Amateur Radio - Digital Modes
Practical Considerations

What are we going to talk about?

- HF digital modes
  - What pieces and parts you need to get started
  - How you use the pieces and parts
- General principles can be adapted to any station

What do you need?

- Radio
  - Almost any radio will do
- Computer
  - Almost any computer will do
- Software
  - Lots of free programs
- Interface
  - Homebrew or commercial

Radio

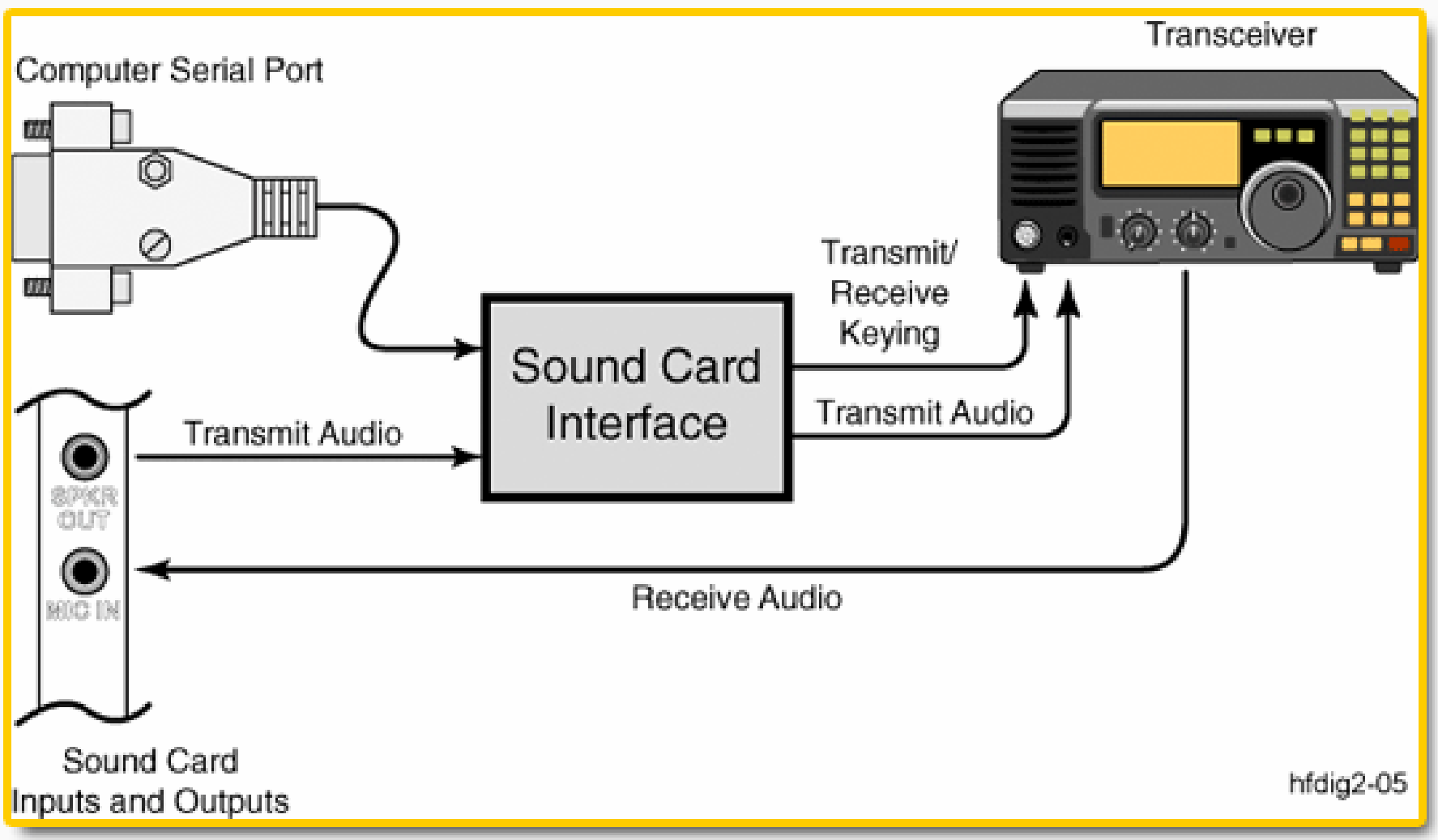
- We need to get the receive audio from the rig and get it to the mic in or line in of the sound card
- We need to get the computer audio from the speaker output or line out of the sound card to the mic in of the rig
- We need a way to key the rig to transmit (PTT)
- We need a ground (ground)

Why a Sound Card?

