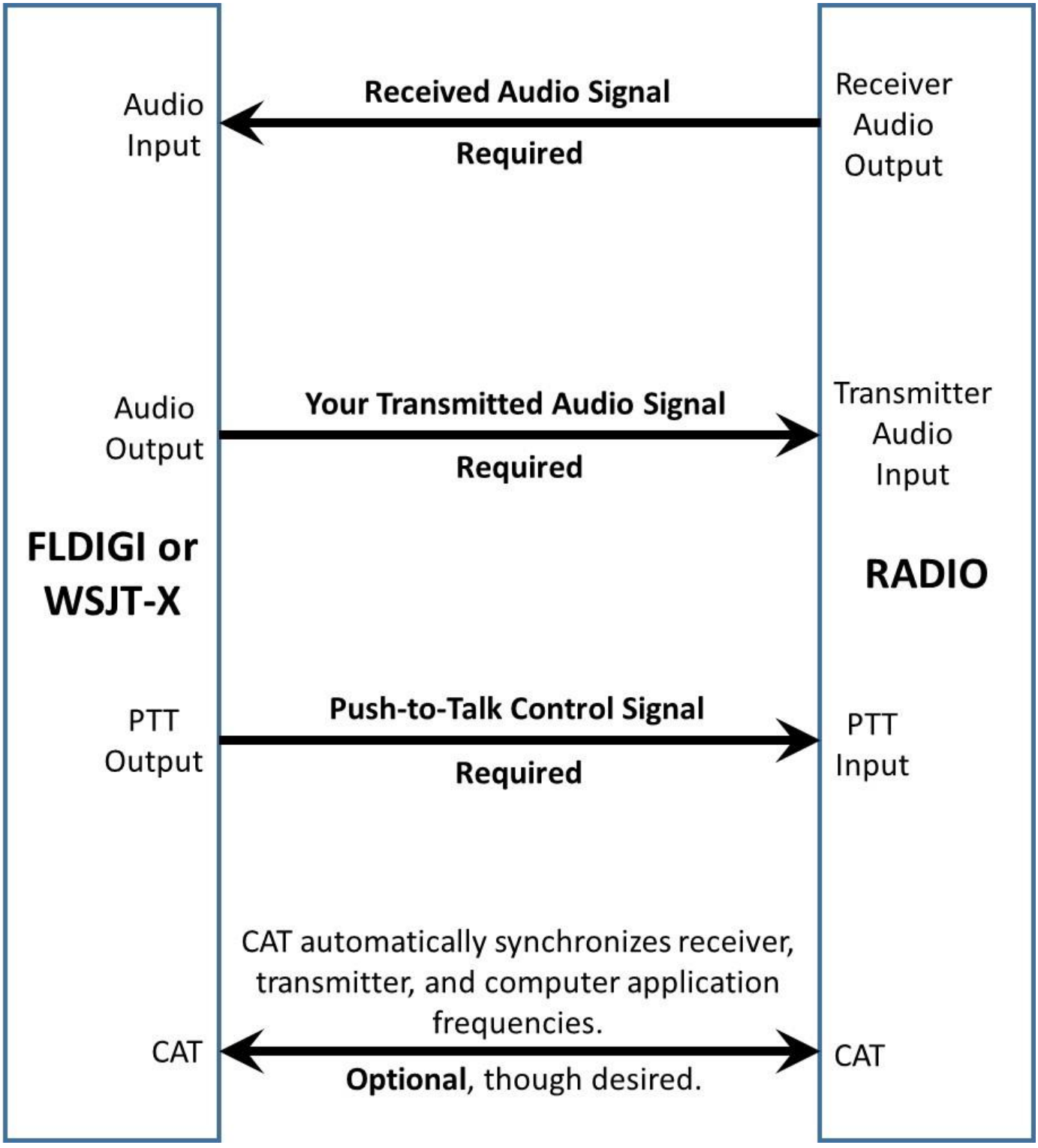
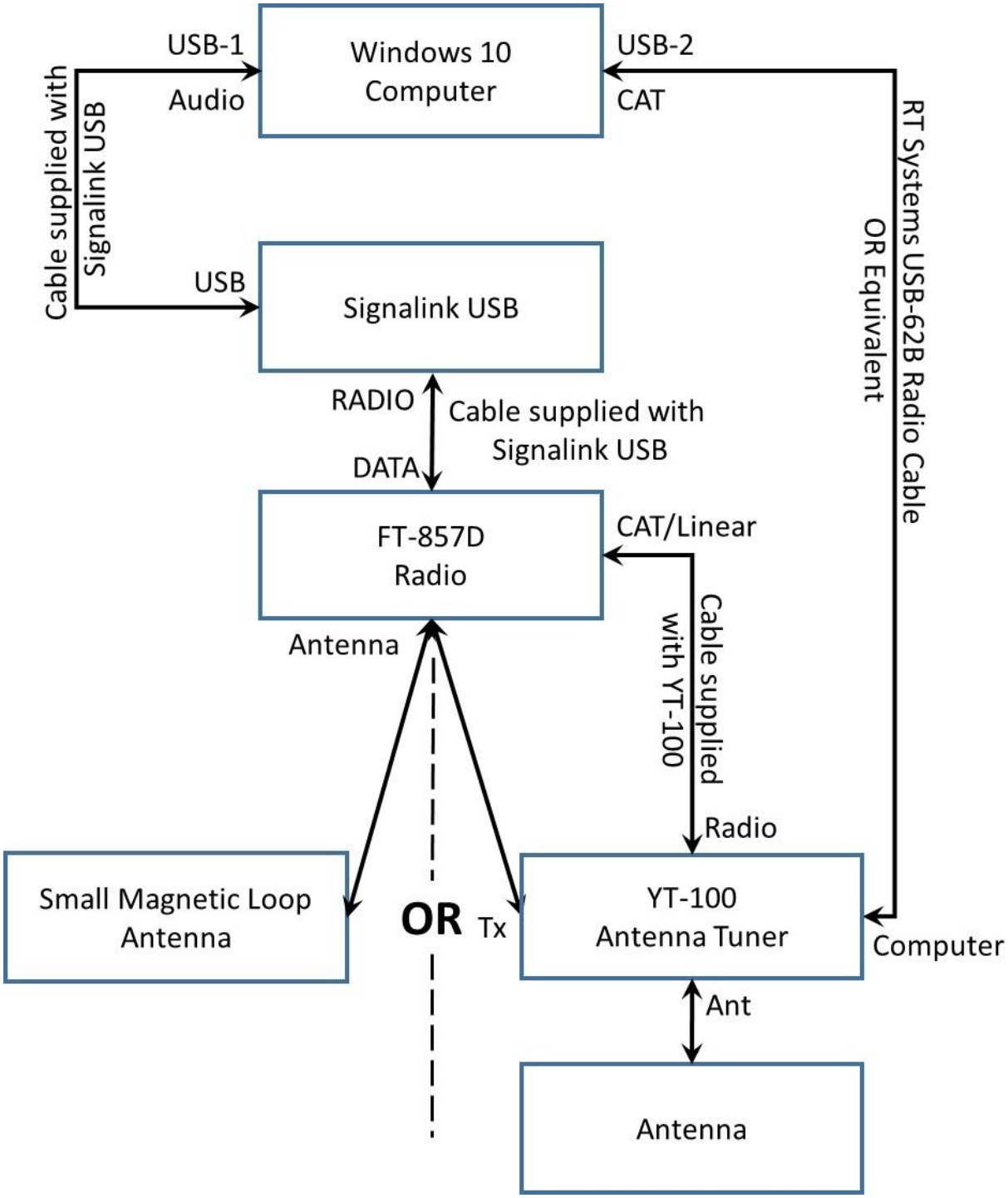
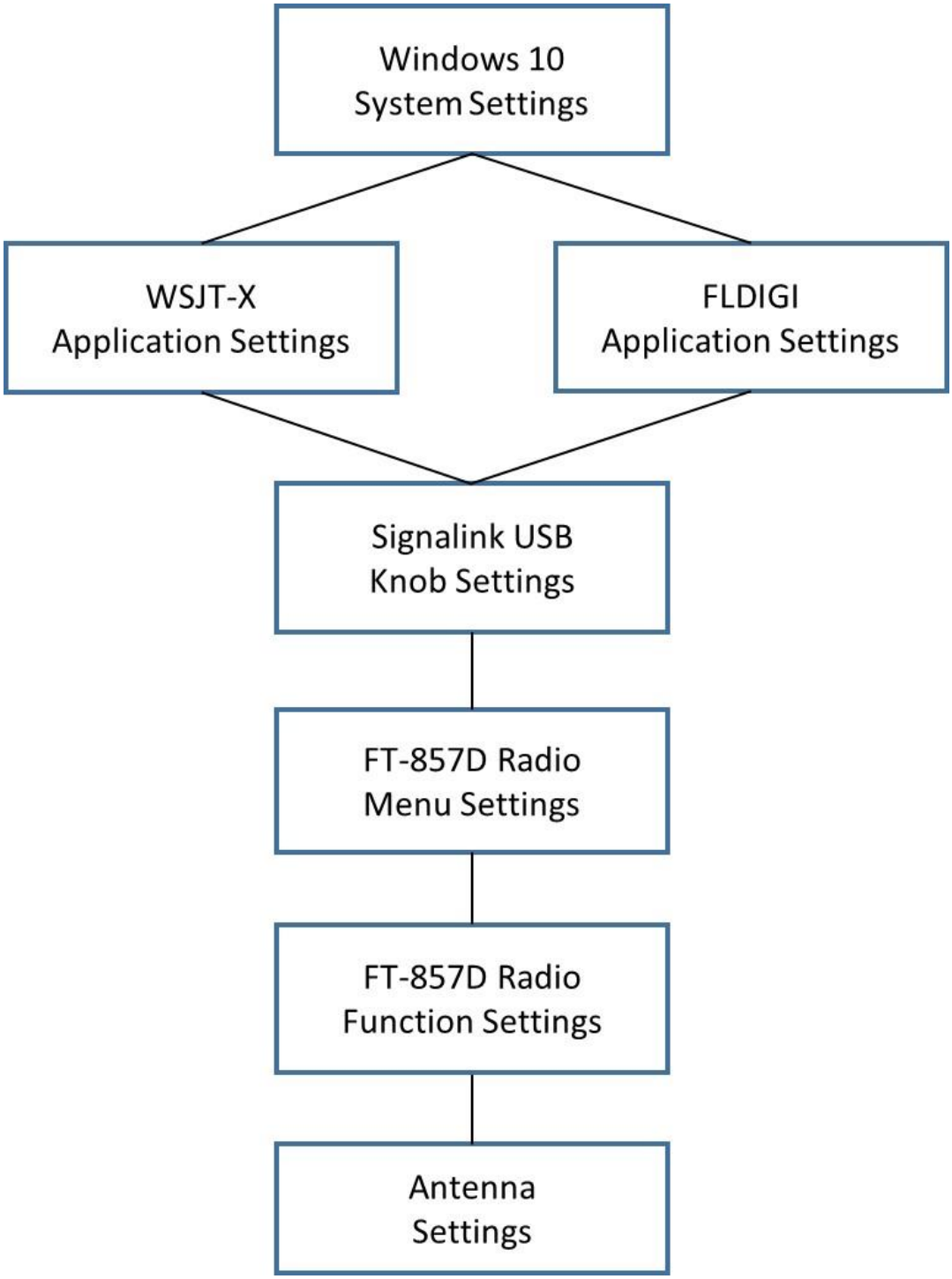
Signals Needed for Digital Communications



