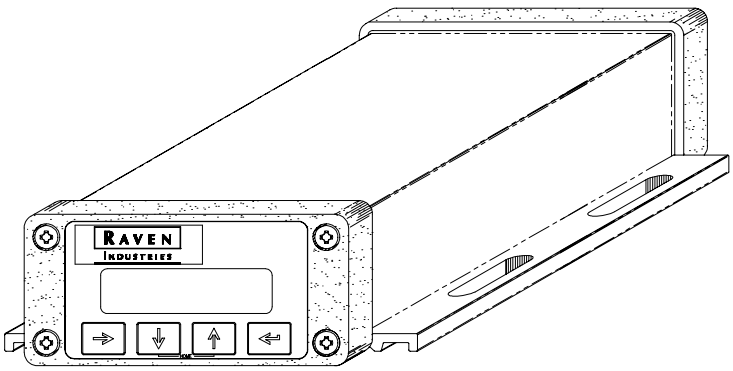
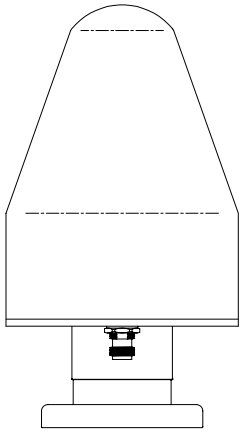
THE Right PRODUCTS PEOPLE CHOICE

RAVEN INDUSTRIES

FLOW CONTROL DIVISION

RPR 310





OPERATION AND SERVICE MANUAL

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APPENDIX

Introduction

Congratulations on selecting the Raven RPR 310 GPS receiver to provide you with highly accurate and reliable GPS navigation and position solutions. GPS/DGPS receiver performance is the key to successful yield mapping and monitoring, swathing, and other precision farming functions. The RPR 310 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 simple.

Functional Description

The Raven RPR 310 gives the user a choice of differential correction services. A sophisticated dual-channel beacon receiver with superior impulse noise performance provides reliable tracking of USCG, Canadian, or IALA beacon signals automatically. Satellite differential correction is also available using the OmniSTAR subscription-based service. This service can be activated on demand. The Raven RPR 310's 10-channel GPS engine completes the process providing quick and stable satellite acquisition.

Software is not required to setup the receiver. However, software is provided for control and monitoring and upgrades are available free via the Internet.

To enhance receiver performance and make installation and use easy, each receiver comes with Raven's MBA-4 antenna. The MBA-4 is a combination GPS/L-band helix antenna and DGPS radiobeacon loop antenna integrated into a single unit. The MBA-4 antenna mounts on a standard 1″-14 thread. Thread adapters are available for adapting to survey poles (5/8″ – 11 thread). Magnetic mounts are also available.

Two bi-directional RS-232 serial interface ports are provided to operate numerous peripheral devices.

Radar Out

The RPR 310 uses a sophisticated Doppler effect of the GPS signal to calculate speed. This information is formatted into a signal identical to those output by radar devices. This "simulated radar" signal can be used to interface to rate monitoring equipment and variable rate applicators that normally use radar.

This feature is standard in the RPR 310 receiver to eliminate the need for radar devices.

PPS Out

The receiver may be configured to output one pulse per second (PPS) instead of the radar signal. The PPS signal is valuable when synchronizing external equipment.

INSTALLATION

POWER

Connect the antenna before powering the receiver. The RPR 310 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 RPR 310 (any grounded equipment will have the same problem).

Connect the red wire from the supplied power cable to the positive (+) power source and the black wire to ground (-) or negative (the green and white wires are not used). 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 RPR 310 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/BEACON ANTENNA

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

LOCATION

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

The GPS can be detuned 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 the GPS signals.

Raven beacon antennas use magnetic sensing technology. The primary advantage of this technology is that no electrical grounding is required.

The antenna is sensitive to magnetic fields, therefore keep it away from any wiring. The wiring will radiate magnetic fields and could interfere with antenna operation. High tension power lines can also interfere with antenna operation.

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 convert DC to 110VAC often produce considerable interference.

MOUNTING

The antenna can be erected on a standard (one inch diameter, 14 thread per inch) marine antenna mount. Magnetic mounts and threaded survey pole adapters are also available.

NOTE:	Do not tighten the antenna on the marine antenna mount by turning on 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 ¾".

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.

OPERATION

INITIAL STARTUP

Both the internal GPS and Beacon receiver must perform a Cold Start the first time the system is powered up. The GPS receiver will search the sky for satellites and download data necessary for operation. The beacon receiver will perform an auto scan using both receiver channels until a DGPS beacon signal is obtained. The L-Band receiver will track OmniStar correction signals. The cold start will take up to 15 minutes but is only required during the initial power up.

Make sure the antenna is connected to the receiver before powering the unit. Connect power to the RPR 310 and verify that the front panel display is illuminated.

Connect the serial cable provided between the RPR 310 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.

ACTIVIATION OF OMNISTAR SERVICE

If using the OmniStar DGPS correction service, refer to the OmniStar card provided with the receiver.

