



# **WanderSearch Equipment Manual**

**Wandatrak response receiver  
Regal 1000, 2000 and 2021 Models**

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Wandatrak receiver kit shown above, the Regal 1000 receiver in the green pouch, charger plus both antennas (directional Yagi in grey sleeve and magnetic base whip antenna).

## Terminology

The following terminology is used throughout this manual. It is listed here to aid understanding and clarity.

- **Beacon / Device** RF transmitting device worn by a WanderSearch client
- **Frequency** Radio Frequency used by the Beacon / Device
- **Receiver** Radio receiver used to locate Beacon / Device
- **Whip aerial** Omnidirectional antenna with magnetic base that goes on a car roof
- **Yagi aerial** Directional antenna that is hand held

## Introduction

The Wandatrak receiver can be tuned into any one of hundreds of WanderSearch devices (beacons), and in most cases enables a skilled operator to find any beacon that may be in their area, if they know the beacon's frequency number. This frequency is normally held in a database that links the beacon frequency to the person issued with the beacon.

## Beacons



The pendant type of beacon has an external wire antenna about 20cm long inside the black necklace cord. The wrist or key ring type beacons have an internal antenna, the signal range of these are about a third of the range of the pendant. The signal from the wrist or key ring are stronger when the beacons are positioned with the raised text side facing away from the wearer's body.

## Receivers

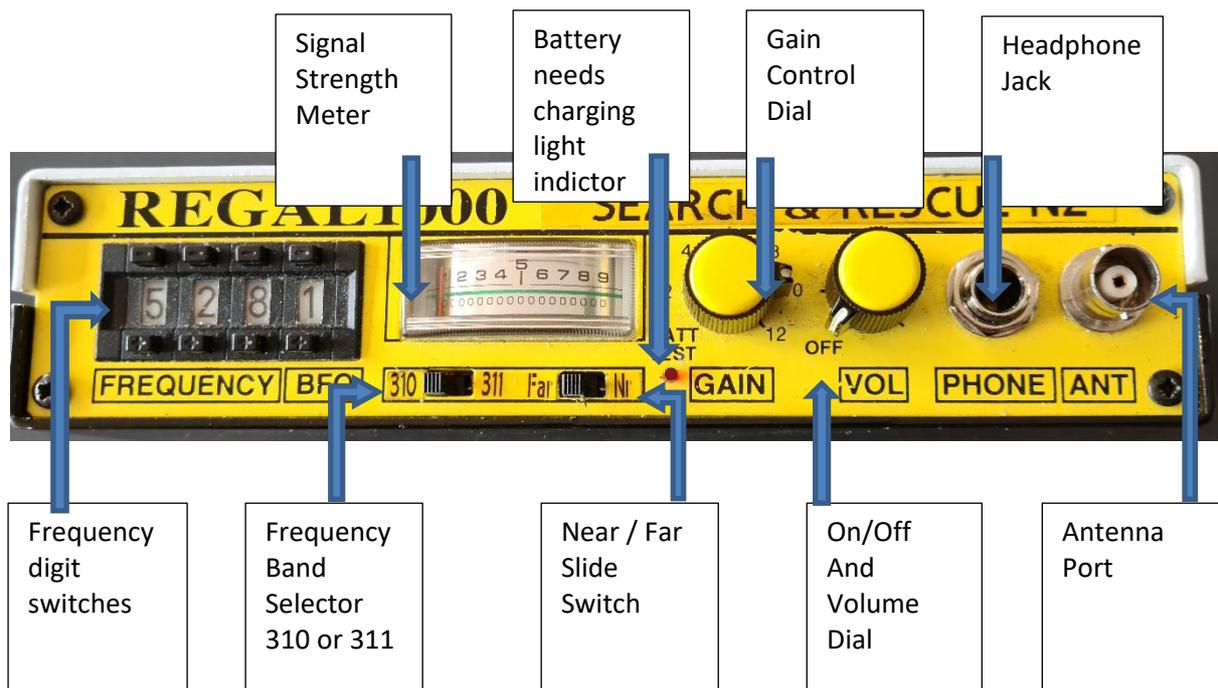
Different receiver models have been developed over the years since initial introduction. The following instructions separate the Regal 1000 and 2000 models (page 5-7) from the 2021 model (page 8-11). Photos of the different models can be seen in the below instructions. For example, the 2021 model says 'Regal 2021' on the top left of the front face of the receiver. It is important to note the difference between the different receivers, such as the battery, switch and charging differences between the units.

