

Configuring the TS-990S for Fldigi

Without Using an outboard Interface

This guide is specifically aimed at the user of the Kenwood TS-990S transceiver, but the steps are very similar to those needed for the TS-590SG and TS590S, as well as other transceivers with USB sound and CAT interfaces built in.

This guide is the work of Mitchel Baum – AE2A, and may be reproduced and distributed only in its entirety.

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Preparation

Download the Fldigi and Flrig programs from Source Forge at: [Source Forge - Fldigi](#) .

At this time the best versions are the ‘alpha-test’ versions found in the ‘alpha-tests’ folder.

The most current versions of Fldigi for windows is: [fldigi-3.23.07_setup.exe](#) .

The most current versions of Flrig for windows is: [flrig-1.3.24_setup.exe](#) .

These versions may be updated by the time you read this, but use a fresh pair of these programs as they are meant to function as a pair. If you need to update these programs do so by first removing the old versions, then installing the updated versions.

Download the Virtual COM Port Driver from : [Kenwood Download Site](#) .

Download the ARCP-990 Program from: [Kenwood Download Site](#) .

Download the ARUA-10 USB Audio Controller software from: [Kenwood Download Site](#) .

If you have not upgraded the firmware in your TS990S to v 1.10, now would be a good time to do this. You can find the firmware update here also and instructions on how to perform the update are here also.

Obtain a good quality shielded USB-A to USB-B cable. Install one or two ferrite RFI suppressors to protect both the radio and your PC from any RFI effects. Install one at each end of the cable. Do not connect the cable to your PC yet, but you may connect the USB-B end into the TS990S at this time.

NOTE:

If you are using the TS590SG or TS590S, the process is very similar and the downloads are on the same page.

Install the software

Install the Virtual COM Port Driver software by double clicking the downloaded file. Ensure you are using an administrative account! Likewise install the ARCP-990 Program and the ARCP-990 Program. Although you may wish to enjoy these stand-alone programs, we will not actually use these in this document, but they are needed to properly install the required software ‘drivers’. Other than creating some new icons on your desktop, you should not see anything happen.

Plug in the USB cable to the Transceiver

Plug in the USB cable to the back panel socket on the TS990S. The PC will then begin the installation of the driver software which may take some time to complete. When the process is complete, the notices will disappear. You will not see anything different on your desktop when this completes.

Configure the Sound Device Names

Open your 'Control Panel' by clicking the 'Start' button on your desktop and selecting the Control Panel option (on the Right Side).

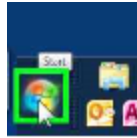


Figure 1 'The Start Button'

Select Control Panel Option

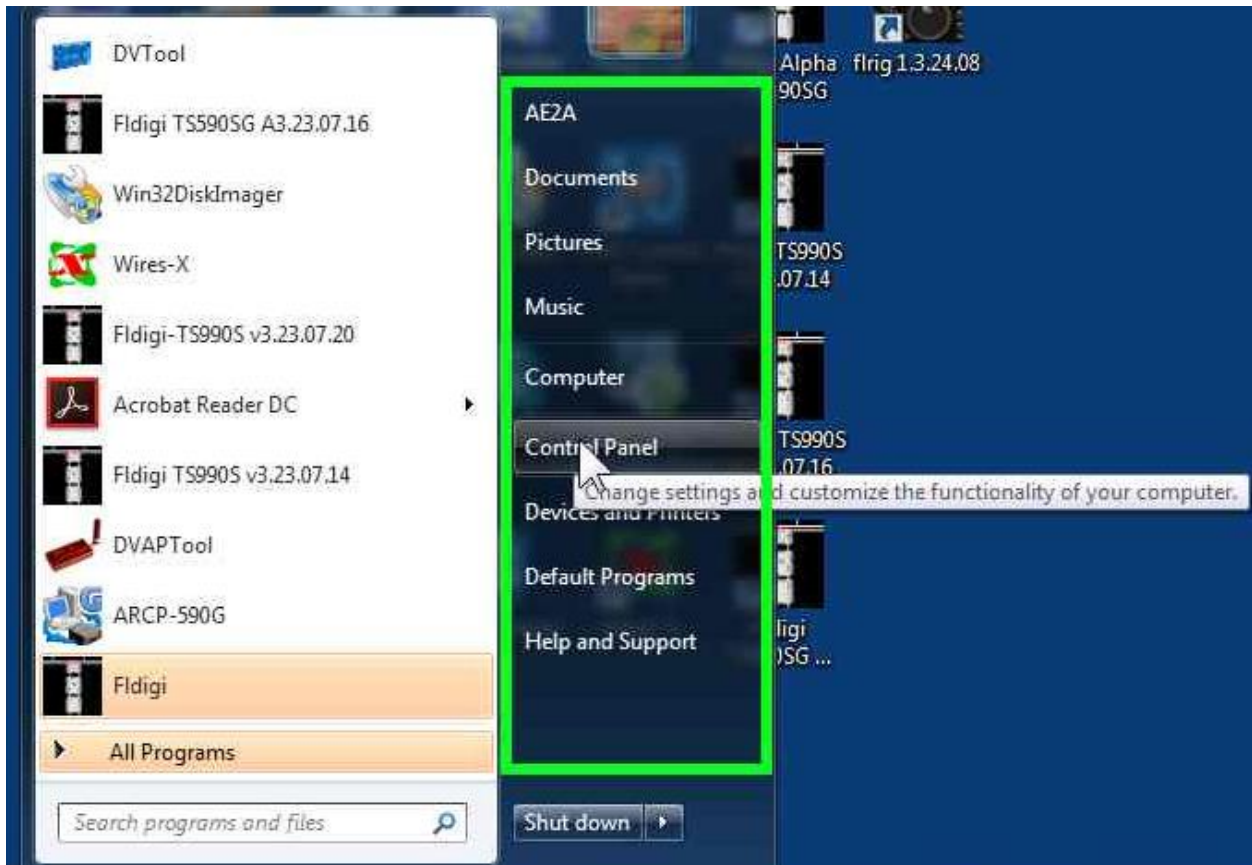


Figure 2 Select the Control Panel

This will open the control panel to a screen like this:

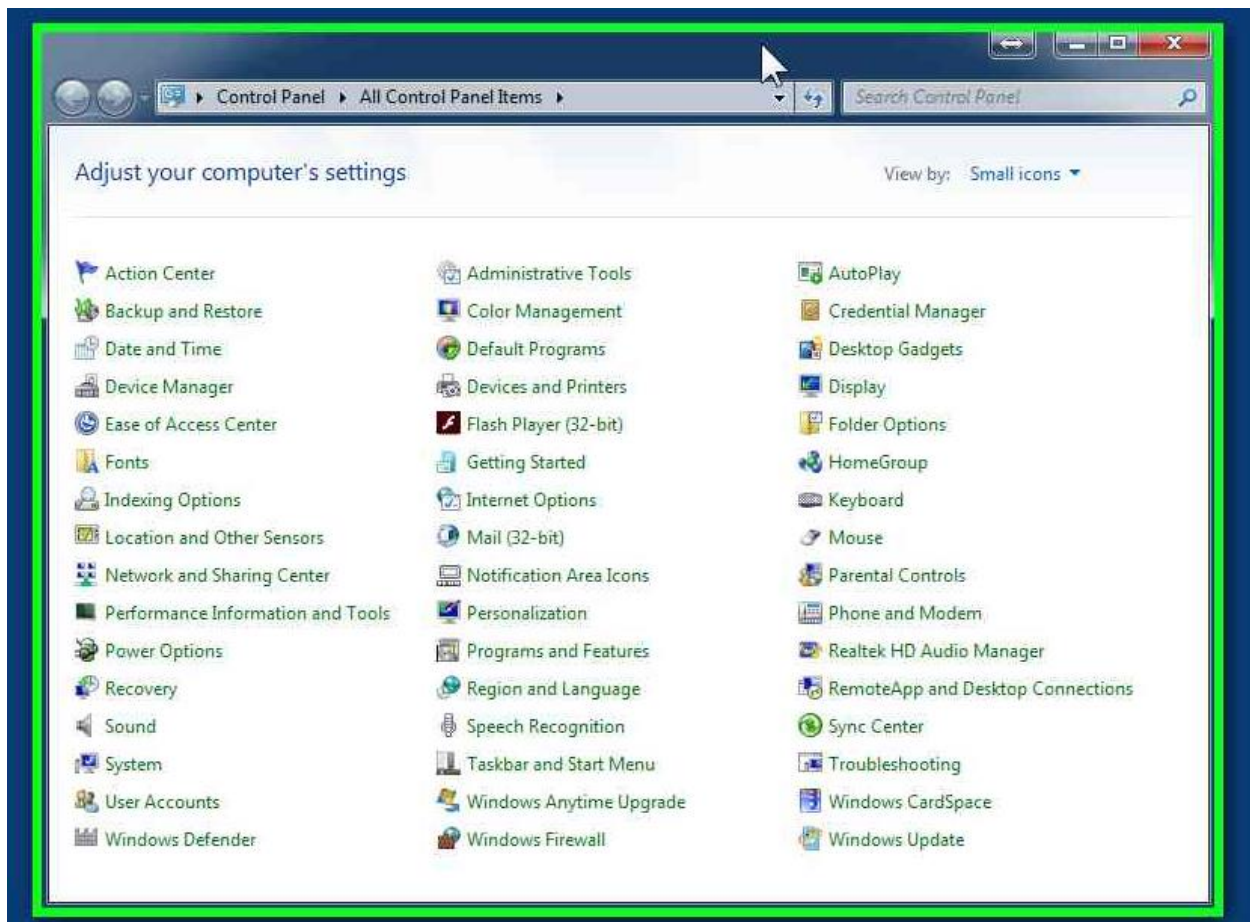


Figure 3 Select the Sound option

Click on the 'Sound' Icon and this will open the Sound settings:



Figure 4 Playback Device Naming

Take note of how I have labelled the 'USB Audio Codec' in the 'Playback' Tab for the TS990S, Think about this: 'Playback' is an Output, so this 'output' will be the 'input' sound to your transceiver, so we label this 'TS990 TX! Later we will associate the Fldigi 'Playback' device with this (TX) device. By the same token, the other side of the same device (RX) is listed in the 'Recording' Tab and this should be labelled 'TS990 RX'. The 'TS990 RX' is the input side of this device (remember this is both an input and output device) which will be associated with the 'Capture' device name in Fldigi. Take note of how Windows identifies this device. There is a number in this name; in this example the number is '7'. This should also be the COM Port number of the serial 'virtual' device (COM 7). We will need the COM Port number when configuring Flrig for CAT. Write down the COM Port number for later use. Double-click the device entry, select the 'name' of the device, and type the correct name for the device as per the above. See the figure below. Note the default device is the 'Playback' device which is an output, hence the TX designation.

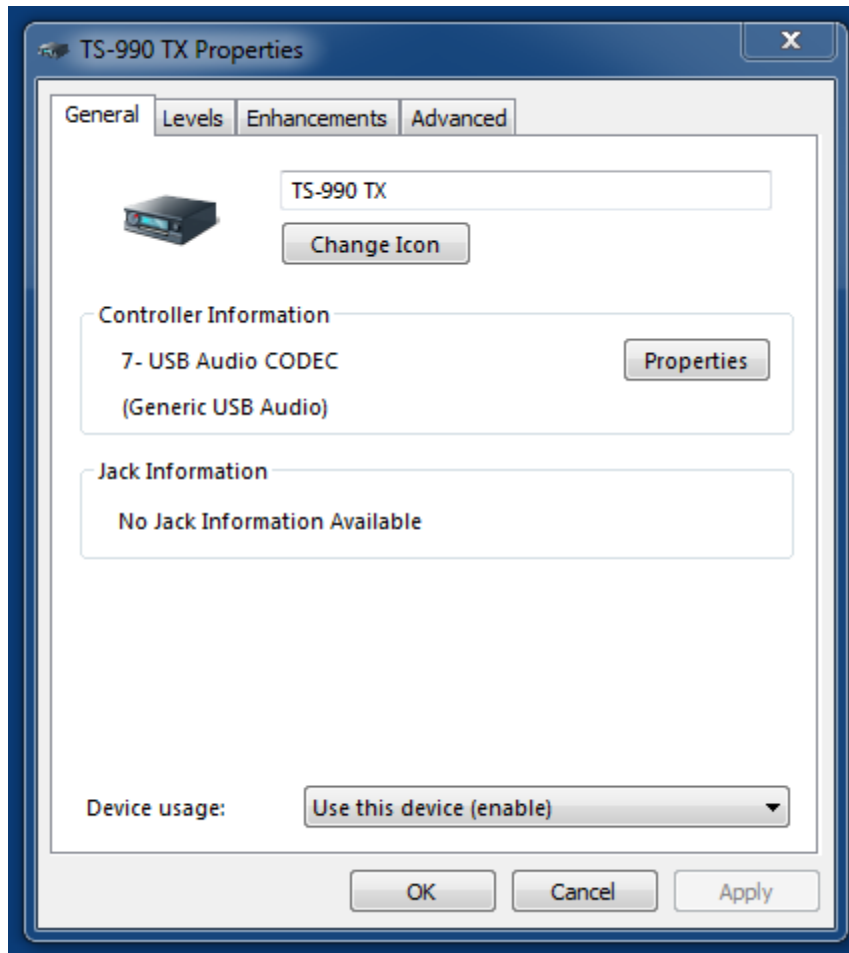


Figure 5 Properties

Similarly select the 'Recording' device which is the input device and change its name. See the figure below.

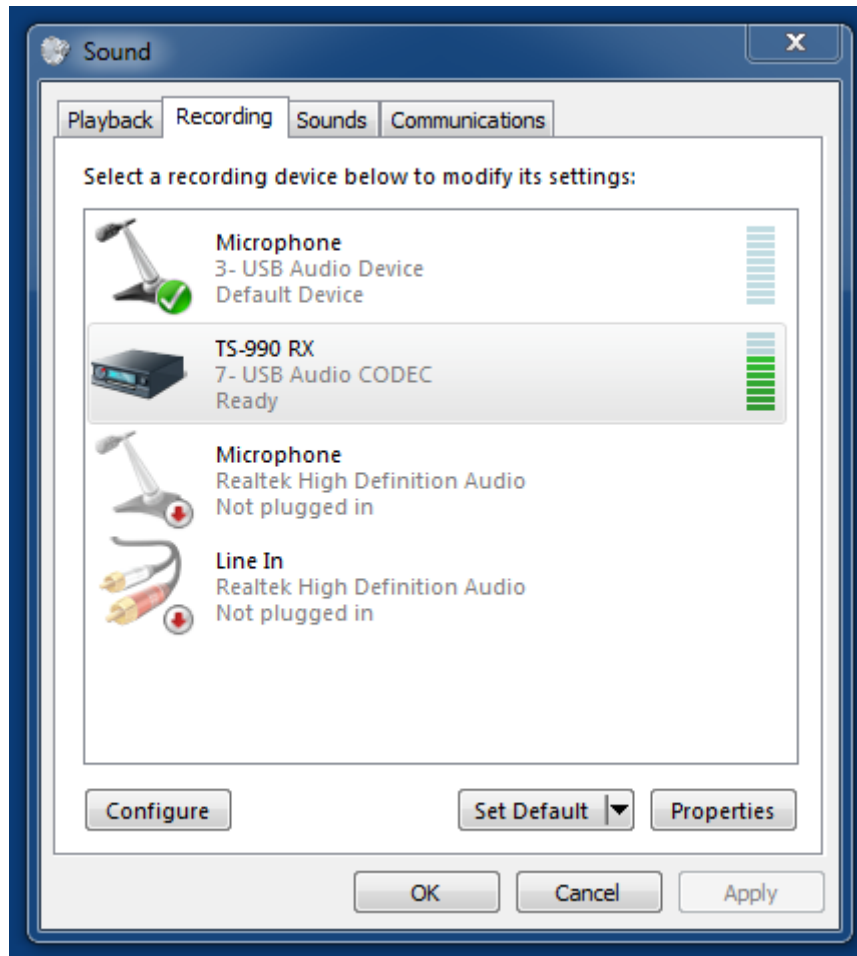


Figure 6 Recording Device

Be sure that you do not see the green check mark on either of these devices or they will become the Windows default device, not a desired selection. Click 'apply' and OK to set this. Next, double-click the RX device and select the 'Levels' TAB. Set the microphone gain to about 34(%) as a starting value. This sets the receive input level to Fldigi and will vary according to the receiver gain, noise conditions, and AGC settings. We will refine this setting later once we 'connect' this device in Fldigi.

