

Digital Modes

Scott Simpson, KF5WAY

Digital Modes

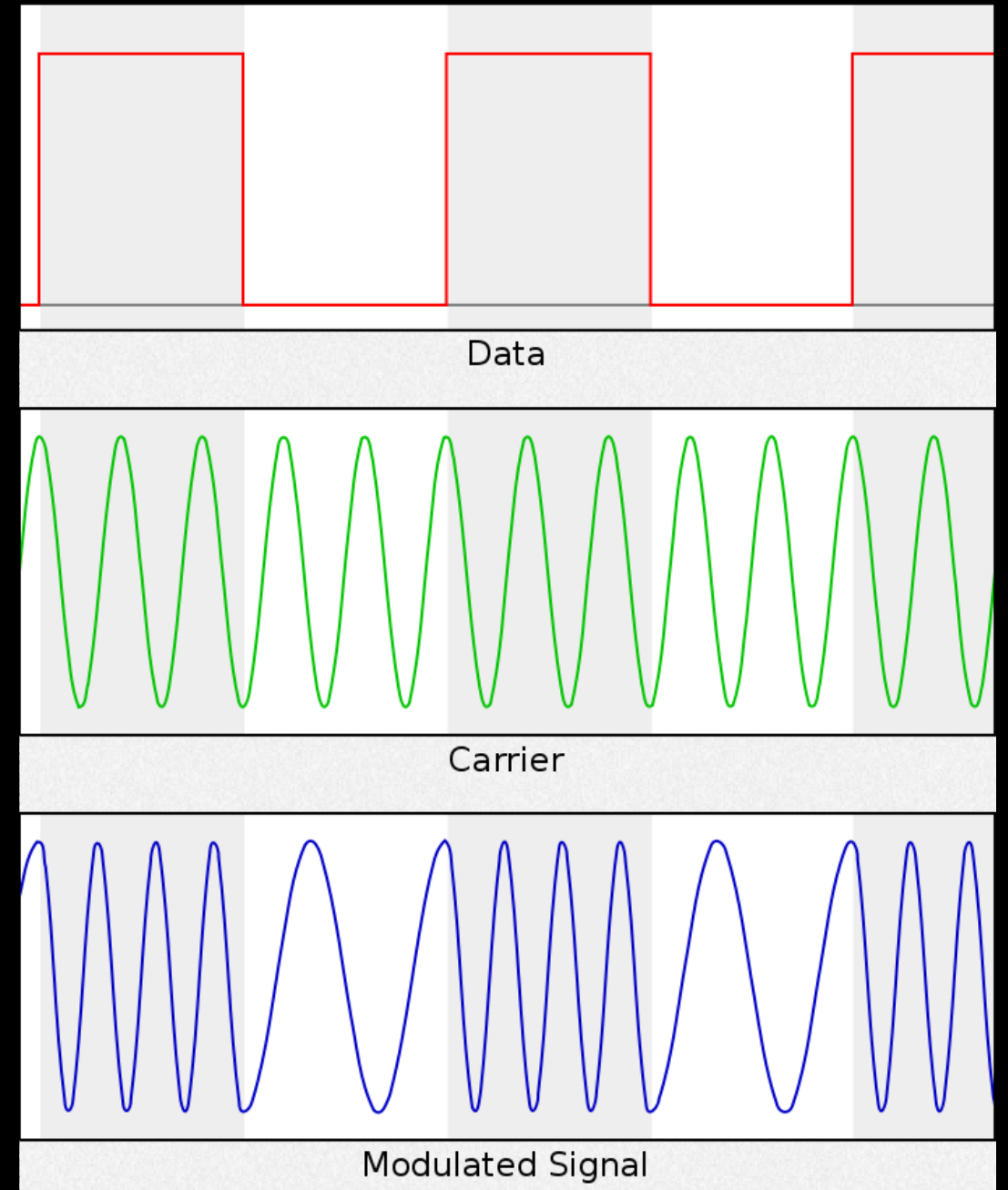
- What is a “Digital Mode”?
- Examples
- Where can I find them?
- How do I use them?

What is a “Digital Mode”?

