Technician License Course
Chapter 5

Lesson Plan Module 11 –
Transmitters, Receivers and Transceivers

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Generalized Transceiver Categories

• Mobile	VHF/UHF FM
• Single Band	VHF or UHF FM
• Dual Band	VHF/UHF FM
• All Band	HF and VHF/UHF
• Multimode	VHF/UHF CW/SSB/FM
• Handheld (HT)	

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Single-Band 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.

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Dual-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 dual-band antenna.

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Multimode Transceiver

- Nearly all HF rigs are multimode.
- VHF multimode operates on FM plus AM/SSB/CW modes.
  - Required for “weak-signal” operation on VHF/UHF
- More features add complexity and cost.
- More flexibility will allow you to explore new modes as you gain experience.

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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.

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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.

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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.

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Handheld (HT) Accessories

- 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

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Rig Vocabulary

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

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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

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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

- Mode selector (both TX and RX for multimode rigs).
  - AM/FM/SSB (LSB or USB)
  - CW
  - Data (RTTY or PSK)
- Could be automatic based on recognized band plan.

Transmitter Controls and Functions

- Microphone controls
  - Gain
    - Controls transmitter sensitivity to your voice
  - Speech Compressor or Speech Processor
    - Increases microphone gain at lower sound levels to increase overall signal strength or “punch”
  - Too much gain or compression can cause problems
    - Splatter
    - Over-deviation
    - Over-modulation

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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

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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

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Microphones and Keys

- Transmitter ON/OFF or “keying”
  - Push-to-Talk (PTT)
  - Voice-Operated Transmission (VOX)
    - VOX Gain
    - VOX Delay
    - Anti-VOX
  - Key jack
  - Manually-Operating Transmission (MOX or SEND - varies with manufacturer)

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Microphones and Keys

- 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

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

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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

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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)

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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

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Popular Digital Modes & Systems

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

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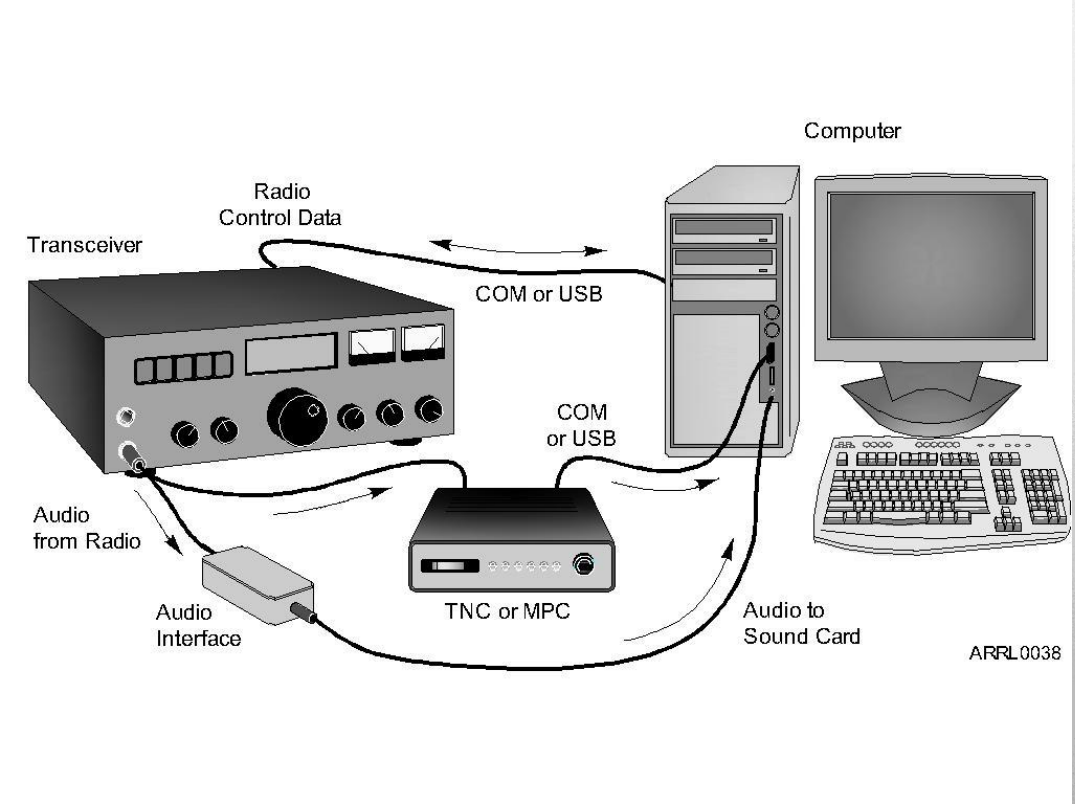
Popular Digital Modes