NORMAL OPERATION

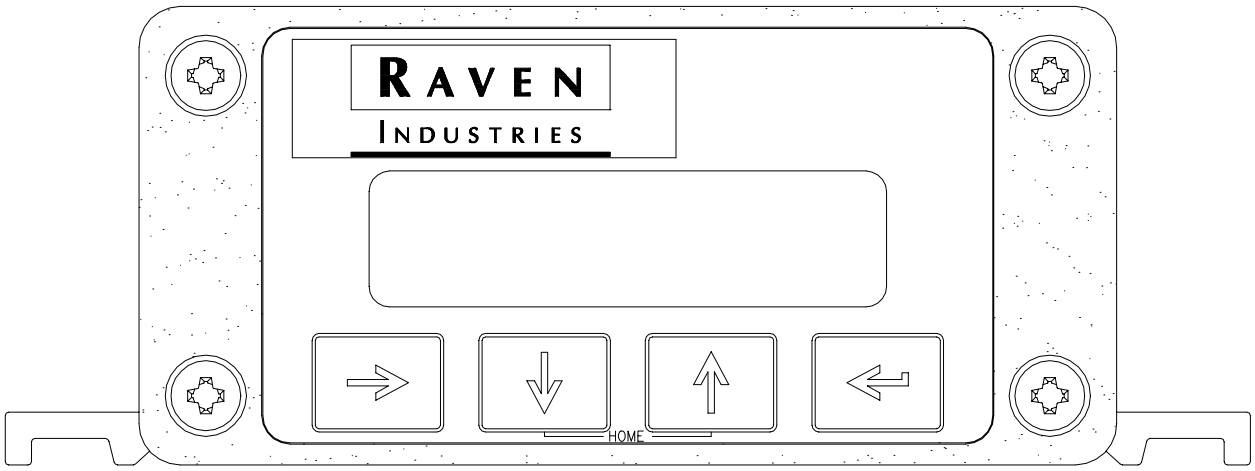
Upon completion of the initial “Cold Start”, the receiver begins to operate in “Normal Mode”. The unit should be operating in full DGPS mode within a few minutes of power on.

All configuration and beacon frequency data is stored in nonvolatile memory inside the RPR 310. Configuration changes are made using the front panel display or the GPS Mon software provided.

Be aware of possible satellite obstructions which may interfere with GPS operation. For high precision performance, watch the Horizontal Dilution of Precision (HDOP), an error estimate, and Beacon Age of Data (AOD). The HDOP should be 2 or less and the AOD less than 15 seconds. Be aware of possible interfering signals to the beacon receiver.

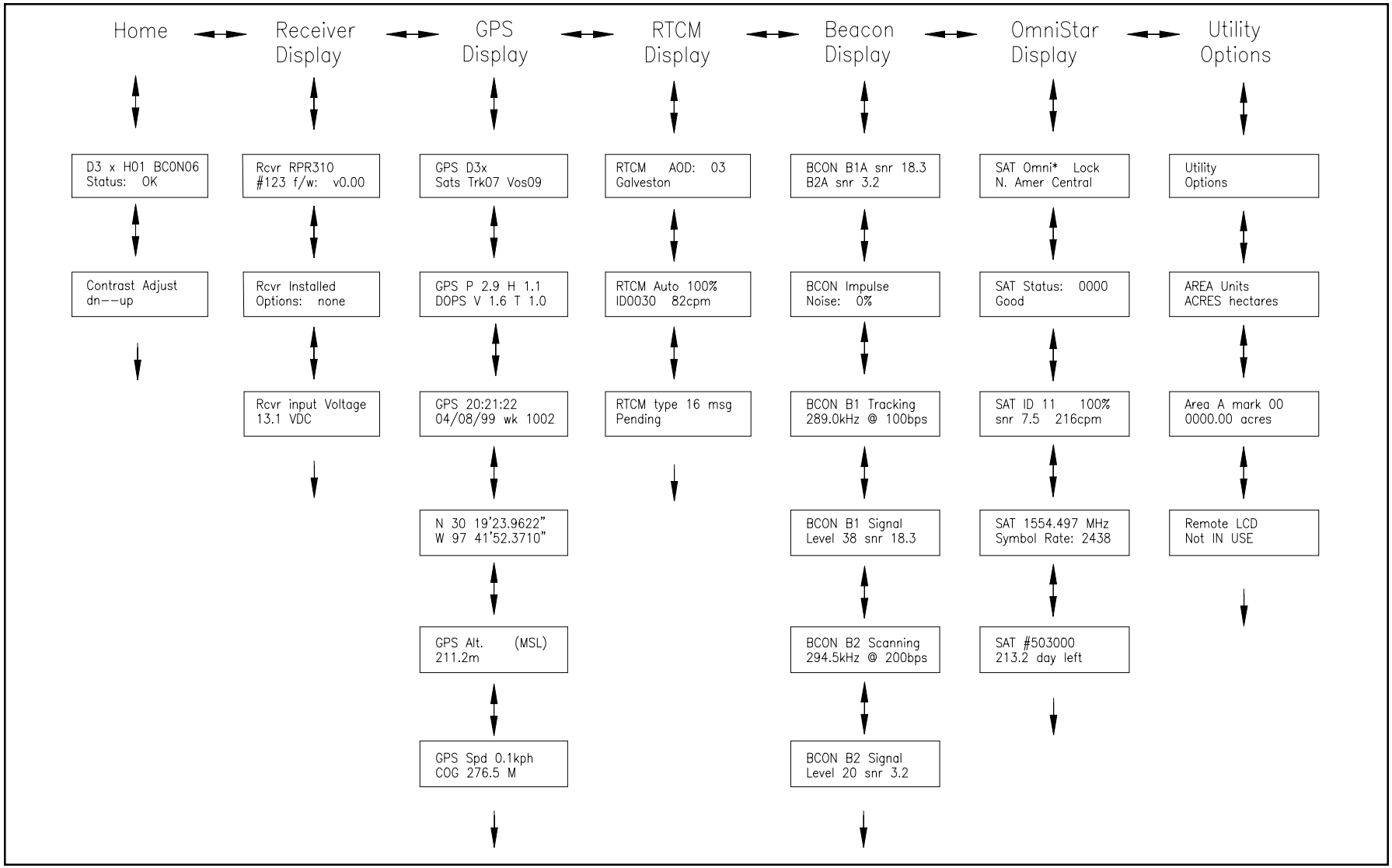
Front Panel Display

Gently peel away the protective film covering the front panel display. The RPR 310 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, activate OmniStar differential service, and observe how the receiver is performing. The keypad arrows are used to navigate thru the display and configuration menus.



