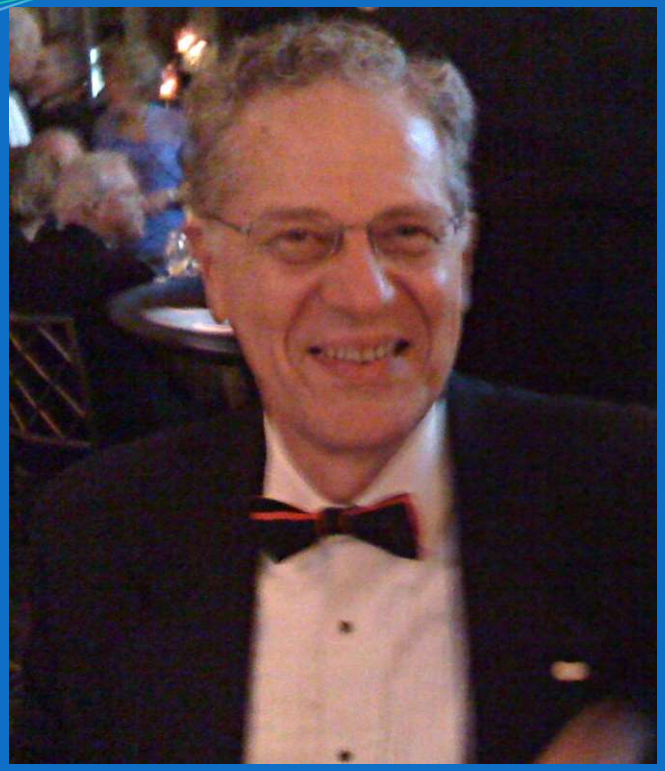


JT-65 & JT-9

Digital Mode by Dr. Joe Taylor K1JT

Astrophysicist

By: Joe Molter – N8IDA

Dr. Joe Taylor

- Nobel Prize in Physics 1993
- First Pulsar in a Binary Star System
- Confirmed the existence of gravitational radiation predicted by Albert Einstein
- Amateur Radio Operator – K1JT

Weak Signal Interest

- Study in Pulsars developed interest in weak signals
- “Free Space Path Loss”
  - Loss of transmit power to receive station
  - Proportional to the square of …
    - Distance between transmitter and receiver
    - Frequency of the radio signal
- Interest in EME as an Amateur Radio Operator

Birth of JT65 and JT9

- Combination of
  - Narrow bandwidth (177.6 Hz) JT9 (15.6 Hz)
  - Redundant multiple-frequency shift keying
  - Data compression
  - *Reed-Solomon* coding
  - Time synchronized
  - WSJT-X Version 1.7.0 (current version)
  - http://physics.princeton.edu/pulsar/k1jt/

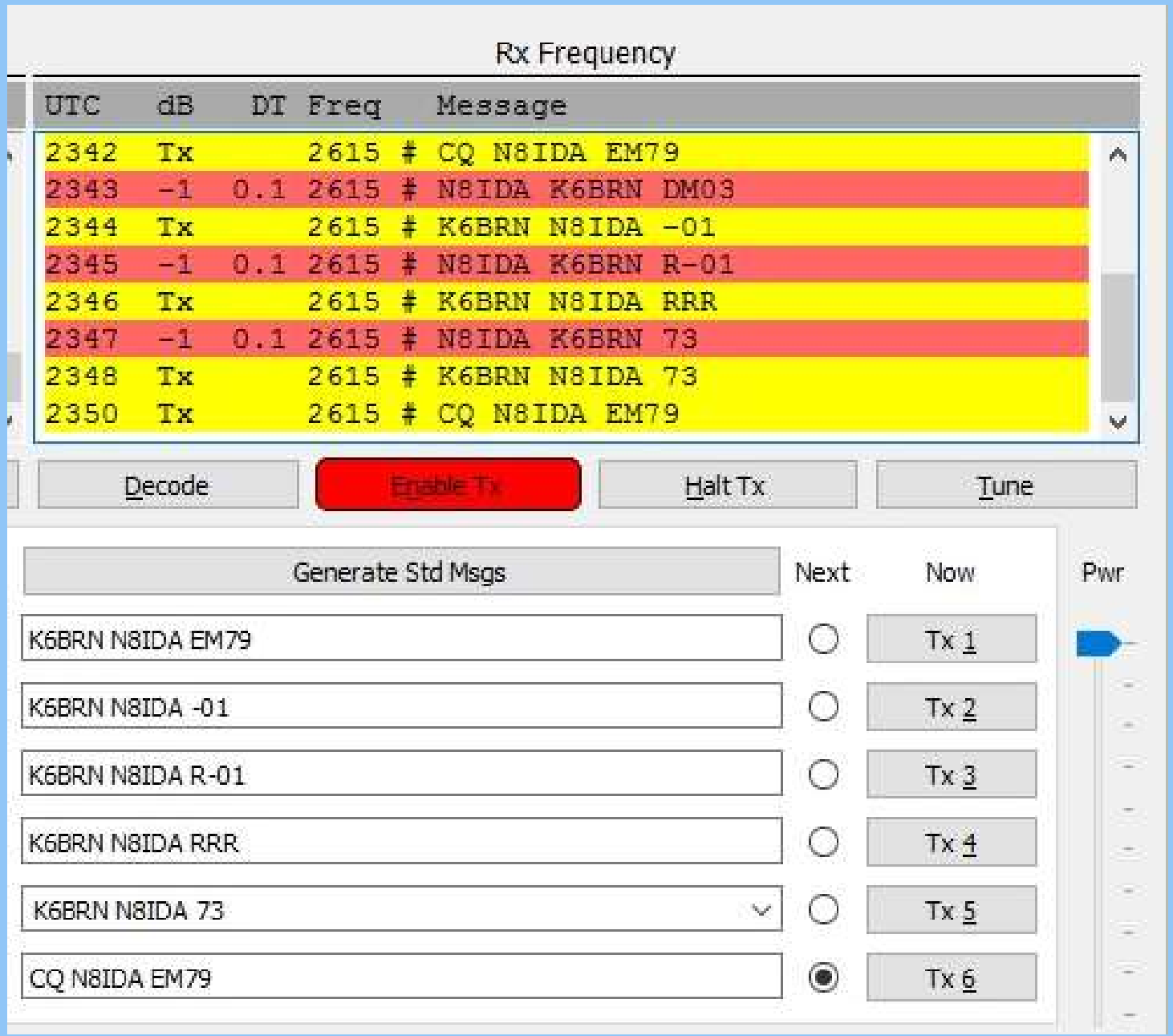
JT-65 Format

- Not conversational like PSK31
- Basic information exchange
  - Call signs and Grid square
  - Signal reports (in dB ie., -07 dB)
  - Salutations
- *Always* use Upper Sideband data mode regardless of frequency
- *Do not* use speech processor, NB
- Signal reports are constrained to -01 to -30 dB
- Non-linear above -10 dB
- ~100% decoding down to S/N = -22dB
- ~50% decoding down to S/N = -24dB
- Atmospheric noise will affect ability to decode

JT-9

- Similar in message structure
- Still uses the one minute transmission as JT-65
- Narrower band width 15.6 Hz vs. 177.6Hz
- Greater signal to noise ratio -50 to +49 dB
- JT-9 is 2 dB better than JT-65 for decoding
  - JT-65 100% at -22dB 50% at -24dB
  - JT-9 100% at -24db 50% at -26db
- JT-65 may perform better in bad ionospheric condtions due to JT-9's smaller tone spacing
- JT-9 was specifically developed for LF, MF and low parts of the HF bands

Typical QSO on JT-65



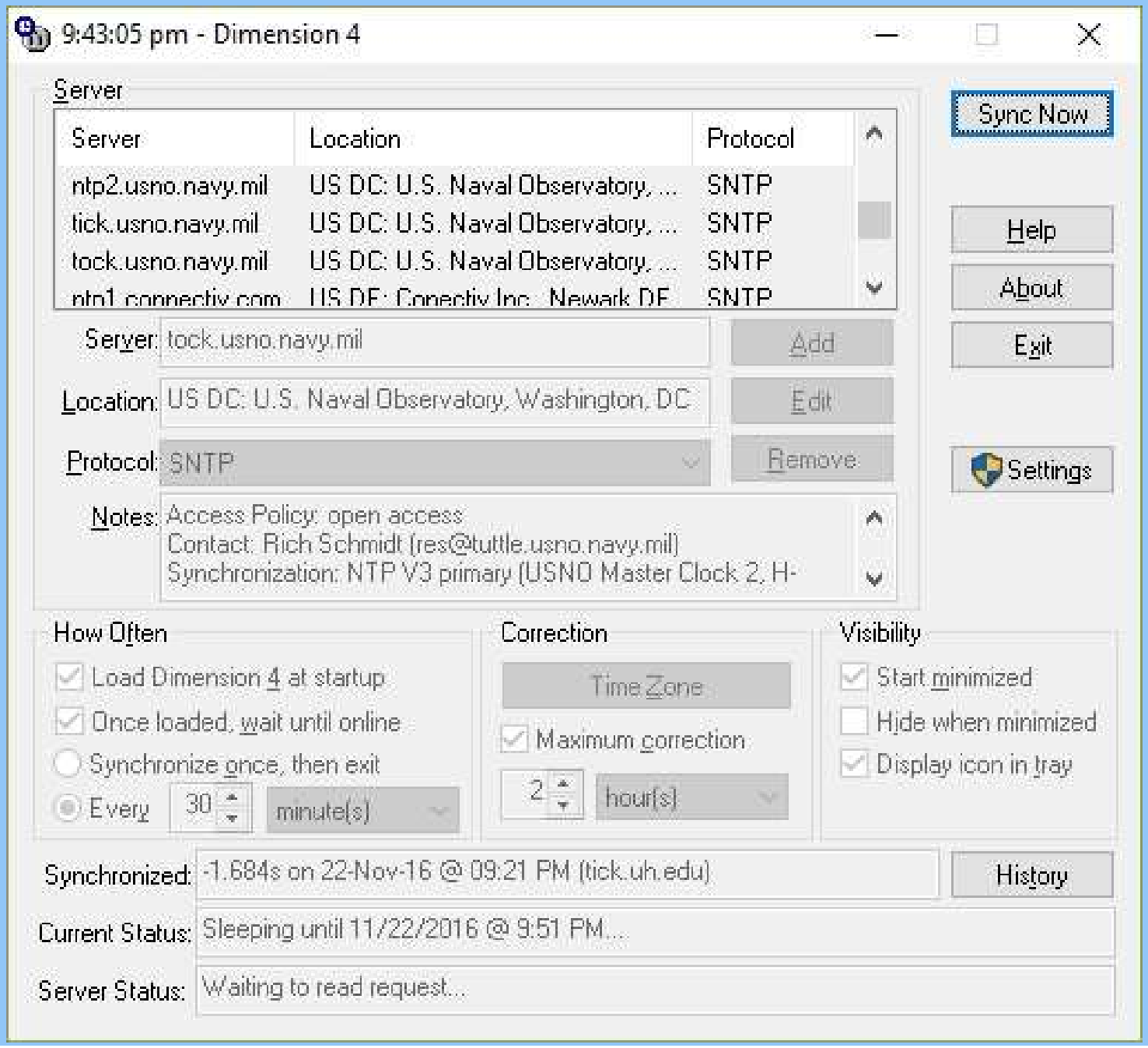
Radio Duty Cycle

- SSB duty cycle is 40% , CW duty cycle is 30%
- JT-65 duty cycle is 100%
- NEVER use full power – may damage transmitter finals
- 20 watts is more than enough on a 100 watt radio
- QRP rigs may be damaged at full power (ie., 10 watts)
  - Reduce power to ~ 5 watts
  - Check for excessive rig heating

