

# Soundcard Interface Kit Construction Manual

Gordon L. Gibby KX4Z

Version 1.1 March 2017

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**Cover Design**

First Prototype soundcard interface constructed & worked well. Small improvements have been made to the Version 1.1 printed circuit board.

## PREFACE

This instruction manual is designed to accompany a printed circuit board created using ExpressPCB printed circuit board design tools. I developed this printed circuit board to:

- dramatically speed up construction of transformer-isolated soundcard interface circuitry
- allow the use of laptop-built-in soundcard, or inexpensive external USB-based soundcards, some of which function well with Raspberry Pi `linbpq` and `alsamixer`
- considerably reduce the cost of getting into digital amateur radio communications modes, compared with (otherwise excellent) commercial isolation interface systems

For the amateur radio club or group that wishes to turn this into a project, I'll gladly send them (by email) the .pcb file that allows them to order their own boards. While finished boards start at about \$20, they drop to \$10 with large quantities. (Contact me if you would like to join in an order.) The parts for this kit can be obtained under \$10. A simple steel house wiring octagon junction box can be had for just over a buck, and a cover for just over 50 cents. Makes for a very inexpensive shielded box! With an experienced and patient mentor, this would be a great project for helping amateur radio operators with little previous construction experience, learn what fun it can be to actually *build your own equipment*.

Contact me at: [docvacuumtubes@gmail.com](mailto:docvacuumtubes@gmail.com)

Gordon L. Gibby MD KX4Z  
Newberry, Florida  
March 28 2017

REF: <https://www.expresspcb.com/>

## DEDICATION

This short instruction manual is devoted to my long-suffering and wonderful wife, Nancy Gibby, who put up with the kitchen table being taken over many, many times during the development of this system....my own workbench already covered with other projects.

She's a great example of a Lady who serves her Lord.

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And the verse below (written 2,500 years ago) , was used by Pastor David Chauncey of Westside Baptist Church, Gainesville, FL to urge Christians to be *active* in serving their communities.

*Seek the welfare of the city where I have sent you into exile,  
and pray to the Lord on its behalf;  
for in its welfare you will find your welfare.*

Jeremiah 29:7  
c. 627 BC

## CONTENTS

Chapter	Title	Page
1	Construction, connection & adjustment	1
2	Standardized RJ-45 Wiring, Microphone pinouts, and PCB artwork	19

## ACKNOWLEDGMENTS

The brave souls of the Alachua County ARES group who spent HOURS soldering together kit after kit, back before we had this printed circuit board, and who put up one after another BPQ node stations, deserve a huge amount of appreciation. And John Wiseman G8BPQ for writing wonderful “BPQ” software that has benefited so many. And then Andrei Kopanchuk, UZ7HO, of Ukraine, who has greatly served the ham radio community by writing wonderful software that does packet decoding and terminal functions, soundmodem and easyterm.

## 1 CONSTRUCTION

NOTICE: THIS KIT REQUIRES UNDERSTANDING OF SIMPLE CIRCUITRY AND BASIC SOLDERING AND CONSTRUCTION ABILITIES. IT MAY NOT BE APPROPRIATE FOR BEGINNERS WHO DO NOT HAVE ADEQUATE MENTORING. THE INSTRUCTIONS ARE SET AT A LEVEL APPROPRIATE FOR A BUILDER WHO HAS BUILT KITS BEFORE. IF YOU HAVE NEVER BUILT A KIT BEFORE, SEEK A COMPETENT MENTOR BEFORE BEGINNING. PLEASE READ THE ENTIRE INSTRUCTIONS BEFORE BEGINNING. THIS KIT AND THE INSTRUCTIONS AND ANY OTHER COMPONENTS ARE PROVIDED WITHOUT ANY WARRANTEE OR GUARANTEE OF PERFORMANCE AND THE BUILDER AGREES TO HOLD THE DEVELOPER OF THIS KIT HARMLESS FOR ANY AND ALL DAMAGES.

### **INTRODUCTION**

In order to be able to transmit information digitally using a voice transceivers (whether SSB on HF bands, or FM on VHF/UHF bands) some circuitry/software is needed to change alphanumeric characters into tones that will go into a microphone jack, and to key the transmitter. Vice versa, to unscrambled the mishmash of audio signals and turn them into readable data, software/hardware is needed also. Hardware-only solutions (which often included a processor running obligatory software, but hidden inside) have long been sold and named Terminal Node Controller, or PACTOR modem, or similar. Recently, the power of the personal computer and capabilities of modern sound cards have taken on much of this work, so that a much simpler hardware system, providing adjustment of signal level, isolation of transceiver from computer, and push-to-talk (PTT) activation, can be used along with relevant software. Commercial solutions abound for this, with the Tigertronics Signalink being very popular, along with the Rigblaster, a recent MFJ product, and

some older systems that relied on a signal from a 9-pin serial port.

