Amateur Radio General License Training

Welcome

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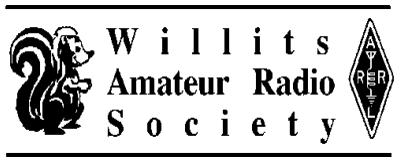

G4 Amateur Radio Practices

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G4 – Amateur Radio Practices

60 questions, 5 sections, 5 exam questions

Sections Include

- Station configuration and operation (13 questions)
- Tests and test equipment (13 questions)
- Interference to consumer electronics; grounding and bonding (12 questions)
- Speech processors; S meters; sideband operation near band edges (11 questions)
- Mobile and portable HF stations; alternative energy source operation (11 questions)

Question Topics

- Alternative Power
- Basic Test Equipment
- Transmitters
- Amplifiers
- Receivers
- HF Station Installation
- Mobile HF Antennas

Alternative Power

General Class License Manual page 4-39

Solar power is “photovoltaic conversion” of sunlight to electricity.

Solar cells are PN junctions; electrons absorb photons from the sunlight, energizing sufficiently to travel across the PN junction thus creating DC current flow.

A system with solar panels and batteries must accommodate periods with and without sunlight and with and without charged batteries. A charge controller is used to manage these situations.

Alternative Power

G4E08: In what configuration are the individual cells in a solar panel connected together?

A. Series-parallel

B. Shunt

C. Bypass

D. Full-wave bridge

Alternative Power

G4E09: What is the approximate open-circuit voltage from a fully illuminated silicon photovoltaic cell?

A. 0.02 VDC

B. 0.5 VDC

C. 0.2 VDC

D. 1.38 VDC

Alternative Power

G4E10: Why should a series diode be connected between a solar panel and a storage battery that is being charged by the panel?

A. To prevent overload by regulating the charging voltage

B. To prevent discharge of the battery through the panel during times of low or no illumination

C. To limit the current flowing from the panel to a safe value

D. To prevent damage to the battery due to excessive voltage at high illumination levels

Alternative Power

G4E11: What precaution should be taken when connecting a solar panel to a lithium iron phosphate battery?

A. Ground the solar panel outer metal framework

B. Ensure the battery is placed terminals-up

C. A series resistor must be in place

D. The solar panel must have a charge controller

Basic Test Equipment

General Class License Manual pages 4-42 – 4-46

Voltmeters/Multimeter – measures voltage, current or resistance.

Oscilloscope – displays voltage (vertical scale) over time (horizontal scale).

Antenna analyzer – measures standing wave ratio (SWR), antenna and feedline impedance, velocity factor, electrical length and characteristic impedance.

Directional wattmeter – measures forward and reflected power.

Basic Test Equipment

G4B01: What item of test equipment contains horizontal and vertical channel amplifiers?

A. An ohmmeter

B. A signal generator

C. An ammeter

D. An oscilloscope

Basic Test Equipment

G4B02: Which of the following is an advantage of an oscilloscope versus a digital voltmeter?

A. An oscilloscope uses less power

B. Complex impedances can be easily measured

C. Greater precision

D. Complex waveforms can be measured

Basic Test Equipment

G4B03: Which of the following is the best instrument to use for checking the keying waveform of a CW transmitter?

A. An oscilloscope

B. A field strength meter

C. A sidetone monitor

D. A wavemeter

Basic Test Equipment

G4B04: What signal source is connected to the vertical input of an oscilloscope when checking the RF envelope pattern of a transmitted signal?

A. The local oscillator of the transmitter

B. An external RF oscillator

C. The transmitter balanced mixer output

D. The attenuated RF output of the transmitter

Basic Test Equipment

G4B05: Why do voltmeters have high input impedance?

A. It improves the frequency response

B. It allows for higher voltages to be safely measured

C. It improves the resolution of the readings

D. It decreases the loading on circuits being measured

Basic Test Equipment

G4B06: What is an advantage of a digital multimeter as compared to an analog multimeter?

A. Better for measuring computer circuits

B. Less prone to overload

C. Higher precision

D. Faster response

Basic Test Equipment

G4B09: When is an analog multimeter preferred to a digital multimeter?

A. When testing logic circuits

B. When high precision is desired

C. When measuring the frequency of an oscillator

D. When adjusting circuits for maximum or minimum values

Basic Test Equipment

G4B10: Which of the following can be determined with a directional wattmeter?

A. Standing wave ratio

B. Antenna front-to-back ratio

C. RF interference

D. Radio wave propagation

Basic Test Equipment

G4B11: Which of the following must be connected to an antenna analyzer when it is being used for SWR measurements?

