GMRS Radio Training for CERT
BTECH and Baofeng UV82-HP Radios

Overview

This document explains how to use the BTECH GMRS radio and the Baofeng UV82-HP radio as a GMRS radio for CERT members. This document is focused strictly on operation of the radio, not on how to best communicate with a radio.

The two radios are virtually identical, the only difference being the firmware on the BTECH that restricts transmission to the GMRS channels. This information was compiled by Dale Mosby, K7FW. Please address comments and corrections to dale@archcape.com.

This document is intended to accompany classroom instruction and to serve as a useful reference. The goal is that using this document along with a classroom demonstration you will be able to:

- Turn the radio on and adjust volume.
- Lock and unlock the keypad.
- Select the desired GMRS frequency (channel).
- Transmit on the desired GMRS channel.

BTECH GMRS left
Baofeng UV82-HP right

Definitions

GMRS – General Mobile Radio Service. Intended for fairly short-range[1] communication by individuals. A license is required but no testing is needed. One license covers all members of a family.

FRS – Family Radio Service. Channels are shared with GMRS but power levels are lower and communication distances much less than with GMRS. No license is required. FRS radios are typically smaller and less expensive than GMRS radios and must have a fixed (non-removeable) antenna. Communication range is less than GMRS.

HAM (Amateur) Radio –Testing is required to obtain a HAM license, of which there are 3 classes. Many different methods of communication are available and high power levels are allowed.

Squelch – The feature of a radio that prevents static until a signal is received. A signal, or sometimes strong interference, causing the radio to make noise is said to "break squelch".

Repeater – A radio typically placed at a high elevation that "repeats" a radio signal extending the useful coverage area. GMRS allocates 8 channels for repeaters. FRS may not use a repeater.

VFO – Variable Frequency Oscillator – The electronic circuitry that controls the frequency on which a radio communicates. These radios use the term to refer to manually entering a frequency instead of selecting a pre-programmed frequency from one of the available channels.

Licensing

Using the GMRS frequencies requires a license issued by the FCC. The cost is $70 and a license is good for 10 years. A license covers all members of a family and the definition of "family" is broad. Details of obtaining a license are given in a later section "Rules And Regulations".

HAM radio also requires a license from the FCC. There are three license classes, each of which allows additional privileges. Obtaining a HAM license requires passing a test. The cost of the license is low, only $15 to take the test, and the license good for life.[2]

The FCC issues a unique "call sign" for each license issued. The call sign is used as an identifier on the radio and must be given periodically.[3]

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[1] The useful range of a handheld radio is depended on what sort of obstacles are between the two radios, this can vary greatly. The ranges stated in advertisements are wildly optimistic and usually unrealistic.

[2] The GMRS radio service is useful for short range communication and widely used by CERT teams as well as families that wish to stay in contact in a small area. HAM radio offers many communication capabilities beyond that of GMRS. Obtaining a HAM license is encouraged.

[3] HAMS give their call sign often, typically at the start of a conversation when calling another HAM. The requirement is to give a HAM call every 10 minutes and at the end of a conversation. GMRS users are required to give their call sign every 15 minutes and at the end of a conversation. In practice GMRS users seem to seldom give their call sign.

Radio Comparison
The BTECH radio is designed to operate as a GMRS radio. The first 30 memory locations (channels) have been factory programmed with GMRS frequencies. There are 98 additional memory locations that can be programmed with other frequencies which will be receive-only.

The Baofeng radio is designed to operate as an amateur (HAM) radio. It has 128 memory locations which can be programmed with GMRS as well as HAM frequencies. If programmed with both GMRS and HAM frequencies the licensing requirements must be observed with the proper license held in order to use those respective services.[4]

Programming
Both radios have 128 memory locations (called "channels") which can store frequencies. The BTECH radio has the first 30 of these set to GMRS frequencies. This allows the radio to be used as it is received from the factory. The Baofeng radio must be programmed with the desired frequencies before it can be used.

It is possible to enter a frequency manually and store this in a memory location. This would be time consuming and the chance of doing this correctly for very many channels is small. The only practical way to program a radio with the desired set of frequencies is using a computer and inexpensive cable connecting the radio to the computer. This is discussed in a separate document covering radio configuration.

