Field Marshall tracking receiver

OWNER'S MANUAL

Contents:

Introduction

Your new Field Marshall™ receiver is a high-performance telemetry receiver designed for optimum ease of use in the field. It features the most up-to-date technological advances and components to achieve the performance of more expensive receivers, including high sensitivity (range) and sharp directionality. Three models allow for five, ten, or fifteen channels.

Lightweight and permanently mounted, the patented yagi antenna collapses to a compact size for convenient storage and travel. The machined aluminum casing has been engineered to provide perfect balance in the hand, providing a compact unit you can easily carry into the most demanding situations.

Getting Started

Your new Marshall Receiver was tested prior to shipping and comes to you ready for immediate use. The first thing to understand is how to deploy the collapsible yagi antenna. There are four easy steps:

First, remove your receiver from your hawking bag or backpack.

1 **Remove the receiver** from whatever carrying case you are using (hunting bag, holster or carrying case) and hold it in front of you with the pistol grip.

Second, push forward on the rear of the sliding channel to release the spring-loaded elements out into postiion.

2 **Push forward on the rear of the sliding channel.** The spring-loaded elements will automatically (instantly!) flip out into the open position.

Next, lift the ends of the driven elements, one at a time, up and out from their notched holders. They will pop out into their correct postiions.

Warning: to avoid injury be sure to keep a careful distance from your face or others when performing this procedure.

3 **Lift the center elements** up and out of their slots one at a time and let them spring into position.

4 Reach forward and **pull the forward element bracket forward** to fully extend the sliding channel into its locked position.

Finally, pull the director elements out forward until they click at their extended postition. The yagi is now fully extended and ready for use.

FOLDING UP THE ANTENNA

Simply reverse the process. It may require some effort at first, but, with practice, you can learn to do it in a few seconds.

1. Retract the front bracket by sliding it all the way toward you.
2. Fold the center elements, one at a time, toward you and lift them slightly up and into their slots on the rear bracket.
3. Rotate one of the right front elements toward you while bringing the rear one forward to hold it and snap the rear element into its slot on the front bracket. Do the same on the left side. ***This operation is best done with one hand.***

Receiver Controls

Volume Knob: Turn on the unit by rotating the knob clockwise. Use this knob to adjust the volume of the sound. Experienced users go easy on the volume, keeping it as low as possible while still being able to hear the transmitter signal clearly. ***High volume drains the battery faster and makes pinpointing the signal more difficult.***

Trigger Switch (optional feature): Turn on the receiver using the button on the pistol grip. It has a "click-on, click-off" feature to allow hands off use. If the optional trigger switch is not installed, use the volume knob to turn the reciever on and off.

Channel Selector: Use the Channel Selector to switch to a different transmitter. A channel is a specific frequency band, 10 kilohertz wide. You can use more than one transmitter at a time as long as they are on different channels.

Frequency Chart: Some transmitters specify a frequency rather than a channel number. The chart on the bottom of the receiver gives the center frequency of each channel.

Tuning Knob: After choosing the right channel, you must tune to your transmitter's unique frequency. As you get tuned in you will hear a beeping sound (the signal) coming from the transmitter.

When you are tracking a very weak signal, it is important to tune carefully to get the best performance from the receiver. Always remember: ***Tune to the pitch that gives the loudest volume.***

Filter Switch (Narrow/Wide): This controls the shape of the tuning curve:

> ***Wide*** makes the tuning "broader", so it's easier to tune. **Use this setting most of the time.** If you're a beginner, use it always.

Narrow reduces the background noise and makes it possible to hear a weaker signal. Use this setting when you're tracking a distant signal or have lots of noise or interference, especially near a city.

***Note:* When the switch is in *narrow*, you must tune very precisely to the loudest pitch. As you tune across the signal slowly you will suddenly find a single point where the signal gets much louder than anywhere else.**

Range Switch (Near/Medium/Far): This switch performs the important function of cutting down signals that are too strong (it's also called an attenuator.) All you have to remember is this: Switch it to the position that gives the weakest signal you can comfortably work with.

Normally, when tracking a faint signal, keep it on Far. As you get closer to the transmitter and the signal starts "booming", switch to Medium. And when you're really close, switch to Near.

Signal Strength Meter (S-Meter): This meter indicates how strong the signal is. As you point the antenna directly at the transmitter, or get closer to it, the meter will read higher. If the needle is hitting the right side, turn down the volume. The signal strength meter is an accurate supplement to your ear in judging which bearing gives the strongest signal.

Headphone Jack: When tracking a weak signal you're better off using headphones since they help shield out the noise of wind and passing cars, making it easier to hear a weak signal. They also allow you to hold the receiver up high (where it will get a better signal) and still be able to hear well. High-quality, cupping headphones do the best job of keeping out extraneous noise. They are invaluable in airplanes. Marshall receivers use a standard 1/8 inch, stereo or mono plug. It's important to note that biologists, tracking wildlife, always use headphones.

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External Power Plug

This plug on the back of the receiver allows you to use an external power source, such as a cigarette lighter adapter (available from Marshall Radio) from your vehicle. Any power source of 6 to 12 volts will work. Do not use rechargeable batteries. The External Power Plug will not recharge the batteries inside the receiver.

Batteries

A red warning light comes on when the batteries need to be replaced (It is normal for this indicator to flash briefly as the receiver is turned on and off.) Operation with low batteries may give poor sound quality and erratic results.

Changing Batteries: The receiver uses two 9 volt batteries. Ordinary alkaline batteries may be used, but for extended life and less weight, use the more expensive 9 volt lithium batteries. Change the batteries by removing the thumb screw on the bottom of the receiver and removing the battery cover.

