

Novatel Tutorial

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- **Overview**

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This tutorial will give you a basic run down on how to use a NovAtel ProPak-G2+ GPS receiver. Included are instructions on installing and using the GPS control software for the factory-default firmware for the NovAtel system. At the end are the results of a test of the NovAtel system against a Garmin eTrx Vista handheld system at a benchmark geodetic landmark.

There are many different GPS receiver systems in today's consumer market. An individual can purchase a handheld GPS receiver for \$200 dollars or even less. However, one of the disadvantages of a cheaper system is its accuracy. As the price of a receiver decreases so does its accuracy. For example, a \$200 Garmin eTrex handheld GPS unit can provide Differential GPS (DGPS) accuracy up to 3 meters. As opposed to a more expensive system, like the NovAtel ProPak-G2+ that is accurate within 0.45 meters.

Differential GPS in general was designed as an enhancement to increase the accuracy of a GPS receiver. DPS utilizes a network of ground based reference stations that broadcast the difference between the positions indicated by satellite systems and their fixed positions. Specifically they broadcast the difference between the measured satellite pseudoranges and actual internally computed pseudoranges. Using stationary systems help to compensate for the errors (multipath) that can be caused by satellite signals and their reflections.

So purchasing larger GPS receivers like a NovAtel ProPak-G2 provide better accuracy, expansion capabilities, and generally better GPS technology to compensate for GPS positioning errors i.e. Differential GPS. The error processing allows to receiver boast centimeter accuracy.

- **Parts/Components**

Table 1. Parts List

Part Description	Vendor	Part#	Price (2006)
ProPak G2 Plus (GPS Receiver)	NovAtel		
GPS Antenna	NovAtel		
eTrex Vista Handheld Receiver	Garmin	010-00243-00	\$246.41

- **Configure Hardware**

- Required Hardware Components
 - NovAtel ProPak G2 Plus



- GPS Antenna



- Power Cord



- USB-to-Serial Connector or Straight-through Serial Connector
- NovAtel ProPak G2 Installation CD
- Configure Power Connector
 - Because the power cord requires DC power, you will need to hook up the cord to a power supply. Make sure to use between **9 - 18 V**. To ensure a secure connection to the car adapter style power connector, you can take apart the power connector. Expose the connector like the following (make sure to not lose any of the components):





- Connect the power cord to a power supply. Make sure not to short the power connection. The following image is the power connector connected to a **12 V** power supply.



- Configure NovAtel ProPak G2



- First, connect the power cord to the Novatel system; make sure to align the red dot on the power cord so that it faces the top of the Novatel system. **DO NOT SUPPLY POWER TO THE NOVATEL YET.**
- Second, connect the Serial cable to the **COM1** port.
- Third, connect the coaxial GPS antenna wire to the GPS antenna and the **GPS** port on the Novatel system.
- The final cord configuration should look like the following:



- The entire hardware configuration should look like the following:



- **Configure Software**

- If you are using the **USB-to-Serial connector** that comes with the Novatel system. Power on the Novatel system by turning on the DC power supply and then Windows should detect a USB connection. Use the **USB driver** that is enclosed with the **Novatel Installation CD**.
- Install the *OEM4 PC Utilities* that is also enclosed in the **Novatel Installation CD**. Go through the process to install the *NovAtel GPS PC Utilities* setup utility.
- With the *GPS PC Utilities* program installed and an active serial port communication, run the *GPSolution* software.
- To establish communication with the receiver, Open the *Device* menu and select *Open...*



- Select the *New...* button in the *Open* dialog box.



- Enter a name for the new device configuration in the *Name* field of the *New Config* dialog box.
- Select the *Settings* button.



- Select the PC serial port the ProPak is connected to from the *PC Port* drop-down list.
- Select *57600* from the *Baud Rate* list.

- Uncheck the *Use hardware handshaking* checkbox.
- Select OK to save the settings.



- Select the *OK* button to close the *New Config* dialog box and create the new device configuration.



- Select the new configuration from the *Available device configs* list in the *Open* dialog box.
- Select the *Open* button to open communications with the ProPak.