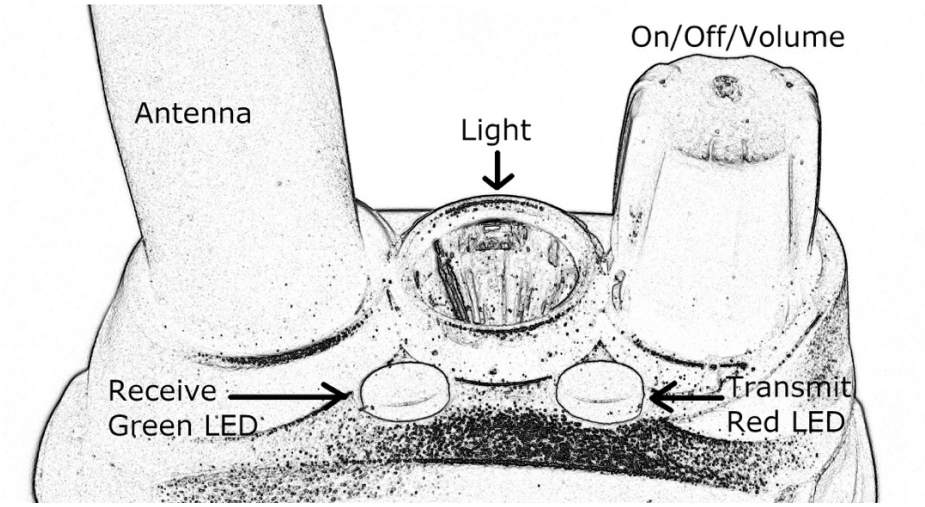
This document and related training assumes that the Baofeng radio has been programmed for you by means of computer software. If this has not been done this will be required before the radio is used. The BTECH radio should also be programmed with additional frequencies which are useful to monitor.[5]

Radio Controls
The radio has controls on the top, side, and front of the radio.

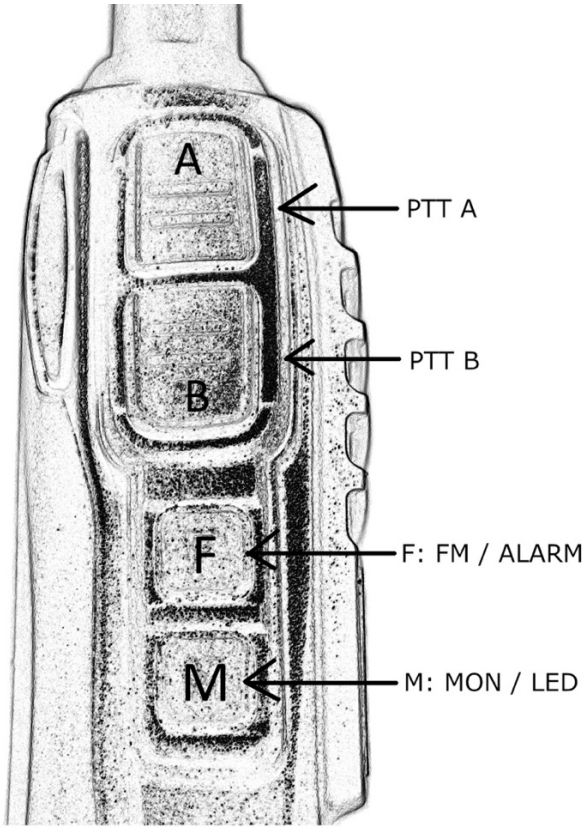
The top of the radio has a single switch which turns the radio on and controls the volume. Rotate this clockwise to turn on and increase volume. There are also two small LED lights which indicate if the radio is receiving a signal (Green LED on left) or if the radio is transmitting (Red LED on right).

[4] The FCC issues what is called "type acceptance" to radios. FRS and GMRS must use radios that are type accepted for the radio service. Because the Baofeng radio allows transmitting on frequencies other than GMRS it seems unlikely that it is type accepted for GMRS although it is commonly used for this service. HAMs can use any radio including a home-built radio; therefore, there is no type acceptance for HAM radios.
[5] The Baofeng radio can be programmed to have exactly the frequency set supplied with the BTECH radio making it equivalent to a GMRS-only radio. The Baofeng radio can also be programmed to receive HAM frequencies but not transmit on those frequencies. This will avoid the problem of accidentally transmitting on a frequency for which the user does not hold a license to operate. It is legal to receive any frequency (except cellular phone). Only transmission requires a license.

The antenna is removeable and will not be attached when new. Be sure and always have the antenna attached when using the radio. **Transmitting without an antenna may damage the radio.**



The left side of the radio has 4 controls with labels A, B, F, and M.



