

Vara FM Digital on Winlink Express



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.
- GPS location information and mapping.
- 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, Vara HF, Vara FM)
- Less expensive hardware options, may be built-in to radio
- 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.)

SOUND CARD OPERATION

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 computer
- 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

SOUND CARD OPERATION

WINLINK EXPRESS SOUND CARD MODES

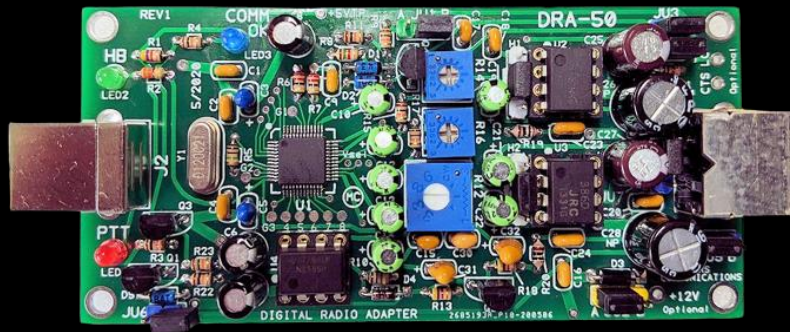
Mode	Speed	Application
ARDOP (HF)	Up to 4000bps	Included
Vara (HF)	Up to 7,000bps	External
Packet (V/UHF)	1200/9600bps ¹	External
Vara FM (V/UHF)	Up to 25,210bps	External

- The ARDOP modem was developed by the WDT and is included with Winlink Express
- Vara and Packet modes are provided by external modem 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

SOUND CARD INTERFACE

- Simple device powered by USB connection.
- Cost is between \$50-\$150 depending on features.
- Radio needs to have a "data" (analog) port or use the microphone and speaker connections for lower speed.
- Some modes need to run an external modem application like Direwolf or UZ7HO soundmodem (for packet) or Vara FM.



SOUND CARD INTERFACE OPTIONS



RIM Lite

Various interfaces designed around USB codec chips (C-Media or others). May be kits, pre-built, or DIY. Many “AllStar Link” interfaces are available and will likely work fine for digital modes.



Masters Communications DRA-50



IC-7100 with built-in sound card

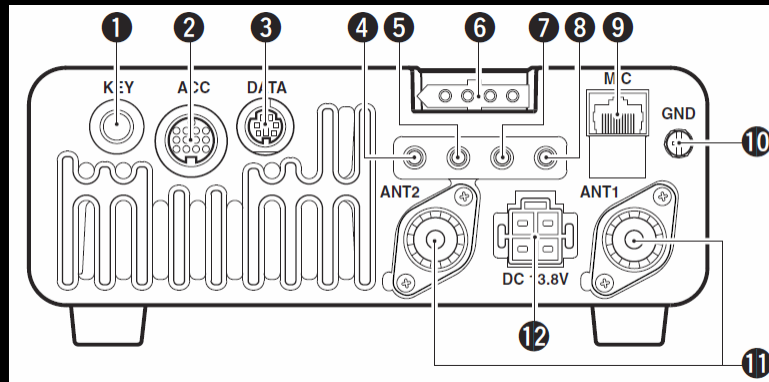
RESOURCES NEEDED FOR WINLINK EXPRESS

V/UHF Packet/Vara FM

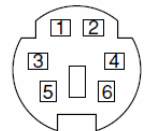
- Windows computer, Windows 10+
- Winlink Express
- V/UHF radio with "data" (analog) port or speaker and mic jack
- USB soundcard interface or radio with built-in sound card
- Appropriate cables to connect interface to radio
- External application, Soundmodem, Direwolf, Vara FM
- All software is free (except Vara), but donation is suggested

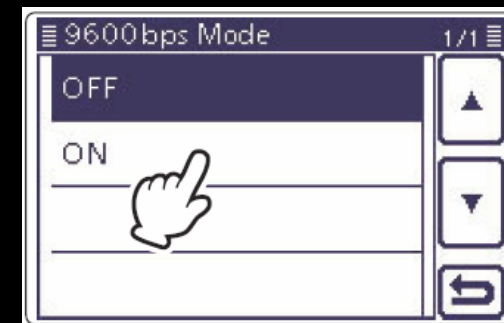
Vara registration is \$69/call sign or \$50/call sign for groups of 10 or more

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 menu changes

DATA	PIN No.	NAME	DESCRIPTION
 <p>Rear panel view</p>	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. <ul style="list-style-type: none"> •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.



