Field Marshall tracking receiver

OWNER'S GUIDE

Contents:

Introduction

Congratulations on your purchase of the all new digital Field Marshall receiver. It combines superior range and convenience in a compact and rugged design. The Field Marshall is great for tracking Marshall Transmitters under any conditions (see page 37).

- **More frequencies** (100, 800, 1000, or 4000 frequency models).
- Broad and **smoother tuning**.
- **Increased range** (more than any other receiver, and equal to the Marshall Stealth).
- Much **less noise and static** interference
- **Pinpoint accuracy** (to within inches of the transmitter).
- **Omni-directional sound**.
- **Smaller, narrower size.**
- **More rugged antenna** design.
- **Quick-Release handle**.
- **Improved range detection**.

The digital Field Marshall won't sound like your old receiver, because it has unique ***Polyphase Filters*** that dramatically reduce the background noise. The quietness means that you will hear the desired signal *crystal clear* and be able to keep the volume down without blasting your ears with noise.

This quietness translates into better range and increased speed in finding your transmitter.

Introduction, cont.

"The Quiet One" comes through with a more effective and pleasant tracking experience.

The Quiet One™

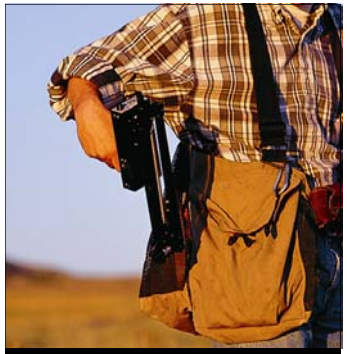
When you turn on your **Digital Field Marshall**, you'll notice the quietness immediately. You usually won't turn it up as loud as your old receiver because you don't have to. While other receivers are producing lots of noise, the new Field Marshall is producing more signal.

How does the digital Field Marshall's *lower noise* translate into *better range*? Well, the answer is that with all receivers it's the *noise floor* of the receiver that ultimately limits its range. Any receiver can amplify a weak signal from a faraway transmitter. The problem is that when you turn up the volume to amplify that weak signal *the noise just gets louder* as well and continues to overpower the signal*. That's why the difference between a mediocre receiver and the best receiver is sophisticated filtering and expensive electronic devices that minimize noise. It turns out that's the *only* way to increase the range of a receiver. Other receivers simply make a loud sound, but loudness alone means nothing in terms of range.

* The technical term for the *sensitivity* of a receiver, or its ability to discern weak signals, is the *signal-to-noise ratio*. A higher signal-to-noise ratio translates directly into better sensitivity and range, regardless of how loud the actual output of the receiver is.

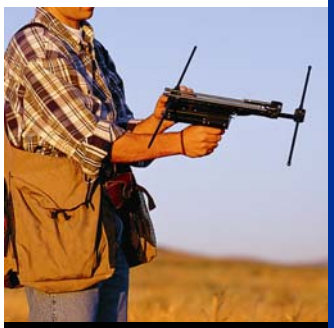
Getting Started

The first thing to understand is how to deploy the collapsible yagi antenna, which is a *full-size* three element Y*agi* Antenna *for maximum range* and *pin-point accuracy*, using Marshall's patented design.



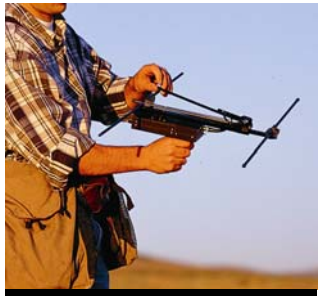
First, remove your receiver from your field holster or backpack.

1 Remove the receiver from whatever carrying case you are using (hunting bag, holster or carrying case) and hold it pointing away.



Second, push forward on the rear of the slide bar to release the spring-loaded elements out into position.

2 Push forward on the rear of the slide bar. The spring-loaded elements will automatically (instantly!) flip out into the open position. ***Warning***: *to avoid injury be sure to keep a careful distance from your face or others when performing this procedure.*



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

3 Lift the Center Elements up and out of their slots one at a time and let them spring open.

4 Reach forward and **pull the slide bar forward** to fully extend the forward elements until it clicks into place.

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

REMEMBER! *The antenna won't give its best range and pin-point* accuracy ***unless*** **fully deployed** as shown in the picture above.

