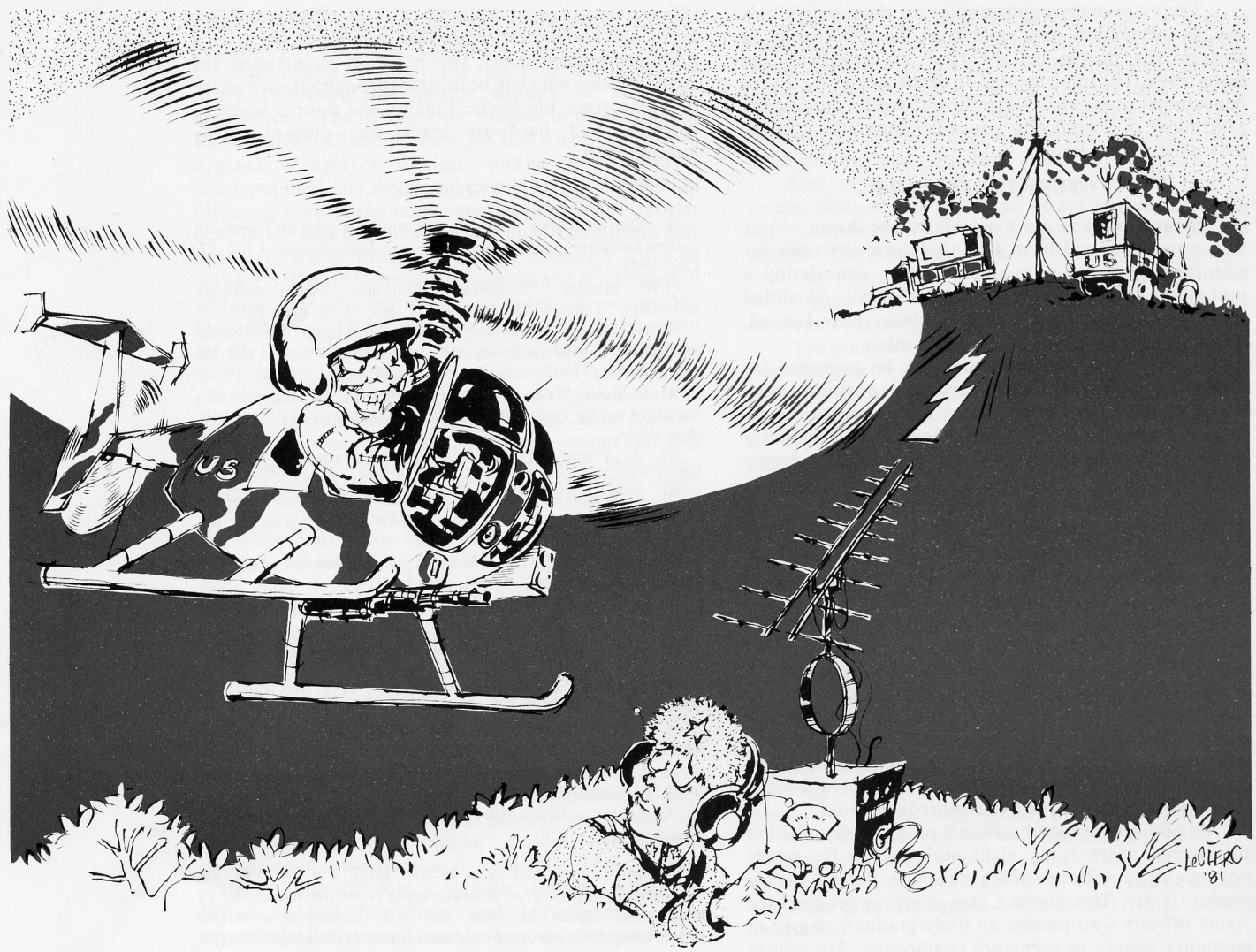


HOW TO GET YOURSELF OUT OF A JAM

by David M. Fiedler

If tactical commanders take advantage of standard aircraft, avionics and personnel organic to TO&E units, they can quickly and effectively stop enemy jammers from interfering with their VHF-FM voice command and control radio nets. Pilots can be trained to use the "homing" feature inherent in their aircraft's VHF-FM transceivers, along with their associated indicator equipment and compasses, to locate and effect the elimination or neutralization of enemy jammers. With this system, a solitary enemy jammer hidden in a brigade-sized area can be tracked down and pinpointed within five to eight minutes after receipt of the first jamming signal.

