OmniSTAR.

3200LR12 Receiver

User Manual

Issue 1.5 June 2005

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 this publication.

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

OmniSTAR Customer Support and 24 Hour Help Line

OmniSTAR B.V.
Dillenburgsingel 69
2263 HW Leidschendam
The Netherlands

Contact Numbers:
Office:	+31-70 31 70 900
Subscriptions	+31-70 31 70 910
Technical Support	+31-70 31 70 913

Fax Numbers:
Office:	+31-70 31 70 919

World Wide Web
Internet Address:	www.omnistar.nl
Email address:	info@omnistar.nl

OmniSTAR a Fugro Group Company

Dealer Information

Name   _____

Address   _____

City   _____

State   _____

Post Code _____

Country   _____

Phone   _____

Fax   _____

Email   _____

OmniSTAR a Fugro Group Company

One-Year Limited Hardware Warranty

OmniSTAR B.V. and its operating companies world-wide (OmniSTAR), warrants this product to be free from defects in workmanship and material for a period of one year from the date of original sale by OmniSTAR or its authorised dealers, to the original purchaser or end user.

OmniSTAR reserves the right to repair and/or replace, at its option, any part or parts found to be defective, provided such defects, in their opinion, are due to faulty material or workmanship and are not caused by unauthorised or improper repair or abuse, or normal wear. Purchaser shall be responsible for shipping and insurance of the returned product for repair under this warranty. OmniSTAR will pay shipping and insurance for the product's return to purchaser provided that the product returned proves to be defective under this limited warranty.

This warranty applies only to normal usage of the product. It does not apply to units or electronic circuit boards defective due to improper installation or handling. Physical damage due to lightning or other electrical discharge and units subjected to fresh or salt water contamination is not covered. OmniSTAR reserves the right not to warrant the product if, upon request, sufficient proof of recommended installation compliance as laid out in this manual is not provided. No other warranties are expressed or implied. No other warranties exist.

OmniSTAR assumes no responsibility for any consequential or incidental losses or damages of any nature with respect to the use of this product.

REVISION HISTORY		
Issue 1.0	September 1999	First Draft
Issue 1.1	January 2000	Amendments to text and layout
Issue 1.1.1	January 2000	Modified to OmniSTAR B.V.
Issue 1.2	January 2001	Added appendix B and GPS/DGPS
Issue 1.3	March 2003	Modified Appendix C and D
Issue 1.4	October 2003	Modified footer

Manual Reference: *3200LR12 Manual*

OmniSTAR a Fugro Group Company

TABLE OF CONTENTS

OmniSTAR a Fugro Group Company

List of Figures

OmniSTAR a Fugro Group Company

List of Tables

OmniSTAR a Fugro Group Company

INTRODUCTION

The 3200LR12 receiver consists of both a 12-channel GPS receiver and a L-Band differential receiver built into a single unit. It provides differentially corrected positions at update rates up to 5 times a second through two independently configurable RS-232 I/O ports. Position accuracy is typically less than one metre and the receiver is suitable for both ground and air applications. Three LED indicator lights give operational status at a quick glance. The receiver can have a one-pulse-per-second output signal synchronised to GPS time.

The 3200LR12 receiver is easily configured using TSIP commands. Baud rate, position update rate, common NMEA string output and binary data output are among the variables which can be controlled using the TSIP commands. More detail on these commands is provided in a later section and in the View 3200 software Manual.

OmniSTAR a Fugro Group Company

GPS/DGPS Introduction

The Global Positioning System (GPS) is a reliable, continuous, all-weather navigation system, which is operated by the United States Government. At the time of writing, the space segment of GPS includes a constellation of 28 satellites, which orbit the earth at an altitude of approximately 22.000 km.

These satellites (Space Vehicles or SV's) transmit radio signals containing precise satellite time and position information. By receiving four or more of these signals a 3-dimensional position can be computed.

Although GPS provides an acceptable level of performance for some users, many applications demand a more reliable and precise position than GPS alone can provide. In such cases Differential GPS (DGPS) must be used.

The purpose of DGPS is to minimise the effects of atmospheric and satellite errors on the position determination. In order to achieve this a reference GPS receiver must be installed at a point of known co-ordinates. This receiver uses the radio signals from each of the GPS satellites, which are in view to measure so-called pseudo-ranges to these satellites. Because the exact locations of the satellites and the reference receiver are known, it is then possible to determine the difference between the actual and the expected pseudo-ranges (pseudo-range correction or PRC).