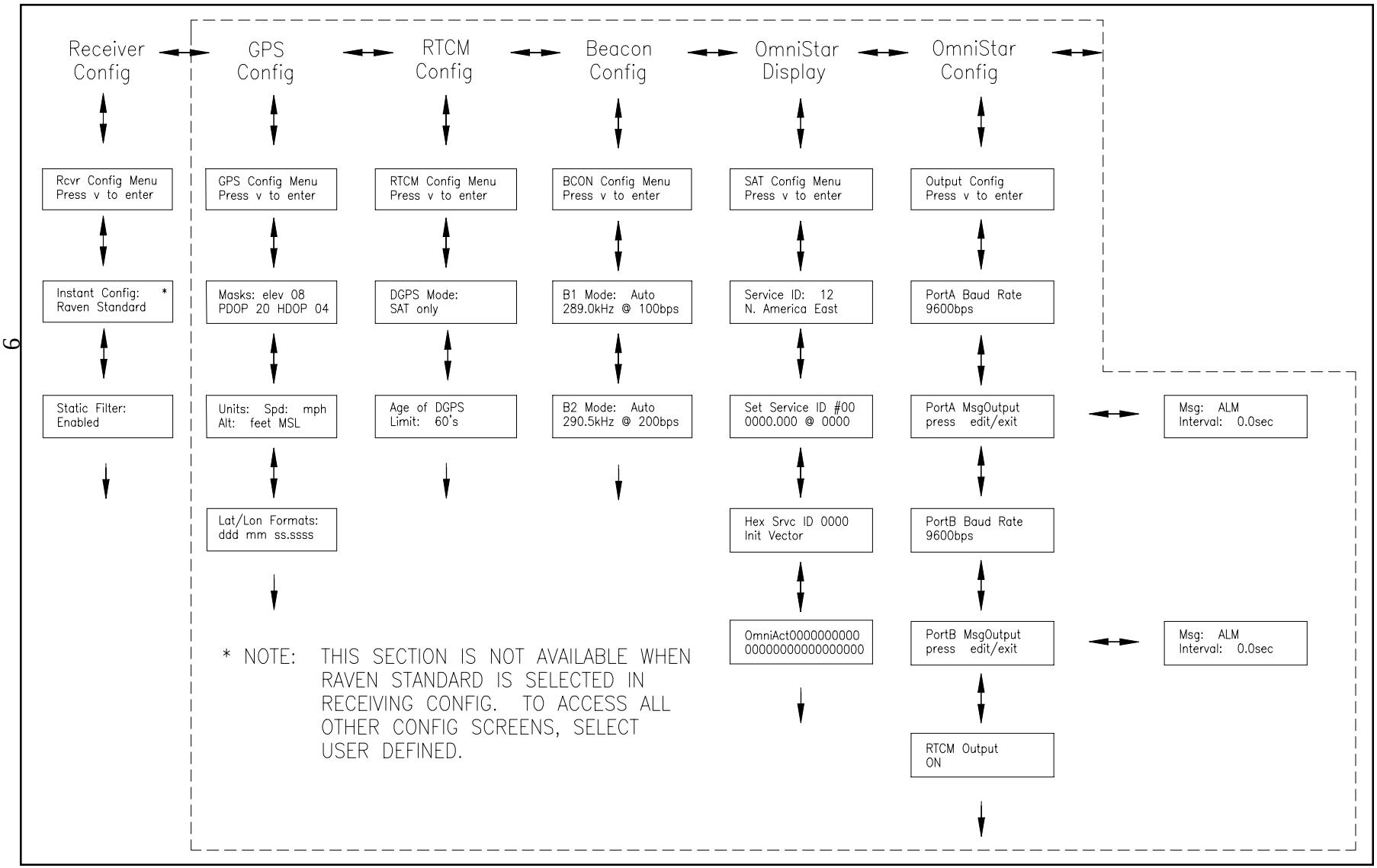
FRONT PANEL DISPLAY MENU

INFORMATION SCREENS



FRONT PANEL DISPLAY MENU

CONFIGURATION/EDITABLE SCREENS



HOME SCREEN

(Recommend using this screen during normal receiver operation.)

Return to the home screen by pressing the [↑] and [↓] arrow keys at the same time.

EXAMPLE:

```
D3X06  H01  BCON06
   Status:   OK
```

SETTING	DESCRIPTION
D or ’’	Displays differential mode. D=Differential Blank=GPS Only
0, 2, or 3	Type of position solution. (None, 2 Dimensional, 3 Dimensional)
06	Number of satellites used in position solution.
H01	Horizontal Dilution of Precision. (HDOP)
BCON 06	Current source of differential corrections with its associated age of data. BCON=Beacon SAT=Satellite
Status	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).

EXAMPLE:

```
Contrast    Adjust
      dn--up
```

Pressing the [↵] key on the home screen moves display to this screen, pressing [↵] again returns to Home Screen. Press [↑] and [↓] arrows to adjust contrast.

RECEIVER DISPLAY

Displays receiver model, serial number, firmware version, receiver options, and receiver input voltage.

EXAMPLE:

```
Rcvr RPR 310
#123 f/w:  v3.12
```

Displays receiver model (310,210), serial number, and firmware version.

EXAMPLE:

```
Rcvr Installed◄┘
Options:  none
```

Pressing [◄┘] will display all options currently installed (Reference station, Ten Hz, Ag utilities-acreage calculation, None).

EXAMPLE:

```
RcvrInputVoltage
 13.1 VDC
```

Pressing [◄┘] will display the input voltage level to the receiver.

GPS Display

Displays differential status, satellites being tracked, DOPS, time and date, position, altitude reference, and speed.

