

# Introduction to Digital Modes

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# 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

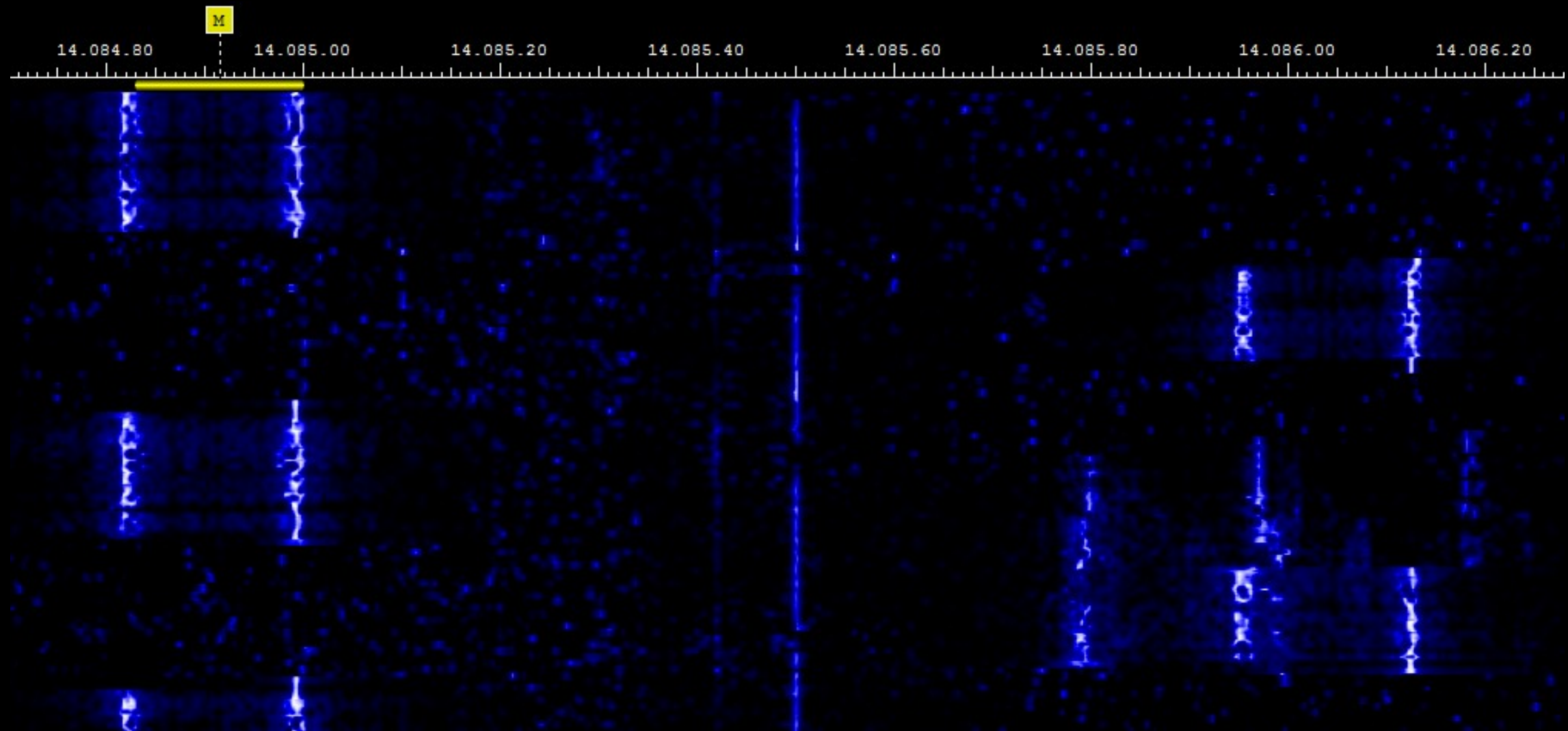
# Popular Examples on HF

- 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