- **Test GPS Connection**

- There are a lot of features that come with the *GPSolution* utility.
 - **Receiver Status** - displays the status of the receiver serial communication.



- **Tracking Status** - status of satellite communication.



- **Constellation** - displays the number of detected satellites relative to the receiver.



- **Plan Window** - displays a scatter plot of position readings in scaled metrics i.e. meters.



- **Position** - displays the status of the GPS receiver.
- **NOTE: The GPS receiver is working properly when the *Solution Status is Computed***



• Calibration Test Results

- **Overview** - To compare how well the GPS systems perform, I took them to be calibrated at a nearby Geodetic benchmark provided by [National Geodetic Survey \(NGS\)](#). The location I chose was a triangulation station disk [JU3162](#) located on the University of Pennsylvania's Franklin Field at **N 39° 56.959 W 075° 11.337**. In addition to the NovAtel system, I also tested a Garmin eTrex Vista handheld system for comparison purposes. More information about the test and location can be found [here](#).

- **Garmin eTrex Vista Results**

Table 2. Sample GPS Data Recordings from Garmin eTrex Vista

Latitude	Longitude	Accuracy (feet)
N 39°56.954'	W 75°11.346'	26
N 39°56.966'	W 75°11.337'	50

N 39°56.965'	W 75°11.336'	59
N 39°56.961'	W 75°11.336'	69
N 39°56.961'	W 75°11.339'	30
N 39°56.961'	W 75°11.339'	33
N 39°56.962'	W 75°11.339'	33
N 39°56.960'	W 75°11.337'	49
N 39°56.959'	W 75°11.335'	49
N 39°56.961'	W 75°11.337'	46
N 39°56.961'	W 75°11.337'	46

Observations: In general, the latitude and longitude readings were within 0.05 minutes from the benchmark. However it is important to notice the accuracy readings taken from the Garmin system. It ranged from 26 feet to as high as 59 feet. The system was extremely sensitive any obstruction caused satellite signal to drop significantly. It also lost and gained signals with assorted number of satellites forcing it to triangulate its position numerous times. Overall the system worked well but was extremely sensitive due to its much weaker GPS antenna.

◦ **NovAtel ProPak-G2+ Results**

Table 3. Sample GPS Data Recordings from NovAtel ProPak-G2+

Latitude	Standard Deviation (ft)	Longitude	Standard Deviation (ft)
N 39°56.9609405'	15.1541995	W 75°11.338614'	10.7480315
N 39°56.9611434'	15.3018373	W 75°11.338708'	10.6692914
N 39°56.9612052'	15.3707349	W 75°11.338491'	10.6332021
N 39°56.9611866'	15.1017061	W 75°11.338211'	10.5183727
N 39°56.9604534'	15.6791339	W 75°11.338313'	10.2526247
N 39°56.9606867'	15.7677166	W 75°11.338465'	10.1640420
N 39°56.9606833'	15.8038058	W 75°11.338443'	10.1213911
N 39°56.9610350'	15.8103675	W 75°11.338680'	10.1148294
N 39°56.9610350'	15.8169292	W 75°11.338680'	9.8917323
N 39°56.9595167'	20.4986877	W 75°11.338490'	9.6391076

Observations: As expected the NovAtel system provided much more detailed information compared to the Garmin system. The recordings provided better precision and also included the standard deviation for both latitude, longitude, and altitude. Based on the recorded data, the accuracy of the readings were better than that of the data from the Garmin device. Because the GPS antenna was much more powerful, the signals from assorted satellites allowed the receiver to triangulate a much more precise location. The actual position data that was recorded deviated but at the centimeter level. Overall the data was precise and its general accuracy was better than the Garmin.

