PHOENIX 50

Installation & Operator's Manual

Phoenix 50

RAVEN PRECISION Solutions

DISCLAIMER

While every effort has been made to ensure the accuracy of this document, Raven Industries assumes no responsibility for omissions and errors. Neither is any liability assumed for damages resulting from the use of information contained herein.

Raven Industries shall not be held responsible or liable for the effects of atmospheric conditions and sunspot activity on the performance of our products.

Raven Industries cannot guarantee the accuracy, integrity, continuity, or availability of the GPS signal from the US Department of Defense/NAVSTAR GPS satellites, the OmniSTAR correction service or the WAAS correction service.

Raven Industries accepts no responsibility for the use of the signal for other than the stated purpose. Raven Industries shall not be responsible or liable for incidental or consequential damages or a loss of anticipated benefits or profits, work stoppage or loss or impairment of data arising out of the use or inability to use the Smartrax or any of its components.

INTRODUCTION

Congratulations on your purchase of the Raven Phoenix 50 GPS Receiver. This compact, all in one unit, will provide you with the ability to log data and provide speed to your Raven controller. Setup is fast and easy and can have you in the field within a half hour, in most cases. This manual will assist you in installing your Phoenix 50 GPS receiver.

Note: This receiver should not be used for steering systems, since it is only a 4 Hz receiver.

GPS RECEIVER

The Phoenix 50 GPS receiver can generate real-time position solutions at a rate of 4 solutions per second. Position solutions are output via RS232 in NMEA format messages.

The Phoenix 50 has two RS232 ports and can communicate at 1200, 2400, 4800, 9600, 19.2k, 38.4k, 57.6k, or 115.2k BPS. The baud rate and the desired output messages can be configured via either serial port using configuration messages.

NMEA format messages are standard for most GPS receivers and therefore should be compatible with almost any software or hardware application designed to work with GPS.

The receiver comes from the factory with message settings that should be compatible with most applications. Refer to the connecting equipment manuals for information about what message types and serial settings they require.

DEFAULT SERIAL SETUP

PORT	NMEA MESSAGE	MESSAGE RATE	BAUD RATE
A	GGA, VTG ZDA	4 Hz 200mHz	19200 BPS
B	GGA, VTG ZDA	4 Hz, 200mHz	19200 BPS

WAAS RECEIVER

The Phoenix 50 provides real time differential solutions using free corrections (WAAS) broadcast from a satellite. WAAS corrections are available without a subscription free everywhere in the US, parts of Canada, Mexico and Europe using a compatible system called EGNOS. These corrections are available 24 hours a day in all weather conditions.

UTILITY SOFTWARE

Utility software is not required to setup or use the receiver in most applications. However, a utility program is available from Raven. See Receiver Firmware Updates for Software location.

RECEIVER FIRMWARE UPDATES

Firmware is software, which resides inside the receiver. Raven continues to improve the performance of its receiver products and sometimes makes special features available. When this happens, a new version of firmware is created. A request can be made for this firmware from Raven. It will be necessary to connect the receiver to a PC and run the included programming software to update the unit. Check with a Raven dealer for a new version of firmware. Make sure to read the updated directions included with the latest download.

Firmware and upgrade utilities may be obtained at the following locations:

main download page:
http://www.ravenprecision.com/us/Support/Software/

Receiver page:
http://www.ravenprecision.com/us/Support/Software/softwareCategory.jsp?ID=1

SPECIAL FEATURES

The Phoenix 50 has several special features that make it ideal for some applications. Raven is always interested in adding special features to the receiver. If you have a good idea, please send us an email at fcdinfo@ravenind.com or give us a call at 800-243-5435. We can't guarantee that your idea will be implemented, but we do want to consider it.

RADAR OUT

The GPS receiver is always calculating speed and can generate the signals, which can be used by equipment requiring RADAR input. The receiver is normally configured at the factory for RADAR output.

