OmniSTAR 8300HP

User Manual

FUGRO

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Notice to Customers

This manual has been produced to ensure the very best performance from your OmniSTAR receiver. The manual has been clearly set out with simple instructions to ensure trouble free usage of your OmniSTAR receiver.

This publication could contain technical inaccuracies or typographical errors. Changes are periodically made to the information herein; these changes will be incorporated in new editions of the manual.

Should you require further assistance please contact your local dealer or the OmniSTAR B.V. office.

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Introduction

About This Manual

This manual has been produced to assist the typical user with the installation and operation of the OmniSTAR 8300HP DGPS Receiver.

System Features

The OmniSTAR 8300HP DGPS Receiver is part of the Fugro world-wide DGPS Service. The Fugro service is a full-time differential GPS (DGPS) broadcast system delivering corrections from an array of GPS reference stations located around the globe. Reference stations provide industry standard formatted corrections to Network Control Centres (NCC's) at strategic geographic locations, where the corrections are decoded, checked, and repackaged in a highly efficient format for broadcast. The data is modulated onto a RF carrier that is then up-converted for transmission to an L-band communications satellite.

The signals are received at the user's location by an antenna, demodulated by a receiver, and are made available, after selection of the desired individual reference site's data set, as corrections for use in a GPS, differential-capable, receiver.

The OmniSTAR 8300HP series of receivers support the following OmniSTAR® services:

HP, this is the High Performance service where dual frequency GPS carrier phase measurements are used in an intelligent and innovative way to create wide area positioning results of unmatched accuracy and performance.

VBS, this is the Virtual Base Station service where single frequency GPS code phase measurements are used to create RTCM corrections data optimised for the users current position.

Receiver Features

The OmniSTAR 8300HP receiver has the following features:

- 24 channel “all-in-view” parallel tracking
- Pulse Aperture Correlator (PAC) technology
- Fast reacquisition
- Fully field-upgradeable firmware
- Low power consumption
- 5 Hz position output data
- 10 Hz (optional)
- Voltage and temperature monitoring and reporting

The following models are available for the 8300HP:

- L1 only
- L1/L2
- L1/L2 plus OmniSTAR HP
- L1/L2 plus RTK (optional)

Housing

The 8300HP is housed in a enclosure to provide a complete receiver solution. When connected to an antenna and a power source, the 8300HP is a fully functioning DGPS/HP receiver.

The enclosure offers protection against environmental conditions and RF interference. In addition, it provides an easy-to-use interface to the GPS card’s data, power and status signals and a rugged, water, shock and vibration resistant housing for outdoor applications.

Interface

The 8300HP provides the following:

- A rugged, environmentally-sealed enclosure
- 3 serial ports with Switchcraft-brand connectors
- GPS antenna and power ports
- Auxiliary strobe signals for status and synchronization
- Indicator to provide status information

The following accessories are included with the 8300HP:

- 1 automotive power adapter cable
- 3 straight serial port cables
- GPS antenna and power ports
- A CD containing PC utilities and product documentation

For technical specifications on the 8300HP, please see

Figure 1: 8300HP Back End Cap

Icon	Name	Description
	PWR	DC power input
	RES	Reserved
	COM1	RS232 signals (NMEA) and auxiliary strobe signals
	COM2	RS232 signals (NMEA) with optional flow control
	COM3	RS232 (NMEA) and general I/O signals
	ANT	Antenna connection

Table 1: 8300HP Interface

Installation and Set Up

Installation Considerations

Before commencing installation of the OmniSTAR 8300HP in a vehicle or aircraft, the following should be considered:

- Determine the preferred location for each unit. Consider cable length, connector attachment space (cable bend radius), stowing excess cable, moisture, chemical corrosion, vibration and heat exposure.

- Before drilling holes, consider using existing hardware and locations where equipment was previously installed. Avoid drilling holes that may damage other equipment (e.g. structural frame members, electrical cables or fluid lines).

- High vibration and high temperature locations should be avoided whenever possible.

- In application where vibration exceeds 5Gs acceleration, shock mounts are required. (Refer to Customer support for mounting recommendations).

- Vehicle primary power has voltages that may be harmful to personnel and equipment. Disconnect the battery cable from the battery –ve (negative) terminal before making connection to any power terminal within the vehicle.

Counter Electromagnetic Force (CEMF)

A potential problem inherent in any installation of electronic systems within a vehicle is Counter Electro-magnetic Force (CEMF).

CEMF is caused when relays or solenoids, connected to the vehicle DC power distribution, are de-energised. The voltage produced may exceed – 400 volts.

CEMF is produced by equipment such as the following:

- **Electric fan brakes**
- **Air conditioners**
- **Starter relays**
- **Electric pump relays**

CEMF is more than sufficient to damage or cause erratic operation of any electronic system that is also connected to the same vehicle DC power supply. CEMF can be eliminated by installing diodes at the relays and solenoids that cause the problem, and more importantly at the power supply cable connections on the receiver.

A 47V, 5W, Zener diode (1N5368 or equivalent) should be connected between the receiver +ve (positive) power input terminal and ground, as illustrated in Figure 2.

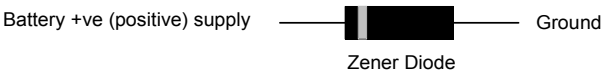


Figure 2: Zener Diode Connected

Cable Installation

Cables must be correctly installed for optimum system operation. Therefore, the following should be noted:

- Do not route an L-Band receiver remote antenna cable with the cabling of any other radio system. This may cause interference between both systems.
- If at all possible, do not run L-Band receiver antenna cables parallel to other radio system cabling closer than 30 centimetres.
- If cables must cross, ensure that they cross at an angle of 90°. This minimises the possibility of interference.
- As far as is practicable, ensure that cables and I/O connectors are unique and fit only in their allocated location.
- Avoid routing cables along-side power generator cabling and other high electrical noise sources. This can cause interference.
- Do not kink or force cables into sharp bends that may damage the cables and cause system failure.
- After installation, ensure that excess cable in looped and clamped or tied safely away from any control cables, fuel lines, hydraulic lines or moving parts.
- When stowing over length cables, form loops not less than 150 mm minimum cable bend radius.
- Cable routing must avoid high temperature exposure (e.g. exhaust manifold).

Additional Features and Information

This section contains information on the additional features of the 8300HP receiver.

Strobes

On the 8300HP, a set of inputs and outputs that provide status and synchronisation signals are given. These signals are called strobes.
Access to the 8300HP strobe signals is obtained through the COM1 port.

Strobe signals include an input (MKI) and a One Pulse Per Second output (PPS).

- Mark Input (MKI) — Falling edge on this input triggers certain logs to be generated in response to an external event.
- One Pulse Per Second output (PPS) — Falling edge is synchronised with GPS time.

Status Indicators

The 8300HP has LED indicators that provide the status of the 8300HP. See table 2.

Indicator	Indicator Color	Status
	Red	Hardware error.
	Green	Valid position computed.
	Red	The receiver is powered.

Table 2: 8300HP Status Indicators

Mounting Bracket

Along with the 8300HP, mounting kits have been provided to facilitate mounting the receiver to a surface. This section provides information on how to mount the receivers.

Note: The mounting kits are not designed for use in high-dynamics or high-vibration environments.

To install the mounting bracket provided with the 8300HP, refer to the instructions provided with the mounting kit. Figure 3 is included to provide the dimension information for the bracket.

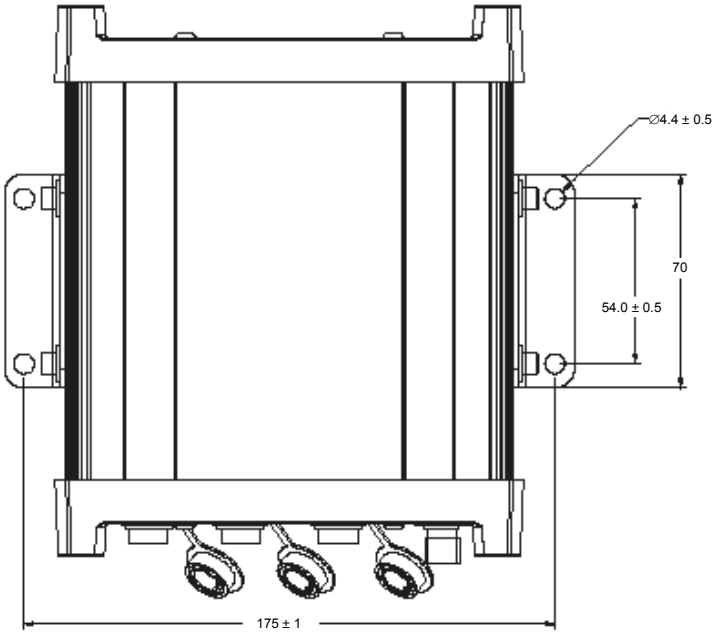


Figure 3: 8300HP with Mounting Bracket

Antenna Location

Antenna positioning is critical to system performance.

