Amateur Radio
General Class License
Study Guide

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Compliments of:

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Source Material is Publicly Available
(Source: Question Pool of 431 questions and CFR Title 47, Part 97, Amateur Radio Service.)

Foreword

This document is simply a compilation of the publicly available question pool which has been converted into statements and formatted. The intent was to retain as much of the original words from the question pool as possible to leverage familiarization in the learning and memory process. The 18 terms most frequently used in the text are:

RF	**HF**	**FCC**
power	**meter**	**band**
station	**output**	**signal**
antenna	**amateur**	**operator**
frequency	**transmitter**	**exposure**
impedance	**transmitting**	**radiation**

The author's hope is that this document might be useful as a resource in studying for the Element 3, General Class License Amateur Radio Exam.

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SUBELEMENT G1 -- COMMISSION'S RULES [6 Exam Questions -- 6 Groups]

General control operator frequency privileges

- Frequency privileges for a General Class control operator (ITU Region 2):

Band	Frequencies
160-meter	1800 - 2000-kHz
75/80-meter	3525 - 3750-kHz and 3850 - 4000-kHz
40-meter	7025 - 7150-kHz and 7225 - 7300-kHz
30-meter	10100 - 10150-kHz
20-meter	14025 - 14150-kHz and 14225 - 14350-kHz
17-meter	18068 - 18168-kHz
15-meter	21025 - 21200-kHz and 21300 - 21450-kHz
12-meter	24890 - 24990-kHz
10-meter	28000 - 29700-kHz
10-meter	28300 - 29700-kHz Phone emissions

Antenna structure limitations

- Provided it is not at or near a public-use airport, 200 feet is the maximum height above ground an antenna structure may rise without requiring its owner to notify the FAA and register with the FCC.

Good engineering and good amateur practice

- If the FCC Rules DO NOT specifically cover a situation, you must operate your amateur station in accordance with good engineering and good amateur practice.

Beacon operation

- Beacon Stations transmit only one-way communications.
- All transmissions must use audio frequency shift keying (AFSK) is NOT an FCC requirement regarding beacon stations.

Restricted operation

- Under limited circumstances, music may be transmitted by an amateur station when it is an incidental part of a space shuttle retransmission.
- In two-way communication, an amateur station may never transmit a message in a secret code in order to obscure the meaning of the communication.
- Abbreviations or procedural signals in the amateur service may be used if they do not obscure the meaning of a message.

Retransmitting radio signals

- Retransmission of space shuttle communications is NOT prohibited by the FCC Rules.
- Turn down the volume of background audio to prevent your station from retransmitting music or signals from a non-amateur station.

Transmitter power standards; Certification of external RF- power-amplifiers; Standards for certification of external RF-power amplifiers; HF data emission standards

- The maximum transmitting power an amateur station may use is the minimum power necessary to carry out the desired communications with a maximum of:

Frequency	Power
1825 kHz	1500 watts PEP output.
3690 kHz	*200 watts PEP output*
7080 kHz	1500 watts PEP output
7255 kHz	1500 watts PEP output.
10.140 MHz	*200 watts PEP output*
14.300 MHz	1500 watts PEP output.
21.305 MHz	1500 watts PEP output.
24.950 MHz	1500 watts PEP output

- The maximum transmitting power a station with a General Class control operator may use is the minimum power necessary to carry out the desired communications with a maximum of:

Frequency	Power
28.150 MHz	1500 watts PEP output.
28.400 MHz	1500 watts PEP output.

- When a station is transmitting on the 60-meter band, it is NOT a requirement for antenna height to not exceed 50 feet above mean sea level (AMSL).

Examination element preparation

- Examination elements that you may prepare when you hold a General class operator license are Elements 1 and 2 only.
- The minimum examination elements an applicant must pass for a Technician Class operator license is Element 2 only.
- Elements 1 and 2 are the minimum examination elements an applicant must pass for a Technician Class operator license with Morse code credit to operate on the HF bands.

Examination administration

- The license examinations you may administer when you are an accredited VE holding a General Class operator license is the Technician and Morse code.
- The requirements for administering a Technician Class operator examination are that three VEC-accredited General Class or higher VEs must be present.
- You may participate as an administering VE for a Technician Class operator license examination once you have been granted your FCC General class or higher license and received your VEC accreditation.
- Once you have been granted your FCC General Class or higher operator license and received your VEC accreditation you may participate as a VE in administering a Morse code examination.

Temporary station identification

- If you are a Technician Class operator with a CSCE for General Class operator privileges, you must give your call sign, followed by the slant

mark "/", followed by the identifier "AG" to identify your station when transmitting on 14.035 MHz.

- If you are a Technician Class operator with a CSCE for General Class operator privileges, you must give your call sign, followed by any suitable word that denotes the slant mark and the identifier "AG" to identify your station when transmitting phone emissions on 14.325 MHz.
- If you are a Technician Class operator with a CSCE for General Class operator privileges, whenever you operate using your new frequency privileges you must add the special identifier "AG" after your call sign.
- If you are a Technician Class operator with a CSCE for General Class operator privileges, you must include the special identifier "AG" after your call sign on all the following band segments:
  - Whenever you operate from 18068 - 18168-kHz
  - Whenever you operate from 14025 - 14150-kHz and 14225 - 14350-kHz
  - Whenever you operate from 10100 - 10150-kHz
  - (All of these choices are correct)
- If you are a Technician licensee with Morse code credit and hold a CSCE for Element 3, one way you could identify your station when transmitting phone emissions on a General class amateur frequency is to give your call sign followed by the words "temporary AG".

Local control

- As a General Class control operator at the station of a Technician Class operator, you must identify the station while transmitting on 7250 kHz with the Technician Class operator's station call sign, followed by the slant bar "/" (or any suitable word) and your own call sign.
- Only if the 10-meter control operator holds at least a General class license may a 10-meter repeater retransmit the 2-meter signal from a station having a Technician Class control operator.

Repeater and harmful interference definitions

- A Repeater station is an amateur station that simultaneously retransmits the signals of other stations on a different channel.
- Harmful interference is a form of interference that seriously degrades, obstructs or repeatedly interrupts a radiocommunication service.
- Should a repeater cause harmful interference to another repeater when a frequency coordinator has recommended the operation of one station only, the licensee of the uncoordinated repeater is responsible for resolving the interference.
- Where the FCC rules say that the amateur service is a secondary user and another service is a primary user this means that amateur stations are allowed to use the frequency band only if they do not cause harmful interference to primary users.
- The action you must take while using the 30-meter band when a station assigned to the band's primary service causes interference is change frequencies; you may be causing harmful interference to the other station, in violation of FCC rules.
- Amateur radio stations have no protection from harmful interference caused by primary service users while operating in the 60-meter band.
- Amateur radio stations must not cause harmful interference to stations operating in other radio services while operating in the 60-meter band.

