

RAVEN



INVICTA 210/310



OPERATION AND SERVICE MANUAL

GENERAL REMARKS:

- 1) Character positions in screen shots often do not reflect actual displays.
- 2) Key symbols (e.g. [↓] should be consistently rendered.

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Introduction

Congratulations on selecting the Raven Invicta 210/310 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 Invicta 210/310 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 Invicta 210/310 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 (Invicta 210/310). Satellite differential correction is also available using WAAS DGPS corrections (Invicta 210/310), or using the OmniSTAR subscription-based service (Invicta 310 only). This service can be activated on demand. The Raven Invicta 210/310's 10-channel GPS engine completes the process providing quick and stable satellite acquisition.

Software is not required to set up 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 antenna. The MBA-2 is a GPS patch and DGPS radiobeacon loop antenna (Invicta 210) integrated into a single unit. The MBA-4 is a combination GPS/L-band helix antenna and DGPS radiobeacon loop antenna (Invicta 310) integrated into a single unit. Both antennas mount 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 Invicta 210/310 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. To use this feature, you will need a special cable from Raven.

This feature is standard in the Invicta 210/310 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 Invicta 210/310 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 Invicta 210/310 (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 Invicta 210/310 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 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 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, so it should be kept 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 threads per inch) marine antenna mount. Magnetic mounts and threaded survey pole adapters are also available.

<p>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 $\frac{3}{4}$".</p>
--

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 Invicta 310 and verify that the front panel display is illuminated.

Connect the serial cable provided between the Invicta 210/310 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.

ACTIVATION OF OMNISTAR SERVICE *(Invicta 310 only)*

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

NORMAL OPERATION

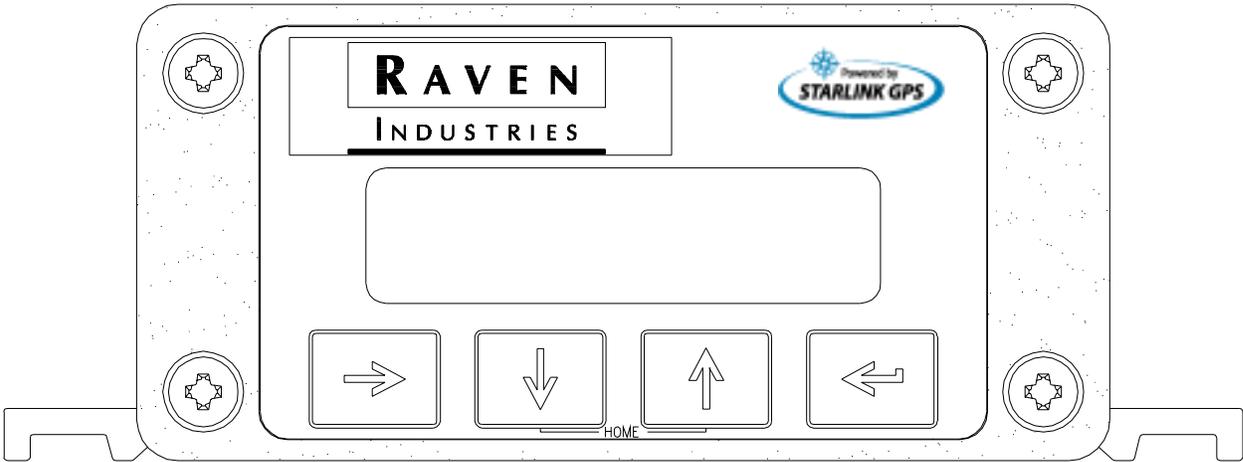
Upon completion of the initial “Cold Start”, the receiver begins to operate in “Normal Mode”. The unit should be operating in full DGPS mode within a few minutes of power on.

All configuration and beacon frequency data is stored in nonvolatile memory inside the Invicta 210/310. Configuration changes are made using the front panel display, the GPSSMON software provided, or with a terminal program.