The following conditions must be met for optimum system performance:

- Antenna must be mounted at least 1.5 metres away from transmitting antennas of any frequency. Closer positioning may cause overloading of receiver RF circuits.

- The antenna should be mounted at the highest practical point that will give a good view of the horizon and be as near level as possible.

- The antenna must be located along the vehicle centre-line, or at a relevant reference point on the vehicle.

Power Supply Requirements

The 8300HP contains a DC to DC converter that is very tolerant to noise and ripple at its input. A tightly regulated input supply to the 8300HP is not required, as long as it falls within the input range +7.5 to +15VDC.
The power supply used should be capable of 5 W.

Warning: If the voltage supplied is below the minimum specification, the receiver will suspend operation. If the voltage supplied is above the maximum specification, the receiver may be permanently damaged, voiding your warranty.

Operating considerations

The 8300HP has proven to be a high-quality positioning device. The accuracy that the user can obtain depends on several factors, including:

- Number of visible satellites
- Multipath
- Dilution of Precision (DOP)
- Satellite elevations
- Differential correction

Number of visible satellites

A minimum of four satellites is required to calculate a 3-dimensional position. In general it can be said that every increase in the number of visible satellites will result in an increase in the system's accuracy. As the GPS satellites orbit around the earth the number of visible satellites will change in time. The GPS constellation has been designed so as to provide a minimum of 4 visible satellites at any location at all times. The number of visible satellites can decrease due to blockage by objects such as trees and buildings.

Multipath

It is possible for satellite signals to reflect off large nearby objects such as buildings, cars or even the ground, thereby resulting in an erroneous distance measurement. This phenomenon is known as multipath. Multipath can cause significant errors in the position determination and it is therefore important to place the receiver in an environment, which is free of large reflective surfaces. It is also recommended to mount the receiver directly onto a surface, while maintaining a clear view of the sky in all directions.

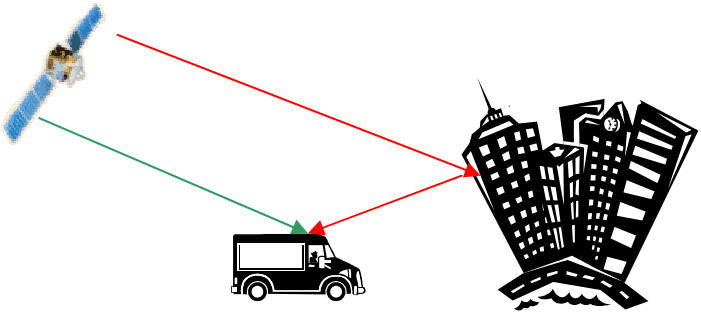


Figure 4: Multipath

Position Dilution of Precision (PDOP)

The Position Dilution of Precision (PDOP) is a measure of the satellite geometry. The lower the PDOP value, the more accurate the GPS position will be.

Satellite elevations

The signal from a satellite that is low on the horizon will travel a greater distance through the atmosphere. This results in a lower signal strength and a delayed reception, thereby causing erroneous and noisy data. By default the 8300HP is configured to ignore any satellites that have an elevation angle lower than 5° for VBS and lower than 8° for HP.

Differential corrections

For accurate positioning it is essential that the differential corrections are received. In order to ensure reception of the OmniSTAR satellite signal the line of sight towards the satellite must not be blocked by objects such as trees and buildings.

Multipath reflections can cause destructive interference, thereby significantly decreasing the signal strength. It is therefore recommended to mount the 8300HP directly onto a surface in a reflection free environment.

Although the 8300HP has been designed to provide optimal system performance under most circumstances, it is possible, due to the nature of radio communications that the system performance degrades due to local interference sources.

Operation

Before operating the receiver for the first time, ensure that you have followed the installation instructions.

Communications with the Receiver

Communications with the receiver is straightforward, and consist of issuing commands through the communications ports from an external serial communication device. This could be either a terminal or an IBM-compatible PC that is directly connected to the receiver serial port. For more information about commands and logs that are useful for basic operation of the receiver, refer to Appendix D.

Serial Port Default Settings

The receiver communicates with your PC or Terminal via serial port. For communication to occur, both the receiver and the operator interface have to be configured properly. The receiver's COM1, COM2 and COM3 default port settings are as follows:

- **9600 BPS, no parity, 8 data bits, 1 stop bit, no handshaking, echo off**

The data transfer rate you choose will determine how fast information is transmitted. Take for example a log whose message byte count is 96. The default port settings will allow 10 bits/byte. It will therefore take 960 bits per message. To get 10 messages per second then will require 9600 BPS. Please also remember that even if you set the bps to 9600 the actual data transfer rate will be less and depends on the number of satellites being tracked, filters in use, and idle time. It is therefore suggested that you leave yourself a margin when choosing a data rate.

Getting Started

The purpose of this section is to get you started with the 8300HP as quickly as possible. The guide will address receiving the satellite data carrier, and then checking the functionality and status of the HP Process.
Generally when the receiver is supplied to you it will be configured for the mode and data link(s) you have subscribed to. In most cases to get up and running will be a case of connecting the appropriate cables and applying power to the system.

Included with your receiver is the GPS solution and Convert program. GPS solution is a Microsoft Windows-based graphical user interface, which allows you to access the receiver's many features without struggling with communications protocol or writing special software. The convert utility is a windows-based utility that allows you to convert between file formats and strips unwanted records for data file compilation.

Starting the Receiver

The receiver's software resides in read-only memory. As such, the unit "self-boots" when turned on and undergoes a complete self-test. If an error condition is detected during a self-test, the self-test status word would change; this self-test status word can be viewed in the header of any data output log.
When the receiver is first turned on, no activity information is transmitted from the COM ports except for the port prompt. The external data communications equipment screen will display one of these three messages:

[COM1] *if connected to COM1 por*t,
[COM2] *if connected to COM2 por*t,
or
[COM3] *if connected to COM3 port*

Any of these prompts indicate that the receiver is ready and waiting for command input.
Commands are typed at the interfacing terminal's keyboard, and executed after issuing a carriage return command which is usually the same as pressing the terminal's <Enter> key.

When an input is accepted **<OK** appears.
If a command is incorrectly entered, the receiver will respond with "<Invalid Message ID" (or a more detailed error message).

Initial Setup

1. Refer to the following diagrams, as you will need to assemble all the required items.

   - OmniSTAR 8300HP DGPS Receiver
   - DGPS Antenna
   - DGPS Antenna Cable
   - Power Cable
   - 3x Data Port Cable

2. Install the DGPS antenna where it has a clear view of the sky in the direction of the satellite.

3. Connect the DGPS antenna cable between the DGPS antenna and the 8300HP (TNC connector on rear panel).

4. Connect the power cable to a suitable 7.5-15 VDC power supply being sure to check correct polarity. The Power LED should turn red.

5. Send the following commands to any of the comports:

   - psrdiffsource omnistar
   - rtksource omnistar
   - assignomni user 1535153 1200

6. Select the output you want using the command:

   LOG [port] message [trigger [period [offset [hold]]]] (see for further information and available logs Appendix C and D)

7. Save the settings by sending the command SAVECONFIG to any of the comports.

Appendix A

Real-Time Kinematic (RTK)

RTK is a real-time kinematic software product. It can only be used in conjunction with the 8300HP.

The RTK software algorithms utilise both carrier and code phase measurements; thus, the solutions are robust, reliable, accurate and rapid.
RTK achieves its extra accuracy and precision due to its being able to utilise dual-frequency measurements. Dual-frequency GPS receivers have two main advantages over their single-frequency counterparts when running RTK software:

1. resolution of cycle ambiguity is possible due to the use of wide lane searching
2. longer baselines are possible due to the removal of ionospheric errors

The RTK system in the receiver provides two kinds of position solutions. The Matched RTK position is computed with buffered observations, so there is no error due to the extrapolation of base station measurements. This provides the highest accuracy solution possible at the expense of some latency, which is affected primarily by the speed of the differential data link. The MATCHEDPOS log contains the matched RTK solution and can be generated for each processed set of base station observations. The RTKDATA log provides additional information about the matched RTK solution.

The Low-Latency RTK position and velocity is computed from the latest local observations and extrapolated base station observations. This supplies a valid RTK position with the lowest latency possible at the expense of some accuracy. The amount of time that the base station observations are extrapolated is provided in the "differential log" field of the position log. The Low-Latency RTK system will extrapolate for 30 seconds. The RTKPOS log contains the Low-Latency RTK position when valid, and an "invalid" status when a low-latency RTK solution could not be computed. The BESTPOS log contains the low-latency RTK position when it is valid, and superior to the pseudorange-based position. Otherwise, it will contain the pseudorange-based position. Similarly, RTKVEL and BESTVEL will contain the low-latency RTK velocity.

