

AHØA Technician Class  
Exam Study Notes  
for use  
7/1/2010-6/30/2013

# T1 - FCC Rules, Descriptions And Definitions For The Amateur Radio Service, Operator And Station License Responsibilities

The Amateur Radio Service is intended for persons who are interested in radio technique solely with a personal aim and without pecuniary interest.

The agency that regulates and enforces the rules for the Amateur Radio Service in the United States is the FCC. The station licensee must make the station and its records available for FCC inspection at any time upon request by an FCC representative.

Part 97 of the FCC rules contains the rules and regulations governing the Amateur Radio Service. The FCC Part 97 definitions are:

- ε space station - an amateur station located more than 50 km above the Earth's surface
- ε telecommand - a one-way transmission to initiate, modify or terminate functions of a device at a distance
- ε telemetry - a one-way transmission of measurements at a distance from the measuring instrument
- ε amateur station - a station in the Amateur Radio Service consisting of apparatus necessary for radio communications

The type of amateur station that simultaneously retransmits the signal of another amateur station on a different channel or channels is called a **repeater station**. An **auxiliary station** transmits signals over the air from a remote receive site to a repeater for retransmission.

Amateur operators in a local or regional area whose stations are eligible to be auxiliary or repeater stations select a Frequency Coordinator. The Frequency Coordinator recommends transmit/receive channels and other parameters for auxiliary and repeater stations.

The FCC definition of harmful interference is a transmission which seriously degrades, obstructs, or repeatedly interrupts a radio communication service operating in accordance with the Radio Regulations.

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The ITU is a United Nations agency for information and communication technology issues. North American amateur stations are located in ITU Region 2.

When an amateur frequency band is said to be available on a secondary basis the FCC rules mean that amateurs may not cause harmful interference to primary users.

The bands available to Technician Class operators that have mode-restricted sub-bands are the 6 meter, 2 meter, and 1.25 meter bands. The emission mode permitted in the mode-restricted sub-bands at 50.0 to 50.1 MHz and 144.0 to 144.1 MHz is CW only.

- ε A frequency within the 6 meter band is 52.525 MHz
- ε The amateur band you are using when your station is transmitting on 146.52 MHz is 2 meter band
- ε The amateur band you are using if you are transmitting on 223.50 MHz is 1.25 meter band
- ε A 70 cm frequency authorized to a Technician Class license holder operating in ITU Region 2 is 443.350 MHz
- ε A 23 cm frequency is authorized to a Technician Class operator license is 1296 MHz.

All of the following choices are correct; you should not set your transmit frequency to be exactly at the edge of an amateur band or sub-band

- A. to allow for calibration error in the transmitter frequency display
- B. so that modulation sidebands do not extend beyond the band edge
- C. to allow for transmitter frequency drift

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A valid US amateur radio station call sign is W3ABC. Callsigns that have a single letter in both the prefix and suffix are special event callsigns.

The normal term for an FCC-issued primary station/operator license grant is ten years. The grace period following the expiration of an amateur license within which the license may be renewed is two years.

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. If your license has expired and is still within the allowable grace period, transmitting is not allowed until the ULS database shows that the license has been renewed.

When correspondence from the FCC is returned as undeliverable because the grantee failed to provide the correct mailing address, revocation of the station license or suspension of the operator license may occur.

In addition to places where the FCC regulates communications, you may transmit from an FCC-licensed amateur station from any vessel or craft located in international waters and documented or registered in the United States.

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.

The types of international communications permitted by an FCC-licensed amateur station are communications incidental to the purposes of the amateur service and remarks of a personal character.

You are allowed to operate your amateur station in a foreign country when the foreign country authorizes it. The FCC rules authorize the transmission of non-emergency third party communications to any station whose government permits such

communications.

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An FCC-licensed amateur station may exchange messages with a U.S. military station during an Armed Forces Day Communications Test. FCC-licensed amateur stations are prohibited from exchanging communications with any country whose administration has notified the ITU that it objects to such communications.

An amateur station is authorized to automatically retransmit the radio signals of other amateur stations when the signals are from an auxiliary, repeater, or space station.

The only time an amateur station is authorized to transmit music is when incidental to an authorized retransmission of manned spacecraft communications. The transmission of codes or ciphers allowed to hide the meaning of a message transmitted by an amateur station is permitted only when transmitting control commands to space stations or radio control craft. Transmissions that contain obscene or indecent words or language are prohibited.

The control operator of an amateur station may receive compensation for operating the station when the communication is incidental to classroom instruction at an educational institution. Amateur radio operators may use their stations to notify other amateurs of the availability of equipment for sale or trade when the equipment is normally used in an amateur station and such activity is not conducted on a regular basis.

The term broadcasting in the FCC rules for the amateur services means transmissions intended for reception by the general public. Only where such communications directly relate to the immediate safety of human life or protection of property are amateur stations authorized to transmit signals related to broadcasting, program production, or news gathering, assuming no other means is available.

Brief transmissions to make station adjustments are a type of communications permitted in the Amateur Radio Service.

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An amateur station must have a control operator only when the station is transmitting. The station licensee must designate the station control operator. Only a person for whom an amateur operator/primary station license grant appears in the FCC database or who is authorized for alien reciprocal operation is eligible to be the control operator of an amateur station.

The FCC presumes the station licensee is the control operator of an amateur station unless documentation to the contrary is in the station records. Should a repeater inadvertently retransmit communications that violate the FCC rules the control operator of the originating station is accountable. 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.

The class of operator license held by the control operator determines the transmitting privileges of an amateur station. A Technician Class licensee may never be the control operator of a station operating in an exclusive Extra Class operator segment of the amateur bands.

The location at which the control operator function is performed is the amateur station control point. The type of control being used for a repeater when the control operator is not present at a control point is called automatic control. Under automatic control it is permissible for the control operator to be at a location other than the control point.