Cable Setup


USB-1
Audio
Windows 10
Computer
USB-2
CAT
Cable supplied with
Signalink USB
USB
Signalink USB
RT Systems USB-62B Radio Cable
OR Equivalent
RADIO
DATA
Cable supplied with
Signalink USB
FT-857D
Radio
CAT/Linear
Antenna
Cable supplied
with YT-100
Radio
Small Magnetic Loop
Antenna
OR
Tx
YT-100
Antenna Tuner
Computer
Ant
Antenna

Setup Functional Block Diagram



Setup Procedure Flow Summary

1) USB cable removal from computer
2) SignaLink power off
3) FT-857D Radio
    1) Set Function settings
    2) Set Menu settings
    3) Adjust SMA for highest S-meter level
4) Windows 10 Computer start
5) FT-857D Radio
    1) Connect USB cables to computer
    2) Power on radio
6) Windows 10 Computer
    1) Select Speaker Codec and Level
    2) Select Line/Microphone Codec and Level
    3) Identify CAT cable COM port number
7) NetTime computer time synchronization
8) WSJT-X
    1) Start WSJT-X
    2) Set Operator information
    3) Select radio configuration
    4) Set RigCAT control configuration
    5) Set Audio configuration
    6) View WSJT frequency list
9) FLDIGI
    1) Start FLDIGI
    2) Select radio configuration hml file
    3) Set RigCAT control configuration
    4) Set Audio configuration
    5) Set Operator information
    6) Set FLDIGI display configuration
10) FT-857D Radio
    1) Set meter to SWR
    2) Adjust SMA for lowest SWR
    3) Tune YT-100 for lowest SWR
11) SignaLink
    1) Set FLDIGI SignaLink levels
    2) Set WSJT-X SignaLink level
    3) Set SignaLink TX level
12) System is now ready for use
    1) USB cable management
    2) Monitoring and adjustments during operations
    3) Station shut down sequence
    4) Station start up sequence

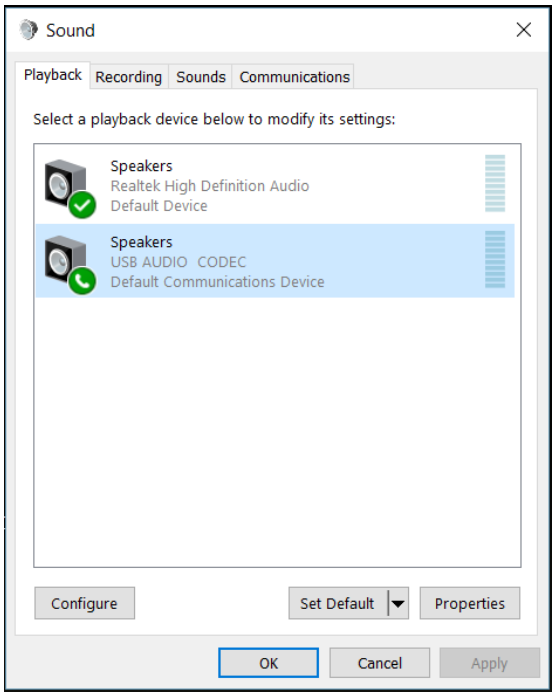
Setup Procedure

1) **Remove the CAT control USB cable and the SignaLink USB cable from the Windows 10 Computer (Computer)**, if not already so. Always remove these cables prior to starting computer, not doing so will cause windows to configure sound hardware incorrectly for use with FLDIGI. **Continue to use the same Computer USB port for each USB cable** to minimize the number of configuration items needing changes on Computer restarts.
   The order of performance of many of the following steps is *important*.
2) SignaLink:
   a) **TURN-OFF** SignaLink red power button on front of unit. Button sticks out more when off.
3) FT-857D Radio:
   a) **TURN-ON** FT-857D power by pressing and holding the unmarked gray button on top of the control head.
   b) Press the UP and DOWN keys to **set the band to 20m (14.070.00 for PSK31)**.
   c) Press the ◀ and ▶ keys to **set the mode to MTUNE DIG**.
   d) **DSP must not be present** in the display, located at the top of the display. If it is, momentarily depress the DSP button to display the MFp mode menu. Momentarily press the "A", "B", and/or the "C" keys to remove any arrows in front of DNP, DNF, and DBF, in the menu. Momentarily press the DSP button to return to the previous menu key selections.
   e) **Clarifier must be turned off**. If no symbol appears to the right of the radio frequency in the display, the Clarifier is off. If an arrow, double arrow, or dash is present, press the CLAR button momentarily to turn off the Clarifier.
   f) **IF Shift must be turned off**. If no symbol appears to the right of the radio frequency in the display, the IF SHIFT is off. If a large dot is present, the IF SHIFT is present, press and hold the CLAR button to turn off the IF SHIFT.
   g) **AGC must be set to AUTO**. Press FT-857D Function key briefly and rotate the Select knob to display the MF1 software defined key selection. Key "B" will display AGC. An arrow in front of the AGC must be present. If no arrow is present, press the "B" key to turn on the AGC. Key "C" needs to display AUTO. Press the "C" key as needed to display AUTO.
   h) **Noise Blanker must be turned off**. Key "A" will display NB. No arrow should be present in front of the NB. If an arrow is present, press the "A" key to turn off Noise Blanking.
   i) **IPO** may be used to bypass the receiver RF preamplifier to **reduce the receiver gain**, this provides substantial protection against intermodulation from strong signal input to the receiver. Rule of thumb, if the S-meter is moving on background noise, additional front-end gain is not required. An "I" icon will be present after MTUNE DIG when the function is turned on. To switch the function on and off, press FT-857D Function key briefly and rotate the Select knob to display the MFm software defined key selection. Key "A" will display IPO. An arrow in front of the IPO indicates the function is turned on. If no arrow is present, press the "A" key to turn on the IPO.
   j) **ATT must be turned off**. An "A" icon will be present after MTUNE DIG when the function is turned on.. Key "B" will display ATT. An arrow in front of the ATT indicates the function is turned on. If arrow is present, press the "A" key to turn off the ATT. Press FT-857D Function key briefly, and rotate the Select knob to display the MFi software defined key selection.
   k) **Split frequency should be turned off**, except for any operating mode requiring it. If no SPL symbol appears in the top of the display, the split frequency is off. If SPL is present, the split frequency mode is present, press the "C" key to remove the SPL from the top of the display. The arrow in front of the "C" key SPL will also be removed from the display.
   l) Press and hold the Function key for the MENU MODE to display.
   m) Rotate the Select knob to display **No-001 EXT MEMU**. Turn Main Dial to the setting of **ON**.

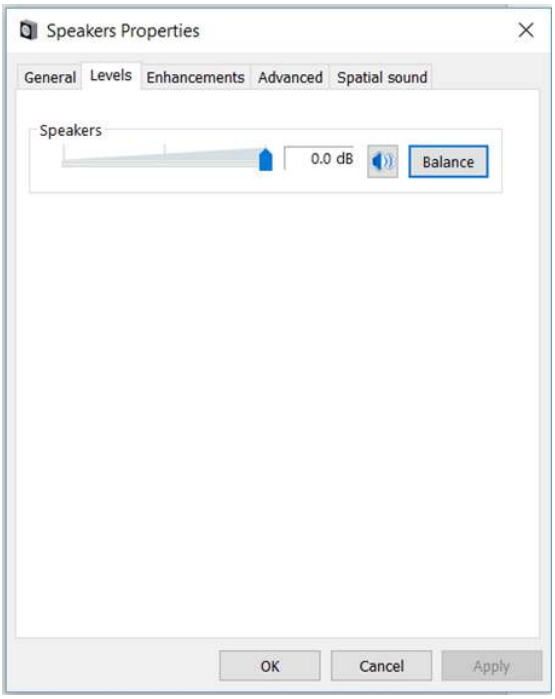
n) Rotate the Select knob to display **No-075 RF POWER SET**. Turn Main Dial to the setting of **10 watts.**
o) Rotate the Select knob to display **No-019 CAT RATE**. Turn Main Dial to the setting of **4800 bps**. This baud rate is required for use of the LDG Automatic Antenna Tuner (YT-100).
p) Rotate the Select knob to display **No-020 CAT/LIN/TUN**. Turn Main Dial to the setting of **CAT**.
q) Rotate the Select knob to display **No-037 DIG GAIN**. Turn Main Dial to the setting of **50**.
r) Rotate the Select knob to display **No-040 DIG VOX**. Turn Main Dial to the setting of **0**.
s) Rotate the Select knob to display **No-038 DIG MODE**. Turn Main Dial to **PSK31-U or RTTY-L or USER-U** for the standard digital mode of operation that will be used first. For QPSK the two working stations must use the same sideband. For BPSK the injection does not matter. Start with **USER-U for WSJT-X** modes. This hardware only supports AFSK for RTTY.
t) Rotate the Select knob to display **No-039 DIG SHIFT**. Turn the Main Dial to **+1500Hz**. This **function only applies to the USER-U and USER-L** digital modes. It sets the BFO offset that determines the center frequency for the receiver response. This setting is a good starting place for WSJT-X digital modes. This sets up the USER digital modes for **WSJT-X operations**. **USER-U** is normally used. FLDIGI does not support WSJT-X digital modes. For more information on WSJT-X go to http://physics.princeton.edu/pulsar/K1JT/wsjtx.html
u) Rotate the Select knob to display **No-036 DIG DISP**. This **function also only applies to the USER-U and USER-L** digital modes. Depending on how you want the display to respond, turn the Main Dial to set the corresponding display shift to that set in menu No-039 DIG SHIFT, **+1500Hz**.
v) Rotate the Select knob to display **No 086 TX IF FILTER**. Turn Main Dial to the setting of **CFIL.**
w) Press and hold the Function key to save settings and **exit the MENU MODE** menu.
x) Set FT-857D to **digital mode, the band to 20m, and the frequency to 14.070 MHz**.
y) Pressing the unmarked gray button briefly will turn on and off the **Running Man** function, allowing faster frequency adjustment.
z) When using a Small Magnetic Loop Antenna, adjust the tuning knob of the **Small Magnetic Loop Antenna** for the **maximum signal** on the FT-857D.
S-meter. Tuning is sensitive, and only a slight knob rotation is required to peak the signal once resonance is reached.
aa) **TURN-OFF** FT-857D power.

