# ARRL Amateur Radio Education & Technology Program

## Unit 5
## Amateur Radio Operating Procedures

Have you ever received a telephone call from someone who you couldn't understand? Perhaps they were speaking too softly, or were eating something while trying to speak. Did you have to ask them to repeat what they said? It can be frustrating and make you want to hang up the phone. Now put yourself in an emergency situation, where people's lives are at risk. Perhaps you can see how important it is to be understood when communicating, whether by phone or over the radio.

In this unit we will be discussing some basic radio procedures and how they are used in emergencies. You will learn how relay stations, called *repeaters*, are used and how long distance communications are also used for emergencies.

## Section 5.1
## REPEATER OPERATION

Repeaters are used by a variety of organizations to relay their radio signals over a wide area. Police and fire department use repeaters to communicate with each other to help save lives and serve the public. Other governmental organizations, like city public works and water departments also use repeaters. See **Figure 5.1.** Amateur Radio operators have their own repeater systems and they use them to speak to each other over wide areas.

**Figure 5.1.**

*(We have decided to discuss the use of Amateur Radio repeaters because these repeaters are open and available to anyone in the general public who has the proper FCC license.)*

We will cover the technical aspects of how repeaters work in the next unit, but for now we are interested in the "process" of communicating using repeaters.

**Making Contact** – All that is required to make a contact with another station (calling CQ) on a local repeater is to push the PTT switch on the microphone and give your call sign. If the repeater is quiet, just say your call sign, to attract someone's attention. You will then hear a funny noise, that is the unmodulated repeater carrier, for a second or two. This is what's called the *squelch tail*. It lets you know the repeater is working. If someone is interested in speaking with you, they will call you after you give your call. Some repeaters have specific rules for making yourself heard. In general, however, your call sign is all you need.

**Joining a QSO** – How do you join a conversation in progress? If you hear a conversation going on and would like to join in, wait for a break in the conversation and

just transmit your call sign. The station that transmits next will usually acknowledge you and tell you to "go ahead."

**Calling Another Station** – To call another station when the repeater is not in use, just give both calls. For example: "K3UFG this is KH6HU." If the other station is listening, they will answer your call and you can have a conversation. What if the repeater is in use when you want to call someone? If the conversation sounds like it is about to end, wait before calling the other station. If the conversation sounds like it will continue for a while, transmit only your call sign between their transmissions. Usually the other stations will stand by while you make a call to your friend. Make your call short. If your friend responds, try to meet on another repeater or on a *simplex* frequency, that is, a frequency that is not used for repeaters. Otherwise, ask your friend to stand by until the present conversation ends.

**Courtesy** – If you are in the midst of a conversation and another station transmits his or her call sign between transmissions, the next station in line to transmit should acknowledge the new station and permit the new arrival to make a call or join the conversation. It is impolite not to acknowledge new stations, or to acknowledge them but not let them speak. The calling station may need to use the repeater immediately. There may be an emergency, so let them make a call promptly.

**Emergency** – To make a distress call over a repeater when it is in use, say "*break break*" and then your call sign to alert all stations to stand by while you deal with the emergency. It's important not to use the word "*break*" to join a conversation – unless you want to use the repeater to help in an emergency.

**Sidebar** – A Word about Emergencies

**Some General Rules**

When using a repeater, keep your transmissions as short as possible, so more people have a chance to use it. All repeaters encourage short transmission by "timing out" (shutting down for a few minutes) when someone talks too long. The time-out timer also prevents the repeater form transmitting continuously, due to distant signals or interference. Continuous operation can damage the repeater.

When using a repeater, use plain language. If you want to know someone's location, say, "Where are you?" If you want to know whether someone you're talking with is using a mobile rig or a hand-held radio, just ask: "What kind of radio are you using?" You get the idea.

When using a repeater, the FCC requires you to transmit your call sign at the end of a contact and at least every 10 minutes during the course of any communications. You do not have to transmit the call sign of the station to which you are transmitting.

When using a repeater, *never transmit without giving your call sign*. For example, pressing the transmit button (PTT) to turn on the repeater without saying your call sign is illegal.