Third party communications

- Messages of a technical nature or remarks of a personal character for a third party may be transmitted by an amateur station to a foreign country.
- While you are using a language other than English in making a contact, what language you must use English when identifying your station.
- Use local or remote station control at an amateur radio station while it is transmitting third party messages.

Certification of external RF-power-amplifiers; Standards for certification of external RF-power amplifiers

- External RF power amplifiers designed to operate below 144 MHz may require FCC certification.
- Without a grant of FCC certification, you may build or modify one (1) external RF amplifier of a given design capable of operation below 144 MHz in one calendar year.
- Where FCC certification of an external RF amplifier is required, the amplifier must not be capable of reaching its designed output power when driven with less than 50 watts.
- The capability of being switched by the operator to all amateur service frequencies below 24 MHz would NOT disqualify an external RF power amplifier from a FCC certification grant.
- In order to receive a FCC grant of certification an external RF amplifier exhibit must not be capable of operation on any frequency between 24 MHz and 35 MHz.
- The maximum power gain that a 10-meter RF amplifier can have to receive FCC certification is 6 dB.

HF data emission standards

- The maximum symbol rate permitted for RTTY emissions transmitted on frequency bands below 10 meters is 30 bauds.
- The maximum symbol rate permitted for packet emission on the 2-meter band is 19.6 kilobauds.
- The maximum symbol rate permitted for RTTY or data emission on the 10-meter band is 1200 bauds.
- The maximum symbol rate permitted for RTTY or data emission on the 6- and 2-meter bands is 19.6 kilobauds.
- The maximum authorized bandwidth for RTTY, data or multiplexed emissions using an unspecified digital code transmitted on the 6- and 2-meter bands is 20 kHz.

SUBELEMENT G2 -- OPERATING PROCEDURES [6 Exam Questions -- 6 Groups]

Phone operating procedures

- Lower sideband is commonly used on 3925-kHz (75/80 meters) and 40-meters for phone operation.
- Upper sideband is commonly used for:
  - 10-meter phone operation.
  - 15-Meter phone operation.
  - 17-Meter phone operation.
  - 20-meter phone operation.
- Most amateur stations use lower sideband on the 160-, 75- and 40-meter bands because current amateur practice is to use lower sideband on these frequency bands.
- Single sideband (SSB) mode of voice communication is most commonly used on the High Frequency Amateur bands.
- Single sideband mode of voice transmission used is more frequently than Amplitude Modulation (AM) on the HF amateur bands because of the following:
  - Single sideband transmissions use less spectrum space
  - Single sideband transmissions are more power efficient
  - No carrier is transmitted with a single sideband transmission
  - (All of these choices are correct)
- Lower sideband transmission is called lower sideband because the lower sideband is the only sideband transmitted, since the upper sideband is suppressed.
- With upper sideband transmission only the upper sideband is transmitted, since the lower sideband is suppressed.

Operating courtesy

- If you are the net control station of a daily HF net and the frequency on which you normally meet is in use just before the net begins you should conduct the net on a clear frequency 3 to 5-kHz away from the regular net frequency.
- If a net is about to begin on a frequency which you and another station are using, you should as a courtesy to the net, move to a different frequency.
- If propagation changes during your contact and you notice increasing interference from other activity on the same frequency, you should move your contact to another frequency.
- When selecting a CW transmitting frequency, the minimum frequency separation from a contact in progress you should allow to minimize interference is 150 to 500 Hz.
- When selecting a single-sideband phone transmitting frequency to minimize interference, you should allow approximately 3 kHz (between suppressed carriers) as the minimum frequency separation from a contact in progress.
- When selecting a RTTY transmitting frequency, 250 to 500 Hz is the minimum frequency separation from a contact in progress you should allow (center to center) to minimize interference.
- A band plan is a voluntary guideline beyond the divisions established by the FCC for using different operating modes within an amateur band.
- A "Band Plan" is another name for a voluntary guideline that guides amateur activities and extends beyond the divisions established by the FCC for using different operating modes within an amateur band.

- When choosing a frequency for Slow-Scan TV (SSTV) operation, to comply with good amateur practice you should:
  - Review FCC Part 97 Rules regarding permitted frequencies and emissions
  - Follow generally accepted gentlemen's agreement band plans
  - Before transmitting, listen to the frequency to be used to avoid interfering with an ongoing communication
  - *(All of these choices)*
- When choosing a frequency for Radioteletype (RTTY) operation, to comply with good amateur practice you should:
  - Review FCC Part 97 Rules regarding permitted frequencies and emissions
  - Follow generally accepted gentlemen's agreement band plans
  - Before transmitting, first listen to the frequency to be used to avoid interfering with an ongoing communication
  - *(All of these choices)*
- When choosing a frequency for HF Packet operation, to comply with good amateur practice you should:
  - Review FCC Part 97 Rules regarding permitted frequencies and emissions
  - Follow generally accepted gentlemen's agreement band plans
  - Before transmitting, first listen on the frequency to be used to avoid interfering with an ongoing communication
  - *(All of these choices)*
- A considerate way to avoid harmful interference when using phone is to ask if the frequency is in use, and say your call sign.
- A considerate way to avoid harmful interference when using Morse code or CW is to send "QRL? de" followed by your call sign and listen for a response.

Emergencies, including drills and emergency communications

- Any means of radiocommunication may be used by an amateur station in distress to attract attention, make known its condition and location, and obtain assistance.
- During a disaster in the US, an amateur station may make transmissions necessary to meet essential communication needs and assist relief operations when normal communication systems are overloaded, damaged or disrupted.
- If a disaster disrupts normal communications in your area, the FCC may declare a temporary state of communication emergency.
- If a disaster disrupts normal communications in an area the FCC may include in any notice of a temporary state of communication emergency any special conditions and special rules to be observed by stations during the emergency.
- During an emergency, there are no limitations during an emergency. This includes no power output limitations that must be observed by a station in distress.
- During a disaster in the US, any frequency may be used to obtain assistance.
- If you are communicating with another amateur station and hear a station in distress break in, the first thing you should do is acknowledge the station in distress and determine its location and what assistance may be needed.

- Stations in the Radio Amateur Civil Emergency Service (RACES) participate in training tests and drills to provide orderly and efficient operations for the civil defense organization they serve in the event of an emergency.
- You are not ever prohibited from helping any station in distress.
- When FCC declares a temporary state of communication emergency, you must abide by the limitations or conditions set forth in the FCC notice.
- During a disaster in the US, any emission modes may be used to obtain assistance.
- A person who sends a distress transmission should give to stations who answer the location and nature of the distress.
- Whatever frequency has the best chance of communicating the distress message should be used to send a distress call.

Amateur auxiliary to the FCC's Compliance and Information Bureau

- The Amateur Auxiliary as compared to the FCC's Compliance and Information Bureau are amateur volunteers who are formally enlisted to monitor the airwaves for rules violations.
- The objectives of the Amateur Auxiliary to the FCC's Compliance and Information Bureau are to encourage amateur self-regulation and compliance with the rules.
- Direction-finding "Fox Hunts" are important to the Amateur Auxiliary because Fox Hunts provide an opportunity to practice direction-finding skills.