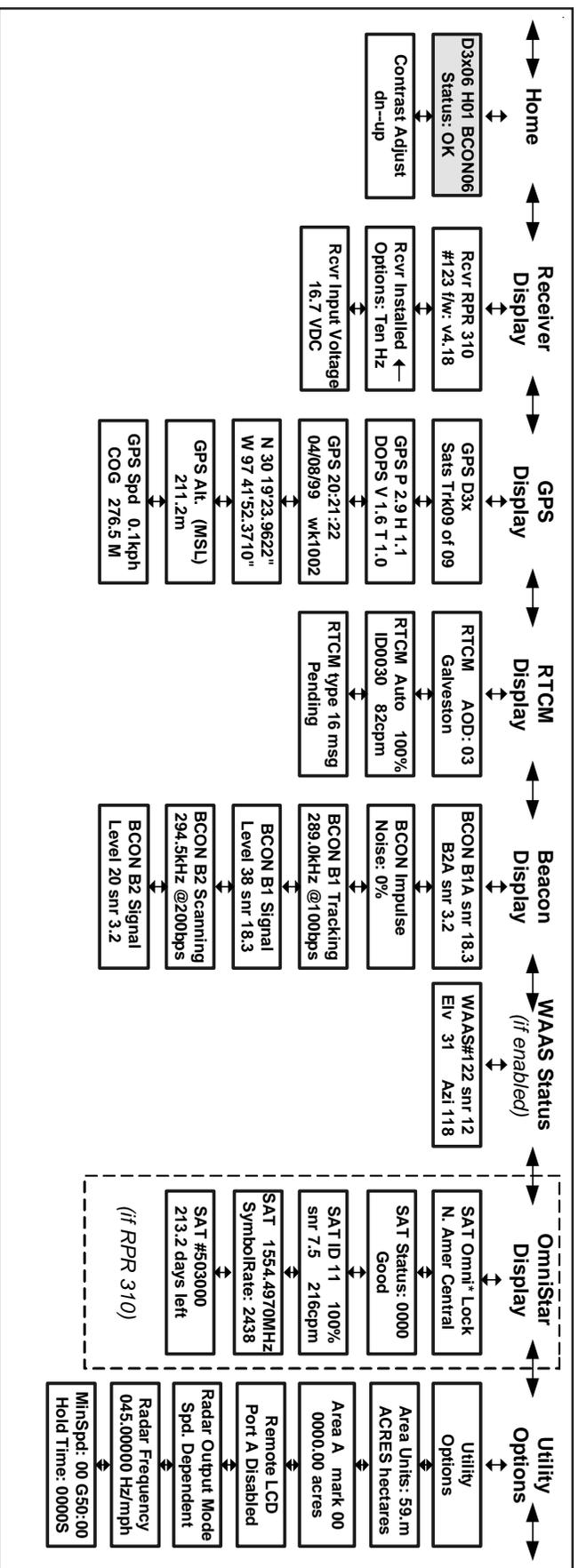
Be aware of possible satellite obstructions which may interfere with GPS operation. Also be aware of possible interfering signals to the beacon receiver. For high precision performance, watch the Horizontal Dilution of Precision (HDOP), which is an error estimate, and Beacon Age of Data (AOD). The HDOP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

Front Panel Display

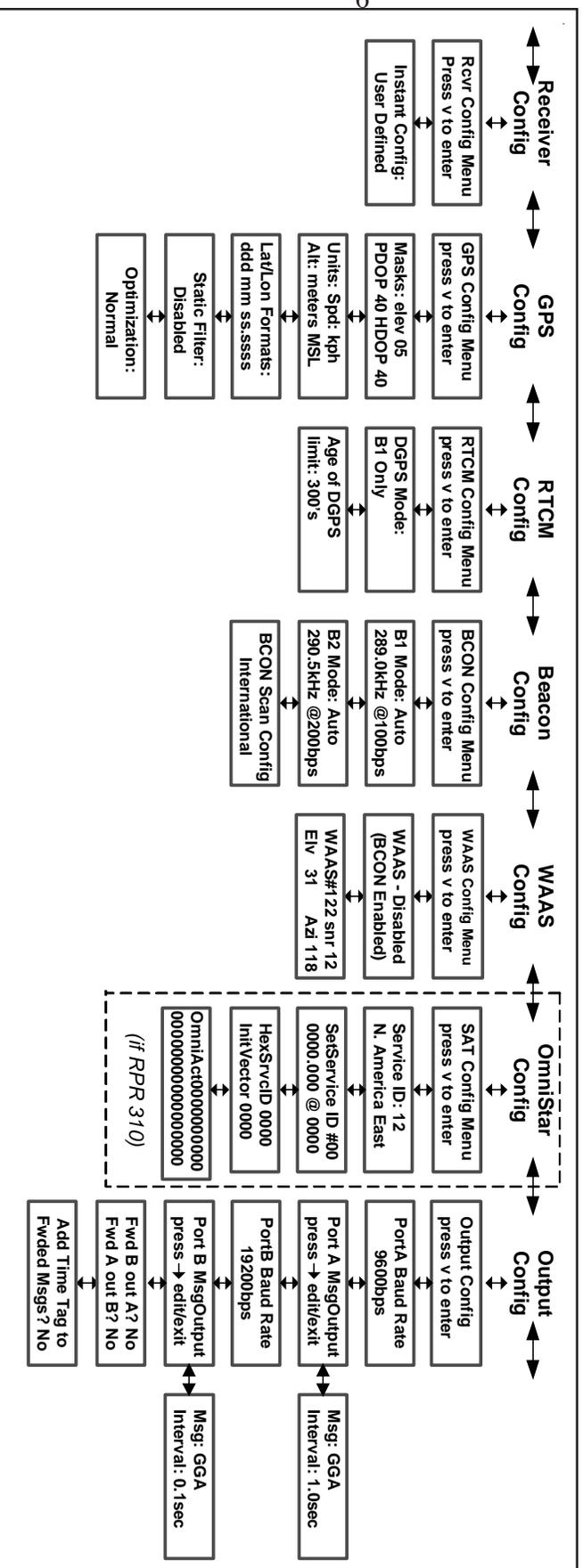
Gently peel away the protective film covering the front panel display. The Invicta 210/310 receiver is configured at the factory to operate in automatic mode. This allows the receiver to begin operation immediately following initial installation. The front panel display allows the user to reconfigure the receiver, activate OmniStar differential service, and observe how the receiver is performing. The keypad arrows are used to navigate through 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 WAAS = WAAS
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 [↑] or [↓] keys 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: v4.18
```

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).

GPS Display

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

EXAMPLE:

GPS	D3x
Sats	Trk07 of 09

SETTING	DESCRIPTION
D3x	Current position solution (differentially corrected 3D).
Trk07	Number of satellites used in position solution.
of 09	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 or true.

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 is not in the list of Coast Guard beacons or OmniStar beams, 'Unknown' is reported.



EXAMPLE:

RTCM Auto 100%
ID0030 82cpm

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



Off	= No differential
B1 only	= Beacon 1
B2 only	= Beacon 2
Sat only	= Satellite corrections received (Invicta 310)
Ext only	= External corrections received
Auto	= Selects Satellite or Beacon automatically depending on which source provides the greater corrections per min (cpm).
WAAS	= Uses WAAS Satellite Corrections



EXAMPLE:

RTCM type 16 msg
Pending

NOTE: Display of RTCM type 16 message is not yet implemented

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 signal tracked. 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 less the interference.



EXAMPLE:

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

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



EXAMPLE:

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

Displays beacon channel 1 signal level in dB microvolts and SNR in dB. Signal strength will vary 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 are being received.



EXAMPLE:

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

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

WAAS DISPLAY

EXAMPLE:

