Technician License Course

Technician License Course

Chapter 5

Lesson Plan Module - 11

Transmitters, Receivers and Transceivers

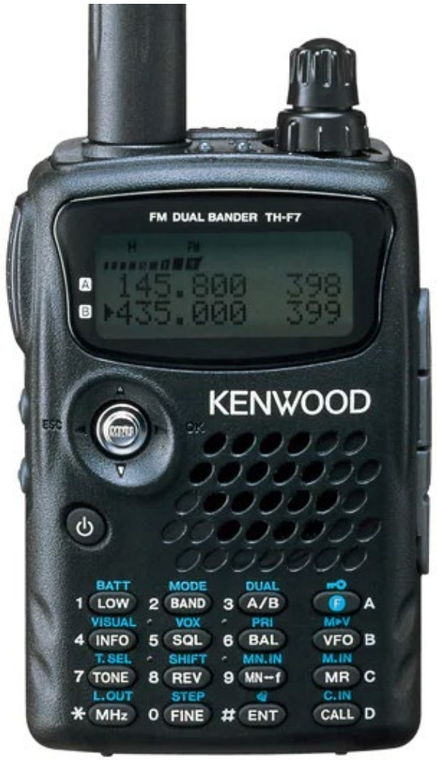
Before Shopping for Your First Radio

- Think about your ham radio interests
  - VHF/UHF FM radios for chatting with friends around town
  - HF radios for talking with people across the country and around the world
- How much $$ can you afford to spend
- Get advice from MARC members
- Consider buying used equipment

Generalized Transceiver Categories

VHF and/or UHF FM (mostly line of sight)

- Can be mobile or handheld (HT)
- Can be single band or multiband
- May or may not have features for sending data from a computer over the air
- May or may not have provisions for talking to other stations over the internet


FM DUAL BANDER TH-F7
145.800 398
435.000 399
KENWOOD
BATT MODE DUAL
1 LOW 2 BAND 3 A/B A
VISUAL VOX PRI M▸V
4 INFO 5 SQL 6 BAL VFO B
T.SEL SHIFT MN.IN M.IN
7 TONE 8 REV 9 MN-f MR C
L.OUT STEP C.IN
* MHz 0 FINE # ENT CALL D


DATA
GPS
KENWOOD
FM DUAL BANDER TM-D710G
144.390
448.525
KEY F MARK GPS LOG POS TARGET

Generalized Transceiver Categories

HF (beyond line of sight)

- Most are multimode (CW/SSB/Data/FM)
- Most cover all the HF bands plus 6 m (50 MHz)
- Most can be used at home, in a vehicle, or in a temporary field location
- Performance is a function of cost


YAESU
HF/50MHz TRANSCEIVER FTDX101MP
14.195.000
3.550.000


A 7,020,00
QRP Labs QCX-mini CW Transceiver


ICOM IC-718
HF TRANSCEIVER
14.195.718
MIC
PHONES
LOCK

Generalized Transceiver Categories

HF

- Some have the ability to operate on various VHF/UHF bands using weak-signal modes (CW/SSB/Data)
- Some have ability to operate on 2 m and 70 cm bands, but only using FM


HF radio optimized for QRP (low power) operation and/or portable use
ELECRAFT KX3 TRANSCEIVER
digirig mobile

Generalized Transceiver Categories

VHF/UHF multimode

- Complexity and performance comparable to the best HF radios, but are optimized for operation on the VHF and UHF bands
- More expensive than VHF/UHF FM-only radios
- Mostly used for radiosport

Icom IC-9700
144/430/1296 MHz

Single-Band FM Mobile

- Single-band, 2 meter is a good starter radio.
- Operates from 13.8 volts dc, requires external power supply or car battery.
- Requires an external antenna.
- Can be operated mobile or as a base station.
- Limited to frequency modulation (FM) and usually either 2 meters or 70 cm bands.
- Up to approximately 50 watts output.