When valid L2 measurements are available, RTK solutions will have other solution types that depend on convergence time, baseline length, satellite length, satellite geometry and the level of ionospheric activity detected. The Low-Latency RTK algorithms further reduce latency by not using the narrow-lane ambiguities. This does not significantly degrade performance because the error induced by extrapolation dominates.

Types used in RTK are summarised in the following table.

Position Type	Low Latency RTK	Matched RTK
Floating L1	X	
Floating Ionospheric Free	X	X
Floating Narrow-Lane		X
Fixed Integer L1	X	
Fixed Integer Wide-Lane	X	X
Fixed Integer Narrow-Lane		X

Table 3: Summary of position types

Appendix B

Technical Specifications

PERFORMANCE

Position Accuracy [1]	VBS: 1.0 m 2DRMS HP: 0.10 m 2DRMS RTK: 0.04 m 2DRMS
Reacquisition	0.5 s L1 (typical) 6 s L2 (typical)
Data Rates	5 Hz (10 Hz optional)
Time Accuracy [1 2]	20 ns RMS
Velocity Accuracy	0.03 m/s RMS
Measurement Precision	2 mm RMS
Dynamics	Vibration 4 G (sustained tracking) Maximum Velocity 515 m/s [3] Maximum Height 18.288 m [3]

ENVIRONMENTAL

Operating Temperature	-40°C to +75°C
Storage Temperature	-40°C to +90°C
Humidity	Not to exceed 95% non-condensing

[1] Typical values. Performance specifications are subject to GPS system characteristics, U.S. DOD operational degradation, ionospheric and tropospheric conditions, satellite geometry, baseline length and multipath effects.

[2] Time accuracy does not include biases due to RF or antenna delay.

[3] In accordance with export licensing.

POWER REQUIREMENTS

Voltage	+7 to +15 VDC
Allowable Input Voltage Ripple	100 mV p-p (max.)
Power consumption	2.7 W (typical)

RF INPUT / LNA POWER OUTPUT

Antenna connector impedance	TNC female, 50 Ω nominal
RF Input Frequencies	1575.42 MHz (L1), 1227.60 MHz (L2), 1525 MHz – 1559 MHz (L-Band)
LNA Power	+ 4.25 to +5.25 VDC

INPUT / OUTPUT DATA INTERFACE

Electrical Format	RS232
Bit Rate[1]	300, 1200, 4800, 9600 (default), 19200, 57600, 115200, 230400 bps
Lead input	CTS (and DCD on COM2)
Lead output	RTS (and DTR on COM2)
Signals Supported	TX, RX, RTS, CTS, DTR, DCD (DTR and DCD are on COM2 only)

[1] Baud rates higher than 115200 bps are not supported by standard PC hardware. Special PC hardware is required for higher rates, including 230400 bps.

Input / Output Connectors

ANT		TNC female jack, 50 Ω nominal impedance + 4.25 to +5.25 VDC, 90 mA max (output from 8300HP to antenna/LNA)
PWR		2-pin Switchcraft EN3 connector +7 to +15 VDC at 5 W typical (operating range)[1]
COM1		6-pin Switchcraft EN3 connector
COM2		7-pin Switchcraft EN3 connector
COM3		8-pin Switchcraft EN3 connector

Physical

Size	180 x 154 x 71 mm (not including mounting bracket) 180 x 186 x 75 mm (including mounting bracket)
Weight	1.1 kg maximum

[1] The receiver will turn off and be undamaged at voltages between 15 and 30 VDC. Protection is included for brief transients above 30 VDC.

Dimensions

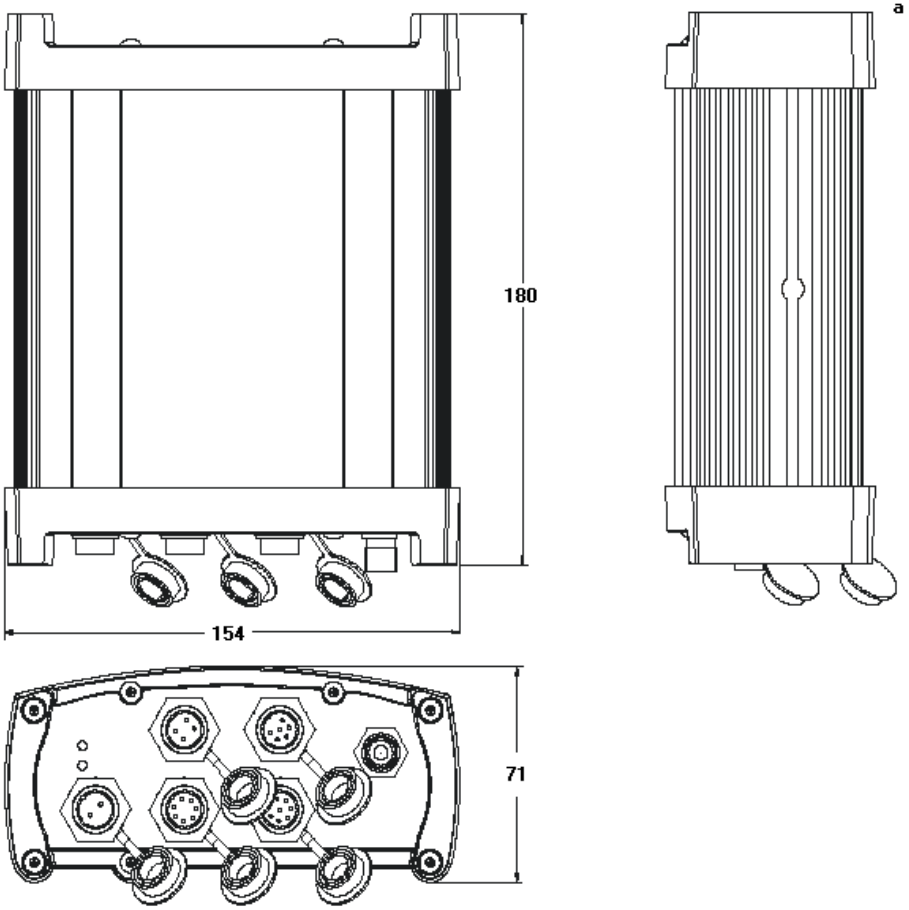


Figure 5: 8300HP Dimensions

[a] All dimensions are in millimetres.

Port Pin-Outs

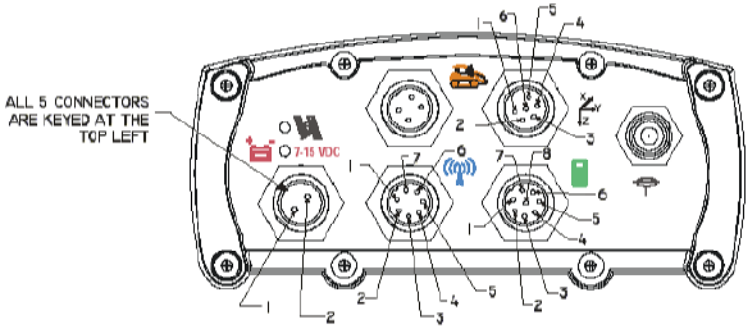


Figure 6: 8300HP Port Pin-Outs

Connector Pin No.	Signal Name	Signal Description
1	VIN+	Positive power terminal
2	VIN-	Negative power terminal

Table 4: 8300HP PWR Port Pin-Out Descriptions

Connector Pin No.	Signal Name	Signal Description
1	1PPS	One pulse per second output
2	MKI	Mark input
3	POUT	Power output [1]
4	RXD1	RS232 receive to COM1 on the receiver
5	TXD1	RS232 transmit from COM1 on the receiver
6	GND	Signal/power ground

Table 5: 8300HP COM1 Port Pin-Out Descriptions

[1] Both COM1 and COM2 have power output pins that can be used to pass power to peripherals. The voltage on each will be approximately 1 V lower than VIN. The maximum contimuous current is 500 mA.

Connector Pin No.	Signal Name	Signal Description
1	SGND	Signal ground
2	RTS2	RS232 ready to send from COM2 on the receiver
3	CTS2	RS232 clear to send to COM2 on the receiver
4	POUT	Power output [1]
5	RXD2	RS232 receive to COM2 on the receiver
6	TXD2	RS232 transmit from COM2 on the receiver
7	PGND	Power ground [1]

Table 6: 8300HP COM2 Port Pin-Out Descriptions

Connector Pin No.	Signal Name	Signal Description
1	Reserved	Reserved
2	GPIO_SR	Reserved
3	RXD3	RS232 receive to COM3 on the receiver
4	TXD3	RS232 transmit from COM3 on the receiver
5	AIN	General purpose analog input
6	GPIO_SL	Reserved
7	GND	Digital ground
8	GPIO_GPI	Reserved

Table 7: 8300HP COM3 Port Pin-Out Descriptions

[1] Both COM1 and COM2 have power output pins that can be used to pass power to peripherals. The voltage on each will be approximately 1 V lower than VIN. The maximum contimuous current is 500 mA.

