PHOENIX 250

Installation & Operators Manual

Phoenix 250

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CHAPTER

1

INTRODUCTION

The Raven Phoenix 250 GPS receiver is an L-band capable receiver that provides highly accurate and reliable DGPS navigation using three possible sources of DGPS corrections. Depending on the purchased model, the receiver can apply any two of the following correction types: OmniSTAR VBS, WAAS, and e-Dif. This receiver is ideal for GIS, precision farming or any other application where a high performance, rugged, and simple to operate receiver is required.

The Phoenix 250 GPS Receiver can generate real-time position solutions at a rate of 10 solutions per second. Position solutions are output via RS232 in NMEA format messages.

The Phoenix 250 GPS Receiver 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 or FP3 Simulator on a P.C.

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	10 Hz .2 Hz	19200 bps
B	GGA, VTG ZDA	5 Hz .2 Hz	19200 bps

L- Band Receiver

The Phoenix 250 GPS receiver utilizes L-Band differential corrections via OmniSTAR VBS with the purchase of an OmniSTAR subscription. The service can be activated on demand.

SBAS (WAAS/ EGNOS) Receiver

The Phoenix 250 GPS Receiver can also provide real time differential solutions using free corrections broadcast from a satellite (satellite-based augmentation service or SBAS). SBAS corrections are available without a subscription free everywhere in the United States and parts of Canada, and Mexico. Europe uses a compatible system called EGNOS. These corrections are available 24 hours a day in all weather conditions.

RADAR Out

The receiver can simulate a Doppler RADAR commonly used on agricultural equipment for detecting speed. The GPS receiver is always calculating speed and can generate the signals needed by equipment requiring RADAR input. The receiver is normally configured at the factory for RADAR output with a default setting of 45 Hz per 1 mph.

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 to many satellites or if for some other reason the receiver unable to navigate, then the RADAR output could become invalid.

CHAPTER

2

INSTALLATION AND INITIAL POWER UP

Power

The Phoenix 250 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. Initial Power Up.

1. Start by selecting a tentative location for each of the various parts of the system. Until setup is complete and you have confirmed the receiver is working properly, do not route the cables or permanently mount the Phoenix 250 receiver.
2. Turn off all the equipment on the machine to avoid interference with the Phoenix 250 receiver setup.
3. 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).

Important: To check power connections connect a lightbar or some other serial interface device to the Phoenix 250 receiver. If attached to a lightbar, it should light up when you apply power 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 responses occur check the connections.

4. Once properly connected, the GPS receiver searches for satellites and downloads the data necessary for operation. This process may take 15 minutes, but is only required during the initial startup.

If you are using the OmniSTAR correction service, call OmniSTAR to activate your OmniSTAR subscription.

Region	Phone Number
North & South America	888-883-8476
Europe/North Africa/ Middle East/ West Asia	31-70-317-0900
Australia & Far East	61-8-9322-5295
Southern Africa	27-21-552-0535

At this point, the receiver tracks satellites and generates good differential position.

Note: 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 or OmniSTAR satellite.

Checking Your Installation

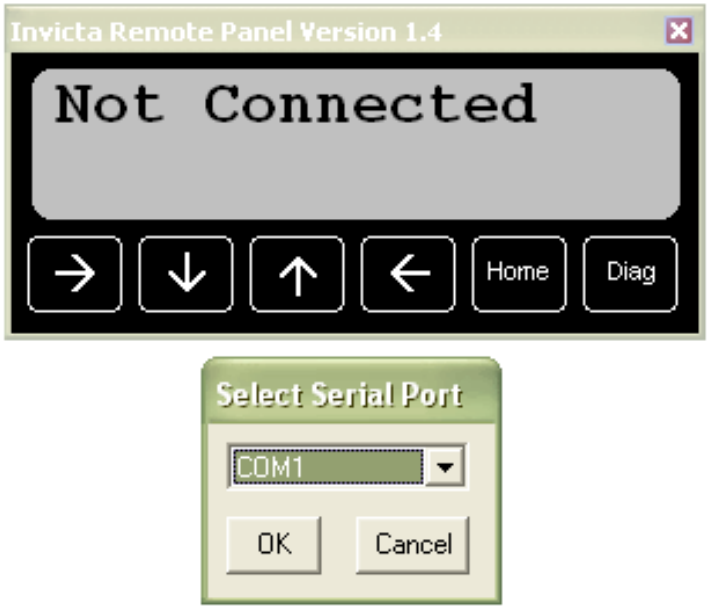
1. Start turning on the other equipment on the machine. Since a device could interfere with the GPS, WAAS, or L-Band signals, wait about 30 seconds after each device is turned on to see if the receiver stops tracking satellites.
2. If after turning a device on, a problem is found, try moving the receiver further away from that device. Check that the device is functioning properly and check the power connections to that device. Some devices can generate too much noise naturally or because of defective components.
3. Finally, start up the machine and again watch for any problems.
4. Once the receiver is working with everything that may cause interference, power off everything, mount the receiver, and route the cables. Repeat the power up steps necessary
5. Upon completion of the initial startup, the receiver begins operating in full DGPS mode within a few minutes if running WAAS, OmniSTAR VBS, or e-Dif.

