PRODUCT SUPPORT MANUAL

Y1-03-0162
Rev. A

Vecta$_2$™

Direction Finder

Product No. 2769.4
121.5 MHz

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ACR / VECTA$_2$ ™
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1.0 PRODUCT DESCRIPTION

The innovations brought by ACR to the radio DF market are that our "Macro / Zoom" signal meter is very user friendly, and we have created a system that works well in either a Man Overboard or ELT false activation "Alert and Locate" scenario.

- The "Macro / Zoom" ultra sensitive signal strength meter gives the user 255 logarithmic units of measure. This allows a novice to determine a true signal from reflected signals like a seasoned SAR professional with a minimum of training.

- In a Man Overboard or ELT activation situation response time is of the essence and our "Alert and Locate" system provides the purchaser of a **Vecta$_2$™** with the opportunity to monitor 121.5 MHz at all times.

The **Vecta$_2$™** has a small beam, directional-finding antenna. The antenna is mated to a calibrated AM receiver sensitive to –113 dbm, a micro processor that interprets the strength of a signal and an LED scale that is maximized when the **Vecta$_2$™** is within a few feet of the typical 75 mW emergency transmitter. What this means is that under ideal conditions the **Vecta$_2$™**, at two meters above water line, will detect the Mini B^2 EPIRB floating at sea level from a distance of up to 8NM.

1.1 Accessories and Options

The **Vecta$_2$™** comes with the following standard accessories package: a remote omnidirectional antenna, AC and DC power adapters, waterproof storage case, a pistol grip style handle, a holster style carrying pouch and external head phones. No DF or rescue equipment is effective without training. ACR delivers the **Vecta$_2$™** DF system with a test beacon and Instructional video, which makes owners of our system more prepared.

Accessories

Test Beacon Replacement Battery

All routine service or battery replacement must be carried out by factory authorized personnel at authorized service centers. Please call ACR for the location of your nearest authorized service center at least 30 days before expiration date.

Characteristics for Test Beacon

The **ACR/MINI B$_2$ ™ Test Beacon (2762.2)** is an o-ring sealed battery operated unit. The test beacon case, with its external antenna is waterproof. The semiconductor circuits are mounted within the case assembly, which also contains the battery power supply. An "ON-OFF" switch is installed on top of the test beacon, along with a light emitting diode (LED) operation indicator.

The Beacon is used in testing the **Vecta$_2$™** Direction Finder by emitting signals on Channel 2 of the **Vecta$_2$™**. This is a non-emergency channel.

Bracket and Handle

The **Vecta$_2$™** is supplied with a folding handle that also functions as part of the mounting bracket. *See Figure 1*. This handle allows the **Vecta$_2$™** to be hand held in the "Search" mode, as well as secured in the helm bracket in the "Monitor" mode. See Figure 2 and 3 to mount the Bracket to the helm station, select a flat location that will allow for the antenna and power wires to be routed there. Before drilling holes and screwing down the bracket, test fit the **Vecta$_2$™** to make sure unit is able to slide in and out of the bracket unobstructed. *See Figure 4*. It is not necessary to deploy the antenna blades while the unit is in its bracket and attached to the remote Omni-Directional antenna.

Omni-Directional Antenna

The **Vecta$_2$™** is supplied with a specially designed and tuned 121.5 MHz. antenna. While it looks and mounts like a standard VHF marine antenna, it is not. Do not attempt to use the **Vecta$_2$™** with any other antenna. This action will damage the **Vecta$_2$™** and may void the warranty. The Omni-Directional antenna should be mounted as high as practical. Use a standard VHF style mount appropriate for your mounting location. Route the wire to the helm station where the **Vecta$_2$™** will be mounted. When the **Vecta$_2$™** is in its bracket, the Omni-Direction antenna should be plugged in to achieve optimum performance while in the "Monitor" Mode. When a signal has been detected, remove the **Vecta$_2$™** from its bracket, disconnect Omni-Directional Antenna and deploy the antenna blades for "Search" mode. Refer to Video for proper method of homing in on a signal.