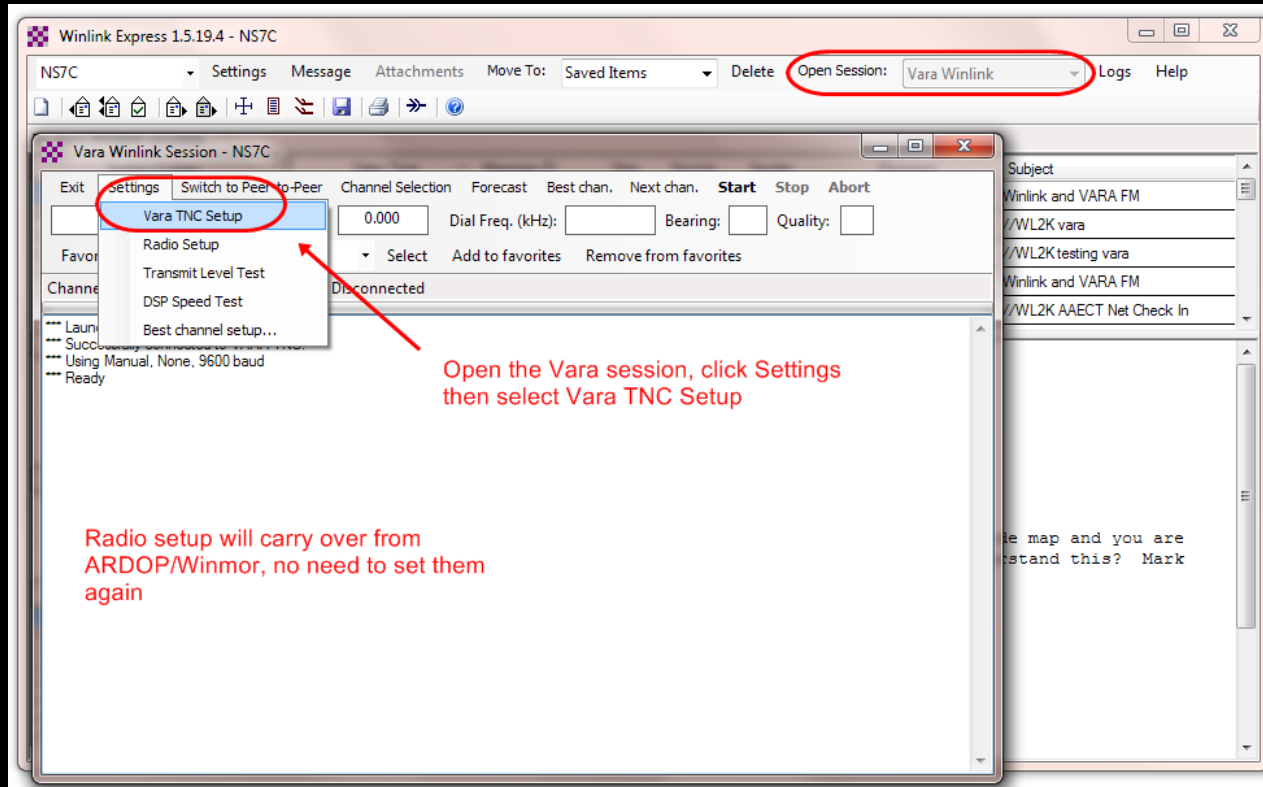
HARDWARE CONNECTIONS

Data Jack (6-Pin DIN connector) explained:

- Used for analog signals, not really digital signals
- Not really related to 1200 or 9600 bps data rate
- “1200” connections go through the regular “voice” path in the radio, including pre/de-emphasis. Audio frequency bandwidth is typically filtered to about 3kHz (voice frequencies).
- “9600” connections go direct to the modulator and discriminator. Greater audio bandwidth is possible, maybe up to 6kHz.
- Pin assignments are standardized; however, impedance and voltage levels are not! Some manufacturers do not even document what is expected at this jack.

