A Covert Tracking System Using the DDF5931

A Technical Application Note from Doppler Systems

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1.0 Introduction

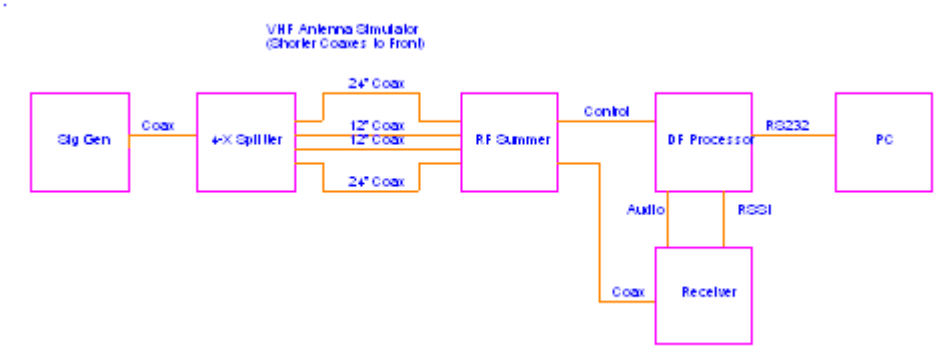
This application note describes a simple covert tracking system using the Doppler Systems Series DDF5900, an Icom R10 receiver and a Schell Electronics 3MDA transmitter.

The 3MDA came with a transmit frequency of 167.550 MHz and a pulse ON time of 100 msec which is adequate for use with DDF5931 processors with firmware versions V1.10 or later and with DDF6001 and DDF6002 processors having firmware versions V4.19 or later. Earlier versions will not work with 100 msec long pulses. (You can download the latest version for these processors from our web site).

The ICOM R10 must be modified if you want the signal strength to be displayed on the direction finder. Follow the directions in the application note for R10 Receiver Modifications for these changes and for construction of the cables used to connect the receiver to the direction finder.

2.0 Calibration

The bearing angle and signal strength may be calibrated using the field procedure described in the User's Manual for the Series 5900, or if the equipment is available, the following process may be followed (which is much more accurate). Connect a signal generator to the direction finder/receiver combination using a 4-way splitter and coaxes cut as shown in the following figure:



Set the signal generator for unmodulated output at a VHF frequency (167.550 may be used) and set the R10 to the same frequency. Be sure the R10 is in the FM mode and set its audio output to a comfortable listening level. Check the overall sensitivity of the setup by reducing

the signal generator output until the direction finder stops updating its bearing. (The decimal point following the units digit stops blinking). This should be about -120 dBm or a bit less at the signal generator. Then disconnect the remote display and connect the same cable to a PC. With the signal generator set at the following levels, issue the calibration commands listed below using a PC running Hyperterm at 4800 8N1.