A. Receiver

B. Transmitter

C. Antenna and feed line

D. All these choices are correct

Basic Test Equipment

G4B12: What effect can strong signals from nearby transmitters have on an antenna analyzer?

A. Desensitization which can cause intermodulation products which interfere with impedance readings

B. Received power that interferes with SWR readings

C. Generation of harmonics which interfere with frequency readings

D. All these choices are correct

Basic Test Equipment

G4B13: Which of the following can be measured with an antenna analyzer?

A. Front-to-back ratio of an antenna

B. Power output from a transmitter

C. Impedance of coaxial cable

D. Gain of a directional antenna

Transmitters

General Class License Manual pages 5-12 – 5-14

HF transmission modes include CW, SSB, AM, FM and numerous digital modes (FT4, FT8, RTTY, etc.).

The FCC states that phone signals should not occupy more bandwidth than is dictated by good amateur practice (<3kHz for SSB, <6kHz for AM).

Overmodulation (excessive signal amplitude) generates signals beyond the normal bandwidth causing interference.

A transmitter's ALC (automatic level control) will reduce output power during voice peaks, reducing or eliminating overmodulation.

Transmitters

Two-tone tests are used to measure transmitter linearity. The transmitter is modulated with two non-harmonically related tones (typically 700 and 1900 Hz) while observing the transmitted signal on an oscilloscope.

When transmitting, you must stay inside the band. The VFO displays the carrier frequency. When using LSB, your signal bandwidth is carrier – 3kHz; USB is carrier + 3kHz, so tune 3kHz above the bottom for LSB or 3kHz below the band top for USB.

Speech processing AM and SSB signals increases average power by compressing the audio peaks but can distort the signal.

Transmitters

G4A11: Why should the ALC system be inactive when transmitting AFSK data signals?

A. ALC will invert the modulation of the AFSK mode

B. The ALC action distorts the signal

C. When using digital modes, too much ALC activity can cause the transmitter to overheat

D. All these choices are correct

Transmitters

G4B07: What signals are used to conduct a two-tone test?

A. Two audio signals of the same frequency shifted 90 degrees

B. Two non-harmonically related audio signals

C. Two swept frequency tones

D. Two audio frequency range square wave signals of equal amplitude

Transmitters

G4B08: What transmitter performance parameter does a two-tone test analyze?

A. Linearity

B. Percentage of suppression of the carrier and undesired sideband for SSB

C. Percentage of frequency modulation

D. Percentage of carrier phase shift

Transmitters

G4D01: What is the purpose of a speech processor in a transceiver?

A. Increase the apparent loudness of transmitted voice signals

B. Increase transmitter bass response for more natural-sounding SSB signals

C. Prevent distortion of voice signals

D. Decrease high-frequency voice output to prevent out-of-band operation

Transmitters

G4D02: How does a speech processor affect a single sideband phone signal?

A. It increases peak power

B. It increases average power

C. It reduces harmonic distortion

D. It reduces intermodulation distortion

Transmitters

G4D03: What is the effect of an incorrectly adjusted speech processor?

A. Distorted speech

B. Excess intermodulation products

C. Excessive background noise

D. All these choices are correct

Transmitters

G4D08: What frequency range is occupied by a 3 kHz LSB signal when the displayed carrier frequency is set to 7.178 MHz?

A. 7.178 MHz to 7.181 MHz

B. 7.178 MHz to 7.184 MHz

C. 7.175 MHz to 7.178 MHz

D. 7.1765 MHz to 7.1795 MHz

Transmitters

G4D09: What frequency range is occupied by a 3 kHz USB signal with the displayed carrier frequency set to 14.347 MHz?

A. 14.347 MHz to 14.647 MHz

B. 14.347 MHz to 14.350 MHz

C. 14.344 MHz to 14.347 MHz

D. 14.3455 MHz to 14.3485 MHz

Transmitters

G4D10: How close to the lower edge of a band's phone segment should your displayed carrier frequency be when using 3 kHz wide LSB?

A. At least 3 kHz above the edge of the segment

B. At least 3 kHz below the edge of the segment

C. At least 1 kHz below the edge of the segment

D. At least 1 kHz above the edge of the segment

Transmitters

G4D11: How close to the upper edge of a band's phone segment should your displayed carrier frequency be when using 3 kHz wide USB?

