RPR 410

GPS Antenna & Receiver

Installation & Operators Manual

RPR 410

CHAPTER

1

INTRODUCTION

Congratulations on your purchase of the Raven 410 GPS receiver! This receiver will provide you with highly accurate and reliable GPS navigation and positioning solutions. GPS/DGPS receiver performance is the key to successful yield mapping and monitoring, swathing, and other precision farming functions. The 410 is designed to meet these needs while operating in the rugged agricultural environment. A front panel display is provided to make configuring and operating the receiver easier and more user friendly.

Functional Description

The Raven 410 receiver gives the user a choice of differential correction services. A sophisticated dual-channel receiver with superior impulse noise performance provides reliable tracking of USCG or Canadian signals automatically. Satellite differential correction is also available using WAAS DGPS and CDGPS corrections, or using the OmniSTAR subscription-based service. This service can be activated on demand. The Raven 410's 10-channel GPS system completes the process providing quick and stable satellite acquisition.

Software is not required to set up this receiver. However, software is provided for control and monitoring and upgrades are available free via the Internet. Two bi-directional RS-232 serial interface ports are provided for operation of numerous peripheral devices.

Contacting Raven Industries

We welcome your feedback about this manual. If you have any comments or suggestions for improvement, please let us know by contacting our Customer Support Center by any of the following methods:

- **Via phone**: 1-800-243-5435
- **Via mail**:
  Raven Industries
  Flow Control Division
  205 E. 6th St.
  Sioux Falls, SD 57104
- **Via email**: fcdinfo@ravenind.com

Notes:

CHAPTER

2

INSTALLATION

Power

Important: Before powering this receiver, make sure the antenna is connected. The 410 is reverse-power protected. A direct path exists between the ground pin of the power connector and the chassis. If power is reversed with the chassis grounded, a short exists between power and ground and the power wire could be damaged or even catch fire. This is not a problem unique to the 410, as any grounded equipment will have the same issue.

Connect the red wire from the supplied power cable to the positive (+) power source and the black wire to ground (-) or negative. If an automotive power adapter is used, verify that the vehicle has a negative ground system before connecting to power. If an AC adapter is used, connect the adapter to an AC source.

Connect power to the 410 before connecting the receiver chassis to ground during installation. If power is reversed, the internal self-resetting fuse will open and power will be removed. If this occurs, disconnect the power connector, wait five seconds, correct the polarity, and reconnect power. After verifying that power is being supplied properly, it is safe to install the receiver.

Receiver

Mount the receiver using the elongated holes in the flange assembly. Tighten the support screws securely to prevent jarring or bouncing of the receiver.

GPS Antenna

GPS is a line-of-sight system. This means that in order for the receiver to track the satellites, there must be an unobstructed path. Buildings, trees, machinery, and human bodies are common obstructions.

Items such as electrical motors, generators, alternators, strobe lights, radio transmitters, cellular telephones, microwave dishes, radar, active antennas, etc. all generate electrical and magnetic fields which can interfere with GPS, or L-Band signal. Mount the antenna away from such potential sources of interference.

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

The antenna is relatively insensitive to electric noise generated by alternators or spark plugs, but these noise sources can still interfere. A common source of interference is DC motors which use brushes (the fan blower motor in a car, for example). Power inverters which connect DC to 110VAC often produce considerable interference also.

Antenna Mounting

The antenna can be mounted on a standard (one inch diameter, 14 threads per inch) marine antenna mount.

Important: Do not tighten the antenna on the marine antenna mount by turning the antenna cover. Hold the mounting shaft located at the bottom of the antenna and tighten by hand. Do not thread the shaft deeper than 3/4”.

Antenna Cable

The supplied cable is 15 feet in length. Other cable lengths are also available. Additional cable can be added as long as the voltage drop across the cable does not exceed 0.5 Volts. This does not normally present a problem if the cable length is 50 feet or less.

CHAPTER

3

OPERATION

Initial Startup

The internal GPS receiver must perform a “cold start” the first time the system is powered up. During this cold start, the GPS receiver will search for satellites and download the data necessary for operation. The receiver will also perform an auto scan using both receiver channels until a signal is obtained. The L-Band receiver will only track OmniSTAR correction signals. The cold start will take up to 15 minutes, but is only required during the initial power up.

1. Make sure the antenna is connected to the receiver before powering up the unit. Connect power to the 410 and verify that the front panel display is illuminated.
2. Connect the serial cable provided between the 410 and the computer. Allow the receiver to operate while installing the software program on the computer. Turn off all unnecessary electrical equipment to minimize electrical noise interference.

OmniSTAR Service

If you are using the OmniSTAR DGPS correction service, refer to the OmniSTAR card provided with the receiver.

Normal Operation

Upon completion of the initial cold start, the receiver begins to operate in “Normal Mode”. The unit should be operating in full DGPS mode within a few minutes of power-on if running WAAS, CDGPS, or OmniStar VBS. OmniStar HP may take up to 45 minutes to be locked on.

All configuration and frequency data is stored in non-volatile memory inside the 410. Configuration changes are made using the front panel display.

Be aware of possible satellite obstructions which may interfere with GPS operation. For high precision performance, watch the Horizontal Dilution of Precision (HDOP), which is an error estimate. The HDOP should be 2 or less.

Notes:

