

# General License Course

## Chapter 2

Lesson Plan Module 4 –  
HF Operating Techniques



**ARRL**

*The national association for  
AMATEUR RADIO*



# Basic Operating

- Operating techniques on HF are similar to operating SSB or CW on 10 meters and 6 meters but are fairly different from VHF and UHF FM.
- CQ – Calling any station. CQ DX means calling stations other than in one's own country
- To join an on-going QSO, give your call sign during a break in the conversation



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# Good Practices

- Choosing a frequency is most important
- Listen, listen, listen
- Ask if the frequency is in use (*“Is the frequency in use? This is WØPC”*) then ask again, identifying your transmission
  - If using CW or digital modes, send: *QRL? DE WØPC*
- No one “owns” a frequency – have a “Plan B”

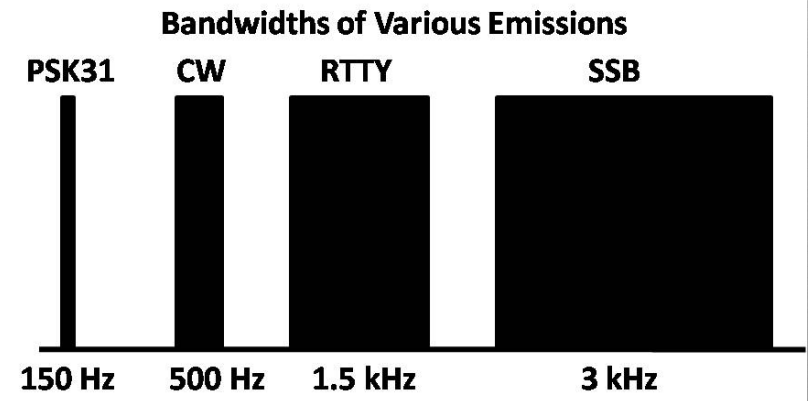


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# Good Practices

- Try to put enough separation between your signal and adjacent signals to minimize interference.

Recommended Signal Separation	
CW	150-500 Hz
SSB	Approximately 3 kHz
RTTY	250-500 Hz
PSK31	150-500 Hz





# Nets and Schedules

- Many on-the-air activities are scheduled in advance
- Courtesy and flexibility are required by everyone – have a backup plan
- If you're in a QSO and another station requests the use of the frequency for a scheduled activity, try to accommodate the request
- If you're the net control and the net's chosen frequency is busy, find a clear frequency



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# Band Plans

- The FCC regulations help stations using compatible modes stay together by dividing the amateur frequency bands.
- Additional divisions of the band have been created by radio amateurs and are used on a strictly voluntary basis. These are called “*Band Plans*.”

# Band Plans

- Example of the 20 meter band plan:
  - 14.060 QRP CW calling frequency
  - 14.070-14.095 RTTY/Data
  - 14.095-14.0995 Automatically controlled data
  - 14.100 IBP/NCDXF beacons
  - 14.1005-14.112 Automatically controlled data
  - 14.230 SSTV
- Frequencies Modes/Activities
  - 14.233 D-SSTV
  - 14.236 Digital Voice
  - 14.285 QRP SSB calling frequency
  - 14.286 AM calling frequency



# Band Plans

- Band plans are not regulations and are only guidelines for operating under normal band conditions – be flexible!
- When choosing a frequency for SSTV, RTTY, or PSK31 operation, check the band plan for recommended frequencies
- DX windows are a section of the band where stations (other than U.S. stations in the contiguous 48 states) may be contacted



# Managing Interference

- Interference occurs for several reasons
  - QRM – Interference from other signals
  - QRN – Static (storms, motors, power lines, etc.)
- Harmful interference – Seriously degrades, obstructs, or repeatedly interrupts communication
- Deliberate interference – Malicious, willful
  - Rare – don't engage, just avoid it