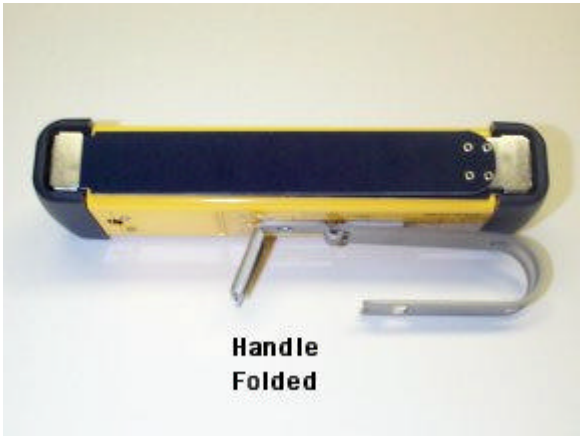


FIGURE 1

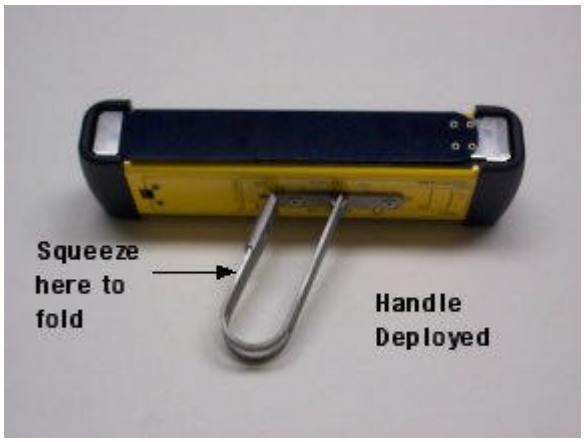


FIGURE 2

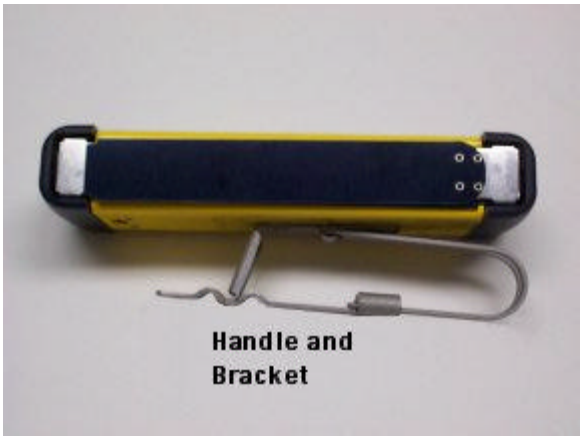


FIGURE 3

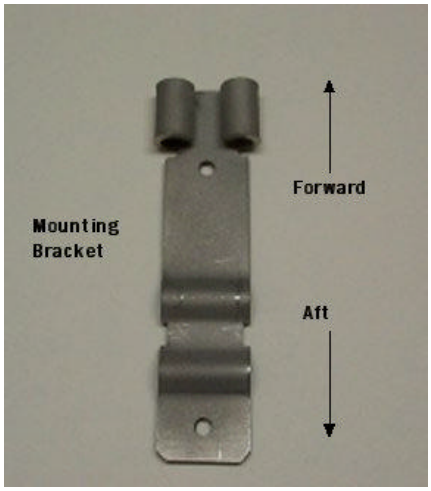


FIGURE 4

2.0 PRODUCT CONFIRGURATIONS

Technical Data

Pertinent technical data is listed below for test beacon:

ITEM	**CHARACTERISTICS**
Frequency	121.775 Test
Power Output	Minimum 75 mW on each frequency
Operating Life	48 hours minimum at –20°, (-4°F) longer in temperature climates
Battery	Lithium battery, 12 year shelf life
Emission	Type A3X
Modulation	Downward sweeping tone between 1600 and 300 Hz at 2 to 4 sweeps per second
Frequency Stability	.005% (Crystal controlled)
Operating Temperatures	-20°C to +55°C (-4°F to + 131°F)
Activation	Manual "ON-OFF" switch
Size	6.0" H x 2.6" W x 1.6" D (152mm x 66mm x 41mm) excluding antenna
Weight	9.9 ounces (280 g)
Attachments	Lanyards, Hanked

The **Vecta$_2$™** will "home-in" on any of the following emergency beacons:

- ELT's, c91 and c91a — 121.5 MHz
- ELT's, c126 — 121.5 MHz only
- Class A and B EPIRBs — 121.5 MHz
- All 406 MHz EPIRBs — 121.5 MHz only
- ETS 300 152 — 121.5 MHz *(* see comments)*