Cables

Automobile Power Adapter Cable

The power cable supplied with the 8300HP provides a convenient means for supplying +12 VDC while operating from an automobile.

The output of the power adapter uses a 2-pin Switchcraft socket. This cable plugs directly into the PWR port on the rear end cap of the 8300HP.

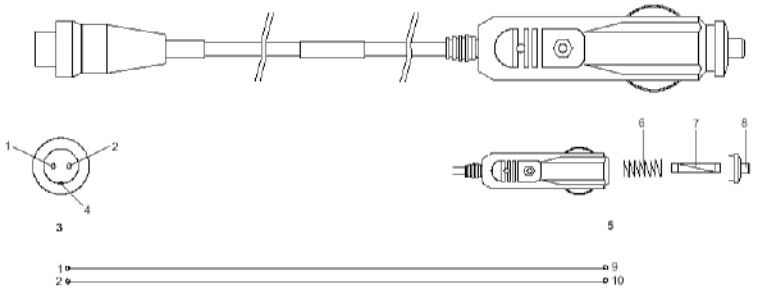


Figure 7: Automobile Power Adapter Cable

Reference	Description
3	2-pin Switchcraft EN3C2F16K connector
4	Connector key
5	Automobile power outlet plug
6	Spring
7	Slow blow fuse
8	Universal tip
9	Red
10	Black

Table 8: Figure 7 Reference numbers description

Figure 8: 8300HP Power cable

6-Pin Switchcraft to DB9 Serial Cable

The serial cable shown below provides a means of interfacing between the COM1 port on the 8300HP and another serial communications device, such as a PC. At the 8300HP end, the cable is equipped with a 6-pin Switchcraft connector, which plugs directly into the COM1 port. At the other end, a DB9S connector is provided. The cable is 2 m in length.

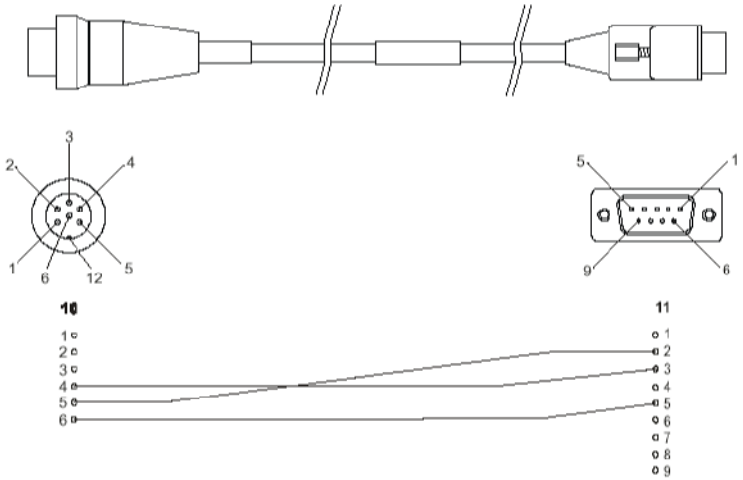


Figure 9: 6-pin Switchcraft DB9 Serial Cable

Reference	Description
10	6-pin Switchcraft EN3C6F connector
11	DB9S connector
12	Connector key

Table 9: Figure 9 Reference numbers descriptions

Figure 10: 8300HP 6-pin Serial Cable

7-Pin Switchcraft to DB9 Serial Cable

The serial cable shown below provides a means of interfacing between the COM2 port on the 8300HP and another serial communications device, such as a PC. At the 8300HP end, the cable is equipped with a 7-pin Switchcraft connector, which plugs directly into the COM2 port. At the other end, a DB9S connector is provided.

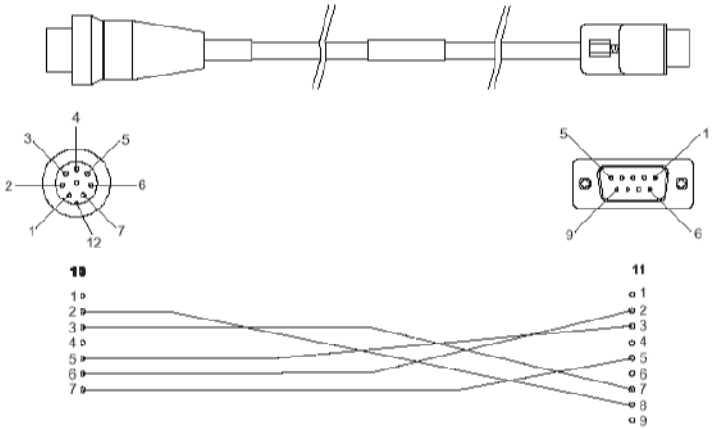


Figure 11: 7-Pin Switchcraft to DB9 Serial Cable

Reference	Description
10	7-pin Switchcraft EN3C7F connector
11	DB9S connector
12	Connector key

Table 10: Figure 11 Reference numbers descriptions

Figure 12: 8300HP 7-pin Serial Cable

8-Pin Switchcraft to DB9 Serial Cable

The serial cable shown below provides a means of interfacing between the COM3 port on the 8300HP and another serial communications device, such as a PC. At the 8300HP end, the cable is equipped with a 8-pin Switchcraft connector, which plugs directly into the COM3 port. At the other end, a DB9S connector is provided.

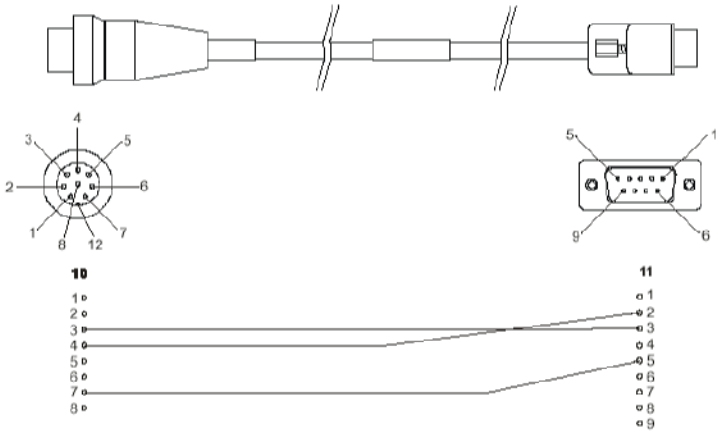


Figure 13: 8-Pin Switchcraft to DB9 Serial Cable

Reference	Description
10	8-pin Switchcraft EN3C8F connector
11	DB9S connector
12	Connector key

Table 11: Figure 13 Reference numbers descriptions

Figure 14: 8300HP 8-pin Serial Cable

Appendix C

Commands

Following are the commands with detailed descriptions that can be send to the 8300HP.

assignomni

This command allows you to use manual instructions to ensure that the receiver searches for a specified OmniSTAR satellite at a specified frequency with a specified baud rate.

Field	Field Type	ASCII Value	Description
1	header	-	This field contains the command name
2	mode	user	Set the mode to USER and enter specific frequency and baud rate values
3	freq	1525000 to 1560000	OmniSTAR service frequency of satellite (kHz).
4	baud	300, 600, 1200, 2400 or 4800	Data rate for communication with OmniSTAR satellite.

Table 12: Description of the assignomni command

Abbreviated ASCII Syntax: **Message ID: 467**

ASSIGNOMNI mode freq baud

ASCII Example:

ASSIGNOMNI USER 1535153 1200

com

This command permits you to configure the receiver's asynchronous serial port communications drivers.

The current COM port configuration can be reset to its default state at any time by sending it two hardware break signals of 250 milliseconds each, spaced by fifteen hundred milliseconds (1.5 seconds) with a pause of at least 250 milliseconds following the second break. This will:

• Stop the logging of data on the current port

• Clear the transmit and receive buffers on the current port

• Return the current port to its default settings

Abbreviated ASCII Syntax: **Message ID: 4**

COM [port] bps [parity[databits[stopbits[handshake[echo[break]]]]]]

Field	Field Type	ASCII Value	Description

1	header	-	This field contains the command name
2	port	See table 15, serial port identifiers for COM command on page 31	Port to configure. (default is THISPORT)
3	bps / baud	300, 600, 900, 1200, 2400, 9600, 19200, 38400, 57600, 115200 or 230400	Communication baud rate (bps).
4	parity	See table 16, Parity, on page 31	Parity
5	databits	7 or 8	Number of databits (default = 8)
6	stopbits	1 or 2	Number of stopbits (default = 1)
7	handshake	See table 17, Handshaking, on page 31	Handshaking
8	echo	OFF	No echo (default)
		ON	Transmit any input characters as they are received.
9	break	OFF	Disable break detection
		ON	Enable break detection (default)

Table 13: Description of COM command

ASCII Example:

COM COM1,57600,N,8,1,N,OFF,ON

ASCII	Binary	Description
COM1	1	Com port 1
COM2	2	Com port 2
COM3	3	Com port 3
THISPORT	6	The current com port.
ALL	8	All com ports.