4) Windows 10 Computer:
   a) **Start Computer**.
5) FT-857D Radio:
   a) With FT-857D power off:
      i) **Select the specific USB ports** of the Computer that will be used to communicate with the SignaLink and the FT-857D.
      ii) Connect **CAT** control **USB** cable to the selected USB port on the Computer. Using the same Computer USB port each time, decreases the chance Windows redefines the port, making setup simpler.
      iii) Connect **SignaLink USB** cable to the selected USB port on the Computer. Using the same Computer USB port each time, decreases the chance Windows redefines the port, making setup simpler.
   b) **TURN-ON** FT-857D power.

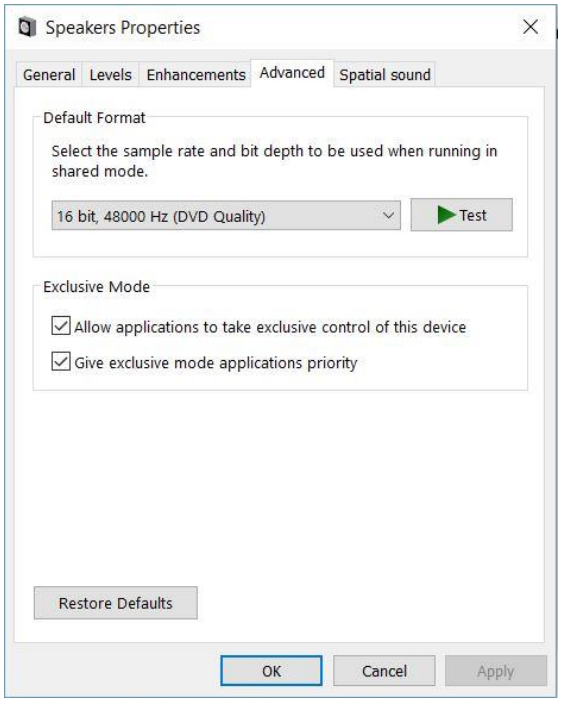
6) Windows 10 Computer:
   a) Right click the speaker icon in the system tray. Click on "Playback devices". The devices need to be configured as shown, with **Realtek High Definition Audio set as Default Device**, and **USB AUDIO CODEC set as Default Communications Device**. If changes are required, use pull down arrow to the right of the Set Default button to set them.



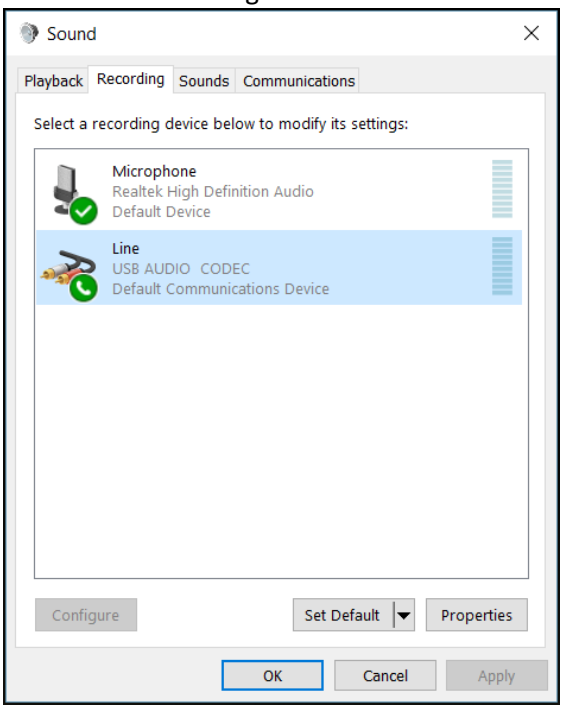
   b) Click on **USB AUDIO CODEC** to select it. Click on Properties. Click on the Levels tab. The level needs to be in dB. Right click the amount window to select decibels, if needed. Set the slider to **0.0 dB**. Click OK.



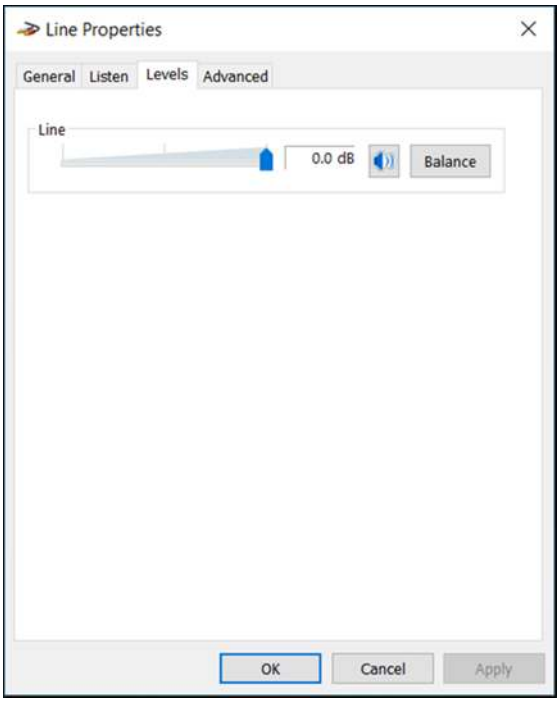
c) Click on the **Advanced** tab. Use the down arrow to select **16 bit, 48000 Hz (DVD Quality)**. **Check both boxes** under Exclusive Mode.



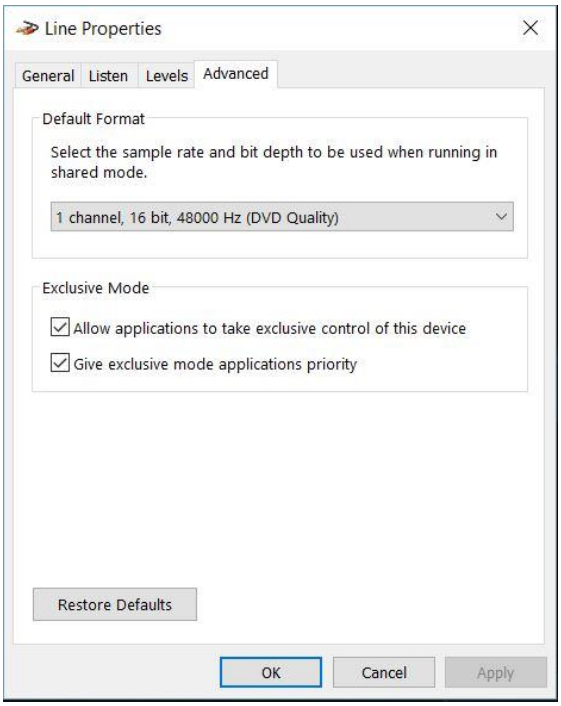
d) Click the Recording tab. The devices need to be configured as shown, with **Realtek High Definition Audio set as Default Device**, and **USB AUDIO CODEC set as Default Communications Device**. If changes are required, use pull down arrow to the right of the Set Default button to set them.



e) Click on **USB AUDIO CODEC** to select it. Click on Properties. Click on the **Levels tab**. The level needs to be in dB. Right click the amount window to select decibels, if needed. Set the slider to **0.0 dB**. Click OK.

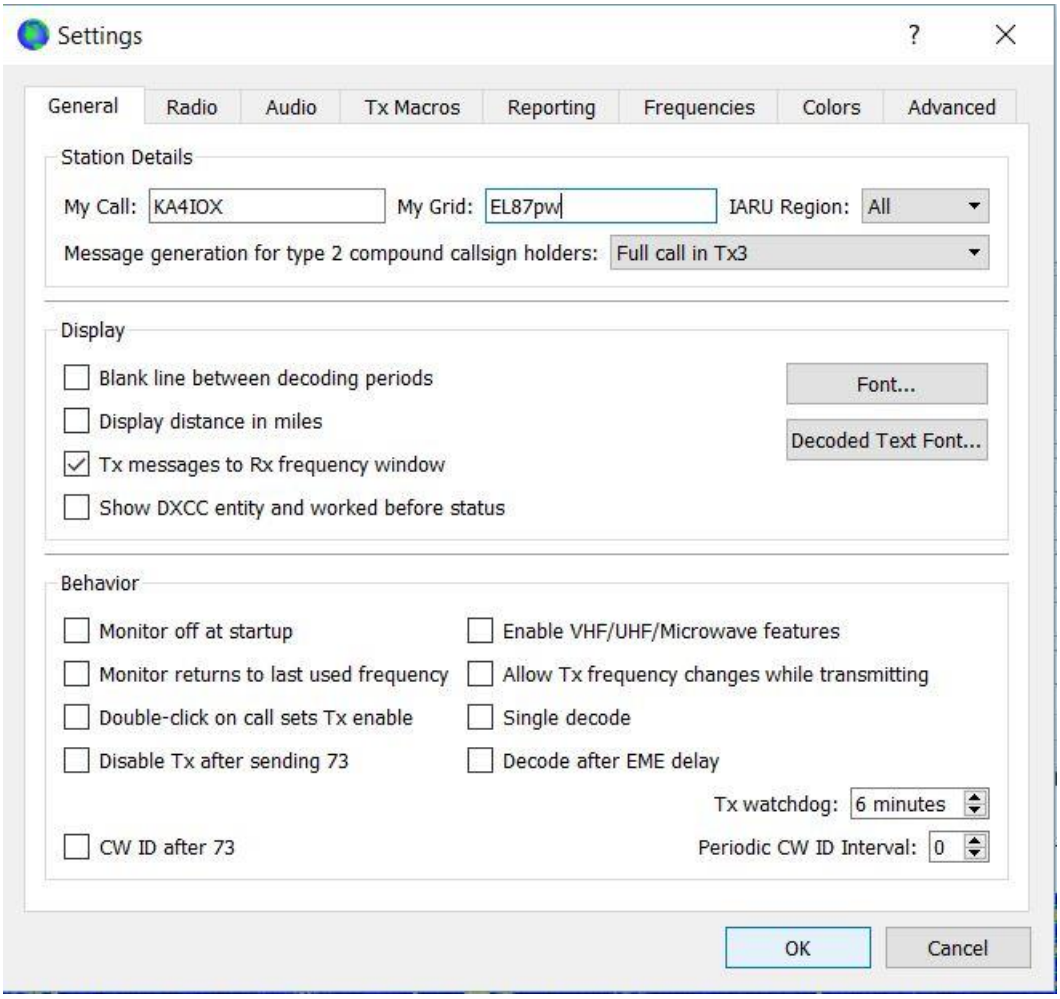


f) Click on the **Advanced** tab. Use the down arrow to select **1 channel 16 bit, 48000 Hz (DVD Quality)**. **Check both boxes** under Exclusive Mode.

