

# Amateur Radio Pedestrian Mobile Handbook

Edward R. Breneiser, WA3WSJ

Reading, Pennsylvania, USA

The door to the world  
is strapped to my back.

Chris, K4FH

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# Preface

This handbook is the project of Edward R. Breneiser, WA3WSJ. The purpose of this handbook is to provide the amateur radio operator who is interested in operating pedestrian mobile with the needed information to get on the airwaves. Hopefully, with this information the average amateur radio operator will have enough knowledge to build and operate a pedestrian mobile amateur radio station. Input was solicited from around the globe so that a broader scope of subject material may be presented in this handbook.

Please note that the author defines pedestrian mobile as any radio station that can be operated and made mobile by a person walking and not assisted by mechanical means. This definition eliminates all vehicles, boats and all types of cycle operation etc. While these are fun ways to operate and a great way to get out into the great outdoors, they are not considered pedestrian mobile operation in this handbook.

While most contributors have sent information, a few hams were solicited to provide information from their websites etc. Again, thanks to all who have provided information for this handbook. Also, certain sections in this handbook were taken from older material or from reference websites. All material in this handbook is not copyrighted and free for all to use or to distribute.

It is my hope that this handbook will guide the amateur radio operator interested in operating pedestrian mobile to a point where he or she builds a pedestrian mobile station and gets outdoors to operate that station. If this handbook adds one additional pedestrian mobile operator to our ranks, it has fulfilled its purpose.

## Acknowledgements

This handbook wouldn't have been possible without material from several amateur radio operators located worldwide. Most of the hams who contributed pictures and other information do operate pedestrian mobile stations. I would like to thank Dave Starkie-G4AKC, Jose Rivera- N2LRB, John Neeley- W6ZKH, Dennis Starks- KB0SFP, Martin Gillen-VA3SIE, Brian Levy-W2BRI, Stephen Yates-AA5TB, Alexandre Grimberg-PY1AHD, Budd Drummond-W3FF, Daniel Kemppainen-N8XJK, Matt Ireland -MW3YMY, Michael P Olbrisch-KD9KC and Ken Muggli -K0HL for their pictures and information used in this handbook.

Dennis Starks, KB0SFP, has contributed many pictures for Chapter Twelve – Military Surplus Stuff. Thanks you Dennis for all the pictures and information you have provided for this handbook. Dennis has been involved with military radio gear for many years and has a wealth of information on the subject.

I would like to especially thank Paul Signorelli, W0RW, for providing many pictures and much information for this handbook. Paul has been my Elmer and started me operating as pedestrian mobile. It's funny to say that I recently had an "Elmer" because I've been active in this hobby since 1973 or about thirty-eight years now. Just shows that you can always learn something new from amateur radio! Paul has written many articles including " 100 Countries on a Ten-Foot Whip."

Thank you Paul, W0RW, for all your help with the writing of this book. Without your help, this book wouldn't have be written or published so that all hams and future pedestrian mobile operators could enjoy it.



WA3WSJ/pm operating from Pulpit Rock on the Appalachian Trail near Hamburg, Pennsylvania. This is way I love to operate pedestrian mobile! The view is just awesome and the weather is perfect for a fun day out on the trail and playing radio. If you want to see beautiful places and meet new people, cut the power cord on your rig and operate pedestrian mobile.

**Try it – you’ll love it!**

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# 1

## Early Pedestrian Mobile

While the article below may not be the first article on pedestrian mobile operation, it still gives the reader a sense of just how far technology has advanced since 1917. It also illustrates just how much effort went into establishing communications in the field.

*Popular Science Monthly*, May, 1917, pages 795-799:



The author of this article, Capt. A.P. Corcoran, has just returned home from France where he served with the British army. His military work included the installation of signaling apparatus. The following contribution from his pen, therefore, will give our wireless readers some first-hand information on the war-time usage of radio apparatus. EDITOR

“To the public at large there is little that is romantic in the performance of the wireless man in warfare. He does not charge with bayonet fixed to rush an enemy trench. He does not kill or conquer. And the popular imagination finds it hard to see a hero in a man whose duty is the mere recording of others' exploits.

Like the dispatch-rider, indeed, the wireless operator is likely to become conspicuous only when he fails in the task assigned him. Then he has an opportunity to judge his importance by the measure of the opprobrium poured on him. When he fails, of course, he never fails alone.

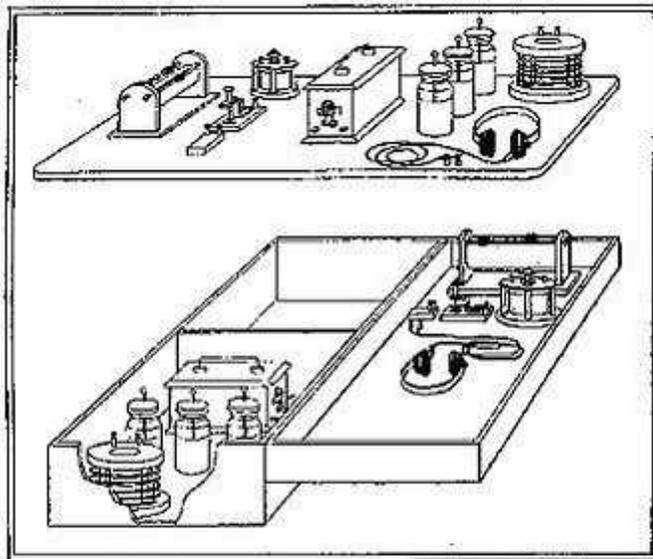
Yet technical and unheroic as his task may seem, it calls for gallantry equal to that of any. Not only does he share in all the risks run by the Tommies, but he lacks all their means of defense. Though he stands side by side with them in the front line trench, ready to join in the attack, his sole weapon is his wireless apparatus. He carries neither rifle nor bayonet.

The position of the wireless man is now quite definite. There is no scrap in which he does not have his share, no division of the army in which he does not have his place, whether it be infantry, artillery, air-service or cavalry. That he is absolutely indispensable in achieving results has been conclusively proved in the battles along the Somme by endless instances of distinguished services rendered. In spite of his obscurity, he has won many decorations.

But that his service is still far from perfect, however effective it has proved, was still evident when I left France less than a year ago. I do not intend to be technical in my explanations in this article, but, in order to make clear the experimenting that has been done in wireless in this war, it is necessary for me to go back to the beginning. My aim is to give a short history of the wireless in France--its development in brief outline.

At the very outset of hostilities, before the trench warfare had begun and the armies had settled down to their present deadlock, the wireless was necessarily of a different character from that used now. Then a motor lorry set--a 1½ K. W. Marconi set--was supplied to the Signal Branch of the Royal Engineers. All through the retreat from Mons and during the fight on the Maine, this set was used and did excellent work.

But with the end of the moving fighting and the beginning of trench monotony, the lorry set lost its value. Soon it was entirely supplanted by the systematic working of trench telephones, and for a while the wireless went almost completely out of use..."



The first set was placed loosely on a board, but it soon became apparent that a different outfit was needed and one more easily transported; hence the box set came into use

“But not for long. The ineffectiveness of trench telephones under certain conditions was soon very painfully apparent. When actual fighting was in progress, they failed more than once at critical moments. Sometimes a shell would break down the communications; or an artillery battery would carry off the air line poles; or an enterprising Tommy, on his way through a communication trench, would cut off a length of cable to make a shoe lace.

Even commanding officers who were always skeptical on the subject of wireless in the trenches, were forced to confess that their old friend, the telephone, was not always reliable in case of a crisis. So, on their recommendation, it was decided to undertake some experiments which would perfect the wireless for warfare.

It was now decided that the requirements of the new fighting called for a **portable set for the first line trenches**, and a group of officers who had already distinguished themselves in various capacities, were detailed to take charge of the work and evolve an instrument for the purpose.

They introduced a small, simple set consisting of a 1-in. spark coil, Leyden jar condenser (3) and an aerial coil. Receiving, a single inductance, silicon detector, variable capacity 'phone condenser and 'phones 1000 ohms.

The aerial was supported on two 8-ft. bamboo poles, 80 ft. apart with a single wire. The ground consisted of a wire gauze mat 8 by 3 ft. With this set it was discovered that fairly loud signals could be heard from three to five miles.

When the instrument, however, was put to its first real test at L-----, it rose magnificently to the demands of the situation, acting to its full range of five miles. For a long time this set was used with excellent and unvarying results. In regard to the transmission of messages it lacked nothing. But it had just one drawback--a minor one but occasionally important. Being placed loosely on a board, it was clumsy to carry, a fact which often hindered the work by causing loss of time.

Once more the officers set to work. It was a Captain L----- who found the means of combating the difficulty. He discarded the board, and substituted a box 18 by 9 by 9 in. in which he placed the set. **This was carried on the back and proved to be a most compact and convenient instrument.**

I remember when the first experiments were made with this set, some distance behind the line. They took the form of contests between the wireless and telephone. A detachment from each would start off from a trench, as if during an actual engagement, to a position some 500 yd. distant. Then each would do his utmost to establish communications as quickly as possible.

From the very first the wireless man won by an average of some thirty seconds, no small consideration in warfare, when perhaps it is a question of holding ground already gained.

The instrument being now perfected, the next question was the training of the men. In England depots were at once established, and young fellows already equipped with a working knowledge of the job, such as Post Office Telegraphers and the like, were enrolled in the wireless section.

Similar schools were established in France behind the lines at each of the Army Headquarters, and the officers in charge would occasionally go into the trenches and pick out a few of the most intelligent infantry men with a view to training them as operators. No Tommy but tried his hardest to be picked. He looked on the training as a good opportunity to rest, a nice break in the monotony of trench life.

In addition to these schools for the training of operators, there was also one for the officers, to which I myself was attached for some time in the capacity of lecturer.

The wireless section is now, of course, one of the largest and most important factors in the Royal Engineers, but at that time it was comparatively unimportant, and there was naturally a shortage of officers fully trained in this branch of the work.

Consequently to meet this deficit it was the custom to bring back signaling officers from their brigades for a short, sharp course of two weeks. This, coupled with their previous knowledge of telegraphy and circuits, was found to be sufficient to make them efficient leaders.

The operator naturally took longer, being absolutely untrained in such work, and his course usually lasted from three months to four or even more. The measure of his qualifications, however, was high and definitely fixed. He had to be able to send and receive at the rate of twenty-five words a minute, English, and twenty words a minute code and foreign languages. He had to be able to assemble and dismantle Marconi 1½ K. W.; also to have a working knowledge of trench sets and a thorough knowledge of army procedure.

As a matter of fact, he rarely needed to work to the full height of his ability, for, in actual warfare, he found that the necessary speed rarely exceeded from fifteen to twenty words a minute, according to the activity of the Boche gunners.

The wireless, as I have said, is now an essential part in all trench warfare. When the infantry advances to an attack, the operator is always slightly in the rear. Where formerly a detachment of men had to reel out hundreds upon hundreds of yards of cable to establish telephone communication between a trench newly taken from the enemy and the first line reserve behind, now the operator simply picks up his box, his ground mat and his aerial single-handed and advances simultaneously with the attackers. Arriving at his new position, he props up his aerial, lays his ground mat, and communications are established almost at once.

It would be hard to overestimate the importance of his duties. When an enemy trench is being taken, it is he who reports the progress of the encounter--the number of the enemy, the nature of their defense, the amount of the casualties on either side, the condition of the trench when it is finally taken--whether it has been badly damaged by artillery fire, or whether it is practically intact. If a gas attack is coming, it is he who sends the warning to the men behind to put their gas helmets on.

If the aeronaut can be called the eyes of the army, the wireless man is its ears. Naturally their work is made to dovetail. When one sees, the other hears and also reports..."

# 2

## Why Operate Pedestrian Mobile?

Many amateur radio operators and especially non-hams ask the question, “Why operate pedestrian mobile?” The simple answer is that it’s just FUN! But, to answer this question more completely, we have to look at the differences between operating at a home station, a portable station, a mobile station, and finally operating as a pedestrian mobile station.

### **Amateur Radio Station Types vs. Pedestrian Mobile Station**

**Home Station:** A home station usually consists of a large radio or radios and a rather nice antenna or antenna farm. The amateur radio operator really doesn’t worry much about the amount of power each piece of radio equipment draws from the power source. The power source is usually the power company power grid.

**Portable Station:** A portable radio station requires somewhat more concern for power considerations, but the amateur radio operator can still use a portable generator, batteries and even solar panels for the power source. The radios don’t even need to be power efficient. Antennas can still be put on a rather large footprint requiring minimal concern for the real-estate needed to erect the antennas.

**Mobile Station:** Now let's compare the mobile radio station with a portable radio station. The typical mobile radio station draws power from a battery or batteries. This type station is somewhat more concerned about power draw from the power source, the battery, because the battery has a limited amount of power compared to a utility grid or generator. Furthermore, the mobile has a limited amount of space to work with for the radio station. The antenna is usually some sort of loaded-vertical mounted on the vehicle body or bumper etc. Not too much to worry about yet.

**Pedestrian Mobile Station:** Finally, let's take a look at what a pedestrian mobile amateur radio station is and what difficulties this type of radio station has to overcome. An amateur radio pedestrian mobile station is a completely self-sufficient system. That is every piece of radio gear needed to operate the station is "on or carried" by that individual. The transceiver with all the pieces such as remote control head, microphone and paddles are "on or carried" by that individual. . The power source usually a battery is "on or carried" by that individual. The antenna or antennas are "on or carried" by that individual.

The main reason to operate pedestrian mobile is FUN. The PM operator can walk almost anywhere and have lots of fun doing it. To operate as pedestrian mobile, you will need to put together a PM Station.

The main components of a PM Station are:

- Mount System
- Transceiver
- Power Source (battery)
- Antenna

Yes, as you might be thinking, it's a lot to load on a person and have it all work! But, if properly designed and managed, all should work just fine. All these components are discussed in the handbook.

**Get out there and have some FUN!**

## **Obstacles to Operating Pedestrian Mobile**

Let's look at what obstacles the pedestrian mobile operator must overcome to get on the air.

**Space:** The number one obstacle is space. Yes, there's only so much radio gear that you can put on a human body. The adult human body contains an average of fourteen to eighteen square feet. This isn't much real-estate. Plus, some of this real-estate isn't usable! The complete radio station must fit on an average of about twelve square feet.

**Weight:** The second obstacle presented to the pedestrian mobile operator is weight. Yes, the pedestrian mobile operator can only take a limited amount of additional weight. A well-trained hiker might be able to carry up to one third of his own body weight as FSO weight. In general, however, one fourth will already be very cumbersome. From one fifth and down, you should be able to hike comfortably.

According to the National Center for Health Statistics, the average weight for an adult male in the United States is 189.8 pounds or about 190 pounds. To safely walk around with a pedestrian mobile station, the entire station should not weigh over one-fifth your body weight.

**Therefore, the average male should not have a pedestrian mobile station that weighs-in over thirty-eight pounds.**

**People:** This really sounds funny that people are an obstacle to operating a pedestrian mobile radio station, but it's true. The more people that are in your operating-area - the more problems you will encounter. People tend to see pedestrian mobile operators as very strange! First they usually don't know that much about amateur radio and nothing about operating as pedestrian mobile. They tend to be attracted to the pedestrian mobile operator like bears to honey!



Once had an entire scout troop of approximately thirty people run over to me. The first thing you do is STOP operating because of the possible RF exposure to others - especially kids. They also will probably tear off your drag wire or counterpoise wire by stepping on all over it. Oh yes, this happened to me on the Appalachian Trail in Pennsylvania! The next thing you will do is answer a thousand questions about, “what are you doing?” This isn’t a bad thing, but still it’s an obstacle to pedestrian mobile operation.

Another obstacle involving people are their vehicles. Yes, their cars, SUVs, boat trailers etc all have one common obstacle to pedestrian mobile operation – TIRES! Vehicle tires are like magnets to your drag wire.

As you walk by a vehicle’s tires, you MUST watch that your drag wire doesn’t go under a tire. If it does, your drag wire will tear off or break away from your system.

### **Low-Hanging Obstacles:**

Another obstacle to pedestrian mobile operation is the low-hanging item. Items such as trees, bridges, overpasses etc. These things tend to “hit you” when you least expect it. As you walk and are concentrating on operating, you next feel a jolt!

You didn't think that tree was that low, but it hit your antenna all the same! My HFpack is mounted on my back and I'm over six-feet tall.

My antenna connector therefore sits approximately five feet off the ground and the antenna is about nine feet in length. This means that I need a minimum clearance of fourteen feet!

Please note that some utility lines that I've seen are less than fourteen-feet off the ground! This is especially true when hiking in the mountains, remote areas, etc. The pedestrian mobile operator MUST always be aware of where he or she is walking and what that antenna might hit! More about this subject later in the handbook.

### **Places to Operate Pedestrian Mobile**

Many pedestrian mobile operators say they really enjoy the freedom experienced by walking around almost anywhere while operating a radio station. The pedestrian mobile operator is not connected to the utility power grid and he or she is not restricted to a small area to operate. The world is wide open to operate as a pedestrian mobile radio station!

**Neighborhood:** Many first time pedestrian mobile operators start by building an HFpack and taking it outside to try it out. They then walk around their neighborhoods answering the age-old question that all pedestrian mobile operators are asked, “ what are you doing?”

**Parks:** You may operate in your local park, a state park or a national park. You do have to operate in an area free of low, over-hanging trees and crowds of people. Also, if there are park rangers, you'll probably have to tell them what you are doing in the park. Park rangers are pretty good about it, but they always ask the famous question, “what are you doing?”

**Trails:** The United States of America has many trails systems. The trails can be local trails, hiking trails or national trails. Trails provide the needed places to operate pedestrian mobile away from large crowds of people. While some trails are remote, others are may be close to civilization.

**(See Chapter 16)**

It really depends on how much of a walk you want to do that day and what kind of physical shape you're in.

**Mountain Peaks:** Mountain peaks can be more challenging to get to, but the reward is just awesome! Many mountain peaks are remote and the only way to get there is to hike. This usually involves hiking through low over- hanging trees in the eastern portion of the US. But in other parts of the world the mountain peaks are accessible by vehicle etc. This is true in the western parts of the US and in the eastern US above tree line. The great thing about operating pedestrian mobile from a mountain top is that elevation is , "the great equalizer." The more elevation you have above the surrounding terrain means a better signal to operate some nice DX etc.

<sup>1</sup>Summits on the Air (SOTA) is an award scheme for radio amateurs and shortwave listeners that encourages portable operation in mountainous areas. SOTA has been carefully designed to make participation possible for everyone - this is not just for mountaineers! There are awards for activators (those who ascend to the summits) and chasers (who either operate from home, a local hilltop or are even Activators on other summits).

SOTA is now fully operational in many countries across the world. Each country has its own Association which defines the recognized SOTA summits within that Association. Each summit earns the activators and chasers a score which is related to the height of the summit. Certificates are available for various scores, leading to the prestigious "Mountain

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<sup>1</sup> <http://www.sota.org.uk/>

Goat" and "Shack Sloth" trophies. An Honor Roll for Activators and Chasers is maintained at the SOTA online database.

**Beaches:** Beaches usually have easy access and that's what makes them good and bad places to operate from as pedestrian mobile.

By having easy access, large crowds of people usually are on the beach in the summer.

But, other times of the year when it's too cool for swimming beaches are not so populated and are great places to operate as pedestrian mobile. If you can find a deserted beach in the summer, you have the best of both worlds! The pedestrian operator can walk around the beach operating and when he or she gets hot, just jump in the ocean or lake to cool down.

**Fire Lookouts:** Yes, fire lookouts are great places to operate a pedestrian mobile station. Fire lookouts have a couple of great attributes working for them. The main positive attribute is elevation. Yes, the higher the elevation you operate from will usually produce more contacts than operating at lower elevations. Secondly, there are usually less people walking around a fire lookout. I've also noticed that depending what material the fire lookout is made from, you can use it to receive and transmit better signals. More about this later. The Forest Fire Lookout Association is a great place to find a fire lookout near you.

<sup>2</sup>The Forest Fire Lookout Association (FFLA), founded in 1990, is an organization involved in research of former forest fire lookout sites, ground cabins and early forest fire detection methods. Anecdotes of Lookout operators both past and present are documented. The organization encourages efforts of public groups and others in the restoration of forest fire lookouts. Some lookout projects are undertaken by chapters of the organization itself. The Forest Fire Lookout Association's by-laws prohibit the lobbying for retaining lookout operator jobs and there is no political connection to any such groups that encourage these efforts. The membership is composed of lookout enthusiasts, hikers, conservationists, forest fire personnel, foresters, story writers, and members of the environmental community. Conferences are held twice a year in the eastern and western United States and Canada.

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<sup>2</sup> <http://www.firelookout.org/about.htm>

A Board of Directors meeting is held each January and state chapter meetings are held periodically. The Forest Fire Lookout Association issues a quarterly newsletter, Lookout Network and is a benefit of membership. A Plus membership is available which includes quarterly issues of National Woodlands Magazine which has articles and information on the National Historic Lookout Register and the FFLA. The Forest Fire Lookout Association has chapters in twenty-five states and are represented by directors. Correspondence is currently received by almost all fifty states. Chapters are also located in Western Australia and Canada..

# 3

## Pedestrian Mobile Mount Systems

The mounting device the pedestrian mobile operator selects is a critical decision. The mounting structure may support your entire station or just the radio or antenna. But, it will have to work 100 percent of the time or you'll have trouble. If your radio, battery or antenna becomes inoperable, you still can just walk back to where you started the adventure. But, if your pedestrian mobile mount fails, you might have to carry the entire station out using just your arms! This might sound easy, but after walking a few miles carrying around thirty pounds in your arms, your arms will hurt!

Pedestrian mobile mounting systems come in all sizes, shapes and colors, but all have one common function – **to support the radio system**. The mount may support the entire radio station or it might only support the radio or only the antenna.

**Station Mount:** The entire radio station mount supports your radio, battery, antenna and all other major station components. It must be capable of supporting the weight of all the gear plus more. This **MUST** work 100 percent of the time! The pedestrian mobile operator should look for two main characteristics in a station mount.

The station mount should be strong and lightweight. It should also fit the person wearing it. What makes a good station mount depends how you design your HFpack.

## Factors affecting a station mount selection:

**Radio:** The size and weight of the transceiver you select to use will dictate what type mount you will need for your HFpack. If you use a medium-sized radio such as an Icom 703 Plus, you'll need a sturdy mount to support the radio, battery etc. One excellent station mounting system is an ALICE Frame.

**Battery:** Battery size and weight will also dictate the size of your mounting system. If you decide to use a huge battery, you'll need a large mounting system and a very strong back! My personal preference is not to use a battery larger than 10AH. But, with the introduction of the nano-phosphate battery chemistry, you can now use larger capacity batteries as they are smaller and lighter and pack more of a punch! More on this subject later in the handbook.

## Pedestrian Mobile Mount Types:

**Frame:** There are various backpack style frames used to hold your station, but the ALICE Frame is a good one. ALICE is an acronym for:

All-Purpose-Lightweight Individual  
Carrying Equipment.



<sup>3</sup>The All-Purpose Lightweight Individual Carrying Equipment is the end result of the LINCLOE [Lightweight Individual Clothing And Equipment] program that began in 1965 and was terminated with the adoption of the ALICE system on 17 January 1973. The goal of the individual equipment portion of the LINCLOE program was to develop a lightweight load-carrying system in an effort to lighten a combat soldier's overall load.

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<sup>3</sup> [http://en.wikipedia.org/wiki/All-purpose\\_Lightweight\\_Individual\\_Carrying\\_Equipment](http://en.wikipedia.org/wiki/All-purpose_Lightweight_Individual_Carrying_Equipment)

These frames were manufactured in the seventies for the Army and can hold your radio, battery and antenna. It can also hold a small pack to store personal items such as water etc. This type of frame mount is made from aluminum tubing and is rather lightweight on your back. ALICE Frames<sup>4</sup> are available from many Army/Navy Surplus stores and are sold at large ham fests and at online at internet stores .

**5Backpacks:** The word backpack was coined in the United States in the 1910s. moneybag and packsack were used before; they now occur mainly as regionalisms. The word rucksack is a German loanword mainly used in the UK and in the US Army: in German 'der Rücken' means 'the back' (the part of the body), and Sack for bag. The name Rucksack is cognate with Danish Rygsæk, Norwegian Ryggsekk, Dutch Rugzak, Afrikaans Rugsak and Swedish Ryggsäck. Alternative names include Haversack, and in German language called Kraxe (in 19th century the term kraxeln was used for climbing).

Backpacks can often simply be referred to as "packs", especially in outdoors contexts; though sometimes ambiguous compared to other bags such as saddlebags and duffel bags, context is generally sufficient for identification.

**Internal Frame Backpacks:** The internal frame backpack is a recent innovation, invented in 1967 by Greg Lowe, who went on to found Lowe Alpine and Lowepro, companies specializing in backpacks and other forms of carrying bags for various equipment. An internal-frame pack has a large fabric section around an internal frame composed of strips of either aluminum, titanium or plastic, sometimes with additional metal stays to reinforce the frame. A complex series of straps works with the frame to distribute the weight and hold it in place.

The internal frame permits the pack to fit closely to the wearer's back and minimizes shifting of the load, which is desirable when participating in activities that involve upper-body movement such as scrambling over rocky surfaces and skiing. However, the tight fit reduces ventilation, so these type of packs tend to be more sweaty than external frame packs.

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<sup>5</sup> <http://en.wikipedia.org/wiki/Backpack>

The internal construction also allows for a large storage compartment; a few lash points (including webbing loops and straps for sleeping bags and other large items) may be present, but as the frame is completely integrated. It is difficult to securely lash larger and heavier items which do not fit inside the compartment to the outside of the pack. Internal frame packs originally suffered from smaller load capacity and less comfortable fit during steady walking, but newer models have improved greatly in these respects. In addition, because of their snug fit, The improved internal frame models have largely replaced external frame backpacks for many activities.

Internal backpacks provide the pedestrian mobile operator with several advantages. The first being comfort or fit. Many internal packs just feel good on your back. The second advantage is ease of movement. By having a tight fit next to your body, you can move around objects more gracefully than with a rigid frame.

Again where you hike is an important decision on what type of mounting system is right for you. The cost can be inexpensive, but the “wear-factor” must also be considered when purchasing a pack. Wear-factor means how long it will last. This again depends on where you will be walking and the weight of your system components.

The disadvantages of internal backpacks are weight restriction, movement of system components and wearing out. Many internal frame backpacks will work for the average pedestrian mobile operator, but the pack will only hold a limited amount of weight. Your battery capacity will be severely limited using this type of mount system. Another main disadvantage is the movement of system components on or in the pack such as the antenna, radio etc. But, if you use a small, lightweight radio and antenna, these factors are not much of an issue and the wear-factor isn't a problem. Many QRPers could use this type of mounting-system.

**External Frame Backpacks:** Many hikers still use External frame packs. External Frame packs were designed to carry heavy loads (>20 kg or 40 lb), giving the wearer more support and protection and better weight distribution than a simple, frameless strapped bag. Wooden pack frames were used for centuries around the world.

Ötzi the Iceman may have used one in Copper Age Alpine Italy<sup>6</sup>, though some archaeologists believe the frame found with the body was part of a snowshoe. Such packs are common in military and mountaineering applications; metal versions first appeared in the mid-20th century.

The frame of an external frame pack is typically made from aluminum, other lightweight metal alloy, and recently reinforced synthetic polymers or plastic and is equipped with a system of straps and tautly-stretched netting which prevents contact between the metal frame and user's back. In addition to comfort, this "stand-off" provides the additional benefit of creating air circulation between the frame and the wearer's back.

For this reason, external frame packs are generally considered to be a "cooler load" than internal frame designs. External frame packs have a fabric "sack" portion which is usually smaller than that of internal frame packs, but have exposed frame portions above and below the sack to accommodate attachment of larger items. In addition, the sack can often be removed entirely, permitting the user to customize the configuration of his load, or to transport a non-conventional load such as a quartered game animal. Military packs are often external frame designs due to their ability to carry loads of different shapes, sizes and weights.

The External frame pack has one major advantage over all other mounting systems – it's sturdy! Because it's sturdy an external frame with a small pack can easily support most radios and most loaded-vertical antennas. The operator may also pack additional items such as batteries, microphones, paddles, etc. Again, maybe this rigid support isn't necessary if you use lightweight, low power radio gear.

How and where you operate will dictate what mount support you need to safely operate your pedestrian mobile station.

**6Frameless:** The simplest backpack design is a bag attached to a set of shoulder straps. Such packs are used for general transportation of goods, and have variable capacity. The simplest designs consist of one main pocket.

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<sup>6</sup> <http://en.wikipedia.org/wiki/Backpack>

This may be combined with webbing or cordage straps, while more sophisticated models add extra pockets, waist straps, chest straps, padded shoulder straps, padded backs, and sometimes reflective materials for added safety at night. These packs are generally produced inexpensively. Some outdoor packs, particularly those sold for day hikes, ultralight backpacking and mountaineering are sometimes frameless as well.

This type of mount system should only be used for very small, lightweight radio systems. The pedestrian mobile operator will most likely have to carry his or her antenna and the power source or battery will most likely be smaller in capacity. Many smaller QRP radios will work with this type of mounting system.

**Misc Mounts:** Miscellaneous pedestrian mobile mounting systems are all those other mount types that are not frame, frameless, and backpacks. There may be many different miscellaneous mount types, but only two additional types will be discussed here.

**Antenna Mount:** The antenna mount is just that some sort of device that supports only the antenna. The operator usually holds his or her radio in his hands or on a waist-type radio mount. This type of mount usually is very light and usually supports some type of lightweight antenna.



The picture to the left shows Paul Signorelli, WORW/pm operating with an antenna mount. Paul actually calls this type of mount his Antenna Sling Mount. The antenna, a military-style vertical whip is supported much like a gun sling is on the shoulder. Again, this style mount is usually only used with handheld radios or radios clamped to a waist belt etc. In the

picture Paul is operating pedestrian mobile with his Elecraft KX1.

This type of system is small, lightweight and very mobile. The disadvantage is that only low power output may be used so the bands need to be in relatively good shape.

The BIG advantage here is mobility. That is, the pedestrian mobile operator can go almost anywhere and not have much weight on him or her.

**Hand Cart Mount:** The hand cart mount is somewhat different than all the other mounts discussed so far in that most if not all of the components are not mounted on the pedestrian mobile operator. This type of mount usually has wheels and is pulled or pushed along with the pedestrian mobile operator. While this type of mount has some mechanical assistance, the operator is still required to walk to make it mobile.

The main advantage with the hand cart mount is that the operator doesn't have to walk with the station weight on him . He or she just pulls or pushes the entire station along as he walks. With is type of mount, more battery capacity may be loaded on the mount. This means a more powerful radio can be used to reach more people. The main disadvantage is that the operator is limited to where he may operate with this mount. This type of mount may weigh-in at well over fifty pounds! You wouldn't want to push this type of system up a mountain etc. But, again where you operate will dictate what type of mount system you'll want to use.

The picture to the right shows Dave's, G4AKC, pedestrian mobile hand cart mount system.

This particular system seems rather lightweight and looks like it is completely self-sufficient.

Again your choice of a mount system will depend on what gear you use and where you want to operate.

The hand cart mount system is a wonderful choice for those pedestrian mobile operators who might not be physically able to carry weight on their back, but still wish to use a more powerful radio station.



The picture below is Jose B Rivera, N2LRB and his pedestrian mobile setup that utilizes a combination of two mounting systems. He uses a hand cart mount, but also uses a frameless backpack mounted to the hand cart.



Please note that Jose uses the hand cart to also support his antenna in the field. When he's finished operating, he simply packs the station in the backpack, attaches the backpack to the hand cart and walks home.



The only disadvantage with this setup is that operating while walking could prove to be difficult.

The pack looks like a frameless pack and is secured to the hand truck mount for travel, but additional hardware would have to be installed for full pedestrian mobile operation.

# 4

## Pedestrian Mobile Radios

The number of radios or transceivers that a pedestrian mobile operator may use is almost infinite. Again, the main factors that will influence what radio you will use are:

- 1- Where you want to operate.
- 2- How much power output you want to use.
- 3- Receiver current draw
- 4- Your physical condition
- 5- How much money you want to spend on a radio
- 6- Kit or already built radio

**Location:** Again, if you want to operate in remote locations such as remote mountain tops, fire towers, etc you will have to use a low power radio in the 5W to 10W power output range.. This is because the radio power source or the battery will require less capacity or ampere hours to run a lower power radio. If you just want to operate locally and not have to walk or climb very much, you may use a higher power output radio and a larger battery to run it.

**Radio Power Output:** The radio power output is a key factor in determining what type pedestrian mobile system you will use to operate. If you are a QRPer that is one who operates from five to ten watts power output, you may use almost any mounting system you wish. Some 20W transceivers work really nice for SSB operation in the field. But, if you want to operate a 100W station as pedestrian mobile, you probably are limited to a frame type system.

Many manufactures sell a variety of 100w radios, but most pedestrian mobile operators use some sort of mobile rig at the higher power output levels. Almost any HF, VHF or UHF smaller mobile or portable radio will work, but you'll need a high capacity battery to run it. While we're on this subject, why run a radio at 100W when you probably can still work many stations at the 50W power level? The difference between 100W and 50W is only approximately three-db. When you operate pedestrian mobile why not save your battery and turn down the power!

