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https://rvnet.wbcci.net/

- Technician class license is the entry-level license
- Choice for most new ham radio operators
- Pass an examination totaling 35 questions
- Exam covers radio theory, regulations and operating practices
- Allows access to all Amateur Radio frequencies above 30 megahertz
- Gives ability to communicate locally
- Includes limited privileges on the HF (also called "short wave") bands

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The No-Nonsense, Technician Class License Study Guide (for tests given after July 1, 2022)

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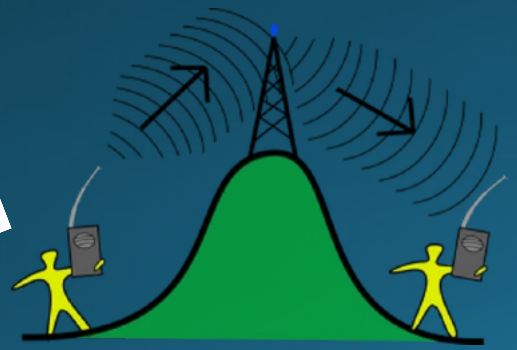
What is amateur (ham) radio?

Amateur radio, also known as ham radio, is a hobby enjoyed by hundreds of thousands of Americans and millions around the world. They enjoy communicating with one another via two-way radios and experimenting with antennas and electronic circuits.



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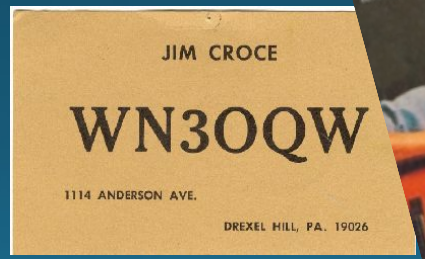
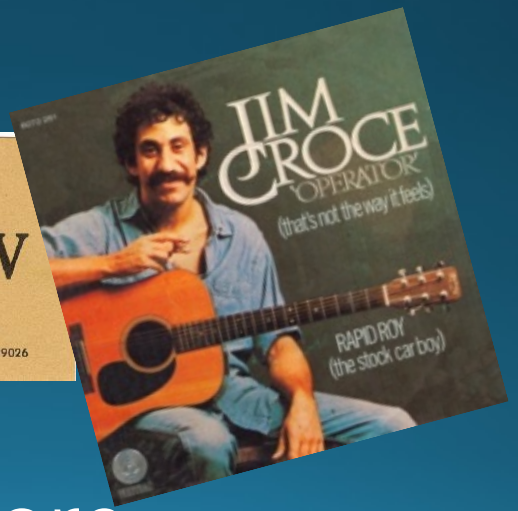
What is amateur (ham) radio?

All kinds of people are amateur radio operators, also known as "hams." Hams are young, old, men, women, boys, and girls. Kids as young as seven years old have gotten amateur radio licenses, and many hams are active into their 80s and beyond.

Marlon Brando-KE6PZH

Barry Goldwater





Arthur Godfrey-k4lib

And many more

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Amateur Radio in Space

NASA'S SPACE AMATEUR RADIO EXPERIMENT IS CONNECTING STUDENTS AND HAM RADIO OPERATORS ON EARTH WITH ASTRONAUTS IN EARTH ORBIT.

Almost all communications with ISS is in the frequencies above 30 mHz – The Tech. Bands

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How to get into Amateur Radio

With just a little study, you can learn all you need to know to get a Technician Class license, which is the license class designed for beginners. To get a Technician Class license, you must take a test with 35 multiple-choice questions and answer 26 questions correctly. The test covers basic regulations, operating practices, and electrical and electronics theory. Knowing Morse Code is no longer required to get this license, nor any class of license. Technician Class licensees have all amateur radio privileges above 30 MHz.

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How much does it cost?

Basic study materials, such as this study guide, can be had for free, and the license exam fee will be $15.

Once you have your first license, most hams find it best to start with simple equipment and grow over time.

A handheld VHF FM transceiver can be purchased for less than $100 new, and excellent used equipment is often available at low prices. All things considered, the cost should be under $200.

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Where do I take the test?

AMATEUR RADIO LICENSE EXAMINATIONS ARE GIVEN BY VOLUNTEER EXAMINERS, OR VES. VES ARE LICENSED RADIO AMATEURS WHO HAVE BEEN TRAINED TO ADMINISTER AMATEUR RADIO TESTS.

THE OFFICIAL QUESTION BANK IS MAINTAINED BY THE NATIONAL COUNCIL OF VOLENTEER EXAMINER CONTROLLSER AT THE WEBSITE: HTTP://WWW.NCVEC.ORG/PAGE.PHP?ID=373

WE WILL HAVE A VE EXAM THE DAY AFTER THIS COURSE.

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Will this One Day Course Teach me what I need to know?.

Yes and no.

This manual will help you get your license, but getting your license is only the beginning. There is still much to learn, and to get the most out of amateur radio, you will have to continually learn new things. This study guide will teach you the answers to the test questions, but will not give you a deep understanding of electronics, radio, or the rules and regulations. That will be up to you after you get your license. .

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HamStudy.org $3.99

https://apps.apple.com/us/app/hamstudy-org/id1371288324

HamRadioPrep Free

https://apps.apple.com/us/app/ham-radio-prep/id1525090989

HamTestPrep $5.99 per class

https://apps.apple.com/us/app/ham-test-prep-technician/id297951496

iOS app study guides

LETS GET STARTED !

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Electrical principles:

Math for electronics, electronic principles, Ohm's Law

Voltage *is the electrical term for the electromotive force (EMF) that causes electron flow. (T5A05)* ***The volt*** *is the basic unit of electromotive force. The letter V is the symbol we use for volts.* ***About 12 volts*** *is the amount of voltage that a mobile transceiver usually requires.*

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CURRENT.

- ***Current*** *is the name for the flow of electrons in an electric circuit. (T5A03)*
- *Electrical current is measured in* ***amperes****. (T5A01)*
- ***Direct current*** *is the name for a current that flows only in one direction. ()*

Batteries supply direct current, or simply DC.

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CURRENT.

- **Alternating current** *is the name for a current that alternates between positive and negative directions. (T5A09)*
- ***Frequency*** *is the term that describes the number of times per second that an alternating current reverses direction. (T5A12)*
- *Alternating current, or AC, is what is available from your home's wall sockets.*

Power supplies convert the AC into DC, which is required for most modern amateur radio equipment.

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CURRENT.

Resistance *is the term used to describe opposition to current flow in a circuit. The basic unit of resistance is the ohm. The Greek letter omega (Ω) is shorthand for ohms.*

Conductors *are materials that conduct electrical current well, or, in other words, have a low resistance.*

The copper wires that we use to connect a power supply to a radio are good conductors because ***copper*** *is a good electrical conductor. (T5A07)*

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CURRENT.

Insulators are materials that that have a high resistance. They do not conduct electrical current very well.

Plastics and **glass**, for example, are good electrical insulators. (T5A08)

The term that describes the rate at which electrical energy is used (or generated) is **power**. (T5A10)

Electrical power is measured in **watts**. (T5A02) The letter W is the symbol we use for watts.

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Ohm's Law: formulas and usage

- Ohm's Law is the relationship between voltage, current, and the resistance in a DC circuit.
- When you know any two of these values, you can calculate the third.

- The most basic equation for Ohm's Law is: $E = I \times R$

- This is the formula for calculating voltage in a circuit. (T5D02)

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Ohm's Law: formulas and usage.

- We can rearrange ohms law to calculate resistance and current.
- To calculate resistance in a circuit is **resistance (R) equals voltage (E) divided by current (I).**
- (T5D03) We can also write this formula as
- R =E / I

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Ohm's Law: formulas and usage.

When you know the voltage across a circuit and the resistance of a circuit, the formula used to calculate current in the circuit is **current (I) equals voltage (E) divided by resistance (R)**. (T5D01)

This formula is written $I = E \div R$

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Ohm's Law: formulas and usage.

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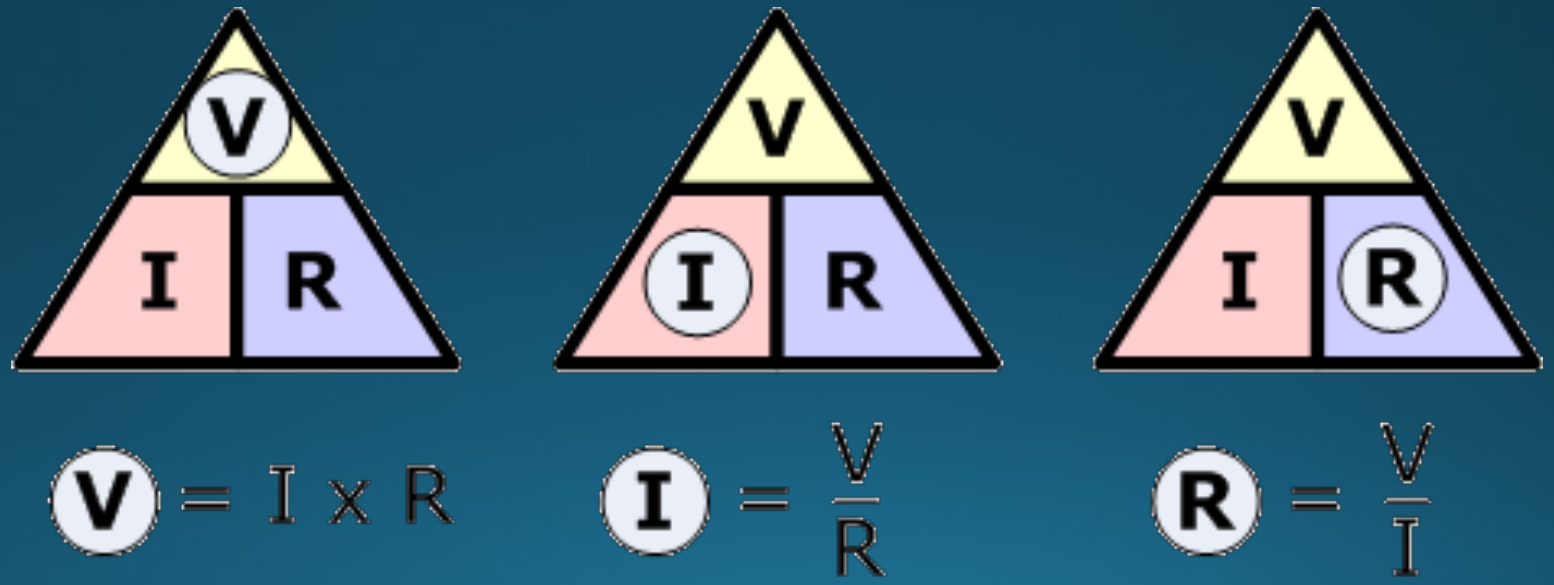

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Ohm's Law: formulas and usage.

Examples

- The resistance of a circuit in which a current of 3 amperes flows through a resistor connected to 90 volts is **30 ohms**. (T5D04)

$$R = E \div I = 90\ V \div 3\ A = 30\ \Omega$$

- The resistance in a circuit for which the applied voltage is 12 volts and the current flow is 1.5 amperes is **8 ohms**.(T5D05)

$$R = E \div I = 12\ V \div 1.5\ A = 8\ \Omega$$

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Ohm's Law: formulas and usage.

Examples

- The resistance of a circuit that draws 4 amperes from a 12-volt source is **3 ohms**. (T5D06) R = E ÷ I = 12 V ÷ 4 A = 3 Ω
- The current flow in a circuit with an applied voltage of 120 volts and a resistance of 80 ohms is **1.5 amperes**. (T5D07) I = E ÷ R = 120 V ÷ 80 Ω = 1.5 A
- The current flowing through a 100-ohm resistor connected across 200 volts is **2 amperes**. (T5D08) I = E ÷ R = 200 V ÷ 100 Ω = 2 A
- The current flowing through a 24-ohm resistor connected across 240 volts is **10 amperes**. (T5D09) I = E ÷ R = 240 V ÷ 24 Ω = 10 A

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Ohm's Law: formulas and usage.

Examples

- The voltage across a 2-ohm resistor if a current of 0.5 amperes flows through it is **1 volt**. (T5D10) $E = I \times R = 0.5\ A \times 2\ \Omega = 1\ V$
- The voltage across a 10-ohm resistor if a current of 1 ampere flows through it is **10 volts**. (T5D11) $E = I \times R = 1\ A \times 10\ \Omega = 10\ V$
- The voltage across a 10-ohm resistor if a current of 2 amperes flows through it is **20 volts**. (T5D12) $E = I \times R = 2\ A \times 10\ \Omega = 20\ V$

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Electronic principles: DC power calculation

Power is the rate at which electrical energy is generated or consumed.

The formula used to calculate electrical power in a DC circuit is

power (P) equals
voltage (E) multiplied by
current (I), or

$$P = E \times I$$ (T5C08)

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Electronic principles: DC power calculation.

- **138 watts** is the power being used in a circuit when the applied voltage is 13.8 volts DC and the current is 10 amperes. (T5C09)

$$P = E \times I = 13.8\ V \times 10\ A = 138\ W$$

. When the applied voltage in a circuit is 12 volts DC and the current is 2.5 amperes, the power being used is **30 watts**. (T5C10)

$$P = E \times I = 12\ V \times 2.5\ A = 30\ W$$

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Electronic principles: DC power calculation.

Just as with Ohm's Law, you can use algebra to come up with other forms of this equation to calculate the voltage if you know the power and the current, or to calculate the current if you know the power and the voltage. The formula to calculate the current, if you know the power and the voltage is I =P÷E.

For example, **10 amperes** are flowing in a circuit when the applied voltage is 12 volts DC and the load is 120 watts. (T5C11)

I = P ÷ E = 120 W ÷ 12 V = 10 A

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Math for electronics: conversion of electrical units, decibels, the metric system

When dealing with electrical parameters, such as voltage, resistance, current, and power, we use a set of prefixes to denote various orders of magnitude:

- **milli**- is the prefix we use to denote 1 one-thousandth of a quantity. A milliampere, for example, is 1 one-thousandth of an ampere, or 0.001 A.
- Often, the letter m is used instead of the prefix milli-. 1 milliampere is, therefore, 1 mA.

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Math for electronics: conversion of electrical units, decibels, the metric system

- **micro**- is the prefix we use to denote 1 millionth of a quantity. A microvolt, for example, is 1 millionth of a volt, or 0.000001 V.
- Often you will see the Greek letter **mu, or μ**, to denote the prefix micro-. 1 microvolt is, therefore, 1 μV.
- **pico-** is the prefix we use to denote 1 trillionth of a quantity. A picovolt is 1 trillionth of a volt, or 0.000001 μV.

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Math for electronics: conversion of electrical units, decibels, the metric system

kilo- is the prefix we use to denote 1 thousand of a quantity. A kilovolt, for example, is 1000 volts. Often, the letter **k** is used instead of the prefix kilo-. 1 kilovolt is, therefore, 1 kV.

mega- is the prefix we use to denote 1 million of a quantity. A megahertz, for example, is 1 million Hertz. The unit of frequency is the **Hertz.** (T5C05) It is equal to one cycle per second. Often, the letter **M** is used instead of the prefix mega-. 1 megahertz is, therefore, 1 MHz.

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Math for electronics: conversion of electrical units, decibels, the metric system

Here are some examples:

- **1,500 milliamperes** is 1.5 amperes. (T5B01)
- Another way to specify a radio signal frequency of 1,500,000 hertz is **1500 kHz**. (T5B02)
- **One thousand volts** are equal to one kilovolt. (T5B03)
- **One one-millionth of a volt** is equal to one microvolt. (T5B04)
- **0.5 watts** is equivalent to 500 millwatts. (T5B05)

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Math for electronics: conversion of electrical units, decibels, the metric system

Here are some examples:

- If an ammeter (a meter that measures current) calibrated in amperes is used to measure a 3000-milliampere current, the reading it would show would be **3 amperes**. (T5B06)

- If a frequency readout calibrated in megahertz shows a reading of 3.525 MHz, it would show **3525 kHz** if it were calibrated in kilohertz. (T5B07)

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Math for electronics: conversion of electrical units, decibels, the metric system

Here are some examples:

- **1 microfarad** is 1,000,000 picofarads. (T5B08) (Farad is the unit for capacitance.)
- **28.400 MHz** is equal to 28,400 kHz. (T5B12)
- If a frequency readout shows a reading of 2425 MHz, the frequency in GHz is **2.425 GHz**. (T5B13)

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Decibels.

. When dealing with ratios—especially power ratios—we often use decibels (dB). The reason for this is that the decibel scale is a logarithmic scale, meaning that we can talk about large ratios with relatively small numbers. At this point, you don't need to know the formula used to calculate the ratio in dB, but keep in mind the following values:

- **3 dB** is the approximate amount of change, measured in decibels (dB), of a power increase from 5 watts to 10 watts. (T5B09) This is a ratio of 2 to 1.
- **–6 dB** is the approximate amount of change, measured in decibels (dB), of a power decrease from 12 watts to 3 watts. (T5B10) This is a ration of 4 to 1.

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Decibels.

10 dB is the approximate amount of change, measured in decibels (dB), of a power increase from 20 watts to 200 watts. (T5B11) This is a ratio of 10 to 1.

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Electronic principles and components:.

A ***resistor*** is the electrical component used to oppose the flow of current in a DC circuit. (T6A01)

- Most resistors have a fixed value, which is specified in ohms.
- Some resistors are variable, that is you can change the resistance of the resistor by turning a shaft or sliding a control back and forth. These variable resistors are called potentiometers.
- A **potentiometer** is the type of component that is often used as an adjustable volume control. (T6A02)
- **Resistance** is the electrical parameter that is controlled by a potentiometer. (T6A03).