Caution:

This receiver is water-resistant, but not water-proof! Do not immerse in water.

In The Field – A Quick Tutorial

Basic Tracking

The best way to become familiar with your receiver is to use it outside. Turn on a transmitter and place it about 100 yards away. Set the Range Switch to *medium*. Adjust the Tuning Knob until you hear a clear beeping tone from the transmitter. Adjust the volume to a comfortable level.

Hold the receiver in front of you at eye level with the elements horizontal. Now, rotate your body 360°, keeping the receiver in the same position. Can you hear the volume of the beep change as you turn around? Was it strongest when you pointed it at the transmitter? This is the basic technique of telemetry: Scan the horizon with the antenna until you get the strongest signal. That will generally be the direction that will take you to the transmitter (that's not always the case, though; see the next chapter for more about this.)

Vertical vs. Horizontal

Now, point the receiver at the transmitter again and rotate the antenna until the elements are vertical. Did the strength of the signal change? In most cases, one orientation will be stronger than any other. **This is important:** ***Make it a habit to rotate the receiver from horizontal to vertical every time you use it at a new location.***

Practice:

1. Have someone hide the transmitter in a difficult spot and see if you can find it. You can make a game out of this. (Thousands of ham radio enthusiasts actually conduct competitive transmitter hunts in major cities on Saturdays.) Or, put the transmitter on a person, give them a head start, and see if you can track them down.

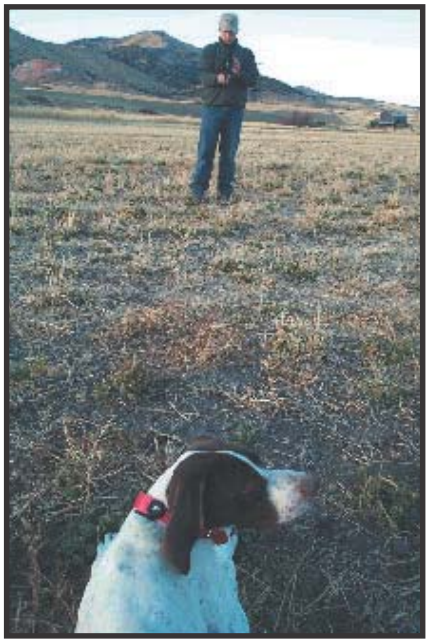
2. Hang the transmitter on a wooden object or a string and drive away with your receiver (don't set it on the ground, though; transmitters always perform poorly on the ground.) See how far you can go before losing the signal. Try tuning in the signal when it is very weak. Experiment with all the controls and see what effect on the signal they have at a distance.

In the Field

When you're ready to use the system in the field, tune in the signal just before letting your bird or dog go. That ensures you'll be ready with the best signal instead of having to try to locate it in the rush of the moment when the animal first becomes lost.

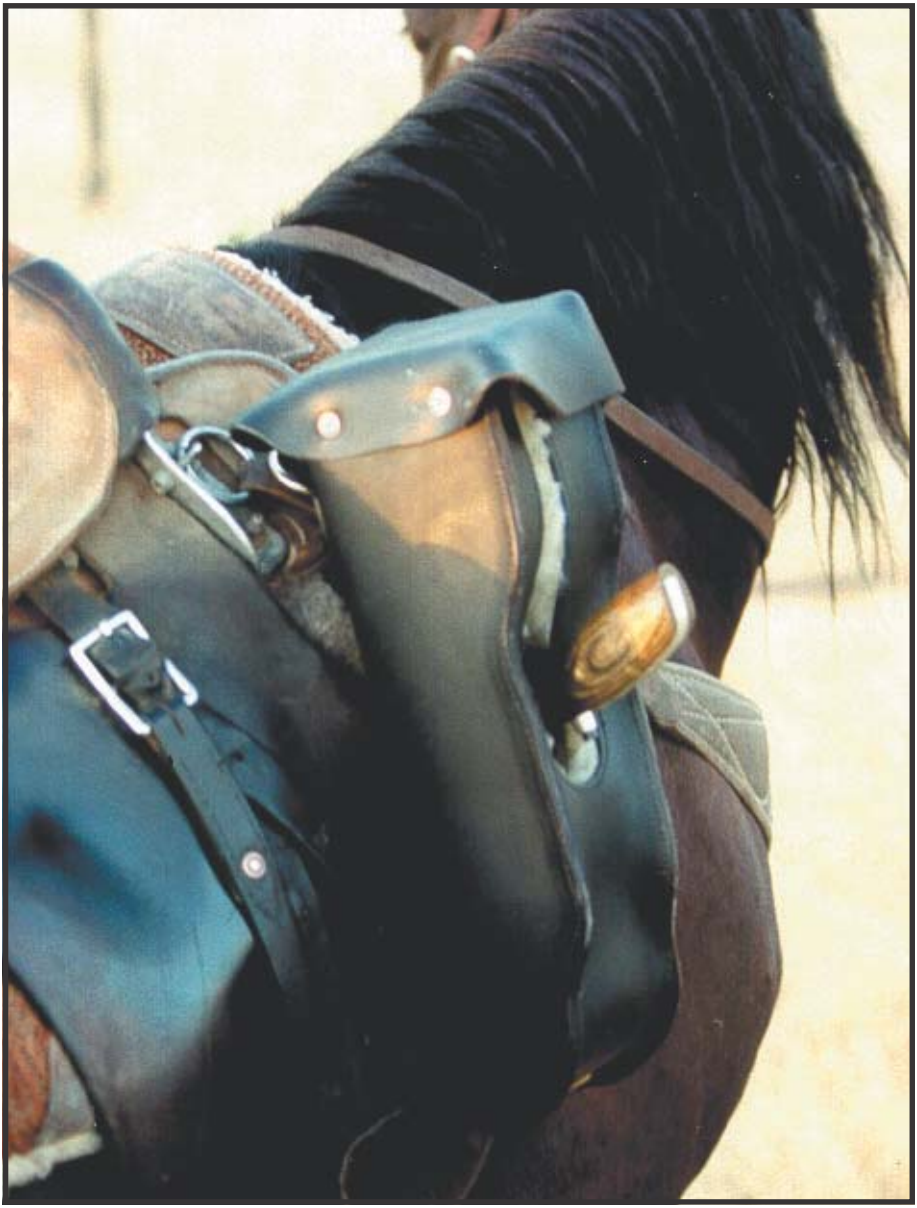
A few pointers on tuning:

- Set the Filter Switch on *Wide* until you are experienced with the receiver.
- Tune the receiver for the loudest sound after the transmitter is on the animal and has reached the outside air temperature. This is because the frequency of the transmitter can change when you put it on the animal. More importantly, all transmitters will *drift* with changes in temperature. If you tune up in a warm truck and take it into bitter cold, the frequency will probably change significantly.



- If you tune in while the transmitter is sitting next to you on the car seat, the signal will be so powerful that your receiver may pick it up on incorrect channels. If you mistakenly tune in on the wrong channel the signal may sound fine in the car, but will be quickly lost when the transmitter is far away. To avoid this, set the Range Switch on *Near* while tuning anywhere near the transmitter.

Try locating your animal several times for practice. Experiment with holding the receiver antenna vertically and horizontally while watching the position of your animal. Use the system many times until you feel confident in finding your animal with telemetry. *When your bird or dog is lost is not the time to be learning how to use telemetry.*



To avoid this, set your receiver on *Near* when you tune up – this removes all but the real, genuine signal you want to tune to. And stand a short distance away when you tune up.

Also, if you have the Filter Switch on *Narrow*, be sure to tune precisely to the loudest tone. This requires some practice and a steady hand. The Narrow Filter is the key to getting the best range. With it, your Marshall receiver will deliver range as good or better than any other telemetry receiver on the market. But like any high performance piece of equipment, if you use it wrong, the performance can be degraded.

"What is the single most important thing to do if I absolutely don't want to lose my animal?"

Put a backup transmitter on the animal. The second transmitter can be a smaller one, or perhaps one with longer battery life (a good combination would be one extremely powerful transmitter that you can use the first few days, and another that lasts a long time, in case you don't find it right away.) Just remember this: if your animal has a working transmitter, you can almost always find it. It may take hiring a plane to fly over the area, but eventually you can find it if you're patient and there is a signal.

"I'm not exactly certain what direction the transmitter is. Am I doing something wrong?"

Getting the sharpest bearing to your transmitter saves a lot of searching (that's why Marshall receivers use a full size, three element yagi antenna). But even a three or five element yagi has a fairly broad forward response (see the chart later on.) The following, easy technique can help you get a more accurate bearing.

Instead of trying to find the strongest signal, try to find two points on either side of it. Scan to both sides of the maximum signal and notice the points on the horizon where the signal drops 1 unit on the S-Meter. Your best bet is that the transmitter is halfway between those two points. By the way, the wrong setting of the Range Switch could cause this problem, too. See the following question.

“Why is the Range Switch necessary? My other receiver didn’t have one.”

It’s not that loud signals will hurt the receiver. It’s simply a matter of keeping your receiver optimally directional. Without this switch it would be difficult to track and get a direction of a strong signal up close.

If the signal is very strong and you don’t switch down to *Medium* or *Near*, the receiver will not point out the right direction very precisely. This is because the signal is strong enough to bypass the antenna altogether and go straight into the receiver. The antenna, the only thing that gives you directionality, is effectively disabled. The strong signal also *saturates* the receiver, making all signals sound equally loud.

Marshall receivers use precisely machined, solid aluminum cases to shield out these unwanted signals, but the Range Switch is still needed. Your Marshall receiver employs a sophisticated *active attenuator circuit,* which other receivers don’t have, and that’s how it can take you to within a few feet of your transmitter! Marshall receivers have unequalled performance up close. You just have to flip the switch.

"How can I tell how far away my transmitter is?"

One of the biggest challenges in telemetry is determining distance. There is no scientifically sound way of getting the distance from a transmitter signal. You can easily be deceived by a loud signal from a transmitter very far away. However, there are a couple of tricks to estimating it:

Distance Technique #1: Let's assume you are receiving a strong signal with the Range Switch on *Far*. Now flip the switch from *Far* to *Medium.* If the signal remains strong, it means you are fairly close to the transmitter.

With a strong signal, here are typical ranges to a transmitter near the ground:

Near ..... Less than 30 meters
Medium ..... Less than 400 meters
Far ..... Over 400 meters

The above table is only an example; you won't get the same results. It depends on your transmitter, the terrain, and many other factors. But over time you'll get a feel for the distance these Range settings repre sent with your transmitter and terrain.

Distance Technique #2: Just take a reading on the S-Meter and then proceed in the direction of the transmitter until the meter reads *twice* as much. You will have covered approximately *half* the distance to your target. This only works with direct line-of-sight signals of the same polarization and gives only an approximation. Still, it could save you from driving miles out of your way. Adjust the Volume Knob during the first reading so the meter reads about a third of full scale (where it is likely to be the most linear.)

"What is a kHz and a MHz?"

These are measurements of *frequency*. Every transmitter has a unique frequency that makes it distinguishable from all others. Fortunately, a receiver can tune into a single frequency at a time and reject all the others.

