The Radio Active Pilot
Part 2: Getting an Amateur Radio License

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Abstract - In Part 2 of this series we discuss the process for getting an amateur radio license, the classes of licenses, the exam, and the advantages that a license provides a pilot. Purchasing and using amateur radio equipment and how a repeater can be used to extended coverage are also presented.

The *USHGA Radio Authorization Study Guide* states:

> *The amateur radio service was inadequate, in spite of two-meter use of frequency modulated emissions (FM) and many useable frequencies, because of their stringent licensing requirements for both pilot and retrieval driver, and expense.*

It is true there was a time when amateur radio had stringent licensing requirements. At that time, operators had to show they had the skills to build and/or repair their own equipment, which required a solid understanding of electronic theory and design. However, few operators now build their own equipment, so on April 15, 2000 new rules and licensing procedures became effective.

Prior to the rules change, the candidate had to be able to send and receive Morse code, which was an additional barrier to many. By removing the code requirement and changing the difficulty level of the questions, obtaining an amateur radio license today isn't much more difficult than obtaining a USHGA special skills signoff that we discussed in Part 1 of this series. In fact, when comparing the two exams, they aren't that different. The amateur radio Technician class license requires passing a 35-question exam, while the USHGA exam asks 24 questions. And if you compare cost, the USHGA exam is $15 while an amateur exam is typically $6 to $8. So difficultly and cost shouldn't be an excuse.

The major factor for pursuing an amateur radio license is the greater flexibility that it offers over USHGA business class authorization. For one, an amateur radio operator is provided more frequency spectrum, which increases the likelihood of finding a clear channel. A licensed operator can also use repeaters to extend coverage; which is particularly attractive to cross country pilots.

LICENSES

There are three classes of licenses: Technician, General, and Extra Class. The entry level Technician license provides all the privileges needed by pilots. For all classes of licenses, the exam questions are taken from a published pool of questions available at http://www.arrl.org/arrlvec/pools.html. Many questions address operating procedures and therefore are not technical. Other questions require only commonsense. For example, it should be obvious that one should not maliciously interfere with other radio transmissions or use fowl language. Arguably, if you are good at taking tests, you may even find you won't have to study for the exam.

If you need some help preparing for the exam, try locating a licensed operator. He/she can explain questions and inform you of exam locations, local amateur radio clubs, and books to use to study. One of the best ways to learn is through classes provided by local amateur radio clubs. The American Radio Relay League (http://www.arrl.org) is also an excellent source of information. The ARRL is the largest organization in the US devoted entirely to amateur radio. It supports all aspects of the hobby and provides everything you need to prepare for the exam.

TECHNICIAN

The Technician license gives a pilot legal use of the 2-meter band, 144 MHz to 148 MHz (Mega Hertz). The exam consists of 35 questions taken from a published pool of 511 questions. Since the

questions are published, you know in advance what will be asked, just not which of the questions. The question pool consists of questions from ten areas called Supplements.

1. FCC Rules
2. Methods of Communication
3. Radio Phenomena
4. Station Licensee Duties
5. Control Operator Duties
6. Good Operating Practices
7. Basic Communications Electronics
8. Good Engineering Practice
9. Special Operations
10. Electrical, Antenna Structure and RF Safety Practices

Several questions are taken from each supplement. Let's look at one from the FCC Rules supplement.

Who makes and enforces the rules for the amateur service in the United States?
A. The Congress of the United States
B. The Federal Communications Commission (FCC)
C. The Volunteer Examiner Coordinators (VECs)
D. The Federal Bureau of Investigation (FBI)

This is one of those questions that most folks know without studying, especially if you are a Howard Stern fan. Just in case, the answer is B, the FCC. There are many other questions that are equally easy while others may require study.

After passing the exam, you are authorized to use all amateur VHF (Very High Frequency) and UHF (Ultra High Frequency) frequencies. VHF includes the 2-meter band, which is of most interest to pilots.

GENERAL

The General class license is the only license that requires Morse code skills. It also requires more technical expertise. Higher-power High Frequency (HF) privileges are granted which allows for worldwide communication. Technicians may upgrade to General Class by passing a 5 Words Per Minute (WPM) Morse code test and a 35-question multiple-choice examination. The written exam covers intermediate regulations, operating practices, and electronics theory with a focus on HF applications. Although the license provides use of additional frequency spectrum and modes of operation, it does not provide additional benefit to paragliding pilots since HF frequencies are of limited use based on their long-range propagation properties. We'll discuss propagation in a moment.