- 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



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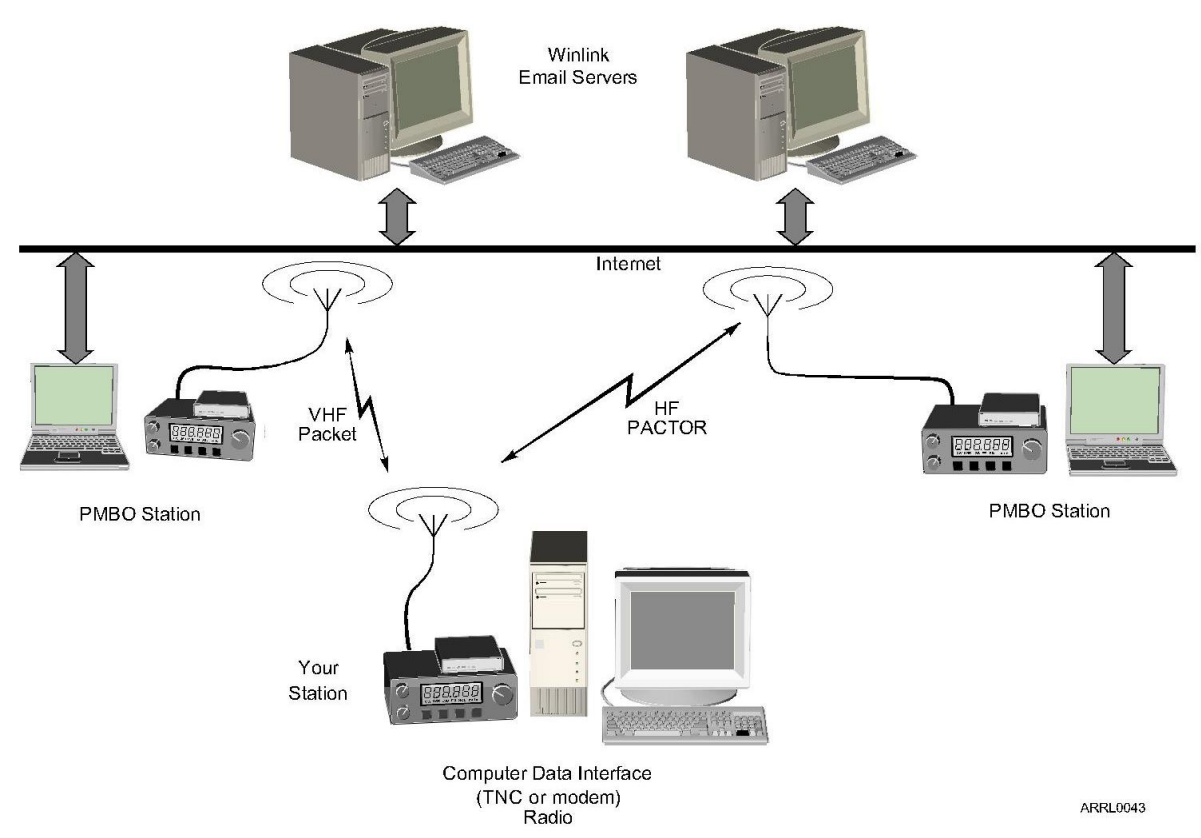
Internet Gateway