```
WAAS #122 snr 12
Elv 31 Azi 118
```

Displays WAAS PRN #, SNR (signal to noise ratio), ELV (elevation in degrees), and Azi (azimuth in degrees East of North).

OMNISTAR DISPLAY

(This menu will only appear on the Invicta 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 status 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.
0000	Good.



EXAMPLE:

SAT ID 11	100%
snr 7.5	216cpm

SETTING	DESCRIPTION
SAT ID	Station ID for service being tracked.
PPR	Pass parity ratio (100% in example).
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	1554.4970MHz
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



EXAMPLE:

AREA Units: sq.m
ACRES hectares

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



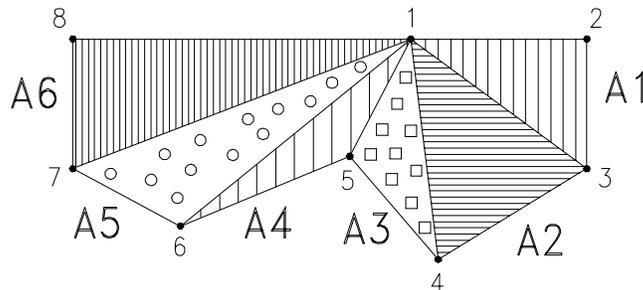
EXAMPLE:

Area A mark 0 0
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.

REMOTE LCD



EXAMPLE:

Remote LCD
"Port B Disabled"

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

RADAR OUTPUT MODE



EXAMPLE:

Radar Output Mode
Spd. Dependent

Press [←] to select the Radar Output operating mode.

Radar Output Operating Mode	Description
Spd. Dependent	Radar output frequency depends on speed. The faster the antenna moves, the higher the output frequency.
Constant Freq.	The receiver outputs a constant frequency set by the user.
OFF	No output on the radar pin.



EXAMPLE:

Radar Frequency
045.00000 Hz/mph

Press [←] to change the Radar Frequency. The leftmost digit of the frequency will begin to blink. Use the [↑] and [↓] arrow keys to change the digit, then use the [→] key to select the next digit. Press the enter key [↵] when frequency entry is complete.

Radar Output Operating Mode	Description
Spd. Dependent	<p>Example: 045.00000 Hz/mph</p> <p>Every mile per hour of speed translates to 45 Hz output on the radar pin. So in this example, 10 mph = 450 Hz.</p> <p>Default is 45 Hz/mph.</p>
Constant Freq.	<p>Example: 001.00000 Hz</p> <p>Default is 0 Hz.</p>
OFF	000.00000 OFF



EXAMPLE:

MinSpd: 02 GSO:08
Hold Time: 0005s

Press [←] to begin data entry. The MinSpd value field will begin to blink. The [→] key may be used to move the GSO and Hold Time value fields. When the desired field has been selected, use the [↑] and [↓] arrow keys to change the value, then press the enter key [↵] when entry is complete.

Radar Output Operating Mode	Description
MinSpd (Minimum Speed Cutoff)	This sets the minimum speed (in mph) below which radar output shuts off.
GSO (Ground Speed Override)	This sets the speed (in mph) below which the radar output is fixed. For example, if GSO is set to 5, then at speeds below 5 mph, radar output is fixed at 5 mph times the radar frequency (so at 45 Hz/mph, radar output is 225 Hz).
Hold Time	This sets the number of seconds the receiver will continue to use the last valid radar output in the event that navigation is lost.

For example, with MinSpd set to 2 mph, GSO set to 8 mph, and Hold Time set to 5 seconds:

- ◆ Radar output will begin when the receiver's speed reaches 2 mph (MinSpd).
- ◆ Radar output frequency will be as if the receiver's speed were 8 mph (GSO) until the receiver's speed exceeds 8 mph, at which time the radar output will correspond directly to the receiver's speed.
- ◆ If the receiver loses navigation while its speed is (for example) 10 mph, the radar frequency corresponding to 10 mph will continue to be output for 5 seconds (Hold Time). If normal navigation has not resumed within 5 seconds, the radar output will shut off until navigation does resume.

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: 19200 baud, GGA, VTG, GSA, ZDA at 1Hz Port B: 19200 baud, GGA, VTG at 10Hz Elevation mask is 5 and AOD limit is 300s DGPS Mode is B1 unless WAAS is being used.
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 300s DGPS Mode is B1 unless WAAS is being used.
Config 3	Port A: 19200 baud, GGA, VTG at 10Hz Port B: 9600 baud, GGA, VTG at 10Hz Elevation mask is 5 and AOD limit is 300s DGPS Mode is B1 unless WAAS is being used.
Config 2	Port A: 9600 baud, GGA at 10Hz Port B: 9600 baud, GGA at 10Hz Elevation mask is 5 and AOD limit is 300s DGPS Mode is B1 unless WAAS is being used.
Config 1	Port A: 9600 baud, GGA at 1Hz Port B: 9600 baud, GGA at 1Hz Elevation mask is 5 and AOD limit is 300s DGPS Mode is B1 unless WAAS is being used.
User Defined	See following Configuration menus.

When options other than “User Defined” are selected, all of the following configuration menus will be inaccessible. In order to access the additional configuration menus, the user must select the “User Defined” option.

If any receiver configuration settings are changed via serial communication with a personal computer, the Instant Config selection will revert automatically to “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

Press [←] to begin data entry. The “elev” value field will begin to blink. The [→] key may be used to move to the PDOP (Position Dilution of Precision) and HDOP (Horizontal Dilution of Precision) value fields. When the desired field has been selected, use the [↑] and [↓] arrow keys to change the value, then press the enter key [↵] when entry is complete.

NOTE: The elevation mask angle should always be set to 5 degrees or more. The PDOP and HDOP settings are user-preference.



EXAMPLE:

Units: Spd: mph
Alt: feet MSL

Press [←] to begin data entry. The “Spd” units field will begin to blink. The [→] key may be used to move the Alt (altitude units) and Altitude reference fields. When the desired field has been selected, use the [↑] and [↓] arrow keys to change the value, then press the enter key [↵] when entry is complete.

Units	Description
Spd	Speed units: mph (miles per hour) kph (kilometers per hour), or knots
Alt	Altitude units: feet or meters Altitude reference: MSL (mean seal level, or geoid) or GPS ellipsoid



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).



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.



Optimization
Normal

Optimization: The user can optimize the receiver's performance for specific applications by changing the code-carrier combining filter time constant, or CCT.

Optimization (CCT) Selection	Description
Absolute (1-second filter)	"Absolute" accuracy determines the overall uncertainty of a position measurement. The receiver's code-carrier filter is adjusted to provide its best estimate of the antenna's actual position. Select "Absolute" when precise positioning is desired (for example, exact location for ship pilots).
Normal (500-second filter)	"Normal" accuracy adjusts the receiver's filter such that it places more confidence in the actual position and will determine its confidence in the next measurement accordingly. Select "Normal" for standard operation. This is the factory default and is recommended for most applications.
Relative (999-second filter)	"Relative" accuracy adjusts the receiver's filter such that it places more confidence in the last good measurement and will determine its confidence in the next measurement accordingly. Select "Relative" when swathing, as it increases accuracy from swath to swath.

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

RTCM CONFIG MENU

EXAMPLE:

RTCM Config Menu
Press v to enter

Press the [↓] arrow key to enter.



EXAMPLE:

DGPS Mode:
Sat only

DGPS Mode selects the type of differential corrections to be applied.

DGPS Selection	Description
OFF	Do not use differential corrections.
WAAS only	Use WAAS corrections.
Sat only	Use Omnistar satellite corrections (Invicta 310 only).
Ext only	Use externally-supplied corrections (via serial Port A or B).
B2	Use Beacon 2.
B1	Use Beacon 1.
Auto Select	Use differential correction source that supplies the most corrections per minute (cpm).

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



EXAMPLE:

Age of DGPS
Limit: 300s

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

AOD (age of data) sets the maximum age of DGPS corrections acceptable by the receiver before reverting to a non-differential solution (differential corrections are usable for some time after their broadcast). This allows the user to decide how long to stretch old measurements in the event that the differential correction source is lost or degraded.

BEACON CONFIGURATION MENU

EXAMPLE:

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

Press the [↓] arrow key to enter.



EXAMPLE:

```
B1 Mode: Auto
301.0kHz @200bps
```

Set Channel 1 Beacon mode.

Press the enter key [↵] to begin data entry. The current Channel 1 Beacon mode setting will begin to blink. If "Fixed" mode is selected, the [→] key may be used to move to the frequency and baud rate fields. Use the [↑] and [↓] arrow keys to change the mode (or frequency and baud rate in "Fixed" mode), then press the enter key [↵] when entry is complete.

Beacon Mode	Description
Auto	The receiver automatically sets the frequency and baud rate of the Beacon channel.
Fixed	The user can set the frequency and baud rate of the Beacon channel. Available baud rate settings are: 25bps, 50bps, 100bps, 200bps, or "auto".
Idle	The receiver is not tracking the Beacon channel.



EXAMPLE:

```
B2 Mode: Auto
307.0kHz @ 100bps
```

Channel 2 Beacon Mode.

Mode selection and data entry for Channel 2 Beacon Mode are done in the same manner as for Channel 1 Beacon Mode.



EXAMPLE:

```
BCON Scan Config
US Only
```

Press the enter key [↵] to toggle between US Only and International.

BCON Scan Mode	Description
US Only (default)	The Beacon channels tune in 1 kHz steps.
International	The Beacon channels tune in half kHz (0.5 KHz) steps.

Note 1: Half kHz steps are not used in the US, so the default setting speeds up the search for valid beacons.

Note 2: The screen will display “Custom” if the user has altered the beacon directory manually via serial commands.

WAAS CONFIGURATION MENU

EXAMPLE:

```
WAAS Config Menu
press v to enter
```

Press the down arrow key [↓] to enter.



EXAMPLE:

```
WAAS - Enabled
(BCON Disabled)
```

Use enter key [↵] to toggle between the following selections:

WAAS - Enabled (BCON Disabled)

WAAS - Disabled (BCON Enabled)



EXAMPLE:

```
WAAS #122 snr 12
Elv 31 Azi 118
```

This screen selects the WAAS satellite to use for WAAS differential corrections in your area.

Use the enter key [↵] to begin entry. The current selection will begin to blink. Use the up [↑] and down [↓] arrow keys to select a different WAAS satellite. Press the enter key [↵] when complete.

OMNISTAR CONFIGURATION MENU

(INVICTA 310 ONLY)

EXAMPLE:

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



The following screens are provided to aid in activating an 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.

EXAMPLE:

```
Service ID: 12
N. Amer Central
```

The Service ID screen is used to select the correct OmniStar satellite for your area.

Press the enter key [↵] to begin data entry. The current Service ID number and region setting will begin to blink. Use the [↑] and [↓] arrow keys to select the correct Service ID number, then press the enter key [↵] when entry is complete.



EXAMPLE:

```
SetService ID #11
0000.000 @ 0000
```

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. Note: This operation is not normally used.

Press the enter key [↵] to change the frequency and symbol rate. The leftmost digit of the satellite frequency will begin to blink. Use the [↑] and [↓] arrow keys to change the digit, then use the [→] key to move to the next digit. When both values have been set, press the enter key [↵] to complete data entry.



EXAMPLE:

HexSvcID	0000
InitVector	0000

This screen can be used to enter a hexadecimal service ID number and initialization vector for your service ID (ServiceID screen) if instructed to do so by OmniStar. Note: This operation is not normally used.

Press the enter key [↵] to change the hex service ID and InitVector. The leftmost digit of the hex service ID will begin to blink. Use the [↑] and [↓] arrow keys to change the digit, then use the [→] key to move to the next digit. When both values have been set, press the enter key [↵] to complete data entry.

EXAMPLE:

OmniAct	00000000
	0000000000000000

This screen can be used to enter a 24-digit activation code provided by OmniStar for the purpose of activating or extending a service subscription. Note: This operation is not normally used.

Press the enter key [↵] to change the OmniStar activation code. The leftmost digit of the code will begin to blink. Use the [↑] and [↓] arrow keys to change the digit, then use the [→] key to move to the next digit. Press the enter key [↵] to complete data entry.

OUTPUT CONFIGURATION MENU

EXAMPLE:

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

Press the [↓] arrow key to enter.



EXAMPLE:

```
Port A Baud Rate
9600 bps
```

Select Baud Rate for Port A. Press the enter key [↵] to begin entry. Press the [↑] and [↓] arrow keys to select the new baud rate, then 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 intervals for Port A. 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.

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



EXAMPLE:

```
Port B Baud Rate
9600 bps
```

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



EXAMPLE:

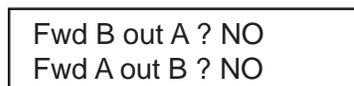


Used to select output message types and reporting intervals for Port B. Press the [↑] and [↓] arrow keys to select MSG type, press the enter key [↵] to highlight selection, press the [↑] and [↓] arrow keys to set interval, and press the enter key [↵] when complete.

Note: An interval of 0.0 sec disables output of the selected message on Port B.



EXAMPLE:



Fwd B out A - If yes, serial messages received on port B are forwarded out port A.

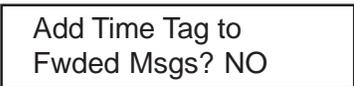
Fwd A out B - If yes, serial messages received on port A are forwarded out port B.

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

Press the [↓] down arrow key to enter.

Add time tag to forwarded messages.

EXAMPLE:



Add Time Tag to Fwded Msgs - adds time stamp (GPS or UTC, depending on configuration of receiver) to messages that are forwarded (from Port A to Port B or vice versa). This allows the user to see at what time the messages were received and forwarded.

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 a differentially corrected position. |
| 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 beacon, or the beacon may be off air. Beacon status information is available on the Internet at www.navcen.uscg.mil . 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 |
| 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 entitled “Rear Panel Serial Interface”. |

RECEIVER SPECIFICATIONS

Position Accuracy	< 1.0 meters rms	Operating Temperature	-40 C to +50 C
Timing Accuracy	N/A	Position Updates	10 solutions per sec