In order to provide compatibility for exchanging this correction data, a standard has been developed by the Radio Technical Commission for Maritime Services Special Committee 104. This standard is commonly known as RTCM SC-104.

When RTCM version 2.0 correction data from the reference receiver is applied to a nearby GPS receiver, the position accuracy will be substantially better than if stand-alone GPS were to be used.

The OmniSTAR system

The 3200LR12 is one of several DGPS receivers which have been designed to work with the world-wide OmniSTAR service.

The OmniSTAR DGPS system delivers corrections from an array of reference stations, which are located all around the world (see appendix C). The RTCM correction data from these reference stations is provided to OmniSTAR's three Network Control Centres (NCC), where the corrections are decoded, checked, and repackaged in a highly efficient format for broadcast.

The OmniSTAR data is broadcast over a series of L-band communication satellites. The signal transmitted over each of these satellites contains the corrections from the reference stations in and close to the region in which this satellite can be received.

When a receiver with a valid subscription receives data through one of OmniSTAR's satellite channels it will output a differentially corrected position. The way in which the correction data from each individual reference station will be used in the position calculation depends on the user's OmniSTAR subscription.

Subscription type

The 3200LR12 supports the following OmniSTAR service:

- Virtual Base Station (VBS), where the data from multiple reference stations is used in the processor software to produce enhanced corrections for the user's location. This service provides optimal position accuracy with a minimum dependence on the user's location. The VBS service can be obtained on a continental, country or regional basis.

OmniSTAR a Fugro Group Company

The 3200LR12

General Description

The 3200LR12 is the main part of a portable system. It contains the satellite RF receiving and signal processing components. All ancillary equipment is plugged into the appropriate sockets on the receiver rear panel.

A typical 3200LR12 package will consist of the following items:

- 3200LR12 (receiver)

- User manual

- Data cable

- Power cable

- Antenna

- RF cable

- CD-ROM with View 3200 software and manual

- View3200 manual

OmniSTAR a Fugro Group Company

Options

The 3200LR12 is supplied with combined GPS and DGPS antenna, it must be plugged into the GPS socket on the rear panel of the receiver.

A system equipped with a combined GPS and DGPS antenna is illustrated in figure 1.

DC Power Supply
(Typically vehicle cigarette lighter or
12 V DC sealed lead acid battery)

DGPS Antenna

3200LR12 Receiver

Power   Data

Data, Command
or Utility Port   Data Logger

DGPS

Laptop Computer
(Configuration & Maintenance)
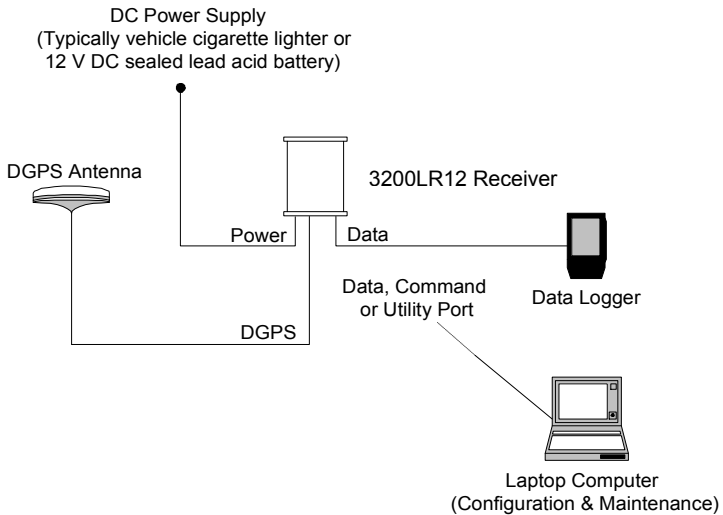
Figure 1: 3200LR12 with DGPS Antenna

OmniSTAR a Fugro Group Company

Operating considerations

The 3200LR12 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.