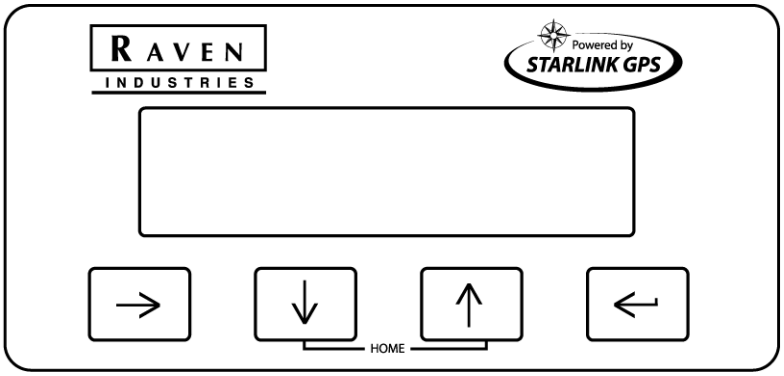
CHAPTER

4

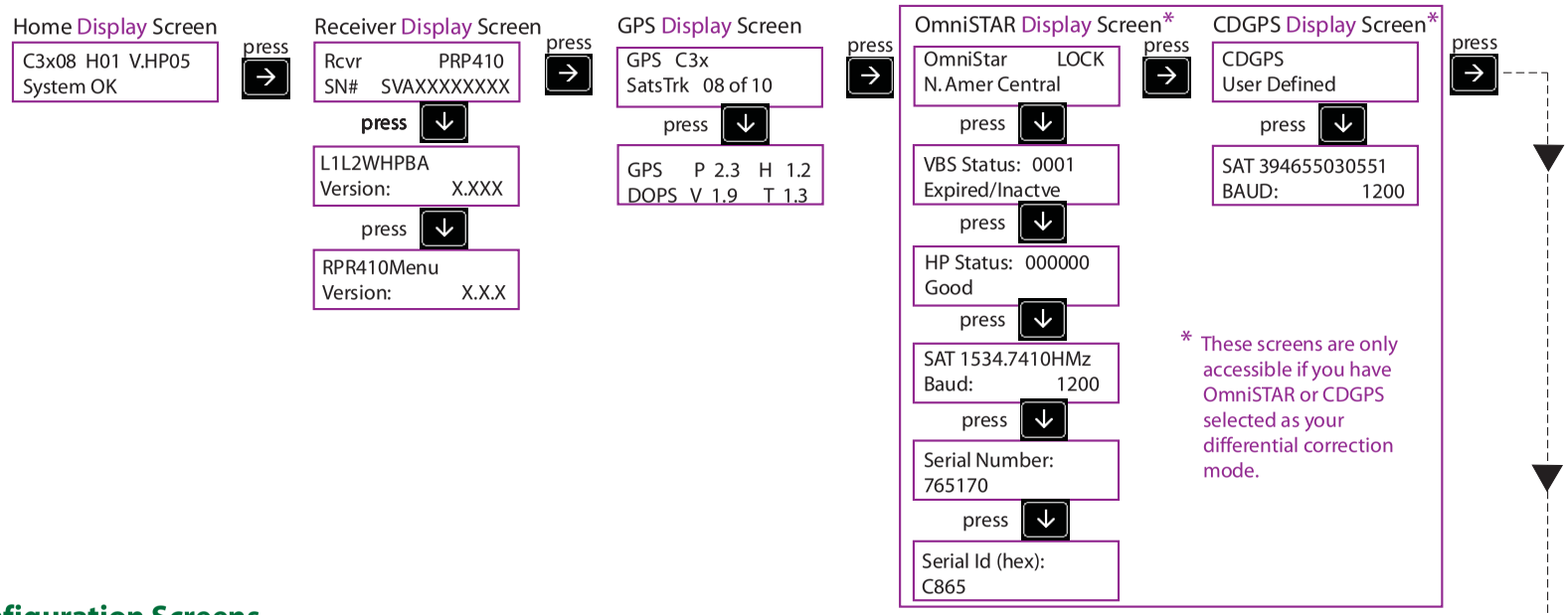
FRONT PANEL DISPLAY

Display Setup

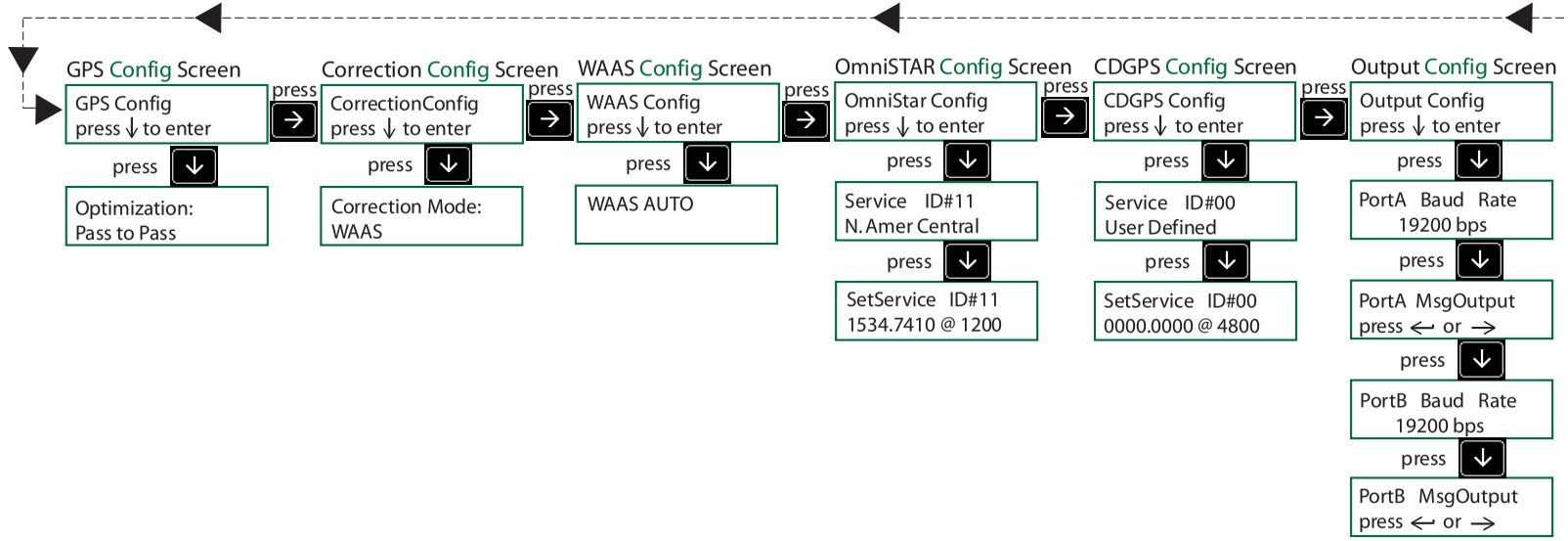
Gently peel away the protective film covering the front panel display. The 410 receiver is configured at the factory to operate in automatic mode. This allows the receiver to begin operation immediately following initial installation. The front panel display allows the user to reconfigure the receiver, switch to an alternate differential source, and observe how the receiver is performing. The keypad arrows are used to navigate through the display and configuration menus.



Display Screens



Configuration Screens



Operation

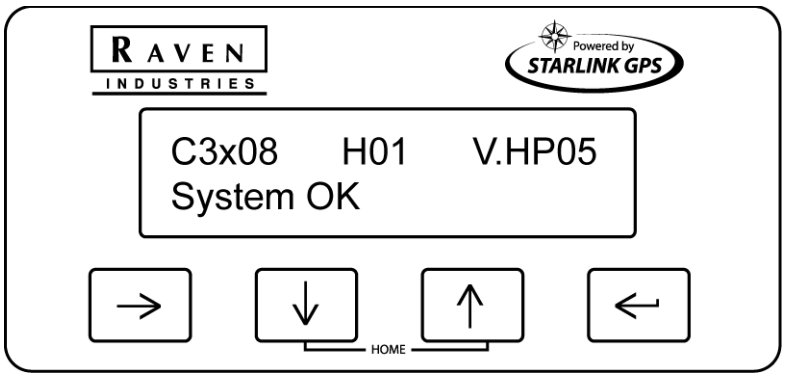
The following are different screens and settings used by the front panel display.

Home Display Screen

Raven recommends that you use this screen during normal receiver operation.

Note: You can return to the Home screen anytime by pressing the ↑ and ↓ arrow keys at the same time.

If the receiver is operating under normal operation without warnings, the front panel display will show:



The following is a list of display characters and their description:

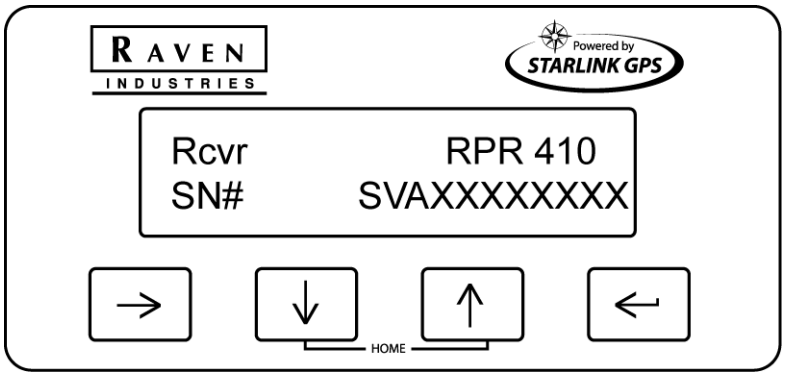
Character(s)	Description
C	Displays differential mode. **D**=Differential, **C**=Converging, **R**=RTK/Decimetric, **Blank**=GPS only
3	Type of position solution (None, 2 Dimensional, 3 Dimensional)
08	Number of satellites use in position solution
H01	Horizontal Dilution of Precision (HDOP)
V.HP	Current source of differential corrections with its associated age of data. WAAS=WAAS, CGPS=Canadian GPS, V.HP=OmniStar

Status OK	The second line is reserved for warning messages (OK, Poor SV Tracking, High AOD, High GDOP, High HDOP, No Diff Corrs, Hgt Constrained, No Pos Solution, Antenna Fault)

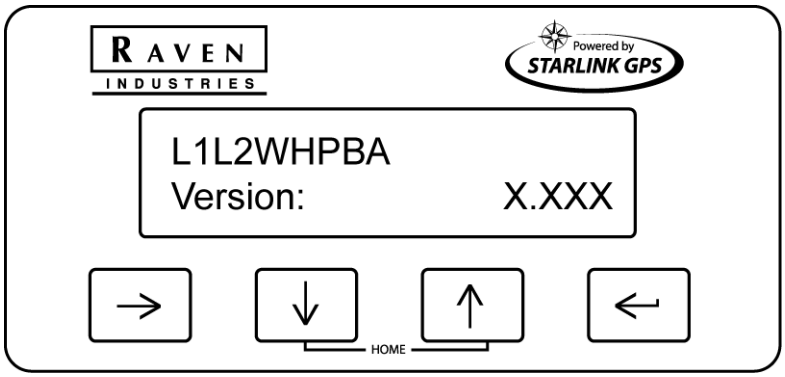
Receiver Display Screen

This screen displays the receiver model, serial number, firmware version, and receiver options.