Additionally, the Regal 1000 and 2000 models search for 310 and 311 MHz, and the 2021 has been extended to be able to search for 312 and 313 MHz ranges.

All Regal receivers have an adjustable sensitivity control labelled Gain. This may seem to do the same job as the volume control, however, it actually controls how sensitive the receiver is and controls how far to the right the meter needle can move in response to the signal being received.



## Regal 1000 and 2000 Controls



### Turn On

Turn the Volume Dial clockwise to turn the receiver on and return dial to the OFF position to turn off.

### Volume Control

The Volume dial (right hand knob) controls the speaker loudness and does not affect the meter indication or receiver sensitivity. It is normal for the receiver to hiss when both Gain and Volume controls are increased to maximum.

Always remember to turn the Volume dial to the OFF position when finished with the receiver.

### Setting the Frequency

The beacon frequency number will have a format like "310.517 MHz". The 310 is the band and selected by the Frequency Band slide switch 310 or 311 (this is marked "**Band**" on the some of the receiver models). The next three digits after the decimal point are set by the first three black frequency digit switches. The last digit position (on the right) is simply a further reduction in frequency step size, this can be used to adjust the audible pitch of the signal from the receiver speaker.

For example:

310.517 MHz - 310 is the band slide switch position on the front of the receiver.

310.517 MHz - 517 is the first three black frequency digit switch.



The last black frequency digit switch can be set to 0 or the operator may change it to suit their hearing, it is simply a finer step of the previous digits and slightly changes the pitch of the sound made by the receiver's speaker. When trying to hear a weak bleep in a noisy environment, the pitch of the sound can be a very important factor. Some operators will be able to hear a certain pitch better than others, so although the frequency digits are recorded for every beacon, the last two digits may differ slightly with temperature and operator hearing preferences.

### Signal Strength Meter



The meter on the front of the receiver displays a signal strength range from minimum (on the left) to maximum (on the right). The needle movement on the meter requires careful adjustment of the Gain Control dial since the signal can be much lower (beacon is far away) or much higher (beacon is close) than the display range. When using the meter to measure signal strength the operator needs to keep the signal level inside the display scale of the meter. The operator can then sense if they are closer or farther away from the beacon by the change in meter reading and loudness of the signal from the receiver speaker.

### Near / Far Switch

Not all models have this switch, but it is useful when searching for a lost beacon in a confined space. The switch should be normally set on Far. When very close the signal strength may be so strong that the needle does not move to indicate a change when you move closer to the beacon. Slide the switch to the Nr (near) position as this reduces the signal strength. When you switch from Far to Near you will need to re-adjust the Gain control to once again get the signal in the range of the meter. The receiver can then be used to search within a room e.g. in drawers/cupboards etc. to locate a lost beacon.

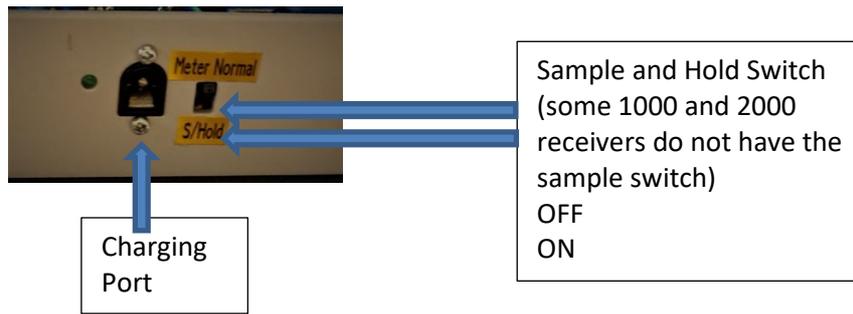
### Headphones

In noisy environments it may be useful to use headphones. When the headphones are plugged into the receiver, the receiver speaker does not work. If a headphone jack adaptor is left plugged into the receiver, then there will be no sound.

