N0GSG DSP Doppler RDF

OPERATORS MANUAL

Version 2.01

Revised: June 11, 2007 © W6DFW

Table of Contents

Antenna Orientation:

Regardless of the construction method the antennas should be arranged on a metal ground plane in a square pattern with a 1/4 wavelength separation

All directions are relative to the vehicle, front left being the U.S. drivers side front).

Antenna #1 must be the front left antenna.

Antenna #2 must be the front right antenna.

Antenna #3 must be the right rear antenna.

Antenna #4 must be the left rear.

Mount the antenna unit on top of the vehicle. Make certain that no other antennas are nearby.

Nearby antennas can act as parasitic elements and cause directional errors also they are more likely to be modulated by 800 Hz when transmitting if the Doppler is running.

If the Doppler modulation causes an objectionable level of modulation on your transmissions then it will be necessary to turn off the Doppler during your transmissions.

Calibration:

Calibration will be necessary any time you use your Doppler on a different vehicle.

In addition if you remove and replace the antennas on your vehicle and they do not go back in precisely the same locations and geometry making it necessary to recalibrate.

Connect the RF output from the Antenna Control unit to the FM receiver's antenna jack. Connect the Antenna Control cable between the Antenna Control unit and the Doppler Main Circuit board.

Connect the FM receiver's external speaker audio to the audio input jack on the Doppler unit.

Open the squelch on your receiver.

Turn on the power to your Doppler unit.

Turn on the receiver and tune it to the frequency desired.

You should hear a 700Hz or 800 Hz tone imposed on any audio present depending upon the Antenna Speed selection at startup.

The easiest way for most of us to calibrate is to drive to an open area and have a friend position himself/herself at least 100 feet away with low power and directly ahead of the vehicle while transmitting an unmodulated carrier.

If your friend is using an HT, have him/her hold it vertical at approximately the height of the vehicle antennas.

With the Doppler already turned on, depress and hold the CALIBRATE pushbutton for several seconds until the display flashes twice, then release it. The 0 degree LED should indicate that the signal is directly ahead of the vehicle.

As a double check your friend can then transmit while circling the vehicle at approximately the same distance and the display should follow him/her.

That is all that is needed. The Doppler will retain this calibration even after power is turned off.

An alternate method of calibrating the unit is to drive directly towards a known transmitter site, across an open area. This will give you the best calibration but

Calibration (Continued)

may be difficult or impossible in urban areas. The simpler method should be quite adequate.

You may develop other methodologies that work better in your situation and by all means use them.

BASIC OPERATION:

Once the calibration has been performed you are ready to use your DSP-Doppler as a radio direction finding tool.

The basic display is in increments of 22.5 degrees with a possible discrepancy of +/- 11.5 degrees.

The visual display is always relative to the front of your vehicle with 0 degrees being straight ahead, 90 degrees to the right, 180 degrees to the rear and 270 degrees to the left.

When a signal is received the lighted LED indicates the direction from which it came. Should the signal go away, the led will begin flashing still showing the direction to the transmitter.

When using the DSP DOPPLER it is common to see brief erroneous bearings, this is due to several different conditions such as signal reflections, road vibrations, wind whipping the antennas, heterodynes with other signals, inter modulation , noisy signals and almost any other phenomenon that affects 2 way communications.

One improvement that sometimes can be made is to use more rigid material for the antennas, for instance 1/4 in brass brazing rod turned down to fit the center pin of a PL-259 connector instead of 3/32 inch material.

With a little practice you should learn to discriminate between these false indications and the real signal you are tracking.

Operation with a GPS and Computer.

Adding a NMEA compliant Serial GPS has several advantages over the relative display.

As soon as your GPS can acquire enough satellites for navigation and position

determination the DSP Doppler will automatically convert relative bearings to True bearings for display on the computer.

NOTE: **The visual display will always display relative headings.**

IMPORTANT: Should your GPS lose its view of the satellites after about 3 seconds the bearing on the computer will revert to a relative bearing.

The 3 second delay allows for brief passage under an overpass, for instance, without loss of bearings.

After 3 seconds the display will revert to relative bearings until the GPS is again able to provide valid data.

The effect of this is, for instance assume you are traveling on a True heading of for instance 90 degrees with a relative bearing to the transmitter of 270 degrees while the GPS is operating, and providing valid data,.

The computer display will show a bearing of zero degrees True or due north. While the visual LED display shows 270 degrees.

About three seconds after the GPS ceases to provide valid data, the computer display will switch to a relative display and the vector shown will be incorrectly drawn as 270 degrees. When the GPS again is able to supply valid data the display bearing reported to the computer will revert to True bearings. There is really little that can be done from a practical standpoint to correct this situation.

