

CHAPTER 11

Establishing & Equipping an Amateur Radio Station

(Nothing to do with bankruptcy)

Doug Elliott VA3DAE

1

Overview

- What gear do I need for Ham Radio?
- How do I connect it up?
- How does it work?

2

How do I Get Started?

- Think about what part of Ham Radio you want to explore first, and try it out at Club station or friends shack
- Find an experienced ham (Elmer) who can advise you, especially on expensive or used equipment
- Make a rough budget
- Find a corner of your home for your shack

3

Where can I get gear?

1) Dealer\$

- only source of new stuff with warranty
- can provide service / repairs
- can supply accessories you need
- Buying Canadian minimizes shipping

4

Where can I get gear?

2) Other Amateurs

- Ham Fests / swap shops / web ads
- best if you know seller, else risky
- ask for a demo, test the gear if you can
- ask an Elmer for advice
- be careful shipping across a border

5

Where do I set it up - Shack?

- everything from a shelf to a building
- Basic Needs:
 - a 120 V power outlet, ideally dedicated
 - a pathway to antenna for feedlines
 - a safe place to mount antenna(s)
 - a proper station ground
 - optional: Computer, phone, storage

6

VHF and UHF Stations

- A frequent starting point, low cost
 - Transceiver (maybe a mobile)
 - Power Supply to generate 12V
 - Microphone
 - Feedline cable
 - Antenna

7

Adjustments to Make

- Microphone deviation, gain
- variable power supply output
- adequate ventilation
- programming memories with repeater frequencies, offsets, PL tones, meaningful names

8

All in One VHF/UHF Station

- Handheld Transceiver / Handytalky
 - portable, of course
 - VHF and/or UHF and/or 220
 - menus and tiny buttons
 - speaker mics, spare batteries, chargers

9

VHF / UHF in your Vehicle

- Need to be careful with installation:
 - fuses in both sides of cable to battery
 - suitable power wire gauge
 - adequate ventilation
 - antenna mounting and cabling
 - the joy of passing through firewalls

10

Fancy Features

- Voice Operated Transmit (VOX)
- Cross Band Repeat
- APRS Support
- Monitoring Multiple bands, frequencies

11

Distracted Driving

- Exemption for licensed hams using permanently mounted radios
- keep a copy of your license, and the laws in your glove compartment
- Don't assume officers are current
- Don't flaunt radio use

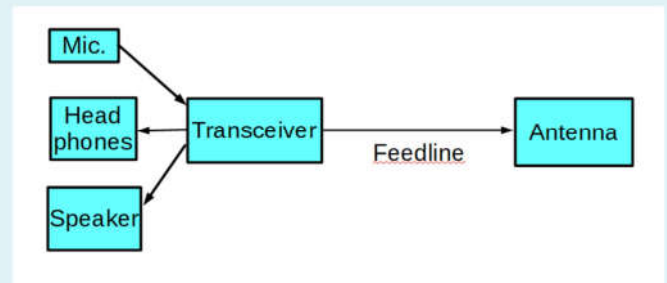
12

The HF World

- The exciting international contacts
- Shack: more, bigger equipment
- Antenna: bigger, outside or attic
- more complicated cabling
- more potential for interference

13

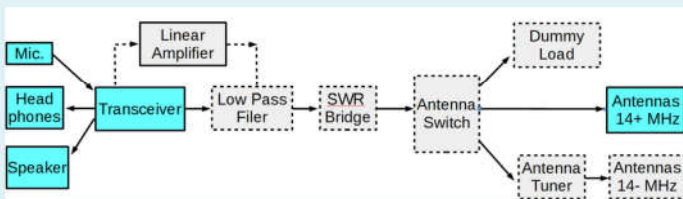
The Basic HF Station



(Plus power and grounding cables)

14

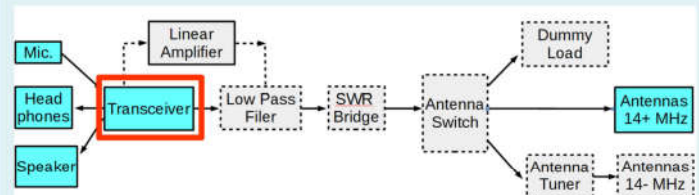
HF with the optional extras



Don't panic! We'll explain each one...