**Receiver Current Draw:** While many operators dwell on their transceiver's power output, the real power drain is the receiver current draw. Unless you are continually calling CQ, most of your operating time is listening! Once others know what frequency you are operating on, most of your time is spent receiving rather than transmitting. The ratio between receive and transmit will vary according to when you decide to operate. Let's say you decide to operate during a weekday. Chances are that that this ratio will decrease that is you'll spend additional time transmitting your CQ. This is because less people are on the air operating during a weekday than during the weekend days.

When operating pedestrian mobile, try to pick a transceiver that has a receiver current draw of 500ma or less. Many mobile radios that can be used for pedestrian mobile operation are small enough, but the receive current might be over one ampere! Using a radio with a receive current draw of over 1A will quickly drain a battery.

When researching mil-spec military transceivers to find their receive currents, I found it hard to find this data. Most spec sheets list the battery type/s, voltage and operating hours, but not the receive current. Just remember that the receive current spec on the radio you pick to use for pedestrian mobile should be 500ma or less.

I've put together a listing of a few radios and their receive currents. The one item that is obvious is that the mil-spec military transceivers usually have receive currents less than the amateur radios.

<b>Transceiver</b>	<b>RX Current</b>
IC-706MKII	1.80A
TS-480sat	1.5A
IC-7000	1.3A
FT-857D	1.00A
FT-897D	1.00A
FT-817ND	450ma
IC-703 Plus	450ma
PRC-319	180ma
KX3	150ma
PRC-1099	130ma
PRC74B	100ma
KX1	40ma
PRC-64	30ma

**Physical Condition:** This sounds like an odd criteria to pick a radio to operate pedestrian mobile operation, but let's investigate more closely on why it's an important one. If you hike around the mountains and run ten miles a day, you're probably in great physical shape, but you still have to watch what radio you pick. Most amateur radio operators don't run ten miles every day and don't hike up and down the mountains. So for most potential pedestrian mobile operators station weight will be a huge factor on whether you enjoy the adventure or hate it!

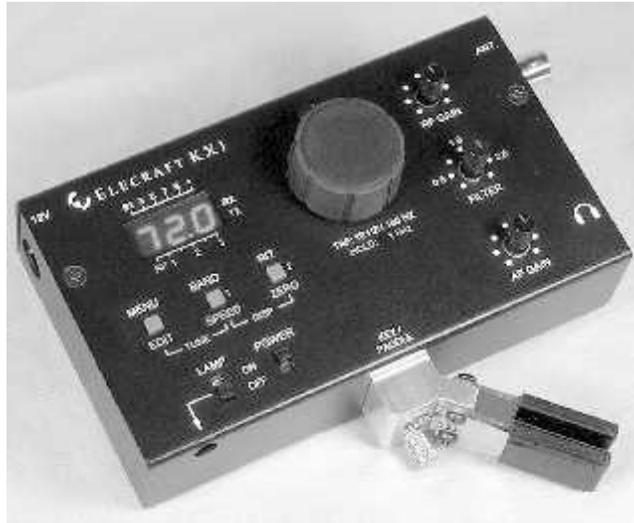
As stated earlier, try to keep your radio station weight down to something that feels comfortable. This will vary for each person. If you want to use a 100W radio, it will require a larger capacity battery and this usually means more weight. Only you will know what feels good to carry and what feels to heavy. Only you will know if you can physically climb up a mountain. Only you will know how far to walk etc. Maybe the only weight that feels good is a small QRP radio with a light backpack or antenna mount.

Maybe you feel ok carrying around a frame mount with forty pounds of gear. It all boils down to what type of physical condition you're in and how well you can move around in the great outdoors.

**Radio Cost:** This is an interesting criterion for the selection of a radio for a pedestrian mobile station. While all the other factors are important, this is probably the most influential criteria in the selection of a radio. You have to be able to afford to buy the radio! The range of radios to use is almost breath-taking. Transceivers range from thousands of dollars to less than twenty dollars. Let's see if we can narrow this broad statement down to where it makes sense to you.

As a potential pedestrian mobile operator, you think that you have a huge array of radios to use, but cost will dramatically limit your choice. Many of the new more compact mobile radios now cost over \$ 1,000! But, if you look for a good used transceiver, you can save hundreds of dollars. Cheaper yet are an array of smaller low-cost QRP transceivers.

I use an Elecraft KX1 Transceiver (pictured below) to operate as WA3WSJ/pm. This small radio is a kit that I built and cost around \$400.



If you do use a QRP radio, please be aware that although small and lightweight, you will usually make less contacts than with a higher power output radio. Plus many QRP radios transmit only in the CW mode. But, if the bands are open, even with this small transceiver, you'll have a lot of fun.

I also use an Icom 703 Plus Transceiver (below) that is no longer manufactured by Icom. This radio had sold for around \$700 new without the options. Pictured below is an Icom 703 Plus. This radio may be purchased used for around \$400 - \$500 today. This type of transceiver has a few features that most pedestrian mobile operators like for pedestrian mobile operation.



**Yaesu 857:** I've included the Yaesu 857 because many HFpack operators use this rig for pedestrian mobile operation. This is a small rig measuring in at just 6.1" x 2" x 9.2" (155 x 52 x 233 mm). The new FT-857D version includes coverage of the U.S. 60-meter (5 MHz) band, plus the previously-optional DSP circuitry. This transceiver covers HF/VHF/UHF as a mobile transceiver and provides base station-type performance from an ultra-compact package that's ideal for mobile or external battery portable work. The one negative specification about this radio is a receive current of 550ma to 1A maximum. The radio sells new for around US \$800.



#### **Pedestrian Mobile Radio Desirable Features and Cost:**

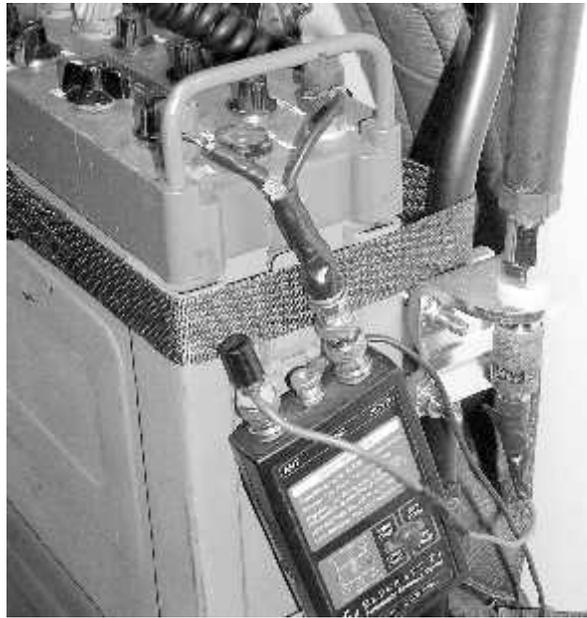
**Remote Head:** A remote head allows the pedestrian mobile operator to have the control head in front of him while he walks around the countryside. This is a very nice feature as it allows for heads-free operation. Just clamp the head to your frame mount style waist belt and bolt this type radio to the frame mount on your back and you're ready to go into the great outdoors!

Below is a picture of my Icom 703 Plus control head utilizing the remote head bracket and two cheap paint clamps purchased from a Home Depot Paint Department Store..

As you can see, I just clamp the remote head to my ALICE Frame waist belt and I now can easily control the radio as I walk the countryside. This feature is nice, but adds cost to the radio.



**Automatic Antenna Tuner:** I use resonate antennas so why use an antenna tuner at all? Well when you tuned your system, did you tune it while standing on ground, grass, blacktop, or sidewalk? Did you tune your antenna on wet ground or grass? Yes, environmental conditions change and so will how your antenna tunes. Yes, it does make a difference! That's why an antenna tuner is really nice to have in a radio. You can use an external antenna tuner, but it's sure nice to just hit a button on the control head. Plus an external antenna tuner will take additional space on the frame and add weight to the system. A transceiver with an internal antenna tuner will usually cost more, but the tuner is worth it. Plus, most internal antenna tuners weight less as they don't have the extra case etc. I would say that this one feature is almost a must have item.



This picture shows an older military PRC74 Radio mounted on an ALICE frame with an Elecraft T1 Antenna Tuner.

**Multi-Bands and Modes:** Yes a mono band or single band radio will work just fine and the cost is usually much cheaper, but if there's no activity say on 20M, why not just switch to 40M or another band?

Once I was on the Appalachian Trail in Pennsylvania operating 20M CW. I ran Europe for two hours! But, after that the band was dead so I switched to 40M CW and worked more locals. Please note that here is where the cost of a radio will dramatically increase due to all the additional components needed for multi-band operation.

**Internal CW Keyer:** If you operate mainly CW, an internal keyer is almost a must-have item. Yes you can buy some paddles etc with built-in keyers, but how long will that paddle hold up in the field.

I have dropped my Palm Paddles all over the place, but because the paddles slide into the case – no problems! Also, to adjust the keyer speed, I just hit a button or two on the control head and it's done.

Again this feature adds costs , but most manufactures of multi-mode transceivers today include this item as a standard feature.

**Voice Keyer:** Having this feature in a radio might sound trivial, but have you ever yelled into a microphone while walking for several hours? You'll get tired from walking hills etc and you really don't need to be talking as you hike or walk. It is really nice to just hit a button and let a voice keyer call CQ for you. As for the cost, they can be cheap!

My Icom 703 Plus doesn't even have an option for a voice keyer. So I just use a cheap MP3 Player to call CQ for me. Pictured below is a cheap MP3 player wired to the microphone input to the radio. I wired the MP3 player and the microphone into a y-adapter so I can use the microphone or the MP3 player. I use the VOX function in the Icom 703 to key the radio when the audio from the MP3 player starts to play.



With this setup, I now just hit a button on the MP3 player and all hear my voice calling CQ over the airwaves. I works really nice and when someone answers my CQ, I just hit a button on the control head and turn off the VOX function in the radio to use the microphone.

I believe the entire voice keyer costs me around \$20.00. I purchased the MP3 player used off eBay for a couple of dollars, but bought the cables and Y-adapter new. I also had to install a resistor in the audio line for some isolation between the radio and the MP3 player.

**Yaesu 817:** The FT-817 is designed for operation on the 160-10 meter HF bands, plus the 6 meter, 2 meter, and 70 cm bands. All this in one small radio but, the power output is limited to 5W. The 817 operating modes are SSB, CW, AM, FM, Packet, or SSB-based Digital modes like PSK31.



This transceiver has a receive current of only around 300ma so it won't kill your battery while out in the field. This is a one radio does it all type of rig, but with limited output power of five watts.

### Elecraft KX3:



The Elecraft KX3 Transceiver was first introduced during the 2011 Dayton Hamvention. This small transceiver is one of the first software defined radios or SDR with operator control knobs etc. The KX3 covers 160M to 6M with all the bells and whistles you could want or need! It can operate CW, SSB, AM, RTTY, PSK31 etc. It even has a RTTY and PSK31 decoder in it. All this comes at a price of around \$800 for the basic kit. You can buy options such as an internal antenna tuner, etc. This radio comes as a kit or pre-built by Elecraft, but add on a few dollars to have Elecraft build it for you.

**Manufactured Transceiver or Kit:** This decision is entirely up to you. Maybe you want to build the radio you use or maybe you just want to get on the air and you're not interested in building a radio etc. As for price, kits will generally be cheaper than a new radio. But, if you buy a new full blown multi-band and multi-mode transceiver with all the options, it could be more expensive than a standard new commercial transceiver.

Sometimes this decision whether to buy a kit or already built commercial radio is made by looking at the ergonomics of the transceiver. For example, I had to build my Elecraft KX1 Transceiver because there just wasn't anything like it on the market. at that time.

Building your own radio has a few advantages. You will learn how to read a schematic, learn to solder and learn how the radio operates. One really nice thing is that you probably will learn how to fix the radio should it need repair. Plus, by building a kit, you have the personal satisfaction that you "made" the radio.

If you are interested in building your own radio from a kit, here are a few kit vendors:

<b>Kit Manufacturer</b>	<b>URL</b>
Elecraft	<a href="http://www.elecraft.com/">http://www.elecraft.com/</a>
Hendricks's QRP Kits	<a href="http://www.qrpkits.com/">http://www.qrpkits.com/</a>
Juma Kits	<a href="http://www.nikkemedia.fi/juma/">http://www.nikkemedia.fi/juma/</a>
MFJ	<a href="http://www.mfjenterprises.com/">http://www.mfjenterprises.com/</a>
Small Wonder Labs	<a href="http://www.smallwonderlabs.com/">http://www.smallwonderlabs.com/</a>
Ten -Tec	<a href="http://www.tentec.com/?s=kits#trx">http://www.tentec.com/?s=kits#trx</a>
YouKits	<a href="http://www.youkits.com/">http://www.youkits.com/</a>

# 5

## Antennas

**Antennas:** Again what antenna you use is really dictated by where you want to operate. If you want to operate in a wooded area with lots of low-hanging trees, a tall vertical just won't work. You'll soon find out that any antenna over five or six feet above your head will strike the tree limbs.

I once operated on the Appalachian Trail here in Pennsylvania with a loaded vertical antenna that extended about eight feet over my head. Well I think it hit every tree limb on the trail! I even started to bend forward so the antenna wouldn't hit the tree limbs, but this gets old fast.

If you plan to operate in open areas away from low-hanging objects, then you can pretty much use any antenna you like as long as it works! Let's investigate what types of antennas many pedestrian mobile operators are successfully using in the field.

**Verticals:** Many pedestrian mobile operators seem to like verticals. Why do they like to use verticals? They tend to use a vertical because of one main factor – size. Many verticals are lightweight and have a small footprint on a mount. Another factor for high usage is cost. You can design and build your own vertical and not break the bank. Also, materials to build a vertical antenna are readily available in most hardware stores etc. In addition to the above there are many manufactures producing many types of verticals today at economical prices. All these factors have contributed to the wide usage of verticals in pedestrian mobile operation.

There are many different types of vertical antennas, but we will only discuss a few used by pedestrian mobile operators.



**Inductance –Loaded Vertical:**

This type of vertical antenna usually uses a coil and whip combination. It is very popular for one reason – compact size. A loaded vertical is a compromised antenna at best, but they do work. That’s why I like to add some elevation under me when I use this type of antenna as it seems to level the playing field.

Pictured to the left is W6ZKH using a MFJ-1664 Inductance-loaded vertical antenna. This particular vertical is manually tuned and works for him. Take note at the size of the coil.

The **coil size** will depend of a number of factors:

**Band Usage:** If you want you to operate in the lower frequency bands such as 80M and 160M, you will need more inductance to load the antenna. This means more wire and a larger length coil. It also means a less efficient antenna.

**Power:** Another factor that will determine the coil size is the maximum power you plan to use. More power equates to a larger size

wire needed for the coil turns. The lower the power you plan to use – the smaller the size wire needed to handle the power.

We haven’t even considered the “ Q” of the coil - just power for now.

Sometimes the inductive-loaded vertical antenna really doesn't look like a coil at all! In the picture below KB0SFP uses a commercial vertical known as the "Outback Joey."

<sup>7</sup>The Outbacker mobile series is comprised of a group of slim line multi band antennas ranging in length from only four feet long to just over six feet long. These antennas are designed to suit a wide range of limited space applications. There is no need to change whips or coils as with competitive models because band selection is accomplished by the simple insertion of a band tap lead.



This antenna will work 40M to 2 M plus the WARC bands. It can handle twenty watts PEP and is fifty Inches tall. One additional note is that this antenna may load on 80m by using a ten foot whip. This type of loaded vertical tends to work well where low-hanging objects are in the walking path.

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<sup>7</sup> <http://www.outbackerantennas.com/>

**Pole Vertical:** Still another type of inductance-loaded vertical is the pole vertical. This type of vertical usually utilizes a collapsible fiberglass pole. The height of the pole may vary from sixteen feet to thirty-three feet! The pole length is dependent on the amount of inductive-loading.



Pictured below is Martin Gillen, VA3SIE operating pedestrian mobile in the winter using a pole-type vertical. If you closely look at the pole, you'll see that he has wire wrapped around the pole to help inductively load the antenna.

Here's how Martin, VA3SIE, describes his pole vertical antenna. This antenna uses distributed inductive loading. The wire is wound more tightly at the top of the antenna (with a 1/2-inch pitch) and more loosely towards the bottom (with a 2 inch pitch). The winding pitch increases constantly over the length of the antenna.

It is constructed this way because the higher RF current (contributing to the far field radiation pattern) is in the center of the dipole (the base of the pole).

The antenna is naturally resonant at 9MHz but the tuner can pull it up to 14MHz or down to 7MHz for a 1:1 match. Electrically it is a center-fed dipole. The antenna consists of 32' of #26 AWG Teflon coated, silver plated wire wrapped helically around a twenty-foot Shakespeare Wonderpole Fishing Pole.

I made a harness from PVC pipe which I zipped into a backpack. The counterpoise wire is another thirty-two feet of #26AWG Teflon- coated silver plated wire, which drags along behind me.

Using a pole vertical has one major disadvantage – it's very high! If you do use a pole vertical, make sure you walk around in an open area with no or very few low-hanging obstructions.

You'll also need to use a stable support or mount for this type of antenna because it's so high above you.



**Fiberglass Whip Vertical:** The fiberglass whip vertical is usually lightweight and has a small diameter. This type of antenna is usually mono band or it's resonate on only one band. This type of antenna is cheap, easy to tune and works rather well considering its size. Again, this type of antenna is a compromised antenna as are most loaded verticals, but it does work very nicely on the air.



Pictured to the left is the author, WA3WSJ using my Icom 703 Plus HFpack with a fiberglass whip vertical attached to my ALICE Frame. This particular picture was taken while I cross country skied on frozen Hopewell Lake in French Creek State Park, Pennsylvania. As you can see, the whip is rather high above my head - about seven feet, but it works as I have worked many DX stations with this setup.

The antenna pictured is a 20M Workman Fiberglass Whip Antenna that sells for around \$14.00 plus shipping.

Please note – you don't have to spend lots of money for a pedestrian mobile antenna.

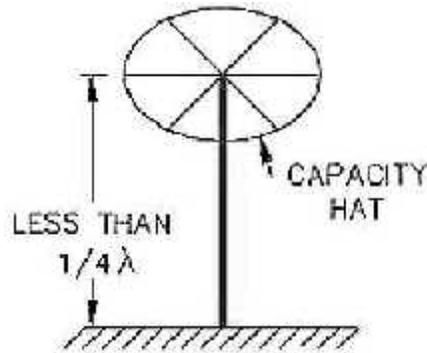
My \$14.00 antenna works just great!

There are a number of manufactures who make fiberglass loaded whip antennas. Here are a few of them:

<b>Manufacturer</b>	<b>URL</b>
Workman	<a href="http://www.workmanelectronics.com/main.htm">http://www.workmanelectronics.com/main.htm</a>
MFJ	<a href="http://www.mfjenterprises.com/">http://www.mfjenterprises.com/</a>
Profilant	<a href="http://www.profilant.net/">http://www.profilant.net/</a>
Hamstick	<a href="http://www.hamstick.com/home.html">http://www.hamstick.com/home.html</a>
Newtronics	<a href="http://www.new-tronics.com/main/index.html">http://www.new-tronics.com/main/index.html</a>

**Vertical Capacity Hat:** 8 Capacity hats will reduce the amount of inductance necessary to resonate the antenna and increase bandwidth. But, contrary to popular belief they add nothing to the radiation resistance. For a component of an antenna to increase radiation resistance it must itself radiate.

It is true if you put a capacity hat on top of a short mobile antenna it will change the antennas efficiency but what happens is the current on the radiating element moves further up to the top.



Because the current is now further away from ground this lowers ground loss. So the ratio of radiation resistance to ground loss and Omni Loss resistance, which is the reduction in the amount of inductance needed for the loading coil, goes down. Yes the amount of inductance loading required to obtain

resonance is less. As stated above, this is a good thing as it increases the efficiency of the antenna.

I did an experiment using my Workman 40M Stick Antenna. I added a capacity hat consisting of twelve one-foot long wires near the top. Before adding the capacity hat the resonate frequency of the stick on 40m was 7.059 mhz. After adding the hat, the resonate frequency was lowered to 5.950 mhz! That's a change of approximately 1.1 mhz. This mans that I could remove some of the coils to decrease the inductive load.

I tested the antenna on 30m and had about the same result of lowering the resonate frequency by approximately 1.1 mhz. The antenna 20m resonate point was also lowered by about 1.5 mz.

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<sup>8</sup> [http://www.amateur-radio-wiki.net/index.php?title=Capacity\\_hat](http://www.amateur-radio-wiki.net/index.php?title=Capacity_hat)



The capacity hat above was made by Paul, WORW. This top hat has four twenty-two inch spokes soldered into a small hub..<sup>9</sup> The wire for the capacity hat below was harvested from buried gas and utility line markers. Each wire weighs only two ounces. I have noticed 6 dB improvements using this top hat on lower frequencies.

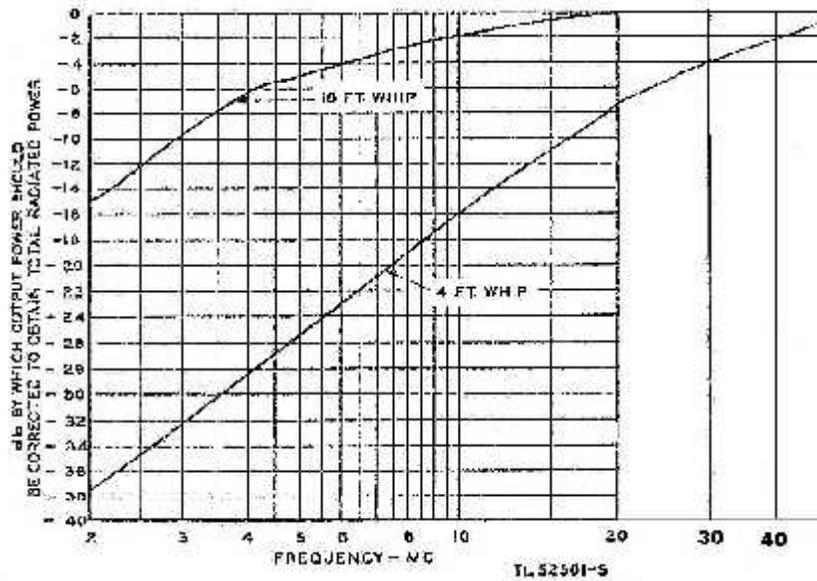
I always use it on 160 meters. I have used it on a an 8 foot whip (without any loading coils) on 20 thru 160 meters.

Pedestrian mobile verticals come in many sizes and shapes. I have presented you with just a few of the vertical types that many hams are using in the field. There are other types of verticals in use today, but the ones mentioned above are the type of verticals the majority of pedestrian mobile operators are successfully using in the field today.

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<sup>9</sup> WORW/pm

## Whip Efficiency:



<sup>10</sup>The above whip efficiency chart shows just how more efficient a sixteen foot whip is at 21 mhz when compared to a four-foot whip. The four-foot whip is approximately -8db down in radiated signal.

As the frequency is lowered to 7 mhz, that same four-foot whip is now about -17 db compared to the sixteen-foot whip in radiated signal strength!

**Loop Antenna:** <sup>11</sup> A loop antenna is a radio antenna consisting of a loop (or loops) of wire, tubing, or other electrical conductor with its ends connected to a balanced transmission line. Within this physical description there are two very distinct antenna designs: the small loop (or magnetic loop) with a size much smaller than a wavelength, and the resonant loop antenna with a circumference approximately equal to the wavelength.

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<sup>10</sup> US Army TM 11-486 Manual - 25 April, 1945

<sup>11</sup> [http://en.wikipedia.org/wiki/Loop\\_antenna](http://en.wikipedia.org/wiki/Loop_antenna)

Small loops have a poor efficiency and are mainly used as receiving antennas at low frequencies. Except for car radios, almost every AM broadcast receiver sold has such an antenna built inside of it or directly attached to it. These antennas are also used for radio direction finding.

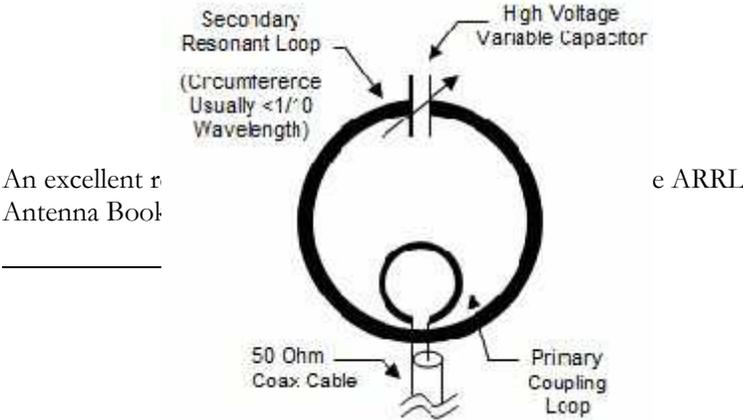
Resonant loop antennas are less common. They are typically used at higher frequencies, especially VHF and UHF, where their size is manageable. They can be viewed as a modification of the folded dipole antenna and have somewhat similar characteristics.

**What is a Magnetic Loop?**

12A Magnetic loop or STL (small transmitting loop) is a large coil with a capacitor added to bring the system to resonance. It is unlike a large resonant loop (more common) in that the loop size is smaller than 1/4 wavelength and does not resonate on its own. The loop is brought to resonance by attaching a capacitor to the two open ends of the loop.

The loop is tuned by changing the value of the capacitor. An increase in capacitance will bring the resonance of the loop lower in frequency, a decrease in capacitance will make the loop resonate higher.

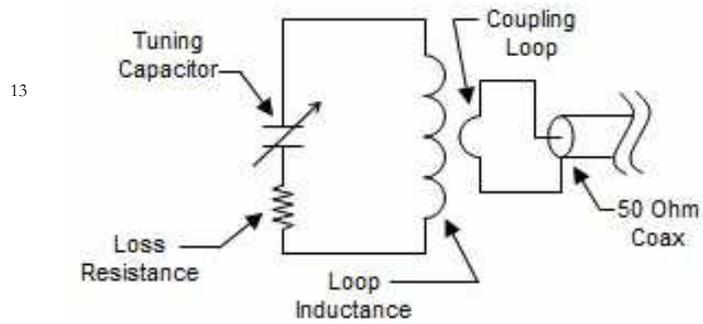
**Diagram of a Small Loop Antenna**



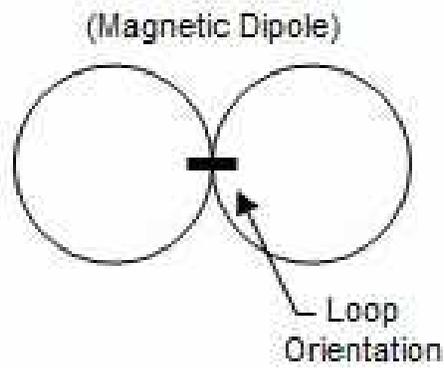
An excellent r  
Antenna Book

<sup>12</sup> <http://www.standpipe.com/w2bri/faq.htm>

## Equivalent Circuit



## 14 Magnetic Loop Antenna Pattern



## 15 How well does it perform compared to other antennas?

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<sup>13</sup> <http://www.aa5tb.com/loop.html>

<sup>14</sup> <http://www.aa5tb.com/loop.html>

A Magnetic Loop's performance seems to be dependent on construction, placement above ground, and other factors. A generalization of performance would place it a bit below that of a dipole, and in some instances exceeding the performance of a dipole. It usually will far surpass the performance of most mobile antennas, and other compromise configurations (however, there are always exceptions).

**STL:** Pictured below is Alex,<sup>16</sup> PY1AHD using his motorized loop antenna while out operating pedestrian mobile. As you can see, the loop may work, but you will have to use this type antenna in open spaces where there aren't low-hanging objects to hit it.



While these STL's may work fine, they do tend to cost more than other type antennas.

This is because the antenna has more parts to it and if you buy a commercial STL, the variable capacitor that tunes the loop is expensive. Commercial STLs typically cost around \$ 300 - \$400. By home brewing your own and running lower power levels say around 10w – 20w,

you can save some money. Many amateurs just love to operate using these Small Transmitting Loop (STL) Antennas.

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<sup>15</sup> <http://www.standpipe.com/w2bri/faq.htm>

<sup>16</sup> <http://www.alexloop.com/>

The following is a report from KD9KC about his experiences with a loop while visiting in Europe.



Many of you know we took a vacation to visit family and friends in Germany. Instead of taking my tried and true 88' doublet, I took my new and relatively untried (only 4 contacts before we packed up) Alex-Loop antenna. Here is a copy of my notes from my SOTA activities. This was ALL done on the Alex-Loop Walk-Ham (except for the 2m/70cm contacts).

I found the Alex-Loop antenna to work well. Not as good (I believe) as my 88' doublet. But all things considered, the Alex-Loop antenna performed well. In the configuration I had it set for; I could set up and break down in 5 minutes. Tune up was quick and simple. I just used the internal SWR meter of the FT-817. I never attempted 12m or 10m operation, the bands were not open.

On 15m-17m-20m, I made plenty of contacts.

It seemed there was a contest every weekend, so finding a place to call CQ-SOTA was all but impossible. So my operating was search and pounce. If they were S-8 or better, they answered my call.

DL/KD9KC - Notes from ham operations in Germany - 28 Jun to 13 July 2011

Countries worked:

Austria - 20m, Belarus - 20m, Belgium - 20m, Bosnia and Herzegovina - 20m, Bulgaria - 20m, 15m, Canary Islands - 15m, Czech Republic - 20m, 2m, England - 20m, Estonia - 20m, European Russia - 20m  
France - 20m, Germany - 15m, 2m, 70cm, Isle of Wright - 20m, Italy - 20m, 17m, Netherlands - 20m, Romania - 20m, 17m, 15m, Sardinia - 20m  
Serbia - 20m, Slovak Republic - 20m, Spain - 17m, 15m

On the Hutsberg we operated in an old castle ruin. There was no way to get above the walls. Inside the floor the walls of the main building were 30 to 40 feet high, built of stone. Outside the building was surrounded by brennessel, a sort of German Poison Ivy. We found a break in the outer wall where we could climb to the parapet and set up.

Certainly not optimal, but the little Alex-Loop made enough contacts to get me the completed activation despite the poor site conditions.

The one disappointment was 40m. I DO NOT BLAME THE ANTENNA! There were a few rainy evenings at the in-laws house where I tried 40m. You need to understand, 40m in Europe is brutal. It used to be worse. But I was next to the house, under a wet patio cover, running 5-watts SSB, and calling stations that were S-9 in an S-8 noise level. The loop allowed me to null the noise out. The other stations didn't have that option. The best I got was: QRZ? - Again - again - again - sorry old man try later... I do not hold the Alex-Loop antenna fully responsible. While my 88' doublet may have done better, 40m in the evening in Europe is just brutal to start. The antenna was not in the open, under a wet patio cover, and I only had 5 watts. I was really just hoping against hope for a 40m contact. I never even looked at 80m, no antenna.

One other MINOR complaint. I really wish the Alex-Loop could do 6m. Alas, not possible according to Alex. Perhaps another antenna? The SPEED of assembly and disassembly of this antenna is amazing. If you look at the listing, I did FOUR 10-point SOTA Summits in one day.

I could have done better, but we mixed in some sight-seeing activities with SOTA that day.

Next time we intend to dedicate a SOTA day and see what we can do. I admit I only called S-8 or better stations, but they all came back with 5-x reports, usually S-6 or better.

I still need to evaluate it more before I just dump my 88' doublet for SOTA. But I can safely say my Alex-Loop antenna IS NOT FOR SALE! Not to worry - next trip I want a DB6NT (who I worked on 2m-SSB) transverter for 23cm.

ALEX... I know you are reading this. I got to attend a ham radio meeting in Meiningen Germany. This was formerly enemy occupied territory for me. The club members were all very nice - and they measured everything about your antenna they could. I suspect they will try to build a few for the club to operate portable with. Buying gear is not easy there, and culturally they had to build everything before the fall of the iron curtain. They are very good at it.

Anyway - that is my report on the Alex-Loop.

Vy73 - Mike - KD9KC.

I must admit that I've never used a STL, but after reading about this antenna, the STL seems like a very intriguing antenna type. What I've been reading seems to indicate that less noise is heard on the band. It seems that a STL has an area of around -10db nulls. Thus mounting a loop horizontally on a roof should reduce much of the QRM generated from household appliances etc. I can't confirm this, but it sounds interesting to me.

So far I have only mentioned small transmitting loop or STL type loop antennas. There are other types of loop antennas, but most are too large to be used for pedestrian mobile operation.

There are some companies that manufacture STLs:

<http://www.mfjenterprises.com/Product.php?productid=MFJ-1786>

<http://www.alexloop.com/>

<http://www.pixelsatradio.com/>



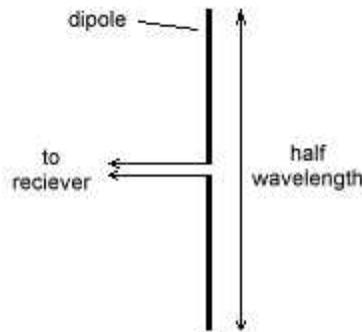
## Counterpoise Wire/Radiation Patterns

**Drag Wire or Counterpoise Wire:** So far only one type of antenna discussed doesn't need a counterpoise wire or second half to the antenna and that's the small transmitting loop or STL Antenna. Almost all verticals used in pedestrian mobile operation need some type of counterpoise wire.

Why do most vertical antennas used in pedestrian mobile operation need an additional counterpoise wire? Most verticals in use today for pedestrian mobile operation are a quasi form of a dipole antenna. That is a half wave dipole antenna.