- CW was the first digital mode
- Frequency or Phase Shift Keying
- Encodes data as signals
- Decodes signals to text

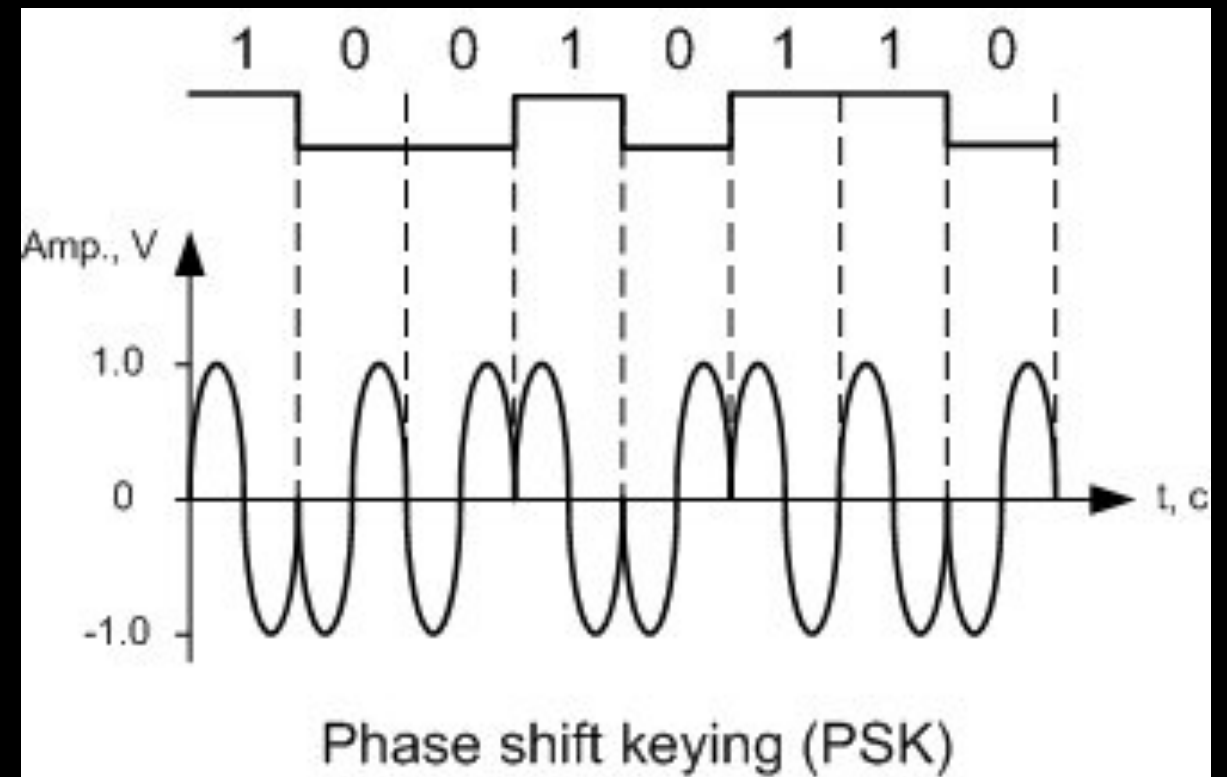
Frequency Shift Keying

- Encodes data via Frequency Modulation



Phase Shift Keying

- Encodes data via Phase Modulation



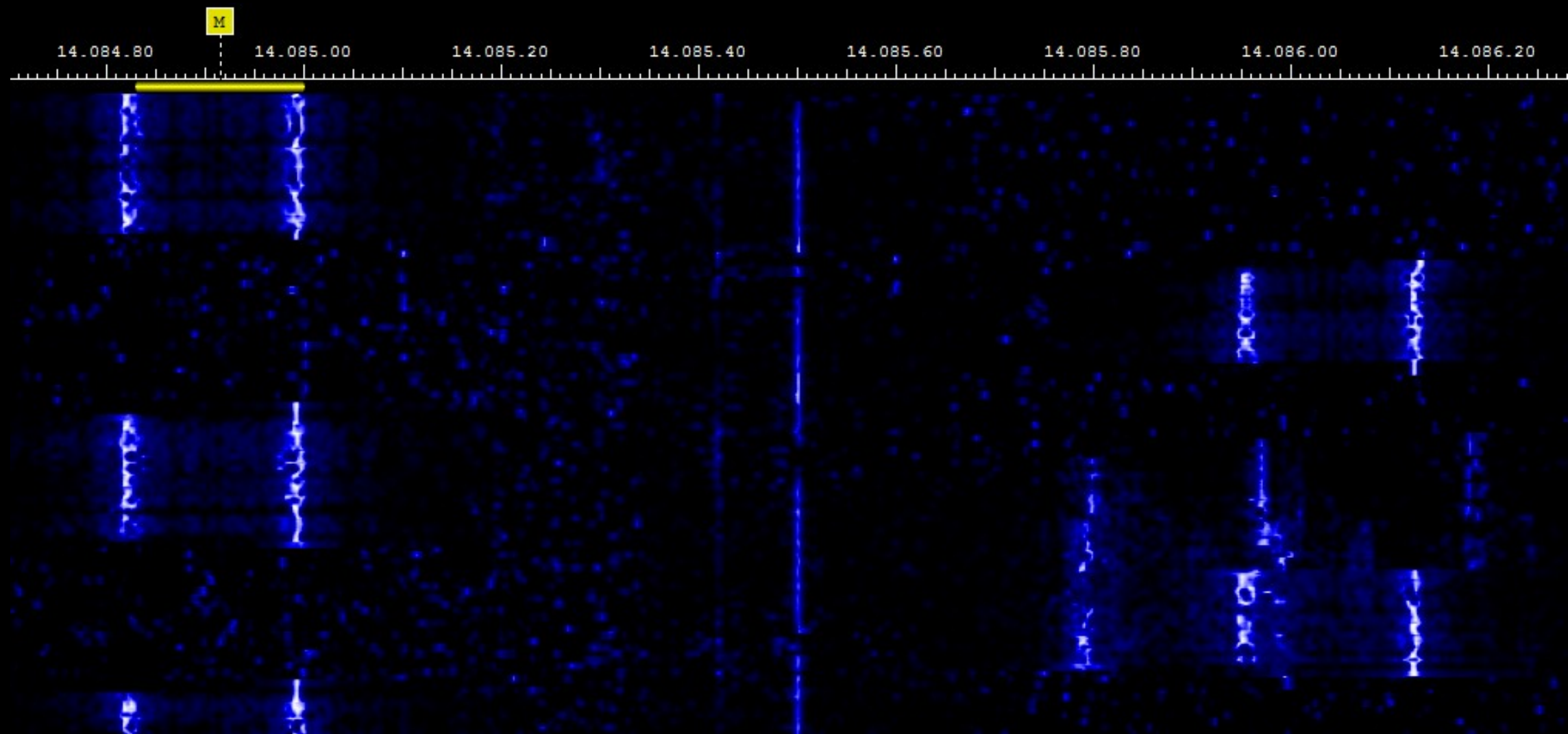
Popular Examples on HF

- RTTY
- PSK (31/63/125)
- JT65/JT9
- Olivia

RTTY

- RadioTeleTYpe
- FSK and AFSK
 - Frequency Shift Keying
- Based on Baudot coding
- Low spectral efficiency
- No error correction
- 170 Hz bandwidth

