



Providing Heading for your Vessel with 2 GPS Units

By Joe Burnett

I previously wrote an article about the importance of having heading for your vessel. Here is a way to provide heading for your vessel without the expense of additional equipment.

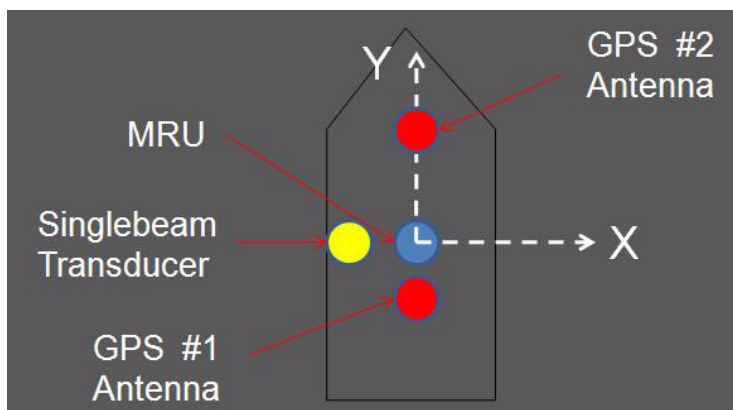
Most surveying firms have multiple GPS units. By installing 2 separate GPS units, you can achieve a fairly accurate heading for your vessel. I will show just how accurate this type of setup can be, what affects its accuracy, and under what situations it can and can NOT be used. Previously known as OTFGYRO, HYPACK® has long supported this technology, but in HYPACK® 2009A, it was incorporated into the GPS driver.

This process can easily be achieved with a few simple steps.

1. Mount your 2 GPS antennas and measure their offsets from the Boat Reference Point.
2. Setup your HYPACK Hardware.

MOUNTING YOUR GPS ANTENNAS AND MEASURE THEIR OFFSETS.

FIGURE 1.