In its simplest form a half wave dipole antenna uses two quarter wave pieces of wire fed in the middle with coax. This type of antenna is usually erected in the horizontal plane, but in pedestrian mobile applications, it's used in the vertical plane as shown below.

The top part of the dipole is usually one of the vertical types previously listed above. It may have a loading-coil in series with the top section to keep the height down to a reasonable length for pedestrian mobile operation. But, the antenna still needs the other half to properly radiate. The bottom part of the antenna is commonly known as the counterpoise as it balances out the antenna.



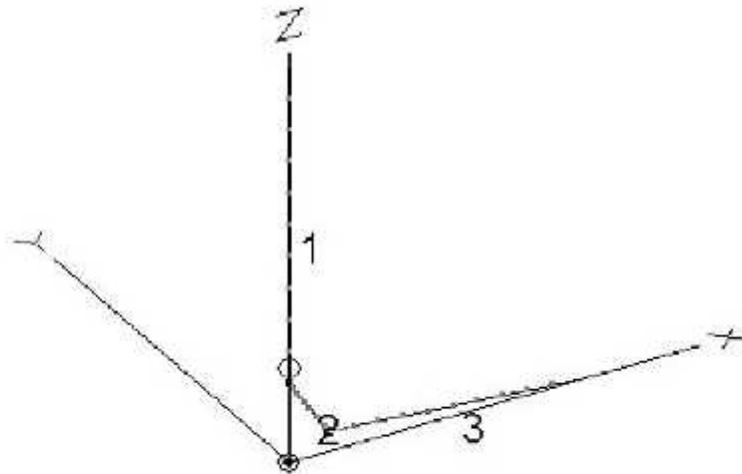
Most counterpoise theory talks about ground radials or elevated ground radials. But, the pedestrian mobile operator usually uses parts of both types of radials. He or she usually uses what we call a “drag wire.” This is nothing more than the bottom half of the dipole antenna and it’s neither a ground radial nor an elevated radial. In fact it incorporates parts of both types of radials.

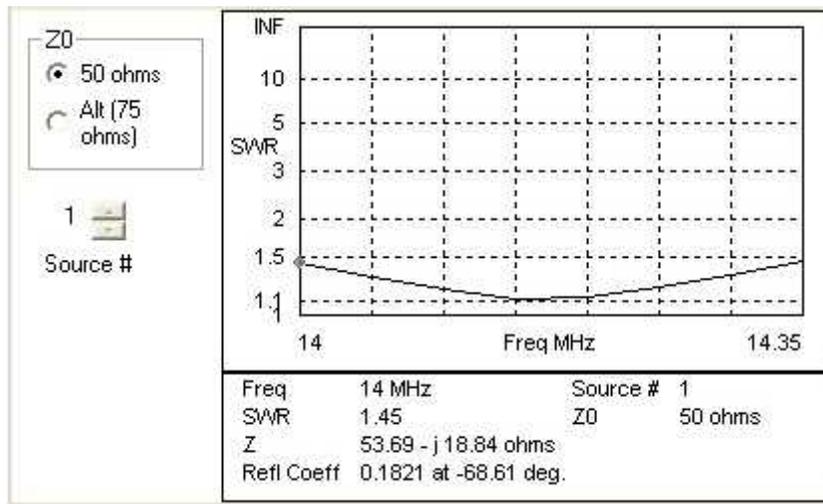
**Counterpoise:** A conductor or system of conductors used as a substitute for ground in an antenna system; a wire or group of wires mounted close to the ground, but insulated from ground, to form a low-impedance, high-capacitance path to ground.

### Counterpoise Wire Height Above Earth vs. SWR

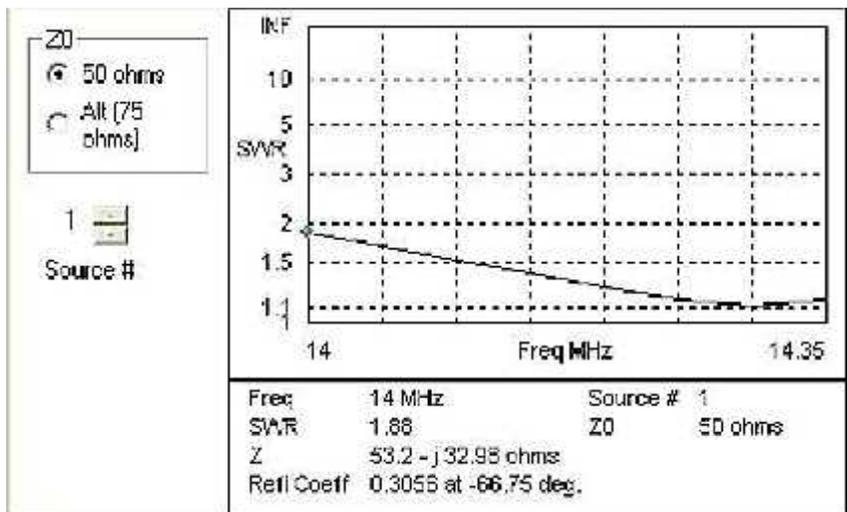
This is a parameter most pedestrian mobile operators don’t worry about, but it does make a difference on your antenna SWR. As for your radiated pattern, it does change, but not that much. The charts below will indicate just how much your SWR will vary as your drag wire is moved above ground.

Pictured below is the EZNEC configuration of a HFpack 20m Vertical. The feed point is five feet off the ground with a seventeen foot drooping radial or counterpoise wire. The vertical radiator wire is sixteen feet long. Using this antenna as a model, I only changed one parameter: the height above ground for the end of the counterpoise wire.

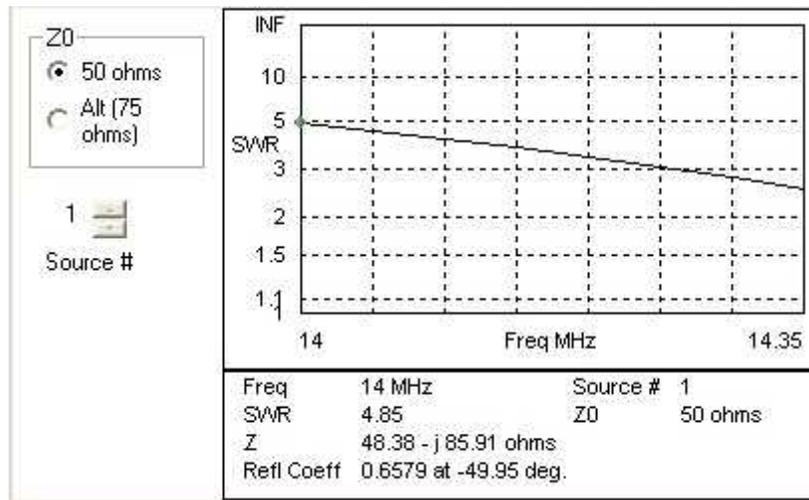




17.0 Foot Counterpoise Wire .12 inches Above Ground

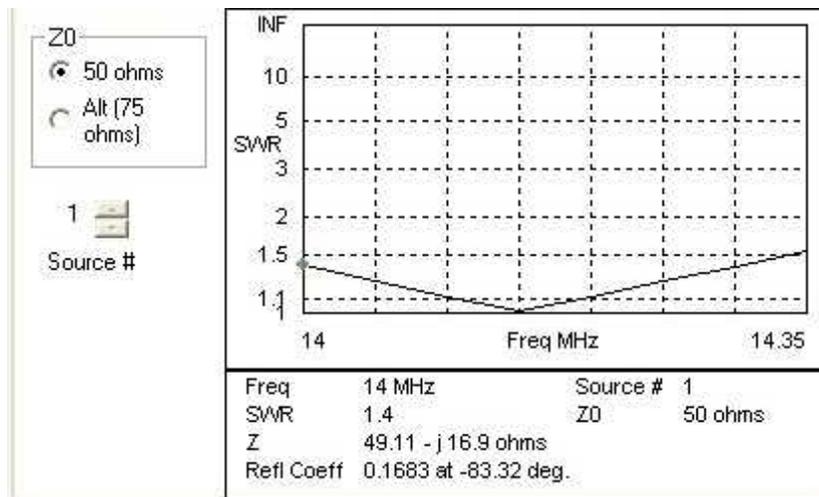


17.0 Foot Counterpoise Wire 6 inches Above Ground



**17.0 Foot Counterpoise Wire 12 inches Above Ground**

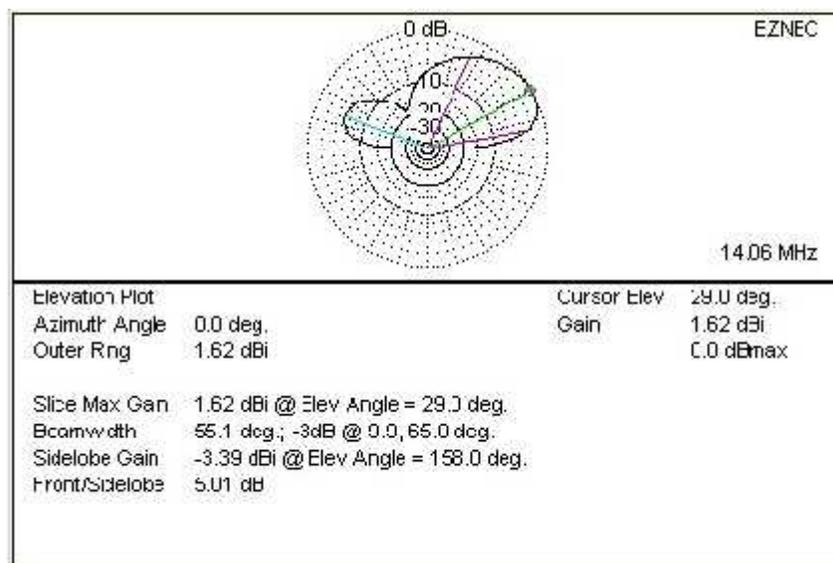
The charts above indicate that as the counterpoise wire is lifted above ground, the resonate frequency is shifted higher.



**17.8 Foot Counterpoise Wire 12 inches Above Ground**

To compensate for this effect the counterpoise wire length was increased an additional 9.6 inches to lower the SWR.

## Radiation Pattern - Counterpoise Wire vs. Rotation Around Vertical



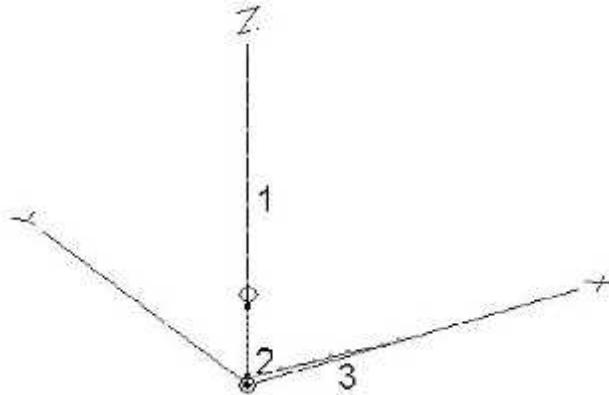
Counterpoise Wire 90 Degrees to Right of Radiator Wire

The chart above indicates this vertical actually has radiation pattern directivity in the direction of the counterpoise wire. One important fact must be taken in account to get directivity – the counterpoise angle away from vertical.

The above chart has the counterpoise wire running two feet away from the vertical plane at approximately 45 degrees then down towards the ground. This is a good simulation of your drag wire as it drags behind you while walking around outdoors.

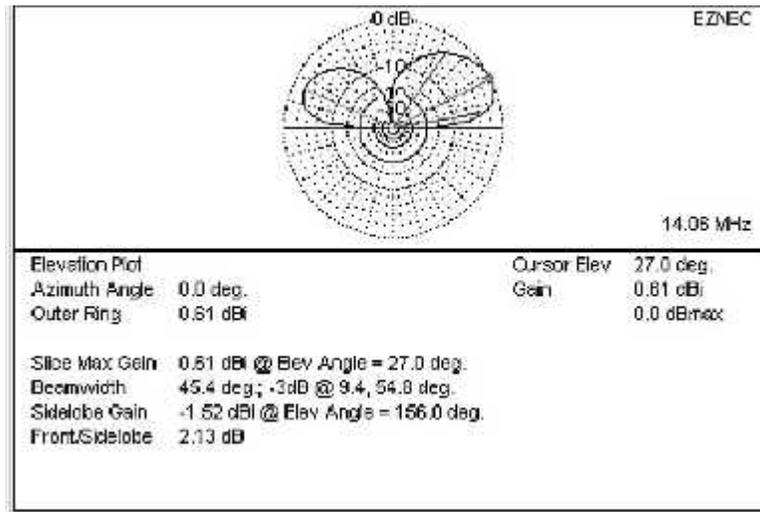
So remember if you use a drag wire, as you walk in a straight line, you're vertical antenna main lobe radiation pattern will have directivity behind you.

## Radiation Pattern - Counterpoise Wire Angle off Vertical Plane



The 20M pedestrian mobile antenna model pictured above shows the counterpoise wire running straight down nearly five feet then out on the X-axis.

Radiation Pattern: Counterpoise wire running straight down then out.



As stated above, the counterpoise angle is critical in producing directivity to your pedestrian mobile vertical. But, if you have a counterpoise wire that runs straight down then out, your antenna radiation pattern will now look more like an omni-directional pattern pictured above that slightly favors the direction of the counterpoise wire as pictured above.

## Things to Remember about Counterpoise Wires

The pedestrian mobile operator should be familiar with these features concerning drag wires and radiation patterns.

- If your drag wire is angled away from your body, generally, your antenna radiation pattern will have directivity in the direction of your drag wire.
- The closer your drag wire is to the vertical plane (straight down), the more your antenna radiation pattern will exhibit an omnidirectional pattern.

### Counterpoise wire touching Earth

<sup>17</sup>The problem of predicting or computing the length of a resonant wire gets more complex when using dragging counterpoises, very low radials or radial wires laying partly on the ground. Because of proximity to the earth surface, the wire needs to be shorter. Earth (soil) conductivity affects the resonance, so different soil types may require different length counterpoises. Generally, the more conductive the soil, the shorter the counterpoise. I've also noticed that different materials you walk over will change the antenna tuning to resonance. There is a marked difference between soil and blacktop. Soil or earth tends to be a better conductor so a shorter counterpoise wire is needed compared to blacktop.

### Pedestrian Mobile Counterpoise Length Thoughts

<sup>18</sup>With broadly tunable whips (such as MP-1, mobile whips, etc) I've found empirically that a pedestrian dragging counterpoise wire can be about 10% to 25% shorter than the standard quarter wave formula predicts, and the whip will usually tune to a fairly good 50-ohm match. Insulated wire with low ohmic resistance should be used.

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<sup>17</sup> <http://tech.groups.yahoo.com/group/hfpack/files/>

<sup>18</sup> <http://tech.groups.yahoo.com/group/hfpack/files/>

For best dragging quality, Teflon or slick PVC-jacketed or oil-resistant multi strand wire seems to work best.

Although many say that your drag wire should be close to a quarter wavelength as stated above, I've had great success using a 14-foot drag wire. I actually tune the top half of the vertical using only a 14-foot counterpoise wire. I then just hit the automatic tuner button on my rig to touch it up as I walk.

I can operate on 20m, 30m and 40m with one Workman 40m Vertical Stick by adding tap points or jumper points on the coil.

All three bands tune up with the 14-foot counterpoise wire. I have worked many DX stations with this setup

**Drag Wire Safety:** While walking with a drag wire, some sort of break-away -connector or an alligator clip should be used so that the connection will break apart if the wire is caught by an object as you walk around outdoors. I use just a simple alligator clip pushed on a mirror mount on my ALICE Frame.

**Counterpoise Wire Length vs. Band:** The best counterpoise or drag wire would be a perfect match to the other half of the antenna. Below is a table that gives approximate counterpoise wire lengths for the different bands. Please remember that these lengths are a general length and will vary with your setup, the different materials used for the wire and the different surfaces you walk on.

<b>Band</b>	<b>Counterpoise Length</b>
10M	7.4 Ft
12M	8.0 Ft
15M	9.9 Ft
17M	11 Ft
20M	14 Ft
30M	18.5 Ft
40M	26.3 Ft
75M	45.4 Ft
80M	49.3 Ft

**“ I find that any drag wire over 30 feet long is unmanageable on the trail and 30 feet works well even on 160 meters.” – WORW**

**Counterpoise Wire Position:** Most people don't even think about the position of the counterpoise wire. It does make a big difference in the tuning of your antenna system. I have found that the best position of the counterpoise wire for my vertical whip is to have it run straight down to the ground as far a possible next to me. As the counterpoise wire angles farther away from my body, the tuning gets worse. In fact when I stop walking, I always pull the drag wire close to me. Sometimes I can even hear the receive signal increase or decrease as the wire moves closer or farther from my body.

I even use a cable tie at the bottom of my ALICE Frame to try and keep the wire straight down to the earth from the frame as far as possible for better tuning of the antenna.

I suspect the counterpoise drag wire angle is critical due to my short fourteen-foot counterpoise wire that I use for 20m, 30m and 40m.

But, If you remember setting up a dipole fed with coax, the coax should be run straight down to the ground etc. If you angle the coax away from straight down, your SWR will increase. I have noticed he same applies to using a pedestrian mobile vertical.

**“ I always let the drag wire fan out away from my back as I am walking to reduce the RF on my body.” – WORW**

# 7

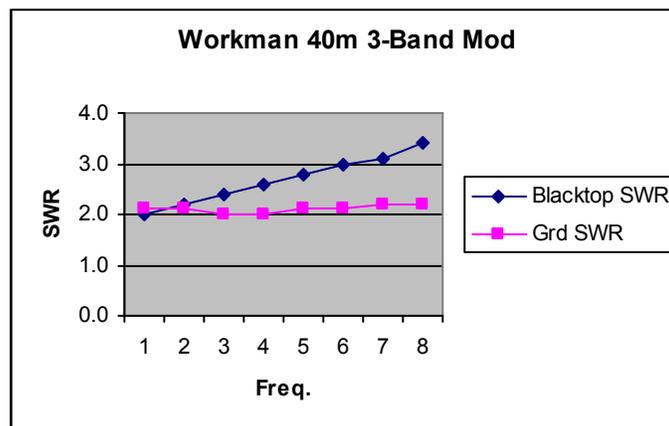
## Automatic Antenna Tuners

Antenna tuners and pedestrian mobile operation are like cookies and milk – just a great match! The pedestrian mobile operator rarely sits in one spot and doesn't move around outside. Let's face it we like to get outdoors and walk around while operating as this is why we do it.

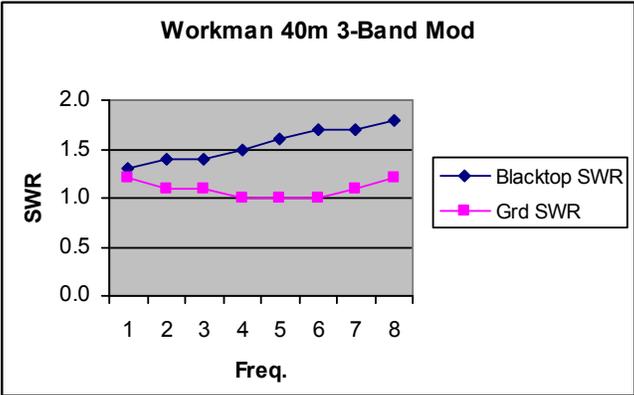
Having said that, the surface we walk over is an ever changing RF medium. The single most important thing that I've noticed with my Icom 703 Plus HFpack is that I need to hit the antenna tuner button as I walk from earth to blacktop to concrete etc. Remember that your counterpoise wire is a vital part of your antenna. Yes it's not pointed up in the air, but nonetheless it does radiate RF as it's not a ground radial nor is it an elevated radial.

Below are a few charts to help to understand how your counterpoise wire reacts to the differences between earth and blacktop. The data for the charts was taken by the author using my Icom 703 Plus HFpack. The antenna used was a Workman 40m Modified Vertical Whip Antenna. The soil was damp, but not wet and covered with low grass.

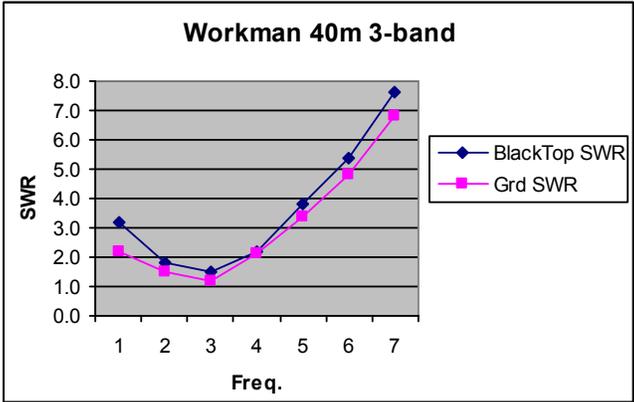
**20M: 14.000 mhz – 14.350 mhz**



30M: 10.000 mhz – 10.170 mhz



40M: 7.000 mhz – 7.350 mhz



As you can see, the above charts indicate that the data consistently points to ground providing a better RF medium for your counterpoise wire than blacktop. I have also noticed that earth or soil also provides a better RF medium for your counterpoise than concrete.

This is one reason why you might want to use an antenna tuner.

**Counterpoise Wire Angle:** The other reason you need an antenna tuner is due to your counterpoise wire changing its angle relative to the medium you're walking on. You may be walking on ground, grass-covered ground, blacktop, concrete etc. But, as you walk, your drag wire usually changes its angle away from straight down. The greater your drag wire moves away from straight down – the greater your SWR will be on your antenna.

Sometimes as I walk across blacktop, this angle has little deviation. So I just hit the antenna tuner button and continue to transmit. Yes, the tuner is compensating, but we don't live in a perfect world. Pedestrian mobile operation has the greatest number of variables known to RF. It's what makes it a challenge and so rewarding all at the same time. You "gotta love it."

**Antenna Tuner Types:** This text will discuss only two main types of tuners – internal and external antenna tuners as used in pedestrian mobile operation. This one subject could be a book itself. Even if you use a resonate antenna and at home your antenna looks like a 1:1 match, it will change as you walk!

**Internal Tuner:** As stated earlier, many new transceivers now come with internal antenna tuners as standard equipment. In some radios an internal antenna tuner is an option. I highly recommend using an internal antenna tuner. The main reason to use an internal tuner is convenience. All I do as I walk is push a button and my antenna is tuned. It's just really nice to hit a button and done. This is not to say that internal antenna tuners don't have their limitations. Here's a big disadvantage that many of the new internal antenna tuners have – you can't have an SWR over 3:1 or it won't tune.

**Icom 703 Plus Internal Antenna Tuner:** <sup>19</sup> The internal automatic antenna tuner matches the transceiver to the connected antenna automatically. Once the tuner matches an antenna, the latching relays combination are memorized as a preset point for each frequency range (100 kHz steps). Therefore, when you change the frequency range, the latching relays are automatically preset to the memorized combination.

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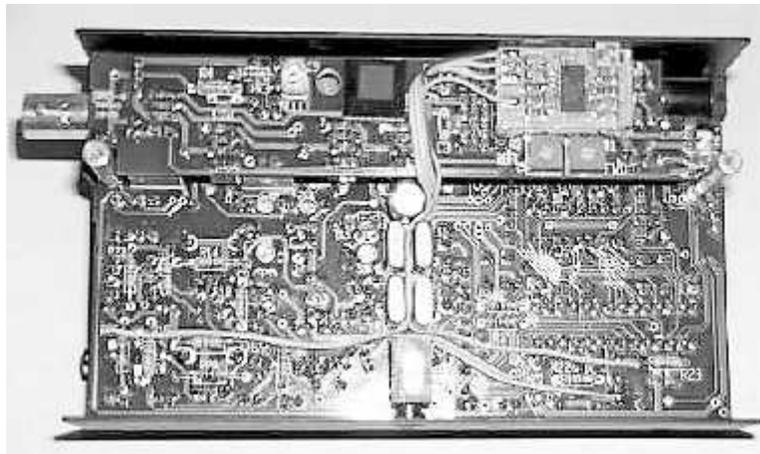
<sup>19</sup> <http://www.icomamerica.com/en/downloads/Default.aspx?Category=18>

If the tuner will not tune the antenna, check that the unaltered antenna SWR. (Less than 3:1 for HF bands; Less than 2.5:1 for 50 MHz band)

As you can see, this internal antenna tuner is ok, but it will only match the radio to the antenna if the SWR without the tuner is 3:1 or less. Most new radios with internal tuners operate in a similar manner. I'm using the Icom 703 Plus as an example.

Please note one important issue concerning antenna tuners - latching relays. The use of latching relays means less current draw as the relays don't need to consume battery current when not in use. Older antenna tuners may not incorporate this technology.

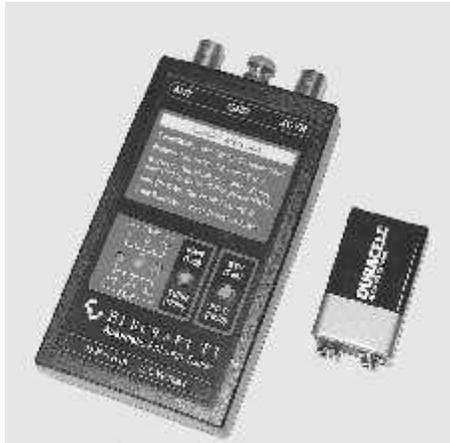
**Elecraft KX1 Internal Antenna Tuner:** The picture below shows my Elecraft KX1 Transceiver open exposing the internal antenna tuner. The antenna tuner is the small top board in line with the BNC connector. Yes, it's really small, but it does a nice job.



It would be impossible to mention all the transceivers with and without internal antenna tuners. The main idea here is to look for a radio that has an internal antenna tuner and to use a resonate or near resonate antenna with it for pedestrian mobile operation.

**External Antenna Tuners:** Sometimes the antenna you want to use just won't provide a SWR of less than 3:1. If this is the case, you will probably need to use an external antenna tuner. As the name implies, it's usually a separate box with or without tuning knobs.

## Elecraft T1 External Antenna Tuner



This antenna tuner is small and lightweight making it a great way to match your antenna with your radio, but it can only handle 20W peak power and 10w continuous power. But, if you plan to use lower power levels, it's a good choice for your HFpack. This antenna tuner may be purchased as a kit or already assembled and ready to use in the field. The price is somewhere around \$150 USD.

Here's what Elecraft says about counterpoise wires. <sup>20</sup>Ground system: A good ground counterpoise is a necessity for efficient transmit operation with verticals, whips, and end-fed random-wire antennas.

With a poor ground, the receiver may still sound "hot," and the indicated SWR may be low when you transmit, but your effective transmit power will be much lower – often by 10 to 20 dB or more.

Use at least one ground radial, cut to about 1/4th wavelength on the lowest band. When possible, use two or more radials, with at least one cut to 1/4 wavelength on each band used. While the use of multiple counterpoise wires is better, it may be difficult to use more than one wire when walking around in the outdoors.

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<sup>20</sup> <http://www.elecraft.com/T1/T1.htm>

## LDG Electronics Z-11ProII

<sup>21</sup>Meet the Z-11ProII, everything you always wanted in a small, portable tuner designed from the ground up for battery operation. Only 5" x 7.5" x 1.5", and weighing only 18 ounces, it handles 0.1 to 125 watts, making it ideal for both QRP and standard 100 watt transceivers from 160 - 6 meters.



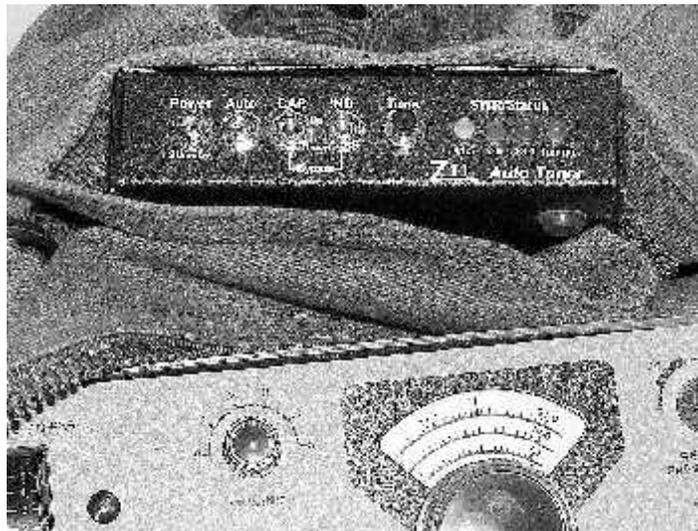
This external antenna tuner is larger in size, but can handle up to 125 watts of RF power. If you decide to use over 10W – 20W, this would make a great tuner for your HFpack. This tuner also utilizes latching-relays so it only draws 25ua of current when not in an active tuning



Plus, at around \$180, it provides the pedestrian mobile operator with a tuner that won't break the bank!

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<sup>21</sup> <http://www.ldgelectronics.com/c/252/products/1/9/1>



Pictured above is Paul, W0RW's Heathkit HW-7 used with a LDG Z-11 Auto Antenna tuner. He decided to mix a classic radio with a new antenna tuner.

#### **LDG Z817 Antenna Tuner:**



<sup>22</sup>The Z-817 is the ultimate auto tuner for QRP radios including the Yaesu FT-817(D).

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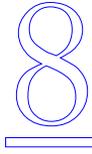
<sup>22</sup> <http://www.ldgelectronics.com/c/252/products/1/45/1>

The Z-817 interfaces to the CAT port (ACC) on the back of the FT-817 radio with the provided cable. Tuning could not be simpler; one button push on the tuner is all that is needed and the Z-817 takes care of the rest. It will switch to PKT mode, transmit a carrier, tune the tuner, then restore the radio to the previous mode! 2000 memories cover 160 through 6 meters.

This antenna tuner also uses latching relays to save battery power while out in the field. Once again this antenna will only handle a maximum of around 20W. It does tune 6 to 600 ohms (about 10:1 SWR range). 16 to 150 on 6M (about 3:1) and has SO-239 in and out connections for dipoles, verticals, beams, G5RV etc. The dimensions are 5.1" L x , 4.7" W, x 1.7" H. It weighs-in at around 10 ounces and includes a one foot long CAT cable.

Yes, you guessed it, this baby was built to be used with the Yaesu 817 Series of radios. One item to note is even with its small size, it will tune up to a SWR of 10:1. So, if you own a Yaesu 817, this would be the ticket to tune your antenna while operating pedestrian mobile outdoors.

The main features you want to look for in an antenna tuner for pedestrian mobile operation are small current drain, small size, lightweight and one pushbutton auto-tune. . The above external antenna tuners are a few examples of auto tuners meeting these criteria.



## Batteries etc.

How does a pedestrian mobile operator power his entire station? Most of the time power for all the radio equipment is taken from a battery or batteries. This text will examine batteries for amateur radio commercially built or kit transceivers. Surplus Military transceiver batteries will not be discussed as they are outside the realm of this text.

### <sup>23</sup>Abbreviations

A – Ampere, a measure of current

AH - Ampere hour, used to specify the capacity of a battery

C- Capacity battery, specified in Amp Hours (AH) or milliamp hours

Li-ion – Lithium Ion

Li-Poly – Lithium Ion Polymer

(mAh)

mA - milliampere

mAh – milliampere hour, used to specify the capacity of a small battery

Ni-Cd- Nickel cadmium, a rechargeable battery chemistry type

Ni-MH – Nickel Metal Hydride a rechargeable battery chemistry

SLA- Sealed Lead-Acid, a rechargeable battery type

V- Volt

### Types of Batteries

<sup>24</sup>Batteries fall into two general categories, primary and secondary. Primary batteries are designed to be used once; secondary batteries are designed to be recharged and used multiple times. The common alkaline battery is a primary battery; the Nickel Cadmium (Ni-Cd) battery is secondary battery. Table I lists common battery types.

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<sup>23</sup> James R. Duffey KK6MC, “Batteries and charging systems for QRP”, 2005

<sup>24</sup> James R. Duffey KK6MC, “Batteries and charging systems for QRP”, 2005

**Table I – Types of batteries**

Primary	Secondary
Carbon - Zinc	Lead-Acid (Gel Cells)
Alkaline	Nickel Cadmium (Ni-Cd)
Lithium	Nickel Metal Hydride(Ni-MH)
	Li-ion
	Li-Poly
	A123 Nanophosphate

Carbon-Zinc batteries are useless for pedestrian mobile use. The capacity is small and gets worse as more current is drawn. They can leak and corrode battery holders or worse yet, your favorite rig. They have a short life. Tom, WB5QYT, told me that he tried carbon zinc batteries in his FT-817 once. He got just 20 minutes of battery life out of that set with no transmitting! Fortunately, Carbon-Zinc batteries are becoming harder and harder to find. When they are available, they are cheap. They are often packaged with inexpensive toys, tools, and flashlights. You may find them sold side by side with alkaline cells at discount drug stores and flea markets, often marked as “heavy duty”, but do not make the mistake of purchasing them instead of the preferred alkaline cells. Alkaline batteries are marked as such; if in doubt, look for the word “alkaline” on the package somewhere. You can use carbon-zinc batteries in an emergency if nothing else is available, but you will be disappointed and frustrated at their performance.