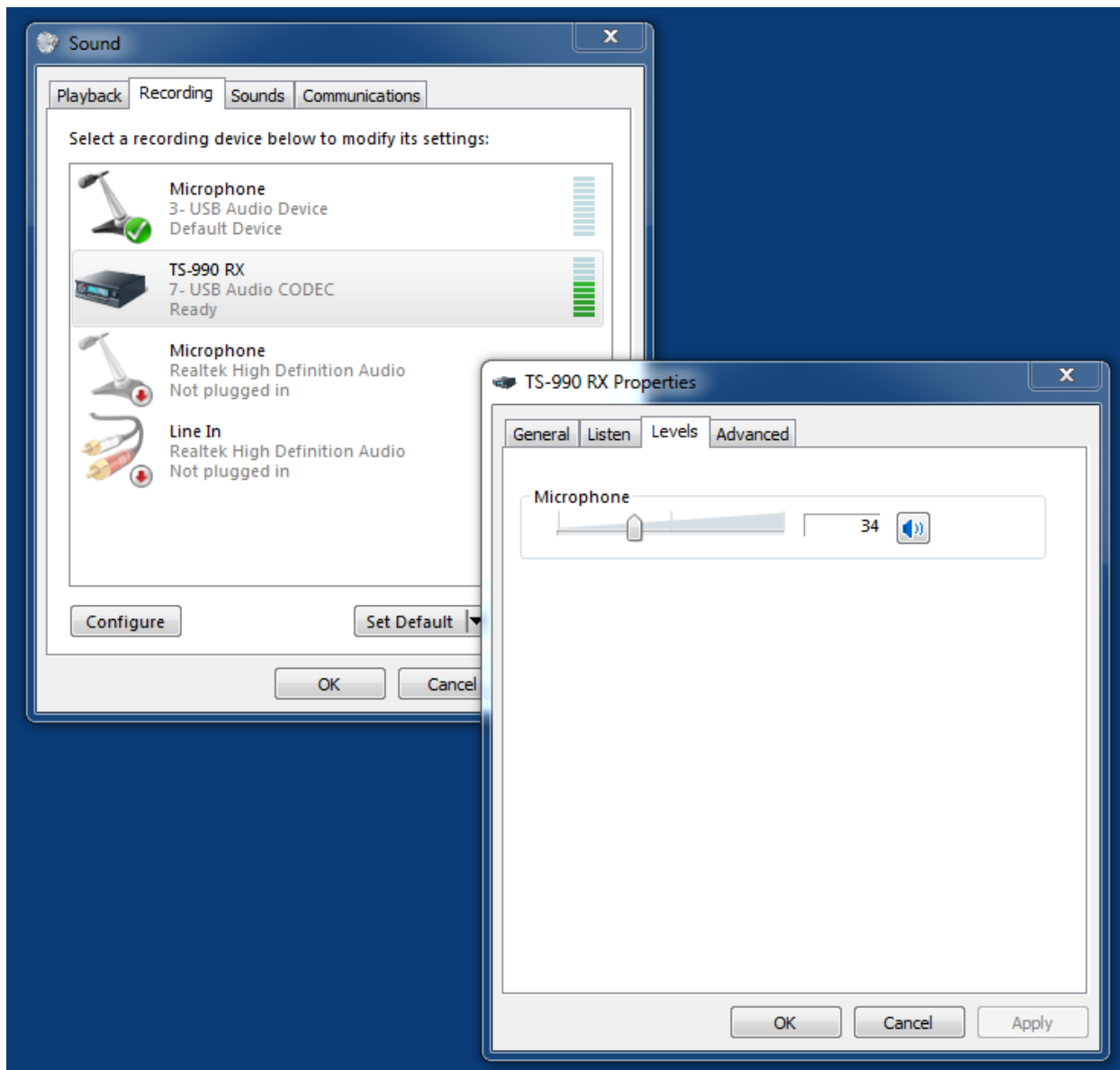


Figure 7 RX Volume Level

At this point if you are receiving a signal you should see a few green bars varying in level. *This is a good sign! Do not worry at this point if you don't see this as we will need to set the USB audio levels in the transceiver in the next section.*

Now let's go back to the playback TAB and select the device, double-click the device and select the Levels Tab. Set the TX audio gain (Speakers) at approximately 29(5). See the figure below for more detail.

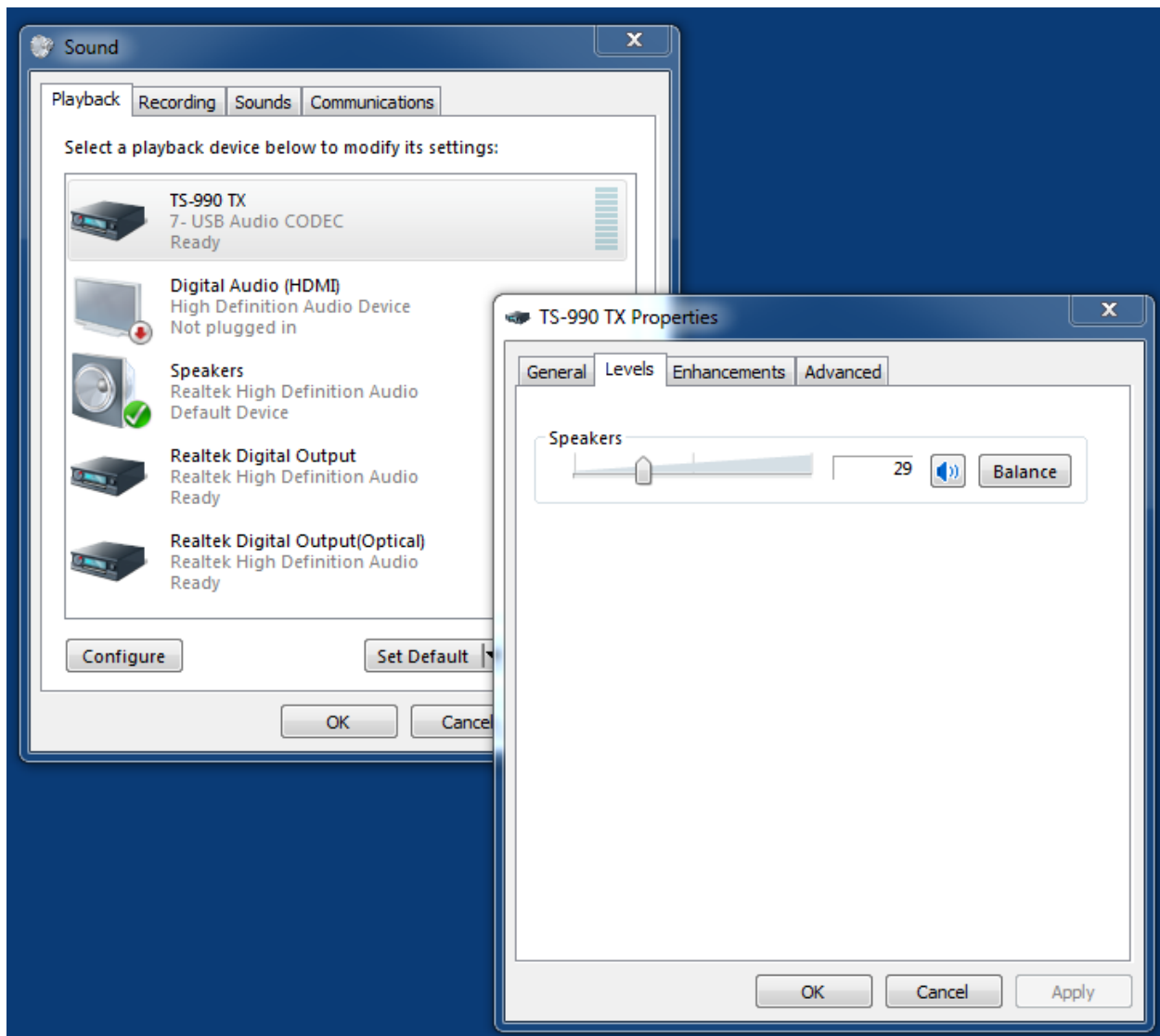


Figure 8 TX Volume Level (Initial)

This setting is the TX audio drive level to the transceiver. We will further adjust this value later so that when we go to transmit there will be no ALC action. When we refer to the TX audio gain, this is the setting we are referring to. If your sound card device has a setting in 'dB', use 0 dB. See the figure above for an example. Click 'apply' and OK. Close the remaining windows. This completes the basic preliminary audio device configuration.

Configuring the Audio Levels in the Transceiver

Press the “MENU” button on the TS990S front panel and select: Group 7 – Rear Connectors.
See figure 5 (below).

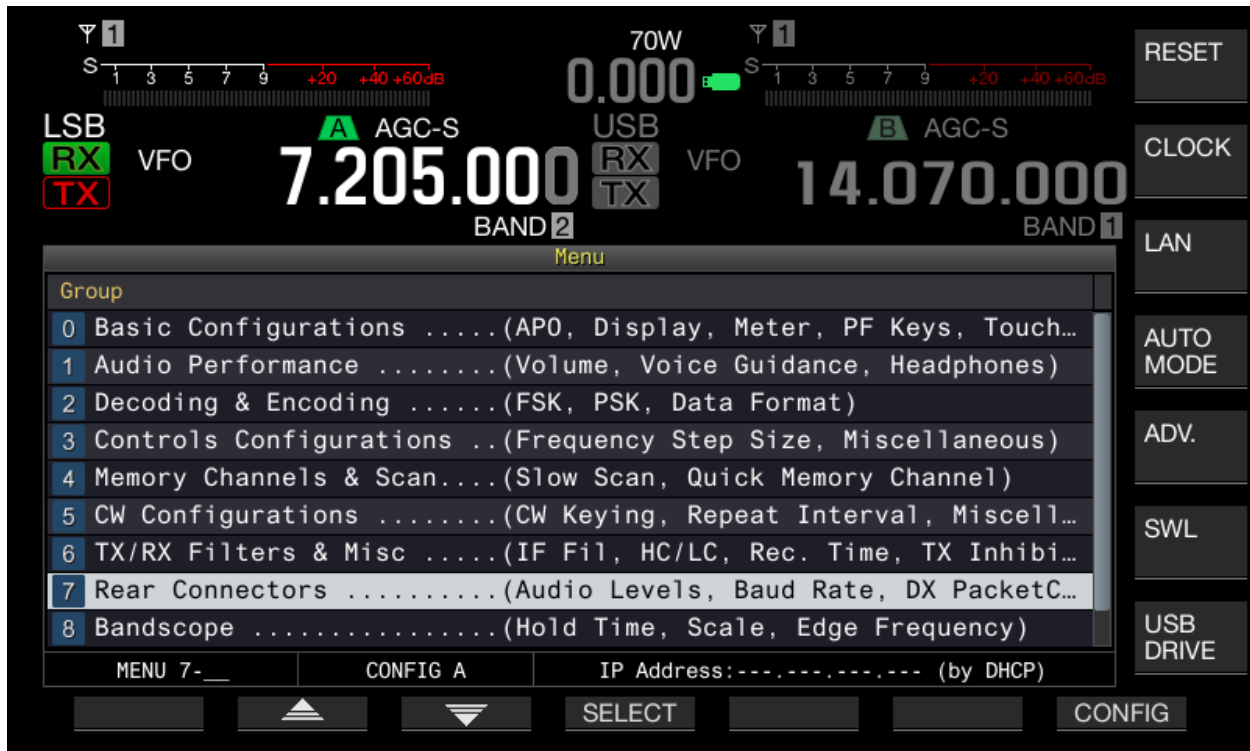


Figure 9 TS-990S Menu Group 7

Press the F4 soft key to select this sub menu. See the Figure (Below) and enter these settings in this submenu.



Figure 10 TS-990S USB Baud Rate Setting

The critical value we are concerned with here are submenu '01' the USB 'Virtual COM Port baud rate should be set to 115200 (bps). In the next figure, we will set the audio levels for the USB audio input and output (TX and RX respectively).



Figure 11 Rear Connector Settings

Note the values for submenu '05', '08', and '09'. Although we rarely use the sub-receiver for data it's still a good idea to set both output levels the same. Note that all the values for submenu items 06 through 13 are the factory defaults. If you use any other device connections to the 'ACC2' or 'optical' outputs, this will be where you make those level adjustments. You may use these for a packet TNC or External RTTY Terminal Unit (TU). You may need to adjust the value of '05' very low (maybe less than 5) in order to reduce ALC indication for no activity later on. This is not a problem, but make changes only 1 digit at a time. In some cases it may be necessary to use the value of 1 here.

At this point you have completed the 'basic' preliminary settings which should allow us to being the actual configuration of the CAT program – Flrig. Other models of transceivers will have similar settings and will most like not look exactly or be named like these. Be sure to copy down the critical settings of baud rate for the transceiver side of the CAT program as this is important! We will use the same setting for baud rate in Flrig (the CAT program).

Congratulations on your work so far! In the next sections we will be connecting the rig to the CAT program (Frig), then pulling the entire configuration together and actually connecting it to the main Program – Fldigi.

Installing the CAT Program (Flrig)

Navigate to the location on your computer where you downloaded the Flrig and Fldigi installer files. Double-click the Flrig setup file. See the below figure:

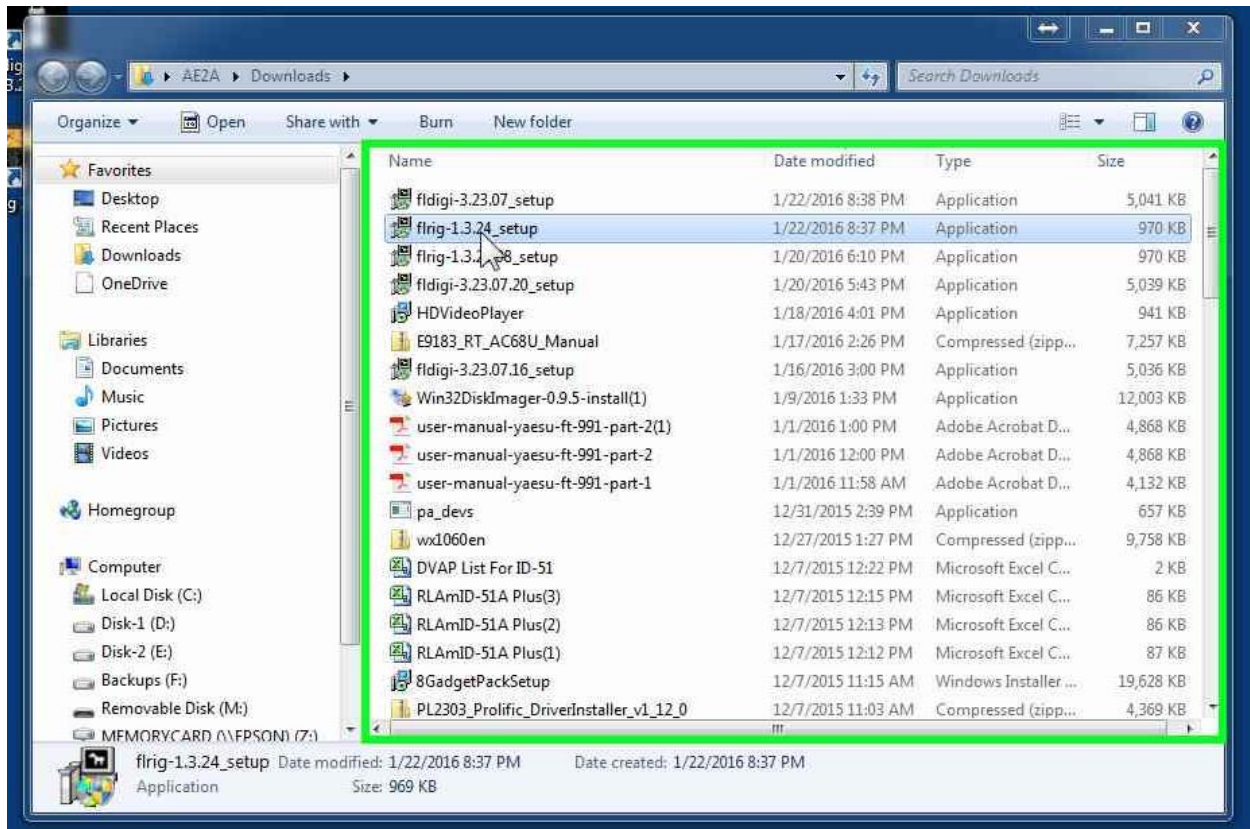


Figure 12 'Downloads Folder'

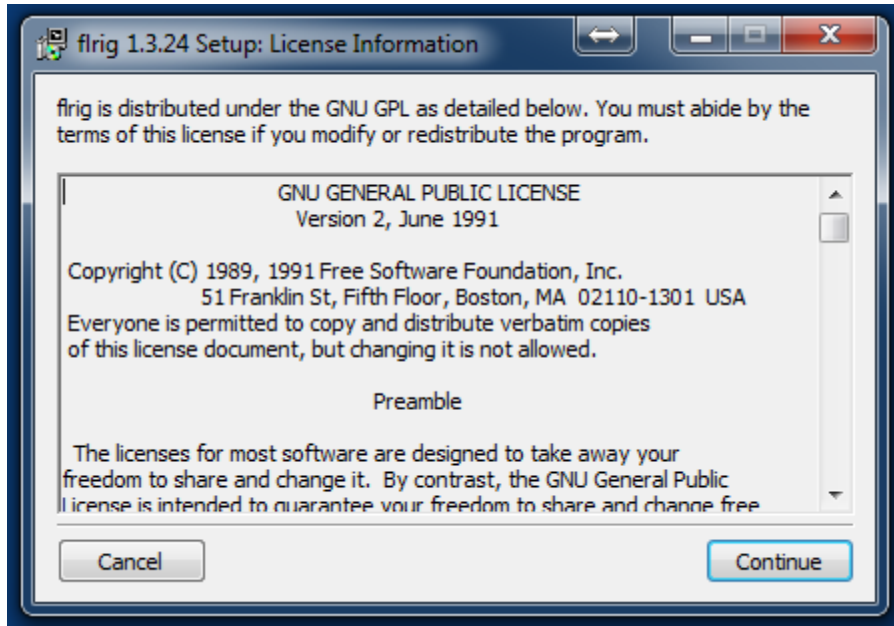


Figure 13 GNU License

Click on the 'Continue' button to accept the GNU/GPL License Agreement.