The last few steps deal with connecting the other equipment that gets data from the Phoenix 250 GPS receiver. 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 250 GPS receiver works with most systems without any adjustments.

FP3 Simulator Application

For easy receiver configuration, download FP3 Simulator from the Raven website. If trying to obtain an OmniSTAR subscription, run the FP3 Simulator application after connecting to the receiver via the serial cable, and verify that OmniSTAR VBS is selected as the correction mode. The OmniSTAR operator will need to know the 6-digit portion of the receiver serial number when activating the subscription. Refer to the remote menu map for help finding this information.

This application facilitates easy configuration of the receiver. Select the appropriate com port and click OK to invoke the menu interface.

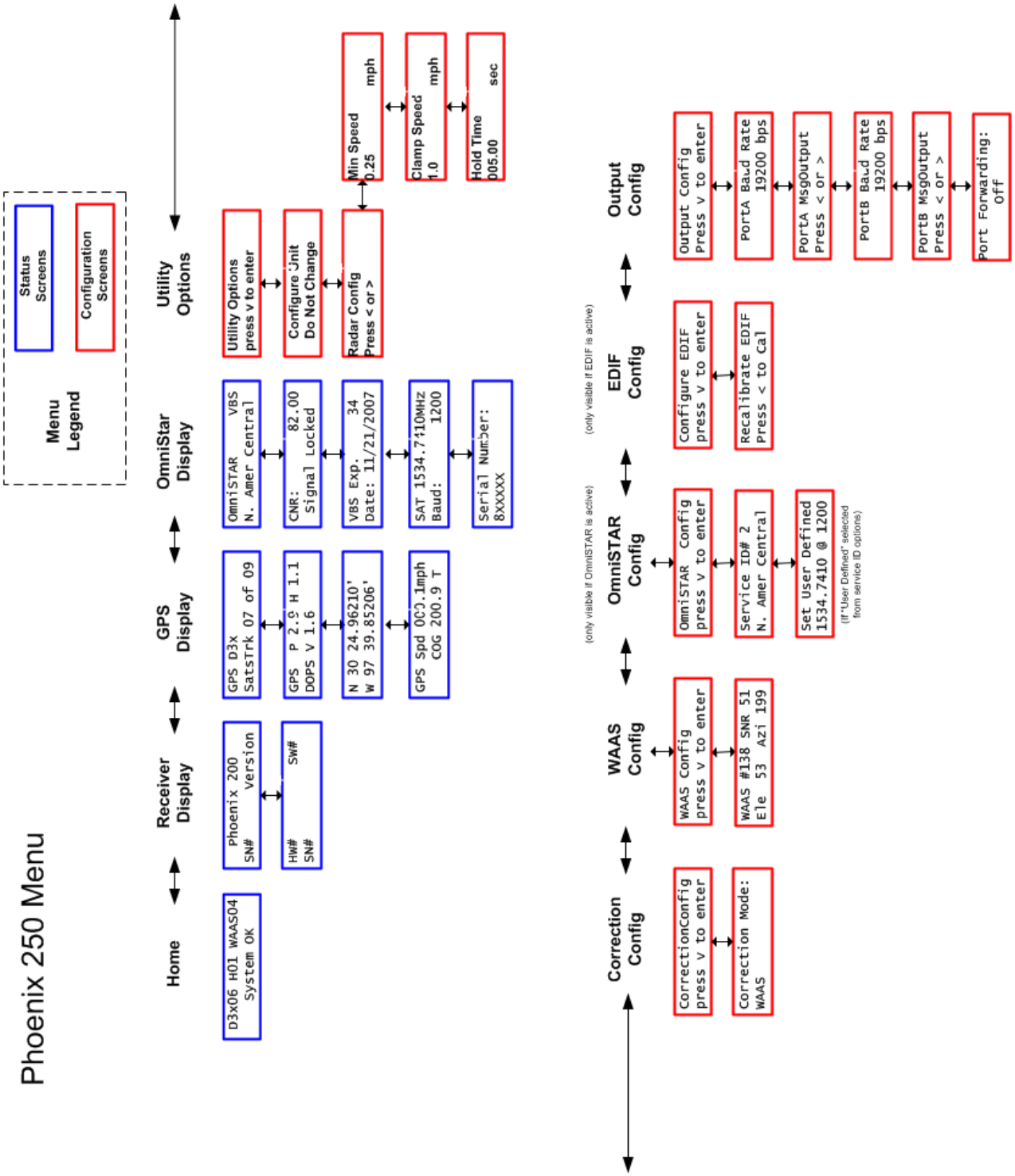


Starlink Protocol

Visit the Raven website for literature on using Starlink Protocol commands to configure the receiver.

Menu Map

Use this menu map a reference guide for navigating through the configuration screens.



CHAPTER

3

TROUBLESHOOTING

Mount the antenna 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
- OmniSTAR Subscription
- Serial Communications
- Peripheral Device

Receiver/ Antenna – Normally only five GPS satellites are required for good accuracy. If a lightbar is connected, ensure the three center LEDs are green.

Transmitting Site – If the receiver is operating in SBAS 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://gps.faa.gov/programs/waas/waas.htm

OmniSTAR Subscription - If running into a high AOD warning after the initial differential lock when trying to use OmniSTAR VBS corrections, it is likely that the subscription is not set up correctly. Refer to the OmniSTAR section for detailed steps on activating the subscription. The OmniSTAR web site can be reached at http://www.omnistar.com

Serial Communications – Using FP3 Simulator software, check for the proper communication settings such as baud rate and COM port number. Make sure the cable used, if not provided by Raven, is wired correctly. Also, try the Com port on the receiver to see if you can get a connection. See the section titled “Serial Interface.”

Notes:

CHAPTER

4

RECEIVER SPECIFICATIONS AND CONFIGURATION

Receiver Specification	
Size	6.88” x 5.13”
Weight	32 Ounces
Operating Temperature	-40° to +70° C