### **Alkaline**

Alkaline cells are the workhorse of the primary battery world. They are widely available, consistent in quality and provide reliable power over a long time. They are widely available in sizes other than the ubiquitous AA. They have a relatively large capacity, and are inexpensive. They have a long shelf life, usually in excess of 5 years. If you don't do a lot of work that requires batteries, they are a good choice for the occasionally trip to the field. They have two to three times the capacity of rechargeable Ni-Cd cells.

They do have their downside. The power output is not constant, but varies over the useful life from 1.55 V per cell to about 0.9 V per cell. This has a couple of drawbacks.

In order to extract all of the useful power available in the battery, your rig should be able to operate over this entire range, which means 12 V down to 7.2 V for a nominally 12 V powered rig. Few rigs can do this. Those that can will show a steady power reduction over the range. Not a bad thing in and of itself, as some prefer a gentle degradation to a sudden one, but you should be aware of it. The alkaline battery has a reduced output at 32 F; about 0.5X that at room temperature. It gets worse below that. You might want to use another battery technology for cold weather, or stuff that battery inside your jacket to keep it warm. If you buy alkaline batteries in bulk, the price for AA alkaline batteries is reasonable. Large buying club stores such as Costco or Sam's Club often have the best prices.

### **Lithium**

Lithium cells are very lightweight for the power they provide and hence provide high capacity for their size. They typically supply twice the amp-hour capacity of alkaline cells, but are much lighter. They have extremely long shelf lives; 10 years or more is commonly specified.

They have two down sides; they are very expensive and they provide 3 V rather than the 1.5 V we are accustomed to for primary cells. A lithium cell is nearly fully discharged when it approaches 2.5 V per cell. In order to extract all of the energy in a 12 V lithium battery pack, a QRP rig should operate down to 10 V. Lithium cells provide excellent cold temperature operation, hence they are a good choice for cold weather. Overall, the detractions of lithium cells overwhelm the attractions, particularly the cost, and limit their utility for QRP. Recently AA lithium cells with nominal 1.5 V have become available, but they are still quite expensive. I have not evaluated them.

### **Secondary Batteries (rechargeable)**

#### **Sealed Lead Acid (Gel-Cells)**

Sealed lead acid batteries, a type of lead acid battery that often goes by the name gel cell, are widely available, but not in smaller than C size. A "D" sized cell is also available, as are larger single cells, but most pedestrian mobile operators use a 12 V or a pair of 6 V batteries in a single package. These are specified by their capacity; 2.5 AH, 4.5AH, and 7 AH are all commonly available and are useful sizes for portable operation. Larger sizes are available, but these are more useful to the home station or extended portable operation than they are to the QRPer for portable operation. They have less capacity than Ni-Cd or Ni-MH batteries and much less capacity at high discharge rates.

The voltage drops as the cell is discharged, so a 12 V rig must operate at 10.5 V in order to get the most out of a SLA when it is nearly fully depleted.

Sealed acid cells have a low self discharge rate, typically 1% to 5% per month. They keep 80 % of their capacity at 32 F, but decrease rapidly below that as anyone who has tried to start a car in a South Dakota winter can testify. Sealed lead acid cells are easy to charge and easy to keep charged by “floating” them at a constant voltage. They can be charged with constant voltage, constant current, or a mix of the two methods. Manufacturers often print the charging recommendations on the side of the battery.

Trickle charging at a constant voltage is about a foolproof method of charging SLA batteries as there is. Unless the battery manufacturer supplies different values, apply a constant voltage of 13.2 V to 13.8 V at an available a current of  $c/4$  or less. The current will generally decrease to zero as the battery becomes fully charged. As the battery self discharges the charger will supply additional current and keep it fully charged. There are two downsides to this method. It takes a long time to fully charge the battery. As the battery approaches the charger voltage it draws less and less current and charges slower and slower. It is not possible to charge the battery to full capacity using this technique, but typically it is possible to charge it to 85% of rated capacity.

The SLA can also be charged with a constant current. Using this technique, the battery is charged at  $c/10$  to  $c/4$  (or whatever value the manufacturer specifies), until a terminal voltage of 14.4 V is reached. The battery is nearly fully charged at this point and may be float charged to maintain charge.

Constant voltage and constant charging may be mixed and this is the technique that is often used in commercial chargers. Using this multi-mode technique, the battery is charged at a constant current until 14.4 volts is reached. The battery is then held at this voltage until the current drops to 10% or so of the charge value. Then the charger switches to the float voltage, usually 13.6 V or so. This technique results in a fully charged battery.

The SLA is capable of giving good life. Expect 500 to 1000 full discharge/charge cycles. The fewer deep discharges the SLA sees, the greater number of charge/discharge cycles you will get out of the battery. Charge the battery immediately after use to prolong life.

Store the battery fully charged and top it off every 6 months or so to account for self discharge.

The SLA is a good choice for a battery to run a home QRP station or to operate a station that is used in portable operations where transportation is done by car. They are a bit heavy for backpacking. SLA batteries are widely available new in a variety of sizes. They are relatively inexpensive. SLA batteries are widely used in alarm systems, uninterruptible power supplies, and emergency lighting systems. Batteries in these systems are usually pulled for preventative maintenance every year or two and the pulls are often available surplus or as giveaways. These batteries have usually been well maintained and have lots of life available after they are pulled. Alarm companies are a good place to check for these pulls.

**AGM (Absorption Glass Mat)** sealed battery technology was originally developed in 1985 for military aircraft where power, weight, safety, and reliability were paramount considerations.

AGM battery technology has continued to develop and offer improvements over other sealed battery technologies. AGM technology has become the next step in the evolution of both starting and deep cycle sealed batteries for marine, RV, and aviation applications. This "next generation" technology delivers increased safety, performance, and service life over all other existing sealed battery types, including gel technology.

In AGM sealed batteries, the acid is absorbed between the plates and immobilized by a very fine fiberglass mat. No silica gel is necessary. This glass mat absorbs and immobilizes the acid while still keeping the acid available to the plates. This allows a fast reaction between acid and plate material.

The AGM battery has an extremely low internal electrical resistance. This, combined with faster acid migration, allows the AGM batteries to deliver and absorb higher rates of amperage than other sealed batteries during discharging and charging.

In addition, AGM technology batteries can be charged at normal lead-acid regulated charging voltages, therefore, it is not necessary to recalibrate charging systems or purchase special chargers.

### **Nickel Cadmium (Ni-Cd)**

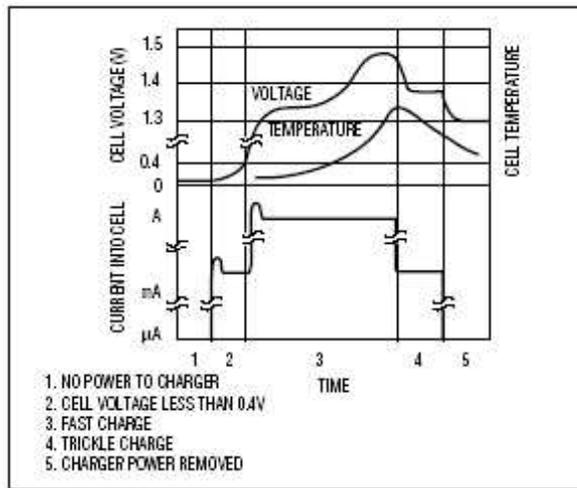
Ni-Cd cells are a good choice for QRP use, although in the AA size, they have been largely supplanted by Ni-MH batteries. Ni-Cd cells have fairly high capacity for their weight, certainly better than SLA batteries. This makes them a good choice for portable use. Ni-Cds have a flat discharge curve, holding constant at nearly 1.2 V until fully discharged. They are pretty much fully discharged at 1 V. Therefore, equipment running on a 12 V Ni-Cd pack should operate at voltages down to 10 V to extract the most energy from a Ni-Cd battery.

Ni-Cd cells have good capacity at 32 F and decrease somewhat below that, but are better than alkaline cells or SLA batteries for cold weather operation. They have a relatively high self-discharge rate, 10% or so a month, so if they are not used and charged often, they should be topped off every month or so. Ni-Cd cells can be charged indefinitely with a constant current charger at  $c/10$ .

Charging at this rate for 14 hours will result in a full charge. The battery can be left connected to the charger, but it is wise to reduce the current to 0.02 C or less if the charger is to be left connected.

A better way to charge these batteries is to monitor the voltage with respect to time as the battery is charged with a constant current charger. When the voltage ceases to rise and begins to decrease, the battery is fully charged.

This effect is shown in Figure 1. The temperature also rises when full charge is approached. Commercial chargers use this technique or a combination of these techniques. A simple versatile charger can be built from this chip. Commercial chargers are commonly available inexpensively and are a good way to charge cells. Unlike the SLA, the endpoint voltage cannot be used to determine when a Ni-Cd battery has reached full charge, as the endpoint voltage depends on how the battery was discharged previously.



The graphic above is the Voltage and Temperature of a Ni-Cd cell being charged with constant current. The voltage peaks when the cell is fully charged and the temperature rises. Full charge can be determined by detecting when  $dV/dt$  goes to zero or negative, or when the temperature rises. Commercial chargers use these methods to determine full charge. (From MAX712/713 data sheet)

The Ni-Cd battery is capable of giving good life. Expect 500 or more discharge/charge cycles. The fewer deep discharges the Ni-Cd sees, the greater number of charge/discharge cycles you will get out of the battery. Charge the battery immediately after use to prolong life. Store the battery fully charged and top it off every month to account for self discharge.

Although Ni-Cd cells have been largely supplanted by Ni-MH in the AA size, if you want larger capacity, Ni-Cd is still the choice. C cell and D cell sizes are available and Radio Shack stocks both.

One of the best values in rechargeable batteries is the 2/3 C or “sub C” size. These are widely used in rechargeable power tools and rechargeable household appliances such as portable vacuum cleaners. Due to their wide use, they are often available in surplus cheaper than either C cells or AA cells, often with solder tabs. It is easy to make up a 12 V battery pack using 10 of these cells and heat shrink tubing.

One should beware of Ni-Cd C and D cells that are the correct size physically, but contain a smaller AA, 2/3 C, or C cell. Several manufacturers, including several major battery manufacturers, do this to save money.

These cells have limited capacity. Be sure to check the capacity when you purchase a Ni-Cd or Ni-MH C or D cell. Table II lists capacity of the various sized cells to help guide your choice

### **Nickel Metal Hydride (Ni-MH)**

Due to the proliferation of digital cameras, Ni-MH cells are widely available in AA size in large capacities. AA Ni-Cd cells, once widely available at discount stores are now hard to find. The Ni-MH chemistry has significantly improved in the past 5 years and the discharge rate, 15% to 20% per month, is significantly lower than when first introduced.

Ni-MH cells share many of the same characteristics with Ni-Cd cells. They have a flat discharge curve and good capacity at 32 F. At 15% to 20% self discharge per month, Ni-MHs have a much more rapid self discharge rate than do Ni-Cds or SLA batteries. If not used and charged regularly, they should be topped off every two weeks or so.

Unlike Ni-Cds, Ni-MH cells are intolerant of overcharging. Some have reported success at charging these at 0.05C with no damage, but it will take 28 hours to fully charge a discharged battery at this rate.

It is better to monitor the voltage when charging and cease charging when the voltage stops to increase,  $dV/dt = 0$ .

The peak is quite shallow, so waiting for the derivative to go negative, like can be done for Ni-Cd cells, will lead to overcharging of Ni-MH cells and their quick demise. The temperature also rises when the cell becomes fully charged. Both of these techniques are used in commercial chargers. An IC, the Maxim MAX712 can be used to build an effective Ni-MH charger.

Ni-MH batteries are most widely available in AA size. Other sizes are harder to find. Panasonic makes them in AAA, sub C, and D cells. Digi-Key stocks these cells. Beware of large cells being sold with AA cells in them. Check the capacity.

The Ni-MH battery is capable of giving modest life. Expect 300 to 500 full discharge/charge cycles. This is significantly less than either the Ni-Cd or SLA. The fewer deep discharges the Ni-MH sees, the greater number of charge/discharge cycles you will get out of the battery. Charge the battery immediately after use to prolong life. Store the battery fully charged and top it off every 2 weeks to account for self discharge.

If you need an AA battery pack for QRP use, particularly for backpacking applications, Ni-MH batteries are a good choice. Care should be exercised with their charging.

## Lithium

Lithium cells are now becoming widely available due in large part to the widespread use of cell phones. They have very high power density, but as anyone who has replaced a cell phone battery knows, they are expensive. Rechargeable lithium cells share many of the properties of the primary lithium cells; they have long shelf life, are lightweight and are very usable in cold weather. The rechargeable lithium cells are usually in non-conventional proprietary physical packages, so incorporating them into existing battery packs can be difficult.

Lithium batteries are usually available in 3.6 V or 7.2 V sizes. A 12 V rig operating on lithium cells would need to operate from either a 10.8 V or 14.4 V rechargeable battery pack. Both Voltages aren't ideal for the rig, 10.8 V is too low and 14.4 V is a bit high when fully charged.

\* WA3WSJ Note

A 10.8V Li-ion battery now has a working voltage of 11.8v and will charge to 12.1v. I use this type of battery for my KX1 and it works great.

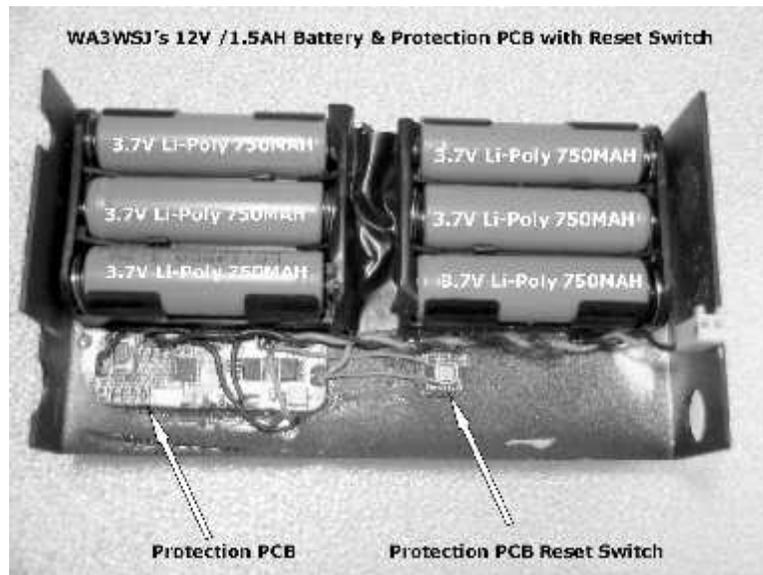
Lithium batteries are usually charged with constant voltage until the battery is fully charged. Charging must be terminated as soon as full charge is reached, or the battery heats rapidly and can destroy itself. Commercial chargers are the best way to charge these. I am unaware of anyone using a homebuilt charger with lithium cells. Lithium batteries are being widely used by radio-control hobbyists, as they are quite concerned with weight considerations.

**Lithium Ion:** The high energy density Li-ion chemistry reduces the cell's weight by half and the volume by 20 to 50 percent. The self-discharge rate is less than half that of nickel-based chemistries, and there is no "memory effect."

But, rechargeable Li-ion cells are more expensive than both NiCD and NiMH, and they require protection circuitry to keep voltage and current within safe levels.

All lithium-based chemistries are subject to shipping regulations.

I use 7.5V Li-ion AA-size batteries in my Elecraft KX1 Transceiver for a few years now with no problems to date. This type of battery is being used by more radio operators in the field. Plus, with cheap protection circuit boards and chargers they are now cost effective. I've purchased my Li-ion batteries etc from Batteryspace.com.



Pictured above is my Elecraft KX1 with Li-ion AA-size cells installed to make a 1.5AH /11.8V battery with a protection circuit board all purchased from Batteryspace.com.

The cost of Lithium-based batteries has dropped recently making them more affordable to the pedestrian mobile operator.

**Lithium Ion Polymer:** Li-Polymer batteries have greater energy density in terms of weight than Li-ion. There is more flexibility in cell sizes and shape with Li-Polymer with superior stability in over-voltage and high temperature conditions. But, Li-Po batteries command a slight premium price. The cells require protection circuitry and they are subject to shipping regulations.

**Lithium Ion Iron Phosphate:** Excellent cycle life, high rate capability, and best in class safety. But, Low energy density compared to conventional Li-ion chemistries.

**A123 Nanophosphate:** <sup>25</sup>These cells are designed to be safer and more abuse tolerant than the battery technologies that have been traditionally used by amateur radio operators.

The proprietary Nanophosphate cathodes are inherently stable, and are not susceptible to thermal runaway while under abusive conditions.

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<sup>25</sup> <http://www.buddipole.com/portablepower.html>

The chemistry also has the lowest intrinsic reaction heat of any lithium ion battery technology, meaning that your battery will heat up very little during heavy use. The advanced vent technology allows for the safe release of any internal gas pressure buildup in a cell.



As of this writing, Buddipole is selling this type of battery. All of the A123 batteries sold by Buddipole include an integrated poly switch to prevent large amounts of over current in the event of a short circuit.

Each Buddipole battery also comes with 30 ampere Anderson Powerpole connectors preinstalled, which nearly eliminates the risk of reversing the power supply polarity to your equipment.

Most battery technologies used in amateur radio service have a voltage discharge curve which gradually ramps down, ending with a sharp drop when the battery is nearly completely discharged. By contrast, A123 Nanophosphate batteries maintain a nearly constant voltage until the charge is nearly depleted. This gives you a wider window of operation at full transmitter power.

The disadvantage with this type of battery is price – they are expensive! Compared to my \$20 SLA 10AH Battery, a similar A123 Nanophosphate battery will cost you close to \$300, but they are small and lightweight.

## Calculating the Battery Capacity Needed

<sup>26</sup>A common question asked is how much battery do I need for such and such an operation? It is straight forward to calculate the battery capacity you need.

First you need to determine how much average current the battery needs to supply to the rig when receiving,  $I_{rec}$  and how much it draws during transmit,  $I_{tran}$ . My K1 draws about 80 mA at comfortable listening level. At 5 Watts output power, it draws about 0.8 A. CW is a 40% duty cycle mode. This information should be in the instruction manual, or you can measure it yourself with an ammeter. Manufacturer's numbers tend to be on the low side.

If we spend half our time transmitting and half our time receiving, typical of a contest situation, then the average current,  $I_{av}$ , drawn by the transceiver is:

$$I_{av} = 1/2 (I_{rec}) + 1/2(I_{tran}) = 1/2(0.08A) + 1/2 (I_{tran})$$

For casual operating, you might want to change the fraction spent transmitting and receiving. A ratio of  $3/4$  listening –  $1/4$  transmitting is probably more typical of non contest operating.

Recalling that CW is a 40% duty cycle mode,

$$I_{tran} = 0.4(0.8A) + (0.6)(0.08A) = .32 + .042A = .362A$$

The 0.6 is the fraction of time the rig spends in receive during a typical transmission.

The average current the K-1 will draw is then:

$$I_{av} = 1/2(0.08A) + 1/2(.362A) = 0.04A + 0.181 A = 0.220A$$

Now determine how long you wish to operate. If you want to operate for 12 hours, then the current capacity the battery needs to supply is:

$$C = 0.22A(12 \text{ hours}) = 2.64 \text{ Ampere Hours}$$

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<sup>26</sup>James R. Duffey KK6MC, "Batteries and charging systems for QRP", 2005

You will need a SLA battery that has a larger capacity than this for several reasons.

- Most battery capacities are stated for a 20 H discharge rate. If Sealed Lead Acid batteries are discharged at a faster rate, they will have less capacity. At the 10 hour discharge rate, the capacity is about 0.8 to 0.9 times the 20 hour rate.
- You do not want to fully discharge the battery, as that can cause permanent damage. You should leave at least 10% charge remaining.
- It is difficult to fully charge SLA batteries, particularly with a simple charger. A battery that is trickle charged will be able to supply only 85% of its rated capacity.

With all these caveats, you should over specify the battery capacity, unless you don't have a hard and fast requirement for time duration. Using the worse case from the above 3, we need to multiply the C by:

$$1/0.8*0.9*0.85 = 1/0.61 = 1.6$$

So we need to look for a battery that has a capacity of:

$$1.6*2.64 = 4.2 \text{ AH or greater.}$$

SLA cells are available in a 4.5 AH capacity. If you power accessories such as a keyer, tuner, or lamp, you should add in that current draw. With the exception of the lamp, the power required by these devices is usually negligible compared to even the receive current drawn.

You can do a similar calculation for Ni-Cd or Ni-MH batteries. Ni-Cds can deliver nearly their full rated capacity at almost any reasonable discharge rate unless the current draw is very high. It is easy to fully charge Ni-Cds with a constant current charger as long as the charge is stopped at the proper time.

You don't want to fully discharge the Ni-Cds though. So, only factor 2, restraining from fully discharging the battery applies from above; and we need to adjust our capacity only by 1/0.9 or 1.11 so we need to have 2.9 AH capacity. C cell Ni-Cds and Ni-MH AA cells have a capacity of about 2.5 AH, but that would be a bit light. Ni-Cd D cells have a capacity of about 4.5AH, but they are pricey. It is difficult, but not impossible to find Ni-MH batteries in sizes other than AA.

Table II lists the various size cells available in the various chemistries. These calculations are approximate and depend greatly on personal operating habits. It is best to leave some headroom until you are familiar with the power consumption of you rig and your operating habits.

Please note - the 1.5v Li-ion primary batteries listed in Table II are the LiFeS2 composition type batteries.

Table II- Size and Capacity of Cells Available for Various Battery Types

Cell size	Alkaline mAH	Lead-Acid	Ni-Cd mAH	Ni-MH mAH
AAA	1100	NA	250	700
AA	2450	NA	1000	2300
2/3 C sub C	NA	NA	1500	3000
C	7100	2500	2400	NA
D	14000	4500	4400	6500
Lantern Battery	20,000 ( 6 V)	NA	NA	NA
Cell size	Li-ion mAH	Li-Poly mAH	LiMnNiCo	Nanophosphate
AAA	1.5v/1A,2A 3.7v/300			
AA	3.7v/650, 750, 940 1.5v/1A,2A,			
C	3.6v /200			
D	3.6v /200			
Flat Cell		3.7v/ 190 – 21000	3.65v/ 8A, 15A ,20A	
9V	500, 1A			
Cylinder				3.3v / 1100,2300,4400

\* WA3WSJ Note

Please note that in recent years new battery chemistries have been introduced such as LiMnNi, LiFePO4 and LiMnNiCo and Nanophosphate.

These new chemistries have produced higher capacity batteries that are smaller and lighter than some of ones listed in Table II.

These newer, smaller and lighter battery types make operating pedestrian mobile easier as your pack weight is lighter than with older type batteries.

It also seems that many of the newer Lithium rechargeable batteries are changing from Li-ion chemistry to Li-Ploy.

### **Battery Chargers**

Since charging Ni-MH and lithium batteries requires care, it may be best to purchase a commercial charger for these batteries. Determining when a battery is fully charged is the trick in successfully charging a battery, and time, voltage, current, and temperature are all used. This is generally the most difficult part of building a homemade charger. The easiest chargers to build are those for non-critical battery charging situations, trickle charging SLA batteries at constant voltage, and Ni-Cds at constant (and low) current.

### **Using a Solar Panel to Charge Batteries**

It is easy to use a solar panel to charge a battery in the field. This is attractive from the point of being self contained and many contests offer an additional multiplier for solar power. Visitors to a portable site are often impressed by the solar panel powering a ham radio station that is working other stations all over the country.

Small solar panels can often be found surplus or at ham fests. A 3 to 5 Watt size is a good choice for most portable operations. Such a panel will produce 250 mA to 300 mA at 18V in full sun and is a good mate to a 7 AH SLA battery. Some foreign car manufacturers ship their cars with a small solar panel on the dash to keep the battery charged. These panels are sold or given away after the car is received. Check with your local VW dealer, or they can often be found on e-bay. Harbor Freight has several solar panels which go on sale form time to time. When on sale these are usually good deals.

A solar panel is a constant current device and can be thought of as a constant current charger.

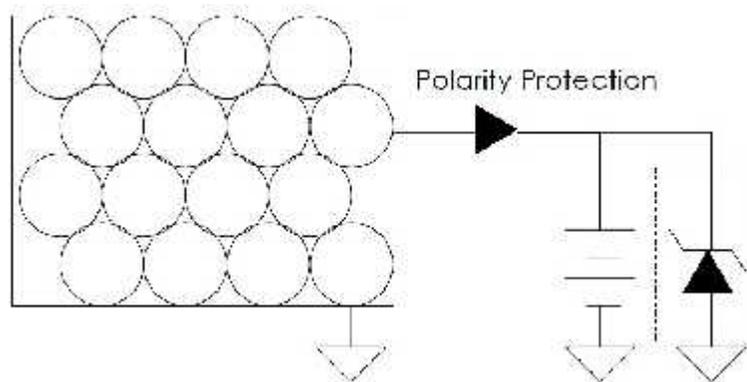
SLA batteries and Ni-Cd batteries lend themselves to constant current charging and hence to simple charging by the solar panel.

In the simplest arrangement the panel is simply hooked up to the battery, observing polarity, and allowed to charge.

This works best if the panel output is less than 0.1C or if the current drawn by the rig is less than the current supplied by the panel. If either of these two conditions are not present it is wise to use a zener diode or a charge controller.

The zener diode should have a voltage rating higher than the highest expected fully charged battery voltage. A 15 V zener is adequate for 12 V Ni-Cd or SLA batteries. The power rating should be the same as the panel. The full power of the panel will be dissipated by the zener when the battery is fully charged.

Simplest solar charging setup is shown below. The solar panel is a constant current device and can charge Ni-Cd and SLA batteries. The zener diode is provided for over-voltage protection to the battery and should be a slightly higher value than the fully charged battery potential. It can be omitted if the charging rate is less than 0.1C or if the current drawn by the transceiver is equal to or greater than the current supplied by the panel. The series diode is often built into solar panels and avoids discharging the battery into the solar cell at night.



If the solar panel is to be used long term in a fixed location, or if the current supplied by the panel is higher than 0.1C, or the power consumed by the attached rig is less than the panel can supply, a charge controller should be used to avoid damage by Polarity Protection overcharging the battery.

A shunt controller is preferred to a series controller. A series controller will often have significant voltage drops that will limit the amount of power the solar panel can deliver to the battery.

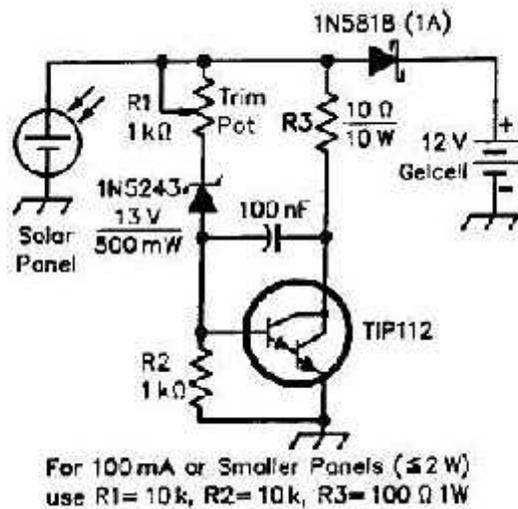
There are a number of shunt controller designs, some with elaborate microprocessor control and others using exotic switching devices.

A simple and straight forward design from commonly available parts is shown below.

This design is from the ARRL Publication “QRP Power”, p 3-24, and is simple, easy to build, and simple to setup. It is capable of handling charge currents of up to 1A. Alternate component values are given in the figure for lower current applications. The only adjustment is the voltage trip point when the current is shunted through the transistor and load resistor.

This should be set with a fully charged battery. As the transistor and R3 have the entire panel’s output across them when the battery is fully charged, they should be well heat sunk.

This simple charge controller will handle charging currents up to 1 A. When the battery is fully charged, all of the current from the panel will be going through R3 and the Darlington transistor TIP112, so these must be well heat sunk. Adjust R1 for the trip point, usually 14.4 V – 15 V for a 12 V SLA or a 12 V Ni-Cd battery. (From “QRP Power” p 3-24)



## A Strategy for Using Batteries

<sup>27</sup>It is useful to develop a strategy for using batteries in your QRP shack and portable rig. If you do not, you can end up needing many different size batteries, connectors, and chargers. For fixed station use, this is not so bad, for portable operation, it always seems like you will be missing a crucial battery for a crucial application, or you will end up needing to use different battery types in a single application.

For rigs that have low-power consumption and lightweight requirements, like backpacking with the NE602 based SW-XX rigs, KD1JV's ATS rigs and K-1s, standardizing on AA cells is a good strategy. A 12 V AA pack made of either alkaline or rechargeable Ni-Cd/Ni-MH cells is a good idea. You should power any accessories, keyers, or tuners with additional AA batteries, or from the same battery pack.

Choose AA battery based flashlights so you can scavenge batteries from them if you need to. Encourage others who go camping with you to do the same. You can make up a battery pack using "solder tab" cells. Heat-shrink tubing can be used to hold it all together or you can use battery holders.

As 10 Ni-Cd/Ni-MH cells make up the nominal 12 V required for most rigs, use a 10 cell holder, Mouser 12BH310A. Or you can make up a custom holder using an eight cell (or 2-4s) holder in series with a two cell holder. That way, if your Ni-Cd/Ni-MH cells get exhausted, you can replace them with eight easily available alkaline cells.

For rigs that require more power or where weight is not a concern, a lead acid battery is a good choice. Power all of the accessories from the same battery. If the voltages required are different, use the same battery and power them with a low-dropout micro power regulator if they need a lower voltage. The 78L0X series is not a good choice, here, good choices include the LP2951 (adjustable), LP2950-X (X is the specified voltage), and Lt-1121CZ-X.

The 2.1mm coaxial power connector center pin positive is pretty much standard on most QRP rigs these days. It is a good idea to use it on all of your equipment.

I use power cords with this connector on one end and alligator clips on the other end, so I don't need to worry about matching connectors on the batteries.

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<sup>27</sup>James R. Duffey KK6MC, "Batteries and charging systems for QRP", 2005

I have a few cords that have the Radio Shack/Molex connector on the battery end. The ARRL was pushing this as a standard a few years back. I prefer the alligator clips.

The Anderson Power Pole connectors are now becoming standard and they are a very effective system. There are a number of power distribution stations available, including one from Saratoga Systems that has voltage regulators (and fuses) built in to supply voltages at other (lower) than 12 V. This is a very convenient device.

It is pretty much a tautology that you should have spare batteries for each battery powered device. But we have all been caught short with a dead keyer battery and no spare at one time or another. Now is the time to raid all of those battery powered devices for a spare. Flashlights are an obvious choice, as are Walkman tape players and CD players, but we often overlook garage door openers and multimeters. You might want to raid those AA cells in your handie-talkie for another use. But the best idea is to bring spares.

I carry a small 4.5 AH SLA cell as a back up to my standard 7 AH SLA, and often an alkaline 9 volt battery as well. Having 8 alkaline AA cells as backup is a good idea. If you go with a group, invariably someone will show up with a dead battery and no spare. If you can supply a spare, you will be a hero. It is not a bad idea to carry spares not only for your own gear, but also for others. Be prepared.

A voltmeter is a good device for checking the health of a battery, but 12 V light bulbs are probably more useful as they provide a load. Twelve volt lamps are available in a wide variety of sizes; pick one with a current draw roughly equal to your rig to test your battery. Radio Shack has a wide variety of 12 V bulbs, as does your auto parts store. The bulbs are also good for checking those surplus batteries often available at swap meets. In the field, I find it enlightening to make periodic measurements with a voltmeter over the course of operating to determine how the battery is really holding up. It gives me an idea if I really need a battery that big, or if I can get away with a slightly smaller one next time.

If you use a rechargeable battery to operate your rig in the shack, you should keep it charged. For an evening or afternoon of operating I operate from the battery and connect the charger at the end of the operating session. For longer sessions, like in a contest, I keep the charger connected to the battery.

If you only operate from batteries occasionally, you should top off your batteries from time to time. Ni-MH should be topped off once every two weeks, Ni-Cds once a month and SLA batteries once every six months. Always top off a battery before going to the field

## Summary and Conclusions

<sup>28</sup>So what battery technology should you chose?

If you only go to the field occasionally, or want to try portable operation without a lot of expense, alkaline cells are probably the best choice. If weight is not a factor, you can operate a typical QRP rig from alkaline D-cells for months of casual operating and from a pair of lantern cells for almost a year

For portable operations where weight is not a concern, sealed lead-acids are probably the best bet. They are relatively inexpensive, particularly if you can get a pull, and are easy to charge. Do some homework first to size the battery properly.

For backpacking with efficient low power rigs, where low weight is paramount, use a battery pack made from Ni-MH AA cells. If the capacity of an AA cell is not sufficient, use the larger sizes available in Ni-Cd cells. Ni-MH cells must be charged with care, they are no where as forgiving as Ni-Cd cells.

\* WA3WSJ Note

The newer Lithium rechargeable batteries are great for the field, but select the proper charger for your battery. They are small and pack larger power densities than some older battery types.

If you want to try solar power, SLA batteries and Ni-Cd batteries are the easiest to use with solar panels and the most forgiving to charge.

Cold weather operation favors lithium, Ni-Cd, and Ni-MH cells. SLA batteries and alkaline cells are definitely poor choices for cold weather

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<sup>28</sup>James R. Duffey KK6MC, "Batteries and charging systems for QRP", 2005

In order to make your rechargeable batteries last the longest, do not overcharge them, do not discharge them fully, store them fully charged, top them off as required, and avoid long term trickle charging of Ni-Cd cells.