GPS #1

Offsets

Starboard0.00ftUS

Forward-3.50ftUS

Vertical-7.50ftUS

Vertical Postive Downward

GPS #2

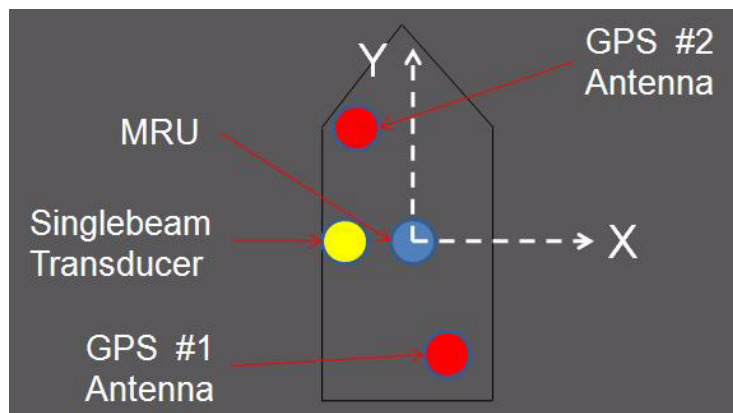
Offsets

Starboard0.00ftUS

Forward7.00ftUS

Vertical-7.50ftUS

Vertical Postive Downward



GPS #1

Offsets

Starboard

-3.00

ftUS

Forward

7.00

ftUS

Vertical

-7.50

ftUS

Vertical Postive Downward

GPS #2

Offsets

Starboard

2.00

ftUS

Forward

-7.00

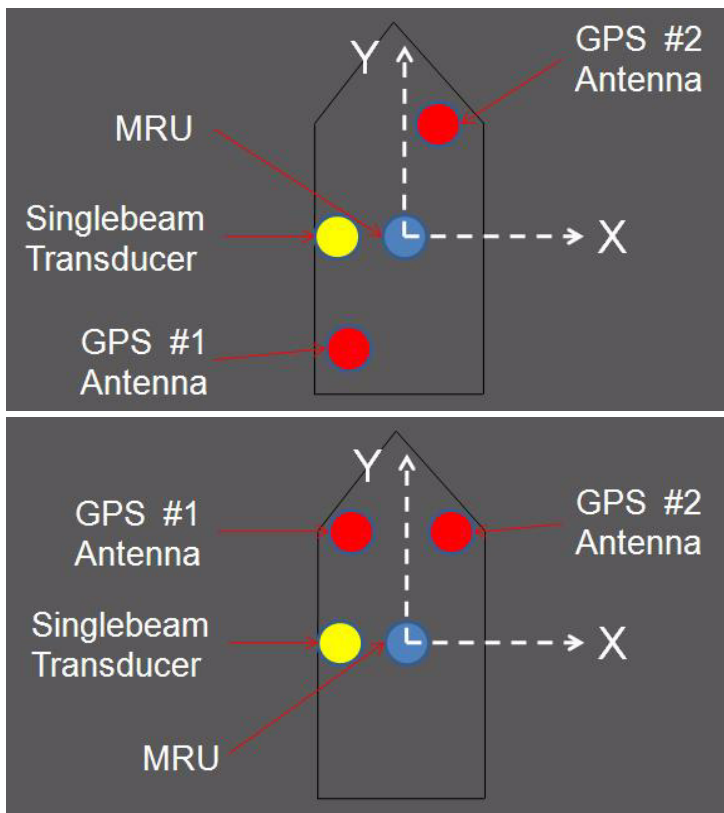
ftUS

Vertical

-7.50

ftUS

Vertical Postive Downward



GPS #1		GPS #2	
Offsets		Offsets	
Starboard	-3.00 ftUS	Starboard	2.00 ftUS
Forward	-7.00 ftUS	Forward	7.00 ftUS
Vertical	-7.50 ftUS	Vertical	-7.50 ftUS
Vertical Postive Downward		Vertical Postive Downward	

GPS #1		GPS #2	
Offsets		Offsets	
Starboard	-3.00 ftUS	Starboard	3.00 ftUS
Forward	7.00 ftUS	Forward	7.00 ftUS
Vertical	-7.50 ftUS	Vertical	-7.50 ftUS
Vertical Postive Downward		Vertical Postive Downward	

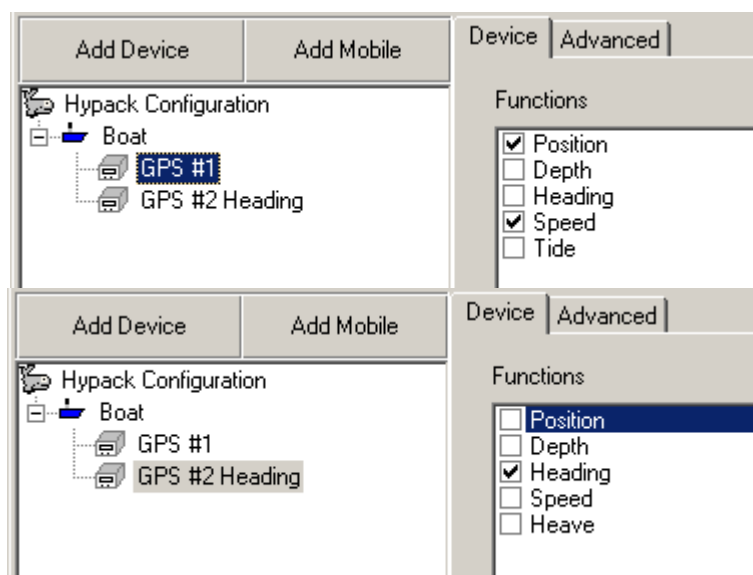
The importance of these four figures, is that the orientation of the antennas does NOT matter. However, it *is* important that they are correctly referenced to each other through their hardware offsets. The accuracy of the heading that is calculated, is directly related to the distance that separates the antennas.

HYPACK® HARDWARE CONFIGURATION

After mounting your antennas and measuring their offsets from the Boat Reference Point, you must configure them in the HYPACK® HARDWARE program.

