

# Digital Communications Modes for Amateur Radio

Presented by Bob Cheek N4RFC  
For the  
Cherokee Amateur Radio Society

# Digital Modes

- Let's start with a QUIZ!
  - What was the FIRST DIGITAL MODE?
  - What was the SECOND DIGITAL MODE?

# Digital Modes

- RTTY
  - PSK
  - MFSK
  - Hellscriber
  - Contestia
  - VarAC
- |              |              |
|--------------|--------------|
| MT63         | TOR          |
| FSQ          | AMTOR        |
| IFKP         | JT-65        |
| THOR         | FT-4         |
| THROB        | FT-8         |
| Packet Radio | And more.... |

# Equipment

- What type of equipment do I need to run digital modes on HF?
  - A HF Transceiver (and antenna)
  - A sound interface:
    - Built-in USB sound interface in rig
    - Signal LinkUSB
    - Sound card in a computer
  - A computer – Almost anything will do, For Windows, a dual core processor, 4GB of RAM, a USB Port or two, enough disk space to install the software.
  - An accurate clock is needed for the JT/FT and WSPR modes
  - Some way to key the transmitter, Signalink USB is great for this!

# Modem vs App

- I often see confusion around the terminology around digital modes
- The “modem” and the digital application are often confused.
- The term “modem” is a contraction of Modulator/Demodulator
  - Remember your “dial-up” modem in your Commodore 64? That was a hardware modem that took digital data from your computer and converted it to sound to transmit over the phone lines.
- Today we have software modems that perform the same functions converting digital data from your computer to send over the radio.

# Equipment

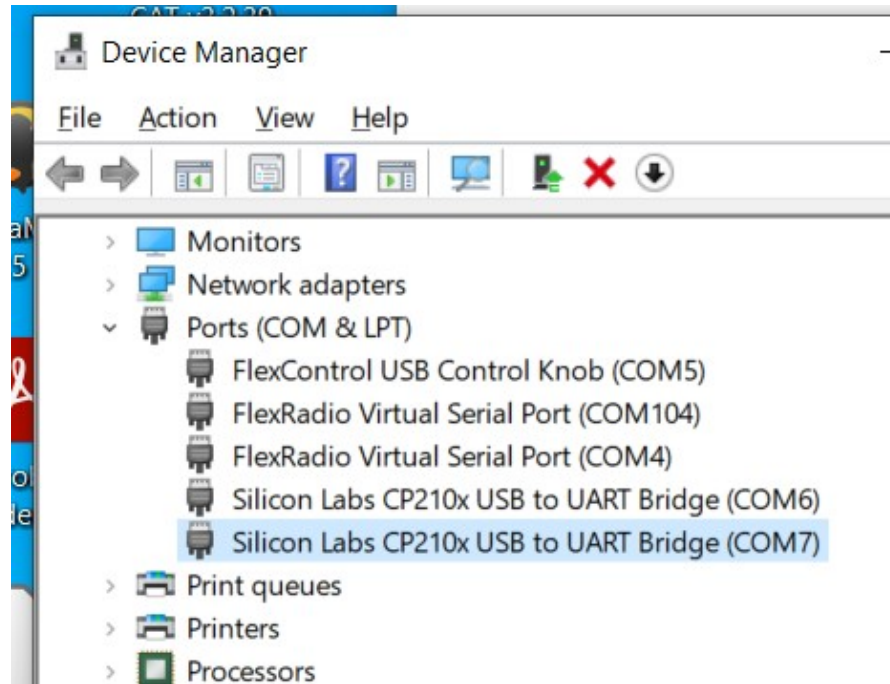
- Digital Mode Software (most popular)
  - FLDIGI – Supports many different Digital Modes
  - WSJT-X – FT-8 / 4 WSPR
  - JTDX – Best thing I have found for FT-8/4 weak signal modes
  - VarAC – HF chat, broadcast, and mail drop software
  - For you Linux Geeks, FLDIGI and JTDX have install packages for Debian Linux that work beautifully! No compiling required.

# Setup of Hardware & Software

- ICOM with built in sound interface – IC-7100, IC-7300 etc.
  - Install the application software I.E. JTDX, FLDIGI on your PC.
  - Install ICOM drivers for USB interface. **(install driver before plugging in the USB Cable)**
  - Open ‘Device Manager’ on PC and make note of the COM ports.
  - Plug in USB cable and turn on radio. USB installation will start automatically allow it a couple of minutes to complete.
  - Open “Device Manager” on PC and find the two new COM ports that have appeared, these are the ports for the ICOM radio.