EXAMPLE:

```
GPS    D3x
Sats    Trk07  Vis 09
```

SETTING	DESCRIPTION
D3x	Current position solution (differentially corrected 3D).
Trk07	Number of satellites used in position solution.
Vis09	Number of satellites visible to the receiver.

EXAMPLE:

```
GPS     P 2.9 H 1.1
DOPS  V 1.6 T 1.0
```

Displays PDOP, HDOP, VDOP, and TDOP.
The term DOP (Dilution of Precision) is an estimation of error caused by the varying geometry of satellites used in the position solution.

P=Position
H=Horizontal
V=Vertical
T=Time

EXAMPLE:

```
GPS  20:21:22
04/08/99      wk1002
```

GPS time, date, and GPS week. GPS week began January 1, 1980 and resets on August 22, 1999.

EXAMPLE:

```
N/30/19’23.9622”
W/97/41’52.3710”
```

Position in degrees, minutes, seconds (displayed as fractions of seconds to 4 places of precision).

EXAMPLE:

```
GPS   Alt.      (MSL)
635ft
```

Displays Altitude referenced either to Mean Sea Level (MSL) or to GPS Ellipsoid (ELLIP)and expressed either in feet or meters.

EXAMPLE:

```
GPS   Spd     3.5MPH
COG  276.5  M
```

Displays speed in MPH, KPH, or knots and course over ground in degrees magnetic.

RTCM DISPLAY

Displays Age of Data, number of corrections per minute, and RTCM-Type 16 messages.

EXAMPLE:

```
RTCM          AOD:   03
Galveston
```

Displays the name of the currently selected source of differential corrections and its corresponding age of data. If source in not in the list of Coast Guard beacons or OmniStar beams, 'Unknown' is reported.

EXAMPLE:

```
RTCM  Auto      100%
ID0030          82cpm
```

SETTING	DESCRIPTION
Auto	Displays differential mode (Auto Select, B1 only, B2 only, Ext. only, Sat only, and Off).
100%	Parity pass ratio (PPR). % of data throughput.
ID0030	Corrections per minute.

```
Off      = No differential
B1 only  = Beacon 1
B2 only  = Beacon 2
Sat only = Satelite corrections
           received
Ext only = External corrections
           received
Auto     = Selects Satellite or
           Beacon automatically
           depending on which
           source provides the
           corrections per min
           (cpm).
```

EXAMPLE:

```
RTCM type 16 msg
Pending
```

BEACON DISPLAY

Displays SNR (Signal to Noise Ratio), noise, tracking/scanning, and signal strength.

EXAMPLE:

```
BCON  B1A  snr  18.3
      B2A  snr   3.2
```

Displays the current mode of each beacon channel and the SNR of whatever signal each channel is currently tracking. An SNR reading of 8 or more is required to ensure beacon reception.

EXAMPLE:

```
BCON   Impulse
Noise:  0%
```

Displays impulse noise in the form of % blanking. This is a relative indicator of the quality of the signal being received. The lower the number, the better the signal.

EXAMPLE:

```
BCON  B1  Tracking
289.0kHz  @100bps
```

Status of beacon channel 1 (Tracking or Scanning), which frequency and bit rate is being received.

EXAMPLE:

```
BCON  B1  Signal
Level 38  snr   18.3
```

Displays beacon channel 1 signal level in dB microvolts and SNR. Signal strength between 20 and 80. An SNR reading of 8 or more is required to ensure beacon reception.

EXAMPLE:

```
BCON  B2  Scanning
294.5kHz  @200bps
```

Status of beacon channel 2 (Tracking or Scanning), which frequency and bit rate being received.

EXAMPLE:

```
BCON  B2  Signal
Level  20  snr  3.2
```

Displays beacon channel 2 signal level in dB microvolts and SNR. Signal strength will vary between 20 and 80. An SNR reading of 8 or more is required to ensure beacon reception.

OMNISTAR DISPLAY

(This menu will only appear on the RPR 310 model.)

Displays OmniStar satellite correction data.

EXAMPLE:

```
SAT  Omni*      Lock
N.    Amer  Central
```

Lock indicator (‘Lock’ if locked, ‘ ’ if not) and name of beam being tracked.

EXAMPLE:

```
SAT  Status:  0000
Good
```

The status code is a four digit hexadecimal value characterized by OmniStar status bits. The associated warning is displayed on the second line.

SETTING*	**DESCRIPTION**
8000	Needs update.
0080	Needs time from GPS receiver.
0040	Needs position from GPS receiver.
0020	Needs almanac from broadcast.
0010	Needs site info from broadcast.
0008	Link error.
0004	Subscription not valid for maritime use.
0002	Position is not in service area.
0001	Subscription expired/not activated.

EXAMPLE:

```
SAT  ID  11      100%
Snr  7.5       216cpm
```

SETTING*	**DESCRIPTION**
ID	Station ID for service being tracked.
PPR	Pass parity ratio.
SNR	Signal to noise ratio. An SNR reading of 5 or more is required to ensure OmniStar reception.
CPM	Number of differential corrections per minute being received.

EXAMPLE:

```
SAT       1554.497MHz
SymbolRate:    2438
```

Displays frequency and symbol rate of currently tracked beam.

EXAMPLE:

```
SAT       #503000
213.2 days  left
```

Displays OmniStar serial number and number of days remaining until the user’s subscription expires.

UTILITY OPTIONS

EXAMPLE:

Utility
Options

Will only appear if a Utility option is installed.