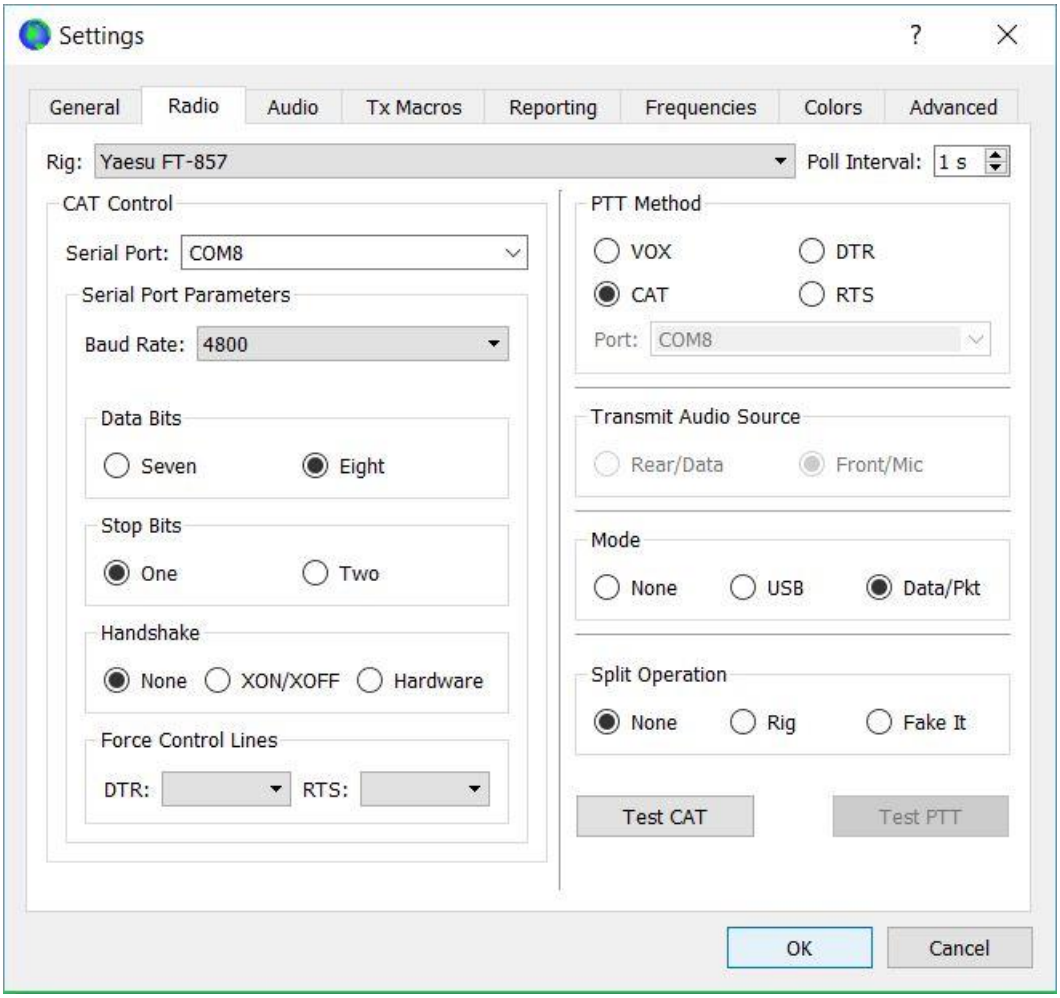


g) Right click on the Computer Start button in the lower left of the desktop. Left click on Device Manager. Click on the side arrow of Ports (COM & LPT). Look for USB-62B Radio Cable (COM <*Number*>). **Note the number of the COM port**. It will be needed for FLDIGI setup. Close the window by clicking on the upper right X.

7) Many digital modes, like WSJT modes, require an accurate computer clock. This is achieved though **computer clock synchronization** to accurate time servers on the internet. Use a tool like NetTime to synchronize your computer clock to a server using the internet. **Do this first**. For more information on NetTime go to http://timesynctool.com
8) WSJT-X v1.9.0 rc3 r8576 (skip section if not installing WSJT-X at this time)
   a) Download the latest version of WSJT-X for Windows from http://physics.princeton.edu/pulsar/K1JT/wsjtx.html and execute to **install WSJT-X**.
   b) **Start WSJT-X**. The **FT-857D must already be powered** on to properly configure WSJT-X CAT radio control
   c) Click on File then Settings in the Menu Bar of WSJT-X, then on the **General** tab. Enter *your* **call** and **grid** square. The last two characters of the Maidenhead identifier need to be lower case, **like this: EL87pw**. **Check** the box for **Tx messages to Rx frequency**.



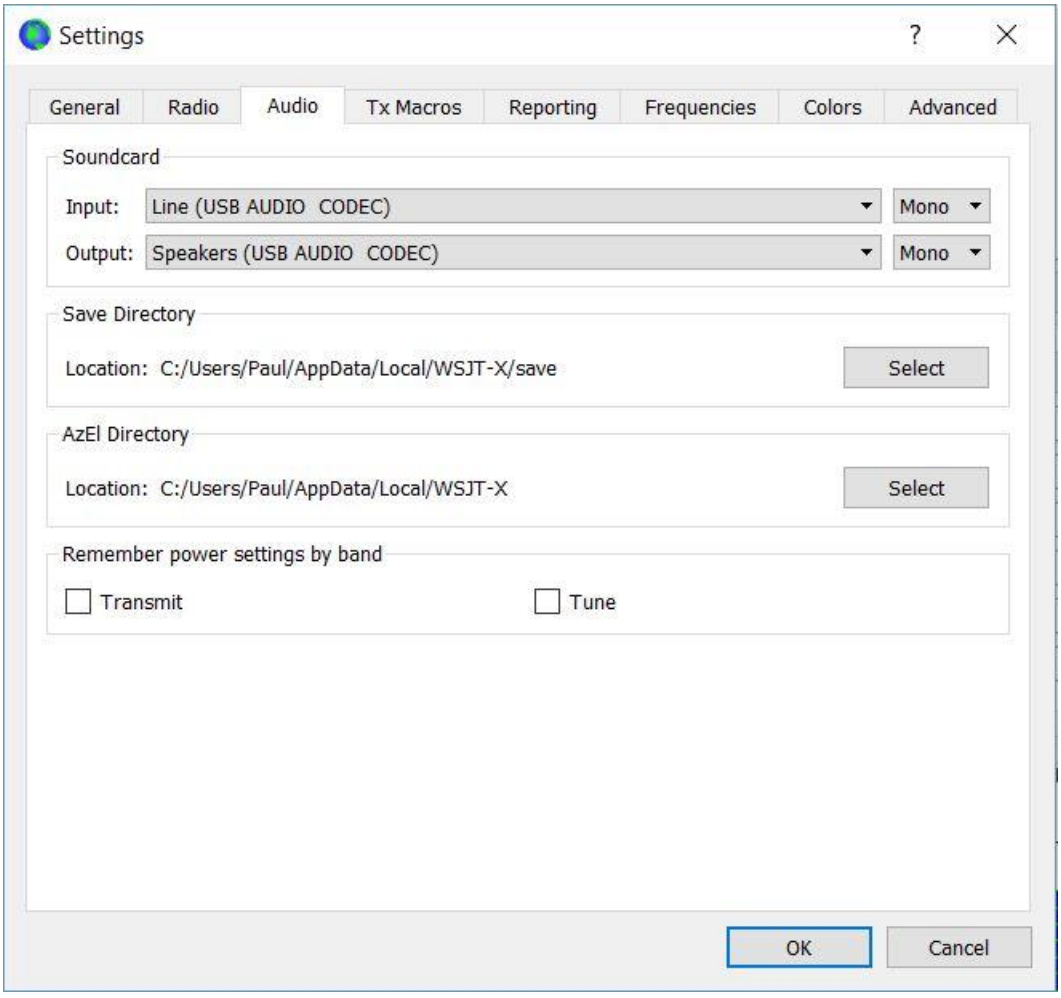
d) Click on the **Radio** tab. **Select *your* radio** from the pull down list. This is important, it will tell WSJT-X how to access your radio.



i) In the Radio tab, using the down arrow for **Device:**, **select the COM port number** that was identified in the computer Device Manager, Ports (COM & LPT, USB-62B Radio Cable (COM <*Number*>) during step 6f.
ii) Set the **Baud rate**: to **4800**.
iii) Set **Data Bits** to **8**
iv) Set **Stopbits** to **1**.
v) Set **Handshake** to **None**.
vi) Set **Poll Interval** to **1 second**.
vii) Set **PTT Method** to **CAT**.
viii) Set **Mode** to **Data/Pkt**.
ix) Set **Split Operation** to **None**.
x) Click the **Test CAT** button to see if CAT is working, the button will turn **Green** if it is working.

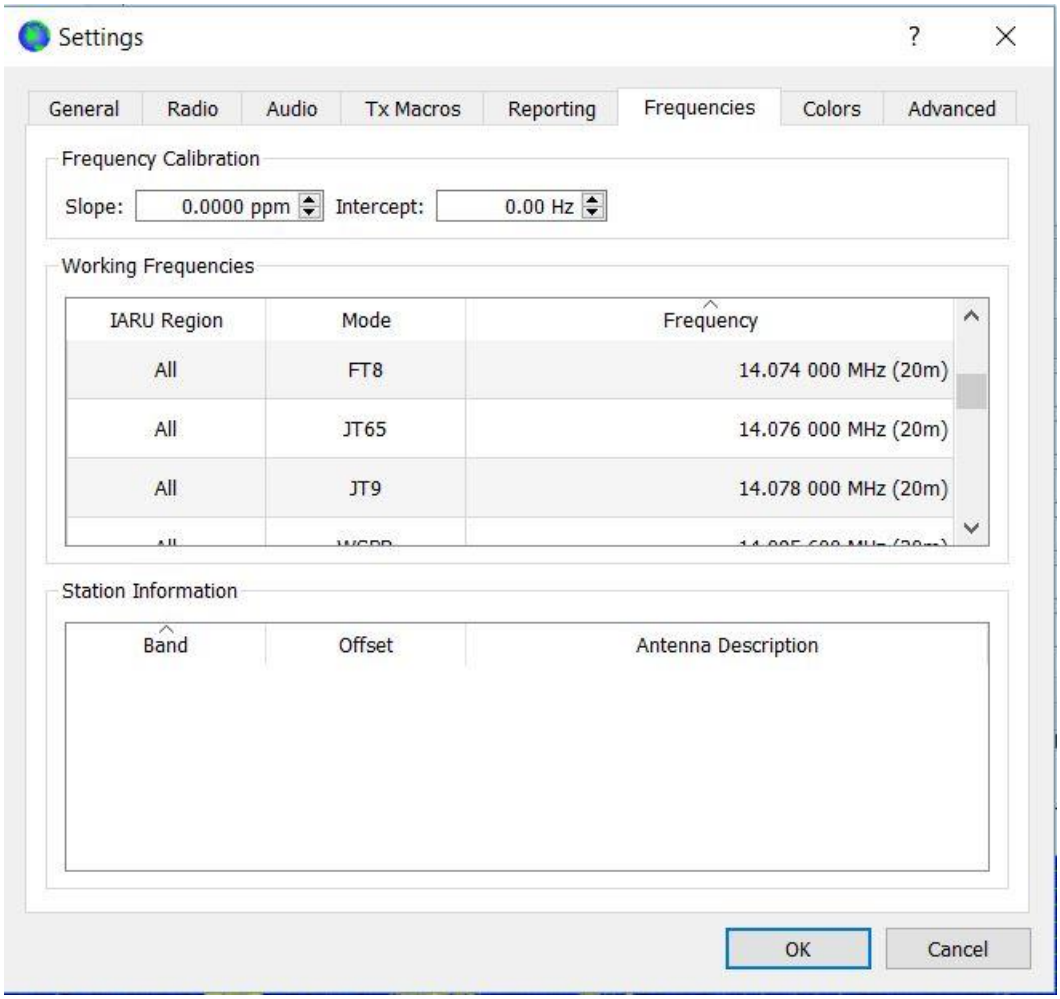
xi) Click the **Test PTT** button to see if the Radio transmitter will turn on. Check the **transmit indicator on the Radio** to confirm function. **Click the Test PTT button again to turn off the transmitter**.

