



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 conditions 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

Rx Frequency

UTC	dB	DT	Freq	Message
2342	Tx		2615	# CQ N8IDA EM79
2343	-1	0.1	2615	# N8IDA K6BRN DM03
2344	Tx		2615	# K6BRN N8IDA -01
2345	-1	0.1	2615	# N8IDA K6BRN R-01
2346	Tx		2615	# K6BRN N8IDA RRR
2347	-1	0.1	2615	# N8IDA K6BRN 73
2348	Tx		2615	# K6BRN N8IDA 73
2350	Tx		2615	# CQ N8IDA EM79

Decode Enable Tx Halt Tx Tune

Generate Std Msgs

	Next	Now
K6BRN N8IDA EM79	<input type="radio"/>	Tx 1
K6BRN N8IDA -01	<input type="radio"/>	Tx 2
K6BRN N8IDA R-01	<input type="radio"/>	Tx 3
K6BRN N8IDA RRR	<input type="radio"/>	Tx 4
K6BRN N8IDA 73	<input type="radio"/>	Tx 5
CQ N8IDA EM79	<input checked="" type="radio"/>	Tx 6

Pwr

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
ntn1.connectiv.com	US DE: Connectiv Inc. Newark DE	SNTP

Server:

Location:

Protocol:

Notes: Access Policy: open access
Contact: Rich Schmidt (res@tuttle.usno.navy.mil)
Synchronization: NTP V3 primary (USNO Master Clock 2, H-

How Often

☒ Load Dimension 4 at startup
☒ Once loaded, wait until online
☐ Synchronize once, then exit
☒ Every

Correction

☒ Maximum correction

Visibility

☒ Start minimized
☐ Hide when minimized
☒ Display icon in tray

Synchronized:

Current Status:

Server Status:

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

WSJT-X v1.6.0 by K1JT

File View Mode Decode Save Help

Band Activity

UTC	dB	DT	Freq	Message
2256	-2	0.1	2395	# N8IDA W4PIO RRR
2256	-15	-0.2	1559	# PY2JF LX1JX -08
2256	-20	-0.4	1609	# N4WXB OK1AFO -22
2256	-3	0.1	1953	# RRTU W2PKY 73
2256	-16	0.5	2193	# VP8ALJ F4CVQ JN38
2258	-3	0.1	2395	# N8IDA W4PIO 73
2258	-15	0.3	2194	# VP8ALJ F4CVQ JN38
2258	-10	-0.2	2594	# VE3MZD LX1JX -21

Rx Frequency

UTC	dB	DT	Freq	Message
2252	-7	0.1	2395	# CQ W4PIO FM18
2253	Tx		2395	# W4PIO N8IDA EM79
2254	-1	0.1	2395	# N8IDA W4PIO -01
2255	Tx		2395	# W4PIO N8IDA -07
2256	-2	0.1	2395	# N8IDA W4PIO RRR
2257	Tx		2395	# W4PIO N8IDA 73
2258	-3	0.1	2395	# N8IDA W4PIO 73

Log QSO

Stop

Monitor

Erase

Decode

Enable Tx

Halt Tx

Tune

40m

7.076 000

60+
50
40
30
20
10
0
55dB

DX Call

W4PIO

DX Grid

FM18

Az: 93

647 km

Lookup

Add

2016 Sep 20

22:59:20

Tx JT65 #

☐ Tx even

Tx 2395 Hz

Tx<Rx

Rx 2395 Hz

Rx<Tx

☐ Lock Tx=Rx

Report -7

Generate Std Msgs

Next

Now

Pwr

W4PIO N8IDA EM79

W4PIO N8IDA -07

W4PIO N8IDA R-07

W4PIO N8IDA RRR

W4PIO N8IDA 73

CQ N8IDA EM79

☐ Tx 1

☐ Tx 2

☐ Tx 3

☐ Tx 4

☐ Tx 5

☒ Tx 6

Receiving

JT65 A

Last Tx: W4PIO N8IDA 73

Tx-Enable Disarmed

41%

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

Settings

General Radio Audio Tx Macros Reporting Frequencies Colors

Rig: Yaesu FT-991 Poll Interval: 1 s

CAT Control

Serial Port: COM3

Serial Port Parameters

Baud Rate: 38400

Data Bits

☐ Seven ☒ Eight

Stop Bits

☐ One ☒ Two

Handshake

☐ None ☒ XON/XOFF ☐ Hardware

Force Control Lines

DTR: RTS:

PTT Method

☐ VOX ☐ DTR

☒ CAT ☐ RTS

Port: COM3

Transmit Audio Source

☐ Rear/Data ☒ Front/Mic

Mode

☐ None ☐ USB ☒ Data/Pkt

Split Operation

☒ None ☐ Rig ☐ Fake It

Test CAT Test PTT

OK Cancel

Configure Audio Codecs

The screenshot shows the 'Settings' dialog box for WSJT-X, with the 'Audio' tab selected. The 'Soundcard' section has 'Input' set to 'Microphone (USB Audio CODEC)' and 'Output' set to 'Speakers (USB Audio CODEC)', both with 'Mono' selected for the format. The 'Save Directory' section shows the path 'C:/Users/n8ida/AppData/Local/WSJT-X/save' with a 'Select' button. The 'AzEl Directory' section shows the path 'C:/Users/n8ida/AppData/Local/WSJT-X' with a 'Select' button. At the bottom are 'OK' and 'Cancel' buttons.