To collapse the antenna, follow the same steps in reverse:

- *Slide* the Slide Bar with the two Forward Elements back toward the receiver.
- *Rotate* the Center Elements into their collapsed position.
- *Rotate* the two Back Elements and *click* them into their silver clips.

5 Turning It On

The receiver is turned on by rotating the Volume Knob on the front panel. It turns off again by turning to the left with a final click.

6 Tuning

The frequency is selected with the three numbered switches (two switches in the case of the FM100.) They indicate the kilohertz (KHz) of the frequency.

*The **FM1000** gives 1000 different frequency choices.*

The frequency of the receiver is very accurate (within one KHz) but to get the best tone may need to set the frequency 1 to 3 kHz above or below the frequency marked on your transmitter. This is perfectly normal. If you can't hear the signal at all, try moving through the whole range of numbers on the rightmost digit. For example, if your transmitter is marked 216.025 you may end up tuning somewhere between 216.022 and 216.028 (possibly even further away.)

The FM4000 gives 4000 different frequencies choices by providing a Band Selection Switch.

The **FM4000 Model** has a **Band Switch** which gives you a choice of which megahertz (MHz) band you want to tune to. (For example, each of the 216, 217, 218, and 219 MHz bands.)

The Fine Tune Knob is available so you can adjust the frequency slightly (within one KHz.) The tuning is very broad and not "touchy."

When tracking an extremely weak signal this knob is useful because you will get the *best range* by adjusting the Fine Tune to the strongest pitch (about 700-800 Hertz, or the upper end of the treble clef on a piano).

For everyday tracking you can set Fine Tune anywhere you want – many people prefer very high tones because they are sound so clear. Just tune to what sounds best to you.

7 The **Range Switch** is provided to be able to estimate the distance to the transmitter, a process called *ranging*. When you are driving in your vehicle toward the transmitter from a distance, the key question often is, “when should I get out and start walking?” A common mistake is getting out on foot too soon, thinking you are near enough to walk. The **Medium** setting helps you avoid this mistake. When the signal can be heard on Medium, you’re close enough to get out and *search on foot.*

Note: Other receivers have powerful Medium settings which tend to fool you into thinking a transmitter is closer than it is. This high sensitivity is good on Far, but on Medium, this is *not a virtue*. The Field Marshall is intentionally designed with a weaker, and more precise Medium range.

Setting	**Action**
Far	Stay in car
Medium	Start Walking
Near	Look around you

The **Near** range setting is not used in ordinary tracking. In extreme situations it allows you to accurately pinpoint a transmitter which is very near but hidden from sight.

The **Far** range setting is for use in all situations when the signal is too weak to be heard on Medium.

Comparing the range of two receivers set on **Medium** is like racing two cars in only second gear — winning means nothing because the gear ratios are arbitrary. Only compare performance of receivers with the ranges of both receivers set to **Far**. To have a race, put them both in high gear.

8 As with any receiver, you want to avoid *overdriving it*. This happens when you turn up the **Volume** too far. Overdriving doesn’t hurt the digital Field Marshall, but makes it so you get the same signal in every direction, (sometimes the signal may actually *decrease* in the direction of the transmitter.)

Solution: If the Receiver has lost directionality simply *turn down the* ***Volume***, or *switch to* ***Medium*** *or* ***Near***.

Other Features . . .

Batteries

The digital Field Marshall uses six AAA 1.5 Volt batteries. You can use any name brand Alkaline batteries, although more expensive Lithium batteries can be used for longer life. (Older style Zinc-Carbon batteries are not recommended.) AAA Lithium 1.5V batteries work better in cold weather (below about -7º C (20º F).)

The Low battery Light will begin to come on when it is time to change the batteries.

Actual battery life depends on many factors, including temperature and how long it is used continuously. All batteries will run longer if used for short periods of time with time to rest in between (rather than continuously with no rest.)

Caution: *Please observe the battery polarity* as shown in the picture and marked on the battery cover lid – negative on the two sides and positive in the middle.

Energizer Battery	Typical Life (hours)	Cost per Hour (USD)
AAA Alkaline	10.5	$.36
AAA Titanium	11.5	$.65
AAA Lithium	14.0	$1.07

Maintaining Directionality.

Avoid deflecting the Meter much more than full scale (the Meter is not much use then anyway.) This can be done by switching to Medium or Near or just turning down the Volume.

External Power

The External Power Jack is available for use with a standard 12 volt automotive cigarette lighter adapter with a *negative ground*. You can also use DC voltage from any external source between 7.5 and 14 volts that can supply up to 200 mA.