SOFTWARE SETUP

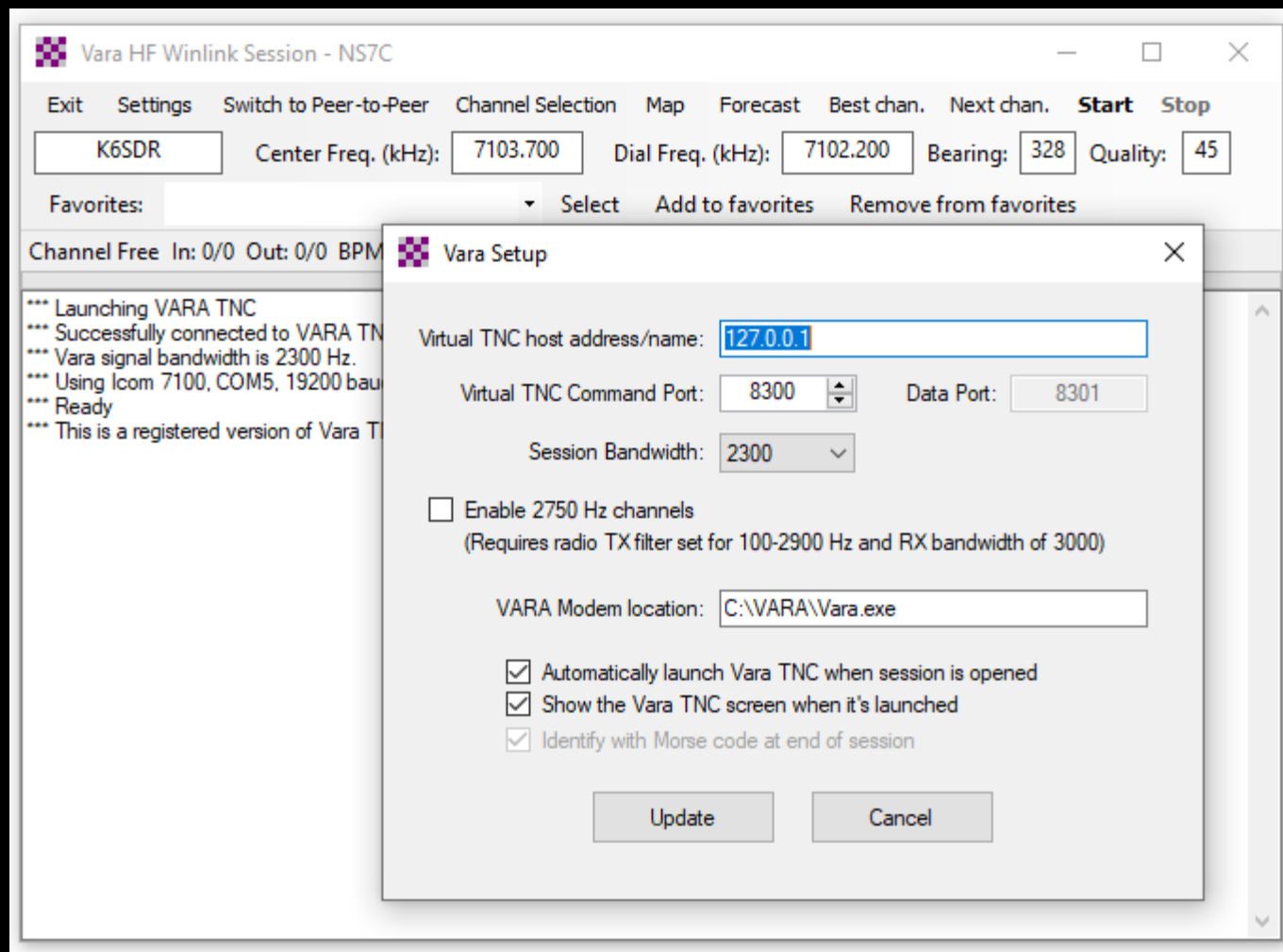
VARA HF



Open a Vara session, then select Settings and Vara TNC Setup. If Vara is not found on the computer in the default location, you will be given a link to the download page for Vara. The radio setup will carry over from ARDOP if you have already setup that session.

SOFTWARE SETUP

VARA HF



Again, accept the defaults of local host and port 8300/8301 unless you need to make a change. Select the default session bandwidth (usually 2300) and check the boxes to launch the modem automatically and start it non-minimized.

SOFTWARE SETUP

VARA HF

The image shows the VARA HF v4.6.1 software interface. The main window displays a graph of bps (bits per second) over time, with a scale from 0.0 to 1.0. Below the graph are two circular gauges: VU (Audio Input: -12 dBFS) and CPU (CPU Usage: 19%). There are also buttons for DATA, ACK, IDLE, NACK, BREAK, REQ, and QRT. The status bar at the bottom shows a green dot for RX and the text "Disconnected".

The VARA Setup dialog box is open, showing the following settings:

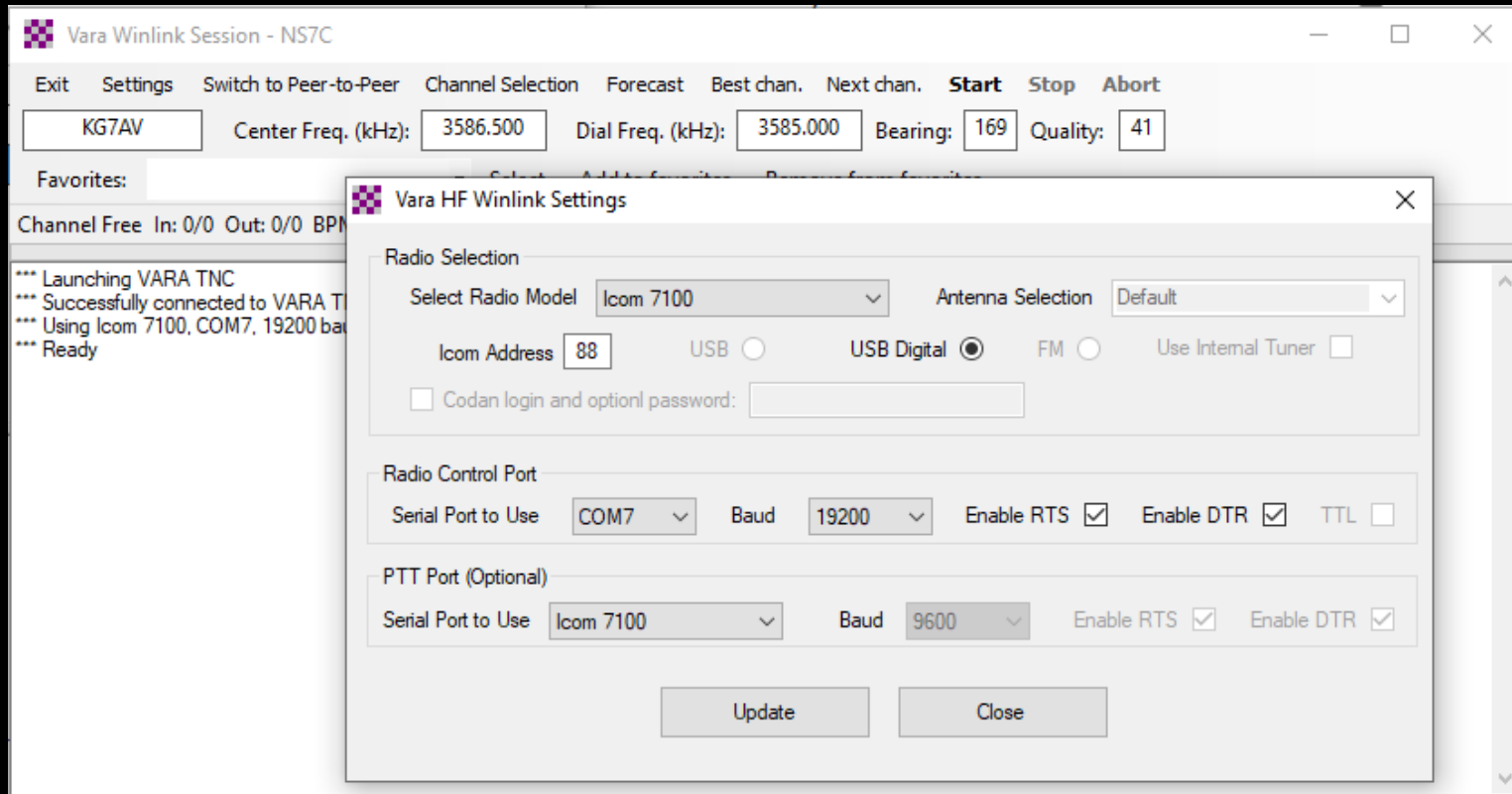
- TCP Ports: Command 8300, Data 8301
- VARA Licenses: Callsign: NS7C, Registration Key: [masked]
- Callsign: [empty], Registration Key: [empty]
- Callsign: [empty], Registration Key: [empty]
- Callsign: [empty], Registration Key: [empty]
- Callsign: [empty], Registration Key: [empty]
- Allow VARA check for updates via internet
- Accept 500 Hz connections
- Tuner enhancement
- CW ID
- KISS Interface
- RA-Board PTT
- SysLog
- Retries: 15

Close

Bring up the Vara TNC, select settings and Vara Setup. Make sure the ports match the Winlink Session. Add your registration key and set retries to at least 5. If you are using a C-Media based sound card interface, select the RA-Board PTT option.

SOFTWARE SETUP

VARA HF



Adjust your radio selections to match your HF Rig Settings (CAT/CI-V). There are different options for PTT depending on what your rig supports.