e) Click on the **Audio** tab.



i) Using the down arrow box, for **Input:** select **Line (USB AUDIO CODEC)** and **Mono**.
ii) Using the down arrow box, for **Output**: select **Speakers (USB AUDIO CODEC)** and **Mono**.
iii) No other boxes should be checked.

f) Click on the **Frequencies tab**. Note the table of Working Frequencies. The slider for the table will show the operating frequencies for each band for many of the WSJT modes. Very useful.



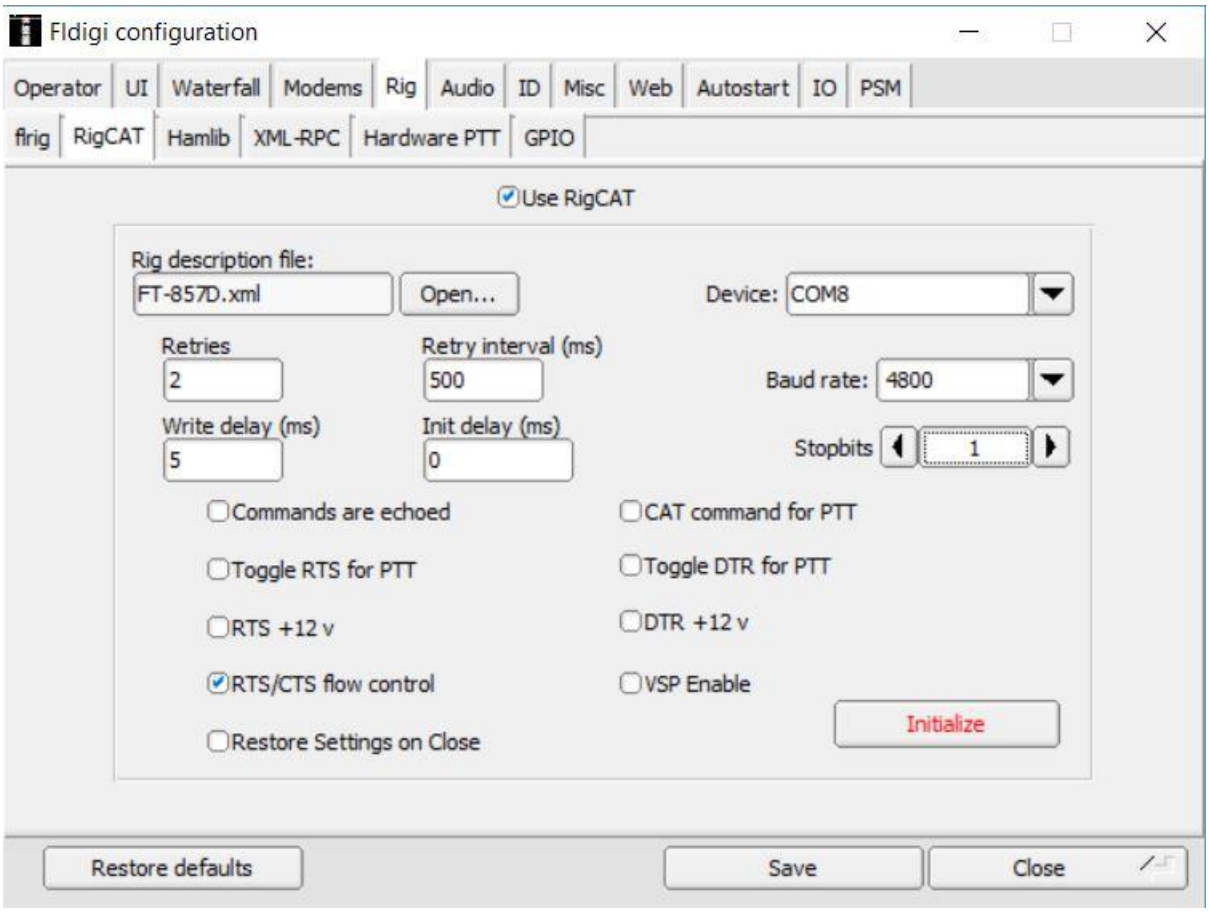
g) Click **OK**.

h) **Close WSJT-X**.

i) See **section 11** for setting WSJT-X **signal levels**. If you are also installing FLDIGI proceed to the next section.

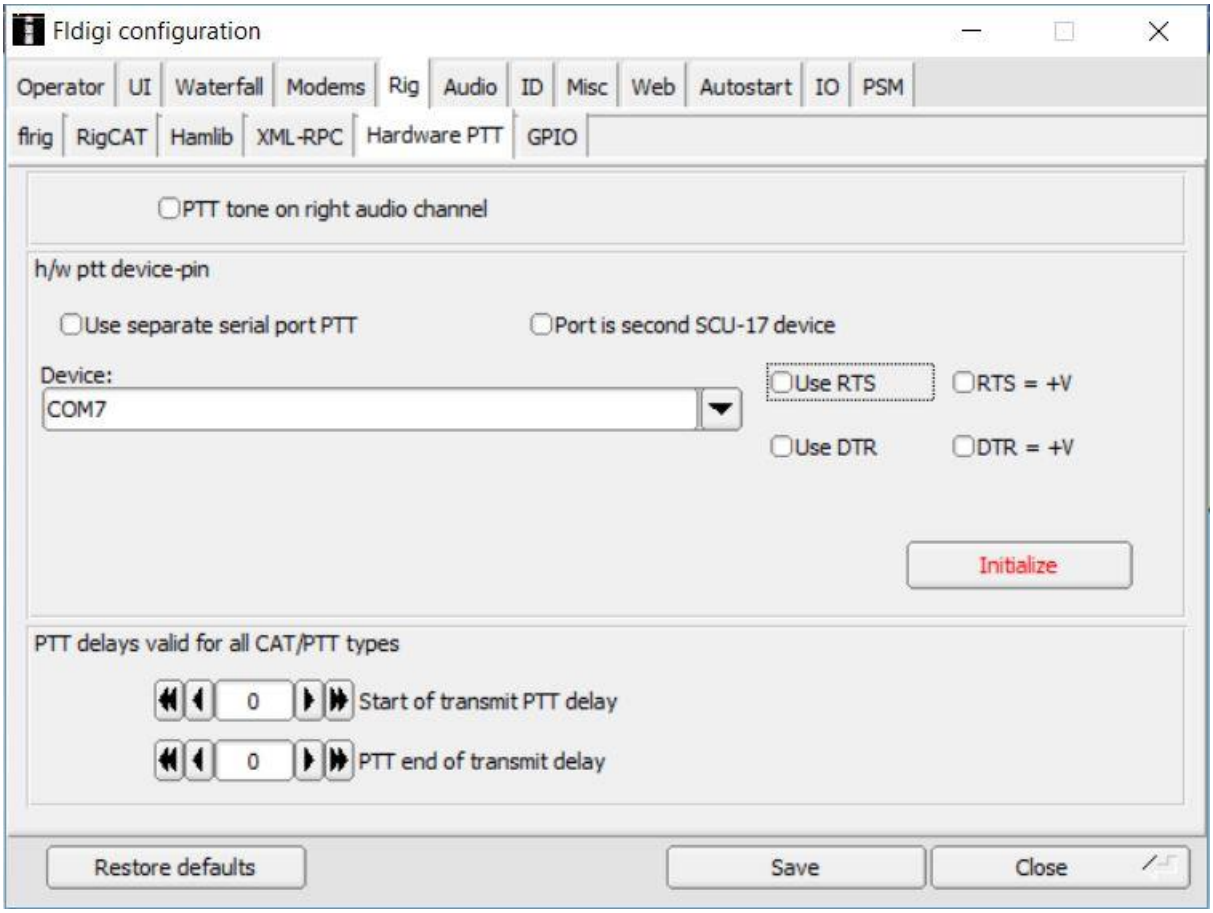
j) Further details on WSJT-X setup can be found at http://w4ti.com/wsjt-x-help-files/wsjt-x-configuration-guide/
Or a pdf file named **WSJT-X User Guide.pdf** at
https://sourceforge.net/p/wsjt/mailman/attachment/From_ik1wvq@stmb.it_Fri_Sep_09_16%3A50%3A27_2016/1/

9) FLDIGI 4.0.16 http://www.w1hkj.com/
   a) Download file "fldigi-x.x.xx_setup.exe" from http://www.w1hkj.com/files/fldigi and execute to **install FLDIGI**.
   b) **Start FLDIGI**. The **FT-857D must already be powered** on to properly configure FLDIGI CAT radio control.
   c) Click on Configuration in the Menu Bar of FLDIGI, then on **Rig control** in the drop down menu.