Batteries in the receiver *cannot* be recharged through the External Power Jack.

Quick Release Handle

The handle can be conveniently removed if desired by simply turning the thumbwheel and sliding the handle out.

Water

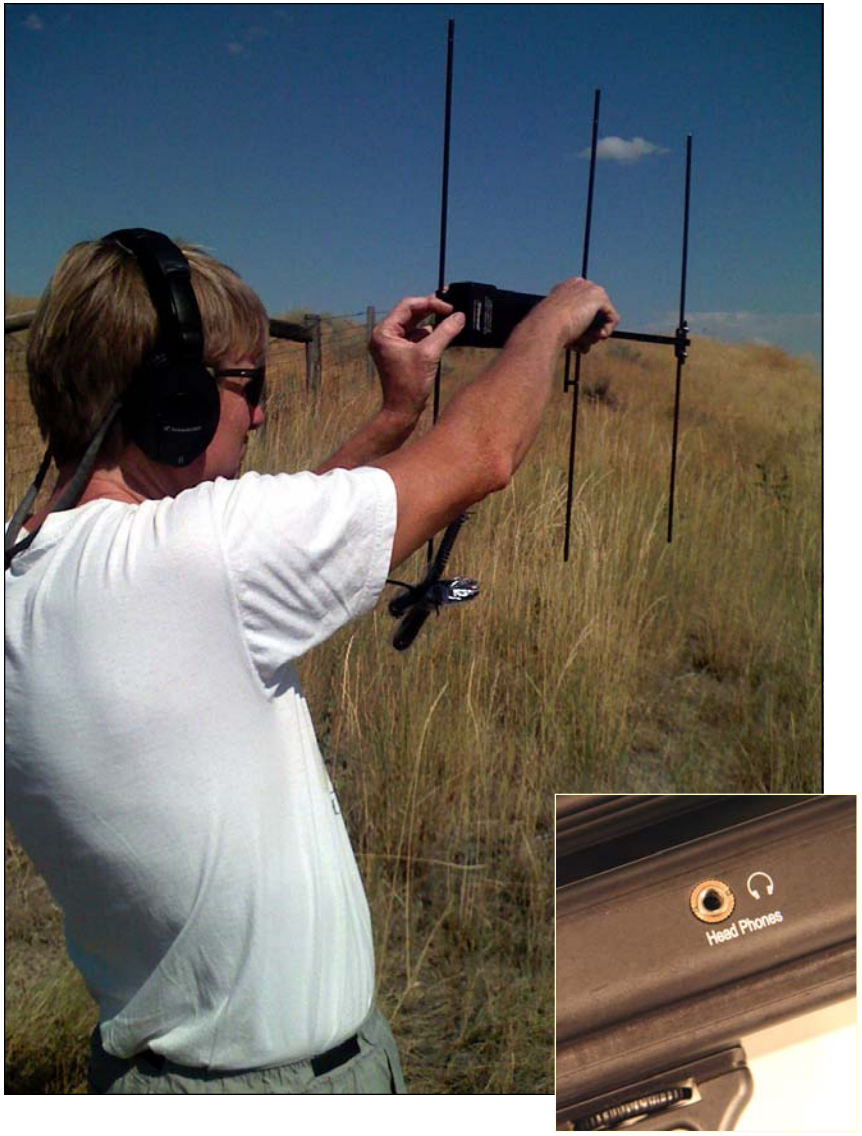
The Field Marshall is *very water resistant, and the speakers are completely waterproof.* It should have no problem with an ordinary rainstorm as long as you shield the Front Panel from the direct spray of the rain. That said, the receiver is not warranted against any water damage.

If water does get into the receiver (or if it has unusual behavior after exposure to water):

First: Immediately turn off the receiver and take the batteries out. (Wet batteries may swell up and become impossible to remove.)

Set the receiver on a flat surface with the Front Panel tilted downward so the water drains out the bottom of the front. Don't turn the receiver back on until it is completely dry.

The "drying out" position



Headphones give a big advantage when tracking weak signals in noisy environments and are strongly recommended for serious tracking and listening to very weak signals.

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? Or was it strongest somewhere in-between? 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 in the US and around the world.) Or, put the transmitter on a person, give them a head start, and see if you can track them down.

