Technician License Course
Chapter 5

Lesson Plan Module 11:

Transmitters, Receivers and Transceivers

Digital Communications

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Generalized Transceiver Categories

Single Band	VHF or UHF FM
Dual Band	VHF/UHF FM
Multimode	VHF/UHF
Multiband	HF and VHF/UHF
Handheld (HT)	VHF or UHF FM
Mobile	

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Single Band Transceiver

The simplest VHF or UHF station might be a Handheld Transceiver (HT) on a single band or a Mobile Transceiver operated as a base station.

- Mobiles are typically 50 Watts output with a low power option – HTs are less than 5 Watts.
- Usually comes with a handheld microphone. Memories and accessories improve ease of operation.
- Frequency Modulation (FM) on either 2 meters or 70 cm bands.
- Mobiles need an External 12 volts dc power supply and external antenna.

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Dual Band Transceiver

Like the single band transceiver but includes additional band(s).

Most common are 2 meter and 70 cm bands.

Could include 6 meters, 222 MHz or 1.2 GHz for a third band.

Depending on antenna connectors, might require separate coax for each band or a duplexer for single coax.

Multimode Transceiver

Multimode Transceivers can operate on all major modes SSB, AM, FM, CW, Data, RTTY etc.

- HF Transceivers are usually multiband and multimode.
- VHF/UHF transceivers are usually FM only. SSB and CW are deluxe modes added to multimode transceivers.
- More features add complexity and cost.
- May include features for working satellites.

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HF/VHF Multiband Transceiver

Covers many bands – may be HF only or may be HF/VHF/UHF.

- Usually covers all modes – SSB, CW, FM.
- Frequently 100 watts on HF, and reduced power on VHF or UHF bands (50 watts).
- Most newer equipments need external power supply (13.8 V, 20 Amps.). Some older equipment had built in P.S.

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Handheld (HT) Transceiver

Small handheld VHF/UHF FM units. Can be single band or dual band. An attractive first starter rig – but make sure it is what you want and not more than you need..

- Limited power (usually 5 watts or less).
- Includes power (battery) and antenna in one package. Battery chargers and extra batteries are a plus.
- Look for easy to use menu systems and memories.

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Side-by-Side Comparison

	Single Band	Dual Band	Multimode	Multiband	Handheld
Freq Agility	Limited	Medium	Medium	Full	Limited
Functionality	Limited	Limited	Full	Full	Limited
Ease of Use	Easy	Medium	Medium	Difficult	Easy
Programming	Easy	Easy	Medium	Challenging	Easy/Medium
Power	Low	Low	Medium	High	Low
Cost	Low	Modest	High	High	Low

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Controlling Your Radio

Older radios had many knobs, dials, switches, meters, etc.

Some controls which are separate in receivers and transmitters are combined in a transceiver.

Controls and features in most modern transceivers are accessed by menu programming.

Setting the Operating Frequency

Band Switch chooses the band. VFO (Variable Frequency Oscillator) chooses the actual frequency

- Adjusted by Knobs, Keypads, Up/Down buttons
- Tuning is usually in “Steps” with a resolution of: 10Hz, 100Hz, 1KHz, 25KHz, etc.
- RIT (Receiver Incremental Tuning) – Clarifier used for SSB to adjust over a few Hz. (Also XIT)
- “Split” – different RX and TX frequencies by using two VFOs.

Memory channels may store Band, VFO, Mode for recall.

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Controls used in Transmitting and Receiving Functions

Mode selector affects both TX and RX.

- AM, LSB, or USB
- FM
- CW
- Data (RTTY)
- Might be automatic with frequency and band based on recognized band plan, i.e., LSB below 10MHz, USB 10MHz and above.

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Receiver Controls and Functions

AF Gain or Volume controls the audio level to the speaker or headphones.

RF Gain controls the amplification of RF signal before demodulation.

- May be used to limit (attenuate) very strong local signals.
- Usually operated in the max-gain position but turning down RF Gain may seem to reduce noise on HF.
- Works in conjunction with Automatic Gain Control
- FM receivers don't need an RF Gain control because of Limiter.