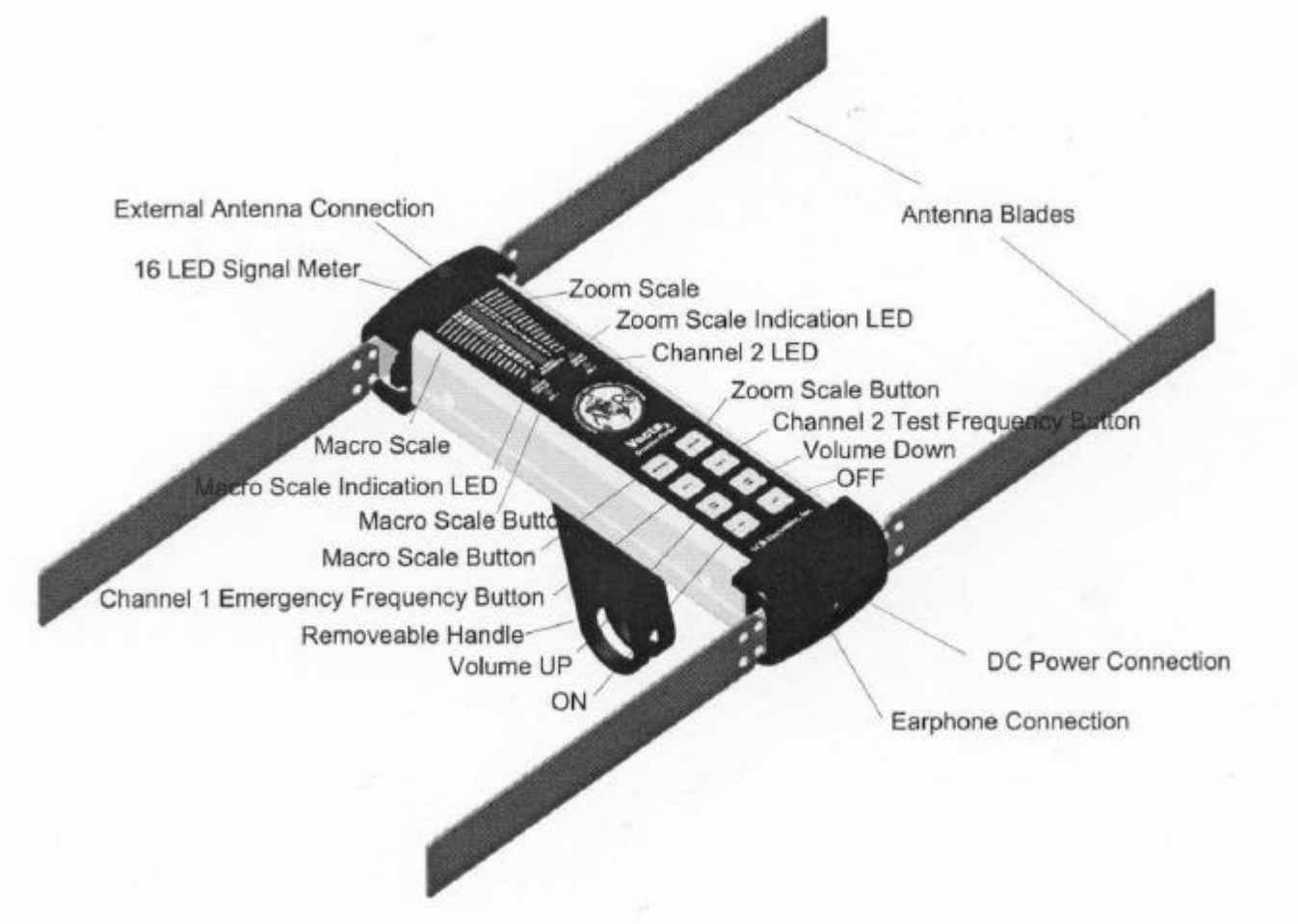


FIGURE 5

** Due to the nature of this Beacon Signal, it is recommended to practice Directional Finding skills prior to searching for this beacon.*

3.0 SWITCH DESCRIPTION

1. Power On - Turns Unit ON with default settings at Channel 1, MACRO mode and Volume at mid range. Unit will go into an automatic turn OFF 30 minutes after, if no buttons have been pushed. This feature is disabled when running on the AC/DC adapter.
2. Power Off - Turns OFF the unit
3. Volume Up - Increases Volume (additional 3 steps up)
4. Volume Down - Decreases Volume (additional 3 steps down)
5. Channel 1 - (Emergency Rescue Frequency) 121.5 MHz on P/N 2769
6. Channel 2 - (Test Frequency) 121.775 MHz on P/N 2769
7. MACRO Mode - 16 steps resolution of a full scale
8. ZOOM Mode - 255 step resolution of a full scale (Default Mode)

