Technician License Class

W5IAS

Tulsa Amateur Radio Club

Slides by Tom White, K5EHX

Images from Wikipedia, Other Sources

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Shoot for 2 hours and 30 minutes presentation time. Provide breaks each hour, for about ten minutes. Estimating 10 minutes at beginning to handle signins and introductions.

Chapter 3

Operating Station Equipment

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Chapter 3

3.1 Transmitters and Receivers

Transceiver Basics

- Hold down the push-to-talk button while talking, release when done.
- Speak into the microphone. If the microphone gain is set too high (or you talk too loud), the signal may become distorted and unreadable.
- When the PTT button is not down, received signals are heard in the speaker.
- If the microphone and speaker are operating at the same time, and too close to each other, audio feedback will occur.
- Some transceivers have an “F” or “Function” key that selects an alternate action for some control buttons.
- When testing a transmitter, a special antenna that doesn't transmit, called a “dummy load” can be used.

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T5A03 What is the term used to describe what happens when a microphone and speaker are too close to each other? Audio feedback

T5B01 What may happen if a transmitter is operated with the microphone gain set too high? It may cause the signal to become distorted and unreadable

T5B11 What is the purpose of the "function" or "F" key found on many transceivers? It selects an alternate action for some control buttons

T5D11 What may be the problem if another operator reports that your SSB signal is very garbled and breaks up? RF energy may be getting into the microphone circuit and causing feedback

T9A07 What is the primary purpose of a dummy load? It does not radiate interfering signals when making tests

Receiver Basics

- The squelch control quiets noise when no signal is being received.
- A noise blanker can reduce noise, such as ignition noise in a car, to make signals easier to copy.
- Receiver Incremental Tuning (RIT) allows you to change the frequency step by step.
- You can sometimes change the size of the step with the “step” function of your radio.
- A Variable Frequency Oscillator (VFO) allows you to directly enter any valid frequency.

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T5B04 What is the purpose of the squelch control on a transceiver? It is used to quiet noise when no signal is being received

T5B06 What might you do to improve the situation if the station you are listening to is hard to copy because of ignition noise interference? Turn on the noise blanker

T5B09 What does RIT mean? Receiver Incremental Tuning

T5B03 What is one way to select a frequency on which to operate? Use the keypad or VFO knob to enter the correct frequency

T5B10 What is the purpose of the "step" menu function found on many transceivers? It sets the tuning rate when changing frequencies

Transceiver Settings

Band

- HF bands - High Frequency - Below 30Mhz
- VHF bands - 30Mhz to 300Mhz
- UHF bands - 300Mhz to 1Ghz

Frequency

- Variable Frequency Oscillator

Mode

- FM, SSB, CW, Others

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Memories

Each memory may store various settings

- CTCSS (Continuous Tone Coded Squelch System) Tone
- Offset
- Power Level

Up / Down button on Microphone can usually switch through memories

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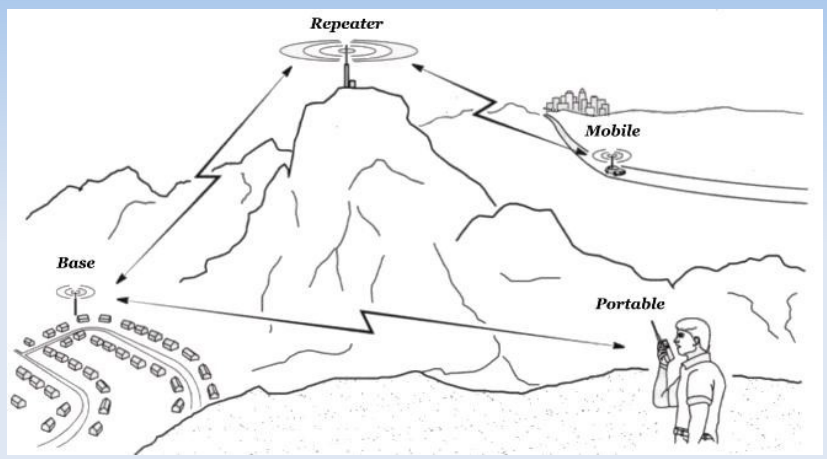
T5B02 What kind of information may a VHF/UHF transceiver be capable of storing in memory? Transmit and receive operating frequency; CTCSS tone frequency; Transmit power level