# Managing Interference

- Learn the characteristics of each band
- Know the strengths and weaknesses of your station
- Keep your transmitted signal clean
- Use directional antennas
- Reacting to Interference
  - No one owns any frequency, be flexible
  - Change your frequency if necessary



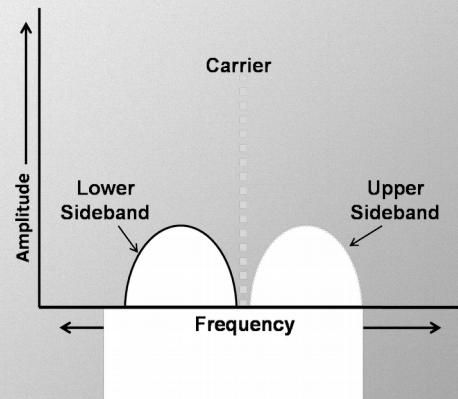
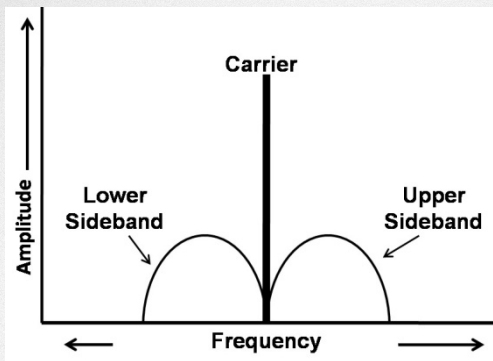
# CW Mode

- CW (Morse code) – Found at the bottom of each HF band, but can be transmitted on almost any amateur frequency
- Speeds vary from 5 to 50 WPM
- Answer a CQ at the speed at which it was sent
- Most CW ops will slow down if you send “QRS” (send slower)
- Code is sent by keys, paddles, bugs, and keyboards



# AM & SSB Modes

- AM and SSB phone (voice)
- On HF, SSB is the most common phone signal
- SSB (3 kHz) uses less spectrum than AM (6 kHz) because the carrier and one sideband are suppressed and not transmitted



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# AM & SSB Modes

- Upper sideband (USB) is used above 9 MHz (20 meters – 10 meters) and on 60 meters
- Lower sideband (LSB) is used below 9 MHz (160 meters, 80 meters, and 40 meters)
- Upper sideband is used on VHF and UHF bands
- FM is found only on the upper portion of 10 meters

# Image Mode

- SSTV popular on HF
  - Permitted wherever phone transmissions are permitted, except 60 meters
  - Computer, soundcard, interface, and software are required
- Fast-scan (FSTV or ATV) used on UHF and up



# HF Receiving

- FM radios have controls for frequency or channel selection, squelch, and volume
- SSB/CW receivers have more controls
  - They are designed for non-channelized, continuous tuning operation
  - Squelch is generally not used on HF receivers because of the high noise levels
  - DSP features are used for noise reduction and filtering

# HF Transmitting – Phone

- Push-to-talk – Just like on VHF/UHF
- Voice-operated-transmit (VOX)
  - Hands-free operation
  - Great for contesting & roundtable operations
  - VOX also used for CW and digital transmissions



# HF Transmitting – Phone

- VOX controls:
  - VOX Gain – The more sensitive the VOX circuit, the less audio it takes to key the transmitter
  - VOX Delay – VOX delay holds the transmitter on for a short period (it keeps the transmitter from continuously turning on and off)
  - Anti-VOX – The anti-VOX prevents received audio from turning on the VOX circuit