The type of control being used when transmitting using a handheld radio is called Local control.

The type of control used when the control operator is not at the station location but can indirectly manipulate the operating adjustments of a station is called remote control.

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Methods of call sign identification required for a station transmitting phone signals include sending the call sign using CW or phone emission. The English language is an acceptable language for use for station identification when operating in a phone sub-band.

When appending a self-assigned call sign indicator it must not conflict with any other indicator specified by the FCC rules or with any call sign prefix assigned to another country. All of the following choices are correct; these self-assigned indicators are acceptable when identifying a phone transmission,

- A. KL7CC stroke W3
- B. KL7CC slant W3
- C. KL7CC slash W3

The type of identification being used when identifying a station on the air as "Race Headquarters" is a tactical call. When using tactical identifiers, your station must transmit the station's FCC-assigned call sign every ten minutes. An amateur station is required to transmit its assigned call sign at least every 10 minutes during and at the end of a contact.

At least 4 persons are required to be members of a club for a club station license to be issued by the FCC.

## T2 - Operating Procedures

The common meaning of the term "repeater offset" is the difference between the repeater's transmit and receive frequencies. The most common repeater frequency offset in the 2 meter band is plus or minus 600 kHz. A common repeater frequency offset in the 70 cm band is plus or minus 5 MHz.

The national calling frequency for FM simplex operations in the 70 cm band is 446.000 MHz.

The procedural signal "CQ" means calling any station. A brief statement often used in place of "CQ" to indicate that you are listening on a repeater is to say your call sign.

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

An amateur operator must properly identify the transmitting station when making on-air transmissions to test equipment or antennas. When making a test transmission station identification is required at least every ten minutes during the test and at the end.

A band plan, beyond the privileges established by the FCC is a voluntary guideline for using different modes or activities within an amateur band.

FCC rules regarding power levels used in the amateur bands require an amateur must use the minimum transmitter power necessary to carry out the desired communication.

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The term used to describe an amateur station that is transmitting and receiving on the same frequency is simplex communication.

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

The muting of receiver audio controlled solely by the presence or absence of an RF signal is called carrier squelch.

All of the following choices are correct; common problems that might cause you to be able to hear but not access a repeater even when transmitting with the proper offset are,

- ⋄ 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

The amount of deviation of an FM signal is determined by the amplitude of the modulating signal. When the deviation of an FM transmitter is increased its signal occupies more bandwidth.

If you receive a report that your station's transmissions are causing splatter or interference on nearby frequencies you should check your transmitter for off-frequency operation or spurious emissions. If a transmitter is operated with the microphone gain set too high the output signal might become distorted.

The method encouraged by the FCC when identifying your station when using phone is the use of a phonetic alphabet.

The proper course of action, if your station's transmission unintentionally interferes with another station, is to properly identify your transmission and move to a different frequency.

The "Q" signal used to indicate that you are receiving interference from other stations is QRM. The "Q" signal used to indicate that you are changing frequency is QSY.

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The set of rules that applies to proper operation of your station when using amateur radio at the request of public service officials is the FCC Rules.

An amateur station may use any means of radio communications at its disposal for essential communications in connection with immediate safety of human life and protection of property when normal communications systems are not available.

The Radio Amateur Civil Emergency Service is a radio service using amateur stations for emergency management or civil defense communications. RACES and ARES have in common that both organizations may provide communications during emergencies.

A common practice during net operations to get the immediate attention of the net control station when reporting an emergency is to begin your transmission with "Priority" or "Emergency" followed by your call sign. To minimize disruptions to an emergency traffic net once you have checked in you should not transmit on the net frequency until asked to do so by the net control station.

The most important job of an amateur operator when handling emergency traffic messages is to Pass messages exactly as written, spoken or as received. 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. The term "check" in reference to a formal traffic message is a count of the number of words or word equivalents in the text portion of the message.

## T3 - Radio Wave Characteristics, Radio And Electromagnetic Properties,

# Propagation Modes

The type of wave that carries radio signals between transmitting and receiving stations is an **electromagnetic wave**.

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**.

If another operator reports that your station's 2 meter signals were strong just a moment ago, but now they are weak or distorted you should **try moving a few feet, as random reflections may be causing multi-path distortion**.

If the antennas at opposite ends of a VHF or UHF line of sight radio link are not using the same polarization the **signals could be significantly weaker**.

When using a directional antenna, your station might be able to access a distant repeater, even if buildings or obstructions are blocking the direct line of sight path, by **trying to find a path that reflects signals to the repeater**.

The term most commonly used to describe the rapid fluttering sound sometimes heard from mobile stations that are moving while transmitting is **picket fencing**.

The part of the atmosphere that enables the propagation of radio signals around the world is the **ionosphere**.

The antenna polarization normally used for long-distance weak-signal CW and SSB contacts using the VHF and UHF bands is **horizontal polarization**.

A common effect of "skip" reflections between the Earth and the ionosphere is that the **polarization of the original signal is randomized**. A 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**.

If VHF or UHF data signals propagate over multiple paths the **error rates are likely to increase**.

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Two components of a radio wave are the **electric and magnetic fields**.

The term that describes the number of times per second that an alternating current reverses direction is the **frequency**. The name for the distance a radio wave travels during one complete cycle is the **wavelength**.

A radio wave travels through free space **at the speed of light**. The approximate velocity of a radio wave as it travels through free space is **300,000,000 meters per second**. The formula for converting frequency to wavelength in meters is "**wavelength in meters equals 300 divided by frequency in megahertz**". The wavelength of a radio wave relates inversely to its frequency - **the wavelength gets shorter as the frequency increases**.

The property of radio waves that is often used to identify the different frequency bands is **the approximate wavelength**.