Dual/Multi-Band Mobile

- Same as the single-band transceiver but includes additional band(s).
- Most common are 2 meter and 70 cm bands.
- Could add 6 meters, 222 MHz or 1.2 GHz.
- Might have separate antenna connections for each band or a single connection for a multi-band antenna

Multimode Transceiver

- Nearly all HF rigs are multimode (AM/SSB/CW/
- Data/FM). Multimode capability is less common on VHF and above.
- SSB, CW, and some data modes are considered “weak-signal” modes. FM is less useful for long-distance communications.
- More features add complexity and cost.

Multiband Transceiver

- Covers many bands – usually refers to coverage of HF + VHF/UHF.
- Also covers all modes.
- Frequently 100 watts on HF, some power limitations on high bands (25–50 watts).
- Larger units have internal power supplies, smaller units need external power supply.

Handheld (HT) Transceiver

- Small handheld FM units.
- Can be single band or dual band.
- Limited power (usually 5 watts or less).
- Includes power (battery) and antenna in one package.
- Often purchased as a starter rig but low power limits range.

Handheld (HT) Transceiver

- Single, dual and multiband versions (with increasing cost and complexity).
  - Some can receive outside the ham bands, such as aircraft, commercial FM broadcast, etc.
- Very portable and self-contained.
  - Internal microphone and speaker.
  - Rubber duck antenna.
  - Battery powered.

Handheld (HT) Transceiver

- Extra battery packs
  - AA cell pack useful in emergencies
- Drop-in, fast charger
- Extended antenna
- External microphone and speaker
- Headset

Side-by-Side

	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

Rig Vocabulary

- We will now go through some jargon and vocabulary specific to the receive and transmit functions and controls of a transceiver.

Rig Vocabulary

Frequency and Mode Selection

Multifunction Meter and Transmit Audio Controls (ALC and Compression)

AF and RF Gain, Receiver Preamp, and Attenuator Controls

Automatic Gain Control

Filters


ON/OFF
KEY
PHONES
MIC
YAESU
HF/VHF/UHF ALL MODE TRANSCEIVER FT-991A
VFO-A
USB
18:24Z
14.19500
RF-P
TUNER
AMP2
SPLIT
VFO-B
USB
14.22000
S
PO
METER
PO
RF PWR
100W
MIC GAIN
70
SWEEP
F
M-LIST
MENU
SETUP
BAND
MODE
MULTI
MEM
VFO-A
VFO-B
A=B
A/B
FAST
LOCK
RCL/STO
CLAR
TUNE
V/M
C.S
A-M
TXW
SPLIT
CLAR/VFO-B
RF GAIN
AF GAIN

Squelch


ON/OFF
KEY
PHONES
MIC
YAESU
HF/VHF/UHF ALL MODE TRANSCEIVER FT-991A
VFO-A
USB
18:24Z
14.19500
RF-P
TUNER
AMP2
SPLIT
VFO-B
USB
14.22000
S
PO
METER
PO
RF PWR
100W
MIC GAIN
70
SWEEP
MULTI
F
M-LIST
MENU
SETUP
BAND
MODE
MEM
VFO-A
VFO-B
A=B
A/B
FAST
LOCK
RCL/STO
CLAR
TUNE
V/M
C.S
A-M
TXW
SPLIT
CLAR/VFO-B
RF GAIN
AF GAIN

Band and Frequency Selection

- Fundamental to all amateur transceivers
- Can set by VFO (continuously variable) or by keypad “direct” entry
- Memories can generally store:
  - Frequency
  - Mode
  - Filter and similar settings
  - Alphanumeric labels (sometimes)

Transmitter Controls and Functions

- Main tuning display (both TX and RX):
  - Controls the frequency selection via the variable frequency oscillator (VFO).
  - Frequency can be set with a knob or keypad or programmed channels.
  - Variable frequency step size (tuning rate, resolution).
  - Rigs can usually store the information for two operating frequencies (VFO A and VFO B).