4.0 OPERATION GUIDE

1. Turn Unit ON
2. Hold Unit in hand *(see Figure 8)* and scan horizon all around (360°) listening for a tone.
3. If no tone is heard, rotate the unit in hand 90° and scan horizon all around (360°) listening for a tone.
4. If a tone is heard the BEACON is in range, and the rescue can continue with greater pace.
5. There are two indication modes for direction.

A. **Tone Mode:** When just coming into range of the Beacon (Weak Signal) an audio tone will be your guide for direction. A louder tone will be received from the beacon direction.

B. **Visual Mode:** When Audio Tone has stabilized (as signal strength increases), the LED Signal Meter will scroll in an upward fashion indicating an increase in signal strength, as you approach the beacon. Signal strength can be observed in two different modes: ZOOM and MACRO.

ZOOM MODE: Standard mode for direction finding (most sensitive signal level display).

MACRO MODE: Special mode for direction finding (most sensitive signal level display).

6. The **Vecta$_2$™** unit will be pointing in the direction of the Beacon as the LED's light up to a relatively higher position. Sometimes it may be useful to use the MACRO MODE in confirming direction.

   Once tone is heard and you're going in the direction of the BEACON, the LED Bar will become very active showing you visually that you're getting closer to your rescue position as the LED's start to climb up the Signal Meter.

5.0 EMERGENCY SCENARIOS

Typical man overboard Alert and Locate scenario

A cruising couple sailing in high seas shipping lanes at night where one person is at the helm and the other below deck eating, sleeping, etc.

Due to unforeseen circumstances, (rough wave, wind, accidental gibe, etc.), the crewman on deck is knocked overboard unknowingly to the companion below.

The intrepid cruising couple will have a **Vecta$_2$™** installed and running on ships power in a location within audio range of the below deck crewman. The **Vecta$_2$™** will be connected to the omnidirectional antenna remotely mounted on the highest point of the vessel and the on-watch crewman will be wearing a Mini B2™ personal EPIRB.

If conscious the overboard crewman will activate the Mini B2™. The Mini B2™ signal will be picked up by the omnidirectional antenna and the familiar oscillating tone will broadcast over the **Vecta$_2$™** speaker alerting the remaining crewman to the emergency. (Range is determined by height of the omnidirectional antenna and meteorological conditions. It can be as much as 8NM.)

The crewman on board can quickly disconnect the ships power and remote antenna from the **Vecta$_2$™**, fold the directional antennas step onto the deck of the vessel, conduct a sweep of the horizon, determine the direction of the transmitter from the boat, and thereby be able to turn around and effect a rescue.

As an added safety feature, the Mini B2™ is satellite detectable and the man overboard will be located by the USCG, if not by his own crew.

Typical ELT false activation Alert and Locate scenario

A Cessna 172 inbound to land at John Q. Public Airport bounces in on a hard landing setting off his impact activated ELT. His old fashioned c91 ELT does not notify him that it is transmitting. He taxis to his tie down spot shuts his plane and leaves, not realizing that his c91 ELT is transmitting a signal to the COSPAS-SARSAT satellite system.

The intrepid airport manager, (or ATC, FBO, Unicom, etc.), will have a **Vecta$_2$™** running on AC power connected to the omnidirectional antenna remotely mounted on top of his building. Alerted to the ELT transmission by the **Vecta$_2$™**, airport personnel respond by removing the **Vecta$_2$™** remote omnidirectional antenna connector and AC power supply, unfolding the directional indicating antennas and initiating a search of the airport grounds to identify the source of the emergency signal and determine if indeed there is an emergency or if the signal has been set off by a accident.

Within minutes they identify the Cessna, notify the owner that his ELT is falsely transmitting, confirm the transmission via the onboard Nav-Com radio and shut off the ELT- hopefully, before a satellite passes overhead – but, certainly before the SAR system devotes any resources to finding the signal source.