SOFTWARE SETUP

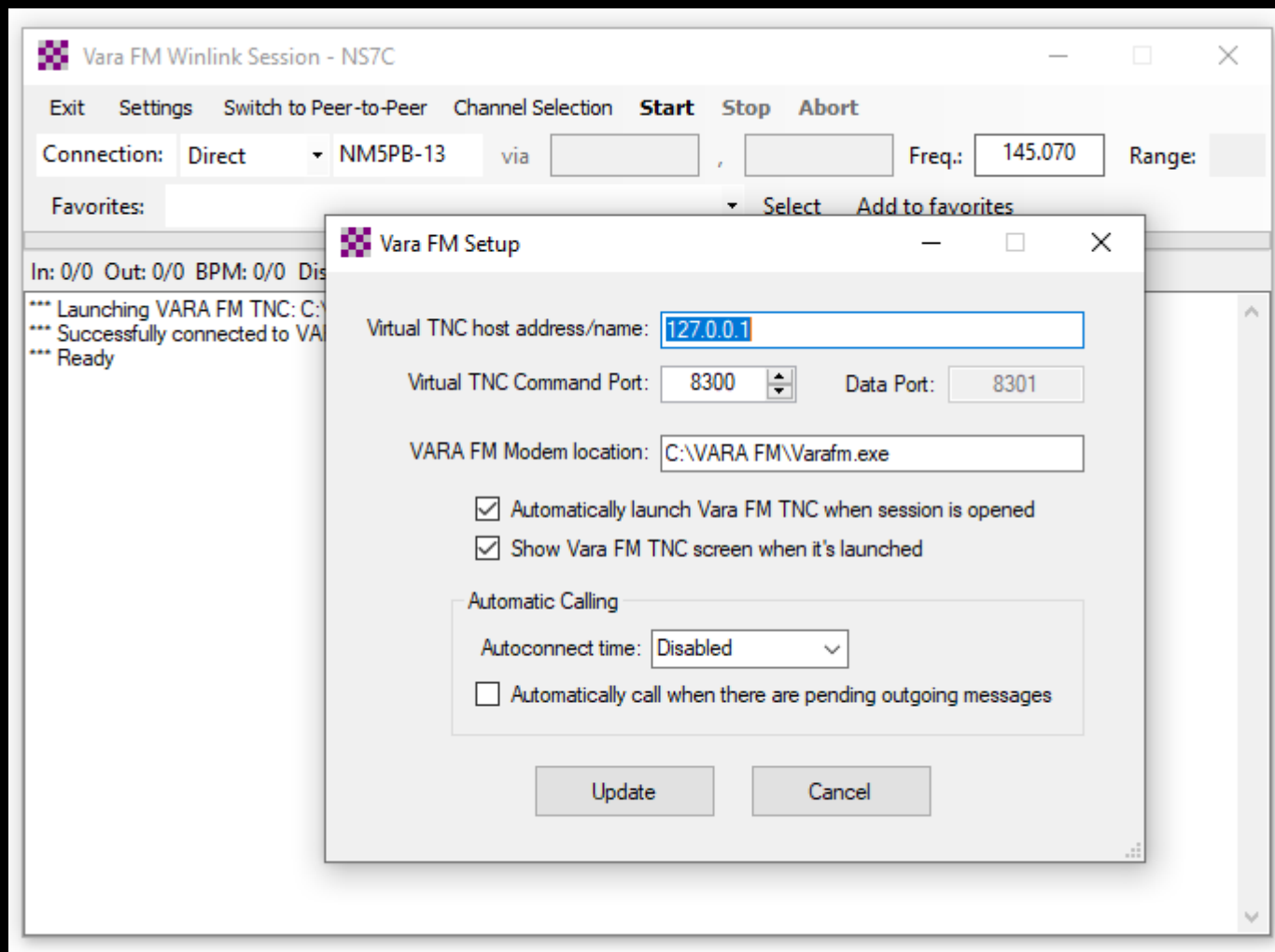
VARA HF

The screenshot displays the VARA HF v4.6.1 software interface. The top window shows the 'SoundCard' settings, where 'Device Input' and 'Device Output' are both set to '7100RX (USB Audio CODEC)'. The 'Drive level' is set to -4 dB, and a red 'Tune' button is visible. A tip below the slider reads: 'Press Tune and set the Drive Level for ALC=1/3'. The bottom window shows the main monitoring interface with a frequency display of 14.067.00 MHz. The ALC meter is highlighted with a red box and an arrow pointing to the '1/3 ALC' mark. Other meters include VU (Audio Input: -7 dBFS), CPU (Usage: 22%), P.AMP1, AGC-F, AN, NB, COMP, SWR, Id, V_o, and TEMP.

Select settings again, then Sound Card. Here you will select the sound card interface, and check/adjust the drive level. Note the tip on adjusting drive for about 1/3 scale on the ALC meter.

SOFTWARE SETUP

VARA FM V/UHF



Open a Vara FM session and select Settings. If Vara FM is not found on the computer in the default location, you will be given a link to the download page for Vara FM. Check the host and port settings. Select the ports and start options similar to Vara HF.

SOFTWARE SETUP

VARA FM V/UHF

The screenshot displays the VARA FM v4.2.3 software interface. The main window shows a menu bar with 'Settings' circled in red. Below the menu is a graph showing signal strength in bps, and two VU meters for 'Audio Input: -14 dBFS' and 'CPU'. The 'VARA Setup' window is open, showing 'TCP Ports' (Command: 8300, Data: 8301), 'FM System' (NARROW), 'Digipeater' (NS7C-1), and 'Retries' (3). The 'VARA Licenses' window shows 'Callsign: NS7C' and a registration key. The 'SoundCard' window shows 'Device Input: DRA RX (USB PnP Sound Device)' and 'Device Output: DRA TX (USB PnP Sound Device)'. The 'PTT' window shows 'PTT Via' set to 'RA-Board'. The 'Speakers Properties' window shows 'Speakers' set to 100. The 'DRA-30 Properties' window shows 'AGC' set to 'Must not be checked'.

