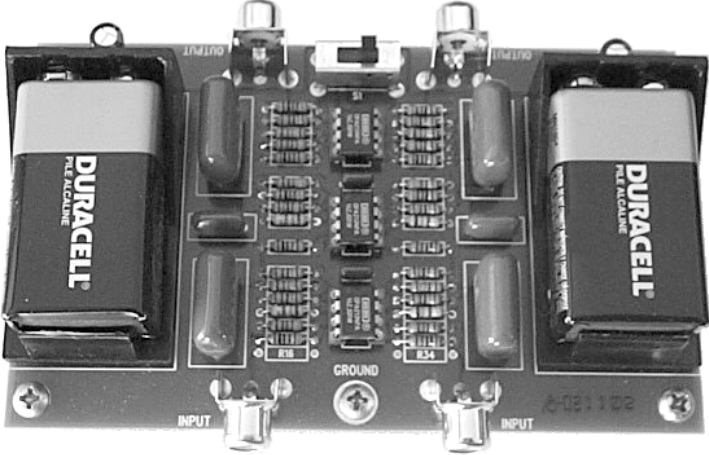
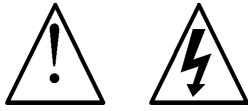




# Bugle

Phono Preamp Kit  
User's Manual





## **Warnings**

This product does not use any dangerous voltages. Power is supplied from two 9V batteries and is inherently safe. However, some kit builders may want to design their own power supplies or install into another product that connects to the ac power line. In such a case, potentially lethal voltages can be involved, and Hagerman Technology assumes no liability.

Signal outputs are dc-coupled and may present a dc offset voltage if one of the batteries fails prior to the other.

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# 1 Before You Begin

## Description

Congratulations! You have just purchased one of the highest performance-per-dollar audiophile products available. The Bugle was designed to be a simple yet flexible phono stage capable of achieving very good sound quality comparable to far more costly units. The circuit topology uses dual audio opamps to implement passive split equalization filters and provide a low output impedance to drive interconnects. Gain can be selected (fixed) to accommodate virtually any moving magnet or moving coil cartridge.

The Bugle half-kit comprises only a blank circuit board and these instructions. To complete, you must decide upon equalization and gain specifications, determine component values, and then purchase them yourself from DigiKey ([www.digikey.com](http://www.digikey.com)). A finished project will cost about \$50 total. Since it is a kit, and the circuit board is professionally layed-out with a ground plane and narrow traces, you must be rather skilled at soldering.

## Features

- Battery operated for low hum
- AnyEQ™ split passive customizable equalization
- 40dB to 60dB gain
- Clean, quiet solid-state design
- Quality components

## Uses

- Phono stage for older non-RIAA equalized LPs (two per board)
- Outboard phono stage for your existing linestage
- Rip your vinyl collection onto CD
- Build into other equipment

## Tools

You will need a few basic shop tools (screwdriver, pliers, wire cutters, etc.) and a fine-tip soldering iron to build this kit.

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# 2 Parts to Buy

## Kit

If you purchased the assembled version, go straight to Chapter 6.

The Bugle kit does not need to be built as specified. You may make any circuit and component changes you wish. Feel free to upgrade opamps or capacitors. Buy your parts from anyone. A suggested parts list is given below using DigiKey part numbers. If you do plan to make changes, please read Chapter 5 before ordering parts.

## AnyEQ™

To customize your equalization to other-than-RIAA, visit [www.anyeq.com](http://www.anyeq.com) and follow the online instructions for calculating component values. You should be able to print out a parts list, which consists of changes to the table below.

## Parts List

This parts list is for a stock 40dB gain RIAA phono stage. You can order components directly from [www.digikey.com](http://www.digikey.com). Not listed are the few assorted screws, nuts, standoffs, batteries, etc., that you'll need to finish the project. The grounding nut and corner mounting holes are sized for #6-32 screws. The battery holders need tiny #2-56 screws and nuts to hold in place.