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Electronic principles and components:

- The type of electrical component that consists of two or more conductive surfaces separated by an insulator is a ***capacitor***. (T6A05)
- A **capacitor** is the electrical component that stores energy in an electric field. (T6A04)
- **Capacitance** is the ability to store energy in an electric field. (T5C01)
- **The** farad is the basic unit of capacitance. (T5C02)

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Electronic principles and components:

- The type of electrical component that stores energy in a magnetic field is an ***inductor***. (T6A06)
- The electrical component that is usually composed of a coil of wire is an inductor. (T6A07)
- The ability to store energy in a magnetic field is called **inductance**. (T5C03)
- **The henry** is the basic unit of inductance. (T5C04)
-

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Electronic principles and components:

- An ***SPDT switch*** is the electrical component used **to switch between one of two other circuits**. (T6A08)

- A ***fuse*** is the electrical component used to protect other circuit components from current overloads. (T6A09)

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Electronic principles and components:

BATTERY:

As amateur radio operators, we often use batteries to power our radio equipment. The length of time equipment can be operated is determined by ***dividing the battery ampere-hour rating by the average current draw***. (T4A09) Some types of batteries are rechargeable, while others are not. The battery type that is **not rechargeable** is the **carbon-zinc** battery. (T6A11) Battery ***types that are rechargeable*** are **nickel-metal hydride, lithium-ion, and lead-acid gel-cells.** (T6A10):

.

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Semiconductors:

- basic principles and
- applications of solid state devices,
- diodes and
- transistors

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Semiconductors:

- A diode is an electronic component that allows current to flow in only one direction. (T6B02)
- Diodes have only two electrodes. **Anode and cathode** are the names of the two electrodes of a diode. (T6B09)
- A **semiconductor diode's** cathode lead is usually identified **with a stripe**. (T6B06)
- LEDs or Light-emitting diodes are a particular type of diode. When **forward current** flows through them, they **emit light**, making them useful as indicators and as part of digital readouts. (T6B07)
- The **forward voltage drop of a diode** is **lower in some diode types than in others**. (T6B01)

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Semiconductors:

- *A transistor* is a component made of three regions of semiconductor material. (T6B04)
  - can be used as **an electronic switch**. (T6B03) or to **provide power gain**. (T6B10)
  - A devices ability to amplify a signal is called **gain**. (T6B11)
- The three electrodes of a **bipolar** transistor are the **emitter, base and collector**. (T6B12)

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Semiconductors:

- Another type of transistor often found in amateur radio equipment is ***the field-effect transistor***.
- The abbreviation "FET" stands for **Field Effect Transistor**. (T6B08)
- FETs, like NPN and PNP transistors have three leads. **Source, gate, and drain** are the three electrodes of a field effect transistor. (T6B05)

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Circuit diagrams, schematic symbols, component functions

- **Schematic symbols** is the name for standardized representations of components in an electrical wiring diagram. (T6C01)

- **The way components are interconnected** is accurately represented in electrical circuit schematic diagrams. (T6C12)

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Circuit diagrams, schematic symbols, component functions

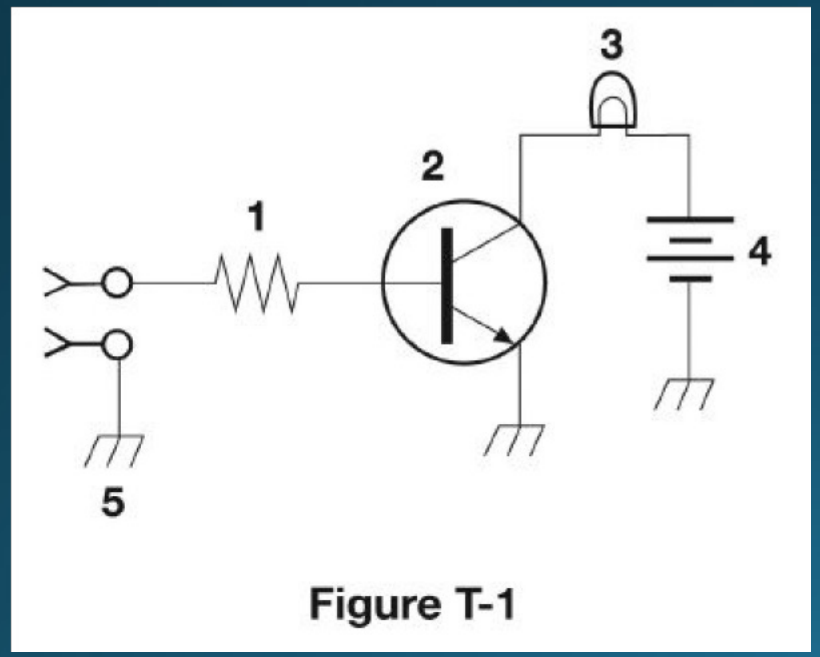

Figure T-1

Figure T1 is a schematic diagram of a simple circuit that turns on a lamp when a positive voltage is applied to the input.

- Component 1 in figure T1 is a **resistor**. (T6C02) Its function is to limit the input current.
- Component 2 in figure T1 is a **transistor**. (T6C03) Its function is to **control the flow of current**. (T6D10) and switch the current through the lamp on and off
- Component 3 in figure T1 is the **lamp**. (T6C04)
- Component 4 in figure T1 is a **battery**. (T6C05) This battery supplies the current that lights the lamp.

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Circuit diagrams, schematic symbols, component functions

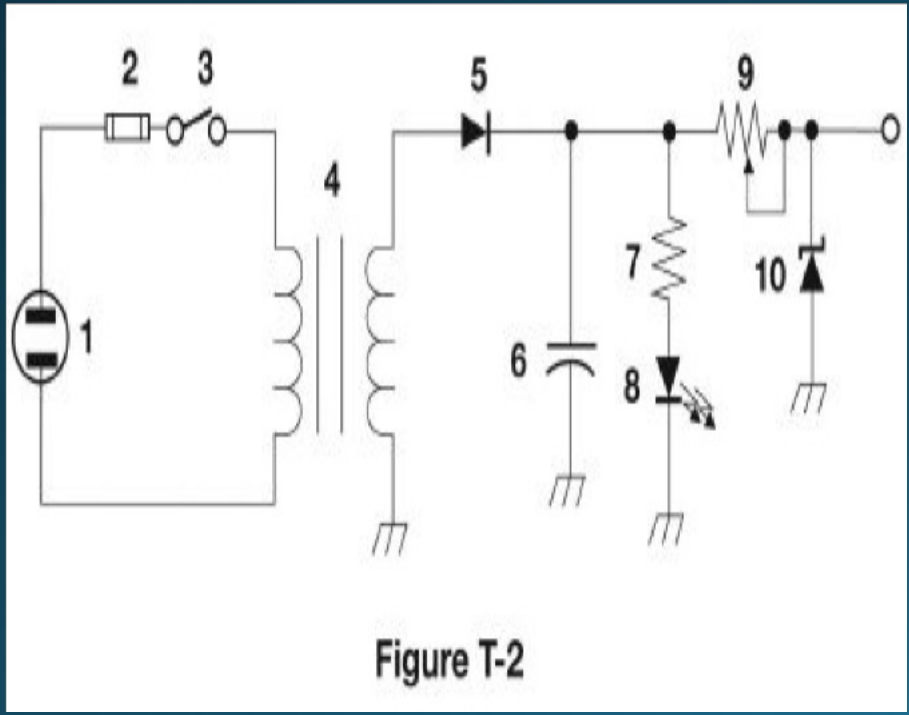

Figure T-2

The circuit shown in Figure T2 is a simple power supply.

Component 4 in figure T2 is a transformer. (T6C09) A transformer is commonly **used to change 120V AC house current to a lower AC voltage for other uses**. (T6D06)

A rectifier **changes an alternating current into a varying direct current** signal. (T6D01) Component 5 in Figure T2 is a rectifier diode.

Component 10 is a zenor diode. It is used as a **regulator to control the amount of voltage from the power supply.** (T6D05)

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Circuit diagrams, schematic symbols, component functions

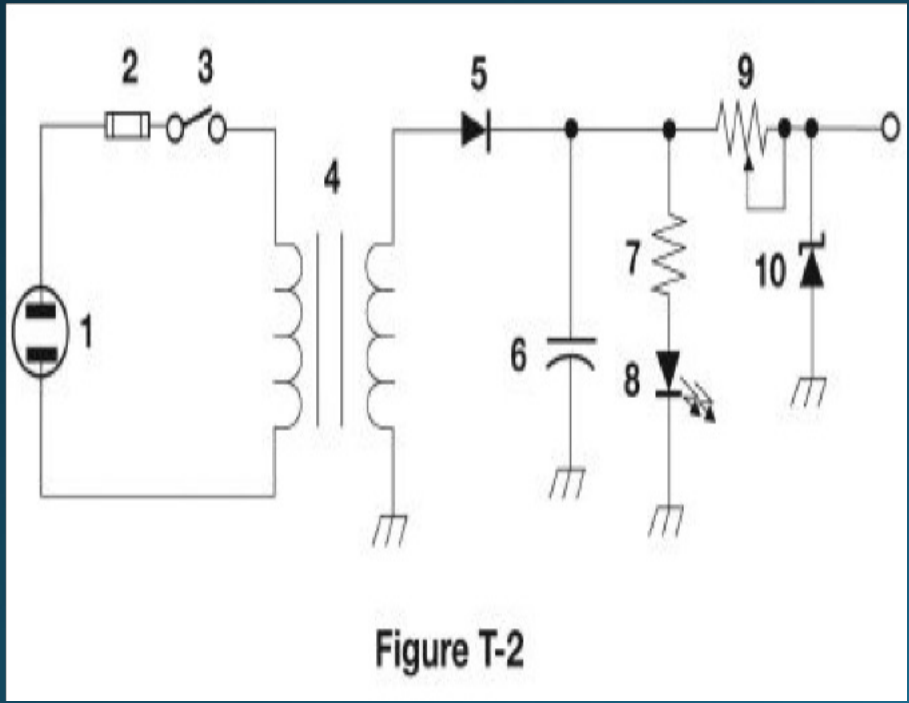

Figure T-2

Component 6 in figure T2 is a **capacitor**. (T6C06) It is a filter capacitor, whose function is to help filter out the 60 Hz component of the rectified AC.

Component 8 in figure T2 is a **light emitting diode**. (T6C07). An LED is **commonly used as a visual indicator** here to show the power supply is on. (T6D07)

Component 9 in figure T2 is a **variable resistor**, or potentiometer. (T6C08) Its purpose is to limit the output current of the supply.

Component 4 is a transformer. (T6C09) Its purpose is to change to voltage of the input to the desired output.

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Circuit diagrams, schematic symbols, component functions

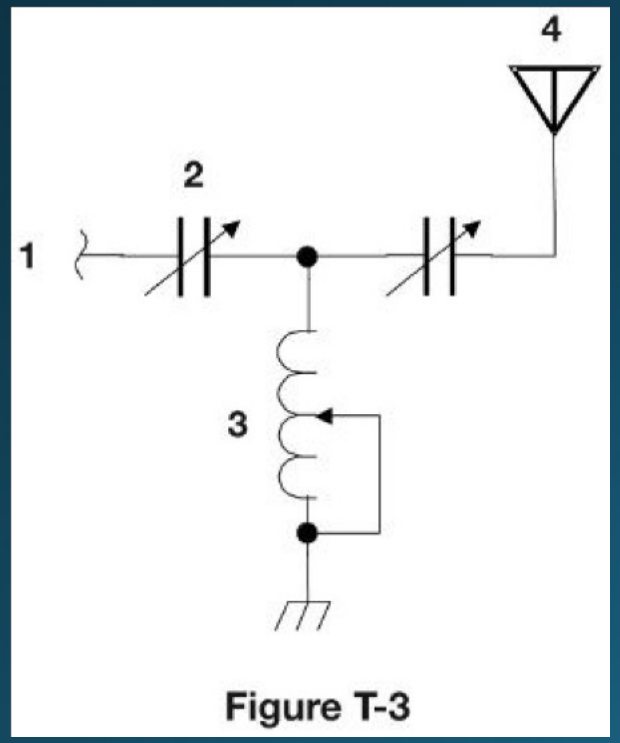

Figure T-3

- The circuit shown in Figure T3 is the output circuit of a transmitter. Component 3 in figure T3 is a **variable inductor**. (T6C10)
- There are two variable capacitors in this circuit—component 2 and the unlabeled component. A **capacitor** is used **together with an inductor to make a resonant circuit**. (T6D08)
- Component 4 in figure T3 is an **antenna**. (T6C11)
- **An inductor and a capacitor connected in series or parallel to form a filter** is a simple resonant or tuned circuit. (T6D11)
- When the capacitor and inductor are connected in series, the circuit has a very low impedance at the resonant frequency. When the capacitor and inductor are connected in parallel, the circuit has a very high impedance at the resonant frequency.

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Circuit diagrams, schematic symbols, component functions

Other components -There are many different types of components in modern radio equipment. Below, we will describe the types of components you will need to know about to pass the Technician Class license examination.

- A relay is an **electrically controlled switch** actuated by an electromagnet. (T6D02)
- Meters are devices used to indicate many different values. For example, a **meter** can be used to **display signal strength on a numeric scale**. (T6D04) They are used to indicate the output voltage of a power supply, the output power of a transmitter, and many other parameters.
- The integrated circuit is the name of a device that **combines several semiconductors and other components into one package**. (T6D09)
- Using shielded wire is **can prevent coupling of unwanted signals to or from the wire**. (T6D03)

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Radio wave characteristics:

properties of radio waves, propagation modes

<u>Frequency, wavelength, the electromagnetic spectrum</u>

- **Electromagnetic** is the type of wave that carries radio signals between transmitting and receiving stations. (T3A07)
- As the name would imply, the two components of a radio wave are **electric and magnetic fields**. (T3B03)
- These two components are at **right angles** to each other. (T3B01)
- One important parameter of a radio wave is its frequency, or the number of cycles that it goes through per second. The unit of frequency is the **Hertz** (Hz). (T5A06) One Hz is one cycle per second.

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Radio wave characteristics:

properties of radio waves, propagation modes

Frequency, wavelength, the electromagnetic spectrum

- A radio wave travels **at the speed of light** through free space. (T3B04)
- Because the speed of light is about 300,000,000 meters per second, the approximate velocity of a radio wave as it travels through free space is **300,000,000 meters per second**. (T3B11)
- Because radio waves travel at the speed of light, no matter what their frequency happens to be, **the wavelength gets shorter as the frequency increases**. (T3B05)
- The formula for converting frequency to wavelength in meters is **wavelength in meters equals 300 divided by frequency in megahertz**. (T3B06)

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Radio wave characteristics:

properties of radio waves, propagation modes

Frequency, wavelength, the electromagnetic spectrum

- **The approximate wavelength** of radio waves is often used to identify the different frequency bands. (T3B07)
- For example, when we refer to the 2 meter band, we are referring to the amateur radio band that spans 144 MHz to 148 MHz.
- A radio wave with a frequency of 148 MHz, would have a wavelength of 2.03 meters.

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Radio wave characteristics:

properties of radio waves, propagation modes

Frequency, wavelength, the electromagnetic spectrum

- The abbreviation "RF" refers to **radio frequency signals of all types**. (T5C06)

For convenience, we split the entire range of radio frequencies into sub-ranges, including high frequency (HF), very high frequency (VHF), and ultra-high frequency (UHF).

- The frequency range **3 to 30 MHz** is referred to as HF. (T3B10)
- The frequency limits of the VHF spectrum are **30 to 300 MHz**. (T3B08)
- The frequency limits of the UHF spectrum are **300 to 3000 MHz**. (T3B09)

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Radio wave characteristics:

how a radio signal travels, propagation modes

As amateur radio operators, we should always try to use the right frequency and the right mode when communicating. To do this, we need to know how radio signals travel from one point to another and what affect frequency, our antennas, and even our location have on signal propagation.

Communications at VHF and UHF frequencies are generally "line of sight" communications. That is to say that normally they travel in a straight line from the transmitter to the receiver. For this reason, they are normally used for local communications.

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Radio wave characteristics:

How a radio signal travels, propagation modes

. The reason "direct" (not via a repeater) UHF signals are rarely heard from stations outside your local coverage area is that **UHF signals are usually not reflected by the ionosphere**. (T3C01) We'll talk more about the ionosphere below.

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Radio wave characteristics:

How a radio signal travels, propagation modes

One problem often encountered when using VHF and UHF frequencies is multi-path distortion. Multi-path distortion occurs when your signals arrive at a receiving station via two or more paths. Since the signal paths may be different lengths, they may arrive out of phase and cancel one another. For example, if another operator reports that your station's 2 meter signals were strong just a moment ago, but now they are weak or distorted, **try moving a few feet, as random reflections may be causing multi-path distortion**. (T3A01)

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Radio wave characteristics:

How a radio signal travels, propagation modes

Multi-path distortion affects both voice and digital transmissions.

Error rates are likely to increase if VHF or UHF data signals propagate over multiple paths. (T3A10)

When using a repeater, you may find yourself in a place where a direct path to the repeater is not possible. If you find yourself in this situation, you could try using a directional antenna. When using a directional antenna, **try to find a path that reflects signals to the repeater** if buildings or obstructions are blocking the direct line of sight path to a distant repeater.

(T3A05)

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Radio wave characteristics:

How a radio signal travels, propagation modes

If you try to use a hand-held transceiver inside a building to communicate with someone, you might want to choose to operate in a UHF band. The reason for this is that UHF signals are often more effective from inside buildings than VHF signals because the shorter wavelength allows them to more easily penetrate the structure of buildings.

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Radio wave characteristics:

How a radio signal travels, propagation modes

Another interesting phenomenon is "knife-edge" propagation.

Knife-edge propagation is the term used to describe when **signals are partially refracted around solid objects exhibiting sharp edges**. (T3C05)

You might be able to use this phenomenon to get your signal around a building in an urban setting.

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Radio wave characteristics:

How a radio signal travels, propagation modes

Antenna polarization is also important at VHF and UHF frequencies.

The orientation of the electric field is the property of a radio wave that is used to describe its polarization. (T3B02)

Signals could be significantly weaker if the antennas at opposite ends of a VHF or UHF line of sight radio link are not using the same polarization. (T3A04)

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Radio wave characteristics:

How a radio signal travels, propagation modes

When using a repeater, vertical polarization is most often used. So, when using a hand-held transceiver, make sure to hold it so that your antenna is vertically oriented.

On the other hand, **horizontal** antenna polarization is normally used for long-distance weak-signal CW and SSB contacts using the VHF and UHF bands. (T3A03)

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Radio wave characteristics:

How a radio signal travels, propagation modes

Mobile operation has its own unique challenges as your transmitter location is constantly changing.

This means that the signal at the receiving station constantly changes as well.