To use this feature, a special cable from Raven will be needed. It should be noted that the GPS can only determine speed when it is navigating. If a tree line blocks too many satellites or if for some other reason the receiver is unable to navigate, then the RADAR output could become invalid.

The scaling factors and timing controls that govern the operation of this feature can be controlled via a serial configuration message as defined in the serial Protocol Definition document. The receiver outputs a default of 45Hz per 1mph.

INSTALLATION

Start by selecting a location for each of the various parts of the system. Do not route the cables or permanently mount the Phoenix 50 receiver yet. Once the system is operating, route the cables and permanently mount the Phoenix 50 receiver. This will reduce the amount of trouble if a problem is found in the initial locations.

INITIAL POWER UP

Phoenix 50 receivers are reverse power protected to prevent damage to the receiver if you follow these steps:

Turn off all the equipment on the machine. The receiver draws very little power and this test will only take a few minutes. All other equipment should be off because it might interfere with the receiver. Once the Phoenix 50 is working, turn on the other equipment and watch for problems.

Apply power to the receiver by connecting the black wire to the negative (-) and the red wire to the positive (+) post on the power source (most likely the battery). To check power connections connect a lightbar or some other serial interface device to the Phoenix 50 receiver. If attached to a lightbar, it should light up when power is applied to the receiver. If using a serial interface device, look for NMEA strings such as GGA to scroll across the screen. If none of these things respond remove the red and black wires from the power source and check the connections again. If in a car or Ag machine, try turning the key on. If still having trouble refer to the power section below or call our technical support line.

Once the receiver power is connected correctly go ahead and shut the power off. Mount the Phoenix 50 and repeat the previous step.

At this point, the power is connected to the mounted receiver. The Phoenix 50 will be looking for satellites, which may take a few minutes. Eventually, if the antenna has a clear view of the sky, the receiver will send data to the lightbar or other serial interface devise.

Wait for the receiver to find and track the WAAS signal, it could take 15 or more minutes before the receiver gets the necessary almanac data from the selected WAAS satellite. This initial startup time is necessary only during the first time the receiver is used. Once the broadcast is found the receiver will power up and start receiving signals after about 20 seconds. If a signal is not received within about 30 minutes there could be some form of interference or the receiver may not be in the coverage area of the selected WAAS satellite.

At this point, the receiver should be tracking satellites and generating good differential position. Start turning on other equipment on the machine. A device could interfere with the GPS satellites or WAAS signals. Wait about 30 seconds after each device is turned on to see if the receiver stops tracking satellites. Finally, start up the machine and again watch for any problems.

If after turning something on, a problem is found, try moving the antenna further away from that device. Check that the device is functioning properly and also check its power connections. Some devices can generate too much noise naturally or because of defective components.

Now the receiver is working with everything that could interfere. Shut everything off, mount the receiver, and route the cables. Once this is done, repeat the power up steps.

The last few steps deal with connecting the other equipment that gets data from the Phoenix 50. Refer to the manufacturer's documentation for details such as baud rates and required messages. It is very likely it will only be necessary to connect the interface cables to the device. The Phoenix 50 is configured, by default, to work with most systems without any adjustments.

All configuration and WAAS data is stored in non-volatile memory inside the Phoenix 50. If it is necessary to change the WAAS or GPS setups, run the receiver software to make the changes.

POWER

The Phoenix 50 receiver needs DC power between 9 and 16 Volts. DC power is usually provided by battery on the machine or via a power adapter of some type. If the unit came with an automotive power adapter, verify that the vehicle has a negative ground system before connecting power. If the unit came with an AC adapter, it will be necessary to only connect the adapter to an AC source.

GPS ANTENNA

GPS is a line of sight system, which means in order for the receiver to track the satellites there must be an unobstructed path directly to them. Buildings, trees, machinery, and human bodies are common obstructions. When locating the antenna/receiver find a place where the antenna will have an unobstructed view of the sky. Items such as electrical motors, generators, alternators, strobe lights, radio transmitters, cellular phones, microwave dishes, radar, active antennas, etc., all generate electrical and magnetic fields which can interfere with the GPS or WAAS signal. Mount the Antenna/receiver away from such potential sources of interference.