Table 14: Serial port identifiers for COM command.

Binary	ASCII	Description

0	N	No parity (default)
1	E	Even parity
2	O	Odd parity

Table 15: Parity

Binary	ASCII	Description
0	N	No handshaking (default)
1	XON	XON/XOFF software handshaking
2	CTS	CTS/RTS hardware handshaking

Table 16: Handshaking

log

Many different types of data can be logged using several different methods of triggering the log events. Every log element can be directed to any combination of the three COM ports.

Table 17 shows the ASCII command format.

The optional parameter [hold] will prevent a log from being removed when the UNLOGALL command is issued. To remove a log which was invoked using the [hold] parameter requires the specific use of the UNLOG command.
The [port] parameter is optional. If [port] is not specified, [port] is defaulted to the port that the command was received on.

The OEM4 family of receivers can handle 30 logs at a time. If you attempt to log more than 30 logs at a time, the receiver will respond with an Insufficient Resources error.

Abbreviated ASCII Syntax: **Message ID: 1**

LOG [port] message [trigger [period [offset [hold]]]]

Field	Field Type	ASCII Value	Description

1	header	-	This field contains the command name
2	port	See table 15, serial port identifiers for COM command on page 31	Output port (default = THISPORT)
3	message	Any valid message name	Message name of log to output
4	trigger	ONNEW	Output when the message is updated (not necessarily changed).
		ONCHANGED	Output when the message is changed.
		ONTIME	Output on a time interval.
		ONNEXT	Output only the next message.
		ONCE	Output only the current message (default).
		ONMARK	Output when a pulse is detected on the Mark1 input, MKI.
5	period	Any positive double value larger than the receiver's minimum raw measurement.	Log period (for ontime trigger) in seconds (default = 0).
6	offset	Any positive double value smaller than the the period.	Offset for period (ONTIME trigger) in seconds. If you wished to log data at 1 second after every minute you would set the period to 60 and the offset to 1 (default = 0)
7	hold	NOHOLD	Allow log to be removed by the UNLOGALL command (default).
		HOLD	Prevent log being removed by th UNLOGALL command.

Table 17: Description of the LOG command.

Abbreviated ASCII Example:

LOG COM1 GPGGARTK ONTIME 1

psrdiffsource / rtksource

This command sets the receiver to accept OmniSTAR HP and Virtual Base Station (VBS) differential corrections.

Enable OmniSTAR HP and VBS:

RTKSOURCE OMNISTAR
PSRDIFFSOURCE OMNISTAR

reset

This command performs a hardware reset. Following a RESET command, the receiver will initiate a cold-start boot up. Therefore, the receiver configuration will revert either to the factory default if no user configuration was saved or the last SAVECONFIG settings.

The optional delay field is used to set the number of seconds the receiver is to wait before resetting.

Abbreviated ASCII Syntax: **Message ID: 18**

RESET [delay]

Field	Field Type	ASCII Value	Description
1	header	-	This field contains the command name
2	delay		Seconds to wait before resetting. (default = 0)

Table 18: Description of the RESET command.

saveconfig

This command saves the user's present configuration in non-volatile memory. The configuration includes the current log settings, FIX settings, port configurations, etc. and is output in the RXCONFIG log.

Abbreviated ASCII Syntax: **Message ID: 19**

SAVECONFIG

Data Logs

Refer to the LOG command, see Page 32, for details on requesting logs.

The receiver is capable of generating many different logs. These logs are divided into the following three types:

Synchronous, asynchronous and polled.

The data for synchronous logs is generated on a regular schedule.

Asynchronous data is generated at irregular intervals. If asynchronous logs were collected on a regular schedule, they would not output the most current data as soon as it was available.

The data in polled logs is generated on demand. An example would be RXCONFIG. It would be polled because it changes only when commanded to do so. Therefore, it would not make sense to log this kind of data ONCHANGED, or ONNEW.

For available NMEA logs see table 20 on page 36.

Datatype	Description
OMNIHPPOS	HP position data
OMNIINFO	Configuration Information
OMNISTAT	Status Information

Table 19: Available OmniSTAR specific logs

Appendix D

NMEA 0183 Message Options

The OmniSTAR 8300HP is factory configured with 4 NMEA 0183 sentences GGA, GLL, GSA and VTG. Sentences can be added or removed by the factory to a maximum of four sentences. The output rate is fixed at a 1-second interval. As an option faster output rates are available up to 20 times per second. There are more messages possible who are GPS receiver specific and not a NMEA 0183 standard.

Standard	Message Sentence	Description
	ALM	GPS Almanac Data
*	GGA	GPS Fix Data
	GLL	Geographic Position – Latitude/Longitude
	GRS	GPS Range Residuals
*	GSA	GPS DOP and Active Satellites
	GST	GPS Pseudorange Noise Statistics
*	GSV	GPS Satellites in View
	RMC	Recommended Minimum Specific GPS Data
*	VTG	Track Made Good and Ground Speed
	ZDA	Time and Date

Table 20: NMEA 0183 messages available for the 8300HP

NMEA 0183 Message Formats

In this section each message is described in more detail.

ALM – GPS Almanac Data

The ALM message identifies the GPS week, SV health and contains the almanac for one satellite. One sentence per satellite, up to a maximum of 32.

$GPALM,1,1,03,698,00,6ae6,1d,779f,fdef,a10d68,6469a6,7c1f62,
5f5839,*43

Field Number	Description
1	Total number of ALM sentences for this cycle
2	Sentence sequence number
3	SV PRN number, 01 to 32
4	GPS week number
5	SV health status
6	Eccentricity
7	Almanac reference time
8	Inclination angle
9	Rate of right ascension
10	Root of semi-major axis
11	Argument of perigee
12	Longitude of ascension node
13	Mean anomaly
14	A f0, clock parameter
15	A f1, clock parameter

Table 21: Description of the ALM message.

GGA – GPS Fix Data

The GGA message includes time, position and fix related data for the GPS receiver.

$GPGGA,hhmmss.s,llll.llll,a,yyyyy.yyyy,a,x,xx,x.x,x.x,M,x.x,M,x.x,xxxx

Field Number	Description
1	UTC of Position
2,3	Latitude, N (North) or S (South). *
4,5	Longitude, E(East) or W (West). *
6	GPS Quality Indicator: 0=No GPS, 1=GPS, 2=DGPS, 5=HP.
7	Number of Satellites in Use.
8	Horizontal Dilution of Precision (HDOP).
9,10	Height above Mean Sea level in Meters, M = Meters.
11,12	Geodial Separation in Meters, M = Meters. **
13	Age of Differential GPS Data. ***
14	Differential Reference Station ID (0000 – 1023)

Table 22: Description of the GGA message.

NOTES:
* The GGA message provides 4 decimal points of precision in non-differential mode, and 5 decimal points of accuracy in differential mode.

** Geodial Separation is the difference between the WGS-84 earth ellipsoid and mean-sea-level (MSL).

*** Time in seconds since the last RTCM SC-104 message type 1 or type 9 update.

GLL – Geographic Position – Latitude/Longitude

The GLL message contains the latitude and longitude of the present position, the time of the position fix and the status.

$GPGLL,llll.lll,a,yyyyy.yyy,a,hhmmss.s,A

Field Number	Description
1,2	Latitude, N (North) or S (South).
3,4	Longitude, E (East) or W (West).
5	UTC of Position.
6	Status: A = Valid, V = Invalid.

Table 23: Description of the GLL message.

GRS – GPS Range Residuals

The GRS sentence is used to support the Receiver Autonomous Integrity Monitoring (RAIM).

$GPGRS,220320.0,0,-0.8,-0.2,-0.1,-0.2,0.8,0.6,,,,,,,*55

Field Number	Description
1	UTC time of GGA position fix
2	Residuals 0: Residuals used to calculate position given in the matching GGA line 1: Residuals recomputed after the GGA position was computed
3 to 14	Range residuals for satellites used in the navigation solution, in meters

Table 24: Description of the GRS message.

NOTE:
* Because the contents of this NMEA message do not change significantly during a 1-second interval, the receiver outputs this message at a maximum rate of 1 Hz.

** If running in HP mode this NMEA message is not valid.

GSA – GPS DOP and Active Satellites

The GSA message indicates the GPS receivers operating mode and lists the satellites used for navigation and the DOP values of the position solution.

$GPGSA,a,x,xx,xx,xx,xx,xx,xx,xx,xx,xx,xx,xx,xx,x.x,x.x,x.x

Field Number	Description
1	Mode: M = Manual, A = Automatic.
2	Current Mode 1 = Fix not available, 2 = 2D fix, 3 = 3D fix.
3 to 14	PRN numbers of the satellites used in the position solution. *
15	Position Dilution of Precision (PDOP).
16	Horizontal Dilution of Precision (HDOP).
17	Vertical Dilution of Precision (VDOP)

Table 25: Description of the GSA message.

