Winlink Express using DIY Sound Card Interfaces

WHAT WINLINK OFFERS FOR EMCOMM

Flexibility:

- Internet-only (Telnet) direct connections to Winlink.
- Radio link bridge to Internet e-mail.
- Radio-only store and forward messaging.
- Peer-to-peer connections between radio end-users.
- Familiar and simple e-mail client interface.

Interoperability: Connect different types of systems

- Bridge different radio capabilities (VHF/UHF/HF).
- Seamless integration with Internet e-mail.

Geographical dispersion and redundancy for reliability

WHAT WINLINK OFFERS FOR EMCOMM (MORE)

- Standard e-mail format with many features.
  - Binary file attachments (pictures, pdf, spreadsheets).
  - Automatic message compression/decompression.
  - White listing used to prevent spam.
- Time independence.
- Ability to collect messages while unattended.
- Good operation at most power levels.
- Not limited by station-to-station propagation.
- Message logging, and ICS report generation.
- Forms and template support.
- Wide adoption by EmComm related agencies.

WHY SOUND CARD DIGITAL?

Flexibility and Performance:

- Most Winlink modes are available using only a sound card interface (Packet, ARDOP, Winmor, Vara, Vara FM)
- Less expensive hardware options
- Superior decode performance over hardware devices
- Not limited to just Winlink, other weak signal and experimental modes require a sound card interface (WSJT, WSPR, FT8, etc.)

WHY DIY INTERFACES?

- Save money (maybe)
- Technical challenge/Skill development
- Customize design for specific needs

DIY DEFINITIONS?

- Assemble a kit from a manufacturer
- Build a device from a schematic or reference document
- Design and build from scratch

“If we all did the things we are really capable of doing, we would literally astound ourselves.”
— Thomas A. Edison

SOUND CARD OPERATION

Sound Card Interface:

- Basically a simple signal interface, it is *not* a TNC
- May provide ground isolation between radio and computer
- Provides Push To Talk (PTT) signal
- Does not process the modem signals
- Signal processing is done by software running on the host
- May include additional ports for rig control

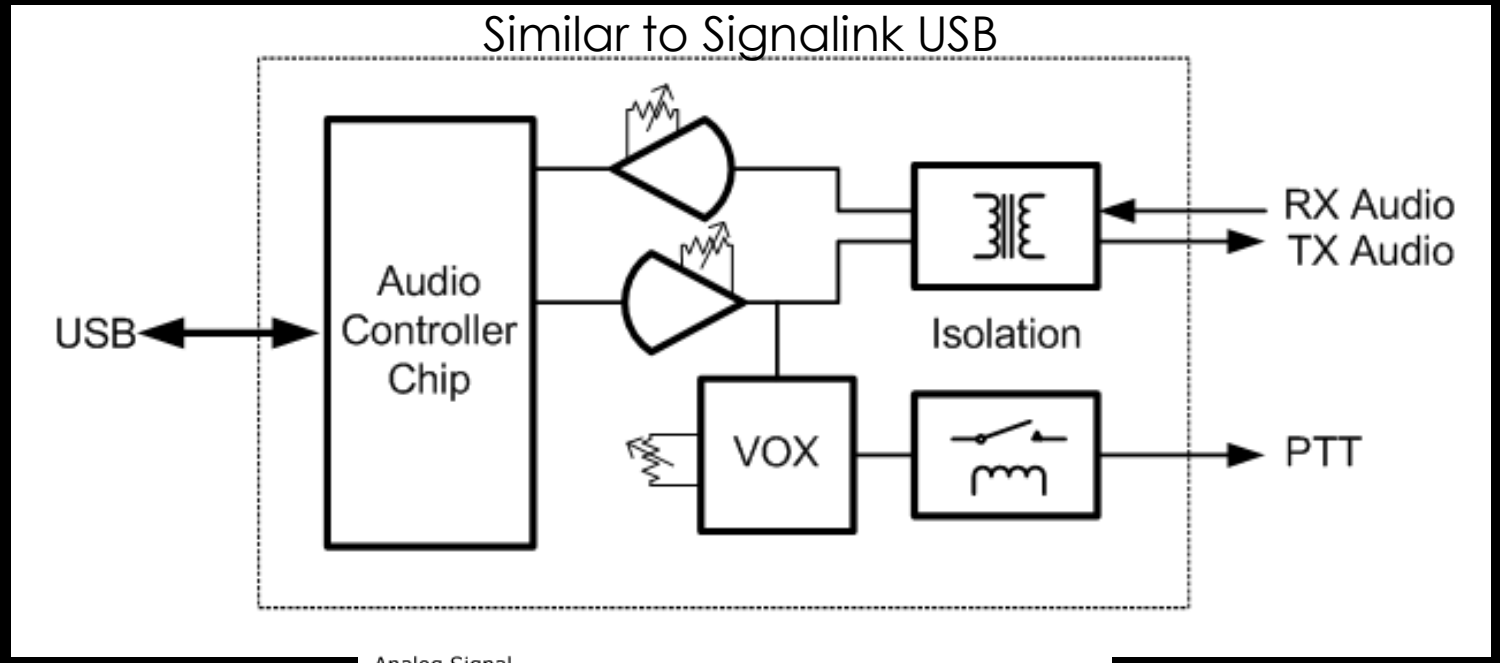
Host Software:

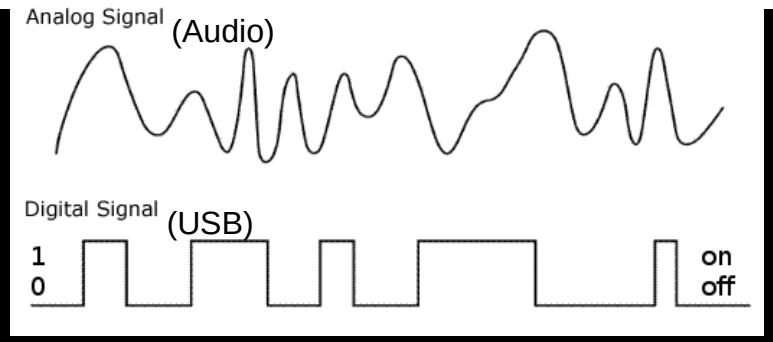
- Does signal processing (modulation/demodulation)
- Provides timing of data and control signals
- Implements the data protocol

SIGNALINK SOUNDCARD INTERFACE

- Simple device powered by USB connection.
- Cost is about $100 including radio-specific cable.
- Radio needs to have a data (sound) port or use microphone and speaker connections.
- Transformers in the Signalink limit audio bandwidth, and therefore maximum data speed

SOUND CARD INTERFACE BLOCK DIAGRAM





SOUND CARD OPERATION

WINLINK EXPRESS MODES

Mode	Speed	Application
~~Winmor (HF)~~	~~Up to 1300bps~~	~~Included~~
ARDOP (HF)	Up to 4,000bps	Included
Vara (HF)	Up to 7,000bps	External
Packet (V/UHF)	1200/9600bps[1]	External
Vara FM (V/UHF)	Up to 25,210bps	External

- Both Winmor and ARDOP were developed by the WDT and are included with Winlink Express
- Vara and Packet modes are provided by separate TNC applications:
  - Vara (HF) and Vara FM (V/UHF)
  - UZ7HO Soundmodem (V/UHF Packet)
  - Direwolf (V/UHF Packet)

1. Both Soundmodem and Direwolf provide additional PSK modes between 1200 and 9600

OTHER SOUNDCARD INTERFACES

RIM Lite

Various interfaces designed around USB codec chips (C-Media or others). Some are kits, pre-built, or DIY. Many AllStar interfaces can be found and work fine for digital (may be PTT issues).

Masters Communications DRA-30

NS7C Homebrew Modified USB fob

OTHER SOUNDCARD INTERFACES

Many new radios have a sound card interface built-in. With these radios, no external device is needed, only a simple USB cable connection from the computer to the radio is required. Often these built-in sound cards will not operate at the fastest speeds (9600) but do make for a clean installation.