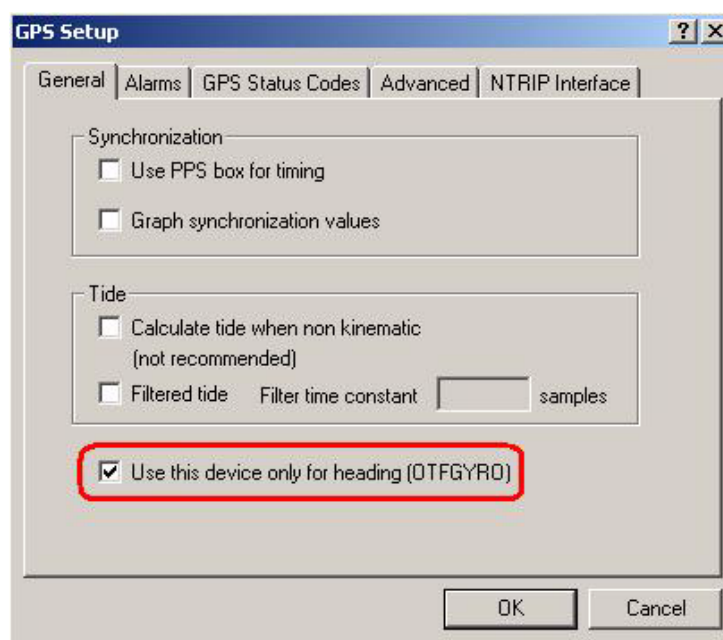
1. Using the **GPS.dll** for each GPS unit, choose the correct Functions for each unit.

FIGURE 2. Selecting the Functions for Each GPS - GPS #1 (top) and GPS #2 (bottom)



2. With the GPS #2 Heading Device selected, click [Setup] and enter the following options:
 - In the General Tab, select the “Use this device only for heading (OTFGYRO)” option.

FIGURE 3. Check the OTRGYRO option for GPS#2



- In the Advanced Tab, select the positioning string (GGA, GGK, etc.), so that the driver can calculate the distance between the two GPS systems.

HEADING ACCURACY - DUAL GPS VS SINGLE GPS WITH DUAL ANTENNAS

To calculate the accuracy of the heading generated from a Dual GPS setup, the driver uses the following equation:

$$\text{Heading Accuracy} = \text{TAN}^{-1} (2 * \text{GPS Positional Error} / \text{Baseline Distance}) \quad (\text{EQ 1})$$

Example: Assume both GPS units were using differential corrections and that the setup has a worst-case horizontal error of 2.0 feet. If the baseline distance between antennas is 10.5 feet, the equation would look like this:

$$\text{TAN}^{-1} (2 * 2.0 / 10.5) = \text{TAN}^{-1} (0.3890524) = 20.85^{\circ} \text{ Heading Accuracy} \quad (\text{EQ 2})$$

Twenty degrees sounds extreme, but that is the *worst-case* accuracy. For the most part, due to the proximity to the GPS systems, they will both be effected by the same conditions that effect position accuracy--the number of satellites, the same satellites, and the same errors and jumps--therefore, the calculated heading will be very close to the actual heading.

Even if you were using two RTK GPS units with worst-case horizontal error of only 0.1 feet, the Heading Accuracy would still only be 0.54° .

Beware! Either way, a dual antenna/dual GPS setup *would NOT be accurate enough for use in a multibeam survey.*

I asked our GPS guru and programmer how it was possible for GPS companies to get a 0.1° Heading Accuracy with their dual antenna setup, Differential corrections, and a 2 meter separation. He said that it had to do with the way they were calculating the GPS positions for both antennas internally and simultaneously. Also, since they are doing **ALL** of the calculations for both antennas, they can factor out the majority of the errors; 2 separate systems can not do that. This is why we would recommend using a Dual Antenna/Single GPS setup, versus a Dual GPS/Dual Antenna setup, is NOT recommended for Multibeam data collection.