OmniSTAR a Fugro Group Company
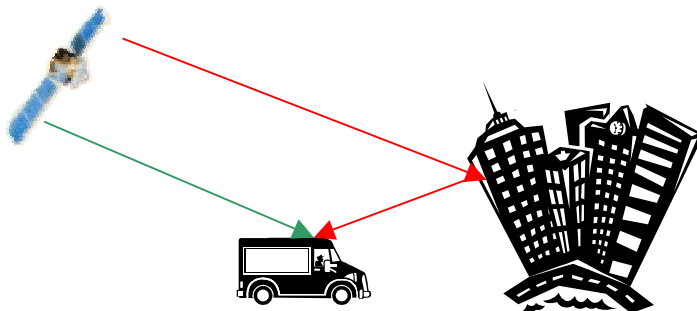
Figure 2: Multipath

Position Dilution of Precision (DOP)

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. By default the 3200LR12 is configured to output position data as long as the Position Dilution of Precision does not exceed 10.

Satellite elevations

The signal from a satellite, which 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 3200LR12 is configured to ignore any satellites, which have an elevation angle, lower than 5°.

OmniSTAR a Fugro Group Company

Differential corrections

For accurate positioning it is essential that the differential corrections are received. In order to ensure reception of the OmniSTAR satellite signal it must be prevented that the line of sight towards the satellite is 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 3200LR12 directly onto a surface in a reflection free environment.

Although the 3200LR12 has been designed to provide optimal system performance under most circumstances, it is possible, due to the nature of radio communications, that system performance degrades due to local interference sources.

GETTING STARTED

The purpose of this section is to get you started with the 3200LR12 as quickly as possible. The guide will address receiving the satellite data carrier, and then checking the functionality of the internal GPS engine fitted.

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.
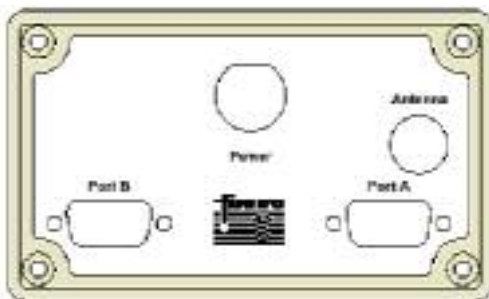
Figure 3: Bare Rear View of 3200LR12 Receiver

Initial Setup

Steps 1 through 7 pertain to all OmniSTAR receiver models.

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

•   OmniSTAR Receiver
•   Antenna
•   Antenna Cable
•   Power Cable
•   Data Port Cable
•   Power Supply

OmniSTAR a Fugro Group Company

2. Connect the power cable to a suitable 10 V – 32 VDC power supply being sure to check correct polarity.

>   Red   – Positive VDC
>   Black – Negative VDC

3. The 3200LR12 is an integrated GPS, DGPS receiver and needs only one antenna. You need to install the antenna where it has a clear 360° unobstructed view of the sky through an elevation of 5° through 90°.

4. Connect the antenna cable between the antenna and the TNC connector on rear panel.

5. Ensure the OmniSTAR power is OFF then connect the power cable into the power socket on the receiver.

6. Turn on the 3200LR12 and the Power LED will illuminate. Data LED's will illuminate when Data is present in the respective Data ports.

7. The GGA output message will indicate a non-corrected stand-alone position with a 1 (one) after the 'E' in the message when viewed on a suitable data logging device or computer.

A differentially corrected position is indicated by a 2 (two) directly after the 'E' in the GGA message from Port A.

OmniSTAR a Fugro Group Company

Figure 4: World coverage map for the OmniSTAR service

Figure 5: EA-SAT coverage in Europe

OmniSTAR a Fugro Group Company

Interfacing

Electrical Interface Description

The RF Connector is a standard TNC 50 Ohm female connector. There are 10vDC present when the unit is powered up to bias the LNA in the remote antenna. Care should be taken not to connect or disconnect the antenna while powered up.

The I/O cable connector is a standard DB 9 connector. The pin-out is defined below.

Pin No	Name	Description
1	Not Connected	N/A
2	Receive	Rx
3	Transmit	Tx
4	Not connected	N/A
5	Ground	GND
6	Not Connected	N/A
7	Not Connected	N/A
8	Not Connected	N/A
9	Not Connected	N/A

This is the pin assignment for the 3200LR12 communication ports. The connector type is a 9-pin female 'D' type.

PORT A (DCE)

1	CANL_A
2	TXDA*
3	RXDA*
4	
5	GND*
6	
7	CTSA
8	RTSA
9	CANH_A

PORT B (DCE)

1	CANL_B
2	TXDB*
3	RXDB*
4	PPS
5	GND*
6	EVENT
7	CTSB/422B In
8	RTSB/422B Out
9	CANH_B

*Indicates standard cable connections.

