Lesson 13: Operating Modes

Preparation for Amateur Radio Technician Class Exam

Topics

- Operating Modes
- Conventional Terms
- Voice Operating
- Working DX
- Operating CW
- Signal Report
- Internet Gateways
- Bandwidth
- Spurious Signals
- Interference
- Exam Questions for this section

Reading

- Chapter 6

Operating Modes

- There are many modes of operating in ham radio:
  - FM phone
  - SSB voice
  - CW
  - Packet
  - Etc.
- Band plans are voluntary guidelines, beyond the divisions established by the FCC, for using different operating modes within an amateur band

General Operating Tips

- On all bands remember to be:
  - Courteous
  - Communicate efficiently
  - Remember your conversations are public
- Use plain language
- Listen before transmitting to make sure others are not using the frequency
- Transmit your call sign in English, preferably using the ITU phonetic alphabet
  - These words are understood internationally
  - Avoid “cute” phonetics because not everyone will understand them

Conventional Voice Terms

- QSO = Conversation
- CQ = Seek you; calling any station
- DX = contact with another country or long distance
- QSL Card = A written acknowledgement between two hams of their communication; typically a postcard, often very colorful.
- 73 = Best Regards

Conventional CW Terms

- RST = Readability, Signal Strength, Tone (a signal report)
- DE = from, or this is (KN6FO DE KE7BOF)
- K = Any station Transmit
- QRS = Send More Slowly

- Also the voice terms on the previous page

Voice Operating

- Call CQ:
  - CQ CQ CQ “this is” call-sign call-sign call-sign
- Answer CQ:
  - Their-call-sign “this is” your-call-sign
- Use “over” or “go ahead” when you finish talking to indicate to the other person that they can speak
- Transmit your call sign every 10 minutes
- Use “clear” at the end of the conversation to indicate that other hams can use the frequency

Working DX Tips

- Listen with care
- Take your time speaking
- Keep your transmissions short and to the point
- Use standard ITU phonetics for your call sign
- Send a QSL card to acknowledge contact

Operating CW

- Call CQ:
  - CQ CQ CQ DE call-sign call-sign call-sign K
- Answer CQ:
  - Their-call-sign their-call-sign DE your-call-sign your-call-sign $\overline{\text{AR}}$
- Send CW at the speed you can copy it
- Include a signal report with your transmission

Signal Report

- This is a report on the relative strength of the signal
  - RST = readability, signal strength, tone
  - Can be given as a 3 digit number, one digit for each part of the RST
  - 9 is the best, 1 is the worst
  - RST 368 means
    - 3 = readability, 6 = signal strength, 8 = tone

Signal Report

- Sometimes the signal report is just RS (readability, signal strength)
  - This would be a 2 digit number, one digit for each part of the RS
  - RS 59 means
    - 5 = readability, 9 = signal strength
- Signal strength might include something plus xx dB, such as 59 plus 20 dB
  - This means your signal strength is 9 (the maximum) plus another 20 dB – a very strong signal! (Note: Your signal in this case is too strong. You need to reduce power output from your station.)

Signal Report

- Sometimes the signal report is stated as signal quieting
  - Quieting refers to how much the signal overcomes receiver noise
  - Full quieting means your signal is strong enough to overcome all receiver noise
    - This is a good thing!

Internet Gateways

- Voice Over IP (VoIP) is becoming a popular way to use the internet to extend your range of DX
- An amateur station known as a “gateway” connects amateur stations with the Internet
- The Internet acts as a relay between amateur radio stations

Bandwidth

- Bandwidth measures how wide a range of frequencies is received when a receiver is tuned to one frequency
- Different emission types use different bandwidths
- From narrowest to widest bandwidth:
  - CW - 250 – 500 Hz
  - RTTY – 500 Hz
  - SSB voice – 2-3 kHz
  - FM voice – 10-20 kHz
  - UHF amateur fast-scan TV - About 6 MHz

Spurious Signals

- Undesired signals from a transmitter
- Any signal produced by the radio that falls outside the band on which you are operating
  - If someone tells you that signals from your hand-held transceiver are interfering with other signals on a frequency near yours, your hand-held may be transmitting spurious signals
- Causes:
  - Harmonics
  - Splatter

Harmonics

- Harmonics are whole number multiples of a given frequency
  - To get the second harmonic, multiply by 2
  - To get the fourth harmonic, multiply by 4
  - For example, if your signal is 50.25 MHz, the fourth harmonic is 4 * 50.25 or 201.00 MHz
- Harmonics can interfere with other frequencies, so the FCC requires them to be greatly reduced or eliminated
- Tuned circuits in transmitters reduce or eliminate harmonic emissions