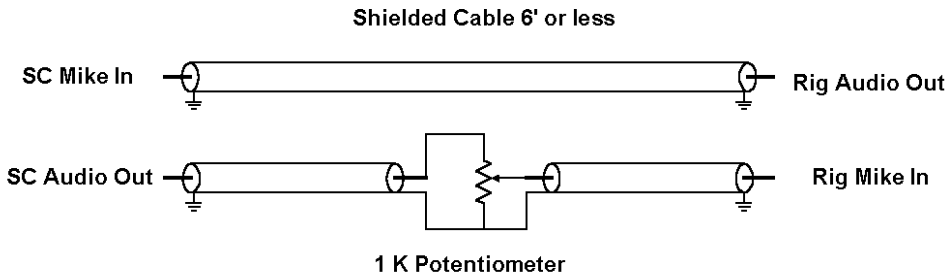
- The computer operates in the digital world
- The rig operates in the analog world
- The sound card functions as the modem
  - Converts rig analog audio to digital data
  - Converts keyboard digital data to analog

Radio – Simple Case

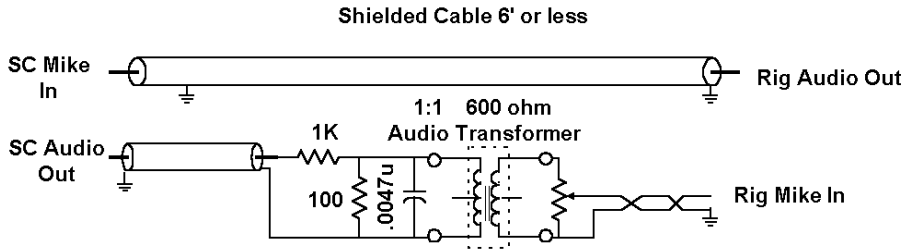
- Receive audio from the ext speaker jack
- Inject transmit audio into the mic connector of the rig
  - Major caveat – this should not be a direct connection
    - Break this connection by using a 1:1 transformer, optical isolator, or commercial interface

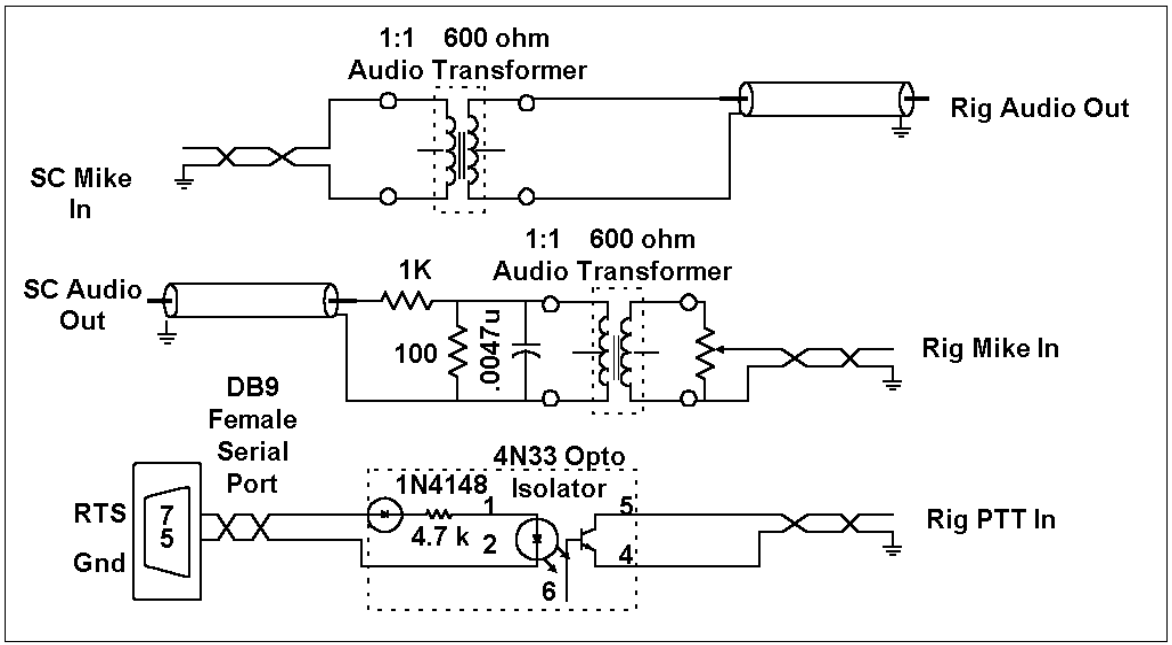

Transceiver
Computer Serial Port
Transmit/
Receive
Keying
Sound Card
Interface
Transmit Audio
Transmit Audio
SPKR
OUT
MIC IN
Receive Audio
Sound Card
Inputs and Outputs
hfdig2-05