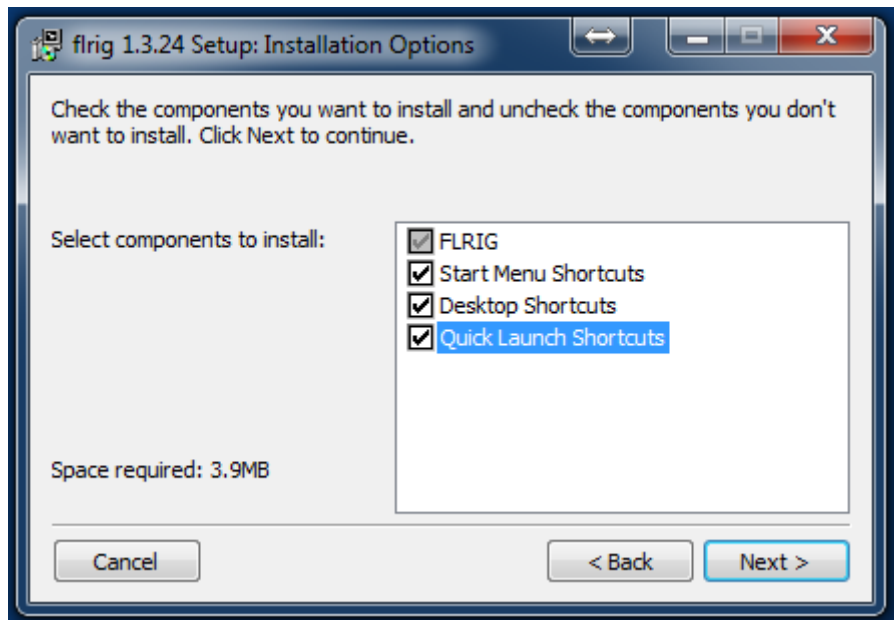


Figure 14 Flrig Options

Select all of the check boxes and click 'Next'.

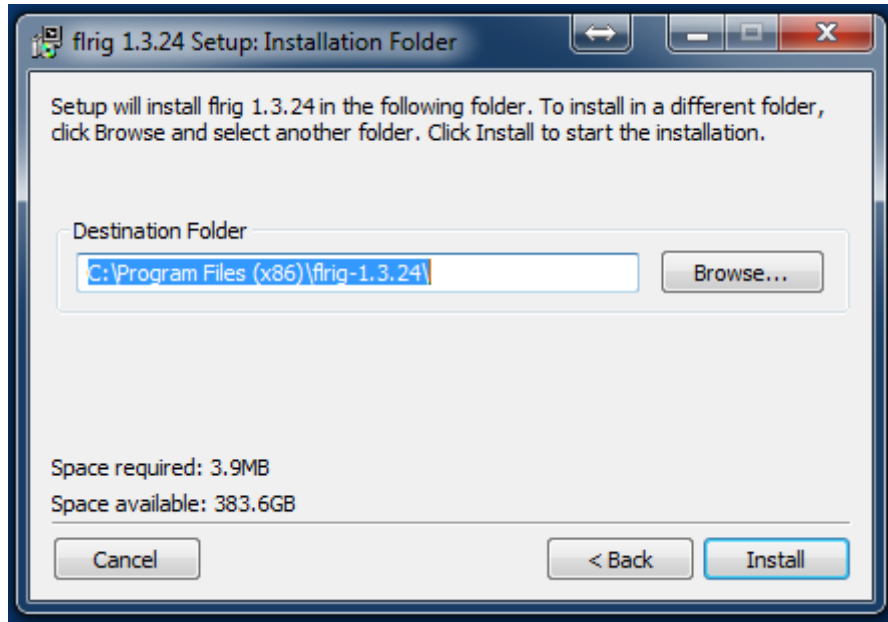


Figure 15 Flrig Folder Selection

Click the 'Install' button and Flrig will install. You may click on the 'Show details' button to ensure there were no errors.

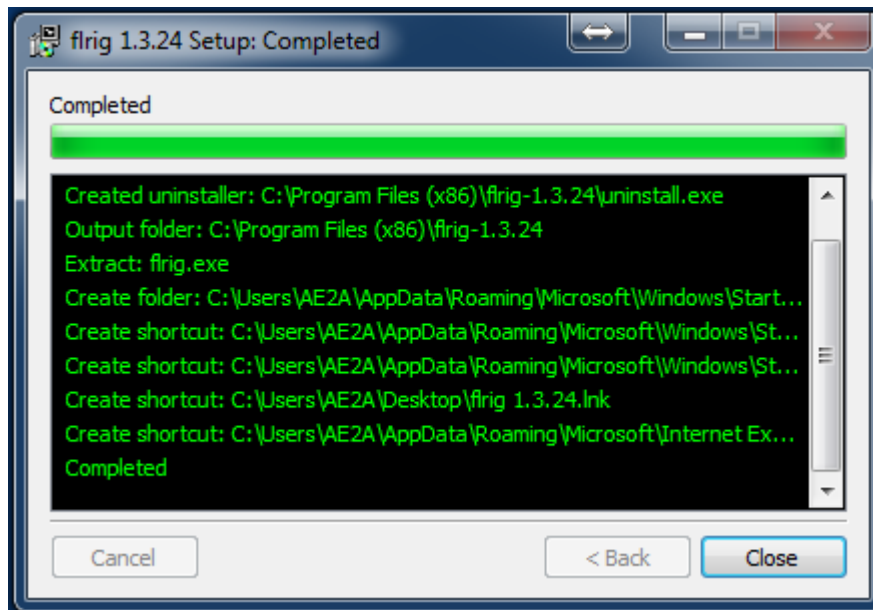


Figure 16 install Progress

Click the 'Close' button.

Installing the main Program (Fldigi)

Navigate back to the downloads Folder and similarly to the above section, Install the Fldigi program. I will show only the sequence of dialog boxes here as the steps to install Fldigi are exactly the same as for Flrig.

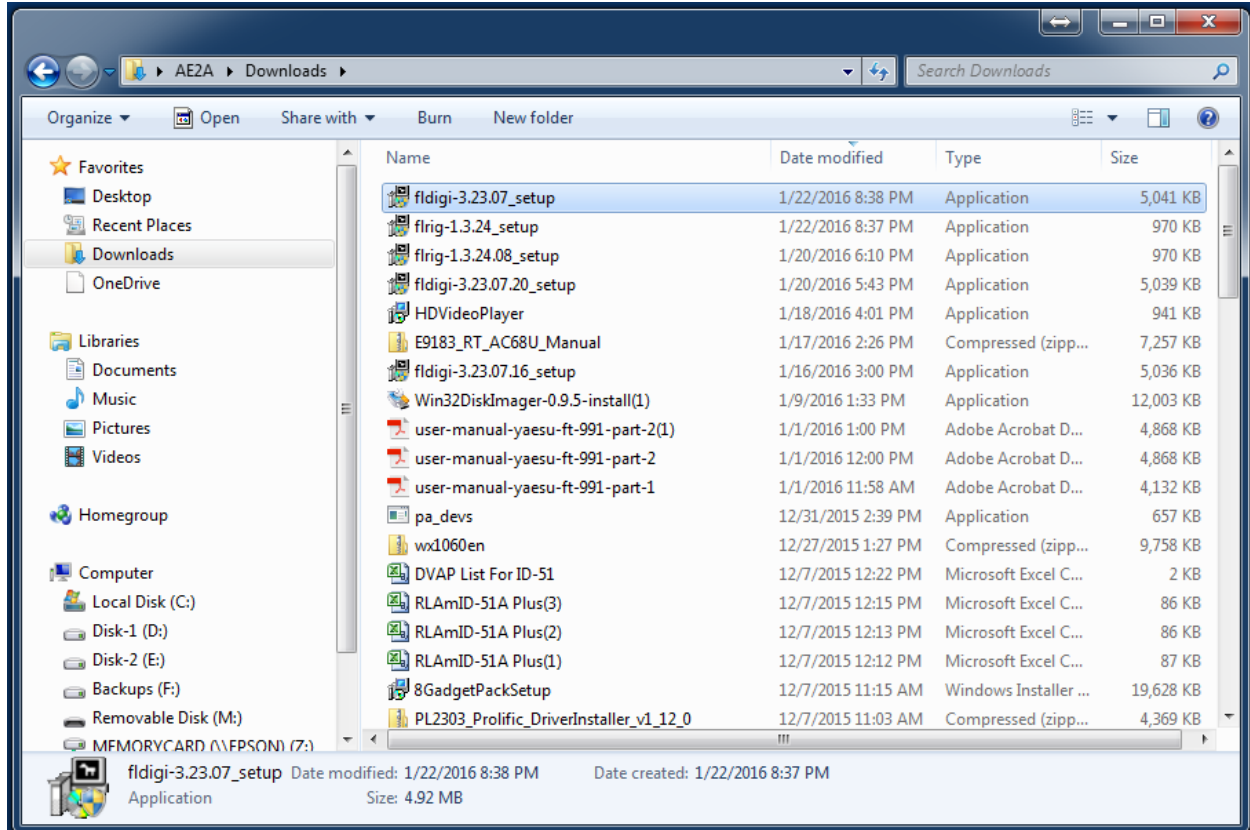


Figure 17 'Downloads' Folder

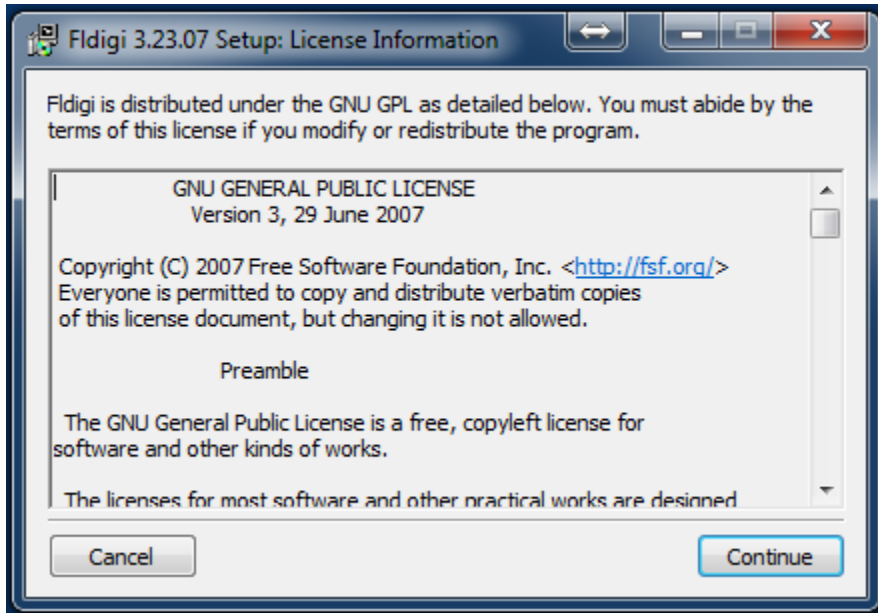


Figure 18 GNU License

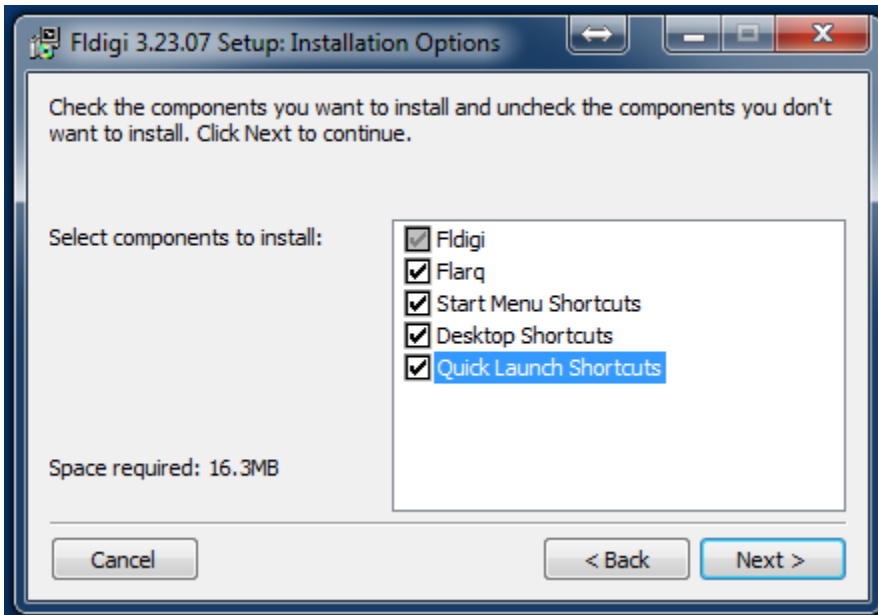


Figure 19 Fldigi Install Options

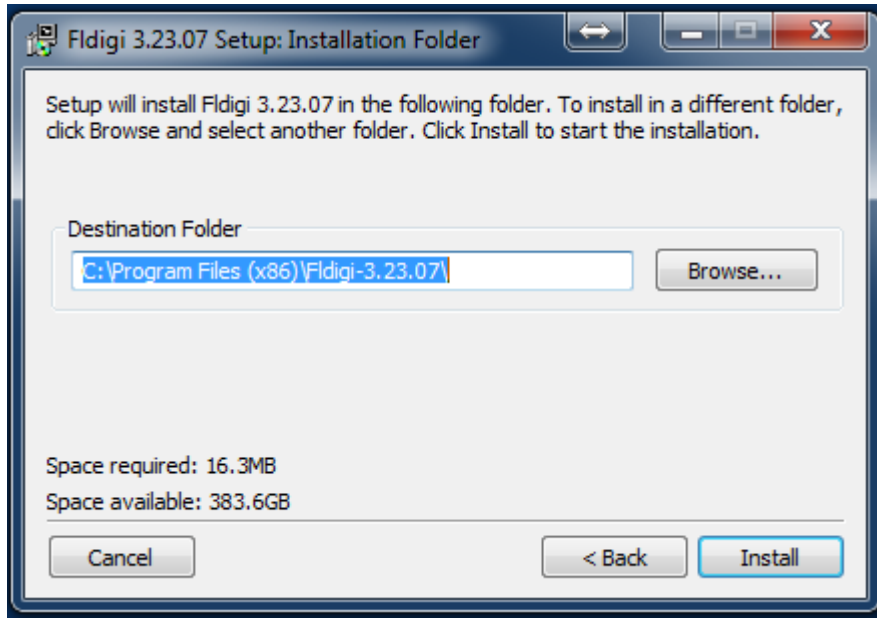


Figure 20 Fldigi Folder Selection

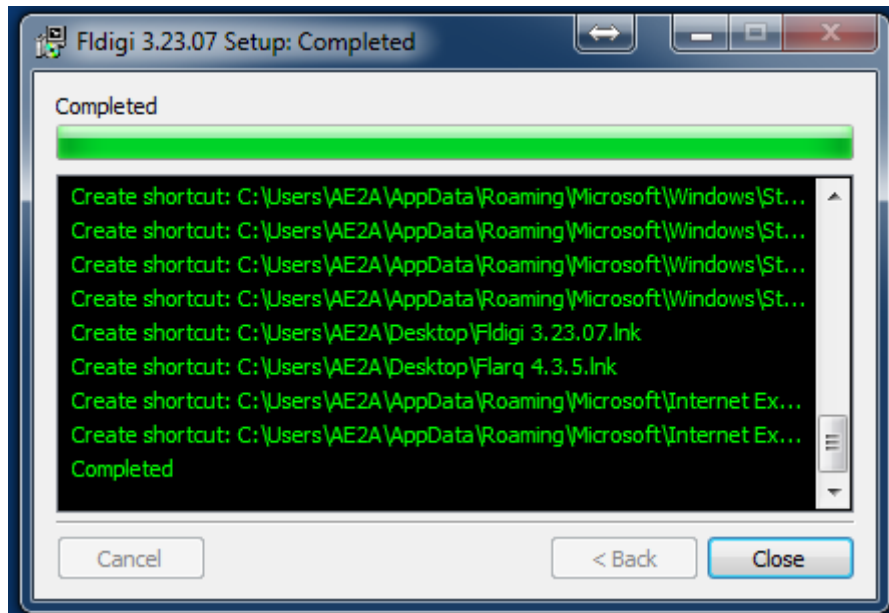


Figure 21 Fldigi Install Progress

This completes the installation of all the digimode software from W1HKJ!

Configuring the Rig Control Software

Open the Flrig program by double-clicking on the Flrig desktop icon.



Figure 22 Flrig Desktop Icon

The main Flrig screen will open. See below.

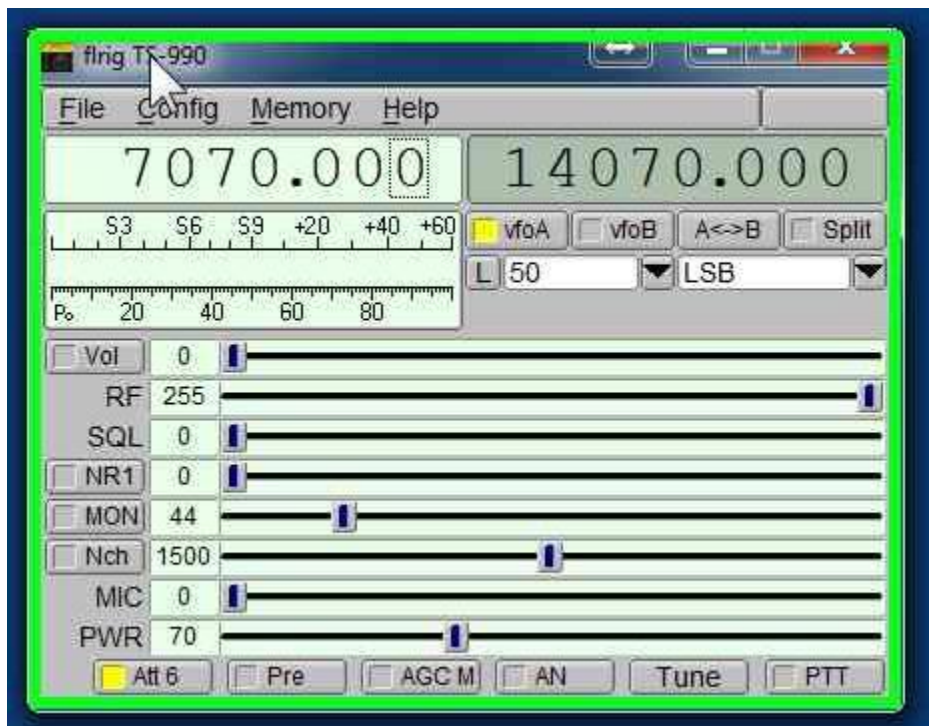


Figure 23 Flrig Main Screen

Please note that there will be no 'Rig Selection' identifier in your first time running version. The 'Rig Selection' identified in the window title will appear after you configure the transceiver, in the following steps. Click on 'Config > Setup > Transceiver' as the below figure illustrates.