15

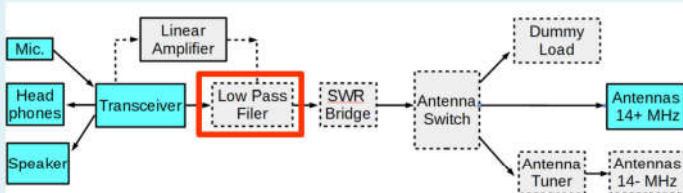
HF - Transceiver



- Transceiver = Transmitter + Receiver = Radio
- **Connects to microphone for voice operations**
- uses a single antenna connection for both send and receive
- connects to 12 - 13.8 Volt DC power
- has a built in speaker, not always high quality

16

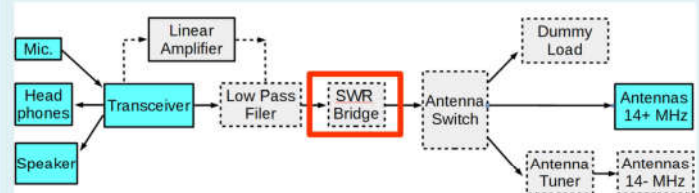
HF - Low Pass Filter



- removes unintended frequencies that could cause interference
- **reduces the effects of harmonic radiation**
- lets low frequencies pass, blocks higher frequencies
- modern rigs usually have good built-in filtering
- **best located close to transceiver or linear amplifier**

17

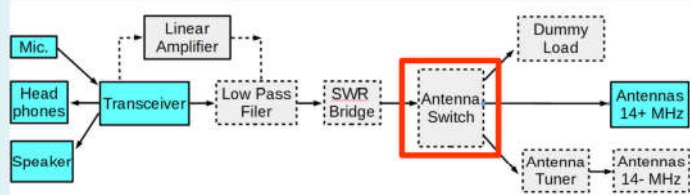
HF - SWR Bridge



- Also known as SWR Meter, VSWR meter
- SWR = Standing Wave Ratio, a measure of power reflection
- Many SWR meters can also measure power out and reflected
- need different SWR meters for HF and VHF/UHF
- **useful for determining the effectiveness of the antenna system**
- modern rigs have SWR metering built in
- modern rigs will reduce power if SWR gets too high

18

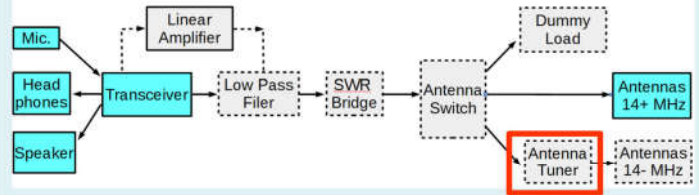
HF - Antenna Switch



- allows you to rapidly change the antenna connection to your rig
- lets you quickly use a dummy load for tuning / testing
- lets you connect via tuner to an antenna, or straight to antenna
- lets you effectively disconnect to avoid lightning damage
- remote controlled antenna switches are available, but expensive
- **is component that feeds antenna, tuner and dummy load**

19

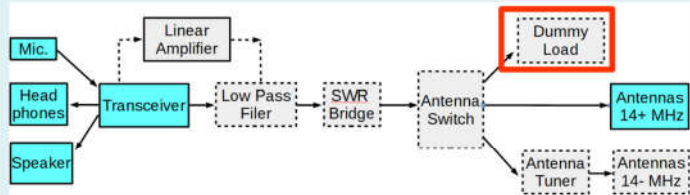
HF - Antenna Tuner



- AKA Antenna Tuning Unit ATU, antenna coupler, **antenna matching unit**, transmatch, matchbox, antenna coupler, tuner
- **matches transceiver impedance to that of your antenna**
- tuners are built into many modern rigs
- **highly desirable for HF, especially below 14 MHz**
- **can allow you to use an antenna on a band it wasn't designed for**

20

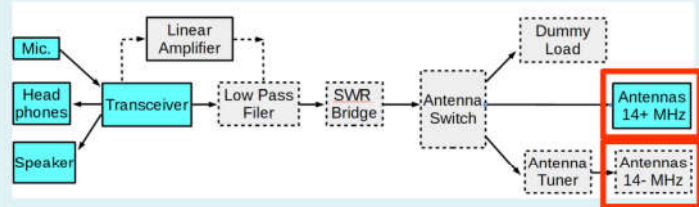
HF - Dummy Load



- a "pretend" test antenna that has exactly 50 Ohms impedance
- **is connected temporarily for the tuning process**
- essentially a big 50 Ohm resistor with heavy heat sinking
- **may get warm changing RF energy into heat**
- does not transmit, or interfere with other transmissions
- has a power rating that you shouldn't exceed