<u>Warning:</u> Do not use standard RS 232 cables as all connections will be made to the computer and there are non standard assignations on the pins of both ports. Use the provided Data Cables.

OmniSTAR a Fugro Group Company

Power Requirements

The unit will operate on any DC Voltage between 10 V and 32 VDC without interruption. When operational, the unit dissipates 7 W of power. The 3200LR12 can also withstand voltage surges up to 85 V. The input has reverse polarity protection, however as the negative terminal pin is also attached to the housing ground, large currents may flow to any ground attachments made to the housing. Reverse polarity must therefore be avoided to prevent damage to the vehicle supply. At Voltages below 10 Volts the unit will reset itself to prevent any data loss. At Voltages below 8.5 Volts the receiver will turn off.

Mechanical Interface

Mounting of the receiver is done with a mounting brace or brackets.

Interfacing with the 3200LR12 Receiver

The standard configuration is:

Port A: 4 string NMEA @ 1 Hz, 9600 Baud (GGA, GSA, VTG, GLL)

Port B: TSIP Binary @ 1 Hz, 9600 Baud, 8-Odd-1

The receiver will default to the below settings if the 3200LR12 is reset to defaults.

Port A: NMEA @ 9600, 8-N-1
Port B: TSIP @ 9600, 8-Odd-1

The 3200LR12 Receiver has two fully configurable RS-232 serial ports. Commands may be issued on either port and the receiver may be configured to output any of the available messages on either port. The baud rate on each port is adjustable, however the data bits, parity and stop bits are set to 8-0dd-1 for TSIP, Port B and may not be changed. These settings are necessary for the communication with the View3200 software.

OmniSTAR a Fugro Group Company

Cables

The 3200LR12 is supplied with three cables.

ANTENNA CABLE

5 metre low loss RG58 Double shielding or equivalent			
TNC Male		N Type Male	
N/A	GPS/DGPS Signal	GPS/DGPS Signal	N/A

DATA CABLE

DB9 Male   DB9 Female

-2m-

2 ————————————————————	2
3 ————————————————————	3
5 ————————————————————	5
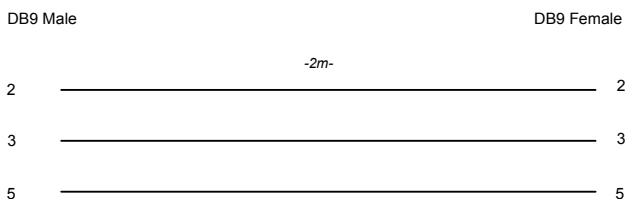
POWER CABLE

2metre Black Jacket Red & Black 2 Core Cable		
Pin #		Wire colour
1	Positive DC Voltage	Red
2	Negative DC Voltage	Black
3	Not connected	
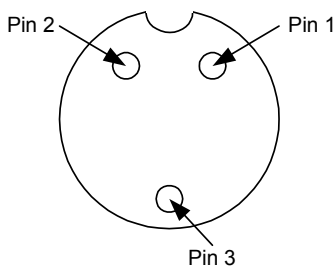
Figure 6: **Mating end of Female Connector, Switchcraft EN3C3F**

OmniSTAR a Fugro Group Company

LED Indicators

The 3200LR12 has three LED indicator lights. These LED lights serve as status indicators.

The 'Power' LED indicates power to the 3200LR12 and should remain solid once power is applied to the receiver. Both Data Port LED's will flash as data is transmitted from the respective ports.

The LED's will flash at the output rate of the port, one or five hertz.

Figure 7: 3200LR12 front panel

Installation

Installation Consideration

•	Determine preferred location of each unit prior to beginning installation. 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 hardware locations. Avoid drilling holes that may damage other equipment (example: structural frame members, electrical cables or fluid lines).

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

•	In application where vibration exceeds 5 G's acceleration, shock mounts are required. Refer to Customer support for mounting recommendations.

•	Vehicle primary power contains voltages that may be harmful to personnel and equipment. Detach battery cable connector from battery Negative (-) terminal before attempting connection to any power terminal.

Electrical Grounding Requirements

The 3200LR12 requires a perfect ground to vehicle structure at the negative line in 00the receiver power input. The L-Band Receiver should read zero Ohms to where the battery negative terminal is connected to vehicle ground.