2. Hang the transmitter with the antenna vertical 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 numbers to match the frequency shown on the transmitter. From there you might rotate the third number up or down to get the best signal.

- Tune the receiver for the loudest sound after the transmitter is on the animal and has reached the outside air temperature. This is not necessary with Marshall transmitters but other brands can experience frequency drift with changes in temperature.

- 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 adjacent or 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.*

Frequently Asked Questions

Why does my receiver pick up all my transmitters at the same time? They're on different channels.
Extremely strong signals will get through even the most powerful filters in a receiver. If you have transmitters on adjacent channels transmitting right around you, you might hear a *popping* or *thumping* sound from them. This can be a distraction when you're trying to pick up a very weak signal from a lost animal.

The solution is to turn off the transmitters around you while you track a lost animal. If you're just tuning up, switching the Range Switch to *Near* will help to remove the unwanted signals.

I lost the signal and tried to tune it in. I couldn't get it again.
If you lose the signal, don't panic and tune all over the dial. It's essential not to lose the correct tuning. The signal may have drifted, but not much. So if you really think the signal could have drifted, take note of the setting and then just turn the Tuning Knob very slightly and search for the signal by scanning the horizon 360º. If you don't find it, you're out of range. Turn the Tuning Knob back where it was when you last heard the signal and go to *higher location* and try again.

I could only pick up a transmitter a half a mile away.
This usually happens because the transmitter is putting out a weak signal. The range of transmitters varies tremendously, depending on where they are. A transmitter on the ground may go less than half a mile. If the antenna is pointing directly at you, you may hear almost nothing.

If the transmitter is putting out a good signal, the problem is almost always *improper tuning* of the receiver. It's possible to tune to a tone that sounds like your transmitter, but is actually at the wrong frequency (or even on the wrong channel!) It will sound fine when you're right next to the transmitter, but when you get in the field it becomes weak (This can happen on any receiver.)

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.

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). A three or five element yagi is more precise, and a two element antenna is almost worthless. But 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 exactly 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.
The Range Switch is a feature that allows you to get a rough idea of the distance to the transmitter.

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. The strong signal also *saturates* the receiver, making all signals sound equally loud. This is common to all receivers.

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 200 feet

Medium ..... About 1/2 mile

Far ..... Over 1/2 mile

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 represent 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 in 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 tens of millions 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. .

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, gold-plated SMB connectors. Call to order a short adapter that will fit the larger BNC connectors used on some other antennas.

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 if you want to find your bird or dog when it is really lost.

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 the diagram on page 27.

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.

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.

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. The best orientation could be somewhere between vertical and horizontal, maybe at 60º from horizontal.

Rule #1: ***When tracking a weak signal, always try rotating the orientation by 180 degrees. 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 target can change positions at any time.

The yagi antenna's directionality is somewhat sharper if you hold it horizontally, so you'll want to use this orientation whenever you have a strong signal.

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. 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 Stealth Antenna 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 use-

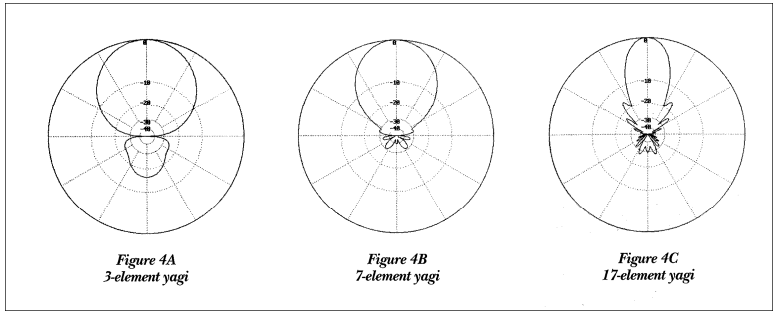


Figure 4A
3-element yagi

Figure 4B
7-element yagi

Figure 4C
17-element yagi

less, 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.

