



ARRL The national association for
AMATEUR RADIO®

The ARRL General Class License Course

All You Need to Pass Your General Class Exam
LEVEL 2: General

For use with *The ARRL General Class License Manual*, Ninth Edition

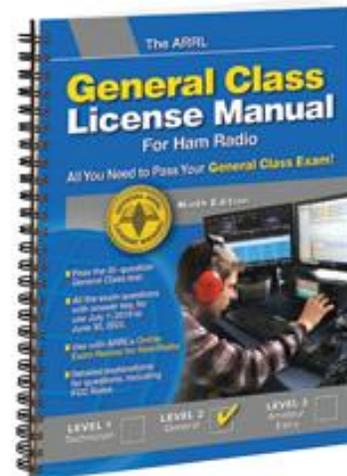


General Class License Course

Discovering the Excitement of Ham Radio



General Class License Manual and other resources



<http://www.arrl.org/shop/Licensing-Education-and-Training/>



Module 2

ARRL General Class

Chapter 2 – Procedures and Practices

(2.1, 2.2)

HF Operating Techniques, Emergency Operation



HF Operating Techniques

- Technician class operators focus skills for VHF and higher bands
 - Although 10 meters (voice) and 80, 40, and 15 meters (CW) are HF options for technicians
- General class operators have the advantage of using HF
 - A General license opens up many more frequencies, modes, and activities



Selecting a Frequency

- Check FCC Part 97 for frequency & mode restrictions
 - Refer to Band Plan in Module 1 (<http://www.arrl.org/graphical-frequency-allocations>)
- On HF, perfectly clear channels are rare
- Goal: Find a frequency that minimizes interference to adjacent stations (and, vice versa) – see recommended signal separation table ...

RECOMMENDED SIGNAL SEPARATION

CW:	150-500 Hz
SSB:	2.5-3 kHz
RTTY:	250-500 Hz
PSK31:	150-500 Hz



Selecting a Frequency (cont.)

- Once frequency is found, check if other station is using it ...
 - Listen for 10-20 seconds ... then ...
 - Voice Mode: *Is this frequency in use? This is [your call].*
 - CW/Digital Modes: *QRL? DE [your call].*
- Frequency selection summary ...
 - Confirm frequency is authorized for your license privileges
 - Follow the band plan under normal circumstances
 - Listen to avoid interfering with ongoing communications



Split / Dual Frequency Operation

- When a rare or interesting station is on the air with many calling stations, it's common to operate *split* ...
 - Set transceiver to listen on one frequency and transmit on another
 - Allows for more orderly/effective operating
 - Doesn't work on all transceivers
 - Referred to as a *dual-VFO feature* on a transceiver

More Info ... HF Operating Techniques

- HF equipment is designed for continuous tuning. The control used for continuous tuning is called a *VFO* or *Variable Frequency Oscillator*
 - The minimum frequency change is called *step size* or *step rate*
- For short-range contacts, use 80 or 40 meters
 - Using long-distance bands for short-range contacts needlessly occupies precious radio spectrum space (signal will be heard over much wider range than you're using)
- Longer range contacts, use 30 through 10 meters