Transmitter Controls and Functions

- Too much gain or compression can cause problems
  - Splatter
  - Over-deviation
  - Over-modulation

Transmitter Controls and Functions

- Automatic Level Control (ALC)
  - –Automatically limits speech modulation, reducing transmitter over-drive
  - –Causes some speech distortion
  - –Do NOT use for data modes like PSK
- Also prevents overdrive to external power amplifier

Microphones and Keys

- Microphones (mic)
  - Hand mics
  - Desk mics
    - Preamplified desk mics
  - Speaker-mics
  - Headsets or boom-sets
  - Internal mics
- Speak *across* the mic, not into the mic

Microphones and Keys

- Transmitter ON/OFF or “keying”
  - –Push-to-Talk (PTT)
  - –Voice-Operated Transmission (VOX)
    - •VOX Gain
    - •VOX Delay
    - •Anti-VOX

Microphones and Keys

- –Key jack
- –Manually-Operating Transmission (MOX or SEND - varies with manufacturer)

- Morse code
  - –Straight key
  - –Electronic keyer and paddle
  - –Semi-automatic (Bug)

Receiver Controls and Functions

- AF Gain or Volume
  - Controls the audio level to the speaker or headphones
- RF Gain
  - Controls the gain of the receiver’s input amplifiers
- Attenuator
  - Reduces signal at the receiver input

Receiver Controls and Functions

- Receive Incremental Tuning (RIT)
  - “Fine tuning”
  - Adjusts receive frequency independent of main VFO
  - Doesn’t vary the transmitted frequency
  - Transmitters have a similar function (XIT)

Receiver Controls and Functions

- Automatic Gain Control (AGC)
  - –Automatically limits the incoming signals during signal (voice) peaks to maintain even volume
  - –Keeps strong signals from blasting the listener
  - –Different time response settings:
    - –Fast setting for CW
    - –Slow settings for SSB and AM
    - –Not used in FM because amplitude is constant

Receiver Controls and Functions

- Squelch
  - –Mutes audio to speaker when signal is not present
- Used in FM primarily
  - –Open – allows very weak signals to pass through (along with noise)
  - –Tight – allows only the strongest signals to pass

Receiver Controls and Functions

- Advance the squelch control until the noise just disappears
  - Also opened by MON (Monitor) control on handhelds

Receiver Controls and Functions

- Filters (can be electronic modules or DSP)
  - –IF filter
    - •Used to narrow the width of signal that is passed.
    - •Can attenuate adjacent signals.
  - –Notch filter
    - •Very narrow filter that can be moved over an interfering signal to attenuate it.

Receiver Controls and Functions

- Noise blanker (NB)
  - Removes signal pulses that are frequently associated with random naturally generated noise
  - Can cause problems if strong signals are present
- Noise reduction (NR)
  - DSP function to remove noise from signal
- Noise limiter (NL)
  - Simply limits maximum volume of a noise pulse

Receiver Controls and Functions

- Preamplifier
  - Increases sensitivity but can cause overload
- Reception and Transmission Meter
  - In transmit, indicates output power or ALC or other functions as selected by switch setting
  - In receive, indicates signal strength
    - In “S” units S1 through S9 – S9 is strongest
    - Above S9, meter is calibrated in dB (i.e S9+10 dB)

Receiver Controls and Functions

- Receivers can be limited to ham bands or can cover other parts of the spectrum.
- General coverage receivers cover a wide area of the spectrum and can be used for shortwave listening (SWL).

Data Modes

- Computer-to-computer communication
- Specialized modems
  - Terminal Node Controller (TNC)
  - Multiple Protocol Controller (MPC)
- Computer sound card software
  - Requires radio interface

- In the interest of time, I’m going to skip a few slides that talk about data modes. Some of the information is a bit dated, and in any case, the slides barely scratch the surface of the topic. There is a lot of cool stuff that can be done by marrying radios with computer. You’ll see some examples in the demos today, and some of these topics will be covered in other modules as well.

