

# UNIVERSAL AUDIO AMPLIFIER SYSTEM



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## Ramsey Electronics Model No. UAM4SYS

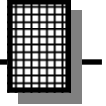
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*The UAM4SYS is a state of the art audio amplifier that utilizes a class D power amplifier. Professional balanced input is provided along with an unbalanced line output that can be configured as a buffered input feed thru or as the “processed”, (tone, balance, level) signal to feed remote locations. All controls use DC or digital levels, eliminating control noise. Headphone level is provided by a 64 step digital control with memory. Automatic over temperature protection and power stage mute is provided. All this in a rugged compact aluminum case.*

### FEATURES

- 42 watt class D amplifier (21W per channel stereo mode)
- 0.1% + N distortion
- Balanced or unbalanced inputs
- All DC or digital controls for noise free operation
- Selectable direct or processed (bass, treble, balance, level, loudness) line outputs
- Pre-mute headphone output
- 64 step digital headphone level adjustment with level memory
- Operates on 12 to 18VDC @ 3.3A max power input (up 87% efficient)
- Quick connect spring terminal output terminals accept 28AWG to 14AWG wire
- Selectable 22, 25, 29.5 or 36dB gain
- Rugged shielded aluminum case
- Compact profile (5.6in x 6.6in x 1.6in) weighs in at 1.24 lbs (excluding power supply)





## PARTIAL LIST OF AVAILABLE KITS:

### RAMSEY TRANSMITTER KITS

- FM10C, FM25B FM Stereo Transmitters
- AM1C, AM25 Transmitter

### RAMSEY RECEIVER KITS

- FR1C FM Broadcast Receiver
- AR1C Aircraft Band Receiver
- AR2 Aircraft Band Receiver
- SR2C Shortwave Receiver
- AA7C Active Antenna
- SC1C Shortwave Converter

### RAMSEY HOBBY KITS

- SG7 Personal Speed Radar
- SS70C Speech Scrambler/Descrambler
- TT1C Telephone Recorder
- MD3C Microwave Motion Detector
- PH14C/15C/16C Peak hold Meters

### RAMSEY AUDIO KITS

- SHA1C and SHA2 Headphone Amplifier kits
- UAM4 40 Watt Stereo Amplifier kit

### RAMSEY AMATEUR RADIO KITS

- HR Series HF All Mode Receivers
- DDF1 Doppler Direction Finder Kit
- QRP Series HF CW Transmitters
- CW7C CW Keyer
- QRP Power Amplifiers

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UAM4SYS

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## KIT ASSEMBLY AND INSTRUCTION MANUAL FOR

# Universal Audio Amplifier System

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## **UAM4SYS Theory of Operation**

Note: There are four pages of schematics included in this manual. Please refer to them as directed as you read the following.

### **Power Supply**

Since electronic equipment doesn't work without power, lets start off by describing the UAM4SYS power supply. For reference when reading this section, check schematic sheets 1 and 2 (pages 38 & 39). The UAM4SYS requires a 12 to 18 volt DC input at 3.3 amps applied to Power jack J5. From there the power goes two directions. First, to VR1, a 7810 positive 10 volt 1 amp regulator. C28 filters the regulator's output. 10 Volts is used to power most of the circuitry you see in schematic 1, as well as the 5 volt power supply on schematic sheet 2. Since the regulator is before the power switch, all circuits powered by the 10 volt are powered as soon as the unit is plugged in. On schematic sheet 2, regulator VR2, a 7805 positive 5 volt 1 amp regulator that powers circuitry on schematic sheets 1, 2, and 4. C39 filters VR2's 5 volt output.

Turn back to schematic sheet 1. The second place the input power is routed to the power switch, S1. When this switch is turned on, power is applied to the power amp IC, U7 on schematic page 4. It is also applied to R29 through J6 pin 10 to J40 pin 1 on the front panel (schematic sheet 3). This causes D4, the power indicator LED, to light.

An interesting note is that because the 10 volt and 5 volt circuits are active whenever the power supply is plugged in, you can listen to the input signal on the headphones and the line outputs will be active even though the power switch is off. The operation of these sections is discussed in detail in the following sections. I'm sure you can think of some interesting applications for this 'feature!'

### **Input Buffer**

IC U1 contains 4 operational amplifiers, (op amp). U1A and U1B are set up as a buffer with unity gain. C5, C10, C11, and C12 are input coupling capacitors. They provide DC isolation between the input audio device and the UAM4SYS. R11 and R14 provide a 5 volt bias to the op amp buffers. Because the input can be a balanced signal and there is negative feedback applied to the '-' input of U1A and U1B, R1, R15, R23 and R24 are necessary to isolate that feedback signal from the applied input signal. A resistor is needed on both the '+' and '-' inputs because the signal is balanced. C47 provides filtering of any signal that might try to sneak thru to the power supply and therefore assures a stable reference bias on the op amp input.

The input buffer allows both unbalanced and balanced input signals to be applied to the UAM4SYS. First we will take an unbalanced signal into the unbalanced input at J4.

An unbalanced single is one that uses two conductors, one for the audio signal and one for ground. This is the type of signal that comes out of an MP3 player, CD player, tape deck, VCR, computer, or other similar device. J4 takes a 3.5mm Stereo plug. A 3.5mm stereo plug consists of three conductors called tip, ring, and sleeve. The tip at the very end of the plug is normally the left audio channel. The next conductor down is called the ring and is normally the right audio channel. The last and biggest conductor is called the sleeve and is the ground connector that is common to both the left and right channels.

Now that we know what a 3.5mm stereo plug is let's follow an unbalanced signal from the connector through the Input Buffer. When a plug is inserted into J4 the electrical connections between pins 2 & 4 and 1 & 3 are opened. The left channel signal from the tip enters J4 pin 2 through C10 and R1 to U1A's non-inverting input at pin 3. The left channel signal is buffered and exits at pin 1. The right channel signal from the ring enters J4 pin 1 through C11 and R23 to U1B's non-inverting input at pin 5. The right channel signal is buffered and exits at pin 7. Ground comes in on the sleeve and is connected to the circuit board ground plane.

A little information about balanced signals is probably a good idea at this time. Balanced audio signals use three conductors, positive, negative, and ground for each channel. The actual signal is not referenced to ground but is applied on the '+' and '-' lines. The signal on the '+' line is exactly the opposite of the '-' line. The two signals are applied to the two amplifier inputs and the amplifier uses both of these to produce an output. The ground is simply there to provide some shielding of the cable and is not used in any other way. Most noise that sneaks onto the lines will be the same level, both in amplitude and polarity at any given time. Since it is applied to the opposite polarity inputs the noise will be canceled and not appear at the output. This is called common mode rejection, a big advantage of the differential inputs of the op amps. Balanced lines are used in most professional equipment and for long signal runs.

For separate unbalanced inputs we will again use a 3.5mm stereo plug but now we need one for each channel. When a plug is inserted into J2 and J3 the electrical connections between pins 2 & 4 and 1 & 3 of these jacks are opened. Let's follow the right channel and leave the left channel to you. The positive tip signal enters J2 pin 4 goes to J4 pin 3 which is connected to pin 1 (no plug in J4). From J4 pin 1 the signal goes through C11 and R23 to U1B's non-inverting input at pin 5. The negative ring signal enters through J2 pin 1

and goes through C12 and R15 to U1B's inverting input at pin 6. The right channel signal is buffered and exits at pin 7.

J2 and J3 can also be used as unbalanced inputs by simply connecting an unbalanced input to the connector tip and the ground to the ring and sleeve. The signal will now be applied to the '-' input of the op amps and the op amp '+' inputs will be tied to ground. This is handy if you have inputs that use separate left and right cables and mono 3.5mm plugs. Also, when using the UAM4SYS in mono mode only the right channel, J2, input is used for mono operation. Again this can then be used either balanced or unbalanced.

From the output of the input buffer the left and right audio signals go to two different places. First they go to the line output buffer input headers H1 and H2. They also go to the tone, volume, balance control IC, U3.

### **Tone/Volume/Balance**

U3, an LM1034, provides tone, volume, balance, and loudness control for both channels of the UAM4SYS. The IC supplies a DC reference voltage for the bass, treble, balance, and volume controls. These controls are adjusted by the user and provide individual DC levels to the IC where they set appropriate levels of each function. Because DC levels are used to control the various functions the scratchy noise produced by the controls in many audio components is not a problem in the UAM4SYS.

C15 and C21 set the treble operation points. C19 and C20 set the bass operation points. C18 and C16 are bypass capacitors for the IC. C6, C7, C8, and C26 act as filters for the DC control lines. R17, R18, R19, and R20 (sheet 3) are the control potentiometers. R5, R6, R8, and R13 provide isolation between the control pots and the IC. If you wish to learn more about how the LM1034 actually works and how component values were selected do an internet search on National Semiconductor and download the data sheet.

The unprocessed audio enters U3 pins 2 and 19 from the input buffers through C9 and C4 which are coupling capacitors. The audio is then processed according to the settings of the control potentiometers and fed to the right channel output at pin 8 and left channel output at pin 13. From here the processed audio goes three places the line output buffer headers H1 & H2 (sheet 1), headphone amp (sheet 2), and power amp (sheet 4).

### **Loudness**

The loudness function is turned on when U3 pin 7 is connected to U3 pin 12. It is turned off when U3 pin 7 is connected to U3 pin 17. Loudness is controlled by front panel switch S4 (sheet 3) which controls U5A and U6 as described below.

U5A is a flip flop set up in the toggle mode. Its outputs at pin 6, called 'Q', and pin 7, called 'Q not' indicated by a line over the Q symbol, are opposite DC levels of either +5 volts or 0 volts. R27 is a pull up resistor for the flip flop's set line. C32 delays the +5 volts to U5A's set line ensuring it comes up in the set condition, which is +5V on output 'Q' at pin 6 and 0V on pin 7, 'Q not', when power is first turned on. When S4 is pressed it applies a ground to C31 (sheet 2) causing C31 to discharge. When the button is released the ground is removed from C31 and it charges through R38 to +5 volts. This positive transition causes U5A to change states, (flip flop). An interesting thing to know is when a switch opens or closes it usually has problems and may actually open and close many times before finally ending up in it's final state. This is called switch bounce and is actually 'seen' by logic circuits like U5 and causes unpredictable results. C31 and R38 help prevent these 'bounces' from getting to U5 and is called de-bouncing.

U6 is called an analog switch. It contains 4 electronic switches, we'll only be using 2 of them that are turned on and off by signals applied to pins 7 and 13. With +5 volts on these pins it's associated switch is turned on and 0 volts turns it off. With U5 Pin 6 at +5 volts U6 pin 13 is also at +5 volts. This causes the switch between U6 pins 1 and 2 to close. At the same time U5 pin 7 is at 0V. This applies 0V to U6 pin 5 which causes the switch between U6 pin 3 and 4 to open. This turns off the Loudness function as mentioned above. When S4 is pressed and released, U5A toggles causing pin 6 to change to 0V and pin 7 to change to +5V. This places 0V on U6 pin 13 opening the switch between pins 1 and 2. It also places +5 V on U6 pin 5 closing the switch between pins 3 and 4 and turns off the loudness function. Since pin 7 is +5V, power is applied to the loudness LED on the front panel (sheet 3) through current limiting resistor R28 which lights the LED indicating the UAM4SYS is muted.

### **Line Output Buffer**

With headers H1 and H2 the user can select either processed (from U3) or unprocessed (directly from input buffers U1A and U1B) audio to be sent to the line outputs. R4 and R30 set the bias to  $\frac{1}{2}$  supply voltage (+5 volts) while isolating the bias voltage from the power supply. R32 and R33 are pull-up resistors which prevent oscillations that can be caused by external load capacitance. C13, C14, C17, and C30 are coupling capacitors. The selected right channel audio signal enters through the header pin 2 and is applied to the op amp buffer through C14. The output at U1 pin 8 is applied to the right line output RCA connector through C17. The left channel is identical to the right.

Notice that the signal to the line output buffer is before the mute function which will be discussed in the 'Power Amp' description. This means that even though the amplifier is muted the input signal will be present on the line output

jacks. Therefore if you are using the line outputs to record a program you can mute the speakers but continue to record the input. If you are feeding another amplifier the mute function on the UAM4SYS will silence only the local amplifier output.