### Representative (AND INCOMPLETE) Collections of Software / Hardware Digital Solutions

Frequency Bands	Digital Mode / Goal	Software	Hardware
HF	Winlink / WINMOR for email	RMS EXPRESS <sup>1</sup>	Soundcard and interface capable of electronic control of PTT
HF	PSK31, Olivia, etc. used for QSO's	FLDIGI <sup>2</sup> , Ham radio deluxe or any of multiple software packages.	Soundcard and interface; PTT can be done manually if electronic control not available
VHF/UHF	Packet / email	RMS EXPRESS + soundmodem.exe <sup>3</sup>	Soundcard, software and interface capable of electronic control of PTT
VHF/UHF	“Classic Packet” where you use a keyboard for connections / contacts.	Easyterm.exe terminal software plus Soundmodem.exe	Soundcard, software and interface capable of electronic control of PTT

The cost can be reduced somewhat by building one's own interface, and either using a laptop's built in sound card, or an inexpensive USB-connected sound dongle. For the Raspberry Pi user (including those building a **linbpq**-based node) a “classless” (no driver required) USB audio adapter such as the Adafruit 1475 (typically \$5<sup>4</sup>), Sabrent USB

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1 Download from [www.winlink.org](http://www.winlink.org)

2 Download the version for your operating system from: <https://sourceforge.net/projects/flfdigi/files/flfdigi/>

3 Download soundmodemXX.exe and easytermXX.exe from <http://uz7.ho.ua/packetradio.htm>

4 Available from: <https://www.adafruit.com/products/1475> as well as from: <https://chicagodist.com/search?q=1475>

sound card<sup>5</sup> or equivalent is preferred. The classless adapters will function properly with Raspbian `alsamixer` to allow easy gain adjustment of the sound card system; generally you want to have fairly high signal levels in and out of the soundcard (but not into distortion!) to reduce the damaging effects of hum pickup etc. Then inside the soundcard adapter, gain adjustments are made with a hardware potentiometer. If you're using `alsamixer`, make your adjustments permanent afterwards with

```
sudo alsactl store
```

Figure 1 (below) shows a schematic of a single transistor-based soundcard interface that provide for gain adjustment in both directions, transformer-based ground isolation, and fast automated PTT control derived from the audio on one channel (VOX-type circuit). The basic idea of this circuit is certainly not original with me; countless previous similar designs have been presented. It simply consists of transformer isolation of signals in both directions between the sound card and the radio transceiver, and a simple audio amplifier driving a diode detector to create a VOX-type signal that is then used to switch a relay, as well as an indicator LED to facilitate initial setup.

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5 Available from [https://www.amazon.com/gp/product/B00IRVQ0F8/ref=oh\\_aui\\_detailpage\\_o05\\_s00?ie=UTF8&psc=1](https://www.amazon.com/gp/product/B00IRVQ0F8/ref=oh_aui_detailpage_o05_s00?ie=UTF8&psc=1)

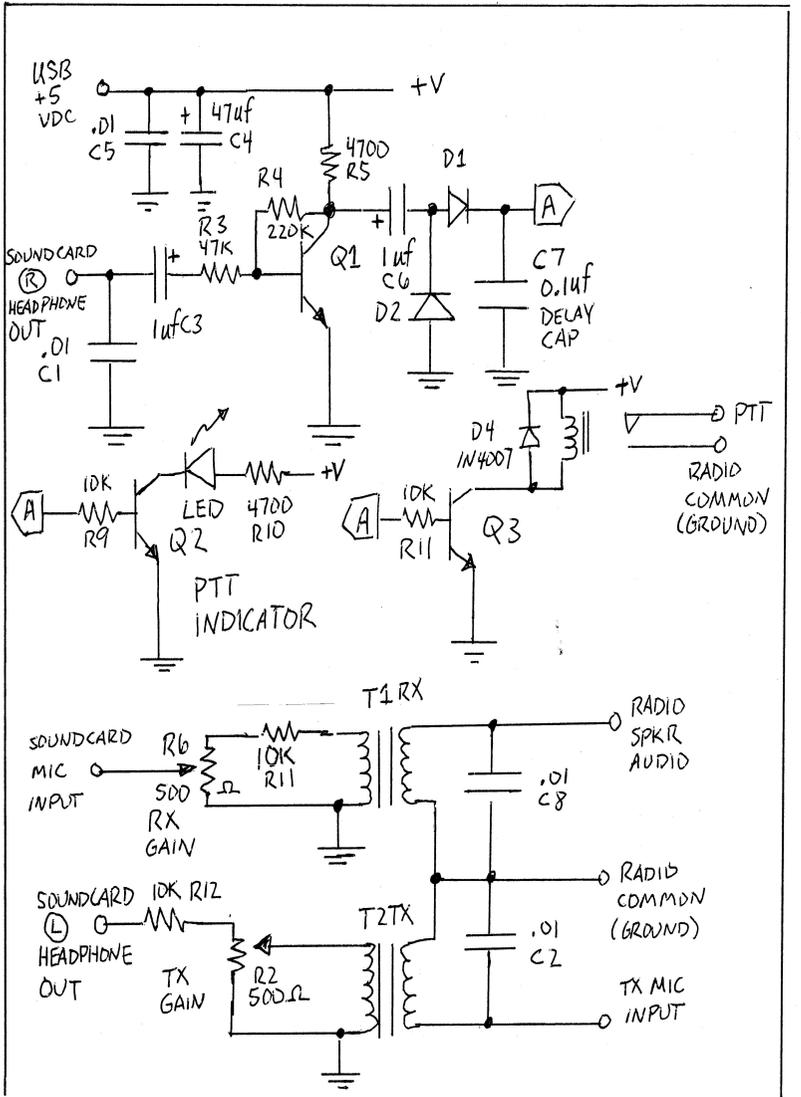


FIGURE 1-1. Schematic for sound card interface. The values of R11 and R12 are not critical but may be changed to better match your radio's signal levels; typical values are either 4700 or 10K. The printed circuit board includes an additional "backward" diode between USB+5 and Ground to protect against accidentally applied reverse power supply voltage.