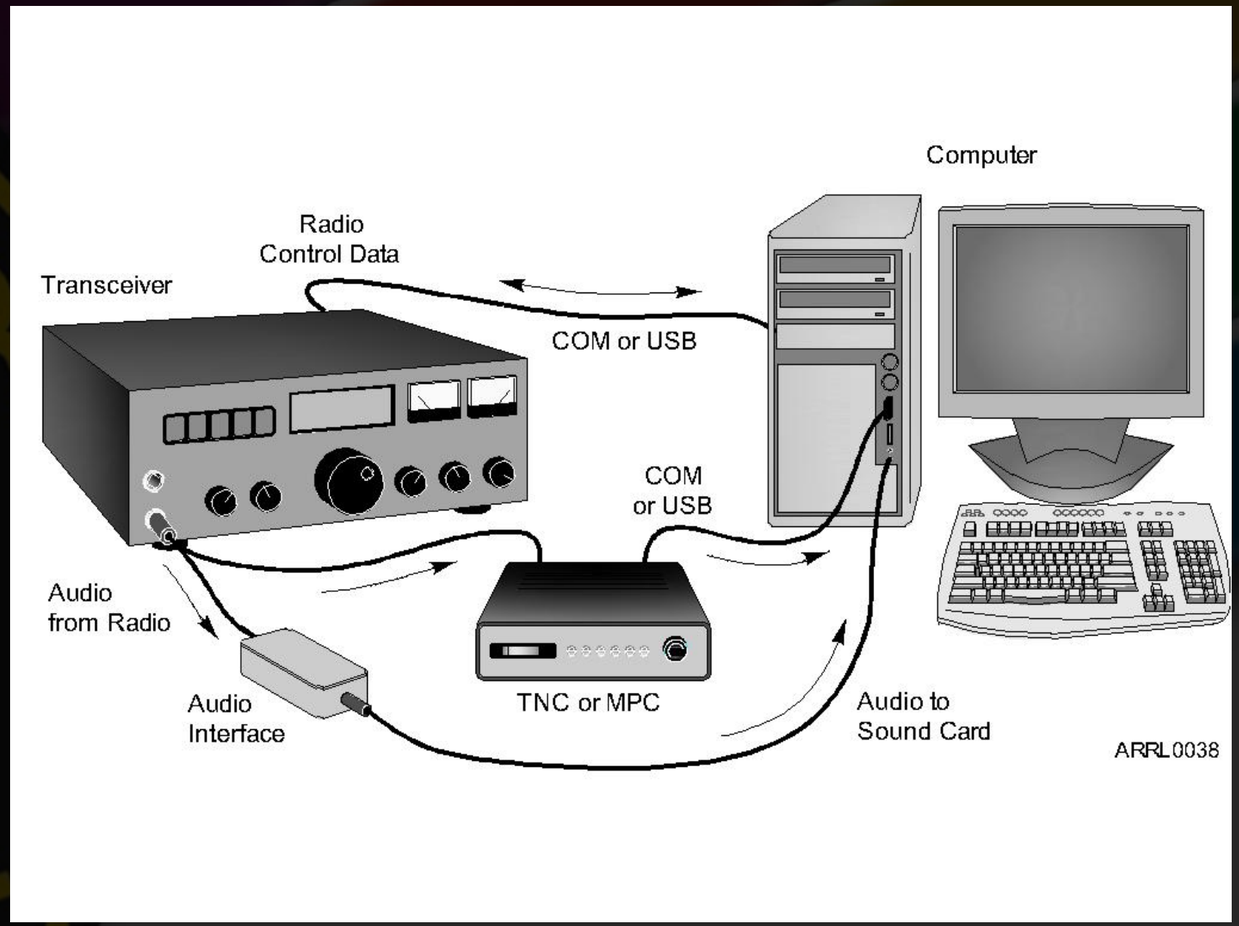
Popular Digital Modes & Systems

- Radioteletype (RTTY)
- PSK31
- MFSK
- Packet Radio and PACTOR
- CW (International Morse)
- Automatic Packet Reporting System (APRS)
- Winlink System