The GPS can be de-tuned by close proximity to other objects. For example, if you place the antenna under fiberglass its performance could be degraded. Usually, if the antenna/receiver is lowered so that at least a quarter of an inch gap is made between the antenna/receiver and the covering plastic or fiberglass, acceptable performance can be achieved. Metal or other dense materials will completely block the GPS signals.

TROUBLESHOOTING

- Make sure the antenna is mounted so that it has a clear view of the sky and is as far away from electrical noise sources as possible.

Attempt to isolate all problems as either:

- Receiver/Antenna
- Power
- Transmitting Site
- Serial Communications
- Peripheral Device

CHECKING YOUR INSTALLATION

Monitor the effects on the GPS receiver performance as each device on the vehicle is powered on. If the receiver stops operating properly when a device is powered on, that device is causing interference and the receiver location may need to change. For example, if running the engine causes interference, then ignition noise or alternator noise is interfering with signal reception. Move the receiver further away from the engine.

Receiver – Normally only 5 GPS satellites are required for good accuracy. If a lightbar is connected, ensure the 3 center LED are green.

Transmitting – If the receiver is operating in WAAS mode, the receiver may be out of range of a satellite or the satellite may be off the air. WAAS status information is available on the Internet at http://www.nstb.tc.faa.gov/RT_WaasSatelliteStatus.htm or http://www.omnistar.com/space/index.html

Serial Coms – Using RFP Sim software, check for proper communication settings baud rate, and COM port number. Make sure the cable used, if not provided by Raven, is wired correctly. See section titled “serial Interface.”

RECEIVER SPECIFICATIONS

Size	2.1 x 5.09	**Protocols**	NMEA v2.2
Weight	18 ounces		
Operating Temperature	-40°C to +70°C		
Operating Humidity	5% to 95% R.H., Non-condensing, at +60°C		
Channels	12 GPS, 1 WAAS		
Update Rate	4/second Port A 4/second Port B	**Mounting**	Magnetic
Power Consumption	3 - 2 Watts Typical	**Storage Temp.**	-40°C to +85°C
Voltage	9-16 VDC	**Storage Humid.**	100% Condensing

CONFIGURATION

Serial Interface

The Phoenix 50 GPS receiver has two bi-directional RS232 serial ports available on an 8-pin Con-X-All male connector.

8-Pin Con-X-All

Pin Number	Signal Name
1	TXA
2	RXA
3	GND
4	RADAR
5	TXB
6	12 VDC
7	+12 VDC Pwr Output RT
8	RXB

GLOBAL POSITIONING SYSTEM (GPS)

GPS is a satellite-based global navigation system created and operated by the United States Department of Defense (DOD). Originally intended solely to enhance military defense capabilities, GPS capabilities have expanded to provide highly accurate position and timing information for many civilian applications.

An in-depth study of GPS is required to fully understand it, but not to see how it works or appreciate what it can do for you. Simply stated, thirty-two satellites in six orbital paths circle the earth twice each day at an inclination angle of approximately 55 degrees to the equator. This constellation of satellites continuously transmits coded positional and timing information at high frequencies in the 1500 Megahertz range. GPS receivers with antennas located in a position to clearly view the satellites pick up these signals and use the coded information to calculate a position in an earth coordinate system.

GPS is the navigation system of choice for today and many years to come. While GPS is clearly the most accurate worldwide all-weather navigation system yet developed, it still can exhibit significant errors. GPS receivers determine position by calculating the time it takes for the radio signals transmitted from each satellite to reach earth. It's that old "Distance = Rate x Time" equation. Radio waves travel at the speed of light (Rate). Time is determined using an ingenious code matching technique within the GPS receiver. With time determined, and the fact that the satellite's position is reported in each coded navigation message, by using a little trigonometry the receiver can determine its location on earth.