Counter Electromagnetic Force (CEMF)

A potential problem inherent in any installation of electronic systems in a vehicle is Counter Electromagnetic Force (CEMF).

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

OmniSTAR a Fugro Group Company

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 also connected to DC power.

CEMF can be eliminated by installing Diodes at the relays and solenoids that cause the CEMF and more importantly at the Power Supply Cable connections of the 3200LR12 system. A 47 V, 5 W, Zener Diode (1N5368 or equivalent) should be connected.

+_24 Vdc ____ ▇▇▇ ____ Ground

Figure 8: Zener Diode Installation.

Cable Installation Considerations

- Cables must be correctly installed for optimum system operations.

- Do not route L-Band Receiver remote antenna cable with those of any other radio system cabling, as this may cause interference between both systems. If at all possible, do not run L-Band Receiver antenna cables parallel to other radio system cable closer than 30 centimetres.

- If any cables must cross; cross at a 90 degree angle. This prevents interference between systems

- Cables and I/O connectors are unique and fit only in the correct place.

- Routing cables along side power generator wires and other high noise electrical sources may cause interference.

- Do not kink or force cables into sharp bends that may damage 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 150mm minimum cable bend radius.

- Cable routing must avoid high temperature exposure (example: exhaust manifold).

OmniSTAR a Fugro Group Company

Antenna Location

Antenna position is critical to system performance. These conditions must be met for proper system operations:

• Antenna must be mounted at least 1.5 metres away from transmitting antennae 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 to level as possible.

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

APPENDIX A
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.

OmniSTAR a Fugro Group Company

APPENDIX B
Introduction NMEA 0183

NMEA 0183 is an interface protocol created by the National Marine Electronics Association. The latest release of NMEA 0183 is Version 2.1. This protocol was originally established to allow marine navigation equipment to share information. NMEA 0183 is a simple, yet comprehensive ASCII protocol, which defines both the communication interface and the data format.

This appendix provides a brief overview of the NMEA protocol and describes both the standard and optional messages offered by the Trimble BD132 GPS receiver employed in the 3200LR12 DGPS Receiver.

NMEA 0183 Message Format

NMEA 0183 allows a single source (talker) to transmit serial data over a single twisted wire pair to one or more receivers (listeners). The MNEA 0183 protocol covers a broad array of navigational data. This is separated into discrete messages, which convey a specific set of information. The NMEA 0183 message structure is outlined below.

$IDMSG,D1,D2,D3,D4,……..,Dn*CS[CR][LF]

"$"   The "$" signifies the start of message.

    ID   The Talker identification is a two letter mnemonic which describes the source of the navigation information. The GP identification signifies a GPS source.

    MSG   The message identification is a three letter mnemonic which describes the message content and the number and order of the data fields.

","   Commas serve as deliminators for the data fields.

Dn   Each message contains multiple data fields (Dn) which are delimited by commas.

"*"   The asterisk serves as a checksum delimiter.

CS   The checksum field contains two ASCII characters which indicate the hexadecimal value of the checksum.

[CR][LF]   The carriage return [CR] and line feed [LF] combination terminate the message.

NMEA messages vary in length, but each message is limited to 79 characters or less. This length limitation excludes the "$" and the [CR] [LF]. The data field block, including delimiters, is limited to 74 characters or less.

OmniSTAR a Fugro Group Company

3200LR12 RECEIVER
USER MANUAL

NMEA 0183 Message Options

The OmniSTAR 3200LR12, when supplied with an "Trimble BD132" GPS receiver 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. Faster output rates are available up to 10 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
	GBS	GNSS Satellite Fault Detection
*	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
	PTNLDG	DGPS Receiver Status
	PTNL, GGK	Time, Position, Position Type and DOP Values
	PTNLID	Receiver Identity
	PTNLSM	RTCM Special Message

Table 1: NMEA 0183 messages available for the 3200LR12

OmniSTAR a Fugro Group Company

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 2: Description of the ALM message.

GBS   **– GNSS Satellite Fault Detection**

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

$GBS,183059.30,0.0,0.0,0.0,0.0,0.0,0.0*6F

Field Number	Description
1	UTC time of the GGA or GNS fix associated with this sentence.
2	Expected error in latitude.
3	Expected error in longitude.
4	Expected error in altitude.
5	ID number of most likely failed satellite.
6	Probability of missed detection for most likely failed satellite.
7	Estimate of bias, in meters, on most likely failed satellite.
8	Standard deviation of bias estimate.