T5B05 What is a way to enable quick access to a favorite frequency on your transceiver? Store the frequency in a memory channel

T5B07 What is the purpose of the buttons labeled "up" and "down" on many microphones? To allow easy frequency or memory selection

Repeaters



Repeaters extend the useful range of a mobile or portable station. A repeater listens on one frequency and transmits on another.

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T5C07 What is meant by the terms input and output frequency when referring to repeater operations? The repeater receives on one frequency and transmits on another

Repeater Input and Output

The difference between the input frequency and the output frequency is called the “Offset”.

The standard offset for the 2m (144-148Mhz) band is 0.6 Mhz.

The standard offset for the 70cm (420-450Mhz) band is 5Mhz.

Many repeaters will not re-transmit a signal without a special low frequency tone. If the repeater requires it, you must set it in your radio. The tone for most repeaters in the Tulsa area is 88.5 Hertz.

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T5C05 What is the most common input/output frequency offset for repeaters in the 2-meter band? 0.6 MHz

T5C06 What is the most common input/output frequency offset for repeaters in the 70-centimeter band? 5.0 MHz

Repeater Operation

- The “shift” control found on many VHF/UHF transceivers adjusts the offset between the transmit and receive frequencies.
- The most important things to know about a repeater are the input and output frequencies.
- Repeater operation is often called “duplex”, because two frequencies are in use simultaneously. Operating directly from one radio to another is called “simplex”.

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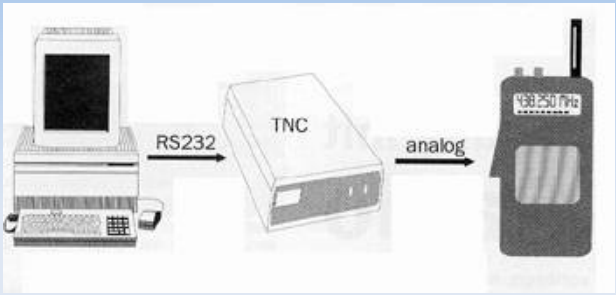
T5B08 What is the purpose of the "shift" control found on many VHF/UHF transceivers? Adjust the offset between transmit and receive frequency

T5C03 Which of the following is the most important information to know before using a repeater? The repeater input and output frequencies

T5C08 What is the meaning of the term simplex operation? Transmitting and receiving on the same frequency

Packet and Digital Radio



A Terminal Node Controller (TNC) connects a radio to a computer for digital communications.

Alternatively, a radio can be connected to the sound card of a computer.

A microphone is not necessary for digital communications.

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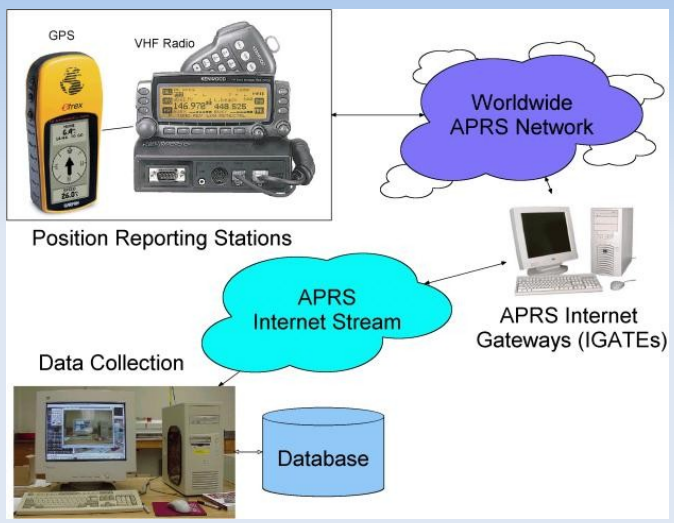
T5A08 What is connected between the transceiver and computer terminal in a packet radio station? Terminal Node Controller

T5A09 Which of these items is not required for a packet radio station? Microphone

T5A10 What can be used to connect a radio with a computer for data transmission? Sound Card

Radio Gateway



A gateway is an amateur radio station that connects other stations to the internet.