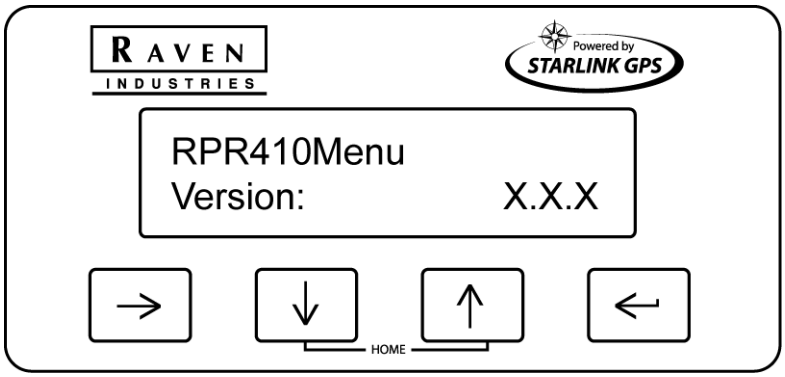
The following example displays the receiver model, serial number, and firmware version. From the Home screen, press the → key to show your settings:



Pressing the ↓ key will display all options currently installed:

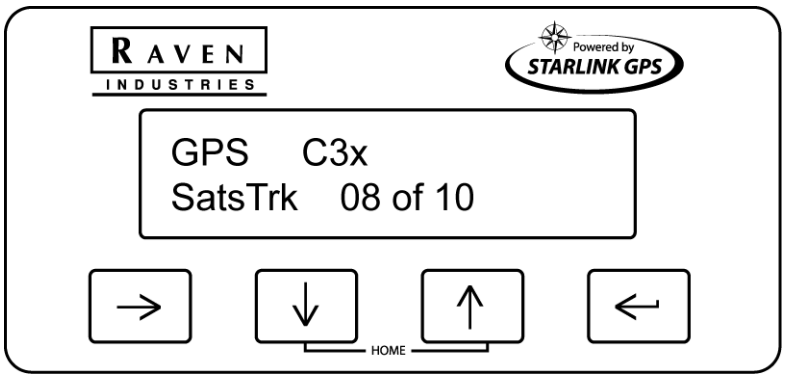


Pressing the ↓ key will display more options currently installed:

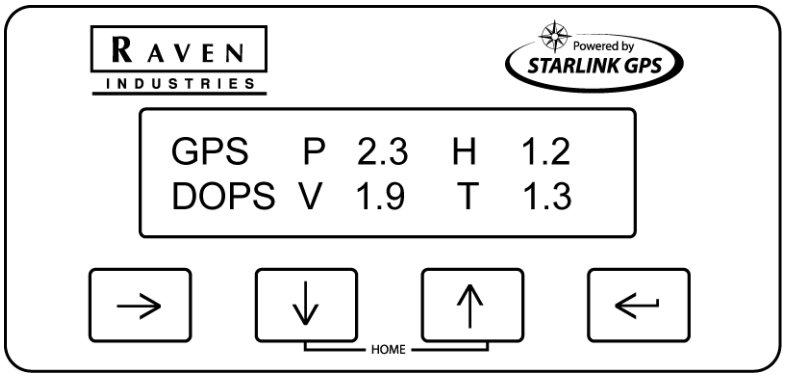


GPS Display Screen

From the Home screen, press the → key until you get to the GPS Display screen:



Pressing the ↓ key will display the PDOP, HDOP, VDOP, or TDOP:



The term ‘DOP’ (Dilution of Precision) is an estimation of error cause by the geometry created by the position of the satellites used in the GPS solution.

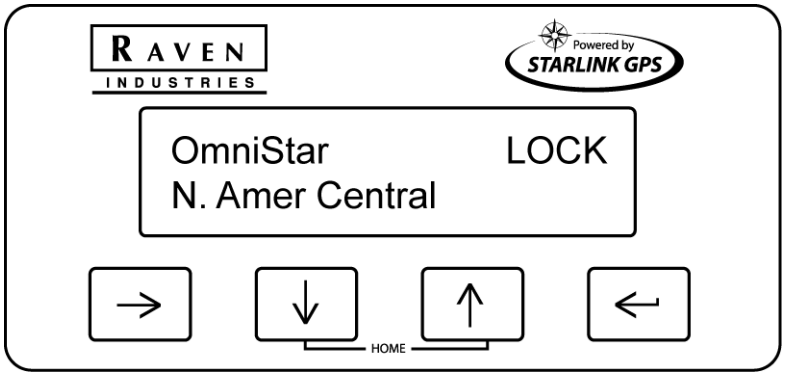
Smaller values denote better accuracy. A value of 9.9 is displayed when there are not enough satellites being tracked to provide a usable GPS solution.

DOP	Definition
H (HDOP)	Horizontal (East/West)
V (VDOP)	Vertical (North/South)
T (TDOP)	Time
P (PDOP)	Position

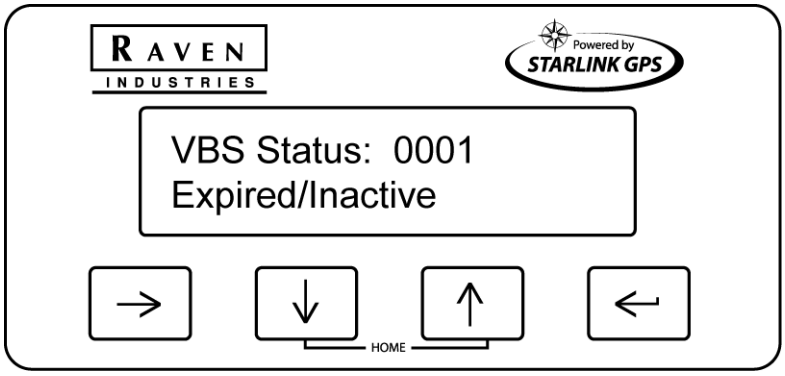
OmniSTAR Display Screen

If you have OmniSTAR selected as your differential correction mode, the OmniSTAR display screen will be available. You can access it by pressing the → key until you get to it:

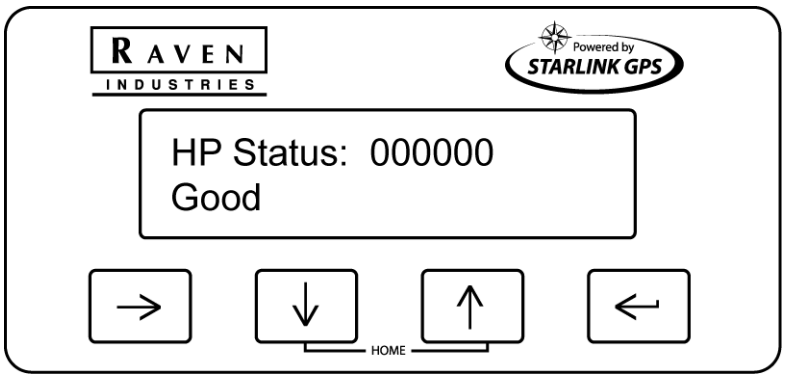
Note: Do not confuse this screen with the CDGPS Configuration screen. Display screens are for viewing the settings, Configuration screens are for changing the settings.



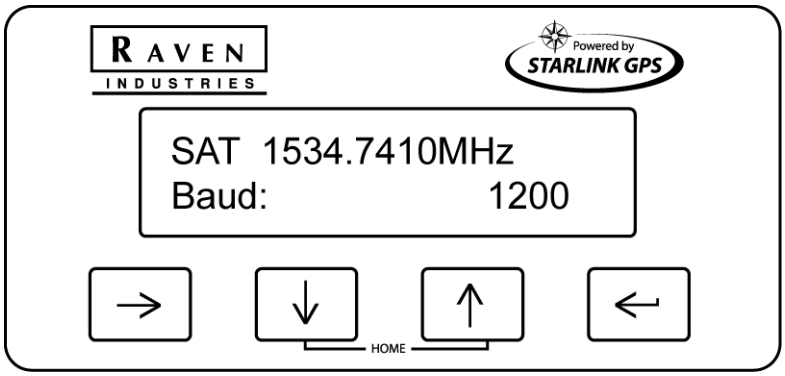
Pressing the ↓ key will display the status of your OmniSTAR VBS subscription:



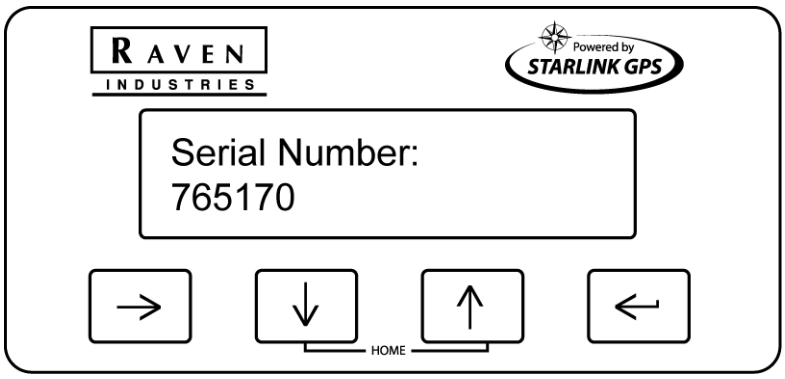
Pressing the ↓ key again will display the status of your OmniSTAR HP subscription:



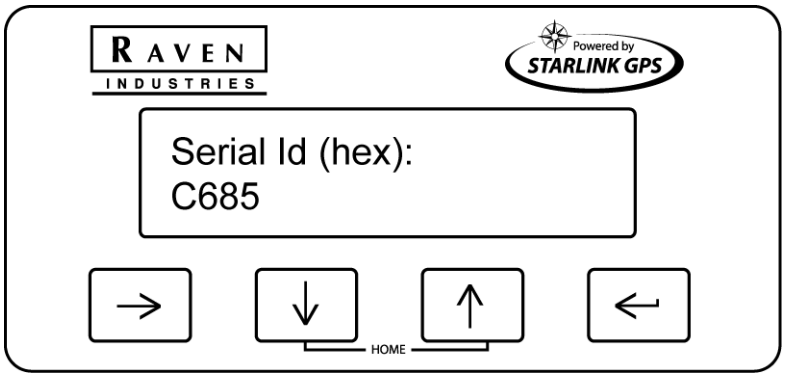
Press ↓ key again to display the satellite frequency and baud rate:



Pressing the ↓ key again will display your OmniSTAR serial number:



Press the ↓ key again to display the OmniSTAR Service ID number:

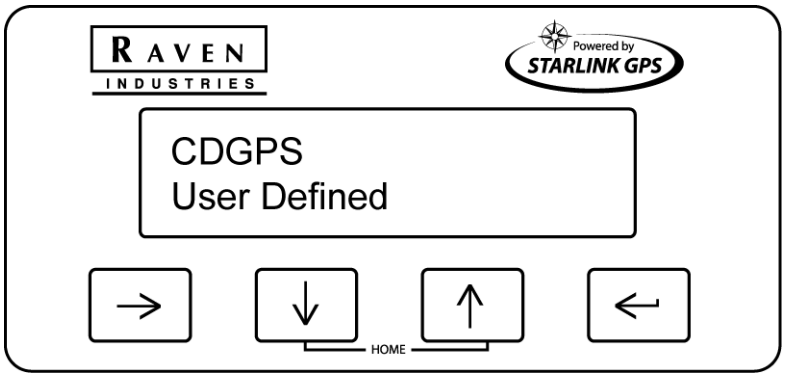


CDGPS Display Screen

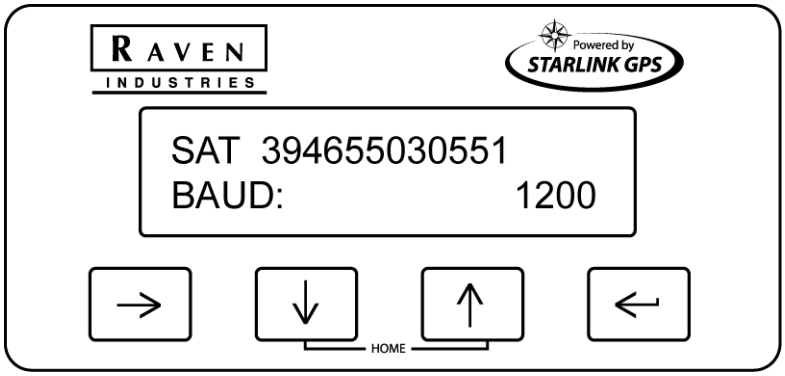
If you have CDGPS selected as your differential correction mode, the

CDGPS display screen will be available. You can access it by pressing the → key until you get to it:

Note: Do not confuse this screen with the CDGPS Configuration screen.



Pressing the ↓ key will display the satellite frequency number and baud rate:



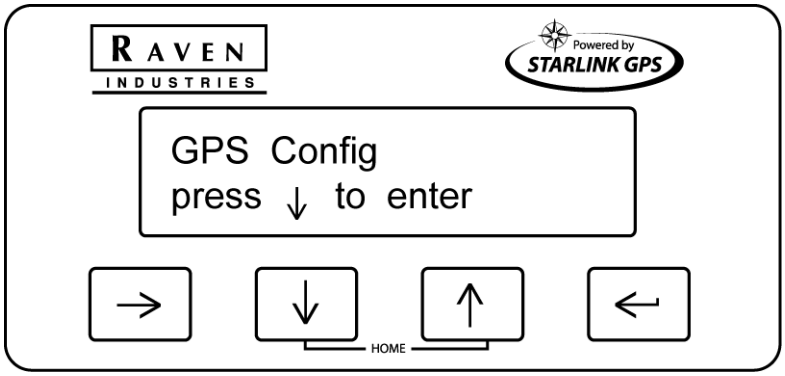
CHAPTER

5

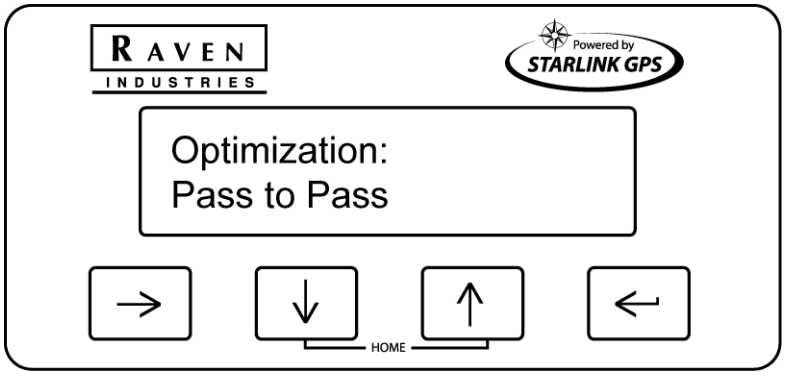
CONFIGURATIONS

GPS Configuration Menu

To get to the GPS Configuration screen, press the → key until you get to the GPS Configuration screen:



To change the masks, PDOP, or HDOP configuration, press the ↓ key to get to this screen:

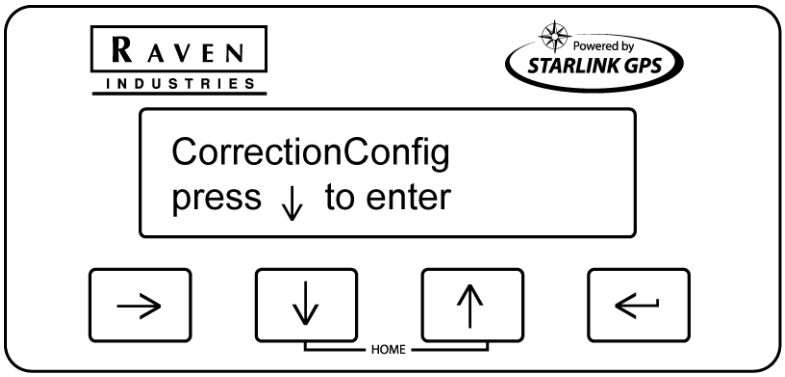


Optimization Setting	Definition
Pass to Pass	Uses a filter to improve performance for long straight paths. **Note:** Performance may be slightly degraded when there are many turns in the path. The filter is ideal for field applications in which pass to pass accuracy is primarily needed.
None	Does not use the 'Pass to Pass' mode filter.