The top two buttons, A and B, are Push-To-Talk (PTT) controls. The radios have two channels. The upper channel in the display is A and the lower channel in the display is B. The default radio configuration (which may be changed if you desire) uses PTT button A to transmit on the upper display channel A. The PTT button B will transmit on the lower display channel B.

It is possible to configure the radio so that the two PTT buttons function as a single push-to-talk button transmitting on the selected channel no matter which button is depressed.

Momentarily pressing the button "F" will activate a broadcast FM receiver. Another momentary press of the "F" button will turn the broadcast FM signal off. Holding the "F" button down will activate the alarm feature of the radio. Pressing the F button again will disable the alarm. **Caution**: The default configuration of the radio (as received from the factory) causes three actions when the alarm button F is pressed:

1. Radio will make a "siren" sound.
2. The LED light on top of the radio will flash.
3. The radio will transmit a siren sound on the active channel.

This third action will tie up the active channel frequency preventing anyone from communicating on that channel. This is bad and will annoy other users! If your radio was programmed for you this alarm feature should have been disabled.

A momentary press of the button "M" will illuminate the white LED on top of the radio allowing it to be used as a flashlight. A second momentary press causes the LED to flash. A third momentary press of the "M" button will turn the LED off.

Holding down the button "M" will allow open squelch[6] allowing you to monitor the channel. This is useful to adjust the radio volume. Normally you will hear static when you hold down the "M" button however if there is a very weak signal which does not always open the squelch this may allow you to copy (hear) the signal.

Radio Operation

The user manual for the radio has complete programming details. This document is intended to provide enough information to use the radio but is not intended as a substitute for reading and understanding the information provide in the user manual.

[6] The "squelch" setting determines how strong a signal is required to activate the speaker. Without this static would be constantly heard from the speaker. Initially radios had a squelch adjustment knob similar to the volume know that controlled the squelch setting. Now less expensive radios typically use a digital setting to control the squelch sensitivity. This generally does not work well.

The front of the radio has a display showing channels being monitored and other radio settings. Below this display is a keypad used to program frequencies and settings.

Power On and Adjust Volume
Turn the radio on using the volume knob on top of the radio. The radio will emit two beeps. After using the radio for a while, you will have an idea of how far to rotate the volume knob to set a comfortable audio level.

Press and hold the lowest button on the left side of the radio (the button marked with "M" for "monitor") as you rotate the volume control to set the volume to a comfortable level and get an idea of where you want the setting.

Keypad Lock
The radio allows the keyboard to be "locked" so that an accidental button press does not alter the settings such as channel, causing you to no longer be able to communicate. The radio should normally be placed in the locked state and only unlocked when you desire to change a setting.

When the radio is locked you can still transmit on either of the two channels, A or B, and use the other side buttons. The keypad on the front of the radio is disabled with the exception of the ability to unlock the radio using the "#" key in the lower right corner of the keypad. This helps to prevent accidental changes to the radio programming should you have the radio in your pocket or pick it up and unintentionally hit one of the front buttons.

With the radio powered on, press and hold the "#" button on the keypad for about two seconds. This button has a blue "key" symbol to the right of the hash mark. In the upper right of the display is the battery level symbol, looking like a battery with lines in it to show state of charge. Immediately to the left of the battery symbol a "key" will appear when the keypad is locked.

When changing radio settings as described in this document you should have the keypad unlocked. If something does not work check for the key symbol and make sure the radio is not in the locked mode. **Once settings such as channel selection have been made the radio should again be placed in the locked state.**

Channel Mode and Frequency Mode
The radio operates in two modes:

- *Channel Mode* – The display will show the name of the channel assigned to each of the channels programmed in the radio (up to 128). The "up/down" buttons on the front panel will step through the channels. This is the mode in which the radio will be used.
- *Frequency Mode* – The display will show the frequency in use as a number (vs a name). The "up/down" buttons on the front panel will adjust the frequency up or down. This is also called "VFO mode". VFO stands for "Variable Frequency Oscillator". GMRS use always selects the desired frequency by channel, never direct frequency input.

The available memory locations (channels) in the radio have been programmed with useful frequencies and given names to identify each channel. Because this varies over time as some of the frequencies used in the area change, this document does not state what memory location corresponds to what frequency. To determine this, refer to the channel list you received when your radio was programmed.[7]

To switch between channel and frequency mode turn the radio off, hold down the "menu" key, and turn the radio on. Repeat this until the display shows names instead of digits. *This mode can be changed even if the keypad is locked.*

When using the radio make sure it is in channel mode. In this mode channel names will appear in the display.

