by Gordon West

MORE ON 121.5 MHz

In the April issue of *Nuts & Volts*, we described the importance of the emergency locator beacon service at 121.5 MHz and the relatively new 406.025 MHz datastream. When the 406.025 MHz signal also carries GPS coordinates, rescue personnel can get activated and on-scene much faster than conventional COSPAS-SARSAT Doppler shift positioning solely on 121.5 MHz.

But once rescuers arrive at the 406.025 MHz GPS-derived position, they won't necessarily be right on top of the activated emergency beacon. You may be assured that the GPS system is accurate within the radius of a 300-foot circle, but the uploaded 406.025 MHz GPS datastream may be rounded off. This occurs in order to minimize the frequency of updates of the position data.

The 406 MHz encoded position signal is encoded initially to be as close as possible to the actual position. The initial offset encoded is selected so that it may be summed with the course position to produce a finer position that is as close as possible to the actual position. Subsequent position updates (if applicable) are then encoded by retaining the course position and changing only the offset, provided that the required value is within the range of the offset. If the position update cannot be encoded by changing the offset alone, there is a reset according to procedure for the initial position encoding.

Another problem might creep in where the position is in hours, minutes, and fractions of a minute, yet navigation to the EPIRB GPS-derived position is in hours, minutes, and seconds. The difference between fractions of a minute calculations and seconds within a minute calculations may affect how close rescue agencies are able to arrive on-scene to the indicated 406.025 MHz GPS-derived EPIRB position.

And what really happens out there with search and rescue agencies clearly illustrates the need for local homing in on the ever-present, half-watt, 121.5 MHz "localizer" signal. It is *this* signal that also transmits along with the now-and-then 406 MHz signal that allows rescuers to zero in on the activated ELT or EPIRB.

"We use the 406 MHz GPS position to get us in close, and then direction-find right down to the activated EPIRB on 121.5 MHz," comments William Alber, a reserve aero squadron sheriff. "Some of the equipment I own personally allows me to walk right up to an activated beacon, even though it might be totally hidden from the air," adds Alber.

Aboard the Coast Guard search and rescue boats and aircraft, direction finding to the 121.5 MHz signal employs an ADCOCK array antenna system which electronically spins the incoming signal heterodyned with an internal signal to calculate phase relationships among the multi-element antenna. These phase relationships are computed within the ADF to a visual readout of the signal source. As they fly in a direct path to the signal source, the ADF reads the bearing dead ahead. When they fly over the signal source, the ADF immediately shows the bearing behind the aircraft, and the signal strength begins to fall off, indicating the position has indeed been flown over.

But ADF systems are mighty expensive for rescue squad personnel who may only receive funding from donations. And this is where the ACR VECTA handheld direction-finder really pays off.

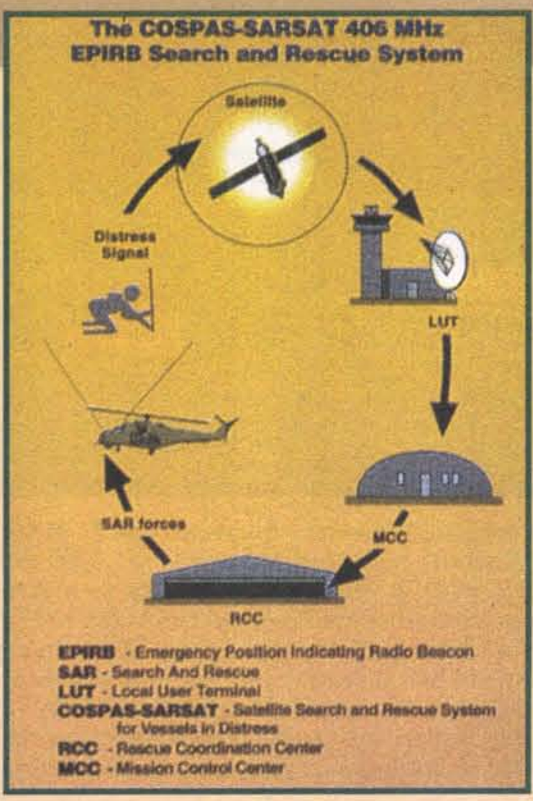
The ACR VECTA is a small, two-element beam antenna with an integral boom super-heterodyne receiver tuned to 121.5 MHz in Channel 1, and test frequency 121.775 MHz in Channel 2. The receiver outputs to a built-in weatherproof speaker, and the bright red LED signal strength indicator shows 255 step resolution of full scale in the zoom mode, and 16 steps of resolution on a full-scale mode. The LED signal meter will scroll in an upward fashion indicating an increase in signal strength as you approach the beacon and rotate the directional antenna in the direction of the beacon. During our trials on both the water, as well as in dense foliage, the LED bar becomes quite active showing our operators visually that they were getting closer to the rescue position as the LEDs began to climb up the signal meter. We would swing the beam back and forth, and easily see the general direction of the transmitting beacon.