Splatter

- Interference on nearby frequencies
- Can be caused by setting your microphone gain too high or talking too loud, thus over-modulating the signal
- If other hams report your signal is over-deviating, adjust your microphone gain or speak softer

Interference

- Electronic devices that emit radio frequencies can interfere with each other's operation
  - Radio
  - Television
  - Computer
  - Cell Phone
- There are a variety of kinds of Radio Frequency Interference (RFI)
  - Receiver Overload
  - Harmonic Interference
  - Telephone Interference

Receiver Overload

- Interference to the receiver caused by strong nearby signals
  - Also called front-end overload
  - This happens most often to consumer electronic equipment near a transmitter, especially VHF and UHF
- This is when the RF signal overloads the receiver
  - Affects the picture on a television – black screen, white with bits of color
  - Audio may also be affected
- It is a fundamental problem with the receiver
  - It is the responsibility of the owner of the receiver to fix it

Receiver Overload

- TV front-end overload
  - Check your radio station and TV to see if the problem is with your transmitter
  - Check for loose cable TV connections or damaged transmission lines that can allow radio signals into the TV receiver, or TV signals into a radio receiver
  - A high-pass filter can be installed (by a qualified technician) at the TV or FM receiver input
    - A high-pass filter passes high frequencies to the receiver

Receiver Overload

- TV channels 12 and 13 can interfere with a ham radio receiver in the 222 MHz band
  - You can install a band-pass filter to the output of your 222 MHz transceiver to block theses signals
  - A band-pass filter blocks signals above and below the desired frequency

Harmonic Interference

- Harmonic signals from a transmitter causing interference in other bands, typically HF transmitters
- Some harmonics fall within the home entertainment bands
  - For example, harmonics may be in the same frequency bands as TV or FM broadcast signals
  - If the harmonics are strong enough, they can interfere with the received signal
    - Crosshatch or herringbone pattern on TV screen
- It is a fundamental problem with the transmitter
  - It is the responsibility of the owner of the transmitter to fix it

Harmonic Interference

- To fix spurious harmonic transmissions:
  - Install a low-pass filter between your transmitter and antenna
    - A low-pass filter passes low frequencies
  - A buzzing or hum in the signal of an HF transmitter could be caused by a bad filter capacitor in the transmitter's power supply

Telephone Interference

- Interference to telephones and other audio devices is NOT the fault of the transmitter
- Many telephones, especially cordless, have interference problems because the telephone was not equipped with interference protection when it was manufactured
  - Radio frequency interference filters can be installed in the telephone line where it connects to the telephone

Exam Questions

- The following slides contain questions from the exam pool that are covered in this section of the notes

T6A01

- T6A01 What is the advantage of using the International Telecommunication Union (ITU) phonetic alphabet when identifying your station?
  - A. The words are internationally recognized substitutes for letters
  - B. There is no advantage
  - C. The words have been chosen to represent Amateur Radio terms
  - D. It preserves traditions begun in the early days of Amateur Radio

T6A02

- T6A02 What is one reason to avoid using "cute" phrases or word combinations to identify your station?
  - A. They are not easily understood by non-English-speaking amateurs
  - B. They might offend English-speaking amateurs
  - C. They do not meet FCC identification requirements
  - D. They might be interpreted as codes or ciphers intended to obscure the meaning of your identification

T6A03

- T6A03 What should you do before you transmit on any frequency?
  - A. Listen to make sure others are not using the frequency
  - B. Listen to make sure that someone will be able to hear you
  - C. Check your antenna for resonance at the selected frequency
  - D. Make sure the SWR on your antenna feed line is high enough

T6A07

- T6A07 What is the meaning of the procedural signal "CQ"?
  - A. Call on the quarter hour
  - B. New antenna is being tested (no station should answer)
  - C. Only the called station should transmit
  - D. Calling any station

T6A09

- T6A09 What is the correct way to call CQ when using voice?
  - A. Say "CQ" once, followed by "this is," followed by your call sign spoken three times
  - B. Say "CQ" at least five times, followed by "this is," followed by your call sign spoken once
  - C. Say "CQ" three times, followed by "this is," followed by your call sign spoken three times
  - D. Say "CQ" at least ten times, followed by "this is," followed by your call sign spoken once

T6A10

- T6A10 How should you answer a voice CQ call?
  - A. Say the other station's call sign at least ten times, followed by "this is," then your call sign at least twice
  - B. Say the other station's call sign at least five times phonetically, followed by "this is," then your call sign at least once
  - C. Say the other station's call sign at least three times, followed by "this is," then your call sign at least five times phonetically
  - D. Say the other station's call sign once, followed by "this is," then your call sign given phonetically