- ε The frequency range referred to as HF is **3 to 30 MHz**
  - ε The frequency limits of the VHF spectrum are **30 to 300 MHz**
  - ε The frequency limits of the UHF spectrum are **300 to 3000 MHz**
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"Direct" (not via a repeater) UHF signals are rarely heard from stations outside your local coverage area because **UHF signals are usually not reflected by the ionosphere**.

When VHF signals are being received from long distances it is because **signals are being refracted from a sporadic E layer**. The propagation type most commonly associated with occasional strong over-the-horizon signals on the 10, 6, and 2 meter bands is **Sporadic E**.

The best time for long-distance 10 meter band propagation is **during daylight hours**.

The band best suited to communicating via meteor scatter is **6 meters**.

A characteristic of VHF signals received via auroral reflection is the **signals exhibit rapid fluctuations of strength and often sound distorted**.

The mode responsible for allowing over-the-horizon VHF and UHF communications to ranges of approximately 300 miles on a regular basis is **Tropospheric scatter**. "Tropospheric ducting" is caused by **temperature inversions in the atmosphere**.

The radio horizon is the **distance at which radio signals between two points are effectively blocked by the curvature of the Earth**. VHF and UHF radio signals usually travel somewhat farther than the visual line of sight distance between two stations because the **Earth seems less curved to radio waves than to light**.

The term "knife-edge" propagation means **signals are partially refracted around solid objects exhibiting sharp edges**.

## T4 - Amateur Radio Practices And Station Set Up

Some of the microphone connectors on amateur transceivers include push-to-talk and voltages for powering the microphone.

A set of headphones could be used in place of a regular speaker to help you copy signals in a noisy area.

A good reason to use a regulated power supply for communications equipment is it prevents voltage fluctuations from reaching sensitive circuits.

A filter must be installed between the transmitter and the antenna to reduce harmonic emissions.

A band-reject filter should be connected to a TV receiver as the first step in trying to prevent RF overload from a nearby 2 meter transmitter.

A terminal node controller would be connected between a transceiver and computer in a packet radio station.

When conducting digital communications using a computer the sound card provides audio to the microphone input and converts received audio to digital form.

A Flat strap conductor is best to use for RF grounding.

A ferrite choke is used to reduce RF current flowing on the shield of an audio cable.

The source of a high-pitched whine that varies with engine speed in a mobile transceiver's receive audio is the alternator.

A mobile transceiver's power negative connection should be made at the battery or engine block ground strap.

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The keypad or VFO knob can be used to enter the operating frequency on a modern transceiver. A way to enable quick access to a favorite frequency on your transceiver is to store the frequency in a memory channel.

The purpose of the squelch control on a transceiver is to mute receiver output noise when no signal is being received.

To reduce ignition interference to a receiver, turn on the noise blanker.

The term "RIT" means Receiver Incremental Tuning. The receiver RIT or clarifier could be used if the voice pitch of a single-sideband signal seems too high or low.

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.

An appropriate receive filter to select in order to minimize noise and interference for CW reception is 500 Hz.

An appropriate receive filter to select in order to minimize noise and interference for SSB reception is 2400 Hz.



## T5 - Electrical Principles, Math For Electronics, Electronic Principles, Ohm's Law

The term that describes the rate at which electrical energy is used is **power**. Electrical power is measured in **watts**.

The electrical term for the electromotive force (EMF) that causes electron flow is **voltage**. The basic unit of electromotive force is the **volt**.

The name for the flow of electrons in an electric circuit is **current**. Electrical current is measured in **amperes**. The name for a current that flows only in one direction is **Direct Current**. The name for a current that reverses direction on a regular basis is **Alternating Current**.

**Copper** is a good electrical conductor. **Glass** is a good electrical insulator.

A mobile transceiver usually requires about **12 volts**.

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A current flow of 1.5 amperes is the same as **1,500 milliamperes**. If an ammeter calibrated in amperes is used to measure a 3000-milliamperere current, it would show a reading of **3 amperes**.

One kilovolt is the same as **one thousand volts**. One microvolt is equal to **one one-millionth of a volt**.

There 1,000,000 picofarads in **1 microfarad**.

A power of **0.5 watts** is equivalent to **500 milliwatts**. The approximate amount of change, measured in decibels (dB), of a power increase from 5 watts to 10 watts is **3 dB**.

The approximate amount of change, measured in decibels (dB), of a power decrease from 12 watts to 3 watts is **6 dB**.

The approximate amount of change, measured in decibels (dB), of a power increase from 20 watts to 200 watts is **10 dB**.

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The ability to store energy in an electric field is called **Capacitance**. The basic unit of capacitance is the **farad**.

The ability to store energy in a magnetic field is called **Inductance**. The basic unit of inductance is the **henry**.

The usual name for electromagnetic waves that travel through space is **radio waves**. The abbreviation that refers to radio frequency signals of all types is **RF**. The unit of frequency is the **Hertz**.

A radio signal frequency of 1,500,000 hertz is the same as **1500 kHz**.

A frequency readout calibrated in megahertz shows 3.525 MHz, if it were calibrated in kilohertz, it would show **3525 kHz**.

The formula used to calculate electrical power in a DC circuit is **Power (P) equals voltage (E) multiplied by current (I)**.

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

The power being used in a circuit when the applied voltage is 12 volts DC and the current is 2.5 amperes is **30 watts**.

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The formula used to calculate voltage in a circuit is **voltage (E) equals current (I) multiplied by resistance (R)**.

The voltage across a 2-ohm resistor if a current of 0.5 amperes flows through it is **1 volt**.

The voltage across a 10-ohm resistor if a current of 1 ampere flows through it is **10 volts**.

The voltage across a 10-ohm resistor if a current of 2 amperes flows through it is **20 volts**.

The formula used to calculate current in a circuit is **current (I) equals voltage (E) divided by resistance (R)**.

The amperes flowing in a circuit when the applied voltage is 12 volts DC and the load is 120 watts is **10 amperes**.

The current flow in a circuit with an applied voltage of 120 volts and a resistance of 80 ohms is **1.5 amperes**.