# Device Manager

- The Silicon Labs ports are the ICOM ports.





# Know your COM Ports!

- Make a list of your COM ports

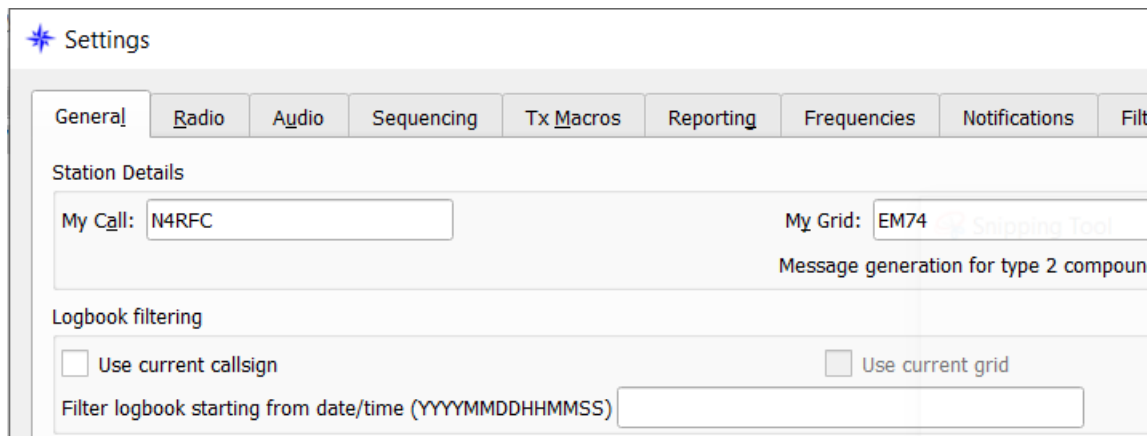
Port	Device
3	
5	WinKeyer
6	FlexRadio CAT
7	Kenwood TNC
8	FT-847
9	FT-1000MP
10	Palstar HF-AUTO
11	FlexControl
106	FlexRadio CAT

# Configure JTDX

- Four things must be configured:
  - the Sound Interface
  - CAT Control
  - the PTT
  - System clock (For FT-4/8 Modes)
- CAT interface will allow the software to control the band settings, but it is not necessary to operate. I have used digital modes with old school analog radios!

# Configure JTDX

- Operate FT-8 with JTDX, three sections of setup must be modified
  - Enter your CALL LETTERS and GRID SQUARE



The screenshot shows the 'Settings' window in JTDX, with the 'General' tab selected. The 'Station Details' section contains two text input fields: 'My Call:' with the value 'N4RFC' and 'My Grid:' with the value 'EM74'. Below this, there are two checkboxes: 'Use current callsign' and 'Use current grid', both of which are unchecked. At the bottom, there is a text input field labeled 'Filter logbook starting from date/time (YYYYMMDDHHMMSS)' which is currently empty.

# Configure JTDX

- Radio Info – CAT Settings

The screenshot shows the 'Settings' dialog box with the 'Radio' tab selected. The 'Rig' is set to 'Icom IC-7100' and the 'Poll Interval' is '1 s'. There are checkboxes for 'On', 'Off Rig power', 'S meter', and 'Output power'. The 'CAT Control' section includes a 'Serial Port' dropdown set to 'COM6', 'Serial Port Parameters' with a 'Baud Rate' of '19200', and radio buttons for 'Data Bits' (Default, Seven, Eight) and 'Stop Bits' (Default, One, Two). The 'Handshake' section is partially visible. The 'PTT Method' section has radio buttons for 'VOX', 'CAT' (selected), 'DTR', and 'RTS', with a 'Port' dropdown set to 'COM4'. The 'Transmit Audio Source' section has radio buttons for 'Rear/Data' and 'Front/Mic' (selected). The 'Mode' section has radio buttons for 'None', 'USB', and 'Data/Pkt' (selected).