Receiver Controls and Functions

Automatic Gain Control (AGC) reduces the RF gain for strong signals, making strong and weak signals have similar loudness.

- Prevents peaks from blocking the receiver and limiting reception of lower level portions of the incoming signal.
- Fast setting for CW.
- Slow settings for SSB and AM.
- FM receivers use signal limiting and squelch but may also have AGC.

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Receiver Controls and Functions

Squelch – Turns off audio to speaker when signal is not present. Used primarily in FM – advance the squelch control until the noise just disappears.

- Carrier Squelch
- Tone Squelch or CTCSS sometimes called PL.
- Open – allows very weak signals to pass through (along with noise).
- Tight – allows only signals above the squelch level to pass through.

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Receiver Controls and Functions

Filters make reception better when QRM occurs. Bandpass filter is used to narrow the width of signal that is passed and attenuate adjacent interference.

- 2.8 KHz, 2.4 KHz, 1.8 KHz for SSB Voice
- 500 Hz, 200 Hz for CW
- Notch filter is a very narrow filter that can be moved over an interfering signal to attenuate it.
- Noise blanker or limiter reduces signal spikes that are associated with man-made and naturally generated noise.
- Digital Signal Processing – DSP – can filter out interference and noise.

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Receiver Controls and Functions

Meter – Analog or Digital, Electronic or Mechanical.

In Transmit, meter may be switched to Power, SWR, ALC or other functions.

In Receive, meter indicates signal strength.

- “S” units S1 through S9 – S9 is strongest.
- dB over S9 to cover very strong signals.
- “Standard” is 6 dB per S Unit and S9 equals 50 microVolts.

Frequency Coverage

Ham Band receivers allow reception only on amateur bands. Older radios were easier to build for single bands.

General coverage receivers can be used for shortwave listening (SWL).

Transceivers usually have circuits to prevent transmitting outside the ham bands.

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Transmitter Controls and Functions

Microphone controls let you tailor the audio response to match your microphone.

- Gain – Adjusts voice level needed to get full transmitter output. FM transceivers don't have an external control.
- EQ (Equalizing) to adjust frequency response and noise rejection

Transmitter Controls and Functions

Speech Compressor or Speech Processor

- Compacting your speech into a narrow frequency or amplitude range to make a signal stand out from interference. Compression increases Average Speech Power. Signal has “Punch”.

Too much gain or compression can cause:

- Increased Background noise and hum
- Over-modulation and Splatter on AM
- Over-deviation on FM

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Transmitter Controls and Functions

Automatic Level Control (ALC) automatically limits transmitter drive (output level) to prevent problems associated with too much gain or compression.

- Also can be controlled by a voltage derived from external power amplifier operation.
- Good meter indication to watch while you talk.

Transmitter Controls and Functions

Changing from Receive to Transmit:

- PTT – Push-To-Talk button on microphone, foot-switch, or computer control.
- VOX – Voice Operated Xmit
  - Sensitivity sets the trip point.
  - Delay sets the dropout delay.
  - Anti-VOX keeps speaker audio from tripping the VOX.
- CW – Key or Keying Relay

Transmitter Accessories – Voice

Microphone (Mike). The built-in mike or hand mike may be limited in sound quality or ease of use. Desk mikes allow more relaxed operating.

- Speech Amps and Equalizers
- Speaker-mike add-ons for HTs
- Headsets or boom-sets
- Internal mikes in handheld transceivers may sound best if you speak across the mike to limit deviation.
- No “standard” mike connector. Depends on manufacturer. Most transceiver jacks have PTT input and voltage for Electret element.

Sending Morse – CW

Simplest is the Straight Key with up-and-down motion. Sending long messages may be tiring.

- Electronic keyer with a paddle for dit and dah auto-completion and repeating.
- Semi-automatic (Bug) with vibrating arm.
- Computer keyboard or program

CW may be sent on either LSB or USB but the actual signal might not be at the dial frequency.