Operating Humidity	5% to 95% R.H. Non-condensing at + 60° C
Channels	12 GPS, 2 WAAS
Update Rate (Adjustable)	**Port A** - GGA, VTA = 10 Hz ZDA = .2 Hz **Port B** - GGA, VTA = 5 Hz ZDA = .2 Hz
Power Consumption	2-3 Watts Typical
Voltage	9-16 VDC
Protocols	NMEA v2.2
Storage Temperature	-40° to 80° C
Storage Humidity	100% Condensing
Mounting	Magnetic

Serial Interface

The Phoenix 250 has two bi-directional RS232 serial interface available on a 8-pin Con-X-All male connector.

8-Pin Con-X-All	
Pin Number	**Signal Name**
1	TXA
2	RXA
3	Ground
4	Radar
5	TXB
6	+12VDC
7	Ground
8	RXB

APPENDIX

A

OVERVIEW

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.

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. SA was turned off at midnight on May 1, 2000, but the capability stills exists.

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 approximately 25 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.

e-Dif

e-Dif was developed for customers needing guidance accuracy to be better than what raw GPS offers (~5 to 15 meters). e-Dif is for customers who are looking for an option without a yearly subscription fee. It is a reliable differential source for anybody using an enabled receiver in South America, Africa, Asia, Australia and other parts of the world who want accuracy approximately the same as corrections systems such as SBAS or OmniSTAR VBS service. It is also a good backup for those using free differential sources, such as SBAS (WAAS, EGNOS).

e-Dif provides positions that are very accurate in relation to a temporary reference location. This is done by gathering continuous data from satellites for 5-20 minutes and then computing a matching differential corrector for that specific location -- a process called calibration. This provides a 'localized correction', correcting mostly for local atmospheric conditions. Calibration is automatically started upon applied power, and may per performed either while stationary or driving. During the calibration process, the user must have a clear view of the sky for the duration of the calibration process (5-20 minutes). Once e-Dif is running, it is continually adjusted to match changing conditions on the GPS signals caused by the atmosphere.

Once calibration is completed, the user may continue to operate continuously for many hours, often up to 4 hours. There is no need to re-calibrate unless the unit has been switched off. The unit automatically starts the calibration process when powered up.