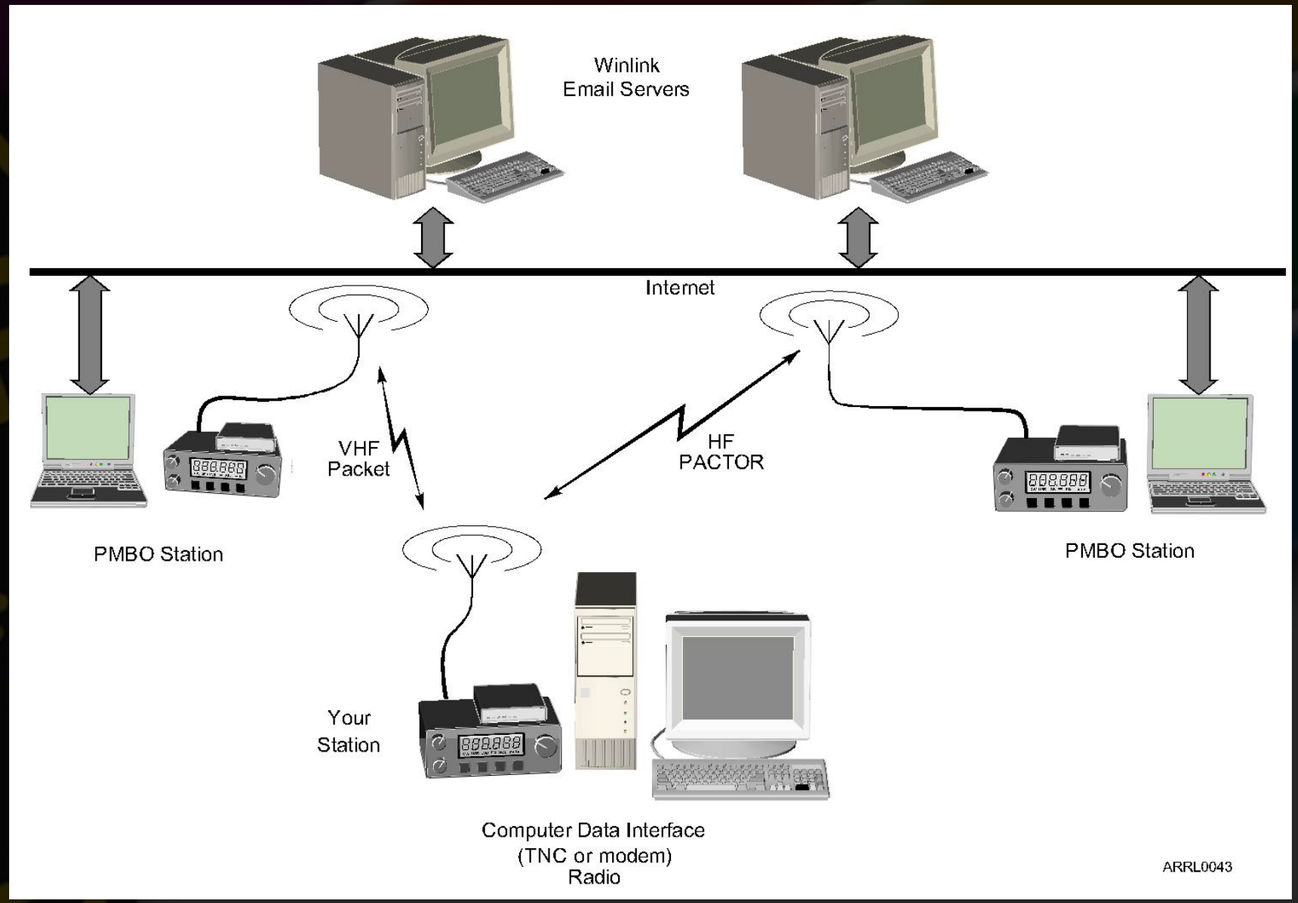
Popular Digital Modes & Systems

- Error detection
  - Yes: Packet radio, MFSK
  - No: RTTY, PSK31
- Error correction
  - MFSK (forward error correction or FEC)
  - Packet radio
    - Checksums and call signs
    - Retransmission or ARQ