<i>Frequencies</i>	<i>Modes/Activities</i>	<i>Frequencies</i>	<i>Modes/Activities</i>
1.800-2.000	CW	14.236	Digital Voice
1.800-1.810	Digital Modes	14.285	QRP SSB calling frequency
1.810	QRP CW calling frequency	14.286	AM calling frequency
1.843-2.000	SSB, SSTV and other wideband modes		
1.910	SSB QRP calling frequency	18.100-18.105	RTTY/Data
1.995-2.000	Experimental	18.105-18.110	Automatically controlled data stations
1.999-2.000	Beacons	18.110	IBP/NCDXF beacons
		18.162.5	Digital Voice
3.500-3.510	CW DX window		
3.560	QRP CW calling frequency	21.060	QRP CW calling frequency
3.570-3.600	RTTY/Data	21.070-21.110	RTTY/Data
3.585-3.600	Automatically controlled data stations	21.090-21.100	Automatically controlled data stations
3.590	RTTY/Data DX	21.150	IBP/NCDXF beacons
3.790-3.800	DX window	21.340	SSTV
3.845	SSTV	21.385	QRP SSB calling frequency
3.885	AM calling frequency		
3.985	QRP SSB calling frequency	24.920-24.925	RTTY/Data
		24.925-24.930	Automatically controlled data stations
		24.930	IBP/NCDXF beacons
7.030	QRP CW calling frequency		
7.040	RTTY/Data DX		
7.070-7.125	RTTY/Data	28.060	QRP CW calling frequency
7.100-7.105	Automatically controlled data stations	28.070-28.120	RTTY/Data
7.171	SSTV	28.120-28.189	Automatically controlled data stations
7.173	D-SSTV	28.190-28.225	Beacons
7.285	QRP SSB calling frequency	28.200	IBP/NCDXF beacons
7.290	AM calling frequency	28.385	QRP SSB calling frequency
		28.680	SSTV
10.130-10.140	RTTY/Data	29.000-29.200	AM
10.140-10.150	Automatically controlled data stations	29.300-29.510	Satellite downlinks
		29.520-29.580	Repeater inputs
14.060	QRP CW calling frequency	29.600	FM simplex
14.070-14.095	RTTY/Data	29.620-29.680	Repeater outputs
14.095-14.0995	Automatically controlled data stations		
14.100	IBP/NCDXF beacons		
14.1005-14.112	Automatically controlled data stations		
14.230	SSTV		
14.233	D-SSTV		

ARRL band plans for frequencies above 28.300 MHz are shown in *The ARRL Repeater Directory* and on www.arrl.org.

Band-by-Band Frequency Guide

General Class License
Manual, Ninth Edition,
Page 2-3



PRACTICE QUESTIONS



When choosing a transmitting frequency, what should you do to comply with good amateur practice?

- A. Ensure that the frequency and mode selected are within your license class privileges
- B. Follow generally accepted band plans agreed to by the Amateur Radio community
- C. Monitor the frequency before transmitting
- D. All these choices are correct



Which of the following is true concerning access to frequencies?

- A. Nets always have priority
- B. QSOs in progress always have priority
- C. Except during emergencies, no amateur station has priority access to any frequency
- D. Contest operations must always yield to non-contest use of frequencies



What is good amateur practice if propagation changes during a contact and you notice interference from other stations on the frequency?

- A. Tell the interfering stations to change frequency
- B. Report the interference to your local Amateur Auxiliary Coordinator
- C. Attempt to resolve the interference problem with the other stations in a mutually acceptable manner
- D. Increase power to overcome interference



When selecting a CW transmitting frequency, what minimum separation should be used to minimize interference to stations on adjacent frequencies?

- A. 5 to 50 Hz
- B. 150 to 500 Hz
- C. 1 to 3 kHz
- D. 3 to 6 kHz



When selecting an SSB transmitting frequency, what minimum separation should be used to minimize interference to stations on adjacent frequencies?

- A. 5 to 50 Hz
- B. 150 to 500 Hz
- C. Approximately 3 kHz
- D. Approximately 6 kHz



What is a practical way to avoid harmful interference on an apparently clear frequency before calling CQ on CW or phone?

- A. Send “QRL?” on CW, followed by your call sign; or, if using phone, ask if the frequency is in use, followed by your call sign
- B. Listen for 2 minutes before calling CQ
- C. Send the letter “V” in Morse code several times and listen for a response, or say “test” several times and listen for a response
- D. Send “QSY” on CW or if using phone, announce “the frequency is in use,” then give your call sign and listen for a response



Which of the following complies with good amateur practice when choosing a frequency on which to initiate a call?

- A. Check to see if the channel is assigned to another station
- B. Identify your station by transmitting your call sign at least 3 times
- C. Follow the voluntary band plan for the operating mode you intend to use
- D. All these choices are correct



What does the Q signal “QRL?” mean?

- A. “Will you keep the frequency clear?”
- B. “Are you operating full break-in?” or “Can you operate full break-in?”
- C. “Are you listening only for a specific station?”
- D. “Are you busy?” or “Is this frequency in use?”



Which of the following are examples of the NATO Phonetic Alphabet?

- A. Able, Baker, Charlie, Dog
- B. Adam, Boy, Charles, David
- C. America, Boston, Canada, Denmark
- D. Alpha, Bravo, Charlie, Delta



What is normally meant by operating a transceiver in “split” mode?