The basic measure of frequency is the "*hertz."* It represents one cycle or vibration per second. A *kilohertz (kHz)* is a thousand cycles per second, and a *megahertz (MHz)* is a million cycles per second.

An AM broadcast station is fairly low in frequency, perhaps .7 MHz, while an FM station is much higher, say at 105 MHz. Your telemetry operates at a still higher frequency, such as 216.055 MHz. Thus, a single short pulse from your transmitter is made up of several hundred million electro-magnetic vibrations.

The kilohertz unit is usually used in telemetry to measure the difference between frequencies. For example, if you had a second transmitter at 216.070, it would be 15 kHz higher than the one mentioned in the previous paragraph. Each of the channels on your Marshall receiver covers a range of 10 kHz.

"My Marshall receiver doesn't tune in as "broadly" as the other receiver I'm used to. What's wrong?"

Your Marshall receiver may tune "quicker" than some other receivers. If so, it's probably because it covers more frequency spectrum on each channel, in order to give more coverage. It's a feature, not a problem. Just turn the Tune Knob a little more slowly than you're used to. If you tune across a signal slowly you'll hear the pitch go from high to low until the sound is so low it disappears. If you keep turning the knob the sound will return, this time going from low to high. This is normal.

"Is there an easier way to get the receiver in and out of the car?"

It's a lot easier if you push the sliding channel closed, partially collapsing the antenna. However, don't forget to extend it when using the receiver in order to get maximum performance from the antenna.

“How can I use my Marshall receiver with my car top antenna? It’s got a different plug.”

Marshall receivers use high reliability, lightweight SMB connectors. Call to order an adapter that will fit the larger BNC connectors used on some other antennas. You can plug into a car top antenna and click on the receiver to monitor signals while driving, then switch back to the yagi when close enough to get out.

Advanced Telemetry

The Field Marshall Receiver is easy to use successfully for almost all occasions. But there are those times when you will stretch it to its limits. It will be worth your time to read this section and learn a few more techniques. First we cover some theory on how radio works which is essential to understand if you want to find your bird or dog when it is really lost.

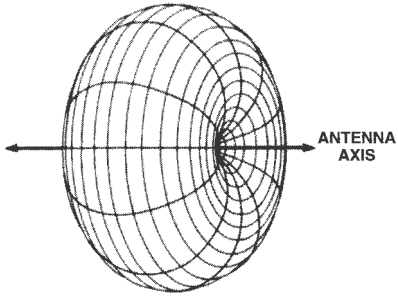


Figure 1
Transmitter radiation pattern

Transmitter Patterns

The one thing telemetry transmitters all have in common is the antenna. The wire commonly used on transmitters is known as a *short end-fed dipole*. With this kind of antenna most of the energy radiates from the side. It's called *broadside* radiation and the pattern looks like a donut, as in this diagram.

The same radiation comes from short *helical* antennas.

Little energy comes from the end of the antenna, so when the antenna is pointed right at you, you get the worst possible signal.

When attached to the body of a dog, the dog's body acts as part of the antenna and alters this pattern in unpredictable ways. The pattern then will not look like a donut, but maybe more like a partly inflated beach ball. There simply is no flexible antenna that radiates equally in all directions.

Hint: When your bird or dog is out of sight, the donut pattern can tell you much about its movements. Listen for the signal fading in and out as the it moves around, alternately pointing the antenna toward and broadside to you. You can also tell when the antenna is near the ground or vegetation by changes in the strength of the signal and the frequency.

Polarization

Radio waves are electromagnetic, exactly the same as light. When your animal is lost you're literally seeing it, with different eyes. The miracle is that the transmitters used in telemetry emit such small power, a few thousandths of a watt. Picking up that tiny signal is equivalent to seeing a dim, blinking flashlight miles away in daylight. Listening to your receiver is like looking through a telescope: you can look but one direction at a time, but your visibility is high.

You know from using sunglasses that sunlight is somewhat polarized. Radio waves are strongly polarized. Polarization has to do with the alignment of the magnetic and electric fields that make up the wave. When the transmitter antenna is vertical we say the waves are vertically polarized, and when it's laying on its side they are horizontally polarized.
Rotate the antenna to find the strongest signal.

The thing to remember is that your receiving antenna should be oriented the same way as your transmitter antenna. This is important with weak signals. Your antenna will work poorly if it's oriented the wrong way, as much as *ten times* worse. With a dog, the best orientation could be somewhere between vertical and horizontal, maybe at 60º from horizontal.

Rule #1: ***When tracking a weak signal, always try both orientations first! Stay with the orientation that gives the strongest signal.***
This cannot be emphasized strongly enough. It is easy to develop a preference for which way to hold your antenna, but in doing so you will miss the boat half the time. Try them both and remember that your animal can change positions at any time.

It may seem that polarization doesn't matter once you have a nice strong signal. Not quite so. The yagi antenna's directionality is somewhat sharper if you hold it horizontally. Radiation from the end of the transmitter antenna (around the hole of the donut) has elements of *both* vertical and horizontal polarization. And after a signal has been reflected it loses its polarization altogether (it actually becomes elliptically polarized, with equal elements of vertical and horizontal polarization). The same loss of polarization can occur after the wave travels through obstacles.

Hint: Absence of polarization can be a clue. Suppose you're in a canyon and get a strong reading from a canyon wall. Either your transmitter's up there, or it's a reflection off the canyon wall from somewhere else. Before climbing, check the polarity of the signal. If it's a reflection the strength won't change much as you rotate the yagi around its axis.

Yagi Pattern

The antenna on the Field Marshall is a form of directional antenna called a y*agi*. It receives signals better in one direction than in others, and that's the only way you'll find your animal when it's out of sight. Listening to the strength of the signal alone is almost useless, unless you have a lot of time to travel. You need a bearing. The yagi also has *gain,* picking up weak signals better as if it were amplifying them. It can pick up a far away transmitter when other antennas would get nothing.