Picket fencing is the term commonly used to describe the rapid fluttering sound sometimes heard from mobile stations that are moving while transmitting. (T3A06)

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Radio wave characteristics:

How a radio signal travels, propagation modes

- **Long-distance ionospheric propagation is far more common on HF** than VHF and higher frequencies. (T3C02). However there are occasions when VHF communications are possible to communicate over long distances.
- One example is **Sporadic E** propagation most commonly associated with occasional strong over- the-horizon signals on the 10, 6, and 2 meter bands. (T3C04)
- Another is VHF signals received via **auroral reflection**. However these **signals exhibit rapid fluctuations of strength and often sound distorted**. (T3C03)

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Radio wave characteristics:

How a radio signal travels, propagation modes

- Some hams also bounce signals off meteor showers. This propagation mode is called **meteor scatter**. **6 meters** is the band best suited to communicating via meteor scatter. (T3C07)
- The troposphere is the lowest region of the atmosphere, extending from the earth's surface to a height of about 6–10 km. **Temperature inversions in the atmosphere** causes "tropospheric ducting." (T3C08)
- **Tropospheric ducting** is the mode responsible for allowing over-the-horizon VHF and UHF communications to ranges of approximately 300 miles on a regular basis. (T3C06)

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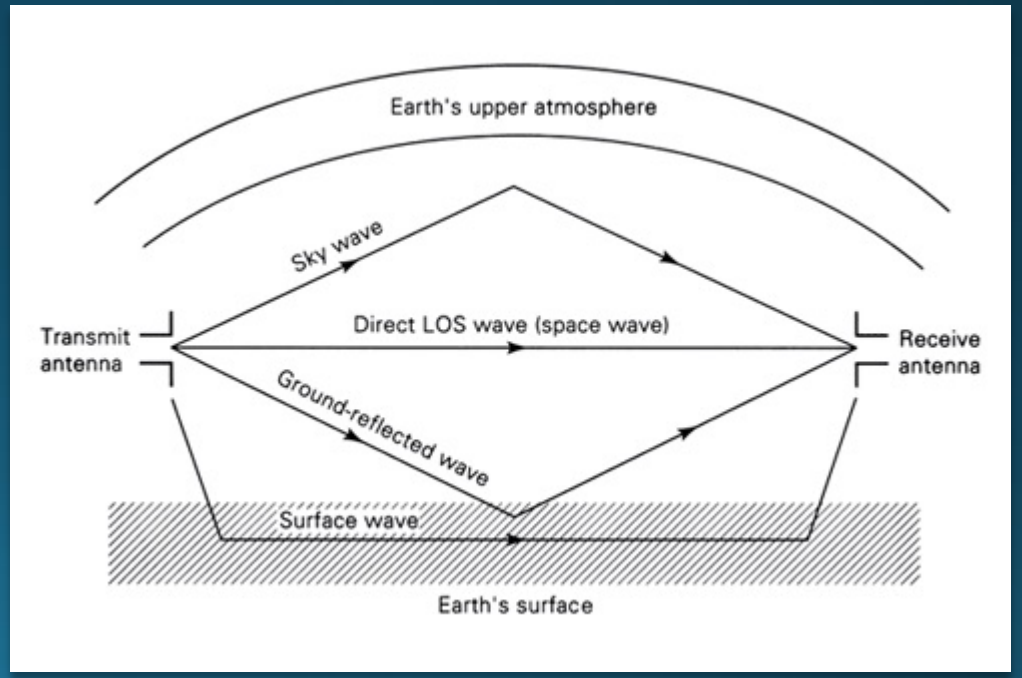
HF Propagation:

For more reliable long-distance communications, amateurs use the HF frequencies. The reason for this is that HF signals bounce off the ionosphere.



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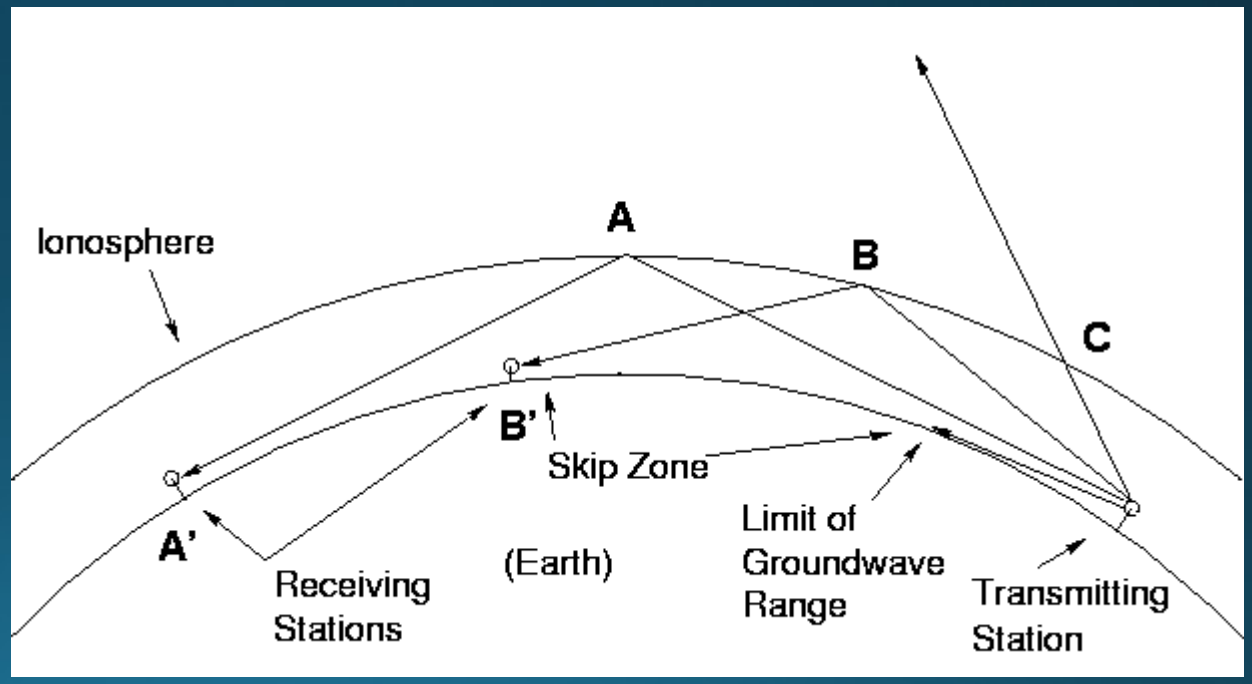
HF Propagation:

The ionosphere is the part of the atmosphere that can refract or bend HF and VHF radio waves and enables the propagation of radio signals around the world. (T3A11)

It contains a high concentration of ions and free electrons and is able to reflect radio waves. It extends from about 50 to 600 miles above the earth's surface.



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HF Propagation:

One interesting phenomenon that is related to HF propagation is the sunspot cycle.

Generally, the number of sunspots increases and decrease over an 11-year cycle, and HF propagation is best at times when there are many sunspots. Because of this, **six or ten meters** may provide **long distance communications via the ionosphere's F region** during the **peak of the sunspot cycle**. (T3C10)

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HF Propagation:

Because of the way that the ionosphere changes throughout the day, propagation is best on the higher frequency bands, such as 10m, 15m and 20m, during the day while propagation is best on the lower frequency bands (160m, 80m, 40m) at night.

Consequently, the best time for **long-distance 10 meter band propagation via the F layer** is ***from dawn to shortly after sunset during periods of high sunspot activity***. (T3C09).

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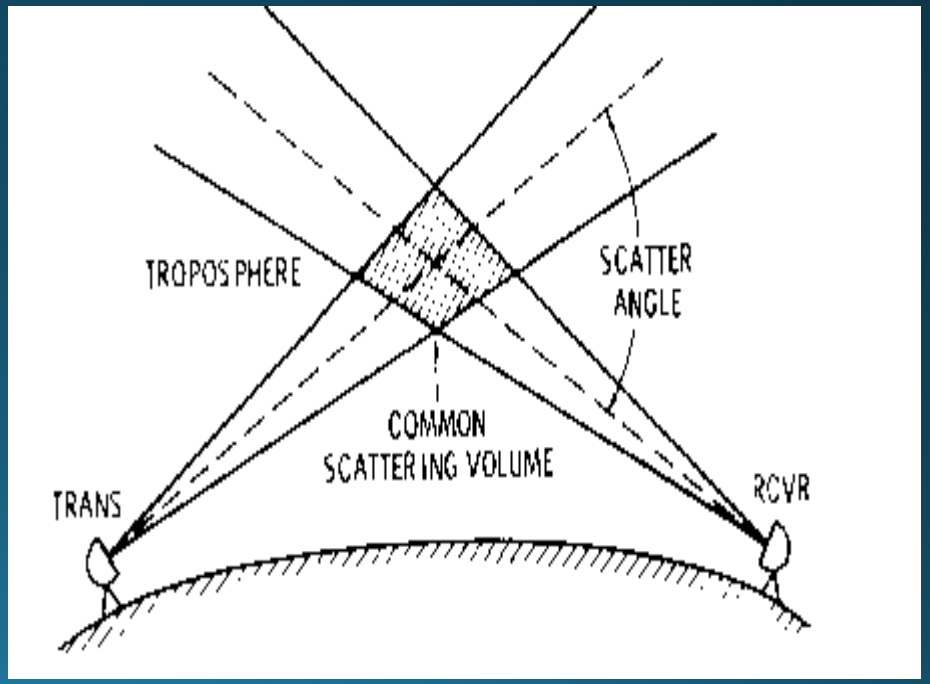
HF Propagation:

A common phenomenon of HF signal propagation is fading.

The cause of irregular fading of signals from distant stations during times of generally good reception is ***random combining of signals arriving via different path lengths***. (T3A08)



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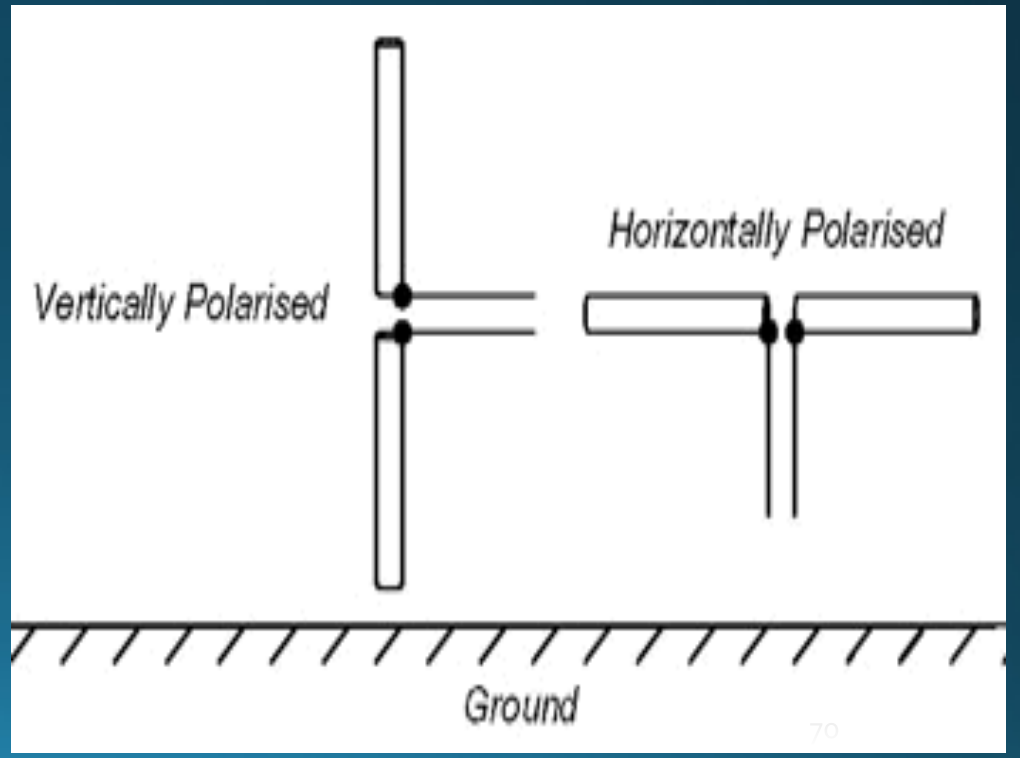
HF Propagation:

Unlike VHF/UHF communications, antenna polarization is not quite so important. This is because signals "skip" off the ionosphere and become elliptically polarized. Because skip signals refracted from the ionosphere are elliptically polarized, **either vertically or horizontally polarized antennas may be used for transmission or reception**. (T3A09).



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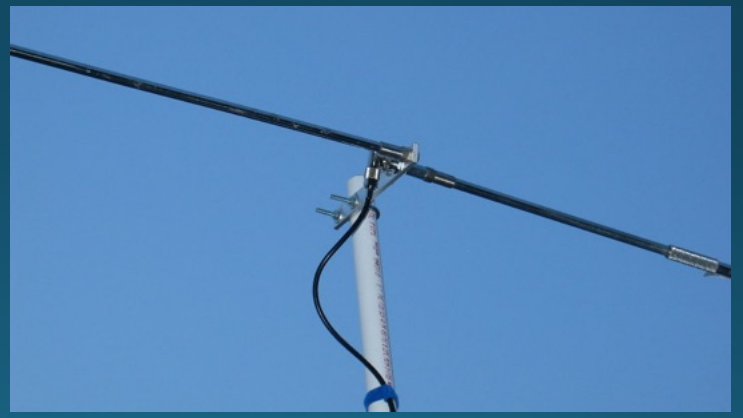
Antennas and feedlines:

***Antenna types, antenna polarization*.**

- ***The most common***, and perhaps the simplest, antenna is the half-wave dipole antenna. As the name suggests, it measures close to one half wavelength from one end of the antenna to the other. A simple dipole mounted so the conductor is parallel to the Earth's surface is **a horizontally polarized antenna**. (T9A03).



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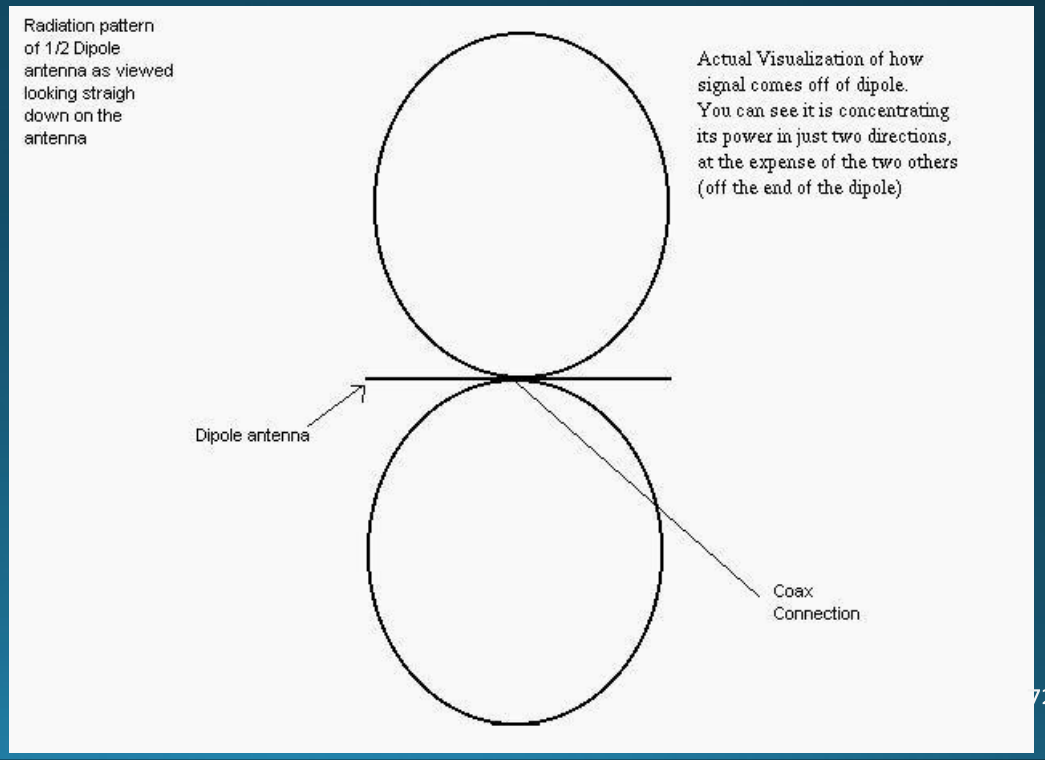
Antennas and feedlines:

***Antenna types, antenna polarization*.**

The direction that radiation is strongest from a half-wave dipole antenna in free space *is* ***broadside to the antenna***. (T9A10)



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Antennas and feedlines:

***Antenna types, antenna polarization*.**

The length of a dipole antenna is actually about 5% shorter than the value that you would calculate using the formula ***wavelength in meters equals 300 divided by frequency in megahertz***. The reason for this is that there will be some stray capacitance between the wire and the ground and other objects near the antenna. Consequently, the approximate length of a 6 meter 1/2-wavelength wire dipole antenna is **112** inches. (T9A09)

To make a dipole antenna resonant on a higher frequency, you would **shorten it**. (T9A05)

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Antennas and feedlines:

***Antenna types, antenna polarization*.**

Perhaps the second-most popular type of amateur radio antenna is the quarter-wave vertical antenna. This makes them vertically-polarized antennas.