Selecting Channels

The radio is able to monitor two channels at the same time. The name of channel A is displayed in the top of the display and the name of channel B is displayed in the bottom of the display. Pressing the top "PTT" button (**P**ush **T**o **T**alk) will transmit on channel A. Pressing the lower "PTT" button will transmit on channel B.[8]

There are two ways to change the channels in use:

1. Use the "up" and "down" buttons in the top row of the keypad to step through the channels.
2. Enter the desired channel number. Three digits must be used. Enter leading zeros if necessary, for example, "005" for channel 5.

To change channels, you must unlock the keypad.

One of the two channels is the "active" channel that will be changed by use of the up/down buttons or direct channel number. That channel is indicated by an "up" or "down" arrow to the left of the channel name. The last channel that was used to transmit will be the active channel.

Switch between the two channels by pressing the upper right key marked "EXIT/AB". While pressing this key the small up/down arrow to the left of the left of the channel name will move from one channel to the other indicating which channel is "active" and can be changed.

[7] Clatsop County Auxiliary Communications (AuxComm) has a set of frequencies they recommend that all HAMS have programmed as the first 20 channels of a radio. See www.clatsopauxcomm.org for the list. It is recommended that you keep the programming in your radio up to date.

[8] It is common for handheld radios to be able to monitor two frequencies. A typical use would be listening to local communication on a simplex frequency and also a repeater covering a wide area. This can be confusing at times because you may not always know on which frequency someone was calling you. The advantages of monitoring two frequencies typically outweigh the potential confusion.

Pressing the up or down buttons in the top row of the keypad will move to the higher or lower channel number. The channel number is displayed to the right of the channel name.

Entering three digits representing a channel number will select the associated channel. The channel number entered must be between 001 and 128 and must be a channel that has been programmed with a frequency. The radio will store up to 128 channels but not all are required to be in use. To select channel 5 enter “005”. To select channel 15 enter “015”. Consult the paper showing what channels have been programmed in your radio to determine the channel number associated with a name and frequency.

The BTECH radio has channel 001 as GMRS01, GMRS channel 1. The GMRS channels continue up through the first 22 channels. After this the 8 repeater channels appear, listed as “REPT15” through “REPT22”. See the chart “GMRS Channels” for a list of the channel names and some information about each channel.

The Baofeng radio must be programmed before it is useable. It will arrive from the factory without any frequencies entered in the memory locations. Programming is easy and this will be done for you to place locally used frequencies in each channel. You will receive a paper listing all channels by name and memory location. From time to time the useful frequencies used in this area may be updated. When this happens the radio programming can easily be updated.

The BTECH radio can be used for the GMRS channels as it is received. Other frequencies can be added which will allow the radio to monitor (but not transmit on) other channels. This is done using programming software in the same manner as is done with the Baofeng radio.

Advanced Topics

The basic information you need to use this radio, selecting a channel and transmitting, has been covered above. To make the best use of the radio you should understand the difference between simplex operation and using a repeater. Basic operation can be done successfully without knowledge of CTCSS or “tones” but you may encounter situations where understanding of this feature is useful.

Simplex Operation

Simplex refers to communication directly from one radio to another radio. The distance over which communication can take place is limited by obstacles between the two radios. Two people standing on mountain tops will be able to talk a long way (10 or 15 miles) with a 5-watt handheld radio. In a city with flat terrain a mile or two is a more reasonable expectation. On the beach with no obstructions the distance two people can communicate will be a few miles. Communication from the north end of Cannon Beach south to Tolovana Park is generally not possible due to the hills near Haystack Rock.

GMRS channels 1 through 22 can be used for simplex communication. Channels 1 through 14 are dedicated to simplex. Channels 15 through 22 are shared with repeater output channels. These channels can be used for simplex communication, but before using one of these channels

it is recommended that you make sure you are not in an area with a GMRS repeater on that channel.[9] See the next section discussing repeaters.

Repeater Operation

A radio repeater is an intermediate radio, normally placed at a high location, that will "repeat" any transmission it receives. Using a repeater allows a much greater coverage area than is possible with simplex communication.