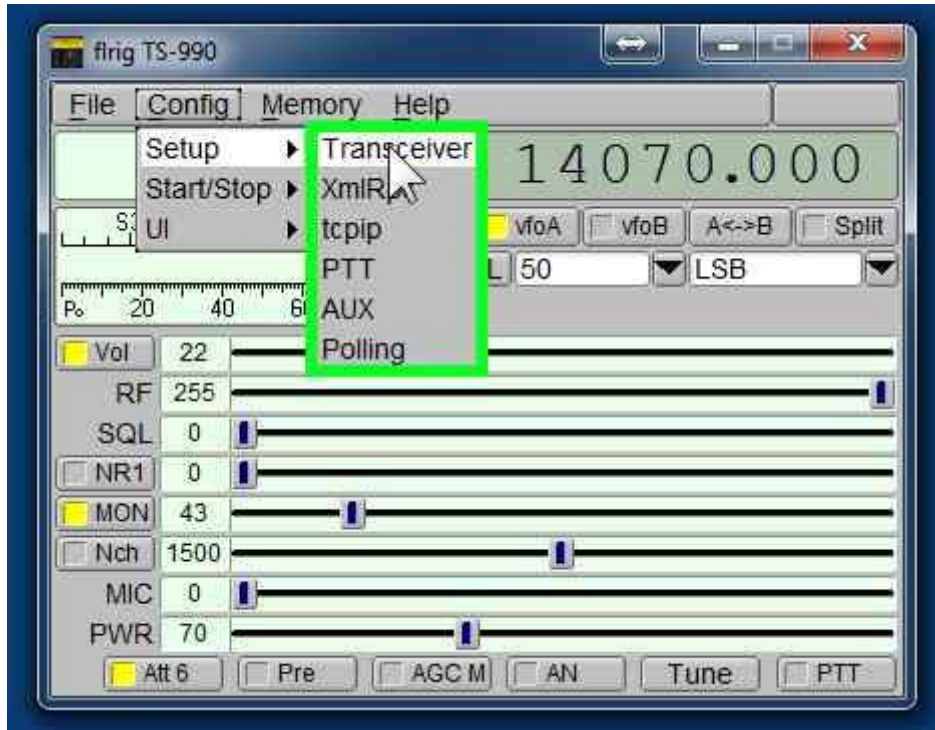


Figure 24 Flrig Setup Selection

This will open the main page of the transceiver configuration. Click the drop-down arrow for the 'Rig' selection and scroll down to the selection for TS-990 (or TS590SG if that is your transceiver). Click the drop-down selection for 'Ser. Port' and select the serial COM port we wrote down from the device configuration section. Only currently active COM ports will show up in the drop down. In my case COM10 is the USB serial device connected to the TS-990S. Click the drop-down selection for 'Baud' and select the serial COM port speed we configured as '115200'. Click the checkbox for 'PTT via CAT and RTS/CTS (handshaking)'. In a similar fashion set the timing parameters to the values shown although the starting defaults will generally work for first time users not familiar with CAT timing. Make sure to check the box labelled 'key fldigi'! My settings here work well with a more powerful CPU and lots of RAM. See the figure below.

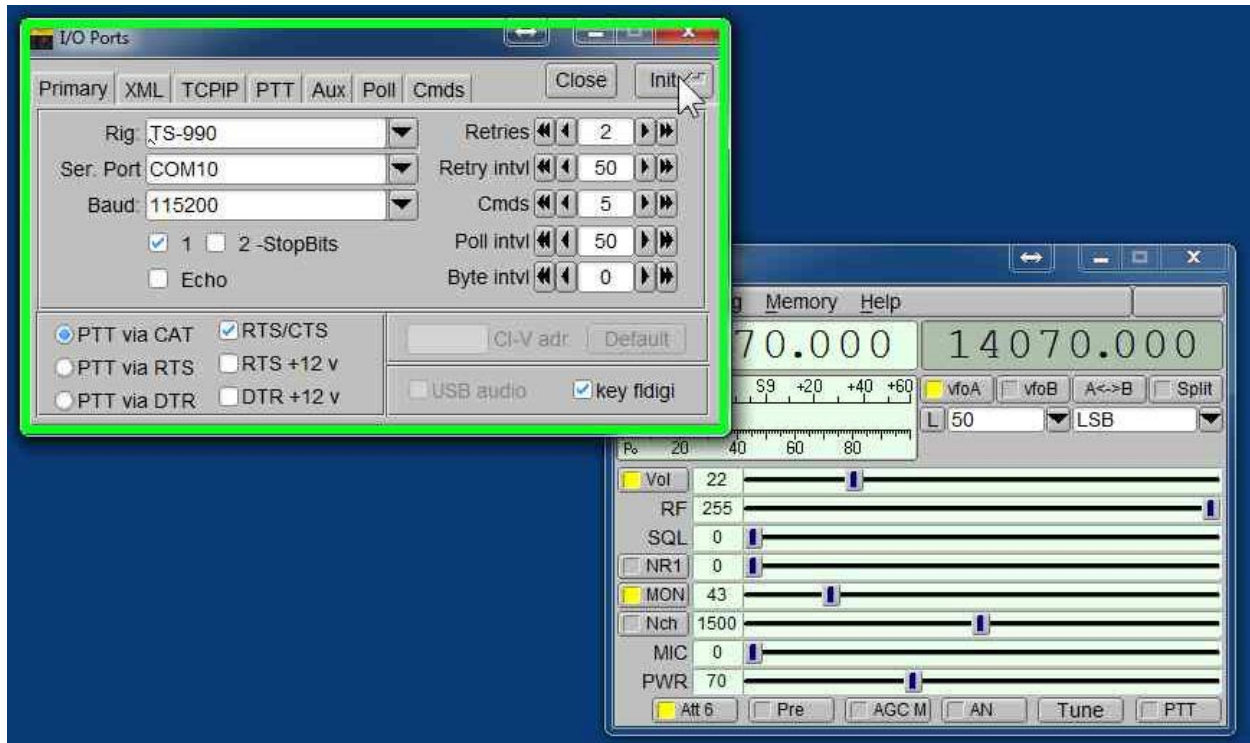


Figure 25 Flrig Transceiver Setup

When you have all the values set , click the 'Init' button and if all is well Flrig will begin communicating with the TS-990S! If you hear a few beeps and see some frequency and display changes, this will confirm all is working!

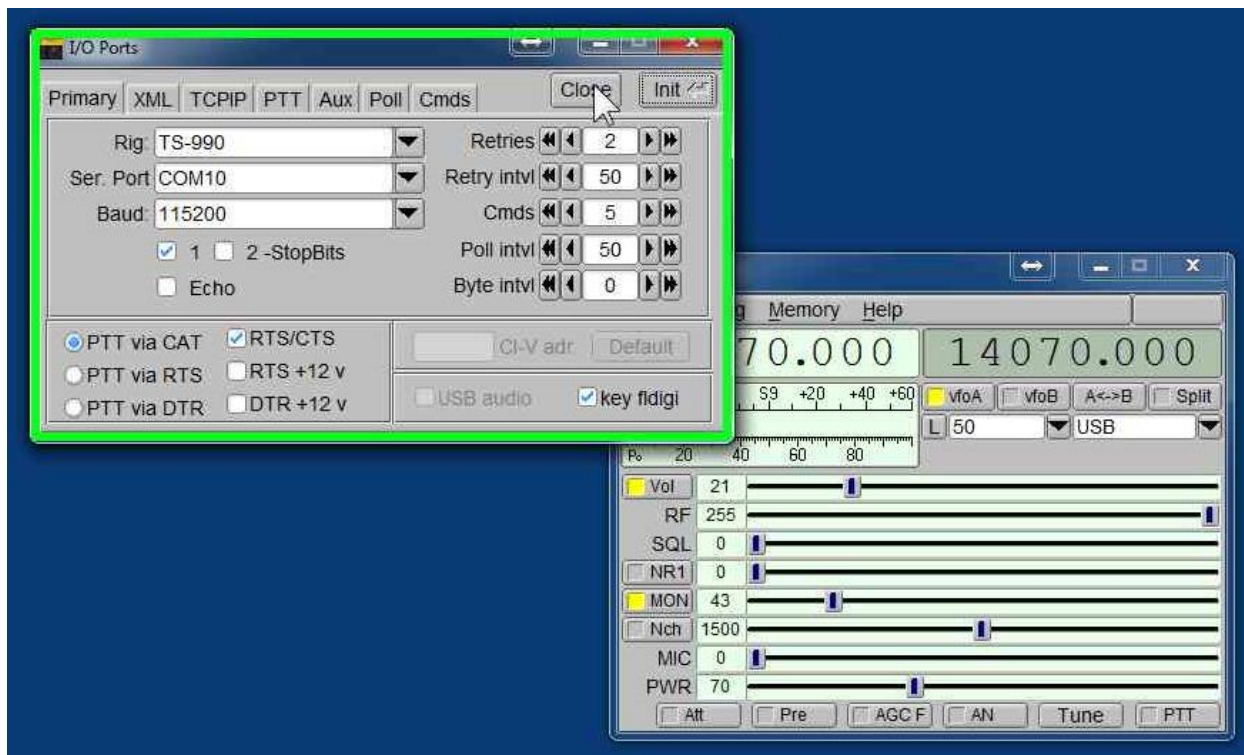


Figure 26 Flrig Close Options

Click the 'Close' button and the 'I/O Ports' dialog box will close leaving just the Flrig main window. You can now change the various controls on the transceiver by means of CAT control right from this window. Change the frequency on the transceiver and Flrig should follow your changes. Change the frequency in Flrig by clicking a digit on the main display and the rig should follow. Clicking the top of a digit will increase the value, while clicking the lower portion will decrease the value. Note that there is also a S-Meter reading bar graph that will closely follow the meter readings on the rig.

There are many more functions included in Flrig, but for the purposes of this document this configuration should be sufficient. I do suggest that you pull the user guide from the Source Forge download page and read it to understand all this wonderful program can do.

At this point you may simply close Flrig after you have familiarized yourself with the basic functions.

Pat yourself on the back as this is not a trivial task and many hams have yet to figure out what you just accomplished!

Configuring Fldigi

The first time you start Fldigi, it will begin a very basic configuration by asking you to fill in your call sign, name, grid square and other basic data about you, your station and other miscellaneous information. Complete the requested inputs and when the program gets to the Rig Control and Sound Card configuration, follow the directions that follow.

Left double click on "Fldigi 3.23.07" on the desktop. Left click on "Fldigi configuration" from the top menu selections. Select the TS-990 RX device from the 'Capture' dropdown as shown below.

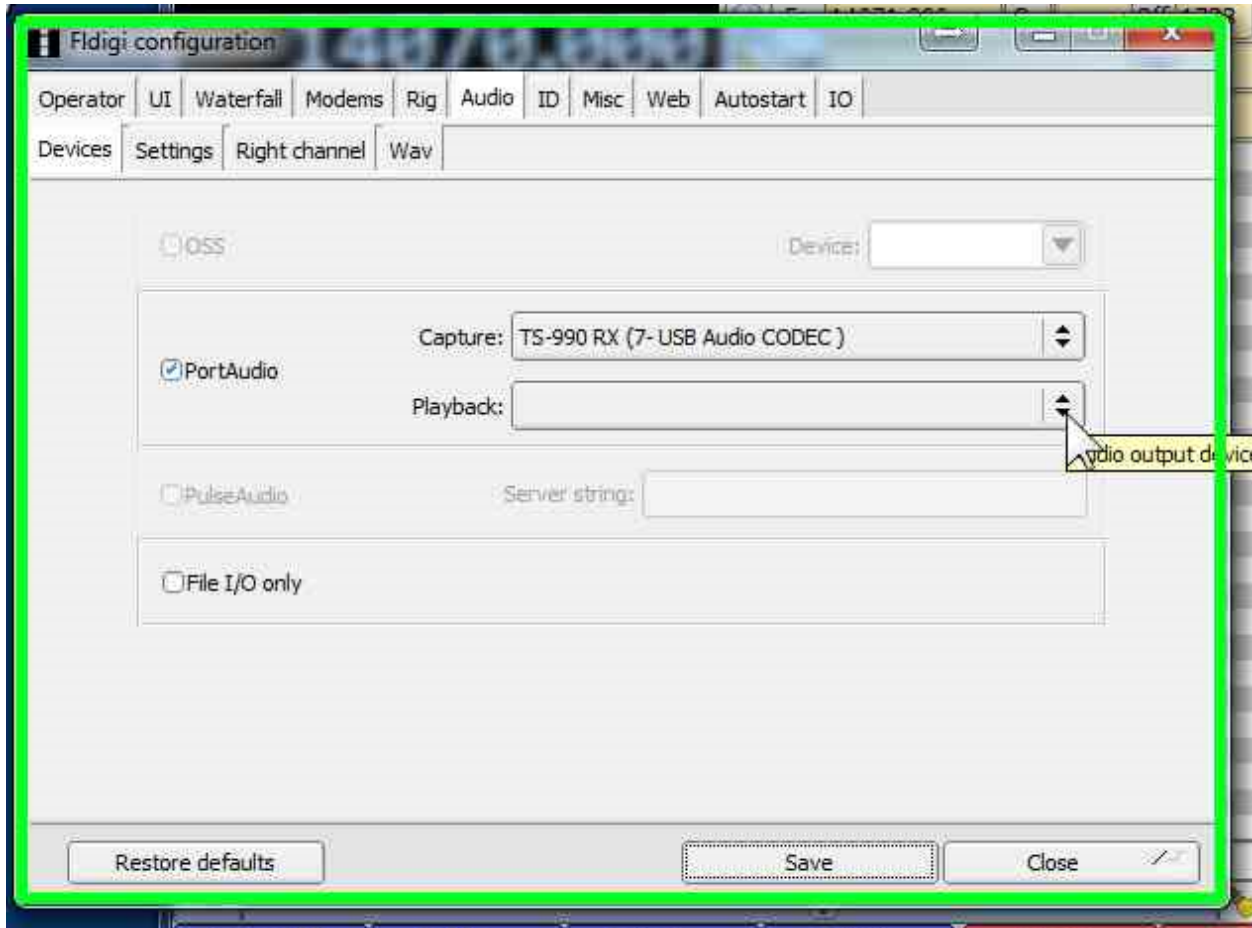


Figure 27 Fldigi RX Device Selection

Remember that this is the receive audio device section of the USB Audio CODEC or the 'Audio Output' of the transceiver. Similarly, select the 'TS-990 TX' device on the Playback dropdown.

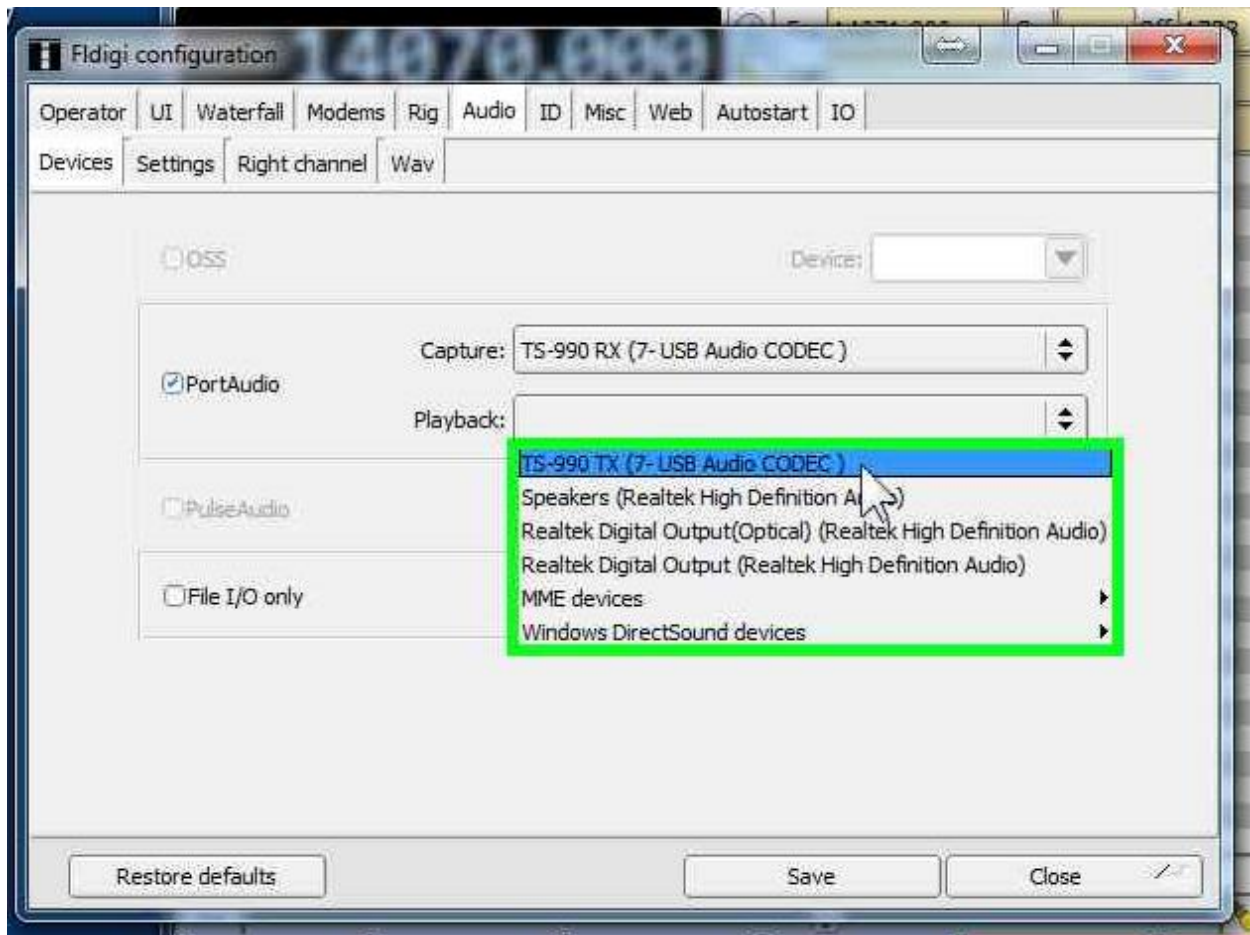


Figure 28 Fldigi TX Device Selection

Consider the 'Playback' or output of Fldigi audio as the input to the transceiver on the USB Audio CODEC device. The levels on the transceiver were previously set lower as Fldigi will by default set the output to 100% (or 0 dB attenuation). We will (try to) always use 0 dB as the highest output level in normal use as a steady tone (or data tone) is always 13 dB hotter than voice for the same peak level. Although we will test at 0 dB output level, we will allow for about 3 dB of headroom. This will require significant attenuation later on. Click 'Save' when done.