Station Configuration – Time Accuracy

- Your computer and the receiving computer must be in time sync to within 2 seconds
- Personal Computers are notorious for poor time accuracy
- Number one issue for non-decoding of signals
- Use software to correct
- Dimension 4 (www.thinkman.com/dimension4/)
- Windows time server may also work

Dimension 4


9:43:05 pm - Dimension 4
Server
Server
Location
Protocol
ntp2.usno.navy.mil
US DC: U.S. Naval Observatory, ...
SNTP
tick.usno.navy.mil
US DC: U.S. Naval Observatory, ...
SNTP
tock.usno.navy.mil
US DC: U.S. Naval Observatory, ...
SNTP
ntp1.connectiv.com
US DE: Connectiv Inc., Newark DE
SNTP
Server: tock.usno.navy.mil
Add
Location: US DC: U.S. Naval Observatory, Washington, DC
Edit
Protocol: SNTP
Remove
Notes: Access Policy: open access
Contact: Rich Schmidt (res@tuttle.usno.navy.mil)
Synchronization: NTP V3 primary (USNO Master Clock 2, H-
Sync Now
Help
About
Exit
Settings
How Often
Load Dimension 4 at startup
Once loaded, wait until online
Synchronize once, then exit
Every 30 minute(s)
Correction
Time Zone
Maximum correction
2 hour(s)
Visibility
Start minimized
Hide when minimized
Display icon in tray
Synchronized: -1.684s on 22-Nov-16 @ 09:21 PM (tick.uh.edu)
History
Current Status: Sleeping until 11/22/2016 @ 9:51 PM...
Server Status: Waiting to read request...

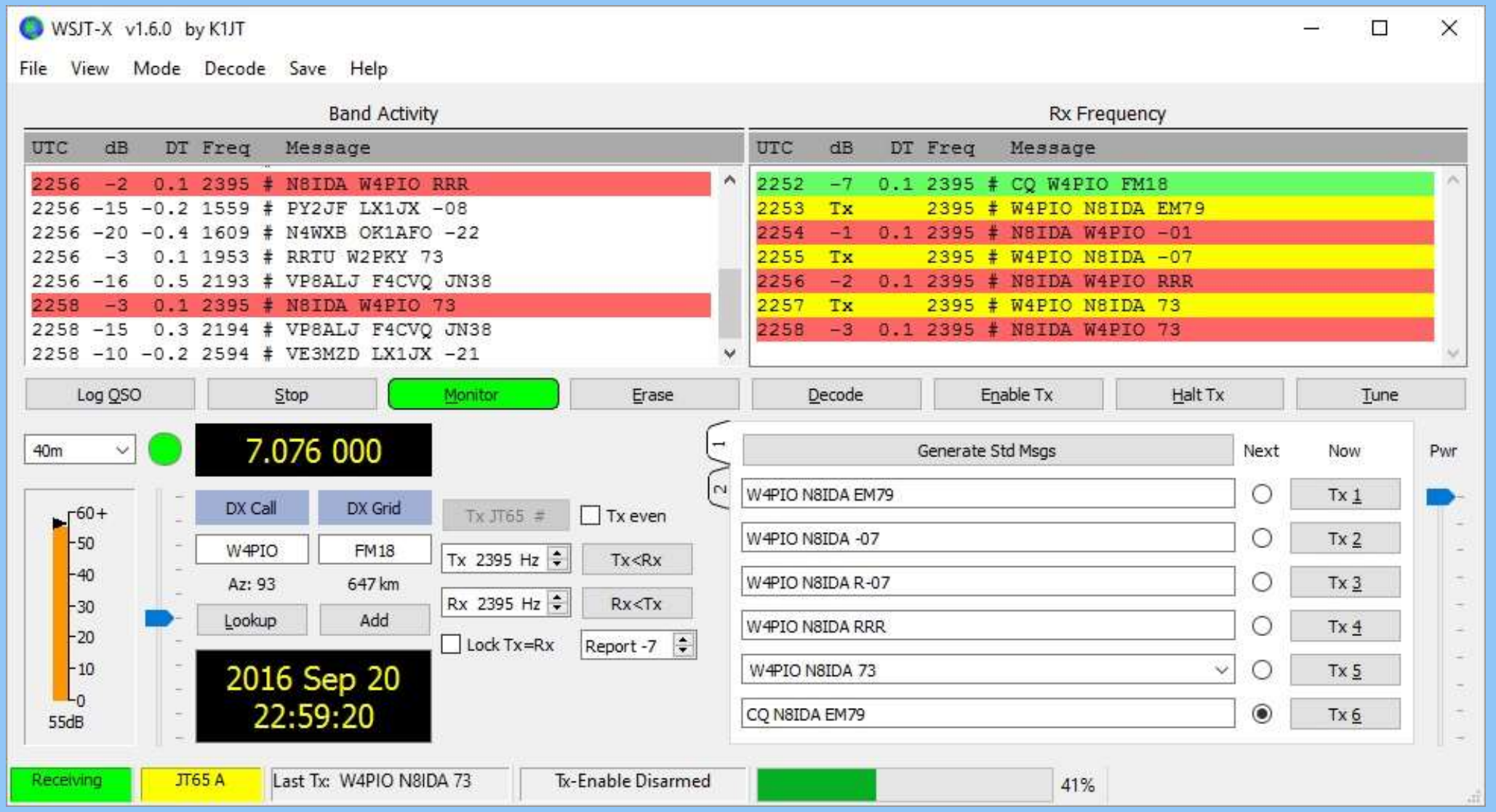
Computer Control

- True accessory port must control
  - Audio transmit keying
  - Audio receive keying
  - Computer control of radio
- Many new rigs will have full control on USB
  - (Universal Serial Bus)
  - CAT control based on HAMLIB
- Some rigs will only allow CAT (Computer Aided Transceiver)
- Necessitate Sound Card Interface
- TigerTronics – *Signal Link USB*

Drivers for the Radio

- Many radios will require drivers to be loaded
- Drivers may create two COM ports
- One enhanced port, one standard port
- Always use the enhanced com port if possible
- Other radios may only create one port
- Check device manager for the port number

WSJT-X Software



Configure General Settings

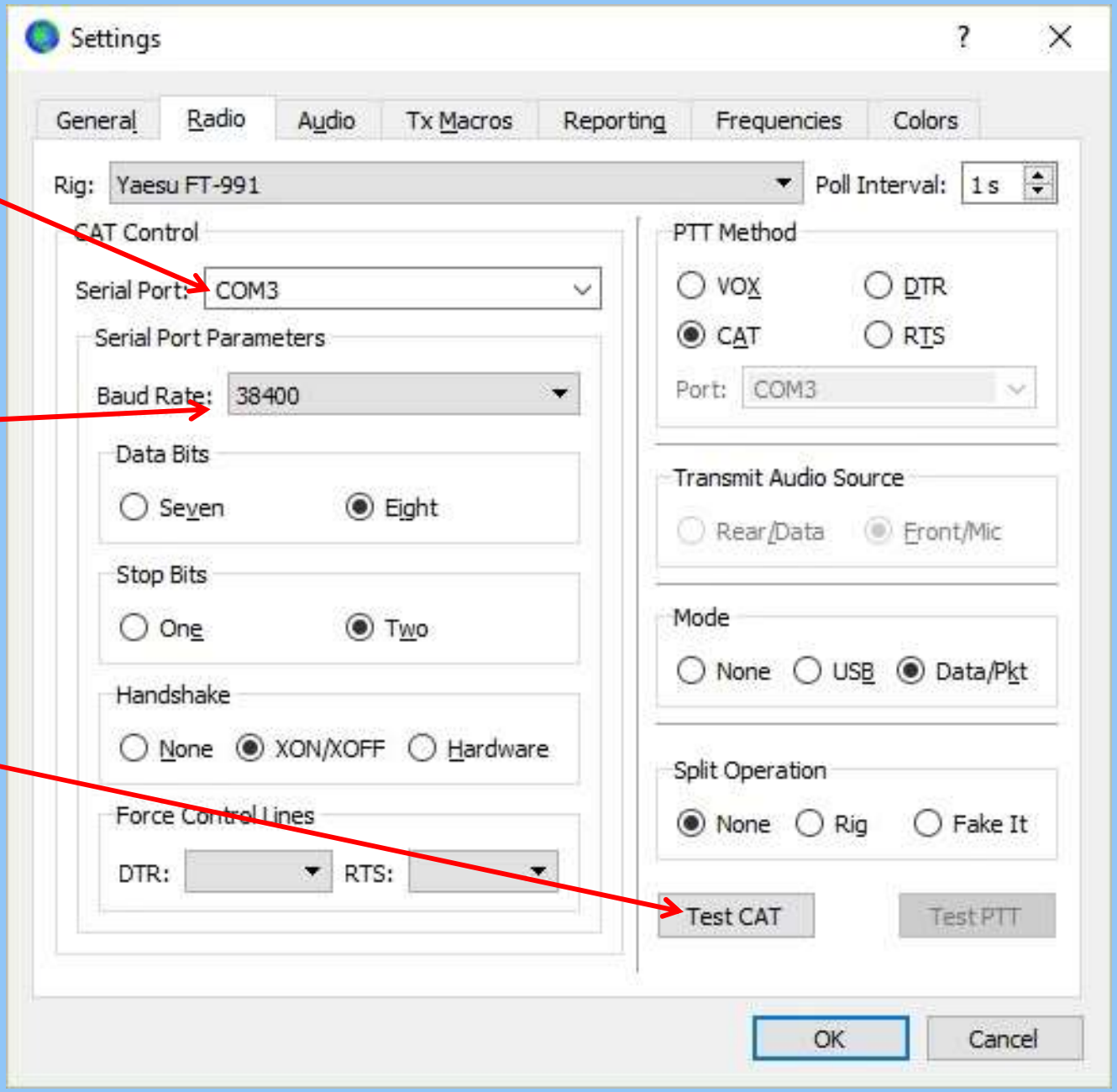
- Input your call sign N8IDA
- Maidenhead grid square EM79
- Other settings can be default