◦ **Data Comparison**

Figure 1. GPS Position Comparison in Degrees

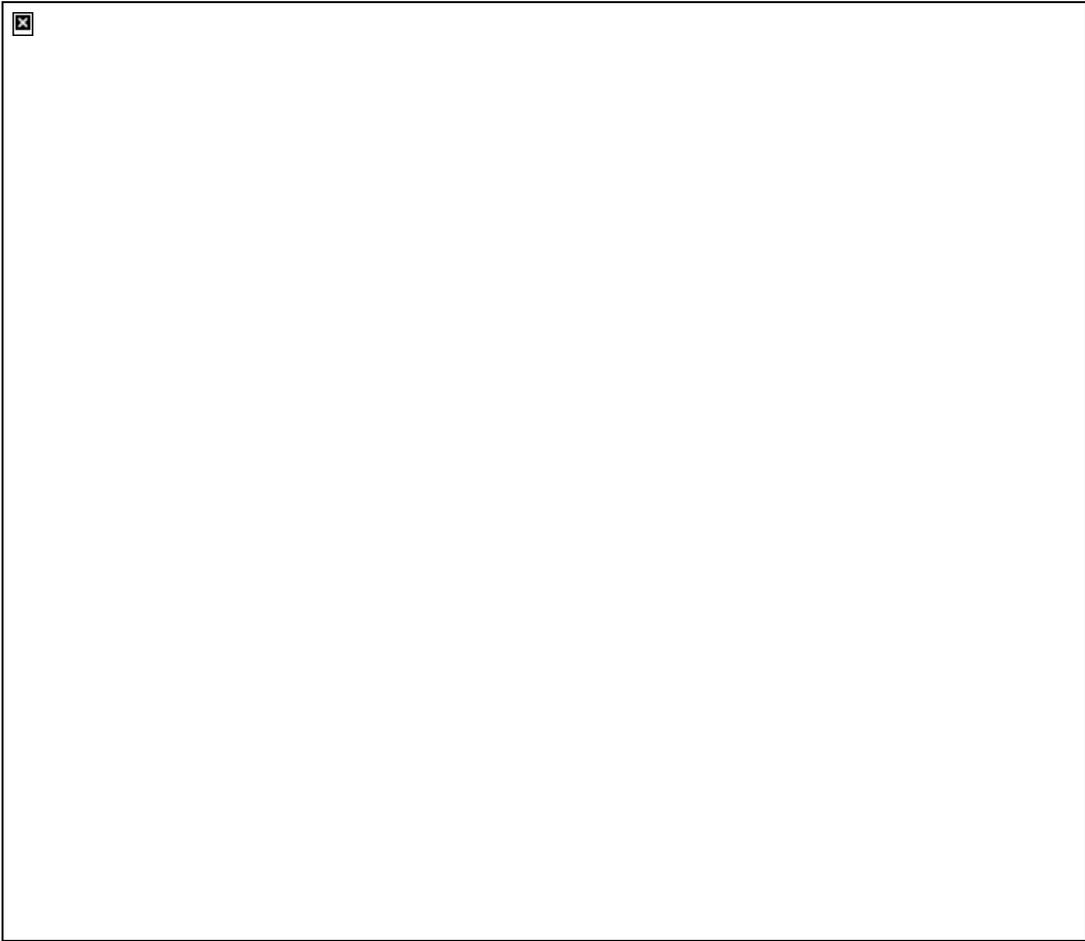
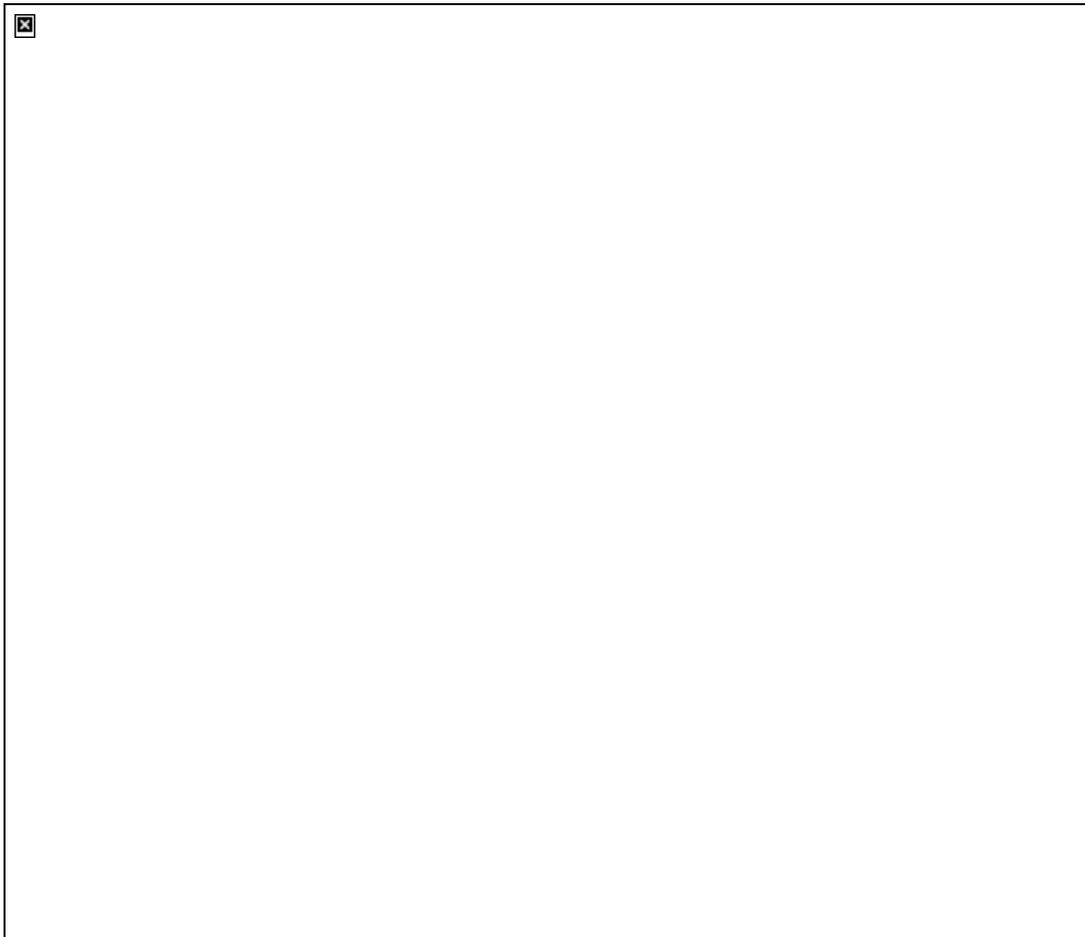