21

HF - Antenna



- You learned about Antennas in chapter 8
- A good radio won't perform well with a poor antenna
- You can build your own antennas, and upgrade over time.
- Use the best quality feedline you can to minimize losses
- Using tuner below 14 MHz helps with deep valley SWR curves

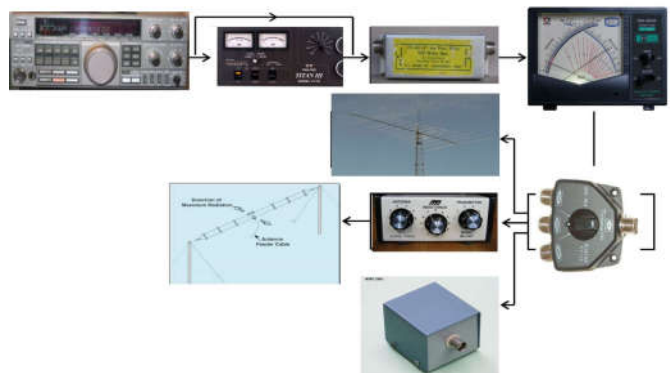
22

Placement of Components in a Station



23

Placement of Components in an HF Station



24

Towers

- allow high antennas that rotate
- not just HF, not a necessity
- need carefully planning
- federal and municipal laws apply
- safety critical for tower work
- more on towers in chapter 16

25

Voice Operated Transmit (VOX)

- “hands-free” radio, but tricky
- PTT controlled by voice & timer
- **VOX transmits when you speak into mic**
- Background noise also pushes PTT
- use with caution

26

Solid State Finals

- modern rigs need little adjustment:
 - mic gain, speech processor, RF power
- don't overdo speech processing
- ALC = Automatic Level Control (AGC)
- use dummy load as much as possible

27

Speech Processing

- also known as compression
- **= signal processing to improve signal intelligibility at the receiver**
- gives your signal more punch
- **does NOT change the PEP** - peak envelope power
- too much causes distortion / splatter - don't overdo it

28

Tube Finals

- AKA shack heaters, rare today
- need tuning before every session
- tubes are tolerant of mis-tuning
- varies by rig - check your manual

29

Using Antenna Tuners

- AKA transmatch, matchbox, antenna coupler
- built in to many modern rigs
- level of automation varies
- modern ones are microprocessor controller, and are noisy as relays switch components in and out
- “Is this frequency in use?” before tuning
- modern rigs reduce power on high SWR

30

Monitoring Performance

- you may have SWR bridge / power meter in your config
- modern rigs have multiple readouts
- things to watch:
 - SWR, Power, Signal Levels (S9..)

31

Frequency Calibration

- generally unneeded with newer rigs
- need accuracy to comply with regulations related to Ham bands
- measured using a frequency counter

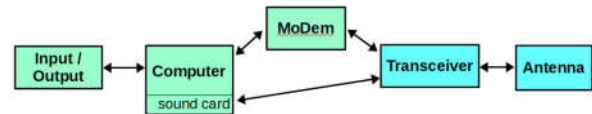
32

Operating CW

- CW = Continuous Wave > Morse Code
- device in your hand is a **key** or bug
 - straight, semi-automatic, iambic
- **“Keyer”** electronically forms good Morse Code
 - built in to many modern rigs
- Computer software to learn CW
- Practice, practice, practice! shortform city!

33

Operating Digital Modes

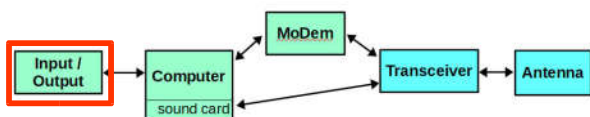


Computer to computer communications, like:

Packet Radio, AMTOR, RTTY, PSK31, JT65, WSPR, FT8

34

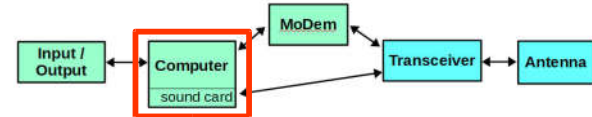
Digital Modes - Input / Output



- How information gets into and out of the computer
- keyboard, monitor, printer
- **input / output is controlled by the computer**
- nothing specific to ham radio