The battlefield of the 80's will be awesome. We will face an enemy who will be as well-equipped as us — perhaps he will be even better equipped. He will have sophisticated combined arms tactics and a range of conventional and nuclear weapons similar to our own.

But he will be impressed by us. He will find a well-armed force able to move and react on any type battlefield, a force capable of concentrating overwhelming combat power at critical points and times, a force capable of fighting outnumbered and winning.

A closer examination of our forces, however, will show a potential weak point in our structure which they may exploit and we must strengthen. This weak point from my point of view as a combat communicator is our VHF-FM voice command radio system. This system, when working, provides instantaneous command secure voice communications at division and lower level. It is a good system when using the AN/VRC-12 and an even better system when using SINCGARS; however, it is a radio system and therein lies its weakness.

Soviet/Warsaw Pact published doctrine clearly shows how they and others intend to employ what they term Radio Electronic Combat (REC) to disrupt and/or deny or exploit our radio systems to their advantage.

There are many components to the REC doctrine; among them are jamming, direction finding, traffic analysis and intrusion. My remarks here will focus on a specific method to counter the very significant jamming threat at division and lower level.

The Soviet/Warsaw Pact Radio Electronic Combat (REC) doctrine on jamming is extensive. They have thoroughly planned and integrated jamming equipment at every level of command to such an extent that a US commander must face the jamming threat to his Command and Control Communications anywhere in a division area with the intensity of the threat growing as one approaches the Forward Edge of Battle Area (FEBA).

To counter this threat our doctrine calls for several measures to be taken at various levels; some are effective, some may show marginal results under certain circumstances and many will most probably be ineffective. Let's briefly review some of them:

At Corps level several radio intercept and locating systems are deployed. These systems will locate enemy jammers (as well as any other transmitting station) accurately enough to destroy the station by artillery fire or air attack. The location and destruction of jammers is not, however, the prime mission of this equipment. It is intended for intelligence gathering.

The use of a Steerable Null Antenna Processor CP-1380/VRC is an excellent solution for protecting friendly receivers. This device forms a spatial "null" in the direction of a jamming station thus reducing the jammer's signal strength below that of friendly stations. When CP-1380/VRC is fully fielded, much of the jamming threat will be greatly reduced.

The only other method of defending ourselves at division and lower levels against Radio Electronic Combat (REC) in the VHF-FM range, are the methods outlined in FM 32-30.

These methods range from the simple to the complicated, but for the most part, they are ineffective. Here are some samples of recommended actions and their problems:

Switch to alternate frequencies: Unfortunately, this tactic can easily be tracked by enemy scanning receivers.

Select frequencies close to enemy frequencies: The idea here is that the jammer will interfere with one of his own nets and be forced to shut down. This is fine if you know the enemy's frequency.

Use the brevity list: This too is fine if you have trained operators, and the enemy cooperates by not using jam on receive jammers.

Change the mode of operation: This is impossible with our equipment.

Detune: This is also impossible with our equipment.

Use high power: Who's not on high power already?

VHF-FM voice command radio systems, using AN/VRC-12 series radio sets (left), provide secure voice communications when they are working, and even better protection with SINCGARS (right). However, because they are radio systems, they can be jammed and compromised by Radio Electronic Combat (REC). Therein lies their weakness.

Use terrain masking: This will work — if the terrain and enemy cooperate.

Use directional antennas: Fine if you have one.

Happily, the situation is getting better. SINCGARS-V, directional log periodic antennas and CP-1380/VRCs are all coming, but what can a battalion, brigade or division commander do if he encounters Radio Electronic Combat (REC) jamming attacks today?

The tactical commander can locate and destroy an enemy jammer using equipment already organic to our TO&E units.

This equipment is our ever-present family of helicopters and their associated compass (AN/ASN-43 etc.) and VHF-FM radio (AN/ARC-114 and AN/ARC-131) plus associated indicator equipment.

In order to use this equipment against an enemy jammer, let us quickly review in elementary terms the characteristics of jammers to see how we can use these characteristics and our aircraft and communications equipment to locate and destroy them. The jammer that we are concerned with will have the following characteristics, or they would not be a threat to us.

A powerful transmitter: By definition a jammer is the strongest signal transmitted on an operational frequency, thereby interfering with friendly reception.

A frequency range of at least 30-75.95 MHz: Since our VHF-FM radios operate in this range, any enemy jammer must cover all or at least a great portion of this frequency range to be effective.

Directional antennas: These are used to boost the effective jammer power by more efficiently radiating the transmitters signal and directing the transmitter power toward our area of operation.