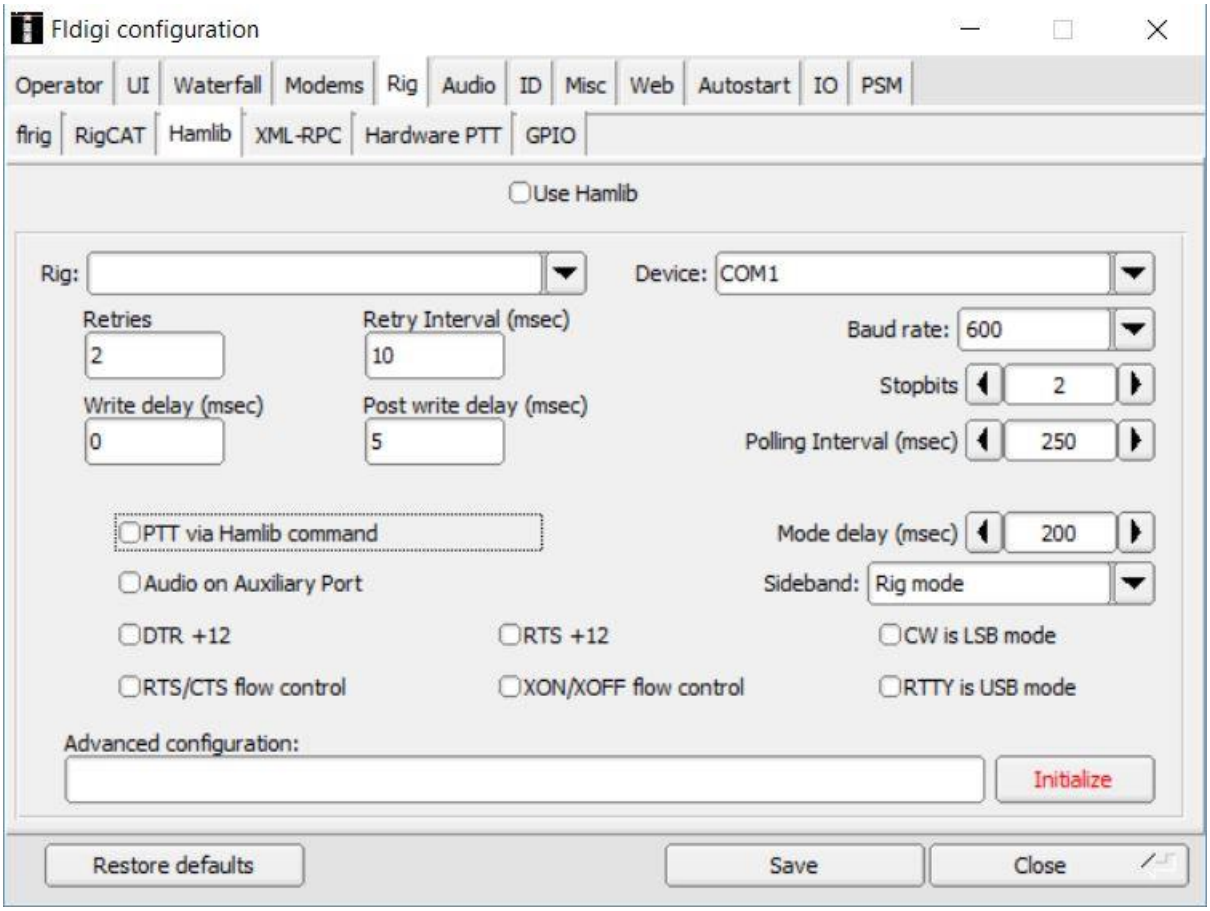


   i) Click on **RigCAT** sub-tab. **Confirm FT-857D.xml** is in the Rig description file: text box. If not, click the Open… button and select it from the folder **<*user*>\fldigi.files\rigs**, and then click Open. Confirm **FT-857D.xml** is in the Rig description file: text box. Click the **red colored Initialize** button.
   ii) In the **RigCAT** sub-tab, place a **check** in boxes for **RTS/CTS flow control**. **No other** boxes should be checked in the RigCAT sub-tab.
   iii) In the RigCAT sub-tab, using the down arrow for **Device:**, **select the COM port number** that was identified in the computer Device Manager, Ports (COM & LPT, USB-62B Radio Cable (COM <*Number*>) during step 6f.
   iv) Set the **Baud rate**: to **4800**.
   v) Set **Stopbits** to **1**.
   vi) Set **Retries** to **2**.
   vii) Set **Retry interval (ms)** to **500**.
   viii) Set **Write delay (ms)** to **5**.
   ix) Set **Init delay (ms)** to **0**.
   x) Click the **red colored Initialize** button.
   xi) Click the **Save** button.

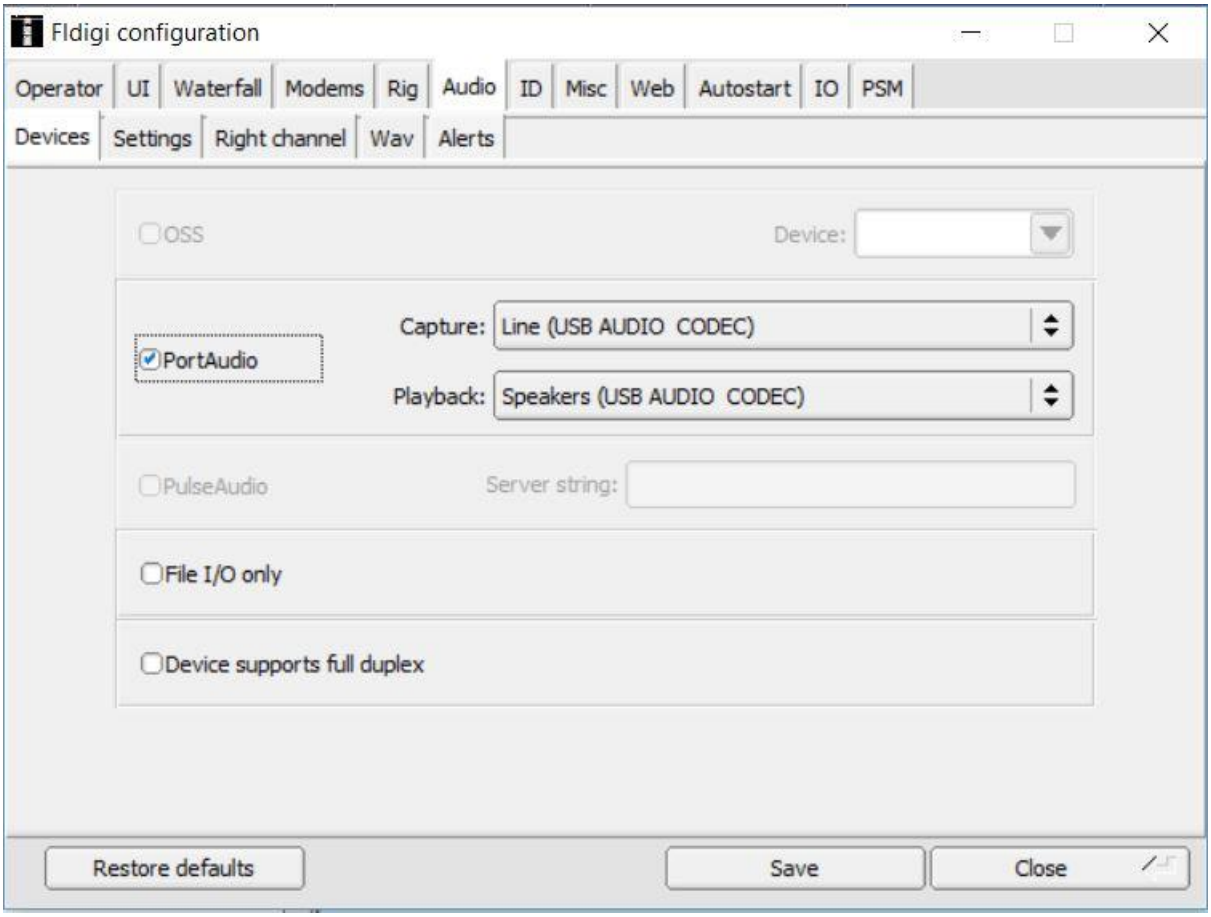
xii) Click on **Hardware PTT** sub-tab. **Uncheck all boxes**. Click the **red colored Initialize** button if present. Click the **Save** button if the configuration was changed.



xiii) Click on **Hamlib** sub-tab. **Uncheck Use Hamlib**, if present. Click the **red colored Initialize** button if present. Click the **Save** button if the configuration was changed.



d) Click on the **Audio** tab.

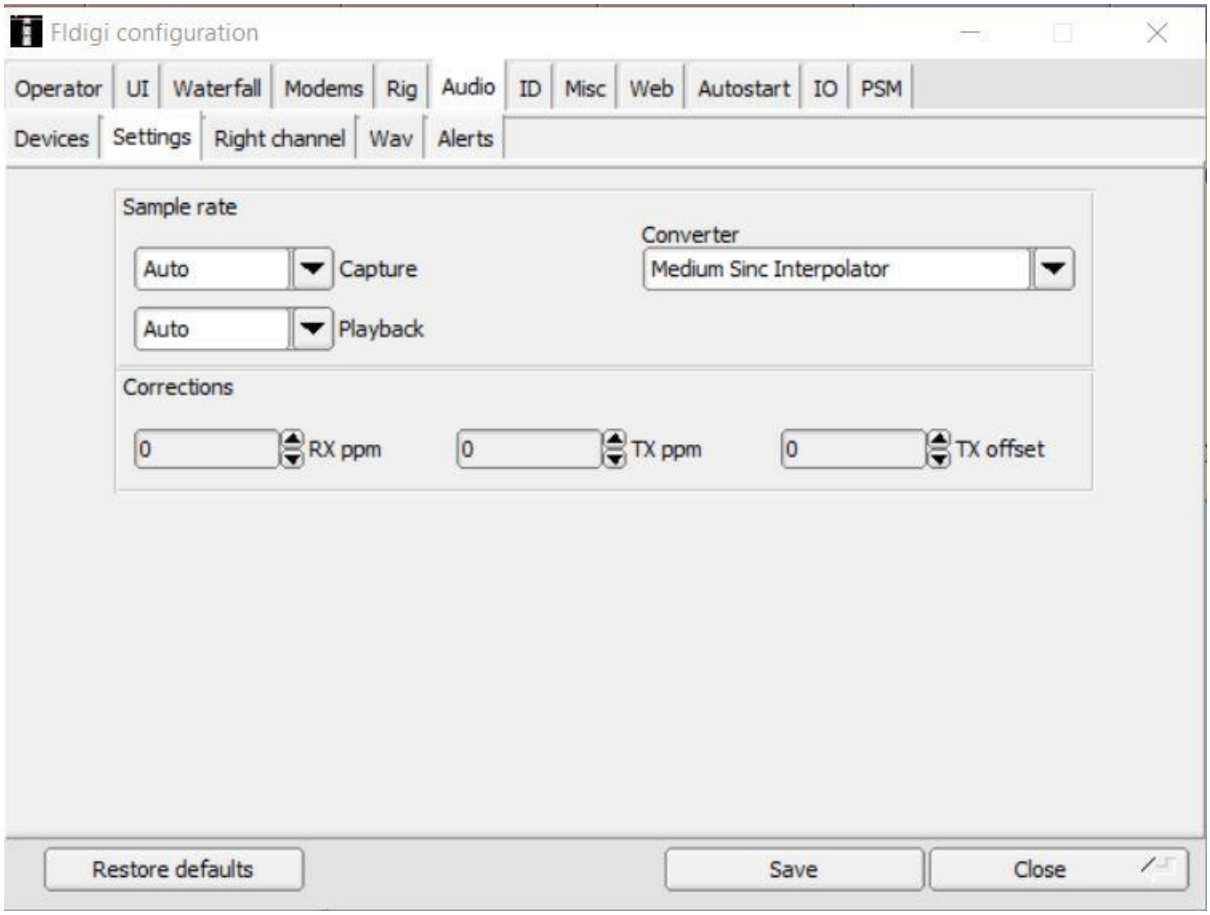


i) Click on **Devices** sub-tab. Check **PortAudio**. Using the up/down arrow box, for **Capture:** select **Windows DirectSound devices**, then **Line (USB AUDIO CODEC)**.