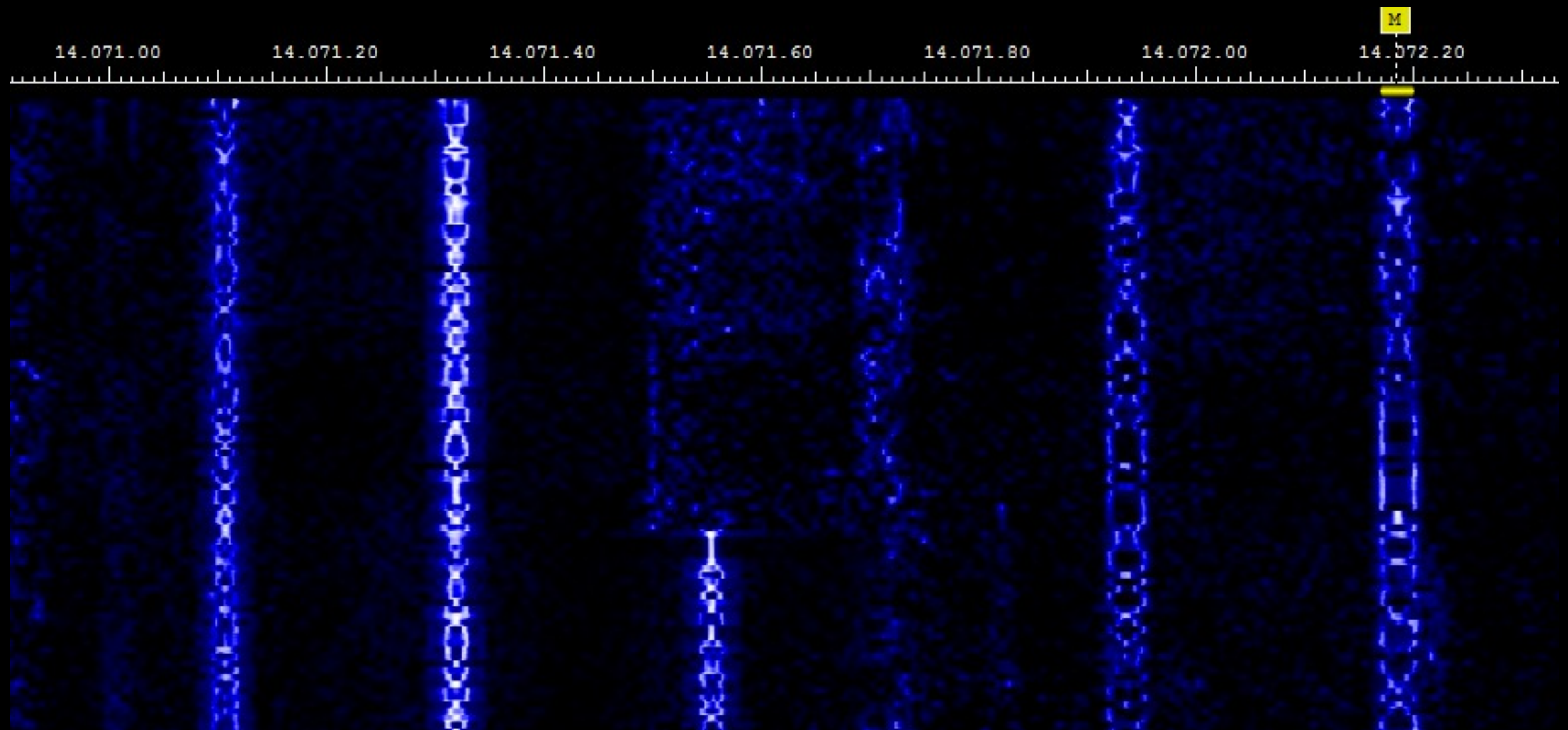
RTTY



PSK

- Phase Shift Keying
- Binary and Quadrature PSK
- Common Baud Rates for BPSK
 - 31
 - 63
 - 125
- No error correction
- 30-130 Hz bandwidth
- QPSK faster in same bandwidth