**Simplex Operation**

After you have made contact on a repeater, it is a good idea to move your conversation to a *simplex* frequency. This frees up the repeater for others to use. What is a simplex frequency? Simplex simply means transmitting and receiving on the same frequency, one that isn't used for repeaters. To operate simplex both radios must be in "line of sight" with each other.

The function of a repeater is to provide communications between stations that can't otherwise communicate because of terrain, distance or equipment limitations. It follows that stations able to communicate without a repeater should not use one. In the US the 2-meter national simplex calling frequency is 146.52 MHz.

Family Radio Service (FRS) radios operate on simplex using the FM mode. They are limited in range and no license is required. The limited range is a drawback, but the transceivers are relatively inexpensive and are great for practicing radio communications. **Picture 5.1**

### Autopatch Operation

An autopatch allows repeater users to make telephone calls through the repeater. Long before cell phones, Amateur Radio operators were making phone calls from their radios. There are strict guidelines for autopatch use. The first question you should ask is "Is this call necessary?" If it is an emergency, there is no problem – just do it! Calling for an ambulance or a tow truck is okay. Other reasons may fall into a gray area. As a result, some repeater groups expressly forbid autopatch use, except for emergencies.

You should never use the autopatch for anything that could be considered business communications. The FCC strictly forbids hams from using their radios to conduct business. You may, however, use the autopatch to conduct your own personal communications, such as making a doctor's appointment.

## Section 5.2
## HF - SINGLE SIDEBAND OPERATION

When we use repeaters, we are using the Frequency Modulation (FM) mode to communicate. We also use selected frequencies assigned by a frequency coordinator. On High Frequency (HF) the most popular mode for voice (phone) is *single sideband (SSB)*. On HF there are no assigned frequencies or frequency coordinators involved, but rather a sliding scale of frequencies open to everyone. As we learned in Unit 4, with SSB we can use either lower sideband or the upper sideband to transmit. Amateurs normally use the upper sideband for phone operation on frequencies higher than 14 MHz. This includes the VHF and UHF bands.

Whatever band or mode you are using, there are three fundamental things to remember. These apply to any type of voice operating you might try.

- First – courtesy costs very little. It is often rewarded by bringing out the best in others.
- Second – the aim of each radio contact should be 100% effective communication. A good operator is never satisfied with anything less.
- Third – your "private" conversation with another station is actually open to the public. Anyone with a receiver can listen in on your conversation.

When working HF single sideband, proper voice procedure is very important. Whether you're working a DX operator (a ham in another country) who may not fully understand your language, or speaking to your friend down the street, speak slowly and clearly. That way, you'll have fewer requests to repeat information.

When using SSB, use plain language and keep jargon to a minimum. If the other operator is having difficulty copying your signals you should use the standard International Telecommunication Union (ITU) *phonetic alphabet*. See **Table 5.1.** Use the words in the phonetic alphabet to spell out the letters in your call sign, your name or any other piece of information that might be confused if the letters are not received correctly. Hams in all countries around the world generally understand this phonetic alphabet.

### Table 5.1
**Standard ITU Phonetics**

| Letter | Word | Pronunciation |
|---|---|---|
| A | Alfa | **AL** FAH |
| B | Bravo | **BRAH** VOH |
| C | Charlie | **CHAR** LEE |
| D | Delta | **DELL** TAH |
| E | Echo | **ECK** OH |
| F | Foxtrot | **FOKS** TROT |
| G | Golf | GOLF |
| H | Hotel | HOH **TELL** |
| I | India | **IN** DEE AH |
| J | Juliett | **JEW** LEE ETT |
| K | Kilo | **KEY** LOH |
| L | Lima | **LEE** MAH |
| M | Mike | MIKE |
| N | November | NO **VEM** BER |
| O | Oscar | **OSS** CAH |
| P | Papa | PAH **PAH** |
| Q | Quebec | KEH **BECK** |
| R | Romeo | **ROW** ME OH |
| S | Sierra | SEE **AIR** RAH |
| T | Tango | **TANG** GO |
| U | Uniform | **YOU** NEE FORM |
| V | Victor | **VIK** TAH |
| W | Whiskey | **WISS** KEY |
| X | X-Ray | **ECKS** RAY |
| Y | Yankee | **YANG** KEY |
| Z | Zulu | **ZOO** LOO |

**Note:** The **boldfaced** syllables are emphasized. The pronunciations shown in this table were designed for those who speak any of the international languages. The pronunciations given for "Oscar" and "Victor" may seem awkward to English-speaking people in the US.