Improvements made to the circuit recently (which are not yet reflected in the schematic above):

- Added “backwards diode” D3 between +5 and ground to protect against reverse supply polarity
- Placed 22 ohm 1/4 watt series resistor in +5 line to act as a current limiter/fuse in the event of a short circuit within the circuitry
- Optional 0.01 uf capacitors across the soundcard mic input and left channel headphone output to further reduce RFI (have not been needed to date).

The author & many friends have built a dozen or more of this circuit and they are in continuous usage inside several packet node stations, as well as in use for WINLINK client email applications, as well as casual radio QSO's. However, construction on standard perfboard takes an experienced builder roughly 2 hours, and novices may take *quite a few* hours.

To make construction much faster and easier, a printed circuit board design was created which resulted in a 2-layer PCB (3.8” x 2.5” ) with silk screen lettering.

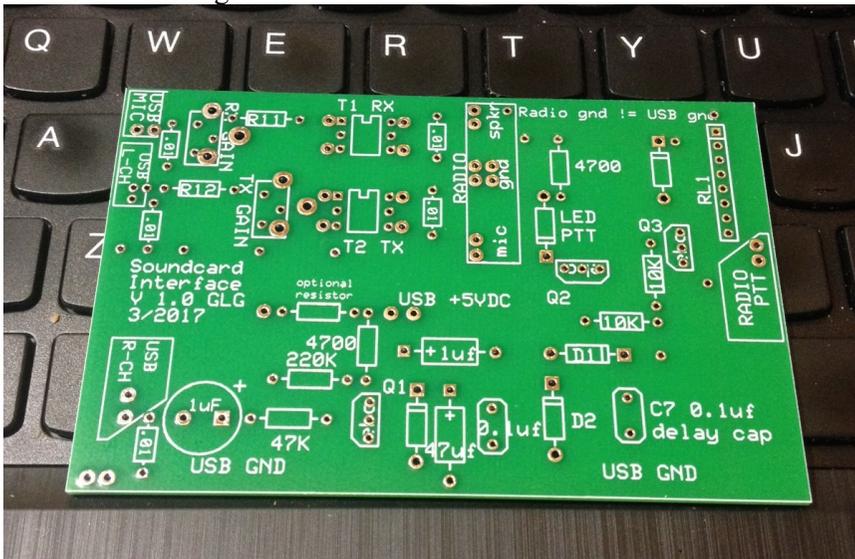


Figure 1-2. Bare printed circuit board (prototype board shown)  
Your board may have slight improvements.

## CONNECTIONS:

This circuit connects soundcard signals, arranged generally along the left side of the board, to an amateur radio transceivers' mic/speaker/ptt, which are connected generally at the upper middle and right hand side of the board as follows:

### SOUND CARD CONNECTIONS

Connection	Location
sound card ground	bottom left corner of board, two larger pads, marked USB GND
USB +5 volts	Can be connected to either of the two larger pads at center of board labeled "USB +5VDC" or if the optional series 22 ohm resistor (as a current limiter/fuse) is used, can be connected to the single large pad to the left of the optional 22 ohm resistor +5V IN.
Sound card mic	2 larger pads upper left corner labeled "USB MIC"
Left channel headphone output (used to send signal for transmission to the transceiver)	2 larger pads just below the mic input, labeled "USB L-CH"
Right channel headphone output (used to operate the PTT via a "voice-activated VOX" type circuit)	2 larger pads left lower portion of the board, labeled "USB R-CH"

**RADIO CONNECTIONS**

<b>Connection</b>	<b>Location</b>
Radio ground ( <i>isolated from USB ground</i> )	Center of boxed-in area, center-top of board, labeled “gnd”. Multiple pads provided
Radio MIC input	Lower portion of boxed-in radio connection area, labeled “mic”. 2 pads provided
Radio SPEAKER OUT	Upper portion of boxed-in radio connection area, labeled “spkr”. 2 pads provided
Radio PTT connection (relay output, limit current to 50 mA). During intended transmission, this connect is shorted to Radio ground.	Right hand edge of the board, labeled “RADIO PTT”. 2 pads provided.

NOTE: if your radio has separate PTT and MIC grounds, this circuit does not provide separated grounds for those purposes, so connect both of them to “Radio Ground.”

Extra pads were provided for connections simply for redundancy.

**COMPONENTS**

The components in the table that follows will be required. All resistors can be 1/4 watt. (The board is drilled for 1/4 watt resistors.) All electrolytic capacitors can be 10V or greater (e.g., 15, 25 or 35 will work) . Transistors are specified as 2N3904 but many general purpose small NPN transistors would work. Know the emitter, base, collector pinout of the transistor you are using! (They are NOT all the same!)