The approximate length of a quarter wavelength vertical antenna for 146 MHz is **19** inches. (T9A08)

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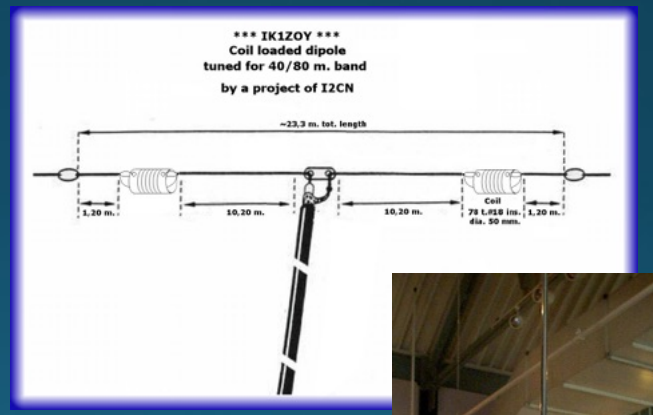
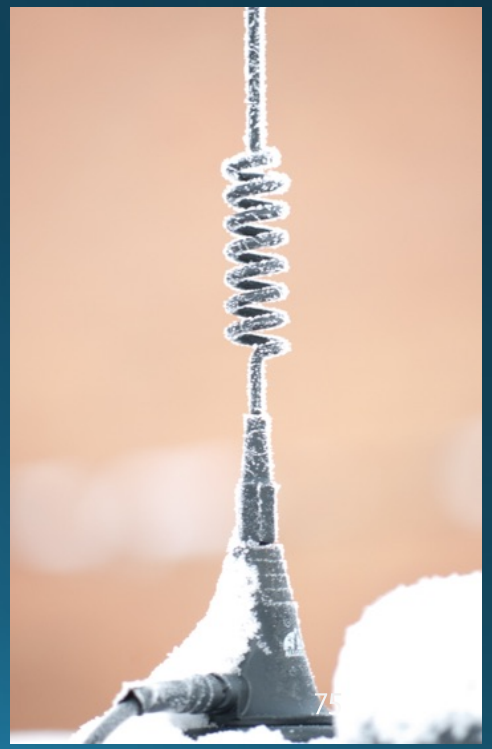
Antennas and feedlines:

***Antenna types, antenna polarization*.**

Because HF antennas can be very long, many amateurs use a technique called "loading" to shorten them. Loading, when referring to an antenna, means ***inserting an inductor in the radiating portion of the antenna to make it electrically longer***. (T9A02)





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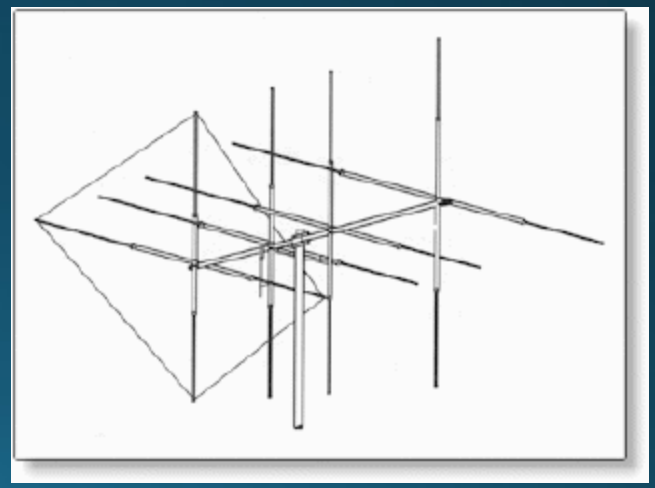
Antennas and feedlines:

***Antenna types, antenna polarization*.**

Another popular type of antenna is the **beam antenna**. A beam antenna ***is an antenna that concentrates signals in one direction.*** (T9A01) The quad, Yagi, and dish antennas are **directional antennas**. (T9A06) The gain of an antenna is **the increase in signal strength in a specified direction when compared to a reference antenna**. (T9A11)



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Antennas and feedlines:

***Antenna types, antenna polarization*.**

The ***yagi*** antenna has a ***greater gain*** than an isotropic, 5/8 vertical, or J-pole. (T9A09)

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Antennas and feedlines:

***Antenna types, antenna polarization*.**

Most hand-held VHF and UHF transceivers come with what's called a "rubber duck" antenna. Rubber duck antennas use inductive loading to make them shorter than a full-sized antenna. A disadvantage of the "rubber duck" antenna supplied with most handheld radio transceivers is ***that it does not transmit or receive as effectively as a full-sized antenna.*** (T9A04) A good reason not to use a "rubber duck" antenna inside your car is ***that signals can be significantly weaker than when it is outside of the vehicle.*** (T9A07)

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Antennas and feedlines:

***Antenna types, antenna polarization*.**

A better option is to use an externally-mounted antenna. VHF or UHF mobile antennas are often mounted in the center of the vehicle roof because a roof mounted antenna normally provides the most uniform radiation pattern.

- Many mobile installations use a 5/8-wavelength vertical antenna. One reason to use a properly mounted 5/8 wavelength antenna for VHF or UHF mobile service is that ***it offers a lower angle of radiation and more gain than a 1/4 wavelength antenna and usually provides improved coverage***. (T9A12)

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Feedlines: types of feedline, connectors.

- Feedlines connect radios to antennas. There are many different types of feedlines, but coaxial cable is used more often than any other feedline for amateur radio antenna systems ***because it is easy to use and requires few special installation considerations***. (T9B03) **.**

- Note, however, that ***the loss increases*** as the frequency of a signal passing through coaxial cable is increased. (T9B05)

- Another type of **coaxial cable is the air core** which has lower loass. However, special techniques are needed to prevent moisture from entering the cable. (T7C11)

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Feedlines: types of feedline, connectors.

- When choosing a feedline, it is important to match the impedance of the feedline to the output impedance of the transmitter and the input impedance of the antenna. Impedance ***is a measure of the opposition to AC current flow in a circuit***. (T5C12)
- ***Ohms*** are the units of impedance. (T5C05)

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Feedlines: types of feedline, connectors.

Most amateur radio transmitters are designed to have an output impedance of 50 ohms. Because that is the case, the impedance of the most commonly used coaxial cable in typical amateur radio installations is ***50 ohms***. (T9B02)

RG-58 and RG-213 are two types of coaxial cable used in amateur radio stations. Both have an impedance of 50 ohms, but there are important differences between the two. One electrical difference between the smaller RG-58 and RG-213 coaxial cables is ***that RG-213 cable has less loss at a given frequency.*** (T9B10)

The type of coax that has the lowest loss at VHF and UHF is ***air-insulated hard line***. (T9B11)

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Feedlines: types of feedline, connectors.

Moisture contamination is the most common cause for failure of coaxial cables. (T7C09)

One way that moisture enters a cable is via cracks in the cable's outer jacket. The reason that the outer jacket of coaxial cable should be resistant to ultraviolet light is ***that ultraviolet light can damage the jacket and allow water to enter the cable***.(T7C10)

A disadvantage of "air core" coaxial cable when compared to foam or solid dielectric types is that ***it requires special techniques to prevent water absorption.*** (T7C11)

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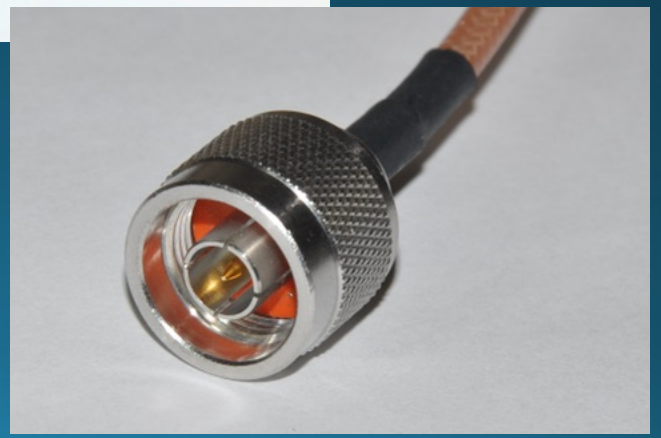
Feedlines: types of feedline, connectors.

PL-259 connectors are the most common type of connectors used on coaxial cables in amateur radio stations. One thing that is true of PL-259 type coax connectors is that ***they are commonly used at HF frequencies***. (T9B07)

One problem with PL-259 connectors is that they are not the most suitable connector when operating at higher frequencies. Instead, ***a Type N connector*** is most suitable for frequencies above 400 MHz. (T9B06)



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Feedlines: types of feedline, connectors.

No matter what type of connector you use, coax connectors exposed to the weather should be sealed against water intrusion to prevent an increase in feedline loss.

Also make sure to tighten connectors well. Also make sure that your antenna connections are tight and the connectors are soldered properly. A loose connection in an antenna or a feedline might cause erratic changes in SWR readings.

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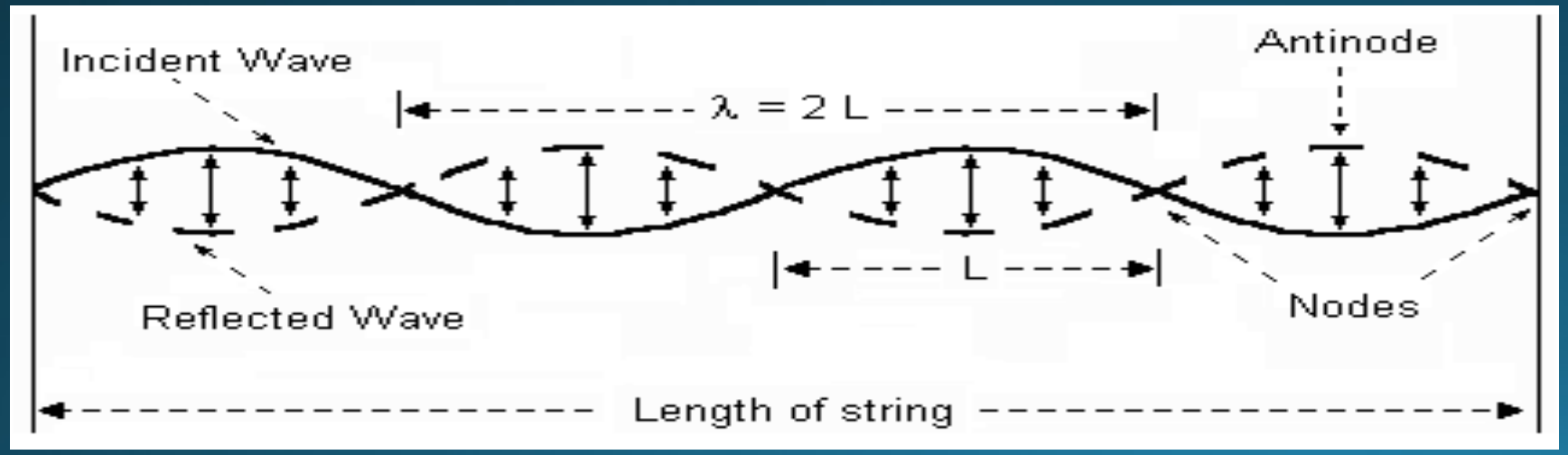
Standing wave ratio and antenna measurements.

- Standing wave ratio is a term you'll often hear when talking about antennas and feedlines. In general terms, standing wave ratio (S.W.R.) is ***a measure of how well a load is matched to a transmission line***. (T9B12)



In this context, the "load" is the antenna. When we say that an antenna is matched to a transmission line, we mean that the impedance of the transmission line is equal to the impedance of the antenna.

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Standing wave ratio and antenna measurements.

- The reason it is important to have a low SWR in an antenna system that uses coaxial cable feedline is ***to allow the efficient transfer of power and reduce signal losses***. (T9B01)

- The bigger the mismatch is between the feedline and the load, the higher the SWR will be, and the more power you will lose in the feedline. Power lost in a feedline ***is converted into heat*** meaning a weaker signal radiated by your antenna. (T7C07)

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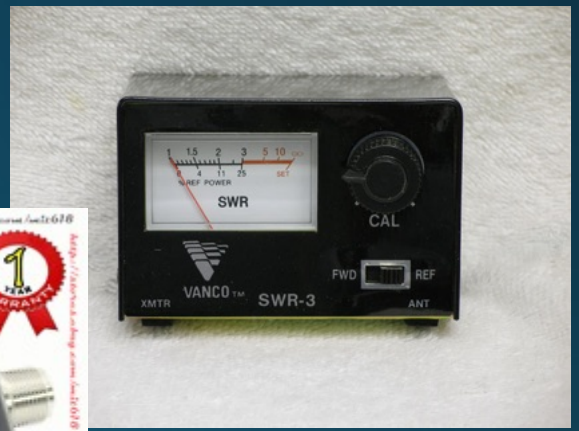
Standing wave ratio and antenna measurements.

- You can measure the SWR of your antenna system with an SWR meter.
- In-line SWR meters and Power Meters should be connected ***in series with the feed line, between the transmitter and antenna*** to monitor the standing wave ratio of the station antenna system. (T4A05) It's important to have a low SWR at that point.
- Make sure to select an SWR meter for ***the frequency and power level for the measurements you will make***. (T4A02)



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Standing wave ratio and antenna measurements.

An SWR meter is not the only way to measure SWR.

A directional wattmeter is an instrument other than an SWR meter that you could use to determine if a feedline and antenna are properly matched. (T7C08)

When using a directional wattmeter, you first measure the forward power, then the reflected power, and from those two values, calculate the SWR.

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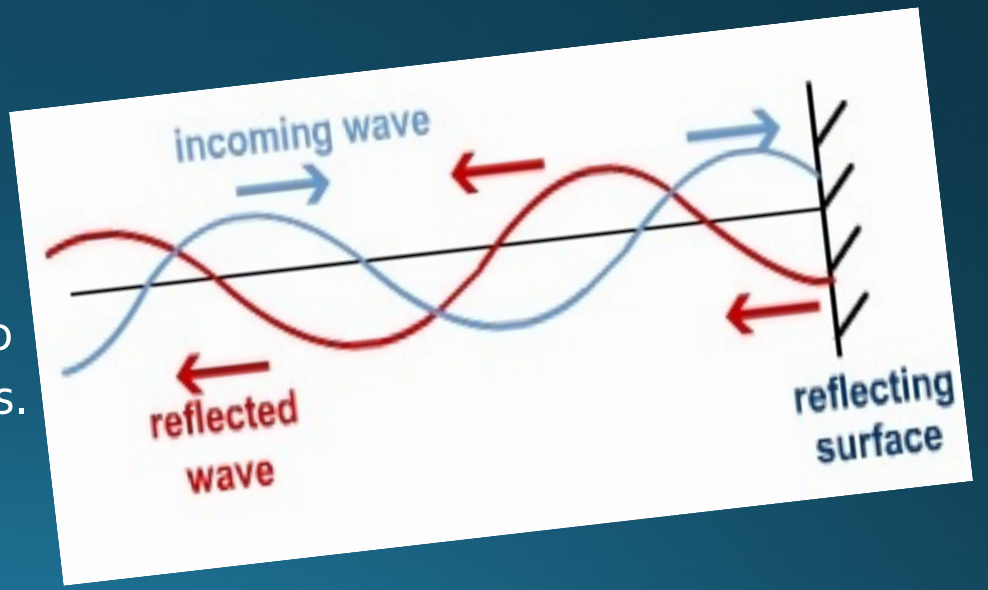
Standing wave ratio and antenna measurements.

- ***1 to 1*** is the reading on an SWR meter indicates a perfect impedance match between the antenna and the feedline. (T7C04)

- 2 to 1 is the approximate SWR value above which the protection circuits in most solid-state transmitters begin to reduce transmitter power to ***protect the output transistor***s. (T7C05)

- An SWR reading of 4:1 means that there ***is an impedance mismatch***. (T7C06)



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Standing wave ratio and antenna measurements.

In addition to the SWR meter and the directional wattmeter, there are a couple of other types of test instruments commonly found in an amateur's "shack."

One instrument that every shack should have is the dummy load. A dummy load consists of *a non-inductive resistor and a heat sink.* (T7C03)

The primary purpose of a dummy load is ***to prevent the radiation of signals when making tests***. (T7C01)

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Standing wave ratio and antenna measurements.

Another common test instrument is the antenna analyzer.

An *antenna analyzer* is an instrument that can be used to determine if an **antenna is resonant at the desired operating frequency**. (T7C02)

You can also make a number of other measurements that will help you set up an antenna system, such as SWR, capacitive reactance, and inductive reactance.

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Amateur radio signals

Modulation modes, signal bandwidth

When you get your Technician license, chances are FM is the type of modulation that you'll use first. Frequency modulation, or ***FM or PM***, is the type of modulation most commonly used for VHF and UHF voice repeaters. (T8A04)

FM of PM is also the type of modulation most commonly used for VHF packet radio transmissions. (T8A02)

The approximate bandwidth of a VHF repeater FM phone signal is ***between 10 and 15 kHz***. (T8A09)

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Amateur radio signals

Modulation modes, signal bandwidth

Single sideband, or ***SSB*****,** is the type of voice modulation most often used for long-distance or weak signal contacts on the VHF and UHF bands. (T8A03) ***Single sideband*** is a form of amplitude modulation. (T8A01)

A single-sideband signal may be upper- or lower-sideband. ***Upper sideband*** is normally used for 10 meter HF, VHF and UHF single-sideband communications. (T8A06)

The primary advantage of single sideband over FM for voice transmissions is that ***SSB signals have narrower bandwidth***. (T8A07) The approximate bandwidth of a single sideband voice signal is ***3 kHz***. (T8A08)

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Amateur radio signals

Modulation modes, signal bandwidth

Morse Code, or ***CW*****,** is the type of emission that has the narrowest bandwidth. (T8A05)

The approximate maximum bandwidth required to transmit a CW signal is ***150 Hz***. (T8A11)

International Morse is the code used when sending CW in the amateur bands. (T8D09)

When transmitting CW operators use straight keys, computer keyboards and electronic keyers. ***Electronic keyers*** **assist in manual sending of Morse code**. (T4A12)

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Amateur radio signals

Modulation modes, signal bandwidth

Some modes have very wide bandwidths.

The typical bandwidth of analog fast-scan TV transmissions on the 70 cm band, for example, is ***about 6 MHz***. (T8A10)

The type of transmission indicated by the term NTSC is ***an analog fast scan color TV signal***. (T8D04)

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Amateur radio signals

Modulation modes, signal bandwidth

Digital modes: packet, PSK31

When hams talk about "digital modes," we are talking about modes that send digital data rather than voice or other types of analog signals, such as television. Usually, we connect our transceivers to a computer to modulate and demodulate the digital signals, but some newer transceivers can do this internally.

All of these choices are correct (***examples of a digital communications method***) (T8D01):

- Packet radio
- IEEE 802.11
- FT8

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Amateur radio signals

Modulation modes, signal bandwidth

Packet radio was one of the first digital modes. It is called packet radio because the data to be sent from station to station is separated into a number of packets which are then sent separately by the transmitting station and received and re-assembled by the receiving station.