Number of Channels	10 GPS, 2 Beacon	Maximum Velocity	1000 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 x 5.7" W x 2.1" H
Dynamic Range	> 100 dB	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 I/O	Current	540 mA @ 12VDC

Antenna

The ANT connector is used for interfacing between the Invicta 210/310 and its Antenna/Preamplifier assembly.

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

CONFIGURATION

Rear Panel Serial Interfaces

The Invicta 210/310 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 Invicta 210/310 and external navigation equipment.

Port A

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

Port B

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

POWER CONNECTOR

The Invicta 210/310 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	N/A
3	Power Return (GND)	BLACK
4	Not Used	N/A

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 coded navigation message, by using a little trigonometry the receiver can determine its location on earth.

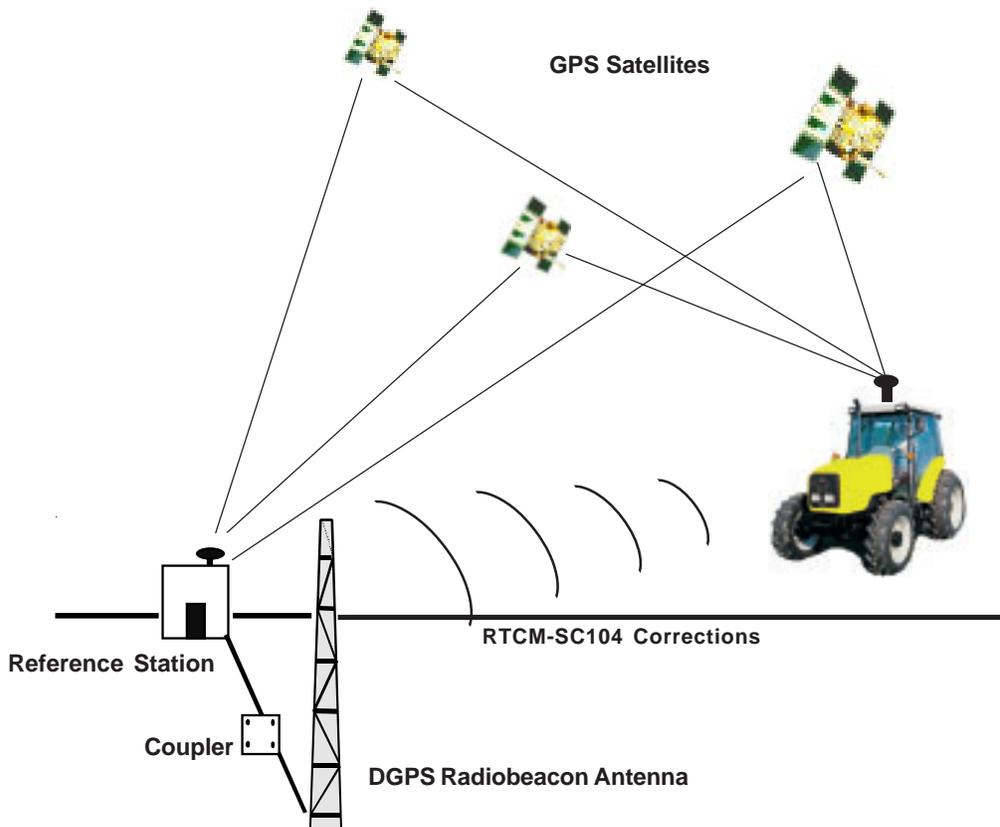
Position accuracy depends on the receiver's ability to accurately calculate the time it takes for each satellite signal to travel to earth. This is where the problem lies. There are primarily four sources of errors which can affect the receiver's calculation. These errors consist of:

1. Ionospheric and tropospheric 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 users. The correction message format follows the standard established by the Radio Technical Commission for Maritime Services, Special Committee 104 (RTCM SC-104). 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 Invicta 210/310 can achieve accuracy on the order of 1 meter or less.