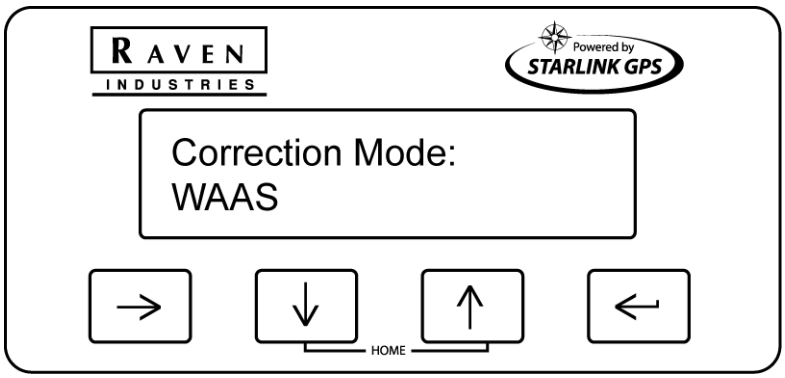
Press the ← key to begin data entry. The current optimization mode will begin to blink. Use the ↑ and ↓ arrow keys to change the setting, if needed, then press the ← key when entry is complete.

Correction Configuration Menu

To get to the Correction Configuration screen, press the → key until you get to the Correction Configuration screen:



To get to the Correction Mode screen, press the ↓ key:



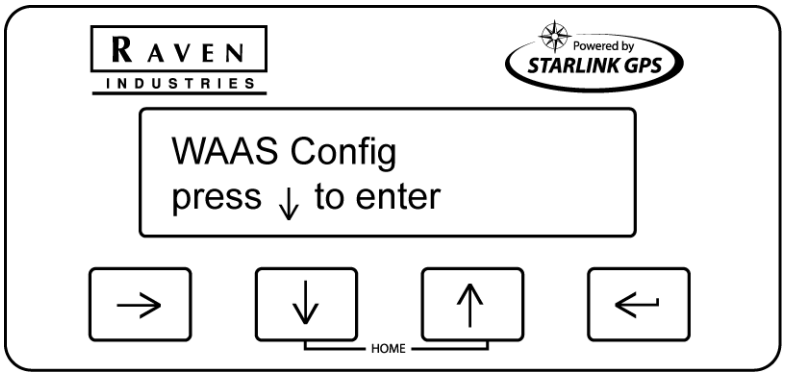
Press the ← key to begin data entry. The current correction mode setting will begin to blink. Use the ↑ and ↓ arrow keys to change the setting, then press the ← key when entry is complete.

The following table lists the possible differential correction modes:

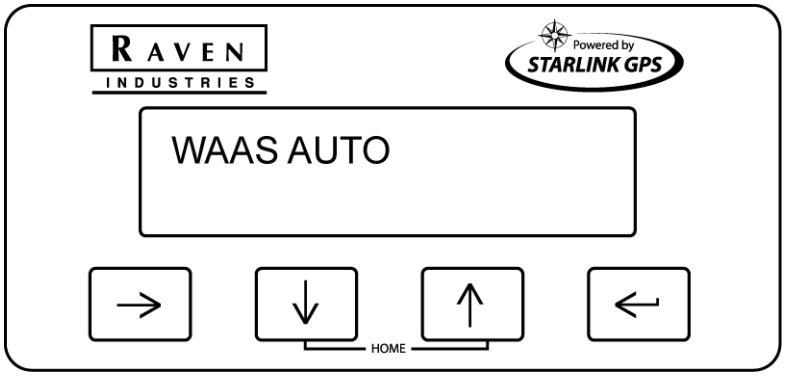
Type	**Description**
WAAS	Wide Area Augmentation System
OmniSTAR VBS/HP	OmniSTAR DGPS
CDGPS	Canadian DGPS
CMR	N/A
RTCM	N/A
RTCA	N/A
None	No differential correction

WAAS Configuration Menu

To get to the WAAS Configuration screen, press the → key until you get to the WAAS Configuration screen:



Press the ↓ key and the current configuration is displayed:



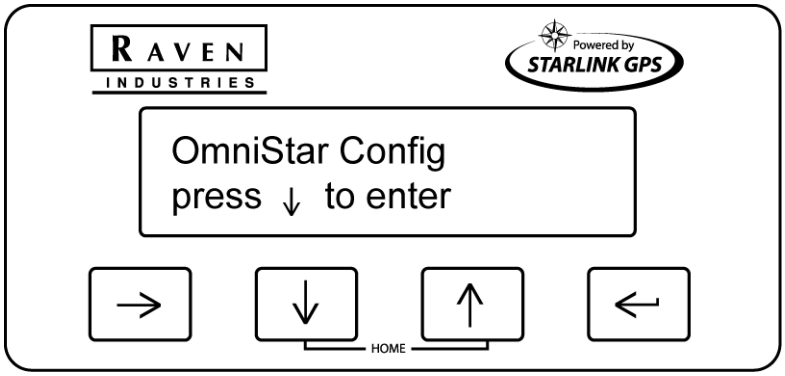
Press the ← key to begin data entry. The current WAAS number setting will begin to blink. Use the ↑ and ↓ arrow keys to change the setting, then press the ← key when entry is complete.

Note: The WAAS number is the current satellite that is being used for correction. When in Auto mode, the satellite with the best frequency will be used.

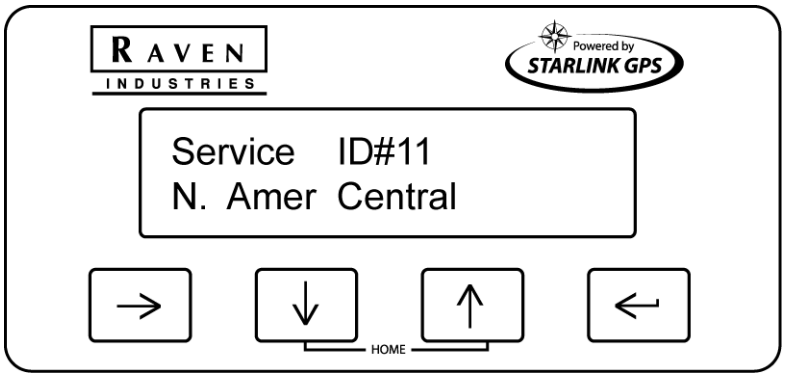
OmniSTAR Configuration Menu

The following screens are provided to aid in activating your OmniSTAR DGPS subscription service. Refer to the OmniSTAR subscription card included with your receiver for detailed information on how to activate your satellite differential signal.

To get to the OmniStar Configuration screen, press the → key until you get to the OmniSTAR Configuration screen:



The Service ID screen is used to select the correct OmniSTAR satellite for your area. Press the ↓ key and the current Service ID number and region setting is displayed:

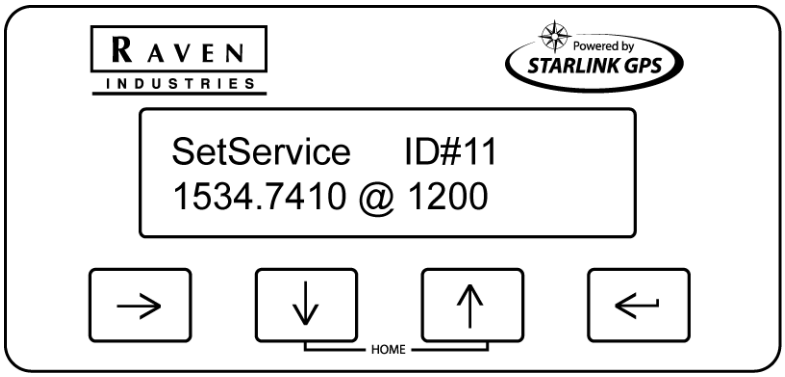


Press the ← key to begin data entry. The current Service ID region setting will begin to blink. Use the ↑ and ↓ arrow keys to change the setting, then press the ← key when entry is complete.