ICOM IC-7100

ROLL YOUR OWN INTERFACE

"To invent, you need a good imagination and a pile of junk."
— Thomas A. Edison

Four signals are needed for Sound Card operation:

- Transmit Audio
- Receive Audio
- Push To Talk (PTT)
- Ground reference

ROLL YOUR OWN INTERFACE

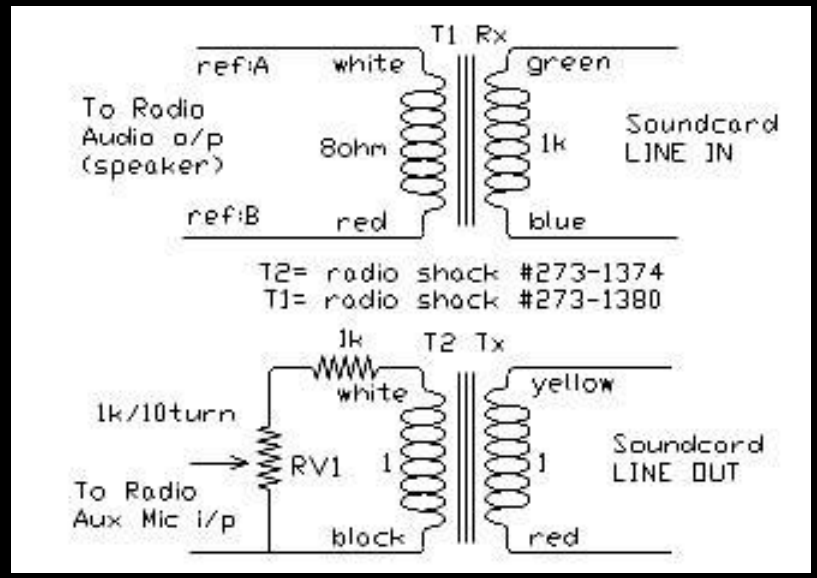
In the beginning…….

ROLL YOUR OWN INTERFACE

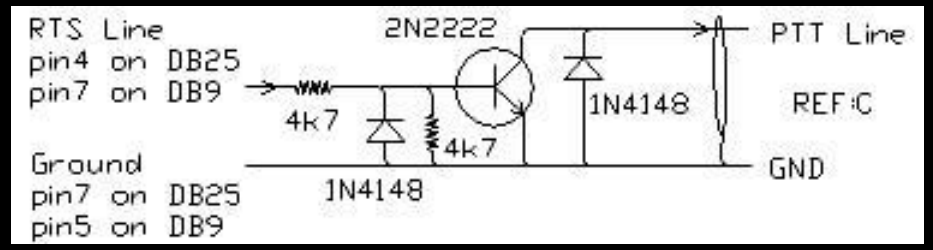
Revised and improved…..

ROLL YOUR OWN INTERFACE

Audio connections with ground isolation and level conversion (attenuation)

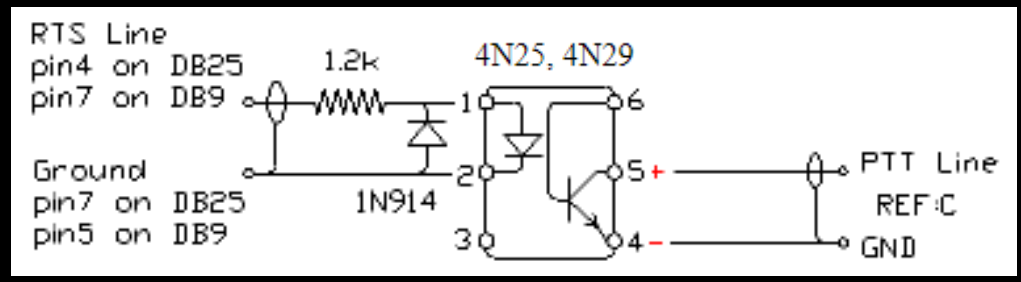


Simple PTT signal derived from the serial (COM) port

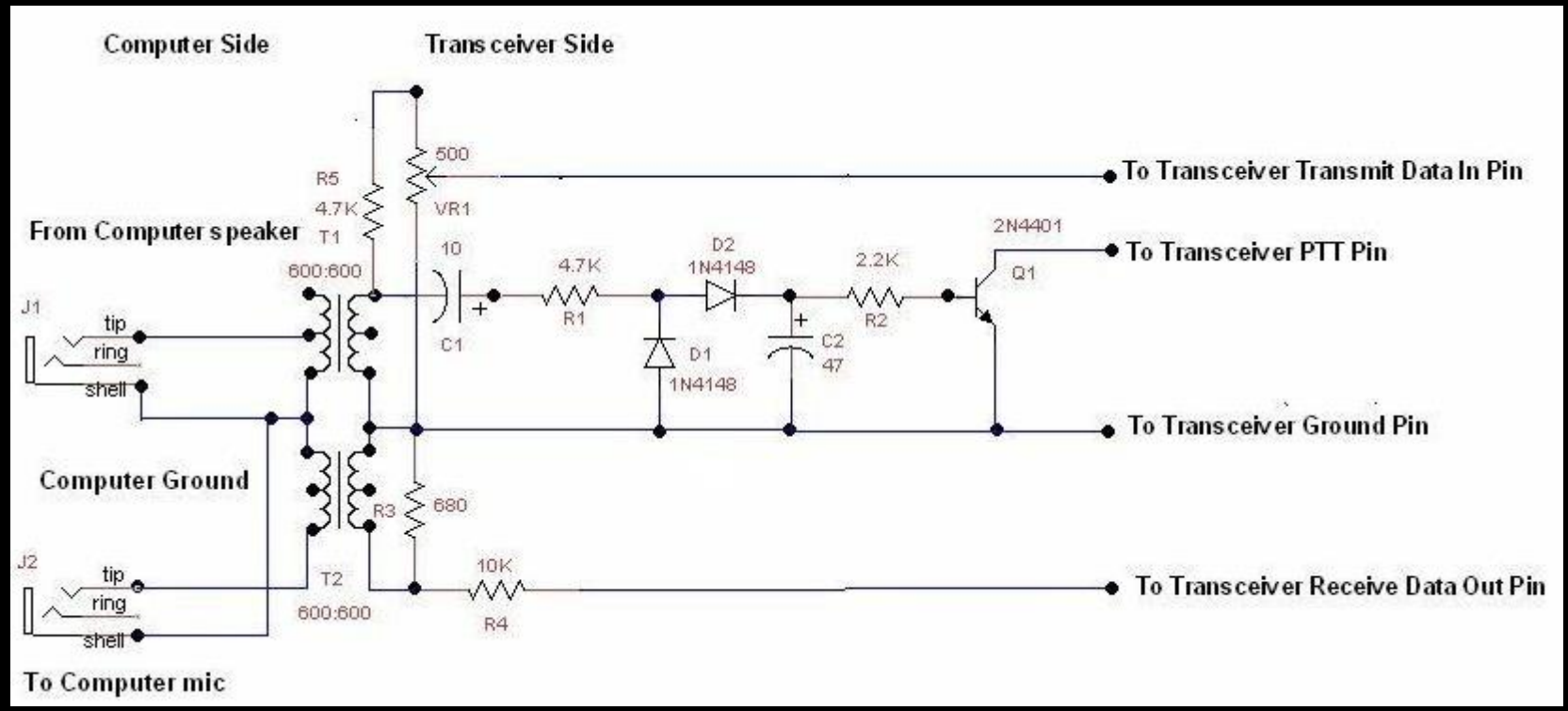


ROLL YOUR OWN INTERFACE

PTT alternative using COM Port with ground isolation via opto isolator



Alternative interface using VOX for PTT and ground isolation



ROLL YOUR OWN INTERFACE

The previous designs make use of the computer's built-in sound card, this may not be the best option:

- On low end computers, the built-in sound card is often low quality, or suffers from noise from other components on the system board
- The built-in sound card will also be used for other system sounds which may interfere with digital operations
- Many interfaces make use of a dedicated USB sound card, these work well for digital operations