35

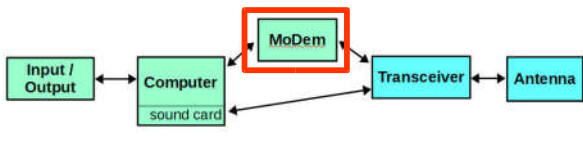
Digital Modes - Computer



- PC / Laptop / MAC, etc
- in the olden days, an external MoDem was used to produce sounds fed to radio and listen to it
- these days, the computers sound card does this, and communicates directly with the radio
- software is usually free on Internet, from hams
- high quality external sound cards are sometimes used

36

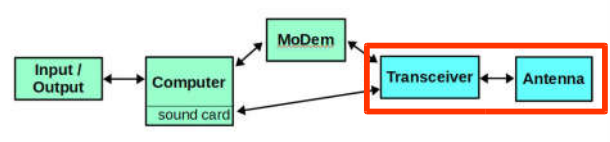
Digital Modes - MoDem



- Obsolete
- stands for Modulator / Demodulator
- **sits between computer and transceiver**
- converts computer info into sounds for radio
- today this is done using the computer's sound card
- Used to need a Terminal Node Controller (TNC) between computer and modem - even more obsolete

37

Digital Modes - Transceiver and Antenna



- Same gear as for voice over radio
- generally use low power for digital modes
- some radios have extra features to support digital modes

38

“Transducers”

- fancy engineering word for **microphones** and **loudspeakers**
- transducers convert between forms of energy
- for us, between sound energy and electrical energy

39

Microphone Characteristics

- ideal frequency response:
20 Hz - 20 kHz = human hearing
- sensitivity: how much voltage is produced by a small sound
- directional qualities - variable sensitivity
- impedance: matching is efficient

40

Microphone Types - Crystal

- electricity is formed if crystal is deformed, AKA piezoelectric effect
- diaphragm linked mechanically to crystal
- respond up to 10 kHz
- rare now, compared to past

41

Microphone Types - Dynamic

- electricity generated by moving a conductor through magnetic field
- coil on diaphragm moves within a magnetic field, generating signal
- respond up to 10 kHz

42

Microphone Types - Condenser

- AKA electrostatic or capacitor
- diaphragm is one side of an air dielectric capacitor
- as diaphragm moves, capacitance changes
- “electret” microphone is similar

43

Microphone Types - Carbon

- diaphragm causes compression of carbon granules, changing their resistance
- very sensitive, but generate noise
- respond up to 4 kHz
- used in old phones, but not today

44

Loudspeakers

- applies to speakers, headphones and ear pieces
- usually an inverted dynamic microphone, using electrical signal to move coil on diaphragm
- **sometimes, a loudspeaker can be used as a dynamic microphone**

45

Loudspeaker Characteristics

- frequency response: stable over whole audio spectrum
- impedance: matching connected gear maximizes power transfer
- Power rating: exceeding the designed power rating will likely cause damage

46

Loudspeaker Realities

- making radios smaller means the built in speaker can't perform as well.
- plugging in an external speaker or headphones will give better sound
- don't forget to match impedance

47

Headphones

- useful on all radios
- your radio's output doesn't bother others
- background noise doesn't bother you
- you can concentrate better, especially on weak signals
- hands-free via a boom mic and foot pedal or VOX, so you can log / type on a computer.

48

Orphan Exam Questions

B-003-14-8 (1) When switching from receive to transmit:

1. the receiver should be muted
2. the transmit oscillator should be turned off
3. the receiving antenna should be connected
4. the power supply should be off

B-003-14-9 (2) A switching system to enable the use of one antenna for a transmitter and receiver should also:

1. ground the antenna on receive
2. disable the unit not being used
3. switch between meters
4. disconnect the antenna tuner

49

Orphan Exam Questions

B-003-14-10 (1) An antenna changeover switch in a transmitter-receiver combination is necessary:

1. so that one antenna can be used for transmitter and receiver
2. to change antennas for operation on other frequencies
3. to prevent RF currents entering the receiver circuits
4. to allow more than one transmitter to be used

50

The End

Questions?

Class Evaluation Forms

51