- A. The radio is operating at half power
- B. The transceiver is operating from an external power source
- C. The transceiver is set to different transmit and receive frequencies
- D. The transmitter is emitting an SSB signal, as opposed to DSB operation



Which of the following is a common use for 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 permit monitoring of two different frequencies
- D. To facilitate computer interface



Making Contacts

- Calling CQ is rare on VHF/UHF FM channels, but **it** is how many contacts are initiated on HF
- To call CQ on phone/voice ...
 - “CQ CQ CQ, this is [your call repeated a few times with phonetics]”
 - Pause for a response
 - If no response, repeat your CQ
- To call CQ on CW ...
 - “CQ CQ CQ DE [your call without phonetics]”



Making Contacts, CQ Variations

- CQ DX (DX means *distant stations*)
 - If you hear CQ DX from a station on the US mainland, it means the person calling is looking for stations outside the lower 48 states
 - On HF, it generally refers to any station outside the caller's country
- During CQ contests, you'll generally hear ...
 - "CQ Contest", "CQ test", or "CQ from special event station"
- CQ for stations from certain areas ...
 - "CQ North America" or "CQ California"



Joining an Ongoing QSO (Contact)

- Joining a QSO (also called *breaking in*) is common
- On phone/voice, just say your call sign
- On CW or digital modes, send BK (break) followed by your call sign
- Same rules apply during contests and competitive events



Logging Contacts

- Although no longer required, most amateurs keep a log to verify contacts for awards and to record items of interest – see **NOTE** below
- Typical log: time, date, frequency or band, mode of the contact (USB, PSK, etc.), call sign, signal reports, names, and equipment used
- Can be useful in providing info requested by the FCC
- **NOTE: If you operate on 60 meters with any antenna other than a dipole, the FCC requires you to keep a record of the antenna gain calculations or manufacturer's data (ensures you meet the 100 W ERP restrictions).**



Managing Interference

- Interference is going to occur on HF ...
 - Frequencies aren't channelized
 - There are many amateurs using the frequencies
 - Occurs due to crowding, propagation, personal choice, atmospheric conditions, and consumer electronics
- Learning how to make contacts under these conditions is part of becoming a good operator



Types of Interference

- Harmful
 - Defined by FCC 97.3(a)(23) as “interference which ... seriously degrades, obstructs or repeatedly interrupts a radio communication service operating in accordance with the Radio Regulations”
 - It’s not always illegal, but needs to be resolved to keep communicating
- Malicious, deliberate or willful
 - Specifically forbidden by FCC 97.101(d)



Avoiding Interference

- Learn what bands are crowded and when
- Learn characteristics of each band (propagation & noise)
- Learn how to use your equipment (understand strengths & weaknesses)
- Check published calendars for major operating events

Reacting to Interference

- Be flexible ... no one has a claim to any frequency
- Have a back-up plan (especially for scheduled events)
 - Do this in advance!
- Keep a cool head ... don't allow *harmful* interference to turn into *deliberate* interference!



PRACTICE QUESTIONS



Which of the following is required by the FCC rules when operating in the 60-meter band?

- A. If you are using an antenna other than a dipole, you must keep a record of the gain of your antenna
- B. You must keep a record of the date, time, frequency, power level, and stations worked
- C. You must keep a record of all third-party traffic
- D. You must keep a record of the manufacturer of your equipment and the antenna used



What is the recommended way to break in to a phone contact?

- A. Say “QRZ” several times, followed by your call sign
- B. Say your call sign once
- C. Say “Breaker Breaker”
- D. Say “CQ” followed by the call sign of either station



Generally, who should respond to a station in the contiguous 48 states who calls “CQ DX”?

- A. Any caller is welcome to respond
- B. Only stations in Germany
- C. Any stations outside the lower 48 states
- D. Only contest stations



What is the voluntary band plan restriction for U.S. stations transmitting within the 48 contiguous states in the 50.1 to 50.125 MHz band segment?

- A. Only contacts with stations not within the 48 contiguous states
- B. Only contacts with other stations within the 48 contiguous states
- C. Only digital contacts
- D. Only SSTV contacts



Which of the following is a good way to indicate on a clear frequency in the HF phone bands that you are looking for a contact with any station?