Settings

General | Radio | Audio | Sequencing | Tx Macros | Reporting | Frequencies | Notifications | Filters | Scheduler | Advanced

Rig: Icom IC-7100 Poll Interval: 1 s  On  Off Rig power  S meter  Output power

CAT Control

Serial Port: COM6

Serial Port Parameters

Baud Rate: 19200

Data Bits

Default  Seven  Eight

Stop Bits

Default  One  Two

Handshake

PTT Method

VOX  DTR

CAT  RTS

Port: COM4

Transmit Audio Source

Rear/Data  Front/Mic

Mode

None  USB  Data/Pkt

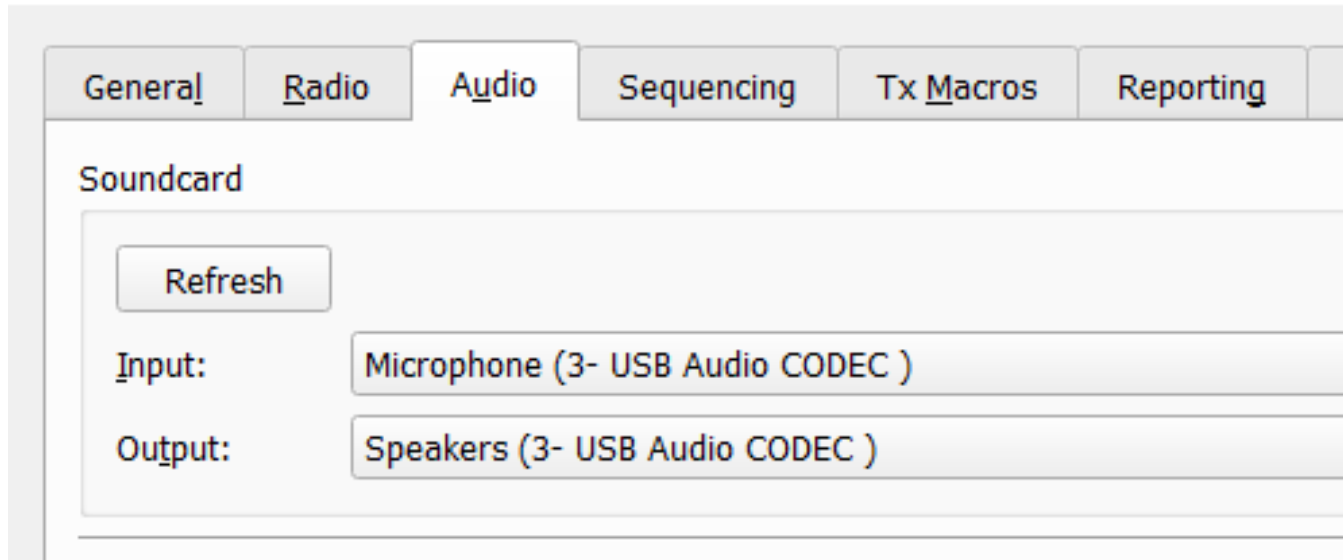
# Configure JTDX

- What does Baud Rate mean anyway?
  - It is the rate that data will be sent over the RS-232 link
  - Data is sent both from and to the computer/radios
  - Data Rate – in this example 19200 bits per second
  - Next is the number of data bits sent, 7 or 8 – (usually 8 bits)
  - Also configured is the Parity Bit – Parity or No Parity (usually No)
  - Stop bits, used by the serial protocol to signal end of the data
  - Finally, Handshake, this is most always NONE!

# Configure JTDX

- The Audio connection, in this case the USB Audio CODEC

\* Settings



The screenshot shows the 'Settings' window for JTDX, specifically the 'Audio' tab. The window has a title bar with a blue asterisk icon and the text 'Settings'. Below the title bar is a tabbed interface with tabs for 'General', 'Radio', 'Audio', 'Sequencing', 'Tx Macros', and 'Reporting'. The 'Audio' tab is selected. Under the 'Soundcard' section, there is a 'Refresh' button. Below that, the 'Input' is set to 'Microphone (3- USB Audio CODEC )' and the 'Output' is set to 'Speakers (3- USB Audio CODEC )'.