Configure Radio Settings

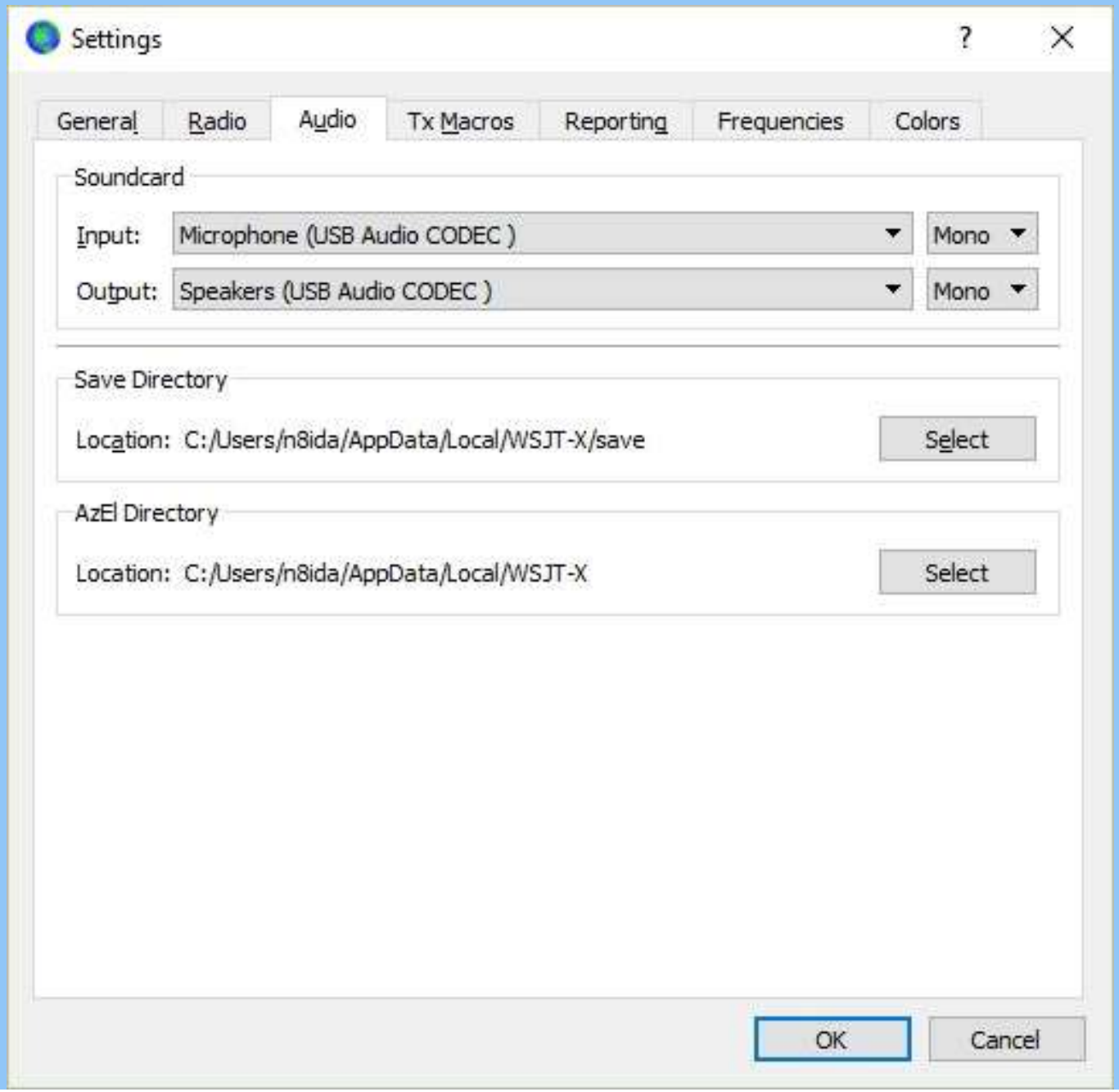
Enhanced COM Port number

Baud setting to match radio

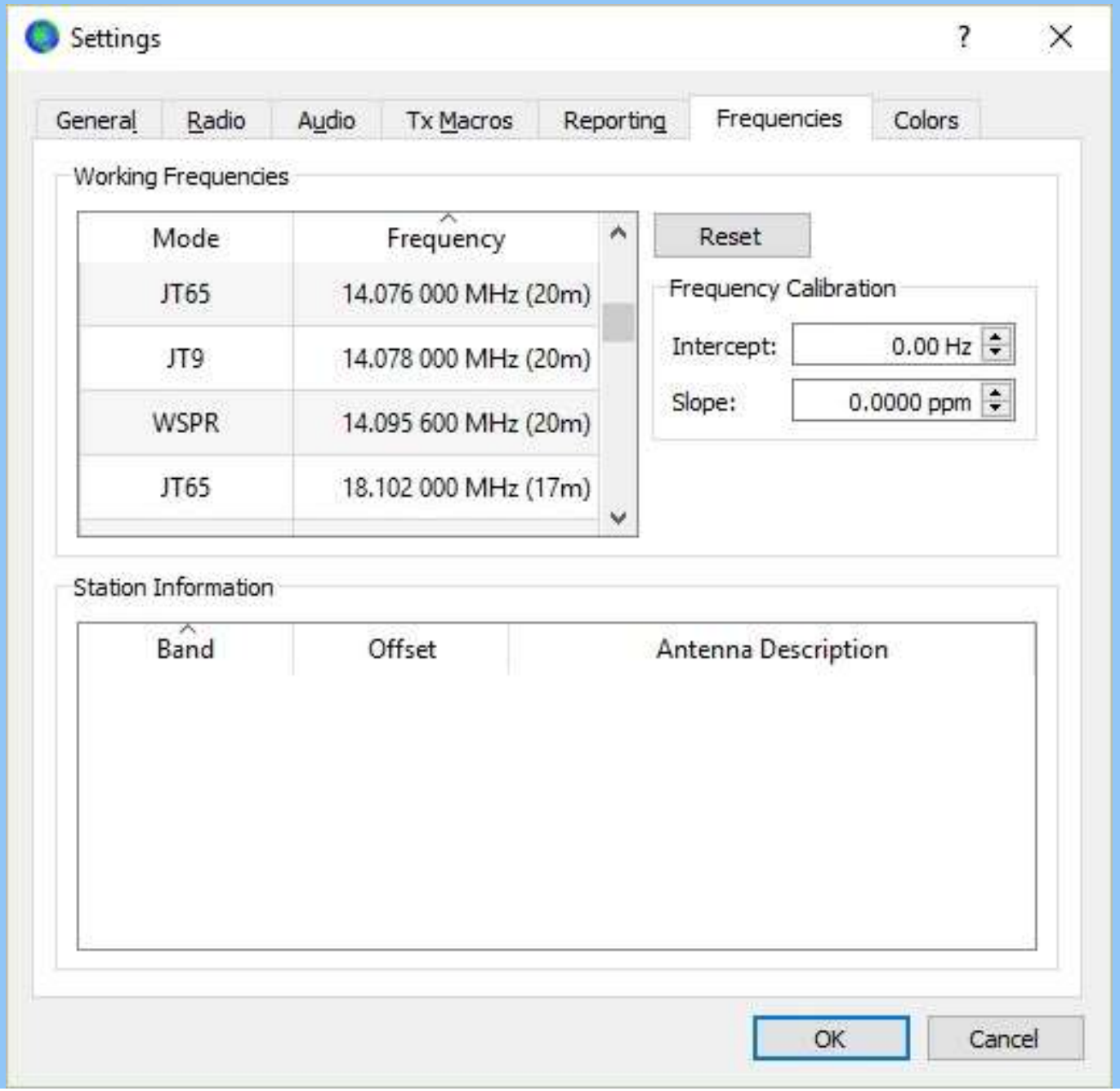
Test CAT control of transceiver



Configure Audio Codecs



Frequencies for JT-65

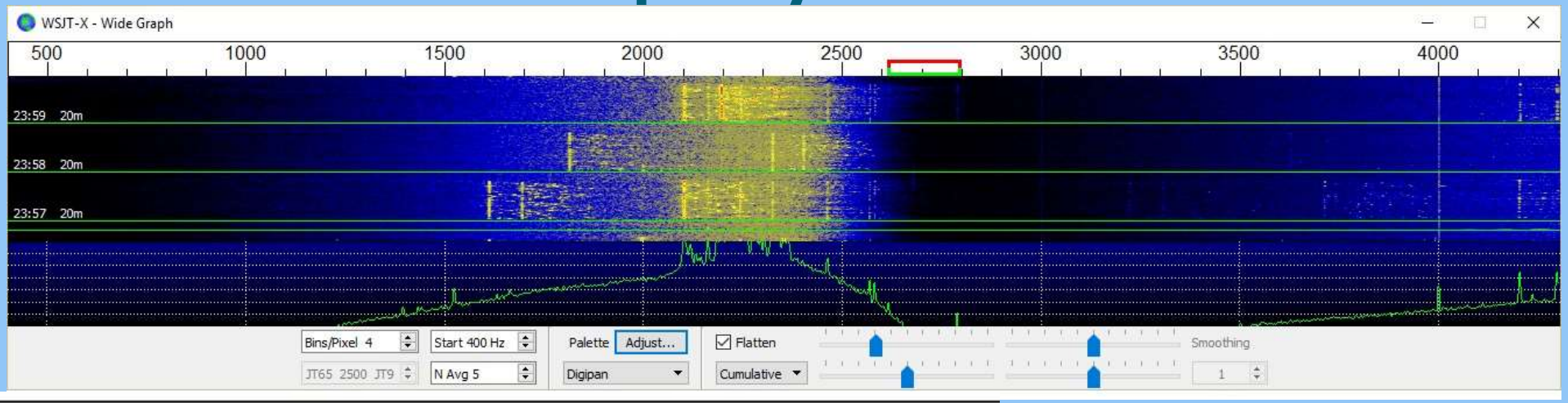


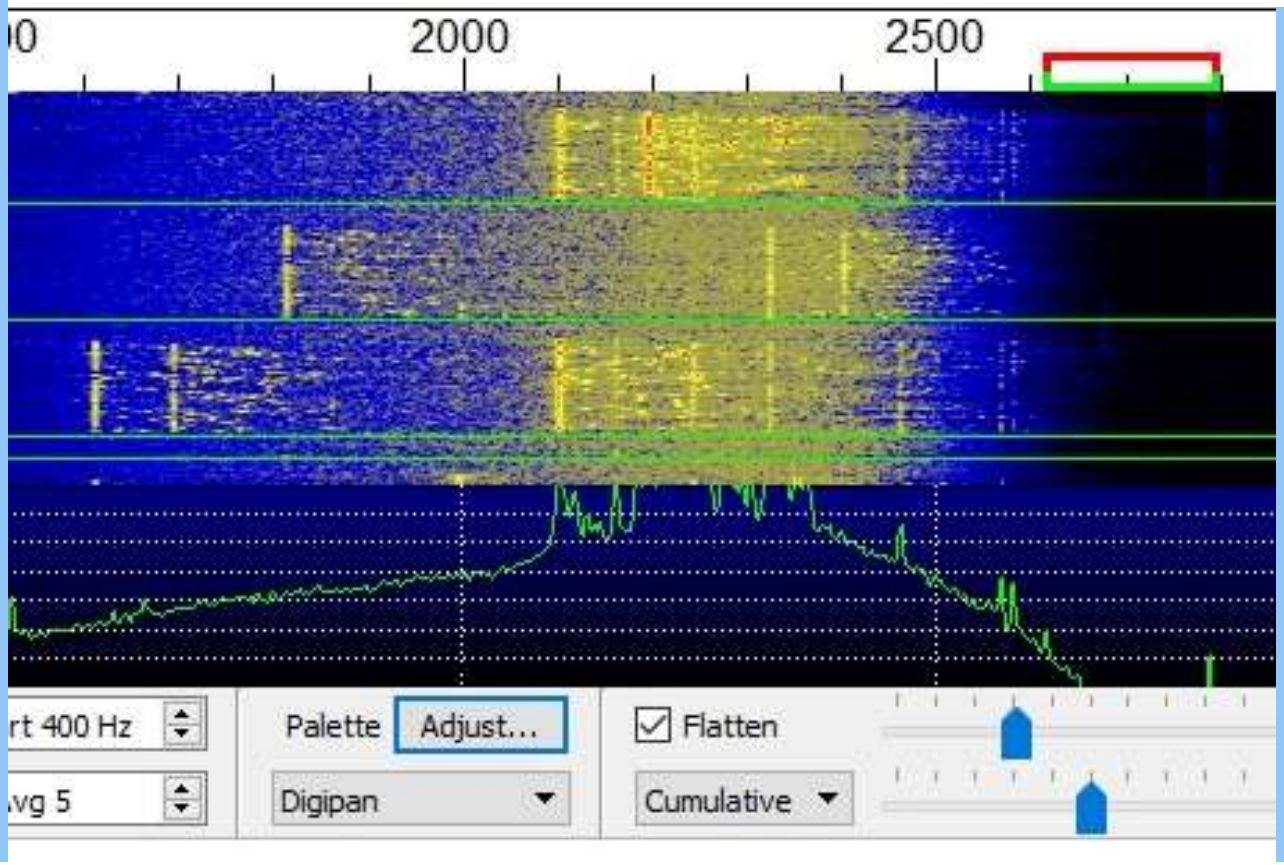
Radio Configuration-Yaesu FT991