Click the 'Right channel' tab and set the dialog box like the below figure.

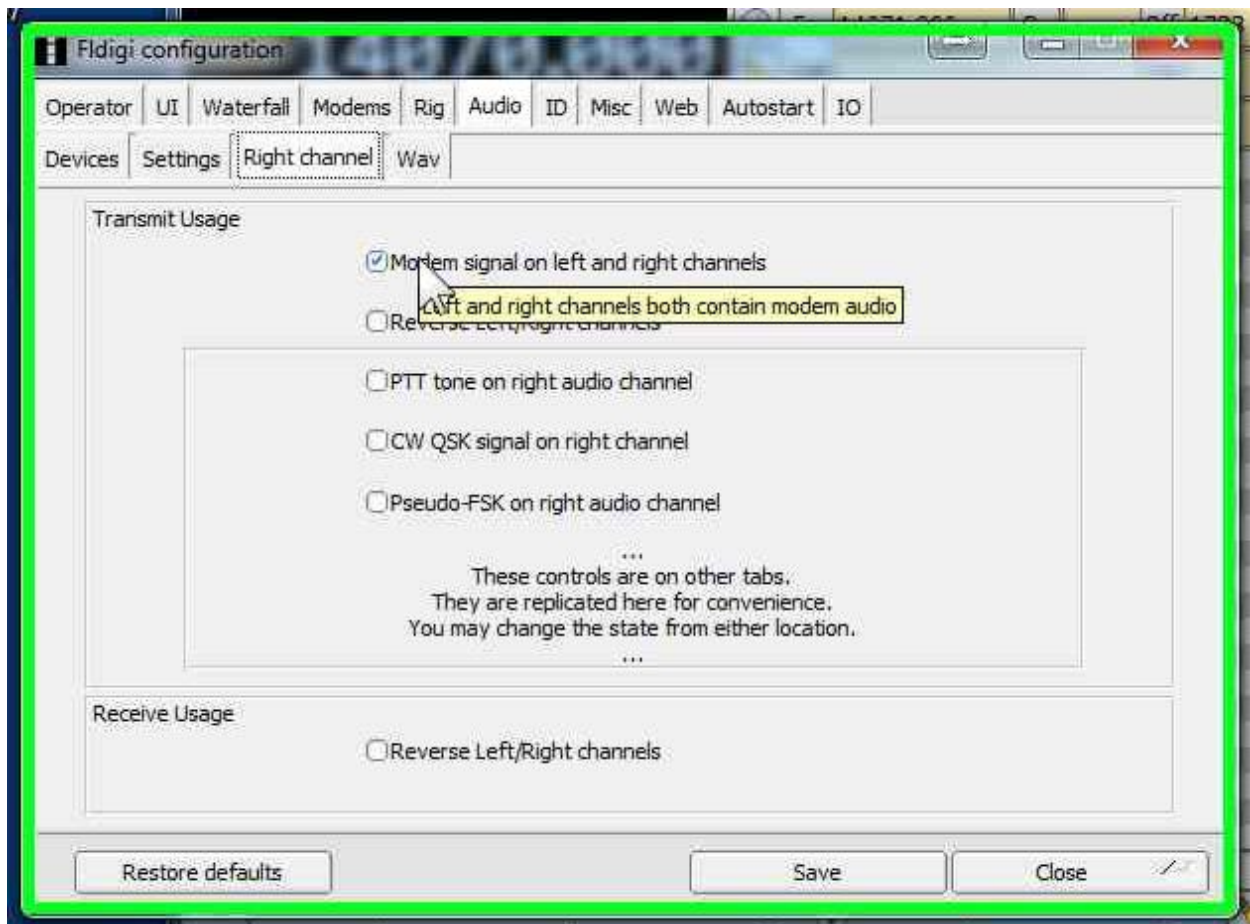


Figure 29 Fldigi Right Channel Selection

Some transceiver USB inputs only look at one or the other channels, setting both Left and Right to output the data audio will solve this issue. Click 'Save', then 'Close'.

Return to the main screen and select the Configure > Autostart selection. We will configure Fldigi to 'autostart' the Flrig program in this menu.

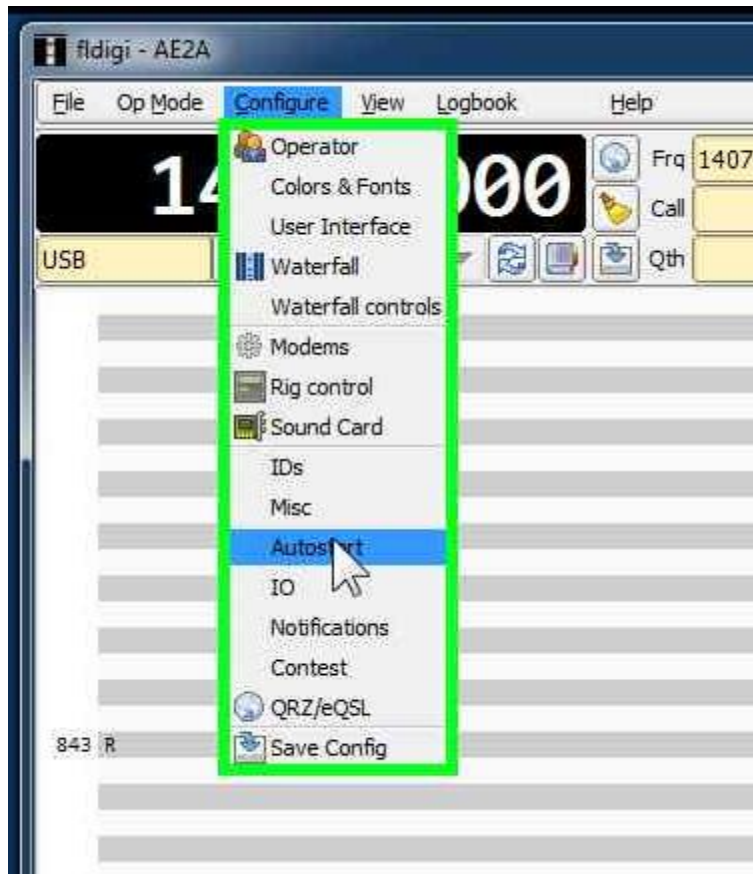


Figure 30 Fldigi Autostart

This will open a dialog box where you will need to navigate to the folder where Fldigi was installed and select the correct executable program (Fldigi).

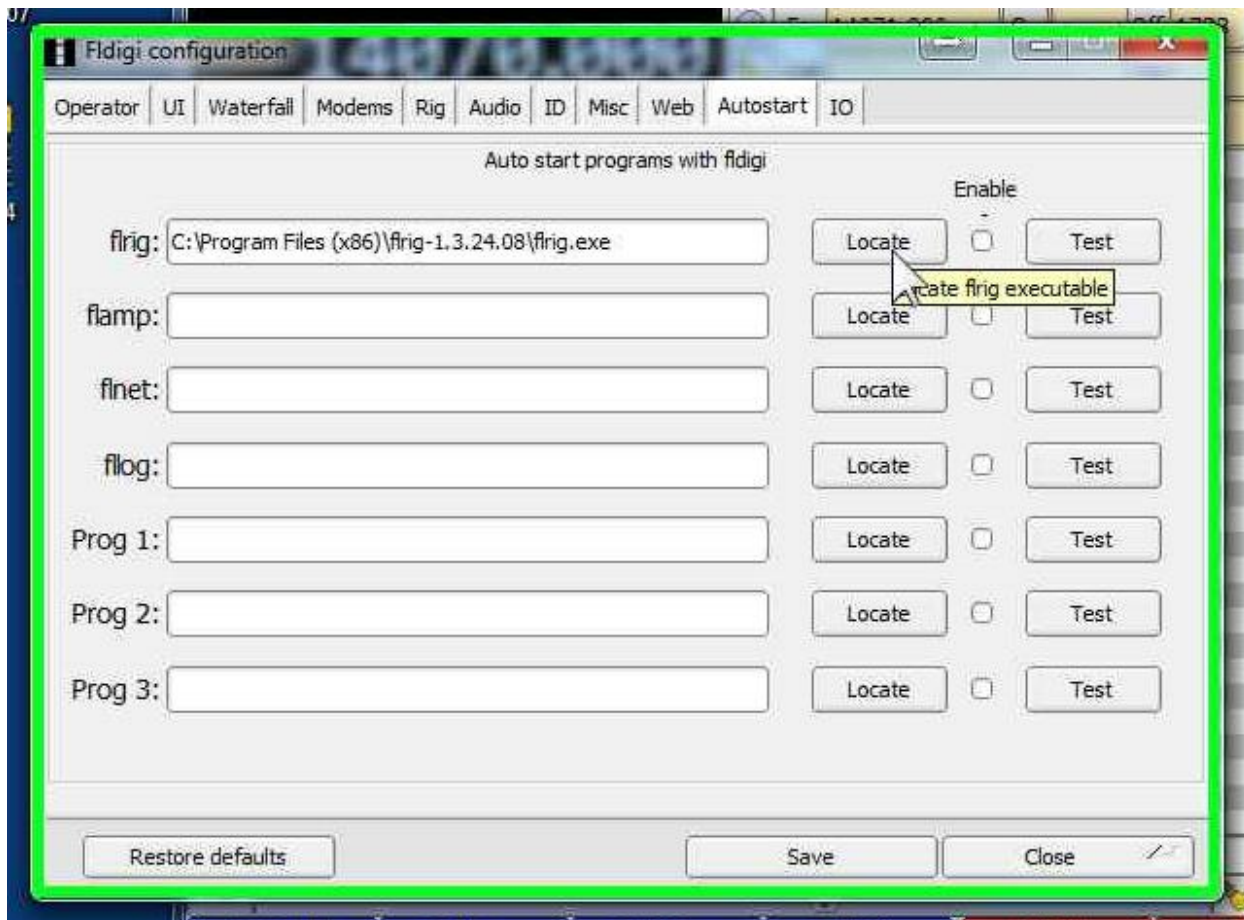


Figure 31 Fldigi Executable Location

Click the 'Locate' button which will open a 'finder' dialog box or simply type the exact full path to the executable. I do suggest using the locate button and following the next few figures as an example.

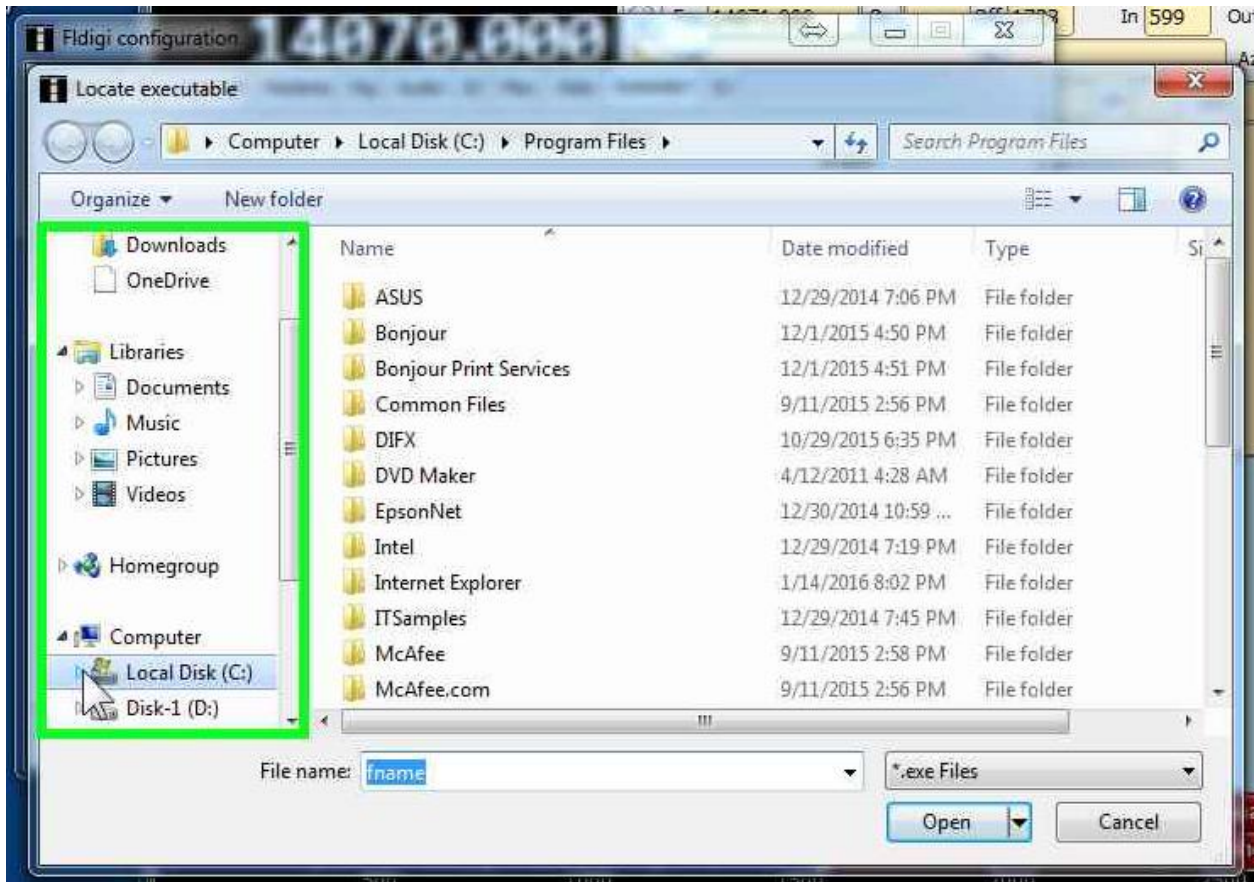


Figure 32 Locate Executable

Double-click the Local Disk (C:).