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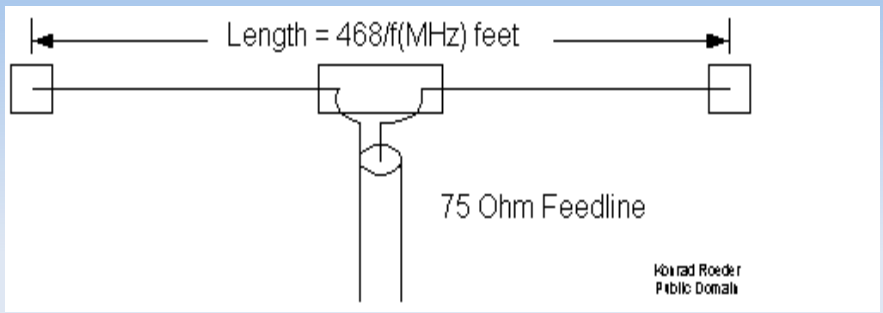
T6A03 What name is given to an amateur radio station that is used to connect other amateur stations to the Internet? A gateway

Chapter 3

3.2 Antenna Systems

Dipole Antennas



The full length of a dipole antenna is approximately half of the wavelength of the transmitted signal.

To calculate the length in feet, divide the frequency in Mhz into 468.

Example problem:

What is the approximate length, in inches, of a 6-meter 1/2 wavelength wire dipole antenna?

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T9A12 What is the approximate length, in inches, of a 6-meter 1/2 wavelength wire dipole antenna? 112 inches

Whip Antennas

- A vertical (whip) antenna is a single element mounted perpendicularly to the Earth's surface.
- A magnet mount whip antenna offers good efficiency when operating mobile and can be easily installed or removed.
- The advantage of 5/8 wavelength over 1/4 wavelength vertical antennas is that their radiation pattern concentrates energy at lower angles.
- A “rubber duck” handheld antenna used inside a car can be 10 to 20 times less effective inside a vehicle than when inside.

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T9A02 What is an antenna that consists of a single element mounted perpendicular to the Earth's surface? A vertical antenna

T9A06 What is the advantage of 5/8 wavelength over 1/4 wavelength vertical antennas? Their radiation pattern concentrates energy at lower angles

T9A09 What is one type of antenna that offers good efficiency when operating mobile and can be easily installed or removed? A magnet mount vertical antenna

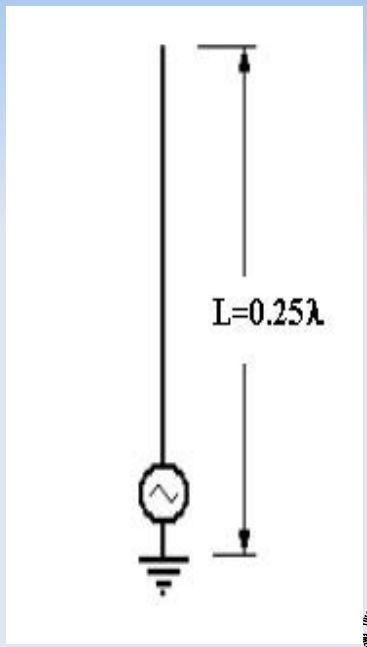
T9A10 What is a good reason not to use a "rubber duck" antenna inside your car? Signals can be 10 to 20 times weaker than when you are outside of the vehicle

Vertical / Whip Antenna Length

To calculate the length of the vertical whip in feet, divide the frequency in Mhz into 234.