**Making Contact on SSB** – Making contact on single sideband is a little different than making contact on a repeater. Before attempting a contact, it is important to find a frequency that appears to be unoccupied by another station. We call this looking for a *clear frequency*. Once you find a clear frequency you start your contact by calling CQ. We use the letters CQ, which literally means "Seek you: Calling any station" to let other stations know we would like to speak with someone. A good operator sends short calls separated by periods of listening. For example: "CQ, CQ, CQ. This is KB1AFE, Kilo Bravo One Alfa Foxtrot Echo, KB1AFE calling CQ and standing by." Make sure you let up on the PTT (push-to-talk) switch between calls so you can hear what is going on.

Once you make contact, it is no longer necessary to use the phonetic alphabet for your call sign or to give the other station's call. Remember, the FCC regulations say that you need to give your call only every 10 minutes and at the end of the contact.

**What do You Say?** – Aside form a signal report (we'll cover that later), most hams exchange names, location (QTH) and equipment information (especially antenna!). Once these routine details are out of the way, you can talk about your families, the weather,

your favorite music or any appropriate subject.  You need to be aware that your signal, once it leaves your antenna, goes worldwide.  Appropriate language is important.
**Worldwide Communications** – Using HF frequencies involves transmitting your signal worldwide.  You should be aware of the time zones of the different countries you are contacting.  To understand the structure of international time zones, see the sidebar "UTC Explained."  See Activity Sheet #5.1

A good way to practice making contact (calling CQ), answering CQs and carrying on a QSO is to use Family Radio Service (FRS) radios.  More detailed information on SSB operating can be found in *Now You're Talking*.

**Operating CW (Morse Code)**

What is CW?  The letters CW are an abbreviation for Continuous Wave – an unmodulated carrier wave (a steady signal with no information included).  A CW signal can carry information if you switch it on and off according to a system called the Morse code.  The Morse code is a system of turning a transmitter on and off in short and long transmission, each signal, or group of signals, represent a letter, number or punctuation mark, thus allowing words to be formed.  Operating CW (Morse Code) is a lot like operating single sideband (SSB).  Many of the procedures are the same.

Morse code CQ calls should follow the same general procedure as an SSB CQ.  Generally, a "3x3" call is more than sufficient.  For example: CQ CQ CQ DE KA7XYZ KA7XYZ KA7XYZ K (K stands for "over.")

You will learn the meaning of many *Q signals* as you gain operating experience.  A Q signal is a set of abbreviations that have very specific meanings.  They are mostly used to communicate information between operators who do not speak the same language.  Q signals are also useful when you need to communicate quickly, using as few words or letters as possible.  QTH means "location."  Followed by a question mark, it asks, "What is your location?" (QTH?).  QSL means, "I acknowledge receipt" (of a message or information).  A *QSL card* is a written confirmation of an amateur contact.  QSY means, "change frequency."  **Table 5.2** lists many common Q signals.  Although hams use some Q signals in face-to-face conversations, when you're on the air, use them on CW only.  On voice, say what you mean.

For amateurs to understand each other, we must standardize our communications.  You'll find, for instance that most hams use abbreviations on CW.  Why?  It's faster to send a couple of letters than it is to spell out a word.  But there's no point in using an abbreviation if no one else understands you.  Over the years, amateurs have developed a set of standard abbreviations (**Table 5.3**). If you use these abbreviations, you'll find that everyone will understand you, and you'll understand them.

**Table 5.2**

**Q Signals**

These Q signals are the ones used most often on the air. (Q abbreviations take the form of questions only when they are sent followed by a question mark.)