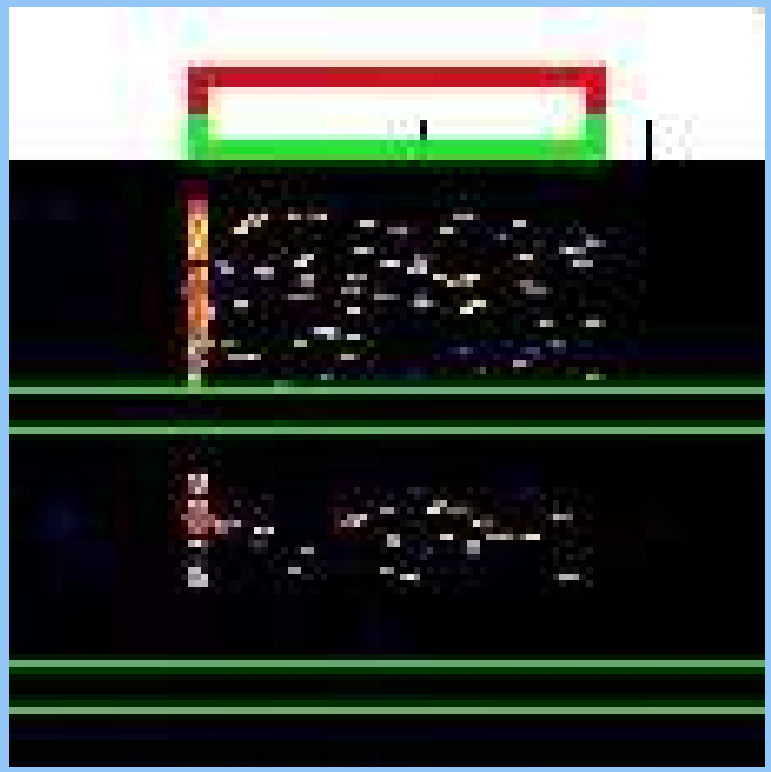
Menu 31: CAT Rate - 38400	Menu 33: CAT RTS - Enable
Menu 60 PC Keying - RTS	Menu 62: Data Mode - PSK
Menu 70: Data In Select - Rear	Menu 71: Data In Select - RTS
Menu 72: Data Port Select - USB	Menu 73: Data Out Level - 50
Menu 110: SSB PTT Select - RTS	Menu 111: SSB Port Select - USB
Menu 112: SSB Tx BPF – 100-3000	

