Get on the air with FT8

How to make your first contact.

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Introduction

- FT8 is optimized for the efficient exchange of call signs, signal reports and a few additional bits of information.
- If you want to try FT8 but aren't sure how to get started, stay tuned.
- The objective here is to just put together a working system and get on the air.

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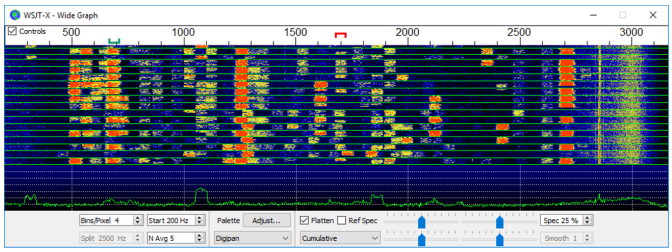
The End Result

When we're finished you'll see a waterfall display (below) and a control screen (next slide) on the PC.



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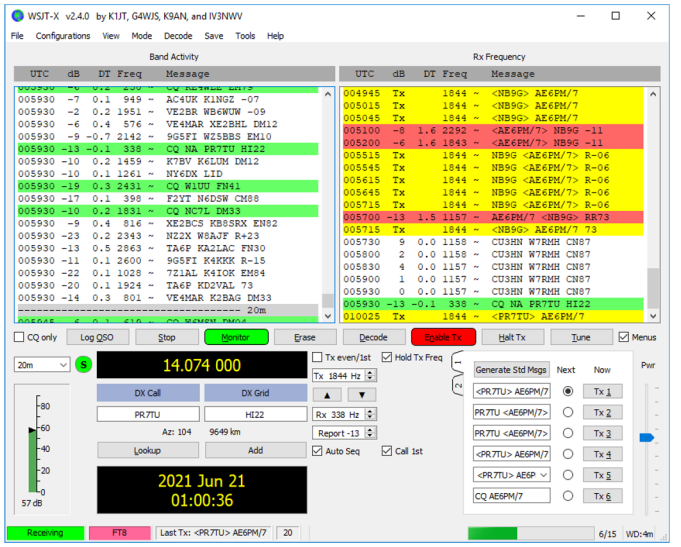

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System Requirements

- SSB transceiver and antenna.
  - Frequency stability is important.
- Computer & monitor.
- Computer-to-radio interface for rig control.
- Computer-to-radio interface for audio I/O.
- Some means to synchronize the computer clock to UTC within 1 second.
- WSJT-X software.

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Three Steps to Getting Started

1. Connect the radio to the PC.
2. Install the WSJT-X software.
3. Install the time-sync software (optional).

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Radio/PC Interface

- Radio (Rig) Control
  - Need to control PTT and the operating frequency.
- Audio Signals
  - Need to send and receive audio signals between PC sound card interface and radio.
- Connect direct from radio or via accessory box and/or software.

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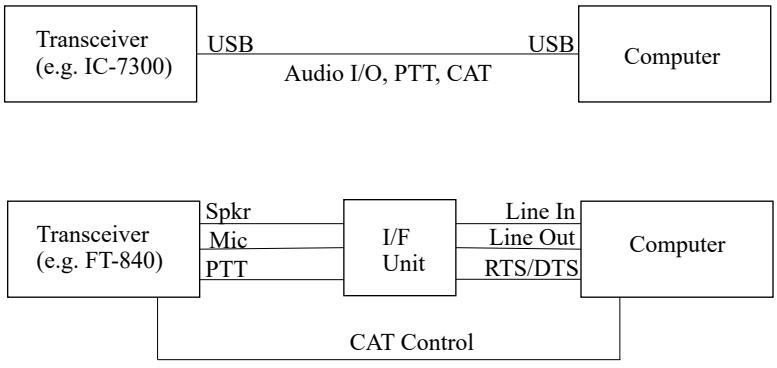
Transceiver-Computer Interconnect



WSJT-X provides CAT control from a dropdown rig-selection list.
PTT control selection is CAT, DTR or RTS.