# Set the CLOCK

- Set your system clock

## Date & time

### Current date and time

10:30 AM, Friday, January 7, 2022

Set time automatically



Set time zone automatically



Set the date and time manually

Change

Synchronize your clock

Last successful time synchronization: 1/7/2022 2:19:30 PM

Time server: time.windows.com

Sync now

# Ready to Operate

\* JTDX by HF community

v2.2.156, derivative work based on WSJT-X by K1JT

File View Mode Decode Save AutoSeq DXpedition Misc Language Help

UTC dB DT Freq Avg=0.43 Lag=-0.08/25 Band Activity ● 7.074 000 15:33:39

UTC	dB	DT	Freq	Avg	Lag	Message	Rx Frequency
153300	-12	0.4	1882	~		YB4JTB N6JV R+01	U.S.A.
153300	-1	0.6	907	~		K5AEM KI5QYY EM20	*U.S.A.
153300	-9	0.3	506	~		CQ DX KI5MIV EM10	*U.S.A.
153300	-3	0.3	1240	~		CQ KG4CJA EM88	U.S.A.
153300	-17	-0.4	1721	~		UR4QRH NF7Z CN84	U.S.A.
153300	-1	0.2	1184	~		KD2BMX AA5HH RR73	U.S.A.
153300	1	0.5	1059	~		WA7TV KO4FSZ R-06	U.S.A.
153300	-7	0.7	1500	~		K7ZGQ KN4WUF EL98	U.S.A.
153300	-12	0.3	1354	~		BG4KXB N6PM RR73	U.S.A.
153300	-16	0.4	807	~		BH1HWF W6TMD 73	U.S.A.
153300	-11	-0.2	1406	~		YO4NF N7JP -15	U.S.A.
153300	-5	0.4	1503	~		N4DKN KB5VAI EM42	*U.S.A.
153300	1	0.3	1255	~		CQ KR0P EN10	U.S.A.
153300	-12	1.6	1154	~		CQ CO3LY EL82	Cuba
153300	-16	0.5	1302	~		IZ5DKJ K5DTC -16	U.S.A.
-----	07.01.22	15:33:29	UTC	-----	40m	-----	
153315	5	0.4	1911	~		WJ2N KK6YA R-04	U.S.A.
153315	-3	0.5	1073	~		CQ KR0P EN10	U.S.A.

40m Spt  Menu  Tx 1510 Hz Report -15

DX Call DX Grid ▲ ▼ CL 100 %

Lookup Add Rx 1510 Hz DT 0.0 s

Lockd Tx=Rx  Wanted

UTC	dB	DT	Freq	Message	Rx Frequency
152945	-3	0.7	1500	~ WA7PVE K7ZGQ 73	U.S.A.
153000	-4	0.4	1504	~ N4DKN KB5VAI EM42	U.S.A.
153030	-4	0.4	1504	~ N4DKN KB5VAI EM42	*U.S.A.
153100	-5	0.4	1503	~ N4DKN KB5VAI EM42	*U.S.A.
153100	-15	0.3	1503	~ DS4EOI KB0UGQ DM79	U.S.A.
153130	-5	0.4	1504	~ N4DKN KB5VAI EM42	U.S.A.
153200	-2	0.4	1503	~ N4DKN KB5VAI EM42	*U.S.A.
153215	-4	0.5	1501	~ CQ K7ZGQ EM11	U.S.A.
153230	-2	0.4	1503	~ N4DKN KB5VAI EM42	*U.S.A.



# Sound Level Control

- Sound level control is important so that you don't overdrive the transceiver's audio input. This will cause distortion that will make your signal not decode properly on the receiver.
- JTDX has sound level control built into the software
- FLDIGI does not have sound level adjustments, you will have to adjust your sound output with the level controls on your computer

# Sounds Simple?

- Be prepared for issues
  - Many different radio/computer/sound interfaces sometimes make setup very trying!
  - HAMLIB and RIGCAT for some rigs are still in BETA
  - Be patient – if you get frustrated, step away from it for a while
  - Search internet for specific setup information
  - My technique, “mess” with it until it works!
  - Still no Joy, Call Marty KB4MG!