In the macro mode, with the macro scale LED illuminated, the bottom light-emitting diode represents a value of zero, or no incoming 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 has a value of 240 units in macro mode.

In the zoom mode, the bottom LED represents a value of 1, the second a value of 2, and so on. Each LED represents a value jump of 1 unit giving the top LED a value of 16, which is

ELT DEMO IN THE MALIBU HILLS ...

(Above) Red Cross radio volunteers attend a briefing before an ELT transmitter hunt. (Right) Author West turning on the ACR test beacon during a search and rescue drill.



roughly equivalent to a 10 times increase of signal strength, 10 dB. The 16 LED units displayed in the zoom mode are equal to 1 LED unit of signal strength displayed in the macro mode, so it allowed us to switch between different modes as we began to get closer to the activated ELT.

It is important to slowly rotate the two-element beam antenna from horizontal to vertical when searching for the signal. This is because the activated transmitter could be in either the vertical or the horizontal plane, and you will receive best signal strength when the two planes are aligned.

When in the immediate vicinity of the beacon, signal reflections may cause you to receive numerous false direction indications. We wanted to reduce the sensitivity of the VECTA, so we closed the antennas and then wrapped our hands around the VECTA to detune the antennas. We next held the unit close to our body, using the body as a shield by holding the base of the VECTA next to our belt line. By doing a couple of body twirls, we were finally able to figure out the general direction of the incoming signal in the direction of our belt buckle. The buckle actually has nothing to do with DFing, but the signal is dramatically less when coming in and needing to pass through our body back side.

Amateur radio operators who take part in VHF "fox hunting" are expert in tracking down hidden low-power transmitters, and anyone wishing to increase their fox hunting skills should buy the well-illustrated book by Joe Moell K0OV, at most ham radio dealers.

ACR is so committed to emergency locator beacon tracking, they offer a complete training package with the VECTA handheld portable direction-finder, along with a low-power test beacon operating on FCC-authorized EPIRB/ELT training frequency 121.775 MHz. The test beacon is an O-ring-sealed, battery-operated unit with an external antenna. It is submersible and carries a flotation collar for on-the-water training exercises. Although the unit only transmits 75 milliwatts, this is plenty of power at 121.775 MHz for open field or open water testing with the handheld VECTA direction finder.

Emergency groups working near an airport may also use the ACR emergency transmitter direction finder on the supplied external antenna as an initial alert device to an activated ELT that sometimes may occur with a hard landing. Many older aeronautical ELTs have no audible alert that the equipment is activated. The emergency group, or airport manager, or the airport Unicom station would have the VECTA running on AC power connected to the omnidirectional antenna. There is no mistaking the sound of an activated ELT. The emergency group would then respond by taking the VECTA off of the omnidirectional antenna and power supply, going outside and unfolding the directional antennas, and beginning the initial search of the airport grounds to identify the source of the emergency signal.

If this can be done within a few minutes after activation, it very well could save a local Civil Air Patrol or United States Coast Guard unit from beginning an all-out search when notified by a mission control station that satellites are picking up an activated EPIRB somewhere in their area (as we described last month in *Nuts & Volts*).

"It is much easier to track down an activated EPIRB on the water than it is an activated ELT at an airport," claims Bill Alber. "On the water, there are little reflections of the signal, and the ACR handheld direction finder can easily spot the transmitting beacon. But at an airport, the VHF signals are easily reflected and scattered by metal hangars, and this is where the ACR equipment really pays off with its capability of attenuating the incoming signal," adds Alber. He points out that on-the-water signals can sometimes be traced in as little as 20 minutes, but down at the airport, it might take up to 40 minutes.

"Even though there is tremendous emphasis on boaters choosing a new 406 MHz EPIRB, this does not mean that 121.5 MHz is going away," comments Paul Hardin of ACR.

"121.5 MHz is still the frequency of choice for radio direction finding, or homing purposes – the 406 MHz side of the EPIRB is only on the air for less than a half a second duration at 50-second broadcast intervals – it is much easier to home in on 121.5 MHz, almost ignoring the 406 MHz signal when in close during direction-finding procedures," adds Hardin.

But when the 406 MHz signal is activated, along with the unique ACR interfaced GPS position datastream, rescue efforts start immediately, and ultimately end up with local rescue units homing in on the activated EPIRB with the 121.5 MHz local signal. If you have any type of VHF equipment that can listen in on 121.5 MHz, give it a try and see if you can pick up the sounds of an activated ELT or EPIRB. **NV**