### **Headphone Amplifier**

U11 and U12 (sheet 2) are 750mW headphone amplifiers. C45 is a power supply filter capacitor. C33, C37, C34, and C38 are coupling capacitors. C35 and C36 are bypass capacitors. U10 is a digital potentiometer that provides a DC level output at pin 6 that controls the gain of U11 and U12. S5 and S6 (sheet 3) are used to increase or decrease this DC level.

To increase the gain of the headphone amps S6 is pressed. This places a ground on pin 2 of U10. This high to low transition tells the IC to increase the output voltage (pin 6) 1/64 of the +V to -V voltage (5 volts). If S6 is held down for more than one second the output voltage will go another 1/64 step every 100 milliseconds until it is released or the full +5 volt level is reached. The output voltage is applied to the volume control, pin 4, of U11 and U12. The down button S5 functions just like S6 except the voltage is decreased. The really neat thing about U10 is that it remembers where it is set even when the power is removed. So if you turn off the UAM4SYS and then turn it back on the headphone level will be where you left it. Also notice that the signal to the headphones is before the mute function, just like the line output signals, which will be discussed in the 'Power Amp' description. This means that even though the amplifier is muted you can still hear the input signal. Therefore you can make sure the correct program is ready to go before you apply it to the speakers for everybody else to hear.

The right channel audio from the Tone/Volume/Balance IC, U3, is applied to U12 through C38. The signal is amplified and fed to headphone jack J20 through C34.

### **Power Amp**

The Power Amp U7 a MAX9708, is a class D amplifier. The letter D is simply the next letter after C, and does not stand for digital. Class D and Class E amplifiers are sometimes mistakenly described as "digital" because the output waveform superficially resembles the pulse-train of a digital signal, but a Class D amplifier merely converts an input waveform into a continuously pulse-width modulated (square wave) signal. A digital waveform would be pulse-code modulated.

Class D amplifiers are much more efficient than Class AB power amplifiers. As such, Class D amplifiers do not need large transformers and heavy heat sinks, which mean that they are smaller and lighter in weight than an equivalent



Class AB amplifier. All power devices in a Class D amplifier are operated in on/off mode. The term usually applies to devices intended to reproduce signals with a bandwidth well below the pulse switching frequency which in our case is about 200kHz.

The MAX9708 converts the input signal to a sequence of pulses whose averaged value is directly proportional to the instantaneous amplitude of the signal. The frequency of the pulses is typically ten or more times the highest frequency of interest in the input signal. The pulse frequency in the Power Amp is around 200kHz or 10 times 20kHz. The output of such an amplifier contains unwanted spectral components (that is, the pulse frequency and its harmonics) which must be removed by a passive filter. The resulting filtered signal is then an amplified replica of the input. This filtering is handled by the patented technology of the Maxim MAX9807 amplifier chip and the speaker. The design uses a unique filterless modulation and spread-spectrum switching mode. This eliminates the need for large inductors and capacitors on the output.

Typical class D amplifiers use a simple modulation method called 'Fixed-Frequency Modulation' (FFM). This simply means that a switching frequency is selected and that is the frequency at which the output is switched. The MAX9708 can use this method but it also has a special method called 'Spread-Spectrum Modulation' (SSM). With this method the switching frequency is actually changed around a center frequency, in this case  $\pm 4\%$  around 200kHz. Using this method the MAX9708 is able to reduce the noise generated with typical class D amplifiers and the need for large filters described above is minimized. How this is accomplished is beyond this manual. If you are interested you can find information on the web by searching for 'spread spectrum' and also check out the Maxim web site at "www.maxim-ic.com" and go to the data sheet for the MAX9708.

The main advantage of a class D amplifier is power efficiency. Because the output pulses have a fixed amplitude the output devices, which are MOSFETS in the case of the MAX9708, are switched either on or off rather than operated in linear mode. This means that very little power is dissipated by the transistors except during the very short interval between the on and off states. The MAX9708 is capable of achieving up to 87% efficiency. The wasted power, the remaining 13%, is low because the instantaneous power dissipated in the transistor is the product of voltage and current, and one or the other is almost always close to zero. The lower losses permit the use of a smaller heat sink while the power supply requirements are lessened too.

The input signal(s) are applied to U7 though C57 and C59. Once the signal reaches the MAX9708 there isn't a lot more to say other than it amplifies the signal and applies it to the output terminals at T1.

The 'GAIN' jumpers, H4 and H5, are used to adjust the gain of the MAX9708. See the tables on the schematic for specific settings. The gain settings are also printed on the UAM4SYS circuit board next to the jumpers.

The 'MUTE' input terminal located below the left and right channel inputs is used to place the UAM4SYS into the mute mode. The mute mode causes the output transistors to stop switching. This may be used to silence the UAM4SYS with the advantage of a built in click/pop suppression feature of the MAX9708. Shutdown mode reduces the power consumption of the UAM4SYS to a very low level, about 0.1uA. This is handy for battery operated applications to increase battery life. The mute function is controlled by the second half of flip flop IC U5. This circuit operates in exactly like the flip flop used for the loudness function with the exception that the 'Q' output on pin 10 is connected to the power amplifier, U7 pin 31, instead of controlling an analog switch. U7 is muted when the 'Q' output is low, 0 volts. Note that the mute function only controls the output of the speaker output. It will not have any effect on the headphone or line outputs of the UAM4.

The UAM4SYS may be operated as either a 2 channel, 21 watt per channel, or a single 42 watt amplifier. The mode of operation is determined by header jumper H3 and the placement of jumpers at L+, L-, R+ & R- located near the output terminals. With no jumper installed on H3 the MAX9708 is in 2 channel or stereo mode. This means that it is operating like two separate amplifiers. In this mode there should be no jumpers installed at the L+, L-, R+, & R- points.

**DO NOT INSTALL ANY JUMPERS AT L+, L-, R+, & R- WHEN NO JUMPER IS INSTALLED AT H3**

If a jumper is installed at H3 the MAX9708 will operate in mono mode. In this mode only the signal applied to the right channel input is used. You may use the UAM4SYS as either a single 42 watt amplifier if are installed between L+ & R+ and between L+ & R-. If jumpers are not installed between L+ & R+, and between L+ & R-, the UAM4SYS will operate as two 21 amplifiers with the same input signal.

Note that even though it appears you could connect the left and right speaker outputs together at a point away from the UAM4SYS

**DO NOT ATTEMPT THIS!!!**

Connections away from the board may cause signal phasing differences and cause damage to your UAM4SYS.

That's about it. The rest of the components are simply support components required by the MAX9708 and are used to provide stable voltages and signals generated within the MAX9708. Again if you want more in depth information about the MAX9708 go to "[www.maxim-ic.com](http://www.maxim-ic.com)" and locate the data sheet for it.

### **RAMSEY Learn-As-You-Build KIT ASSEMBLY**

Successful kit assembly requires close attention to the assembly the assembly instructions, good soldering techniques and proper tools. Here are some helpful suggestions.

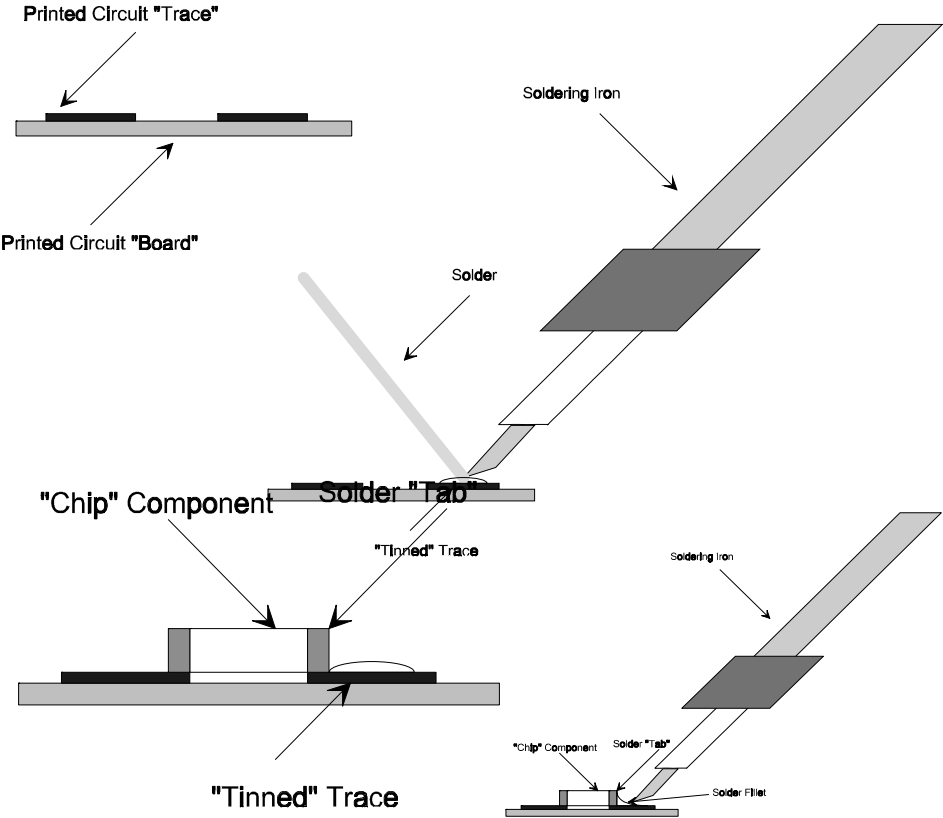
- Use a 25-watt soldering pencil with a clean, sharp tip.
- Use only rosin-core solder intended for electronics use.
- Use bright lighting; a magnifying lamp or bench-style magnifier may be helpful.
- Do your work in stages, taking breaks to check your work. Carefully brush away wire cuttings so they don't lodge between solder connections.

We have a two-fold "strategy" for the order of the following kit assembly steps. First, we install parts in physical relationship to each other, so there's minimal chance of inserting wires into wrong holes. Second, whenever possible, we install in an order that fits our "Learn-As-You Build" Kit building philosophy. This entails describing the circuit that you are building instead of just blindly installing components. We hope that this will not only make assembly of our kits easier, but help you to understand the circuit you're constructing. For each part, our word "Install" always means these steps:

1. Pick the correct part value to start with.
2. Place it in the correct PC board location.
3. Orient it correctly, follow the PC board drawing and the written directions for all parts - especially when there's a right way and a wrong way to place it on the board. (Diode bands, electrolytic capacitor polarity, transistor shapes, dotted or notched ends of IC's, and so forth.)
4. Solder all connections unless directed otherwise. Use enough heat and solder flow for clean, shiny, completed connections.

**SURFACE MOUNT COMPONENT SOLDERING INSTRUCTIONS:**

You'll notice that the circuit board contains only a few holes for component leads to pass through. This is because the SMT components will be affixed to the TOP side of the PC board, the side with the white printing. Be aware that the component view for assembly is looking at the TOP side of the PC board. Patience is the key when installing surface mount components. Typically, the first step (after identifying the component) is to "tin" one of the PC traces that will connect to the part. Once this is accomplished, the part can be installed by holding it with tweezers in contact with the "tinned" trace and re-heating the solder (see the following diagrams). Another commonly used technique is to glue the surface mount components to the printed circuit board before soldering. The procedure is to take a small amount of glue (usually with a pin or toothpick) and "dab" the circuit board in the place where the component will be affixed. Be careful not to apply too much glue as when the part is placed it may "squash" the glue underneath the soldering tabs of the component. Carefully place the part into position, and when the glue dries, solder the connection.



## UAM4SYS PARTS LIST

Sort and “check off” the components in the boxes provided. We do our best to pack all our kits correctly but it is *possible* that a mistake has occurred and we missed a part. Please note that physical descriptions of parts are for those currently being shipped. Sometimes the parts in your kit may have a different appearance but still have the same values. Do not separate Surface Mount parts from their packaging until installation.