Figure 2. GPS Position Comparison in Meters



By graphically comparing the data from both devices it shows how much more accurate the NovAtel receiver is. The Garmin position points are scattered; the outliers are quite far from the benchmark point. On the other hand, the NovAtel system position points stayed relatively close to the benchmark. As stated above, the NovAtel points did deviate slightly but not as much as the Garmin readings; The deviations were close within a couple meters to a few centimeters.

- **Final Thoughts & Useful Links**

- In comparison, the much more expensive NovAtel ProPak G2+ is a much more accurate and precise system when compared to a cheaper and more portable Garmin eTrex Vista handheld receiver. The NovAtel system was continuously more accurate than the Garmin but also much more precise. The deviations in the NovAtel position points were within a few meters much smaller than the Garmin. Overall, if one was looking for a receiver that was accurate and precise it is obvious the choice should be the NovAtel. However, if cost is an issue a device like the Garmin eTrex Vista is a very capable device but as stated as the price decreases so does its accuracy and capabilities. It comes down if you want to spend \$5000 dollars for a precision system or \$200 dollar device that will just get the job done.
- *Useful Links*
 - Other GPS Tutorials: <http://www.edu-observatory.org/gps/dgps.html>
 - Geocache Website: <http://www.geocaching.com/mark/>
 - Calculator to convert Latitude & Longitude Degrees to Meters/Feet: <http://www.csgnetwork.com/degreelenlavcalc.html>
 - NGS Datasheet Point Radius Form: http://www.ngs.noaa.gov/cgi-bin/ds_radius.prl
 - GPS Project Training Course: http://facility.unavco.org/project_support/campaign/training/antenna.html
 - Contact [me](#)