Example problem:

What is the approximate length, in inches, of a quarter-wavelength vertical antenna for 146 MHz?



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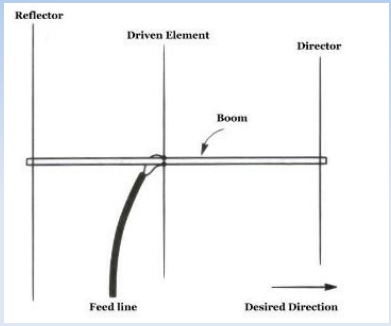
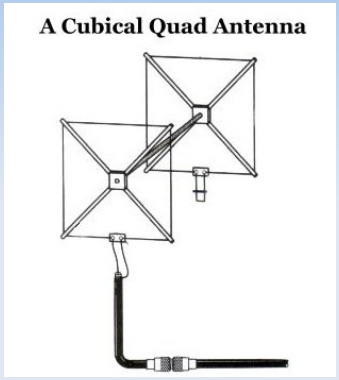
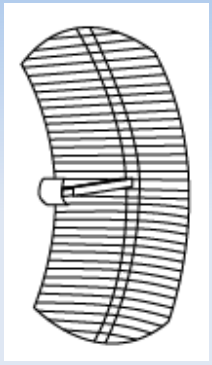
T9A11 What is the approximate length, in inches, of a quarter-wavelength vertical antenna for 146 MHz? 19 inches

Directional Antennas







An antenna that concentrates signals in one direction is called a “beam” antenna.

Yagi, Quad and Dish antennas are examples of directional antennas.

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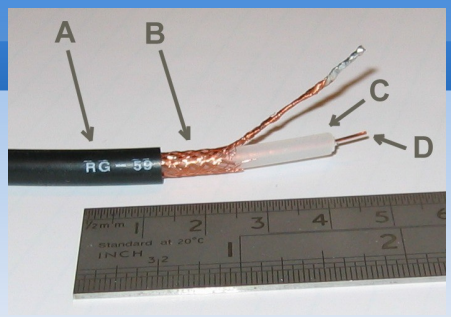
T9A01 What is a beam antenna? An antenna that concentrates signals in one direction

T9A08 What type of antennas are the quad, Yagi, and dish? Directional or beam antennas

Coax Feedline



The most common cause of coax feedline failure is moisture in the line (moisture contamination).

Older coaxial cables that are exposed to weather and sunlight for several years have have dramatically increasing losses.

The outside of most coax is black because that color provides the most protection against ultraviolet damage.

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T9C07 What is the most common reason for failure of coaxial cables? Moisture contamination

T9C09 What can happen to older coaxial cables that are exposed to weather and sunlight for several years? Losses can increase dramatically

T9C10 Why is the outer sheath of most coaxial cables black in color? Black provides protection against ultraviolet damage

Antenna Masts

Antennas are supported by masts, which hold the actual antenna in the air.

Most antenna masts are made of stainless steel, because stainless steel parts are much less likely to corrode.

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T0B10 Why is stainless steel hardware used on many antennas instead of other metals?
Stainless steel parts are much less likely to corrode

Chapter 3

3.3 Power Supplies and Batteries

Battery Types

Alkaline / Carbon-Zinc

(Not rechargeable!)

Lead-Acid

Nickel-Cadmium (NiCad)

Lithium Ion

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T4C08 What battery type on this list is not designed to be re-charged? Carbon-zinc

Rechargeable Batteries

NiCad are weak, with only 1.2 Volts per cell.

Lithium Ion last longer than any other battery type.

Rechargeable batteries must be maintained!

- Inspect for physical damage and replace if necessary
- Store in a cool and dry location
- Must be given a maintenance recharge at least every 6 months

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T4C06 Which of the battery types listed below offers the longest life when used with a hand-held radio, assuming each battery is the same physical size? Lithium-ion

T4C07 What is the nominal voltage per cell of a fully charged nickel-cadmium battery? 1.2 volts

T4C09 What is required to keep rechargeable batteries in good condition and ready for emergencies? They must be inspected for physical damage and replaced if necessary; They should be stored in a cool and dry location; They must be given a maintenance recharge at least every 6 months

Battery Tips

Draw current from the battery at the slowest rate needed to increase battery life.