Component	Qty	DigiKey	Reference Designators
220uF 16V el	2	P5139	C7, C10
0.1uF 50V pe	2	P4525	C8, C11
0.01uF 50V pp	2	P3103	C2, C5
0.22uF 50V pp	4	P3224	C1, C3, C4, C6
316	4	316XBK	R7, R13, R25, R31
1.00k	6	1.00KXBK	R9, R11, R12, R27, R29, R30
1.30k	4	1.30KXBK	R3, R5, R21, R23
1.43k	4	1.43KXBK	R1, R14, R19, R32
8.45k	2	8.45KXBK	R8, R26
13.0k	8	13.0KXBK	R2, R4, R6, R10, R20, R22, R24, R28
47.5k	4	47.5KXBK	R15, R17, R33, R35
OPA2134	3	OPA2134PA	U1, U2, U3
Battery Holder	2	BH9V-PC	B1, B2
RCA Jack	4	CP-1402	J1, J2, J3, J4
Socket, DIP 8	3	A400	U1, U2, U3
Switch, DPDT	1	EG1905	S1

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# 3 Assembly

## Step by Step

Please follow this systematic procedure for assembling the amplifier. Make sure you have purchased all necessary components before you begin.

- ❑ Bend and form the leads on the resistors and install into their proper places.
- ❑ Solder in place and cut leads.
- ❑ Install sockets and solder in place.
- ❑ Install RCA jacks and solder in place. Cut signal leads so they don't stick out.
- ❑ Install capacitors, solder in place and cut leads.
- ❑ Install switch and solder in place.
- ❑ Mount battery connectors, secure in place using at least one screw. Solder in place.

That's it for the electronics. However, there is one more recommended step, and that is to clean the flux and other surface contaminants from the board. To do this, soak the entire assembly in isopropyl alcohol. You can buy a bottle at any drug store. Soak for about ½ hour, and then use a paintbrush (big) to dab in-between components scrubbing away any remaining residue. Use a strong fan (or leaf blower) to dry both sides. When finished, the circuit board will be shiny and clean. Cleanliness is key to eliminating leakage current paths that develop over time.

- ❑ Add screw to grounding nut.
- ❑ Install opamps.

## Chassis Mounting

Mount the circuit board on legs so that nothing is touching the leads or traces on the bottom. A shielded chassis will help reduce stray EMI fields. Install 9V batteries and you are ready to go!

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# 4 Testing & Installation

## Testing

Performance testing is possible if you have access to laboratory test equipment, but is typically unnecessary. You can do a basic test with a DVM by checking supply voltages on the opamps and insuring there is no dc offset at the outputs.

## Connections

Connect the Bugle just like any other phono stage. The input and output jacks are RCA types. Make sure the ground lead from the turntable is connected to the grounding screw between the input jacks.

Battery operation should help eliminate ground loops and hum, but not necessarily. The location of the open-frame circuit board may prove critical. Close proximity to large electric or magnetic fields will induce hum or buzz into the signal. This will be common to all phono stages.

For maximum battery life, always turn off when not in use. There is no warm-up time.

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# 5 Customization

## Circuit Modifications

The Bugle does not have to be built as specified. For example, you do not need to use the batteries for power. A good, clean +/-15V supply will add more headroom. The stock opamps can handle supplies up to +/-18V. Be sure to add adequate decoupling and pay attention to grounding.

You can mount the Bugle into a linestage or other piece of equipment. If the circuit board is too large, it can be cut down using a hacksaw. Just chop off the battery “wings”. Use a file to smooth any cut edge to make sure no traces short to the ground plane. Connectors can be panel mounted and then wired to the circuit board. You may need to use shielded cables. The switch can also be remotely mounted or even bypassed. Buy only the parts you need!

For moving coil cartridges, the loading resistance is often specified to be much less than 47k. There are two unused resistor locations on the board, R16 and R34, where you can solder in whatever load resistance you need.

The two channels do not have to be identical. You can implement two independent mono channels for different 78rpm equalizations and just use one at a time. It is best to short the unused input to reduce any possible crosstalk.

## Component Substitution

You can substitute any component with another type or manufacturer. Value changes are possible too if you are careful. For example, the 0.22uF and 0.01uF capacitors used in the equalization networks can be changed to any other value you prefer, just be sure to recalculate resistor values using the AnyEQ™ online web calculator.

Stock component values were specifically chosen by design to optimize the circuit for sound quality, noise, distortion, bandwidth, power dissipation, availability, and cost. Stray from nominal values at your own risk.