ROLL YOUR OWN INTERFACE

"AllStar" DIY interfaces abound on the Internet, these can make excellent digital interfaces

- Ground isolation may sound like a good idea, but is generally no longer needed and can actually create problems
- Most AllStar interfaces do not have "galvanic isolation" (transformers), and therefore tend to have more audio bandwidth
- "AllStar" interfaces make use of the GPIO pins on the audio codec chip for PTT (appears as an HID)

ROLL YOUR OWN INTERFACE

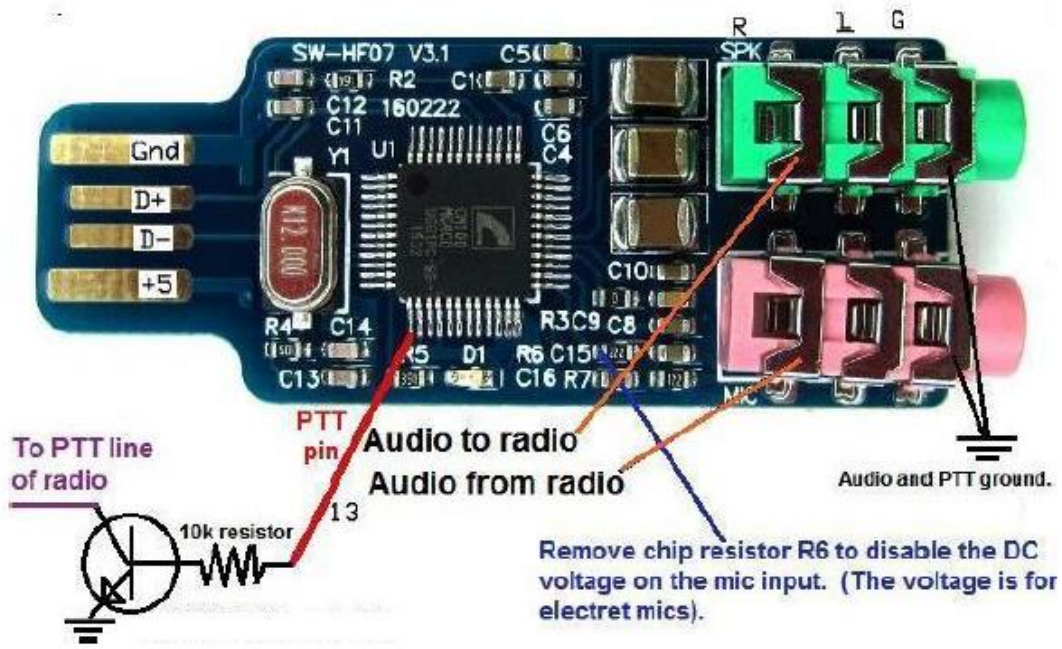
One of many articles available on the Internet on how to use a "AllStar" type interface for digital operations.

Set-up the CM108 PTT with the CAT7200 utility on Windows Bob Klaus N0YWB

This document describes how to make Windows (XP, 7, 8, and 10; 32-bit or 64-bit) support the PTT (Push To Talk) radio keying using a C-media CM108 or CM119 USB sound interface.

There is nothing new in this article. This is a summary of previous work by several developers, most notably John Wiseman, G8BPQ; Jose Alberto Nieto Ros, EA5HVK; and Scott Currie NS7C. For more detail from these authors, please read the references at the end. There are hyperlinks to the references throughout this article.

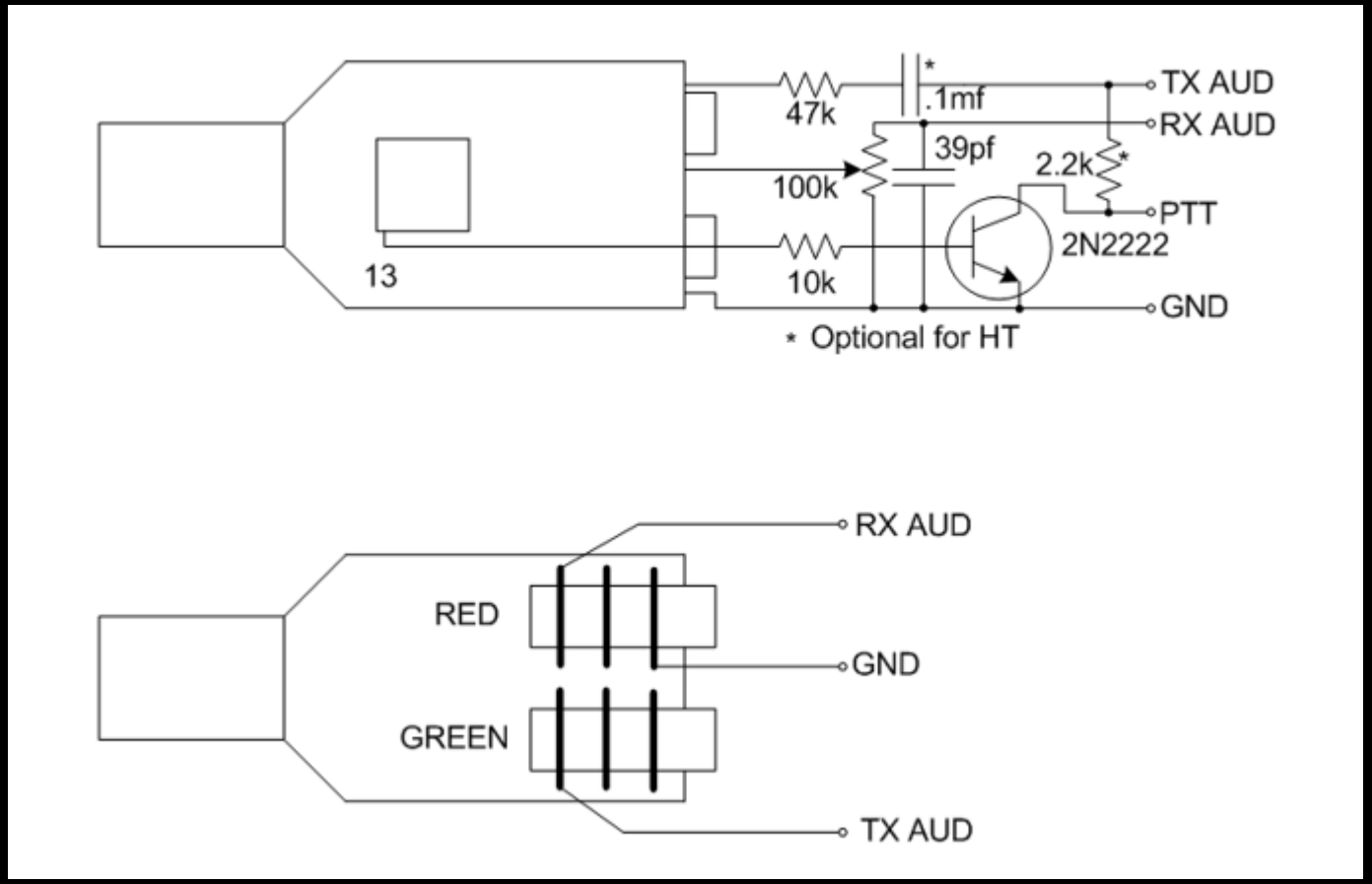
The CM108 or CM119 USB sound interface integrated circuit (IC) is used inside the DMK URIx, RIM-Lite V2, DRA series and other USB radio sound interfaces. You can build a low cost functional equivalent from an inexpensive CM108 or CM119 USB sound fob that performs as well as a SignaLink or RigBlaster USB interface.