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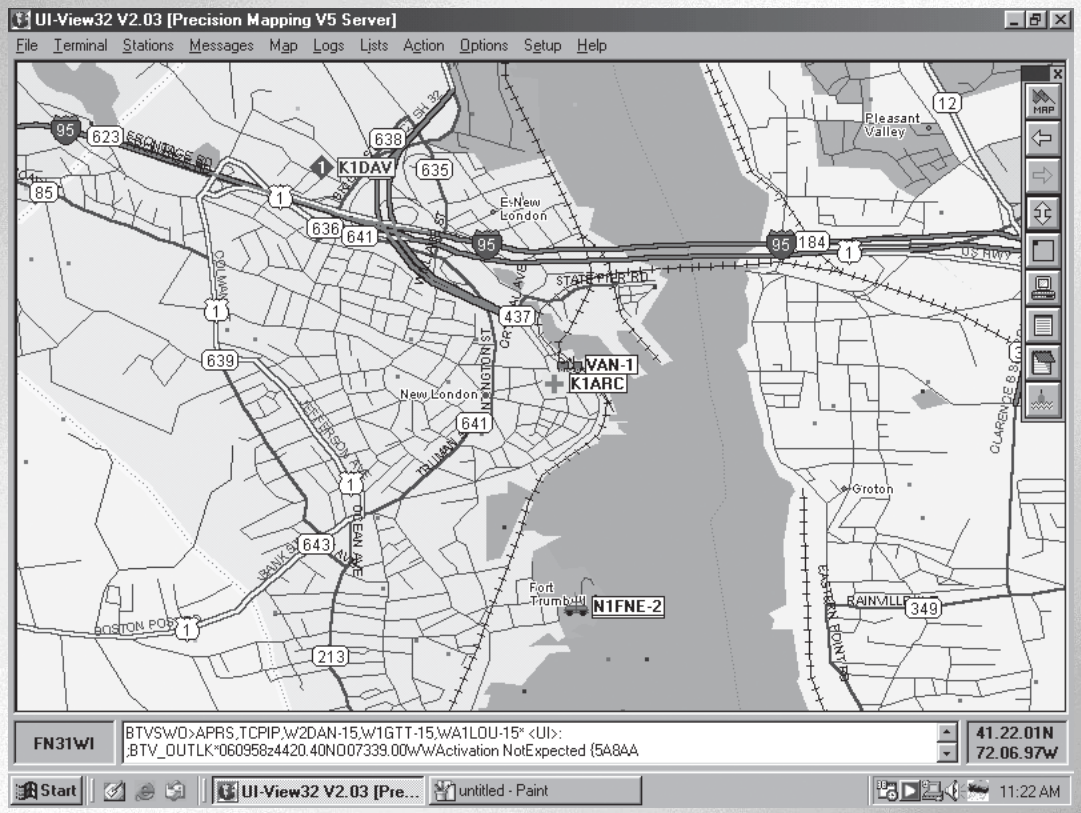
Automatic Position Reporting System (APRS)



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Practice Questions

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

A. Tone squelch

B. Carrier squelch

C. CTCSS

D. Modulated carrier

T2B03 HRLM (5-7)

ARRL The national association for AMATEUR RADIO

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D. Modulated carrier

T2B03 HRLM (5-7)

ARRL The national association for AMATEUR RADIO

Which of the following is true concerning the microphone connectors on amateur transceivers?

A. All transceivers use the same microphone connector type

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

C. All transceivers using the same connector type are wired identically

D. Un-keyed connectors allow any microphone to be connected

T4A01 HRLM (5-6)

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T4A01 HRLM (5-6)

ARRL The national association for AMATEUR RADIO

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

A. For logging contacts and contact information

B. For sending and/or receiving CW

C. For generating and decoding digital signals

D. All of these choices are correct

T4A02 HRLM (5-1)

ARRL The national association for AMATEUR RADIO

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T4A02 HRLM (5-1)

ARRL The national association for AMATEUR RADIO

Which of the following would be connected between a transceiver and computer in a packet radio station?

A. Transmatch

B. Mixer

C. Terminal node controller

D. Antenna

T4A06 HRLM (5-13)

ARRL The national association for AMATEUR RADIO

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T4A06 HRLM (5-13)

ARRL The national association for AMATEUR RADIO

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

A. The sound card communicates between the computer CPU and the video display

B. The sound card records the audio frequency for video display

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

D. All of these choices are correct

T4A07 HRLM (5-13)

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T4A07 HRLM (5-13)

ARRL The national association for AMATEUR RADIO

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

A. The output power might be too high

B. The output signal might become distorted

C. The frequency might vary

D. The SWR might increase

T4B01 HRLM (5-4)

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T4B01 HRLM (5-4)

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Which of the following can be used to enter the operating frequency on a modern transceiver?