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Install the WSJT-X Software

- WSJT-X software (ver 2.4)
  - https://physics.princeton.edu/pulsar/k1jt/wsjtx-2.4.0-win32.exe
  - https://physics.princeton.edu/pulsar/k1jt/wsjtx-2.4.0-win64.exe
  - Also available for Linux and MacOS
    - See the WS6JT website
    - https://physics.princeton.edu/pulsar/k1jt/wsjtx.html

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Timing

- Messages are initiated at specific time slots.
- Accurate timing (UTC within one second) is required.
- Set the PC clock manually or use free internet time sync software such as Meinberg NTP.
  - https://www.meinbergglobal.com/english/sw/ntp.htm

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Software Settings

- Launch WSJT-X and go to File:Settings
- There are eight tabs:
  1. General
  2. Radio
  3. Audio
  4. Tx Macros
  5. Reporting
  6. Frequencies
  7. Colors
  8. Advanced
- We only care about 1, 2, 3 and 5 for now.

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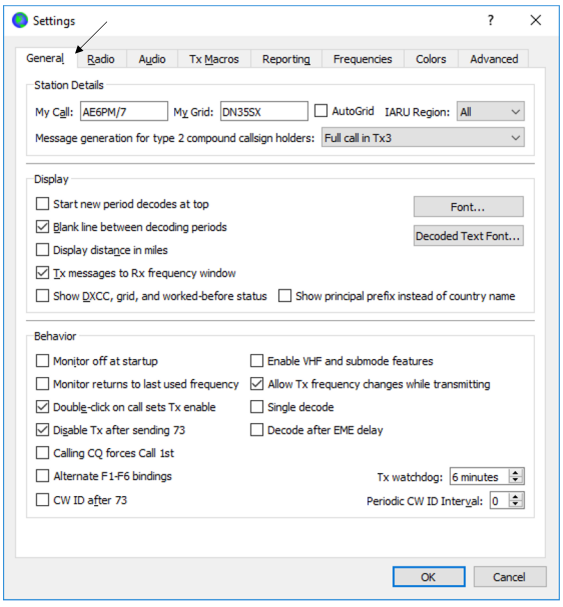

Enter your call and maidenhead grid square.

My personal choices are shown.

You might want to select Display distance in miles. I don't because I'm operating from Montana and the miles will be from Saratoga.

Tx watchdog is to stop runaway transmissions. 4 minutes would be adequate.

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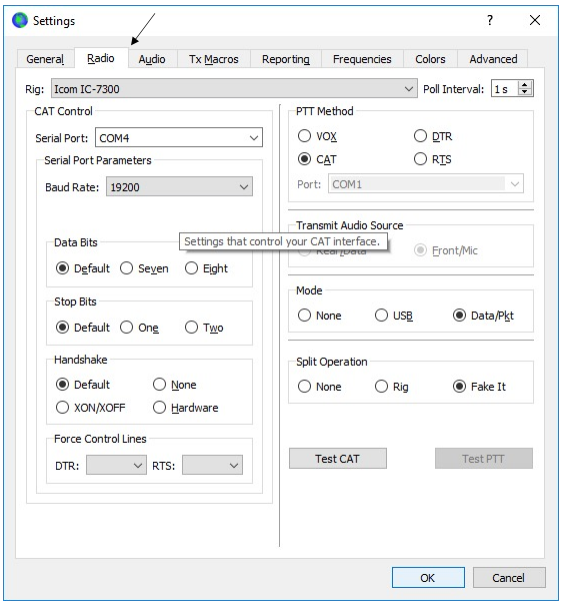

This is all about controlling the radio.

Select your radio from the Rig menu.

These settings work for me.

WSJT-X uses these settings to control the radio transmit and receive frequencies and PTT.

Be sure to use the Test button to see if you are in control. It should turn green.