NS7C DIY INTERFACE

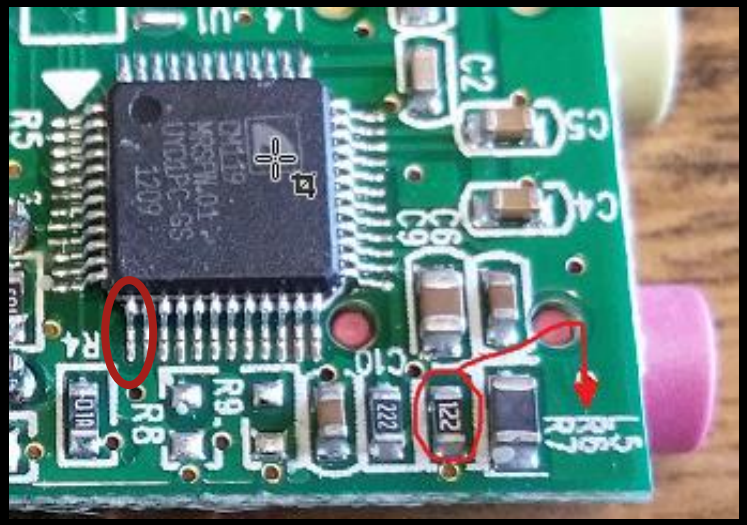
- Based on the C-Media audio FOB (uses the C-Media CM119A audio codec chip
- Modifications to the board and additional external circuitry for signal buffering and PTT
- Minimal parts count, but does require good soldering skills

NS7C DIY INTERFACE



NS7C DIY INTERFACE

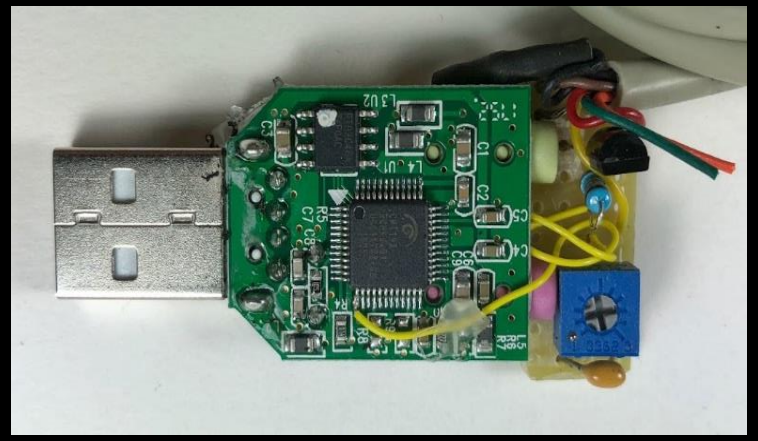
Removal of the mic bias resistor, and also location of the GPIO pin used for PTT control (typically GPIO 3)



NS7C DIY INTERFACE

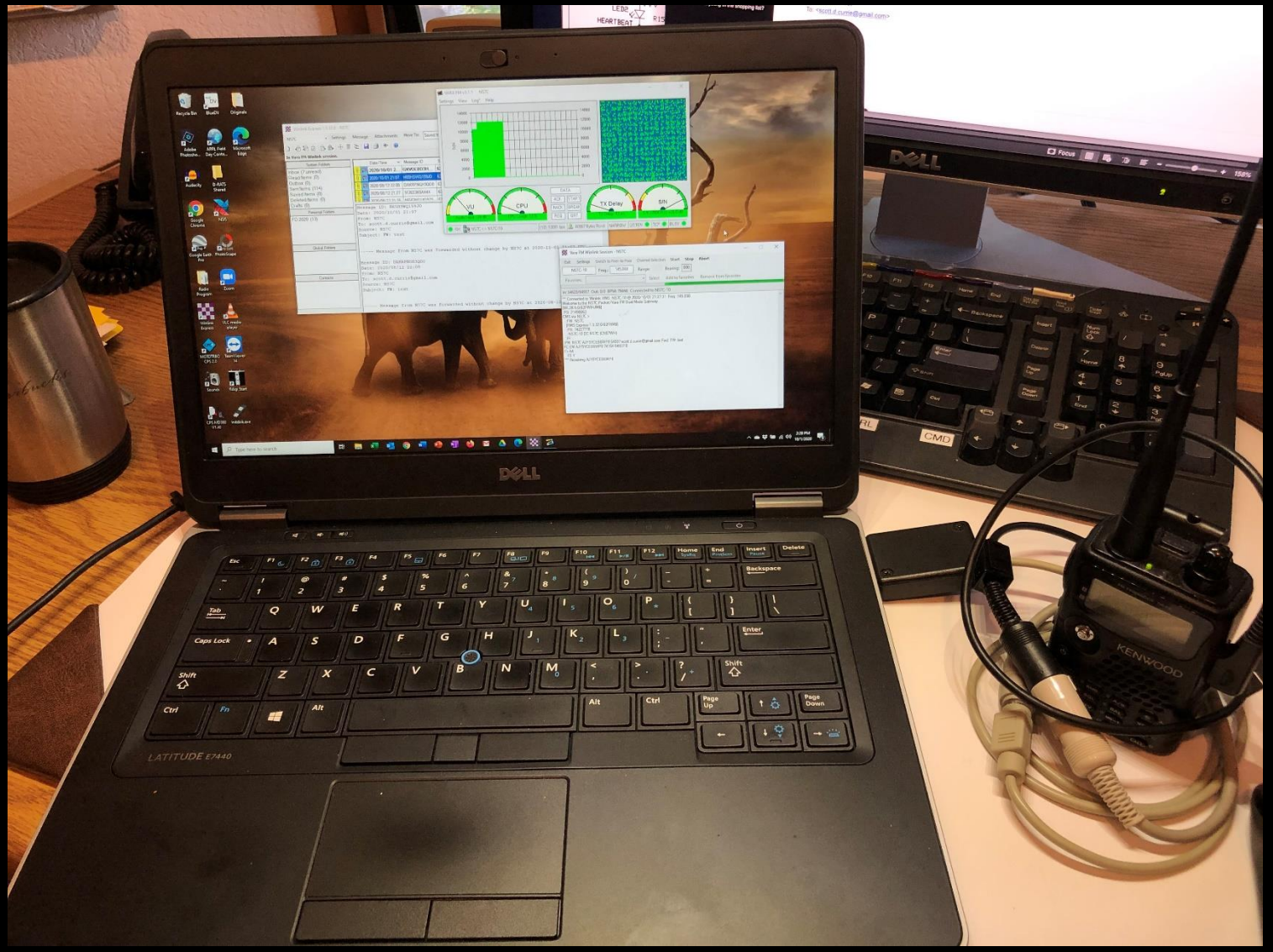
Layout of components is not critical, make use of component leads to complete the circuits

Note the addition of the #30 wire to pin 13 of the codec chip for PTT, this requires a steady hand and good eyes!

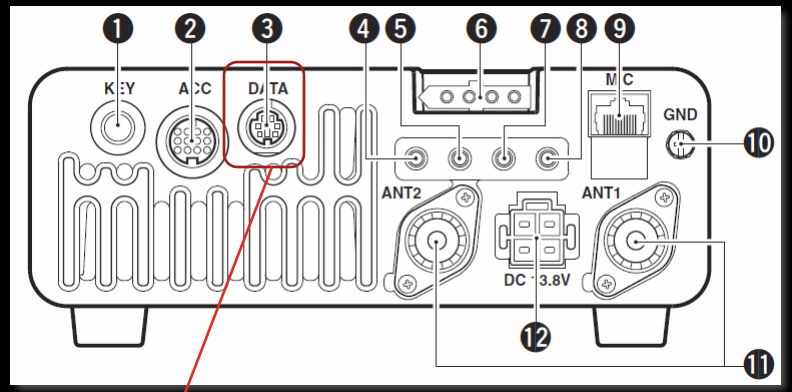


NS7C DIY INTERFACE

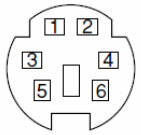
The interface in action with Vara FM Narrow, Level 10.