### CAPACITORS

- ☐ 3 0.01uF Ceramic Disk [marked 103] (C3, 15, 21)
- ☐ 8 0.1uF Ceramic Disk [marked 104] (C24, 31, 40, 41, 42, 44, 46, 47)
- ☐ 8 0.22uF Ceramic [marked 224] (C6, 7, 8, 23, 26, 32, 37, 38)
- ☐ 2 0.39uF Metal Film [marked 394] (C19, 20)
- ☐ 2 1uF Electrolytic [marked 1uF] (C35, 36)
- ☐ 18 10uF Electrolytic [marked 10uF] (C4, 5, 9, 10, 11, 12, 13, 14, 16, 17, 18, 22, 28, 29, 30, 39, 45) {extra included to make test jig}
- ☐ 2 100uF Electrolytic [marked 100uF] (C33, 34)
- ☐ 1 1000uF 25Volt Electrolytic [marked 1000uF 25V] (C1)
- ☐ 4 47uF Tantalum SMT [marked 476] (C48, 50, 60, 62)  
Preinstalled
- ☐ 1 0.01uF Ceramic 0805 SMT [not marked] (C53) Preinstalled
- ☐ 4 0.1uF Ceramic 0805 SMT [not marked] (C49, 51, 55, 61) Preinstalled
- ☐ 4 0.001uF Ceramic 0805 SMT [not marked] (C25, 27, 43, 63)  
Preinstalled
- ☐ 5 1uF Ceramic 0805 SMT [not marked] (C54, 56, 57, 58, 59)  
Preinstalled
- ☐ 1 4.7uF tantalum 1210 SMT [not marked] (C52) Preinstalled

### RESISTORS

- ☐ 2 150 ohms [marked Brown, Green, Brown] (R34, 35)
- ☐ 2 1 K ohms [marked Brown, Black, Red] (R32, 33)
- ☐ 7 2.2 K ohms [marked Red, Red, Red] (R21, 22, 27, 28, 29, 37, 38)
- ☐ 4 10 K ohms [marked Brown, Black, Orange] (R1, 15, 23, 24)
- ☐ 4 47 K ohms [marked Yellow, Violet, Orange] (R5, 6, 8, 13)
- ☐ 2 470 K ohms [marked Yellow, Violet, Yellow] (R11, 14)
- ☐ 2 1M ohm [marked Brown, Black, Green] (R4, R30)
- ☐ 4 10 K ohms Potentiometer [marked B10K] (R17, 18, 19, 20)
- ☐ 1 4.7 K ohms SMT 0805 [marked 472] (R2) Preinstalled
- ☐ 1 2.2 K ohms SMT 0805 [marked 222] (R7) Preinstalled
- ☐ 2 10 K ohms SMT 0805 [marked 103] (R3, 9) Preinstalled

### SEMICONDUCTORS

- ☐ 4 LED [red] (D1, 3, 4, 5)
- ☐ 1 LMC660AIN [marked LMC660AIN] (U1)
- ☐ 1 LM1036N [marked LM1036N] (U3)

- ☐ 1 74HC109 [marked 74HC109] (U5)
- ☐ 1 CD4066DCN [marked CD4066] (U6)
- ☐ 1 DS1669 [marked DS1669] (U10)
- ☐ 1 7810 [marked 7810] (VR1)
- ☐ 1 7805 [marked 7805] (VR2)
- ☐ 1 MMBT3906 [marked 2A] (Q3) Preinstalled
- ☐ 2 LM4875M [marked LM4875M] (U11, 12) Preinstalled
- ☐ 1 MAX9708 [marked MAX9708] (U7) Preinstalled

## MISCELLANEOUS

- ☐ 4 3 Pin Header (H1, 2, 4, 5)
- ☐ 1 2 Pin Header (H3)
- ☐ 2 RCA Jack (J1, 8)
- ☐ 4 3.5 mm Phone Jack (J2, 3, 4, 20)
- ☐ 1 2.1 mm Power Jack (J5)
- ☐ 2 10 Pin Dual In-Line Connector (J40, J7)
- ☐ 1 DPDT Push Button Switch (S1)
- ☐ 4 SPST Momentary Push Button Switch (S2, 4, 5, 6)
- ☐ 1 4 Pin Wire Locking Connector (T1)
- ☐ 5 Jumper Blocks
- ☐ 1 5" length of 18 gauge wire.
- ☐ 4 Ferrite bead filter SMT 805, 600 ohms@100MHz(L1, 2, 3, 4)  
Preinstalled

## HARDWARE

- ☐ 6 Beryllium Grounding Fingers
- ☐ 1 Push Button Cover
- ☐ 4 Knobs.

## ASSEMBLY

We will begin with the main board oriented in the direction shown. Be sure not to confuse the side of the board where the parts go. On the board you will see the side that has white silk screen parts locations. This is the side where most parts are mounted. We will begin with lower profile parts and work up to the higher ones in each functional section. Don't use sockets for integrated circuits (IC's).

In this day of miniaturization not all parts are made in the familiar through-hole style packages (a part with leads that go through the circuit board and are soldered on the board's back side). Some of these parts come in surface mount or SMT packages (parts that are soldered on the same side of the circuit board they mount on). An example of this is the MAX9708 Class D 40 watt audio amplifier IC (U7) used in this kit. Since SMT parts are normally small they can be difficult or impossible to install by hand, so we have installed

them and the circuit has been pre-tested at the factory for you. Due to circuit requirements U7's support parts are also SMT.

## GF. GROUNDING FINGER INSTALLATION

I know you are anxious to start soldering parts but first let's install the beryllium grounding fingers in the case bottom. These fingers have glue that needs to set before the circuit board can be installed in the case. Let's use our time efficiently by using the time we are going to take installing parts to also let the glue set on the fingers.

Locate the 6 brass colored shield 'finger' contacts and the case bottom. These fingers will be mounted on the two small 'shelves' along the edges of the case bottom. The shielding fingers **MUST** be placed so the fingers are all in the same direction. See the picture below for correct placement.

**NOTE:** The adhesive is pressure activated and once you press it in place any attempt to reposition it will result in failure of the adhesive, so make sure the fingers are all facing the same direction **BEFORE** pressing into place! It is best to clean the case bottom with denatured or rubbing alcohol before attaching the fingers.

- ☐ 1. Remove the protective paper on the double back tape, and position the finger so it is tight against the side of the case bottom on the small 'shelf' running the length of the tray.
- ☐ 2. Mount four fingers on the shelf so they are 1/2 inch in from the ends of the case bottom on each side.
- ☐ 3. The remaining two fingers are mounted mid way between the four fingers installed in the previous step.
- ☐ 4. Once properly positioned use a flat screwdriver blade to firmly press the strip onto the case bottom.
- ☐ 5. Set the case bottom aside for now. Full adhesion requires 24 hours. Be careful not to disturb the fingers once pressed into place.



## IB. INPUT BUFFER CIRCUIT

- ☐ 1. Install R15, a 10K ohm resistor (marked Brown, Black, Orange). Resistors have no special polarity so they can be installed in either direction.

- ☐ 2. Install R23, another 10K ohm resistor (marked Brown, Black, Orange).
- ☐ 3. Install R1, yet another 10K ohm resistor (marked Brown, Black, Orange).
- ☐ 4. Install R24, the last 10K ohm resistor (marked Brown, Black, Orange).
- ☐ 5. Install R11, a 470K ohm resistor (marked Yellow, Violet, Yellow).
- ☐ 6. Install R14, the last 470K ohm resistor (marked Yellow, Violet, Yellow).
- ☐ 7. Install U1, the LMC660AIN quad operational amplifier IC (marked LMC660AIN). Before soldering make absolutely sure that you have installed all 14 pins through the appropriate holes. Verify that the notch or dot indicating pin one is facing the same direction shown in the parts layout diagram or the circuit board's silk screen. Solder two pins in opposite corners of the IC. Make sure the IC is flat and square to the board. If not, reheat one pin at a time to properly seat the IC. Now solder the rest of the pins. Check for any possible solder bridges when you're done.
- ☐ 8. Install C47, a 0.1uF ceramic capacitor (marked 104). Ceramic capacitors are like resistors they have no polarity so they can be installed in either direction.
- ☐ 9. Install C12, a 10uF electrolytic capacitor (marked 10uF). This is the first electrolytic capacitor you are about to install. Pay close attention to the polarity markings on this part and all subsequent electrolytic capacitors. In most cases the negative (-) side is marked on the capacitor, while the positive side (+) is marked on the parts layout. If you fail to mount this component correctly, the part can fail as well as prevent proper operation of your project. Make sure you install the (+) lead of the capacitor in the (+) lead of the board. We will be installing many more of these later in the project so be sure and remember this!
- ☐ 10. Install C11, another 10uF electrolytic capacitor (marked 10uF). Watch that polarity!
- ☐ 11. Install C10, another 10uF electrolytic capacitor (marked 10uF). Polarity check!
- ☐ 12. Install C5, yet another 10uF electrolytic capacitor (marked 10uF). Four in a row, I probably don't have to remind you about that polarity thing again.
- ☐ 13. Install J2, a 3.5mm stereo phone jack. Make sure that this jack and all that follow in this kit sit flat and square to the board before soldering.
- ☐ 14. Install J4, another 3.5mm stereo phone jack.



- ☐ 15. Install J3, the last 3.5mm stereo phone jack in this section.

## **LOB. LINE OUTPUT BUFFER CIRCUIT**

- ☐ 1. Install R33, a 1K ohm resistor (marked Brown, Black, Red).
- ☐ 2. Install R32, another 1K ohm resistor (marked Brown, Black, Red).
- ☐ 3. Install R4, a 1M ohm resistor (marked Brown, Black, Green).
- ☐ 4. Install R30, the last 1M ohm resistor (marked Brown, Black, Green).
- ☐ 5. Install C46, a 0.1uF ceramic capacitor (marked 104).
- ☐ 6. Install H1 a 3 pin header. Solder one pin first, make sure the header is flush and square to the board before soldering the last two pins.
- ☐ 7. Install H2 another 3 pin header. Install this part just like H1.
- ☐ 8. Install C14, a 10uF electrolytic capacitor (marked 10uF). Remember to watch polarity!
- ☐ 9. Install C13, yet one more 10uF electrolytic capacitor (marked 10uF).
- ☐ 10. Install C17, another 10uF electrolytic capacitor (marked 10uF).
- ☐ 11. Install C30, the last 10uF electrolytic capacitor in this section (marked 10uF).
- ☐ 12. Install J8, an RCA jack. Make sure this jack is flush and square before soldering.
- ☐ 13. Install J1, another RCA jack. Installed just like J8.

## **TVB. TONE/VOLUME/BALANCE CIRCUIT**

- ☐ 1. Install R5, a 47K ohm resistor (marked Yellow, Violet, Orange).
- ☐ 2. Install R8, another 47K ohm resistor (marked Yellow, Violet, Orange).
- ☐ 3. Install R6, that's right another 47K ohm resistor (marked Yellow, Violet, Orange).
- ☐ 4. Install R13, the last 47K ohm resistor (marked Yellow, Violet, Orange).
- ☐ 5. Install U3, a LM1036N tone control IC (marked LM1036N). Before soldering make absolutely sure that you have installed all 20 pins through the appropriate holes. Verify that the notch or dot indicating pin one is facing the same direction shown in the parts layout diagram or the circuit board's silk screen. Solder two pins in opposite corners of the IC. Make sure the IC is flat and square to the board. If not, reheat one pin at a time

to properly seat the IC. Now solder the rest of the pins. Check for any solder bridges when you're done.

- ☐ 6. Install C26, a 0.22uF ceramic capacitor (marked 224).
- ☐ 7. Install C3, a 0.01uF ceramic capacitor (marked 103).
- ☐ 8. Install C7, a 0.22uF ceramic capacitor (marked 224).
- ☐ 9. Install C19, a 0.39uF metal film capacitor (marked 394). Metal film capacitors are like ceramic capacitors, they have no polarity.
- ☐ 10. Install C21, a 0.01uF ceramic capacitor (marked 103).
- ☐ 11. Install C15, the last 0.01uF ceramic capacitor (marked 103).
- ☐ 12. Install C6, a 0.22uF ceramic capacitor (marked 224).
- ☐ 13. Install C20, a 0.39uF metal film capacitor (marked 394).
- ☐ 14. Install C8, a 0.22uF ceramic capacitor (marked 224).
- ☐ 15. Install C16, a 10uF electrolytic capacitor (marked 10uF). Remember to check polarity.
- ☐ 16. Install C4, another 10uF electrolytic capacitor (marked 10uF).
- ☐ 17. Install C22, you guessed it another 10uF electrolytic capacitor (marked 10uF).
- ☐ 18. Install C9, yet another 10uF electrolytic capacitor (marked 10uF).
- ☐ 19. Install C18, the last 10uF electrolytic capacitor in this circuit (marked 10uF).