If, for instance the last valid heading data from the GPS were retained then the display would continue unaffected by the loss of the GPS but your vehicle position would no longer be plotted and as soon as you changed direction the bearing would be incorrect. This would become particularly troublesome if the transmitter were also moving.

As soon as the GPS reacquires the satellites the RS-232 output to the computer will again deliver True bearings.

GPS operation while stopped:

While using a GPS with your Doppler, the Doppler firmware requires a GPS reported speed of three knots, (about 3.5 miles per hour), before it will accept the GPS heading. This was done for two reasons both of which increase the reliability of the True bearings calculated by the DSP Doppler.

Operation during GPS loss of data:

Operation during data loss is a trade-off.

Software mapping programs require GPS input

If the GPS looses its lock on the satellites it will be unable to calculate position, and other parameters required by the mapping software..

The Doppler output will revert to a relative display which has no meaning to the mapping software.

The Doppler requires the GPS Valid Data flag, GPS Speed, and GPS Heading, none of which will be available therefore the Doppler output will revert to relative bearings which, again have no valid meaning in map based programs.

One program, WinDOPP, presents the data in a pelorus display, looking like a radar PPI display.

This program can present the relative information in a little more sensible manner but it has 2 drawbacks.

First and foremost, although it is Called WinDOPP, it relies on MSDOS and may or may not run on more current windows operating systems some programs.

WinDopp presents a pelorus display, as mentioned so the user has to interpret the bearings on a separate map.

Some Foxhunting Tips:

For safety, you should always have at least two persons in the vehicle while Foxhunting/DF'ing. One person should concentrate on the driving and the other(s) on display interpretation and map reading.

One effective search methodology is to drive in the general direction of the RF source until display changes to 90 degrees or 270 degrees. At that time turn towards the source on the nearest street available and continue until the display again reads 90 degrees or 270 degrees. At that time repeat the sequence.

Should you loose the signal, continue on the course until you re-acquire it. Do not be too hasty to go some other direction.

First and foremost the speed threshold effectively filters out incorrect GPS bearings that sometimes occur during poor GPS signal conditions. For instance the GPS may momentarily report a forward speed while standing still and the accompanying GPS heading will not be reliable. Seldom do these errors reach a speed magnitude of 4 knots thus using the 4 knot threshold eliminates them.

Some GPS units hold the last heading when speed goes to zero and others zero the speed. The NMEA specification does not address this issue.

Because the GPS heading is ignored at speeds of less than 3 knots, when you stop at a stop signal for instance, the last valid GPS heading will be retained and used maintain the True bearing so the map display will remain correct regardless of the GPS behavior.

Discussion of the Options considered

For operation during GPS Data Loss when the Vehicle stops at a stoplight.

The loss of GPS data presents an entirely different situation from that which occurs when you stop at a stop light. In the stop light case the GPS is still producing valid data, the speed becomes zero, (or close to zero), and the heading generally becomes zero degrees. This combination by its self would force the display to switch from True to relative at every stop light.

In the case of a stop light, assuming valid GPS data we can safely hold the last GPS heading and use it for conversion to a True bearing. The assumption here is that the GPS data is valid and that any speed less than 3 knots can be ignored. This filters out transient data spikes that otherwise would revert the heading to a relative display. It is still possible that occasional transient GPS readings may cause an error but the 3 knot threshold seems to be adequate.

No special provisions have been implemented to cover the special case of loosing GPS Data while stopped.

Initially consideration was given to simply using the last valid heading during data loss as is done when stopped at a stop light. This was rejected as being of less value than a relative display because as soon as the vehicle turned a corner, the vector would rotate the same angular amount in the opposite direction to the turn. This could be quite chaotic to try and sort out during a hunt.

Next thought was given to stopping GPS streaming when the GPS stopped outputting valid data. This would have the advantage of being noticeable in programs, such as WinAPRS which show the raw input data. The down side to this is that depending upon conditions it could be over ten minutes at startup before any GPS data was visible. This delay would mask GPS problems such as dead batteries or GPS becoming unplugged and thus it was rejected.

Another approach considered was to halt output of all data when the GPS was not valid. This, possibly with just a diagnostic message such as "GPS DATA LOST", might serve to inform the user of the problem if the software package allowed the viewing of the raw data. If the package didn't display the raw data or didn't allow unexpected data strings other problems could show up.

The final decision was that since the software packages already routinely deal with valid Vs invalid GPS data and some packages, such as WinDOPP, can use relative

information it was probably most practical to simply warn the user as to the behavior of the Doppler under these conditions.