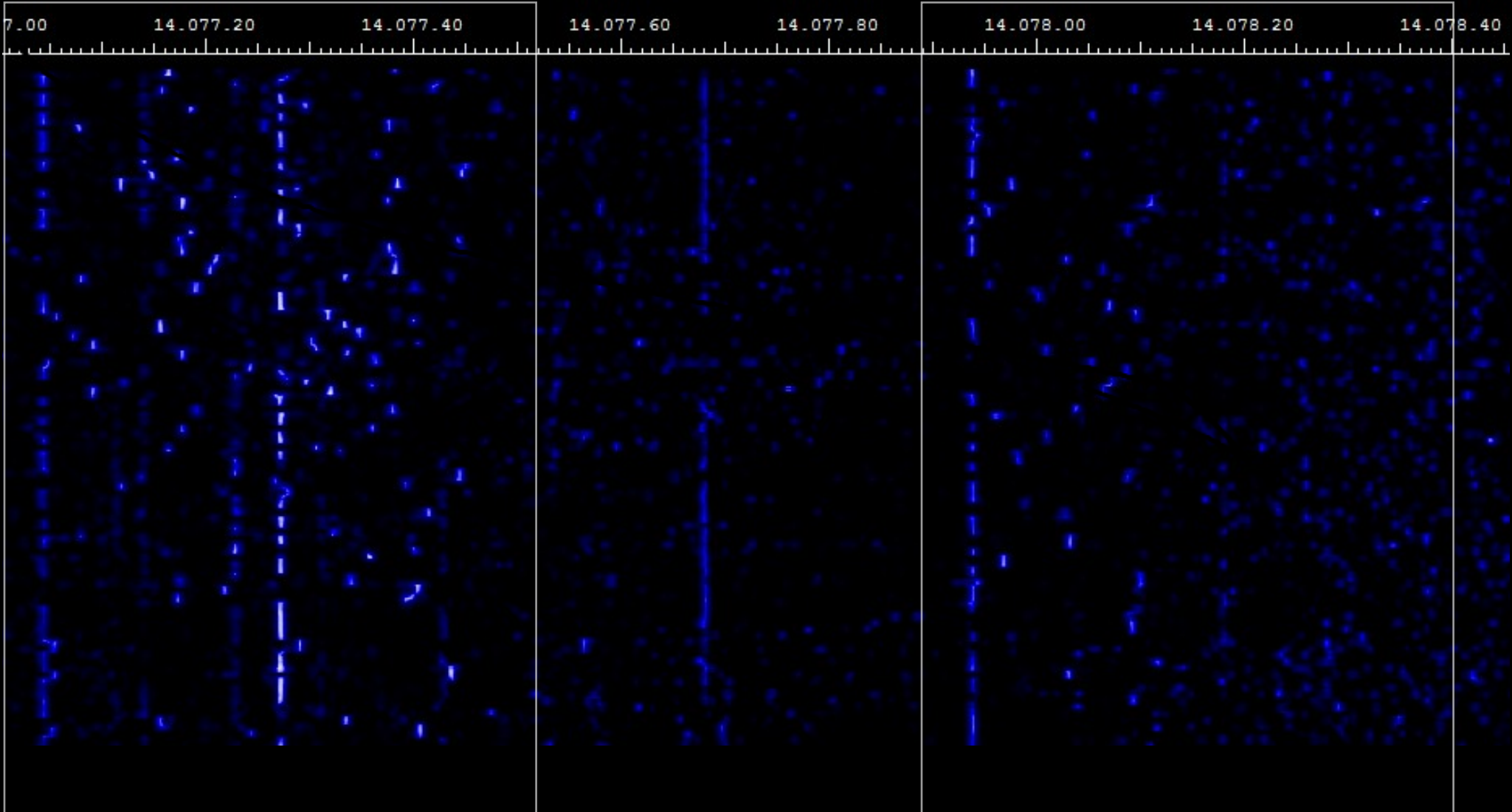
PSK



JT65

- Multiple Frequency Shift Keying (MFSK)
- Weak signal mode
- Intended for EME or Troposcatter
- Highly synchronized in minute intervals
- No error correction