## HA. HEADPHONE AMPLIFIER CIRCUIT

We have preinstalled the surface mount (SMT) IC's U11 and U12 for you.

- ☐ 1. Install R34, a 150 ohm resistor (marked Brown, Green, Brown).
- ☐ 2. Install R35, another 150 ohm resistor (marked Brown, Green, Brown).
- ☐ 3. Install U10, a DS1669 digital rheostat IC (marked DS1669). Install this IC like you did U1 and U3.
- ☐ 4. Install C38, a 0.22uF ceramic capacitor (marked 224).
- ☐ 5. Install C37, another 0.22uF ceramic capacitor (marked 224).
- ☐ 6. Install C45, a 10uF electrolytic capacitor (marked 10uF). Very good

you remembered to check polarity!

- ☐ 7. Install C35, a 1uF electrolytic capacitor (marked 1uF).
- ☐ 8. Install C36, the last 1uF electrolytic capacitor in this circuit (marked 1uF).
- ☐ 9. Install C33, a 100uF electrolytic capacitor (marked 100uF).
- ☐ 10. Install C34, the last 100uF electrolytic capacitor in this circuit (marked 100uF).
- ☐ 11. Install J20, the last 3.5mm stereo phone jack.

## **M. MUTE CIRCUIT**

- ☐ 1. Install R22, a 2.2K ohm resistor (marked Red, Red, Red).
- ☐ 2. Install R21, another 2.2K ohm resistor (marked Red, Red, Red).
- ☐ 3. Install R37, the last 2.2K ohm resistor in this circuit (marked Red, Red, Red).
- ☐ 4. Install U5, a 74HC109 dual JK flip-flop IC (marked 74HC109). Install this IC like you did U1, U3, and U10.
- ☐ 5. Install C24, a 0.1uF ceramic capacitor (marked 104).
- ☐ 6. Install C23, a 0.22uF ceramic capacitor (marked 224).
- ☐ 7. Install C44, the last 0.1uF ceramic capacitor in this circuit (marked 104).

## **L. LOUDNESS CIRCUIT**

- ☐ 1. Install R27, a 2.2K ohm resistor (marked Red, Red, Red).
- ☐ 2. Install R38, another 2.2K ohm resistor (marked Red, Red, Red).
- ☐ 3. Install R28, the last 2.2K ohm resistor in this circuit (marked Red, Red, Red).
- ☐ 4. Install U6, a CD4066 analog switch IC (marked CD4066). Install this like you did the other IC's.
- ☐ 5. Install C41, a 0.1uF ceramic capacitor (marked 104).
- ☐ 6. Install C31, another 0.1uF ceramic capacitor (marked 104).
- ☐ 7. Install C32, the last 0.22uF ceramic capacitor (marked 224).

- ☐ 8. Install C42, a 0.1uF ceramic capacitor (marked 104).

## **PS. POWER SUPPLY CIRCUIT**

- ☐ 1. Install R29, the last 2.2K ohm resistor (marked Red, Red, Red).
- ☐ 2. Install C28, a 10uF electrolytic capacitor (marked 10uF). That's right, watch the polarity. You are getting good at this.
- ☐ 3. Install J5, the 2.1mm power jack. Make sure it is flush and square to the board before soldering.
- ☐ 4. Install S1, a DPST power switch. Just like with the jacks, make sure this part is flush and square to the circuit board before soldering.
- ☐ 5. Install VR1, a 7810 +10 volt regulator. This part is polarity sensitive so it must go into the board in a certain way. Take a close look at VR1's pattern on the layout diagram or the circuit board's silk screen. It is made up of two rectangles. The smaller rectangle represents the metal tab on the actual regulator. Install VR1 so the metal tab faces C28.
- ☐ 6. Install C40, the last 0.1uF ceramic capacitor (marked 104).
- ☐ 7. Install C39, a 10uF electrolytic capacitor (marked 10uF). Polarity!
- ☐ 8. Install C29, finally the last 10uF electrolytic capacitor (marked 10uF).
- ☐ 9. Install VR2, a 7805 +5 volt regulator. VR2 is like VR1 every way except output voltage. Install VR2 so the metal tab faces C45.

## **A. AMPLIFIER CIRCUIT**

Most of the parts in the amplifier circuit are surface mount or SMT. Since some of these parts are almost impossible to install by hand they have been installed for you.

- ☐ 1. Install H3 a 2 pin header. Solder one pin first, make sure the header is flush and square to the board before soldering the other pin.
- ☐ 2. Install H4 a 3 pin header. Solder one pin first, make sure the header is flush and square to the board before soldering the last two pins
- ☐ 3. Install H5 the last 3 pin header. Install this part just like H4.
- ☐ 4. Install T1 a 4 position spring loaded terminal block. This part must be flush and square to the board before soldering.
- ☐ 5. Install C1, a 1000uF electrolytic capacitor. Remember to watch polarity!

- ☐ 6. Find the 5" length of 18 gauge wire. Strip ¼ inch of the insulation from each end. Twist the little wires together and lightly tin each end. Solder one end of the wire in the hole at JP2.
- ☐ 7. Route the wire below C37, C9, C22, and C4 and continue on above C16 and straight down to JP1 just above power switch S1.
- ☐ 8. Solder this end of the wire in the hole at JP1.

## **FPB. FRONT PANEL CIRCUIT BOARD**

It is time to assemble the front panel. DO NOT install D1, D3, D4, and D5 until told to do so in the "Board Attachment" section. We need to get the proper spacing for these LED's so they fit properly through the front panel.

- ☐ 1. Install S2, a SPST momentary push button switch. This switch looks square but it is not. It will only go into the circuit board two ways, either way will work.
- ☐ 2. Install S4, another SPST momentary push button switch.
- ☐ 3. Install S5, a third SPST momentary push button switch.
- ☐ 4. Install S6, the last SPST momentary push button switch.
- ☐ 5. Install R18 a 10K ohm potentiometer. Make sure this part is flush and square to the circuit board before soldering.
- ☐ 6. Install R17 a second 10K ohm potentiometer.
- ☐ 7. Install R19 another 10K ohm potentiometer.
- ☐ 8. Install R20 the last 10K ohm potentiometer.
- ☐ 9. Locate one of the 10 pin dual in-line connectors. This part is installed on the back side and of the circuit board. Find the location for J40 on the front panel circuit board. Insert the shorter legs of the connector though from the back side of the circuit board. Make sure this part is flush and square to the board. Solder the pins on the component or silk screen side of the circuit board.
- ☐ 10. Install J7, the other 10 pin dual in-line connector, the same way you installed J40 in the previous step.

## **BA. BOARD ATTACHMENT**

In order to properly attach the front panel circuit board to the main board part of the case needs to be assembled.

- ❑ 1. Locate one of the bezels. (the bezel is the black plastic piece in which the front panel or back panel sits). The bezel has a smooth side and a side with ridges on it. The smooth side is where you place the front panel and the ridged side fits onto the case bottom. The ridges help align the bezel and panel. Place the front panel into the bezel so that the bezel can be screwed to the case bottom.
- ❑ 2. Now the front panel/bezel assembly will be mounted onto the case bottom. Remember that case bottom? We put the beryllium fingers on it way back in steps GF1- GF6. You must first identify which end of the case bottom is the front. Notice that the fingers installed in step GF1 – GF6 are flexible and folded. The BACK of the case bottom is the end toward the adhesive on the fingers. (See picture after step GF6.) The front is the other end where the front panel/bezel is to be mounted. We will use the front panel/bezel assembly from step BA1, and the case bottom from step GF6. Before assembling the parts you'll want to peel the protective plastic from the front panel. The front panel sits inside the bezel; the included black screws go first through the front panel then the bezel holding the assembly to the case bottom. Align the holes of the front panel, bezel, and case bottom front (upper slot) and insert the black screws.
- ❑ 3. It is now time put our front panel circuit board and main board together. Slide the main board between the two rows of long pins on J40 and J7 on the front panel circuit board so that J6 and J9, respectively, on the main board are aligned. **DO NOT SOLDER** the connectors at this time. Now it is time to align the front panel controls with the front panel. Carefully slide the front panel circuit board and main circuit board assembly, from step BA3, into the front panel/case bottom assembly from step BA2. Line up the front panel circuit board so the switches and potentiometers extend out through the front panel of the case. Make sure the front edges of the main circuit board are seated firmly against the back side of the front panel. This is important because it will not be possible to install the rear panel if there is any space between the two.
- ❑ 4. Slide the front panel circuit board back and forth until all switches, buttons and the 3.5mm jack are centered in the front panel holes. When everything is neat and right where you want it to be, take your soldering iron and solder one of the pins of J9 on the top side of the main circuit board.
- ❑ 5. Check the alignment one more time because once you make the next solder connection it will be difficult to take the boards apart. Make sure the front panel circuit board is square and not angled with respect to the main board and parallel with the front panel. Make sure that the main circuit board front left and right tips (under S1 and J20) touch the back side of the front panel. When you are satisfied that everything is correct

solder a pin on J6 on the top side of the main circuit board to hold things in place.

- ❑ 6. Carefully slide the circuit board assembly out of the case bottom. Solder the rest of the pins on J6 and J9 on both the top and bottom of the main circuit board.
- ❑ 7. Insert D1, D3, D4, and D5; red LED's into the front panel circuit board. LED's are polarity sensitive and **MUST** be installed in the proper direction. The LED patterns on the layout diagram and the front panel circuit board's silk screen show a circle with a flat edge near one of the lead holes. This flat edge corresponds to a flat edge on the LED. This represents the cathode lead. Make sure to match the flat edge of the LED to the flat edge of the board's silk screen. **DO NOT SOLDER** the LED's at this time.
- ❑ 8. Carefully slide the front and main circuit board assembly back into the front panel/case assembly. Line up the LED's with their corresponding hole in the front panel of the case. Make sure that main circuit board front left and right tips touch the Front Panel of the case. Adjust the LED's so that they are all penetrating the front panel equally. It is up to you how far you wish them to stick out. Solder one lead on each LED. Make sure you are happy with their alignment and then solder the other lead of each KLED. Now cut off the excess lead length close to the circuit board. Verify no solder bridges are across their leads.

## AR. ASSEMBLY REVIEW

Before applying power it is a good idea to look over the board for assembly mistakes. I know you think you were careful during assembly and didn't make any mistakes. However, we have noticed that the more confident someone is that they didn't make any mistakes, the more likely it is that they did. Over 95% of all kits returned for repair have assembly errors.

The following steps check for common assembly errors that could cause damage when the kit is powered up. All these steps should be compared to the parts location diagram. Take your time and examine the boards carefully.

- ❑ 1. Look over all IC's for proper orientation.
- ❑ 2. Check all electrolytic capacitors for proper orientation.
- ❑ 3. Check the two regulators VR1 and VR2 for proper orientation.
- ❑ 4. Look between the circuit board and case bottom to make sure all leads are short enough so they don't touch the case bottom.
- ❑ 5. Check the back of the front panel circuit board for solder bridges.

- ☐ 6. Remove the main/front panel circuit board assembly from the case bottom and check the back of the main circuit board for solder bridges.
- ☐ 7. Reinstall the circuit boards assemble into the case bottom.