Stage 1 Cable & Pad



Stage 2 Isolating the Tx Drive with a Transformer



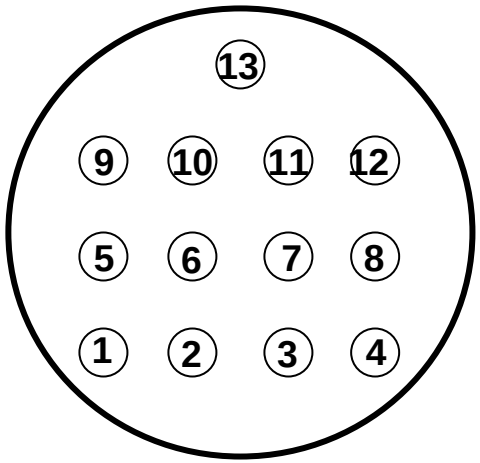


AARC April 14, 2009

Radio – Better Case

- Most HF rigs have an accessory socket on the back
  - Audio in (mic)
  - Audio out (fixed level)
  - PTT
  - Gnd

Kenwood TS-2000 Accessory Din Connector



Rear Panel
Front View

- 1 Audio output from sub-rcvr
- 2 RTTY key input
- **3 Audio output from main-rcvr**
- 4 GND
- 5 Main rcvr squelch control
- 6 no connection
- 7 Sub-rcvr squelch control
- 8 GND
- **9 PTT Line control (mic mutes)**
- 10 no connection
- **11 Mic audio input**
- **12 GND**
- 13 PTT control (mic does NOT mute)

Commercial Interfaces

- Audio isolation
- Many inject audio into the mic connector (with or without mic pass-through)
- Maybe TX volume control
- Maybe with cables specific for your rig
  - Rigblaster
  - MFJ
  - Signalink
  - Rascal and many others

Kenwood®, Elecraft® and SGC® 2020 8 pin round screw on

Pin # Connection

1 Microphone audio

2 Push to talk, PTT

3 not used

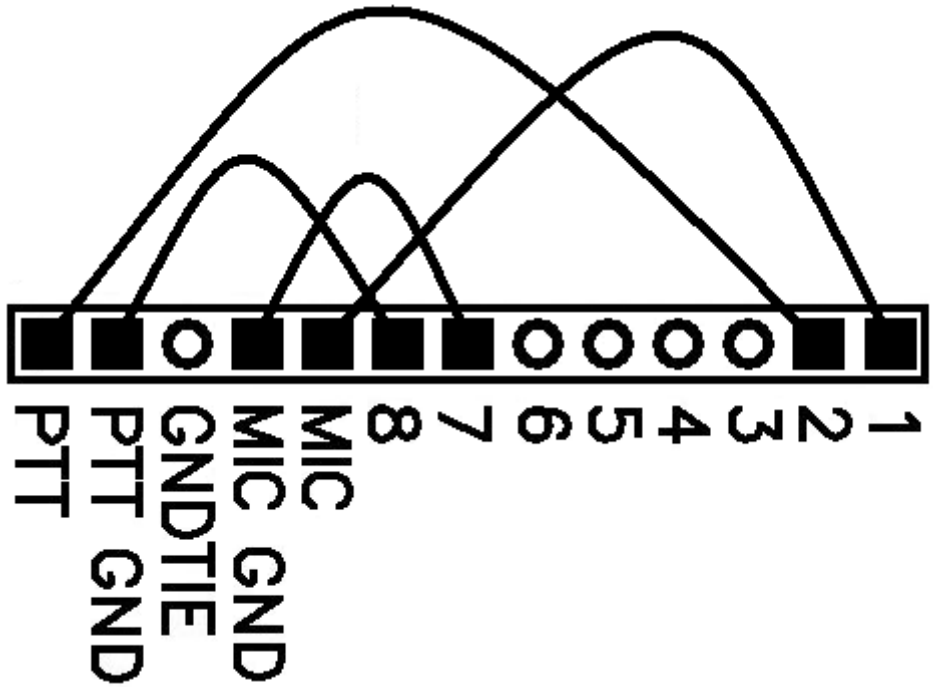
4 not used

5 not used

6 not used

7 Mic. common (Ground)

8 PTT common (Ground)



FSK vs AFSK

- FSK – Frequency shift keying
  - Computer sends data from rig by shifting the frequency of SSB carrier at a fixed audio frequency
- AFSK
  - Computer sends data from rig by shifting the audio frequency at a fixed SSB carrier frequency

Computer

- Almost any reasonable modern computer will work
- You need a serial port
  - Most desktops still have a serial port
  - For laptops without a serial port, use a USB-serial converter assigned to a port number the software recognizes
- You must have a sound card
  - Convert received analog audio to digital data
  - Convert transmitted digital data to analog audio