Position accuracy depends on the receiver's ability to accurately calculate the time it takes for each satellite signal to travel to earth. This is where the problem lies. There are primarily five sources of errors, which can affect the receiver's calculation. These errors consist of:

1. Ionosphere and troposphere delays on the radio signal.
2. Signal multi-path.
3. Receiver clock biases.
4. Orbital satellite (ephemeris) position errors.
5. Intentional degradation of the satellite signal by the DOD (SA).

This intentional degradation of the signal is known as "Selective Availability" (SA) and is intended to prevent adversaries from exploiting highly accurate GPS signals and using them against the United States or its allies. SA accounts for the majority of the error budget. The combination of these errors in conjunction with poor satellite geometry can limit GPS accuracy to 100 meters 95% of the time and up to 300 meters 5% of the time. Fortunately, many of these errors can be reduced or eliminated through a technique known as "**Differential**."

DIFFERENTIAL GPS (DGPS)

WAAS

DGPS works by placing a high-performance GPS receiver (reference station) at a known location. Since the receiver knows its exact location, it can determine the errors in the satellite signals. It does this by measuring the ranges to each satellite using the signals received and comparing these measured ranges to the actual ranges calculated from its known position. The difference between the measured and calculated range is the total error. The error data for each tracked satellite is formatted into a correction message and transmitted to GPS users. The correction message format follows the standard established by the Radio Technical Commission for Maritime Services, Special Committee 104 (RTCM-SC104). These differential corrections are then applied to the GPS calculations, thus removing most of the satellite signal error and improving accuracy. The level of accuracy obtained is a function of the GPS receiver. WAAS is based on a network of ground reference stations that cover a very large service area. Signals from GPS satellites are received by wide area ground reference stations and used to generate DGPS corrections.

NMEA MESSAGES

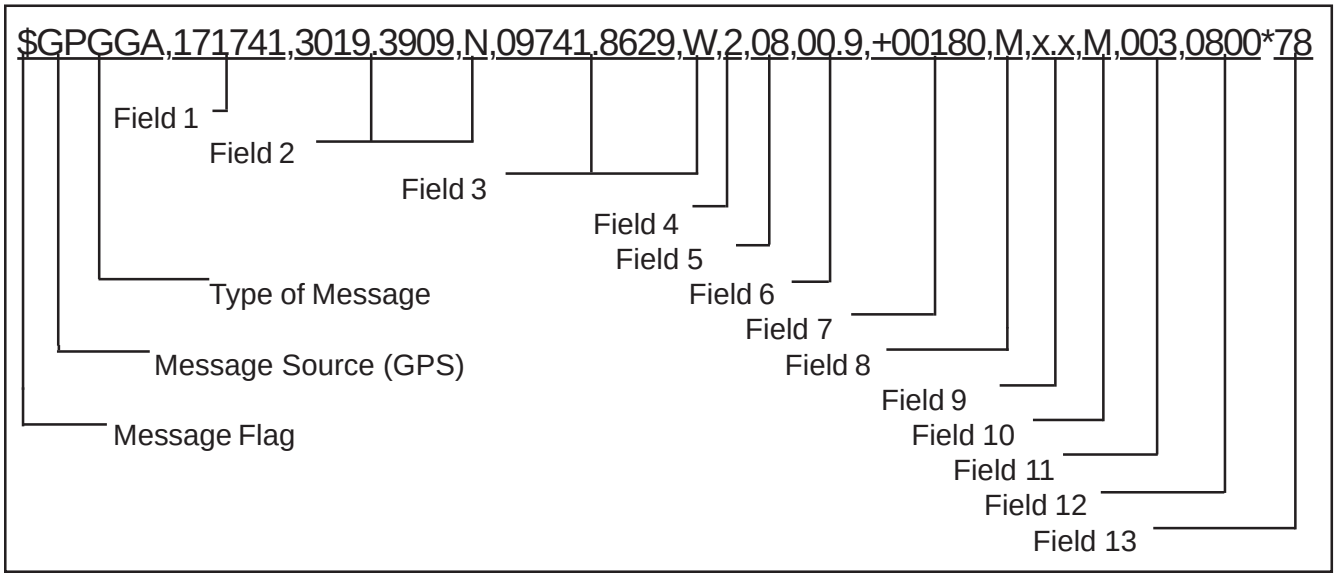
The Phoenix 50 receiver can be used to communicate with other electronic devices including Raven's Envizio. A communication protocol (set of rules) known as the NMEA 0183 standard has been established by the National Marine Electronics Association. The NMEA 0183 standard contains numerous message formats such as the ones described below which the Phoenix 50 receiver uses to communicate with other devices.