EXAMPLE:

AREA Units
ACRES Hectares

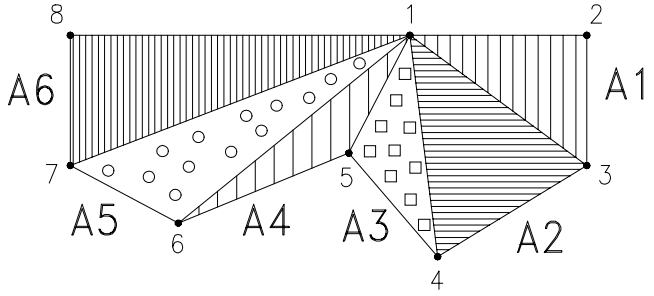
Press the [↵] to select units displayed in Acreage Calculation. The selected units are displayed in all capital letters.

EXAMPLE:

Area A Mark
0000.00 acres

Acreage calculation. Press [↵] to highlight 'A' and use [↑] and [↓] to choose an area (A-E). Press [→] to view a previously calculated area or press [↵] to select an area and begin marking boundary points. The 'mark' field '00' will be blinking in the display. Press [↵] to mark a point (as many as 99). Press [→] to end the calculation and save its value.

EXAMPLE:
Area A



A1 = Points 1, 2, 3 = 1st area calculated
A2 = Points 1, 3, 4 = 2nd area calculated
A3 = Points 1, 4, 5 = 3rd area calculated
A4 = Points 1, 5, 6 = 4th area calculated
A5 = Points 1, 6, 7 = 5th area calculated
A6 = Points 1, 7, 8 = 6th area calculated

(99 Points possible) Sum = total acreage calculation for Area A

Repeat procedure for Area B, C, D etc.

EXAMPLE:

```
Remote LCD
NOT IN USE
```

Press [↵] to configure Port B for use with a remote front panel. Port B is set to 38400 baud. All NMEA and RTCM is disabled.

RECEIVER CONFIGURATION MENU

Use the enter key [↵] to highlight desired selection, the value will blink. Use the [↑] and [↓] arrow keys to change the value and the enter key [↵] when complete.

EXAMPLE:

```
Rcvr  Config  Menu
Press  v  to  enter
```

Press the [↓] arrow key to enter.

EXAMPLE:

```
Instant   Config:
RAVEN  Standard
```

Use the enter key [↵] to highlight desired selection, the value will blink. Use the [↑] and [↓] arrow keys to change the value and the enter key [↵] when complete.

AVAILABLE OPTIONS	**DESCRIPTION**
RAVEN Standard	Port A : 9600 baud, GGA, VTG, GSA, ZDA at 1Hz Port B : 19200 baud, GGA, VTG at 10Hz Elevation mask is 5 and AOD limit is 30s Diff Mode is Auto Select
Config 4	Port A : 9600 baud, GGA, VTG, GSA, ZDA at 1Hz Port B : 4800 baud, GGA, VTG, GSA, ZDA at 1Hz Elevation mask is 5 and AOD limit is 30s Diff Mode is Auto Select.
Config 3	Port A : 19200 baud, GGA, VTG at 10Hz Port B : 9600 baud, GGA, VTG at 10 Hz Elevation mask is 5 and AOD limit is 30s Diff Mode is Auto Select.
Config 2	Port A : 9600 baud, GGA at 10Hz Port B : 9600 baud, GGA at 10Hz Elevation mask is 5 and AOD limit is 30s Diff Mode is Auto Select.
Config 1	Port A : 9600 baud, GGA at 1Hz Port B : 9600 baud, GGA at 1Hz
User Defined	

EXAMPLE:

```
Static Filter:
Enabled
```

If Static Filter is enabled, the receiver utilizes a position averaging algorithm suitable for static positioning determination. If Static Filter is disabled, GPS filtering is kept to a minimum.

GPS CONFIGURATION MENU

EXAMPLE:

```
GPS  Config  Menu
press  v  to  enter
```

Press the [↓] arrow key to enter.

EXAMPLE:

```
Masks:  elev  08
PDOP  20  HDOP 04
```

Use the enter key [↵] to highlight desired selection, the value will blink. Use the [↑] and [↓] arrow keys to change the value and the enter key [↵] when complete. The elevation mask angle should always be set to 5 degrees or more. Dilution of Precision (DOP) settings are user-preference.

EXAMPLE:

```
Units:  Spd:  mph
Alt:  feet  MSL
```

EXAMPLE:

```
Lat/Lon  Formats:
Ddd  mm  ss.ssss
```

Use the enter key [↵] to select **ddd mm ss.ssss** (degrees, minutes, seconds, and fractions of seconds) or **ddd mm.mmmmm** (degrees, minutes, and fractions of minutes).

RTCM CONFIG MENU

EXAMPLE:

```
RTCM  Config  Menu
Press  v  to  enter
```

Press the [↓] arrow key to enter.

EXAMPLE:

```
DGPS  Mode:
Sat  only
```

Set DGPS by pressing the enter key [↵]. Use [↑] and [↓] arrow keys to select option. Press enter key [↵] when done.

```
Off          = No differential
B1 only      = Beacon 1
B2 only      = Beacon 2
Sat only     = Satellite correction received
Ext only     = External corrections received
Auto         = Selects Satellite or Beacon
               automatically depending on
               which source provides the most
               corrections per minute (cpm)
```

EXAMPLE:

```
Age of DGPS
Limit:  60's
```

Set Age of Data limit by pressing the enter key [↵]. Use [↑] and [↓] arrow keys to select option. Press enter key [↵] when done.

BEACON CONFIGURATION MENU

EXAMPLE:

```
BCON Config Menu
press  v  to  enter
```

Press the [↓] arrow key to enter

EXAMPLE:

```
B1  Mode:  Auto
289.0kHz  @100bps
```

Set Channel 1 Beacon mode. Options include Auto, Fixed, and Idle. Fixed mode sets the frequency and baud rate of Beacon channel. Press the enter key [↵] to highlight option, the [↑] and [↓] arrow keys to select option, the [→] arrow key to select parameters, [↑] and [↓] arrow keys to set value, press the enter key [↵] when complete.