Compatible with Signalink USB

SQL
DATA OUT 9600bps
DATA
DATA OUT 1200bps
PTT
DATA IN

* VARA FM WIDE needs a FM rig set for use with a special soundcard interface (6 kbps panel: RA-Board, Signalink "Black" transformer (red audio transformers removed), home direct cable)...

* In other case, you must select VARA I

On the Vara FM modem, select Settings and Vara setup. Like Vara HF, check the TCP ports, and enter the call sign and registration key. 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 then PTT and select the PTT option based on your radio and sound card interface. Also note the information about AGC and levels.

SOFTWARE SETUP

VARA FM V/UHF

VARA Setup

TCP Ports:
Command: 8300
Data: 8301

FM System: **NARROW**
Digipeater: NS7C-1
Retries: 3
 Allow VARA check for updates
 KISS interface SysLog

VARA Licenses:
Callsign: Registration Key:
NS7C
Callsign: Registration Key:
N6APR
Callsign: Registration Key:
Callsign: Registration Key:

Compatible with Signalink USB

SQL
DATA OUT 9600bps
GND
DATA
DATA IN
PTT
DATA OUT 1200bps
to PC input
from PC output

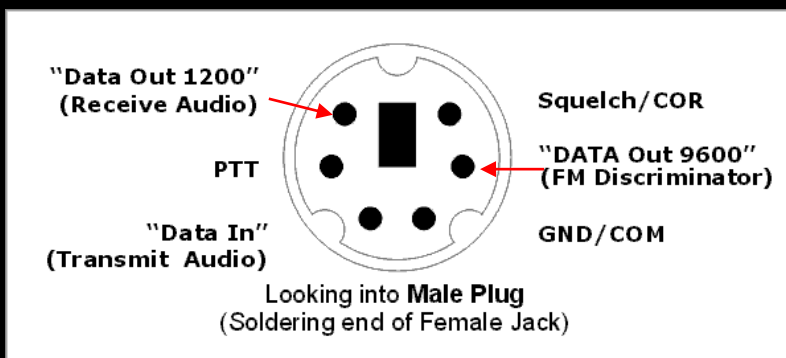
* VARA FM WIDE needs a FM rig set for 9600 Packet operation, with a special soundcard interface (6 kHz BW) connected to rear panel: RA-Board, Signalink "Black" transforms, Modified Signalink (red audio transforms removed), homebrew interface (a simple direct cable)...

* In other case, you must select VARA FM NARROW

Close

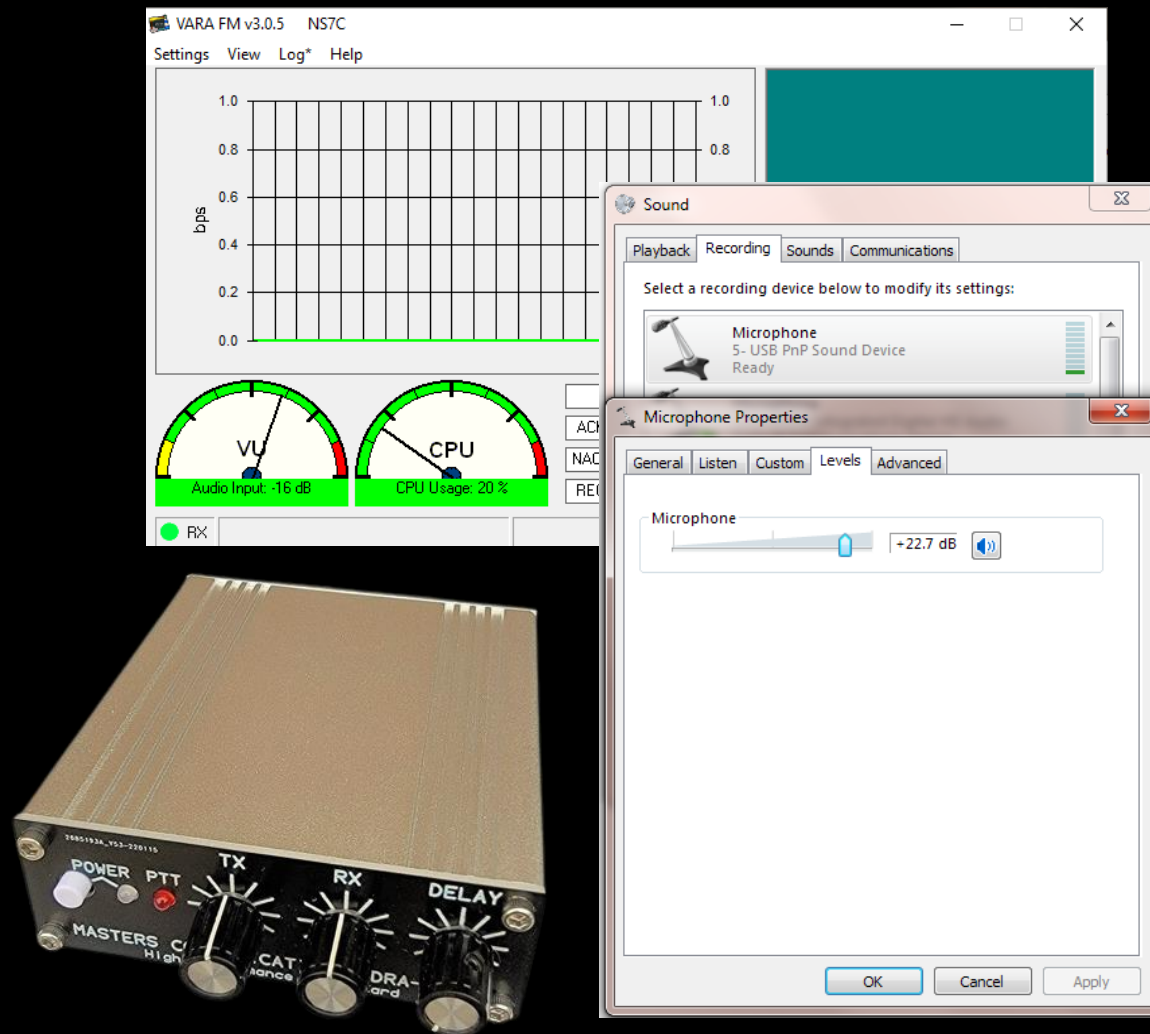
Vara FM has two speed modes that are selectable within Winlink Express. Narrow mode can be used with limited bandwidth radio connections like speaker and microphone, or the "1200" pins on the data connector. Wide mode requires more audio bandwidth and must use the "9600" connection on the data connector. 9600 mode will also need to be set in the radio menus. The speed mode can be set in the setup menu, on the session screen, and also in the channel selector. Stations that are set for Wide mode can connect to Narrow stations. The mode is adjusted automatically.