GMRS supports 8 channels for repeater operation. A repeater has an *input* frequency and an *output* frequency. Channels 15 through 22 are used as repeater output frequencies in addition to being used for simplex communication. Setting the radio for channels REPT15 through REPT22 causes the radio to transmit on a repeater input and receive on a repeater output.

CTCSS Tones

Handheld radios have the ability to add a very low frequency tone to the signal when transmitting and also detect such a tone when receiving. The frequency is low enough that many people will not hear it and it will not interfere with conversation. The purpose of this is to keep a radio silent, ignoring received signals other than one transmitting a selected tone.

Programming a radio to transmit a tone is known as "tone encode". The Baofeng and BTECH radios use the menu keyword "R-CTCS" for this option.

Programming a radio to require a tone on a received signal in order to output audio is known as "tone decode". The Baofeng and BTECH radios use the menu keyword "T-CTCS" for this option.

A potential problem with the use of tones is that a conversation may be taking place that you will not notice. You may think a frequency is clear and begin transmitting and interfere with someone else. You may also find that a group of people are using radios on the same channel that you selected, and all have tone encode and decode set. They will not hear you unless you figure out what tone they are using and configure your radio to use that. These people will think the frequency is clear and interfere with your conversations.[10]

You can determine if a channel is busy by looking at the green "receive" LED on top of the radio. If the LED is illuminated, then the radio is receiving a signal. If you have tone decode set and this LED is illuminated, then the channel is busy even though you do not hear anyone talking. You will also see a signal strength indication in the upper left corner of the display. This looks like the familiar cell phone display of bars showing signal strength.

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[9] If you are in an area with a GMRS repeater and you use one of the repeater output frequencies (channels 15 to 22) for simplex conversations, you may be heard by nearby users monitoring the repeater. It is generally considered bad form to use a repeater output frequency for simplex use. GMRS repeaters are not common in rural areas but are seeing more frequent user in urban areas.

[10] There is no good solution for the problem of people using tones using the same channel as you are using and not hearing you. In an emergency if you need to ask someone to stop using a frequency you would have to set your radio to transmit with one tone after another and call them. This is a good reason to consider using HAM radio.

Nearly all repeaters require a tone on the input frequency. This is something that will be programmed in your radio for you.

There are several names used for this tone system. CTCSS stands for Continuous Tone Coded Squelch System. This is the most technically correct term today. Other names you may hear are "PL" for "Private Line" which is a name Motorola used for the system many years ago. This is sometimes also called a "Privacy Tone". It is important to understand that *this does not* make a conversation "private".

FRS Family Radio Service

The Family Radio Service (FRS) shares channels 8 through 14 with GMRS. This means that you may hear FRS users on these channels and experience more disruption from other conversations than on the first 7 channels. FRS radios are typically smaller and somewhat less expensive than GMRS radios. They are required to have a fixed (non-removeable) antenna and operate at less power than GMRS radios. There is no license required for FRS use.

GMRS Rules and Regulations

Complete details of the GMRS regulations can be found on the FCC web site. Rules are defined in 47 C.F.R. Part 95, Subpart E. (https://www.fcc.gov/general-mobile-radio-service-gmrs) A summary of the rules is given here. For complete details please reference the FCC web page.

A license is required to use the GMRS channels with a GMRS radio. The license is $70 for a 10-year period. One license is good for all members of a family. A license is available to individuals only. In the past businesses could use GMRS but this is no longer true, however businesses that were using GMRS in the past are grandfathered to continue using GMRS. The family members covered by a single GMRS license are: licensee's spouse, children, grandchildren, stepchildren, parents, grandparents, stepparents, brothers, sisters, aunts, uncles, nieces, nephews, and in-laws. The URL for GMRS license application is:
https://wireless2.fcc.gov/UlsEntry/licManager/login.jsp

The FCC issues a call sign for each GMRS license. A station must give this call sign once every 15 minutes and at the final transmission.

GMRS Channels

GMRS radios can transmit on 30 channels (1 through 22, plus 8 repeater inputs).
Channels 15 through 22 can be used both as a repeater output and also for direct radio-to-radio (simplex) communication.
Channels 1 through 7 can use 5 watts and 20 kHz bandwidth.
Channels 8 through 14 must adhere to the FRS requirements of 0.5 watts and 12.5 kHz bandwidth.
Channels 15 through 22 can use 50 watts and 20 kHz bandwidth.
The 22 channels are shared with FRS however FRS must use 12.5 kHz bandwidth and FRS is restricted to 2 watts maximum and a non-removeable antenna.