## **UAM4SYS SET-UP AND TESTING**

### **REQUIRED EQUIPMENT**

- ☐ 12 to 18 Volt Power Supply with a 2.1mm power plug (+) center pin
- ☐ Headphones with a 3.5mm Stereo Phone plug
- ☐ Unbalanced stereo audio source with 3.5mm Stereo Phone plug (typical consumer audio outputs such as IPODs, portable CD players, and computers), unbalanced stereo audio source with two mono plugs (one left, one right), or Stereo Balanced Audio Source (professional audio) with two 3.5mm Stereo Phone plugs (one left, one Right)
- ☐ Two speakers that can handle 20 Watts each
- ☐ Volt meter
- ☐ Two, Alligator clip leads
- ☐ 10uF electrolytic capacitor

### **JUMPER SETTINGS**

1. Set the jumpers on headers H1 (REC LEFT) and H2 (REC RIGHT). If you wish the LINE OUT audio (jacks J1 and J8) to be the same as the input audio, place the jumpers on both H1 and H2 so that they connect pins 1 and 2 of the headers. If you wish the LINE OUT audio to be processed by the Tone/Volume/Balance IC then set the jumpers on headers H1 and H2 so that pins 2 and 3. Set these jumpers to pins 1 to 2 for testing.
2. Set the MONO jumper on H3. If you wish your UAM4SYS to operate in stereo mode place the jumper on only one pin of H3. This is just to keep the jumper with the kit so in case you need it in the future you will have it. For mono mode place a jumper across both pins of H3. For testing set the unit to stereo mode.
3. Set the GAIN jumpers on H4 and H5. Use the following chart or the one on the circuit board to set these jumpers. For testing set both jumpers to pins 1-2.



GAIN	H4	H5
+22dB	1 - 2	2 - 3
+25dB	2 - 3	2 - 3
+29.5 dB	2 - 3	1 - 2
+36dB	1 - 2	1 - 2

## SET-UP

Connect headphones to J20.

Connect a stereo audio source in one of the three configurations below:

Unbalanced audio (3.5mm stereo plug)

Connect an unbalanced audio source to J4.

Unbalanced audio (two 3.5mm mono plugs required for stereo)

Connect the left channel plug to J3.

Connect the right channel plug to J2.

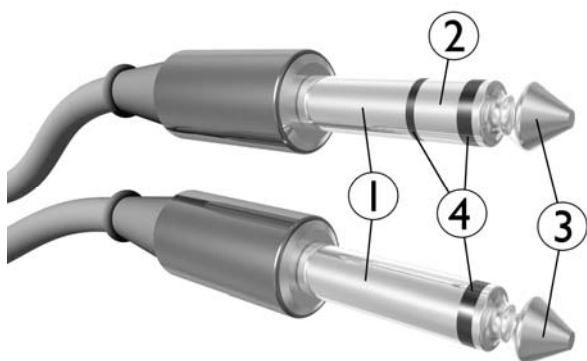
3.5mm stereo plugs can be substituted by making both the ring and sleeve ground.

Balanced audio (two 3.5mm stereo plugs required for stereo)

Connect the left channel plug to J3.

Connect the right channel plug to J2.

If you are making your own cables, refer to the information below for details on the different tip-ring-sleeve configurations:



1. **Sleeve:** usually ground
2. **Ring:** Right-hand channel for stereo signals, negative phase for balanced mono signals.
3. **Tip:** Left-hand channel for stereo signals, positive phase for balanced mono signals, signal line for unbalanced mono signals
4. **Insulating rings**

Tip-Ring-Sleeve Jack Plug

	Unbalanced	Balanced	Stereo
<b>Tip</b>	Signal	Positive	Left
<b>Ring</b>	Ground/No Conn.	Negative	Right
<b>Sleeve</b>	Ground	Ground	Ground

Connect speakers to T1. As you look at the back of the unit the left most contact of T1 is Left (+), the second contact is Left (-), the third contact is Right (+), and the right most contact is Right (-). Make sure to match these polarities to your speakers. **DO NOT** for any reason short the speak wires. If you are going to use your UAM4SYS in single channel mono mode, connect the output lines together on the circuit board at the locations provided near T1. Instructions are provided both on the circuit board and in this manual. It is recommended that all testing be done in stereo mode so if a problem exists it is easier to identify.

Set the bass, treble and balance to midrange, volume control fully counter clockwise and the power switch S1 to off (out position).

## **TESTING**

If any of the following steps fail to produce the indicated result please refer to the troubleshooting section of this manual.

### **Power Supply**

Note in the following steps all VOLTAGE measurements are take with the RED or “+” lead of the voltmeter connected to the indicated test point. The BLACK lead or the terminal labeled “-“ or “common” of the voltmeter is connected to the outside (ground) bracket on J8.

#### **MAIN POWER INPUT (12VDC to 18VDC)**

With the power switch, S1, turned off connect the power supply to J5. Turn on or plug in the power supply and measure the voltage at the connection on the back of J5, (that’s the terminal on the back of the connector itself on the top of the board). [READING = +12 to +18VDC depending on the power supply]

#### **10 VOLT SUPPLY**

Measure the voltage on pin 4 of U1. [Reading = +10VDC +/- 0.2VDC]

#### **5 VOLT SUPPLY**

Measure the voltage on pin 1 of U10. [Reading = +5VDC +/- 0.2VDC]

## **Input Buffer, Headphone Amp, Loudness, and Tone/Volume/Balance Circuits**

Once the power supply is plugged in and the audio input source is turned on you should be able to hear audio in the headphones (even with the power, S1, switch off). If you cannot press and hold HEADPHONE LEVEL UP switch until audio is heard.

Press the HEADPHONE LEVEL Down button to test for function.

Test the bass, treble, balance, and volume control for proper function.

Check the Loudness control for proper function. Verify the loudness LED D3 illuminates.

## **Making a Headphone Test Jig**

Remove the headphones from J20.

Connect an alligator clip lead to the sleeve of the headphone plug. The second clip of this lead will be use to connect to ground of the circuit board.

Connect one end of a second alligator clip lead to the tip of the headphone plug. To the other clip connect the (-) lead of the extra 10uf electrolytic capacitor. The positive end of the capacitor will be used as a test probe for testing and troubleshooting.

## **Line Output Buffer**

Connect the ground lead of your headphone test jig to the outside bracket of J8. Touch the (+) lead of the electrolytic capacitor of the headphone test jig to J8's center conductor. You should hear the right channel audio in the left headphone speaker.

Leave the ground lead of the test jig in place. Touch the tip of the (+) lead of the electrolytic capacitor of the headphone test jig to J1's center conductor. You should hear the left channel audio in the left headphone speaker.

## **Power Amp**

Set the bass, treble, and balance controls to midrange

Set the volume control to minimum or fully counter-clockwise.

Verify the mute and loudness LED's are off.

Turn on power switch S1. The power LED, D4, should illuminate.

Slowly rotate the volume control. Listen for clean audio from the speakers.

Press the MUTE switch. Verify the speaker audio mutes and the mute

LED D1 illuminates.

Turn off unit. Adjust jumpers at H4 and H5 for best control of audio amplifier with the volume control. This setting will be different for different audio sources. This may take a little trial and error. Always turn off unit before moving jumpers!

This completes testing. With the unit off set up jumpers at H1, H2, and H3 and the speaker output jumpers near speaker connector T1 for the desired operating conditions.

## **FINAL CASE ASSEMBLY**

Now that we have the UAM4SYS operating we'll complete the case assembly.

1. Locate the top cover. In order to assure a good ground connection between the cover and the case bottom for noise shielding purposes we need to make a slight adjustment to the cover. To do this simply hold the cover by the sides and carefully slightly bend it inward toward the non-painted side of the metal. This will tighten up the fit of the cover in the grooves of the case bottom tray.
2. Looking at the end of the case bottom you will see two slots on either side at the bottom of the tray. The cover simply slides into these slots. Push it as far as it will go on to the tray.
3. Now install the back panel and bezel assembly using the remaining 2 black screws.
4. Rotate all of the potentiometers fully counter-clockwise. Install a knob on each potentiometer shaft. Make sure that the lines on the knobs point to the 7 o'clock position, tighten the Allen screws.
5. Install the push button cover onto the shaft of S1.

## **UAM4SYS TROUBLESHOOTING**

95% of the problems we see with kits returned for repair are due to assembly errors. This is true even after emails and phone calls to our technical support staff. The components of today are well made, well tested, and have an extremely small failure rate. Please take your time verifying all component placement before sending your kit back for repair.

The following section is designed to help you identify the circuit on the board that is causing your failure. Use the schematic diagrams to identify all parts in a circuit. If you have questions please contact our technical support staff by phone or email. Contact information can be found on the inside back

cover of the manual.

Note in the following steps all VOLTAGE and RESISTANCE measurements are taken with the RED or “+” lead of the meter connected to the indicated test point. The BLACK lead or the terminal labeled “-” or “common” of the voltmeter is connected to the outside (ground) bracket on J8. The expected reading is indicated in the “[READING = rrr]” text after the instruction to make the reading

## **POWER SUPPLY PROBLEMS**

**Problem:** No 12 to 18 Volts Input

**Checks:** 1. With S1 turned off, measure the voltage at the connection on the back of J5, (that’s the terminal on the back of the connector itself on the top of the board). [READING = +12 to +18VDC depending on the power supply]

If the voltage does not equal the rated power supply output or is not present check for shorts on the circuit board between J5 and the connection to S1

**Problem:** No +10 Volts out of VR1

**Checks:** 1.First perform the “No 12 to 18 Volts Input” procedure. Once the input voltage is verified to be good go to step 2.

2. Measure the voltage on U1 pin 4. [READING = +10VDC +/- 0.2VDC] If good go to step 3. If bad check VR1’s soldering.

3.If you still don’t have 10VDC check VR1’s output resistance. If close to 0 ohms check for shorts on all of the 10V foil runs on the circuit board. If the resistance is higher than 5 ohms but less than 5k ohms check IC orientations.

**Problem:** No +5 Volts out of VR2

**Checks:** 1. Check VR2’s input pin for 10 volts. If good go to step 2. If bad check VR2’s soldering and also see the “No +10 Volts out of VR1” problem troubleshooting step, otherwise go to step 2.

2.Check VR2’s output resistance, if it is close to 0 ohms check for shorts on all of the 5V foil runs on the circuit board. If the resistance is higher than 5 ohms but less than 5k ohms check IC orientations.

## **AUDIO PROBLEMS**

Problem: No audio from headphones only

- Check:
1. First, make sure you have an audio signal applied to both left and right inputs then try pressing the headphone level up button for a second or two. If you still don't hear any audio go to step 2.
  2. Use the headphone test jig to test Pin2 on U11 and U12. If you hear audio signals go to step 3. Otherwise go to step 4.
  3. Use the headphone test jig to test Pin 5 on U11 and U12. If you hear audio signals check all components and connections between these pins and J20. Also make sure the ground connection on J20 is soldered properly. Otherwise go to step 4.
  4. Measure the voltage on pin 1 of U11 and U12. [Reading = +5VDC +/- 0.2VDC] If the correct voltage is present check all connections and components connected to U11 and U12. If you still can't find the problem go to step 5.
  5. Measure the voltage on pin 4 of U11 and U12. This reading will be between 0 and +5VDC depending on the setting of digital potentiometer U10. Press the up or down headphone level buttons and observe if the reading increases and decreases. If it does NOT change check all connections on U10 for opens or shorts and also measure the voltage on pins 1 and 8 on U10. If you do not measure +5VDC trace and check the 5VDC circuit back to the 5 volt regulator VR2.

Problem: No audio from only the line output jacks J1 and J8

- Check:
1. Check to make sure the jumpers on headers H1 and H2 are installed properly between either pins 1 and 2 or pins 2 and 3 depending on the desired configuration. If not correctly installed, install them and recheck the outputs. Otherwise go to step 2.
  2. With good audio in the headphones only the line output buffer circuit can be at fault. Measure the voltage on U10 pins 8, 9, 10, 11, 12, and 14. [READING = +5VDC +/- 0.02VDC] If not correct check the placement and connections of R4 and R30. If correct go to step 3.
  3. Use the headphone test jig to check for signal on pins 10 and 12 of U1. If signal is present go to step 4. Otherwise check for opens on the signal path between pin 2 on H1 and H2 and pins 10 and 12 on U1. Also check that C13 and C14 are installed correctly.
  4. Use the headphone test jig to check for signal on pins 8 and 14 of U1. If no signal is present check the signal path between these pins

and output jacks J1 and J8 for shorts, opens and proper placement of C17, C30, R32 and R33.