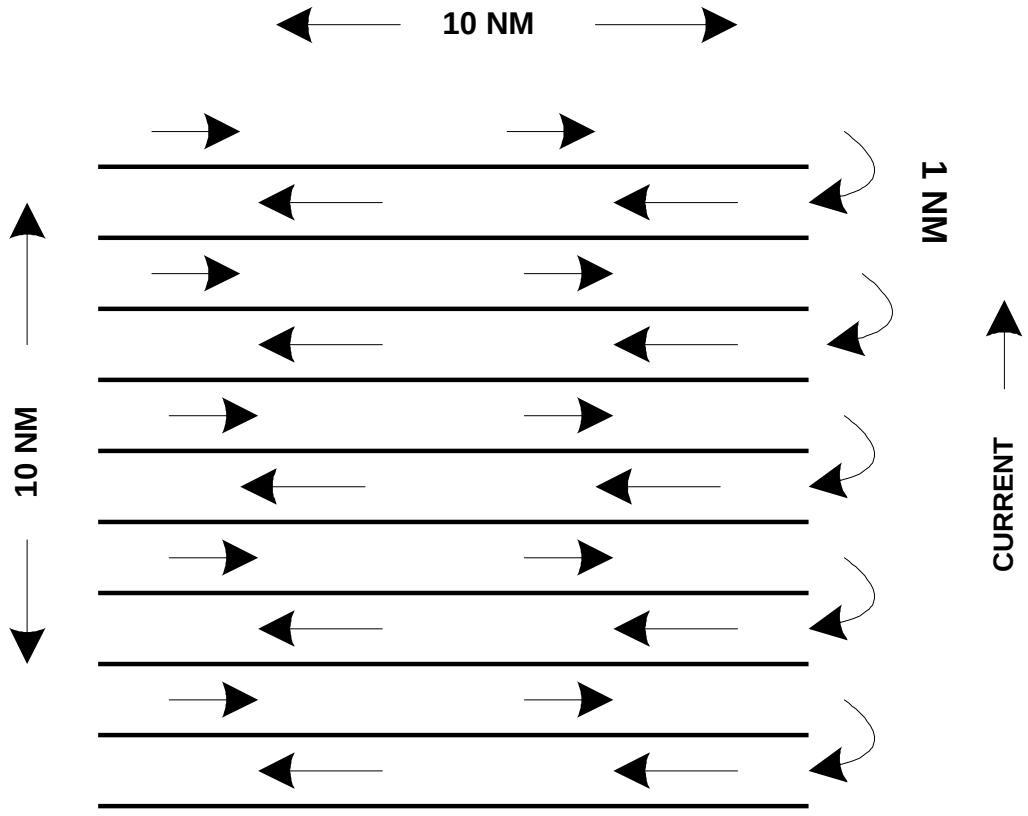


FIGURE 6

6.0 DIRECTIONAL FINDING INSTRUCTIONS

The first step in learning to use your **Vecta$_2$™** is to understand how it displays signal strength. A transmitter signal strength correlates very well with distance from the transmitters. The further you are from the transmitter, the weaker the signal and the closer you are the stronger the signal. The **Vecta$_2$™** signal strength meter measures the decibel level of a signal in 256 units of measure displayed on a single row of 16 LED's via two scales, "Macro" and "ZOOM".

When in the Macro mode, (the Macro scale LED is illuminated), the bottom LED represents a value of 0, or no signal. The next LED represents a value of 16, the third LED a value of 32, and so on. Each LED step represents a value jump of 16 units until you reach the top LED that it has a value of 240 units.

FIGURE 7

When in the Zoom mode, (the Zoom Scale LED is illuminated), the bottom LED represents a value of 1, the second value of 2, and so on. Each Led step represents a value jump of 1 unit giving the top LED a value of 16, which is roughly equivalent to 10db of signal strength. The 16 LED units displayed in the ZOOM Mode are equal to one LED unit of signal strength displayed in the MACRO Mode.

By flashing back and forth between the Macro and Zoom scale you can determine the relative value of a given signal with amazing accuracy. A macro scale reading of 32 combined with a Zoom scale reading of 10 gives you an overall signal strength reading of 42. A Macro reading of 32 combined with a Zoom scale of 16 gives you an overall Zoom scale strengthens past 16, the 1 LED illuminates. A quick jump over to the Macro scale reveals that it has moved up to a value of 48 giving an overall signal strength value of 49.

This process continues until the signal meter maxes out at a reading corresponding with the signal strength of the given transmitter. (The actual final signal strength measurement may not be 255, depending on the actual strength of the transmitter.)