Antenna orientation to minimize interference

- An azimuthal projection map is a map projection centered on a particular location, used to determine the shortest path between points on the surface of the earth equator with each orbit.
- The most useful type of map to use when orienting a directional HF antenna toward a distant station is an Azimuthal projection map.
- A directional antenna pointed in the long-path direction to another station is generally oriented 180 degrees from its short-path heading.
- A unidirectional HF antenna would best be used to focus your signal to minimize interference.

HF operations, including logging practices

- If a visiting amateur transmits from your station on 14.325 MHz, it is NOT true that you must keep in your station log the call sign of the visiting amateur together with the time and date of transmissions.
- Even though the FCC doesn't require it, you should keep a log:
  - To help with your reply, if FCC requests information on who was control operator of your station for a given date and time
  - Logs provide information (callsigns, dates & times of contacts) used for many operating contests and awards
  - Logs are necessary to accurately verify contacts made weeks, months or years earlier, especially when completing QSL cards
  - *(All of these choices)*
- Information that is normally contained in a station log:
  - Date and time of contact
  - Band and/or frequency of the contact
  - Call sign of station contacted and the RST signal report given
  - *(All of these choices)*

- A good reason to keep a log of your station's activities is that it can aid you in resolving interference complaints.
- As required by FCC rules, if you are using other than a dipole antenna, you must keep a record of the gain of your antenna when operating in the 60-meter band.

Third-party communications

- Messages of a technical nature or personal remarks of relative unimportance may be transmitted to an amateur station in a foreign country.

ITU Regions

- The initials "ITU" stand for International Telecommunications Union.
- The International Telecommunications Union (ITU) is responsible for international regulation of the radio spectrum.
- Europe and Africa are in International Telecommunication Union (ITU) Region 1.
- The continental United States is in International Telecommunication Union (ITU) Region 2.
- Australia is in International Telecommunication Union (ITU) Region 3.

VOX operation

- VOX operation mode allows "Hands Free' operation.
- The following user adjustable controls are usually associated with VOX circuitry:
    - Anti-VOX
    - VOX Delay
    - VOX Sensitivity
    - (All of these choices are correct)
- The purpose of the VOX sensitivity control is to set the audio level at which the transmitter activates.
- VOX is the circuit called that causes a transmitter to automatically transmit when an operator speaks into its microphone.
- The best reason to use a headset with an attached microphone and VOX control, when using a mobile station is for safer, hands-free operation.
- The anti-VOX circuit prevents received audio from keying the transmitter.

CW operating procedures, including procedural signals, Q signals and common abbreviations

- The prosing, AR - end of message, is sent using CW to indicate the end of a formal message.
- The phrase, "End of message" would indicate the completion of the transmitting of a formal message when using phone.

Full break-in

- Full break-in telegraphy (QSK) is where incoming signals are received between transmitted key pulses.

RTTY operating procedures, including procedural signals and common abbreviations and operating procedures for other digital modes, such as HF packet, AMTOR, PacTOR, G-TOR, Clover and PSK31

- The 3580 – 3620-kHz segment of the 80-meter band is where most data transmissions take place.
- The 14.070 – 14.095 MHz segment of the 20-meter band is where most RTTY transmissions take place.
- It is NOT correct that the two major AMTOR operating modes are SELCAL and LISTEN.
- The most common frequency shift for RTTY emissions is 170 Hz in the amateur HF bands.
- The string of letters R and Y (sent as "RYRYRYRY...") are occasionally used at the beginning of RTTY or other data transmissions to allow time to 'tune in' a station prior to the actual message being sent.
- The abbreviation "RTTY" stands for Radioteletype.
- The character sequence, "NNNN", is sent using RTTY or other data modes to indicate the end of a formal message.
- The number of data bits sent varies in a single PSK31 character.
- The Header part of a data packet contains the routing and handling information.

SUBELEMENT G3 -- RADIO WAVE PROPAGATION [3 Exam Questions -- 3 Groups]

Ionospheric disturbances

- An amateur station may need to try a higher frequency to continue communications during a sudden ionospheric disturbance.
- The effect that a sudden ionospheric disturbance has on the day-time ionospheric propagation of HF radio waves is it disrupts signals on lower frequencies more than those on higher frequencies.
- Geomagnetic disturbance is a dramatic change in the earth's magnetic field over a short period of time.
- Those latitudes greater than 45 degrees latitude are the propagation paths more sensitive to geomagnetic disturbances.
- Degraded high-latitude HF propagation can be the effect of a major geomagnetic storm on radio-wave propagation.
- The K-index is a measure of geomagnetic stability.
- The A-index is a daily value measured on a scale from 0 to 400 to express the range of disturbance of the geomagnetic field.
- A visible aurora might result during periods of high geomagnetic activity.

Sunspots and solar radiation

- It takes 8 minutes for the increased ultraviolet and X-ray radiation from solar flares to affect radio-wave propagation on the earth.
- Solar flux is the radio energy emitted by the sun.
- The solar-flux index is a measure of solar activity that is taken at a specific frequency.
- Long-distance radio communication in the upper HF and lower VHF range is enhanced when sunspot numbers are high.
- The sunspot number is a daily index of sunspot activity.
- The sunspot cycle is the approximately 11-year variation in the sunspot number.
- Solar coronal hole activity affects radio communications because the activity emits charged particles that usually disrupt HF communications.
- It takes charged particles from coronal mass ejections (CMEs) 20 to 40 hours to affect radio-wave propagation on the earth.

Maximum usable frequency

- If the maximum usable frequency (MUF) on the path from Minnesota to France is 24 MHz, the 15 meter band should offer the best chance for a successful contact.
- If the maximum usable frequency (MUF) on the path from Ohio to Germany is 17 MHz, the 20 meter band should offer the best chance for a successful contact.
- If the HF radio-wave propagation (skip) is generally good on the 24-MHz and 28-MHz bands for several days, 28 days later you might expect a similar condition to occur.
- One way to determine if the maximum usable frequency (MUF) is high enough to support 28-MHz propagation between your station and western Europe is to listen for signals on a 10-meter beacon frequency.
- Radio waves with frequencies below the maximum usable frequency (MUF) are bent back to the earth when they are sent into the ionosphere.
- When the lowest usable frequency (LUF) exceeds the maximum usable frequency (MUF) no HF radio frequency will support communications along an ionospheric signal path.

- The factors that affect the maximum usable frequency (MUF) are:
  - Path distance and locations
  - Time of day and season
  - Solar radiation and ionospheric disturbances
  - *(All of these choices are correct)*

Propagation "hops"

- You would tune to 14.1 MHz to hear beacons that would help you determine propagation conditions on the 20-meter band.
- During periods of low solar activity, Frequencies above 20 MHz are the least reliable for long-distance communication.
- At any point in the solar cycle the 20-meter band usually supports worldwide propagation during daylight hours.
- The maximum distance along the Earth's surface that is normally covered in one hop using the F2 region is 2500 miles.
- The maximum distance along the Earth's surface that is normally covered in one hop using the E region is 1200 miles.
- A skywave signal sound can be heard like a well-defined echo if it arrives at your receiver by both short path and long path propagation.
- A short distance hop on 10 meters might indicate the MUF exceeds 50 MHz on the 6 meter band.