A yagi can best be described by its radiation pattern. It always has a distinct *forward lobe* in the favored direction. The width of the forward lobe is its *beamwidth,* the range over which the antenna picks up strong signals as you scan across the horizon. A sharper beamwidth allows you to pinpoint the

direction to your animal more precisely, like a spotlight compared to a floodlight. **Here is the theoretical pattern of your Field Marshall's antenna:**

Yagis also pick up signals in other directions besides forward. The *back* and *side lobes* can confuse your ability to determine the direction to your animal. The strength of the forward lobe relative to the back is known as the *front-to-back* ratio, a higher ratio being better.

Rule #2: ***Whenever you take a new bearing with your yagi, scan the entire horizon first, all 360 degrees. Otherwise you could find yourself following the back lobe, going exactly the opposite direction from your animal.***

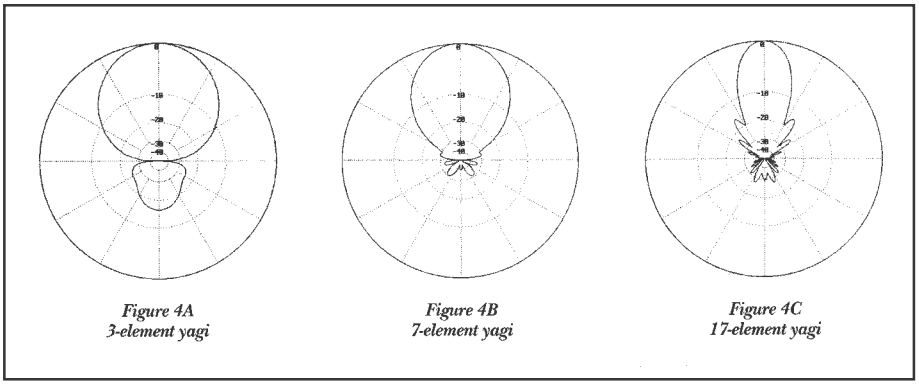


Figure 4A
3-element yagi

Figure 4B
7-element yagi

Figure 4C
17-element yagi

The Field Marshall's antenna provides the best combination of gain and sharp pattern possible in a 3 element yagi. Your Marshall receiver can be used with other antennas in addition to the integrated antenna. A car-mounted 5 or 7 element yagi is an excellent antenna for long distance telemetry.

Yagi Tips

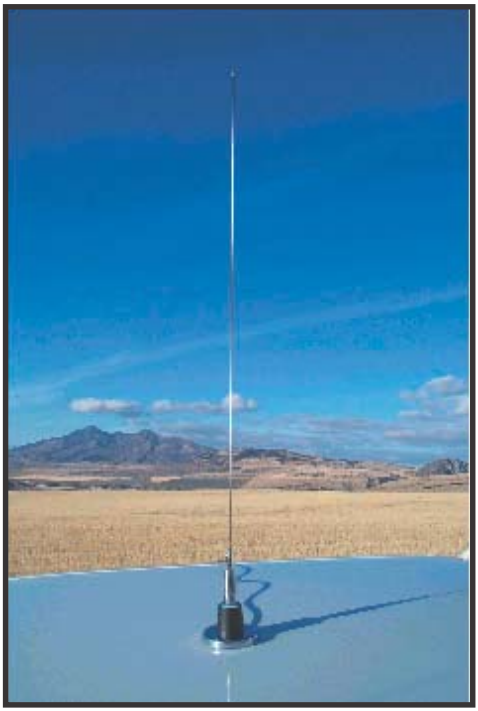
Don't bend the elements and don't touch them while using it. Keep it away from other objects, especially cars and other people. Don't substitute other lengths of coax. The gain of your antenna can change if you raise it up or down, so keep it at a fixed height as you scan (higher is generally better.) In spite of the above guidelines, a yagi is very forgiving. It will almost always guide you directly to your lost animal, hopefully awaiting your appearance.

Omni-directional antennas

These antennas pick up equally well in all directions. You should use one in your vehicle when moving to the next point where you'll take a bearing. Hearing the signal from your animal can tell you if you're going in the right direction and warn you if you're about to lose the signal.

Hint: If the signal starts getting weak you know to stop and take a bearing with your yagi. At least then you'll know what point of the horizon your animal just disappeared behind, a vital piece of information.

The omni-directional antenna is also useful when you lose the signal altogether. Hook it up and drive around in widening circles around where you think the animal should be until you hear something.



The most common omni-directional antenna is probably a *magnetically mounted whip*. It should be in the center of the vehicle roof, as the roof forms a key component of the antenna. Whip antennas are usually 1/4 wavelength long. A 5/8 wavelength whip has more gain.

Be aware that a vertical whip is vertically polarized. That can be a big disadvantage if your transmitter's antenna is horizontal and the signal is weak.

Radio Propagation

Radio waves normally travel in straight lines, but like light, they can also play tricks. Unless you do your hunting on an utterly flat, dry, treeless plain, you will experience all of the deceptions below:

Reflections

Radio waves *reflect* under many conditions and the result is always an illusion. You think the transmitter is behind the point of reflection, but it isn't so.

Suppose, for example, you pick up the signal coming from the side of a mountain. You spend hours climbing to the place only to find no transmitter there. It never was there. What you saw was the reflection of the transmitter's signal from another valley. You're comforted by the fact that without a reflection you would have gotten no signal at all.