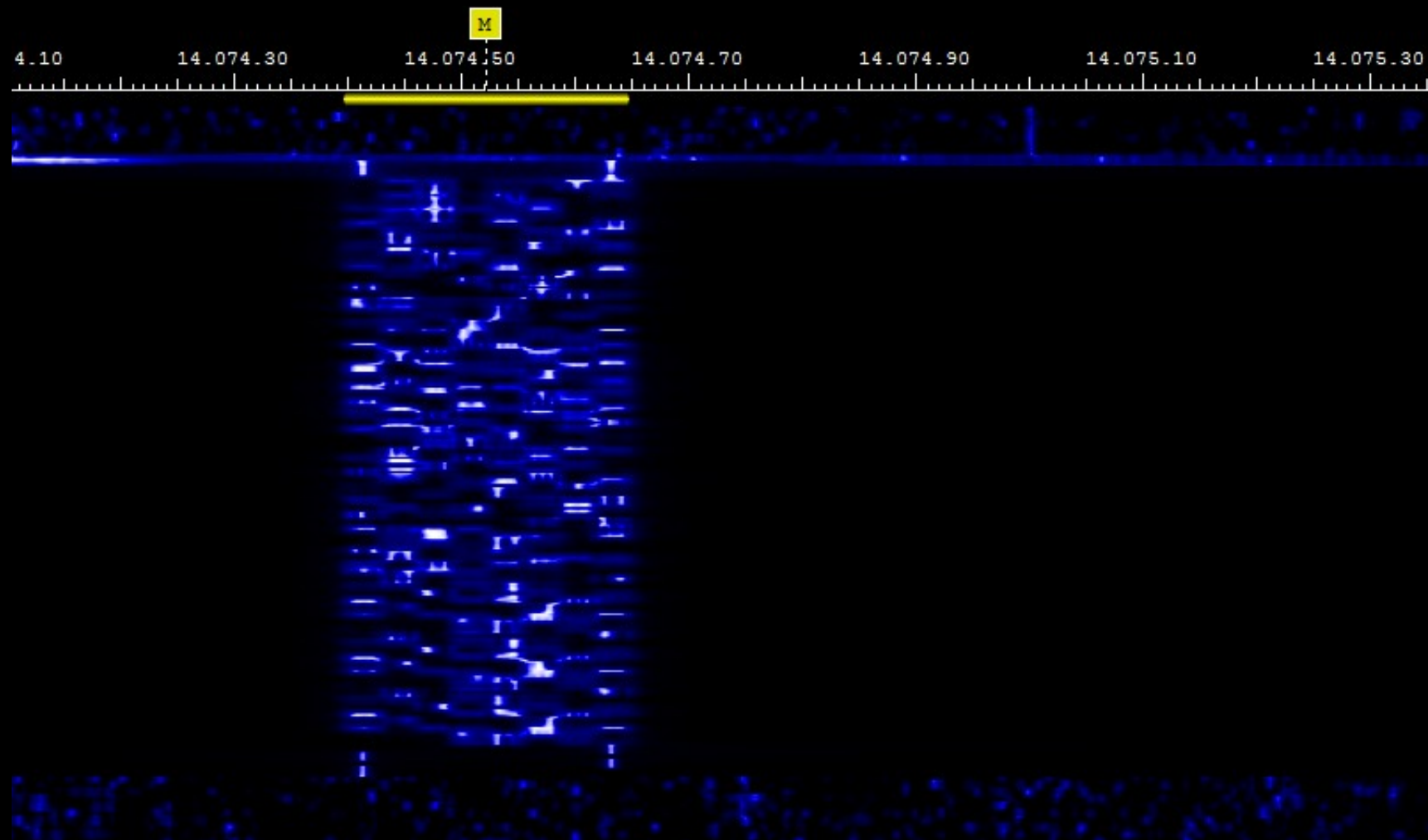
JT65



Olivia

- Multiple Frequency Shift Keying (MFSK)
- # of tones/bandwidth
 - ex Olivia 16/500 or 8/250
 - more tones == more redundancy
 - more tones == slower transmission
- Great in difficult conditions
 - 10-14dB below NF
- Error Correcting

Olivia 8/250



Other modes

- Contestia
- Pactor/Winlink
- Hellschreiber (Hell)
- Throb
- Domino
- Thor
- WSPR
- APRS

Where can I find them?