The current flowing through a 100-ohm resistor connected across 200 volts is **2 amperes**.

The current flowing through a 24-ohm resistor connected across 240 volts is **10 amperes**.

The formula used to calculate resistance in a circuit is **resistance (R) equals voltage (E) divided by current (I)**.

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

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

The resistance of a circuit that draws 4 amperes from a 12-volt source is **3 ohms**.

## T6 - Electrical Components, Semiconductors, Circuit Diagrams, Component Functions

The electrical component used to oppose the flow of current in a DC circuit is the **Resistor**. The electrical parameter is controlled by a potentiometer is **resistance**. The component often used as an adjustable volume control is the **potentiometer**.

The electrical component that stores energy in an electric field is the **capacitor**. An electrical component that consists of two or more conductive surfaces separated by an insulator is the **capacitor**.

The electrical component that stores energy in a magnetic field is the **inductor**. The electrical component usually composed of a coil of wire is the **inductor**.

The electrical component used to connect or disconnect electrical circuits is the **switch**.

The electrical component used to protect other circuit components from current overloads is the **fuse**.

The nominal voltage of a fully charged nickel-cadmium cell is **1.2 volts**. A type of battery that is not rechargeable is a **Carbon-zinc battery**.

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A class of electronic components capable of using a voltage or current signal to control current flow is the **transistor**. A component that can be used as an electronic switch or amplifier is the **transistor**. An electronic component that can amplify signals is the **transistor**. The term that describes a transistor's ability to amplify a signal is **gain**.

A component made of three layers of semiconductor material is a **bipolar junction transistor**. The semiconductor component that has an emitter electrode is the **Bipolar transistor**.

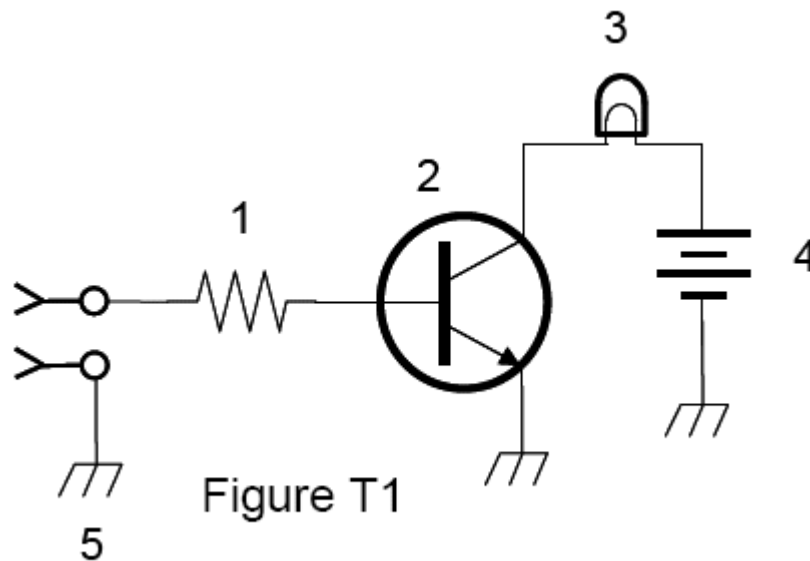
An electronic component that allows current to flow in only one direction is the **diode**. The names of the two electrodes of a diode are **anode and cathode**.

A semiconductor diode's cathode lead is usually identified **with a stripe**.

The abbreviation "FET" stand for **Field Effect Transistor**. The semiconductor component that has a gate electrode is the **Field Effect Transistor**.

The abbreviation "LED" stands for **Light Emitting Diode**.

The name for standardized representations of components in an electrical wiring diagram is **schematic symbols**. Symbols on an electrical circuit schematic diagram represent **electrical components**. The way components are interconnected is accurately represented in electrical circuit schematic diagrams.



Component 1 in Figure T1 is a **resistor**. Component 2 in Figure T1 is a **transistor**. Component 3 in Figure T1 is a **lamp**. Component 4 in Figure T1 is a **battery**.

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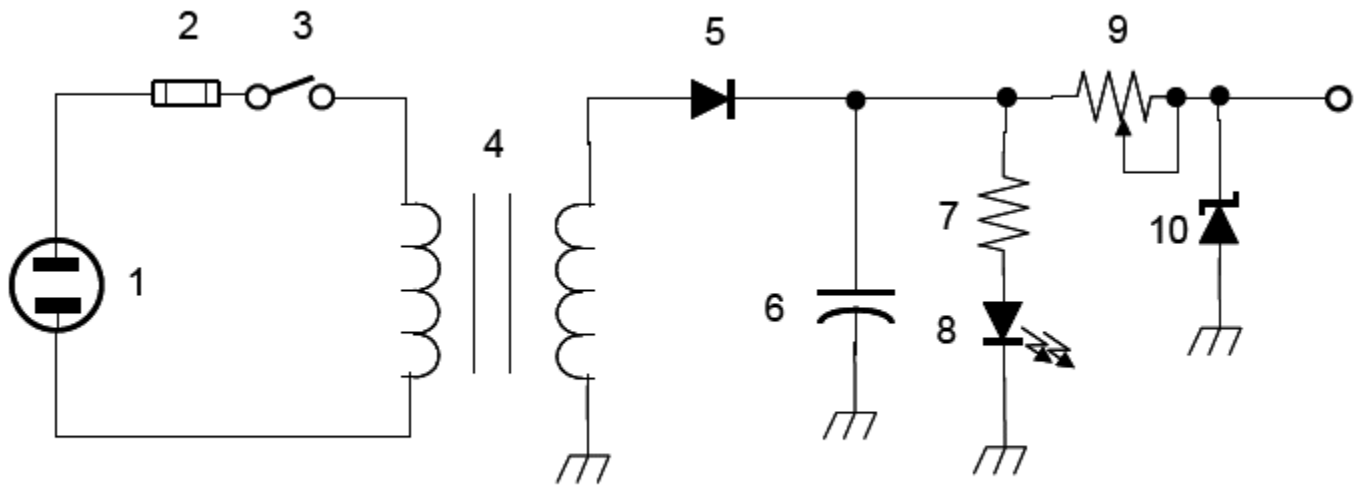


Figure T2

The function of component 2 in Figure T2 is to **control the flow of current**. The type of switch represented by item 3 in Figure T2 is a **single-pole single-throw**. Component 4 in Figure T2 is a **transformer**. Component 6 in Figure T2 is a **capacitor**. Component 8 in Figure T2 is a **Light Emitting Diode**. Component 9 in Figure T2 is a **variable resistor**.