All of these choices are correct when talking about what may be included in a ***packet transmission*** (T8D08):

- 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

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Amateur radio signals

Modulation modes, signal bandwidth

Some amateur radio digital communications systems use protocols which ensure error-free communications.

- One such system is called an automatic repeat request, or ARQ, transmission system. An ARQ transmission system ***is a digital scheme whereby the receiving station detects errors and sends a request to the sending station to retransmit the information.*** (T8D11)

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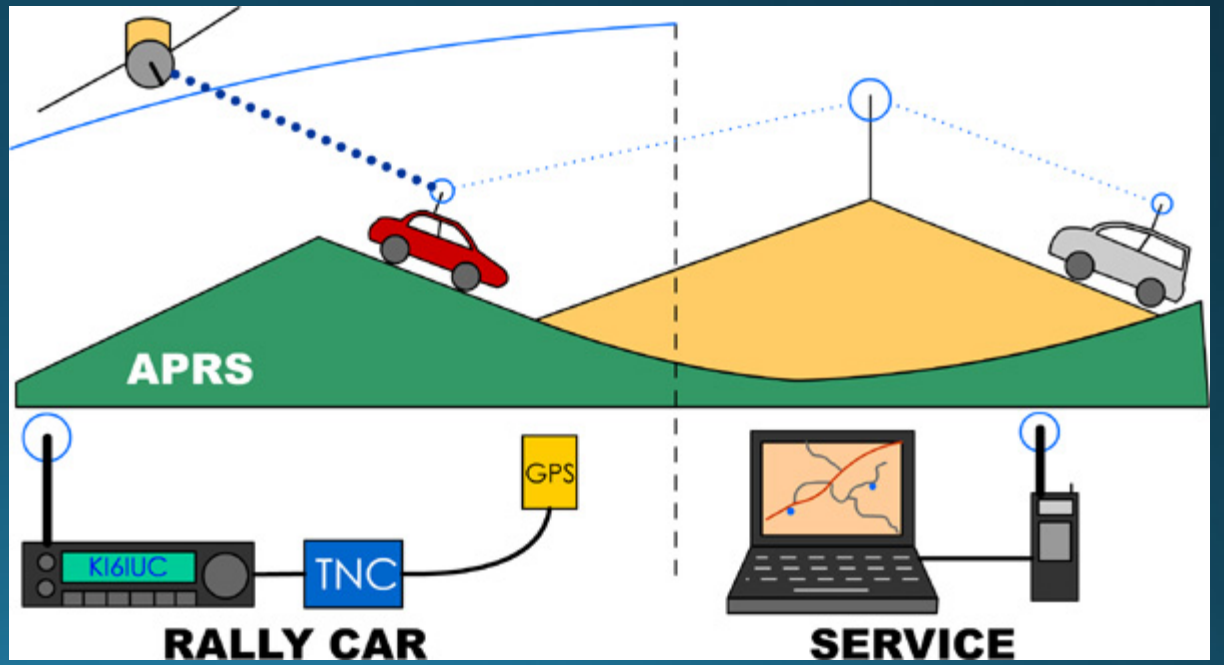
Amateur radio signals

Modulation modes, signal bandwidth

- APRS is one service that uses packet radio. The term ***APRS*** means Automatic Packet Reporting System. *It's* ***used to send GPS position data, text messages, and weather data***. (T8D03)
- ***Providing real time tactical digital communications in conjunction with a map showing the locations of stations*** is an application of APRS (Automatic Packet Reporting System). (T8D05)



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Electrical safety:

AC and DC power circuits, antenna installation, RF hazards

Power circuits and hazards: hazardous voltages, fuses and circuit breakers, grounding, lightning protection, battery safety, electrical code compliance

BE SAFE!

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Electrical safety:

AC and DC power circuits, antenna installation, RF hazards

When operating or working on amateur radio equipment, it's possible to come into contact with dangerous voltages and currents. People have died working on high-voltage circuits or putting up antenna.

Because it would be a shame to lose a single person, it's important to know how to be safe when working with electricity. Having said that, ***30 volts*** is the commonly accepted value for the lowest voltage that can cause a dangerous electric shock, and ***100 mA*** is the lowest amount of electrical current flowing through the body that is likely to cause death. These are not very large values.

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Electrical safety:

AC and DC power circuits, antenna installation, RF hazards

All of these choices are correct when considering how current flowing through the body can cause a **health hazard** (T0A02):

- By heating tissue
- It disrupts the electrical functions of cells
- It causes involuntary muscle contractions

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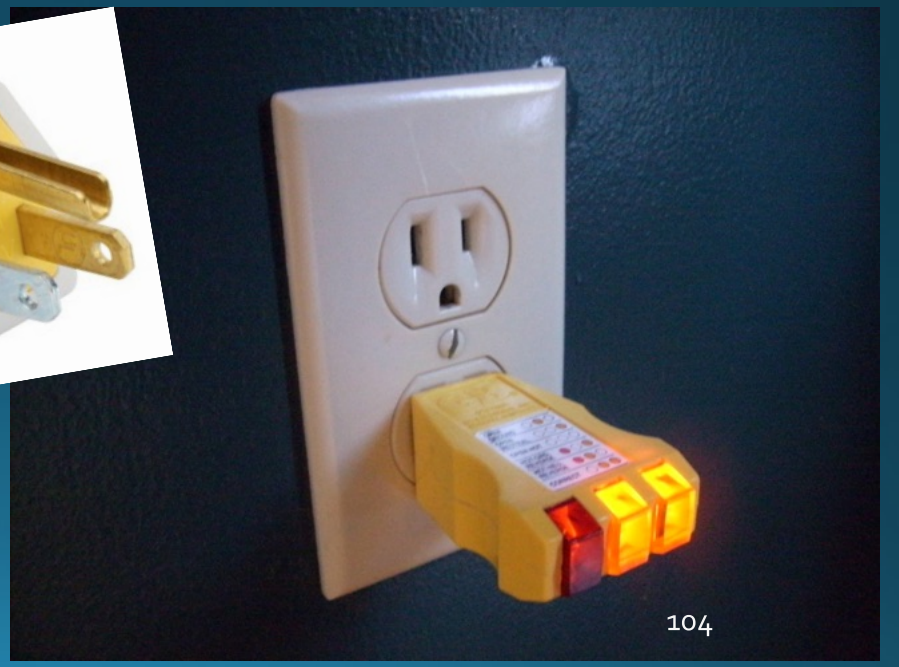
Electrical safety:

AC and DC power circuits, antenna installation, RF hazards

When properly wired, three-wire electrical outlets and plugs are safer than two-wire outlets and plugs, and you should use three-wire plugs for all of your amateur radio equipment. The third wire provides an independent, or safety ground. In the **US, the black wire in a 120v circuit** is the ***HOT*** circuit. (ToA03)



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Electrical safety:

AC and DC power circuits, antenna installation, RF hazards

All of these choices are correct when choosing a good way to ***guard against electrical shock*** at your station (ToA06):

- Use three-wire cords and plugs for all AC powered equipment
- Connect all AC powered station equipment to a common safety ground
- Install mechanical interlocks in high-voltage circuits

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Electrical safety:

AC and DC power circuits, antenna installation, RF hazards

Individual pieces of equipment may have their own fuses to protect that piece of equipment should something happen that causes that equipment to draw excessive current.

The purpose of a fuse in an electrical circuit is ***to interrupt power in case of overload***. (T0A04)

When replacing a fuse, always replace the blown fuse with a fuse of the same type and value. It is, for example, unwise to install a 20-ampere fuse in the place of a 5-ampere fuse because ***excessive current could cause a fire***. (T0A05)

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Electrical safety:

AC and DC power circuits, antenna installation, RF hazards

If you plan to build your own equipment, be sure to include fuses in your designs.

A fuse or circuit breaker in series with the AC "hot" conductor only should always be included in homebuilt equipment that is powered from 120V AC power circuits. (T0A08)

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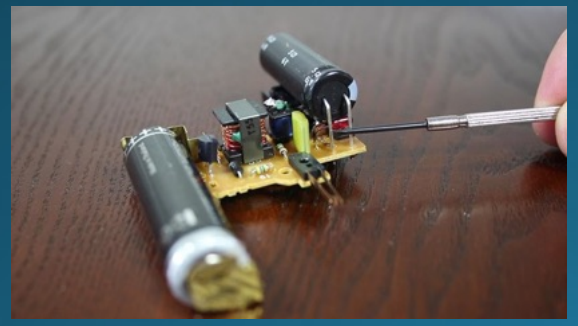
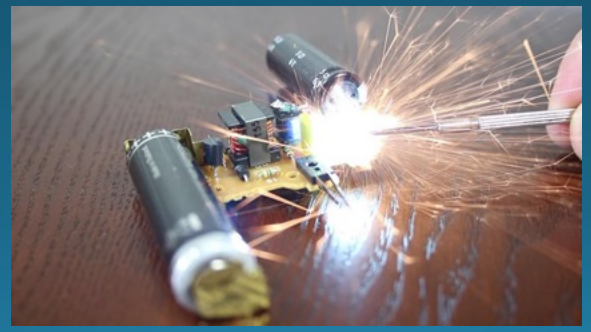
Electrical safety:

AC and DC power circuits, antenna installation, RF hazards

Whenever you're working on equipment, be sure to disconnect it from the power lines, and even then be careful working around a power supply's capacitors.

- If a power supply is turned off and disconnected, ***you might receive an electric shock from stored charge in large capacitors***. (ToA11)





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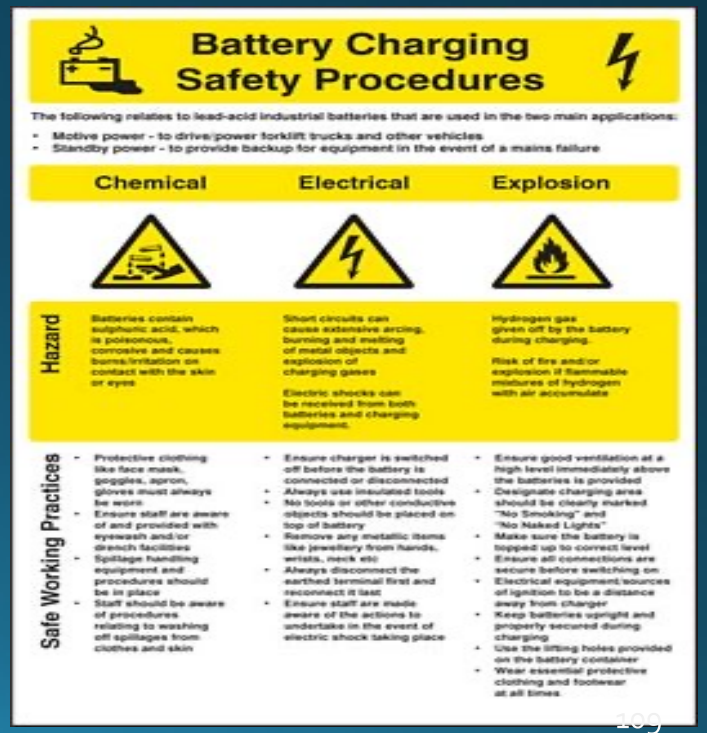
Electrical safety:

AC and DC power circuits, antenna installation, RF hazards

Finally, it's necessary to take precautions when using batteries to power your amateur radio station. Conventional 12-volt storage batteries present several safety hazards. ***Shorting the terminals can cause burns, fire, or an explosion*** (ToA01), and, if a lead-acid storage battery is charged or discharged too quickly, ***the battery could overheat and give off flammable gas or explode***. (ToA10)



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Antenna safety:

tower safety, erecting an antenna support, overhead power lines, installing an antenna

Antenna safety is also of primary concern. There are two aspects of antenna safety—

1. being safe when installing an antenna and
2. safely operating an antenna.

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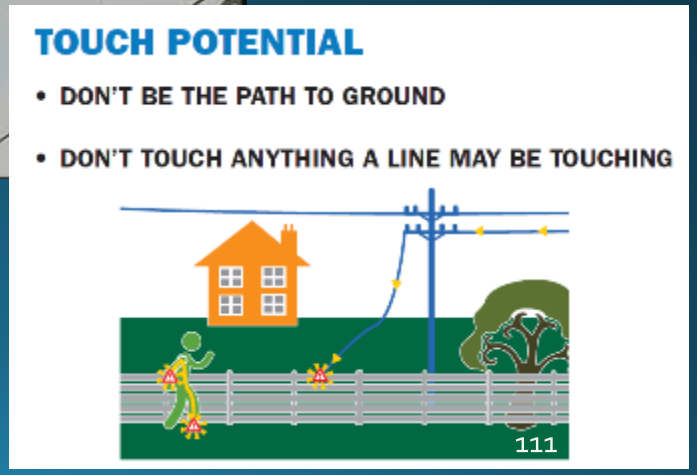
Antenna safety:

tower safety, erecting an antenna support, overhead power lines, installing an antenna

When installing an antenna, make sure that it is far enough from power lines, ***so that if the antenna falls unexpectedly, no part of it can come closer than 10 feet to the power wires***. (ToB06)

This is the reason you should avoid attaching an antenna to a utility pole. *The antenna could contact high-voltage power wires.* (ToB09)



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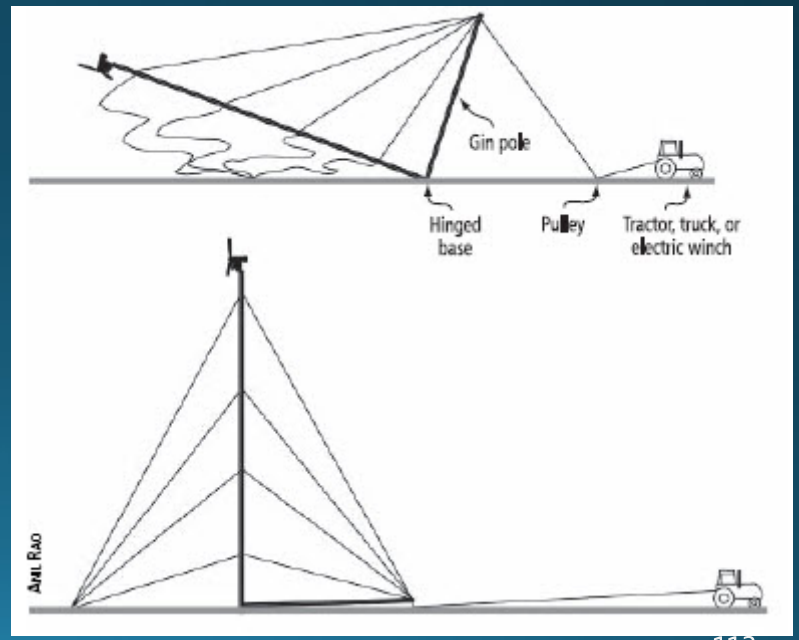
Antenna safety:

tower safety, erecting an antenna support, overhead power lines, installing an antenna

Turnbuckles are typically used to adjust the tension on guy wires used on antenna towers. It's good practice to **use safety wire through the turnbuckle** to ***prevent loosening of the turnbuckle from vibration***. (ToB05)



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Antenna safety:

tower safety, erecting an antenna support, overhead power lines, installing an antenna

- ***When climbing and antenna tower*, have sufficient training on safe climbing, use appropriate tie-off to the tower, wear an approved climbing harness**. (T0B02)
- When putting up a tower **look and stay clear of any overhead electrical wires**. (T0B04)
- It is *never safe* to climb a tower without a helper or observer. (T0B03)
- When using a crank-up tower, an important safety rule to remember is ***that this type of tower must never be climbed unless it is in the fully retracted position***. (T0B07)

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Antenna safety:

tower safety, erecting an antenna support, overhead power lines, installing an antenna

- Grounding is very important when installing a tower because the tower is basically a big lightning rod. ***Local electrical codes*** establish grounding requirements for an amateur radio tower or antenna. (ToB11)
- ***Separate eight-foot long ground rods for each tower leg, bonded to the tower and each other*** is considered to be a proper grounding method for a tower. (ToB08)
- When installing ground wires on a tower for lightning protection, it is good practice to ***ensure that connections are short and direct***. (ToB01)
- ***Sharp bends must be avoided*** when installing grounding conductors used for lightning protection. (ToB10)

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Antenna safety:

tower safety, erecting an antenna support, overhead power lines, installing an antenna

Lightning can also be conducted down a feedline and into your shack. To prevent this, several manufacturers make devices designed to shunt this current to ground before it gets into the shack. When installing devices for lightning protection in a coaxial cable feedline, **ground all of the protectors to a common plate which is in turn connected to an external ground**. (ToA07)

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RF hazards:

radiation exposure

Finally, let's consider the safety hazards of being exposed to radio waves.

- When using high power, you are required to perform an RF exposure evaluation, even though VHF and UHF radio signals are ***non-ionizing radiation***. (ToC01)

- RF radiation differs from ionizing radiation (radioactivity) in that ***RF radiation does not have sufficient energy to cause genetic damage***. (ToC12)

- The hazards of touching an antenna during transmission are ***electrocution, RF burn to the skin, and radiation poisoning***. (ToC07)

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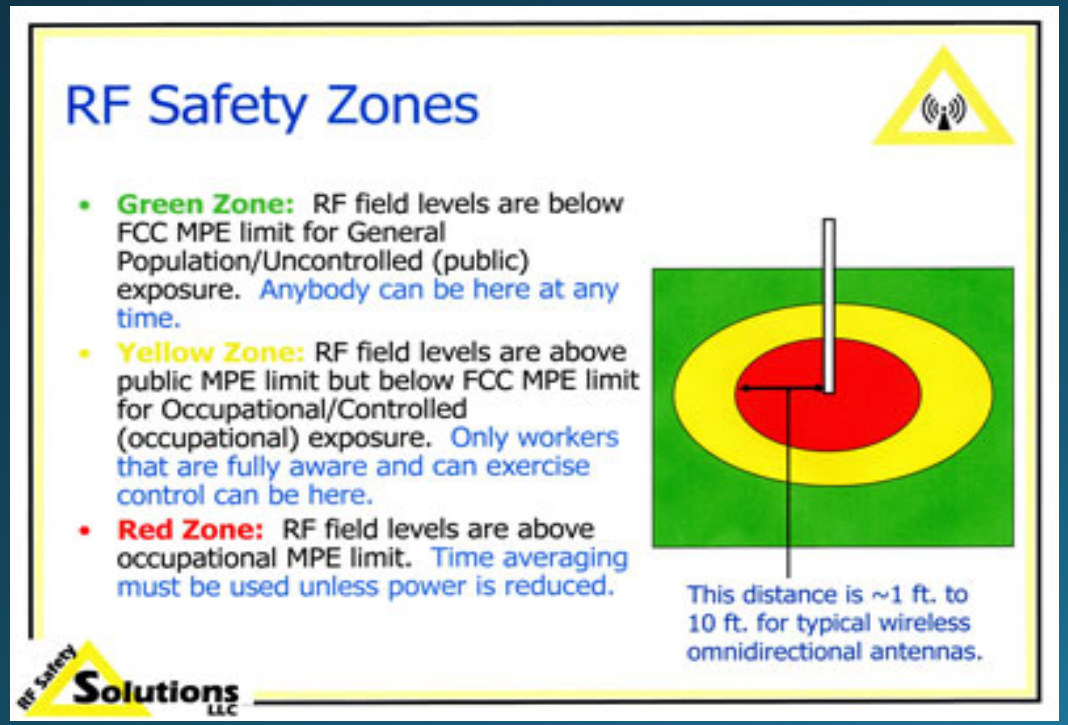
RF hazards:



How do you perform an RF exposure evaluation? ***All of these choices are correct*** as acceptable methods to determine if your station complies with FCC RF exposure regulations (ToCo6):

- By calculation based on FCC OET Bulletin 65
- By calculation based on computer modeling
- By measurement of field strength using calibrated equipment

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RF hazards:

One of the factors to consider when performing an RF exposure evaluation is the duty cycle of your transmissions.