**Battery Selection:** What size battery do you need to operate that radio you plan to use in the field? When we speak of size, what is really meant is battery capacity in ampere/hours. Usually the pedestrian mobile radio operator is concerned with two battery features. You have to select a battery voltage and an ampere/hour rating for the battery.

**Battery Voltage:** Most pedestrian mobile operators use transceivers that require an input voltage in the range of 9VDC to 15VDC. Most mobile radios used for pedestrian mobile operation usually require an input voltage somewhere around 12VDC to 14VDC.

So check your radio specification page for the input voltage range. Some lower power radios like the Icom 703 can work down to around 9.5VDC or so.

**The RX-TX Ratio** means the time you're receiving to the time you're transmitting. You want this ratio to be as large as possible to save your battery capacity.

#### **Battery Boosters:**

What is a battery booster? Why do I need a battery booster? Where can I buy one? How much does a battery booster cost? Yes you may have lots of questions regarding battery boosters, but this section of the handbook should answer most of them.

What is a battery booster? Yes many pedestrian mobile ops really don't know much about battery boosters. A battery booster will take a DC voltage in the range of 9VDC to 12VDC and convert it to around 13vdc to 15vdc. Why do you need a battery booster? Most VHF/UHF and HF radios work best when the input voltage is close to 13.8VDC. Most batteries will output around 12.6vdc or less as they discharge.

Some radios will actually shutdown on transmit when the input supply drops below 12vdc or so. So as you can see, it won't take long for your 12vdc battery to discharge to a state where the radio won't properly transmit! Alas, the answer is a battery booster. The reviews of TG Electronics battery boosters has been very positive.

Where can I buy a battery booster? After reviewing a couple of battery boosters for ham radio use, it looks like folks have two manufactures that will work for portable use . The first unit is made by TG Electronics. They make a variety of battery boosters with accessories. The second is a battery booster made by MFJ.

### **N8XJK Marine Booster**



<sup>29</sup>The N8XJK Marine Booster is a 12volt DC Booster Regulator. It is designed to boost your 12volt DC power up to 15volts DC even with the supply voltage drops as low as 9volt. It is a sealed water tight unit and is suitable for boating or outdoor conditions. Although it can be used indoors as well. I personally like the idea of no adjustments on the case as they might tend to become intermittent over time. The output voltage adjustment is internal in this unit. Options are available. You can have a Remote Switch with Cable that you can place where you like, or a Water Tight Switch can be mounted on the Front Panel.

### **The New N8XJK Boost Regulator**

<sup>30</sup>Introducing the NEW N8XJK BOOST REGULATOR. This unit is a variable 9 - 12volt DC to 12 - 15volt DC Booster Regulator.. It will boost and regulate an input as low as 9 volts DC and will Output an adjustable voltage as high as 15volts DC. It is amazing.

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<sup>29</sup> <http://stores.tgelectronics.org/StoreFront.bok>

<sup>30</sup> <http://stores.tgelectronics.org/StoreFront.bok>

This unit has the same basic functions as our original unit, but with improvements and some new added features. This N8XJK Boost Regulator is the original and is produced and backed by the original 12volt booster/regulator circuit designer and comes with a full one year warranty.

### The N8XJK Super Booster



<sup>31</sup>Introducing the N8XJK Super Booster. It is Super with the new added fan for cooling. The Fan allows for up to 40Amps of Output Power.

Plus all of the regular features of The New N8XJK Boost Regulator. Introducing - The N8XJK SUPER BOOSTER!! Now with up to 40 Amps Output Power and a Fan for cooling.

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<sup>31</sup> <http://stores.tgelectronics.org/StoreFront.bok>

## The MFJ-4416B Super Battery Booster



<sup>32</sup>The MFJ-4416B Super Battery Booster eliminates low voltage problems by boosting input voltages as low as 9 volts up to the desired 13.8 volts at up to 25 amps peak with a typical efficiency of close to 90%.

It is compact at just 7 3/4"W x 4"H x 2 1/8"D and lightweight at 1.3 lbs. And the MFJ-4416B Super Battery Booster is designed to be rugged, reliable, and easy to use. MFJ-4416B includes Anderson PowerPole™ connectors and high-current 5-way binding posts for both the DC input and regulated output. An internal 30-amp input fuse protects the unit from excess output current demands.

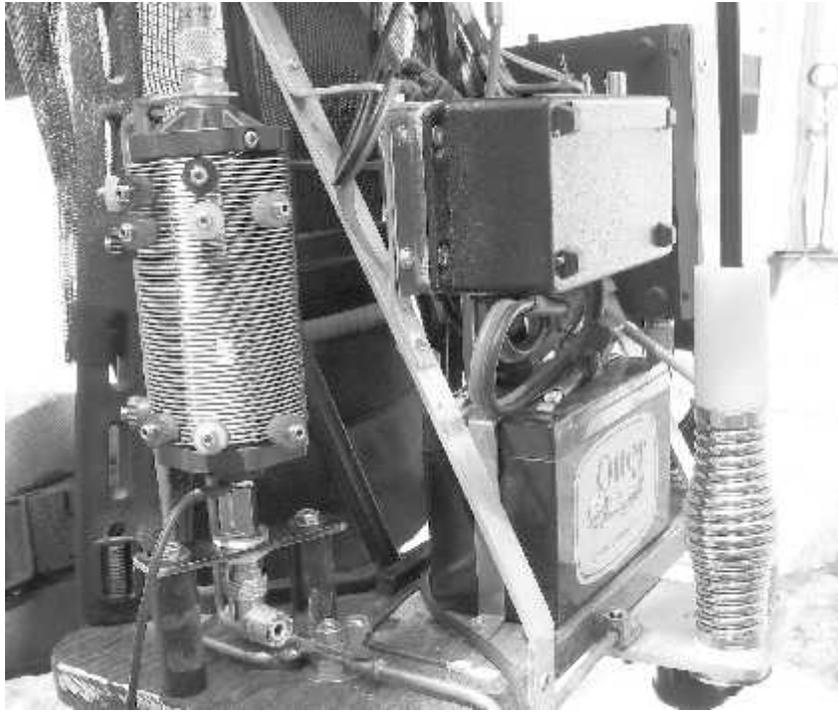
### W0RW Battery Booster Comments:

- They are heavy and burn up energy...
- The best way to extend your battery life is to add an extra cell to your battery pack..
- You run your KX1 on 12V with 3 Li Ion cells, I run my KX1 on 4 Li Ion cells at 16V starting voltage - all the energy goes into the rig..
- I run my Wilderness Sierra and my HW7 on 4 cells.
- I run my PRC319 on 7 Cells, That's 29 VDC instead of 24 VDC, The radio likes it.
- I think it is a more efficient way to power your radio. No loss in a converter and no possible noise from a converter.

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<sup>32</sup> <http://www.mfjenterprises.com/Product.php?productid=MFJ-4416B>

The picture below shows how Ken Muggli, K0HL/pm uses a battery booster to extend his pedestrian mobile operating time in the field. The battery booster is the black box located above the battery.



I've covered a few types of battery boosters in use today. You may however elect not to use a battery booster by selecting a radio that isn't so voltage sensitive. I use an Icom 703 Plus that will transmit down to around 9.5vdc or so, but at reduced power output.

If you plan to use a transceiver with a power output of over 20W, a battery booster isn't a bad idea. But as Paul Signorelli, WORW states, "they are heavy and burn up energy."

By using a battery booster, you will enjoy many hours of pedestrian mobile operation in the great outdoors and extend your range because your battery will play longer!



## Pedestrian Mobile Operating Modes

Pedestrian mobile operators mainly use two modes of radio operation – SSB or CW. Is one mode better than the other? Well, before that question can be answered we have to look at a few other factors that will influence what mode will work best for you.

**Band Conditions:** Before heading out to operate in the field why not check to see what shape the bands are in that day. Why not check the indexes to see what's going on?

### HF Radio Propagation

#### A Index and K Index

The Earth's magnetic field is continuously monitored by a network of magnetometers. These readings are converted into the A and K index values. The higher the A and K Indexes, the more unstable HF propagation.

A0 – A7: Quite

A8 – A15: Unsettled

A16 – A29: Active

A30 – A49: Minor storm

A50 – A99: Major storm

A100 – A400: Severe storm

**The K index** is computed once every three hours (eight times a day) and the values can range from 0 to 9, with 0 being inactive, and 9 representing an extreme severe storm condition. The values are quasi-logarithmic.

K0 – Inactive

K1 – Very Quiet

K2 – Quiet

K3 – Unsettled

K4 – Active

K5 – Minor storm

K6 – Major storm

K7 – Severe storm

K8 – Very severe storm

K9 – Extremely severe storm

A-Index Values below 7 are very desirable for HF communications. Higher A numbers can mean excessive absorption of HF radio waves due to increased storm conditions in the ionosphere.

Generally, propagation conditions are best when the Sunspot and SFI numbers are over 200. Also look at the A-Index and the K-Index. When the A-Index is below 7 and the K-Index is below 3, look for good HF propagation.

**WA3WSJ - I remember these index numbers by saying, “AK-73.”**

**Beacons:** Beacons are another way to hear if the bands are open for you to head out and operate your pedestrian mobile station. The article by Paul Signorelli, W0RW, is an excellent primer on listening for HF beacons to see what shape the bands are in.

### **Check DX Propagation with Beacons**

By Paul Signorelli, W0RW

Here is a good way check the propagation and MUF to DX in less than a minute using the Northern California DX Foundation world wide beacon system.

First, you need to put the following frequencies in sequence (low to high) into your radios memory for CW. 14100, 18110, 21150, 24930, 28200. (You may need to enter a slight offset to hear a good CW tone, like 14199.6, 18109.6, 21149.6, etc.)

If you want to check the propagation and Maximum Usable Frequency to New York, tune in 4U1UN (United Nations HQ in NYC) listen at 0:00 on 14100 kHz, then switch to 18110 at 0:10, switch to 21150 at 0:20, switch to 24930 at 0:30, switch to 28200 at 0:40. You can easily tell which frequency has the best propagation in less than a minute.

If you want to check the propagation to San Francisco listen for W6WX at 0:20 past the cycle start time on 14100, Then switch to the next higher band you have stored in your memory bank every ten seconds and if the next higher band is open you will hear W6WX .

If you have a good Atomic Clock (WWVB) or accurate clock you can identify the beacons without even knowing the Morse Code.

Each beacon has a ten second slot, They send their call sign (CW at 22 WPM) followed by 1 Dash at 100w, then 3 dashes at 10W, then 1W then 0.1W. If you can hear all the dashes, the band is really open.

The 14100 kHz cycle starts at 00 at the beginning of the hour and repeats the cycle every 3 minutes: 00, 03, 06, 09, 12, 15, 18, 21, 24, 27, 30, 33, 36, 39, 42, 45, 48, 51, 54, 57...minutes past the hour.

The table below is a listing of the worldwide Northern California DX Foundation Beacon List. This table gives the minute and second of the start of the first transmission within the hour for each beacon on each frequency.

Call	Location	14.100	18.110	21.150	24.930	28.200
4U1UN	United Nations	00:00	00:10	00:20	00:30	00:40
VE8AT	Canada	00:10	00:20	00:30	00:40	00:50
W6WX	United States	00:20	00:30	00:40	00:50	01:00
KH6WO	Hawaii	00:30	00:40	00:50	01:00	01:10
ZL6B	New Zealand	00:40	00:50	01:00	01:10	01:20
VK6RBP	Australia	00:50	01:00	01:10	01:20	01:30
JA2IGY	Japan	01:00	01:10	01:20	01:30	01:40
RR9O	Russia	01:10	01:20	01:30	01:40	01:50
VR2B	Hong Kong	01:20	01:30	01:40	01:50	02:00
4S7B	Sri Lanka	01:30	01:40	01:50	02:00	02:10
ZS6DN	South Africa	01:40	01:50	02:00	02:10	02:20
5Z4B	Kenya	01:50	02:00	02:10	02:20	02:30
4X6TU	Israel	02:00	02:10	02:20	02:30	02:40
OH2B	Finland	02:10	02:20	02:30	02:40	02:50
CS3B	Madeira	02:20	02:30	02:40	02:50	00:00
LU4AA	Argentina	02:30	02:40	02:50	00:00	00:10
OA4B	Peru	02:40	02:50	00:00	00:10	00:20
YV5B	Venezuela	02:50	00:00	00:10	00:20	00:30

<sup>33</sup>For complete information on the Northern California DX Foundation or NCDXF Beacons go to the NCDXF web site:

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<sup>33</sup> <http://www.ncdxf.org/beacon/beaconschedule.html>

If the bands are dead, maybe using a 100w station instead of a 10W station might help somewhat, but not that much. Why not just change modes?

### **Power Density: SSB and CW**

Assuming a SSB signal takes up 2000 Hz., and comparing a 100 watt 25 WPM CW signal with a 100 watt SSB signal, we have the following.

The average power density for CW is 100W / 100 Hz. or 1 w/Hz. For SSB it's 100W / 2000 Hz. or .05 w/Hz. We could say that the gain in using CW over SSB is Gain(db) = 10\*log(1/.05) which is about 13db.

If we use the formula given by the FCC in EPA FCC OET Bulletin # 65, it states that power density equal to:

$$S = \frac{P \times G}{4 \times \pi \times R^2}$$

S = Power density

P = Power input to antenna

G = Power gain of antenna

R = Distance to center radiation of antenna

The calculated power density of a 100w SSB signal using 0db gain at one meter is 0.796mw/cm<sup>2</sup>.

The calculated power density of a 5w CW signal using 13db gain at one meter is 0.794mw/cm<sup>2</sup>.

Therefore we could estimate that all external factors being equal, a 5w CW signal could be heard approximately the same as a 100w SSB signal on the air. Again, this is all hypothetical, but many CW operators, myself included, believe this to be the case. Whether it's 13 db is debatable, but CW will give you a "bigger bang for your buck" than many voice modes.

If CW can be heard better given the same power output as a SSB transmitting station, this means that a pedestrian mobile operator needs less power output to be heard on the bands. Less power output usually equates to a smaller radio, smaller battery and less weight! This means more time on the air and more fun!

This doesn't mean that operating SSB isn't fun. In fact, if the band is open, I have had a ton of fun running the bands while operating my radio using SSB. The main point I'm trying to make is that a CW signal can usually be heard in questionable band conditions while a voice signal may not be copied by most operators.

Is CW the better mode to use then? Not really, the best mode to use is the one you have the most fun operating with at that time. Maybe CW today or SSB tomorrow? But, please remember that if you want to use less power output to make contacts CW usually is the way to go on the air. Less power means less battery capacity means less weight means more fun!

But, if the bands are open, you can operate voice or CW and still have lots of fun with less power output. I remember a few years ago when 10M was open all the time and an amateur radio operator could talk around the world with one watt!

I once was hiking on the Appalachian Trail in Virginia with my Elecraft K2 Transceiver. I stopped along the AT and setup my Elecraft K2 Transceiver with a 40M dipole. I then made a contact with a station back home in Pennsylvania using SSB and he sounded like he was sitting next to me.

We chatted for about a half hour using SSB while I was running 100mw! Maybe if the sunspots change, we will again have those great band conditions.

I once operated my Icom 703 Plus HFpack on the AT in Pennsylvania using 5w on 20m one Saturday afternoon. I made one call and never called CQ again for two hours!

I ran Europe that Saturday afternoon and had a real blast using 5W power output and CW . I had a few things working for me that afternoon. The 20M band was in fair shape, I was operating CW and I had elevation.

**Elevation:** I can't say enough about operating from higher elevations. It's like having an amplifier on your back! I never believed that elevation made a significant difference when using HF – boy was I wrong!

Operating from a higher elevation using HF just smacked me in the face during a PA QSO Party. We where operating from a large RV vehicle and I was operating SSB on 40M. As the vehicle gained elevation up the mountain, my Q-Rate started to increase. At the summit I had a pileup on me! But, as the vehicle descended from the summit, my Q-Rate decreased until at the bottom I couldn't make a contact. We all started yelling at the driver, “ go back up!”

I'm trying to make three points here:

- 1- CW usually requires less power output to communicate.
- 2- Great band conditions mean low power CW or SSB will work!
- 3- Elevation means less power output needed to communicate.

# 10

## Keys, Paddles etc.

If you do decide to operate CW, you'll need some sort of key or paddle. Yes, to send those dits and dahs out over the airwaves your hand will need to mechanically make contact with a key or paddle. What type of device you decide to use is completely up to you the pedestrian mobile operator.

What factors influence whether you use a key or paddle will depend on how you plan to operate.

**Speed:** The speed you plan to send at will dictate if you will use a key or paddle. If you operate CW or Morse at 10 wpm or less, a straight key or any type of paddle will work just fine. But, if you plan to operate at 20wpm, maybe a paddle would feel more comfortable to you. You can operate Morse at 20wpm with a straight key, but your hand will get tired after an hour or so of operating at that speed. There's really only one answer as to what type key or paddle to use. The answer is to use whatever type feels good to you!

**Location:** This might sound like an odd factor to pick a key or paddle, but just think about all the things that you'll be walking through and around in the field. Here in Pennsylvania most summits have lots of trees and low-hanging ones too! We also have a bunch of sticker bushes etc to contend with in the field. A large paddle or key just wouldn't cut it while walking around in the woods here. But, if you have wide open spaces to walk around with little or no trees etc, you could use any type of paddle or key.

**HFpack Setup:** This one factor will influence what type paddle or key you use in the field more than any other factor. I don't hold a radio control head or anything from the radio in my hands. Therefore, I can hold my paddle in my hands.



The picture to the left shows how Ken, K0HL/pm operates his pedestrian mobile HFpack. By having a shelf in front of himself, he now may use a larger paddle or key to operate as he has plenty of room. Please also note that the shelf is supported by using a strap around the back of his neck. I have seen others use this same method and all seem to like it. This way the pedestrian mobile operator can let go of the shelf and still use his or her hands say for

logging etc. Take a close look at Ken and you'll see he is ready to operate SSB or Morse. This guy is ready for anything!

The picture below is Ken, K0HL/pm operating pedestrian mobile with the Icom 703 Remote Head and a paddle on his shelf. It's not that small of a paddle, but he seems to enjoy using it.



Pictured below is the author, WA3WSJ operating pedestrian mobile from a local Reading, Pennsylvania Landmark – The Pagoda. Please note that I

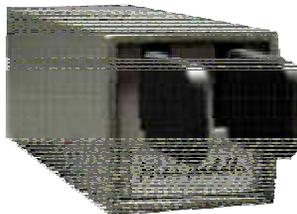


use a clip arrangement on my waist to mount the Icom 703 Remote Head. I'm holding a Palm Paddle in my right hand. This works great, but what do you do to log? If you look closely on my right shoulder, you'll see a white patch. That white patch is part of a Velcro Tape Holder that I use in the field. I send CQ and when someone comes back to me, I then simply push my Palm Paddle on the Velcro Tape to keep it on my shoulder. I then grab my logbook from my pocket and start to log. This arrangement works great for me in the field.

Pictured below is my <sup>34</sup>Palm Paddle. I really like this paddle because of one nice feature – the paddles slide into the enclosure. This feature has saved my paddle more than one time in the field. Let's face it, if you're walking around in the outdoors with a HF pack on, odds are that sometime you will drop your key or paddle.

When I'm finished with this paddle, I simply push it back in the enclosure for safety.

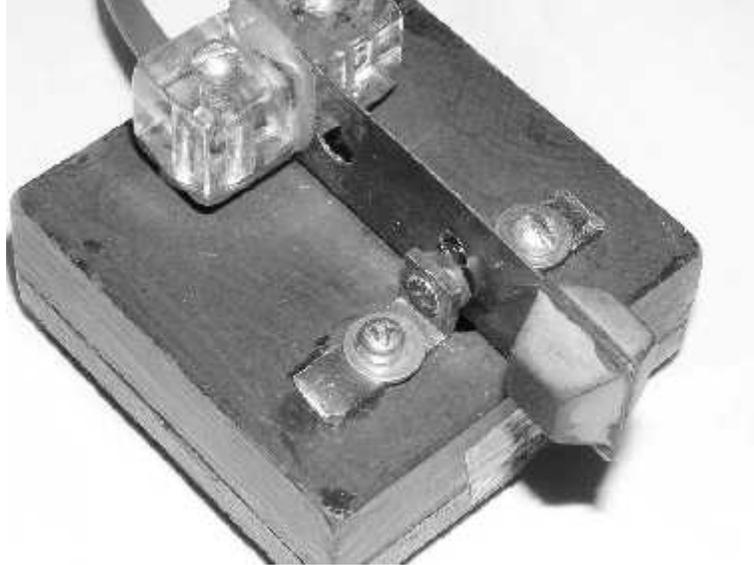
The cable also just plugs into the case so you can simply pull it off when finished operating in the field to save some valuable space!



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<sup>34</sup> <http://www.palm-radio.de/>

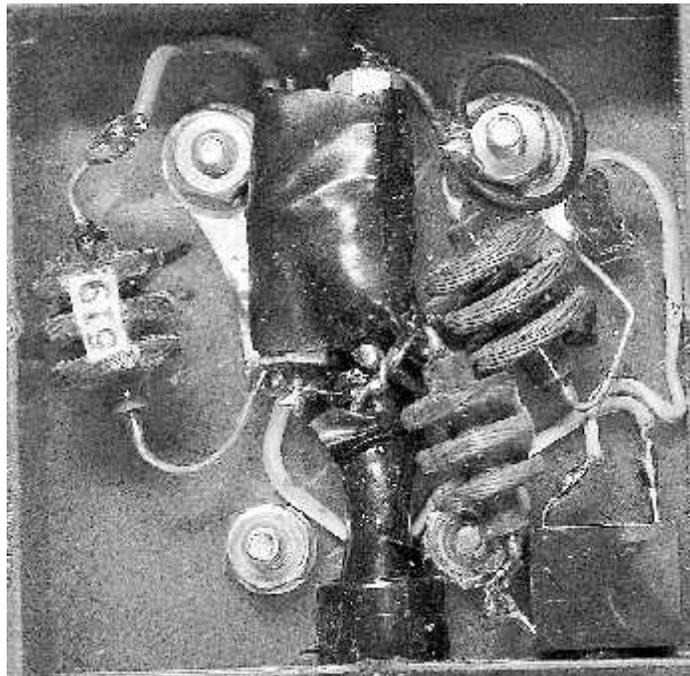
Paul Signorelli, WORW describes his key as follows, “This is my main key...The original key had the plastic swinger break, so I replaced it with BeCu -Beryllium Copper. I use my “Ruggedized Greenrook MK33 single lever action key. It has filtering inside to prevent RF burns. Simple, no adjustments...”



The original key was a Whiterook MK33 manufactured by Whiterook Mini keys. Paul, WORW also added some filtering inside the plastic enclosure to stop RF radiation from reaching his body through the key.

Pictured below is a RF filter that Paul, WORW installed in his Whiterook MK33 Key to prevent RF from reaching his body etc. This type of filter may be needed if you run at power levels over five watts. But, I have felt RF “tingling” my hands even at 3-4 watts of RF power. As you can see, Paul had plenty of room to install all the filter components in the enclosure. <sup>35</sup>Whiterook makes a complete line of mini keys some with built in keyers etc.

What key or paddle you use is really more a personal thing as many Morse operators say they use a particular key or paddle because they “like the feel of it.” While others, like myself, use what feels good, but must also be small and compact.



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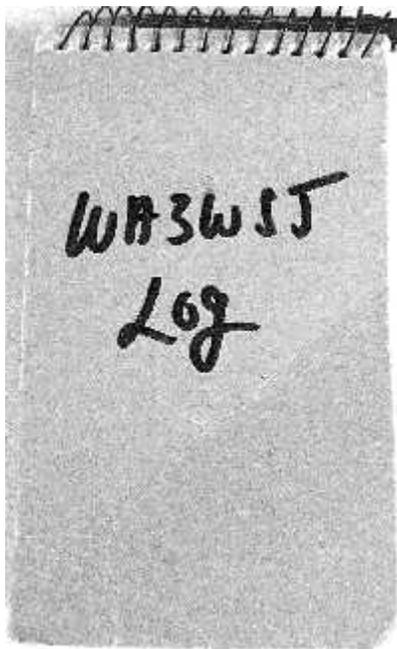
<sup>35</sup> <http://electronicsusa.com/mk.html>

# 11

## Logging etc.

So, we've covered many topics relating to pedestrian mobile operation, but now that you have your pedestrian mobile station operational, how do you log all the contacts you'll make in the field?

Do you take a computer with you? Maybe you'll want to use a PDA, smart phone or other similar devices? Well, let's just dial it back a bit and go "old-school." While all those fancy gadgets work fine, I've found that a simple small spiral notebook and a golf pencil work best for me. The cost of the small 5" x 3" spiral notebook is around fifty cents and the golf

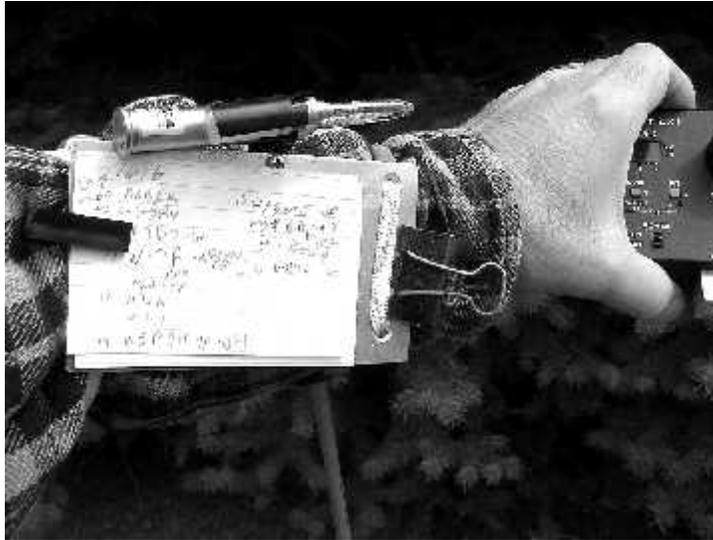


pencil was free! The best thing about the small notebook is that it stores almost anywhere. I have put it in my pants pocket, my jacket pocket, stuffed under my belt, etc.

The picture to the left is one of my cheap logbooks that I use in the field.. It fits almost anywhere you want to put it and the golf pencil stores in it. This single attribute makes it an ideal logging instrument! It's lightweight, small and inexpensive. What more could you want to log with in the field!

One main positive feature with this logbook is that in winter when the temperature is below freezing, the pencil works fine. If you use a pen, most of the time the ink will freeze!

Below Paul, WORW/pm is using a wrist-logging unit to log his contacts in the field. What looks like a microphone is actually a portable light for night operation. As you can see, Paul, WORW/pm holds his Elecraft KX1 in the same hand as the log and writes in the log with his right hand. This setup is small, Lightweight and very portable for the field.



**Electronic Logging:** While many pedestrian mobile operators use manual logging by using paper, other operators like to use electronic devices to log. The number and type of electronic devices on the market for the pedestrian mobile operator are almost infinite! Therefore, this handbook will only list a few of them.

**Computer:** Computers are really great to use for logging, but walking around in the outdoors requires the pedestrian mobile operator to simultaneously do several things. He or she has to operate a radio, use a key or microphone and log the contact. While this is easy at home, the pedestrian mobile operator is loaded-down with gear so logging is often just a tertiary item. Even small computers take up valuable real-estate on the pedestrian mobile operator. There are two other items that make a computer not the best device to use for logging. All computers use power and all must display things on a screen. Extra batteries add weight and limit time in the field. The display also may be hard to read in the sun.



**Digital Voice Recorder:** Digital voice recorders or DVRs are used by many pedestrian mobile operators. Today DVRs are small, lightweight. The battery required to power this type of device need only be one or two AAA batteries! <sup>36</sup>Here's what PC Magazine says about DVRs, "PCMag.com occasionally rates digital voice recorders, and its reviews are detailed and backed by hands-on use. This listing is updated periodically. The current front-runner is the Olympus WS-500M shown to the left which was named an Editors' Choice in 2009. Other top picks include the Philips LFH 0662 and the Sanyo ICR-FP600D."

Some features to look for in a DVR for pedestrian mobile use are size, weight, ease of use, battery life, audio file types and how easy is it to transfer files to your computer at home.

**MP3 Player:** In fact many MP3 players play back audio and include a microphone to record audio so they make great loggers for the field. These devices are extremely small, lightweight and can be powered by only one AAA battery!



The picture to the left is a ScanDisk MP3 Player similar to the one that the author uses for portable operation. I use it to send CQ on SSB and record QSOs . It measures only 3" x 1.25" x 1" and weighs-in at about 2 ounces!

It's powered by one AAA battery that lasts for a while. The model number I use is a ScanDisk m240 with 1G memory.

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<sup>36</sup> <http://www.consumersearch.com/digital-voice-recorders/reviews>

Here's how Tim Hayes, NH0H logged his pedestrian mobile contacts. "...Once I got everything set up for PM operating (radio, pack, antenna, etc), I would clip the recorder to either my shirt collar or the pack strap, turn it on and turn on the voice activation. As I walked and either called CQ or another station, the voice activation would start recording everything I said. If the environment wasn't too noisy the little machine would also pick up most of what came out of the radio's speakers.

When I got home, I would listen to the recording and log the info. Although this sounds laborious, it wasn't really as an hour's walk and several QSO's might only yield 5 to 10 minutes of conversation. Also, I almost forgot ... at the start of each QSO I would look at my watch and say the time so that would also be on the recording. Most of the time I also remembered to record the time at the end of the QSO."

There were a few problems with this set up:

- As this was the early days of voice activation, the first syllable or two of each recording might get clipped. It sometimes took the little recorder a little time to get started.
- Sometimes, when it got noisy, my recording would sound garbled and be difficult to interpret. Again this was the early days for these little devices and I am sure that the newer ones are much better (and probably a lot cheaper now).
- One time the little clip on the back of the recorder came loose and I dropped the recorder in the woods. It took a couple of hours to find it. After that I bought a little microphone that would plug into the recorder, clipped that to myself and carried the recorder in my pocket! I think the mic cost less than \$10 at Radio Shack.

Another example of pedestrian mobile logging is given by Matt Ireland, MW3YMY. Matt says that, "I use my mobile telephone to record QSO details. Very quickly, I say the call of the other station, the frequency, and the start time into my phone towards the beginning of the QSO. I then record the other operator's name and end time of the QSO after the QSO. I then listen to the recording and transfer it into my station log when I get home. It is not terribly efficient, but it saves writing whilst walking. I have also just used a simple notes application on the mobile phone and written down the details, but I prefer to look where I am going whilst walking, rather than typing."



Matt bring up another subject walking and safety. Yes, by all means you the pedestrian mobile operator must watch where you are walking. By writing the log information in the logbook, your eyes must leave where you are walking. That's why I always stop walking as I write down the log information in my logbook. I then usually just continue walking as I work the station.

37**HamLog** is an amateur radio logging application. It maintains past contacts in chronological order giving the user the ability to quickly add new and edit existing contacts. It is meant for use when operating portable from the field or mobile (drive safe!). It supports automatic name and QTH lookup via 3G or WLAN and supports exporting contacts via email as CSV, as ADIF over WLAN, to your favorite computer based logging program. You can also do bulk export directly to eQSL.cc. HamLog supports iPhone, iPod Touch and iPad.

**Features:**

- \* Contact Logging and search
- \* Export via email as CSV, ADIF, or eQSL.cc
- \* Import ADIF
- \* Automatic name/QTH resolution based on callsign
- US Callsigns Only (Currently)
- \* Independent callsign look up tool
- \* Q signal list
- \* IARU Prefixes List
- \* DXCC Entities List
- \* US Band Plan
- \* QRZ Look Up via Web
- \* Latest DX Spots from DX Summit
- \* ADIF Export
- \* Grid Square tool using GPS
- \* Manual Grid Square Calculator given lat/long
- \* Bearing (and long path) calculation given two grid squares,
- \* WWV Propagation report
- \* Contest Calendar
- \* Wavelength Calculator
- \* UTC Clock
- \* PSKReporter.info search and map display
- \* DX Cluster - real time telnet access



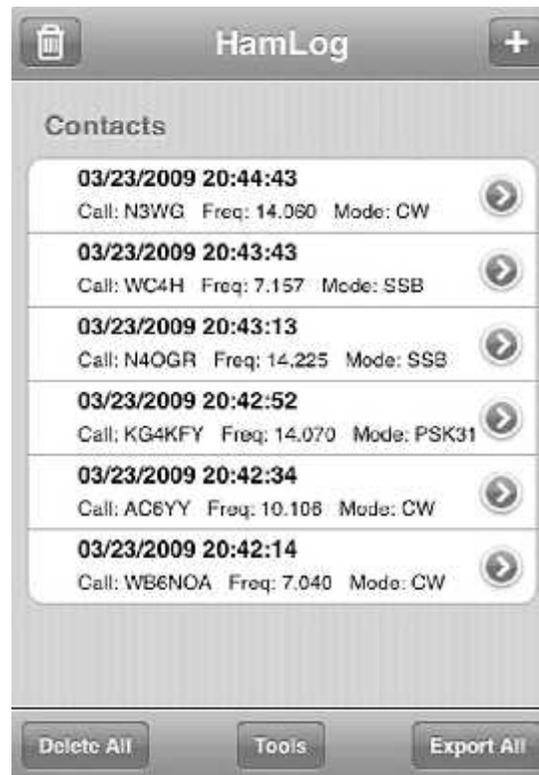
<sup>37</sup> <http://itunes.apple.com/us/app/hamlog/id308437400?mt=8>

- \* Grid to map - enter gridsquare and it will display it on a map
- \* Solar Data from NONBH ([www.hamqsl.com/solar](http://www.hamqsl.com/solar))
- \* Part 97 - Full Text

The iPad supports both Landscape and Portrait orientations.