Settings

General | Radio | **Audio** | Tx Macros | Reporting | Frequencies | Colors

Soundcard

Input: Microphone (USB Audio CODEC) Mono

Output: Speakers (USB Audio CODEC) Mono

Save Directory

Location: C:/Users/n8ida/AppData/Local/WSJT-X/save Select

AzEl Directory

Location: C:/Users/n8ida/AppData/Local/WSJT-X Select

OK Cancel

Frequencies for JT-65

The screenshot shows the 'Settings' window with the 'Frequencies' tab selected. The 'Working Frequencies' section contains a table with four rows. The 'Station Information' section is empty. The 'Frequency Calibration' section has two input fields: 'Intercept' set to 0.00 Hz and 'Slope' set to 0.0000 ppm. The 'Reset' button is located above the calibration section.

Settings

General Radio Audio Tx Macros Reporting **Frequencies** Colors

Working Frequencies

Mode	Frequency
JT65	14.076 000 MHz (20m)
JT9	14.078 000 MHz (20m)
WSPR	14.095 600 MHz (20m)
JT65	18.102 000 MHz (17m)

Reset

Frequency Calibration

Intercept: 0.00 Hz

Slope: 0.0000 ppm

Station Information

Band	Offset	Antenna Description
------	--------	---------------------

OK Cancel

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	

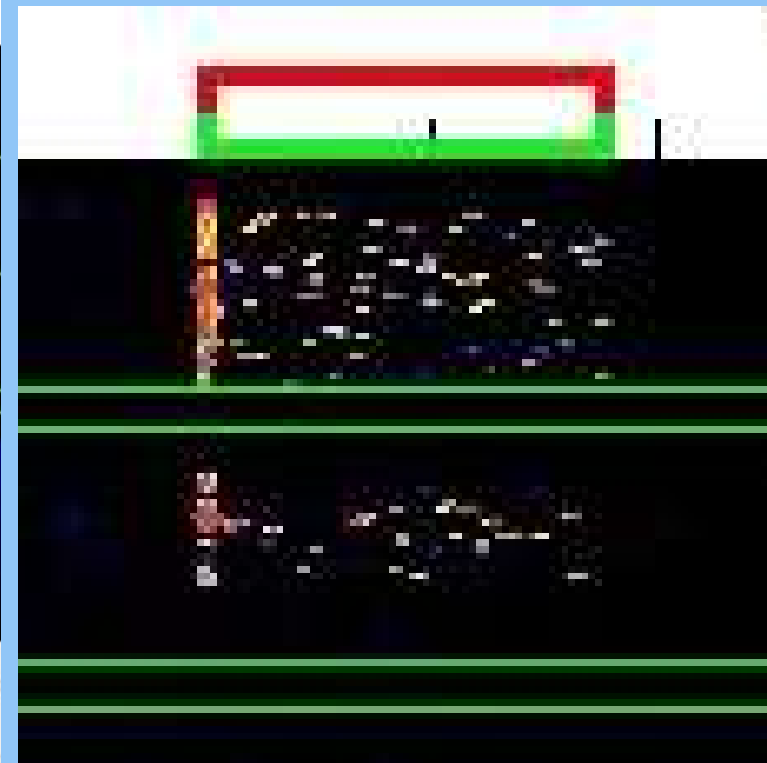
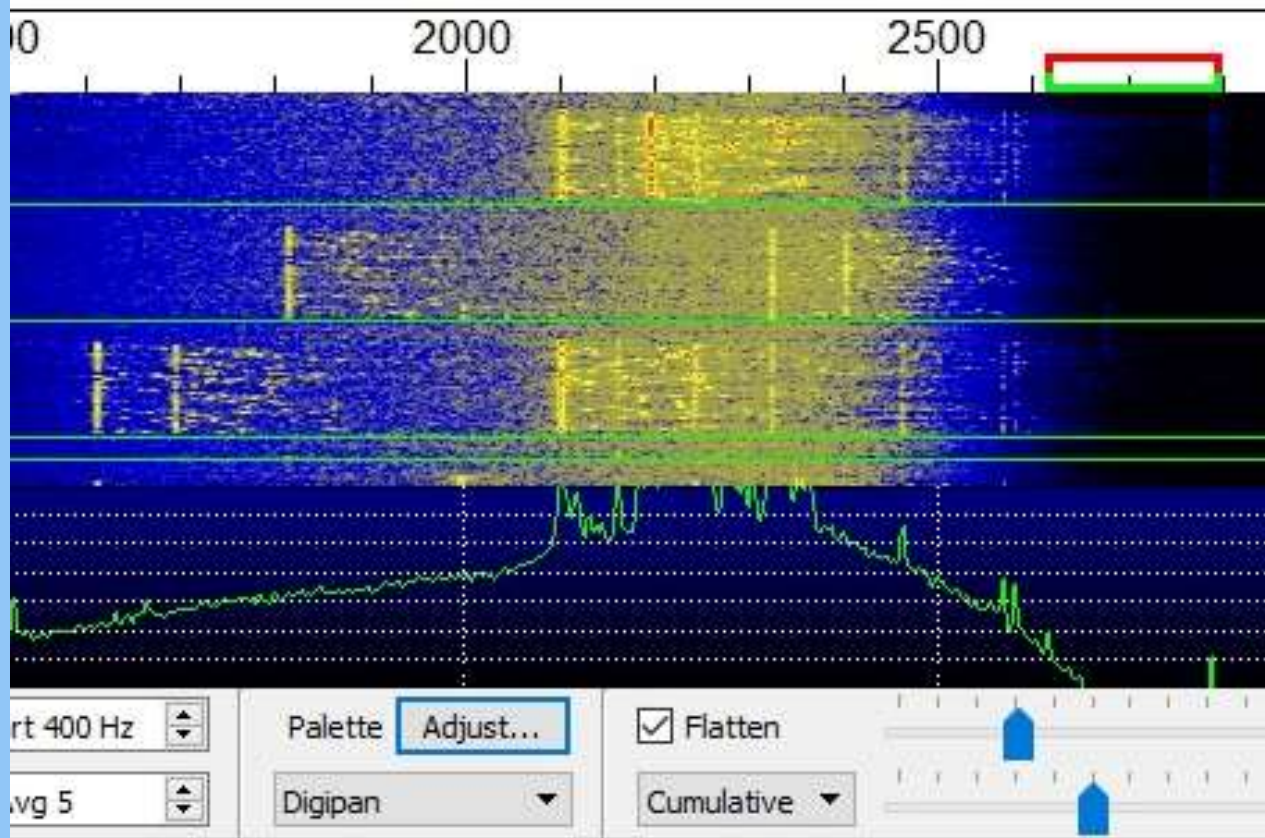
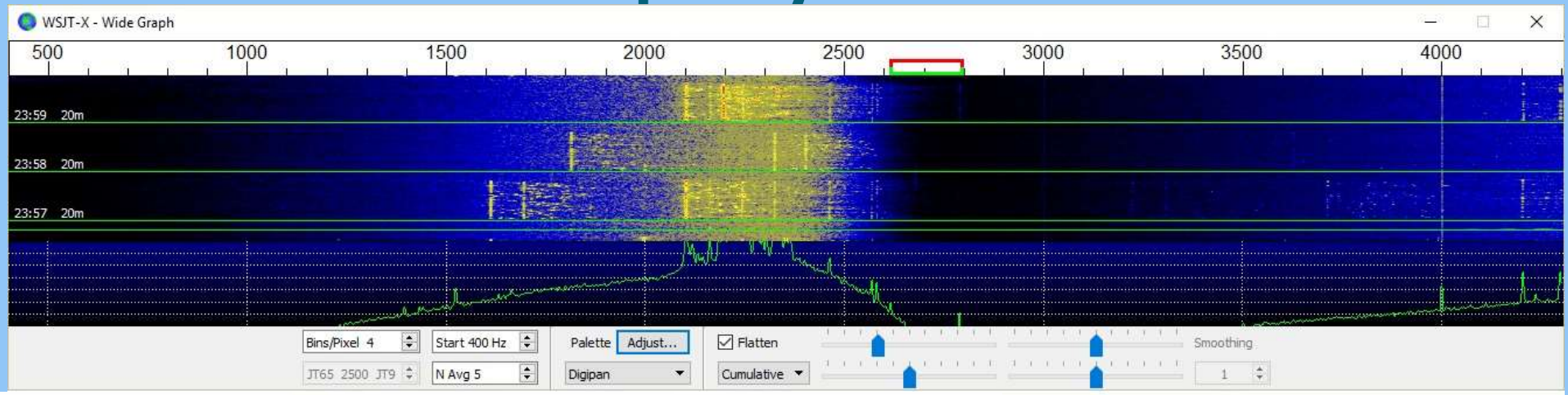
Mode: Data USB (All Bands)