T6A12

- T6A12 What is meant by the term "DX"?
  - A. Best regards
  - B. Distant station
  - C. Calling any station
  - D. Go ahead

T6B06

- T6B06 What is a band plan?
  - A. A voluntary guideline beyond the divisions established by the FCC for using different operating modes within an amateur band
  - B. A guideline from the FCC for making amateur frequency band allocations
  - C. A plan of operating schedules within an amateur band published by the FCC
  - D. A plan devised by a club to best use a frequency band during a contest

T6A05

- T6A05 What does RST mean in a signal report?
  - A. Recovery, signal strength, tempo
  - B. Recovery, signal speed, tone
  - C. Readability, signal speed, tempo
  - D. Readability, signal strength, tone

T6A06

- T6A06 What is the meaning of: "Your signal report is five nine plus 20 dB..."?
  - A. Your signal strength has increased by a factor of 100
  - B. Repeat your transmission on a frequency 20 kHz higher
  - C. The bandwidth of your signal is 20 decibels above linearity
  - D. A relative signal-strength meter reading is 20 decibels greater than strength 9

T6A08

- T6A08 What is a QSL card in the amateur service?
  - A. A letter or postcard from an amateur pen pal
  - B. A Notice of Violation from the FCC
  - C. A written acknowledgment of communications between two amateurs
  - D. A postcard reminding you when your license will expire

T6A11

- T6A11 What is the meaning of: "Your signal is full quieting..."?
  - A. Your signal is strong enough to overcome all receiver noise
  - B. Your signal has no spurious sounds
  - C. Your signal is not strong enough to be received
  - D. Your signal is being received, but no audio is being heard

T6A13

- T6A13 What is the meaning of the term "73"?
  - A. Long distance
  - B. Best regards
  - C. Love and kisses
  - D. Go ahead

T6B05

- T6B05 What name is given to an amateur radio station that is used to connect other amateur stations with the Internet?
  - A. A gateway
  - B. A repeater
  - C. A digipeater
  - D. FCC regulations prohibit such a station

T6B07

- T6B07 At what speed should a Morse code CQ call be transmitted?
  - A. Only speeds below five WPM
  - B. The highest speed your keyer will operate
  - C. Any speed at which you can reliably receive
  - D. The highest speed at which you can control the keyer

T6B08

- T6B08 What is the meaning of the procedural signal "DE"?
  - A. "From" or "this is," as in "W0AIH DE KA9FOX"
  - B. "Directional Emissions" from your antenna
  - C. "Received all correctly"
  - D. "Calling any station"

T6B09

- T6B09 What is a good way to call CQ when using Morse code?
  - A. Send the letters "CQ" three times, followed by "DE," followed by your call sign sent once
  - B. Send the letters "CQ" three times, followed by "DE," followed by your call sign sent three times
  - C. Send the letters "CQ" ten times, followed by "DE," followed by your call sign sent twice
  - D. Send the letters "CQ" over and over until a station answers

T6B10

- T6B10 How should you answer a Morse code CQ call?
  - A. Send your call sign four times
  - B. Send the other station's call sign twice, followed by "DE," followed by your call sign twice
  - C. Send the other station's call sign once, followed by "DE," followed by your call sign four times
  - D. Send your call sign followed by your name, station location and a signal report

T6B11

- T6B11 What is the meaning of the procedural signal "K"?
  - A. "Any station transmit"
  - B. "All received correctly"
  - C. "End of message"
  - D. "Called station only transmit"

T6B12

- T6B12 What is one meaning of the Q signal "QRS"?
  - A. "Interference from static"
  - B. "Send more slowly"
  - C. "Send RST report"
  - D. "Radio station location is"

T6B01

- T6B01 Which list of emission types is in order from the narrowest bandwidth to the widest bandwidth?
  - A. RTTY, CW, SSB voice, FM voice
  - B. CW, FM voice, RTTY, SSB voice
  - C. CW, RTTY, SSB voice, FM voice
  - D. CW, SSB voice, RTTY, FM voice

T6B02

- T6B02 What is the usual bandwidth of a single-sideband amateur signal?
  - A. 1 kHz
  - B. 2 kHz
  - C. Between 3 and 6 kHz
  - D. Between 2 and 3 kHz

T6B03

- T6B03 What is the usual bandwidth of a frequency-modulated amateur signal?
  - A. Less than 5 kHz
  - B. Between 5 and 10 kHz
  - C. Between 10 and 20 kHz
  - D. Greater than 20 kHz