Top speed on Narrow is 12,098bps
Top speed on Wide is 25,210bps



SOFTWARE SETUP

VARA FM V/UHF



The Vara FM input level should be in the 50-75% range on the VU meter. Transmit audio should be 2.5kHz (much more drive is needed for Wide connections). Adjust the TX and RX levels on the sound card interface controls, and/or the Windows mixer to achieve these levels. Some experimenting will be needed to achieve top performance. The built-in "Autotune" function will adjust the TX level automatically against a destination station. Document these settings for future reference or for resetting them after changing modes.

SOFTWARE SETUP

VARA FM V/UHF

The screenshot displays the VARA FM v4.2.3 software interface. A 'Drive Level Calibration' dialog box is open, showing the following results:

- Drive Level: +0 dB
- S/N: +13.9 dB
- VU: -25 dB

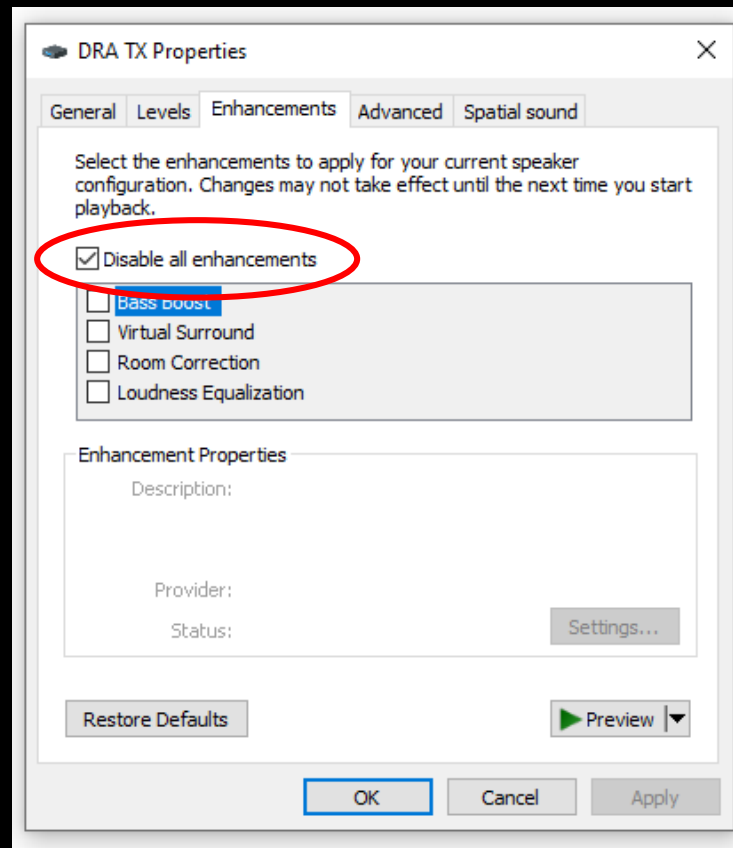
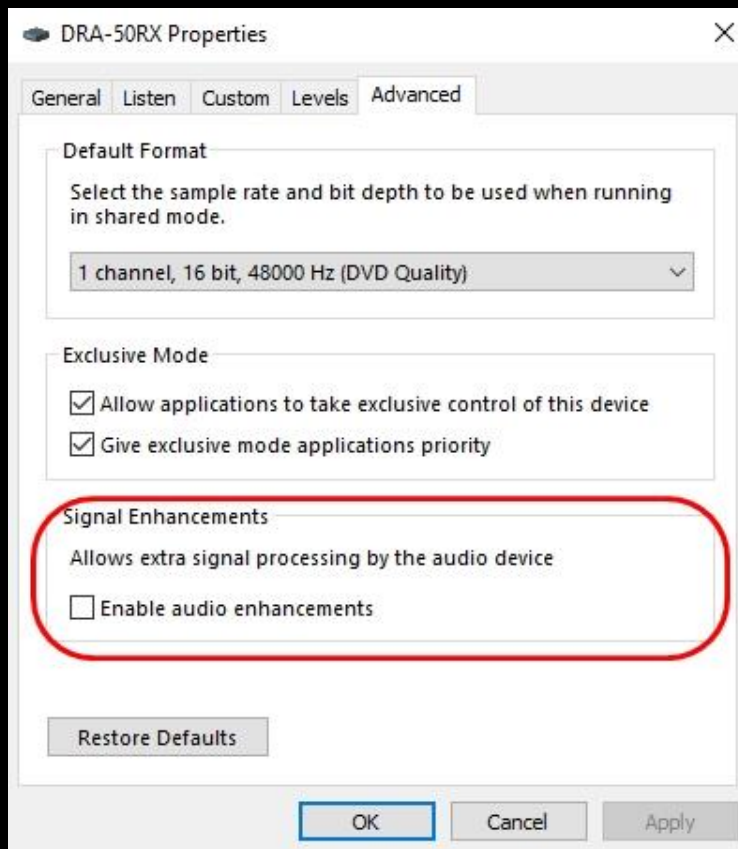
Below the results is an image of a green printed circuit board (PCB) with a red arrow pointing to a blue trimpot labeled R14. The text below the image reads: "Turn the R14 trimpot to the right". A "Close" button is located at the bottom of the dialog box.

The background software interface includes a graph showing a signal level of 1.0 bps, a VU meter with "Audio Input: -15 dB", and a "SoundCard" window showing "Device Input" and "PTT RA-Board-1". A red "Auto Tune" button is also visible.

The Vara FM AutoTune function assists in setting up the transmit drive level. Select AutoTune, enter the call sign of an available station to test with, and press the “plug” button. Vara FM will send a series of test transmissions, adjusting the level with each transmission. The remote station will then respond with the setting that had the best S/N ratio. Vara will adjust the drive slider to that level. If the level is too high, or too low, Vara will instruct you to adjust the level on the Windows mixer or the sound card TX controls. Green “Approved” results are good!