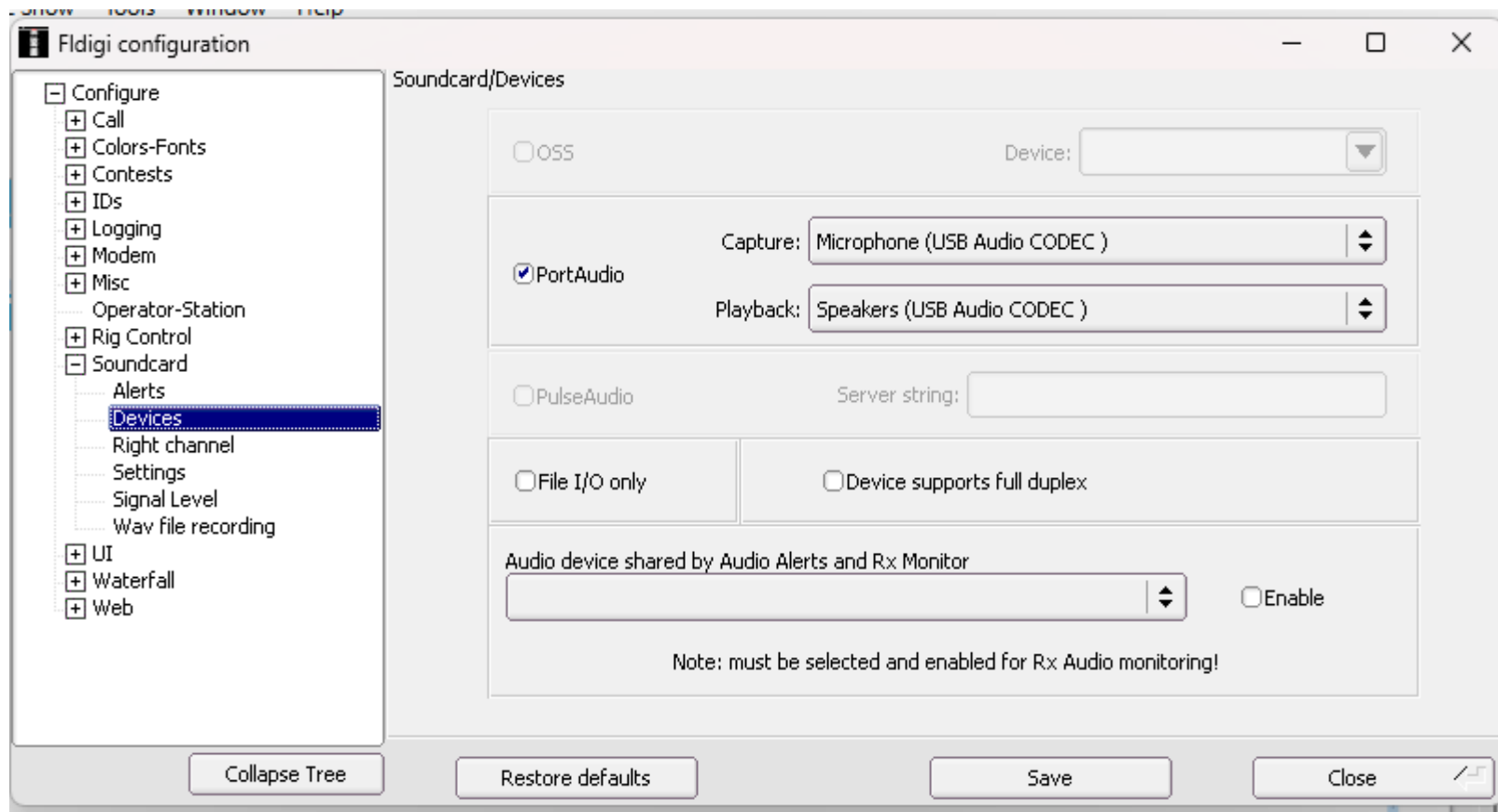
# Signal Link with FLDIGI

The screenshot shows the 'Fldigi configuration' window with the 'Operator-Station' tab selected. The left sidebar contains a tree view with the following items: Call, Colors-Fonts, Contests, IDs, Logging, Modem, Misc, Operator-Station (highlighted), Rig Control, Soundcard, UI, Waterfall, and Web. The main area contains the following fields:

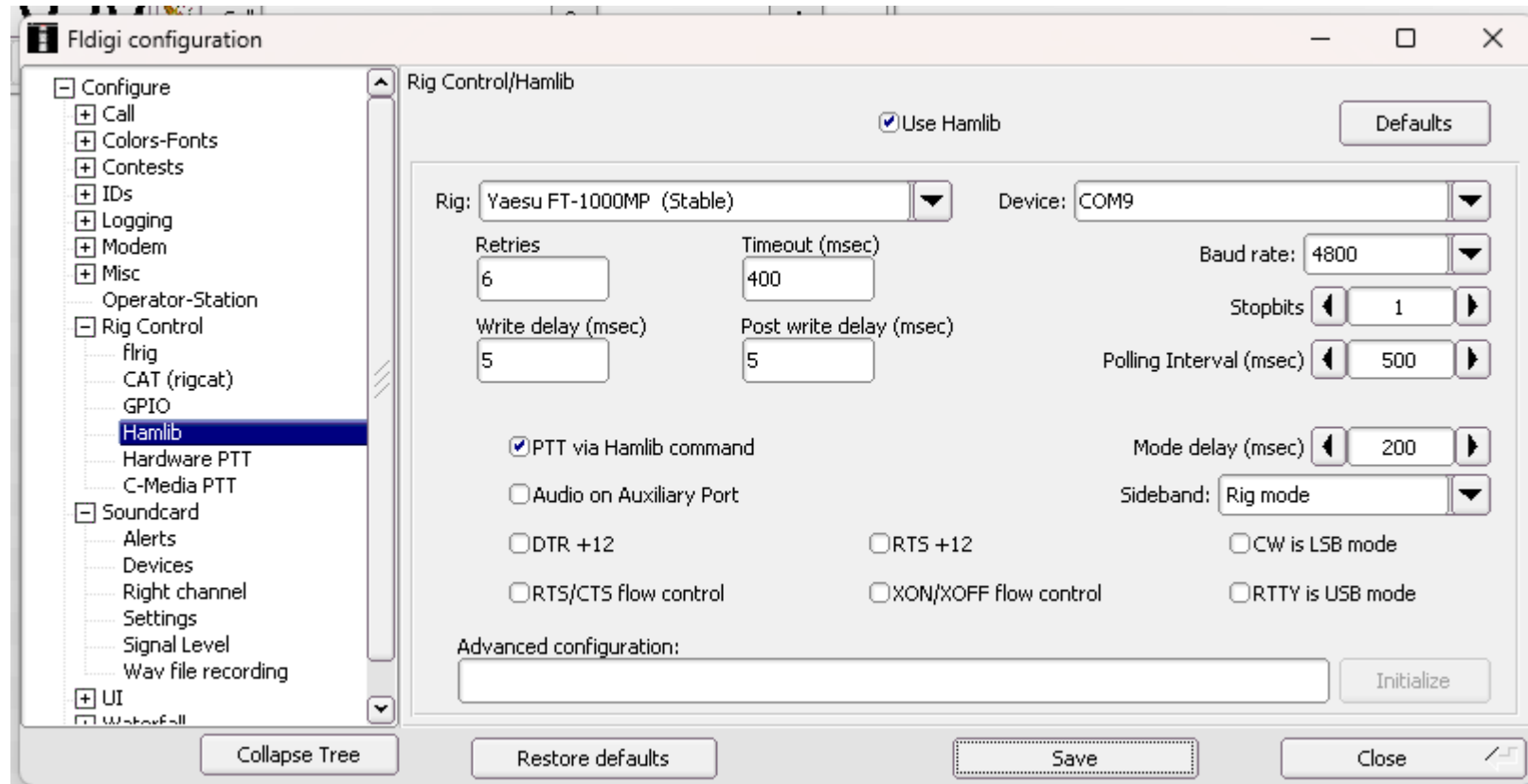
- Station Callsign: N4RFC
- Operator Callsign: (empty)
- Operator Name: Bob
- Antenna: Dipole
- Station City: Woodstock, GA
- Station Locator: EM74td
- State/Prov./Country: Georgia (dropdown) GA (button)
- Counties / Regions: Cherokee (dropdown) CHER (button)

At the bottom of the window are four buttons: Collapse Tree, Restore defaults, Save, and Close.

# FLDIGI – Configure Sound Card



# FLDIGI – Configure CAT Ctrl



# Signalink Sound Settings

- Signalink is affected by the sound level settings in Winders
  - Goto Setting > System > Sound > Input and set a level that shows signals on the waterfall display
  - The Signalink also has manual gain settings on the front panel
    - Start with both set mid scale and adjust from there as required
    - Make sure you are not over driving the audio on the rig
      - Set you meter to display ALC level and adjust TX audio levels just show ALC

# FLDIG Display

The screenshot displays the fldigi software interface. At the top, the window title is "fldigi ver4.2.05 / Hamlib FT-1000MP - N4RFC". The main display area shows the frequency "14070.000" in large digits. Below this, there are fields for "Freq" (14071.109), "Call", "Op", "Az", "Qth", "St", "Pr", and "L". A yellow text box contains the message: "fantastic. ie should be able to see him 1on when we all go to nd for a family reunion in a month or so. nothing like getting out on two wheels! enjoy the trails. i'm going to wrap up here and get my day started, so i'll sh you 73. we'll aatch up again soon! take care. tn". Below the text box is a blue area with a cursor. The bottom section features a control panel with various modes (RsID CQ, ANS, QSO, KN, SK, Me/Qth, Brag, T/R, Tx, Rx, TX) and a frequency scale from 500 to 2500. The bottom status bar shows "BPSK31", "S/N 22 dB", "IMD -22 dB", and "AFC" and "SQL" indicators.

# VarAC Setup

- VarAC has become a very popular HF/VHF chat program. It allows for real time keyboard to keyboard chatting, relaying through other stations, and their “Vmail” automatic messaging to other stations all over the world
- VarAC is the application program and it requires a software modem to interface to the radio. VaraHF or VaraFM are the software modems that do the sound connection between the computer and the application program.