Once you understand the working relationship of the Macro / Zoom scale, you need to do a range exercise. The range exercise involves placing your test beacon in area similar to where you will be using the **Vecta$_2$™**. If your application is on a boat, you will need to anchor your beacon in an area where you have at least 8-nautical miles of open water in all directions around you and the beacon. (Anchor your beacon well with plenty of buoyancy aid to insure that it is not moved or pulled under by wind or current. It is strongly recommended that you tie the test beacon securely to an orange life buoy to improve the test beacons visibility, as it can be difficult to see at close range in heavy seas.)

If your application is an oil platform you will need to anchor the test beacon in an area around the platform. If your application is around an airport then you need to locate your test beacon somewhere on the airport grounds, (you may want to do several range exercises at an airport with the beacon on the open ground, inside a hangar, or setting amidst several rows of airplanes.) If you may find yourself conducting a search in more than one environment you will need to do a range exercise in each environment.

Once the test beacon is properly placed and the location accurately determined it should be turned on and the **Vecta$_2$™** pointed directly at the beacon. The Macro and Zoom readings should be recorded. Moving away from test beacon, the Macro and Zoom readings should be recorded at mile, (nautical and statutory), intervals of 0.25, 0.75, 1.0, 1.5, 2.0, 2.5, 3.0, 3.5, 4.0, 5.0, 6.0, 7.0, 8.0, etc. until it can no longer be heard under any circumstances. A form like the following will assist in recording the results of your range exercise:

	0.0	0.25	0.5	0.75	1.0	1.5	2.0	2.5	3.0	3.5	4.0	5.0	6.0	7.0	8.0
Macro															
Zoom															

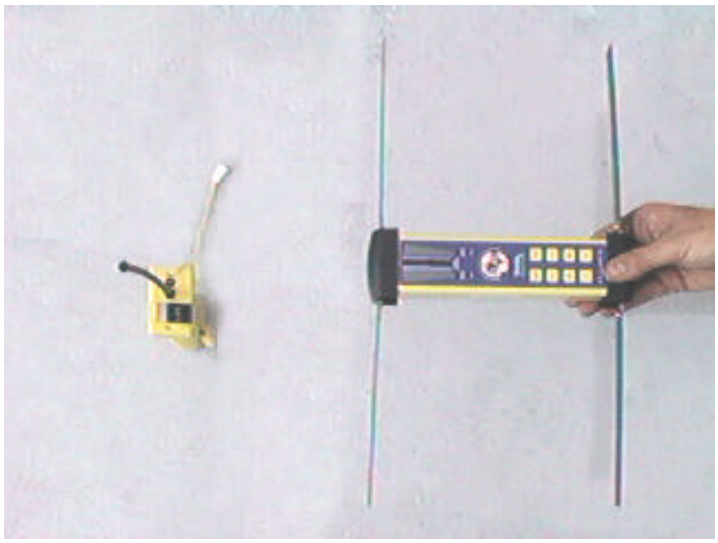
Notes:

When doing a range exercise in the ocean, especially at greater distances, wave height can cause a beacon to be heard intermittently as it rides up out of a trough to the crest of a swell or wave and back down.

A GPS is invaluable in insuring accurate distance intervals.

The ability of the **Vecta$_2$™** to pick up a weak signal is improved when the antenna of the **Vecta$_2$™** is polarized with the antenna of the transmitter.

To "polarize" the antennas simply rotate the **Vecta$_2$™** antennas from a horizontal position to a vertical position so they are in alignment with the transmitting beacon's antenna.



The Vecta$_2$™ is unpolarized when the antenna blades of the unit are in a perpendicular orientation with the transmit antenna.