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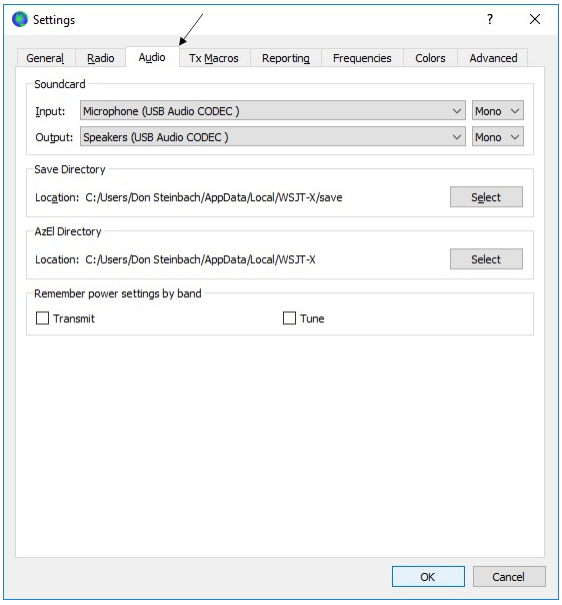

This tab defines the sound I/O between the PC and the radio as well as some unrelated directory information.

Choose selections from the pulldown menu.

Make sure that the PC microphone isn't active. No barking dog or other extraneous noises are allowed!

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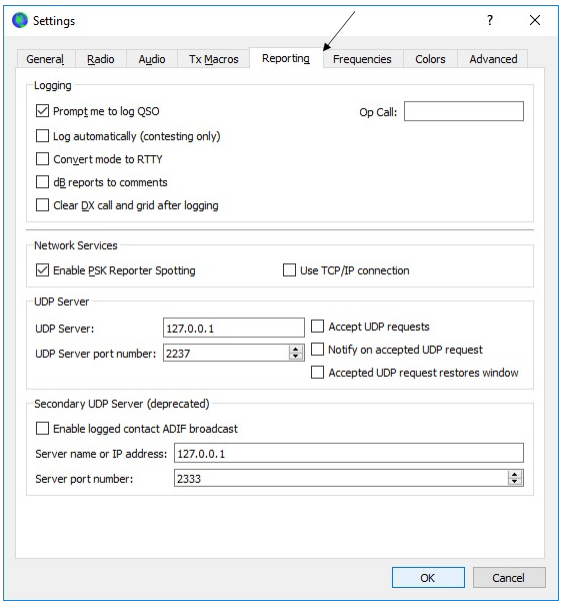

There are only two items of interest on this tab.

The Logging prompt causes a reminder screen, with details of the contact, to pop up when the QSO has ended. You can then save it to the log.

PSK Reporter can display on a map where your signal was heard. https://pskreporter.info/

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Transmitter Settings

- Use SSB USB or USB Data on all bands.
- Select widest available audio bandwidth.
- Don't use any audio processing including compression or spectrum shaping.
  - Use Data port if available.
- Adjust levels so that chain from AF generation through RF transmission is operating linearly.
  - Overdriving anywhere creates distortion and harmonics.

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Transmitter Settings (Cont'd)

- Setting Tx levels:
  1. Set the power output of the transmitter to 50% of normal.
  2. Increase the PC audio output from zero until transmit output power is observed and ALC is just starting.
  3. Reduce the audio level until the transmitter power drops 20%.
- ALC should be little or none when transmitting.
- Power output typically 30 watts more or less.

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Receiver Settings

- Widest available bandwidth
- AGC – Slow
- NB/NR – Off
- Notch Filter – Off
- USB/Data Mode
- Take from data port if available or Line Out
- Sampling s/b 16 bit, 48000 Hz (DVD Quality)

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Receiver Settings (Cont'd)

- Pay attention to WSJT-X bar graph
  - Adjust receiver audio output level for 20-30 dB with no signal and 40-70 dB with signals present

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Get on the Air

1. Launch WSJT-X
2. Select the operating band (e.g. 20m)
3. Select FT8 from Mode pulldown menu
4. Check the Hold Tx Freq box
5. Observe signals on the waterfall display
6. Observe decoded messages on the Band Activity display

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Make a Contact

- Find a station calling CQ.
- Double-click on it.
- Your radio will transmit a predefined message at the next 15-second time slot.
  - Message will include just his callsign.
- If you're lucky, the other station will respond at the next 15-second time slot with your signal report.
- You respond with his signal report.