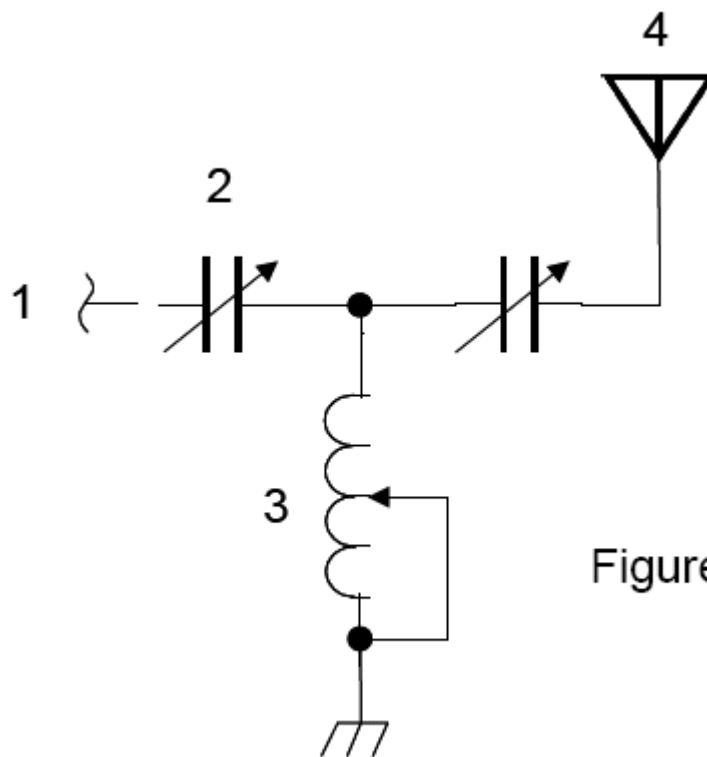


Figure T3

Component 3 in Figure T3 is a **variable inductor**. Component 4 in Figure T3 is an **antenna**.

Devices or circuits that change an alternating current into a varying direct current signal are **rectifiers**. The circuit that controls the amount of voltage from a power supply is the **regulator**. The component commonly used to change 120V AC house current to a lower AC voltage for other uses is the **transformer**.

An **LED** is commonly used as a visual indicator. A switch controlled by an electromagnet is the best description a relay. A **meter** can be used to display signal strength on a numeric scale. A **Capacitor** is used together with an inductor to make a tuned circuit. A device that combines several semiconductors and other components into one package is an **Integrated circuit**. A common use of coaxial cable is to carry **RF** signals between a radio and antenna.

## T7 - Station Equipment; Common Transmitter And Receiver Problems,

# Antenna Measurements And Troubleshooting, Basic Repair And Testing

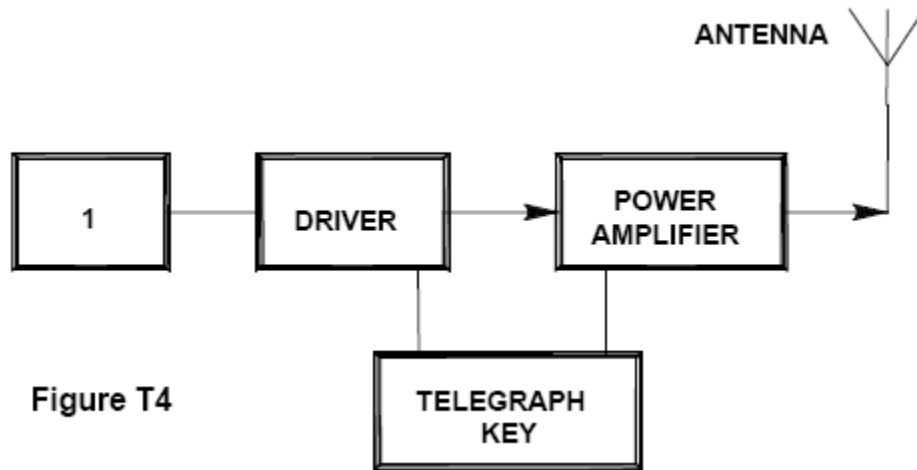


Figure T4

Figure T4 is a simple CW transmitter and the function of block 1 is an oscillator.

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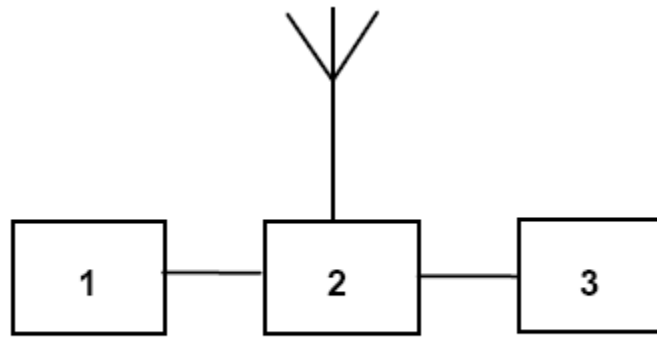


Figure T5

Figure T5 represents a transceiver in which block 1 is the transmitter portion and block 3 is the receiver portion, and the function of block 2 is a transmit-receive switch.