# VarAC Setup

First thing in setting up VarAC to do is download and install the VaraHF or VaraFM modems. I highly recommend allowing the installers to install these modems into their default locations. Then install VarAC. On the menu bar click Settings → My Information

My Information

**Language**  
Interface language: English  
[Don't find your language?](#)

**Callsign**

Special prefix	Your callsign	Special suffix
	N4RFC	
Example: W9	Example: 4Z1AC	Example: QRP

[How complex callsigns work?](#)

**Basic information**

QTH: Woodstock, GA  
Name: Bob      Locator: EM74TD

**Setup**

RIG: Flex 6300  
Power (W): 50  
Antenna: 3/8 wave Vertical

**Ice Breaker**  
Sharing more about yourself beyond ham radio can spark longer and more enjoyable chats.

Age: 73  
Profession: Quality Management / Manufacturing  
Other hobbies: Ham Radio, Motorcycles, and Classic Cars

Use the following tags during a QSO or in your canned messages to share your information:

<CALL>	<RIG>
<QTH>	<PWR>
<NAME>	<ANT>
<LOC>	<ICE>

SAVE AND EXIT

# VarAC Setup

Two stages to setting up VarAC, first the CAT controls are configured in the VarAC program, under Settings → RIG

Using the pull downs, select your rig under the PTT Configuration section. Set the COM port in the CAT Configuration section

Then set the Frequency Control section. The Mode setting will be rig dependent.

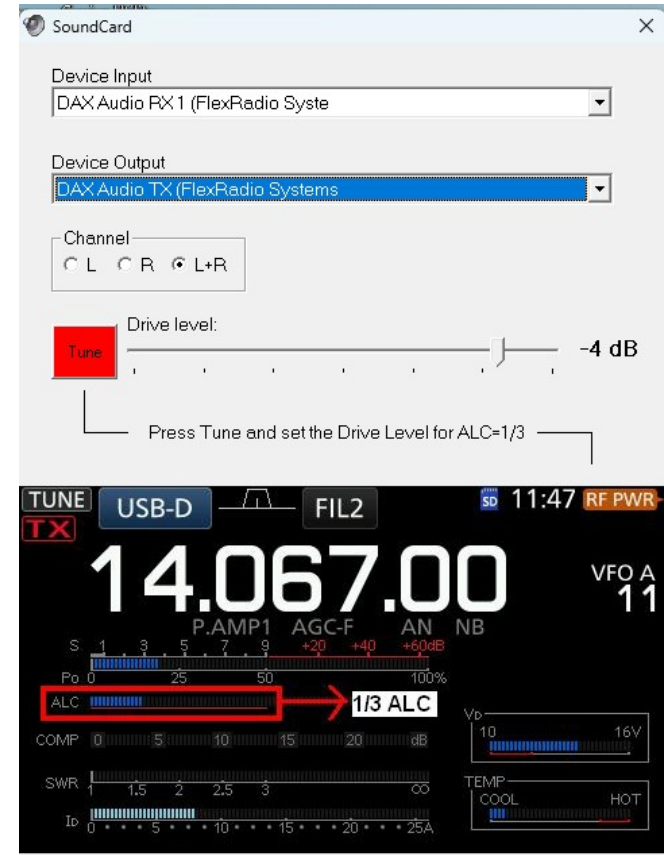
The screenshot shows the 'Settings' window for VarAC, with the 'RIG' tab selected. The window is divided into several sections:

- PTT Configuration:** A dropdown menu is set to 'SmartSDR'. Below it are radio buttons for 'OmniRig', 'FLRig', 'DTR/RTS', 'Hamlib', and 'None'. There are three buttons: 'TEST', 'PTT ON', and 'PTT OFF'.
- CAT Configuration:** Radio buttons for 'COM Port' and 'TCP' are shown, with 'TCP' selected. Below are fields for 'Port' (COM5), 'Baud' (9600), 'Parity' (None), 'DataBits' (8), 'StopBits' (1), 'Host' (127.0.0.1), and 'Port' (5002). There are also dropdowns for 'DTR' (L) and 'RTS' (L).
- Frequency Control:** A dropdown menu is set to 'SmartSDR'. Below it are radio buttons for 'OmniRig', 'FLRig', 'None', and 'Hamlib'. There is a checked checkbox for 'Load last frequency' and an 'Offset Hz (?)' field set to 0. There is an unchecked checkbox for 'Read frequency every' with a dropdown set to 2 and the unit 'seconds'. There is an 'Antenna tuner' dropdown set to 'OFF'. Below these are three fields: 'USB-D' (dropdown), '7105000' (text), and 'TEST' (button).
- FLRig:** Fields for 'Host' (localhost) and 'Port' (12345).
- DTR/RTS:** Fields for 'Port' (dropdown) and 'Type' (DTR dropdown).
- Hamlib (Rigctlid):** Fields for 'Host' (localhost) and 'Port' (4532).
- OmniRig:** Fields for 'Rig#' (1 dropdown) and 'VFO' (A+B dropdown).