### Battery Check

The battery when fully charged will operate for about 40 hours, the small red light will come on when the battery needs to be recharged.

## Rear of Receiver



## Charging

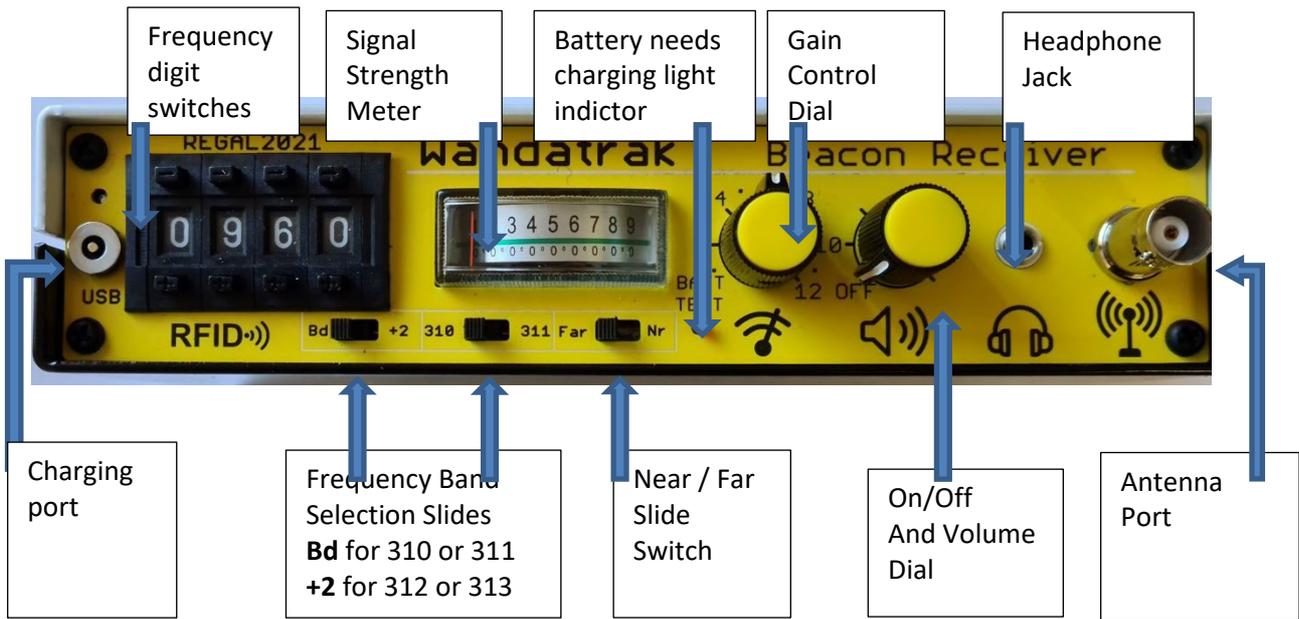
The charging port is located at the rear of the receiver.

The Regal 1000 and 2000 models use a special 12 Volt battery pack – the charger is supplied with the receiver and cannot (at point of writing this guide) be replaced due to the age of the charging cord; therefore this needs extreme care. If the battery needs to be replaced (goes flat after a short time of operation) the unit needs to be sent to the supplier for a battery replacement.