Problem: No audio from any output

- Check:
1. First, make sure you have an audio signal applied to both left and right channel inputs. If you still don't hear any audio remove any jumpers installed on H1 and H2 and check for audio on the headphone and speaker outputs. If you still don't have any audio on the speaker and headphone outputs go to the **"No audio from only the line output jacks J1 and J8"** problem section. Otherwise go to step 2
  2. Make sure **ALL** of the power supplies are operating properly. See the **"POWER SUPPLY PROBLEMS"** section if you have any doubts. If correct go to step 3.
  3. Use the headphone test jig to check for signal on pins 1 and 7 of U1. If signal is present go to step 4. Otherwise check for shorted connections in the entire signal path between these pins and pin 1 on H1 and H2 and also pins 2 and 19 on U3. Also check that C4 and C9 are installed correctly.
  4. Measure the voltage on U1 pins 3 and 5. [READING = +5VDC +/-0.02 VDC] If good go to step 5. If the reading is not correct check for component placement and shorts on the connections around R1, R11, R14 and R23.
  5. If you still don't have any audio outputs there may be a problem between the input jacks, J2, J3 and J4 and the input buffer amplifiers U1:A and U1:B. Unfortunately the headphone test jig will probably not work to test signals in this area. The best thing to do if you don't have any other test equipment is to check all the components and connections between the input jacks and input buffers.

### **BASS/TREBLE/BALANCE/LOUDNESS/VOLUME CONTROLS**

Problem: Improper operation of ALL controls (bass, treble, balance, loudness and volume)

Checks:

1. Turn all controls fully counter clockwise and measure the voltage on U3 pin 17. [READING = 5.4VDC] If the voltage is correct check the entire circuit path for open circuits from U3 pin 17 to all connections on both the main board and front panel board. This is the only 'signal' that is common to all these functions. If the voltage is not correct go to step 2.
2. Check the entire circuit path for short circuits from U3 pin 17 on

all circuit foil runs on both the main board and front panel board. If you can't find anything wrong it is possible that U3 is defective but first let's check one more thing. Turn all the controls fully clockwise and check the voltage again. If you find it is correct go to step 4, otherwise go to step 3.

3. Because the voltage changed with the setting of the controls there appears to be a problem with one or more of the wiper, or center pin connections, on one or more of the controls. While measuring the voltage turn each of the controls to the fully counter clockwise position. If the voltage on U3 pin 17 changes the problem is somewhere in the circuit path between that control's wiper and it's associated resistor (R5, R6, R8 or R13). There could also be a short on any of the circuit paths connected to U6 pins 1, 2, 3, or 4. Check all these paths for shorts.
4. If you still can't find the problem it is possible U3 is defective. You may want to contact our technical support department.

Problem: Bass control only not functioning properly

Checks:

1. Measure the voltage on U3 pin 17, [READING = 5.4VDC] If correct go to step 2, otherwise go to the "Improper operation of bass, treble, balance, loudness and volume controls" troubleshooting section.
2. Measure the voltage on the actual terminal from the front of the front panel board, not at the circuit board of R18. [READING = 5.4VDC] If not correct go to step 3 otherwise re-solder the connection on R18.
3. While adjusting R18 measure the voltage on the center connection of R18. [READING varies between 0 and 5.4VDC] If correct measure the voltage on U3 pin 14 while adjusting R18. [READING varies between 0 and 5.4VDC] If correct U3 may be defective. Otherwise check for opens, shorts and incorrect component installation of C7, C19, C20, R6 and R18 and connected circuit paths or U3 may be defective.

Problem: Treble control only not functioning properly

Checks:

1. Measure the voltage on U3 pin 17, [READING = 5.4VDC] If correct go to step 2, otherwise go to the "Improper operation of bass, treble, balance, loudness and volume controls" troubleshooting section.



2. Measure the voltage on the actual terminal from the front of the front panel board, not at the circuit board of R17. [READING = 5.4VDC] If not correct go to step 3 otherwise re-solder the connection on R17.
3. While adjusting R17 measure the voltage on the center connection of R17. [READING varies between 0 and 5.4VDC] If correct measure the voltage on U3 pin 4 while adjusting R17. [READING varies between 0 and 5.4VDC] Otherwise check for opens, shorts and incorrect component installation, C6, C15, C21, R5 and R17 and connected circuit paths or U3 may be defective.

Problem: Balance control only not functioning properly

Checks:

1. Measure the voltage on U3 pin 17, [READING = 5.4VDC] If correct go to step 2, otherwise go to the "Improper operation of bass, treble, balance, loudness and volume controls" troubleshooting section.
2. Measure the voltage on the actual terminal from the front of the front panel board, not at the circuit board of R19. [READING = 5.4VDC] If not correct go to step 3 otherwise re-solder the connection on R19.
3. While adjusting R19 measure the voltage on the center connection of R19. [READING varies between 0 and 5.4VDC] If correct measure the voltage on U3 pin 9 while adjusting R19. [READING varies between 0 and 5.4VDC] Otherwise check for opens, shorts and incorrect component installation, C8, R8 and R19 and connected circuit paths or U3 may be defective.

Problem: Volume control only not functioning properly

Checks:

1. Measure the voltage on U3 pin 17, [READING = 5.4VDC] If correct go to step 2, otherwise go to the "Improper operation of bass, treble, balance, loudness and volume controls" troubleshooting section.
2. Measure the voltage on the actual terminal from the front of the front panel board, not at the circuit board of R20. [READING = 5.4VDC] If not correct go to step 3 otherwise re-solder the connection on R20.
3. While adjusting R20 measure the voltage on the center connection of R20. [READING varies between 0 and 5.4VDC] If correct measure the voltage on U3 pin 12 while adjusting R20.

[READING varies between 0 and 5.4VDC] Otherwise check for opens, shorts and incorrect component installation, C26, R13 and R20 and connected circuit paths or U3 may be defective.

Problem: Loudness control only not functioning properly

Checks:

1. Measure the voltage on U3 pin 17, [READING = 5.4VDC] If correct go to step 2, otherwise go to the "Improper operation of bass, treble, balance, loudness and volume controls" troubleshooting section.
2. Make sure the "LOUDNESS" control button toggles the loudness LED on and off. If it does not go to "**LOUDNESS AND MUTE FUNCTION PROBLEMS**" problem section. Otherwise go to step 3
3. With the loudness LED off turn the volume control to mid position and measure the voltage on U3 pin 7. [READING approx 5.4VDC] If not check for shorts, opens and correct component installation for all circuit paths associated with U6 pins 1, 2, 3, 4. Otherwise go to step 4.
4. Press the loudness control button to turn on the loudness LED, adjust the volume control to mid position and measure the voltage on U3 pin 7. [READING approx 3VDC +/- 0.2VDC] This reading will change with the setting of the volume control. If this is not correct then check for shorts, opens and correct component installation for all circuit paths associated with U6 pins 1, 2, 3, 4. If this is correct then U3 or U6 may be defective.

### **LOUDNESS AND MUTE FUNCTION PROBLEMS**

Problem: Loudness and/or mute LED's and/or functions not working

The loudness and mute functions are controlled by two flip-flop circuits that both work the same way. The flip-flops are both part of U5. The following checks apply to both the loudness and mute functions. The entries in "( )" refer to the mute function components. Also refer to the schematic diagram.

Checks:

1. Measure the voltage at U5 pins 1(15), 2(14), 5(11), 4(12) and 16. [READING = +5VDC +/-0.02VDC] If good go to step 6. Otherwise check all connections and components between these pins and the +5 volt supply for open and short circuits and correct installation.
2. While measuring the voltage at U5 pin 4(12) press the loudness

(mute) button. The reading should be 0VDC with the button pressed and +5VDC when not pressed. If this is not the case check all connections and components between pin 4(12) and the push button for opens, shorts and incorrect installation.

3. If only the loudness (mute) LED does not turn on and off but the functions operate properly go to step 5.
4. While measuring the voltage at U5 pin 6(10) press the loudness (mute) pushbutton one time.

*Note that the voltage on pins 7(9) and 3(13) MUST be opposite the voltage on pin 6(10).*

The voltage should change state to either +5VDC or 0VDC. If it does change check all connections and components between U5 pins 6(10) and the LED for opens or shorts and proper installation and values. If it does not change go to step .....

5. While measuring the voltage at U5 pins 7(9) and/or 3(13), (they MUST be the same voltage), press the loudness (mute) pushbutton one time. The voltage should change it's state to either +5VDC or 0VDC. If it does not change go to step 6. If it does change check all connections and components between U5 pins 7(9) and 3(13) and the LED for opens or shorts and proper installation and values. Note that pins 7(9) and 3(13) MUST be the same voltage
6. Measure the voltage at U5 pins 7(9) and/or 3(13). [READING = +5VDC or 0VDC] If the reading is +5VDC and the LED is not on go to step 7.
7. If the LED is not on measure the voltage on both sides of R28 (R22). If both readings are 5VDC check all connections between D3(D1) and R28(R22). If the LED is still not on the LED may be defective or installed wrong.

## **POWER AMPLIFIER OUTPUT SECTION**

The power amplifier section of your UAM4SYS was preassembled and tested at the factory but there is a possibility you may have problems with it's operation. If you think there is a problem we suggest you first make sure you have installed and configured headers H3, H4 and H5 properly and there are no solder bridges in those areas. Also make sure the 18 volt power supply jumper between location JP1 and JP2 is installed. If you are using the UAM4SYS in single channel mono mode make sure you have installed the jumpers between "L+" and "R+" and "L-" and "R-" correctly, H3 is installed and you are applying the input signal to the **RIGHT** input channel. Other than the surface mounted capacitors and resistors there is nothing else you can repair without specialized soldering equipment. Any attempt to repair this section

may result in voiding your warranty. Please contact our technical support department for further information.

**CONCLUSION**

As our customers, we value your opinions, comments, and additions that you would like to see in future publications. Please submit comments or ideas to:

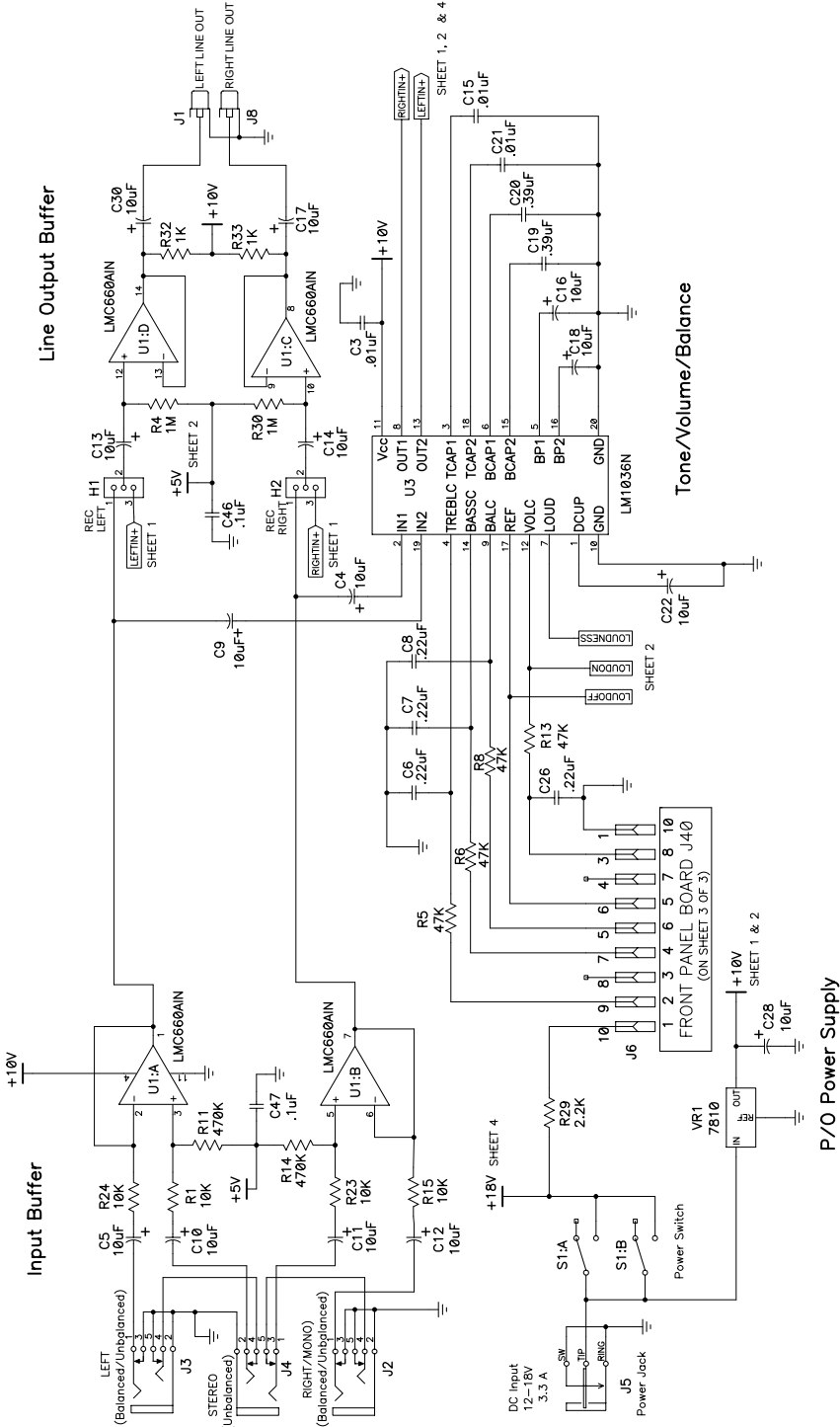
Ramsey Electronics, LLC  
Attn. Hobby Kit Department  
590 Fishers Station Drive  
Victor, NY 14564  
or email us at: techsupport@ramseyelectronics.com