Please NOTE: This application is not meant to replace a more formal method of logging such as a computer based logging application or the classic paper method. It is more for quick logging while portable or mobile.

**HamLog By Pignology** as of this writing, sells for \$0.99!





## Logbook of the World

Now that you have selected what type of device to use for logging in the field, it's time to figure out how you want to more permanently store your log data. You could just buy a paper logbook and transfer the data by writing your contacts from your field log to a paper logbook. Then you'll have to store the logbooks etc. What about storing them electronically, but not on your home computer? Want a safe and easy place to store all your field contacts? Why not try the ARRL Logbook of the World.

LoTW is a repository of log records submitted by amateurs from around the world. This online system is free to all amateurs and can track and confirm contacts for ARRL Awards etc. Better yet, it can store all your pedestrian mobile contacts you'll ever make out in the field!

I use LoTW for all my pedestrian mobile contacts. This is how I make sure all my contacts are recorded and stored in a safe place. My field log is a small 3" x 5" notebook where I write down all the contacts by pencil in the field. Then I take the notebook home and later enter them in a software program authored by Scott, N3FJP, called <sup>39</sup>AClog.

Amateur Contact Log or AClog provides full support for standard Amateur Data Interchange Format (ADIF) import and export. Export your whole log or selected records in ADIF for applications such as eQSL and the <sup>40</sup>ARRL's LoTW (Log Book of the World).

The next feature of AClog is really cool and I use it all the time. AClog will easily manage your log using Logbook of the World. AClog will sign and upload your contacts to LoTW and download your confirmations from LoTW. What I do is to type in to AClog all my pedestrian mobile contacts. I then hit a button and upload my contacts for that day. I don't save my contacts in AClog so I then just delete them all, but you could save them.

Try LoTW out as I think you'll like having all your QSOs in a safe and secure place where you can easily search and access your contacts.

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<sup>39</sup> <http://www.n3fjp.com/>

<sup>40</sup> <http://www.arrl.org/logbook-of-the-world>

# 12

## Military Surplus Gear

Today many pedestrian mobile operators use surplus military radio gear. Many Army/Navy Surplus stores sell the gear as do many online stores like eBay etc. This chapter will introduce the reader to military radios, but will not attempt to do an in-depth study on them as this subject could be a complete book. In fact Mark Francis, KI0PF, has written a book on military radios starting from the Korean War to present day entitled, “Mil Spec Radio gear.”

He has also authored an additional book entitled, “Mil Spec Radio Gear Volume 2.” Chapters include: HF Manpack/Portable Radios, HF Mobile Radios, HF Fixed Radios, VHF Manpack Radios, UHF Manpack /Portable Radios, Ancillary Equipment, Audio Accessories, Test Equipment and Specialized Equipment.

To list surplus military radios that can be used for pedestrian mobile operation, I asked for and have received a few pictures from pedestrian mobile operators. Again, I would like to thank them for providing the information. It's beyond the scope of this handbook to list all the military radios that could be used for pedestrian mobile operation. Therefore only a few have been included in this text.



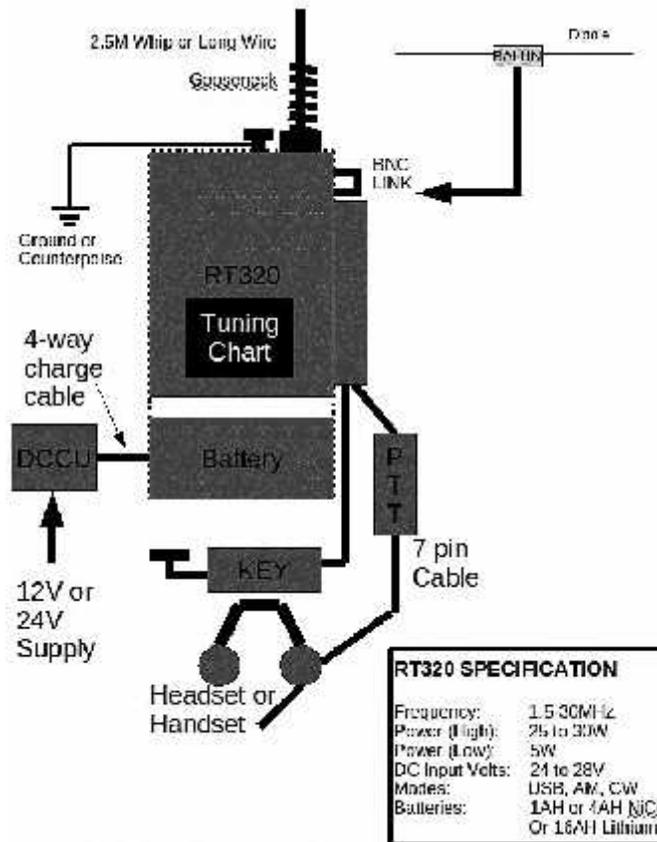
Matt Ireland, MW3YMY, is shown operating with his **Plessey RT-320**. “The radio is an RT-320 (ex British Army). The 24V battery clips onto the bottom of the rig and vertical antenna on top. The rig has an built in antenna tuner, which is very convenient. I usually trail a long radial behind me when out portable. The only downside is it is difficult to change frequency without taking the radio off your back, but I don't mind taking it off my back to tune around if necessary.”

The Plessey RT-320 Transceiver will operate on AM (6KHZ), CW-Wide (2.7Khz), SSB (USB 2.7Khz) and CW –Narrow ( 250 hz). The frequency range of this unit is 2 mhz to 30mhz selectable using a main frequency range switch and six frequency decade switches.

The radio operates at two power output setting 3W or 30W. The battery is a 24VDC/ 3.3AH capacity that the manual states will last for twelve hours at a 1:9 Transmit/Receive Ratio.

## Plessey RT-320 / Clansman320 Transceiver

The illustration to the right depicts how this radio can be used in the field. Please note that a dipole can be connected to the BNC connector on the side and used to operate from a portable location in the field.



Although the radio only operates SSB on USB, there is a documented modification to install LSB in this transceiver. This modification will allow for LSB operation in the amateur radio bands.

**PRC-1099:** The picture to the right is Dennis Starks, KB0SFP using his PRC-1099 Manpack in the field. The PRC-1099 specs are as follows:

Frequency: 1.6 mhz – 30 mhz

Channels: 284,000

Memory Channels: 10

Voice: (300 – 2700 hz)

Modes: USB/LSB, CW Data

Voltage: 12vdc – 15vdc

Hi Power: 20W @ 1.5A

Lo Power: 5W @ 1A

RX Current: 130ma

Battery: Lithium, Sealed Lead Calcium

Battery Life: Hi Power 50 hrs  
9:1 RX-TX Ratio



PRC-1099

Below is John Vendely, K9WT running the 51mc Cold War Net at Dayton 2010. John is using a PRC-70 Transceiver.



**PRC-70:** Technical data:

Channels: 740

Modes: AM, SSB, CW, FSK (2 -76 MHz)  
FM (30 .. 76 MHz)

HF: CW, SSB, FM, FSK : 21 .. 42 W

AM: 7.5 W carrier; 30 W PEP

Bandwith:

SSB/FSK/CW 2.8 kHz, AM 6 kHz, FM  
32 kHz

Voltage needed: 24 .. 32 V

1972 (Built by: Cincinnati)

Consumption: Receiving: 7 W

Transmitting low output: 50 W

Transmitting high output: 160 W ( FSK,  
CW, FM, AM)

Transmitting high output: 115 W ( SSB)

Powered by:

Hand generator G-76/G with cable CX-13175/G

(PRC-70 itself needs cable CX-13176/G)

Power supply / charger PP-6148/U

Battery BB-542/U

Antennas:

Rod antenna short 6 feet; AS-2976/PRC-70 (for 4 ... 76 MHz)

Rod antenna long 9 feet; AS-2976/PRC-70 (for 3 ... 76 MHz)

Dipole antenna AS-2975/PRC (for 2 ... 30 MHz)

Pictured below is Joe Munson, WA4VAG with his PRC-515 at Dayton 2010.

**PRC-515:** Technical Data

Frequency : 2 to 30 MHz

Modes: USB, LSB, AME, CW, DATA from external line audio input

RF Power: 20 Watts pep

Tuning Time: 2 seconds

Receiver Sensitivity:  
0.5uV SSB, 2uV AM

Power: 25 VDC nominal, full performance from 22 to 30 VDC.

Accessories:

Handset: H-189/GR or H-250/U

Antennae: 2.4 meter whip (AS-5093/PRC-515), long-wires and dipoles

Antenna (Whip Body Only, No Base): p/n 013-1577-010 (96" long extended)

Vehicle Whip: AB-652 base with 3 x MS116A, 1 x MS-117A and 1 x MS-188A elements

Mount, Antenna: p/n 635-5246-001 or 635-5246-002

Remote: Removable control head

Battery: BB-706/U, Nickel Cadmium, 25.2 VDC, 1.8 A/Hour (10 hours time capacity)

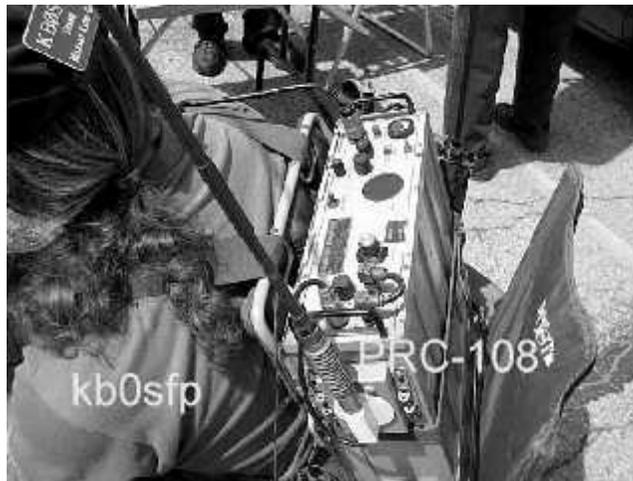
Battery Pack (Cells Only): p/n ST-1108, 21 X RC2-C type cells in series

Hand Generator, DC: G-5002/PRC-515

Harness (Packset): MT-5167/PRC-515



**PRC-108:** The picture below is Dennis Starks, KB0SFP walking around Dayton in 2010 with his PRC-108.



Frequency Coverage: 2 to 30 MHz in 100 Hz steps  
Modes of Operation: USB, LSB, AME, CW, DATA from external line audio input  
RF Power Output: 20 Watts pep/average into a 50 Ohms load  
Tuning Time: 2 seconds nominal, 7 seconds maximum  
Range: Short for ground communications and long range using sky-waves  
Receiver Sensitivity: 0.5uV ssb, 2uV am  
Power Requirements: 25 VDC nominal, full performance from 22 to 30 VDC.

Accessories:

Handset: H-189/GR or H-250/U  
Antennae: 2.4 meter whip (AS-5093/PRC-515), long-wires and dipoles  
Antenna (Whip Body Only, No Base): p/n 013-1577-010 (96" long extended)  
Vehicle Whip: AB-652 base with 3 x MS116A, 1 x MS-117A and 1 x MS-188A elements  
Mount, Antenna: p/n 635-5246-001 or 635-5246-002  
Remote: Removable control head  
Battery: BB-706/U, Nickel Cadmium, 25.2 VDC, 1.8 A/Hour (10 hours)  
Battery Pack (Cells Only): p/n ST-1108, 21 X RC2-C type cells in series  
Hand Generator, DC: G-5002/PRC-515  
Harness (Packset): MT-5167/PRC-515

**PRC-319:** The picture below is Paul Signorelli, W0RW/pm, operating his PRC-319 using RTTY near Colorado Springs, Colorado.



The PRC-319 was built by MEL (Mullard Electronics Ltd) for the UK Ministry of Defense (MOD) around 1988. MEL was a Philips subsidiary and was later sold to Thales. Support for MEL equipment has been discontinued.

This radio was primarily used by special operations units in Britain, Australia, and New Zealand. It was built by M.E.L. in the U.K. Included is an Electronic Message Unit, which is a small keyboard that allows transmission of data.

PRC-319 Technical Specifications:

All solid state, 1.5 MHz to 40 MHz, Transceiver w/automatic antenna tuner.

Power levels are selectable at 5W or 50W; Modes are CW or SSB USB only - USB voice mode uses 'The Third Method' to generate single sideband or Data

Stability is better than +/- 0.5 ppm, -31C to +55C and is NTIA Approved

The radio is sealed and will withstand immersion in 6 feet of water.

Pack weight is 20 pounds with small NiCad 1.2 AH or with a Li Ion pack attached, It is 25 pounds with 4 AH NiCad battery pack.

It has a 10 channel receive and 10 channel transmit (Fixed frequency operation only) memory. It has no frequency dial or up/down buttons to 'tune' around.



PRC-319

# 13

## Amateur Radio Spotting Networks

You have your pedestrian mobile pack ready for the field, but you now need to let others know when and on what frequency you plan to operate. You could just go out and call CQ, but remember that will take its toll on your battery.

What if you could head out to operate pedestrian mobile in the field and many operators in the field and at home would already know your call sign and what frequency you are operating on at that time. Yes, this sounds like a dream, but it's now a reality for most hams. Even if you have been out in the field for days without human contact, you still can let others know that you are operating in the outdoors!

### Twitter QRPSPOTS

<sup>41</sup>**Background:** The initial goal was to receive and send “spots” while away from an internet connection using your cell phone. In particular, using the standardized SMS (Short Messaging Service protocol ...see <http://en.wikipedia.org/wiki/SMS> for more detail) or “texting”, could a ham radio “spot” message be sent via your cell phone and have that “spot” message delivered to subscribers on their cell phones? If so, this would enable any “field operator” to interact with the internet via the SMS texting network and receive “spots” from other field operators from their cell phone. So I can now share information, i.e. “advertise”, my transmitting station frequency with others who might be interested thereby facilitating a contact. So how is this accomplished?

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<sup>41</sup> <http://qrspots.blogspot.com/>

Here's some recent history on how QRPSPTS came into existence. Guy Hamblen, N7UN states, that, "in mid-2008, I was sending/texting SMS messages to friends, not unlike other teenagers, using Twitter as a framework.

Twitter made it easy to propagate a direct message to one other single account. Twitter itself does not have a "groups" feature. But the Twitter folks published their API ("application programming interface") which allowed for a "groups" feature external to the Twitter network. So I established QRPSPTS as a Twitter group, which allowed any messages from that group to propagate to all group members.

Several months after this network was established in the spring of 2009, Martin Gillen, VA3SIE, extended this network by taking one of these group messages, parsing it for correct syntax and error detection/correction and then forwarded that message to [www.qrpspots.com](http://www.qrpspots.com), a separate and independent web-based application. So now my Twitter-originated message would show up on [www.qrpspots.com](http://www.qrpspots.com). Then, by working closely with the web-based [www.qrpspots.com](http://www.qrpspots.com) application, Martin had it send web-originated messages to the Twitter network for propagation to all subscribers. Now you effectively have an integrated network between two disparate applications, Twitter and [www.qrpspots.com](http://www.qrpspots.com). In addition, Martin polls for messages in the APRS.fi network (APRS originated messages) and propagates them into these two networks.

A more complete history and explanation occurs in the Feb 2010 issue of QST on page 72.

See <http://qrpspots.blogspot.com/> for complete instructions on how to setup and use this network messaging system.

I personally find it very useful to "spot" the beginning of my field portable operations to this network. The Twitter-based QRPSPTS group has over 350 followers today and likewise, many hundreds of folks monitor [www.qrpspots.com](http://www.qrpspots.com) for activity. I get a 10-20 qso "spike" or pileup within minutes of spotting my operation via the SMS cell phone network. In comparison, without using this system, I can call CQ for many tens of minutes and only have 1 or 2 contacts. So does it work? Invariably yes!"

Twitter QRPSPOTS spots to:

- 1- On every cell phone which is following by phone on Twitter
- 2- On <http://qrpspots.com/>
- 3- On <http://www.obriensweb.com/sked/> (under FISTS).
- 4- On the International DX Cluster
- 5- Two APRS Networks

As you can see, by sending one text message, you will announce to hundreds if not thousands of hams what frequency, time and band you are operating on out in the field – cool!

#### 42DXSummit

DXSummit is an online spotting network for those who want to work DX. The site has some nice features such as DX Spots, Band Spots, announcements and a search feature. Using the search tool, I typed in my call WA3WSJ and here's what popped up for 2011.

W7CNL-@ 14059.6 WA3WSJ/PM Ed ped mobile  
1748 01 Jan United States

OZ1PMX-@ 3583.0 WA3WSJ OLIVIA 8/500 Net  
0130 24 Nov United States

SQ4GXF 14072.6 WA3WSJ tnx BPSK31 QSO, 73 !  
1243 11 Aug United States

KC0CF 50098.5 WA3WSJ FN20<es>en32  
1435 16 Jul United States

W9RM 50099.0 WA3WSJ EN52RB<ES>FN20  
1435 16 Jul United States

WA3WSJ-@ 14260.0 WA3WSJ QRP via @WA3WSJ: WA3WSJ  
14260 185 1854 11 Jul United States

WV9E 50125.0 WA3WSJ en43<>fn20  
1529 10 Jul United States

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<sup>42</sup> <http://www.dxsummit.fi/DxSpots.aspx>

K2OWR 50130.0 WA3WSJ EM75<ES>FN20 lid....anybody re  
 1453 10 Jul United States  
 WA3WSJ-@ 7030.0 WA3WSJ QRP via @WA3WSJ: WA3WSJ  
 7030 2005 2006 18 Jun United States  
 N3SW-@ 7030.0 WA3WSJ QRP via @N3SW: Wa3wsj 7030  
 2108 10 Jun United States  
 S51RS 14070.0 WA3WSJ BPSK-31  
 2021 08 May United States  
 PA0DX-@ 14071.5 WA3WSJ BPSK31  
 2103 03 May United States  
 W7CNL-@ 4060.0 WA3WSJ ed on mt penn with polar bears  
 1942 27 Feb United States  
 TF3IG-@ 14081.5 WA3WSJ RTTY via Direct or bureau Edward  
 R 1622 24 Feb United States  
 VA3MJR 7264.0 WA3WSJ Lightship Overfalls ARLHS USA-  
 1842 08 Aug United States  
 VA3MJR 7266.0 WA3WSJ Lightship Overfalls ARLHS USA-  
 1711 08 Aug United States  
 N9GWO 7264.0 WA3WSJ LITE SHIP DEL  
 1408 08 Aug United States  
 VE3ZZ-@ 14286.9 WA3WSJ LH USA-222 Delaware  
 1953 06 Aug United States

As you can see, the list gives the call who listed the DX , frequency, DX  
 Call, message time, date and country. This is a really handy spotting  
 network to use to find some rare operations etc.

The link below is where to find this great online spotting network.

<http://www.dxsummit.fi/DxSpots.aspx>

### 43DXWatch.com

The DXWatch is another online spotting Network. It works similar to the above DX Summits. This spotting network also has a search feature and here's what popped up when I searched WA3WSJ.

<a href="#">OZ1PMX</a>  <a href="#">WA3WSJ</a>	3583.0 [LoTW] OLIVIA 8/500 Net	0130z 24 Nov
<a href="#">SQ4GXF</a>  <a href="#">WA3WSJ</a>	14072.6 [LoTW] txn BPSK31 QSO, 73 !	1243z 11 Aug
<a href="#">N4VN</a>  <a href="#">WA3WSJ</a>	50098.5 [LoTW]	1435z 16 Jul
<a href="#">KC0CF</a>  <a href="#">WA3WSJ</a>	50098.5 [LoTW] FN20<es>en32	1435z 16 Jul
<a href="#">W9RM</a>  <a href="#">WA3WSJ</a>	50099.0 [LoTW] EN52RB<ES>FN20	1434z 16 Jul
<a href="#">WV9E</a>  <a href="#">WA3WSJ</a>	50125.0 [LoTW] en43<>fn20	1530z 10 Jul
<a href="#">K2OWR</a>  <a href="#">WA3WSJ</a>	50130.0 [LoTW] EM75<ES>FN20 lid....anybody remember that term?	1453z 10 Jul

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<sup>43</sup> <http://www.dxwatch.com/>

N3SW	 WA3WSJ	7030.0 70	[LoTW] QRP via @N3SW: Wa3wsj	2106z 10 Jun
S51RS	 WA3WSJ	14070.0	[LoTW] BPSK-31	2022z 08 May
PA0DX	 WA3WSJ	14071.5	[LoTW] BPSK31	2104z 03 May
TF3IG	 WA3WSJ	14081.5 Edward	[LoTW] RTTY via Direct or bureau	1622z 24 Feb

If you look at the entry spotted by N3SW in the above table, you'll see that it looks like N3SW spotted WA3WSJ. In reality, I used N3SW's cell phone while we were in camp on the Appalachian Trail in the State of Maryland. I spotted myself operating 40M on this network while camped on the AT using QRPSPTS!

These are just a few of the DX spotting networks that the pedestrian mobile operator can use for spotting your operation.

If someone makes a contact with you while you're out in the field, why not ask them to "post" you on one of the above spotting networks. As Guy, N7UN, says, "It's all about having more fun!"

Listed below are some amateur radio spotting networks that hams use today. They are all over the internet! The <sup>44</sup>DX Zone is a great place to find this and other amateur radio information.

### Amateur Radio Spotting Networks etc.

- **DX cluster Telnet links** - This page contains links to 60 DXcluster telnet sites around the world.  
<http://www.iw5edi.com/ham-radio/?dx-cluster-telnet-links,65>
- **DX Summit by OH2AQ** DX Summit Web Cluster, built up and operated by the members of OH9W OH2AQ Radio Club.  
<http://www.dxsummit.fi/DxSpots.aspx>
- **F5LEN Webcluster** - Web cluster F5LEN member of the European DxCluster network. <http://cluster.f5len.org/>
- **DXWatch** - Cluster spot filter service and web cluster, receive your filtered spots via email or icq. <http://www.dxwatch.com/>
- **Asia (((DX))) Window HF WebCluster** - All asian DX spots Web Cluster. Full time connection with Japan VHF BBS and Clusters.  
<http://www.dxscape.com/jacw.html>
- **DX Central** - DX web site includes DX cluster spots, DX news bulletins, band statistics, search spot archive and allow to receive DX spots in your mail box. <http://www.dx-central.com/>.
- **DX infos from Japan - DX Cluster From JAPAN**  
<http://www.big.or.jp/~ham/dx.html>
- **DX Lite - mobile phone cluster interface** - DX Cluster for mobile devices. Uses a lite interface to easily fit mobile phones display by G7VJR <http://dxlite.g7vjr.org/>
- **DX-Cluster nodes on maps** - Here you get pages with TELNET and HYPER links to all DX-Cluster Nodes in a graphic manner.  
[http://www.ampr-gates.net/dxc/intro\\_e.htm](http://www.ampr-gates.net/dxc/intro_e.htm)

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<sup>44</sup> <http://www.dxzone.com/>

- **[DX-Sherlock - QSO real time maps and listings](http://www.vhfdx.info/sitemap.html)** - Shows QSO and SWL in real time, taking data from many different sources (DX-Cluster, WSPR, Reverse Beacon). It also allows to send DX-Spots and more features. <http://www.vhfdx.info/sitemap.html>
- **[DXFun Web Cluster](http://www.dxfuncluster.com/)** - DX Cluster mainly in Spanish, with chat, filtering available upon user registration, propagation reports and solar status, includes also latest DX news. <http://www.dxfuncluster.com/>
- **[DXSpot.us](http://67.117.125.106/WebCluster/dx.asp)** - K6LLK Web DX cluster <http://67.117.125.106/WebCluster/dx.asp>
- **[EA3MM-5 Cluster](http://www.urb-ea3mm.org/)** - Telnet cluster from EA3MM, Barcelona <http://www.urb-ea3mm.org/>
- **[GB7MBC DXCluster](http://www.gb7mbc.spoo.org/)** - Offer a web and telnet cluster access along to forum and DX cluster stats <http://www.gb7mbc.spoo.org/>
- **[Ham Radio Deluxe DX Spots](http://dxcluster.ham-radio.ch/main.htm)** - Ham Radio Deluxe DX Cluster data is taken from the Amateur Radio DX cluster using DXSpider <http://dxcluster.ham-radio.ch/main.htm>
- **[IV3GKE web cluster and dx-call lookup](http://www.atr-br.com/cgi-bin/iv3gke/ham.pl?page=dx25)** - Single page live DX spots organized by Band. Includes an extremely fast call sign lookup. <http://www.atr-br.com/cgi-bin/iv3gke/ham.pl?page=dx25>
- **[Japan DX Cluster](http://www.big.or.jp/~ham/pubhtml/dxclhf.html)** - HF DX Web Cluster from JAPAN <http://www.big.or.jp/~ham/pubhtml/dxclhf.html>
- **[K7AR DX NorthWest Web Cluster](http://k7ar.net/WebCluster/dx.asp)** - Web cluster by K7AR <http://k7ar.net/WebCluster/dx.asp>
- **[NC7J DX Cluster](http://www.nc7j.com/)** - AR DX Cluster by W7CT and NG7M <http://www.nc7j.com/>
- **[Noantri WebCLX](http://webclx.noantri.org/)** - HamRadio Cluster by Noantri Dx Group ARI Roma <http://webclx.noantri.org/>
- **[ODXC Web Monitor](http://dx.obninsk.org/dxc.htm)** - Obninsk DX Cluster Web Monitor, telnet and Java based Web access. Offer a simple DX Cluster web interface. <http://dx.obninsk.org/dxc.htm>
- **[ON6LR web cluster](http://on6lr.dyndns.org:8200/)** - AR web cluster from Belgium <http://on6lr.dyndns.org:8200/>
- **[PI4CC DX Cluster](http://www.pi4cc.nl/cgi-bin/webcluster)** - Web cluster by PI4CC Contest Club <http://www.pi4cc.nl/cgi-bin/webcluster>
- **[QRSPOTS.com](http://qrspots.com/qrspots.php)** - QRP Spots, brought To You By The Four State QRP Group <http://qrspots.com/qrspots.php>

- [RadioCQ.com DX WebCluster](http://www.radiocq.com/) - RadioCQ DX WebCluster mainly in spanish offer a graphical web cluster with flags, band selector, locator using google maps, chat and forum.  
<http://www.radiocq.com/>
- [RadioSerwis - DX-Cluster](http://cluster.radio.org.pl/) - Polish DX cluster  
<http://cluster.radio.org.pl/>
- [S50CLX Palk DXCluster](http://s50clx.infrax.si:41115/) - S50CLX - Cerkno Linux - Palk DXCluster in Cerkno, Slovenia JN66XD <http://s50clx.infrax.si:41115/>
- [SK6AW DX-Cluster on the web](http://www.sk6aw.net/cluster/) - A flexible and configurable DX-Cluster with many options, ability to send spots, different skins, e-mail & push notifications and other features. Be sure to check out the "Options" page. (ex SM6.SE) <http://www.sk6aw.net/cluster/>
- [WC2L Web Cluster](http://dxc.wc2l.com/webcluster/dx.asp) - An AR-Cluster powered web interface to packet cluster by WC2L <http://dxc.wc2l.com/webcluster/dx.asp>

# 14

## Pedestrian Mobile Hazards and Safety

The pedestrian mobile operator faces a number of hazards operating in the great outdoors. That's not to say that most of the hazards can't be mitigated in the field. To find all of the possible hazards facing the pedestrian mobile operator is almost impossible, but with some investigation, most of the major hazards will be discussed in this text.

What type hazards will you face in the field? It depends on a number of factors such as the location you operate, time of operation, power output, weather and your physical fitness.

**Location:** The location you operate from could be a major source for hazards. Let's look at a few types of locations where the pedestrian mobile operator may want to operate his HFpack. In chapter two I discussed a few types of locations so let's start there.

**Neighborhood:** After you put your HFpack together, you probably will try it out by walking around your own neighborhood. This is a place full of potential hazards!

**Power Line:**

The first thing you must lookout for is an overhead power line. Remember that your HFpack has a metal stick up in the air ten feet or higher. Contacting an overhead power line could be fatal! Many newer communities now have underground power lines so this minimizes this hazard. When walking around, always keep an eye up in the air for potential wire hazards.

**People:**

Your neighborhood probably has a higher population density than most other places you will operate so beware! Yes, people are hazards because they really have no idea what you are doing out there walking around in the street etc.

They are drawn to you like bees to honey and will walk right up to you. If you are using 100W power output, they could get an RF burn if they touch the antenna! Always stop transmitting when people walk up to you. I still do this even operating at QRP levels. To minimize this risk I walk around my neighborhood during weekdays when most people are at work –hi!

**Vehicles:**

If you're operating in the street, they can and will hit you. Most people today are so busy doing other things while driving that they can easily miss a person walking in the street. It's not that they don't see you – their brain just isn't looking for you! Always be alert for moving vehicles. Even parked vehicles pose a hazard. All vehicles have tires and tires will grab drag wires! If you use a drag wire, make sure it has a break-away feature. I use an alligator clip to prevent my drag wire breaking or pulling me down should it catch something like a tire.

**Police:**

What would you think if you saw a character walking around the neighborhood with all kinds of electronic gear on his pack and a high “stick” up in the air? Yes, that's what a police officer sees when he or she looks at you! Again, your neighborhood will probably have more police driving around than out in the wilderness. Depending on the neighborhood, they might stop and ask the proverbial question, “what are you doing?” Just be prepared to explain to him or her that you're a ham radio operator. I don't say amateur radio operator as police and others in law enforcement tend to know the words “ham radio.” Sometimes that's all I say as they look at me – ham radio. They then just nod their heads that they now understand what the heck you're up to.

These are a few of the potential hazards facing the pedestrian mobile operator operating in a neighborhood. Is this all of them? The answer is a big NO! But, these are the major hazards.

**Parks:** Moving away from the neighborhood to a park mitigates some hazards such as power lines, but this location presents another set of potential hazards. People still use parks, but depending on the day of the week and time of day, the people hazard can be kept to a minimum. The pedestrian mobile operator now possibly encounters a new medium for his antenna – more earth!

**Local Park:**

Your local park will usually present higher hazards mainly because you're closer to people and things that people use.

Using a local park on a nice weekend during primetime hours will guarantee the greatest risk for trouble. If you use a local park during a weekday –less risk. Use the same local park during a weekday when the weather is cold or overcast presents far less risks. Local parks usually have more trees than a neighborhood so watch out for them. Local parks usually have more ground to walk on and this medium will change your antenna tuning compared to blacktop.

**State Park:**

Moving out farther yet is operating from a state park. State parks usually have more isolation as they are farther away from people. But, here again, a whole new set of hazards is presented to the pedestrian mobile operator. Far more ground is now found beneath your feet and less blacktop. An antenna tuner is a good idea right about now!

The people hazard is still present, but can be mitigated by the pedestrian mobile operator by operating in more remote sections of the park. Again, the weekends will present more of a people hazard than weekdays. State parks have more people in them in the summer than the other seasons. More trees are now in play and less blacktop etc.

Many state parks have higher elevation places to operate and this is a great way to work more stations as elevation means more propagation to different and more distant places such as working some DX.

**National Park:**

National parks are great ways to operate pedestrian mobile, but more isolation means greater risks. The terrain you will walk on may take on a whole new set of hazards. You now might be walking on dirt, mud, grass, snow and or ice! Yes, even in the summer season some national parks do have all of the above to walk on. The pedestrian mobile operator now has to do more route planning and weather-watching.

The pedestrian mobile operator now has to watch for animals and take the proper precautions. What do you do if you see a bear etc. The best advise is to educate yourself before you leave to operate in the park. Generally, look big and make noise for black bears, but for grizzly or brown bear encounters slowly back away or if need be, play dead.

Most black bears here in Pennsylvania will run away at the sight of a human. The best way to protect yourself outdoors is education!

**Trails:**

In the US alone there are thousands of trails. Your local park might have a trail in it. State parks usually have many trails all over the park. National parks have lots of trails some even have long distance trails in the park.

**Take a look at chapter sixteen where you can view a list of some of the many trails systems to operate pedestrian mobile.**

The hazards presented to the pedestrian mobile operator on a trail are all of the above and more! I have hiked and operated on the Appalachian Trail in the states of Pennsylvania, Maryland, New York, New Jersey, West Virginia, Virginia, New Hampshire and Maine. People are not a major hazard, but the terrain is a major hazard. As you walk many trails, you might encounter trees, rocks, steep mountains, snakes, bears, insects, water crossings, bad weather etc. The hazards are numerous, but with the proper planning you can mitigate these dangers.

The best advice to walk and operate pedestrian mobile on a trail is again – educate yourself! If you're new to walking or hiking, start walking around your neighborhood to operate. But, only do this if your doctor gives you a “clean bill of health.” Next, walk around your local park and operate. Then try a state park that is close to your home and operate there to gain some experience.

The more you operate pedestrian mobile, the more experience you'll gain about the terrain, your gear and most importantly yourself. Yes, the most important factor in all this stuff is – YOU! You have to know your limits as to how far to walk. You have to know your limit on how heavy a pack to wear. You have to know your limits on how much heat or cold you can take outdoors.

Basically – **YOU HAVE TO KNOW YOURSELF.**

But, the only way to know how much of all this you can take, is for you to gain some experience at operating pedestrian mobile. You have to start slow and keep adding to the experience.