EXTRA CLASS

The Extra Class license is the highest level amateur radio license and requires the most technical knowledge. It authorizes the licensee to operate on all frequencies allocated to the Amateur Service. General licensees may upgrade to Extra Class by passing a 50-question multiple-choice examination. In addition to some obscure regulations, the test covers specialized operating practices, advanced electronics theory, and radio equipment design. I mention this license for the sake of completeness, since like the General class license, it provides little additional use for a paragliding pilot who is primarily interested in short range communication.

BAND PLAN

It is fairly common for a group of paragliding pilots with 2-meter equipment to arrive at a site and randomly select a frequency to use. If you don't have a license, you shouldn't be transmitting within the 2-meter band and if you do have a license, you should select an operating frequency with care since it is

illegal to interfere with other communications. To limit interference, specific types of transmission have been allocated to specific portions of the band. This is referred to as a "band plan".

The 2-meter band plan shown in Table 1 shows satellite communication is allocated from 145.80 to 146.00 MHz. Receiving a signal from a satellite a few thousand miles above the earth is difficult enough without having a pilot a few miles away transmitting on the same frequency. The same is true of 144.10 to 144.20 MHz, where EME (Earth Moon Earth) operations are conducted. As crazy as it may sound, some operators bounce signals off the surface of the moon and listen to their echoes. The signals are extremely weak and any other signal will cause interference.

Now that we know about band plans, the next time you arrive at a flying site and someone asks what frequency to use, select a "simplex" frequency. Simplex is the term used to described communication where the same frequency is used for transmitting and receiving. It also means that while one person is transmitting, the other is listening. As shown in the band plan, these are frequencies from 146.40 to 146.58 and 147.42 to 147.57 MHz. If you are determined not to pursue an amateur radio license, these are still the frequencies to use, since you are less likely to cause interference and the FCC may be more lenient if you do get caught.

BUYING AN AMATEUR RADIO

Purchasing a radio can be difficult since there are many amateur radio manufacturers and each has several models to choose from. The good news is that almost anything you purchase will be more than enough radio for paragliding. Nevertheless, let's look at a few things to consider.

Amateur radios fall into two categories, handheld (portable) units, and mobile (vehicular) units. Figures 1 and 2 are examples of each. Unless you are going to be in a chase vehicle following a cross-country pilot, the portable handy talkie is your best option. The least expensive handheld transceiver should provide every feature necessary for good communication. Higher priced handheld transceivers provide more frequency coverage such as access to bands in addition to 2 meters, (i.e., 6 meters and 70 cm are common). Higher priced units may offer more memory channels and a computer interface with software. However, for pilots these radios do not offer enough benefit to justify the additional cost.

WAVELENGTH

Did you ever wonder why the radio that you use is called a 2 meter radio. After all, what does length (i.e., 2 meters) have to do with a radio? The answer is that the length refers to the wavelength on which the radio operates. As an example, a 2-meter transceiver transmits and receives a frequency that has a wavelength of 2-meters.

If you know the frequency, you can compute its wavelength and visa versa. The wavelength is equal to the speed of light, (300,000,000 meters per second) divided by the frequency. So if you are transmitting on 148 MHz, the wavelength is 300,000,000 divided by 148,000,000 (1 MHz is 1,000,000), or approximately 2 meters.

PROPAGATION

Propagation is the term used to describe the way RF signals travel (propagate). Amateur radio equipment that operates in the 2-meter band is limited to line-of-sight (LOS) communication. In practical terms, it means that your coverage area is limited to a few miles. The curvature of the earth prevents longer distance communication. If you are in a mountainous area, you will be limited further, since radio frequency signals can't pass through mountains.

You may have heard that amateur radio operators can talk to people around the world, so how can they do that when I just said communication is limited to a few miles. The answer lies in the frequency that is used. High frequency signals (3 to 30 MHz) bounce off the ionosphere. This allows someone in

New York to talk to someone in San Diego. Figure 3 provides an example of this phenomenon. It shows the curvature of the earth and the propagation of the signal between two points. The skip distance can be hundreds or even thousands of miles.