Height of ionospheric regions

- The average height of maximum ionization of the E region is 70 miles.
- The F2 region can be expected to reach its maximum height at your location at noon during the summer.
- The F2 region is mainly responsible for the longest-distance radio-wave propagation because it is the highest ionospheric region.

Critical angle and frequency

- The "critical angle" as used in radio-wave propagation is the highest takeoff angle that will return a radio wave to the earth under specific ionospheric conditions.

HF scatter

- A wavering sound is a characteristic of HF scatter signals.
- HF scatter signals often sound distorted because the energy is scattered into the skip zone through several radio-wave paths.
- HF scatter signals are usually weak because a part of the signal energy is propagated into the skip zone.
- Scatter radio-wave propagation allows a signal to be detected at a distance too far for ground-wave propagation but too near for normal sky-wave propagation.
- Scatter propagation on the HF bands most often occurs when communicating on frequencies above the maximum usable frequency (MUF).
- Ionospheric absorption will be at minimum near the maximum usable frequency (MUF).
- Daylight fading on the 40-meter band is associated most with which ionospheric D layer.
- The main reason the 160-, 80- and 40-meter amateur bands tend to be useful only for short-distance communications during daylight hours is because of D-region absorption.

SUBELEMENT G4 -- AMATEUR RADIO PRACTICES [5 Exam Questions -- 5 Groups]

Two-tone test

- Two audio-frequency sine waves are used to test the amplitude linearity of a single-sideband phone transmitter while viewing the output on an oscilloscope.
- When testing the amplitude linearity of a single-sideband transmitter, two non-harmonically related tones are fed into the microphone input, and the output is observed on an oscilloscope.
- Any two audio tone frequencies may be used in a two-tone test of the linearity of a single-sideband phone transmitter, but they must be within the transmitter audio passband, and should not be harmonically related.
- A two-tone test analyzes transmitter linearity performance.
- Two non-harmonically related audio signals are within the modulation bandpass of a transmitter to conduct a two-tone test.

Electronic TR switch

- An electronic TR switch would normally appear between the transmitter and low-pass filter in an HF transceiver block diagram.
- An electronic TR switch preferable to a mechanical one because it has a higher operating speed.
- A diode is like a switch in that it permits current flow when forward biased and blocks current when reverse biased.

Amplifier neutralization

- As a power amplifier is tuned, the reading on its grid-current meter indicates the best neutralization when a minimum change in grid current as the output circuit is changed.
- Neutralization is necessary for some vacuum-tube amplifiers to cancel oscillation caused by the effects of interelectrode capacitance.
- In a properly neutralized RF amplifier, negative feedback is used.
- A neutralizing circuit cancels the effects of positive feedback in an RF amplifier.
- The reason for neutralizing the final amplifier stage of a transmitter is to eliminate self oscillations.

Test equipment

Oscilloscope/Monitoring oscilloscope

- An oscilloscope contains horizontal- and vertical-channel amplifiers.
- A digital oscilloscope is an oscilloscope designed around digital technology rather than analog technology.
- A monitoring oscilloscope is the best instrument to use to check the signal quality of a CW or single-sideband phone transmitter.
- The RF output of the transmitter is connected to the vertical input of a monitoring oscilloscope when checking the quality of a transmitted signal.
- To check AM or SSB transmitter modulation using double trapezoidal patterns on an oscilloscope, couple the RF output signal to the vertical plates and external trigger; set the internal sweep to twice the modulating frequency.

Signal tracer

- A signal tracer would normally be used to identify an inoperative stage in a receiver.

Antenna noise bridge

- A noise bridge is normally connected between a receiver and an antenna of unknown impedance and is tuned for minimum noise.
- One way a noise bridge might be used is for pre-tuning an antenna tuner.

Field-strength meters

- The purpose of a field-strength meter is to monitor relative RF output.
- A field-strength meter may be used to monitor relative RF output during antenna and transmitter adjustments.
- In order to raise the S-meter reading on a receiver from S8 to S9, the power output of a transmitter must be increased approximately 4 times.
- A field strength meter provides the field pattern of an antenna.
- Close-in RDF work might be an application for a field strength meter.
- A noise bridge could directly provide characteristic impedance for an unknown length and type of transmission line.

Audio rectification in consumer electronics

- You would install bypass capacitors in home-entertainment systems to reduce or eliminate audio-frequency interference.
- If a properly operating amateur station is the cause of interference to a nearby telephone you should install RFI filters at the affected telephone.
- Distorted speech from the transmitter's signals is heard from a public-address system if audio rectification of a nearby single-sideband phone transmission occurs.
- On-and-off humming or clicking is heard from a public-address system if audio rectification of a nearby CW transmission occurs.

RF ground

- If your third-floor amateur station has a ground wire running 33 feet down to a ground rod, you might get an RF burn if you touch the front panel of your HF transceiver because the ground wire is a resonant length on several HF bands and acts more like an antenna than an RF ground connection.
- To avoid stray RF energy in your amateur station keep the station's ground wire as short as possible.
- With regard to station grounding it is NOT true that only transceivers and power amplifiers need to be tied into a station ground.
- With regard to station grounding, RF hot spots can occur in a station located above the ground floor if the equipment is grounded by a long ground wire.
- The RF exposure limits of the human body are NOT covered in the National Electrical Code.
- Induced currents in conductors that are in poor electrical contact can cause the unintended rectification of an RF signal.
- An intermittent RF ground is one cause of severe, broadband radio frequency noise at an amateur radio station.
- A ground loop can be avoided by connecting all ground conductors to a single point.

Speech processors

- The reason for using a properly adjusted speech processor with a single-sideband phone transmitter is it improves signal intelligibility at the receiver.
- If a single-sideband phone transmitter is 100% modulated, the speech processor will add nothing to the transmitter's output PEP.
- The operating benefit that a properly adjusted speech clipping provides is it prevents overdriving the transmitter's modulator stage.

PEP calculations

Formulas → Vpeak = Vpeak-to-peak/2
Vrms = Vpeak*0.7071
PEP = (Vrms*Vrms)/Z

- If an oscilloscope measures 200 volts peak-to-peak across a 50-ohm resistor connected to the transmitter output, the output PEP from the transmitter is 100 watts.
- If an oscilloscope measures 500 volts peak-to-peak across a 50-ohm resistor connected to the transmitter output, the output PEP from a transmitter is 625 watts.
- If an average-reading wattmeter connected to the transmitter output indicates 1060 watts, the output PEP of an unmodulated carrier transmitter is 1060 watts.