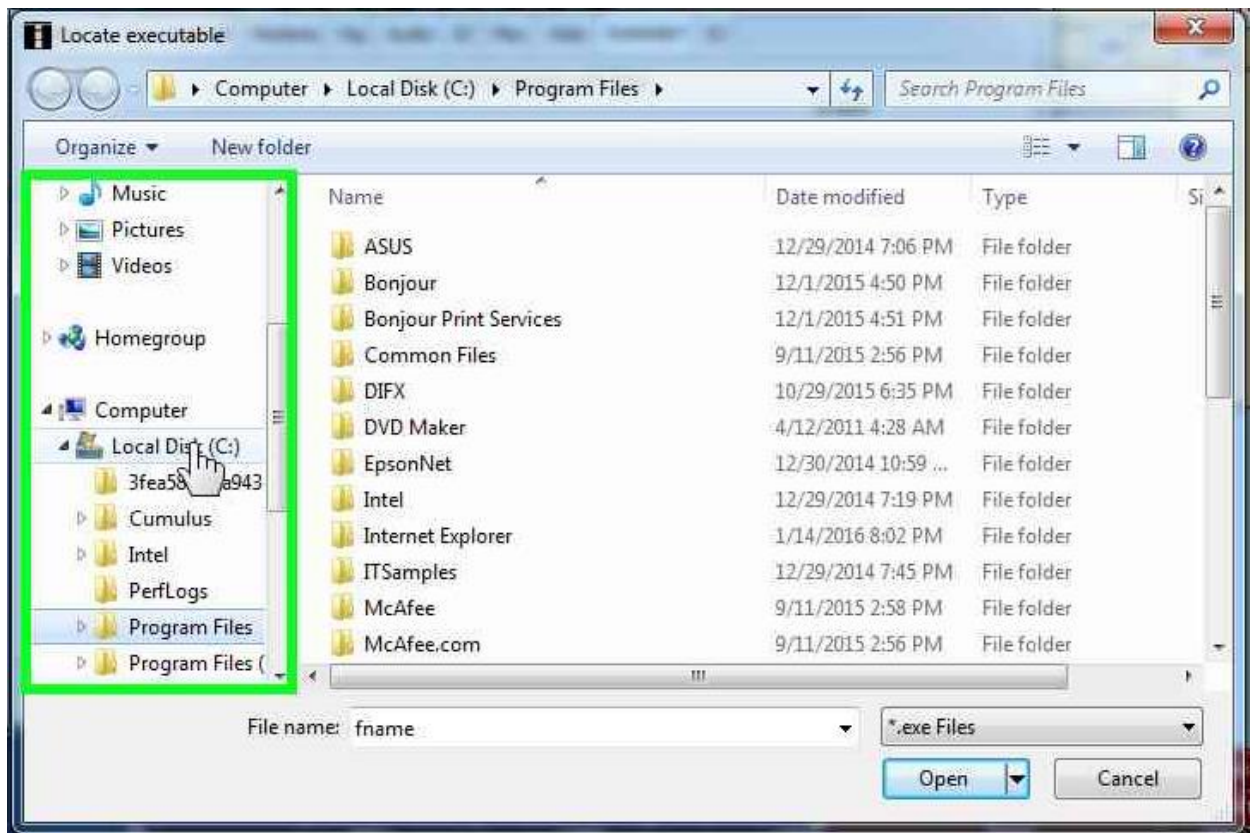


Figure 33 Select C: Drive

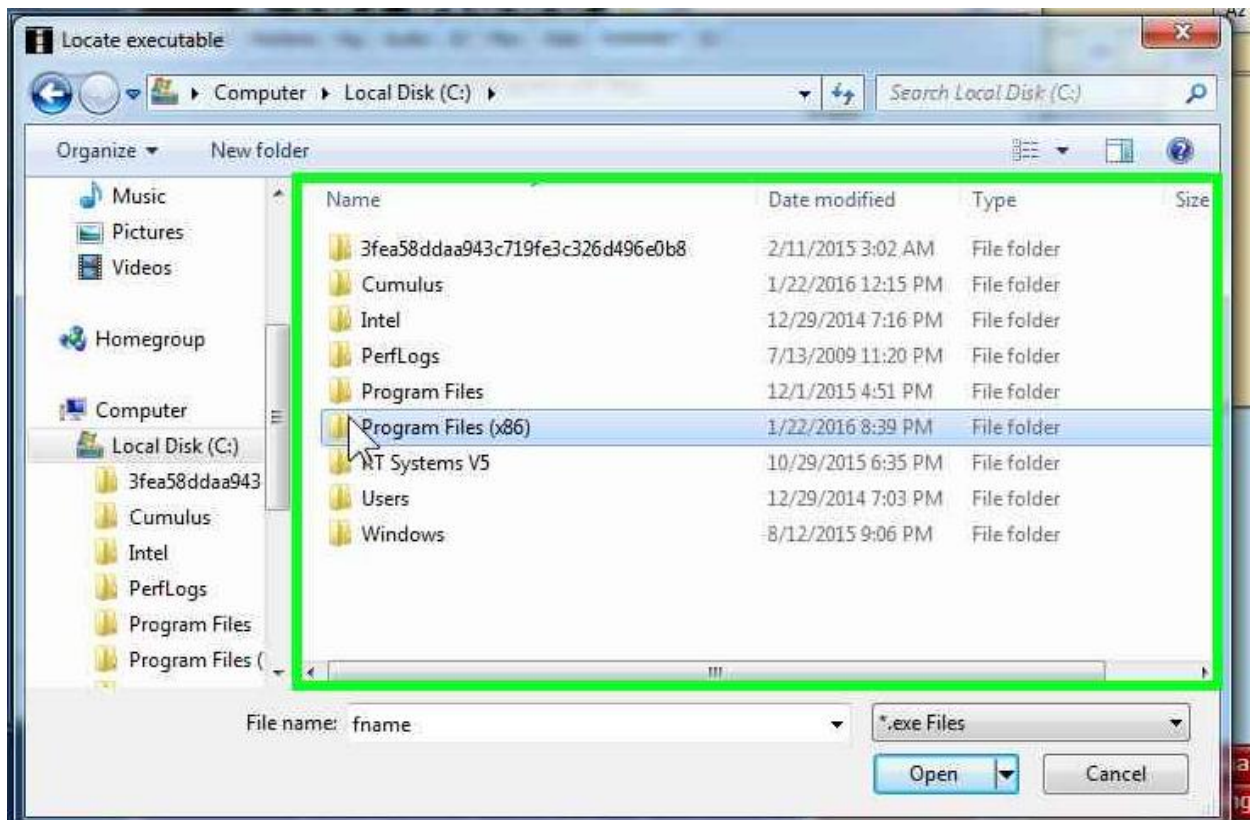


Figure 34 Select Program Files (x86)

Double-click on 'Program Files (x86)'.

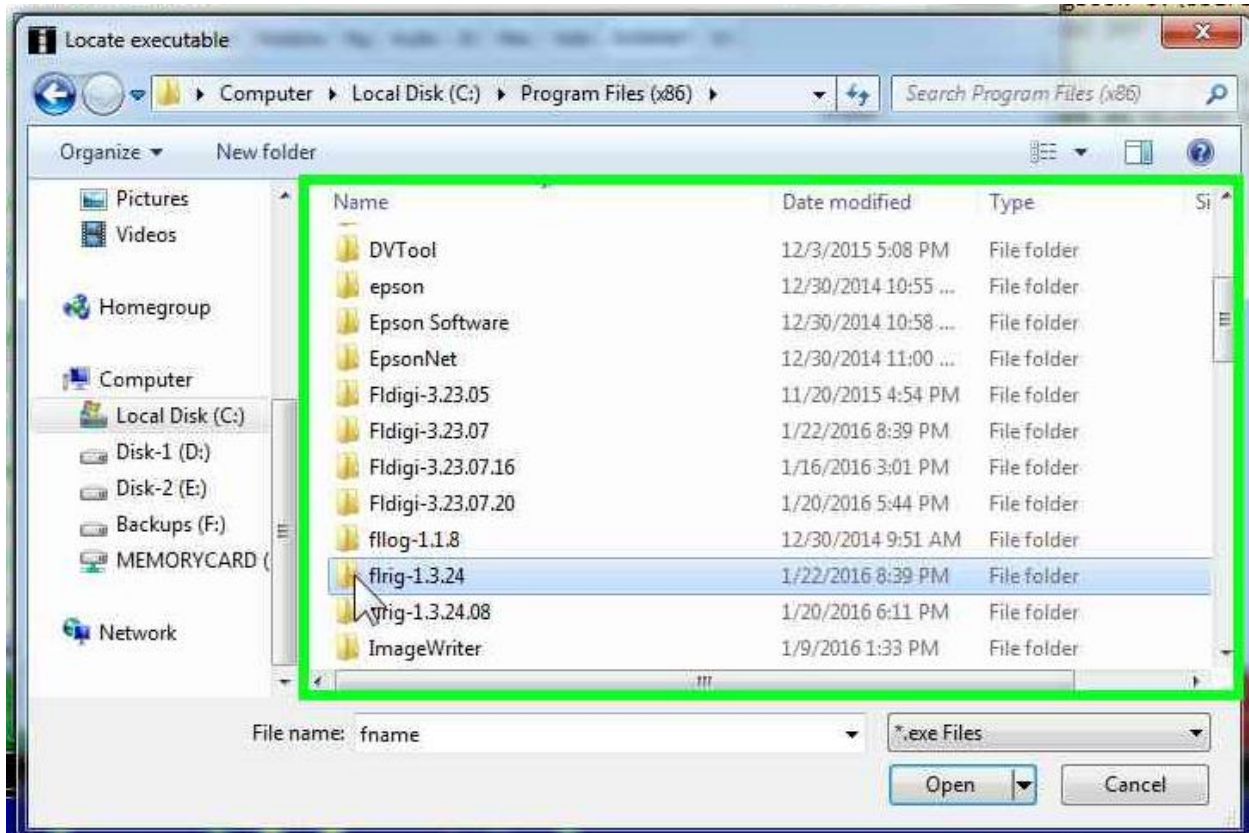


Figure 35 Select Flrig Folder

Double-click on 'flrig-1.3.24'.

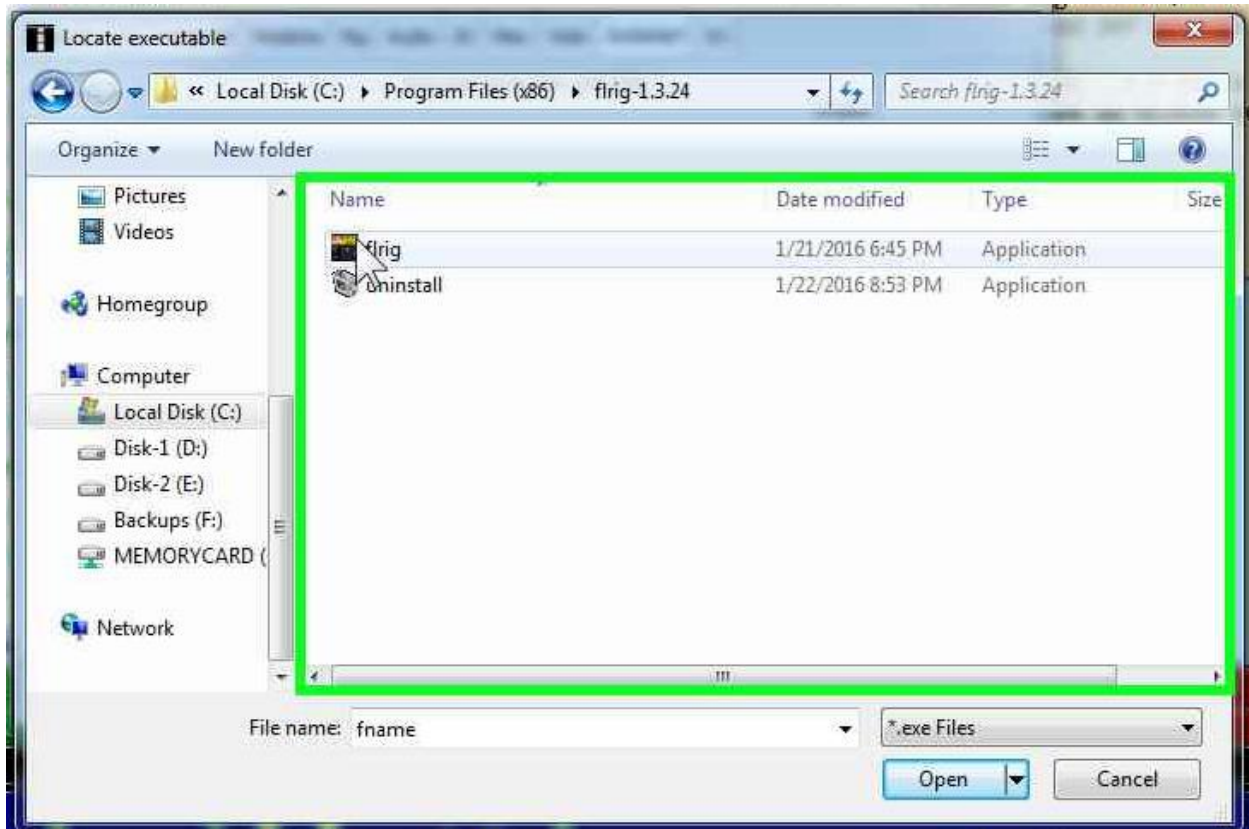


Figure 36 Select Flrig

Click on Flrig.

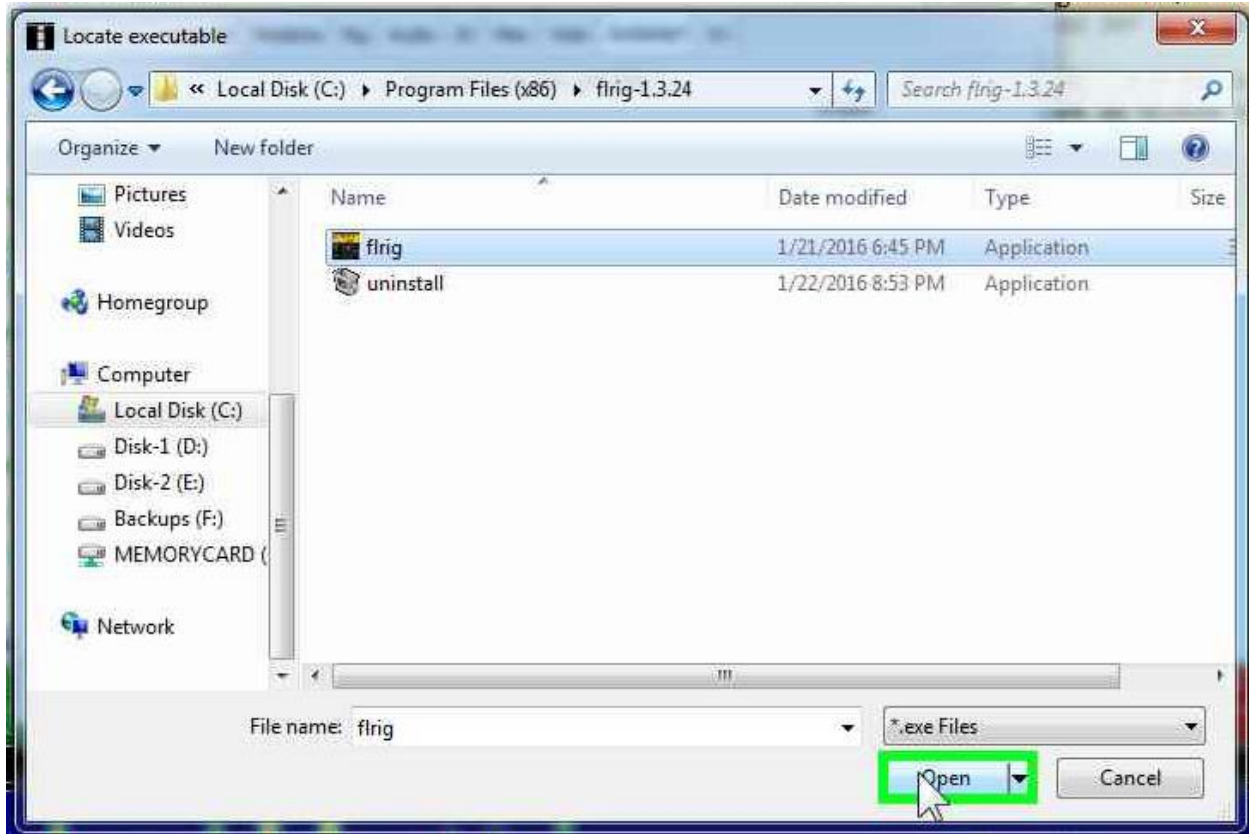


Figure 37 lick Open

Click on 'Open'..

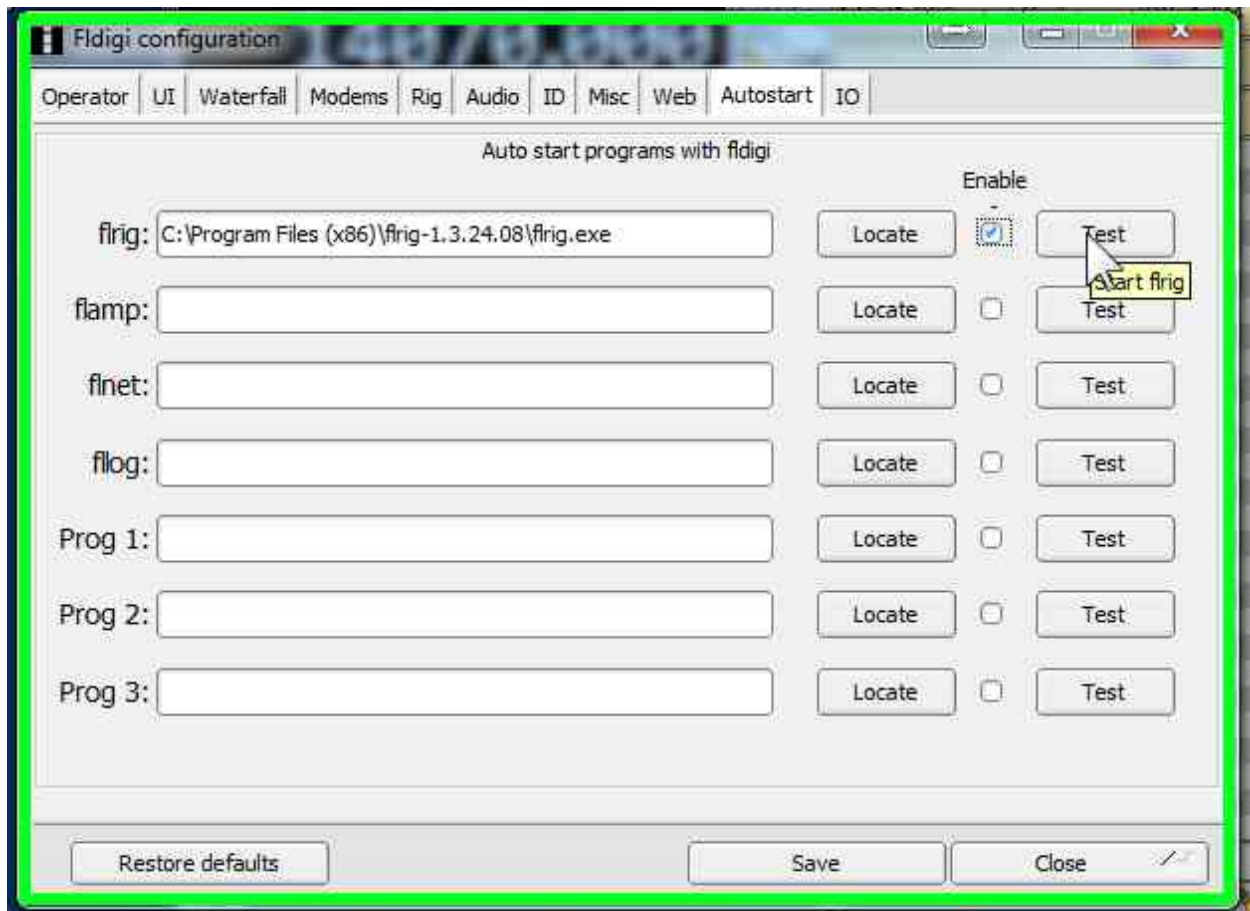


Figure 38 Test Path

Click on the 'Test' button which will cause Fldigi to start. If all went well, click the checkbox for 'Enable' and then click 'Save', and 'Close'.