SOFTWARE SETUP

VARA HF/FM



Windows Sound Settings include options to Enhance the recording and playback experience (bass boost, dynamic range, noise reduction, etc.). While these enhancements may be good for music and gaming, they are terrible for data transmission. Be sure to disable all enhancements.

Note: Create a shortcut on your desktop that calls `mmsys.cpl` to get directly to the sound settings.

SOFTWARE SETUP

VARA FM V/UHF

VARA FM v3.0.5

Level	VARA FM WIDE				VARA FM NARROW			
	Symbol Rate	Carriers	Mod.	Net Rate (bps)	Symbol Rate	Carriers	Mod.	Net Rate (bps)
1	42	55	4PSK	1098	42	55	4PSK	1098
2	42	55	4PSK	2253	42	55	4PSK	2253
3	42	98	4PSK	4040	42	55	4PSK	3022
4	42	98	4PSK	5387	42	55	16QAM	4032
5	42	98	16QAM	7185	42	55	16QAM	5375
6	42	98	16QAM	9580	42	55	32QAM	6720
7	42	116	16QAM	11340	42	55	64QAM	8065
8	42	116	32QAM	14144	42	55	64QAM	9072
9	42	116	64QAM	16932	42	55	128QAM	10585
10	42	116	64QAM	19003	42	55	256QAM	12091
11	42	116	128QAM	22102				
12	42	116	256QAM	25210				

Vara FM uses a very efficient FEC protocol, resulting in a significant speed improvement over traditional Packet Radio (over 2X 9600 packet). It will shift to the different speed levels automatically based on the receive signal quality.

Vara FM Narrow can also be used over regular voice repeaters or cross-band repeaters (at somewhat slower rates).

Unlike Packet, Vara FM does not support link-level network systems like network nodes, but it does have support for digipeating.

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



SPECIAL THANK YOU TO
SCOTT CURRIE NS7C FOR
PROVIDING THESE SLIDES