## Mountain Peaks:

Mountain peaks can be really fun to operate as pedestrian mobile because you have higher elevation and usually have a great view. But, depending on the elevation, a whole new hazard is now introduced to the pedestrian mobile operator – altitude sickness.

### Altitude Sickness

<sup>45</sup>Most people can go up to 8,000 feet (2,438 meters) with minimal effect. If you haven't been to high altitude before, it's important to be cautious.

<sup>46</sup>When you are going to operate at 'Altitude' you need to be aware of the symptoms of altitude sickness. When you start to get dizzy and feel a slight head ache or light headed, you probably have it.

If you can't remember how to use the menus on your phone or radio, that is a sign. If you can not walk a straight line, like they make you walk when testing for DUI, You are sick. You must get oxygen right away or go to a lower altitude right away. You don't want to be driving down the hill when you are seeing double.

There are no guard rails. Here is one of many detailed web sites with more information:

<http://www.princeton.edu/~oa/safety/altitude.html>

The highest mountain peak I've climbed is Mount Washington in the State of New Hampshire at around 6,300 feet. Both my daughter and myself had no problem with altitude sickness, but we slowly gained elevation starting at 2,000 feet and two days later we made the summit of Mt. Washington. If operating above 8,000 feet and if you aren't accustomed to this elevation, you must acclimate your body before trying to climb to the higher elevations.

### Mountain Weather:

Weather in the mountains especially on mountain summits can be dangerous! As you gain elevation, the temperate will drop.

I once hiked Mt. Washington in July and on the Summit of it was 50 degrees Fahrenheit with 40mph winds - a nice day!

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<sup>45</sup> <http://www.princeton.edu/~oa/safety/altitude.html>

<sup>46</sup> W0RW

Many mountain peaks create their own weather. It can be sunny and warm down in the valley, but on a high mountain peak or ridge it may turn cold, windy with some rain thrown into the picture. You need to be prepared for all of the above when operating pedestrian mobile on a mountain peak.

**Never assume the nice weather up there will stay nice – it could cost you your life!**

I once was hiking with my daughter in the summer trying to summit Mt. Lafayette in the White Mountains of New Hampshire. Mt. Lafayette summit is only 5,249 feet high, but as we left the hut, we could see the weather on the summit wasn't the best. As we climbed, we encountered 70mph wind gusts and we couldn't see ten feet in front of us! Yet only a thousand feet down the mountain it was sunny, clear and warm. We decided to turn right and hike out Franconia Ridge Trail. We hiked only approximately one mile out the ridge and we now had sunny, great weather. Yes, the mountain can and will make its own weather!

**Beaches:**

Beaches really are fun locations to operate pedestrian mobile, but here again the people hazard is something you must contend with on a beach. The best advice I can give to the new pedestrian mobile operator is to pick a more secluded beach or location on a beach.

I usually go to Cape Henlopen State Park in the State of Delaware. The section of beach where the lifeguards are located for swimmers is always packed with swimmers etc. Yet, only about a mile down the beach it's empty! I operate around this part of the beach as I have it all to myself most of the time.

Another factor is time of day. Yes, if you operate after the swimmers are gone, that same beach that was packed with people will now be almost empty. Plus you will now probably be able to park your vehicle close to the beach.

If you see a storm approaching, get off the beach with your radio! Lightning can be miles away and still hurt you. It's best to play it safe and just go back to your vehicle and wait for the storm to pass or just call it a day.

Wear shoes as the sand gets really hot on a sunny day! Another item is hydration. Make sure you bring water or have water available to you while you're on the beach.

**Fire Lookouts:**

A fire lookout can be a great place to operate from as they are usually in higher elevation and more remote areas. This gives the pedestrian mobile operator a chance to make more contacts. But, with all the positive things associated with a fire lookout there are also more hazards.

Some fire lookouts are located near roads and you can drive right up to them. But, others are located in more remote areas and you will have to hike miles to get to one.

**The more remote – the more hazards!**

If you have to hike to the fire lookout, you'll need a map.

**NEVER hike unfamiliar terrain without a map.**

**Hiking Water Requirements etc.**

You'll also need to bring an adequate water supply or bring a water filter/pump with you and know where to find water during the hike.

There are three common methods for treating water: boiling, iodine tablets, and filters. It is a good idea to be prepared with one of these methods when hiking trails.

Under normal conditions, the human body will be able to go without food for days. Without water, however, problems come a lot quicker.

**The general rule-of-thumb is that a human body can go three weeks without food, but only three days without water.**

#### **<sup>47</sup>Plan your Water Needs**

- The absolute minimum is at least two liters per day. Take at least two liters with you even if you expect to find places where you can refill your water reserves.
- Take about one liter for every two hours of hiking with the above- mentioned two-liter minimum.
- Under normal hiking conditions, three to four liters per day should suffice.
- Higher temperatures will increase the needed fluid intake.
- Increased exercise will increase the needed fluid intake.
- If you plan to spend nights outdoors while hiking, calculate extra water reserves for washing yourself and possibly rinsing cooking utensils.
- Hydration Packs and water bladders have drinking tubes that make it easy to drink as you continue hiking. However, a possible danger is that you have no real way of checking your fluid reserves. So make sure to stop and check your bladder's content at regular intervals.

#### **Always plan for the worst, but hope for the best!**

Just because a map indicates a water source, it doesn't mean that water will be there! I once had to hike for hours on the AT in hot temperatures with the sun beating down on me because I trusted the map water source – never again!

Always make sure you have at least the minimum water requirements on yourself at all times. Sometimes drought conditions will dry up many water sources. If the weather has been wet, many of those same water sources will have plenty of water.

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<sup>47</sup> <http://www.abc-of-hiking.com/hiking-provisions/>

**Time Hazard:**

This seems like a funny hazard – time? But, if you don't properly plan what time you have to operate etc, you can and will get into trouble. The more remote location you pick to operate pedestrian mobile means the more you need to budget your time.

You don't want to walk into the great outdoors for miles only to now find that it's getting dark and you aren't prepared for it.

**Time is never ending and doesn't stop for anyone.**

If you plan to operate near beaches, tourist destinations etc, this again means you will need to plan when you will operate. If you operate near busy people places, time your operation when the least number of people will be there.

You also must budget the total time your batteries will allow you to operate in the field. You don't want to walk into the field making contacts only to have your battery go dead on you. It's a good idea to know how long you can operate in the field and plan your route to your battery capacity.

Time of day means propagation will change and you must plan for this or just keep calling CQ on a dead band! It's a good idea to know how the bands are acting before you leave to operate in the field.

One last item concerning time. When you operate pedestrian mobile in the field, you will not be able to walk as fast as you plan. That short two mile walk that would take you around an hour of regular walking will take you much longer if you are making contacts.

I always stop to make the contact to write down the log information. You can't believe how much time this takes in the field and it will slow you down. So don't be rigid on your walking route. If it's getting late and you are only just a quarter way along your planned route, turn around and start back.

Most of this stuff is just common sense, but when you are making contacts in the field, sometimes you forget about time!

### Power Output Hazard:

The FCC has established maximum permissible power limits or MPE Limits that all amateur radio stations must be in compliance - <sup>48</sup>see table 1 below. Please refer to the FCC OET 65 Supplement B Document.

**Table 1**  
**You must perform an RF environmental evaluation if the peak-envelope-power (PEP) input to the antenna exceeds these limits.**

<b>Band</b>	<b>Power (W)</b>
160 meters	500
80	500
40	500
30	425
20	225
17	125
15	100
12	75
10	50
6	50
2	50
1.25	50
70 cm	70
33	150
23	200
13	250
SHF (all bands)	250
EHF (all bands)	250

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<sup>48</sup> <http://www.arrl.org/fcc-rf-exposure-regulations-the-station-evaluation>

Most hams will not have difficulty meeting the requirements. In fact, most hams are already in compliance with the maximum permissible exposure (MPE) levels.

The rules define two exposure environments, each with different MPE levels. The **uncontrolled** environment applies to areas where people would not normally know they are being exposed. This includes "public" areas such as your property line or a neighboring apartment.

**Controlled** environments apply where people are aware of their exposure and have the ability and knowledge to control it. Greater MPE levels are permitted in controlled areas. A good rule of thumb is that the controlled exposure limit can be applied to those areas in which you can control access. An example of this is your fenced-in backyard.

FCC rules define amateur power in PEP. (PEP is the average power of a single RF cycle at the peak of a modulation envelope.) The MPE limits, however, are based on average exposure, not peak exposure. This means that the total exposure for the averaging period must be below the limits. One way of factoring in average exposure could be to determine the average transmitter power.

To calculate average power, multiply PEP by the duty factor for the mode being used. The duty factors for various modes are shown in Table 2. Multiply that result by the percentage of time the transmitter could be in use during the appropriate averaging period -- **6 minutes for controlled exposure, 30 minutes for uncontrolled.**

**Table 2**  
**Operating Duty Factors by Mode**

<i>Mode</i>	<i>Duty Factor</i>	<i>Notes</i>
Conversational SSB	20%	Note 1
Conversational SSB	40%	Note 2
Voice FM	100%	
FSK/RTTY	100%	
AFSK	100%	
Conversational CW	40%	
Carrier	100%	Note 3

**Note 1:** No speech processing.

**Note 2:** Moderate speech processing employed.

**Note 3:** A full carrier – tune up

Here a few examples:

<sup>49</sup> For example, if a 1,500-watt PEP amateur single-sideband station (with no speech processing) transmits ("worst case") two minutes on, two minutes off then two minutes on again in any six-minute period (the averaging time period for **controlled exposure**), then for controlled exposure situations the effective power would be:

$$1,500 \text{ W} \times 0.2 \text{ (20\% from Table 2)} \times (4 \text{ of 6 minutes}) = 200 \text{ W}$$

For **uncontrolled exposures** the averaging time is 30 minutes and the total transmission time during any 30-minute period would be 16 minutes out of 30. The result would then also be:

$$1,500 \text{ W} \times 0.2 \times (16 \text{ of 30 minutes}) = 160 \text{ W}$$

On the other hand, if the transmission cycle were, say, 7 minutes on, 7 minutes off, the average power would be higher, since there would be continuous exposure over a six-minute period (controlled and uncontrolled time-averaging periods specify any six or thirty minute period, respectively). In this case the average power (**for controlled exposure**) becomes:

$$1,500 \text{ W} \times 0.2 \times 1.0 \text{ (6 of 6 minutes)} = 300 \text{ W}$$

For **uncontrolled/general population exposure** average power becomes:

$$1,500 \text{ W} \times 0.2 \times .53 \text{ (16 of 30 minutes)} = 159 \text{ W}$$

The examples below show the MPE Limits a Pedestrian Mobile operator and others might be subjected to while operating a HFpack. Please note I started with an average power of only 50w. This is a more realistic starting average power.. Let's take a couple of examples to make my point.

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<sup>49</sup> FCC OET 65 Supplement B

Example 1:

You are operating cw with your 100w rig on your HFpack with a vertical antenna. You are operating a pileup so let's assume one minute on and one minute off. I assume a controlled area – yourself!

Average Power = 100w x .4 (Table-2) x (3 of 6) or .5 = 20W

Now let's see if this amount of HF power meets the Maximum Permissible Limits (MPE) to you! I assume a distance of one foot. Your antenna probably will be around this distance away from your body at some point. Take a look at the table below because if you operate 80m to 10m, the only bands that put you within the MPE Limits are 80m, 40m and 30m. Maybe 20m as it's a close call for that band.

Freq.	Ave Pwr (W)	Dist. (ft)	PD mw/cm <sup>2</sup>	MPE Contrl	Uncontrl MPE	Contrl (ft)	Uncontrl (ft)
28	20	1	5.521	1.153	0.235	2.243	4.953
21	20	1	5.521	2.045	0.413	1.694	3.727
18	20	1	5.521	2.782	0.561	1.459	3.202
14	20	1	5.521	4.596	0.923	1.146	2.501
10	20	1	5.521	9.005	1.805	0.833	1.801
7	20	1	5.521	18.372	3.678	0.598	1.276
3.5	20	1	5.521	73.474	14.698	0.324	0.663

<sup>50</sup>The power density or PD you are radiating is 5.521 mw/cm<sup>2</sup>. At a distance of one-foot on 10m in a controlled area such as yourself the MPE is only 1.153 mw/cm<sup>2</sup>. Looking at the chart, it can be seen that the minimum distance for the average power of 20w is 2.243 feet. Yes, you'll need around two feet of separation from your antenna on 10m. As you may have noticed, the higher the frequency the worst it gets!

Example 2:

You are operating RTTY with your 100w rig on your HFpack with a vertical antenna. You are operating a pileup so let's assume one minute on and one minute off.

Average Power = 100w x 1 (Table-2) x (3 of 6) or .5 = 50w

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<sup>50</sup> [http://hintlink.com/power\\_density.php](http://hintlink.com/power_density.php)

Freq.	Ave. Pwr (W)	Dist (ft)	PD (mw/cm <sup>2</sup> )	MPE Contrl	Uncontrl MPE	Contrl (ft)	Uncontrl (ft)
28	50	1	13.803	1.153	0.235	3.517	7.803
21	50	1	13.803	2.045	0.413	2.650	5.865
18	50	1	13.803	2.782	0.561	2.279	5.034
14	50	1	13.803	4.596	0.923	1.783	3.926
10	50	1	13.803	9.005	1.805	1.288	2.819
7	50	1	13.803	18.372	3.678	0.916	1.988
3.5	50	1	13.803	73.474	14.698	0.483	1.019

<sup>51</sup>The power density or PD you are radiating is 13.803 mw/cm<sup>2</sup>. At a distance of one-foot on 10m in a controlled area such as yourself the MPE is only 1.153 mw/cm<sup>2</sup>. Looking at the chart, it can be seen that the minimum distance for the average power of 50w is around 3.5 feet. Yes, you'll need almost four-feet of separation from your antenna on 10m. Again, at one-foot you're good on 80m, 40m and maybe 30m. As you may have noticed, the higher the frequency the worst it gets.

#### Example 3:

You are operating SSB with your 100w rig on your HFpack with a vertical antenna. You are operating in "rag-chew" mode so let's assume three minutes on and three minutes off.

$$\text{Average Power} = 100\text{w} \times .2 \times (3 \text{ of } 6) \text{ or } .500 = 10 \text{ w}$$

Freq.	Ave. Pwr (W)	Dist. (ft)	PD (mw/cm <sup>2</sup> )	MPE Contrl	Uncontrl MPE	Contrl (ft)	Uncontrl (ft)
28	10	1	2.761	1.153	0.235	1.600	3.517
21	10	1	2.761	2.045	0.413	1.213	2.650
18	10	1	2.761	2.782	0.561	1.046	2.279
14	10	1	2.761	4.597	0.923	0.825	1.783
10	10	1	2.761	9.005	1.805	0.604	1.288
7	10	1	2.761	18.372	3.678	0.438	0.917
3.5	10	1	2.761	73.474	14.699	0.244	0.147

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<sup>51</sup> [http://hintlink.com/power\\_density.php](http://hintlink.com/power_density.php)

<sup>52</sup>The power density or PD you are radiating is 2.761 mw/cm<sup>2</sup>. At a distance of one-foot on 10m in a controlled area such as yourself the MPE is only 1.153 mw/cm<sup>2</sup>.

Looking at the chart, it can be seen that the minimum distance for the average power of 50w is 1.6 feet. Yes, you'll need around 1.5 feet of separation from your antenna on 10m. Again, at one-foot you're good on 80m, 40m, 30m, 20m, and maybe 17m.

On 15m you would need just over one-foot of separation from your antenna. 10m is even worst as you would need just over 1.5 feet of separation.

The point I'm trying to make here is to watch your power on the upper bands like 15m and 10m. Yes, these are worst-case scenarios, but as a pedestrian operator you need to be aware of the "RF Power Hazard" to yourself.

### **RF Power Hazard to Others**

So far I've covered the power hazard to yourself, but what about others walking around where you operate in the field? Do you need to be concerned about them? The short answer is yes! If we look into this deeper, the answer is maybe.

**Never allow other people or animals to make contact with your antenna – RF burns!**

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<sup>52</sup> [http://hintlink.com/power\\_density.php](http://hintlink.com/power_density.php)

Example 1:

You are operating cw with your 100w rig on your HFpack with a vertical antenna. You are operating a pileup so let's assume one minute on and one minute off. I assume an uncontrolled area.

$$\text{Average Power} = 100\text{w} \times .4 \text{ (Table-2)} \times (15 \text{ of } 30) \text{ or } .5 = 20\text{W}$$

Now let's see if this amount of HF power meets the Maximum Permissible Limits (MPE) to others close to you. I assume a distance of three-feet.

Your antenna probably will be around this distance away from others at some point. Take a look at the table below because if you operate 80m to 10m, the only bands that put others within the MPE Limits at three-feet are 80m, 40m, 30m and 20m. Maybe 17m is ok, but it's a close call. Once again the upper bands of 15m and 10m are MPE non-compliant.

Freq.	Ave. Pwr (W)	Dist. (ft)	PD (mw/cm <sup>2</sup> )	MPE Contrl	Uncontrl MPE	Contrl (ft)	Uncontrl(ft)
28	20	3	0.614	1.153	0.235	2.243	4.953
21	20	3	0.614	2.045	0.413	1.694	3.727
18	20	3	0.614	2.782	0.561	1.459	3.203
14	20	3	0.614	4.596	0.923	1.146	2.502
10	20	3	0.614	9.005	1.805	0.833	1.801
7	20	3	0.614	18.372	3.679	0.598	1.276
3.5	20	3	0.614	73.474	14.698	0.324	0.663

If you operate on 15m and 10m with an average power of 20 watts, others will have to have a minimum distance away from your antenna of almost four-feet on 15m and five-feet on 10m to be MPE Compliant.

I'm trying to make a few points:

- Lower power - especially on 100% duty cycle modes
- 15m and 10M are the worst HF bands for MPE Limits
- Keep others away from you!
- DO NOT transmit close to people and animals
- RF does burn!
- FCC MPE Regulations don't fully consider PM operation!

**Drag wire Safety:**

- Always install a quick disconnect on your drag wire. Failure to install the disconnect could break the wire or pull you down.
- Do not use capacity plates (body counterpoise) or stuff Brillo Pads down your shorts for a counterpoise. It will cause RF burns and/or give you cancer – it's not safe!
- Keep the drag wire away from your body.

**Antenna Safety:**

- Always make sure your antenna doesn't make contact with overhead lines etc.
- Even a long whip can hit someone in the face when you are bending over putting on your pack.
- Always watch the top of your whip for clearance.

### **Battery Safety:**

- Never short out your battery!
- Cover the battery contacts with insulation material
- Use only non-spill battery types
- Do not over charge the battery
- Lithium type batteries and some others require special chargers.
- **Use the proper charger for your battery type.**
- Always use the proper voltage battery to match the voltage input for your transceiver.
- Lithium batteries – keep them dry! This is because when Lithium comes in contact with water or air's moisture it burns violently. Never try to extinguish such a fire with water! Only with suitable extinguisher.
- Never short circuit, reverse polarity, disassemble, damage or heat over 100 degrees Celsius a Li-Ion cell. It can be really dangerous.
- Lithium batteries – never solder directly on the battery.

There are other safety issues concerning batteries, but the above are the main safety issues. Please refer to your battery manufacturer's specification sheet for more safety precautions.

### **Headphone Safety:**

- The big “cover your ears” headphones are great for keeping out wind and external noise.
- The smaller ear buds are ok and they come in noise-canceling versions.
- You can eliminate headphone RF burns and “brain-heating” by adding two RFCs to the headphone lines. Depending on the operating frequency, 200 uH should be adequate for 7MHz and higher.

**RFI Issues:**

- Microphone RF feedback can occur requiring ferrite beads, coaxial feed through filters or extra shielding.
- Headset boom microphones are susceptible to high power RF.
- CW keyers may have to be specially filtered and shielded for proper operation.
- If you operate near buildings, you may encounter huge levels of RFI. In fact, the RFI may be so bad that you really can't operate near the building.
- Some vehicles have a tremendous amount of ignition RFI. Stay away from them as the RFI will get worst the closer they are to you.

# 15

## Connecting the Dots

So, you've read all about the who, what, when and where of pedestrian mobile operation. Now let's just sit back and think about how you will put all this together or how to "connect the dots."

The world today isn't at all like it was even ten years ago. Today a person can just send an email to another person across the globe. That same person not only reads a newspaper, but can now download many newspapers and now watch that same newspaper on his or her smart phone. Many people now text each other or groups of people. Yes, the world is now what some say "flat" and "hyper-connected."

But, there's one thing about amateur radio that hasn't changed since its inception – the thrill of making that first contact on the airwaves! Yes, there's just something almost magical about hearing your call sign on the air and knowing that another person wants to talk to you. They don't want anyone else – just you!

Many hams become complacent after many years on the air. They have worked many DX stations, special event stations and some rare countries etc. I hear this all the time from some older hams, "I've worked most of everything I wanted to and there's nothing else for me in this hobby." Boy, are they wrong!

I say that old timer is similar to a new amateur radio operator. If you ask that old-timer how many times have you operated a pedestrian mobile station, you'll get the usual blank stare. Most don't know or have never heard of a pedestrian mobile station. That's the common thread between the old-timer and the new ham – they both have a new avenue to explore in amateur radio!

Here's an example of what many amateur radio operators say after working a pedestrian mobile station.

**“Great, now I can add a pedestrian mobile, never had one of those before. Way to go Ed. 72 Brion, VE3FUJ”**

Many hams spend lots of money and time planning and going on expeditions etc. Heck, I have gone to many countries and operated as DX. But that same thrill of having a pileup operating as DX can be had cheaper and with a lot less travel by operating as a pedestrian mobile station. Most hams are puzzled and curious about a “/PM” station and will go out of their way to work you.

So you now want to try this pedestrian mobile thing, but what to do first? The first thing is to build your HFpack. Your HFpack will hold your transceiver, battery, antenna etc. In other words, just about all the gear needed to operate will be on or connected to your HFpack. Try to keep the weight of the whole thing down to less than thirty pounds.

After you have your HFpack working, you'll now have to select a place to operate and have some fun. For your first “shake-down” tour pick a location close to home. Why close to home? Maybe it worked fine in the backyard and around the neighborhood, but now you're twenty miles or more from home and that used battery you bought for a bargain fails – now what? Maybe your paddle or microphone dies on you – now what? How about your radio decides to stop transmitting? The list could go on and on – you get the picture.

Stay close to home and run a few “shake-down” tours of your HFpack. That way you can just drive home and fix it and drive back and start having some fun. When all seems to work fine or has been “shaken-down,” then start heading farther away from home.

Now that you have built your HFpack and it's properly working, it's time to learn how to use it. This may seem odd at first, but think about it. You now have to get all the motions down on what to use and when to use it while walking.

For example, I operate mainly CW as I walk all over the place. While I walk, I need to hit a button to send CQ and then listen for any answers. If someone does come back to me, I then have to write down the call sign and information in a log.

I then need to have a paddle in my hands to send my report. Plus, all this has to be accomplished in seconds not minutes!

This all sounds very complicated, but as you gain experience, it will seem very natural to you. After a while, you don't even think about what to do next as it just happens –hi!

Let's see you have built your HFpack and it's working great. You also have mastered the art/science of using the pack so now you're ready to walk the world and make contacts. You're now looking for a place to operate and have fun. Where you operate is your choice, but pick a day with nice weather and interesting views etc.

I like to operate on mountain summits along the Appalachian Trail here in Pennsylvania. This way I combine two hobbies hiking and amateur radio. Maybe you like fishing and amateur radio?

Why not take your HFpack with you and do some fishing while you operate your radio. Maybe you're not into physical outdoor activities, but like to read books. Why not take your pack to a park and do some reading. Then take a break from the book and operate some pedestrian mobile with your HFpack.

The list of possibilities goes on and on, but there's one constant theme here – **your HFpack can go almost anywhere!**

That's what makes operating pedestrian mobile so appealing to me. You can take your HFpack almost anywhere in the world with little effort on your part. You are free to see and hear the world as you open that new door.

**“The door to the world is strapped to my back” - Chris, K4FH**

My hope is that this handbook will get more amateur radio operators thinking about operating pedestrian mobile. It's a big world out there and you can open that door to it by operating a pedestrian mobile station.

**“I Walk the World to Hear the Signals” - WA3WSJ/pm**

# 16

## Pedestrian Mobile Reference Charts

US Amateur Radio HF Band Plan			
Band	Class	Modes	Frequency
160M	General, Advanced, Extra	CW, Phone, Image, RTTY/Data	1.800-2.000 MHz
80M	Novice and Technician	CW Only	3.525-3.600 MHz
	General	CW, RTTY/Data	3.525-3.600 MHz
		CW, Phone, Image	3.800-4.000 MHz
	Advanced	CW, RTTY/Data	3.525-3.600 MHz
		CW, Phone, Image	3.700-4.000 MHz
	Extra	CW, RTTY/Data	3.500-3.600 MHz
		CW, Phone, Image	3.600-4.000 MHz
60M	General, Advanced, Extra	Channel Center	Tuning Freq.
USB Only		5332 kHz	5330.5 kHz
50w ERP		5348 kHz	5346.5 kHz
all channels		5368 kHz	5366.5 kHz
		5373 kHz	5371.5 kHz
		5405 kHz (common US/UK)	5403.5 kHz

40M	Novice and Technician	CW Only	7.025-7.125 MHz
	General	CW, RTTY/Data	7.025-7.125 MHz
		CW, Phone, Image	7.175-7.300 MHz
	Advanced	CW, RTTY/Data	7.025-7.125 MHz
		CW, Phone, Image	7.125-7.300 MHz
	Extra	CW, RTTY/Data	7.000-7.125 MHz
		CW, Phone, Image	7.125-7.300 MHz
30M	General, Advanced, Extra	CW, RTTY/Data	10.100-10.150 MHz
20M	General	CW, RTTY/Data	14.025 -14.150 MHz
		CW, Phone, Image	14.225 -14.350 MHz
	Advanced	CW, RTTY/Data	14.025 -14.150 MHz
		CW, Phone, Image	14.175 -14.350 MHz
	Extra	CW, RTTY/Data	14.000 - 14.150 MHz
		CW, Phone, Image	14.150 -14.350 MHz
17M	General, Advanced, Extra	CW, RTTY/Data	18.068-18.110 MHz
		CW, Phone, Image	18.110-18.168 MHz
15M	Novice and Technician	CW Only	21.025-21.200 MHz
	General	CW, RTTY/Data	21.025-21.200 MHz
		CW, Phone, Image	21.275-21.450 MHz
	Advanced	CW, RTTY/Data	21.025-21.200 MHz
		CW, Phone, Image	21.225-21.450 MHz

			MHz:
	Extra	CW, RTTY/Data	21.000-21.200 MHz
		CW, Phone, Image	21.200-21.450 MHz
12M	General, Advanced, Extra	CW, RTTY/Data	24.890-24.930 MHz
		CW, Phone, Image	24.930-24.990 MHz
10M	Novice and Technician	CW, RTTY/Data --- 200w PEP	28.000-28.300 MHz:
		Phone-- 200w PEP	28.300-28.500 MHz
	General, Advanced, Extra	CW, RTTY/Data	28.000-28.300 MHz
		CW, Phone, Image	28.300-29.700 MHz
6M	All Amateurs except Novices	CW Only	50.0-50.1 MHz
		Phone, Image, MCW, RTTY/Data	50.1-54.0 MHz

US Amateur Radio VHF/UHF etc. Band Plan			
Band	Class	Modes	Frequency
2M	All except Novices	CW only	144.0 - 144.1 Mhz
	All except Novices	CW, Phone, Image, MCW, RTTY/Data	144.1 - 148.0 Mhz
1.25 M	All, Novices 25w PEP	CW, Phone, Image, MCW, RTTY/Data	222.00-225.00 MHz
70C M	All except Novices	CW, Phone, Image, MCW, RTTY/Data	420.0-450.0 MHz
33C M	All except Novices	CW, Phone, Image, MCW, RTTY/Data	902.0-928.0 MHz
23C M	Novices 5w PEP	CW, phone, Image, MCW, RTTY/Data	1270-1295 MHz
	All except Novices	CW, Phone, Image, MCW, RTTY/Data	1240-1300 MHz
	All except Novices	All Modes	2300-2310 MHz
	All except Novices	All Modes	2390-2450 MHz
	All except Novices	All Modes	3300-3500 MHz
	All except Novices	All Modes	5650-5925 MHz
	All except Novices	All Modes	10.0-10.5 GHz
	All except Novices	All Modes	24.0-24.25 GHz

	All except Novices	All Modes	47.0-47.2 GHz
	All except Novices	All Modes	77.1-81.9 GHz
	All except Novices	All Modes	119.98-120.02 GHz
	All except Novices	All Modes	142-149 GHz
	All except Novices	All Modes	241-250 GHz
	All except Novices	All Modes	All above 300 GHz

Here's a list of the National parks in the United States:

Acadia National Park –Maine

[http://en.wikipedia.org/wiki/Acadia\\_National\\_Park](http://en.wikipedia.org/wiki/Acadia_National_Park)

Arches National Park-Utah

[http://en.wikipedia.org/wiki/Arches\\_National\\_Park](http://en.wikipedia.org/wiki/Arches_National_Park)

Badlands National Park-South Dakota

[http://en.wikipedia.org/wiki/Badlands\\_National\\_Park](http://en.wikipedia.org/wiki/Badlands_National_Park)

Big Bend National Park-Texas

[http://en.wikipedia.org/wiki/Big\\_Bend\\_National\\_Park](http://en.wikipedia.org/wiki/Big_Bend_National_Park)

Biscayne National Park -Florida

[http://en.wikipedia.org/wiki/Biscayne\\_National\\_Park](http://en.wikipedia.org/wiki/Biscayne_National_Park)

Black Canyon of the Gunnison National Park-CO

[http://en.wikipedia.org/wiki/Black\\_Canyon\\_of\\_the\\_Gunnison\\_National\\_Park](http://en.wikipedia.org/wiki/Black_Canyon_of_the_Gunnison_National_Park)

Bryce Canyon National Park- Utah

[http://en.wikipedia.org/wiki/Bryce\\_Canyon\\_National\\_Park](http://en.wikipedia.org/wiki/Bryce_Canyon_National_Park)

Canyonlands National Park- Utah

[http://en.wikipedia.org/wiki/Canyonlands\\_National\\_Park](http://en.wikipedia.org/wiki/Canyonlands_National_Park)

Capitol Reef National Park- Utah

[http://en.wikipedia.org/wiki/Capitol\\_Reef\\_National\\_Park](http://en.wikipedia.org/wiki/Capitol_Reef_National_Park)

Carlsbad Caverns National Park- New Mexico

[http://en.wikipedia.org/wiki/Carlsbad\\_Caverns\\_National\\_Park](http://en.wikipedia.org/wiki/Carlsbad_Caverns_National_Park)

Channel Islands National Park- California

[http://en.wikipedia.org/wiki/Channel\\_Islands\\_National\\_Park](http://en.wikipedia.org/wiki/Channel_Islands_National_Park)

Congaree National Park- South Carolina

[http://en.wikipedia.org/wiki/Congaree\\_National\\_Park](http://en.wikipedia.org/wiki/Congaree_National_Park)

Crater Lake National Park- Oregon

[http://en.wikipedia.org/wiki/Crater\\_Lake\\_National\\_Park](http://en.wikipedia.org/wiki/Crater_Lake_National_Park)

Death Valley National Park- California, Nevada

[http://en.wikipedia.org/wiki/Death\\_Valley\\_National\\_Park](http://en.wikipedia.org/wiki/Death_Valley_National_Park)

Denali National Park and Preserve- Alaska

[http://en.wikipedia.org/wiki/Denali\\_National\\_Park\\_and\\_Preserve](http://en.wikipedia.org/wiki/Denali_National_Park_and_Preserve)

Dry Tortugas National Park- Florida

[http://en.wikipedia.org/wiki/Dry\\_Tortugas\\_National\\_Park](http://en.wikipedia.org/wiki/Dry_Tortugas_National_Park)

Everglades National Park- Florida

[http://en.wikipedia.org/wiki/Everglades\\_National\\_Park](http://en.wikipedia.org/wiki/Everglades_National_Park)

Gates of the Arctic National Park and Preserve- AK  
[http://en.wikipedia.org/wiki/Gates\\_of\\_the\\_Arctic\\_National\\_Park\\_and\\_Preserve](http://en.wikipedia.org/wiki/Gates_of_the_Arctic_National_Park_and_Preserve)

Glacier Bay National Park and Preserve- Alaska  
[http://en.wikipedia.org/wiki/Glacier\\_Bay\\_National\\_Park\\_and\\_Preserve](http://en.wikipedia.org/wiki/Glacier_Bay_National_Park_and_Preserve)

Glacier National Park- Montana  
[http://en.wikipedia.org/wiki/Glacier\\_National\\_Park\\_\(U.S.\)](http://en.wikipedia.org/wiki/Glacier_National_Park_(U.S.))