A. At least 3 kHz above the edge of the band

B. At least 3 kHz below the edge of the band

C. At least 1 kHz above the edge of the segment

D. At least 1 kHz below the edge of the segment

Transmitters

G4A10: What is the function of an electronic keyer?

A. Automatic transmit/receive switching

B. Automatic generation of dots and dashes for CW operation

C. To allow time for switching the antenna from the receiver to the transmitter

D. Computer interface for PSK and RTTY operation

Amplifiers

General Class License Manual page 5-15

An amplifier is connected between the transceiver and antenna to boost the transmitted signal strength. When receiving, the signal received on the antenna bypasses the amplifier via a transmit-receive changeover relay.

There are both solid state and vacuum tube amplifiers.

Tube amplifiers require setting the band and adjusting the TUNE control on the amplifier to minimize the plate current, making it resonant at the transmit frequency. After that, adjust the LOAD control to maximize output power. Then readjust TUNE so max output power doesn’t exceed maximum plate current. (TUNE for dip; LOAD for peak; TUNE for dip).

ALC again to limit excess drive causing distortion and splatter.

Amplifiers

G4A04: What is the effect on plate current of the correct setting of a vacuum-tube RF power amplifier’s TUNE control?

A. A pronounced peak

B. A pronounced dip

C. No change will be observed

D. A slow, rhythmic oscillation

Amplifiers

G4A05: Why is automatic level control (ALC) used with an RF power amplifier?

A. To balance the transmitter audio frequency response

B. To reduce harmonic radiation

C. To prevent excessive drive

D. To increase overall efficiency

Amplifiers

G4A08: What is the correct adjustment for the LOAD or COUPLING control of a vacuum tube RF power amplifier?

A. Minimum SWR on the antenna

B. Minimum plate current without exceeding maximum allowable grid current

C. Highest plate voltage while minimizing grid current

D. Desired power output without exceeding maximum allowable plate current

Amplifiers

G4A09: What is the purpose of delaying RF output after activating a transmitter’s keying line to an external amplifier?

A. To prevent key clicks on CW

B. To prevent transient overmodulation

C. To allow time for the amplifier to switch the antenna between the transceiver and the amplifier output

D. To allow time for the amplifier power supply to reach operating level

Receivers

General Class License Manual pages 5-20 – 5-21

Receivers amplify and filter the signals coming from the antenna.

Receiver amplification is called RF gain. Gain is applied equally to all signals within the receive bandwidth.

Automatic gain controls (AGC) vary the gain so the output volume of the received signal stays relatively constant for both weak and strong signals. AGC adjusts the voltage that controls the IF amplifier gain and is measured in “S” units (S for signal).

As AGC decreases, the S meter reading increases (less gain, constant output volume indicates a stronger signal).

S meters are calibrated in S-units, with 1 S-unit equal to a 6DB change in signal strength (4x).

Receivers

Overload occurs when the received signal is too strong for the circuitry to handle and distortion results. Either filter out the offending signal or reduce receive gain using the receive attenuator.

Filters can narrow the receiver's passband and remove unwanted signals.

Notch filters remove very narrow signals.

Passband filters adjust the passband above or below the displayed carrier frequency to avoid interfering signals.

Reverse sideband controls enable switching between receiving CW signals above or below the displayed carrier frequency. This can help avoid interfering signals by placing them outside the passband.

Noise blankers turn down gain when a strong sharp pulse is detected.

Increasing noise reduction can cause loss of desired signals increasing distortion.

Receivers

G4A01: What is the purpose of the notch filter found on many HF transceivers?

A. To restrict the transmitter voice bandwidth

B. To reduce interference from carriers in the receiver passband

C. To eliminate receiver interference from impulse noise sources

D. To remove interfering splatter generated by signals on adjacent frequencies

Receivers

G4A02: What is the benefit of using the opposite or “reverse” sideband when receiving CW?

A. Interference from impulse noise will be eliminated

B. More stations can be accommodated within a given signal passband

C. It may be possible to reduce or eliminate interference from other signals

D. Accidental out-of-band operation can be prevented

Receivers

G4A03: How does a noise blanker work?

A. By temporarily increasing received bandwidth
B. By redirecting noise pulses into a filter capacitor
C. By reducing receiver gain during a noise pulse
D. By clipping noise peaks

Receivers

G4A07: What happens as a receiver’s noise reduction control level is increased?

A. Received signals may become distorted

B. Received frequency may become unstable

C. CW signals may become severely attenuated

D. Received frequency may shift several kHz

Receivers

G4A12: Which of the following is a common use of the dual-VFO feature on a transceiver?