Radio waves reflect off any surfaces that conduct electricity, including the following:

- **Metal** is the ideal reflector. Reflections from your nearby vehicle can easily give you a false reading and the steel in a building can scatter your signal in every direction. Put a few buildings together and you have a major problem.
- **Water** is another good conductor. Radio waves will bounce off the surface of a lake like light off a reflecting pool.
- **Hills and mountains** reflect, but their properties will depend on the nature of the material in them, particularly the moisture they hold; wetter structures reflect better. Most natural structures will give significant reflections.
- **Live trees** reflect radio waves, but dry wood does not. A forest can scatter the signal in many directions. Any green plant more than a meter in size can do it.

Radio reflections occur just like with a mirror, in that the angle the wave comes out is the same as the angle going in. A flat surface will reflect the signal in only one direction (the concept behind the flat, angular surfaces of Stealth aircraft), while a rounded surface will reflect in many directions, and most natural surfaces behave like that. Multiple reflections are possible and a signal may funnel a long distance down a canyon through successive reflections.

Fences & Wires

A power line or fence wire can really mix things up. The fence picks up your transmitter's signal, like an antenna, and the signal races down the wire and *re-radiates*. Your receiver picks up false signals which will most likely be horizontally polarized. The effect is worst when your animal is right next to the wire.

Checkerboard Patterns

When you are near the animal you may experience checkerboard patterns (technically known as *interference patterns.)* If you plotted the strength of the signal near your transmitter, it would look something like a round checkerboard. One spot is strong, while a few feet away you get little signal.

Checkerboard patterns occur when the signal reaches your receiver over two different paths, one being line-of-sight and the other usually a reflection off the ground. When the two signals combine they compliment each other in certain spots, nullifying each other in others.

> **When the transmitter is close:** The checkerboard effect is most pronounced when your animal is off the ground in a tree, especially when the transmitter antenna is pointing at you. Checkerboard patterns can weaken the signal in the direction of the animal while it remains strong in some other false direction. It can throw you off by exactly ninety degrees!

Don't rely on signal strength alone to find the animal, especially up close, because you could have just moved into one of the low signal pockets. Instead, rely on the directionality provided by your antenna. Don't get too close. Circle where you think the animal is. *Use vertical polarization*, since ground doesn't reflect vertical waves well.

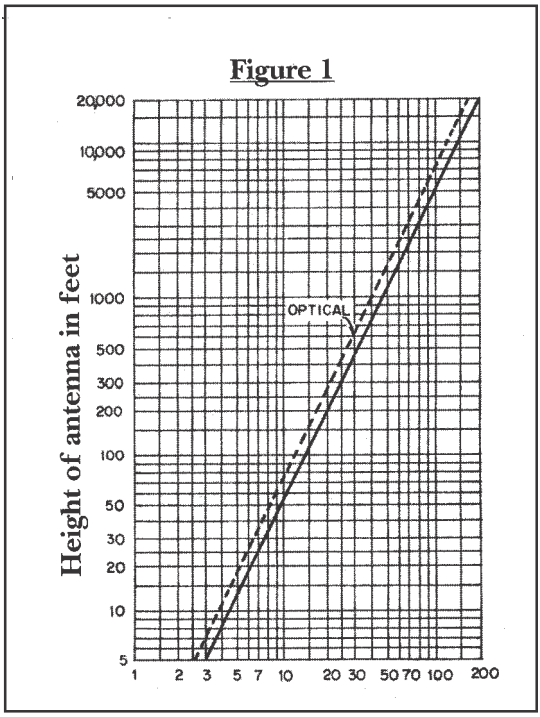
When the transmitter is distant: The checkerboard effect simply makes the signal stronger in some spots. Therefore, when you're trying to pick up a very weak signal, *always move around and try to get the signal at several spots within a 15 foot radius.*

Terrain Absorption

As radio waves pass through objects they diminish in strength. The effect is most noticeable in wooded areas where vegetation saps the strength of your signal. The further it goes through a forest the greater the loss. Fog, clouds, snow and rain also absorb radio waves, lowering your transmitter's range. Your Marshall system, between 173 and 220 mHz, avoids the absorption problems that are more pronounced at higher frequencies.

Radio Shadows

The biggest obstacle to radio waves is the earth itself. The range of a telemetry system is limited first and foremost by the *horizon*. The curvature of the earth creates a circular area around the transmitter where you can pick up the signal, the so-called *line-of-sight radius*. The actual radius depends on the elevation of both the transmitter and the receiver.

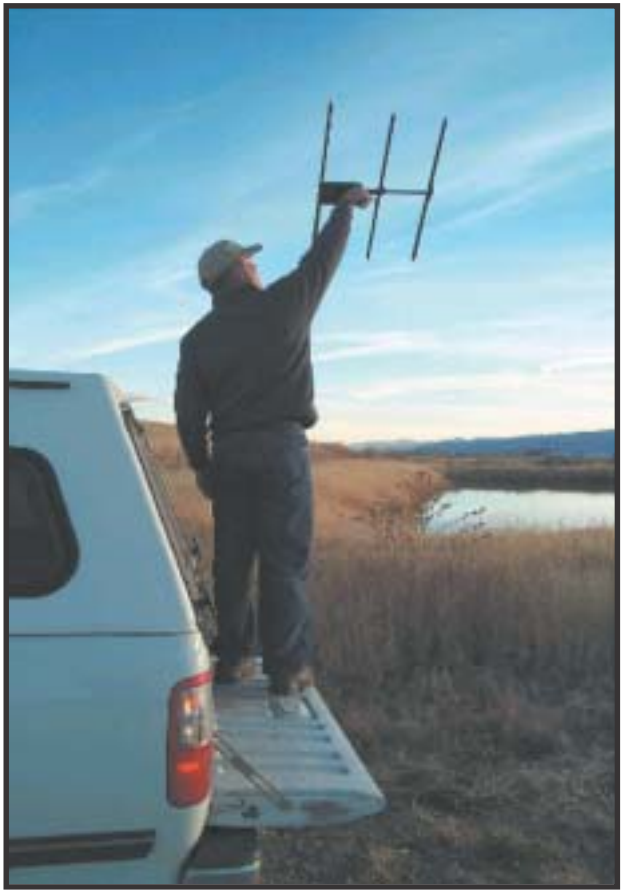


This diagram can give you an idea of the line-of-sight distance. To use it compute the distance for the height of the transmitter and your own height separately, then add them together. For example, if your transmitter was on a hill 25 feet high and your receiver was 8 feet high, the line-of-site distance would be 11 miles (7 + 4 miles).