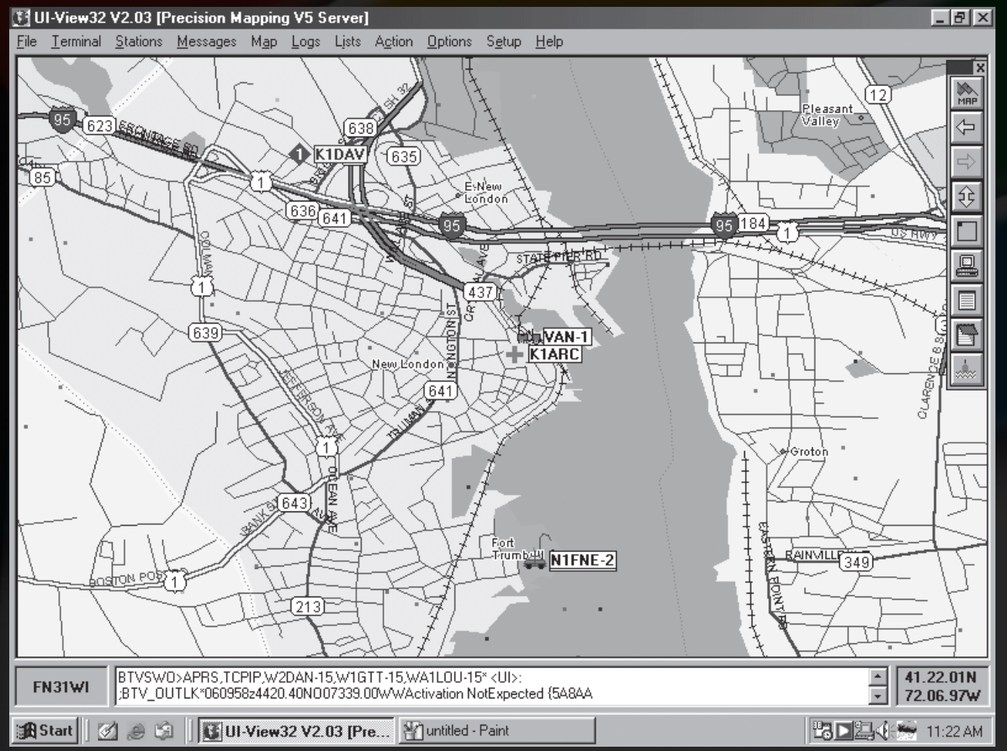
Data Station Setup



Internet Gateway



Automatic Position Reporting System (APRS)



Practice Questions

What describes the muting of receiver audio controlled solely by the presence or absence of an RF signal?

What describes the muting of receiver audio controlled solely by the presence or absence of an RF signal?

Carrier squelch

What is true concerning the microphone connectors on amateur transceivers?

What is true concerning the microphone connectors on amateur transceivers?

Some connectors include push-to-talk and voltages for powering the microphone

How might a computer be used as part of an amateur radio station?

How might a computer be used as part of an amateur radio station?

For logging contacts and contact information
For sending and/or receiving CW
For generating and decoding digital signals

What would be connected between a transceiver and computer in a packet radio station?

What would be connected between a transceiver and computer in a packet radio station?

Terminal node controller

How is a computer’s sound card used when conducting digital communications using a computer?

How is a computer’s sound card used when conducting digital communications using a computer?