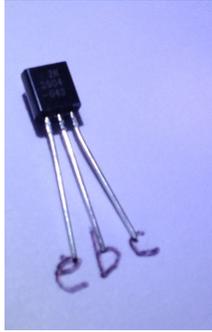


Figure 1-3. *2N3904 pinout with flat side up, curved down side. TO-92 package.*

The relay is a somewhat delicate but fast reed relay; most radios have a tiny push-to-talk current, but limit this to 50 mA. The specified relay has 4 pins on 0.2" centers, while the circuit has 6 pads on 0.1" centers. **Thus not all the pads will be used!** The pads are wired so that the relay may be installed starting either from the bottom pad or the top pad (there will be one left over at the opposite end) and it works either way. This was due to the limited number of standard "components" offered in the design package and my lack of knowledge to create a customized relay pad structure. The relay is symmetrical, it can be installed with either end up or down. The center two pins are the coil, and the end pins are the relay contacts. The Ver. 1.1 screenprint puts circles on suggested insertion points; the relay is symmetrical and can be installed with either end upwards.



Figure 1-4. *Reed Relay. Device is symmetrical, center pins are the coil, end pins are the contacts.*

Either of two sizes of trimmer potentiometer may be used. The tiniest size requires a thumbnail or small plus head screwdriver; the larger size can be operated with the fingers. Alternatively, wires can be soldered and go to a panel mounted potentiometer, if for example you'll be using this device with multiple radios. For most installations connected long term to a single radio, simple set and forget will work well.

The transformers have one winding to the left, and the other to the right. The circuit board center hole is not used on each side (not connected). I'm unable to tell primary from secondary on general purpose 600 ohm 1:1 transformers, so mount either way as long as one side is LEFT and the other side if RIGHT, not up and down.

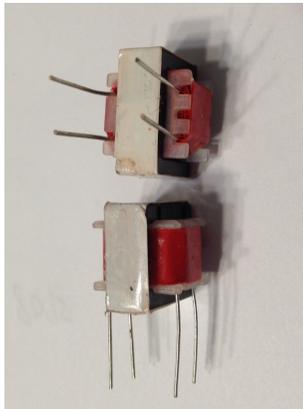


Figure 1-5 *Audio 1:1 Transformers. Yours may have center taps (not used in this circuit) or may be as these, with only 2 connections on each side.*

The printed circuit board has positions for optional 0.01 uf capacitors across soundcard mic and left headphone channels. I haven't needed these, but they may benefit some.

u = “micro”

**NOTE:** *Most of these components are literally only PENNIES. The cost of shipping is one of the larger costs, and frequently if you buy 10 of an item you get a price break. As an amateur radio operator going to the trouble to order parts, you might want to buy some “extras” and keep them in your “spare parts” drawer.*

Component	Qty req.	Digikey Part No.
0.01 uf ceramic capacitor (used to filter out RF)	4-6	490-11884-ND <a href="https://www.digikey.com/product-detail/en/murata-electronics-north-america/RCER71H103K0K1H03B/490-11884-ND/4277785">https://www.digikey.com/product-detail/en/murata-electronics-north-america/RCER71H103K0K1H03B/490-11884-ND/4277785</a>
0.1 uf capacitor to act as short delay capacitor	1	445-2637-ND <a href="https://www.digikey.com/product-detail/en/tdk-corporation/FK26X7R2E104K/445-2637-ND/970587">https://www.digikey.com/product-detail/en/tdk-corporation/FK26X7R2E104K/445-2637-ND/970587</a>
1 uf electrolytic capacitor	2	493-10230-1-ND <a href="https://www.digikey.com/product-detail/en/nichicon/UMF1V010MDD1TP/493-10230-1-ND/4312489">https://www.digikey.com/product-detail/en/nichicon/UMF1V010MDD1TP/493-10230-1-ND/4312489</a>
47uf electrolytic capacitor to filter out any hum on +5 line	1	P5539-ND <a href="https://www.digikey.com/product-detail/en/panasonic-electronic-components/ECA-1EHG470/P5539-ND/245138">https://www.digikey.com/product-detail/en/panasonic-electronic-components/ECA-1EHG470/P5539-ND/245138</a>
22 ohm 1/4W resistor, optional, used as current limit/fuse in the +5 line	1	CF14JT22R0CT-ND <a href="https://www.digikey.com/product-detail/en/stackpole-electronics-inc/CF14JT22R0/CF14JT22R0CT-ND/1830311">https://www.digikey.com/product-detail/en/stackpole-electronics-inc/CF14JT22R0/CF14JT22R0CT-ND/1830311</a>
47K 1/4W resistor	1	CF14JT47K0CT-ND <a href="https://www.digikey.com/product-detail/en/stackpole-electronics-inc/CF14JT47K0/CF14JT47K0CT-ND/1830391">https://www.digikey.com/product-detail/en/stackpole-electronics-inc/CF14JT47K0/CF14JT47K0CT-ND/1830391</a>