You can see that if your transmitter is on flat ground and you are standing on the ground, the range can be just a few miles. Irregularities like hills reduce the line-of-sight to even less than what it would be if the earth were smooth. Every kind of terrain produces “radio shadows”. As you move around you can go in and out of shadows, even picking up a signal much further away from a spot where you picked up no signal.

The key to getting the best range from your receiver is *altitude.* **High spots are least likely to be in a shadow.** If you're not getting a good signal, the first thing to do is get higher. Driving to the top of a hill or climbing a water tower can dramatically increase your transmitter's range.

Hint: When tracking a weak signal, hold your antenna as high as you can reach instead of keeping it at eye level. Standing on your vehicle will also boost the signal significantly.



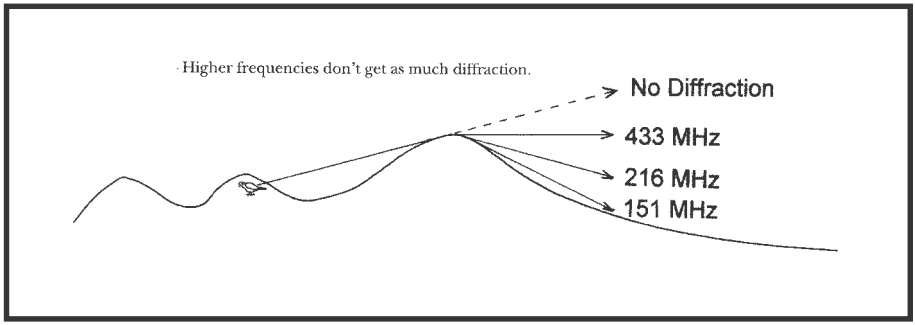
Diffraction

Radio waves can *bend* around objects. Diffraction works best around metal edges in buildings, but also happens with hills, trees and mountains. Diffraction increases the range of your transmitter in hilly country, because the signal bends over the crest of the hills.

This means your transmitter's range is not determined strictly by the above line-of-sight chart. Diffraction allows some of the signal to "hug the earth" and go further than the strict horizon, tapering off gradually as you go beyond it. A transmitter beyond a hill or in a deep ravine would be undetectable if it weren't for diffraction around the edges. A powerful transmitter can use diffraction to punch a signal beyond the line-of-site limit.

Diffraction around trees combined with reflections can create complex patterns within the forest. You should hold your antenna horizontally in a forest because trees produce mostly vertical interference.

It is important to remember that the frequency is very important. Higher frequency means less diffraction. Higher frequency transmitters may perform equally well at close range on flat ground, but will not do well at a distance or in hilly terrain. This is unfortunate, because higher frequencies allow smaller antennas. The frequency of your Marshall receiver, between 173 and 220 mHz gives a good compromise between antenna size and ground-hugging (diffraction) ability.



Tracking Strategies

The Marshall receivers and transmitters are the finest available to telemetry users. While good equipment helps, good technique is equally important when your animal is really lost. Most of the time you'll find it absolutely no problem, but there are those times when you'll want every advantage possible. Here are some techniques that can help:

Before starting

Always check your transmitters for a strong antenna connection and for any kind of corrosion on the battery contacts. Test your transmitter's battery with a battery tester or use a new one. The battery is the most likely component in your system to fail. Also, test your receiver batteries and have spares ready. Turn on the transmitters and attach to the animals. After waiting for the transmitters to reach the outside air temperature, select the channel of each transmitter and adjust the tuning for the optimal (loudest) sound.

The Initial Bearing

When you first lose the animal, use your receiver immediately to acquire the signal. You may not be able to run back to the vehicle; the receiver should be with you and ready. Try to determine the animal's direction through your last visual contact and by considering its past behavior. A strong signal indicates you have line-of-sight conditions. A sudden weakening of the signal indicates the animal has just gone over a hill.

Whatever you do, don't lose the signal. While driving use an omni-directional antenna on your vehicle roof. Stop frequently to take new bearings, depending on how far away the animal is and on your confidence in your estimating its direction and speed. Your goal is to keep within range of the animal until you have an indication it has halted, through the activity sensor on the transmitter or the lack of change in the signal.

Each time you take a bearing always scan a full 360°radius first to find the peak response. Remember that every yagi has a certain response 180° from the peak and if you're not careful you could go in exactly the wrong direction. To get the most precise bearing, turn the volume *down* so you get no signal except on the peak.

If the signal is weak, rotate the yagi around it's boom to find the best polarization, vertical or horizontal. If both polarizations are about equal, the signal could be coming from a reflection from a hill or mountain or could be diffracting over a hill. If you suspect you have a reflection, try to figure out where the transmitter would be if it is (remember that radio waves reflect off a surface exactly the way light waves do in a mirror; the incoming angle equals the outgoing angle.) Check for a weaker signal coming from the true direction to the transmitter masked by some obstacle.