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Make a Contact (Cont'd)

- This will continue until the six predefined messages have been exchanged.
  - The final message contains 73.
- Press the Log QSO button to automatically log the details of the contact.
- If you weren't lucky, your station will continue to try to contact the same station until it times out or you select another.

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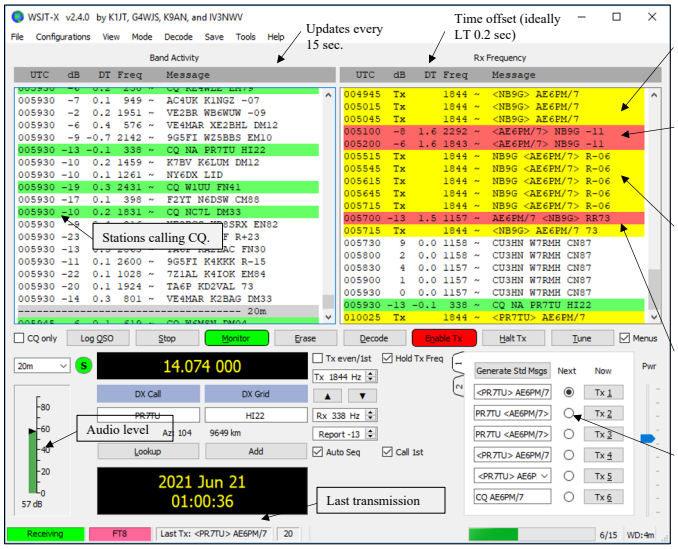
Typical decoded data for each signal.



AE6PM calling NB9G every 30 seconds.

NB9G answering AE6PM (incl signal strength).

AE6PM responding to NB9G (incl signal strength).

RR73 or 73 ends contact.

Messages queued up to work PR7IU.

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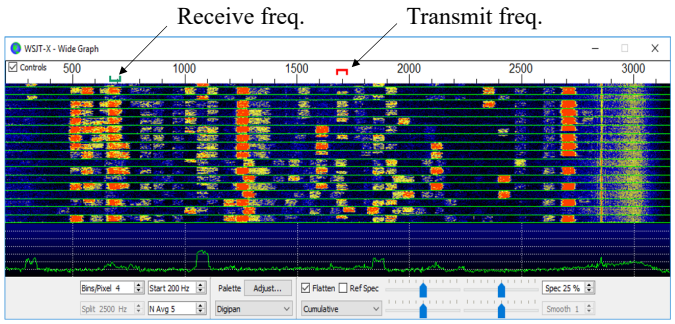
Typical waterfall display



1. The audio frequency span is 200 to 3000 Hz.
2. Each blob is a decoded FT8 signal.
3. Each signal occupies less than 50 Hz.
4. Data updates every 15 seconds.

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Mission Accomplished!

See the remaining slides for more information.

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Additional Information

- PSK Reporter
- FT8 Overview
- Where to find signals
- WSJT-X Automated messages
- WSJT-X Logging
- System Setup Notes
- Windows PC Audio I/O Setting Locations
- PC/Radio Audio IFU
- Reference Documents
- Highlights from the WSJT-X User Guide
- Highlights from the FT8 Operating Guide
- Reading Material