Radio frequency propagation is very different in the 2-meter band that pilots use. These signals do not bounce off the ionosphere; they travel along the ground, which explains why they provide limited coverage. To be completely correct, the signal also travels upwards to the ionosphere, but rather than bouncing off it, it penetrates it. As a side note, that is one reason why your satellite system uses microwave frequencies that are virtually unaffected by the ionosphere.

REPEATERS

Pilots can communicate over extended distances with small hand held transceivers by using a repeater. As its name implies, a repeater repeats the signal it receives.

Figure 4 shows two towns, A and B, separated by a mountain with a repeater on top that has a view of both towns. When a radio operator in town A transmits, his/her signal is received by the repeater and re-transmitted (repeated) over an area that covers both town A and B. The same is true for a person in town B.

The astute reader may wonder how a repeater can simultaneously transmit and receive on the same frequency. The answer is that it can't. The repeater gets around this limitation by transmitting on a different frequency than it receives. This is called a frequency offset. For the 2 meter band, the standard is to separate transmit and receive frequency by 600 MHz.

The really astute reader may suggest that repeaters have such a wide coverage area due to their view of distance cities that they may interfere with each other. In practice, they can and do. For example, here in San Diego, I often hear Los Angeles repeaters on the same frequency as local repeaters. This can't be completely prevented, but using sub-audible tones, called Private Line (PL) tones the problem can be mitigated. Sub-audible tones are tones so low that you can't hear them. For the purist, the tones actually can be heard since they are around 100 Hz, well within the range of human hearing. However, the small speaker in amateur radio equipment can't reproduce the tone, so you don't hear it.

There are two types of repeaters, open and closed. An open repeater is one that is open to all amateur radio operators to use without any restrictions or costs. A closed repeater is typically a repeater that is maintained by a group of operators that have joined together to pay for the cost and maintenance of the repeater. Repeaters are expensive and require significant effort to maintain. For this reason, a small yearly fee and membership in the group is required before using the repeater. Fortunately, there are many open repeaters that are free to use and provide great coverage.

CONCLUSION

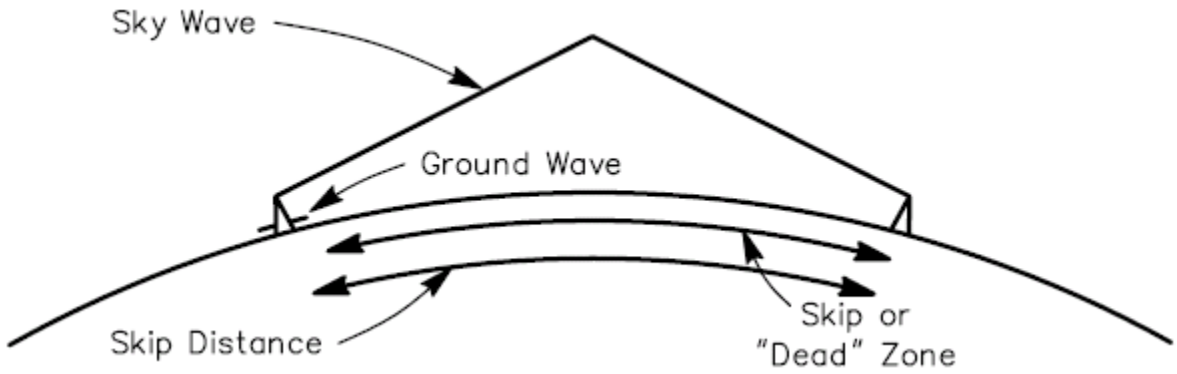
In this installment, we discussed what it takes to get an amateur radio license and the advantages of holding such a license. We also covered how RF propagates and how repeaters can be used to extend the range of communication. Next time we'll see how amateur radio can be used for a lot more than just talking. For those who can't wait, take a look at: http://w9if.net/cgi-bin/torreywx/wx.pl.