At this point Fldigi will 'autostart' flrig when starting and establish full CAT control. Your sound devices are properly configured for input and output, and the basic User data has been configured. In the next section we will fine tune the audio levels and transmit power settings.

Fine Tuning the Audio Levels

One thing that we will need to verify is that the transceiver will use the audio input from Fldigi. There are many options in the TS-990S for audio and menu selections so I will present only those that pertain to the correct functioning of Fldigi.

Selecting the Audio Source for TX on the TS-990S

Press and HOLD (for 2 seconds) the 'DATA' button on the front panel of the TS-990S to open the 'DATA Mode 1' Audio Input selection. Note: There are four 'Data Mode' selections in the TS-990S. Each can be selected by an additions button push on the 'DATA' button. For the purposes of this document we will only be concerned with 'DATA Mode 1' Audio Input selection. You may wish to configure the others at a later time. It is important to note that you can also make a selection in the 'DATA Mode Off' section for 'Normal' SSB operation. Don't get crazy trying to turn 'OFF' the mic input under 'Send PTT' or 'DATA SEND' as this will unfortunately disable PTT by CAT command also! You will need to either disconnect your microphone or turn the 'MIC' gain control fully counterclockwise (minimum) so the room noses are not transmitted while in digital modes. *If you wish to experiment with the 'DATA VOX' turned 'ON' and using VOX for PTT, you may be able to automatically disable the microphone audio that way. I have not tried this method.*

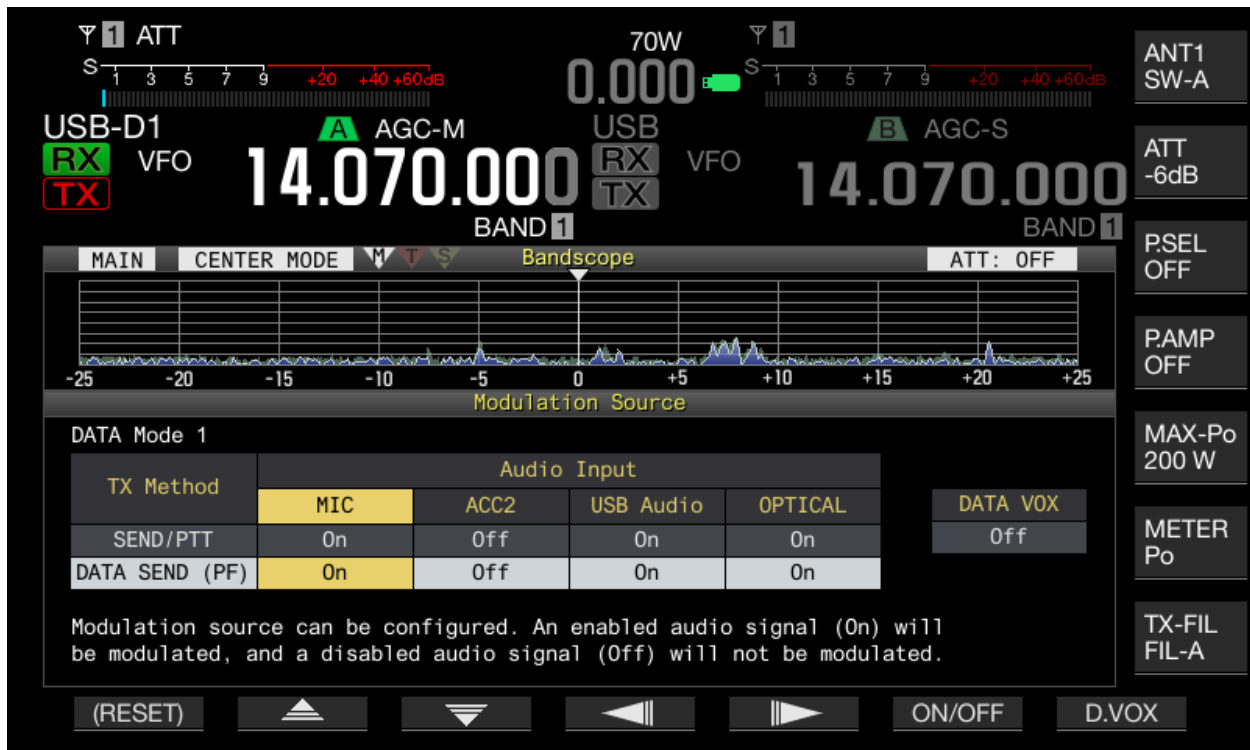


Figure 39 TS-990S Audio Input Selection

Ensure that 'DATA Mode 1' settings are set like the above. Press the 'DATA' button until you get to the 'DATA Mode Off' screen.

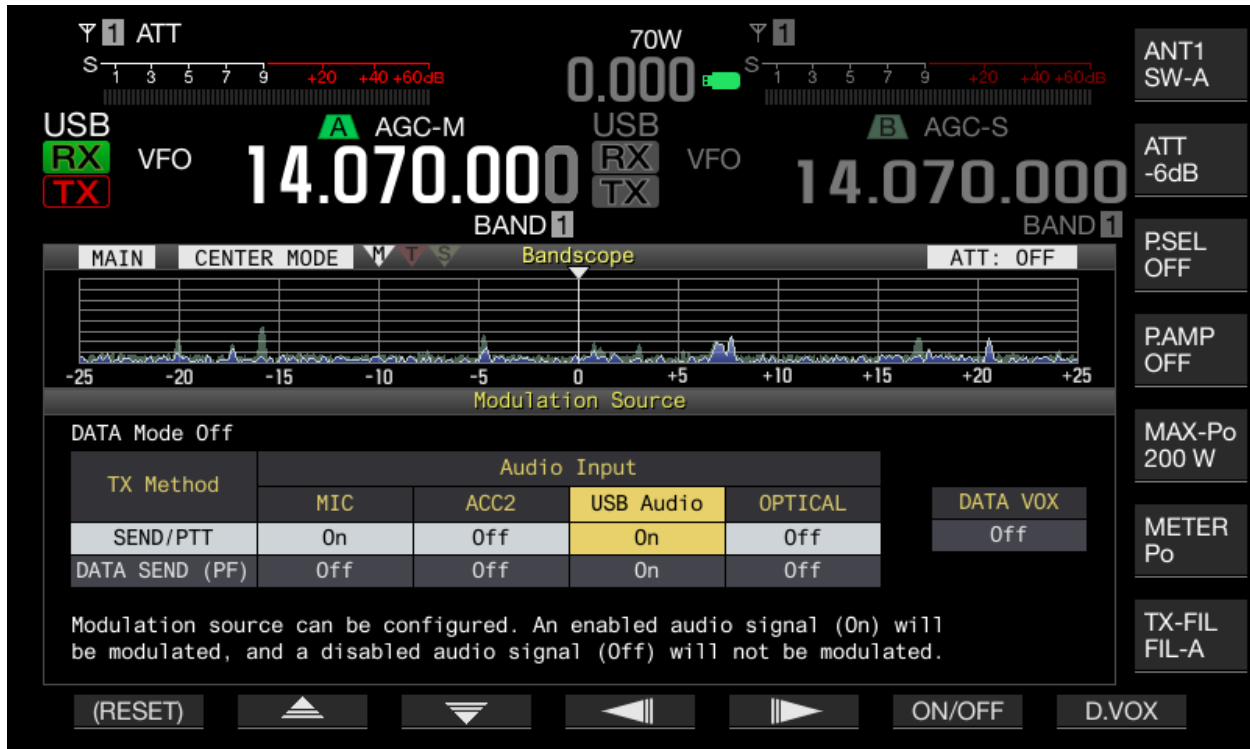


Figure 40 Select USB Audio

Configure the settings here like the above for the USB audio input selection. This completes the audio input selection on the TS-990S, the same process will need to be followed for any other transceiver that has a USB audio input, but the exact steps will be dependent on the specific rig. Refer to the 'Operator Manual' for specifics on each transceiver.

A Note about Audio Level Settings

There are some basics to understanding how the 'gain' controls either in Windows or in the transceiver operate. Specifically in the TS-990S, the gain controls in the USB configuration menus are course adjustments meant to get you close enough to 'fine tune' the levels in Windows for (fine control) best performance.

Transmit audio level controls the TX output power. Up to the maximum power output of the current TX power setting, the audio level set in Fldigi will be your method of controlling your TX power output. Using too high an audio level (above -13 dB per the way we will set the levels) will result in high Intermodulation Distortion (IMD) and a MUCH wider than normal TX signal that will be hard to decode. The combination of the maximum TX power (the PWR control) and the audio level set in both Windows and Fldigi (the total audio level sent to the USB audio device in the TS-990S) control the quality and actual TX power. Keep this in mind as we proceed to 'fine tune' your signal! We will begin with the receive audio level ('recording level' in Windows).

Fldigi Receive Input Level

The receive audio input level to Fldigi is entirely controlled by Windows once to 'course' level has been set in the TS-990S USB RX Output menu. Fldigi has an input level indicator (the little diamond icon) in the lower right portion of the main Fldigi screen. Using the default colors scheme setting in Fldigi, this icon should remain GREEN all of the time. Some excursions into the YELLOW zone are unavoidable due to the varying effects of RX signal strength, AGC action, and band conditions. Flashes of RED indicate that the audio level is consistently too high. Fldigi also provides an easy to use audio level indication to aid in this adjustment. These two methods work with each other.

This is the 'diamond' Icon:

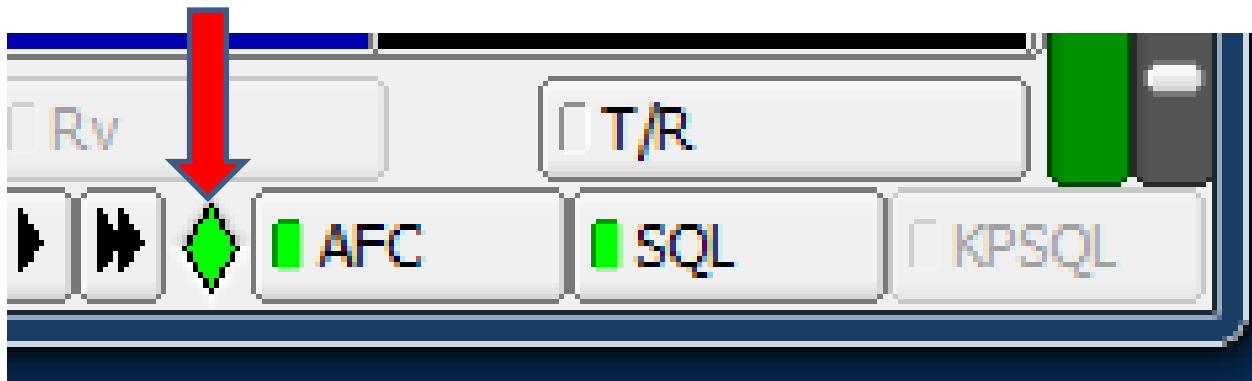


Figure 41 Fldigi RX Level Icon

This is your 'rough' idea of how the audio level is adjusted. The much finer level display is to use the 'WAV' display. You can get to this display by clicking the 'WF' (wave form) button in the lower left corner of the Fldigi main window.

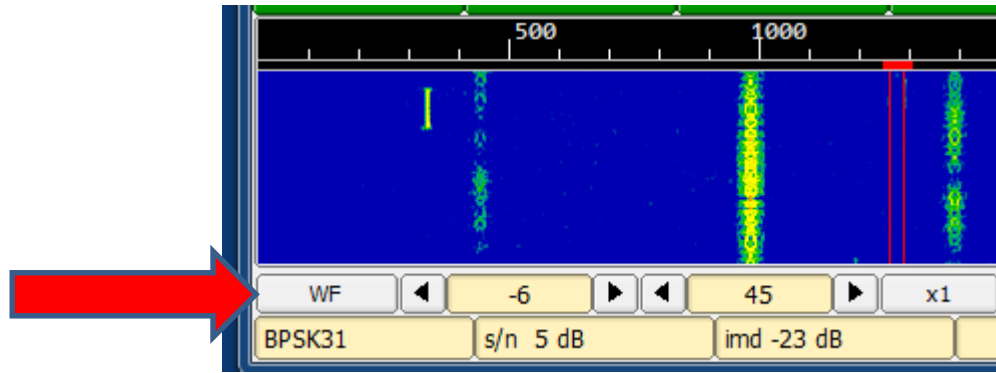


Figure 42 Fldigi Waterfall View Button

Click this button twice to change the display .The first click will change the display on the waterfall to the histogram display. The second will put you in the ‘WAV’ display. There are three different views in total.

The figure below shows a proper input level that does not exceed the two white limit lines.

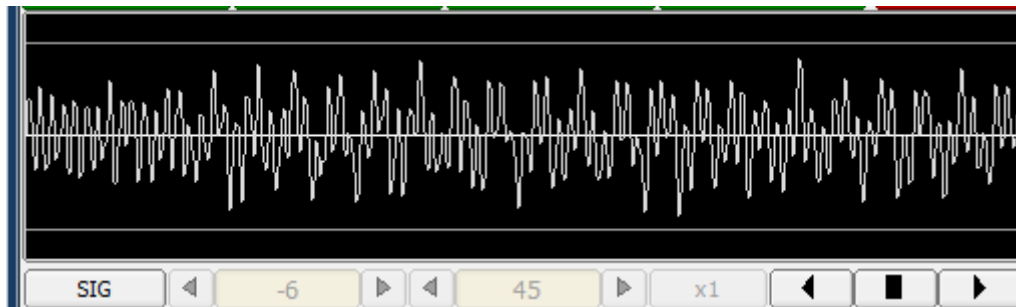


Figure 43 Fldigi Signal View

It is better to have a little less gain than too much gain here, the digital detectors are very sensitive. Your display may not look exactly like this, but the peak levels of the trace should not exceed the limit lines. Adjust the Windows recording device levels using the Control Panel > Sound menus and adjust the ‘TS-990 RX’ device.

Select this Device (this assumes that you have named the device per this document earlier).

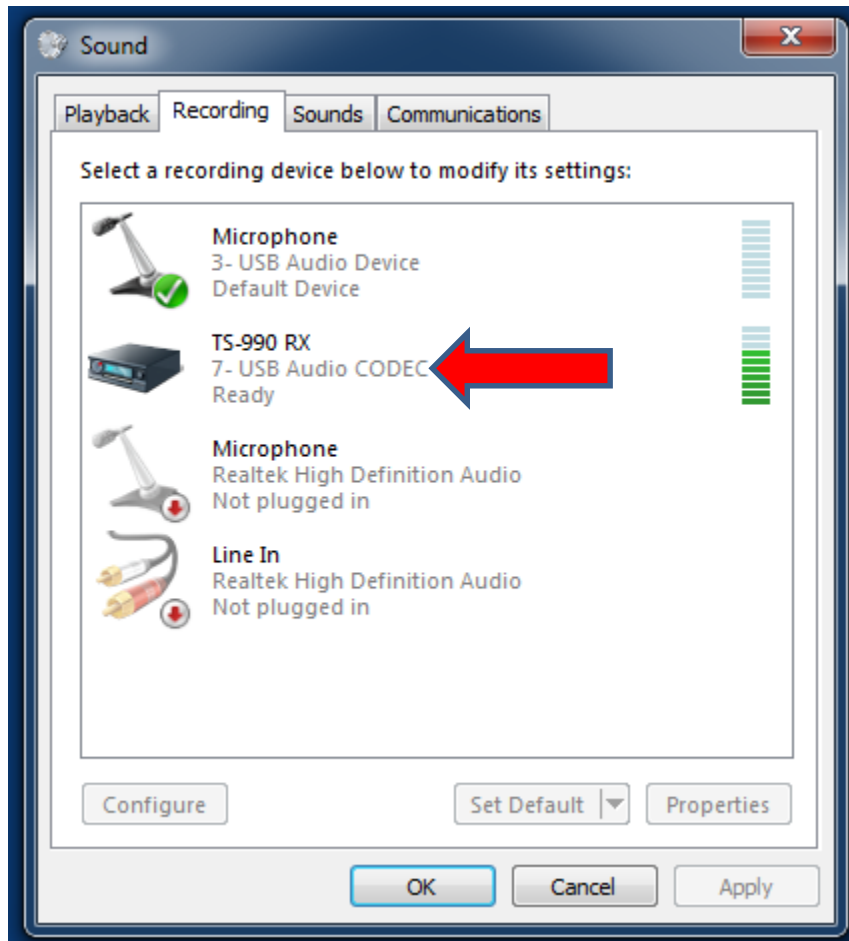


Figure 44 Select RX Device

Note the vertical bar graph indicating this device has audio on it and is receiving input from the TS-990S.