- A. Sign your call sign once, followed by the words “listening for a call” -- if no answer, change frequency and repeat
- B. Say “QTC” followed by “this is” and your call sign -- if no answer, change frequency and repeat
- C. Repeat “CQ” a few times, followed by “this is,” then your call sign a few times, then pause to listen, repeat as necessary
- D. Transmit an unmodulated carrier for approximately 10 seconds, followed by “this is” and your call sign, and pause to listen -- repeat as necessary



What is a reason why many amateurs keep a station log?

- A. The ITU requires a log of all international contacts
- B. The ITU requires a log of all international third-party traffic
- C. The log provides evidence of operation needed to renew a license without retest
- D. To help with a reply if the FCC requests information



Which of the following is required when participating in a contest on HF frequencies?

- A. Submit a log to the contest sponsor
- B. Send a QSL card to the stations worked, or QSL via Logbook of The World
- C. Identify your station per normal FCC regulations
- D. All these choices are correct



Modes

- CW (*continuous wave*) ... found in lower ranges for each HF band. However, CW can be transmitted anywhere on HF.
- AM & SSB (single-side band)
 - SSB is the most common voice mode or phone signal
 - Has displaced AM as the preferred HF voice modulation method
 - SSB signals use less spectrum space than AM (3 kHz vs. 6 kHz ... this increases efficiency ... results in SSB having a greater range than AM)

Modes (cont.)

- USB vs. LSB (upper and lower side band)
 - Good amateur practices is to use USB above 9 MHz (20 thru 10 meters) and LSB elsewhere except on 60 meters
 - USB is used on VHF and UHF
- FM is generally not used on HF because higher noise hurts intelligibility
 - Exception: FM repeaters can be found on the higher frequencies of 10 meters (above 29 MHz) where cross-continent and DX contacts can be made when the band is open



Modes (cont.)

- Digital Voice ...
 - Relatively new on HF bands
 - Operator's voice converted to and from a digital stream via modem or sound card. Modem connects to a regular SSB transceiver.
 - Fidelity comparable to regular SSB signals, but less affected by fading
 - Most popular digital voice modes: FreeDV and protocol developed by G4GUO (Charles Brain)

Modes (cont.)

- Digital Modes ...
 - Packet radio common on VHF and UHF to exchange digital data, but also common on HF
 - FT8: Most popular
 - FT8, PSK63 and PSK31: Effective at low power levels ... all widely used
 - RTTY: Oldest, and still common (*radioteletype*)
 - PACTOR or WINMOR: Used for semi-automatic and automatic messaging for small files

Modes (cont.)

- Image Modes
 - Image mode transmissions on HF encode photos & graphics to tones
 - These tones are reconstructed as an image on a display
 - Image modes are allowed on same frequencies as voice, except for 60 meters
 - Most common image mode: *Slow-scan television* (SSTV)
 - Called *slow* because each image takes several seconds
 - *Fast-scan amateur television* (ATV) allows full motion video
 - Restricted to 432 MHz and higher frequency bands (due to wide bandwidth)



Mode Comparison

Table 2.2
Mode Comparison

<i>Mode</i>	<i>Bandwidth</i>	<i>Examples</i>	<i>Data Rate</i>	<i>Notes</i>
CW	Up to 150 Hz		Up to 60 WPM	
AM	6 kHz			Can be higher fidelity than SSB
SSB	3 kHz			
Narrow Bandwidth HF Digital	Up to 500 Hz	RTTY, PSK31 JT65 or FT8	Up to 100 WPM	Keyboard-to-keyboard
Wide Bandwidth HF Digital	Up to 2.3 kHz	PACTOR, WINMOR	Up to 1200 baud	Keyboard-to-keyboard and file transfer
VHF/UHF Digital	Up to 100 kHz	Packet, D-STAR SystemFusion		Max bandwidth varies by band
Narrow Bandwidth Image	3 kHz max on HF	SSTV		
Video (full motion)	6 MHz max	NTSC, HDTV		UHF and microwave only