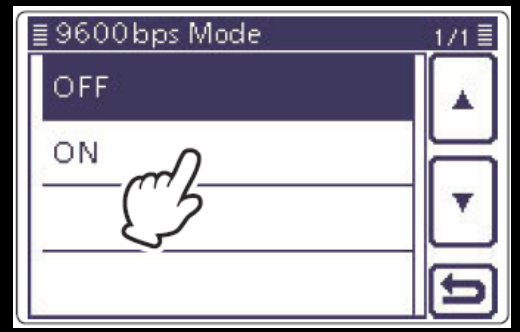


HARDWARE CONNECTIONS



- Data Jack, poor name, but standard
- ACC jack varies by manufacturer
- 1200/9600bps doesn't really mean that
- CI-V, Cat varies by manufacturer
- Switching between 1200 and 9600 operation also requires rig menu changes

DATA	PIN No.	NAME	DESCRIPTION
 Rear panel view	1	DATA IN	Input terminal for data transmit. (1200 bps: AFSK/9600 bps: G3RUH, GMSK)
	2	GND	Common ground for DATA IN, DATA OUT and AF OUT.
	3	PTT P	PTT terminal for packet operation. Connect to ground to activate the transmitter. When grounded, microphone input (pin 6) of [MIC] connector will be disconnected.
	4	DATA OUT	Data out terminal for 9600 bps operation only.
	5	AF OUT	Data out terminal for 1200 bps operation only.
	6	SQL	Squelch out terminal. This pin is grounded when the transceiver receives a signal which opens the squelch. •To avoid interfering transmissions, connect squelch to the TNC to inhibit transmission when squelch is open. •Keep RF gain at a normal level, otherwise a "SQL" signal will not be output.

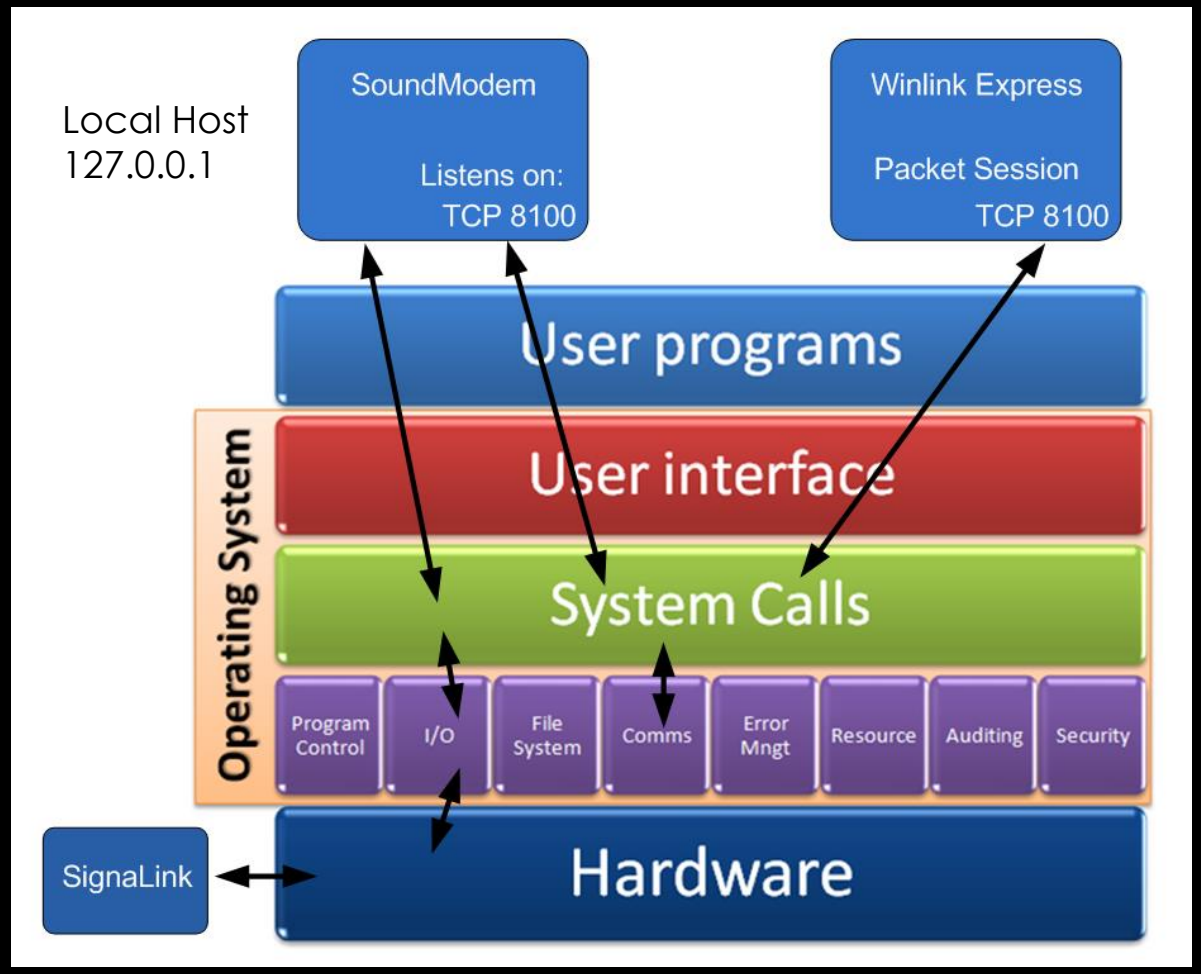


HARDWARE CONNECTIONS

Data Jack (6-Pin DIN connector) explained:

- Used for analog signals, not true digital data
- Not really related to 1200 or 9600 bps data speed
- "1200" connections go through the regular "voice" path in the radio, including pre/de-emphasis and CTCSS filter. Audio Bandwidth is limited to about 3kHz
- "9600" connections go direct to the modulator and discriminator. Greater audio bandwidth is possible, maybe up to 6kHz (in theory)
- Pin assignments are standard between manufacturers; however, impedance and voltage levels are not! Some manufacturers do not even document what signals are expected or provided at this jack

SOFTWARE CONNECTIONS



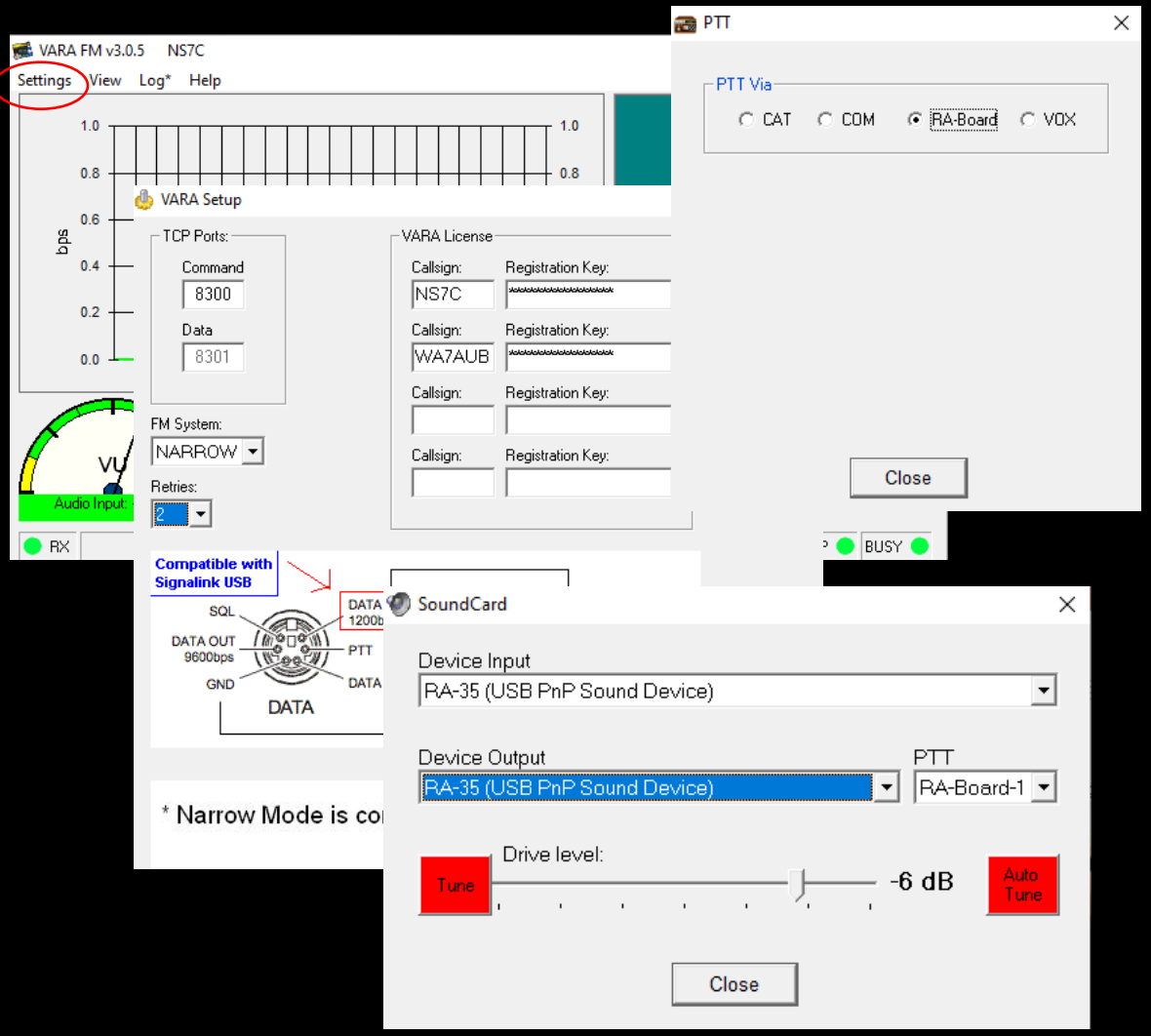
Programs communicate using the OS (Windows) network stack via TCP addresses and ports.