The most popular substitution will be the opamps. That is why sockets are specified. Everyone has his or her own sonic tastes and preferences. Each opamp will sound different. The recommended Burr-Brown ([www.ti.com](http://www.ti.com)) OPA2134PA opamps are a good fit for this particular circuit. However, they will discharge the batteries rather quickly.

For a 10x improvement (160 hours), use the OPA2137PA. Beware, these are much noisier devices and should not be used for high gain stages. Opamps using bipolar transistor front-ends are not recommended because of their tendency to demodulate radio stations and the Bugle's non-inverting architecture. Most importantly, use DUAL devices and make sure pin 1 is oriented towards the output jacks.

A good alkaline 9V battery will have about 500mAh of energy. The stock opamps draw about 5mA per amplifier, and there are six of them (three dual packages), for a total of 30mA idle current. The rest of the circuit does not add to this, except under signal and load. Since average signal levels are low, the typical battery draw is roughly equal to the idle current. Life is then calculated by  $500\text{mAh} / 30\text{mA} = 16.7$  hours.

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# 6 Specifications

The following specifications are subject to change without notice. Values given are for stock components at 40dB gain.

Item	Specification
Gain	40dB to 60dB (fixed)
Input Impedance	47k ohm plus 14pF
Output Impedance	330 ohms
RIAA Response	+/-0.5dB from 30Hz to 60kHz
Bandwidth (-3dB)	15Hz to 150kHz (minimum)
Distortion	0.05% @1kHz
SNR	74dB ref 5mV A-weighted
Overload	55mV @1kHz
Battery Life	16 hours
Size (PCB)	3" x 5"

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# 7 Warranty & Service

## Warranty

Hagerman Technology LLC warrants this product free of defects in materials and workmanship for 10 years. If you discover a defect, Hagerman Technology LLC will, at its option, repair or replace the product at no charge to you provided you return it during the warranty period, transportation charges prepaid to Hagerman Technology LLC. This warranty does not apply if the product has been damaged by negligence, accident, abuse or misuse or misapplication, has been damaged because it has been improperly connected to other equipment or has been modified without the express written permission of Hagerman Technology LLC. This warranty is limited to the replacement or repair of this product and not to damage to equipment of other manufacturers.

Any applicable implied warranties, including warranty of merchantability, are limited in duration to a period of the express warranty as provided herein beginning with the original date of purchase and no warranties, whether express or implied shall apply to the product thereafter.