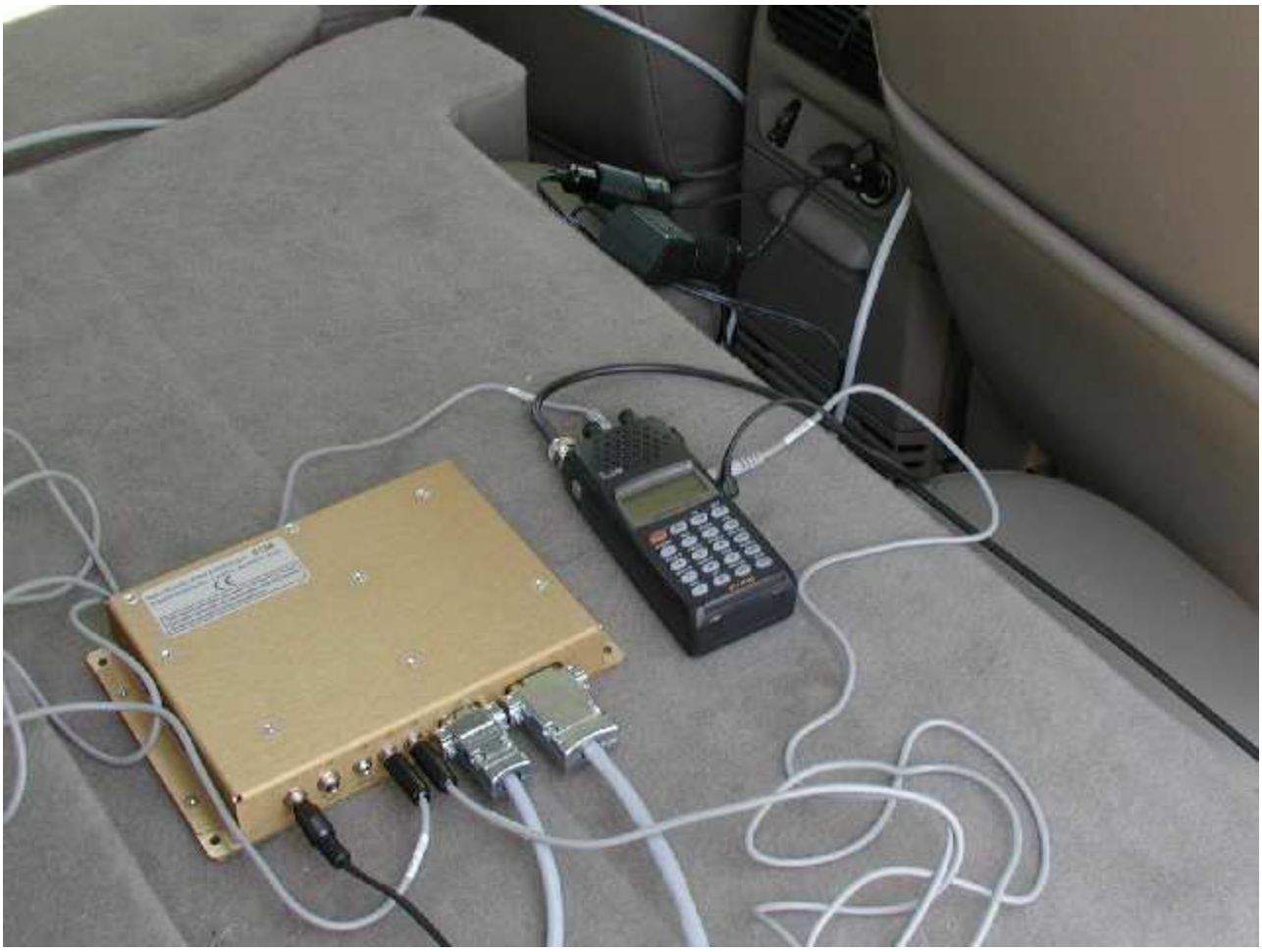
Calibration	Signal Generator Output (dBm)	Serial Command
Bearing Angle = 0	-82	5
S = 9 (Attenuator OFF)	-82	22
S = 1 (Attenuator OFF)	-114	21
Turn Attenuator to ON		4
S = 9 (Attenuator ON)	-30	22
S = 1 (Attenuator ON)	-78	21
Turn Attenuator OFF		3

3.0 Vehicle Setup

Open the bottom cover of the DDF5931 processor and move the shunt on JP1 so it connects pins 1 and 2 (closest to R117). This change bypasses the notch filter circuitry on the audio amplifier and allows the short duration pulse to be heard as a short tone burst.

Cut the whips on the antenna rods to 15-3/4 inches (or to whatever length is given by the cutting chart provided with the DDF5962 antennas for the frequency or the transmitter).

Place the whips on the car roof approximately 14 inches apart, leaving at least 17 inches from the front and sides of the car roof for a ground plane. Place the DDF5980 RF summer behind the antennas with its connectors facing the rear of the vehicle, and connect all four to the summer in the same order (right front antenna to right front TNC jack, etc.). Route the cables from the summer through a rear car window to the receiver and processor which may be placed in the back of the car. The following figures show a typical installation. The remote display, DDF5921, is in the front of the car where it can be easily seen by the driver.



Note that the Auto Plug power connector from the DDF5931 processor and from the receiver (Icom adapter CP-12L) are connected to the single cigar outlet using a 2-way power adapter available from Radio Shack (catalog #270-1535). If Icom power adapter OPC-254L were used instead, the 12 VDC for the receiver could be obtained from the spare power jack on the DDF5931.

4.0 Performance

Set the receiver volume to a comfortable level and be sure the squelch on the receiver is open (so noise is heard at all times). This is necessary for short pulse detection. The volume may then be reduced for listening using the buttons on the remote display without affecting the direction finding performance.

You should hear the transmitter tone burst within the static, and the display should update immediately following the tone. If the display is updating continuously, it indicates the direction finder is hearing a continuous signal. Such bearings should be ignored. When the Covert 3MD is in motion, it outputs a pulse every 1.75 seconds and for practical reasons, the line of bearing between the transmitter and direction finder will not change much in this interval. The

direction finder processor only allows the bearing to change 30 degrees between consecutive pulses. However, when the transmitter is not moving, it transmits every 7 seconds and since is possible to turn the car around in this time, the bearing change limiter may at first be confusing because it will take 6 x 7 = 42 seconds for the bearing to change 180 degrees in this mode.

The measured range of the system was between 2 and 4 miles in the residential area tested with the transmitter sitting on a bench inside the office. The signal strength displayed in the RED zone when the transmitter was less than about 1/2 mile; in the YELLOW zone between 1/2 and 1 mile, and in the GREEN zone beyond 1 mile.

With the transmitter attached underneath another car, its range dropped to between 1 and 2 miles. In an urban area with many tall building, it will be less.