A. The keypad or VFO knob

B. The CTCSS or DTMF encoder

C. The Automatic Frequency Control

D. All of these choices are correct

T4B02 HRLM (5-2)

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T4B02 HRLM (5-2)

ARRL The national association for AMATEUR RADIO

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

A. To set the highest level of volume desired

B. To set the transmitter power level

C. To adjust the Automatic Gain Control

D. To mute receiver output noise when no signal is being received

T4B03 HRLM (5-7)

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T4B03 HRLM (5-7)

ARRL The national association for AMATEUR RADIO

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

A. Enable the CTCSS tones

B. Store the frequency in a memory channel

C. Disable the CTCSS tones

D. Use the scan mode to select the desired frequency

T4B04 HRLM (5-2)

ARRL The national association for AMATEUR RADIO

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C. Disable the CTCSS tones

D. Use the scan mode to select the desired frequency

T4B04 HRLM (5-2)

ARRL The national association for AMATEUR RADIO

Which of the following would reduce ignition interference to a receiver?

A. Change frequency slightly

B. Decrease the squelch setting

C. Turn on the noise blanker

D. Use the RIT control

T4B05 HRLM (5-7)

Which of the following would reduce ignition interference to a receiver?

A. Change frequency slightly

B. Decrease the squelch setting

C. Turn on the noise blanker

D. Use the RIT control

T4B05 HRLM (5-7)

ARRL The national association for AMATEUR RADIO

Which of the following controls could be used if the voice pitch of a single-sideband signal seems too high or low?

A. The AGC or limiter

B. The bandwidth selection

C. The tone squelch

D. The receiver RIT or clarifier

T4B06 HRLM (5-7)

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T4B06 HRLM (5-7)

ARRL The national association for AMATEUR RADIO

What does the term "RIT" mean?

A. Receiver Input Tone

B. Receiver Incremental Tuning

C. Rectifier Inverter Test

D. Remote Input Transmitter

T4B07 HRLM (5-7)

ARRL The national association for AMATEUR RADIO

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T4B07 HRLM (5-7)

ARRL The national association for AMATEUR RADIO

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

A. Permits monitoring several modes at once

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

C. Increases the number of frequencies that can be stored in memory

D. Increases the amount of offset between receive and transmit frequencies

T4B08 HRLM (5-7)

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T4B08 HRLM (5-7)

ARRL The national association for AMATEUR RADIO

Which of the following is an appropriate receive filter bandwidth to select in order to minimize noise and interference for SSB reception?

A. 500 Hz

B. 1000 Hz

C. 2400 Hz

D. 5000 Hz

T4B09 HRLM (5-7)

ARRL The national association for AMATEUR RADIO

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T4B09 HRLM (5-7)

ARRL The national association for AMATEUR RADIO

Which of the following is an appropriate receive filter bandwidth to select in order to minimize noise and interference for CW reception?

A. 500 Hz

B. 1000 Hz

C. 2400 Hz

D. 5000 Hz

T4B10 HRLM (5-7)

ARRL The national association for AMATEUR RADIO

Which of the following is an appropriate receive filter bandwidth to select in order to minimize noise and interference for CW reception?

A. 500 Hz

B. 1000 Hz

C. 2400 Hz

D. 5000 Hz

T4B10 HRLM (5-7)

ARRL The national association for AMATEUR RADIO

What is the function of automatic gain control or AGC?

A. To keep received audio relatively constant

B. To protect an antenna from lightning

C. To eliminate RF on the station cabling

D. an asymmetric goniometer control used for antenna matching

T4B12 HRLM (5-7)

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T4B12 HRLM (5-7)

ARRL The national association for AMATEUR RADIO

What is meant by the term "PTT"?

A. Pre-transmission tuning to reduce transmitter harmonic emission

B. Precise tone transmissions used to limit repeater access to only certain signals

C. A primary transformer tuner use to match antennas

D. The push to talk function which switches between receive and transmit

T7A07 HRLM (5-6)

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T7A07 HRLM (5-6)

ARRL The national association for AMATEUR RADIO

Which of the following devices is most useful for VHF weak-signal communication?