Soundcard Interface Kit

4700 1/4W resistor	2-4	CF14JT4K70CT-ND <a href="https://www.digikey.com/product-detail/en/stackpole-electronics-inc/CF14JT4K70/CF14JT4K70CT-ND/1830366">https://www.digikey.com/product-detail/en/stackpole-electronics-inc/CF14JT4K70/CF14JT4K70CT-ND/1830366</a>
10K 1/4 W resistor	4	CF14JT10K0CT-ND <a href="https://www.digikey.com/product-detail/en/stackpole-electronics-inc/CF14JT10K0/CF14JT10K0CT-ND/1830374">https://www.digikey.com/product-detail/en/stackpole-electronics-inc/CF14JT10K0/CF14JT10K0CT-ND/1830374</a>
220K 1/4W resistor used to bias Q1 into quasi linear range	1	CF14JT220KCT-ND <a href="https://www.digikey.com/product-detail/en/stackpole-electronics-inc/CF14JT220K/CF14JT220KCT-ND/1830407">https://www.digikey.com/product-detail/en/stackpole-electronics-inc/CF14JT220K/CF14JT220KCT-ND/1830407</a>
2N3904 transistor epoxy package TO-92 case  Pay attention to the mfg. drawing of EBC leads.	3	2N3904FS-ND <a href="https://www.digikey.com/product-detail/en/fairchild-on-semiconductor/2N3904BU/2N3904FS-ND/1413">https://www.digikey.com/product-detail/en/fairchild-on-semiconductor/2N3904BU/2N3904FS-ND/1413</a>
Diode, 1N4007 or almost any diode	4	1N4007-TPMSCT-ND <a href="https://www.digikey.com/product-detail/en/micro-commercial-co/1N4007-TP/1N4007-TPMSCT-ND/773694">https://www.digikey.com/product-detail/en/micro-commercial-co/1N4007-TP/1N4007-TPMSCT-ND/773694</a>
500 ohm trimmer	2	Choice of miniature or thumb-adjustable size Miniature: 3306K-501-ND <a href="https://www.digikey.com/product-detail/en/bourns-inc/3306K-1-501/3306K-501-ND/84791">https://www.digikey.com/product-detail/en/bourns-inc/3306K-1-501/3306K-501-ND/84791</a>  Thumb adjustable: 201XR501B-ND

		<a href="https://www.digikey.com/product-detail/en/cts-electrocomponents/201XR501B/201XR501B-ND/98331">https://www.digikey.com/product-detail/en/cts-electrocomponents/201XR501B/201XR501B-ND/98331</a>
LED (push to talk indicator)	1	C503B-RCN-CW0Z0AA1-ND <a href="https://www.digikey.com/product-detail/en/cree-inc/C503B-RCN-CW0Z0AA1/C503B-RCN-CW0Z0AA1-ND/1922930">https://www.digikey.com/product-detail/en/cree-inc/C503B-RCN-CW0Z0AA1/C503B-RCN-CW0Z0AA1-ND/1922930</a>
Reed Relay	1	306-1062-ND <a href="https://www.digikey.com/product-detail/en/coto-technology/9007-05-00/306-1062-ND/301696">https://www.digikey.com/product-detail/en/coto-technology/9007-05-00/306-1062-ND/301696</a>
600 ohm 1:1 audio transformers	2	<p>These can be obtained much more inexpensively over ebay. The impedance can be anything near 600 ohms.</p> <p>Here is an example of TEN transformers for less than \$4, shipped from Europe: <a href="http://www.ebay.com/itm/10X-Audio-Transformers-600-600-Ohm-Europe-1-1-EI14-Isolation-Transformer-TSUS/112271494516?_trksid=p2045573.c100506.m3226&amp;_trkparms=aid%3D555014%26algo%3DPL.DEFAULT%26ao%3D1%26asc%3D41376%26meid%3Dd49cdfe8fb154623a304652fcb7f689c%26pid%3D100506%26rk%3D1%26rkt%3D1%26">http://www.ebay.com/itm/10X-Audio-Transformers-600-600-Ohm-Europe-1-1-EI14-Isolation-Transformer-TSUS/112271494516?_trksid=p2045573.c100506.m3226&amp;_trkparms=aid%3D555014%26algo%3DPL.DEFAULT%26ao%3D1%26asc%3D41376%26meid%3Dd49cdfe8fb154623a304652fcb7f689c%26pid%3D100506%26rk%3D1%26rkt%3D1%26</a></p> <p>Digikey has an expensive model at \$5.60 each:</p> <p>MT4135-ND <a href="https://www.digikey.com/product-detail/en/tamura/TTC-105-1/MT4135-">https://www.digikey.com/product-detail/en/tamura/TTC-105-1/MT4135-</a></p>

Soundcard Interface Kit

		<a href="#">ND/285702</a>
Snap on ferrite core for cables	2	240-2599-ND <a href="https://www.digikey.com/product-detail/en/laird-signal-integrity-products/28A1507-0A2/240-2599-ND/2242762">https://www.digikey.com/product-detail/en/laird-signal-integrity-products/28A1507-0A2/240-2599-ND/2242762</a>