Power: 20 watts

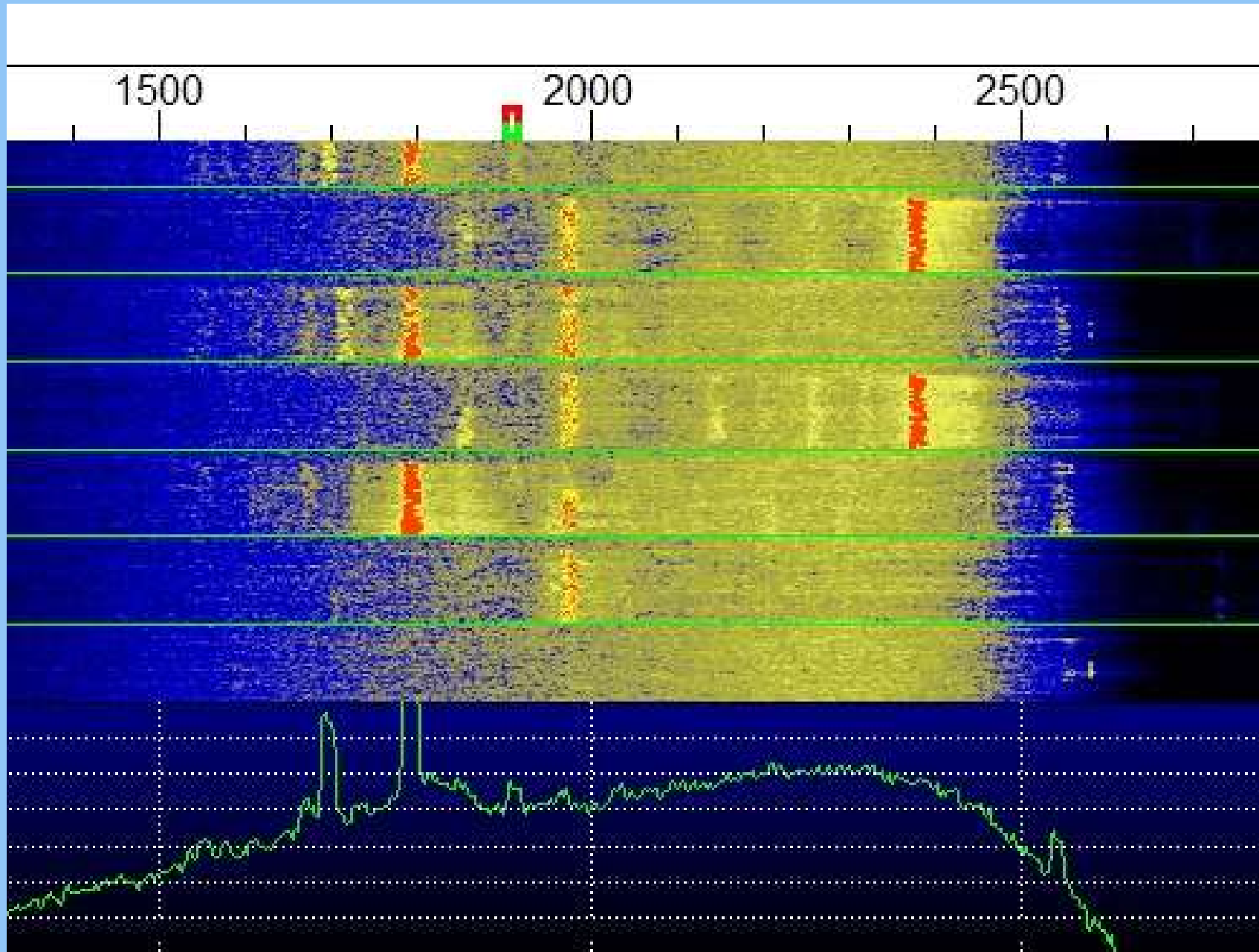
Monitor: 20

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

UTC	dB	DT	Freq	Message
0023	-3	0.2	1470	# N8IDA VA3MJR R-00
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

Rx Frequency

UTC	dB	DT	Freq	Message
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: VA3MJR, DX Grid: FN03, Az: 41, 668 km

2016 Sep 28 00:29:09

Tx JT65 #, Tx even, Tx 1470 Hz, Tx<Rx, Rx 1470 Hz, Rx<Tx, Lock Tx=Rx, Report -4

Generate Std Msgs

	Next	Now	Pwr
VA3MJR N8IDA EM79	<input type="radio"/>	Tx 1	
VA3MJR N8IDA -04	<input type="radio"/>	Tx 2	
VA3MJR N8IDA R-04	<input type="radio"/>	Tx 3	
VA3MJR N8IDA RRR	<input type="radio"/>	Tx 4	
VA3MJR N8IDA 73	<input type="radio"/>	Tx 5	
CQ N8IDA EM79	<input checked="" type="radio"/>	Tx 6	

Tx: CQ N8IDA EM79, JT65 A, Last Tx: CQ N8IDA EM79, Tx-Enable Disarmed, 18%

PSK Reporter

Display Reception Reports - Mozilla Firefox

File Edit View History Bookmarks Tools Help

Display Reception Reports

https://www.pskreporter.info/pskmap.html

Search

Now: 37°F 28°F Sun: 49°F 29°F Mon: 55°F

NBC Freshnews Tested StarTalk TreeHugger Enquirer eBay WLWT CityBeat YouTube Weather WC8VOA SOLARHAM QRZ eQSL ARRL

On 20m, show signals, sent/rcvd by, the callsign, n8ida, using JT65, over the last 3 hours, Go! [Display options](#) [Permalink](#)

Monitoring N8IDA (last heard 16 mins ago). Automatic refresh in 5 minutes. Small markers are the 10 transmitters ([show logbook](#)) heard ([distance chart](#)) at N8IDA (43 reports, 9 countries last 24 hours; 284 reports, [33 countries](#) last week).