QRG    Your exact frequency (or that of ___) is ____kHz. Will you tell me my exact frequency (or that of _____)?
QRL    I am busy (or I am busy with ____). Are you busy?
QRM    Your transmission is being interfered with ____ (1. Nil; 2. Slightly; 3. Moderately; 4. Severely; 5. Extremely.) Is my transmission being interfered with?
QRN    I am troubled by static ____. (1 to 5 as under QRM.) Are you troubled by static?
QRO    Increase power. Shall I increase power?
QRP    Decrease power. Shall I decrease power?
QRQ    Send faster (____wpm). Shall I send faster?
QRS    Send more slowly (____wpm). Shall I send more slowly?
QRT    Stop sending. Shall I stop sending?
QRU    I have nothing for you. Have you anything for me?
QRV    I am ready. Are you ready?
QRX    I will call you again at ___hours (on ___kHz). When will you call me again?
QRZ    You are being called by ____ (on ___kHz). Who is calling me?
QSB    Your signals are fading. Are my signals fading?
QSK    I can hear you between signals; break in on my transmission. Can you hear me between your signals and if so can I break in on your transmission?
QSL    I am acknowledging receipt. Can you acknowledge receipt (of a message or transmission)?
QSN    I did hear you (or ___) on ___kHz. Did you hear me (or ___) on ____kHz?
QSO    I can communicate with ____ direct (or relay through ___). Can you communicate with ___ direct or by relay?
QSP    I will relay to ___. Will you relay to ___?
QST    General call preceding a message addressed to all amateurs and ARRL members. This is in effect "CQ ARRL."
QSX    I am listening to ___ on ___kHz. Will you listen to ___on ___kHz?
QSY    Change to transmission on another frequency (or on ___kHz). Shall I change to transmission on another frequency (or on ___kHz)?
QTB    I do not agree with your counting of words. I will repeat the first letter or digit of each word or group. Do you agree with my counting of words?
QTC    I have ___messages for you (or for ___). How many messages have you to send?
QTH    My location is ____. What is your location?
QTR    The time is ____. What is the correct time?

## Table 5.3

**Some Common Abbreviations Used on CW**

Although abbreviations help to cut down unnecessary transmission, it's best not to abbreviate unnecessarily when working an operator of unknown experience.

| | | | | | |
|---|---|---|---|---|---|
| AA | All after | GN | Good night | SASE | Self-addressed, stamped envelope |
| AB | All before | GND | Ground | SED | Said |
| ABT | About | GUD | Good | SIG | Signature; signal |
| ADR | Address | HI | The telegraphic laugh; high | SINE | Operator's personal initials or nickname |
| AGN | Again | HR | Here, hear | | |
| ANT | Antenna | HV | Have | SKED | Schedule |
| BCI | Broadcast interference | HW | How | SRI | Sorry |
| BCL | Broadcast listener | LID | A poor operator | SSB | Single sideband |
| BK | Break; break me; break in | MA, MILS | Milliamperes | SVC | Service; prefix to service message |
| BN | All between; been | MSG | Message; prefix to radiogram | T | Zero |
| BUG | Semi-automatic key | N | No | TFC | Traffic |
| B4 | Before | NCS | Net control station | TMW | Tomorrow |
| C | Yes | ND | Nothing doing | TNX-TKS | Thanks |
| CFM | Confirm; I confirm | NIL | Nothing; I have nothing for you | TT | That |
| CK | Check | NM | No more | TU | Thank you |
| CL | I am closing my station; call | NR | Number | TVI | Television interference |
| CLD-CLG | Called; calling | NW | Now; I resume transmission | TX | Transmitter |
| CQ | Calling any station | OB | Old boy | TXT | Text |
| CUD | Could | OC | Old chap | UR-URS | Your; you're; yours |
| CUL | See you later | OM | Old man | VFO | Variable-frequency oscillator |
| CW | Continuous wave (that is, radiotelegraphy) | OP-OPR OT | Operator Old-timer; old top | VY WA | Very Word after |
| DE | From, this is | PBL | Preamble | WB | Word before |
| DLD-DLVD | Delivered | PSE | Please | WD-WDS | Word; words |
| DR | Dear | PWR | Power | WKD-WKG | Worked; working |
| DX | Distance, foreign countries | PX | Press | WL | Well; will |
| ES | And, & | R | Received as transmitted | WUD | Would |
| FB | Fine business, excellent | RCD | Received | WX | Weather |
| FM | Frequency modulation | RCVR-RX | Receiver | XCVR | Transceiver |
| GA | Go ahead | REF | Refer to; referring to; reference | XMTR-TX | Transmitter |
| GB | Good-by | RFI | Radio frequency interference | XTAL | Crystal |
| GBA | Give better address | RIG | Station equipment | XYL (YF) | Wife |
| GE | Good evening | RPT | Repeat; I repeat | YL | Young lady |
| GG | Going | RTTY | Radioteletype | 73 | Best regards |
| GM | Good morning | RX | Receiver | 88 | Love and kisses |