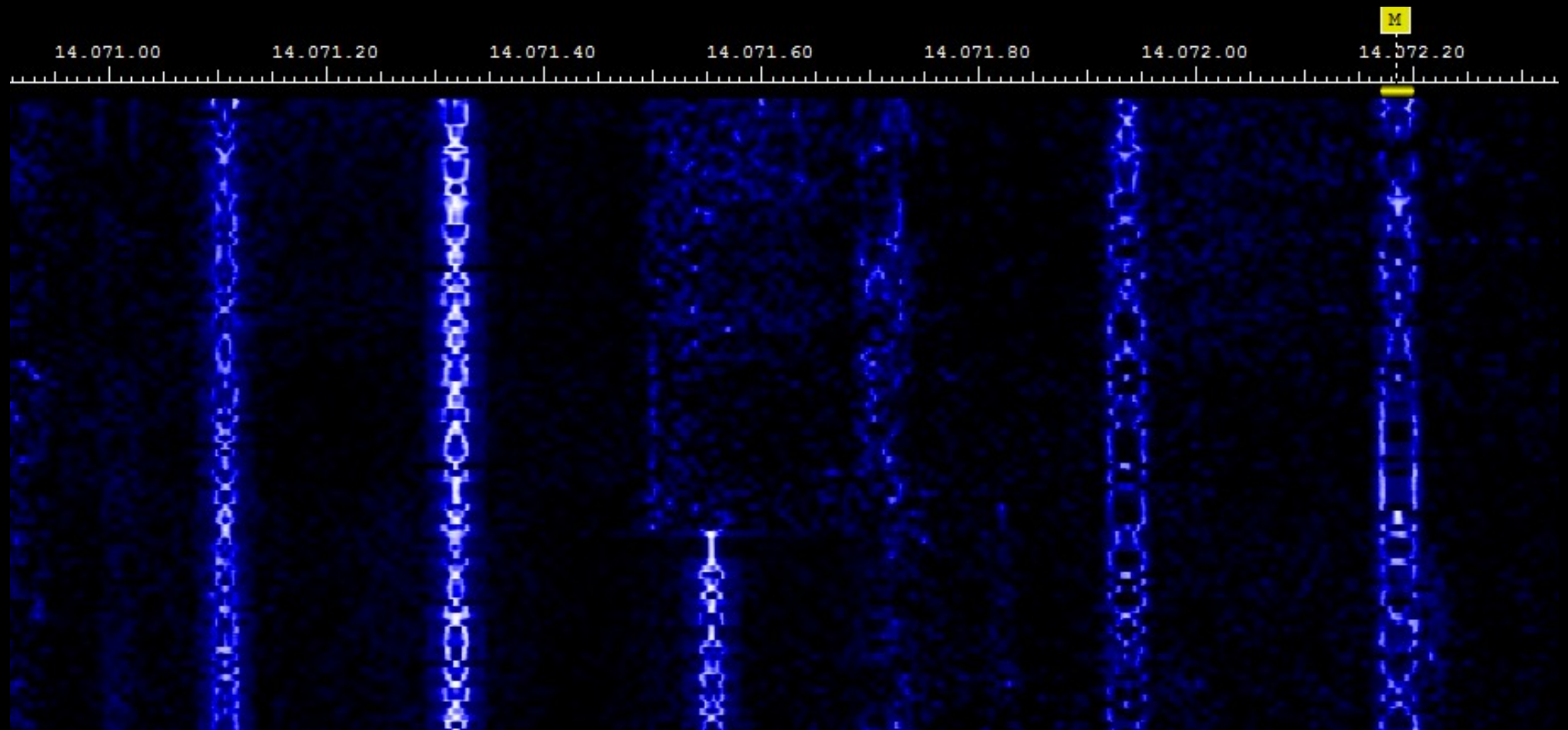
# RTTY



# 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

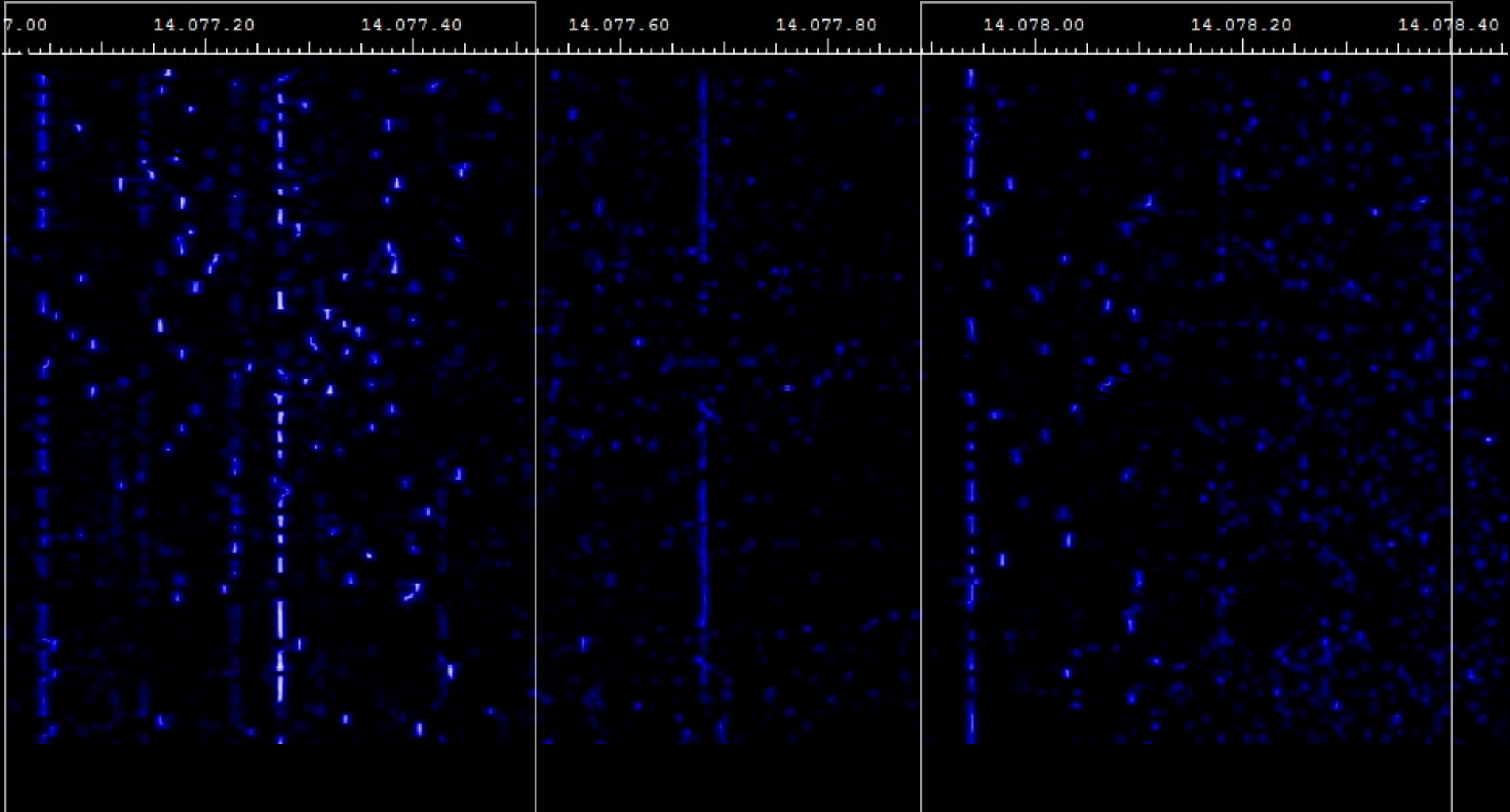




# JT65

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

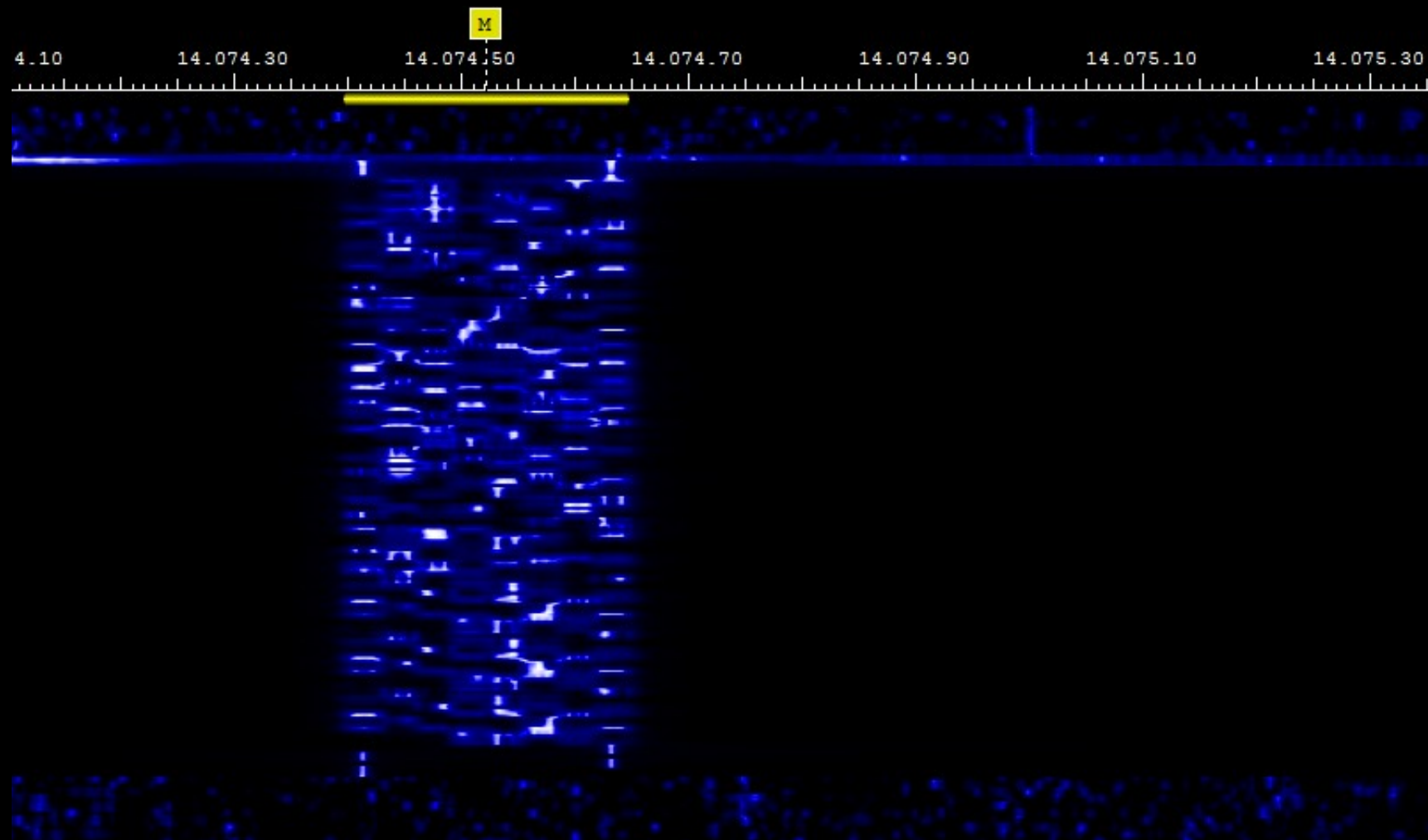