The sound card provides audio to the microphone input and converts received audio to digital form

What may happen if a transmitter is operated with the microphone gain set too high?

What may happen if a transmitter is operated with the microphone gain set too high?

The output signal might become distorted

What can be used to enter the operating frequency on a modern transceiver?

What can be used to enter the operating frequency on a modern transceiver?

The keypad or VFO knob

What is the purpose of the squelch control on a transceiver?

What is the purpose of the squelch control on a transceiver?

To mute receiver output noise when no signal is being received

What is a way to enable quick access to a favorite frequency on your transceiver?

What is a way to enable quick access to a favorite frequency on your transceiver?

Store the frequency in a memory channel

What would reduce ignition interference to a receiver?

What would reduce ignition interference to a receiver?

Turn on the noise blanker

What control could be used if the voice pitch of a single-sideband signal seems too high or low?

What control could be used if the voice pitch of a single-sideband signal seems too high or low?

The receiver RIT or clarifier

What does the term "RIT" mean?

What does the term "RIT" mean?

Receiver Incremental Tuning

What is the advantage of having multiple receive bandwidth choices on a multimode transceiver?

What is the advantage of having multiple receive bandwidth choices on a multimode transceiver?

Permits noise or interference reduction by selecting a bandwidth matching the mode

What is an appropriate receive filter bandwidth to select in order to minimize noise and interference for SSB reception?

What is an appropriate receive filter bandwidth to select in order to minimize noise and interference for SSB reception?

2400 Hz

What is an appropriate receive filter bandwidth to select in order to minimize noise and interference for CW reception?

What is an appropriate receive filter bandwidth to select in order to minimize noise and interference for CW reception?

500 Hz

What is the function of automatic gain control or AGC?

What is the function of automatic gain control or AGC?

To keep received audio relatively constant

What is meant by the term "PTT"?

What is meant by the term "PTT"?

The push to talk function which switches between receive and transmit

What device is most useful for VHF weak-signal communication?

What device is most useful for VHF weak-signal communication?

A multi-mode VHF transceiver

What device increases the low-power output from a handheld transceiver?

What device increases the low-power output from a handheld transceiver?

An RF power amplifier

What can you do if you are told your FM handheld or mobile transceiver is over-deviating?

What can you do if you are told your FM handheld or mobile transceiver is over-deviating?

Talk farther away from the microphone

What name is given to an amateur radio station that is used to connect other amateur stations to the Internet?

What name is given to an amateur radio station that is used to connect other amateur stations to the Internet?

A gateway

Which of the following is an example of a digital communications method?

Which of the following is an example of a digital communications method?

Packet
PSK31
MFSK

What does the term APRS mean?

What does the term APRS mean?

Automatic Packet Reporting System

What device provides data to the transmitter when sending automatic position reports from a mobile amateur radio station?

What device provides data to the transmitter when sending automatic position reports from a mobile amateur radio station?

A Global Positioning System receiver

What is an application of APRS (Automatic Packet Reporting System)?

What is an application of APRS (Automatic Packet Reporting System)?

Providing real time tactical digital communications in conjunction with a map showing the locations of stations

What does the abbreviation PSK mean?

What does the abbreviation PSK mean?

Phase Shift Keying

What is PSK31?

What is PSK31?

A low-rate data transmission mode

What may be included in packet transmissions?

What may be included in packet transmissions?

A check sum which permits error detection
A header which contains the call sign of the station to which the information is being sent
Automatic repeat request in case of error

What code is used when sending CW in the amateur bands?

What code is used when sending CW in the amateur bands?

International Morse

What can be used to transmit CW in the amateur bands?