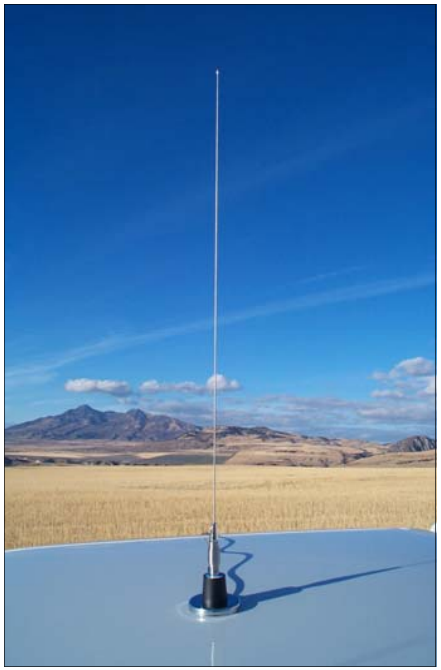
Yagis also pick up signals in other directions besides forward. The *back* and *side lobes* can confuse your ability to determine the direction to your animal. The strength of the forward lobe relative to the back is known as the *front-to-back* ratio, a higher ratio being better.

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.***

The Field Marshall 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 built-in Antenna. A car-mounted 5 or 7 element yagi is an excellent antenna for long distance telemetry.

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.



Yagi Tips

Don't touch the elements 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.)

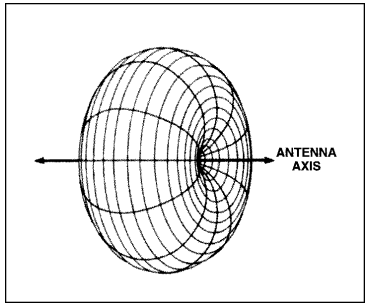
In spite of the above guidelines, a yagi is very forgiving. It will almost always guide you directly to your lost animal, hopefully awaiting your appearance.

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* (shown below). 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 is a little stronger in the horizontal directions.

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



Radio Wave 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 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 the signal in every direction.
- **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 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 most pronounced when your target 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 a reflection off the ground. When the two signals combine they complement 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.

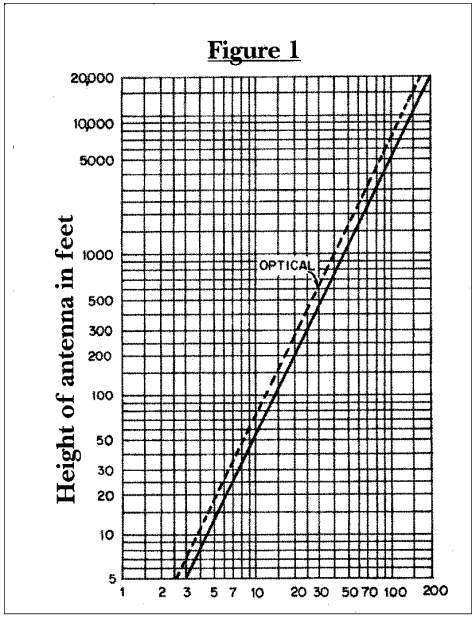
When the transmitter is distant: The checkerboard effect simply makes the signal stronger in some spots. Therefore, when you're trying to pick up a very weak signal, *always move around and try to get the signal at several spots within a 15 foot radius.*