There are [369 active JT65 monitors](#) on 20m. [Show all JT65 on all bands](#). [Show all on all bands](#). [Legend](#)

Rx at Sat, 04 Feb 2017 18:28:51 GMT
From N8IDA by DK2AMS Loc JO61pd
Frequency: 14.076.712 MHz (20m), JT65, -6dB
Distance: 7202 km bearing 43°

Google

Map data ©2017 Google, INEGI Terms of Use

[System statistics](#). Comments, problems etc to [Philip Gladstone](#). [Online discussion](#) of problems/issues. Reception records: 1,275,851,056 [G+](#) 643 [PSKREPORTER.INFO](#)

Signal Reports (dB)

WSJT-X v1.6.0 by K1JT

File View Mode Decode Save Help

Band Activity

UTC	dB	DT	Freq	Message
2343	-1	0.7	2098	# IU8CFX W3ATV RRR
2343	-6	0.3	2249	# LU7FN W5CHA EM40
2343	-1	0.3	2577	# LW8DJI AB5XS -15
2345	-5	3.2	1571	# N8IDA KD2JKV R-08
2345	-2	0.5	1319	# IT9GJK K1FT FN41
2345	-1	0.3	1842	# PY2XAT W5CHA EM40
2345	-1	0.7	2098	# TU 73 FROM PA
2345	-1	0.3	2578	# LW8DJI AB5XS -15

Rx Frequency

UTC	dB	DT	Freq	Message
2339	-12	3.2	1570	# N8IDA KD2JKV -23
2340	Tx		1571	# KD2JKV N8IDA -07
2341	-10	3.2	1570	# N8IDA KD2JKV -23
2342	Tx		1571	# KD2JKV N8IDA R-07
2343	-13	3.3	1571	# N8IDA KD2JKV R-08
2344	Tx		1571	# KD2JKV N8IDA 73
2345	-5	3.2	1571	# N8IDA KD2JKV R-08
2346	Tx		1571	# KD2JKV N8IDA 73