T6B04

- T6B04 What is the usual bandwidth of a UHF amateur fast-scan television signal?
  - A. More than 6 MHz
  - B. About 6 MHz
  - C. About 3 MHz
  - D. About 1 MHz

T2A02

- T2A02 How does the frequency of a harmonic compare to the desired transmitting frequency?
  - A. It is slightly more than the desired frequency
  - B. It is slightly less than the desired frequency
  - C. It is exactly two, or three, or more times the desired frequency
  - D. It is much less than the desired frequency

T2A05

- T2A05 What is the fourth harmonic of a 50.25 MHz signal?
  - A. 201.00 MHz
  - B. 150.75 MHz
  - C. 251.50 MHz
  - D. 12.56 MHz

T6C01

- T6C01 What is meant by receiver overload?
  - A. Too much voltage from the power supply
  - B. Too much current from the power supply
  - C. Interference caused by strong signals from a nearby source
  - D. Interference caused by turning the volume up too high

T6C02

- T6C02 What type of filter might be connected to an amateur HF transmitter to cut down on harmonic radiation?
  - A. A key-click filter
  - B. A low-pass filter
  - C. A high-pass filter
  - D. A CW filter

T6C03

- T6C03 What type of filter should be connected to a TV receiver as the first step in trying to prevent RF overload from an amateur HF station transmission?
  - A. Low-pass
  - B. High-pass
  - C. Band pass
  - D. Notch

T6C04

- T6C04 What effect might a break in a cable television transmission line have on amateur communications?
  - A. Cable lines are shielded and a break cannot affect amateur communications
  - B. Harmonic radiation from the TV receiver may cause the amateur transmitter to transmit off-frequency
  - C. TV interference may result when the amateur station is transmitting, or interference may occur to the amateur receiver
  - D. The broken cable may pick up very high voltages when the amateur station is transmitting

T6C05

- T6C05 If you are told that your amateur station is causing television interference, what should you do?
  - A. First make sure that your station is operating properly, and that it does not cause interference to your own television
  - B. Immediately turn off your transmitter and contact the nearest FCC office for assistance
  - C. Connect a high-pass filter to the transmitter output and a low-pass filter to the antenna-input terminals of the television
  - D. Continue operating normally, because you have no reason to worry about the interference

T6C06

- T6C06 If harmonic radiation from your transmitter is causing interference to television receivers in your neighborhood, who is responsible for taking care of the interference?
  - A. The owners of the television receivers are responsible
  - B. Both you and the owners of the television receivers share the responsibility
  - C. You alone are responsible, since your transmitter is causing the problem
  - D. The FCC must decide if you or the owners of the television receivers are responsible

T6C07

- T6C07 If signals from your transmitter are causing front-end overload in your neighbor's television receiver, who is responsible for taking care of the interference?
  - A. You alone are responsible, since your transmitter is causing the problem
  - B. Both you and the owner of the television receiver share the responsibility
  - C. The FCC must decide if you or the owner of the television receiver are responsible
  - D. The owner of the television receiver is responsible

T6C08

- T6C08 What circuit blocks RF energy above and below certain limits?
  - A. A band-pass filter
  - B. A high-pass filter
  - C. An input filter
  - D. A low-pass filter

T6C09

- T6C09 If someone tells you that signals from your hand-held transceiver are interfering with other signals on a frequency near yours, what may be the cause?
  - A. You may need a power amplifier for your hand-held
  - B. Your hand-held may have chirp from weak batteries
  - C. You may need to turn the volume up on your hand-held
  - D. Your hand-held may be transmitting spurious emissions

T6C10

- T6C10 What may happen if an SSB transmitter is operated with the microphone gain set too high?
  - A. It may cause digital interference to computer equipment
  - B. It may cause splatter interference to other stations operating near its frequency
  - C. It may cause atmospheric interference in the air around the antenna
  - D. It may cause interference to other stations operating on a higher frequency band

T6C11

- T6C11 What may cause a buzzing or hum in the signal of an HF transmitter?
  - A. Using an antenna that is the wrong length
  - B. Energy from another transmitter
  - C. Bad design of the transmitter's RF power output circuit
  - D. A bad filter capacitor in the transmitter's power supply

T6C12

- T6C12 (Reference: FCC CIB Telephone Interference Bulletin) What is the major cause of telephone interference?
  - A. The telephone ringer is inadequate
  - B. Tropospheric ducting at UHF frequencies
  - C. The telephone was not equipped with interference protection when it was manufactured.
  - D. Improper location of the telephone in the home