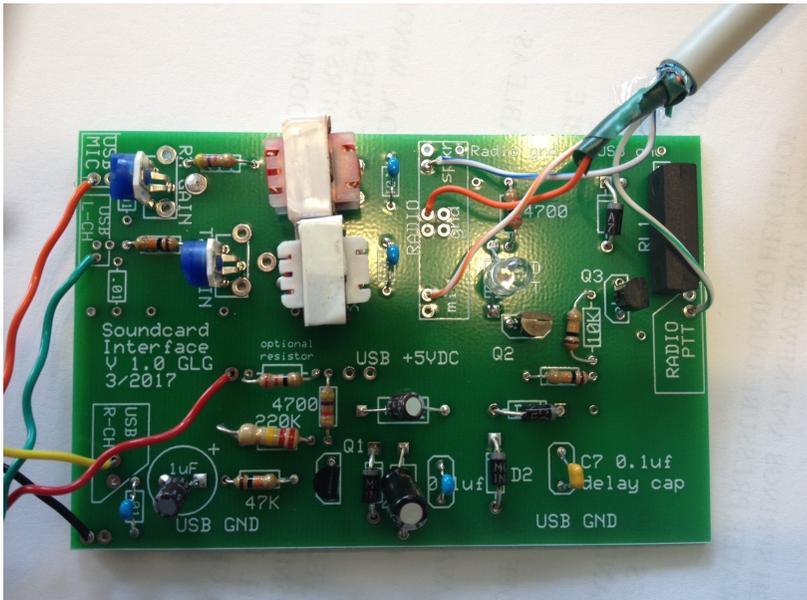


Figure 1-6. Completed circuit board, using “tiny” potentiometers. The spacing for the transformers has been since increased.

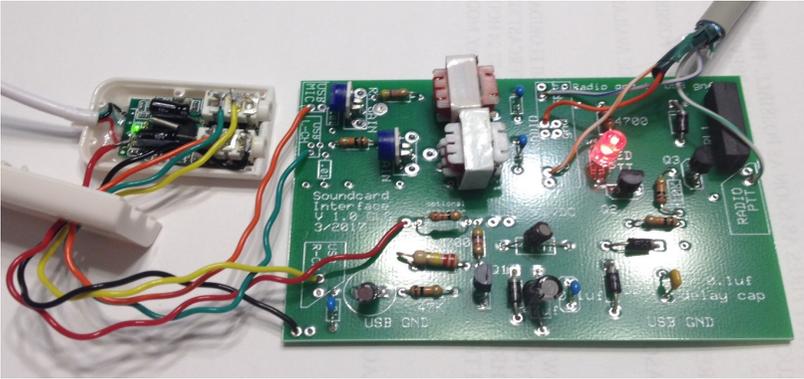


Figure 1-7. Completed circuit board wired (by direct soldered connections) to an Adafruit 1475 sound adapter. (The connections to the sound adapter can also be made by stereo 3.5 mm (1/8") cables/plugs<sup>6</sup>, and USB +5 and ground obtained using a cut-off USB cable (RED generally +5V and BLACK = ground, but verify with a voltmeter before wiring to be safe.)

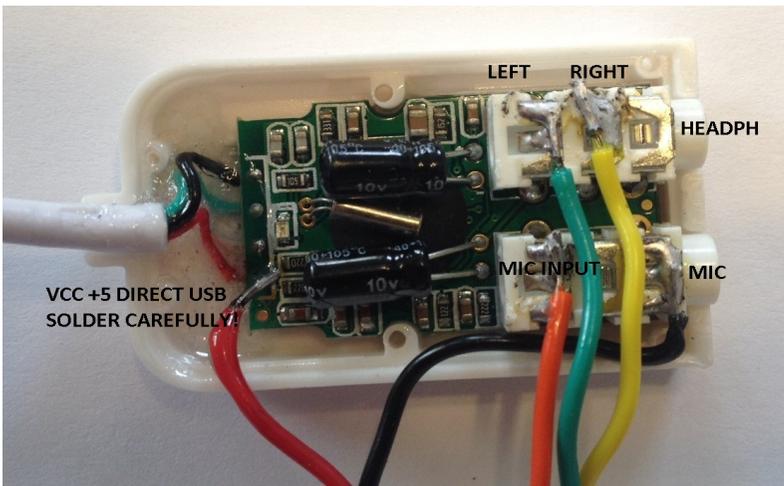


Figure 1-8. Close-up of direct soldered connections to Adafruit 1475 sound adapter, after gently prying case open. The +5V red wire connection requires special finesse to avoid the delicate red USB wire on the underside coming loose. The right-most top connection of both headphone output (top) and mic input (bottom) are connected together in

6 Stereo cabled terminated with 3.5mm stereo plugs at both ends, can be found for less than \$1 such as: [https://www.monoprice.com/product?p\\_id=644](https://www.monoprice.com/product?p_id=644) Cut in half to make both mic and headphone from one cable.

*the 1475 sound adapter.*

## **SOLDERING & CONSTRUCTION**

I'll never forget one of my friends trying to solder tiny 1/4 watt resistors and heat-sensitive 2N3904 transistors using the blunt tip of a huge 100-watt soldering gun! *There are ways to make this project difficult, and that is one of them!*

Use a low wattage soldering iron, such as 20-25 watts, with a fairly sharp and well-tinned (with solder) tip. While lead-free solder is encouraged today, 60/40 lead/tin rosin-core solder (still available) melts at a very low temperature, flows well and is very easy for beginners to work with. Try to avoid breathing the fumes!

