

General Class Digital Modes Presentation

Question groups: G1E, G2E, G8A, G8B, G8C

General

Segment of the 20 meter band used for digital transmissions? (14.070-14.100 MHz)
Segment of the 80 meter band used for digital transmissions? (3570 – 3600 kHz)
What describes a waterfall display? (Freq horiz, sig strength intensity, time vertical)
Why know duty cycle? (High duty cycles could exceed TX average power rating)
Why match RX bandwidth to mode bandwidth? (Best SNR)
Symbol rate vs. Baud
Relationship between symbol rate and bandwidth? (>symbol rates require > bandwidth)
FSK uses Mark and Space

RTTY

Mode used with RTTY signal via AFSK with a SSB transmitter (LSB)
Most common frequency shift for RTTY? (170 Hz)
Cannot decode RTTY (or other FSK) signal? (Mark/space reversed, wrong baud rate, wrong SB)
Describe Baudot? (5 bits w/ start & stop bits)

PACTOR

How do you determine if the channel is in use? (Monitor mode)
Symptoms of interfering signals? (Retries/timeouts, long pauses, failure to establish connection)
How to join a conversation using PACTOR? (not possible; limited to two stations)
Approximate bandwidth of PACTOR3? (2300 Hz)
What part of data packet contains routing/handling info? (Header)
NAK? (RX request packet be retransmitted)
What happens after excessive transmit attempts? (Connection dropped)
ARQ contains errors? (Request to retransmit)
How does FEC work? (Transmits redundant information w/ data)

Winlink

Common system that uses Internet to transfer messages? (Winlink)
How to establish a connection to a digital messaging system? (Send connect message to published freq)

JT9/65

Standard sideband for JT9/65 using AFSK? (USB)
Uses extremely low signal strength on HF (JT9/65)

PSK31

In what segment of the 20 meter band is PSK31 commonly found? (Below RTTY, near 14.070 MHz)
What do vertical lines mean adjacent to PSK31 signal? (Overmodulation)
How many data bits in a single PSK31 character? (Varies ... Varicode)
Upper case letters use longer varicode and slow down transmission
What does "31" represent? (approximate symbol rate)
Varicode used to send PSK31 signals.

Digital Mode Presentation

General Knowledge

Digital communication is the exchange of digital data over the air

- Email, Digital files, Keyboard-to-keyboard (chat), and others

Protocols on today's menu

- RTTY, PACTOR, JT9/65, PSK31

Communication = digital mode if info is exchanged as individual characters encoded as digital bits.

Example:

A = ASCII 01000001

Some consider CW a digital mode. (an A = di-dah)

Some modes are old, like radio-teletype, invented in the 1930's.

Some modes are new, like FSQ, invented in the mid-2015's.

Where?

- Look at an amateur band chart (80 meters and 20 meters)
- Look at a band plan (2-4, 2-17, 6-2)
- Show CW, PSK31 (3.570 & 14.070) and RTTY
- Look at <http://bandplans.com>

Definitions

Air Link – the part of the communication system involving radio transmissions and reception of signals.

Bit – fundamental unit of data; a 0 or 1 in binary

Bit rate – number of bits per second sent from one system to another.

Symbol – signal characteristics that make up each distinct state of the transmitted signal

- CW symbols = on and off
- RTTY symbols are tones
- Baudot or ASCII (simple methods) encode one bit in each symbol
- Sophisticated codes use complex audio signals to carry the data and encode more than one bit in each symbol

Baud – number of symbols per second that are sent from one system to another.

Duty cycle – ratio of transmitting to total on/off time

- Important to know duty cycle of mode because most transmitters are not designed to operate at full power for extended periods of time.
- CW = 50%
- SSB = 25%
- PSK31 & RTTY = 100%

Protocol – rules that control the method used to exchange data

Mode – combination of the protocol and the modulation

Bandwidth of a digital signal changes with the symbol rate. As symbol rate increases, bandwidth increases. (ex. Olivia: more tones, more symbols, more bandwidth)

Introduce waterfall display

[open FLDigi]

X-axis = frequency

Y-axis = time

Intensity = strength of signal

RTTY

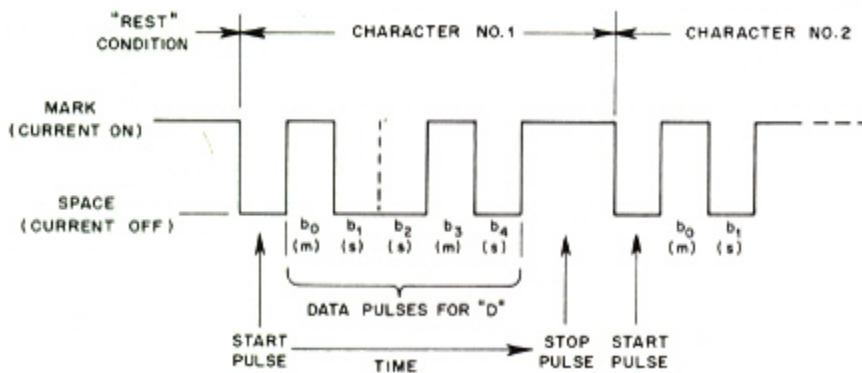
Radioteletype

One the oldest modes, developed in 1930's

Uses ASFK (Audio Frequency Shift Keying), LSB

Encodes data using Baudot (origin of Baud)

- Each character encoded in 5 bits
- Initial start bit and inter-character pause (stop bit) are used to synchronize the stations
- 5 bits = 32 characters (not enough for ALL upper- and lower-case letters and numbers and punctuation)
 - Uses two special codes to switch between characters sets = 62 characters



Mark (2125 Hz) and space (2295 Hz)

Difference = signal shift (most common shift = 170Hz)

The rate of shifting determines the character speed

- 60, 75, 100 WPM = 45, 56, 75 baud

Can't decode?