More details in Chapters 5 & 6

HF Receiving

- On VHF, FM receivers have 3 basic controls ...
 - Frequency (channel), squelch, volume
- SSC/CW receivers have additional controls to accommodate non-channelized, continuous-tuning operation (must be able to receive signals in the presence of noise and interference from adjacent channels) ... for examples ...
 - *Selectivity*: Ability to discriminate between closely-spaced signals
 - *Sensitivity*: Ability to detect a signal



Signal Reporting

- Usually exchanged between stations at beginning of a contact
- Most common is *RST*
 - *R*eadability: Scale of 1 to 5 (5 = best)
 - *S*trength: Scale of 1 to 9 (9 = best)
 - *T*one: Also 1 to 9 scale. Only used for CW and digital mode contacts.
 - Indicates signal purity
 - Values less than 9 indicate some kind of transmitter problem
 - A *C* added after RST indicates an unstable signal or *chirp*



PRACTICE QUESTIONS



Which sideband is most commonly used for voice communications on frequencies of 14 MHz or higher?

- A. Upper sideband
- B. Lower sideband
- C. Vestigial sideband
- D. Double sideband



Which of the following modes is most commonly used for voice communications on the 160-meter, 75-meter, and 40-meter bands?

- A. Upper sideband
- B. Lower sideband
- C. Vestigial sideband
- D. Double sideband



Which of the following is most commonly used for SSB voice communications in the VHF and UHF bands?

- A. Upper sideband
- B. Lower sideband
- C. Vestigial sideband
- D. Double sideband



Which mode is most commonly used for voice communications on the 17-meter and 12-meter bands?

- A. Upper sideband
- B. Lower sideband
- C. Vestigial sideband
- D. Double sideband



Which mode of voice communication is most commonly used on the HF amateur bands?

- A. Frequency modulation
- B. Double sideband
- C. Single sideband
- D. Phase modulation



Which of the following is an advantage when using single sideband, as compared to other analog voice modes on the HF amateur bands?

- A. Very high fidelity voice modulation
- B. Less subject to interference from atmospheric static crashes
- C. Ease of tuning on receive and immunity to impulse noise
- D. Less bandwidth used and greater power efficiency



Which of the following statements is true of the single sideband voice mode?

- A. Only one sideband and the carrier are transmitted; the other sideband is suppressed
- B. Only one sideband is transmitted; the other sideband and carrier are suppressed
- C. SSB is the only voice mode that is authorized on the 20-meter, 15-meter, and 10-meter amateur bands
- D. SSB is the only voice mode that is authorized on the 160-meter, 75-meter, and 40-meter amateur bands



Why do most amateur stations use lower sideband on the 160-meter, 75-meter, and 40-meter bands?

- A. Lower sideband is more efficient than upper sideband at these frequencies
- B. Lower sideband is the only sideband legal on these frequency bands
- C. Because it is fully compatible with an AM detector
- D. It is good amateur practice



HF Transmitting – PHONE

- Putting transceiver into transmit mode is called *keying* the transmitter
 - The PTT (*push-to-talk*) button works the same as on FM
- Some HF operators use *voice-operated transmit* or *VOX*
 - Allows hands-free operation



HF Transmitting – CW

- CW operators use *prosigns* (2-letter shortcuts)
 - Prosign example: \overline{AR} (means End of Message)
- Respond to a CQ at the fastest speed you're comfortable copying, up to the speed of the sending station
 - Reply with *QRS* to request sender to slow down (*QRQ* ... speed up!)
- As with voice, give call sign every 10 minutes and at end of contact

Prosign reference: <http://www.radiotelegraphy.net/prosigns.htm>



CW Additional Information

- FISTS: www.fists.org
- CWOps: www.cwops.org
- ARRL: www.arrl.org/cw-mode



PRACTICE QUESTIONS



Which of the following statements is true of voice VOX operation versus PTT operation?

- A. The received signal is more natural sounding
- B. It allows “hands free” operation
- C. It occupies less bandwidth
- D. It provides more power output



Which of the following describes full break-in telegraphy (QSK)?

- A. Breaking stations send the Morse code prosign “BK”
- B. Automatic keyers, instead of hand keys, are used to send Morse code
- C. An operator must activate a manual send/receive switch before and after every transmission
- D. Transmitting stations can receive between code characters and elements



What should you do if a CW station sends “QRS?”

