



**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

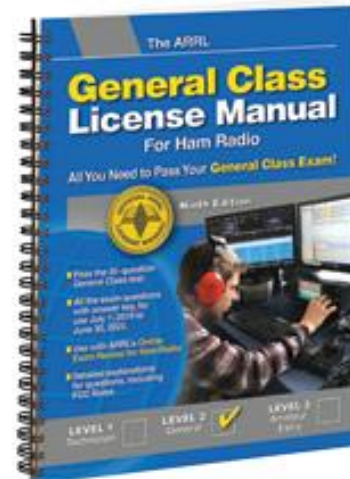


# General Class License Course

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



### Frequencies

1.800-2.000  
1.800-1.810  
1.810  
1.843-2.000  
1.910  
1.995-2.000  
1.999-2.000

### Modes/Activities

CW  
Digital Modes  
QRP CW calling frequency  
SSB, SSTV and other wideband modes  
SSB QRP calling frequency  
Experimental  
Beacons

3.500-3.510  
3.560  
3.570-3.600  
3.585-3.600  
3.590  
3.790-3.800  
3.845  
3.885  
3.985

CW DX window  
QRP CW calling frequency  
RTTY/Data  
Automatically controlled data stations  
RTTY/Data DX  
DX window  
SSTV  
AM calling frequency  
QRP SSB calling frequency

7.030  
7.040  
7.070-7.125  
7.100-7.105  
7.171  
7.173  
7.285  
7.290

QRP CW calling frequency  
RTTY/Data DX  
RTTY/Data  
Automatically controlled data stations  
SSTV  
D-SSTV  
QRP SSB calling frequency  
AM calling frequency

10.130-10.140  
10.140-10.150

RTTY/Data  
Automatically controlled data stations

14.060  
14.070-14.095  
14.095-14.0995  
14.100  
14.1005-14.112  
14.230  
14.233

QRP CW calling frequency  
RTTY/Data  
Automatically controlled data stations  
IBP/NCDXF beacons  
Automatically controlled data stations  
SSTV  
D-SSTV

### Frequencies

14.236  
14.285  
14.286  
  
18.100-18.105  
18.105-18.110  
18.110  
18.162.5

21.060  
21.070-21.110  
21.090-21.100  
21.150  
21.340  
21.385

24.920-24.925  
24.925-24.930  
24.930

28.060  
28.070-28.120  
28.120-28.189  
28.190-28.225  
28.200  
28.385  
28.680  
29.000-29.200  
29.300-29.510  
29.520-29.580  
29.600  
29.620-29.680

ARRL band plans for frequencies above 28.300 MHz are shown in *The ARRL Repeater Directory* and on [www.arrl.org](http://www.arrl.org).

### Modes/Activities

Digital Voice  
QRP SSB calling frequency  
AM calling frequency  
  
RTTY/Data  
Automatically controlled data stations  
IBP/NCDXF beacons  
Digital Voice

QRP CW calling frequency  
RTTY/Data  
Automatically controlled data stations  
IBP/NCDXF beacons  
SSTV  
QRP SSB calling frequency

RTTY/Data  
Automatically controlled data stations  
IBP/NCDXF beacons

QRP CW calling frequency  
RTTY/Data  
Automatically controlled data stations  
Beacons  
IBP/NCDXF beacons  
QRP SSB calling frequency  
SSTV  
AM  
Satellite downlinks  
Repeater inputs  
FM simplex  
Repeater outputs

## 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	PACKTOR, 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: 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](http://www.fists.org)
- CWOps: [www.cwops.org](http://www.cwops.org)
- ARRL: [www.arrl.org/cw-mode](http://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



**ARRL** The national association for  
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