## Sample and Hold Switch

Please note some of the 1000 and 2000 models came out without this switch. When searching for beacons with a pulse rate of about 2 second intervals the meter is continually fluctuating. On the rear panel of the Regal 1000 and 2000 receiver models there is a switch - the Sample and Hold switch (S/Hold), it is turned on when in the down (on) position. When on, the signal meter needle is frozen after it registers a pulse. However, this is a very difficult feature to use correctly, and it is not recommended that it is used. A small dab of hot melt glue can be used to avoid the switch being accidentally switched on.

## Regal 2021 Controls



Turn the Volume knob clockwise to turn the receiver ON and return the knob to the OFF position to turn off.

## Volume Control

The Volume knob controls the speaker loudness and does not affect the meter indication or receiver sensitivity. It is normal for the receiver to hiss loudly when both Gain and Volume controls are increased to maximum. The controls can be set appropriately to the required frequency and proximity.

Always remember to turn the receiver off with the Volume knob turned to the OFF position. Also ensure all three slides are switched to the left (Bd, 310, Far) for the start of a search.

## Setting the Frequency

The WanderSearch device (beacon) frequency number will have a format like "310.096 MHz" the 310 is the band and selected by the Frequency Band Selection Slide set to Bd and 310. The next three digits after the decimal point are set by the first three black frequency digit switches.



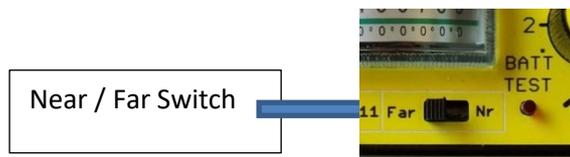
The last black frequency digit switch is simply a further reduction in frequency step size, this can be used to change the audible pitch of the signal in the receiver speaker. Once tuned into a signal, the pitch of the sound can be adjusted to suit the operators hearing, for example if the operator hears low pitch better than high pitch the last 2 digits can be changed to a lower number. When trying to hear a weak bleep in a noisy environment, the pitch of the sound can be a very important factor. Although the frequency digits are recorded for every beacon, the last two digits may differ slightly with temperature, age, and operator hearing.

### Signal Strength Meter



The meter on the front of the receiver displays a signal strength range from minimum to maximum. The needle movement on the meter requires careful adjustment using the Gain Control dial. If the beacon is far away the signal can be weak and the gain control may need to be on or near maximum, so that the signal is registered on the meter. When the beacon is closer the gain control needs to be turned down (to a lower number) so the indicator on the meter reaches about the middle of the scale not the maximum. When using the meter to measure signal strength the indicator needs to stay within the meter scale, ideally at about midway. The operator can then see if they are getting closer or farther away from the beacon. The closer the receiver is to the beacon the greater the signal strength and the louder the signal. The Gain should be at or close to Zero when you are close to the Beacon, if it is higher than Zero you may still be some distance away.

### Near / Far Switch



This switch should be normally set on Far. When very close to a beacon it is difficult to register any change in signal strength, slide the switch to the Nr (near) position as this reduces the signal strength, and re-adjust the gain control. The receiver can then be used to search within a room e.g. in drawers/cupboards etc. to locate a lost beacon.

## Headphones

In noisy environments it may be useful to use headphones, the headphone jack size is 3.5mm. When the headphones are plugged into the receiver, the receiver speaker does not work. If a headphone jack adaptor is left plugged into the receiver, then there will be no sound.

## Battery Check



The battery will operate for about 60 hours when fully charged, the small red light will start to flash when there is about 3 hours of battery life left. The light will flash faster as the battery becomes weaker. It will take about 1 hour to fully charge.