NOTE:
* When less than 12 satellites are used, the unused fields are null.

GST – GPS Pseudorange Noise Statistics

The GST sentence is used to support Receiver Autonomous Integrity Monitoring (RAIM).

$GPGST,220320.0,1.3,0.8,0.5,166.1,0.8,0.5,1.6,*4F

Field Number	Description
1	UTC time of GGA fix
2	RMS value of the standard deviation of the range inputs to the navigation process (range inputs include pseudoranges and DGPS corrections)
3	Standard deviation of semi-major axis of error ellipse, in meters
4	Standard deviation of semi-minor axis of error ellipse, in meters
5	Orientation of semi-major axis of error ellipse, in degrees from true north
6	Standard deviation of latitude error, in meters
7	Standard deviation of longitude error, in meters
8	Standard deviation of altitude error, in meters

Table 26: Description of the GST message.

NOTE:
* Because the contents of this NMEA message do not change significantly during a 1-second interval, the receiver outputs this message at a maximum rate of 1 Hz.

GSV – GPS Satellites in View

The GSV sentence identifies the number of SVs in view, the PRN numbers, elevation, azimuth and SNR values.

$GPGSV,4,1,13,02,02,213,,03,-3,000,,11,00,121,,14,13,172,05*67

Field Number	Description
1	Total number of sentences of this type in this cycle
2	Sentence number
3	Total number of SVs visible
4	SV PRN number
5	Elevation in degrees, 90 ½ maximum
6	Azimuth, degrees from true north, 000 ½ to 359 ½
7	SNR, 00-99 dB (null when not tracking)
8-11	Information about second SV, same format as fields 4-7
12-15	Information about third SV, same format as fields 4-7
16-19	Information about fourth SV, same format as fields 4-7

Table 27: Description of the GSV message.

NOTE:
* Because the contents of this NMEA message do not change significantly during a 1-second interval, the receiver outputs this message at a maximum rate of 1 Hz.

RMC – Recommended Minimum Specific GPS Data

The RMC sentence identifies the UTC time, status, latitude, longitude, speed over ground (SOG), date and magnetic variation of the position fix.

$GPRMC,184804.00,A,3723.476543,N12202.239745,W,000.0,0.0,051196,15.6,E*7C

Field Number	Description
1	Time: UTC time of the position fix in hhmmss.ss format
2	Status A: Valid V: Navigation Receiver Warning (V is output whenever the receiver suspects something is wrong)
3	Latitude coordinate
4	Latitude direction: N = North, S = South
5	Longitude coordinate
6	Longitude direction: W = West, E = East
7	Speed Over Ground (SOG) in knots (0-3 decimal places)
8	Track Made Good, True, in degrees
9	Date in dd/mm/yy format
10	Magnetic Variation in degrees
11	Direction of magnetic variation E: Easterly variation from True course (subtracts from True course) W: Westerly variation from True course (adds to True course)
12	Mode Indication A: Autonomous D: Differential N: Data not valid

Table 28: Description of the RMC message.

VTG – Course Over Ground and Ground Speed

The VTG sentence identifies the actual track made good and speed over ground.

$GPVTG,0,T,,,0.00,N,0.00,K*33

Field Number	Description
1	Track made good
2	Fixed text 'T' shows that track made good is relative to true north
3	Not used
4	Not used
5	Speed over ground in knots (0-3 decimal places)
6	Fixed text 'N' shows that speed over ground is in knots
7	Speed over ground in kilometers/hour (0-3 decimal places)
8	Fixed text 'K' shows that speed over ground is in kilometers/hour

Table 29: Description of the VTG message.

NOTE:
* Because the contents of this NMEA message do not change significantly during a 1-second interval, the receiver outputs this message at a maximum rate of 1 Hz.

ZDA – Time and Date

The ZDA message contains UTC, the day, the month and the year of the local time zone.

$GPZDA,hhmmss.s,xx,xx,xxxx,xx,xx

Field Number	Description
1	UTC.
2	Day (0 – 31).
3	Month (0 – 12).
4	Year.
5	Local Zone Description Hours (± 13 Hours). *
6	Local Zone Description Minutes.

Table 30: Description of the ZDA message.

NOTES:
* Local zone description is the number of whole hours added to local time to obtain UTC. The zone description is always negative for eastern longitudes. Fields 5 and 6 are Null fields in the "Trimble BD132". A GPS receiver cannot independently identify the local time zone offsets.
* Because the contents of this NMEA message do not change significantly during a 1-second interval, the receiver outputs this message at a maximum rate of 1 Hz.

OmniSTAR logs message formats

OMNIHPPOS – OmniSTAR HP Position

The OMNIHPPOS string outputs OmniSTAR High Performance (HP) information.

#OMNIHPPOSA,COM1,0,72.0,FINESTEERING,1161,321910.000,00000000, ad26,683;SOL_COMPUTED,OMNISTAR_HP,51.11635244839,114.03819232 612,1064.1015,-16.2713, WGS84,0.1371,0.1390,0.2741,"",5.000,0.000,7,6,6, 6,0,0,0,0*66c318fb

Field #	Field Type	Description	Format	Binary Bytes	Binary Offset
1	Header	Log header		H	0
2	Sol status	Solution status	Enum	4	H
3	Pos type	Position type	Enum	4	H+4
4	Lat	Latitude	Double	8	H+8
5	Lon	Longitude	Double	8	H+16
6	Hgt	Height above mean sea level	Double	8	H+24
7	Undulation	Undulation	Float	4	H+32
8	Datum id#	Datum ID number	Enum	4	H+36
9	Lat σ	Latitude standard deviation	Float	4	H+40
10	Lon σ	Longitude standard deviation	Float	4	H+44
11	Hgt σ	Height standard deviation	Float	4	H+48
12	Stn id	Base station ID	Char[4]	4	H+52
13	Diff_age	Differential Age	Float	4	H+56
14	Sol_age	Solution age in seconds	Float	4	H+60

15	#obs	Number of observations tracked	Uchar	1	H+64
16	#GPSL1	Number of GPS L1 ranges used in computation	Uchar	1	H+65
17	#L1	Number of GPS L1 ranges above the RTK mask angle	Uchar	1	H+66
18	#L2	Number of GPS L2 ranges above the RTK mask angle	Uchar	1	H+67
19	Reserved		Uchar	1	H+68
20			Uchar	1	H+69
21			Uchar	1	H+70
22			Uchar	1	H+71
23	Xxxx	32-bit CRC (ASCII and Binary only)	Hex	4	H+72
24	[CR][LF]	Sentence terminator (ASCII only)	-	-	-

Table 31: Description of the OMNIHPPOS message

Solution Status (Binary)	(ASCII)	Description
0	SOL_COMPUTED	Solution computed
1	INSUFFICIENT_OBS	Insufficient observations
2	NO_CONVERGENCE	No convergence
3	SINGULARITY	Singularity at parameters matrix
4	COV_TRACE	Covariance trace exceeds maximum (trace>1000m)
5	TEST_DIST	Test distance exceeded (maximum of 3 rejections if distance > 10km)
6	COLD_START	Not yet converged from cold start
7	V_H_LIMIT	Height or velocity limits exceeded (in accordance with COCOM export licensing restrictions)
8	VARIANCE	Variance exceeds limits
9	RESIDUALS	Residuals are too large
10	DELTA_POS	Delta position is too large
11	NEGATIVE_VAR	Negative variance
12	Reserved	
13	INTEGRITY_WARNING	Large residuals make position unreliable

Table 32: Solution Status

OMNIINFO – OmniSTAR Configuration Information

This log outputs configuration information for our VBS and HP service.

```
#OMNIINFOA,COM1,0,64.5,FINESTEERING,1164,240223.642,
000000,00,4797,33477;1551489,1200,c685,0,704312,EXPIRED,0,
0,EXPIRED,0,0,0*e8bea6a3
```

Field #	Field Type	Description	Format	Binary Bytes	Binary Offset
1	Header	Log header		H	0
2	Freq	Selected frequency for OmniSTAR service (kHz)	Ulong	4	H
3	Baud	Communication baud rate from OmniSTAR satellite	Ulong	4	H+4
4	ID	OmniSTAR signal service ID	Ushort	2	H+8
5	Reserved	Longitude	Ushort	2	H+10
6	OSN	OmniSTAR serial number	Ulong	4	H+12
7	vbs sub	OmniSTAR VBS subscription type	Enum	4	H+16
8	Vbs exp week	GPS week number of OmniSTAR VBS expiration date	Ulong	4	H+20
9	Vbs exp secs	Number of seconds into the GPS week of VBS expiration date	Ulong	4	H+24

10	Hp sub	OmniSTAR HP subscription type	Enum	4	H+28
11	Hp exp week	Hp exp week GPS week number of OmniSTAR HP expiration date	Ulong	4	H+32
12	Hp exp secs	Number of seconds into the GPS week of OmniSTAR HP expiration date[1]	Ulong	4	H+36
13	Reserved		Ulong	4	H+40
14	Xxxx	32-bit CRC (ASCII and Binary only)	Hex	4	H+44
15	[CR][LF]	Sentence terminator (ASCII only)	-	-	-

Table 33: Description of the OMNIINFO message

[1] If the subscription is COUNTDOWN, see FIELD #7 above, the expiration seconds into the GPS week will contain the amount of running time remaining in the subscription.
If the subscription type is COUNTDOWNOVERRUN, the expiration week and expiration seconds into GPS week will count the amount of the overrun time.