**SPECIFICATIONS**

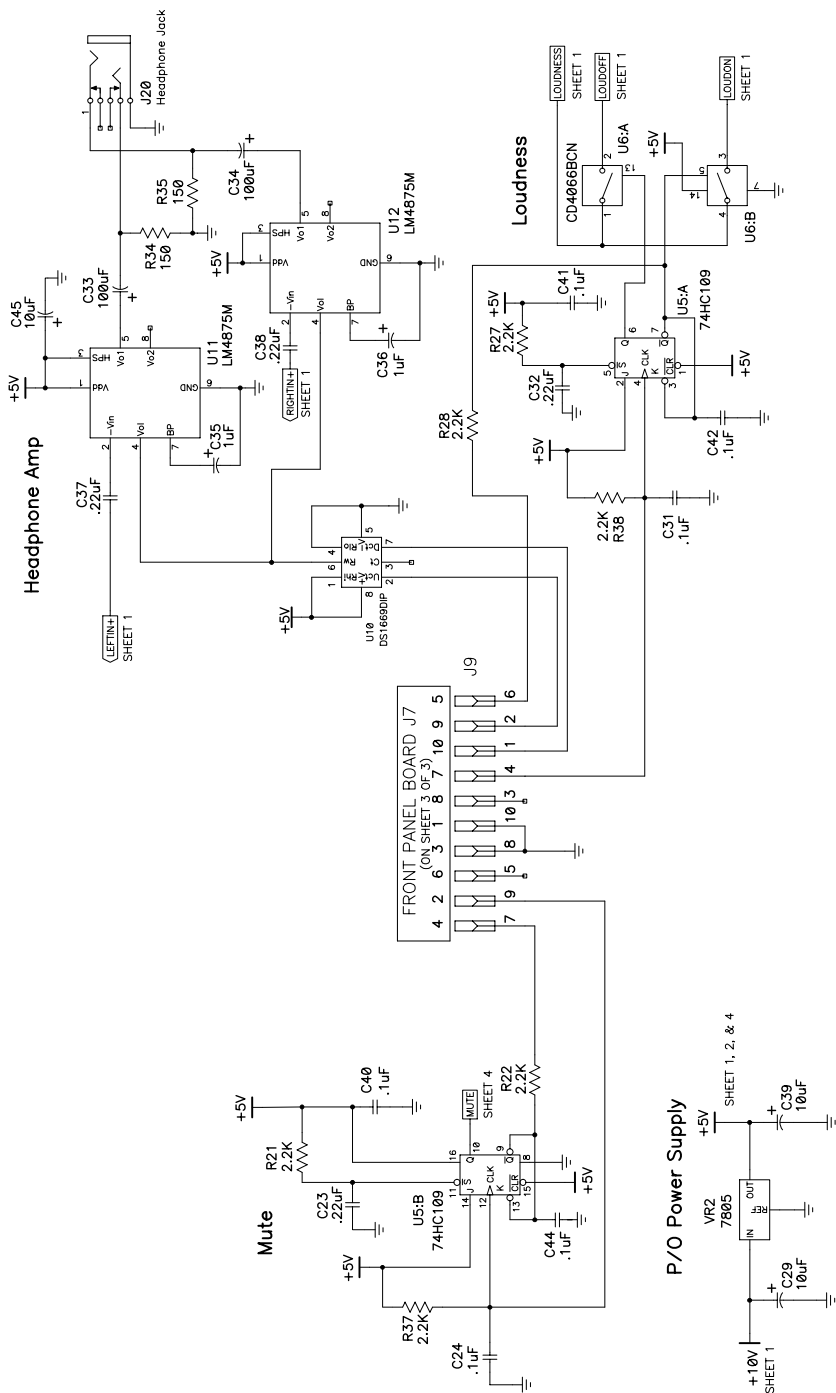
Power Supply:	
Voltage	12VDC to 18VDC
Current	3.3A max @ 18VDC
Connector	2.1mm center positive (rear panel)
Audio Outputs (left & right):	
Line Outputs:	
Buffered:	Selectable direct input or processed by main audio controls
Connector:	2 x RCA jacks (rear panel)
Headphones:	
Connector:	3.5mm stereo (front panel)
Speaker Outputs:	
Connector:	Spring clamp terminal block (28AWG – 14AWG wire) (rear panel)
Power:	2 x 21W Max @ 18VDC input voltage (stereo mode) (8 ohm load, THD = 10%) 1 x 42W Max @ 18VDC input voltage (mono mode) (4 ohm load, THD = 10%)
Controls/Indicators:	
Front Panel:	
Main audio:	Bass, Treble, Balance, Volume
Headphone:	Digital 64 step up/down level buttons with memory
Mute:	Digital push button with LED indicator
Loudness:	Digital push button with LED indicator

Power:	ON/OFF with LED indicator
Over temp:	LED indicator
Efficiency:	Up to 87%
Audio Input:	
Connector:	
L/R:	3.5mm (x1) stereo unbalanced (left & right) 3.5mm (x2) stereo balanced/unbalance (Separate left & right connectors)
Impedance:	Greater than 10K ohms balanced or unbalanced (Each channel)
Gain:	Selectable 22dB, +25dB, +29.5dB, +36dB
Distortion:	O.1% THD + N
Modulation Scheme:	Spread-spectrum (SSM) Clock frequency 200kHz +/- 4kHz
MAX9708 Junction Temperature 139 (degrees C)	
Dimensions:	
Board	5.28in x 6.2in x 1.21in (13.2cm x 15.75cm x 3.1cm)
Case	5.6 in x 6.6 in x 1.6 in (14.22cm x 16.76cm x 4.1cm) (shielded aluminum)
Weight:	1.24lbs (.567kg)