A. To allow transmitting on two frequencies at once

B. To permit full duplex operation -- that is, transmitting and receiving at the same time

C. To transmit on one frequency and listen on another

D. To improve frequency accuracy by allowing variable frequency output (VFO) operation

Receivers

G4A13: What is the purpose of using a receive attenuator?

A. To prevent receiver overload from strong incoming signals

B. To reduce the transmitter power when driving a linear amplifier

C. To reduce power consumption when operating from batteries

D. To reduce excessive audio level on strong signals

Receivers

G4D04: What does an S meter measure?

A. Carrier suppression

B. Impedance

C. Received signal strength

D. Transmitter power output

Receivers

G4D05: How does a signal that reads 20 dB over S9 compare to one that reads S9 on a receiver, assuming a properly calibrated S meter?

A. It is 10 times less powerful

B. It is 20 times less powerful

C. It is 20 times more powerful

D. It is 100 times more powerful

Receivers

G4D06: How much change in signal strength is typically represented by one S unit?

A. 6 dB

B. 12 dB

C. 15 dB

D. 18 dB

Receivers

G4D07: How much must the power output of a transmitter be raised to change the S meter reading on a distant receiver from S8 to S9?

A. Approximately 1.5 times

B. Approximately 2 times

C. Approximately 4 times

D. Approximately 8 times

HF Station Installation

General Class License Manual pages 5-21 – 5-25

Mobile Installation

- Mobile radios need 15-20A at 12V when transmitting and should be wired directly to the battery with fused leads.
- Mobile antennas are electrically short (typically with a loading coil) and less efficient than full size antennas. As frequencies go down into the HF bands, electrically short antennas become even less efficient.
- Pretty much everything in a modern auto causes RF interference – control computers, fuel pump, power windows, battery charging systems, etc.

HF Station Installation

Grounding and Bonding

- Bond all equipment enclosures to a common ground buss to avoid hot spots that could burn you with short copper strap or #10 or #12 copper wire.
- Ground the buss to the AC house ground, keeping the connection short.
- If you use a ground rod, and the connection length approaches resonance at an odd number of ¼ wavelengths at any frequency, it will present a high impedance, enabling RF voltages to exist on your equipment enclosures and connecting cables.
- Avoid ground loops (a continuous path around a series of equipment connections) by bonding everything to a ground buss.

HF Station Installation

RF Interference in consumer electronics

- CW, FM and data interference typically consists of buzzes, humming, clicks or thumps when transmitting.
- SSB interference results in distorted or garbled voice in the equipment.

HF Station Installation

G4C01: Which of the following might be useful in reducing RF interference to audio frequency circuits?

A. Bypass inductor

B. Bypass capacitor

C. Forward-biased diode

D. Reverse-biased diode

HF Station Installation

G4C02: Which of the following could be a cause of interference covering a wide range of frequencies?

A. Not using a balun or line isolator to feed balanced antennas

B. Lack of rectification of the transmitter’s signal in power conductors

C. Arcing at a poor electrical connection

D. Using a balun to feed an unbalanced antenna

HF Station Installation

G4C03: What sound is heard from an audio device experiencing RF interference from a single sideband phone transmitter?

A. A steady hum whenever the transmitter is on the air

B. On-and-off humming or clicking

C. Distorted speech

D. Clearly audible speech

HF Station Installation

G4C04: What sound is heard from an audio device experiencing RF interference from a CW transmitter?

A. On-and-off humming or clicking

B. A CW signal at a nearly pure audio frequency

C. A chirpy CW signal

D. Severely distorted audio

HF Station Installation

G4C05: What is a possible cause of high voltages that produce RF burns?

A. Flat braid rather than round wire has been used for the ground wire

B. Insulated wire has been used for the ground wire

C. The ground rod is resonant

D. The ground wire has high impedance on that frequency

HF Station Installation

G4C06: What is a possible effect of a resonant ground connection?

A. Overheating of ground straps

B. Corrosion of the ground rod

C. High RF voltages on the enclosures of station equipment

D. A ground loop

HF Station Installation

G4C07: Why should soldered joints not be used in lightning protection ground connections?

A. A soldered joint will likely be destroyed by the heat of a lightning strike

B. Solder flux will prevent a low conductivity connection

C. Solder has too high a dielectric constant to provide adequate lightning protection

D. All these choices are correct

HF Station Installation

G4C08: Which of the following would reduce RF interference caused by common-mode current on an audio cable?