Computer – Simple Case

- Most modern computers have a sound card chip set on the mother board
- This will work, but sound card applications require system resources and memory
- Connections
  - Mic in
  - Speaker out

Computer – Better Case

- PCI sound card
  - Inexpensive cards have mic in and speaker out
  - Better cards have mic in and line in, speaker and line out
  - More resources on the PCI card
- USB external sound card
  - Always have line in and line out
  - Line in and out are easier to regulate

Computer – Better Case - More

- Creative Soundblaster
  - Mic in impedence 600 Ω
  - Mic in sensitivity 10-200 mV
  - Versus
  - Line in impedence 47 k Ω
  - Line in sensitivity 0-2 V

Caveats about Sound Cards

- Windows OS is very stupid
  - Can only use one sound card at a time
  - Conflict with default sound card in settings
- Some software will capture the sound card
  - Won't return it when the app closes
  - May return it with different settings

On to Software

- Software that supports multiple modes
  - MixW
    - www.mixw.net Nick UT2UZ and Denis UU9JDR
  - MultiPSK
    - multipsk.eqth.info Patrick F6CTE
- For other software go to
  - K4THE education page at www.albemarleradio.org

MixW

- Some of the features of MixW are
  - Callbook lookup
  - Logging
  - Multiple modes
  - Macros
  - Waterfall or spectrum
  - Rig control

On to Modes

- PSK31
  - Phase shift keying
    - 31.25 baud at theoretical 30 Hz bandwidth
    - Higher bandwidth is needed to send higher baud rates
    - Audio signal is shifted between 0° (in phase) and 180° (out of phase) in 31.25 bit/sec data stream
    - Also referred to as Binary Phase Shift Keying (BPSK)

More on PSK

- PSK31
  - Uses Varicode (like CW)
    - More common letters use fewer phase changes
      - E 1110111 e 11
      - T 1101101 t 101
      - O 10101011 o 111
    - Caps use more shifts (take more time to send) than lower case letters
    - NEVER send using Caps Lock on

More on PSK

- PSK31
  - Tx and Rx stations must synchronize
    - Every Tx starts with a short string of 0s
    - Varicode never uses 2 0s in a row
      - 00 is reserved as character interspace
  - Software is using
    - DSP algorithm
    - Synchronized sampling

More on PSK

- PSK31
  - When sending continuous phase reversals (idle)(string of 0s) result is a two tone signal
  - On the display
    - Two vertical parallel lines
    - Look and listen to this

More on Digital

- RTTY regardless of band uses LSB
- All other digital modes regardless of band use USB
- However, PSK doesn’t care, it is indifferent to the SB used

Sound Card – Rig Settings

- Vary the mic in or line in volume to see that the waterfall will change
- If PSK signals don't decode well you may be overdriving the audio input to the sound card

Sound Card – Rig Settings

- Audio drive level to the rig is CRITICAL
- Start out rig power set to 20W and volume slider of speaker out and/or wave out all the way down
- Key the rig with an idle
- Slowly raise the output volume until you see some power out, no ALC and about 10W output

Sound Card – Rig Settings

- PSK 2nd harmonic should be -60db
- If the audio drive is too high
  - The output signal is too wide
  - You spatter into other QSOs
  - You are not a welcome addition to the digital world

Sound Card – Rig Settings

- IMD (intermod distortion) is a measure of the ratio of the fundamental signal to its harmonics
- Ask for a report
  - You want to be -20 or greater

A PSK QSO

- Recorded and saved as MP3 file
- Marginal for playback

What about some other modes?

- Once you have the computer, interface and rig operating together a whole world of new modes opens up to you
  - RTTY
  - MFSK16
  - Hellschreiber
  - Olivia
  - Chip64

Other Digital Modes

- Learn to recognize the modes by the sound

Sending Images - SSTV

- SSTV
  - Rasterized image transmission
  - Various algorithms that software will automatically detect
  - 2-4 min/image depending on mode
  - Interference results in lost data/noisy image


KE5RS
WBØLCC de KE5RS


Pueblo Colo John 500 watts - G5RV Ant.
Hi Mike
KB6SSH 57 P2=3 de WBØLCC


STEV
EA8PE

Sending Images EasyPal

- Easypal
  - JPG2 compressed file
  - Converted to wav file
  - 1-4 min depending on file size
  - Error correction with automatic resend of missing blocks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XE1RK

What have we talked about?

- HF digital modes
  - What you need to get started
  - How you use the pieces and parts
- General principles can be adapted to any station
- Go home get setup and get on the bands
- Have fun