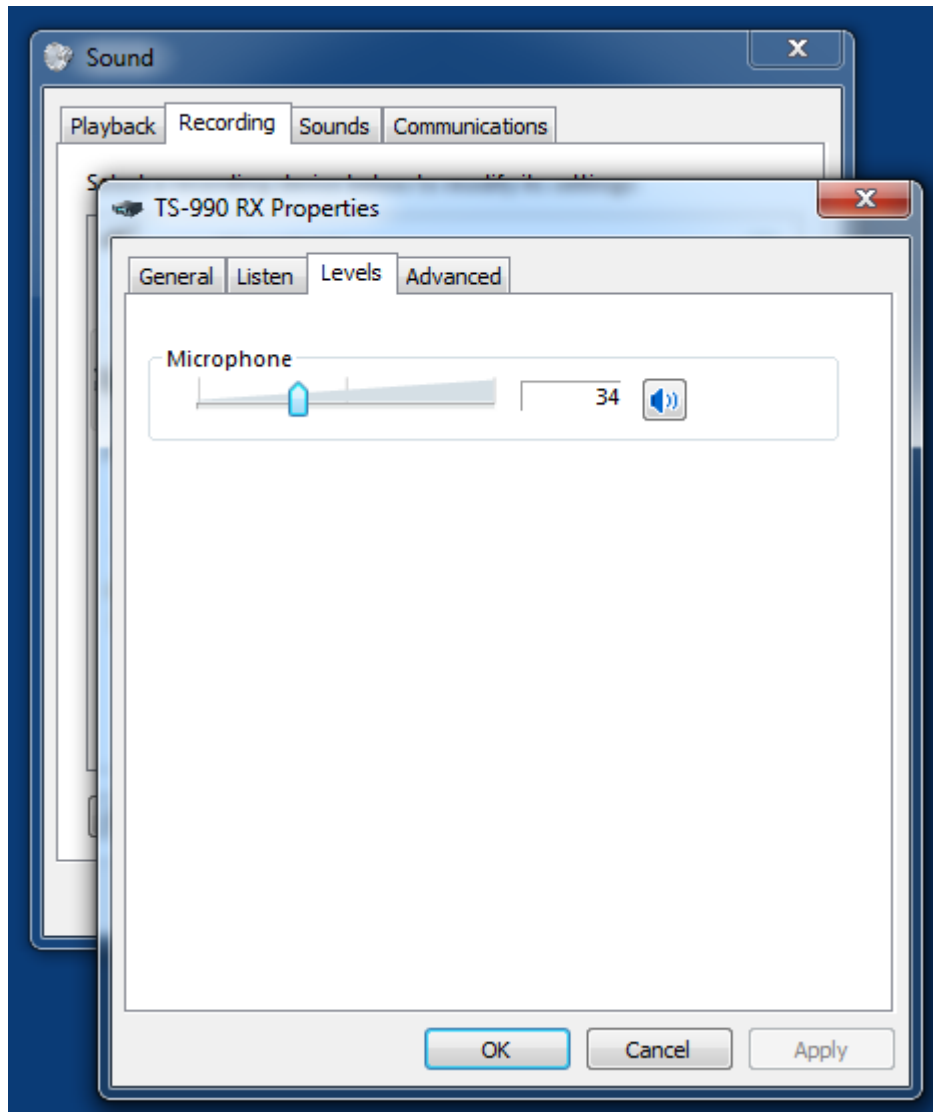


Figure 45 Initial Audio Level RX

Adjust the 'Microphone' level so that you meet the limits discussed above (between the white 'limit' lines). Your level will likely be different than those shown. Dual monitors help a lot while performing this step as you can view the Fldigi screen and adjust the level at the same time. When completed, click 'Apply' then 'OK'. Then close the 'Sound' dialog box and the Control Panel. Adjust the Fldigi waterfall 'Gain' and 'Dynamic Range' controls for a display that you like. You can start with the settings I have used here.

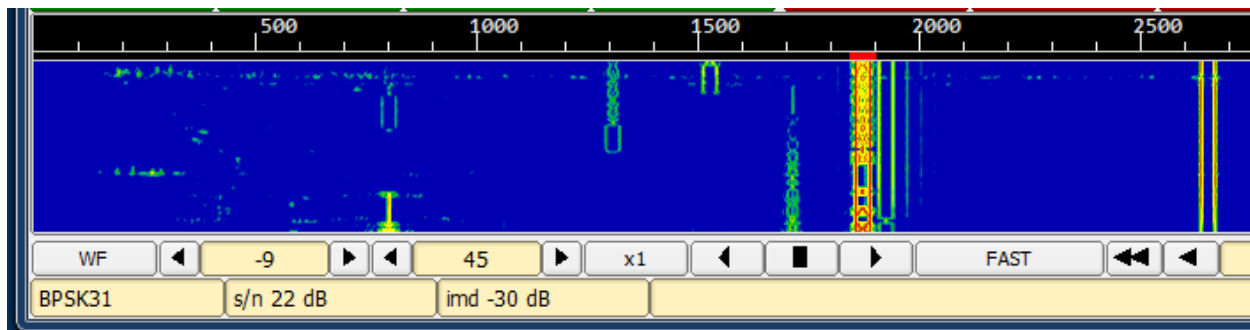


Figure 46 Waterfall Controls

This display shows my settings on a quiet band. The -9 setting shows 9 dB of ‘gain’ (the more negative the value, the higher the ‘gain’), the 45 number relates to the ‘dynamic range’ of the display. Lower numbers of ‘dynamic range’ will tend to ‘compress’ the signals into a narrower range of colors. Experiment here for something you like.

At this point you are left with only one more set of adjustments – transmit audio settings, the next section. You are on the home stretch!

Fldigi Transmit Output Levels

I deliberately left the most important adjustment for last so that you would be familiar with all of the controls we have needed to adjust. By now you should be comfortable with how to access the sound level adjustments in Windows and how the Fldigi interface controls some levels. There is a unique method of setting the actual TS power as it pertains to the TS-990S. Knowing that we will likely use between 10 and 25 watts TX power most of the time (high power is not needed for digital modes if an RF path exists) and that data tone levels MUST be set a minimum of 13 dB lower than voice levels, we will set the SSB voice power level (the PWR control) at about 70 watts (remember we will be using the -13 dB level most of the time) and adjust the TX audio gain into the TS-990S so that we obtain **NO ALC INDICATION**. Any ALC action due to the way ALC works is non-linear operation. Any non-linear operation will distort our transmit signal making the IMD climb and making it more difficult for the far end station to decode properly. ***A ‘clean’ signal at lower level is much easier to decode than a stronger distorted one.*** Keep this in mind. A properly adjusted PSK31 signal will be transmitted in a little over 35 Hz of bandwidth. This is usually described as clean lines and narrow signal (on the waterfall display). This properly adjusted transmit path is also not hard to obtain if you follow this method. Using this method of adjusting the audio transmit drive, we will attempt to keep the audio level attenuator in Fldigi to between 0 and -3 dB for our adjustments. This will give us about 3 dB of headroom so that we will not need to perform this adjustment when changing digital ‘modes’. Once you have mastered this method, it applies to any transceiver used in digital modes.

Step 1

- Set the TS-990S transmit power (PWR control) to 75 watts.
- Set the METER on the TS-990S to read ‘ALC’.
- Set the Fldigi ‘base level’ attenuator value to 0 dB.

- Ensure that you have a dummy load as the antenna selected.
- Ensure you do not have the antenna tuner on the TS-990S engaged (OFF).

See the figure below and adjust your setup to this value. (this figure indicates -10 dB which was an older method). By keeping the Fldigi output as close to 0 dB as possible, we keep the actual digitized audio as pure as possible.



Figure 47 TX Attenuator Setting

Use the single or double arrows to adjust this value. When using Fldigi normally, you will adjust this value down to about -0 dB or a maximum of 3 dB lower. During your fine tuning you may wish to set this a bit lower (more attenuation), but you should strive to keep this attenuation below 3 dB! Select the PSK31 mode from the 'Op Mode' menu of Fldigi.

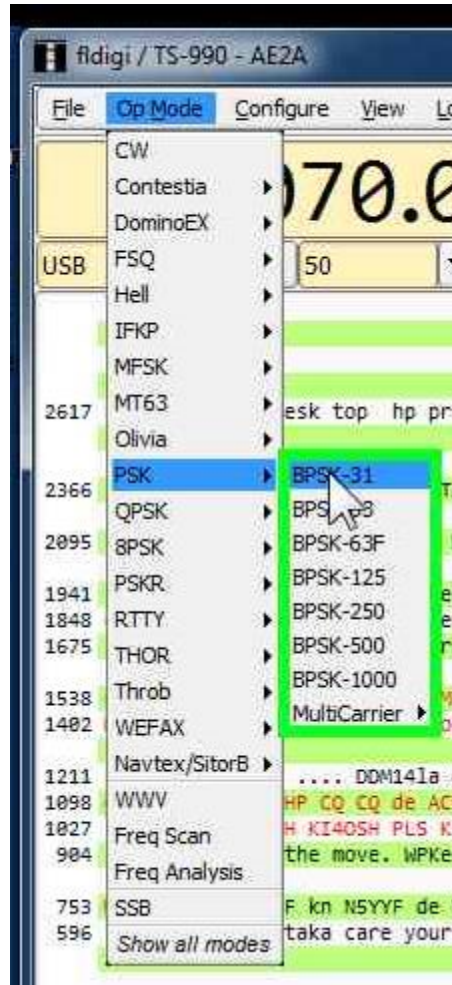


Figure 48 Fldigi Op Mode Selection

Now that we have the correct 'mode' selected and that Fldigi and Flrig are running, we have full software control of the transceiver and PTT as well as the audio input levels. With the TX attenuator set at 0 dB, we will set the audio transmit frequency to a mid-passband frequency of 1500 Hz using the left and right arrows to either side of the TX Audio frequency control. See below.

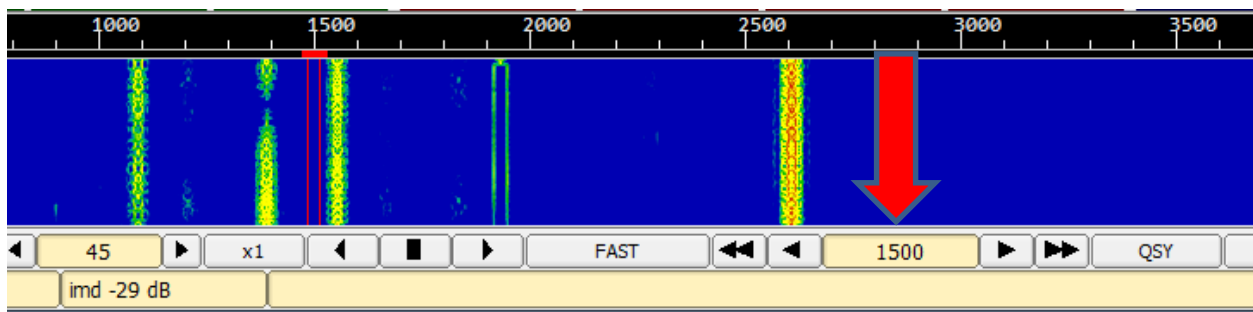


Figure 49 Fldigi Audio Frequency

I chose this frequency as it is middle of the 'normal' TX audio passband of the SSB filters. Depending on your exact transceiver this may be between 900 Hz and 1800 Hz. Fldigi has a setting for this and it is called 'Sweet Spot', a topic for further discussion.

We will cause the software to transmit the PSK31 'idle' signal by using the 'TUNE' button in Fldigi. This control button will put Fldigi into TX and supply the correct audio signal to the TS-990S. See the figure below for the location of this button (top left).

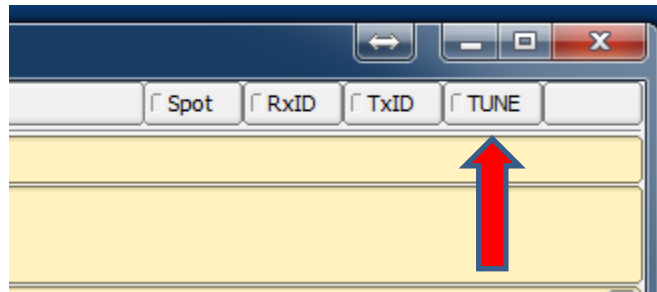


Figure 50 Fldigi Tune Button

Step 2

Open the Control Panel > Sound > Playback device selection, and double click on the TS 990 TX audio device. Select the Levels Tab.

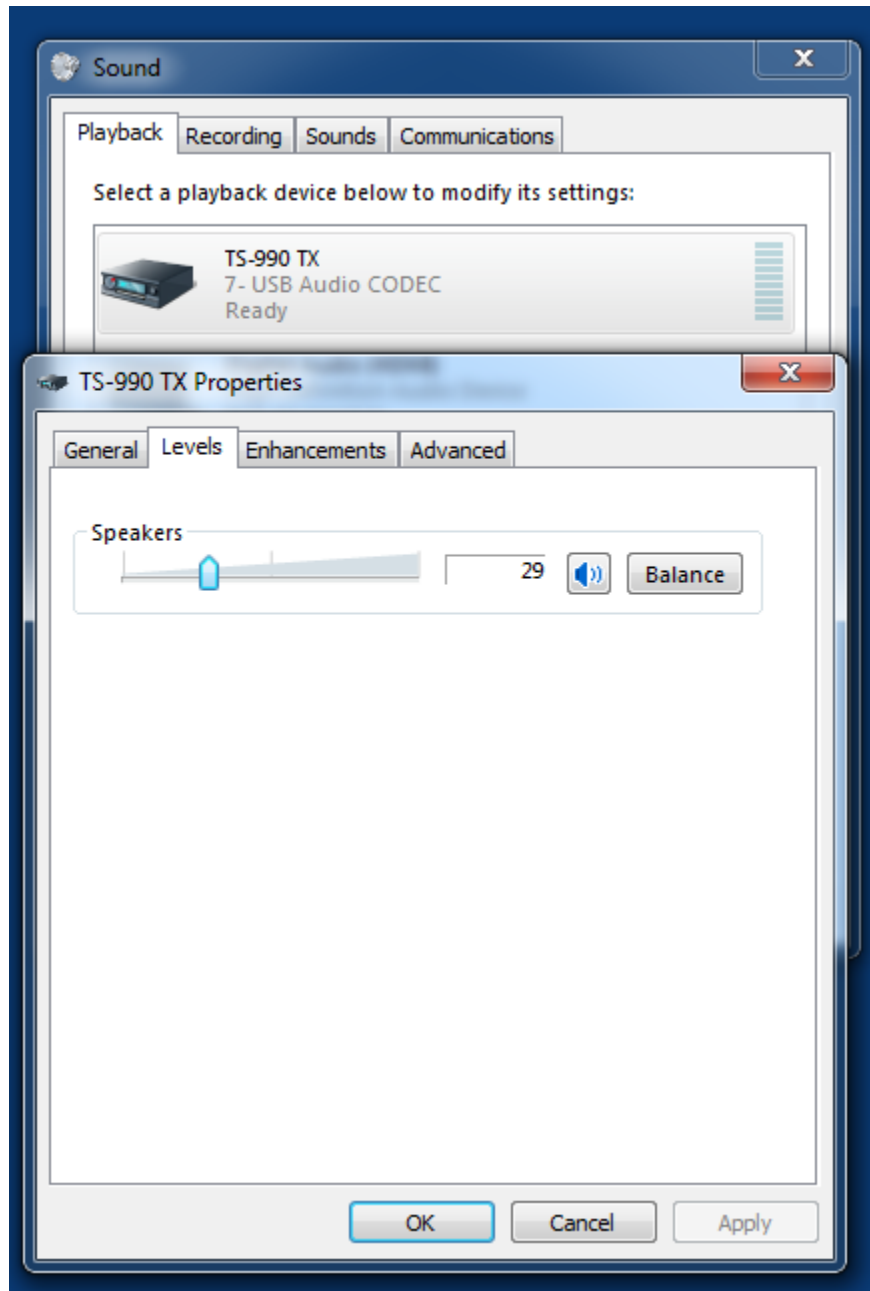


Figure 51 Fldigi TX Level

Step 3

Set the 'Speaker Volume' control to a low value (10). Note: if your sound card allows this setting in 'dB', use the 0 dB setting! Click the 'TUNE' button in Fldigi and watch the ALC indication on the TS-990S. Switch to the 'Speaker Volume' window and advance the volume control upwards (increase) until you see an indication of ALC on the TS-990S meter. Reduce the 'Speaker Volume' setting by one digit until the ALC indication returns to zero. Click the 'TUNE' button again and the TS-990S will revert to receive (and the 'active' condition of the button will go back to inactive). Click 'Apply', then 'OK'. Close the 'Sound' device dialog box.

Step 4

Reset the Fldigi audio attenuator value to 0 dB. Click on the 'Configure' menu in the top of the Fldigi main window, select the bottom option 'Save Config' to save your work.

NOTE:

Various sound card and audio combinations may require more than just one or two iterations of adjustment between the TS-990S USB audio levels and the Windows sound card volume controls. Some of the newer HP and Dell computers have sound card drivers that do not update the settings while being used by another program. This will cause some issues and may require many restarts of Fldigi to find a set of gain values that works well. You may also find that you may need to reduce the TS-990S audio input levels on the menus to very low values (typically less than 5) in order for the TX input level to be low enough so that there is no ALC reading. Again this may take a number of iterations to accomplish, but is well worth the effort to get this right!

Congratulations! You have now completed the entire configuration of Fldigi, Flrig and the TS-990S. You may need to return to this final set of steps if you make any drastic changes to TX power, or USB audio levels.

Recognition

At this point I would like to recognize the efforts of many individuals who have contributed time and effort toward the development of Fldigi and the suite of programs that make it work, especially Dave Freese – W1HKJ who is the lead developer and without whose help this program and document would not exist. There is also a need to recognize the efforts of all the other developers and testers, as well as all of the other users who have contributed time and effort to document their results and experiences.

If you found this document helpful, be sure to pay it forward in the ham tradition and use your knowledge gained to help those folks who may need it!