- The term "duty cycle" when referring to RF exposure is ***the percentage of time that a transmitter is transmitting.*** (T0C11)
- Duty cycle is one of the factors used to determine safe RF radiation exposure levels because ***it affects the average exposure of people to radiation***. (T0C10)
- Reducing the duty cycle from 100 percent to 50 percent increases the ***allowable power density by a factor of 2***. (T0C03)

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RF hazards:

- Because of the way radio waves interact with the body, the exposure limits are different for each amateur radio band. Exposure limits vary with frequency ***because the human body absorbs more RF energy at some frequencies than at others.*** (T0C05)

- The ***50 MHz band*** has the lowest Maximum Permissible Exposure limit. (T0C02) ***All of these choices are correct*** when talking about factors that affect the RF exposure of people near an amateur station antenna (T0C04):
    - Frequency and power level of the RF field
    - Distance from the antenna to a person
    - Radiation pattern of the antenna

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RF hazards:

- One action amateur operators might take to prevent exposure to RF radiation in excess of FCC-supplied limits is to ***relocate antennas***. (ToC08)
- You could also lower the power or simply transmit less.
- After the initial RF exposure evaluation, you make sure your station stays in compliance with RF safety ***regulations by re-evaluating the station whenever an item of equipment is changed***. (ToC09)
- The station licensee is responsible for ensuring that no person is exposed to RF energy above the FCC exposure limits. (ToC13)

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Amateur radio practices and station setup:

Station setup: connecting microphones, reducing unwanted emissions, power source, connecting a computer, RF grounding, connecting digital equipment

When setting up an amateur radio station, choosing the radio itself is the most important consideration, but you must also choose a wide range of accessories, such as power supplies and microphones. In addition, how you set up the station is important for it to operate efficiently.

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Amateur radio practices and station setup:

One accessory that you'll definitely need is a power supply to provide the DC voltage and current that your radio needs.

Short, heavy gauge wire should be used for a transceiver's DC power connection to ***minimize voltage drop when transmitting***. (T4A03)

When choosing a supply, check the voltage and current ratings of the supply and be sure to choose one capable of supplying a high enough voltage and enough current to power your radio.

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Amateur radio practices and station setup:

Audio and power supply cables in a amateur radio station sometimes pick up stray RF. At minimum, this RF can cause the audio to be noisy. At worst, it can cause a radio or accessory to malfunction. To reduce RF current flowing on the shield of an audio cable (or in a power supply cable), you would use a ***ferrite choke***. (T7B04)

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Amateur radio practices and station setup:

Digital modes are becoming more and more common place with easy to use open source software and computers as a common part of the operator's equipment.

- Typically the ***transceiver's speaker connector is connected to the computer "line in"*** when operating digital modes. (T4A07)
- Digital mode hot spots can be used with a transceiver when ***communicating using digital voice or data via the internet***. (T4A10)
- The computer-radio interface uses ***receive audio, transmit audio, and transmitter keying*** signals for digital mode mode operation. (T4a06)
- For example the ***audio input and output of a computer running WSJIT-X software*** are connected to a transceiver to operate FT8 digital mode. (T4A04)

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Amateur radio practices and station setup:

Good grounding techniques can help you avoid interference problems. When grounding your equipment, you should connect the various pieces of equipment to a single point, keep leads short, and use a heavy conductor to connect to ground. ***Flat copper strap*** is the type of conductor that is best to use for RF grounding. (T4A08).

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Amateur radio practices and station setup:

If you plan to install a radio in your car and operate mobile, you have a different set of challenges. One is connecting the radio to the car's power system. Some amateurs connect their radio with a cigarette lighter plug, but this plug is not designed for high currents. Instead, a mobile transceiver's power negative connection should be made **at *the 12v battery chassis ground***. (T4A11) The positive connection can also be made at the battery or through an unused position of the vehicle's fuse block.

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Amateur radio practices and station setup:

A typical 50 watt ouput mobile FM transceiver will require a power ***supply rating of 13.8 volts at 12 amperes***. (T4A01)

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Operating controls:

tuning, use of filters, squelch function, AGC, repeater offset, memory channels

To properly operate a transceiver, you need to know how to use the controls.

Perhaps the most important transmitter control is microphone gain. If a transmitter is operated with the microphone gain set too high, ***the output signal might become distorted.*** (T4B01)

You also need to know how to set the operating frequency of your transceiver. ***The keypad or VFO knob*** can be used to enter the operating frequency on a modern transceiver. (T4B02)

A way to enable quick access to a favorite frequency on your transceiver ***is to store the frequency in a memory channel.*** (T4B04)

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Operating controls:

tuning, use of filters, squelch function, AGC, repeater offset, memory channels

A common receiver control on VHF/UHF transceivers is the squelch control.
The purpose of the squelch control on a transceiver is to mute receiver output noise when no signal is being received. Set the ***threshold so audio is heard all the time the receive weak FM signals***. (T4B03) If set too high, then you will not be able to hear low-level signals.

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Operating controls:

tuning, use of filters, squelch function, AGC, repeater offset, memory channels

- ***The receiver RIT or clarifier*** are controls that could be used if the voice pitch of a single-sideband signal seems too high or low. (T4B06)

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Operating controls:

tuning, use of filters, squelch function, AGC, repeater offset, memory channels

HF transceivers are often equipped with a variety of different filters.

- The advantage of having multiple receive bandwidth choices on a multimode transceiver is that it ***permits noise or interference reduction by selecting a bandwidth matching the mode***. (T4B08)
- For example***, 2400 Hz*** is an appropriate receive filter to select in order to minimize noise and interference for **SSB reception**. (T4B10)
- For CW reception 500 Hz is an appropriate receive filter to select in order to minimize noise and interference.

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Amateur radio practices and station setup:

A common transmitter control is push-to-talk, or PTT.
The push to talk function is the function which switches between receive and transmit.
(T7A07)

Most of the time PTT refers to an actual switch on the microphone that an operator must push to begin transmitting, but it also refers to the name of a signal line on a transceiver's accessory socket that can be used to automatically switch a transceiver into transmit mode.

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Station equipment:

Receivers, transmitters, transceivers, modulation, transverters, low power and weak signal operation, transmit and receive amplifiers

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Station equipment:

In the early days of radio, amateur radio operators used separate receivers and transmitter units. Nowadays, however, most use radios called transceivers. ***A transceiver is a unit combining the functions of a transmitter and a receiver***. (T7A02)

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Station equipment:

Instead of purchasing a multi-mode VHF transceiver, some amateurs use a transverter to **convert the signals from their HF transceiver to the VHF, UHF, and even microwave bands**. For example, a device that would take the output of a low-powered 28 MHz SSB exciter and produces a 222 MHz output signal is a *transverter*. (T7A06)

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Station equipment:

Many, if not most, new amateurs buy a hand-held transceiver, usually called an "HT," as their first transceiver. One disadvantage of using a hand-held transceiver is that the maximum output power is generally only 5 W, and because of this, they have limited range. To increase the low-power output of a handheld transceiver, and therefore its, range, you can use ***an RF power amplifier***. (T7A10)

VHF Power Amplifiers are equipped with an SSB/CW-FM switch the ***set the amplifier for proper operation in the selected mode***. (T7A09) **.**

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Station equipment:

When talking about a transceiver's specifications, we still refer to its receiver and transmitter. The two most important specifications for a receiver are sensitivity and selectivity.

Sensitivity is the term that describes the ability of a receiver to detect the presence of a signal. (T7A01)

The term that describes the ability of a receiver to discriminate between multiple signals is ***selectivity***. (T7A04)

To improve the sensitivity of a receiver, you can use an RF preamplifier. An RF preamplifier is installed ***between the antenna and receiver***. (T7A11)

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Station equipment:

Most HF transceivers have some version of a superheterodyne receiver. In a superheterodyne receiver, we first convert an incoming radio signal from its frequency to an intermediate frequency, or IF. The circuit that does this is the mixer. A ***mixer*** is used to **convert a radio signal from one frequency to another**. (T7A03)

When transmitting, we want to generate an RF signal with a specific frequency. To do that, we use an oscillator. ***Oscillator*** is the name of a circuit that **generates a signal of a desired frequency**. (T7A05)

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Station equipment:

To transmit a voice or data signal, we have to combine an audio frequency signal from the microphone with the RF carrier signal generated by the transmitter. ***Modulation*** is the term that describes combining speech with an RF carrier signal. (T7A08)

Modulators use a type of mixer circuit to accomplish this process.

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Common transmitter and receiver problems

Since Murphy's Law—the law that states if anything can go wrong, it will—applies to amateur radio as much as it does to any other pursuit, at some point you will have to deal with problems. These may include overload, distortion, feedback, and interference.

Let's first consider interference. ***All of these choices are correct*** when talking about causes of radio frequency interference (T7B03):

- fundamental overload
- harmonics
- spurious emissions.

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Common transmitter and receiver problems

- Any of these could cause interference to a TV set or radio, and you will want to take steps to find and eliminate that interference. If someone tells you that your station's transmissions are interfering with their radio or TV reception, you should first ***make sure that your station is functioning properly and that it does not cause interference to your own radio or television when it is tuned to the same channel*** or frequency. (T7B06)
- While it's not very likely that your amateur radio station will interfere with a neighbor's cable TV service, it can sometimes occur. The first step to resolve cable TV interference from your ham radio transmission is to ***be sure all TV coaxial connectors are installed properly.*** (T7B09)

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Common transmitter and receiver problems

Your amateur radio station may interfere with a nearby radio receiver if your signal is so strong that the receiver cannot reject the signal even though your signal is not on the frequency to which the receiver is tuned.

When a ***receiver is unable to reject strong signals outside the AM or FM band***, it can cause a broadcast AM or FM radio to receive an amateur radio transmission unintentionally. (T7B02)

One way to reduce or eliminate the overloading of a non-amateur radio or TV receiver by an amateur signal is to ***block the amateur signal with a filter at the antenna input of the affected receiver.*** (T7B05)

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Common transmitter and receiver problems

Installing a band-reject filter can help reduce overload of a VHF transceiver by commercial FM stations (T7B07)

If something in a ***neighbor's home is interfering*** with your amateur station you should first **make sure your station meets goot amateur practice, then politely inform your neighbor that the FCC prohibits devices that cause interference and then work closely with your neighbor to identify the offending the device.** (T7B08)

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Common transmitter and receiver problems

Perhaps the most common problem that amateur radio operators have is distorted or noisy audio when transmitting. There are many reasons for poor audio.

All of these choices are correct if you receive a report that your audio signal through the repeater is distorted or unintelligible (T7B10):

- ***Your transmitter may be slightly off frequency***
- ***Your batteries may be running low***
- ***You could*** be in a bad location

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Common transmitter and receiver problems

Reports of garbled, distorted, or unintelligible transmissions is a symptom of RF feedback in a transmitter or transceiver. (T7B11)

Sometimes, garbled or distorted audio when operating FM is the result of over-deviation. ***Talk farther away from the microphone*** is one thing you can do if you are told your FM handheld or mobile transceiver is over-deviating. (T7B01)

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Basic repair and testing:

Voltage and resistance are two measurements commonly made using a multimeter. (T7D07)

You use **a *voltmeter*** to measure electric potential or electromotive force. (T7D01)

The correct way to connect a **voltmeter** to a circuit is ***in parallel with the circuit***. (T7D02)

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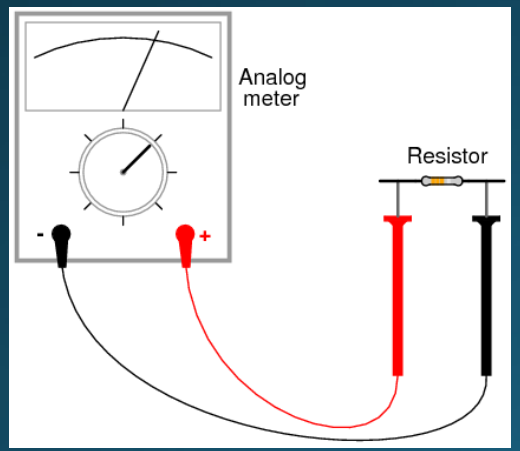
Basic repair and testing:

When measuring circuit resistance with an ***ohmmeter ensure that the circuit is not powered***. (T7D11)

A multimeter can be damaged if attempting to ***measure voltage using the resistance setting***. (T7D06)



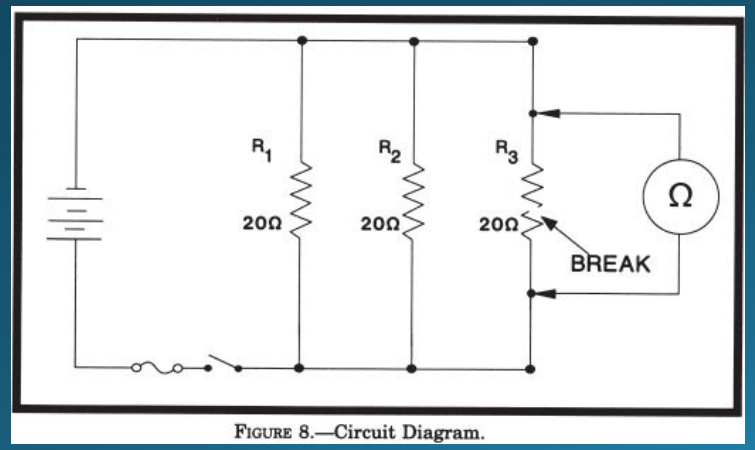


FIGURE 8.—Circuit Diagram.

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Basic repair and testing:

What is probably happening when an ohmmeter, connected across a circuit, initially indicates a **low resistance and then shows increasing resistance with time** is that ***the circuit contains a large capacitor***. (T7D10)

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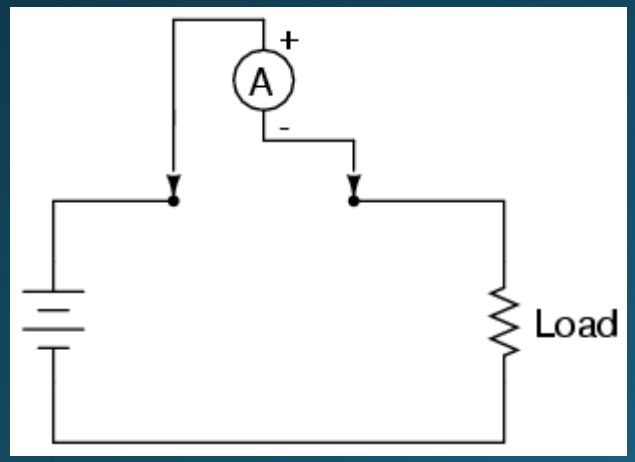
Basic repair and testing:

An ammeter is the instrument used to measure electric current. (T7D04)

An ammeter is usually connected to a circuit **in *series with the circuit***. (T7D03)



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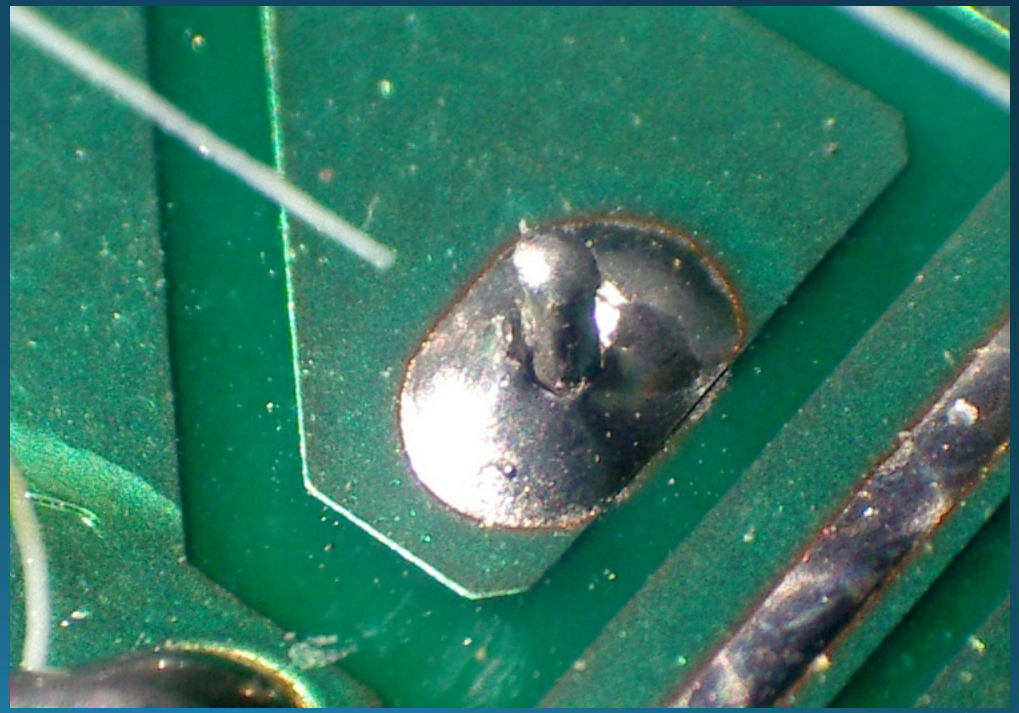
Basic repair and testing:

In addition to knowing how to make electrical measurements, knowing how to solder is an essential skill for amateur radio operators. Rosin-core solder is best for radio and electronic use. ***Do not use acid-core solder***. (T7D08)

A grainy or dull surface is the characteristic appearance of a "cold" solder joint. (T7D09).