Mode: Data USB (All Bands)
Power: 20 watts
Monitor: 20
DT Gain: 55

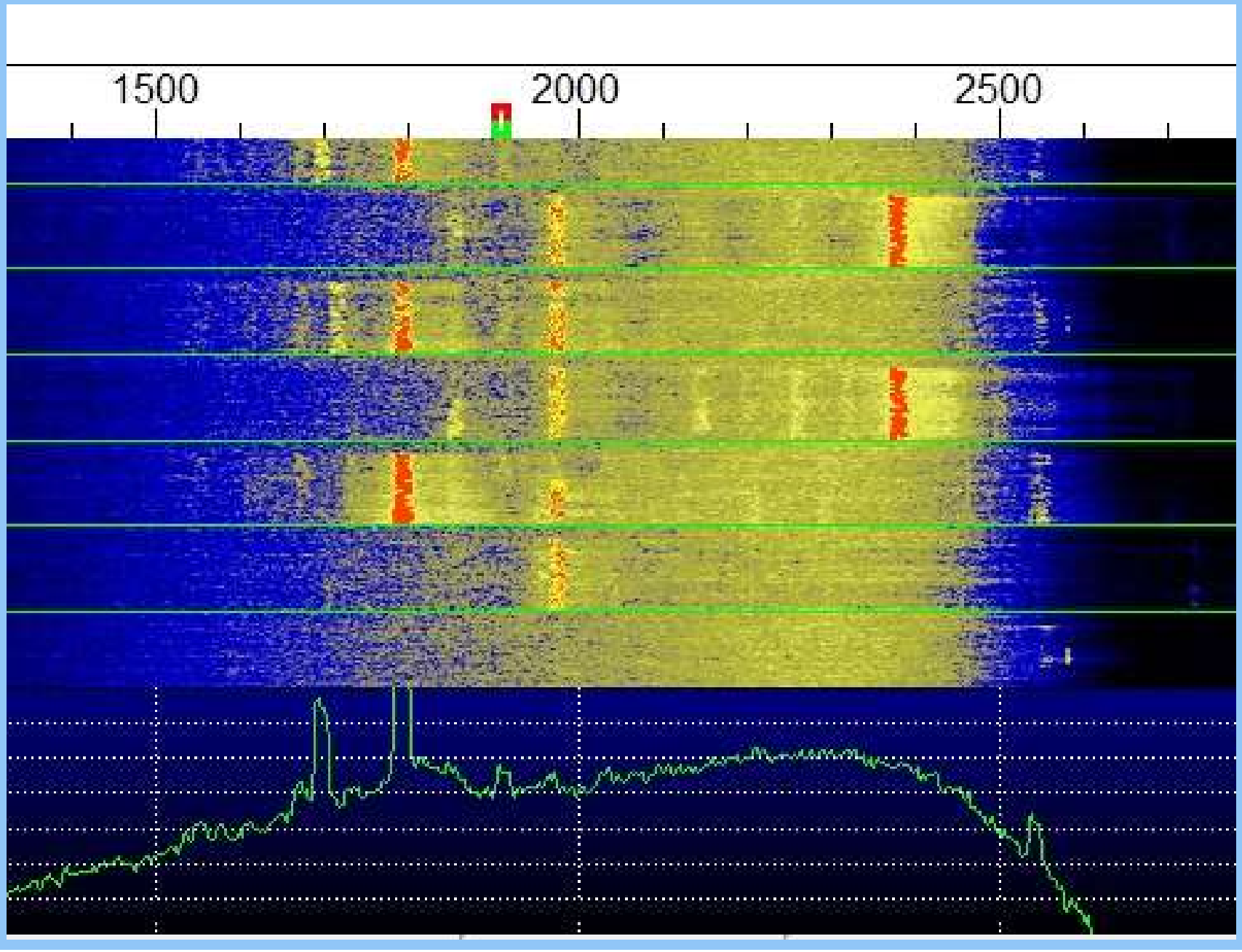
Waterfall Display JT-65







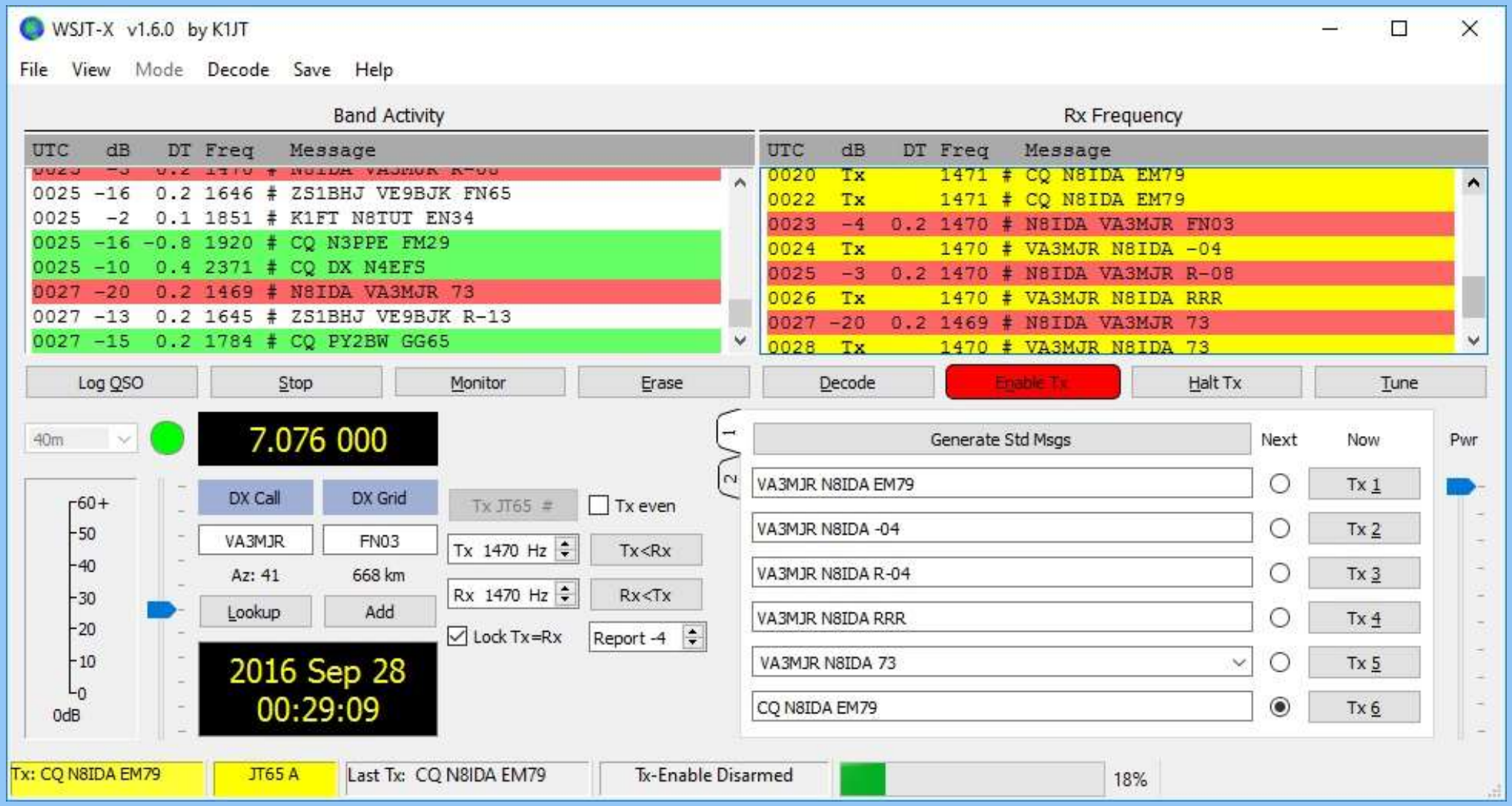
Waterfall Display JT-9



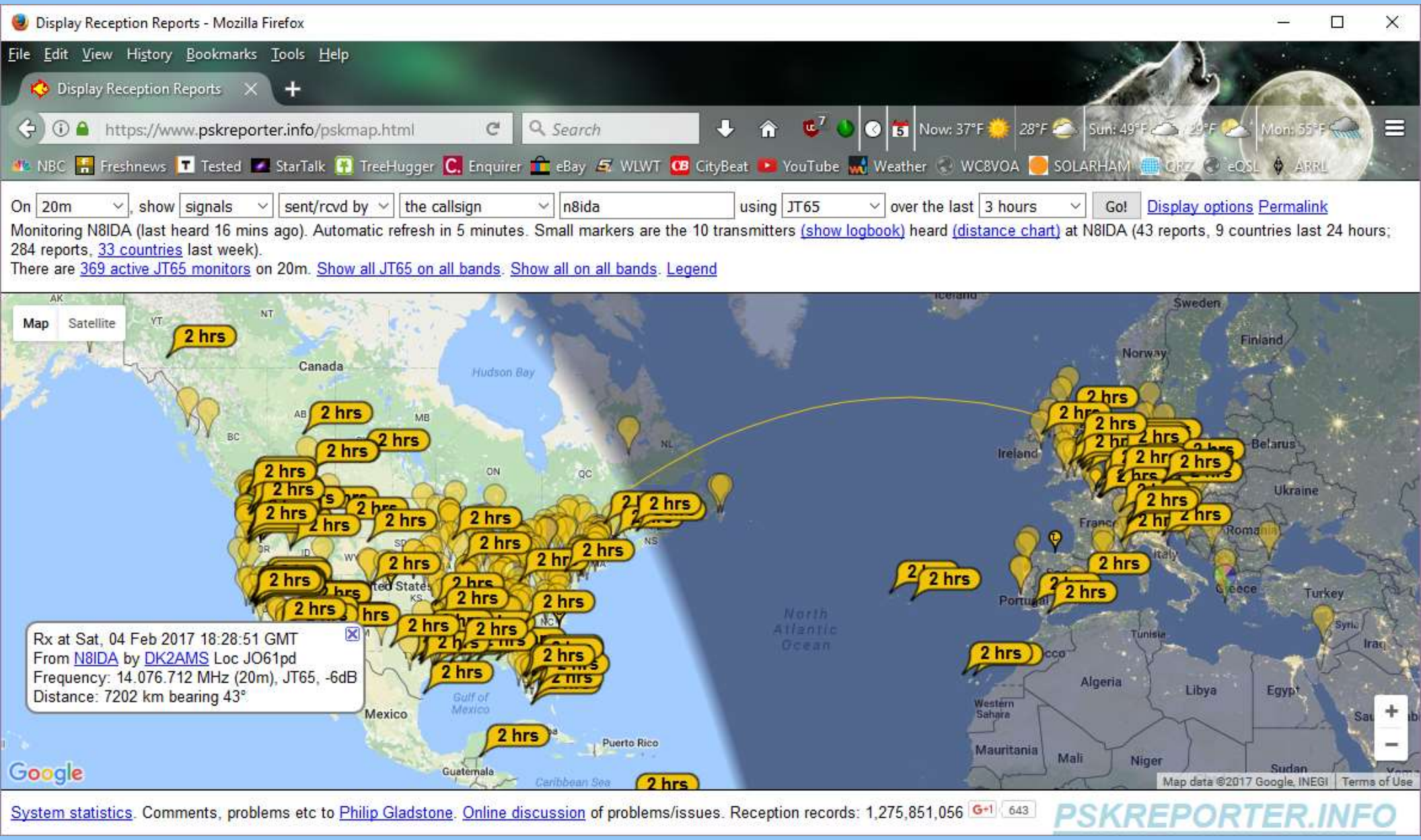
Calling CQ

- Watch waterfall display first for current QSO's
- Find an open frequency
- Make sure grid square and call sign show up on screen
- Turn on monitor function on the radio
  - Will allow you to check your tone quality
  - Drive you crazy at the same time
  - Remember the flutophone from grade school??