**Common Procedural Signals (Prosigns)**

| | |
|---|---|
| AR | End of transmission or end of message |
| AS | Please stand by |
| R | All received correctly |
| K | Go ahead. Any station transmit |
| KN | Only called station transmit |
| SK | End of contact |
| CL | Closing. Going off the air |
| BK | Break or Back to you |
| DN | Slant mark, used to indicate portable, mobile or other additional identifying information with your call sign |

**Exchanging Signal Reports**

One very important piece of information you will exchange with another station on HF is their signal report. The scales, found in Table 5.4, are simply a general indication of how you are receiving the other station. As you gain experience with the descriptions given you will be more comfortable estimating the proper signal report.

A report of RST 368 would be interpreted, as "Your signal is readable with considerable difficulty, good strength, with a slight trace of modulations." The tone report is a useful indication of transmitter performance. When the RST system was developed, the tone report of amateur transmitters varied widely. Today, a tone report of less than 9 is cause to ask a few other amateurs for their opinion of your transmitted signal. Consistently poor tone reports means your transmitter has a problem.

Signal reports of SSB are two-digit numbers using the RS portion of the RST system. No tone report is required. The maximum signal report would be "five nine" – that is readability 5, strength 9. A signal report of "five seven" means your signal is perfectly readable and moderately strong. On the other hand, a signal report of "three three" would mean that the other operator is only able to understand our signal with considerable difficulty and your signals are weak in strength.

**CW Operating Tips**
- Listen before transmitting
- Send short CQs and listen between each
- Send no faster than you can reliable copy
- Use standard abbreviations whenever possible
- Use prosigns such as "K," and Q signals properly
- Identify at the end of a QSO and every 10 minutes
- Use R only if you've receive 100 percent of what the other station said
- Be courteous

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**Table 5.4**

**The RST System**

**READABILITY**
1—Unreadable.
2—Barely readable, occasional words distinguishable.
3—Readable with considerable difficulty.
4—Readable with practically no difficulty.
5—Perfectly readable.

**SIGNAL STRENGTH**
1—Faint signals barely perceptible.
2—Very weak signals.
3—Weak signals.
4—Fair signals.
5—Fairly good signals.
6—Good signals.
7—Moderately strong signals.
8—Strong signals.
9—Extremely strong signals.

**TONE**
1—Sixty-cycle ac or less, very rough and broad.
2—Very rough ac, very harsh and broad.
3—Rough ac tone, rectified but not filtered.
4—Rough note, some trace of filtering.
5—Filtered rectified ac but strongly ripple-modulated.
6—Filtered tone, definite trace of ripple modulation.
7—Near pure tone, trace of ripple modulation.
8—Near perfect tone, slight trace of modulation.
9—Perfect tone, no trace of ripple or modulation of any kind.

# Section 5.3
## EMERGENCY OPERATIONS

Have you ever experienced a tornado, hurricane, flood or earthquake? When these natural disasters strike, local radio communications are disrupted. Power lines are down. Police and fire radio systems are not working. Normal telephone systems are overloaded or not working, and a call goes out for help. When city, town, county and state officials call for help, Amateur Radio operators answer. They use their own equipment to serve the community. During an emergency, when there is no electrical power, hams bring in their own generators, car batteries, windmills and solar panels to provide power for their radio equipment.

**Antenna** – A wire *dipole* antenna (antenna with a center insulator and two wire "legs" of equal length) is the best choice for a portable HF station that can be set up in emergencies. It can be installed easily, and wire is light and portable.