Grand Canyon National Park- Arizona  
[http://en.wikipedia.org/wiki/Grand\\_Canyon\\_National\\_Park](http://en.wikipedia.org/wiki/Grand_Canyon_National_Park)

Grand Teton National Park- Wyoming  
[http://en.wikipedia.org/wiki/Grand\\_Teton\\_National\\_Park](http://en.wikipedia.org/wiki/Grand_Teton_National_Park)

Great Basin National Park- Nevada  
[http://en.wikipedia.org/wiki/Great\\_Basin\\_National\\_Park](http://en.wikipedia.org/wiki/Great_Basin_National_Park)

Great Sand Dunes National Park & Preserve –CO  
[http://en.wikipedia.org/wiki/Great\\_Sand\\_Dunes\\_National\\_Park\\_and\\_Preserve](http://en.wikipedia.org/wiki/Great_Sand_Dunes_National_Park_and_Preserve)

Great Smoky Mountains National Park – NC&TN  
[http://en.wikipedia.org/wiki/Great\\_Smoky\\_Mountains\\_National\\_Park](http://en.wikipedia.org/wiki/Great_Smoky_Mountains_National_Park)

Guadalupe Mountains National Park - Texas  
[http://en.wikipedia.org/wiki/Guadalupe\\_Mountains\\_National\\_Park](http://en.wikipedia.org/wiki/Guadalupe_Mountains_National_Park)

Haleakala National Park - Hawaii  
[http://en.wikipedia.org/wiki/Haleakala\\_National\\_Park](http://en.wikipedia.org/wiki/Haleakala_National_Park)

Hawaii Volcanoes National Park - Hawaii  
[http://en.wikipedia.org/wiki/Hawaii\\_Volcanoes\\_National\\_Park](http://en.wikipedia.org/wiki/Hawaii_Volcanoes_National_Park)

Hot Springs National Park - Arkansas  
[http://en.wikipedia.org/wiki/Hot\\_Springs\\_National\\_Park](http://en.wikipedia.org/wiki/Hot_Springs_National_Park)

Isle Royale National Park - Michigan  
[http://en.wikipedia.org/wiki/Isle\\_Royale\\_National\\_Park](http://en.wikipedia.org/wiki/Isle_Royale_National_Park)

Joshua Tree National Park - California  
[http://en.wikipedia.org/wiki/Joshua\\_Tree\\_National\\_Park](http://en.wikipedia.org/wiki/Joshua_Tree_National_Park)

Katmai National Park and Preserve - Alaska  
[http://en.wikipedia.org/wiki/Katmai\\_National\\_Park\\_and\\_Preserve](http://en.wikipedia.org/wiki/Katmai_National_Park_and_Preserve)

Kenai Fjords National Park - Alaska  
[http://en.wikipedia.org/wiki/Kenai\\_Fjords\\_National\\_Park](http://en.wikipedia.org/wiki/Kenai_Fjords_National_Park)

Kings Canyon National Park - California

[http://en.wikipedia.org/wiki/Kings\\_Canyon\\_National\\_Park](http://en.wikipedia.org/wiki/Kings_Canyon_National_Park)

Kobuk Valley National Park - Alaska

[http://en.wikipedia.org/wiki/Kobuk\\_Valley\\_National\\_Park](http://en.wikipedia.org/wiki/Kobuk_Valley_National_Park)

Lake Clark National Park and Preserve - Alaska

[http://en.wikipedia.org/wiki/Lake\\_Clark\\_National\\_Park\\_and\\_Preserve](http://en.wikipedia.org/wiki/Lake_Clark_National_Park_and_Preserve)

Lassen Volcanic National Park - California

[http://en.wikipedia.org/wiki/Lassen\\_Volcanic\\_National\\_Park](http://en.wikipedia.org/wiki/Lassen_Volcanic_National_Park)

Mammoth Cave National Park - Kentucky

[http://en.wikipedia.org/wiki/Mammoth\\_Cave\\_National\\_Park](http://en.wikipedia.org/wiki/Mammoth_Cave_National_Park)

Mesa Verde National Park - Colorado

[http://en.wikipedia.org/wiki/Mesa\\_Verde\\_National\\_Park](http://en.wikipedia.org/wiki/Mesa_Verde_National_Park)

Mount Rainier National Park - Washington

[http://en.wikipedia.org/wiki/Mount\\_Rainier\\_National\\_Park](http://en.wikipedia.org/wiki/Mount_Rainier_National_Park)

National Park of American Samoa - American Samoa

[http://en.wikipedia.org/wiki/National\\_Park\\_of\\_American\\_Samoa](http://en.wikipedia.org/wiki/National_Park_of_American_Samoa)

North Cascades National Park - Washington

[http://en.wikipedia.org/wiki/North\\_Cascades\\_National\\_Park](http://en.wikipedia.org/wiki/North_Cascades_National_Park)

Olympic National Park - Washington

[http://en.wikipedia.org/wiki/Olympic\\_National\\_Park](http://en.wikipedia.org/wiki/Olympic_National_Park)

Petrified Forest National Park - Arizona

[http://en.wikipedia.org/wiki/Petrified\\_Forest\\_National\\_Park](http://en.wikipedia.org/wiki/Petrified_Forest_National_Park)

Redwood National and State Parks - California

[http://en.wikipedia.org/wiki/Redwood\\_National\\_and\\_State\\_Parks](http://en.wikipedia.org/wiki/Redwood_National_and_State_Parks)

Rocky Mountain National Park - Colorado

[http://en.wikipedia.org/wiki/Rocky\\_Mountain\\_National\\_Park](http://en.wikipedia.org/wiki/Rocky_Mountain_National_Park)

Saguaro National Park - Arizona

[http://en.wikipedia.org/wiki/Saguaro\\_National\\_Park](http://en.wikipedia.org/wiki/Saguaro_National_Park)

Sequoia National Park - California

[http://en.wikipedia.org/wiki/Sequoia\\_National\\_Park](http://en.wikipedia.org/wiki/Sequoia_National_Park)

Shenandoah National Park - Virginia

[http://en.wikipedia.org/wiki/Shenandoah\\_National\\_Park](http://en.wikipedia.org/wiki/Shenandoah_National_Park)

Virgin Islands National Park - U.S. Virgin Islands  
[http://en.wikipedia.org/wiki/Virgin\\_Islands\\_National\\_Park](http://en.wikipedia.org/wiki/Virgin_Islands_National_Park)

Voyageurs National Park - Minnesota  
[http://en.wikipedia.org/wiki/Voyageurs\\_National\\_Park](http://en.wikipedia.org/wiki/Voyageurs_National_Park)

Wind Cave National Park - South Dakota  
[http://en.wikipedia.org/wiki/Wind\\_Cave\\_National\\_Park](http://en.wikipedia.org/wiki/Wind_Cave_National_Park)

Wrangell-St. Elias National Park and Preserve -  
Yellowstone National Park - Idaho, Montana, Wyoming  
[http://en.wikipedia.org/wiki/Yellowstone\\_National\\_Park](http://en.wikipedia.org/wiki/Yellowstone_National_Park)

Yosemite National Park - California  
[http://en.wikipedia.org/wiki/Yosemite\\_National\\_Park](http://en.wikipedia.org/wiki/Yosemite_National_Park)

Zion National Park - Utah  
[http://en.wikipedia.org/wiki/Zion\\_National\\_Park](http://en.wikipedia.org/wiki/Zion_National_Park)

[http://en.wikipedia.org/wiki/List\\_of\\_areas\\_in\\_the\\_United\\_States\\_National\\_Park\\_System](http://en.wikipedia.org/wiki/List_of_areas_in_the_United_States_National_Park_System)

As I stated before the Summits on the Air Program or SOTA is a great way to hike to a few local summits. This is a worldwide program with many summits. Some are easy to hike to while others are hard to hike to, but one thing they all have in common – great views!

Trails are a great way to get outdoors and operate your radio. Trails are located all over the globe! All you have to do is find one and hike it to operate. Again, you could operate portable or pedestrian mobile.

Here's a list of some US trails:

Allegheny Trail -A 330-mile trail, mostly in WV  
[http://en.wikipedia.org/wiki/Allegheny\\_Trail](http://en.wikipedia.org/wiki/Allegheny_Trail)

American Discovery Trail- 6,800-mile CA-to-DE  
[http://en.wikipedia.org/wiki/American\\_Discovery\\_Trail](http://en.wikipedia.org/wiki/American_Discovery_Trail)

Appalachian Trail  
2,178-mile -Along the length of the Appalachian Mountains  
[http://en.wikipedia.org/wiki/Appalachian\\_Trail](http://en.wikipedia.org/wiki/Appalachian_Trail)

Arizona Trail -790-mile trail from Mexico to Utah  
[http://en.wikipedia.org/wiki/Arizona\\_Trail](http://en.wikipedia.org/wiki/Arizona_Trail)

Bay Area Ridge Trail  
500-mile trail circling the San Francisco Bay Area  
[http://en.wikipedia.org/wiki/Bay\\_Area\\_Ridge\\_Trail](http://en.wikipedia.org/wiki/Bay_Area_Ridge_Trail)

Benton MacKaye Trail  
300 miles through the Appalachian mountains

[http://en.wikipedia.org/wiki/Benton\\_MacKaye\\_Trail](http://en.wikipedia.org/wiki/Benton_MacKaye_Trail)

Bigfoot Trail

400-mile through the Klamath Mountains

[http://en.wikipedia.org/wiki/Bigfoot\\_Trail](http://en.wikipedia.org/wiki/Bigfoot_Trail)

Bonneville Shoreline Trail

90-mile trail in Utah

[http://en.wikipedia.org/wiki/Bonneville\\_Shoreline\\_Trail](http://en.wikipedia.org/wiki/Bonneville_Shoreline_Trail)

Buckeye Trail

Circling the state of Ohio

[http://en.wikipedia.org/wiki/Buckeye\\_Trail](http://en.wikipedia.org/wiki/Buckeye_Trail)

Chief Ladiga Trail

Alabama's rails-to-trails project

[http://en.wikipedia.org/wiki/Chief\\_Ladiga\\_Trail](http://en.wikipedia.org/wiki/Chief_Ladiga_Trail)

Chilkoot Trail

Alaska into British Columbia, Canada

[http://en.wikipedia.org/wiki/Chilkoot\\_Trail](http://en.wikipedia.org/wiki/Chilkoot_Trail)

C&O Canal Trail

Chesapeake and Ohio Canal

[http://en.wikipedia.org/wiki/Chesapeake\\_and\\_Ohio\\_Canal](http://en.wikipedia.org/wiki/Chesapeake_and_Ohio_Canal)

Cohos Trail

Through northern NH

[http://en.wikipedia.org/wiki/Cohos\\_Trail](http://en.wikipedia.org/wiki/Cohos_Trail)

Colorado Trail

483-mile from Denver to Durango

[http://en.wikipedia.org/wiki/Colorado\\_Trail](http://en.wikipedia.org/wiki/Colorado_Trail)

Continental Divide Trail

Length of the Rocky Mountains

[http://en.wikipedia.org/wiki/Continental\\_Divide\\_Trail](http://en.wikipedia.org/wiki/Continental_Divide_Trail)

Cumberland Trail - 175-mile in Tennessee

[http://en.wikipedia.org/wiki/Cumberland\\_Trail](http://en.wikipedia.org/wiki/Cumberland_Trail)

East Coast Greenway - Maine to Florida

[http://en.wikipedia.org/wiki/East\\_Coast\\_Greenway](http://en.wikipedia.org/wiki/East_Coast_Greenway)

Eastern Continental Trail

5,400-mile Florida to Canada.

[http://en.wikipedia.org/wiki/Eastern\\_Continental\\_Trail](http://en.wikipedia.org/wiki/Eastern_Continental_Trail)

Finger Lakes Trail - Catskills to Western New York

[http://en.wikipedia.org/wiki/Finger\\_Lakes\\_Trail](http://en.wikipedia.org/wiki/Finger_Lakes_Trail)

Florida Trail - 1,400-mile south Florida

[http://en.wikipedia.org/wiki/Florida\\_Trail](http://en.wikipedia.org/wiki/Florida_Trail)

Foothills Trail

76-mile scenic path from SC into NC and GA

[http://en.wikipedia.org/wiki/Foothills\\_Trail](http://en.wikipedia.org/wiki/Foothills_Trail)

George S. Mickelson Trail

108.8 miles South Dakota.

[http://en.wikipedia.org/wiki/George\\_S.\\_Mickelson\\_Trail](http://en.wikipedia.org/wiki/George_S._Mickelson_Trail)

Grand Enchantment Trail

730-mile Phoenix, AZ to Albuquerque, NM

[http://en.wikipedia.org/wiki/Grand\\_Enchantment\\_Trail](http://en.wikipedia.org/wiki/Grand_Enchantment_Trail)

Great Allegheny Passage

A rail trail in Maryland and Pennsylvania

[http://en.wikipedia.org/wiki/Great\\_Allegheny\\_Passage](http://en.wikipedia.org/wiki/Great_Allegheny_Passage)

Great Eastern Trail - New York to Alabama

[http://en.wikipedia.org/wiki/Great\\_Eastern\\_Trail](http://en.wikipedia.org/wiki/Great_Eastern_Trail)

Great Western Trail - Canada to Mexico

[http://en.wikipedia.org/wiki/Great\\_Western\\_Trail](http://en.wikipedia.org/wiki/Great_Western_Trail)

Great Western Loop

6,800 mile loop of the American west combining the PCT, PNT, Continental Divide Trail

[http://en.wikipedia.org/wiki/Great\\_Western\\_Loop](http://en.wikipedia.org/wiki/Great_Western_Loop)

Hayduke Trail

800-mile Utah and Arizona, linking Zion, Grand Canyon, Bryce Canyon, Capitol Reef, Canyonlands, and Arches National Parks

<http://www.hayduketrail.org/>

High Line Canal

A 58-mile Denver, Colorado

[http://en.wikipedia.org/wiki/High\\_Line\\_Canal](http://en.wikipedia.org/wiki/High_Line_Canal)

Highlands Trail

Hudson River to the Delaware Water Gap

High Sierra Trail

61.5-mile Sequoia National Park to Mount Whitney

[http://en.wikipedia.org/wiki/High\\_Sierra\\_Trail](http://en.wikipedia.org/wiki/High_Sierra_Trail)

Horse Shoe Trail

Valley Forge to the ATI near Harrisburg

[http://en.wikipedia.org/wiki/Horse\\_Shoe\\_Trail](http://en.wikipedia.org/wiki/Horse_Shoe_Trail)

Ice Age Trail - Wisconsin

[http://en.wikipedia.org/wiki/Ice\\_Age\\_Trail](http://en.wikipedia.org/wiki/Ice_Age_Trail)

Idaho Centennial Trail - 900-mile Idaho

[http://en.wikipedia.org/wiki/Idaho\\_Centennial\\_Trail](http://en.wikipedia.org/wiki/Idaho_Centennial_Trail)

Iditarod Trail

1,000 miles of Alaskan wilderness from Seward to Nome

[http://en.wikipedia.org/wiki/Iditarod\\_Trail](http://en.wikipedia.org/wiki/Iditarod_Trail)

International Appalachian Trail

Maine into Canada

[http://en.wikipedia.org/wiki/International\\_Appalachian\\_Trail](http://en.wikipedia.org/wiki/International_Appalachian_Trail)

John Muir Trail

211-mile Yosemite Valley to the summit of Mt. Whitney

[http://en.wikipedia.org/wiki/John\\_Muir\\_Trail](http://en.wikipedia.org/wiki/John_Muir_Trail)

Katy Trail - 240-mile Missouri

[http://en.wikipedia.org/wiki/Katy\\_Trail\\_State\\_Park](http://en.wikipedia.org/wiki/Katy_Trail_State_Park)

Knobstone Trail - 58-mile southern Indiana

[http://en.wikipedia.org/wiki/Knobstone\\_Trail](http://en.wikipedia.org/wiki/Knobstone_Trail)

Laurel Highlands Hiking Trail - 70-mile SW PA

[http://en.wikipedia.org/wiki/Laurel\\_Highlands\\_Hiking\\_Trail#Laurel\\_Highlands\\_Hiking\\_Trail](http://en.wikipedia.org/wiki/Laurel_Highlands_Hiking_Trail#Laurel_Highlands_Hiking_Trail)

Lone Star Hiking Trail

120-mile Sam Houston National Forest north of Houston Texas

<http://lonestartail.org/>

Long Path

347.4-mile Fort Lee, NJ - Altamont, NY

[http://en.wikipedia.org/wiki/Long\\_Path](http://en.wikipedia.org/wiki/Long_Path)

Long Trail -VT, from MA to Canada.

[http://en.wikipedia.org/wiki/Long\\_Trail](http://en.wikipedia.org/wiki/Long_Trail)

Maah Daah Hey Trail -North Dakota

[http://en.wikipedia.org/wiki/Maah\\_Daah\\_Hey\\_Trail](http://en.wikipedia.org/wiki/Maah_Daah_Hey_Trail)

Mason-Dixon Trail -Pennsylvania

[http://en.wikipedia.org/wiki/Mason-Dixon\\_Trail](http://en.wikipedia.org/wiki/Mason-Dixon_Trail)

Mattabesett Trail

57 miles south-central CT

[http://en.wikipedia.org/wiki/Mattabesett\\_Trail](http://en.wikipedia.org/wiki/Mattabesett_Trail)

Metacomet-Monadnock Trail

MA-CT state line to Mt. Monadnock in New Hampshire.

[http://en.wikipedia.org/wiki/Metacomet-Monadnock\\_Trail](http://en.wikipedia.org/wiki/Metacomet-Monadnock_Trail)

Michigan Shore-to-Shore Trail

Lake Michigan and Lake Huron

[http://en.wikipedia.org/wiki/Michigan\\_Shore-to-Shore\\_Trail](http://en.wikipedia.org/wiki/Michigan_Shore-to-Shore_Trail)

Midstate Trail (Massachusetts) -92 miles

[http://en.wikipedia.org/wiki/Midstate\\_Trail\\_\(Massachusetts\)](http://en.wikipedia.org/wiki/Midstate_Trail_(Massachusetts))

Pennsylvania Mid State Trail - 327-miles PA

[http://en.wikipedia.org/wiki/Pennsylvania\\_Mid\\_State\\_Trail](http://en.wikipedia.org/wiki/Pennsylvania_Mid_State_Trail)

Monadnock-Sunapee Greenway -50 miles sw NH

[http://en.wikipedia.org/wiki/Monadnock-Sunapee\\_Greenway](http://en.wikipedia.org/wiki/Monadnock-Sunapee_Greenway)

Mountains-to-Sea Trail - 530-miles NC

[http://en.wikipedia.org/wiki/Mountains-to-Sea\\_Trail](http://en.wikipedia.org/wiki/Mountains-to-Sea_Trail)

Natchez Trace Trail - TN, AL ,MS

[http://en.wikipedia.org/wiki/Natchez\\_Trace\\_Trail](http://en.wikipedia.org/wiki/Natchez_Trace_Trail)

North Country Trail - 4,600-mile NY to ND

[http://en.wikipedia.org/wiki/North\\_Country\\_Trail](http://en.wikipedia.org/wiki/North_Country_Trail)

Northville-Placid Trail

125 miles New York, Adirondack State Preserve

[http://en.wikipedia.org/wiki/Northville-Placid\\_Trail](http://en.wikipedia.org/wiki/Northville-Placid_Trail)

Old Croton Trail

26.2 miles Westchester County, NY

[http://en.wikipedia.org/wiki/Old\\_Croton\\_Trail#Old\\_Croton\\_Trail](http://en.wikipedia.org/wiki/Old_Croton_Trail#Old_Croton_Trail)

Oregon Coast Trail - 425 mi Pacific coast OR

[http://en.wikipedia.org/wiki/Oregon\\_Coast\\_Trail](http://en.wikipedia.org/wiki/Oregon_Coast_Trail)

Ouachita National Recreation Trail

223 miles OK - AR

[http://en.wikipedia.org/wiki/Ouachita\\_National\\_Recreation\\_Trail](http://en.wikipedia.org/wiki/Ouachita_National_Recreation_Trail)

Ozark Highlands Trail - 180 miles Arkansas

[http://en.wikipedia.org/wiki/Ozark\\_Highlands\\_Trail](http://en.wikipedia.org/wiki/Ozark_Highlands_Trail)

Ozark Trail - 350 miles MO  
[http://en.wikipedia.org/wiki/Ozark\\_Trail\\_\(hiking\\_trail\)](http://en.wikipedia.org/wiki/Ozark_Trail_(hiking_trail))

Pacific Crest Trail - 2,654 miles CA, OR, WA  
[http://en.wikipedia.org/wiki/Pacific\\_Crest\\_Trail](http://en.wikipedia.org/wiki/Pacific_Crest_Trail)

Pacific Northwest Trail - 1200 miles MT, WA  
[http://en.wikipedia.org/wiki/Pacific\\_Northwest\\_Trail](http://en.wikipedia.org/wiki/Pacific_Northwest_Trail)

Palmetto Trail - unfinished 425-mile SC  
[http://en.wikipedia.org/wiki/Palmetto\\_Trail](http://en.wikipedia.org/wiki/Palmetto_Trail)

Pennsylvania Mid State Trail - 327 miles PA, NY  
[http://en.wikipedia.org/wiki/Pennsylvania\\_Mid\\_State\\_Trail](http://en.wikipedia.org/wiki/Pennsylvania_Mid_State_Trail)

Pinhoti Trail - 335 miles Alabama  
[http://en.wikipedia.org/wiki/Pinhoti\\_Trail](http://en.wikipedia.org/wiki/Pinhoti_Trail)

Potomac Heritage Trail - VA, MD, PA, DC  
[http://en.wikipedia.org/wiki/Potomac\\_Heritage\\_Trail](http://en.wikipedia.org/wiki/Potomac_Heritage_Trail)

Robert Frost Trail - 47 miles MA  
[http://en.wikipedia.org/wiki/Robert\\_Frost\\_Trail\\_\(Massachusetts\)](http://en.wikipedia.org/wiki/Robert_Frost_Trail_(Massachusetts))

Sheltowee Trace Trail - 282 miles Kentucky  
[http://en.wikipedia.org/wiki/Sheltowee\\_Trace\\_Trail](http://en.wikipedia.org/wiki/Sheltowee_Trace_Trail)

Sierra High Route - 195 miles CA  
[http://en.wikipedia.org/wiki/Sierra\\_High\\_Route](http://en.wikipedia.org/wiki/Sierra_High_Route)

Silver Comet Trail - 61.5 miles rails-to-trails GA  
[http://en.wikipedia.org/wiki/Silver\\_Comet\\_Trail](http://en.wikipedia.org/wiki/Silver_Comet_Trail)

Skyline-to-the-Sea - 29.5 miles CA  
[http://en.wikipedia.org/wiki/Skyline-to-the-Sea\\_Trail](http://en.wikipedia.org/wiki/Skyline-to-the-Sea_Trail)

Superior Hiking Trail  
275 miles, Lake Superior MN  
[http://en.wikipedia.org/wiki/Superior\\_Hiking\\_Trail](http://en.wikipedia.org/wiki/Superior_Hiking_Trail)

Susquehannock Trail - 85 mile loop PA  
[http://en.wikipedia.org/wiki/Susquehannock\\_Trail](http://en.wikipedia.org/wiki/Susquehannock_Trail)

Tahoe Rim Trail  
165 miles Loop Lake Tahoe  
[http://en.wikipedia.org/wiki/Tahoe\\_Rim\\_Trail](http://en.wikipedia.org/wiki/Tahoe_Rim_Trail)

Tahoe-Yosemite Trail  
180 Mile Tuolumne Meadows in Yosemite and Lake Tahoe  
<http://outhiking.com/ty%20index.html>

Tuscarora Trail - 252 miles PA, MD,VA, WV  
[http://en.wikipedia.org/wiki/Tuscarora\\_Trail](http://en.wikipedia.org/wiki/Tuscarora_Trail)

Timberline Trail  
41 miles Loop Mt. Hood Oregon  
[http://en.wikipedia.org/wiki/Timberline\\_Trail](http://en.wikipedia.org/wiki/Timberline_Trail)

Virginia Creeper Trail - 35 miles SW VA  
[http://en.wikipedia.org/wiki/Virginia\\_Creeper\\_Trail](http://en.wikipedia.org/wiki/Virginia_Creeper_Trail)

Wonderland Trail  
93 miles loop Mount Rainier in Washington  
[http://en.wikipedia.org/wiki/Wonderland\\_Trail](http://en.wikipedia.org/wiki/Wonderland_Trail)

If trail-hiking is interesting to you, you're in luck because there are plenty of different types of trails. There are bicycle trails, canal system trails, coastal trails, coast-to-coast trails, horse trails, mountain trails, national trails, peninsular trails, cross-country trails, cross-continent trails and rail trails.

I can't list all the trails in the world as it would take another book just to list them all.

To find a trail list for your country, please use the link.

[http://en.wikipedia.org/wiki/Long-distance\\_trail](http://en.wikipedia.org/wiki/Long-distance_trail)

# PM MPE Limits -1FT

Freq	Ave. Pwr (W)	Dist (ft)	PD mw/cm <sup>2</sup>	MPE Contrl	Uncontrl MPE	Contrl (ft)	Uncontrl (ft)
28	100	1	27.605	1.153	0.235	4.950	11.010
21	100	1	27.605	2.045	0.413	3.727	8.274
18	100	1	27.605	2.782	0.561	3.202	7.099
14	100	1	27.605	4.596	0.923	2.501	5.532
10	100	1	27.605	9.005	1.805	1.801	3.966
7	100	1	27.605	18.372	3.678	1.276	2.791
3.5	100	1	27.605	73.474	14.698	0.663	1.420
Freq	Ave. Pwr (W)	Dist. (ft)	PD mw/cm <sup>2</sup>	MPE Contrl	Uncontrl MPE	Contrl (ft)	Uncontrl (ft)
28	50	1	13.803	1.153	0.235	3.517	7.803
21	50	1	13.803	2.045	0.413	2.650	5.865
18	50	1	13.803	2.782	0.561	2.279	5.034
14	50	1	13.803	4.596	0.923	1.783	3.926
10	50	1	13.803	9.005	1.805	1.288	2.819
7	50	1	13.803	18.372	3.678	0.916	1.988
3.5	50	1	13.803	73.474	14.698	0.483	1.019
Freq	Ave. Pwr (W)	Dist. (ft)	PD mw/cm <sup>2</sup>	MPE Contrl	Uncontrl MPE	Contrl (ft)	Uncontrl (ft)
28	20	1	5.521	1.153	0.235	2.243	4.953
21	20	1	5.521	2.045	0.413	1.694	3.727
18	20	1	5.521	2.782	0.561	1.459	3.202
14	20	1	5.521	4.596	0.923	1.146	2.501
10	20	1	5.521	9.005	1.805	0.833	1.801
7	20	1	5.521	18.372	3.678	0.598	1.276
3.5	20	1	5.521	73.474	14.698	0.324	0.663
Freq	Ave. Pwr (W)	Dist. (ft)	PD mw/cm <sup>2</sup>	MPE Contrl	Uncontrl MPE	Contrl (ft)	Uncontrl (ft)
28	10	1	2.761	1.153	0.235	1.600	3.517
21	10	1	2.761	2.045	0.413	1.213	2.650
18	10	1	2.761	2.782	0.561	1.046	2.279
14	10	1	2.761	4.597	0.923	0.825	1.783
10	10	1	2.761	9.005	1.805	0.604	1.288
7	10	1	2.761	18.372	3.678	0.438	0.917
3.5	10	1	2.761	73.474	14.699	0.244	0.147

# PM MPE Limits - 3Ft

Freq	Ave. Pwr (W)	Dist (ft)	PD mw/cm <sup>2</sup>	MPE Contrl	Uncontrl MPE	Contrl (ft)	Uncontrl (ft)
28	100	3	3.067	1.153	0.235	4.953	11.015
21	100	3	3.067	2.045	0.413	3.727	8.274
18	100	3	3.067	2.782	0.561	3.202	7.099
14	100	3	3.067	4.596	0.923	2.502	5.533
10	100	3	3.067	9.005	1.805	1.801	3.966
7	100	3	3.067	18.372	3.679	1.276	2.791
3.5	100	3	3.067	73.474	14.698	0.663	1.420
Freq	Ave. Pwr (W)	Dist. (ft)	PD (mw/cm <sup>2</sup> )	MPE Contrl	Uncontrl MPE	Contrl (ft)	Uncontrl (ft)
28	50	3	1.537	1.153	0.235	3.517	7.803
21	50	3	1.537	2.045	0.413	2.650	5.865
18	50	3	1.537	2.279	0.561	2.279	5.035
14	50	3	1.537	4.597	0.923	1.783	3.926
10	50	3	1.537	9.005	1.805	1.288	2.819
7	50	3	1.537	18.372	3.679	0.917	1.988
3.5	50	3	1.537	73.474	14.699	0.483	1.019
Freq	Ave. Pwr (W)	Dist. (ft)	PD (mw/cm <sup>2</sup> )	MPE Contrl	Uncontrl MPE	Contrl (ft)	Uncontrl (ft)
28	20	3	0.614	1.153	0.235	2.243	4.953
21	20	3	0.614	2.045	0.413	1.694	3.727
18	20	3	0.614	2.782	0.561	1.459	3.203
14	20	3	0.614	4.596	0.923	1.146	2.502
10	20	3	0.614	9.005	1.805	0.833	1.801
7	20	3	0.614	18.372	3.679	0.598	1.276
3.5	20	3	0.614	73.474	14.698	0.324	0.663
Freq	Ave. Pwr (W)	Dist. (ft)	PD (mw/cm <sup>2</sup> )	MPE Contrl	Uncontrl MPE	Contrl (ft)	Uncontrl (ft)
28	10	3	0.307	1.153	0.235	1.600	3.517
21	10	3	0.307	2.045	0.413	1.213	2.650
18	10	3	0.307	2.782	0.561	1.046	0.561
14	10	3	0.307	4.596	0.923	0.825	1.783
10	10	3	0.307	9.005	1.805	0.604	1.288
7	10	3	0.307	18.372	3.678	0.438	0.917
3.5	10	3	0.307	73.474	14.698	0.243	0.483

### Counterpoise Wire Lengths

Band	Counterpoise Length
10M	7.4 Ft
12M	8.0 Ft
15M	9.9 Ft
17M	11 Ft
20M	14 Ft
30M	18.5 Ft
40M	26.3 Ft
75M	45.4 Ft
80M	49.3 Ft

**Coax Cable Signal Loss (Attenuation) in dB per 100ft\***

Loss*	<b>RG-174</b>	<b>RG-58</b>	<b>RG-8X</b>	<b>RG-213</b>	<b>RG-6</b>	<b>RG-11</b>	<b>RF-9914</b>	<b>RF-9913</b>
1MHz	1.9dB	0.4dB	0.5dB	0.2dB	0.2dB	0.2dB	0.3dB	0.2dB
10MHz	3.3dB	1.4dB	1.0dB	0.6dB	0.6dB	0.4dB	0.5dB	0.4dB
50MHz	6.6dB	3.3dB	2.5dB	1.6dB	1.4dB	1.0dB	1.1dB	0.9dB
100MHz	8.9dB	4.9dB	3.6dB	2.2dB	2.0dB	1.6dB	1.5dB	1.4dB
200MHz	11.9dB	7.3dB	5.4dB	3.3dB	2.8dB	2.3dB	2.0dB	1.8dB
400MHz	17.3 B	11.2dB	7.9dB	4.8dB	4.3dB	3.5dB	2.9dB	2.6dB
700MHz	26.0dB	16.9dB	11.0dB	6.6dB	5.6dB	4.7dB	3.8dB	3.6dB
900MHz	27.9 B	20.1dB	12.6dB	7.7dB	6.0dB	5.4dB	4.9dB	4.2dB
1GHz	32.0dB	21.5dB	13.5dB	8.3dB	6.1dB	5.6dB	5.3dB	4.5dB
Imped. Ohms	50	50	50	50	75	75	50	50

## HFpack Frequencies

14342.5	USB	International
18157.5	USB	International
10117.5	CW	International
<b>80 meters</b>		
3791	USB	HFPACK
3845	USB	HFPACK USA East
3885	AM	Mil packset
3996	USB	HFPACK USA West
3997	CW	HFpack
<b>60 meters</b>		
5371.5	USB	HFPACK "CH-371"
5403.5	USB	HFpack QSY "CH-403"
<b>40 meters</b>		
7029.5	CW	HFPACK CW
7185.5	USB	HFPACK
7260	USB	Green Radio Net, 0200 UTC
7296	USB	HFPACK QSY, HFPACK USA West
<b>30 meters</b>		
10117.5	CW	HFPACK CW
<b>20 meters</b>		
14059	CW	HFpack CW
14342.5	USB	HFPACK PRIMARY
14343	CW	HFpack (CW for cross-mode use with SSB voice)
14346	USB	HFpack QSY, HFLINK International Emergency/Relief
<b>17 meters</b>		
18081.5	CW	HFpack CW
18117.5	USB	HFpack QSY, HFLINK
18157.5	USB	HFPACK SECONDARY

18158	CW	HFPACK (CW for cross-mode use with SSB voice)
<b>15 meters</b>		
21437.5	USB	HFPACK
21438	CW	HFpack (CW for cross-mode use with SSB voice)
<b>12 meters</b>		
24977.5	USB	HFPACK
24978	CW	HFpack (CW for cross-mode use with SSB voice)
<b>10 meters</b>		
28312.5	USB	HFpack QSY, HFLINK International Emergency/Relief
28327.5	USB	HFPACK Local, Hamfests
28328	CW	HFpack (CW for cross-mode use with SSB voice)
<b>6 meters</b>		
50162.5	USB	HFpack 6m SSB, HFLINK
51000	FM	Mil Packset
<b>2 meters</b>		
144162.5	USB	HFpack 2m SSB, HFLINK
144300	FM Simplex	HFpack 2m FM (HTs at Hamfests, Meetings) Transmit PL=151.4 (Mil radios transmit Tone Squelch=150Hz)