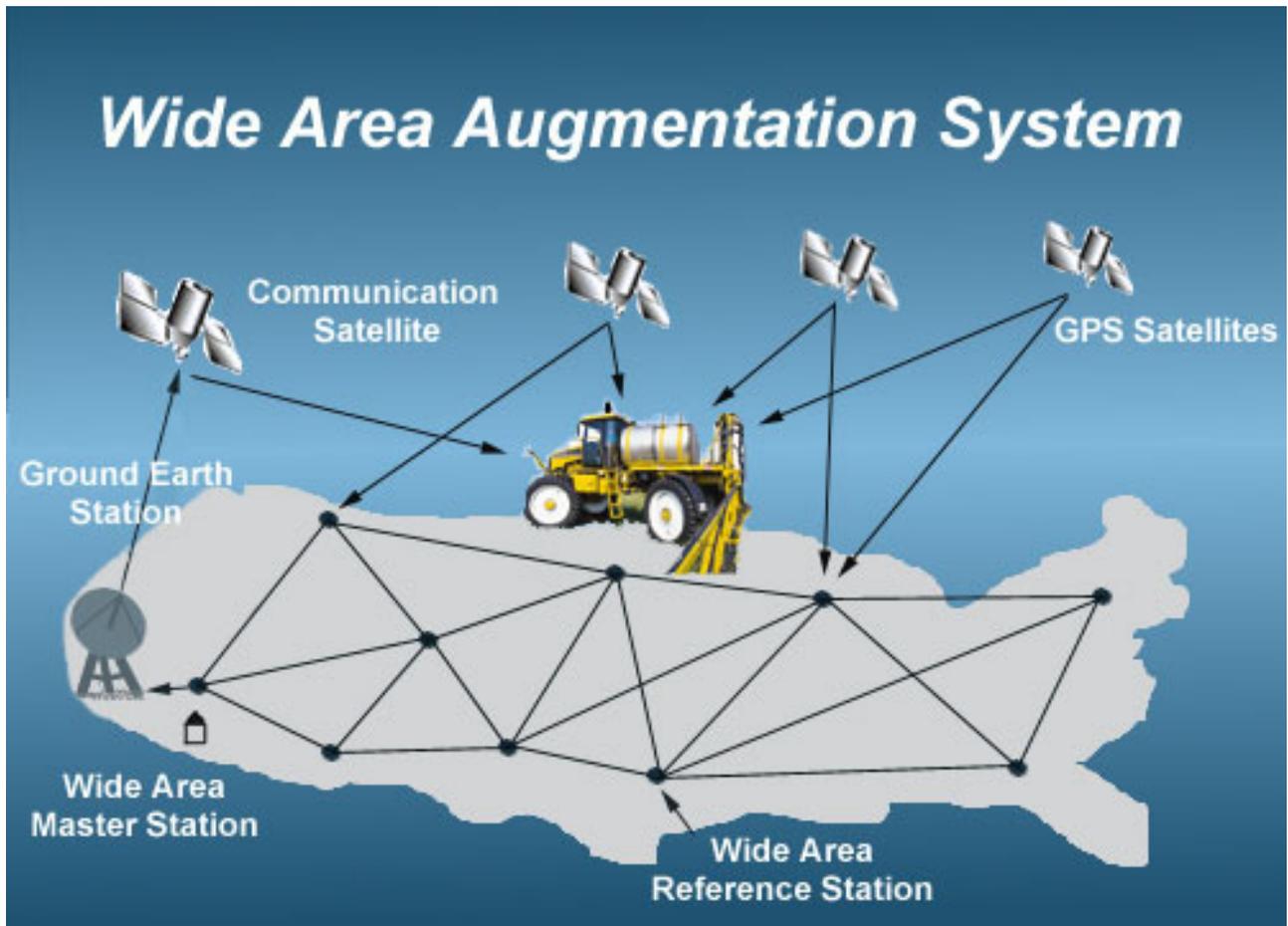
DIFFERENTIAL GPS BROADCAST SITE



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.

DIFFERENTIAL GPS BROADCAST SITE



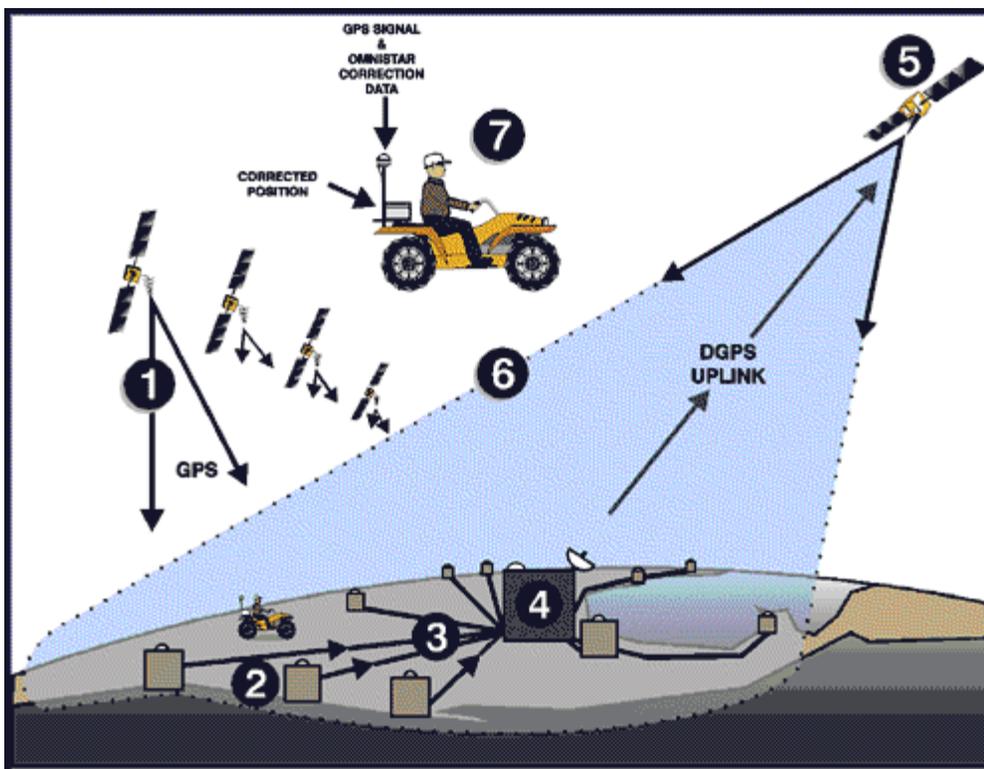
DGPS OMNISTAR (Invicta 310 ONLY)

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 RTCM 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 Invicta 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 Invicta 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 Invicta 210/310 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 Invicta 210/310 receiver uses to communicate with other devices.

INVICTA 210/310 NMEA MESSAGES

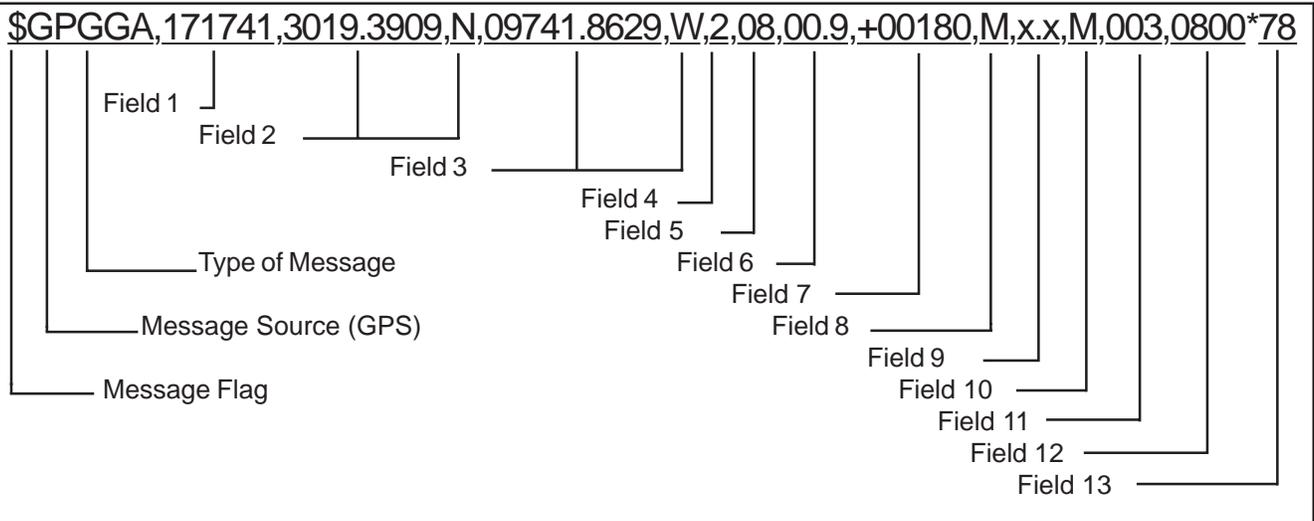
ALM	GPS Almanac Data
DTM	Datum Reference
GGA	Global Positioning System Fix Data
GLL	Geographic Position
GRS	GPS Range Residuals
GSA	GPS Dillution of Precision (DOP) and Active Satellites
GST	GPS Pseudorange Noise Statistics
GSV	GPS Satellites in View
MSK	MSK Receiver Interface
MSS	MSK Signal Status
RMC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

Raven Proprietary NMEA Messages

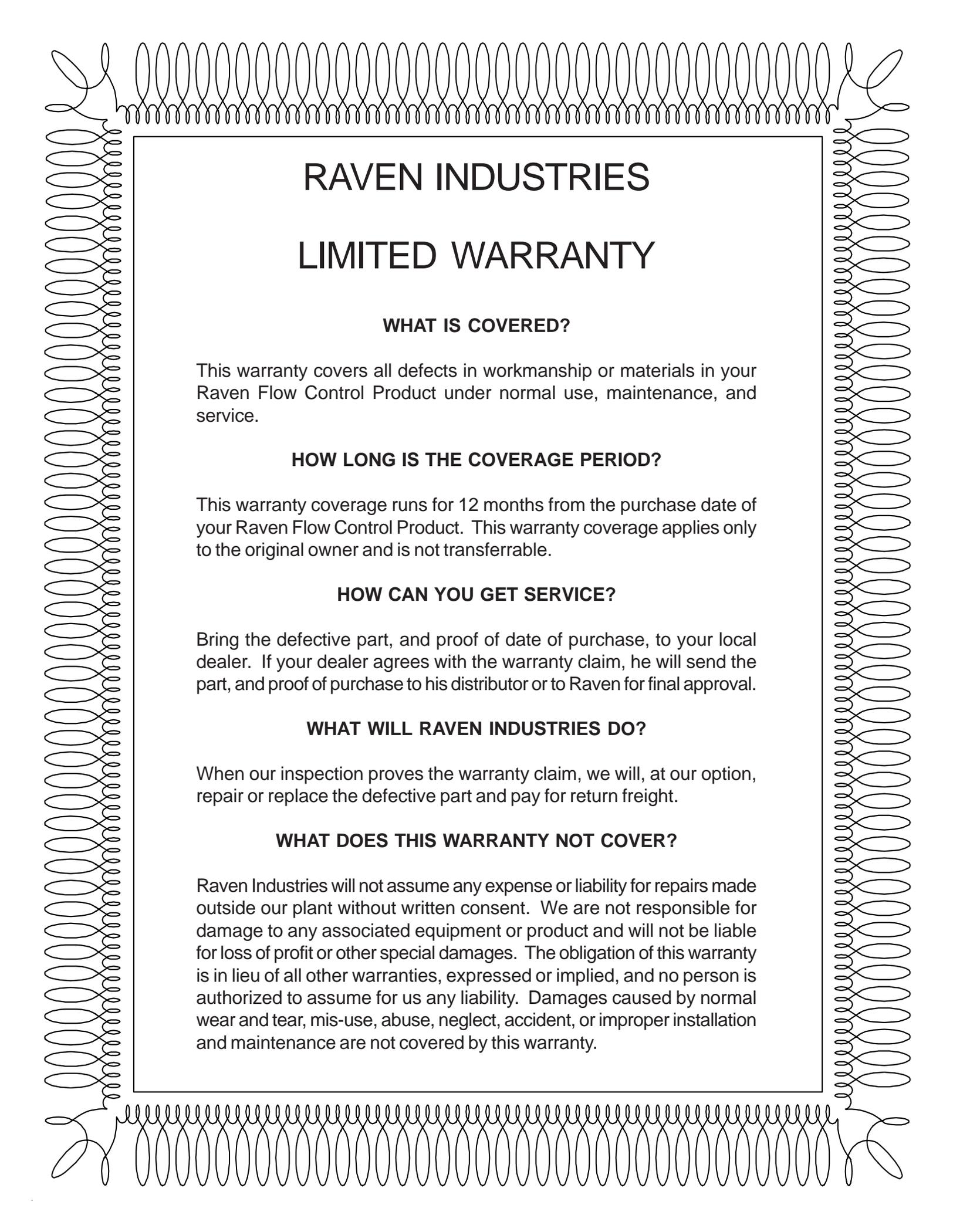
SLIB1S	Beacon Receiver Channel 1 Status
SLIB2S	Beacon Receiver Channel 2 Status
SLIDIF	DGPS Status Information
SLIE1S	External RTCM Channel 1 Status
SLIRTC	RTCM Message Data Received
SLISDA	Satellite Age of Data
SLISOL	Position Solution
SLIWRN	Receiver Warning Message

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



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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Invicta 210/310 Operation Manual #016-0159-798 Rev D 01/04