144.00-144.05	EME (CW)
144.05-144.10	General CW and weak signals
144.10-144.20	EME and weak-signal SSB
144.200	National calling frequency
144.200-144.275	General SSB operation
144.275-144.300	Propagation beacons
144.30-144.50	New satellite subband
144.50-144.60	Linear translator inputs
144.60-144.90	FM repeater inputs
144.90-145.10	Weak signal and FM simplex
145.10-145.20	Linear translator outputs
145.20-145.50	FM repeater outputs
145.50-145.80	Miscellaneous and experimental modes
145.80-146.00	Satellite subband
146.01-146.37	Repeater inputs
146.40-146.58	Simplex
146.52	National Simplex Calling Frequency
146.61-146.97	Repeater outputs
147.00-147.39	Repeater outputs
147.42-147.57	Simplex
147.60-147.99	Repeater inputs

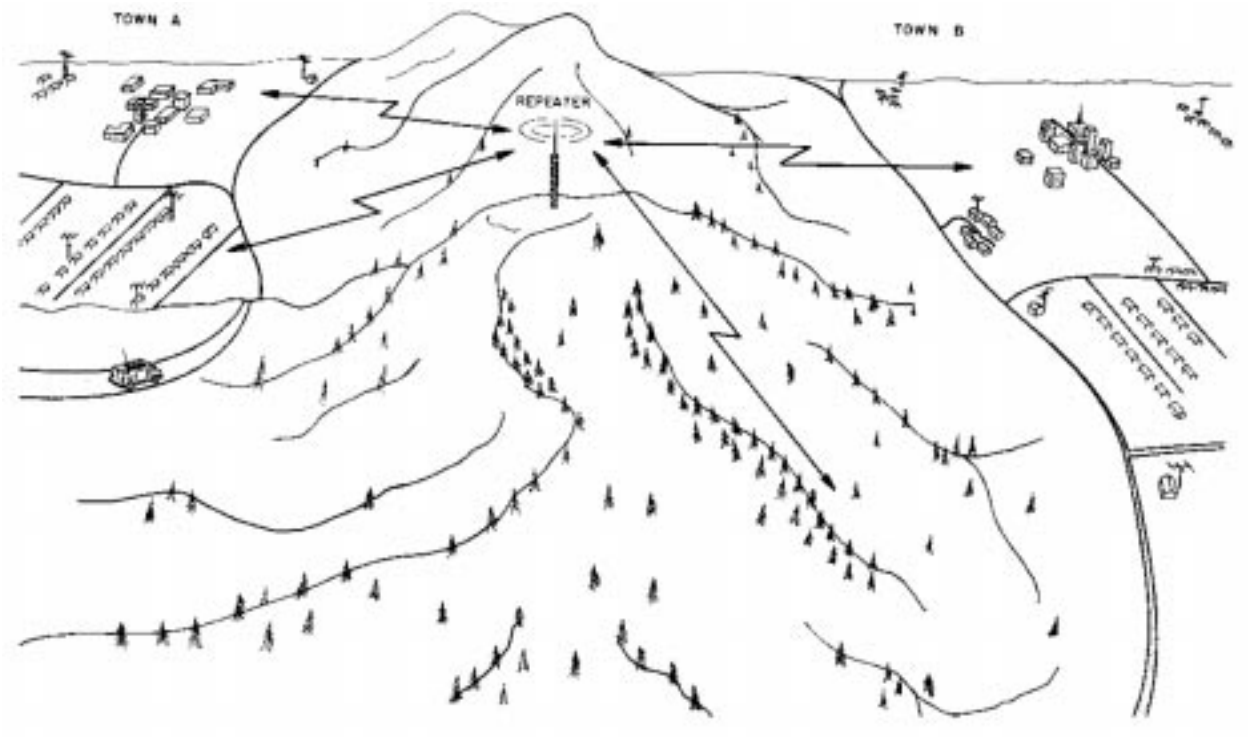
Part 2 - Table 1. 2-meter band plan.

Part 2 - Figure 1. Other than size, this 2 meter amateur radio has little in common with a business radio. It provides more control and features such as a computer interface for programming. Photo courtesy of ICOM America Inc.

Part 2 - Figure 2. This 2-meter amateur radio is intended for installation in a vehicle and the preferred type of radio for tracking pilots flying cross-country. Photo courtesy of ICOM America Inc.



Part 2 - Figure 3. Amateur radio operators can communicate over several thousand miles by bouncing signals off the ionosphere.



Part 2 - Figure 4. A repeater high atop a mountain can be used to extend coverage to allow pilots to communicate over a wide area.