronics.com