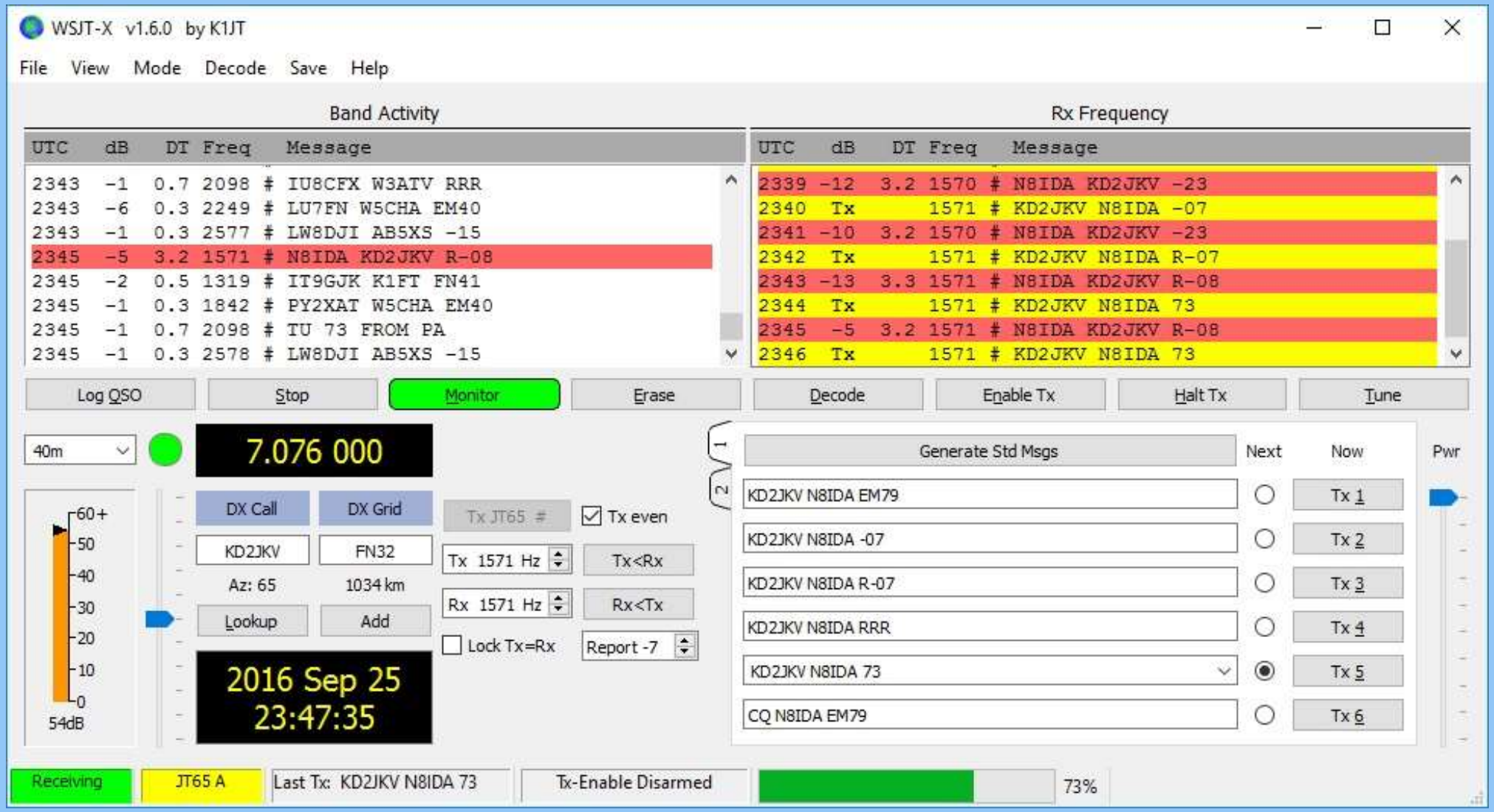
Calling CQ


WSJT-X v1.6.0 by K1JT
File View Mode Decode Save Help
Band Activity
Rx Frequency
UTC dB DT Freq Message
0025 -16 0.2 1646 # ZS1BHJ VE9BJK FN65
0025 -2 0.1 1851 # K1FT N8TUT EN34
0025 -16 -0.8 1920 # CQ N3PPE FM29
0025 -10 0.4 2371 # CQ DX N4EFS
0027 -20 0.2 1469 # N8IDA VA3MJR 73
0027 -13 0.2 1645 # ZS1BHJ VE9BJK R-13
0027 -15 0.2 1784 # CQ PY2BW GG65
0020 Tx 1471 # CQ N8IDA EM79
0022 Tx 1471 # CQ N8IDA EM79
0023 -4 0.2 1470 # N8IDA VA3MJR FN03
0024 Tx 1470 # VA3MJR N8IDA -04
0025 -3 0.2 1470 # N8IDA VA3MJR R-08
0026 Tx 1470 # VA3MJR N8IDA RRR
0027 -20 0.2 1469 # N8IDA VA3MJR 73
0028 Tx 1470 # VA3MJR N8IDA 73
Log QSO
Stop
Monitor
Erase
Decode
Enable Tx
Halt Tx
Tune
40m
7.076 000
DX Call
DX Grid
VA3MJR
FN03
Az: 41
668 km
Lookup
Add
2016 Sep 28
00:29:09
Tx JT65 #
Tx even
Tx 1470 Hz
Rx 1470 Hz
Tx<Rx
Rx<Tx
Lock Tx=Rx
Report -4
Generate Std Msgs
Next
Now
Pwr
VA3MJR N8IDA EM79
VA3MJR N8IDA -04
VA3MJR N8IDA R-04
VA3MJR N8IDA RRR
VA3MJR N8IDA 73
CQ N8IDA EM79
Tx 1
Tx 2
Tx 3
Tx 4
Tx 5
Tx 6
Tx: CQ N8IDA EM79
JT65 A
Last Tx: CQ N8IDA EM79
Tx-Enable Disarmed
18%

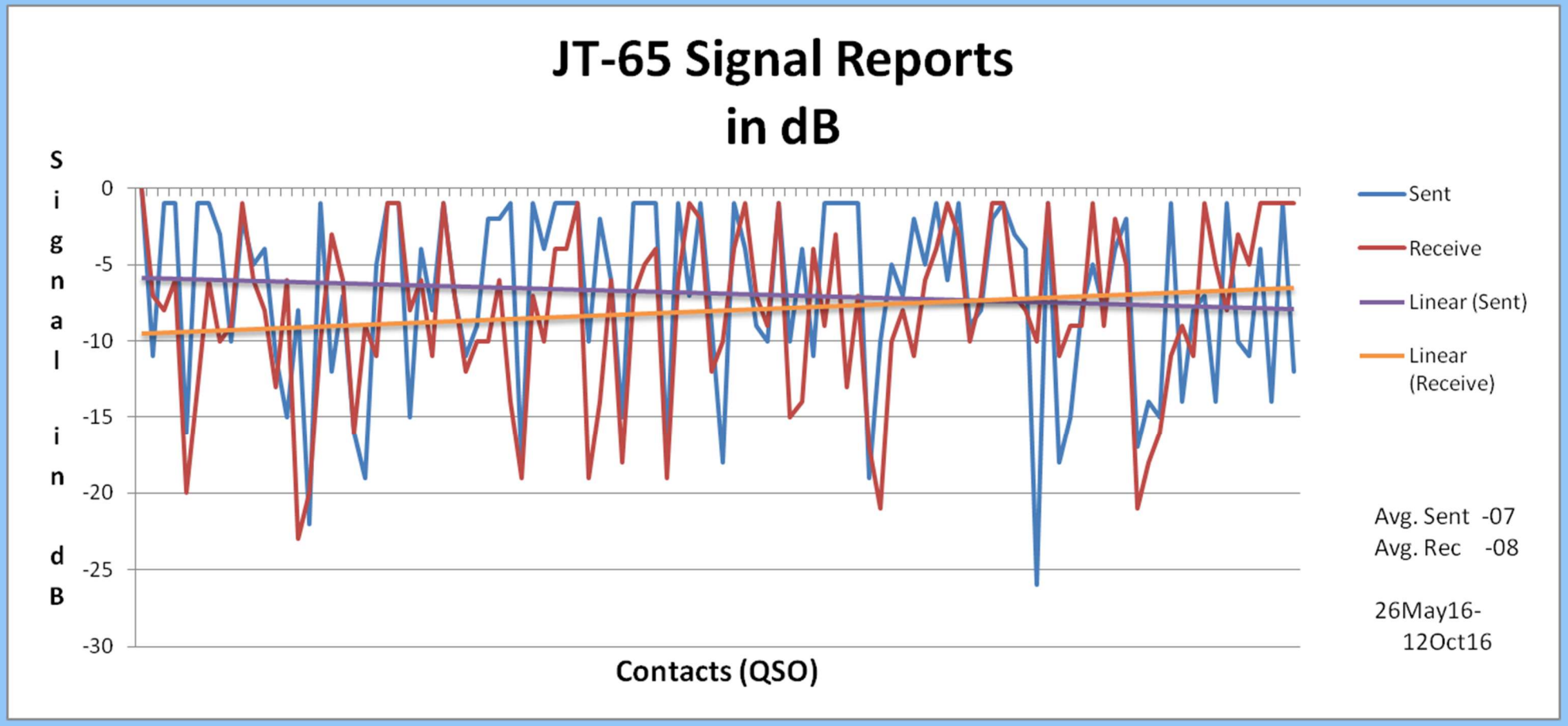
PSK Reporter



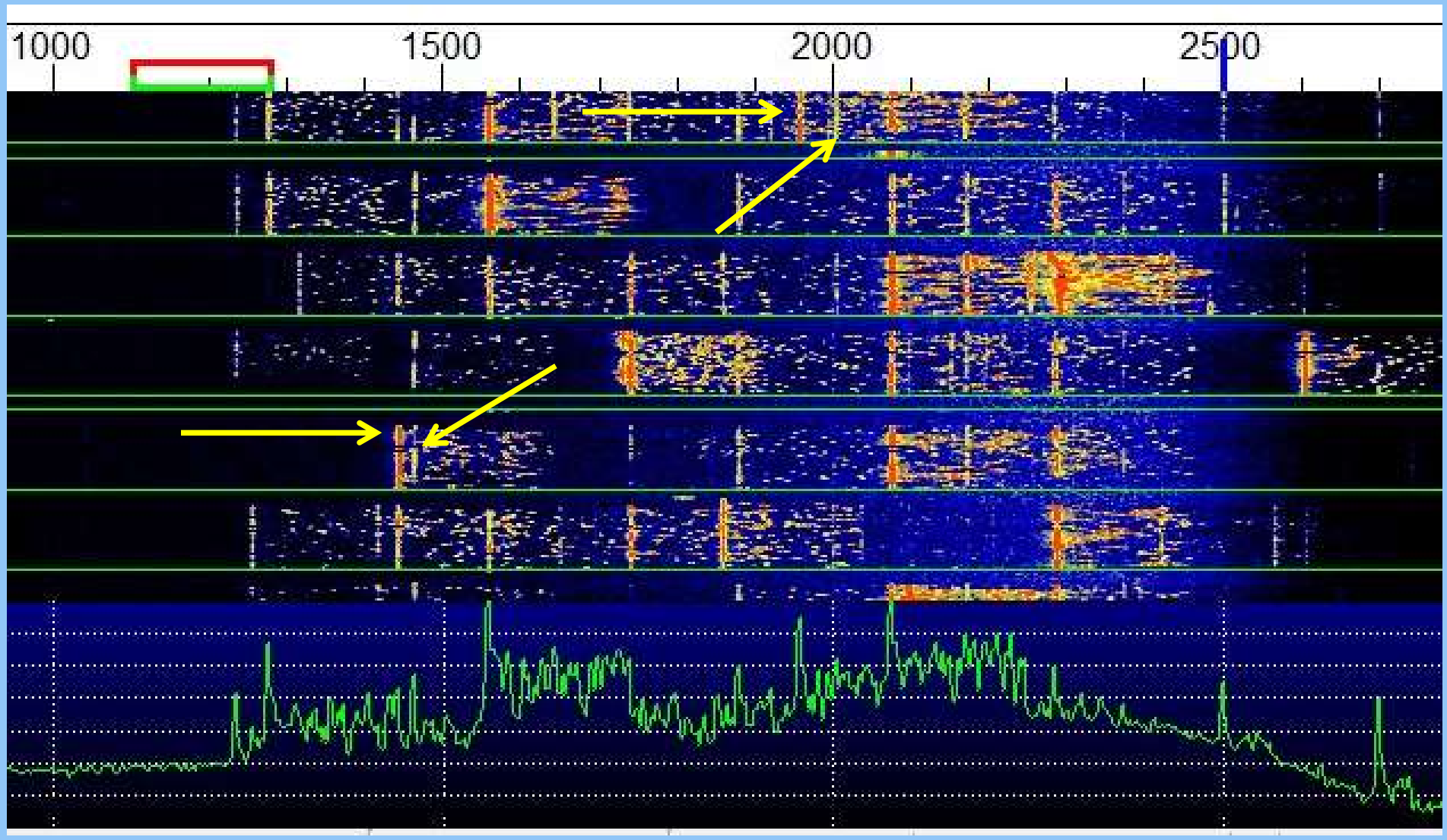
Signal Reports (dB)