Possible ID numbers and regions include:

ID #	Description		ID #	Description
00	User Defined		08	South America
01	Atlantic O. East		09	Atlantic O. West
02	Indian Ocean		10	N. America West
03	Europe-Asia		11	N. Amer Central
04	Africa		12	N. America East
05	Asia-Pacific		13	CHARTCO
06	Perth		15	Optus-Australia
07	Pacific Ocean			

Press the ↓ key again and the current SetService ID number is displayed. This screen can be used to enter a satellite frequency (e.g., 1554.4970 MHz) and symbol rate (e.g., 2438) supplied by OmniSTAR for your Service ID configuration:



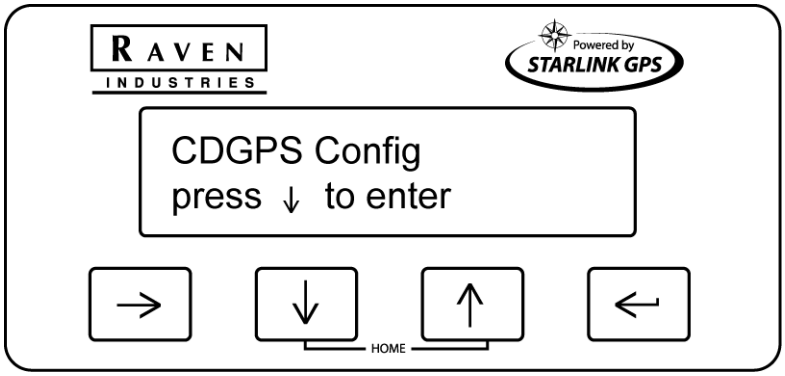
Press the ← key to begin data entry. The current SetService ID number will begin to blink. Use the ↑ and ↓ arrow keys to change the setting, then press the ← key when entry is complete. The baud rate will begin to blink. Use the ↑ and ↓ arrow keys to change the setting, then press the ← key when entry is complete

Note: Use the → key to scroll to different numbers in the SetService ID number.

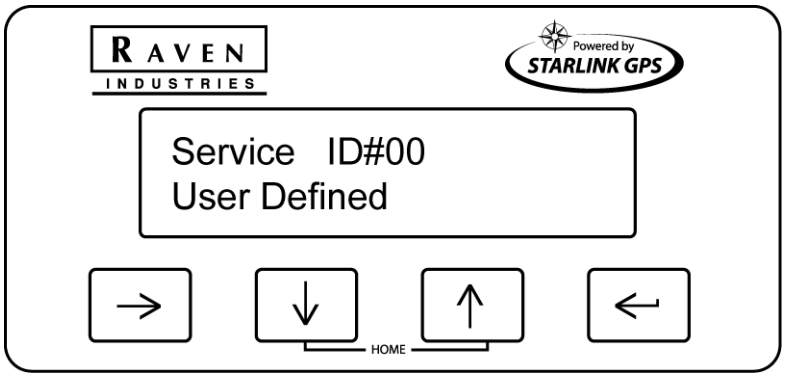
Important: This operation is not normally used.

CDGPS Configuration Menu

To get to the CDGPS Configuration screen, press the → key until you get to the CDGPS Configuration screen:

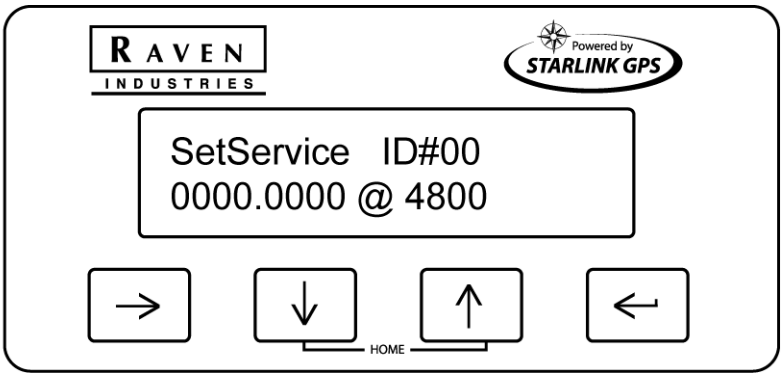


Press the ↓ key and the current Service ID is displayed:



Press the ← key to begin data entry. The current Service ID number will begin to blink. Use the ↑ and ↓ arrow keys to change the setting, then press the ← key when entry is complete.

Press the ↓ key again and the current SetService ID is displayed:



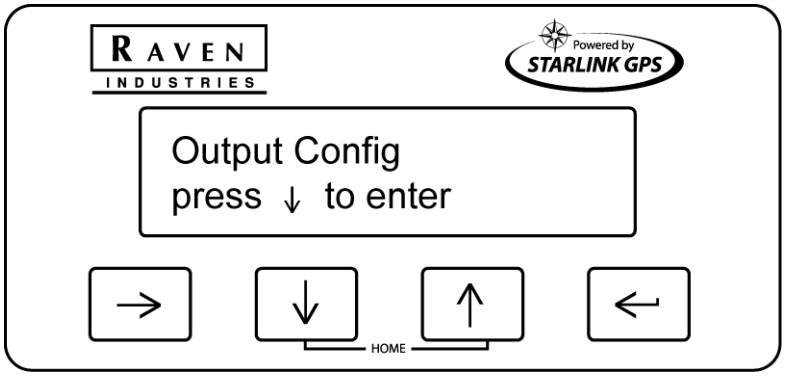
Press the ← key to begin data entry. The current SetService ID number will begin to blink. Use the ↑ and ↓ arrow keys to change the setting, then press the ← key when entry is complete and the rate will blink.

Use the ↑ and ↓ arrow keys to change the setting, then press the ← key when entry is complete

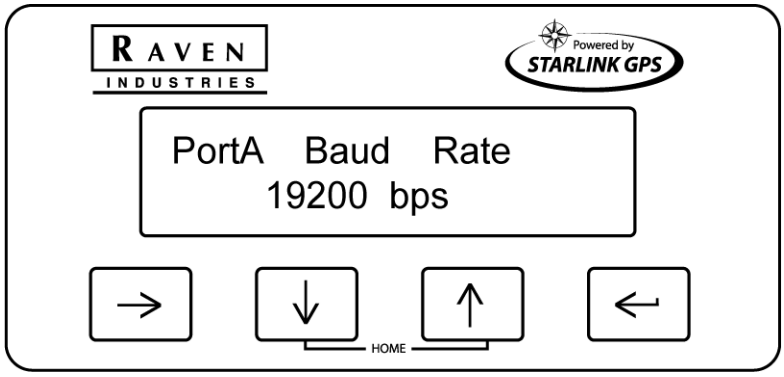
Note: Use the → key to scroll to different numbers.

Output Configuration Menu

To get to the Output Configuration screen, press the → key until you get to the Output Configuration screen:

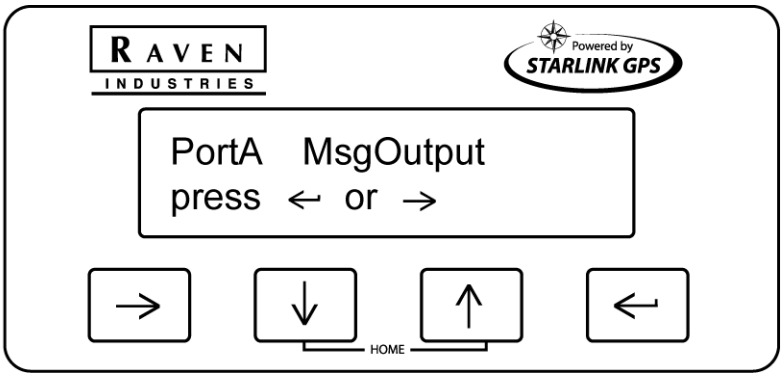


Press the ↓ key and the baud rate for Port A is displayed:



Press the ← key to begin data entry. The current Baud Rate for Port A will begin to blink. Use the ↑ and ↓ arrow keys to change the setting, then press the ← key when entry is complete.

Press the ↓ key and the Port A message output screen is displayed:



Use the → arrow key to change the port messages, then use the ↑ and ↓ arrow keys to scroll through the messages. Use the ← key to adjust the speed of the selected message. Use the → key to select the digit you want to adjust and then the ↑ and ↓ arrow keys to change the value. When finished, press the ← key and the digits will stop blinking.

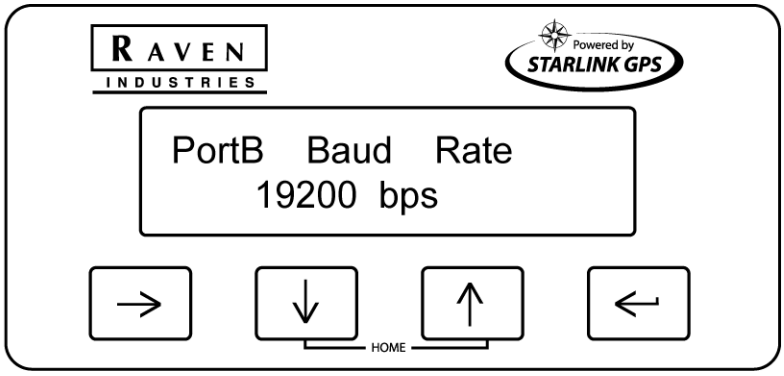
Press the → key to get back to the Port A message output screen when entry is complete.