Binary	ASCII	Description
0	EXPIRED	The OmniSTAR subscription has expired or does not exist.
1	FIXEDTIME	The OmniSTAR subscription will expire at a fixed date and time.
2	COUNTDOWN	The OmniSTAR subscription will expire after the specified amount of running time.
3	COUNTDOWNOVERRUN	The COUNTDOWN subscription has expired but has entered a brief grace period. Resubscribe immediately.

Table 34: Subscription types

OMNISTAT – OmniSTAR Status Information

This log outputs status information for our VBS and HP service.

```
#OMNISTATA,COM1,0,64.0,FINESTEERING,1164,240276.647,
00000000,a578,33477;1551488896,41.99,149.7,0.00,0082,0000,
18742,33,0,0000,0000,0,0,0*634d507a
```

Field #	Field Type	Description	Format	Binary Bytes	Binary Offset
1	Header	Log header		H	0
2	freq	Measured frequency of OmniSTAR signal (kHz).	Ulong	4	H
3	C/N0	Carrier to noise density ratio C/N0=10[log 10(S/N0)] (dB-Hz)	Float	4	H+4
4	locktime	Number of seconds of continuous tracking (no cycle slipping)	Float	4	H+8
5	Reserved		Float	4	H+12

6	Tracking	Tracking status of OmniSTAR signal	Hex	2	H+16
7	Vbs status	Status word from the VBS process.	Hex	2	H+20
8	#bytes vbs	Number of bytes fed to the VBS process.	Ulong	4	H+24
9	#good dgps	Number of VBS updates.	Ulong	4	H+28
10	#bad data	Number of missing VBS updates.	Ulong	4	H+32
11	Hp status 1	Status word from the HP process.	Hex	2	H+36
12	Hp status 2	Additional status word from the HP process.	Hex	2	H+40
13	#bytes hp	Number of bytes fed to the HP process.	Ulong	4	H+44
14	Reserved		Ulong	4	H+48
15			Ulong	4	H+52
16	xxxx	32-bit CRC (ASCII and Binary only)	Hex	4	H+56
17	[CR][LF]	Sentence terminator (ASCII only)	-	-	-

Nibble #	Bit #	Mask	Description	Range Value
N0	0	0x0001	Tracking State	0=searching, 1=Pull-in, 2=Tracking
	1	0x0002		
	2	0x0004	Reserved	
	3	0x0008		
N1	4	0x0010		
	5	0x0020		
	6	0x0040		
	7	0x0080	Phase Locked	0=not Locked, 1=Locked
N2	8	0x0100	Reserved	
	9	0x0200		
	10	0x0400		
	11	0x0800		
N3	12	0x1000		
	13	0x2000		
	14	0x4000		
	15	0x8000	Error	0=Good, 1=Error

Table 35: OmniSTAR Signal Tracking Status

Nibble #	Bit #	Mask	Description	Bit=0	Bit=1
N0	0	0x0001	Subscription Expired	False	True
	1	0x0002	Out of Region	False	True
	2	0x0004	Wet Error	False	True
	3	0x0008	Link Error	False	True
N1	4	0x0010	No Remote Sites	False	True
	5	0x0020	No Almanac	False	True
	6	0x0040	No Position	False	True
	7	0x0080	No Time	False	True
N2	8	0x0100	Reserved		
	9	0x0200			
	10	0x0400			
	11	0x0800			
N3	12	0x1000			
	13	0x2000			
	14	0x4000			
	15	0x8000	Updating Data	False	True

Table 36: OmniSTAR HP/VBS Status Word

Nibble #	Bit #	Mask	Description	Bit=0	Bit=1
N0	0	0x0001	Solution not fully converged	False	True
	1	0x0002	Reserved		
	2	0x0004			
	3	0x0008			
N1	4	0x0010	HP enabling key invalid	False	True
	5	0x0020	Reserved		
	6	0x0040			
	7	0x0080			
N2	8	0x0100			
	9	0x0200			
	10	0x0400			
	11	0x0800			
N3	12	0x1000			
	13	0x2000			
	14	0x4000			
	15	0x8000			

Table 37: OmniSTAR HP Additional Status Word

32-Bit CRC

The OmniSTAR logs message formats all contain a 32-bit CRC for data verification. This allows the user to ensure that the data received (or transmitted) is valid with a high level of certainty. This CRC can be generated using the following C algorithm:

```
#define CRC32_POLYNOMIAL 0xEDB88320L

/* --------------------------------------------------------------------------
Calculate a CRC value to be used by CRC calculation functions.
-------------------------------------------------------------------------- */

unsigned long CRC32Value(int i)
{
  int j;
  unsigned long ulCRC;


  ulCRC = i;
  for ( j = 8 ; j > 0; j-- )
  {
    if ( ulCRC & 1 )
      ulCRC = ( ulCRC >> 1 ) ^ CRC32_POLYNOMIAL;
    else
      ulCRC >>= 1;
  }
  return ulCRC;
}

/* --------------------------------------------------------------------------
Calculates the CRC-32 of a block of data all at once
-------------------------------------------------------------------------- */

unsigned long CalculateBlockCRC32(
  unsigned long ulCount, /* Number of bytes in the data block */
  unsigned char *ucBuffer ) /* Data block */
{
  unsigned long ulTemp1;
  unsigned long ulTemp2;
  unsigned long ulCRC = 0;

  while ( ulCount-- != 0 )
  {
    ulTemp1 = ( ulCRC >> 8 ) & 0x00FFFFFFL;
    ulTemp2 = CRC32Value( ((int) ulCRC ^ *ucBuffer++ ) & 0xff );
    ulCRC = ulTemp1 ^ ulTemp2;
  }
  return( ulCRC );
}
```

Appendix E

Acronyms used in this manual

1PPS	One Pulse Per Second
2D	Two Dimensional
3D	Three Dimensional
ASCII	American Standard Code for Information Interchange
BPS	Bits per Second
CEMF	Counter Electro-magnetic Force
DGPS	Differential Global Positioning System
GGA	Global Positioning System fixed data (NMEA standard)
GLL	Geographic position (NMEA standard)
GPS	Global Positioning System
GSA	Global Positioning System, dilution of position, active satellite (NMEA standard)
GSV	GPS satellites in view (NMEA standard)
HP	High Performance
LED	Light Emitting Diode
LNA	Low Noise Amplifier
NCC	Network Control Centre
NMEA	National Marine Electronics Association (Standard for interfacing marine electronic devices)
RF	Radio Frequency
RTCM	Radio Technical Commission Maritime
VTG	'Track mode good' and 'ground speed' (NMEA standard)
ZDA	Time and date (NMEA standar

Appendix F

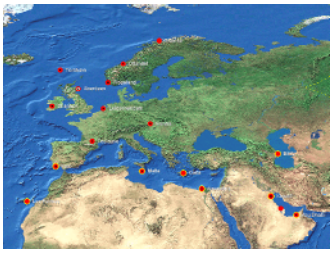
List of communication satellites

The following table presents a list of L-band communication satellites, which will enable you to use your 8300HP over the entire world (depending on your subscription type you might only be entitled to a restricted area).

Table 38: World-wide satellite frequencies and baud rates

Satellite Channel	Frequency (Hz)	Baud Rate	Latitude	Longitude
EA-SAT	1 535 152 500	1200	0° 0' 0.00"	25° 0' 0.00"
AF-SAT	1 535 180 000	1200	0° 0' 0.00"	40° 0' 0.00"
AP-SAT	1 535 137 500	1200	0° 0' 0.00"	109°30'0.00"
AM-SAT	1 535 137 500	1200	0° 0' 0.00"	-97°59'59.99"
OPTUS	1 558 510 000	1200	-19°59'59.99"	144°59'59.99"
MSV-W	1 536 782 000	1200	45°00'00.00"	-119°59'59.99"
MSV-C	1 534 741 000	1200	45°00'00.00"	-94°59'59.99"
MSV-E	1 530 359 000	1200	45°00'00.00"	-80° 0' 0.00"

Figure 15: Reference stations and coverage area for EA-SAT and AF-SAT.