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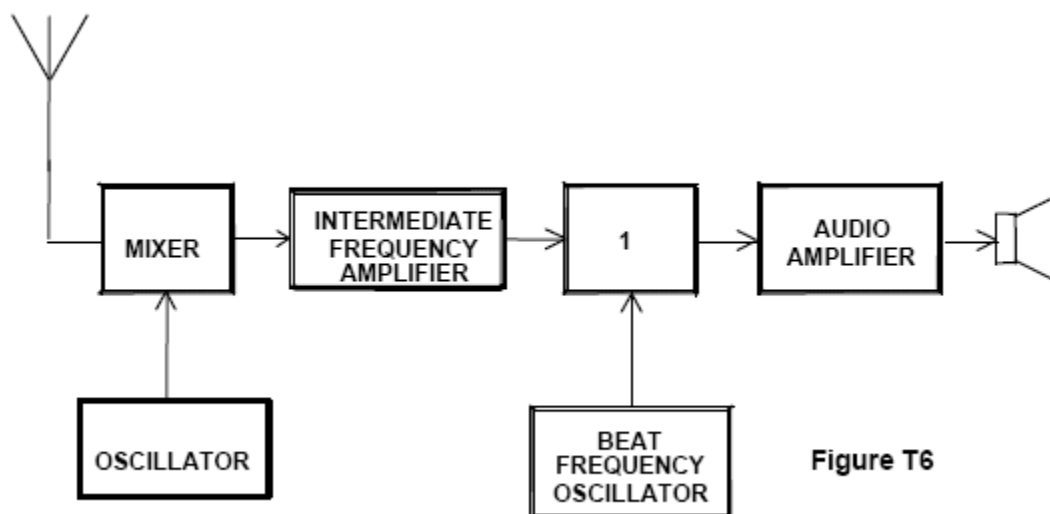


Figure T6

The type of receiver shown in Figure T6 is a **single-conversion superheterodyne**. The function of a mixer in a superheterodyne receiver is to **shift the incoming signal to an intermediate frequency**.

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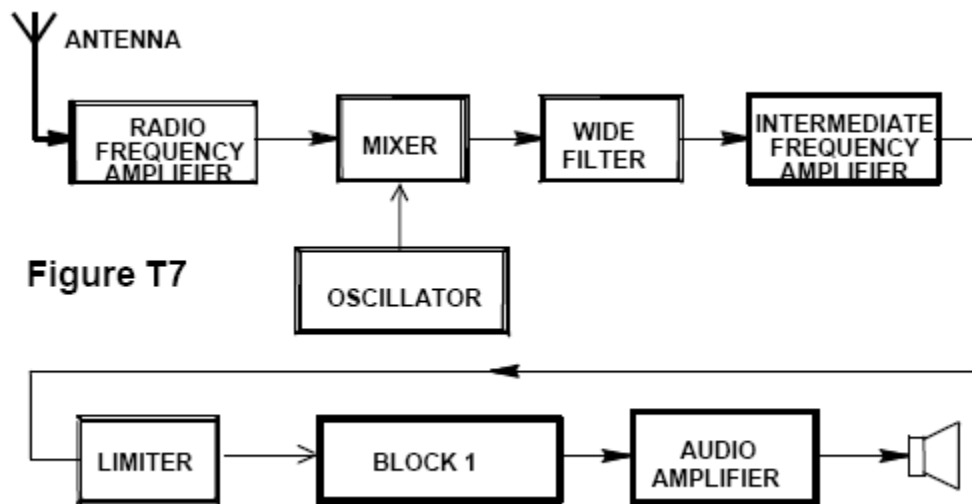


Figure T7

The circuit pictured in Figure T7, when block 1 is a frequency discriminator, is an **FM receiver**. A **Discriminator** circuit demodulates FM signals.

A circuit that combines a speech signal and an RF carrier is called a **modulator**. The function of a product detector is to **detect CW and SSB signals**. The term that describes the ability of a receiver to discriminate between multiple signals is **selectivity**.

A **multi-mode VHF transceiver** is most useful for VHF weak-signal communication. An **RF preamplifier** is installed **between the antenna and receiver**.

An **RF power amplifier** increases the low-power output from a handheld transceiver.

A device that takes the output of a low-powered 28 MHz SSB exciter and produces a 222 MHz output signal is a **transverter**.

If you are told your FM handheld or mobile transceiver is over deviating, **talk farther away from the microphone**.

A likely cause of interference to a non-cordless telephone from a nearby transmitter is that **the telephone is inadvertently acting as a radio receiver**. A logical first step when attempting to cure a radio frequency interference problem in a nearby telephone is to **install an RF filter at the telephone**.

If someone tells you that your station's transmissions are interfering with their radio or TV reception, **make sure that your station is functioning properly and that it does not cause interference to your own television**.

Fundamental overload in reference to a receiver is **interference caused by very strong signals**. All of the following choices are **correct**; any of the following may be a cause of radio frequency interference,

- A. fundamental overload
- B. harmonics
- C. spurious emissions

All of the following choices are correct; any of the following may be useful in correcting a radio frequency interference problem,

- A. snap-on ferrite chokes
- B. low-pass and high-pass filters
- C. band-reject and band-pass filters

All of the following choices are correct; if a "Part 15" device in your neighbor's home is causing harmful interference to your amateur station, you should,

- A. work with your neighbor to identify the offending device
- B. politely inform your neighbor about the rules that require him to stop using the device if it causes interference
- C. check your station and make sure it meets the standards of good amateur practice

All of the following choices are correct; if you receive a report that your audio signal through the repeater is distorted or unintelligible, it could be because,

- A. your transmitter may be slightly off frequency
- B. your batteries may be running low
- C. you could be in a bad location

If another operator reports a variable high-pitched whine on the audio from your mobile transmitter, it could be because, **noise on the vehicle's electrical system is being transmitted along with your speech audio.**

A symptom of RF feedback in a transmitter or transceiver is reports of garbled, distorted, or unintelligible transmissions.