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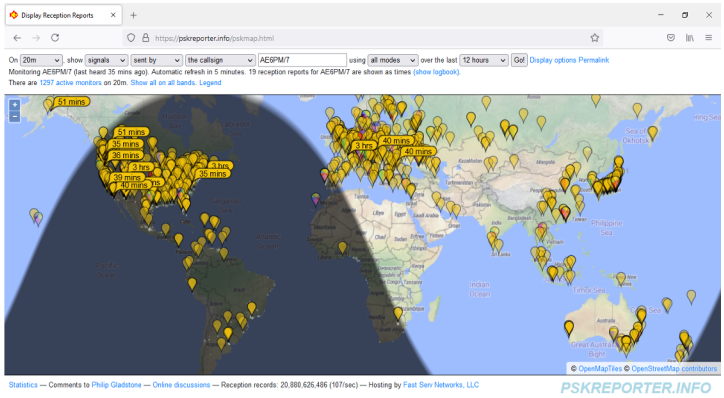
PSK Reporter Screenshot



1297 active monitors on 20M.
20 reported hearing me.

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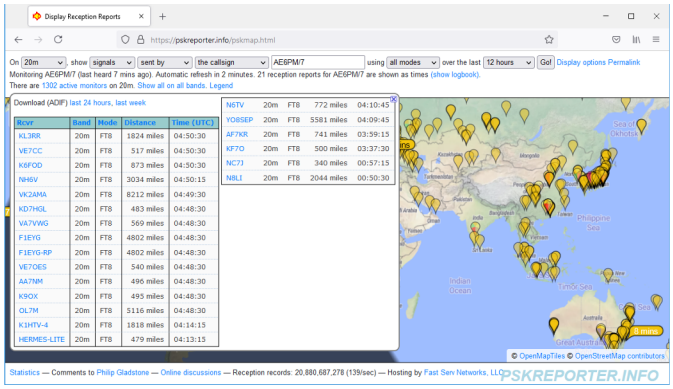
PSK Reporter Log



20 different locations reporting.
340 miles (Layton, Utah) to 8,200 miles (Sussex Inlet, Australia).

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FT8 Overview

- FT8 is one of ~~10~~ 11 digital communication modes developed by Joe Taylor, K1JT.
- Intended for weak-signal communication
  - Capable of decoding signals below the local noise level.
- Uses predefined digital message content and known time slots for transmitting and receiving.

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FT8 Overview (Cont'd)

- Designed for rf communication, not long conversations or ragchewing.
- Transmitted signal is constant-carrier FSK.
- Audio from receiver is AFSK.
  - Resulting audio tones are decoded by PC via sound card and software.
- Transmissions are 12.6 seconds long transmitted at 0, 15,30 or 45 into a UTC minute.

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FT8 Overview (Cont'd)

- Decodes every signal present in the receiver passband during that time interval.
  - Displays on waterfall and in a list.
  - Click on the one you want to attempt to contact.
  - Software 'fills in the banks' and transmits predefined messages over the next n 15-second intervals, alternately receiving and transmitting.

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Where to find signals

- WSJT-X FT8 mode will automatically select the following frequencies:

1.840 MHz	18.100 MHz
3.573 MHz	21.074 MHz
7.074 MHz	24.915 MHz
10.136 MHz	28.074 MHz
14.074 MHz	50.323 MHz

- The instantaneous frequency will be up to 3 kHz above the dial frequency.

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Automated Messages

- WSJT software automatically formats the messages
  - Software then knows what to expect to receive and how to respond.
- A free text message of up to 13 characters can be added.
- The total message payload is 77 bits.

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Logging

- WSJT-X has the capability to maintain an internal log of stations worked.
  - It's a text file located at
  - File:Open log directory:wsjtx.log
- Press the Log QSO button at the end of the contact.
  - You will be prompted if you checked the box under the Reporting tab earlier.