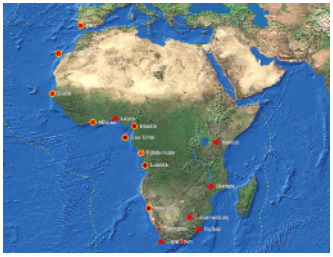
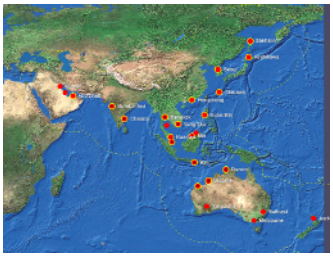


Figure 16: Reference Stations and coverage area for AM-SAT and AP-SAT.



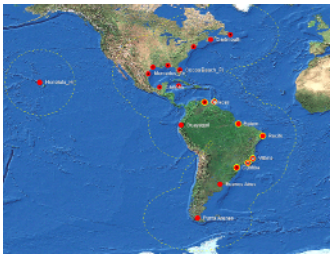
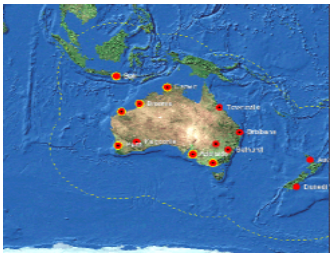


Figure 17: Reference stations and coverage area for OPTUS and MSV.



APPENDIX G

List of reference stations

The following tables present the current list of reference stations, which are broadcast over the different satellites. Check www.surveyplanner.com for the latest updates of these lists.

Table 39: Reference stations on EA-SAT

Nr	Station	ID	VBS	HP
1	Abu Dhabi, UAE	016	YES	YES
2	Kuwait	290	YES	YES
3	Bahrain	260	YES	NO
4	Aberdeen, Scotland	571	YES	YES
5	Alexandria, Egypt	310	YES	NO
7	Baku, Azerbaijan	400	YES	NO
8	Bodo, Norway	122	YES	NO
9	Crete, Greece	340	YES	NO
10	Faro, Portugal	371	YES	YES
11	Istanbul, Turkey	410	YES	NO
12	Leidschendam, The Netherlands	521	YES	YES
13	Malta	351	YES	NO
14	Ny Alesund, Spitsbergen	101	YES	NO
15	Orlandet, Norway	630	YES	YES
16	Rogaland, Norway	580	YES	YES
17	Shannon, Ireland	530	YES	NO
18	Torshavn, Faroes	620	YES	NO
19	Toulouse, France	431	YES	NO
20	Tromso, Norway	690	YES	NO
21	Vardo, Norway	114	YES	NO
22	Visby, Sweden	229	YES	NO
23	Vienna, Austria	480	YES	NO
24	Kharkiv, Russia	500	YES	NO

Table 40: Reference stations on AF-SAT

Nr	Station	ID	VBS	HP
1	Abidjan, Ivory Coast	050	YES	NO
2	Blantyre, Malawi	155	YES	NO
3	Cape Town, South Africa	335	YES	NO
4	Dakar, Senegal	144	YES	NO
5	Douala, Cameroon	043	YES	YES
6	Durban, South Africa	305	YES	NO
7	Faro, Portugal	371	YES	NO
8	Lagos, Nigeria	060	YES	NO
9	Las Palmas, Canaries	280	YES	NO
10	Luanda, Angola	095	YES	YES
11	Nairobi, Kenya	015	YES	NO
13	Pointe-Noire, Congo	045	YES	YES
14	Port Elizabeth, South Africa	337	YES	NO
15	Rogaland, Norway	580	YES	YES
16	Sao Tome, Sao Tome	011	YES	YES
17	Walvis Bay, Namibia	235	YES	NO

Table 41: Reference stations on AP-Sat

Nr	Station	ID	VBS	HP
1	Auckland, NZ	022	YES	NO
2	Karratha, Australia	215	YES	NO
3	Darwin, Australia	125	YES	NO
4	Broome, Australia	185	YES	NO
9	Asahikawa, Japan	261	YES	NO
10	Singapore	010	YES	YES
11	Miri, Malaysia	042	YES	YES
12	Vung Tua, Vietnam	012	YES	YES
13	Hong Kong	220	YES	NO
14	Seoul, S. Korea	370	YES	NO
15	Kota Kinabalu, Malaysia	061	YES	NO

16	Bali, Indonesia	096	YES	YES
17	Mumbai-Arvi, India	191	YES	YES
19	Subic Bay, Phillipines	151	YES	NO
20	Kuwait	290	YES	NO
21	Abu Dhabi, UAE	016	YES	NO
23	Kuantan, Malaysia	041	YES	NO
25	Bangkok, Thailand	141	YES	YES
26	Chennai, India	131	YES	NO
27	Bathurst, Australia	336	YES	NO
28	Kalgoorlie, Australia	315	YES	NO
31	Melbourne, Australia	385	YES	NO
32	Okinawa, Japan	261	YES	NO
33	Platong, Thailand	018	YES	NO
34	Sakhalin, Russia	510	YES	NO
35	Bahrain, Bahrain	260	YES	NO

Table 42: Reference stations on AM-Sat

Nr	Station	ID	VBS	HP
1	Houston, Texas	100	YES	YES
2	Cocoa Beach, Florida	120	YES	YES
3	Long Island, New York	333	YES	YES
4	Carmen, Mexico	110	YES	YES
5	Punta Arenas, Chile	210	YES	NO
6	Guayaquil, Ecuador	202	YES	NO
7	Rio de Janeiro, Brazil	225	YES	YES
8	St. Johns, Newfoundland	470	YES	YES
9	Dartmouth, Nova Scotia	440	YES	NO
10	Recife, Brazil	075	YES	NO
11	Port Of Spain, Trinidad	111	YES	YES
12	Caracas, Venezuela	112	YES	YES
13	Belem, Brazil	017	YES	NO
14	Caymen, Grand Cayman	192	YES	YES

15	Honolulu, USA	210	YES	NO
16	Curtiba, Brazil	257	YES	YES
17	Pensacola, USA	301	YES	YES
18	Vitoria, Brazil	205	YES	YES
19	Mercedes, USA	263	YES	YES
20	Buenos Aires, Argentina	345	YES	NO

APPENDIX H

GPS Time of Week To Week and Time of Day (example)

51200 s	Day	511200 / 86400 seconds per day	**5**.91666666 **days**
	Hour	0.9166666 x 86400 / 3600 s per hour	**22**.0000 **hours**
	Minute	0.000 x 3600 / 60 s per minute	**0**.000 **minutes**
	Second	0.000 x 60	**0**.000 **seconds**

Day 5 (Thursday) + 22 hours, 0 minutes, 0 seconds into Friday.

Calendar Date to GPS Time (e.g. 13:30 hours, January 28, 2005)

Days from January 6, 1980 to January 28, 2005 = 6 years x 365 days / year = 9125 days

Add one day for each leap year (a year which is divisible by 4 but not by 100 unless it is divisible by 400; every 100 years a leap year is skipped)	7 days
Days into 2005 (28^{th} is not finished)	27 days
Total days	**9159 days**
Deduct 5 days: (Jan. 1 – 5, 1980)	9154 days

GPS Week: 9154 x 86400 sec. per day = 790905600 sec. / 604800 sec. per week

Seconds into week 6^{th} day: 13.5 hrs x 3600 sec./hr **48600** seconds

GPS time of week: **Week 1307, 48600 second**

APPENDIX I

Receiver Service Procedure

If an OmniSTAR receiver unit fails to perform, contact the OmniSTAR office within the region, after following the procedural checks. We wish to hear about frequently experienced problems and your assistance will help by copying the form on the next page, filling in the details requested and faxing or mailing the form to the OmniSTAR office for on-forwarding to Product Marketing.

The most common problems are interfacing, and usually occur at installation time. If you have an interfacing connection not covered in this manual we would like to assist you and produce another technical bulletin that may assist other users in the future.

If a problem appears that you think may be caused by a system performance problem, contact the OmniSTAR office in your region for any system aberrations that may have been experienced.

We are sensitive to our customers' needs and we want to assure specified system performance at all times. There could, however, be situations where conditions are below par, such as fringe area operations, radio communication disturbance etc., and, as OmniSTAR receiver monitors the system performance continuously, these conditions would be noted.

APPENDIX J

OmniSTAR Receiver Problem Report Form

Please copy this form and report problem with as much detail as possible.

Problem with: **Signal Y/N** **Manual Y/N** **OmniSTAR Y/N** **Receiver Y/N**	**Date:**
Description of problem:	
Person Reporting:	**Contact Phone #:**
Model #:	**Serial #:**
Customer Name:	**Customer Address:**
Customer Phone #:	
Date purchased: / /	**Dealer:**
GPS Receiver used:	**Serial #:**
Area of operations:	
Symptoms from display (if any):	

User Notes