The accuracy of the position reported by an e-Dif receiver is initially very high and degrades slowly over time. Position jitter is always kept to a minimum. In addition, when rising satellites are acquired, new correctors are automatically generated. When satellites are lost from the solution, by setting or being masked, there is virtually no jump in position.

e-Dif is an optional feature offered by Raven Industries and may not by default be installed in a receiver. For information on obtaining e-Dif authorization codes, or more information concerning e-Dif please contact your local distributor.

OmniSTAR VBS

The OmniSTAR system is a full-time differential GPS broadcast system, delivering corrections to the world's major landmasses from a worldwide array of reference sites. Data from these reference sites flows to Network Control Centers (NCC's) where the RTCM corrections are decoded, checked, and repackaged in a highly efficient format for broadcast. The data is then upconverted for transmission to communication satellites which broadcast over geographical areas. Communication links with each reference site include a dial-up line to serve as backup to leased lines to allow control of the receivers. For more information, refer to the OmniSTAR website at www.omnistar.com.

Note: The receiver must be powered on during the activation.

Obtaining a VBS subscription:

1. Connect to the receiver via the FP3Simulator application and make sure OmniSTAR VBS is selected from the Correction Config menu.
2. Ensure that the correct region is selected under the OmniSTAR configuration screen or change the setting to "Auto".
3. Write down the OmniSTAR serial number from the OmniSTAR Display screens.
4. Move the receiver to a location where it has an unobstructed view of the sky and call your regional OmniSTAR operator. They will need to know the 6 digit serial number found on the OmniSTAR display screens in order to set up the subscription. More information can be obtained at http://www.omnistar.com.
5. If the subscription broadcast was successful, the receiver should pick up the authorization within a few seconds. The High AOD warning will disappear once the subscription is active, and the expiration date should be updated on the OmniSTAR Display menu screens.

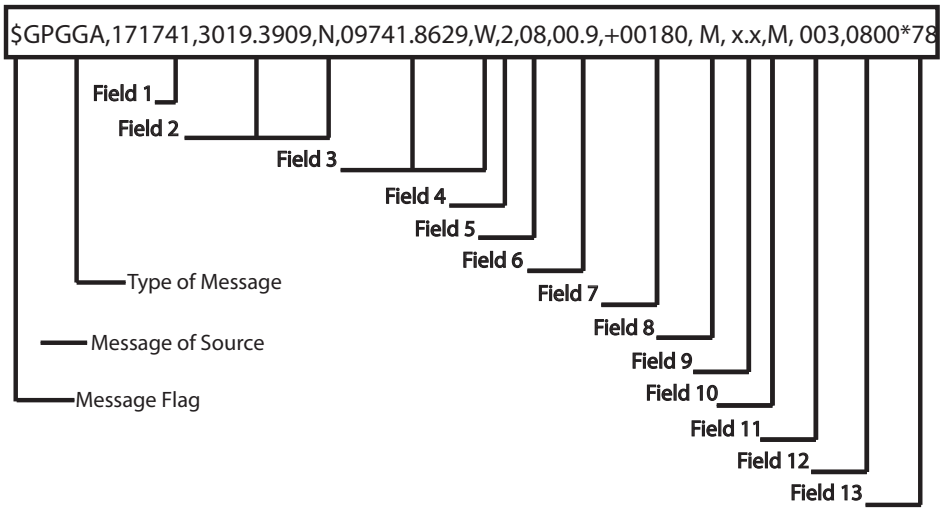
The internal L-band radio demodulates the satellite broadcast passed to a processor that reformats the corrections for use in the Phoenix 250 GPS receiver. In OmniSTAR VBS broadcasts, atmospheric corrections are applied to the data from multiple sites which are then combined to provide an optimal correction for the user's location. The Phoenix 250 GPS receiver uses these corrections, rebroadcast in RTCM SC-104 format, to provide maximum accuracy positions solutions.

NMEA MESSAGES

The Phoenix 250 receiver can be used to communicate with other electronic devices including the Raven Viper PRO and Envizio PRO. The National Marine Electronics Association has established a communication protocol know as the NMEA 0183 standard. The NMEA 0183 standard contains numerous message formats such as the ones described below which the Phoenix 250 receiver uses to communicate with other devices.

Phoenix 250 NMEA Messages	
GGA	Global Positioning System Fix Data
GLL	Geographic Position
GSA	GPS Dilution of Precision (DOP) and Active Satellites
GST	GPS Pseudorange Noise Statistics
GSV	Course Over Ground and Ground Speed
RMC	Recommended Minimum specific GPS/Transit Data
VTG	Course Over Ground and Ground Speed
ZDA	Time and Date through a technique known as "Differential"

Sample GGA Message Structure



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

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.

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