The usual way to build a printed circuit board is to install a few components (3-5), bend their leads just a bit so that the component hugs the surface of the board, and then quickly solder each lead on the **BOTTOM** of the board with a well-applied iron and a quick touch of solder. As soon as the solder melts and flow, remove both iron and solder to avoid overtemperature. Solid state devices --- particularly transistors, can be damaged by too high a temperature for too long, so solder fast -- only a very few seconds are required. Then clip off the excess leads (avoiding hitting an eye with the projectile lead). Move on to the next components. (Do not solder on the top of the board.)

Before applying power, very very carefully look through the entire circuitry to be sure that you have put the right components in the right places, have polarized components (such as diodes, transistors, electrolytic capacitors, LEDs) inserted properly. This circuit has a "fuse" made of a 22 ohm 1/4 watt resistor to try and avoid damage to the USB bus of a laptop. When power is first applied, do it for only a second or two and watch for signs of untoward effects. It is normal for the LED to briefly flash when power is applied. Add a few seconds each successive connection, until the circuitry has proven itself safe.

The collector of Q1's voltage should be measured using a voltmeter. It should neither be saturated (0.2 V) nor cut-off (5 volts) -- it should best be somewhere in the middle (1-4 volts). If that voltage isn't right, something isn't correct with the biasing of Q1.

Once the circuit is deemed safe, connect receiver audio and verify that audio proceeds to the computer through the mic input (usually allowing signals to be seen on a waterfall, and characters displayed on a monitor). Adjust the RX GAIN if nothing shows up.

Next work on testing the PTT circuit, applying audio to the R CHAN in-- the PTT LED should illuminate. BE CERTAIN THAT YOUR LAPTOP SPEAKER OUTPUT TO THE RIGHT CHANNEL IS AT 100% to properly activate the PTT LED.

## **MOUNTING**

To protect the soldered connections on the bottom of the circuitboard, affix a piece of cardboard either with a bit of epoxy glue or (better) some double-stick mounting tape such as used to hold posters to walls. This will avoid short circuits from metallic surfaces touching the bottom of the circuit board.

It is advantageous to mount this circuit inside a metal box of some sort to provide RF shielding. Computer and transistor circuitry can be very sensitive to radio frequency energy picked up by wires and leads. Such a shielding box can be constructed in several ways, from the extremely cheap to the very expensive

1. Enclose in a cardboard box, bring out the required leads, cover the box with simple aluminum foil like a Christmas present, and tape.
2. Enclose in an appropriately sized metal tin such as for fine teas, or wallets or other small commercial items. Be careful of sharp edges if you drill holes for the leads to come out.
3. (My preferred) use a 4" electrical junction box with lid and 3/8" ("non-metallic") clamp connector to protect the leads from sharp edges. Such a box already includes knockouts, which can allow you easy access to the trimmers by removing the appropriate knock-out. The board JUST fits into a 4" junction box. (A tiny bit of sanding on the edge of the board might make it fit better.) These are available inexpensively from any home improvement store in the \$1 range. Use double-stick mounting foam tape to secure the board into the junction box. Sand or file any rough edges on the flat cover that matches the box.
4. Purchase an aluminum hobby box. The production board



## ADJUSTMENT

This assumes that you are familiar with the software you will be using. Select the proper choice to pick the sound card that is connected to the interface. With the squelch on your receiver wide open, adjust the receiver volume and the RX GAIN trimmer for the best results on character detection while listening to an active packet channel if possible. Some radios provide a direct connection to the demodulator that will have a constant 100 mV (or similar) signal level, independent of the transceiver's front panel speaker volume level adjustment; this is ideal.

The goal in adjusting the transmitted level is to get just below the maximum correct deviation of your transmitter -- which for FM corresponds to an audio perceived signal in an FM receiver that is slightly softer than maximum loudness. Cause your transmitter to transmit repetitively (e.g., calling a non-existent station) and adjust for just below the maximum deviation while listening on a 2<sup>nd</sup> transceiver.

For HF SSB, adjust so that you are near the top of the linear range of output power but NOT so as to “flat top” or cause significant Automatic Level Control (ALC) to be developed by your transmitter. You can observe your transmitted signal level in any of several ways, possibly including an display of your transmitted power, an analog forward SWR meter, or a power meter in the transmission line.

## MORSE CODE

At modest speeds you can even use the PTT to key a CW transmitter if desired. Be certain that the current carried is not more than about 50 mA and that the open circuit voltage isn't above approximately 15 volts. The reed relay was not meant to switch significant power. FLDIGI will happily send and receive CW for you. Alternatively, you can use the audio output (L channel) to send modulated tone CW, which is very similar to A0 if there is little hum or distortion on your output sine wave.

NOTE: Why use the RIGHT channel to run the PTT? The reason is that some modes (particularly some HF modes) vary the signal amplitude and might not keep the PTT activated -- FLDIGI provides a helpful continuous tone on the R channel to guarantee steady PTT. Packet doesn't have this problem! For packet, you could actually tie both L and R Channel sound inputs together and drive with only one channel of your laptop, potentially allowing you to run two different speeds/modes with two circuits.

## 2 STANDARDIZED RJ-45 PLUG/JACK WIRING

### *ALACHUA COUNTY FLORIDA STANDARDIZED RJ45 PINOUT*

The radio connection pads on the circuit board (microphone, PTT, ground, receiver audio output) simply need to get to the right signals on your transceiver. Using shielded cable from the circuit board to an appropriate connector(s) to your transceiver works fine.