A. A quarter-wave vertical antenna

B. A multi-mode VHF transceiver

C. An omni-directional antenna

D. A mobile VHF FM transceiver

T7A09 HRLM (6-28)

ARRL The national association for AMATEUR RADIO

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T7A09 HRLM (6-28)

ARRL The national association for AMATEUR RADIO

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

A. A voltage divider

B. An RF power amplifier

C. An impedance network

D. All of these choices are correct

T7A10 HRLM (5-8)

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T7A10 HRLM (5-8)

ARRL The national association for AMATEUR RADIO

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

A. Talk louder into the microphone

B. Let the transceiver cool off

C. Change to a higher power level

D. Talk farther away from the microphone

T7B01 HRLM (5-4)

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T7B01 HRLM (5-4)

ARRL The national association for AMATEUR RADIO

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

A. A gateway
B. A repeater
C. A digipeater
D. A beacon

T8C11 HRLM (5-14)

ARRL The national association for AMATEUR RADIO

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

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D. A beacon

T8C11 HRLM (5-14)

ARRL The national association for AMATEUR RADIO

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

A. Packet

B. PSK31

C. MFSK

D. All of these choices are correct

T8D01 HRLM (5-9)

ARRL The national association for AMATEUR RADIO

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

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T8D01 HRLM (5-9)

ARRL The national association for AMATEUR RADIO

What does the term APRS mean?

A. Automatic Packet Reporting System

B. Associated Public Radio Station

C. Auto Planning Radio Set-up

D. Advanced Polar Radio System

T8D02 HRLM (5-11)

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C. Auto Planning Radio Set-up

D. Advanced Polar Radio System

T8D02 HRLM (5-11)

Which of the following devices provides data to the transmitter when sending automatic position reports from a mobile amateur radio station?

A. The vehicle speedometer

B. A WWV receiver

C. A connection to a broadcast FM sub-carrier receiver

D. A Global Positioning System receiver

T8D03 HRLM (5-11)

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T8D03 HRLM (5-11)

ARRL The national association for AMATEUR RADIO

Which of the following is an application of APRS (Automatic Packet Reporting System)?

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

B. Showing automatically the number of packets transmitted via PACTOR during a specific time interval

C. Providing voice over Internet connection between repeaters

D. Providing information on the number of stations signed into a repeater

T8D05 HRLM (5-11)

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T8D05 HRLM (5-11)

What does the abbreviation PSK mean?

A. Pulse Shift Keying

B. Phase Shift Keying

C. Packet Short Keying

D. Phased Slide Keying

T8D06 HRLM (5-11)

ARRL The national association for AMATEUR RADIO

What does the abbreviation PSK mean?

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B. Phase Shift Keying

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D. Phased Slide Keying

T8D06 HRLM (5-11)

ARRL The national association for AMATEUR RADIO

What is PSK31?

A. A high-rate data transmission mode

B. A method of reducing noise interference to FM signals

C. A method of compressing digital television signals

D. A low-rate data transmission mode

T8D07 HRLM (5-11)

ARRL The national association for AMATEUR RADIO

What is PSK31?

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C. A method of compressing digital television signals

D. A low-rate data transmission mode

T8D07 HRLM (5-11)

ARRL The national association for AMATEUR RADIO

Which of the following may be included in packet transmissions?

A. A check sum which permits error detection

B. A header which contains the call sign of the station to which the information is being sent

C. Automatic repeat request in case of error

D. All of these choices are correct

T8D08 HRLM (5-10)

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T8D08 HRLM (5-10)

ARRL The national association for AMATEUR RADIO

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

A. Baudot

B. Hamming

C. International Morse

D. Gray

T8D09 HRLM (5-9)

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C. International Morse

D. Gray

T8D09 HRLM (5-9)

Which of the following can be used to transmit CW in the amateur bands?

A. Straight Key
B. Electronic Keyer
C. Computer Keyboard
D. All of these choices are correct

T8D10 HRLM (5-6)

ARRL The national association for AMATEUR RADIO

Which of the following can be used to transmit CW in the amateur bands?

A. Straight Key

B. Electronic Keyer

C. Computer Keyboard

D. All of these choices are correct

T8D10 HRLM (5-6)

ARRL The national association for AMATEUR RADIO

What is an ARQ transmission system?

A. A special transmission format limited to video signals

B. A system used to encrypt command signals to an amateur radio satellite

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

D. A method of compressing the data in a message so more information can be sent in a shorter time

T8D11 HRLM (5-10)

ARRL The national association for AMATEUR RADIO

What is an ARQ transmission system?

A. A special transmission format limited to video signals

B. A system used to encrypt command signals to an amateur radio satellite

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

D. A method of compressing the data in a message so more information can be sent in a shorter time

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ARRL The national association for AMATEUR RADIO