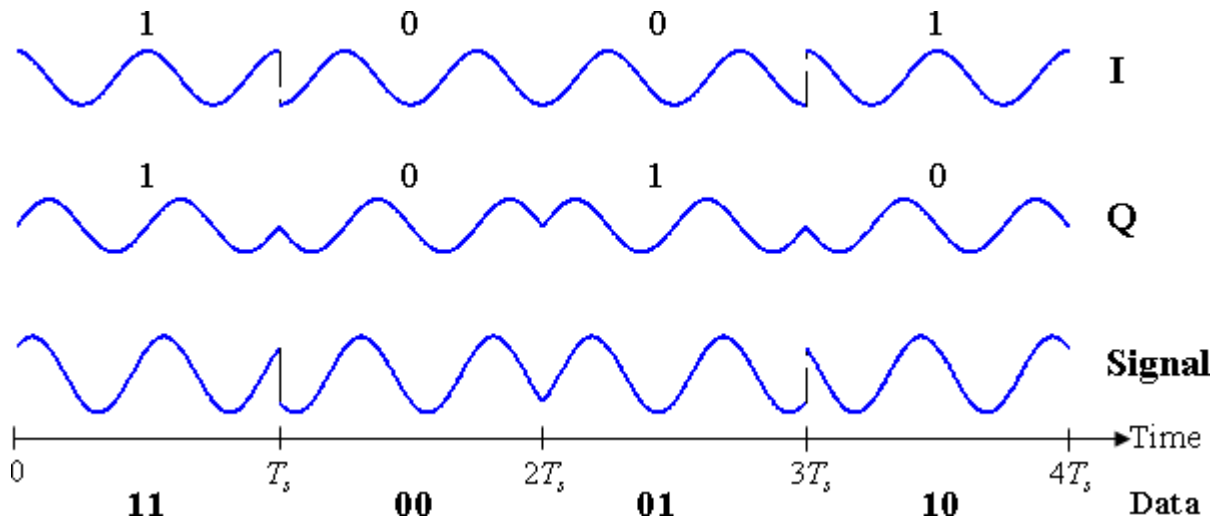
- Mark/shift reversed
- Wrong baud rate
- Wrong side-band

Approximate bandwidth = 200 Hz

PSK31

Phase Shift Keying

- Signals out of phase
- Information is encoded in the differences of the phases



"31" is the symbol rate, 31.25 baud

Variable length character code – varicode

- Uses shorter codes for more common characters.
- Uppercase characters utilize more bits (and more time) to send.

Vertical lines adjacent to PSK31 signal is over-modulation (demonstrate w/ high volume?)

PSK31 transmissions generally located at the bottom of the data bands, below RTTY, 20 meters = 14.070 MHz

Approximate Bandwidth = 50 Hz

JT9/65

AFSK protocol, uses USB

Excels at getting an extremely weak signal through atmospheric noise and ionospheric distortion

9 or 65 tones audio tones

Waterfall looks like the music for a player-piano

Transmissions are time-synced

- Start at :00
- Transmit for 48 seconds
- Off for 12 seconds
- Stations take turns in even and odd minutes transmitting and receiving
- 13 characters per minute (0.2 characters per second)

Approximate Bandwidth = 350 Hz

PACTOR

Packet basics

Anatomy

- Header – routing, control, status, error correction
- Data – information
- Trailer – status and error detection

Error Detection

- Most common = Cyclic Redundancy Check (CRC)
- Calculated and transmitted with data
- Receiving station calculates and compares
 - If correct, receiving stations sends ACK
 - If not correct, receiving stations sends NAK
 - Example of Automatic Repeat reQuest (ARQ)
- Forward Error Correction (FEC)
 - Goes beyond error *detection*
 - Includes redundant encoded information so that receiver can self-correct certain types of errors.
- Maybe be an interfering signal if...
 - Many retries or timeouts
 - Long pauses
 - Failure to establish a connection

Approximate Bandwidth = 2300 Hz

Pactor (packet in general) is a point-to-point interaction. There is no breaking in or three way conversations. You can tell if a “channel” is busy by putting your software in monitor mode or watching the waterfall.

Winlink

RTTY was not designed to manage transmission errors.

Text is frequently garbled

Teletype Over Radio (TOR) systems developed to send short bursts of characters with error correction. More reliable, but originals (AMTOR and G-TOR) were quite slow.

PACTOR (Packet-based TOR) and WINMOR (Windows Messaging Over Radio) were developed to extend the capabilities of TOR modes.

Winlink is an amateur radio email system. It is a common system that uses the Internet to transfer messages.

Demonstrate (?)

In order to establish a connection, send a message to a published frequency.

You're most likely contacting an automatically controlled station.

- (Can't expect an operator to be manning his station 24x7!)

Speaking of automatically controlled stations...

- Automatically controlled stations can communicate with other automatically controlled stations
 - Anywhere above 222 MHz (1.25 meters)
 - Specified segments in 80 meters through 2 meters.