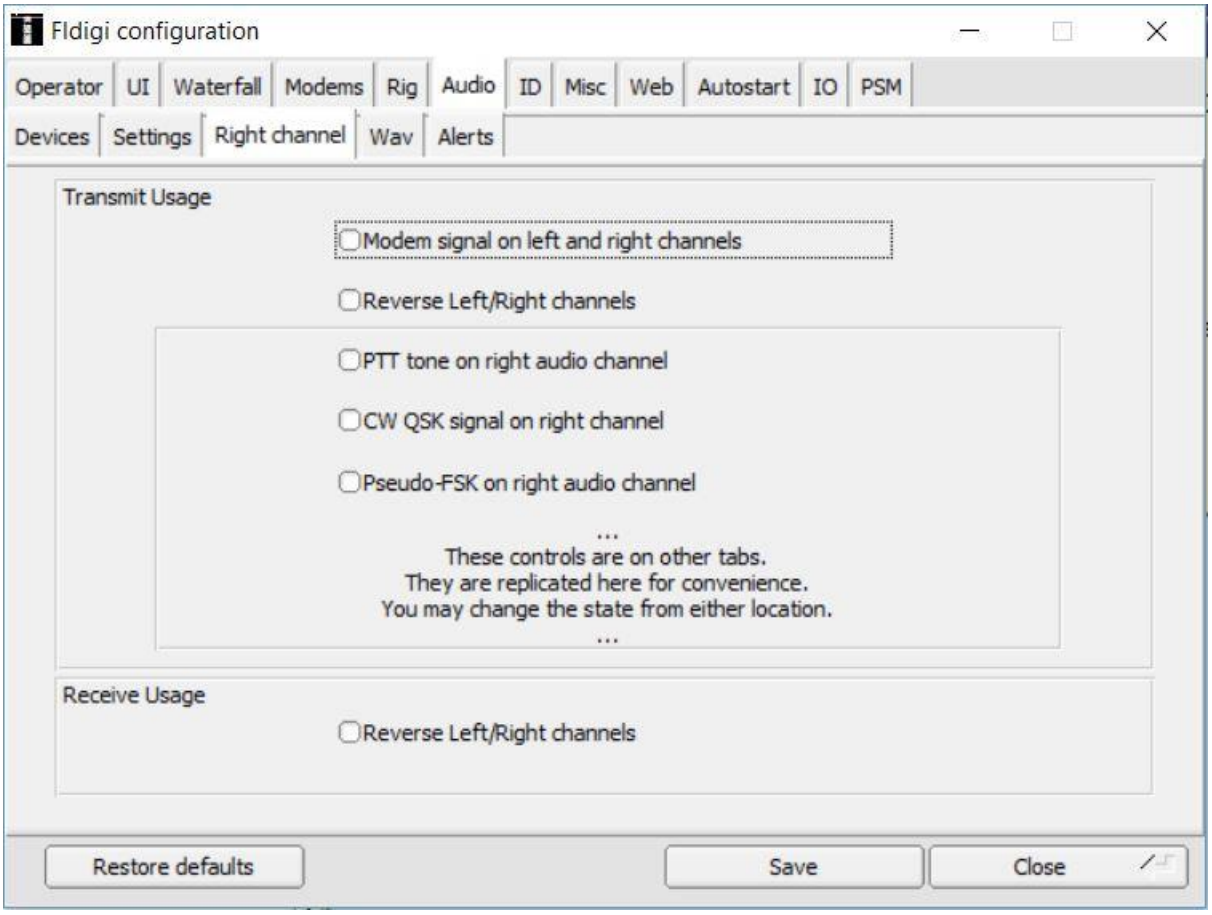
ii) Using the up/down arrow box, for **Playback**: select **Windows DirectSound devices**, then **Speakers (USB AUDIO CODEC**. No other boxes should be checked.

iii) Click the **Save** button.

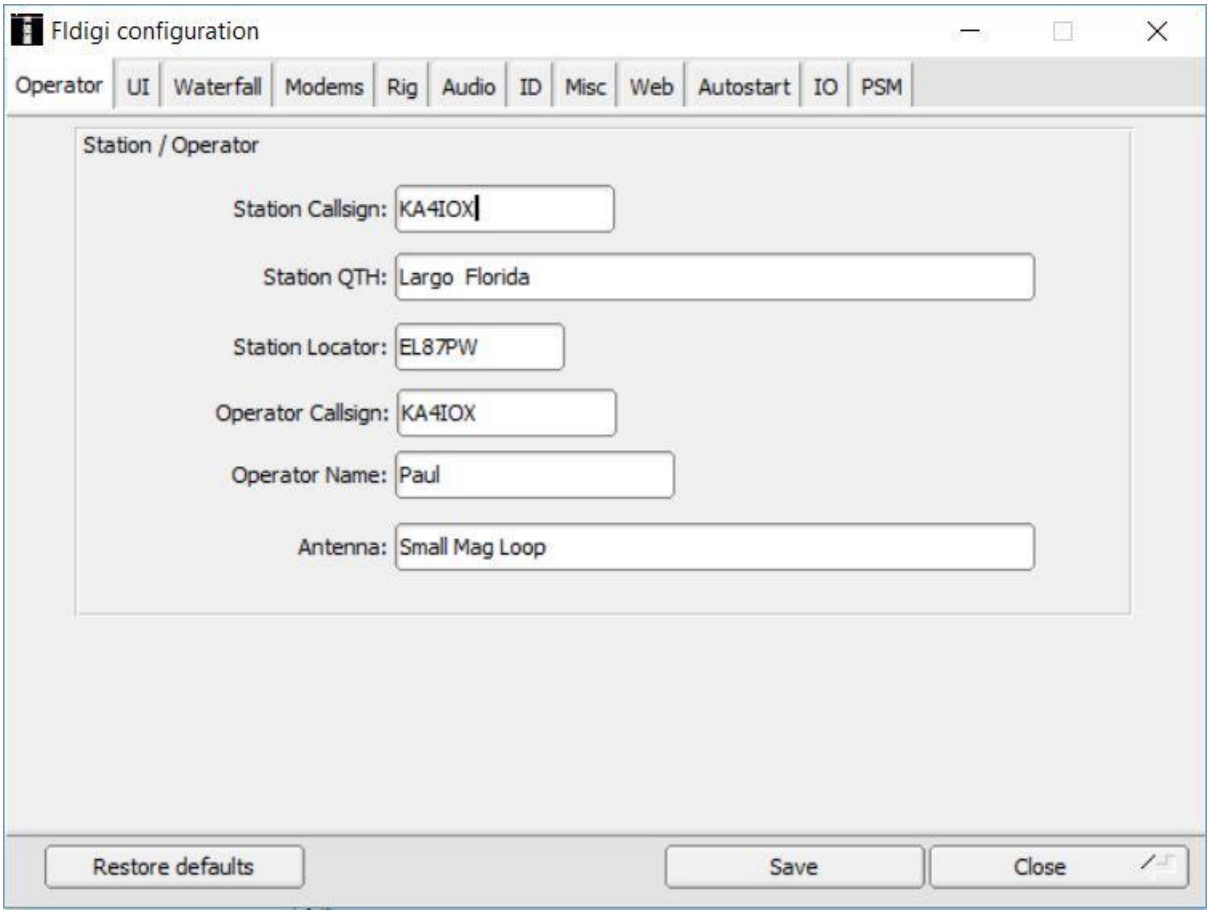
iv) Click on the **Settings sub-tab**. Sample rate for **Capture and Playback** should be **Auto**. The **Converter** should be **Medium Sinc Interpolator**. The **Correction** settings are all **0**. These are the default settings for this configuration. Click the **Save** button if the configuration was changed.



v) Click on the **Right channel** sub-tab. **Uncheck all boxes**. Click the **Save** button if the configuration was changed.



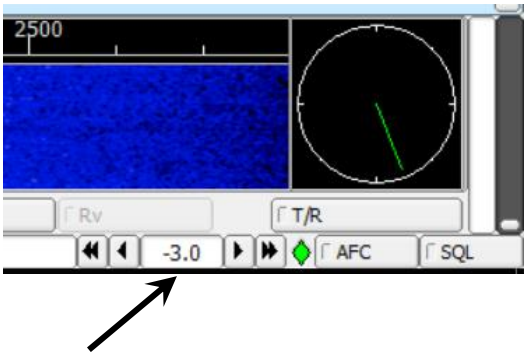
e) Click on the **Operator** tab. Enter *your* station and operator details in the text boxes. Click **Save**. Click **Close**.



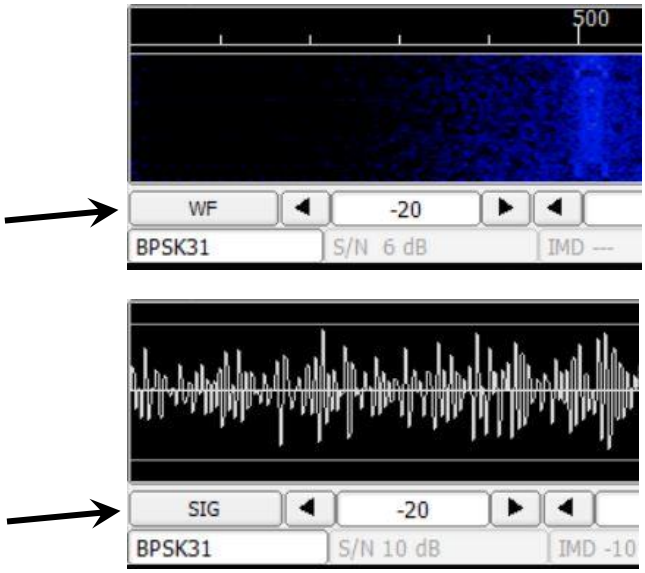
f) Further details on FLDIGI setup can be found at http://www.w1hkj.com/FldigiHelp/index.html

Or a pdf file named **fldigi-help.pdf** at https://sourceforge.net/projects/fldigi/files/fldigi/

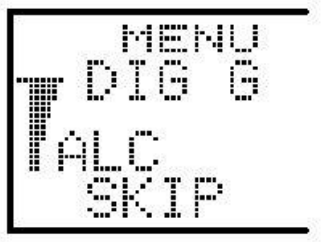
g) Set the FLDIGI **transmit attenuator to -3 dB** (control to the left of the AFC button).



h) Change the waterfall display to the Scope view by clicking on the **WF button** to **display SIG.** This shows the entire audio signal, and just not the signal that is currently decoded.