A large but mobile configuration: This is necessary to transport the required equipment (antenna, generators, transmitter, direction finders, receivers, and so on far enough and fast enough to keep pace with mechanized combat forces.

With these characteristics in mind, let's now look at our AN/ARC-114 and AN/ARC-131 (fig 1 and 2) VHF-FM transceivers.

These transceivers are not only designed to operate as communication devices, they also contain a "homing" feature. Without getting into the engineering details, homing basically works like this:

Two receiving antennas are mounted on the aircraft separated by a predetermined distance. When a signal is sent from a transmitter, these antennas will both receive it, but since they are separated physically, they cannot arrive at the same time. This difference in signal arrival times will cause the signals in both antennas to be what engineers call "out of phase." The phase difference can then be processed in the receiving circuitry to produce a voltage proportional to the phase difference. Since the phase difference and hence the voltage depend on the bearing from the aircraft to the transmitter (jammer), this voltage can be fed to an indicator (ID-1351, ID-1347, for example. See fig 3). The indicator will then show the direction to the transmitter (jammer) by deflecting a centered needle. These indicators are also connected to the aircraft compass (AN/ASN-43) or attitude heading reference system (AN/ASN-76) so that when used properly, compass headings to the transmitter can be obtained.

Here's how to operate the system:

Tune the transceiver in the aircraft (AN/ARC-114 or AN/ARC-131) to the frequency of the net being jammed and switch to homing mode.

Position the aircraft in an area known to be under jamming attack.

Listen for the jamming signal; if the jammer is using tones, bagpipe, voices and the like, it can be easily heard.

Observe the homing indicator (see fig 3). The needle will swing in the direction of the jammer.

When the enemy is using noise jamming, only the "rushing" sound of noise and the breaking of the receiver squelch will be heard; however, the indicator needle will still point toward the jammer.

Once the jamming signal is acquired, the aircraft pilot must take the following actions to locate the jammer: center the indicator needle by turning the aircraft to the bearing of the jammer; the indicator will center. Note the aircraft heading in case the jammer shuts off so the direction to the jammer will not be lost. Fly the aircraft, keeping the indicator needle centered until it deflects fully to the

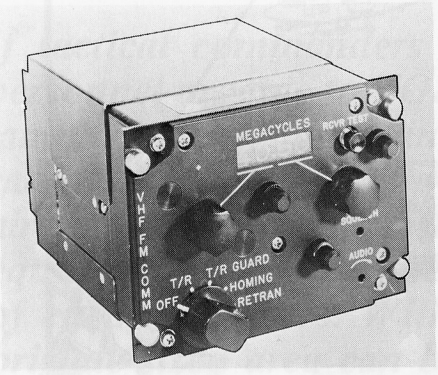


Figure 1. Airborne VHF-FM radio transceiver AN/ARC-114

Figure 2. Airborne VHF-FM radio transceiver AN/ARC-131

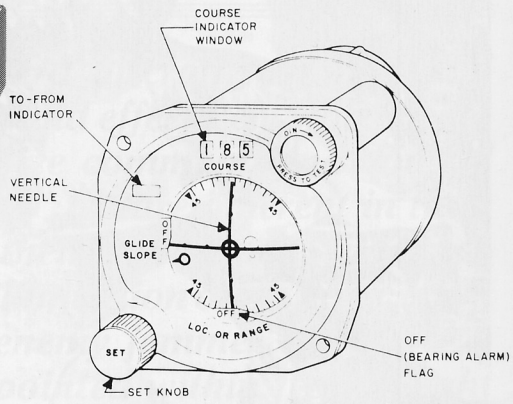
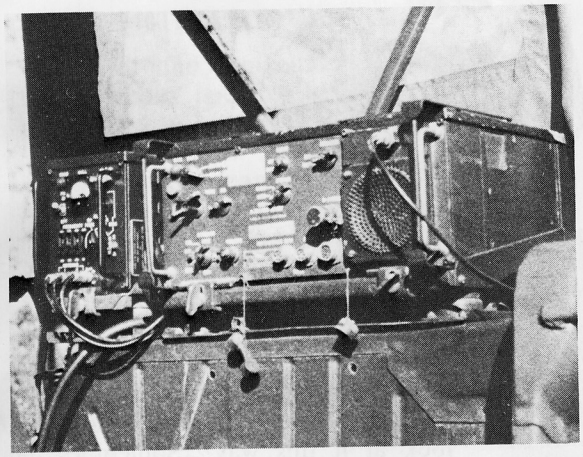
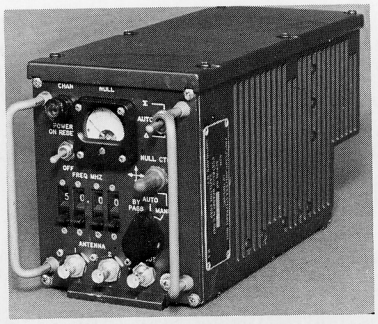
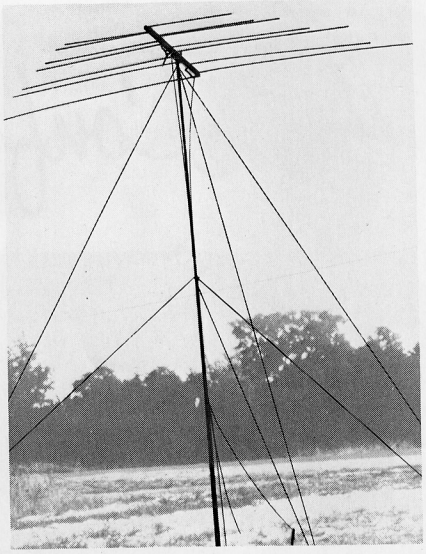