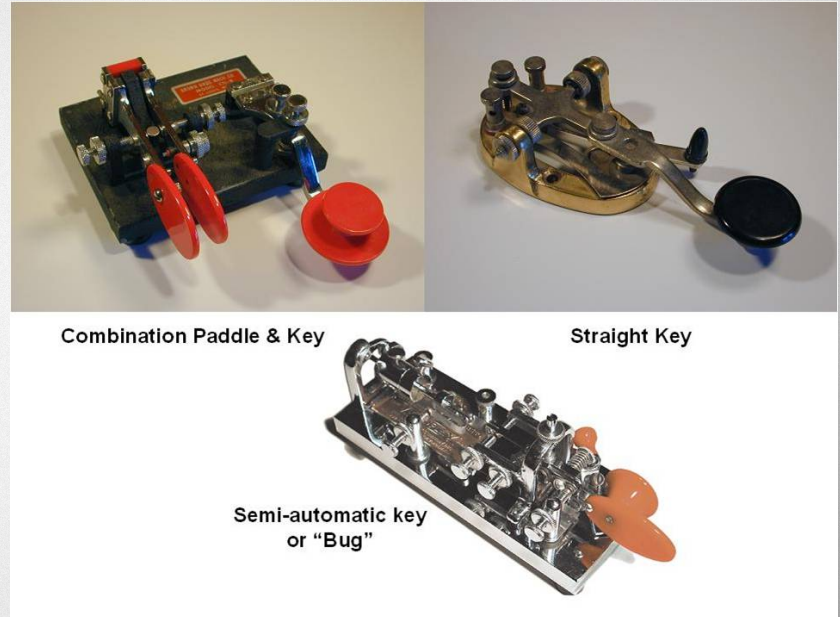
# HF Phone Procedures and Abbreviations

- Same basic procedure as VHF/UHF
- Phonetics are important on HF
- Q-Signals – Heard on SSB even though they were designed as shorthand for CW
- Avoid “CB Talk” and 10-codes (“10-4”)
  - Obsolete and bad form
  - Plain speech is more effective



# HF CW Transmitting

- Morse code is alive and well in Amateur Radio
- Morse ops use:
  - Straight keys
  - Iambic paddles
  - Bugs
  - Keyboards
- Most radios offer full break-in (QSK)



# HF CW Transmitting

- Zero beating is adjusting the transmitter frequency to the other station's transmitting frequency, producing the same audio tone
- “RST” (Readability, Strength, and Tone). The higher the number the better (e.g., 489, 579, 599, or 5NN)
- Readability (1-5) – Strength (1-9) – Tone (1-9)
- Add “C” to indicate “chirp” on transmission – 479C



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# CW Procedures / Abbreviations

- *Procedural signals* like “K” (over) control the flow of the contact
- *Prosigns* are two letters sent as a single Morse character, written with an overscore

$\overline{\text{AR}}$  End of Message

$\overline{\text{SK}}$  End of Communication

$\overline{\text{BT}}$  Separation (between message text and other information)

$\overline{\text{KN}}$  Only the station with whom I am in contact should respond

# CW Procedures / Abbreviations

## Abbreviations:

- WX – Weather
- CUL – See you later
- TNX – Thanks
- 73 – Best wishes
- CL – Clear, going off the air

## Q-Signals:

- QRN – Atmospheric noise
- QRM – Man-made noise
- QRV – Ready to copy
- QSL – Acknowledge receipt
- QRL – Frequency is in use
- QRP – Low power, 5 W or less

Q-Signals (statement or made into a question)



# Practice Questions



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

- A. Insure 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 of these choices are correct

FCC Rule: [97.101(a)] G1B08



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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

G2A01



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G2A01

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

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G2A02



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G2A02

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

G2A03



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G2A03

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

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G2A04



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G2A04

# 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

G2A05



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G2A05

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 bandwidth used and greater power efficiency
- C. Ease of tuning on receive and immunity to impulse noise
- D. Less subject to interference from atmospheric static crashes

G2A06



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G2A06

# 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

G2A07



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G2A07

Which of the following is a recommended way to break into a contact when using phone?