Communication stays within the system (local host) and does not go out on the LAN or the Internet.

Port numbers must match and must not conflict with other running programs.

SOFTWARE SETUP

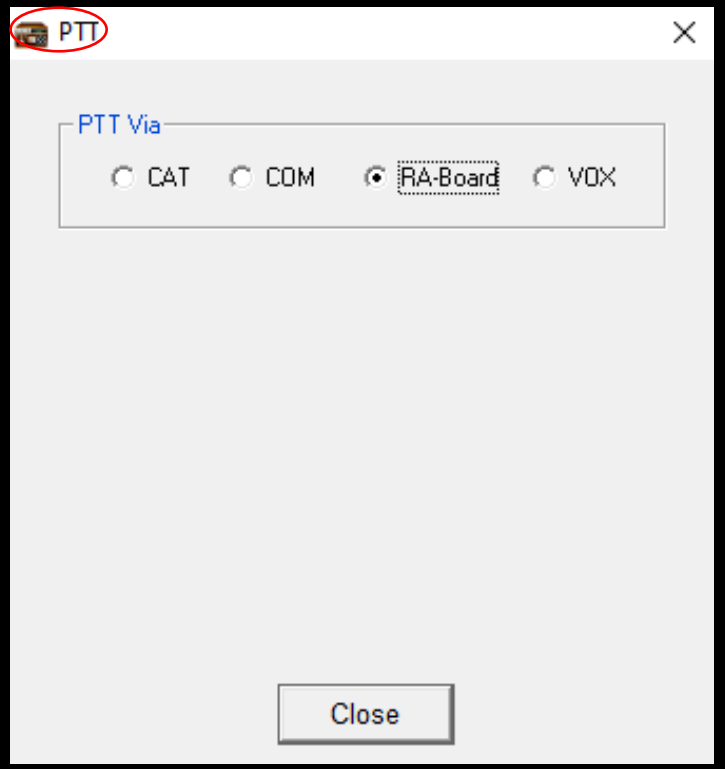
VARA FM V/UHF



On the Vara FM modem, select Settings and Vara setup. Like Vara HF, check the TCP ports, and enter the registration key. TX Delay is now automatic. Select settings then Sound Card and select the sound card interface input and output, click on Tune and adjust the drive as needed.
Select Settings, PTT and select the appropriate method for your configuration.

SOFTWARE SETUP

VARA FM V/UHF



There are multiple options for PTT control on Vara FM:

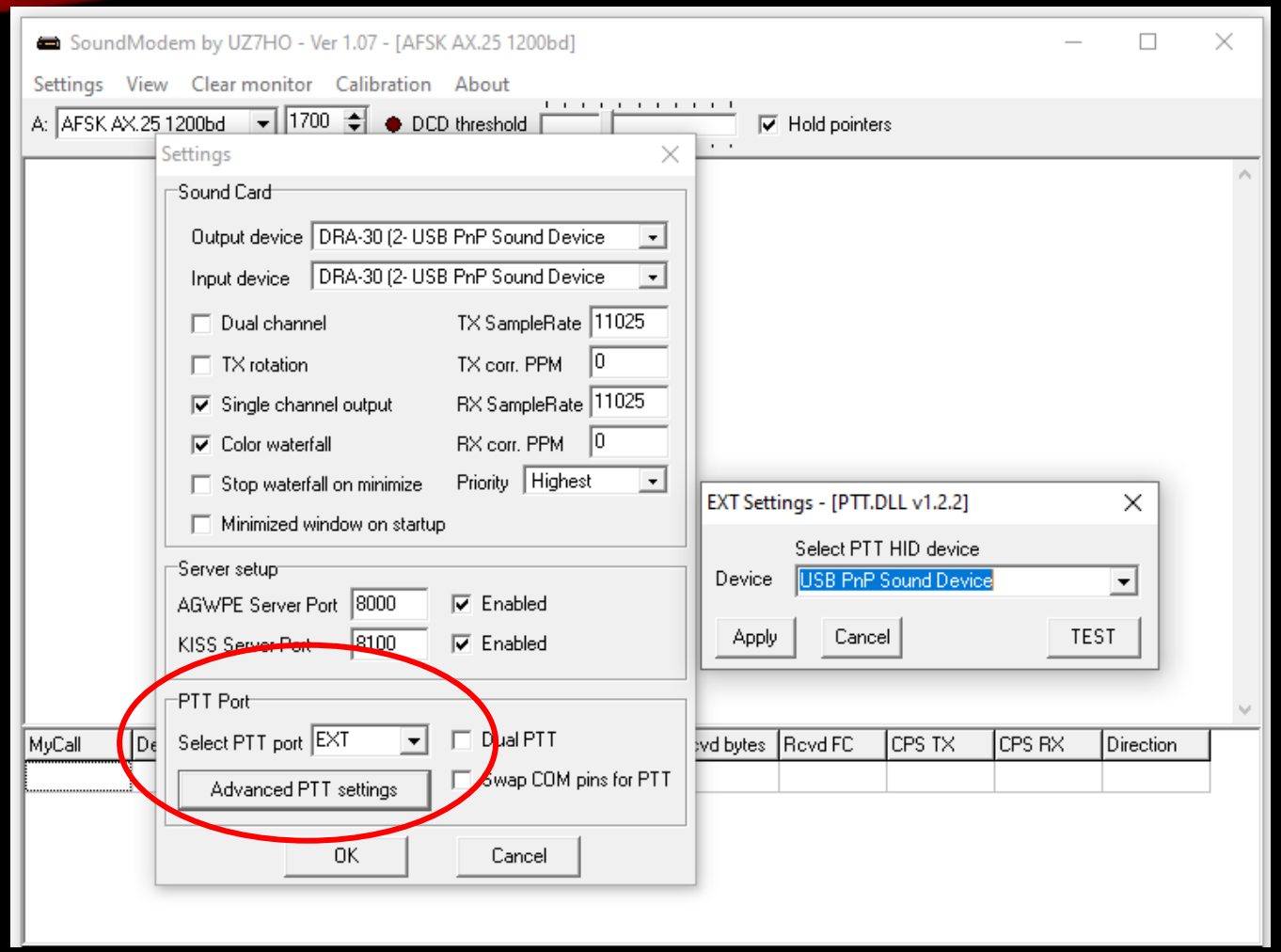
CAT-Use this option if you have a multimode transceiver that supports CAT or CI-V control