Log QSO

Stop

Monitor

Erase

Decode

Enable Tx

Halt Tx

Tune

40m

7.076 000

60+
50
40
30
20
10
0
54dB

DX Call

KD2JKV

Az: 65

Lookup

DX Grid

FN32

1034 km

Add

Tx JT65 #

Tx 1571 Hz

Rx 1571 Hz

Lock Tx=Rx

Tx even

Tx<Rx

Rx<Tx

Report -7

2016 Sep 25
23:47:35

Generate Std Msgs

KD2JKV N8IDA EM79

KD2JKV N8IDA -07

KD2JKV N8IDA R-07

KD2JKV N8IDA RRR

KD2JKV N8IDA 73

CQ N8IDA EM79

Next

Now

Pwr

Tx 1

Tx 2

Tx 3

Tx 4

Tx 5

Tx 6

Receiving

JT65 A

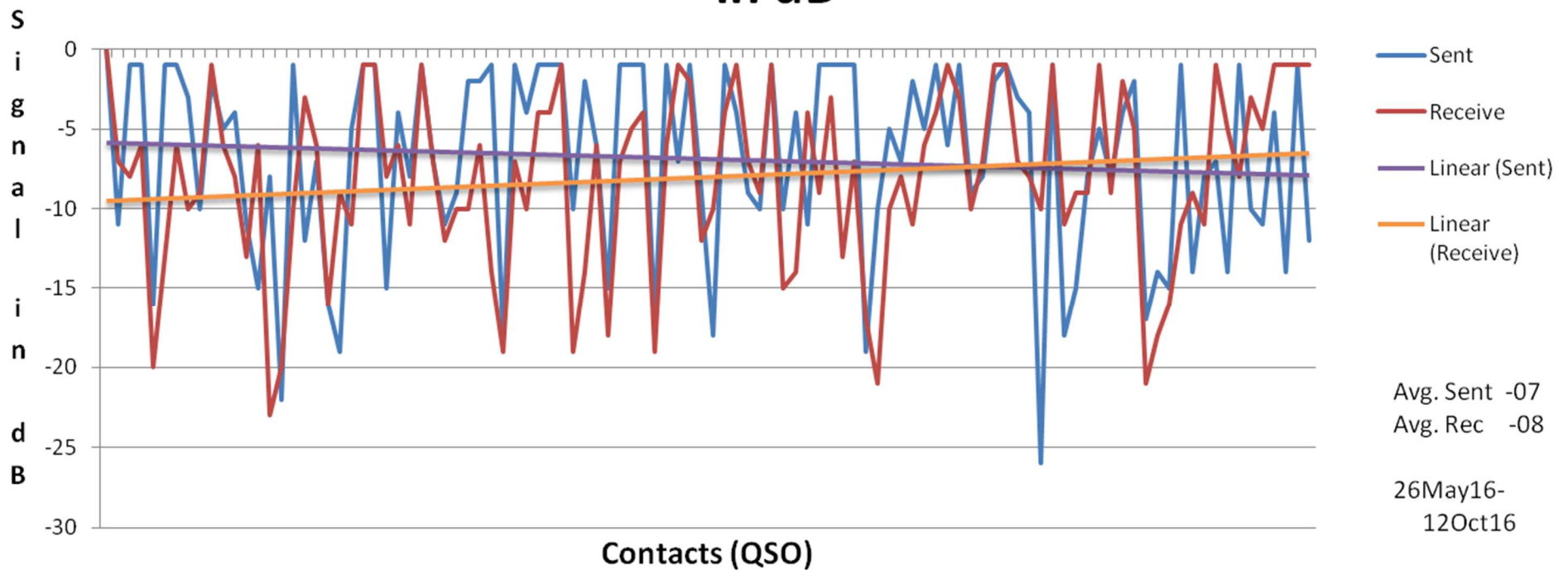
Last Tx: KD2JKV N8IDA 73

Tx-Enable Disarmed

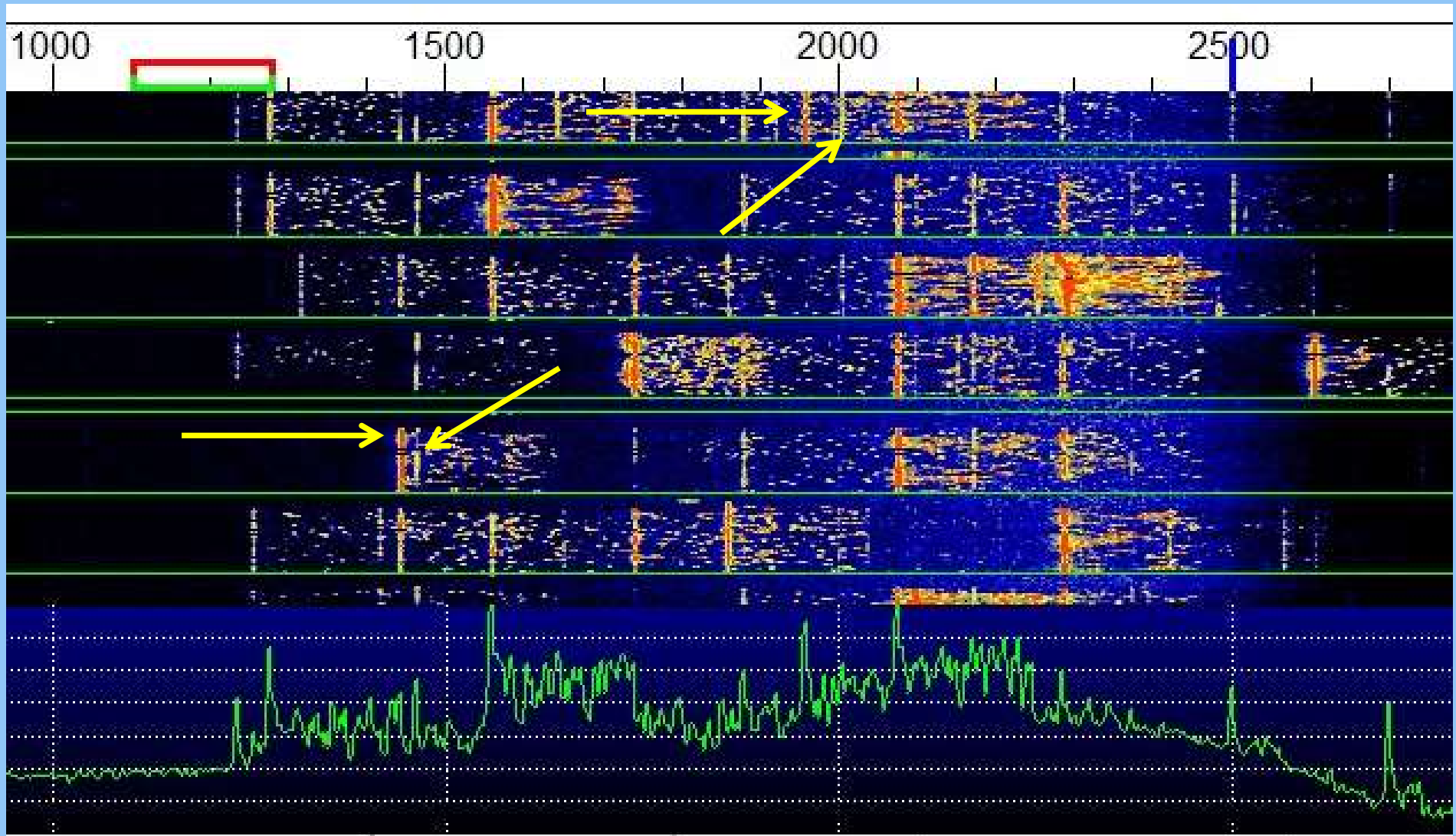
73%

Signal Reports on 100 QSO's

JT-65 Signal Reports in dB



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 ($\sim < -18$ Db)