A. Place a ferrite choke on the cable

B. Connect the center conductor to the shield of all cables to short circuit the RFI signal

C. Ground the center conductor of the audio cable causing the interference

D. Add an additional insulating jacket to the cable

HF Station Installation

G4C09: How can the effects of ground loops be minimized?

A. Connect all ground conductors in series

B. Connect the AC neutral conductor to the ground wire

C. Avoid using lock washers and star washers when making ground connections

D. Bond equipment enclosures together

HF Station Installation

G4C10: What could be a symptom caused by a ground loop in your station’s audio connections?

A. You receive reports of “hum” on your station’s transmitted signal

B. The SWR reading for one or more antennas is suddenly very high

C. An item of station equipment starts to draw excessive amounts of current

D. You receive reports of harmonic interference from your station

HF Station Installation

G4C11: What technique helps to minimize RF “hot spots” in an amateur station?

A. Building all equipment in a metal enclosure

B. Using surge suppressor power outlets

C. Bonding all equipment enclosures together

D. Placing low-pass filters on all feed lines

HF Station Installation

G4C12: Why must all metal enclosures of station equipment be grounded?

A. It prevents a blown fuse in the event of an internal short circuit

B. It prevents signal overload

C. It ensures that the neutral wire is grounded

D. It ensures that hazardous voltages cannot appear on the chassis

HF Station Installation

G4E03: Which of the following direct, fused power connections would be the best for a 100-watt HF mobile installation?

A. To the battery using heavy-gauge wire

B. To the alternator or generator using heavy-gauge wire

C. To the battery using insulated heavy duty balanced transmission line

D. To the alternator or generator using insulated heavy duty balanced transmission line

HF Station Installation

G4E04: Why should DC power for a 100-watt HF transceiver not be supplied by a vehicle's auxiliary power socket?

A. The socket is not wired with an RF-shielded power cable

B. The socket's wiring may be inadequate for the current drawn by the transceiver

C. The DC polarity of the socket is reversed from the polarity of modern HF transceivers

D. Drawing more than 50 watts from this socket could cause the engine to overheat

HF Station Installation

G4E05: Which of the following most limits an HF mobile installation?

A. “Picket fencing”

B. The wire gauge of the DC power line to the transceiver

C. Efficiency of the electrically short antenna

D. FCC rules limiting mobile output power on the 75-meter band

HF Station Installation

G4E07: Which of the following may cause receive interference to an HF transceiver installed in a vehicle?

A. The battery charging system

B. The fuel delivery system

C. The control computers

D. All these choices are correct

Mobile HF Antennas

Pages 7-5 – 7-6

Typical mobile antennas are vertical whips. At HF frequencies, full size ¼ wavelength whips are not feasible below 24Mhz (lengths start at ~10 feet).

Antenna loading techniques are used to increase the electrical length without increasing the physical length.

Loading coils (typically at the base or mid point of the antenna) can be used to tune the antenna to a lower frequency.

Capacitance hats (spokes or a wheel shaped structure) added near the top of the antenna can also be used.

Loading the antenna reduces the efficiency, narrowing the operating bandwidth of the antenna. A screwdriver antenna design includes a whip with an adjustable loading coil and can be tuned for various operating frequencies.

Most mobile whips also include a corona ball at the tip to eliminate high voltage discharges from the tip when transmitting.

Mobile HF Antennas

G4E01: What is the purpose of a capacitance hat on a mobile antenna?

A. To increase the power handling capacity of a whip antenna

B. To reduce radiation resistance

C. To electrically lengthen a physically short antenna

D. To lower the radiation angle

Mobile HF Antennas

G4E02: What is the purpose of a corona ball on an HF mobile antenna?

A. To narrow the operating bandwidth of the antenna

B. To increase the “Q” of the antenna

C. To reduce the chance of damage if the antenna should strike an object

D. To reduce RF voltage discharge from the tip of the antenna while transmitting

Mobile HF Antennas

G4E06: What is one disadvantage of using a shortened mobile antenna as opposed to a full-size antenna?

A. Short antennas are more likely to cause distortion of transmitted signals

B. Q of the antenna will be very low

C. Operating bandwidth may be very limited

D. Harmonic radiation may increase

Miscellaneous

Miscellaneous

G4A06: What is the purpose of an antenna tuner?

A. Reduce the SWR in the feed line to the antenna

B. Reduce the power dissipation in the feedline to the antenna

C. Increase power transfer from the transmitter to the feed line

D. All these choices are correct

Resources

ARRL General Class License Manual (10th edition)

HamExam.org