Unpolarized

FIGURE 8

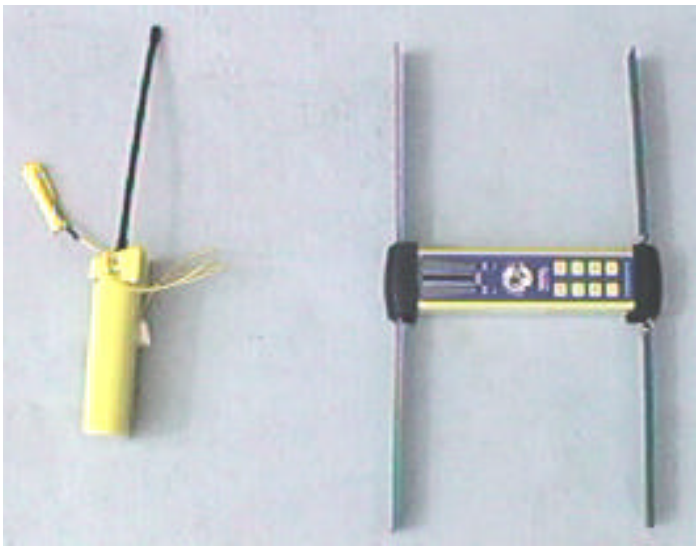
Emergency transmitters in the VHF 121.5 MHz frequencies are limited to line of sight and will be detectable at much greater range or distance on the open ocean than on land. This is a function of the transmitted signal being absorbed by hilly terrain, vegetation and buildings.

The third step is becoming proficient with the **Vecta$_2$™** is to conduct a blind search. It is very beneficial to have established a correlation between range and your **Vecta$_2$™** in your environment, as described above. A partner should hide the test beacon within a realistic search area. The trainee using the **Vecta$_2$™** should be aware of only the search area boundaries.

A search area should be larger than the range as determined above. The test beacon should be placed in an area that does not inhibit the signal, such as in a hole, or submerged under water, laying on its side, laying on a metal plate, etc. (A beacon can be found in these situations, but those exercises should be conducted once the searcher has gained more experience.)

A search pattern should be determined. (*see illustration on page 6*) The pattern should be a methodical pattern that begins up current, when at sea, and works toward the opposite end of the search area. A common search pattern on land is to drive the perimeter of the search area, stopping periodically to sweep the horizon with the **Vecta$_2$™**. The magnetic base omnidirectional antenna provided with the **Vecta$_2$™** can be mounted on a vehicle or to a mast on a yacht to aid in the early stage of a search.

In this instance you would drive or sail your search pattern until a signal is detected, then disconnect the **Vecta$_2$™** from the omnidirectional antenna to sweep the horizon to establish a directional bearing to the beacon.



The Vecta$_2$™ is polarized for maximum signal strength when the antenna blades of the unit are in a parallel orientation with the transmit antenna.

Polarization for Maximum Strength
FIGURE 9

Notes: The headphones are valuable in the early stage of a search. When outside the range of a transmitter, the **Vecta$_2$™** will pick up ambient electromagnetic interference, (EMI), or static noise. The EMI or static noise can over power the signal of a distant transmitter. At times the oscillating tone of a beacon can be heard faintly amidst the static by listening with the headphones. When this occurs the beacon is located in the general direction that the **Vecta$_2$™** is pointed when the oscillating tone is heard. Move in that direction.

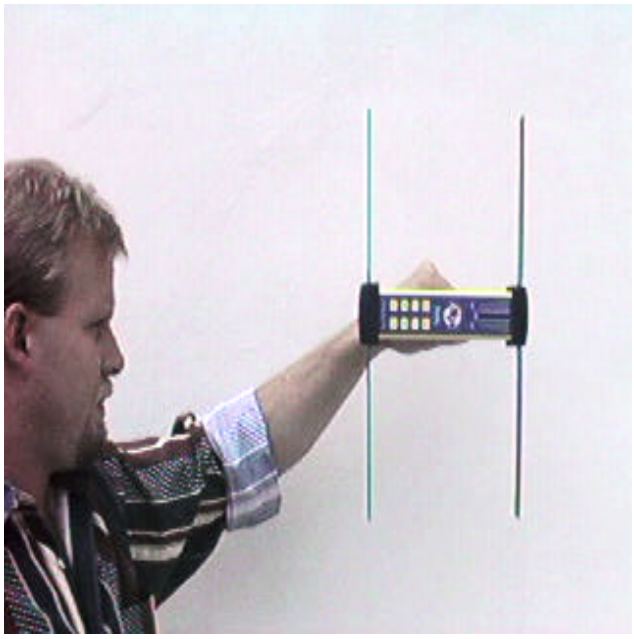


FIGURE 10

In the early stage of a search experienced rescuers prefer to hold the **Vecta$_2$™** in the left hand away from their body, in a vertical orientation and at ear level. The right hand front antenna element of the **Vecta$_2$™** is the electrically active element and the body's affect on the front to back ration of the antenna is minimized when in this position. Holding the **Vecta$_2$™** in this manner also polarizes the antenna with a vertically oriented beacon antenna and improves your ability to hear the signal in the early stages of a search by positioning the **Vecta$_2$™** speaker next to your ear.