Formulas → V = sqrt(R/P) as derived from V=I*R and P=I*V

- The voltage across a 50-ohm dummy load dissipating 1200 watts would be 245 volts.

Wire sizes and fuses

- Only the "hot" (black and red) wires in a four-conductor line cord should be attached to fuses in a 240-VAC primary (single phase) power supply.
- Wire size, AWG number 12, is normally used on a 20-ampere, 120-VAC household appliance circuit.
- The maximum size fuse or circuit breaker that should be used in a household appliance circuit using AWG number 12 wiring is 20 amperes.

Common connectors used in amateur stations: types; when to use; fastening methods; precautions when using

- A DB-25 connector is NOT designed for RF transmission lines.
- When installing a power plug on a line cord you should:
  - Twist the wire strands neatly and fasten them so they don't cause a short circuit
  - Observe the correct wire color conventions for plug terminals
  - Use proper grounding techniques
  - *(All of these choices)*
- A direct, fused power connection to the battery using heavy gauge wire would be the best for a 100-watt HF mobile installation.
- The type of coaxial connector, Type N, would be a good choice to use for 10 GHz feed-line connections.

HF mobile radio installations

- It is best NOT to draw the DC power for a 100-watt HF transceiver from an automobile's cigarette lighter socket because the socket's wiring may not be adequate for the current being drawn by the transceiver.
- The HF mobile antenna system most limits the effectiveness of an HF mobile transceiver operating in the 75-meter band.

Emergency power systems

Generators

- All of the following is true of both a permanent or temporary emergency generator installation:
  - The generator should be located in a well ventilated area
  - The installation should be grounded
  - Extra fuel supplies, especially gasoline, should not be stored in an inhabited area
  - *(All of these choices)*
- You should avoid placing a gasoline-fueled generator to power your station inside a building or outside an open window.
- Safety precautions you should observe when using a gasoline-fueled generator to power your home station:
  - Always ground the frame of the generator
  - Use only generators that produce a clean sine wave output
  - Make sure that the engine is well lubricated
  - *(All of these choices are correct)*
- During a commercial power outage, it would be unwise to back feed the output of a gasoline generator into your house wiring by connecting the generator through an AC wall outlet because:
  - It presents a hazard for electric company workers
  - You may draw too much current, overloading your generator
  - Power may be restored to your house, damaging your generator
  - *(All of these choices are correct)*

Battery storage devices and charging sources including solar

- When a lead-acid storage battery as it is being charged it gives off explosive hydrogen gas.
- Photovoltaic conversion is the name of the process by which sunlight is directly changed into electricity.
- The approximate open-circuit voltage from a modern, well illuminated photovoltaic cell is 0.5 VDC.
- The panel's voltage rating and maximum output current determines the proper size solar panel to use in a solar-powered battery-charging circuit.

Wind generation

- The biggest disadvantage to using wind power as the primary source of power for an emergency station is a large electrical storage system is needed to supply power when the wind is not blowing.

SUBELEMENT G5 -- ELECTRICAL PRINCIPLES [2 Exam Questions -- 2 Groups]

Impedance, including matching

- Impedance is the opposition to the flow of AC in a circuit.
- When the impedance of an electrical load is equal to the internal impedance of the power source the source delivers maximum power to the load.
- The unit used to measure impedance is the Ohm.
- Impedance matching is important so the source can deliver maximum power to the load.
- Core saturation of a conventional impedance matching transformer should be avoided because harmonics and distortion could result from saturation.

Resistance, including ohm

Reactance

- Reactance is opposition to AC caused by inductors and capacitors.
- The unit used to measure reactance is the Ohm.

Inductance

- In an inductor, reactance causes opposition to the flow of AC.
- A coil reacts to AC such that as the frequency of the applied AC increases, the reactance increases.

Capacitance

- In a capacitor, reactance causes opposition to the flow of AC.
- A capacitor reacts to AC such that as the frequency of the applied AC increases, the reactance decreases.

Metric divisions of these values

Decibel

- A two-times increase in power results in a change of 3 dB higher.
- A percentage loss of 20.6% would result from a transmission line loss of 1 dB.

Ohm's Law

Current and voltage dividers

- In a parallel circuit with a voltage source and several branch resistors, the total current equals the sum of the branch current through each resistor.
- The capacitance and voltage rating of a series circuit consisting of two equal value capacitors with equal voltage ratings would be the total capacitance, which would be half that of each capacitor, and maximum voltage, which would be twice that of each capacitor.
- If three equal resistors in parallel produce 50-ohms of resistance and the same resistors in series produce 450-ohms, the value of each resistor is 150-ohms.

Electrical power calculations and series and parallel components

- If 400 VDC is supplied to an 800-ohm load, 200 watts of electrical power are used.
- The electrical power used by a 12-VDC light bulb that draws 0.2 amperes is 2.4 watts.
- Approximately 61 milliwatts are being dissipated when 7.0 milliamperes flow through 1.25 kilohms.

Transformers (either voltage or impedance)

- If the 2250-turn primary is connected to 120 VAC, the voltage across a 500-turn secondary winding in a transformer is 26.7 volts.
- The turns ratio of a transformer to match an audio amplifier having a 600-ohm output impedance to a speaker having a 4-ohm impedance is 12.2 to 1.
- Mutual inductance causes a voltage to appear across the secondary winding of a transformer when a voltage source is connected across its primary winding.

Sine wave root-mean-square (RMS) value

- A DC voltage equal to the RMS value of an applied sine-wave AC voltage would produce the same amount of heat over time in a resistive element.
- The peak-to-peak voltage of a sine wave that has an RMS voltage of 120 volts is 339.4 volts.
- A sine wave of 17 volts peak is equivalent to 12 volts RMS.

SUBELEMENT G6 -- CIRCUIT COMPONENTS [1 exam question -- 1 group]

Resistors

- If a carbon resistor's temperature is increased, the resistance will change depending on the resistor's temperature coefficient rating.
- It would not be a good idea to use a wire-wound resistor in a resonant circuit because the resistor's inductance would detune the circuit.

Capacitors

- An electrolytic capacitor is often used in power-supply circuits to filter the rectified AC.
- A capacitor serves as a Suppressor capacitor, if it is used in a power-supply circuit to filter transient voltage spikes across the transformer's secondary winding.

Inductors/Transformers

- Advantages of ferrite toroidal inductors:
  - Large values of inductance may be obtained
  - The inductor may be used in applications where core saturation is desirable
  - Most of the magnetic field is contained in the core
  - *(All of these choices are correct)*
- Two solenoid inductors should be placed at right angles to their winding axis so as to minimize their mutual inductance.
- It might be important to minimize the mutual inductance between two inductors in order to reduce or eliminate stray coupling between RF stages.
- The source of energy is connected to the primary winding in a transformer.
- If no load is attached to the secondary winding of a transformer, the current in the primary winding is called the Magnetizing current.