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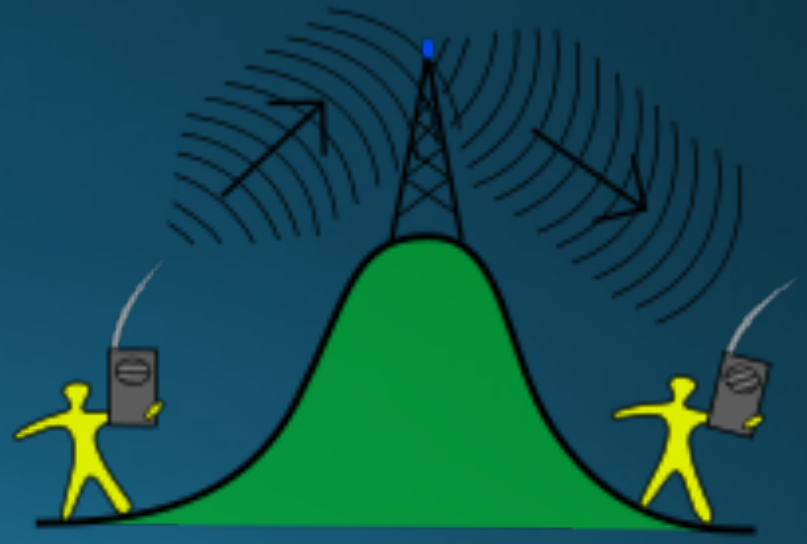
Operating Procedures

FM Operation

Once they get their licenses, most Technicians purchase a VHF/UHF FM transceiver. This type of radio allows them to use ***repeaters*** and participate in public-service events.

- A *repeater station* is the type of amateur station that simultaneously retransmits the signal of another amateur station on a different channel or channels. (T1F09)
- ***Auxiliary, repeater, or space stations*** amateur stations can automatically retransmit the signals of other amateur stations. (T1D07)



WBCCI - ARC

One Day **Amateur Radio License - Technician License**

Operating Procedures

FM Operation

To use repeaters, you need to know how to set up your radio. Repeaters receive on one frequency and transmit on another. You program your radio so that it receives on the repeater's transmit frequency and transmits on the repeater's receive frequency.

The difference between the transmit frequency and receive frequency is called the ***repeater offset***. (T2A07)

Plus or minus 600 kHz is the most common repeater frequency offset in the **2 meter band**. (T2A01)

Plus or minus 5 MHz is a common repeater frequency offset in the **70 cm band**. (T2A03)

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Operating Procedures

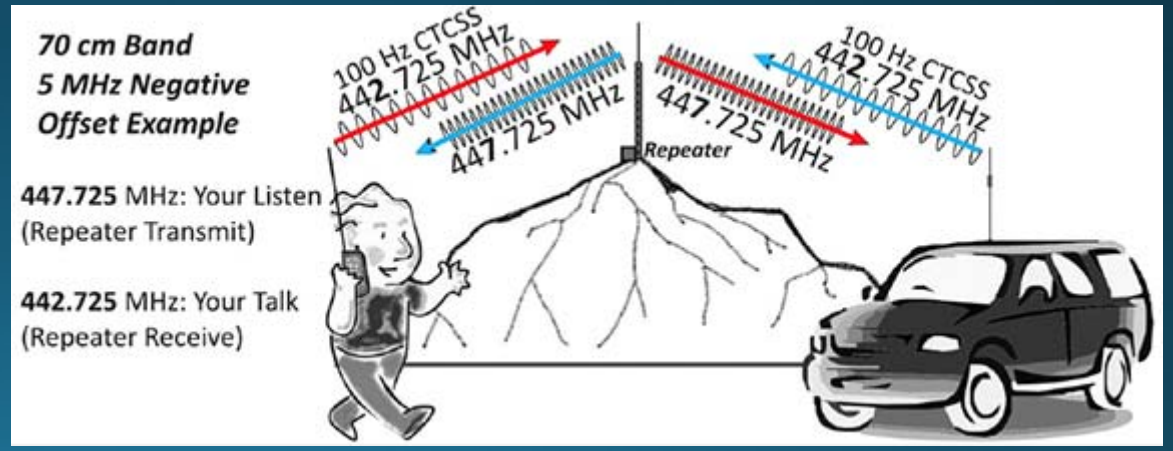
FM Operation

2meter off set is 600 kHz

70cm off set is 5 mHz

147.195 + = 147.795 + 600 kHz

146.970 - = 146.370 - 600 kHz



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Operating Procedures

FM Operation

Repeater operation is called duplex operation because you're transmitting and receiving on two different frequencies.

When the stations can communicate directly without using a repeater, you should consider communicating via simplex rather than a repeater. (T2B12)

Simplex communication is the term used to describe an amateur station that is transmitting and receiving on the same frequency. (T2B01)

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Operating Procedures

FM Operation

To help amateurs operating simplex find one another, frequencies on each band have been set aside as "national calling frequencies." ***446.000 MHz*** is the national calling frequency for FM simplex operations in the 70 cm band. (T2A02)

146.52 MHz is the national calling frequency for FM simplex operation in the 2 m band.

146.55 has been adopted by the RV community while traveling. (not on the test)

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Operating Procedures

FM Operation

Because repeaters often operate in environments where there is a lot of interference they are programmed not to operate unless the station they are receiving is also transmitting a sub- audible tone of a specific frequency. These tones are sometimes called PL (short for "private line") tones or CTCSS (short for "continuous tone-coded squelch system") tones.

CTCSS is the term used to describe the use of a sub-audible tone transmitted with normal voice audio to open the squelch of a receiver. (T2B02)

If your radio has not been programmed to transmit the proper sub-audible tone when you transmit, the repeater will not repeat your transmission.

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Operating Procedures

FM Operation

All of these choices are correct when talking about common problems that might cause you to be able to hear but not access a repeater even when transmitting with the proper offset: (T2B04)

- Your transceiver offset is incorrect
- The repeater receiver requires audio tone burst for access
- The repeater receiver requires a CTCSS tone for access
- The repeater receiver may require a DCS tone sequence for access

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Operating Procedures

FM Operation

In addition to knowing how to set the controls of your radio, you need to know the protocol for making contacts. First, when using a repeater, it is rare to hear stations calling CQ.

- In place of "CQ," ***say your call sign followed by the work "monitoring"*** to indicate that you are listening on a repeater. (T2A09)

- An appropriate way to call another station on a repeater if you know the other station's call sign is to ***say the station's call sign then identify with your call sign***. (T2A04)

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Operating Procedures

HF Operation

On the HF bands, when you want to contact another station, you "call CQ."
That is to say, you would say something like, "CQ CQ CQ. This is KB6NU."

The meaning of the procedural signal "CQ" ***is calling any station***. (T2A08)

When choosing an operating frequency for calling CQ ***listen first to make sure no one else is using it, ask if it is in use, make sure you are authorized on that frequency***. (T2A12)

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Operating Procedures

HF Operation

When responding to a call of CQ, you should transmit ***the other station's call sign followed by your call sign.*** (T2A05)

For example, if W8JNZ heard my call and wanted to talk to me, he would reply, "KB6NU this is W8JNZ. Over." Then, I would return the call, and our contact would begin.

It's important to always identify your station, even when only performing tests. An amateur operator must ***properly identify the transmitting station*** when making on-air transmissions to test equipment or antennas. (T2A06)

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Operating Procedures

HF Operation

As a technician, you will be able to operate ***Morse Code*** on certain portions of the 80 m, 40 m, 15 m, and 10 m bands. To shorten the number of characters sent during a CW contact, amateurs often use three-letter combinations called Q-signals.

QRM is the "Q" signal used to indicate that you are receiving interference from other stations. (T2B10)

The "Q" signal used to indicate that you are changing frequency is ***QSY***. (T2B11)

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One Day **Amateur Radio License - Technician License**

Operating Procedures

General Guidelines

FCC rules specify broadly where amateur radio operators have operating privileges, but are not very detailed.
Band plans take this one step further, suggesting where amateurs should use certain modes.

- While consulting **a band plan** before operating is a good idea, realize that a band plan is *a voluntary guideline for using different modes or activities within an amateur band.* (T2A10)

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Operating Procedures

General Guidelines

Regarding power levels used in the amateur bands under normal, non-distress circumstances, the FCC rules state that the maximum peak envelope power output for **Technician class operators** ***above 30 MHz is 1,500 watts***. (T1B12)

200 watts is the limit below 30 MHz. However, you really should only use that much power when you really need it.

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Operating Procedures

General Guidelines

The basics of good operation include keeping your signals clean and avoid interference to other stations. When two stations transmitting on the same frequency interfere with each other, common courtesy should prevail, but no one has absolute right to an amateur frequency***. The stations should negotiate continued use of the frequency***. (T2B08)

When **identifying your station** when using phone, use of a ***phonetic alphabet is encouraged by the FCC***. (T1A03)

Most hams around the world understand and use the NATO, or ITU phonetic alphabet. Learn it and use it.

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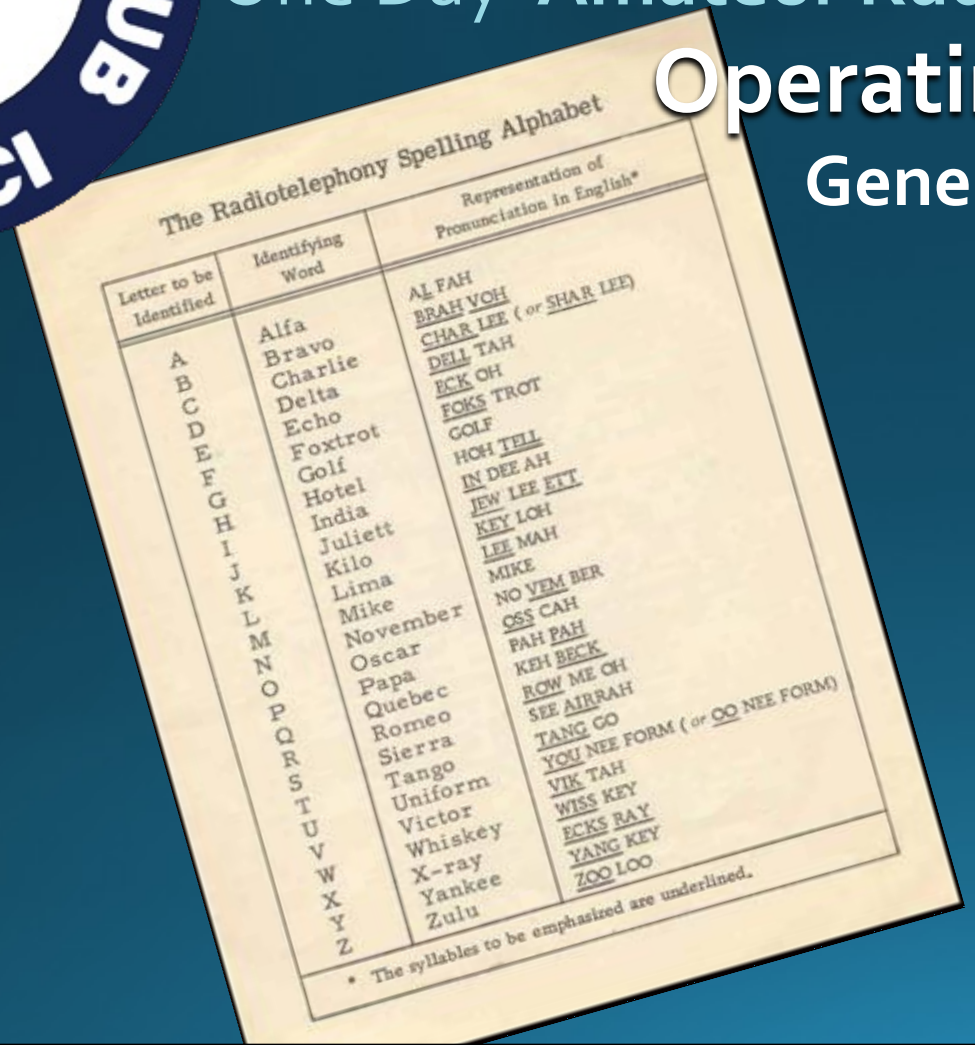
Operating Procedures

General Guidelines



The Radiotelephony Spelling Alphabet

Letter to be Identified	Identifying Word	Representation of Pronunciation in English*
A	Alfa	AL FAH
B	Bravo	BRAH VOH
C	Charlie	CHAR LEE (or SHAR LEE)
D	Delta	DELL TAH
E	Echo	ECK OH
F	Foxtrot	FOKS TROT
G	Golf	GOLF
H	Hotel	HOH TELL
I	India	IN DEE AH
J	Juliett	JEW LEE ETT
K	Kilo	KEY LOH
L	Lima	LEE MAH
M	Mike	MIKE
N	November	NO VEM BER
O	Oscar	OSS CAH
P	Papa	PAH PAH
Q	Quebec	KEH BECK
R	Romeo	ROW ME OH
S	Sierra	SEE AIRRAH
T	Tango	TANG GO
U	Uniform	YOU NEE FORM (or OO NEE FORM)
V	Victor	VIK TAH
W	Whiskey	WISS KEY
X	X-ray	ECKS RAY
Y	Yankee	YANG KEY
Z	Zulu	ZOO LOO

* The syllables to be emphasized are underlined.

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Public service:
Emergency and non-emergency operations

One of the reasons amateur radio exists at all is that ham radio operators are uniquely set up to provide emergency and public-service communications.

As a result, many hams consider it an obligation to be prepared to help out when called upon to do so.

This includes having the proper equipment and knowing the proper operating procedures.

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Public service:

Emergency and non-emergency operations

There are two organizations that provide emergency communications:

- Radio Amateur Civil Emergency Service (**RACES**) , an ***FCC part 97 amateur radio service for civil defense communications during national emergencies***. (T2C04)
- Amateur Radio Emergency Service (ARES).

Both organizations may provide communications during emergencies.

The Amateur Radio Emergency Service (ARES) is ***a group of licensed amateurs who have voluntarily registered their qualifications and equipment for communications duty in the public service.*** (T2C06)

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Public service:
Emergency and non-emergency operations

All of these choices are correct when describing the Radio Amateur Civil Emergency Service (RACES) (T1A10):

- A radio service using amateur frequencies for emergency management or civil defense communications
- A radio service using amateur stations for emergency management or civil defense communications
- An emergency service using amateur operators certified by a civil defense organization as being enrolled in that organization

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Public service:

Emergency and non-emergency operations

When an emergency occurs, it's common for amateur radio operators to form a network or "net" to facilitate emergency communications. The net is led by the net control station, whose job it is to make sure that messages are passed in an efficient and timely manner.

Typical duties of a Net Control Station are to ***call the net to order and direct communications between stations checking in***. (T2C02)

Stations other than the net control station are said to "check into" the net. An accepted practice for an amateur operator who has checked into an emergency traffic net is to ***remain on frequency without transmitting until asked to do so by the net control station.*** (T2C07

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Public service:
Emergency and non-emergency operations

The term for messages passed between stations in an emergency net is "traffic," and the process of passing messages to and from amateur radio stations is called "handling traffic." Message traffic may be formal or informal. A characteristic of good emergency traffic handling is ***passing messages exactly as received***. (T2C08)

To insure that voice message traffic containing proper names and unusual words are copied correctly by the receiving station***, such words and terms should be spelled out using a standard phonetic alphabet.***
(T2C03)

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Public service:

Emergency and non-emergency operations

Formal traffic messages consists of four parts: preamble, address, text, signature. The **preamble in a formal traffic** message ***is the information needed to track the*** message as it passes through the amateur radio traffic handling system. (T2C10)

Part of the preamble is the check. ***The check is a count of the number of words or word equivalents in the text portion of the message***. (T2C11)

The address is the name and address of the intended recipient, the text is the message itself, and the signature is the part of the message that identifies the originator of the message.

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Public service:
Emergency and non-emergency operations

An important thing to remember is that ***FCC rules always apply*** to the operation of an amateur station. (T2C01)

Amateur station control operators are permitted to operate outside the frequency privileges of their license class ***only if necessary in situations involving the immediate safety of human life or protection of property***. (T2C09)

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Amateur satellite operation

Amateur satellite operation, Doppler shift, basic orbits, operating protocols, control operator, transmitter power considerations, satellite tracking, digital modes

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One Day **Amateur Radio License - Technician License**

Amateur satellite operation

As a Technician Class licensee, you can make contacts via amateur radio satellites.

Amateur satellites are basically repeaters in space. As such they have an uplink frequency, which is the frequency on which you transmit and the satellite receives, and a downlink frequency, on which the satellite transmits and you receive. As with other transmissions, the minimum amount of power needed to complete the contact should be used on the uplink frequency of an amateur satellite or space station to ***avoid blocking access by other users.*** (T8B02)

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Amateur satellite operation

Often, the uplink frequency and downlink frequency are in different amateur bands. For example, when a satellite is operating in "**mode U/V**'***, the satellite uplink is in the 70 cm band and the downlink is in the 2 meter band***. (T8B08)

The 70 cm band is in the UHF portion of the spectrum, while the 2 meter band is in the VHF portion of the spectrum hence the term, "U/V".