Note: An interval of 0.0 sec disables output of the selected messages on Port A.

The table below lists the optional interval rates:

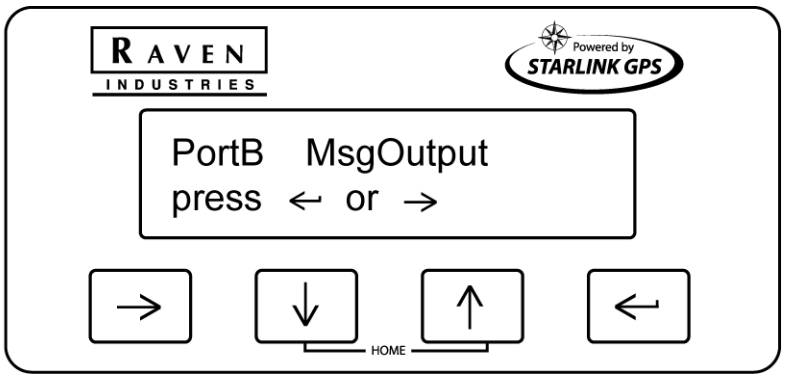
Programmed Interval of NMEA message	**Output frequency (number of updates per second)**
0.0	OFF
0.1 sec	10 Hz
0.2 sec	5 Hz
0.5 sec	2 Hz
1.0 sec	1 Hz

To select the Baud Rate for Port B, press the ↓ button:



Press the ← key to begin data entry. The current Baud Rate for Port B will begin to blink. Use the ↑ and ↓ arrow keys to change the setting, then press the ← key when entry is complete.

Press the ↓ key and the Port B message output screen is displayed:



Use the → arrow key to change the port messages, then use the ↑ and ↓ arrow keys to scroll through the messages. Use the ← key to adjust the speed of the selected message. Use the → key to select the digit you want to adjust and then the ↑ and ↓ arrow keys to change the value. When finished, press the ← key and the digits will stop blinking.

Press the → key to get back to the Port B message output screen when entry is complete.

Note: An interval of 0.0 sec disables output of the selected message on Port B. See the table under Port A for message and interval options.

Notes:

CHAPTER

6

TROUBLESHOOTING

Important: Make sure that 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.

Before troubleshooting, attempt to isolate problems into one of these categories:

- Receiver
- Antenna (including cables)
- Power
- Transmitting Site
- Serial Communications (receiver or peripheral device)

Checking the Installation

Monitor the effects of 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 antenna location may need to be changed. For example, if running the engine causes interference, then ignition noise or alternator noise is interfering with signal reception. Move the antenna further away from the engine.

Receiver

Normally only 5 GPS satellites are required for good accuracy. View the Front Panel Display Home Screen and check the number of satellites being tracked. Also look for the ‘D’, ‘C’,or ‘R’ indicating a differentially corrected position. Refer to page 9 in this manual for letter descriptions.

Antenna

Check the connections between the antenna and receiver. Verify the connectors and cable are in good condition. An ohmmeter can be used to determine if the antenna cable is open or shorted.

Power

The front panel display should remain lit while power is applied.

Transmitting

If the receiver is operating in WAAS mode, make sure the proper PRN is selected (e.g., - WAAS #122). WAAS status information is available on the Internet at http://www.waasperformance.raytheon.com/sis/sis.html. If the receiver is in OmniSTAR mode, verify the frequency of the satellites.

Receiver Specifications

Position Accuracy	See chart below	**Operating Temp.**	-40 to +65 C
Timing Accuracy	N/A	**Position Upgrades**	20 solutions/sec
Num. of Channels	24	**Max. Velocity**	1000 Knots
Frequency Range	283.5-3250.0 kHz	**Rel. Humidity**	95% non-condens.
Tuning Resolution	< 1 Hz	**Altitude**	60,000 feet
Min. Signal Strength	5 uV @ 1000 bps	**Dimensions**	8.3” L x 5.7” W x 2.1” H
Dynamic Range	> 100 dB	**Weight**	20 ounces
Adj. Channel Rej.	50 dB at 1 KHz	**Antenna Weight**	< 1.3 pounds
Cold Start	6 min. typical, 15 min. max.	**Antenna Diam.**	7.5 inches
Warm Start	40 seconds	**Input Voltage**	8-18 VDC
Reacquisition	1 second	**Power Consump.**	< 34 W @ 12VDC
Acceleration	2G	**Current**	400 mA @ 12VDC
Connectors/Ports	2 RS-232 I/O		

Position Accuracy Chart:

Differential Source	Direction	Accuracy
WAAS	Horizontal RMS	<1 m (40 in)
CDGPS	Horizontal RMS	<0.8 m (35 in)
OmniSTAR VBS	Horizontal RMS	<1.2 m (50 in)
OmniSTAR HP	Horizontal RMS	<0.12 m (5 in)

Configuration

Rear Panel Serial Interfaces

The 410 has two bidirectional RS232 serial interfaces. Each port is assigned a single letter in uppercase, 'A' or 'B', and each one provides the necessary interfacing between the 410 and external navigation equipment.

PORT A

Pin	Signal Name
1	Port "A" TX
2	Port "A" RX
3	GND
4	
5	
6	Ext. PWR
7	GND

PORT B

Pin	Signal Name
1	Port "B" TX
2	Port "B" RX
3	GND
4	
5	
6	Ext. PWR
7	GND

Power Connector

The 410 is designed to operate between 8 and 18 VDC. The unit is reverse-voltage and overvoltage power protected to reduce the possibility of damage during installation. The table below identifies each pin and gives the wire colors for the supplied cable.

Pin	Description	Wire Color
1	+12 VDC Power Input	Red
2	Not Used	N/A
3	Power Return (GND)	Black
4	Not Used	N/A

Notes:

CHAPTER

7

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. Simply stated, twenty-four 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 transmit 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 code navigation message, by using a little trigonometry, the receiver can determine its location on earth.

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

- Ionospheric and tropospheric delays on the radio signal
- Signal multi-path
- Receiver clock biases
- Orbital satellite (ephemeris) position errors

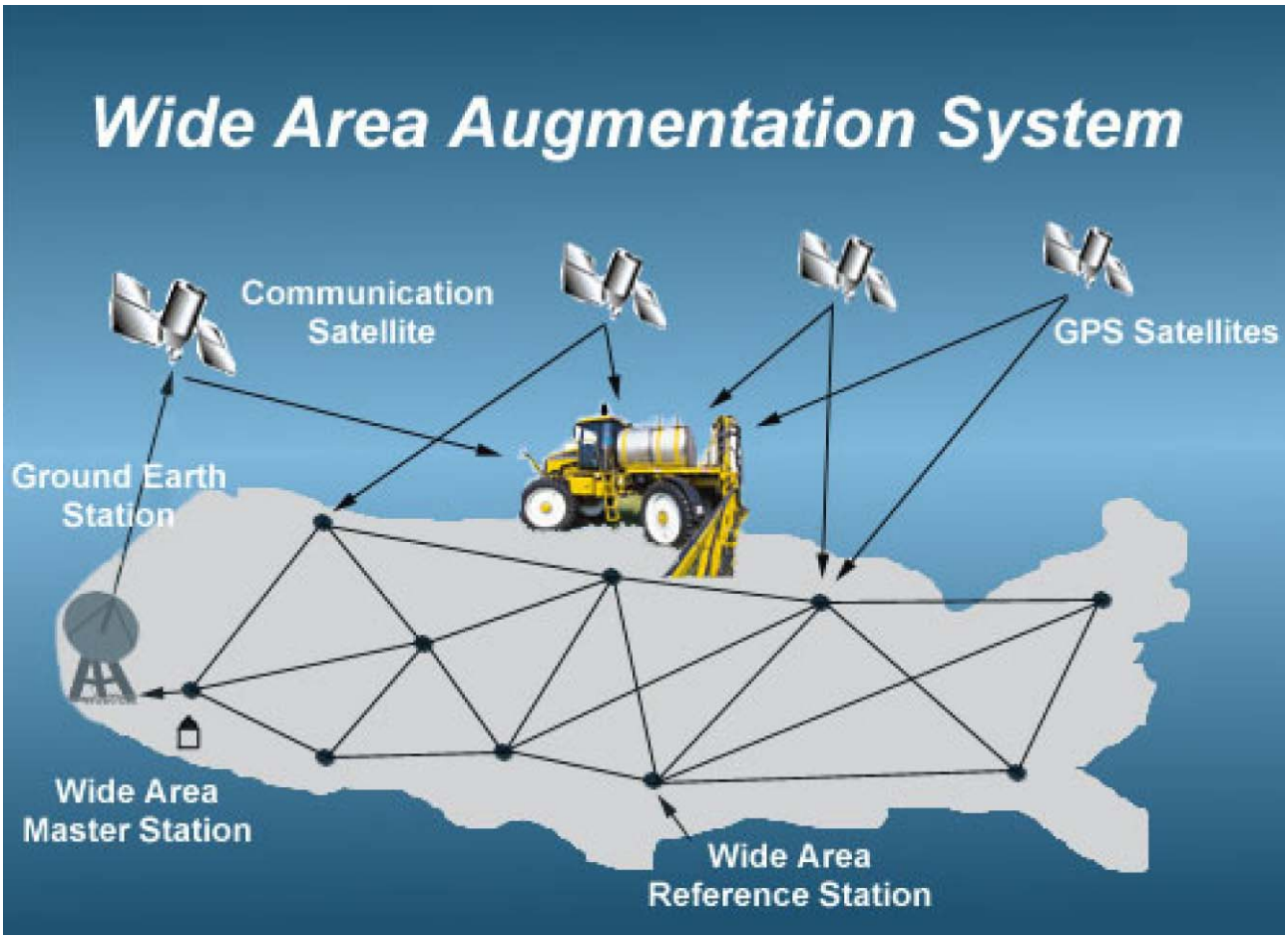
Notes:

CHAPTER

8

DIFFERENTIAL GPS (DGPS) WAAS

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.



Notes:

CHAPTER

9

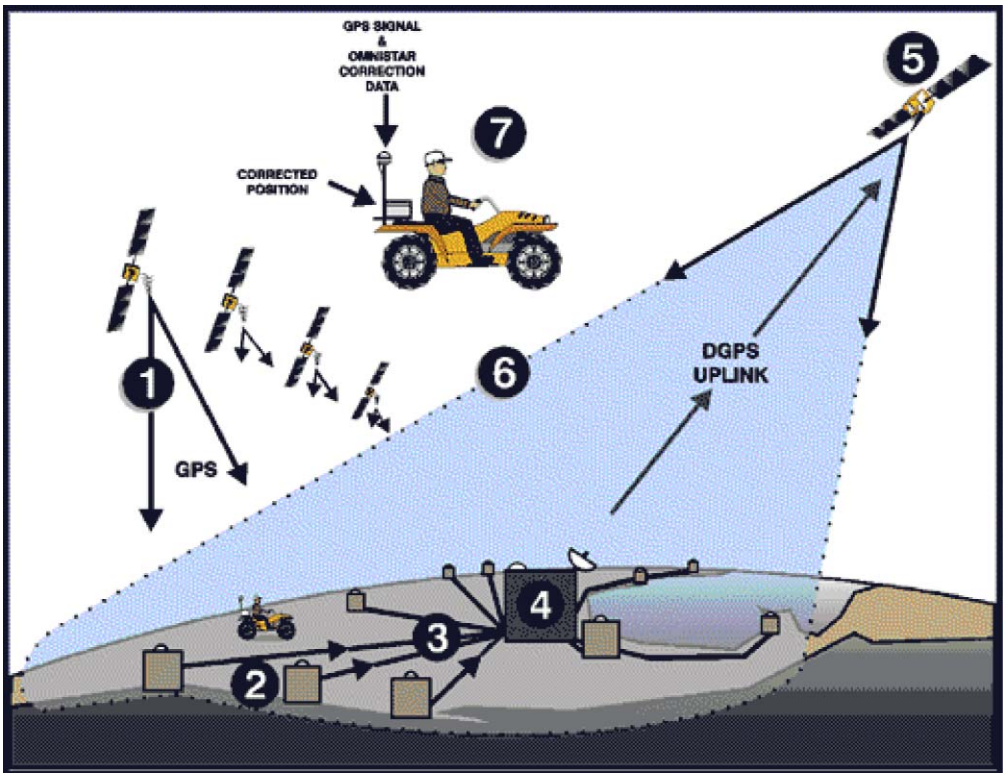
DGPS OMNISTAR

The OmniSTAR system is a full-time differential GPS broadcast system, delivering corrections to the world's major land masses 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.

The satellite broadcast is received at the user's location, demodulated, and passed to a processor that reformats the data into corrections for use in the 410 receiver. In OmniSTAR, atmospheric corrections are applied to the data from multiple sites which are then combined to provide an optimal correction for the user's location. These corrections, recast in RTCM SC-104 format, are used by the 410 receiver for maximum accuracy.

How it works:

1. GPS Satellites
2. Multiple OmniSTAR GPS reference sites
3. Differential GPS corrections send vial lease line to
4. NCC's where data corrections are checked and repackaged for uplink to communication satellites
5. Geostationary communications satellite
6. Satellite broadcast footprint - OmniSTAR user area
7. Correction data are received and applied real-time



CHAPTER

10

NMEA MESSAGES

The 410 receiver can be used to communicate with other electronic devices including Raven's Guidance Lightbar. 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 410 receiver uses to communicate with other devices.

410 NMEA Messages

GGA	Global Positioning System Fix Data
RMC	Recommended Minimum Specific GPS/Transit Data
VTG	Course Over Ground and Ground Speed
ZDA	Time and Date

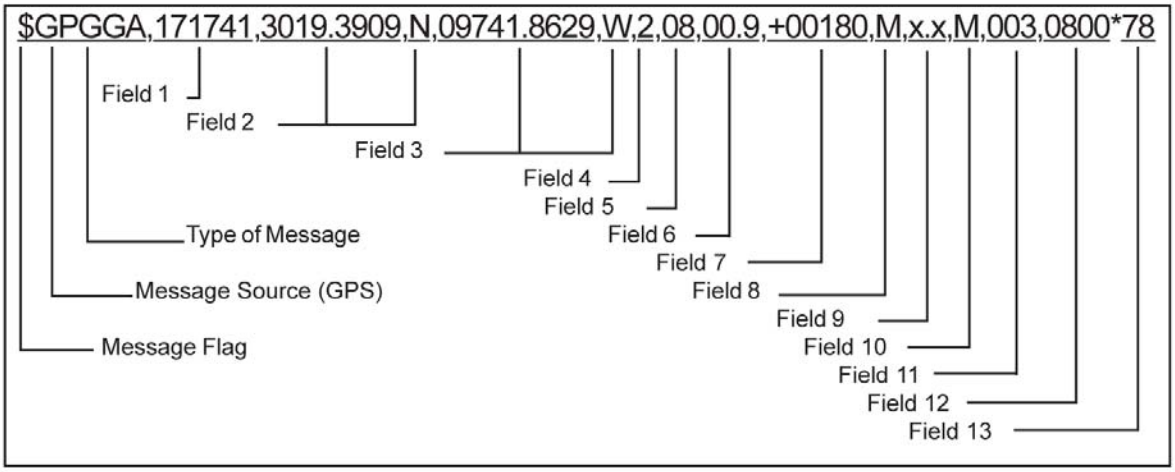
Notes:

CHAPTER

11

SAMPLE MESSAGE STRUCTURE

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



Field	Description		Field	Description
$	Message Flag		**3**	Longitude, East or West
GP	Message Source (GPS)		**4**	GPS Quality Indicator (mode)
GGA	Type of Message		**5**	Number of Satellites in use
1	Universal time coordinate (UTC) of Position		**6**	Horizontal Dilution of Precision
2	Latitude, North or South		**7**	Antenna Altitude Ref: Sea Level (geoid)

Field	Description		Field	Description
8	Units of Antenna Altitude (meters in example)		**11**	Age of Differential Data, seconds
9	Geoidal Separation		**12**	Reference Station ID
10	Units of Geoidal Separation (meters in example)		**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.

RPR 410 GPS Antenna & Receiver Installation & Operators Manual (P/N 016-0159-977) 10/05

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