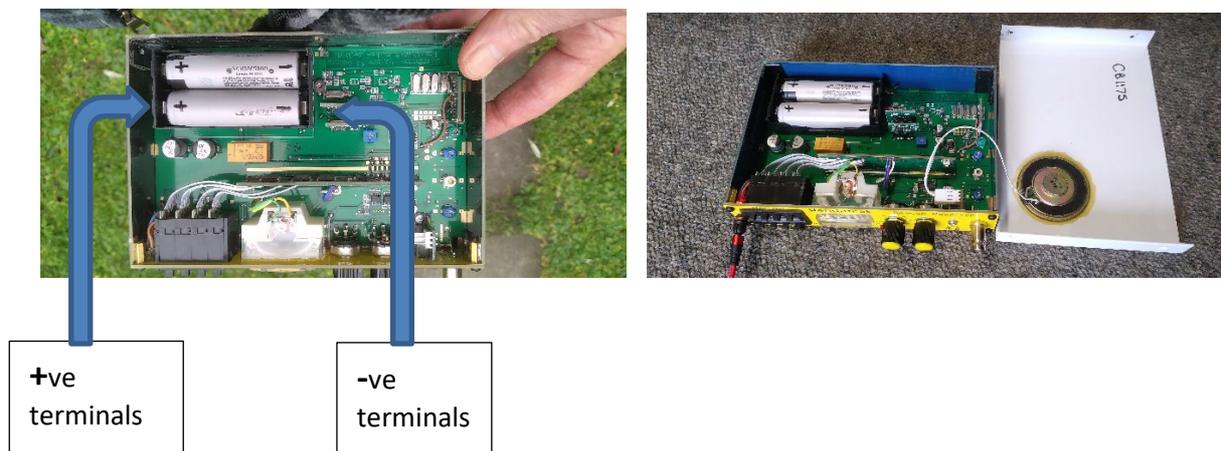
## Charging



The Regal 2021 model is supplied with a magnetic USB charging cable. The USB can plug into any USB port, then the other end placed on the charging port. The charging port has a magnetic adaptor inserted. The adaptor can be removed if using a Micro B USB to Type A USB cable, however, it is recommended this that the original charging cable provided is used, rather than removing the adaptor. If using a car USB adaptor port to charge the receiver it may take longer than 1 hour due to the lower power. The light above the charging port will be orange when the battery is charging and will go blue when it is fully charged.

**SAFETY NOTE:** As the unit contains Lithium batteries do not leave the receiver unattended when charging, and always charge under supervision. Once fully charged, the unit should not be left on charge.

## Battery



The Regal 2021 uses 2 x 3-volt Panasonic NCR18650B lithium-ion rechargeable battery. When the batteries need to be charged often, for example goes flat after a few hours of operation instead of 60 hours it is time to replace the batteries. This is expected to occur after about 5 years. The batteries can be purchased on-line and replaced easily by the operator. If new batteries are fitted by the user both batteries need to be replaced at the same time and would need to be the same type, manufacturer and level of charge to be balanced. Any imbalance can cause issues (such as a rush of charge with the balance difference within the receiver). Alternatively, you can send to the supplier to replace. It is VERY important that the new batteries are placed in the same orientation as the old one (see image above). If the batteries are placed the wrong way around, it might damage the receiver.

## Antenna

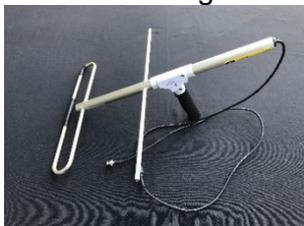
There are two types of antennae that are used with the receiver.

### The Yagi Antenna

The receiver detects a stronger signal when the Yagi antenna is pointed toward the beacon and a weaker signal when the antenna is pointed away from the beacon.

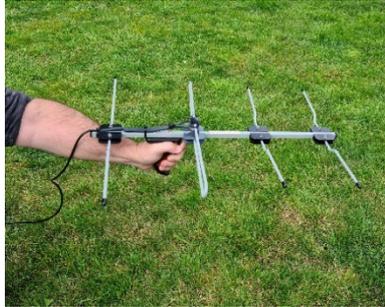


There are a variety of different Yagi antenna in use, some are fixed, and some are folding models, they are all specifically designed to optimise detection of radio frequencies in the 310 – 313 MHz range.