EXAMPLE:

```
B2  Mode:  Auto
290.5kHz  @200bps
```

Set Channel 2 Beacon mode. Options include Auto, Fixed, and Idle. Fixed mode sets the frequency and baud rate of Beacon channel. Press the enter key [↵] to highlight option, the [↑] and [↓] arrow keys to select option, the [→] arrow key to select parameters, [↑] and [↓] arrow keys to set value, press the enter key [↵] when complete.

OMNISTAR CONFIGURATION MENU

EXAMPLE:

```
Sat  Config  Menu
press  v  to  enter
```

Press the [↓] arrow key to enter.

EXAMPLE:

```
Service  ID:   12
N. America  East
```

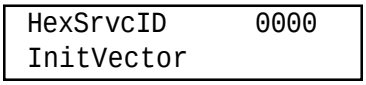
Select Service option. Press the enter key [↵] to highlight option, the [↑] and [↓] arrow keys to select option, and press the enter key [↵] when complete.

EXAMPLE:

```
SetService  ID  #00
0000.000  @  0000
```

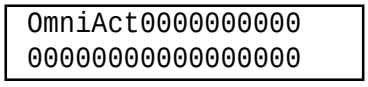
This screen is used to insert a frequency and symbol rate supplied by OmniStar for service ID#00. The frequency and symbol rate are just two of four parameters required. The next screen (User Defined Hexadecimal Service ID) must also be accessed. The settings will be saved to enable the user to select the user defined ID#00 from the list of services available on the Service ID selection screen above.

EXAMPLE:



This screen is used to insert a hexadecimal service ID# and initialization vector supplied by OmniStar for service ID#00. The hexadecimal service ID# and initialization vector are just two of four parameters required. The previous screen (User Defined Service ID) must also be accessed. The settings will be saved to enable the user to select the user defined ID#00 from the list of services available on the Service ID selection screen above.

EXAMPLE:



In lieu of the Service ID screen, users may enter a 24-digit activation code provided by OmniStar for the purpose of activating or extending a service subscription. This option is not normally used.

OUTPUT CONFIGURATION MENU

EXAMPLE:

```
Output  Config
press  v  to  enter
```

Press the [↓] arrow key to enter.

EXAMPLE:

```
PortA  Baud  Rate
9600bps
```

Select Baud Rate. Press the enter key [↵] to highlight option, the [↑] and [↓] arrow keys to select option, and press the enter key [↵] when complete.

EXAMPLE:

```
Port  A  MsgOutput
press  →  edit/exit
```

```
Msg:   ALM
Interval:   0.0sec
```

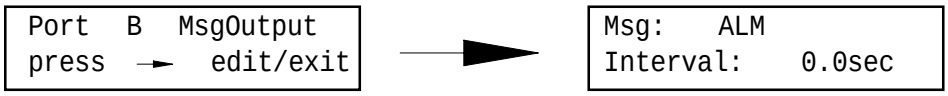
Used to select output message types and reporting interval. Press the [↑] and [↓] arrow keys to select MSG type, press the enter key [↵] to highlight selection, press [↑] and [↓] arrow keys to set interval, press the enter key [↵] when complete.

EXAMPLE:

```
PortB Baud Rate
9600bps
```

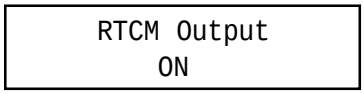
Select Baud Rate. Press the enter key [↵] to highlight option, the [↑] and [↓] arrow keys to select option, and press the enter [↵] key when complete.

EXAMPLE:



Used to select output message types and reporting interval. Press the [↑] and [↓] arrow keys to select MSG type, press the enter key [↵] to highlight selection, press the [↑] and [↓] arrow keys to set interval, and press the enter key [↵] when complete. Port B messages can only be set if RTCM output (next screen) is set to OFF.

EXAMPLE:



Turns differential corrections (RTCM) that are available as an output on Port B, either ON or OFF. Press the enter key [↵] to highlight selection, [↓] arrow key to set value, and press the enter key [↵] when complete. If RTCM output is set to ON, NMEA messages at Port B will be unavailable.

TROUBLESHOOTING

*Make certain 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 (including cables)
- Power
- Transmitting Site
- Serial Communications
  a. Receiver
  b. Peripheral device

CHECKING THE INSTALLATION

Monitor the effects on the beacon and 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 change. 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” indicating good differential reception.

Antenna - Check 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 - Front panel display remains lit while power is applied.

Transmitting - If the receiver is operating in Beacon Mode, you may be out of range of a Site beacon, or the beacon may be off air. Beacon status information is available on the internet at www.navcen.uscg.mil.

Serial Coms - Using GPS Mon 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 “Rear Panel Serial Interface”.

RECEIVER SPECIFICATIONS

Position Accuracy	<1.0 meters rms	**Operating Temperature**	-40 C to +50 C
Timing Accuracy	N/A	**Standard**	10 solutions per sec
Number of Channels	10 GPS, 2 Beacon	**Maximum Velocity**	10000 Knots
Frequency Range:	283.5-3250.0 kHz	**Relative Humidity**	95% non-condensing
Tuning Resolution:	< 1 Hz	**Altitude**	60,000 Feet
Minimum Signal Strength	5 uV @ 100bps	**Dimensions**	8.3″L x5.7″W x 2.1″H
Dynamic Range	> 100dB	**Weight**	20 ounces
Adjacent Channel Rejection	50 dB at 1 KHz.	**Antenna Weight**	<1.3 pounds
Cold Start	6 min. typical, 15 min. max	**Antenna Diameter**	7.5 inches
Warm Start	40 seconds	**Antenna Diameter**	4.5 inches
Reacquisition	1 second	**Input Voltage**	11 – 32 VDC
Acceleration	2G	**Power Consumption**	<10 Watts @ 12VDC
Connectors / Ports	2 RS-232 VO	**Current**	540 mA @ 12VDC

Antenna

The ANT connector is used for interfacing between the RPR 310 and its Antenna/ Preamplifier assembly.