Table 3: Description of the GBS 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.

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.
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 4: 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.

OmniSTAR a Fugro Group Company

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 5: 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 6: 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.

OmniSTAR a Fugro Group Company

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,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 7: 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 8: 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.

OmniSTAR a Fugro Group Company

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 9: 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.

OmniSTAR a Fugro Group Company

3200LR12 RECEIVER
USER MANUAL

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,000.0,0.0,0
51196,15.6,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 10: Description of the RMC message.

OmniSTAR a Fugro Group Company

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 11: 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.

OmniSTAR a Fugro Group Company

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 12: 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 a Fugro Group Company

PTNLDG   --DGPS Receiver Status

The PTNLDG sentence is a sentence for identifying the DGPS receiver channel strength, channel SNR, channel frequency, channel bit rate, channel number, channel tracking status, RTCM source and channel performance indicator for satellite DGPS.

$PTNLDG,xxx.x,xx.x,xxxxxxx.x,xxxxx,xx,x,x,x,xx*xx

The PTNLDG sentence fields are defined in free format with the maximum number of characters in the field indicated in above (i.e. 25 bps displayed as xxx,25,xxx instead of xxx,00025,xxx). Additionally, if a channel is disabled, the channel fields may be null fields (commas only). If more then one channel is available, the sentence should be repeated for each channel.

Field Number	Description
1	Channel signal strength, in 1 dBµV/m. This is the ADC input voltage level.
2	Channel signal to noise (SNR) level, in dB
3	Channel frequency, in kHz
4	Channel bit rate, in bits per second (bps)
5	Channel number, 0-99
6	Channel tracking status 0: Channel idle 1: Wideband FFT search 2: Searching for signal 3: Channel has acquired signal 4: Channel has locked on signal 5: Channel disabled
7	Specified channel is used as RTCM source 0: Not used 1: Used
8	Channel tracking performance indicator. This is the time since the last sync, in tenths of seconds ranging from 0-255

Table 13: Description of the PTNLDG 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 of 1 Hz.

OmniSTAR a Fugro Group Company

PTNL,GGK – Time, Position, Position Type and DOP Values

$PTNL,GGK,172814.00,071296,3723.46587704,N,12202.26957864
,W,3,06,1.7,EHT-6.777,M*48

Field Number	Description
1	UTC of position fix, in hhmmss.ss format
2	UTC Date of position, in mmddyy format
3	Latitude, in degrees and decimal minutes (for example, dddmm.mmmmmmm)
4	Direction of latitude: N: North S: South
5	Longitude, in degrees and decimal minutes (for example, dddmm.mmmmmmm)
6	Direction of Longitude: E: East W: West
7	GPS Quality indicator: 0: Fix not available or invalid 1: Autonomous GPS fix 4: Differential, code phase only solution (DGPS)
8	Number of satellites used in GPS solution
9	DOP of fix
10	Ellipsoidal height of fix (antenna height above ellipsoid)
11	M: Ellipsoidal height is measured in meters

Table 14: Description of the PTNL,GGK message.

PTNLID **–Receiver Identity**

The PTNLID sentence is a sentence for identifying the receiver's machine ID, product ID, major and minor release numbers and firmware release date.

$PTNLID,097,01,xxx,xxx,DD/MM/YY*XX

Field Number	Description
1	Machine ID
2	Product ID
3	Major firmware release number
4	Minor firmware release number
5	Firmware release date, in DD/MM/YY format

Table 15: Description of the PTNLID message.

NOTE:
* The PTNLID sentence is, if enabled, output every 30 seconds.

PTNLSM **– RTCM special message**

The PTNLSM sentence is a sentence for identifying the Reference Station ID and the ASCII Text message included in a RTCM Type 16 Special Message. The PTNLSM message is generated anytime a RTCM stream receives a valid Type 16 Special Message.

$PTNLSM,0022,This is a message,*.XX

Field Number	Description
1	Reference Station ID number, ranging from 0 to 1023. Leading zeros must be added to fill 4-digit field.
2	ASCII text message sentence contained within the Type 16 RTCM message.

Table 16: Description of the PTNLSM message.

APPENDIX C
List of communication satellites

The following table presents a list of L-band communication satellites, which will enable you to use your 3200LR12 over the entire world (depending on your subscription type you might only be entitled to a restricted area).