Rectifiers

- The peak-inverse-voltage rating of a power-supply rectifier is the maximum voltage the rectifier will handle in the non-conducting direction.
- The two major ratings that must not be exceeded for silicon-diode rectifiers used in power-supply circuits are Peak inverse voltage and average forward current.
- The output waveform of an unfiltered full-wave rectifier connected to a resistive load is a series of pulses at twice the frequency of the AC input.
- A half-wave rectifier conducts during 180 degrees of each cycle.
- A full-wave rectifier conducts during 360 degrees of each cycle.
- When two or more diodes are connected in parallel to increase the current-handling capacity of a power supply, the purpose of the resistor connected in series with each diode is to ensure that one diode doesn't take most of the current.

Transistors

- The stable operating points for a bipolar transistor that are used as a switch in a logic circuit are in its saturation and cut-off regions.

SUBELEMENT G7 -- PRACTICAL CIRCUITS [1 exam question -- 1 group]

Power supplies and filters

- The safety feature a power-supply bleeder resistor provides is it discharges the filter capacitors.
- Capacitors and inductors are used in a power-supply filter network.
- The minimum peak-inverse-voltage rating of the rectifier in a full-wave power supply is double the normal peak output voltage of the power supply.
- The minimum peak-inverse-voltage rating of the rectifier in a half-wave power supply should be one to two times the normal peak output voltage of the power supply.
- The impedance of a low-pass filter as compared to the impedance of the transmission line into which it is inserted should be about the same.
- A Crowbar power supply circuit is often used to provide overvoltage protection at its output.
- Capacitors with low equivalent series resistance should be used to filter the rectified DC output of a switching power supply.
- An advantage of a switched-mode power supply as compared to a linear power supply is the relatively high frequency power oscillator allows the use of small, lightweight and low-cost transformers in the switched-mode supply.
- In a switched-mode power supply, the first step in converting the 120 volt AC input voltage to a 12 volt DC output voltage is the 120 volt AC is rectified and filtered.

Single-sideband transmitters and receivers

- In a typical single-sideband phone transmitter, a Filter circuit processes signals from the balanced modulator and sends signals to the mixer.
- In a single-sideband phone transmitter, a Balanced Modulator circuit processes signals from the carrier oscillator and the speech amplifier and sends signals to the filter.
- In a single-sideband phone superheterodyne receiver, the Mixer circuit processes signals from the RF amplifier and the local oscillator and sends signals to the IF filter.
- In a single-sideband phone superheterodyne receiver, the Detector circuit processes signals from the IF amplifier and the BFO and sends signals to the AF amplifier.

SUBELEMENT G8 -- SIGNALS AND EMISSIONS [2 Exam Questions -- 2 Groups]

Signal information

AM

- An Amplitude Modulation system changes the amplitude of an RF wave for the purpose of conveying information.
- In the emission type, Amplitude modulation, the instantaneous amplitude (envelope) of the RF signal varies in accordance with the modulating audio.

FM

- A Frequency modulation system changes the frequency of an RF wave for the purpose of conveying information.
- When a modulating audio signal is applied to an FM transmitter the RF carrier signal frequency changes proportionally to the instantaneous amplitude of the modulating signal.

PM

- A Phase modulation system changes the phase of an RF wave for the purpose of conveying information.
- Phase modulation emission is produced by a reactance modulator connected to an RF power amplifier.

Single and double sideband and carrier

- One advantage of carrier suppression in a double-sideband phone transmission is more power can be put into the sidebands.
- The microphone gain control should be adjusted on a single-sideband phone transmitter for slight movement of the ALC meter on modulation peaks.

Modulation envelope

- Both upper and lower sidebands signal(s) would be found at the output of a properly adjusted balanced modulator.

Deviation

- The frequency deviation for a 12.21-MHz reactance-modulated oscillator in a 5-kHz deviation, 146.52-MHz FM-phone transmitter is 416.7 Hz.

Overmodulation

- The signal of an overmodulated single-sideband or double-sideband phone transmitter becomes distorted and occupies more bandwidth.
- Flattopping in a single-sideband phone transmission means signal distortion caused by excessive drive.

Multiplication

- The Multiplier stage in a VHF FM transmitter selects a harmonic of an HF signal to reach the desired operating frequency.

Frequency mixing

- The Mixer receiver stage combines a 14.25-MHz input signal with a 13.795-MHz oscillator signal to produce a 455-kHz intermediate frequency (IF) signal.
- If a receiver mixes a 13.800-MHz VFO with a 14.255-MHz received signal to produce a 455-kHz intermediate frequency (IF) signal, a 13.345-MHz signal will produce Image response interference in the receiver.
- A mixer stage in a transmitter would change a 5.3-MHz input signal to 14.3 MHz.
- Another term for the mixing of two RF signals is Heterodyning.

Bandwidths

- Frequency modulated (FM) phone isn't used below 29.5 MHz because the bandwidth would exceed FCC limits.
- The total bandwidth of an FM-phone transmission having a 5-kHz deviation and a 3-kHz modulating frequency would be 16 kHz.
- The maximum bandwidth permitted by FCC rules for amateur radio stations when operating on USB frequencies in the 60-meter band is 2.8 kHz.
- The popular phone emission, Single-sideband, uses the narrowest frequency bandwidth.

HF data communications

- Frequency shift is related to keying speed in an FSK signal in that greater keying speeds require greater frequency shifts.
- RTTY, Morse code, PSK31 and packet communications have in common the fact that they are digital communications.
- When sending data modes, it is important to know the duty cycle of the mode you are using to prevent damage to your transmitter's final output stage due to its inability to dissipate excess heat.
- Most PSK31 operations are found below the RTTY segment, near 14.070 MHz, in the 20-meter band.

SUBELEMENT G9 -- ANTENNAS AND FEED-LINES [4 Exam Questions -- 4 Groups]

Yagi antennas - physical dimensions

- When designing a Yagi antenna, SWR bandwidth can be increased by using larger diameter elements.
- The driven element of a Yagi antenna for 14.0 MHz is approximately 33 feet long.
- The director element of a Yagi antenna for 21.1 MHz is approximately 21 feet long.
- The reflector element of a Yagi antenna for 28.1 MHz is approximately 17.5 feet long.
- Regarding a three-element Yagi antenna the director is normally the shortest parasitic element.
- A good way to get maximum performance from a Yagi antenna is to optimize the lengths and spacing of the elements.
- The polarization of the antenna elements is NOT a Yagi antenna design variable that should be considered to optimize the forward gain, front-to-rear ratio and SWR bandwidth.
- One effect of increasing the boom length and adding directors to a Yagi antenna is Gain increases.

Impedance matching

Radiation patterns

- A Yagi antenna is often used for radio communications on the 20-meter band because it helps reduce interference from other stations off to the side or behind.
- In reference to a Yagi antenna, "antenna front-to-back ratio" means the power radiated in the major radiation lobe compared to the power radiated in exactly the opposite direction.

Directivity and major lobes

- The "main lobe" of a Yagi antenna radiation pattern is the direction of maximum radiated field strength from the antenna.