- A. Send slower
- B. Change frequency
- C. Increase your power
- D. Repeat everything twice



What does it mean when a CW operator sends “KN” at the end of a transmission?

- A. Listening for novice stations
- B. Operating full break-in
- C. Listening only for a specific station or stations
- D. Closing station now



What is the best speed to use when answering a CQ in Morse code?

- A. The fastest speed at which you are comfortable copying, but no slower than the CQ
- B. The fastest speed at which you are comfortable copying, but no faster than the CQ
- C. At the standard calling speed of 10 wpm
- D. At the standard calling speed of 5 wpm



What does the term “zero beat” mean in CW operation?

- A. Matching the speed of the transmitting station
- B. Operating split to avoid interference on frequency
- C. Sending without error
- D. Matching the transmit frequency to the frequency of a received signal



What prosign is sent to indicate the end of a formal message when using CW?

- A. SK
- B. BK
- C. AR
- D. KN



What does the Q signal “QSL” mean?

- A. Send slower
- B. We have already confirmed by card
- C. I acknowledge receipt
- D. We have worked before



What does the Q signal “QRV” mean?

- A. You are sending too fast
- B. There is interference on the frequency
- C. I am quitting for the day
- D. I am ready to receive messages



What is the purpose of an electronic keyer?

- A. Automatic transmit/receive switching
- B. Automatic generation of strings of dots and dashes for CW operation
- C. VOX operation
- D. Computer interface for PSK and RTTY operation

Emergency Operation

- Amateurs should be familiar with emergency rules and procedures
- See Table 2.3 (General Class License Manual, Page 2-16/2-17)
 - FCC 47 CFR § 97.401 Operating during a disaster
 - FCC 47 CFR § 97.403 Safety of life and protection of property
 - FCC 47 CFR § 97.405 Station in distress
 - FCC 47 CFR § 97.407 Radio amateur civil emergency service

ARES & RACES

Amateur Radio two primary emergency response organizations

- ARES = Amateur Radio Emergency Services (sponsored by ARRL)
 - Mission: provide communications assistance to local and regional government and relief agencies
 - <http://www.arrl.org/ares>
- RACES (sponsored by FEMA)
 - Mission: provide essential communications for State and local governments in time of emergency
 - Only a licensed amateur may be the control operator of a RACES station



Distress Calls

- If you receive a call for help ...
 - Immediately suspend your existing contact
 - Immediately acknowledge to the station calling for help
 - Stand by to receive the location of the emergency and the name of the assistance required
 - Relay the info to the proper authorities and stay on frequency



Distress Calls (cont.)

- If you're the station making the distress call ...
 - On voice mode, say *MAYDAY MAYDAY MAYDAY*. On CW or digital send *SOS SOS SOS* followed by *Any station come in please*.
 - Identify the transmission with your call sign
 - State your location and the nature of the situation
 - Describe the type of assistance required
- FCC 47 CFR § 97.405 allows the distress station to use ANY means of communication available, even frequencies, mode, or power level outside your normal privileges



PRACTICE QUESTIONS



What is the first thing you should do if you are communicating with another amateur station and hear a station in distress break in?

- A. Continue your communication because you were on the frequency first
- B. Acknowledge the station in distress and determine what assistance may be needed
- C. Change to a different frequency
- D. Immediately cease all transmissions



Who may be the control operator of an amateur station transmitting in RACES to assist relief operations during a disaster?

- A. Only a person holding an FCC-issued amateur operator license
- B. Only a RACES net control operator
- C. A person holding an FCC-issued amateur operator license or an appropriate government official
- D. Any control operator when normal communication systems are operational



When is an amateur station allowed to use any means at its disposal to assist another station in distress?

- A. Only when transmitting in RACES
- B. At any time when transmitting in an organized net
- C. At any time during an actual emergency
- D. Only on authorized HF frequencies



What frequency should be used to send a distress call?

- A. Whichever frequency has the best chance of communicating the distress message
- B. Only frequencies authorized for RACES or ARES stations
- C. Only frequencies that are within your operating privileges
- D. Only frequencies used by police, fire, or emergency medical services



END OF MODULE 2

General Class License Course

Discovering the Excitement of Ham Radio



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