COM-Use this option if you have a sound card interface that creates a COM port that will be used to activate PTT by toggling a control line (usually RTS)

RA-Board-Use this option if are using a device like the DRA or other C-Media based sound card interface

VOX-Use this option for VOX devices like Signalink

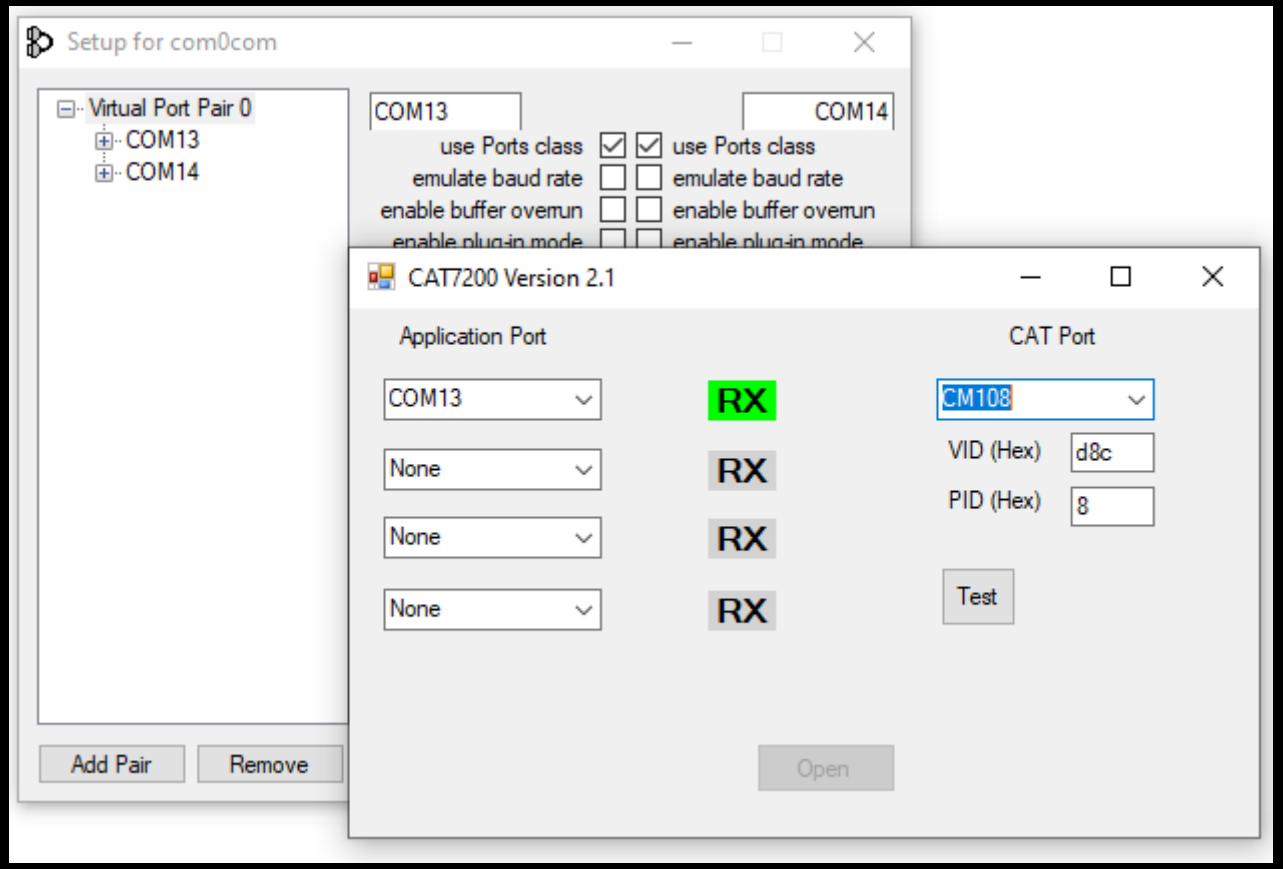
SOFTWARE SETUP
UZ7HO SOUNDMODEM V/UHF



PTT selection on Soundmodem (Packet operations) can be set to use COM ports (RTS line), CAT commands (rigs with built-in sound cards), or External devices like "AllStar" interfaces that use a GPIO pin on the audio codec

SOFTWARE SETUP

CAT7200



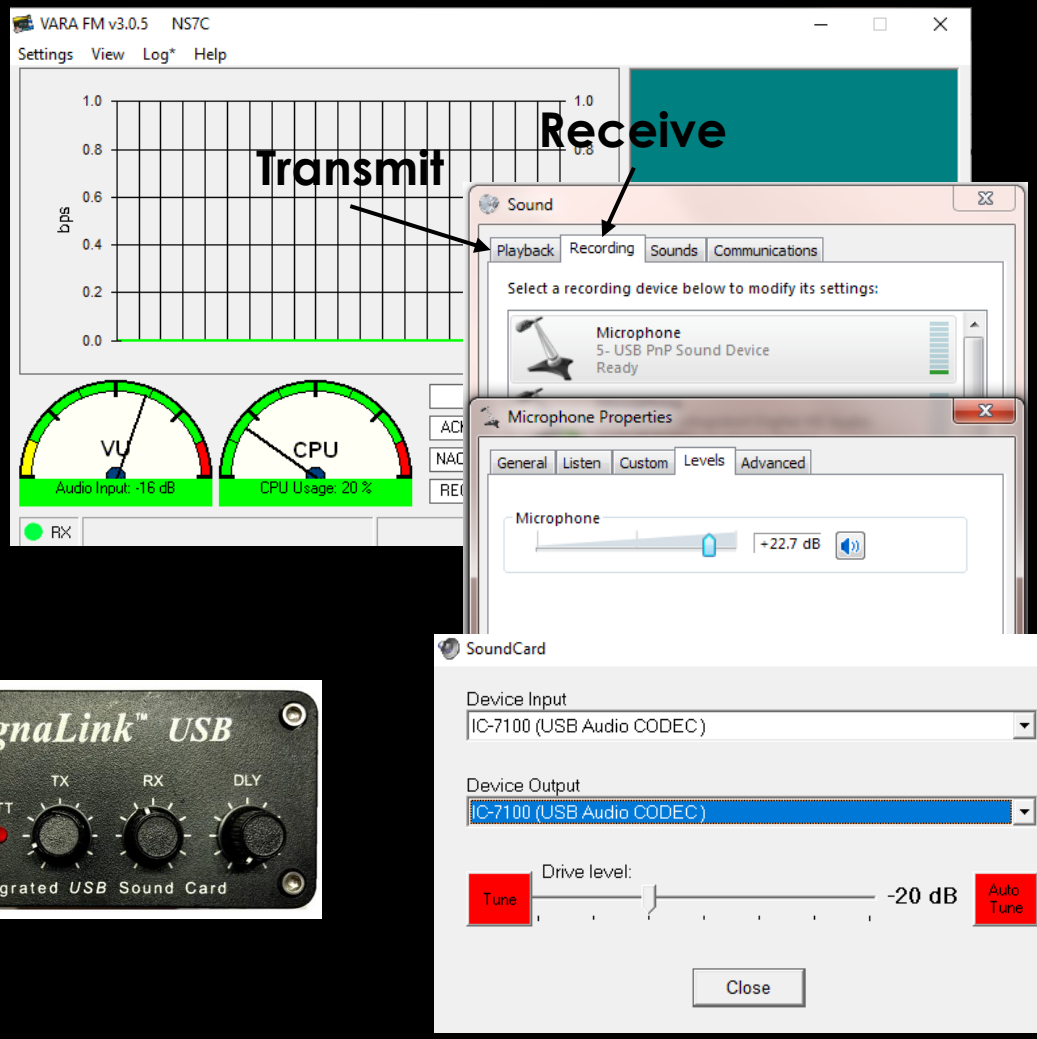
For applications that do not natively support control of C-Media GPIO pins, CAT7200 v2.1 (and the HID library) and com0com can provide a virtual COM port that applications can use. CAT7200 monitors this VCP and will then send commands to the C-Media device to activate PTT.