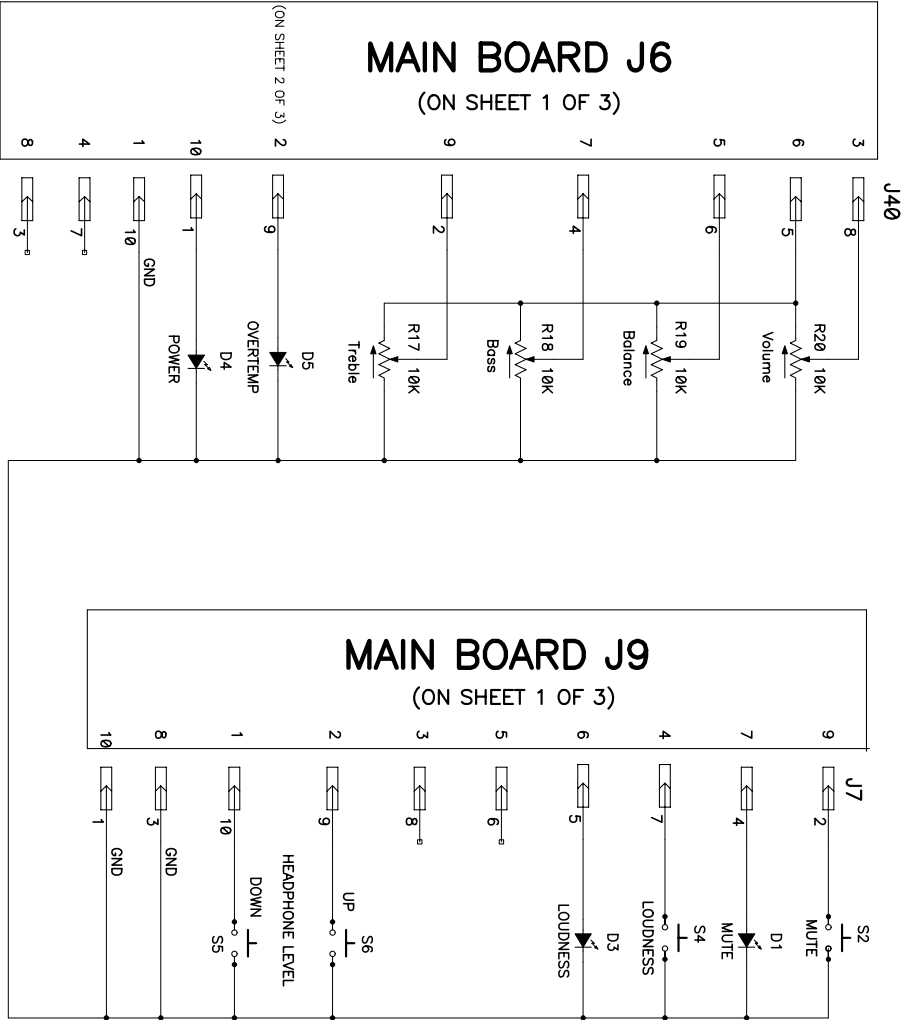
Schematic Sheet 1/4—Input Processing



## **Schematic Sheet 2/4—Control and Headphone Amps**

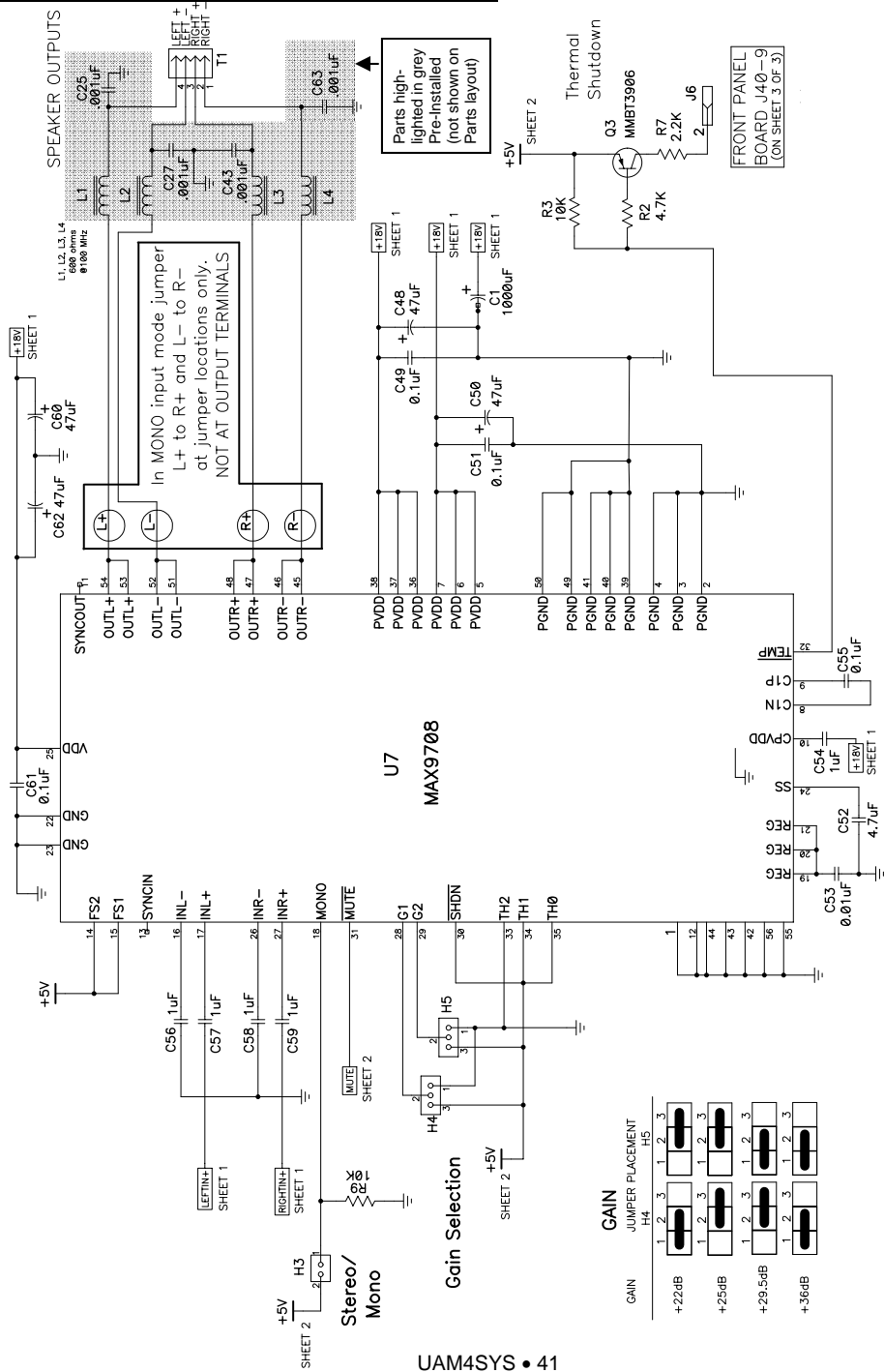


Schematic Sheet 3/4—Front Panel

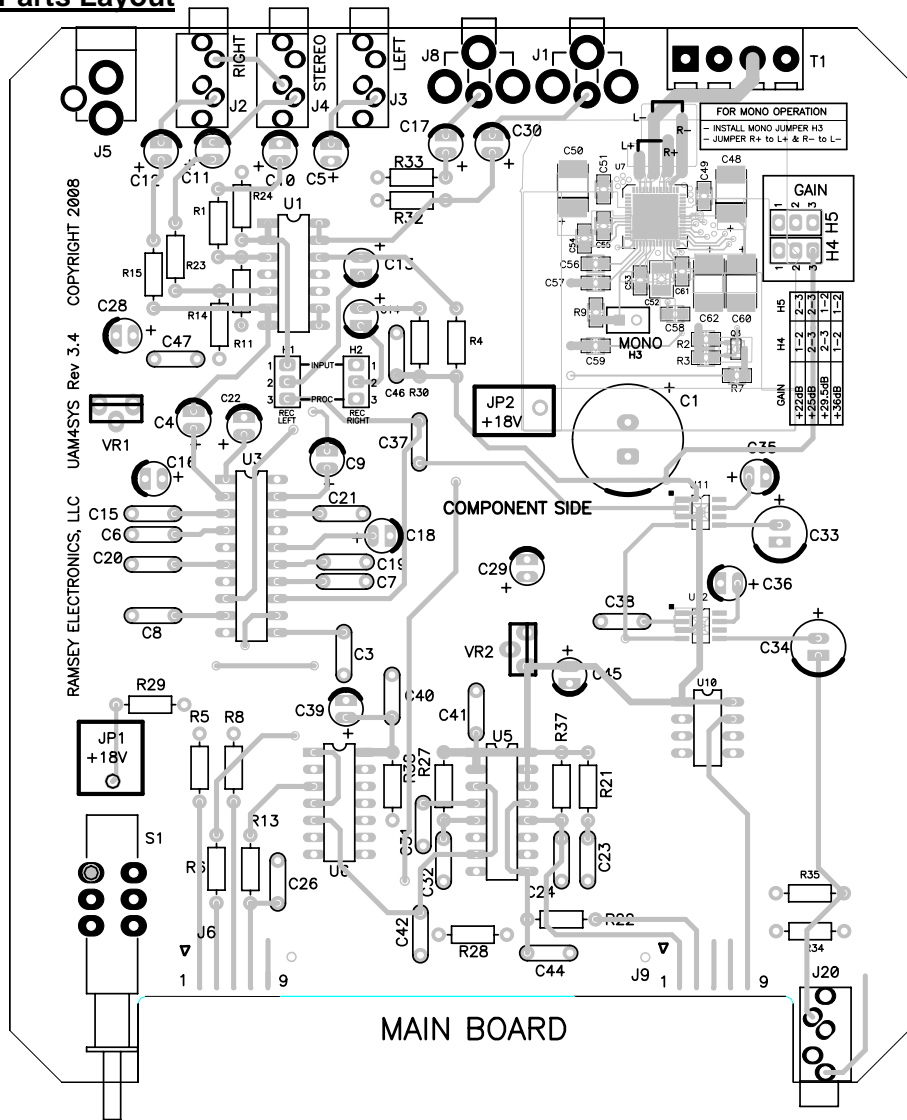




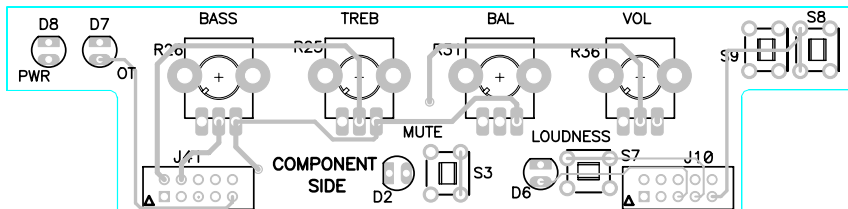
## Schematic Sheet 4/4—Power Amp



## Parts Layout



FRONT PANEL



# THE RAMSEY KIT WARRANTY

## 1. GENERAL:

Notice that this is not a "fine print" warranty. We want you to understand your rights and ours too! All Ramsey kits will work if assembled properly. The very fact that your kit includes this new manual is your assurance that prior to release of this kit, a varied group of knowledgeable people have assembled this kit from scratch using this manual. During this process, changes and additions are noted by each assembler and integrated into the final version of the manual...which you have! If you need help, please read through your manual carefully, all information required to properly build and test your kit is contained within the pages! However, customer satisfaction is our goal, so in the event that you do have a problem, please note the following:

## 2. DEFECTIVE PARTS:

It's always easy to blame a part for a problem in your kit. Before you conclude that a part may be bad, thoroughly check your work. Today's semiconductors and passive components have reached incredibly high reliability levels, and it's sad to say that our human construction skills have not! But on rare occasions a sour component can slip through. All of our kit parts carry the Ramsey Electronics Warranty that they are free from defects for a full ninety (90) days from the date of purchase. Defective parts will be replaced promptly at our expense. If you suspect any part to be defective, please mail it to our factory for testing and replacement. Please send only the defective part(s), not the entire kit. The part(s) MUST be returned to us in suitable condition for testing. Please be aware that testing can usually determine if the part was truly defective or damaged by assembly or usage. Don't be afraid of telling us that you "damaged it" or "burned it out", we're all human and in most cases, replacement parts are very reasonably priced. Remember, our goal for over three decades is to have a happy customer, and we're here to work WITH you, not AGAINST you!

## 3. MISSING PARTS:

Before assuming a part value is missing, check the parts listing carefully to see if it is a critical value such as a specific coil or IC, or whether a RANGE of values is suitable for the component (such as a "100 to 500 uF capacitor"). Often times, common sense will solve a mysterious missing part problem. If you're missing five 10K ohm resistors and received five extra 1K resistors, you can pretty much be assured that the "1K ohm" resistors are actually the "missing" 10 K parts ("Hum-m-m, I guess the orange band really does look red!") Ramsey Electronics project kits are packed with pride in the USA by our own staff personnel. While separate QC checks are made on all product kits, we too are human, and once in a great while there is a chance something can get through those checks! If you believe we packed an incorrect part or omitted a part clearly indicated in your assembly manual for your Ramsey kit, please contact us with information on the part you need. Contact our Repair Department via telephone, email or writing. Please have your invoice number and date of purchase handy.

## 4. REFUNDS:

All Ramsey products, kit or factory assembled units have an unconditional 10 day (from the date of purchase) return policy to examine our products. If you are not satisfied for any reason, you may return your unassembled kit with all the parts and instructions, or your factory assembled and tested product, together with your proof of purchase to the factory for a full refund less shipping. The return package should be packed securely. Insurance and tracking is highly recommended. A reminder, this applies to unassembled kits. They must be in the same new condition as received, not partially assembled! Assembled kits cannot be returned for credit. No RMA's are required; simply return to Ramsey Electronics LLC, Attn: Product Returns, 590 Fishers Station Drive, Victor, NY, 14564. If you have any questions, please contact us at 585-924-4560.

## 5. FACTORY REPAIR OF ASSEMBLED KITS:

Most of us at Ramsey are technically oriented and we do realize that things happen! Even following the best practices, with all of the best intentions, there is that chance that your kit doesn't work when you have completed it. Each manual goes into detailed troubleshooting based on the specific kit to help you troubleshoot the problem. We have found that 95% of returned kits involved wrongly installed components (wrong part or backwards polarity). This section of the warranty assumes you have gone through all those steps, and have now reached the point that you need to send it back.

To qualify for factory repair of customer assembled kits, the following conditions apply:

1. Kits must not be assembled with acid solder flux
2. Kit boards or circuits must not be modified in any manner from the version received
3. Kits must be fully assembled, not partially assembled. Our warranty does not include "finishing" your kit!
4. Must include a full description of the problem encountered including the troubleshooting steps you have already done.
5. Must not include non-standard, non-Ramsey accessories, cases, enclosures, knobs, etc. or any batteries.
6. Must include the minimum repair fee of \$25 USD in the form of check, money order or credit card authorization.
7. Ramsey Electronics, LLC reserves the right to refuse any repair due to excessive errors in construction methods.
8. If, due to customer construction methods, the repair is estimated to exceed the minimum flat rate, Ramsey Electronics, LLC will contact the customer to discuss the repairs needed and to receive authorization and payment for repair prior to repair.
9. In the unlikely case that a defective part is found to be the cause of the problem, the repairs will be made at no-charge to the customer, and any payments received for repair will be returned or credited back to the customer.
10. Properly pack your kit, insure the package, and use a carrier that can be tracked. Ramsey Electronics, LLC is not responsible for any loss or damage in shipment. Send the package together with your repair fee to the return address below. No RMA is required.

## 6. FACTORY REPAIR FEES:

Please understand that our Tech Support Group personnel are not volunteers! They are a dedicated group of highly trained technicians each configured with a very properly equipped test bench. Upon receipt of a repair, the setup, testing, diagnosis, repair, paperwork, and repacking of your kit requires nearly an hour of their time regardless of the size or complexity of the kit! The minimum repair fee represents ½ hour Tech Support time at \$50/hour USD. We try to keep all kit repairs within the realm of the \$25 flat rate whenever possible...and trust us; we exceed that time spent on most kits received more often than not!

## 7. CONTACT INFORMATION AND RETURN ADDRESS:

### Technical Questions

#### **RAMSEY ELECTRONICS, LLC**

Attn: Tech Support  
590 Fishers Station Drive  
Victor, NY 14564  
585-924-4560; 585-924-4886 Fax  
techsupport@ramseyelectronics.com

### Product Repair & Returns

#### **RAMSEY ELECTRONICS, LLC**

Attn: Repairs  
590 Fishers Station Drive  
Victor, NY 14564  
585-924-4560; 585-924-4886 Fax  
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## REQUIRED TOOLS

- Soldering Iron
- Thin Rosin Core Solder
- Needle Nose Pliers
- Small Diagonal Cutters

## ADDITIONAL SUGGESTED ITEMS

- Helping Hands Holder
- Desoldering Braid
- OptiVisor Magnifier
- Tweezers



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