It is important to slowly rotate the **Vecta$_2$™** antennas from horizontal to vertical and back when searching for the signal as the signal will be more easily detected when the **Vecta$_2$™** becomes aligned or polarized with the antenna of the transmitter, which may not be known to the searcher.

It is better to watch the Zoom signal scale for signs of a strengthening of the signal. Once the signal strength rises above the "noise floor", the signal meter should be used primarily to determine the directional bearing to the transmitter.

Flash back and forth between Zoom and Macro to continually calculate the signal strength so you can estimate range.

Signal reflections, or false signals, can be a problem at any time of the search. Signal reflections can be caused by large or metallic objects such as buildings, bridges, airplanes, cars, trees, towers, ships, hills, etc. or by being in a close or confined area, such as in a hangar. Signal reflections can become more pronounced as you become closer to the beacon.

Follow the strengthening signal meter. If is starts to fall or weaken, stop and **slowly** move the **Vecta$_2$™** in a circle to clearly establish the strongest signal indication. Trust the meter, not your instincts, until you have more experience.

As you move closer to the beacon, it may be helpful to do a cross-directional search that can be useful when you are getting a lot of false signals.

A cross-directional search pattern involves moving in a straight line in a direction that causes the signal meter to strengthen, *(which would be any direction falling within the hatched area of the illustration in figure 11)*. You do not deviate from your straight-line course as long as the signal is strengthening. You stop at the instance the signal peaks and starts to weaken. The beacon will be laying "close" to a line *perpendicular* to your current course.

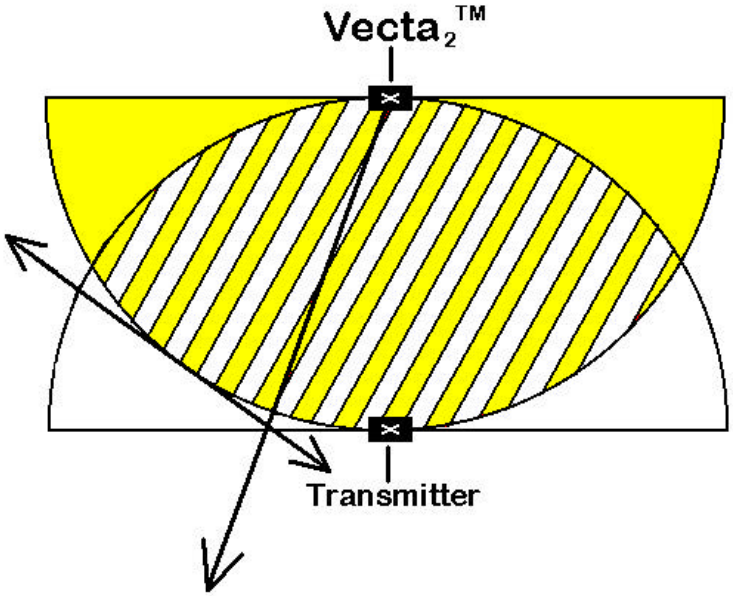


FIGURE 11

You then take signal strength readings at 90° angles from your current straight line course and heading and try to determine if the signal is stronger in one direction or another. You then turn exactly 90° and repeat the first step of walking in a straight line as long as the signal strengthens, stopping as soon as it begins to fall. If for some reason you have chosen the wrong direction the signal will begin to weaken steadily from the moment you turn and start moving. If signal meter shows the signal is weakening you need to turn around and work in the reverse direction.

When your signal strength peaks on the second leg of your search pattern you will be close to the beacon. If visual contact isn't made with the beacon, or if there are still a lot of signal reflections you may have to do a third leg, in the same way that runs perpendicular to your second, but parallel to the first leg.

FIGURE 12

When in the immediate vicinity of the beacon, but before visual contact is made, signal reflections may cause you to receive numerous false directional indications. You may want to reduce the sensitivity of the **Vecta$_2$™** by closing the antennas and then wrapping your hands around the **Vecta$_2$™** to detune the antennas. (*figure 12)*

It is then essential to use your body as a shield by holding the base of the **Vecta$_2$™** next to your abdomen. This technique will cause the **Vecta$_2$™** to receive only the strongest and true signal. This technique is especially helpful in confined areas such as airplane hangers.