In Alachua County we have standardized on an intermediate interconnection (optional, but helpful) that allows us to “mix and match” radios and interfaces similar to the effect of the RJ45 jack on the back of a Signalink or other similar products. On the shielded cable coming from the circuit toward the radio, we crimp an inexpensive RJ45 plug, and then add a 8-conductor double female jack to create a RJ45 jack. (Those are less than 50c online<sup>7</sup> Then we create individual wired cables to each radio, all of which terminate in a RJ45 plug, and we wire all these RJ45 plugs/jacks in a standardized pinout:

PIN	SIGNAL	Wire Color
1	microphone	white/orange

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<sup>7</sup> [https://www.monoprice.com/product?c\\_id=105&cp\\_id=10519&cs\\_id=1051902&p\\_id=7280&seq=1&format=2](https://www.monoprice.com/product?c_id=105&cp_id=10519&cs_id=1051902&p_id=7280&seq=1&format=2)

2	ground	orange
3	push to talk	white/green
4	unused	blue
5	receiver audio	white/blue

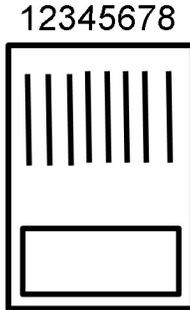
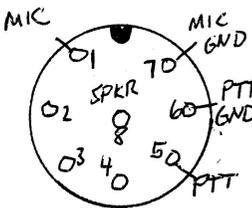
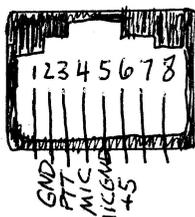
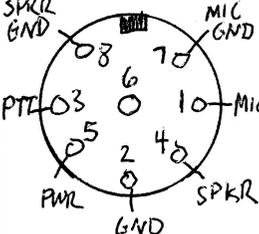
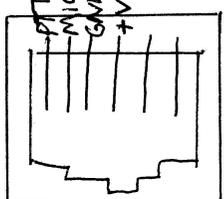
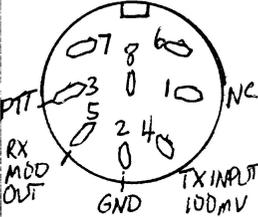
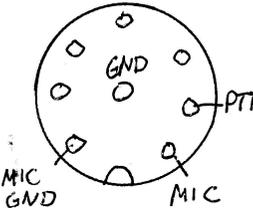
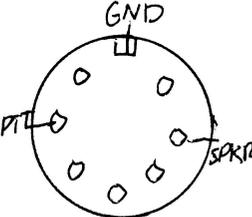
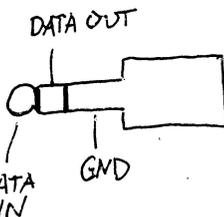
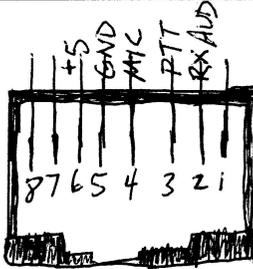


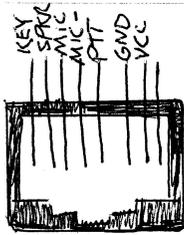
Figure 2-1 *Top View (pins visible) numbering of the RJ45 plug pins.*

This happens to be the standard pinout of commercially available cables intended to connect the popular Baofeng UV5RA (which uses a special molded double-plug connector) to a Signalink. This allows one to easily plug in a Baofeng UV5RA low power transceiver to test a system.

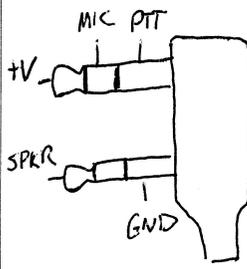
You can also purchase surface mountable 8-pin RJ45 jacks which could be mounted on your enclosure. My local Home Depot carries those.

## MICROPHONE JACK PINOUT AS VIEWED FROM THE EXTERIOR OF THE TRANSCEIVER

 <p>ICOM TYP 8-PIN ROUND</p>	 <p>YAESU SYSTEM 600</p>	 <p>DX7X00 FACTOR Socket</p>
 <p>YAESU FT2900R (ext spkr 3.5mm)</p>	 <p>ACC 1 Socket ICOM 725/728</p>	 <p>KENWOOD TS430 Male Mic Jack</p>
 <p>KENWOOD TS430 REAR CONN (Ext Spkr 3.5mm)</p>	 <p>YAESU SYSTEM 600</p>	 <p>YAESU FT-2500M (reverse numbering)</p>



JUENTAI JT-6881



BAOFENG UV5RA  
(plug view)



ALACHAUA ARES  
RJ45 STANDARD



## ABOUT THE AUTHOR

Gordon L. Gibby is a practicing physician with previous education in Electrical Engineering. As kids grew up and moved off, more time became available for amateur radio and other hobbies to be resumed. As a high school student, he learned construction from venerable Heathkit vacuum tube transceivers (one of which is still in routine usage -- even for Winlink!) as well as high power vacuum tube amplifier design.

His current amateur radio interest is Emergency Communications, particularly the high speed data communication possible with modern digital software.