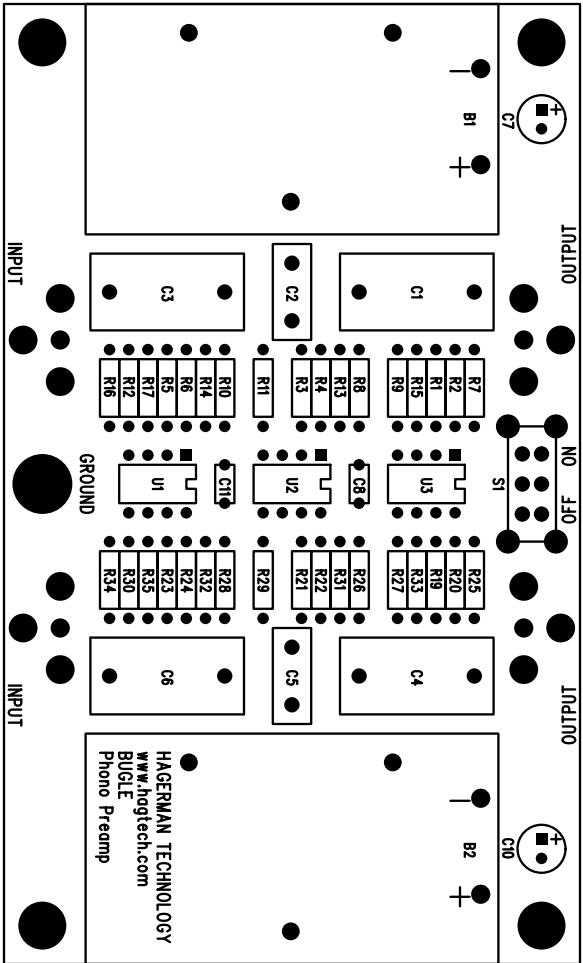
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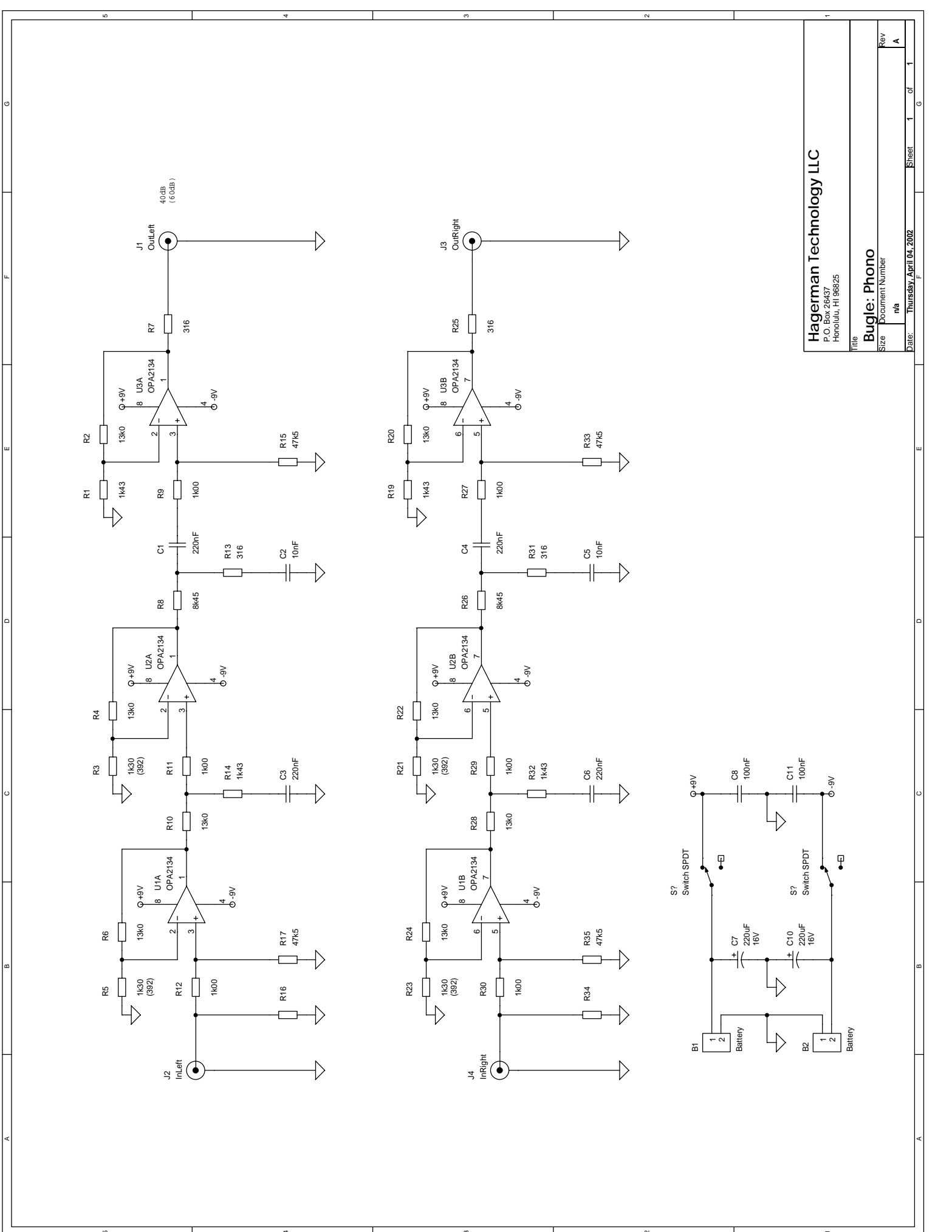
## Service

Refer to Chapter 4 for troubleshooting information. If the problem persists, contact Hagerman Technology for service at <http://www.hagtech.com>.

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Title: **Bugle: Phono**  
 Size: Document Number  
 n/a  
 Date: **Thursday, April 04, 2002**

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