Phoenix 50 NMEA Messages

GGA	Global Positioning System Fix Data
GLL	Geographic Position
GSA	GPS Dillution of Precision (DOP) and Active Satellites
GST	GPS Pseudorange Noise Statistics
GSV	GPS Satellites in View
RMC	Recommended Minimum specific GPS/Transit Data
VTG	Course Over Ground and Ground Speed
ZDA	Time and Date

SAMPLE GGA MESSAGE STRUCTURE

The following example of the GGA message shows the format typical of NMEA messages.



Field	Description	Field	Description
$	Message Flag	6	Horizontal Dilution of Precision
GP	Message Source (GPS)	7	Antenna Altitude Ref: Mean Sea Level (geoid)
GGA	Type of Message	8	Units of Antenna Altitude (meters in example)
1	Universal time coordinate (UTC) of Position	9	Geoidal Separation
2	Latitude, North or South	10	Units of Geoidal Separation (meters in example)
3	Longitude, East or West	11	Age of Differential Data, seconds
4	GPS Quality Indicator (mode)	12	Reference Station ID
5	Number of Satellites in Use	13	Checksum

Starlink Protocol

Control of Raven receivers is performed using a proprietary set of commands named the “Starlink Protocol”. These commands are compliant with NMEA 0183. A complete listing and description of each command may be obtained from

http://www.ravenprecision.com.

The following is a list of commands/queries that may be supported in the Phoenix 50.

Receiver Command	Receiver Query
DIF	DIF
NME	GPSID
PBM	NME
PTA	PAR
PTB	PBM
RKC	PTA
RST	PTB
SAV	RID
SLI	RKC
SPD	SLI
W1M	W1S

RAVEN INDUSTRIES

LIMITED WARRANTY

WHAT IS COVERED?

This warranty covers all defects in workmanship or materials in your Raven Flow Control Product under normal use, maintenance, and service.

HOW LONG IS THE COVERAGE PERIOD?

This warranty coverage runs for 12 months from the purchase date of your Raven Flow Control Product. This warranty coverage applies only to the original owner and is not transferrable.

HOW CAN YOU GET SERVICE?

Bring the defective part, and proof of date of purchase, to your local dealer. If your dealer agrees with the warranty claim, he will send the part, and proof of purchase to his distributor or to Raven for final approval.

WHAT WILL RAVEN INDUSTRIES DO?

When our inspection proves the warranty claim, we will, at our option, repair or replace the defective part and pay for return freight.

WHAT DOES THIS WARRANTY NOT COVER?

Raven Industries will not assume any expense or liability for repairs made outside our plant without written consent. We are not responsible for damage to any associated equipment or product and will not be liable for loss of profit or other special damages. The obligation of this warranty is in lieu of all other warranties, expressed or implied, and no person is authorized to assume for us any liability. Damages caused by normal wear and tear, mis-use, abuse, neglect, accident, or improper installation and maintenance are not covered by this warranty.

Phoenix 50 Installation & Operator's Manual (P/N 016-0171-211 Rev A 2/08)

RAVEN

PRECISION Solutions

Raven Industries
Flow Controls Division
P.O. Box 5107
Sioux Falls, SD 57117-5107

Toll Free (U.S. and Canada): 800-243-5435
or Outside the U.S.: +1 605-575-0722
Fax 605-331-0426
www.ravenprecision.com
fcdinfo@ravenind.com