**Radio** – A hand-held transceiver is a very useful piece of equipment. It can be used in a variety of emergency situations. You can use it at home, in a car, and on an emergency search and rescue mission. It works well for communications from an emergency shelter or you can take it into the field for making damage reports to government officials. It's important to remember to bring a back-up battery pack for the hand-held, and to have a method of charging the spare when not in use.

**Calling For Help** – If you should ever find yourself in a life or property-threatening situation and you want to make an emergency call for help, you should know the basic procedures. For Morse code (**CW**) operation, the proper distress call is to send SOS several times and then your call sign. Pause for a reply and then repeat the procedure until you receive an answer. It's important that the SOS be sent as a single group, with no spacing between letters. For phone (**FM or SSB**) the proper distress call is MAYDAY sent several times followed by your call sign. Again you should pause for an answer, and then repeat the procedure until you receive an answer. For an emergency, you can use any frequency and any mode that you think will be most likely to make a contact.

**Tactical Communications**

During some emergency situations radio operators will set up a special type of communication system. Called *tactical communications*, it is usually used for "first-response teams at an emergency site. This type of communication is a little informal in nature. It may be such things as urgent instructions or requests such as "Send an ambulance," or "Who has the medical supplies?"

Tactical communications are very important when working with local government and law-enforcement agencies. If you are involved in a tactical situation, use 12-hour local time for times and dates when working with relief agencies such as the Red Cross. Most people in these organizations may not understand the 24-hour system or Coordinated Universal Time (UTC).

Tactical communications usually use 2-meter repeater frequencies, or the 146.52-MHz simplex calling frequency. Most hams have 2-meter mobile, portable and fixed-station equipment for these frequencies.

Another way to make tactical communications efficient is to use tactical call signs, which describe a function, location or agency.  This helps coordinate individuals or agencies that are monitoring.  When operators change shifts or locations, the set of tactical call signs remains the same.  For example:  EOC, this is Base Unit 1.  Where are the medical supplies?  Base Unit 1, this is EOC.  Medical supplies are on the way.  When a new operator takes over at the EOC, they will use EOC as their call.  Amateurs may use such tactical call signs as parade headquarters, finish line, Red Cross or Net Control.  This procedure promotes efficiency and coordination in public-service communication activities. Technical call signs do not fulfill the FCC identification requirements, however.  Amateurs must also identify their station operation with their FCC-assigned call sign.

**Health-and-Welfare Traffic**
There can be a large amount of radio traffic to handle during a disaster.  Phone lines still in working order are often overloaded.  They should be reserved for emergency use by those people in peril.  Shortly after a major disaster, *Emergency Traffic* messages are sent from the disaster area.  These have life-and-death urgency or are for medical help and critical supplies.  Handle them first.  Next is *Priority Traffic*.  These are emergency-related messages, but not as important as Emergency messages.  Then, handle *Health-and-Welfare Traffic*, which pertains to the well being of disaster victims.
This results in timely advisories to those waiting outside the disaster area.  Hams inside disaster areas cannot immediately find out about someone's relative when their own lives may be threatened – they are busy handling emergency messages.  After the emergency is over, concerned friends and relatives of possible victims can send health-and-welfare messages into the disaster area.

**ARES**
The Amateur Radio Emergency Service (ARES) is sometimes confused with RACES.  ARES is sponsored by the ARRL and presents a way for local hams to provide emergency communications while working with groups such as the American Red Cross and local Emergency Operations Centers.  You may see an ARES group providing communications at community events such as Walk-a-Thons, Triathlons and parades.  These events are used as practice for the ARES group to hone their communication skills.

**RACES**
The Radio Amateur Civil Emergency Service (RACES) is a part of the amateur service that provides radio communications only for civil defense purposes.  It is active only during periods of local, regional or national civil emergencies.  You must be registered with the responsible civil defense organization to operate as a RACES station.  RACES stations may not communicate with amateurs not operating in a RACES capacity.
Only civil-preparedness communications can be transmitted during RACES operation.  These are defined in section 97.407 of the FCC regulations.  Rules permit tests and drills for a maximum of one hour per week.  All test and drill messages must be clearly identified as such.