Loop antennas - physical dimensions

- Each side of a cubical-quad antenna driven element for 21.4 MHz is approximately 11.7 feet long.
- Each side of a cubical-quad antenna driven element for 14.3 MHz is approximately 17.6 feet long.
- Each side of a cubical-quad antenna reflector element for 29.6 MHz is approximately 8.7 feet long.
- Each leg of a symmetrical delta-loop antenna driven element for 28.7 MHz is approximately 11.7 feet long.
- Each leg of a symmetrical delta-loop antenna driven element for 24.9 MHz is approximately 13.45 feet long.
- Each leg of a symmetrical delta-loop antenna reflector element for 14.1 MHz is approximately 24.35 feet long.

Impedance matching

Radiation patterns

- A two-element quad antenna compares favorably with a three-element Yagi.
- As compared to dipole antenna directional radiation characteristics, the cubical-quad antenna has more directivity in both horizontal and vertical planes.
- Moving the feed point of a multielement quad antenna from a side parallel to the ground to a side perpendicular to the ground will change the antenna polarization from horizontal to vertical.
- In reference to a cubical-quad antenna, the term "antenna front-to-back ratio" means the power radiated in the major radiation lobe compared to the power radiated in exactly the opposite direction.

Directivity and major lobes

- The "main lobe" of a cubical-quad antenna radiation pattern is the direction of maximum radiated field strength from the antenna.

Random wire antennas – physical dimensions

- An end-fed random-wire antenna is a type of multiband transmitting antenna that does NOT require a feed-line.
- One advantage of using a random-wire antenna is that it is a multiband antenna.
- One disadvantage of a random-wire antenna is that you may experience RF feedback in your station.

Impedance matching

Radiation patterns

- The low-angle radiation pattern of an ideal half-wavelength dipole HF antenna installed a half-wavelength high, parallel to the earth is a figure-eight at right angles to the antenna.
- For a horizontal dipole HF antenna, if the antenna is less than one-half wavelength high, the horizontal (azimuthal) radiation pattern is almost omnidirectional.
- If the horizontal radiation pattern of an antenna shows a major lobe at 0 degrees and a minor lobe at 180 degrees, most of the signal would be radiated towards 0 degrees and a smaller amount would be radiated towards 180 degrees.

Directivity and major lobes

- If a slightly shorter parasitic element is placed 0.1 wavelength away and parallel to an HF dipole antenna mounted above ground, the antenna's radiation pattern major lobe will develop in the horizontal plane, toward the parasitic element.
- If a slightly longer parasitic element is placed 0.1 wavelength away and parallel to an HF dipole antenna mounted above ground, the antenna's radiation pattern major lobe will develop in the horizontal plane, away from the parasitic element, toward the dipole.

Feed point impedance of ½-wavelength dipole and 1/4-wavelength vertical antennas

- An advantage of downward sloping radials on a ground-plane antenna is it brings the feed-point impedance closer to 50 ohms.
- The feed-point impedance of a ground-plane antenna increases when its radials are changed from horizontal to downward-sloping.
- The radial wires of a ground-mounted vertical antenna system should be placed on the surface or buried a few inches below the ground.

Popular antenna feed-lines - characteristic impedance and impedance matching

- The distance between the centers of the conductors and the radius of the conductors is factor that can help determine the characteristic impedance of a parallel-conductor antenna feed-line.
- The typical characteristic impedance of coaxial cables used for antenna feed-lines at amateur stations 50 and 75 ohms.
- The characteristic impedance of flat-ribbon TV-type twin-lead is 300 ohms.
- A difference between feed line impedance and antenna feed-point impedance is the typical cause of power being reflected back down an antenna feed-line.
- The antenna feed-point impedance must be matched to the characteristic impedance of the feed-line to prevent standing waves of voltage and current on an antenna feed-line.
- You would use an inductively coupled matching network with a dipole antenna fed with parallel-conductor feed line to match the unbalanced transmitter output to the balanced parallel-conductor feed line.
- If a 160-meter signal and a 2-meter signal pass through the same coaxial cable, the attenuation will be greater at 2 meters.
- RF feed line losses are usually expressed in dB/100 ft.
- The physical aspects, diameter of the conductors and the distance between their centers, of an air-insulated parallel-conductor transmission line determine its characteristic impedance.

SWR calculations

- A standing-wave-ratio of 4:1 will result from the connection of a 50-ohm feed line to a resonant antenna having a 200-ohm feed-point impedance.
- A standing-wave-ratio of 5:1 will result from the connection of a 50-ohm feed line to a resonant antenna having a 10-ohm feed-point impedance.
- A standing-wave-ratio of 1:1 will result from the connection of a 50-ohm feed line to a resonant antenna having a 50-ohm feed-point impedance.
- If you feed a vertical antenna that has a 25-ohm feed-point impedance with 50-ohm coaxial cable the SWR would be 2:1.
- If you feed a folded dipole antenna that has a 300-ohm feed-point impedance with 50-ohm coaxial cable the SWR would be 6:1.

SUBELEMENT G0 -- RF SAFETY [5 Exam Questions -- 5 Groups]

RF Safety Principles

- Depending on the wavelength of the signal, the energy density of the RF field, and other factors, in what way can RF energy heats body tissue.
- When estimating RF energy's effect on body tissue, its critical angle is NOT an important property.
- The frequency (or wavelength) of the energy has the most direct effect on the permitted exposure level of RF radiation.
- The unit of measurement, Specific absorption rate (W/kg), best describes the biological effects of RF fields at frequencies used by amateur operators.
- RF radiation in the 1270-MHz range has the most effect on the human eyes.
- The term "athermal effects" of RF radiation means the biological effects from RF energy other than heating.
- At the very-high-frequency (30-300-MHz) range the human body absorbs RF energy at a maximum rate.
- The term "time averaging" when it applies to RF radiation exposure, means the total RF exposure averaged over a certain time.
- The guideline to determine whether or not a routine RF evaluation must be performed for an amateur station is if the transmitter's PEP and frequency are within certain limits given in Part 97, an evaluation must be performed.
- If you perform a routine RF evaluation on your station and determine that its RF fields exceed the FCC's exposure limits in human-accessible areas, you are required to take action to prevent human exposure to the excessive RF fields.
- At a site with multiple transmitters operating at the same time, each of the transmitters that produce more than 5% of the maximum permissible power density exposure limit for that transmitter must be included in the RF exposure site evaluation.
- Factors that can affect the thermal aspects of RF energy exposure to human body tissues:
    - The body part and duration of its exposure
    - Frequency and power density
    - Wave polarization
    - *(All of these choices are correct)*

RF Safety Rules and Guidelines

- The FCC's RF-safety rules are designed to control the maximum permissible human exposure to all RF radiated fields.
- At a site with multiple transmitters, all licensees contributing more than 5% of the maximum permissible power density exposure for that transmitter are equally responsible to ensure that all FCC RF-safety regulations are met.
- When evaluating RF exposure, low duty-cycle emissions permit greater short-term exposure levels.
- The threshold power of 100 watts PEP is used to determine if an RF environmental evaluation is required when the operation takes place in the 15-meter band.
- The power levels used to determine if an RF environmental evaluation is required vary with frequency because Maximum Permissible Exposure (MPE) limits are frequency dependent.