Ghost Signals

WSJT-X v1.6.0 by K1JT

File View Mode Decode Save Help

Band Activity

UTC	dB	DT	Freq	Message
0004	-1	0.1	2457	# N8IDA N8LAN 73
0004	-21	-1.0	1600	# CQ LU3VCC FE48
0004	-8	-0.2	1840	# CQ PY2XAT GG66
0004	-1	0.5	2099	# WA8QYJ W3ATV RRR
0004	-9	0.5	2598	# WA8QYJ W3ATV RRR
0004	-18	0.5	2848	# WA8QYJ W3ATV RRR
0004	-19	0.5	3099	# WA8QYJ W3ATV RRR
0004	-21	0.5	3349	# WA8QYJ W3ATV RRR

Log QSO Stop Monitor Erase

40m 7.076 000

60+
50
40
30
20
10
0
56dB

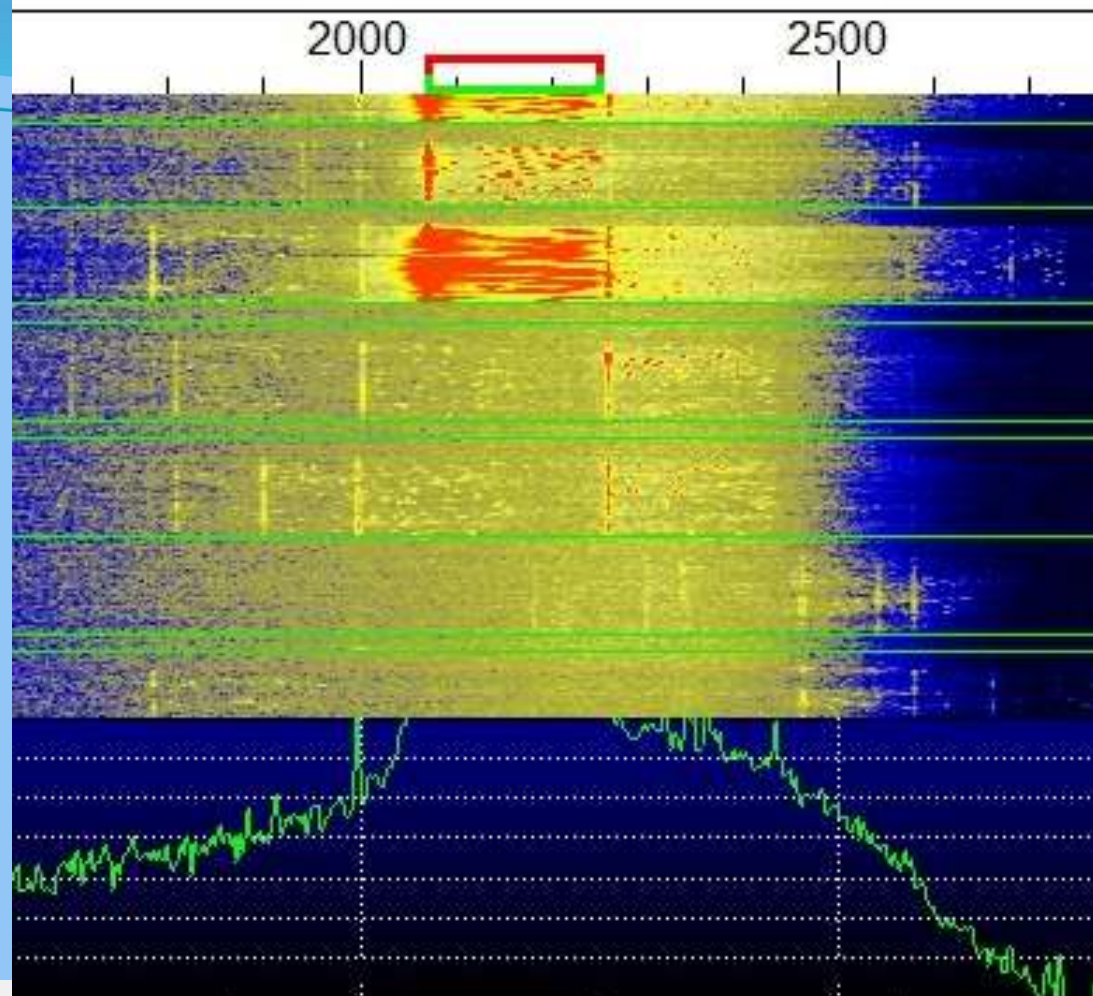
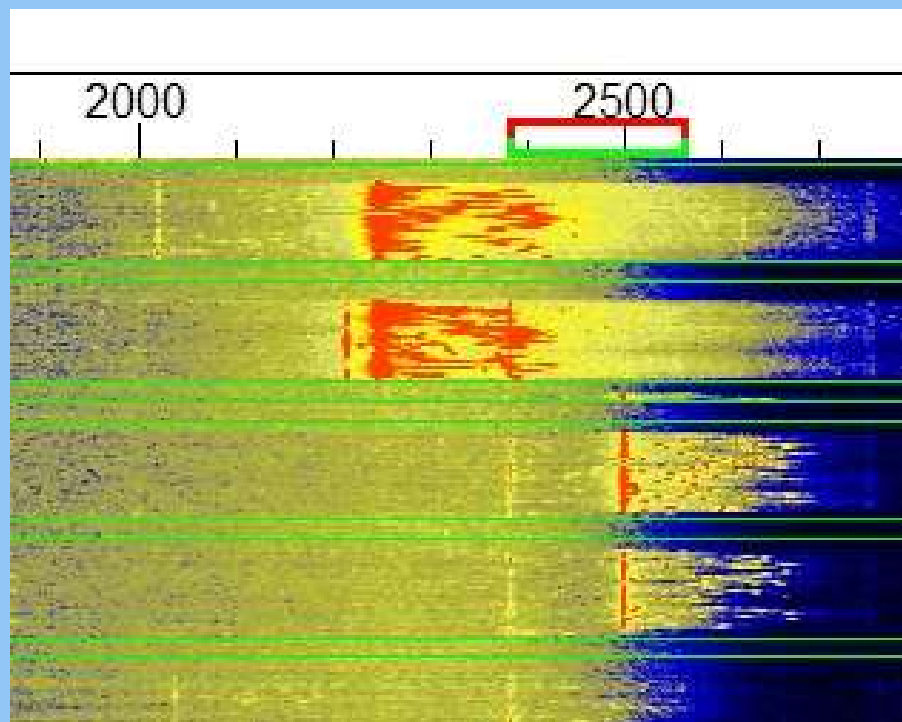
DX Call DX Grid
N8LAN EN34
Az: 313 932 km
Lookup Add