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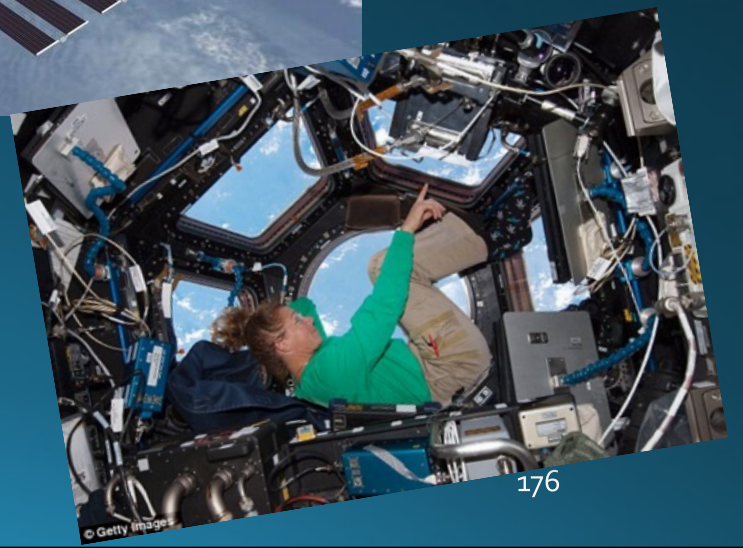
Amateur satellite operation



The International Space Station often has amateur radio operators on board. ***Any amateur holding a Technician or higher class license*** may make contact with an amateur station on the International Space Station using 2 meter and 70 cm band amateur radio frequencies. (T1B02)

Like most amateur satellites, the Space Station is in low earth orbit. When used to describe an amateur satellite, the initials LEO means ***that the satellite is in a Low Earth Orbit.*** (T8B10)

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One Day **Amateur Radio License - Technician License**

Amateur satellite operation

Amateur satellites are often equipped with beacons. A satellite beacon is ***a transmission from a space station that contains status information about a satellite***. (T8B05)

How do you know when you are able to communicate via an amateur satellite? A satellite **tracking program** can ***show real-time maps of position, time, azimuth, and maximum elevation of the pass as well as the apparent frequency of the satellite, even the effects of dopplar shift***. (T8B03)

The Keplerian elements are inputs to a satellite tracking program. (T8B06)

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One Day **Amateur Radio License - Technician License**

Amateur satellite operation

Two problems that you must deal with when communicating via satellite is Doppler shift and spin fading.

Doppler shift is ***an observed change in signal frequency caused by relative motion between the satellite and the earth station***. (T8B07)

Rotation of the satellite and its antennas causes "spin fading" of satellite signals. (T8B09)

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Operating activities:

- Radio direction finding,
- Radio control,
- Contests,
- Linking over the Internet,
- Grid locators

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One Day **Amateur Radio License - Technician License**

Operating activities:

There are many different ways to have fun with amateur radio.

Contesting, for example, is a popular operating activity that involves contacting as many stations as possible during a specified period of time. (T8C03)

When contacting another station in a radio contest, a good procedure is ***to send only the minimum information needed for proper identification and the contest exchange.*** (T8C04)

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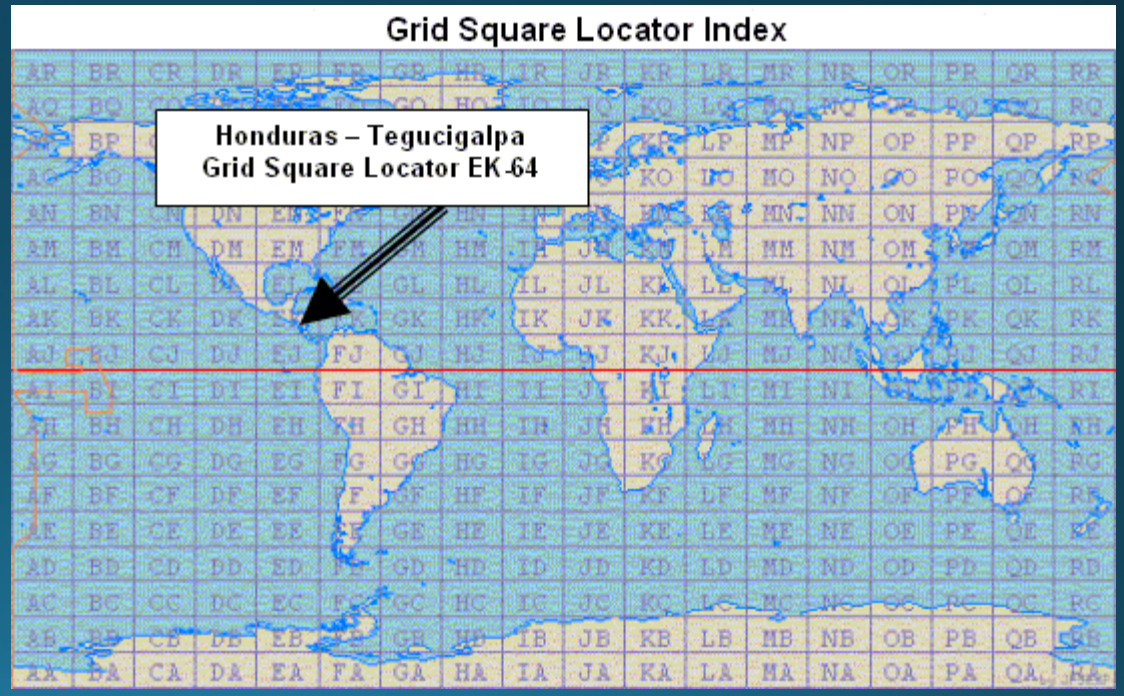
Operating activities:

In VHF/UHF contests, stations often send each other their grid locators.

A grid locator ***is a letter-number designator assigned to a geographic location***. (T8C05)

Pahrump
QTH locator : DM26AE



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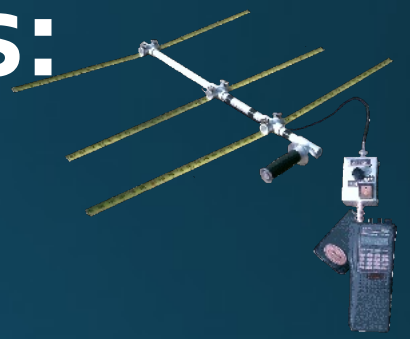
Operating activities:



One fun activity that is very practical is radio direction finding.

You would use radio direction finding equipment and skills to participate in a hidden transmitter hunt, sometimes called a "fox hunt."

In addition to participating in this kind of contest, ***radio direction finding*** is one of the methods used to locate sources of noise interference or jamming. (T8C01)

A directional antenna would be useful for a hidden transmitter hunt. (T8C02)

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Operating activities:

If the only radios that you have are VHF or UHF radios, you might want to look into EchoLink and the Internet Radio Linking Project (IRLP).

The Internet Radio Linking Project (IRLP) is ***a technique to connect amateur radio systems, such as repeaters, via the Internet using Voice Over Internet Protocol (VoIP)***. (T8C08)

VoIP is a ***method of delivering voice communications over the internenet using digital techniques***. (T8C07)

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Operating activities:

- Stations can use ***EchoLink*** **to transmit through a repeate without using a radio to initiate the transmission.** (T8C09)
- You access an IRLP node ***by using DTMF signals***. (T8C06)
- Before using the **EchoLink** system operators ***must register their coall sign and provide proof of license***. (T8C10)
- Sometimes nodes are also called gateways. ***A gateway*** is the name given to an amateur radio station that is **used to connect other amateur stations to the Internet.** (T8C11)

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FCC Rules:

- *The FCC* is the agency that regulates and enforces the rules for the Amateur Radio Service in the United States. (T1A02)

- *Advancing skills in the technical and communication phases of the radio art* is a purpose of the Amateur Radio Service as stated in the FCC rules and regulations. (T1A01)

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FCC Rules:

Part 97 also defines terms and concepts that every amateur radio operator needs to know. Here are some examples:

- The FCC Part 97 definition of a **space station** is ***a amateur station located more than 50 miles above the Earth's surface.*** (T1A07)
- An amateur ***station transmitting communication for observing propagation or related experimental activities*** is the FCC Part 97 definition of a **beacon**. (T1A06)

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FCC Rules:

At no time is willful interference to other amateur radio stations permitted. (T1A11)

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FCC Rules:

The *Radionavigation Service* is one of the services that are protected from interference by amateur signals under all circumstances. (T1A06)

If you are operating on the 23 cm band and learn that you are interfering with a radiolocation station outside the United States, you must ***stop operating or take steps to eliminate the harmful interference***. (T1A14)

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FCC Rules:

FCC Part 97 **that one person** may ***hold only one operator/primary station license***. (T1A04)

The ***appearance of the license in the FCC ULS database*** is the primary proof the **FCC has issued an operator/primary license** grant. (T1A05)

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FCC Rules:

The *Frequency Coordinator* is the entity that recommends transmit/receive channels and other parameters for auxiliary and repeater stations. (T1A08)

Amateur operators in a local or regional area whose stations are eligible to be auxiliary or repeater stations select a Frequency Coordinator. (T1A09)

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Authorized frequencies:

The ITU is **a** *United Nations agency for information and communication technology issues.*(T1B01)
There are three ITU regions. North American amateur stations are located in ITU region 2.

One of the reasons that it is important to know about the ITU zones is that different zones often have different frequency assignments. For example, the frequency assignments for some U.S. Territories are different from those in the 50 U.S. States because ***some U. S. Territories are located in ITU regions other than region 2***. (T1B02)

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Authorized frequencies:

Similarly, frequency assignments for U.S. stations operating maritime mobile are not the same everywhere in the world because ***amateur frequency assignments can vary among the three ITU regions***. (T1B12)

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Authorized frequencies:

Because operation outside of the amateur radio bands is a serious offense, it is important to know about the frequencies and bands that amateur radio operators can use:

- ***52.525 MHz*** **is a** frequency within the 6 meter band. (T1B03)
- The ***2 meter band*** is the amateur band are you using when your station is transmitting on 146.52 MHz. (T1B04)
- Technician class operators my use **phone on HF** ***only in the 10 meter band***.(T1B06) These are the frequencies ***28.3 – 28.5 MHz***. (T1B01)
- **50.0 – 50.1 MHz and 144.0 – 144.1 MHz** are ***limited to CW only***. (T1B07)
- **219 – 220 MHz in the 1.25 meter band** is for ***fixed digital message forwarding systems only***. (T1B05)

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Authorized frequencies:

All of these choices are correct when thinking about why you should **not** set your transmit frequency to be **exactly at the edge of an amateur band** or sub-band (T1B09):

- To allow for calibration error in the transmitter frequency display
- So that modulation sidebands do not extend beyond the band edge
- To allow for transmitter frequency drift

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Authorized frequencies:

Amateur radio operators share some bands with users from other services.

Sometimes, amateurs are the primary users, such as the 2m band, but sometimes amateur radio operators are secondary users.

One result of the fact that the amateur service is secondary in some portions of the 70 cm band is ***that U.S. amateurs may find non-amateur stations in the bands, and must avoid interfering with them***. (T1B08) [97.303]

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One Day **Amateur Radio License - Technician License**

Operator licensing:

Technician, General, Amateur Extra are the license classes for which new licenses are currently available from the FCC. (T1C01)

You may operate a transmitter on an amateur service frequency after you pass the examination required for your first amateur radio license ***as soon as your name and call sign appear in the FCC's ULS database*** (T1C10).

Ten years is the normal term for an FCC-issued primary station/operator amateur radiolicense grant (T1C08). With a ***two year grace period for renewal*** after it expires. (T1C09)

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One Day **Amateur Radio License - Technician License**

Operator licensing:

When the FCC issues an amateur radio operator license, it also issues a station license. The call sign of that station consists of one or two letters, followed by a number and then one, two, or three letters.

KF1XXX is an example of a valid US Technician class call sign (T1C05).

After you pass the test, the FCC will assign you a call sign sequentially from the pool of available call signs. If you do not like this call sign, you can apply for a vanity call sign.

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One Day **Amateur Radio License - Technician License**

Operator licensing:

Any licensed amateur may select a desired call sign under the vanity call sign rules. (T1C02)

The call sign you select must not only be available, it must have an appropriate format for the class of license you hold.
Extra class licensees are the only ones who may hold 1x2 or 2x1 call signs.

K1XXX is, therefore, a vanity call sign which a Technician class amateur operator might select if available. (T1C05)

A Technician class amateur radio operator may not choose the call signs KA1X or W1XX.

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Operator licensing:

Clubs may apply for a station license for their club station. The club may even apply for a vanity call sign. ***At least 4*** persons are required to be members of a club for a club station license to be issued by the FCC. (T1F11)

When you get your first license, you must give the examiners a mailing address. Should you move, you must inform the FCC of your new mailing address. ***Revocation of the station license or suspension of the operator license*** may result when correspondence from the FCC is returned as undeliverable because the grantee failed to provide the correct mailing address (T1C07).

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Operator licensing:

You can also operate your station while aboard a ship in international waters.

An FCC- licensed amateur station may transmit ***from any vessel or craft located in international waters and documented or registered in the United States***, in addition to places where the FCC regulates communications (T1C06)

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Authorized and prohibited transmission: communications with other countries, music, exchange of information with other services, indecent language, compensation for use of station, retransmission of other amateur signals, codes and ciphers, sale of equipment, unidentified transmissions, broadcasting

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Authorized and prohibited transmission:

As a licensed radio amateur, it's important to know what you can and can't do on the air.

For example***, any language*** that is considered obscene or indecent *is prohibited*. (T1D06).

For the most part, transmitting music is also prohibited. The only time an amateur station is authorized to transmit music is ***when incidental to an authorized retransmission of manned spacecraft communications*** (T1D04).

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Authorized and prohibited transmission:

Transmitting any codes whose specifications are not published or well-known is prohibited. The transmission of codes or ciphers that hide the meaning of a message transmitted by an amateur station is allowed only when transmitting control commands to space stations or radio control craft **(T1D03).**

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Authorized and prohibited transmission:

FCC-licensed amateur stations are prohibited from exchanging communications with ***any country whose administration has notified the ITU that it objects to such communications.*** (T1D01)

Currently, there are no countries that U.S. amateurs are prohibited from contacting.

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Authorized and prohibited transmission:

Amateur radio operators may not use their stations to make money, except in some very special circumstances. For example, the control operator of an amateur station may receive compensation for operating the station only ***when the communication is incidental to classroom instruction at an educational institution*** (T1D08).

Amateur radio operators may use their stations to notify other amateurs of the availability of equipment for sale or trade, but only ***when the equipment is normally used in an amateur station and such activity is not conducted on a regular basis*** (T1D05).

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Authorized and prohibited transmission:

All amateur communications must be station to station. That is to say, amateur radio operators may not broadcast. The term broadcasting in the FCC rules for the amateur services means ***transmissions intended for reception by the general public*** (T1D10).

Amateur stations may **not engage in one-way transmissions that are *broadcasting***. (T1D02)

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Authorized and prohibited transmission:

Amateur stations are authorized to transmit signals related to broadcasting, program production, or news gathering, assuming no other means is available, ***only where such communications directly relate to the immediate safety of human life or protection of property.*** (T1D09).

So, what is allowed? ***Communications incidental to the purposes of the amateur service and remarks of a personal character*** are the types of international communications that are permitted to an FCC-licensed amateur station. (T1C03).

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Control operator and control types:

An important concept in amateur radio is the control operator. The FCC presumes ***the station licensee*** to be the control operator of an amateur station, unless documentation to the contrary is in the station records. (T1E11)

An amateur station is ***never*** permitted to transmit without a control operator. (T1E01)

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Control operator and control types:

The station licensee must designate the station control operator. (T1E03)

When the control operator is not the station licensee, ***the control operator and the station licensee are equally responsible*** for the proper operation of the station. (T1E07)

The control operator of the originating station is accountable should a repeater inadvertently retransmit communications that violate the FCC rules. (T1F10)

During remote control the control operator is required at all times, must be at the control point, must indirectly manipulate the controls. *(T1E09)*

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Control operator and control types:

The class of operator license held by the control operator determines the transmitting privileges of an amateur station. (T1E04)

At no time, under normal circumstances, may a Technician Class licensee be the control operator of a station operating in an exclusive Extra Class operator segment of the amateur bands. (T1E06)

Two related concepts are the control type and control point. An amateur station control point ***is the location at which the control operator function is performed***. (T1E05)

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Control operator and control types:

Operating the station over the Internet is an example of remote control as defined in Part 97. (T1E10)

Repeater operation is an example of automatic control. (T1E08)

Any amateur allowed to transmit on the uplink frequency may communicate through an amateur satellite. (T1E02)

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Station identification, repeaters, third party communications, club stations, FCC inspection

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Station identification

.Proper station identification is also very important.
The basic rule is that an amateur station is required to transmit its assigned call sign **at *least every 10 minutes during and at the end of a communication*.** (T1F03)

The only time an amateur station may transmit without identifying is ***when transmitting signals to control a model craft***. (T1D11)

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Station identification

The English language is the only acceptable language for use for station identification when operating in a phone sub-band. (T1F04)

Sending the call sign using CW or phone **emission** is the required method of call sign identification for a station transmitting phone signals.
(T1F05)

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Station identification

When using tactical identifiers such as “Race Headquarters” during a community service net operation, your station must transmit the station’s FCC-assigned call sign ***at the end of each communication and every ten minutes during a communication***. (T1F02)

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Station identification

When operating mobile or portable, or when you wish to note something about your station, you may use a self-assigned call sign indicator, such as "/3," "mobile," or "QRP." ***All of these choices are correct*** when choosing formats for self-assigned indicators that are acceptable when identifying using a phone transmission. (T1F06)

- •KL7CC stroke W3
- •KL7CC slant W3
- •KL7CC slash W3

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Station identification

Third-party communications are **messages from a control operator to another amateur station control operator on behalf of another person**. (T1F08) For example, if you have a friend over to your house and let him or her talk on your radio, that is a third-party communication.

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Station identification

A non-licensed person is allowed to speak to a foreign station using a station under the control of a Technician Class control operator only if ***the foreign station is one with which the U.S. has a third party agreement***. (T1F07)

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Station identification

Finally—and I do mean finally—the station licensee must make the station and its records available for FCC inspection ***any time upon request by an FCC representative***. (T1F01) They're not going to knock on your door at 3 a.m. some morning to take a look at your shack, but one of your obligations as a licensee is to make your station and your records available when requested to do so.

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Whew!