## Signal Polarity

Signals generally have a defined polarity, horizontal or vertical. The Yagi antenna will give a stronger signal if it is aligned in the same polarity as the incoming signal. The position of the beacon on the person (and if the person is upright or lying down) will alter the beacon's antenna and therefore polarity. Sometimes the polarity can also change across town, so when taking measurements with the Yagi antenna, try orientating the Yagi horizontally then vertically (and even variations in between horizontal and vertical) to see which operates best.



## Magnetic base Whip Antenna

The magnetic base whip antenna is useful because it allows responders to cover a lot of distance quickly. The antenna specifications are: 311MHz magnetic base, 1/4 wave whip antenna, 3-meter coax 50-ohm BNC terminated, MM, Mag mount, AW12, Whip adaptor, W05, 1/4 wave whip element, CNBNCP58F, BNC plug RG58 fitted.

The whip antenna is usually placed in the centre of a vehicle's roof and the cable ducted through the top of a slightly open rear door window that is generally not going to be opened by passengers (drivers side rear is the best). The antenna is connected to the Antenna Port on the receiver.

The antenna can be placed in a different position on the roof if the operator is finding interference from the vehicle's operating systems. A thin cloth can be placed under the magnetic base if the operator is concerned about damaging the car paintwork. The metal body of the vehicle forms part of the signal detection by the antenna.

Place Magnetic mount antenna on vehicle roof then feed cable through rear driver's side door window.



**SAFETY NOTE:** When removing the whip aerial from the roof, do not pull towards your face so the aerial does not cause an eye injury.

## Approximate Comparative Ranges

A beacon that can be heard at 25 metres on a receiver with no antenna, will be heard when a Yagi or magnetic antenna is connected at about 30 times the range e.g.  $25 \times 30 = 750\text{m}$ . Overlooking the area from a hilltop can multiply this range by a further 10 times or more.

## Principle of Operation

There are two simple methods used to find a beacon.

- Using a directional antenna (Yagi) to indicate the direction of the strongest signal.
- Using a roof mounted magnetic base whip antenna on a vehicle to drive a criss-cross pattern noting the increased/decreased signal strength of the beacon to determine if the operator is getting closer or further away from the beacon.

**SAFETY NOTE:** A minimum of 3-person team is required to use the equipment safely and effectively. A 3-person team allows for a driver, a receiver user, and a spotter/navigator. The spotter's role is to visually look for the subject as well as ensuring the safety of, and providing support to, the other two members of the team.

The team must be trained and have experience using the specialist equipment used for WanderSearch. Practise regularly with the equipment and the 3-person team format to increase search efficiency and effectiveness of the WanderSearch response and equipment.

## Searching for a Beacon

### Initial experience

One simple exercise that a budding operator can begin with is to try finding a beacon that a colleague has hidden in a closet or drawer etc. No antenna is needed to be fitted to the receiver, the operator can start at 20 – 30 metres away with the Gain Control dial set to maximum and volume at a comfortable level, as long as the beacon can be heard. The idea is to keep reducing the gain (**not the volume**) on approach to the beacon. The Near position can also be selected if the receiver model has a Near/Far switch. Soon the beacon will be located – remember to return the Near/Far slide to the Far position when finished. Once this technique is mastered on foot, it is a simple matter to transfer the same principles in a vehicle with an antenna on a larger scale.

'Body shielding' is where a person's body can reduce the signal you are receiving where their body is between the device and the receiver. This will cause a reduced signal, and when the person turns towards you the signal will increase. This can be seen when searching for a person who is on the move, as the signal may fluctuate.

Similarly, if you have found a signal as you turn away from the signal and your body goes between the signal and the receiver, signal will reduce and that will confirm that the signal is behind you.

This technique can be used to direct the received signal either with or without an antenna, so it is recommended that when using a Yagi directional antenna, you use it from directly in front of your body to reduce signals from behind.