2016 Sep 26
00:05:24

Tx JT65 # ☐ Tx even
Tx 2457 Hz Tx<Rx
Rx 2457 Hz Rx<Tx
☐ Lock Tx=Rx Report -5

Receiving JT65 A Last Tx: N8LAN N8IDA 73 Tx-Enable Disarmed

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

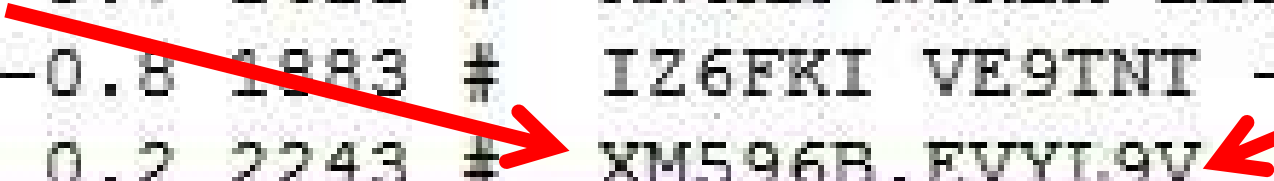
Decode Enable Tx Halt Tx Tune

Generate Std Msgs

	Next	Now	Pwr
N0KM N8IDA EM79	<input type="radio"/>	Tx 1	
N0KM N8IDA -01	<input type="radio"/>	Tx 2	
N0KM N8IDA R-01	<input type="radio"/>	Tx 3	
N0KM N8IDA RRR	<input type="radio"/>	Tx 4	
N0KM N8IDA 73	<input type="radio"/>	Tx 5	
CQ N8IDA EM79	<input checked="" type="radio"/>	Tx 6	

Secret Code? (maybe)

1906	-10	0.7	1411	#	RN6AM	N5KEX	EL28
1906	-22	-0.8	1883	#	IZ6FKI	VE9TNT	-23
1906	-20	0.2	2243	#	XM596B	EVYL9V	
1906	-15	0.2	2264	#	QRZ	KE5YTA	EM12
1906	-18	0.2	2747	#	KZ9DX	SV2TX	R-17



1700	-18	-0.5	2123	#	WG0G	OM4AB	RR73
1702	-19	0.0	1799	#	N8IDA	NS6E	-16
1702	-19	0.1	1497	#	109WV14	IIK51G	
1702	-13	0.0	1582	#	CQ	W8JBL	EM79
1702	-18	-0.7	1887	#	S59GCD	YV4DHS	-09
1702	-13	0.1	2205	#	KE0DH	KK7X	RRR
1702	-16	0.0	1847	#	K7NUU	OE3UKW	73




ARRL Book on JT65 and JT9

**WORK THE WORLD WITH
JT65 AND JT9**

*Digital communication
via Amateur Radio!*

Steve Ford, WB8IMY



The image displays the JT65/JT9 software interface, which is used for digital communication via amateur radio. The interface features a world map in the background, overlaid with a grid of latitude and longitude lines. In the foreground, there are several windows and panels. On the left, a window shows a list of stations with columns for call sign, frequency, and other details. Below this, a log window displays a list of contacts. On the right, a window shows a list of stations with columns for call sign, frequency, and other details. The interface is designed to be user-friendly and efficient for digital communication.

ARRL The national association for
AMATEUR RADIO

Happy Dx'ing on JT-65 and JT-9