The acronym "BER" when applied to digital communications systems means **Bit Error Rate.**

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The primary purpose of a dummy load is **to prevent the radiation of signals when making tests.** An antenna analyzer can be used to determine if an antenna is resonant at the desired operating frequency.

In general terms, the standing wave ratio (SWR) is **a measure of how well a load is matched to a transmission line.** A reading of **1 to 1** on an SWR meter indicates a perfect impedance match between the antenna and the feedline. An approximate SWR value of **2 to 1** is the value above which the protection circuits in most solid-state transmitters begin to reduce transmitter power. An SWR reading of **4:1** means **an impedance mismatch.** Power lost in a feedline is converted into heat.

Other than an SWR meter, another instrument you could use to determine if a feedline and antenna are properly matched is a **directional wattmeter.**

The most common cause for failure of coaxial cables is **moisture contamination.** The outer jacket of coaxial cable should be resistant to ultraviolet light because **ultraviolet light can damage the jacket and allow water to enter the cable.** A disadvantage of "air core" coaxial cable when compared to foam or solid dielectric types is it requires special techniques to prevent water absorption.

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The instrument you would use to measure electric potential or electromotive force is a **voltmeter.** The correct way to connect a voltmeter to a circuit is **in parallel with the circuit.**

The instrument used to measure electric current is **an ammeter.** An ammeter is usually connected **in series with the circuit.**

The instrument used to measure resistance is **an ohmmeter.** When measuring circuit resistance with an ohmmeter **ensure that the circuit is not powered.** When an ohmmeter, connected across a circuit, initially indicates a low resistance and then shows increasing resistance with time, it probably indicates **the circuit contains a large capacitor.**

Voltage and resistance measurements are commonly made using a multimeter. Attempting to measure voltage when using the resistance setting might damage a multimeter.

Rosin-core solder is best for radio and electronic use. A characteristic appearance of a "cold" solder joint is a **grainy or dull surface.**

## T8 - Modulation Modes; Amateur Satellite Operation, Operating Activities, Non-Voice Communications

**Single sideband** is a form of amplitude modulation. The type of voice modulation most often used for long-distance or weak signal contacts on the VHF and UHF bands is **SSB**. The approximate bandwidth of a single sideband voice signal is **3 kHz**.

The **upper sideband** is normally used for 10 meter HF, VHF and UHF single-sideband communications.

The type of modulation is most commonly used for VHF packet radio transmissions is **FM**. The type of modulation most commonly used for VHF and UHF voice repeaters is **FM**. The approximate bandwidth of a VHF repeater FM phone signal is **Between 5 and 15 kHz**.

The primary advantage of single sideband over FM for voice transmissions is that **SSB signals have narrower bandwidth**.

The approximate maximum bandwidth required to transmit a CW signal is **font>150 Hz**. The type of emission that has the narrowest bandwidth is **CW** (in the list for question T8A05).

The typical bandwidth of analog fast-scan TV transmissions on the 70 cm band is **About 6 MHz**.

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Using an amateur radio satellite you can talk to amateur radio operators in other countries. Any amateur whose license privileges allow them to transmit on the satellite uplink frequency may be the control operator of a station communicating through an amateur satellite or space station

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. A satellite operating in "mode U/V" means the satellite uplink is in the 70 cm band and the downlink is in the 2 meter band.

The transmitter power used on the uplink frequency of an amateur satellite or space station should be the minimum amount of power needed to complete the contact.

A commonly used method of sending signals to and from a digital satellite **FM Packet**.

A satellite beacon is a transmission from a space station that contains information about a satellite. A satellite tracking program can be used to determine the time period during which an amateur satellite or space station can be accessed.

With regard to satellite communications, the Doppler shift is an observed change in signal frequency caused by relative motion between the satellite and the earth station.

"Spin fading" when referring to satellite signals means that rotation of the satellite and its antennas is causing the fading.

The initials **LEO** tells you an amateur satellite is in a **Low Earth Orbit**.

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**Radio direction finding** is used to locate sources of noise interference or jamming. A **directional antenna** would be useful for a hidden transmitter hunt.

**Contesting** is a popular operating activity that involves contacting as many stations as possible during a specified period of time. When contacting another station in a radio contest send only the minimum information needed for proper identification and the contest exchange.

Temporary "1 by 1" format (letter-number-letter) call sign are assigned for operations in conjunction with an activity of special significance to the amateur community.

The maximum power allowed when transmitting telecommand signals to radio controlled models is **1 watt**. In place of on-air station identification when sending signals to a radio control model using amateur frequencies a label indicating the licensee's name, call sign and address must be affixed to the transmitter.

You might obtain a list of active nodes that use VoIP from a repeater directory.

When using a portable transceiver, you use the keypad to transmit the **IRLP node ID** to select a specific IRLP node.

The name given to an amateur radio station that is used to connect other amateur stations to the Internet is a **gateway**.

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

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All of the following choices are correct; examples of digital communications methods are:

- A. Packet
- B. PSK31
- C. MFSK

The term **APRS** means **A**utomatic **P**osition **R**eporting **S**ystem. A **Global Positioning System** receiver is normally used when sending automatic location reports via amateur radio.

The abbreviation **PSK** means **P**hase **S**hift **K**eying. **PSK31** is a low-rate data transmission mode.

**Data emission modes may be used by a Technician Class operator between 219 and 220 MHz (in the list for question T8D05).**

**All of the following choices are correct; Any of the following may be included in packet transmissions:**

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

**A "parity" bit is an extra code element used to detect errors in received data.**

**When sending CW in the amateur bands the International Morse is used. All of the following choices are correct; Any of the following can be used to transmit CW in the amateur bands:**

- A. Straight Key**
- B. Electronic Keyer**
- C. Computer Keyboard**

**NTSC is the term used to indicate transmission of an analog fast scan color TV signal.**



## T9 - Antennas, Feedlines

A beam antenna is an antenna that concentrates signals in one direction. Quad, Yagi, and dish are all examples of directional antennas.