https://www.cantab.net/users/john.wiseman/Downloads/Beta/

https://sourceforge.net/projects/com0com/

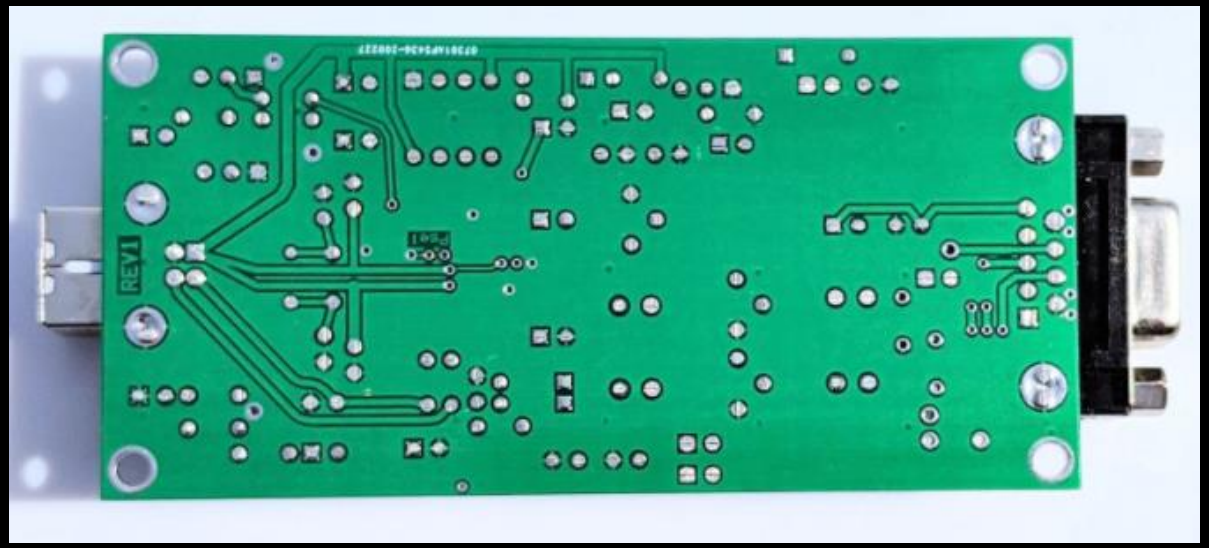
SOFTWARE SETUP

TX/RX LEVELS



Transmit and receive level control can be set with the Windows Sound Controls, application levels, controls found on the device (Signalink), internal POTS (DRA devices), or rig menus (transceivers with built-in sound cards)

IS IT REALLY WORTH THE TROUBLE?

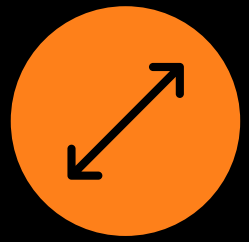


Building a device from scratch may enhance your technical skills, reduce cost, and impart a certain sense of satisfaction, but is it worth it? Will you end up with a reliable device for sending emergency communications during a disaster response?

Maybe a kit of proven design, built from quality parts on a quality circuit board, may be the better option, and will still provide the "I built it myself" satisfaction.

"The three great essentials to achieve anything worthwhile are, first, hard work; second, stick-to-itiveness; third, common sense."
— Thomas A. Edison

CONCLUSION



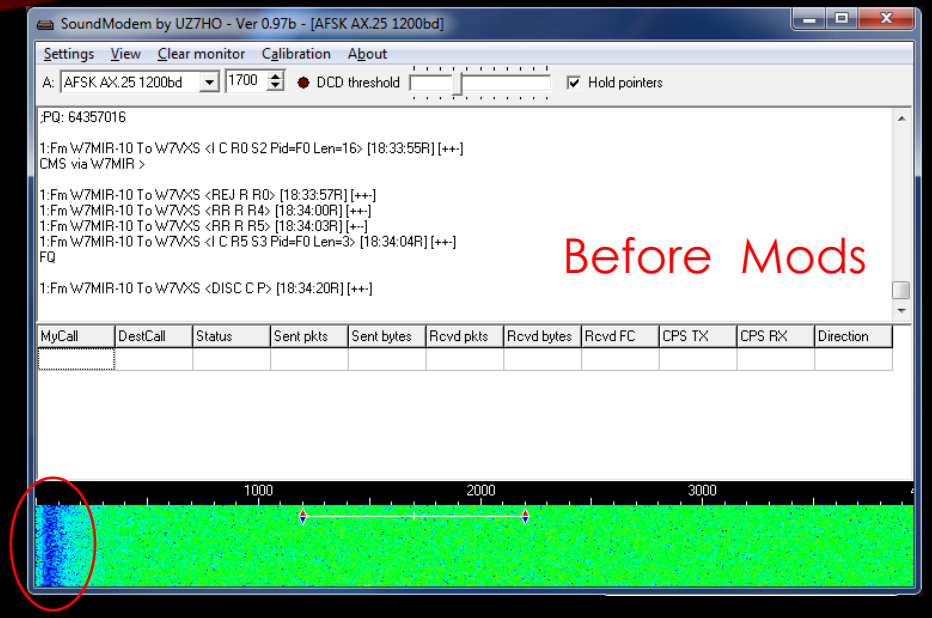
WINLINK USE CONTINUES TO GROW, ESPECIALLY FOR EMCOMM USE

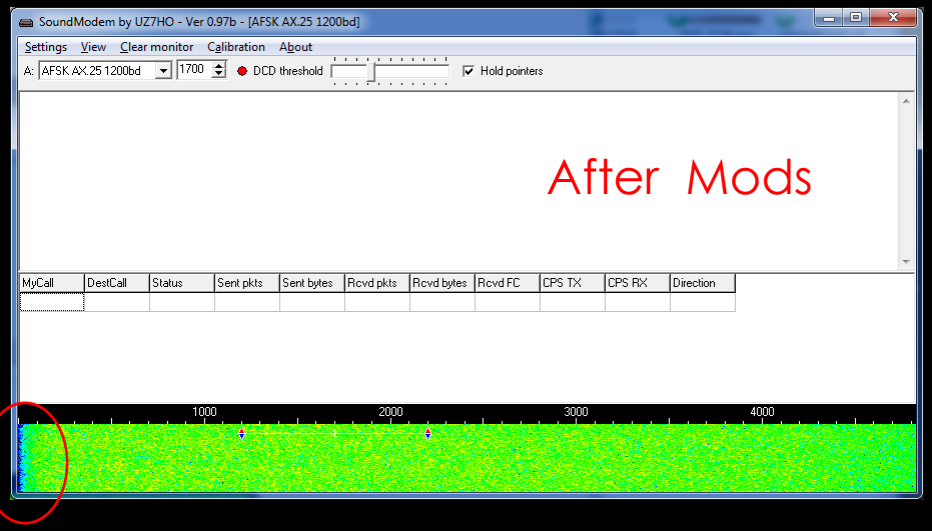
THE WINLINK DEVELOPMENT TEAM CONTINUES TO ENHANCE CAPABILITIES TO ADAPT TO CHANGING NEEDS

STEADY IMPROVEMENTS ARE BEING IMPLEMENTED

SOUND CARD INTERFACES AND MODES PROVIDE LOW COST AND HIGH PERFORMANCE SOLUTIONS TO DATA TRANSFER OVER RF

BONUS





Signalink Modifications to improve performance:

- New Transformers
- Change OpAmp BIAS
- Filter USB power bus
- Fix power switch

http://www.frenning.dk/OZ1PIF_HOMEPAGE/SignaLinkUSB-mods.html

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