- Look at the ARRL band plans.
- Digital Modes fall in Data/RTTY space

Example for 3 bands			
Band	PSK	RTTY	JT65
10 m	28.070	28.070-28.150	28.076
15 m	21.070	21.070-21.100	21.076
20 m	14.070	14.070-14.095	14.076

How do I use them?

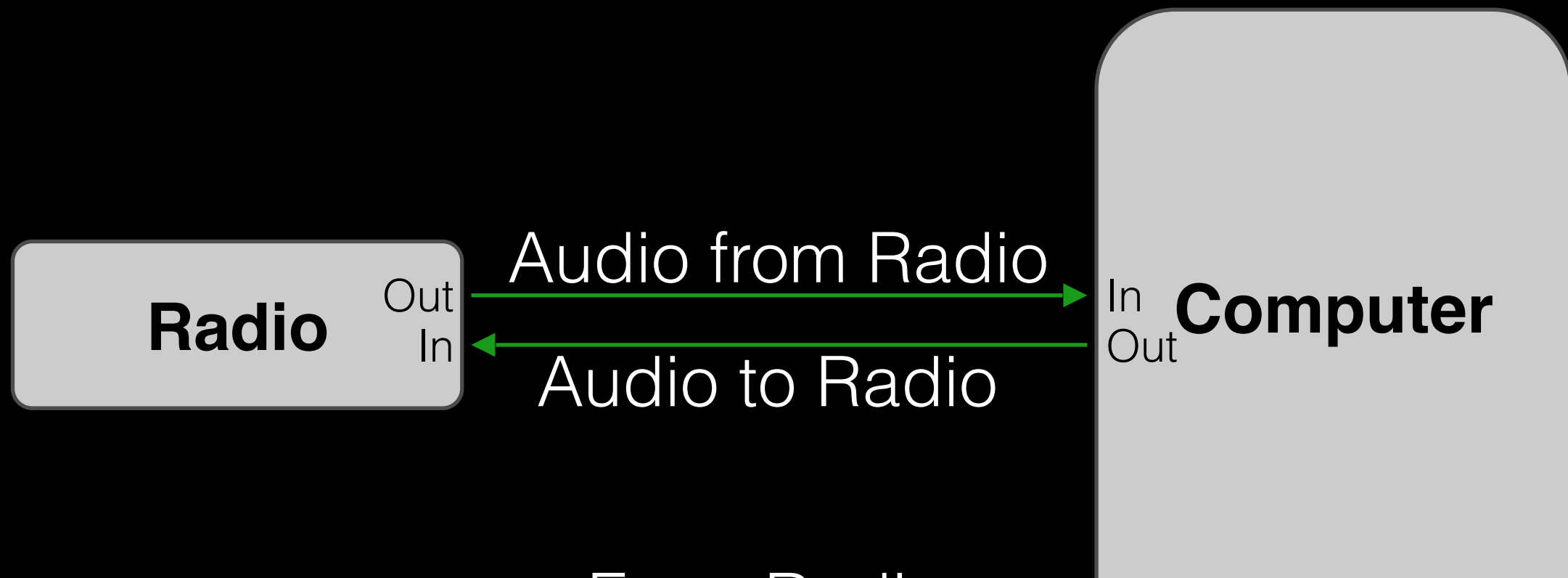
- You need:
 - Radio
 - Computer with sound card
 - Digital Mode Software
- Optional:
 - External sound card or Signalink
 - Some radios can decode built in