Signal Reports on 100 QSO's



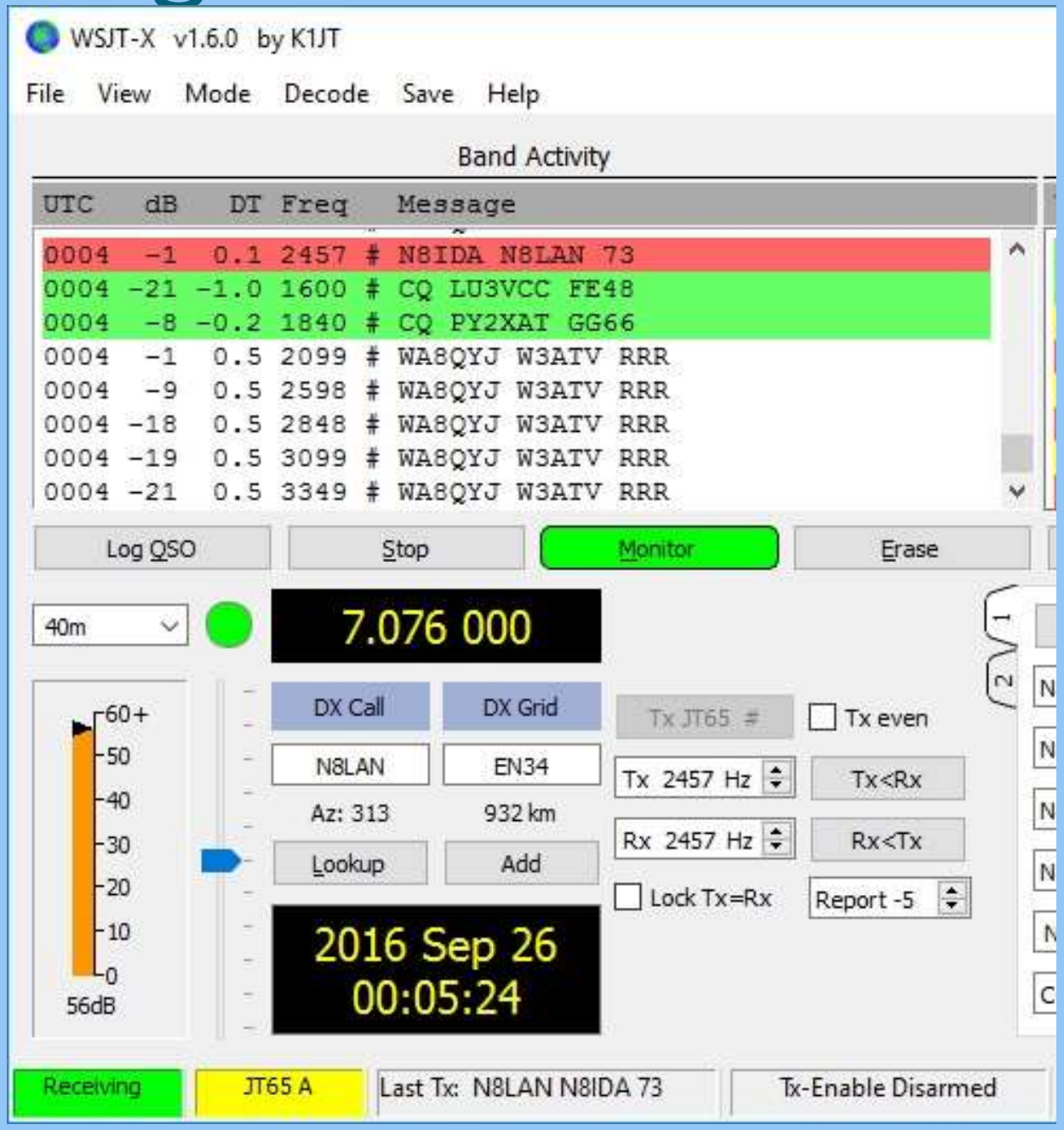
Signal Overlap



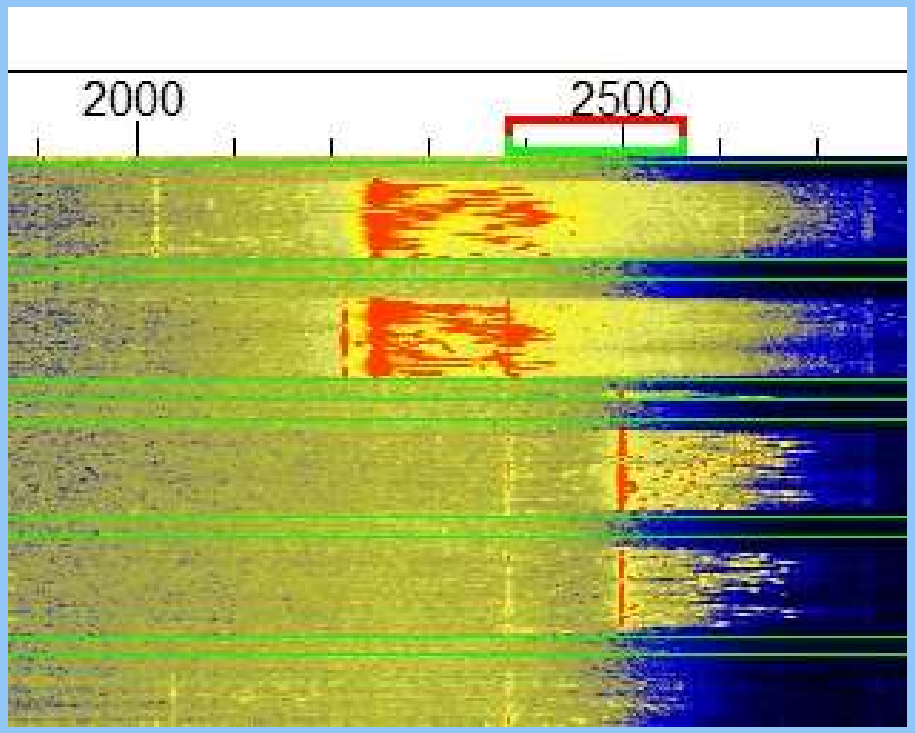
Signal Overlap

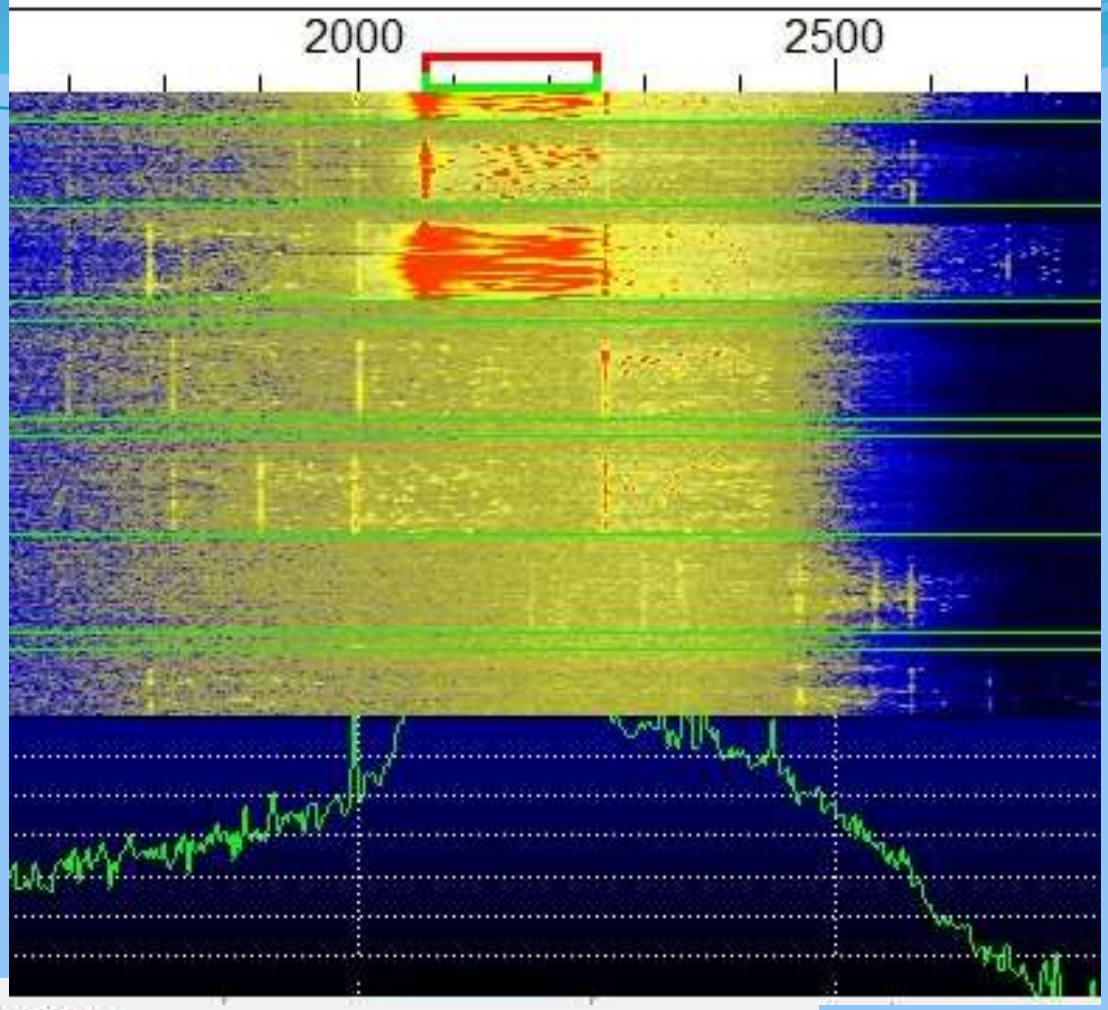
- Will occur when closer than 177.7 Hz
- May still decode correctly if
  - Not too close
  - Strong enough
  - Amount of background noise present
- May receive two signals virtually on top of one another
- You will only see the text if it decodes properly, you will not see any corrupted text due to error correction
- Signal overlap will affect the decoding of very weak signals (~<-18 Db)

Ghost Signals



Dirty Signal?