Table 17: World-wide satellite frequencies and baud rates

Satellite Channel	Frequency (MHz)	Baud Rate
EA-SAT	1535.1525	1200
AF-SAT	1535.0800	1200
MSV-Central	1534.7410	1200
MSV-East	1530.3590	1200
MSV-West	1536.7820	1200
AP-SAT	1535.1375	1200
AM-SAT	1535.1375	1200

The coverage-area of each satellite and its reference stations are displayed in the following figures.

Figure 9: Reference stations and coverage area per satellite

AF-SAT

EA-SAT

AP-SAT

AM-SAT

ugro Group

APPENDIX D
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 18: Reference stations on EA-SAT

Nr	Station	ID	VBS	HP
4	Aberdeen, Scotland	571	YES	YES
1	Abu Dhabi, UAE	016	YES	YES
3	Bahrain	260	YES	YES
7	Baku, Azerbaijan	400	YES	YES
8	Cairo	300	YES	YES
9	Dakar	144	YES	YES
10	Faro, Portugal	371	YES	YES
11	Istanbul, Turkey	410	YES	YES
24	Kharkiv, Russia	500	YES	YES
2	Kuwait	290	YES	YES
12	Leidschendam, The Netherlands	521	YES	YES
13	Malta	351	YES	NO
14	Ny Alesund, Spitsbergen	101	YES	NO
15	Pointe-Noire,Congo	045	YES	NO
16	Rogaland, Norway	580	YES	YES
17	Sao Tome,Sao Tome	011	YES	NO
18	Torshavn, Faroes	620	YES	YES
19	Toulouse, France	431	YES	YES
20	Tromso, Norway	690	YES	YES
21	Vardo, Norway	114	YES	NO
23	Vienna, Austria	480	YES	YES
24	Visby, Sweden	229	YES	NO
25	Lagos,Nigeria	060	YES	NO
26	Las Palmas,Canaries-Sp	280	YES	NO
27	Luanda,Angola	095	YES	NO
28	Shanon,Ireland	530	YES	YES
29	Trondheim,Norway	632	YES	YES
30	Visby, Sweden	576	NO	YES

OmniSTAR a Fugro Group Company

Table 17: 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 18: 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

OmniSTAR a Fugro Group Company

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 19: 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

OmniSTAR a Fugro Group Company

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 E
OmniSTAR Receiver Problem Report Form

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

PROBLEM with: GPS Signal Y/N Manual Y/N	Date:
OmniSTAR Y/N Receiver Y/N	

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):	

OmniSTAR a Fugro Group Company

APPENDIX F
3200LR12 - Technical Specifications

Standard Features

- Submetre differential GPS accuracy
- Satellite L-band differential capability
- 12 Channel, parallel tracking, L1 C/A code with carrier phase filtered measurements
- <2 second acquisition and reacquisition time, typical
- Two programmable RS-232 serial ports
- RTCM SC-104 input
- NMEA-0813 output

Inputs and Outputs

Serial Ports :	Command, Data
Electrical Interface :	RS-232-C
Data Rates :	4800, 9600, 19200, 38400
Message Rate :	Typically 1-2 seconds output
Plug Types :	DB-9 connectors
RF Input to Receiver :	TNC
Power Connector :	3 pin snaplock

Optional Features

- Everest multipath reduction.
- 10Hz update rate

OmniSTAR a Fugro Group Company

Technical Specifications

General	12 parallel channels
	Tracks up to 12 satellites, L1 GPS
	L-band satellite differential correction
Update Rate	1Hz standard, 10 Hz optional
Differential Accuracy	Less than 1 metre horizontal RMS
	Assumes at least 5 satellites, PDOP less than 4 and RTCM SC-104.
Time to first fix	<30 seconds, typical
NMEA messages	ALM, GGA*, GLL, GSA*, GSV, VTG*, ZDA*, RMC, GRS, GBS, GST, MSS, PTNLID, PTNLDG, PTNLSM, PTNL/GGK
Power	5 Watts, max @ 10 to 32VDC

Physical Characteristics

Weight (approx.)	0.75kg
Display	3 LED indicators
Control	Power switch and Command Port

Appendix G
OmniSTAR subscription agreement form

The form is necessary to apply for a new OmniSTAR subscription for your 3200LR12 receiver. And can be found on our website: www.omnistar.nl

OmniSTAR a Fugro Group Company