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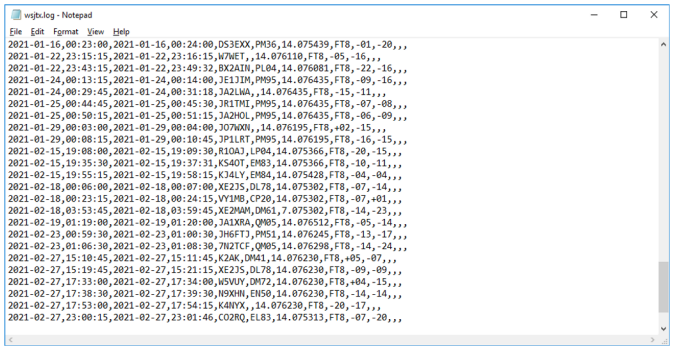
WSJT-X Log File

- Start time, end time, callsign, grid square, frequency, mode, your signal strength, their signal strength



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System Setup Notes

- Check system signal linearity.
  - Increasing audio level from the PC should cause the rf output to increase proportionally.
- Signal strength report of 0 to -10 dB is very good.
  - Reports consistently higher than that implies that you should reduce your power.
  - I'm typically between -2 and -24 dB.

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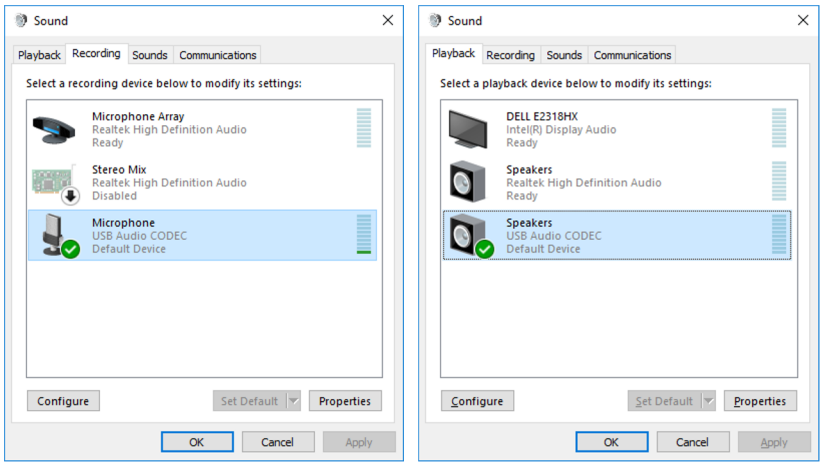
Windows PC Audio I/O Setting Locations



WSJT-X must be running before you can see these.

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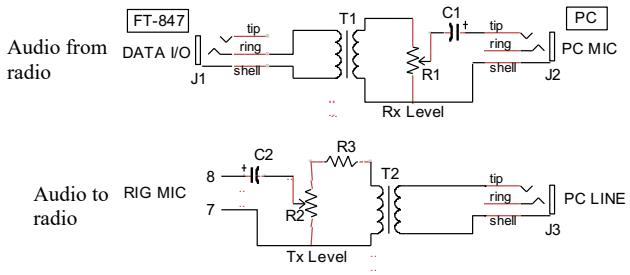
PC/Radio Audio IFU



J1-J3 1/8" stereo jack
J4 8-pin(m) mic conector
R1,R2 10k AB Type W
R3 470K

C1,C2
T1,T2 Midcom 671-9373 600:600
Enclosure Radio Shack 270-1893

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Interface Candidates

- External sound card data mode interface
  - Rigblaster (West Mountain Radio) ~ $70-$300
  - SignaLink USB (Tigertronics) ~ $130
  - MFJ (1204, 1275, 1279) ~ $110 - $140
  - Digimode (xggcoms.com) ~ $89
  - EasyDigi (audio isolation only, no processing, no USB, opto-isolated PTT) ~ $10
- CAT Cables
  - RTSystems (rtsystemsinc.com) ~ $30