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

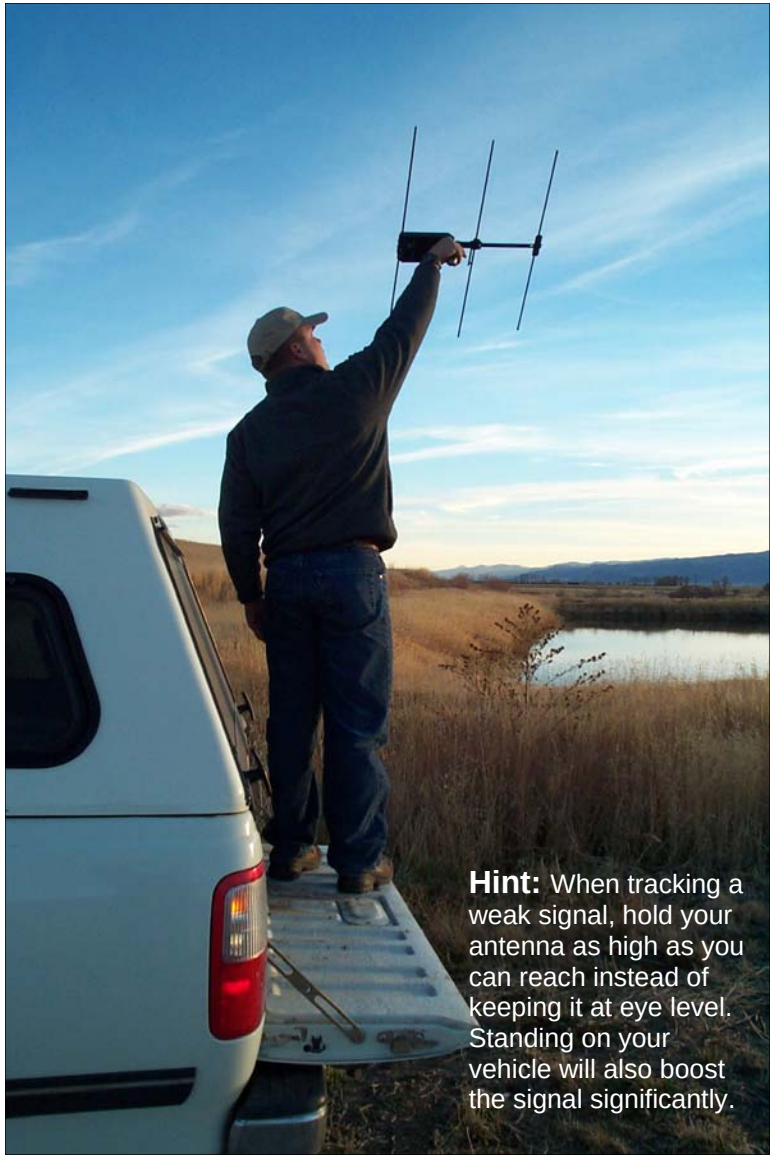
The biggest obstacle to radio waves is the earth itself. The range of a telemetry system is limited first and foremost by the *horizon*. The curvature of the earth creates a circular area around the transmitter where you can pick up the signal, the so-called *line-of-sight radius*. The actual radius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

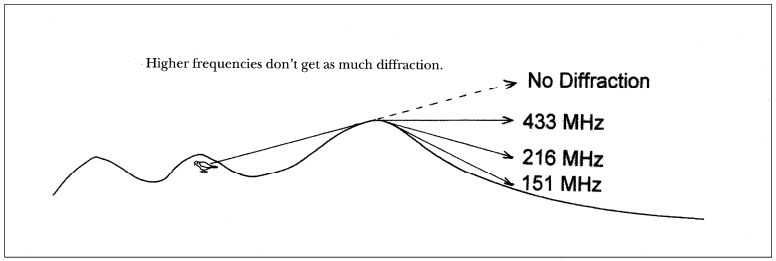


Diffraction

Fortunately, 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 beyond line-of-sight, 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. Check your transmitter's battery 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. 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 off 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 in the direction of the bounce (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.

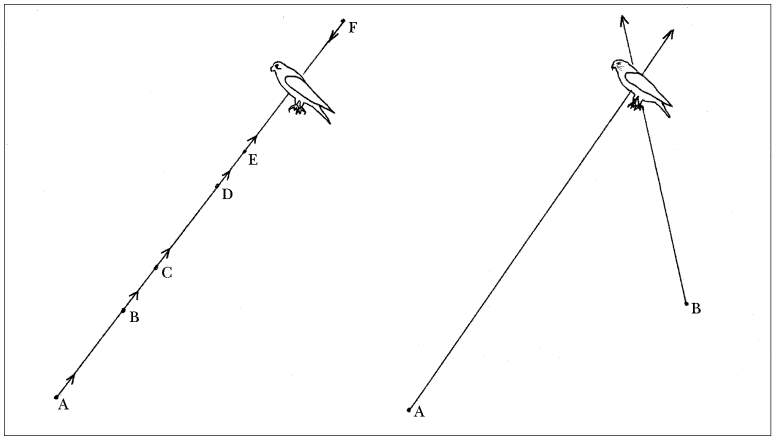
As you move the yagi across the horizon, is the peak response sharp or broad? A broad response may indicate a reflection or diffraction over an obstacle. As you drive away does the signal drop off rapidly? This may indicate the transmitter is low or is behind an obstruction rather than high.

Note whether there are any buildings, 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 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. 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 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 Field Marshall 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.

Warranty

Marshall Radio Telemetry warrants that its receivers will be free from defects of workmanship and materials for THREE YEARS 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 800-729-7123 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. Do not return products without calling first.

In Europe:

Call the Marshall Direct office in the UK at (44) 161-870-6518. 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. Do not return products without calling first.

Worldwide:

Contact your local distributor, or Call (001) 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. Do not return products without calling first.

(800) 729-7123
(801) 936-9000
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