Other Transmitter Accessories

Dummy Antenna is used to absorb transmitter output power while testing.

- 50 Ohm, Non-Inductive Resistor
- Big enough for full transmitter output – 100 Watts to 2000 Watts
- Usually air-cooled. May be filled with oil.

Built-in AutoTuner to match Antenna and Feedline impedance.

Power Amplifier

- Linear for SSB
- Class C for CW or FM

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Handheld Transceivers

Single, dual and multiband

- Variations in cost and complexity
- Many parameters are programed by internal menus. Software is available for PC programming.
- Some have expanded receiver coverage (wide-band receive).

Very portable and self-contained.

- Internal microphone and speaker. Jack for external speaker-mike.
- Rubber duck antenna.
- Battery powered.

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Handheld Accessories

Extra battery packs.

Drop-in, fast charger.

Extended antenna.

External microphone and speaker.

Headset.

External Power Amplifier.

Digital Communications

Information that is sent digitally can be more reliable. Modems convert a stream of “ones” and “zeroes” into a stream of tones.

Modems can be hardware or software.

- Computer Sound Cards and software.
- Terminal Node Controller (TNC).
- Multiple Protocol Controller (MPC).

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Digital Communications Errors

Errors can be caused by interference, fading, or noise. Measure of error is the Bit Error Rate (BER)

Errors can be detected and corrected by sending extra bits of data like a Parity bit in each character, or by sending the data multiple times, or by using a checksum.

The receiving system protocol can ask for repeats of messages which have errors.

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Popular Digital Modes

Radioteletype (RTTY) using Baudot code.

PSK31 generated by computers for keyboard to keyboard “chat” QSO’s

Packet Radio using AX.25 protocol

Winlink 2000 using PACTOR or WINMOR or B2F code used for sending email.

Morse Code (CW) by hand or computer.

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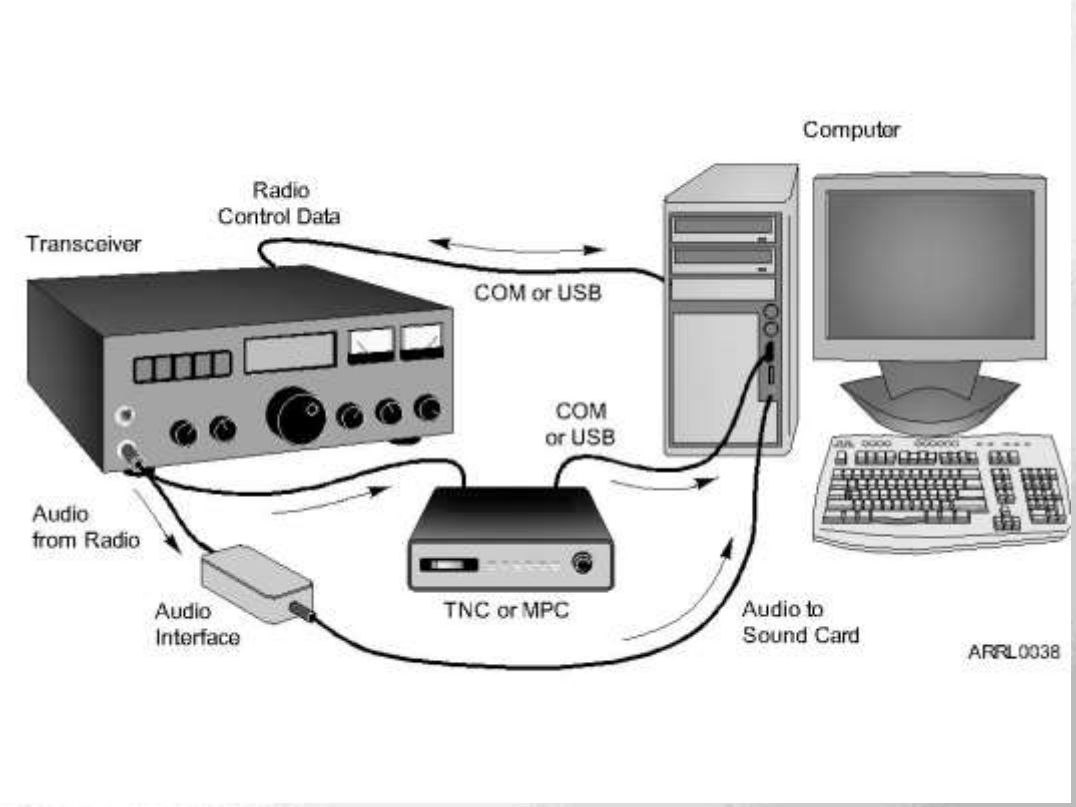
Data Station Setup