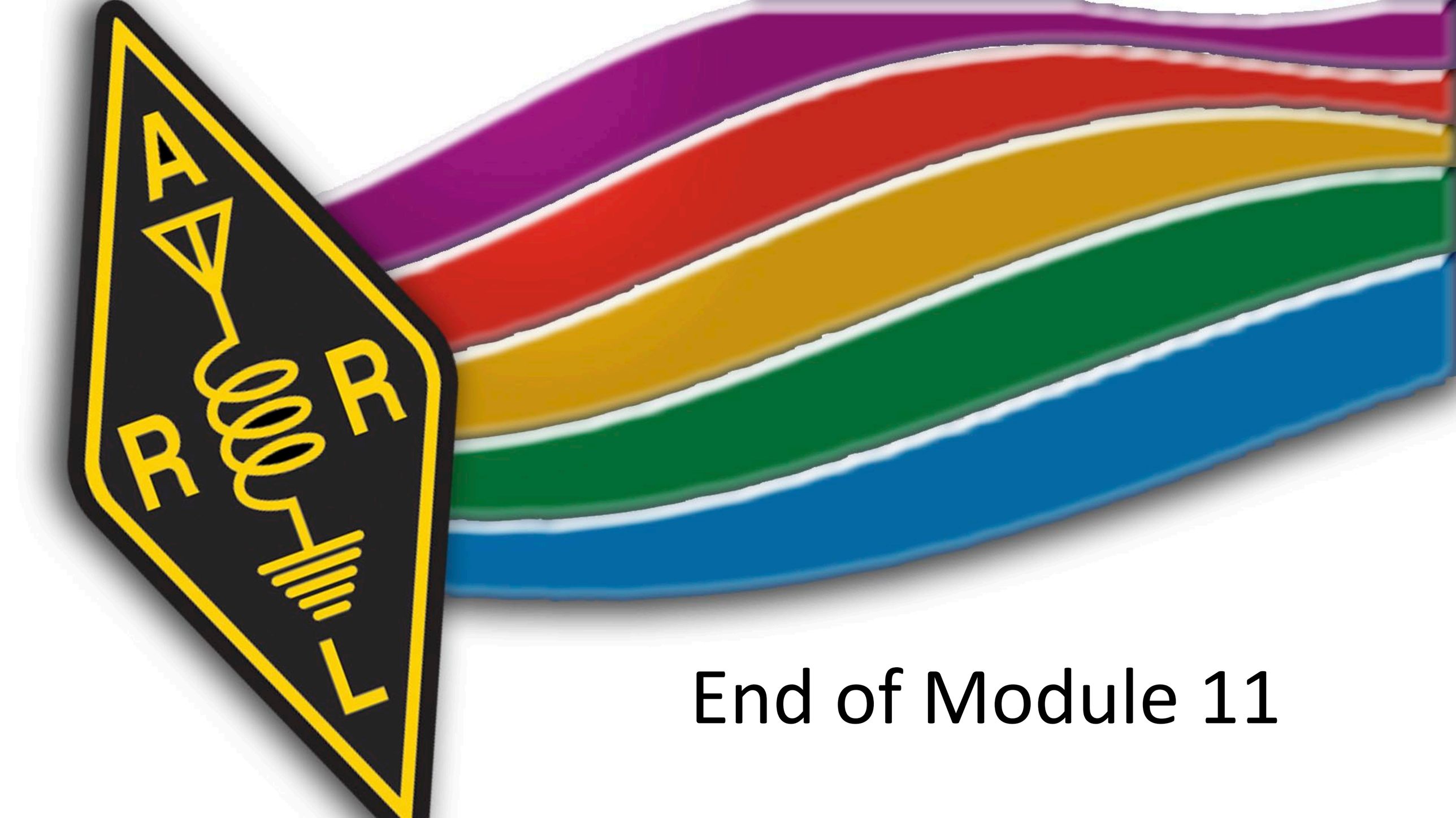
What can be used to transmit CW in the amateur bands?

Straight Key
Electronic Keyer
Computer Keyboard

What is an ARQ transmission system?

What is an ARQ transmission system?

A digital scheme whereby the receiving station detects errors and sends a request to the sending station to retransmit the information



End of Module 11