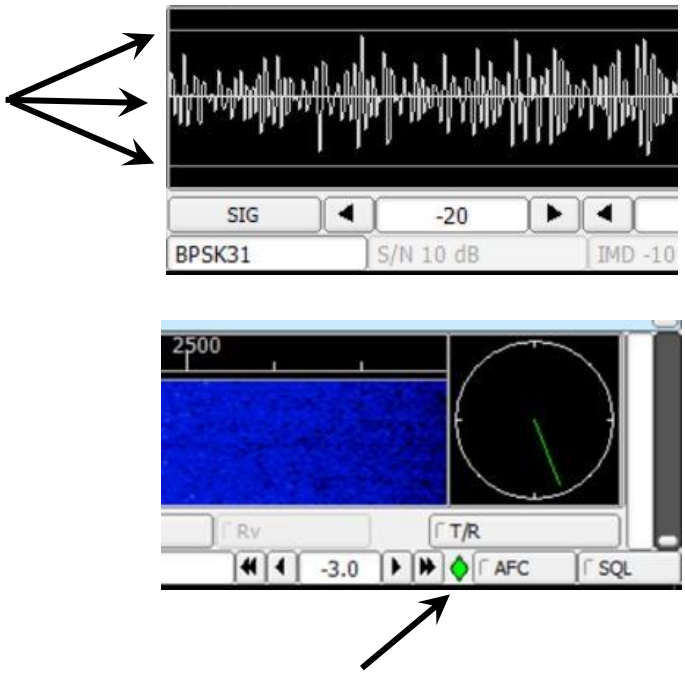


10) FT-857D Radio:
    a) Press FT-857D Function key briefly and use Select knob to display the MFi software defined key selection. Key "A" will display MTR. Press key "A" repeatedly to select **SWR** on key "B". Press the Function key briefly to exit the MFi menu.
    b) When using a **Small Magnetic Loop Antenna,** set the **FT-857 to PSK-U** operating mode, use **FLDIGI with PSK31** and **send a tune message macro**. Adjust the tuning knob of the **Small Magnetic Loop Antenna** for the **lowest SWR** on the FT-857D **SWR-meter**.
    Tuning is sensitive, and only a slight knob rotation is required to find the lowest SWR once resonance is reached.
    Tune Message Macro consists of the following text:
        i) **<TX>**
        Radio Adjust Radio Adjust Radio Adjust Radio Adjust <MYCALL>
        <RX>
    c) When using the YT-100 Antenna Tuner, use the automatic tuning function by pressing the button on the front of the tuner. Confirm the response of the YT-100 LED shows SWR is satisfactory.
11) SignaLink USB:
    a) **TURN-ON** SignaLink red power button on front of unit. Button is in more when on, and Green LED is lit.
    b) Set **SignaLink DLY level** fully counter clockwise to the **minimum level.**
    c) Press FT-857D Function key briefly and use Select knob to display the MFi software defined key selection. Key "A" will display MTR. Press key "A" repeatedly to select **ALC** on key "B". Press the Function key briefly to exit the MFi menu.

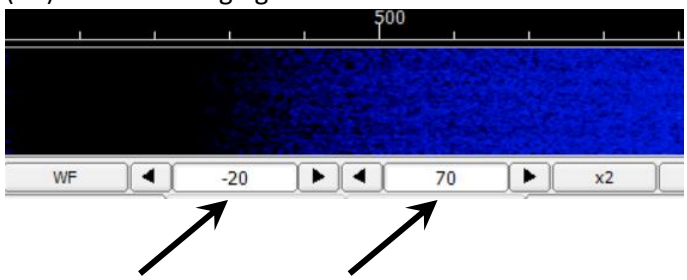


    d) **FLDIGI signal levels**.
        i) Set the **FT-857 operation mode to PSK-U**.
        ii) Set **FLDIGI SignaLink RX level**.
            (1) Change the waterfall display to the Scope view by clicking on the WF button to **display SIG**. If the SignaLink is functioning correctly, there should be no signal offset and the signal will be centered vertically about the y-axis. Set the FT-857D to 14.070 MHz and adjust the SignaLink RX front knob so the Scope signals are within the upper and lower gray lines on the display. The diamond indicator to the left of the FLDIGI AFC button will be colored as follows:
                (a) • BLACK - no signal, or insufficient Rx audio
                (b) • GREEN - signals are in the correct range
                (c) • YELLOW - signals are exceed 75% of maximum, but are less than 90% of maximum

(d) • RED - signals exceed 90% of maximum a/d capability. NOT GOOD



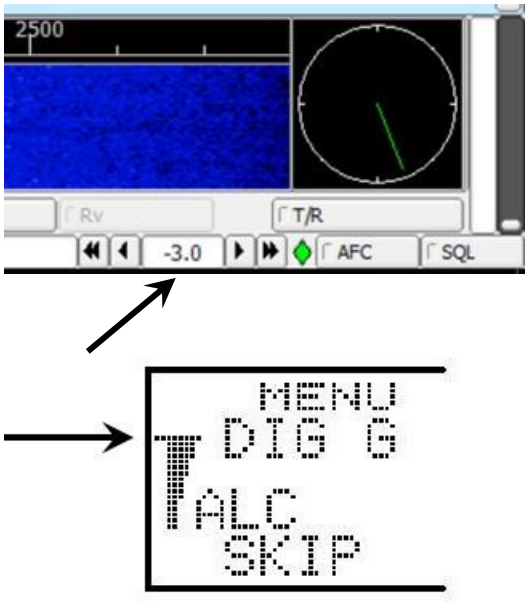
(2) The FLDIGI waterfall appearance can now be adjusted by changing the Upper signal level (dB), and Signal range (dB) without changing RX levels.



iii) Set **FLDIGI SignaLink TX level**.

(1) **Use ALC power level**.

(2) Set the FLDIGI **transmit attenuator to -3 dB.** Using **FLDIGI with PSK31** , send a tune message macro, and adjust the **SignaLink TX front knob** so the FT-857D **ALC meter is at or just below the intermediate long bar** of the display (16 bars up from the bottom). This sets the gain so that transmissions are at maximum power without saturating. Saturating an output is a very bad thing with digital communication. All signals FLDIGI produces will be limited to this peak to peak voltage.

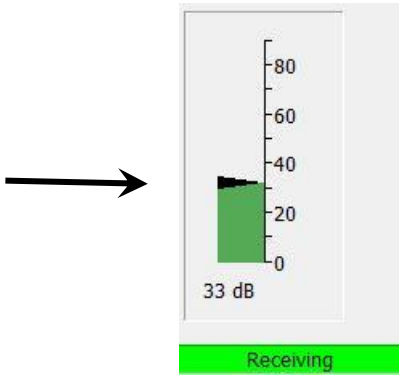


e) **WSJT-X signal levels**

i) Set the **FT-857 operation mode to USER-U**.

ii) Set **WSJT-X SignaLink RX level.**

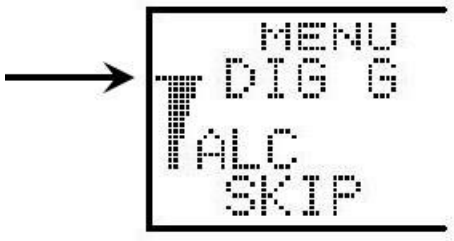
(1) The monitor button starts receive operations when it is green. If it is not green, click it to turn it green and start receiving. Adjust the **SignaLink RX front knob** to obtain **approximately 30 dB** on the WSJT-T receive signal meter. This sets the receive signal level.



iii) Set **FLDIGI SignaLink TX level.**

(1) **Use ALC power level.**

(2) Click the **TUNE button** to transmit a steady audio tone. Adjust the SignaLink TX front knob so the FT-857D **ALC meter is at or just below the intermediate long bar** of the display (16 bars up from the bottom). This sets the gain so that transmissions are at maximum power without saturating. Saturating an output is a very bad thing with digital communication. All signals WSJT-X produces will be limited to this peak to peak voltage.



12) The system is now ready for use.
   a) If you start Windows with the USB cables plugged into the computer, Windows will try to help you configure the ports and change their configuration. This is not fun. Run though the instructions in **section 6** to fix it. Windows may not except these configuration changes as expected. If so, power down the computer completely. Be certain power is off, and not just in sleep mode. Power must be removed from the port controller chip to cause it to reboot. The configuration should then be accepted. Older laptops allowed the battery to be removed easily, facilitating power removal. Now it is often not easy to remove power. Depending on how your computer power button is configured, pressing the power button for 10 seconds can force a power shut down, but it could just put the computer to sleep. The configuration of the power button can be changed in the computer setup menus.
   b) If you make a FT-857D setting adjustment and FLDIGI stops working correctly, first exit FLDIGI and restart it. This often clears issues.
   c) During use, the FT-857D **S-meter** is used to **closely adjust the Small Magnetic Loop Antenna** for band and frequency. Listen for the loudest signal during adjustment, and use the S-meter.
   d) Afterwards, the FT-857D MTR function should be set to **SWR** to **finely adjust the Small Magnetic Loop Antenna for the lowest SWR** while sending tune messages.
   e) During use of the **YT-100 Antenna Tuner**, use the automatic tuning function by pressing the button on the front of the tuner, when changing bands or significantly changing frequency.
   f) During use, the FT-857D MTR function can be set to **ALC** to **confirm the computer and SignaLink settings** are working.
   g) Use this sequence to shut down the station:
      i) **Close FLDIGI** or **WSJT-X**. ***Only one application can be open at any time***.
      ii) **Power down Radio**.
      iii) **Remove** the two **USB cables** from the computer USB ports.
      (Label the cables to identify the exact port where they are plugged into the computer)
      iv) **Shut down Windows**.
   h) Use this sequence to start the station:
      i) Start Windows *completely*
      ii) **Plug** the two **USB cables** into the **SAME** computer USB ports that they were removed from.
      iii) **Turn on the Radio**.
      iv) **Start *either* FLDIGI** or **WSJT-X**. Both can be open at the same time with special configuration changes and operational considerations that are beyond this tutorial.