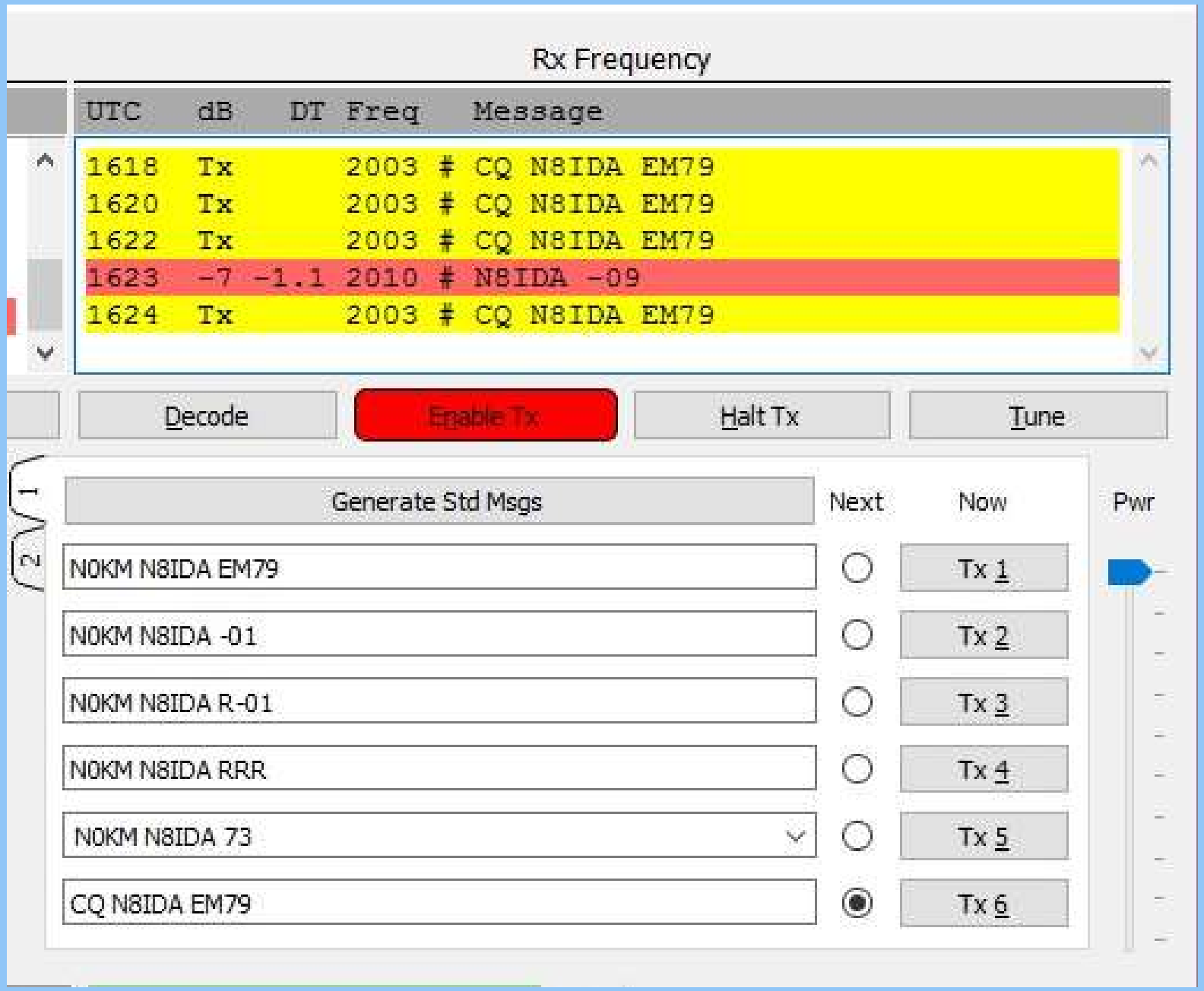




Band Activity

UTC	dB	DT	Freq		Message
1854	-16	0.3	1784	#	FK8HA K7CBJ DN06
1854	-1	0.1	2071	#	CQ W5LE EM15
1854	-20	0.1	2821	#	CQ W5LE EM15
1854	-15	0.1	3071	#	CQ W5LE EM15
1854	-27	0.1	3321	#	CQ W5LE EM15
1854	-18	0.1	4071	#	CQ W5LE EM15

Who Are You???

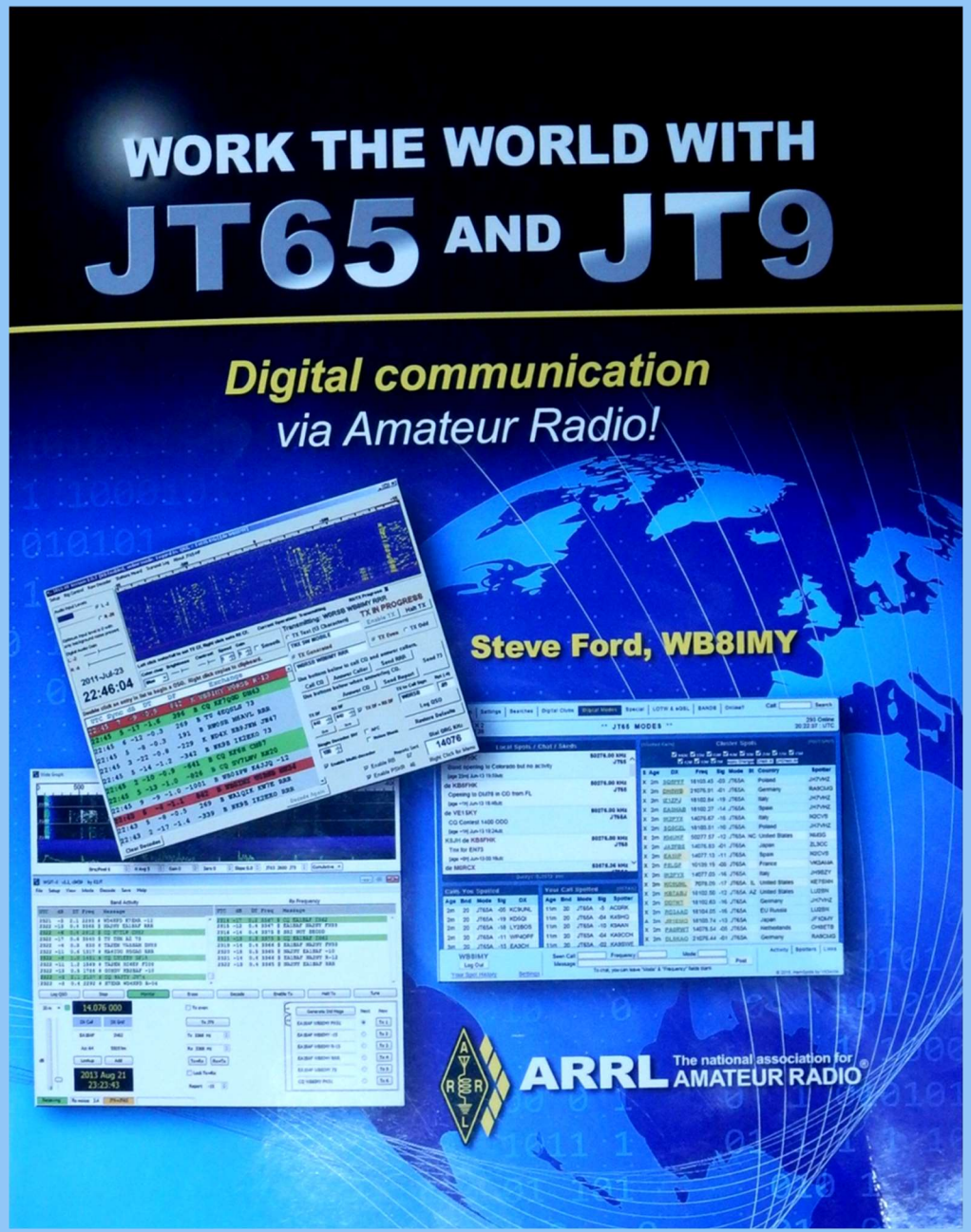

Rx Frequency
UTC dB DT Freq Message
1618 Tx 2003 # CQ N8IDA EM79
1620 Tx 2003 # CQ N8IDA EM79
1622 Tx 2003 # CQ N8IDA EM79
1623 -7 -1.1 2010 # N8IDA -09
1624 Tx 2003 # CQ N8IDA EM79
Decode
Enable Tx
Halt Tx
Tune
Generate Std Msgs
Next
Now
Pwr
N0KM N8IDA EM79
N0KM N8IDA -01
N0KM N8IDA R-01
N0KM N8IDA RRR
N0KM N8IDA 73
CQ N8IDA EM79
Tx 1
Tx 2
Tx 3
Tx 4
Tx 5
Tx 6

Secret Code? (maybe)

```
1906 -10   0.7 1411 #   RN6AM N5KEX EL28
1906 -22  -0.8 1883 #   IZ6FKI VE9INT -23
1906 -20   0.2 2243 #   XM596B.EVYL9V
1906 -15   0.2 2264 #   QRZ KE5YTA EM12
1906 -18   0.2 2747 #   KZ9DX SV2IX R-17
```

```
1700 -18 -0.5 2123 #   WG0G OM4AB RR73
1702 -19   0.0 1799 #   N8IDA NS6E -16
1702 -19   0.1 1497 #   109WV14IIK51G
1702 -13   0.0 1582 #   CQ W8JBL EM79
1702 -18 -0.7 1887 #   S59GCD YV4DHS -09
1702 -13   0.1 2205 #   KF0DH KK7X RRR
1702 -16   0.0 1847 #   K7NUU OE3UKW 73
```

ARRL Book on JT65 and JT9



Happy Dx’ing on JT-65 and JT-9