PIN	**DESCRIPTION**
Center	RF Input and +8 VDC Output for Antenna Preamplifier
Shield	Signal Ground

CONFIGURATION

Rear Panel Serial Interface

The RPR 310 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 RPR 310 and the navigation equipment.

Port A

Port A	Signal Name
1	Port “A” TX
2	Port “A” RX
3	GND
4	
5	Port “B” TX
6	EXT. PWR
7	GND

Port B

Port B	Signal Name
1	Port “B” TX
2	Port “B” RX
3	GND
4	RAD/PPS
5	
6	EXT. PWR
7	GND

POWER CONNECTOR

The RPR 310 is designed to operate between 11 and 32 volts DC. 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 Volt DC Power Input	RED
2	Not Used	GREEN
3	Power Return (GND)	Black
4	Not Used	White

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 take 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.

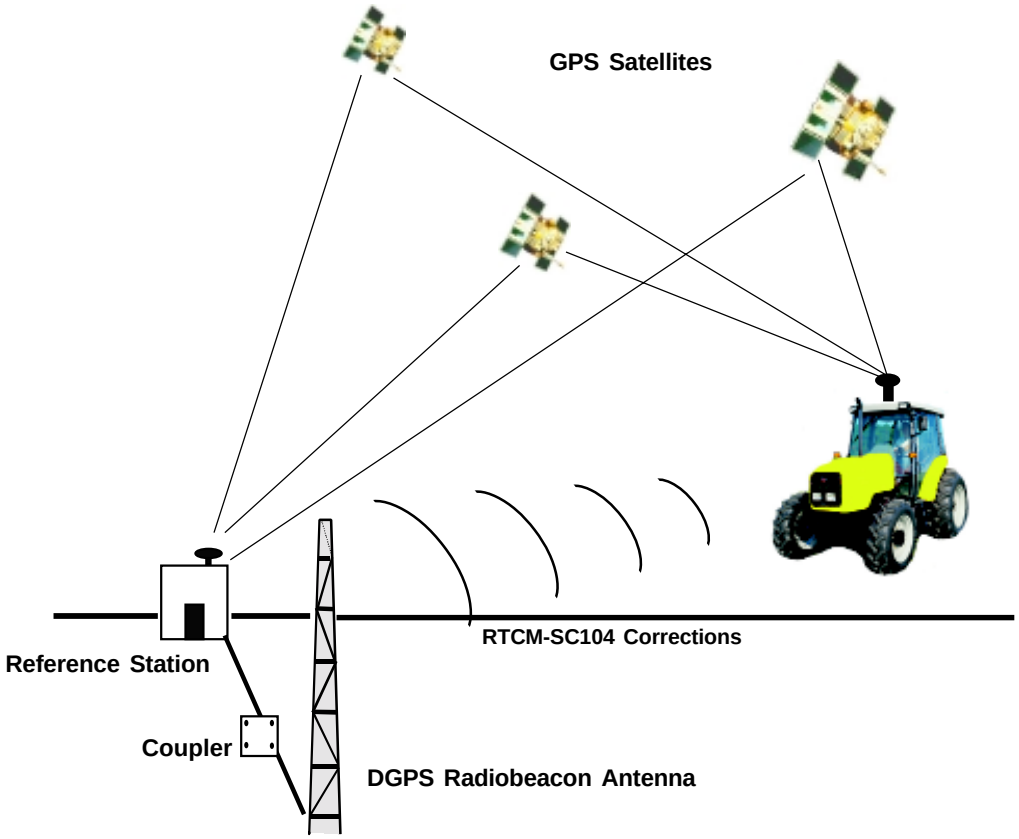
Position accuracy depends on the receiver's ability to accurately calculate the time it takes for each satellite signal to travel to earth. This is where the problem lies. There are primarily four sources of errors which can affect the receiver's calculation. These errors consist of:

1. Ionosphere and troposphere delays on the radio signal.
2. Signal multi-path.
3. Receiver clock biases.
4. Orbital satellite (ephemeris) position errors.

DIFFERENTIAL GPS (DGPS) BEACON

DGPS works by placing a high-performance GPS receiver (reference station) at a known location. Since the exact location of the receiver is known, it can determine the errors in the satellite signals. This is done 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 user. The correction message format follows the standard established by the Radio Technical Commission of 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. Sophisticated receivers like the Raven RPR 310 can achieve accuracy on the order of 1 meter or less.