Sound Interface

- USB or Internal
- Signalink
- Custom



Basic Setup



From Radio

Audio Out == Data Out

Audio In == Data In

Software

- Ham Radio Deluxe
 - v6+ \$99
 - v5 Free
- FLDigi
 - OpenSource aka Free
- DXLab
 - Freeware

Ham Radio Deluxe

- Ham radio software package includes:
 - Radio control app
 - Digital modes app
 - Logging app
 - Satellite tracking app
 - Rotator control app
 - <http://www.ham-radio-deluxe.com/>

Ham Radio Deluxe

The screenshot displays the Ham Radio Deluxe software interface during a PSK-63 QSO session. The main window is titled "BPSK-63" and shows a log entry for a contact with XE3VDK de KF5WAY. The log entry includes the call sign, name (JAVIER JIVIER), QTH (Merida In The Peninla Of Yucatan Mexico), locator (EL51EA), and a message: "73 Javier and thanks for the PSK63 QSO 18 on 20m. be safe and good luck out there!". The interface also shows a frequency of 14.070.000, a band of 20m, and a mode of PSK63. The bottom status bar indicates the current frequency is 14.071.677 MHz, the signal strength is 30 secs, and the S/N ratio is 22dB. The interface includes a menu bar (File, Edit, View, QSO, Browser, Logbook, SSTV, SuperSweeper, World Map, Tools, Window, Help), a toolbar with various icons, and a waterfall display at the bottom showing the frequency spectrum.

File Edit View QSO Browser Logbook SSTV SuperSweeper World Map Tools Window Help

QSO SuperSweeper Radio Soundcard Waterfall Rig Control Logbook Rotator Configure Program Options

01:34:40 14.070.000

BPSK-63

Add Log Entry

(F2) Start: 01:34 (F3) End: 01:34 (F5) Call: Name: QTH: State/prov: Locator: Country: Frequency: 14.070.000 Band: 20m Mode: PSK63 Sent: 599 Rcvd: 599 Remark:

Add (F7) Reset (F4)

Add More My Station QSL Help

BPSK-63

BTU XE3VDK de KF5WAY pse kn
_F5WAY de XE3VDK
H o tt, Tnxieport: 599 599
Name: JAVIER JIVIER
QTH: Merida In The Peninla Of Yucatan Mexico
Locator: EL51EA [134.8° 821.4mi]
Qsl CardOnly Dnrect ,o My Qth u& B4REAH°lease.
Infoá el: www.qe.z.nom
BTU Sco Me KF5WA oVDbe
01:34:29> Main
XE3VDK de KF5WAY
73 Javier and thanks for the PSK63 QSO 18 on 20m.
be safe and good luck out there!

Send (F4) Auto (F2) Pause (F3) Stop (F5) Repeat RSID

Call CQ Info Reply Closing Default

~~XE3VDK de KF5WAY <add-log>~~
~~73 Javier and thanks for the PSK63 QSO 18 on 20m.~~
~~be safe and good luck out there!~~
~~XE3VDK de KF5WAY sk <stop>~~

Sending (Autostop), press Escape to abort 14.071.677 MHz 30 secs IMD: S/N: 22dB

Waterfall: Microphone (Sound Blaster X-Fi Go! Pro)/Speakers (Sound Blaster X-Fi Go! Pro)

Zoom: x1 Main: << 1677 >> Signal: AFC Decode Options 40m 30m 20m 17m 15m 12m 10m 6m << >> Faves

CW RTTY-45 (AFSK) BPSK-31 BPSK-63 BPSK-125 Olivia 16/500 CW RTTY PSK OLIVIA Modes

14.070.10 14.070.30 14.070.50 14.070.70 14.070.90 14.071.10 14.071.30 14.071.50 14.071.70 14.071.90 14.072.10 14.072.30 14.072.50 14.072.70 14.072.90