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Packet Networks

Commonly use Simplex channels on 2 Meters.

TNC outputs sound like noise bursts

- 1200 or 9600 baud – 400 or 3000 bits per second
- Errors in checksum cause Automatic Repeat Requests (ARQ)
- Can be connected in a network of nodes.
- Nodes can forward messages.
- DigiPeaters connect to out-of-range nodes using store and forward.

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Keyboard to Keyboard

RTTY and PSK31 are commonly used on HF in the data segments just above CW segments.

- Sound card outputs sound like warbling tone.
- RTTY sends characters using Baudot (machine) or ASCII (computer) codes.
- PSK31 – Phase Shift Keying, 31 baud – is slow but good for noisy and fading conditions.
- Free computer programs are widely available.

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Automatic Position Reporting System – APRS

Uses Packet Radio to transmit location of vehicles as determined from a GPS receiver.

- Packets sent to DigiPeaters for forwarding.
- DigiPeaters can act as Internet Gateways to store location data on web servers.
- Web sites or user software retrieves locations and displays on a map.
- Free computer programs are widely available.

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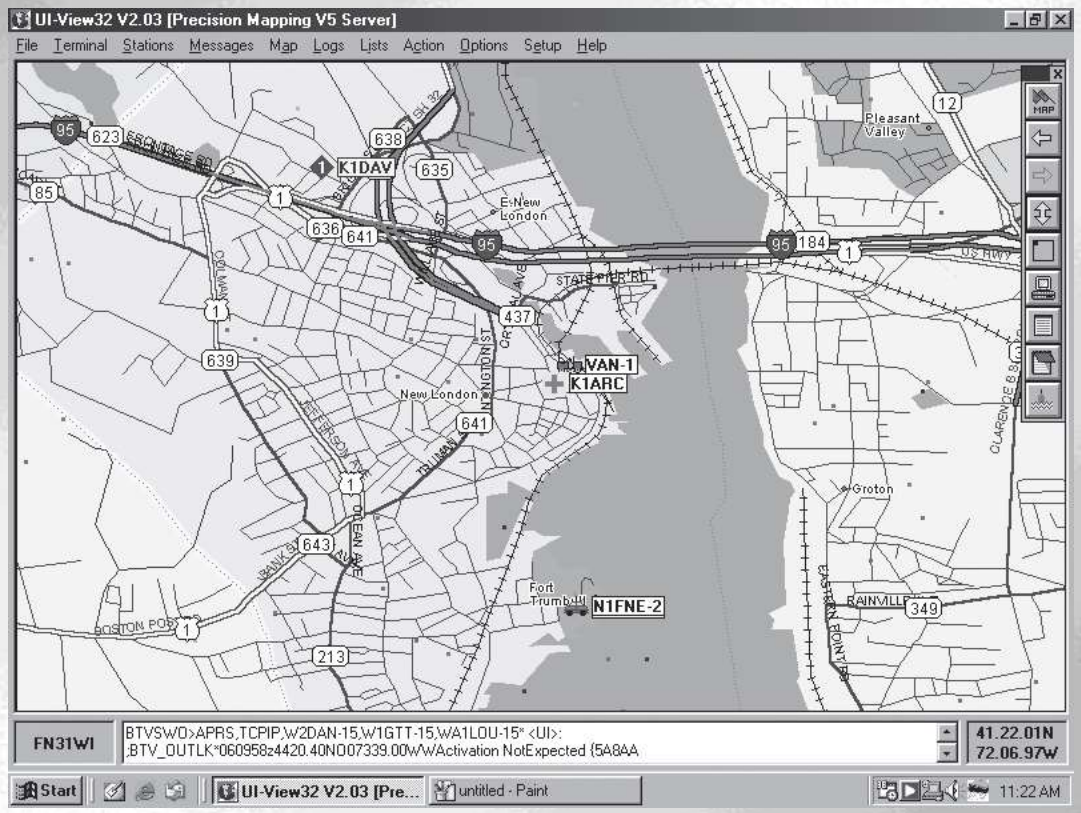
Automatic Position Reporting System (APRS)