# VarAC Setup

To setup the modem, go to the modem screen, click Settings → SoundCard

This example is showing setting up for a Flex Radio. If you are using an Icom, or a Signalink you simply select the audio source for those devices. Once the audio source is selected, set your HF transceiver meter to show ALC, click the red “Tune” button and adjust the audio level for 1/3 reading on the ALC meter.



# VarAC Setup

The screenshot shows the 'Settings' window for VarAC, with the 'RIG' tab selected. The 'Logging', 'Vara', 'QSO', 'CQ / Beacon', 'DX Cluster', 'GPS', and 'Misc.' sub-tabs are visible. The 'PTT Configuration' section has 'CAT' selected with 'Yaesu FT-847' in the dropdown, and 'None' selected for the PTT method. The 'Frequency Control' section has 'CAT' selected with 'Yaesu FT-847' in the dropdown, and 'Load last frequency' and 'Read frequency every 2 seconds' checked. The 'CAT Configuration' section has 'COM Port' selected, with 'COM15' as the port, '4800' as the baud rate, 'None' as the parity, '8' as data bits, '2' as stop bits, and '127.0.0.1' as the host. The 'FLRig' section has 'localhost' as the host and '12345' as the port. The 'DTR/RTS' section has 'DTR' as the type. The 'Hamlib (RigctlId)' section has 'localhost' as the host and '4532' as the port. The 'OmniRig' section has '1' as the rig number and 'A' as the VFO.

- Setup of Yaesu HF radio with Signalink USB
  - NO PTT the signal link does the PTT for you
  - Set CAT to rig Model
  - Set CAT Configuration for your the COM Port of the radio CAT interface

# VarAC Setup

- The main screen of VarAC

The screenshot displays the VarAC software interface. At the top, the title bar reads "VarAC by 4Z1AC (V9.2.3)". Below this, there are menu options: "Settings", "Tools", "Logs", "Resources", and "About". The current date and time are shown as "UTC: 2024-08-03 20:18:20".

The main interface is divided into several sections:

- FREQUENCY:** A dropdown menu showing "14.105.000".
- Profile:** A dropdown menu showing "VarAC".
- VarAC Log:** A log window showing the following entries:
  - 20:17:07 - Connecting IZ8FAV
  - 20:17:43 - PSKReporter self report: Logged successfully
  - 20:17:43 - PSKReporter: Sending accumulated records
  - 20:17:59 - Disconnected from IZ8FAV
- Beacons:** A table showing beacon data:

Bnd	TΔ	Callsign	SNR
20m	00:01	IZ8FAV	-18
40m	00:58	N9CYN	-22
20m	03:06	W6EZE	-08
20m	03:07	WY6Y	+06

Below the logs, there is a "VARA Log" section with the following entries:

- 20:17:59 - PTT OFF
- 20:17:59 - DISCONNECTED
- 20:17:59 - BUSY OFF
- 20:18:20 - BUSY ON

At the bottom, there is a "In QSO with" field and a "Duration: 00:00:11" field.

The interface also features several control buttons: "CONNECT MODEM", "CONNECT", "PING", "DISCONNECT MODEM", "DISCONNECT", "ABORT", "TUNE", "CALL CQ", "END CQ", and "SEND BEACONS". There is also a checkbox for "PTT Disabled".

At the bottom of the interface, there is a table with the following columns: "Bnd", "Time", "From", "To", "SNR", and "Broadcast message". The table is currently empty.

# Digital Modes Summary

- There is a digital mode for just about every one and everything!
  - FT-8 is by far the most popular on the air
  - Lots of DX to be worked on FT-8!
- For EMMCOM Vara HF/ Vara FM very useful transmission media
- Getting the rig interfaced is usually the most difficult part of setup
- A rig with built-in sound card and CAT is preferred
  - But even older rigs with a Signalink USB can be used effectively.