If a battery is discharged or charged too quickly, it could overheat and give off dangerous gas or explode!

12 volt lead batteries have a lot of capacity, and are ideal for amateur radio. But there are dangers:

- The battery contains dangerous acid that can spill and cause injury
- Short circuits can damage wiring and possibly cause a fire
- Explosive gas can collect if not properly vented

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T4C10 What is the best way to get the most amount of energy from a battery? Draw current from the battery at the slowest rate needed

T0A10 What kind of hazard is presented by a conventional 12-volt storage battery? It contains dangerous acid that can spill and cause injury; Short circuits can damage wiring and possibly cause a fire; Explosive gas can collect if not properly vented

T0A11 What can happen if a storage battery is charged or discharged too quickly? The battery could overheat and give off dangerous gas or explode

Power Supplies

A power supply converts 120 volt AC from the power company into 12 volts for amateur radio equipment.

A regulated power supply can protect equipment from voltage fluctuations.

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T5A05 What is a good reason for using a regulated power supply for communications equipment? To protect equipment from voltage fluctuations

Chapter 3

3.4 Handheld Transceivers

Handheld Transceiver

A handheld transceiver (HT) is a complete radio in a package small enough to hold entirely in one hand.

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HT Antennas

An HT antenna does not transmit or receive as effectively as a full sized antenna.

You can make the signal from a hand-held radio stronger by using an external antenna instead of the rubber-duck antenna.

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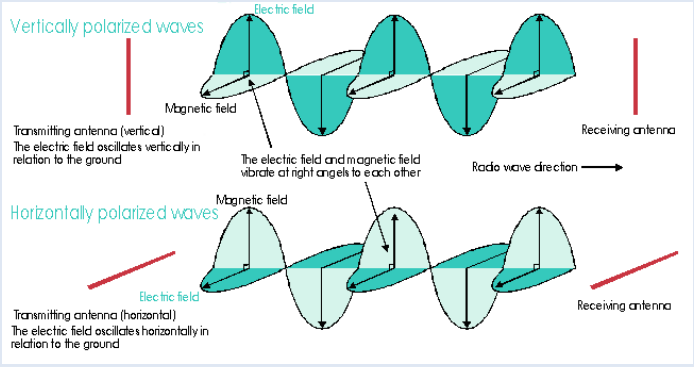
T7A03 How can you make the signal from a hand-held radio stronger when operating in the field? Use an external antenna instead of the rubber-duck antenna

T9A04 What is a disadvantage of the "rubber duck" antenna supplied with most hand held radio transceivers? It does not transmit or receive as effectively as a full sized antenna

Antenna Polarization

- Communicating with another station using the wrong polarization can weaken signals by a factor of 100.
- VHF and UHF repeaters use vertical polarization, so be sure to hold your HT antenna vertically while sending or receiving.



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T9B07 What is a good thing to remember when using your hand-held VHF or UHF radio to reach a distant repeater? Keep the antenna as close to vertical as you can

T9B08 What can happen if the antennas at opposite ends of a VHF or UHF line of sight radio link are not using the same polarization? Signals could be as much as 100 times weaker

Chapter 3

3.5 RF Interference

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Sources of Interference

Harmonics.

Bad or “noisy” connections between wires.

Insufficient shielding of components or wires that either transmit radio waves when they shouldn't, or receive radio waves when they shouldn't.

Bad receiver design.

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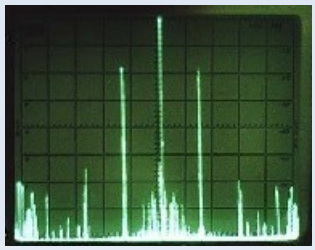
T5D02 Which of the following is NOT a cause of radio frequency interference? Doppler shift

RF Harmonics

Anything that vibrates, tends to vibrate on extra frequencies known as harmonics - two, three or more times the main frequency.