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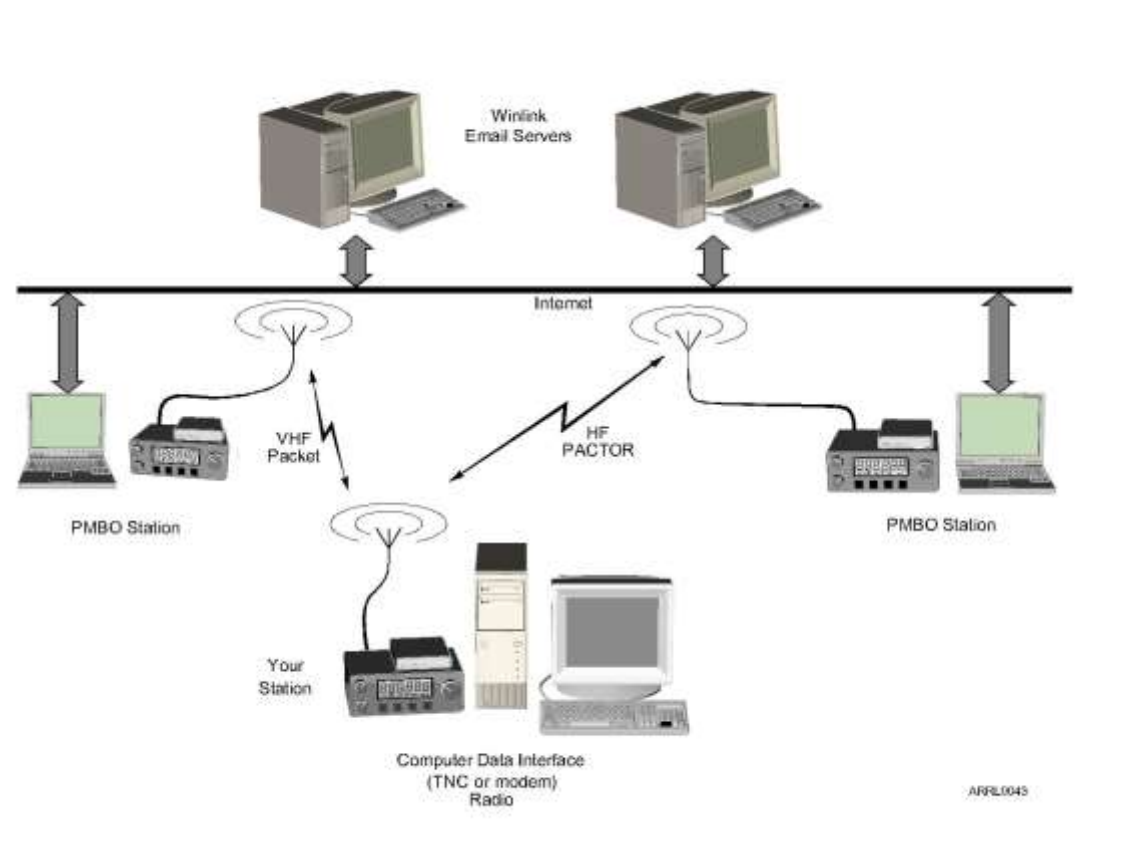
Internet Gateway



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