- The threshold power, 50 watts PEP, is used to determine if an RF environmental evaluation is required when the operation takes place in the 10-meter band.
- The threshold power, 500 watts PEP, is used to determine if an RF environmental evaluation is required for transmissions in the amateur bands with frequencies less than 10 MHz.
- All amateur frequency bands between 1.25 and 10 meters have the lowest power limits above which an RF environmental evaluation is required.
- The threshold power, 225 watts PEP is used to determine if an RF safety evaluation is required when the operation takes place in the 20-meter band.
- Those amateur radio stations with transmitter output levels exceeding 500-watts PEP on the 40, 75/80 and 160 meter bands are subject to routine environmental evaluation.

Routine Station Evaluation and Measurements (FCC Part 97 refers to RF Radiation Evaluation)

- If the free-space far-field strength of a 10-MHz dipole antenna measures 1.0 millivolts per meter at a distance of 5 wavelengths, the field strength will measure 0.50 millivolts per meter at a distance of 10 wavelengths.
- If the free-space far-field strength of a 28-MHz Yagi antenna measures 4.0 millivolts per meter at a distance of 5 wavelengths, field strength will measure 1.0 millivolts per meter at a distance of 20 wavelengths.
- If the free-space far-field strength of a 1.8-MHz dipole antenna measures 9 microvolts per meter at a distance of 4 wavelengths, the field strength will measure 3 microvolts per meter at a distance of 12 wavelengths.
- If the free-space far-field power density of an 18-MHz Yagi antenna measures 10 milliwatts per square meter at a distance of 3 wavelengths, the field strength will measure 2.5 milliwatts per square meter at a distance of 6 wavelengths.
- If the free-space far-field power density of an antenna measures 9 milliwatts per square meter at a distance of 5 wavelengths, the field strength will measure 1 milliwatt per square meter at a distance of 15 wavelengths.
- The wavelength of the signal and physical size of the antenna are factors that determine the location of the boundary between the near and far fields of an antenna.
- An amateur operator might perform a routine RF exposure evaluation to ensure compliance with the RF safety regulations.
- In the free-space far field, the electric field (E field) and magnetic field (H field) has a fixed impedance relationship of 377 ohms.
- A calibrated field-strength meter with a calibrated antenna can be used to accurately measure an RF field.
- If your station complies with the RF safety rules and you reduce its power output from 500 to 40 watts, you would not need to perform an RF safety evaluation, but your station would still need to be in compliance with the RF safety rules.
- If your station complies with the RF safety rules and you reduce its power output from 1000 to 500 watts, since your station was in compliance with RF safety rules at a higher power output, you need to do nothing more with respect to the RF safety rules that apply to your operations.

Practical RF-safety applications

- Considering RF safety, if you install an indoor transmitting antenna locate the antenna as far away as possible from living spaces that will be occupied while you are operating.
- Considering RF safety, be sure no one can activate the transmitter whenever you make adjustments to the feed line of a directional antenna system.
- The best reason to place a protective fence around the base of a ground-mounted transmitting antenna is to reduce the possibility of persons being exposed to levels of RF in excess of the maximum permissible exposure (MPE) limits.
- As an RF-safety precaution, be sure to turn off the transmitter and disconnect the feed-line before beginning repairs on an antenna.
- As a precaution when installing a ground-mounted antenna, it should be installed so no one can be exposed to RF radiation in excess of the maximum permissible exposure (MPE) limits.
- As a precaution, be sure the transmitter is turned off and the power source is disconnected before beginning repairs on a microwave feed horn or waveguide.
- Directional high-gain antennas should be mounted higher than nearby structures so they will not direct excessive amounts of RF energy toward people in nearby structures.
- For best RF safety, the ends and center of a dipole antenna be located should be as far away as possible to minimize RF exposure to people near the antenna.
- To reduce RF radiation exposure when operating at 1270 MHz you should keep the antenna away from your eyes when RF is applied.
- Considering RF safety, the best reason to mount the antenna of a mobile VHF transceiver in the center of a metal roof is that the roof will greatly shield the driver and passengers from RF radiation.
- You should avoid using attic-mounted antennas because they may expose people in the house to strong, near field RF energy.
- You must be careful when aiming EME (moonbounce) arrays toward the horizon because:
    - Their high ERP may produce hazardous RF fields in uncontrolled areas
    - They could cause TVI/RFI for your neighbors
    - Reflections from nearby objects could detune the array
    - *(All of these choices are correct)*

RF-safety solutions

- If you receive minor burns every time you touch your microphone while you are transmitting, you and others in your station may be exposed to more than the maximum permissible level of RF radiation.

- If measurements indicate that individuals in your station are exposed to more than the maximum permissible level of radiation, all of the following corrective measures would be effective:
    - Ensure proper grounding of the equipment
    - Ensure that all equipment covers are tightly fastened
    - Use the minimum amount of transmitting power necessary
    - *(All of these choices are correct)*

- If calculations show that you and your family may be receiving more than the maximum permissible RF radiation exposure from your 20-meter indoor

dipole, it might be an appropriate step to move the antenna to a safe outdoor environment.

- Considering RF exposure, you should take all of the following steps when installing an antenna:
  - Install the antenna as high and far away from populated areas as possible
  - If the antenna is a gain antenna, point it away from populated areas
  - Minimize feed line radiation into populated areas
  - *(All of these choices are correct)*
- If an RF radiation evaluation shows that your neighbors may be receiving more than the maximum RF radiation exposure limit from your Yagi antenna when it is pointed at their house take precautions to ensure you can't point your antenna at their house.
- If an RF radiation evaluation shows that your neighbors may be receiving more than the maximum RF radiation exposure limit from your quad antenna when it is pointed at their house reduce your transmitter power to a level that reduces their exposure to a value below the maximum permissible exposure (MPE) limit.
- A dummy antenna provides an RF safe environment for transmitter adjusting because the RF energy is not radiated from a dummy antenna, but is converted to heat.
- From an RF radiation exposure point of view, aluminum would be the best material to use for your homemade Transmatch enclosure.
- From an RF radiation exposure point of view, the advantage to using a high-gain, narrow-beamwidth antenna for your VHF station is the RF radiation can be focused in a direction away from populated areas.
- From an RF radiation exposure point of view, the disadvantage in using a high-gain, narrow-beamwidth antenna for your VHF station is that individuals in the main beam of the radiation pattern will receive a greater exposure than when a low-gain antenna is used.
- If your station is located in a residential area, you can reduce the RF exposure to your neighbors from your amateur station by installing your antenna as high as possible to maximize the distance to nearby people.
- You could construct fencing to exclude people from getting too close to the antenna to ensure greater RF safety near a ground mounted vertical antenna.