# JT65



# 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

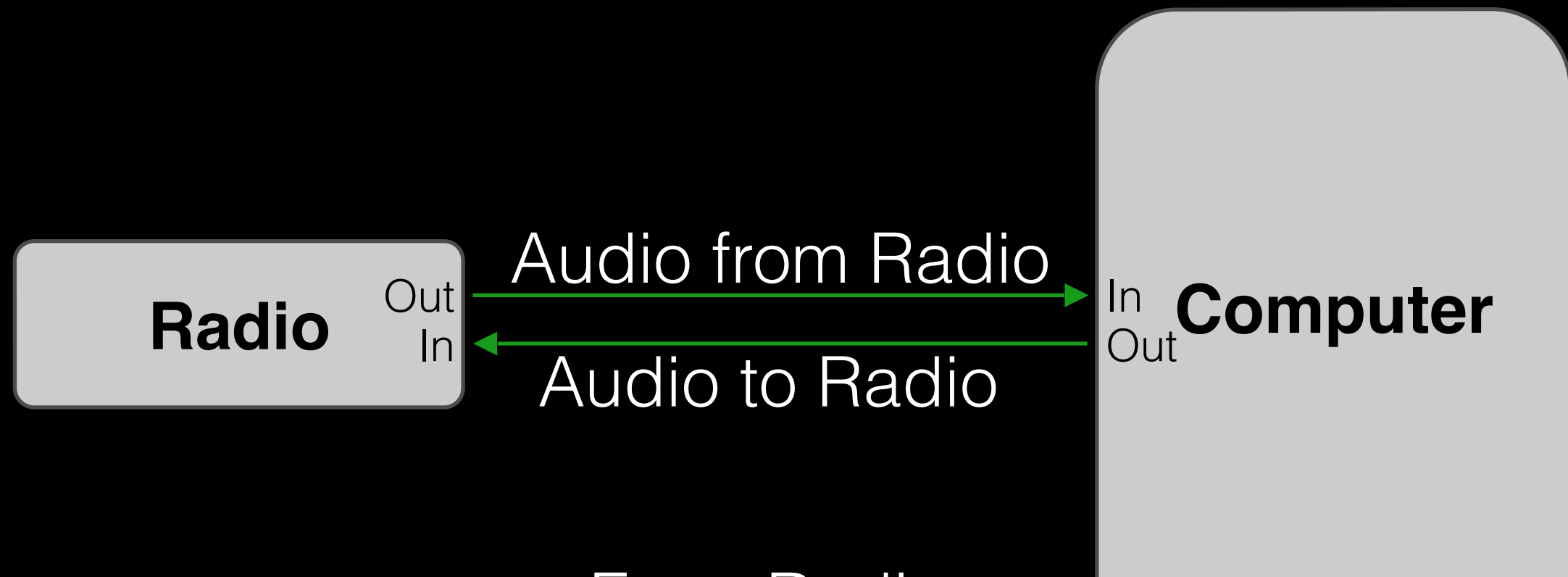
# Sound Interface

- USB or Internal
- Signalink
- Custom





# Basic Setup



From Radio

Audio Out == Data Out

Audio In == Data In

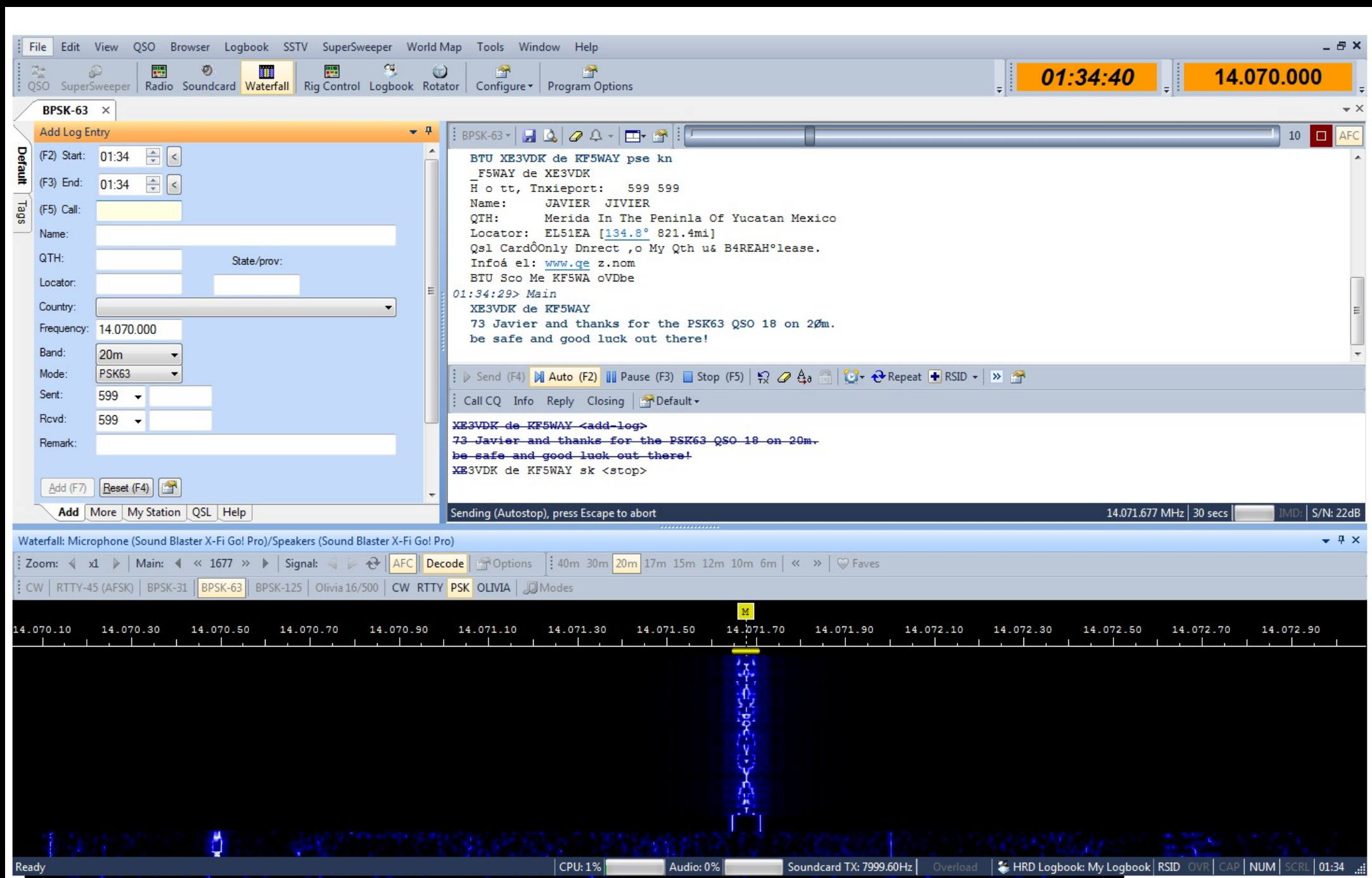
# Software

- 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



# 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 spectrum display with a frequency scale from 500 to 3500 Hz. A red vertical line is positioned at 1000 Hz. The spectrum shows a signal at 18100.000 Hz. The bottom status bar includes various controls and indicators: WF, -20, 70, x1, NORM, 1000, QSY, Store, Lk, Rv, T/R, BPSK31, s/n 15 dB, imd -15 dB, -3.0, AFC, SQL, and KPSQL. A "Signal Browser" window is open on the right, showing a list of signals and a "Find" field with the text "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
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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](http://hfradio.org.uk/html/digital_modes.html))
- 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?