DIFFERENTIAL GPS BROADCAST SITE



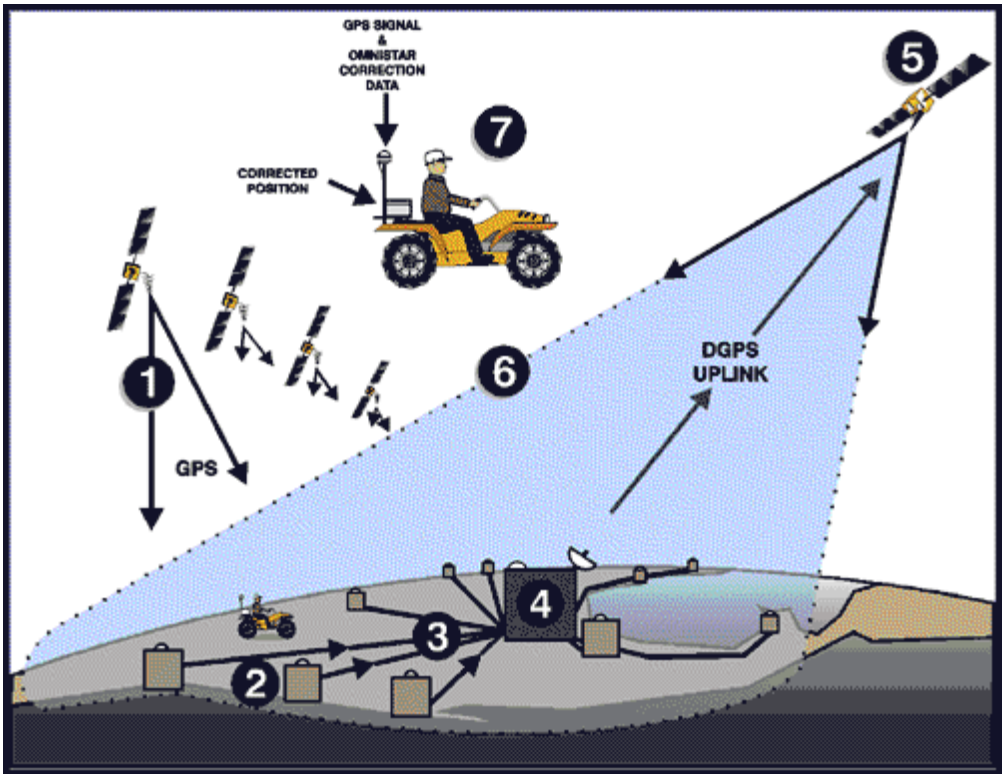
DGPS OMNISTAR

OmniStar, Inc. 8200 Westglen, Houston, TX 77063. Toll-free 1-888-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 TRCM corrections are decoded, checked, and repackaged in a highly efficient format for broadcast. The data are then upconverted for transmission to communication satellites which broadcast over wide geographical areas. Communication links with each reference site include a dial-up line to serve as backup to leased lines and 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 RPR 310 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 RPR 310 GPS receiver for maximum accuracy.

How it works...



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

NMEA MESSAGES

The RPR 310 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 RPR 310 receiver used to communicate with other devices.

RPR 310 NMEA MESSAGES

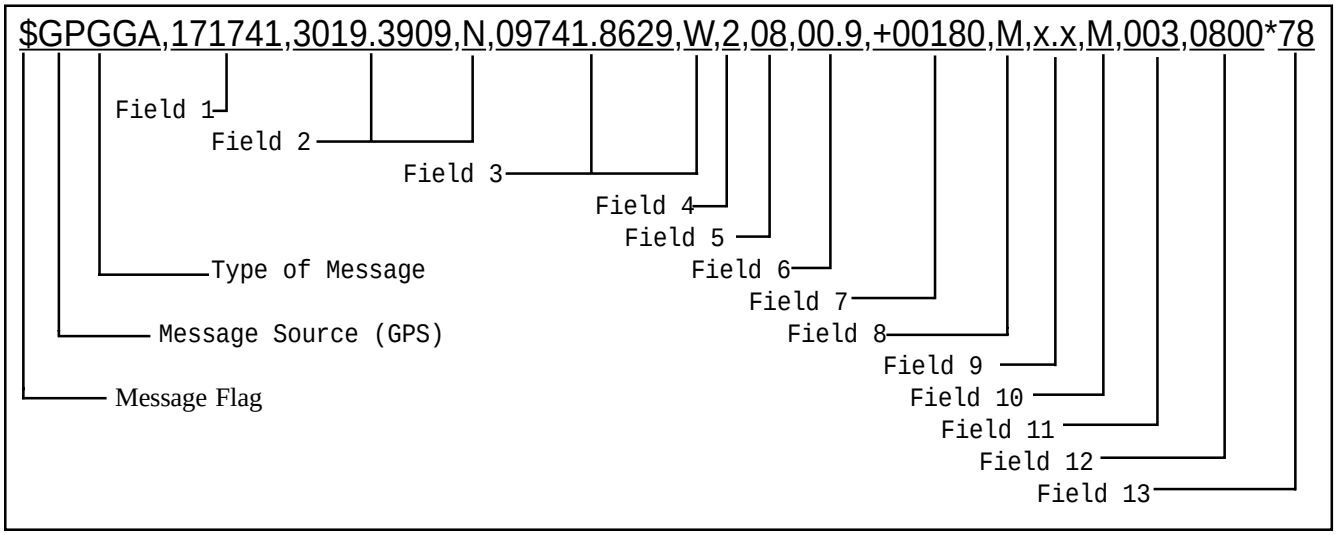
ALM	GPS Almanac Data
DTM	Daturn Reference
GGA	Global Positioning System Fix Data
GLL	Geographic Position
GRS	GPS Range Residuals
GSA	GPS Dillution of Precision (DOP) and Active Satellites
GST	GPS Pseudorange Noise Statistics
GSV	GPS Satellites in View
MSK	MSK Receiver Interface
MSS	MSK Signal Status
RMC	Recommended Minimum specific GPS/Transit Data
VTG	Course Over Ground and Ground Speed
ZDA	Time and Date

Raven Proprietary NMEA Messages

SLIB1S	Beacon Receiver Channel 1 Status
SLIB2S	Beacon Receiver Channel 2 Status
SLIDIF	DGPS Status Information
SLIE1S	External RTCM Channel 1 Status
SLIRTC	RTCM Message Data Received
SLISDA	Satellite Age of Data
SLISOL	Position Solution
SLIWRN	Receiver Warning Message

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
1	Universal time coordinate (UTC) of Position	9	Geoidal Separation
2	Latitude, North or South	10	Units of Geoidal Separation, Meters
3	Longitude, East or West	11	Age of Differential Data
4	GPS Quality Indicator	12	Reference Station ID
5	Number of Satellites in Use	13	Check Sum

NOTES

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.

Manual Rev. B, RPR 310
11/00 016-0159-798