## Testing the kit on the road

Place a beacon that is switched ON in a stationary location (for example hanging in a tree where it is unlikely to be found by any passers-by). Position the vehicle mount magnetic base antenna in the centre of the vehicle roof then connect to the receiver (via the rear door window on the driver's side). Switch the receiver on, select the correct band/frequency of the beacon, ensure the Near/Far slide is in the Far position, and turn up the Gain Control until the beacon is heard and the volume to a comfortable level. The beacon should be close enough to be heard. Drive away from the beacon and notice that the signal gets weaker, adjust the Gain Control to increase the gain so that the beacon can still be heard at the maximum range, this may be something less than a kilometre.

Now drive back noting the increasing signal strength and reduce the Gain control. It becomes very evident when you have gone past the beacon as the signal will quickly reduce in strength, this would be one way to quickly find the general location of the beacon. A valid method of searching is to note where the beacon signal is not present and then move on to a new location to continue the search. As you move through an area don't forget to let your operations base know where you are through your agreed group communication protocols. If you remain still and see that the signal strength is moving up and down this could mean that the person wearing the beacon is moving around. If a person wearing a pendant is facing away from you then their body is most likely between you and the pendant that they are wearing (refer body shielding above). Note that when tracking a person who is on the move the signal strength will vary as the person goes behind vehicles, buildings or trees etc.

When the beacon signal strength is very high sometimes the receiver antenna can be disconnected, and the signal found by turning up the Gain control. If the beacon can be heard without an external antenna, then the beacon must be within about 25 meters. Try walking around with the receiver, listening for the loudest signal, or adjusting the signal level on the meter using the Gain control and watching for an increase or decrease in signal strength as you walk a search grid. When holding the search receiver closely and directly in front of you pause and slowly turn around noting when the signal is loudest. When the signal reduces then your body is between you and the pendant, so your target is behind you.

Some operators prefer to plug external earphones/headphones into the headphone jack on the receiver, Walkman style are fine, but you need to purchase a 6.5/3.5mm headphone adapter (Regal 1000 and 2000 model) to fit the headphone jack on the receiver. On approach to the beacon continue to adjust down the gain control until eventually the beacon is found, even when the beacon is hidden, the experienced operator will know when the beacon has been reached.

**SAFETY NOTE:** Be aware of sound and keep health and safety in mind when operating the receiver. Do not operate the receiver too loud for too long. Be aware of reduction of external sounds such as approaching vehicles etc.

The search process in general is a combination of driving a line/road while evaluating the signal strength, returning to the area of road the signal was judged the strongest, and turning into an intersection close to that point and repeating the process at 90 degrees to the previous track. After the process has been followed several times the beacon signal will become very strong and therefore very close. The operator may need to proceed on foot carrying the receiver to approach the beacon.

Note that when you have a definite direction in front of you and there is a building (e.g. house) in front of you the signal may be coming from the house or, a hill behind the house, or in the

next street behind the house. You have a definite direction but without more searching you do not yet have a distance to your target.

It is important to maintain maximum gain when the signal is weak and reduce-gain when the signal is strong so that the receiver performs correctly and does not overload when the beacon is close. This will help to highlight the diminishing signal when the operator drives past the beacon and increase the operator's sense of where the beacon is.

## Using the Yagi Directional Antenna



Experiment by taking the receiver and handheld directional Yagi antenna about half a kilometre from the beacon, since the operator will need two hands free, the receiver should be mounted in the receiver pouch and the strap around the neck supporting the receiver. Use one hand to hold the Yagi antenna pointed toward the beacon and the other hand to operate the receiver controls. Adjust the volume for audio comfort and the gain sufficient to obtain a mid-range meter reading from the signal. Rotate your whole body while holding the antenna and receiver slowly through 360 degrees noting the meter level changes. If the meter level exceeds the scale's maximum position, stop and reduce the gain until the indicator comes to the midway position. It should then be evident where the beacon direction is, when this principle is mastered try the same test when another person shifts the beacon to a location that the operator is unaware of. A couple of handheld radios are handy for this type of exercise, but the operator probably needs someone else with them to use the radio.