The following table summarizes the channels and frequencies used by GMRS and FRS. The names are those used by the BTECH radio.

Name	Channel	Frequency	GMRS Power	FRS Power	GMRS Bandwidth	Notes
GMRS01	1	462.5625	5 W	2 W	20 kHz	
GMRS02	2	462.5875	5 W	2 W	20 kHz	
GMRS03	3	462.6125	5 W	2 W	20 kHz	
GMRS04	4	462.6375	5 W	2 W	20 kHz	
GMRS05	5	462.6625	5 W	2 W	20 kHz	
GMRS06	6	462.6875	5 W	2 W	20 kHz	
GMRS07	7	462.7125	5 W	2 W	20 kHz	
GMRS08	8	467.5625	0.5 W	0.5 W	12.5 kHz	
GMRS09	9	467.5875	0.5 W	0.5 W	12.5 kHz	
GMRS10	10	467.6125	0.5 W	0.5 W	12.5 kHz	
GMRS11	11	467.6375	0.5 W	0.5 W	12.5 kHz	
GMRS12	12	467.6625	0.5 W	0.5 W	12.5 kHz	
GMRS13	13	467.6875	0.5 W	0.5 W	12.5 kHz	
GMRS14	14	467.7125	0.5 W	0.5 W	12.5 kHz	
GMRS15	15	462.5500	50 W	2 W	20 kHz	Repeater output
GMRS16	16	462.5750	50 W	2 W	20 kHz	Repeater output
GMRS17	17	462.6000	50 W	2 W	20 kHz	Repeater output
GMRS18	18	462.6250	50 W	2 W	20 kHz	Repeater output
GMRS19	19	462.6500	50 W	2 W	20 kHz	Repeater output
GMRS20	20	462.6750	50 W	2 W	20 kHz	Repeater output
GMRS21	21	462.7000	50 W	2 W	20 kHz	Repeater output
GMRS22	22	462.7250	50 W	2 W	20 kHz	Repeater output
REPT15		467.5500	50 W		20 kHz	Repeater input
REPT16		467.5750	50 W		20 kHz	Repeater input
REPT17		467.6000	50 W		20 kHz	Repeater input
REPT18		467.6250	50 W		20 kHz	Repeater input
REPT19		467.6500	50 W		20 kHz	Repeater input
REPT20		467.6750	50 W		20 kHz	Repeater input
REPT21		467.7000	50 W		20 kHz	Repeater input
REPT22		467.7250	50 W		20 kHz	Repeater input

The frequency of the repeater inputs (REPT15 through REPT22) is 5 megahertz (MHz) higher than the repeater output. This is also the offset used for amateur radio in the UHF band.

Care Of Your Radio

As mentioned earlier do not transmit without an antenna attached. Doing so can damage the radio. This, and keeping the radio dry are the only two critical things you need to know to avoid damage.

You can prolong the life of the battery by not leaving the radio on so long that the battery is completely discharged. Once the battery is fully charged remove the radio from the charger.[11]

[11] The more expensive the battery charger, the more likely it is to have circuitry that will protect a battery from over charging. Charging somewhat longer than necessary, for example 24 hours, is not a great problem but leaving the radio always charging will shorten battery life. Fortunately, these batteries are not terribly expensive.

Accessories
You can get additional rechargeable batteries for the radio on Amazon. Use the search string "Baofeng Battery BL-8". Look for batteries compatible with the UV-82 series. The extended size batteries, 3800 mAh, give longer operating time than the batteries shipped with the radio.

A "speaker/mic" is useful. This is a small handheld speaker that also operates as a microphone.

Also available is a battery pack which will accept AAA batteries and a battery pack that connects to a standard automotive cigarette lighter socket.

Resources
The Sunset Empire Amateur Radio Club, SEARC, operates a network of HAM repeaters in Clatsop County. Information on local HAM classes may be obtained by contacting SEARC. The web site is w7bu.club.

The questions for a HAM license are published which makes study easy. There are many on-line resources to aid in obtaining a HAM license as well as local classes offered.

The Clatsop County Auxiliary Communications, AuxComm, web site has many useful resources. One of these is a frequency chart for the local area. AuxComm recommends programming HAM radios with a set of 20 frequencies as the first 20 channels to make it easy for all area HAMs to have easy access to those frequencies. The web site is: www.clatsopauxcomm.org