- A. Say “QRZ” several times followed by your call sign
- B. Say your call sign during a break between transmissions by the other stations
- C. Say “Break Break Break” and wait for a response
- D. Say “CQ” followed by the call sign of either station

G2A08



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G2A08

# 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. Current amateur practice is to use lower sideband on these frequency bands

G2A09



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G2A09

# 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

G2A10



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G2A10

# What does the expression “CQ DX” usually indicate?

- A. A general call for any station
- B. The caller is listening for a station in Germany
- C. The caller is looking for any station outside their own country
- D. A distress call

G2A11



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# Which of the following is true concerning access to frequencies in non-emergency situations?

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

G2B01



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G2B01

If propagation changes during your contact and you notice increasing interference from other activity on the same frequency, what should you do?

- A. Tell the interfering stations to change frequency
- B. Report the interference to your local Amateur Auxiliary Coordinator
- C. As a common courtesy, move your contact to another frequency
- D. Increase power to overcome interference

G2B03



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G2B03

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

G2B04



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G2B04

What is the customary minimum frequency separation between SSB signals under normal conditions?

- A. Between 150 and 500 Hz
- B. Approximately 3 kHz
- C. Approximately 6 kHz
- D. Approximately 10 kHz

G2B05



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G2B05

# 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 and listen for a response



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- D. Send “QSY” on CW or if using phone, announce “the frequency is in use”, then give your call 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 of these choices are correct

G2B07



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G2B07

# What is the “DX window” in a voluntary band plan?

- A. A portion of the band that should not be used for contacts between stations within the 48 contiguous United States
- B. An FCC rule that prohibits contacts between stations within the United States and possessions in that portion of the band
- C. An FCC rule that allows only digital contacts in that portion of the band
- D. A portion of the band that has been voluntarily set aside for digital contacts only

G2B08



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G2B08

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

- A. Breaking stations send the Morse code prosign BK
- B. Automatic keyers are used to send Morse code instead of hand keys
- 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

G2C01



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G2C01

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

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

G2C02



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G2C02

# 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

G2C03



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G2C03

# 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?”

G2C04



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G2C04

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

- A. The fastest speed at which you are comfortable copying
- B. The speed at which the CQ was sent
- C. A slow speed until contact is established
- D. At the standard calling speed of 5 wpm

G2C05



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G2C05

# 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 your transmit frequency to the frequency of a received signal

G2C06



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G2C06

# When sending CW, what does a “C” mean when added to the RST report?

- A. Chirpy or unstable signal
- B. Report was read from an S meter rather than estimated
- C. 100 percent copy
- D. Key clicks

G2C07



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G2C07

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

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

G2C08



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G2C08

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

G2C09



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G2C09

# What does the Q signal “QRN” mean?

- A. Send more slowly
- B. I am troubled by static
- C. Zero beat my signal
- D. Stop sending

G2C10



# What does the Q signal “QRN” mean?

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G2C10

# 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

G2C11



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G2C11

# Which of the following describes an azimuthal projection map?

- A. A map that shows accurate land masses
- B. A map that shows true bearings and distances from a particular location
- C. A map that shows the angle at which an amateur satellite crosses the equator
- D. A map that shows the number of degrees longitude that an amateur satellite appears to move westward at the equator with each orbit

G2D04



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G2D04

# What is QRP operation?

- A. Remote piloted model control
- B. Low power transmit operation
- C. Transmission using Quick Response Protocol
- D. Traffic relay procedure net operation

G2D10



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- B. Low power transmit operation**
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G2D10

# Which HF antenna would be the best to use for minimizing interference?

- A. A quarter-wave vertical antenna
- B. An isotropic antenna
- C. A directional antenna
- D. An omnidirectional antenna

G2D11



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G2D11

Which of the following is a good indicator of the possibility of sky-wave propagation on the 6-meter band?

- A. Short skip sky-wave propagation on the 10-meter band
- B. Long skip sky-wave propagation on the 10-meter band
- C. Severe attenuation of signals on the 10-meter band
- D. Long delayed echoes on the 10-meter band

G3B02



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G3B02

# 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

G4A10



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G4A10