This may be a problem in a transmitter.

If intereference from your station is reported, be sure that your station meets standards of good engineering practice.



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T5A06 Where must a filter be installed to reduce spurious emissions? At the transmitter

T5D08 What is the proper course of action to take when a neighbor reports that your radio signals are interfering with something in his home? Check your station and make sure it meets the standards of good amateur practice

Bad connections

Connection problems can either transmit noise or receive noise.

Transmit noise:

Cable television can “leak” radio frequency noise if there are bad connections or cables.

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T3D07 What effect might a break in a cable television transmission line have on amateur communications? TV interference may result when the amateur station is transmitting, or interference may occur to the amateur receiver

Shielding Problems

- Many telephones are not equipped with adequate interference protection when manufactured.
- A telephone may actually pick up radio signals and be heard by a neighbor.
- A logical first step when attempting to cure a radio frequency interference problem in a nearby telephone would be to install an RF filter at the telephone.

T3D03 What is the major cause of telephone interference? The telephone was not equipped with adequate interference protection when manufactured.

T5D03 What is the most likely cause of telephone interference from a nearby transmitter? The transmitter's signals are causing the telephone to act like a radio receiver

T5D04 What is a logical first step when attempting to cure a radio frequency interference problem in a nearby telephone? Install an RF filter at the telephone

Front End Overload

Front end overload is caused by bad receiver design where a receiver picks up strong signals from a nearby source. The strong signals are not received, but the desired signal appears to be dramatically weakened.

A notch filter on a television may help prevent RF overload from a nearby 2-meter transmitter.

Snap-on ferrite chokes; Low-pass and high-pass filters; Notch and band-pass filters may help the receiver may be needed for various types of RFI problems.

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T5A07 What type of filter should be connected to a TV receiver as the first step in trying to prevent RF overload from a nearby 2-meter transmitter? Notch filter

T3D02 Who is responsible for taking care of the interference if signals from your transmitter are causing front end overload in your neighbor's television receiver? The owner of the television receiver is responsible

T3D11 What is meant by receiver front-end overload? Interference caused by strong signals from a nearby source

T5D01 What is meant by fundamental overload in reference to a receiver? Interference caused by very strong signals from a nearby source

T5D07 Which of the following may be useful in correcting a radio frequency interference problem? Snap-on ferrite chokes; Low-pass and high-pass filters; Notch and band-pass filters

Other Interference

Strong signals overloading the receiver are the most likely cause of sudden bursts of tones or fragments of different conversations that interfere with VHF or UHF signals.

If another operator tells you he is hearing a variable high-pitched whine on the signals from your mobile transmitter, the power wiring for your radio is probably picking up noise from the vehicle's electrical system.

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T9B03 What is the most likely cause of sudden bursts of tones or fragments of different conversations that interfere with VHF or UHF signals? Strong signals are overloading the receiver and causing undesired signals to be heard

T5D10 What could be happening if another operator tells you he is hearing a variable high-pitched whine on the signals from your mobile transmitter? The power wiring for your radio is picking up noise from the vehicle's electrical system

Dealing with RFI Problems

If a "Part 15" device in your neighbor's home is causing harmful interference to your amateur station:

- Work with your neighbor to identify the offending device.
- Politely inform your neighbor about the rules that require him to stop using the device if it causes interference.
- Check your station and make sure it meets the standards of good amateur practice.

Radio direction finding is a method used to locate sources of noise interference or jamming.

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T5D09 What should you do if a "Part 15" device in your neighbor's home is causing harmful interference to your amateur station? Work with your neighbor to identify the offending device; Politely inform your neighbor about the rules that require him to stop using the device if it causes interference; Check your station and make sure it meets the standards of good amateur practice

T7A05 What is a method used to locate sources of noise interference or jamming? Radio direction finding

Chapter 3

The End