Ready CPU: 1% Audio: 0% Soundcard TX: 7999.60Hz Overload HRD Logbook: My Logbook RSID OVR CAP NUM SCRL 01:34

fldigi

- Open Source aka Free
- Has many apps to help hams:
 - fllog - Logging
 - flrig - Rig Control
 - flkey - interface to Winkeyer

fldigi

The screenshot displays the fldigi software interface, titled "fldigi / Hamlib K3/KX3 - KF5WAY". The main window features a menu bar (File, Op Mode, Configure, View, Logbook, Help) and a toolbar with buttons for Spot, RxID, TxID, and TUNE. The frequency display shows 18100.000. Below this, there are fields for Call, Op (records), Az, Qth, St, Pr, and Loc. A log window shows the following text:

```
*** Reading 909 bytes from logbook.adif  
*** Read 4 records in 0.00 seconds  
i  
<<2015-01-10T12:40Z BPSK-31 @ 14070000+1016>>  
e Na% stöeéua=thw Z6t=taHt w sdte hoiB ele oe trtae t r=Ottt irttUeieie ett t tL ef o e eee aiaee eoeeee e o eeee-e loeeoe oeo o r etneee to e  
gae ee a e eo loee teet oe eee e soe ettee ieTto eio eee ea peeee teeee er otee
```

The main display area is a large blue rectangle. Below it is a frequency scale from 500 to 3500 kHz. A red vertical line is positioned at 1000 kHz. The bottom of the interface shows a control panel with buttons for CQ, ANS, QSO, KN, SK, Me/Qth, Brag, T/R, Tx, Rx, and TX. The status bar at the bottom indicates BPSK31, s/n 15 dB, imd -15 dB, and other settings like -3.0, AFC, SQL, and KPSQL. A "Signal Browser" window is open on the right, showing a list of signals and a "Find" field containing "CQ".

JT65 Software

- wsjtx
 - <http://physics.princeton.edu/pulsar/K1JT/wsjtx.html>
- JT65-HF
 - <http://jt65-hf.sourceforge.net/>

wsjtx

WSJT-X v1.3, r3673 by K1JT

File Setup View Mode Decode Save Help

Band Activity

UTC	dB	DT	Freq	Message
0139	-1	0.1	523	# CQ WA9THI EM69
0139	-1	0.5	746	# KA4HOT NOMHL -08
0139	-6	0.5	933	# N4OVQ KE7XE R-13
0139	-5	0.2	1227	# KG4VMF K4SHQ R-04
0139	-14	1.2	1375	# WL7CG KK4JSJ EM78
0139	-15	0.4	1514	# PP1ER KD8HHG 73
0139	-5	-0.8	1936	# CQ KI6CYT CM87
0139	-19	0.6	2614	@ CQ HC6PE FI08
0139	-3	0.4	2672	@ KM4BWU WB0N 73
0139	2	0.2	2916	@ CQ WB7CTI DN06
0139	-11	0.2	3034	@ KG4OXA N6TE DM12

Rx Frequency

UTC	dB	DT	Freq	Message
-----	----	----	------	---------

Log QSO

20 m

☐ +2 kHz

50
40
30
20
10
21 dB

Stop

Monitor

Erase

Decode

Enable Tx

Halt Tx

Tune

14.076 000

DX Call

DX Grid

Lookup

Add

2014 Sep 03

01:39:53

☐ Tx even

Tx JT65 #

Tx 1626 Hz

Rx 1624 Hz

Tx=Rx

Rx=Tx

☐ Lock Tx=Rx

Report -15

Generate Std Msgs

Next

Now

Tx 1

Tx 2

Tx 3

Tx 4

Tx 5

Tx 6

CQ KF5WAY EL09

Pwr

Receiving

JT9+JT65

Useful Links

- Digital Modes, sound and pictures (http://hfradio.org.uk/html/digital_modes.html)
- Digital Modes - Sight & Sound (<http://www.w1hkj.com/FldigiHelp-3.21/Modes/>)
- ARRL Digital Modes (<http://www.arrl.org/digital-modes>)
- Digital Modes audio samples (<http://www.kb9ukd.com/digital/>)
- PSKReporter (<http://pskreporter.info>)

More Links

- Passband Modulation (<http://en.wikipedia.org/wiki/Modulation>)
- FLDigi (<http://www.w1hkj.com>)
- DX Lab Suite (<http://www.dxlabsuite.com>)
- Tigertronics, Signalink (<http://www.tigertronics.com>)
- KF5WAY Blog (<http://blog.kf5way.com>)

Questions?