Figure 3. Typical aircraft course indicator (ID)







The Steerable Null Antenna Processor CP-1380/VRC (left and above) and directional log periodic antenna (right) will provide some protection against jamming when they are fully fielded, but what about now?

left or right. This indicates that the aircraft is directly over the jammer or just passing it.

Due to the design of the homing circuit, it is sometimes possible to be flying directly away from the jammer instead of directly toward it. To check this electrically, all the pilot needs to do is turn the aircraft off the indicated course by a few degrees (5-10). When heading toward the station (jammer), turning to the left will cause the center indicator needle to move right, and turning right will cause the needle to move left. If the indicator does the reverse, the pilot should change course 180 degrees and pick up a new center needle indication since he was heading away from the jammer.

If the indicator following technique leads the aircraft into heavily defended enemy territory while hunting for the jammer, an alternate location method can be employed.

With the transceiver in the homing mode, hover the aircraft over a known fixed point from which the jamming station can be heard. Turn the aircraft so that the needle on the indicator indicates a center reading. When the needle is centered, read the aircraft compass or heading reference bearing of the aircraft and record. Repeat this procedure over one to three more known fixed points.

After these bearings are obtained, a simple intersection drawing of the bearings will give the location of the jammer usually within one grid square (one sq km) or less. While this location is not sufficiently accurate for firing data, other means can then be used to finally locate and destroy the jammer. These methods include:

Map reconnaissance: There may be only one possible or obvious location within a targeted grid square for the jammer to be located; this can be spotted on a map and attacked by artillery or aircraft.

Ground reconnaissance: Forward observers (FOs) and/or scouts should be able to spot the jamming facility (antenna, vehicle, shelter generator sounds) when told in which grid square to look. The jammer can then be destroyed by artillery or mortar fire or by air attack.

Air reconnaissance: Scout helicopter/gunship teams should be able to spot a jamming station from the air when given the intersection data. Jamming stations are large enough and move often enough so that camouflage cover is usually spotty. If the aircrew knows what to look for, location from the air is very probable. If the hunting team is fortunate enough to seek a jammer that is still operating, they can use their own on-board VHF-FM radios in the homing mode to assist in location by following their homing indicator as outlined in the technique described.

By developing these techniques, I have tried to bring the location and destruction of enemy jammers down to units that can quickly react to changing tactical situations. By using standard aircraft and avionics, the method outlined here provides quick reaction to as low as the brigade level (the lowest level to which aircraft are normally assigned), reaction that will destroy stations interfering with vital communication links. Use of this tactic will also cause potential enemies to be more wary in employment of jammers since use of them can bring on swift counterattack by forces located quite near them. This threat of destruction should also reduce the quantity of jamming attacks and thus improve our own command and control.

These techniques also provide battalion and brigade commanders a quick direct action they can take to eliminate interference with their command and control radio nets from within their own resources without requiring increases in manpower or equipment. In addition, these actions can be taken without adding any additional burden to higher level intercept and location assets. Preliminary field test results of both of these methods indicate that well trained pilots operating in a brigade size area of operation can locate jamming stations within five to eight minutes after receiving the first jamming signals.

Maj. David M. Fiedler (NJARNG) was commissioned in the Signal Corps upon graduation from the Pennsylvania Military College in 1968. He is a graduate of the Signal Officers Basic Course, the Radio and Microwave Systems Engineering Course, the Signal Officers Advanced Course and the Command and General Staff College.