For vertical antennas the electric field is perpendicular to the Earth.

A simple dipole mounted so the conductor is parallel to the Earth's surface is a horizontally polarized antenna. The strongest radiation from a half-wave dipole antenna in free space is Broadside to the antenna. You would shorten a dipole antenna to make it resonant on a higher frequency.

A disadvantage of the "rubber duck" antenna supplied with most handheld radio transceivers is it does not transmit or receive as effectively as a full-sized antenna. 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.

The approximate length of a quarter-wavelength vertical antenna for 146 MHz is 19 inches.

The approximate length of a 6 meter 1/2-wavelength wire dipole antenna is 112 inches.

The gain of an antenna is the increase in signal strength in a specified direction when compared to a reference antenna.

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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. The impedance of the most commonly used coaxial cable in typical amateur radio installations is 50 ohms.

It is important to have a low SWR in an antenna system that uses coaxial cable feedline to allow the efficient transfer of power and reduce losses.

An antenna tuner matches the antenna system impedance to the transceiver's output impedance.

As the frequency of a signal passing through coaxial cable is increased, the loss increases. Air-insulated hard line feedline has the lowest loss at VHF and UHF.

A Type N connector is most suitable for frequencies above 400 MHz. PL-259 type coax connectors are commonly used at HF frequencies. Coax connectors exposed to the weather should be sealed against water intrusion to prevent an increase in feedline loss.

A loose connection in an antenna or a feedline might cause erratic changes in SWR readings.

An electrical difference between the smaller RG-58 and larger RG-8 coaxial cables is RG-8 cable has less loss at a given frequency.

## T0 - AC Power Circuits, Antenna Installation, RF Hazards

The purpose of a fuse in an electrical circuit is to interrupt power in case of overload. It is unwise to install a 20-ampere fuse in the place of a 5-ampere fuse because excessive current could cause a fire. Safety equipment that should always be included in home-built equipment powered from 120V AC power circuits is a fuse or circuit breaker in series with the AC "hot" conductor.

All of the following choices are correct; current flowing through the body can cause a health hazard A. by heating tissue, B. disrupting the electrical functions of cells and C. causing involuntary muscle contractions

All of the following choices are correct; A good way to guard against electrical shock at your station is A. use three-wire cords and plugs for all AC powered equipment, B. connect all AC powered station equipment to a common safety ground and C. use a circuit protected by a ground-fault interrupter.

The safety ground is connected to the green wire in a three-wire electrical AC plug.

A precaution that should be taken when installing devices for lightning protection in a coaxial cable feedline is to ground all of the protectors to a common plate which is in turn connected to an external ground.

A way to recharge a 12-volt lead-acid station battery if the commercial power is out is to connect the battery to a car's battery and run the engine. A hazard presented by a conventional 12-volt storage battery is explosive gas can collect if not properly vented. If a lead-acid storage battery is charged or discharged too quickly the battery could overheat and give off flammable gas or explode.

A hazard that might exist in a power supply when it is turned off and disconnected is you might receive an electric shock from stored charge in large capacitors.

A commonly accepted value for the lowest voltage that can cause a dangerous electric shock is 30 volts.

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Members of a tower work team should wear a hard hat and safety glasses at all times when any work is being done on the tower.

A good precaution to observe before climbing an antenna tower is put on a climbing harness and safety glasses. It is Never safe to climb a tower without a helper or observer. An important safety rule to remember when using a crank-up tower is that this type of tower must never be climbed unless it is in the fully retracted position.

An important safety precaution to observe when putting up an antenna tower is to look for and stay clear of any overhead electrical wires. When installing an antenna, allow a minimum safe distance from a power line so that if the antenna falls unexpectedly, no part of it can come closer than 10 feet to the power wires. You should avoid attaching an antenna to a utility pole because the antenna could contact high-voltage power wires.

A good practice to follow when installing ground wires on a tower for lightning protection is ensure that connections are short and direct. A proper grounding method for a tower is to use separate eight-foot long ground rods for each tower leg, bonded to the tower and each other. On grounding conductors used for lightning protection you should avoid sharp bends must be avoided.

The purpose of a gin pole is to lift tower sections or antennas.

Local electrical codes establish grounding requirements for an amateur radio tower or antenna.

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VHF and UHF radio signals are non-ionizing radiation.

Exposure limits vary with frequency because the human body absorbs more RF energy at some frequencies than at others. The frequency that has the lowest Maximum Permissible Exposure limit is 50 MHz (in the list for question T0C02).

All of the following choices are correct; The factors that affect the RF exposure of people near an amateur station antenna are A. frequency and power level of the RF field, B. distance from the antenna to a person and C. radiation pattern of the antenna

All of the following choices are correct ways to determine that your station complies with FCC RF exposure regulations - A. by calculation based on FCC OET Bulletin 65, B. by calculation based on computer modeling and C. by measurement of field strength using calibrated equipment

If a person accidentally touched your antenna while you were transmitting they might receive a painful RF burn. An action that amateur operators might take to prevent exposure to RF radiation in excess of FCC-supplied limits is relocate antennas.

The maximum power level that an amateur radio station may use at VHF frequencies before an RF exposure evaluation is required, is 50 watts PEP at the antenna.

"Duty cycle" when referring to RF exposure is the ratio of on-air time to total operating time of a transmitted signal. Duty cycle is one factor used to determine safe RF radiation exposure levels because it affects the average exposure of people to radiation.

You can make sure your station stays in compliance with RF safety regulations by re-evaluating the station whenever an item of equipment is changed.