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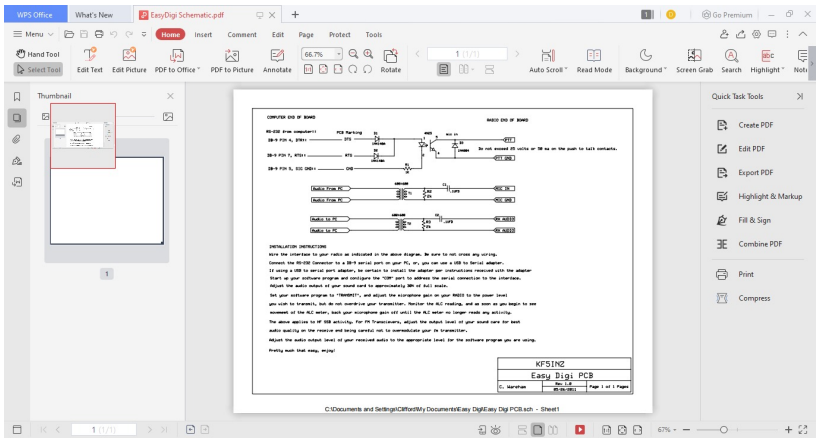
Easy Digi Schematic



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Reference Documents

- User Guide under Help (It's great!)
  - Must launch WSJT-X first.
  - Same as User Guide below.
- WSJT-X 2.4 User Guide by Joe Taylor K1JT
  - https://physics.princeton.edu/pulsar/k1jt/wsjtx-doc/wsjtx-main-2.4.0_en%20%28USLetter%29.pdf
- FT8 Operating Guide by Gary Hinson ZL2IFB
  - https://www.g4ifb.com/FT8_Hinson_tips_for_HF_DXers.pdf
- WSJT-X v1.4 Installation Guide (old but very good)
  - http://w4ti.com/wsjt-x-help-files/wsjt-x-v1-4-installation-guide/

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Highlights from the WSJT-X User Guide

- Waterfall Notes [6.6]
- Standard Message Exchange [7.1]
- Signal Reports [7.1]
- On-Screen Controls [Chapter 10]

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Waterfall Notes [6.6]

There are two frequency markers (goal posts) at the top of the display.

- The green marker is the receive frequency.
  - Click anywhere on the display and the marker will jump to that frequency.
- The red marker is the transmit frequency.
  - Use shift-click to move that marker.

To decode a particular signal, double-click near the left edge of its waterfall trace.

If you double click on any line in the Band Activity window, the green marker will jump to that stations' frequency. The transmit frequency remains unchanged.

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Standard Message Exchange [7.1]

He sends CQ
    You answer (by double-clicking on his line)
He sends your signal report
    You send R plus his signal report
He sends RRR
    You send 73

You send CQ
    He answers
You send his signal report
    He sends R plus your signal report
You send RRR
    He sends 73

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Signal reports [7.1]

Signal reports are specified as signal-to-noise ratio (S/N) in dB, using a standard reference noise bandwidth of 2500 Hz.

On-Screen Controls [Chapter 10]
Explains all 8 of the menu buttons across the top, the row of buttons 11 across the middle (FT8 doesn't use Clear Avg), the boxes at the lower left, lower center and lower right, and the status bar at the bottom.
The explanations of the 8 menu buttons leave a lot to be desired.

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Highlights from the FT8 Operating Guide

- This document is full of good information. If nothing else, look at:
  - Chapter 3 – accurate timing
  - Chapter 4 – transmit levels
  - Chapter 5 – receive levels
  - Chapter 7 – respond to CQ or call a station
  - Chapter 8 – how to call CQ
  - Chapter 9 – miscellaneous operating tips

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Reading Material

- General
  - Get on the Air with HF Digital (ARRL publication)
    - ARRL item no. 0833, ISBN 978-1-62595-083-3
  - https://hfradio.org.uk/html/digital_modes.html
  - https://stationproject.blog/2012/12/06/setting-up-a-digital-hf-station/
- For IC-7300 Owners
  - https://www.fbnews.jp/201805/technical_en/
- Commercial Digital/Sound Card Interfaces
  - https://ftp.unpad.ac.id/orari/library/library-sw-hw/amateur-radio/rtty/docs/getting-started/Getting%20Started%20on%20RTTY%20-%20Page%209.htm

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