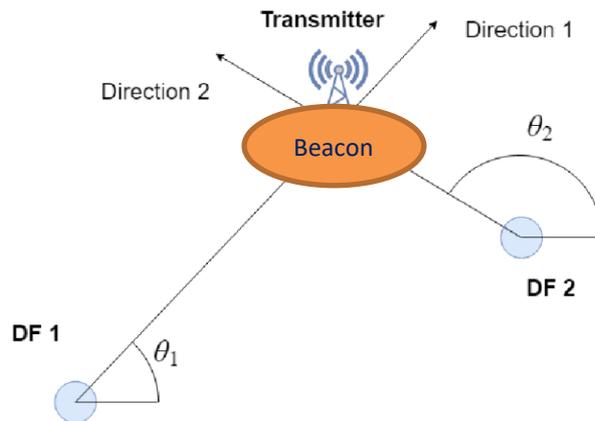
## Using the Signal Strength Meter

The ear is not as good at sensing a slight increase or decrease in signal strength as a visual display. However, the Gain Control dial can be a bit touchy to get the gain just right for the meter to display when midrange, where a slight increase or decrease can easily be seen. When using the Yagi antenna and noting the meter reading in different positions a precise rather than a general direction can be determined. In most cases an audible signal is good enough.

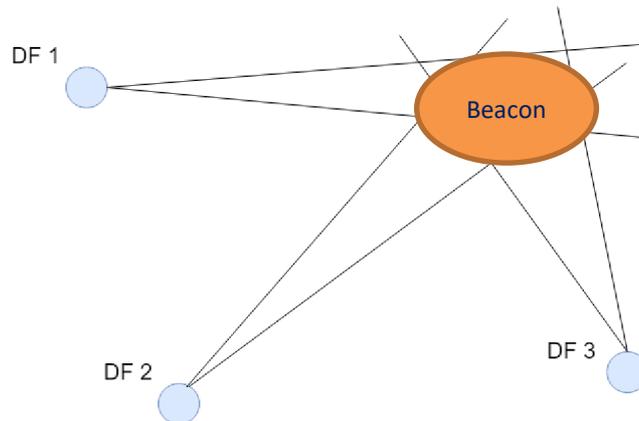
## Triangulation

A useful technique that can be used at long range or close range is triangulation. Triangulation is where using a directional antenna you take a bearing to the signal from different locations, this could be simultaneously using two receivers and search teams, or by taking a bearing from

one location and moving to another location and taking another bearing (note that if the beacon is moving while you relocate this can invalidate this technique).



This technique can be used at long range from two high points to cover a wide area, or it can be used up and down a street, or from corners of a property or park for example. Although two points should intersect, a further third bearing from another point can be taken if desired, which hopefully will intersect giving a triangle which in theory the missing party will be inside.



## Useful Hints

You need to be able to hear a beacon to track it down. If you cannot hear the beacon, check the frequency is correctly dialled and set the Gain Control dial to maximum, and Volume dial set to a comfortable level. The options are then to use a high building or drive to a high location, or hill and try listening from that vantage point.

If still no beacon heard, check the equipment by changing frequency to another beacon operating in the area. If a known beacon is heard, this will give the confidence that the receiver, antenna, and cables are all functioning properly.

To increase confidence in the equipment, the installation of a permanent beacon in a high building in a central location allows the receiving equipment to be tested at any time simply by switching to the test beacon frequency and pointing the Yagi directional antenna. Thus, the receiving equipment can be verified at any time eliminating any doubt and confirming that cables and antenna are all in working order. Any faulty equipment can be immediately identified before valuable time is lost.

## Acknowledgments

This Instruction Document is adapted by LandSAR from the original produced by Ian Trethowen with permission. Thanks to Ray Harkness and Steve Davis who were involved with the review of this instructional document.

Images: Ian Trethowen, LandSAR, NZ Police, Waikato WanderSearch Trust

For further information, questions on equipment provision, or supplier information:

Contact the National WanderSearch Coordinator on [wandersearch@landsar.org.nz](mailto:wandersearch@landsar.org.nz) or 0204534363.