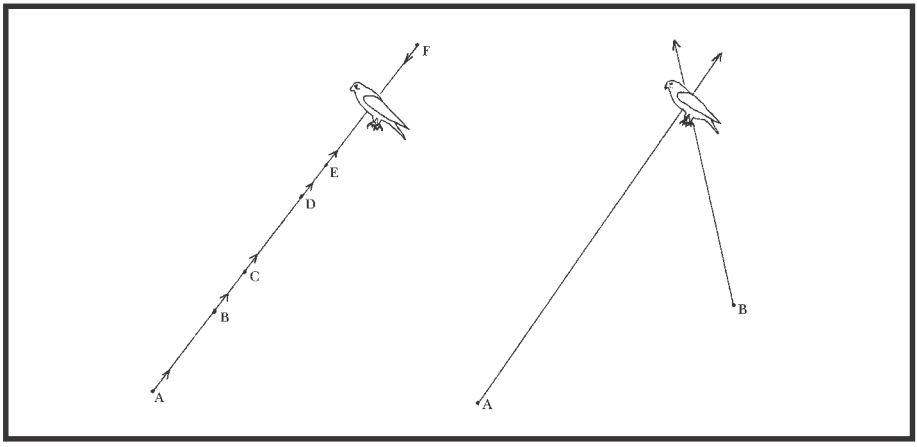
As you move the yagi across the horizon, is the peak response sharp or broad? A broad response may indicate a reflection or diffraction over an obstacle. As you drive away does the signal drop off rapidly? This may indicate the transmitter is low or is behind an obstruction rather than high.

Note whether there are any wires or fences in the vicinity, or other obvious objects the signal could be reflecting from. The signal can travel many miles along wires. Also remember the signal intensity on your S-Meter for comparison with the next reading you take.

Triangulation

After you take your first bearing, the natural tendency is to go straight in that direction toward the transmitter. And if you have a pretty good idea where the transmitter is that's not a bad idea. However, usually you will end up taking a lot of extra measurements that way because you lack information about the transmitter's distance. If the signal is weak it doesn't always mean the transmitter is far away.

Another approach is *triangulation*. Instead of moving directly toward where you think the transmitter is, you move closer and sideways. By taking only two bearings you can theoretically pinpoint the exact location of the transmitter: at the intersection of the two lines. You probably can't follow the line to the transmitter directly anyway because of roads and obstacles or the need to stay on high ground, so take advantage of that fact.



For triangulation to work, you have to remember the line of the previous bearing. You can do that mentally by noting two landmarks on that line as you take the bearing. Note a landmark behind the transmitter and another behind you. When you take the next bearing you'll know that the transmitter should be somewhere on the line connecting the two landmarks. Proceed toward the point of intersection, but again offset to a third point. You'll end up rapidly closing in on the transmitter in a spiral.

If you lose the signal altogether:

Go to high ground that looks down on where you expect the transmitter to be. If that doesn't help try high ground on the other side of where you expect the transmitter to be or that looks over the horizon in the direction the animal was headed. If you have no clue where the animal is, drive in widening concentric circles around where you last saw it, as closely as roads will permit. If you have an omni-directional antenna put it on and keep your receiver on.

When you are on a hilltop, the best location for getting a weak signal is usually slightly in front of the peak, though you can get a better 360°radius from the top.

The ultimate way to get up high is to hire an airplane and circle the area, using a yagi antenna mounted on the wing struts, pointing at an angle downward. Be sure to use good headphones in a plane. You'll need a long piece of antenna coax with the right connectors on each end.

Getting Hot

When you're close to the transmitter, it's tempting to rush in to find the bird or dog. However, you will do well to keep taking frequent bearings to avoid overshooting its location. You may have come to this spot based on a reflection while the main signal was obscured by an obstacle. Once you're past the obstacle the real signal may actually be behind you. So continue to take 360° readings as you proceed closer.

Before setting out on foot, make sure you're within walking distance. You'll waste a lot of time if you leave your vehicle prematurely. Triangulation will give you a good clue how close you are, or you can use the S-Meter technique described above.

Reduce your receiver volume and switch to *Medium* or *Near* range as you get close. Don't remove your antenna as you may do with other receivers. The Stealth Receiver has exceptional shielding that maintains sharp directionality even when you walk to without a few feet of the transmitter.

Continue triangulating, circling around the apparent location at a distance and taking multiple bearings. Then just walk to where they all intersect. Look out for reflections from fences and other metal objects, which will be much stronger when you're close to the transmitter. If the transmitter antenna happens to be pointing at you you'll get the weakest signal while the strong broadside radiation may reflect off nearby objects giving much stronger signals in those directions.

Notes:

Warranty

Marshall Radio Telemetry warrants that its receivers will be free from defects of workmanship and materials for ONE YEAR from date of purchase. If your receiver is defective return it to your distributor and we will repair or replace it and return it free of charge. However, we will not be responsible for damage from misuse or normal damage incurred during use. Under no circumstances will Marshall Radio be responsible for damages or loss beyond the value of the receiver itself, including the loss of an animal or lost time. The complete unit must be returned, transportation prepaid, to a Marshall Radio authorized Service Center.

Service

If something is wrong with your receiver, whether under warranty or otherwise, please do the following:

In the USA and Canada:

Call 801-936-9000 and talk to Marshall Radio Telemetry's Customer Service department. We will first try to determine the nature of the problem over the telephone and, if necessary, give you instructions on how to return the unit for repair, including an RMA number. Do not return products without calling first.

Everywhere else:

Contact your authorized distributor for assistance and information about returning the unit for repairs.

Marshall
RADIO TELEMETRY

(800) 729-7123
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